GE
159 Plastics Avenue
Pittsfield, MA 01201
USA

March 20, 2008

Ms. Susan Svirsky
U.S. Environmental Protection Agency
c/o Weston Solutions, Inc.
10 Lyman Street
Pittsfield, MA 01201

Re: GE-Pittsfield/Housatonic River Site
Rest of River (GECD850)
Corrective Measures Study Report

Dear Ms. Svirsky:

Pursuant to Special Condition II.G of the Reissued RCRA Corrective Action Permit issued by the U.S. Environmental Protection Agency (EPA) to General Electric Company (GE) for the Rest of River portion of the Housatonic River, enclosed is GE's Corrective Measures Study (CMS) Report for the Rest of River. Submission of this CMS Report is subject to GE's reservations of rights set forth in this report (including in Section ES.1, Section 1.2, and Section 9).

GE looks forward to discussing this report with EPA.

Very truly yours,

Andrew T. Silfer

Andrew T. Silfer, P.E.
GE Project Coordinator

Enclosure

cc: Dean Tagliaferro, EPA
Timothy Conway, EPA
John Kilborn, EPA
Robert Cianciarulo, EPA
Holly Inglis, EPA
Rose Howell, EPA (cover letter only)
Richard McGrath, Sleeman Hanley & DiNitto
Richard DiNitto, Sleeman Hanley & DiNitto
Scott Campbell, Weston Solutions
Joel Lindsay, Weston Solutions

Tony Delano, Weston Solutions
Anthony Riccio, Weston Solutions
Edward Garland, HydroQual
Mark Velleux, HydroQual (CD Only)
Rooni Mathew, HydroQual (CD Only)
Michael Palermo, Mike Palermo Consulting
Gary Lawrence, Golder Associates
John Lortie, Stantect Inc.
Donna Vorhees, The Science Collaborative
Susan Steenstrup, MDEP (2 copies)
Anna Symington, MDEP
Jane Rothchild, MDEP
Thomas Angus, MDEP
Dale Young, MA EOEA
Susan Peterson, CDEP (2 copies and CD)
Michael Carroll, GE
Jane Gardner, GE
Roderic McLaren, GE
Kevin Mooney, GE
Stuart Messur, ARCADIS
Mark Gravelding, ARCADIS
James Rhea, QEA
Kevin Russell, QEA
James Bieke, Goodwin Procter
Samuel Gutter, Sidley Austin
Public Information Repositories
GE Internal Repository

ARCADIS
Infrastructure, environment, facilities

QEA
Quantitative Environmental Analysis, LLC

General Electric Company
Pittsfield, Massachusetts

Housatonic River – Rest of River Corrective Measures Study Report

Volume 1 – Text, Tables, and Figures

March 2008

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Acronyms

µg/L	micrograms per liter
1-D	one-dimensional
ACO	Administrative Consent Order
AOC	Area of Contamination
APEG	alkaline polyethylene glycol
ARARs	applicable or relevant and appropriate requirements
BB	Brown Bullhead
BBD	Bulls Bridge Dam
BBL	Blasland, Bouck & Lee
BSAFs	biota-sediment accumulation factors
CAMU	Corrective Action Management Unit
CD	Consent Decree
CDEP	Connecticut Department of Environmental Protection
CDF	Confined Disposal Facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	cubic feet per second
CMS	Corrective Measures Study
CP	Cyprinids
CTE	Central Tendency Exposure
cy	cubic yards
DEM	Digital Elevation Model
DNAPL	dense non-aqueous-phase liquid
DOT	Department of Transportation
EAs	exposure areas
EFDC	Environmental Fluid Dynamics Code
EPA	United States Environmental Protection Agency
EPC	exposure point concentration
ERA	Ecological Risk Assessment

EREs	Environmental Restrictions and Easements
FCM	Food Chain Model
FEMA	Federal Emergency Management Agency
FMDR	Final Model Documentation Report
g/cm^3	grams per cubic centimeter
GE	General Electric Company
GIS	geographic information system
ha	hectare
HHRA	Human Health Risk Assessment
HI	Hazard Index
HSPF	Hydrological Simulation Program-FORTRAN
IMPGs	interim media protection goals
IRIS	Integrated Risk Information System
ITRC	The Interstate Technology and Regulatory Council
kg/yr	kilograms per year
lbs	pounds
LH	Lake Housatonic
LL	Lake Lillinonah
LMB	Largemouth Bass
LNAPL	light non-aqueous-phase liquid
LP	liquefied petroleum
LZ	Lake Zoar
MATCs	Maximum Acceptable Threshold Concentrations
MCL	Maximum Contaminant Level
MCP	Massachusetts Contingency Plan
MDEP	Massachusetts Department of Environmental Protection
mg/kg	milligrams per kilogram
MIA	Model Input Addendum
MIA-S	Supplement to the Model Input Addendum

mm	millimeters
MNR	monitored natural recovery
MVP	minimum viable population
NAPL	non-aqueous-phase liquid
NCP	National Contingency Plan
ng/L	nanograms per liter
NHESP	Natural Heritage and Endangered Species Program
NRC	National Research Council
OMM	operation, monitoring, and maintenance
OSC	On-Scene Coordinator
OSHA	Occupational Safety and Health Adminstration
PCBs	polychlorinated biphenyls
POTW	publicly owned treatment works
PSA	Primary Study Area
QEA	Quantitative Environmental Analysis, LLC
RAOs	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SA	sediment exposure areas
SF	Sunfish
SI Work Plan	Site Investigation Work Plan
sf	square feet
TBCs	To Be Considered
TCLP	Toxicity Characteristic Leaching Procedure
TDS	total dissolved solids
TEQs	toxicity equivalency quotients
TOC	total organic carbon

TSCA	Toxic Substances Control Act
TSS	total suspended solids
UCL	upper confidence limit
USACE	U.S. Army Corps of Engineers
USDA	United States Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
WS	White Sucker
WWTP	wastewater treatment plant

Executive Summary

Introduction

For more than three decades, the General Electric Company (GE) has worked with federal and state agencies to address historical environmental issues related to its Pittsfield, Massachusetts manufacturing operations where polychlorinated biphenyls (PCBs) were used until the 1970s in the production of transformers and capacitors. Since a landmark agreement in 2000, GE and the U.S. Environmental Protection Agency (EPA) have focused on cleaning up three major areas – the former GE plant site and adjacent areas, the first two miles of the Housatonic River near and downstream from the plant site, and an area that has come to be known as the "Rest of River." Remedial projects on and around the plant site have been completed or will be completed in the near future. Two major sediment and soil removal projects have taken place in the first two miles of the River, dramatically reducing the amount of PCBs. This report addresses the "Rest of River" – the portion of the Housatonic that begins at the confluence of the East and West Branches of the Housatonic in Pittsfield and ends at Long Island Sound.

This report is known as the Corrective Measures Study (CMS) because it evaluates clean-up alternatives, or corrective measures, that could be taken to further reduce the presence of PCBs in the River and on the adjoining floodplain. Evaluated in the pages that follow are eight options for addressing sediments, seven options for addressing floodplain soils, and five options for handling sediments and soils that would be removed from the River and floodplain. All were chosen with EPA's approval and all were evaluated using nine criteria contained in a permit issued by EPA.

GE selected one option to recommend to EPA for consideration – a major sediment and soil removal and capping project in the first ten miles of the River and floodplain between Pittsfield and Woods Pond. This is the area of the Housatonic that extensive sampling has shown contains the highest concentrations of PCBs. Completion of the recommended project would reduce the amount of PCBs moving downstream at the end of that 10-mile stretch by 94%, reduce PCB levels in fish by 70% to 99%, and best meet EPA's clean-up evaluation criteria. The project would require an estimated 10 years to complete.

Overview

Over more than the past 30 years, GE has conducted numerous source control and other remedial activities at GE's Pittsfield facility, located on the East Branch of the Housatonic River. Over the last 9 years, GE and EPA have conducted additional remedial activities as part of the comprehensive settlement embodied in a Consent Decree (CD) for this site. Specifically, under the CD, GE and EPA have jointly remediated a two-mile reach of the River adjacent to and immediately downstream of GE's Pittsfield facility (a seven-year program). In addition, GE has completed remediation of numerous other areas adjacent to that two-mile reach, and will complete the remediation of several other such areas (as well as an area on the West Branch of the River) within the next couple of years. As agreed with EPA, these activities have focused in particular on the remediation of PCBs, which came to be present in the sediments and floodplain of the River as the result of historic releases from GE's Pittsfield facility, which used PCBs in the manufacture of transformers and capacitors (a practice that ended in 1976). These source control and remediation efforts have already resulted in clean-up of the two-mile reach and a significant reduction in the transport of PCBs to downstream reaches.

The CD also prescribes a detailed process for further investigation and evaluation of the portion of the Housatonic River and its floodplain downstream of the two-mile reach to decide what additional remediation, if any, is most appropriate for that stretch of the River. As noted above, this stretch of the River begins at the confluence of the East and West Branches of the River in Pittsfield (the Confluence) and is known as the Rest of River. The Rest of River process has been ongoing since 1997, with EPA and GE each performing numerous studies, evaluations, and other efforts. This CMS Report represents the next step in the process. It has been prepared pursuant to a permit issued by EPA to GE under the federal Resource Conservation and Recovery Act (RCRA) (the Permit) as part of the settlement embodied in the CD.

In the CMS, GE has evaluated numerous remedial alternatives for the Rest of River, which were approved by EPA for study. These consist of a total of eight alternatives for addressing sediments, seven alternatives applicable to floodplain soil, and five alternatives for treatment and/or disposition of sediments and soils that may be removed from the River and floodplain. These alternatives have been thoroughly evaluated according to criteria set out in the Permit. Among other criteria, the Permit requires an evaluation of each alternative in terms of its overall protectiveness of human health and the environment, its reliability and effectiveness, the potential short-term and long-term impacts that it would cause, and its implementability and costs. In conducting these evaluations, as required by the Permit, GE has used a PCB model developed by EPA, which is designed to forecast the results of different remedial approaches for the sediments. As part of these efforts, GE has used a number of EPA-mandated inputs for that model, as well as a number of other assumptions, inputs, and interpretations that EPA directed GE to use in the CMS.

Any evaluation of remedial alternatives for the Rest of River requires a careful balancing of benefits, impacts, and costs. Whereas the areas along the River between the GE facility and the Confluence are primarily residential and commercial, large areas of the Rest of River are undisturbed and scenic areas that are enjoyed for their recreational value. This is particularly true for the 10-mile stretch of the River between the Confluence and Woods Pond, on which the CMS evaluations have focused particular attention given that this area contains the highest PCB concentrations. Wide floodplains, extensive wetlands, and large backwaters border portions of the River in this stretch. These areas would be directly impacted by remediation. While the use of innovative technologies to address PCBs in place has been explored, no such method has been demonstrated to be effective in the field for a large remedial project. As a result, the accepted methods available for addressing PCBs in sediments and floodplain soils are largely conventional: dredging, excavating, capping, backfilling, and monitored natural recovery (MNR). Apart from MNR, these activities would unavoidably impact flora, fauna, and aesthetics, and the larger the area that is disturbed, the greater the impacts. Consistent with the process described in the Permit, the goal of the evaluation of alternatives presented in this CMS Report is to select a remedial approach that achieves overall protection of human health and the environment with the least amount of adverse impacts and in the most cost-effective way.

Another important consideration is the time needed to implement the remedy. The less time that it takes to implement the remedy, the faster any potential benefits will be realized, the shorter the time over which disruptions and impacts will occur, and the sooner the ecosystem can begin to be restored. Extreme remedial alternatives that take 25 to 50 years to implement would prolong these impacts. On the other hand, remedial alternatives that are faster to implement will accelerate any potential benefits and recovery.

Finally, the analysis of sediment remedial alternatives using EPA's model shows that no matter how extensive the remediation, residual amounts of PCBs entering the Rest of River from upstream and present within the system will, for the foreseeable future, keep fish in Massachusetts from attaining PCB levels deemed necessary by EPA to allow people to eat fish without restrictions. As a result, fish consumption advisories – which are in place today – will need to remain in place, and the Housatonic River will remain (like many other waterbodies) a catch-and-release fishery. That conclusion has to be taken into account in balancing the benefits and impacts of different remedial alternatives, since even the extreme impacts of the largest remediation cannot yield, in return, the unrestricted consumption of fish within the foreseeable future.

As required by the Permit, after considering these factors and the specific criteria set out in the Permit, the CMS Report presents GE's conclusions as to which of the sediment, floodplain, and treatment/disposition alternatives evaluated are best suited to meet the Permit criteria.

ES.1 Background

Upstream Source Control/Remediation**:** As noted above, GE and EPA have undertaken a wide range of remedial projects in and adjacent to the East Branch of the Housatonic River upstream of the Confluence. GE has conducted major source control activities at and near the GE facility over the last 40 years to prevent and control PCBs and other chemicals present in soils and underground oil plumes from entering the River. GE also performed extensive sediment and bank soil remediation in the Upper ½-Mile Reach of the River (between the GE facility and the Lyman Street Bridge in Pittsfield). Following that action, EPA remediated the 1½-Mile Reach of the River (between the Lyman Street Bridge and the Confluence).

GE's remedial efforts in upstream areas have also included remediation of soils in floodplain and former oxbow areas adjacent to the River above the Confluence. In addition, over the next few years GE will conduct a sediment removal/capping project in Silver Lake (which discharges to the River), remediation of Unkamet Brook (which flows into the River), and additional soil remediation at the GE facility adjacent to the East Branch. GE will also conduct remediation of targeted sediments and riverbank soils in the West Branch adjacent to Dorothy Amos Park in Pittsfield, which represent the major identified remaining source of PCBs in the West Branch. Collectively, these completed and planned activities represent one of the largest remedial projects within EPA Region 1.

These activities have significantly reduced the amount of PCBs entering the Rest of River area, although they will not completely eliminate that influx. Further reductions are anticipated from the upcoming remedial efforts. In fact, even in the absence of any additional remediation, EPA's model predicts that remediation in and along the East Branch and in the West Branch, along with natural recovery, will result over the next 50 years in an overall reduction of around 40% in the PCB loads passing over the Woods Pond and Rising Pond Dams (the major dams on the River in Massachusetts) and 50% in the PCB mass transported from the River to the adjacent floodplain between the Confluence and Woods Pond Dam.

Analysis of Rest of River Leading Up To the CMS**:** The CD and Permit set forth the process for investigating the Rest of River, and for studying the need for and scope of additional remediation.[1] From 1997 through 2002, EPA conducted numerous sampling activities and investigations of the Rest of River area, building on the considerable investigations that had previously been conducted by GE and other entities. The resulting

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[1] Copies of the reports discussed below are available on EPA's website for the Housatonic River, http://www.epa.gov/region1/ge/index.html.

data were presented in GE's RCRA Facility Investigation (RFI) Report, finalized in September 2003, which documented the extent and concentrations of PCBs in the surface water, sediments, floodplain soils, and biota of the Rest of River.

Next, EPA performed a Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) for the Rest of River. GE then developed and submitted proposed Interim Media Protection Goals (IMPGs), which are preliminary goals, applicable to various environmental media, that are considered to be protective of human health and ecological receptors under EPA's HHRA and ERA. The IMPGs were approved by EPA after GE revised them to incorporate numerous directions from EPA. Under the Permit, attainment of the IMPGs is one of the factors to be considered in evaluating remedial alternatives and is to be balanced along with other factors specified in the Permit (as described below).

At the same time that these efforts were proceeding, EPA developed a mathematical model to simulate the fate, transport, and bioaccumulation of PCBs within the Rest of River. The model is used to forecast the outcome of the different sediment remedial scenarios. That is, it predicts future PCB concentrations in the water, sediments, and fish in the Rest of River both in the absence of any additional remediation and in response to various remedial alternatives.

In February 2007, GE submitted a CMS Proposal to EPA – essentially a workplan for conducting the CMS. The CMS Proposal, along with a number of addenda, identified and screened potential remediation technologies for the Rest of River, developed a set of specific remedial alternatives for detailed evaluation, and described the proposed methodology to be used for that evaluation. EPA approved the CMS Proposal and addenda, subject to a number of conditions.

<u>GE's Reservations of Rights</u>**:** During the course of the process described above, GE has disagreed with EPA on many key issues. First, GE has a fundamental disagreement with EPA regarding the effects of PCBs on human health and the environment. GE believes, based on the weight of scientific evidence from human studies, that PCBs have not been shown to cause cancer in humans or adverse non-cancer effects in humans at environmental levels. Further, GE does not believe that the evidence reveals significant adverse effects of PCBs on the Rest of River ecosystem; indeed, field surveys by both EPA and GE contractors have demonstrated abundant, diverse, and thriving fish and wildlife populations and communities in the Rest of River area despite decades of exposure to PCBs. In addition, GE has disagreed with many of the specific assumptions, input values, interpretations, and conclusions in EPA's HHRA and ERA, which GE believes overstate the risks of PCBs to humans and ecological receptors. GE has also disagreed with numerous directives that EPA has issued to GE both for revising the IMPGs and for conducting the CMS. GE has preserved its position on all of these issues.

In addition, as discussed above, upstream remediation/source control activities, along with natural recovery processes, have significantly reduced the PCB loads in the Rest of River, and those improvements are continuing. Moreover, as documented in this report, remedial action would unavoidably damage the environment of the River and floodplain, including wetlands, mature growth trees, and the biota that live in the floodplain. In all these circumstances, GE believes that, other than monitoring the ongoing natural recovery processes, it is neither necessary nor appropriate to conduct additional remedial actions in the Rest of River area, with the attendant adverse impacts on the environment.

Nevertheless, while preserving its position, GE has, as required by the CD and Permit, conducted the evaluations in the CMS taking into account EPA's HHRA and ERA and using the assumptions, procedures, and other inputs that EPA directed GE to use. Many of these EPA assumptions and directives with which GE disagrees have fundamentally shaped the analyses in this CMS. Accordingly, this CMS Report should not be regarded as GE's endorsement of the conclusions set forth herein regarding remedial alternatives; nor does it constitute, given GE's appeal rights under the CD and the Permit, a proposal by GE to implement those alternatives.

ES.2 Scope of CMS Report

There are three major elements in the analysis of remedial alternatives for the Rest of River: sediments, floodplains, and treatment and/or disposition of removed materials. In the CMS Proposal, GE presented a screening assessment of various potential remedial technologies for each of these elements to narrow them down to a more manageable set of technologies for detailed evaluation in the CMS. GE then developed a range of alternatives for that detailed evaluation, and EPA approved them for evaluation in the CMS. These include alternatives to address the sediments in the Rest of River, along with certain erodible riverbanks that contain PCBs, and alternatives for addressing floodplain soils. For both sediments and floodplain soils, the alternatives range from the "no action" alternative all the way through to extreme remedial measures. GE also has evaluated a range of alternatives for treating and/or disposing of sediments and soils that would be removed from the River and floodplain under various alternatives.

***Reaches Addressed*:** For purposes of these evaluations, GE has divided the Rest of River area into a number of reaches and subreaches as designated by EPA. These are shown on Figure ES-1 and are as follows:

- Reach 5, from the Confluence to Woods Pond, which is further divided into three subreaches – 5A (Confluence to Pittsfield wastewater treatment plant [WWTP]); 5B (Pittsfield WWTP to Roaring Brook); and 5C (Roaring Brook to start of Woods Pond) –

and which also contains, in the lower half of Reach 5, a large number of backwater areas adjacent to the River (sometimes collectively referred to as Reach 5D);

- Reach 6, Woods Pond;
- Reach 7, Woods Pond Dam to Rising Pond (the next large impoundment);
- Reach 8, Rising Pond;
- Reach 9, Rising Pond Dam to the Connecticut border; and
- Reaches 10-17, Connecticut border to Long Island Sound.

Sediment/Riverbank Alternatives**:** To address the sediments and erodible riverbanks, GE has developed and evaluated a total of eight remedial alternatives (designated SED 1 through SED 8). These alternatives provide a broad range of options, from no action (SED 1) through alternatives using various combinations of the remediation technologies, including: (a) sediment removal (via mechanical or hydraulic methods) followed by capping or placement of backfill; (b) placement of a clean cap over existing sediments; (c) thin-layer capping (placement of a thin layer of clean material over existing sediments to provide a reduction in PCB concentrations in the biologically active zone, thereby accelerating the natural recovery process); (d) removal of PCB-containing soil from erodible banks, followed by stabilization of those banks to minimize further erosion; and (e) MNR (reliance on naturally occurring processes to contain or otherwise reduce the bioavailability or toxicity of PCBs in sediment, with monitoring to assess the rate of recovery). The eight sediment remedial alternatives evaluated in the CMS are summarized in Table ES-1 below.

Table ES-1 – Summary of Remediation Alternatives for Sediments and Erodible Riverbanks

Alternative	Description
SED 1	No action
SED 2	MNR
SED 3	Sediment removal in Reach 5A, MNR in Reach 5B, combination of thin-layer capping and MNR in Reach 5C, thin-layer capping in Woods Pond, and MNR for the remainder of the River.
SED 4	Combination of sediment removal, capping, and thin-layer capping from Confluence to Woods Pond Dam: Same as SED 3 plus combination of sediment removal and thin-layer capping in Reach 5B and Woods Pond, capping in portions of Reach 5C, and thin-layer capping in portions of the backwaters.
SED 5	Combination of additional sediment removal and capping to Woods Pond Dam and thin-layer capping in Rising Pond: Same as SED 4 with additional removal in Reaches 5B (entire subreach) and 5C, capping alone in a portion of Woods Pond, and thin-layer capping in Rising Pond.
SED 6	Combination of sediment removal and capping for the entire River from Confluence to Woods Pond Dam and combination of capping and thin-layer capping in Reach 7 impoundments and Rising Pond: Same as SED 5 with additional removal in Reach 5C and backwaters, thin-layer capping in Reach 7 impoundments, and combination of capping and thin-layer capping in Rising Pond.
SED 7	Combination of sediment removal (with capping or backfill) for entire River from Confluence to Woods Ponds Dam and combination of removal and thin-layer capping in Reach 7 impoundments and Rising Pond: Same as SED 6 with additional (deeper) removal in Reaches 5A and 5B, backwaters, and Woods Pond, and sediment removal in portions of Reach 7 impoundments and Rising Pond.
SED 8	Removal of all sediments from the main channel and backwaters of River between Confluence and Woods Pond Dam, from Reach 7 impoundments, and from Rising Pond, with the depth of removal set as the depth to which PCBs above 1 mg/kg are estimated to occur.

Note: Each alternative (except SED 1) also includes: (a) removal and stabilization of erodible riverbanks containing PCB in Reaches 5A and 5B; and (b) continued maintenance of fish consumption advisories.

The following table lists, for each of these eight alternatives, the total sediment and bank soil removal volume, the total area that would be capped or backfilled following removal, the total area that would be subject to capping alone, the total area subject to thin-layer capping, and the total estimated number of years for implementation:

Table ES-2 – Overview of Volumes, Areas, and Duration for Sediment Alternatives

	SED 1/2	SED 3	SED 4	SED 5	SED 6	SED 7	SED 8
Removal volume (cubic yards [cy])	0	167,000	295,000	410,000	554,000	793,000	2,250,000
Capping after removal (acres)	0	42	91	126	178	146	0
Backfill after removal (acres)	0	0	0	0	0	69	340
Capping without removal (acres)	0	0	37	60	45	45	0
Thin-layer capping (acres)	0	97	119	102	101	65	0
Time to implement (years)	0	10	15	18	21	25	51

Note: MNR would be a component of all alternatives except SED 1.

***Floodplain Soil Alternatives*:** To address floodplain soil, GE has developed and evaluated a total of seven remedial alternatives (designated FP 1 through FP 7). Except for the no action alternative (FP 1), these alternatives all involve the removal of soil, followed by replacement of that soil with clean backfill and revegetation of the remediated area. These alternatives are of two types: (1) risk-based alternatives, which are based on soil removal and backfilling as necessary to achieve average PCB concentrations, in specified areas, within the ranges of particular EPA-approved IMPGs (FP 2, FP 3, FP 4, and FP 7); and (2) concentration-based alternatives, which are based on removal of all soils within a given depth that have PCB concentrations exceeding a specified level (FP 5 and FP 6). The seven floodplain soil alternatives are described in Table ES-3 (below). As approved by EPA, all of these focus on the top foot of soil, except that, for alternatives FP 3 through FP 7, the depth of evaluation and removal extends to 3 feet in certain heavily used areas.

Table ES-3 – Summary of Remediation Alternatives for Floodplain Soils

Alternative	Description
FP 1	**No Action**
FP 2	**Remediation to Upper-Bound Health-Based IMPGs**: Soil removal/backfilling to achieve the health-based RME IMPGs based on a 10^{-4} cancer risk or a non-cancer Hazard Index (HI) of 1 (whichever is lower).
FP 3	**Remediation to Combination of Upper-Bound and Mid-Range IMPGs**: Same as FP 2 except: (a) in certain frequently used areas (e.g., trails, access points, known recreational areas, and farm areas evaluated for agricultural products consumption), removal/backfilling to achieve the health-based RME IMPGs based on a 10^{-5} cancer risk or a non-cancer HI of 1 (whichever is lower); and (b) supplemental remediation to achieve certain upper-bound IMPGs for ecological receptors.
FP 4	**Remediation to Mid-Range IMPGs**: Soil removal/backfilling to achieve the health-based RME IMPGs based on a 10^{-5} cancer risk or a non-cancer HI of 1 (whichever is lower). Supplemental remediation to achieve certain upper-bound IMPGs for ecological receptors.
FP 5	**Remediation of Soils with $\geq$ 50 mg/kg**: Removal of soils that contain PCB concentrations of 50 mg/kg or greater, with backfilling.
FP 6	**Remediation of Soils with $\geq$ 25 mg/kg**: Removal of soils that contain PCB concentrations of 25 mg/kg or greater, with backfilling.
FP 7	**Remediation to Lower-Bound IMPGs**: Soil removal/backfilling to achieve the health-based RME IMPGs based on a 10^{-6} cancer risk, but no lower than 2 mg/kg for direct human contact, since that level is considered protective for unrestricted use. Supplemental remediation to achieve lower-bound IMPGs for ecological receptors.

Note: "RME IMPGs" refer to the IMPGs that were based on EPA's "Reasonable Maximum Exposure" assumptions in its HHRA.

The following table lists, for each of these seven alternatives, the total removal volume, the total area subject to removal, and the total estimated number of years for implementation.[2]

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[2] For comparative purposes, the estimated implementation times listed in this table assume that the floodplain alternatives would be implemented independently of the sediment alternatives. In fact, floodplain remediation would likely be coordinated with sediment remediation, in which case the actual times to implement the floodplain alternatives could be different from those listed.

Table ES-4 - Overview of Volumes, Areas, and Duration for Floodplain Alternatives

	FP 1	FP 2	FP 3	FP 4	FP 5	FP 6	FP 7
Removal volume (cy)	0	17,000	60,000	99,000	100,000	316,000	569,000
Removal area (acres)	0	11	38	62	60	194	350
Time to implement (years)	0	1	3	4	4	13	22

Treatment/Disposition Alternatives**:** GE has evaluated a total of five alternatives for the disposition or treatment of removed sediments or soils. These alternatives (designated TD 1 through TD 5) include three disposition alternatives and two alternatives that would involve treatment followed by disposal, as follows:

- TD 1 – Off-site Disposal: Sediments and soils would be transported for disposal in a permitted off-site landfill or landfills.

- TD 2 – Confined Disposal Facility (CDF): Sediments would be hydraulically dredged from certain river reaches where that is feasible, and would be pumped into on-site CDF(s) that would be built within a local waterbody (e.g., deep portion of Woods Pond and/or a backwater area). Note that under this option, sediments that are not hydraulically dredged, as well as soils, would have to be handled by another treatment/disposition method.

- TD 3 – Upland Disposal Facility: An Upland Disposal Facility would be constructed in an area near the River (but outside the 100-year floodplain), with rigorous cover, liner, and monitoring systems.

- TD 4 – Chemical Extraction: Removed sediments/soils would be treated using a chemical extraction process, in which an extraction fluid is mixed with those materials to remove the PCBs from the solids into the fluid. For purposes of the CMS, it is assumed that the treated solids would be disposed of off-site and that the fluid would be subject to wastewater treatment. (At EPA's request, a bench-scale treatability study was conducted of this technology, using a process developed by BioGenesis Enterprises, Inc. A report of that study is included in this CMS Report.)

- TD 5 – Thermal Desorption: Removed sediments/soils would be treated using a thermal desorption process, in which PCBs are removed from those materials through application of heat to volatilize the PCBs and the volatilized PCBs are then condensed as a liquid. It has been assumed for the CMS that a portion of the treated solids could be reused on-site as backfill in the floodplain, after amendment with organic material and sampling to ensure that the concentrations are sufficiently low to allow reuse. It has also been assumed that the remainder of the treated materials would be sent off-site for disposal, and that the PCB-containing liquid condensate would be sent off-site for incineration.

Use of EPA's Model**:** For sediments, as required by the Permit, GE has used EPA's fate, transport, and bioaccumulation model to predict future PCB concentrations in sediment, surface water, and fish resulting from the alternatives, for 52 years into the future (or 30 years after completion of remediation for the given alternative, if longer than 52 years). However, EPA also directed GE to temporally extrapolate the model projections to estimate the time to achieve IMPGs if they were not met during the model projection period – these extrapolations can sometimes extend hundreds of years into the future. EPA also requested GE to spatially extrapolate the model projections, which end at Rising Pond Dam, downstream into Connecticut. GE has performed these extrapolations, although GE regards both of them as highly speculative and not reliable predictors of future PCB concentrations. EPA's model has also been used to evaluate the long-term reliability and effectiveness of caps, thin-layer caps, and backfill used in the various remedial alternatives. The model includes simulations of various measured storm events, including a severe storm event on the scale of a 50- to 100-year storm event. By simulating the forces of high flow and erosion, the model can predict the long-term ability of these remedial components to prevent or mitigate exposure to the subsurface PCBs.

Evaluation Criteria**:** In accordance with the Permit, each of the alternatives discussed above has been evaluated under three "General Standards" and six "Selection Decision Factors" specified in the Permit. These criteria are as follows:

General Standards:

- Overall Protection of Human Health and the Environment;
- Control of Sources of Releases; and
- Compliance with Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) (or the basis for a waiver of an ARAR).

Selection Decision Factors:

- Long-Term Reliability and Effectiveness (including magnitude of residual risk, adequacy and reliability of alternative, and potential long-term adverse impacts on human health or the environment);

- Attainment of IMPGs;

- Reduction of Toxicity, Mobility, or Volume of Wastes;

- Short-Term Effectiveness (including impacts to the environment, nearby communities, and workers during implementation);

- Implementability; and

- Cost.

Under the Permit, GE is required to conclude the CMS Report with a recommendation as to which alternatives or combination of alternatives, in GE's opinion, is "best suited to meet the [General Standards] in consideration of the [Selection Decision Factors], including a balancing of those factors against one another."

ES.3 Evaluation

***Overview*:** GE has conducted a thorough and very detailed evaluation of each of the remedial alternatives described above under each of the nine Permit criteria listed above, given the constraints imposed by the Permit and the EPA directives for the CMS. These evaluations are presented in Section 4 for the sediment alternatives, Section 6 for the floodplain soil alternatives, and Section 7 for the treatment/disposition alternatives. Each of those sections also contains a comparative evaluation of the alternatives using the same criteria.

ES.3.1 Evaluation of Sediment Alternatives

GE believes that all the sediment alternatives that would involve removal (SED 3 through SED 8) would meet the General Standards in the Permit, and that consideration and balancing of the Selection Decision Factors indicate that SED 3 is "best suited" to do so.

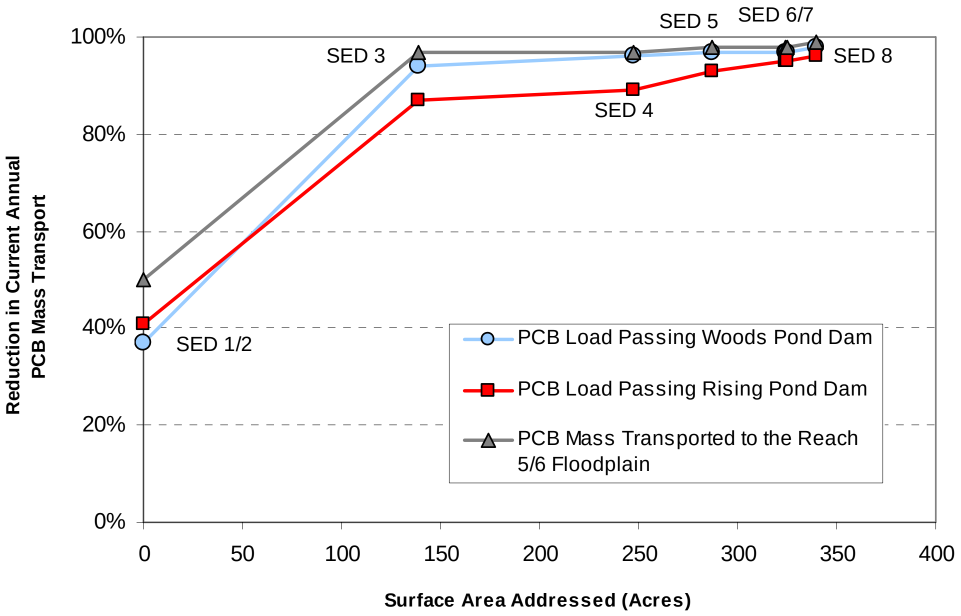
Attainment of General Standards

Overall Protection of Human Health: As discussed in detail in this CMS Report, each of the alternatives involving removal would provide overall protection of human health. First, looking at direct contact with sediments, EPA's model predicts that each of these alternatives would achieve the IMPGs based on a 10^{-5} cancer risk (well within EPA's cancer risk range) or lower, as well as the non-cancer IMPGs. In fact, many of those levels are achieved now, without additional remediation. By contrast, for human consumption of fish, the predicted post-remediation concentrations under all alternatives would not, in Massachusetts, achieve the levels that EPA considers to be protective for unrestricted consumption of Housatonic River fish within the model period; and, as a result, fish consumption advisories would have to remain indefinitely in place no matter the extent of remediation. In Connecticut, however, where fish levels are much lower, extrapolation of EPA's model indicates that all of these alternatives (SED 3 through SED 8) are more likely to lead to levels of PCBs in fish that EPA considers protective for unrestricted fish consumption within (or shortly after) the model period.

Overall Protection of the Environment: All of the same sediment removal alternatives would address ecological risks identified in the ERA and would provide overall protection of the environment. SED 3 would achieve levels within or below the IMPG range for some receptors (benthic invertebrates, warmwater and coldwater fish, and threatened and endangered species) in all areas. For the remaining receptors (amphibians, piscivorous birds, insectivorous birds, and piscivorous mammals), it would achieve such levels in some areas and circumstances. However, since the local populations of those receptors extend beyond the areas of the IMPG exceedances to other areas where PCB levels are lower or that are outside the site, GE does not believe that the IMPG exceedances would prevent the maintenance of healthy local populations of these receptors, let alone adversely impact the overall wildlife community in the Rest of River area. Moreover, while other alternatives would achieve additional IMPGs, they would cause greater short-term and long-term harm to the environment through significantly more habitat destruction. In short, SED 3 would provide overall environmental protection by achieving a substantial reduction in the exposure levels of ecological receptors while causing the least amount of environmental damage of any of these alternatives.

Control of Sources of Releases: By far, SED 3, in combination with upstream remediation and natural recovery, will bring about the most significant incremental reduction in PCB loads to the River. Compared to current conditions, EPA's model predicts that SED 3, in combination with upstream remediation and natural recovery, would result in an overall reduction of 94% and 87% in the PCB loads passing Woods Pond Dam and Rising Pond Dam, respectively, and 97% in the PCB mass transported from the River to the floodplain in Reaches 5 and 6. In contrast, SEDs 4 through 8 would result in only slight additional reductions, on the order of a few percent. These reductions are shown (versus surface area addressed by each alternative) on Figure ES-2. Moreover, EPA's model predicts no significant differences among all these alternatives in the extent to which they would mitigate effects of a flood that could cause buried sediments to be exposed.

Figure ES-2 – Reduction in Current PCB Mass Transport Over the Model Projection Period Versus Surface Area Addressed in Remedy

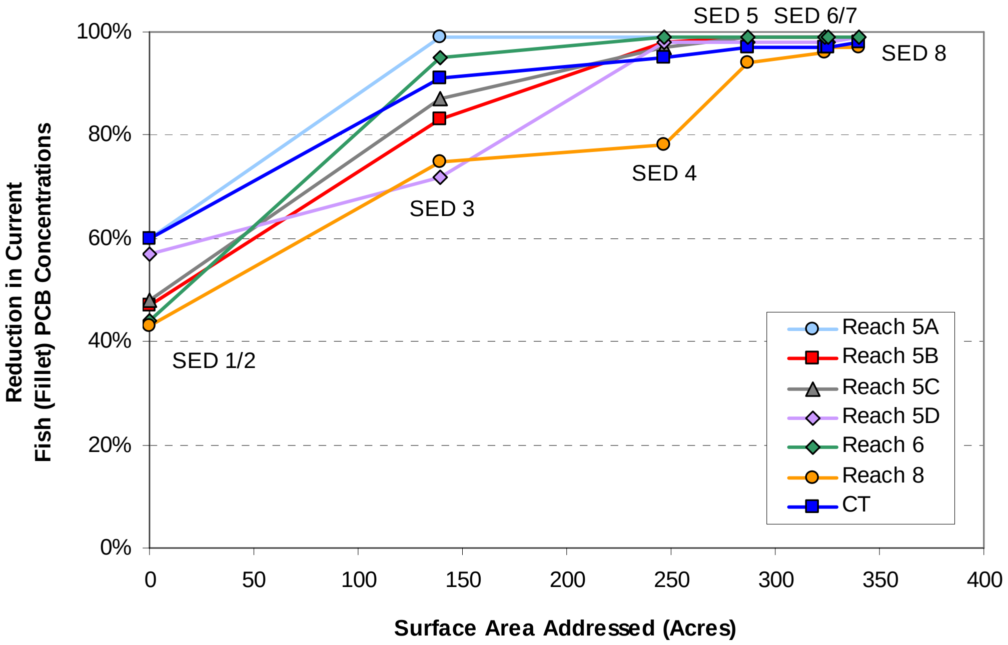


<u>Compliance with ARARs</u>: As detailed in later sections of this report, it is anticipated that all the removal alternatives would meet the ARARs that have been identified, with a few exceptions that would be technically impracticable to achieve and thus would likely require a waiver, irrespective of the alternative. In short, there is no material basis for distinguishing among these alternatives based on ARAR compliance.

<u>Consideration and Balancing of Selection Decision Factors</u>: A balancing of the Selection Decision Factors clearly favors SED 3. For example:

- SED 3 would result in the greatest incremental reductions in PCB levels in fish: 99% in Reach 5A and about 70-95% in the other reaches (relative to current levels). Additional remediation would result in relatively small additional reductions. This pattern is shown graphically (versus surface area addressed) on Figure ES-3 (below). Moreover, since SED 3 would have the shortest implementation time, it would achieve the reductions faster, particularly when measured against SED 7 and SED 8.

Figure ES-3 – Reduction in Current Fish (Fillet) PCB Concentrations Over the Model Projection Period Versus Surface Area Addressed in Remedy



- The greater the scale of the remediation, the greater the long-term adverse effects on the environment (e.g., loss of mature trees in the floodplain staging areas, changes in the nature of wetlands, and long-term adverse impacts on biota and their habitat). SED 3 would produce fewer of these impacts than the other alternatives. The story is much the same for short-term adverse impacts: SED 3 would result in less potential for resuspension of PCB-containing sediments during sediment removal, less habitat destruction from remediation, and less habitat destruction from supporting activities in the floodplain. Similarly, SED 3 would have the fewest impacts to local communities resulting from disruption of recreational use of the River during remediation, as well as the least amount of noise and truck traffic associated with remediation. SED 3 would also have the least potential for injury to on-site workers.

- SED 3 would cost approximately $148 million. While that cost is substantial, it is less than the remaining removal alternatives, whose total estimated costs range from $216 million to $615 million (even without including the substantial additional costs of sediment disposition/treatment). Thus, SED 3 would achieve the largest incremental reduction in PCB loading, transport, and fish concentrations for the lowest cost; the remaining alternatives would achieve much smaller incremental reductions at much greater costs.

ES.3.2 Evaluation of Floodplain Soil Alternatives

GE believes that, of the floodplain soil removal alternatives, FP 3 is “best suited” to meet the General Standards in the Permit after consideration and balancing of the Selection Decision Factors. The reasons include the following:

<u>Attainment of General Standards</u>

<u>Overall Protection of Human Health</u>: FP 2, FP 3, and FP 4 would all be protective of human health, by achieving relevant IMPG levels within EPA’s cancer risk range, as well as those based on non-cancer impacts, in 100% of the human exposure areas. In comparison, while FP 5 and FP 6 would achieve IMPG levels within the cancer risk range in all areas, they would achieve the non-cancer IMPGs for the most highly exposed individuals in only 94% of the area evaluated. FP 7 would provide human health protection by achieving the most stringent IMPGs in all human exposure areas, but it would require removal of a huge volume of floodplain soil (569,000 cy) over a very large area (350 acres) and would take a very long time to implement (22 years), thus resulting in the longest overall time to achieve the IMPGs.

<u>Overall Protection of the Environment</u>: The floodplain soil alternatives involving removal would provide varying degrees of environmental protection. FP 3 would achieve levels within the range of IMPGs for omnivorous/carnivorous mammals in all areas and for amphibians in all vernal pools in the floodplain. It would achieve the IMPGs for insectivorous birds in all or most areas, depending on the associated sediment levels; and it would achieve the levels within the IMPG range for piscivorous mammals if the associated sediment levels were $\leq$ 1 mg/kg, though not at higher sediment levels.[3] FP 2 and FP 4 would have generally similar results, except that FP 2 would not achieve levels within the IMPG range for amphibians in most vernal pools in the floodplain. FP 5 and FP 6 would likewise have generally similar results to FP 3, with some greater achievement of IMPGs for piscivorous mammals, but considerably less for amphibians. However, FP 6 would cause substantial adverse short-term and long-term environmental impacts through the widespread loss of ecological habitat, especially upland forest and wetland habitat. Finally, FP 7 would achieve all the ecological IMPGs but would cause the greatest short-term and long-term harm to the environment over the longest period. It would require removal of over 350 acres of floodplain habitat, including 45% (135 acres) of the mature upland forest in the floodplain, as well as large amounts (123 acres) of wetlands, including vernal pools and palustrine (wooded) wetlands – which are wetland types whose successful restoration is uncertain or may take decades.

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[3] As discussed above for sediments, GE does not believe that IMPGs exceedances for these receptors would prevent the maintenance of healthy local populations, given that those populations extend beyond the areas of the exceedances, including to areas outside the site.

Based on these considerations, GE has concluded that: (a) FP 2 would be generally protective of the environment but with uncertainty for certain receptor groups; (b) FP 3, FP 4, and FP 5 would provide overall protection of the environment; and (c) while FP 6 and FP 7 would provide protection from most (FP 6) or nearly all (FP 7) of the ecological risks identified by EPA, the widespread and extensive environmental damage that would be caused by those alternatives would not justify the incremental risk reduction, and thus these alternatives would have a net negative impact on the environment.

Control of Sources of Releases: Existing floodplain soils are not a significant source of potential releases to the River, so this factor does not provide a basis for distinguishing among the floodplain alternatives.

Compliance with Federal and State ARARs: This factor also applies equally to all the floodplain alternatives and does not provide a basis for distinguishing among them.

Consideration and Balancing of Selection Decision Factors**:** A balancing of the Selection Decision Factors shows that FP 3 is "best suited" to meet those standards. The principal reasons are:

- From a health standpoint, FP 3 would achieve IMPGs within EPA's cancer risk range and the non-cancer IMPGs in all areas. From an ecological standpoint, while FP 7 would achieve the most stringent IMPGs, FP 3 would achieve more IMPGs than FP 2 and generally comparable amounts to those achieved by FP 4, FP 5, and FP 6 (although the specific receptors and areas would differ).

- Long-term and short-term adverse impacts to the floodplain are directly a function of the area impacted by remediation. Apart from FP 2 (which would be less protective of ecological receptors), FP 3 would have the least overall potential for long-term adverse impacts on the environment, while FP 6 and FP 7 would most likely cause substantial long-term adverse impacts. These impacts would include, in particular: (a) the loss of mature upland forests, which, after replanting, could take decades to be reestablished; and (b) the loss of wetlands, including palustrine (wooded) wetlands (which could experience long-term effects for similar reasons as upland forests) and vernal pools (which are complex wetlands important to amphibians and could experience long-term impacts due to uncertainties in restoration). The removal actions under FP 3 would affect much less upland forest habitat (12 acres) than FPs 4 and 5 (30 acres), FP 6 (84 acres), and FP 7 (135 acres). For palustrine wetlands, FPs 3 and 4 would affect a limited amount of such habitat (1 acre), while FP 5, FP 6, and FP 7 would affect much larger areas (12, 39, and 40 acres). For vernal pools, FPs 3, 4, 6, and 7 would all affect a large number of pools and a substantial portion of the site's vernal pool habitat. In addition to these impacts, FP 6 and FP 7 are more likely to adversely affect rare, threatened, or endangered species than the other alternatives.

- Apart from FP 2, FP 3 would also cause the fewest short-term adverse impacts on the environment and on local communities. The environmental impacts from floodplain remediation include the temporary removal of plant and wildlife habitat, with the most significant impacts consisting of the loss of upland forest habitat and wetlands, along with the wildlife that depend on those habitats. The remediation would also cause disruption of recreational activities within the floodplain due to the remediation and support facilities, as well as construction traffic and noise during excavation and backfilling activities. Apart from FP 2, FP 3 would result in the least amount of these impacts, while FP 6 and FP 7 would cause the greatest adverse impacts over the longest duration.

- In terms of implementability, all the floodplain soil removal alternatives would involve soil removal, backfilling, and replanting using available techniques. However, the more extensive removal alternatives such as FP 6 and FP 7 would affect substantially more area (including more wetlands), in many cases over contiguous areas, which would increase the uncertainties for successful restoration. In addition, it is likely that the large volumes of backfill and planting material needed to support those alternatives would be less readily available than the smaller amounts needed to support the other alternatives. Also, there could be difficulties in obtaining access agreements from the owners of private properties to which access would be necessary to perform the work. These difficulties would increase with the number of such property owners, which is estimated to be 15 for FP 2, 30 for FP 3, 40 for FP 4, 35 for FP 5, 45 for FP 6, and 70 for FP 7.

- While FP 2 has the lowest cost ($10.6 million), it would be less protective of ecological receptors. At an estimated cost of $27 million, FP 3 is the most cost-effective alternative. FP 4 through FP 7 would all cause more adverse impacts and have higher costs – $38 million to $168 million (not including treatment and/or disposition costs).

ES.3.3 Evaluation of Treatment/Disposition Alternatives

Applying the Permit criteria, TD 3, disposition in an on-site Upland Disposal Facility, presents the best alternative, combining protection of human health and the environment with relatively greater reliability and cost-effectiveness than other alternatives.

At the outset, GE believes that TD 2 (disposition in local in-water CDF(s)) would not be viable because it: (a) could be used only for certain hydraulically dredged sediments under certain sediment alternatives and would not provide for disposition of the remaining sediments or of soils; (b) would likely not meet some ARARs; (c) would result in a permanent loss of aquatic habitat in a large portion of Woods Pond and backwaters, where the CDF(s) would be constructed; and (d) could result in an associated loss of flood storage capacity. TD 2, therefore, is not included in the discussion of the treatment/disposition alternatives below.

Among the remaining alternatives, an analysis of the Permit criteria favors TD 3 (on-site upland disposition), including for the following reasons:

<u>Attainment of General Standards</u>

<u>Overall Protection of Human Health and the Environment</u>: TD 1 and TD 3 would both provide overall protection through permanent disposal and isolation of removed sediments and soils in a permitted off-site landfill (TD 1) or in an Upland Disposal Facility, which would be constructed with an impermeable liner and cover and would be subject to long-term monitoring and maintenance to ensure its effectiveness (TD 3). TD 4 (chemical extraction) would provide protection by reducing the PCB concentrations in the sediments and soils, followed by appropriate disposal of the treated material. Based on bench-scale study results, it appears that the chemical extraction process could not reduce PCB concentrations in the treated material to levels that would allow on-site reuse. Thus, the treated solid material would have to be transported off-site for disposal, and the large volumes of wastewater would also need to be treated prior to discharge. Finally, TD 5 (thermal desorption) would provide protection by reducing the PCB concentrations in the sediments and soils, assumed to be followed by the on-site reuse of a portion of the treated solids as backfill in the floodplain (with sampling to confirm that those materials would not present any health or environmental concern) and off-site disposal of the remainder.

<u>Control of Sources of Releases</u>: All these treatment/disposition alternatives would also meet the standard for control of sources of future releases of PCBs within the River or onto the floodplain. TD 1 would eliminate that potential through off-site disposal, and TD 3 would minimize the potential for releases through placement of those materials into a properly designed and monitored Upland Disposal Facility, which would be located outside the 100-year floodplain. TD 4 and TD 5 would control future releases through treatment of the sediments and soils in operations located outside the 100-year floodplain, followed by appropriate disposition of the treated material, although these alternatives do present the potential for some leaks or spills during treatment and transport activities.

<u>Compliance with Federal and State ARARs</u>: There are no identified ARARs that are relevant to TD 1, since that alternative would involve off-site transport and disposal. For TD 3 through TD 5, GE believes the alternatives could be designed and implemented to meet the pertinent ARARs (provided that EPA makes any necessary risk-based approval determination under its Toxic Substances Control Act [TSCA] regulations), with the possible exception of certain requirements that could potentially apply if the materials involved should constitute hazardous

waste under RCRA criteria (which is not anticipated). In the latter case, GE would evaluate various options described in this report.

Consideration and Balancing of Selection Decision Factors**:** GE believes that an overall balancing of the Selection Decision Factors favors TD 3. The main reasons are:

- On-site disposal in a properly designed facility has been used reliably at numerous sites, and would have the highest degree of long-term effectiveness and reliability. Use of off-site disposal facilities (TD 1) is also common for permanent disposal, but due to the potential length of time required to implement this alternative (8 to > 50 years), there are uncertainties regarding future off-site landfill capacity.

  The use of chemical extraction (TD 4) has not been demonstrated at full scale on sediments and soils that could be considered representative of those in the Rest of River, and there are uncertainties regarding the extent to which that process can reduce PCB concentrations in such materials. Results from the site-specific BioGenesis bench-scale study indicate that PCB concentrations cannot be reduced to levels that would allow reuse. Moreover, based on those results, there are some uncertainties regarding the extent to which the treated materials could be disposed of off-site as non-TSCA-regulated materials.

  Thermal desorption (TD 5) has rarely been used to treat PCB-containing sediments, due in part to the time and cost of removing moisture from the sediments prior to treatment. Mechanical problems can result from treatment of high-organic, high-moisture-content, fine-grained materials, which can clump and clog equipment or otherwise be physically difficult to treat. Further, while thermal desorption has been used at several sites to treat PCB-containing soils, the volumes of materials treated in those cases were substantially smaller and the duration of the treatment operation was substantially shorter that the volumes and duration that could be involved at the Rest of River. Moreover, when on-site reuse of thermally treated materials has occurred, the materials have typically been placed in a small area and covered with clean backfill. In short, the reliability of this process for a long-term treatment operation with a large volume of materials like the Rest of River sediments and soils is unknown, as is the ability to use the treated solids, amended by organic material, as backfill in the floodplain without being covered by other material.

- All the alternatives (except TD 1) would have some short-term impacts on the environment and local communities in the Rest of River area. In general, those impacts would be limited to the specific area of the disposal or treatment facility, although the thermal desorption process (TD 5) could lead to the volatilization and emission of certain metals (e.g., mercury), as well as PCBs, and the emission of dioxins/furans which can be formed during the process. In addition, all these alternatives would cause an increase in truck traffic for the transport of excavated or treated materials to off-site disposal facilities (for TD 1, TD 4, and TD 5) or for the delivery of construction materials and equipment to the disposal or treatment facility (for TD 3 through TD 5). This increase in truck traffic would create short-term impacts, including increased noise and an increased risk of accidents, not only for local communities but also for communities along the transportation routes. It is estimated that the greatest number of off-site truck trips would be needed for TD 1 and TD 4 (~14,000 to 212,000), followed closely by TD 5 (~12,000 to 190,000), with far fewer truck trips needed for TD 3 (~1,400 to 13,000).

- The costs of these alternatives have been estimated based on the potential range of volumes from the smallest (185,000 cy based on SED 3 plus FP 2) to the largest (2.8 million cy based on SED 8 plus FP 7). (These estimates do not include costs for removal of the sediments or soils.) The estimated total costs of TD 3 would be the lowest ($22 million to $121 million), compared to much higher costs for the other alternatives ($50 million to $790 million for TD 1, $90 million to $958 million for TD 4, and $64 million to $912 million for TD 5 with partial reuse of treated material or $66 million to $969 million for TD 5 with no reuse). Thus, based on the costs for treatment/disposition, TD 3 is the most cost-effective alternative. Under the National Contingency Plan, when more than one alternative would achieve the threshold criteria, the more cost-effective alternative must be selected (see 40 CFR § 300.430(f)(1)(ii)(D)).

ES.4 Overall Conclusion

Taking into account EPA’s HHRA and ERA and using EPA’s directives for the CMS, as required under the Permit, GE has concluded that a combination of alternatives SED 3, FP 3, and TD 3 is best suited to meet the General Standards of the Permit in consideration of the Selection Decision Factors, including balancing of those factors against one another. Taken as a whole, this would be a major remedial project – a 10-year construction and restoration project involving the excavation and disposal of over 225,000 cubic yards of sediment and soil, at an estimated combined cost of $184 million. As noted above, this conclusion is subject to GE’s reservations of rights, including its appeal rights, and thus does not constitute a proposal to implement these alternatives.

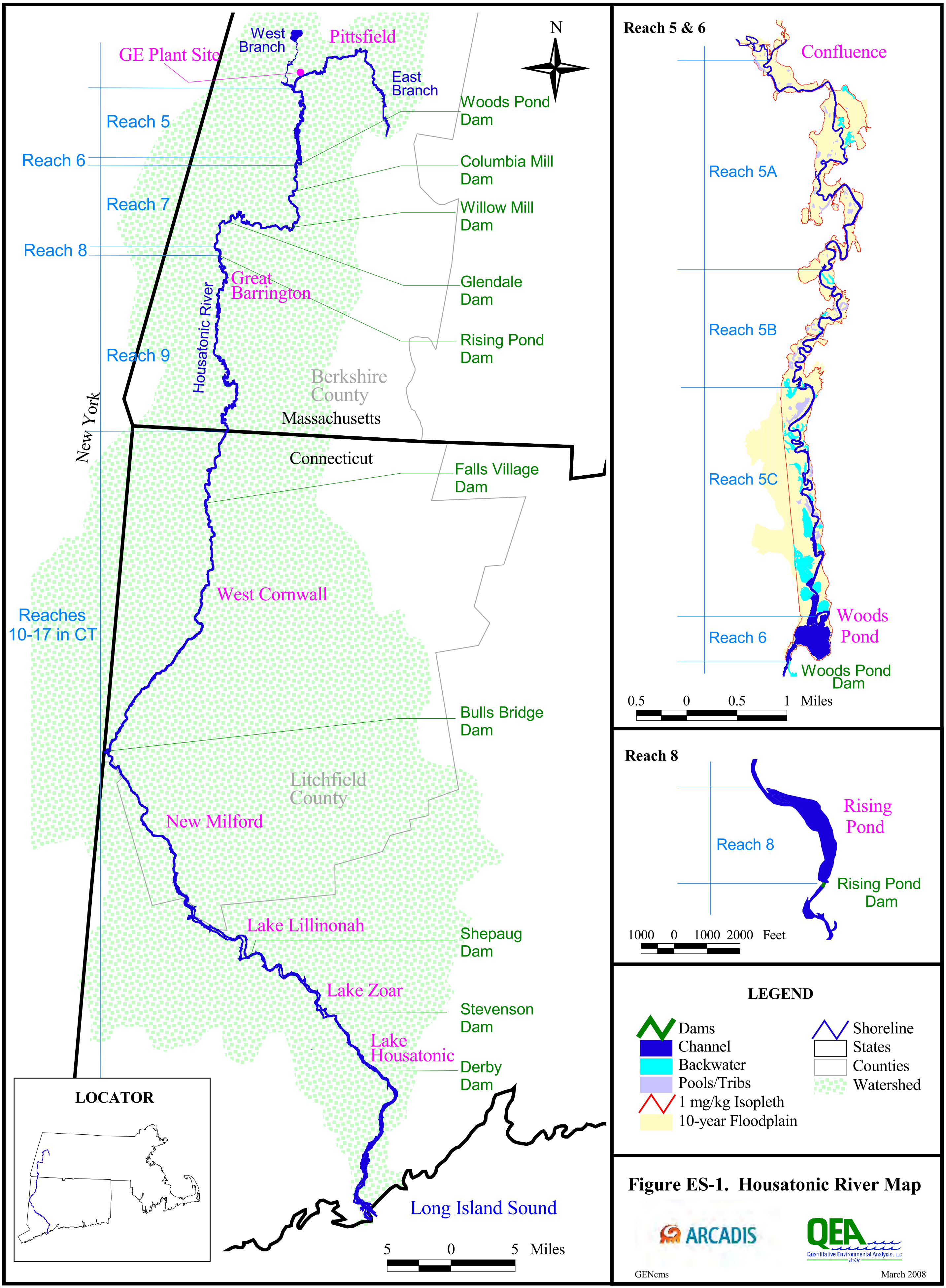

Figure ES-1. Housatonic River Map

ARCADIS

QEA
Quantitative Environmental Analysis, LLC

GENcms

March 2008

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1. Introduction

This Corrective Measures Study (CMS) Report presents the evaluations conducted by the General Electric Company (GE) of potential corrective measures (remedial actions) to address polychlorinated biphenyls (PCBs) within the Rest of River portion of the Housatonic River. The Rest of River is defined as that portion of the River and its floodplain located downstream of the confluence of the East and West Branches of the Housatonic River (the Confluence) to which releases of hazardous waste or hazardous constituents from the GE facility in Pittsfield, Massachusetts, have migrated.

1.1 Background

This CMS Report is submitted pursuant to Special Condition II.G of a permit issued to GE by the United States Environmental Protection Agency (EPA) under the corrective action provisions of the federal Resource Conservation and Recovery Act (RCRA) on July 18, 2000, and reissued on December 5, 2007, to extend its expiration date (the Permit). This Permit (which constitutes a reissuance of a RCRA permit previously issued to GE in the early 1990s) was issued as part of a comprehensive settlement embodied in the Consent Decree (CD) for the GE-Pittsfield/Housatonic River Site, and it became effective on the effective date of the CD, October 27, 2000.[1] The CD details the terms of an agreement among GE, EPA, the Massachusetts Department of Environmental Protection (MDEP), the Connecticut Department of Environmental Protection (CDEP) and other federal, state and local governmental entities relating to the cleanup of GE's facility in Pittsfield, Massachusetts, the Housatonic River downstream of GE's facility, and other adjacent and nearby areas.

As provided in the Permit and based on both recent and historical data, GE developed a RCRA Facility Investigation Report (RFI Report) for the Rest of River area to document the nature, extent, fate, and transport of PCBs and certain other chemical constituents that have potentially migrated from the GE facility in Pittsfield into the surface water, sediments, and floodplain soils of the Rest of River area, as well as their resulting presence in the biota in the Rest of River area. The RFI Report was submitted in draft form to EPA in January 2003 and the final RFI Report was issued in September 2003 (Blasland, Bouck & Lee, Inc. [BBL] and Quantitative Environmental Analysis, LLC [QEA], 2003).

As provided in the CD, EPA conducted a Human Health Risk Assessment (HHRA) and an Ecological Risk Assessment (ERA) of the Rest of River area. Those draft assessments were then subject to peer review. Following the peer reviews, EPA revised the draft risk

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[1] Under the Permit as reissued on December 5, 2007, the expiration date of the Permit was extended to December 5, 2017. No other changes were made to the Permit.

assessment reports, issuing a revised draft ERA in November 2004 (EPA, 2004e) and a revised draft HHRA in February 2005 (EPA, 2005a). After a public comment period on new information in those revised drafts, EPA issued Responsiveness Summaries for the ERA in March 2005 (EPA, 2005b) and for the HHRA in June 2005 (EPA, 2005c), concluding in both cases that no further changes to the risk assessment reports were warranted and that the November 2004 ERA and February 2005 HHRA, together with the Responsiveness Summaries, should be considered the final risk assessments for the Rest of River.

Following completion of the HHRA and ERA, GE submitted an Interim Media Protection Goals Proposal (IMPG Proposal) to EPA in September 2005, which presented proposed interim media protection goals (IMPGs) for PCBs and certain other hazardous constituents in the Rest of River area. In December 2005, EPA disapproved that IMPG Proposal and directed GE to submit a revised IMPG Proposal incorporating a number of revisions specified by EPA. Although GE disagreed with a number of EPA's directives and preserved its position on those issues, the Company submitted a revised IMPG Proposal in March 2006 implementing EPA's directives (GE, 2006). EPA approved that revised IMPG Proposal on April 3, 2006. In accordance with the Permit, attainment of these IMPGs is one of the factors considered by GE in evaluating various potential corrective measures, as discussed further in this CMS Report.

As provided in the CD, EPA also conducted a modeling study of the fate, transport, and bioaccumulation of PCBs within the Rest of River. The overall objective of the modeling study was to develop a model that could be used to reasonably predict future conditions in the Housatonic River in the absence of any further remedial action and to evaluate the relative effectiveness of various remedial alternatives, particularly with regard to PCB fate, transport, and bioaccumulation. The EPA model consists of the following components: watershed submodel (Hydrological Simulation Program-FORTRAN, known as HSPF), hydrodynamic and sediment/contaminant transport and fate submodel (Environmental Fluid Dynamics Code, known as EFDC), and bioaccumulation submodel (Food Chain Model, known as FCM, derived from QEAFDCHN Version 1.0). The modeling study was conducted in three phases: model framework design (EPA, 2004a), model calibration (EPA, 2004g), and model validation (EPA, 2006a). Each phase was subject to peer review. On November 29, 2006, EPA notified GE of the Agency's determination that the peer review process on validation of EPA's model had been completed, and provided to GE the Final Model Documentation Report (FMDR; EPA, 2006b). However, EPA continued to make some changes to the model following that date.

As required by Special Condition II.E of the Permit, GE submitted a Corrective Measures Study Proposal (CMS Proposal) to EPA on February 27, 2007 (ARCADIS BBL and QEA, 2007a). In accordance with the Permit, the CMS Proposal provided the first steps of the CMS evaluation process, including identifying Remedial Action Objectives (RAOs), and identifying and screening potential remediation technologies and process options to develop a preliminary list of remedial alternatives – for sediments, floodplain soil, and management/disposition of removed sediments/soil – that would be subject to detailed evaluation in the CMS. The CMS Proposal also described the proposed methodology for evaluating those alternatives in this CMS Report.

On April 13, 2007, EPA issued a letter to GE stating that it was providing “conditional approval” of the CMS Proposal, subject to numerous conditions and directives relating to the CMS, including a requirement to submit, for EPA review and approval, a Supplement to the CMS Proposal addressing several of the conditions in that letter. On April 27, 2007, GE invoked dispute resolution under the Permit with respect to several conditions and directives in EPA’s conditional approval letter. Following discussions between the parties, EPA and GE exchanged letters on May 22 and 23, 2007, in which EPA revised certain of the disputed conditions and GE agreed that it would not proceed with the dispute resolution proceeding initiated on April 27, 2007, while reserving its future rights regarding those or any of the other conditions in EPA's April 13, 2007 letter.

In the meantime and subsequently, GE submitted to EPA a number of additional documents to supplement the CMS Proposal, and EPA provided responses to those submittals. The following is a list of those submittals and EPA’s responses, and, where applicable, disputes invoked by GE:

- On April 16, 2007, GE submitted a Model Input Addendum (MIA) to specify a number of the input parameters and values that GE proposed to use in applying EPA’s model to evaluate the sediment alternatives in the CMS. That MIA included a proposal for supplemental PCB sampling of sediments and surface water in the East Branch of the River to provide data to assist in establishing the upstream boundary conditions for the East Branch for use in the model; and it stated that following review of those data, GE would submit an additional deliverable summarizing the results and describing the proposed current and future boundary condition values for the East Branch.

- On May 11, 2007, GE submitted a CMS Proposal Supplement to address several of the conditions and directives in EPA’s April 13, 2007 letter.

- On May 14, 2007, GE submitted certain proposed revisions to the model code to be used in the model simulations of sediment alternatives.

- On May 24, 2007, EPA issued a “conditional approval” letter for the MIA.

- On May 31, 2007, GE submitted an addendum to the CMS Proposal Supplement containing a revised table listing the sediment remediation alternatives in response to EPA's April 13, 2007 conditional approval letter.

- On July 11, 2007, in response to a request by EPA in its April 13, 2007 conditional approval letter, GE submitted a work plan for the performance of a treatability study of a chemical extraction technology.

- Also on July 11, 2007, EPA issued a "conditional approval" letter for the CMS Proposal Supplement as well as the model code revisions. That letter contained a number of additional conditions and directives for the CMS.

- On July 25, 2007, GE invoked dispute resolution under the Permit on certain directives contained in EPA's July 11, 2007 conditional approval letter for the CMS Proposal Supplement, relating to the methodology for developing and applying target floodplain soil concentrations associated with the IMPGs for mink. Following discussions between the parties, EPA and GE exchanged letters on August 29 and 30, 2007, in which EPA revised certain of the disputed directives and GE agreed that it would not proceed with the dispute resolution proceeding, while reserving its future rights regarding those or any of the other conditions in EPA's July 11, 2007 letter.

- On July 31, 2007, EPA issued a conditional approval letter for the proposed chemical extraction treatability study.

- On August 3, 2007, GE submitted a Supplement to the MIA (MIA-S) summarizing the supplemental sediment and water column sampling proposed in the MIA and proposing current and future PCB boundary condition values for the East Branch.

- On August 28, 2007, EPA issued a "conditional approval" letter for the MIA Supplement. That letter contained additional directives with respect to the East Branch boundary conditions proposed by GE in the MIA-S.

- On September 11, 2007, GE invoked dispute resolution under the Permit on EPA's May 24, 2007 conditional approval letter for the MIA[2] and its August 28, 2007 conditional approval letter for the MIA-S. Following discussions between the parties, EPA and GE exchanged letters on September 17, 2007, in which EPA eliminated one of the disputed conditions in its May 24, 2007 conditional approval letter and GE agreed that it would not

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[2] EPA and GE had previously agreed to extend the time for GE to invoke dispute resolution on this letter until after GE received EPA's response to the MIA Supplement.

proceed with the dispute resolution proceeding, while reserving its future rights regarding those or any of the other conditions in EPA's May 24, 2007 and August 28, 2007 letters.

1.2 Purpose and Scope

This CMS Report presents the results of the evaluations conducted by GE of potential remedial actions to address PCBs within the Rest of River portion of the Housatonic River. This report evaluates a number of remedial alternatives in accordance with a set of General Standards and Selection Decision Factors specified in Special Condition II.G of the Permit. As further required by the Permit, this CMS Report then compares the remedial alternatives on the basis of each criterion, and presents conclusions as to which alternatives, in GE's opinion, best meet the General Standards in consideration of the Selection Decision Factors.

In accordance with the Permit, EPA will approve, conditionally approve, or disapprove this CMS Report, as provided in Special Condition II.H of the Permit. Thereafter, EPA will select and propose remedial actions, along with associated Performance Standards and applicable or relevant and appropriate requirements (ARARs), for the Rest of River as a modification to the Permit, and will solicit public comments on that proposed permit modification. EPA then will issue a modification of the Permit specifying the remedial actions for the Rest of River, which will be subject to appeals in accordance with the CD and the Permit. Following any appeals, the selected remedial actions (with any modifications stemming from the appeals) will be implemented under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the CD.

It is important to note that, as required by the Permit, the evaluations and conclusions presented in this CMS Report have taken into account EPA's HHRA and ERA and have used the assumptions, IMPGs, procedures, and other inputs that EPA directed GE to use in the CMS. However, GE does not agree with many of EPA's conclusions and directives. For example, GE has a fundamental disagreement with EPA regarding the effects of PCBs on human health and the environment, and does not agree with many of the exposure assumptions, toxicity values, and data interpretations used in EPA's HHRA and ERA.[3] In addition, GE does not agree with a number of the specific assumptions, parameter values, procedures, and other inputs that EPA directed GE to apply in the CMS. These include, but are not limited to: (a) the revised IMPGs, as approved by EPA (which are based on the HHRA and ERA); (b) some of the assumptions and values used in converting tissue-based IMPGs to target concentrations in other media (e.g., certain factors used in converting IMPGs for agricultural products to target soil concentrations, assumption that mink forage entirely within the defined floodplain for purposes of converting IMPGs for mink prey into target floodplain soil concentrations); (c) some of the methods of applying the IMPGs (e.g., conversion of modeled whole-body fish concentrations to fish fillet concentrations, determination of appropriate averaging areas for several ecological receptor groups, directive not to use EPA's own wood frog population model in applying the IMPGs for amphibians); (d) some of the inputs to the PCB fate, transport, and bioaccumulation model (e.g., use of a PCB half-life in estimating the future PCB input to the Rest of River from the East Branch; and (e) certain components of the remedial alternatives evaluated (e.g., increase in the soil removal depth, for most floodplain remedial alternatives, from 1 to 3 feet in certain heavily used areas).

These EPA conclusions and directives are fundamental to and directly affect many of the evaluations of remedial alternatives presented in this CMS Report, as well as the comparative evaluation of the alternatives and the conclusions drawn from them. Since GE does not agree with those underlying conclusions and directives, GE likewise does not endorse the resulting evaluations and conclusions. GE preserves its position on these and all other issues on which it has previously presented its position to EPA; and it reserves its right, pursuant to Special Condition II.N.5 of the Permit, to raise any objections on these or other issues in a challenge to EPA's modification of the Permit to select corrective measures for the Rest of River, as well as any other rights that GE has under the Permit, the CD, or applicable law to raise such objections.

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[3] For the reasons given in previous submissions to EPA, GE believes that, based on the weight of evidence from human studies, there is no credible evidence that PCBs have caused cancer in humans or have caused adverse non-cancer effects in humans at environmental levels. Further, GE does not believe that the evidence reveals significant adverse effects from PCBs on the overall Rest of River ecosystem, given that PCBs have been present in this system for over 70 years and yet field surveys showed abundant, diverse, and thriving fish and wildlife populations and communities in the area. Additionally, GE believes that many of the specific exposure assumptions, inputs, and data interpretations in the HHRA and ERA overstate PCB exposures and risks in the Rest of River area. All these points are explained in GE's comments on the HHRA and ERA (AMEC and BBL, 2003, 2005; BBL et al., 2003, 2005; GE, 2003, 2004a) and in the attachments and documents referenced therein.

1.3 Report Organization

The content and structure of this CMS Report are based on the requirements of Special Condition II.G of the Permit and are outlined below.

- Section 1 (this section) presents relevant background information, including a summary of the CMS Proposal, which provided the preliminary screening and selection of alternatives for evaluation in this CMS Report, and a summary of the remedial alternatives evaluated in the CMS.

- Section 2 describes the evaluation criteria and the process for applying the criteria to the different sets of remedial alternatives. The subsections identify and discuss the General Standards and Selection Decision Factors that are the foundation of the evaluation process under the Permit.

- Section 3 describes certain other aspects of the approach used in evaluating the sediment remedial alternatives, including additional details relating to those alternatives, use of EPA's model to quantify the reductions in sediment, surface water, and fish PCB concentrations predicted to result from those alternatives, and the averaging procedures used in the evaluations.

- Section 4 presents the evaluations of the sediment remedial alternatives. This section includes a detailed description of each alternative and a detailed evaluation of that alternative under the Permit criteria. The last subsection in Section 4 provides a comparative evaluation of the alternatives.

- Section 5 describes the exposure/averaging areas used in developing and evaluating the floodplain soil remedial alternatives and the methods used to estimate the areal extent and volume of soil removal for each alternative.

- Section 6 presents the evaluations of the floodplain soil remedial alternatives. This section includes a detailed description of each alternative and a detailed evaluation of that alternative under the Permit criteria. The last subsection in Section 6 provides a comparative evaluation of the alternatives.

- Section 7 describes the treatment/disposition alternatives and provides a detailed evaluation of each alternative under the Permit criteria. The last subsection includes a comparative analysis of the alternatives.

- Section 8 provides cost estimates for the alternatives. Combined costs for sediment alternatives and associated treatment/disposition alternatives, and for floodplain soil alternatives and associated treatment/disposition alternatives, are discussed with reference to tables that provide a comparison of the costs.

- Section 9 summarizes GE's conclusions, based on the evaluations contained in this report, as to which remedial alternatives would, in GE's opinion, be best suited to meet the General Standards in the Permit, in consideration of the Selection Decision Factors, including a balancing of those factors against one another. For the reasons given in Section 1.2, these conclusions are subject to GE's reservations of rights and thus do not constitute a proposal to implement these alternatives.

- Tables, figures, and appendices are referenced throughout this CMS Report and provide supporting information.

1.4 Site Description

From the early 1900s, GE owned, and previously operated, a manufacturing plant along the East Branch of the Housatonic River in Pittsfield, Massachusetts. GE's primary industrial activities at this plant included the manufacturing and servicing of power transformers (GE Transformers), defense and aerospace operations (GE Ordnance), and the manufacture of plastics (GE Plastics). GE no longer conducts manufacturing activities at this plant. The release of PCBs to the Housatonic River was primarily associated with the former GE Transformer Division's activities, which included the construction and repair of electrical transformers utilizing dielectric fluids containing PCBs. GE manufactured and serviced transformers containing PCBs at this facility from approximately 1932 through 1977. During this period, releases of PCBs reached the East Branch of the Housatonic River and Silver Lake through the facility's wastewater and stormwater systems.

PCBs were initially discovered in sediments and fish in impounded lakes along the Housatonic River in Connecticut in the mid-1970s. Since that time, numerous investigations have been conducted by GE and others to assess the presence and extent of PCBs and other hazardous substances in various media in both the Massachusetts and Connecticut portions of the Housatonic River, including the Rest of River area. GE has undertaken numerous source control and remediation measures along the Housatonic River as a result of these investigations. The more recent source control and remedial measures (which were described in Section 2.3 of the CMS Proposal) include:

- Source control activities at and near the GE facility to prevent or control the migration of PCBs and other chemical constituents present in non-aqueous-phase liquid (NAPL) into the River, including installation of sealed sheetpile barriers and active light NAPL (LNAPL) and dense NAPL (DNAPL) collection systems.

- Sediment and bank soil remediation projects in the Upper ½-Mile Reach of the River, including the Building 68 Area Removal Action and the Upper ½-Mile Reach Removal Action.

- Additional remediation activities in floodplain and former oxbow areas adjacent to the East Branch of the River as necessary to meet Performance Standards set forth in the CD.

- Investigations and initiation of remediation activities at Silver Lake (which discharges to the East Branch of the River) under the CD.

In addition, under the CD, EPA performed an extensive sediment/bank soil remediation project in the 1½-Mile Reach of the River between the Upper ½-Mile Reach and the Confluence.

In addition to the remediation activities already conducted, GE will be performing a number of other remediation activities in areas upstream of the Confluence that will result in a further reduction in the PCBs entering the Rest of River from upstream. These include: (a) completion of the remediation of Silver Lake (which will include some sediment removal and capping of the entire lake), as well as the banks adjacent to Silver Lake; (b) remediation of the Unkamet Brook Area at the GE facility, including Unkamet Brook, which flows into the East Branch of the River; (c) remediation of other areas at the GE facility adjacent to the East Branch (e.g., East Street Area 2-South) to meet Performance Standards under the CD; and (d) remediation of the sediments and lower riverbank soils in the West Branch adjacent to Dorothy Amos Park, which represent the major identified PCB source in the West Branch. These activities will be conducted under the CD, except for the remediation of the West Branch, which will be conducted under an Administrative Consent Order (ACO) executed by GE and MDEP covering certain areas outside the CD Site.

The Rest of River area consists of the portion of the Housatonic River and its floodplain downstream of the Confluence (located approximately 2 miles downstream from the GE facility) and to which releases of hazardous waste or hazardous constituents from the GE facility have migrated. The Rest of River area is shown on Figure 1-1 and is identified according to river reach designations established by EPA in the Site Investigation Work Plan (SI Work Plan) (EPA, 2000) and Model Validation Report (EPA, 2006a). The reaches are:

- Reach 5, from the Confluence downstream to Woods Pond (the first significant impoundment). This reach is further divided into three subreaches: Reach 5A (from the Confluence to the Pittsfield wastewater treatment plant [WWTP]); Reach 5B (from the Pittsfield WWTP to Roaring Brook); and Reach 5C (from Roaring Brook to the start of Woods Pond). The lower half of Reach 5 contains a large number of backwater areas that are adjacent to the Housatonic River (sometimes referred to herein as Reach 5D).

- Reach 6, Woods Pond.

- Reach 7, Woods Pond Dam to Rising Pond (the next significant impoundment).

- Reach 8, Rising Pond.

- Reach 9, Rising Pond Dam to the Connecticut border.

- Reaches 10 through 17, Connecticut border to Long Island Sound. However, EPA has not included Reach 17 in its studies of the Rest of River because that reach has received inputs of PCBs and other contaminants from industries in the immediate area.

Section 2 of the CMS Proposal provides a more detailed description of the Rest of River area, including characteristics and landmarks associated with the river reaches, and watershed, river and floodplain characteristics. It also provides a summary of the nature and extent of PCBs in sediment, surface water, floodplain soil, and biota, as well as a conceptual site model. As discussed in that section, the highest concentrations and greatest mass of PCBs are found in Reaches 5 and 6, which are known as the Primary Study Area (PSA), with considerably lower concentrations downstream of Woods Pond Dam.

It should also be noted that, under the CD, GE currently performs monitoring and maintenance of Woods Pond Dam and coordinates with the owner to monitor and maintain Rising Pond Dam, and it will continue to monitor and maintain these dams. This work consists of frequent visual inspections, with more detailed inspections of the dams’ structural integrity on a periodic basis, and the performance of maintenance and repairs as needed. The monitoring and maintenance of these dams ensure that they will continue to operate properly and prevent any major releases of sediments contained behind the dams.

1.5 Remedial Action Objectives

This section identifies general RAOs for the remedial alternatives evaluated in the CMS. As noted in the CMS Proposal, the Permit does not require that specific RAOs be identified or considered in the CMS. Nevertheless, the CMS Proposal set forth certain proposed RAOs, and EPA's April 13, 2007 "conditional approval" letter for the CMS Proposal directed GE to revise and expand those RAOs. However, as EPA's letter recognized, these RAOs are not directly tied to the evaluation criteria specified in the Permit. As such, while the RAOs describe overall goals and desired outcomes for the Rest of River, they have not been used as specific comparison criteria for the evaluations in the CMS. Rather, the evaluations presented in this CMS Report have been based on the criteria specified in the Permit.

As stated by EPA in its April 13, 2007 letter, the general RAOs for the Rest of River remediation are as follows:

- Reduce the cancer risk and non-cancer health hazard for humans (defined as achieving concentrations that do not pose unacceptable risks using EPA's cancer risk range of 1 x 10^{-6} to 1 x 10^{-4} and a non-cancer Hazard Index [HI] of 1) from exposure to PCBs in dietary items, floodplain soil, and/or sediment in the Rest of River.

- Reduce the risks to ecological receptors from exposure to PCBs in dietary items, floodplain soil, and/or sediment in the Rest of River to levels that will result in the recovery and maintenance of healthy local populations and communities of biota.

- Eliminate/minimize the long-term downstream transport of PCBs in the Rest of River. The objective of this RAO is to reduce the transport of PCBs from the highly contaminated upper reaches of the River to downstream reaches as quickly as possible and over the long term. This RAO also includes the control of sources of releases to the River.

In addition to these RAOs, GE's revised IMPG Proposal (GE, 2006) included, at EPA's direction, a statement regarding the desired outcome of the human health and ecological goals for the Rest of River in terms of designated uses for that portion of the River. That statement is that, for PCBs, the Rest of River portion of the Housatonic River will attain the designated uses defined in the Massachusetts and Connecticut water quality standards – namely: (a) for the Housatonic River from Pittsfield to the Connecticut border, "habitat for fish, other aquatic life, and wildlife," "primary and secondary contact recreation," "irrigation and other agricultural uses," and "compatible industrial cooling and process uses" (314 CMR 4.05(3)(b)); and (b) for the Connecticut portion of the River from the Massachusetts border to Lake Housatonic (Derby) Dam, "habitat for fish and other aquatic life and wildlife; recreation, navigation; and industrial and agricultural water supply" (Connecticut Water Quality Standards). In accordance with the EPA-approved IMPG Proposal, these designated uses have likewise not been used as specific comparison criteria in the evaluations of remedial alternatives in the CMS. Rather, as noted above, those evaluations have been based on the criteria specified in the Permit.

1.6 Summary of Retained Technologies and Process Options

In accordance with the Permit, the CMS Proposal identified the remedial alternatives to be studied in the CMS and provided justification for the selection of those alternatives. The first step in this process was to identify the general response action types, remedial technologies, and process options that could potentially be applied to address PCBs in the three environmental media identified for potential remediation: sediments, erodible riverbanks, and floodplain soils. For example, sediment removal is a response action type, which includes the remedial technology of dredging; and that technology includes process options such as mechanical dredging in the wet, mechanical dredging in the dry, and hydraulic dredging.

For each of the three media, GE identified general response action types as well as associated remedial technologies and process options. In addition, GE identified response action types, remedial technologies, and process options that would be applicable to manage sediments and soils if these were removed during remediation. GE conducted a two-step screening process, as described below, to select an appropriate group of corrective measures to study in the CMS.

The initial screening evaluated the remedial technologies based on technical implementability and was used to eliminate those technologies that were not appropriate based on site conditions or chemical/physical characteristics of the site media, or that had not been successfully applied on a full-scale basis at other PCB-impacted sites. For those technology types that were retained after the initial screening, the associated process options were then subject to a secondary screening based on effectiveness and implementability. The overall goal of this secondary screening was to develop a list of the most promising process options to be combined into a set of remedial alternatives for detailed evaluation in the CMS.

Subsequently, at EPA's direction, GE provided further justification in the CMS Proposal Supplement for the screening out of *in situ* treatment technologies, as well as the rationale for why monitored natural recovery (MNR) is appropriate for Reaches 9 through 16. EPA stated in its July 11, 2007 conditional approval letter that it agreed with those conclusions. EPA also requested that two process options (bioengineering techniques and Geotubes) be included or kept for potential reconsideration in the CMS.

The technologies/process options for river sediments retained for detailed evaluation are listed below with a brief description of each.

- No action – Reliance on ongoing, naturally occurring processes to contain, or otherwise reduce the bioavailability and/or toxicity of, PCBs in sediment, with no active remediation in the Rest of River.

- Engineering/institutional controls – Implementation of physical, legal, and/or administrative controls to limit exposure to PCBs in sediment or biota. Institutional controls include biota consumption advisories, as well as fishing or hunting restrictions. (In this CMS Report, the term "biota consumption advisories" is assumed to include fishing or hunting restrictions, if any, that may be deemed appropriate to assist in preventing or limiting consumption of PCB-containing biota.)

- MNR – Reliance on ongoing, naturally occurring processes to contain, or otherwise reduce the bioavailability and/or toxicity of, PCBs in sediment, with monitoring to assess the rate of recovery or attenuation.

- Thin-layer capping – Placement of a thin layer (e.g., 3 to 6 inches) of clean material over PCB-containing sediment to provide an immediate reduction of PCB concentrations in the biologically active zone and to accelerate natural recovery.

- Mechanical dredging in the wet – Removal of PCB-containing sediment using conventional earthmoving equipment through the water column.

- Mechanical dredging in the dry – Removal of PCB-containing sediment using conventional earthmoving equipment after dewatering the removal area.

- Hydraulic dredging – Removal of PCB-containing sediment using a hydraulic pump or compressed air to create a vacuum at the dredge head.

- Capping – Placement of a layer of clean isolating material over PCB-containing sediment to stabilize and sequester those sediments from the biologically active zone within the sediment bed and from the overlying water column, overlain, where warranted based on river conditions, by an armor stone layer designed to keep the cap in place during high flow events.

- Rechannelization (for limited areas) – Permanent redirection of the waterway into a newly constructed channel and covering the material in the original channel in place to isolate that material.

The technologies/process options for erodible riverbank soils retained for further evaluation (including those specifically identified by EPA in its April 13, 2007 conditional approval letter) are listed below with a brief description of each.

- No action – No active remediation.

- Mechanical excavation – Removal of PCB-containing soil from the riverbank using conventional earthmoving equipment.

- Armor stone – Placement of stone on the riverbank to create a barrier to destructive flow/wave/ice action.

- Revetment mats – Placement of double layers of woven fabric forms filled with concrete or grout, reno mattresses (stone-filled wide baskets), or cellular (cabled) concrete mats on the slope to be protected.

- Bioengineering techniques – Use of vegetation and in some cases vegetative support materials (e.g., coir logs/mats, brush mattresses, vegetative geogrid) to stabilize the banks.

For purposes of this CMS Report, the available remedial options for the riverbanks were considered only insofar as the riverbanks affect the River through the erosion of soil with PCB levels of concern. Thus, in developing and evaluating remedial alternatives, the technologies/process options for addressing erodible riverbanks have been combined with those for addressing sediments, since both affect the River.[4]

The technologies/process options for floodplain soils retained for further evaluation are listed below with a brief description of each.

- No action – No active remediation.

- Access restrictions – Implementation of physical restraints, such as fencing and signs, to restrict access to floodplain areas containing PCBs.

- Activity and use restrictions – Implementation of deed restrictions on uses or activities at properties to reduce the potential for human exposure to PCBs in the floodplain soil. These include, for example, the Grants of Environmental Restrictions and Easements (EREs) as provided for in the CD.

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[4] To the extent that the riverbanks provide an opportunity for direct contact with the soil, the remedial options discussed below for floodplain soil would apply (combined with any necessary techniques listed above to address potential erosion of PCB-containing soil).

- Conditional Solutions – An approach that requires GE to conduct remediation necessary to achieve the applicable standards for the property's current use and to agree to conduct additional remediation in the future, under certain conditions, to address actual changes in the property's use that would require such remediation. This approach, for example, is provided for in the CD for non-GE-owned non-residential properties that do not meet the Performance Standards for residential use.

- Consumption advisories – Advisories that warn the public to avoid or limit consumption of certain biota found in, or certain agricultural products grown in, portions of the floodplain.

- MNR – Reliance on ongoing, naturally occurring processes to contain, or otherwise reduce the bioavailability or toxicity of, PCBs in floodplain soil, with monitoring to assess the rate of recovery or attenuation.

- Mechanical excavation and replacement – Removal of PCB-containing soil from the floodplain using conventional earthmoving equipment and then backfilling the excavated area with clean material.

- Covers – Placement of soil fill and topsoil or pavement over PCB-containing floodplain soil to provide a barrier to contact.

- Engineered barriers – Placement of a permanent cover, which can be paved or unpaved, designed to isolate and contain underlying soils, prevent direct contact with those soils, and minimize the potential for PCB migration from those soils via erosion or infiltration of precipitation water.

The technologies/process options retained in the CMS Proposal for managing removed sediment and soil (including those specifically identified by EPA in its April 13, 2007 conditional approval letter) are listed below with a brief description of each.

- Plate and frame filter press – Use a series of plates and frames held together using a hydraulic ram. Dredged material (which could be chemically conditioned to enhance filterability) is pumped into the space between the plates within the frames. Water is forced through filter media on the plates and out the plate outlets. The dewatered solids are then removed by separating the plates and frames.

- Stockpiling – Placement of the removed sediment and soil in an on-site stockpile, where free liquids would be allowed to drain by gravity. The liquids are collected within a sump for proper treatment/disposal.

- Geotubes – Pumping the sediment slurry into fabric tubes, which help to consolidate the slurry as liquids are forced out using gravity through the fabric matrix. The liquids are collected for proper treatment/disposal.

- *Ex situ* stabilization/solidification – Physical stabilization of the removed materials by mixing immobilizing agents, and/or segregating PCB-containing solids via particle separation.

- Chemical extraction – Process that involves mixing an extraction fluid/solvent with the removed sediment and soil, so that PCBs are preferentially desorbed from the solid media into the extraction fluid. The extraction fluid containing PCBs can be treated or disposed of in several different ways depending on the specific extraction fluid that was used. The treated solids may be disposed of or reused, depending on their chemical and physical characteristics.[5]

- Thermal desorption – Physical separation of the PCBs from the sediment/soil by adding heat to the material to volatilize the PCBs, which are subsequently condensed/collected as a liquid, captured on activated carbon, and/or destroyed in an afterburner.

- Disposal at a local in-water Confined Disposal Facility (CDF) – Construction of a CDF within the water at the site and pumping or placement of removed sediment into that CDF so as to permanently isolate that PCB-containing material from the environment.

- Disposal at a local Upland Disposal Facility – Placement of the PCB-containing sediment and soil, following dewatering where necessary, in an Upland Disposal Facility constructed at the site in proximity to the River.

- Disposal at off-site permitted facility(ies) – Transport of PCB-containing sediment and soil, following dewatering where necessary, to an off-site permitted facility or facilities for disposal.

In subsequent discussions with EPA, it was determined that for those sediment and floodplain soil alternatives that involve removal, the alternatives will include the appropriate post-removal sediment/soil dewatering and other handling procedures that are logically associated with

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[5] The effectiveness of chemical extraction for PCBs in soil and sediment is not fully documented. To obtain information on the effectiveness of this type of treatment and its potential applicability to this site, EPA requested that GE conduct a treatability study of chemical extraction using Housatonic River sediment and floodplain soil. In response, GE conducted bench-scale treatability tests on a chemical extraction technology in the fall of 2007. The results are presented in Appendix A. The findings from these tests are discussed and incorporated in the evaluation of chemical extraction in Section 7.4.

them. Thus, the first four process options listed above (plate and frame filter press, stockpiling, geotubes and *ex situ* stabilization/solidification) have been evaluated as part of the sediment and floodplain soil remedial alternatives. The other five process options listed above have been evaluated as treatment/disposition alternatives.

1.7 Summary of Approved Alternatives for Detailed Evaluation

The CMS Proposal identified several sets of remedial alternatives for: (a) sediments and erodible riverbanks; (b) floodplain soil; and (c) treatment/disposition of removed sediments and soils, for detailed evaluation in the CMS. These included eight sediment/riverbank alternatives (designated SED 1 through SED 8), seven floodplain soil alternatives (designated FP 1 through FP 7), and five treatment/disposition alternatives (designated TD 1 through TD 5). As required by EPA in its April 13, 2007 conditional approval letter, each sediment/riverbank and floodplain soil alternative includes restoration requirements commensurate with the alternative being considered.

The eight sediment/riverbank remedial alternatives provide a broad range of alternatives using various combinations of the retained technologies and process options for remediation of sediments and erodible riverbanks. Development of these alternatives has taken into account the distribution of PCBs in the Rest of River and the suitability of the various remedial technologies and process options for the varying physical conditions found in the different river reaches. For example, a number of removal and capping scenarios have been developed which focus primarily on the river reaches where the PCB concentrations are highest – namely, portions of Reaches 5 and 6 – with some alternatives also addressing sediments in Reaches 7 and/or 8. In the CMS Proposal Supplement, GE provided a justification for evaluating MNR as the only remedial alternative (other than no action) for the further downstream reaches (i.e., Reaches 9 through 16), and EPA agreed with that conclusion in its July 11, 2007 conditional approval letter. The eight sediment/riverbank remedial alternatives are summarized in Table 1-1 on a reach-specific basis, and described in detail in Sections 3 and 4.

As noted above, seven floodplain soil remediation alternatives have been evaluated in the CMS. In addition to the no-action alternative (FP 1), these alternatives are of two types: (a) alternatives based on soil removal/backfilling as necessary to achieve certain specified average PCB concentrations, based on IMPGs, within a given depth in various types of averaging areas (IMPG-based alternatives); and (b) alternatives based on removing all soils within a given depth having PCB concentrations that exceed certain concentration thresholds (threshold-based alternatives). (For all alternatives, the floodplain within the PSA is defined as the area within the 1 milligram per kilogram [mg/kg] isopleth.) These two types of floodplain alternatives are described below.

- The IMPG-based alternatives (FP 2, FP 3, FP 4, and FP 7) were designed to achieve certain PCB IMPGs that apply to the floodplain. As discussed in Section 2.2.2, most of the EPA-approved IMPGs consist of ranges of PCB concentration values. For human health protection, these ranges include values based on different sets of exposure assumptions – i.e., EPA's Reasonable Maximum Exposure (RME) assumptions and its Central Tendency Exposure (CTE) assumptions, as used in its HHRA – and based on different risk levels within EPA's acceptable cancer risk range of 1×10^{-6} to 1×10^{-4} as well as non-cancer impacts using a target HI of 1. For ecological receptors, the IMPG ranges include values based on different thresholds identified in or derived from EPA's ERA.[6] The various IMPG-based alternatives were developed to achieve different sets of IMPG values within these ranges – e.g., the upper bounds of the ranges, mid-range values, or the lower bounds of the ranges.[7]

- The threshold-based alternatives (FP 5 and FP 6) involve the removal of all floodplain soils with PCB concentrations above certain selected thresholds.

The seven floodplain soil remediation alternatives are summarized in Table 1-2 and described in detail in Sections 5 and 6 of this CMS Report. All of these alternatives focus on the top foot of soil, except that for FP 3 through FP 7, as required by EPA in its April 13, 2007 conditional approval letter (as modified on May 22, 2007), the depth of evaluation and removal extends to 3 feet in certain heavily used portions of frequently used areas (as defined in Section 5.2.1 below).

The five treatment/disposition alternatives evaluated in this CMS Report for removed sediment and soil include: (a) three alternatives involving final disposition without treatment (TD 1 – off-site disposal, TD 2 – local disposal in in-water CDF, and TD 3 – local upland disposal); and (b) two alternatives involving treatment (TD 4 – chemical extraction, and TD 5 – thermal desorption).[8] These alternatives are summarized in Table 1-3 and described in detail in Section 7. As noted previously, at EPA's request, GE has conducted a bench-scale

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[6] In addition, as discussed in Section 2.2.2.3, some of the IMPGs could not be directly applied to floodplain soil, because they apply to tissue concentrations in animals; and in these cases, the IMPGs have been converted to ranges of target floodplain soil concentrations. For purposes of the discussion herein, these target soil levels are included within the term "IMPGs."

[7] For the human health-based IMPGs, the upper bounds of the ranges refer to the RME IMPGs based on a 10^{-4} cancer risk or non-cancer HI of 1, whichever is lower; the mid-range values refer to the RME IMPGs based on a 10^{-5} cancer risk or non-cancer HI of 1, whichever is lower; and the lower bounds of the ranges refer to the RME IMPGs based on a 10^{-6} cancer risk, except that, for human direct contact, they are no lower than 2 mg/kg, which is the CD standard for unrestricted use.

[8] As noted above, dewatering and *ex situ* stabilization/solidification options have been considered, as necessary, as part of the sediment and floodplain soil remediation alternatives.

treatability study of a chemical extraction technology. The results of this study are presented in Appendix A and discussed in the evaluation of chemical extraction in Section 7.4.

1.8 Overview of Evaluation Process

In developing and evaluating these remedial alternatives, GE has focused on addressing PCBs, since PCBs are the primary constituent of concern in the Rest of River. In EPA's April 13, 2007 conditional approval letter for the CMS Proposal, EPA agreed that "for the purpose of evaluating alternatives in the Proposal, use of total PCB concentrations is acceptable."

A flow chart (Figure 1-2) has been prepared to illustrate the process used to evaluate and compare the alternatives and to combine the removal alternatives with treatment/disposition options. The specific remedial alternatives for addressing sediment/riverbanks and floodplain soil have been evaluated based on the evaluation criteria specified in the Permit, which consist of the three General Standards and six Selection Decision Factors (described in detail in Section 2 of this CMS Report). These criteria have been used to conduct a detailed and comparative evaluation of each remedial alternative. For each sediment and floodplain soil alternative, the evaluations have identified the results of the evaluation for each river reach where there are significant differences among the reaches, and costs have been provided separately for each river reach.

To evaluate the sediment alternatives, GE has used the model that was developed by EPA under the CD to simulate the fate, transport, and bioaccumulation of PCBs in the Housatonic River between the Confluence and Rising Pond Dam. Specifically, the PCB fate and transport (EFDC) and bioaccumulation (FCM) submodels developed by EPA have been used to predict future sediment, surface water, and fish tissue PCB concentrations resulting from the alternatives. The use of the EPA model for making these predictions is described in detail in Section 3.2. For the portion of the River below Rising Pond Dam, a semi-quantitative framework referred to as the CT 1-D Analysis, which involves an extrapolation from the EPA model results, has been used to evaluate potential impacts of the remedial alternatives on the major impoundments in the Connecticut portion of the River. The CT 1-D Analysis is summarized in Section 3.2.5 and described in detail in Appendix F.

In evaluating the floodplain soil alternatives, GE has utilized various averaging or evaluation areas for assessing attainment of IMPGs or other target levels. Separate averaging areas have been used for the various types of human and ecological exposure involved; these are described in detail in Section 5.2.

For the sediment/riverbank and floodplain alternatives that involve material removal, treatment/disposition of the removed material will be necessary. The sediment/soil treatment/disposition alternatives have been evaluated on a detailed and comparative basis using the relevant standards and factors in the Permit, considering, as appropriate, the potential range of volumes that could be collectively generated by the sediment/riverbank and floodplain soil alternatives.

Costs have been developed for combined sediment and treatment/disposition alternatives and for combined floodplain soil and treatment/disposition alternatives. These combined cost estimates are presented in Section 8.

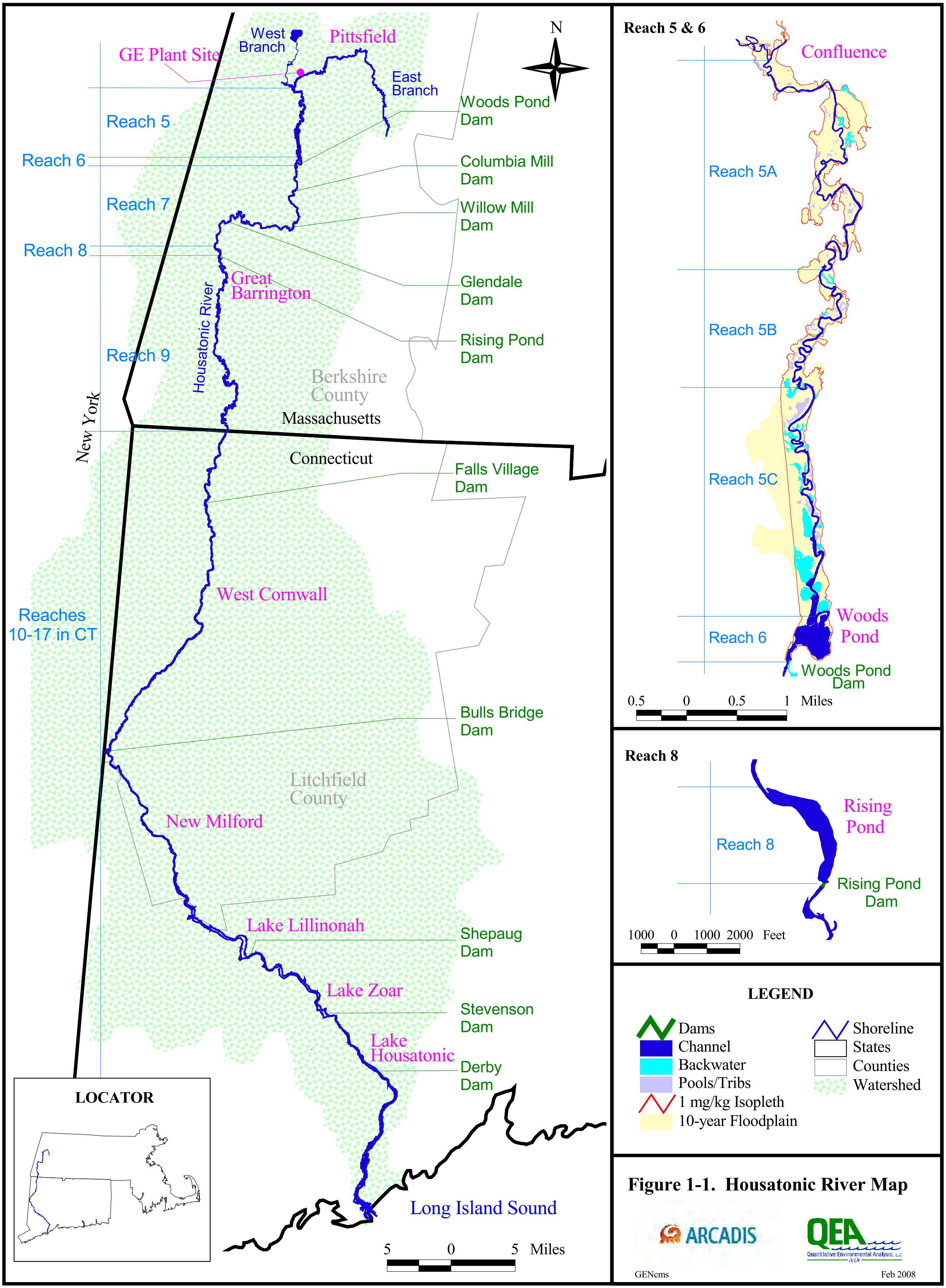

Figure 1-1. Housatonic River Map

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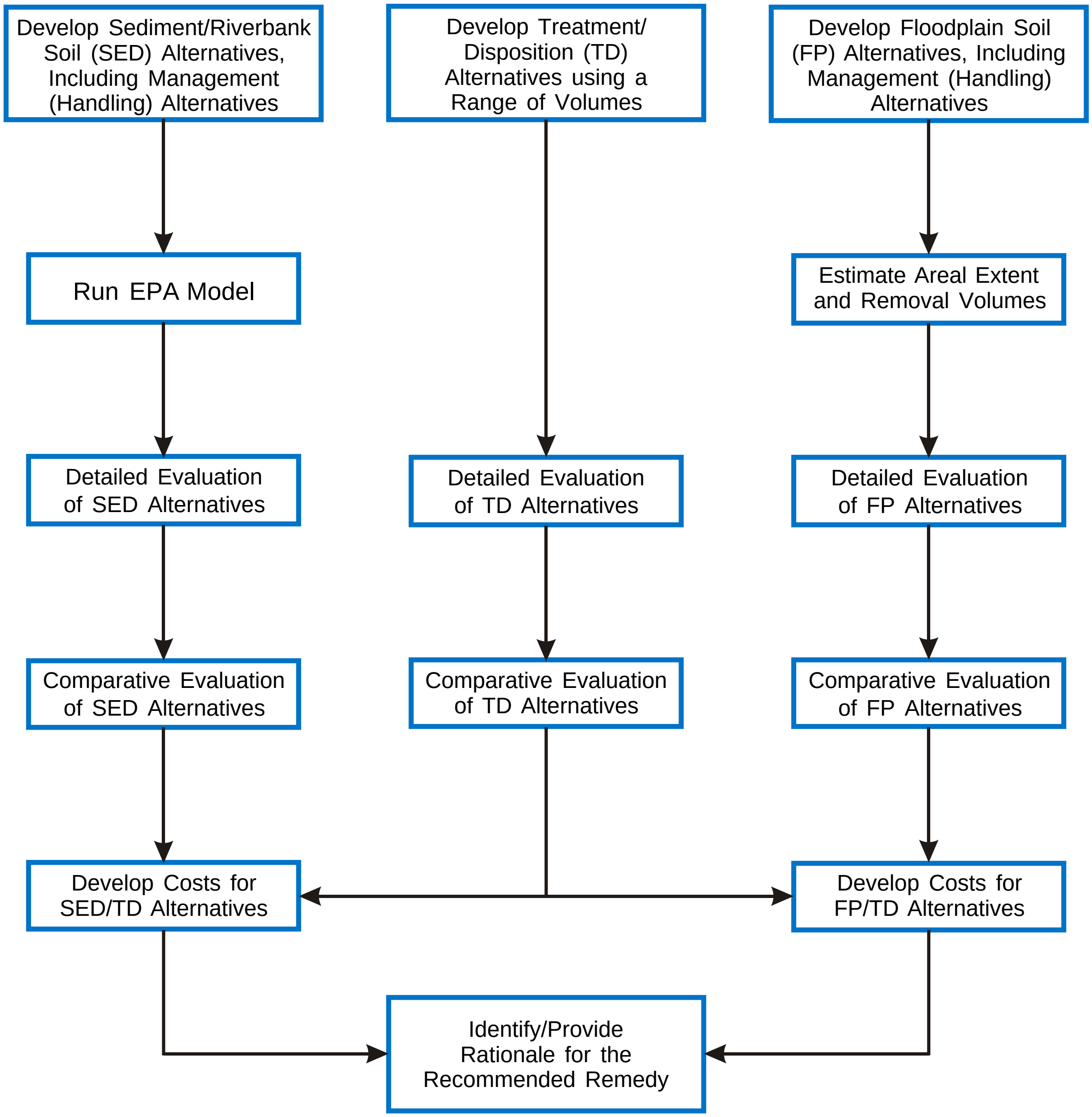

GENERAL ELECTRIC COMPANY
PITTSFIELD, MASSACHUSETTS
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CMS REPORT

PROCESS FOR CONDUCTING CMS EVALUATION

ARCADIS QEA Quantitative Environmental Analysis, LLC

FIGURE
1-2

03/17/08 SYR-D85-DJH
C:/B0030929/0000/00001CDR/30929F01.CDR

Table 1-1 – Summary of Remediation Alternatives for In-River Sediments and Erodible Riverbanks[1]

Alt.	Reach 5A	Reach 5B	Erodible Banks	Reach 5C	Reach 5 Backwaters	Reach 6 (Woods Pond)	Reach 7 Impoundments	Reach 7 Channel	Reach 8 (Rising Pond)	Reaches 9 - 16
SED 1	No action	No action	No action	No action	No action	No action	No action	No action	No action	No action
SED 2	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR
SED 3	2-foot removal with capping	MNR	Removal/ stabilization	Combination of thin-layer capping and MNR	MNR	Thin-layer capping	MNR	MNR	MNR	MNR
SED 4	2-foot removal with capping	Combination of 2-foot removal with capping and thin-layer capping (dep. on depth & velocity)	Removal/ stabilization	Combination of thin-layer capping (in shallow and depositional areas) and capping (in deeper areas)	Combination of thin-layer capping and MNR	Combination of 1.5-foot removal with capping in shallow areas and thin-layer capping in deep area	MNR	MNR	MNR	MNR
SED 5	2-foot removal with capping	2-foot removal with capping	Removal/ stabilization	Combination of 2-foot removal with capping (in shallow areas) and capping (in deeper areas)	Combination of thin-layer capping and MNR	Combination of 1.5-foot removal with capping in shallow areas and capping in deep area	MNR	MNR	Thin-layer capping	MNR
SED 6	2-foot removal with capping	2-foot removal with capping	Removal/ stabilization	2-foot removal with capping	Removal of sediments >50 mg/kg in top 1 foot (with capping[2]); thin-layer capping for remainder >1 mg/kg	Combination of 1.5-foot removal with capping in shallow areas and capping in deep area	Thin-layer capping	MNR	Combination of thin-layer capping in shallow areas and capping in deep areas	MNR
SED 7	3- to 3.5-foot removal with backfill	2.5-foot removal with backfill	Removal/ stabilization	2-foot removal with capping	Removal of sediments >10 mg/kg in top 1 foot (with capping[2]); thin-layer capping for remainder >1 mg/kg	Combination of 2.5-foot removal with capping in shallow areas and capping in deep area	Removal of higher PCB levels (e.g., >3 mg/kg) in top 1.5 feet (with capping[2]); thin-layer capping for remainder >1 mg/kg	MNR	Comb. of removal of higher PCB levels (e.g., >3 mg/kg) in top 1.5 feet (with capping[2]) & thin-layer capping in shallow areas and capping in deep areas	MNR
SED 8	Removal to 1 mg/kg depth horizon with backfill	Removal to 1 mg/kg depth horizon with backfill	Removal/ stabilization	Removal to 1 mg/kg depth horizon with backfill	Removal to 1 mg/kg depth horizon with backfill	Removal to 1 mg/kg depth horizon with backfill	Removal to 1 mg/kg depth horizon with backfill	MNR	Removal to 1 mg/kg depth horizon with backfill	MNR

Notes:
1. Each alternative (except SED 1) includes continued maintenance of biota consumption advisories as necessary to limit the public's consumption of fish and other biota from the River.
2. Either capping or backfilling would be conducted following removal, considering remaining PCB concentrations – this would be determined during design. For purposes of the CMS, it has been assumed that the removal areas would be capped.

MNR = Monitored Natural Recovery
mg/kg = milligram per kilogram

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Table 1-2 – Summary of Remediation Alternatives for Floodplain Soils

Alternative	Description
FP 1	**No action**
FP 2	**Remediation to Upper-Bound Health-Based IMPGs**: Removal and backfill of floodplain soils as necessary to achieve, in the various averaging areas, the health-based floodplain soil IMPGs based on RME exposures and a 10^{-4} cancer risk or a non-cancer HI of 1, whichever is lower. No supplemental remediation designed to achieve IMPGs for ecological receptors.
FP 3	**Remediation to Combination of Upper-Bound and Mid-Range IMPGs**: Same as FP 2 except that: (a) in certain frequently used areas (e.g., trails, access points, known recreational areas, and, for agricultural products exposures, pasture and crop land), removal and backfill of soils would be conducted to achieve the health-based RME IMPGs based on a 10^{-5} cancer risk or a non-cancer HI of 1, whichever is lower; and (b) supplemental remediation would be conducted as necessary to achieve certain upper-bound IMPGs for ecological receptors.
FP 4	**Remediation to Mid-Range IMPGs**: Removal and backfill of floodplain soils as necessary to achieve, in the various averaging areas, the health-based floodplain soil IMPGs based on RME exposures and a 10^{-5} cancer risk or a non-cancer HI of 1, whichever is lower. Supplemental remediation as necessary to achieve certain upper-bound IMPGs for ecological receptors.
FP 5	**Remediation of Soils with $\geq$ 50 mg/kg**: Removal of floodplain soils that contain PCB concentrations of 50 mg/kg or greater, followed by backfill.
FP 6	**Remediation of Soils with $\geq$ 25 mg/kg**: Removal of floodplain soils that contain PCB concentrations of 25 mg/kg or greater, followed by backfill.
FP 7	**Remediation to Lower-Bound IMPGs**: Removal and backfill of floodplain soils as necessary to achieve, in the various averaging areas, the most stringent health-based floodplain soil IMPGs, i.e., the RME IMPGs based on a 10^{-6} cancer risk, except that, for direct contact exposures, where such values are lower than 2 mg/kg, a concentration of 2 mg/kg is used, since it is considered protective for unrestricted use. Supplemental remediation as necessary to achieve lower-bound IMPGs for ecological receptors.

Notes:

1. The IMPGs referred to in this table are the IMPGs for PCBs. The term IMPGs in this table also includes the target floodplain soil PCB concentrations that have been derived to achieve IMPGs that apply to biota tissue (as discussed in Section 2.2.2.3).
2. For all alternatives, the remediation described applies to the top 1 foot of soil, except that alternatives FP 3 through FP 7 also involve additional remediation in certain Heavily Used Subareas of frequently used areas (as identified in Section 5.2.1) as necessary to achieve the specified criteria in the top 3 feet of soil.
3. All alternatives (except FP 1) also include the use of EREs and Conditional Solutions as necessary to address reasonably anticipated uses and activities that are not addressed by the removals described above.
4. IMPGs = Interim Media Protection Goals
5. RME = Reasonable Maximum Exposure
6. HI = Hazard Index
7. mg/kg = milligram per kiliogram

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Table 1-3 – Summary of Treatment/Disposition Alternatives for Removed Sediment and Soil

Alternative	Description
TD 1	**Off-Site Disposal in Permitted Landfill**: Would involve transporting the PCB-containing materials, after dewatering (where necessary), via trucks to an existing off-site permitted landfill for disposal. Materials subject to regulation under TSCA would be transported to a TSCA-permitted landfill, while remaining materials could go to a solid waste landfill.
TD 2	**Local Disposal in CDF**: Would involve pumping or placing PCB-containing sediments into a local in-water CDF, which would be constructed to permanently isolate PCB-containing material from the environment. The materials would settle out and the accompanying water would evaporate, percolate through the walls/into the ground, and/or be released through a water release mechanism (e.g., overflow weir, filter cell). After operation, the CDF would be capped, graded, and seeded.
TD 3	**Local Disposal in Upland Disposal Facility**: Would involve transporting the PCB-containing materials via trucks to an on-site Upland Disposal Facility constructed in proximity to the River. This option would include dewatering, where necessary, prior to placement.
TD 4	**Chemical Extraction**: Would involve a chemical extraction process in which an extraction fluid/solvent is mixed with the removed material and the PCBs are removed from the solid media into an extracting fluid to desorb solid-phase PCBs. The resulting PCB-containing extraction fluid would be treated via conventional wastewater treatment. The treated solids would be disposed of (through one of the disposal options described above) or may potentially be re-used (e.g., as backfill/capping material) depending on their PCB concentrations and physical characteristics.
TD 5	**Thermal Desorption**: Would involve a thermal desorption process, which physically separates the PCBs from the removed sediment/soil by adding heat to the material to volatilize the PCBs. The volatilized PCBs are then condensed/collected as a liquid, captured on activated carbon, and/or destroyed in an afterburner. The removed liquid PCBs would require treatment and/or disposal. The remaining treated solid materials would be disposed of (through one of the disposal options described above) or may potentially be re-used (e.g., as backfill/capping material) depending on their PCB concentrations and physical characteristics.

Notes:

TSCA = Toxic Substances Control Act
CDF = Confined Disposal Facility

2. Description of Evaluation Criteria

During the CMS process, the nine criteria specified in the Permit have been used to evaluate the alternatives for sediments and erodible riverbanks (referred to jointly herein as sediment alternatives), the floodplain soil alternatives, and the alternatives for treatment/disposition of removed sediment and soil. These criteria consist of three “General Standards” and six “Selection Decision Factors” (Special Permit Condition II.G), as follows:

General Standards

1. Overall protection of human health and the environment;
2. Control of sources of releases; and
3. Compliance with federal and state ARARs (or the basis for an ARAR waiver).

Selection Decision Factors

1. Long-term reliability and effectiveness;
2. Attainment of IMPGs;
3. Reduction of toxicity, mobility, or volume of wastes;
4. Short-term effectiveness;
5. Implementability; and
6. Cost.

These General Standards and Selection Decision Factors are described below. Where there are differences in how these criteria were applied to the different types of alternatives (i.e., sediment, floodplain soil, and treatment/disposition alternatives), those differences are noted.

2.1 General Standards

This subsection describes how the General Standards specified in the Permit have been applied to the sediment, floodplain soil, and treatment/disposition alternatives.

2.1.1 Overall Protection of Human Health and the Environment

The first General Standard set forth in the Permit is “overall protection of human health and the environment,” and requires an evaluation of how each alternative “would provide human health and environmental protection, taking into account EPA’s Human Health and Ecological Risk Assessments.” This standard has been applied to all sediment, floodplain soil, and treatment/disposition alternatives. For sediment and floodplain soil remedial alternatives, application of this standard includes comparison of the PCB concentrations estimated to result from implementation of the alternatives to levels considered by EPA to be protective of human health and the environment, taking into account EPA's HHRA and ERA. It also considers other aspects of the alternatives, such as institutional controls as well as other factors, relevant to protecting human health or the environment. In addition, as stated in the preamble to the National Contingency Plan (NCP), "[t]he overall assessment of protection draws on the assessments conducted under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs" (55 Fed. Reg. 8720, March 8, 1990). In accordance with that statement, and as directed by EPA in its April 13, 2007 conditional approval letter, the discussion of the overall protectiveness standard includes consideration of those other criteria. These components of the protectiveness standard are described further below.

From a human health standpoint, the evaluation of sediment and floodplain soil remedial alternatives has involved an assessment of the extent to which each alternative would achieve a condition in which PCB concentrations do not present risks to human health at levels deemed significant by EPA, as determined by reference to EPA's cancer risk range of 1 x 10^{-6} to 1 x 10^{-4} and a non-cancer HI of 1. This cancer risk range is set forth in the NCP, which also provides that the 10^{-6} risk level is to be used as the "point of departure for determining remediation goals for alternatives" (40 CFR § 300.430(e)(2)(i)(A)(2)). This evaluation includes comparison of the model-predicted sediment and fish tissue PCB concentrations for the sediment alternatives, as well as the estimated floodplain soil levels for the floodplain alternatives, to PCB levels in those media considered protective of human health under the benchmarks identified above. For purposes of this CMS, given the requirement to take account of EPA's HHRA, GE has used the ranges of human health-based IMPGs for these comparisons, since they were based on EPA's HHRA and include values corresponding to the same range of risk levels noted above. In addition, however, since human health may be protected through means other than achievement of the IMPGs (e.g., through biota consumption advisories), such other means have been considered in applying this standard.

From an ecological standpoint, the evaluation of protectiveness includes an assessment of the extent to which the sediment and floodplain soil remedial alternatives would achieve PCB levels protective of ecological receptors. As stated in EPA guidance, the goal for ecologically based remediation is to "reduce ecological risks to levels that will result in the recovery and maintenance of healthy local populations and communities of biota" (EPA, 1999a, p. 3). Thus, in evaluating whether particular remedial alternatives would achieve protective levels for ecological receptors, GE has considered the extent to which the alternatives would achieve that population- or community-level goal. This evaluation includes, as one factor, comparison of the modeled sediment and fish tissue PCB concentrations for the sediment alternatives and the estimated floodplain soil levels for the floodplain alternatives to the IMPGs for ecological receptors. In addition, where relevant for particular receptors, GE has considered the potential implications of those estimated PCB concentrations for the local populations and communities of the receptor in question, given the habitat and characteristics of the receptor population, including the home range of animals within that population.

Further, in evaluating "overall protection" of the environment, GE has considered the degree to which a given alternative would achieve the IMPGs. As indicated above, attainment of IMPGs is a Selection Decision Factor, to be balanced against the other such factors; it is not determinative of whether a given alternative would provide overall protection of the environment. Thus, GE does not believe that an alternative must achieve all the ecological IMPGs to meet the standard of overall environmental protection; the fact that a given alternative may not achieve the IMPGs for some receptors in some areas should not by itself render that alternative not protective of the environment. This is particularly true given the conservative nature of the IMPGs. Rather, the overall circumstances need to be considered in assessing this standard, given the ecological goal quoted above.

In addition, as noted above, consistent with the NCP, the evaluation of overall protection of human health and the environment includes consideration of the long-term effectiveness and permanence of the alternatives (including any long-term adverse health or environmental impacts from implementation of the alternatives), the short-term impacts of the alternatives, and the alternatives' ability to comply with ARARs. As stated by EPA (1999a, p. 6), "[w]hen evaluating remedial alternatives, the NCP highlights the importance of considering both the short-term and long-term effects of the various alternatives, including the no action alternative, in determining which ones 'adequately protect human health and the environment.'"[9]

In this regard, it is important to note that, as EPA guidance makes clear, the standard of "overall protection" of the environment also includes a balancing of the short-term and long-term ecological impacts of the alternatives with the residual risks. Thus, EPA's *Ecological Risk Assessment Guidance for Superfund* specifies that "[m]anagement of ecological risks must take into account the potential for impacts to the ecological assessment endpoints from implementation of various remedial options," and must "balance: (1) residual risks posed by site contaminants before and after implementation of the selected remedy with (2) the potential impacts of the selected remedy on the environment independent of contaminant effects" (EPA, 1997, p. 8-3). Similarly, EPA's *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* states: "[W]hile a project may be designed to minimize habitat

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[9] EPA made similar statements in the preamble to the NCP: "[D]etermining whether a remedy is protective of human health and the environment also requires consideration of the acceptability of any short-term or cross-media impacts that may be posed during implementation of a remedial action" (EPA, 1990a, p. 8701).

loss, or even enhance habitat, sediment removal and disposal do alter the environment. It is important to determine whether the loss of a contaminated habitat is a greater impact than the benefit of providing a new, modified but less contaminated habitat" (EPA, 2005e, p. 6-6).

As the above description shows, the evaluation of overall protection of human health and the environment relies heavily on the evaluations under other Permit criteria – namely, the comparison to IMPGs, compliance with ARARs, long-term reliability and effectiveness (including long-term adverse impacts), and short-term effectiveness. In these circumstances, to avoid unnecessary repetition of the discussions of those other criteria (which are often lengthy) under the protectiveness standard, the evaluation sections in this CMS Report provide, for each remedial alternative, the detailed evaluation of overall health and environmental protection at the end, rather than the beginning, of each such section, so that it can draw upon and take account of the evaluations of the other criteria noted above, as well as other relevant factors.

2.1.2 Control of Sources of Releases

The second General Standard in the Permit requires an evaluation of how each alternative "would reduce or minimize further PCB releases, including (but not limited to) the extent to which each alternative would mitigate the effects of a flood that would cause contaminated sediments to become available for human or ecological exposure." In applying this standard in the CMS, GE has evaluated each alternative's ability to reduce further PCB releases within the Rest of River. This evaluation has focused primarily on the alternatives for addressing sediments/riverbanks, but also has been included for the floodplain soil and treatment/disposition alternatives. For the sediment alternatives, this assessment has initially considered the extent to which releases from sources upstream of the Confluence into the Rest of River would be controlled by the completed and planned remediation actions in and adjacent to the East and West Branches of the River. It has also considered the extent to which each alternative would reduce future releases of PCBs from the sediments and riverbanks in the Rest of River area to the River via erosion. This assessment has also considered the impacts of the potential failure of dams on the River and the need for ongoing dam maintenance. In addition, based on results from EPA's model, the annual PCB loading passing Woods Pond Dam and Rising Pond Dam and the annual PCB flux from the River to the floodplain within the PSA have been assessed. Further, as required by the Permit, the evaluations under this standard have considered the extent to which each alternative would mitigate the impacts of future flood events that could cause PCB-containing materials that have been buried, contained beneath a cap, or covered with a thin-layer cap or backfill to become exposed for potential human or ecological exposure.

2.1.3 Compliance with Federal and State ARARs

The third General Standard specified in the Permit requires an evaluation of how each remedial alternative would meet ARARs under federal and state law, or, when such a requirement would not be met, the basis for an ARAR waiver under CERCLA and the NCP. This standard has been applied to the sediment alternatives, the floodplain soil alternatives, and the treatment/disposition alternatives.

To apply this standard, GE has preliminarily identified potential ARARs for the alternatives evaluated. These include chemical-specific ARARs specifying numerical standards or criteria for key chemicals of interest, location-specific ARARs pertinent to the types of locations at which remedial actions may occur, and action-specific ARARs relating to implementation of the technologies and process options that are part of remedial alternatives. In identifying such ARARs, GE has considered the NCP provisions defining ARARs (40 CFR § 300.5), as well as EPA guidance on identifying ARARs (EPA, 1988, 1989). Specifically, GE has identified requirements that meet the following criteria:

First, to be an ARAR, a requirement must have been either enacted into law or formally promulgated as a regulation under federal or state law after notice-and-comment rulemaking. Thus, in identifying ARARs themselves, GE has reviewed and identified such enacted or promulgated requirements. In addition, as required by EPA's April 13 and July 11, 2007 conditional approval letters, GE has also reviewed certain agency guidance and policy documents and identified them as items "To Be Considered" (or TBCs).

Second, the requirements must be either "applicable" or "relevant and appropriate." To be "applicable," a requirement must "specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance" in the Rest of River (40 CFR § 300.5). "'Applicability' implies that the remedial action or circumstances at the site satisfy all of the jurisdictional prerequisites of a requirement" (EPA, 1988, p. 1-10). "Relevant and appropriate" requirements are those that, while not applicable, "address problems or situations sufficiently similar to those encountered at [the Rest of River] site that their use is well suited to the particular site" (40 CFR § 300.5).

Third, ARARs are limited to "substantive" requirements (40 CFR § 300.5), as opposed to "administrative" requirements. EPA has explained that "substantive" requirements are those "that pertain directly to actions or conditions in the environment" (EPA, 1988, p. 1-

11).[10] By contrast, "administrative" requirements are "those mechanisms that facilitate the implementation of the substantive requirements of a statute or regulation," including "the approval of, or consultation with administrative bodies, consultation, issuance of permits, documentation, reporting, recordkeeping, and enforcement" (*id*.).[11] Thus, GE has identified as ARARs laws, regulations, and other authorities that set forth or include specific substantive requirements. It should be noted, however, that in many cases the regulatory provisions identified include a mixture of substantive and administrative requirements. In such cases, the ARARs consist only of the substantive requirements of those provisions and not requirements that would be considered administrative as described above, such as permit/approval requirements, consultation requirements, requirements for submitting particular plans, training requirements, inspection and procedural monitoring requirements, and recordkeeping and reporting requirements.

Fourth, for state requirements to constitute ARARs, they must be promulgated requirements of general applicability, legally enforceable, and more stringent than federal requirements (CERCLA § 121(d)(2)(A); 40 CFR § 300.5; EPA, 1989, pp. 7-2 to 7-3, 7-7). GE has taken this criterion into account in its identification of state ARARs.

Based on these criteria, GE has prepared tables identifying potential chemical-specific, location-specific, and action-specific ARARs (and TBCs) for the remedial alternatives being evaluated in the CMS. These ARARs (and TBCs) are set forth in Tables 2-1 (chemical-specific), 2-2 (location-specific) and 2-3 (action-specific).[12] These tables are divided into sub-parts that address different subjects and present both federal and state ARARs for

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[10] According to EPA (1988, p. 1-11), such requirements include "quantitative health- or risk-based restrictions upon exposure to types of hazardous substances (e.g., Maximum Contaminant Levels [MCLs] establishing drinking water standards for particular contaminants), technology-based requirements for actions taken upon hazardous substances (e.g., incinerator standards requiring particular destruction and removal efficiency), and restrictions upon activities in certain special locations (e.g., standards prohibiting certain types of facilities in floodplains)."

[11] As EPA has further explained: "In general, administrative requirements prescribe methods and procedures by which substantive requirements are made effective for purposes of a particular environmental or public health program. For example, the requirement of the Fish and Wildlife Coordination Act to consult with the U.S. Fish and Wildlife service, Department of the Interior, and appropriate State agency before controlling or modifying any stream or other water body is administrative." (EPA, 1988, pp. 1-11 to 1-12.)

[12] The identification of ARARs in these tables should be considered preliminary and solely for the purpose of evaluating the remedial alternatives. EPA will propose ARARs for the Rest of River remedy as part of its proposed Permit modification to select corrective measures for the Rest of River under Special Condition II.J of the Permit, and it will identify the actual ARARs when it selects the Rest of River remedy in the Permit modification.

those subjects.[13] In preparing these tables, GE has taken into account EPA's comments, in its April 13, 2007 conditional approval letter, on the CMS Proposal's preliminary listing of categories of potential ARARs, as well as EPA's additional comments, in the July 11, 2007 conditional approval letter, on the ARARs discussion in the CMS Proposal Supplement. GE has also made several other modifications to these lists of potential ARARs based on further review of the regulations involved.

In evaluating the various remedial alternatives for sediments, floodplain soil, and treatment/disposition of removed sediments and soil, GE has considered whether they would achieve the pertinent ARARs set forth in these tables, also recognizing, as EPA has stated, that "ARARs do not by themselves necessarily define protectiveness" (EPA, 1990a, p. 8701).

In addition, GE has considered the need or potential need for a waiver of certain ARARs under CERCLA and the NCP. CERCLA and the NCP set forth a number of conditions in which a waiver of ARARs is appropriate – e.g., that compliance with the requirement "will result in greater risk to human health and the environment" than other alternatives, or that compliance with the requirement is "technically impracticable from an engineering perspective," or that an alternative will achieve an equivalent standard of performance "through use of another method or approach," or that, for a state ARAR, the State has not consistently applied that requirement in similar circumstances at other sites (CERCLA § 121(d)(4)(B), (C), (D), & (E); 40 CFR § 300.430(f)(1)(ii)(C*)(2), (3), (4) & (5)*). In a number of instances, GE has determined that a particular potential ARAR should be waived or may require a waiver, generally on the ground that it would be technically impracticable to achieve. These instances and the basis for that determination are identified in the discussions of the ARARs criterion in the evaluation of the alternatives.

2.2 Selection Decision Factors

In addition to applying the General Standards, the sediment, floodplain soil, and treatment/disposition alternatives have been evaluated based on the Selection Decision Factors specified in the Permit, as described below. Any general differences in how they were applied to the different sets of alternatives are noted.

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[13] These tables also include a Comments column, which notes certain points relating to the ARARs identified.

2.2.1 Long-Term Reliability and Effectiveness

The first Selection Decision Factor is long-term reliability and effectiveness. Under the Permit, this factor requires an evaluation of the following sub-factors: (a) the magnitude of residual risk after implementation of the alternative; (b) the adequacy and reliability of the alternative; and (c) any potential long-term adverse impacts of the alternative on human health or the environment. Each of these sub-factors is discussed below.

Consideration of the magnitude of residual risk has involved assessing the extent to which the alternative would mitigate long-term potential exposure to residual PCB levels in the Rest of River and the time over which the alternative would reduce the level of exposure to such PCBs. The application of this sub-factor has included an assessment of the PCB levels to which receptors might be exposed following implementation of the alternatives, using the following procedures:

- For the sediment alternatives, this assessment has relied on the results of the application of EPA's PCB fate, transport, and bioaccumulation model to the alternative in question so as to estimate the resulting concentrations of PCBs in surface water, surface sediment (top 6 inches), and fish tissue (whole body and fillet).

- For the floodplain soil alternatives, this assessment has relied on the methodology described in Section 5.4 to estimate average PCB concentrations in the top foot (and in the top 3 feet of soil in certain heavily used portions of frequently used areas) that would remain in place in the floodplain soil after implementation of each alternative.

- For the treatment/disposal alternatives that involve leaving PCB-containing material at the site, this assessment has included a general evaluation of the potential for exposure to the PCB-containing material remaining at the site.

These results were combined with information on exposure to such residual PCB concentrations by human and ecological receptors, given other aspects of the alternative (e.g., engineering or institutional controls), so as to assess the extent to which and (where pertinent) timing over which the alternative would reduce exposure levels.

The next sub-factor included in the evaluation of the long-term reliability and effectiveness for all the alternatives was an assessment of the adequacy and reliability of each alternative. This assessment has examined whether the technology(ies) included in the alternative have been used under similar conditions at other riverine sites and the effectiveness and reliability of the technology(ies) at those sites. This evaluation has also considered whether the combination of technologies included in a given alternative has been used together at other sediment sites around the country. In addition, the assessment under this sub-factor has included an overall evaluation of the effectiveness and reliability of the technology(ies) involved. For the sediment alternatives, where relevant, this evaluation has included an assessment of the stability of the caps, thin-layer caps, or backfill that would be part of a given alternative (or, in MNR areas, the surface sediment) during high flow events. Further, application of this sub-factor has included consideration of the reliability of operation, monitoring, and maintenance (OMM), including the availability of personnel, equipment, and materials needed to effectively implement and maintain an OMM program. Also considered under this sub-factor was the potential need to replace technical components of the alternative, such as a cap or cover, and the potential exposure risks should components of the remedial action need replacement.

Another sub-factor in the evaluation of the long-term reliability and effectiveness for all the alternatives was an assessment of the potential long-term adverse impacts on human health and the environment from implementation of the alternative. This assessment has included the identification of potentially affected populations and an assessment of potential long-term adverse impacts from implementation of the alternative on: (a) biota and their habitat; (b) wetlands; and (c) the aesthetics of the natural environment. Further, for the sediment alternatives, GE has considered the long-term impacts of the alternative on physical riverine processes, such as natural erosion of banks, lateral movement of banks, and bedload movement. For example, consideration was given to the potential impact that stabilized banks may have on other banks, and the consequent need to stabilize non-erodible banks to minimize the potential for future scour/movement of those banks. Finally, the assessment under this sub-factor has included an identification of possible measures to mitigate potential long-term adverse impacts.

2.2.2 Attainment of IMPGs

The second Selection Decision Factor requires an evaluation of the ability of each remedial alternative to achieve the IMPGs approved by EPA. Under Special Condition II.C of the Permit, IMPGs consist of preliminary goals that have been shown to be protective of human health and the environment. They apply to specific media in the Rest of River area (e.g., sediments, floodplain soils, biota) and are required to “take into account” the HHRA and ERA conducted by EPA. As the Permit makes clear, IMPGs are not equivalent to cleanup standards or Performance Standards for the Rest of River remedy, which will be developed by EPA in connection with the selection of that remedy.

As noted above, by letter dated December 9, 2005, EPA disapproved GE’s initial IMPG Proposal and directed GE to submit a revised IMPG Proposal that included a number of revisions required by EPA. GE disagreed with a number of EPA’s directives and preserved its position on those issues. Nevertheless, as required by the Permit, GE submitted a revised IMPG Proposal on March 9, 2006, which implemented EPA’s directives, as set forth in EPA's December 9, 2005 comments or as modified by EPA in subsequent discussions. EPA approved that revised IMPG Proposal on April 3, 2006.

The revised IMPG Proposal (GE, 2006) presented preliminary numerical concentration-based goals for the protection of both human health and ecological receptors.[14] From a human health standpoint, the revised IMPG Proposal addressed direct human contact with sediments and floodplain soil and human consumption of fish, waterfowl, and agricultural products from the Rest of River area. From an ecological standpoint, it addressed several groups of ecological receptors, including benthic invertebrates, amphibians, fish, and certain groups of birds and mammals. It presented concentration values for PCBs – and, in some cases, dioxin toxicity equivalency quotients (TEQs) – in sediments, floodplain soil, fish tissue, and/or other biota tissue as relevant to these human and ecological receptors.[15]

To allow for full evaluation of an appropriate array of remedial alternatives in the CMS, the revised IMPG Proposal presented ranges of numerical concentration values, rather than single numbers, for most pathways and/or receptors.[16] As required by EPA's directives, these numerical concentration values were calculated based directly on the exposure assumptions, toxicity values, and data interpretations and analyses used or set forth in EPA's HHRA and ERA – although GE made clear that the use of this approach did not indicate GE's agreement with or acceptance of those inputs. The relevant IMPGs used in the CMS are described below.

2.2.2.1 Human Health-Based IMPGs

EPA's HHRA contained three separate assessments – an assessment of direct human contact with soil or sediment, an assessment of fish and waterfowl consumption, and an assessment of agricultural products consumption. Consistent with those three assessments and with the requirements in the Permit, GE developed health-based numerical IMPGs for:

- Floodplain soil and sediment based on direct human contact with those media;

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[14] Although the Permit also allows for the development of narrative descriptive IMPGs, GE elected, in light of EPA's December 9, 2005 comments, not to include narrative descriptive IMPGs in the revised IMPG Proposal.

[15] The IMPG Proposal demonstrated, based on conservative screening-level assessments conducted by EPA, that there was no need to develop IMPGs for surface water or ambient air. Those conclusions were approved by EPA.

[16] Although the values in these ranges were referred to as Risk-based Media Concentrations (RMCs) in the IMPG Proposal, we have, for ease of reference, referred to these values as IMPGs in this CMS Report (as was done in the CMS Proposal).

- Edible fish and waterfowl tissue based on human consumption of fish and waterfowl; and
- Edible agricultural products based on human consumption of those products.

For each of these media and pathways, the IMPGs consist of ranges of numerical concentration values for PCBs (and, for fish and waterfowl consumption, TEQs). These ranges include values based on different sets of exposure assumptions – namely, EPA's RME assumptions (representing more highly exposed individuals) and its CTE assumptions (representing individuals with average exposure). Further, for each set of assumptions, the ranges include values based on different risk levels within EPA's acceptable cancer risk range specified in the NCP (namely, risks of 1 x 10^{-6}, 1 x 10^{-5}, and 1 x 10^{-4}), as well as non-cancer-based values using a target HI of 1. In addition, as directed by EPA, the RME-based concentration values associated with a 10^{-6} cancer risk and a non-cancer HI of 1 have been identified as "points of departure."

These health-based IMPGs were described and listed in Section 3.2.3 of the CMS Proposal. For convenience, and given EPA's concurrence in its April 13, 2007 letter that the evaluations in the CMS could focus on total PCB concentrations, the IMPGs for PCBs are shown in tables herein. Specifically:

- Table 2-4 lists the IMPGs for PCBs in floodplain soil and sediments based on direct contact of humans with such media via incidental ingestion and dermal contact. As shown in that table, specific IMPGs were developed for each of 15 direct contact exposure scenarios and for each potentially exposed age group of the relevant target population within those scenarios. These IMPGs were back-calculated using the same exposure assumptions and toxicity values used in the Direct Contact Assessment in the HHRA.

- Table 2-5 lists the IMPGs for PCBs in the edible tissues of fish and waterfowl based on human consumption of fish and waterfowl. As shown in that table, specific IMPGs were calculated for bass fillets, trout fillets, and duck breast tissue, using both a deterministic approach (based on the assumptions and parameters used in EPA's deterministic Fish and Waterfowl Consumption Risk Assessment) and also a probabilistic approach (based on the one-dimensional Monte Carlo model that EPA used in the HHRA). For each type of edible tissue, IMPGs were derived for cancer risks based on combined adult and childhood exposure, and non-cancer IMPGs were separately derived for adults and children. To be consistent with the HHRA methodology, the IMPG values developed for bass consumption are applicable to consumption of largemouth bass, brown bullhead, sunfish, and perch, while the IMPG values for trout consumption are applicable only to the consumption of trout.

- Table 2-6 lists the IMPGs for PCBs in agricultural products based on human consumption of such products. As shown in that table, specific IMPGs were calculated for PCBs in cow milk, beef tissue, poultry meat, and poultry eggs for both commercial and backyard farms, using the exposure assumptions and toxicity values in EPA's Agricultural Products Consumption Risk Assessment. For each type of farm, IMPGs were calculated for cancer risks (for adults and children combined) and for non-cancer impacts (for adults and children separately). In addition, to be consistent with the HHRA, IMPGs were calculated for homegrown produce consumed by humans – specifically, exposed fruit, exposed vegetables, and root vegetables (as well as for all three types of produce combined). For these farm products, based on advice from EPA, IMPGs were calculated for children only and were based on non-cancer health effects, using a target HI of 1.

2.2.2.2 Ecologically Based IMPGs

EPA's ERA evaluated risks to a number of ecological receptor groups, including benthic invertebrates, amphibians, fish, piscivorous birds, insectivorous birds, piscivorous mammals, omnivorous and carnivorous mammals, and threatened and endangered species. As required by the Permit, GE developed ecologically based IMPGs for PCBs (and in some cases TEQs) for each of the ecological receptor groups evaluated in the ERA. For some receptor groups, these IMPGs consist of ranges of numerical values, while for others they consist of single values. Where ranges were developed for receptor groups for which EPA identified Maximum Acceptable Threshold Concentrations (MATCs) in the ERA, the ranges include the EPA MATCs as well as certain other threshold levels which were derived from the ERA. In these cases, as directed by EPA, the values based on the MATCs have been identified as "points of departure." For those receptor groups for which EPA did not calculate MATCs (namely, avian groups for which there are no site-specific effects data), the IMPGs consist of values based on the literature. Specifically, for these groups, the IMPGs for PCBs were derived using a calculated effect level of less than 20% from a literature study of the most sensitive avian species identified in the ERA (chickens); as directed by EPA, these IMPGs are also identified as "points of departure."

As in the ERA, most of the IMPGs were developed based on the results of studies of specific species (i.e., wood frogs, ospreys, wood ducks, mink, short-tailed shrews, bald eagles) that are considered by EPA to be representative of broader receptor groups (i.e., amphibians, piscivorous birds, insectivorous birds, piscivorous mammals, omnivorous and carnivorous mammals, and threatened and endangered species). Thus, the derivation of the IMPGs reflects studies and life history characteristics specific to the selected receptor species, but the resultant IMPGs are considered to be protective of the range of species within each of the broader receptor groups.

The EPA-approved IMPGs for ecological receptors were described and listed in Section 3.2.4 of the CMS Proposal. For convenience, and again given EPA's agreement that the CMS evaluations could focus on total PCB concentrations, the ecological IMPGs for PCBs are set forth in Table 2-7. That table lists, for each receptor group, the specific environmental medium to which the IMPG(s) for that group apply (e.g., sediment, floodplain soil, tissue) and the numerical IMPG concentration value(s) for PCBs. As required by EPA directives, these IMPGs were based on EPA's exposure assumptions, toxicity values, and data interpretations and analyses set forth in the ERA.

2.2.2.3 Other Target Levels

In some cases, the IMPGs set forth in the revised IMPG Proposal could not be directly applied in the CMS, because they apply to media that are not subject to evaluation in the CMS. These are: (1) the IMPGs based on consumption of agricultural products by humans, which apply to PCB concentrations in the agricultural biota themselves; and (2) the IMPGs for insectivorous birds (represented by the wood duck) and piscivorous mammals (represented by the mink), which apply to PCB concentrations in the prey items of those receptors (including both aquatic and terrestrial prey items). In such cases, the IMPGs have been converted to target PCB concentrations in media subject to evaluation – namely, floodplain soil and/or sediments – for purposes of application in the CMS. These target concentrations, along with the bases for their derivation, are summarized below and have been applied like IMPGs in the application of the IMPG evaluation criterion.

Floodplain Soil Levels Derived from Agricultural Products Consumption IMPGs

As shown in Table 2-6, the IMPGs for agricultural products consumption by humans apply to PCB concentrations in the tissue of those products. In order to be used for the CMS evaluations, these tissue-based IMPGs needed to be converted, for the relevant exposure scenarios, to target PCB concentrations in floodplain soil for comparison to the average floodplain soil concentrations resulting from the remedial alternatives evaluated. For farm animals, this conversion required that the animal tissue concentrations first be translated into concentrations in the products consumed by those animals (e.g., grass or corn grown in the floodplain) and then be translated into floodplain soil concentrations. For produce, the conversion required translation from the produce values into soil values.

The CMS Proposal set forth (in Section 3.3.1 and associated tables) the equations, assumptions, and exposure variables that would be used to convert the relevant tissue-based IMPGs (based on both RME and CTE assumptions) into corresponding target floodplain soil concentrations. These equations, assumptions, and exposure variables are the same as those used by EPA in the HHRA and have been approved by EPA.

Using these equations and inputs, GE has back-calculated target soil concentrations for the agricultural products consumption scenarios that have been evaluated in the CMS. As discussed further in Section 5.2.2, based on review of current agricultural uses within the floodplain, the only farms known to exist within the Rest of River floodplain between the Confluence and Rising Pond Dam (Reaches 5 through 8) are commercial dairy farms. However, it appears that, in addition to such farms, certain other farm types – namely, poultry meat and vegetable farms – are present in Reach 9. In this situation, GE has back-calculated target floodplain soil levels for: (a) commercial dairy farms, based on consumption of cow milk; (b) commercial poultry farms, based on consumption of poultry meat; and (c) vegetable farms, based on consumption of both exposed and root vegetables. The calculations of these target floodplain soil levels were based on the assumption that 100% of the farmland in question (i.e., the growing or grazing land) is located within the floodplain. The resulting levels are listed in Table 2-8.

The levels presented in Table 2-8 apply only to properties where the farmland in question is completely contained within the floodplain. For areas where the farmland is not entirely contained within the floodplain, these levels have been adjusted to take into account the portion of the farmland that lies within the floodplain. This was accomplished by dividing the target soil concentrations listed in Table 2-8 for the appropriate scenario by the fraction of the cropland or grazing land that falls within the floodplain at the particular farm property involved. These adjustments and the resulting adjusted target floodplain soil levels for farms within the Rest of River floodplain are described in Section 5.2.2 below.

Sediment and Floodplain Soil Levels Associated with IMPGs for Insectivorous Birds

As shown in Table 2-7, the PCB IMPG for insectivorous birds (4.4 mg/kg), which was based on potential risks to wood ducks, applies to PCB concentrations in the tissue of the aquatic and terrestrial invertebrates consumed by these birds. To be applied in the CMS, this dietary IMPG needed to be translated into a corresponding concentration in a medium subject to evaluation in the CMS, such as sediment or floodplain soil. However, this translation was complicated by the fact that the invertebrate portion of the wood duck's diet consists of both aquatic invertebrates, in which PCB concentrations derive from sediments, and terrestrial invertebrates, in which PCB concentrations derive from floodplain soil. When calculating sediment and floodplain soil concentrations associated with the IMPG for invertebrate prey, the target concentration in one medium affects the target concentration in the other – i.e., a higher concentration in sediments would require a lower concentration in soil in order to achieve the IMPG, and vice versa. Thus, it is not possible to derive a value corresponding to the IMPG in one medium without knowing the value in the other, and there is an infinite number of combinations of target sediment and floodplain soil concentrations.

In these circumstances, GE first selected a range of target sediment PCB concentrations that fall within the range of other sediment IMPGs (e.g., based on human direct contact and other ecological receptors). Those selected target PCB concentrations are 1, 3, and 5 mg/kg. GE then calculated target floodplain soil concentrations associated with achieving the PCB IMPG of 4.4 mg/kg in wood duck prey assuming that the sediment PCB concentrations are equal to the selected target values. Calculations of such target floodplain soil concentrations were initially presented in Appendix B to the CMS Proposal. However, EPA's April 13, 2007 conditional approval letter provided several comments on those calculations and directed GE to revise the calculations of the target floodplain soil levels. Based on those comments, GE has revised the calculations of target floodplain soil levels. The revised calculations, including the equations and assumptions used and the resulting target soil levels, are presented in Appendix B to this CMS Report.

As shown in Appendix B, the revised target floodplain soil levels associated with achieving the IMPG for insectivorous birds vary by subreach in the PSA (i.e., Reaches 5A, 5B, 5C, and 6), due to subreach-specific differences in the total organic carbon (TOC) content of the surface sediments and in the biota-sediment accumulation factors (BSAFs) calculated using EPA's FCM. For each of these subreaches, the resulting target floodplain soil PCB concentrations associated with each of three target sediment concentrations are as follows:

Table 2-9 – Target Floodplain Soil PCB Levels (mg/kg) Associated with IMPG for Insectivorous Birds

Sediment Concentration	Reach 5A	Reach 5B	Reach 5C	Reach 6
1 mg/kg	50	48	53	53
3 mg/kg	39	33	49	50
5 mg/kg	29	18	46	46

The procedures and averaging areas used for application of these target floodplain soil concentrations, in conjunction with the specified target sediment concentrations, are described in Section 5.2.3.3 below.

<u>Sediment and Floodplain Soil Levels Associated with IMPGs for Piscivorous Mammals</u>

As shown in Table 2-7, the PCB IMPGs for piscivorous mammals (0.984 to 2.43 mg/kg), which were based on potential risks to mink, also apply to the prey items of these animals. In the CMS Proposal, GE noted that because the components of the mink's diet are highly diverse and unspecified, GE proposed to use the assumed diet of a river otter (which consists primarily of fish) for application of the IMPGs for piscivorous mammals. However, in its April 13, 2007 letter, EPA directed GE to use mink for the IMPG comparisons in the CMS, and to develop a methodology (similar to that proposed for insectivorous birds) for determining target floodplain soil levels consistent with the IMPGs for mink, using assumptions in EPA's ERA.

GE set forth its proposed methodology in Section 5 of the May 2007 CMS Proposal Supplement. As with the IMPGs for insectivorous birds, the IMPGs for piscivorous mammals apply to PCB concentration in mink prey, which consist of both aquatic organisms (in which PCB concentrations derive from sediments) and terrestrial organisms (in which PCB concentrations derive from floodplain soil); and thus it is not possible to derive a target level corresponding to the IMPGs in one medium without knowing the value in the other. Accordingly, GE again selected target sediment PCB concentrations of 1, 3, and 5 mg/kg; and it then calculated target floodplain soil concentrations associated with achieving the high and low ends of the dietary IMPG range in mink prey for each of the selected target sediment PCB values. These calculations were based on data obtained from the PSA, and they assumed conservatively that mink forage exclusively within the defined floodplain in the PSA (i.e., within the 1 mg/kg PCB isopleth). However recognizing that mink are in fact also likely to forage in tributaries and other areas outside the 1 mg/kg isopleth, GE proposed to adjust the calculated target levels to account for the portion of the mink's foraging range outside the 1 mg/kg isopleth.

In its July 11, 2007 conditional approval letter for the CMS Proposal Supplement, EPA stated that the overall approach described in the Supplement was acceptable, but directed GE to make some significant changes in that approach. GE invoked dispute resolution on these directives on July 25, 2007. Following discussions, EPA modified some of its disputed directives in a letter dated August 29, 2007, but retained the requirement not to adjust the target floodplain soil levels to account for foraging by mink outside the 1 mg/kg isopleth.[17]

Based on EPA's directives and comments, as modified in its August 29, 2007 letter, GE has recalculated target floodplain soil levels associated with the mink IMPGs, given the selected set of target sediment levels. The methodology, including equations and assumptions, used in calculating the revised target floodplain soil levels and the resulting target levels are presented in Appendix C. As shown in Appendix C, separate target floodplain soil levels have been calculated for: (1) Reaches 5A and 5B; and (2) Reaches 5C, 5D (backwaters), and 6, due to differences in TOC content and bioaccumulation factors. The resulting target floodplain soil PCB concentrations associated with the upper and low bounds of the mink IMPGs at each of the three target sediment levels are summarized in the following table:

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[17] GE disagrees with that requirement and has preserved its position on that issue.

Table 2-10 – Target Floodplain Soil PCB Levels (mg/kg) Associated with IMPGs for Mink

Sediment Concentration	IMPG = 0.98 mg/kg		IMPG = 2.4 mg/kg	
	Reach 5A/5B	Reach 5C/5D/6	Reach 5A/5B	Reach 5C/5D/6
1 mg/kg	3.42	6.87	16.63	19.55
3 mg/kg	NA	2.98	5.12	15.66
5 mg/kg	NA	NA	NA	11.78

NA: Indicates that attainment of the mink IMPG is not achievable because, at the given sediment concentration, PCB levels in aquatic prey alone would exceed the IMPG.

The procedures and averaging areas used for application of these target floodplain soil concentrations (in conjunction with the specified target sediment concentrations) are described in Section 5.2.3.4 below.

2.2.2.4 Application of IMPG Attainment Factor

The IMPG attainment factor has been applied to each sediment remedial alternative and each floodplain soil remedial alternative. Each sediment remediation alternative has been evaluated based on its ability to attain the relevant IMPGs applicable to sediments and fish tissue. These evaluations have been based on the predicted PCB concentrations in surface sediments and fish tissue resulting from application of EPA's PCB fate, transport, and bioaccumulation model to the given alternative. Those modeled concentrations have been compared with the relevant IMPGs for PCBs, considering, for the human health-based IMPGs, both the IMPGs based on RME assumptions and those based on CTE assumptions. Where the IMPGs consist of ranges, the evaluations have considered whether the predicted sediment or fish tissue PCB concentrations fall within (or below) those ranges. In addition, these evaluations have included an assessment of the time period in which the given alternative would result in attainment of the IMPGs (or IMPG ranges).

Similarly, each floodplain soil remediation alternative has been evaluated based on its ability to attain the IMPGs applicable to floodplain soil (or, for the IMPGs noted in Section 2.2.2.3 above, the target floodplain soil levels derived from those IMPGs). To make such evaluations, the average floodplain soil PCB concentrations resulting from a given alternative have been estimated for the pertinent averaging areas (described in Section 5.2 below), and those average concentrations have been compared to the applicable IMPGs or target floodplain soil levels. Further, for the target floodplain soil levels that depend on the associated sediment levels (i.e., those for insectivorous birds and piscivorous mammals), the comparisons have been made based on assumptions about the sediment levels in the pertinent averaging areas.

2.2.3 Reduction of Toxicity, Mobility, or Volume

The third Selection Decision Factor focuses on the degree to which the alternatives would reduce the toxicity, mobility, or volume of wastes, in this case PCBs. For the sediment and floodplain soil alternatives, that those alternatives would not include any treatment processes that would reduce the toxicity of the PCBs in the sediments. However, all these alternatives that involve sediment or soil removal would include a contingency that if those activities should encounter “principal threat” wastes – defined, for this Site, as free NAPL, drums of liquid waste, or similar wastes – those wastes would be segregated and transported off-site for treatment and disposal, as appropriate. In this way, all these alternatives would satisfy the CERCLA preference for treatment, given EPA’s expectation, stated in the NCP, that treatment would be used to address such principal threat wastes where practicable (40 CFR § 300.430(a)(1)(iii)(A)).[18] In applying the other prongs of this factor to the sediment and floodplain soil alternatives, GE has included an assessment of each alternative’s ability to reduce the mobility of PCBs in sediment and soils, including an estimate of the acres capped/covered, and an assessment of the alternative’s ability to reduce the volume of PCBs in sediment and soil, including an estimate of volume and mass removed.

In applying this factor to the treatment/disposition alternatives, the CMS evaluation has included, for each treatment alternative, identification of: (a) the treatment process to be used and the materials to be treated in the alternative; (b) an estimate of the amount of PCB-containing materials to be treated; (c) the degree of expected reductions in toxicity, mobility, or volume; (d) the degree to which the treatment is irreversible; and (e) the type and quantity of residuals produced by the treatment.

2.2.4 Short-Term Effectiveness

The fourth Selection Decision Factor, short-term effectiveness, involves consideration of the impacts to the environment, nearby communities, and workers during implementation of the

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[18] The NCP notes that “principal threat” wastes include “liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials” (40 CFR § 300.430(a)(1)(iii)(A)). As EPA noted in the CD (regarding Areas Outside the River), such principal threat wastes at this Site consist of wastes such as recovered NAPL and drums of liquid waste, and do not include “relatively low levels of PCB contaminated soils and/or sediments which are spread over a large area measuring hundreds of acres,” given that “PCBs are relatively immobile due to their low solubility in water” (CD, Appendix D, p. 38). Thus, EPA concluded that the preference for treatment does not apply to the latter types of material (*id*.). The same conclusion applies to the PCB-containing sediments and soils that would be removed from the Rest of River area.

alternative. This factor has been applied to all alternatives, including those for addressing sediments, floodplain soils, and treatment/disposition of removed sediments and soil. Specifically, GE has considered the short-term impacts and risks associated with the following, as applicable: (a) active remediation activities, such as excavation and/or capping, as well as the necessary ancillary site work (e.g., construction of access roads, staging/dewatering facilities, etc.); (b) treatment operations (if any) for removed sediments/soils; (c) transportation of removed sediments/soils from, and backfill materials to, the site; and (d) local disposal activities.

For each alternative, the short-term-impacts evaluated include the impacts of the various components of the alternative on the environment in the affected areas, including impacts on the various types of habitat that would be affected and the biota that depend on those habitats. In addition, this evaluation has considered the impacts on local communities in terms of disruption of recreational and other uses of the affected areas, as well as increased noise and truck traffic in those areas. It has also considered the public safety risks from the increased truck traffic on public roads to transport excavated or treated materials off-site for disposal (where relevant) and/or to transport backfill or construction materials to the site. Finally, the evaluation of this factor has included an assessment of potential risks to the on-site remediation workers during implementation of the alternative.

To assist in evaluating risks to public safety and to remediation workers, GE retained ENVIRON International Corporation (ENVIRON) to develop estimates of the risks of injuries and fatalities arising from (a) traffic accidents related to the increased off-site truck traffic that would be associated with the alternatives, and (b) work site accidents associated with implementation of the alternatives. The procedures used in developing these estimates are described, and the resulting estimates are presented, in a separate report provided in Appendix D, prepared by ENVIRON. These estimates are referenced and considered in the evaluations of the specific alternatives.

2.2.5 Implementability

The fifth Selection Decision Factor focuses on the ease or difficulty of implementing each alternative and the availability of various services and materials required during implementation. In evaluating the implementability of each sediment, floodplain soil, and treatment/disposition alternative for this CMS Report, GE has evaluated both the technical feasibility and the administrative feasibility of the alternative.

Technical Implementability

An alternative's technical feasibility has been assessed in terms of the availability of the necessary resources (personnel, equipment, methods) to implement the alternative, technical issues associated with the construction and operation of the technology involved, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. More specifically, the evaluation of technical implementability has involved consideration of the following:

- The general availability of the technology or process option: This has included identifying potential equipment, materials, and methods needed to implement the alternative and determining whether such equipment, materials, and methods, as well as qualified personnel, would be readily available to implement the alternative.

- The ability of a technology or process option to be implemented given relevant Rest of River site characteristics: For example, GE has considered the appropriateness of the technologies and process options for various river conditions, given that some technologies/options are more appropriate for the high energy, shallow water areas of the River, while others alternatives would be more effective in the lower energy, deeper portions. In addition, for those alternatives that may ultimately change the elevation/bathymetry of the River and/or floodplain (e.g., the river bottom in places where capping alone is implemented, construction of a CDF within a local waterbody), the impact of any change on the flood storage capacity of the River and floodplain has been considered.

- The reliability of each technology or process option, based on information from other sites across the country.

- The availability of space for the necessary facilities: For the alternatives involving sediment or soil removal, this has involved consideration of the availability of space at the site for the necessary infrastructure such as staging areas and access roads. For the treatment/disposition options, GE has considered, for the alternatives involving local treatment or disposition, the availability of space at the site for the treatment or disposition facilities, and for the off-site disposal alternative, the availability of space at commercial landfills.

- The ease of undertaking additional measures at a later date should they be deemed necessary.

- The ability to monitor the effectiveness of the alternative, including the potential to implement a post-remediation monitoring program to measure whether the alternative is effective over the long term.

Administrative Implementability

The administrative implementability of each alternative has been assessed taking into account its ability to comply with the substantive requirements of applicable laws and regulations, as well as the activities needed to coordinate with agencies, affected property owners, and the public. More specifically, the evaluation of administrative implementability has considered the following:

- The ability of each alternative to comply with location-specific and action-specific ARARs (as discussed under the third General Standard in Section 2.1.3 above);
- The need for access agreements from property owners; and
- The need for coordination with federal, state, and local governmental agencies in implementing institutional controls, in addressing potential health and safety issues during implementation of the active remediation alternatives, and in providing support for public/community outreach programs.

2.2.6 Cost

The sixth Selection Decision Factor requires evaluation of the capital costs, OMM costs, and present worth costs of each alternative. In accordance with this factor, GE has developed cost estimates for implementation of each alternative, as well as for certain combinations of alternatives, as described below.

Individual Cost Estimates

Individual cost estimates have been developed for each sediment, floodplain soil, and treatment/disposition alternative. For the sediment and floodplain soil alternatives, capital and OMM costs were developed by reach for each alternative to allow for the evaluation of different combinations of alternatives. These cost estimates include up-front capital costs associated with remedy implementation and short- and/or long-term OMM costs associated with the remedy. Capital costs were estimated in 2008 dollars, and OMM costs were estimated as annual costs (also in 2008 dollars) applied over reach- and alternative-specific time periods. Finally, the capital and OMM costs were combined, for each alternative, into a total alternative cost estimate (in 2008 dollars) and a present worth cost estimate, based on the anticipated schedule of implementation (discussed in Section 3) and an assumed OMM period.

Since, at the alternative comparison stage, it is not known which sediment alternative would be combined with which floodplain alternative, it was necessary to develop the cost estimates independently for the sediment and floodplain soil alternatives. For example, where certain activities could potentially overlap (e.g., site clearing, construction of access roads and staging areas, etc.), costs for those activities were independently estimated for the sediment and floodplain soil alternatives. Although this may somewhat overestimate the total alternative costs, this approach allows comparative cost evaluations of the sediment and floodplain soil alternatives to be performed independently.

Costs for the treatment/disposition alternatives were estimated for the range of potential volumes that could potentially be generated by the sediment and floodplain soil alternatives; the low end of this range was based on volume that would result from a combination of the sediment and floodplain alternatives that would involve the smallest volume of removal, while the high end of the range was based on the volume that would result from a combination of the sediment and floodplain alternatives that would involve the greatest removal volume.[19] The capital and OMM costs and total present worth costs for each alternative, based on this range, were then developed in the same manner as for the sediment and floodplain soil alternatives.

The present worth (or present value) cost calculations presented herein applied guidance found in a joint U.S. Army Corps of Engineers (USACE) and EPA document titled A Guide to Developing and Documenting Cost Estimates during the Feasibility Study (USACE/EPA,2000). Present worth cost assessment, or discounting, is the process of translating future costs into present costs to account for the time value of money by adjusting costs that occur in different time periods to a common unit of measurement. As prescribed by the above document, the present worth of each alternative was assessed over the respective anticipated duration of each alternative. A (real) discount rate of 7% was used to perform the present worth calculations for all of the sediment, floodplain, and treatment/disposition alternatives. A discount rate of 7% is typically used for remedial projects for the present worth assessment (e.g., USACE/EPA, 2000); however, it should be noted that the discounting calculation is particularly sensitive to the discount rate that is selected. In general, present worth costs are inversely related to the discount rate (i.e., a higher discount rate translates to a lower present value costs, and vice versa). The discount rate “effect” is particularly evident when costs are discounted over longer time periods. The following table illustrates the effect

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[19] The range is composed of different elements for the CDF alternative than for the other treatment/disposition alternatives. As discussed below, the CDF would be used only for sediments that would be hydraulically dredged from Reaches 5C and 6 under alternatives SED 6 through SED 8 (the only alternatives that would use that dredging method). Under the CDF alternative, all other removed sediments and the removed floodplain soils are assumed to be disposed of off-site. As a result, the costs for the CDF alternative are based on: (1) the CDF costs for the range of volumes that would be hydraulically dredged from Reaches 5C and 6 under SED 6 through SED 8; and (2) costs for off-site disposal of all other removed materials (assuming implementation of those sediment alternatives).

of the application of a 7% discount rate over time periods up to 100 years using an example dollar amount of $1,000.

Year	**Discount Rate**	
	0%	**7%**
1	$1,000	$935
5	$1,000	$713
10	$1,000	$508
20	$1,000	$258
50	$1,000	$34
75	$1,000	$6
100	$1,000	$1

As shown above, the discounting process, as applied to longer-duration alternatives, can significantly reduce their present worth costs, and can make large costs seem small when they are incurred over long periods. As a result, for longer-duration alternatives, discounting will have a tendency to lessen the ability to differentiate among alternatives based on cost. In many situations, the Office of Management and Budget (OMB) recommends that a present-worth assessment consider different discount rates to evaluate the “sensitivity” of the present worth costs (OMB, 2003). For example, in addition to a 7% discount rate, a lower discount rate of 3% is also used in some cases (see, e.g., OMB [2003], EPA [1999b], EPA [2005g]). Indeed, the joint USACE and EPA document recommends that long-term assessments include a “no discounting” or 0% discount rate evaluation (USACE/EPA 2000).

In addition to the choice of discount rates, the discounting process is also very sensitive to the duration of the assessment. As noted above, discounting over long periods reduces present worth costs. The cost estimates and evaluations presented in this CMS Report are based on information that is currently available. Given the inherent uncertainties associated with the timing, implementation, and duration of the various alternatives, it is possible that alternatives could be completed earlier or later. As an example, if the implementation of the alternatives could be completed faster than anticipated, the calculated present worth costs would be higher.

For the reasons presented above – discounting effects over long periods, uncertainties associated with choice of discount rate, and the potential impact of changing the implementation durations – the cost evaluations and comparisons presented in this CMS focus on the total (undiscounted) cost of each alternative. However, as required by the Permit, the present worth cost for each alternative and each combination of alternatives (discussed below) is also presented, using the recommended 7% discount rate.

A discussion of the total costs and present worth costs is presented in the individual evaluation sections for the sediment, floodplain, and treatment/disposition alternatives. Additional information related to the development of the individual cost estimates and associated assumptions is included in Appendix E.

Combined Cost Estimates

Cost estimates have also been developed for the relevant combinations of sediment and floodplain soil alternatives with treatment/disposition alternatives. That is, each sediment and floodplain alternative was matched with the pertinent treatment/disposition alternatives, and the costs were estimated for each such combination. The costs for the resulting combinations are provided in tables in Section 8.[20] This way, costs for the various combinations of the sediment or floodplain remedial alternatives with the treatment/disposition alternatives could be compared against each other.

Additional information related to the development of the combined cost estimates and associated assumptions is included in Appendix E.

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[20] In developing these combined estimates, certain adjustments were made to the estimated costs for the individual alternatives to reflect cost savings that would result from the combinations. These adjustments are described in Section 8.

Table 2-1 – Potential Chemical-Specific ARARs

A. PCBs

Authority/Regulation	Comments
Federal ARARs	
Clean Water Act – National Ambient Water Quality Criteria for PCBs (EPA-822-R-02-047, Nov. 2002): ▪ Freshwater chronic aquatic life criterion (based on protection of mink): 0.014 µg/L ▪ Human health criterion based on human consumption of water and organisms: 0.000064 µg/L.	For the reasons given in the text, GE believes that the human health criterion be should waived as technically impracticable to achieve.
State ARARs	
Numeric Massachusetts water quality criteria (314 CMR 4.05(5)(e)): Same as federal water quality criteria (unless Mass. DEP establishes site-specific criterion or determines that naturally occurring background concentrations are higher).	For the reasons given in the text, GE believes that the human health criterion be should waived as technically impracticable.
Numeric Connecticut water quality criteria (*Connecticut Water Quality Standards*, effective Dec. 17, 2002, Appendix D): ▪ Freshwater chronic aquatic life criterion: 0.014 µg/L. ▪ Human health criterion, based on human consumption of organisms only or water and organisms: 0.00017 µg/L.	The CT human health criterion is based on the prior federal criterion and has not been revised since the federal criterion was revised. As such, it is not clear that this criterion would constitute an ARAR, since it is less stringent (and less up-to-date) than the comparable federal criterion (see 40 CFR 300.5). If this criterion is considered an ARAR, GE believes that it should be waived as technically impracticable for the reasons given in the text.
Guidances To Be Considered	
Cancer Slope Factors (from EPA's Integrated Risk Information System [IRIS]) – guidance values used to evaluate potential carcinogenic risk associated with exposure to PCBs	To be considered.

Table 2-1 – Potential Chemical-Specific ARARs

Authority/Regulation	Comments
Reference Doses (from EPA's IRIS) – guidance values used to evaluate potential non-carcinogenic hazards associated with exposure to PCBs	To be considered.
PCBs: Cancer Dose-Response Assessment and Application in Environmental Mixtures (EPA/600/P-96/001F, September 1996) – guidance describing EPA's reassessment of the carcinogenicity of PCBs – includes revised Cancer Slope Factors for PCBs	To be considered.

B. Particulate Matter

Authority/Regulation	Comments
State ARAR	
Massachusetts air pollution control requirements for activities with particulate emissions (310 CMR 7.09).	Apply to dust-generating activities and to operation of thermal desorption facility (if used) or other waste handling or ancillary facility that generates particulate emissions.

Table 2-2 – Potential Location-Specific ARARs

A. Rivers, Streams, and Impoundments

Authority/Regulation*	Comments
Federal ARARs	
Clean Water Act – Section 404 (33 USC 1344) and EPA's implementing regulations at 40 CFR Part 230	Apply to discharges of dredged or fill material to waters of the U.S. GE believes that one requirement of these regulations – that discharge not contribute to violation of state water quality standards – should be waived as technically impracticable, since Housatonic River does not currently meet MA water quality criteria for PCBs.
Rivers and Harbors Act of 1899, Section 10 (33 USC 403)	This section prohibits obstruction, excavation, filling, or altering any navigable water of the United States without authorization from U.S. Army Corps of Engineers. In this case, due to on-site permit exemption, no permit required.
Fish and Wildlife Coordination Act requirements (16 USC 662(a); 40 CFR 6.302(g))	Applicable to EPA; relevant and appropriate to work in river.
State ARARs	
Massachusetts Clean Water Act – water quality certification regulations (pursuant to § 401 of federal Clean Water Act) for discharges of dredged or fill material, dredging, and dredged material management (314 CMR 9.01 - 9.08); variances allowed.	Specific portions of these regulations are also listed as action-specific ARARs for certain response actions (e.g., staging/dewatering of dredged material, use of in-water Confined Disposal Facility for dredged material).
Massachusetts Wetlands Protection Act (MGL c. 131, § 40) and implementing regulations (310 CMR 10.53(3)(q), 10.54 -10.58) Also, 310 CMR 10.05(6)(b) and MDEP Stormwater Management Policy	Under 10.53(3)(q), actions responding to the release or threat of release of hazardous materials are allowed as "limited project" if they meet requirements specified therein. If response actions would not meet these criteria, the requirements of 10.54 -10.58 would apply. MDEP's Stormwater Management Policy establishes standards for management and control of storm water.

* ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-2 – Potential Location-Specific ARARs

Authority/Regulation*	Comments
Massachusetts Dam Safety Standards (302 CMR 10.00)	Existing dams on Housatonic River in Massachusetts are subject to these standards.
Connecticut Dam Safety Inspection Regulations (Conn. Agencies Regs. Sec. 22a-409-2)	Existing dams on Housatonic River in Connecticut are subject to these regulations.
Connecticut Inland Wetlands and Watercourses Act (Conn. Gen. Stat. 22a-36 *et seq*.) and regulations (Conn. Agencies Regs. Sec. 22a-39-4)	Relates to sampling in Connecticut portion of Housatonic. Although these provisions require permit for removal of material from inland wetlands or watercourses and allow general permit for minor activities such as monitoring and sampling, no permit required in this case due to on-site permit exemption.
To Be Considered	
Massachusetts Freshwater Fish Consumption Advisory List, Housatonic River (MA Dept. of Public Health, 2007) – also includes frogs and turtles	To be considered.
Massachusetts Provisional Waterfowl Consumption Advisory (MA Dept. of Public Health, 1999)	To be considered.
Advisory for Eating Fish from Connecticut Waterbodies (CT Dept. of Public Health, 2006)	To be considered.

* ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-2 – Potential Location-Specific ARARs

B. Floodplains, Wetlands, and Banks

Authority/Regulation*	Comments
Federal ARARs	
Clean Water Act – Section 404 (33 USC 1344) and EPA's implementing regulations at 40 CFR Part 230	
Executive Order 11990 for Wetlands Protection; see also 40 CFR 6.302(a), 40 CFR Part 6, App. A	Applicable to EPA; relevant and appropriate to work in wetlands.
Executive Order 11988 for Floodplain Management; see also 40 CFR 6.302(b), 40 CFR Part 6, App. A	Applicable to EPA; relevant and appropriate to work in floodplains.
Resource Conservation and Recovery Act (RCRA) requirements for hazardous waste facilities in floodplains (40 CFR 264.1(j)(7), 264.18(b))	Apply to treatment, storage, or disposal facility(ies) for excavated sediments and/or soils that constitute RCRA hazardous waste (if any), if such facility is located in 100-year floodplain. If applicable, may not be technically practicable to meet for some temporary staging areas.
State ARARs	
Massachusetts Clean Water Act – water quality certification regulations (pursuant to § 401 of federal Clean Water Act) for discharges of dredged or fill material, dredging, and dredged material management (314 CMR 9.01 - 9.08); variances allowed.	Apply to dredging or dredged material disposal from wetlands in MA that constitute waters of U.S., and to discharge of dredged or fill material to such wetlands if certain criteria are met.
Massachusetts Wetlands Protection Act (MGL c. 131, § 40) and implementing regulations (310 CMR 10.53(3)(q), 10.54 -10.58) Also, 310 CMR 10.05(6)(b) and MDEP Stormwater Management Policy	Same as discussed for these provisions in Part A of this Table 2-2.

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* ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-2 – Potential Location-Specific ARARs

Authority/Regulation*	Comments
Massachusetts location standards for hazardous waste management facilities in floodplains (310 CMR 30.701)	These standards would apply to treatment, storage, or disposal of excavated materials (if any) that constitute hazardous waste under state regulations and are not exempt under 310 CMR 30.104(3)(f), 310 CMR 30.501(3)(a), or 310 CMR 40.033 (described in Table 2-3, Part A). Some of these standards would not be technically practicable to meet for treatment, storage, or disposal facilities for such materials (e.g., prohibition on waste piles within 500-year floodplain).
Connecticut Inland Wetlands and Watercourses Act (Conn. Gen. Stat. 22a-36 *et seq*.) and regulations (Conn. Agencies Regs. Sec. 22a-39-4)	Same as discussed for these provisions in Part A of this Table 2-2.

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* ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-2 – Potential Location-Specific ARARs

C. Critical Habitat for Threatened and Endangered Species

Authority/Regulation*	Comments
Federal ARARs	
Endangered Species Act (16 USC 1536(a)-(d)) and regulations (40 CFR 6.302(h), 50 CFR Part 402, Subparts A & B)	Apply to actions that are likely to jeopardize the continued existence of a federally listed threatened or endangered species or result in destruction or adverse modification of critical habitat.
State ARARs	
Massachusetts Endangered Species Act (MGL c. 131A) and regulations (321 CMR 10.00, Parts I, II, IV & V)	Apply to activities in a State-designated Priority Habitat in MA. (Would also apply to activities affecting State-designated Significant Habitat in MA; however, no such habitat has been designated.)

D. Potential Historical or Archaeological Sites

Authority/Regulation*	Comments
Federal ARARs	
National Historic Preservation Act (16 USC 470f) and regulations (36 CFR Part 800)	Apply to actions in areas where property(ies) listed or eligible for inclusion on National Register of Historic Places may be present.
State ARARs	
Massachusetts Historical Commission Act (MGL c. 9, § 27C) and regulations (950 CMR 71.07)	Apply to projects in areas in MA that have an area of potential impact on property(ies) listed in State Register of Historic Places. Certain requirements also apply to excavations or construction on state or local government lands in MA.

* ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-3 – Potential Action-Specific ARARs *

A. Excavation/Removal of Sediments and Soils

Authority/Regulation*	Comments
Federal ARARs	
Toxic Substances Control Act (TSCA) regulations on PCB Remediation Waste (40 CFR 761.50, 761.61)	Options for cleanup of PCB Remediation Waste include self-implementing provisions (not applicable to sediments) and risk-based approval by EPA. Risk-based approval is pursuant to 40 CFR 761.61(c) and requires demonstration that cleanup method will not pose an unreasonable risk of injury to health or the environment.
TSCA regulations on decontamination (40 CFR 761.79)	Apply to decontamination of equipment used in excavation.
RCRA regulations on identification of hazardous waste (40 CFR Part 261)	Establish criteria for determining whether excavated sediments or soils must be managed as a hazardous waste.
Clean Water Act – NPDES regulations under Section 402 of Act (40 CFR 122.26(c)(1)(ii)(C), 122.44(k))	Apply to storm water discharges during construction and excavation activities.

* Except as otherwise noted, this table does not repeat the ARARs listed as potential Location-Specific ARARs in Table 2-2.

** ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-3 – Potential Action-Specific ARARs *

Authority/Regulation**	Comments
State ARARs	
Massachusetts hazardous waste regulations on identification of hazardous waste (310 CMR 30.100)	Establish criteria for determining whether excavated sediments or soils must be managed as a hazardous waste under state law. Note that certain wastes are exempt from the state hazardous waste management regulations. These include: ▪ Dredged material that is temporarily stored at an intermediate facility (pursuant to 314 CMR 9.07(4)) or placed in a confined disposal facility (pursuant to 314 CMR 9.07(8)) and is managed in accordance with a state water quality certification and requirements of § 404 permit under the Clean Water Act (see 310 CMR 30.104(3)(f)); ▪ Wastes that contain PCBs $\geq$ 50 ppm (which are listed hazardous wastes) that are managed in compliance with EPA's TSCA regulations (see 310 CMR 30.501(3)(a)); and ▪ Hazardous waste treated or disposed of (but not stored) as part of remedial actions unless MDEP determines that such action requires compliance with the hazardous waste regulations (see 310 CMR 40.0033). (These wastes are referred to in this table as "exempt.")
Massachusetts air pollution control regulations (310 CMR 7.09)	Apply to excavation and construction activities generating dust.

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* Except as otherwise noted, this table does not repeat the ARARs listed as potential Location-Specific ARARs in Table 2-2.

** ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-3 – Potential Action-Specific ARARs *

B. Backfilling/Restoration of Excavations; Installation of Caps, Covers, and Engineered Barriers; Rechannelization; Thin-Layer Capping; and Bank Stabilization

Authority/Regulation**	Comments
Federal ARARs	
TSCA regulations on PCB Remediation Waste (40 CFR 761.61)	Same as discussed for these regulations in Part A of this Table 2-3.
TSCA regulations on decontamination (40 CFR 761.79)	Apply to decontamination of equipment used in these activities.
Clean Water Act – NPDES regulations (40 CFR 122.26(c)(1)(ii)(C), 122.44(k))	Apply to storm water discharges during construction activities.
State ARARs	
Massachusetts air pollution control regulations (310 CMR 7.09)	Apply to construction activities generating dust.

* Except as otherwise noted, this table does not repeat the ARARs listed as potential Location-Specific ARARs in Table 2-2.

** ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-3 – Potential Action-Specific ARARs *

C. Temporary On-Site Accumulation and/or Storage of Excavated Sediments or Soils

Authority/Regulation**	Comments
Federal ARARs	
TSCA regulations on storage of PCB Remediation Waste (40 CFR 761.50, 761.65, 761.61(c))	These regulations include specific provisions for storage of bulk PCB Remediation Waste in piles at the cleanup site or site of generation for up to 180 days (761.65(c)(9)). They also allow for risk-based approval by EPA of alternate storage method (761.61(c)), based on determination that it will not pose an unreasonable risk of injury to health or the environment.
TSCA regulations on decontamination (40 CFR 761.79)	Apply to decontamination of equipment used in handling of PCB-containing materials.
RCRA regulations for generators of hazardous waste (40 CFR 262.30 - 262.33)	Would apply if any excavated sediments/soils at accumulation/storage facility constitute RCRA hazardous waste.

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* Except as otherwise noted, this table does not repeat the ARARs listed as potential Location-Specific ARARs in Table 2-2.

** ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-3 – Potential Action-Specific ARARs *

Authority/Regulation**	Comments
RCRA regulations for hazardous waste management facilities, including: ▪ Requirements for less than 90 day accumulation of hazardous waste (40 CFR 262.34); ▪ General requirements for remediation waste (40 CFR 264.1(j)) (in lieu of Part 264, Subparts B, C, and D); ▪ Requirements for storage of hazardous waste (40 CFR Part 264, Subpart J [tanks], Subpart L [waste piles outside structures], Subpart DD [containment buildings]); ▪ Groundwater protection requirements (40 CFR Part 264, Subpart F); ▪ Land disposal restrictions (40 CFR 268.50) – not applicable to: (a) on-site storage in tanks or containment buildings to facilitate recovery, treatment, or disposal; (b) staging pile under § 264.554; or (c) consolidation within Area of Contamination (EPA, 1995).	Potentially applicable to accumulation or storage of excavated sediments/soils that constitute RCRA hazardous waste (if any). Some of these requirements would not be technically practicable for temporary staging areas.
Clean Water Act – NPDES regulations (40 CFR 122.26(c)(1)(ii)(C), 122.44(k))	Apply to storm water discharges during construction activities.
State ARARs	
Massachusetts § 401 regulations on dredged material management – use of intermediate facilities (314 CMR 9.07(4) (Note: Also included in location-specific ARARs in Table 2-2, Part A.)	“Intermediate facility” is area used to manage dredged material (e.g., by stockpiling, dewatering, processing, etc.) prior to disposal or reuse. These requirements apply to staging/dewatering areas for sediments excavated from water.
Massachusetts hazardous waste regulations for generators (310 CMR 30.321 - 30.324)	Would be relevant if any excavated sediments/soils at accumulation/storage facility constitute hazardous waste under state regulations.

* Except as otherwise noted, this table does not repeat the ARARs listed as potential Location-Specific ARARs in Table 2-2.

** ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-3 – Potential Action-Specific ARARs *

Authority/Regulation**	Comments
Massachusetts hazardous waste management regulations, including: ▪ Requirements for less than 90 day accumulation of hazardous waste (310 CMR 30.340 - 30.343); ▪ General requirements for hazardous waste management facilities (310 CMR 30.513, 30.514, 30.524, 30.560); ▪ Location standards for units used to store hazardous waste (310 CMR 30.701(2) & (6), 30.703(2), 30.704(3), 30.705(3) & (6)); ▪ Technical requirements for storage of hazardous waste (310 CMR 30.602, 30.580, 30.640 & 30.660 [waste piles], and 30.690 [tanks])	May not apply to staging/dewatering areas for excavated sediments due to exemption from hazardous waste regulations for dredged materials temporarily stored at intermediate facility and managed in accordance with a state water quality certification and § 404 under the Clean Water Act (see 310 CMR 30.104(3)(f)). Would apply to accumulation or storage of other excavated materials (i.e., soils) that constitute non-exempt hazardous waste under state regulations (if any). Some of these requirements would not be technically practicable for temporary staging areas (e.g., prohibition on waste piles within 500-year floodplain).
Massachusetts air pollution control requirements (310 CMR 7.09)	Apply to activities generating dust.

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* Except as otherwise noted, this table does not repeat the ARARs listed as potential Location-Specific ARARs in Table 2-2.

** ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-3 – Potential Action-Specific ARARs *

D. *Ex Situ* Physical or Chemical Treatment at On-Site Facility

Authority/Regulation**	Comments
Federal ARARs	
TSCA regulations on cleanup and disposal of PCB Remediation Waste (40 CFR 761.50, 761.61)	Regulations specify methods for disposal of PCB remediation waste (e.g. incineration, approved TSCA landfill). Disposal includes actions relating to destroying, degrading, or decontaminating PCB-containing materials. No specific provisions for physical or chemical treatment. Regulations allow risk-based approval by EPA of cleanup or disposal method (761.61(c)) based on determination that such method will not pose an unreasonable risk of injury to health or the environment.
TSCA regulations on decontamination (40 CFR 761.79)	Apply to decontamination of equipment used in handling of PCB-containing materials.
RCRA regulations for hazardous waste management facilities, including: ▪ Same requirements listed in Part C of this Table 2-3 for storage of RCRA hazardous waste; ▪ Requirements for facilities that treat hazardous waste in miscellaneous units (40 CFR Part 264, Subpart X); and ▪ Air emission standards for process vents (40 CFR Part 264, Subpart AA)	Would apply if treatment facility is used for physical or chemical treatment of excavated sediments/soils that constitute RCRA hazardous waste (if any). Air emission standards would apply only if solvent extraction is used to treat such waste that contains total organic concentrations $\geq$ 10 ppm. Some of these requirements may not be technically practicable for physical or chemical treatment facility or associated storage facilities.
Clean Water Act – NPDES regulations (40 CFR 122.26(c)(1)(ii)(C), 122.44(k))	Apply to storm water discharges during construction activities.

* Except as otherwise noted, this table does not repeat the ARARs listed as potential Location-Specific ARARs in Table 2-2.

** ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-3 – Potential Action-Specific ARARs *

Authority/Regulation**	Comments
State ARARs	
Massachusetts hazardous waste management regulations, including same requirements listed in Part C of this Table 2-3 for storage of hazardous waste	Could apply if treatment facility is used for physical or chemical treatment of excavated sediments/soils that constitute hazardous waste under state regulations (if any) and are not exempt. Some of these requirements may not be technically practicable for physical or chemical treatment facility or associated storage facilities.
Massachusetts air pollution control requirements (310 CMR 7.09) Same as described for this regulation in Part A of this Table 2-3.	Apply to activities generating dust.
Massachusetts requirements for storage and handling of flammable liquids, including requirements for installation of liquefied petroleum (LP) gas systems (527 CMR 6.05, 6.07) and requirements for storage and handling of flammable liquids (527 CMR 14.03, 14.04, 14.07)	Would apply to storage of LP gas or flammable liquids if used as extraction fluids in chemical treatment.
Massachusetts tank regulations (527 CMR 9.03, 9.04)	Would apply to above-ground storage of any non-water liquids in > 10,000 gallon tanks or storage of flammable liquids in ≤ 10,000 gallon tanks.

* Except as otherwise noted, this table does not repeat the ARARs listed as potential Location-Specific ARARs in Table 2-2.

** ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-3 – Potential Action-Specific ARARs *

E. *Ex Situ* Thermal Desorption at On-Site Facility with Potential On-Site Reuse of Portion of Treated Materials

Authority/Regulation**	Comments
Federal ARARs	
TSCA regulations on cleanup and disposal of PCB Remediation Waste (40 CFR 761.50, 761.61(b) & (c))	Regulations specify methods for disposal of non-liquid PCB remediation waste. They include disposal in incinerator meeting requirements in 761.70 and disposal in chemical waste landfill meeting requirements in 761.75. Thermal desorption facility would not meet definition of incinerator, and on-site reuse is not explicitly authorized. Regulations allow risk-based approval by EPA of alternate disposal method (761.61(c)) based on determination that such method will not pose an unreasonable risk of injury to health or the environment.
TSCA regulations on decontamination (40 CFR 761.79)	Apply to decontamination of equipment used in handling of PCB-containing materials.
RCRA regulations for hazardous waste management facilities, including: ▪ Same requirements listed in Part C of this Table 2-3 for storage of RCRA hazardous waste; and ▪ Requirements for facilities that treat hazardous waste in miscellaneous units (40 CFR Part 264, Subpart X)	Would apply if thermal desorption facility will treat excavated sediments or soils that constitute RCRA hazardous waste (if any). Some of these requirements may not be technically practicable for thermal desorption facility or associated storage facilities.
State ARARs	
Massachusetts air pollution control regulations (310 CMR 7.00), as pertinent to thermal desorption facility	Pertinent to design and operation of thermal desorption facility.

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* Except as otherwise noted, this table does not repeat the ARARs listed as potential Location-Specific ARARs in Table 2-2.

** ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-3 – Potential Action-Specific ARARs *

Authority/Regulation**	Comments
Massachusetts hazardous waste management regulations, including: ▪ Same requirements listed in Part C of this Table 2-3 for storage of hazardous waste; and ▪ Technical requirements for miscellaneous units (310 CMR 30.606)	Could apply if thermal desorption facility will treat excavated sediments/soils that constitute hazardous waste under state regulations (if any) and are not exempt. Some of these requirements may not be technically practicable for thermal desorption facility or associated storage facilities.
Massachusetts tank regulations (527 CMR 9.03, 9.04)	Same as discussed for these regulations in Part D of this Table 2-3.
Massachusetts regulations on beneficial use of solid waste (310 CMR 19.060)	Pertinent to on-site reuse of treated material.

* Except as otherwise noted, this table does not repeat the ARARs listed as potential Location-Specific ARARs in Table 2-2.

** ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-3 – Potential Action-Specific ARARs *

F. Discharge of Treated Water from Dewatering or Treatment Facility to Housatonic River

Authority/Regulation**	Comments
Federal ARARs	
Clean Water Act – NPDES regulations (under 33 USC 1342) (40 CFR 122.44, 125.1 - 125.3; see also 40 CFR 122.3(d))	Regulations require discharge to meet technology-based and water quality-based effluent limitations, but exempt discharges in compliance with instructions of On-Scene Coordinator acting pursuant to NCP (122.3(d)). GE believes that, to extent discharge is not so exempt, any requirement to meet MA water quality criteria for PCBs in the receiving waters should be waived as technically impracticable.
TSCA regulations for discharge of water containing PCBs to navigable waters (40 CFR 761.50(a)(3))	Apply to discharges of treated water to Housatonic River.

* Except as otherwise noted, this table does not repeat the ARARs listed as potential Location-Specific ARARs in Table 2-2.

** ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-3 – Potential Action-Specific ARARs *

G. Local Disposal of Excavated Sediments or Soils in Upland Facility

Authority/Regulation**	Comments
Federal ARARs	
TSCA regulations on disposal of PCB Remediation Waste in landfill (40 CFR 761.50(d)(4), 761.61(b) & (c), and 761.75)	Section 761.75 establishes standards and requirements for chemical waste landfills used for disposal of PCBs. However, section 761.61(c) allows risk-based approval of alternate method of disposal of PCB Remediation Waste if EPA finds that such method will not pose an unreasonable risk of injury to health or the environment. As another alternative, dredged material with < 50 ppm may be disposed of in accordance with permit under § 404 of Clean Water Act or equivalent (761.61(b)(3)).
TSCA regulations on decontamination (40 CFR 761.79)	Apply to decontamination of equipment used in handling of PCB-containing materials.
RCRA regulations for hazardous waste management facilities, including: ▪ General requirements (40 CFR 264.1(j)) (in lieu of Part 264, Subparts B, C, and D); ▪ Requirements for landfills (40 CFR Part 264, Subpart N); ▪ Groundwater protection requirements (40 CFR Part 264, Subpart F).	Potentially applicable to disposal facility for excavated sediments/soils that constitute RCRA hazardous waste (if any). Some of these requirements may be technically impracticable to achieve at upland disposal facility.
RCRA land disposal restrictions (40 CFR Part 268; see also 40 CFR 264.552)	Potentially applicable to disposal of excavated sediments/soils that constitute RCRA hazardous waste (if any) unless location of disposition is part of Corrective Action Management Unit (CAMU) under § 264.552 or part of Area of Contamination (AOC) per EPA (1995). If applicable, land disposal restrictions may be infeasible.

* Except as otherwise noted, this table does not repeat the ARARs listed as potential Location-Specific ARARs in Table 2-2.

** ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-3 – Potential Action-Specific ARARs *

Authority/Regulation**	**Comments**
Clean Water Act – NPDES regulations (40 CFR 122.26(c)(1)(ii)(C), 122.44(k))	Apply to storm water discharges during construction activities.
State ARARs	
Massachusetts hazardous waste management regulations, including: ▪ General requirements (310 CMR 30.513, 30.514, 30.524, 30.560); ▪ Location standards for hazardous waste landfills (310 CMR 30.701(6), 30.703(2)-(4), 30.704, 30.705(3) & (6)) ▪ Technical requirements for hazardous waste landfillls (310 CMR 30.602, 30.620, 30.660, 30.580, 30.590)	Could apply to disposal facility for excavated sediments/soils that constitute hazardous waste under state regulations (if any) and are not exempt. Depending on selected location for upland disposal facility, some of these requirements may be technically impracticable to achieve.
Massachusetts air pollution control requirements (310 CMR 7.09)	Apply to activities generating dust.

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* Except as otherwise noted, this table does not repeat the ARARs listed as potential Location-Specific ARARs in Table 2-2.

** ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-3 – Potential Action-Specific ARARs *

H. Local Disposal of Sediments in In-Water Confined Disposal Facility (CDF)

Authority/Regulation**	Comments
Federal ARARs	
TSCA regulations on disposal of PCB Remediation Waste (40 CFR 761.50(d)(4), 761.61(b) & (c), 761.75)	Same as discussed for these regulations in Part G of this Table 2-3.
TSCA regulations on decontamination (40 CFR 761.79)	Apply to decontamination of equipment used in handling of PCB-containing materials.
Clean Water Act – Section 404 (33 USC 1344) and EPA's implementing regulations at 40 CFR Part 230 (Note: Also listed as location-specific ARAR in Table 2-2, Part A.)	Apply to disposal of sediments in in-water CDF.
Rivers and Harbors Act of 1899, Section 10 (33 USC 403) (Note: Also listed as location-specific ARAR in Table 2-2, Part A.)	Same as discussed for this provision in Table 2-2, Part A.
RCRA regulations for hazardous waste management facilities, including: ▪ General requirements (40 CFR 264.1(j)) (in lieu of Part 264, Subparts B, C, and D); ▪ Requirements for surface impoundments (40 CFR Part 264, Subpart K) and/or landfills (40 CFR Part 264, Subpart N); ▪ Groundwater protection requirements (40 CFR Part 264, Subpart F).	Potentially applicable to CDF for sediments that constitute RCRA hazardous waste (if any). Some of these requirements would not be technically practicable to meet for local CDF.

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* Except as otherwise noted, this table does not repeat the ARARs listed as potential Location-Specific ARARs in Table 2-2.

** ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-3 – Potential Action-Specific ARARs *

Authority/Regulation**	Comments
RCRA land disposal restrictions (40 CFR Part 268; see also 40 CFR 264.552)	Potentially applicable to disposal in CDF of sediments that constitute RCRA hazardous waste (if any) unless location of disposition is part of CAMU under § 264.552 or part of AOC per EPA (1995). If applicable, land disposal restrictions may be infeasible.
Clean Water Act – NPDES regulations (40 CFR 122.26(c)(1)(ii)(C), 122.44(k))	Apply to storm water discharges during construction activities.
State ARARs	
Massachusetts § 401 regulations on dredged material management – use of confined disposal facilities (310 CMR 9.07(8)) (Note: Also included in location-specific ARARs in Table 2-2, Part A.)	Apply to in-water CDF for dredged material. Some of these requirements may not be necessary or technically practicable for local CDF.
Massachusetts hazardous waste management regulations, including: ▪ General requirements (310 CMR 30.513, 30.514, 30.524, 30.560); ▪ Relevant location standards for hazardous waste facilities in 310 CMR.700; ▪ Technical requirements for hazardous waste surface impoundments or landfills (310 CMR 30.602, 30.610 or 30.620, 30.660, 30.580, 30.590)	Status as ARAR is uncertain. Potentially relevant to CDF for sediments that constitute hazardous waste under state regulations (if any) and are not exempt. Several of these requirements would not be technically practicable to meet at local CDF (e.g., prohibition on discharge of hazardous waste into waterbodies, prohibition on surface impoundments or landfills within 500-year floodplain or within wetlands).
Massachusetts air pollution control requirements (310 CMR 7.09)	Apply to activities generating dust.

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* Except as otherwise noted, this table does not repeat the ARARs listed as potential Location-Specific ARARs in Table 2-2.

** ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

Table 2-3 – Potential Action-Specific ARARs *

I. Sampling and Monitoring

Authority/Regulation**	Comments
Federal ARARs	
TSCA regulations on decontamination (40 CFR 761.79)	Apply to decontamination of equipment used in sampling of PCB-containing materials.
State ARARs	
Connecticut fisheries and game laws (Conn. Gen. Stat. 26-60)	Relates to biota sampling in Connecticut portion of Housatonic. This provision authorizes CT DEP to issue permits for sampling of fish, crustaceans, and wildlife for educational and scientific purposes, but no permit required in this case due to on-site permit exemption.

J. Other

Authority/Regulation**	Applicability/ Appropriateness
To Be Considered	
TSCA PCB Spill Cleanup Policy (40 CFR Part 761, Subpart G)	To be considered for any new PCB spills at concentrations ≥ 50 ppm that occur during the work.
Use of Area of Contamination (AOC) Concept During RCRA Cleanups (Memorandum from EPA Office of Solid Waste and Emergency Response, March 13, 1995)	Describes EPA policy on use of Area of Contamination under RCRA.

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* Except as otherwise noted, this table does not repeat the ARARs listed as potential Location-Specific ARARs in Table 2-2.

** ARARs consist only of the substantive requirements of the provisions listed in this column, not any administrative requirements included therein.

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Table 2-4 – IMPGs for PCBs Based on Human Direct Contact (Soil/Sediment)

Type of Area/Exposure Scenario	**Receptor**	**RME or CTE**	**Assumed Frequency of Use**	**IMPGs (in mg/kg)**			
				Cancer @ 10^{-6}	**Cancer @ 10^{-5}**	**Cancer @ 10^{-4}**	**Non-Cancer**
Residential (Actual/Potential Lawn areas)	All	RME	150 d/yr	**2*** (per Consent Decree)			
Residential (banks, steep slopes, wet areas)	All	Both	Variable	Use IMPGs for general recreation scenarios based on appropriate exposure frequencies for parcel-specific conditions			
High-use general recreation	Young child (high use)	RME	90 d/yr	**1.3***	13	134	**4.6***
		CTE	30 d/yr	18	184	1,842	32
	Young child (low use)	RME	15 d/yr	**8.0***	80	802	**27***
		CTE	15 d/yr	37	368	3,684	63
	Older child	RME	90 d/yr	**3.9***	39	388	**27***
		CTE	30 d/yr	51	514	5,143	176
	Adult	RME	90 d/yr	**1.4***	14	143	**38***
		CTE	30 d/yr	63	630	6,305	234

Table 2-4 – IMPGs for PCBs Based on Human Direct Contact (Soil/Sediment)

Type of Area/Exposure Scenario	Receptor	RME or CTE	Assumed Frequency of Use	IMPGs (in mg/kg)			
				Cancer @ 10^{-6}	Cancer @ 10^{-5}	Cancer @ 10^{-4}	Non-Cancer
Medium-use general recreation	Young child	Not assessed		NA	NA	NA	NA
	Older child	RME	60 d/yr	**5.8***	58	582	**40***
		CTE	30 d/yr	51	514	5,143	176
	Adult	RME	60 d/yr	**2.1***	21	215	**58***
		CTE	30 d/yr	63	630	6,305	234
Low-use general recreation	Young child	Not assessed		NA	NA	NA	NA
	Older child	RME	30 d/yr	**12***	116	1,165	**80***
		CTE	15 d/yr	103	1,029	10,286	353
	Adult	RME	30 d/yr	**4.3***	43	429	**115***
		CTE	15 d/yr	126	1,261	12,610	468

Table 2-4 – IMPGs for PCBs Based on Human Direct Contact (Soil/Sediment)

Type of Area/Exposure Scenario	Receptor	RME or CTE	Assumed Frequency of Use	IMPGs (in mg/kg)			
				Cancer @ 10^{-6}	Cancer @ 10^{-5}	Cancer @ 10^{-4}	Non-Cancer
Bank fishing	Older child	RME	30 d/yr	**6.2***	62	619	**42***
		CTE	10 d/yr	52	524	5,237	180
	Adult	RME	30 d/yr	**2.6***	26	256	**56***
		CTE	10 d/yr	70	702	7,015	220
Dirt biking/ATVing	Older child	RME	90 d/yr	**2.0***	20	205	**14***
		CTE	30 d/yr	29	290	2,901	99
Marathon canoeist	Adult	RME	150 d/yr	**0.78***	7.8	78	**13***
		CTE	90 d/yr	5.8	58	575	25
Recreational canoeist	Older child	RME	30 d/yr	**6.2***	62	619	**42***
		CTE	15 d/yr	35	349	3,491	120
	Adult	RME	60 d/yr	**1.2***	12	121	**28***
		CTE	30 d/yr	13	129	1,286	73

Table 2-4 – IMPGs for PCBs Based on Human Direct Contact (Soil/Sediment)

Type of Area/Exposure Scenario	**Receptor**	**RME or CTE**	**Assumed Frequency of Use**	**IMPGs (in mg/kg)**			
				Cancer @ 10^{-6}	**Cancer @ 10^{-5}**	**Cancer @ 10^{-4}**	**Non-Cancer**
Waterfowl hunting	Older child	RME	14 d/yr	**41***	408	4080	**140***
		CTE	7 d/yr	233	2325	23,253	399
	Adult	RME	14 d/yr	**9.0***	90	904	**196***
		CTE	7 d/yr	75	752	7,518	537
Agricultural use (based on direct contact by farmer)	Adult	RME	40 d/yr	**1.2***	12	118	**43***
		CTE	10 d/yr	42	419	4,195	348
High-use commercial (groundskeeper scenario)	Adult	RME	150 d/yr	**1.8***	18	177	**25***
		CTE	150 d/yr	17	166	1,664	57
Low-use commercial (groundskeeper scenario)	Adult	RME	30 d/yr	**8.9***	89	885	**126***
		CTE	15 d/yr	166	1,664	16,642	571

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Table 2-4 – IMPGs for PCBs Based on Human Direct Contact (Soil/Sediment)

Type of Area/Exposure Scenario	Receptor	RME or CTE	Assumed Frequency of Use	IMPGs (in mg/kg)			
				Cancer @ 10^{-6}	Cancer @ 10^{-5}	Cancer @ 10^{-4}	Non-Cancer
Utility worker	Adult	RME	5 d/yr	**17***	169	1,694	**242***
		CTE	5 d/yr	209	2,093	20,933	718
Sediments	Older child	RME	36 d/yr	**4.5***	45	453	**31***
		CTE	12 d/yr	36	365	3,645	125
	Adult	RME	36 d/yr	**1.3***	13	135	**40***
		CTE	12 d/yr	28	280	2,800	152

Notes:

1. CTE = central tendency exposure
2. d/yr = days per year
3. EPA = United States Environmental Protection Agency
4. IMPGs = interim media protection goals
5. mg/kg = milligram per kilogram
6. PCBs = polychlorinated biphenyls
7. RME = reasonable maximum exposure
8. * = Points of departure, as specified by EPA.

Table 2-5 – IMPGs for PCBs in Fish and Waterfowl Tissue Based on Human Consumption

Tissue Type and Constituent	**Assessment Type**	**RME or CTE**	**IMPGs (in mg/kg)**				
			Cancer @ 10^{-6}	**Cancer @ 10^{-5}**	**Cancer @ 10^{-4}**	**Non-Cancer – Child**	**Non-Cancer – Adult**
Bass fillets – PCBs	Deterministic	RME	**0.0019***	0.019	0.19	**0.026***	**0.062***
		CTE	0.049	0.49	4.9	0.19	0.43
	Probabilistic	RME (5th percentile)	**0.0064***	0.064	0.64	**0.059***	**0.12***
		CTE (50th percentile)	0.057	0.57	5.7	0.71	1.5
Trout fillets – PCBs	Deterministic	RME	**0.0048***	0.048	0.48	**0.069***	**0.16***
		CTE	0.11	1.1	11	0.40	0.93
	Probabilistic	RME (5th percentile)	**0.014***	0.14	1.4	**0.13***	**0.27***
		CTE (50th percentile)	0.12	1.2	12	1.5	3.1

Table 2-5 – IMPGs for PCBs in Fish and Waterfowl Tissue Based on Human Consumption

Tissue Type and Constituent	**Assessment Type**	**RME or CTE**	**IMPGs (in mg/kg)**				
			Cancer @ 10^{-6}	**Cancer @ 10^{-5}**	**Cancer @ 10^{-4}**	**Non-Cancer – Child**	**Non-Cancer – Adult**
Duck breast – PCBs	Deterministic	RME	**0.0084***	0.084	0.84	**0.12***	**0.28***
		CTE	0.066	0.66	6.6	0.25	0.58
	Probabilistic	RME (5th percentile)	**0.0075***	0.075	0.75	**0.080***	**0.17***
		CTE (50th percentile)	0.072	0.72	7.2	0.67	1.4

Notes:
1. CTE = central tendency exposure
2. EPA = United States Environmental Protection Agency
3. IMPGs = interim media protection goals
4. mg/kg = milligram per kilogram
5. PCBs = polychlorinated biphenyls
6. RME = reasonable maximum exposure
7. * = Points of departure, as specified by EPA.

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Table 2-6 – IMPGs for PCBs in Agricultural Products Based on Human Consumption

Tissue Type	Farm Type	RME or CTE	IMPGs (in mg/kg-wet weight)				
			Cancer @ 10^{-6}	Cancer @ 10^{-5}	Cancer @ 10^{-4}	Non-Cancer Child	Non-Cancer Adult
Cow milk	Commercial dairy	RME	**0.000026***	0.00026	0.0026	**0.00030***	**0.0014***
		CTE	0.00012	0.0012	0.012	0.00047	0.0017
	Backyard dairy	RME	**0.000032***	0.00032	0.0032	**0.00030***	**0.0012***
		CTE	0.00016	0.0016	0.016	0.00047	0.0010
Beef tissue	Commercial beef	RME	**0.00033***	0.0033	0.033	**0.0077***	**0.014***
		CTE	0.0015	0.015	0.15	0.010	0.017
	Backyard beef	RME	**0.00047***	0.0047	0.047	**0.0077***	**0.013***
		CTE	0.0027	0.027	0.27	0.010	0.013
Poultry meat	Commercial poultry	RME	**0.00052***	0.0052	0.052	**0.015***	**0.021***
		CTE	0.0030	0.030	0.30	0.019	0.034
	Backyard poultry	RME	**0.0009***	0.009	0.09	**0.015***	**0.026***
		CTE	0.0054	0.054	0.54	0.019	0.027

Table 2-6 – IMPGs for PCBs in Agricultural Products Based on Human Consumption

Tissue Type	**Farm Type**	**RME or CTE**	**IMPGs (in mg/kg-wet weight)**				
			Cancer @ 10^{-6}	**Cancer @ 10^{-5}**	**Cancer @ 10^{-4}**	**Non-Cancer Child**	**Non-Cancer Adult**
Poultry eggs	Commercial poultry	RME	**0.00055***	0.0055	0.055	**0.011***	**0.025***
		CTE	0.0025	0.025	0.25	0.013	0.031
	Backyard poultry	RME	**0.00082***	0.0082	0.082	**0.011***	**0.025***
		CTE	0.0044	0.044	0.44	0.013	0.026
Exposed fruit	Commercial or backyard fruit farm	RME	NC			**0.11***	NC
		CTE	NC			0.15	NC
Exposed vegetables	Commercial or backyard farm with exposed vegetables	RME	NC			**0.024***	NC
		CTE	NC			0.037	NC
Root vegetables	Commercial or backyard farm with root vegetables	RME	NC			**0.030***	NC
		CTE	NC			0.049	NC

Table 2-6 – IMPGs for PCBs in Agricultural Products Based on Human Consumption

Tissue Type	Farm Type	RME or CTE	IMPGs (in mg/kg-wet weight)				
			Cancer @ 10^{-6}	Cancer @ 10^{-5}	Cancer @ 10^{-4}	Non-Cancer Child	Non-Cancer Adult
All produce	Commercial or backyard farm with all three types of above produce	RME	NC			**0.012***	NC
		CTE	NC			0.018	NC

Notes:
1. CTE = central tendency exposure
2. EPA = United States Environmental Protection Agency
3. IMPGs = interim media protection goals
4. mg/kg = milligram per kilogram
5. NC = Not calculated
6. PCBs = polychlorinated biphenyls
7. RME = reasonable maximum exposure
8. * = Points of departure, as specified by EPA.

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Table 2-7 – Summary of Media-Specific IMPGs for PCBs in Ecological Receptors

Receptor Group	Medium	IMPGs
Benthic invertebrates	Sediments	**3*** to 10 mg/kg
Amphibians (represented by wood frog)	Vernal pool sediments	**3.27*** to 5.6 mg/kg
Fish	Fish tissue in PSA (whole body)	**55*** mg/kg
	Fish tissue downstream of PSA (whole body)	**55*** mg/kg for warmwater fish **14*** mg/kg for coldwater fish
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	**3.2*** mg/kg
Insectivorous birds (represented by wood duck)	Aquatic and terrestrial invertebrate prey	**4.4*** mg/kg
Piscivorous mammals (mink and otter)	Prey items	**0.984*** to 2.43 mg/kg
Omnivorous and carnivorous mammals (represented by short-tailed shrew)	Floodplain soil	**21.1*** to 34.3 mg/kg
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	**30.41*** mg/kg

Notes:
1. EPA = United States Environmental Protection Agency
2. IMPGs = interim media protection goals
3. mg/kg = milligram per kilogram
4. PCBs = polychlorinated biphenyls
5. PSA = Primary Study Area
6. * = Point of departure, as specified by EPA.

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Table 2-8 – Target Floodplain Soil PCB Concentrations Associated with IMPGs for Consumption of Agricultural Products [1]

			Target Soil Concentrations (mg/kg)				
Farm Type	**Tissue Type**	**RME or CTE**	**Cancer at 10^{-6}**	**Cancer at 10^{-5}**	**Cancer at 10^{-4}**	**Non-Cancer Child**	**Non-Cancer Adult**
Commercial Dairy	Milk	RME	0.24	2.4	24	2.7	12.8
		CTE	1.1	11.0	110	4.3	15.6
Commercial Poultry	Poultry Meat	RME	0.015	0.15	1.5	0.44	0.62
		CTE	0.16	1.6	16	1.0	1.8
Commercial Vegetable	Exposed Vegetable	RME	NC	NC	NC	13.3	NC
		CTE	NC	NC	NC	20.6	NC
	Root Vegetable	RME	NC	NC	NC	100	NC
		CTE	NC	NC	NC	163	NC

Notes:

1. These levels apply to farm properties where 100% of the growing or grazing land is located within the floodplain.
2. CTE = central tendency exposure
3. IMPGs = interim media protection goals
4. mg/kg = milligram per kilogram
5. NC = Not calculated
6. PCBs = polychlorinated biphenyls
7. RME = reasonable maximum exposure

3. Approach to Evaluating Remedial Alternatives for Sediments/Erodible Riverbanks

This section provides additional details on the approach used to evaluate the eight alternatives for sediments and erodible riverbanks. Section 3.1 describes particular approaches used to conduct the detailed evaluations, such as defining areas to be dredged versus areas to be capped, and establishing production rates used to estimate the length of time to implement an alternative. Section 3.2 describes the use of EPA's PCB fate, transport, and bioaccumulation model to predict the PCB concentrations in the sediment, water column, and fish in the area between the Confluence and Rising Pond Dam that would result from each of the remedial alternatives. This section also describes the method used to evaluate the impacts of the remedial alternatives on the impoundments in the Connecticut portion of the River. Section 3.3 describes the spatial scales and types of sediment and fish tissue concentration averages used to compare model predictions of future sediment and fish PCB concentrations for each alternative with the IMPGs applicable to those media. Finally, Section 3.4 discusses the way in which the model results were used to evaluate remedial alternatives, and the model output graphics used to support those evaluations.

3.1 Details Regarding Remedial Alternatives

This section provides additional details, beyond the description in the CMS Proposal, on specific analyses that were needed to develop and conduct a detailed evaluation of remedial alternatives. These details include spatial delineation of areas for removal and/or capping in reaches where a combination of these technologies was considered, description of where specific removal techniques (e.g., dry versus wet excavation) would be applied for each alternative, specification of the depths assumed for the capping technologies, the estimated times required for completion of each alternative, and the procedures used for calculating volumes and areas for each alternative.

3.1.1 Spatial Delineation of Remedial Areas

As previously noted, the eight remedial alternatives for addressing sediments and erodible riverbanks containing PCB are summarized, by reach, in Table 1-1. Six of those alternatives include sediment removal and/or capping (SED 3 through SED 8). For these alternatives, the evaluation usually assumed that the same remedial technology would be applied throughout an entire reach or subreach, as described in Table 1-1.[21] In some cases, however, river conditions led to consideration of combinations of remedial technologies within a single reach or subreach. In those cases, additional criteria were used to define where a particular remedial technology would be applied within that reach or subreach. The following discussion summarizes each of the six sediment remediation alternatives that includes removal and/or capping and then describes, for each, the criteria used to determine where each technology would be applied within each reach or subreach when combinations of remedial technologies were specified. Figures showing the remedial technologies that would be used have been included in the detailed descriptions of the sediment alternatives in Section 4. (In this CMS Report, the term "capping" refers to engineered capping; thin-layer capping is identified separately. Also, the term "removal" refers to removal followed by capping unless otherwise indicated.)

<u>SED 3</u> – Sediment removal in Reach 5A, MNR in Reach 5B, a combination of thin-layer capping and MNR in Reach 5C, thin-layer capping in Woods Pond, and MNR for the remainder of the River.

For SED 3, a single remedial technology would be applied in each subreach (as described in Table 1-1), with the exception of Reach 5C. In Reach 5C, where a combination of thin-layer capping and MNR would be applied, thin-layer capping was specified for the lower portion of the subreach corresponding to the last two "spatial bins" in this subreach (a distance of approximately 1.5 miles).[22] The basis for the specification of a thin-layer cap in this area was that the last two spatial bins exhibited markedly higher PCB concentrations than the remaining portion of the subreach.

<u>SED 4</u> – Combination of sediment removal, capping, and thin-layer capping from Confluence to Woods Pond Dam. This alternative involves the same elements as SED 3 with the addition of a combination of sediment removal and thin-layer capping in Reach 5B and Woods Pond, capping in portions of Reach 5C, and thin-layer capping in portions of the backwaters.

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[21] As discussed in the CMS Proposal, the development of the sediment alternatives was based on knowledge of river conditions and a review of which technologies would be suitable under the conditions present within the various river reaches, making use of the conceptual model of the system described in the RFI Report and EPA's FMDR.

[22] In the development of the model, EPA divided the River within the PSA into "spatial bins," which are approximate ¼- to ½-mile sections, over which the sediment PCB data were averaged. The "spatial bin" averages were then used by EPA in model calibration and validation to assign sediment initial conditions and to make model-data comparisons. These same "spatial bins" were used in the CMS.

With the exception of Reach 5A, SED 4 includes multiple remedial technologies within four subreaches (i.e., Reaches 5B and 5C, Reach 5 backwaters, and Woods Pond; see Table 1-1):

- Reach 5B: In this subreach, a combination of 2-foot removal and thin-layer capping would be applied under this alternative. The split between removal and thin-layer capping was specified based on both water depth and flow velocity, with the lower portion of the subreach (e.g., downstream of New Lenox Road) exhibiting generally greater water depths and lower flow velocities -- which result in lower potential for sediment resuspension. Based on these conditions, a thin-layer cap was judged suitable for the area corresponding to the last three spatial bins within the subreach (a distance of approximately 1 mile), and 2-foot removal was specified for the upper portion.

- Reach 5C: In this subreach, a combination of thin-layer capping and capping (without prior removal) would be applied under this alternative. While physical conditions throughout the subreach were judged amenable to thin-layer capping, specification of capping areas was based on consideration of water depth as well as the differences in PCB concentrations within the subreach. Thus, thin-layer capping was specified to occur in the upper four spatial bins (a distance of approximately 1.5 miles), which generally have lower PCB concentrations and relatively shallower water depths; capping (without prior removal) was specified to occur in the last two spatial bins (a distance of approximately 1.5 miles), which have higher concentrations (as discussed above) as well as relatively deeper water depths and lower flow velocities.

- Reach 5 Backwaters: Within these backwater regions (as shown on Figure 1-1), a combination of thin-layer capping and MNR would be applied. Those backwaters having generally higher PCB concentrations (i.e., defined as 15 mg/kg or higher based on the area-weighted average 0- to 6-inch concentration in the EPA model at the end of the validation period) were specified to have a thin-layer cap.

- Woods Pond: Within this reach, a combination of 1.5-foot removal/capping and thin-layer capping would be applied under this alternative. For SED 4, a thin-layer cap would be applied over the “deep hole” portion in the southeastern half of Woods Pond, while removal/capping would be performed in the remaining shallower areas.

<u>SED 5</u> – Combination of additional sediment removal and capping to Woods Pond Dam and thin-layer capping in Rising Pond. This alternative involves the same elements as SED 4 with additional removal in Reaches 5B (removal for the entire subreach) and 5C, capping alone in a portion of Woods Pond, and thin-layer capping in Rising Pond.

The SED 5 alternative would use multiple remedial technologies within three subreaches (i.e., Reach 5C, Reach 5 backwaters, and Woods Pond; see Table 1-1):

- Reach 5C: In this subreach, a combination of 2-foot removal and capping alone would be applied. Similar to the spatial segmentation used for this subreach in SED 4, the removal was specified to occur in the upper four spatial bins exhibiting shallower water depths and higher flow velocities, while capping alone was specified to occur in the last two spatial bins. Each of these stretches comprises a distance of approximately 1.5 miles.

- Reach 5 backwaters: Same as defined for SED 4 above.

- Woods Pond: Within this reach, a combination of 1.5-foot removal and capping alone would be applied. For SED 5, the cap (without prior removal) would be installed over the "deep hole" portion of Woods Pond, and removal would be performed in the remaining shallower areas.

<u>SED 6</u> – Combination of sediment removal and capping for the entire River from the Confluence to Woods Pond Dam and a combination of capping and thin-layer capping in the Reach 7 impoundments and Rising Pond. This alternative involves the same elements as SED 5 with additional removal in Reach 5C and the backwaters, thin-layer capping in the Reach 7 impoundments, and a combination of capping and thin-layer capping in Rising Pond.

For SED 6, a single remedial technology of 2-foot removal would be used throughout the Reach 5 main channel (i.e., subreaches 5A, 5B, and 5C; see Table 1-1), while a combination of technologies would be applied in Reach 5 backwaters, Woods Pond, and Rising Pond:

- Reach 5 backwaters: Under SED 6, a combination of 1-foot removal and thin-layer capping would be applied in the backwaters. For this alternative, areas with sediments containing PCBs $\geq$ 50 mg/kg were identified for removal to a depth of 1 foot, while sediments containing PCBs between 1 and 50 mg/kg would be covered with a thin-layer cap. To support most of the detailed evaluations of SED 6 presented in Section 4 (e.g., estimation of removal volumes and thin-layer capping acreages), removal and thin-layer capping locations were delineated based on sampling data collected in the backwaters (represented by Thiessen polygons of 0- to 12-inch PCB data). However, for simulating the remediation of backwaters under SED 6 in the model, delineation of areas for removal/thin-layer capping was based on the model's simulated concentrations at the start of the projections.[23]

- Woods Pond: Same as defined for SED 5 above.

- Rising Pond: For SED 6, a cap (with no removal) would be applied in the "deep" portion of the Pond, and a thin-layer cap would be applied in the remaining "shallow" areas. The "deep" portion of Rising Pond was defined as areas that correspond to the former river channel, and was delineated based on existing bathymetry data.

<u>SED 7</u> – Combination of sediment removal (with capping or backfill) for the entire River from the Confluence to Woods Ponds Dam and a combination of removal and thin-layer capping in the Reach 7 impoundments and Rising Pond. This alternative involves the same elements of SED 6 with additional (deeper) removal in Reaches 5A and 5B, the backwaters, and Woods Pond, and sediment removal in portions of the Reach 7 impoundments and Rising Pond.

For SED 7, a single remedial technology would be used in each subreach where removal and/or capping would occur (as defined in Table 1-1), with the exception of the Reach 5 backwaters, Woods Pond, Reach 7 impoundments, and Rising Pond:

- Reach 5 backwaters: Same as defined for SED 6, except that under SED 7, sediments containing PCBs greater than 10 mg/kg would be removed to a depth of 1 foot, and sediments containing PCBs between 1 and 10 mg/kg would be covered with a thin-layer cap.

- Woods Pond: Same as defined for SED 5 and SED 6, except that the removal in shallow areas of the Pond would be increased to 2.5 feet.

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[23] The areas delineated for removal/thin-layer capping based on the data assessment used to estimate removal volumes and capping areas for this alternative are different from the areas of removal/thin-layer capping specified in the model. This is due to differences between the PCB concentrations specified in the model and the sampling data at the small scale of an individual backwater. For example, during model development, PCB concentration data in the backwaters were averaged to develop model sediment initial conditions; as a result of this averaging, there are no backwaters in the model that contain PCB concentrations greater than 50 mg/kg (while there are individual data points collected in backwaters with concentrations greater than 50 mg/kg). Note that if such an alternative were selected, the actual areas with PCB concentrations above 50 mg/kg and between 1 and 50 mg/kg would be determined based on data collected during design.

- Reach 7 impoundments: In these areas (defined as the impounded areas directly upstream of Columbia Mill, Willow Mill, and Glendale Dams), sediments having PCB concentrations greater than 3 mg/kg would be removed to a depth of 1.5 feet, and sediments containing PCBs less than 3 mg/kg would be thin-layer capped. For SED 7, the delineation of areas for removal and thin-layer capping in these impoundments was based on the same approach used for backwater areas in SED 6 described above. That is, Thiessen polygons generated from the 0- to 12-inch sampling data were used for estimating removal volumes and capping acreages, whereas for the model simulations, the grid cells specified for removal/capping were delineated based on the model predictions at the end of the validation period. As discussed previously for the backwaters, this different methodology was used in the model simulations because the model's predictions in Reach 7 are not accurate at a scale that is smaller than an individual impoundment.

- Rising Pond: Under SED 7, the "shallow" portion of the Pond containing sediments greater than 3 mg/kg would be removed to a depth of 1.5 feet, and sediments containing PCBs less than 3 mg/kg would be thin-layer capped. A cap would be applied over the deep portion of Rising Pond. As with SED 6, the "deep" portion of Rising Pond was defined as areas that correspond to the former river channel, and was delineated based on existing bathymetry data. Within the "shallow" region, the delineation between removal and thin-layer capping areas used the same concentration-based approach described above for the Reach 7 impoundments.

<u>SED 8</u> – Removal of all sediments from the main channel and backwaters of the River between the Confluence and Woods Pond Dam, from the Reach 7 impoundments, and from Rising Pond, with the depth of removal set as the depth to which PCBs above 1 mg/kg are estimated to occur (referred to as the 1 mg/kg depth horizon).

Under SED 8, as shown in Table 1-1, a single remedial technology would be used in each individual subreach to be remediated (i.e., removal to a depth corresponding to the 1 mg/kg horizon). The depth of the 1 mg/kg horizon in each reach was estimated based on the available sediment data.[24] For the CMS evaluations, the average depth to the 1 mg/kg PCB horizon within each reach was defined as listed in Table 3-1 below.

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[24] In some reaches or subreaches, the sediment PCB data at depth are limited, and as such there is uncertainty in these estimates. If such an alternative were selected, the actual depth to the 1 mg/kg PCB horizon in each reach and subreach would be based on data collected during design.

Table 3-1 – Depth to 1 mg/kg PCB Horizon Used for Removal Depths in SED 8

Reach	Depth (feet)
Reach 5A	4
Reach 5B	3.5
Reach 5C	3
Reach 5 backwaters [25]	2 to 3
Woods Pond	6
Reach 7 impoundments	2
Rising Pond	7

3.1.2 Removal Technique Selection

Different conditions in particular areas of the River indicate the need to apply different approaches for the removal and capping or backfilling of sediments (where specified in the alternatives). It is necessary to specify which approach will be used in order to simulate the alternatives with the EPA model. For purposes of the CMS, the selection of the technique for sediment removal and capping/backfill in each reach and alternative considered a number of factors (e.g., ease of access, channel geometry, hydraulic characteristics, and geography) as discussed below.

3.1.2.1 Reaches 5A and 5B

For purposes of the CMS, removal and cap/backfill placement in Reaches 5A and 5B were assumed to be performed mechanically in the dry for all alternatives where such removal would be conducted. In these subreaches, a relatively narrow and consistently shaped channel, relatively shallow water depths, availability of potential access, and the ability to construct access roads along the riverbanks allow for the use of sheetpile diversion walls to create isolated work cells which could be dewatered to allow excavation in the dry. Although water velocities are relatively high at times in these reaches, they are not so high as to preclude the use of this technique. Cap/backfill material was assumed to be placed in the dry as well, using similar equipment.

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[25] A removal depth of 3 feet was estimated for larger backwaters (> 2 acres) based on available data from those areas. For smaller backwaters (< 2 acres in size), the data were too limited to support estimation of the 1 mg/kg depth horizon; for these backwaters, a removal depth of 2 feet was specified.

3.1.2.2 Reach 5C

Removal in Reach 5C was assumed to be conducted mechanically in the wet for SED 5 and hydraulically in the wet for SED 6 through SED 8. A relatively wide channel, deeper water depths, and limited access to certain riverbank areas make the use of sheetpile diversion and dry excavation impractical in this subreach. Under SED 5, the remedial scenario in Reach 5C includes volumes and areas that are not sufficiently large to warrant consideration of hydraulic dredging; thus, removal was assumed to be conducted by mechanical equipment. Conversely, under SEDs 6, 7, and 8, the remediation in Reach 5C includes removal throughout the entire reach, resulting in greater removal volumes over a larger contiguous area. This makes hydraulic removal a more viable option for these alternatives. Placement of cap/backfill material was assumed to be conducted mechanically in the wet in Reach 5C for all alternatives where removal activities would be performed.

3.1.2.3 Reach 5 Backwaters

For those alternatives involving removal in the Reach 5 backwaters (i.e., SEDs 6, 7, and 8), it was assumed for purposes of the CMS that removal in those areas would be conducted in the wet. The relatively large open surface areas associated with these backwaters make the use of sheetpiling or other dewatering techniques generally impractical. Further, since these alternatives involve hydraulic dredging in the adjacent Reach 5C (see above), it would be more efficient to use the same technique in the Reach 5 backwaters than to mobilize different equipment for a different technique. Thus, removal in the backwaters was assumed to be performed by hydraulic dredging as well. Similarly, as in Reach 5C, any placement of cap/backfill material in Reach 5 backwaters was assumed to be conducted mechanically in the wet.

3.1.2.4 Reach 6 (Woods Pond)

In Woods Pond, it was assumed for purposes of the CMS that removal would be conducted in the wet. Again, in this impoundment, the large open surface area, coupled with increased water depths in some areas, makes the use of sheetpiling diversion and dewatering techniques generally impractical. Since SED 4 and SED 5 include removal in a portion of Woods Pond, mechanical equipment was assumed to be used for those alternatives. Conversely, since SEDs 6, 7, and 8 have increased volumes over the area of Woods Pond as well as the adjacent Reach 5C, hydraulic dredging was assumed to be more viable for those alternatives. Placement of cap/backfill material was assumed to be conducted mechanically in the wet in Woods Pond for all alternatives where such activities would occur.

3.1.2.5 Reach 7 Impoundments

For the Reach 7 impoundments, it was assumed that removal would be conducted in the wet for the alternatives involving such removal (SED 7 and SED 8). In these impoundments, limited available access to the banks, higher flows, and deeper water depths make the use of sheetpile diversion and dewatering techniques impractical. As sediment removal volumes in these impoundments are relatively small in SED 7, it was assumed that removal activities in the impoundments would be conducted mechanically in the wet for SED 7. Conversely, since SED 8 has a substantially larger removal volume over larger, relatively open areas of the impoundments, removal in SED 8 was assumed to be conducted using hydraulic dredging equipment. For both of these alternatives, placement of cap/backfill material in the impoundments was assumed to be conducted mechanically in the wet.

3.1.2.6 Reach 8 (Rising Pond)

Since the large open surface area and deeper water depths in Rising Pond make the use of sheetpile diversion and other dewatering techniques impractical, it was assumed in the CMS that removal in that impoundment would be conducted in the wet for those alternatives involving such removal (SED 7 and SED 8). Since SED 7 has a smaller removal volume in Rising Pond, removal was assumed to be conducted mechanically in the wet. For SED 8, removal in Rising Pond was assumed to be conducted by hydraulic dredging, since that alternative has sufficient volume over a large, relatively open area to make the use of hydraulic dredging equipment more viable. For both alternatives, placement of cap/backfill material in Rising Pond was assumed to be conducted mechanically in the wet.

3.1.3 Specification of Capping and Thin-Layer Capping Depths

The sediment alternatives described previously specify three types of capping and thin-layer capping scenarios: (1) capping following prior sediment removal; (2) capping alone (i.e., without prior removal); and (3) thin-layer capping. The thickness of material used in the CMS evaluations differs among these three techniques, as described below:

- <u>Capping following prior removal</u>: For the reaches and subreaches that would undergo sediment removal under a given alternative, the thickness of the cap was specified to be the same as the depth of removal (i.e., it was assumed that the bed would be restored to its pre-remediation elevation).

- <u>Capping without prior removal</u>: As described in Section 3.1.1, capping alone is specified for several alternatives in areas with relatively low current velocities where the water depths can accommodate such a cap. For the CMS evaluations, the thickness of caps, when placed without prior sediment removal, was specified to be 18 inches (nominally assumed to consist of 12 inches of isolation material and 6 inches of armor stone).

- Thin-layer capping: For areas receiving a thin-layer cap in the sediment alternatives, the thin-layer cap thickness was assumed to be 6 inches. The actual thickness of the thin-layer cap would be determined during design.

3.1.4 Project Schedule Development

Construction schedules were developed to estimate the duration of the various components of the remedial alternatives for use in the model and other evaluations presented in Section 4. This section describes the approach employed in developing construction schedule estimates. Design, any additional sampling necessary to support design, and other preparatory work would be conducted prior to initiation of remediation.

3.1.4.1 General Construction Schedule Assumptions

Based on EPA's conditional approval letters of April 13 and July 11, 2007, the construction season (i.e., the total available time each year for the implementation of the remedial alternatives) was defined, for purposes of the CMS, as consisting of 9 months/year, 22 days/month, and 8 hours/day, for a total of 198 working days per year.

3.1.4.2 Daily Productivity

In conjunction with the construction season defined above, individual production rate ranges were developed for the reach-specific remedial activities. Specifically, production rate ranges were estimated for mechanical/hydraulic removal performed in the wet, mechanical removal in the dry, thin-layer capping, cap/backfill placement, and bank removal/stabilization operations. The production rate ranges were presented in the CMS Proposal Supplement and modified by EPA's July 11, 2007 conditional approval letter.

For purposes of developing a reasonable estimate of the construction duration for each alternative, a daily average production rate per construction crew was selected from these ranges based on previous project experience and site-specific considerations. Although an individual daily production rate may be higher, the average production rate provides a reasonable estimate over a longer duration considering potential construction delays and downtime. Average removal rates were increased for SED 7 and SED 8 to account for the somewhat faster production anticipated for increased removal volumes from within the same removal area. Table 3-2 below summarizes the technique-specific average production rates assumed in the development of the respective construction duration schedules. EPA agreed in discussions with GE that these average production rates are reasonable assumptions to use in the CMS.

Table 3-2 – Range of Technique-Specific Base Rates

Remedial Techniques	Daily Average Production Rate per Crew (cy/day)	
	SED 3 – SED 6	SED 7 and SED 8
Mechanical/Hydraulic Dredging in the Wet	275	350
Mechanical Dredging in the Dry	110	140
Thin-Layer Capping	110	110
Capping	220	220
Bank Removal/Stabilization	110	110

Note:

1. The average production rates presented above are inclusive of ancillary activities (e.g., mobilization, set-up, site restoration, and demobilization).

3.1.4.3 Reach-Specific Productivity

In addition to the technique-specific average per crew production rates discussed above, estimates of alternative-specific production rates considered, for each reach, the number of construction crews that could reasonably be anticipated to be operating simultaneously in that reach. This reach-specific number of crews was determined by the physical characteristics of each reach, and was held constant across all alternatives despite any changes in remedial technique (removal, capping, etc.). To produce a reach- and alternative-specific production rate, the technique-specific average rates presented above were multiplied by the number of crews assumed to be able to work in each reach to determine the overall rate of productivity. It was further assumed that, in general, each alternative would be implemented sequentially from Reach 5A to Reach 8, as applicable, and that, within a given reach, work would progress from upstream to downstream.

The following assumptions were made to estimate the number of crews that could be expected to work in a given reach:

- Reaches 5A and 5B involve mechanical removal in the dry, as described in Section 3.1.2 above. As only one sheetpile cell would be active at any given time, based on access limitations and size constraints, it was assumed that Reaches 5A and 5B could only accommodate one crew.

- Significant portions of Reach 5C are wide enough to allow two crews to operate. However, in certain portions of Reach 5C, the channel is too narrow to allow simultaneous operations, and thus it was assumed that only one crew could be in operation in these areas. In these circumstances, for the development of the CMS construction durations, an average of 1.5 crews was assumed for Reach 5C.

- Similar to Reach 5C, a few, but not all, of the backwaters in Reach 5 are large enough to allow two crews to operate simultaneously. Further, it is conceivable that, given the geography and the adjacent operations in Reach 5C, two or more of these backwaters could be addressed concurrently. On the other hand, it is anticipated that some of the backwaters would need to be addressed one at a time with only one crew in operation due to the smaller size of the backwater and/or limited access. In these circumstances, an average of 1.5 crews was assumed for the Reach 5 backwaters. Reach 6 is large enough to accommodate two crews operating simultaneously for the duration of construction.

- The Reach 7 impoundments could only accommodate one crew as these river impoundments are too narrow and small to allow the efficient application of simultaneous operations.

- Reach 8 is large enough to accommodate two crews operating simultaneously for the duration of construction.

Table 3-3 presents a summary of the crew sizes and associated production rates by reach for each alternative.

3.1.4.4 Overall Schedule

The overall construction schedule was determined based on the average daily production rates and crew sizes noted above, along with the assumption that work would proceed from upstream to downstream. Ancillary activities (e.g., mobilization, site restoration, demobilization) were assumed to be performed concurrently and did not add to the schedule.

While the estimated construction schedules were primarily based on the average removal rates and the crew sizes discussed above, some additional time was added to the schedule to take account of subsequent backfill/capping activities. In channel areas, it was assumed that backfill/capping operations would start in portions of a given reach or area while excavations were still occurring in more downstream portions of that reach or area. In impounded areas, however, it was assumed that backfill/capping operations could not begin until all excavations in that impoundment were completed, because in those areas it may be more difficult to isolate the backfill/capping activities from the removal activities and thus also more difficult to minimize the deposition of resuspended materials within the clean backfill layers that could occur if such activities were conducted simultaneously. In all cases, additional time to complete backfill/capping operations beyond the time of removal was added to the construction schedule. Table 3-4 lists the assumptions that were made related to the timing/overlap of removal and backfill/capping operations. Note that the reach-specific schedules in Reaches 5A and 5B also assume that bank removal/stabilization operations would commence once backfill/capping is 25% complete and thus include some additional time for the completion of bank removal/stabilization operations (i.e., for the portion that did not overlap with backfill/capping activities).

Table 3-4 – Excavation/Backfill Schedule Overlap Assumptions

Removal Technology	Location	Excavation Percent Complete Prior to Commencing Backfill/Capping
Dry Excavation	Channel	80%
Wet Excavation	Channel	50%
Wet Excavation	Pond/Impoundment	100%

The schedule generally assumes that the alternatives would be implemented sequentially from Reach 5A to Reach 8, as applicable. However, it should be noted that remedial activities in Reach 5C and the Reach 5 backwaters were assumed to be performed concurrently. As Reach 5C remedial activities would generally take longer to complete than those in the Reach 5 backwaters, only the time for Reach 5C remedial activities was factored into the overall project schedule. The only exception is for SED 8, where the activities in the Reach 5 backwaters would take longer to complete than those in Reach 5C. Thus, for that alternative, the additional time to complete the remediation of the Reach 5 backwaters was included in the overall construction schedule.

Based on the assumptions and considerations described above, Table 3-5 summarizes the estimated construction durations for each of the sediment remedial alternatives. EPA has indicated that these durations are reasonable assumptions to use in the CMS evaluations.

3.1.5 Volume and Area Calculations

To support the detailed evaluations of the sediment alternatives, removal volumes and acreages of capping, backfill, and thin-layer capping (as applicable) were calculated using geographic information system (GIS) techniques. Surface areas were computed based on the GIS representation of the shoreline within each reach or portion of a reach, for each of the delineations described in Section 3.1.1 (figures illustrating those areas have been included in the detailed description of each alternative in Section 4). Likewise, removal volumes were calculated as the product of the surface area and the removal depth for a given reach/alternative. To further support the evaluation of alternatives involving sediment removal, volumes were further broken down into estimates of material that would need to be handled as waste subject to Toxic Substances Control Act (TSCA) requirements based on containing PCB concentrations of 50 mg/kg or higher, and non-TSCA material. The fraction of TSCA versus non-TSCA material for a given reach/alternative was estimated using Thiessen polygon coverages of the sediment sampling data from the corresponding removal depth. Where multiple samples were collected at a given location over the specified removal depths, that location’s polygon was identified as containing TSCA material if any of the samples within the removal depth had a PCB concentration at or above 50 mg/kg.

3.2 Use of PCB Fate, Transport, and Bioaccumulation Model

As required by the Permit, GE has applied the EPA model to evaluate the sediment alternatives. Specifically, the PCB fate and transport (EFDC) and bioaccumulation (FCM) submodels developed by EPA were applied to predict future PCB concentrations in sediment, surface water, and fish between the Confluence and Rising Pond Dam under the different remedial alternatives. In addition, GE developed a semi-quantitative method to estimate future changes in PCB concentrations in four impoundments within the Connecticut portion of the River.

In the CMS Proposal, GE included a description of how the EPA model would be applied during the CMS. GE stated that it would provide, in a subsequent deliverable, additional information on several of its proposed inputs to the model to be used during the CMS. This subsequent deliverable, the MIA (ARCADIS BBL and QEA, 2007b), was submitted to EPA on April 16, 2007 and was conditionally approved by EPA on May 24, 2007.[26] In the MIA, GE proposed to collect additional water column data from the East Branch at Pomeroy Avenue and surface sediment data from the Upper ½-Mile Reach to facilitate the development of the East Branch PCB boundary condition that would be used in the CMS model projections. On August 3, 2007, GE submitted the MIA-S (ARCADIS BBL and QEA, 2007c) that presented the results of the supplemental sampling and described the proposed model boundary conditions for the East Branch. The MIA-S was conditionally approved by EPA on August 28, 2007. Following dispute resolution on EPA's conditional approval letters for the MIA and MIA-S, as discussed in Section 1.1, EPA issued a letter on September 17, 2007, eliminating one of the conditions (related to the West Branch PCB boundary condition) for its approval of the MIA.

The sections below provide a summary of the application of the model and the various model inputs used during the CMS, as described in the CMS Proposal, the MIA, and the MIA-S. In its conditional approval letters for the CMS Proposal, the MIA, and the MIA-S, EPA set forth several conditions directing GE to use alternate lower-bound values for certain inputs, resulting in two sets of input values that were used in the CMS model simulations (i.e., a "base case" and a "lower bound"); these lower-bound inputs are also discussed in the sections below.

3.2.1 Scale of Model Application

Temporal Scale

As described in the CMS Proposal, EPA's model calibration and validation efforts were conducted over decadal timescales. Specifically, EPA's model validation simulated the 26-year period between 1979 and 2004. Remedial scenario simulations conducted during the CMS simulated a 52-year period that consists of two cycles of the 26-year validation period. The length of the numerical model simulations has been extended for certain sediment alternatives (SED 7 and SED 8) so as to provide a minimum of 30 years following completion of the simulated remedy; Section 3.2.4 below provides a discussion of the model projection period used for the different sediment alternatives, which was based on the estimated timeframe for each remedy presented in Section 3.1.4.

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[26] In addition, as discussed further in Section 3.2.4, on May 14, 2007, GE submitted certain proposed revisions to the model code to be used in the model simulations in the CMS. EPA conditionally approved those revisions on July 11, 2007, directing GE to modify the code to address certain comments. GE addressed those comments and provided EPA with a revised code on September 21, 2007. In November 2007, EPA called to GE's attention certain flaws in the model and subsequently issued two corrected subroutines for the model on November 30, 2007.

In addition, as directed by EPA, mathematical functions were developed to project the model trajectory beyond the end of the numerical model simulations; the purpose of this extrapolation was to estimate the time it might take to achieve various IMPGs that are not predicted to be achieved within the model simulation period.[27] This extrapolation consisted of using least squares regression to fit an exponential decay function to the model-predicted PCB concentrations in sediment and fish (expressed on an annual average basis) over the last 20 years of the simulations.[28] In cases where the calculated slope was greater than zero (i.e., indicative of an increase), such extrapolation was not performed. Furthermore, analysis of preliminary extrapolation results indicated that there were several cases where the regressions produced very small slopes that were sensitive to annual variations in predicted PCB levels over Years 32 to 52. These preliminary results were also confounded by the fact that the IMPGs that were the subject of the extrapolation were often two to three orders of magnitude lower than the levels predicted by the model at the end of the projection period. It was found that nearly all these cases produced estimated times to achieve IMPGs that exceeded 250 years, which corresponds to extrapolation over a period tenfold longer than the regression period. It was therefore considered that further extrapolations based on such small slopes to estimate 100-fold or greater additional reductions (which could range into timescales of a millennium or more) were so unreliable as to be meaningless. As such, the times to achieve IMPGs in these cases are presented as ">250 years" in Section 4.

This approach of projecting the model trajectory beyond the model simulation period is highly uncertain because simple empirical functions are not a reliable replacement for the model's equations, which represent the complex underlying mechanisms that determine the fate, transport, and bioaccumulation of PCBs. As a result, predictions of the ability of an alternative to meet IMPGs in the period beyond the model simulation period are highly speculative.

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[27] For example, where the model predicts that the RME IMPGs that EPA considers to be protective for unrestricted human consumption of fish would not be achieved the model simulation period, this extrapolation has been used to estimate the number of years that it would take to achieve such levels (using, for this purpose, the RME IMPGs based on a 10^{-5} cancer risk as well as non-cancer impacts). As discussed further below, such estimates are highly speculative, but have been used due to EPA's direction.

[28] The last 20 years was selected as representative of the alternatives' post-remediation trajectory since the model simulations were all run to span a minimum of 30 years following the completion of the remedies, and fish concentrations require an additional 10 years after remediation to respond to changes in exposure concentrations associated with the remediation (i.e., the oldest fish represented in EPA's model is age 10 largemouth bass). For SED 1 and SED 2, where no remedial action was simulated, the regression period was extended to cover 42 years, which provides a longer period over which to estimate the temporal trajectory, yet allows for a 10-year response period for fish.

Model Domain

The spatial domain for the EPA model extends from the Confluence to Rising Pond Dam and is simulated by two separate models. The “PSA Model” extends from the Confluence to Woods Pond Dam and includes the main river channel, backwaters, and associated 10-year floodplain over this reach. The “Downstream Model” extends from Woods Pond Dam to Rising Pond Dam and includes the main river channel and associated 10-year floodplain. These two models are linked at the Woods Pond Dam boundary and together have been used to predict water, sediment, and fish PCB concentrations in Reaches 5 through 8.

Since the model developed by EPA does not extend below Rising Pond Dam, it cannot be used to predict the response of the River downstream of that point. For this reason, GE developed a semi-quantitative framework that incorporates the available data from the Connecticut section of the River, as well as predictions from the EPA model, to provide estimates of future changes in PCB concentrations in the four major impoundments in the Connecticut portion of the River. That framework, labeled the “CT 1-D Analysis,” is summarized in Section 3.2.5 and described in detail in Appendix F.

3.2.2 Model Boundary Conditions

Application of the model to forecast natural recovery and the River’s response to various sediment remediation scenarios for the CMS required specification of future hydrologic conditions, as well as future solids and PCB loadings to the system, for each model boundary (i.e., boundary conditions). The model boundaries include the East Branch, West Branch, tributaries, and direct drainage inputs.

3.2.2.1 Flow

As described in the CMS Proposal, the 26-year hydrograph for the model validation period (i.e., 1979-2004) provides a good statistical representation of the historical flow record on the River. Therefore, specification of future hydrologic conditions for the model was achieved by repeating the 26-year validation period hydrograph twice, producing a 52-year hydrograph, which was used for the CMS simulations. As discussed in Section 3.2.1, some simulations were extended beyond 52 years to provide a minimum projection period that included 30 years beyond the simulated completion of the remedy. In these cases, the 26-year hydrograph was repeated additional times until the necessary post-remediation period was achieved.

To represent the potential impact of an extreme hydrologic event on future sediment, water column, and fish PCB levels, the hydrograph from an extreme event was included in the 52-year hydrograph used for the CMS projections. The methodology used by EPA to develop the hydrograph for this extreme event was described in the MIA (ARCADIS BBL and QEA, 2007b). Specifically, a 20-day period representing the extreme event was developed based on: (1) data from the March 1936 high flow event for the East and West Branches;[29] and (2) watershed model predictions of the August 1990 event associated with Hurricane Bertha for tributaries and direct drainage inputs. The flows from this 20-day synthesized event were inserted into the 52-year projection hydrograph in March/April of Year 26 of the model projection period. The 52-year projection hydrographs used during the model projection simulations, including the extreme event, for the East Branch, West Branch, tributaries, and direct drainage boundary conditions, are presented on Figures 3-1 though 3-4, respectively.

3.2.2.2 Total Suspended Solids

Similar to the approach for specifying future hydrologic conditions, future solids loadings from the East Branch, West Branch, tributaries, and direct drainage were specified by repeating the 26-year validation period solids loadings resulting in a 52-year time series (or a minimum of 30 years following completion of the simulated remedy, whichever is longer). Also, as in the case of the flow boundary conditions, the potential impact of an extreme hydrologic event on future EFDC model projections of sediment and water column PCB levels was simulated by including estimated solids loadings for the extreme event described above in Year 26 of the projection period. Details on the method used to develop the solids loading for each of the model boundary conditions during the extreme event were described in the MIA. The total suspended solids (TSS) time series used during the model projection simulations, including the extreme event, for the East Branch, West Branch, tributaries, and direct drainage boundary conditions, are presented on Figures 3-5 though 3-8, respectively.

3.2.2.3 Bank Erosion

Similar to the approach used to develop future solids loadings, future sediment loads originating from erodible banks located in Reaches 5A and 5B (as specified in the EPA model) were generated by repeating the 26-year validation period bank erosion rate time series, resulting in a 52-year or longer (i.e., 30-year post-remedy) time series. Similar to the solids boundary condition, the potential impact of an extreme hydrologic event on future EFDC model projections of sediment and water column PCB levels was simulated by including estimated bank erosion loadings for the extreme event described above. The total erosion rate during the extreme event was estimated using the flow-based equations provided in Appendix B.7 of the FMDR (EPA, 2006b), and was inserted into Year 26 of the projection

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[29] The March 1936 flow event is the highest multi-day flow event on record at the Coltsville, MA United States Geological Survey (USGS) gauge, with a peak flow of 6,000 cfs. The estimated flood return frequency for this flow is between 50 and 100 years (see Table 2-3 of the CMS Proposal).

period using the same method described for solids in the MIA. The 52-year time series of bank erosion rates (including the extreme event) is presented on Figure 3-9.[30]

3.2.2.4 PCBs

<u>East Branch</u>

The most significant PCB boundary condition needed for application of the EPA model to evaluate the sediment remedial alternatives is the PCB load entering the Rest of River from the East Branch. Although EPA considered and began to develop an "Upstream Model" to project that load, it did not complete that model. Instead, as stated in the MIA-S, EPA specified PCB loads from the East Branch during the model calibration and validation periods using a data-based approach, described in Appendix B.2 of the FMDR (EPA, 2006b). That approach specified East Branch (as well as West Branch) PCB boundary conditions during periods when data were not available based on equations developed from relationships between particulate-phase PCB concentrations and river flow rate. While this approach was appropriate for specifying PCB loads for the model calibration and validation periods (1979 - 2004), it could not be used directly in the CMS for the simulation of potential remedial scenarios in the River, because it does not account for reductions in PCB loading that have resulted and would result from the various remedial measures conducted and to be conducted by GE and EPA within and near the upper two miles of the River.

Given these circumstances, it was necessary for GE to develop an approach for specifying an East Branch PCB boundary condition that could be used in the model projections. Consistent with the approach used by EPA during the model validation, the water column PCBs entering the Rest of River from the East Branch were estimated based on relationships between particulate-phase PCB concentrations and river flow rate. For the CMS simulations, particulate-phase PCB concentrations were estimated for both "current" and projected "future" conditions. The particulate-phase PCB concentrations under "current" conditions were based on supplemental water column and surface sediment data collected from the East Branch between April and July 2007 (i.e., after completion of remediation of the Upper ½-Mile and 1½-Mile Reach sediments). To account for the anticipated reduction in PCB load at the East

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[30] During long-term test simulations conducted with EFDC, EPA noted that changes in bed elevation due to bank erosion and mass failure had resulted in conditions in some model grid cells such that no further erosion would be expected to occur in these locations (see Attachment 2 [Code Bugs and Comments] to EPA's July 11, 2007 conditional approval letter for the CMS Proposal Supplement and model code revisions). To address this issue, EPA provided GE with a revised model input file that remapped these depleted bank erosion cells to cells immediately upstream or downstream of the cells being depleted, and proposed that this remapping be performed at the end of the first 26-year cycle. As directed, the re-mapped bank erosion cells were used in the second 26-year cycle of the model projection period during the CMS.

Branch boundary due to the additional remedial projects planned in areas affecting the East Branch, it was necessary to make some estimate of that future reduction. Any such estimate is necessarily uncertain, because: (1) the relative contribution of PCBs to the East Branch from each of the various remaining upland sources (including sources in the GE Plant area) is unknown; (2) since the remediation of a number of those sources has either not been started or not been completed, there is no reliable way to predict with confidence the extent of the reduction in their contribution of PCBs to the East Branch; and (3) any predictions of future conditions cannot be verified by water column data from the East Branch. Thus, the future conditions in the East Branch cannot be known with certainty until the remaining remediation work has been completed, the system has reached equilibrium with the PCB inputs, and additional post-remediation water column PCB data from the East Branch has been obtained. Nevertheless, given the need to specify a future condition in order to conduct the model simulations in the CMS, such conditions were estimated based on a qualitative assessment of the reduction in PCB loads anticipated through completion of the remaining remediation actions, as discussed in the MIA-S.

The following is a summary of the East Branch PCB boundary condition that was developed, approved (with modifications) by EPA, and used for the CMS model projections.

- In general, the East Branch PCB boundary condition starts at a PCB level representative of “current” conditions, decreases linearly over the first 10 years of the model projection period to a PCB level representative of “future” conditions, and then decreases exponentially at a 52-year half life thereafter.[31]

- PCB concentrations in the East Branch boundary condition are specified on a particulate-phase basis (dissolved-phase PCBs are calculated based on equilibrium partitioning formulae, consistent with EPA’s methodology described in the FMDR; EPA, 2006b) and vary with flow rate:

    - The “current” particulate-phase PCB levels were calculated as a function of the river flow rate at Pomeroy Avenue (based on the 2007 monitoring data).

        - At lower flows (defined as < 550 cubic feet per second [cfs]), the particulate-phase PCB levels exhibit an inverse relationship with flow; particulate-phase PCB

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[31] In its conditional approval letter for the MIA-S, EPA directed GE to apply this 52-year half-life to the East Branch PCB boundary condition. As described in the MIA-S, GE believes that application of a half life to the East Branch boundary condition is inappropriate since the upland PCB sources that will continue to contribute PCBs to the East Branch are not subject to the same natural recovery processes that occur within a riverine environment, and will likely remain in their post-remediation condition. Nonetheless, GE has applied the 52-year half-life, as directed by EPA.

    levels are higher at lower flows due to less dilution (e.g., PCB concentrations on particles are up to 5 mg/kg at a flow of approximately 20 cfs).

    - At higher flows (defined as ≥ 550 cfs), particulate-phase PCB concentrations are constant at 0.52 mg/kg.

- The “future” particulate-phase PCB levels were calculated as a percent reduction from the "current" levels.

    - At flows < 550 cfs, a 90% reduction was applied to the “current” PCB levels based on a qualitative evaluation of the potential reduction in PCB loads to the system under low flow conditions due to future remediation.

    - At flows ≥ 550 cfs, a 50% reduction was applied to the “current” PCB level (in the “base case” simulations) based on a qualitative evaluation of the potential reduction in PCB loads associated with remediation and control of the remaining sources in the various upland areas that likely contribute PCBs to the East Branch during periods of higher flow. In addition, at EPA’s direction, GE conducted “lower-bound” simulations using an assumed 75% reduction from the “current” PCB levels under higher flow conditions.

Multiplication of the particulate-phase PCB concentrations calculated from the methods described above (using the 52-year flow time series described in Section 3.2.2.1) by the 52-year total suspend solids time series described in Section 3.2.2.2 (which includes the extreme event) produced a volumetric water column particulate-phase PCB concentration (in micrograms per liter [µg/L]). The corresponding dissolved-phase component was then calculated based on the particulate-phase PCB concentration and the three-phase partitioning equations used by EPA for the validation period boundary conditions (as described in FMDR Appendix B.2; EPA, 2006b). The dissolved and particulate fractions were summed to compute the whole-water PCB concentrations that were input to the model. Figure 3-10 shows the 52-year East Branch PCB boundary condition time series used during the model projection simulations.

<u>West Branch</u>

In EPA’s model, the West Branch PCB boundary condition was specified based on loading equations developed from river flows and PCB concentrations as described in Appendix B.2 of the FMDR (EPA, 2006b). As stated in the MIA, this boundary condition provided a representation of PCB concentrations for current conditions in the West Branch, but is not representative of the conditions that will exist following GE’s planned remediation of sediments and lower riverbank soils adjacent to Dorothy Amos Park on the West Branch (see

Section 2.3.7 of the CMS Proposal). Because the sediments and lower riverbanks adjacent to Dorothy Amos Park represent the major identified source of PCBs to the West Branch, the West Branch PCB boundary condition for the CMS projections was developed by reducing the existing model boundary condition by a factor intended to represent the decrease in sediment PCB concentrations anticipated to result from the planned remediation adjacent to Dorothy Amos Park. That reduction factor was 0.3 and was applied at the beginning of the model projection period. The methodology used to develop this reduction factor is discussed in the MIA. Similar to the flow and solids boundary conditions, a 52-year model projection time series was developed by repeating the scaled-down 26-year time series.

Also, for specifying the 52-year time series of PCB boundary conditions in the West Branch, it was further assumed that the sediments would naturally attenuate (to some degree) following remediation of the major PCB source. Since there are no data from the West Branch to estimate such an attenuation rate, PCB levels in the West Branch boundary condition were reduced exponentially at a 20-year half-life based on a temporal trend analysis conducted by EPA (see MIA for additional discussion). The 52-year West Branch PCB boundary condition time series used during the model projection simulations is presented on Figure 3-11.

Tributaries

As described in the MIA, the PCB boundary conditions for tributaries in the model projections were developed to reflect inputs of PCBs from atmospheric sources. This was accomplished in the CMS by setting tributary PCB concentrations to a starting value of 0.11 nanograms per liter (ng/L).[32] This value was subsequently reduced exponentially at a 10-year half-life to reflect long-term reductions in atmospheric PCB loadings during the projection period. Figure 3-12 presents the 52-year PCB boundary condition time series that was used for the modeled tributaries during the CMS model simulations.

Direct Drainage

In the MIA, GE stated that direct runoff entering the River from the watershed, which includes floodplain soils containing PCBs, could contribute some amount of PCBs to the River. Following additional discussions with EPA, GE determined that PCB inputs from direct drainage are likely small and would be difficult to estimate given anticipated changes in floodplain soil PCB levels due to the floodplain remedial alternatives described in Section 6.

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[32] GE was directed by EPA to use this starting concentration of 0.11 ng/L for the tributary PCB boundary conditions in the CMS model projections; the methodology used to determine this value is described in EPA's May 24, 2007 conditional approval letter for the MIA.

For these reasons, the CMS model projections assumed that zero PCB load enters the River via direct drainage.

3.2.3 Sediment Initial Conditions

The sediment initial conditions (i.e., horizontal and vertical distribution of PCB concentrations) required for simulation of future conditions were set equal to the results predicted by the model at the end of the validation period (i.e., 2004).

3.2.4 Simulation of Remedial Actions

As described in the CMS Proposal, the remedial technologies that comprise the alternatives discussed in Section 4 of this Report consist of two groups: (1) “passive” alternatives, which include no action and MNR (SED 1 and SED 2, respectively); and (2) alternatives that contain some form of in-river remediation work consisting of removal, capping, and/or thin-layer capping (SED 3 through SED 8). Model simulation of SED 1 and SED 2 required no change to the model framework since the processes that govern these remedial alternatives are implicitly accounted for in EPA’s model (e.g., sediment deposition). However, simulation of the remaining remedial alternatives required specification of the following:

- Timing and production rates for the remedial alternatives (Section 3.2.4.1);
- Post-remediation PCB concentrations in backfill and capping materials (Section 3.2.4.2);
- PCB releases during sediment removal (Section 3.2.4.3);
- Representation of bank soil removal and stabilization (Section 3.2.4.4); and
- Sediment properties (e.g., grain size distribution, bulk density, porosity, and organic carbon content) of capping and backfill materials (Section 3.2.4.5).

In an attempt to improve the efficiency of model simulations of sediment remedial alternatives during the CMS, GE developed computer code and model pre-processors (hereafter referred to as the “remediation code”) to represent the various in-river remediation technologies in the EFDC simulations. These code changes consisted of the following:

- Modifying the simulated sediment PCB concentrations to reflect removal and subsequent placement of a cap or backfill material;
- Including the PCB loads that result from resuspension/releases during dredging in the water column mass balance;

- Setting specified bank erosion rates to zero to represent bank stabilization; and
- Changing the model bed structure by adding the appropriate mass of solids to represent placement of a cap (without prior sediment removal) or a thin-layer cap.

The remediation code performs these functions according to an approximate remediation schedule developed for each alternative, which was described in Section 3.1.4.4 and is discussed further in Section 3.2.4.1. A technical memorandum summarizing the remediation code (and a copy of the code itself) was transmitted to EPA on May 14, 2007; the remediation code was conditionally approved by EPA on July 11, 2007.[33]

3.2.4.1 Timing and Production Rates

As described in Section 3.2.1, sediment remedial scenario simulations in the CMS were conducted over a 52-year period that consists of two cycles of EPA's 26-year validation hydrograph (or a minimum of 30 years following completion of the simulated remedy, whichever is longer). For all of the active remediation alternatives simulated, the start of remediation was specified to begin in the first year of the projection period.

The timing and production rates used to simulate the remedial action alternatives that involve removal and/or capping were consistent with those described in Section 3.1.4. Specifically, model-simulated remediation was completed according to the construction durations described in Section 3.1.4 and considered the times required for implementation of each remedial technology within each subreach (Table 3-5). Tables 3-6 through 3-11 summarize the model-simulated remediation schedules by subreach and remedial technology type for SED 3 through SED 8, respectively.

Additionally, the simulation of remedial scenarios assumed that remediation would progress from upstream to downstream, at a rate consistent with the construction schedules described above, except in backwaters, where remediation was specified to progress from north to south once channel remediation reached the entrance to the backwater. It was also assumed that remediation would occur between March 1st and November 31st of each year, consistent with the construction schedules described in Section 3.1.4.

Simulated areas of removal/capping in the model were consistent with those described in Table 1-1 and Section 3.1.1, and shown on figures in the detailed evaluations of the alternatives presented in Section 4.

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[33] In an attachment to that conditional approval letter, EPA included a document summarizing a number of comments it had on the remediation code that were subsequently addressed by GE.

3.2.4.2 Post-Remediation Backfill and Capping Material PCB Concentrations

SED 3 through SED 8 all include sediment removal, capping, and/or thin-layer capping. Sediment removal with capping, capping without prior removal, and thin-layer capping were simulated in the model by changing the sediment bed PCB concentrations in the appropriate model grid cells from the current predicted value to an estimated post-remediation concentration. The post-remediation concentrations used for these simulations are described below.

Cap/Backfill PCB Concentrations for Mechanical Dredging in the Dry and Thin-Layer Capping

As described in the CMS Proposal, “base case” model simulations of mechanical dredging in the dry (with subsequent addition of cap or backfill material) and thin-layer capping applied a concentration of 0.021 mg/kg for the cap/backfill materials. This value is the PCB concentration used for backfill in remedial action evaluations in areas outside the River under the CD, and represents one-half of the average PCB detection limit from sampling of backfill sources. In addition, the alternative “lower-bound” model simulations were performed using a PCB concentration of 0 mg/kg in cap/backfill materials, as directed by EPA in its conditional approval of the CMS Proposal.

Cap/Backfill PCB Concentrations for Dredging in the Wet and Capping Without Removal

Simulation of hydraulic or mechanical dredging in the wet (with subsequent addition of cap or backfill material) and capping alone (without prior removal) required the specification of a starting PCB concentration for the post-placement cap/backfill material. This initial concentration is higher than that of the cap/backfill material described above to reflect the mixing between the native sediment and the cap/backfill material that is likely to occur during placement. For the CMS model simulations, the EPA-approved initial post-remediation sediment PCB concentrations are as follows:

- For hydraulic or mechanical dredging in the wet with subsequent addition of cap/backfill material, the initial post-remediation PCB concentration of the cap/backfill material was calculated as the vertical average concentration of sediments removed (within an individual grid cell) times 0.01. This represents a “reduction efficiency” of 99% from the pre-remediation sediment concentration due to the cap/backfill placement and reflects the likelihood of some mixing between the disturbed native sediment and the cap/backfill material. This value was determined based on a review of literature and information from other sites. Details are provided in the MIA.

- For capping alone (i.e., without prior removal), the starting PCB mass in the cap material was calculated assuming that 1% of the PCB mass within the upper 6 inches of sediment would be uniformly mixed into the cap material upon placement (i.e., 99% reduction efficiency).

In addition, the alternative “lower-bound” model simulations were conducted assuming that no mixing occurs between disturbed native sediments and the cap/backfill material (i.e., 100% reduction efficiency from the cap/backfill placement), as directed by EPA in its conditional approval of the MIA.

3.2.4.3 PCB Release during Dredging

As described in the CMS Proposal, model simulations of remedial scenarios that include hydraulic dredging or mechanical dredging in the wet assumed a release to the water column of 1% of the mass of dredged sediment solids and PCBs for hydraulic dredging and 2% for mechanical dredging. Releases of solids and PCBs during dredging were specified in the model as a mass flux that enters the water column from an individual grid cell undergoing dredging. Simulations involving mechanical dredging in the dry, capping without removal, and thin-layer capping conservatively assumed that no mass of PCBs or solids would be released to the water column during such activities.

3.2.4.4 Bank Soil Removal and Stabilization Assumptions

In addition to removal and/or capping, SED 3 through SED 8 include removal and stabilization of erodible banks containing PCBs within the upper portion of the PSA. The only such areas that have been identified and represented in EPA’s model are located within Reaches 5A and 5B. For the simulation of these alternatives, bank removal/stabilization was represented in the model by setting the bank erosion rates to zero in the appropriate model grid cells.

3.2.4.5 Bed Properties for Simulation of Backfill and Cap Placement

Each of the alternatives that includes sediment removal (SED 3 through SED 8) provides for replacement to grade with backfill or a cap. In the model simulations, the physical properties of the backfill material (e.g., grain size distribution, bulk density, porosity, and TOC) were assumed to be same as the properties of the native sediments removed. For thin-layer capping, the bed properties of the cap material in the model were assumed to be the same as those of the surficial sediment layer.

For the simulation of capping, based on the assumption that the cap would include an appropriately sized armor stone layer designed to resist erosion, the properties of the cap material were specified in the model to reflect that erosion of the cap material would not occur. This was achieved in the model by specifying for the cap material an additional non-cohesive sediment class (specified as NC4, as documented in the Remediation Code technical memorandum [QEA, 2007]) having the same physical properties as the coarsest native non-cohesive sediment class (NC3) but a higher critical shear stress to avoid erosion of the cap material.

In the model, placement of a thin-layer cap or cap (without prior removal) was represented as an addition of those materials to the existing sediment surface. This was achieved in the model by numerically altering the simulated sediment bed structure within the appropriate model grid cells to represent an “instantaneous deposition” of additional solids (representing placement of the cap/backfill material). The mass of cap material added to the bed was based on the simulated thickness of the cap or the thin-layer cap. As discussed in Section 3.1.3, the simulated thin-layer cap and cap (without prior removal) thicknesses were 6 and 18 inches, respectively. In the model simulation, the thin-layer cap material (6 inches) was subject to mixing, erosion, and deposition, while the thicker cap (18 inches) was assumed to include armoring as discussed above and thus would not be subject to erosion.

3.2.5 CT 1-D Analysis

The model developed by EPA does not extend below Rising Pond Dam and therefore it cannot be used to predict the response of the River in Connecticut to various potential remedial scenarios. For this reason, GE developed a semi-quantitative one-dimensional (1-D) framework that incorporates the available data from the Connecticut section of the River, as well as predictions from the EPA Downstream Model, to provide estimates of future changes in PCB concentrations within the major Connecticut impoundments of the River in response to remedial actions performed upstream.

This framework, referred hereafter as the “CT 1-D Analysis,” was generally described in the CMS Proposal and conditionally approved by EPA in its April 13, 2007 letter. In brief, the CT 1-D Analysis estimates surface sediment and fish PCB concentrations within the Connecticut impoundments based on the following four steps:

(1) Estimates of water column dissolved and particulate-phase PCB concentrations within the Bulls Bridge Dam impoundment were developed based on predictions from the EPA “Downstream Model” of PCB concentrations passing over Rising Pond Dam, modified by an attenuation factor developed from spatial differences in river flow and suspended solids loading.

(2) A one-dimensional mass balance model of the sediment column was developed to relate the calculated water column particulate-phase PCB concentrations (described in Step 1 above) to estimated surface sediment PCB concentrations within the bioavailable zone of the Bulls Bridge Dam impoundment.

(3) Attenuation factors developed from measured and estimated increases in river flow were applied to estimate water column and surface sediment PCB concentrations at the further downstream impoundments (Lake Lillinonah, Lake Zoar, Lake Housatonic) from PCB concentrations calculated for Bulls Bridge Dam as described in Steps 1 and 2 above.

(4) The EPA FCM from Reach 8 (as directed by EPA in its conditional approval of the CMS Proposal) was utilized to simulate fish PCB concentrations in the four Connecticut impoundments using water column and surface sediment exposure concentrations calculated as described in Steps 1 through 3 above.

A detailed description of the CT 1-D Analysis is presented in Appendix F. As discussed in that appendix, while the CT 1-D Analysis provides a means of generally estimating the impact of the different sediment alternatives on the four major Connecticut impoundments, the results are very uncertain due to the empirical, semi-quantitative nature of the analysis, as well as the significant data limitations. As such, the estimates cannot be regarded as reliable predictions of specific PCB concentrations, and thus cannot be used as a reliable way of making fine distinctions among the alternatives, particularly when the concentrations are low and generally similar.

3.3 Spatial Scale and Other Averaging Assumptions for Model Simulations

A number of quantitative forecast metrics generated from the model outputs were used to differentiate the impacts of remedial alternatives on PCBs in the water column, sediment, and fish. The primary metrics include water column concentrations at several key locations (i.e., the same locations used for model calibration and validation by EPA), surface sediment concentrations averaged over various spatial scales (see Section 3.3.1), and fish tissue concentrations averaged by subreach.[34] For the fish tissue evaluations, as discussed in Section 3.3.2, model-computed whole-body PCB concentrations were converted to fillet-based concentrations for use in the evaluation of human receptors, while whole-body concentrations for various species and size classes were used in the evaluation of ecological receptors.

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[34] GE identified an inconsistency in reach definitions between what EPA defined in the model as Reaches 5D and 6 and how GE operationally defined these reaches for the purposes of the CMS remedial alternatives. The boundary between Reaches 5C and 6 that GE defined in the CMS Proposal is further south than the definition of that boundary in the EPA model; the boundary was moved further south for the purposes of the CMS because the point where the River changes from the narrow entry channels to where it opens up to the much wider pond itself serves as an obvious break-point where different remedial technologies may be used and/or different constructability issues may be encountered. Also, the EPA EFDC model included one large backwater in the average for Reach 6, rather than in Reach 5D (the backwater reach). With EPA concurrence, the definition of these reaches in EFDC has been modified to be consistent with the definition of these reaches used for the CMS.

In addition, several other model output metrics were used to support the evaluation of alternatives discussed in Section 4, including:

- The water column PCB load transported to downstream reaches, which was quantified as the annual PCB loads exiting the PSA (i.e., load passing Woods Pond Dam) and exiting the Downstream Model domain (i.e., load passing Rising Pond Dam that enters Reach 9) at the end of the simulation;

- Estimates of the mass of PCBs removed/remaining after completion of removal actions;

- Calculations of the extent of erosion, if any, occurring in areas that were simulated to receive caps or thin-layer caps;

- The annual PCB flux from the River to the floodplain in the PSA at the end of the simulation (computed to evaluate the change in mass of PCBs transported from the River to the floodplain due to the various sediment alternatives); and

- The PCB mass transported during the simulated extreme event (described in Section 3.2.2.1).

The following sections describe specific averaging assumptions and spatial scales over which model outputs were evaluated in the CMS. Most of these were dictated by the averaging areas and assumptions associated with the applicable IMPG comparisons.

3.3.1 Evaluation of Sediment PCB Levels

To support a general evaluation of the sediment alternatives, the model-predicted spatial and temporal distributions of PCBs within river sediments were quantified as subreach-averaged surface sediment PCB concentrations. For the evaluation of post-remediation sediment levels in Connecticut, temporal distributions of surface sediment PCB concentrations were generated for each of the impoundments modeled as part of the CT 1-D Analysis (i.e., Bulls Bridge, Lake Lillinonah, Lake Zoar, and Lake Housatonic; averaged by impoundment). For the purposes of these evaluations, as well as for making comparisons to IMPGs, the surface sediment layer was defined as the top 6-inch average in the model outputs, consistent with the depth interval used by EPA to calculate risks to human and ecological receptors from exposure to sediments in the HHRA and ERA, respectively.

For comparison to the various sediment IMPGs, model outputs were averaged using the same averaging areas that were used to develop the IMPG values, as described below:

Human Direct Contact with Sediments

Model-predicted surface sediment concentrations were averaged over each of the eight sediment exposure areas identified in the HHRA:

- SA 1: Confluence to New Lenox Road.
- SA 2: New Lenox Road to Woods Pond Headwaters.
- SA 3: Woods Pond.
- SA 4: Columbia Mill Dam impoundment.
- SA 5: Eagle Mill Dam impoundment.
- SA 6: Willow Mill Dam impoundment.
- SA 7: Glendale Dam impoundment.
- SA 8: Rising Pond.

As defined in the HHRA, the sediment exposure areas associated with the various impoundments (i.e., SA 3 through SA 8) generally only extend approximately 6 meters from shore. Due to the coarser spatial resolution of the EFDC model grid in shoreline areas (i.e., model grid cells generally extend anywhere from 20 to 60 meters from shore), model grid cells adjacent to the shoreline for these impoundment areas were selected as representative of the 6-meter exposure area. Figures 3-13a and 3-13b illustrate the model grid cells selected to represent the sediment human direct contact exposure areas in Reaches 5/6 and 7/8, respectively.

Benthic Invertebrates

For comparison to the benthic invertebrate IMPGs, model-predicted surface sediment concentrations were averaged over individual spatial bins in Reaches 5 and 6, as directed by EPA (see conditional approval letter for the CMS Proposal). For Reaches 7 and 8, surface sediment concentrations were averaged over each of the EPA-defined channel/impoundment subreaches, as EPA did not develop spatial bins for those reaches; these subreaches were thus used as averaging areas for evaluating benthic invertebrate exposure in this portion of the River. Figures 3-14a and 3-14b present the averaging areas used for benthic invertebrate sediment IMPG comparisons in Reaches 5/6 and 7/8, respectively.

Amphibians (represented by Wood Frog)

The primary averaging areas for assessing amphibian IMPGs are the vernal pools, which were evaluated as part of the floodplain in the CMS (see Section 5.2.3.1). However, as directed by EPA (see conditional approval letter for the CMS Proposal), individual backwater areas were also included as sediment averaging areas used for comparison to the amphibian IMPGs. The areas treated as backwaters in the CMS evaluations (as shown on Figure 1-1) were delineated based on EPA mapping of habitat types in the ERA (including vernal pools), EPA mapping of "boatable" areas in the HHRA, and review of aerial photography. Figure 3-15 shows the model grid cells that were averaged to represent these backwater areas for use in amphibian IMPG comparisons for the sediment alternatives.

Insectivorous Birds (represented by Wood Duck)

As described in Section 5.2.3.3, GE has used a conservative 1-km foraging range for wood ducks to establish averaging area boundaries within the floodplain of the PSA. For comparison to pre-set target sediment levels (as defined in Section 2.2.2.3) for the protection of insectivorous birds, the same 1-km averaging areas used in the comparison to floodplain IMPGs were utilized. Figure 3-16 shows the EFDC grid cells that were used to define the 1-km sediment averaging areas for these comparisons.

Piscivorous Mammals (represented by Mink)

As described in Section 5.2.3.4, GE has used two averaging areas (as specified by EPA) to represent mink foraging areas within the floodplain – one consisting of Reaches 5A and 5B and one consisting of Reaches 5C, 5D, and 6. For comparison to pre-set target sediment levels (as defined in Section 2.2.2.3) for the protection of piscivorous mammals, the same averaging areas used in the comparison to floodplain IMPGs were used. Figure 3-17 shows the EFDC grid cells that were used to define the sediment averaging areas for these comparisons.

3.3.2 Evaluation of Fish PCB Levels

As described above, comparisons of model-predicted fish concentrations to the relevant IMPGs were conducted on the scale of an individual subreach (the same scale used in the development, calibration, and validation of the EPA FCM, and the scale at which the FCM provides outputs). In addition, other averaging criteria were applied (e.g., averaging across fish species and size classes) so that the comparisons of IMPGs to the model outputs agreed with the assumptions used in EPA's HHRA and ERA. Below is a summary of the various averaging assumptions applied to the FCM output for comparison with the human health and ecological IMPGs that apply to fish.

Human Consumption

For the human health IMPG comparisons in the Massachusetts portion of the River, largemouth bass (the top predator "game fish" in the EPA model) age classes 6-10 were used as representative species and age classes for human consumption of fish. Age classes 6-10 represent the sub-population of fish that meets or exceeds the legal size limit for largemouth bass of 12 inches. Similarly, the results for top predator fish from the application of FCM in the CT 1-D Analysis, which were calibrated to smallmouth bass data, were used for comparisons to the human fish consumption IMPGs for the four impoundments in the Connecticut portion of the River.

Also, the EPA FCM is designed to predict PCB levels in whole-body fish. Therefore, to evaluate model scenario outcomes for game fish fillet PCB concentrations on a wet weight basis (the endpoint for human consumption), modeled whole-body results were converted to their fillet equivalent by dividing the model-predicted PCB concentrations by a factor of 5, as directed by EPA in its April 13 conditional approval letter for the CMS Proposal and its follow-up letter of May 22, 2007 regarding the dispute resolution on that letter.[35]

Ecological Receptors

For the comparisons to the ecological IMPGs based on fish PCB concentrations, three endpoints were evaluated: fish protection, consumption of fish by threatened and endangered species (represented by bald eagle), and consumption of fish by piscivorous birds (represented by osprey). Specific assumptions for each of these receptors are described below.

Fish Protection: For the fish protection IMPG comparisons, average largemouth bass (age classes 1 through 10) were used as representative species and age classes for warmwater fish species.[36] Largemouth bass, a top predator, is conservatively representative of warmwater species since it generally has the highest PCB concentrations among the trophic levels simulated by the model. For coldwater fish (trout below the PSA), largemouth bass (age classes 1 through 10) were used as a surrogate, as trout are not a modeled species.

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[35] In the CMS Proposal, GE proposed to use a factor of 1.7 to convert whole-body fish PCB concentrations to fillet concentrations, and GE subsequently invoked dispute resolution on EPA's directive to use a factor of 5. For the reasons given in GE's April 27, 2007 Statement of Position in that dispute resolution proceeding, GE believes that EPA's directive to use a conversion factor of 5 is unjustified, but it has used that value as required by EPA.

[36] Largemouth bass generally reach sexual maturity within 5 months.

Threatened and Endangered Species (represented by Bald Eagle): For the IMPG comparisons for threatened and endangered species, model-predicted PCB concentrations from fish greater than 120 millimeters (mm) in total length, which corresponds to the size range used by EPA for assessing risks to bald eagle in the ERA, were averaged for each subreach. The resulting ranges of modeled age classes corresponding to this length are shown for each species simulated by FCM (i.e., largemouth bass, sunfish, cyprinids, brown bullhead, and white sucker) in Table 3-12. To determine the overall PCB concentration in fish prey consumed by bald eagles, the modeled PCB concentrations in each of these species for the relevant age class were determined (for each subreach), and then averaged using weighting factors based on prey preferences for bald eagle, as presented in the ERA.[37] The weighting factors used are shown in Table 3-13 for each subreach.

Piscivorous Birds (represented by Osprey): For the IMPG comparisons for piscivorous birds, model-predicted PCB concentrations from fish corresponding to 130 to 400 mm total length, which corresponds to the size range used by EPA for assessing risks to osprey in the ERA, were averaged for each subreach. The resulting ranges of modeled age classes corresponding to this length range are shown for each species simulated by FCM in Table 3-14. Similar to the procedure used for threatened and endangered species, the overall PCB concentration in fish prey consumed by osprey was calculated by averaging the predicted PCB concentrations in the five modeled species for the relevant age classes. In this case, since the ERA averaged PCB concentrations across all species in assessing risk to osprey, the predicted PCB concentrations for the five modeled fish species were weighted equally, except in reaches where there were no data for a particular species (e.g., no brown bullhead data in Reach 5A; no white sucker data in Woods Pond). The weighting factors used in these calculations are provided in Table 3-15.

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[37] This procedure involved averaging across model predictions for largemouth bass, sunfish/cyprinids (50:50 split between these two species), and brown bullhead/white sucker (50:50 split between these two species, except where there were no data for one of those species – e.g., no brown bullhead data in Reach 5A, no white sucker data in Woods Pond). Weighted averages were calculated using weighting factors derived from Table K.2-1 of the ERA, which lists the following prey preferences for bald eagle: 50.6% bottom feeders, 16.2% predatory fish, 11.8% forage fish, and an assumed value of 21.4% birds/mammals. However, the IMPG for bald eagle is based on whole-body fish tissue PCBs (i.e., no consumption of birds/mammals); therefore, the fish portion of the bald eagle diet was scaled to sum to 100%. As a result, the following weighting factors were used to average the model-predicted concentrations: 64.4% bottom feeders, 15.0% forage fish, and 20.6% predatory fish. In addition, weighting factors varied by subreach based on the available prey (e.g., because there were no brown bullhead data in Reach 5A, bottom feeders were represented entirely by white sucker in that reach, whereas other reaches having data for both species used an average of the two to represent bottom feeders), as shown in Table 3-13.

3.4 Model Application and Output Graphics

The model was applied to each of the eight sediment alternatives to predict the surface sediment, water column, and whole-body fish PCB concentrations that would result from implementation of that alternative, using the averaging areas and other averaging assumptions described in Section 3.3. As noted above, fish fillet PCB concentrations were estimated by dividing the model-predicted whole-body results by a factor of 5, as directed by EPA. The model results are presented and discussed in the evaluations of the individual sediment alternatives in Section 4. The main evaluations presented in that section are based on model predictions using the “base case” input assumptions. However, the model predictions using the alternative, “lower bound” input assumptions that EPA directed GE to use are also discussed in terms of the extent to which they would impact the comparisons of the model results to the relevant IMPGs.

In addition, as also noted above, in cases where the IMPGs are not predicted to be achieved by the end of the model projection period, the time to achieve the IMPGs has been estimated by extrapolating the model results beyond that period, using the extrapolation method described in Section 3.2.1. Although these extrapolations are highly uncertain, they have been included in the evaluations in Section 4 at the direction of EPA.

To support the model-based evaluations presented in Section 4, a complete set of graphics generated from the model results is contained in Appendix G. These graphics are provided for the model simulations for each of the eight alternatives, for both the base case and the EPA-directed “lower-bound” simulations. In addition, several of the model output time-series were plotted over both the standard 52-year projection period (or 30 years post remediation), as well as over an extended time scale to display the results from the EPA-directed extrapolation that was used to estimate the time to achieve IMPGs in cases where they were not predicted to be achieved during the model simulation period. Below is a brief summary of the graphics included in Appendix G.

- Appendix G-1: Temporal profiles of model-predicted PCB concentrations in surface water (annual average concentrations at Holmes Road, New Lenox Road, Woods Pond Headwaters, and Woods Pond Outlet), subreach-average surface sediments, whole body fish, and fish fillets (using the largemouth bass age classes specified for the human health IMPG comparisons described in Section 3.3.2 above).

- Appendix G-2: Spatial profiles of surface sediment PCB concentrations at the start and end of the model projection period.

- Appendix G-3: Temporal profiles of model-predicted surface sediment concentrations averaged over each of the eight sediment exposure areas used in the assessment of human direct contact with sediment (SA 1 through SA 8, as identified in the HHRA). These charts indicate the various IMPGs for human direct contact with sediments and illustrate the estimated time to achieve those IMPGs.

- Appendix G-4: Temporal profiles of model-predicted surface sediment concentrations averaged over the spatial bins used in the assessment of the benthic invertebrate IMPGs. These charts indicate the upper- and lower-bound IMPGs for benthic invertebrates, and illustrate the estimated time to achieve those IMPGs.

- Appendix G-5: Temporal profiles of model-predicted surface sediment concentrations averaged over the individual backwaters used in the assessment of the amphibian IMPGs. These charts indicate the upper- and lower-bound IMPGs for amphibians, and illustrate the estimated time to achieve those IMPGs.

- Appendix G-6: Temporal profiles of model-predicted surface sediment concentrations averaged over the 1-km averaging areas used in the assessment of insectivorous birds (wood ducks). These charts indicate the 1, 3, and 5 mg/kg sediment target levels, and illustrate the estimated time to achieve those levels.

- Appendix G-7: Temporal profiles of model-predicted surface sediment concentrations averaged over the two averaging areas used in the assessment of piscivorous mammals (mink) (Reaches 5A/5B and Reaches 5C/5D/6). These charts indicate the 1, 3, and 5 mg/kg sediment target levels, and illustrate the estimated time to achieve those levels.

- Appendix G-8: Temporal profiles of model-predicted fish concentrations averaged by subreach and converted to a fillet basis using the assumptions for human consumption described in Section 3.3.2 above. These plots also include results from the CT 1-D Analysis for the four impoundments within the Connecticut portion of the River. These charts indicate the various IMPGs developed for human consumption of fish, and illustrate the estimated time to achieve those values.

- Appendix G-9: Temporal profiles of model-predicted fish concentrations averaged by subreach using the assumptions for fish protection described in Section 3.3.2 above. These charts indicate the fish protection IMPGs, and illustrate the estimated time to achieve those values.

- Appendix G-10: Temporal profiles of model-predicted fish concentrations averaged by subreach using the species and size class assumptions for consumption of fish by threatened and endangered species (bald eagle) described in Section 3.3.2 above. These charts indicate the threatened and endangered species IMPGs, and illustrate the estimated time to achieve those values.

- Appendix G-11: Temporal profiles of model-predicted fish concentrations averaged by subreach using the species and size class assumptions for consumption of fish by piscivorous birds (osprey) described in Section 3.3.2 above. These charts indicate the piscivorous bird IMPGs, and illustrate the estimated time to achieve those values.

- Appendix G-12: Temporal plots overlaying model results from all eight sediment alternatives to facilitate comparisons. These plots show predicted concentrations of PCBs in subreach-average surface sediments and fish fillets (using the largemouth bass age classes specified for the human consumption IMPG comparisons described in Section 3.3.2 above) for all subreaches within Reaches 5 through 8.

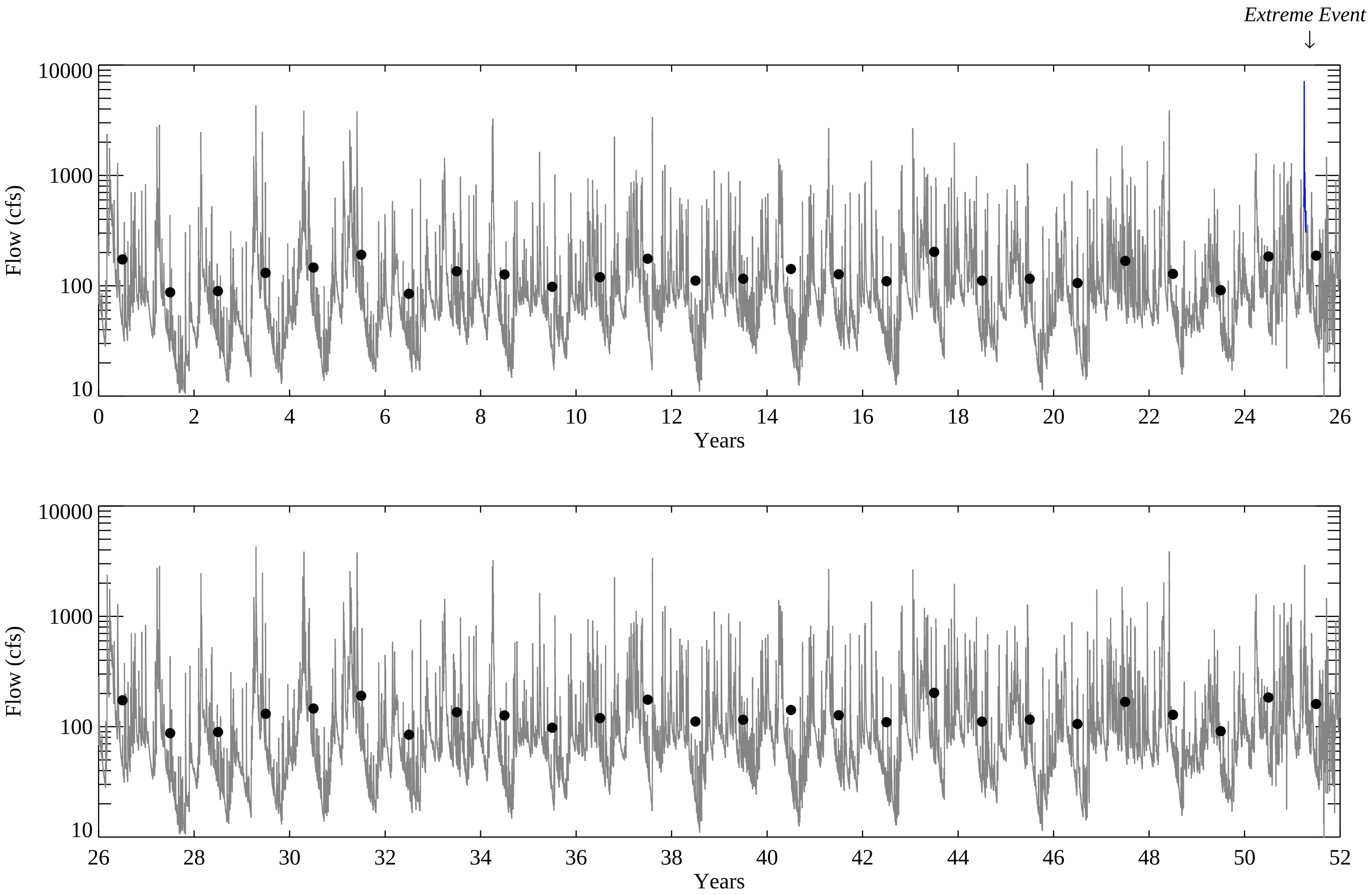

Figure 3-1. 52-year hydrograph used for the East Branch during model projection simulations.

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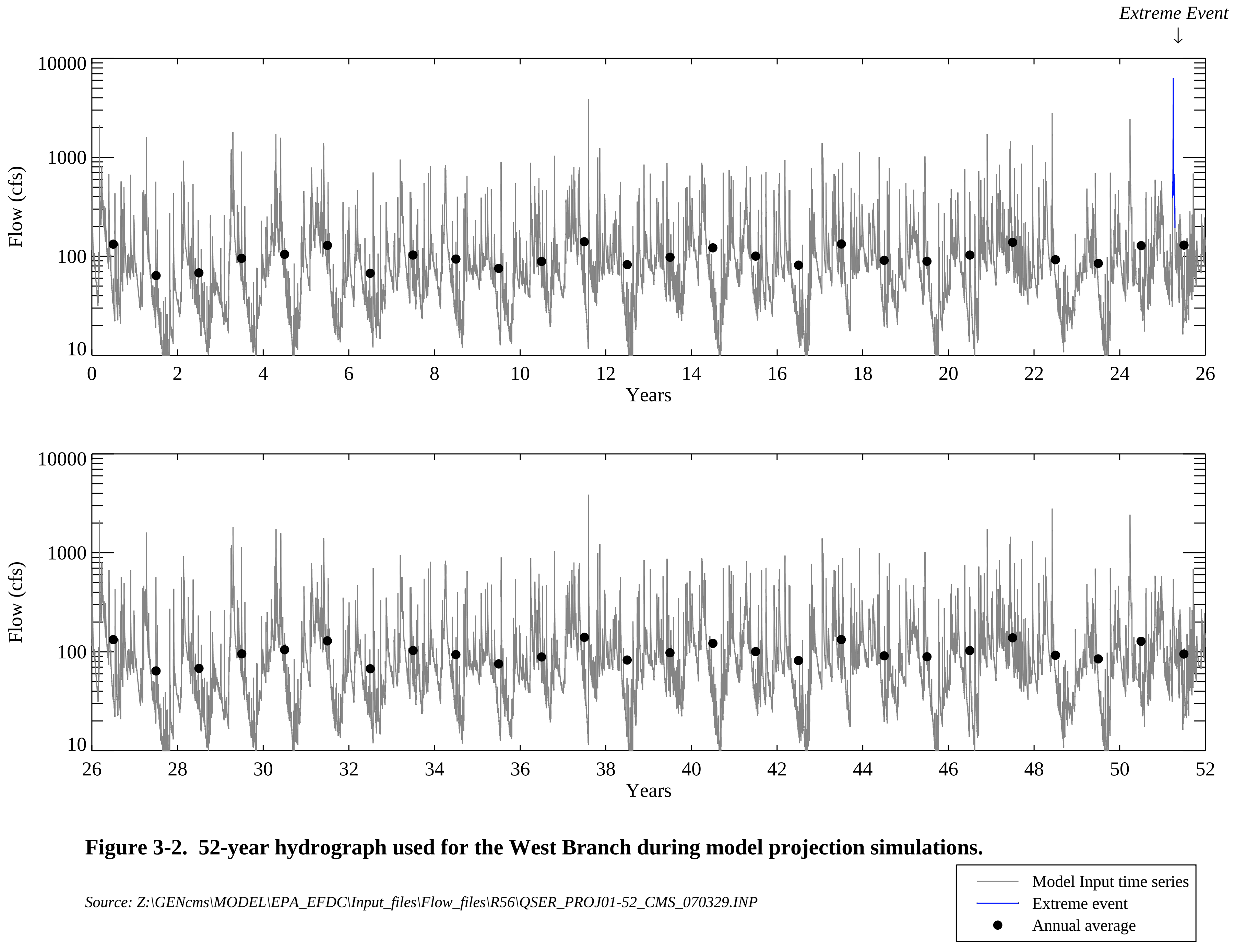

Figure 3-2. 52-year hydrograph used for the West Branch during model projection simulations.

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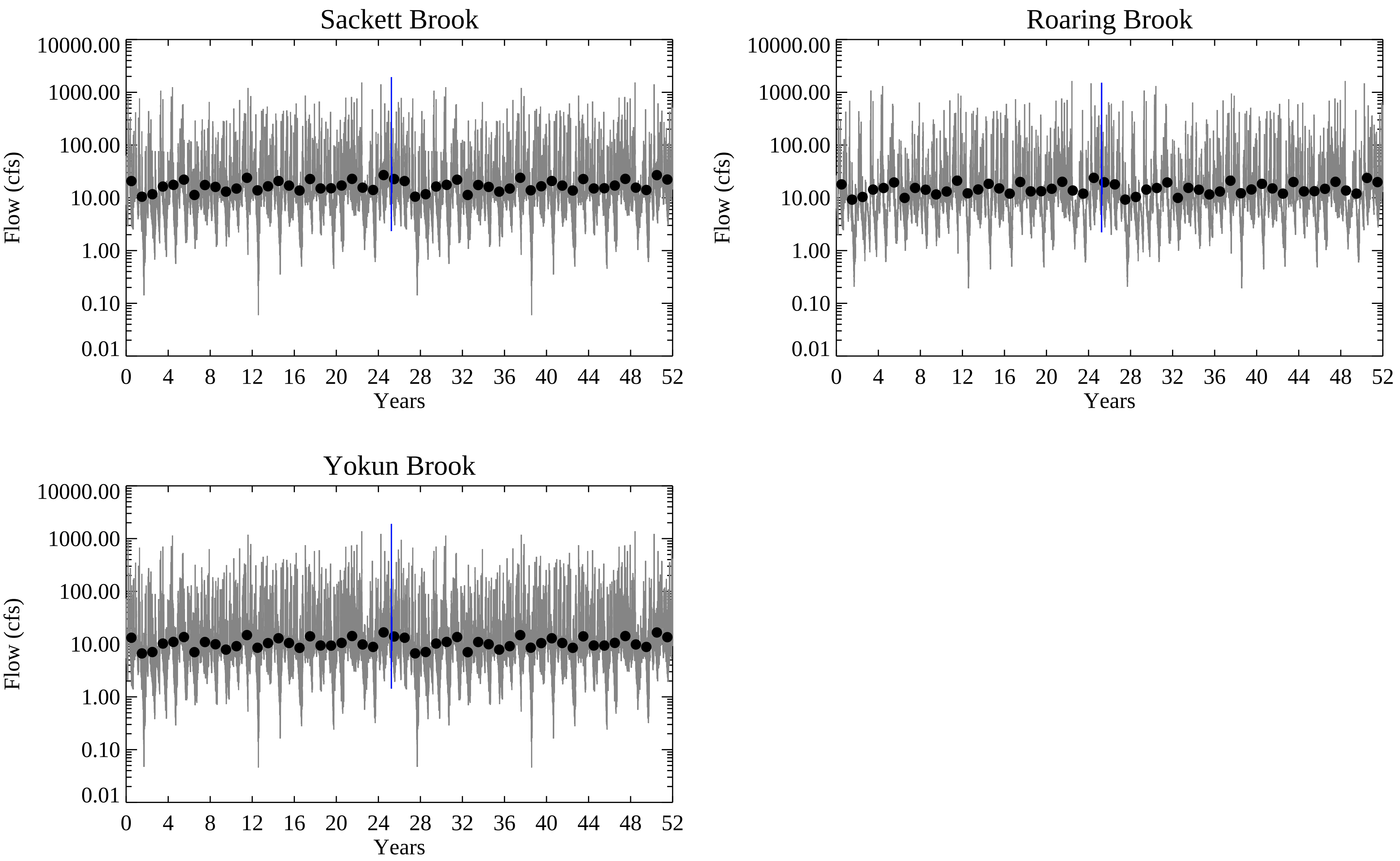

Figure 3-3a. 52-year hydrographs used for the Reach 5/6 tributaries during model projection simulations.

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— Extreme event
● Annual average

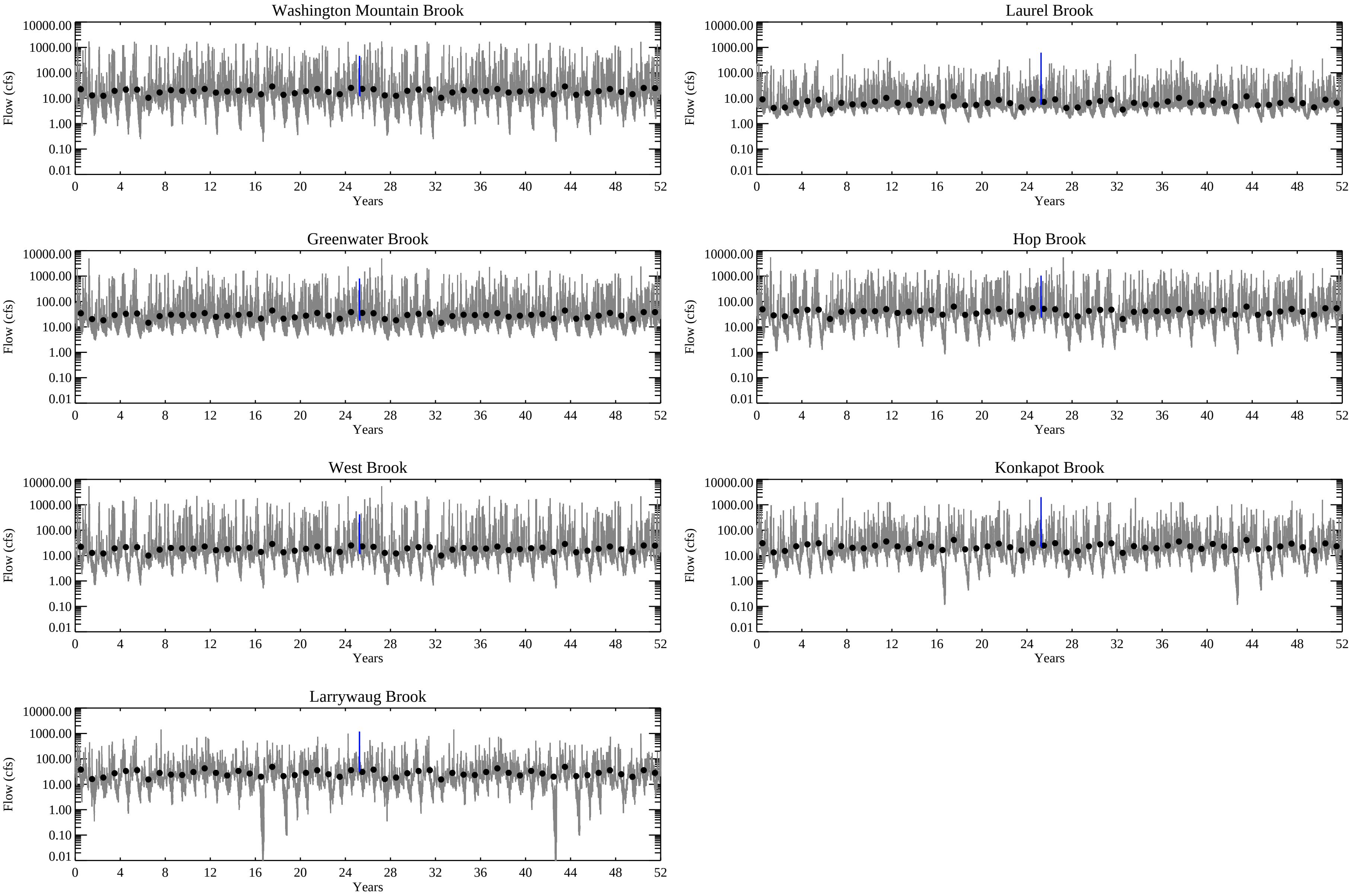

Figure 3-3b. 52-year hydrographs used for the Reach 7/8 tributaries during model projection simulations.

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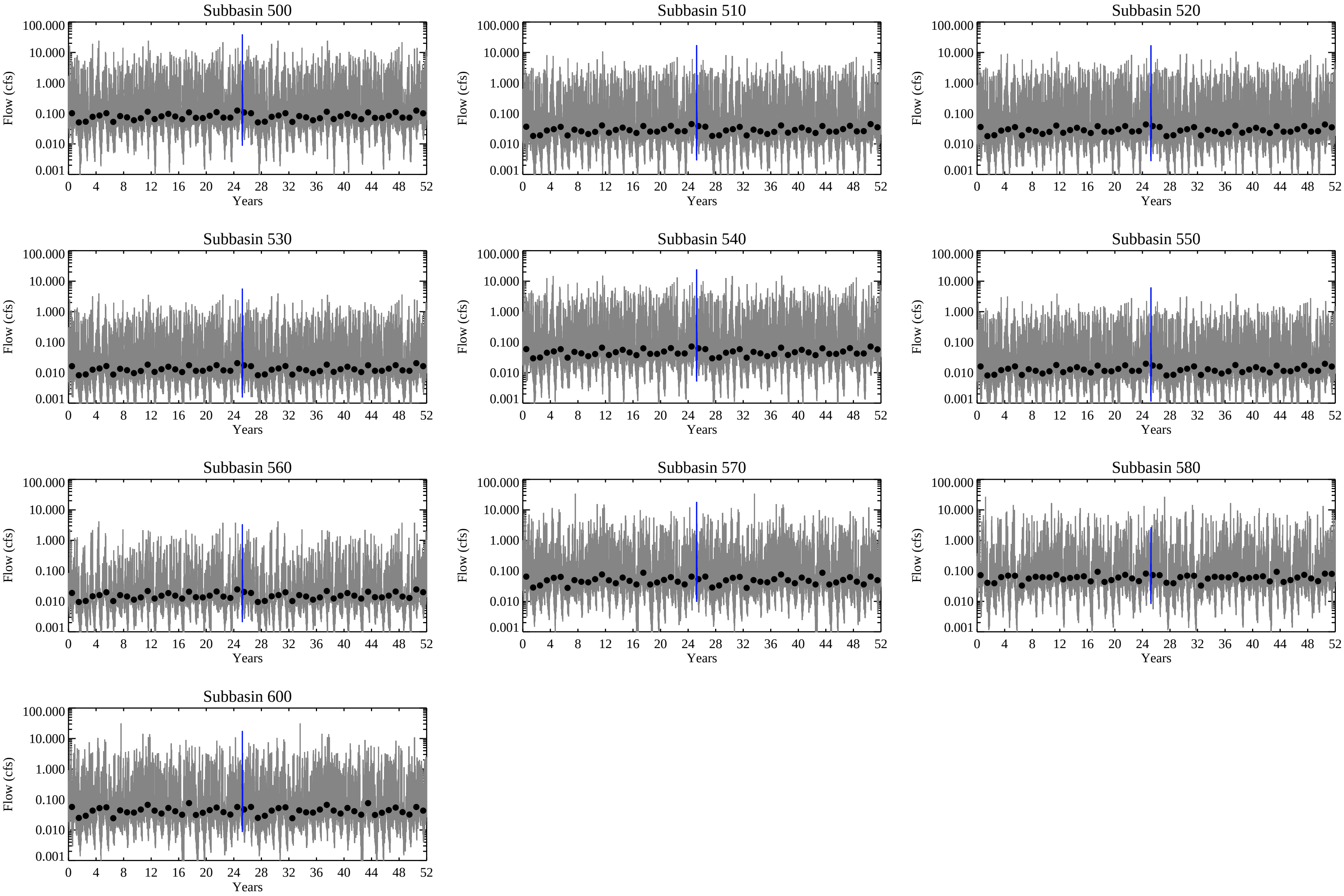

Figure 3-4a. 52-year hydrographs used for the Reach 5/6 direct drainage subbasins during model projection simulations.

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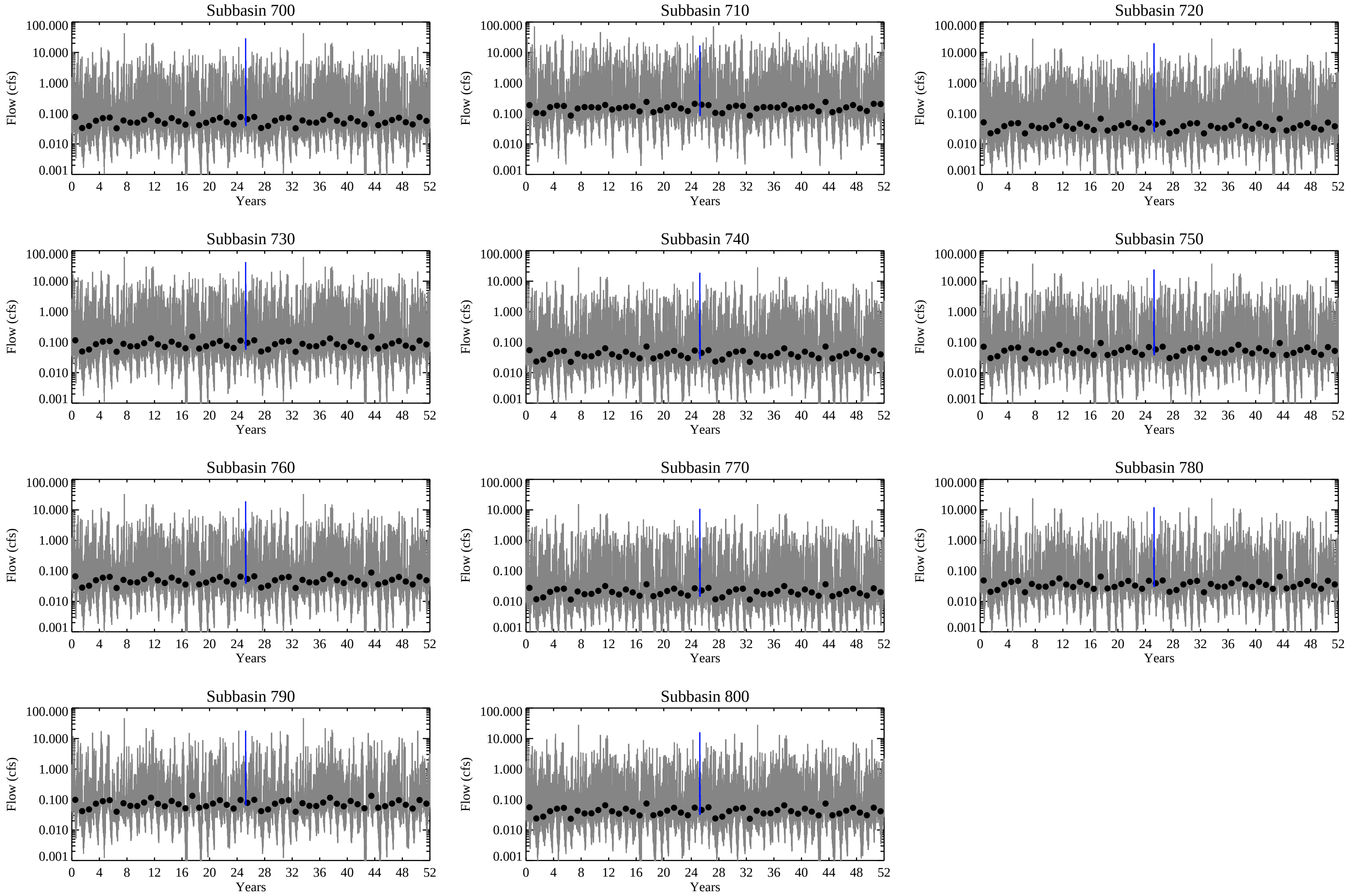

Figure 3-4b. 52-year hydrographs used for the Reach 7/8 direct drainage subbasins during model projection simulations.

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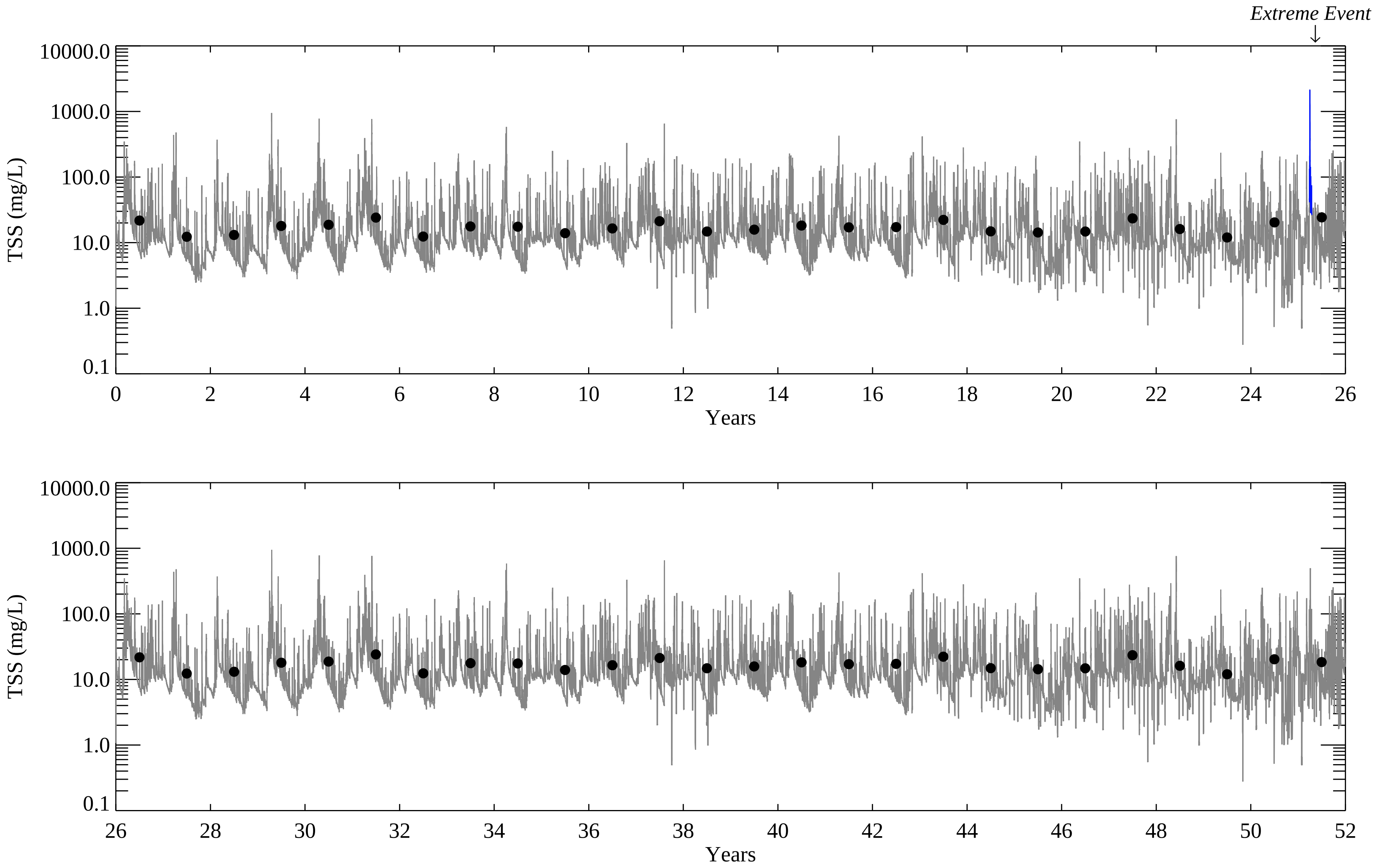

Figure 3-5. 52-year East Branch total suspended solids time series used during the model projection simulations.

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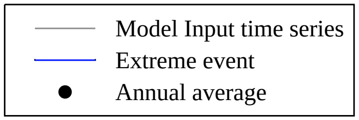

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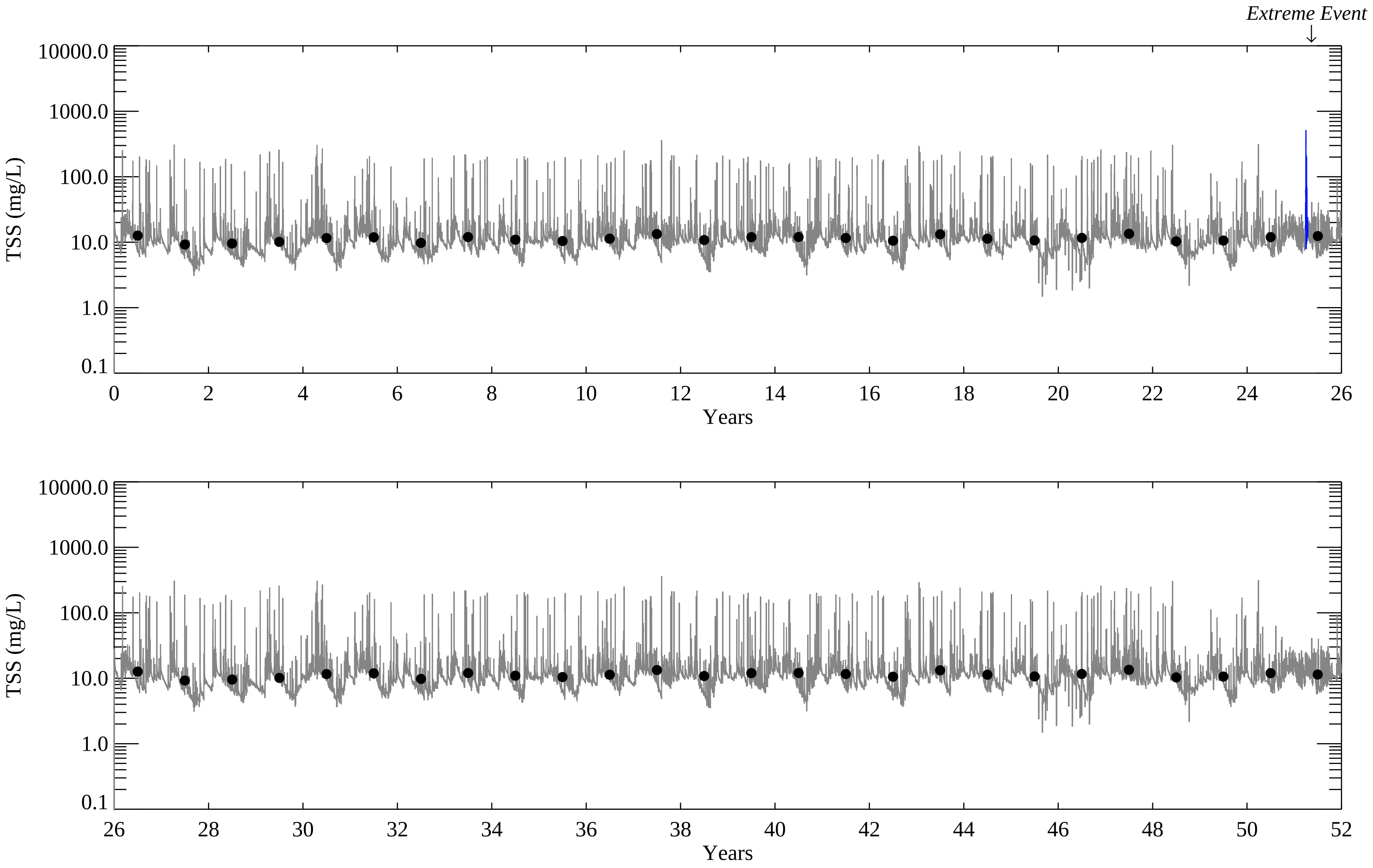

Figure 3-6. 52-year West Branch total suspended solids time series used during the model projection simulations.

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—	Model Input time series
—	Extreme event
●	Annual average

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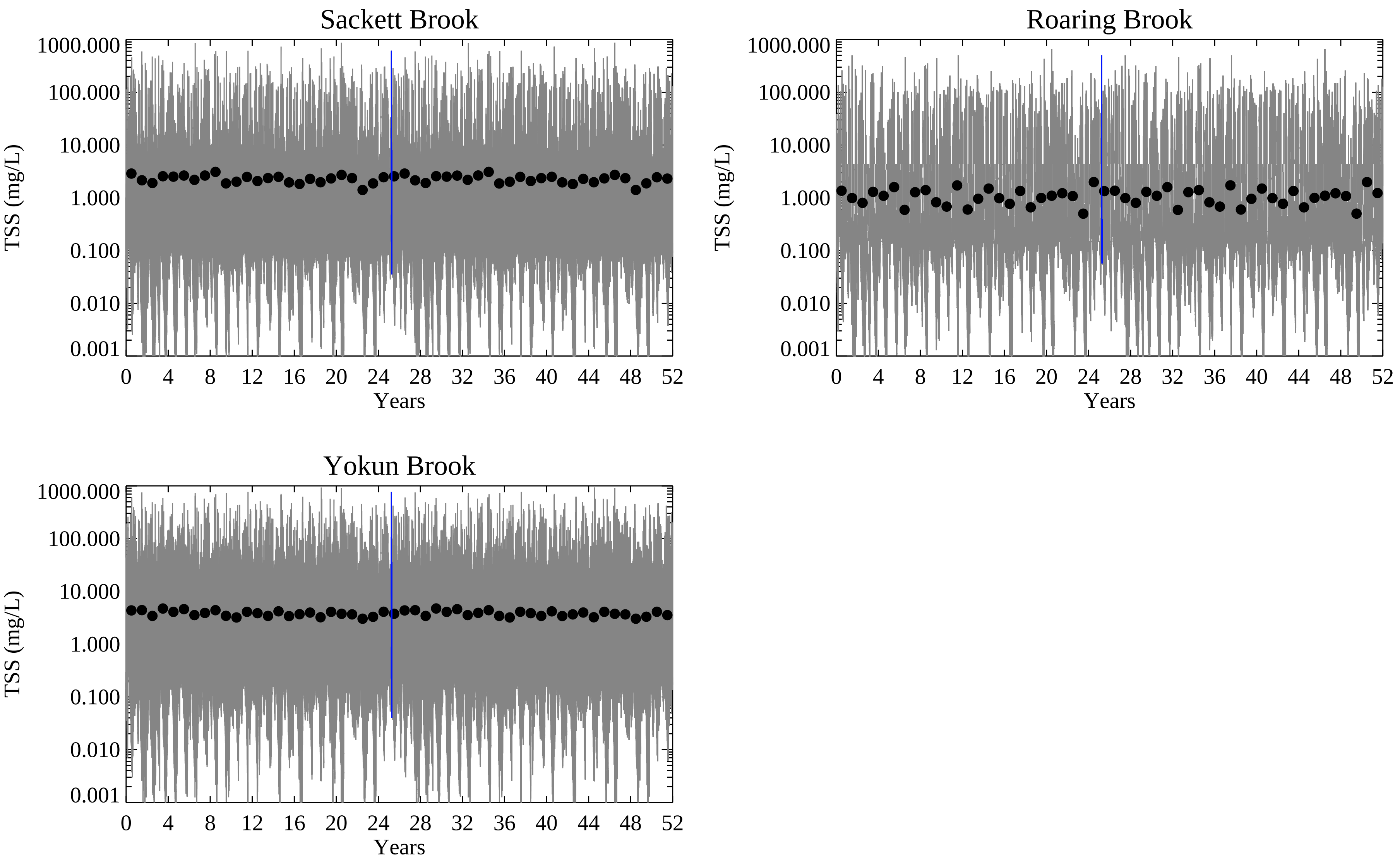

Figure 3-7a. 52-year Reach 5/6 tributary total suspended solids time series used during the model projection simulations.

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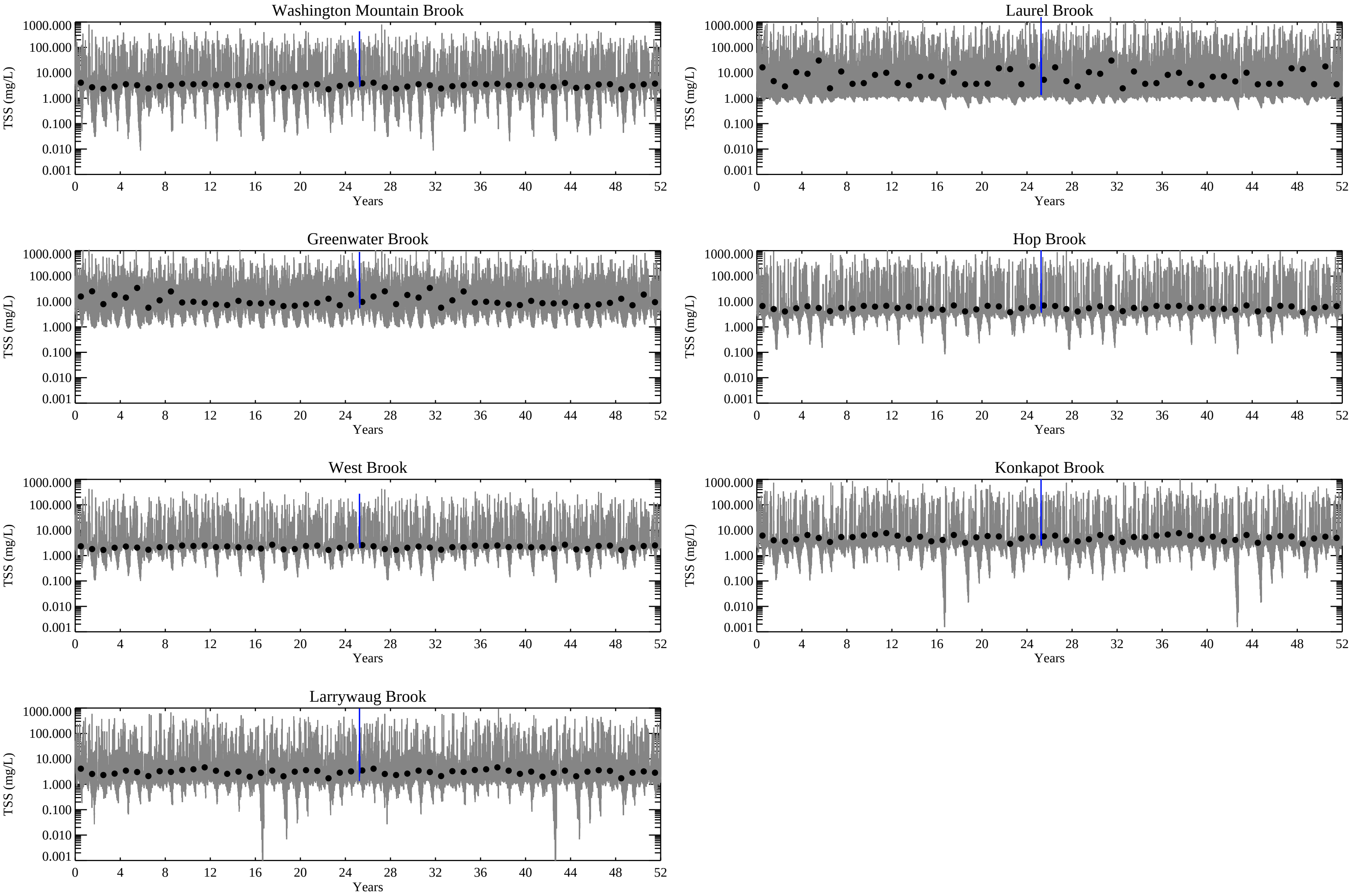

Figure 3-7b. 52-year Reach 7/8 tributary total suspended solids time series used during the model projection simulations.

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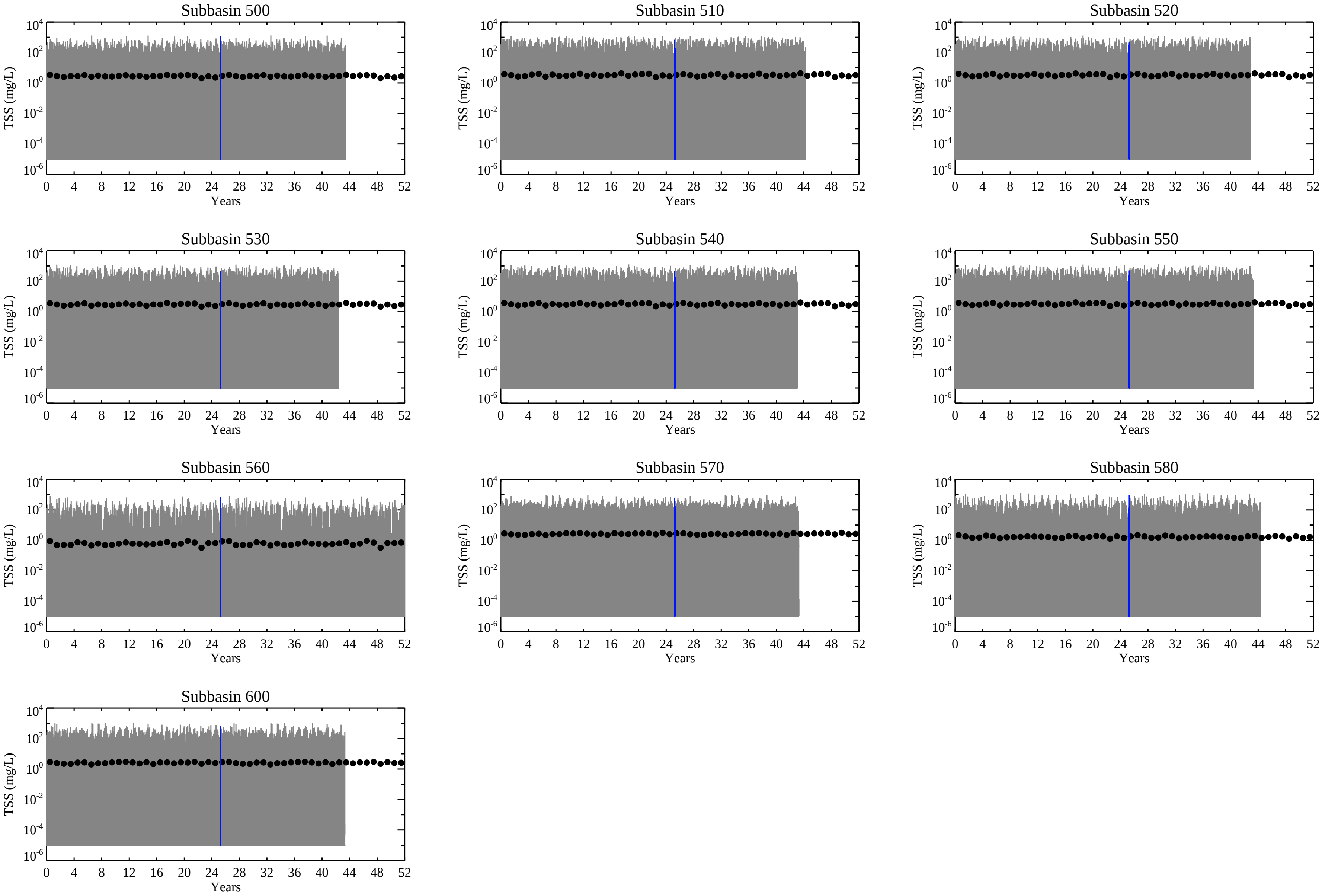

Figure 3-8a. 52-year Reach 5/6 direct drainage total suspended solids time series used during the model projection simulations.

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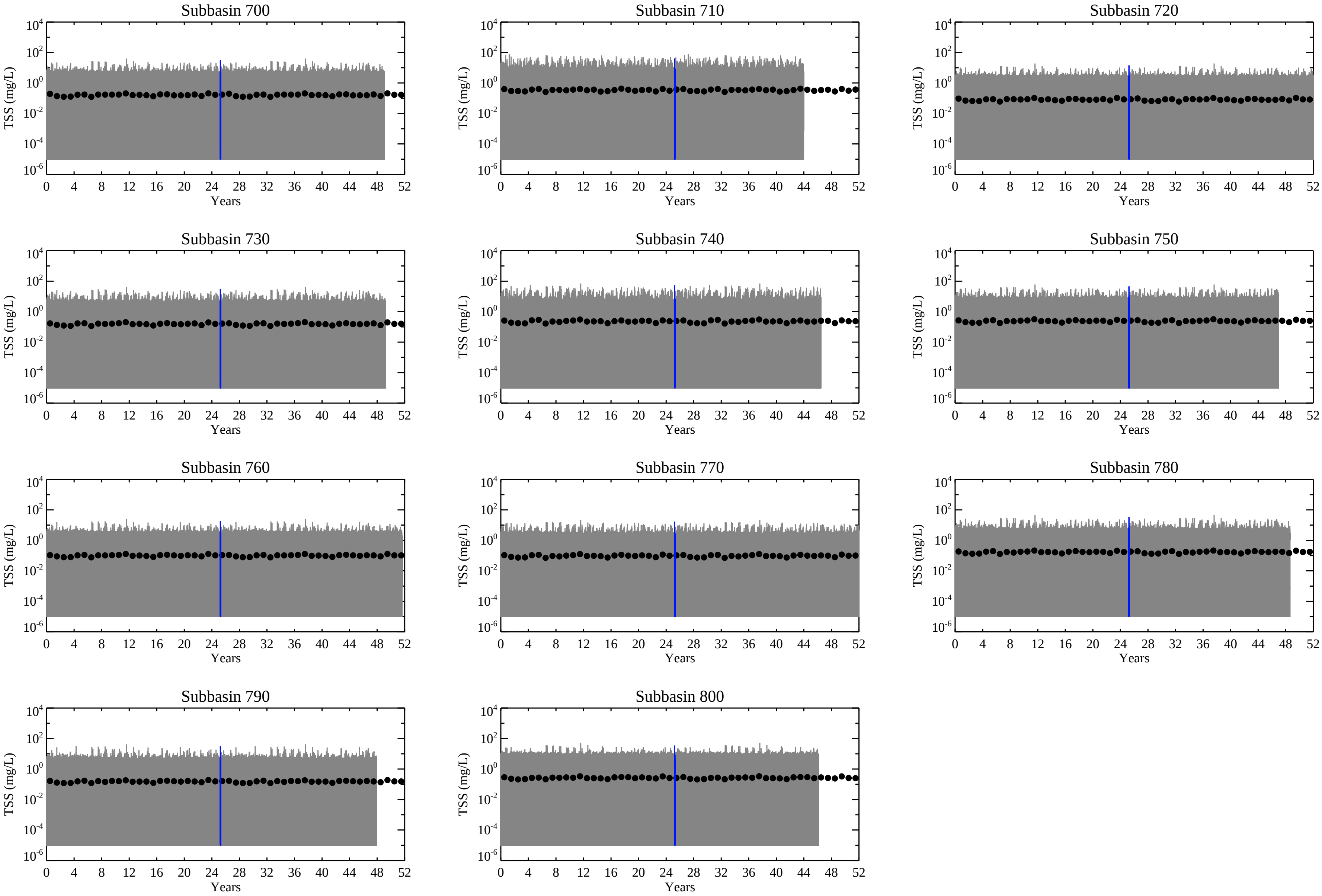

Figure 3-8b. 52-year Reach 7/8 direct drainage total suspended solids time series used during the model projection simulations.

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— Model Input time series
— Extreme event
● Annual average

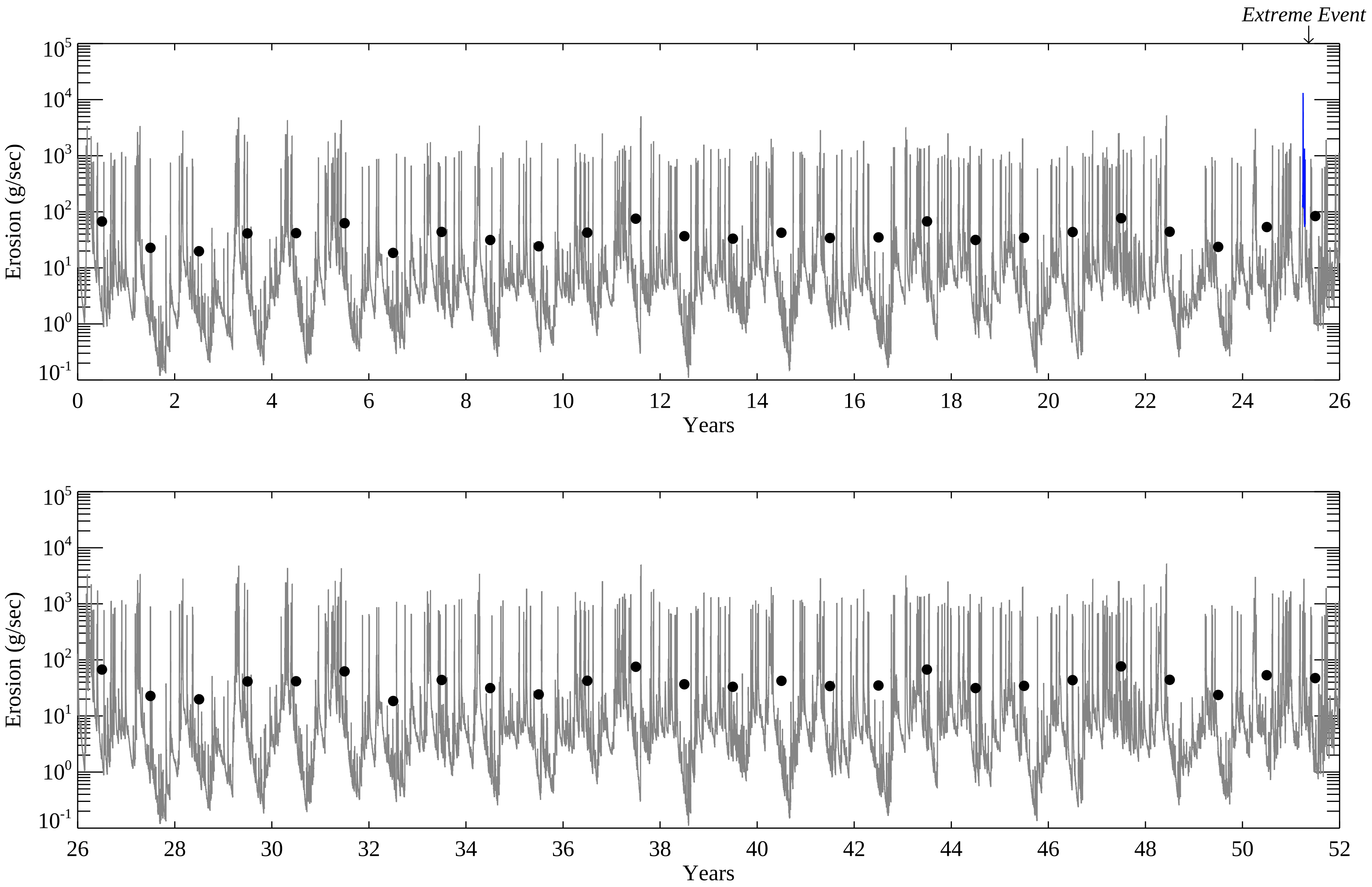

Figure 3-9. 52 year time series of bank erosion rates used during model projection simulations.

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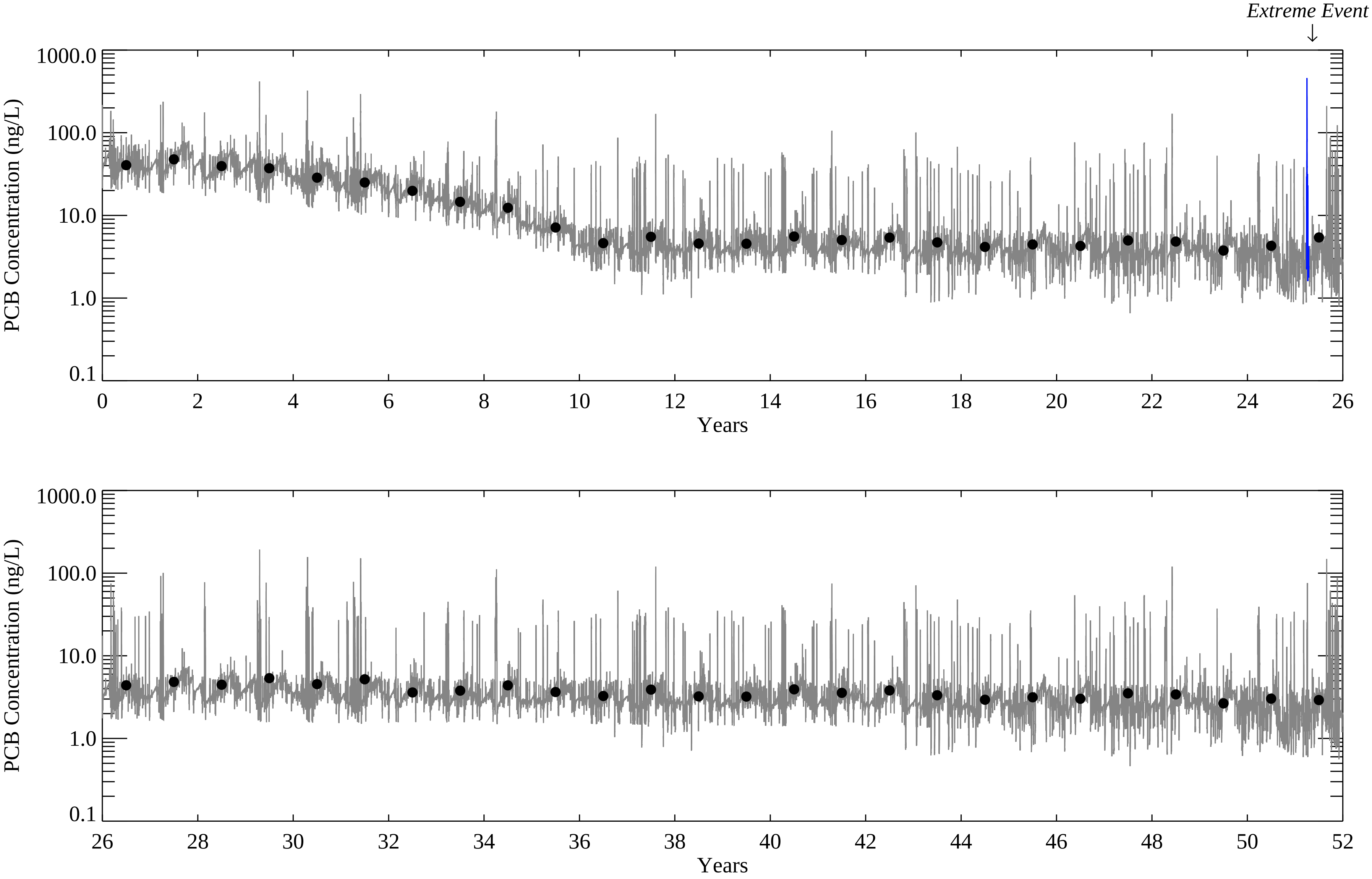

Figure 3-10. 52-year PCB boundary condition used for the East Branch during model projection simulations.

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—	Model Input time series
—	Extreme event
●	Annual average

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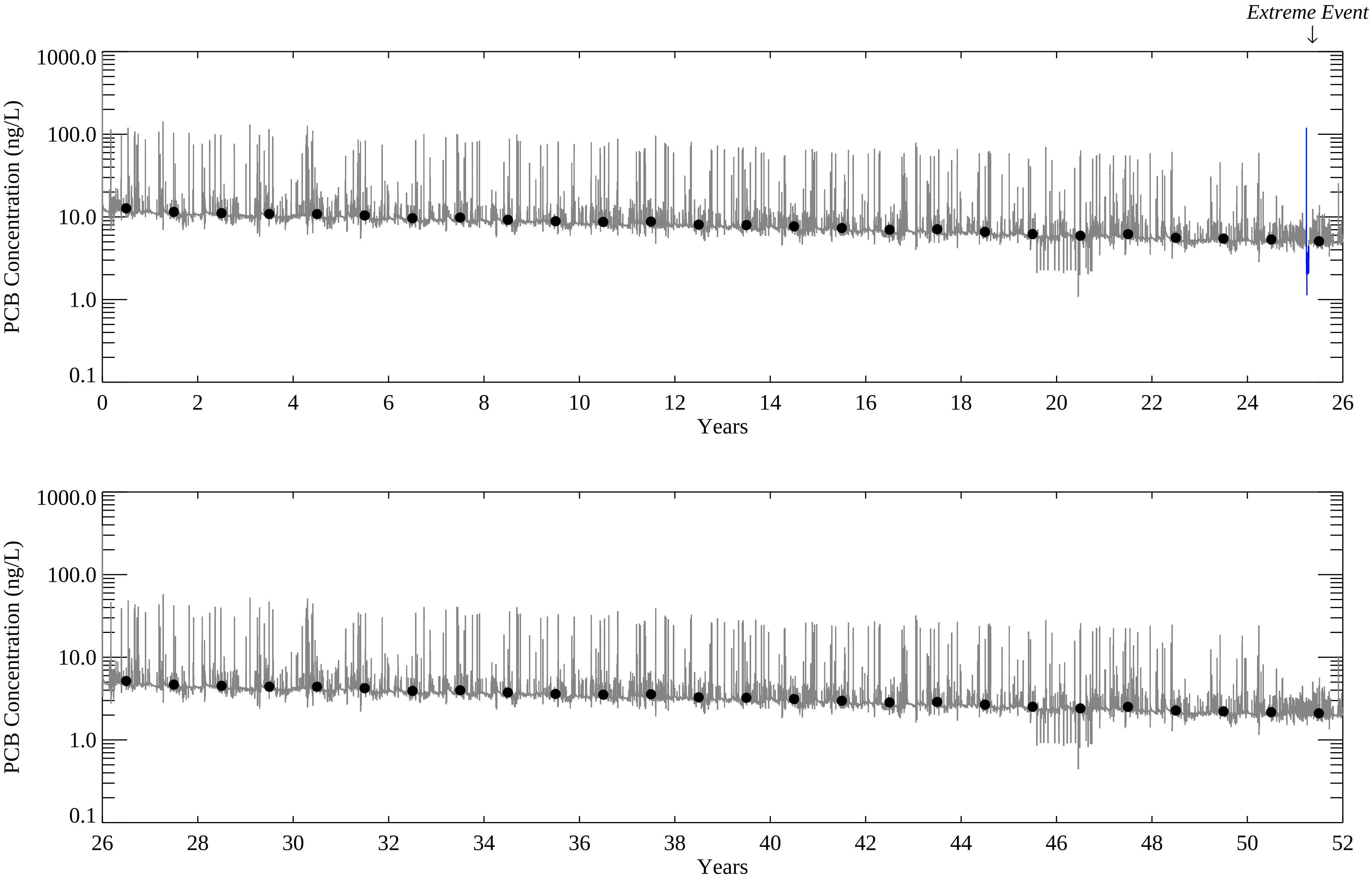

Figure 3-11. 52-year PCB boundary condition used for the West Branch during model projection simulations.

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—	Extreme event
●	Annual average

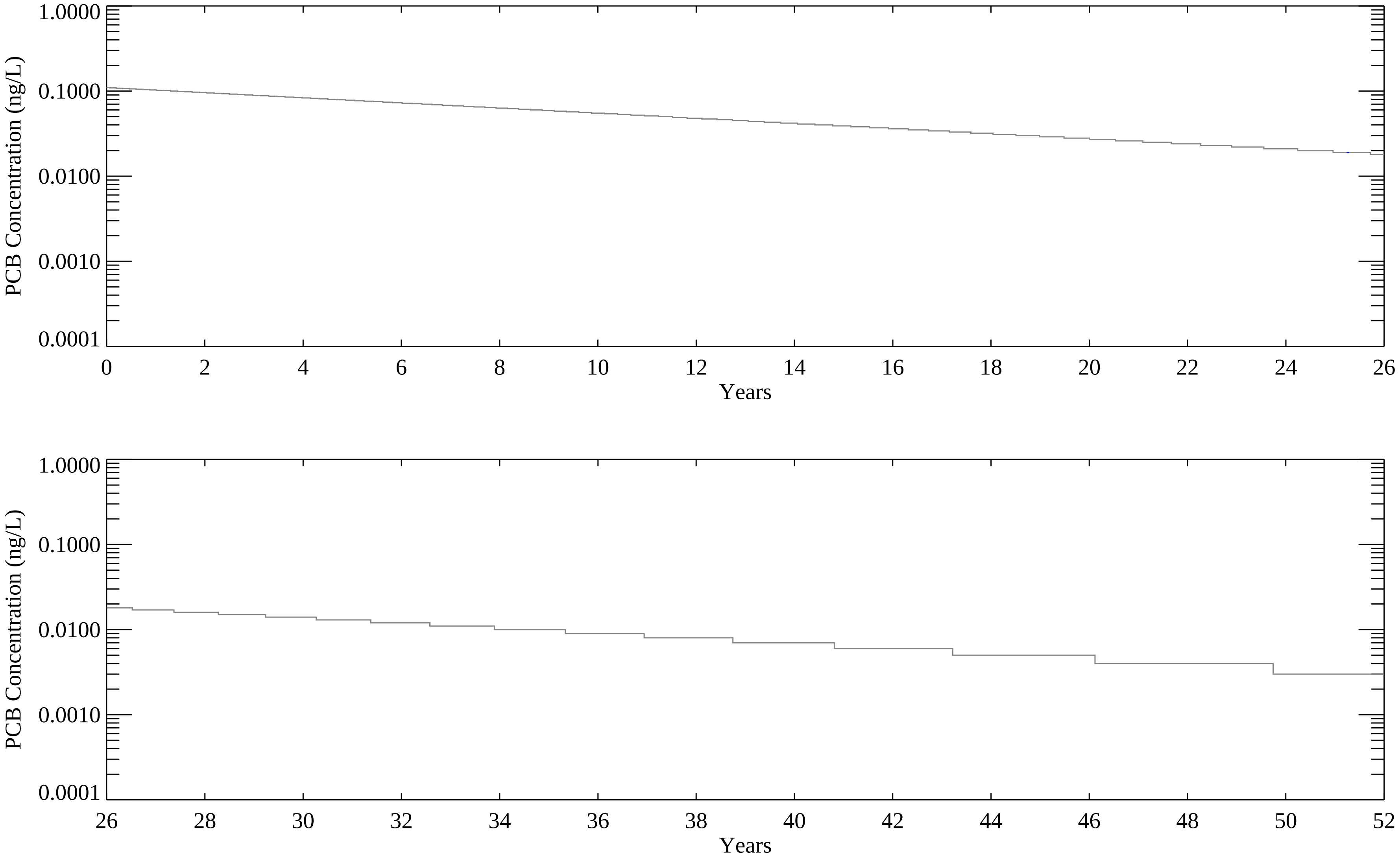

Figure 3-12. 52-year PCB boundary conditions used for the tributaries during model projection simulations.

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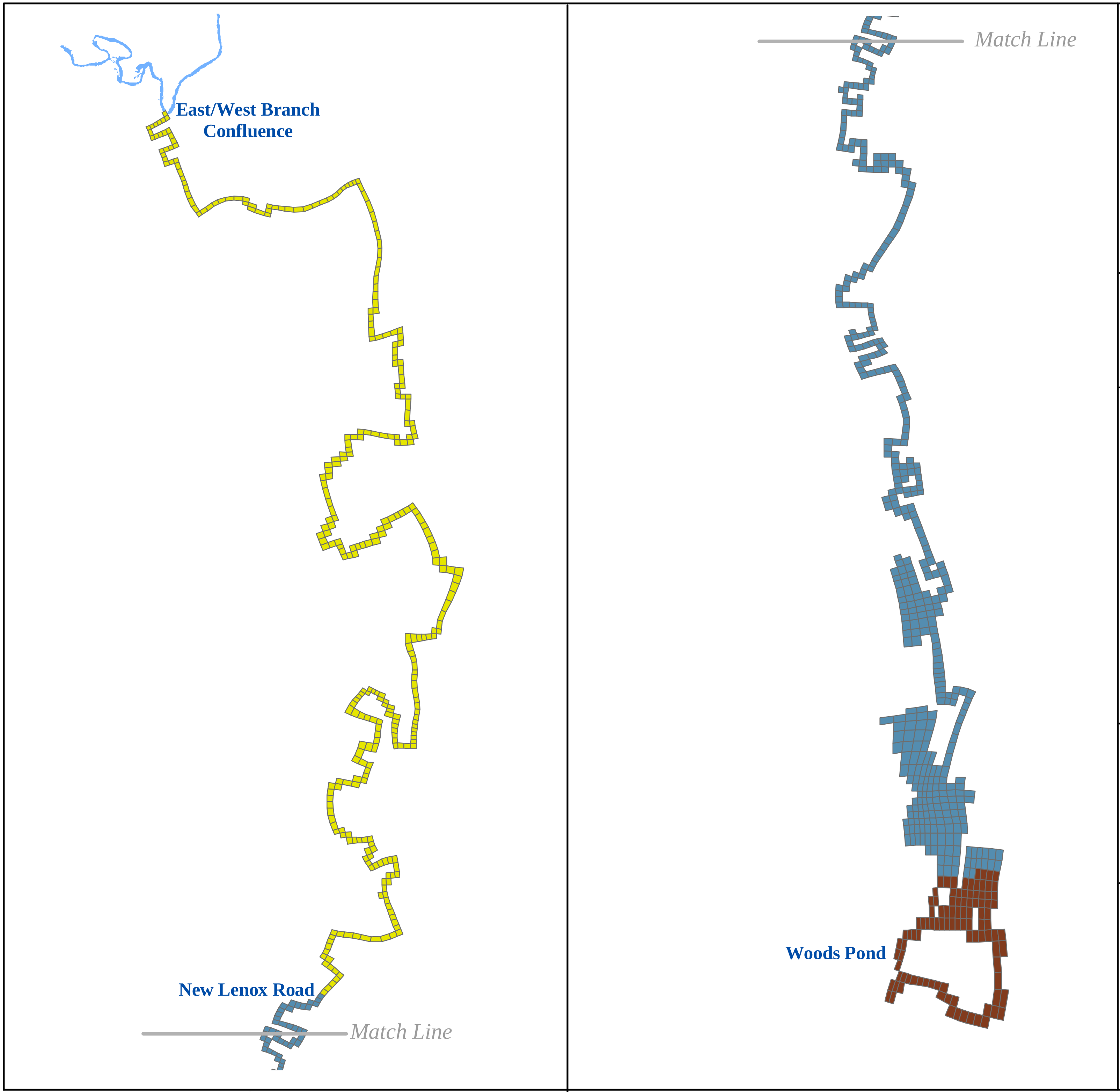

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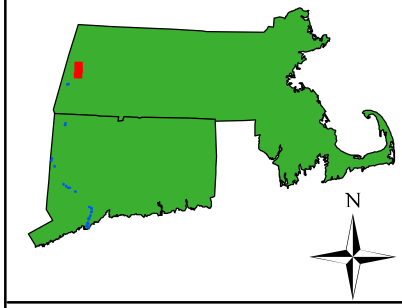

SCALE

LEGEND

Human Direct Contact

Sediment Exposure Areas

🟨 SA 1

🟦 SA 2

🟫 SA 3

Figure 3-13a.
Model grid cells selected to represent the sediment human direct contact exposure areas in Reaches 5 & 6.

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Quantitative Environmental Analysis, LLC
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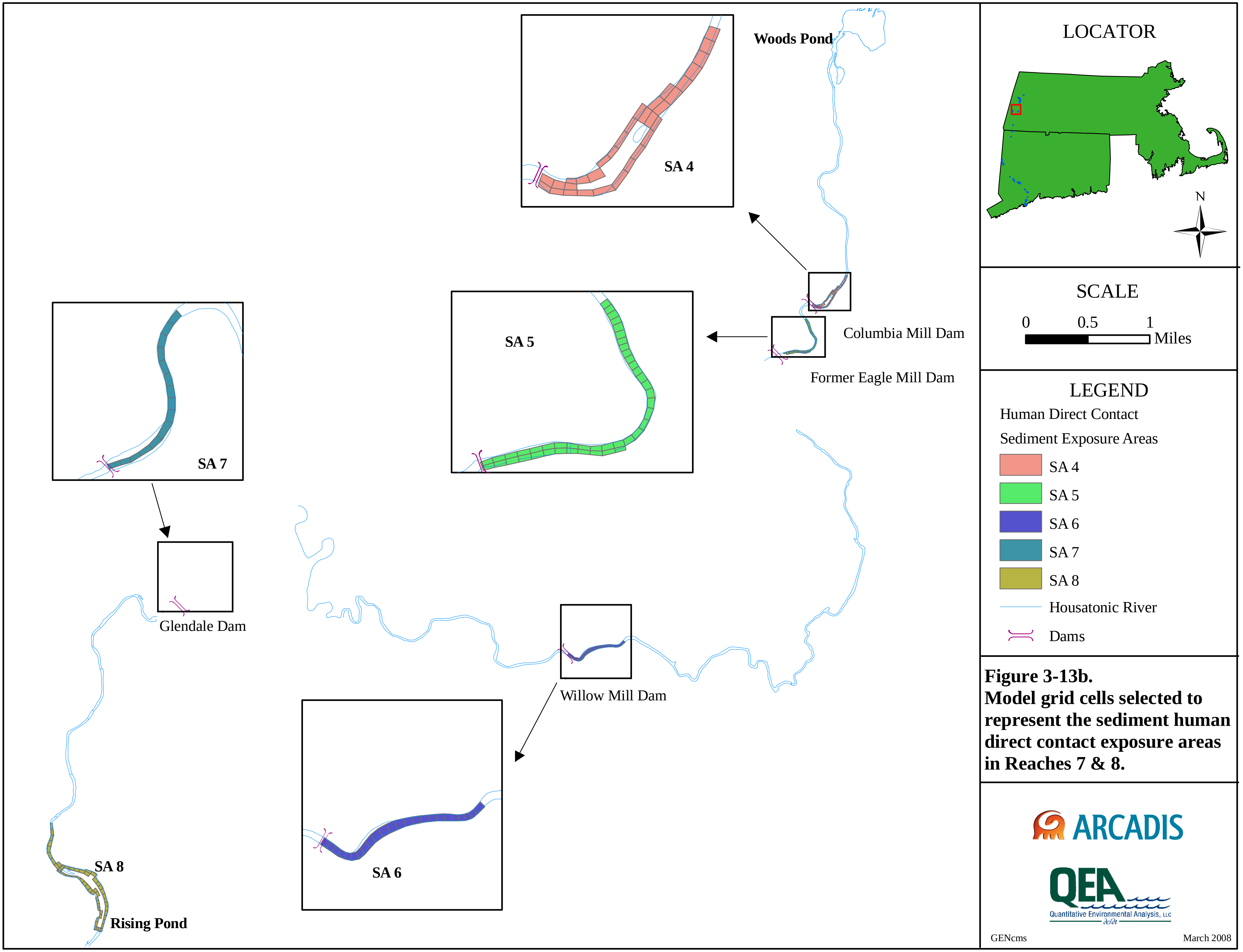

Figure 3-13b.
Model grid cells selected to represent the sediment human direct contact exposure areas in Reaches 7 & 8.

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Quantitative Environmental Analysis, LLC

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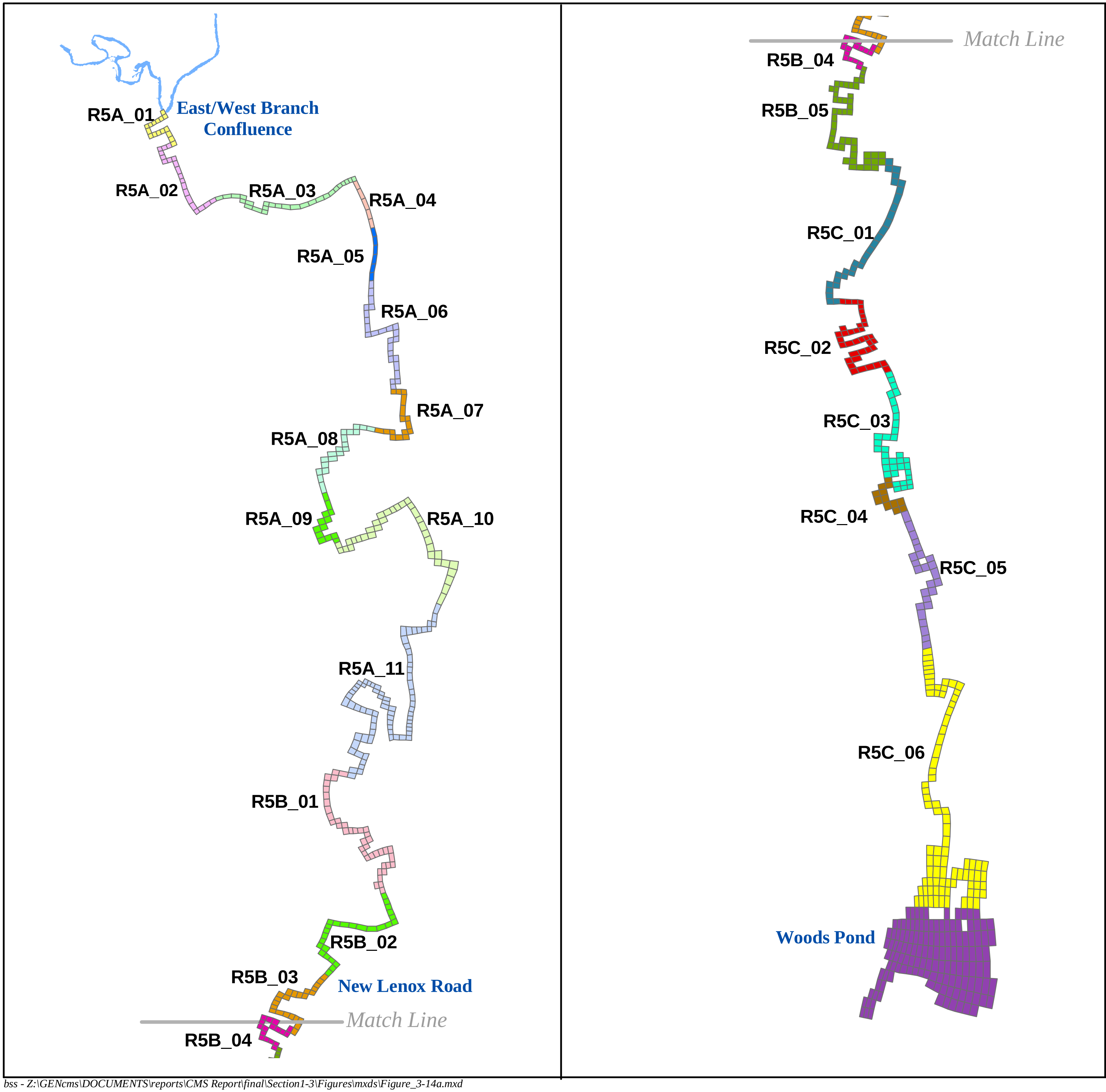

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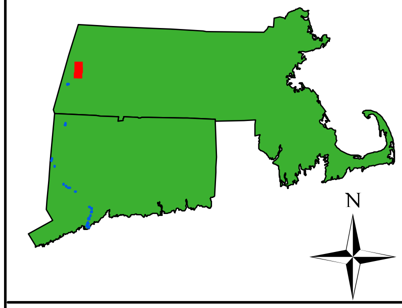

SCALE

0 0.25 0.5 Miles

LEGEND

▭ Averaging Area

NOTES:
Benthic invertebrate averaging areas are EPA "spatial bins" in Reaches 5/6, and are subreaches in Reaches 7/8.

Separate averaging areas are shown as different colors, and labels (e.g., R5C_01) represent averaging area IDs.

Figure 3-14a.
Averaging areas used for benthic invertebrate sediment IMPG comparisons in Reaches 5 & 6.

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Quantitative Environmental Analysis, LLC
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March 2008

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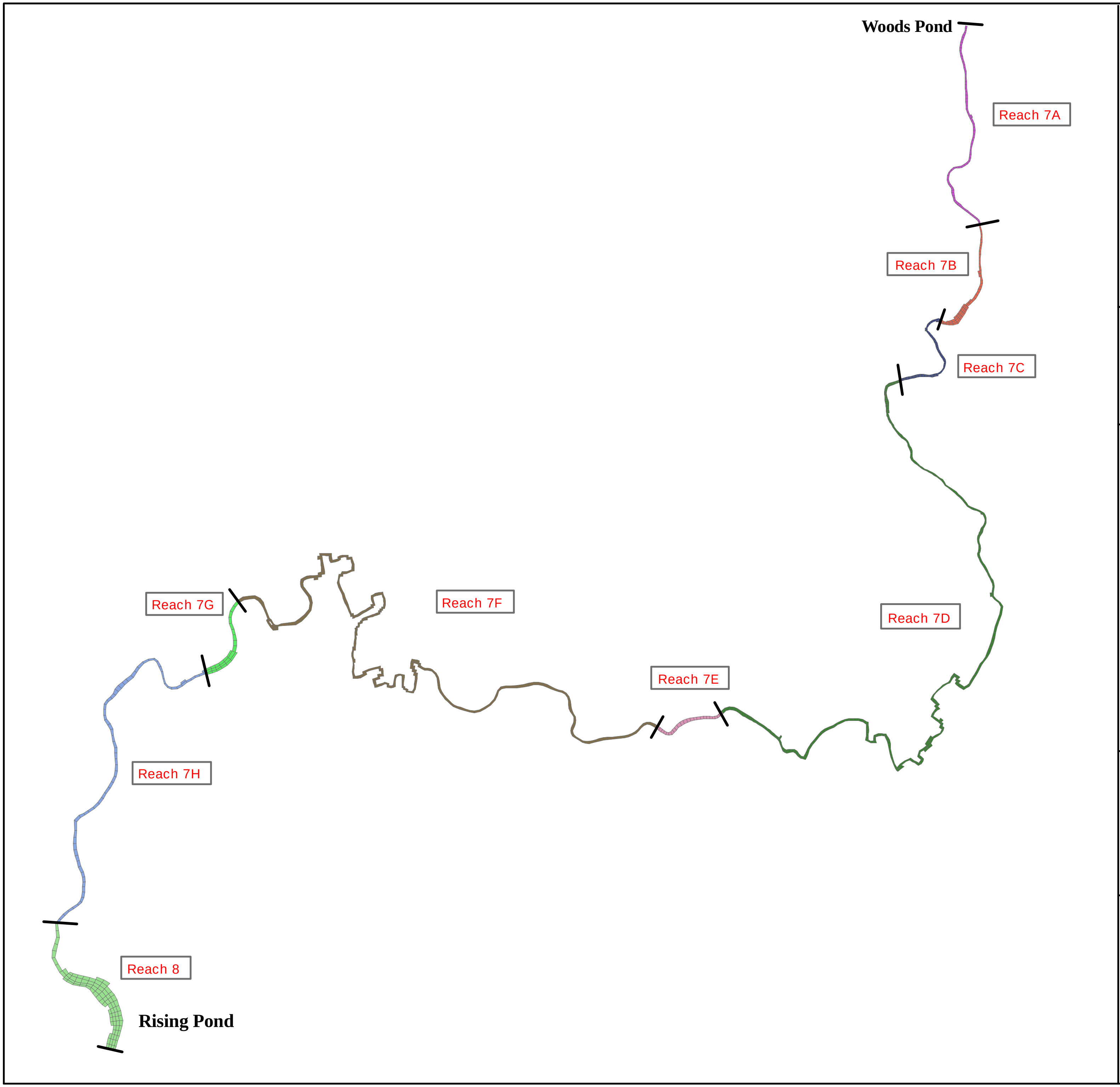

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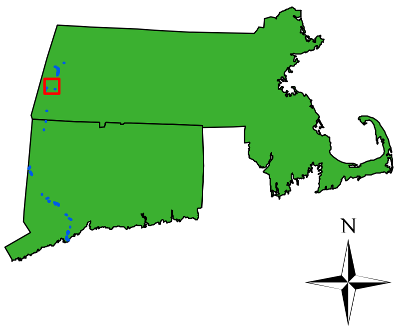

SCALE

0 0.5 1
Miles

LEGEND

▭ Averaging Area

NOTES:

Benthic invertebrate averaging areas are EPA "spatial bins" in Reaches 5/6, and are subreaches in Reaches 7/8.

Separate averaging areas are shown as different colors.

Figure 3-14b.
Averaging areas used for benthic invertebrate sediment IMPG comparisons in Reaches 7 & 8.

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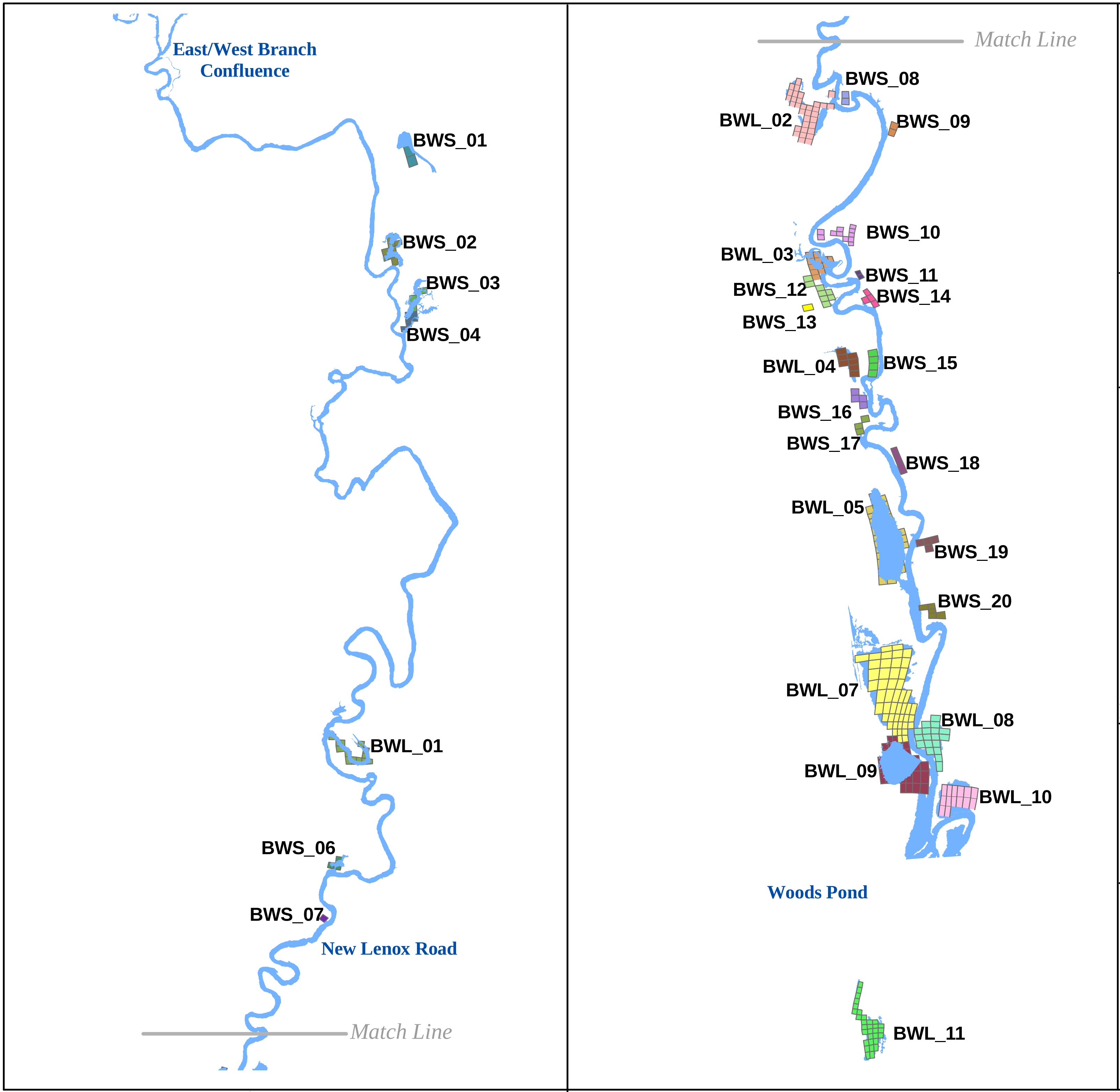
QEA
Quantitative Environmental Analysis, LLC

GENcms March 2008



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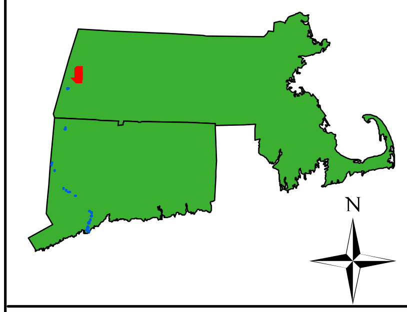


SCALE

0 0.25 0.5 Miles

LEGEND

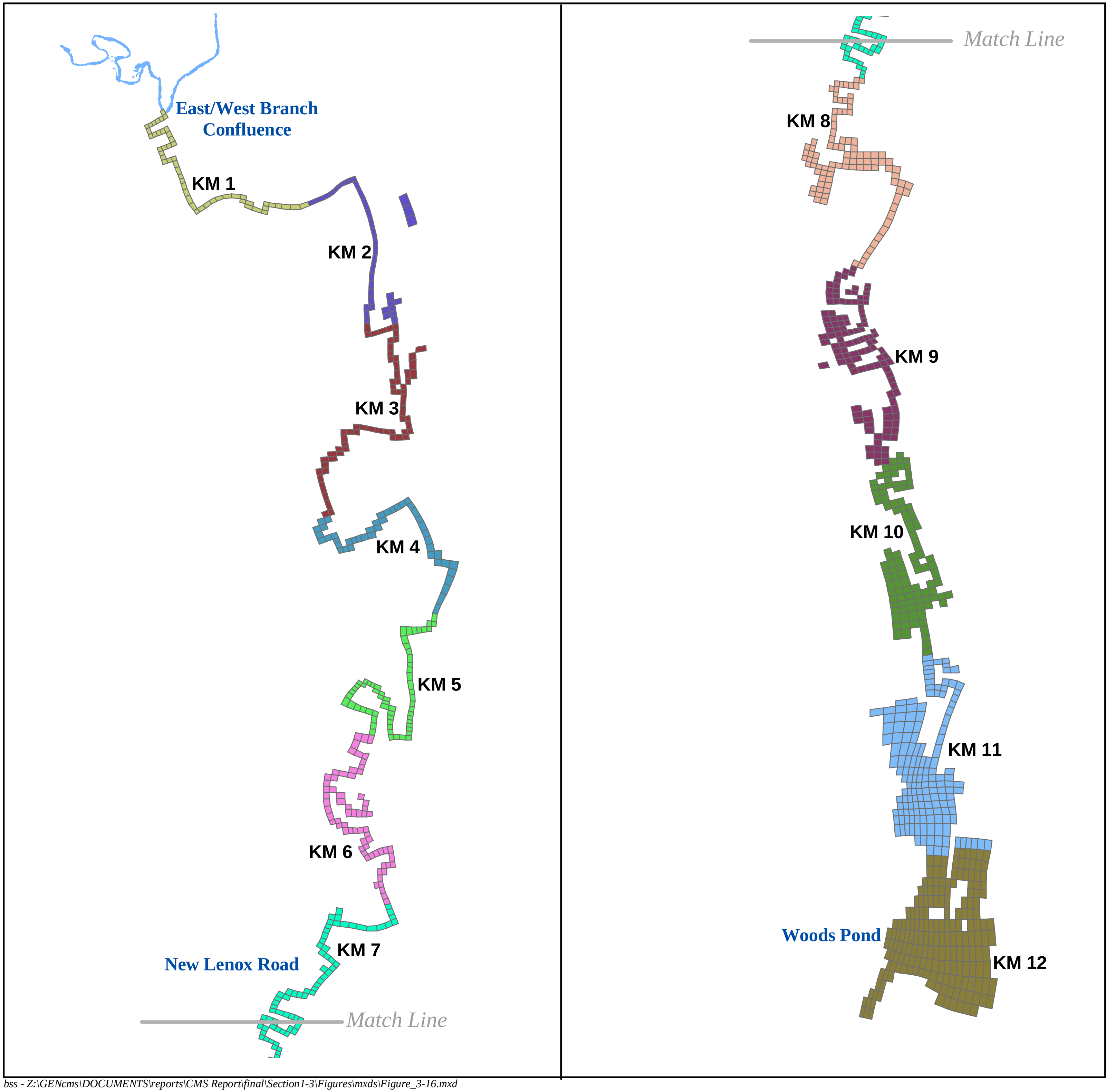
☐ Averaging Area
▇ Housatonic River

NOTE:
Separate averaging areas are shown as different colors, and labels (e.g., BWL_11) represent averaging area IDs.

Figure 3-15.
Averaging areas used for amphibian sediment IMPG comparisons.

ARCADIS

QEA
Quantitative Environmental Analysis, LLC



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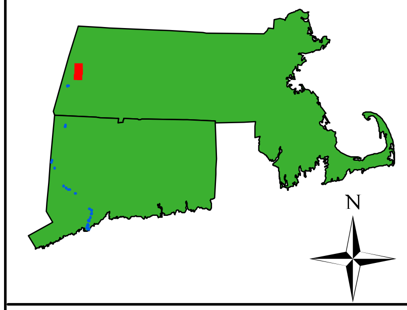

SCALE

LEGEND

☐ Wood Duck Averaging Areas

NOTE:
Separate averaging areas are shown as different colors, and labels (e.g., KM 11) represent averaging area IDs.

Figure 3-16.
Model grid cells used to define the 1-km sediment averaging areas for insectivorous bird comparisons to sediment target levels.

ARCADIS

QEA
Quantitative Environmental Analysis, LLC
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March 2008

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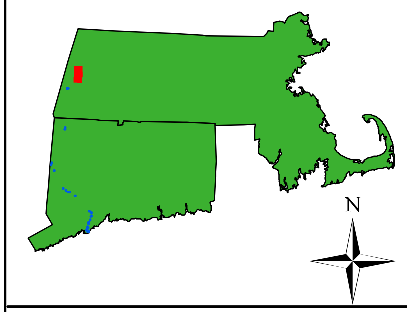
LOCATOR MAP



SCALE

LEGEND

Averaging Areas for Mink

- 🟨 Reaches 5A/5B
- 🟦 Reaches 5C/5D/6

Figure 3-17.
Model grid cells used to define the sediment averaging areas for piscivorous mammal comparisons to sediment target levels.

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Table 3-3 - Summary of Assumed Reach-/Alternative-Specific Production Rates

Alt.	Reach 5A	Reach 5B	Reach 5C	Reach 5 Backwaters	Reach 6 (Woods Pond)	Reach 7 Impoundments	Reach 7 Channel	Reach 8 (Rising Pond)	Reaches 9-17
SED 1	NA	NA	NA	NA	NA	NA	NA	NA	NA
SED 2	NA	NA	NA	NA	NA	NA	NA	NA	NA
SED 3	1 crew removal: 110 cy/d eng. cap: 220 cy/d bank removal: 110 cy/d	NA	1.5 crews no removal TLC: 165 cy/d	NA	2 crews no removal TLC: 220 cy/d	NA	NA	NA	NA
SED 4	1 crew removal: 110 cy/d eng. cap: 220 cy/d bank removal: 110 cy/d	1 crew removal: 110 cy/d eng. cap: 220 cy/d TLC: 110 cy/d bank removal: 110 cy/d	1.5 crews no removal eng. cap: 330 cy/d TLC: 165 cy/d	1.5 crews no removal TLC: 165 cy/d	2 crews removal: 550 cy/d eng. cap: 440 cy/d TLC: 220 cy/d	NA	NA	NA	NA
SED 5	1 crew removal: 110 cy/d eng. cap: 220 cy/d bank removal: 110 cy/d	1 crew removal: 110 cy/d eng. cap: 220 cy/d bank removal: 110 cy/d	1.5 crews removal: 412.5 cy/d eng. cap: 330 cy/d	1.5 crews no removal TLC: 165 cy/d	2 crews removal: 550 cy/d eng. cap: 440 cy/d	NA	NA	2 crews no removal TLC: 220 cy/d	NA
SED 6	1 crew removal: 110 cy/d eng. cap: 220 cy/d bank removal: 110 cy/d	1 crew removal: 110 cy/d eng. cap: 220 cy/d bank removal: 110 cy/d	1.5 crews removal: 412.5 cy/d eng. cap: 330 cy/d	1.5 crews removal: 412.5 cy/d eng. cap: 330 cy/d TLC: 165 cy/d	2 crews removal: 550 cy/d eng. cap: 440 cy/d	1 crew no removal TLC: 110 cy/d	NA	2 crews no removal eng. cap: 440 cy/d TLC: 220 cy/d	NA
SED 7	1 crew removal: 140 cy/d eng. cap: 220 cy/d bank removal: 110 cy/d	1 crew removal: 110 cy/d eng. cap: 220 cy/d bank removal: 110 cy/d	1.5 crews removal: 412.5 cy/d eng. cap: 330 cy/d	1.5 crews removal: 412.5 cy/d eng. cap: 330 cy/d TLC: 165 cy/d	2 crews removal: 700 cy/d eng. cap: 440 cy/d	1 crew removal: 275 cy/d eng. cap: 220 cy/d TLC: 110 cy/d	NA	2 crews removal: 550 cy/d eng. cap: 440 cy/d TLC: 220 cy/d	NA
SED 8	1 crew removal: 140 cy/d eng. cap: 220 cy/d bank removal: 110 cy/d	1 crew removal: 140 cy/d eng. cap: 220 cy/d bank removal: 110 cy/d	1.5 crews removal: 525 cy/d eng. cap: 330 cy/d	1.5 crews removal: 525 cy/d eng. cap: 330 cy/d	2 crews removal: 700 cy/d eng. cap: 440 cy/d	1 crew removal: 275 cy/d eng. cap: 220 cy/d	NA	2 crews removal: 700 cy/d eng. cap: 440 cy/d	NA

Notes:

1. Average removal rates may increase in certain reaches for SED 7 and SED 8 to account for the somewhat faster production anticipated for increased removal volumes from within the same removal area. This results in higher removal rates in the following: Reach 5A and 6 in SED 7; Reach 5A, 5B, 5C, 5 Backwaters, 6, and 8 in SED 8.
2. cy/d = cubic yards per day
3. removal = rate of removal for mechanical excavation/hydraulic dredging
4. eng. cap = rate of placement of engineered cap
5. TLC = rate of placement of thin layer cap
6. bank removal = rate of bank removal/stabilization

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Table 3-5 - Construction Schedule Summary
(Construction durations are shown in Years)

	SEDIMENT REMEDIAL ALTERNATIVE							
REACH	**SED 1**	**SED 2**	**SED 3**	**SED 4**	**SED 5**	**SED 6**	**SED 7**	**SED 8**
5A	No Action Alternative	Monitored Natural Recovery	7.6	7.6	7.6	7.6	9.5	11.5
5B			0.4	2.9	4.7	4.7	5.8	6.5
5C (Upper Section)			0.0	0.5	1.3	1.3	1.3	*2.5*
5C (Lower Section)			0.5	1.4	1.4	2.4	2.4	*4.5*
5 Backwaters (Small)			0.0	*0.2*	*0.2*	*0.4*	*0.4*	1.4
5 Backwaters (Large)			0.0	*1.3*	*1.3*	*1.6*	*2.0*	8.2
6 Woods Pond (Shallow)			0.7	1.8	1.8	1.8	2.8	6.6
6 Woods Pond (Deep)			0.4	0.4	0.6	0.6	0.6	4.2
7 (Channel)			0.0	0.0	0.0	0.0	0.0	0.0
7 (Impoundments)			0.0	0.0	0.0	1.0	1.9	3.6
8 Rising Pond (Shallow)			0.0	0.0	0.4	0.4	0.5	4.1
8 Rising Pond (Deep)			0.0	0.0	0.4	0.4	0.4	4.7
9 to 17			0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.0**	**0.0**	**9.6**	**14.6**	**18.2**	**20.2**	**25.2**	**50.8**

Notes:
1. Dark shading indicate those reaches in each SED alternative for which MNR is the anticipated remedial implementation.
2. Numbers shown in italics are not included in the alternative-specific assessment of project duration, as activities in Reach 5C and the Reach 5 backwaters will be performed concurrently.

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Table 3-6 - Construction Schedule - SED 3
(Construction durations are shown in Years)

	SEDIMENT REMEDIAL TECHNOLOGY							
	REMOVAL		BACKFILL/CAPPING			BANK STABILIZATION	MONITORED NATURAL RECOVERY	TOTAL
REACH	Mechanical - Dry	Hydraulic/ Mechanical - Wet	Backfill	Engineered Capping	Thin-Layer Capping			
5A	6.2	--	0.6	--	--	0.8		**7.6**
5B	--	--	--	--	--	0.4	MNR	**0.4**
5C (Upper Section)	--	--	--	--	--	--	MNR	**0.0**
5C (Lower Section)	--	--	--	--	0.5	--	--	**0.5**
5 Backwaters (Small)	--	--	--	--	--	--	MNR	**0.0**
5 Backwaters (Large)	--	--	--	--	--	--	MNR	**0.0**
6 Woods Pond (Shallow)	--	--	--	--	0.7	--	--	**0.7**
6 Woods Pond (Deep)	--	--	--	--	0.4	--	--	**0.4**
7 (Channel)	--	--	--	--	--	--	MNR	**0.0**
7 (Impoundments)	--	--	--	--	--	--	MNR	**0.0**
8 Rising Pond (Shallow)	--	--	--	--	--	--	MNR	**0.0**
8 Rising Pond (Deep)	--	--	--	--	--	--	MNR	**0.0**
9 to 17	--	--	--	--	--	--	MNR	**0.0**

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Table 3-7 - Construction Schedule - SED 4
(Construction durations are shown in Years)

	SEDIMENT REMEDIAL TECHNOLOGY							
	REMOVAL		BACKFILL/CAPPING			BANK STABILIZATION	MONITORED NATURAL RECOVERY	TOTAL
REACH	Mechanical - Dry	Hydraulic/ Mechanical - Wet	Backfill	Engineered Capping	Thin-Layer Capping			
5A	6.2	--	0.6	--	--	0.8	--	**7.6**
5B	1.8	--	0.2	--	0.6	0.3	--	**2.9**
5C (Upper Section)	--	--	--	--	0.5	--	--	**0.5**
5C (Lower Section)	--	--	--	1.4	--	--	--	**1.4**
5 Backwaters (Small)	--	--	--	--	0.2	--	MNR	**0.2**
5 Backwaters (Large)	--	--	--	--	1.3	--	--	**1.3**
6 Woods Pond (Shallow)	--	0.8	1.0	--	--	--	--	**1.8**
6 Woods Pond (Deep)	--	--	--	--	0.4	--	--	**0.4**
7 (Channel)	--	--	--	--	--	--	MNR	**0.0**
7 (Impoundments)	--	--	--	--	--	--	MNR	**0.0**
8 Rising Pond (Shallow)	--	--	--	--	--	--	MNR	**0.0**
8 Rising Pond (Deep)	--	--	--	--	--	--	MNR	**0.0**
9 to 17	--	--	--	--	--	--	MNR	**0.0**

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Table 3-8 - Construction Schedule - SED 5
(Construction durations are shown in Years)

	SEDIMENT REMEDIAL TECHNOLOGY							
	REMOVAL		BACKFILL/CAPPING			BANK STABILIZATION	MONITORED NATURAL RECOVERY	TOTAL
REACH	Mechanical - Dry	Hydraulic/ Mechanical - Wet	Backfill	Engineered Capping	Thin-Layer Capping			
5A	6.2	--	0.6	--	--	0.8	--	**7.6**
5B	4.0	--	0.4	--	--	0.3	--	**4.7**
5C (Upper Section)	--	0.8	0.5	--	--	--	--	**1.3**
5C (Lower Section)	--	--	--	1.4	--	--	--	**1.4**
5 Backwaters (Small)	--	--	--	--	0.2	--	MNR	**0.2**
5 Backwaters (Large)	--	--	--	--	1.3	--	--	**1.3**
6 Woods Pond (Shallow)	--	0.8	1.0	--	--	--	--	**1.8**
6 Woods Pond (Deep)	NA	--	--	0.6	--	--	--	**0.6**
7 (Channel)	--	--	--	--	--	--	MNR	**0.0**
7 (Impoundments)	--	--	--	--	--	--	MNR	**0.0**
8 Rising Pond (Shallow)	NA	--	--	--	0.4	--	--	**0.4**
8 Rising Pond (Deep)	NA	--	--	--	0.4	--	--	**0.4**
9 to 17	--	--	--	--	--	--	MNR	**0.0**

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Table 3-9 - Construction Schedule - SED 6
(Construction durations are shown in Years)

	SEDIMENT REMEDIAL TECHNOLOGY							
	REMOVAL		BACKFILL/CAPPING			BANK STABILIZATION	MONITORED NATURAL RECOVERY	TOTAL
REACH	Mechanical - Dry	Hydraulic/ Mechanical - Wet	Backfill	Engineered Capping	Thin-Layer Capping			
5A	6.2	--	0.6	--	--	0.8	--	**7.6**
5B	4.0	--	0.4	--	--	0.3	--	**4.7**
5C (Upper Section)	--	0.8	0.5	--	--	--	--	**1.3**
5C (Lower Section)	--	1.5	0.9	--	--	--	--	**2.4**
5 Backwaters (Small)	--	0.0	0.0	--	0.4	--	MNR	**0.4**
5 Backwaters (Large)	--	0.3	0.3	--	1.0	--	MNR	**1.6**
6 Woods Pond (Shallow)	--	0.8	1.0	--	--	--	--	**1.8**
6 Woods Pond (Deep)	NA	--	--	0.6	--	--	--	**0.6**
7 (Channel)	--	--	--	--	--	--	MNR	**0.0**
7 (Impoundments)	NA	--	--	--	1.0	--	--	**1.0**
8 Rising Pond (Shallow)	NA	--	--	--	0.4	--	--	**0.4**
8 Rising Pond (Deep)	NA	--	--	0.4	--	--	--	**0.4**
9 to 17	--	--	--	--	--	--	MNR	**0.0**

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Table 3-10 - Construction Schedule - SED 7
(Construction durations are shown in Years)

	SEDIMENT REMEDIAL TECHNOLOGY							
	REMOVAL		BACKFILL/CAPPING			BANK STABILIZATION	MONITORED NATURAL RECOVERY	TOTAL
REACH	Mechanical - Dry	Hydraulic/ Mechanical - Wet	Backfill	Engineered Capping	Thin-Layer Capping			
5A	7.9	--	1.0	--	--	0.6	--	**9.5**
5B	5.0	--	0.5	--	--	0.3	--	**5.8**
5C (Upper Section)	--	0.8	--	0.5	--	--	--	**1.3**
5C (Lower Section)	--	1.5	--	0.9	--	--	--	**2.4**
5 Backwaters (Small)	--	0.1	--	0.1	0.2	--	MNR	**0.4**
5 Backwaters (Large)	--	0.6	--	0.7	0.7	--	MNR	**2.0**
6 Woods Pond (Shallow)	--	1.1	--	1.7	--	--	--	**2.8**
6 Woods Pond (Deep)	--	--	--	0.6	--	--	--	**0.6**
7 (Channel)	--	--	--	--	--	--	MNR	**0.0**
7 (Impoundments)	--	0.6	--	0.8	0.5	--	--	**1.9**
8 Rising Pond (Shallow)	--	0.1	--	0.2	0.2	--	--	**0.5**
8 Rising Pond (Deep)	--	--	--	0.4	--	--	--	**0.4**
9 to 17	--	--	--	--	--	--	MNR	**0.0**

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Table 3-11 - Construction Schedule - SED 8
(Construction durations are shown in Years)

	SEDIMENT REMEDIAL TECHNOLOGY							
	REMOVAL		BACKFILL/CAPPING			BANK STABILIZATION	MONITORED NATURAL RECOVERY	TOTAL
REACH	Mechanical - Dry	Hydraulic/ Mechanical - Wet	Backfill	Engineered Capping	Thin-Layer Capping			
5A	9.7	--	1.2	--	--	0.6	--	**11.5**
5B	5.5	--	0.7	--	--	0.3	--	**6.5**
5C (Upper Section)	--	1.0	1.5	--	--	--	--	**2.5**
5C (Lower Section)	--	1.7	2.8	--	--	--	--	**4.5**
5 Backwaters (Small)	--	0.6	0.9	--	--	--	--	**1.4**
5 Backwaters (Large)	--	3.2	5.0	--	--	--	--	**8.2**
6 Woods Pond (Shallow)	--	2.5	4.1	--	--	--	--	**6.6**
6 Woods Pond (Deep)	--	1.6	2.6	--	--	--	--	**4.2**
7 (Channel)	--	--	--	--	--	--	MNR	**0.0**
7 (Impoundments)	--	1.6	2.0	--	--	--	--	**3.6**
8 Rising Pond (Shallow)	--	1.6	2.5	--	--	--	--	**4.1**
8 Rising Pond (Deep)	--	1.8	2.9	--	--	--	--	**4.7**
9 to 17	--	--	--	--	--	--	MNR	**0.0**

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Table 3-12 – Age Classes in FCM Corresponding to 120 mm Length, by Species Used for Comparison of Model Results to IMPGs for Threatened and Endangered Species

Species	Minimum Age Class	Maximum Age Class
Brown bullhead (bottom feeder)	2	6
Cyprinids (forage fish)	5	6
Largemouth bass (predatory)	2	10
Sunfish (forage fish)	3	6
White sucker (bottom feeder)	2	6

Table 3-13 –– FCM Species Weighting Factors in Each Subreach Used to Compute Average Concentrations for Evaluation of Threatened and Endangered Species IMPGs

Species	Subreach													
	5A	5B	5C	5D	WP	7A	7B	7C	7D	7E	7F	7G	7H	RP
BB	0	0.322	0.322	0.322	0.644	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322
WS	0.644	0.322	0.322	0.322	0	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322
LMB	0.206	0.206	0.206	0.206	0.206	0.206	0.206	0.206	0.206	0.206	0.206	0.206	0.206	0.206
SF	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075
CP	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075

Notes: BB = Brown Bullhead (bottom feeder); WS = White Sucker (bottom feeder); LMB = Largemouth Bass (predatory); SF = Sunfish (forage fish); CP = Cyprinids (forage fish)

Table 3-14 – Age Classes in FCM Corresponding to 130 to 400 mm Length, by Species Used for Comparison of Model Results to IMPGs for Piscivorous Birds

Species	Minimum Age Class	Maximum Age Class
Brown bullhead (bottom feeder)	2	6
Cyprinids (forage fish)	6	6
Largemouth bass (predatory)	2	10
Sunfish (forage fish)	3	6
White sucker (bottom feeder)	2	6

Table 3-15 – FCM Species Weighting Factors in Each Subreach Used to Compute Average Concentrations for Evaluation of Piscivorous Bird IMPGs

Species	Subreach													
	5A	5B	5C	5D	WP	7A	7B	7C	7D	7E	7F	7G	7H	RP
BB	0	0.2	0.2	0.2	0.25	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
WS	0.25	0.2	0.2	0.2	0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
LMB	0.25	0.2	0.2	0.2	0.25	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
SF	0.25	0.2	0.2	0.2	0.25	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
CP	0.25	0.2	0.2	0.2	0.25	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Notes: BB = Brown Bullhead (bottom feeder); WS = White Sucker (bottom feeder); LMB = Largemouth Bass (predatory); SF = Sunfish (forage fish); CP = Cyprinids (forage fish)

4. Analysis of Remedial Alternatives for Sediments and Erodible Riverbanks

This section provides detailed descriptions of each of the eight alternatives evaluated for addressing sediments and erodible riverbanks (referred to as sediment alternatives), and includes a detailed evaluation of each using the nine Permit criteria (General Standards and Selection Decision Factors) described in Section 2.

As detailed in the CMS Proposal, the eight sediment alternatives that have been developed and approved by EPA for evaluation (SED 1 through SED 8) encompass a broad range of options and technologies, from no action to extensive remediation. Development of the remedial alternatives focused primarily on the Rest of River reaches with the highest PCB concentrations in sediments, specifically Reaches 5 and 6 (the PSA), and to a lesser degree Reaches 7 and 8. As noted in Section 1.7 above, EPA agreed that (apart from no action) MNR is the only remedial alternative that needed to be evaluated for the further downstream reaches (Reaches 9 through 16).

The eight sediment alternatives were summarized in Section 3.1.1 and in Table 1-1. For convenience, the alternatives are summarized again below. Note that the term “capping,” when used alone, refers to engineered capping; thin-layer capping is identified separately and refers to a 6-inch sand cover used to enhance natural recovery. The term “removal” refers to removal followed by capping (or, for SED 7 and SED 8, removal followed by backfilling), unless otherwise indicated.

- SED 1 – No action in all reaches.
- SED 2 – MNR with institutional controls in all reaches.
- SED 3 – Sediment removal in Reach 5A, MNR in Reach 5B, a combination of thin-layer capping and MNR in Reach 5C, thin-layer capping in Woods Pond, and MNR for the remainder of the Rest of River.
- SED 4 – Combination of sediment removal, capping and thin-layer capping from Confluence to Woods Pond Dam. This alternative involves the same elements as SED 3 with the addition of sediment removal and thin-layer capping in Reach 5B and Woods Pond, capping in portions of Reach 5C, and thin-layer capping in portions of the backwaters.
- SED 5 – Combination of sediment removal, capping, and thin-layer capping from the Confluence to Woods Pond Dam and thin-layer capping in Rising Pond. This alternative involves the same elements as SED 4 with additional sediment removal in Reaches 5B

and 5C, capping alone in a portion of Woods Pond, and thin-layer capping in Rising Pond.

- SED 6 – Combination of sediment removal, capping, and thin-layer capping for the entire River from the Confluence to Woods Pond Dam, and a combination of capping and thin-layer capping in the Reach 7 impoundments and Rising Pond. This alternative involves the same elements as SED 5 with additional removal in Reach 5C and the backwaters, thin-layer capping in the Reach 7 impoundments, and a combination of capping and thin-layer capping in Rising Pond.

- SED 7 – Combination of sediment removal, capping, and thin-layer capping for the entire River from the Confluence to Woods Ponds Dam, in the Reach 7 impoundments, and Rising Pond. This alternative involves the same elements as SED 6 with additional removal in Reaches 5A and 5B and backfilling rather than capping in those reaches, additional removal in the backwaters and Woods Pond, and sediment removal in portions of the Reach 7 impoundments and Rising Pond.

- SED 8 – Removal of sediments, followed by backfilling, in all areas of the main channel and backwaters of the River between the Confluence and Woods Pond Dam, in the Reach 7 impoundments, and in Rising Pond, with the depth of removal set as the depth to which PCBs above 1 mg/kg are estimated to occur (1 mg/kg depth horizon), and MNR for the remaining portions of the Rest of River.

Where these alternatives specify a combination of remedial technologies (e.g., removal and capping) for a specific reach or subreach, the areas where each technology would be applied were described in Section 3.1.1. In addition, each of the above alternatives (except SED 1 and SED 2) includes removal and stabilization of erodible riverbanks containing PCBs in Reach 5. Further, each alternative includes (or, in the case of SED 1, assumes) the continuation and maintenance of biota consumption advisories as necessary to limit the public's consumption of fish and other biota from the River.

To evaluate the alternatives, EPA's PCB fate, transport, and bioaccumulation model was used to quantify the PCB reductions in sediment, water column, and fish predicted to result from implementation of each alternative. The use of this model in the CMS evaluations was described in detail in Section 3.2.[38] The resulting sediment and fish PCB concentrations for each alternative were compared to the relevant IMPGs in those media, using an appropriate spatial scale and type of sediment or fish concentration for the human or ecological receptor

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[38] A separate analysis was conducted for the impoundments in the Connecticut portion of the River, as described in Section 3.2.5.

group subject to the IMPG in question. The averaging areas and other assumptions used in these comparisons were described in Section 3.3. The water column PCB concentrations predicted by the model were used for comparisons to the chemical-specific ARARs for PCBs.

Each alternative has been evaluated in detail based on nine criteria: the three General Standards and six Selection Decision Factors specified in the Permit (described in Sections 2.1 and 2.2 above). The results of these detailed evaluations are presented in Sections 4.1 through 4.8 for each of the eight alternatives. Finally, a comparative evaluation of the eight alternatives was performed using the same nine criteria. This comparative evaluation is presented in Section 4.9.

4.1 Evaluation of Sediment Alternative 1

4.1.1 Description of Alternative

SED 1 is the no action alternative. As required by the NCP, it was evaluated for all reaches of the Rest of River and provides a baseline against which other sediment alternatives can be compared. SED 1 would not include any sediment or riverbank remediation in the Rest of River area – i.e., no additional remediation beyond the remediation already conducted or planned for areas upstream of the Confluence. Rather, it would rely on those completed and ongoing upstream source control and remediation measures, along with natural recovery processes (e.g., silting over with cleaner sediments) in the Rest of River, to reduce potential exposures to PCBs in the sediments over time. It would not include any long-term monitoring to track these reductions. Upstream source control and remediation measures were described in Section 2.3 of the CMS Proposal and summarized in Section 1.4 above. The more recent activities completed have included installation of NAPL collection systems at and near the GE facility, sediment and bank remediation activities in the Upper ½-Mile and 1½-Mile Reaches, and additional remediation activities in the floodplain and former oxbow areas adjacent to the East Branch of the River. Planned future activities that will result in further reduced PCB inputs to the Rest of River include remediation of Silver Lake, the Unkamet Brook Area (including Unkamet Brook), areas at the GE plant adjacent to the East Branch (e.g., East Street Area 2-South), and the sediments and lower bank soils in the West Branch adjacent to Dorothy Amos Park (which represent the major identified PCB source in the West Branch).

Although not specifically part of this alternative, it is assumed that Massachusetts and Connecticut would keep in place the existing biota consumption advisories based on PCBs, as necessary. The consumption advisories in Massachusetts warn against eating fish, frogs and turtles from the Housatonic River in Massachusetts, as well as eating ducks from the River between Pittsfield and Rising Pond. In Connecticut, the PCB fish consumption advisories for the Housatonic River vary by species, location, and group of potential consumers (e.g., children and pregnant women), ranging from "do not eat" (for a few species and locations) to advice for limiting fish meals to one meal per month or week. (In addition, both Massachusetts and Connecticut have state-wide fish consumption advisories based on mercury levels in fish.) It is also assumed that the existing inspection, monitoring, and maintenance programs for the dams on the River would continue under other authorities.

4.1.2 Overall Protection of Human Health and the Environment – Introduction

The first General Standard in the Permit, "Overall Protection of Human Health and the Environment," requires an evaluation of whether a remedial alternative "would provide human health and environmental protection, taking into account EPA's Human Health and Ecological Risk Assessments." As discussed in Section 2.1.1, application of this standard to a particular sediment remedial alternative relies heavily on the consideration of several other Permit criteria – notably: (a) a comparison of sediment and fish PCB concentrations predicted to result from implementation of the alternative to the human health and ecological IMPGs, which represent the levels that EPA considers to be protective of human health and ecological receptors based on the HHRA and ERA; (b) compliance with ARARs; (c) long-term effectiveness and permanence of the alternative, including long-term adverse impacts on health or the environment; and (d) short-term effectiveness. In these circumstances, the evaluation of whether SED 1 would be protective of human health and the environment is presented at the end of Section 4.1 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment. This same approach will be followed for the other sediment alternatives.

4.1.3 Control of Sources of Releases

SED 1 does not include any remediation activities within the Rest of River area. PCB levels in water column and surface sediments would be reduced over time due to the decrease in PCB transport from the East and West Branches as a result of the completed and remaining remediation activities upstream of the Confluence, in conjunction with the natural recovery processes within the Rest of River. Completed upstream source control and remediation measures have resulted in a reduction in the water column PCB load entering the Rest of River from the East Branch. For example, water column PCB sampling data collected from the station located immediately upstream of the Confluence (Dawes/Pomeroy Avenue) indicate that the in-river and upland remediation has reduced the East Branch PCB concentrations by a factor of three to five under both base flow and storm conditions (see Section 3 of the RFI Report [BBL and QEA, 2003] for pre-remediation data and the MIA-S for post-remediation data). Likewise, the annual average PCB loads entering the Rest of River from the East Branch from the model simulations exhibit a marked reduction from the upstream remediation. For example, the East Branch PCB load over the first 5 years of the model projections (see Section 3.2.2.4) is 90% lower than the load over the last 5 years of the model validation (i.e., 1999-2004; EPA 2006b). Some additional decreases in this PCB load would also be anticipated based on the planned future activities summarized in Section 4.1.1.

The existing dams along the River would continue to limit movement of the PCB-containing sediments within the impoundments behind the dams, thereby reducing the potential for transport of those sediments to further downstream reaches. While failure of those dams could lead to the release of the PCB-containing sediments impounded behind them, measures are in place under other authorities to prevent or minimize that possibility. As noted in Section 1.4, for the two principal dams on the River in Massachusetts, GE currently monitors and maintains Woods Pond Dam and ensures the monitoring and maintenance of Rising Pond Dam. This work consists of frequent visual inspections, with more detailed inspections of the dams' structural stability on a periodic basis, and the performance of maintenance and repairs as needed. The other dammed impoundments in Massachusetts have considerably lower PCB concentrations and sediment volumes (which would reduce any potential impacts of dam failure), and in any event the owners of those dams are required to inspect and maintain them under state law. The owners of the dams on the River in Connecticut are likewise required to inspect and maintain those dams. Continuation of these activities would help ensure that the dams remain intact, minimizing the potential for any future release and transport of sediments in the impoundments behind the dams.

The extent to which the sediment alternatives would control PCB releases was expressed using the following metrics calculated by the EPA model: (1) the PCB loading passing Woods Pond and Rising Pond Dams and the mass of PCBs transported from the River to the floodplain within the PSA; and (2) the ability of a flood to cause buried PCBs to become available for exposure.

Control of in-river PCB loads and mass transport to the floodplain were assessed by comparing 5-year averages calculated from model outputs over the first 5 and last 5 years of the projections, for each of the different sediment alternative projections. Five-year averages were used to minimize the effects of annual variations in flows and associated PCB transport on these comparisons. Furthermore, projection results from the first 5 years of SED 1 were used as the reference point to represent current conditions for all sediment alternatives in these comparisons.

Control of flood impacts on buried PCBs was assessed by examining predictions of erosion and subsequent changes in surface sediment PCB concentrations attributed to the extreme flow event simulated in Year 26 of the projection (see Section 3.2.2.1) as well as other large storm events included in the simulation period.

Based on EPA's model, under SED 1 the annual average PCB load passing Woods Pond Dam is predicted to decrease by 37% over the 52-year model projection period (i.e., from 20 kilograms per year [kg/yr] to 13 kg/yr). The annual average PCB load passing Rising Pond Dam is predicted to decrease by 41% over the same period (i.e., from 19 kg/yr to 11 kg/yr). Similarly, the annual average PCB mass transported from the River to the floodplain within Reaches 5 and 6 is predicted to decrease by 50% over the model projection period (i.e., from 12 kg/yr to 6 kg/yr).

To assess the effects of an extreme flow event that may expose buried sediments, temporal profiles of model-predicted reach-average PCB concentrations in surface sediments resulting from SED 1 over the 52-year model projection period are shown on Figure 4-1b. Under SED 1, EPA's model predicts no perceptible change (e.g., less than 0.1 mg/kg) in reach-average surface sediment (top 6-inch) PCB concentrations in the PSA following the extreme event simulated in Year 26, which has a return frequency between 50 and 100 years (Figure 4-1b). Similar imperceptible or small changes in reach-average surface sediment PCB concentrations were predicted in reaches downstream of the PSA (the only notable increase in sediment concentration predicted to result from the extreme event in Reaches 7 and 8 is a 0.5 mg/kg increase in Reach 7G). While the model predicts varying extents of sediment erosion in these reaches during this event, the underlying sediments contain PCBs at concentrations similar to those of the scoured surface sediments, resulting in no perceptible changes in reach-average surface sediment PCB concentrations. That is, under SED 1, the event is not predicted to expose buried PCBs at concentrations exceeding those already exposed at the sediment surface.

4.1.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE were discussed in Section 2.1.3 and are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs (Table 2-1) include the federal and state water quality criteria for PCBs. The federal water quality criteria consist of a freshwater chronic aquatic life criterion of 0.014 µg/L and a human health criterion of 0.000064 µg/L based on consumption of organisms or water and organisms.[39] The Massachusetts and Connecticut criteria are the same, except that Connecticut has not revised its human health criterion since the federal criterion was revised and thus maintains the prior, less stringent criterion of 0.00017µg/L. As such, the latter may not be an ARAR, since it is less stringent (and less up-to-date) than the federal criterion (see 40 CFR § 300.5).

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[39] The human health criterion for PCBs is the same for consumption of water and organisms and for consumption of organisms only and is driven by assumed effects on organisms. The level for water consumption would be much higher. The EPA national drinking water standard for PCBs is 0.5 µg/L (40 CFR 141.61(c)). As shown below (Table 4-1), the model-predicted water column concentrations under SED 1 are below that level.

To evaluate whether SED 1 would achieve those criteria, GE reviewed the water column PCB concentrations predicted by EPA's model for SED 1. The predicted water column concentrations are presented in Table 4-1 (in Section 4.1.5.1 below). As shown in that table, annual average water column concentrations predicted by the model at the end of the simulation period are above the freshwater chronic aquatic life criterion of 0.014 µg/L (equivalent to 14 ng/L) in all reaches except Reaches 5A and 8 (which have annual average water column PCB concentrations at Holmes Road and Rising Pond Dam of approximately 0.009 and 0.013 µg/L at the end of the model projection period, respectively) and the four Connecticut impoundments (which have estimated water column PCB concentrations ranging between 0.0006 and 0.001 µg/L). Further, model-predicted water column concentrations exceed the federal and Massachusetts human health consumption criterion of 0.000064 µg/L (0.064 ng/L) in all reaches, and the water column concentrations estimated by the CT 1-D Analysis exceed the Connecticut consumption criterion of 0.00017 µg/L (0.17 ng/L).

GE believes that the ARARs based on the human consumption water quality criterion of 0.000064 µg/L should be waived on the ground that achievement of that criterion is technically impracticable, as provided in CERCLA (§ 121(d)(4)(C)) and the NCP (40 CFR § 300.430(f)(1)(ii)(C)*(3)*). There are two reasons for this: (1) that criterion is extremely low and is below the current ability to reliably measure;[40] and (2) that criterion would not be achieved by any of the eight sediment remedial alternatives under consideration, even the most stringent, SED 8, as shown in Section 4.8.4 and Table 4-43.**[41]**

Since SED 1 would not involve any remedial actions in the Rest of River area, the location-specific and action-specific ARARs (listed in Tables 2-2 and 2-3, respectively) would not apply.

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[40] The preamble to EPA's NCP states that "ARARs must be measurable and attainable since their purpose is to set a standard that an actual remedy will attain" (EPA, 1990a, p. 8752); and EPA guidance on ARARs indicates where compliance with applicable standards cannot be measured due to detection limit issues, "the technical impracticability waiver should generally be invoked" (EPA, 1990b). The latter notes further that, in the absence of a reliable measurement tool, extrapolations should not be used because they "cannot be verified scientifically with any degree of certainty."

[41] As noted above, the Connecticut water quality criterion of 0.00017 µg/L based on human consumption may not constitute an ARAR since it is not more stringent than the comparable federal criterion and is less up-to-date. However, if it were, GE believes that it should also be waived. Although, as discussed in subsequent sections, the CT 1-D Analysis indicates that, under all of the sediment alternatives that include removal and/or capping, this criterion would be met in some or all of the Connecticut impoundments by the end of the model period, those predictions (which are extrapolations of the EPA model results) are highly uncertain and cannot be considered a reliable indicator that this criterion would be achieved. In addition, it has not been demonstrated to date that levels below that criterion can be reliably measured on a routine basis. As such, GE believes that this criterion should be considered technically impracticable to attain.

4.1.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness of a remedial alternative includes an evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts associated with the alternative on human health or the environment. Each of these considerations is evaluated below for SED 1.

4.1.5.1 Magnitude of Residual Risk

The assessment of the magnitude of residual risk includes consideration of the extent to which and timing over which the alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure, such as engineering and institutional controls.

Since SED 1 would involve no remediation in the Rest of River area, the reductions in PCB concentrations and exposure that would occur in that area would consist solely of those resulting from upstream source control and remediation measures and natural recovery processes. The following table shows, by reach, the average PCB concentrations predicted by EPA's model to be present at the end of the model simulation period (Year 52) in the media to which such receptors may be exposed – i.e., sediments in the bioavailable zone (top 6 inches), surface water, and fish (whole body and fillet-based concentrations). The fish tissue concentrations listed are for largemouth bass age classes 6-10 (or smallmouth bass in Connecticut), which are the species and age classes assumed for human consumption of fish (as described in Section 3.3.2).

Table 4-1 – Modeled PCB Concentrations at End of 52-Year Projection Period (SED 1/SED 2)

Reach	Average Surface Sediment (0-6") (mg/kg)	Average Surface Water (ng/L)	Average Fish (whole body) (mg/kg)	Average Fish (fillet) (mg/kg)[2]
5A	13	9.0	36	7.3
5B	7.0	44	47	9.3
5C	20	34	37	7.4
5D (backwaters)	17	---	48	9.5
6	16	33	43	8.6
7[1]	0.4 - 5.1	14 – 29	14 - 32	2.8 - 6.4
8	2.9	13	18	3.6

Reach	Average Surface Sediment (0-6”) (mg/kg)	Average Surface Water (ng/L)	Average Fish (whole body) (mg/kg)	Average Fish (fillet) (mg/kg)[2]
CT[1]	0.04 – 0.08	0.6 – 1.3	0.4 – 0.8	0.08 – 0.2

Notes:

1. Values shown as ranges in Reach 7 and CT represent the range of modeled PCB concentrations at the end of the projection within each of the Reach 7 subreaches, and the range of concentrations indicated by the CT 1-D Analysis for the four Connecticut impoundments.
2. Fish fillet concentrations were calculated by dividing the modeled whole-body fish PCB concentrations by a factor of 5, as directed by EPA.

The potential residual risks to human and ecological receptors from the concentrations shown in the above table have been evaluated in the context of the extent to which they would achieve the IMPGs, as discussed in Section 4.1.6.

Temporal profiles of reach-average PCB concentrations in surface sediments, annual average surface water, whole body fish, and fish fillets resulting from no action over the 52-year model projection period are shown on Figures 4-1a-c. These figures show the timeframes over which PCB concentrations in each respective medium would be reduced under SED 1. Although the model results vary by reach (and annually in the water column due to changing hydrologic inputs), PCB concentrations in all three media generally exhibit a slow, steady decline throughout the projection period due the decreases in PCB loads entering at the Confluence and natural attenuation processes. As a result, fish PCB concentrations are reduced by 40% to 60% over the projection period (Figure 4-1c).

PCBs would remain in the sediments deeper than 6 inches and could be mobilized by high-flow events on the River. The extent to which a flood event could cause such buried PCBs to become available for human and ecological exposure was discussed in Section 4.1.3. As discussed in that section, model predictions indicate that flood events would not expose buried PCBs at concentrations exceeding those already exposed at the sediment surface.

Under SED 1, given the model results, it is presumed that biota consumption advisories would continue for an indefinite period.

4.1.5.2 Adequacy and Reliability of Alternative

Since SED 1 would not involve any remediation in the Rest of River, considerations relating to the adequacy and reliability of specific remedial technologies are not applicable. Note that natural recovery processes are documented to be occurring in the River as described in Section 4.2.5.2. However, under SED 1, the adequacy and reliability of natural recovery processes would not be determined in the future, since no monitoring activities would be implemented.

4.1.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

Since SED 1 would not involve any remediation in the Rest of River, it would not cause any long-term adverse impacts on human health or the environment.

4.1.6 Attainment of IMPGs

As part of the evaluation of SED 1, average PCB concentrations in surface sediment and fish predicted by the model at the end of the 52-year projection period have been compared to applicable IMPGs. For these comparisons, model-predicted sediment and fish PCB concentrations were averaged in a manner consistent with the methods used in the human health and ecological risk assessments (see Section 3.3). The sections below describe the human health and ecological receptor IMPG comparisons for SED 1; Tables 4-2 through 4-7 summarize the comparisons of SED 1 model results to the IMPGs that apply to sediments and fish.

As described below, IMPGs would be achieved in some areas by the end of the 52-year model simulation period due to natural recovery processes. The numbers of years required to achieve the various IMPGs are presented in Tables 4-2 through 4-7. In addition, the figures in Appendix G show temporal profiles of model-simulated PCB concentrations for each of the IMPG comparisons described in this section (including the estimated time to achieve each IMPG). Where certain IMPGs would not be achieved by the end of the model projection period, the time to achieve the IMPGs has been estimated by extrapolating the model projection results beyond the 52-year simulation period, as directed by EPA, using the extrapolation method described in Section 3.2.1. Such extrapolation produces estimates that are highly uncertain. Nonetheless, the extrapolated estimates of the time to achieve the IMPGs that are not met within the 52-year model projection period are described below.

Also, as described in Section 3.2, bounding simulations have been conducted with the model (as directed by EPA) to evaluate the significance of various assumptions regarding the East Branch PCB boundary condition and sediment residual values. Since SED 1 does not involve remediation, the sediment residual bounding assumptions do not apply. Further, the bounding simulation conducted for SED 1 to evaluate the significance of the East Branch boundary condition assumptions indicated that the impact on the model results is negligible. Therefore, the results of the bounding simulation for SED 1 are not included in the discussion below.

4.1.6.1 Comparison to Human Health-Based IMPGs

For human direct contact with sediments, the average predicted surface sediment (0- to 6-inch) concentrations for SED 1 would achieve IMPG values within EPA's cancer risk range, as well as all non-cancer-based IMPGs, in all eight of the sediment direct contact exposure areas located within Reaches 5 through 8 (see Table 4-2). Specifically, this alternative would achieve all direct contact IMPG values with the exception of the RME values based on a 10^{-6} cancer risk and, in areas SA 2 and SA 3, the RME values based on a 10^{-5} cancer risk (which would be slightly exceeded). The majority of the IMPGs that would be achieved within the 52-year model simulation period are met at the onset of the model projection period, while some would be achieved over a period of approximately 10 to 40 years via natural recovery processes.

For human consumption of fish, the fish PCB concentrations predicted to result from SED 1 at the end of the 52-year simulation period, when converted to fillet-based concentrations, would not achieve any of the IMPGs within the EPA cancer risk range or based on the non-cancer target HI in any reaches by the end of the simulation period (Table 4-3), except as follows:

- The CTE IMPGs based on a 10^{-4} cancer risk would be achieved in some of the subreaches between Woods Pond Dam and Rising Pond Dam after approximately 5 to 50 years (although the corresponding CTE IMPGs based on non-cancer impacts would not be achieved).

- The RME IMPGs based on a 10^{-4} cancer risk would be achieved in most of the Connecticut impoundments, although the corresponding RME IMPGs based on non-cancer impacts would generally not be achieved. In addition, the CTE IMPGs based on a 10^{-5} cancer risk would be achieved in most of the Connecticut impoundments at the onset of the model simulation period.

Extrapolation of the model results beyond the model period indicates that achievement of the RME-based IMPGs that EPA considers protective for unrestricted fish consumption of 50 fish meals per year, based on the deterministic approach and on a 10^{-5} cancer risk as well as non-cancer impacts, would take >250 years in the PSA and in Reaches 7 and 8, and 170 to 230 years in the Connecticut impoundments.[42]

4.1.6.2 Comparison to Ecological IMPGs

For benthic invertebrates, predicted average surface sediment PCB concentrations within the relevant averaging areas (i.e., “spatial bins” in Reaches 5 and 6 and subreaches in Reaches 7 and 8) would achieve the lower-bound IMPG (3 mg/kg) in approximately 20% of these areas, are within the range of IMPGs (3 to 10 mg/kg) in 50% of these areas, and exceed the upper-bound IMPG (10 mg/kg) in approximately 30% of these areas (Table 4-4). The time required to achieve the upper-bound IMPG (when attained within the 52-year model projection period) ranges from <1 to 40 years; however, in areas where this upper-bound is not achieved, extrapolation of the model results indicates that time to achieve the upper-bound IMPG for benthic invertebrates could range between 80 and >250 years.

For amphibians, predicted surface sediment PCB levels in the backwater areas at the end of the modeled period would achieve the lower-bound IMPG (3.27 mg/kg) in 25% of these areas (10 acres), are within the range of IMPGs (3.27 to 5.6 mg/kg) in 10% of these areas (5 acres), and exceed the upper-bound IMPG (5.6 mg/kg) in approximately 65% of these areas (71 acres) (Table 4-5). Time to achieve the IMPGs in backwaters varies between 5 and >250 (extrapolated) years for the upper-bound IMPG and between 10 and >250 (extrapolated) years for the lower-bound IMPG.

For insectivorous birds (represented by wood ducks) and piscivorous mammals (represented by mink), predicted average surface sediment PCB levels in the relevant averaging areas exceed the highest selected target sediment level (5 mg/kg) in all relevant averaging areas in Reaches 5 and 6, except for one wood duck averaging area (where achievement of that level would take approximately 50 years) (Table 4-6). Extrapolated estimates of the time required to achieve the wood duck sediment target levels in the remaining averaging areas range from 100 to >250 years for the 5 mg/kg target level, and 130 to >250 years for the 1 mg/kg target level. For mink, extrapolated estimates of the time required to achieve the sediment target

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[42] In this and subsequent sections, in order to have a consistent metric for specifying the time in which the extrapolations indicate that fish PCB levels would reach those for unrestricted fish consumption, GE has used the lower of (a) the deterministic RME IMPG based on a 10^{-5} cancer risk or (b) the deterministic RME IMPG based on a non-cancer HI of 1. Further, as discussed in Section 3.2.1, where that extrapolated time exceeds 250 years, the time has been specified as > 250 years, because (1) that timeframe corresponds to a duration ten times as long as that used to develop the extrapolation function, and (2) the uncertainty and unreliability of the projections render meaningless any attempt to compare alternatives beyond that timeframe.

levels are approximately 200 to 220 years for the 5 mg/kg target level and >250 years for the other target levels.

For piscivorous birds (represented by osprey), the model-predicted average whole-body fish PCB concentrations for the size ranges relevant to this receptor are greater than the IMPG of 3.27 mg/kg in all reaches (Table 4-7). Extrapolated estimates of the time required to achieve this IMPG range from approximately 90 years in Reach 7H to >250 years in several of the remaining reaches.

For the remaining ecological receptor groups (warmwater fish and threatened and endangered species), the model-predicted average whole-body fish PCB concentrations for the size ranges relevant to those receptors are below their respective IMPGs (55 and 30.4 mg/kg, respectively) in all reaches. In contrast, the coldwater fish IMPG of 14 mg/kg would not be met in five of the eight subreaches in Reach 7. Time to achieve the warmwater fish IMPG (in reaches where it was not already met at the beginning of the model projection period) ranges from approximately 5 to 35 years, while time to achieve the threatened and endangered species IMPG ranges from approximately 5 to 30 years. Estimates of the time to achieve the coldwater fish IMPG range from 30 to 110 (extrapolated) years.

4.1.7 Reduction of Toxicity, Mobility, or Volume

Since SED 1 would not involve any remediation in the Rest of River, it does not include any processes that would reduce the toxicity or volume of PCBs in the sediment, and any reduction in the mobility of PCBs in that area would occur in the long term through upstream source control/remediation and naturally occurring processes (e.g., silting over with cleaner sediments). However, these reductions would not be documented via monitoring.

4.1.8 Short-Term Effectiveness

Since SED 1 would not involve any remediation in the Rest of River, it would not result in any short-term impacts.

4.1.9 Implementability

Since SED 1 would include no remedial action or associated activities in the Rest of River, there would be no technical or administrative implementability issues associated with this alternative.

4.1.10 Cost

There would be no cost associated with SED 1.

4.1.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 4.1.2, the evaluation of whether SED 1 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As noted previously, since SED 1 would involve no remedial action in the Rest of River, it would rely solely on upstream source control/remediation measures and natural recovery processes, expected to primarily involve physical processes (e.g., silting over with cleaner sediments), to reduce the concentrations and human and ecological exposures to PCBs in sediments, surface water, and fish in that area. As shown in Section 4.1.3, EPA's model predicts that, due to these processes, the PCB load in the River passing Woods Pond Dam and Rising Pond Dam would be reduced by 37% and 41%, respectively, over the course of the modeled period. Further, EPA's model predicts that, due to these processes, there would be a reduction in sediment and fish PCB concentrations over that period, as shown in Section 4.1.5.1. For example, that model predicts that the fish PCB concentrations (whole body) would be reduced over the modeled period from 70-110 mg/kg to approximately 35-50 mg/kg in Reaches 5 and 6, from 30-50 mg/kg to approximately 20-30 mg/kg in the Reach 7 impoundments (i.e., Reaches 7B, 7E, and 7G), from approximately 30 mg/kg to approximately 20 mg/kg in Rising Pond, and from 1-2 mg/kg to 0.4-0.8 mg/kg in the Connecticut impoundments.

Compliance with ARARs: As discussed in Section 4.1.4, the predicted annual average water column concentrations resulting from SED 1 would not achieve the freshwater chronic aquatic life water quality criterion of 0.014 µg/L in any reaches except Reaches 5A and 8 and the four Connecticut impoundments. SED 1 would also not achieve the water quality criteria based on human consumption of water and organisms in any reaches, but GE believes that the ARARs based thereon should be waived as technically impracticable for the reasons given in Section 4.1.4.

Human Health Protection: As shown in Section 4.1.6.1, for direct human contact with sediments, SED 1 would achieve sediment PCB levels within EPA's cancer risk range and below the target non-cancer HI of 1 in all sediment direct contact exposure areas, with the majority of these IMPGs met at the present time. As such, SED 1 would provide human health protection from direct contact with sediments. For human consumption of fish, the fish PCB concentrations predicted to result from SED 1 at the end of the 52-year simulation period, when converted to fillet-based concentrations, would not achieve the IMPG levels based on RME assumptions, which EPA considers protective for unrestricted human fish consumption, in any reaches (except for the RME IMPGs based on a 10^{-4} cancer risk, but not the corresponding non-cancer IMPGs, in most of the Connecticut impoundments). Extrapolation of the model results beyond the 52-year simulation period indicates that PCB concentrations in fish fillets would not reach the RME IMPG levels based on a 10^{-5} cancer risk and non-cancer impacts for >250 years in Reaches 5 through 8, and 170 to 230 years in the Connecticut impoundments. In these circumstances, it is assumed that existing fish consumption advisories would continue to be used to protect human health from fish consumption.

Environmental Protection: From an environmental standpoint, as discussed in Section 4.1.6.2, the model results indicate that SED 1 would achieve fish PCB levels below the IMPGs for protection of warmwater fish and threatened and endangered species within the modeled period, but would not achieve sediment or fish IMPG levels for other ecological receptor groups in a number of averaging areas. For example, SED 1 would result in PCB levels in sediments and fish at the end of the modeled period that: (a) exceed the upper bound of the sediment IMPGs for benthic invertebrates (10 mg/kg) in about 30% of the relevant averaging areas; (b) exceed the upper bound of the sediment IMPGs for amphibians (5.6 mg/kg) in about 65% of the backwaters (covering approximately 80% of the backwater area); (c) exceed the highest selected target sediment level (5 mg/kg) developed to assess protection of insectivorous birds and piscivorous mammals in all relevant averaging areas (except one wood duck averaging area); (d) exceed the fish IMPG for piscivorous birds (3.2 mg/kg) in all relevant reaches; and (e) exceed the coldwater fish IMPG (14 mg/kg) in over half of the relevant reaches.

On the other hand, since SED 1 would not involve remediation in the Rest of River, it would not produce any adverse long-term or short-term environmental impacts.

The number and extent of exceedances of the IMPGs for multiple ecological receptors under SED 1 indicate that, if one accepts the EPA's conclusions in the ERA on which the ecological IMPGs were based, SED 1 would not be protective of those ecological receptors. However, as previously noted, GE does not agree with EPA's conclusions in the ERA or the resulting bases for these IMPGs.

Summary: Based on the foregoing considerations, it is concluded that, under SED 1, human health would be protected from direct contact with sediments and that human health protection from fish consumption would be provided by the continuation of fish consumption advisories. With respect to environmental protection, if one accepts EPA's conclusions in the ERA on which the ecological IMPGs were based, SED 1 would not achieve protective levels for several groups of ecological receptors.

4.2 Evaluation of Sediment Alternative 2

4.2.1 Description of Alternative

SED 2 consists of MNR with institutional controls for all reaches of the Rest of River, and would rely on upstream source control and remediation measures and natural recovery processes for reduction of PCB concentrations in surficial sediments over time. Institutional controls (i.e., maintenance of current biota consumption advisories, including continued posting of signs along the River) would be continued to reduce the potential for human exposure to PCBs. MNR is assumed to include the performance of routine monitoring activities in various reaches of the River to document changes in river conditions over time. Natural recovery processes (e.g., silting over with cleaner sediments) have been documented in portions of the Housatonic River (BBL and QEA, 2003, Sections 4.6 and 6.6) and would continue throughout the River downstream of the Confluence at varying rates due in part to the completed and planned source control and remediation measures in and adjacent to upstream reaches.

For purposes of this CMS Report, it is assumed that the monitoring program would include biota, water column, and sediment monitoring. Specifically, it is assumed that monitoring would include collection of the following:

- Adult fish sampling at eight locations (four locations each in Massachusetts and Connecticut) every 5 years, consisting of two species, 10 fish per species per location, with all samples submitted for PCB Aroclor and lipid content analysis;

- Quarterly water column sampling at 12 locations along the Housatonic River in Massachusetts and Connecticut for analysis of PCBs (total) and TSS; and

- Sediment sampling every 5 years, consisting of the collection of 100 surface sediment samples for PCB analysis.

Monitoring is assumed to continue for a period of 30 years. Although this program has been assumed for purposes of this CMS Report, the actual scope of monitoring activities would be determined during the design phase.

It is also assumed that the existing inspection, monitoring, and maintenance programs for the dams on the River would continue under other authorities.

4.2.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 4.1.2, the evaluation of whether a sediment remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether SED 2 would be protective of human health and the environment is presented at the end of Section 4.2 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

4.2.3 Control of Sources of Releases

Since SED 2 would not include any PCB removal or containment in the Rest of River, it would not significantly reduce the potential for future PCB releases from the sediments and riverbanks within that area via erosion during high-flow events. As described for SED 1, PCB levels in the water column and surface sediments would be reduced due to the decrease in PCB transport from the East and West Branches as a result of the completed and remaining remediation activities upstream of the Confluence, in conjunction with the natural recovery processes within the Rest of River. As summarized in Section 4.1.3, completed upstream source control and remediation measures have already resulted in a decrease in PCB loading to the water column. Decreases in PCB concentrations entering the Rest of River from the East Branch would be anticipated to continue, to some extent, based on the planned future activities summarized in Section 4.1.1.

Existing dams along the River would continue to limit movement of the PCB-containing sediments within the impoundments behind those dams, thereby reducing the potential for transport of those sediments further downstream. While failure of those dams could lead to the release of the PCB-containing sediments impounded behind them, the inspection, monitoring, and maintenance programs in place under other authorities, as described for SED 1 in Section 4.1.3, would prevent or minimize that possibility.

Modeling results (which are the same as for SED 1) indicate that, under SED 2, the average annual PCB loads passing Woods Pond Dam and Rising Pond Dam would decrease by approximately 37% and 41%, respectively over EPA's model projection period, and the average annual flux of PCBs entering the Reach 5/6 floodplain from the River would decrease by 50% over that period. Such reductions would be tracked over time via monitoring activities.

In addition, the effects of a flood in causing buried contaminated sediments to become available for exposure is the same under SED 2 as under SED 1, as discussed in Section 4.1.3.

4.2.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs, set forth in Table 2-1, include federal and state water quality criteria for PCBs. These criteria consist of a freshwater chronic aquatic life criterion of 0.014 µg/L and a human health criterion (based on consumption of water and organisms) of 0.000064 µg/L (0.00017 µg/L under the Connecticut standards, although that may not be an ARAR since it is less stringent and less up-to-date than the federal criterion).

To evaluate whether SED 2 would achieve those criteria, GE reviewed the water column PCB concentrations predicted by the model for SED 2. Since the model results for SED 2 are the same as those for SED 1, this comparison is the same as that described for SED 1 in Section 4.1.4 and is shown in Table 4-1 above. As for SED 1, the model-predicted annual average water column concentrations at the end of the simulation period are above the freshwater chronic aquatic life criterion of 0.014 µg/L in all reaches except Reaches 5A and 8 and the four Connecticut impoundments. Further, model-predicted water column concentrations exceed the federal and Massachusetts human health consumption criterion of 0.000064 µg/L in all reaches, and those estimated by the CT 1-D Analysis exceed the Connecticut consumption criterion of 0.00017 µg/L (0.17 ng/L). However, GE believes that the ARARs based on the human health consumption criteria should be waived under CERCLA and the NCP as technically impracticable for the reasons given in Section 4.1.4.

For SED 2, the applicable location-specific and action-specific ARARs (and TBCs) are those listed in Tables 2-2 and 2-3 that relate to sampling in waterbodies, floodplains, and wetlands, as well as biota consumption advisories and requirements pertaining to dam inspection/maintenance activities. The activities performed under SED 2 would be conducted in accordance with those ARARs.

4.2.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness of SED 2 includes an evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment, as described below.

4.2.5.1 Magnitude of Residual Risk

The assessment of the magnitude of residual risk associated with implementation of SED 2 has included consideration of the extent to which and timing over which the alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure, such as institutional controls.

Similar to SED 1, implementation of SED 2 would involve no PCB removal or containment in the Rest of River. As such, the reductions in PCB concentrations and exposure that would occur in that area would consist solely of those resulting from upstream source control and remediation measures and natural recovery processes. Table 4-1 (included in Section 4.1.5.1) shows, by reach, the average PCB concentrations predicted by EPA's model to be present at the end of the model period in surface sediments, surface water, and fish for SED 1. Those same predictions apply to SED 2.

The time trend plots presented on Figures 4-1a-c also apply to SED 2. These figures show temporal profiles of reach-average PCB concentrations in surface sediments, annual average surface water, whole body fish, and fish fillets, resulting from the implementation of SED 2 over the 52-year model projection period, as well as the timeframes over which SED 2 would reduce the PCB concentrations in each respective medium. As discussed in Section 4.1.5.1, a steady decline in PCB concentrations is predicted for most reaches in all media, due to reductions in PCB inputs from upstream and natural attenuation processes.

In addition, as with SED 1, PCBs would remain in the sediments deeper than those included in Table 4-1 and could be mobilized by high-flow events on the River. As noted in Section 4.2.3, the extent to which a flood event could cause such buried sediments to become available for human and ecological exposure is the same as for SED 1.

As part of SED 2, human exposure to PCBs in fish and other biota (e.g., fish, turtles, and ducks) would be addressed through biota consumption advisories (described in Section 4.1.1). Similar to SED 1, given EPA's model results, biota consumption advisories would need to be continued for an indefinite period. A long-term monitoring program would be implemented to evaluate the long-term effectiveness of this remedial alternative in mitigating potential human and ecological exposures to PCBs.

4.2.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of SED 2 has included an assessment of the following factors: whether the technology used in that alternative (MNR) has been used effectively at other sites under similar conditions; reliability of OMM requirements and availability of labor and materials needed for OMM; and the potential need to replace technical components of the alternative.

Use of Technologies under Similar Conditions

MNR has been selected as part of the overall remedial approach for contaminated sediments at numerous Superfund sites (EPA, 2005e). With specific regard to PCBs, MNR with source control was the selected for a seven-mile stretch of Twelvemile Creek and the 56,000-acre Lake Hartwell at the Sangamo-Weston Superfund Site in Pickens, SC (EPA, 1994a). At other PCB sites, MNR has been selected as a remedy component in conjunction with removal and/or capping; these include the Charleston Boat Yard, OR site (ORDEQ, 2001), the Fox River (EPA and WDNR, 2007), the Little Mississinewa River, IN (EPA, 2004c), and the Wycoff/Eagle Harbor Superfund Site East Harbor, WA (EPA, 1994b). Based on monitoring results available for some of these sites, natural recovery when combined with source controls has been demonstrated to be effective in reducing contaminant levels in sediment and biota (e.g., shellfish), although long-term monitoring data are not yet available at most sites to document risk reductions (EPA, 2005e).

Certain portions of the Rest of River, such as Woods Pond, Rising Pond, and the Connecticut impoundments, are currently demonstrating natural recovery, as indicated by the analysis of finely sectioned cores in Woods Pond and Rising Pond that indicate deposition of cleaner sediments on the surface of the ponds and by trends in fish and benthic insect PCB levels in the Connecticut impoundments (BBL and QEA, 2003, Sections 4.6 and 6.6). It is also likely that some natural recovery processes (e.g., silting over with cleaner sediments) are ongoing or will occur elsewhere in the River at varying rates due to completed and future PCB remedial measures implemented by GE and EPA in upstream areas. Thus, there are conditions in portions of the Rest of River which are similar to those at sites where MNR has been selected as a remedy component.

Reliability of Operation, Monitoring, and Maintenance Requirements/Availability of Labor and Materials

SED 2 would include long-term monitoring of biota, water column, and sediment to evaluate the effectiveness of the natural recovery processes. Such monitoring activities are considered a reliable means of tracking changes in constituent concentrations over time (EPA, 2005e). The labor and materials required to implement the long-term monitoring activities should be readily available. There would be no operation or maintenance requirements associated with implementation of SED 2, apart from maintaining the signs and other measures to publicize the biota consumption advisories.

Technical Component Replacement Requirements

Since SED 2 would not include in-river excavation/construction activities, there would be no need to replace technical components of the remedy.

4.2.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

SED 2 would not cause any long-term adverse impacts on health or the environment due to its implementation. The monitoring activities that are part of SED 2 would not produce any such adverse impacts, and no construction activities that might cause such impacts would be performed. In the absence of such construction activities, implementation of this alternative would not result in any changes to currently existing biota and corresponding habitat, nor would it affect any wetlands, change the River aesthetics, or impact the natural erosion of the riverbanks and bedload movement beyond those that would occur through natural processes.

4.2.6 Attainment of IMPGs

Since the model predictions for SED 2 are the same as those for SED 1, the extent to which SED 2 would achieve the IMPGs for human health and ecological protection and the time periods in which it would achieve those IMPGs (where it would do so) are the same as those described for SED 1 in Section 4.1.6. The comparisons of SED 2 model results to the IMPGs that apply to sediments and fish are summarized in Tables 4-2 through 4-7.

4.2.7 Reduction of Toxicity, Mobility, or Volume

Since SED 2 would not include any PCB removal or containment activities in the Rest of River, it does not include any processes that would reduce the toxicity or volume of PCBs in the sediment, and any reduction in the mobility of PCBs in that area would occur through upstream source control/remediation and naturally occurring processes (e.g., silting over with cleaner sediments). The reductions in PCB concentrations predicted by the model from implementation of this alternative are discussed in Section 4.2.5.1. The actual reductions would be tracked and evaluated through long-term monitoring.

4.2.8 Short-Term Effectiveness

Implementation of SED 2 would not cause any significant short-term adverse impacts on the local communities, the environment, or the workers involved in the remedial activities (i.e., long-term monitoring). No construction activities would be performed that could cause disruption or other adverse impacts to the local communities or the local environment, and the monitoring activities could be performed without producing such impacts. While the monitoring activities would involve the potential for exposure to PCBs by site workers involved in those activities, as well as the potential for accidents to such workers, these risks would be minimal, and would be mitigated through implementation of health and safety measures similar to those successfully applied during such activities on the River in the past.

4.2.9 Implementability

4.2.9.1 Technical Implementability

The technical implementability of SED 2 has been evaluated considering the factors identified below.

General Availability of Technologies: SED 2 would be implemented using well-established and readily available methods for long-term monitoring and dissemination of biota consumption advisory information. Fish, water column, and sediment monitoring would be conducted using conventional equipment.

Ability To Be Implemented: As described above, SED 2 could be readily performed. There would be no construction activities performed as part of SED 2.

Reliability: The monitoring activities that would be performed under SED 2 are reliable, as shown through implementation at other sites and the Housatonic River. Monitoring activities provide data necessary to evaluate trends in fish, water column, and sediment, so as to help determine the extent to which PCB concentrations are changing over time.

Availability of Space for Support Facilities: Since there would be no construction activities associated with SED 2, no staging areas or support areas would be needed along the River. Sampling activities would require only boat or shoreline access.

Ease of Conducting Additional Corrective Measures: SED 2 does not include any construction activities; therefore, implementation of this alternative would not interfere with the performance of additional corrective measures if deemed necessary at some point in the future.

Ability to Monitor Effectiveness: The effectiveness of SED 2 would be determined over time through monitoring to document PCB concentrations in the water column, sediment, and fish in various reaches of the River. Such monitoring has been used to document changes in sediment, surface water and biota PCB concentrations, and is expected to be an effective means of tracking the effects of implementing SED 2 over time.

4.2.9.2 Administrative Implementability

The administrative implementability of SED 2 has been evaluated considering the criteria listed below.

Regulatory Requirements: Implementation of SED 2 would need to comply with the substantive requirements of applicable and appropriate regulations pertaining to the performance of this alternative (unless waived). Since SED 2 includes only monitoring activities and maintenance of institutional controls, it could be conducted in accordance with the location-specific and action-specific ARARs relating to those activities (see Section 4.2.4).

Access Agreements: It is anticipated that implementation of SED 2 would require GE to obtain permission for access to private and publicly owned areas to conduct monitoring and for posting of biota consumption advisory signs. If GE should be unable to obtain access agreements with particular property owners, GE would request EPA and/or MDEP to provide assistance.

Coordination with Agencies: Implementation of biota consumption advisories would require coordination with state public health departments and/or other appropriate agencies in dissemination of information to the public and surrounding communities. In addition, GE would need to coordinate with EPA, as well as state and local agencies, to provide as-needed support with public/community outreach programs.

4.2.10 Cost

Since SED 2 does not include excavation or construction activities, there are no anticipated capital costs. The estimated annual cost of the long-term monitoring program associated with SED 2 ranges from $275,000 to $520,000 per year depending on the extent of monitoring occurring within a given year, resulting in a total OMM cost of $10.3 M over 30 years. The long-term monitoring program costs include the performance of quarterly surface water monitoring activities, as well as collection of representative sediment and fish tissue samples every 5 years, for 30 years following completion of construction. The following summarizes the total capital and OMM costs estimated for SED 2:

SED 2	Est. Cost	Description
Total Capital Cost	$0	Not applicable
Total OMM Cost	$10.3 M	Costs for performance of the 30-year Long-Term Monitoring Program
Total Cost for Alternative	$10.3 M	Total cost of SED 2 in 2008 dollars

Note: $ M = millions of dollars

The total estimated present worth cost of SED 2, which was developed using a discount factor of 7% and considering an OMM period of 30 years, is approximately $4.5 M. More detailed cost estimate information and assumptions for each of the sediment alternatives are included in Appendix E.

4.2.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 4.2.2, the evaluation of whether SED 2 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As noted previously, since SED 2 would involve no PCB removal or containment activities in the Rest of River, it would rely on upstream source control/remediation measures and natural recovery processes, expected to primarily involve physical processes (e.g., silting over with cleaner sediments), to reduce the concentrations and human and ecological exposures to PCBs in sediments, surface water, and fish in that area. Due to these processes, EPA's model predicts that SED 2 would result in the same reductions in PCB loading in the River and the same reductions in sediment and fish PCB concentrations as described for SED 1. However, under SED 2, these reductions would be tracked over time via monitoring.

Compliance with ARARs: As discussed in Section 4.2.4, similar to SED 1, the predicted annual average water column concentrations resulting from implementation of SED 2 would not achieve the freshwater chronic aquatic life criterion of 0.014 µg/L in any reaches except Reaches 5A and 8 and the four Connecticut impoundments evaluated. SED 2 would also not achieve the water quality criteria based on human consumption of water and organisms in any reaches, but GE believes that the ARARs based thereon should be waived as technically impracticable for the reasons given in Section 4.1.4. It is anticipated that SED 2 would achieve the location-specific and action-specific ARARs pertinent to MNR.

Human Health Protection: Since the model-predicted concentrations for SED 2 are the same as those for SED 1, the ability of SED 2 to achieve the IMPGs for human health protection is the same as that discussed for SED 1 in Section 4.1.11. For direct human contact with sediments, SED 2 would achieve sediment IMPGs within EPA's cancer risk range, as well as the non-cancer-based IMPGs, in all sediment exposure areas, with the majority of these IMPGs met at the present time. For human consumption of fish, the fish PCB concentrations predicted to result from SED 2 at the end of the 52-year simulation period, when converted to fillet-based concentrations, would not achieve the IMPG levels based on RME assumptions, which EPA considers protective for unrestricted human fish consumption, in any reaches (except for the RME IMPGs based on a 10^{-4} cancer risk, but not the associated non-cancer

IMPGs, in most of the Connecticut impoundments). Extrapolation of the model results beyond the 52-year simulation period indicates that PCB concentrations in fish fillets would not reach the RME IMPG levels based on a 10^{-5} cancer risk and non-cancer impacts for >250 years in Reaches 5 through 8 and 170 to 230 years in the Connecticut impoundments. In these circumstances, SED 2 would rely on the continuation of fish consumption advisories to protect human health from fish consumption.

Environmental Protection: For ecological receptors, like SED 1, SED 2 would achieve the IMPGs for protection of warmwater fish and threatened and endangered species within the modeled period. However, it would not achieve sediment or fish IMPGs levels for other ecological receptor groups – namely, benthic invertebrates, amphibians, piscivorous birds, and coldwater fish – in a number of averaging areas; and it would result in sediment levels that would exceed the highest selected target sediment level (5 mg/kg) developed to assess protection of insectivorous birds and piscivorous mammals in all relevant averaging areas (except one wood duck averaging area).

On the other hand, since SED 2 would not involve excavation or construction activities, it would not produce any adverse long-term or short-term environmental impacts.

As with SED 1, the number and extent of exceedances of the IMPGs for multiple ecological receptors under SED 2 indicate that, if one accepts the EPA's conclusions in the ERA on which the ecological IMPGs were based, SED 2 would not be protective of those ecological receptors. However, as previously noted, GE does not agree with EPA's conclusions in the ERA or the resulting bases for these IMPGs.

Summary: Based on the foregoing considerations, it is concluded that SED 2 would provide human health protection from direct contact with sediments and would rely on institutional controls (fish consumption advisories) to provide human health protection from fish consumption. With respect to environmental protection, if one accepts EPA's conclusions in the ERA on which the ecological IMPGs were based, SED 2 would not achieve protective levels for several groups of ecological receptors.

4.3 Evaluation of Sediment Alternative 3

4.3.1 Description of Alternative

SED 3 would include the removal (followed by capping) of 167,000 cy of sediment and bank soils over 42 acres, and application of a thin-layer cap over 97 acres. Specifically, the components of SED 3 include the following:

- Reach 5A: Sediment removal (134,000 cy over 42 acres);
- Reach 5B, upstream portion of Reach 5C, and Reach 5 backwaters: MNR;
- Reach 5 erodible banks: Removal and stabilization (33,000 cy);
- Downstream portion of Reach 5C and Reach 6 (Woods Pond): Thin-layer capping (37 acres in Reach 5C and 60 acres in Woods Pond); and
- Reaches 7 through 16: MNR.

Remediation would proceed from upstream to downstream to minimize the potential for recontamination of remediated areas. Figure 4-2 identifies the remedial action(s) that would be taken in each reach as part of SED 3.

The following summarizes the general remedial approach (and associated assumptions) related to implementation of SED 3. It is estimated that SED 3 would require approximately 10 years to complete. It should be noted that while details on equipment and processes are provided in this description for purposes of the evaluations in this CMS Report, the specific methods for implementation of any selected remedy would be determined during design based on engineering considerations and site conditions.

Site Preparation: Prior to implementation of remedial activities, access roads and material and equipment staging/handling areas (staging areas) would be constructed to support implementation of this alternative. Grubbing and clearing of vegetation would likely be necessary, and appropriate erosion and sedimentation controls would be put in place prior to construction. The conceptual plans developed for this CMS Report indicate that 24 staging areas and approximately 20 miles of access roads would be constructed between the Confluence and Woods Pond Dam to support implementation of SED 3.

Sediment Removal: In Reach 5A, 134,000 cy of sediment covering an area of 42 acres would be removed to a depth of 2 feet, followed by placement of a 2-foot cap over the removal areas (Figure 4-2). It is assumed that the excavation would be performed in the dry with conventional mechanical excavation equipment. Similar to the approach used for the Upper ½-Mile Reach and portions of the 1½-Mile Reach of the Housatonic River, sheetpiled cells would be established in the River to facilitate removal activities and limit downstream transport of sediment. A water treatment system would be used to treat water pumped from the excavation areas. Periodic water column and air sampling would be performed during implementation to monitor potential impacts associated with implementation.

Cap Placement: The cap installed in Reach 5A would be placed in the dry following excavation. The cap would be designed to limit the potential for upward migration of PCBs from the underlying sediment to the bioavailable zone within the cap and to limit the potential for erosion of the cap materials. Cap materials would be transferred to the River using conventional earth-moving equipment. It is assumed that the cap would contain 12 inches of sand (which may be amended with organic material to increase the TOC content) placed over the excavated riverbed, followed by 12 inches of armor stone over the sand. The composition and size of the sand and armor stone would be selected during design to limit the potential for migration of PCBs from the underlying sediments through the cap (sand material) and to preclude the movement of cap materials during high flow events (armor stone).

Thin-Layer Cap Placement: A thin-layer cap would be installed in downstream portions of Reach 5C (37 acres) and in Woods Pond (60 acres), as shown on Figure 4-2. The thin-layer cap would consist of a 6-inch layer of sand, placed via a combination of techniques, including mechanical and/or hydraulic means.

Sediment Dewatering and Handling: Sediment dewatering operations would be performed as necessary in the staging areas. For purposes of this CMS Report, it has been assumed that sediments removed in the dry from Reach 5A would contain some residual water and would require further dewatering by being stockpiled at the staging areas to allow them to dewater by gravity, with stabilization agents (e.g., other dry sediments, excavated soil, Portland cement) added as necessary prior to treatment and/or disposal. Treatment/disposition alternatives have been evaluated separately and are discussed in Section 7. A water treatment system would be used to treat water pumped from the excavation areas, as well as any decant water collected from excavated materials in the staging areas.

Bank Removal/Stabilization: SED 3 would include the removal of 33,000 cy of soil from the erodible banks in Reach 5 followed by bank stabilization. Bank stabilization is assumed to consist of bank grading and material removal to promote stable slopes (assumed to be 1½:1 to 3:1 slopes [horizontal:vertical]), followed by stabilization with revetment mats, armor stone, or bioengineering techniques. For purposes of this CMS Report, bioengineering techniques include such activities as log revetments, locked log walls, and vegetated geogrids. While the most appropriate removal/stabilization options would be selected in the design phase based on the physical features of the bank area in conjunction with the adjacent sediment and/or floodplain soil remedial activities, the following assumptions have been used for the current evaluation:

- Revetment mats for restored bank slopes of 1½:1 or greater;
- Armor stone for restored bank slopes between 1 ½:1 and 3:1; and
- Bioengineering for restored bank slopes of 3:1 or less.

For the purposes of this CMS Report, it is assumed that bank stabilization would be limited to Reaches 5A and 5B,[43] and would consist of 20% revetment mats, 60% armor stone, and 20% bioengineering techniques.

MNR: MNR would be implemented in the remainder of the Rest of River (Reach 5B, the upper portion of Reach 5C, Reach 5 backwaters, and Reaches 7 through 16). As previously discussed, natural recovery processes have been documented in portions of the Housatonic River and would be expected to continue throughout the Rest of River area at varying rates, due in part to completed and planned upstream source control and remediation measures, as well as the remediation that would be conducted as part of this alternative.

Restoration: SED 3 would include restoration of areas that are directly impacted by the sediment removal activities, the bank removal/stabilization activities, and ancillary construction activities, as appropriate to restore the habitat value of the affected systems to the extent practical. Restoration would be accomplished using a combination of passive procedures (practices to facilitate natural re-establishment of the resource) and active procedures (plantings or other mitigation). For purposes of this CMS Report, the extent and type of restoration activities that have been assumed for SED 3 are as follows:

- In Reach 5A, where approximately 42 acres would be affected by sediment removal, the river bottom would be restored to existing bathymetry through subsequent placement of a cap. Experience in the Upper ½-Mile Reach indicates that armor stone is an excellent substrate for benthic invertebrates, and it is anticipated that the armor stone (and any newly deposited sediment) would be readily recolonized by benthic invertebrates. Experience in that reach also indicates that aquatic vegetation would readily re-establish itself in areas where silt has redeposited over the armor stone, through transport from upstream sources of plants. Depending upon the extent of potentially impacted riverine wetland areas, supplemental plantings of emergent vegetation would be considered.

- It is not anticipated that restoration would be required for the thin-layer cap areas, as the capping substrate (much like that deposited in and around the armor stone in the Upper ½-Mile Reach) would serve as a ready base for recolonization by benthic invertebrates. As noted above for Reach 5A, aquatic vegetation would readily re-establish itself through transport from upstream sources of plants in the water column.

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[43] If erodible banks are identified in reaches other than Reaches 5A and 5B, measures similar to those identified here for Reaches 5A and 5B would be utilized to address those areas.

- On riverbanks where revetment mats or armor stone are used for stabilization, supplemental habitat structures (e.g., trees, log and root wad revetments, and/or log and brush shelters) would be considered as part of the restoration to replace similar existing structures. For the lower banks which are more frequently inundated, particularly during storm events, siltation and re-vegetation would occur over time, consistent with observations made in the Upper ½-Mile Reach. On banks where bioengineering techniques are used, plantings would be used to restore an appropriate riparian community.

- In the areas adjacent to the River where access roads and staging areas have been constructed to support work in the River, those support facilities would be removed and the disturbed areas revegetated with plantings that, over time, would restore the habitat value of those areas.

Restoration activities would be conducted following completion of the remedial action within successive reaches of the River as appropriate.

Institutional Controls: SED 3 would include the continued maintenance of biota consumption advisories, as appropriate, to limit the public's consumption of fish and other biota from the River.

Long-Term OMM: Once implemented, it is assumed that SED 3 would include a 5-year post-construction monitoring program and a long-term (30-year) monitoring and maintenance program.

The post-construction monitoring program would include annual visual observation of the remediated riverbed, riverbanks, and thin-layer cap areas for a period of 5 years following implementation in a given reach. For purposes of this CMS Report, it is assumed that the 5-year post-construction monitoring program would include the following:

- Visual observations of the cap over the restored Reach 5A riverbed, supplemented with probing in areas not visually observable to confirm the presence of the cap materials.

- Collection of sediment cores for visual observation in the thin-layer cap areas in Reach 5C and Woods Pond. Approximately 25 sediment cores (i.e., one core every 4 to 5 acres) would be collected for observation to assess cap thickness.

- Visual observations of the Reach 5 riverbanks to monitor for potential erosion and to assess riverbank stability.

- Monitoring via visual observation and quantitative/qualitative assessment of restored staging areas and access roads to confirm planting survival and extent of areal coverage, and visual observation to verify that habitat structures (if any) are intact.

In addition, it is assumed that the long-term monitoring program for SED 3 would include sampling of fish and the water column using the same program described for SED 2 in Section 4.2.1. Sampling of sediments under the long-term monitoring for this alternative would be developed based on the remedial components and size of the area impacted, and is assumed to occur every 5 years and include collection with PCB analysis of the following:

- Approximately 75 surface sediment samples from the MNR areas.

- Approximately 10 cores with a total of 30 samples from the removal areas (one core every 4 to 5 acres, three samples per core).

- Approximately 25 cores with a total of 25 samples from the thin-layer cap areas (one core every 4 to 5 acres, one sample per core).

Sampling is assumed to occur for a period of 30 years. In addition, a maintenance program would be implemented, as necessary.

4.3.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 4.1.2, the evaluation of whether a sediment remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether SED 3 would be protective of human health and the environment is presented at the end of Section 4.3 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

4.3.3 Control of Sources of Releases

SED 3 would reduce the potential for PCB releases from certain riverbanks and sediments through removal of PCB-containing sediments (with capping) in Reach 5A, removal with stabilization of erodible banks in Reach 5, and to a lesser extent thin-layer capping in portions of Reach 5C and in Woods Pond. Implementation of these remedial activities would address PCB sources over approximately 139 acres of the riverbed and approximately 7 miles of erodible riverbank, removing 167,000 cy of sediment and bank soils containing PCBs, thereby resulting in a reduction in the potential for future PCB transport within the River or onto the floodplain for potential human or ecological exposure. For Reach 5A (and erodible banks in all of Reach 5), PCB-containing surface sediments and bank soils which are prone to scour during high-flow events would be removed, and the residual PCBs remaining in these areas contained using caps and bank stabilization techniques, respectively. In portions of Reach 5C and Woods Pond where the water is deeper and the river bottom is less prone to scour, a thin-layer cap would be placed over the existing river bottom to accelerate the natural recovery process and assist in controlling releases from the river bed.

It should also be noted that the remaining remediation activities to be conducted upstream of the Confluence (i.e., in areas adjacent to the East Branch and in the West Branch) would reduce the PCBs available for scour/transport into the Rest of River, and that the natural recovery processes within the Rest of River would further reduce the PCBs in the surface sediments. Additionally, the existing dams along the River would continue to limit movement of PCB-containing sediments within the impoundments behind the dams and limit transport of those sediments further downstream. While failure of those dams could lead to the release of the PCB-containing sediments impounded behind them, the inspection, monitoring, and maintenance programs in place under other authorities, as described in Section 4.1.3, would prevent or minimize the possibility of such dam failure.

Implementation of SED 3, in combination with upstream source control, would reduce the mass of PCBs transported within the River to downstream reaches and to the floodplain, as demonstrated by EPA’s model. The annual average PCB load passing Woods Pond Dam at the end of the model projection is predicted to decrease by approximately 94% from that calculated at the beginning of the model projection period (i.e., from 20 kg/yr to 1.3 kg/yr). Likewise, SED 3 is predicted to achieve an 87% reduction in the average PCB load passing Rising Pond Dam over this same period (i.e., from 19 kg/yr to 2.4 kg/yr). Similarly, the annual average PCB mass transported from the River to the floodplain in Reaches 5 and 6 is predicted to decrease by 97% over the model projection period (i.e., from 12 kg/yr to 0.4 kg/yr).

The effects of an extreme flow event were examined using the Year 26 flood, which is the maximum flood during the 52-year projection period and has a return frequency between 50 and 100 years (see Section 3.2.2.1). The impact of this flood on surface sediment PCB concentrations can be seen on Figure 4-3b, which shows temporal profiles of model-predicted reach-average PCB concentrations in surface sediments resulting from the implementation of SED 3 over the 52-year model projection period. Similar to SED 1, the model results for SED 3 indicate that, in reaches subject to MNR only (i.e., Reaches 5B, 5D, 7, and 8), the extreme event is not predicted to expose buried PCBs at concentrations exceeding those already exposed at the sediment surface. This is supported by the minimal changes (generally less than 0.1 mg/kg) in reach-average surface sediment PCB concentrations predicted for those reaches (Figure 4-3b). Within Reach 5A, which would be capped, EPA's model predicts that, given the cap's armor layer, buried sediments would not be exposed during the extreme storm event, and consequently no change in reach-average surface sediment PCB concentrations is predicted (Figure 4-3b).[44] In reaches undergoing thin-layer capping (Reaches 5C and Woods Pond), the model predicts that those cap materials and the underlying sediments would largely remain stable during the extreme event in Year 26. The model results indicate that only limited portions of these areas (1% to 5% of the thin-layer capped areas) would experience erosion, which would result in relatively minor increases (0.5 to 1 mg/kg) in reach-average surface sediment PCB concentrations (Figure 4-3b). These concentration increases are small relative to the pre-remediation levels in these reaches (30 to 35 mg/kg) such that the concentrations following the extreme event still represent significant reductions relative to current levels (90% in Reach 5C and 96% in Woods Pond; Figure 4-3b). Thus, the model results indicate that buried sediments containing PCBs would not become exposed to any significant extent during an extreme flow event following implementation of SED 3.

4.3.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs, set forth in Table 2-1, include federal and state water quality criteria for PCBs. These criteria consist of a freshwater chronic aquatic life criterion of 0.014 µg/L and a human health criterion (based on consumption of water and organisms) of 0.000064 µg/L (0.00017 µg/L under the Connecticut standards, although that may not be an ARAR since it is less stringent and less up-to-date than the federal criterion).

To evaluate whether SED 3 would achieve those criteria, GE reviewed the water column PCB concentrations predicted by the model for SED 3. The water column concentrations are presented in Table 4-8 (in Section 4.3.5.1 below). As shown in that table, annual average water column concentrations predicted by the model at the end of the simulation period are below the freshwater chronic aquatic life criterion of 0.014 µg/L (14 ng/L) in all reaches. However, model-predicted water column concentrations exceed the federal and Massachusetts human health consumption criterion of 0.000064 µg/L (0.064 ng/L) in all reaches. For the Connecticut impoundments, the water column concentrations estimated by the CT 1-D Analysis (0.0001 to 0.0002 µg/L [0.1 to 0.2 ng/L]) are below the Connecticut consumption criterion of 0.00017 µg/L (0.17 ng/L) in two of the four Connecticut

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[44] Further evaluation of the stability of cap and thin-layer cap materials under SED 3 based on model predictions of erosion is provided in Section 4.3.5.2. The results of this stability analysis (i.e., percentages of cap/thin-layer cap areas that are stable) are cited in the remainder of this discussion.

impoundments, although these estimates are highly uncertain. GE believes that the ARARs based on the human health consumption criteria should be waived on the ground that achievement of those ARARs is technically impracticable for the reasons given in Section 4.1.4.

The potential location-specific and action-specific ARARs are listed in Tables 2-2 and 2-3. Based on review of those ARARs, GE believes that SED 3 could be designed and implemented to achieve most of the ARARs that would be pertinent to this alternative, although there are a couple that might require a specific EPA determination. For example, it is uncertain whether the temporary staging areas for dewatering and handling of PCB-containing sediments would meet all the default conditions of EPA's TSCA regulations for storage of PCB remediation waste at the cleanup site or site of generation (40 CFR § 761.65(c)(9)). Thus, depending on the specific design for those areas, it may be necessary to obtain an EPA determination that those staging areas meet the substantive requirements of the TSCA regulations for a risk-based approval (40 CFR § 761.61(c)). Additionally, the requirements for discharges from the water treatment facility(ies) include a requirement for effluent limitations or other conditions necessary to meet state water quality standards (40 CFR § 122.44(d)), except that discharges in compliance with instructions of the On-Scene Coordinator (OSC) acting under the NCP are exempt from such requirements (40 CFR § 122.3(d)). A requirement that the discharge meet state water quality standards is not technically feasible since current water quality conditions in the Housatonic River do not meet the Massachusetts water quality criteria for PCBs (see Section 4.1.4). Hence, an instruction from the OSC would be necessary to allow such discharge.

The ARARs that may not be met are those that could potentially apply to the temporary staging areas in the event that the excavated sediments should be found to constitute hazardous waste under RCRA criteria or comparable state criteria. Based on prior experience at other portions of this site (e.g., the 1½-Mile Reach and floodplain), it is not anticipated that the excavated sediments would constitute RCRA characteristic hazardous waste. However, appropriate testing of representative sediments would be conducted, using the Toxicity Characteristic Leaching Procedure (TCLP), to determine whether they would do so. In the event that any particular excavated sediments should be found to constitute hazardous waste under RCRA, the temporary staging areas may not meet all the substantive requirements of EPA's RCRA regulations for hazardous waste storage facilities. For example, it is not anticipated that waste pile staging areas would be constructed with the double liner/leachate collection systems specified for new waste pile units to be used for storage of hazardous waste (40 CFR § 264.251(c)), or that they would have groundwater monitoring systems such as is required for regular hazardous waste management facilities (40 CFR Part 264, Subpart F). Additionally, depending on the locations of these facilities and site characteristics, it is possible that at least some of them would not meet the hazardous waste facility requirements for preventing impacts from a 100-year flood (see 40 CFR §

264.18(b)), although they would include appropriate engineering controls for storm events. GE does not believe that it would be practical or necessary for the temporary staging facilities to be constructed and operated to comply with all the regular RCRA storage requirements (which are designed for more permanent storage facilities) simply due to the possibility that these facilities may be used for staging of some sediments that might constitute hazardous waste. Accordingly, GE believes that, to the extent that some sediments may constitute hazardous waste, the design and operating requirements for regular RCRA hazardous waste storage facilities should be considered inapplicable[45] or, if necessary, waived as technically impracticable.

Similarly, although not anticipated, it is possible that some excavated sediments may constitute hazardous waste under the Massachusetts hazardous waste regulations on grounds other than containing PCBs $\geq$ 50 mg/kg.[46] Even if they did so, GE believes that the Massachusetts hazardous waste regulations would not apply to the staging and dewatering of such sediments, provided that the sediments were temporarily stored at an "intermediate facility" (defined above) in accordance with the State's water quality certification regulations.[47] However, if those regulations were considered to apply, the staging areas would not meet certain requirements of the Massachusetts hazardous waste regulations. For example, since these areas need to be located close to the River and would contain waste piles, they could not feasibly meet the requirement that waste piles used for hazardous waste storage may not be constructed within the 500-year floodplain (310 CMR 30.701(6)). In addition, depending on the locations of the staging areas, some of those areas may not meet other location standards set forth in these regulations for such waste piles (e.g., 310 CMR 30.704(3), 30.705(3) & (6)) or certain design requirements for such waste piles (e.g., that the liner must be a minimum of 4 feet above the probable high groundwater table) (310 CMR 30.641). Further, construction of groundwater monitoring systems (per 310 CMR 30.660) for these temporary staging areas is not practical. In these circumstances, to the extent that some sediments may constitute hazardous waste and that the Massachusetts hazardous waste

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[45] For example, under EPA's Area of Contamination (AOC) policy (EPA, 1995), an overall area that includes discrete areas of generally dispersed contamination may be considered an AOC, within which the movement of waste is not considered "placement," such that the RCRA land disposal restrictions and other RCRA requirements, including minimum technology requirements, would not be triggered.

[46] Although wastes with PCB concentrations $\geq$ 50 mg/kg are listed hazardous wastes in Massachusetts, the Massachusetts hazardous waste regulations exempt facilities that manage such wastes so long as such facilities comply with EPA's TSCA regulations (310 CMR 30.501(3)(a)), and the staging facilities would meet substantive TSCA requirements. The other pertinent bases for characterizing a waste as hazardous are the same under state regulations as those under RCRA.

[47] The Massachusetts hazardous waste regulations exempt dredged material that is temporarily stored at an intermediate facility pursuant to 314 CMR 9.07(4) and managed in accordance with a state water quality certification and the requirements of a permit under § 404 of the Clean Water Act (310 CMR 30.104(3)(f)).

regulations were deemed to apply, such requirements should be waived as technically impracticable for the temporary staging areas.

4.3.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for SED 3 has included an evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment, as described below.

4.3.5.1 Magnitude of Residual Risk

The assessment of the magnitude of residual risk associated with implementation of SED 3 has included consideration of the extent to which and timing over which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure, such as engineering and institutional controls.

Implementation of SED 3, along with upstream source control/remediation measures and natural recovery processes, would reduce the exposure of humans and ecological receptors to PCBs in sediments, surface water, and fish in the Rest of River area. Potential exposure to sediments containing PCBs would be significantly reduced in Reach 5A due to the sediment removal and capping activities, and to the Reach 5 erodible banks following bank soil removal and stabilization. The placement of a thin-layer cap over the sediments in a portion of Reach 5C and in Woods Pond would reduce the surface sediment PCB concentrations in these reaches, thereby reducing potential human and ecological exposure risks. The following table shows, by reach, the average PCB concentrations predicted by EPA's model to be present at the end of the model simulation period (Year 52) for surface sediments, surface water, and fish (including both modeled whole body and calculated fillet-based concentrations). This table uses the same format described in Section 4.1.5.1.

Table 4-8 – Modeled PCB Concentrations at End of 52-Year Projection Period (SED 3)

Reach	Average Surface Sediment (0-6") (mg/kg)	Average Surface Water (ng/L)	Average Fish (whole body) (mg/kg)	Average Fish (fillet) (mg/kg)[2]
5A	0.06	2.6	1.3	0.3
5B	5.5	3.0	15	3.0
5C	3.0	4.0	9.1	1.8

Reach	Average Surface Sediment (0-6”) (mg/kg)	Average Surface Water (ng/L)	Average Fish (whole body) (mg/kg)	Average Fish (fillet) (mg/kg)[2]
5D (backwaters)	15	---	31	6.3
6	1.5	4.4	3.6	0.7
7[1]	0.4 – 4.7	2.1 – 4.1	3.6 – 11	0.7 – 2.1
8	2.7	2.3	7.9	1.6
CT[1]	0.009 – 0.02	0.1 – 0.2	0.09 – 0.2	0.02 – 0.04

Notes:

1. Values shown as ranges in Reach 7 and CT represent the range of modeled PCB concentrations at the end of the projection within each of the Reach 7 subreaches, and the range of concentrations indicated by the CT 1-D Analysis for the four Connecticut impoundments.
2. Fish fillet concentrations were calculated by dividing the modeled whole-body fish PCB concentrations by a factor of 5, as directed by EPA.

The potential residual risks to human and ecological receptors from the concentrations shown in the above table have been evaluated in the context of the extent to which they would achieve the IMPGs, as discussed in Section 4.3.6.

Temporal profiles of reach-average PCB concentrations in surface sediments, annual average surface water, whole body fish, and fish fillets resulting from the implementation of SED 3 over the 52-year model projection period are shown on Figures 4-3a-c. These figures show the timeframes over which PCB concentrations in each respective medium would be reduced under SED 3. The general pattern exhibited by these temporal profiles is one of a large reduction associated with the remediation, followed by a period of slow decline or, in some instances, a leveling off or increase to a new steady-state concentration determined by upstream PCB inputs and natural attenuation processes. In the surface sediments, this pattern is observed mainly in the remediated reaches, while most reaches exhibit this pattern for water column and fish concentrations, which illustrates how remediating upstream source areas (e.g., Reach 5A) translates to reductions in PCBs in downstream areas. As a result of the remediation under SED 3, predicted fish PCB concentrations are reduced over the projection period by 87% to 99% in the remediated reaches (i.e., Reaches 5A, 5C, and 6) and by 72% to 91% in the other reaches (Figure 4-3c).

PCBs would also remain in the sediments beneath and outside the areas addressed by SED 3. However, in Reach 5A, the cap would prevent direct contact with, and effectively reduce the mobility of, the PCB-containing sediments beneath the cap; and the thin-layer caps in portions of Reach 5C and in Woods Pond would provide a cover layer over the underlying PCB-containing sediments. Overall, the extent to which SED 3 would mitigate the effects of a flood event that could cause the PCB-containing sediments that have been contained by a cap or buried due to natural processes to become available for human and ecological exposure was discussed in Section 4.3.3. As discussed in that section, the model results indicate that buried sediments containing PCBs would not become exposed to any significant extent during an extreme flow event following implementation of SED 3.

In addition, potential human exposure to PCBs in fish and other biota would be reduced during and after implementation of SED 3 through biota consumption advisories. Also, a long-term monitoring program would be implemented to assess the continued effectiveness of this remedial alternative to mitigate potential human and ecological exposures to PCBs.

4.3.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of SED 3 has included an assessment of the following factors: whether the technologies have been used under similar conditions; whether the combinations of technologies in the alternative have been used together effectively; general reliability and effectiveness; reliability of OMM requirements and availability of labor and materials needed for OMM; and the potential need to replace technical components of the alternative, along with a consideration of potential exposure pathways and the associated risks should the remedial action need replacement.

Use of Technologies under Similar Conditions and in Combination

The SED 3 remedy components were selected for application in various reaches of the Rest of River based in part on the study and application of each technology (and combination of technologies) at other sites. As stated in EPA’s Contaminated Sediment Remediation Guidance for Hazardous Waste Sites, for remediation in “multiple water bodies or sections of water bodies with differing characteristics or uses, or different levels of contamination, project managers have found that alternatives that combine a variety of approaches are frequently the most promising” (EPA, 2005e, p. 3-2). Further, in response to variable site conditions at other sites (e.g., water depth, water velocity, sediment characteristics, etc.), a combination of technologies is often required to mitigate the potential for exposure to constituents in sediments. The recent report by the National Research Council (NRC) of the National Academy of Sciences on Sediment Dredging at Superfund Megasites stated that “dredging alone achieved the desired cleanup levels at only a few of the 26 dredging projects, and that capping after dredging was often necessary to achieve cleanup levels” (NRC, 2007, p. 4). It also noted that “the ability of combination remedies to lessen the adverse effects of residuals should be considered when evaluating the potential effectiveness of dredging” (NRC, 2007, p. 164), and that “some combination of dredging, capping or covering, and natural recovery will be involved at all megasites” (NRC, 2007, p. 248). As such, many sediment remedial projects have employed a combination of remedial technologies to achieve their respective remedial objectives.[48]

SED 3 includes such a combination of technologies. It includes sediment removal followed by capping using dry excavation techniques in Reach 5A, thin-layer capping in a portion of Reach 5C and in Woods Pond, and MNR in the remaining areas. These remedial components have been applied in various combinations at other PCB-containing sites as described below.

Sediment removal using dry excavation techniques and the removal and stabilization of erodible banks has been applied at sites containing PCBs under similar conditions to those in Reach 5A (e.g., higher energy environments), as discussed in the CMS Proposal (ARCADIS BBL and QEA, 2007a). These approaches, including both sediment removal in the dry followed by capping (or backfill) and the removal and stabilization of bank soils using a combination of stabilization techniques (e.g., revetment, armor stone, and bioengineering), were successfully demonstrated at the Upper ½-Mile Reach (including the Building 68 area banks) and the 1½-Mile Reach of the Housatonic River, which have similar conditions to Reach 5A (ARCADIS BBL and QEA, 2007a; Weston Solutions, Inc. [Weston], 2007). Bioengineering techniques such as those defined in Section 4.3.1 were successfully used at the Loring Air Force Base Wetland and Stream Restoration project (Woodlot Alternatives, Inc. [Woodlot], 2007). The same type of restoration techniques were also successfully used along 5,000 feet of the Missouri River in Vermillion, South Dakota (Derrick, 2008).

Placement of a thin-layer cap, such as would be used for the lower part of Reach 5C and in Woods Pond under SED 3, was pilot tested at the Grasse River (NY), and implemented at Eagle Harbor West Site (WA) and Pier 64 (WA), and has been incorporated into the ROD Amendment for the Fox River (WI) as part of a remedy which also includes sediment removal with capping, capping alone, and MNR. Thin-layer cap placement in a near-shore area at the Grasse River (NY) demonstrated a 99% reduction in surface PCB concentrations, with long-term monitoring ongoing (www.thegrasseriver.com). Water depths at the Grasse River where the thin-layer cap was placed were less than 5 feet, which is similar to portions of Reach 5C and Woods Pond where thin-layer capping would be performed. The ability to place a cap in thin lifts has also been successfully demonstrated in various depths up to 25 feet during pilot capping activities completed for Silver Lake (ARCADIS BBL, 2008).

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[48] Some examples of sites where a combination of remedial technologies was utilized include the St. Lawrence River Site (NY) (hydraulic dredging, mechanical excavation, and capping to address PCB-containing sediments; BBLES, 1996) and Fox River (WI) (sediment removal with capping, capping alone, and MNR to address PCB-containing sediments; EPA and WDNR, 2007). Moreover, MNR with institutional controls is commonly used at sites in combination with active remedial technologies, such as at Kalamazoo River (MI), Spokane River (WA), and Sheboygan River (WI).

MNR (with institutional controls) has been in place for several years at Lake Hartwell (SC) to address low-level PCBs in stretches of the lake and adjoining river where natural recovery processes were known or expected. Conditions at Lake Hartwell are somewhat similar to conditions in Reaches 7 and 8 as well as in Reaches 9 through 16, where MNR would be implemented under SED 3. Other reaches selected for MNR under SED 3 include Reach, 5B, the upper portion of Reach 5C, and Reach 5 backwaters, where PCB concentrations are higher than those observed at other sites, and conditions may differ from Lake Hartwell. However, in such areas, river conditions (i.e., slower moving depositional areas) should support the natural recovery process over time.

General Reliability and Effectiveness

SED 3 utilizes technologies that have been shown to be reliable and effective in reducing exposure of humans and ecological receptors to PCBs in sediments. Sediment removal combined with capping in Reach 5A and thin-layer capping in a portion of Reach 5C and in Woods Pond would effectively address the higher concentration areas in the River. MNR would address the remaining areas.

EPA has concluded that sediment excavation, capping, and MNR should be evaluated at every sediment site (EPA, 2005e). Under certain circumstances, sediment excavation can be effective and reliable in reducing the long-term potential for exposure of human and ecological receptors to contaminated sediments through removal of contaminant(s) of interest; however, there are some limitations associated with the technology, including sediment resuspension during removal and residual contamination following removal (EPA, 2005e). Placement of a cap over sediment removal areas has been used to address residual contamination. Capping is an EPA-approved technology for the effective remediation of contaminated sediments (EPA, 2005e), and has been successfully applied, either following removal or without removal, in a variety of settings, including rivers, near-shore areas, and estuaries. Various capping materials and cap placement techniques are available, and monitoring data collected for a number of projects have indicated that capping can be an effective remedy (Fredette et al., 1992; Brannon and Poindexter-Rollings, 1990; Sumeri et al., 1994).

Thin-layer capping can be effective at reducing the potential for human and/or ecological exposure to PCBs in sediment. Its greatest effectiveness has been typically demonstrated where it is not subject to high erosional forces. Assuming even low rates of natural sedimentation in the future, thin-layer capping can provide a base for sustained long-term reduction in surficial PCB concentrations. Studies have indicated that even very thin layers of new clean material placed on the sediment bed can result in a dramatic reduction in the interaction of sediment-associated contaminants with the overlying water (Talbert et al., 2001). In addition, EPA has acknowledged that placement of a thin layer "of clean sediment may accelerate natural recovery in some cases" (EPA, 2005e, p. 4-13).

Certain MNR and enhanced MNR approaches have been demonstrated at aquatic sites with PCB-containing sediment (EPA, 2005e). These approaches can be applied alone or in combination with other, more active remedial technologies (e.g., removal, *in situ* containment). MNR has been selected as a component of the remedy for contaminated sediment at numerous Superfund sites (EPA, 2005e). EPA has stated that MNR should "receive detailed consideration" where site conditions are conducive to such a remedy (EPA, 2005e, p. 4-3). EPA has also noted that many contaminants that remain in sediment are not easily transformed or destroyed, and that for this reason, "risk reduction due to natural burial through sedimentation is more common and can be an acceptable sediment management option" (EPA, 2005e, p. 4-1). Sedimentation would be expected to be the primary natural recovery mechanism for the Rest of River, and would eliminate or reduce exposure and risk by containing the contaminants in place through the deposition of cleaner sediments on top of impacted sediments.

To further assess the reliability and effectiveness of SED 3, model predictions of erosion in areas receiving a cap or a thin-layer cap were evaluated to assess cap stability. Two metrics were used in this assessment: (1) the area predicted to remain stable (i.e., undergo limited or no erosion) for the full duration of the model projection, including the extreme (50- to 100-year) flow event simulated in Year 26;[49] and (2) the predicted impact of such erosion (if any) on reach-average 0- to 6-inch surface sediment PCB concentrations. The results of these stability assessments for SED 3 are as follows:

Caps: Under SED 3, a cap would be installed in Reach 5A following removal. Those caps would be designed to resist erosion by including an appropriately sized armor layer. The model inputs for areas receiving a cap were specified accordingly, as discussed in Section 3.2.4.5. Thus, the areas receiving a cap under SED 3 are predicted to be 100% stable.

Thin-Layer Caps: SED 3 includes placement of a thin-layer cap in the lower portion of Reach 5C and Woods Pond to enhance natural recovery. For the purposes of evaluating long-term effectiveness, the thin-layer cap was considered stable (and therefore reliable) when EPA's model predicted that at least 1 inch of this material would remain for the full duration of the model projection.[50] Based on this definition, the model predicts that approximately 99% of the

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[49] Review of model results indicated that, in general, the most significant erosion is predicted to occur during the extreme flow event; thus, that event was a primary focus of this analysis (although other high flow events occurring within the projection period were evaluated as well).

[50] Because the model simulates mixing of thin-layer cap material with native sediment when the cap material erodes to less than 3 inches, there are circumstances where thin-layer capped cells increase in concentration due to such mixing and yet the 1-inch stability criterion is still met. However, model results based on a criterion of 3 inches were very similar to those for the 1-inch criteria used here, with the number of grid cells exceeding the criteria differing by only 1 or 2, and only in some reaches.

thin-layer capped area within Reach 5C would be stable under SED 3. The remaining 1% of the area predicted to contain less than 1 inch of thin-layer cap material occurs within a single model grid cell located in a narrow part of the channel of Reach 5C. That limited erosion is predicted to occur during the extreme flow event simulated in Year 26, and would result in an increase of less than 0.5 mg/kg in the reach-average 0- to 6-inch surface sediment PCB concentrations in Reach 5C (Figure 4-3b). Similarly, EPA's model predicts that approximately 95% of the thin-layer capped area in Woods Pond would remain stable. Erosion in the remaining 5% of the area was predicted by the model to occur in the pond's outlet channel during the extreme flow event. However, such erosion resulted in an increase of less than 1 mg/kg in the reach-average 0- to 6-inch surface sediment PCB concentration (Figure 4-3b). Even after such increases in concentration are taken into account, the concentrations following the high flow events still represent significant reductions relative to current levels for both reaches where SED 3 includes a thin-layer cap (90% to 96%, as discussed in Section 4.3.3). Based on these results, the model indicates that the thin-layer caps under SED 3 would be an effective means of reducing surficial PCB concentrations, even under an extreme flow event.

Reliability of Operation, Monitoring, and Maintenance Requirements/Availability of Labor and Materials

A combination of reliable OMM techniques, including periodic analytical sampling (fish, water column, and sediment), visual monitoring (i.e., visual observation supplemented with sediment probing and/or coring as necessary), and maintenance of the restored riverbed and riverbanks, would be implemented to maintain and track the long-term effectiveness of SED 3. Post-remediation sampling is commonly used (and recommended by EPA) to monitor the effectiveness of completed sediment removal and capping remedies (EPA, 2005e). Visual observation of the sediment cap and restored banks has been successfully implemented in the Upper ½-Mile and 1½-Mile Reaches of the Housatonic River, where river conditions are similar to those for Reach 5A and parts of Reach 5B. Should changes in cap conditions be noted that require maintenance, labor and materials (e.g., cap material, conventional earth-moving equipment, etc.) needed to perform repairs are expected to be readily available.

In addition, a monitoring and maintenance program would be implemented for actively restored areas to confirm planting survival and areal coverage and to determine whether habitat structures (if any) are intact. Such monitoring is considered a reliable means of tracking the progress of the restoration efforts. The necessary labor and equipment for such a program are expected to be readily available.

Technical Component Replacement Requirements

The technologies that comprise SED 3 were selected for application in areas of the River where site conditions are expected to support long-term reliability with minimal maintenance requirements. However, if erosion of cap and/or bank stabilization materials should occur that expose the underlying sediments/bank soil, an assessment would be conducted to determine the need for and methods of repair. Depending on the timing and location of the repair, access roads and staging areas may need to be temporarily constructed in the nearby floodplain. Periodic small-scale repairs would likely pose minimal risks to humans and ecological receptors that use/inhabit the disturbed river bottom and nearby floodplain. While not anticipated, redesign/replacement of larger remedy components could require more extensive disturbance of the river bottom, banks, and/or the adjacent floodplains to support access.

4.3.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of SED 3 on human health or the environment has included identification and evaluation of potentially affected populations, adverse impacts on biota and their habitat, adverse impacts on wetlands, impacts on the aesthetics of the natural environment, impacts on banks and bedload movement, and potentially available measures that may be employed to mitigate these impacts.

Potentially Affected Populations

Implementation of SED 3 would alter the habitat of the areas that would be excavated or subject to thin-layer capping, as well as the adjacent floodplain areas used for access roads and staging areas. These habitat alterations would affect people using these areas as well as the fish and wildlife in these areas. In some instances, the habitat alterations may actually improve habitat conditions. For example, placement of armor stone in excavated areas would increase the heterogeneity of the habitat for benthic invertebrates, particularly when portions of the dredged area are silted in over time. In other areas, the impacts will only be short-term as natural processes are expected to result in recovery of the biological communities and their associated habitat. In general, the species most affected by the remedial action would be those species with limited mobility such as reptiles and amphibians. It is expected that fish would move out of the active construction areas and mammals and birds would move away from the ancillary clearing activities in the floodplain that would occur in support of SED 3 remedial activities.

Adverse Impacts on Biota and Corresponding Habitat

The potential long-term impacts of SED 3 on biota and their habitat are discussed below in relation to the type of remediation involved. Note that, to the extent that affected areas constitute habitat for any rare, threatened, and/or endangered species, implementation of SED 3 could affect those species. In general, for the more mobile species and/or species with a wide range of habitat requirements, long-term impacts from the remedial activities are unlikely, because the activities would only displace these species to other areas of the river system. However, for animal species with narrower habitat requirements and for any threatened or endangered plant species, any long-term alteration of the habitat (as discussed below) could have a long-term adverse impact on those species.

Sediment Removal in Reach 5A: SED 3 would not be expected to have a substantial long-term adverse impact on biota and their habitat in Reach 5A. While aquatic organisms (fish and benthic invertebrates) would be disrupted on a short-term basis as a result of removal and capping activities in this area, such organisms should be re-established in a relatively short time following completion of the remediation. Based on observations made during monitoring of the Upper ½-Mile and the 1½-Mile Reaches, the armor stone used in the construction of the cap is an excellent substrate for benthic invertebrates. As noted in those reaches, the stone that would be placed in Reach 5A would be expected to be colonized by benthic invertebrates within a 3- to 5-year period following installation. In depositional areas, the armor stone, over time, would become covered by silt/sediment from upstream, which would increase the diversity of habitat for benthic invertebrates. Once the armor stone is covered by silt/sediment, it is anticipated that submerged aquatic vegetation would naturally recolonize those areas from upstream sources.

Riverbank Stabilization: The riverbank stabilization activities involved in SED 3 might have some long-term adverse impacts on riparian habitats in Reaches 5A and 5B, depending upon the stabilization technique that is used.

- In areas where the remediated slope would be 1½:1 or greater and revetment mats would be used for stabilization, the impacts are expected to be relatively minor as there is little in the way of existing riparian community along most of these steep slopes. However, in limited areas where mature trees currently exist at the top of the slope, construction or the placement of the mats would limit any replanting to locations farther away from the River. This would reduce the amount of overhanging tree canopy in such areas. In addition, steeper eroding banks can provide suitable habitat for avian and mammalian bank-dwelling species; the revetment mats would prevent such usage.

- In areas where the remediated bank slope would be between 1½:1 and 3:1 and armor stone would be used for stabilization, there are two potential long-term impacts. First, in those areas that are currently forested, the riparian forested community would be lost within the footprint of the armor stone (typically a strip approximately 5 to 10 feet wide back from the edge of the water). This would occur in approximately 36% of the riverbanks being remediated. Over time, some trees, shrubs, and herbaceous plants would establish themselves in the spaces between the armor stone and thus provide some vegetation in these areas. However, over the long term, there may be fewer mature trees adjacent to the River on these slopes, which could reduce the amount of shade in some of the sections of Reaches 5A and 5B and thus result in increased water temperatures from more constant exposure to the sun (Biedenharn et al., 1997). Second, the armor stone would prevent burrowing by bank-dwelling species, and would act as a barrier to smaller animals moving between the river and riparian habitats (Fischenich, 2003). The loss of these riparian corridors may affect dispersal of wildlife and fragment populations.

- In areas where the remediated bank slope would be 3:1 or less and bioengineering materials would be used for stabilization, there are unlikely to be long-term impacts since woody vegetation would be restored as a component of the bioengineering, thereby helping to restore and likely improve the riparian community.

Thin-Layer Cap in Reach 5C and Woods Pond: Placement of the thin-layer cap in portions of Reach 5C and in Woods Pond could produce long-term adverse impacts in limited areas where the water is less than 12 inches deep and consolidation of the underlying sediment is not anticipated. In these locations, which may occur along the shorelines, the thin-layer cap could increase the substrate elevation such that the vegetative characteristics of these riverine wetlands and the biota dependent on such wetlands would be changed – or in limited cases where the cap thickness would exceed the water depth, the area would no longer support riverine wetlands and the emergent wetlands vegetation would be replaced by species more tolerant of riparian or terrestrial conditions. Under SED 3, such impacts may potentially affect riverine wetlands along the edges of Reach 5C and on the edges of Woods Pond.

In deeper water areas, the placement of the thin-layer capping material is unlikely to have any long-term adverse impacts. The thin-layer cap would not permanently affect the ability of the substrate to support benthic invertebrates, submerged aquatic vegetation, or other aquatic organisms; and benthic communities and submerged aquatic vegetation would eventually be re-established from upstream sources. Further, in some deep locations, the placement of the thin-layer capping material could have a beneficial effect. Specifically, in areas with water depths of 2 to 4 feet, placement of the thin-layer cap could increase the area of the littoral zone, thereby broadening the area available for colonization by emergent aquatic plants.

<u>*Supporting Facilities in Floodplain*</u>: Long-term impacts to biota and their habitats may occur as a result of ancillary supporting activities in the floodplain, including the clearing and creation of access roads and staging areas. The conceptual layout design for SED 3 includes 24 staging areas covering approximately 41 acres (at an assumed size of approximately 1.7 acres per staging area), and approximately 20 miles of temporary roadways, which would amount to an additional 49 acres (assuming a road width of 20 feet). Potential long-term adverse impacts in these areas include habitat modification due to compaction/alteration of the soils, potential displacement of some species due to habitat fragmentation, and colonization by invasive species, as described below.

- *Habitat modification*: Prolonged (e.g., more than 2 to 3 years) use of the roads may compact the underlying substrate, potentially altering water storage capacity and hydrology.

- *Habitat fragmentation*: In forested areas, trees would need to be cleared to allow construction of roads and staging areas. In some instances, the removal of trees would fragment larger intact forested habitats, which would take decades to recover following the removal of the roads. Such habitat fragmentation could lead to displacement of some species and thus changes in the wildlife community.

- *Invasive species:* Active roadways provide a conduit for invasive species to enter disturbed areas (Jodoin et al., 2007). Seeds or fragments can be attached to vehicles (e.g., mud on tires) and transferred into new areas. Certain invasive species such as phragmites and purple loosestrife can displace native species and alter habitat functions (Weinstein and Balletto, 1999) and are extremely difficult, if not impossible, to eradicate once established (Blossey, 2003).

<u>Adverse Impacts on Wetlands</u>

Wetland environments that could potentially be affected by the implementation of SED 3 include: (a) riverine wetlands found along the periphery of removal areas in Reach 5A; (b) riverine wetlands along the periphery of bank stabilization areas in Reaches 5A and 5B; (c) riverine wetlands in Reach 5C and Woods Pond that would be addressed by the placement of the thin-layer cap; and (d) wetlands in the floodplain that could be impacted by access roads and other ancillary construction activities. Each of these is discussed below:

- Riverine wetlands along Reach 5A would be temporarily lost as a result of the removal and capping activities in that reach. However, these areas would be expected to silt in over time and be naturally recolonized from upstream material. Because the bathymetry is not expected to change (i.e., depth of removal is the same as the cap thickness), the post-remediation elevations would be suitable for supporting riverine wetlands.

- Bank stabilization activities in Reaches 5A and 5B may temporarily disturb riverine wetlands adjacent to the banks. However, the bank treatments are not expected to materially alter the bathymetry or substrate in the adjacent in-river areas, and thus would not be expected to have a long-term adverse effect on those riverine wetlands.

- As previously discussed, placement of the thin-layer cap could adversely affect riverine wetlands associated with the bank edges along Reach 5C and Woods Pond where the water is less than 6-12 inches deep and consolidation of the underlying sediment is not anticipated. For riverine wetlands in deeper water, the thin-layer cap would temporarily cover existing vegetation, but these areas would be recolonized from upstream locations and the seedbank (i.e., seeds produced by wetland plants in prior years that are stored, dormant, within the soil and sediment).

- As noted above, based on conceptual plans for placement of roadways and staging areas, it is expected that those ancillary construction activities would affect some wetlands. The long-term impacts on these wetlands would be mitigated by the wetlands restoration that would occur after the roadways and staging areas are removed. However, if some roadways were retained for long periods (e.g., more than 2 to 3 years), their use would likely result in compaction of the underlying substrate, which could alter the water storage capacity and hydrology of wetlands over which these roadways were built.

Long-Term Impacts on Aesthetics

SED 3 could have some long-term impacts on the aesthetic features of the natural environment. The removal activities in the 42 acres of Reach 5A and the bank stabilization activities along approximately 7 miles of Reaches 5A and 5B banks would alter the appearance of the River during the course of those activities. Over time, successional processes would restore the vegetative community bordering the River. However, in bank areas where revetment mats or armor stone are used for bank stabilization, the natural appearance of the banks would be diminished. In addition, in areas where vegetation would return, it would likely not mimic the state of the bordering river community prior to remediation. Vegetative communities that exist along portions of the River at this time are mature systems, and it would take several decades for any planted trees to reach the size of the older trees that would be removed during remediation.

The placement of construction roads and staging areas has the potential for causing long-term impacts on the aesthetics of the floodplain. Conceptually, it is expected that a network of roadways on both sides of the River in Reaches 5A, 5B, and part of 5C would be necessary to support the implementation of SED 3. Additionally, one staging area would be required to support the thin-layer capping activities in Reach 5C and Woods Pond. The placement of these roadways and staging areas would remove trees and vegetation, mostly in upland forest areas; and hence these areas would not be natural in appearance during the period while the roadways and staging areas remain in place and until they are restored. Moreover, the trees in some of the upland forested areas are mature trees that are greater than 50 years in age, and the time for a replanted forest community to develop an appearance comparable to its current appearance would be commensurate with the age of the current community.

Impacts on Banks and Bedload Movement

Previous studies of the riverbanks in Reaches 5A and 5B indicate that portions of these areas, at times, are subject to erosion and lateral movement (as described in Section 8.8.1.9 of the RFI Report, BBL and QEA, 2003). Under SED 3, some of the sediments, as well as soils from erodible riverbanks along Reaches 5A and 5B, would be removed and the banks would subsequently be restored to a more stable slope using a combination of armor stone, revetment mats, and bioengineering techniques. Stabilization of the banks would prevent additional erosion/lateral movement of the banks in these areas in the future. However, these actions could result in the need to stabilize other, currently non-erodible bank or riverbed areas to minimize the potential for future scour/movement of those areas. This is because stabilization of currently erosional bank areas may result in subsequent erosion of currently non-erosional bank areas (Federal Interagency Stream Restoration Working Group, 1998). The potential need to stabilize non-erodible banks and/or nearby riverbed areas would be evaluated and addressed, as necessary, during design.

Stabilization of the erodible riverbanks would also eliminate a source of solids that are transported as bedload in Reaches 5A and 5B.[51] To the extent that eroding banks slump into the River and subsequently contribute to the overall bedload in Reaches 5A and 5B, this process would be reduced following implementation of SED 3. The armor stone placed as a cap component would have an impact on bedload transport by capturing solids moving along the river bottom. Based on experience in the Upper ½-Mile Reach, once the armor stone is silted over, bedload movement should return to current conditions.

Potential Measures to Mitigate Long-Term Adverse Impacts

Actions that would be planned as part of the restoration of affected resources would serve to mitigate and minimize potential long-term adverse impacts to the River caused by implementation of SED 3. For resources affected by remediation work in the River or on the

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[51] Bedload data collected from the PSA indicate that this process occurs predominantly in Reach 5A and to a much lesser extent in Reach 5B, and has not been observed in areas downstream of those reaches (BBL and QEA, 2003).

banks, such actions include: (a) bank restoration measures to re-establish the habitat value of the bank areas through actions such as joint plantings, tree plantings, and/or placement of log and brush piles in bank areas where revetment mats and armor stone are used, and plantings in bank areas where bioengineering techniques are used; and (b) regrading and revegetation of affected riverine wetlands, to restore those wetlands, to the extent practical, or if such wetlands are permanently lost, appropriate wetlands mitigation. The use of armor stone in excavated areas will naturally minimize the long-term adverse impacts of the remedial action on the benthic community within the River by providing suitable habitat for the recolonization of the benthic community from upstream sources.

Actions would also be taken to minimize long-term adverse impacts to floodplain areas affected by the construction of ancillary support activities. These actions would include: (a) modification of roadway layouts and staging areas to avoid sensitive ecological areas such as wetlands, to the extent practical; and (b) restoration of wetland and upland areas impacted by the construction activities to re-establish the habitat value of those areas. Depending upon the severity of possible impacts to hydrology from the placement of roadways and staging areas, wetlands mitigation may be required.

4.3.6 Attainment of IMPGs

As part of the evaluation of SED 3, average PCB concentrations in surface sediment and fish predicted by the model at the end of the 52-year projection period have been compared to applicable IMPGs. For these comparisons, model-predicted sediment and fish PCB concentrations were averaged in the manner discussed in Section 3.3. The sections below describe the human health and ecological receptor IMPG comparisons for SED 3, and those comparisons are illustrated in Tables 4-9 through 4-14.

As described below, PCB concentrations in some areas are sufficiently low that certain IMPGs would be achieved prior to any active remediation of sediments, while some other IMPGs would be achieved at some point within the 52-year model simulation period, and other IMPGs would not be met (if at all) for many years after the modeled period. The numbers of years required to achieve the various IMPGs are presented in Tables 4-9 through 4-14.[52] In addition, figures in Appendix G show temporal profiles of model-simulated PCB concentrations for each of the IMPG comparisons described in this section (including the estimated time to achieve each IMPG). Where certain IMPGs would not be achieved by the end of the model projection period, the time to achieve the IMPGs has been estimated by extrapolating the model projection results beyond the 52-year simulation period, as directed

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[52] The extent to which SED 3 would accelerate attainment of the IMPGs relative to natural processes can be seen by comparing these tables to the comparable tables for SED 1 (see Section 4.1.6 above).

by EPA, using the extrapolation method described in Section 3.2.1. It should be noted that such extrapolation produces estimates that are highly uncertain. Nonetheless, the extrapolated estimates of time to achieve the IMPGs that are not met within the 52-year model projection period are described below.

Also, as described in Section 3.2, bounding simulations have been conducted with the model (as directed by EPA) to evaluate the significance of various assumptions regarding the East Branch PCB boundary condition and sediment residual values. In almost all cases, application of the "lower bound" assumptions in the model did not result in the attainment of additional IMPGs, beyond those attained using the "base case" assumptions, for the receptors/averaging areas described below. Therefore, the discussion below focuses on IMPG attainment resulting from the application of the "base case" model assumptions; however, the single instance of additional IMPG attainment resulting from application of the lower-bound assumptions is noted.

4.3.6.1 Comparison to Human Health-Based IMPGs

For human direct contact with sediments, the average predicted surface sediment (0- to 6-inch) concentrations for SED 3 would achieve the RME IMPGs based on a cancer risk of 10^{-5}, as well as all non-cancer-based IMPGs, in all eight of the sediment direct contact exposure areas located within Reaches 5 through 8 (see Table 4-9). The majority of these IMPGs would be met prior to any active remediation.

For human consumption of fish, the average fish PCB concentrations predicted by the model after 52 years, when converted to fillet-based concentrations, would not achieve any of the fish consumption IMPGs based on RME assumptions in Reaches 5 through 8, except the probabilistic cancer-based IMPG at a 10^{-4} risk (but not the non-cancer IMPG) in Reach 5A (Table 4-10). However, in the Connecticut impoundments, the CT 1-D Analysis indicates that SED 3 would achieve fish PCB levels within the range of the RME-based cancer and non-cancer IMPGs within the modeled period (except for the deterministic non-cancer IMPG for children in the Bulls Bridge Dam and Lake Lillinonah impoundments).

SED 3 would also achieve the CTE IMPG at a cancer risk level of 10^{-4} in nearly all subreaches of Reaches 5 through 8 within approximately 10 years, although the corresponding non-cancer IMPGs would generally not be met.[53] Also, it would achieve the CTE IMPGs at a 10^{-5} cancer risk in Reach 5A within approximately 20 years, although the corresponding non-cancer IMPG is not always met.

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[53] Application of the lower-bound assumptions would result in the additional attainment of the probabilistic CTE non-cancer (child) IMPG in Reach 7H.

Extrapolation of the model results beyond the model period indicates that achievement of the RME-based IMPGs that EPA considers protective for unrestricted fish consumption of 50 meals per year, based on a deterministic approach and on a 10^{-5} cancer risk as well as non-cancer impacts, would take 150 to >250 years in the PSA and >250 years in Reaches 7 and 8.

4.3.6.2 Comparison to Ecological IMPGs

For benthic invertebrates, predicted average surface sediment PCB concentrations within the relevant averaging areas would achieve the upper-bound IMPG (10 mg/kg) in all areas. Further, the predicted average surface sediment PCB concentrations would achieve the lower-bound IMPG (3 mg/kg) in 60% of these areas, and are within the IMPG range (3 to 10 mg/kg) in the remaining 40% of these areas (Table 4-11). Where the IMPGs would be achieved within the 52-year model period, the time required to achieve them ranges from 1 to 7 years in Reach 5A, and up to approximately 20 years in Reaches 5B, 5C and 6. For spatial bins in Reaches 5B, 5C and 6 where the lower-bound IMPG would not be met within the model simulation period, extrapolation of the model results indicates that this IMPG would be generally achieved in the majority of averaging areas within approximately 150 years.

For amphibians, predicted surface sediment PCB levels in the backwater areas at the end of the modeled period would achieve the lower-bound IMPG (3.27 mg/kg) in 30% of these areas (14 acres), are within the range of IMPGs (3.27 to 5.6 mg/kg) in 20% of these areas (12 acres), and exceed the upper-bound IMPG (5.6 mg/kg) in approximately 50% of these areas (59 acres) (Table 4-12). The time to achieve the upper-bound IMPG in the 50% of the backwater areas that achieve it within the model projection period ranges between 5 and approximately 40 years. The estimated time to achieve the lower-bound IMPG in all backwaters varies from approximately 10 years (based on the model) to >250 years (based on the extrapolations).

For insectivorous birds (represented by wood ducks) and piscivorous mammals (represented by mink), predicted average surface sediment PCB levels have been compared to the selected target sediment levels of 1, 3, and 5 mg/kg, which would allow achievement of the IMPGs for these receptors provided that the average floodplain soil concentrations in the same averaging areas are below certain associated target floodplain soil levels. For insectivorous birds, predicted average surface sediment concentrations are below the target sediment levels of 3 and 5 mg/kg in all of the Reach 5A averaging areas and below the target level of 1 mg/kg in some of those areas, but exceed all sediment target levels in nearly all of the exposure areas in Reaches 5B, 5C/5D, and 6 (Table 4-13). Time to achieve the wood duck sediment target levels within the Reach 5A averaging areas is generally shortly after completion of remediation within each area. Estimates of the time required to achieve the wood duck sediment target levels for averaging areas in Reaches 5B, 5C/5D, and 6 range from 10 to 170 (extrapolated) years for the 5 mg/kg target level, to 190 to >250 years for the 1 mg/kg target level.

For piscivorous mammals, the predicted average surface sediment PCB concentration in Reaches 5A/5B exceeds the target sediment level of 1 mg/kg but is below the target sediment levels of 3 and 5 mg/kg, with estimated times to achieve the latter of 45 and 8 years, respectively (Table 4-13). The predicted surface sediment level in the Reaches 5C/5D/6 averaging area exceeds all the target levels, with extrapolated estimates of the time required to achieve those levels ranging from 80 years for the 5 mg/kg target level to >250 years for the 1 mg/kg target level.

For piscivorous birds (represented by osprey), the model-predicted average whole-body fish PCB concentrations for the size ranges relevant to this receptor are greater than the IMPG of 3.2 mg/kg (Table 4-14) in all modeled reaches, except in Reaches 5A and 6 and four of the subreaches within Reach 7, where the IMPG is predicted to be achieved in approximately 10 to 20 years. Extrapolated estimates of the time required to achieve the osprey IMPG in the remaining subreaches range from 60 years in Reach 7D to >250 years in Reach 7B.

For the remaining ecological receptor groups (fish and threatened and endangered species), the model-predicted average whole-body fish PCB concentrations for the size ranges relevant to those receptors would achieve their respective IMPGs in all reaches. Specifically, SED 3 would achieve the IMPGs for fish protection (55 and 14 mg/kg for warmwater and coldwater fish, respectively) and threatened and endangered species (30.4 mg/kg) in all reaches (Table 4-14). In Reaches 5 and 6, time to achieve the warmwater fish IMPG ranges from approximately <1 to 11 years, while time to achieve the threatened and endangered species IMPG ranges from 3 to 10 years. In Reaches 7 and 8, these IMPGs are already achieved at the beginning of the model projection period.

4.3.7 Reduction of Toxicity, Mobility, or Volume

The degree to which SED 3 would reduce the toxicity, mobility, or volume of PCBs is discussed below.

Reduction of Toxicity: SED 3 does not include any treatment processes that would reduce the toxicity of the PCBs in the sediment. However, if removal activities should encounter “principal threat” wastes (described in Section 2.2.3), such as free NAPL or drums of liquid (which is not anticipated), these wastes would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: SED 3 would result in reduced mobility of PCBs in the River by removing approximately 134,000 cy of sediment containing PCBs in Reach 5A followed by capping; removing approximately 33,000 cy of PCB-containing erodible bank soils and stabilizing these banks in Reach 5; and placing a thin-layer cap over a total of 97 acres in portions of Reach 5C and in Woods Pond to enhance recovery processes.

Reduction of Volume: SED 3 would reduce the volume of sediment containing PCBs and the mass of PCBs present in the River through removal of 134,000 cy of sediment from Reach 5A containing approximately 10,300 pounds (lbs) of PCBs.[54] Further, 33,000 cy of bank soil containing approximately 1,200 lbs of PCBs would also be removed from Reaches 5A and 5B under this alternative.

4.3.8 Short-Term Effectiveness

Consideration of the short-term effectiveness of SED 3 has included an assessment of the short-term impacts of implementing SED 3 on the environment, local communities (as well as communities along transport routes), and the workers involved in the remedial activities. Short-term impacts would last for the duration of the active remedial activities, which is estimated to be approximately 10 years – specifically, approximately 8 years for Reach 5A and 2 years for Reaches 5B, 5C, and 6.

Impacts on the Environment

The short-term effects on the environment resulting from implementation of SED 3 would include: potential impacts to the water column, air, and biota in the Rest of River area during excavation, capping, and thin-layer capping activities; alteration/destruction of benthic habitat in the areas subject to those activities; loss of mature trees and other established vegetation found within the riparian habitat as a part of bank stabilization activities; and loss of some floodplain habitat and disruption to the biota that reside in the floodplain due to construction of the supporting facilities. Short-term impacts specifically associated with each remedial component are described below.

Sediment Removal: Sediment removal activities in Reach 5A (134,000 cy over 42 acres) would result in some resuspension of PCB-containing sediment in the water column due to the invasive nature of the removal operation. Resuspension to the water column outside the work area would be controlled in Reach 5A as sheetpiling would be used to contain the area during excavation/capping activities and removal activities would be performed in the dry.

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[54] The mass of PCBs removed from sediment was estimated based on EPA model mass balance results. The mass of PCBs removed from banks was estimated using an estimated average bank soil PCB concentration in Reaches 5A and 5B of 16 mg/kg and soil bulk density of 1.3 grams per cubic centimeter (g/cm^3) (BBL and QEA, 2003).

However, the potential exists for suspended or residual sediment containing PCBs to be released from the work area both during sheetpile installation and during a high flow event should overtopping of the sheeting occur. Water column monitoring would be conducted during the removal activities to assess any potential water quality impacts.

The potential also exists during removal and related sediment processing activities for airborne releases that could impact downwind communities. Air monitoring would be conducted during these activities to assess any potential air quality impacts.

Implementation of removal under SED 3 would cause a loss of aquatic habitat in the 42 acres of Reach 5A where such remedial activities would occur. Implementation of SED 3 would remove the natural bed material, debris, and aquatic vegetation which are used as habitat by both fish and benthic invertebrates in Reach 5A. The sediment removal activities would also result in the direct loss of benthic invertebrates and aquatic organisms (e.g., reptiles and amphibians) residing in the sediments during the removal, and a temporary disruption and displacement of fish in Reach 5A.

In addition, even with the use of sheetpiling, PCB levels in aquatic biota may increase temporarily in the vicinity of the remediation, with such levels decreasing after completion of the work. Such a temporary increase in biota PCB concentrations was noted in the results of the caged mussel monitoring performed during the Upper ½-Mile Reach Removal Action, which involved dry excavation using sheetpiling (GE, 2004b). Finally, sediment removal activities would alter feeding areas for birds and mammals that live adjacent to the River and feed in the areas subject to remediation.

Thin-Layer Capping: Thin-layer capping activities in Woods Pond and parts of Reaches 5C would be performed by placing a thin layer of sand over 97 acres of the undisturbed native sediments. Based on data collected during the Silver Lake capping pilot study, the potential for thin-layer capping to resuspend PCB-containing materials is considered minimal (ARCADIS BBL, 2008). Water column monitoring would be conducted during thin-layer cap placement activities to assess any potential water quality impacts.

Research has shown that placement of a thin layer of material in shallow near-shore areas can have positive (Leonard et al., 2002) or adverse (Jurik et al., 1994) impacts. Determining the thickness of thin-layer cap that can be applied without adverse impacts is a function of habitat type (Ray, 2007; Konig, 2004). Based on existing conditions in Reach 5C and Woods Pond, the thin-layer cap is unlikely to have any substantial adverse impact on the existing communities. The benthic community would quickly recover and emergent wetlands plants and submerged aquatic vegetation would likely work their way back up through the thin-layer cap or recolonize the new substrate from adjacent areas. However, as noted above, in shoreline areas where the water is 6-12 inches deep and consolidation of the underlying sediment is not anticipated, the thin-layer cap could increase the substrate elevation such that the vegetative characteristics of the wetlands, and the biota dependent on such wetlands, could be changed.

Bank Stabilization: Bank stabilization activities in Reach 5 would have an immediate effect on the riparian community bordering the River, which provides habitat that is unique to its position on the landscape. Removal of the riparian area would directly impact wildlife found along the River's edge. Riparian corridors are important for river access for wildlife and the loss of sections of the riparian community due to bank stabilization activities could impact dispersal of wildlife up and down the River, resulting in the fragmentation of populations. Opening the canopy as a result of tree removal from the banks would also increase the opportunity for invasive species to move into areas where they are currently not found. Additionally, these activities would produce a loss of cover, foraging, nesting, and feeding areas for wildlife that live immediately adjacent to the River.

Supporting Facilities: Construction of supporting facilities (e.g., roadways, staging areas) in the floodplain adjacent to the River would result in the temporary loss of habitat in those areas and the wildlife that they support. It is anticipated that SED 3 would require a total of approximately 90 acres for access roads and staging areas (approximately 55 acres within the 10-year floodplain). Development of these support facilities would affect the ability of some wildlife to nest and feed in these areas; and in some instances it would cause habitat fragmentation that could further disrupt the movement and interactions of certain wildlife species.

Impacts on Local Communities and Communities Along Transport Routes

Implementation of SED 3 would result in some short-term impacts to the local communities in the Rest of River area. The removal/thin-layer capping activities in the River, as well as the construction of staging areas and access roads in the adjacent floodplain, would cause disruption of recreational canoeing and other River-related and land-side activities in this area, together with increased noise and truck traffic. These impacts would mainly affect Reach 5A, where remediation activities are anticipated to last approximately 8 years, with lesser impacts in and adjacent to Reaches 5B, 5C, and 6, where remediation is estimated to last for approximately 2 years.

During the period of active construction, restrictions on recreational use of the River and floodplain would be imposed in the areas in which remediation-related activities are taking place. Due to safety considerations, boaters, hikers, anglers, and hunters would not be able to use the River or floodplain in the areas where such activities are being conducted Further, bank stabilization activities in Reach 5 would remove the ability of recreational anglers to use those areas during construction. Aesthetically, the presence of heavy construction equipment and cleared or disturbed areas would detract from the visually undisturbed nature of the area until such time as the restoration plantings for the disturbed areas have matured.

Due to the need to deliver equipment to the work areas and to remove excavated materials and deliver capping materials, truck traffic in the area would increase over current conditions. It is expected that this increased truck traffic would continue for the duration of SED 3 (10 years). As an example, if 20-ton capacity trucks were used to transport excavated sediments and bank soils from the staging areas, it would take approximately 12,500 truck trips to do so. In addition, assuming the use of smaller capacity trucks for local hauling (i.e., 16-ton trucks), approximately 22,700 truck trips would be required to transport sand, stone, and bank stabilization material to Reaches 5A, 5B, and 6. This additional traffic would increase noise levels and emissions of vehicle/equipment exhaust and nuisance dust to the air. Noise in and near the construction zone could affect those residents and businesses located near Reach 5A, with lesser impacts in Reaches 5B and 5C, and Woods Pond.

The additional truck traffic would also increase the risk of traffic accidents along transport routes. Appendix D includes an analysis of potential risks from the increased off-site truck traffic that would be associated with the sediment remedial alternatives. This analysis focuses on the increased truck traffic that would be necessary to transport clean materials to the site for implementation of the alternatives. (The risks from truck traffic to transport excavated materials to the staging areas are evaluated as part of risks to workers, discussed below; and the risks from truck traffic to transport such materials from the staging areas away from the site are evaluated under the relevant treatment/disposition alternatives.) This analysis indicates that the increased truck traffic associated with SED 3 would result in an estimated 0.65 non-fatal injuries due to accidents (with a probability of 48% of at least one such injury) and an estimated 0.03 fatalities from accidents (with a probability of 3% of at least one such fatality).[55]

Engineering controls would be implemented, to the extent practical, to mitigate short-term impacts and risks to the community in association with SED 3 implementation. However, some impacts would be inevitable.

Risks to Remediation Workers

Implementation of SED 3 would result in health and safety risks to site workers. Implementation of SED 3 is estimated to involve 371,480 man-hours over a 10-year timeframe. Appendix D also includes an analysis of potential risks to workers from

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[55] Since the analysis in Appendix D is based on statistics, it can result in an estimate of injuries or fatalities of less than 1.

implementation of the sediment alternatives. This analysis indicates that implementation of SED 3 would result in an estimated 3.68 non-fatal injuries to workers (with a probability of 97% of at least one such injury) and an estimated 0.03 worker fatalities (with a probability of 3% of at least one such fatality). Engineering controls and Occupational Safety and Health Administration (OSHA) procedures designed to mitigate risks to remediation workers would be instituted.

4.3.9 Implementability

4.3.9.1 Technical Implementability

The technical implementability of SED 3 has been evaluated considering the following factors.

General Availability of Technologies: SED 3 would be implemented using well-established and available in-river remediation methods and equipment. These include: conventional mechanical earthmoving equipment such as bulldozers and backhoes; support equipment such as barges for thin-layer capping; land-based dewatering equipment/methods (e.g., mechanical and gravity dewatering); and engineering controls (e.g., sheetpiling). Land-based support areas would be constructed using commonly available construction technologies. Well-established methods and readily available equipment would also be used to monitor the remedial alternative both during and following implementation.

Ability To Be Implemented: Based on site characteristics, the technologies that are part of SED 3 would be suitable for implementation in the reaches where they would be applied. Sediment removal followed by capping would be implemented in Reach 5A, with current grades re-established following cap placement so that flood flows and flood storage capacity in this reach are not altered. Removal and capping would be performed in the dry. Removal and capping in the dry has been successfully used in the Upper ½-Mile Reach, using sheetpiling to divert flow and isolate portions of the River for dewatering and subsequent removal in the dry. Since river characteristics are similar in Reach 5A to those in the Upper ½-Mile Reach, it is believed that the same dry removal/capping techniques could be successfully implemented.

Thin-layer capping would be implemented in portions of Reach 5C and in Woods Pond. These are areas of generally lower velocity, which are the types of areas that are suitable candidates for thin-layer capping. Placement of a thin layer of sand would enhance the ongoing natural recovery processes in these areas. The impacts on flood storage capacity resulting from the placement of thin-layer cap material in these reaches under SED 3 were assessed by comparing EPA model predictions of the area of floodplain within Reaches 5 and 6 inundated during a high flow event to that predicted under SED 1 during the same event. For the purposes of this analysis (and similar analyses conducted for the remaining sediment alternatives), an event occurring in Year 48 of the projection having a 2-year return period was selected.[56] Under SED 3, the area of floodplain within Reaches 5 and 6 predicted by the model to be inundated during this 2-year flow event was equal to that of SED 1 (817 acres). This indicates that the placement of thin-layer cap material in Reaches 5C and 6 under SED 3 would have no impact on flood storage capacity. This result was expected – since the backwater effects in Woods Pond and in Reach 5C are controlled by Woods Pond Dam, impacts to flood storage capacity would not be expected as a result of thin-layer cap placement in those reaches. Nonetheless, additional calculations would be conducted during design as appropriate.

Bank soil removal followed by stabilization would be performed in the erodible bank areas of Reach 5, with the most appropriate removal/stabilization options selected in the design phase based on the physical features of the bank area in conjunction with the adjacent sediment and/or floodplain soil remedial activities. Since the slope of some of the restored erodible banks would likely be reduced during remediation, an increase in flood storage capacity would likely result in those areas of Reach 5.

MNR with institutional controls would be implemented in all other reaches. Monitoring to track changes in PCB concentrations following the other SED 3 activities would be performed using readily available methods and materials, such as has been used previously in the River. The continued maintenance of biota consumption advisories would be expected to use similar techniques to those used previously.

Support facilities in the floodplain necessary for implementation of SED 3 (i.e., staging areas and access roads) could readily be constructed using commonly available construction techniques. The facilities would be constructed to avoid wetlands to the extent practicable.

Reliability: The technologies that comprise SED 3 are considered reliable, based on a review of similar applications at other sites, including previous remediation in the Housatonic River upstream of the Confluence. The use of these technologies at other sites is described in more detail in Section 4.3.5.2.

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[56] This event was selected for two reasons. First, this event is smaller than the 10-year event, which defines the limits of the floodplain in the EPA model. Because the numerical grid does not extend past the 10-year floodplain, the model cannot be used to accurately simulate floodplain inundation for larger events. Indeed, evaluation of predicted water surface elevations during the extreme event in Year 26 of the simulation indicated that the model results did not differ appreciably among the SED alternatives. Results from analysis of other storm events (e.g., 1-, 1.5-, and 5-year events) were similar to those for the 2-year event described here. Second, the event occurs at a time in the projection when sediment remediation within the PSA is complete for all alternatives, allowing a direct comparison of the full impact of remediation on flooding.

Availability of Space for Support Facilities: Implementation of SED 3 would require construction of access roads and staging areas at various locations within the floodplain of the Housatonic River. As noted previously, an estimated 90 acres of space would be needed, and appear to be available to support the SED 3 activities based on a conceptual site layout. Development of staging and support areas would be sequenced over the approximate 10-year implementation period estimated for SED 3.

Availability of Cap Material: Materials required for cap construction must be of suitable quality for in-river placement and habitat restoration. A total of approximately 227,000 cy of cap materials would be required for stabilization, thin-layer capping, and capping activities (i.e., 145,000 cy of sand and 82,000 cy of armor stone and rip-rap). Adequate material sources are assumed to be locally available, based on the availability and use of similar materials for the removal actions completed in the Upper ½-Mile and 1½-Mile Reaches. An evaluation would be performed during design activities to confirm suitable material availability.

Ease of Conducting Additional Corrective Measures: Future corrective measures, if needed to perform cap or bank maintenance or conduct additional remediation, would likely be implementable given the same technical and logistical constraints applicable to the initial implementation of SED 3. Ease of implementation of the corrective measures would be directly related to the extent of the additional corrective measure (i.e., area and/or volume to be addressed) and the ease of access (i.e., location of target area and proximity of access areas).

Ability to Monitor Effectiveness: The effectiveness of SED 3 would be determined through long-term monitoring to document reductions in PCB concentrations in the water column, sediment, and fish in various reaches of the River. Periodic monitoring (i.e., visual observation and sampling) of the capped sediments and restored riverbanks would allow for an evaluation of cap integrity and effectiveness as well as bank stability. Such activities have been successfully performed on the upper portions of the Housatonic River and at other sites previously. Equipment and methods for this type of monitoring are readily available.

4.3.9.2 Administrative Implementability

Administrative implementability of SED 3 has been evaluated in consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: Implementation of SED 3 would need to comply with the substantive requirements of applicable and appropriate regulations pertaining to the performance of the remedial action (unless waived). As noted in Section 4.3.4, GE believes that SED 3 could be designed and implemented to meet such requirements (i.e., the location-specific and action-specific ARARs listed in Tables 2-2 and 2-3), with the exception of certain requirements that could potentially apply to the on-site staging areas if the excavated sediments should constitute hazardous waste, and which GE believes should be waived, if necessary, as technically impracticable.

Access Agreements: Implementation of SED 3 would require GE to obtain access permission from the owners of properties in Reaches 5 and 6 where remedial work or ancillary facilities would be necessary to carry out the alternative. Although the majority of these areas are publicly owned, it is anticipated that access agreements may be required from up to approximately 30 private landowners. Obtaining such access agreements could be problematic in some cases. If GE should be unable to obtain access agreements with particular property owners, GE would request EPA and/or MDEP to provide assistance.

Coordination with Agencies: Implementation of biota consumption advisories would require coordination with state public health departments and/or other appropriate agencies in the dissemination of information to the public and surrounding communities regarding those advisories. In addition, obtaining access to State-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of SED 3, GE would need to coordinate with EPA, as well as state and local agencies, to address any health and safety concerns and to provide as-needed support with public/community outreach programs.

4.3.10 Cost

The estimated total cost to implement SED 3 is $148 M (excluding treatment/disposition costs). The estimated capital cost for implementation of SED 3 is $134 M, assumed to occur over a 10-year construction period. Estimated annual OMM costs include costs for a 5-year inspection and maintenance program for the restored riverbed and riverbanks, thin-layer cap areas, and restored staging areas and access roads; these costs range from $25,000 to $275,000 per year (depending on which reach is being monitored), resulting in a total cost of $3.0 M. The estimated annual OMM costs for SED 3 also include implementation of a long-term water, sediment, and fish monitoring program for a period of 30 years following completion of construction activities on a reach-specific basis. The estimated costs for this long-term program range from approximately $275,000 to $540,000 per year (depending on the extent of monitoring occurring within a given year), resulting in a total cost of $10.4 M. The following summarizes the total capital and OMM costs estimated for SED 3.

SED 3	Est. Cost	Description
Total Capital Cost	$134 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM Cost	$13.4 M	Costs for performance of the OMM programs
Total Cost for Alternative	$148 M	Total cost of SED 3 in 2008 dollars

The total estimated present worth cost of SED 3, which was developed using a discount factor of 7%, a 10-year construction period, and an OMM period of 30 years on a reach-specific basis, is approximately $106 M. More detailed cost estimate information and assumptions for each of the sediment alternatives are included in Appendix E.

These costs do not include the costs of treatment/disposition of removed sediments/bank soils. The estimated costs for combinations of sediment remediation and treatment/disposition alternatives are presented in Section 8.

4.3.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 4.3.2, the evaluation of whether SED 3 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As noted previously, SED 3 would result in a reduction in the potential for exposure of human and ecological receptors to PCBs in sediments, surface water, and fish by: (a) permanently removing 134,000 cy of PCB-containing sediments in Reach 5A and placing a cap over the underlying sediments; (b) removing 33,000 cy of erodible PCB-containing riverbank soils from Reach 5 and stabilizing those erodible banks; (c) placing a thin-layer cap over 97 acres in portions of Reach 5C and in Woods Pond to reduce exposure concentrations and accelerate the process of natural recovery; and (d) relying on natural recovery processes (primarily physical) in other areas to contain and reduce the bioavailability of PCBs in the sediment. As shown in Section 4.3.3, this remediation, along with ongoing remedial activities upstream of the Confluence, is predicted to reduce the PCB load in the River passing Woods Pond Dam and Rising Pond Dam by 94% and 87%, respectively, over the course of the modeled period, and to reduce the annual PCB mass transported from the River to the floodplain in Reaches 5 and 6 by 97% over that period.

Further, as shown in Section 4.3.5.1, EPA's model predicts that SED 3 would result in a substantial permanent reduction in sediment and fish PCB concentrations. For example, that model predicts that the fish PCB concentrations (whole body) would be reduced over the modeled period from 90 mg/kg to approximately 1 mg/kg in Reach 5A, from 70-90 mg/kg to 9-15 mg/kg in Reaches 5B and 5C (and 30 mg/kg in the backwaters), from 80 mg/kg to approximately 4 mg/kg in Woods Pond, from 30-50 mg/kg to 5-11 mg/kg in the Reach 7 impoundments, from 30 mg/kg to 8 mg/kg in Rising Pond, and from 1-2 mg/kg to 0.1-0.2 mg/kg in the Connecticut impoundments.

Compliance with ARARs: As explained in Section 4.3.4, the model predictions of water column PCB concentrations indicate that SED 3 would achieve the chemical-specific ARARs, except for the water quality criterion of 0.000064 µg/L based on human consumption of water and organisms (and the Connecticut criterion of 0.00017 µg/L in two Connecticut impoundments), which GE believes should be waived as technically impracticable. Further, GE believes that SED 3 could be designed and implemented to meet the pertinent location-specific and action-specific ARARs, with the possible exception of certain requirements which could potentially apply to the on-site staging areas if the excavated sediments should constitute hazardous waste, and which GE believes should be waived, if necessary, as technically impracticable.

Human Health Protection: As discussed in Section 4.3.6.1, SED 3 would provide protection of human health from direct contact with sediments, since it would achieve the direct contact IMPG levels based on a 10^{-5} cancer risk or lower, as well as all non-cancer IMPGs, in all sediment exposure areas, with the majority of those levels achieved at the present time. For human consumption of fish, the fish PCB concentrations predicted to result from SED 3 in Reaches 5 through 8 at the end of the 52-year simulation period, when converted to fillet-based concentrations, would not achieve the RME-based IMPGs within EPA's cancer risk range or based on non-cancer impacts, i.e., the levels that EPA considers to be protective for unrestricted consumption of Housatonic River fish (with the exception of the probabilistic RME 10^{-4} cancer IMPG in Reach 5A). Extrapolation of model results beyond the simulation period indicates that PCB concentrations in fish fillets would reach the RME IMPG levels based on a 10^{-5} cancer risk and non-cancer impacts in approximately 150 to >250 years in the PSA and >250 years in Reaches 7 and 8. In the Connecticut impoundments, the CT 1-D Analysis indicates that SED 3 would generally achieve fish PCB levels within the range of the RME IMPGs (except the deterministic non-cancer IMPG for children in two impoundments) within the modeled period. In both States, where the levels for unrestricted fish consumption are not achieved, institutional controls (fish consumption advisories) would continue to be utilized to provide human health protection from fish consumption.

Environmental Protection: From an environmental standpoint, as discussed in Section 4.3.6.2, the model results indicate that, by the end of the modeled period, SED 3 would achieve the IMPG levels for some receptor groups – namely, sediment levels within or below the IMPG range for benthic invertebrates (3 to 10 mg/kg) in all of the relevant averaging areas, as well as fish PCB levels below the IMPGs for warmwater and coldwater fish and threatened and endangered species (55, 14, and 30.4 mg/kg, respectively) in all reaches. For other receptor groups, SED 3 would achieve the IMPG levels in some areas. For amphibians, SED 3 would result in sediment PCB levels within or below the IMPG range (3.27 mg/kg to 5.6 mg/kg) in about 50% of the backwater areas. For piscivorous birds, SED 3 would achieve the fish-based IMPG (3.2 mg/kg) in 6 areas (Reaches 5A and 6 and four subreaches of Reach 7) and would achieve levels close to the IMPG (within 1.2 mg/kg or less) in another 4 areas (see Table 4-14). For insectivorous birds, SED 3 would achieve the target sediment levels of 3 and 5 mg/kg in about half the averaging areas (i.e., those in Reaches 5A and 6) and the target sediment level of 1 mg/kg in 3 areas; while for piscivorous mammals, SED 3 would achieve the target sediment levels of 3 and 5 mg/kg in one of the two averaging areas, but would not achieve the target level of 1 mg/kg in either area.[57] For both of these groups, SED 3 would result in PCB levels much closer to those target levels than would SED 1 and SED 2 (see Table 4-13).

As discussed in Section 2.1.1, attainment of IMPGs, as one of the Selection Decision Factors under the Permit, is not determinative of whether an alternative would provide overall protection of the environment, but rather is a consideration to be balanced against the other Selection Decision Factors. Under SED 3, while the IMPGs would not be achieved for some receptors and areas, the local populations of these receptors extend beyond the areas of the IMPG exceedances (i.e., to other areas of suitable habitat within the Rest of River where the IMPGs would be achieved and/or to nearby areas outside the Rest of River).[58] In these circumstances, GE does not believe that the IMPG exceedances would prevent the maintenance of healthy local populations of these receptors, let alone adversely impact the overall wildlife community in the Rest of River area. This is supported by the fact that EPA's own field surveys conducted in support of its ERA documented the presence of numerous and diverse invertebrate, fish, amphibian, reptile, bird, and mammal species in the PSA under

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[57] As discussed previously, attainment of the IMPGs for insectivorous birds and piscivorous mammals depends on the combination of sediment and floodplain soil concentrations in the relevant averaging areas. Thus, attainment of the target sediment levels (1, 3, and 5 mg/kg) must be evaluated in conjunction with attainment of the corresponding target floodplain soil levels that were developed to achieve the IMPGs when associated with these sediment levels (see Section 6).

[58] For example, the local amphibian population would include not only the amphibians in the backwaters evaluated as part of the sediment alternatives, but also those that inhabit the vernal pools in the floodplain that are evaluated under the floodplain alternatives. As another example, the local population of mink is not limited to the PSA, but extends to areas near the shoreline but outside the 1 mg/kg isopleth, as well as to tributaries of the River and to other riverine areas in the vicinity.

current conditions, despite the fact that PCBs have been present in that area for over 70 years.

At the same time, implementation of SED 3 would have some short-term impacts on the environment in the areas where work would be conducted (e.g., loss of aquatic habitat in areas of removal and capping in Reach 5A, loss of riparian habitat in the bank stabilization areas, potential resuspension of PCB-containing sediments during removal, and loss of floodplain habitat in areas where supporting facilities are constructed), as discussed in Section 4.3.8. It could also potentially have some long-term environmental impacts (e.g., on stabilized banks where mature overhanging trees are removed, on the edges of thin-layer cap areas where the water is less than 6-12 inches deep and consolidation of the sediment is not anticipated, and from ancillary construction activities in the floodplain), as discussed in Section 4.3.5.3. These short- and long-term impacts, however, would be considerably less than those associated with the remaining sediment alternatives, as discussed in subsequent sections.

As EPA guidance makes clear, the standard of "overall protection" of the environment includes a balancing of the short-term and long-term ecological impacts of the alternatives with the residual risks (EPA, 1990a, 1997, 2005e – quoted in Section 2.1.1 above). Based on such balancing, SED 3 would provide overall protection of the environment, since it would achieve a substantial reduction in the exposure levels of ecological receptors, while causing the least amount of environmental damage of any of the sediment alternatives that involve removal and/or capping of sediments.

Summary: Based on the foregoing considerations, it is concluded that SED 3 would provide overall protection of human health and the environment.

4.4 Evaluation of Sediment Alternative 4

4.4.1 Description of Alternative

SED 4 would involve the removal of 295,000 cy of sediment and bank soils. A total of 128 acres would be capped (91 acres after removal and 37 acres without removal), and an additional 119 acres would receive thin-layer caps. Specifically, the components of SED 4 include the following:

- Reach 5A: Sediment removal (134,000 cy over 42 acres);
- Reach 5B: Combination of sediment removal (39,000 cy over 12 acres) and thin-layer capping (15 acres);

- Reach 5C: Combination of thin-layer capping (20 acres) and capping (37 acres);

- Reach 5 erodible banks: Removal and stabilization (33,000 cy);

- Reach 5 backwaters: Thin-layer capping in certain backwaters (61 acres; depending on PCB concentrations);

- Reach 6 (Woods Pond): Combination of sediment removal (89,000 cy over 37 acres) and thin-layer capping (23 acres); and

- Remaining Reach 5 backwaters and Reaches 7 through 16: MNR.

Remediation would proceed from upstream to downstream to minimize the potential for recontamination of remediated areas. Figure 4-4 identifies the remedial action(s) that would be taken in each reach as part of SED 4.

The following summarizes the general remedial approach (and associated assumptions) related to implementation of SED 4. It is estimated that SED 4 would require approximately 15 years to complete. It should be noted that while details on equipment and processes are provided in this description for purposes of the evaluations in this CMS Report, the specific methods for implementation of any selected remedy would be determined during design based on engineering considerations and site conditions.

Site Preparation: Prior to implementation of remedial activities, access roads and staging areas would be constructed to support implementation of this alternative. Grubbing and clearing of vegetation would likely also be necessary, and appropriate erosion and sedimentation controls would be put in place prior to construction. The conceptual plans developed for this CMS Report indicate that 28 staging areas and approximately 21 miles of access roads would be constructed between the Confluence and Woods Pond Dam to support implementation of SED 4.

Sediment Removal: Sediment removal would be performed in Reaches 5A, 5B, and 6, as presented below.

	Average Removal Depth (feet)	Removal Volume (cy)	Acreage
Reach 5A:	2	134,000	42
Reach 5B:	2	39,000	12
Reach 6 (Woods Pond):	1.5	89,000	37
Totals:		**262,000**	**91**

The areas over which removal would occur are shown on Figure 4-4.

In Reaches 5A and 5B, it is assumed that the sediment removal would be performed in the dry with conventional mechanical excavation equipment. Similar to the approach for the Upper ½-Mile Reach and portions of the 1½-Mile Reach, sheetpiled cells would be established in the River to facilitate removal activities and limit downstream transport of sediment. A water treatment system would be used to treat water pumped from the excavation areas. It is assumed that mechanical dredging in the wet would be implemented to accomplish the sediment removal in Woods Pond. Silt curtains would be placed downstream of excavation areas in Woods Pond to limit transport of suspended sediment. Periodic water column and air sampling would be performed during all removal operations to monitor for potential releases.

Cap Placement: Caps would be installed following sediment removal in Reaches 5A, 5B, and Woods Pond (Figure 4-4). A cap would also be installed in the deeper portions of Reach 5C where no excavation would be performed (Figure 4-4). The caps would be designed to limit the potential for upward migration of the PCBs in the underlying sediment to the bioavailable zone and to limit the potential for erosion of the cap materials. Removal of significant debris would be conducted prior to cap material placement. Cap materials would be placed in the dry in areas where dry excavation was performed and through the water column in the remaining areas. Cap materials would be transferred to the River using conventional earth-moving equipment. It is assumed that the cap would contain 12 inches of sand (which may be amended by organic material to increase the TOC content). To minimize the potential for cap erosion in the higher velocity reaches of the River, a 12-inch thick armor stone layer would be placed over the sand cap in Reaches 5A and 5B, and a 6-inch thick armor stone layer would be placed over the sand cap in the lower section of Reach 5C and the shallow areas of Woods Pond. The sand and armor stone composition/size would be selected during design to limit the potential for migration of PCBs from the underlying sediments through the cap (sand material) and to preclude the movement of cap materials during high flow events (armor stone). Silt curtains would be used during capping in the wet to mitigate the potential for downstream transport of materials suspended in the water column.

Thin-Layer Cap Placement: Thin-layer caps would be installed in the deeper part of Reach 5B (15 acres), the shallower portion of Reach 5C having relatively lower concentrations (20 acres), Reach 5 backwaters with average PCB concentrations equal to or greater than 15 mg/kg (61 acres; see Section 3.1.1), and deep areas of Woods Pond (23 acres) as shown on Figure 4-4 (total of 119 acres). The thin-layer cap would consist of an assumed 6-inch layer of sand, and would be placed via a combination of techniques, including mechanical and/or hydraulic means.

Sediment Dewatering and Handling: Sediment dewatering operations would be performed as necessary in the staging areas. For purposes of this CMS Report, it is assumed that a combination of dewatering alternatives would be used, including gravity dewatering via stockpiling for materials removed in the dry and mechanical dewatering using a plate and frame filter press for materials removed in the wet. The addition of stabilization agents (e.g., other dry sediments, excavated soil, Portland cement) may be necessary prior to treatment and/or disposal. Treatment/disposition alternatives have been evaluated separately and are discussed in Section 7. A water treatment system would be used to treat water pumped from the excavation areas, as well as any decant water collected from excavated materials in the staging areas.

Bank Removal/Stabilization: SED 4 would include the removal of 33,000 cy of soil from the erodible banks in Reach 5 followed by stabilization. Bank stabilization is assumed to be limited to Reaches 5A and 5B, and to consist of the same techniques used in SED 3 – i.e., bank excavation to promote stable slopes (assumed to be 1½:1 to 3:1 slopes), followed by stabilization with revetment mats, armor stone, or bioengineering techniques (with an assumed distribution of 20%, 60%, and 20% respectively, for each stabilization technique).

MNR: MNR would be implemented in the remainder of the Rest of River (portions of the Reach 5 backwaters and Reaches 7 through 16). As previously discussed, natural recovery processes have been documented in portions of the Housatonic River and would be expected to continue throughout the Rest of River area at varying rates, due in part to the completed and planned upstream source control and remediation measures, as well as the remediation that would be conducted in the Rest of River as part of this alternative.

Restoration: SED 4 would include restoration of areas that are directly impacted by the sediment removal and/or capping activities, bank removal/stabilization activities, and ancillary construction activities, as appropriate to restore the habitat value of the affected natural resource, to the extent practical. Restoration would be accomplished using a combination of passive procedures (practices to facilitate natural re-establishment of the resource) and active procedures (plantings or other mitigation). For purposes of this CMS Report, the extent and type of restoration activities that have been assumed for SED 4 are as follows:

- In the areas of Reaches 5A and 5B and the shallow portion of Reach 6 where removal and capping would be conducted, the river bottom would be restored to existing bathymetry. In those areas, as well as in the deeper portion of Reach 5C subject to capping without removal, it is anticipated, based on experience in the Upper ½-Mile Reach, that the armor stone, as well as any deposited sediment, would be readily recolonized by benthic invertebrates. It is also anticipated that aquatic vegetation would readily re-establish itself through transport from upstream sources of plants in the water column. Depending upon the extent of riverine wetland areas impacted, supplemental plantings of emergent vegetation would be considered.

- It is not anticipated that restoration would be required for the thin-layer cap areas in Reaches 5B, 5C, and 6. In these areas, the capping substrate would serve as a ready base for recolonization by benthic invertebrates, and aquatic vegetation should readily re-establish itself through transport from upstream sources of plants in the water column.

- On riverbanks where revetment mats or armor stone are used for stabilization, supplemental habitat structures such as trees, log and root wad revetments, and/or log and brush shelters would be considered as part of the restoration to replace similar existing structures. On banks where bioengineering techniques are used, plantings would be utilized to restore an appropriate riparian community.

- In the areas adjacent to the River where access roads and staging areas have been constructed to support work in the River, those support facilities would be removed and the disturbed areas revegetated with plantings that, over time, would restore the habitat value of those areas.

Restoration activities would be conducted following completion of the remedial action within successive reaches of the River as appropriate.

Institutional Controls: SED 4 would include the continued maintenance of biota consumption advisories, as appropriate, to limit the public's consumption of fish and other biota from the River.

Long-Term OMM: Once implemented, it is assumed that SED 4 would include, for each reach involved, a 5-year post-construction monitoring program and a long-term (30-year) monitoring and maintenance program.

The post-construction monitoring program assumed for SED 4 would include annual monitoring of the same components outlined under SED 3 (Section 4.3.1). The SED 4 program is assumed to include visual observation supplemented with probing in areas where armor stone would be placed, collection of approximately 30 cores for visual observation in thin-layer cap areas, visual observations of the Reach 5 riverbanks, and visual observation and quantitative/qualitative assessment of restored staging areas and access roads. These activities would occur annually for a period of 5 years following remedy implementation in a given reach.

In addition, it is assumed that the long-term monitoring program would include analytical sampling of fish and the water column, consistent with the program outlined for SED 2 (Section 4.2.1). It is also assumed to include a sediment sampling program, which would occur every 5 years and include collection and PCB analysis of 50 surface sediment samples from MNR areas, approximately 23 cores (69 samples) from removal areas, approximately 10 cores (30 samples) from cap only areas (one core every 4 to 5 acres, three samples per core), and approximately 30 cores (30 samples) from the thin-layer cap areas. Sampling is assumed for a period of 30 years. In addition, a maintenance program would be implemented, as necessary.

4.4.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 4.1.2, the evaluation of whether a sediment remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether SED 4 would be protective of human health and the environment is presented at the end of Section 4.4 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

4.4.3 Control of Sources of Releases

Implementation of SED 4 would reduce potential future PCB releases from certain sediments and riverbanks that may occur via erosion and flood events. The remedial components of SED 4 would include all the components of SED 3, with additional removal in Reach 5B and Woods Pond, capping in a portion of Reach 5C, and thin-layer capping in Reaches 5B and 5C and certain Reach 5 backwaters. Implementation of these actions would address PCB sources over approximately 247 acres of the riverbed and the erodible portions of approximately 7 miles of riverbank, and would include removal of 295,000 cy of PCB-containing sediment and bank soils. It would thus result in a reduction in the potential for future transport of the PCBs in these areas within the River or onto the floodplain for potential human or ecological exposure. The PCB-containing surface sediments and bank soils in Reaches 5A and 5B and the shallow portion of Woods Pond, which are susceptible to scour during high flow events, would be removed and the residual PCBs remaining in these areas contained using a cap and bank stabilization techniques. A cap (with no excavation) would also be placed in the deeper portion of Reach 5C to isolate the underlying PCB-containing sediments from the water column. In a portion of Reaches 5B and 5C, the Reach 5 backwaters, and the deep portion of Woods Pond, which are more depositional, a thin-layer cap would be placed over the existing river bottom to accelerate the natural recovery process, and in doing so would assist in controlling releases in those areas of the River.

It should also be noted that the remaining remediation activities to be conducted upstream of the Confluence (i.e., in areas adjacent to the East Branch and in the West Branch) would reduce the PCBs available for transport into the Rest of River, and that natural recovery processes within the Rest of River would further reduce PCB concentrations in the surface sediments in that area. Additionally, the existing dams along the River would continue to limit movement of PCB-containing sediments within the impoundments behind the dams, and would further reduce the potential for transport of those sediments downstream. While failure of those dams could lead to the release of the PCB-containing sediments impounded behind them, the inspection, monitoring, and maintenance programs in place under other authorities, as described in Section 4.1.3, would prevent or minimize the possibility of such dam failure.

Implementation of SED 4, in combination with upstream source control, would reduce the mass of PCBs transported within the River to downstream reaches and to the floodplain, as demonstrated by EPA's model. The annual average PCB load passing Woods Pond Dam at the end of the model projection is predicted to decrease by 96% from that calculated at the beginning of the model projection period (i.e., from 20 kg/yr to 0.8 kg/yr). Similarly, SED 4 is predicted to achieve an 89% reduction in the PCB load passing Rising Pond Dam over this same period (i.e., from 19 kg/yr to 2.1 kg/yr). Likewise, the annual average PCB mass transported from the River to the floodplain in Reaches 5 and 6 is predicted to decrease by 97% from that calculated at the beginning of the model projection period (i.e., from 12 kg/yr to 0.4 kg/yr).

The effects of an extreme flow event were examined using the Year 26 flood. The impact of this flood on surface sediment PCB concentrations can be seen on Figure 4-5b, which shows temporal profiles of model-predicted reach-average PCB concentrations in surface sediments resulting from the implementation of SED 4 over the 52-year model projection period. Similar to the other alternatives, the model results for SED 4 indicate that, in reaches subject to MNR only (i.e., Reaches 7 and 8), the extreme event is not predicted to expose buried PCBs at concentrations exceeding those already exposed at the sediment surface. For the reaches that would be capped either following removal or without removal (i.e., Reach 5A, and parts of Reaches 5B, 5C, and Woods Pond), EPA's model predicts that, given the cap's armor layer, buried sediments would not be exposed during the extreme storm event.[59] As a result, the model predicts no change in reach-average surface sediment PCB concentrations in Reach 5A (Figure 4-5b) or in the capped portions of the other reaches. For the portions of Reaches 5B, 5C, and 5D that include thin-layer capping, the model predicts that only limited portions of these areas (<1% to 6% of the thin-layer capped portions) would experience erosion large enough to produce increases in average surface sediment PCB concentrations during storm events (Figure 4-5b). These concentration increases are small (0.2 to 0.3 mg/kg), and the concentrations following the extreme event still represent significant reductions relative to current levels (96% in Reach 5B and 99% in Reaches 5C and 5D; Figure 4-5b). No such erosion of the thin-layer cap is predicted to occur in the deep portion of Woods Pond. Thus, the model results indicate that buried sediments containing PCBs would not become exposed to any significant extent during an extreme flow event under SED 4.

4.4.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs, set forth in Table 2-1, include federal and state water quality criteria for PCBs. These criteria consist of a freshwater chronic aquatic life criterion of 0.014 µg/L and a human health criterion (based on consumption of water and organisms) of 0.000064 µg/L (0.00017 µg/L under the Connecticut standards, although that may not be an ARAR since it is less stringent and less up-to-date than the federal criterion).

To evaluate whether SED 4 would achieve those criteria, GE reviewed the water column PCB concentrations predicted by the model for SED 4. The water column concentrations are presented in Table 4-15 (in Section 4.4.5.1 below). As shown in that table, annual average water column concentrations predicted by the model at the end of the simulation period are below the freshwater chronic aquatic life criterion of 0.014 µg/L (14 ng/L) in all reaches. However, model-predicted water column concentrations exceed the federal and Massachusetts human health consumption criterion of 0.000064 µg/L (0.064 ng/L) in all reaches. For the Connecticut impoundments, the water column concentrations indicated by the CT 1-D Analysis (which range from 0.00007 to 0.0001 µg/L [0.07 to 0.1 ng/L]) are below the Connecticut consumption criterion of 0.00017 µg/L (0.17 ng/L), although these estimates are highly uncertain. As previously discussed, GE believes that the ARARs based on the human health consumption criteria should be waived on the ground that achievement of those ARARs is technically impracticable for the reasons given in Section 4.1.4.

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[59] Further evaluation of the stability of cap and thin-layer cap materials under SED 4 based on model predictions of erosion in these areas is provided in Section 4.4.5.2. The results of this stability analysis (i.e., percentages of cap/thin-layer cap areas that are stable) are cited in the remainder of this discussion.

The potential location-specific and action-specific ARARs are listed in Tables 2-2 and 2-3. Based on review of those ARARs, GE believes that SED 4 could be designed and implemented to achieve most of the ARARs that would be pertinent to this alternative, provided that any necessary EPA approval determinations are obtained, for the same reasons discussed in Section 4.3.4. However, as also discussed in that section, in the event that the excavated sediments should be found to constitute hazardous waste under RCRA or comparable state criteria (which is not anticipated), the temporary staging areas for the dewatering and handling of those sediments might not meet certain hazardous waste storage requirements, if they were determined to apply. In that case, as further discussed in Section 4.3.4, GE believes that such requirements should be considered inapplicable or, if necessary, waived as technically impracticable.

4.4.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for SED 4 has included evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment, as described below.

4.4.5.1 Magnitude of Residual Risk

The assessment of the magnitude of residual risk associated with implementation of SED 4 has included consideration of the extent to which and timing over which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure, such as engineering and institutional controls.

Implementation of SED 4, along with upstream source control/remediation measures and natural recovery processes, would substantially reduce the exposure of humans and ecological receptors to PCBs in sediments, surface water, and fish in the Rest of River area. The sediment removal and/or capping activities in Reach 5A and portions of Reaches 5B, 5C, and Woods Pond would result in a significant reduction in the potential for exposure to PCBs in these areas. The placement of a thin-layer cap over the sediments in portions of Reach 5B, Reach 5C, Woods Pond, and certain backwater areas would reduce the surface sediment PCB concentrations in these reaches, thereby reducing potential human and ecological exposures and risks. The following table shows, by reach, the average PCB concentrations predicted by EPA's model to be present at the end of the model simulation period (Year 52) in the media to which such receptors may be exposed.

Table 4-15 – Modeled PCB Concentrations at End of 52-Year Projection Period (SED 4)

Reach	Average Surface Sediment (0-6”) (mg/kg)	Average Surface Water (ng/L)	Average Fish (whole body) (mg/kg)	Average Fish (fillet) (mg/kg)[2]
5A	0.06	2.5	1.3	0.3
5B	0.4	1.8	1.9	0.4
5C	0.4	1.6	2.1	0.4
5D (backwaters)	0.3	---	2.0	0.4
6	0.3	1.5	1.1	0.2
7[1]	0.4 – 5.0	1.0 – 1.5	2.3 – 8.2	0.5 – 1.6
8[1]	2.7	1.3	6.5	1.3
CT	0.005 – 0.01	0.07 – 0.1	0.05 – 0.1	0.01-0.02

Notes:

1. Values shown as ranges in Reach 7 and CT represent the range of modeled PCB concentrations at the end of the projection within each of the Reach 7 subreaches, and the range of concentrations indicated by the CT 1-D Analysis for the four Connecticut impoundments.
2. Fish fillet concentrations were calculated by dividing the modeled whole-body fish PCB concentrations by a factor of 5, as directed by EPA.

The potential residual risks to human and ecological receptors from the concentrations shown in the above table have been evaluated in the context of the extent to which they would achieve the IMPGs, as discussed in Section 4.4.6.

Temporal profiles of reach-average PCB concentrations in surface sediments, annual average surface water, whole body fish, and fish fillets resulting from the implementation of SED 4 over the 52-year model projection period are shown on Figures 4-5a-c. These figures show the timeframes over which SED 4 would be predicted to reduce the PCB concentrations in each respective medium. The PCB concentration trajectories exhibit the general pattern of a large decline over the remediation period, followed by a period of smaller decline, or in some instances, a small increase until concentrations reach a steady-state with prevailing upstream loads and natural attenuation processes. In the surface sediments, this pattern is generally observed mainly in the reaches undergoing remediation, while patterns in downstream reaches exhibit a shallower trajectory, which illustrates how remediating upstream source areas (e.g., Reaches 5 and 6) translate to reductions in PCBs in downstream areas. While the water column patterns exhibit significant year-to-year variability, including short-term increases in PCB concentration associated with increased PCB transport during the Year 26 extreme flow event and sediment resuspension during remediation, most water column temporal changes follow those of the sediments. Fish concentrations respond to the predicted changes in water column and sediments. As a result of the remediation under SED 4, predicted fish PCB concentrations are reduced over the projection period by 97% to 99% in the remediated reaches (i.e., Reaches 5 and 6) and by 78% to 96% in the other reaches (Figure 4-5c).

PCBs would remain in the sediments beneath and outside the areas addressed by this alternative. However, in the capped areas of Reach 5 and Woods Pond, the caps would prevent direct contact with, and effectively reduce the mobility of, the PCB-containing sediments beneath the caps; and the thin-layer caps would provide a cover layer over the underlying PCB-containing sediments. Overall, the extent to which SED 4 would mitigate the effects of a flood event that could cause the PCB-containing sediments that have been contained by a cap or buried due to natural processes to become available for human and ecological exposure was discussed in Section 4.4.3. As discussed in that section, the model results indicate that buried sediments containing PCBs would not become exposed to any significant extent during an extreme flow event following implementation of SED 4.

In addition, potential human exposure to PCBs in fish and other biota would be reduced during and after implementation of SED 4 through biota consumption advisories. Also, a long-term monitoring program would be implemented to assess the continued effectiveness of this remedial alternative to mitigate potential human and ecological exposures to PCBs.

4.4.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of SED 4 has included an assessment of use of technologies under similar conditions and in combination, general reliability and effectiveness, reliability of OMM and availability of OMM labor and materials, and technical component replacement requirements, as discussed below.

Use of Technologies under Similar Conditions and in Combination

As discussed in Section 4.3.5.2, a combination of remedial technologies is often necessary to mitigate potential exposure to constituents in sediments (e.g., EPA, 2005e; NRC, 2007), and SED 4 involves such a combination. The SED 4 remedy components were selected for application in various reaches of the River based in part on the study and application of each technology under similar conditions at other sites. The components include sediment removal/capping using dry excavation techniques (in Reaches 5A and 5B), mechanical dredging/capping in the wet (in Woods Pond), bank removal and stabilization (for the Reach 5 erodible banks), capping alone (in the deeper part of Reach 5C), thin-layer caps (in portions of Reaches 5B, 5C, 5D, and 6), and MNR (in the remaining areas). These remedial techniques have been applied at a number of sites containing PCBs under somewhat similar conditions to those in various reaches of the River.

Examples related to those SED 4 components that are common to SED 3 were presented in Section 4.3.5.2. The additional components for SED 4 are mechanical removal and capping in the wet in Woods Pond and capping in Reach 5C. Mechanical dredging in the wet followed by capping and capping alone have been used under similar conditions at the Sheboygan River (WI; BBL, 1998) and the Grasse River (NY; www.thegrasseriver.com). Removal in the Sheboygan River was performed using a clamshell bucket, and the cap placed following excavation consisted of sand and armor stone. A cap (without excavation) was also placed over the existing riverbed using sand and armor stone. Mechanical dredging (i.e., clamshell from a barge in select areas) was performed at the Grasse River, and a 1-foot sand/topsoil cap was placed via clamshell over the removal areas. Capping alone was successfully performed through the water column at the Grasse River site using a clamshell bucket to place a cap consisting of sand, gravel, and armor stone over the existing riverbed through an average water depth of approximately 16 feet.

General Reliability and Effectiveness

SED 4 utilizes technologies that have been shown to be reliable and effective in reducing exposure of humans and ecological receptors to PCBs in sediments. Similar to SED 3, these technologies include sediment removal, capping, thin-layer capping, and MNR. Their general reliability and effectiveness were previously discussed in Section 4.3.5.2. As noted in that section, under certain circumstances, dredging and excavation have been shown to be effective and reliable in reducing the long-term potential for exposure of human and ecological receptors to PCB-containing sediments; however, there are some limitations associated with the technology (e.g., sediment resuspension, residual contamination) (EPA, 2005e). As described by EPA (2005e), capping is also a viable and effective approach for remediating impacted sediments. Regarding thin-layer capping, EPA (2005e) has acknowledged that placement of a thin layer "of clean sediment may accelerate natural recovery in some cases." Finally, while EPA has acknowledged the potential limitations of MNR, it has stated that MNR should "receive detailed consideration" where site conditions are conducive to such a remedy (EPA, 2005e). In addition, EPA has noted that many contaminants that remain in sediment are not easily transformed or destroyed, and that for this reason, "risk reduction due to natural burial through sedimentation is more common and can be an acceptable sediment management option" (EPA, 2005e).

To further assess the reliability and effectiveness of SED 4, model predictions of erosion in areas receiving a cap or a thin-layer cap were evaluated to assess cap stability, using the same metrics described for this analysis in Section 4.3.5.2. The results of these stability assessments are as follows:

Caps: Under SED 4, the areas receiving a cap, either following sediment removal or without sediment removal, include Reach 5A, the upper portion of Reach 5B, the lower portion of reach 5C, and the shallow portion of Woods Pond. Those caps would be designed to resist erosion by including an appropriately sized armor layer. The model inputs for areas receiving a cap were specified accordingly, as discussed in Section 3.2.4.5. Thus, the areas receiving a cap under SED 4 are predicted to be 100% stable.

Thin-Layer Caps: SED 4 includes placement of a thin-layer cap in the lower portion of Reach 5B, the upper portion of Reach 5C, several Reach 5 backwaters, and the deeper portion of Woods Pond to enhance natural recovery. As discussed in Section 4.3.5.2, the long-term effectiveness of the thin-layer cap was evaluated by considering it stable (and therefore reliable) when at least 1 inch of material remained for the full duration of the model projection (including the extreme flow event). EPA's model predicts that approximately 94% of the thin-layer capped area within Reach 5B would remain stable under SED 4. The erosion in the remaining 6% of that area is predicted to occur in a few limited sections of the Reach 5B channel, mainly during the Year 26 extreme event. Such erosion is predicted to result in an increase in the reach-average 0- to 6-inch surface sediment PCB concentration of approximately 0.3 mg/kg (Figure 4-5b). Similarly, EPA's model predicts that approximately 95% of the thin-layer capped area in Reach 5C would remain stable, and that the erosion over the remaining 5% of the area, occurring mostly during the extreme flow event, would increase the reach-average 0- to 6-inch surface sediment PCB concentration by approximately 0.2 mg/kg (Figure 4-5b). The model simulates similar erosion of the thin-layer cap within a single grid cell in the Reach 5 backwaters (representing <1% of the thin-layer capped area) in response to storm events in Years 39 and 41 of the simulation. As a result, the Reach 5D average 0- to 6-inch surface sediment PCB concentration is predicted to increase by approximately 0.2 mg/kg (Figure 4-5b). Finally, 100% of the thin-layer cap material within the deep portion of Woods Pond is predicted to be stable. Even after the increases in concentration described above are taken into account, the concentrations following the high flow events still represent significant reductions relative to current levels for all reaches where SED 4 includes a thin-layer cap (96% to over 99%, as discussed in Section 4.4.3). Based on these results, the model indicates that the thin-layer caps under SED 4 would be an effective means of reducing surficial PCB concentrations, even under an extreme flow event.

Reliability of Operation, Monitoring, and Maintenance Requirements/Availability of Labor and Materials

A combination of reliable OMM techniques, including periodic analytical sampling of the fish, water column and sediment, monitoring of the caps and restored banks via visual observations supplemented with sediment probing and/or coring as necessary, and maintenance of the restored riverbed and riverbanks, would be implemented to maintain and track the long-term effectiveness of SED 4. Post-remediation sampling is commonly used to monitor the effectiveness of completed sediment removal and capping remedies. Visual observation of the sediment cap and restored banks has been successfully implemented in the Upper ½-Mile and 1½-Mile Reaches, where river conditions are similar to those in Reach 5A and parts of Reach 5B. Visual observation of capped/armored areas was also successfully performed at the Sheboygan River to determine if the caps were still intact (BBL, 1995). Should changes in cap condition be noted that require maintenance, labor and materials needed to perform repairs are expected to be readily available.

In addition, a monitoring and maintenance program would be implemented for the actively restored areas to confirm planting survival and areal coverage and to determine whether habitat structures (if any) are intact. Such monitoring is considered a reliable means of tracking the progress of the restoration efforts. The necessary labor and equipment for such a program are expected to be readily available.

Technical Component Replacement Requirements

The technologies that comprise SED 4 were selected for application in areas of the River where site conditions are expected to support long-term reliability with minimal maintenance requirements. However, if erosion of cap and/or bank stabilization materials should occur, an assessment would be conducted to determine the need for and methods of repair. Depending on the timing and location of the repair, access roads and staging areas may need to be temporarily constructed in the nearby floodplain. Periodic small-scale repairs would likely pose minimal risks to humans and ecological receptors that use/inhabit the disturbed river bottom and nearby floodplain. While not anticipated, redesign/replacement of larger remedy components could require more extensive disturbance of the river bottom, banks, and/or the adjacent floodplains to support access.

4.4.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of SED 4 on human health or the environment has included identification and evaluation of potentially affected populations, adverse impacts on biota and their habitat, adverse impacts on wetlands, impacts on the aesthetics of the natural environment, impacts on banks and bedload movement, and potentially available measures that may be employed to mitigate these impacts.

Potentially Affected Populations

Since SED 4 would affect more area and would take longer to implement than SED 3, its implementation would have somewhat greater impacts than SED 3 and overall recovery would take longer. These impacts would affect people using these areas, as well as the fish and wildlife in these areas, as discussed below.

Adverse Impacts on Biota and Corresponding Habitat

The potential long-term impacts of SED 4 on biota and their habitat are discussed below in relation to the type of remediation involved. To the extent that affected areas constitute habitat for any rare, threatened, and/or endangered species, implementation of SED 4 could affect those species. In general, for the more mobile species and/or species with a wide range of habitat requirements, long-term impacts from the remedial activities are unlikely, because the activities would only displace these species to other areas of the river system. However, for animal species with narrower habitat requirements and for any threatened or endangered plant species, any long-term alteration of the habitat (as discussed below) could have a long-term adverse impact on those species.

Sediment Removal in Reach 5A and Parts of Reaches 5B and 6: SED 4 would not be expected to have a substantial long-term adverse impact on biota and their habitats in the portions of the main river channel that would be subject to removal (i.e., Reach 5A, the upper part of Reach 5B, and the shallower part of Woods Pond). As discussed under SED 3, observations made during monitoring of the Upper ½-Mile and 1½-Mile Reaches indicate that, within Reach 5A and the upper part of Reach 5B (which are similar to those upstream reaches), while aquatic organisms (fish and benthic invertebrates) would be disrupted on a short-term basis as a result of removal/capping activities, such organisms should be re-established following completion of the remediation and restoration. Similarly, in the shallower part of Woods Pond, it is expected that the types aquatic organisms that would be affected by the removal/capping would be re-established due to recolonization from upstream.

Riverbank Stabilization: The bank stabilization activities that are part of SED 4 may have some long-term adverse environmental impacts on riparian habitats in Reaches 5A and 5B, depending upon the stabilization technique used. Since these activities are the same as in SED 3, the discussion of potential long-term adverse environmental impacts of such activities under SED 3 (in Section 4.3.5.3) also applies to SED 4.

Thin-Layer Cap in Parts of Reaches 5B, 5C, and 6, and in Backwaters: As discussed under SED 3, placement of the thin-layer cap in the main channel sections of Reaches 5B and 5C could have long-term impacts in limited areas where water is less than 6-12 inches deep and consolidation of the underlying sediment is not anticipated. In these areas (e.g., along the shorelines), the thin-layer cap could increase the substrate elevation so as to change the vegetative characteristics of these riverine wetlands and the biota dependent on them or, in limited cases where the cap thickness exceeds the water depth, cause the wetlands vegetation to be replaced by species more tolerant of riparian or terrestrial conditions.

In deeper aquatic areas in Reaches 5B and 5C and in the deep part of Woods Pond, no adverse long-term impacts would be expected from the thin-layer capping. In these areas, any submerged aquatic vegetation would re-establish itself through recolonization from upstream areas. The thin-layer cap would not permanently affect the ability of the substrate to support benthic invertebrates or other aquatic organisms, and benthic communities would eventually be re-established. Further, as discussed under SED 3, in some locations with water depths of 2 to 4 feet, the placement of the thin-layer capping material may have a beneficial effect by increasing the area of the littoral zone, thereby broadening the area available for colonization by emergent aquatic plants.

It is possible that placement of the thin-layer cap in the backwaters could produce some long-term impacts, although some such impacts may not be adverse to the environment. By raising the bottom elevation of the portions of the backwaters where the water depths are currently 1 to 2 feet deep, the extent of the littoral zone would be expanded, which could result in an increased area that could support emergent wetland species. This could result in a modification of the biota that would use this backwater habitat (e.g., wetland-dependent species may become more prevalent than open-water species). This would be an impact, but not necessarily an adverse one. However, in backwater areas where water depths are less than 6-12 inches and consolidation of the underlying sediment is not anticipated, the thin-layer cap could increase the substrate elevation such that the vegetative characteristics of the backwater areas and the biota dependent on such areas would be changed, or in limited cases where the cap exceeds the water depth, change the habitat to one that is no longer suitable for the emergent species.

Capping in Reach 5C: There is a similar potential for long-term impacts in limited areas of Reach 5C where the cap would be placed. Specifically, in areas where the water is less than 24 inches deep (e.g., along the shoreline) and consolidation of the underlying sediment is not anticipated, the cap could increase the substrate elevation so as to change the vegetative characteristics of the riverine wetlands and the biota dependent on them or, in cases where the 18-inch cap would exceed the depth of water, cause the area to be no longer suitable for the riverine wetlands and the emergent wetlands vegetation to be replaced by species more tolerant of riparian or terrestrial conditions. However, in time, some limited recolonization by emergent wetland species would occur in these areas and would be expected to increase as silt from upstream sources covers the cap with finer sediment. In the deeper portions of Reach 5C, the cap would not be expected to have any long-term adverse impacts (and could have beneficial impacts in some areas) for the same reasons described above for thin-layer capping.

Supporting Facilities in Floodplain: Long-term impacts to biota and their habitats may also occur as a result of ancillary supporting activities in the floodplain, including the clearing and construction of access roads and sediment staging areas. The conceptual layout design for SED 4 includes 28 staging areas encompassing 48 acres (at an assumed size of approximately 1.7 acres per staging area), and approximately 21 miles of temporary roadways, which would amount to an additional approximately 51 acres (assuming a road width of 20 feet). Potential long-term impacts from these supporting facilities in SED 4 are similar to those for SED 3 and include habitat modification due to compaction/alteration of the soils, potential displacement of some species due to habitat fragmentation, and colonization by invasive species, as described in Section 4.3.5.3.

Adverse Impacts on Wetlands

The wetland environments that could be affected by SED 4 include: (a) riverine wetlands found along the periphery of removal areas in Reaches 5A and 5B; (b) riverine wetlands along the periphery of the bank stabilization areas; (c) shallow areas along the shoreline in Reaches 5B and 5C and in the backwaters that would be addressed by the placement of the thin-layer cap or the cap; and (d) floodplain wetlands impacted by access roads and other ancillary construction activities. Each of these is discussed below.

- Although riverine wetlands along Reaches 5A and 5B would be initially lost as a result of the removal and capping activities in those reaches, the bathymetry is not expected to change. Fine sediments transported from upstream would accumulate over time and these wetlands would naturally recolonize with wetland vegetation from upstream sources.

- As discussed for SED 3, while bank stabilization activities in Reaches 5A and 5B may temporarily disturb riverine wetlands adjacent to the banks, the bank treatments are not expected to materially alter the bathymetry or substrate in the adjacent in-river areas, and thus would not be expected to have a long-term adverse effect on those riverine wetlands.

- As described above, riverine fringing wetlands in Reaches 5B and 5C that would be subject to thin-layer capping could be impacted where the water is less than 12 inches deep (e.g., along the shoreline) and consolidation of the underlying sediments is not anticipated. The same is true for riverine wetlands in Reach 5C subject to capping where the water depth is less than 24 inches. In both types of areas, placement of the cap material could increase the substrate elevation such that it would change the vegetative characteristics of the area. In addition, placement of a thin-layer cap in the backwaters would affect the riverine wetlands in the backwaters. As noted above, in such areas where the water depths are currently 1 to 2 feet deep, the thin-layer cap could raise those areas into the littoral zone and thus increase the area that could support emergent wetland species; while in areas where water depths are less than 12 inches and consolidation of the underlying sediments is not anticipated, the thin-layer cap could increase the substrate elevation such that it would change the vegetation characteristics.

- As noted above, based on conceptual plans for placement of roadways and staging areas, it is expected that those ancillary construction activities would affect some wetlands. The long-term impacts on these wetlands would be mitigated by the wetlands restoration that would occur after the roadways and staging areas are removed. However, if some roadways were retained for long periods (e.g., more than 2 to 3 years), their use would likely result in compaction of the underlying substrate, which could alter water storage capacity and hydrology of wetlands over which these roadways were built.

Long-Term Impacts on Aesthetics

SED 4 could have some long-term impacts on the aesthetic features of the natural environment. The most severe impacts would occur over the approximately 15-year implementation period and would affect 247 acres of the River where sediment removal, capping, and/or thin-layer capping activities would be conducted. During this period, the appearance of the River would be altered and would reflect ongoing construction activities. Following implementation, successional processes would begin to restore the vegetative community bordering the River. However, in bank areas where revetment mats or armor stone are used for bank stabilization, the natural appearance of the banks would be diminished. In addition, in areas where the natural appearance of the River would return, it would likely not mimic the pre-remediation state of the community along the River. Vegetative communities that exist along portions of the River at this time are mature systems, and it would take several decades for any planted trees to reach the size of the older trees that would be removed during remediation.

The placement of construction roads and staging areas to facilitate remedial activities in Reaches 5 and 6 also has the potential for causing long-term impacts on the aesthetics of the floodplain. Conceptually, it is expected that an extensive network of roadways on both sides of the River would be necessary to support the implementation of SED 4. Additionally, five staging areas would be required to support the removal/capping activities in Reach 5C and Woods Pond. The placement of these roadways and staging areas would remove trees and vegetation, mostly in upland forest areas; and hence these areas would not be natural in appearance during the period while the roadways and staging areas remain in place and until they are fully restored. Moreover, the trees in some of the upland forested areas are mature trees that are greater than 50 years in age, and the time for a replanted forest community to develop an appearance comparable to its current appearance would be commensurate with the age of the current community.

Impacts on Banks and Bedload Movement

The potential physical impacts of SED 4 on banks and bedload movement are the same as those described for SED 3 in Section 4.3.5.3. As discussed there, stabilization of the erodible banks in Reaches 5A and 5B to prevent future erosion could result in the need to stabilize other, currently non-erodible bank or nearby riverbed areas. In addition, the bank stabilization would reduce the current process by which eroding banks slump into the river and subsequently contribute to the overall bedload in Reaches 5A and 5B. Further, the armor stone placed as a cap component in Reaches 5A and 5B would initially impact bedload transport by capturing solids moving along the river bottom. However, once the armor stone is silted over, bedload movement should return to current conditions.

Potential Measures to Mitigate Long-Term Adverse Impacts

Measures to mitigate the potential long-term adverse impacts described above would include the restoration measures described in Section 4.4.1, which are similar to the measures summarized in Section 4.3.5.3 for SED 3.

4.4.6 Attainment of IMPGs

As part of the evaluation of SED 4, average PCB concentrations in surface sediment and fish predicted by the model at the end of the 52-year projection period have been compared to applicable IMPGs. For these comparisons, model-predicted sediment and fish PCB concentrations were averaged in the manner discussed in Section 3.3. The sections below describe the human health and ecological receptor IMPG comparisons for SED 4, and those comparisons are illustrated in Tables 4-16 through 4-21.

As described below, PCB concentrations in some areas are sufficiently low that certain IMPGs would be achieved prior to any active remediation of sediments, while some other IMPGs would be achieved at some point within the 52-year model simulation period, and other IMPGs would not be met (if at all) for many years after the modeled period. The numbers of years needed to achieve the IMPGs are presented in Tables 4-16 through 4-21.[60] In addition, figures in Appendix G show temporal profiles of model-simulated PCB concentrations for each of the IMPG comparisons described in this section (including the estimated time to achieve each IMPG). Where certain IMPGs would not be achieved by the end of the model projection period, the number of years to achieve the IMPGs has been estimated by extrapolating the model projection results beyond the 52-year simulation period, as directed by EPA, using the extrapolation method described in Section 3.2.1. As previously noted, such extrapolation produces estimates that are highly uncertain. Nonetheless, the extrapolated estimates of time to achieve the IMPGs that are not met within the 52-year model projection period are described below.

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[60] The extent to which SED 4 would accelerate attainment of the IMPGs relative to natural processes can be seen by comparing these tables to the comparable tables for SED 1 (see Section 4.1.6 above).

Also, as described in Section 3.2, bounding simulations have been conducted with the model to evaluate the significance of various assumptions regarding the East Branch PCB boundary condition and sediment residual values, as directed by EPA. In almost all cases, application of the "lower bound" assumptions in the model did not result in the attainment of additional IMPGs, beyond those attained using the "base case" assumptions, for the receptors/averaging areas described below. Therefore, the discussion below focuses on IMPG attainment resulting from the application of the "base case" model assumptions; however, the few instances of additional IMPG attainment resulting from application of the lower-bound assumptions are noted.

4.4.6.1 Comparison to Human Health-Based IMPGs

For human direct contact with sediments, the average predicted surface sediment (0- to 6-inch) concentrations would achieve all IMPG values in all eight sediment exposure areas (Table 4-16), with the exception of the averaging areas downstream of Woods Pond Dam, which would not achieve the most stringent RME IMPG at a cancer risk level of 10^{-6} for adults (or that for older children in SA 7); application of the lower bound assumptions does not result in attainment of these IMPGs. Many of the IMPGs that are met are achieved prior to the start of remediation, while the others would generally be achieved in 15 years or less.

For human consumption of fish, the average fish PCB concentrations predicted by the model in Year 52, when converted to fillet concentrations, would not achieve the fish consumption IMPGs based on RME assumptions and either cancer risks or non-cancer impacts in Reaches 5 through 8 (with the exception of the probabilistic RME IMPG at the 10^{-4} cancer risk level, but not the corresponding non-cancer IMPGs, in Reaches 5 and 6 and three subreaches in Reach 7) (Table 4-17).[61] However, in the Connecticut impoundments, the CT 1-D Analysis indicates that SED 4 would achieve fish PCB levels within the range of the RME-based cancer and non-cancer IMPGs.

SED 4 would also achieve some of the CTE-based fish consumption IMPGs in Massachusetts, as well as all CTE IMPGs in Connecticut, within time periods typically ranging up to 25 years (Table 4-17).[62]

Extrapolation of the model results beyond the model period indicates that achievement of the RME-based IMPGs that EPA considers protective for unrestricted fish consumption of 50

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[61] Application of the lower-bound assumptions results in the additional attainment of the deterministic RME IMPG based on a 10^{-4} cancer risk in Reach 6 only.

[62] Application of the lower-bound assumptions also results in the additional attainment of two CTE IMPGs – deterministic non-cancer (child) in Reach 6 and deterministic 10^{-5} cancer in Reach 7A.

meals per year, based on a deterministic approach and a 10^{-5} cancer risk as well as non-cancer impacts, would take 160 to >250 years in the PSA and >250 years in Reaches 7 and 8.

4.4.6.2 Comparison to Ecological IMPGs

For benthic invertebrates, predicted average sediment concentrations in the PSA spatial bins and the simulated subreaches between Woods Pond Dam and Rising Pond Dam would achieve the upper-bound IMPG (10 mg/kg) in all areas and would achieve the lower-bound IMPG (3 mg/kg) in all areas except for a few in Reach 7 (Table 4-18). These levels would generally be achieved immediately following completion of remediation in Reaches 5 and 6.

For amphibians, predicted surface sediment PCB levels in the backwater areas at the end of the modeled period would achieve the lower-bound IMPG (3.27 mg/kg) in 70% of these areas (73 acres), are within the range of IMPGs (3.27 to 5.6 mg/kg) in approximately 20% of these areas (11 acres), and exceed the upper-bound IMPG (5.6 mg/kg) in less than 10% of these areas (1 acre) (Table 4-19). Time to achieve the IMPGs in backwaters that achieve the IMPGs within the model projection period range from approximately 5 to 50 years. In the few backwater areas that would not achieve the IMPGs by the end of the modeled period, extrapolated estimates indicate that they could be achieved within various times between 60 and >250 years.

For insectivorous birds (represented by wood duck) and piscivorous mammals (represented by mink), the model-predicted surface sediment concentrations have been compared to selected target sediment levels of 1, 3, and 5 mg/kg, as discussed previously. For insectivorous birds, the predicted surface sediment concentrations are below the target sediment levels of 3 and 5 mg/kg in all averaging areas, and below the 1 mg/kg target level in approximately 80% (10 of 12) of the averaging areas (Table 4-20). The times to achieve those levels range from 1 to 30 years, but are generally less than 15 years. For piscivorous mammals, the model-predicted surface sediment concentrations are below all three of the target sediment levels (1, 3, and 5 mg/kg) in both averaging areas (Table 4-20). The times to achieve them range from approximately 10 to 15 years.

For piscivorous birds (represented by osprey), the model-predicted average whole-body fish PCB concentrations would achieve the applicable IMPG in about 80% of the modeled reaches (Table 4-21). In two of the Reach 7 subreaches and in Reach 8, the predicted fish concentrations would exceed the IMPG (Table 4-21). Estimated times to achieve the IMPG in reaches where it is not already met prior to the start of the model projection range from 10 to 20 years. In reaches where the IMPG is not attained within the 52-year projection period, the extrapolated time to achieve this IMPG ranges from 80 to >250 years.

For fish (based on both warmwater and coldwater fish protection) and threatened and endangered species (represented by the bald eagle), the model-predicted average whole-body fish PCB concentrations would achieve the applicable IMPGs in all reaches (Table 4-21). Estimated times to achieve these IMPGs in reaches where they are not already met prior to the start of the model projection range from 3 to 11 years.

4.4.7 Reduction of Toxicity, Mobility, or Volume

The degree to which SED 4 would reduce the toxicity, mobility, or volume of PCBs is discussed below.

Reduction of Toxicity: SED 4 does not include any treatment processes that would reduce the toxicity of the PCBs in the sediment. However, if “principal threat” wastes (e.g., free NAPL, drums of liquid) should be encountered (which is not anticipated), they would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: SED 4 would reduce the mobility of PCBs in the River by removing approximately 262,000 cy of sediment containing PCBs in Reaches 5A, 5B, and 6 and placing a cap over those areas (total of 91 acres); removing approximately 33,000 cy of PCB-containing erodible bank soils in Reach 5 and stabilizing those banks; and placing a cap over the deeper portion of Reach 5C (37 acres). The caps would prevent or minimize the mobility of PCB in the underlying sediments. Further, a thin-layer cap would be placed over 35 acres in portions of Reaches 5B and 5C, 61 acres in the Reach 5 backwaters, and 23 acres in a portion of Woods Pond (for a total of 119 acres) to aid in the recovery of those areas.

Reduction of Volume: SED 4 would reduce the volume of sediment containing PCBs and the mass of PCBs present in the River through the removal of approximately 295,000 cy of sediments/bank soil containing approximately 16,200 lbs of PCBs over an area of approximately 91 acres. A summary of the volumes and PCB mass that would be removed under this alternative from each reach is presented below.

	Removal Volume (cy)	**PCB Mass (lbs)**
Reach 5A:	134,000	10,300
Reach 5B:	39,000	700
Reach 6 (Woods Pond):	89,000	4,000
Reach 5A/5B Banks:	33,000	1,200
Totals:	**295,000**	**16,200**

4.4.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of SED 4 has included consideration of the short-term impacts of implementing this alternative on the environment, local communities (as well as communities along transport routes), and the workers involved in the remedial activities. These impacts would last for the duration of the active remedial activities, which is estimated to be approximately 15 years – specifically, approximately 8 years for Reach 5A, 3 years for Reach 5B, 2 years for Reach 5C, 2 years for Reach 5 backwaters (performed concurrently with Reach 5C activities), and 2 years for Reach 6. Since the extent and duration of remediation activities under SED 4 are greater than under SED 3, the short-term impacts would be more extensive and last longer than under SED 3.

Impacts on the Environment

Short-term impacts on the environment resulting from implementation of SED 4 would include: potential impacts to the water column, air, and biota in the Rest of River area during excavation, capping, and thin-layer capping activities; alteration/destruction of benthic habitat in the areas subject to those activities; loss of riparian habitat as a part of bank stabilization activities; and loss of floodplain habitat and disruption to the biota that reside in the floodplain due to construction of the supporting facilities. Short-term impacts specifically associated with each remedial component are described below.

Sediment Removal: Sediment removal activities in Reaches 5A, 5B, and 6 (262,000 cy over 91 acres) would result in resuspension of PCB-containing sediment in the water column due to the invasive nature of the removal operation. Resuspension to the water column outside the work area would be controlled in Reaches 5A and 5B, as removal in those areas would be conducted in the dry with sheetpile enclosing the removal areas. However, the potential exists for sediment containing PCBs to be released from the work area both during sheetpile installation and during a high flow event should overtopping of the sheeting occur. Removal activities in Reach 6 would be conducted in the wet with silt curtains to mitigate sediment releases to downstream reaches. In that area, some sediment containing PCBs could be released from the work area through the excavation process even though the area would be surrounded by silt curtains. In addition, boat and barge traffic could resuspend sediment during the construction phase. Water column sampling would be performed during removal activities to monitor for any potential water quality impacts.

The potential also exists during removal and related sediment processing activities for airborne releases that could impact downwind communities. Air monitoring would be conducted during these activities to assess any potential air quality impacts.

Implementation of SED 4 would cause a loss of aquatic habitat in the 91 acres of Reaches 5A, 5B, and 6 where removal would occur. Implementation of SED 4 would remove the natural bed material, debris, and aquatic vegetation which are used as habitat by both fish and benthic invertebrates. The sediment removal activities would also result in the direct loss of benthic invertebrates and aquatic organisms (e.g., reptiles and amphibians) residing in the sediments during the removal, and a temporary disruption and displacement of fish.

In addition, sediment removal activities conducted in the wet, even with the use of silt curtains, would be expected to result in short-term increases in fish tissue PCB concentrations. For example, wet dredging in the Grasse River, with use of silt curtains, resulted in significantly elevated PCB levels in resident fish samples collected in the same year that dredging was performed; however, monitoring conducted 1 year after completion of the dredging indicated that these increases were temporary, with PCB concentrations returning to pre-dredging levels (www.thegrasseriver.com). Caged mussel monitoring results performed during the Upper ½-Mile Reach activities indicated a similar trend associated with dry excavation using sheetpiling (GE, 2004b). Based on this information, it would be expected that any short-term increase in PCB concentrations in biota as a result the implementation of SED 4 would have limited duration, with tissue levels decreasing after completion of the work.

Additionally, sediment removal activities would alter feeding areas for birds and mammals that live adjacent to the River and feed in areas subject to remediation.

Capping: Capping activities in Reach 5C would be performed during low flow periods with silt curtains in place. While resuspension is possible due to capping activities, the potential for resuspension of PCB-containing sediment is anticipated to be much less than for removal activities, since capping involves placement of clean material on undisturbed native sediment, and silt curtains would be in place to mitigate transport of cap material any resuspended sediments downstream. Water column monitoring would be conducted during capping activities to assess any potential water quality impacts.

Placement of a cap as part of SED 4 would occur over 37 acres of the River, and would have an immediate impact on the aquatic communities. Capping would cover the natural bed material, require removal of any significant debris or structures, and bury aquatic vegetation. The cap placement would result in loss of the existing benthic invertebrates and benthic and fish habitat. Any emergent wetlands plants and submerged aquatic vegetation would be covered and lost. Such losses would be temporary in most such areas since benthic invertebrates, emergent vegetation, and submerged aquatic vegetation would recolonize the capping material over time. However, as discussed in Section 4.4.5.3, in shallow areas where the water is less than 24 inches deep and consolidation of the underlying sediment is not anticipated, placement of the cap could increase the substrate elevation such that the vegetative characteristics of the wetlands and the biota dependent on such wetlands would be changed.

Thin-Layer Capping: Thin-layer capping activities in portions of Reaches 5B and 5C, the backwaters, and Woods Pond would be performed by placement of a thin layer of sand over the undisturbed native sediment. Based on data collected during the Silver Lake capping pilot study, there is little potential for thin-layer capping to resuspend PCB-containing sediments. Water column monitoring would be conducted to assess any potential water quality impacts.

Placement of a thin-layer cap as part of SED 4 would occur over 119 acres of the River, and would have a short-term impact on aquatic vegetation and benthic invertebrates in those areas. However, it is expected that the submerged aquatic vegetation and benthic communities would be re-established from upstream sources. Based on results from the Upper ½-Mile Reach, it is likely that the benthic community would quickly recover, with the rate of recovery dependent on the rate of organic detritus accumulation across the thin-layer cap. Again, however, as discussed in Section 4.4.5.3, in limited shallow water areas where the water depth less is than 6-12 inches and consolidation of the underlying sediment is not anticipated, placement of the thin-layer cap could increase the substrate elevation such that the vegetative characteristics and the biota dependent on such vegetation would be changed.

Bank Stabilization: Bank stabilization activities in Reach 5 would have an immediate effect on the riparian community bordering the River. These impacts would be the same as described for SED 3 in Section 4.3.8.

Supporting Facilities: Construction of supporting facilities (e.g., roadways, staging areas) in the floodplain adjacent to the River, would result in the temporary loss of habitat in those areas and the wildlife that it supports. It is anticipated that SED 4 would require a total of approximately 99 acres for access roads and staging areas (approximately 63 acres within the 10-year floodplain). Development of these support facilities would affect the ability of some wildlife to nest and feed in these areas; and in some instances it would cause habitat fragmentation that could further disrupt the movement and interactions of certain wildlife species.

Impacts on Local Communities and Communities Along Transport Routes

SED 4 would result in short-term impacts to the local communities along the River in Reaches 5 and 6. These impacts would include disruption along the River and within the floodplain due to the remediation and the construction of staging areas and access roads, as well as increased noise and truck traffic. These impacts would mainly affect the upper part of Reach 5 (Reaches 5A and 5B), where remediation activities are estimated to last for 11 years, with lesser impacts in the downstream portion of Reach 5 and Woods Pond, where the remediation is estimated to last for 4 years.

Recreational activities in the areas that would be affected by SED 4 include bank fishing, canoeing, hiking, and waterfowl hunting. During the period of active construction, restrictions on such recreational uses of the River and floodplain would be imposed in the areas in which remediation-related activities are taking place. Due to safety considerations, boaters, hikers, anglers, and hunters would not be able to use the River or floodplain in the areas where activities are being conducted. Further, bank stabilization activities in Reach 5 would remove the ability of recreational anglers and hikers to use those areas during construction. Aesthetically, the presence of heavy construction equipment and cleared or disturbed areas would detract from the visually undisturbed nature of the area until such time as the restoration plantings for the disturbed areas have matured.

Due to the need to deliver equipment to the work areas, to remove excavated materials, and to deliver capping materials, truck traffic in the area would increase over current conditions. It is expected that this increased truck traffic would persist for the duration of the project (approximately 15 years). As an example, if 20-ton capacity trucks were used to transport sediments and bank soils from the staging areas, it would take approximately 22,100 truck trips to do so. In addition, assuming the use of smaller capacity trucks for local hauling (i.e., 16-ton trucks), approximately 46,300 truck trips would be required to transport sand, stone and bank stabilization material to Reaches 5 and 6. This additional traffic would increase noise levels and emissions of vehicle/equipment exhaust and nuisance dust to the air. Further, noise in and near the construction zone could affect those residents and businesses located near the work areas.

The additional truck traffic would also increase the risk of traffic accidents along transport routes. Appendix D includes an analysis of potential risks from the increased truck traffic that would be necessary to transport clean materials to the site for implementation of SED 4.[63] This analysis indicates that the increased truck traffic associated with SED 4 would result in an estimated 1.32 non-fatal injuries due to accidents (with a probability of 73% of at least one such injury) and an estimated 0.06 fatalities from accidents (with a probability of 5% of at least one such fatality).

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[63] The risks from truck traffic to transport excavated materials to the staging areas are evaluated as part of risks to workers, discussed below; and the risks from truck traffic to transport such materials from the staging areas away from the site are evaluated under the relevant treatment/disposition alternatives.

Engineering controls would be implemented, to the extent practical, to mitigate short-term impacts and risks associated with implementation of SED 4. However, some impacts would be inevitable.

<u>Risks to Remediation Workers</u>

There would be health and safety risks to site workers implementing SED 4. Implementation of SED 4 is estimated to involve 635,279 man-hours over a 15-year timeframe. The analysis in Appendix D of potential risks to workers from implementation of the sediment alternatives indicates that implementation of SED 4 would result in an estimated 6.3 non-fatal injuries to workers (with a probability of 100% of at least one such injury)[64] and an estimated 0.05 worker fatalities (with a probability of 5% of at least one such fatality). Engineering controls and OSHA procedures designed to mitigate risks to remediation workers would be instituted.

4.4.9 Implementability

4.4.9.1 Technical Implementability

The technical implementability of SED 4 has been evaluated considering the factors identified below.

<u>General Availability of Technologies</u>: SED 4 would be implemented using well-established and available in-river remediation methods and equipment. Similarly, land-based support areas would be constructed using commonly available construction technologies. Further, well-established and readily available equipment would also be used to monitor the remedial alternative both during and following implementation.

<u>Ability To Be Implemented</u>: The technologies and process options that are part of SED 4 were selected based on river characteristics, and would be suitable for implementation in the reaches where they would be applied. Sediment removal followed by capping is a functional remedy for use both in higher energy river reaches such as Reach 5A and parts of Reach 5B, and in shallow water, lower water velocity river reaches like those found in portions of Woods Pond. Sediment removal would be performed in the dry in Reaches 5A and 5B, and in the wet in Woods Pond. Each technique has been successfully demonstrated at other sites (see

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[64] In this report, probabilities that are effectively 100% (i.e., greater than 99.5%) are referred to as 100%.

Section 4.4.5.2). Sediment removal and subsequent capping would be performed in a manner to cause no net loss of flood storage capacity.

Capping without prior removal would be implemented in portions of Reach 5C where the water is relatively deep and the surface water velocities are low, which are suitable conditions for such capping. In addition, thin-layer capping would be applied in low velocity areas in parts of Reach 5B, Reach 5C, Reach 5 backwaters, and Woods Pond, which have suitable conditions for this technique.

The potential impacts on flood storage capacity resulting from the placement of cap materials in these reaches under SED 4 were assessed by comparing EPA model predictions of the area of floodplain within Reaches 5 and 6 inundated during a high flow event to that predicted under SED 1 during the same event (using a 2-year flow event in Year 48 of the model projections, as discussed for SED 3 in Section 4.3.9.1). In Reach 5 backwaters and Woods Pond, where the backwater effects are controlled by Woods Pond Dam, impacts to flood storage capacity would not be expected as a result of cap placement. However, in Reaches 5B and 5C, there is the potential for the caps to increase water level/flood frequency. Under SED 4, the model-predicted area of inundation within Reaches 5 and 6 during the 2-year flow event in Year 48 of the projection increased by 1% over that predicted under SED 1 (829 acres compared to 817 acres). This analysis suggests that the caps would have a limited impact on flood storage. A more refined assessment of flood storage capacity would be developed during design. If necessary, additional flood storage capacity would be obtained to accommodate placement of the caps in these reaches if this alternative were selected.

Bank soil removal followed by stabilization would be performed in the erodible bank areas of Reach 5 (high energy areas), with the most appropriate removal/stabilization options selected in the design phase based on the physical features of the bank area in conjunction with the adjacent sediment and/or floodplain soil remedial activities. Since the slope of some of the restored erodible banks would likely be reduced during remediation, an increase in flood storage capacity would likely result in those areas of Reach 5.

MNR with institutional controls would be implemented in the remaining backwaters and in the reaches downstream of Woods Pond Dam. Monitoring to track changes in PCB concentrations following the SED 4 remedial activities would be performed using readily available methods and materials, such as have been used previously in the River. Similarly, the continued maintenance of biota consumption of advisories would be expected to use similar techniques to those used previously.

Support facilities in the floodplain area necessary for implementation of SED 4 could readily be constructed using commonly available construction techniques. Efforts would be made to construct the facilities to avoid wetlands to the extent practicable.

Reliability: The technologies that comprise SED 4 are considered reliable, as shown through implementation at other sites and in portions of the Housatonic River upstream of the Confluence. The use of these technologies at other sites is described in Sections 4.3.5.2 and 4.4.5.2.

Availability of Space for Support Facilities: Implementation of SED 4 would require construction of access roads and staging areas at various locations within the floodplain of the River. As noted previously, an estimated 99 acres of space would be needed, and appears to be available to support the SED 4 activities based on preparation of a conceptual site layout. Development of staging areas and access roads would be sequenced over the estimated 15-year implementation period.

Availability of Cap Material: Materials required for cap construction must be of suitable quality for in-river placement and habitat restoration. A total of approximately 460,000 cy of material would be required for stabilization, thin-layer capping, and capping activities (300,000 cy of sand and 160,000 cy of armor stone and rip-rap). Adequate material sources are assumed to be locally available; however, an evaluation would be performed during design activities to confirm suitable material availability.

Ease of Conducting Additional Corrective Measures: Future corrective measures, if needed to perform cap or bank maintenance or conduct additional remediation, would be implementable, given the same technical and logistical constraints applicable to the initial implementation of SED 4. Ease of implementation of the corrective measures would be directly related to the extent of the additional corrective measure (i.e., area and/or volume to be addressed) and the ease of access (i.e., location of target area and proximity of access areas).

Ability to Monitor Effectiveness: The effectiveness of SED 4 would be determined over time through long-term monitoring to document reductions in PCB concentrations in the water column, sediment, and fish in various reaches of the River. Periodic monitoring (i.e., visual observation and sampling) of the capped sediments and restored riverbanks would allow for an evaluation of cap integrity and effectiveness, as well as bank stability. Such activities have been successfully performed on the upper portions of the Housatonic River and at other sites. Equipment and methods for this type of monitoring are readily available.

4.4.9.2 Administrative Implementability

The administrative implementability of SED 4 has been evaluated in consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: Implementation of SED 4 would need to comply with the substantive requirements of applicable and appropriate regulations pertaining to the performance of the remedial action (unless waived). As noted in Section 4.4.4, GE believes that SED 4 could be designed and implemented to meet such requirements (i.e., the location-specific and action-specific ARARs listed in Tables 2-2 and 2-3), with the exception of certain requirements that could potentially apply to the on-site staging areas if the excavated sediments should constitute hazardous waste, and which GE believes should be waived, if necessary, as technically impracticable.

Access Agreements: Implementation of SED 4 would require GE to obtain access permission from the owners of properties in Reaches 5 and 6 where remedial work or ancillary facilities would be necessary to carry out the alternative. Although the majority of these areas are publicly owned, it is anticipated that access agreements may be required from up to approximately 30 private landowners. Obtaining such access agreements could be problematic in some cases. If GE should be unable to obtain access agreements with particular property owners, GE would request EPA and/or MDEP to provide assistance.

Coordination with Agencies: Implementation of biota consumption advisories would require coordination with state public health departments and/or other appropriate agencies in the dissemination of information to the public and surrounding communities regarding those advisories. In addition, obtaining access to State-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of SED 4, GE would need to coordinate with EPA, as well as state and local agencies, to address any health and safety concerns and to provide as-needed support with public/community outreach programs.

4.4.10 Cost

The estimated total cost to implement SED 4 is $216 M (not including treatment/disposition costs). The estimated capital cost for implementation of SED 4 is $202 M, assumed to occur over a 15-year construction period. Estimated annual OMM costs include costs for a 5-year inspection and maintenance program for the restored riverbed and riverbanks, thin-layer cap areas, and restored staging areas and access roads; these costs range from $25,000 to $275,000 per year (depending on which reach is being monitored), resulting in a total cost of $3.2 M. The estimated annual OMM costs for SED 4 also include implementation of a long-term water, sediment, and fish monitoring program for a period of 30 years following completion of construction activities on a reach-specific basis. The estimated costs for this long-term program range from approximately $275,000 to $580,000 per year (depending on the extent of monitoring occurring within a given year), resulting in a total cost of $10.7 M. The following summarizes the total capital and OMM costs estimated for SED 4.

SED 4	**Est. Cost**	**Description**
Total Capital Costs	$202 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM	$13.9 M	Costs for performance of the OMM programs
Total Cost for Alternative	$216 M	Total cost of SED 4 in 2008 dollars

The total estimated present worth cost of SED 4, which was developed using a discount factor of 7%, a 15-year construction period, and an OMM period of 30 years on a reach-specific basis, is approximately $136 M. More detailed cost estimate information and assumptions for each of the sediment alternatives are included in Appendix E.

These costs do not include the costs of treatment/disposition of removed sediments/bank soils. The estimated costs for combinations of sediment remediation and treatment/ disposition alternatives are presented in Section 8.

4.4.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 4.4.2, the evaluation of whether SED 4 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As discussed previously, SED 4 would result in a reduction in the potential for exposure of human and ecological receptors to PCBs in sediments, surface water, and fish by: (a) permanently removing 262,000 cy of PCB-containing sediments in portions of Reaches 5 and 6 and placing a cap over the underlying sediments; (b) removing 33,000 cy of erodible PCB-containing riverbank soils from Reach 5 and stabilizing those erodible banks; (c) placing a cap over 37 acres in the deeper part of Reach 5C where no excavation would be performed; (d) placing a thin-layer cap over 119 acres in Reaches 5B, 5C, and 6, and backwaters in Reach 5 to reduce exposure concentrations and accelerate the process of natural recovery; and (e) relying on natural recovery processes in other areas. As shown in Section 4.4.3, implementation of SED 4 is predicted to reduce the PCB load in the River passing Woods Pond Dam and Rising Pond Dam by 96% and 89%, respectively, over the course of the modeled period, and to reduce the annual PCB mass transported from the River to the floodplain in Reaches 5 and 6 by 97% over that period.

Further, as shown in Section 4.4.5.1, EPA's model predicts that SED 4 would result in a substantial permanent reduction in sediment and fish PCB concentrations. For example, the model predicts that the fish PCB concentrations (whole body) would be reduced over the modeled period from 70-110 mg/kg to approximately 1-2 mg/kg in Reaches 5 and 6, from 30-50 mg/kg to approximately 3-8 mg/kg in the Reach 7 impoundments, from 30 mg/kg to approximately 7 mg/kg in Rising Pond, and from 1-2 mg/kg to 0.05-0.1 mg/kg in the Connecticut impoundments.

Compliance with ARARs: As explained in Section 4.4.4, the model predictions of water column PCB concentrations indicate that SED 4 would achieve the chemical-specific ARARs, except for the water quality criterion of 0.000064 µg/L based on human consumption of water and organisms, which GE believes should be waived as technically impracticable. Further, GE believes that SED 4 could be designed and implemented to meet the pertinent location-specific and action-specific ARARs, with the possible exception of certain requirements that could potentially apply to the on-site staging areas if the excavated sediments should constitute hazardous waste, and which GE believes should be waived, if necessary, as technically impracticable.

Human Health Protection: As discussed in Section 4.4.6.1, SED 4 would provide protection of human health from direct contact with sediments, since it would achieve IMPG levels based on a 10^{-5} cancer risk or lower, as well as all non-cancer IMPGs, in all sediment exposure areas, with the majority of those levels achieved at the present time. For human consumption of fish, the fish PCB concentrations predicted to result from SED 4 in Reaches 5 through 8 at the end of the 52-year simulation period, when converted to fillet-based concentrations, would not achieve the RME-based IMPGs within EPA's cancer risk range or those based on non-cancer impacts, i.e., the levels that EPA considers to be protective for unrestricted consumption of Housatonic River fish (except for the probabilistic RME 10^{-4} cancer IMPG, but not the corresponding non-cancer IMPG, in Reaches 5 and 6 and a few subreaches in Reach 7). Extrapolation of model results beyond the simulation period indicates that PCB concentrations in fish fillets would reach the RME IMPG levels based on a 10^{-5} cancer risk and non-cancer impacts in approximately 160 to >250 years in the PSA and >250 years in Reaches 7 and 8. In the Connecticut impoundments, the CT 1-D Analysis indicates that SED 4 would achieve fish PCB levels within the range of the RME IMPGs within the modeled period. Where the levels for unrestricted fish consumption are not achieved, institutional controls – specifically, fish consumption advisories – would continue to be utilized to provide human health protection from fish consumption.

Environmental Protection: As discussed in Section 4.4.6.2, the model results indicate that, by the end of the modeled period, SED 4 would achieve the IMPG levels for some receptor groups in all areas. Specifically, for benthic invertebrates, SED 4 would result in sediment PCB concentrations within or below the IMPG range (3 to 10 mg/kg) in all averaging areas;

and for fish (warmwater and coldwater) and threatened and endangered species, predicted whole body fish PCB concentrations would achieve the IMPGs for these receptors (55, 14, and 30.4 mg/kg, respectively) in all reaches. For other receptor groups, SED 4 would achieve the IMPGs in the great majority of areas. Specifically, for amphibians, SED 4 would result in sediment PCB concentrations within or below the IMPG range (3.27 to 5.6 mg/kg) in nearly all of the backwaters (27 of 29 backwaters, covering 99% of the backwater acreage); and for piscivorous birds, the predicted whole body fish PCB concentrations would achieve the IMPG (3.2 mg/kg) in Reaches 5, 6, and most of 7. Finally, for insectivorous birds, predicted sediment PCB concentrations are below the target sediment levels of 3 and 5 mg/kg in all averaging areas and below the target level of 1 mg/kg in most areas; and for piscivorous mammals, predicted sediment PCB concentrations are below all three target sediment levels in both averaging areas.[65]

Although this alternative would not achieve the ecological IMPGs for a couple of receptor groups in a few limited areas, GE does not believe that those exceedances would prevent this alternative from being protective of the environment. These exceedances are not widespread and are generally only slightly above the IMPG levels.[66] Given these factors, together with the fact that the local populations of these receptors encompass the numerous areas within the Rest of River where the IMPGs would be achieved, as well as nearby areas outside the Rest of River, it would not be expected that these few exceedances would prevent the maintenance of healthy local populations of these receptors. Much less would these limited exceedances adversely impact the overall wildlife community in the Rest of River area, which has been shown by EPA's own field surveys to consist of numerous and diverse species under current conditions.

At the same time, implementation of SED 4 would cause short-term impacts on the environment in the areas where work would be conducted (e.g., loss of aquatic habitat in areas of remediation in portions of Reaches 5 and 6, loss of riparian habitat in the bank stabilization areas, potential resuspension of PCB-containing sediments during removal, and loss of floodplain habitat in areas where supporting facilities are constructed), as discussed in Section 4.4.8. It could also potentially have some long-term environmental impacts (e.g., on

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[65] As discussed previously, attaining the target sediment levels for insectivorous birds and piscivorous mammals would allow achievement of the IMPGs for those receptors provided that the average floodplain soil concentrations in the same averaging areas are below the associated target floodplain soil levels (see Section 6).

[66] For example, the two backwater areas that do not achieve levels within the IMPG range for amphibians are small (total area of approximately 1 acre), and in both areas, the predicted sediment concentrations are only slightly above the upper-bound IMPG (see Table 4-19). Similarly, the predicted exceedances of the piscivorous bird IMPG occur only in two Reach 7 subreaches and Reach 8, and the predicted fish concentrations in those areas generally do not exceed the IMPG by much (see Table 4-21).

stabilized banks where mature overhanging trees are removed, on the edges of cap or thin-layer cap areas where the water is shallow and consolidation of the underlying sediment is not anticipated, and from ancillary construction activities in the floodplain), as discussed in Section 4.4.5.3. These short- and long-term impacts would be more extensive than those from SED 3.

Despite these impacts, however, SED 4 would address the ecological risks that EPA concluded in the ERA were present in the Rest of River area. Thus, if one accepts EPA's conclusions in the ERA, SED 4 would meet the standard of providing environmental protection.

Summary: Based on the foregoing considerations, it is concluded that SED 4 would provide overall protection of human health and the environment.

4.5 Evaluation of Sediment Alternative 5

4.5.1 Description of Alternative

SED 5 would include the removal of 410,000 cy of sediments and bank soils over 126 acres, placement of a cap over a total of 186 acres including all the removal areas and some non-removal areas, and application of a thin-layer cap over 102 acres. Specifically, the components of SED 5 include the following:

- Reach 5A: Sediment removal (134,000 cy over 42 acres);
- Reach 5B: Sediment removal (88,000 cy over 27 acres);
- Reach 5C: Combination of removal (66,000 cy over 20 acres) and capping without sediment removal (37 acres);
- Reach 5 erodible banks: Removal and stabilization (33,000 cy);
- Reach 5 backwaters: Thin-layer capping (61 acres) in certain backwaters (depending on PCB concentrations);
- Reach 6 (Woods Pond): Combination of removal (89,000 cy over 37 acres) and capping without sediment removal (23 acres);
- Reach 8 (Rising Pond): Thin-layer capping (41 acres); and

- Remaining Reach 5 backwaters, Reach 7, and Reaches 9 through 16: MNR.

Remediation would proceed from upstream to downstream to minimize the potential for recontamination of remediated areas. Figures 4-6a-b identify the remedial action(s) that would be taken in each reach as part of SED 5.

The following summarizes the general remedial approach (and associated assumptions) related to implementation of SED 5. It is estimated that SED 5 would require approximately 18 years to complete. It should be noted that while details on equipment and processes are provided in this description for purposes of the evaluations in this CMS Report, the specific methods for implementation of any selected remedy would be determined during design based on engineering considerations and site conditions.

Site Preparation: Prior to implementation of remedial activities, access roads and staging areas would be constructed to support implementation of this alternative. Grubbing and clearing of vegetation would likely also be necessary, and appropriate erosion and sedimentation controls would be put in place prior to construction. The conceptual plans developed for this CMS Report indicate that 31 staging areas and approximately 21 miles of access roads would be constructed between the Confluence and Rising Pond to support implementation of SED 5.

Sediment Removal: Sediment removal would be performed in Reaches 5 and 6, as presented below.

	Average Removal Depth (feet)	**Removal Volume (cy)**	**Acreage**
Reach 5A:	2	134,000	42
Reach 5B:	2	88,000	27
Reach 5C:	2	66,000	20
Reach 6 (Woods Pond):	1.5	89,000	37
Totals:		**377,000**	**126**

The areas over which removal would be conducted for the reaches listed above are shown on Figure 4-6a.

It is assumed that the excavations in Reaches 5A and 5B would be performed in the dry with conventional mechanical excavation equipment. Sheetpiled cells would be established in the River to facilitate removal activities and limit downstream transport of sediment. A water treatment system would be used to treat water pumped from the excavation areas. In Reach 5C and Woods Pond, it is assumed that removal would be performed in the wet using barge-mounted clamshell excavators. Debris removal would be conducted prior to dredging. Silt curtains would be placed downstream of excavation areas to limit transport of suspended sediment. Periodic water column and air sampling would be performed during all removal operations to monitor potential releases.

Cap Placement: Caps would be installed following excavation in Reaches 5A, 5B, and 5C and Woods Pond (Figure 4-6a). Caps would also be installed in the deeper portions of Reach 5C and Woods Pond where no excavation would be performed (Figure 4-6a). Removal of significant debris would be conducted prior to cap material placement. Cap materials would be placed in the dry in areas where dry excavation was performed and through the water column in the remaining areas. Cap materials would be transferred to the River using conventional earth-moving equipment. For purposes of this CMS Report, it is assumed that in Reach 5, the cap would consist of 12 inches of sand (which may be amended to increase the TOC content), overlain by 12 inches of stone in the removal areas, and 6 inches of armor stone where no excavation would be performed. In Woods Pond, it is assumed that the cap would consist of 12 inches of sand (which may be organically amended) overlain by 6 inches of armor stone in both the removal and non-removal areas. The composition and size of the sand and armor stone would be selected during design to limit the potential for migration of PCBs from the underlying sediments through the cap (sand material) and to preclude the movement of cap materials during high flow events (armor stone). Silt curtains would be used during capping activities through the water column to mitigate the potential for downstream transport of materials.

Thin-Layer Cap Placement: A thin-layer cap would be installed in Reach 5 backwaters with average PCB concentrations equal to or greater than 15 mg/kg (61 acres; see Section 3.1.1) and in Rising Pond (41 acres), as shown on Figures 4-6a-b (total of 102 acres). The thin-layer cap would consist of an assumed 6-inch layer of sand, and would be placed via a combination of techniques, including mechanical and/or hydraulic means.

Sediment Dewatering and Handling: Sediment dewatering operations would be performed as necessary in the staging areas. For purposes of this CMS Report, it has been assumed that a combination of dewatering alternatives would be used, including gravity dewatering via stockpiling for materials removed in the dry and mechanical dewatering using a plate and frame filter press for materials removed in the wet. The addition of stabilization agents (e.g., other dry sediments, excavated soil, Portland cement) may be necessary prior to treatment and/or disposal. Treatment/disposition alternatives have been evaluated separately, and are discussed in Section 7. A water treatment system would be used to treat water pumped from the excavation areas, as well as any decant water collected from excavated materials in the staging areas.

Bank Removal/Stabilization: SED 5 would include the removal of 33,000 cy of soil from the erodible banks in Reach 5 followed by stabilization. Bank stabilization is assumed to be limited to Reaches 5A and 5B, and to consist of the same techniques used in SED 3 – i.e., bank excavation to promote stable slopes (assumed to be 1½:1 to 3:1 slopes), followed by stabilization with revetment mats, armor stone, or bioengineering techniques (with an assumed distribution of 20%, 60%, and 20%, respectively, for each stabilization technique).

MNR: MNR would be implemented in the remainder of the Rest of River under SED 5 (certain Reach 5 backwaters, Reach 7, and Reaches 9 through 16). As discussed previously, natural recovery processes have been documented in portions of the Housatonic River and would be expected to continue at varying rates in the areas where MNR would be implemented under SED 5, due in part to completed and planned remediation conducted upstream of the Rest of River, as well as the remediation that would be conducted as part of this alternative.

Restoration: SED 5 would include restoration of areas that are directly impacted by the sediment removal and/or capping activities, bank removal/stabilization activities, and ancillary construction activities, as appropriate to restore the habitat value of the affected resource, to the extent practical. Restoration would be accomplished using a combination of passive procedures (practices to facilitate natural re-establishment of the resource) and active procedures (plantings or other mitigation). For purposes of this CMS Report, the extent and type of restoration activities assumed for SED 5 are as follows:

- In the areas of Reach 5 and Woods Pond where removal would be conducted, the river bottom would be restored to existing bathymetry with the placement of a cap. In those areas, it is anticipated that the armor stone, as well as any deposited sediment, would be readily recolonized by benthic invertebrates. In the Upper ½-Mile Reach, benthic invertebrates colonized the armor stone, and those areas of stone that silted over, in the first few years. Similarly, in deeper portions of Reach 5C and Woods Pond subject to capping without removal, it is anticipated that benthic invertebrates would readily recolonize the area, based on data developed from deep water capping activities at the St. Louis River/Interlake/Duluth Tar Superfund Site in Duluth, Minnesota (Rogers and Costello, 2007). It is also anticipated that, in all of these areas, aquatic vegetation would readily re-establish itself through transport from upstream sources of plants in the water column.

- It is not anticipated that restoration would be required in the thin-layered cap areas in the Reach 5 backwaters and Rising Pond. In these areas, the capping substrate would serve as a ready base for recolonization by benthic invertebrates, and aquatic vegetation should readily re-establish itself through transport from upstream sources of plants in the water column.

- On riverbanks where revetment mats or armor stone are used for stabilization, supplemental habitat structures such as trees, log and root wad revetments, and/or log and brush shelters would be considered as part of the restoration to replace similar existing structures. On banks where bioengineering techniques are used, plantings would be used to restore an appropriate riparian community.

- In the areas adjacent to the River where access roads and staging areas have been constructed to support work in the River, those support facilities would be removed and the disturbed areas revegetated with plantings that, over time, would restore the habitat value of those areas.

Restoration activities would be conducted following completion of the remedial action within successive reaches of the River as appropriate.

Institutional Controls: SED 5 would include the continued maintenance of biota consumption advisories, as appropriate, to limit the public's consumption of fish and other biota from the River.

Long-Term OMM: Once implemented, it is assumed that SED 5 would include, for each reach involved, a 5-year post-construction monitoring program and a long-term (30-year) monitoring and maintenance program.

The post-construction monitoring program assumed for SED 5 would include annual monitoring of the same components outlined under SED 3 (Section 4.3.1). The SED 5 program is assumed to include visual observation supplemented with probing in areas where armor stone would be placed, collection of approximately 25 cores for visual observation in thin-layer cap areas, visual observations of the Reach 5 riverbanks, and visual observation and quantitative/qualitative assessment of restored staging areas and access roads. These activities would occur annually for a period of 5 years following remedy implementation in a given reach.

In addition, it is assumed that the long-term monitoring program would include analytical sampling of fish and the water column, consistent with the program outlined for SED 2 (Section 4.2.1). It is also assumed to include a sediment sampling program, which would include collection and PCB analysis every 5 years of 50 surface sediment samples from MNR areas, approximately 32 cores (96 samples) from removal areas, approximately 15 cores (45 samples) from cap-only areas, and approximately 25 cores (25 samples) from the thin-layer cap areas. Sampling is assumed for a period of 30 years. In addition, a maintenance program would be implemented, as necessary.

4.5.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 4.1.2, the evaluation of whether a sediment remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether SED 5 would be protective of human health and the environment is presented at the end of Section 4.5 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

4.5.3 Control of Sources of Releases

SED 5 would reduce the potential for future PCB releases from certain sediments and riverbanks that may occur via erosion and flood events. This alternative would address PCB sources over approximately 288 acres of the riverbed and the erodible portions of approximately 7 miles of riverbank, and would include the removal of 410,000 cy of PCB-containing sediment and bank soils. Implementing these actions would result in a reduction in the potential for future availability of PCBs on the sediment/riverbank surface and the potential for transport of the PCBs in these areas within the River and onto the floodplain for potential human or ecological exposure. The PCB-containing surface sediments in Reaches 5A, 5B, and parts of 5C and the shallow portion of the main channel in Woods Pond, some of which are susceptible to scour during high-flow events, would be removed and the residual PCBs remaining in these areas contained by a cap designed to withstand erosion during high flows. Similarly, the erodible banks of Reach 5 that currently provide a source of PCBs to the River during high-flow events would be remediated through a combination of removal and bank stabilization techniques. In portions of Reach 5C and Woods Pond where the water is deeper, a cap would be placed over the existing river bottom to isolate the underlying PCB-containing sediments from the water column. In addition, in portions of the Reach 5 backwaters and Rising Pond, where sediment PCB concentrations and the potential for scour/transport are low, a thin-layer cap would be placed over the existing river bottom to accelerate the natural recovery process and assist in controlling releases from those areas.

It should also be noted that, in conjunction with the remediation and natural recovery processes within the Rest of River, the remaining remediation activities to be conducted upstream of the Confluence (i.e., in areas adjacent to the East Branch and in the West Branch) would further reduce the PCBs in the surface sediments available for scour/transport within the Rest of River. Additionally, the existing dams along the River would continue to limit movement of PCB-containing sediments within the impoundments behind the dams, further reducing the potential for transport of those sediments to the River. While failure of those dams could lead to the release of PCB-containing sediments impounded behind them, the inspection, monitoring, and maintenance programs in place under other authorities, as described in Section 4.1.3, would prevent or minimize the possibility of dam failure.

As indicated by EPA's model, implementation of SED 5, in combination with upstream source control, would reduce the mass of PCBs transported within the River to downstream reaches and to the floodplain. For example, the annual average PCB load passing Woods Pond Dam at the end of the model projection is predicted to decrease by 97% from that calculated at the beginning of the model projection period (i.e., from 20 kg/yr to 0.6 kg/yr). Similarly, SED 5 is predicted to achieve a 93% reduction in the PCB load passing Rising Pond Dam over this same period (i.e., from 19 kg/yr to 1.3 kg/yr). Likewise, SED 5 is predicted to result in a 98% reduction in the annual average mass of PCBs transported from the River to the floodplain within Reaches 5 and 6 over the modeled period (i.e., from 12 kg/yr to 0.3 kg/yr).

The effects of an extreme flow event were examined using the Year 26 flood. The impact of this flood on surface sediment PCB concentrations can be seen on Figure 4-7b, which shows temporal profiles of model-predicted reach-average PCB concentrations in surface sediments resulting from the implementation of SED 5 over the 52-year model projection period. Similar to the other alternatives, the model results for SED 5 indicate that, in reaches subject to MNR only (i.e., Reach 7), the extreme event is not predicted to expose buried PCBs at concentrations exceeding those already exposed at the sediment surface. For the reaches that would be capped either following removal or without removal (i.e., Reaches 5A, 5B, 5C, and Woods Pond), EPA's model predicts that, given the cap's armor layer, buried sediments would not be exposed during the extreme storm event.[67] As a result, no change in reach-average surface sediment PCB concentrations is predicted in these reaches (Figure 4-7b). In the Reach 5 backwater areas undergoing thin-layer capping, the model predicts that the cap materials and underlying sediments also would remain stable during high flow events. Indeed, the model results indicate that only a single model grid cell (representing <1% of the thin-layer capped portion) would experience significant erosion. Such erosion is predicted to result in a small (0.2 mg/kg) increase in the reach-average surface sediment PCB concentration (Figure 4-7b). Similarly, in Rising Pond, the thin-layer cap and underlying sediments are predicted to remain in place over 93% of that impoundment during the extreme flow event. In the remaining area of Rising Pond, limited erosion resulting in a small (0.4 mg/kg) increase in the reach-average concentration is predicted to occur. These concentration increases are small, and the concentrations following the high flow events still

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[67] Further evaluation of the stability of cap and thin-layer cap materials under SED 5 based on model predictions of erosion in these areas is provided in Section 4.5.5.2. The results of this stability analysis (i.e., percentages of cap/thin-layer cap areas that are stable) are cited in the remainder of this discussion.

represent significant reductions relative to current levels (99% in Reach 5D and 91% in Rising Pond; Figure 4-7b). Thus, the model results indicate that buried sediments containing PCBs would not become exposed to any significant extent during an extreme flow event under SED 5.

4.5.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs, set forth in Table 2-1, include federal and state water quality criteria for PCBs. These criteria consist of a freshwater chronic aquatic life criterion of 0.014 µg/L and a human health criterion (based on consumption of water and organisms) of 0.000064 µg/L (0.00017 µg/L under the Connecticut standards, although that may not be an ARAR since it is less stringent and less up-to-date than the federal criterion).

To evaluate whether SED 5 would achieve those criteria, GE reviewed the water column PCB concentrations predicted by the model for SED 5. The water column concentrations are presented in Table 4-22 (in Section 4.5.5.1 below). As shown in that table, annual average water column concentrations predicted by the model at the end of the simulation period are below the freshwater chronic aquatic life criterion of 0.014 µg/L (14 ng/L) in all reaches. However, model-predicted water column concentrations in Reaches 5 through 8 exceed the federal and Massachusetts human health consumption criterion of 0.000064 µg/L (0.064 ng/L) in all reaches. For the Connecticut impoundments, the water column concentrations estimated by the CT 1-D Analysis (which range from 0.00005 to 0.0001 µg/L [0.05 to 0.1 ng/L]) exceed the federal criterion in two of the four impoundments, but are below the Connecticut consumption criterion of 0.00017 µg/L (0.17 ng/L) in all four impoundments, although these estimates are highly uncertain. As previously discussed, GE believes that the ARARs based on the human health consumption criteria should be waived on the ground that achievement of those ARARs is technically impracticable for the reasons given in Section 4.1.4.

The potential location-specific and action-specific ARARs are listed in Tables 2-2 and 2-3. Based on review of those ARARs, GE believes that SED 5 could be designed and implemented to achieve most of the ARARs that would be pertinent to this alternative, provided that any necessary EPA approval determinations are obtained, for the same reasons discussed in Section 4.3.4. However, as also discussed in that section, in the event that the excavated sediments should be found to constitute hazardous waste under RCRA or comparable state criteria (which is not anticipated), the temporary staging areas for the dewatering and handling of those sediments might not meet certain hazardous waste storage requirements, if they were determined to apply. In that case, as further discussed in Section 4.3.4, GE believes that such requirements should be considered inapplicable or, if necessary, waived as technically impracticable.

4.5.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for SED 5 has included evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment, as described below.

4.5.5.1 Magnitude of Residual Risk

The assessment of the magnitude of residual risk associated with implementation of SED 5 has included consideration of the extent to which and timing over which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure, such as engineering and institutional controls.

Implementation of SED 5, along with upstream source control/remediation measures and natural recovery processes, would substantially reduce the exposure of humans and ecological receptors to PCBs in sediments, surface water, and fish in the Rest of River area. The sediment removal and/or capping activities throughout Reach 5 and in Woods Pond would result in a significant reduction in the potential for exposure to PCBs in these areas. The placement of a thin-layer cap over the sediments in certain backwater areas and Rising Pond would reduce the surface sediment PCB concentrations in these reaches, thereby reducing potential human and ecological exposures and risks. The following table shows, by reach, the average PCB concentrations predicted by EPA's model to be present at the end of the model simulation period (Year 52) in the surface sediments, surface water, and fish (including both whole body and fillet-based concentrations).

Table 4-22 – Modeled PCB Concentrations at End of 52-Year Projection Period (SED 5)

Reach	Average Surface Sediment (0-6”) (mg/kg)	Average Surface Water (ng/L)	Average Fish (whole body) (mg/kg)	Average Fish (fillet) (mg/kg)[2]
5A	0.06	2.5	1.3	0.3
5B	0.06	1.8	1.2	0.2
5C	0.1	1.2	0.8	0.2
5D (backwaters)	0.3	---	1.8	0.4
6	0.2	1.2	0.9	0.2
7[1]	0.4 – 5.0	0.9 – 1.2	2.1 – 7.9	0.4 – 1.6
8	0.3	1.0	1.7	0.3
CT[1]	0.004 – 0.008	0.05 – 0.1	0.03 – 0.07	0.006 – 0.01

Notes:

1. Values shown as ranges in Reach 7 and CT represent the range of modeled PCB concentrations at the end of the projection within each of the Reach 7 subreaches, and the range of concentrations indicated by the CT 1-D Analysis for the four Connecticut impoundments.
2. Fish fillet concentrations were calculated by dividing the modeled whole-body fish PCB concentrations by a factor of 5, as directed by EPA.

The potential residual risks to human and ecological receptors from the concentrations shown in the above table have been evaluated in the context of the extent to which they would achieve the IMPGs, as discussed in Section 4.5.6.

Temporal profiles of reach-average PCB concentrations in surface sediments, annual average surface water, whole body fish, and fish fillets resulting from the implementation of SED 5 over the 52-year model projection period are shown on Figures 4-7a-c. These figures show the timeframes over which SED 5 would be predicted to reduce the PCB concentrations in each respective medium. The PCB concentration trajectories exhibit the general pattern of a large decline over the remediation period, followed by a period of smaller decline, or in some instances, a small increase until concentrations reach a steady-state with prevailing upstream loads and natural attenuation processes. In the surface sediments, this pattern is generally observed in the reaches undergoing remediation (Reaches, 5, 6, and 8), while patterns in Reach 7 and the Connecticut impoundments exhibit a shallower trajectory, reflecting the influence of upstream remediation on downstream sediments. While the water column patterns exhibit significant year-to-year variability, including short-term increases in PCB concentration associated with increased PCB transport during the Year 26 extreme flow event and sediment resuspension during remediation, most water column temporal changes follow those of the sediments. Temporal patterns in fish PCB concentrations reflect the predicted changes in water column and sediments. As a result of the remediation under SED 5, predicted fish PCB concentrations are reduced over the projection period by 94% to 99% in the remediated reaches (i.e., Reaches 5, 6 and 8) and by 84% to 96% in the other reaches (Figure 4-7c).

PCBs would also remain in the sediments in areas beneath and outside of the areas addressed by this alternative. However, in the capped areas of Reach 5 and Woods Pond, the caps would prevent direct contact with, and effectively reduce the mobility of, PCB-containing sediments beneath the caps; and the thin-layer caps in the backwaters and Rising Pond, would provide a cover layer over the underlying PCB-containing sediments. Overall, the extent to which SED 5 would mitigate the effects of a flood event that could cause the PCB-containing sediments that have been contained by a cap or buried due to natural processes to become available for human and ecological exposure was discussed in Section 4.5.3. As discussed in that section, the model results indicate that buried sediments containing PCBs would not become exposed to any significant extent during an extreme flow event following implementation of SED 5.

In addition, potential human exposure to PCBs in fish and other biota would be reduced during and after implementation of SED 5 through biota consumption advisories. Also, a long-term monitoring program would be implemented to assess the continued effectiveness of this remedial alternative to mitigate potential human and ecological exposures to PCBs.

4.5.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of SED 5 has included an assessment of the use of technologies under similar conditions and in combination, general reliability and effectiveness, reliability of OMM and availability of OMM labor and materials, and technical component replacement requirements, as discussed below.

<u>Use of Technologies under Similar Conditions and in Combination</u>

As discussed previously, a combination of remedial technologies is often necessary to mitigate potential exposure to constituents in sediments (e.g., EPA, 2005e; NRC, 2007). SED 5 involves such a combination. The SED 5 remedy components were selected for application in various reaches of the River based in part on the study and application of each technology under similar conditions at other sites. These components include sediment removal using dry excavation techniques (in Reaches 5A and 5B) and wet excavation techniques (in Reaches 5C and 6), bank removal and stabilization (for Reach 5 erodible banks), capping alone (in the deeper part of Reach 5C and Woods Pond), thin-layer capping (in Reach 5 backwaters and Rising Pond), and MNR (in the remaining areas). These remedial techniques have been applied at a number of sites containing PCBs under similar conditions to those in various reaches of the River, as discussed under SED 3 and SED 4 in Sections 4.3.5.2 and 4.4.5.2, respectively.

General Reliability and Effectiveness

SED 5 utilizes technologies that have been shown to be reliable and effective in reducing exposure of humans and ecological receptors to PCBs in sediments. Similar to SED 3, these technologies include sediment removal, capping, thin-layer capping, and MNR. Their general reliability and effectiveness were previously discussed in Section 4.3.5.2. As noted in that section, under certain circumstances, dredging and excavation have been shown to be effective and reliable in reducing the long-term potential for exposure of human and ecological receptors to PCB-containing sediments; however, there are some limitations associated with the technology (e.g., sediment resuspension, residual contamination) (EPA, 2005e). As described by EPA (2005e), capping is also a viable and effective approach for remediating impacted sediments. Regarding thin-layer capping, EPA (2005e) has acknowledged that placement of a thin layer "of clean sediment may accelerate natural recovery in some cases." Finally, while EPA has acknowledged the potential limitations of MNR, it has stated that MNR should "receive detailed consideration" where site conditions are conducive to such a remedy (EPA, 2005e). In addition, EPA has noted that many contaminants that remain in sediment are not easily transformed or destroyed, and that for this reason, "risk reduction due to natural burial through sedimentation is more common and can be an acceptable sediment management option" (EPA, 2005e).

To further assess the reliability and effectiveness of SED 5, model predictions of erosion in areas receiving a cap or a thin-layer cap were evaluated to assess cap stability, using the same metrics described for this analysis in Section 4.3.5.2. The results of these stability assessments are as follows:

Caps: Under SED 5, the areas receiving a cap, either following sediment removal or without sediment removal, include Reaches 5A, 5B, 5C, and Woods Pond. Those caps would be designed to resist erosion by including an appropriately sized armor layer. The model inputs for areas receiving a cap were specified accordingly, as discussed in Section 3.2.4.5. Thus, the areas receiving a cap under SED 5 are predicted to be 100% stable.

Thin-Layer Caps: SED 5 includes placement of a thin-layer cap in several backwaters in Reach 5 to enhance natural recovery. As discussed in Section 4.3.5.2, the long-term effectiveness of the thin-layer cap was evaluated by considering it stable (and therefore reliable) when EPA's model predicts that at least 1 inch of material would remain for the full duration of the model projection (including the extreme flow event). In the backwaters, the model predicts that the thin-layer caps would remain stable during the simulated extreme flow event in Year 26, and that erosion causing less than 1 inch of thin-layer cap material to remain would occur within only a single grid cell during a storm event simulated in Year 29. That erosion is predicted to produce an increase of less than 0.2 mg/kg in the reach-average 0- to 6-inch surface sediment PCB concentration in Reach 5D (Figure 4-7b). In Rising Pond, EPA's model predicts that approximately 93% of the thin-layer capped area within that Reach would remain stable under SED 5. The erosion occurring in the remaining 7% of that area is predicted to occur during various high flow events over Years 19 through 43 of the projection, and would result in a relatively small (< 0.3 mg/kg) change in the reach-average 0- to 6-inch surface sediment PCB concentration (Figure 4-7b).[68] Even after such increases in concentration are taken into account, the concentrations following the high flow events still represent significant reductions relative to current levels for both reaches where SED 5 includes a thin-layer cap (91% to 99%, as discussed in Section 4.5.3). Based on these results, the model indicates that the thin-layer caps under SED 5 would be an effective means of reducing surficial PCB concentrations, even under an extreme flow event.

Reliability of Operation, Monitoring, and Maintenance Requirements/Availability of Labor and Materials

A combination of reliable OMM techniques, including periodic analytical sampling of the fish, water column, and sediment, monitoring of the caps and restored banks via visual observations supplemented with sediment probing and/or coring, and maintenance of the restored riverbed and riverbanks, would be implemented to maintain and track the long-term effectiveness of SED 5. Post-remediation sampling is commonly used to monitor the effectiveness of completed sediment removal and capping remedies. Visual observation of the riverbed and restored banks has been successfully implemented in the Upper ½-Mile and 1½-Mile Reaches (where river conditions are similar to those in Reaches 5A and parts of Reach 5B) and at the Sheboygan River, as further described in Section 4.4.5.2. Should changes in the riverbed or riverbanks be noted that require maintenance, labor and materials needed to perform repairs are expected to be readily available.

In addition, a monitoring and maintenance program would be implemented for the actively restored areas to confirm planting survival and areal coverage and to determine whether habitat structures (if any) are intact. Such monitoring is considered a reliable means of tracking the progress of the restoration efforts. The necessary labor and equipment for such a program are expected to be readily available.

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[68] The overall increase in Rising Pond surficial PCB concentration shown on Figure 4-8b (from 0.02 to 0.3 mg/kg over Years 19 through 25) results from a combination of erosion of thin-layer cap material in a limited number of grid cells, as well as from deposition and subsequent mixing of PCB-containing sediments from upstream areas.

Technical Component Replacement Requirements

The technologies that comprise SED 5 were selected for application in areas of the River where site conditions are expected to support long-term reliability and effectiveness with minimal maintenance requirements. However, if erosion of cap and/or bank stabilization materials should occur, an assessment would be conducted to determine the need for and methods of repair. Depending on the timing and location of the repair, access roads and staging areas may need to be temporarily constructed in the nearby floodplain. Periodic small-scale repairs would likely pose minimal risks to humans and ecological receptors that use/inhabit the disturbed river bottom and nearby floodplain. While not anticipated, redesign/replacement of larger remedy components could require more extensive disturbance of the river bottom, banks, and/or the adjacent floodplains to support access.

4.5.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of SED 5 on human health or the environment has included identification and evaluation of potentially affected populations, adverse impacts on biota and their habitat, adverse impacts on wetlands, impacts on the aesthetics of the natural environment, impacts on banks and bedload movement, and potentially available measures that may be employed to mitigate these impacts.

Potentially Affected Populations

Since SED 5 would impact more area and would take longer to implement than the previously discussed alternatives, it would have a more extensive impact in altering the habitat of the River and the adjacent floodplains, and overall recovery would take longer. These habitat alterations would affect people using these areas as well as the fish and wildlife in these areas, as discussed further below.

Adverse Impacts on Biota and Corresponding Habitat

The potential long-term impacts of SED 5 on biota and their habitat are discussed below in relation to the type of remediation involved. It should be noted that as the intrusive level of the remedial activities and the amount of area affected by the remedial action increase with each of the remedial alternatives, the spatial and temporal extent of short-term impacts would increase. At some point, the cumulative effect of the myriad of short-term impacts associated with the remedial action would in and of itself constitute a long-term impact due to the timeframe associated with the remedy.

Note also that, to the extent that affected areas constitute habitat for any rare, threatened, and/or endangered species, implementation of SED 5 could affect those species. In general, for the more mobile species and/or species with a wide range of habitat requirements, long-term impacts from the remedial activities are unlikely, because the activities would only displace these species to other areas of the river system. However, for animal species with narrower habitat requirements and for any threatened or endangered plant species, any long-term alteration of the habitat (as discussed below) could have a long-term adverse impact on those species.

Sediment Removal in Reaches 5 and 6: It is uncertain whether SED 5 would have a long-term adverse impact on biota and their habitats in the portions of the main river channel in Reaches 5 and 6 that would be subject to removal. Sediment removal is anticipated to proceed from upstream to downstream such that as upstream areas recover, they provide organisms (both plants and animals) to downstream areas to facilitate recovery. SED 5 would involve removal of 35 more acres in Reach 5 than SED 4 (an increase of about 65%) and would take 3 years longer to complete. This could potentially extend the recovery period for the downstream areas due to the cumulative impacts of the prolonged remediation. For example, as discussed under SED 3, based on observations made during monitoring of the Upper ½-Mile and 1½-Mile Reaches, remediated areas would be expected to be colonized by benthic invertebrates within a 3- to 5-year period. This recovery period is related, in part, to a sufficient supply of organisms from developed communities in upstream areas. As the length of time that various portions of the River are undergoing recovery increases, it may take longer for upstream communities to be sufficiently developed and provide organisms to downstream locations. As such, there is greater uncertainty as to the length of time it will take for the benthic invertebrate and aquatic vegetation communities to be fully restored under SED 5.

Limited research has been conducted on the cumulative impacts to aquatic resources from multiple and disparate habitat perturbations such as those that would be caused by the sediment removal and capping in SED 5. A delayed recovery of the benthic and vegetative communities could potentially impact fish populations, which use those resources for food and habitat, respectively. Research has also suggested impairments in amphibian populations resulting from the cumulative impacts of stressors over an extended time in a given area (Wright et al., 2006; Gernes and Helgen, 2002). Little is known about such cumulative impacts on waterfowl populations. In addition, the potential for disturbed areas to be colonized by invasive species would likely increase as the length of recovery increases (Burke and Grime, 1996).

Riverbank Stabilization: The bank removal/stabilization activities that are part of SED 5 may have some long-term adverse environmental impacts on riparian habitats in Reaches 5A and 5B, depending upon the stabilization technique used. Since these activities are the same as in SED 3, the discussion of potential long-term adverse environmental impacts of such activities under SED 3 (in Section 4.3.5.3) also applies to SED 5.

Thin-Layer Cap in Backwaters and Rising Pond: Placement of the thin-layer cap in the Reach 5 backwaters could have some long-term effects. Since this activity is the same as in SED 4, the discussion in Section 4.4.5.3 (under SED 4) regarding the potential long-term impacts from placement of a thin-layer cap in the backwaters also applies to SED 5. Specifically, in limited shallow water areas where the water is less than 6-12 inches deep and consolidation of the underlying sediment is not anticipated, the thin-layer cap could increase the substrate elevation so as to change the vegetative characteristics of these riverine wetlands and the biota dependent on them or, in limited cases where the cap material exceeds the water depth, cause the wetlands vegetation to be replaced by species more tolerant of riparian or terrestrial conditions. Similarly, the placement of the thin-layer cap in the shallow portions of Rising Pond that have the same characteristics as the Reach 5 backwaters could produce a similar long-term impact. In deeper portions of Rising Pond, the thin-layer cap would not be expected to have any long-term impacts. Although the thin-layer cap would cover wetland vegetation, submerged aquatic vegetation, and benthic invertebrates, these communities would be re-established through recolonization from upstream areas.

Capping in Reach 5C and Woods Pond (Deep): Placement of the cap in the lower portion of Reach 5C could likewise have some long-term impacts in limited areas (e.g., riverine wetlands along the shoreline) where the water is less than 24 inches deep and consolidation of the underlying sediment is not anticipated. In these areas, the cap could increase the substrate elevation such that it would change the vegetative characteristics of the wetlands or, in cases where the cap would exceed the depth of water, render the area no longer be suitable for submerged aquatic vegetation. No such impacts would be expected in the deeper portions of Reach 5C, as discussed for SED 4 in Section 4.4.5.3.

In Woods Pond, the placement of the cap in the deep portion of the pond is not expected to have long-term impacts. The cap would be colonized by benthic invertebrates from upstream sources. As described above, the cap material may differ from the native sediments resulting in colonization by different benthic invertebrate communities than currently exist, but this change would not necessarily be negative.

As discussed above under sediment removal, because of the increased length of time and the additional removal areas being in Reach 5 under SED 5, it could take longer for these downstream capping areas to be recolonized by plants and animals from upstream sources than with previous alternatives.

Supporting Facilities in Floodplain: Long-term impacts to biota and their habitats may also occur as a result of ancillary supporting activities in the floodplain, including the clearing and construction of access roads and staging areas. The conceptual layout design for SED 5 includes 31 staging areas encompassing approximately 53 acres (at an assumed size of approximately 1.7 acres per staging area), and approximately 22 miles of temporary roadways, which would amount to an additional approximately 53 acres (assuming a road width of 20 feet). Potential long-term impacts from these supporting facilities in SED 5 are similar to those for SED 3 and include habitat modification due to compaction/alteration of the soils, displacement of some species due to habitat fragmentation, and colonization by invasive species, as described in Section 4.3.5.3.

Adverse Impacts on Wetlands

The wetland environments that could be affected by SED 5 include: (a) riverine wetlands found along the periphery of removal areas in Reaches 5 and 6; (b) riverine wetlands along the periphery of the bank stabilization areas; (c) riverine wetlands in the lower portion of Reach 5C where the cap would be placed without prior removal; (d) wetlands in backwater areas and on the shores of Rising Pond addressed by the placement of the thin-layer cap; and (e) floodplain wetlands impacted by access roads and other ancillary activities. Each of these is discussed below.

- Although riverine wetlands in Reaches 5 and 6 would be initially lost as a result of the removal and capping activities in those reaches, the bathymetry is not expected to change. Fine sediments transported from upstream would accumulate over time and these wetlands would naturally recolonize with wetland vegetation from upstream sources. However, as noted above, the length of time for such recovery in the more downstream areas is uncertain given the extent of upstream remediation.

- As discussed for SED 3, while bank stabilization activities in Reaches 5A and 5B may temporarily disturb riverine wetlands adjacent to the banks, the bank treatments are not expected to materially alter the bathymetry or substrate in the adjacent in-river areas, and the riverine wetlands would recolonize any disturbed areas.

- As discussed above, in limited areas of Reach 5C where water is less than 24 inches deep and consolidation of the underlying sediments is not anticipated, the cap could increase the substrate elevation such that it would modify the vegetative characteristics of the riverine wetlands or even cause a loss of these wetlands in some areas (where the cap thickness exceeds the water depth).

- The impacts from the placement of a thin-layer cap over riverine wetlands in the backwaters would be the same as described under SED 4 and discussed above. The same would apply to the placement of a thin-layer cap over the riverine wetlands on the shore of Rising Pond.

- The potential impacts on wetlands in the floodplain due to ancillary construction activities are anticipated to be largely the same as for SED 4, as described in Section 4.4.5.3, with the addition of potential impacts to wetlands in the floodplains adjacent to Rising Pond that would be affected by the supporting facilities there.

Long-Term Impacts on Aesthetics

The most severe impacts to aesthetics of the natural environment along the River would occur during the 18-year implementation period and would affect 287 acres of River where remedial activities would be conducted. Following implementation, successional processes would begin to restore the vegetative community bordering the River. However, in bank areas where revetment mats or armor stone are used for bank stabilization, the natural appearance of the banks would remain diminished. In addition, in areas where vegetation would return, it would likely not mimic the pre-remediation state of the community along the River. Vegetative communities that currently exist along portions of the River are mature systems, and it would take several decades for any planted trees to reach the size of the older trees that are removed as part of remediation.

The construction of an extensive network of roadways and staging areas on both sides of the River to support the implementation of SED 5 also has the potential to cause long-term impacts on the aesthetics of the floodplain. The placement of these roadways and staging areas would remove trees and vegetation, mostly in upland forest areas, and hence these areas would not be natural in appearance during the period while the roadways and staging areas remain in place and until those areas are fully restored. Moreover, since the trees in some of the affected upland forested areas are mature trees that are greater than 50 years in age, it would take a commensurate amount of time for those communities to develop an appearance comparable to their current appearance.

Impacts on Banks and Bedload Movement

The potential physical impacts of SED 5 on banks and bedload movement are largely the same as those described for SED 3 in Section 4.3.5.3. As discussed there, stabilization of the erodible banks in Reaches 5A and 5B to prevent future erosion could result in the need to stabilize other, currently non-erodible bank or nearby riverbed areas. In addition, the bank stabilization would reduce the current process by which eroding banks slump into the River and subsequently contribute to the overall bedload in Reaches 5A and 5B. Further, the armor stone placed as a cap component in Reaches 5A and 5B would initially impact bedload transport by capturing solids moving along the river bottom. However, once the armor stone is silted over, bedload movement should return to current conditions.

Potential Measures to Mitigate Long-Term Adverse Impacts

Measures to mitigate the potential long-term adverse impacts described above would include the restoration measures described in Section 4.5.1, which are similar to the measures summarized in Section 4.3.5.3 for SED 3. However, they would need to be applied on a broader scale for SED 5.

4.5.6 Attainment of IMPGs

As part of the evaluation of SED 5, average PCB concentrations in surface sediment and fish predicted by EPA's model at the end of the 52-year projection period have been compared to applicable IMPGs. For these comparisons, model-predicted sediment and fish PCB concentrations were averaged in the manner discussed in Section 3.3. The sections below describe the human health and ecological receptor IMPG comparisons for SED 5, and those comparisons are illustrated in Tables 4-23 through 4-28.

As described below, PCB concentrations in some areas are sufficiently low that certain IMPGs would be achieved prior to any active remediation of sediments, while some other IMPGs would be achieved at some point within the 52-year model simulation period, and other IMPGs would not be met (if at all) for many years after the modeled period. The numbers of years needed to achieve the IMPGs are presented in Tables 4-23 through 4-28.[69] In addition, figures in Appendix G show temporal profiles of model-simulated PCB concentrations for each of the IMPG comparisons described in this section (including the estimated time to achieve each IMPG). Where certain IMPGs would not be achieved by the end of the model projection period, the number of years to achieve the IMPGs has been estimated by extrapolating the model projection results beyond the 52-year simulation period, as directed by EPA, using the extrapolation method described in Section 3.2.1. As previously noted, such extrapolation produces estimates that are highly uncertain. Nonetheless, the extrapolated estimates of time to achieve the IMPGs that are not met within the 52-year model projection period are described below.

Also, as described in Section 3.2, bounding simulations have been conducted with the model to evaluate the significance of various assumptions regarding the East Branch PCB boundary condition and sediment residual values, as directed by EPA. For SED 5, application of the "lower bound" assumptions in the model did not result in the attainment of any additional IMPGs, beyond those attained using the "base case" assumptions, for the

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[69] The extent to which SED 5 would accelerate attainment of the IMPGs relative to natural processes can be seen by comparing these tables to the comparable tables for SED 1 (see Section 4.1.6 above).

receptors/averaging areas described below. Therefore, the discussion below focuses on IMPG attainment resulting from the application of the "base case" model assumptions.

4.5.6.1 Comparison to Human Health-Based IMPGs

For human direct contact with sediments, the average predicted surface sediment (0- to 6-inch) PCB concentrations would achieve all IMPGs in all eight sediment exposure areas, except for the most stringent RME IMPG (based on a 10^{-6} cancer risk) for adults in Reaches 7 and 8 and that for children in one area in Reach 7 (Table 4-23). Many of these IMPGs are achieved prior to the start of the remediation, while the others would be achieved in time periods generally ranging from 2 to 20 years.

For human consumption of fish, the average fish PCB concentrations predicted by the model in Year 52, when converted to fillet-based concentrations, would not achieve the fish consumption IMPGs based on RME assumptions for either cancer risks or non-cancer impacts in any of the Massachusetts reaches (except for the IMPGs based on a 10^{-4} cancer risk, but not the corresponding non-cancer IMPGs, in a few subreaches) (Table 4-24). However, in the Connecticut impoundments, the CT 1-D Analysis indicates that SED 5 would achieve the RME IMPGs associated with a 10^{-5} cancer risk as well as non-cancer impacts.

SED 5 would also achieve some of the CTE-based IMPGs in Massachusetts, particularly under a probabilistic analysis in Reaches 5 and 6, as well as all CTE IMPGs in Connecticut (Table 4-24).

Extrapolation of the model results beyond the model period indicates that achievement of the RME-based IMPGs that EPA considers protective for unrestricted fish consumption of 50 meals per year, based on a deterministic approach and a 10^{-5} cancer risk as well as non-cancer impacts, would take 160 to >250 years in the PSA and >250 years in Reaches 7 and 8.

4.5.6.2 Comparison to Ecological IMPGs

For benthic invertebrates, predicted average sediment concentrations in the spatial bins within the PSA and in the simulated subreaches between Woods Pond Dam and Rising Pond Dam would achieve the lower-bound IMPG (3 mg/kg) in all areas except for three subreaches in Reach 7, and would achieve the upper-bound IMPG (10 mg/kg) in all areas (Table 4-25). These levels would generally be achieved immediately following completion of remediation in the spatial bins in Reaches 5 and 6.

For amphibians (similar to SED 4), predicted surface sediment PCB levels in the backwater areas at the end of the modeled period would achieve the lower-bound IMPG (3.27 mg/kg) in approximately 70% of these areas (73 acres), are within the range of IMPGs (3.27 to 5.6 mg/kg) in approximately 20% of these areas (11 acres), and exceed the upper-bound IMPG (5.6 mg/kg) in less than 10% of these areas (1 acre) (Table 4-26). Time to achieve the IMPGs in backwaters that achieve the IMPGs within the model projection period range from approximately 5 to 50 years. In the backwater areas that would not achieve the IMPGs by the end of the modeled period, extrapolated estimates indicate that the IMPG would be achieved within various times between 60 and >250 years.

For insectivorous birds (represented by wood duck) and piscivorous mammals (represented by mink), the model-predicted surface sediment concentrations have been compared to selected target sediment levels of 1, 3, and 5 mg/kg, as discussed previously. For insectivorous birds, the predicted surface sediment concentrations are below the target sediment levels of 3 and 5 mg/kg in all averaging areas and below the 1 mg/kg target level in most (10 of 12) of those areas (Table 4-27). For piscivorous mammals, the model-predicted surface sediment concentrations are below all three target sediment levels in both averaging areas (Table 4-27). For both receptor groups, the times to achieve the various target levels are highly variable, and range between 1 and 70 (extrapolated) years.

For piscivorous birds (represented by osprey), the model-predicted average whole-body fish PCB concentrations would achieve the applicable IMPG in more than 90% of the modeled reaches – all areas except Reach 7B (Table 4-28). Estimated times to achieve the IMPG in reaches where it is not already met prior to the start of the model projection range from 10 to 40 years. In Reach 7B where the IMPG is not attained within the 52-year projection period, the extrapolated time to achieve this IMPG is >250 years.

For fish (based on warmwater and coldwater fish protection) and threatened and endangered species (represented by the bald eagle), the model-predicted average whole-body fish PCB concentrations would achieve the applicable receptor IMPGs in all reaches (Table 4-28). Estimated times to achieve these IMPGs (in reaches where they are not already met prior to the start of the model projection) range from 3 to 20 years.

4.5.7 Reduction of Toxicity, Mobility, or Volume

The degree to which SED 5 would reduce the toxicity, mobility, or volume of PCBs is discussed below.

Reduction of Toxicity: SED 5 does not include any treatment processes that would reduce the toxicity of the PCBs in the sediment. However, if “principal threat” wastes (e.g., free NAPL, drums of liquid) should be encountered (which is not anticipated), they would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: SED 5 would reduce the mobility of PCBs in the River by removing approximately 377,000 cy of sediment containing PCBs in Reaches 5 and 6 and placing a cap over those areas, removing approximately 33,000 cy of PCB-containing erodible bank soils in Reach 5 and stabilizing those banks in Reach 5, and placing a cap over the remaining sediments in Reach 5 and Woods Pond. In total, caps would be placed over approximately 42 acres in Reach 5A, 27 acres in Reach 5B, 57 acres in Reach 5C, and 60 acres in Woods Pond. These caps would prevent or minimize the mobility of PCBs in the underlying sediments. In addition, a thin-layer cap would be placed over portions of the Reach 5 backwater areas (61 acres) and in Rising Pond (41 acres) to accelerate the recovery of those areas.

Reduction of Volume: SED 5 would reduce the volume of sediment containing PCBs and the mass of PCBs present in the River through the removal of a total of 410,000 cy of sediments/bank soils containing approximately 18,400 lbs of PCBs over an area of approximately 126 acres. A summary of the volumes and PCB mass that would be removed under this alternative from each reach is presented below.

	Removal Volume (cy)	**PCB Mass (lbs)**
Reach 5A:	134,000	10,300
Reach 5B:	88,000	1,300
Reach 5C:	66,000	1,700
Reach 6 (Woods Pond):	89,000	3,900
Reach 5A/5B Banks:	33,000	1,200
Totals:	**410,000**	**18,400**

4.5.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of SED 5 has included consideration of the short-term impacts of implementing this alternative on the environment, the local communities (as well as communities along transport routes), and the workers involved in the remedial activities. These impacts would last for the duration of the active remedial activities, which is estimated to be approximately 18 years – specifically, 8 years for Reach 5A, approximately 5 years for Reach 5B, 2 years for Reach 5C, 2 years for Reach 5 backwaters (performed concurrently with Reach 5C), 2 years for Reach 6, and 1 year for Reach 8. Since the extent and duration of remediation activities under SED 5 are greater than that under SED 3 and SED 4, the short-term impacts would be more extensive and would last longer.

Impacts on the Environment

The short-term effects on the environment resulting from implementation of SED 5 would include: potential impacts to the water column, air, and biota in the Rest of River area during excavation, capping, and thin-layer capping activities; alteration/destruction of benthic habitat in the areas subject to those activities; loss of riparian habitat as a part of bank stabilization activities; and loss of floodplain habitat and disruption to the biota that reside in the floodplain due to the construction of supporting facilities. Short-term impacts specifically associated with each remedial component are described below.

Sediment Removal: The sediment removal activities in Reaches 5 and 6 (377,000 cy over 126 acres) would result in resuspension of PCB-containing sediment due to the invasive nature of removal operations. Resuspension to the water column outside the work area would be controlled in Reaches 5A and 5B, as removal activities in those areas would be conducted in the dry using sheetpile containment. However, the potential for sediment to be released from the work area exists during sheetpile installation or due to overtopping of sheeting during a high flow event. For Reach 5C and Woods Pond, activities would be conducted in the wet, with silt curtains used to mitigate sediment releases to downstream reaches. In those areas, some sediment containing PCBs could be released from the work area through the excavation process even though the area would be surrounded by silt curtains. In addition, boat and barge traffic could resuspend sediment during the construction phase. Water column sampling would be performed to assess any potential quality impacts.

The potential also exists during removal and related sediment processing activities for airborne releases that could impact downwind communities. Air monitoring would be conducted during these activities to assess any potential air quality impacts.

Implementation of SED 5 would cause a loss of aquatic habitat in 126 acres of Reaches 5A, 5B, 5C, and 6 where sediment removal would occur. Implementation of SED 5 would remove the natural bed material, debris, and aquatic vegetation which are used as habitat by both fish and benthic invertebrates. The sediment removal activities would also result in the direct loss of benthic invertebrates and other aquatic organisms (e.g., reptiles and amphibians) residing in the sediments during removal, and a temporary disruption and displacement of fish.

In addition, short-term increases in PCB concentrations in biota downstream of the removal work areas have been noted at other sites where dredging in the wet has occurred (e.g., Grasse River) and even where excavation in the dry has been conducted (e.g., Upper ½-Mile Reach), as described in Sections 4.3.8 and 4.4.8, and would be expected to occur under SED 5.

Additionally, sediment removal activities would alter feeding areas for birds and mammals that live adjacent to the River and feed in areas subject to remediation.

Capping: Capping activities in Reaches 5C and 6 would be performed during low flow periods with silt curtains in place. While resuspension is possible due to capping activities, the potential for resuspension of PCB-containing sediment is anticipated to be much less than removal activities, since capping would involve placing clean material on undisturbed native sediment, and silt curtains would be in place to mitigate transport of cap material and any solids to downstream reaches. Water column monitoring would be conducted during capping activities to assess any potential water quality impacts.

Placement of a cap as part of SED 5 would occur over 60 acres of the River, and would have an immediate impact on the aquatic communities. Capping would cover the natural bed material, require removal of any significant debris or structures, and cover aquatic vegetation. The placement of the cap would result in the loss of existing benthic invertebrates and benthic and fish habitat. Any emergent wetlands plants and submerged aquatic vegetation would be covered and lost. Such losses would be temporary in most such areas, since benthic invertebrates, emergent vegetation, and submerged aquatic vegetation would recolonize the capping material over time. However, as discussed in Section 4.5.5.3, in shallow shoreline areas where the water is less than 24 inches deep and consolidation of the underlying sediment is not anticipated, placement of the cap could increase the substrate elevation such that it would modify the characteristics of the riverine wetlands and the biota dependent on them, or where the cap would exceed the water depth, render the area no longer suitable for submerged aquatic vegetation.

Thin-Layer Capping: Thin-layer capping activities in Reach 5 backwaters and Rising Pond would be performed by placement of a thin layer of sand over the undisturbed native sediment. Based on data collected during the Silver Lake capping pilot study, there is little potential for thin-layer capping to resuspend PCB-containing sediments. Water column monitoring would be conducted during to assess any potential water quality impacts.

Placement of a thin-layer cap as part of SED 5 would occur over 102 acres of the River, and would have a short-term impact on aquatic vegetation and benthic invertebrates in those areas. However, it is expected that the submerged aquatic vegetation and benthic communities would be re-established from upstream sources. It is likely that the benthic community would quickly recover, with the rate of recovery dependent on the rate of organic detritus accumulation across the thin-layer cap. Again, however, as discussed in Section 4.5.5.3, in shallow water areas where the water depth is less than 6-12 inches and consolidation of the underlying sediment is not anticipated, placement of the thin-layer cap could increase the substrate elevation such that the vegetative characteristics of the wetlands and the biota dependent on them would be modified.

Bank Stabilization: Bank stabilization activities in Reach 5 would have an immediate effect on the riparian community bordering the River. These impacts would be the same as described for SED 3 in Section 4.3.8.

Supporting Facilities: Construction of supporting facilities (e.g., roadways, staging areas) in the floodplain adjacent to the River, would result in the temporary loss of habitat in those areas and impact the wildlife that it supports. It is anticipated that SED 5 would require a total of approximately 106 acres for access roads and staging areas (approximately 63 acres within the 10-year floodplain). Development of these support facilities would affect the ability of some wildlife to nest and feed in these areas; and in some instances, it would cause habitat fragmentation that could further disrupt the movement and interactions of certain wildlife species.

Impacts on Local Communities and Communities Along Transport Routes

SED 5 would result in short-term impacts to the local communities in the Rest of River area. These short-term effects would include disruption along the River and within the floodplain due to the remediation and the construction of access roads and staging areas, as well as increased noise and truck traffic. Under SED 5, these impacts would primarily affect portions of Reaches 5 and 6 for an estimated 18 years, with impacts to Rising Pond occurring over 1 year.

Recreational activities in the areas that would be affected by SED 5 include bank fishing, canoeing, hiking, and waterfowl hunting. During the period of active construction, restrictions on such recreational uses of the River and floodplain would be imposed in the areas in which remediation-related activities are taking place. Due to safety considerations, boaters, hikers, anglers, and hunters would not be able to use the River or floodplain in the areas where such activities are being conducted. Further, bank stabilization activities in Reach 5 would remove the ability of recreational anglers and hikers to use those areas during construction. Aesthetically, the presence of the heavy construction equipment and cleared or disturbed areas would detract from the visually undisturbed nature of the area until such time as the restoration plantings for the disturbed areas have matured.

Due to the need to deliver equipment to the work areas, to remove excavated materials, and to deliver capping materials, truck traffic in the area would increase over current conditions. It is expected that this increased truck traffic would persist for the duration of the project (approximately 18 years). As an example, if 20-ton capacity trucks were used to transport sediments and bank soils from the staging areas, it would take approximately 30,800 truck trips to do so. In addition, assuming the use of smaller capacity trucks for local hauling (i.e., 16-ton trucks), approximately 61,900 truck trips would be required to transport sand, stone, and bank stabilization material to Reaches 5, 6, and 8. This additional traffic would increase noise levels and potential for emissions of vehicle/equipment exhaust and nuisance dust to the air. Further, noise in and near the construction zone could affect those residents and businesses located near the work areas (i.e., between the Confluence and Woods Pond and, for a shorter period, near Rising Pond).

The additional truck traffic would also increase the risk of traffic accidents along transport routes. Appendix D includes an analysis of potential risks from the increased truck traffic that would be necessary to transport clean materials to the site for implementation of SED 5.[70] This analysis indicates that the increased truck traffic associated with SED 5 would result in an estimated 1.76 non-fatal injuries due to accidents (with a probability of 83% of at least one such injury) and an estimated 0.07 fatalities from accidents (with a probability of 7% of at least one such fatality).

Engineering controls would be implemented, to the extent practical, to mitigate short-term impacts and risks associated with implementation of SED 5. However, some impacts would be inevitable.

<u>Risks to Remediation Workers</u>

There would be health and safety risks to site workers implementing SED 5. Implementation of SED 5 is estimated to involve 758,921 man-hours over a 18-year timeframe. The analysis in Appendix D of potential risks to workers from implementation of the sediment alternatives indicates that implementation of SED 5 would result in an estimated 7.51 non-fatal injuries to workers (with a probability of 100% of at least one such injury) and an estimated 0.07 worker fatalities (with a probability of 7% of at least one such fatality). Engineering controls and OSHA procedures designed to mitigate risks to remediation workers would be instituted.

4.5.9 Implementability

4.5.9.1 Technical Implementability

The technical implementability of SED 5 has been evaluated considering the factors identified below.

<u>General Availability of Technologies</u>: SED 5 would be implemented using well-established and available in-river remediation methods and equipment. Similarly, land-based support

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[70] The risks from truck traffic to transport excavated materials to the staging areas are evaluated as part of risks to workers, discussed below; and the risks from truck traffic to transport such materials from the staging areas away from the site are evaluated under the relevant treatment/disposition alternatives.

areas would be constructed using commonly available construction technologies. Further, well-established and readily available equipment would also be used to monitor the remedial alternative both during and following implementation.

Ability To Be Implemented: Based on site characteristics, the technologies and process options that are part of SED 5 would be suitable for implementation in the reaches where they would be applied. Sediment removal followed by capping is a functional remedy for use both in higher energy river reaches such as Reaches 5A and parts of 5B, and in shallow water, lower water velocity river reaches like those found in portions of Reach 5C and Woods Pond. Sediment removal would be performed in the dry in Reaches 5A and 5B, and in the wet in Reach 5C and Woods Pond. Each technique has been successfully demonstrated at other locations (see Section 4.4.5.2). Sediment removal and subsequent capping would be performed in a manner to cause no net loss of flood storage capacity.

Capping without prior removal would be implemented in portions of Reach 5C and Woods Pond where the water is relatively deep, which are suitable conditions for such capping. In addition, thin-layer capping to enhance the ongoing natural recovery process would be applied in low velocity areas with shallow water depths – i.e., Reach 5 backwaters and Rising Pond – which have suitable conditions for this technique.

The potential impacts on flood storage capacity resulting from the placement of cap materials in these reaches under SED 5 were assessed by comparing EPA model predictions of the area of floodplain within Reaches 5 and 6 inundated during a high flow event to that predicted under SED 1 during the same event (using a 2-year flow event in Year 48 of the model projections, as discussed for SED 3 in Section 4.3.9.1). In Reach 5 backwaters, Woods Pond, and Rising Pond, the backwater effects are controlled by the dams and thus no flood storage capacity impacts are expected. In Reach 5C, the potential would exist for the cap to increase water level/flood frequency. Under SED 5, the model-predicted area of inundation within the floodplain of Reaches 5 and 6 during the 2-year flow event in Year 48 of the projection increased by 1% over that predicted under SED 1 (827 acres compared to 817 acres). This analysis suggests that the cap would have a limited impact on flood storage. A more refined assessment of floodplain storage would be developed during design. If necessary, additional flood storage capacity would be obtained to accommodate placement of caps if this alternative were selected.

Bank soil removal followed by stabilization would be performed in the erodible bank areas of Reach 5 (high energy areas), with the most appropriate removal/stabilization options selected in the design phase based on the physical features of the bank area in conjunction with the adjacent sediment and/or floodplain soil remedial activities. Since the slope of some of the restored erodible banks would likely be reduced during remediation, an increase in flood storage capacity would likely result in those areas of Reach 5.

MNR with institutional controls would be implemented in the downstream reaches, where PCB concentrations are already low and are predicted to decrease further following remediation in the upstream reaches. Monitoring to track changes in PCB concentrations following the SED 5 remedial activities would be performed using readily available methods and materials, such as have been used previously in the River. Similarly, the continued maintenance of biota consumption of advisories would be expected to use similar techniques to those used previously.

Support facilities in the floodplain area necessary for implementation of SED 5 could readily be constructed using commonly available construction techniques. Efforts would be made to construct the facilities to avoid wetlands to the extent practicable.

Reliability: The technologies that comprise SED 5 are reliable, as shown through implementation at other sites and in portions of the Housatonic River upstream of the Confluence. The use of these technologies at other sites was described in Sections 4.3.5.2, 4.4.5.2, and 4.5.5.2.

Availability of Space for Support Facilities: Implementation of SED 5 would require construction of access roads and staging areas at various locations within the floodplain. As noted previously, an estimated 106 acres of space would be needed, and appear to be available to support SED 5 activities based on the conceptual site layout. Development of staging areas and access roads would be sequenced and constructed appropriately over the approximate 18-year implementation period.

Availability of Cap Materials: Materials required for cap construction must be of suitable quality for in-river placement and habitat restoration. A total of approximately 620,000 cy of capping material are required for stabilization, thin-layer capping, and capping activities (i.e., 370,000 cy of sand and 250,000 cy of armor stone and rip rap). For purposes of this CMS Report, adequate material sources are assumed to be available, although their proximity to the site is uncertain. An evaluation would be required during design activities to confirm material availability.

Ease of Conducting Additional Corrective Measures: Future corrective measures, if needed to perform cap or bank maintenance or conduct additional remediation, would be implementable, given the same technical and logistical constraints applicable to the initial implementation of SED 5. Ease of implementation would be directly related to the extent of the additional corrective measure (i.e., area and/or volume to be addressed) and the ease of access (i.e., location of target area and proximity of access areas).

Ability to Monitor Effectiveness: The effectiveness of SED 5 would be determined over time through long-term monitoring to document reductions in PCB concentrations in the water column, sediment, and fish tissue in various reaches of the River. Periodic monitoring (i.e., visual observation and sampling) of the capped sediments and restored riverbanks would allow for an evaluation of cap integrity and effectiveness, as well as bank stability. Such activities have been successfully performed on the upper portions of the Housatonic River and at other sites. Equipment and methods for this type of monitoring are readily available.

4.5.9.2 Administrative Implementability

The administrative implementability of SED 5 has been evaluated in consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: Implementation of SED 5 would need to comply with the substantive requirements of applicable and appropriate regulations pertaining to the performance of the remedial action (unless waived). As noted in Section 4.5.4, GE believes that SED 5 could be designed and implemented to meet such requirements (i.e., location-specific and action-specific ARARs listed in Tables 2-2 and 2-3), with the exception of certain requirements that could potentially apply to the on-site staging areas if the excavated sediments should constitute hazardous waste, and which GE believes should be waived, if necessary, as technically impracticable.

Access Agreements: Implementation of SED 5 would require GE to obtain access permission from the owners of properties in Reaches 5 and 6 where remedial work or ancillary facilities would be necessary to carry out the alternative. Although the majority of these areas in Reach 5 are publicly owned, it is anticipated that access agreements may be required from up to approximately 30 private landowners. Obtaining such access agreements could be problematic in some cases. If GE should be unable to obtain access agreements with particular property owners, GE would request EPA and/or MDEP to provide assistance.

Coordination with Agencies: Implementation of biota consumption advisories would require coordination with state public health departments and/or other appropriate agencies in the dissemination of information to the public and surrounding communities regarding those advisories. In addition, obtaining access to State-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of SED 5, GE would need to coordinate with EPA, as well as state and local agencies, to address any health and safety concerns and to provide as-needed support with public/community outreach programs.

4.5.10 Cost

The estimated total cost for implementation of SED 5 is $254 M (not including treatment/disposition costs). The estimated total capital cost is $240 M, assumed to occur over an 18-year construction period. Estimated annual OMM costs include costs for a 5-year inspection and maintenance program for the restored riverbed and riverbanks, thin-layer cap areas, and restored staging areas and access roads; these costs range from $25,000 to $275,000 per year (depending on which reach is being monitored), resulting in a total cost of $3.4 M. The estimated annual OMM costs for SED 5 also include implementation of a long-term water, sediment, and fish monitoring program for a period of 30 years following completion of construction on a reach-specific basis. The estimated costs for the long-term program range from approximately $275,000 to $600,000 per year (depending on the extent of monitoring occurring within a given year), resulting in a total cost of $10.8 M. The following summarizes the total capital and OMM costs estimated for SED 5.

SED 5	**Est. Cost**	**Description**
Total Capital	$240 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM	$14.2 M	Costs for performance of the OMM programs
Total Cost for Alternative	$254 M	Total cost of SED 5 in 2008 dollars

The total estimated present worth cost of SED 5, which was developed using a discount factor of 7%, a 18-year construction period, and an OMM period of 30 years on a reach-specific basis, is approximately $148 M. More detailed cost estimate information and assumptions for each of the sediment alternatives are included in Appendix E.

These costs do not include the costs of treatment/disposition of removed sediments/bank soil. The estimated costs for combinations of sediment remediation and treatment/disposition alternatives are presented in Section 8.

4.5.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 4.5.2, the evaluation of whether SED 5 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As discussed previously, SED 5 would result in a substantial reduction in the potential for exposure of human and ecological receptors to PCBs in sediments, surface water, and fish by: (a) permanently removing 377,000 cy of PCB-containing sediments in Reaches 5 and 6 and placing a cap over the underlying sediments; (b) removing 33,000 cy of erodible PCB-containing riverbank soils from Reach 5 and covering/stabilizing those erodible banks; (c) placing a cap over 60 acres in the deeper parts of Reaches 5C and 6 where no excavation would be performed; (d) placing a thin-layer cap over 102 acres in the Reach 5 backwaters and in Rising Pond to reduce exposure concentrations and accelerate the process of natural recovery; and (e) relying on natural recovery processes in other areas. As shown in Section 4.5.3, implementation of SED 5 is predicted to reduce the PCB load in the River passing Woods Pond Dam and Rising Pond Dam by 97% and 93%, respectively over the course of the modeled period, and to reduce the annual PCB mass transported from the River to the floodplain in Reaches 5 and 6 by 98% over that period.

Further, as discussed in Section 4.5.5.1, EPA's model predicts that implementation of SED 5 would result in a substantial permanent reduction in sediment and fish PCB concentrations. For example, the model predicts that the fish PCB concentrations (whole body) would be reduced over the modeled period from 70-110 mg/kg to approximately 1-2 mg/kg in Reaches 5 and 6, from 30-50 mg/kg to approximately 3-8 mg/kg in the Reach 7 impoundments, from 30 mg/kg to approximately 2 mg/kg in Rising Pond, and from 1-2 mg/kg to 0.03-0.07 mg/kg in the Connecticut impoundments.

Compliance with ARARs: As explained in Section 4.5.4, the model predictions of water column PCB concentrations indicate that SED 5 would achieve the chemical-specific ARARs, except for the water quality criterion of 0.000064 µg/L based on human consumption of water and organisms, which GE believes should be waived as technically impracticable. Further, GE believes that SED 5 could be designed and implemented to meet the pertinent location-specific and action-specific ARARs, with the possible exception of certain requirements that could potentially apply to the on-site staging areas if the excavated sediments should constitute hazardous waste, and which GE believes should be waived, if necessary, as technically impracticable.

Human Health Protection: As discussed in Section 4.5.6.1, SED 5 would provide protection of human health from direct contact with sediments, since it would achieve IMPG levels based on a 10^{-5} cancer risk or lower, as well as all non-cancer IMPGs, in all sediment exposure areas, with the majority of those levels achieved at the present time. For human consumption of fish, the fish PCB concentrations predicted to result from SED 5 in Reaches 5 through 8 at the end of the 52-year simulation period, when converted to fillet-based concentrations, would not achieve the RME-based IMPGs within EPA's cancer risk range or based on non-cancer impacts, i.e., the levels that EPA considers to be protective for unrestricted consumption of

Housatonic River fish (except for the RME 10^{-4} cancer IMPG, but not the non-cancer IMPGs, in a few areas). Extrapolation of model results beyond the simulation period indicates that PCB concentrations in fish fillets would reach the RME IMPG levels based on a 10^{-5} cancer risk and non-cancer impacts in approximately 160 to >250 years in the PSA and >250 years in Reaches 7 and 8. In the Connecticut impoundments, the CT 1-D Analysis indicates that SED 5 would achieve fish PCB levels within the range of the RME IMPGs in all impoundments within the modeled period. Where the levels for unrestricted fish consumption are not achieved, institutional controls – specifically, fish consumption advisories – would continue to be utilized to provide human health protection from fish consumption.

Environmental Protection: As discussed in Section 4.5.6.2, the model results indicate that, by the end of the modeled period, SED 5 would achieve the IMPG levels for some ecological receptor groups in all areas. Specifically, for benthic invertebrates, SED 5 would result in sediment PCB concentrations within or below the IMPG range (3 mg/kg to 10 mg/kg) in all averaging areas; and for fish (warmwater and coldwater) and threatened and endangered species, predicted whole body fish PCB concentrations would achieve the IMPGs for these receptors (55, 14, and 30.4 mg/kg, respectively) in all reaches. For other receptor groups. SED 5 would achieve the IMPG in the great majority of areas. Specifically, for amphibians, SED 5 would result in sediment PCB concentrations within or below the IMPG range (3.27 mg/kg to 5.6 mg/kg) in nearly all of the backwaters (27 of 29 backwaters, covering 99% of the backwater acreage); and for piscivorous birds, the predicted whole body fish PCB concentrations would achieve the IMPG (3.2 mg/kg) in all reaches except one subreach of Reach 7. For insectivorous birds, predicted sediment PCB concentrations in the relevant averaging areas in Reaches 5 and 6 are below the target sediment levels of 3 and 5 mg/kg in all areas and below the target level of 1 mg/kg in 10 of the 12 areas; and for piscivorous mammals, predicted sediment PCB concentrations are below all three target sediment levels in both averaging areas.[71]

Although this alternative would not achieve the ecological IMPGs for a couple of receptor groups in a few limited areas, GE does not believe that those exceedances would prevent this alternative from being protective of the environment. These exceedances are limited in area and are only slightly above the IMPG levels.[72] Given these factors, together with the fact that

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[71] As discussed previously, attaining the target sediment levels for insectivorous birds and piscivorous mammals would allow achievement of the IMPGs for these receptors provided that the average floodplain soil concentrations in the same averaging areas are below the associated target floodplain soil levels (see Section 6).

[72] For example, the two backwater areas that would not achieve levels within the IMPG range for amphibians are small (total area of approximately 1 acre), and in both areas, the predicted sediment concentrations are only slightly above the upper-bound IMPG (see Table 4-26). Similarly, the predicted exceedances of the piscivorous bird IMPG occur only in one Reach 7 subreach, and the predicted fish concentration in that area is not substantially above the IMPG (see Table 4-28).

the local populations of these receptors encompass numerous areas within the Rest of River where the IMPGs would be achieved, as well as nearby areas outside the Rest of River, it would not be expected that these few exceedances would prevent the maintenance of healthy local populations of these receptors. Much less would these limited exceedances adversely impact the overall wildlife community in the Rest of River area, which has been shown by EPA's own field surveys to consist of numerous and diverse species under current conditions.

At the same time, implementation of SED 5 would cause considerable short-term impacts on the environment in the areas where work would be conducted (e.g., loss of aquatic habitat in areas of remediation in portions of Reaches 5 and 6, loss of riparian habitat in the bank stabilization areas, potential resuspension of PCB-containing sediments during removal, and loss of floodplain habitat in areas where supporting facilities are constructed), as discussed in Section 4.5.8. These alternatives would be more widespread and would last longer than those from SED 3 and SED 4.

Implementation of SED 5 could also have some long-term environmental impacts. For example, as discussed in Section 4.5.5.3, it is possible that the extensive removal and capping activities in Reaches 5 and 6 as part of SED 5 would have a long-term adverse environmental impact due to the potential cumulative effects of those activities over an extended area and duration. Additionally, long-term adverse impacts could result from the bank stabilization activities, the placement of a cap or thin-layer cap in shallow areas where consolidation of the sediment is not anticipated, and ancillary construction activities in the floodplain. These impacts would be more extensive than those from SED 3 and SED 4.

Despite these short- and long-term adverse environmental impacts, SED 5 would address the ecological risks that EPA concluded in the ERA were present in the Rest of River area. Thus, if one accepts EPA's conclusions in the ERA, SED 5 would meet the standard of providing environmental protection. However, in doing so, it would cause more environmental damage than necessary to provide such protection.

Summary: Based on the foregoing considerations, it is concluded that SED 5 would provide overall protection of human health and the environment, although at the cost of causing substantial environmental harm.

4.6 Evaluation of Sediment Alternative 6

4.6.1 Description of Alternative

SED 6 would include the removal of 554,000 cy of sediment and bank soils, placement of a cap over a total of 223 acres of river bottom including all removal areas and some non-removal areas, and application of a thin-layer cap over 101 acres. Specifically, the components of SED 6 include the following:

- Reach 5A: Sediment removal (134,000 cy over 42 acres);
- Reach 5B: Sediment removal (88,000 cy over 27 acres);
- Reach 5C: Sediment removal (186,000 cy over 57 acres);
- Reach 5 erodible banks: Removal and stabilization (33,000 cy);
- Reach 5 backwaters: Combination of removal in areas with surface PCB concentrations greater than 50 mg/kg (24,000 cy over 15 acres) and thin-layer capping in areas with surface PCB concentrations between 1 and 50 mg/kg (55 acres);
- Reach 6 (Woods Pond): Combination of removal (89,000 cy over 37 acres) and capping without sediment removal (23 acres);
- Reach 7 impoundments: Thin-layer capping (27 acres);
- Reach 8 (Rising Pond): Combination of capping without sediment removal (22 acres) and thin-layer capping (19 acres); and
- Reach 7 (channel) and Reaches 9 through 16: MNR

Remediation would proceed from upstream to downstream to minimize the potential for recontamination of remediated areas. Figures 4-8a-b identify the remedial action(s) that would be taken in each reach as part of SED 6. Note that either capping or backfilling would be conducted following removal in the Reach 5 backwaters considering the PCB concentrations remaining following removal; this decision would be determined during design. However, for purposes of this CMS Report, it is conservatively assumed that capping would be conducted in the backwater areas.

The following summarizes the general remedial approach (and associated assumptions) related to implementation of SED 6. It is estimated that SED 6 would require approximately 21 years to complete. It should be noted that while details on equipment and processes are provided in this description for purposes of the evaluations in this CMS Report, the specific methods for implementation of any selected remedy would be determined during design based on engineering considerations and site conditions.

Site Preparation: Prior to implementation of remedial activities, access roads and staging areas would be constructed to support implementation of this alternative. Grubbing and clearing of vegetation would likely be necessary, and appropriate erosion and sedimentation controls would be put in place prior to construction. The conceptual plans developed for this CMS Report indicate that 29 staging areas and approximately 21 miles of access roads would be constructed between the Confluence and Rising Pond to support implementation of SED 6.

Sediment Removal: Sediment removal would be performed in Reaches 5 and 6, as presented below.

	Average Removal Depth (feet)	**Removal Volume (cy)**	**Acreage**
Reach 5A:	2	134,000	42
Reach 5B:	2	88,000	27
Reach 5C:	2	186,000	57
Reach 5 backwaters:	1	24,000	15
Reach 6 (Woods Pond):	1.5	89,000	37
Totals:		**521,000**	**178**

The areas over which removal would be conducted for the reaches listed above are shown on Figure 4-8a.

It is assumed that the excavations in Reaches 5A and 5B would be performed in the dry with conventional mechanical excavation equipment. Sheetpiled cells would be established in the River to facilitate removal activities and limit downstream transport of sediment. A water treatment system would be used to treat water pumped from the excavation areas. In Reaches 5C, 5 backwaters, and 6, it is assumed that the removal would be performed using hydraulic dredging. In these areas, debris removal would be conducted prior to dredging, and silt curtains would be placed downstream of dredging areas to limit transport of suspended sediment. Periodic water column and air monitoring would be performed during all removal operations to monitor potential releases.

Cap Placement: Caps would be installed following excavation in Reaches 5A, 5B, and 5C, Reach 5 backwaters, and the shallow portion of Woods Pond (see Figure 4-8a). Caps would also be installed in the deeper portions of Woods Pond and Rising Pond without prior sediment excavation. Removal of significant debris would be conducted prior to cap material placement. Cap materials would be placed in the dry in areas where dry excavation was performed and through the water column in the remaining areas. Cap materials would be transferred to the River using conventional earth-moving equipment.

For those areas where sediment removal is performed, the existing bathymetry would be maintained through construction of caps with a thickness similar to the removal depths. For purposes of this CMS Report, it has been assumed that in the Reach 5 subreaches where sediment removal occurs, the cap would consist of 12 inches of sand (which may be amended by organic material to increase the TOC content), overlain by an armor stone layer of 12 inches to bring the riverbed to the pre-removal elevation. In the areas of Woods Pond where removal would occur, the pre-removal depths would be achieved through placement of a cap consisting of 12 inches of sand and 6 inches of armor stone. In the backwater areas, the pre-removal elevation would be achieved with a 12-inch stable sand layer (which may include some stone mixed in and may be amended by organic material), but no additional armor stone layer. In the deeper portions of Woods Pond and Rising Pond where caps would be installed without prior sediment excavation, the cap would consist of 12 inches of sand and 6 inches of armor stone. It should be noted that the composition and thickness of the sand layer and armor stone layer (where applicable) would be determined during design, and would be selected to limit the potential for migration of PCBs from underlying sediments through the cap (sand material) and resist erosion during high flows (armor stone). Silt curtains would be used during capping in the wet to mitigate the potential for downstream transport of materials in the water column, and water column sampling would be performed to monitor potential releases.

<u>Thin-Layer Cap Placement</u>: In the Reach 5 backwaters, following removal of sediments in the top foot with PCB concentrations over 50 mg/kg, a thin-layer cap would be installed over all remaining areas where PCB concentrations in the top foot exceed 1 mg/kg (55 acres). A thin-layer cap would also be installed in the Reach 7 impoundments (27 acres) and the shallow portion of Rising Pond (19 acres), as shown on Figures 4-8a-b. The thin-layer cap would consist of an assumed 6-inch layer of sand. The thin-layer cap would be placed via a combination of techniques, including mechanical and/or hydraulic means.

<u>Sediment Dewatering and Handling</u>: Sediment dewatering operations would be performed as necessary in the staging areas. For purposes of this CMS Report, it has been assumed that a combination of dewatering alternatives would be used, including gravity dewatering via stockpiling for materials removed in the dry and mechanical dewatering using a plate and frame filter press for materials removed in the wet. The addition of stabilization agents (e.g., other dry sediments, excavated soils, Portland cement) may be necessary prior to treatment and/or disposal. Treatment/disposition alternatives have been evaluated separately and are discussed in Section 7. A water treatment system would be used to treat water pumped from the excavation areas, as well as any decant water collected from excavated materials in the staging areas.

Bank Removal/Stabilization: SED 6 would include the removal of 33,000 cy of soil from the erodible banks in Reach 5 followed by stabilization. Bank stabilization is assumed to be limited to Reaches 5A and 5B, and to consist of the same techniques used in SED 3 through SED 5 – i.e., bank excavation to promote stable slopes (assumed to be 1½:1 to 3:1 slopes), followed by stabilization with revetment mats, armor stone, or bioengineering techniques (with an assumed distribution of 20%, 60%, and 20%, respectively, for each stabilization technique).

MNR: MNR would be implemented in the remainder of the Rest of River under SED 6 (i.e., Reach 7 channel and Reaches 9 through 16). As discussed previously, natural recovery processes have been documented in portions of the Housatonic River and would be expected to continue at varying rates in the areas where MNR would be implemented under SED 6, due in part to the completed and planned remediation conducted upstream of the Rest of River, as well as the remediation that would be conducted as part of this alternative.

Restoration: SED 6 would include restoration of areas that are directly impacted by the removal and/or capping activities, bank removal/stabilization activities, and ancillary construction activities, as appropriate to restore the habitat value of the affected resources, to the extent practical. Restoration would be accomplished using a combination of passive procedures (practices to facilitate natural reestablishment of the resource) and active procedures (plantings or other mitigation). For purposes of this CMS Report, the extent and type of restoration activities assumed for SED 6 are as follows:

- In the areas of Reach 5 (including backwaters) and the shallow portion of Woods Pond, where removal would be conducted, the river bottom would be restored to existing bathymetry with the placement of a cap. In those areas, it is anticipated that the armor stone, as well as any deposited sediment, would be readily recolonized by benthic invertebrates. Similarly, in deeper portions of Reach 5C and Woods Pond subject to capping without removal, it is anticipated that benthic invertebrates would readily recolonize the area, based on data developed from deep water capping activities at the St. Louis River/Duluth Tar Superfund Site (MN) (Rogers and Costello, 2007). It is also anticipated that, in all of these areas, aquatic vegetation would readily re-establish itself through transport from upstream sources of plants in the water column.

- It is not anticipated that restoration would be required in the deep portions of Woods Pond and Rising Pond that would be capped, or in the portions of the backwaters, Reach 7 impoundments, and Rising Pond that would be subject to thin-layer capping. In these areas, the capping substrate would serve as a ready base for recolonization by benthic invertebrates. In areas within the limits of light penetration, the capping substrate would serve as a suitable medium for the recolonization by submerged aquatic plants from upstream sources.

- On riverbanks where revetment mats or armor stone are used for stabilization, supplemental habitat structures such as trees, log and root wad revetments, and/or log and brush shelters would be considered as part of the restoration to replace similar existing structures. On banks where bioengineering techniques are used, plantings would be used to restore an appropriate riparian community.

- In the areas adjacent to the River where access roads and staging areas have been constructed to support work in the River, those support facilities would be removed and the disturbed areas revegetated with plantings that, over time, would restore the current habitat value of those areas.

Restoration activities would be conducted following completion of the remedial action within successive reaches of the River. In certain circumstances, restoration of impacted natural communities affected by ancillary construction activities, such as roadway construction, could be delayed until the remedial action over a broader area is completed.

Institutional Controls: SED 6 would include the continued maintenance of biota consumption advisories, as appropriate, to limit the public's consumption of fish and other biota from the River.

Long-Term OMM: Once implemented, it is assumed that SED 6 would include, for each reach involved, a 5-year post-construction monitoring and maintenance program and a long-term (30-year) monitoring program.

The post-construction monitoring program assumed for SED 6 would include annual monitoring of the same components outlined under SED 3 (Section 4.3.1). The SED 6 program is assumed to include visual observation supplemented with probing in areas where armor stone would be placed, collection of approximately 30 cores for visual observation in stable sand/thin-layer cap areas, visual observations of the Reach 5 riverbanks, and visual observation and quantitative/qualitative assessment of restored staging areas and access roads. These activities would occur annually for a period of 5 years following remedy implementation in a given reach.

In addition, it is assumed that the long-term monitoring program would include analytical sampling of fish and the water column, consistent with the program outlined for SED 2 (Section 4.2.1). It is also assumed to include a sediment sampling program, which would include the collection and PCB analysis every 5 years of 50 surface sediment samples from the MNR areas, approximately 45 cores (135 samples) from the removal areas, approximately 11 cores (33 samples) from the cap-only areas, and approximately 25 cores (25 samples) from the thin-layer cap areas. Sampling is assumed for a period of 30 years. In addition, a maintenance program would be implemented, as necessary.

4.6.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 4.1.2, the evaluation of whether a sediment remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether SED 6 would be protective of human health and the environment is presented at the end of Section 4.6 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

4.6.3 Control of Sources of Releases

SED 6 would reduce the potential for future PCB releases from certain river sediments and riverbanks that may occur via erosion and flood events. This alternative would address PCB sources over approximately 324 acres of the riverbed and the erodible portions of approximately 7 miles of riverbank, and would include the removal of 554,000 cy of sediment and bank soils containing PCBs.

Implementing these actions would significantly reduce the sources of PCBs currently available for potential transport within the River and onto the floodplain for human or ecological exposure. Specifically, SED 6 would result in the removal of 1.5 to 2 feet of sediments throughout of all Reach 5 and the shallow portion of Woods Pond, and removal of sediments with PCB concentrations greater than 50 mg/kg in the top foot in the backwaters. Residual PCBs remaining in these areas would be contained by a cap designed to withstand erosion during high flows. The erodible banks of Reach 5 that currently provide a source of PCBs to the River during high-flow events would be addressed through a combination of removal and bank stabilization techniques. In the deeper portions of Woods Pond and Rising Pond, a cap would be placed over the existing river bottom to isolate the underlying PCB-containing sediment from the water column. In addition, in portions of the Reach 5 backwaters, Reach 7 impoundments, and Rising Pond, where sediment PCB concentrations are lower, a thin-layer cap would be placed over the existing river bottom to accelerate the natural recovery process and assist in controlling releases from those areas.

It should also be noted that in conjunction with the remediation and natural recovery processes within the Rest of River, the remaining remediation activities to be conducted upstream of the Confluence (i.e., in areas adjacent to the East Branch and in the West Branch) would reduce the PCBs available for scour/transport within the Rest of River. Additionally, the existing dams along the River would continue to limit movement of PCB-containing sediments within the impoundments behind the dams, and would further reduce the potential for transport of those sediments to the River. While failure of those dams could lead to the release of PCB-containing sediments impounded behind them, the inspection, monitoring, and maintenance programs in place for the dams under other authorities, as described in Section 4.1.3, would prevent or minimize the possibility of dam failure. Moreover, even if there were a dam failure, the potential for release of PCBs would be mitigated by the cap in Woods Pond and, to some extent, by the cap and thin-layer cap in Rising Pond and the thin-layer caps in the Reach 7 impoundments.

As indicated by EPA's model, implementation of SED 6, in combination with upstream source control, would reduce the mass of PCBs transported within the River to downstream reaches and to the floodplain. For example, the annual average PCB load passing Woods Pond Dam at the end of the model projection is predicted to decrease by 97% from that calculated at the beginning of the model projection period (i.e., from 20 kg/yr to 0.6 kg/yr). Similarly, SED 6 is predicted to achieve a 95% reduction in the PCB load passing Rising Pond Dam over this same period (i.e., from 19 kg/yr to 1.0 kg/yr). Likewise, SED 6 is predicted to result in a 98% reduction in the annual average mass of PCBs transported from the River to the floodplain within Reaches 5 and 6 over the modeled period (i.e., from 12 kg/yr to 0.3 kg/yr).

The effects of an extreme flow event were examined using the Year 26 flood. The impact of this flood on surface sediment PCB concentrations can be seen on Figure 4-9b, which shows temporal profiles of model-predicted reach-average PCB concentrations in surface sediments resulting from the implementation of SED 6 over the 52-year model projection period. Similar to the other alternatives, the model results for SED 6 indicate that, in reaches subject to MNR only (i.e., Reach 7 channel sections), the extreme event is not predicted to expose buried PCBs at concentrations exceeding those already exposed at the sediment surface. For the reaches that would be capped either following removal or without removal (i.e., Reaches 5A, 5B, 5C, Woods Pond, and portions of the backwaters and Rising Pond), EPA's model predicts that, given the cap's armor layer, buried sediments would not be exposed during the extreme storm event.[73] As a result, no change in reach-average surface sediment PCB concentrations is predicted for these areas (e.g., Figure 4-9b). In the portions of Reach 5 backwaters and Rising Pond undergoing thin-layer capping for SED 6, the model predicts that the cap materials and underlying sediments also would largely remain stable during high flow events. Indeed, the model results indicate that only a few model grid cells (representing 1% to 3% of the thin-layer capped portions) would experience significant erosion in these reaches. Such erosion is predicted to produce small (0.1 mg/kg) increases in the reach-average surface sediment PCB concentrations, resulting in levels that are still 97% to 99% lower than pre-

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[73] Further evaluation of the stability of cap and thin-layer cap materials under SED 6 based on model predictions of erosion in these areas is provided in Section 4.6.5.2. The results of this stability analysis (i.e., percentages of cap/thin-layer cap areas that are stable) are cited in the remainder of this discussion.

remediation levels in Reaches 5D and 8, respectively (Figure 4-9b). Similarly, in the Reach 7 impoundments, the model predicts that the thin-layer cap materials and underlying sediments would generally remain stable during the high flow events. Portions of these areas (11% to 21% of the thin-layer capped portions) would experience erosion large enough to produce increases in average surface sediment PCB concentrations (Figure 4-9b). These concentration increases are moderate (0.4 mg/kg to 1.5 mg/kg) relative to the pre-remediation levels (2 mg/kg to 6 mg/kg) such that the concentrations following the erosion are still 50% (Reach 7B) to 80% (Reach 7G) lower than current levels (Figure 4-9b). Overall, the model results indicate that, in most areas, buried sediments containing PCBs would not become exposed to a significant extent during an extreme flow event under SED 6.

4.6.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs, set forth in Table 2-1, include the federal and state water quality criteria for PCBs. These criteria consist of a freshwater chronic aquatic life criterion of 0.014 µg/L and a human health criterion (based on consumption of water and organisms) of 0.000064 µg/L (0.00017 µg/L under the Connecticut standards, although that may not be an ARAR since it is less stringent and less up-to-date than the federal criterion).

To evaluate whether SED 6 would achieve those criteria, GE reviewed the water column PCB concentrations predicted by the model for SED 6. The water column concentrations are presented in Table 4-29 (in Section 4.6.5.1 below). As shown in that table, annual average water column concentrations predicted by the model at the end of the simulation period are below the freshwater chronic aquatic life criterion of 0.014 µg/L (14 ng/L) in all reaches. However, model-predicted water column concentrations exceed the federal and Massachusetts human health consumption criterion of 0.000064 µg/L (0.064 ng/L) in all reaches in Massachusetts. For the Connecticut impoundments, the water column concentrations estimated by the CT 1-D Analysis (which range from 0.00005 to 0.00009 µg/L [0.05 to 0.09 ng/L]) exceed the federal criterion in two of the four impoundments, but are below the Connecticut consumption criterion of 0.00017 µg/L (0.17 ng/L) in all four impoundments, although these estimates are highly uncertain. As previously discussed, GE believes that the ARARs based on the human health consumption criteria should be waived on the ground that achievement of those ARARs is technically impracticable for the reasons given in Section 4.1.4.

The potential location-specific and action-specific ARARs are listed in Tables 2-2 and 2-3. Based on review of those ARARs, GE believes that SED 6 could be designed and implemented to achieve most of the ARARs that would be pertinent to this alternative, provided that any necessary EPA approval determinations are obtained, for the same reasons discussed in Section 4.3.4. However, as also discussed in that section, in the event that the excavated sediments should be found to constitute hazardous waste under RCRA or comparable state criteria (which is not anticipated), the temporary staging areas for the dewatering and handling of those sediments might not meet certain hazardous waste storage requirements, if they were determined to apply. In that case, as further discussed in Section 4.3.4, GE believes that such requirements should be considered inapplicable or, if necessary, waived as technically impracticable.

4.6.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for SED 6 has included an evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment, as described below.

4.6.5.1 Magnitude of Residual Risk

The assessment of the magnitude of residual risk associated with implementation of SED 6 has included consideration of the extent to which and timing over which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure, such as engineering and institutional controls.

Implementation of SED 6, along with upstream source control/remediation measures and natural recovery processes, would substantially reduce the potential exposure of humans and ecological receptors to PCBs in sediments, surface water, and fish in the Rest of River area. The extensive sediment removal and/or capping activities throughout Reach 5 and in Woods Pond and Rising Pond would result in a significant reduction in the potential for exposure to PCBs in these areas. The placement of a thin-layer cap over the sediments in certain Reach 5 backwaters, the Reach 7 impoundments, and the shallow areas of Rising Pond would reduce the surface sediment PCB concentrations in these areas, thereby reducing potential human and ecological exposures and risks. The following table shows, by reach, the average PCB concentrations predicted by EPA’s model to be present at the end of the model simulation period (Year 52) in the surface sediments, surface water, and fish (including both whole body and fillet-based concentrations).

Table 4-29 – Modeled PCB Concentrations at End of 52-Year Projection Period (SED 6)

Reach	Average Surface Sediment (0-6") (mg/kg)	Average Surface Water (ng/L)	Average Fish (whole body) (mg/kg)	Average Fish (fillet) (mg/kg)
5A	0.06	2.5	1.3	0.3
5B	0.06	1.9	1.1	0.2
5C	0.2	1.3	0.8	0.2
5D (backwaters)	0.2	---	1.8	0.4
6	0.2	1.2	0.9	0.2
7[1]	0.4 – 4.0	0.9 – 1.2	1.8 – 5.6	0.4 – 1.1
8	0.1	0.9	1.2	0.2
CT[1]	0.003 – 0.007	0.05 – 0.09	0.03 – 0.05	0.005 – 0.01

Notes:

1. Values shown as ranges in Reach 7 and CT represent the range of modeled PCB concentrations at the end of the projection within each of the Reach 7 subreaches, and the range of concentrations indicated by the CT 1-D Analysis for the four Connecticut impoundments.
2. Fish fillet concentrations were calculated by dividing the modeled whole-body fish PCB concentrations by a factor of 5, as directed by EPA.

The potential residual risks to human and ecological receptors from the concentrations shown in the above table have been evaluated in the context of the extent to which they would achieve the IMPGs, as discussed in Section 4.6.6.

Temporal profiles of reach-average PCB concentrations in surface sediments, annual average surface water, whole body fish, and fish fillets, resulting from the implementation of SED 6 over the 52-year model projection period are shown on Figures 4-9a-c. These figures show the timeframes over which SED 6 would be predicted to reduce the PCB concentrations in each respective medium. The general patterns exhibited within remediated reaches (i.e., Reaches 5, 6, 7 impoundments, and 8) exhibit a large reduction over the period of active remediation, followed by a period of slow decline or, in some instances, a leveling off or increase to a concentration which is in steady-state with upstream loadings and natural attenuation processes. Sediment PCB concentrations in the Connecticut impoundments exhibit a shallower temporal trajectory, reflecting the influence of upstream remediation on these downstream sediments. While the water column patterns exhibit significant year-to-year variability, including short-term increases in PCB concentration associated with increased PCB transport during the Year 26 extreme flow event and sediment resuspension during remediation, the water column temporal changes generally follow those of the sediments. Moreover, temporal patterns in fish PCB concentrations reflect the predicted changes in water column and sediments and result in a 97% to 99% reduction in predicted fish PCB concentrations in the remediated reaches (i.e., Reaches 5, 6, 7 impoundments, and 8), a 90% reduction in the channel sections of Reach 7, and a 97% reduction in the Connecticut impoundments over the projection period (Figure 4-9c).

PCBs would also remain in the sediments beneath and outside of the area addressed by this alternative. However, in the capped areas, the caps would prevent direct contact with, and effectively reduce the mobility of, the PCB-containing sediments beneath the caps; and the thin-layer caps would provide a cover layer over the underlying PCB-containing sediments. Overall, the extent to which SED 6 would mitigate the effects of a flood event that could cause the PCB-containing sediments that have been contained by a cap or buried due to natural processes to become available for human and ecological exposure was discussed in Section 4.6.3. As discussed in that section, the model results indicate that, in most areas, buried sediments containing PCBs would not become exposed to any significant extent during an extreme flow event following implementation of SED 6.

In addition, potential human exposure to PCBs in fish and other biota would be reduced during and after implementation of SED 6 through biota consumption advisories. Also, a long-term monitoring program would be implemented to assess the continued effectiveness of this remedial alternative to mitigate potential human and ecological exposures to PCBs.

4.6.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of SED 6 has included an assessment of the use of technologies under similar conditions and in combination, general reliability and effectiveness, reliability of OMM and availability of OMM labor and materials, and technical component replacement requirements, as discussed below.

Use of Technologies under Similar Conditions and in Combination

As discussed previously, a combination of remedial technologies is often necessary to mitigate potential exposure to constituents in sediments (e.g., EPA, 2005e; NRC, 2007). SED 6 involves such a combination. The SED 6 remedy components were selected for application in various reaches of the River based in part on the study and application of each technology under similar conditions at other sites. These components include sediment removal using dry excavation techniques (in Reaches 5A and 5B), sediment removal using hydraulic dredging (in Reaches 5C, 5 backwaters, and 6), bank removal and stabilization (for Reach 5 erodible banks), capping all the removal areas and some non-removal areas (in the deeper parts of Woods Pond and Rising Pond), thin-layer capping (in Reach 7 impoundments and shallow areas of Rising Pond), and MNR (in the remaining areas). These remedial techniques have been applied at a number of sites containing PCBs under similar conditions to those in various reaches of the River.

Examples of SED 6 remedial technologies that are common to SED 3 and SED 4 were presented in Sections 4.3.5.2 and 4.4.5.2. SED 6 also includes hydraulic dredging for areas downstream of Reach 5B. Similar to mechanical excavation, hydraulic dredging is a remedial technique commonly used at contaminated sediment sites (EPA, 2005e). For example, hydraulic dredging was used for removal of sediments in the main channel (average water depth of 16 feet) at the Grasse River (www.thegrasseriver.com), and also at the St. Lawrence River (BBLES, 1996).

General Reliability and Effectiveness

SED 6 utilizes technologies that have been shown to be reliable and effective in reducing exposure of humans and ecological receptors to PCBs in sediments. These technologies include sediment removal, capping, thin-layer capping, and MNR. Their general reliability and effectiveness were previously discussed in Section 4.3.5.2. As noted in that section, under certain circumstances, dredging and excavation have been shown to be effective and reliable in reducing the long-term potential for exposure of human and ecological receptors to PCB-containing sediments, although there are some limitations associated with this technology (e.g., sediment resuspension, residual contamination) (EPA, 2005e). As described by EPA (2005e), capping is also a viable and effective approach for remediating impacted sediments. Regarding thin-layer capping, EPA (2005e) has acknowledged that placement of a thin layer "of clean sediment may accelerate natural recovery in some cases." Finally, while EPA has acknowledged the potential limitations of MNR, it has stated that MNR should "receive detailed consideration" where site conditions are conducive to such a remedy (EPA, 2005e). In addition, EPA has noted that many contaminants that remain in sediment are not easily transformed or destroyed, and that for this reason, "risk reduction due to natural burial through sedimentation is more common and can be an acceptable sediment management option" (EPA, 2005e).

To further assess the reliability and effectiveness of SED 6, model predictions of erosion in areas receiving a cap or a thin-layer cap were evaluated to assess cap stability, using the same metrics described for this analysis in Section 4.3.5.2. The results of these stability assessments are as follows:

Caps: Under SED 6, the areas receiving a cap, either following sediment removal or without sediment removal, include Reaches 5A, 5B, 5C, portions of backwaters in Reach 5, Woods Pond, and the deep section of Rising Pond. Those caps would be designed to resist erosion by including an appropriately sized armor layer. The model inputs for areas receiving a cap were specified accordingly as discussed in Section 3.2.4.5. Thus, the areas receiving a cap under SED 6 are predicted to be 100% stable.

Thin-Layer Caps: SED 6 includes placement of a thin-layer cap to enhance natural recovery in portions of backwaters in Reach 5, in the impoundments within Reach 7, and in the shallow portion of Rising Pond. As discussed in Section 4.3.5.2, the long-term effectiveness of the thin-layer cap was evaluated by considering it stable (and therefore reliable) when EPA's model predicts that at least 1 inch of material would remain for the full duration of the model projection (including the extreme flow event). In the Reach 5 backwaters, the model predicts that the thin-layer cap would be stable over 99% of the area. In the remaining 1% of the area, erosion causing less than 1 inch of thin-layer cap material to remain is predicted to occur within a limited number of grid cells in response to storm events simulated in Years 16 and 20. This limited erosion is predicted to produce an increase of approximately 0.1 mg/kg in the reach-average 0- to 6-inch sediment PCB concentration in Reach 5D (Figure 4-9b). In the Reach 7 impoundments, the model predicts that approximately 79% to 89% of the thin-layer capped areas would be stable under SED 6. The remaining areas, comprising 11% to 21% of the impoundments, are predicted to contain less than 1 inch of thin-layer cap material during the simulation. That erosion is predicted to occur during the extreme flow event simulated in Year 26, as well as during a high flow event simulated in Year 32 for Reach 7G. Such erosion is predicted to cause increases in the reach-average 0- to 6-inch surface sediment PCB concentrations in those impoundments ranging from 0.4 mg/kg in Reach 7E to approximately 1.3 mg/kg in Reach 7G (Figure 4-9b). In the shallow area of Rising Pond, EPA's model predicts that approximately 97% of the thin-layer capped area would remain stable. Erosion in the remaining 3% of the area (corresponding to a single model grid cell) was predicted to occur over various high flow events simulated in Years 21 through 31 and to result in an increase of approximately 0.1 mg/kg in the reach-average 0- to 6-inch surface sediment PCB concentration (Figure 4-9b).[74] Even after such increases in concentration are taken into account, the concentrations following the high flow events still represent significant reductions relative to current levels for the reaches where SED 6 includes a thin-layer cap (97% to 99% in the Reach 5 backwaters and Rising Pond and 50% to 80% in the Reach 7 impoundments, as discussed in Section 4.6.3). Based on these results, the model indicates that the thin-layer caps under SED 6 would be an effective means of reducing surficial PCB concentrations, although under extreme flow events, erosion of some portions of the thin-layer capped areas within the Reach 7 impoundments would occur.

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[74] The overall increases in the Reach 7 impoundment and Reach 8 surficial sediment PCB concentrations shown on Figure 4-9b result not only from erosion of thin-layer cap material in limited areas, but also from deposition and subsequent mixing of PCB-containing sediment originating from areas upstream.

Reliability of Operation, Monitoring, and Maintenance Requirements/Availability of Labor and Materials

A combination of reliable OMM techniques, including periodic analytical sampling of fish, water column, and sediment, monitoring of caps and restored banks via visual observations supplemented with sediment probing and/or coring, and maintenance of the restored riverbed and riverbanks, would be implemented to maintain and track the long-term effectiveness of SED 6. Post-remediation sampling is commonly used to monitor the effectiveness of completed sediment removal and capping remedies. Visual observation of the sediment cap and restored banks is considered a reliable means of verifying that the capping components of the remedy have remained stable and in place (see Section 4.4.5.2). Should changes in the riverbed or riverbank be noted that require maintenance, labor and materials (e.g., cap material, conventional earth-moving equipment, etc.) needed to perform repairs are expected to be readily available.

In addition, a monitoring and maintenance program would be implemented for actively restored areas to confirm planting survival and areal coverage and to determine whether habitat structures (if any) are intact. Such monitoring is considered a reliable means of tracking the progress of the restoration efforts. The necessary labor and equipment for such a program are expected to be readily available.

Technical Component Replacement Requirements

The technologies that comprise SED 6 were selected for application in areas of the River where site conditions are expected to support long-term reliability and effectiveness with minimal maintenance requirements. However, if erosion of cap and/or bank stabilization materials should occur, an assessment would be conducted to determine the need for and methods of repair. Depending on the timing and location of the repair, access roads and staging areas may need to be temporarily constructed in the nearby floodplain. Periodic small-scale repairs would likely pose minimal risks to humans and ecological receptors that use/inhabit the disturbed river bottom and nearby floodplain. While not anticipated, redesign/replacement of larger remedy components could require more extensive disturbance of the river bottom, banks, and/or the adjacent floodplains to support access.

4.6.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of SED 6 on human health or the environment has included identification and evaluation of potentially affected populations, adverse impacts on biota and their habitat, adverse impacts on wetlands, impacts on the aesthetics of the natural environment, impacts on banks and bedload movement, and potentially available measures that may be employed to mitigate these impacts.

Potentially Affected Populations

Since SED 6 would impact more areas and would take longer to implement than the previously discussed alternatives, it would have a more extensive impact in altering the habitat of the River and adjacent floodplain areas, and overall recovery would take longer. These habitat alterations would affect people using these areas as well as the fish and wildlife in these areas, as discussed further below.

Adverse Impacts on Biota and Corresponding Habitat

The potential long-term impacts of SED 6 on biota and their habitat are discussed below in relation to the type of remediation involved. It should be noted that as the intrusive level of the remedial activities and the amount of area affected by the remedial action increase with each of the remedial alternatives, the spatial and temporal extent of short-term impacts would increase. At some point, the cumulative effect of the myriad of short-term impacts associated with the remedial action would in and of itself constitute a long-term impact due to the timeframe associated with the remedy.

Note also that, to the extent that affected areas constitute habitat for any rare, threatened, and/or endangered species, implementation of SED 6 could affect those species. In general, for the more mobile species and/or species with a wide range of habitat requirements, long-term impacts from the remedial activities are unlikely, because the activities would only displace these species to other areas of the river system. However, for animal species with narrower habitat requirements and for any threatened or endangered plant species, any long-term alteration of the habitat (as discussed below) could have a long-term adverse impact on those species.

Sediment Removal in Reaches 5 and 6: It is uncertain whether SED 6 would have a long-term adverse impact on biota and their habitats in the portions of the main river channel and backwaters in Reaches 5 and 6 that would be subject to removal. In the main channel of Reach 5, the areas subject to removal in SED 6 are comparable to those in SED 5. These activities would disrupt aquatic organisms (fish and benthic invertebrates) during the course of implementation. For the same reasons discussed for SED 5 in Section 4.5.5.3, while it is expected that the aquatic biota would be able to recover in time, there is uncertainty regarding the cumulative effects of such extensive remediation in Reach 5 on the length of time that it would take for the upstream communities to be sufficiently developed to provide organisms to downstream locations and thus for the downstream biotic communities to recover. Similarly, in the shallow portion of Woods Pond, which would be subject to removal, there is uncertainty as to the length of time it would take for this area to be recolonized by aquatic plants and benthic invertebrates from upstream sources given the cumulative effects of the prolonged and extensive upstream remediation.

SED 6 would also involve removal and capping of sediments in the backwaters with PCB concentrations greater than 50 mg/kg – a total of approximately 15 acres. The cap material would not initially be as suitable for emergent plants as the existing sediments. Over time, these 15 acres are expected to silt in; and once a sufficient depth of silt (1 to 2 inches) has been deposited, a vegetative community similar to the existing one should reestablish itself through colonization and/or from the surrounding seedbank. However, the length of time that it would take for a sufficient amount of silt to be deposited to support plant life is unknown. The length of time that it would take for silt and organic detritus to accumulate may also impact the seasonal anoxic conditions typical of the backwaters. Changes in oxygen levels and carbon cycling might modify the fish and benthic invertebrate community currently supported by these backwater areas, but such a change would not necessarily be negative.

Riverbank Stabilization: The bank removal/stabilization activities that are part of SED 6 may have some long-term adverse environmental impacts on riparian habitats in Reaches 5A and 5B, depending upon the stabilization technique used. Since these activities are the same as in SED 3 (and others), the discussion of potential long-term adverse environmental impacts of such activities under SED 3 (in Section 4.3.5.3) also applies to SED 6.

Thin-Layer Capping in Reach 5 Backwaters, Reach 7 Impoundments and Rising Pond (shallow): The placement of the thin-layer cap in portions of the Reach 5 backwaters (i.e., those with surface sediment PCB concentrations between 1 and 50 mg/kg), in the Reach 7 impoundments, and in the shallow portion of Rising Pond would have the same potential for producing long-term effects as the placement of the thin-layer cap in similar environments in SED 4 and SED 5. Specifically, as discussed in Section 4.4.5.3, in limited shallow water areas (e.g., along shorelines) where the water is less than 6-12 inches deep and consolidation of the underlying sediment is not anticipated, the thin-layer cap could increase the substrate elevation such that it would modify the vegetative characteristics of the riverine wetlands and the biota they support or, in limited cases where the cap thickness would exceed the water depth, cause the wetlands vegetation to be replaced by species more tolerant of riparian or terrestrial conditions. In other areas where the thin-layer cap would be placed, long-term adverse impacts are not expected. Although the thin-layer cap would cover the aquatic vegetation and benthic invertebrates, these communities would be re-established through recolonization from upstream areas. In addition, as also noted in Section 4.4.5.3, in areas where the water depths are 2 to 4 feet, the placement of the thin-layer cap may have a beneficial effect by increasing the area of the littoral zone, thereby broadening the area available for colonization by emergent aquatic plants.

Capping in Woods Pond (deep) and Rising Pond (deep): The placement of a cap in the deep portions of Woods Pond and Rising Pond is not expected to have adverse long-term impacts. As discussed under SED 5, the cap material may differ from the finer, silty native sediments that currently exist, resulting in colonization by different benthic invertebrate communities than currently exist, but this change would not necessarily be negative. However, as discussed above, there is some uncertainty as to how long it would take the capped area of Woods Pond to recover given the spatial and temporal extent of remediation upstream of that area.

Supporting Facilities in Floodplain: Long-term impacts to biota and their habitats may also occur as a result of ancillary supporting activities in the floodplain, including the clearing and construction of access roads and sediment staging areas. The conceptual layout design for SED 6 includes 29 staging areas covering 55 acres (assuming a size of approximately 1.7 acres per mechanical removal staging area and varying sizes for the hydraulic dredging staging areas based on available space and storage requirements), and approximately 21 miles of temporary roadways, which would amount to an additional approximately 51 acres (assuming a road width of 20 feet). Potential long-term impacts from these supporting facilities in SED 6 are similar to those for SED 3 and include habitat modification due to compaction/alteration of the soils, displacement of some species due to habitat fragmentation, and colonization by invasive species, as described in Section 4.3.5.3.

Adverse Impacts on Wetlands

The wetland environments that could be affected by SED 6 include: (a) riverine wetlands found along the periphery of removal areas in Reaches 5 and 6 and backwater areas; (b) riverine wetlands along the periphery of the bank stabilization areas in Reach 5; (c) riverine wetlands in the backwater areas and on the shores of the Reach 7 impoundments and Rising Pond where the thin-layer cap would be placed; and (d) floodplain wetlands impacted by access roads and other ancillary activities. Each of these is discussed below.

- Although riverine wetlands in Reaches 5 and 6 would be initially lost as a result of the removal and capping activities in those reaches, the bathymetry is not expected to change. Fine sediments transported from upstream would accumulate over time and these wetlands would naturally recolonize with wetland vegetation from upstream sources. However, as noted above, the length of time for such recovery in the more downstream areas is uncertain given the extent of upstream remediation.

- As discussed for SED 3, while bank stabilization activities in Reaches 5A and 5B may temporarily disturb riverine wetlands adjacent to the banks, the bank treatments are not expected to materially alter the bathymetry or substrate in the adjacent in-river areas, and thus would not be expected to have a long-term adverse impact on these riverine wetlands.

- The impacts from the placement of a thin-layer cap over riverine wetlands in the backwaters and on the shores of the Reach 7 impoundments and Rising Pond would be as discussed above (under thin-layer capping).

- As noted above, based on conceptual plans for placement of roadways and staging areas, it is expected that those ancillary construction activities would affect some wetlands. The long-term impacts on these wetlands would be mitigated by the wetlands restoration that would occur after the roadways and staging areas are removed. However, since some roadways would likely be retained for long periods (e.g., more than 2 to 3 years), the use of these roadways would likely result in compaction of the underlying substrate, which could alter the water storage capacity and hydrology of the wetlands over which these roadways were built.

Long-Term Impacts on Aesthetics

SED 6 would result in long-term impacts to the aesthetics of the natural environment over approximately 13 miles along the River. The most severe impacts would occur during the approximately 21-year implementation period and would affect 324 acres of River where remedial activities would be conducted. Following implementation, successional processes would begin to restore the vegetative community bordering the River. However, in bank areas where revetment mats or armor stone are used for bank stabilization, the natural appearance of the banks would remain diminished. In addition, in areas where vegetation would return, it would likely not mimic the pre-remediation state of the community along the River. Vegetative communities that exist along portions of the River at this time are mature systems, and it would take several decades for any planted trees to reach the size of those older trees.

The construction of an extensive network of roadways and staging areas on both sides of the River to support implementation of SED 6 also has the potential to cause long-term impacts on the aesthetics of the floodplain. As discussed for prior alternatives, the placement of roadways and staging areas would remove trees and vegetation, and hence these areas would not be natural in appearance. The length of time that the appearance of the floodplain in these in these areas would be changed depends on the length of time that the roads and staging areas remain, along with additional time for these areas to return to a natural appearance. As the length of time for SED 6 to be completed is longer than for the prior alternatives, the length of time that some of the roads would be in place would be longer. Moreover, since the trees in some of the affected upland forested areas are mature trees that are greater than 50 years in age, it would take a commensurate amount of time for those communities to develop an appearance comparable to their current appearance.

Impacts on Banks and Bedload Movement

The potential physical impacts of SED 6 on banks and bedload movement are largely the same as those described for SED 3 in Section 4.3.5.3. As discussed there, stabilization of the erodible banks in Reaches 5A and 5B to prevent future erosion could result in the need to stabilize other, currently non-erodible bank or nearby riverbed areas. In addition, the bank stabilization would reduce the current process by which eroding banks slump into the River and subsequently contribute to the overall bedload in Reaches 5A and 5B. Further, the armor stone placed as a cap component in Reaches 5A and 5B would initially impact bedload transport by capturing solids moving along the river bottom. However, once the armor stone is silted over, bedload movement should return to current conditions.

Potential Measures to Mitigate Long-Term Adverse Impacts

Measures to mitigate the potential long-term adverse impacts described above would include the restoration measures described in Section 4.5.1, which are similar to the measures summarized in Section 4.3.5.3 for SED 3. However, they would need to be applied on a broader scale for SED 6.

4.6.6 Attainment of IMPGs

As part of the evaluation of SED 6, average PCB concentrations in surface sediment and fish predicted by the model at the end of the 52-year projection period have been compared to applicable IMPGs. For these comparisons, model-predicted sediment and fish PCB concentrations were averaged in the manner discussed in Section 3.3. The sections below describe the human health and ecological receptor IMPG comparisons for SED 6, and those comparisons are illustrated in Tables 4-30 through 4-35.

As described below, PCB concentrations in some areas are sufficiently low that certain IMPGs would be achieved prior to any active remediation of sediments, while some other IMPGs would be achieved at some point within the 52-year model simulation period, and other IMPGs would not be met (if at all) for many years after the modeled period. The numbers of years needed to achieve each IMPG within a particular averaging area are presented in Tables 4-30 through 4-35.[75] In addition, figures in Appendix G show temporal profiles of model-simulated PCB concentrations for each of the IMPG comparisons described in this section (including the estimated time to achieve each IMPG). Where certain IMPGs would not be achieved by the end of the model projection period, the number of years to achieve those IMPGs has been estimated by extrapolating the model projection results beyond the 52-year simulation period, as directed by EPA, using the extrapolation method described in Section 3.2.1. As previously noted, such extrapolation produces estimates that are highly uncertain. Nonetheless, the extrapolated estimates of time to achieve the IMPGs that are not met within the 52-year model projection period are described below.

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[75] The extent to which SED 6 would accelerate attainment of the IMPGs relative to natural processes can be seen by comparing these tables to the comparable tables for SED 1 (see Section 4.1.6 above).

Also, as described in Section 3.2, bounding simulations have been conducted with the model to evaluate the significance of various assumptions regarding the East Branch PCB boundary condition and sediment residual values, as directed by EPA. In all cases but one, application of the "lower bound" assumptions in the model did not result in the attainment of additional IMPGs, beyond those attained using the "base case" assumptions, for the receptors/averaging areas described below. Therefore, the discussion below focuses on IMPG attainment resulting from the application of the "base case" model assumptions; however, the single instance of additional IMPG attainment resulting from application of the lower-bound assumptions is noted.

4.6.6.1 Comparison to Human Health-Based IMPGs

For human direct contact with sediments, the average predicted surface sediment (0- to 6-inch) concentrations would achieve all IMPGs in all eight sediment exposure areas, except for the most stringent RME IMPG based on a 10^{-6} cancer risk for adults in two areas in Reach 7 (Table 4-30). Many of these IMPGs are achieved prior to the start of the remediation, while the others would be achieved in time periods ranging from 2 to 20 years.

For human consumption of fish, the average fish PCB concentrations predicted by the model in Year 52, when converted to fillet-based concentrations, would not achieve the fish consumption IMPGs based on RME assumptions and either cancer risks or non-cancer impacts in Reaches 5 through 8 (except for the IMPGs based on a 10^{-4} cancer risk, but not the corresponding non-cancer IMPGs, in some subreaches) (Table 4-31).[76] However, in the Connecticut impoundments, the CT 1-D Analysis indicates that SED 6 would achieve the RME IMPGs associated with a cancer risk level of 10^{-5} as well as non-cancer impacts.

SED 6 would also achieve many of the CTE-based IMPGs in Reaches 5 through 8 (particularly under a probabilistic analysis and generally within 10 to 30 years), as well as all CTE IMPGs in Connecticut (Table 4-31).

Extrapolation of the model results beyond the model period indicates that achievement of the RME-based IMPGs that EPA considers protective for unrestricted fish consumption of 50 meals per year, based on a deterministic approach and a 10^{-5} cancer risk as well as non-cancer impacts, would take 140 to >250 years in the PSA and 230 to >250 years in Reaches 7 and 8.

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[76] Application of the lower-bound model assumptions results in the attainment of one additional IMPG (the probabilistic RME IMPG based on non-cancer impacts to adults) in Reach 6.

4.6.6.2 Comparison to Ecological IMPGs

For benthic invertebrates, predicted average sediment concentrations in the spatial bins within the PSA and in the simulated subreaches between Woods Pond Dam and Rising Pond Dam would achieve the lower-bound IMPG (3 mg/kg) in all areas except for one subreach in Reach 7, and would achieve the upper-bound IMPG (10 mg/kg) in all areas (Table 4-32). These levels would generally be achieved immediately following completion of remediation in the spatial bins in Reaches 5 and 6, and within that same timeframe in the portions of Reach 7 and 8 where the levels are not below the range at the beginning of the projection period.

For amphibians, predicted surface sediment PCB levels in the backwater areas at the end of the modeled period would achieve both the lower-bound IMPG (3.27 mg/kg) and the upper-bound IMPG (5.6 mg/kg) in all 85 acres of backwaters evaluated (Table 4-33). Times to achieve these IMPGs in the backwaters range from approximately 2 to 15 years, which correspond to the times in which remediation occurs within these areas.

For insectivorous birds (represented by wood duck) and piscivorous mammals (represented by mink), the model-predicted surface sediment concentrations were compared to selected target sediment levels of 1, 3, and 5 mg/kg, as discussed previously. For insectivorous birds, the predicted surface sediment concentrations are below all three target sediment levels in all averaging areas (Table 4-34). Likewise, for piscivorous mammals, the model-predicted surface sediment concentrations are below those target sediment levels in both averaging areas (Table 4-34). For both receptor groups, the times to achieve the various target levels are variable, and range from 1 to 20 years, with the time required to reach the 1 mg/kg level generally corresponding to the time when a majority of the sediments within a given averaging area have been remediated.

For fish (based on warmwater and coldwater fish protection), piscivorous birds (represented by osprey), and threatened and endangered species (represented by the bald eagle), the model-predicted average whole-body fish PCB concentrations would achieve the applicable receptor IMPGs in all reaches, with the exception of piscivorous birds in Reach 7B (Table 4-35). Estimated times to achieve these IMPGs in reaches where they are not already met prior to the start of the model projection range from approximately 3 to 20 years for fish and threatened and endangered species, and 10 to 35 years for piscivorous birds. In the one subreach where the IMPG for piscivorous birds is not attained within the 52-year projection period, the estimated time to achieve this IMPG, based on the extrapolation beyond the model period, is >250 years.

4.6.7 Reduction of Toxicity, Mobility, or Volume

The degree to which SED 6 would reduce the toxicity, mobility, or volume of PCBs is discussed below.

Reduction of Toxicity: SED 6 does not include any treatment processes that would reduce the toxicity of the PCBs in the sediment. However, if "principal threat" wastes (e.g., free NAPL, drums of liquid) should be encountered (which is not anticipated), they would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: SED 6 would reduce the mobility of PCBs in the River by removing approximately 521,000 cy of sediment containing PCBs in Reaches 5 and 6 and placing a cap over those areas, removing approximately 33,000 cy of PCB-containing erodible bank soils in Reach 5 and stabilizing these banks in Reach 5, and placing a cap over certain additional sediments in the Reach 5 backwaters, Woods Pond, and Rising Pond. In total, caps would be placed over approximately 223 acres (42 in Reach 5A, 27 in Reach 5B, 57 in Reach 5C, 15 in Reach 5 backwaters, 60 in Woods Pond, and 22 in Rising Pond). These caps would prevent or minimize the mobility of PCBs in the underlying sediments. In addition, a thin-layer cap would be placed over portions of the Reach 5 backwater areas (55 acres), Reach 7 impoundments (27 acres), and in Rising Pond (19 acres) – for a total of 101 acres – to accelerate the recovery of those areas.

Reduction of Volume: SED 6 would reduce the volume of sediment containing PCBs and the mass of PCBs present in the River through the removal of a total of 554,000 cy of sediments/bank soils containing approximately 22,400 lbs of PCBs over an area of approximately 178 acres. A summary of the volumes and PCB mass that would be removed under this alternative from each reach is presented below.

	Removal Volume (cy)	PCB Mass (lbs)
Reach 5A:	134,000	10,300
Reach 5B:	88,000	1,300
Reach 5C:	186,000	5,700
Reach 5 backwaters:	24,000	100[77]
Reach 6 (Woods Pond):	89,000	3,800
Reach 5A/5B Banks:	33,000	1,200
Totals:	**554,000**	**22,400**

4.6.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of SED 6 has included consideration of the short-term impacts of implementing this alternative on the environment, the local communities (as well as communities along transport routes), and the workers involved in the remedial activities. These impacts would last for the duration of the active remedial activities, which is estimated to be approximately 21 years – specifically, 8 years for Reach 5A, 5 years for Reach 5B, 4 years for Reach 5C, 2 years for Reach 5 backwaters (performed concurrently with Reach 5C), 2 years for Reach 6, 1 year for the Reach 7 impoundments, and 1 year for Reach 8. Since the extent and duration of remediation activities under SED 6 are greater than those under the alternatives discussed thus far, the short-term impacts would be more extensive and would last longer.

Impacts on the Environment

The short-term effects on the environment resulting from implementation of SED 6 would include potential impacts to the water column, air, and biota in the Rest of River area during excavation, capping, and thin-layer capping activities; alteration/destruction of benthic habitat in the areas subject to those activities; loss of riparian habitat as a part of bank stabilization activities; and loss of floodplain habitat and disruption to the biota which reside in the floodplain due to the construction of supporting facilities. Short-term impacts specifically associated with each remedial component are described below.

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[77] It is likely that a greater PCB mass would be removed from the Reach 5 backwaters than indicated above. As described in Section 3.1.1, the areas delineated for removal in the model (based on PCB concentration thresholds) are different from the data-based assessment used to estimate removal volumes for this alternative. For this reason, the model mass balance does not accurately reflect the magnitude of PCB mass removal from backwaters for this alternative.

Sediment Removal: Sediment removal in Reaches 5 and 6 (521,000 cy over 178 acres) would result in resuspension of PCB-containing sediment due to the invasive nature of removal operations. As discussed under SED 4 (Section 4.4.8), resuspension to the water column outside the work area would be controlled in Reaches 5A and 5B, as removal activities in those areas would be conducted using sheetpile enclosing the removal areas. However, the potential exists for sediment containing PCBs to be released from the work area both during sheetpile installation and during a high-flow event should overtopping of the sheeting occur. For Reach 5C, Reach 5 backwaters, and Woods Pond, activities would be conducted in the wet, with silt curtains used to mitigate sediment release to downstream reaches. In these cases, some sediment containing PCBs could be released from the work area through the dredging process even though the area would be surrounded by silt curtains. In addition, boat and barge traffic could resuspend sediment during the construction phase. Water column sampling would be performed during these removal activities to assess any potential water quality impacts.

The potential also exists during removal and related sediment processing activities for airborne releases that could impact downwind communities. Air monitoring would be conducted during these activities to assess any potential air quality impacts.

Implementation of SED 6 would cause a loss of aquatic habitat over approximately 178 acres of River in Reaches 5A, 5B, 5C, 5 backwaters, and 6 where sediment removal with capping would occur. Implementation of SED 6 would remove the natural bed material, debris, and aquatic vegetation which are used as habitat by both fish and benthic invertebrates. The sediment removal activities would also result in the direct loss of benthic invertebrates and other aquatic organisms (e.g., reptiles and amphibians) residing in the sediments during removal, and a temporary disruption and displacement of fish.

In addition, short-term increases in PCB concentrations in biota downstream of the removal work areas have been noted at other sites where dredging in the wet has occurred (e.g., Grasse River) and even where excavation has been conducted in the dry (e.g., Upper ½ Mile Reach), as described in Sections 4.3.8 and 4.4.8, and would be expected under SED 6.

Additionally, sediment removal activities would alter feeding areas for birds and mammals that live adjacent to the River and feed in areas subject to remediation.

Capping: Capping activities in the deeper portions of Woods Pond and Rising Pond would be performed during low flow periods with silt curtains in place. While resuspension is possible due to capping activities, the potential for resuspension of PCB-containing sediment is anticipated to be much lower than that due to removal activities, since capping would involve placing clean material on undisturbed native sediment, and silt curtains would be in place to mitigate transport of cap material and any resuspended sediments to downstream reaches.

Water column monitoring would be conducted during capping activities to assess any potential water quality impacts.

Placement of the caps as part of SED 6 would occur over 45 acres, and would have an immediate impact on the aquatic communities. Capping would alter the natural bed material and require removal of any significant debris or structures. The placement of the caps in these deep areas would result in the loss of the existing benthic invertebrates and benthic and fish habitat. These losses would be expected to be temporary as benthic invertebrates and aquatic vegetation would eventually recolonize the capping material. However, as discussed above, there is uncertainty regarding the length of time for such recovery to occur.

Thin-Layer Capping: Thin-layer capping activities in portions of the Reach 5 backwaters, Reach 7 impoundments, and Rising Pond would be performed by placement of a thin layer of sand over the undisturbed native sediment. Based on data collected during the Silver Lake capping pilot study, the potential for thin-layer capping to resuspend PCB-containing sediments is considered minimal. Water column monitoring would be conducted during thin-layer capping activities to assess any potential water quality impacts.

Placement of a thin-layer cap as part of SED 6 would occur over 101 acres of River, and could have a short-term impact on aquatic vegetation and benthic invertebrates in those areas. However, it is expected that the submerged aquatic vegetation and benthic communities would be re-established from upstream sources. It is likely that the benthic community would quickly recover, with the rate of recovery dependent on the rate of organic detritus accumulation across the thin-layer cap. Again, as noted in Section 4.6.5.3, in shallow water areas where the water depth is less than 6-12 inches and consolidation of the underlying sediment is not anticipated, placement of the thin-layer cap could increase the substrate elevation such that it would modify the vegetative characteristics of these riverine wetlands.

Bank Stabilization: Bank stabilization activities in Reach 5 would have an immediate effect on the riparian community bordering the River. These impacts would be the same as described for SED 3 in Section 4.3.8.

Supporting Facilities: Construction of supporting structures (e.g., roadways, staging areas, etc.) in the floodplain adjacent to the River would result in the temporary loss of habitat in those areas and would disturb the wildlife that it supports. It is anticipated that SED 6 would require a total of approximately 106 acres for access roads and staging areas (approximately 58 acres within the 10-year floodplain). The loss of this additional habitat would affect the ability of some wildlife to nest and feed in these areas. In some instances, it would also cause habitat fragmentation, which could further disrupt the movement and interactions of certain wildlife species.

Impacts on Local Communities and Communities Along Transport Routes

SED 6 would result in short-term impacts to the local communities in the Rest of River area. These short-term effects would include disruption along the River and within the floodplain due to the remediation and the construction of access roads and staging areas, as well as increased noise and truck traffic. Under SED 6, these impacts would affect portions of Reaches 5 and 6 for an estimated 19 years, with impacts to the Reach 7 impoundments and Rising Pond occurring over 2 years.

Recreational activities in the areas of Reaches 5 and 6 that would be affected by SED 6 include bank fishing, canoeing, hiking, dirt biking/ATVing, and waterfowl hunting. Recreational activities in Reaches 7 and 8 include fishing and canoeing. During the period of active construction, restrictions on such recreational uses of the River and floodplain would be imposed in the areas in which remediation-related activities are taking place. Due to safety considerations, boaters, hikers, anglers, hunters, and other recreational users would not be able to use the River or floodplain in the areas where such activities are being conducted. Further, bank stabilization activities in Reach 5 would remove the ability of recreational anglers and hikers to use those areas during construction. Aesthetically, the presence of the heavy construction equipment and cleared or disturbed areas would detract from the visually undisturbed nature of the area until the restoration plantings for the disturbed areas have matured.

Due to the need to deliver capping and thin-layer capping materials and equipment to the work areas and to remove excavated material, truck traffic in the area would increase substantially over current conditions. It is expected that this increased truck traffic would persist for the duration of the project (approximately 21 years). As an example, if 20-ton capacity trucks were used to transport sediments and bank soils from the staging areas, it would take approximately 41,600 truck trips to do so. In addition, assuming the use of smaller capacity trucks for local hauling (i.e., 16-ton trucks), approximately 70,900 truck trips would be required to transport sand, stone, and bank stabilization material to Reaches 5 through 8. This additional traffic would increase noise levels and potential for emissions of vehicle/equipment exhaust and nuisance dust to the air. Further, noise in and near the construction zone could affect those residents and businesses located near the work areas (i.e., between the Confluence and Woods Pond and, for a shorter time period, near Rising Pond).

The additional truck traffic would also increase the risk of traffic accidents along transport routes. Appendix D includes an analysis of potential risks from the increased truck traffic that would be necessary to transport clean materials to the site for implementation of SED 6.[78] This analysis indicates that the increased truck traffic associated with SED 6 would result in an estimated 2.02 non-fatal injuries due to accidents (with a probability of 87% of at least one such injury) and an estimated 0.09 fatalities from accidents (with a probability of 8% of at least one such fatality).

Engineering controls would be implemented, to the extent practical, to mitigate short-term impacts and risks associated with implementation of SED 6. However, some impacts would be inevitable.

Risks to Remediation Workers

There would be health and safety risks to site workers implementing SED 6. Implementation of SED 6 is estimated to involve 772,399 man-hours over a 21-year timeframe. The analysis in Appendix D of potential risks to workers from implementation of the sediment alternatives indicates that implementation of SED 6 would result in an estimated 7.48 non-fatal injuries to workers (with a probability of 100% of at least one such injury) and an estimated 0.08 worker fatalities (with a probability of 8% of at least one such fatality). Engineering controls and OSHA procedures designed to mitigate risks to remediation workers would be instituted.

4.6.9 Implementability

4.6.9.1 Technical Implementability

The technical implementability of SED 6 has been evaluated considering the factors identified below.

General Availability of Technologies: SED 6 would be implemented using well-established and available in-river remediation methods and equipment. Similarly, land-based support areas would be constructed using commonly available construction technologies. Further, well-established and readily available equipment would also be used to monitor the remedial alternative both during and following implementation.

Ability To Be Implemented: Based on site characteristics, the technologies and process options that are part of SED 6 would be suitable for implementation in the reaches where they would be applied. Sediment removal followed by capping is a functional remedy for use in the

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[78] The risks from truck traffic to transport excavated materials to the staging areas are evaluated as part of risks to workers, discussed below; and the risks from truck traffic to transport such materials from the staging areas away from the site are evaluated under the relevant treatment/disposition alternatives.

various types of environments where it would be applied in SED 6 (e.g., high energy river reaches, shallow areas with lower velocity, etc.). Sediment removal would be performed in the dry in Reaches 5A and 5B, and in the wet in Reach 5C, Reach 5 backwaters, and Woods Pond. Both techniques have been successfully demonstrated in other locations, as noted in Sections 4.4.5.2 and 4.6.5.2. Since the current river bathymetry would be maintained in those areas where sediment removal and subsequent capping are performed, there would be no net loss of flood storage capacity.

Capping without prior removal would be implemented in portions of Woods Pond and Rising Pond where the water is relatively deep, which are suitable conditions for such capping. Since the backwater effects in Woods Pond and Rising Pond are controlled by the dams, impacts to flood storage capacity would not be expected as a result of cap placement. Indeed**,** the model-predicted area of inundation within the floodplain of Reaches 5 and 6 during the 2-year flow event in Year 48 of the projection (as discussed in Section 4.3.9.1) was similar to that predicted under SED 1. This would be evaluated in more detail during design as necessary.

Thin-layer capping to enhance natural recovery processes would be implemented in lower velocity areas – i.e., portions of Reach 5 backwaters, Reach 7 impoundments, and the shallow portion of Rising Pond – which have suitable conditions for this technology. Similar to the capping described above, there would no impacts to flood storage capacity as a result of thin-layer capping in these areas, as these areas are controlled by backwater effects from the dams along the River.

Bank soil removal followed by stabilization would be performed in the erodible bank areas of Reach 5 (high energy areas), with the most appropriate removal/stabilization options selected in the design phase based on the physical features of the bank area in conjunction with the adjacent sediment and/or floodplain soil remedial activities. Since the slope of some of the restored erodible banks would likely be reduced during remediation, an increase in flood storage capacity would likely result in those areas of Reach 5.

MNR with institutional controls would be implemented in the downstream reaches, where PCB concentrations are already low and would likely decrease further following remediation in the upstream reaches. Monitoring to track changes in PCB concentrations following the SED 6 remedial activities would be performed using readily available methods and materials, such as have been used previously in the River. Similarly, the continued maintenance of biota consumption of advisories would be expected to use similar techniques to those used previously.

Support facilities in the floodplain area necessary for implementation of SED 6 could readily be constructed using commonly available construction techniques. Efforts would be made to construct the facilities to avoid wetlands to the extent practicable.

Reliability: The technologies that comprise SED 6 are reliable, as shown through implementation at other sites and in portions of the Housatonic River upstream of the Confluence. The use of these technologies at other sites was described in Sections 4.3.5.2, 4.4.5.2, 4.5.5.2, and 4.6.5.2.

Availability of Space for Support Facilities: Implementation of SED 6 would require construction of access roads and staging areas at various locations within the floodplain. As noted above, an estimated 106 acres of space would be needed, and appear to be available to support the SED 6 activities based on preparation of a conceptual site layout. Development of access roads and staging areas would be sequenced over the approximate 21-year implementation period.

Availability of Cap Materials: Materials required for cap and thin-layer cap placement must be of suitable quality for in-river placement and habitat restoration. Approximately 710,000 cy of capping material would be required for thin-layer capping and capping activities (i.e., 425,000 cy of sand and 285,000 cy of armor stone and rip-rap). Locating suitable sources for such a volume of materials may be a challenge. For purposes of this CMS Report, adequate material sources are assumed to be available, although their proximity to the site is uncertain and obtaining needed quantities might require long travel distances. An evaluation would be required during design activities to determine material availability.

Ease of Conducting Additional Corrective Measures: Future corrective measures, if needed to perform cap or bank maintenance or conduct additional remediation, would be implementable, given the same technical and logistical constraints applicable to the initial implementation of SED 6. Ease of implementation would be directly related to the extent of the additional corrective measure (i.e., area and/or volume to be addressed) and the ease of access (i.e., location of target area and proximity of access areas).

Ability to Monitor Effectiveness: The effectiveness of SED 6 would be determined over time through long-term monitoring to document reductions in PCB concentrations in water column, sediment, and fish tissue in various reaches of the River. Periodic monitoring (i.e., visual observation and sampling) of the capped sediments and restored riverbanks would allow for an evaluation of cap integrity and effectiveness, as well as bank stability. Such activities have been successfully performed on the upper portion of the Housatonic River and at other sites previously. Equipment and methods for this type of monitoring are readily available.

4.6.9.2 Administrative Implementability

The administrative implementability of SED 6 has been evaluated in consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: Implementation of SED 6 would need to comply with the substantive requirements of applicable and appropriate regulations pertaining to the performance of the remedial action (unless waived). As noted in Section 4.6.4, GE believes that SED 6 could be designed and implemented to meet such requirements (i.e., location-specific and action-specific ARARs listed in Tables 2-2 and 2-3), with the exception of certain requirements that could potentially apply to the on-site staging areas if the excavated sediments should constitute hazardous waste, and which GE believes should be waived, if necessary, as technically impracticable.

Access Agreements: Implementation of SED 6 would require GE to obtain access permission from the owners of properties that include riverbank or floodplain areas where remedial work or ancillary facilities would be necessary to carry out the alternative. Although the majority of the area in Reach 5 is publicly owned, it is anticipated that access agreements may be required from up to approximately 40 private landowners to implement SED 6. Obtaining such access agreements could be problematic in some cases. If GE should be unable to obtain access agreements with particular property owners, GE would request EPA and/or MDEP to provide assistance.

Coordination with Agencies: Implementation of biota consumption advisories would require coordination with state public health departments and/or other appropriate agencies in the dissemination of information to the public and surrounding communities regarding those advisories. In addition, obtaining access to State-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of SED 6, GE would need to coordinate with EPA, as well as state and local agencies, to address any potential health and safety concerns and to provide as-needed support with public/community outreach programs.

4.6.10 Cost

The total estimated cost of implementing SED 6 is $312 M (not including treatment/disposition costs). The estimated total capital cost is $297 M, assumed to occur over a 21-year construction period. Estimated annual OMM costs include costs for a 5-year inspection and maintenance program for the restored riverbed and riverbanks, thin-layer cap areas, and restored staging areas and access roads; these costs range from $25,000 to $275,000 per year (depending on which reach is being monitored), resulting in a total cost of $3.6 M. The estimated annual OMM costs for SED 6 also include implementation of a long-term water, sediment, and fish monitoring program for a period of 30 years following completion of construction activities on a reach-specific basis. The estimated costs for this long-term program range from approximately $275,000 to $625,000 per year (depending on the extent of monitoring occurring within a given year), resulting in a total cost of $11.0 M. The following summarizes the total capital and OMM costs estimated for SED 6.

SED 6	**Est. Cost**	**Description**
Total Capital Cost	$297 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM Cost	$14.6 M	Costs for performance of the OMM programs
Total Cost for Alternative	$312 M	Total cost of SED 6 in 2008 dollars

The total estimated present worth cost of SED 6, which was developed using a discount factor of 7%, a 21-year construction period, and an OMM period of 30 years on a reach-specific basis, is approximately $168 M. More detailed cost estimate information and assumptions for each of the sediment alternatives are included in Appendix E**.**

These costs do not include the costs of treatment/disposition of removed sediments/bank soils. The estimated costs for combinations of sediment remediation and treatment/disposition alternatives are presented in Section 8.

4.6.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 4.6.2, the evaluation of whether SED 6 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As discussed previously, SED 6 would result in a substantial reduction in the potential for exposure of human and ecological receptors to PCBs in sediments, surface water, and fish by: (a) permanently removing 521,000 cy of PCB-containing sediments in Reaches 5 and 6 and placing a cap over the underlying sediments; (b) removing 33,000 cy of erodible PCB-containing riverbank soils from Reach 5 and stabilizing those erodible banks; (c) placing a cap over 45 acres in the deeper portions of Reaches 6 and 8 where no excavation would be performed; (d) placing a thin-layer cap over 101 acres in the Reach 5 backwaters, Reach 7 impoundments, and the shallow portion of Rising Pond to reduce exposure concentrations and accelerate the process of natural recovery; and (e) relying on natural recovery processes in other areas. As shown in Section

4.6.3, implementation of SED 6 is predicted to reduce the PCB load in the River passing Woods Pond Dam and Rising Pond Dam by 97% and 95%, respectively (similar to SED 5), over the course of the modeled period, and to reduce the annual PCB mass transported from the River to the floodplain in Reaches 5 and 6 by 98% over that period.

Further, as shown in Section 4.6.5.1, EPA's model predicts that implementation of SED 6, like the previously discussed alternatives that involve removal and/or capping, would result in a substantial permanent reduction in sediment and fish PCB concentrations. For example, the model predicts that the fish PCB concentrations (whole body) would be reduced over the modeled period from 70-110 mg/kg to approximately 1-2 mg/kg in Reaches 5 and 6, from 30-50 mg/kg to approximately 2-6 mg/kg in the Reach 7 impoundments, from 30 mg/kg to approximately 1 mg/kg in Rising Pond, and from 1-2 mg/kg to 0.03-0.05 mg/kg in the Connecticut impoundments.

Compliance with ARARs: As explained in Section 4.4.4, the model predictions of water column PCB concentrations indicate that SED 6 would achieve the chemical-specific ARARs, except for the water quality criterion of 0.000064 µg/L based on human consumption of water and organisms, which GE believes should be waived as technically impracticable. Further, GE believes that SED 6 could be designed and implemented to meet the pertinent location-specific and action-specific ARARs, with the possible exception of certain requirements that could potentially apply to the on-site staging areas if the excavated sediments should constitute hazardous waste, and which GE believes should be waived, if necessary, as technically impracticable.

Human Health Protection: As discussed in Section 4.6.6.1, SED 6 would provide protection of human health from direct contact with sediments, since it would achieve IMPG levels based on a 10^{-5} cancer risk or lower, as well as all non-cancer IMPGs, in all sediment exposure areas, with the majority of those levels achieved at the present time. For human consumption of fish, the fish PCB concentrations predicted to result from SED 6 in Reaches 5 through 8 at the end of the 52-year simulation period, when converted to fillet-based concentrations, would not achieve the RME-based IMPGs within EPA's cancer risk range or based on non-cancer impacts, i.e., the levels that EPA considers to be protective for unrestricted consumption of Housatonic River fish (except for the RME 10^{-4} cancer IMPG, but not the non-cancer IMPGs, in a few areas). Extrapolation of model results beyond the simulation period indicates that PCB concentrations in fish fillets would reach the RME IMPG levels based on a 10^{-5} cancer risk and non-cancer impacts in approximately 140 to >250 years in the PSA and 230 to >250 years in Reaches 7 and 8. In the Connecticut impoundments, the CT 1-D Analysis indicates that SED 6 would achieve the RME fish consumption IMPGs based on a 10^{-5} cancer risk and non-cancer impacts in all impoundments within the modeled period. Where the levels for unrestricted fish consumption are not achieved, institutional controls – specifically, fish consumption advisories – would continue to be utilized to provide human health protection from fish consumption.

Environmental Protection: As discussed in Section 4.6.6.2, the model results indicate that, by the end of the modeled period, SED 6 would achieve the IMPG levels for nearly all ecological receptor groups and areas. For benthic invertebrates, SED 6 would result in sediment PCB concentrations within or below the IMPG range (3-10 mg/kg) in all averaging areas. For amphibians, SED 6 would result in sediment PCB concentrations below both the lower and upper bounds of the IMPG range (3.27 mg/kg to 5.6 mg/kg) in all backwater areas. For warmwater and coldwater fish and threatened and endangered species, predicted whole body fish PCB concentrations would achieve the IMPGs (55, 14, and 30.4 mg/kg, respectively) in all reaches. For insectivorous birds and piscivorous mammals, predicted sediment PCB concentrations in the relevant averaging areas in Reaches 5 and 6 are below the target sediment levels of 1, 3, and 5 mg/kg in all averaging areas.[79] For piscivorous birds, the predicted whole body fish PCB concentrations would achieve the IMPG (3.2 mg/kg) in all reaches except Reach 7B.[80]

At the same time, implementation of SED 6 would cause considerable short-term impacts on the environment in the areas where work would be conducted (e.g., loss of aquatic habitat in areas of remediation in portions of Reaches 5, 6, 7, and 8, loss of riparian habitat in the bank stabilization areas, potential resuspension of PCB-containing sediments during removal, and loss of floodplain habitat in areas where supporting facilities are constructed), as discussed in Section 4.6.8. These impacts would be more widespread and would last longer than those from the alternatives discussed thus far.

Implementation of SED 6 could also have some long-term environmental impacts. For example, as discussed in Section 4.6.5.3, the extensive removal and capping activities in Reaches 5 and 6 could produce long-term adverse environmental impact as a result of the cumulative effects of 19 years of remedial construction activities over the length of Reaches 5 and 6. Additionally, long-term adverse impacts could result from the bank stabilization activities, the placement of a cap or thin-layer cap in shallow areas where consolidation of the sediment is not anticipated, and ancillary construction activities in the floodplain. These impacts would likely be more extensive than the impacts from the alternatives discussed thus far.

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[79] As discussed previously, attaining the target sediment levels for these receptor groups would allow achievement of the IMPGs provided that the average floodplain soil concentrations in the same averaging areas are below the associated target floodplain soil levels (see Section 6).

[80] Given these results, this one exceedance of the IMPG (which is only slightly above the IMPG level) would not be expected to have an adverse impact on the overall local population of these birds in the Rest of River area.

Despite these short- and long-term adverse environmental impacts, SED 6 would address the ecological risks that EPA concluded in the ERA were present in the Rest of River area. Thus, if one accepts EPA's conclusions in the ERA, SED 6 would meet the standard of providing environmental protection. However, in doing so, it would cause more environmental damage than necessary to provide such protection.

Summary: Based on the foregoing considerations, it is concluded that SED 6 would provide overall protection of human health and the environment, although at the cost of causing substantial environmental harm.

4.7 Evaluation of Sediment Alternative 7

4.7.1 Description of Alternative

SED 7 would include the removal of 793,000 cy of sediment and bank soils, placement of a cap or backfill (Reaches 5A and 5B) over a total of 260 acres of river bottom including all the removal areas and some non-removal areas, and placement of a thin-layer cap over 65 acres. Specifically, the components of SED 7 include the following:

- Reach 5A: Sediment removal (218,000 cy over 42 acres);
- Reach 5B: Sediment removal (109,000 cy over 27 acres);
- Reach 5C: Sediment removal (186,000 cy over 57 acres);
- Reach 5 erodible banks: Removal and stabilization (33,000 cy);
- Reach 5 backwaters: Combination of removal in areas with surface PCB concentrations greater than 10 mg/kg (51,000 cy over 32 acres) and thin-layer capping in areas with surface PCB concentrations between 1 and 10 mg/kg (39 acres);
- Reach 6 (Woods Pond): Combination of removal (148,000 cy over 37 acres) and capping without sediment removal (23 acres);
- Reach 7 impoundments: Combination of removal in areas with surface PCB concentrations greater than 3 mg/kg (33,000 cy over 14 acres) and thin-layer capping in the remaining areas (13 acres);
- Reach 8 (Rising Pond): Combination of removal in shallow areas with surface PCB concentrations greater than 3 mg/kg (15,000 cy over 6 acres), thin-layer capping in the

remaining shallow areas (13 acres), and capping in the deep area without sediment removal (22 acres); and

- Reaches 7 (channel), and 9 through 16: MNR.

Remediation would proceed from upstream to downstream to minimize the potential for recontamination of remediated areas. Figures 4-10a-b identify the remedial action(s) that would be taken in each reach as part of SED 7. Note that either capping or backfilling would be conducted following removal in the Reach 5 backwaters, Reach 7 impoundments, and Rising Pond considering the PCB concentrations remaining following removal; this decision would be determined during design. However, for purposes of this CMS Report, it has been conservatively assumed that capping would be conducted for these three areas.

The following summarizes the general remedial approach (and associated assumptions) related to implementation of SED 7. It is estimated that SED 7 would require approximately 25 years to complete. It should be noted that while details on equipment and processes are provided in this description for purposes of the evaluations in this CMS Report, the specific methods for implementation of any selected remedy would be determined during design based on engineering considerations and site conditions.

Site Preparation: Prior to implementation of remedial activities, access roads and staging areas would be constructed to support implementation of this alternative. Grubbing and clearing of vegetation would likely also be necessary, and appropriate erosion and sedimentation controls would be put in place prior to construction. The conceptual plans developed for this CMS Report indicate that 29 staging areas and approximately 21 miles of access roads would be constructed between the Confluence and Rising Pond to support implementation of SED 7.

Sediment Removal: Sediment removal would be performed throughout the reaches of the River as presented below.

	Average Removal Depth (feet)	**Removal Volume (cy)**	**Acreage**
Reach 5A:	3-3.5	218,000	42
Reach 5B:	2.5	109,000	27
Reach 5C:	2	186,000	57
Reach 5 backwaters:	1	51,000	32
Reach 6 (Woods Pond):	2.5	148,000	37
Reach 7 impoundments:	1.5	33,000	14

	Average Removal Depth (feet)	Removal Volume (cy)	Acreage
Reach 8 (Rising Pond):	1.5	15,000	6
Totals:		**760,000**	**215**

The areas over which removal would be conducted for the reaches listed above are shown on Figures 4-10a-b.

It is assumed that the excavations in Reaches 5A and 5B would be performed in the dry with conventional mechanical excavation equipment. Removal to the depths identified above for these reaches would address the majority of PCB-containing materials within these removal areas. Sheetpiled cells would be established in the River to facilitate removal activities and limit downstream transport of sediment. It is assumed that the removal in Reaches 5C, 5 backwaters, 6, and 8 would be performed using hydraulic dredging, and that removal in the Reach 7 impoundments would be excavated in the wet using barge-mounted mechanical clamshell excavators. In these areas, debris removal would be conducted prior to dredging, and silt curtains would be placed downstream of excavation activities to limit transport of suspended sediment. A water treatment system would be used to treat water pumped from the excavation areas. Periodic water column and air monitoring would be performed during all removal operations to monitor potential releases.

Cap/Backfill Placement: Backfill would be placed following excavation in Reaches 5A and 5B, given that the removal activities to the depths specified above would remove the great majority of the PCB-containing sediments in these reaches. Caps would be installed following excavation in Reach 5C and in certain areas in Reach 5 backwaters, Woods Pond, Reach 7 impoundments, and Rising Pond (see Figures 4-10a-b). Caps would also be installed in the deeper portions of Woods Pond and Rising Pond without prior sediment excavation. Removal of significant debris would be conducted prior to cap material placement. Backfill and cap material would be placed in the dry in areas where dry excavation was performed and through the water column in the remaining areas. Backfill and cap materials would be transferred to the River using conventional earth-moving equipment.

It is assumed for purposes of this CMS that, in Reaches 5A and 5B, backfill would include placement of sand and gravel similar to material already there, such that the riverbed would be filled back to the pre-removal elevation. For purposes of the CMS, it is assumed that the caps to be placed following removal in Reach 5C, Woods Pond, the Reach 7 impoundments and Rising Pond would consist of a minimum of 12 inches of sand (which may be amended by organic material to increase the TOC content), overlain by an armor stone layer of 6 to 12 inches, to bring the riverbed to the pre-removal elevation. In the backwaters, the cap would consist of a 12-inch stable sand layer (which may include some stone mixed in and may be amended by organic material), but no additional armor stone layer. In the deeper portions of Woods Pond and Rising Pond where caps would be installed without prior sediment excavation, the cap would consist of 12 inches of sand and 6 inches of armor stone. The composition and size of the sand and armor stone (when applied) would be selected during design to limit the potential for migration of PCBs from the underlying sediments through the cap (sand material) and, where armor stone is applied, to preclude the movement of cap materials during high flow events. Silt curtains would be used during capping and backfilling in the wet to mitigate any solids release from the work area, and water column monitoring would be performed to monitor potential releases.

Thin-Layer Cap Placement: A thin-layer cap would be installed in Reach 5 backwaters where PCB concentrations exceed 1 mg/kg (39 acres), portions of the Reach 7 impoundments (13 acres), and the shallow portion of Rising Pond (13 acres), as shown on Figures 4-10a-b. The thin-layer cap would consist of an assumed 6-inch layer of sand. The thin-layer cap would be placed via a combination of techniques, including potentially mechanical and/or hydraulic means.

Sediment Dewatering and Handling: Sediment dewatering operations would be performed as necessary in the staging areas. For purposes of this CMS Report, it has been assumed that a combination of dewatering alternatives would be used, including gravity dewatering via stockpiling for materials removed in the dry and mechanical dewatering using a plate and frame filter press for materials removed in the wet. The addition of stabilization agents (e.g., other dry sediments, excavated soils, Portland cement) may be necessary prior to treatment and/or disposal. Treatment/disposition alternatives have been evaluated separately and are discussed in Section 7. A water treatment system would be used to treat water pumped from the excavation areas, as well as any decant water collected from excavated materials in the staging areas.

Bank Removal/Stabilization: SED 7 would include the removal of 33,000 cy of soil from the erodible banks in Reach 5 followed by stabilization. Bank stabilization is assumed to be limited to Reaches 5A and 5B, and to consist of the same techniques used in SED 3 through SED 6 – i.e., bank excavation to promote stable slopes (assumed to be 1½:1 to 3:1 slopes), followed by stabilization with revetment mats, armor stone, or bioengineering techniques (with an assumed distribution of 20%, 60%, and 20%, respectively, for each stabilization technique).

MNR: MNR would be implemented in the remainder of the Rest of River under SED 7 (i.e., Reach 7 channel and Reaches 9 through 16). As previously discussed, natural recovery processes have been documented in portions of the Housatonic River and would be expected to continue at varying rates in the areas where MNR would be implemented under SED 7, due in part to completed and planned remediation conducted upstream of the Rest of River, as well as the remediation that would be conducted as part of this alternative.

Restoration: SED 7 would include restoration of areas that are directly impacted by the removal and/or capping activities, the bank stabilization activities, and the ancillary construction activities, as appropriate to restore the habitat value of the affected resources, to the extent practical. Restoration would be accomplished using a combination of passive procedures (practices to facilitate natural reestablishment of the resource) and active procedures (plantings or other mitigation). For purposes of this CMS Report, the extent and type of restoration activities assumed for SED 7 are as follows:

- In those areas of Reach 5 (including backwaters), Woods Pond, Reach 7 impoundments, and Rising Pond where removal would be conducted, the river bottom would be restored to existing bathymetry with the placement of a cap. In those areas, it is anticipated, based on experience at other sites such as the Upper ½-Mile Reach and St. Louis River/Duluth Tar Site (MN) (Rogers and Costello, 2007), that the armor stone, as well as any deposited sediment would be readily recolonized by benthic invertebrates. It is also anticipated that aquatic vegetation would readily re-establish itself through transport from upstream sources of plants in the water column.

- It is not anticipated that restoration would be required in the deep portions of Woods Pond and Rising Pond that would be capped, or in the portions of the backwaters, Reach 7 impoundments, and Rising Pond that would be subject to thin-layer capping. In these areas, the capping substrate would serve as a ready base for recolonization by benthic invertebrates. In areas within the limits of light penetration, the capping substrate will serve as a suitable medium for the recolonization by submerged aquatic plants from upstream sources.

- On riverbanks where revetment mats or armor stone are used for stabilization, supplemental habitat structures such as trees, log and root wad revetments, and/or log and brush shelters would be considered as part of the restoration to replace similar existing structures. On banks where bioengineering techniques are used, plantings would be used to restore an appropriate riparian community.

- In the areas adjacent to the River where access roads and staging areas have been constructed to support work in the River, those support facilities would be removed and the disturbed areas revegetated with plantings that, over time, would restore the current habitat value of those areas.

Restoration activities would be conducted following completion of the remedial action within successive reaches of the River. In certain circumstances, restoration of impacted natural communities affected by ancillary construction activities, such as roadway construction, could be delayed until the remedial action over a broader area is completed.

Institutional Controls: SED 7 would include the continued maintenance of biota consumption advisories, as appropriate, to limit the public's consumption of fish and other biota from the River.

Long-Term OMM: Once implemented, it is assumed that SED 7 would include, for each reach involved, a 5-year post-construction monitoring and maintenance program and a long-term (30-year) monitoring program.

The post-construction monitoring program assumed for SED 7 would include annual monitoring of the same components outlined in Section 4.3.1. The SED 7 monitoring program is assumed to include visual observation supplemented with probing in areas where armor stone would be placed, collection of approximately 25 cores for visual observation in stable sand/thin-layer cap areas, visual observations of the backfilled riverbed and Reach 5 riverbanks, and visual observation and quantitative/qualitative assessment of restored staging areas and access roads. These activities would occur annually for a period of 5 years following remedy implementation in a given reach.

In addition, it is assumed that the long-term monitoring program would include analytical sampling of fish and the water column consistent with the program outlined for SED 2 (Section 4.2.1). It is also assumed to include a sediment sampling program, which would include the collection and PCB analysis every 5 years of 50 surface sediment samples from the MNR areas, approximately 37 cores (111 samples) from the removal areas, approximately 11 cores (33 samples) from the cap-only areas, and approximately 16 cores (16 samples) from the thin-layer cap areas. Sampling is assumed for a period of 30 years. In addition, a maintenance program would be implemented, as necessary.

4.7.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 4.1.2, the evaluation of whether a sediment remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether SED 7 would be protective of human health and the environment is presented at the end of Section 4.7 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

4.7.3 Control of Sources of Releases

SED 7 would reduce the potential for future PCB releases from certain sediments and riverbanks that may occur via erosion and flood events. This alternative would address PCB sources over approximately 325 acres of riverbed and the erodible portions of approximately 7 miles of riverbank, and would include the removal of 793,000 cy of sediment and bank soils containing PCBs.

Implementing these actions would significantly reduce the source of PCBs currently available for potential transport within the River and onto the floodplain for human or ecological exposure. Specifically, SED 7 would result in removal of 2 to 3.5 feet of sediments throughout all of Reach 5 and the shallow portion of Woods Pond, removal of sediments with PCB concentrations greater than 10 mg/kg in the top foot in the backwaters, and removal of sediments with PCB concentrations greater than 3 mg/kg in the top 1.5 feet in the Reach 7 impoundments and shallow portion of Rising Pond. Residual PCBs remaining in these areas would be contained either by a cap designed to withstand erosion during high flows or by backfill in areas where the great majority of PCB-containing sediments would be removed. The erodible banks of Reach 5 that currently provide a source of PCBs to the River during high-flow events would be addressed through a combination of removal and bank stabilization techniques. In deeper portions of Woods Pond and Rising Pond, a cap would be placed over the existing river bottom to isolate the underlying PCB-containing sediment from the water column. In addition, in portions of the Reach 5 backwaters, Reach 7 impoundments, and Rising Pond, where sediment PCB concentrations are lower, a thin-layer cap would be placed over the existing River bottom to accelerate the reduction in PCB concentrations in surface sediments due to the natural recovery process and assist in controlling releases from those areas.

It should also be noted that, in conjunction with the remediation and natural recovery processes within the Rest of River, the remaining remediation activities to be conducted upstream of the Confluence (i.e., in areas adjacent to the East Branch and in the West Branch) would reduce the PCBs available for scour/transport within the Rest of River. Additionally, the existing dams along the River would continue to limit movement of PCB-containing sediments within the impoundments behind the dams, further reducing the potential for transport of those sediments to the River. While failure of those dams could lead to the release of PCB-containing sediments impounded behind them, the inspection, monitoring, and maintenance programs in place under other authorities, as described in Section 4.1.3, would prevent or minimize the possibility of dam failure. Moreover, under SED 7, Woods Pond and Rising Pond would be subject to a combination of removal and capping, which would mitigate the potential for release of PCBs even in the event of dam failure.

As indicated by EPA's model, implementation of SED 7, in combination with upstream source control, would reduce the mass of PCBs transported within the River to downstream reaches and to the floodplain. For example, the annual PCB load passing Woods Pond Dam at the end of the model projection is predicted to decrease by 97% from that calculated at the beginning of the model projection period (i.e., from 20 kg/yr to 0.6 kg/yr). Similarly, SED 7 is predicted to achieve a 95% reduction in the PCB load passing Rising Pond Dam over the same period (i.e., from 19 kg/yr to 0.9 kg/yr). Likewise, SED 7 is predicted to result in a 98% reduction in the annual average mass of PCBs transported from the River to the floodplain within Reaches 5 and 6 over the modeled period (i.e., from 12 kg/yr to 0.2 kg/yr).

The effects of an extreme flow event were examined using the Year 26 flood. The impact of this flood on surface sediment PCB concentrations can be seen on Figure 4-11b, which shows temporal profiles of model-predicted reach-average PCB concentrations in surface sediments resulting from the implementation of SED 7 over the 55-year model projection period. Similar to the other alternatives, the model results for SED 7 indicate that, in reaches subject to MNR only (i.e., Reach 7 channel sections), the extreme event is not predicted to expose buried PCBs at concentrations exceeding those already exposed at the sediment surface. For the reaches that would be capped either following removal or without removal (i.e., Reach 5C, Woods Pond, and portions of the backwaters, Reach 7 impoundments, and Rising Pond), EPA's model predicts that, given the cap's armor layer, buried sediments would not be exposed during the extreme storm event.[81] As a result, no change in reach-average surface sediment PCB concentrations is predicted for these areas (e.g., Figure 4-11b). In Reaches 5A and 5B, where backfill would be placed following removal, the model results indicate that the backfill would be stable, with the exception of a small portion of Reach 5A (representing 2% of the area). Erosion of backfill in that portion of Reach 5A is predicted to produce an increase in the reach-average surface sediment concentration of 0.3 mg/kg (Figure 4-11b). In the portions of Reach 5 backwaters and Rising Pond undergoing thin-layer capping, the model predicts that the cap materials and underlying sediments would remain stable, as evidenced by the lack of a change in average surface sediment PCB concentrations in Reaches 5D and 8 (Figure 4-11b). In the small portions of Reach 7 impoundments receiving a thin-layer cap, the cap materials and underlying sediments would mostly remain stable during high flow events. The model results indicate that a limited number of grid cells in each of these reaches (1 to 6 cells, representing 7% to 46% of the thin-layer capped portions) would experience erosion large enough to produce increases in average surface sediment PCB concentrations (Figure 4-11b). However, these concentration increases are generally small (<0.1 to 0.9 mg/kg), and the concentrations following the

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[81] Further evaluation of the stability of cap, thin-layer cap, and backfill materials under SED 7 based on model predictions of erosion in these areas is provided in Section 4.7.5.2. The results of this stability analysis (i.e., percentages of backfill/cap/thin-layer cap areas that are stable) are cited in the remainder of this discussion.

erosion events are still 60% (Reach 7B) to 90% (Reach 7G) lower than current levels (Figure 4-11b). Overall, the model results indicate that, in most areas, buried sediments containing PCBs would not become exposed to a significant extent during an extreme flow event under SED 7.

4.7.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs, set forth in Table 2-1, include the federal and state water quality criteria for PCBs. These criteria consist of a freshwater chronic aquatic life criterion of 0.014 µg/L and a human health criterion (based on consumption of water and organisms) of 0.000064 µg/L (0.00017 µg/L under the Connecticut standards, although that may not be an ARAR since it is less stringent and less up-to-date than the federal criterion).

To evaluate whether SED 7 would achieve those criteria, GE reviewed the water column PCB concentrations predicted by the model for SED 7. The water column concentrations are presented in Table 4-36 (in Section 4.7.5.1 below). As shown in that table, annual average water column concentrations predicted by the model at the end of the simulation period are below the freshwater chronic aquatic life criterion of 0.014 µg/L (14 ng/L) in all reaches. However, model-predicted water column concentrations in Reaches 5 through 8 exceed the federal and Massachusetts human health consumption criterion of 0.000064 µg/L (0.064 ng/L) in all reaches. For the Connecticut impoundments, the water column concentrations estimated by the Connecticut 1-D Analysis (which range from 0.00005 to 0.0001 µg/L [0.05 to 0.1 ng/L]) exceed the federal criterion in two of the four impoundments, but are below the Connecticut consumption criterion of 0.00017 µg/L (0.17 ng/L) in all four impoundments, although these estimates are highly uncertain. As discussed previously, GE believes that the ARARs based on the human health consumption criteria should be waived on the ground that achievement of those ARARs is technically impracticable for the reasons given in Section 4.1.4.

The potential location-specific and action-specific ARARs are listed in Tables 2-2 and 2-3. Based on review of those ARARs, GE believes that SED 7 could be designed and implemented to achieve most of the ARARs that would be pertinent to this alternative, provided that any necessary EPA approval determinations are obtained, for the same reasons discussed in Section 4.3.4. However, as also discussed in that section, in the event that the excavated sediments should be found to constitute hazardous waste under RCRA or comparable state criteria (which is not anticipated), the temporary staging areas for the dewatering and handling of those sediments might not meet certain hazardous waste storage requirements, if they were determined to apply. In that case, as further discussed in Section 4.3.4, GE believes that such requirements should be considered inapplicable or, if necessary, waived as technically impracticable.

4.7.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for SED 7 has included evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment, as described below.

4.7.5.1 Magnitude of Residual Risk

The assessment of the magnitude of residual risk associated with implementation of SED 7 has included consideration of the extent to which and timing over which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure such as engineering and institutional controls.

Implementation of SED 7, along with upstream source control/remediation measures and natural recovery processes, would substantially reduce the potential exposure of humans and ecological receptors to PCBs in sediments, surface water, and fish in the Rest of River area. The sediment removal and/or capping activities throughout Reach 5 and in Woods Pond and Rising Pond would result in a significant reduction in the potential for exposure to PCBs in these areas. The placement of a thin-layer cap in certain Reach 5 backwaters, Reach 7 impoundments, and shallow areas of Rising Pond would reduce the surface sediment PCB concentrations in these areas, thereby reducing potential human contact and ecological exposures and risks. The following table shows, by reach, the average PCB concentrations predicted by EPA’s model to be present at the end of the model simulation period (Year 55) in the surface sediments, surface water, and fish (including both whole body and fillet-based concentrations).

Table 4-36 – Modeled PCB Concentrations at End of 55-Year Projection Period (SED 7)

Reach	Average Surface Sediment (0-6”) (mg/kg)	Average Surface Water (ng/L)	Average Fish (whole body) (mg/kg)	Average Fish (fillet) (mg/kg)[2]
5A	0.1	2.6	1.4	0.3
5B	0.06	1.8	1.2	0.2
5C	0.2	1.4	0.9	0.2
5D (backwaters)	0.2	---	1.9	0.4
6	0.2	1.3	1.0	0.2
7[1]	0.3 – 4.0	1.0 – 1.4	1.7 – 5.1	0.3 – 1.0
8	0.03	1.0	1.1	0.2
CT[1]	0.003 – 0.007	0.05 – 0.1	0.03 – 0.05	0.005 – 0.01

Notes:

1. Values shown as ranges in Reach 7 and CT represent the range of modeled PCB concentrations at the end of the projection within each of the Reach 7 subreaches, and the range of concentrations indicated by the CT 1-D Analysis for the four Connecticut impoundments.
2. Fish fillet concentrations were calculated by dividing the modeled whole-body fish PCB concentrations by a factor of 5, as directed by EPA.

The potential residual risks to human and ecological receptors from the concentrations shown in the above table have been evaluated in the context of the extent to which they would achieve the IMPGs, as discussed in Section 4.7.6.

Temporal profiles of reach-average PCB concentrations in surface sediments, annual average surface water, whole body fish, and fish fillets, resulting from the implementation of SED 7 over the 55-year model projection period are shown on Figures 4-11a-c. These figures show the timeframes over which SED 7 would be predicted to reduce the PCB concentrations in each respective medium. Similar to the other sediment alternatives, the sediment PCB concentration trajectories within remediated reaches (Reaches 5, 6, 7 impoundments, and 8) exhibit the general pattern of a large decline over the remediation period, followed by a period of smaller decline, or in some instances, a small increase until concentrations reach a steady-state with prevailing upstream loads and natural attenuation processes. However, due to an extended remediation period associated with the larger volume of sediments subject to remediation under SED 7, this period of decline is longer than that observed with SED 3 to SED 6. While the water column patterns exhibit significant year-to-year variability, including short-term increases in PCB concentration associated with increased PCB transport during the Year 26 extreme flow event and sediment resuspension during remediation, most water column temporal changes follow those of the sediments. Temporal patterns in fish PCB concentrations reflect the predicted changes in water column and sediments. As a result of the remediation under SED 7, predicted fish PCB concentrations are reduced over the projection period by 97% to 99% in the remediated reaches (i.e., Reaches 5, 6, 7 impoundments, and 8), by 91% in the channel sections of Reach 7, and by 97% in the Connecticut impoundments (Figure 4-11c).

PCBs would also remain in the sediments beneath and outside the area addressed by this alternative. However, in the capped areas, the caps would prevent direct contact with, and effectively reduce the mobility of, the PCB-containing sediments beneath the caps; in the backfilled areas the majority of the PCBs would be removed; and the thin-layer caps would provide a cover layer over the underlying PCB-containing sediments. Overall, the extent to which SED 7 would mitigate the effects of a flood event that could cause the PCB-containing sediments that have been contained by a cap or buried due to natural processes to become available for human and ecological exposure was discussed in Section 4.7.3. As discussed in that section, the model results indicate that in most areas, buried sediments containing PCBs would not become exposed to a significant extent during an extreme flow event under SED 7.

In addition, potential human exposure to PCBs in fish and other biota would be reduced during and after implementation of SED 7 through biota consumption advisories. Also, a long-term monitoring program would be implemented to assess the continued effectiveness of this remedial alternative to mitigate potential human and ecological exposures to PCBs.

4.7.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of SED 7 has included an assessment of the use of technologies under similar conditions and in combination, general reliability and effectiveness, reliability of OMM and availability of OMM labor and materials, and technical component replacement requirements, as discussed below.

Use of Technologies under Similar Conditions and in Combination

As discussed previously, a combination of remedial technologies is often necessary to mitigate potential exposure to constituents in sediments (e.g., EPA, 2005e; NRC, 2007). SED 7 involves such a combination. The SED 7 remedy components were selected for application in various reaches of the River based in part on the study and application of each technology under similar conditions at other sites. These components include sediment removal using dry excavation techniques (in Reaches 5A and 5B), sediment removal using hydraulic dredging techniques (in Reaches 5C, 5 backwaters, 6, and 8), sediment removal using mechanical dredging techniques (in the Reach 7 impoundments), bank removal and stabilization (for Reach 5 erodible banks), capping or backfilling all the removal areas and capping some non-removal areas (in the deeper parts of Woods Pond and Rising Pond), thin-layer capping (in portions of the Reach 5 backwaters, Reach 7 impoundments, and Reach 8), and MNR (in the remaining areas). These remedial techniques have been applied alone and in various combinations at a number of sites containing PCBs under similar conditions to those in various reaches of the River, as discussed under SED 6 in Section 4.6.5.2.

The additional component for SED 7 is placement of backfill following removal activities in Reaches 5A and 5B. Placement of backfill following removal has been part of the remedial efforts at Ruck Pond (WI; BBL, 1995) following mechanical removal in the dry, and at the Christina River (Newport, DE) and Bayou Bonfouca (LA) sites following mechanical dredging in the wet (to address metals and PAHs, respectively; Malcolm Pirnie, Inc. and TAMS Consultants, Inc., 2004). Note that backfill would be placed via the same methods and equipment used for capping.

General Reliability and Effectiveness

SED 7 utilizes technologies that have been shown to be reliable and effective in reducing exposure of humans and ecological receptors to PCBs in sediments. These technologies include sediment removal, capping, backfilling (after removal), thin-layer capping, and MNR. The general reliability and effectiveness of all these technologies, except backfilling, were previously discussed in Section 4.3.5.2. As noted in that section, under certain circumstances, dredging and excavation have been shown to be effective and reliable in reducing the long-term potential for exposure of human and ecological receptors to PCB-containing sediments, although there are some limitations associated with this technology (e.g., sediment resuspension, residual contamination) (EPA, 2005e). EPA (2005e) has acknowledged that placement of backfill material as needed or as appropriate can be a component of dredging and excavation, and is sometimes necessary to address residual contamination. As noted by EPA (2005e), capping is also a viable and effective approach for remediating impacted sediments. Regarding thin-layer capping, EPA (2005e) has acknowledged that placement of a thin layer "of clean sediment may accelerate natural recovery in some cases." Finally, while EPA has acknowledged the potential limitations of MNR, it has stated that MNR should "receive detailed consideration" where site conditions are conducive to such a remedy (EPA, 2005e). In addition, EPA has noted that many contaminants that remain in sediment are not easily transformed or destroyed, and that for this reason, "risk reduction due to natural burial through sedimentation is more common and can be an acceptable sediment management option" (EPA, 2005e).

To further assess the reliability and effectiveness of SED 7, model predictions of erosion in areas receiving a cap, backfill, or a thin-layer cap were evaluated to assess cap stability, using the same metrics described for this analysis in Section 4.3.5.2. The results of these stability assessments are as follows:

Caps: Under SED 7, the areas receiving a cap, either following sediment removal or without sediment removal, include Reach 5C, portions of backwaters in Reach 5, Woods Pond, portions of the Reach 7 impoundments, and portions of Rising Pond. Those caps would be designed to resist erosion by including an appropriately sized armor layer. The model inputs for areas receiving a cap were specified accordingly, as discussed in Section 3.2.4.5. Thus, the areas receiving a cap under SED 7 are predicted to be 100% stable.

Backfill: SED 7 includes removal with subsequent backfilling in Reaches 5A and 5B. For the purposes of assessing stability of backfill, which would be placed at a thickness of 2 feet or more following removal, the backfill was considered stable when at least 50% of the material remained for the full duration of the model projection (including the extreme flow event). The model predicts that backfill material following removal in SED 7 would largely remain stable, as it would be stable over 98% of the surface area in Reach 5A and 100% of the backfilled area in Reach 5B. The erosion over the remaining 2% of backfilled area within Reach 5A is predicted to occur in response to the Year 26 extreme event in an isolated area near the bend in the river at Holmes Road. Such erosion is predicted to result in small increases (less than 0.3 mg/kg) in the reach-average 0- to 6-inch surface sediment PCB concentration (Figure 4-11b).

Thin-Layer Caps: SED 7 includes placement of a thin-layer cap in portions of backwaters in Reach 5, and in portions of the Reach 7 impoundments and shallow areas of Rising Pond. As discussed in Section 4.3.5.2, the long-term effectiveness of the thin-layer cap was evaluated by considering it stable (and therefore reliable) when EPA's model predicts that at least 1 inch of material would remain for the full duration of the model projection (including the extreme flow event). For the Reach 5 backwaters, EPA's model predicts that the thin-layer cap would be stable over 98% of that area. A single model grid cell representing approximately 2% of the thin-layer capped area within the backwaters would experience erosion in response to a storm event simulated in Year 20. Such erosion, however, is predicted to produce no appreciable increase (less than 0.1 mg/kg) in the reach-average surface sediment PCB concentration in Reach 5D (Figure 4-11b). In the Reach 7 impoundments, the model predicts that approximately 54% to 93% of the thin-layer capped areas would be stable under SED 7. Erosion of the thin-layer cap material in the remaining areas, comprising 7% to 46% of the thin-layer capped portions of the impoundments, is limited to a few model grid cells in each impoundment (i.e., 6, 3, and 1 grid cells in Reaches 7B, 7E, and 7G, respectively).[82] That erosion is predicted to occur mainly during the extreme flow event simulated in Year 26, although such erosion is also predicted to occur during a

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[82] The location where the model predicts 46% erosion corresponds to the thin-layer cap portion of Reach 7B that only includes 13 total grid cells. However there are 29 other grid cells in this impoundment where the sediments would be removed under SED 7. Therefore, the impacts of this erosion on reach-average sediment concentrations are small.

high flow event simulated in Year 25 for Reach 7G. Such erosion is predicted to cause increases in the reach-average 0- to 6-inch surface sediment PCB concentrations in those impoundments ranging from 0.2 mg/kg in Reach 7E to approximately 0.9 mg/kg in Reach 7G (Figure 4-11b).[83] In shallow portions of Rising Pond, EPA's model predicts that 100% of the thin-layer capped area would remain stable. Even after the increases in concentration described above are taken into account, the concentrations following the high flow events still represent significant reductions relative to current levels for all reaches where SED 7 includes a thin-layer cap (99% or more in the Reach 5 backwaters and Rising Pond and 60% to 70% in the Reach 7 impoundments, as discussed in Section 4.7.3). Based on these results, the model indicates that the thin-layer caps under SED 7 would be an effective means of reducing surficial PCB concentrations, although under extreme flow events erosion of some portions of the thin-layer capped areas within the Reach 7 impoundments would occur.

Reliability of Operation, Monitoring, and Maintenance Requirements/Availability of Labor and Materials

A combination of reliable OMM techniques – including periodic analytical sampling of fish, water column, and sediment; monitoring of caps and restored banks via visual observation supplemented with sediment probing and/or coring; visual observation of the backfilled riverbed areas; and maintenance of the capped areas and riverbanks – would be implemented to maintain and track the long-term effectiveness of SED 7. Post-remediation sampling is commonly used to monitor the effectiveness of completed sediment removal and capping remedies. Visual observation of the sediment cap and restored banks is considered a reliable means of verifying that the capping components of the remedy have remained in place. Should changes in the capped riverbed or the riverbank be noted that require maintenance, labor and materials needed to perform repairs are expected to be readily available.

In addition, a monitoring and maintenance program would be implemented for actively restored areas to confirm planting survival and areal coverage and to determine whether habitat structures (if any) are intact. Such monitoring is considered a reliable means of tracking the progress of the restoration efforts. The necessary labor and equipment for such a program are expected to be readily available.

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[83] Additional increases in the Reach 7 impoundment surficial sediment PCB concentrations shown on Figure 4-11b result from deposition and subsequent mixing of PCB-containing sediment originating from areas upstream.

Technical Component Replacement Requirements

The technologies that comprise SED 7 were selected for application in areas of the River where site conditions are expected to support long-term reliability and effectiveness with minimal maintenance requirements. However, if erosion of cap and/or bank stabilization materials should occur, an assessment would be conducted to determine the need for and methods of repair. Depending on the timing and location of the repair, access roads and staging areas may need to be temporarily constructed in the nearby floodplain. Periodic small-scale repairs would likely pose minimal risks to humans and ecological receptors that use/inhabit the disturbed river bottom and nearby floodplain. While not anticipated, redesign/replacement of larger remedy components could require more extensive disturbance of the river bottom, banks, and/or the adjacent floodplains to support access.

4.7.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of SED 7 on human health or the environment has included identification and evaluation of potentially affected populations, adverse impacts on biota and their habitat, adverse impacts on wetlands, impacts on the aesthetics of the natural environment, impacts on banks and bedload movement, and potentially available measures that may be employed to mitigate these impacts.

Potentially Affected Populations

Since SED 7 would impact more areas and would take longer to implement than previously discussed alternatives, it would have more extensive impact in altering the habitat of the River as well as the adjacent floodplain areas, and overall recovery would take longer. These habitat alterations would affect people using these areas and the fish and wildlife in these areas, as discussed further below.

Adverse Impacts on Biota and Corresponding Habitat

The potential long-term impacts of SED 7 on biota and their habitat are discussed below in relation to the type of remediation involved. As previously noted, as the intrusive level of the remedial activities and the amount of area affected by the remedial action increase with each of the remedial alternatives, the spatial and temporal extent of short-term impacts would increase. At some point, the cumulative effect of the myriad of short-term impacts associated with the remedial action would in and of itself constitute a long-term impact due to the timeframe associated with the remedy.

Note also that, to the extent that affected areas constitute habitat for any rare, threatened, and/or endangered species, implementation of SED 7 could affect those species. In general, for the more mobile species and/or species with a wide range of habitat requirements, the activities would displace these species to other areas of the river system. However, as the duration and extent of the disturbance increase, it becomes more likely that the displacement would become permanent, as many protected species are very sensitive to habitat loss and disturbances. Moreover, for animal species with narrower habitat requirements and for any threatened or endangered plant species, any long-term alteration of the habitat (as discussed below) could have a long-term adverse impact on those species.

Sediment Removal with Backfilling/Capping in Reaches 5, 6, 7, and 8: SED 7 involves sediment removal with backfilling or capping throughout the Reach 5 channel and in portions of the Reach 5 backwaters, the Reach 7 impoundments, and Rising Pond. While it is uncertain whether these activities would have a long-term adverse impact on biota and their habitats in these areas, the potential for such impacts is greater than under the previously discussed alternatives. SED 7 involves more removal with backfilling or capping than previous alternatives and would take longer (approximately 25 years). These activities would disrupt local subpopulations of aquatic organisms (plants, fish, and benthic invertebrates) during the course of that 25-year implementation period. As discussed in Section 4.5.5.3, limited research has been conducted on the cumulative impacts to aquatic resources from multiple and disparate habitat perturbations such as those that would be caused by the extensive sediment removal and backfilling/capping in SED 7. While it is expected that the aquatic biota would be able to recover eventually due to the recolonization of downstream areas from upstream sources, the length of time for such recovery to occur when there are such extensive and prolonged remedial impacts throughout the river system is uncertain and could take decades.

With specific respect to the removal activities in the backwaters, similar long-term effects to those discussed for SED 6 in Section 4.6.5.3 could occur, although these could occur over a broader area, since SED 7 involves such activities in 32 acres of backwaters (versus 15 acres in SED 6). In addition, local subpopulations of less mobile organisms such as reptiles and amphibians could be permanently displaced from these areas due to the spatial extent (32 acres) and duration (over 2 years) of the backwater remediation.

Riverbank Stabilization: The bank removal/stabilization activities that are part of SED 7 may have some long-term adverse environmental impacts on riparian habitats in Reaches 5A and 5B, depending upon the stabilization technique used. Since these activities are the same as in SED 3, the discussion of potential long-term adverse environmental impacts of such activities under SED 3 (in Section 4.3.5.3) also applies to SED 7.

Thin-Layer Capping in Reach 5 Backwaters, Reach 7 Impoundments and Rising Pond (shallow): The placement of the thin-layer cap in portions of the Reach 5 backwaters, the Reach 7 impoundments, and Rising Pond could have some long-term effects. These would be the same as the effects discussed for thin-layer capping under previous alternatives. Specifically, in limited shallow water areas where the water less than 6-12 inches deep and consolidation of the underlying sediment is not anticipated, the thin-layer cap could increase the substrate elevation so as to would modify the vegetative characteristics of the riverine wetlands in these areas and the biota they support or, in limited cases where the cap thickness would exceed the water depth, cause the wetlands vegetation to be replaced by species more tolerant of riparian or terrestrial conditions. In other areas where the thin-layer cap would be placed, long-term adverse impacts are not expected. Although the thin-layer cap would cover the aquatic vegetation and benthic invertebrates, these communities would be re-established in time through recolonization from upstream areas. However, as discussed above, there is significant uncertainty as to how long it would take these areas to recover given the spatial extent and duration of SED 7.

Capping in Woods Pond (deep) and Rising Pond (deep): The placement of the cap in the deep portions of Woods Pond and Rising Pond is the same as under SED 6. As discussed under SED 6, this cap is not expected to have adverse long-term impacts. While the cap material may differ from the native sediments resulting in colonization by different benthic invertebrate communities than currently exist, this change would not necessarily be negative. However, as noted above, there is uncertainty as to how long it would take these areas to recover given the extent and length of remediation in areas upstream of these impoundments.

Supporting Facilities in Floodplain: Long-term impacts to biota and their habitats may also occur as a result of ancillary supporting activities in the floodplain, including the clearing and construction of access roads and sediment staging areas. The conceptual layout design for SED 7 includes approximately 29 staging areas covering 55 acres (at an assumed size of approximately 1.7 acres per mechanical removal staging area and varying sizes for the hydraulic dredging staging areas based on available space and storage requirements), and approximately 21 miles of temporary roadways, which would amount to an additional 51 acres (assuming a road width of 20 feet). The types of potential long-term impacts from these supporting facilities in SED 7 are qualitatively similar to those for SED 3, which include habitat modification due to compaction/alteration of the soils, species displacement due to habitat fragmentation, and colonization by invasive species, as described in Section 4.3.5.3. However, in SED 7, such effects could occur over a greater area.

Adverse Impacts on Wetlands

The wetland environments that could be affected by SED 7 include: (a) riverine wetlands found along the periphery of removal areas in Reaches 5, 6, 7, and 8; (b) riverine wetlands along the periphery of the bank stabilization areas in Reach 5; (c) riverine wetlands in the backwater areas and on the shores of the Reach 7 impoundments and Rising Pond where the thin-layer cap would be placed; and (d) floodplain wetlands impacted by access roads and other ancillary activities. Each of these is discussed below.

- Although riverine wetlands along the areas in Reaches 5, 6, 7, and 8 that would be subject to removal with capping or backfilling would be initially lost as a result of those activities, the bathymetry is not expected to change. Fine sediments transported from upstream would accumulate over time and these wetlands would naturally recolonize with wetland vegetation from upstream sources. The length of time for recolonization of backfill areas would likely be shorter than that for capped areas. In both cases, however, as noted above, the time for such recovery in the more downstream areas is uncertain and could be lengthy given the extent of upstream remediation.

- As discussed for SED 3, while bank stabilization activities in Reaches 5A and 5B may temporarily disturb riverine wetlands adjacent to the banks, the bank treatments are not expected to materially alter the bathymetry or substrate in the adjacent in-river areas, and thus would not be expected to have a long-term adverse impact on these riverine wetlands.

- The impacts from the placement of a thin-layer cap over riverine wetlands in the backwaters and on the shores of the Reach 7 impoundments and Rising Pond would be as discussed above.

- The potential impacts on wetlands in the floodplain due to ancillary construction activities are anticipated to be largely the same as for SED 6, as described in Section 4.6.5.3. Specifically, since it is likely that some roadways in wetland areas would be retained for long periods (e.g., more than 2 to 3 years), their use would likely result in compaction of the underlying substrate, which could alter the water storage capacity and hydrology of the wetlands.

Long-Term Impacts on Aesthetics

SED 7 would result in long-term impacts to the aesthetics of the natural environment over approximately 13 miles along the River. The most severe impacts would occur during the approximately 25-year implementation period and would affect 325 acres of River where sediment removal, capping, and thin-layer capping activities would be conducted. Following implementation, successional processes would begin to restore the vegetative community bordering the River. However, in bank areas where revetment mats or armor stone are used for bank stabilization, the natural appearance of the banks would remain diminished. In addition, in areas where vegetation would return, it would likely not mimic the pre-remediation state of the community along the River. Vegetative communities that exist along portions of the River at this time are mature systems, and it would take several decades for any planted trees to reach the size of those older trees.

The construction of an extensive network of roadways and staging areas on both sides of the River to support implementation of SED 7 also has the potential to cause long-term impacts on the aesthetics of the floodplain. As discussed for prior alternatives, the placement of roadways and staging areas would remove trees and vegetation, and hence these areas would not be natural in appearance. The length of time that the appearance of the floodplain in these in these areas would be changed depends on the length of time that the roads and staging areas remain, along with additional time for these areas to return to a natural appearance. As the length of time for SED 7 to be completed is longer than for the prior alternatives, the length of time that the roads would be in place would be longer. Moreover, since the trees in some of the affected upland forested areas are mature trees that are greater than 50 years in age, it would take a commensurate amount of time for those communities to develop an appearance comparable to their current appearance.

Impacts on Banks and Bedload Movement

The potential physical impacts of SED 7 on banks are largely the same as those described for SED 3 in Section 4.3.5.3. As discussed there, stabilization of the erodible banks in Reaches 5A and 5B to prevent future erosion could result in the need to stabilize other, currently non-erodible bank or nearby riverbed areas. In addition, the bank stabilization would reduce the current process by which eroding banks slump into the River and subsequently contribute to the overall bedload in Reaches 5A and 5B. However, it is not anticipated that the backfill that would be placed in Reaches 5A and 5B would result in any significant impacts to bedload transport, as the backfill materials would have generally similar physical characteristics to the existing sediments.

Potential Measures to Mitigate Long-Term Adverse Impacts

Measures to mitigate the potential long-term adverse impacts described above would include the restoration measures described in Section 4.5.1, which are similar to the measures summarized in Section 4.3.5.3 for SED 3. However, they would need to be applied on a much broader scale for SED 7.

4.7.6 Attainment of IMPGs

As part of the evaluation of SED 7, average PCB concentrations in surface sediment and fish predicted by EPA's model at the end of the 55-year projection period have been compared to applicable IMPGs. For these comparisons, model-predicted sediment and fish PCB concentrations were averaged in the manner discussed in Section 3.3. The sections below describe the human health and ecological receptor IMPG comparisons for SED 7, and those comparisons are illustrated in Tables 4-37 through 4-42.

As described below, PCB concentrations in some areas are sufficiently low that certain IMPGs would be achieved prior to any active remediation of sediments, while some other IMPGs would be achieved at some point within the 55-year model simulation period, and other IMPGs would not be met (if at all) for many years after the modeled period. The numbers of years needed to achieve the IMPGs are presented in Tables 4-37 through 4-42.[84] In addition, figures in Appendix G show temporal profiles of model-simulated PCB concentrations for each of the IMPG comparisons described in this section (including the estimated time to achieve each IMPG). Where certain IMPGs would not be achieved by the end of the model projection period, the number of years to achieve the IMPGs has been estimated by extrapolating the model projection results beyond the 55-year simulation period, as directed by EPA, using the extrapolation method described in Section 3.2.1. As previously noted, such extrapolation produces estimates that are highly uncertain. Nonetheless, the extrapolated estimates of time to achieve the IMPGs that are not met within the 55-year model projection period are described below.

Also, as described in Section 3.2, bounding simulations have been conducted with the model to evaluate the significance of various assumptions regarding the East Branch PCB boundary condition and sediment residual values, as directed by EPA. For SED 7, in almost all cases, application of the “lower bound” assumptions in the model did not result in the attainment of additional IMPGs, beyond those attained using the “base case” assumptions, for the receptors/averaging areas described below. Therefore, the discussion below focuses on IMPG attainment resulting from the application of the “base case” model assumptions; however, the few instances of additional IMPG attainment resulting from application of the lower-bound assumptions are noted.

4.7.6.1 Comparison to Human Health-Based IMPGs

For human direct contact with sediments, the average predicted surface sediment (0- to 6-inch) concentrations would achieve all IMPGs in all sediment exposure areas, except for the most stringent RME IMPG based on a 10^{-6} cancer risk for adults in one area (Table 4-37). Many of these IMPGs are achieved prior to the start of the remediation, while the others would be achieved in time periods ranging from approximately 5 to 25 years.

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[84] The extent to which SED 7 would accelerate attainment of the IMPGs relative to natural processes can be seen by comparing these tables to the comparable tables for SED 1 (see Section 4.1.6 above).

For human consumption of fish, the average fish PCB concentrations predicted by the model in Year 55, when converted to fillet-based concentrations, would not achieve the fish consumption IMPGs based on RME assumptions and either cancer risks or non-cancer impacts in Reaches 5 through 8 (except for the RME IMPGs based on a 10^{-4} cancer risk, but not the corresponding non-cancer IMPGs, in some subreaches) (Table 4-38).[85] However, in the Connecticut impoundments, the CT 1-D Analysis indicates that SED 7 would achieve the RME IMPGs associated with a cancer risk level of 10^{-5} as well as non-cancer impacts.[86]

SED 7 would also achieve many of the CTE-based IMPGs in many of the subreaches of Reaches 5 through 8, as well as all CTE IMPGs in Connecticut.[87]

Extrapolation of the model results beyond the model period indicates that achievement of the RME-based IMPGs that EPA considers protective for unrestricted fish consumption of 50 meals per year, based on a deterministic approach and a 10^{-5} cancer risk as well as non-cancer impacts, would take 130 to >250 years in the PSA, >250 years in Reach 7, and 240 years in Reach 8.

4.7.6.2 Comparison to Ecological IMPGs

For benthic invertebrates, predicted average sediment concentrations in the spatial bins within the PSA and in the simulated subreaches between Woods Pond Dam and Rising Pond Dam would achieve the lower-bound IMPG (3 mg/kg) in all areas except for one subreach in Reach 7 and would achieve the upper-bound IMPG (10 mg/kg) in all areas (Table 4-39). These levels would generally be achieved immediately following completion of remediation in the spatial bins in Reaches 5 and 6, and within that same timeframe in the portions of Reach 7 and 8 where the levels are not below the range at the beginning of the projection period.

For amphibians, predicted surface sediment PCB levels in the backwater areas at the end of the modeled period would achieve both the lower-bound IMPG (3.27 mg/kg) and the upper-bound IMPG (5.6 mg/kg) in all 85 acres of backwaters evaluated (Table 4-40). Times to achieve the lower-bound IMPGs generally range from 2 to 20 years, which correspond to the times in which remediation occurs within these areas.

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[85] Application of the lower-bound model assumptions results in the attainment of two additional RME IMPGs in the Massachusetts reaches (the probabilistic IMPG based on non-cancer impacts to adults in Reach 6 and the deterministic IMPG based on a 10^{-4} cancer risk in Reach 8).

[86] Application of the lower-bound model assumptions results in the attainment of one additional RME IMPG in the Connecticut impoundments (the probabilistic IMPG based on a 10^{-6} cancer risk in Lake Lillinonah).

[87] Application of the lower-bound model assumptions results in the attainment of one additional CTE IMPG (the deterministic IMPG based on non-cancer impacts to a child) in Reach 8.

For insectivorous birds (represented by wood duck) and piscivorous mammals (represented by mink), the model-predicted surface sediment concentrations were compared to selected target sediment levels of 1, 3, and 5 mg/kg, as discussed previously. For both receptor groups, the predicted surface sediment concentrations are below all three of the target sediment levels evaluated in all averaging areas (Table 4-41), with times to achieve these target levels generally ranging between 2 and 20 years; the time required to reach the 1 mg/kg level generally corresponds to the time when a majority of the sediments within a given averaging area have been remediated.

For fish (based on warmwater and coldwater fish protection), piscivorous birds (represented by osprey), and threatened and endangered species (represented by the bald eagle), the model-predicted average whole-body fish PCB concentrations would achieve the applicable receptor IMPGs in all reaches, with the exception of piscivorous birds in Reach 7B (Table 4-42). Estimated times to achieve these IMPGs range between 3 and 20 years for fish and threatened and endangered species, and 10 and 40 years for piscivorous birds. In the one subreach where the IMPG for piscivorous birds is not attained within the 55-year projection period, the estimated time to achieve this IMPG, based on the extrapolation beyond the model period, is approximately 150 years.

4.7.7 Reduction of Toxicity, Mobility, or Volume

The degree to which SED 7 would reduce the toxicity, mobility, or volume of PCBs is discussed below.

Reduction of Toxicity: SED 7 does not include any treatment processes that would reduce the toxicity of the PCBs in the sediment. However, if “principal threat” wastes (e.g., free NAPL, drums of liquid) should be encountered (which is not anticipated), they would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: SED 7 would reduce the mobility of PCBs in the River by removing approximately 760,000 cy of sediment containing PCBs in Reaches 5 through 8 and placing a cap (or backfill) over those areas, removing approximately 33,000 cy of PCB-containing erodible bank soils and stabilizing these banks in Reach 5, and placing a cap over certain additional sediments in Woods Pond and Rising Pond. In total, caps or backfill would be placed over approximately 260 acres (42 in Reach 5A, 27 in Reach 5B, 57 in Reach 5C, 32 in Reach 5 backwaters, 60 in Woods Pond, 14 in the Reach 7 impoundments, and 28 in Rising Pond). These caps and backfill would prevent or minimize the mobility of PCBs in the underlying sediments. In addition, a thin-layer cap would be placed over portions of the Reach 5 backwater areas (39 acres), Reach 7 impoundments (13 acres), and in Rising Pond (13 acres) – for a total of 65 acres – to accelerate the recovery of those areas.

Reduction of Volume: SED 7 would reduce the volume of sediment containing PCBs and the mass of PCBs present in the River through the removal of a total of 793,000 cy of sediments/bank soils containing approximately 31,500 lbs of PCBs over an area of approximately 215 acres. A summary of the volumes and PCB mass that would be removed under this alternative from each reach is presented below.

	Removal Volume (cy)	**PCB Mass (lbs)** [88]
Reach 5A:	218,000	14,400
Reach 5B:	109,000	1,700
Reach 5C:	186,000	5,600
Reach 5 backwaters:	51,000	2,900
Reach 6 (Woods Pond):	148,000	5,200
Reach 7 impoundments:	33,000	250
Reach 8 (Rising Pond):	15,000	270
Reach 5A/5B Banks:	33,000	1,200
Totals:	**793,000**	**31,520**

4.7.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of SED 7 has included consideration of the short-term impacts of implementing this alternative on the environment, the local communities (as well as communities along transport routes), and the workers involved in the remedial activities. These impacts would last for the duration of the active remedial activities, which is estimated to be approximately 25 years – specifically, 9 years for Reach 5A, 6 years for Reach 5B, 4 years for Reach 5C, 2 years for Reach 5 backwaters (performed concurrently with Reach 5C), 3 years for Reach 6, 2 years for the Reach 7 impoundments, and 1 year for Reach 8. Since the extent and duration of remediation activities under SED 7 are greater than those of the alternatives discussed thus far, the short-term impacts would be more widespread and last longer.

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[88] It is likely that a greater PCB mass would be removed from the Reach 5 backwaters and Reach 7 impoundments; however, as described in Section 3.1.1, the areas delineated for removal (based on PCB concentration thresholds) in the model are different from the data-based assessment used to estimate removal volumes for this alternative. For this reason, the model mass balance does not accurately reflect the magnitude of PCB mass removal from backwaters for this alternative.

Impacts on the Environment

The short-term effects on the environment resulting from implementation of SED 7 would include potential impacts to the water column, air, and biota in the Rest of River area during excavation, capping, backfilling, and thin-layer capping activities; alteration/destruction of benthic habitat in the areas subject to those activities; loss of riparian habitat as a part of bank stabilization activities; and loss of floodplain habitat and biota due to construction of the supporting facilities. Short-term impacts specifically associated with each remedial component are described below.

Sediment Removal: Sediment removal (with backfilling/capping activities) in Reaches 5, 6, 7, and 8 (760,000 cy over 215 acres) would result in resuspension of PCB-containing sediment due to the invasive nature of removal operations and potential for PCB-containing residuals. As discussed under prior alternatives, resuspension to the water column outside the work area would be controlled in Reaches 5A and 5B as removal activities in those reaches would be conducted in the dry using sheetpile containment. However, the potential exists for suspended or residual sediment containing PCBs to be released during sheetpile installation or due to overtopping of the sheetpiles during a high flow event. For Reach 5C, Reach 5 backwaters, Woods Pond, Reach 7 impoundments, and Rising Pond, activities would be conducted in the wet with silt curtains used to mitigate sediment release to downstream reaches. In these areas, some sediment containing PCBs could be released from the work area through the dredging/excavation process even though the areas would be surrounded by silt curtains. In addition, boat and barge traffic could resuspend sediment during the construction phase. Water column monitoring would be performed during these activities to assess any potential water quality impacts.

The potential also exists during removal and related sediment processing activities for airborne releases that could impact downwind communities. Air monitoring would be conducted during these activities to assess any potential air quality impacts.

Implementation of SED 7 would cause a loss of aquatic habitat over approximately 215 acres of River in Reaches 5A, 5B, and 5C, the Reach 5 backwaters, Woods Pond, the Reach 7 impoundments, and Rising Pond where sediment removal would occur. It is estimated that these impacts would occur over approximately 215 acres of River. Implementation of SED 7 would remove the natural bed material, debris, and aquatic vegetation which are used as habitat by both fish and benthic invertebrates. The sediment removal activities would also result in the direct loss of benthic invertebrates and other aquatic organisms (e.g., reptiles and amphibians) residing in the sediments during removal, and a temporary disruption and displacement of fish.

In addition, short-term increases in PCB concentrations in biota downstream of the removal work areas have been noted at other sites where dredging in the wet has occurred (e.g., Grasse River) and even where excavation has been conducted in the dry (e.g., Upper ½-Mile Reach), as described in Sections 4.3.8 and 4.4.8, and would be expected under SED 7.

Additionally, sediment removal activities would alter feeding areas for birds and mammals that live adjacent to the River and feed in areas subject to remediation.

Capping: Capping activities in Woods Pond and Rising Pond would be performed during lower flow conditions with silt curtains in place. While resuspension is possible due to capping activities, the potential for resuspension of PCB-containing sediment is anticipated to be much less than removal activities since capping would involve placing clean material on undisturbed native sediment, and silt curtains would be in place to mitigate transport of solids to downstream reaches. Water column monitoring would be conducted during capping activities to assess any potential water quality impacts.

Placement of the caps as part of SED 7 would occur over the same 45 acres of River as under SED 6, and would have an impact on the aquatic communities. Capping would alter the natural bed material and require removal of significant debris or structures. The placement of the caps in these deep areas would result in the loss of the existing benthic invertebrates and benthic and fish habitat. These losses would be expected to be temporary as benthic invertebrates and aquatic vegetation would eventually recolonize the capping material. However, as discussed above, there is considerable uncertainty regarding the length of time for such recovery to occur.

Thin-Layer Capping: Thin-layer capping activities in Reach 5 backwaters, Reach 7 impoundments, and Rising Pond would consist of placing a thin layer of sand over the undisturbed native sediment. Based on data collected during the Silver Lake capping pilot study, the potential for thin-layer capping to resuspend PCB-containing sediments is considered minimal. Water column monitoring would be conducted to assess any potential water quality impacts.

Placement of a thin-layer cap as part of SED 7 would occur over 65 acres of River, and could have a short-term impact on aquatic vegetation and benthic invertebrates in those areas. However, it is expected that the submerged aquatic vegetation and benthic communities would eventually be re-established from upstream sources. It is likely that the benthic community would quickly recover, with the rate of recovery dependent on the rate of organic detritus accumulation across the thin-layer cap. Again, as noted in Section 4.6.5.3, in shallow water areas where the water depth is less than 6-12 inches and consolidation of the underlying sediment is not anticipated, placement of the thin-layer cap could increase the substrate elevation such that it would modify the vegetative characteristics of these riverine wetlands.

Bank Stabilization: Bank stabilization activities in Reach 5 would have an immediate effect on the riparian community bordering the River. These impacts would be the same as described for SED 3 in Section 4.3.8.

Supporting Facilities: Construction of supporting structures (e.g., roadways, staging areas, etc.) in the floodplain adjacent to the River would result in the loss of habitat in those areas and the wildlife that it supports. The supporting structures required for SED 7 are similar to SED 6 (Section 4.6.8). It is anticipated that SED 7 would require a total of approximately 106 acres for access roads and staging areas (approximately 59 acres within the 10-year floodplain). The loss of this additional habitat would affect the ability of some wildlife to nest and feed in these areas; and in some instances it would cause habitat fragmentation that could further disrupt the movement and interactions of certain wildlife species.

Impacts on Local Communities and Communities Along Transport Routes

SED 7 would result in short-term impacts to the local communities in the Rest of River area. These short-term effects would include disruption along the River and within the floodplain due to the remediation and the construction of access roads and staging areas, as well as increased noise and truck traffic. Under SED 7, these impacts would affect portions of Reaches 5 and 6 for an estimated 22 years, with impacts to the Reach 7 impoundments and Rising Pond occurring over 3 years.

Recreational activities in the areas of Reaches 5 and 6 that would be affected by SED 7 include bank fishing, canoeing, hiking, dirt biking/ATVing, and waterfowl hunting. Recreational activities in Reaches 7 and 8 include fishing and canoeing. During the period of active construction, restrictions on such recreational uses of the River and floodplain would be imposed in the areas in which remediation-related activities are taking place. Due to safety considerations, boaters, hikers, anglers, hunters, and other recreational users would not be able to use the River or floodplain in the areas where such activities are being conducted. Further, bank stabilization activities in Reach 5 would remove the ability of recreational anglers and hikers to use those areas during construction. Aesthetically, the presence of the heavy construction equipment and cleared or disturbed areas would detract from the visually undisturbed nature of the area until the restoration plantings for the disturbed areas have matured.

Due to the need to deliver materials and associated equipment and remove excavated materials to/from the work areas, truck traffic in the area would increase substantially over current conditions. It is expected that this increased truck traffic would persist for the duration of the project (approximately 25 years). In addition, truck traffic to remove excavated materials and deliver backfill/capping materials and equipment to the work areas would increase substantially, and persist for the duration of the project (approximately 25 years). As an example, if 20-ton capacity trucks were used to transport sediments and bank soils from the staging areas, it would take approximately 59,500 truck trips to do so. In addition, assuming the use of smaller capacity trucks for local hauling (i.e., 16-ton trucks), approximately 92,000 truck trips would also be required to transport the sand, stone, backfill and bank stabilization material to Reaches 5 through 8. This additional traffic would increase noise levels and potential for emissions of vehicle/equipment exhaust and nuisance dust to the air. Further, noise in and near the construction zone could affect those residents and businesses located near the work areas (i.e., between the Confluence and Woods Pond and, for a shorter time period, near the Reach 7 impoundments and Rising Pond).

The additional truck traffic would also increase the risk of traffic accidents along transport routes. Appendix D includes an analysis of potential risks from the increased truck traffic that would be necessary to transport clean materials to the site for implementation of SED 7.[89] This analysis indicates that the increased truck traffic associated with SED 7 would result in an estimated 2.62 non-fatal injuries due to accidents (with a probability of 93% of at least one such injury) and an estimated 0.11 fatalities from accidents (with a probability of 10% of at least one such fatality).

Engineering controls would be implemented, to the extent practical, to mitigate short-term impacts and risks associated with implementation of SED 7. However, some impacts would be inevitable.

Risks to Remediation Workers

There would be potential health and safety risks to site workers implementing SED 7. Implementation of SED 7 is estimated to involve 993,981 man-hours over a 25-year timeframe. The analysis in Appendix D of potential risks to workers from implementation of the sediment alternatives indicates that implementation of SED 7 would result in an estimated 9.57 non-fatal injuries to workers (with a probability of 100% of at least one such injury) and an estimated 0.12 worker fatalities (with a probability of 11% of at least one such fatality). Engineering controls and OSHA procedures designed to mitigate risks to remediation workers would be instituted.

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[89] The risks from truck traffic to transport excavated materials to the staging areas are evaluated as part of risks to workers, discussed below; and the risks from truck traffic to transport such materials from the staging areas away from the site are evaluated under the relevant treatment/disposition alternatives.

4.7.9 Implementability

4.7.9.1 Technical Implementability

The technical implementability of SED 7 has been evaluated considering the factors identified below.

General Availability of Technologies: SED 7 would be implemented using well-established and available in-river remediation methods and equipment, as noted in Section 4.3.9.1. Similarly, land-based support areas would be constructed using commonly available construction technologies. Further, well-established and readily available equipment would also be used to monitor the remedial alternative both during and following implementation.

Ability To Be Implemented: Based on site characteristics, the technologies and process options that are part of SED 7 would be suitable for implementation in the reaches where they would be applied. Sediment removal followed by backfilling or capping would be implemented throughout Reach 5 and in portions of the Reach 5 backwaters, Woods Pond, Reach 7 impoundments, and Rising Pond. Sediment removal with subsequent backfilling would be performed in the dry in Reaches 5A and 5B. Removal in the dry has been successfully used in parts of the 1½-Mile Reach of the Housatonic River, which have characteristics similar to those in Reaches 5A and 5B. Sediment removal in the wet would be performed in areas downstream of Reach 5B, using hydraulic or mechanical dredging techniques, depending on the sediment volumes, composition, and water depths. Removal in the wet (both mechanical and hydraulic) with capping has also been used at other sites, as noted in Sections 4.4.5.2 and 4.6.5.2. Since the current river bathymetry would be maintained in those areas where sediment removal and subsequent backfilling/capping are performed, there would be no net loss of flood storage capacity.

Capping without prior removal would be implemented in portions of Woods Pond and Rising Pond where the water is relatively deep, which are suitable conditions for such capping. Since the backwater effects in Woods Pond and Rising Pond are controlled by the dams, impacts to flood storage capacity would not be expected as a result of cap placement. This would be evaluated during design as necessary.

Thin-layer capping to enhance natural recovery processes would be implemented in lower velocity areas – i.e., portions of Reach 5 backwaters, Reach 7 impoundments, and the shallow portion of Rising Pond – which have suitable conditions for application of this technology. Similar to the capping described above, there would no impacts to flood storage capacity as a result of thin-layer capping in these areas, as these areas are controlled by backwater effects from the dams along the River.

Bank soil removal followed by stabilization would be performed in the erodible bank areas of Reach 5, with the most appropriate removal/stabilization options selected in the design phase based on the physical features of the bank area in conjunction with the adjacent sediment and/or floodplain soil remedial activities. Since the slope of some of the restored erodible banks would likely be reduced during remediation, an increase in flood storage capacity would likely result in those areas of Reach 5.

MNR with institutional controls would be implemented in the downstream reaches, where PCB concentrations are already low and would likely decrease further following remediation in the upstream reaches. Monitoring to track changes in PCB concentrations following the SED 7 remedial activities could be performed using readily available methods and materials, such as have been used previously in the River. Similarly, the continued maintenance of biota consumption of advisories would be expected to use similar techniques to those used previously.

Support facilities in the floodplain area necessary for implementation of SED 7 could readily be constructed using commonly available construction techniques. Efforts would be made to construct these facilities to avoid wetlands to the extent practicable.

Although the technologies needed to implement SED 7 are generally available and suitable, the 25-year period required to implement this alternative introduces other complications and uncertainties (in addition to those described above). It is difficult to contract for a remedial project for that length of time, given the possibility of changes in equipment and techniques, and the possibility that contracting firms will not remain available throughout that long a time period. It is also difficult to predict the availability of large quantities of backfill and capping materials that far into the future. In addition, depending on the treatment or disposition alternative selected (see Section 7), the availability of landfill capacity or treatment capabilities could also affect the ability to implement such a long-term dredging project. Finally, there are uncertainties that can arise due to changes in statutes, regulations, regulatory priorities, property ownership, and other unforeseeable complications over several decades. While these complications cannot be quantified, they do create considerable uncertainties affecting the ability to implement SED 7.

Reliability: The technologies that comprise SED 7 are reliable, as shown through implementation at other sites and in portions of the Housatonic River upstream of the Confluence. The use of these technologies at other sites was described in Sections 4.3.5.2, 4.4.5.2, 4.5.5.2, and 4.6.5.2.

Availability of Space for Support Facilities: Implementation of SED 7 would require construction of access roads and staging areas at various locations within the floodplain. As noted above, approximately 106 acres of space would be needed, and appear to be available to support the SED 7 activities based on preparation of a conceptual site layout. Development of access roads and staging areas would be sequenced and constructed appropriately over the approximate 25-year implementation period for SED 7.

Availability of Cap/Backfill Materials: Materials required for cap/backfill placement must be of suitable quality for in-river placement and habitat restoration. Approximately 920,000 cy of capping/backfill materials would be required for thin-layer capping and capping/backfilling activities (i.e., 560,000 cy of sand and 360,000 cy of armor stone and rip-rap). Locating suitable sources for such a volume of materials may be a challenge, and predicting the availability of suitable material over length of time required to implement this alternative (25 years) introduces additional complications and uncertainties. For purposes of this CMS Report, adequate material sources are assumed to be available, although obtaining needed quantities may require long travel distances. An evaluation would be required during design activities to determine material availability.

Ease of Conducting Additional Corrective Measures: Future corrective measures, if needed to perform cap or bank maintenance or conduct additional remediation, would be implementable, given the same technical and logistical constraints applicable to the initial implementation of SED 7. Ease of implementation would be directly related to the extent of the additional corrective measure (i.e., area and/or volume to be addressed) and the ease of access (i.e., location of target area and proximity of access areas).

Ability to Monitor Effectiveness: The effectiveness of SED 7 would be determined over time through long-term monitoring to document reductions in PCB concentrations in water column, sediment, and fish tissue in various reaches of the River. Periodic monitoring (i.e., visual observation and sampling) of the capped sediments and restored riverbanks would allow for an evaluation of cap integrity and effectiveness, as well as bank stability. Such activities have been successfully performed on the upper portion of the Housatonic River and at other sites previously. Equipment and methods for this type of monitoring are readily available.

4.7.9.2 Administrative Implementability

The administrative implementability of SED 7 has been evaluated in consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: Implementation of SED 7 would need to comply with the substantive requirements of applicable and appropriate regulations pertaining to the performance of the remedial action (unless waived). As noted in Section 4.7.4, GE believes that SED 7 could be designed and implemented to meet such requirements (i.e., location-specific and action-specific ARARs listed in Tables 2-2 and 2-3), with the exception of certain requirements that could potentially apply to the on-site staging areas if the excavated sediments should constitute hazardous waste, and which GE believes should be waived, if necessary, as technically impracticable.

Access Agreements: Implementation of SED 7 would require GE to obtain access permission from the owners of properties that include riverbank or floodplain areas where remedial work or ancillary facilities would be necessary to carry out the alternative. Although the majority of the areas in Reach 5 are publicly owned, it is anticipated that access agreements may be required from up to approximately 40 private landowners to implement SED 7. Obtaining such access agreements could be problematic in some cases. If GE should be unable to obtain access agreements with particular property owners, GE would request EPA and/or MDEP to provide assistance.

Coordination with Agencies: Implementation of biota consumption advisories would require coordination with state public health departments and/or other appropriate agencies in the dissemination of information to the public and surrounding communities regarding those advisories. In addition, obtaining access to State-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of SED 7, GE would need to coordinate with EPA, as well as state and local agencies, to address any potential health and safety concerns and to provide as-needed support with public/community outreach programs.

4.7.10 Cost

The estimated total cost for implementation of SED 7 is $362 M (not including treatment or disposition). The estimated capital cost is $348 M, assumed to occur over a 25-year construction period. Estimated annual OMM costs include costs for a 5-year inspection and maintenance program for the restored riverbed and riverbanks, thin-layer cap areas, and restored staging areas and access roads; these costs range from $25,000 to $275,000 per year (depending on which reach is being monitored), resulting in a total cost of $3.6 M. The estimated annual OMM costs for SED 7 also include implementation of a long-term water, sediment, and fish monitoring program for a period of 30 years following completion of construction activities on a reach-specific basis. The estimated costs for this long-term program range from approximately $275,000 to $600,000 per year (depending on the extent of monitoring occurring within a given year), resulting in a total cost of $10.8 M. The following summarizes the total capital and OMM costs estimated for SED 7.

SED 7	Est. Cost	Description
Total Capital Cost	$348 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM Cost	$14.4 M	Costs for performance of the OMM programs
Total Cost for Alternative	$362 M	Total cost of SED 7 in 2008 dollars

The total estimated present worth cost of SED 7, which was developed using a discount factor of 7%, a 25-year construction period, and an OMM period of 30 years on a reach-specific basis, is approximately $172 M. More detailed cost estimate information and assumptions for each of the sediment alternatives are included in Appendix E.

These costs do not include the costs of pertinent treatment/disposition alternatives for removed sediments/bank soils. The estimated costs for combinations of sediment remediation and treatment/disposition alternatives are presented in Section 8.

4.7.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 4.7.2, the evaluation of whether SED 7 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As discussed previously, SED 7 would result in a substantial reduction in the potential for exposure of human and ecological receptors to PCBs in sediments, surface water, and fish by: (a) permanently removing 760,000 cy of PCB-containing sediments in Reaches 5, 6, and the Reach 7 impoundments and placing a cap/backfill over the underlying sediments; (b) removing 33,000 cy of erodible PCB-containing riverbank soils from Reach 5 and covering/stabilizing those erodible banks; (c) placing a cap over 45 acres in the deeper parts of Reaches 6 and 8 where no excavation would be performed; (d) placing a thin-layer cap over 65 acres in the Reach 5 backwaters, Reach 7 impoundments, and the shallow portion of Rising Pond to reduce exposure concentrations and accelerate the process of natural recovery; and (e) relying on natural recovery processes in other areas. As shown in Section 4.7.3, implementation of SED 7 is predicted to reduce the PCB load in the River passing Woods Pond Dam and Rising Pond Dam by 97% and 95%, respectively (essentially the same as SED 5 and SED 6) over the course of the modeled period, and to reduce the annual PCB mass transported from the River to the floodplain in Reaches 5 and 6 by 98% (same as SED 5 and SED 6) over that period.

Further, as shown in Section 4.7.5.1, EPA's model predicts that implementation of SED 7 would result in a substantial permanent reduction in sediment and fish PCB concentrations. For example, the model predicts that the fish PCB concentrations (whole body) would be reduced over the modeled period from 70-110 mg/kg to approximately 1-2 mg/kg in Reaches 5 and 6, from 30-50 mg/kg to approximately 2-5 mg/kg in the Reach 7 impoundments, from 30 mg/kg to approximately 1 mg/kg in Rising Pond, and from 1-2 mg/kg to 0.03-0.05 mg/kg in the Connecticut impoundments.

Compliance with ARARs: As explained in Section 4.7.4, the model predictions of water column PCB concentrations indicate that SED 7 would achieve the chemical-specific ARARs, except for the water quality criterion of 0.000064 µg/L based on human consumption of water and organisms, which GE believes should be waived as technically impracticable. Further, GE believes that SED 7 could be designed and implemented to meet the pertinent location-specific and action-specific ARARs, with the possible exception of certain requirements which could potentially apply to the on-site staging areas if the excavated sediments should constitute hazardous waste, and which GE believes should be waived, if necessary, as technically impracticable.

Human Health Protection: As discussed in Section 4.7.6.1, for direct human contact with sediments, SED 7 would achieve IMPG levels based on a 10^{-6} cancer risk (or 10^{-5} in two areas), as well as all non-cancer IMPGs, in all sediment exposure areas, with the majority of those levels achieved at the present time. As such, SED 7 would protect human health from direct contact with sediments. For human consumption of fish, the fish PCB concentrations predicted to result from SED 7 in Reaches 5 through 8 at the end of the 55-year simulation period, when converted to fillet-based concentrations, would not achieve the RME-based IMPGs within EPA's cancer risk range or based on non-cancer impacts – i.e., the levels that EPA considers to be protective for unrestricted consumption of Housatonic River fish (except for the RME 10^{-4} cancer IMPG, but not the non-cancer IMPGs, in a limited number of areas). Extrapolation of model results beyond the simulation period indicates that PCB concentrations in fish fillets would reach the RME IMPG levels based on a 10^{-5} cancer risk and non-cancer impacts in approximately 130 to >250 years in the PSA and 240 to >250 years in Reaches 7 and 8. In the Connecticut impoundments, the CT 1-D Analysis indicates that SED 7 would achieve the RME fish consumption IMPGs based on a 10^{-5} cancer risk and all non-cancer IMPGs within the modeled period. Where the levels for unrestricted fish consumption are not achieved, institutional controls – specifically, fish consumption advisories – would continue to be utilized to provide human health protection from fish consumption.

Environmental Protection: As discussed in Section 4.7.6.2, the model results indicate that, by the end of the 55-year modeled period, SED 7 would achieve the IMPG levels for nearly all ecological receptor groups and areas. For benthic invertebrates, SED 7 would result in sediment PCB concentrations below both the lower and upper bounds of the IMPG range (3-10 mg/kg) in all averaging areas (except in one subreach in Reach 7). Similarly, for amphibians, SED 7 would result in sediment PCB concentrations below both the lower and upper bounds of the IMPG range (3.27 to 5.6 mg/kg) in all backwater areas. For warmwater and coldwater fish and threatened and endangered species, predicted whole body fish PCB concentrations would achieve the IMPGs for these receptors (55, 14, and 30.4 mg/kg, respectively) in all reaches. For insectivorous birds and piscivorous mammals, predicted sediment PCB concentrations in the relevant averaging areas in Reaches 5 and 6 are below all 3 target sediment levels (1, 3, and 5 mg/kg) in all averaging areas.[90] For piscivorous birds, the predicted whole body fish PCB concentrations would achieve the IMPG (3.2 mg/kg) in all reaches except Reach 7B.[91]

At the same time, implementation of SED 7 would cause substantial short-term impacts on the environment in the areas where work would be conducted (e.g., loss of aquatic habitat in areas of remediation in portions of Reaches 5, 6, 7, and 8, loss of riparian habitat in the bank stabilization areas, potential resuspension of PCB-containing sediments during removal, and loss of floodplain habitat in areas where supporting facilities are constructed), as discussed in Section 4.7.8. These impacts would be more widespread and would last longer than those from the alternatives discussed previously.

Implementation of SED 7 could also produce adverse long-term environmental impacts. For example, as discussed in Section 4.7.5.3, SED 7 has an increased potential (compared to the alternatives discussed above) for long-term adverse environmental impacts in the portions of the main river channel, backwaters, and impoundments that would be subject to removal and/or backfilling or capping, particularly in Reaches 5 and 6, given the cumulative effects of 25 years of remedial construction activities. Additionally, long-term adverse impacts could result from the bank stabilization activities, the placement of a cap or thin-layer cap in shallow water areas where consolidation of the sediment is not anticipated, and ancillary construction activities in the floodplain. These impacts would likely be more extensive than those from the alternatives discussed previously.

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[90] As discussed previously, attaining the target sediment levels for these receptor groups would allow achievement of the IMPGs provided that the average floodplain soil concentrations in the same averaging areas are below the associated target floodplain soil levels (see Section 6).

[91] Given these results, this one exceedance of the IMPG (which is only slightly above the IMPG level) would not be expected to have an adverse impact on the overall local population of these birds in the Rest of River area.

Nevertheless, SED 7 would address the ecological risks that EPA concluded in the ERA were present in the Rest of River area. Thus, if one accepts EPA's conclusions in the ERA, SED 7 would meet the standard of providing environmental protection from those risks. However, in doing so, it would cause more environmental damage than necessary to provide such protection.

Summary: Based on the foregoing considerations, it is concluded that SED 7 would provide overall protection of human health and the environment, although at the cost of causing substantial environmental harm.

4.8 Evaluation of Sediment Alternative 8

4.8.1 Description of Alternative

SED 8 would include the removal of 2,217,000 cy of sediment, followed by placement of backfill, over 340 acres in Reaches 5A, 5B, and 5C, Reach 5 backwaters, Woods Pond, Reach 7 impoundments, and Rising Pond. In these reaches, removal would be performed to the 1 mg/kg depth horizon as further described in Section 3.1.1. MNR would be included for the remaining portions of the River (Reach 7 channel and Reaches 9 through 16). Additionally, all Reach 5 erodible banks containing PCBs (33,000 cy) would be subject to removal and stabilization. Remediation would proceed from upstream to downstream to minimize the potential for recontamination of remediated areas. Figures 4-12a-b identify the remedial action(s) that would be taken in each reach as part of SED 8.

The following summarizes the general remedial approach (and associated assumptions) related to implementation of SED 8. It is estimated that SED 8 would require approximately 51 years to complete. It should be noted that while details on equipment and processes are provided in this description for purposes of the evaluations in this CMS Report, the specific methods for implementation of any selected remedy would be determined during design based on engineering considerations and site conditions.

Site Preparation: Prior to implementation of remedial activities, access roads and staging areas would be constructed to support implementation of this alternative. Grubbing and clearing of vegetation would likely be necessary, and appropriate erosion and sedimentation controls would be put in place prior to construction. The conceptual plans developed for this CMS Report indicate that approximately 29 staging areas and approximately 21 miles of access roads would be constructed between the Confluence and Rising Pond to support the implementation of SED 8.

Sediment Removal: Sediment removal would be performed throughout the above-identified reaches of the River to the 1 mg/kg depth horizon. A summary of removal by reach, based on existing PCB data, is presented below.

	Average Removal Depth (feet)	**Removal Volume (cy)**	**Acreage**
Reach 5A:	4	268,000	42
Reach 5B:	3.5	153,000	27
Reach 5C:	3	279,000	57
Reach 5 backwaters:	2 to 3	388,000	86
Reach 6 (Woods Pond):	6	575,000	60
Reach 7 impoundments:	2	86,000	27
Reach 8 (Rising Pond):	7	468,000	41
Totals:		**2,217,000**	**340**

The areas over which removal would occur are shown on Figures 4-12a-b.

In Reaches 5A and 5B, it is assumed that the excavations would be performed in the dry with conventional mechanical excavation equipment. Once the excavation depths are achieved, stable backfill would be placed over removal areas. In these reaches, sheetpiled cells would be established in the River to facilitate removal activities and limit downstream transport of sediment. In the remaining reaches, it is assumed that removal would be performed using hydraulic dredging, with placement of a stable backfill following completion of removal activities. Debris removal would be conducted prior to dredging. In these reaches, silt curtains would be placed downstream of excavation activities to limit transport of suspended sediment. A water treatment system would be used to treat water pumped from the excavation areas. Periodic water column and air monitoring would be performed during implementation to monitor potential releases.

Placement of Backfill: Backfill would be placed following excavation in all removal areas (see Figures 4-12a-b), given that PCB-containing sediments would be removed down to the 1 mg/kg depth horizon. Backfill would be placed in the dry in areas where dry excavation was performed and through the water column in the remaining areas. Backfill materials would be transferred to the River using conventional earth-moving equipment. For purposes of this CMS, it is assumed that the backfill would consist of an adequate thickness of sand and gravel (similar to existing riverbed material) such that the riverbed would be filled back to the pre-removal elevation. Silt curtains would be used during backfilling (except in areas where backfilling would be conducted in the dry with the sheetpiles still in place) to mitigate any solids release from the work area, and water column monitoring would be performed to monitor potential releases.

<u>Sediment Dewatering and Handling</u>: Sediment dewatering operations would be performed as necessary in the staging areas. For purposes of this CMS Report, it has been assumed that a combination of dewatering alternatives would be used, including gravity dewatering through stockpiling for materials removed in the dry and mechanical dewatering using a plate and frame filter press for materials removed in the wet. It is also assumed that Geotubes would also be used to dewater sediments hydraulically dredged from the Reach 7 impoundments. Since there is limited space available for construction of staging areas in Reach 7, use of Geotubes would reduce the size requirement for this area. The addition of stabilization agents (e.g., other dry sediments, excavated soils, Portland cement) may be necessary prior to treatment and/or disposal. Treatment/disposition alternatives have been evaluated separately and are discussed in Section 7. A water treatment system would be used to treat the water pumped from the removal areas being excavated in the dry, as well as any decant water collected from excavated materials in the staging areas.

<u>Bank Removal/Stabilization</u>: SED 8 would include the removal of 33,000 cy of soil from the erodible banks in Reach 5 followed by stabilization. Bank stabilization is assumed to be limited to Reaches 5A and 5B – i.e., bank excavation to promote stable slopes (assumed to be 1½:1 to 3:1 slopes), followed by stabilization with revetment mats, armor stone, or bioengineering techniques (with an assumed distribution of 20%, 60%, and 20% respectively, for each stabilization technique).

<u>MNR</u>: MNR would be implemented in the remainder of the Rest of River under SED 8 (i.e., Reach 7 channel and Reaches 9 through 16). As discussed previously, natural recovery processes have been documented in portions of the Housatonic River and would be expected to continue at varying rates in the areas where MNR would be implemented under SED 8, due in part to completed and planned remediation conducted upstream of the Rest of River, as well as the remediation that would be conducted as part of this alternative.

<u>Restoration</u>: SED 8 would include restoration of the areas that are directly impacted by removal and backfilling, bank removal/stabilization, and ancillary construction activities, as appropriate to restore the habitat value of the affected resources, to the extent practical. Restoration would be accomplished using a combination of passive procedures (practices to facilitate natural reestablishment of the resource) and active procedures (plantings or other mitigation). For purposes of this CMS Report, the extent and type of restoration activities assumed for SED 8 are as follows:

- It is assumed that the riverbed in the removal areas would be restored to the existing bathymetry with sand and gravel backfill. It is anticipated that the backfill, as well as any deposited sediment, would be recolonized by benthic invertebrates. It is also anticipated that, in areas within the limits of light penetration, the backfilled substrate would serve as a suitable medium for the recolonization by submerged aquatic plants from upstream sources.

- On riverbanks where revetment mats or armor stone are used for stabilization, supplemental habitat structures such as trees, log and root wad revetments, and/or log and brush shelters would be considered as part of the restoration to replace similar existing structures. On banks where bioengineering techniques are used, plantings would be used to restore an appropriate riparian community.
- In the areas adjacent to the River where access roads and staging areas have been constructed to support work in the River, those support facilities would be removed and the disturbed areas revegetated with plantings that, over time, would restore the current habitat value of those areas.

Restoration activities would be conducted following completion of the remedial action within successive reaches of the River. In certain circumstances, restoration of impacted natural communities affected by ancillary construction activities, such as roadway construction, could be delayed until the remedial action over a broader area is completed.

Institutional Controls: SED 8 would include the continued maintenance of biota consumption advisories, as appropriate, to limit the public's consumption of fish and other biota from the River.

Long-Term OMM: Once implemented, it is assumed that SED 8 would include, for each reach involved, a 5-year post-construction monitoring and maintenance program and a long-term (30-year) monitoring program.

The post-construction monitoring program assumed for SED 8 would include visual observations of the riverbed and Reach 5 riverbanks, and visual observation and quantitative/qualitative assessment of restored staging areas and access roads. These activities would occur annually for a period of 5 years following remedy implementation in a given reach.

In addition, it is assumed that the long-term monitoring program would include analytical sampling of fish and the water column, consistent with the program outlined for SED 2 (Section 4.2.1). It is also assumed to include a sediment sampling program, which would include the collection and PCB analysis every 5 years of 100 surface sediment samples from the MNR and removal/backfill areas. Sampling is assumed for a period of 30 years. In addition, a maintenance program would be implemented, as necessary.

4.8.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 4.1.2, the evaluation of whether a sediment remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether SED 8 would be protective of human health and the environment is presented at the end of Section 4.8 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

4.8.3 Control of Sources of Releases

SED 8 would reduce the potential for future PCB releases from certain sediments and riverbanks that may occur via erosion and flood events. This alternative would include removal of sediments from Reaches 5A, 5B, and 5C, Reach 5 backwaters, Reach 6, Reach 7 impoundments, and Reach 8 to the estimated 1 mg/kg depth horizon, followed by backfilling, and removal with stabilization of erodible banks in Reach 5. These actions would address PCB sources over approximately 340 acres of the riverbed and 7 miles of erodible riverbank, removing 2,250,000 cy of sediment and bank soils containing PCBs. Implementing these actions would significantly reduce the source of PCBs currently available for potential transport within the River and onto the floodplain for human or ecological exposure.

It should also be noted that, in conjunction with the remediation and natural recovery processes within the Rest of River, the remaining remediation activities to be conducted upstream of the Confluence (i.e., in areas adjacent to the East Branch and in the West Branch) would also reduce the PCBs available for scour/transport within the Rest of River area. Additionally, the existing dams along the River would act to minimize the potential for any movement of the limited amounts of PCBs that would be left behind in the impoundments, buried under feet of backfill, behind those dams. As noted above, the inspection, monitoring, and maintenance programs in place for these dams under other authorities, as described in Section 4.1.3, would prevent or minimize the possibility of dam failure. In any case, the removal of PCBs from Woods Pond, the Reach 7 impoundments, and Rising Pond to the 1 mg/kg depth horizon would ensure that, even if one of those dams did fail, there would be no significant release of PCBs from the impoundment behind that dam.

As indicated by EPA's model, implementation of SED 8, in combination with upstream source control, would reduce the mass of PCBs transported within the River to downstream reaches and to the floodplain. For example, the average annual PCB load passing Woods Pond Dam at the end of the 81-year model projection period is predicted to decrease by 98% from that calculated at the beginning of that period (i.e., from 20 kg/yr to 0.4 kg/yr). Similarly, SED 8 is predicted to achieve a 96% reduction in the annual average PCB load passing Rising Pond Dam over that same period (i.e., from 19 kg/yr to 0.7 kg/yr). Likewise, SED 8 is predicted to result in a 99% reduction in the annual average mass of PCBs transported from the River to the floodplain within Reaches 5 and 6 over the modeled period (i.e., from 12 kg/yr to 0.1 kg/yr).

The effects of an extreme flow event were examined using the Year 26 flood. The impact of this flood on surface sediment PCB concentrations can be seen on Figure 4-13b, which shows temporal profiles of model-predicted reach-average PCB concentrations in surface sediments resulting from the implementation of SED 8 over the 81-year model projection period. Similar to the other alternatives, the model results for SED 8 indicate that, in reaches subject to MNR only (i.e., Reach 7 channel sections), the extreme event is not predicted to expose buried PCBs at concentrations exceeding those already exposed at the sediment surface. In the remaining areas, where backfill would be placed following removal to the 1 mg/kg depth horizon, the EPA model predicts that the backfill and underlying sediments containing PCBs (to the extent such sediments exist given the deep removal depths for this alternative) would be largely be stable during high flow events.[92] In nearly all reaches, no observable change in surface sediment PCB concentrations is predicted during the extreme event under SED 8 (Figure 4-13b). The only exceptions are a small portion of Reach 5A (representing 2% of that reach's area) and limited areas within two of the Reach 7 impoundments. In the case of Reach 5A, erosion of backfill in that one section is predicted to produce an increase in the reach-average 0- to 6-inch sediment concentration of 0.3 mg/kg (Figure 4-13b). For the two Reach 7 impoundments (Reaches 7E and 7G), erosion to a depth exceeding 50% of the backfill depth is predicted to occur in limited portions of those reaches (17% and 4%, respectively), but that erosion is not deep enough to expose buried PCBs. Overall, the model results indicate that buried sediments containing PCBs (at concentrations below 1 mg/kg) generally would not become exposed during an extreme flow event under SED 8, due in part to the deep removal under that alternative.

4.8.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs, set forth in Table 2-1, include the federal and state water quality criteria for PCBs. These criteria consist of a freshwater chronic aquatic life criterion of 0.014 µg/L and a human health criterion (based on consumption of water and organisms) of

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[92] Further evaluation of the stability of backfill materials under SED 8 based on model predictions of erosion in these areas is provided in Section 4.8.5.2. The results of this stability analysis (i.e., percentages of backfill areas that are stable) are cited in the remainder of this discussion.

0.000064 µg/L (0.00017 µg/L under the Connecticut standards, although that may not be an ARAR since it is less stringent and less up-to-date than the federal criterion).

To evaluate whether SED 8 would achieve those criteria, GE reviewed the water column PCB concentrations predicted by the model for SED 8. The water column concentrations are presented in Table 4-43 (in Section 4.8.5.1). As shown in that table, annual average water column concentrations predicted by the model at the end of the simulation period are below the freshwater chronic aquatic life criterion of 0.014 µg/L (14 ng/L) in all reaches. However, model-predicted water column concentrations in Reaches 5 through 8 exceed the federal and Massachusetts human health consumption criterion of 0.000064 µg/L (0.064 ng/L) in all of these reaches. For the Connecticut impoundments, the water column concentrations predicted by the CT 1-D Analysis (which range from 0.00004 to 0.00009 µg/L [0.04 to 0.09 ng/L]) exceed the federal in one of the four impoundments, but are below the Connecticut consumption criterion of 0.00017 µg/L (0.17 ng/L) in all four impoundments, although these estimates are highly uncertain. As discussed previously, GE believes that the ARARs based on the human health consumption criteria should be waived on the ground that achievement of those ARARs is technically impracticable for the reasons given in Section 4.1.4.

The potential location-specific and action-specific ARARs are listed in Tables 2-2 and 2-3. Based on review of those ARARs, GE believes that SED 8 could be designed and implemented to achieve most of the ARARs that would be pertinent to this alternative, provided that any necessary EPA approval determinations are obtained, for the same reasons discussed in Section 4.3.4. However, as also discussed in that section, in the event that the excavated sediments should be found to constitute hazardous waste under RCRA or comparable state criteria (which is not anticipated), the temporary staging areas for the dewatering and handling of those sediments might not meet certain hazardous waste storage requirements, if they were determined to apply. In that case, as further discussed in Section 4.3.4, GE believes that such requirements should be considered inapplicable or, if necessary, waived as technically impracticable.

4.8.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for SED 8 has included evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment, as described below.

4.8.5.1 Magnitude of Residual Risk

The assessment of the magnitude of residual risk associated with implementation of SED 8 has included consideration of the extent to which and timing over which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative to reduce potential exposure such as engineering and institutional controls.

Implementation of SED 8, along with upstream source control/remediation measures and natural recovery processes, would substantially reduce the exposure of humans and ecological receptors to PCBs in sediments, surface water, and fish in the Rest of River area. The extensive sediment removal and backfilling throughout Reaches 5 through 8 and removal and stabilization of the bank soils in Reach 5 would result in a significant reduction in the potential for exposure to PCBs in these areas. The following table shows, by reach, the average PCB concentrations predicted by EPA's model to be present at the end of the model simulation period (Year 81) in the surface sediments, surface water, and fish (including both whole body and fillet-based concentrations).

Table 4-43 – Modeled PCB Concentrations at End of 81-Year Projection Period (SED 8)

Reach	Average Surface Sediment (0-6") (mg/kg)	Average Surface Water (ng/L)	Average Fish (whole body) (mg/kg)	Average Fish (fillet) (mg/kg)[2]
5A	0.09	1.8	0.9	0.2
5B	0.05	1.2	0.7	0.1
5C	0.1	0.9	0.5	0.1
5D (backwaters)	0.1	---	1.4	0.3
6	0.2	0.9	0.6	0.1
7[1]	0.01 – 4.0	0.9 – 1.0	0.9 – 4.8	0.2 – 1.0
8	0.07	0.9	0.9	0.2
CT[1]	0.002 – 0.005	0.04 – 0.09	0.02 – 0.04	0.004 – 0.008

Notes:

1. Values shown as ranges in Reach 7 and CT represent the range of modeled PCB concentrations at the end of the projection within each of the Reach 7 subreaches, and the range of concentrations indicated by the CT 1-D Analysis for the four Connecticut impoundments.
2. Fish fillet concentrations were calculated by dividing the modeled whole-body fish PCB concentrations by a factor of 5, as directed by EPA.

The potential residual risks to human and ecological receptors from the concentrations shown in the above table have been evaluated in the context of the extent to which they would achieve the IMPGs, as discussed in Section 4.8.6.

Temporal profiles of reach-average PCB concentrations in surface sediments, annual average surface water, whole body fish, and fish fillets, resulting from the implementation of SED 8 over the 81-year model projection period are shown on Figure 4-13a-c. These figures show the timeframes over which SED 8 would be predicted to reduce the PCB concentrations in each respective medium. Similar to the other sediment alternatives, the sediment PCB concentration trajectories within remediated reaches (Reaches 5, 6, 7 impoundments, and 8) exhibit the general pattern of a large decline over the remediation period, followed by a period of smaller decline, or in some instances, a small increase until concentrations reach a steady-state with prevailing upstream loads and natural attenuation processes. However, due to an extended remediation period associated with the large volume of sediments subject to remediation under SED 8, this period of decline is much longer than that predicted for the other sediment alternatives. While water column patterns exhibit significant year-to-year variability, including short-term increases in PCB concentration associated with sediment resuspension during remediation and the flood event occurring within Year 26, most water column temporal changes follow those of the sediments. Temporal patterns in fish PCB concentrations follow the same general pattern, reflecting the predicted changes in water column and sediments. As a result of the remediation under SED 8, predicted fish PCB concentrations are reduced over the 81-year projection period by 97% to 99% in the remediated reaches (i.e., Reaches 5, 6, 7 impoundments, and 8), by 92% in channel sections of Reach 7, and by 98% in the Connecticut impoundments (Figure 4-13c).

SED 8 would involve no significant residual risk of exposure to PCBs in buried sediments in removal areas, since PCBs would be removed to the 1 mg/kg depth horizon in Reaches 5, 6, 7 impoundments, and 8; and placement of backfill (ranging from 2 to 7 feet in thickness) would prevent direct contact with, and essentially reduce the mobility of, any potential PCB-containing sediments beneath the backfill. Overall, the extent to which SED 8 would mitigate the effects of a flood event that could cause the PCB-containing sediments that have been buried by backfill and/or natural processes to become available for human and ecological exposure was discussed in Section 4.8.3. As discussed in that section, the model results indicate that buried sediments containing PCBs would generally not become exposed during an extreme flow event under SED 8.

In addition, potential human exposure to PCBs in fish and other biota would be reduced during and after implementation of SED 8 through biota consumption advisories. Also, a long-term monitoring program would be implemented to assess the continued effectiveness of this remedial alternative.

4.8.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of SED 8 has included an assessment of the use of technologies under similar conditions and in combination, general reliability and effectiveness, reliability of OMM and availability of OMM labor and materials, and technical component replacement requirements, as discussed below.

Use of Technologies under Similar Conditions and in Combination

As discussed previously, a combination of remedial technologies is often necessary to mitigate potential exposure to constituents in sediments (e.g., EPA, 2005e; NRC, 2007). SED 8 involves such a combination. The SED 8 remedy components include sediment removal using dry excavation techniques (in Reaches 5A and 5B) and hydraulic dredging techniques (in Reaches 5C, 5 backwaters, 6, 7 impoundments, and 8) with backfill placed following removal, as well as bank removal and stabilization (for Reach 5 erodible banks) and MNR (in the remaining areas). These remedial techniques have been applied at a number of sites containing PCBs, as discussed under Sections 4.3.5.2, 4.4.5.2, and 4.6.5.2. However, while sediment removal and backfilling have been applied at other sites using both dry excavation and hydraulic dredging, no completed environmental remediation projects were identified, based on available information, where such an extensive sediment removal and backfilling project (the removal of over 2 million cy of PCB-containing sediments to depths ranging up to 7 feet over a period of > 50 years) was completed. Given the magnitude and estimated time needed to complete SED 8, complications could arise during implementation that have not been noted at other, smaller, completed projects (e.g., restoration difficulties, a higher likelihood of, and greater potential impacts from releases during implementation) and which could compromise the long-term reliability and effectiveness of SED 8.

SED 8 also includes the use of Geotubes in Reach 7 impoundments as a potential dewatering technique. Geotubes have been pilot tested at the Grasse River (NY; www.thegrasseriver.com) and used successfully in Little Lake Butte des Morts (Fox River, WI; www.dnr.wi.gov) for sediments that were hydraulically dredged.

General Reliability and Effectiveness

SED 8 utilizes sediment removal and backfill to reduce exposure of humans and ecological receptors to PCBs in sediments. The general reliability and effectiveness of dredging/excavation were previously discussed in Section 4.3.5.2. As noted in that section, under certain circumstances, dredging and excavation have been shown to be effective and reliable in reducing the long-term potential for exposure of human and ecological receptors to PCB-containing sediments; however, there are some limitations associated with the technology (e.g., sediment resuspension, residual contamination) (EPA, 2005e). EPA (2005e) has also acknowledged that placement of backfill material as needed or as appropriate can be a component of dredging and excavation, and is sometimes necessary to address residual contamination. Further, EPA has recognized that “deeper contaminated sediment that is not currently bioavailable or bioaccessible, and that analyses have shown to be stable to a reasonable degree, do not necessarily contribute to site risks" (EPA, 2005e, p. 7-3). As such, removal of sediment to the depths targeted under SED 8 would not result in a greater reduction in potential exposure to PCB-containing sediments than lesser removal followed by placement of a cap.

To further assess the reliability and effectiveness of SED 8, model predictions of erosion in areas receiving backfill were evaluated to assess the stability of this material, using the same metrics described for this analysis in Section 4.3.5.2. SED 8 includes removal to the 1 mg/kg PCB depth horizon with subsequent backfilling in all portions of Reach 5, Woods Pond, the Reach 7 impoundments, and Rising Pond. As discussed in Section 4.7.5.2, the backfill was considered stable when at least 50% of the material remained for the full duration of the model projection (including the extreme flow event). Within the PSA, the model predicts that the backfill material would be stable over 98% of the surface area in Reach 5A and over 100% of the backfilled areas in Reaches 5B, 5C, the backwaters, and Woods Pond. The erosion over the remaining 2% of backfilled area within Reach 5A is predicted to occur in response to the Year 26 extreme event in an isolated area near the bend in the river at Holmes Road. Such erosion is predicted to result in small increases (less than 0.3 mg/kg) in the reach-average 0- to 6-inch surface sediment PCB concentration (Figure 4-13b). Within Reaches 7 and 8, the model predicts that 100% of the backfilled area would remain stable in Reach 7B and in Rising Pond, and that the backfill would be stable in 83% of the area in Reach 7E and 96% of the area in Reach 7G. Within the remaining backfilled areas of Reaches 7E and 7G, the model predicts erosion in a limited number of grid cells (4 and 1, respectively) during extreme events simulated in Years 56, 58, and 79 of the projection. However, such erosion is predicted to produce no appreciable change (<0.1 mg/kg) in reach-average surface sediment PCB concentrations within those impoundments (Figure 4-13b). Overall, this analysis indicates that the areas receiving backfill following removal in SED 8 would largely remain stable.

Reliability of Operation, Monitoring, and Maintenance Requirements/Availability of Labor and Materials

Given the extensive amount of removal associated with SED 8, the monitoring and maintenance program would be limited in scope and extent. This program would include visual observations of the restored riverbed and riverbanks, as well as post-remediation sampling of fish, water column, and sediment. These are considered reliable techniques for monitoring the effectiveness of this alternative. Should changes in the riverbank be noted that require maintenance, labor and materials needed to perform repairs are expected to be readily available.

In addition, a monitoring and maintenance program would be implemented for actively restored areas to confirm planting survival and areal coverage and to determine whether habitat structures (if any) are intact. Such monitoring is considered a reliable means of tracking the progress of the restoration efforts. The necessary labor and equipment for such a program are expected to be readily available.

Technical Component Replacement Requirements

Given the extensive amount of removal associated with SED 8, the need to replace technical components of the remedy would be limited to the banks remediated in Reach 5. If erosion of Reach 5 bank stabilization materials should occur, an assessment would be conducted to determine the need for and methods of repair. Depending on the timing and location of the repair, access roads and staging areas may need to be temporarily constructed in the nearby floodplain. Periodic small-scale repairs would likely pose minimal risks to humans and ecological receptors that use/inhabit the nearby floodplain. While not anticipated, redesign/replacement of large areas of the restored banks could require more extensive disturbance of the adjacent floodplains to support access.

4.8.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of SED 8 on human health or the environment has included identification and evaluation of potentially affected populations, adverse impacts on biota and their habitat, adverse impacts on wetlands, impacts on the aesthetics of the natural environment, impacts on banks and bedload movement, and potentially available measures that may be employed to mitigate these impacts.

Potentially Affected Populations

Implementation of SED 8 would involve a much greater areal extent of remediation than all other alternatives and would take much longer (e.g., twice as long as SED 7). As such, it would have more extensive impacts than the other alternatives in altering the habitat of the River and adjacent floodplain areas and overall recovery would take longer. These habitat alterations would affect people using these areas as well as the fish and wildlife in these areas, as discussed further below.

Adverse Impacts on Biota and Corresponding Habitat

The potential long-term impacts of SED 8 on biota and their habitat are discussed below in relation to the type of remediation involved. Since SED 8 involves the greatest level of intrusive activities over the greatest amount of area, the spatial and temporal extent of short-term impacts would be the greatest with this alternative. In this situation, the cumulative effect of the myriad of short-term impacts associated with the remedial action could in and of itself constitute a long-term impact due to the timeframe associated with the remedy.

Note also that, to the extent that affected areas constitute habitat for any rare, threatened, and/or endangered species, implementation of SED 8 could affect those species. In general, for the more mobile species and/or species with a wide range of habitat requirements, the activities would displace these species to other areas of the river system. However, as the duration and extent of the disturbances increase, it becomes more likely that the displacement would become permanent, as many protected species are very sensitive to habitat loss and disturbances. Moreover, for animal species with narrower habitat requirements and for any threatened or endangered plant species, any long-term alteration of the habitat (as discussed below) could have a long-term adverse impact on those species.

Sediment Removal with Backfilling in Reaches 5, 6, 7, and 8: SED 8 involves extensive sediment removal with backfilling throughout the Reach 5 channel, the backwaters, the Reach 7 impoundments, and Rising Pond. The potential for such activities to have a long-term adverse impact on biota and their habitats in these areas is greater than under all other alternatives. SED 8 would involve a much greater spatial extent of removal (340 acres) and take far longer to implement than all other alternatives, and thus would continually disrupt local subpopulations of aquatic organisms (plants, fish and benthic invertebrates) during the course of the 51-year implementation period. As discussed in Section 4.5.5.3, limited research has been conducted on the cumulative impacts to aquatic resources from multiple and disparate habitat perturbations such as those that would be caused by the extensive sediment removal and backfilling in SED 8. While it is expected that the aquatic biota in individual areas would be able to recover eventually due to the recolonization of downstream areas from upstream sources, the length of time for such recovery to occur when there are such extensive and prolonged remedial impacts throughout the river system is uncertain and could take many decades, particularly when the disturbances themselves would last for more than 50 years.

With specific respect to the removal and backfilling activities in the backwaters, it is anticipated that natural deposition of organic detritus from upstream sources would eventually provide the base necessary for a fully developed vegetative community. However, because of the magnitude of the area impacted by this remedial alternative, the time required to develop a sufficient organic base would be significant. Over time, the remediated areas are expected to silt in, but the length of time that it would take for them to support emergent species could be lengthy given the spatial extent (86 acres) and duration (10 years) of the backwater remediation. In addition, due to the spatial extent and duration of the remediation, local subpopulations of less mobile organisms such as reptiles and amphibians would likely be permanently displaced from these backwater areas.

Riverbank Stabilization: The bank removal/stabilization activities that are part of SED 8 may have some long-term adverse environmental impacts on riparian habitats in Reaches 5A and 5B, depending upon the stabilization technique used. Since these activities are the same as in SED 3, the discussion of potential long-term adverse environmental impacts of such activities under SED 3 (in Section 4.3.5.3) also applies to SED 8.

Supporting Facilities in Floodplain: Long-term impacts to biota and their habitats may also occur as a result of ancillary supporting activities in the floodplain, including the clearing and construction of access roads and clearing for sediment staging areas. The conceptual layout design for SED 8 is similar to SED 7 and includes 29 staging areas covering 67 acres (at an assumed size of approximately 1.7 acres per mechanical removal staging area and varying sizes for the hydraulic dredging staging areas based on available space and storage requirements), and approximately 21 miles of temporary roadways, which would amount to an additional 51 acres (assuming a road width of 20 feet). The types of potential long-term impacts from these supporting facilities in SED 8 are qualitatively similar to those for SED 3 and include habitat modification due to compaction/alteration of the soils, displacement of some species due to habitat fragmentation, and colonization by invasive species, as described in Section 4.3.5.3. However, in SED 8, such effects could occur over a greater area.

Adverse Impacts on Wetlands

The wetland environments that could be affected by SED 8 include: (a) riverine wetlands found along the periphery of removal/backfilling areas in Reaches 5, 6, 7, and 8 and in backwater and impoundment areas; (b) riverine wetlands along the periphery of the bank stabilization areas in Reach 5; and (c) floodplain wetlands impacted by access roads and other ancillary activities. Each of these is discussed below.

- Although riverine wetlands along the areas in Reaches 5, 6, 7, and 8 that would be subject to removal with backfilling would be initially lost as a result of those activities, the bathymetry is not expected to change. Fine sediments transported from upstream would accumulate over time and these wetlands would naturally recolonize with wetland vegetation from upstream sources. However, as noted above, the time for such recovery in the more downstream areas could be lengthy given the extent and prolonged duration of upstream remediation.

- As discussed for SED 3, while bank stabilization activities in Reaches 5A and 5B may temporarily disturb riverine wetlands adjacent to the banks, the bank treatments are not expected to materially alter the bathymetry or substrate in the adjacent in-river areas, and thus would not be expected to have a long-term adverse impact on these riverine wetlands.

- The potential impacts on wetlands in the floodplain due to ancillary construction activities are anticipated to be largely the same as for SED 6 and SED 7, as described in Section

4.6.5.3. Specifically, since it is likely that some roadways in wetland areas would be retained for long periods (e.g., more than 2 to 3 years), their use would likely result in compaction of the underlying substrate, which could alter the water storage capacity and hydrology of the wetlands.

Long-Term Impacts on Aesthetics

It is expected that there would be severe long-term impacts to aesthetics of the natural environment of the River from the implementation of SED 8. While it would take more than 50 years to implement SED 8 over 13 miles of actual river length, the long-term impacts would extend beyond this, as various reaches are restored and newly planted trees and other plantings along the banks mature. To begin with, in bank areas where revetment mats or armor stone are used for bank stabilization, the natural appearance of the banks would be diminished over the long term. In other areas, following implementation of the remediation, successional processes would begin to restore the vegetative community along the top of the bank bordering the River. However, that vegetation would likely not mimic the pre-remediation state of the community along the River. The vegetative communities that currently exist along portions of the River are mature systems, and it would therefore take several decades for any planted trees to reach the size of those older trees.

The construction of an extensive network of roadways and staging areas on both sides of the River to support implementation of SED 8 also has the potential to cause long-term impacts on the aesthetics of the floodplain. As discussed for prior alternatives, the placement of roadways and staging areas would remove trees and vegetation, and hence these areas would not be natural in appearance. The length of time that the appearance of the floodplain in these in these areas would be changed depends on the length of time that the roads and staging areas remain, along with additional time for these areas to return to a natural appearance. SED 8 would take the longest time to complete of all the sediment alternatives; therefore, its implementation would result in the longest length of time that roads would be in place. Moreover, since the trees in some of the affected upland forested areas are mature trees that are greater than 50 years in age, it would take a commensurate amount of time for those communities to develop an appearance comparable to their current appearance.

Impacts on Banks and Bedload Movement

The potential physical impacts of SED 8 on banks are largely the same as those described for SED 3 in Section 4.3.5.3. As discussed there, stabilization of the erodible banks in Reaches 5A and 5B to prevent future erosion could result in the need to stabilize other, currently non-erodible bank or nearby riverbed areas. In addition, the bank stabilization would reduce the current process by which eroding banks slump into the River and subsequently contribute to the overall bedload in Reaches 5A and 5B. However, it is not anticipated that the backfill that would be placed in Reaches 5A and 5B would result in any significant impacts to bedload transport, as the backfill materials would have generally similar physical characteristics to the existing sediments.

Potential Measures to Mitigate Long-Term Adverse Impacts

Measures to mitigate the potential long-term adverse impacts described above would include the restoration measures described in Section 4.5.1, which are similar to the measures those summarized in Section 4.3.5.3 for SED 3. However, because of the timeframe and spatial extent of this remedial alternative, the prospect for success of these measures is more uncertain. For example, the lengthy recovery period would greatly increase the potential for disturbed areas to be colonized by invasive species (Burke and Grime, 1996), which could permanently alter the biological communities and their associated habitats.

4.8.6 Attainment of IMPGs

As part of the evaluation of SED 8, average PCB concentrations in surface sediment and fish predicted by EPA's model at the end of the 81-year projection period have been compared to applicable IMPGs. For these comparisons, model-predicted sediment and fish PCB concentrations were averaged in the manner discussed in Section 3.3. The sections below describe the human health and ecological receptor IMPG comparisons for SED 8, and those comparisons are illustrated in Tables 4-44 through 4-49.

As described below, PCB concentrations in some areas are sufficiently low that certain IMPGs would be achieved prior to any active remediation of sediments, while some other IMPGs would be achieved at some point within the 81-year model simulation period, and other IMPGs would not be met (if at all) for many years after the modeled period. The numbers of years needed to achieve the IMPGs are presented in Tables 4-44 through 4-49.[93] In addition, figures in Appendix G show temporal profiles of model-simulated PCB concentrations for each of the IMPG comparisons described in this section (including the estimated time to achieve each IMPG). Where certain IMPGs would not be achieved by the end of the model projection period, the number of years to achieve the IMPGs has been estimated by extrapolating the model projection results beyond the 81-year simulation period, as directed by EPA, using the extrapolation method described in Section 3.2.1. As previously noted, such extrapolation produces estimates that are highly uncertain. Nonetheless, the extrapolated estimates of time to achieve the IMPGs that are not met within the 81-year model projection period are described below.

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[93] The extent to which SED 8 would accelerate attainment of the IMPGs relative to natural processes can be seen by comparing these tables to the comparable tables for SED 1 (see Section 4.1.6 above).

Also, as described in Section 3.2, bounding simulations have been conducted with the model to evaluate the significance of various assumptions regarding the East Branch PCB boundary condition and sediment residual values, as directed by EPA. For SED 8, in almost all cases, application of the "lower bound" assumptions in the model did not result in the attainment of additional IMPGs, beyond those attained using the "base case" assumptions, for the receptors/averaging areas described below. Therefore, the discussion below focuses on IMPG attainment resulting from the application of the "base case" model assumptions; however, the few instances of additional IMPG attainment resulting from application of the lower-bound assumptions are noted.

4.8.6.1 Comparison to Human Health-Based IMPGs

For human direct contact with sediments, the average predicted surface sediment (0- to 6-inch) concentrations would achieve all IMPG values in all sediment exposure areas (except one in Reach 7, where the RME IMPG based on a 10^{-6} cancer risk would not be met) (Table 4-44). Many of these IMPGs are achieved prior to the start of the remediation, while the others would be achieved in time periods ranging from 5 to 50 years.

For human consumption of fish, the average fish PCB concentrations predicted by the model in Year 81, when converted to fillet-based concentrations, would not achieve the fish consumption IMPGs based on RME assumptions and either cancer risks or non-cancer impacts in any reaches in Massachusetts (with the exception of the RME IMPGs based on a 10^{-4} cancer risk under the probabilistic analysis in most reaches, and under the deterministic analysis in some reaches, but not the corresponding non-cancer IMPGs) (Table 4-45).[94] However, in the Connecticut impoundments, the CT 1-D Analysis indicates that SED 8 would achieve the RME IMPGs associated with a cancer risk level of 10^{-5} (or lower), as well as non-cancer impacts.

Similar to SED 7, SED 8 would also achieve many of the CTE-based IMPGs in many of the Massachusetts subreaches, as well as all CTE IMPGs in Connecticut.[95]

Extrapolation of the model results beyond the model period indicates that achievement of the RME-based IMPGs that EPA considers protective for unrestricted fish consumption of 50 meals per year, based on a deterministic approach and a 10^{-5} cancer risk as well as non-

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[94] Application of the lower-bound model assumptions results in the attainment of three additional RME IMPGs – the probabilistic non-cancer IMPG for adults in Reach 6, the probabilistic IMPG based on a 10^{-4} cancer risk in Reach 7D, and the deterministic IMPG based on a 10^{-4} cancer risk in Reach 7E.

[95] Application of the lower-bound model assumptions results in the attainment of one additional CTE IMPG (the deterministic non-cancer IMPG for children in Reach 7E).

cancer impacts, would take 180 to >250 years in the PSA and >250 years in Reaches 7 and 8.

4.8.6.2 Comparison to Levels Considered Protective of Ecological Receptors

For benthic invertebrates, predicted average sediment concentrations in all of the EPA spatial bins within the PSA and within the simulated subreaches between Woods Pond Dam and Rising Pond Dam would achieve both the lower and upper bounds of the IMPG range (3 to 10 mg/kg), except in Reach 7C, where the predicted concentration is just above the lower end of the range (Table 4-46). These levels would generally be achieved immediately following completion of remediation in the spatial bins in Reaches 5 and 6, and within that same timeframe in the portions of Reaches 7 and 8 where the levels are not below the range at the onset of the projection period.

For amphibians, predicted surface sediment PCB levels in the backwater areas at the end of the modeled period would achieve both the lower and upper bounds of the IMPG range (3.27 to 5.6 mg/kg) in all 85 acres of backwaters evaluated (Table 4-47). Times to achieve the lower-bound IMPGs generally range from 3 to 30 years, which correspond to the times in which remediation occurs within these areas.

For insectivorous birds (represented by wood duck) and piscivorous mammals (represented by mink), the model-predicted surface sediment concentrations were compared to selected target sediment levels of 1, 3, and 5 mg/kg, as discussed previously. For both receptor groups, the predicted surface sediment concentrations are below all three of the target sediment levels evaluated in all averaging areas (Table 4-48), with times to achieve these target levels generally ranging between 2 and 40 years; the time required to reach the 1 mg/kg level generally corresponds to the time when a majority of the sediments within a given averaging area have been remediated.

For fish (based on warmwater and coldwater fish protection), piscivorous birds (represented by osprey), and threatened and endangered species (represented by the bald eagle), the model-predicted average whole-body fish PCB concentrations would achieve the applicable receptor IMPGs in all reaches, with the exception of piscivorous birds in Reach 7B (Table 4-49). Estimated times to achieve these IMPGs range between 3 and 30 years for fish and threatened and endangered species and 10 and 50 years for piscivorous birds. In the one subreach where the IMPG for piscivorous birds is not attained within the 81-year projection period, the estimated time to achieve this IMPG, based on the extrapolation beyond the model period, is >250 years.

4.8.7 Reduction of Toxicity, Mobility, or Volume

The degree to which SED 8 would reduce the toxicity, mobility, or volume of PCBs is discussed below.

Reduction of Toxicity: SED 8 does not include any treatment processes that would reduce the toxicity of the PCBs in the sediment. However, if "principal threat" wastes (e.g., free NAPL, drums of liquid) should be encountered (which is not anticipated), they would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: SED 8 would reduce the mobility of PCBs in the River by removing approximately 2,217,000 cy of sediment containing PCBs in Reaches 5 through 8 and placing backfill over all the removal areas, and removing approximately 33,000 cy of PCB-containing erodible bank soils in Reach 5 and stabilizing those banks. In total, SED 8 would remediate approximately 340 acres of sediments (42 in Reach 5A, 27 in Reach 5B, 57 in Reach 5C, 86 in Reach 5 backwaters, 60 in Woods Pond, 27 in the Reach 7 impoundments, and 41 in Rising Pond).

Reduction of Volume: SED 8 would reduce the volume of sediment containing PCBs and the mass of PCBs present in the River through the removal of a total of 2,250,000 cy of sediments/bank soils containing approximately 54,500 lbs of PCBs over an area of approximately 340 acres. A summary of the volumes and PCB mass that would be removed under this alternative from each reach is presented below.

	Removal Volume (cy)	**PCB Mass (lbs)**
Reach 5A:	268,000	19,000
Reach 5B:	153,000	2,200
Reach 5C:	279,000	7,600
Reach 5 backwaters:	388,000	5,700
Reach 6 (Woods Pond):	575,000	13,300
Reach 7 impoundments:	86,000	600
Reach 8 (Rising Pond):	468,000	4,900
Reach 5A/5B Banks:	33,000	1,200
Totals:	**2,250,000**	**54,500**

4.8.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of SED 8 has included consideration of the short-term impacts of implementing this alternative on the environment, the local communities (as well as communities along transport routes), and the workers involved in the remedial activities. These impacts would last for the duration of the active remedial activities, which is estimated to be approximately 51 years – specifically, 11 years for Reach 5A, 6 years for Reach 5B, 7 years for Reach 5C (conducted concurrently with Reach 5 backwaters), 10 years for Reach 5 backwaters, 11 years for Reach 6, 4 years for the Reach 7 impoundments, and 9 years for Reach 8. Since the extent and duration of remediation activities under SED 8 are greater than those under all previous alternatives, the short-term impacts would be the most widespread of all alternatives and last the longest.

Impacts on the Environment

The short-term effects on the environment resulting from implementation of SED 8 would include potential impacts to the water column, air, and biota in the Rest of River area during removal and backfilling activities, alteration/destruction of benthic habitat in the areas subject to those activities, loss of riparian habitat as a part of bank stabilization activities, and loss of floodplain habitat and biota due to construction of the supporting facilities. Short-term impacts specifically associated with each remedial component are described below.

Sediment Removal with Backfilling: Sediment removal with backfilling activities in Reaches 5, 6, 7, and 8 (2,217,000 cy over 340 acres) would result in resuspension of PCB-containing sediment due to the invasive nature of removal operations and potential for PCB-containing residuals. As discussed under SED 4 (Section 4.4.8), resuspension to the water column outside the work area would be controlled in Reaches 5A and 5B as removal activities in those reaches would be conducted using sheetpile enclosing the removal/backfill areas. However, the potential exists for suspended or residual sediment containing PCBs to be released from the work area both during sheetpile installation and during a high-flow event should overtopping of the sheeting occur. For Reach 5C, Reach 5 backwaters, Woods Pond, Reach 7 impoundments, and Rising Pond, activities would be conducted in the wet with silt curtains used to mitigate sediment release to downstream reaches. In these areas, some sediment containing PCBs could be released from the work area through the dredging/excavation process even though the area would be surrounded by silt curtains. In addition, boat and barge traffic could resuspend sediment during the construction phase. Based on *The 4Rs of Environmental Dredging Report* (USACE, 2008, p. 19), PCB releases during dredging "may be one to three orders of magnitude greater than pre-dredging releases." For SED 8, these releases would occur over a span of approximately 50 years. Further, studies indicate that approximately 2 to 3% of the PCB mass dredged is lost to the water column during these removal operations (USACE, 2008), equating to approximately

1,000 to 1,500 lbs of PCBs for SED 8. Water column monitoring would be performed during these removal/backfilling activities to assess any potential water quality impacts.

The potential also exists during removal and related sediment processing activities for airborne releases that could impact downwind communities. Air monitoring would be conducted during these activities to assess any potential air quality impacts.

Implementation of SED 8 would cause a loss of aquatic habitat in Reaches 5 through 8 (except in the channel in Reach 7) where sediment removal with backfilling would occur. It is estimated that these impacts would occur over approximately 340 acres along approximately 13 miles of River. Since this alternative would include complete removal of all aquatic main channel and backwater areas between the Confluence and Woods Pond Dam and select locations between Woods Pond Dam and Rising Pond Dam, the short-term loss of aquatic habitat would be comprehensive and significant, and would last for a considerable period. Implementation of SED 8 would remove the natural bed material, debris, and aquatic vegetation which are used as habitat by both fish and benthic invertebrates throughout the River. The sediment removal activities would also result in the direct loss of benthic invertebrates and other aquatic organisms (e.g., turtles and amphibians) residing in the sediments during removal, and disruption and displacement of fish populations.

In addition, short-term increases in PCB concentrations in biota downstream of the removal work areas have been noted at other sites where dredging in the wet has occurred (e.g., Grasse River) and even where excavation has been conducted in the dry (e.g., Upper ½-Mile Reach), as described in Sections 4.3.8 and 4.4.8, and would be expected under SED 8.

Additionally, sediment removal activities would alter feeding areas for birds and mammals that live adjacent to the River and feed in areas subject to remediation.

Bank Stabilization: Bank stabilization activities in Reach 5 would have an immediate effect on the riparian community bordering the River. These impacts would be the same as described for SED 3 in Section 4.3.8.

Supporting Facilities: Construction of supporting structures (e.g., roadways, staging areas, etc.) in the floodplain adjacent to the River would result in the loss of habitat in those areas and the wildlife that it supports. The supporting structures required for SED 8 are similar to those for SED 6 and SED 7 (see Sections 4.6.8 and 4.7.8). It is anticipated that SED 8 would require a total of approximately 118 acres for access roads and staging areas (approximately 59 acres within the 10-year floodplain). The loss of this additional habitat would affect the ability of some wildlife to nest and feed in these areas. In some instances, it would also cause habitat fragmentation, which could further disrupt the movement and interactions of certain wildlife species.

Impacts on Local Communities and Communities Along Transport Routes

SED 8 would result in major short-term impacts to the local communities in the Rest of River area. These short-term effects would include disruption along the River and within the floodplain due to the construction of access areas and roads, disruption of recreational canoeing and other River-related and land-side activities, and increased noise and truck traffic.

Recreational activities in the areas that would be affected by SED 8 include bank fishing, canoeing, hiking, dirt biking/ATVing, and waterfowl hunting. During the period of active construction, restrictions on such recreational uses of the River and floodplain would be imposed in the areas in which remediation-related activities are taking place. Due to safety considerations, boaters, hikers, angler, hunters, and other recreational users would not be able to use the River or floodplain in the areas where such activities are being conducted. Further, bank stabilization activities in Reach 5 would remove the ability of recreational anglers and hikers to use those areas during construction. Aesthetically, the presence of the heavy construction equipment and cleared or disturbed areas would detract from the visually undisturbed nature of the area until the restoration plantings for the disturbed areas have matured. Under SED 8, these impacts would affect portions of Reaches 5 and 6 for an estimated 38 years, with impacts to the Reach 7 impoundments and Rising Pond occurring over approximately 13 years. This length of time would suggest that an entire generation would go over half of their lives without the ability to have full access to the recreational potential of the River.

Due to the need to deliver backfilling materials and equipment to the work areas and to remove excavated material, truck traffic in the area would increase substantially over current conditions. It is expected that this increased truck traffic would persist for the duration of the project (over 50 years). As an example, if 20-ton capacity trucks were used to transport sediments and bank soils from the staging areas, it would take approximately 168,800 truck trips to do so. In addition, assuming the use of smaller capacity trucks for local hauling (i.e., 16-ton trucks), approximately 223,400 truck trips would be required to transport the backfill and bank stabilization material to Reaches 5 through 8. This additional traffic would increase noise levels and potential for emissions of vehicle/equipment exhaust and nuisance dust to the air. Further, noise in and near the construction zone could affect those residents and businesses located along the River.

The additional truck traffic would also increase the risk of traffic accidents along transport routes. Appendix D includes an analysis of potential risks from the increased truck traffic that would be necessary to transport clean materials to the site for implementation of SED 8.[96] This analysis indicates that the increased truck traffic associated with SED 8 would result in an estimated 6.37 non-fatal injuries due to accidents (with a probability of 100% of at least one such injury) and an estimated 0.27 fatalities from accidents (with a probability of 24% of at least one such fatality).

Engineering controls would be implemented, to the extent practical, to mitigate short-term impacts and risks associated with implementation of SED 8. However, some impacts would be inevitable.

<u>Risks to Remediation Workers</u>

There would be potential health and safety risks to site workers implementing SED 8. Implementation of SED 8 is estimated to involve 1,705,705 man-hours over a 51-year timeframe. The analysis in Appendix D of potential risks to workers from implementation of the sediment alternatives indicates that implementation of SED 8 would result in an estimated 16.23 non-fatal injuries to workers (with a probability of 100% of at least one such injury) and an estimated 0.26 worker fatalities (with a probability of 23% of at least one such fatality). Engineering controls and OSHA procedures designed to mitigate risks to remediation workers would be instituted.

4.8.9 Implementability

4.8.9.1 Technical Implementability

The technical implementability of SED 8 has been evaluated considering the factors identified below.

<u>General Availability of Technologies</u>: SED 8 would be implemented using well-established and available in-river remediation methods and equipment. Similarly, land-based support areas would be constructed using commonly available construction technologies. Further, well-established and readily available equipment would also be used to monitor the remedial alternative both during and following implementation.

<u>Ability To Be Implemented</u>: Based on site characteristics, the technologies and process options that are part of SED 8 would be suitable for implementation in the reaches where they

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[96] The risks from truck traffic to transport excavated materials to the staging areas are evaluated as part of risks to workers, discussed below; and the risks from truck traffic to transport such materials from the staging areas away from the site are evaluated under the relevant treatment/disposition alternatives.

would be applied. Sediment removal followed by backfill would be implemented in all river reaches. Sediment removal/backfilling would be performed in the dry in Reaches 5A and 5B and hydraulically in the wet in other reaches. As previously discussed, these techniques have been used at other sites. However, given the length of time required to implement SED 8 (51 years) and, in some reaches, the depths which would be dredged, complications are likely to be encountered during implementation. For example, dredging to depths up to 6 and 7 feet in Woods Pond and Rising Pond would likely require some stabilization measures for the riverbanks to avoid sloughing and bank slope failure. In addition, due to the volume of sediment to be removed in the wet (and time required for removal), it is more likely that a release from the silt-curtained areas would occur.

Since the current river bathymetry is assumed to be maintained in those areas where sediment removal and subsequent backfilling are performed, there would be no net loss of flood storage capacity.

Bank soil removal followed by stabilization would be performed in the erodible bank areas of Reach 5 (high energy areas), with the most appropriate removal/stabilization options selected in the design phase based on the physical features of the bank area in conjunction with the adjacent sediment and/or floodplain soil remedial activities. Since the slope of some of the restored erodible banks would reduced during remediation, some increased flood storage capacity would likely result from bank remediation in those areas of Reach 5.

MNR with institutional controls would be implemented in the downstream reaches, where PCB concentrations are already low and would likely decrease further following remediation in the upstream reaches. Monitoring to track changes in PCB concentrations following the SED 8 remedial activities could be performed using readily available methods and materials, such as have been used previously in the River. Similarly, the continued maintenance of biota consumption of advisories would be expected to use similar techniques to those used previously.

Support facilities in the floodplain area necessary for implementation of SED 8 could readily be constructed using commonly available construction techniques. The facilities would be constructed to avoid wetlands and other sensitive habitats to the extent practicable.

Although the technologies needed to implement SED 8 are generally available and suitable, the 51-year period required to implement this alternative introduces other complications and uncertainties (in addition to those described above). It is difficult to contract for a remedial project for that length of time, given the possibility of changes in equipment and techniques, and the possibility that contracting firms will not remain available throughout that long a time period. It is also difficult to predict the availability of large quantities of backfill and capping materials that far into the future. In addition, depending on the treatment or disposition alternative selected (see Section 7), the availability of landfill capacity or treatment capabilities could also affect the ability to implement such a long-term dredging project. Finally, there are uncertainties that can arise due to changes in statutes, regulations, regulatory priorities, property ownership, and other unforeseeable complications over several decades. While these complications cannot be quantified, they do create considerable uncertainties affecting the ability to implement SED 8.

Reliability: The technologies that comprise SED 8 are reliable, as shown through implementation at other sites and in portions of the Housatonic River upstream of the Confluence. The use of these technologies at other sites was described in Sections 4.4.5.2, 4.5.5.2, 4.6.5.2, and 4.7.5.2. Note that while it is possible to remove sediment at depths of to 7 feet below the riverbed, these sediments are buried below many feet of stable sediments and are currently therefore not available for human and ecological exposure.

Availability of Space for Support Facilities: Implementation of SED 8 would require construction of access roads and staging areas at various locations within the floodplain. As noted previously, an estimated 118 acres of space would be needed, and appear to be available to support the SED 8 activities based on preparation of a conceptual site layout. Development of access roads and staging areas would be sequenced over the approximate 51-year duration of SED 8.

Availability of Backfill Materials: Materials required for backfill placement must be of suitable quality for in-River placement and habitat restoration. Approximately 2,230,000 cy of clean sand and gravel would be required for backfilling. Due to the large volume of material required, it is anticipated that adequate material sources would be difficult to locate, and predicting the availability of suitable material over length of time required to implement this alternative (51 years from initiation of construction) introduces additional complications and uncertainties. For purposes of this CMS Report, it is assumed that necessary quantities would be available. However, obtaining the needed quantities, if feasible, would likely require long travel distances. An evaluation would be required during design activities to determine material availability.

Ease of Conducting Additional Corrective Measures: Future corrective measures, if needed for bank maintenance or to conduct additional remediation, would be implementable, given the same technical and logistical constraints applicable to the initial implementation of SED 8. It is assumed that no corrective measures would be conducted for the areas covered with backfill. Ease of implementation would be directly related to the extent of the additional corrective measures (i.e., area and/or volume to be addressed) and the ease of access (i.e., location of target area and proximity of access areas).

Ability to Monitor Effectiveness: The effectiveness of SED 8 would be determined over time through long-term monitoring to document reductions in PCB concentrations in water column, sediment, and fish tissue in various reaches of the River. Periodic visual observations of the riverbed and restored riverbanks would allow for an evaluation of those components of the remedy. Such activities have been successfully performed on the upper portions of the Housatonic River and at other sites previously. Equipment and methods for this type of monitoring are readily available.

4.8.9.2 Administrative Implementability

The administrative implementability of SED 8 has been evaluated in consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: Implementation of SED 8 would need to comply with the substantive requirements of applicable and appropriate regulations pertaining to the performance of the remedial action (unless waived). As noted in Section 4.8.4, GE believes that SED 8 could be designed and implemented to meet such requirements (i.e., location-specific and action-specific ARARs listed in Tables 2-2 and 2-3), with the exception of certain requirements that could potentially apply to the on-site staging areas if the excavated sediments should constitute hazardous waste, and which GE believes should be waived, if necessary, as technically impracticable.

Access Agreements: Implementation of SED 8 would require GE to obtain access permission from the owners of properties that include riverbank or floodplain areas where remedial work or ancillary facilities would be necessary to carry out the alternative. Although the majority of the areas in Reach 5 are publicly owned, it is anticipated that access agreements may be required from up to approximately 40 private landowners to implement SED 8. Obtaining such access agreements could be problematic in some cases. If GE should be unable to obtain access agreements with particular property owners, GE would request EPA and/or MDEP to provide assistance.

Coordination with Agencies: Implementation of biota consumption advisories would require coordination with state public health departments and/or other appropriate agencies in the dissemination of information to the public and surrounding communities regarding those advisories. In addition, obtaining access to State-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of SED 8, GE would need to coordinate with EPA, as well as state and local agencies, to address any potential health and safety concerns and to provide as-needed support with public/community outreach programs.

4.8.10 Cost

The estimated total cost to implement SED 8 is $615 M (not including treatment or disposition of removed materials). The estimated total capital cost is $601 M, assumed to occur over a 51-year construction period. Estimated annual OMM costs include costs for a 5-year inspection and maintenance program for the restored riverbed (visual observations only), riverbanks, and restored staging areas and access roads; these costs range from $25,000 to $275,000 per year (depending on which reach is being monitored), resulting in a total cost of $4.0 M. The estimated annual OMM costs for SED 8 also include implementation of a long-term water, sediment, and fish monitoring program for a period of 30 years following completion of construction activities on a reach-specific basis. The estimated costs for this long-term program range from approximately $275,000 to $520,000 per year (depending on the extent of monitoring occurring within a given year), resulting in a total cost of $10.3 M. The following summarizes the total capital and OMM costs estimated for SED 8.

SED 8	Est. Cost	Description
Total Capital Cost	$601 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM Cost	$14.3 M	Costs for performance of the OMM programs
Total Cost for Alternative	$615 M	Total cost of SED 8 in 2008 dollars

The total estimated present worth cost of SED 8, which was developed using a discount factor of 7%, a 51-year construction period, and an OMM period of 30 years on a reach-specific basis, is approximately $190 M. More detailed cost estimate information and assumptions for each of the sediment alternatives are included in Appendix E.

These costs do not include the costs of treatment/disposition of removed sediments/bank soils. The estimated costs for combinations of sediment remediation and treatment/disposition alternatives are presented in Section 8.

4.8.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 4.8.2, the evaluation of whether SED 8 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As discussed previously, SED 8 would result in a substantial reduction in the potential for exposure of human and ecological receptors to PCBs in sediments, surface water, and fish by: (a) permanently removing 2,217,000 cy of PCB-containing sediments to the 1 mg/kg depth horizon in Reaches 5 through 8 (except in the Reach 7 channel) and placing backfill over the underlying sediments; and (b) removing 33,000 cy of erodible PCB-containing riverbank soils from Reach 5 and covering/stabilizing those erodible banks. As shown in Section 4.8.3, implementation of SED 8 is predicted to reduce the PCB load in the River passing Woods Pond Dam and Rising Pond Dam by 98% and 96%, respectively (essentially the same as SED 5 through SED 7) over the course of the modeled period, and to reduce the annual PCB mass transported from the River to the floodplain in Reaches 5 and 6 by 99% over that period.

Further, as shown in Section 4.8.5.1, EPA's model predicts that SED 8 would result in a substantial permanent reduction in sediment and fish PCB concentrations. For example, that model predicts that the fish PCB concentrations (whole body) would be reduced over the modeled period from 70-110 mg/kg to approximately 1 mg/kg in Reaches 5 and 6, from 30-50 mg/kg to approximately 1-4 mg/kg in the Reach 7 impoundments, from 30 mg/kg to approximately 1 mg/kg in Rising Pond, and from 1-2 mg/kg to 0.02-0.04 mg/kg in the Connecticut impoundments.

While SED 8 thus provides a substantial permanent reduction in sediment and fish PCB concentrations, the amount of removal in this alternative is far more than necessary to achieve this magnitude of reduction, as demonstrated by the reductions that would be achieved by several of the previously discussed alternatives. Moreover, as discussed in Section 4.8.5.3, potential adverse effects of SED 8 on the environment would be significant due to the comprehensive destruction of habitat areas throughout the Rest of River area.

Compliance with ARARs: As explained in Section 4.8.4, the model predictions of water column PCB concentrations indicate that SED 8 would achieve the chemical-specific ARARs, except for the water quality criterion of 0.000064 µg/L based on human consumption of water and organisms, which GE believes should be waived as technically impracticable. Further, GE believes that SED 8 could be designed and implemented to meet the pertinent location-specific and action-specific ARARs, with the possible exception of certain requirements that could potentially apply to the on-site staging areas if the excavated sediments should constitute hazardous waste, and which GE believes should be waived, if necessary, as technically impracticable.

Human Health Protection: As discussed in Section 4.8.6.1, for direct human contact with sediments, SED 8 would achieve IMPG levels based on a 10^{-6} cancer risk (or 10^{-5} in one area), as well as all non-cancer IMPGs, in all sediment exposure areas, with the majority of those levels achieved at the present time. As such, SED 8 would protect human health from direct contact with sediments. For human consumption of fish, the fish PCB concentrations predicted to result from SED 8 in Reaches 5 through 8 at the end of the 81-year simulation period, when converted to fillet-based concentrations, would not achieve the RME-based IMPGs within EPA's cancer risk range or based on non-cancer impacts, i.e., the levels that EPA considers to be protective for unrestricted consumption of Housatonic River fish (except for the RME 10^{-4} cancer IMPG, but not the non-cancer IMPGs, in several areas). Extrapolation of model results beyond the simulation period indicates that PCB concentrations in fish fillets would reach the RME IMPG levels based on a 10^{-5} cancer risk and non-cancer impacts in approximately 180 to >250 years in the PSA and >250 years in Reaches 7 and 8. In the Connecticut impoundments, the CT 1-D Analysis indicates that SED 8 would achieve the RME fish consumption IMPGs based on a 10^{-5} cancer risk and all non-cancer IMPGs within the modeled period. Where the levels for unrestricted fish consumption are not achieved, institutional controls – specifically, fish consumption advisories – would continue to be utilized to provide human health protection from fish consumption.

Environmental Protection: As discussed in Section 4.8.6.2, the model results indicate that, by the end of the 81-year modeled period, SED 8 would achieve the sediment and fish IMPG levels for all ecological receptor groups and areas, except the IMPG for piscivorous birds in one subreach (Reach 7B).[97] The estimated time to achieve all the other ecological IMPGs in all averaging areas is approximately 50 years.

At the same time, implementation of SED 8 would have substantial short-term and long-term adverse environmental impacts. As discussed in Section 4.8.8, the short-term effects would include comprehensive loss of aquatic habitat in Reaches 5, 6, 7, and 8 (except the Reach 7 channel), loss of riparian habitat in the bank stabilization areas, potential resuspension of PCB-containing sediments during removal, and loss of floodplain habitat in area where supporting facilities are constructed. These short-term impacts would be more widespread and would last longer than those for all other alternatives.

In addition, as discussed in Section 4.8.5.3, due to the comprehensive destruction of habitat and the duration of remedial activities, implementation of SED 8 would have substantial long-term adverse environmental impacts in Reaches 5 through 8 (except in the Reach 7 channel). These impacts would occur in areas that would be removed and backfilled, on stabilized banks in Reaches 5A and 5B, and in upland forested areas and wetlands in the floodplain that would be impacted due to ancillary construction activities for access roads and staging areas. These impacts would include loss of habitat, fragmentation of remaining habitat for some species, and the cumulative effects of the numerous short-term impacts on the affected habitats of the river system. The length of time for existing aquatic communities to fully

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[97] Given these results, this one exceedance of the IMPG (which is only slightly above the IMPG level) would not be expected to have an adverse impact on the overall local population of these birds in the Rest of River area.

recover is uncertain and could take many decades, or multiple generations for the aquatic organisms.

These impacts must be balanced against achieving the ecological IMPGs in determining whether this alternative would provide "overall" protection of the environment. As stated by EPA (2005a, p. 6-6), "[i]t is important to determine whether the loss of a contaminated habitat is a greater impact than the benefit of providing a new, modified but less contaminated habitat." (See also EPA, 1997, discussed in Section 2.1.1 above.) In this case, SED 8 would address the ecological risks that EPA concluded in the ERA were present in the Rest of River area. Thus, if one accepts EPA's conclusions in the ERA, SED 8 would meet the standard of providing environmental protection from those risks. However, in doing so, it would cause much more environmental damage than necessary to provide such protection.

Summary: Based on the foregoing considerations, it is concluded that SED 8 would provide overall protection of human health and the environment, although at the cost of causing substantial environmental harm to the Rest of River area over more than half a century.

4.9 Comparative Evaluation of Sediment Alternatives

The eight sediment alternatives have been individually evaluated in detail in Sections 4.1 through 4.8 against the three General Standards and six Selection Decision Factors specified in the Permit. This section contains a comparative evaluation of those alternatives using the same nine criteria.

In this comparative analysis, the relative performance of each sediment alternative is evaluated against the Permit criteria to identify advantages and disadvantages of each alternative relative to the others. This comparative analysis also addresses the requirement specified in the Permit (Special Condition II.G.3) to reach a conclusion as to which alternative, in GE's opinion, is "best suited to meet the [General Standards] in consideration of the [Selection Decision Factors], including a balancing of those factors against one another." As this language reflects, a comparison of alternatives necessarily involves balancing and trade-offs. A number of alternatives might all satisfy the General Standards of overall protectiveness, source control, and achievement of ARARs, but they might also present differing magnitudes of short-term and long-term impacts, as well as differences in effectiveness, implementability, and cost. The goal of this balancing process is to select remedial alternatives that best achieve ***net*** risk reduction. As recently summarized by the USACE, following a workshop among EPA and dredging experts:

> "[T]here is growing recognition that the effectiveness of any remedial technology, including dredging, is most appropriately measured through a comparison of what

> could be achieved through use of an alternative technology. Comparing predictions of the effectiveness of all potential technologies provides a context for attaching meaning to any particular measure of effectiveness. The importance of this fact is at the heart of recommendations for basing decisions about remedy selection on a comparison of net risk reduction." (USACE, 2008, pp. 49-50)

As a result, the comparative analysis presented herein focuses primarily on differences among the alternatives with respect to each criterion. For criteria (or portions thereof) where there is no clear distinction among the sediment alternatives, a brief statement is included to identify the similarities.

4.9.1 Overview of Alternatives

The following table summarizes, for each of the eight sediment alternatives evaluated, the volume of sediment and bank soil that would be removed, total areas that would be capped or backfilled following removal, the total area that would be subject to capping alone, the total area subject to thin-layer capping, the total surface area addressed, and the estimated construction duration.

Table 4-50 – Overview of Sediment Alternatives

Remedial Component	**SED 1 / 2**	**SED 3**	**SED 4**	**SED 5**	**SED 6**	**SED 7**	**SED 8**
Removal Volume (cy)	---	167,000	295,000	410,000	554,000	793,000	2,250,000
Capping after removal (acres)	---	42	91	126	178	146	---
Backfill after removal (acres)	---	---	---	---	---	69	340
Capping w/o removal (acres)	---	---	37	60	45	45	---
Thin-Layer Capping (acres)	---	97	119	102	101	65	---
Total Surface Area Addressed (acres)	---	139	247	288	324	325	340

Remedial Component	SED 1 / 2	SED 3	SED 4	SED 5	SED 6	SED 7	SED 8
Construction Duration (years)	0	10	15	18	21	25	51

Note: MNR would be a component of all alternatives except SED 1.

4.9.2 Overall Protection of Human Health and the Environment – Introduction

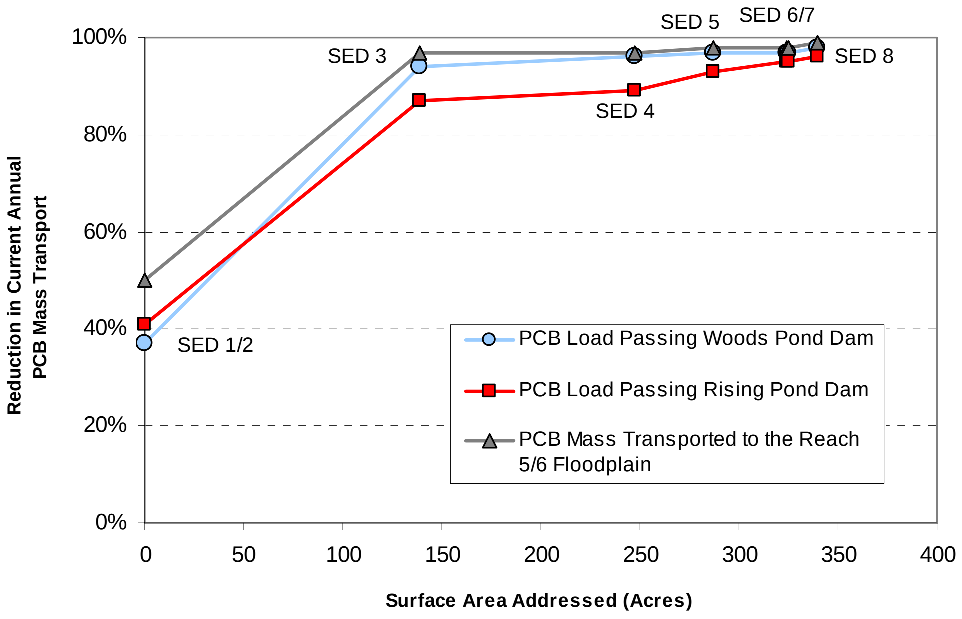
As previously discussed, the evaluation of whether a sediment alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the comparative evaluation of alternatives in regard to overall protection of human health and the environment is presented at the end of Section 4.9 so that it can take account of the comparative evaluations under those other criteria, as well as other aspects of the alternatives and other factors relevant to the protection of human health and the environment.

4.9.3 Control of Sources of Releases

Completed and ongoing source control and remediation measures upstream of the Confluence, along with natural recovery processes, have resulted in significant reductions in the water column PCB load entering the Rest of River (Section 4.1.1). Reduction in PCB loading and transport into the Rest of River is expected to continue, especially considering the planned future remediation activities upstream of the Confluence. Although such remediation will not eliminate PCB inputs from upstream, EPA's model predicts that, in 52 years, the reductions from this remediation along with natural recovery processes (as reflected in SED 1 and SED 2) would result in reductions of 37% and 41% in the PCB loads passing Woods Pond and Rising Pond Dams, respectively, and a reduction of 50% in the mass of PCBs transported from the River to the floodplain in Reaches 5 and 6.

The remaining sediment alternatives (SED 3 through SED 8) would control additional sources within the Rest of River by permanently removing and/or capping PCB-containing sediments, and would thus result in an additional reduction in PCB loading in the River and transport to the floodplain. Compared to current conditions, the most significant incremental reduction in PCB loading and transport would result from SED 3. Compared to that alternative, SED 4 through SED 8 would achieve only small additional incremental reductions. The reductions in the annual PCB load transported downstream (passing Woods Pond and Rising Pond Dams) and to the floodplain within Reaches 5 and 6 at the end of the model projection period are summarized in Table 4-51 and depicted graphically (versus surface area addressed) on Figure 4-14 below.

Figure 4-14 – Reduction in Current PCB Mass Transport Over the Model Projection Period Versus Surface Area Addressed in Remedy



These model results show that, under SED 3, the PCB load passing Woods Pond and Rising Pond Dams would decrease by 94% and 87%, respectively, while the PCB mass transported to the Reach 5/6 floodplain would decrease by 97%. After SED 3, the reductions level off. Compared to SED 3, SED 4 would involve remediation (via removal, capping, and/or thin-layer capping) of 80% more surface area, yet would achieve additional incremental reductions of only 2% for the loads passing Woods Pond and Rising Pond Dams and less than 1% for transport to the Reach 5/6 floodplain. Likewise, for the remaining alternatives (SED 5 through SED 8), although the extent of remediation would continue to increase, the total incremental reductions in load/transport are only 2% at Woods Pond Dam, 7% at Rising Pond Dam, and 2% for the floodplain. In short, the greatest reductions in PCB load and transport would occur through implementation of SED 3, and only marginal additional reductions would occur beyond that point.

To assess the extent to which the sediment alternatives would mitigate the effects of a flood that could cause buried sediments to be exposed, model predictions of erosion and reach-average PCB concentrations in surface sediments following an extreme high flow event were compared. While the EPA model predicts varying responses to high flow events, including the extreme event (50- to 100-year flood) simulated in Year 26 of the projection, the results generally show that buried sediments containing PCBs would not be exposed to any significant extent during high flow events under any remediation alternative (SED 3 through SED 8). Specifically, for areas that would be capped (either with or without prior removal), the model predicts that, with an appropriately sized armor stone layer, those areas would be stable (i.e., would not experience erosion) even under high flow events. For areas receiving a thin-layer cap, the model predicts that those areas would largely remain in place throughout all the high flow events simulated in the model projections. While, in some instances, the model predicts that all or a portion of the thin-layer cap material in certain areas would be eroded, the spatial extent of predicted erosion was small (typically on the order of a few model grid cells), and the resulting increases in reach-average surface sediment PCB concentrations were likewise small. For example, under all alternatives that involve thin-layer capping, the model predicts that erosion would occur over < 6% of the thin-layer cap areas in the Reaches 5 and 6 channel, with resulting concentration increases of < 0.5 and < 1 mg/kg, respectively. In the Reach 5 backwaters, the impacts were even less, with erosion predicted to occur in < 1% of the thin-layer cap area, resulting in concentration increases of < 0.2 mg/kg. In Reaches 7 and 8, predicted erosion was limited, covering generally < 20% of the thin-layer capped areas in Reach 7 and < 7% in Rising Pond (with corresponding concentration increases of < 2 mg/kg and < 0.4 mg/kg, respectively).[98] Moreover, even after the concentration increases described above are taken into account, the concentrations following the high flow events still represent significant reductions relative to current levels for all cases where a thin-layer cap would be placed (90% to 99% for Reaches 5, 6, and 8 and 50% to 90% for the Reach 7 impoundments). Thus, the differences in potential exposure of buried PCBs predicted by the model are minor, and do not represent a significant differentiator among the eight sediment alternatives.

Furthermore, apart from SED 1 and SED 2, each of the sediment alternatives would involve removal of the same volume of PCB-containing soil from the erodible riverbanks, followed by stabilization of those banks. Thus, all of those alternatives would provide the same measure of control of potential future releases of PCBs from those riverbanks to the River.[99]

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[98] Similarly, in the cases where backfill would be placed following removal (e.g., SED 7 and SED 8), the model predicts that a majority of those areas would be stable; the erosion of backfill material predicted in some limited areas of Reach 5A and the Reach 7 impoundments produced little or no change in reach-average surface sediment PCB concentrations (i.e., 0.3 mg/kg or less).

[99] In addition, all sediment alternatives assume that the dams on the River would continue to limit the movement of PCB-containing sediments in the impoundments behind the dams, since all alternatives assume the continuation of the dam inspection, monitoring, and maintenance programs in place under other authorities to prevent or minimize the potential for failure of those dams.

4.9.4 Compliance with Federal and State ARARs

The potential chemical-specific ARARs include federal and state water quality criteria for PCBs. The model's predictions of annual average water column concentrations (presented in Table 4-52) indicate that SED 1 and SED 2 would not achieve the federal and state water quality criterion for freshwater aquatic life (0.014 µg/L or 14 ng/L) in several reaches in Massachusetts, but that SED 3 through SED 8 would achieve that criterion in all reaches.

The model results further show that none of the alternatives would achieve the very low federal and Massachusetts water quality criterion based on human consumption of organisms (0.000064 µg/L or 0.064 ng/L) in any reaches (except, potentially, for the federal criterion in some, but not all, Connecticut impoundments under some alternatives). As a result, and for the reasons given in Section 4.1.4, GE believes that the ARARs based on the human health consumption criteria should be waived on the ground that achievement of those ARARs would be technically impracticable.[100]

Action-specific and location-specific ARARs are not applicable to SED 1, and those relevant to SED 2 (relating to sampling, biota consumption advisories, and dam inspections) would be met. GE believes that SED 3 through SED 8 could be designed and implemented to achieve the pertinent location-specific and action-specific ARARs (provided that any necessary EPA approval determinations are obtained), with the possible exception of certain requirements that could potentially apply to the temporary on-site staging areas in the event that the removed sediments are found to constitute hazardous waste. In the latter event (which is not anticipated), GE believes that the requirements that could not practically be met should be waived as technically impracticable. That possibility, however, applies equally to all the alternatives involving sediment removal and thus does not provide a basis for distinguishing among them.

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[100] As previously discussed, Connecticut currently maintains a state human health consumption criterion of 0.00017 µg/L (0.17 ng/L), which has not been updated since the federal criterion was revised. It is not clear that that criterion would constitute an ARAR since it is less stringent (and less up-to-date) than the federal criterion (see 40 CFR § 300.5). For the Connecticut impoundments, the CT 1-D Analysis estimates that the water column concentrations would exceed that criterion in all impoundments for SED 1 and SED 2 and in some impoundments for SED 3, and would be below that criterion for SED 4 through SED 8. However, even if this criterion were an ARAR, GE believes that it should also be waived as technically impracticable for two reasons: (1) the estimates produced by the CT 1-D Analysis are so uncertain (particularly at these low levels) that they cannot be considered a reliable indicator that the criterion could be achieved under any alternative; and (2) it has not been demonstrated that levels below that criterion can be reliably measured on a routine basis.

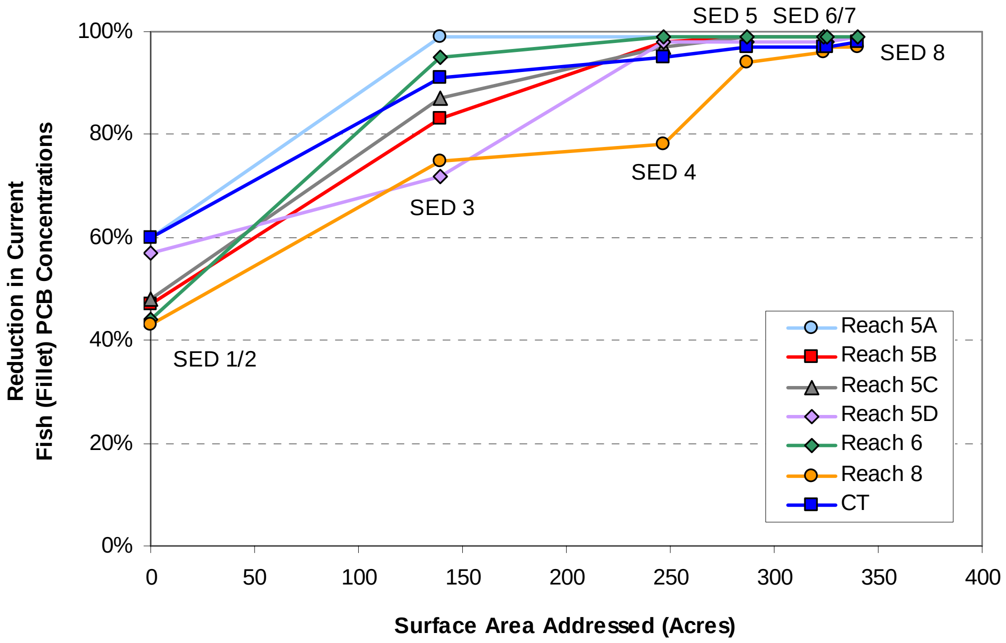
4.9.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for the sediment alternatives has included an evaluation of the magnitude of residual risk, the adequacy and reliability of the alternatives, and potential long-term adverse impacts on human health or the environment.

4.9.5.1 Magnitude of Residual Risk

As previously shown, upstream source control/remediation efforts, together with natural recovery processes, would by themselves result in a considerable reduction in PCB concentrations and potential human and ecological exposures to PCBs in sediments, surface water, and fish in the Rest of River area. Implementation of SED 3 through SED 8 would further reduce the potential for exposure by humans and ecological receptors through a combination of removal, capping, thin-layer capping, and/or natural recovery processes. As discussed in Sections 4.1 through 4.8, EPA's model has been used to predict the extent to which each alternative would reduce PCBs in surface sediments, water column, and fish. For purposes of comparison, fish PCB concentrations are presented here, since fish are representative of the trends and relative success of each alternative in reducing the potential for PCB exposure in the various pathways as they integrate the effects of changes in surface sediments and water column concentrations. Table 4-53 presents the subreach-average fish fillet PCB concentrations at the end of the model projection period and the percent reduction in fish PCB concentrations for each of the sediment alternatives. These results are also presented graphically (versus surface area addressed) for Reaches 5, 6, 8, and the Connecticut impoundments on Figure 4-15 below.

Figure 4-15 – Reduction in Current Fish (Fillet) PCB Concentrations Over the Model Projection Period Versus Surface Area Addressed in Remedy



As shown by these model predictions, upstream source control/remediation measures and natural recovery processes contribute significantly to the overall reduction in PCBs in fish in the Rest of River. The contribution of these processes (i.e., a 43 to 60% reduction in fish PCB levels relative to current conditions) is represented above by SED 1 and SED 2. After that, SED 3 achieves the most significant incremental reductions. For example, the model predicts that SED 3 would result in an overall 99% reduction (i.e., a 39% incremental reduction beyond SED 1 and SED 2) in fish fillet concentrations in Reach 5A and an overall 70-95% reduction in the other reaches. In comparison, SED 4 through SED 8 provide much smaller additional incremental reductions beyond SED 3.

More specifically, review of these predicted reductions indicates the following:

- The remediation of Reach 5A under SED 3 would achieve a substantial additional reduction in fish PCB concentrations in that subreach compared to SED 1 and SED 2 (39% additional reduction, for a total reduction of 99%). The remaining alternatives, including SED 7 and SED 8, which involve deeper excavations in Reach 5A, would not result in any additional fish PCB reductions in that subreach.

- Under SED 3, the remediation of Reach 5A, along with thin-layer capping in part of Reach 5C and in Reach 6, would also result in considerable reductions in fish PCB concentrations not only throughout Reaches 5 and 6, but also in further downstream reaches subject to MNR. For example, in Rising Pond, SED 3 would result in an overall 75% reduction (32% more than SED 1 and SED 2); whereas SED 5, which includes remediation in Rising Pond, would result in a smaller incremental reduction (19% over SED 3 and 16% over SED 4), and SED 6 through SED 8 would result in far smaller incremental reductions over SED 5 (2 to 3%). In the Connecticut impoundments, SED 3 would result in an overall 91% reduction in fish PCB concentrations, while the remaining alternatives would result in additional incremental reductions of only 4% to 7%.

- Compared to SED 3, SED 4 would achieve slightly greater incremental reductions in fish PCB concentrations in several reaches. However, it would require the disturbance of about 80% more surface area (247 acres versus 139 acres in SED 3) and would take 50% longer to implement.

As evidenced by these comparisons, SED 3 would achieve the most significant reductions in fish PCB concentrations by addressing the most upstream portion of the Rest of River to take advantage of natural recovery processes in the downstream reaches, while minimizing the amount of area disturbed and the duration of remediation activities.

In addition to producing the largest incremental reductions in fish PCB concentrations, SED 3 would have the shortest implementation time and thus would achieve such reductions more quickly than the other removal alternatives. This is illustrated by the temporal profiles of model-predicted fish PCB concentrations (converted to a fillet basis) on Figures 4-16a-n. On these figures, model projections for all the sediment alternatives are plotted together by reach (Appendix G-12 contains similar plots for surface sediments). These plots show that the times to achieve the reductions in fish levels associated with remediation are shortest for SED 3 (or, in some instances, comparable under SED 3 as under the other alternatives) and become generally greater as the level of remediation increases with the other alternatives. This trend is increasingly prominent with downstream distance. For example, in Woods Pond (Figure 4-16e), the 95% reduction achieved by SED 3 would be reached in approximately 15 years, while the 99% reductions achieved by the remaining alternatives would be reached in 20 to 25 years for SED 4 through SED 6, 30 years for SED 7, and 45 years for SED 8.

The potential residual risks to human and ecological receptors from the concentrations shown in Table 4-53 have been evaluated in the context of the extent to which they would achieve the IMPGs, as discussed in Section 4.9.6. Since none of the alternatives would achieve the fish PCB levels that EPA considers protective for unrestricted human consumption of fish (as shown in the evaluations of the individual sediment alternatives), the residual risks from fish consumption would be addressed under all alternatives through the continuation of fish consumption advisories.

Finally, under the various alternatives, PCBs would remain in the sediments beneath the depths or outside the areas targeted for remediation. However, the caps (or backfill), where installed, would prevent direct contact with, and effectively reduce the mobility of, the underlying sediments; and the thin-layer caps would provide a cover layer over the underlying PCB-containing sediments. As discussed in Section 4.9.3, EPA's model predicts that an extreme flood event would result in little increase in PCB concentrations for all the sediment alternatives. Further, while potential exposures to PCB-containing sediments in non-remediated areas would be reduced by the extent of removal and/or capping, this factor must be considered in the context of the overall impact of the remediation in reducing PCB concentrations (as discussed above) and must be balanced against the other Selection Decision Factors in determining which alternative is best suited overall to meet the General Standards.

4.9.5.2 Adequacy and Reliability of Alternatives

SED 1 is the no action alternative for the Rest of River and SED 2 applies MNR with institutional controls. MNR has been selected at other contaminated sediment sites as part of an overall remedy (see Section 4.2.5.2). SED 3 through SED 8 involve different combinations of remedial technologies and process options, including removal in the dry and/or wet (followed by capping or backfilling), capping alone, thin-layer capping, bank stabilization, and MNR. As EPA has recognized, a combination of technologies is often necessary or appropriate to achieve remedial objectives at contaminated sediment sites (EPA, 2005e, p. 3-2). All the remedial technologies included in these alternatives have been utilized at other environmental remediation sites, as discussed under the specific alternatives.

While the remedial technologies considered in the CMS have been successfully implemented at the Housatonic River or at other sites, it is important to note that, based on available information, implementation of dredging and capping at contaminated sediment sites at the magnitude of some of the sediment alternatives considered here have very limited or no precedence. For example, of the 26 environmental dredging projects (21 full-scale and 5 pilot studies) evaluated for effectiveness by NRC (2007), only two of the projects performed to date have removed sediment volumes in excess of 400,000 cy (Head of Hylebos [WA] – 419,000 cy; Sitcum [WA] – 428,000 cy). Further, only seven of the other dredging projects resulted in sediment removal volumes greater than 100,000 cy, and all of those projects removed 225,000 cy of sediment or less. While remedies selected for some other large sites include dredging and/or capping of more than 1,000,000 cy (e.g., Fox River [WI], Hudson River [NY]), these remedies have yet to be implemented. Since the magnitude and estimated time to complete the larger sediment alternatives here (i.e., SED 6 through SED 8, involving more than 550,000 cy of sediment removal and longer than 20 years in duration) have very limited (i.e., SED 6 and SED 7) or no precedence (SED 8), in environmental remediation, complications not recognized at other, completed sites could occur during implementation (e.g., restoration difficulties, greater potential for impacts from releases during implementation, etc.), which could compromise the long-term reliability and effectiveness of those alternatives.

To further assess the reliability and effectiveness of the sediment alternatives, model predictions of erosion in areas receiving a cap, thin-layer cap, or backfill were evaluated to assess stability, as discussed in Section 4.9.3. While the model's erosion predictions vary depending on the remedial technology, they demonstrate that the caps, thin-layer caps, and backfill, as specified in the alternatives evaluated in this CMS, would be generally effective and reliable under all alternatives. EPA's model indicates that areas subject to capping would remain stable during high-flow events, and that areas with thin-layer capping or backfill would likewise largely remain in place during such events, with only small areas of erosion that result in very small increases in surface sediment PCB concentrations on a reach-wide basis (see Section 4.9.3). Thus, the stability of these remedial components does not provide a significant basis for distinguishing among the alternatives.

Finally, all the sediment alternatives (except SED 1) would use reliable long-term monitoring and maintenance techniques, and the activities that would be conducted to repair or replace aspects of the caps or bank stabilization measures would be the same for SED 3 through SED 8. However, as the area to be capped increases (progressively more from SED 3 to

SED 7, as shown in Table 4-50 above), there would be a greater probability that repairs or replacement would be needed. (The area of bank stabilization would be the same in all these alternatives.)

4.9.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

All of the sediment alternatives involving removal and/or capping (SED 3 through SED 8) could produce some long-term adverse impacts on ecological habitats. Several specific potential long-term effects on such habitats have been identified in the sections on the individual alternatives:

- First, the installation of a thin-layer cap or a cap without prior removal could have adverse long-term effects in shoreline areas where the water depth is less than 6-12 inches (for thin-layer caps) or 18-24 inches (for caps without removal) and consolidation of the underlying sediments is not anticipated. In such areas, the placement of the thin-layer cap or the cap could change the vegetative characteristics of the riverine wetlands in those areas and the biota that depend on them or, in limited cases where the cap thickness is greater than the water depth, could cause the wetland vegetation and biota to be replaced with species more tolerant of riverine or terrestrial conditions. The overall acreages subject to thin-layer capping or capping without removal are shown in Table 4-50. Apart from SED 8, SED 3 would have the least amount of such acreage (97 acres), compared to 146 to 161 acres for SED 4 through SED 7. Again, however, such impacts would not occur throughout those areas but only in shallow portions on the edges of the areas and where there is no consolidation of the underlying sediment.

- Second, the bank stabilization activities could have potential long-term adverse impacts on riparian habitats, as discussed in Section 4.3.5.3. These potential impacts apply equally to SED 3 through SED 8, all of which would involve the same remediation of erodible banks.

- Third, construction of access roads and staging areas associated with the sediment alternatives could have a long-term adverse impact on biota and their habitat in the floodplain due to compaction/alteration of the soils, displacement of some species due to habitat fragmentation, and/or colonization by invasive species (see Section 4.3.5.3). In addition, such activities could have long-term impacts on the appearance of the floodplain due to the loss of mature trees, given the lengthy period for replanted trees to resemble those that would be removed. These potential impacts would increase with the extent of area affected. Based on conceptual design, the estimated acres of staging areas and access roads associated with the sediment alternatives are shown in Table 4-54 below.

Table 4-54 – Areas Impacted by Support Facilities for the Sediment Alternatives

	SED 1 / 2	SED 3	SED 4	SED 5	SED 6	SED 7	SED 8
Staging Area Extent (Acres)	---	41	48	53	55	55	67
Access Roads (Acres)	---	49	51	53	51	51	51
Total (Acres)		90	99	106	106	106	118

> As shown in this table, it is estimated that the support facilities associated with SED 3 would impact approximately 90 acres. The extent of affected area and thus the potential for impacts to the floodplain habitat would be greater for SED 4 through SED 8 (99 to 118 acres). The length of time that these facilities would remain in place in some part of the floodplain would also increase from 10 years for SED 3 to over 50 years for SED 8.

In addition to these specific impacts, the larger remediation alternatives have an increased potential for causing long-term adverse environmental impacts due to the cumulative effect of numerous short-term impacts. As the duration and spatial extent of the remediation increase, there is increased uncertainty regarding the length of time that it would take for upstream communities in previously remediated areas to be sufficiently developed to provide organisms to downstream locations and thus for the downstream biotic communities to recover. SED 3 would involve the least disturbance of the River, affecting a total of 139 acres of aquatic habitat, compared to 247 to 340 acres for SED 4 through SED 8 (see Table 4-50); and SED 3 would involve the shortest time of disturbance, lasting 10 years, compared to 15 to 51 years for SED 4 through SED 8. As such, SED 3 would have the least potential for causing cumulative long-term adverse impacts on the aquatic habitat and biota.

Finally, it should be noted that, to the extent that affected areas constitute habitat for any rare, threatened, and/or endangered species, implementation of the alternatives could affect those species. In general, for the more mobile species and/or species with a wide range of habitat requirements, the activities would displace these species to other areas of the river system. However, as the duration and spatial extent of the disturbance increase, it becomes more likely that the displacement would become permanent, as many protected species are very sensitive to habitat loss and disturbances. Moreover, for animal species with narrower habitat requirements and for any threatened or endangered plant species, any long-term alteration of the habitat could have a long-term adverse impact.[101]

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[101] In terms of potential impacts on banks and bedload movement, there would be no significant differences among SED 3 through SED 8 (additional details presented in Section 4.3.5.3 for SED 3 and comparable sections for the other alternatives).

4.9.6 Attainment of IMPGs

To evaluate attainment of IMPGs, GE has compared those goals to the average PCB concentrations in surface sediment and fish that would result from each sediment alternative, as predicted by the EPA model (or estimated by the CT 1-D Analysis) for each of the various IMPG averaging areas. This comparative evaluation has focused, in particular, on a comparison of the total number of averaging areas with predicted PCB concentrations that either achieve the applicable IMPG (for receptors that have a single IMPG) or would be within the range of applicable IMPGs (for pathways or receptors that have a range of IMPGs). In addition, as required by the Permit, GE has compared the time that it would take each alternative to achieve the IMPGs.

4.9.6.1 Comparison to Human Health-Based IMPGs

All of the sediment alternatives would achieve IMPGs for human direct contact with sediments. Specifically, for all eight of the sediment alternatives, the average predicted surface sediment (top 6-inch) PCB concentrations at the end of the modeled period in all eight of the exposure areas evaluated are within (or below) the range of the RME IMPGs.[102] This includes SED 1 and SED 2, for which there would be no removal or capping of sediments or bank soils. The remaining alternatives would all achieve the RME IMPGs based on a 10^{-5} cancer risk (or lower) in all exposure areas, and would achieve the most restrictive IMPG based on a 10^{-6} cancer risk in increasing numbers of areas (one under SED 3, four to five under SED 4 and SED 5, and six to seven under SED 6 through SED 8). The time to achieve levels within the IMPG range is prior to the remediation of sediments in all but one of the exposure areas.

In contrast, for human consumption of fish, none of the sediment alternatives would achieve levels within the range of the RME IMPGs in Reaches 5 through 8 within the model period. Table 4-55 shows, for each alternative, the number of averaging areas within those reaches in which the model-predicted fish concentrations at the end of the simulation period would achieve levels within the range of the IMPGs. As shown in that table, the predicted fish PCB concentrations for all alternatives would exceed the range of the fish consumption IMPGs

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[102] For purposes of assessing attainment of the health-based IMPGs within the model period, the predicted PCB concentration in an averaging area is considered to be within the range of applicable RME IMPGs if, at a minimum, it meets the cancer-based RME IMPG at a 10^{-4} cancer risk level and also meets the non-cancer RME IMPG(s) in that area.

based on RME assumptions – which EPA considers protective for unrestricted fish consumption – in all of those areas.[103]

Results from extrapolation of the model results beyond the model period to estimate the times to achieve the RME IMPGs associated with a 10^{-5} cancer risk and non-cancer impacts in Reaches 5 through 8 are shown in Table 4-56 below, although these are highly uncertain.[104] The extrapolated time to achieve these RME IMPGs ranges from approximately 130 years (in Reaches 5A, 5B, and 5C under SED 7) to >250 years. Given the long times to achieve the IMPGs for unrestricted fish consumption, even under the largest remedial alternative, fish consumption advisories would be needed to protect human health (based on EPA's HHRA) for every alternative for the indefinite future.

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[103] For the IMPGs based on CTE assumptions, the predicted fish PCB concentrations would achieve levels within the range of the deterministic IMPGs in two subreaches under SED 5 through SED 7 (both in the PSA) and in six subreaches under SED 8 (four in the PSA, one in Reach 7, and Reach 8). The predicted fish PCB concentrations for SED 3 through SED 8 would achieve levels within the range of the probabilistic CTE IMPGs in increasing numbers of areas (see Table 4-55).

[104] Given the large uncertainty associated with the extrapolation of model results, the comparison of times to achieve unrestricted fish consumption levels beyond the model period was based on the extrapolated time to achieve the deterministic RME IMPGs associated with a 10^{-5} cancer risk and non-cancer impacts, since the former represents the midpoint of the cancer risk range.

Table 4-56 – Estimated Time to Achieve the RME (Deterministic) IMPGs Associated with a 10^{-5} Cancer Risk and Non-Cancer Impacts (in Years) Based on Extrapolation of Model Results

Reach	SED 1 / 2	SED 3	SED 4	SED 5	SED 6	SED 7	SED 8
Reach 5A	>250	150	160	160	150	130	190
Reach 5B	>250	>250	>250	160	150	130	190
Reach 5C	>250	>250	>250	160	140	130	180
Reach 5D (Backwaters)	>250	200	>250	>250	>250	>250	>250
Reach 6 (Woods Pond)	>250	>250	210	190	170	170	190
Reach 7	>250	>250	>250	>250	230 to >250	>250	>250
Reach 8 (Rising Pond)	>250	>250	>250	>250	>250	240	>250

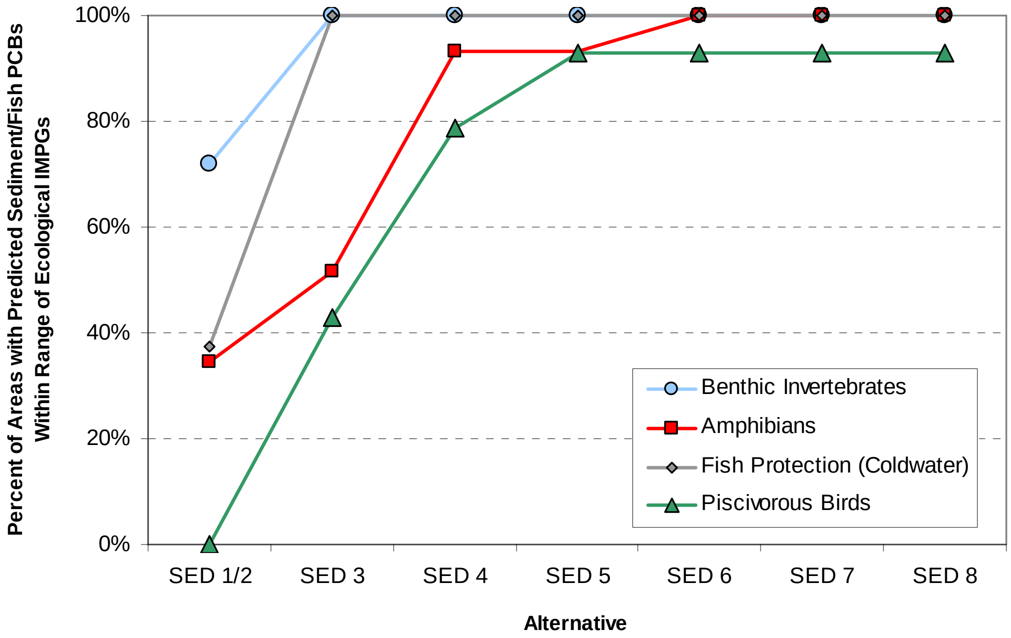
In the four Connecticut impoundments, estimates from the CT 1-D Analysis, although also highly uncertain, suggest a somewhat different situation given that fish PCB concentrations there are already considerably lower than those in Massachusetts. Estimates from the CT 1-D Analysis indicate that, under SED 1 and SED 2, fish concentrations would not achieve levels within the range of the RME IMPGs by the end of the model period, but that, under SED 3 through SED 8, fish PCB concentrations are more likely to achieve levels within that range. SED 3 is estimated to achieve levels within the RME IMPG range in all impoundments within 35 years (except for the deterministic non-cancer IMPG for children in two impoundments which, based on the extrapolations, would be met in approximately 50 to 70 years). SED 4 through SED 8 are estimated to achieve levels within the RME range in all impoundments during the model period (within approximately 30 to 55 years).

In light of the uncertain nature of these extrapolations, all that can be said with confidence is that, while SED 3 through SED 8 may all lead eventually to achievement of the RME fish consumption IMPGs in the Connecticut impoundments, fish consumption advisories will need to remain in place in Connecticut for a considerable time, pending completion of remediation and monitoring of fish PCB levels.

4.9.6.2 Comparison to Ecological IMPGs

In comparing the ability of the various sediment alternatives to achieve the IMPGs for ecological receptors, GE has compared the average surface sediment or fish PCB concentrations predicted by EPA's model at the end of the projection period for the relevant averaging areas to the IMPGs or target sediment levels for those receptors. Table 4-57 shows, for each alternative, the number of averaging areas in which the predicted PCB concentrations would fall within the range of IMPGs for various ecological receptor groups – namely, benthic invertebrates, amphibians, fish, piscivorous birds, and threatened and endangered species.[105] These results are also shown graphically, for several of these receptor groups, on Figure 4-17 below.

Figure 4-17 – Percent of Averaging Areas Meeting or Within Range of Certain Ecological Receptor IMPGs for Sediment Alternatives at End of Model Projection Period



Note: Fish Protection (Warmwater) and Threatened and Endangered Species are not shown since the IMPGs for these receptors would be met for all alternatives.

In addition, as discussed previously, since the IMPGs for insectivorous birds and piscivorous mammals are based on the prey of those receptors, which include both aquatic and terrestrial prey, target levels have been developed for both sediment and floodplain soil. For sediments, the selected target levels are 1, 3, and 5 mg/kg. Attainment of these levels would allow achievement of the IMPGs for these receptors provided that the average floodplain soil PCB concentrations in the same averaging areas are below the associated target floodplain soil levels, as discussed in Section 6. Comparison of the model-predicted sediment

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[105] In this section, concentrations are considered to be within the range of the IMPGs if they either fall between the upper and lower bounds of that range or are below the lower bound.

concentrations to these target sediment levels indicates that: (a) SED 1 and SED 2 would not achieve any of the target sediment levels in any averaging areas (except one averaging area for insectivorous birds at the 5 mg/kg target level); (b) SED 3 would achieve target levels of 3 and 5 mg/kg in about half of the 12 averaging areas for insectivorous birds and in one of the two averaging areas for piscivorous mammals and would achieve the target level of 1 mg/kg in 3 of the 12 averaging areas for insectivorous birds and in neither area for piscivorous mammals; (c) SED 4 and SED 5 would achieve all three target levels in all areas (except the 1 mg/kg level in 2 averaging areas for insectivorous birds); and (d) SED 6 through SED 8 would achieve all three target levels in all averaging areas.

In summary, the comparisons of model-predicted PCB concentrations for the sediment alternatives to the IMPGs and target sediment levels for ecological receptors indicate that SED 1 and SED 2 would achieve the IMPGs for a few receptor groups (warmwater fish and threatened and endangered species) in all averaging areas and another group (benthic invertebrates) in a majority of areas, but would not achieve levels within the IMPG range for other groups (amphibians, piscivorous birds, coldwater fish) or the target sediment levels for insectivorous birds and piscivorous mammals in most or all averaging areas. SED 3 would achieve levels within the IMPG range for benthic invertebrates, warmwater and coldwater fish, and threatened and endangered species in all averaging areas. For the remaining receptors, SED 3 would achieve levels within the IMPG range for amphibians and piscivorous birds in approximately half the averaging areas, and would, for insectivorous birds and piscivorous mammals, achieve target sediment levels of 3 or 5 mg/kg in about half the averaging areas and 1 mg/kg in fewer (insectivorous birds) or no (piscivorous mammals) areas. SED 4 and SED 5 would achieve levels within the IMPG or target level range for all receptors and all areas except amphibians in 2 small backwaters (out of 29, representing 1% of the total backwater acreage) and piscivorous birds in 1 to 3 of the 14 averaging areas. Finally, SED 6 through SED 8 would achieve levels within the IMPG or target level range for all receptors and areas except for piscivorous birds in one area (Reach 7B).

In general, the time to achieve the ecological IMPGs, when met within the modeled period, is projected to be shortly after completion of the remedy in each of the respective averaging areas, with the exception of unremediated portions of the River under each alternative.

4.9.7 Reduction of Toxicity, Mobility, or Volume

The degree to which the sediment alternatives would reduce the toxicity, mobility, or volume of PCBs is discussed below.

Reduction of Toxicity: None of the sediment alternatives includes any treatment processes that would reduce the toxicity of the PCBs in the sediment. However, as noted in Section 2.2.3, should material removed during implementation of any alternative be classified as "principal threat" wastes (e.g., free NAPL, drums of liquid waste), which is not anticipated, those wastes would be segregated and transported off-site for treatment and disposal. Accordingly, this factor does not provide a basis for distinguishing among the sediment alternatives.

Reduction of Mobility: Reduction of mobility of PCBs in the River would be achieved through upstream source control/remediation and naturally occurring processes for SED 1 and SED 2. For SED 3 through SED 8, in addition to these factors, further reductions would be achieved through removal, capping, backfilling, thin-layer capping, and/or bank stabilization activities. Reduction in PCB mobility can be viewed in terms of reduction in annual PCB loads passing Woods Pond and Rising Pond Dams, as discussed in Section 4.9.3. Compared to current levels, SED 3 would achieve the most significant reductions, with small incremental additional reductions achieved by SED 4 through SED 8.

Reduction of Volume: Implementation of SED 3 through SED 8 would reduce the volume of PCB-containing sediment and bank soil in the River through permanent removal of this material. SED 1 and SED 2 do not include removal, and would therefore not reduce the PCB volume. Table 4-58 below summarizes the approximate removal volumes, corresponding PCB mass, and PCB mass per unit of volume removed as part of each alternative.

Table 4-58 – Removal Volume and Corresponding PCB Mass for Sediment Alternatives

SED	Removal Volume – Sediment/Soil (cy)	Estimated PCB Mass Removed (lbs)	Estimated PCB Mass (lbs) per Volume Removed (cy)
1 / 2	---	---	---
3	167,000	11,500	0.0689
4	295,000	16,200	0.0549
5	410,000	18,400	0.0449
6	554,000	22,400	0.0404
7	793,000	31,500	0.0397
8	2,250,000	54,500	0.0242

Although each subsequent alternative would result in the removal of additional PCB mass, the PCB mass per cubic yard of sediment/bank soil removed diminishes with each alternative, with almost three times more PCB mass per cubic yard removed with SED 3 than with SED 8.

4.9.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of the sediment alternatives has included consideration of the short-term impacts of implementing each alternative on the environment, the local communities (as well as communities along transport routes), and the workers involved in the remedial activities. Since SED 1 and SED 2 would not involve excavation/construction activities, they would not produce any short-term adverse impacts. For SED 3 through SED 8, the short-term impacts discussed below would occur at various locations throughout the duration of the active remedial activities, which is estimated to range from 10 years (for SED 3) to 51 years (for SED 8).

Impacts on the Environment

The short-term effects on the environment would include: potential impacts to the water column, air, and biota in the Rest of River during remediation activities; alteration/ destruction of benthic habitat in the areas subject to those activities; loss of mature trees and other established vegetation within the riparian habitat as a part of bank stabilization activities; and loss of some floodplain habitat and disruption to the biota that reside in the floodplain due to construction of the supporting facilities.

Sediment removal activities involve the potential for resuspension of PCB-containing sediment in the water column. Since the activities in Reaches 5A and 5B (as applicable) would be conducted in the dry using sheetpile containment, they would involve the greatest control of such resuspension, although there is a potential for sediment to be released from the work area during sheetpile installation and removal or due to overtopping of the sheeting during a high flow event. For the more downstream reaches, removal activities would be conducted in the wet, with silt curtains used to mitigate sediment releases. In those areas, despite the silt curtains, sediment containing PCBs could be released from the work area through the dredging process. In addition, boat and barge traffic could resuspend sediment during the construction phase. The potential for PCB releases due to resuspension increases with the duration and scope of removal activities, which increase substantially from SED 3 through SED 8, as shown in Table 4-50 in Section 4.9.1. This potential is lowest for SED 3, which would involve the least amount of removal and none in the wet.[106]

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[106] For capping, the potential for resuspension of PCB-containing sediment is anticipated to be much less than for removal activities, since capping would involve placing clean material on undisturbed native sediment. As a further precaution, silt curtains would be in place to mitigate transport of cap material and any resuspended sediments downstream. For thin-layer capping, which is anticipated to be conducted during low flow periods without the use of silt curtains, it appears, based on data collected during the Silver Lake capping pilot study, that there is little potential to resuspend PCB-containing sediments.

Similarly, sediment removal and related sediment processing activities have the potential to produce airborne PCB emissions that could impact downwind communities. This potential also increases with the duration and scope of the removal activities, which increase substantially from SED 3 through SED 8, as shown in Table 4-50.

All in-river remedial activities would impact aquatic habitat in the areas remediated. The removal activities would have the most severe impacts in that they would: (1) cause an immediate loss of submerged aquatic vegetation, riverine wetlands, benthic invertebrates, and other aquatic organisms, such as reptiles and amphibians, in the affected areas and a temporary disruption and displacement of fish; (2) remove the natural bed material, debris, and aquatic vegetation, which are used as habitat by both fish and benthic invertebrates; and (3) alter feeding areas for birds and mammals that live immediately adjacent to the River and feed in the areas subject to remediation. Capping without removal would result in the loss of existing benthic invertebrates and benthic habitat by covering the natural bed material and existing floral and faunal communities. Thin-layer capping could have a similar, though lesser effect. Most of the emergent wetlands plants and submerged aquatic vegetation, as well as benthic invertebrates, would be covered, though some of the plants would be large enough to survive the material placement and others would likely work their way back up through the thin-layer cap. Further, plants and benthic invertebrates would be expected, fairly quickly, to recolonize the new substrate from adjacent areas.

These short-term impacts would increase with the increasing spatial extent of the remediation, particularly the extent of removal. As shown in Table 4-50 (in Section 4.9.1), SED 3 would have the fewest short-term impacts, since it would affect a total of 139 acres of aquatic habitat, compared to 247 to 340 acres for SED 4 through SED 8.[107]

In addition, construction of access roads and staging areas in the floodplain would result in the temporary loss of habitat in those areas and the wildlife that they support. Development of these support facilities would affect the ability of wildlife to nest and feed forage in these areas; and in some instances it could cause habitat fragmentation that could further disrupt the movement and interactions of certain wildlife species. The extent of these impacts would depend on the amount of area affected, the habitat type, and the duration that such facilities would be in place. Based on the conceptual design of the various alternatives in this CMS, the area affected by such facilities is smallest for SED 3 (~ 90 acres), increasing to 99 acres for SED 4 and 106-118 acres for SED 5 through SED 8, as shown in Table 4-54. The total

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[107] In addition, for all of these alternatives, bank removal and stabilization activities in Reaches 5A and 5B would have a direct effect on the riparian vegetative community bordering the River and on wildlife which depend on those riparian areas for cover, nesting, and feeding, or use those riparian corridors for river access. These impacts would be the same for SED 3 through SED 8 and thus do not provide a basis for distinguishing among these alternatives.

length of time that these facilities would be in place in some portion of the floodplain, and thereby cause impacts such as those described above, would increase from 10 years for SED 3 to over 50 years for SED 8.

Impacts on Local Communities and Communities Along Transport Routes

Implementation of SED 3 through SED 8 would result in short-term impacts to the local communities in the Rest of River area. These impacts would include disruption of recreational uses of the River and banks in the areas subject to remediation, as well as portions of the floodplain where access roads and staging areas are built. They would also include increased noise and truck traffic in those areas. The extent of such impacts would be dependent on the extent and duration of remediation. SED 3 would primarily affect Reach 5A, with minor impacts in Reaches 5C and 6, and the impacts would last 10 years. The other alternatives would affect broader areas, and the impacts would last for longer periods.

The increase in truck traffic would result from the need to deliver equipment to the work area, transport removed materials from the staging areas to a disposal/treatment location, and deliver stone, sand, backfill, and bank stabilization materials. This truck traffic would persist for the duration of the alternatives. Table 4-59 summarizes the number of truck trips associated with transporting removed materials from the staging areas and delivering cap/backfill materials for each alternative. In summary, SED 4 would require nearly twice the total number of truck trips as SED 3. The number of truck trips for SED 5 through SED 7 would range from approximately 90,000 to 150,000 (over 2.5 to 4 times the trips needed for SED 3), whereas the total number of trips for SED 8 would be over 390,000 – more than double what would be expected for SED 7 (and an order of magnitude greater than for SED 3).

This additional truck traffic would not only increase disruption, noise, and vehicle emissions, but would also increase the risk of traffic accidents along the transport routes. Appendix D presents an analysis of the potential accident risks from the increased off-site truck traffic necessary to transport clean materials (e.g., capping/backfill materials) to the site for each sediment alternative.[108] A summary of that analysis is presented in Table 4-60. As shown there, the incidence of potential injuries from accidents associated with this increased truck traffic would be lowest for SED 3 (less than 1 injury, with less than 50% probability of occurrence), and would progressively increase with subsequent alternatives (ranging from 1 to over 6 injuries, with a 73% to 100% probability of occurrence).

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[108] The risks from truck traffic to transport excavated materials from the staging areas to disposal locations have been evaluated under the relevant treatment/disposition alternatives.

Risks to Remediation Workers

Implementation of SED 3 through SED 8 would also result in health and safety risks to site workers. Appendix D contains an analysis of the potential risk of fatalities and non-fatal injuries to site workers resulting from implementation of each of the sediment alternatives. That analysis is summarized in Table 4-60. It shows that risks to site workers would be lowest with SED 3, with an estimate of 3.7 injuries, compared to estimates of 6.3 to 16 injuries for SED 4 through SED 8.

4.9.9 Implementability

4.9.9.1 Technical Implementability

All sediment alternatives (other than SED 1, which would involve no remediation) would be implemented using well-established and available in-river methods and equipment, available construction technologies to build land-based support facilities, and readily available methods to implement monitoring and institutional controls. Moreover, as discussed under the individual alternatives, the specific technologies involved in each are considered suitable for implementation in the reaches where they would be applied. The remedial components selected (i.e., removal/capping in the dry or wet, capping alone, thin-layer capping, backfilling, and MNR) have been used in similar applications as part of previous Housatonic River work and/or at other sites.

While all the sediment alternatives are thus considered implementable, available information regarding completed dredging and capping remedies at other contaminated sediment sites indicates that remediation of the magnitude being considered for some of the sediment alternatives here have very limited precedence (SED 6 and SED 7) or no precedence (SED 8).. As a result, these alternatives would involve complications and uncertainties that have not been encountered at other sites to date and that would not be faced (or would be less significant) for the smaller alternatives. These include: difficulties associated with contracting over time periods of multiple decades; uncertainties in obtaining the large quantities of capping and backfill materials that would be needed for such large-scale, long-duration projects (which would range from over 700,000 cy to over 2 million cy, as shown in Table 4-61); greater potential for impacts from releases during implementation; complications associated with the deeper excavations (notably in SED 8); greater uncertainties in restoration; uncertainties in the availability of landfill capacity or treatment capabilities (depending on the treatment/disposition alternative selected); and potential changes in equipment or techniques or in statutes, regulations, regulatory priorities, or property ownership. Thus, the technical implementability factors favor the alternatives with a more reasonable scale and a shorter duration.

4.9.9.2 Administrative Implementability

In terms of administrative implementability, all alternatives would need to comply with the substantive requirements of applicable and appropriate regulations (i.e., the location-specific and action-specific ARARs) pertaining to the performance of the remedial action (unless waived). As discussed in Section 4.9.4, this factor is equivalent for SED 3 through SED 8.

Implementation of SED 3 through SED 8 would also require GE to obtain access agreements from the owners of properties that include riverbank or floodplain areas where remedial work or supporting facilities (access roads and staging areas) would be necessary. Although the majority of the areas are publicly owned, it is anticipated that access agreements may be required from as many as 30 private landowners for SED 3 through SED 5, and up to approximately 40 private landowners for SED 6 through SED 8. Obtaining access agreements could be problematic in some cases. In general, the greater the number of access agreements needed, the greater the potential for complications.

Finally, while all alternatives would include coordination with EPA and/or state agencies in implementation of biota consumption advisories, obtaining access to State-owned lands, and public/community outreach programs, the alternatives with a greater extent of remediation and a longer implementation time would likely require more extensive and prolonged coordination activities.

4.9.10 Cost

Estimated costs for each sediment alternative, including total capital costs, estimated annual OMM costs, and total estimated present worth costs, are summarized for each sediment alternative in Table 4-62 below. It is important to note that the costs associated with disposition/treatment of any removed sediments/soils are not included in these estimates.

Table 4-62 – Cost Summary for Sediment Alternatives

	SED 1	SED 2	SED 3	SED 4	SED 5	SED 6	SED 7	SED 8
Total Capital Cost	$0	$0	$134 M	$202 M	$240 M	$297 M	$348 M	$601 M
Total OMM Cost	$0	$10.3 M	$13.4 M	$13.9 M	$14.2 M	$14.6 M	$14.4 M	$14.3 M
Total Cost for Alternative	**$0**	**$10.3 M**	**$148 M**	**$216 M**	**$254 M**	**$312 M**	**$362 M**	**$615 M**
Total Present Worth Cost	$0	$4.5 M	$106 M	$136 M	$148 M	$168 M	$172 M	$190 M

Notes:

1. All costs are in 2008 dollars. $ M = million dollars.
2. Total capital costs are for engineering, labor, equipment, and materials associated with implementation.
3. Total OMM costs include costs for annual inspections of the restored banks and caps for the first 5 years following completion of construction, and annual performance of surface water monitoring, as well as collection of representative sediment and fish tissue samples every 5 years (as applicable), for a 30-year period after construction.
4. Total present worth cost is based on using a discount factor of 7%, considering the length of the construction period and an OMM period of 30 years on a reach-specific basis.

For the reasons discussed in Section 2.2.6, comparison of the costs of the sediment alternatives focused on the total costs of those alternatives, rather then the present worth estimates, due to the substantial impact of discounting over long periods on present worth costs, the uncertainties associated with choice of discount rate, and the potential impact of changing the implementation durations.

In order to evaluate costs relative to the remedial outcomes, comparisons have been developed between the total alternative costs and model predictions of the reduction in PCB loading/transport and average fish PCB concentrations. These comparisons are presented on Figures 4-18 and 4-19 below.

Figure 4-18 – Modeled Reduction in PCB Loading and Transport at End of Model Projection Period versus Total Cost for Each Alternative

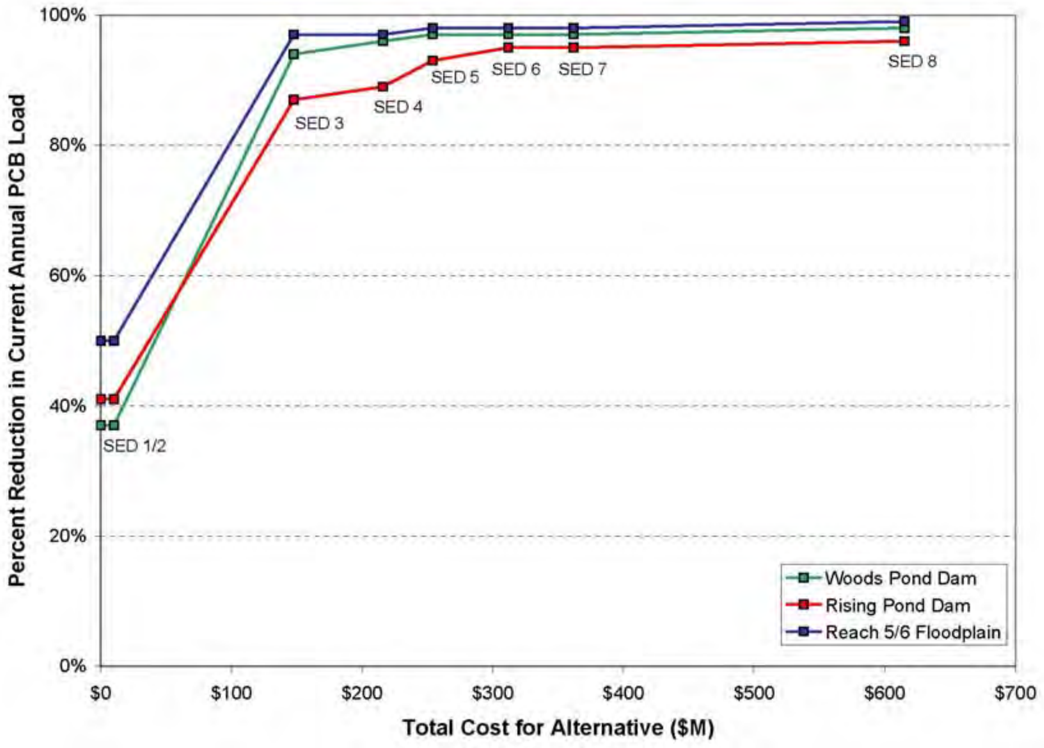

Figure 4-18 indicates that SED 1 and SED 2 would result in a significant reduction (approximately 40% to 50%) in the PCB loads passing Woods Pond Dam and Rising Pond Dam and the PCB mass transported to the Reach 5/6 floodplain at costs, ranging from $0 to ~ $10 M, that are a small fraction of the SED 3 through SED 8 costs. SED 3 would result in a large incremental reduction in PCB loading and transport – leading to a total reduction of 94% and 87% in loading at Woods Pond Dam and Rising Pond Dam, respectively, and a 97% reduction in PCB transport to the Reach 5/6 floodplain – through implementation of remedial activities estimated to cost $148 M. SED 4 through SED 8 would achieve a little incremental improvement in PCB load/transport reduction over SED 3, at an estimated cost of $216 M to $615 M. A comparison of the load/transport reduction versus cost for SED 3 to SED 4 demonstrates that a relatively small additional reduction in the PCB load and transport (approximately 2%) would be achieved at an additional cost of $68 M if SED 4 were implemented (not taking account of the additional treatment/disposition costs for SED 4, compared to SED 3). Further, implementation of SED 5 through SED 8 would only result in an additional 1% to 2% reduction in PCB loading at Woods Pond Dam, up to a 7% reduction at Rising Pond Dam, and 1% to 2% reduction in PCB transport to the Reach 5/6 floodplain, at additional costs of $38 M to approximately $400 M relative to SED 4 (not factoring in the additional cost of treatment/disposition for these alternatives).

Figure 4-19 – Modeled Fish PCB Concentrations at End of Model Projection Period versus Total Cost for Each Alternative

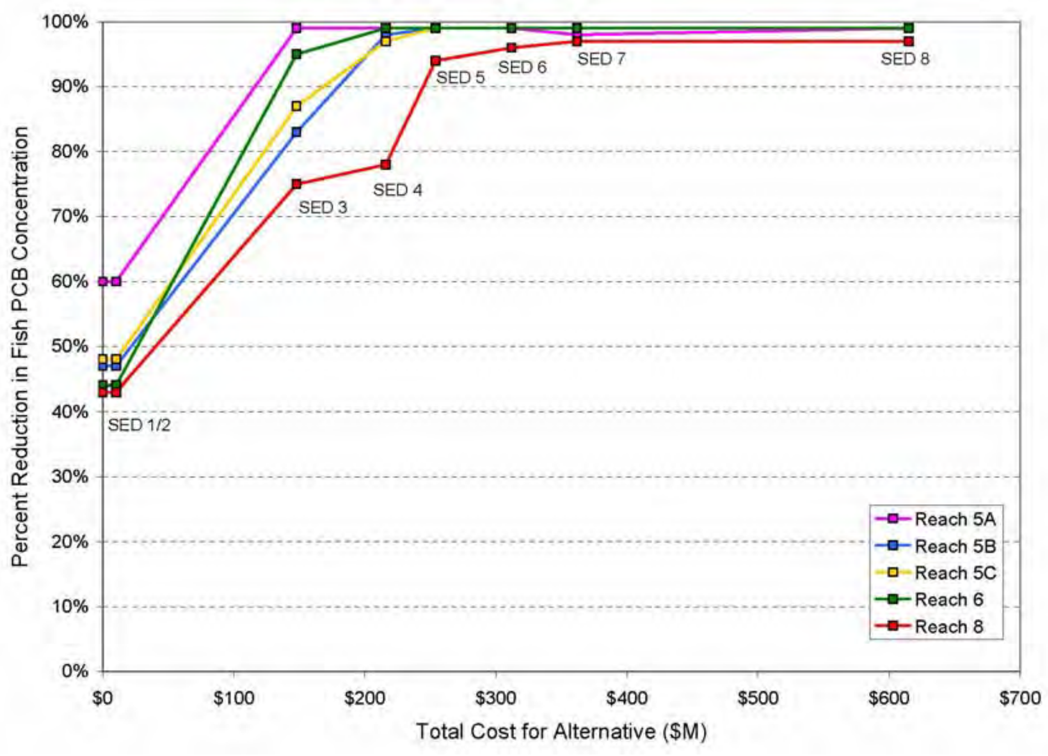

Figure 4-19 illustrates the reduction in fish PCB concentrations in Reaches 5A through 5C, 6, and 8 (as representative examples) versus the estimated total cost of the sediment alternatives. As shown, SED 1 and SED 2 would result in a 40% to 60% reduction in fish PCB concentrations in all reaches at costs ranging from $0 to $10 M (a fraction of the costs for SED 3 through SED 8). SED 3 would result in the greatest incremental reductions in fish PCB concentrations beyond SED 1 and SED 2, with incremental reductions of about 30% to 50% (total reductions of 75% to 99% for all reaches), for a cost of $148 M (not considering treatment/disposition costs). SED 4 through SED 8 would achieve smaller incremental reductions over SED 3, ranging from 0% to about 20%, with associated cost increases of $68 M to $467 M (not factoring in the additional cost of treatment/disposition).

These comparisons demonstrate that, based solely on the costs of the sediment alternatives themselves (without considering treatment/disposition costs), SED 3 is the most cost-effective alternative, both in terms of achieving reductions in PCB loading and transport and in terms of reducing fish PCB concentrations.[109] This conclusion will be reviewed further after considering the combined costs of the sediment alternatives with treatment/disposition alternatives, presented in Section 8.

4.9.11 Overall Protection of Human Health and the Environment – Conclusions

As previously discussed, the evaluation of whether a sediment alternative would provide overall human health and environmental protection relies on a number of other factors – notably: (a) long-term effectiveness in reducing potential exposures of human and ecological receptors to PCBs; (b) compliance with ARARs; (c) the extent to which the alternatives would achieve IMPGs; (d) other aspects of the alternatives or other considerations relevant to protecting human health or ecological receptors (e.g., institutional controls for human health protection, likely impacts on local populations and communities of ecological receptors); and (e) long-term and short-term adverse impacts of the alternatives on human health or the environment. A comparative evaluation of the sediment alternatives considering these factors is presented below.

General Effectiveness: As discussed previously, completed and ongoing upstream source control and remediation measures, as well as natural recovery processes, have significantly reduced, and are expected to continue to reduce, PCB concentrations and potential human and ecological exposures to PCBs in sediments, surface water, and fish in the Rest of River. SED 3 through SED 8 would result in an additional reduction in concentrations and potential exposures by permanently removing PCB-containing sediments/riverbank soils and capping certain areas of the River. All those alternatives are predicted to reduce the PCB loading in the River passing Woods Pond Dam and Rising Pond Dam, as well as the transport of PCBs from the River to the floodplain in the PSA. As shown in Section 4.9.3, by far the most significant incremental decline in PCB loading and transport would result from implementation of SED 3.

Further, as discussed in Section 4.9.5.1, the sediment alternatives are predicted by EPA's model to result in varying levels of permanent reduction in sediment and fish PCB concentrations. For fish fillet concentrations, for example, SED 1 and SED 2 would result in reductions of 40% to 60% relative to current conditions. After that, as with PCB loads, the most significant levels of overall reductions in fish PCB concentrations are predicted to result

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[109] The NCP provides that a selected remedial action "shall be cost-effective, provided that it first satisfies the threshold criteria," that cost-effectiveness includes consideration of "overall effectiveness" (which is determined by evaluating long-term effectiveness and permanence, reduction of toxicity, mobility, or volume, and short-term effectiveness), and that "[a] remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (40 CFR § 300.430(f)(1)(ii)(D)).

from SED 3 (total reductions of 72% to 99%), with much smaller incremental additional reductions resulting from SED 4 through SED 8 (resulting in total reductions of 97-99%).

Compliance with ARARs: As discussed in Section 4.9.4, the model predictions of water column PCB concentrations indicate that SED 1 and SED 2 would not achieve the federal and state water quality criterion for freshwater chronic aquatic life in most reaches, but that SED 3 through SED 8 would do so in all reaches. The model predictions also show that none of the alternatives would achieve the very low federal and Massachusetts water quality criterion based on human consumption of organisms (0.000064 µg/L) in any portion of Reaches 5 through 8. The CT 1-D Analysis indicates that that federal criterion might be achieved in some but not all Connecticut impoundments under some alternatives, and that the alternatives involving removal/capping in Massachusetts could achieve the separate Connecticut consumption criterion (0.00017 µg/L, which may not be an ARAR) in some or all Connecticut impoundments, although these extrapolations are highly uncertain. In any case, as previously discussed, GE believes that the ARARs based on the human consumption criteria should be waived as technically impracticable to achieve.

SED 2 through SED 8 could be designed and implemented to meet the pertinent location-specific and action-specific ARARs, with the possible exception of certain requirements that could potentially apply to the on-site staging areas for SED 3 through SED 8 if some excavated materials should constitute hazardous waste, and which GE believes should be waived, if necessary, as technically impracticable. (These ARARs are not applicable to SED 1.)

Human Health Protection: As discussed in Section 4.9.6.1, all the sediment alternatives would provide protection of human health from direct contact with sediments, since all alternatives are predicted to achieve direct contact IMPGs within EPA's cancer risk range, as well as the non-cancer-based IMPGs, in all sediment exposure areas, with the majority of those levels achieved at the present time. In fact, SED 3 through SED 8 would all achieve the RME IMPGs based on a 10^{-5} cancer risk (or lower) in all sediment exposure areas.

For human consumption of fish, the fish PCB concentrations predicted to result in Reaches 5 through 8 from all alternatives at the end of the model period, when converted to fillet concentrations, would not achieve the levels that EPA considers to be protective for unrestricted consumption of Housatonic River fish. As a result, under all alternatives, institutional controls (fish consumption advisories) would continue to be utilized for the foreseeable future in Massachusetts to provide human health protection from fish consumption. In the four Connecticut impoundments, although estimates from the CT 1-D Analysis are highly uncertain, they indicate that SED 3 through SED 8 appear likely to achieve fish PCB levels within the RME range by the end of the model period (or fairly shortly thereafter). In the meantime, fish consumption advisories would continue to be used in Connecticut to provide human health protection.

Environmental Protection: As shown in Section 4.9.6.2, SED 1 and SED 2 would achieve the IMPGs for a few ecological receptor groups (warmwater fish and threatened and endangered species) in all averaging areas; but they would not achieve levels within the IMPG range for other groups (benthic invertebrates, amphibians, piscivorous birds, and coldwater fish) in a number of averaging areas, and would not achieve the highest selected target sediment level (5 mg/kg) developed for insectivorous birds and piscivorous mammals in all or nearly all averaging areas. Under these alternatives, the number and extent of exceedances of the IMPGs for multiple ecological receptors indicate that, if one accepts the EPA's conclusions in the ERA on which the ecological IMPGs were based (which GE does not agree with), these alternatives would not be protective of those ecological receptors.

By contrast, SED 3 through SED 8 would address ecological risks identified in the ERA. SED 3 would achieve levels within or below the IMPG range for benthic invertebrates, warmwater and coldwater fish, and threatened and endangered species in all averaging areas. For the remaining receptors (amphibians, insectivorous birds, piscivorous mammals, and piscivorous birds), SED 3 would achieve levels within the IMPG (or target level) range for some receptors and/or areas (see Section 4.9.6.2). However, the local populations of the latter receptors extend beyond the areas of the IMPG exceedances (i.e., to other areas within the Site where the IMPGs would be achieved and/or to nearby areas outside the Site), as discussed in Section 4.3.11. In this situation, GE does not believe that the IMPG exceedances (even if they should result in effects on individual animals) would prevent the maintenance of healthy local populations of these receptors, let alone adversely impact the overall wildlife community in the Rest of River area. This is illustrated by EPA's and GE's field surveys, which have shown that, even under current conditions, the wildlife community in the area consists of numerous and diverse species, including the receptor groups mentioned above.

As also shown in Section 4.9.6.2, SED 4 and SED 5 would achieve levels within or below the IMPG (or target level) range for all receptors and all areas except amphibians in 2 small backwaters (out of 29) and piscivorous birds in 1-3 averaging areas (out of 14); and SED 6 through SED 8 would achieve such levels for all receptors and all areas except for piscivorous birds in 1 area. However, those alternatives would cause greater short-term adverse effects on the environment than SED 3, including greater loss of aquatic habitat due to the much greater area subject to remediation (247 to 340 acres for SED 4 through SED 8 versus 139 acres for SED 3), greater potential for resuspension during removal activities, and greater loss of floodplain habitat in areas where supporting facilities would be constructed (see Section 4.9.8). Moreover, as discussed in Section 4.9.5.3, those other alternatives, particularly SED 5 through SED 8, are likely to have greater long-term adverse environmental impacts, due to the greater area affected as well as longer duration (18 to 51 years for SED 5 through SED 8 versus 10 years for SED 3) and the consequent potential for cumulative impacts and less certain recovery from such intrusive remediation over large areas for an extended period.

In this situation, as EPA guidance makes clear, the standard of “overall protection” of the environment includes a balancing of the short-term and long-term ecological impacts of the alternatives with the residual risks (EPA, 1990a, 1997, 2005e – quoted in Section 2.1.1 above). Based on such balancing, it is concluded that SED 3 would provide overall protection of the environment, since it would achieve a substantial reduction in the exposure levels of ecological receptors while causing the least amount of environmental damage of any of the sediment removal alternatives. It is further concluded that SED 4 through SED 8 would also provide overall protection of the environment, although some of them (notably SED 5 through SED 8) would cause more environmental damage than necessary to provide such protection.

Summary: As shown above, all the sediment alternatives would result in a substantial reduction in PCB loading/transport and in sediment and fish PCB concentrations in the Rest of River, with the greatest incremental reduction achieved by SED 3. As also discussed above, all sediment alternatives would provide protection of human health from direct contact with sediments and, through continuation of fish consumption advisories, from consumption of fish from the Housatonic River. With respect to environmental protection, if one accepts EPA’s conclusions in the ERA on which the ecological IMPGs were based, SED 1 and SED 2 would not achieve protective levels for several groups of ecological receptors. The remaining alternatives would provide overall protection of the environment. However, SED 5 through SED 8 would do so at the cost of causing substantial environmental harm, particularly under SED 7 and SED 8.

4.9.12 Overall Conclusion

For the reasons discussed above, it is concluded that SED 3 through SED 8 would meet the General Standards in the Permit. Further, GE has concluded that, among those alternatives, based on a consideration and balancing of the Selection Decision Factors, and given the constraints imposed by the Permit and EPA’s directives for the CMS, SED 3 is “best suited” to meet the General Standards. The principal reasons are that SED 3 would achieve the greatest incremental reduction in PCB loading, transport, and concentrations in the Rest of River in the shortest time, with the fewest short-term and long-term adverse impacts and the fewest implementability problems, and at the lowest cost. This conclusion will be reviewed further after considering the combined costs of the sediment alternatives with treatment/disposition alternatives, presented in Section 8.

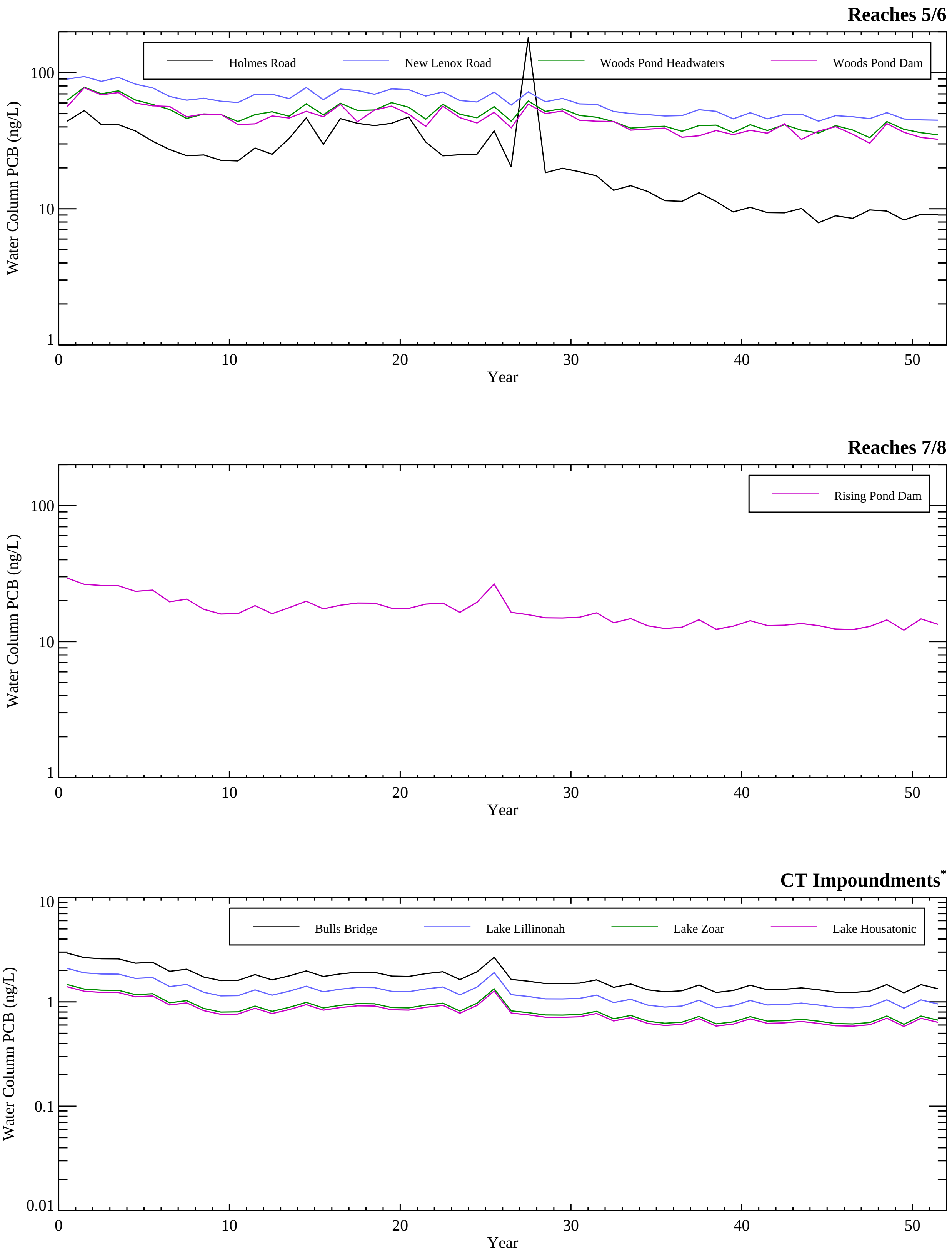

Figure 4-1a. Temporal profile of model-predicted annual average water column PCB concentration by subreach under SED 1 / SED 2.

[*] Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED1CMSBS_0712-01\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED1CMSBS_0712-28\bins
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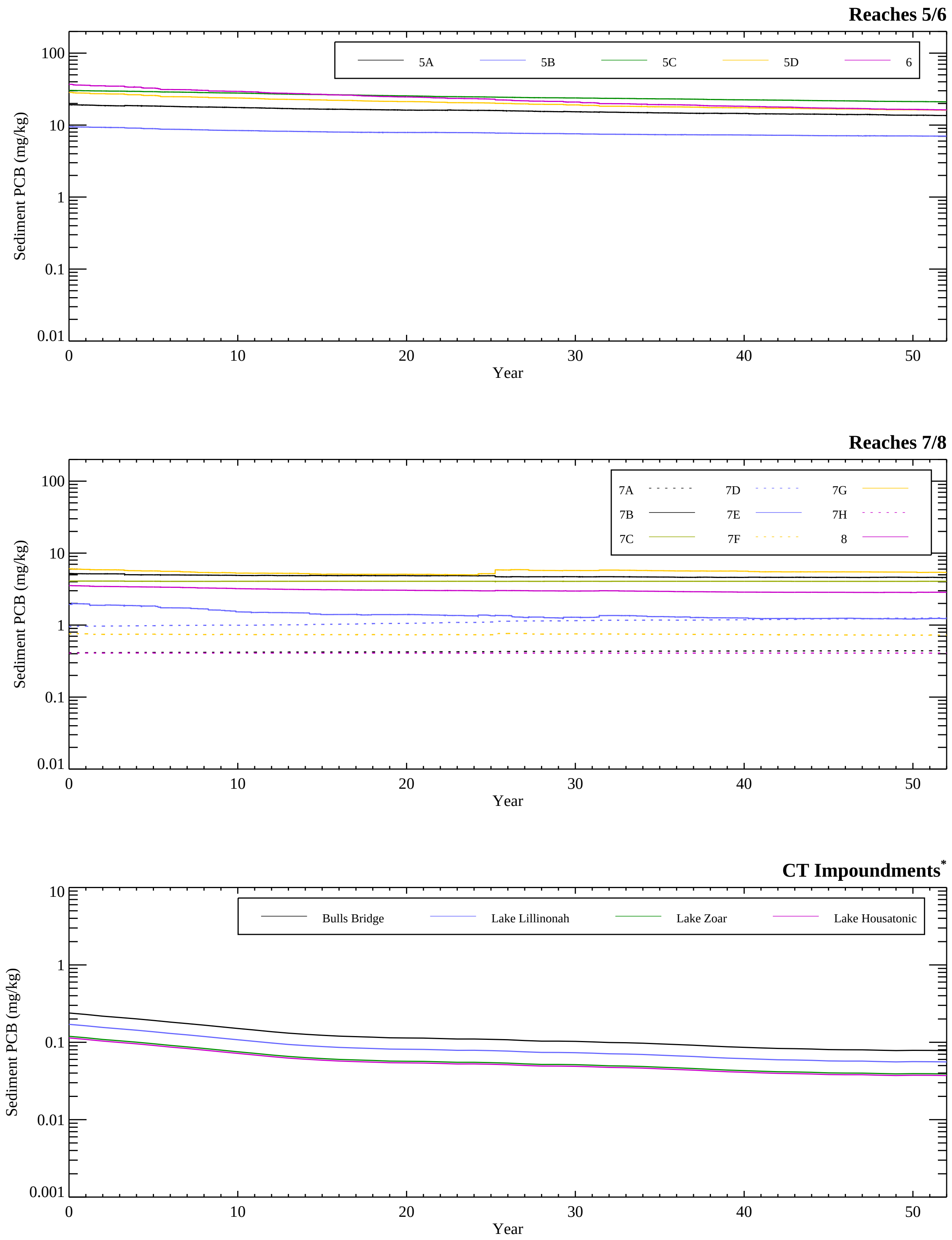

Figure 4-1b. Temporal profile of model-predicted surface (0-6") sediment PCB concentration by subreach under SED 1 / SED 2.

[*] Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED1CMSBS_0712-01\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED1CMSBS_0712-28\bins
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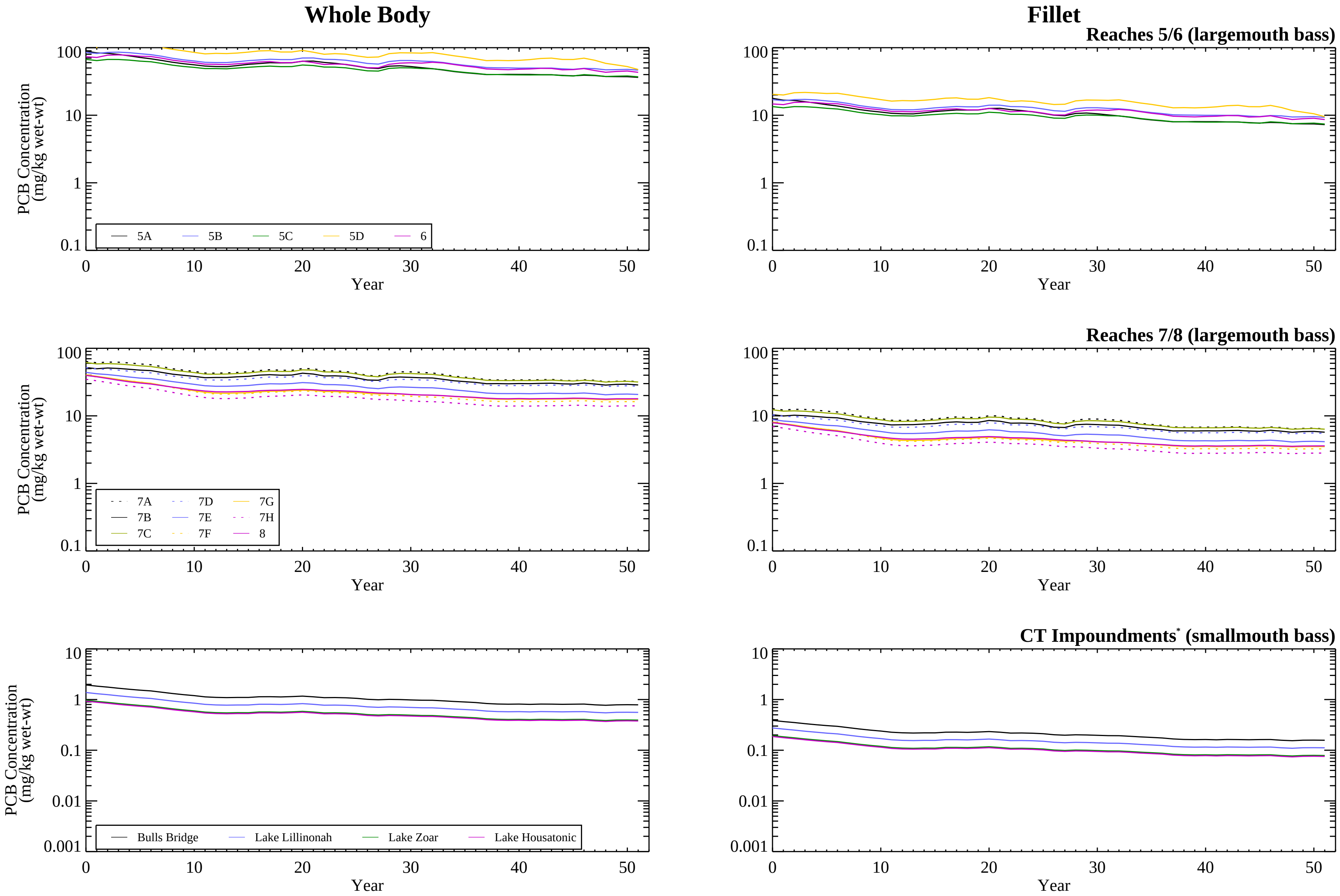

Figure 4-1c. Average PCB concentration in gamefish by subreach under SED 1 / SED2.

Notes: Average calculated for fish ages 5 to 9 from days between Aug. 28th through Oct. 26th of each year
Fillet based concentrations were calculated as whole body concentrations divided by 5.0
** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*

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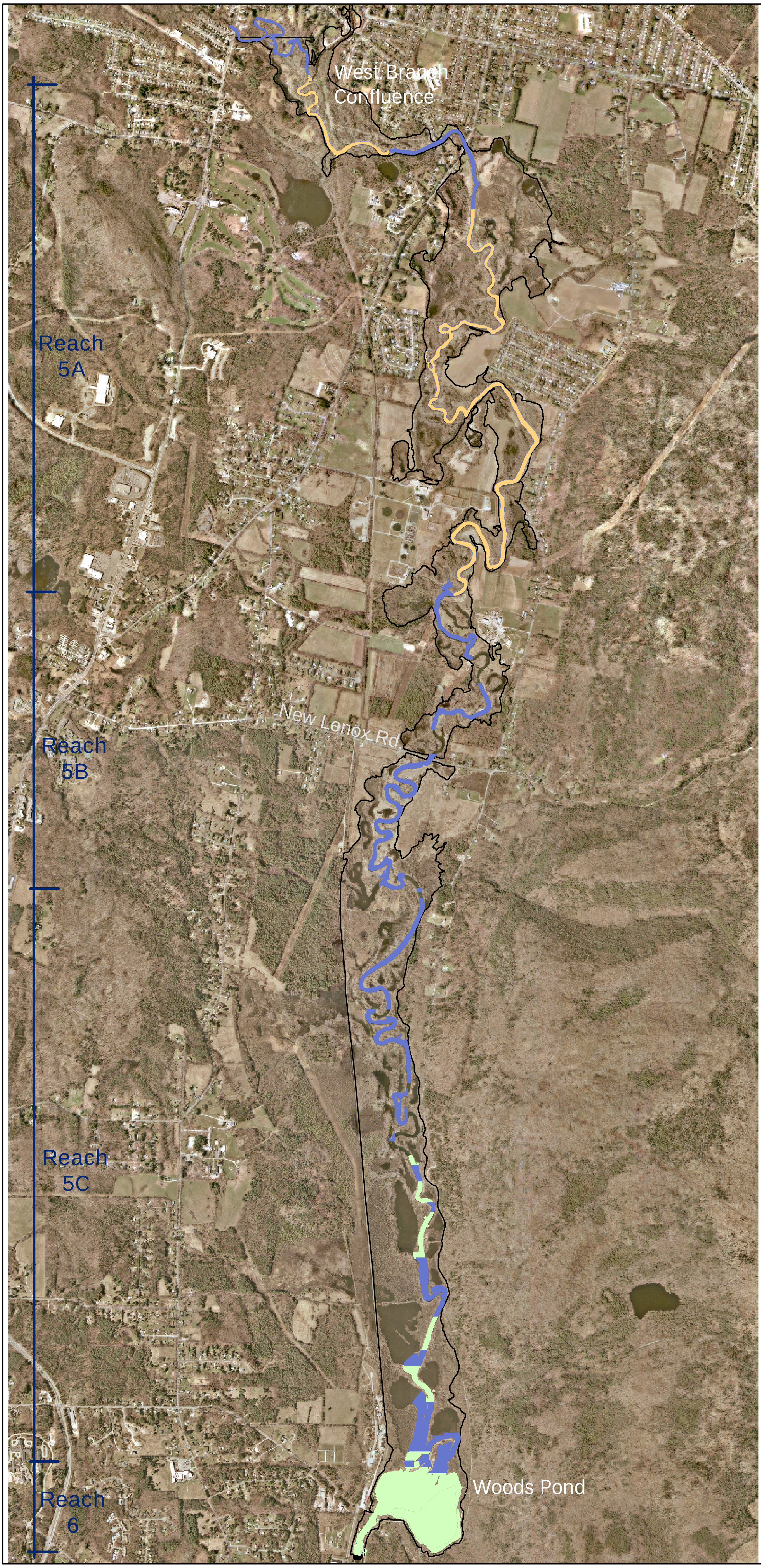

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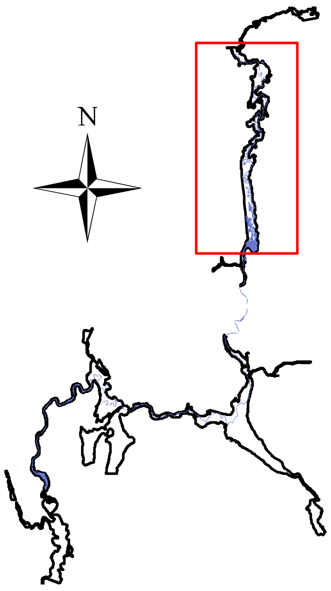

SCALE

1,500 750 0 1,500 Feet

LEGEND

▬ Dams
🟧 Removal of Top 2 ft
🟩 Thin-layer Capping
🟦 Housatonic River
☐ 1 mg/kg PCB Isopleth

SED 3 includes bank removal/ stabilization for Reaches 5A and 5B.

Figure 4-2. Sediment Alternative 3 (SED 3) in Reaches 5 and 6.

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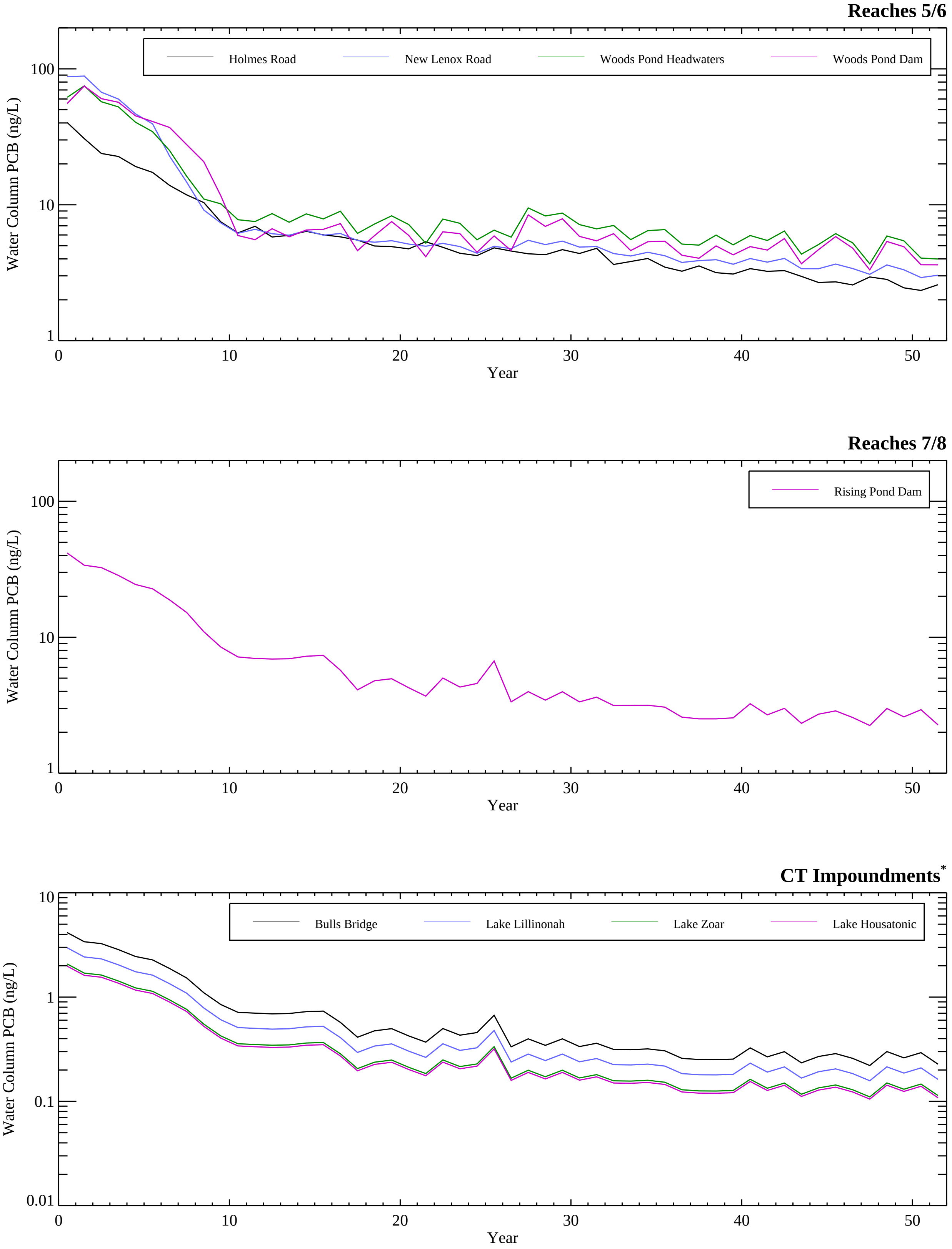

Figure 4-3a. Temporal profile of model-predicted annual average water column PCB concentration by subreach under SED 3.

** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED3CMSBS_0712-13\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED3CMSBS_0712-29\bins
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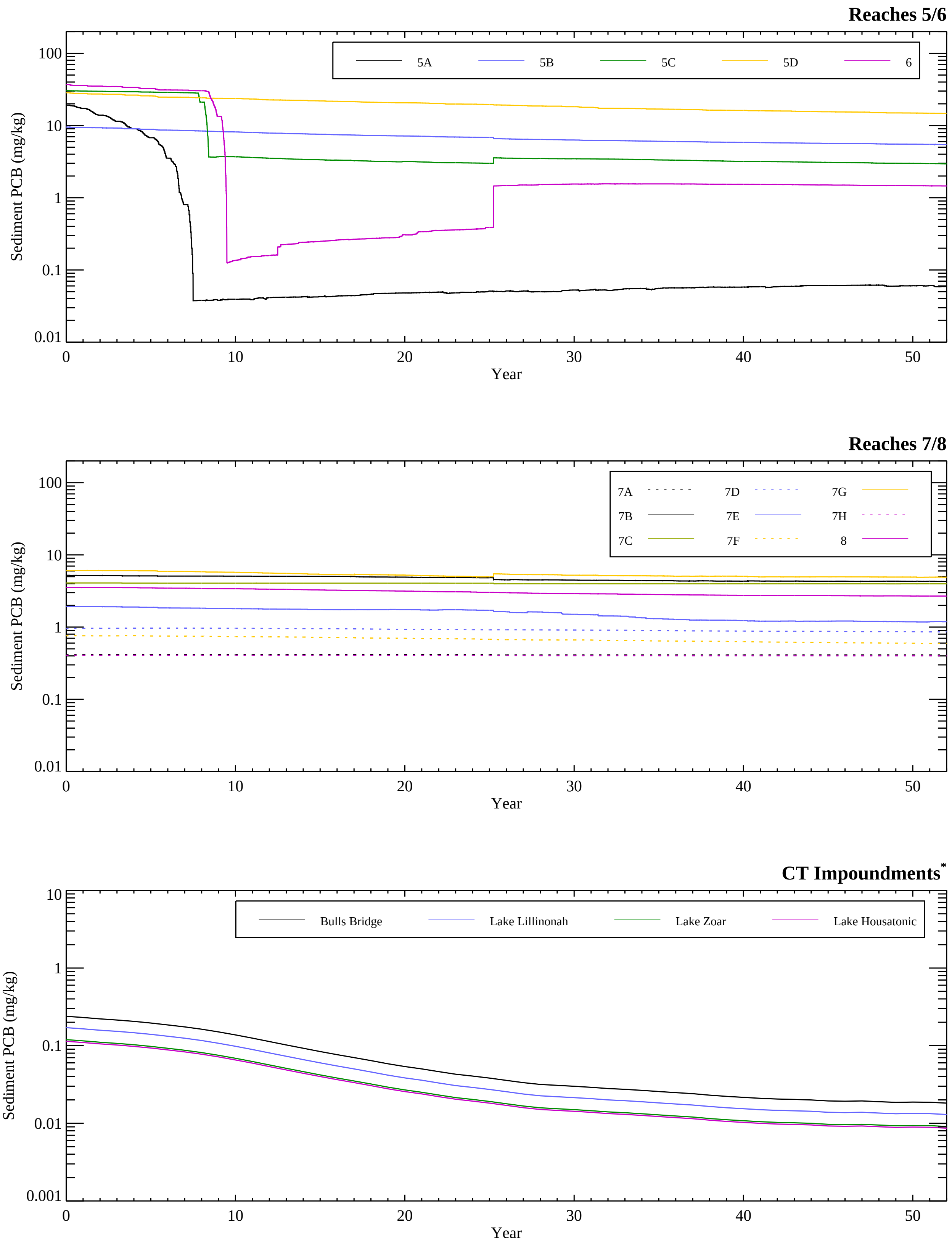

Figure 4-3b. Temporal profile of model-predicted surface (0-6") sediment PCB concentration by subreach under SED 3.

[*] Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED3CMSBS_0712-13\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED3CMSBS_0712-29\bins
CT Impoundments -Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED03_0712-29_base

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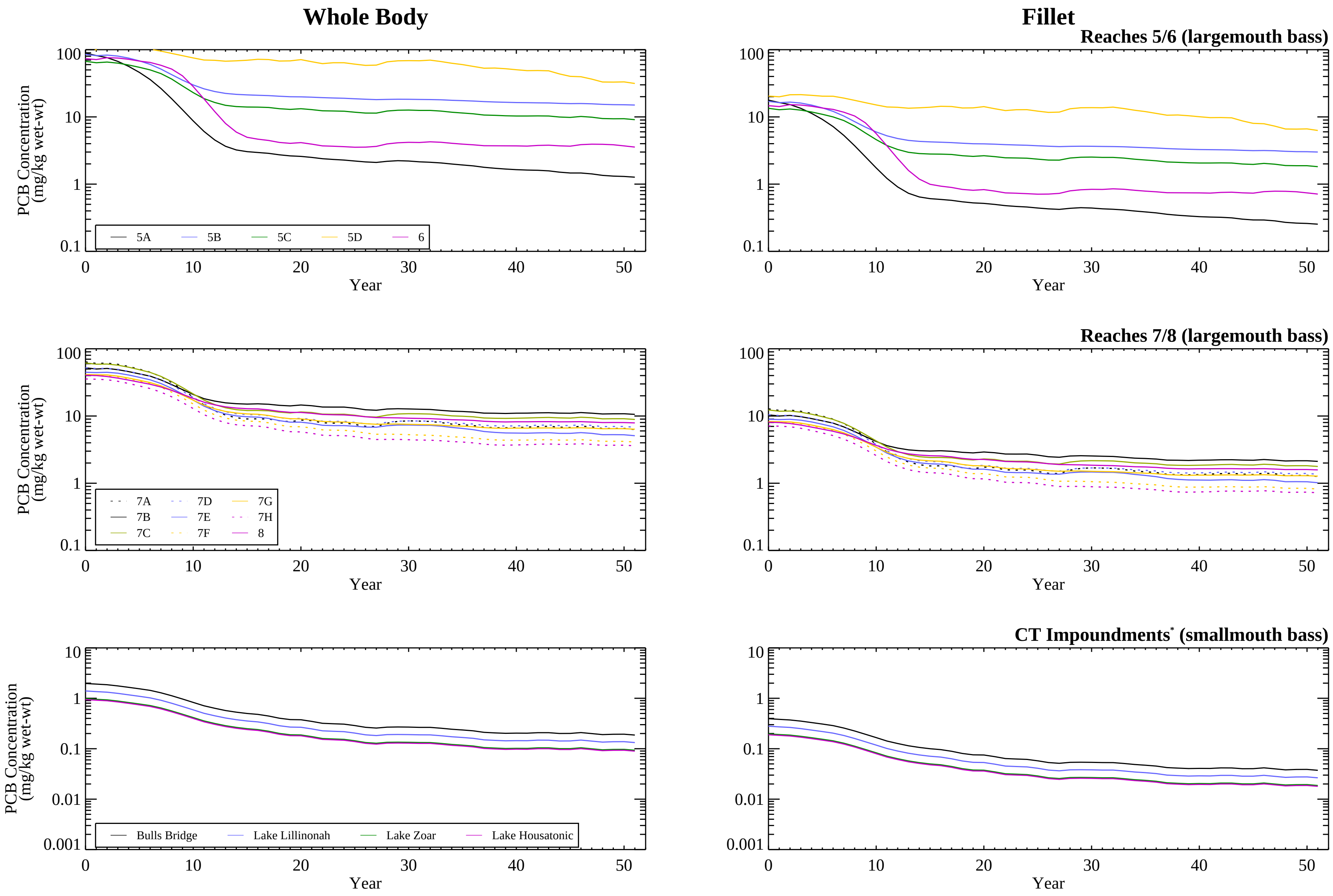

Figure 4-3c. Average PCB concentration in gamefish by subreach under SED 3.

Notes: Average calculated for fish ages 5 to 9 from days between Aug. 28th through Oct. 26th of each year
Fillet based concentrations were calculated as whole body concentrations divided by 5.0
** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*

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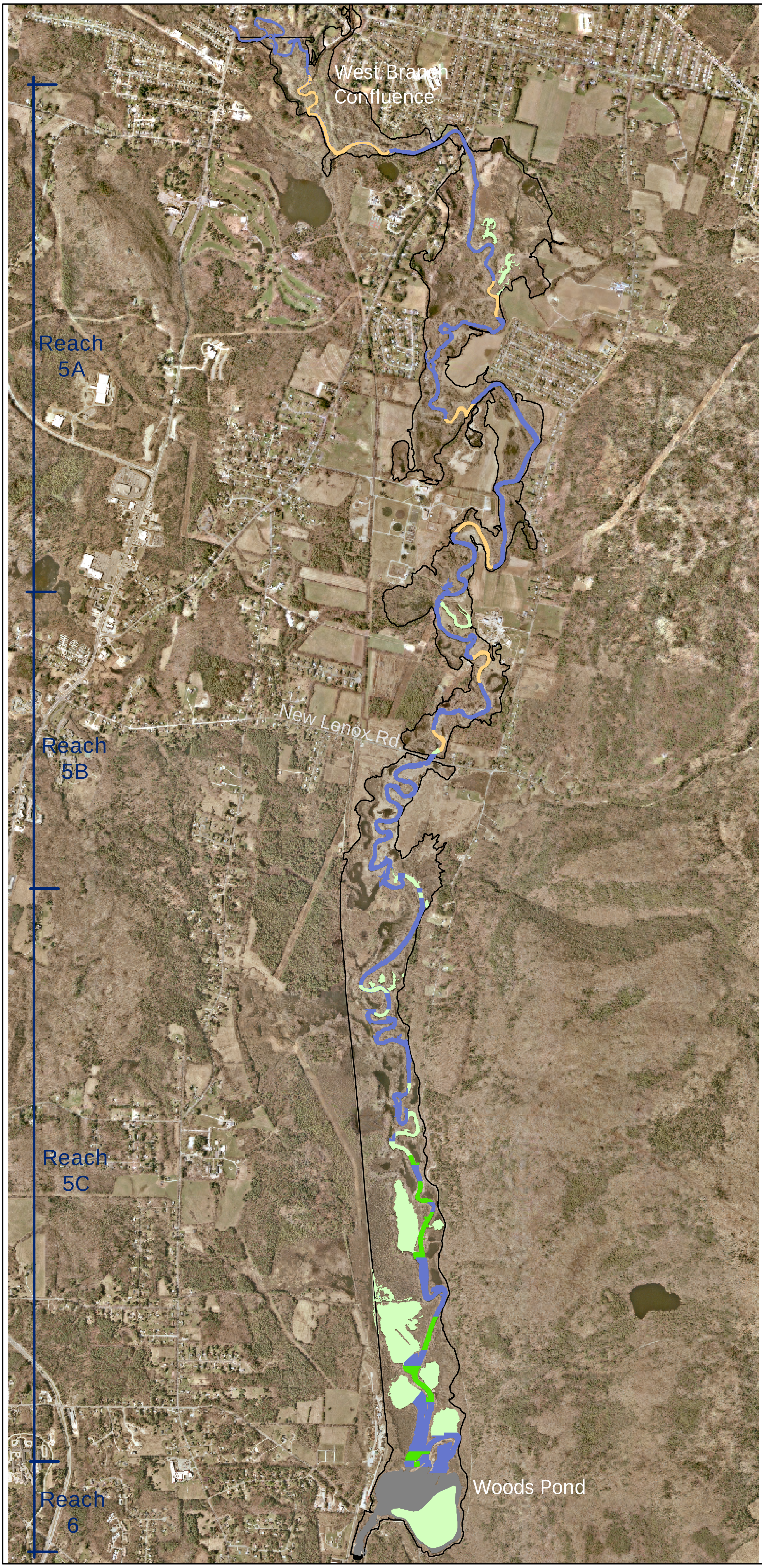

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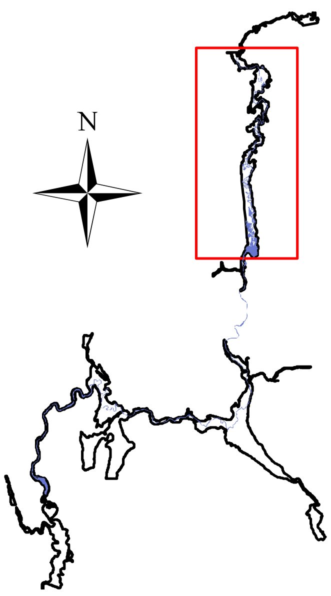

SCALE

1,500 750 0 1,500 Feet

LEGEND

▬ Dams
■ Removal of Top 1.5 ft
■ Removal of Top 2 ft
■ Engineered Capping Only
■ Thin-layer Capping
■ Housatonic River
□ 1 mg/kg PCB Isopleth

SED 4 includes bank removal/ stabilization for Reaches 5A and 5B.

**Figure 4-4.
Sediment Alternative 4 (SED 4) in Reaches 5 and 6.**

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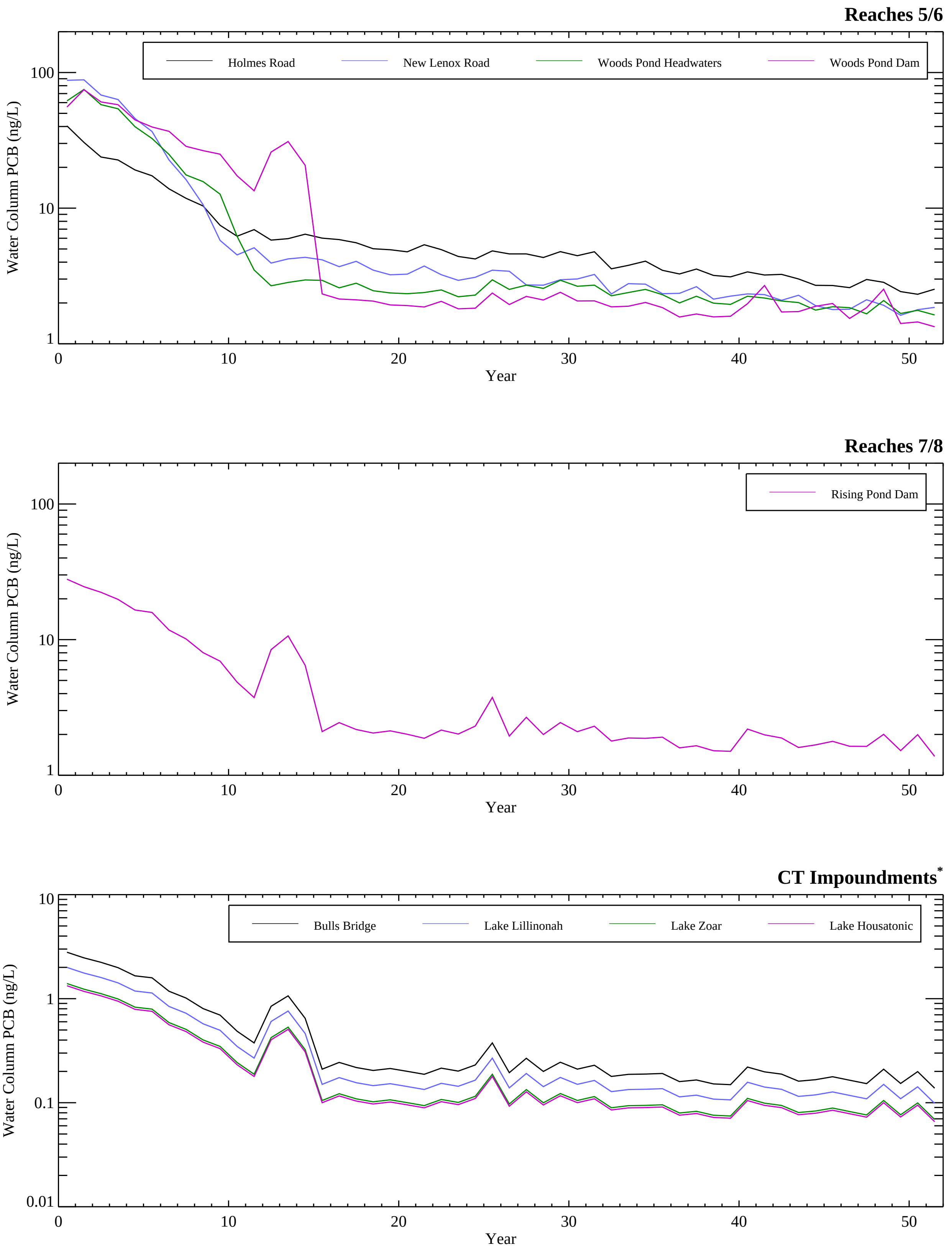

Figure 4-5a. Temporal profile of model-predicted annual average water column PCB concentration by subreach under SED 4.

[*] Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED4CMSBS_0801-01\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED4CMSBS_0802-01\bins
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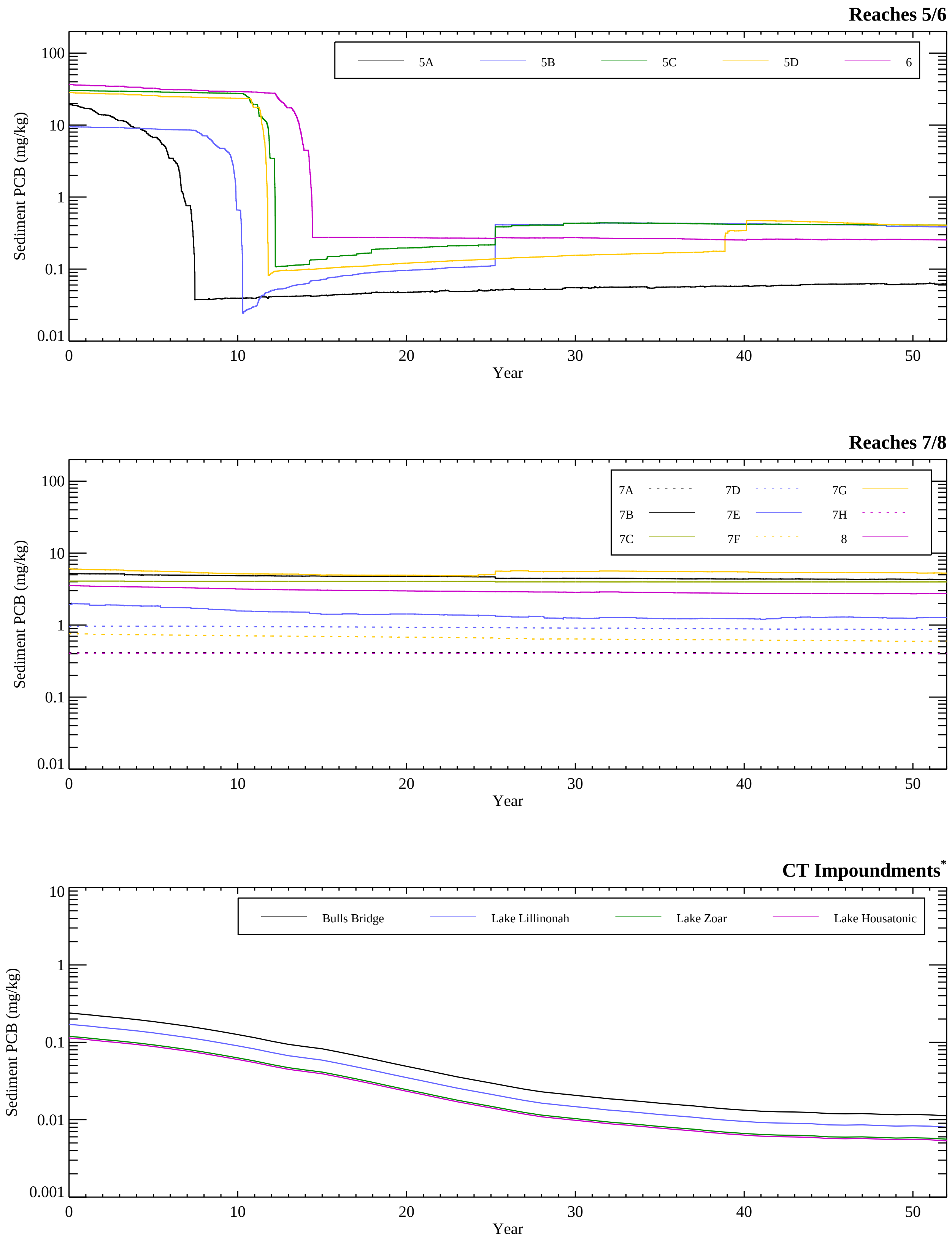

Figure 4-5b. Temporal profile of model-predicted surface (0-6") sediment PCB concentration by subreach under SED 4.

** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED4CMSBS_0801-01\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED4CMSBS_0802-01\bins
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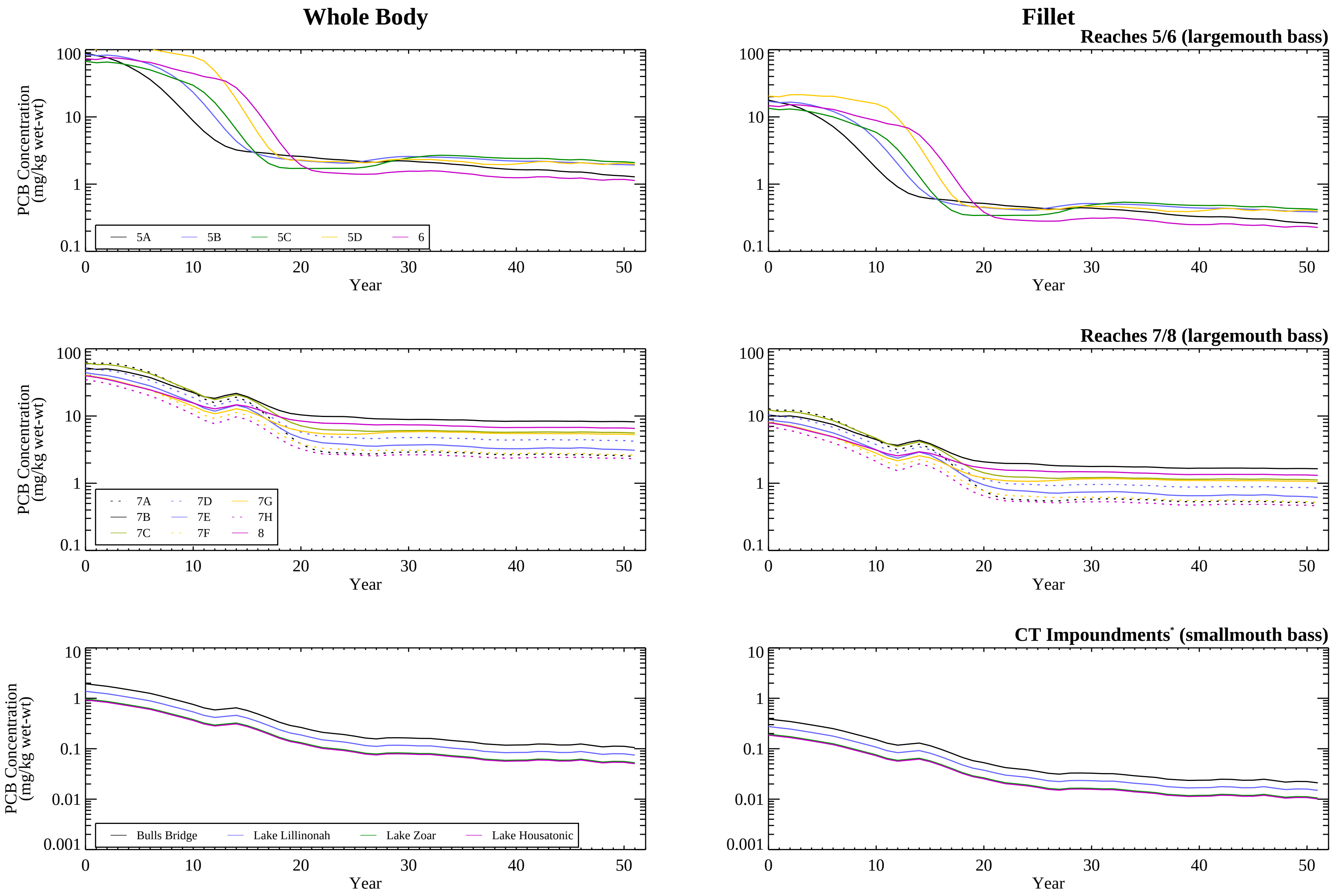

Figure 4-5c. Average PCB concentration in gamefish by subreach under SED 4.

Notes: Average calculated for fish ages 5 to 9 from days between Aug. 28th through Oct. 26th of each year
Fillet based concentrations were calculated as whole body concentrations divided by 5.0
** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*

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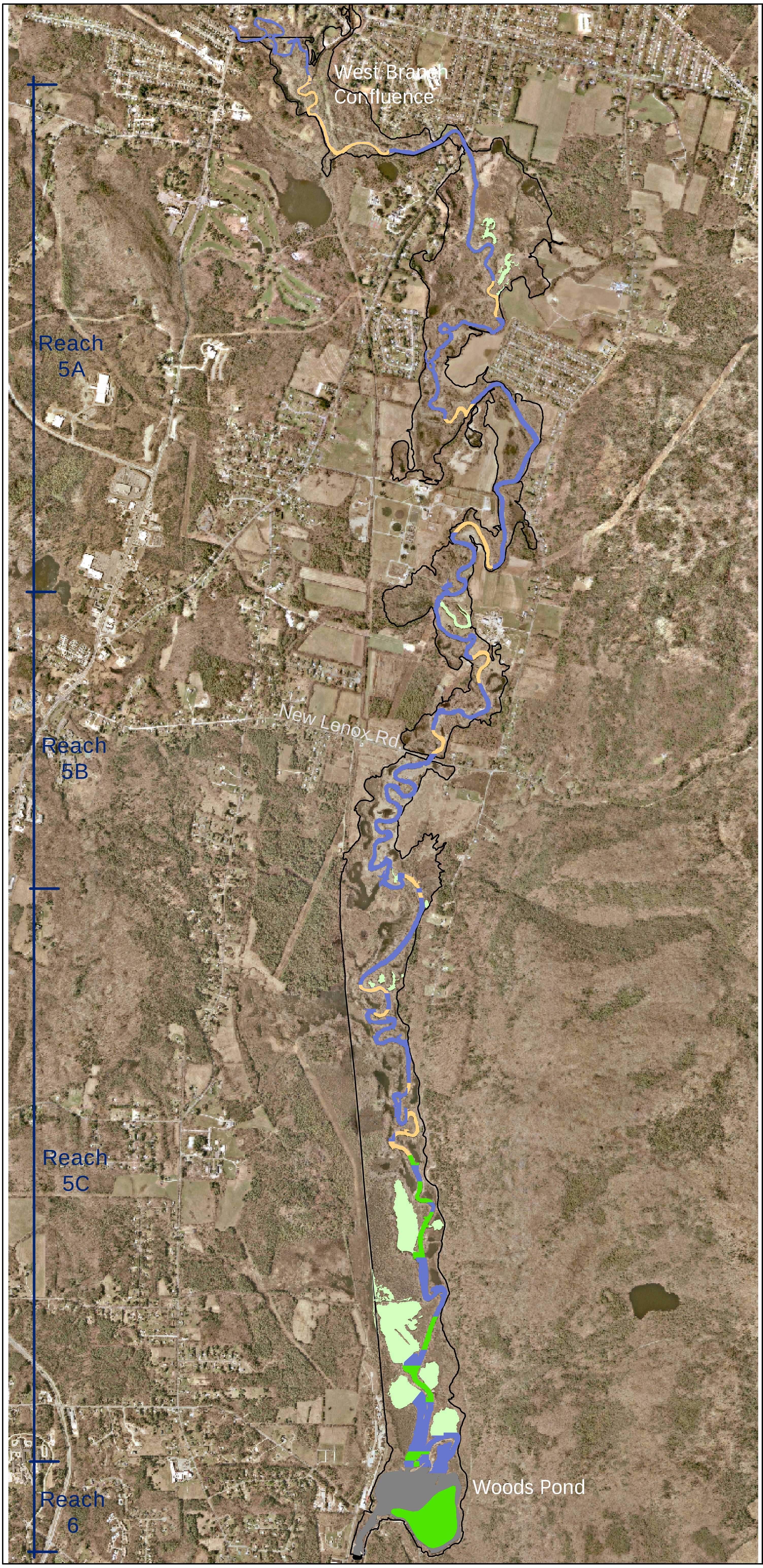

SED 5 includes bank removal/ stabilization for Reaches 5A and 5B.

Figure 4-6a. Sediment Alternative 5 (SED 5) in Reaches 5 and 6.

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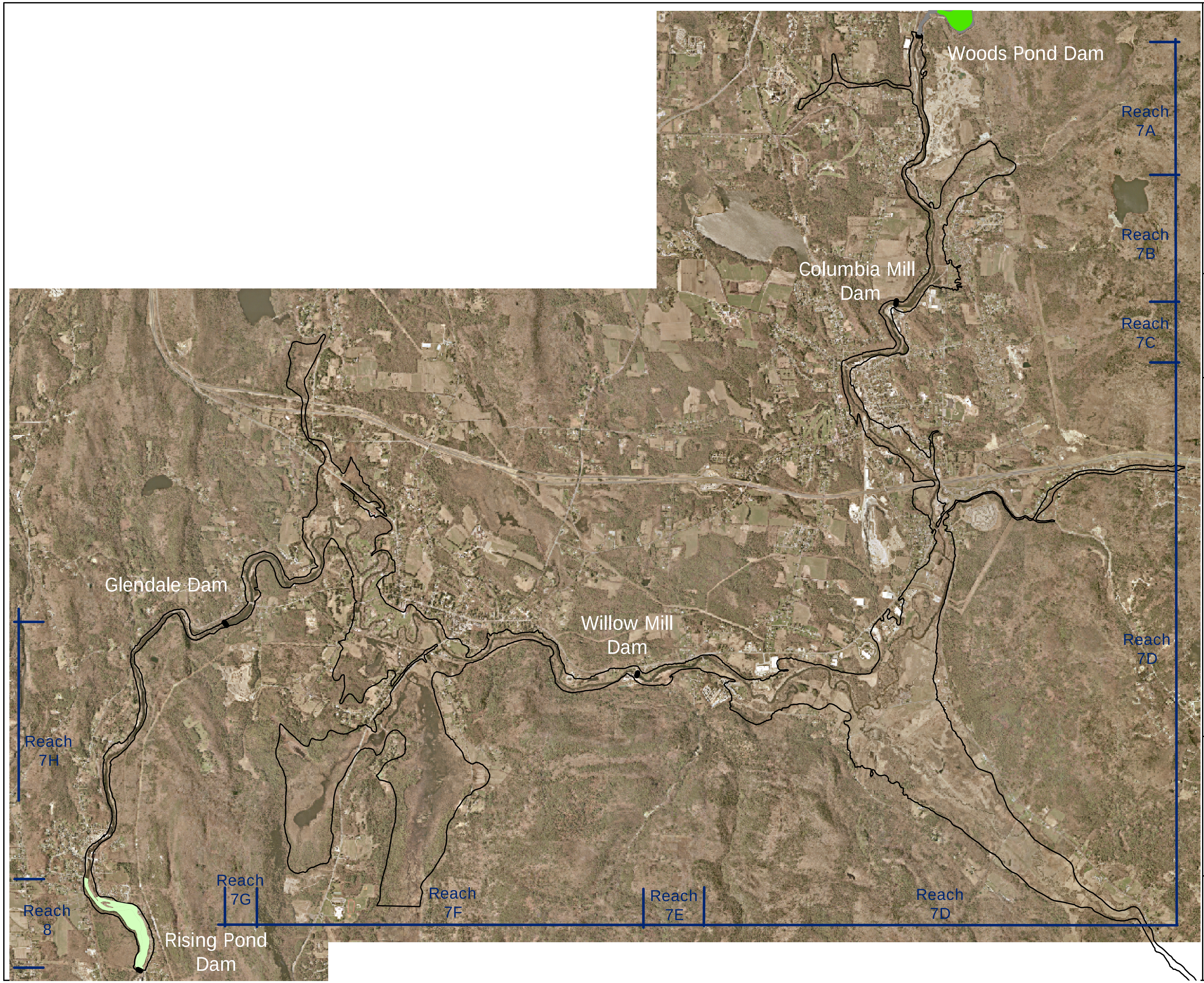

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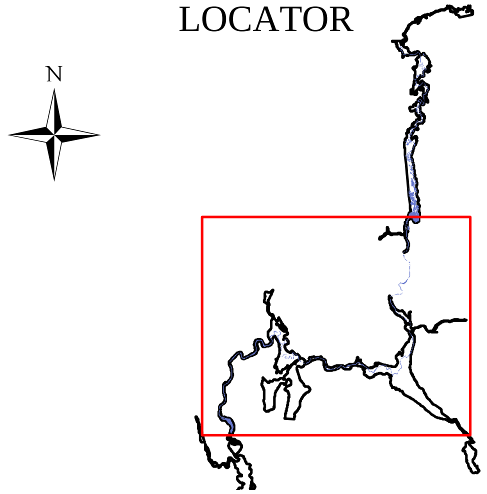

SCALE

1 0.5 0 1 Miles

LEGEND

▬ Dams
▨ Removal of Top 1.5 ft
🟩 Engineered Capping Only
▨ Thin-layer Capping
▨ Housatonic River
☐ 100-Year Floodplain

Figure 4-6b.
Sediment Alternative 5 (SED 5)
in Reaches 7 and 8.

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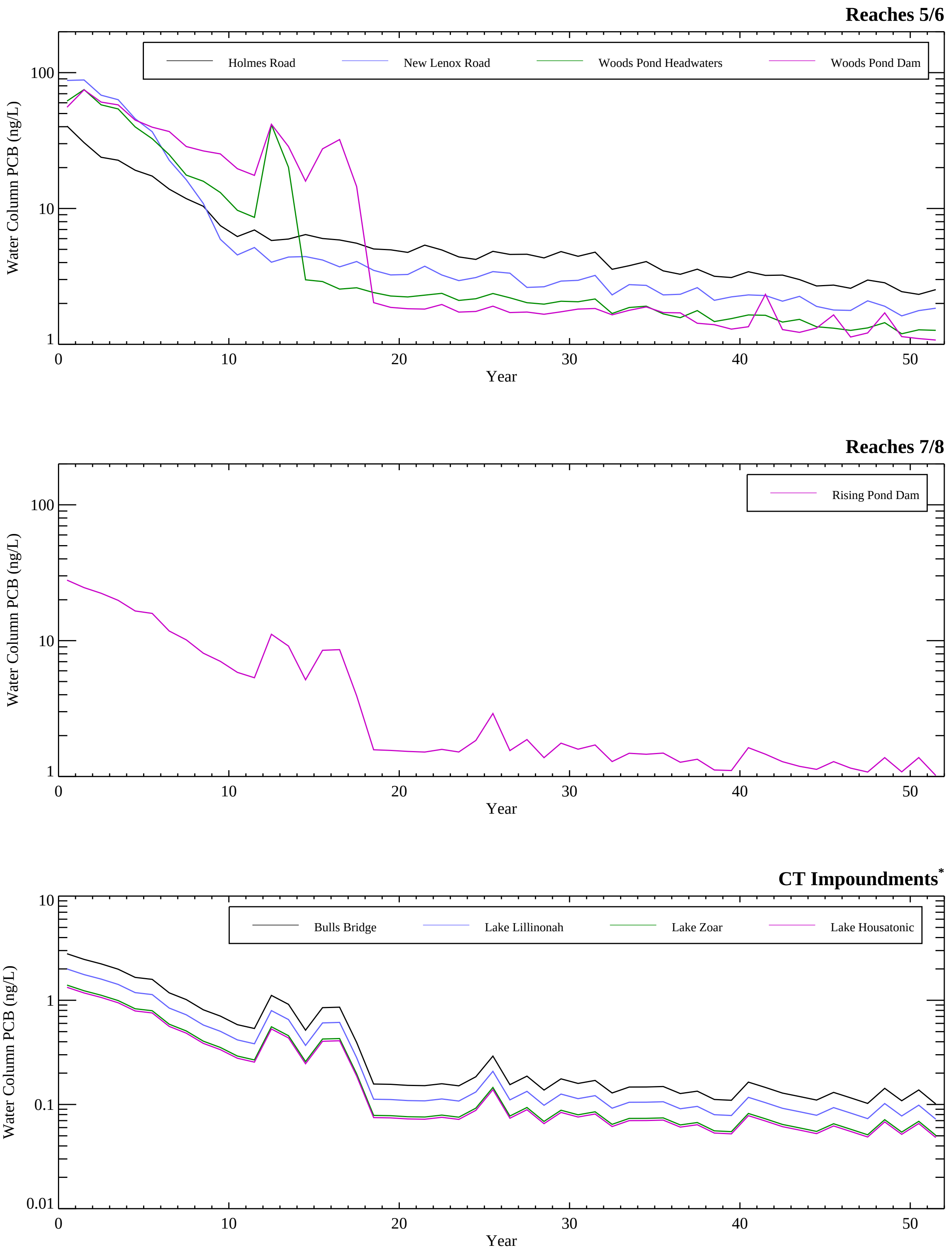

Figure 4-7a. Temporal profile of model-predicted annual average water column PCB concentration by subreach under SED 5.

[*] Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED5CMSBS_0801-02\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED5CMSBS_0802-02\bins
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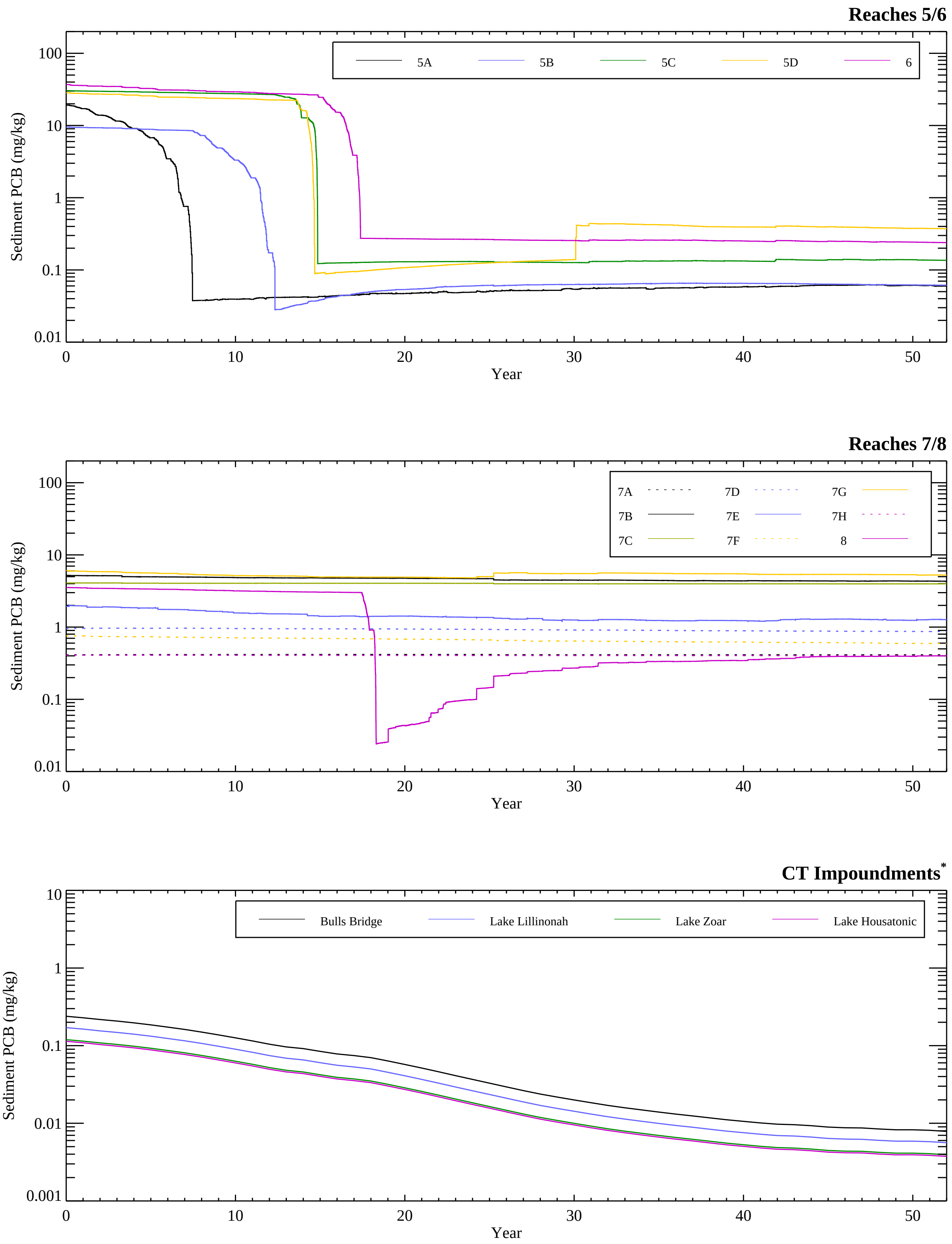

Figure 4-7b. Temporal profile of model-predicted surface (0-6") sediment PCB concentration by subreach under SED 5.

[*] *Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*
Model Results:
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Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED5CMSBS_0802-02\bins
CT Impoundments -Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED05_0802-02_base

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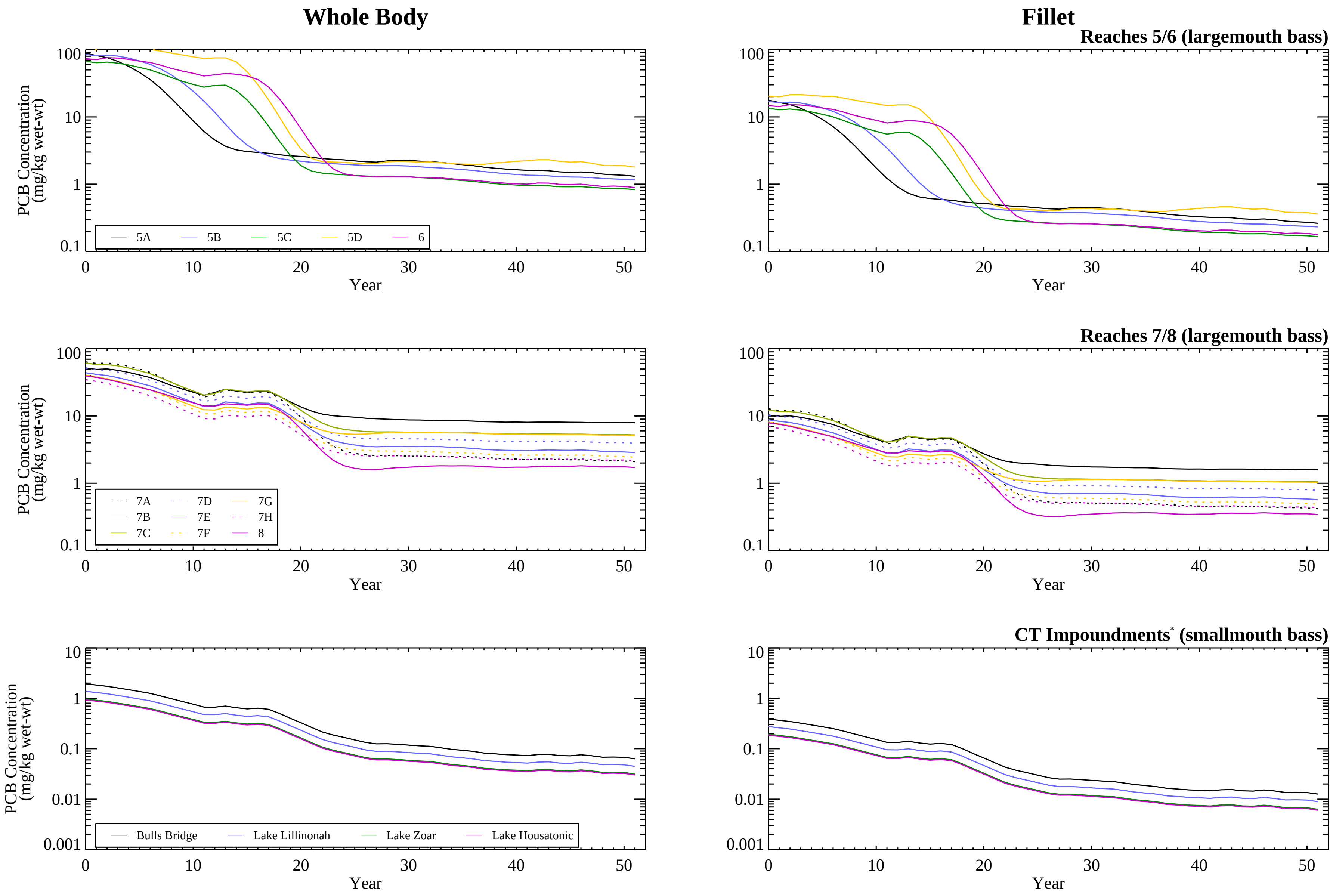

Figure 4-7c. Average PCB concentration in gamefish by subreach under SED 5.

Notes: Average calculated for fish ages 5 to 9 from days between Aug. 28th through Oct. 26th of each year
Fillet based concentrations were calculated as whole body concentrations divided by 5.0
** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*

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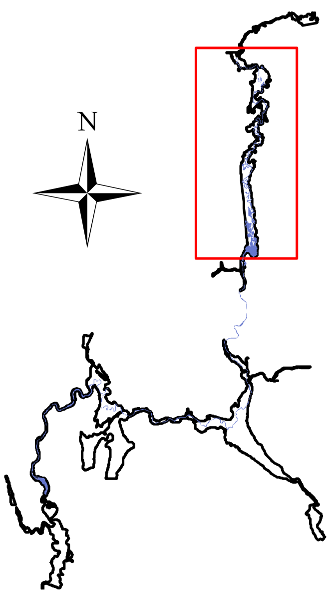

SCALE

1,500 750 0 1,500 Feet

LEGEND

- ━ Dams
- ▒ Removal of Top 1 ft
- ▓ Removal of Top 1.5 ft
- 🟨 Removal of Top 2 ft
- 🟩 Engineered Capping Only
- 🟩 Thin-layer Capping
- 🟦 Housatonic River
- ☐ 1 mg/kg PCB Isopleth

SED 6 includes bank removal/ stabilization for Reaches 5A and 5B.

Figure 4-8a. Sediment Alternative 6 (SED 6) in Reaches 5 and 6.

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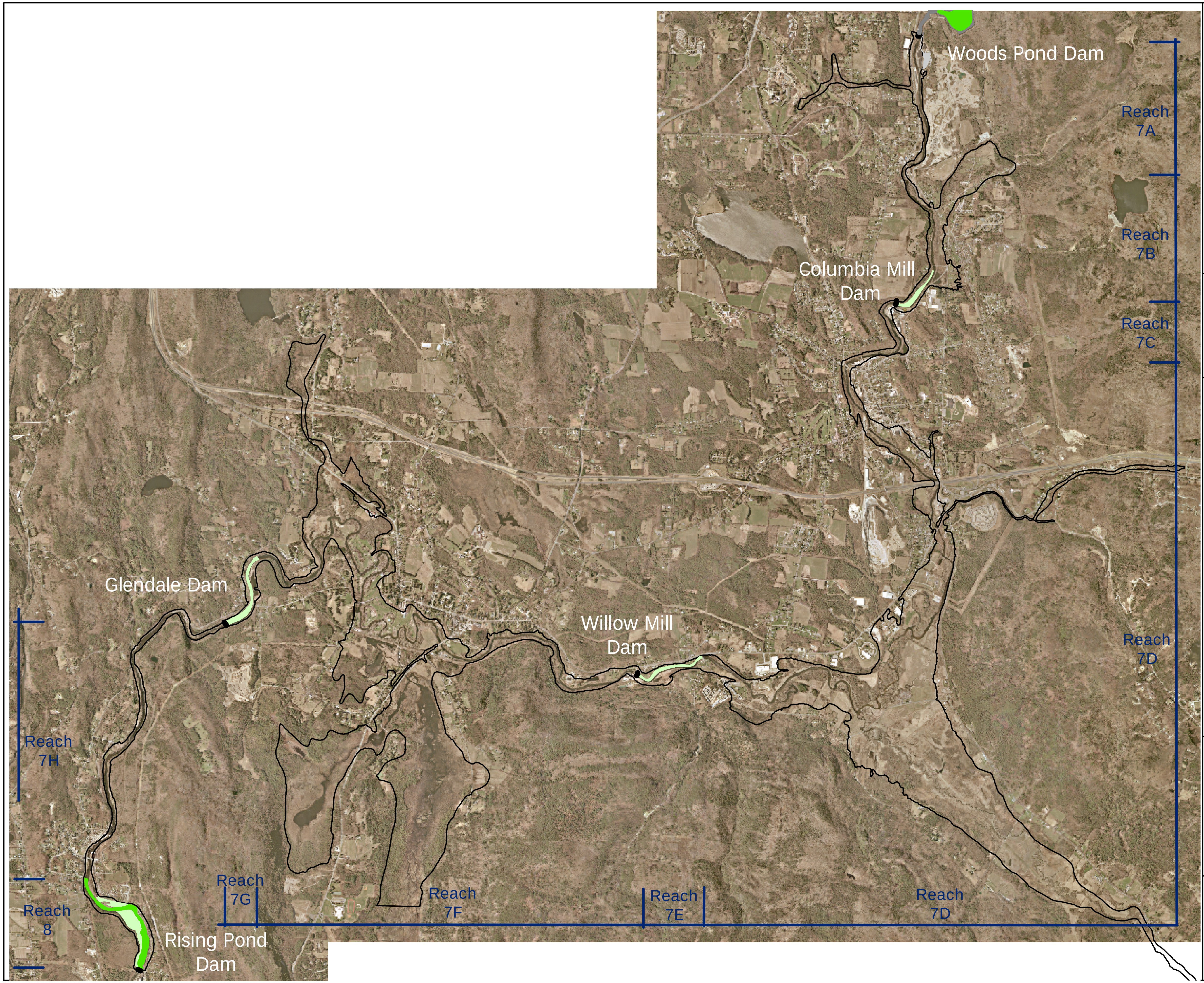

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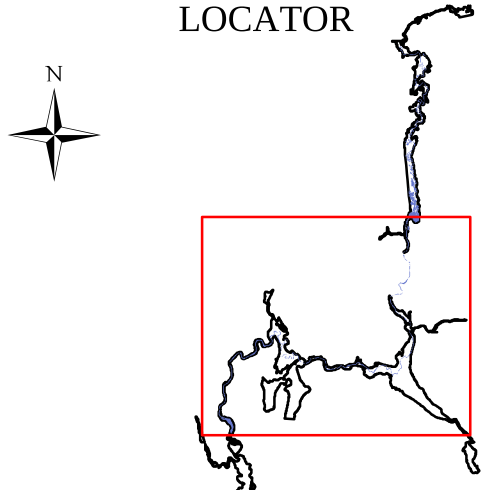

SCALE

1 0.5 0 1 Miles

LEGEND

- ▬ Dams
- ▨ Removal of Top 1 ft
- ▩ Removal of Top 1.5 ft
- 🟩 Engineered Capping Only
- ▢ Thin-layer Capping
- 🟦 Housatonic River
- ☐ 100-Year Floodplain

Figure 4-8b.
Sediment Alternative 6 (SED 6)
in Reaches 7 and 8.

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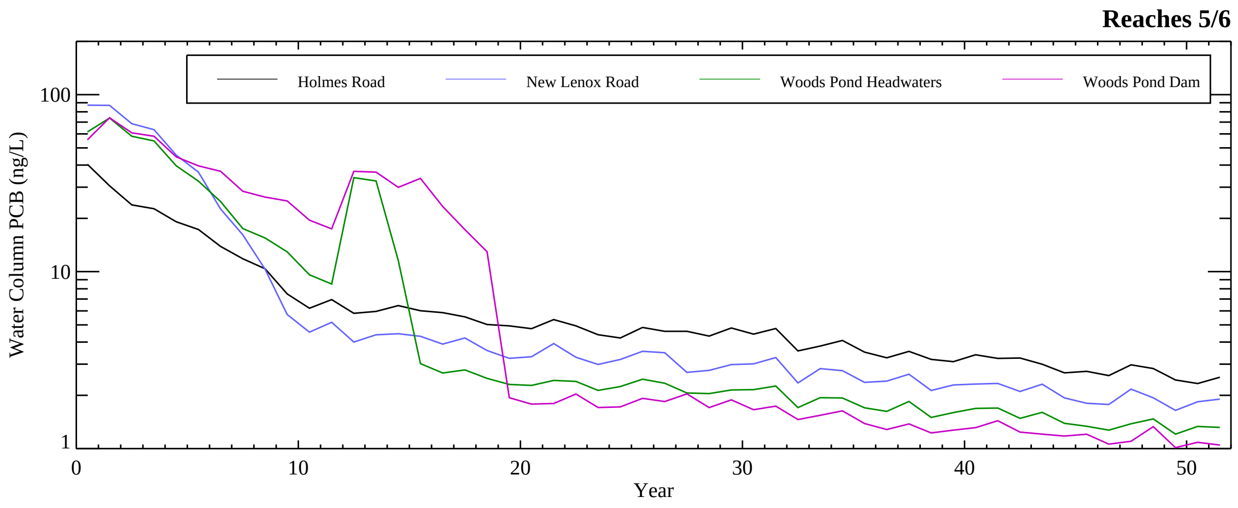

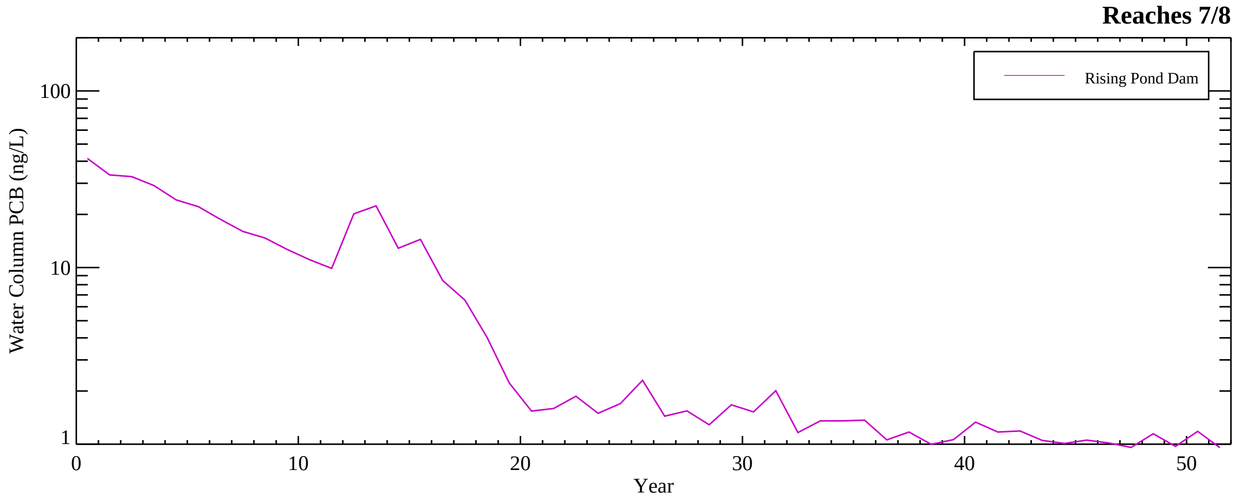

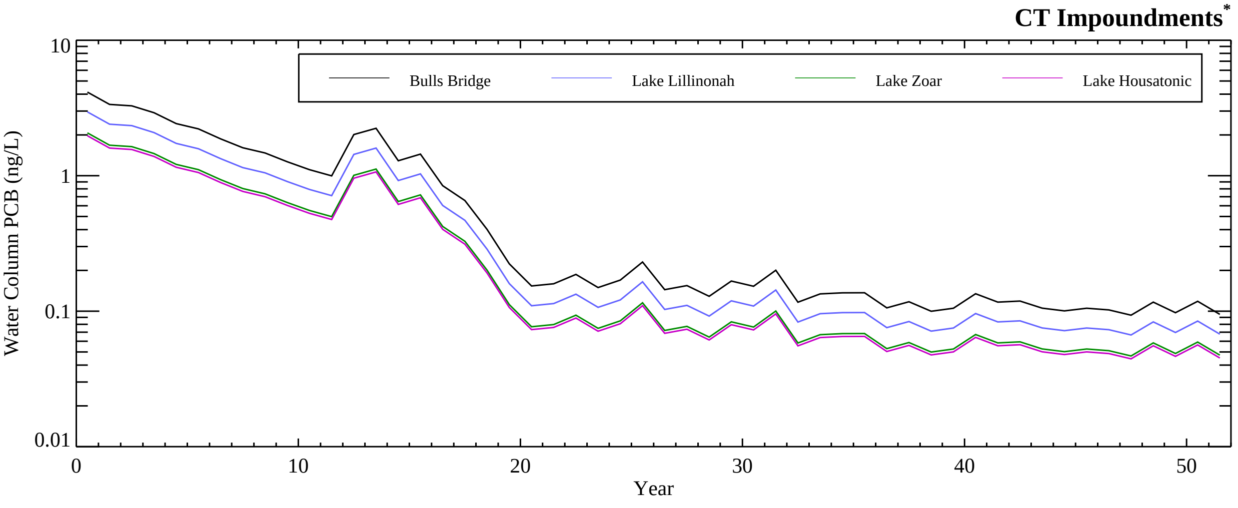

Figure 4-9a. Temporal profile of model-predicted annual average water column PCB concentration by subreach under SED 6.

* *Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED6CMSBS_0712-16\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED6CMSBS_0712-32\bins
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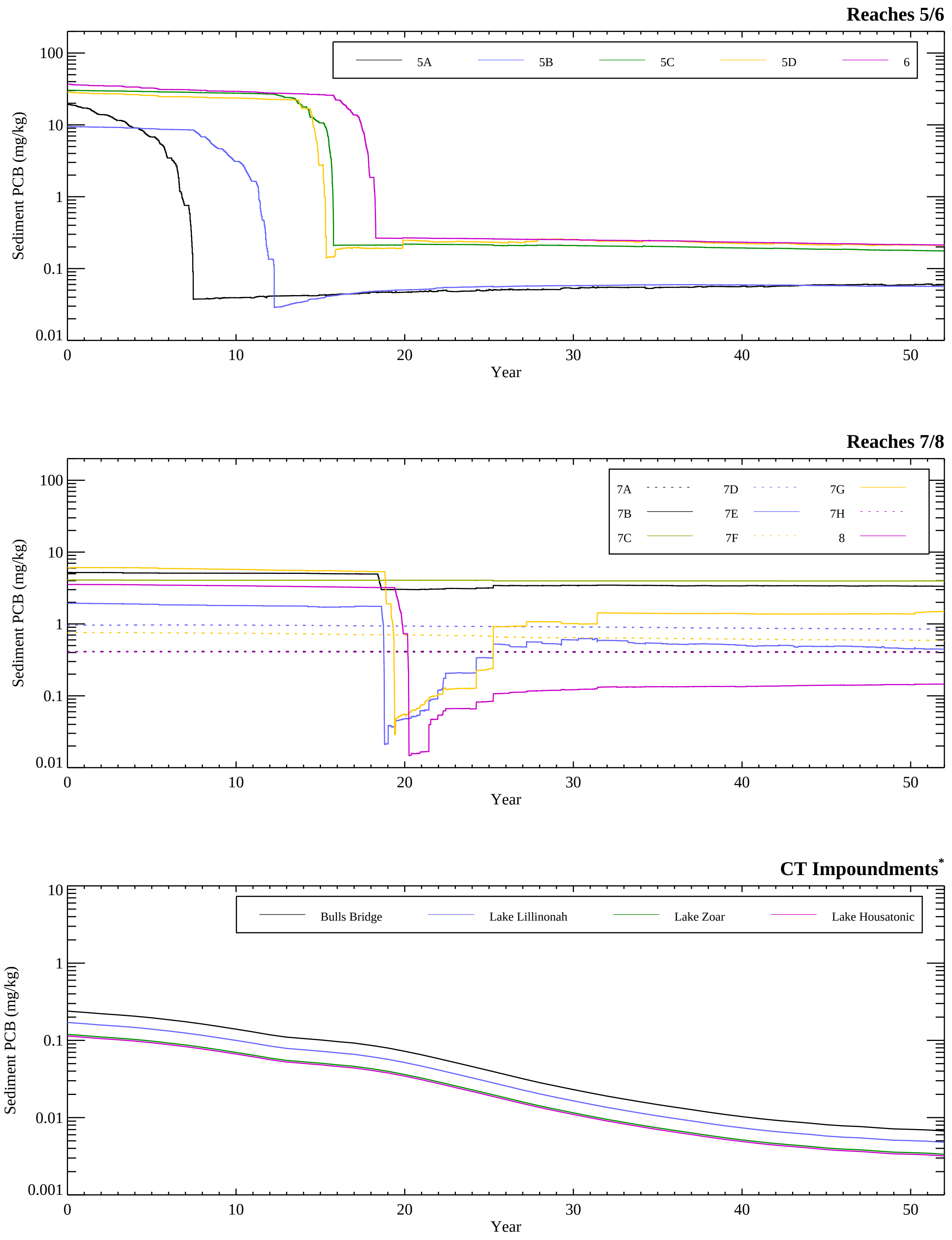

Figure 4-9b. Temporal profile of model-predicted surface (0-6") sediment PCB concentration by subreach under SED 6.

* *Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED6CMSBS_0712-16\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED6CMSBS_0712-32\bins
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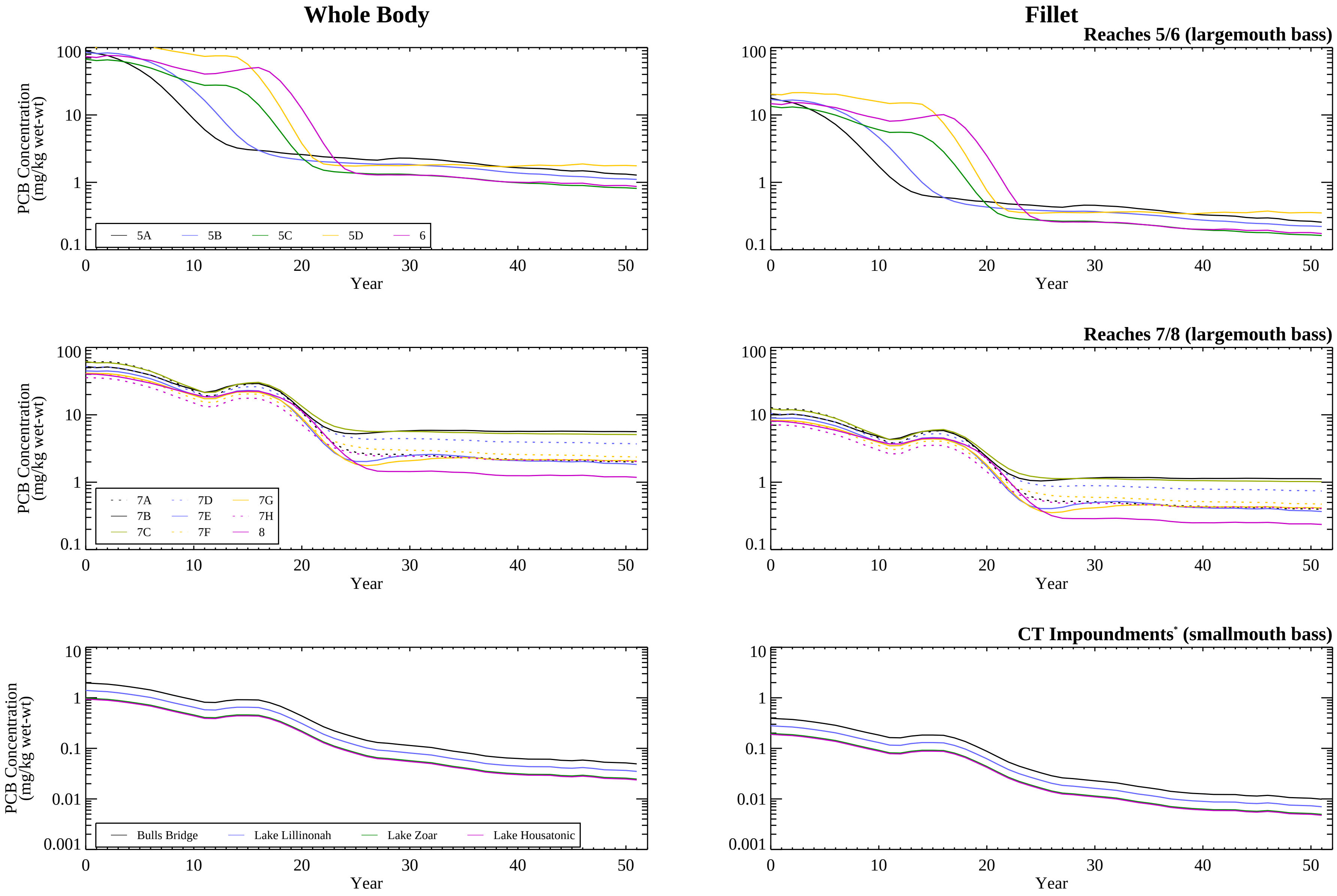

Figure 4-9c. Average PCB concentration in gamefish by subreach under SED 6.

Notes: Average calculated for fish ages 5 to 9 from days between Aug. 28th through Oct. 26th of each year
Fillet based concentrations were calculated as whole body concentrations divided by 5.0
** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*

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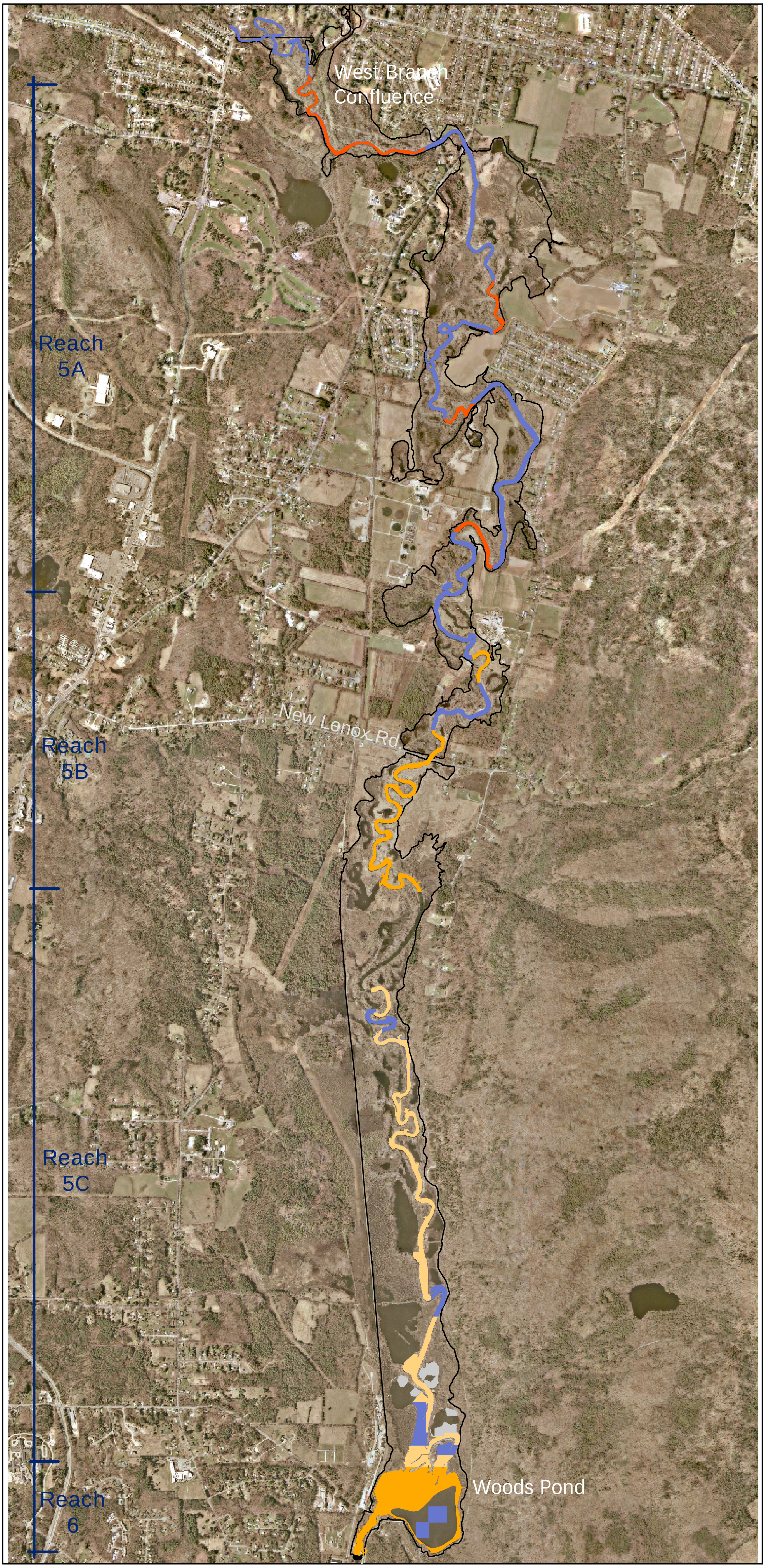

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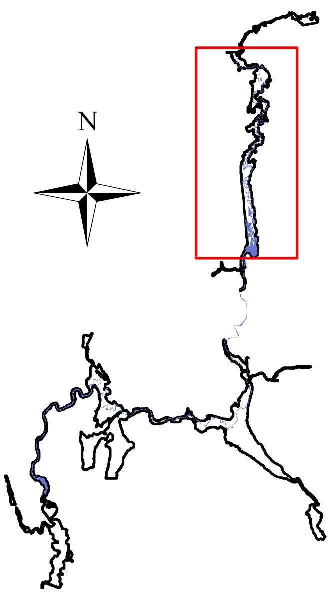

SCALE

1,500 750 0 1,500 Feet

LEGEND

- ▬ Dams
- ⬜ Removal of Top 1 ft
- ⬛ Removal of Top 1.5 ft
- 🟨 Removal of Top 2 ft
- 🟧 Removal of Top 2.5 ft
- 🟥 Removal of Top 3.0-3.5 ft
- 🟩 Thin-layer Capping
- 🟩 Engineered Capping Only
- 🟦 Housatonic River
- ☐ 1 mg/kg PCB Isopleth

SED 7 includes bank removal/
stabilization for Reaches 5A and 5B.

**Figure 4-10a.
Sediment Alternative 7
(SED 7) in Reaches
5 and 6.**

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GENcms 110 March 2008

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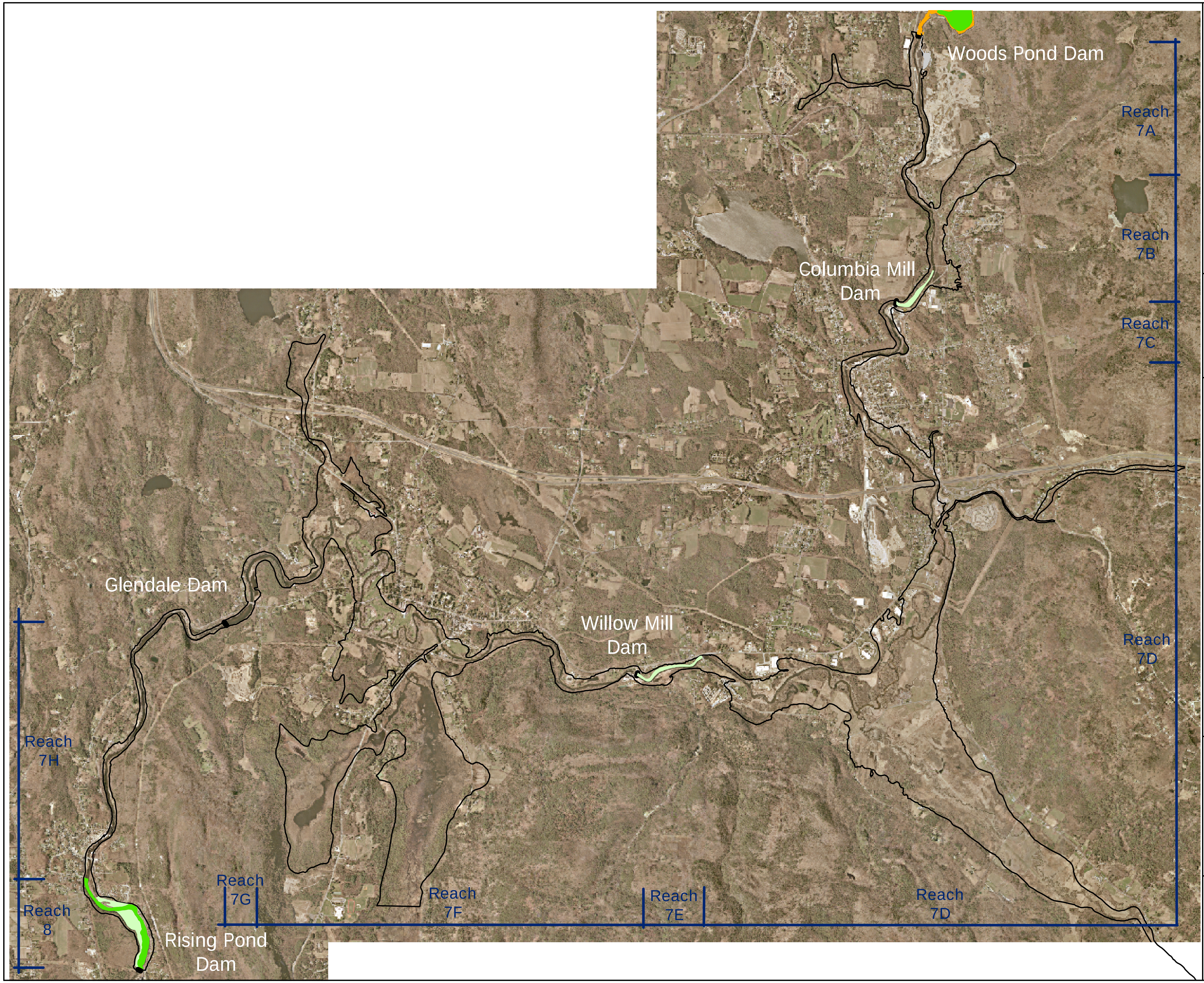

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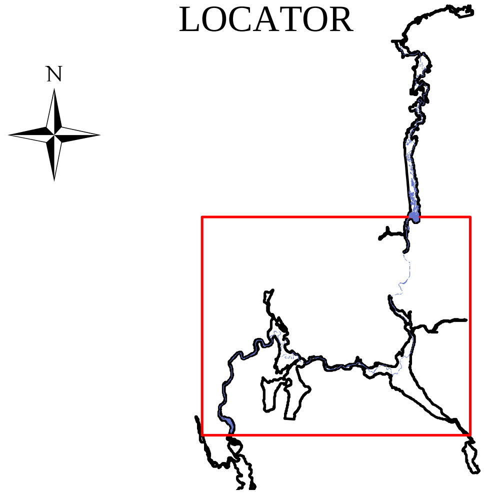

SCALE

1 0.5 0 1 Miles

LEGEND

▬ Dams
⬜ Removal of Top 1 ft
⬛ Removal of Top 1.5 ft
🟧 Removal of Top 2.5 ft
🟩 Thin-layer Capping
🟩 Engineered Capping Only
🟦 Housatonic River
▭ 100-Year Floodplain

Figure 4-10b.
Sediment Alternative 7 (SED 7)
in Reaches 7 and 8.

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wk - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Section4\Figures\mxds\sed_removals_R78.mxd

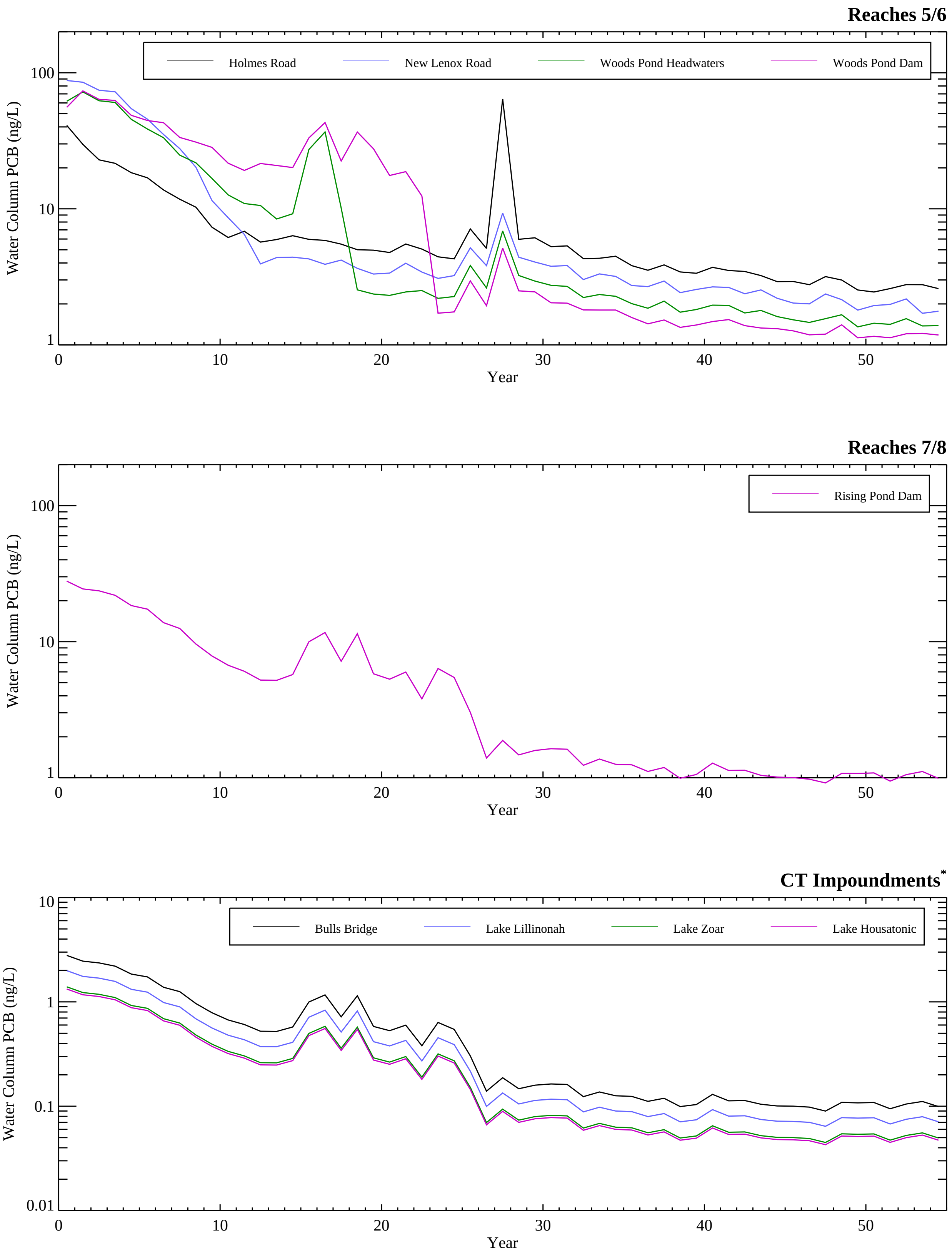

Figure 4-11a. Temporal profile of model-predicted annual average water column PCB concentration by subreach under SED 7.

[*] Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED7CMSBS_0712-03\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED7CMSBS_0712-33\bins
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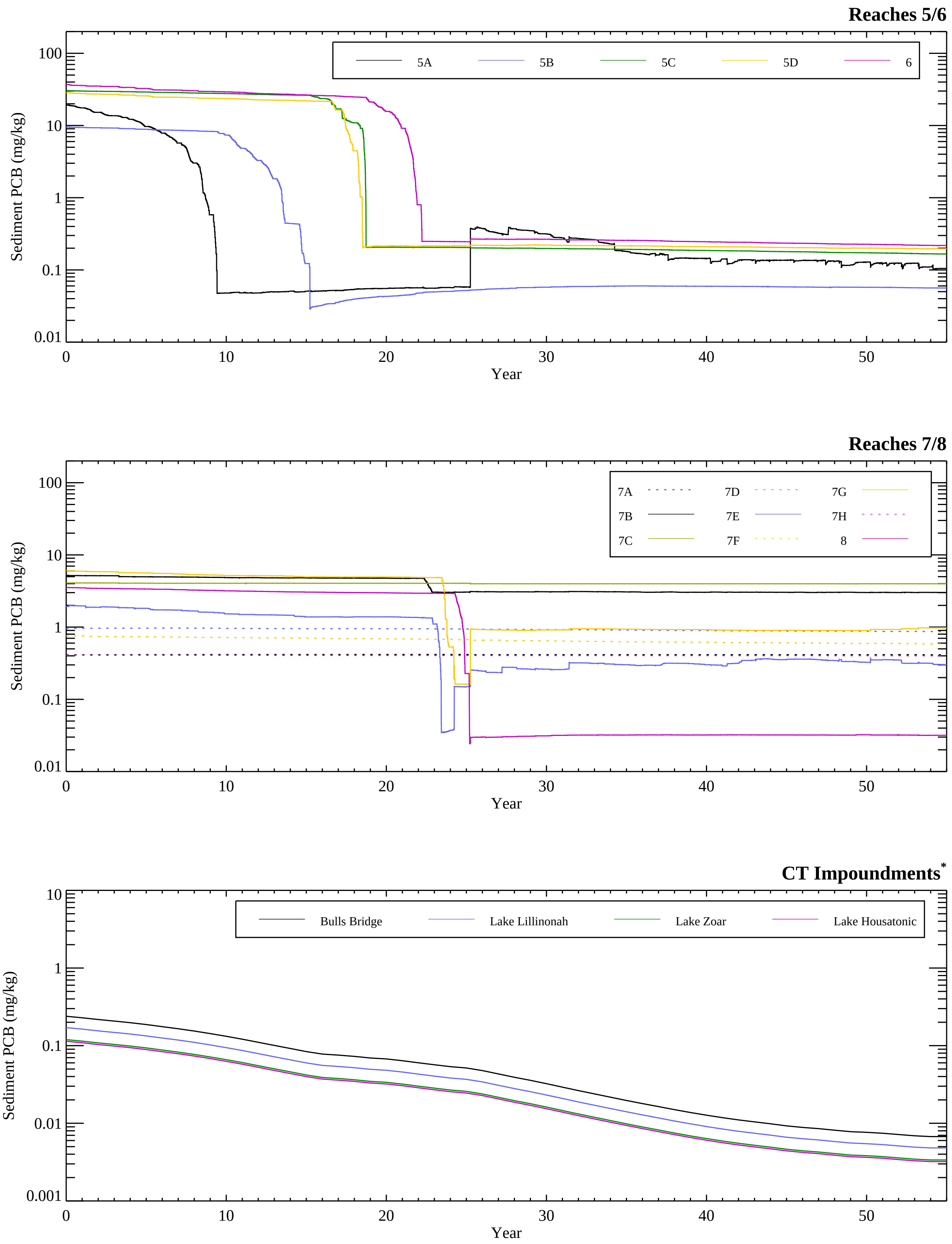

Figure 4-11b. Temporal profile of model-predicted surface (0-6") sediment PCB concentration by subreach under SED 7.

[*] Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED7CMSBS_0712-03\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED7CMSBS_0712-33\bins
CT Impoundments -Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED07_0712-33_base

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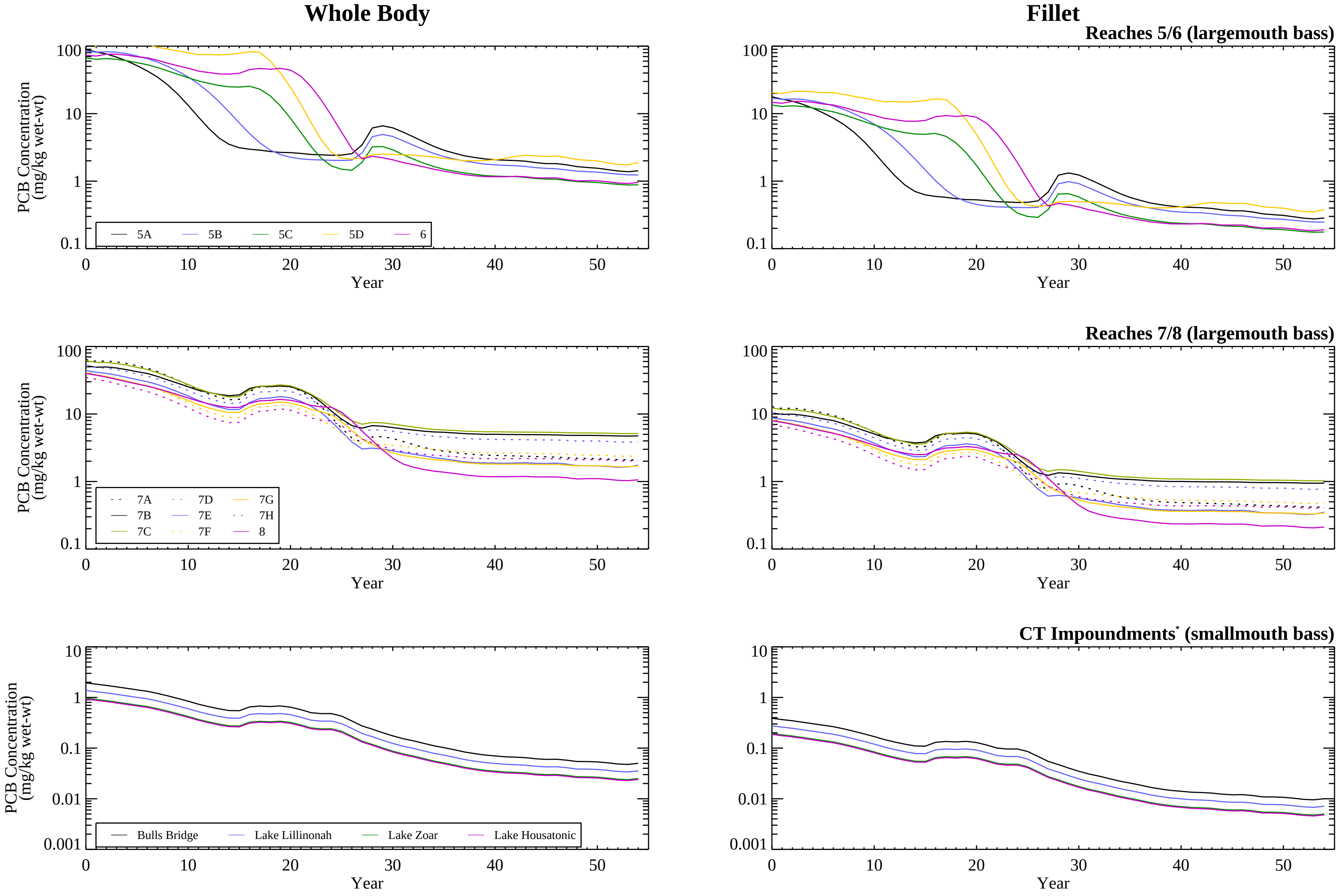

Figure 4-11c. Average PCB concentration in gamefish by subreach under SED 7.

Notes: Average calculated for fish ages 5 to 9 from days between Aug. 28th through Oct. 26th of each year
Fillet based concentrations were calculated as whole body concentrations divided by 5.0
** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*

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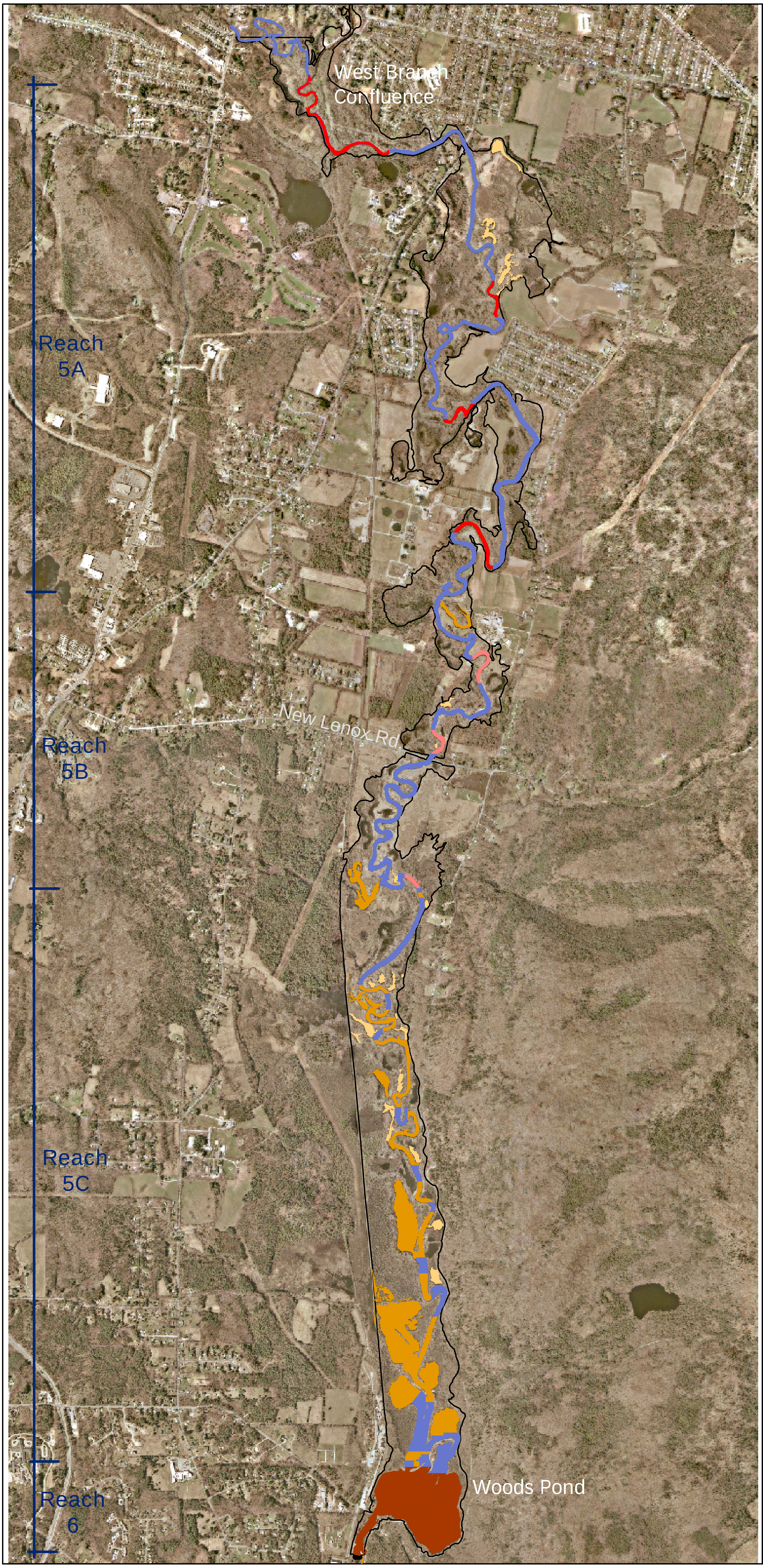

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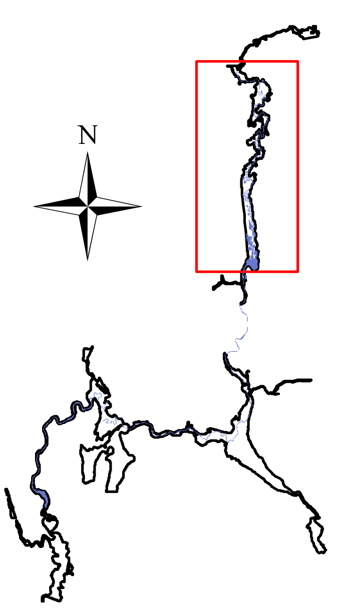

SCALE

1,500 750 0 1,500 Feet

LEGEND

▬ Dams
■ Removal of Top 2 ft
■ Removal of Top 3 ft
■ Removal of Top 3.5 ft
■ Removal of Top 4 ft
■ Removal of Top 6 ft
■ Housatonic River
☐ 1 mg/kg PCB Isopleth

SED 8 includes bank removal/ stabilization for Reaches 5A and 5B.

Figure 4-12a. Sediment Alternative 8 (SED 8) in Reaches 5 and 6.

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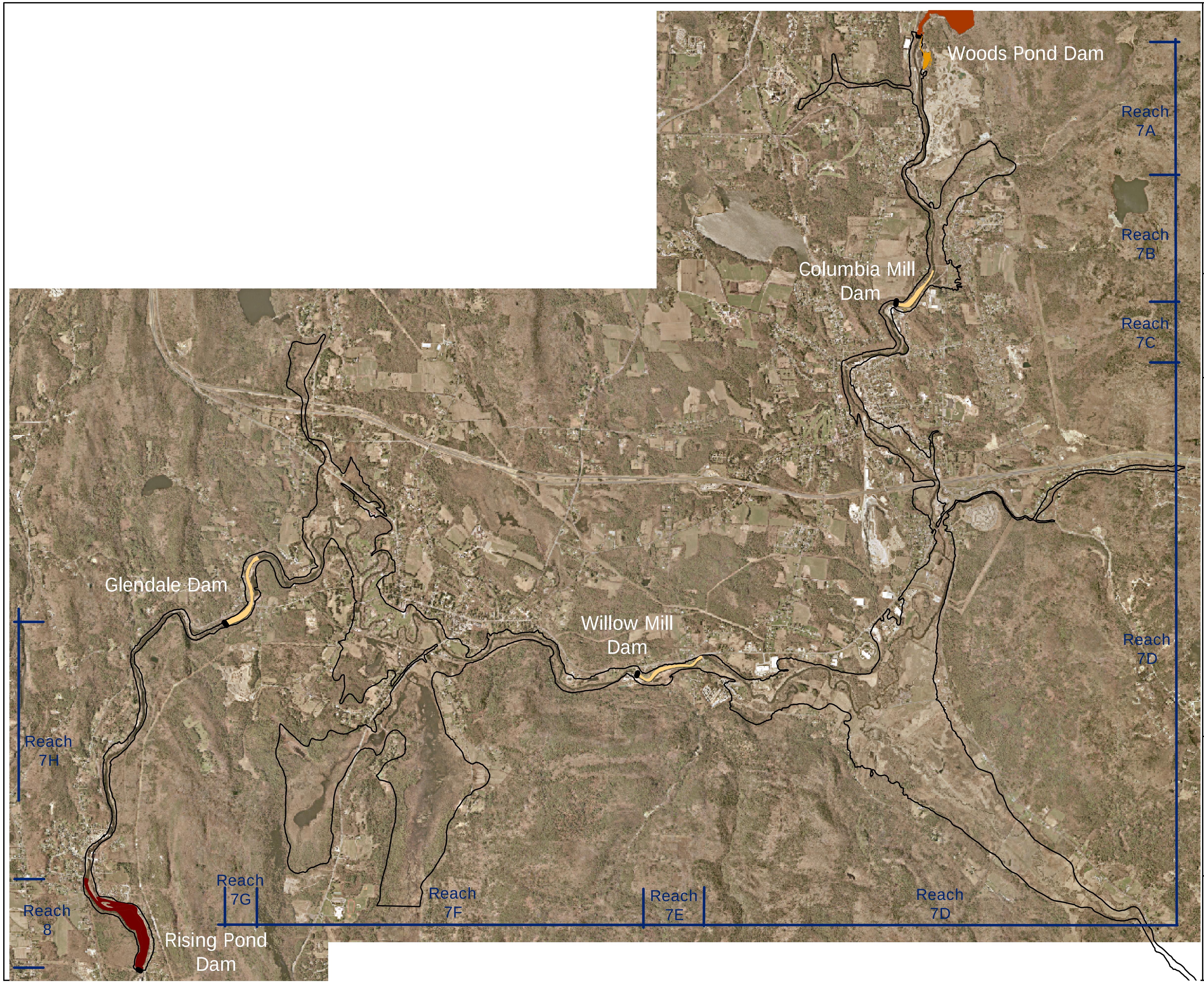
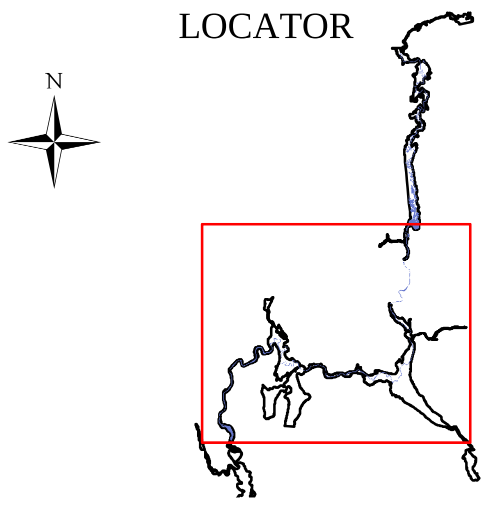


LOCATOR



SCALE

1 0.5 0 1 Miles

LEGEND

━ Dams
🟨 Removal of Top 2 ft
🟧 Removal of Top 3 ft
🟫 Removal of Top 6 ft
🟥 Removal of Top 7 ft
🟦 Housatonic River
☐ 100-Year Floodplain

Figure 4-12b.
Sediment Alternative 8 (SED 8)
in Reaches 7 and 8.

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March 2008

wk - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Section4\Figures\mxds\sed_removals_R78.mxd

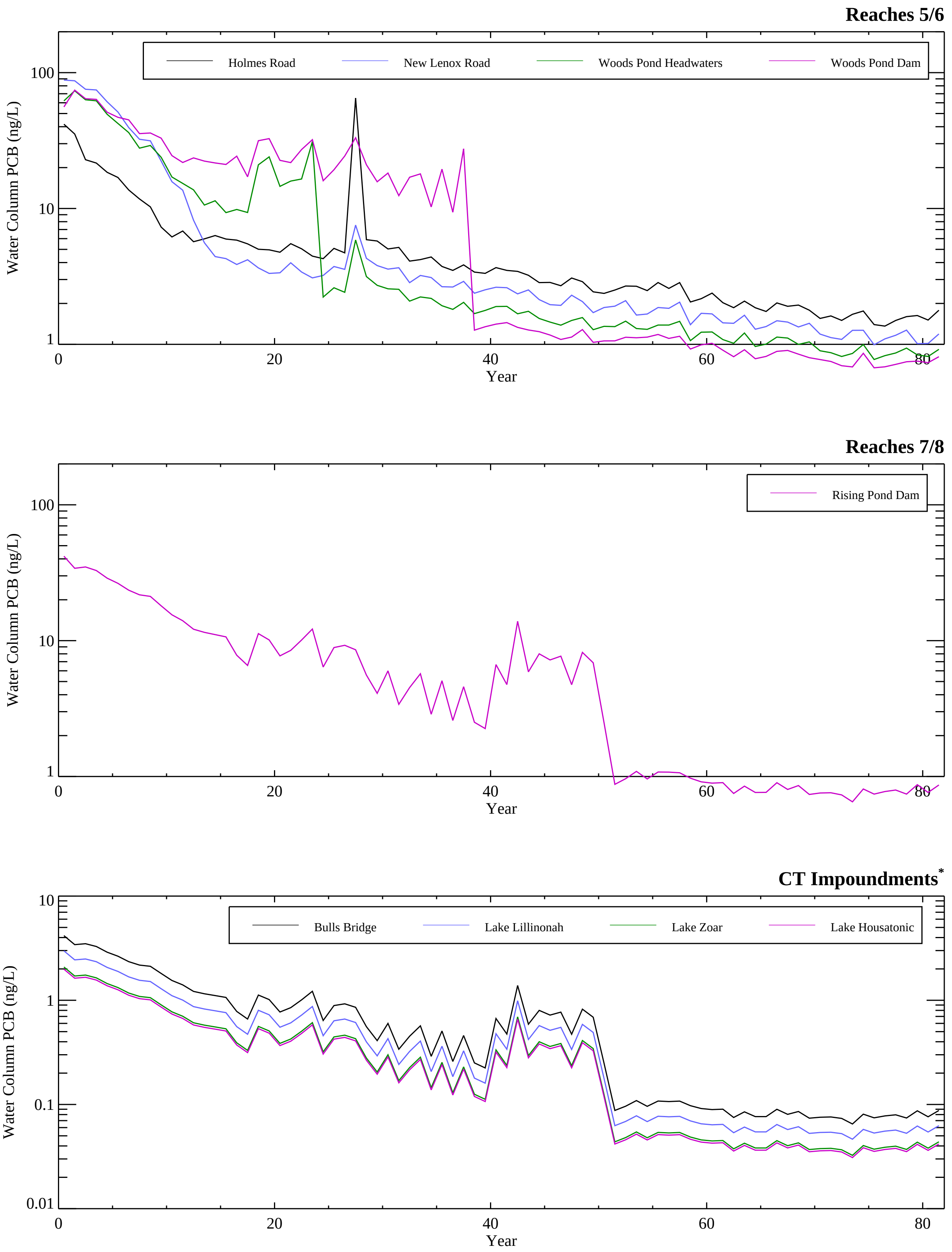

Figure 4-13a. Temporal profile of model-predicted annual average water column PCB concentration by subreach under SED 8.

[*] Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED8CMSBS_0712-18\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED8CMSBS_0712-34\bins
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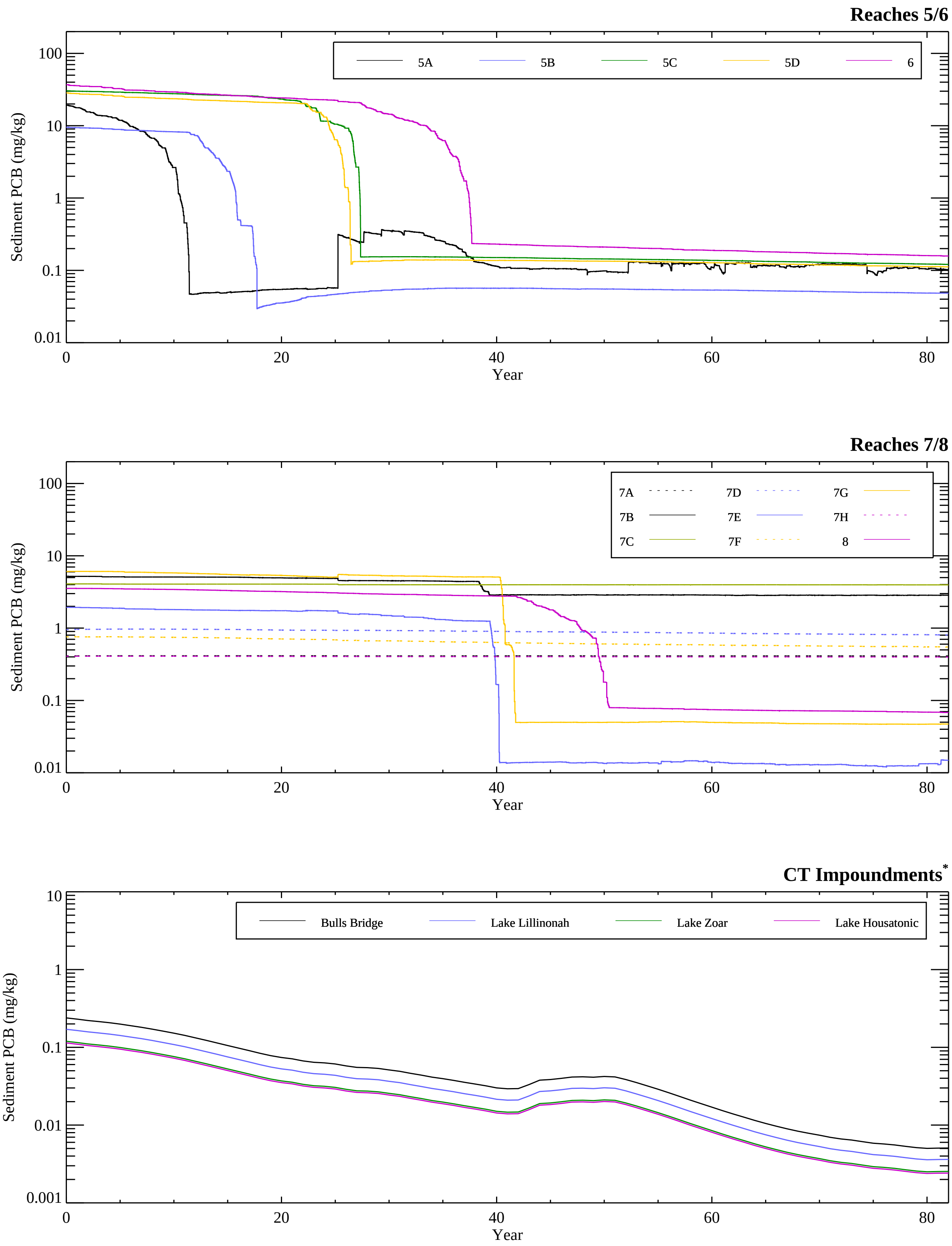

Figure 4-13b. Temporal profile of model-predicted surface (0-6") sediment PCB concentration by subreach under SED 8.

* *Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED8CMSBS_0712-18\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED8CMSBS_0712-34\bins
CT Impoundments -Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED08_0712-34_base

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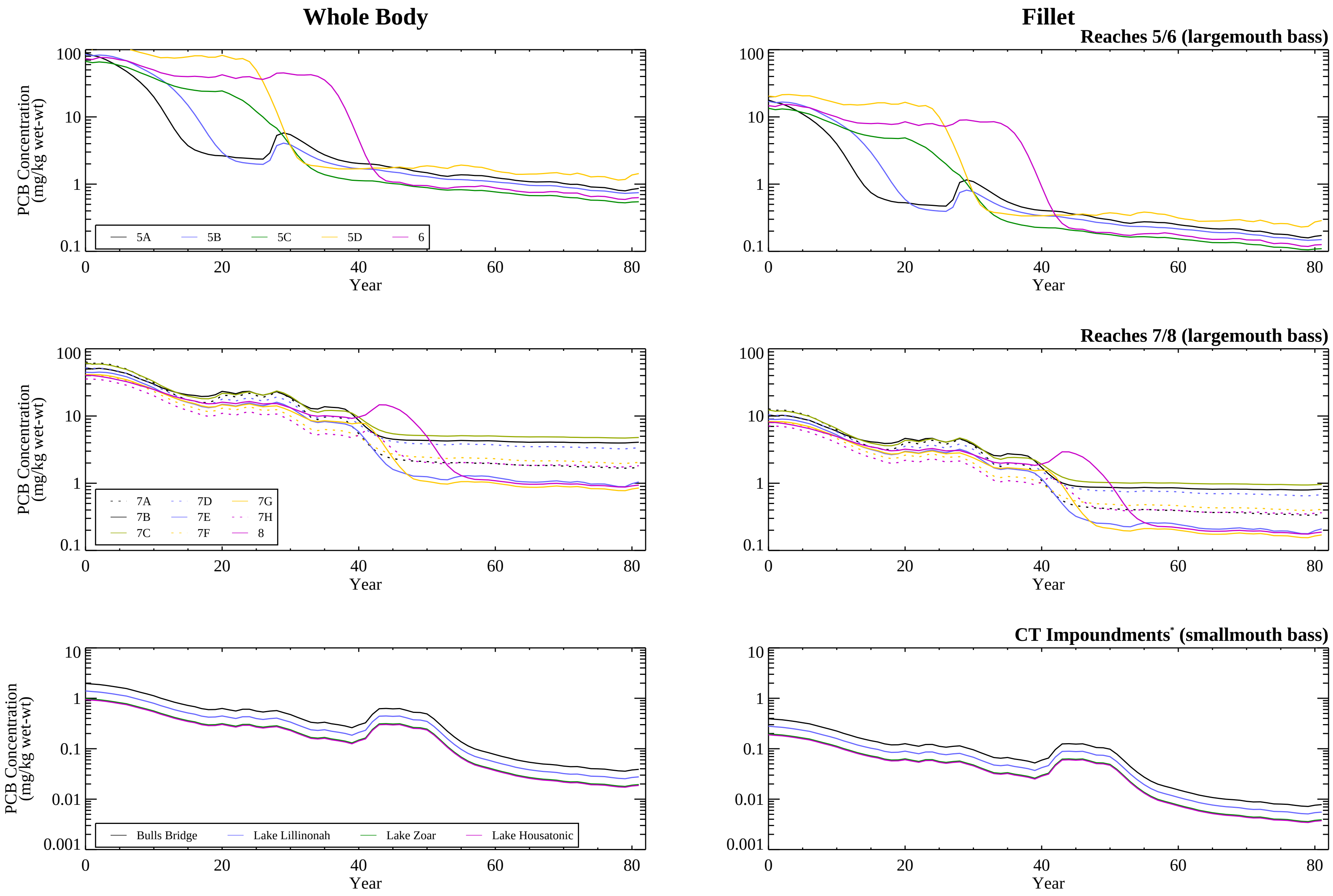

Whole Body

Fillet

Reaches 5/6 (largemouth bass)

Reaches 7/8 (largemouth bass)

CT Impoundments* (smallmouth bass)

Figure 4-13c. Average PCB concentration in gamefish by subreach under SED 8.

Notes: Average calculated for fish ages 5 to 9 from days between Aug. 28th through Oct. 26th of each year
Fillet based concentrations were calculated as whole body concentrations divided by 5.0
** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*

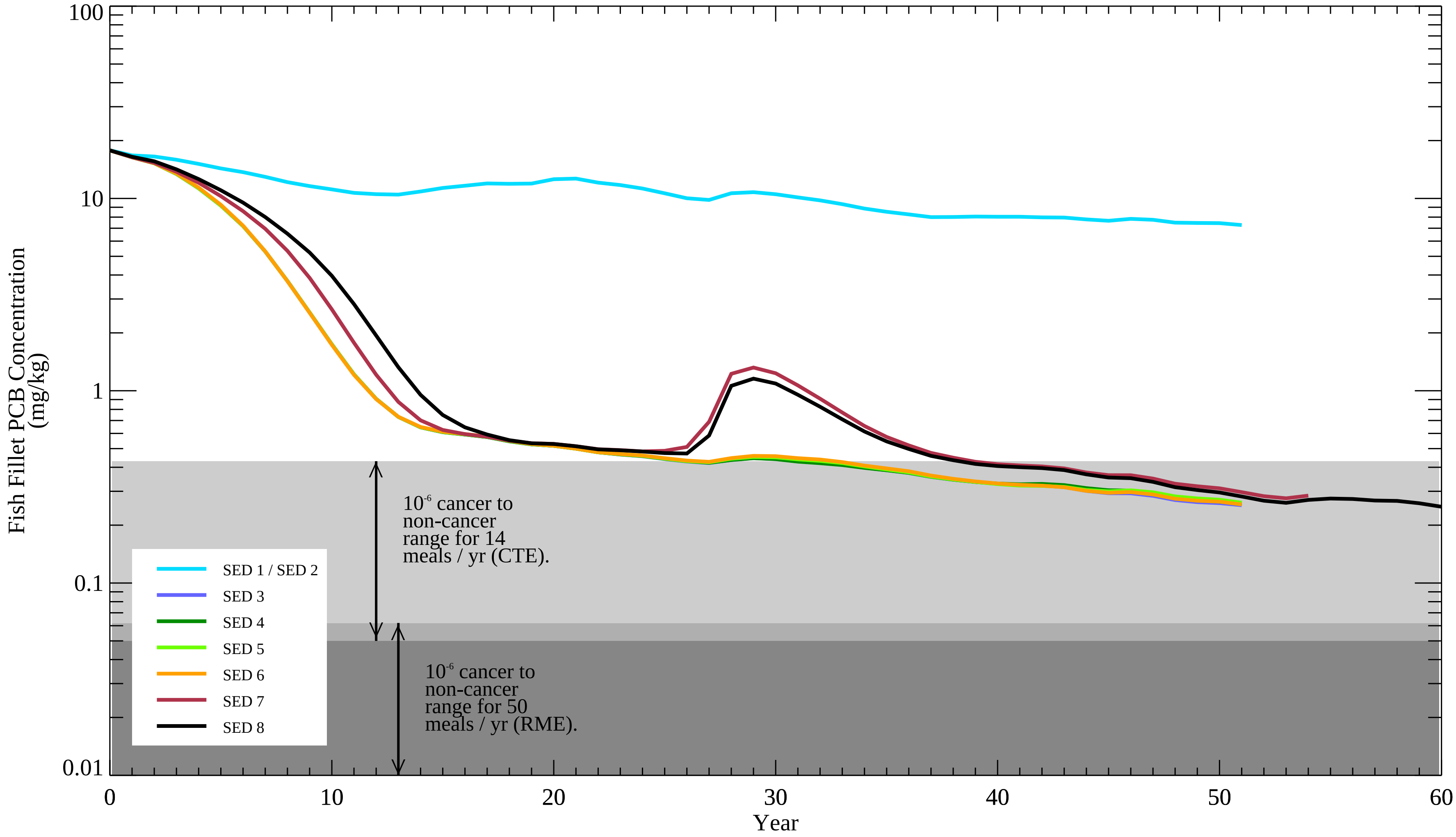

Figure 4-16a. Average fillet PCB concentrations in largemouth bass from Reach 5A

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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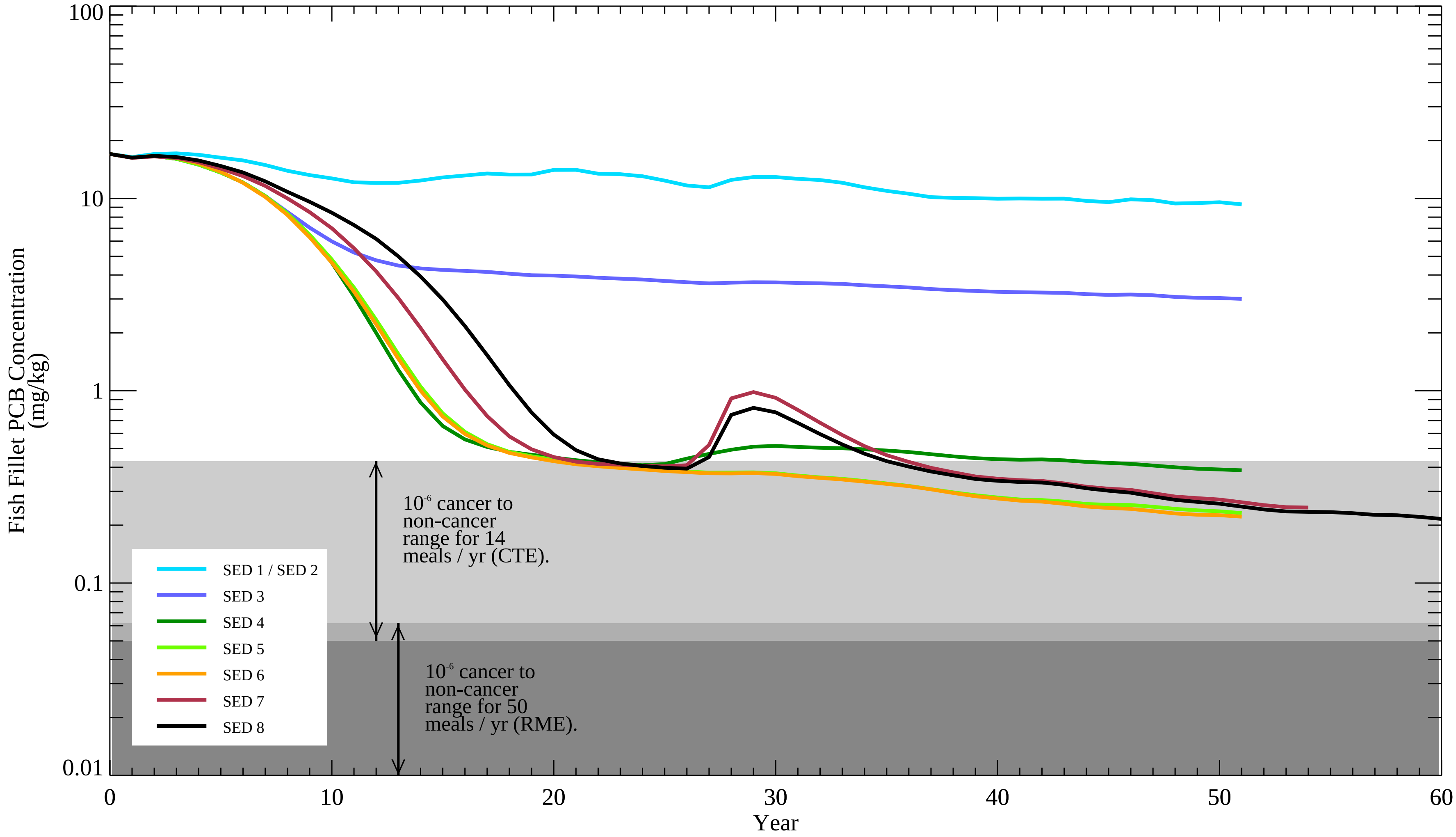

Figure 4-16b. Average fillet PCB concentrations in largemouth bass from Reach 5B

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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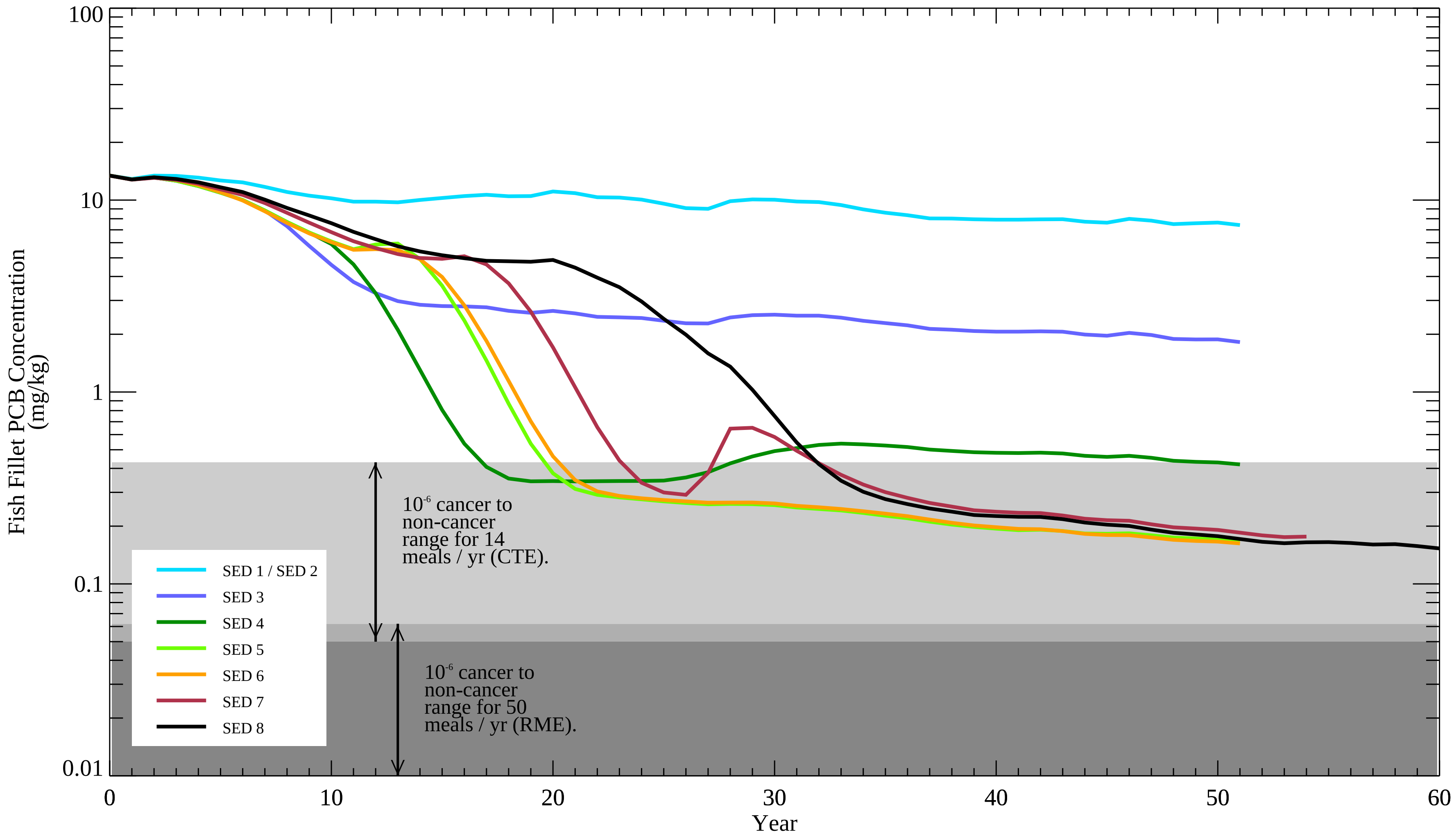

Figure 4-16c. Average fillet PCB concentrations in largemouth bass from Reach 5C

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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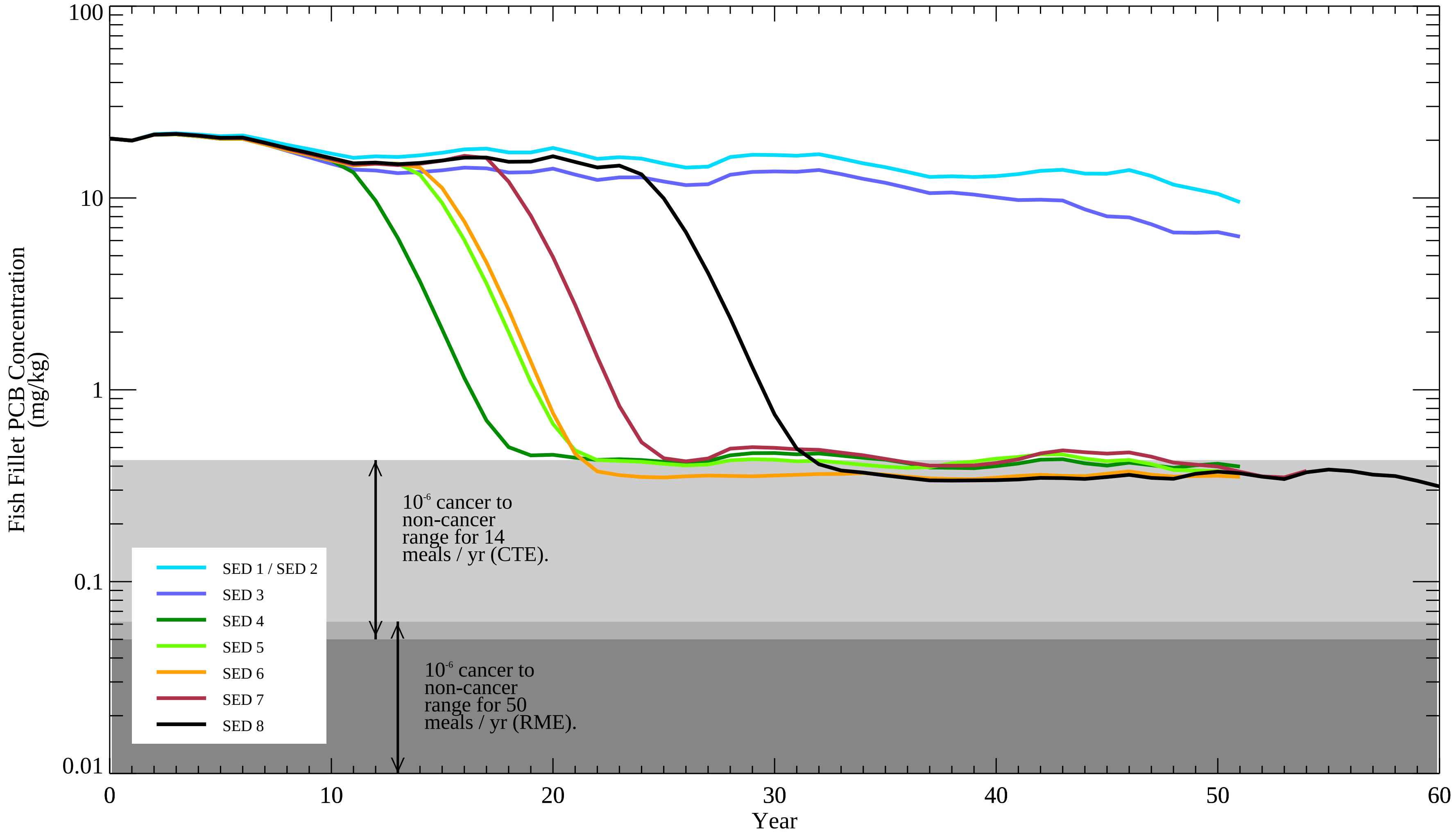

Figure 4-16d. Average fillet PCB concentrations in largemouth bass from Reach 5D

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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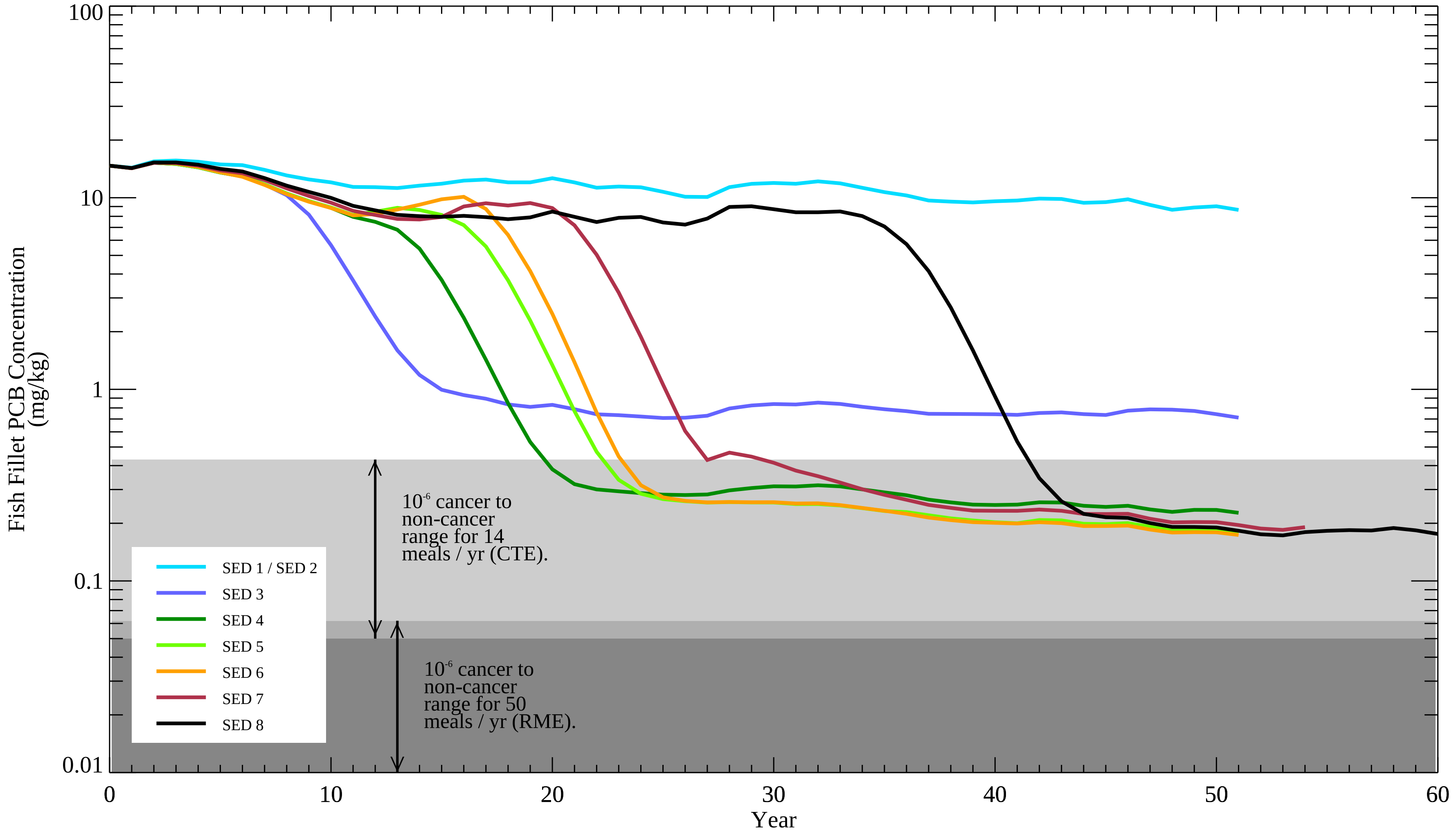

Figure 4-16e. Average fillet PCB concentrations in largemouth bass from Reach 6

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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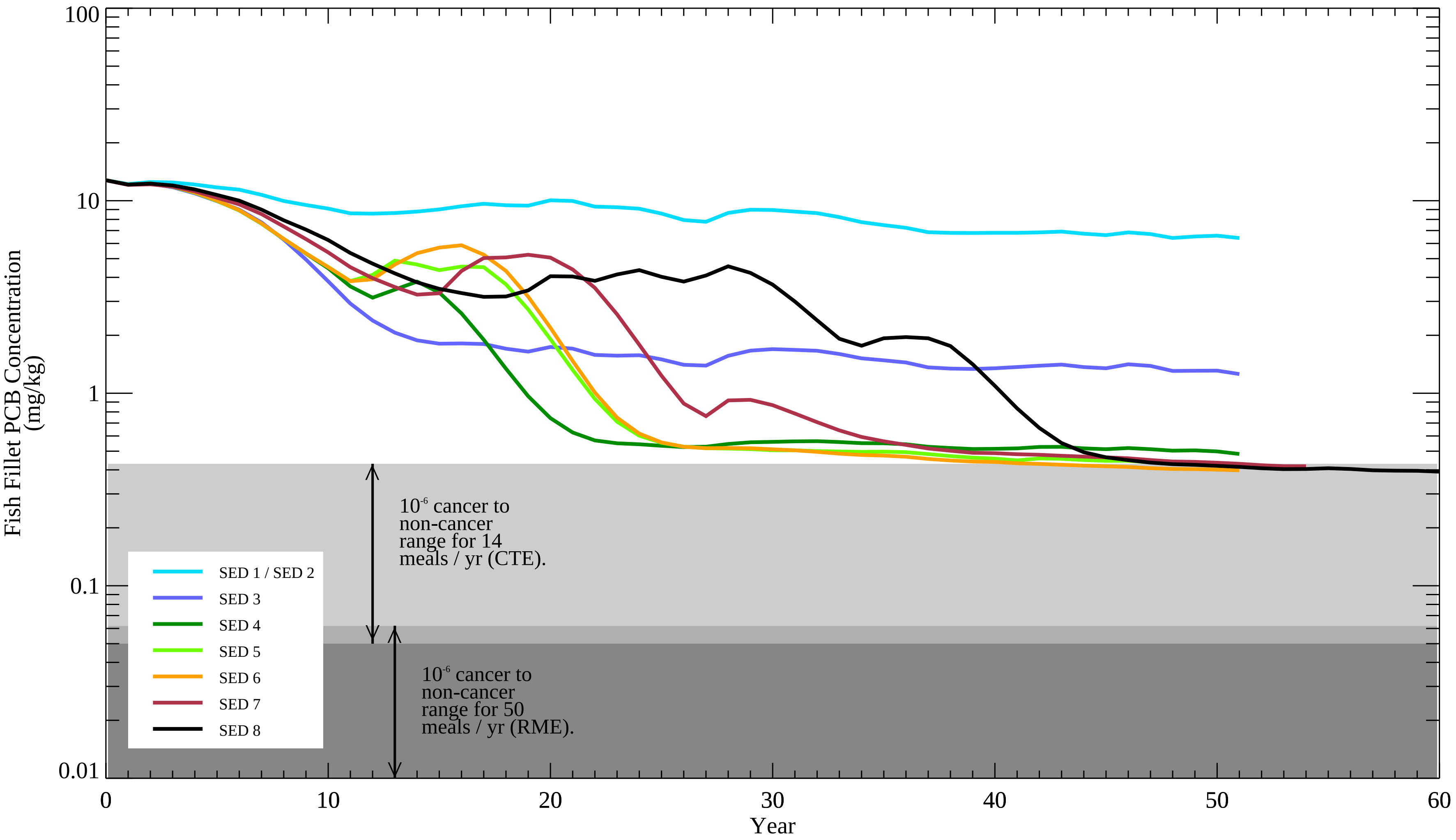

Figure 4-16f. Average fillet PCB concentrations in largemouth bass from Reach 7A

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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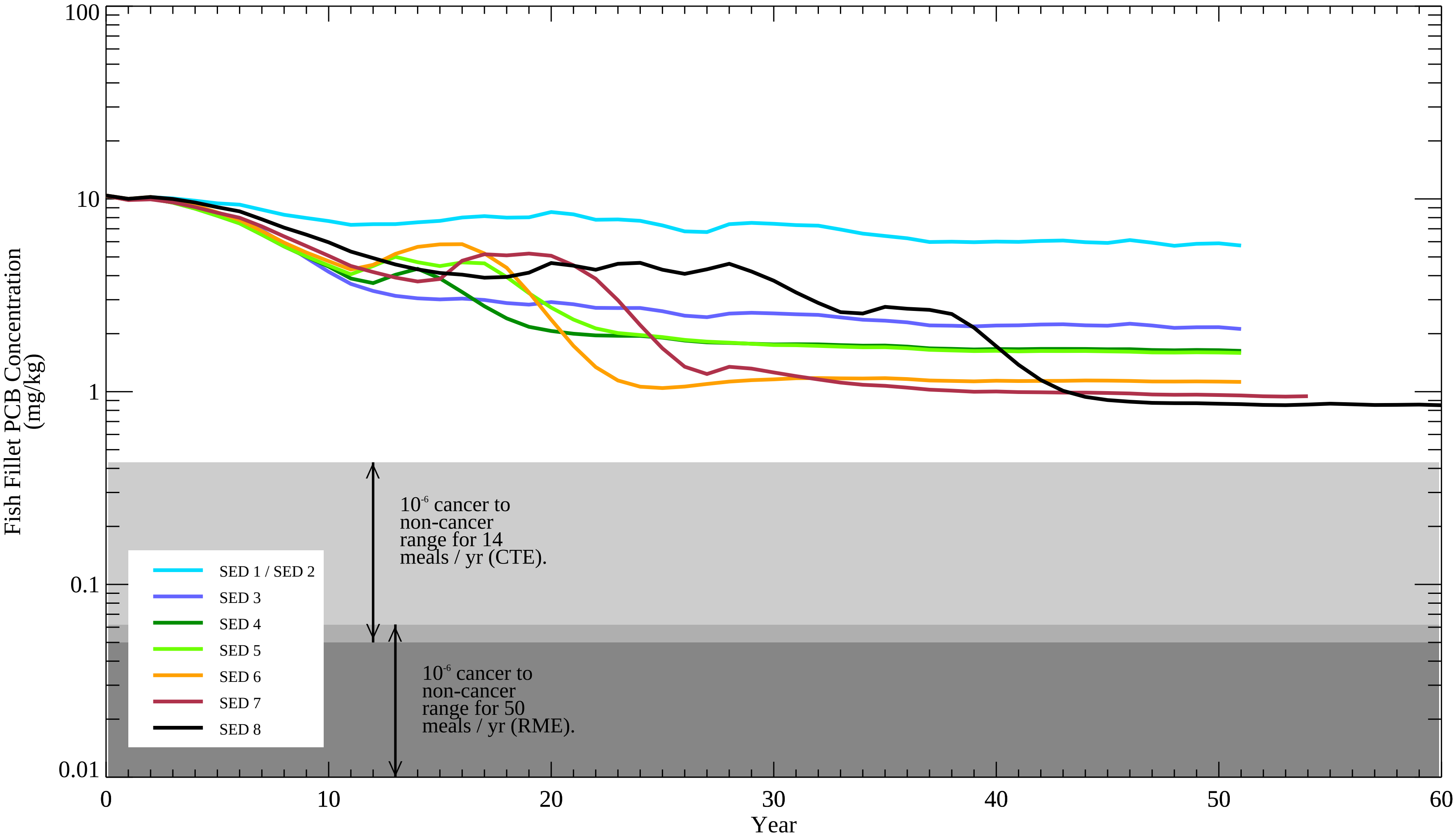

Figure 4-16g. Average fillet PCB concentrations in largemouth bass from Reach 7B

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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Tue Mar 18 11:21:14 2008

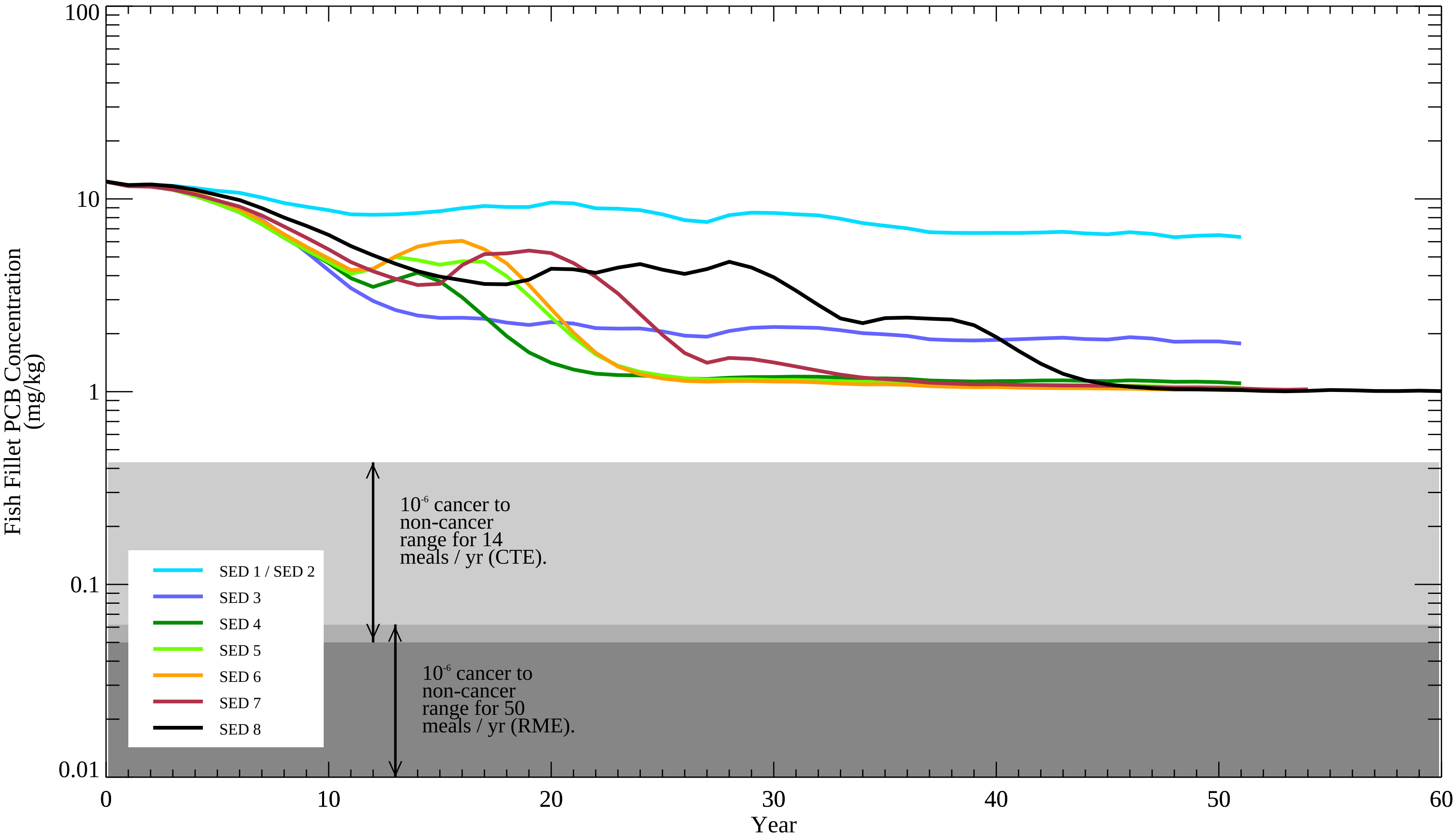

Figure 4-16h. Average fillet PCB concentrations in largemouth bass from Reach 7C

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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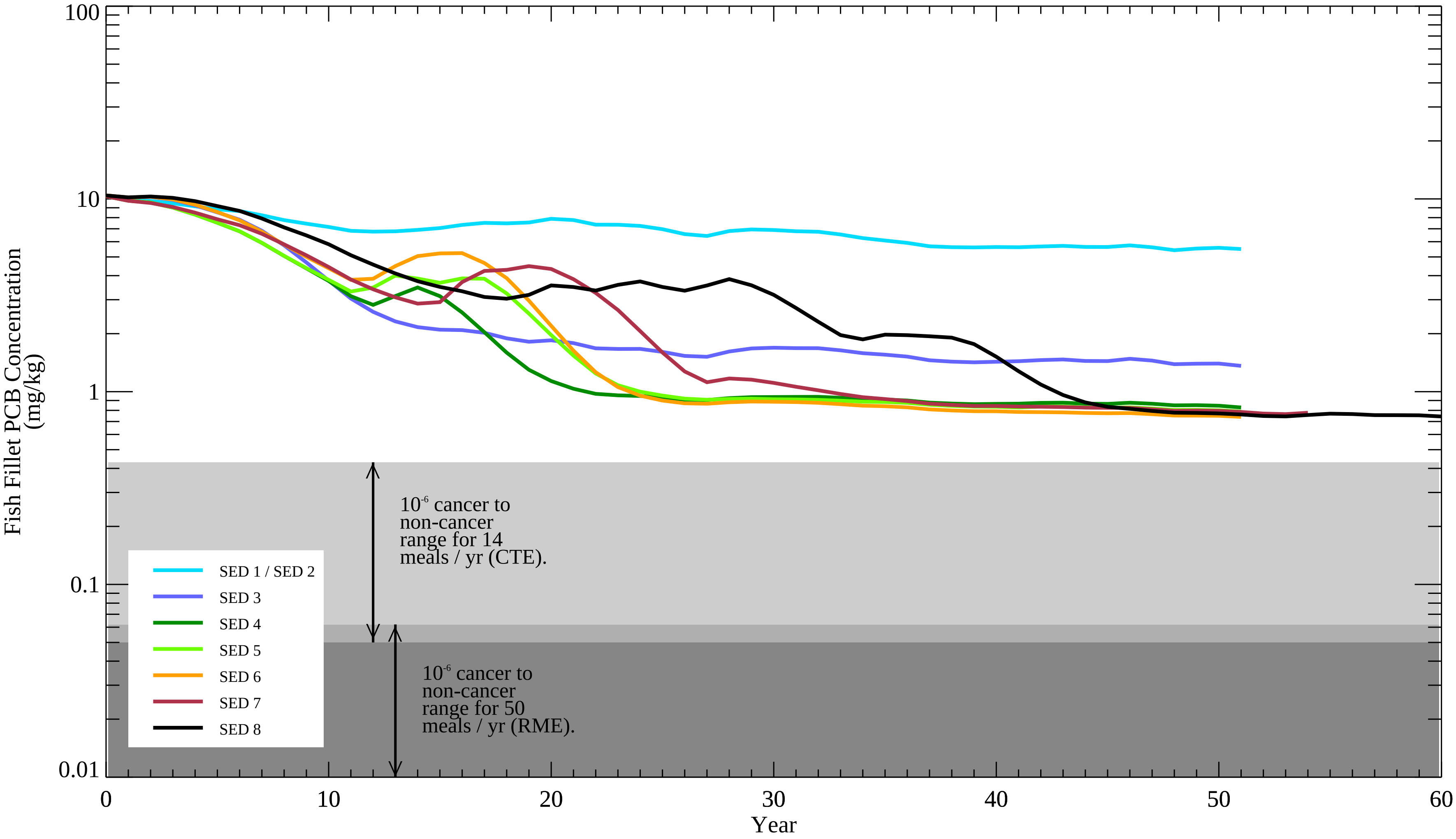

Figure 4-16i. Average fillet PCB concentrations in largemouth bass from Reach 7D

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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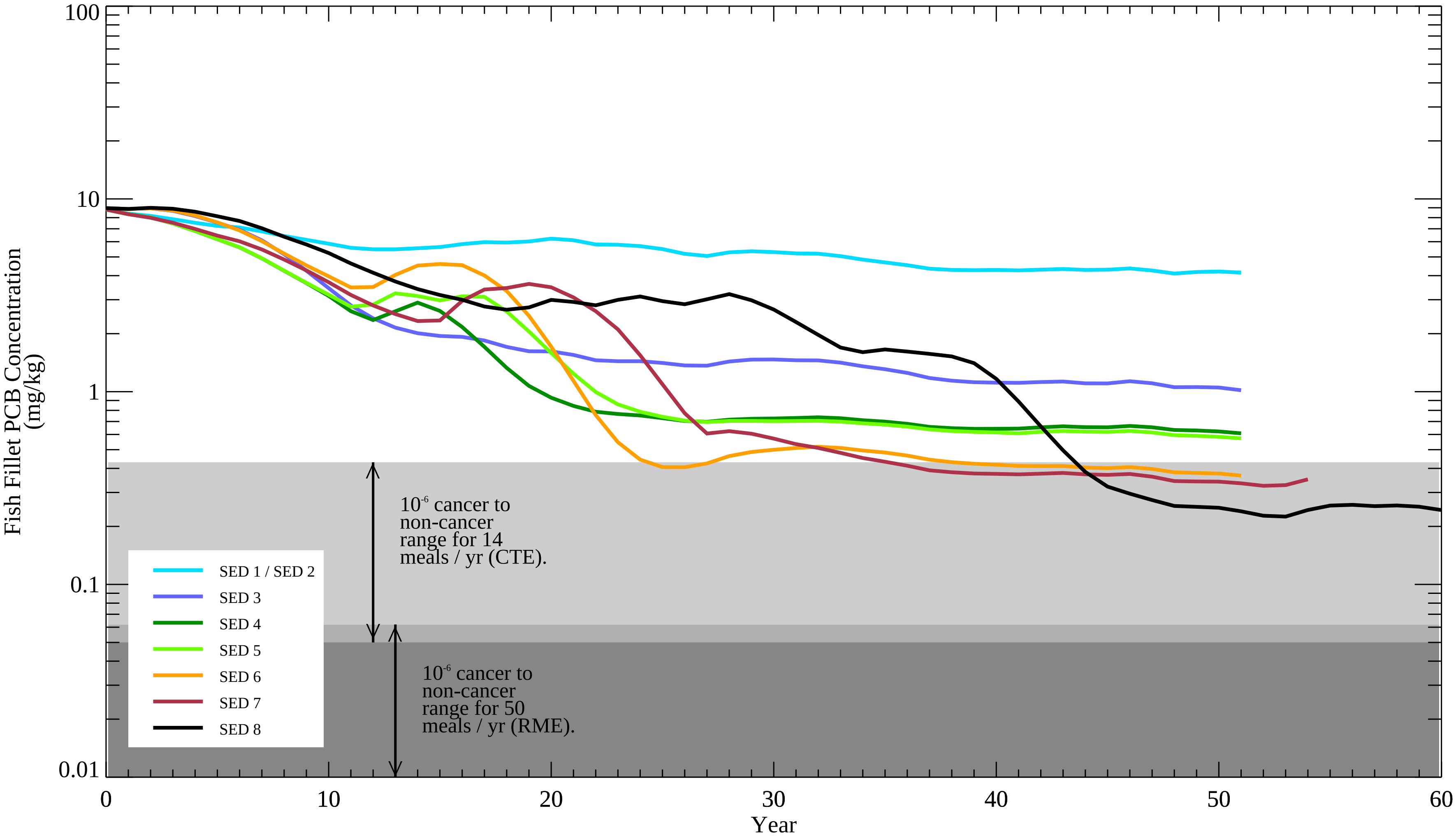

Figure 4-16j. Average fillet PCB concentrations in largemouth bass from Reach 7E

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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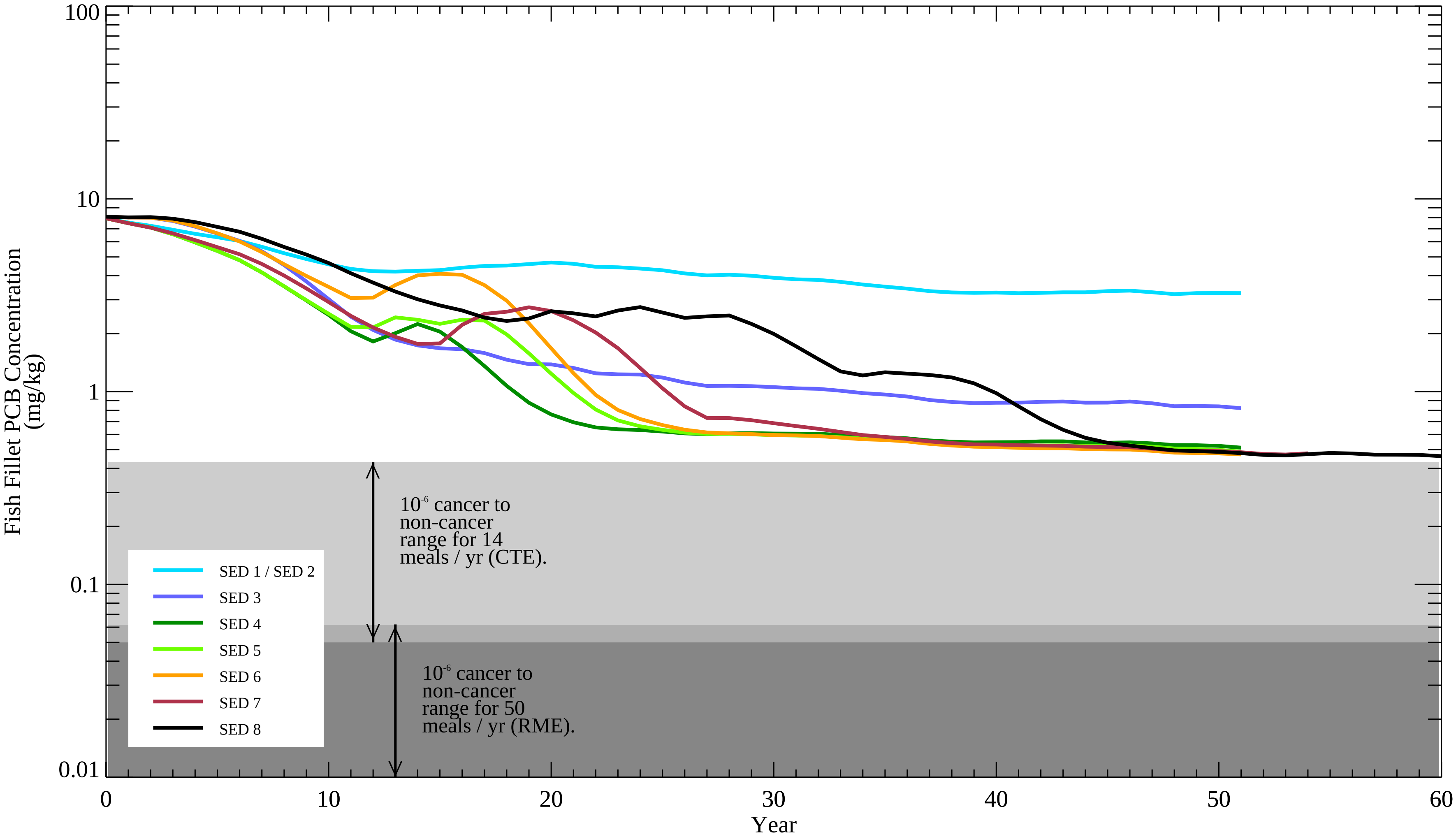

Figure 4-16k. Average fillet PCB concentrations in largemouth bass from Reach 7F

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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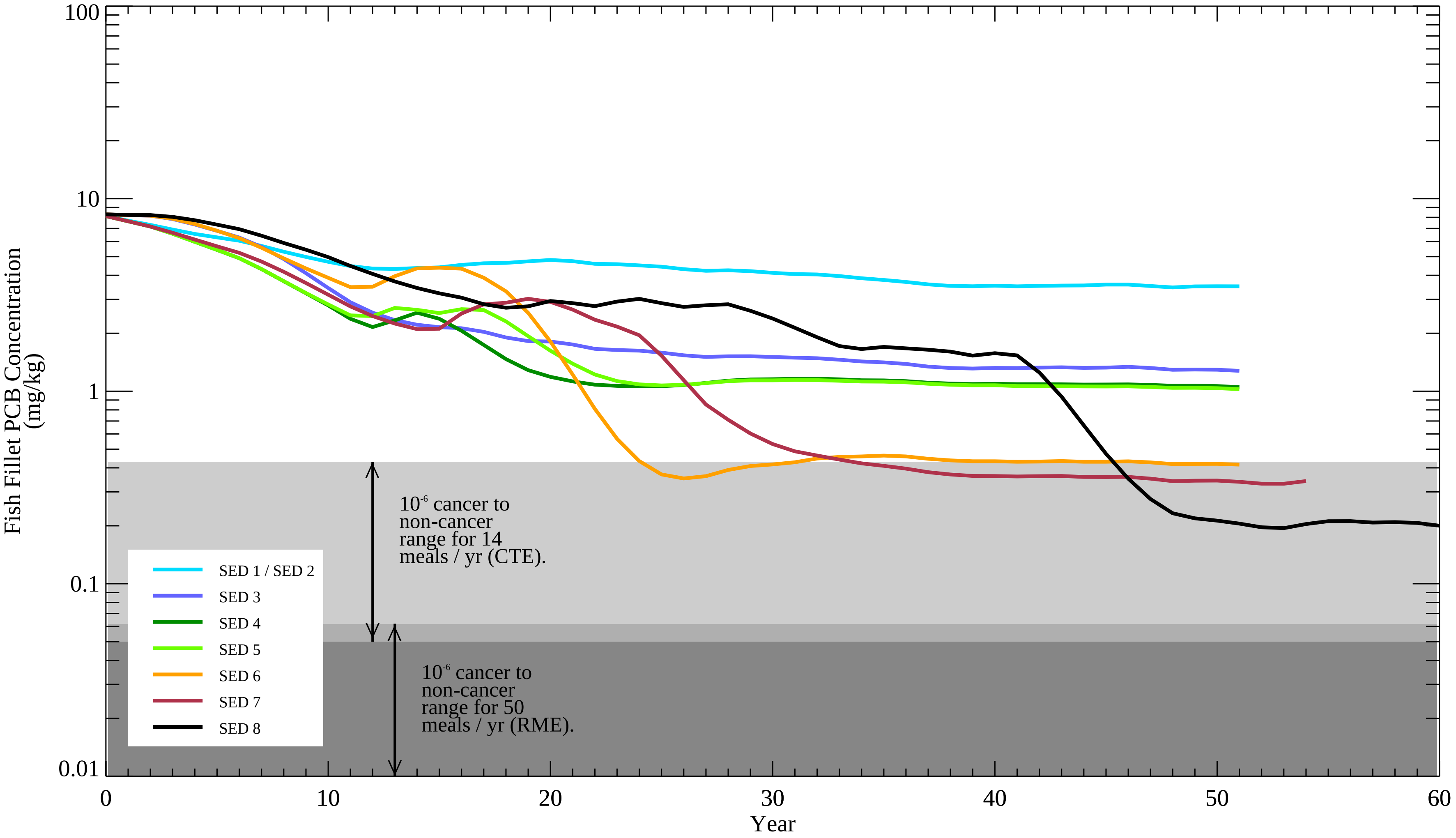

Figure 4-16l. Average fillet PCB concentrations in largemouth bass from Reach 7G

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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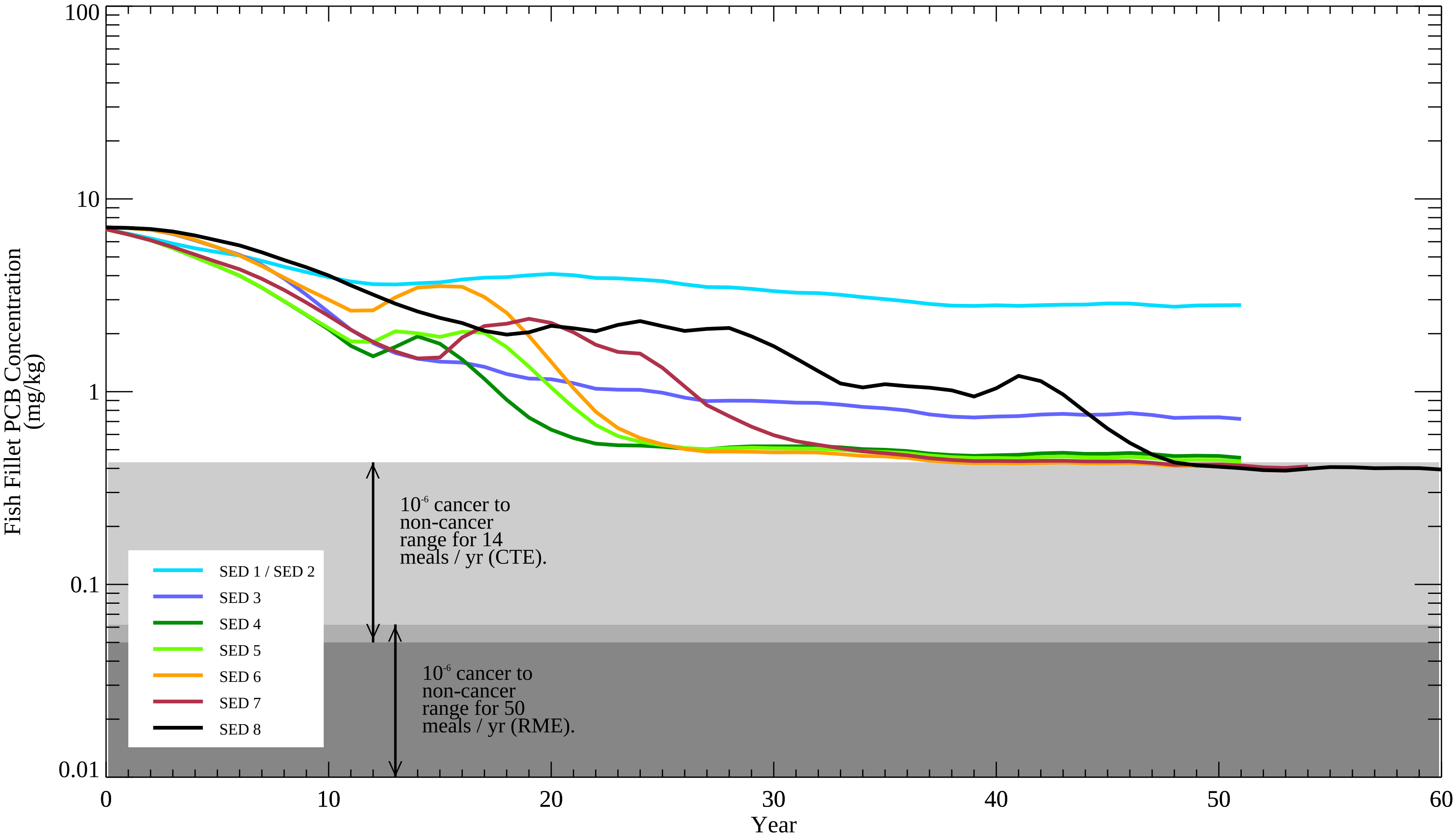

Figure 4-16m. Average fillet PCB concentrations in largemouth bass from Reach 7H

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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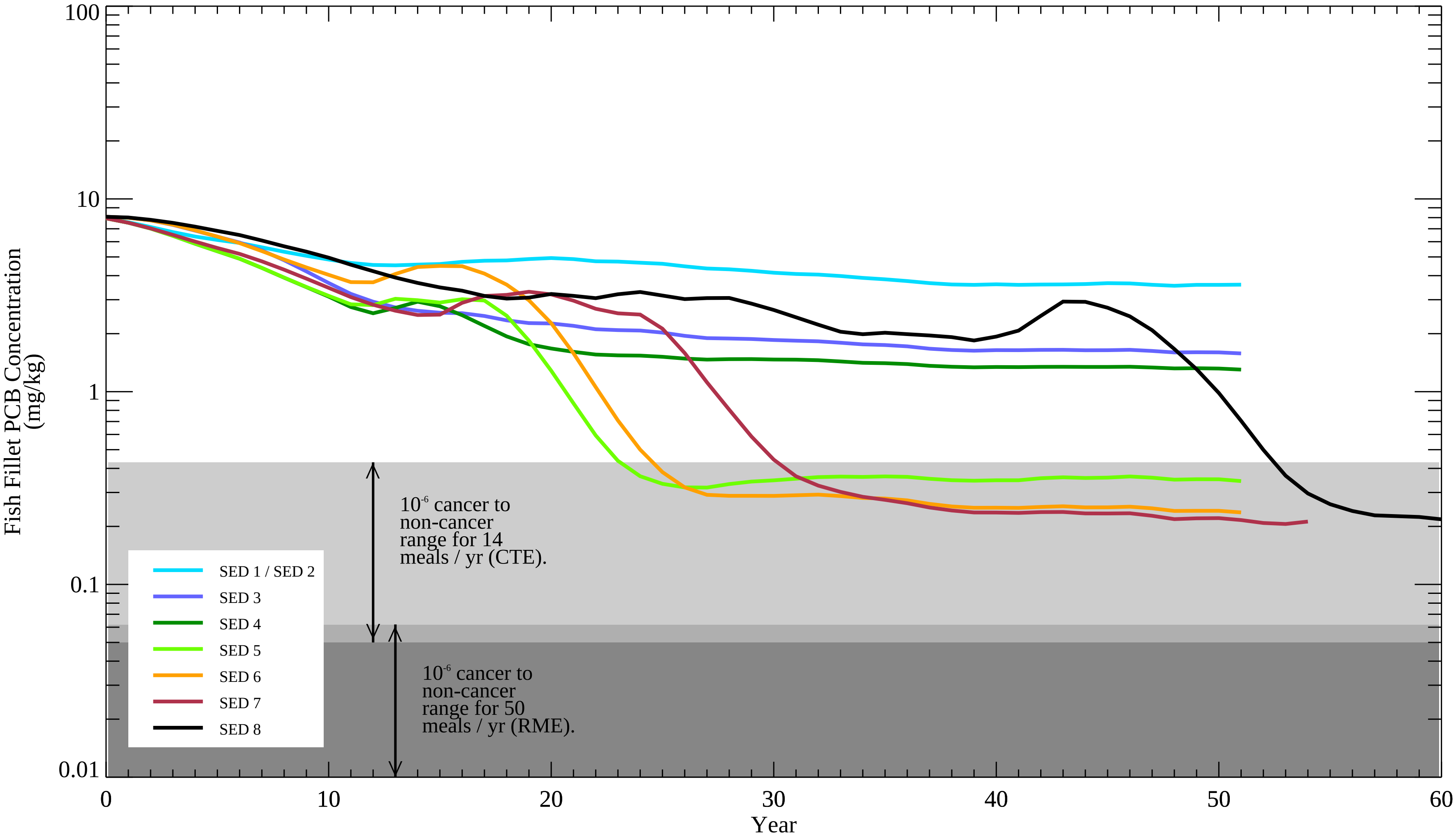

Figure 4-16n. Average fillet PCB concentrations in largemouth bass from Reach 8

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

DR - Z:\GENcms\MODEL\FDCHN\Analysis\Time_Series\Programs\Projection\CMS_Alternatives\NewCode\cms_alternatives_overlay.pro
Tue Mar 18 11:47:18 2008

Table 4-2. Sediment IMPGs for human direct contact compared to projected sediment PCBs (SED 1 / SED 2), including the time to achieve in years (*in italics*).

Risk Category	Receptor	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average 0-6" Sediment PCB Concentration (mg/kg)[1]							
					SA 1	**SA 2**	**SA 3**	**SA 4**	**SA 5**	**SA 6**	**SA 7**	**SA 8**
					12	**16**	**23**	**3.4**	**4.2**	**1.2**	**7.6**	**3.0**
Human Direct Contact	Older Child	RME	Cancer @ 10^{-6}	4.5	■	■	■	*0*	*0*	*0*	■	*0*
			Cancer @ 10^{-5}	45	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	453	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	31	*0*	*0*	*22*	*0*	*0*	*0*	*0*	*0*
		CTE	Cancer @ 10^{-6}	36	*0*	*0*	*8*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-5}	365	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	3645	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	125	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Adult	RME	Cancer @ 10^{-6}	1.3	■	■	■	■	■	*34*	■	■
			Cancer @ 10^{-5}	13	*35*	■	■	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	135	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	40	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		CTE	Cancer @ 10^{-6}	28	*0*	*0*	*30*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-5}	280	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	2800	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	152	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection

CTE = central tendency exposure

RME = reasonable maximum exposure

IMPG = interim media protection goal

SA = EPA Risk Assessment Sediment Exposure Areas

SA 1: Confluence to New Lenox Road
SA 2: New Lenox Road to Woods Pond Headwaters
SA 3: Woods Pond (6-meters from waters edge)
SA 4: Columbia Mill Dam impoundment (6-meters from waters edge)
SA 5: Former Eagle Mill Dam impoundment (6-meters from waters edge)
SA 6: Willow Mill Dam impoundment (6-meters from waters edge)
SA 7: Glendale Dam impoundment (6-meters from waters edge)
SA 8: Rising Pond impoundment (6-meters from waters edge)

Key

□ = model prediction is lower than the IMPG
■ = model prediction exceeds the IMPG

Table 4-3. IMPGs for human consumption of fish tissue compared to projected fillet-based fish PCBs (SED1 / SED 2), including the time to achieve in years (*in italics*).

Tissue Type	Assessment Type	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average Fish Tissue (Fillet) PCB Concentration (mg/kg)[1]																	
					Reach 5A	**Reach 5B**	**Reach 5C**	**Reach 5D**	**Reach 6**	**Reach 7A**	**Reach 7B**	**Reach 7C**	**Reach 7D**	**Reach 7E**	**Reach 7F**	**Reach 7G**	**Reach 7H**	**Reach 8**	**BBD**	**LL**	**LZ**	**LH**
					7.3	**9.3**	**7.4**	**9.5**	**8.6**	**6.4**	**5.7**	**6.3**	**5.5**	**4.1**	**3.2**	**3.5**	**2.8**	**3.6**	**0.2**	**0.1**	**0.08**	**0.08**
Bass Fillets	Deterministic	RME	Cancer @ 10^{-6}	0.0019	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Cancer @ 10^{-5}	0.019	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Cancer @ 10^{-4}	0.19	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*26*	*6*	*5*
			Non-Cancer -- Child	0.026	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Non-Cancer -- Adult	0.062	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
		CTE	Cancer @ 10^{-6}	0.049	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Cancer @ 10^{-5}	0.49	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	4.9	■	■	■	■	■	■	■	■	■	*34*	*9*	*10*	*7*	*10*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.19	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*26*	*6*	*5*
			Non-Cancer -- Adult	0.43	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*0*	*0*	*0*	*0*
	Probabilistic	RME (5th percentile)	Cancer @ 10^{-6}	0.0064	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Cancer @ 10^{-5}	0.064	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Cancer @ 10^{-4}	0.64	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.059	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Non-Cancer -- Adult	0.12	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*26*	*6*	*5*
		CTE (50th percentile)	Cancer @ 10^{-6}	0.057	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Cancer @ 10^{-5}	0.57	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	5.7	■	■	■	■	■	■	*52*	■	*38*	*11*	*7*	*8*	*4*	*7*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.71	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*0*	*0*	*0*	*0*
			Non-Cancer -- Adult	1.5	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average); whole body concentrations divided by a factor of 5.0 to convert to fillet basis
CTE = central tendency exposure
RME = reasonable maximum exposure
BBD: Bulls Bridge Dam Impoundment
LL: Lake Lillinonah
LZ: Lake Zoar
LH: Lake Housatonic

Key

☐ = model prediction is lower than the IMPG
▨
■

Table 4-4. Sediment IMPGs for benthic invertebrates compared to projected sediment PCBs (SED 1 / SED 2), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg) Lower End of Range	IMPG (mg/kg) Upper End of Range
			3	**10**
5A	R5A_01	**1.9**	*46*	*1*
	R5A_02	**3.7**	■	*20*
	R5A_03	**6.4**	■	*40*
	R5A_04	**29**	■	■
	R5A_05	**13**	■	■
	R5A_06	**7.7**	■	*12*
	R5A_07	**15**	■	■
	R5A_08	**17**	■	■
	R5A_09	**9.9**	■	*39*
	R5A_10	**16**	■	■
	R5A_11	**18**	■	■
5B	R5B_01	**9.6**	■	*28*
	R5B_02	**8.5**	■	*0*
	R5B_03	**4.7**	■	*0*
	R5B_04	**5.7**	■	*0*
	R5B_05	**5.6**	■	*0*
5C	R5C_01	**7.2**	■	*0*
	R5C_02	**8.0**	■	*8*
	R5C_03	**4.9**	■	*0*
	R5C_04	**6.1**	■	*8*
	R5C_05	**37**	■	■
	R5C_06	**29**	■	■
6	Woods Pond	**16**	■	■
7A		**0.43**	*0*	*0*
7B		**4.2**	■	*0*
7C		**4.1**	■	*0*
7D		**1.4**	*0*	*0*
7E		**1.2**	*0*	*0*
7F		**0.74**	*0*	*0*
7G		**5.1**	■	*0*
7H		**0.40**	*0*	*0*
8	Rising Pond	**2.9**	*21*	*0*

Notes

[1] Exposure areas in Reach 5 represent EPA spatial bins (1/4 to 1/2-mile segments as defined in EPA's Model Validation Report)

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

□ = model prediction is lower than the IMPG

■ = model prediction exceeds the IMPG

Table 4-5. Backwater sediment IMPGs for amphibians compared to projected sediment PCBs (SED 1 / SED 2), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Area (acres)	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
				Lower End of Range	Upper End of Range
				3.27	5.6
Small Backwaters (< 2 acres)	BWS_01	1.9	**5.7**	🟦	🟦
	BWS_02	1.8	**5.9**	🟦	🟦
	BWS_03	1.9	**3.0**	*48*	*31*
	BWS_04	0.30	**23**	🟦	🟦
	BWS_06	0.56	**2.2**	*30*	*12*
	BWS_07	0.12	**5.4**	🟦	*4*
	BWS_08	0.35	**37**	🟦	🟦
	BWS_09	0.28	**19**	🟦	🟦
	BWS_10	1.5	**16**	🟦	🟦
	BWS_11	0.11	**2.1**	*10*	*5*
	BWS_12	1.7	**6.1**	🟦	🟦
	BWS_13	0.37	**10**	🟦	🟦
	BWS_14	0.57	**8.8**	🟦	🟦
	BWS_15	0.90	**8.9**	🟦	🟦
	BWS_16	1.0	**3.2**	*52*	*23*
	BWS_17	0.58	**2.4**	*32*	*6*
	BWS_18	0.84	**2.3**	*32*	*12*
	BWS_19	0.99	**20**	🟦	🟦
	BWS_20	1.3	**5.8**	🟦	🟦
Large Backwaters (> 2 acres)	BWL_01	2.1	**11**	🟦	🟦
	BWL_02	5.5	**5.7**	🟦	🟦
	BWL_03	2.4	**3.6**	🟦	*25*
	BWL_04	2.1	**4.4**	🟦	*32*
	BWL_05	12	**14**	🟦	🟦
	BWL_07	22	**20**	🟦	🟦
	BWL_08	4.1	**13**	🟦	🟦
	BWL_09	7.0	**15**	🟦	🟦
	BWL_10	6.4	**13**	🟦	🟦
	BWL_11	4.6	**2.3**	*0*	*0*

Notes

[1] Exposure areas represent individual backwaters

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

⬜ = model prediction is lower than the IMPG
🟦 = model prediction exceeds the IMPG

Table 4-6. Sediment IMPGs for insectivorous birds and piscivorous mammals compared to projected sediment PCBs (SED 1 / SED 2), including the time to achieve in years (*in italics*).

Insectivorous Birds (wood duck)

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
			1	3	5
Reach 5A	KM 1	**4.3**	■	■	*48*
	KM 2	**11**	■	■	■
	KM 3	**13**	■	■	■
	KM 4	**15**	■	■	■
	KM 5	**19**	■	■	■
Reach 5B	KM 6	**9.7**	■	■	■
	KM 7	**6.3**	■	■	■
	KM 8	**7.3**	■	■	■
Reaches 5C/5D	KM 9	**7.0**	■	■	■
	KM 10	**18**	■	■	■
	KM 11	**20**	■	■	■
Reach 6	KM 12	**19**	■	■	■

Pisciviorous Mammals (mink)

Exposure Area[4]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
		1	3	5
Reaches 5A/5B	**11**	■	■	■
Reaches 5C/5D/6	**17**	■	■	■

Notes

[1] Exposure areas for wood ducks represent approximate 1 kilometer segments of the river channel

[2] Model endpoint concentrations after 52-year projection

[3] Sediment target levels have corresponding floodplain soil IMPGs due to mixture of aquatic and terrestrial diets for these receptors

[4] Exposure areas represent entire river reach

IMPG = interim media protection goal

Key

□ = model prediction is lower than the target value
■ = model prediction exceeds the target value

Table 4-7. IMPGs for fish protection, and consumption of fish and invertebrates by ecological receptors compared to projected biota tissue PCBs (SED 1 / SED 2), including the time to achieve in years (*in italics*).

Ecological Receptor	**Average Whole Body Fish Tissue PCB Concentration (mg/kg)** [1]													
	Reach 5A	**Reach 5B**	**Reach 5C**	**Reach 5D**	**Reach 6**	**Reach 7A**	**Reach 7B**	**Reach 7C**	**Reach 7D**	**Reach 7E**	**Reach 7F**	**Reach 7G**	**Reach 7H**	**Reach 8**
Fish protection	**28**	**36**	**29**	**36**	**34**	**25**	**22**	**24**	**21**	**16**	**13**	**14**	**11**	**14**
Threatened and endangered species (represented by bald eagle)	**25**	**23**	**24**	**19**	**18**	**9.2**	**16**	**11**	**10**	**6.5**	**5.5**	**7.0**	**4.4**	**7.7**
Piscivorous birds (represented by osprey)	**21**	**22**	**23**	**21**	**22**	**11**	**16**	**12**	**11**	**7.4**	**6.1**	**7.3**	**5.0**	**7.8**

Ecological Receptor	**Tissue Type**	**IMPG (mg/kg)**	Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8
Fish protection	Warmwater fish tissue (whole body)	55	*5*	*8*	*0*	*36*	*7*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Coldwater fish tissue (whole body) - Trout Below PSA	14	▨	▨	▨	▨	▨	■	■	■	■	■	*35*	*41*	*27*	▨
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	30.41	*31*	*9*	*24*	*25*	*7*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	3.2	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average)

IMPG = interim media protection goal

Key

□ = model prediction is lower than the IMPG
■ = model prediction exceeds the IMPG
▨ = IMPG not applicable

Table 4-9. Sediment IMPGs for human direct contact compared to projected sediment PCBs (SED 3), including the time to achieve in years (*in italics*).

Risk Category	Receptor	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average 0-6" Sediment PCB Concentration (mg/kg)[1]							
					SA 1	**SA 2**	**SA 3**	**SA 4**	**SA 5**	**SA 6**	**SA 7**	**SA 8**
					1.6	**8.7**	**1.7**	**3.2**	**4.1**	**1.2**	**7.0**	**2.9**
Human Direct Contact	Older Child	RME	Cancer @ 10^{-6}	4.5	*7*	■	*10*	*0*	*0*	*0*	■	*0*
			Cancer @ 10^{-5}	45	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	453	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	31	*0*	*0*	*9*	*0*	*0*	*0*	*0*	*0*
		CTE	Cancer @ 10^{-6}	36	*0*	*0*	*7*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-5}	365	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	3645	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	125	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Adult	RME	Cancer @ 10^{-6}	1.3	■	■	■	■	■	*34*	■	■
			Cancer @ 10^{-5}	13	*2*	*11*	*10*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	135	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	40	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		CTE	Cancer @ 10^{-6}	28	*0*	*0*	*9*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-5}	280	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	2800	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	152	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection

CTE = central tendency exposure

RME = reasonable maximum exposure

IMPG = interim media protection goal

SA = EPA Risk Assessment Sediment Exposure Areas

- SA 1: Confluence to New Lenox Road
- SA 2: New Lenox Road to Woods Pond Headwaters
- SA 3: Woods Pond (6-meters from waters edge)
- SA 4: Columbia Mill Dam impoundment (6-meters from waters edge)
- SA 5: Former Eagle Mill Dam impoundment (6-meters from waters edge)
- SA 6: Willow Mill Dam impoundment (6-meters from waters edge)
- SA 7: Glendale Dam impoundment (6-meters from waters edge)
- SA 8: Rising Pond impoundment (6-meters from waters edge)

Key

□ = model prediction is lower than the IMPG

■ = model prediction exceeds the IMPG

Table 4-10. IMPGs for human consumption of fish tissue compared to projected fillet-based fish PCBs (SED 3), including the time to achieve in years (*in italics*).

Tissue Type	Assessment Type	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average Fish Tissue (Fillet) PCB Concentration (mg/kg)[1]																	
					Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8	BBD	LL	LZ	LH
					0.25	3.0	1.8	6.3	0.71	1.3	2.1	1.8	1.4	1.0	0.82	1.3	0.72	1.6	0.04	0.03	0.02	0.02
Bass Fillets	Deterministic	RME	Cancer @ 10^{-6}	0.0019	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Cancer @ 10^{-5}	0.019	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Cancer @ 10^{-4}	0.19	■	■	■	■	■	■	■	■	■	■	■	■	■	■	▨ *11*	▨ *9*	*6*	*5*
			Non-Cancer -- Child	0.026	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*34*	*27*
			Non-Cancer -- Adult	0.062	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*22*	*17*	*12*	*12*
		CTE	Cancer @ 10^{-6}	0.049	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*37*	*23*	*17*	*17*
			Cancer @ 10^{-5}	0.49	▨ *22*	■	■	■	■	■	■	■	■	■	■	■	■	■	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	4.9	▨ *8*	▨ *12*	▨ *10*	■	▨ *11*	▨ *9*	▨ *9*	▨ *10*	▨ *9*	▨ *9*	▨ *8*	▨ *8*	▨ *7*	▨ *8*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.19	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*11*	*9*	*6*	*5*
			Non-Cancer -- Adult	0.43	*26*	■	■	■	■	■	■	■	■	■	■	■	■	■	*0*	*0*	*0*	*0*
	Probabilistic	RME (5th percentile)	Cancer @ 10^{-6}	0.0064	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Cancer @ 10^{-5}	0.064	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*22*	*17*	*12*	*12*
			Cancer @ 10^{-4}	0.64	▨ *15*	■	■	■	■	■	■	■	■	■	■	■	■	■	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.059	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*26*	*19*	*14*	*13*
			Non-Cancer -- Adult	0.12	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*11*	*9*	*6*	*5*
		CTE (50th percentile)	Cancer @ 10^{-6}	0.057	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*26*	*19*	*14*	*13*
			Cancer @ 10^{-5}	0.57	*18*	■	■	■	■	■	■	■	■	■	■	■	■	■	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	5.7	*7*	▨ *11*	▨ *10*	■	*11*	▨ *9*	▨ *9*	▨ *9*	▨ *9*	▨ *8*	▨ *7*	▨ *7*	▨ *5*	▨ *7*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.71	*14*	■	■	■	*52*	■	■	■	■	■	■	■	■	■	*0*	*0*	*0*	*0*
			Non-Cancer -- Adult	1.5	*11*	■	■	■	*14*	*26*	■	■	*38*	*23*	*19*	*34*	*15*	■	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average); whole body concentrations divided by a factor of 5.0 to convert to fillet basis
CTE = central tendency exposure
RME = reasonable maximum exposure
BBD: Bulls Bridge Dam Impoundment
LL: Lake Lillinonah
LZ: Lake Zoar
LH: Lake Housatonic

Key

□ = model prediction is lower than the IMPG
▨ = model prediction is lower than the cancer IMPG, but is not lower than the corresponding non-cancer IMPGs
■ = model prediction exceeds the IMPG

Table 4-11. Sediment IMPGs for benthic invertebrates compared to projected sediment PCBs (SED 3), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
			Lower End of Range	Upper End of Range
			3	10
5A	R5A_01	**0.33**	*1*	*1*
	R5A_02	**0.18**	*1*	*1*
	R5A_03	**0.12**	*2*	*2*
	R5A_04	**0.071**	*2*	*2*
	R5A_05	**0.032**	*2*	*2*
	R5A_06	**0.043**	*3*	*2*
	R5A_07	**0.062**	*3*	*3*
	R5A_08	**0.028**	*4*	*4*
	R5A_09	**0.022**	*4*	*4*
	R5A_10	**0.020**	*6*	*5*
	R5A_11	**0.023**	*7*	*7*
5B	R5B_01	**9.1**	🟦	*21*
	R5B_02	**5.3**	🟦	*0*
	R5B_03	**3.2**	🟦	*0*
	R5B_04	**4.4**	🟦	*0*
	R5B_05	**3.9**	🟦	*0*
5C	R5C_01	**5.8**	🟦	*0*
	R5C_02	**6.4**	🟦	*6*
	R5C_03	**3.2**	🟦	*0*
	R5C_04	**4.4**	🟦	*6*
	R5C_05	**1.8**	*8*	*8*
	R5C_06	**1.5**	*9*	*9*
6	Woods Pond	**1.5**	*10*	*10*
7A		**0.41**	*0*	*0*
7B		**3.9**	🟦	*0*
7C		**4.0**	🟦	*0*
7D		**0.92**	*0*	*0*
7E		**1.2**	*0*	*0*
7F		**0.61**	*0*	*0*
7G		**4.7**	🟦	*0*
7H		**0.39**	*0*	*0*
8	Rising Pond	**2.7**	*25*	*0*

Notes

[1] Exposure areas in Reach 5 represent EPA spatial bins (1/4 to 1/2-mile segments as defined in EPA's Model Validation Report)

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

⬜ = model prediction is lower than the IMPG

🟦 = model prediction exceeds the IMPG

Table 4-12. Backwater sediment IMPGs for amphibians compared to projected sediment PCBs (SED 3), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Area (acres)	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
				Lower End of Range	Upper End of Range
				3.27	5.6
Small Backwaters (< 2 acres)	BWS_01	1.9	**4.2**	🟦	*32*
	BWS_02	1.8	**5.0**	🟦	*38*
	BWS_03	1.9	**1.8**	*38*	*28*
	BWS_04	0.30	**22**	🟦	🟦
	BWS_06	0.56	**0.26**	*17*	*10*
	BWS_07	0.12	**5.4**	🟦	*4*
	BWS_08	0.35	**37**	🟦	🟦
	BWS_09	0.28	**19**	🟦	🟦
	BWS_10	1.5	**15**	🟦	🟦
	BWS_11	0.11	**0.14**	*7*	*5*
	BWS_12	1.7	**4.7**	🟦	*42*
	BWS_13	0.37	**9.2**	🟦	🟦
	BWS_14	0.57	**8.1**	🟦	🟦
	BWS_15	0.90	**6.7**	🟦	🟦
	BWS_16	1.0	**1.2**	*30*	*17*
	BWS_17	0.58	**0.44**	*14*	*5*
	BWS_18	0.84	**0.29**	*19*	*11*
	BWS_19	0.99	**20**	🟦	🟦
	BWS_20	1.3	**4.4**	🟦	*36*
Large Backwaters (> 2 acres)	BWL_01	2.1	**11**	🟦	🟦
	BWL_02	5.5	**4.2**	🟦	*35*
	BWL_03	2.4	**2.2**	*37*	*16*
	BWL_04	2.1	**2.4**	*38*	*26*
	BWL_05	12	**12**	🟦	🟦
	BWL_07	22	**19**	🟦	🟦
	BWL_08	4.1	**11**	🟦	🟦
	BWL_09	7.0	**14**	🟦	🟦
	BWL_10	6.4	**12**	🟦	🟦
	BWL_11	4.6	**2.3**	*0*	*0*

Notes

[1] Exposure areas represent individual backwaters

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

⬜ = model prediction is lower than the IMPG

🟦 = model prediction exceeds the IMPG

Table 4-13. Sediment IMPGs for insectivorous birds and piscivorous mammals compared to projected sediment PCBs (SED 3), including the time to achieve in years (*in italics*).

Insectivorous Birds (wood duck)

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
			1	**3**	**5**
Reach 5A	KM 1	**0.20**	*2*	*2*	*1*
	KM 2	**1.8**	■	*26*	*6*
	KM 3	**1.7**	■	*4*	*4*
	KM 4	**0.020**	*6*	*6*	*6*
	KM 5	**0.023**	*7*	*7*	*7*
Reach 5B	KM 6	**7.4**	■	■	■
	KM 7	**4.2**	■	■	*28*
	KM 8	**5.8**	■	■	■
Reaches 5C/5D	KM 9	**5.4**	■	■	■
	KM 10	**7.2**	■	■	■
	KM 11	**12**	■	■	■
Reach 6	KM 12	**1.8**	■	*10*	*10*

Pisciviorous Mammals (mink)

Exposure Area[4]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
		1	**3**	**5**
Reaches 5A/5B	**2.9**	■	*45*	*8*
Reaches 5C/5D/6	**6.2**	■	■	■

Notes

[1] Exposure areas for wood ducks represent approximate 1 kilometer segments of the river channel

[2] Model endpoint concentrations after 52-year projection

[3] Sediment target levels have corresponding floodplain soil IMPGs due to mixture of aquatic and terrestrial diets for these receptors

[4] Exposure areas represent entire river reach

IMPG = interim media protection goal

Key

□ = model prediction is lower than the target value
■ = model prediction exceeds the target value

Table 4-14. IMPGs for fish protection, and consumption of fish and invertebrates by ecological receptors compared to projected biota tissue PCBs (SED 3), including the time to achieve in years (*in italics*).

Ecological Receptor			**Average Whole Body Fish Tissue PCB Concentration (mg/kg)** [1]													
			Reach 5A	**Reach 5B**	**Reach 5C**	**Reach 5D**	**Reach 6**	**Reach 7A**	**Reach 7B**	**Reach 7C**	**Reach 7D**	**Reach 7E**	**Reach 7F**	**Reach 7G**	**Reach 7H**	**Reach 8**
Fish protection			**0.98**	**12**	**7.0**	**24**	**2.8**	**4.8**	**8.2**	**6.7**	**5.2**	**3.9**	**3.1**	**4.8**	**2.8**	**6.0**
Threatened and endangered species (represented by bald eagle)			**0.45**	**13**	**7.7**	**15**	**1.6**	**2.3**	**9.5**	**4.7**	**3.6**	**2.2**	**1.9**	**3.8**	**1.5**	**4.9**
Piscivorous birds (represented by osprey)			**0.55**	**11**	**7.0**	**15**	**1.9**	**2.4**	**8.4**	**4.4**	**3.4**	**2.2**	**1.9**	**3.5**	**1.5**	**4.4**
Ecological Receptor	**Tissue Type**	**IMPG (mg/kg)**														
Fish protection	Warmwater fish tissue (whole body)	55	*3*	*5*	*0*	*11*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Coldwater fish tissue (whole body) - Trout Below PSA	14	▨	▨	▨	▨	▨	*10*	*11*	*11*	*10*	*10*	*9*	*10*	*9*	▨
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	30.41	*3*	*5*	*7*	*10*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	3.2	*10*	■	■	■	*13*	*18*	■	■	■	*22*	*17*	■	*12*	■

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average)

IMPG = interim media protection goal

Key

□ = model prediction is lower than the IMPG
■ = model prediction exceeds the IMPG
▨ = IMPG not applicable

Table 4-16. Sediment IMPGs for human direct contact compared to projected sediment PCBs (SED 4), including the time to achieve in years (*in italics*).

Risk Category	Receptor	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average 0-6" Sediment PCB Concentration (mg/kg)[1]							
					SA 1	SA 2	SA 3	SA 4	SA 5	SA 6	SA 7	SA 8
					0.071	**0.45**	**0.22**	**3.2**	**4.1**	**1.3**	**7.6**	**2.9**
Human Direct Contact	Older Child	RME	Cancer @ 10^{-6}	4.5	*7*	*12*	*15*	*0*	*0*	*0*	■	*0*
			Cancer @ 10^{-5}	45	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	453	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	31	*0*	*0*	*12*	*0*	*0*	*0*	*0*	*0*
		CTE	Cancer @ 10^{-6}	36	*0*	*0*	*7*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-5}	365	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	3645	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	125	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Adult	RME	Cancer @ 10^{-6}	1.3	*9*	*12*	*15*	■	■	*26*	■	■
			Cancer @ 10^{-5}	13	*2*	*11*	*14*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	135	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	40	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		CTE	Cancer @ 10^{-6}	28	*0*	*0*	*12*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-5}	280	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	2800	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	152	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection

CTE = central tendency exposure
RME = reasonable maximum exposure
IMPG = interim media protection goal
SA = EPA Risk Assessment Sediment Exposure Areas
- SA 1: Confluence to New Lenox Road
- SA 2: New Lenox Road to Woods Pond Headwaters
- SA 3: Woods Pond (6-meters from waters edge)
- SA 4: Columbia Mill Dam impoundment (6-meters from waters edge)
- SA 5: Former Eagle Mill Dam impoundment (6-meters from waters edge)
- SA 6: Willow Mill Dam impoundment (6-meters from waters edge)
- SA 7: Glendale Dam impoundment (6-meters from waters edge)
- SA 8: Rising Pond impoundment (6-meters from waters edge)

Key

□ = model prediction is lower than the IMPG
■ = model prediction exceeds the IMPG

Table 4-17. IMPGs for human consumption of fish tissue compared to projected fillet-based fish PCBs (SED 4), including the time to achieve in years (*in italics*).

Tissue Type	Assessment Type	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average Fish Tissue (Fillet) PCB Concentration (mg/kg)[1]																	
					Reach 5A	**Reach 5B**	**Reach 5C**	**Reach 5D**	**Reach 6**	**Reach 7A**	**Reach 7B**	**Reach 7C**	**Reach 7D**	**Reach 7E**	**Reach 7F**	**Reach 7G**	**Reach 7H**	**Reach 8**	**BBD**	**LL**	**LZ**	**LH**
					0.26	**0.39**	**0.42**	**0.40**	**0.23**	**0.50**	**1.6**	**1.1**	**0.84**	**0.62**	**0.52**	**1.1**	**0.46**	**1.3**	**0.02**	**0.01**	**0.01**	**0.01**
Bass Fillets	Deterministic	RME	Cancer @ 10^{-6}	0.0019	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Cancer @ 10^{-5}	0.019	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*51*	*34*	*33*
			Cancer @ 10^{-4}	0.19	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*11*	*8*	*4*	*4*
			Non-Cancer -- Child	0.026	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*37*	*26*	*21*	*21*
			Non-Cancer -- Adult	0.062	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*19*	*17*	*11*	*11*
		CTE	Cancer @ 10^{-6}	0.049	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*22*	*19*	*17*	*17*
			Cancer @ 10^{-5}	0.49	▨ *22*	▨ *18*	▨ *17*	▨ *19*	▨ *20*	■	■	■	■	■	■	■	▨ *37*	■	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	4.9	▨ *8*	▨ *10*	▨ *11*	▨ *14*	▨ *15*	▨ *10*	▨ *10*	▨ *10*	▨ *9*	▨ *7*	▨ *6*	▨ *6*	▨ *5*	▨ *6*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.19	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*11*	*8*	*4*	*4*
			Non-Cancer -- Adult	0.43	*26*	*22*	*17*	*22*	*20*	■	■	■	■	■	■	■	■	■	*0*	*0*	*0*	*0*
	Probabilistic	RME (5th percentile)	Cancer @ 10^{-6}	0.0064	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Cancer @ 10^{-5}	0.064	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*19*	*17*	*11*	*11*
			Cancer @ 10^{-4}	0.64	▨ *15*	▨ *16*	▨ *16*	▨ *18*	▨ *19*	▨ *22*	■	■	■	▨ *50*	▨ *25*	■	▨ *21*	■	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.059	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*20*	*18*	*16*	*16*
			Non-Cancer -- Adult	0.12	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*11*	*8*	*4*	*4*
		CTE (50th percentile)	Cancer @ 10^{-6}	0.057	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*20*	*18*	*16*	*16*
			Cancer @ 10^{-5}	0.57	*18*	*16*	*16*	*18*	*19*	*24*	■	■	■	■	*38*	■	*22*	■	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	5.7	*7*	*10*	*11*	*14*	*14*	*9*	▨ *9*	▨ *9*	▨ *8*	*6*	*5*	▨ *5*	*3*	▨ *5*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.71	*14*	*15*	*16*	*17*	*19*	*21*	■	■	■	*36*	*21*	■	*20*	■	*0*	*0*	*0*	*0*
			Non-Cancer -- Adult	1.5	*11*	*13*	*14*	*16*	*17*	*18*	■	*20*	*19*	*18*	*17*	*18*	*12*	*24*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average); whole body concentrations divided by a factor of 5.0 to convert to fillet basis
CTE = central tendency exposure
RME = reasonable maximum exposure
BBD: Bulls Bridge Dam Impoundment
LL: Lake Lillinonah
LZ: Lake Zoar
LH: Lake Housatonic

Key

□ = model prediction is lower than the IMPG
▨ = model prediction is lower than the cancer IMPG, but is not lower than the corresponding non-cancer IMPGs
■ = model prediction exceeds the IMPG

Table 4-18. Sediment IMPGs for benthic invertebrates compared to projected sediment PCBs (SED 4), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
			Lower End of Range	Upper End of Range
			3	10
5A	R5A_01	**0.33**	*1*	*1*
	R5A_02	**0.17**	*1*	*1*
	R5A_03	**0.14**	*2*	*2*
	R5A_04	**0.072**	*2*	*2*
	R5A_05	**0.033**	*2*	*2*
	R5A_06	**0.048**	*3*	*2*
	R5A_07	**0.075**	*3*	*3*
	R5A_08	**0.023**	*4*	*4*
	R5A_09	**0.022**	*4*	*4*
	R5A_10	**0.020**	*6*	*5*
	R5A_11	**0.026**	*7*	*7*
5B	R5B_01	**0.044**	*9*	*8*
	R5B_02	**0.061**	*10*	*0*
	R5B_03	**1.1**	*10*	*0*
	R5B_04	**0.35**	*10*	*0*
	R5B_05	**0.54**	*10*	*0*
5C	R5C_01	**1.5**	*11*	*0*
	R5C_02	**0.11**	*11*	*6*
	R5C_03	**1.1**	*11*	*0*
	R5C_04	**0.11**	*11*	*6*
	R5C_05	**0.14**	*12*	*11*
	R5C_06	**0.16**	*13*	*12*
6	Woods Pond	**0.25**	*15*	*14*
7A		**0.41**	*0*	*0*
7B		**4.0**	■	*0*
7C		**4.0**	■	*0*
7D		**0.94**	*0*	*0*
7E		**1.3**	*0*	*0*
7F		**0.61**	*0*	*0*
7G		**5.0**	■	*0*
7H		**0.40**	*0*	*0*
8	Rising Pond	**2.7**	*17*	*0*

Notes

[1] Exposure areas in Reach 5 represent EPA spatial bins (1/4 to 1/2-mile segments as defined in EPA's Model Validation Report)

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

□ = model prediction is lower than the IMPG

■ = model prediction exceeds the IMPG

Table 4-19. Backwater sediment IMPGs for amphibians compared to projected sediment PCBs (SED 4), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Area (acres)	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
				Lower End of Range	Upper End of Range
				3.27	5.6
Small Backwaters (< 2 acres)	BWS_01	1.9	**4.1**	■	*32*
	BWS_02	1.8	**0.14**	*3*	*3*
	BWS_03	1.9	**0.20**	*3*	*3*
	BWS_04	0.30	**0.087**	*3*	*3*
	BWS_06	0.56	**0.22**	*16*	*10*
	BWS_07	0.12	**5.4**	■	*4*
	BWS_08	0.35	**0.064**	*11*	*11*
	BWS_09	0.28	**0.11**	*11*	*11*
	BWS_10	1.5	**0.094**	*11*	*11*
	BWS_11	0.11	**0.18**	*7*	*5*
	BWS_12	1.7	**4.1**	■	*37*
	BWS_13	0.37	**8.9**	■	■
	BWS_14	0.57	**7.9**	■	■
	BWS_15	0.90	**5.5**	■	*51*
	BWS_16	1.0	**0.76**	*26*	*17*
	BWS_17	0.58	**0.35**	*14*	*5*
	BWS_18	0.84	**0.21**	*20*	*10*
	BWS_19	0.99	**0.089**	*11*	*11*
	BWS_20	1.3	**4.0**	■	*35*
Large Backwaters (> 2 acres)	BWL_01	2.1	**0.11**	*8*	*8*
	BWL_02	5.5	**3.7**	■	*32*
	BWL_03	2.4	**1.9**	*33*	*16*
	BWL_04	2.1	**1.8**	*32*	*25*
	BWL_05	12	**0.23**	*11*	*11*
	BWL_07	22	**0.20**	*12*	*12*
	BWL_08	4.1	**1.4**	*12*	*12*
	BWL_09	7.0	**0.20**	*12*	*12*
	BWL_10	6.4	**0.15**	*12*	*12*
	BWL_11	4.6	**0.024**	*0*	*0*

Notes

[1] Exposure areas represent individual backwaters

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

□ = model prediction is lower than the IMPG
■ = model prediction exceeds the IMPG

Table 4-20. Sediment IMPGs for insectivorous birds and piscivorous mammals compared to projected sediment PCBs (SED 4), including the time to achieve in years (*in italics*).

Insectivorous Birds (wood duck)

Reach	**Exposure Area**[1]	**Average 0-6" Sediment PCB Concentration (mg/kg)**[2]	**Sediment Target Level (mg/kg)**[3]		
			1	**3**	**5**
Reach 5A	KM 1	**0.21**	*2*	*1*	*1*
	KM 2	**0.80**	*32*	*3*	*3*
	KM 3	**0.059**	*4*	*4*	*4*
	KM 4	**0.020**	*6*	*6*	*6*
	KM 5	**0.024**	*7*	*7*	*7*
Reach 5B	KM 6	**0.054**	*9*	*9*	*8*
	KM 7	**0.56**	*10*	*10*	*10*
	KM 8	**1.8**	■	*13*	*11*
Reaches 5C/5D	KM 9	**1.7**	■	*17*	*11*
	KM 10	**0.17**	*12*	*11*	*11*
	KM 11	**0.42**	*12*	*12*	*12*
Reach 6	KM 12	**0.23**	*15*	*15*	*14*

Pisciviorous Mammals (mink)

Exposure Area[4]	**Average 0-6" Sediment PCB Concentration (mg/kg)**[2]	**Sediment Target Level (mg/kg)**[3]		
		1	**3**	**5**
Reaches 5A/5B	**0.49**	*11*	*9*	*7*
Reaches 5C/5D/6	**0.54**	*15*	*14*	*14*

Notes

[1] Exposure areas for wood ducks represent approximate 1 kilometer segments of the river channel

[2] Model endpoint concentrations after 52-year projection

[3] Sediment target levels have corresponding floodplain soil IMPGs due to mixture of aquatic and terrestrial diets for these receptors

[4] Exposure areas represent entire river reach

IMPG = interim media protection goal

Key

□ = model prediction is lower than the target value
■ = model prediction exceeds the target value

Table 4-21. IMPGs for fish protection, and consumption of fish and invertebrates by ecological receptors compared to projected biota tissue PCBs (SED 4), including the time to achieve in years (*in italics*).

Ecological Receptor			**Average Whole Body Fish Tissue PCB Concentration (mg/kg)** [1]													
			Reach 5A	**Reach 5B**	**Reach 5C**	**Reach 5D**	**Reach 6**	**Reach 7A**	**Reach 7B**	**Reach 7C**	**Reach 7D**	**Reach 7E**	**Reach 7F**	**Reach 7G**	**Reach 7H**	**Reach 8**
Fish protection			**0.99**	**1.5**	**1.6**	**1.6**	**0.89**	**1.9**	**6.3**	**4.2**	**3.2**	**2.3**	**2.0**	**4.0**	**1.8**	**5.0**
Threatened and endangered species (represented by bald eagle)			**0.45**	**1.1**	**1.6**	**0.76**	**0.42**	**1.3**	**8.9**	**3.8**	**3.0**	**1.7**	**1.5**	**3.6**	**1.2**	**4.4**
Piscivorous birds (represented by osprey)			**0.55**	**1.0**	**1.5**	**0.89**	**0.56**	**1.2**	**7.6**	**3.3**	**2.6**	**1.6**	**1.4**	**3.2**	**1.1**	**3.9**
Ecological Receptor	**Tissue Type**	**IMPG (mg/kg)**														
Fish protection	Warmwater fish tissue (whole body)	55	*3*	*5*	*0*	*11*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Coldwater fish tissue (whole body) - Trout Below PSA	14	▨	▨	▨	▨	▨	*11*	*11*	*11*	*10*	*9*	*8*	*8*	*7*	▨
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	30.41	*3*	*5*	*7*	*11*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	3.2	*10*	*12*	*14*	*15*	*17*	*17*	🟦	🟦	*19*	*17*	*16*	*21*	*11*	🟦

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average)

IMPG = interim media protection goal

Key

⬜ = model prediction is lower than the IMPG
🟦 = model prediction exceeds the IMPG
▨ = IMPG not applicable

Table 4-23. Sediment IMPGs for human direct contact compared to projected sediment PCBs (SED 5), including the time to achieve in years (*in italics*).

Risk Category	Receptor	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average 0-6" Sediment PCB Concentration (mg/kg)[1]							
					SA 1	**SA 2**	**SA 3**	**SA 4**	**SA 5**	**SA 6**	**SA 7**	**SA 8**
					0.057	**0.20**	**0.21**	**3.2**	**4.1**	**1.3**	**7.5**	**0.29**
Human Direct Contact	Older Child	RME	Cancer @ 10^{-6}	4.5	*7*	*15*	*18*	*0*	*0*	*0*	■	*0*
			Cancer @ 10^{-5}	45	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	453	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	31	*0*	*0*	*15*	*0*	*0*	*0*	*0*	*0*
		CTE	Cancer @ 10^{-6}	36	*0*	*0*	*7*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-5}	365	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	3645	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	125	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Adult	RME	Cancer @ 10^{-6}	1.3	*9*	*15*	*18*	■	■	*26*	■	*18*
			Cancer @ 10^{-5}	13	*2*	*14*	*17*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	135	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	40	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		CTE	Cancer @ 10^{-6}	28	*0*	*0*	*15*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-5}	280	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	2800	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	152	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection
CTE = central tendency exposure
RME = reasonable maximum exposure
IMPG = interim media protection goal
SA = EPA Risk Assessment Sediment Exposure Areas

- SA 1: Confluence to New Lenox Road
- SA 2: New Lenox Road to Woods Pond Headwaters
- SA 3: Woods Pond (6-meters from waters edge)
- SA 4: Columbia Mill Dam impoundment (6-meters from waters edge)
- SA 5: Former Eagle Mill Dam impoundment (6-meters from waters edge)
- SA 6: Willow Mill Dam impoundment (6-meters from waters edge)
- SA 7: Glendale Dam impoundment (6-meters from waters edge)
- SA 8: Rising Pond impoundment (6-meters from waters edge)

Key

□ = model prediction is lower than the IMPG
■ = model prediction exceeds the IMPG

Table 4-24. IMPGs for human consumption of fish tissue compared to projected fillet-based fish PCBs (SED 5), including the time to achieve in years (*in italics*).

Tissue Type	Assessment Type	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average Fish Tissue (Fillet) PCB Concentration (mg/kg)[1]																	
					Reach 5A	**Reach 5B**	**Reach 5C**	**Reach 5D**	**Reach 6**	**Reach 7A**	**Reach 7B**	**Reach 7C**	**Reach 7D**	**Reach 7E**	**Reach 7F**	**Reach 7G**	**Reach 7H**	**Reach 8**	**BBD**	**LL**	**LZ**	**LH**
					0.26	**0.23**	**0.17**	**0.36**	**0.18**	**0.42**	**1.6**	**1.0**	**0.79**	**0.57**	**0.49**	**1.0**	**0.43**	**0.34**	**0.01**	**0.009**	**0.006**	**0.006**
Bass Fillets	Deterministic	RME	Cancer @ 10^{-6}	0.0019	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Cancer @ 10^{-5}	0.019	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*40*	*33*	*25*	*25*
			Cancer @ 10^{-4}	0.19	■	■	▨ *44*	■	▨ *50*	■	■	■	■	■	■	■	■	■	*11*	*8*	*4*	*4*
			Non-Cancer -- Child	0.026	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*27*	*24*	*22*	*22*
			Non-Cancer -- Adult	0.062	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*21*	*19*	*15*	*11*
		CTE	Cancer @ 10^{-6}	0.049	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*22*	*21*	*19*	*19*
			Cancer @ 10^{-5}	0.49	▨ *22*	▨ *18*	*20*	▨ *21*	*22*	▨ *36*	■	■	■	■	▨ *51*	■	▨ *34*	▨ *23*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	4.9	▨ *8*	▨ *10*	*14*	▨ *17*	*18*	▨ *10*	▨ *10*	▨ *10*	▨ *9*	▨ *7*	▨ *6*	▨ *6*	▨ *5*	▨ *6*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.19	■	■	*44*	■	*50*	■	■	■	■	■	■	■	■	■	*11*	*8*	*4*	*4*
			Non-Cancer -- Adult	0.43	*26*	*21*	*20*	*22*	*23*	*48*	■	■	■	■	■	■	*51*	*24*	*0*	*0*	*0*	*0*
	Probabilistic	RME (5th percentile)	Cancer @ 10^{-6}	0.0064	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*51*	*50*
			Cancer @ 10^{-5}	0.064	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*21*	*19*	*15*	*11*
			Cancer @ 10^{-4}	0.64	▨ *15*	▨ *16*	▨ *19*	▨ *21*	▨ *22*	▨ *24*	■	■	■	▨ *38*	▨ *25*	■	▨ *23*	▨ *22*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.059	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*21*	*20*	*18*	*18*
			Non-Cancer -- Adult	0.12	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*11*	*8*	*4*	*4*
		CTE (50th percentile)	Cancer @ 10^{-6}	0.057	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*21*	*20*	*18*	*18*
			Cancer @ 10^{-5}	0.57	*18*	*17*	*19*	*21*	*22*	*25*	■	■	■	*52*	*36*	■	*24*	*23*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	5.7	*7*	*10*	*11*	*17*	*17*	*9*	▨ *9*	▨ *9*	▨ *8*	*6*	*5*	▨ *5*	*3*	*5*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.71	*14*	*16*	*19*	*20*	*22*	*24*	■	■	■	*27*	*24*	■	*22*	*22*	*0*	*0*	*0*	*0*
			Non-Cancer -- Adult	1.5	*11*	*14*	*18*	*19*	*20*	*21*	■	*23*	*21*	*21*	*20*	*21*	*19*	*20*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average); whole body concentrations divided by a factor of 5.0 to convert to fillet basis

CTE = central tendency exposure

RME = reasonable maximum exposure

BBD: Bulls Bridge Dam Impoundment

LL: Lake Lillinonah

LZ: Lake Zoar

LH: Lake Housatonic

Key

□ = model prediction is lower than the IMPG

▨ = model prediction is lower than the cancer IMPG, but is not lower than the corresponding non-cancer IMPGs

■ = model prediction exceeds the IMPG

Table 4-25. Sediment IMPGs for benthic invertebrates compared to projected sediment PCBs (SED 5), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
			Lower End of Range	Upper End of Range
			3	10
5A	R5A_01	**0.33**	*1*	*1*
	R5A_02	**0.17**	*1*	*1*
	R5A_03	**0.13**	*2*	*2*
	R5A_04	**0.071**	*2*	*2*
	R5A_05	**0.033**	*2*	*2*
	R5A_06	**0.044**	*3*	*2*
	R5A_07	**0.075**	*3*	*3*
	R5A_08	**0.024**	*4*	*4*
	R5A_09	**0.021**	*4*	*4*
	R5A_10	**0.020**	*6*	*5*
	R5A_11	**0.026**	*7*	*7*
5B	R5B_01	**0.043**	*9*	*8*
	R5B_02	**0.055**	*10*	*0*
	R5B_03	**0.058**	*10*	*0*
	R5B_04	**0.089**	*11*	*0*
	R5B_05	**0.075**	*12*	*0*
5C	R5C_01	**0.083**	*13*	*0*
	R5C_02	**0.12**	*13*	*6*
	R5C_03	**0.098**	*14*	*0*
	R5C_04	**0.11**	*14*	*6*
	R5C_05	**0.13**	*14*	*14*
	R5C_06	**0.17**	*15*	*15*
6	Woods Pond	**0.24**	*18*	*17*
7A		**0.41**	*0*	*0*
7B		**4.0**	■	*0*
7C		**4.0**	■	*0*
7D		**0.94**	*0*	*0*
7E		**1.3**	*0*	*0*
7F		**0.61**	*0*	*0*
7G		**5.0**	■	*0*
7H		**0.40**	*0*	*0*
8	Rising Pond	**0.35**	*17*	*0*

Notes

[1] Exposure areas in Reach 5 represent EPA spatial bins (1/4 to 1/2-mile segments as defined in EPA's Model Validation Report)

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

□ = model prediction is lower than the IMPG
■ = model prediction exceeds the IMPG

Table 4-26. Backwater sediment IMPGs for amphibians compared to projected sediment PCBs (SED 5), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Area (acres)	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg) Lower End of Range 3.27	IMPG (mg/kg) Upper End of Range 5.6
Small Backwaters (< 2 acres)	BWS_01	1.9	**4.1**	🟦	*32*
	BWS_02	1.8	**0.14**	*3*	*3*
	BWS_03	1.9	**0.20**	*3*	*3*
	BWS_04	0.30	**0.087**	*3*	*3*
	BWS_06	0.56	**0.24**	*17*	*10*
	BWS_07	0.12	**5.4**	🟦	*4*
	BWS_08	0.35	**0.060**	*12*	*12*
	BWS_09	0.28	**0.098**	*13*	*13*
	BWS_10	1.5	**0.078**	*13*	*13*
	BWS_11	0.11	**0.12**	*7*	*5*
	BWS_12	1.7	**4.2**	🟦	*38*
	BWS_13	0.37	**8.9**	🟦	🟦
	BWS_14	0.57	**7.8**	🟦	🟦
	BWS_15	0.90	**5.6**	🟦	*52*
	BWS_16	1.0	**0.77**	*27*	*17*
	BWS_17	0.58	**0.27**	*15*	*5*
	BWS_18	0.84	**0.24**	*20*	*10*
	BWS_19	0.99	**0.074**	*14*	*14*
	BWS_20	1.3	**4.1**	🟦	*36*
Large Backwaters (> 2 acres)	BWL_01	2.1	**0.11**	*8*	*8*
	BWL_02	5.5	**3.9**	🟦	*32*
	BWL_03	2.4	**1.8**	*33*	*16*
	BWL_04	2.1	**1.9**	*34*	*26*
	BWL_05	12	**0.22**	*14*	*14*
	BWL_07	22	**0.17**	*15*	*15*
	BWL_08	4.1	**1.3**	*15*	*15*
	BWL_09	7.0	**0.16**	*15*	*15*
	BWL_10	6.4	**0.13**	*15*	*15*
	BWL_11	4.6	**0.024**	*0*	*0*

Notes

[1] Exposure areas represent individual backwaters

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

⬜ = model prediction is lower than the IMPG

🟦 = model prediction exceeds the IMPG

Table 4-27. Sediment IMPGs for insectivorous birds and piscivorous mammals compared to projected sediment PCBs (SED 5), including the time to achieve in years (*in italics*).

Insectivorous Birds (wood duck)

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
			1	**3**	**5**
Reach 5A	KM 1	**0.20**	*2*	*1*	*1*
	KM 2	**0.80**	*32*	*3*	*3*
	KM 3	**0.058**	*4*	*4*	*4*
	KM 4	**0.020**	*6*	*6*	*6*
	KM 5	**0.024**	*7*	*7*	*7*
Reach 5B	KM 6	**0.053**	*9*	*9*	*8*
	KM 7	**0.16**	*11*	*10*	*10*
	KM 8	**1.2**	■	*13*	*13*
Reaches 5C/5D	KM 9	**1.4**	■	*18*	*14*
	KM 10	**0.17**	*14*	*14*	*14*
	KM 11	**0.40**	*15*	*15*	*15*
Reach 6	KM 12	**0.21**	*18*	*17*	*17*

Pisciviorous Mammals (mink)

Exposure Area[4]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
		1	**3**	**5**
Reaches 5A/5B	**0.40**	*12*	*9*	*7*
Reaches 5C/5D/6	**0.42**	*18*	*17*	*16*

Notes

[1] Exposure areas for wood ducks represent approximate 1 kilometer segments of the river channel

[2] Model endpoint concentrations after 52-year projection

[3] Sediment target levels have corresponding floodplain soil IMPGs due to mixture of aquatic and terrestrial diets for these receptors

[4] Exposure areas represent entire river reach

IMPG = interim media protection goal

Key

□ = model prediction is lower than the target value
■ = model prediction exceeds the target value

Table 4-28. IMPGs for fish protection, and consumption of fish and invertebrates by ecological receptors compared to projected biota tissue PCBs (SED 5), including the time to achieve in years (*in italics*).

Ecological Receptor			**Average Whole Body Fish Tissue PCB Concentration (mg/kg) [1]**													
			Reach 5A	**Reach 5B**	**Reach 5C**	**Reach 5D**	**Reach 6**	**Reach 7A**	**Reach 7B**	**Reach 7C**	**Reach 7D**	**Reach 7E**	**Reach 7F**	**Reach 7G**	**Reach 7H**	**Reach 8**
Fish protection			**1.0**	**0.89**	**0.65**	**1.4**	**0.70**	**1.6**	**6.1**	**4.0**	**3.0**	**2.2**	**1.9**	**3.9**	**1.6**	**1.3**
Threatened and endangered species (represented by bald eagle)			**0.46**	**0.40**	**0.37**	**0.67**	**0.34**	**1.2**	**8.8**	**3.7**	**2.9**	**1.7**	**1.4**	**3.6**	**1.1**	**0.79**
Piscivorous birds (represented by osprey)			**0.56**	**0.44**	**0.41**	**0.79**	**0.45**	**1.1**	**7.5**	**3.2**	**2.5**	**1.5**	**1.3**	**3.1**	**1.1**	**0.78**
Ecological Receptor	**Tissue Type**	**IMPG (mg/kg)**														
Fish protection	Warmwater fish tissue (whole body)	55	*3*	*5*	*0*	*14*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Coldwater fish tissue (whole body) - Trout Below PSA	14	▨	▨	▨	▨	▨	*11*	*18*	*18*	*10*	*9*	*8*	*8*	*7*	▨
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	30.41	*3*	*5*	*7*	*14*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	3.2	*10*	*12*	*17*	*18*	*19*	*20*	■	*41*	*22*	*19*	*18*	*22*	*11*	*19*

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average)

IMPG = interim media protection goal

Key

□ = model prediction is lower than the IMPG
■ = model prediction exceeds the IMPG
▨ = IMPG not applicable

Table 4-28. IMPGs for fish protection, and consumption of fish and invertebrates by ecological receptors compared to projected biota tissue PCBs (SED 5), including the time to achieve in years (*in italics*).

Ecological Receptor			**Average Whole Body Fish Tissue PCB Concentration (mg/kg) [1]**													
			Reach 5A	**Reach 5B**	**Reach 5C**	**Reach 5D**	**Reach 6**	**Reach 7A**	**Reach 7B**	**Reach 7C**	**Reach 7D**	**Reach 7E**	**Reach 7F**	**Reach 7G**	**Reach 7H**	**Reach 8**
Fish protection			**1.0**	**0.89**	**0.65**	**1.4**	**0.70**	**1.6**	**6.1**	**4.0**	**3.0**	**2.2**	**1.9**	**3.9**	**1.6**	**1.3**
Threatened and endangered species (represented by bald eagle)			**0.46**	**0.40**	**0.37**	**0.67**	**0.34**	**1.2**	**8.8**	**3.7**	**2.9**	**1.7**	**1.4**	**3.6**	**1.1**	**0.79**
Piscivorous birds (represented by osprey)			**0.56**	**0.44**	**0.41**	**0.79**	**0.45**	**1.1**	**7.5**	**3.2**	**2.5**	**1.5**	**1.3**	**3.1**	**1.1**	**0.78**
Ecological Receptor	**Tissue Type**	**IMPG (mg/kg)**														
Fish protection	Warmwater fish tissue (whole body)	55	*3*	*5*	*0*	*14*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Coldwater fish tissue (whole body) - Trout Below PSA	14	▨	▨	▨	▨	▨	*11*	*18*	*18*	*10*	*9*	*8*	*8*	*7*	▨
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	30.41	*3*	*5*	*7*	*14*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	3.2	*10*	*12*	*17*	*18*	*19*	*20*	■	*41*	*22*	*19*	*18*	*22*	*11*	*19*

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average)

IMPG = interim media protection goal

Key

□ = model prediction is lower than the IMPG

■ = model prediction exceeds the IMPG

▨ = IMPG not applicable

Table 4-30. Sediment IMPGs for human direct contact compared to projected sediment PCBs (SED 6), including the time to achieve in years (*in italics*).

Risk Category	Receptor	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average 0-6" Sediment PCB Concentration (mg/kg)[1]							
					SA 1	**SA 2**	**SA 3**	**SA 4**	**SA 5**	**SA 6**	**SA 7**	**SA 8**
					0.054	**0.17**	**0.24**	**1.2**	**4.1**	**0.45**	**2.2**	**0.096**
Human Direct Contact	Older Child	RME	Cancer @ 10^{-6}	4.5	*7*	*15*	*18*	*0*	*0*	*0*	*19*	*0*
			Cancer @ 10^{-5}	45	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	453	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	31	*0*	*0*	*16*	*0*	*0*	*0*	*0*	*0*
		CTE	Cancer @ 10^{-6}	36	*0*	*0*	*7*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-5}	365	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	3645	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	125	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Adult	RME	Cancer @ 10^{-6}	1.3	*9*	*16*	*19*	*19*	■	*19*	■	*20*
			Cancer @ 10^{-5}	13	*2*	*14*	*17*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	135	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	40	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		CTE	Cancer @ 10^{-6}	28	*0*	*0*	*16*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-5}	280	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	2800	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	152	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection

CTE = central tendency exposure

RME = reasonable maximum exposure

IMPG = interim media protection goal

SA = EPA Risk Assessment Sediment Exposure Areas

- SA 1: Confluence to New Lenox Road
- SA 2: New Lenox Road to Woods Pond Headwaters
- SA 3: Woods Pond (6-meters from waters edge)
- SA 4: Columbia Mill Dam impoundment (6-meters from waters edge)
- SA 5: Former Eagle Mill Dam impoundment (6-meters from waters edge)
- SA 6: Willow Mill Dam impoundment (6-meters from waters edge)
- SA 7: Glendale Dam impoundment (6-meters from waters edge)
- SA 8: Rising Pond impoundment (6-meters from waters edge)

Key

□ = model prediction is lower than the IMPG

■ = model prediction exceeds the IMPG

Table 4-31. IMPGs for human consumption of fish tissue compared to projected fillet-based fish PCBs (SED 6), including the time to achieve in years (*in italics*).

Tissue Type	Assessment Type	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average Fish Tissue (Fillet) PCB Concentration (mg/kg)[1]																	
					Reach 5A	**Reach 5B**	**Reach 5C**	**Reach 5D**	**Reach 6**	**Reach 7A**	**Reach 7B**	**Reach 7C**	**Reach 7D**	**Reach 7E**	**Reach 7F**	**Reach 7G**	**Reach 7H**	**Reach 8**	**BBD**	**LL**	**LZ**	**LH**
					0.26	**0.22**	**0.16**	**0.35**	**0.17**	**0.40**	**1.1**	**1.0**	**0.74**	**0.37**	**0.47**	**0.42**	**0.41**	**0.24**	**0.01**	**0.007**	**0.005**	**0.005**
Bass Fillets	Deterministic	RME	Cancer @ 10^{-6}	0.0019	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Cancer @ 10^{-5}	0.019	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*37*	*32*	*26*	*26*
			Cancer @ 10^{-4}	0.19	■	■	▨ *44*	■	▨ *48*	■	■	■	■	■	■	■	■	■	*18*	*9*	*6*	*5*
			Non-Cancer -- Child	0.026	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*29*	*25*	*23*	*23*
			Non-Cancer -- Adult	0.062	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*22*	*20*	*19*	*19*
		CTE	Cancer @ 10^{-6}	0.049	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*23*	*22*	*20*	*20*
			Cancer @ 10^{-5}	0.49	▨ *22*	▨ *18*	*20*	▨ *21*	*23*	▨ *33*	■	■	■	▨ *24*	▨ *47*	▨ *24*	▨ *27*	▨ *25*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	4.9	▨ *8*	▨ *10*	*14*	▨ *17*	*19*	▨ *10*	▨ *10*	▨ *10*	▨ *10*	▨ *9*	▨ *8*	▨ *8*	▨ *7*	▨ *8*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.19	■	■	*44*	■	*48*	■	■	■	■	■	■	■	■	■	*18*	*9*	*6*	*5*
			Non-Cancer -- Adult	0.43	*26*	*20*	*21*	*22*	*24*	*41*	■	■	■	*25*	■	*24*	*38*	*25*	*0*	*0*	*0*	*0*
	Probabilistic	RME (5th percentile)	Cancer @ 10^{-6}	0.0064	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*39*	*38*
			Cancer @ 10^{-5}	0.064	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*22*	*20*	*19*	*19*
			Cancer @ 10^{-4}	0.64	▨ *15*	▨ *16*	▨ *20*	▨ *21*	▨ *23*	▨ *24*	■	■	■	▨ *23*	▨ *26*	▨ *23*	▨ *24*	▨ *24*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.059	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*22*	*21*	*19*	*19*
			Non-Cancer -- Adult	0.12	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*18*	*9*	*6*	*5*
		CTE (50th percentile)	Cancer @ 10^{-6}	0.057	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*22*	*21*	*19*	*19*
			Cancer @ 10^{-5}	0.57	*18*	*17*	*20*	*21*	*23*	*25*	■	■	■	*23*	*35*	*24*	*25*	*24*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	5.7	*7*	*10*	*11*	*17*	*19*	*9*	▨ *9*	▨ *9*	▨ *9*	*8*	*7*	*7*	*5*	*7*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.71	*14*	*16*	*19*	*21*	*23*	*24*	■	■	■	*23*	*25*	*23*	*23*	*24*	*0*	*0*	*0*	*0*
			Non-Cancer -- Adult	1.5	*11*	*14*	*18*	*19*	*21*	*22*	*22*	*23*	*22*	*21*	*21*	*21*	*20*	*22*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average); whole body concentrations divided by a factor of 5.0 to convert to fillet basis

CTE = central tendency exposure

RME = reasonable maximum exposure

BBD: Bulls Bridge Dam Impoundment

LL: Lake Lillinonah

LZ: Lake Zoar

LH: Lake Housatonic

Key

□ = model prediction is lower than the IMPG

▨ = model prediction is lower than the cancer IMPG, but is not lower than the corresponding non-cancer IMPGs

■ = model prediction exceeds the IMPG

Table 4-32. Sediment IMPGs for benthic invertebrates compared to projected sediment PCBs (SED 6), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
			Lower End of Range	Upper End of Range
			3	10
5A	R5A_01	**0.33**	*1*	*1*
	R5A_02	**0.17**	*1*	*1*
	R5A_03	**0.14**	*2*	*2*
	R5A_04	**0.070**	*2*	*2*
	R5A_05	**0.032**	*2*	*2*
	R5A_06	**0.045**	*3*	*2*
	R5A_07	**0.063**	*3*	*3*
	R5A_08	**0.023**	*4*	*4*
	R5A_09	**0.021**	*4*	*4*
	R5A_10	**0.020**	*6*	*5*
	R5A_11	**0.022**	*7*	*7*
5B	R5B_01	**0.035**	*9*	*8*
	R5B_02	**0.042**	*10*	*0*
	R5B_03	**0.060**	*10*	*0*
	R5B_04	**0.090**	*11*	*0*
	R5B_05	**0.072**	*12*	*0*
5C	R5C_01	**0.081**	*13*	*0*
	R5C_02	**0.12**	*13*	*6*
	R5C_03	**0.10**	*13*	*0*
	R5C_04	**0.12**	*14*	*6*
	R5C_05	**0.19**	*14*	*14*
	R5C_06	**0.25**	*16*	*16*
6	Woods Pond	**0.21**	*18*	*18*
7A		**0.41**	*0*	*0*
7B		**2.6**	*19*	*0*
7C		**4.0**	■	*0*
7D		**0.91**	*0*	*0*
7E		**0.45**	*0*	*0*
7F		**0.60**	*0*	*0*
7G		**1.4**	*19*	*0*
7H		**0.39**	*0*	*0*
8	Rising Pond	**0.13**	*20*	*0*

Notes

[1] Exposure areas in Reach 5 represent EPA spatial bins (1/4 to 1/2-mile segments as defined in EPA's Model Validation Report)

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

▢ = model prediction is lower than the IMPG

■ = model prediction exceeds the IMPG

Table 4-33. Backwater sediment IMPGs for amphibians compared to projected sediment PCBs (SED 6), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Area (acres)	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
				Lower End of Range	Upper End of Range
				3.27	5.6
Small Backwaters (< 2 acres)	BWS_01	1.9	**0.18**	*2*	*2*
	BWS_02	1.8	**0.14**	*3*	*3*
	BWS_03	1.9	**0.20**	*3*	*3*
	BWS_04	0.30	**0.12**	*3*	*3*
	BWS_06	0.56	**0.18**	*10*	*10*
	BWS_07	0.12	**0.030**	*10*	*4*
	BWS_08	0.35	**0.061**	*12*	*12*
	BWS_09	0.28	**0.098**	*13*	*13*
	BWS_10	1.5	**0.080**	*13*	*13*
	BWS_11	0.11	**0.13**	*7*	*5*
	BWS_12	1.7	**0.11**	*13*	*13*
	BWS_13	0.37	**0.11**	*13*	*13*
	BWS_14	0.57	**0.049**	*13*	*13*
	BWS_15	0.90	**0.10**	*13*	*13*
	BWS_16	1.0	**0.094**	*14*	*14*
	BWS_17	0.58	**0.11**	*14*	*5*
	BWS_18	0.84	**0.10**	*14*	*10*
	BWS_19	0.99	**0.072**	*14*	*14*
	BWS_20	1.3	**0.11**	*15*	*15*
Large Backwaters (> 2 acres)	BWL_01	2.1	**1.5**	*8*	*8*
	BWL_02	5.5	**0.11**	*12*	*12*
	BWL_03	2.4	**0.096**	*13*	*13*
	BWL_04	2.1	**0.12**	*14*	*14*
	BWL_05	12	**0.25**	*14*	*14*
	BWL_07	22	**0.18**	*15*	*15*
	BWL_08	4.1	**0.19**	*15*	*15*
	BWL_09	7.0	**0.24**	*16*	*15*
	BWL_10	6.4	**0.18**	*16*	*16*
	BWL_11	4.6	**0.024**	*0*	*0*

Notes

[1] Exposure areas represent individual backwaters

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

⬜ = model prediction is lower than the IMPG

🟦 = model prediction exceeds the IMPG

Table 4-34. Sediment IMPGs for insectivorous birds and piscivorous mammals compared to projected sediment PCBs (SED 6), including the time to achieve in years (*in italics*).

Insectivorous Birds (wood duck)

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
			1	**3**	**5**
Reach 5A	KM 1	**0.21**	*2*	*1*	*1*
	KM 2	**0.093**	*3*	*3*	*2*
	KM 3	**0.058**	*4*	*4*	*4*
	KM 4	**0.020**	*6*	*6*	*6*
	KM 5	**0.023**	*7*	*7*	*7*
Reach 5B	KM 6	**0.31**	*9*	*9*	*8*
	KM 7	**0.065**	*11*	*10*	*10*
	KM 8	**0.085**	*13*	*12*	*12*
Reaches 5C/5D	KM 9	**0.10**	*14*	*13*	*13*
	KM 10	**0.19**	*14*	*14*	*14*
	KM 11	**0.20**	*16*	*16*	*15*
Reach 6	KM 12	**0.22**	*19*	*18*	*18*

Pisciviorous Mammals (mink)

Exposure Area[4]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
		1	**3**	**5**
Reaches 5A/5B	**0.11**	*12*	*9*	*7*
Reaches 5C/5D/6	**0.19**	*18*	*18*	*17*

Notes

[1] Exposure areas for wood ducks represent approximate 1 kilometer segments of the river channel

[2] Model endpoint concentrations after 52-year projection

[3] Sediment target levels have corresponding floodplain soil IMPGs due to mixture of aquatic and terrestrial diets for these receptors

[4] Exposure areas represent entire river reach

IMPG = interim media protection goal

Key

🟦 = model prediction is lower than the target value

Table 4-35. IMPGs for fish protection, and consumption of fish and invertebrates by ecological receptors compared to projected biota tissue PCBs (SED 6), including the time to achieve in years (*in italics*).

Ecological Receptor			Average Whole Body Fish Tissue PCB Concentration (mg/kg) [1]													
			Reach 5A	**Reach 5B**	**Reach 5C**	**Reach 5D**	**Reach 6**	**Reach 7A**	**Reach 7B**	**Reach 7C**	**Reach 7D**	**Reach 7E**	**Reach 7F**	**Reach 7G**	**Reach 7H**	**Reach 8**
Fish protection			**0.99**	**0.86**	**0.63**	**1.4**	**0.68**	**1.5**	**4.4**	**3.9**	**2.8**	**1.4**	**1.8**	**1.6**	**1.5**	**0.91**
Threatened and endangered species (represented by bald eagle)			**0.45**	**0.38**	**0.38**	**0.62**	**0.32**	**1.1**	**6.1**	**3.7**	**2.7**	**0.86**	**1.4**	**1.2**	**1.1**	**0.43**
Piscivorous birds (represented by osprey)			**0.55**	**0.42**	**0.41**	**0.77**	**0.43**	**1.1**	**5.2**	**3.2**	**2.4**	**0.84**	**1.3**	**1.1**	**1.0**	**0.46**
Ecological Receptor	**Tissue Type**	**IMPG (mg/kg)**														
Fish protection	Warmwater fish tissue (whole body)	55	*3*	*5*	*0*	*15*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Coldwater fish tissue (whole body) - Trout Below PSA	14	▨	▨	▨	▨	▨	*19*	*19*	*19*	*18*	*11*	*10*	*11*	*9*	▨
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	30.41	*4*	*5*	*7*	*14*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	3.2	*10*	*12*	*17*	*18*	*20*	*20*	■	*36*	*22*	*19*	*20*	*20*	*19*	*21*

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average)

IMPG = interim media protection goal

Key

🟦 = model prediction is lower than the IMPG
■ = model prediction exceeds the IMPG
▨ = IMPG not applicable

Table 4-37. Sediment IMPGs for human direct contact compared to projected sediment PCBs (SED 7), including the time to achieve in years (*in italics*).

Risk Category	Receptor	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average 0-6" Sediment PCB Concentration (mg/kg)[1]							
					SA 1	SA 2	SA 3	SA 4	SA 5	SA 6	SA 7	SA 8
					0.085	0.16	0.24	0.23	4.1	0.30	1.3	0.032
Human Direct Contact	Older Child	RME	Cancer @ 10^{-6}	4.5	*8*	*18*	*22*	*0*	*0*	*0*	*24*	*0*
			Cancer @ 10^{-5}	45	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	453	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	31	*0*	*0*	*19*	*0*	*0*	*0*	*0*	*0*
		CTE	Cancer @ 10^{-6}	36	*0*	*0*	*8*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-5}	365	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	3645	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	125	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Adult	RME	Cancer @ 10^{-6}	1.3	*11*	*19*	*23*	*23*	■	*23*	*24*	*25*
			Cancer @ 10^{-5}	13	*3*	*17*	*21*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	135	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	40	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		CTE	Cancer @ 10^{-6}	28	*0*	*0*	*19*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-5}	280	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	2800	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	152	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 55-year projection

CTE = central tendency exposure

RME = reasonable maximum exposure

IMPG = interim media protection goal

SA = EPA Risk Assessment Sediment Exposure Areas

- SA 1: Confluence to New Lenox Road
- SA 2: New Lenox Road to Woods Pond Headwaters
- SA 3: Woods Pond (6-meters from waters edge)
- SA 4: Columbia Mill Dam impoundment (6-meters from waters edge)
- SA 5: Former Eagle Mill Dam impoundment (6-meters from waters edge)
- SA 6: Willow Mill Dam impoundment (6-meters from waters edge)
- SA 7: Glendale Dam impoundment (6-meters from waters edge)
- SA 8: Rising Pond impoundment (6-meters from waters edge)

Key

□ = model prediction is lower than the IMPG

■ = model prediction exceeds the IMPG

Table 4-38. IMPGs for human consumption of fish tissue compared to projected fillet-based fish PCBs (SED 7), including the time to achieve in years (*in italics*).

Tissue Type	Assessment Type	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average Fish Tissue (Fillet) PCB Concentration (mg/kg)[1]																	
					Reach 5A	**Reach 5B**	**Reach 5C**	**Reach 5D**	**Reach 6**	**Reach 7A**	**Reach 7B**	**Reach 7C**	**Reach 7D**	**Reach 7E**	**Reach 7F**	**Reach 7G**	**Reach 7H**	**Reach 8**	**BBD**	**LL**	**LZ**	**LH**
					0.28	**0.25**	**0.18**	**0.38**	**0.19**	**0.42**	**0.95**	**1.0**	**0.78**	**0.35**	**0.48**	**0.34**	**0.41**	**0.21**	**0.01**	**0.007**	**0.005**	**0.005**
Bass Fillets	Deterministic	RME	Cancer @ 10^{-6}	0.0019	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Cancer @ 10^{-5}	0.019	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*39*	*35*	*32*	*31*
			Cancer @ 10^{-4}	0.19	■	■	*52*	■	*53*	■	■	■	■	■	■	■	■	■	*11*	*9*	*5*	*4*
			Non-Cancer -- Child	0.026	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*33*	*30*	*28*	*28*
			Non-Cancer -- Adult	0.062	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*27*	*25*	*13*	*12*
		CTE	Cancer @ 10^{-6}	0.049	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*29*	*27*	*25*	*25*
			Cancer @ 10^{-5}	0.49	*23*	*20*	*23*	*25*	*27*	*39*	■	■	■	*33*	*48*	*31*	*34*	*30*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	4.9	*9*	*12*	*15*	*20*	*23*	*11*	*11*	*11*	*10*	*8*	*7*	*7*	*5*	*7*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.19	■	■	*52*	■	*53*	■	■	■	■	■	■	■	■	■	*11*	*9*	*5*	*4*
			Non-Cancer -- Adult	0.43	*39*	*21*	*24*	*26*	*27*	*51*	■	■	■	*35*	■	*34*	*44*	*31*	*0*	*0*	*0*	*0*
	Probabilistic	RME (5th percentile)	Cancer @ 10^{-6}	0.0064	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*43*	*41*
			Cancer @ 10^{-5}	0.064	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*27*	*25*	*13*	*12*
			Cancer @ 10^{-4}	0.64	*15*	*18*	*23*	*24*	*26*	*34*	■	■	■	*27*	*33*	*29*	*30*	*29*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.059	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*27*	*26*	*15*	*14*
			Non-Cancer -- Adult	0.12	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*11*	*9*	*5*	*4*
		CTE (50th percentile)	Cancer @ 10^{-6}	0.057	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*27*	*26*	*15*	*14*
			Cancer @ 10^{-5}	0.57	*18*	*19*	*23*	*24*	*27*	*35*	■	■	■	*31*	*37*	*30*	*31*	*30*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	5.7	*8*	*11*	*12*	*20*	*22*	*10*	*10*	*10*	*9*	*7*	*5*	*6*	*3*	*5*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.71	*14*	*18*	*22*	*24*	*26*	*33*	■	■	■	*27*	*30*	*29*	*29*	*29*	*0*	*0*	*0*	*0*
			Non-Cancer -- Adult	1.5	*12*	*16*	*21*	*23*	*25*	*25*	*26*	*27*	*26*	*25*	*24*	*26*	*25*	*27*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 55-year projection (autumn average); whole body concentrations divided by a factor of 5.0 to convert to fillet basis

CTE = central tendency exposure

RME = reasonable maximum exposure

BBD: Bulls Bridge Dam Impoundment

LL: Lake Lillinonah

LZ: Lake Zoar

LH: Lake Housatonic

Key

□ = model prediction is lower than the IMPG

▨ = model prediction is lower than the cancer IMPG, but is not lower than the corresponding non-cancer IMPGs

■ = model prediction exceeds the IMPG

Table 4-39. Sediment IMPGs for benthic invertebrates compared to projected sediment PCBs (SED 7), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
			Lower End of Range	Upper End of Range
			3	10
5A	R5A_01	**0.18**	*1*	*1*
	R5A_02	**0.11**	*1*	*1*
	R5A_03	**0.36**	*27*	*2*
	R5A_04	**0.84**	*3*	*2*
	R5A_05	**0.14**	*3*	*3*
	R5A_06	**0.074**	*4*	*3*
	R5A_07	**0.054**	*5*	*4*
	R5A_08	**0.025**	*5*	*5*
	R5A_09	**0.047**	*6*	*6*
	R5A_10	**0.029**	*7*	*7*
	R5A_11	**0.029**	*9*	*8*
5B	R5B_01	**0.034**	*11*	*10*
	R5B_02	**0.041**	*12*	*0*
	R5B_03	**0.066**	*12*	*0*
	R5B_04	**0.092**	*13*	*0*
	R5B_05	**0.071**	*14*	*0*
5C	R5C_01	**0.083**	*16*	*0*
	R5C_02	**0.12**	*16*	*6*
	R5C_03	**0.10**	*16*	*0*
	R5C_04	**0.12**	*17*	*7*
	R5C_05	**0.20**	*17*	*17*
	R5C_06	**0.22**	*19*	*19*
6	Woods Pond	**0.22**	*22*	*21*
7A		**0.41**	*0*	*0*
7B		**1.9**	*23*	*0*
7C		**4.0**	■	*0*
7D		**0.94**	*0*	*0*
7E		**0.30**	*0*	*0*
7F		**0.60**	*0*	*0*
7G		**0.85**	*24*	*0*
7H		**0.40**	*0*	*0*
8	Rising Pond	**0.031**	*17*	*0*

Notes

[1] Exposure areas in Reach 5 represent EPA spatial bins (1/4 to 1/2-mile segments as defined in EPA's Model Validation Report)

[2] Model endpoint concentrations after 55-year projection

IMPG = interim media protection goal

Key

□ = model prediction is lower than the IMPG
■ = model prediction exceeds the IMPG

Table 4-40. Backwater sediment IMPGs for amphibians compared to projected sediment PCBs (SED 7), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Area (acres)	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
				Lower End of Range	Upper End of Range
				3.27	5.6
Small Backwaters (< 2 acres)	BWS_01	1.9	**0.37**	*2*	*2*
	BWS_02	1.8	**0.30**	*3*	*3*
	BWS_03	1.9	**0.25**	*4*	*4*
	BWS_04	0.30	**0.24**	*4*	*4*
	BWS_06	0.56	**0.20**	*12*	*10*
	BWS_07	0.12	**0.026**	*12*	*4*
	BWS_08	0.35	**0.26**	*15*	*15*
	BWS_09	0.28	**0.17**	*16*	*16*
	BWS_10	1.5	**0.33**	*16*	*16*
	BWS_11	0.11	**0.13**	*7*	*5*
	BWS_12	1.7	**0.13**	*16*	*16*
	BWS_13	0.37	**0.17**	*16*	*16*
	BWS_14	0.57	**0.13**	*16*	*16*
	BWS_15	0.90	**0.14**	*16*	*16*
	BWS_16	1.0	**0.097**	*17*	*17*
	BWS_17	0.58	**0.11**	*16*	*5*
	BWS_18	0.84	**0.10**	*17*	*11*
	BWS_19	0.99	**0.15**	*17*	*17*
	BWS_20	1.3	**0.12**	*18*	*17*
	BWL_01	2.1	**1.6**	*10*	*10*
Large Backwaters (> 2 acres)	BWL_02	5.5	**0.16**	*15*	*15*
	BWL_03	2.4	**0.11**	*16*	*16*
	BWL_04	2.1	**0.19**	*16*	*16*
	BWL_05	12	**0.19**	*17*	*17*
	BWL_07	22	**0.21**	*18*	*18*
	BWL_08	4.1	**0.20**	*18*	*18*
	BWL_09	7.0	**0.19**	*19*	*19*
	BWL_10	6.4	**0.20**	*19*	*19*
	BWL_11	4.6	**0.024**	*0*	*0*

Notes

[1] Exposure areas represent individual backwaters

[2] Model endpoint concentrations after 55-year projection

IMPG = interim media protection goal

Key

▢ = model prediction is lower than the IMPG

■ = model prediction exceeds the IMPG

Table 4-41. Sediment IMPGs for insectivorous birds and piscivorous mammals compared to projected sediment PCBs (SED 7), including the time to achieve in years (*in italics*).

Insectivorous Birds (wood duck)

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
			1	3	5
Reach 5A	KM 1	**0.12**	*2*	*2*	*2*
	KM 2	**0.43**	*34*	*3*	*3*
	KM 3	**0.071**	*5*	*5*	*5*
	KM 4	**0.034**	*8*	*7*	*7*
	KM 5	**0.031**	*9*	*9*	*9*
Reach 5B	KM 6	**0.32**	*11*	*11*	*11*
	KM 7	**0.068**	*13*	*12*	*12*
	KM 8	**0.11**	*16*	*15*	*15*
Reaches 5C/5D	KM 9	**0.13**	*16*	*16*	*16*
	KM 10	**0.17**	*17*	*17*	*17*
	KM 11	**0.19**	*19*	*19*	*19*
Reach 6	KM 12	**0.23**	*22*	*22*	*22*

Pisciviorous Mammals (mink)

Exposure Area[4]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
		1	3	5
Reaches 5A/5B	**0.14**	*14*	*11*	*9*
Reaches 5C/5D/6	**0.19**	*22*	*21*	*20*

Notes

[1] Exposure areas for wood ducks represent approximate 1 kilometer segments of the river channel

[2] Model endpoint concentrations after 52-year projection

[3] Sediment target levels have corresponding floodplain soil IMPGs due to mixture of aquatic and terrestrial diets for these receptors

[4] Exposure areas represent entire river reach

IMPG = interim media protection goal

Key

▢ = model prediction is lower than the target value
■ = model prediction exceeds the target value

Table 4-42. IMPGs for fish protection, and consumption of fish and invertebrates by ecological receptors compared to projected biota tissue PCBs (SED 7), including the time to achieve in years (*in italics*).

Ecological Receptor			Average Whole Body Fish Tissue PCB Concentration (mg/kg) [1]													
			Reach 5A	**Reach 5B**	**Reach 5C**	**Reach 5D**	**Reach 6**	**Reach 7A**	**Reach 7B**	**Reach 7C**	**Reach 7D**	**Reach 7E**	**Reach 7F**	**Reach 7G**	**Reach 7H**	**Reach 8**
Fish protection			**1.1**	**0.97**	**0.70**	**1.6**	**0.77**	**1.6**	**3.7**	**3.9**	**3.0**	**1.4**	**1.9**	**1.3**	**1.6**	**0.84**
Threatened and endangered species (represented by bald eagle)			**0.52**	**0.42**	**0.40**	**0.69**	**0.37**	**1.2**	**5.0**	**3.7**	**2.9**	**0.80**	**1.4**	**0.87**	**1.1**	**0.34**
Piscivorous birds (represented by osprey)			**0.65**	**0.48**	**0.44**	**0.87**	**0.50**	**1.1**	**4.3**	**3.2**	**2.5**	**0.82**	**1.3**	**0.85**	**1.1**	**0.39**
Ecological Receptor	**Tissue Type**	**IMPG (mg/kg)**														
Fish protection	Warmwater fish tissue (whole body)	55	*3*	*5*	*0*	*18*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Coldwater fish tissue (whole body) - Trout Below PSA	14	▨	▨	▨	▨	▨	*13*	*23*	*23*	*12*	*10*	*9*	*9*	*8*	▨
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	30.41	*4*	*6*	*8*	*17*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	3.2	*11*	*14*	*20*	*21*	*24*	*23*	■	*41*	*26*	*23*	*23*	*24*	*12*	*26*

Notes

[1] Model endpoint concentrations after 55-year projection (autumn average)

IMPG = interim media protection goal

Key

▢ = model prediction is lower than the IMPG
■ = model prediction exceeds the IMPG
▨ = IMPG not applicable

Table 4-44. Sediment IMPGs for human direct contact compared to projected sediment PCBs (SED 8), including the time to achieve in years (*in italics*).

Risk Category	Receptor	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average 0-6" Sediment PCB Concentration (mg/kg)[1]							
					SA 1	**SA 2**	**SA 3**	**SA 4**	**SA 5**	**SA 6**	**SA 7**	**SA 8**
					0.076	**0.10**	**0.17**	**0.042**	**4.1**	**0.015**	**0.056**	**0.072**
Human Direct Contact	Older Child	RME	Cancer @ 10^{-6}	4.5	*10*	*25*	*37*	*0*	*0*	*0*	*41*	*0*
			Cancer @ 10^{-5}	45	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	453	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	31	*0*	*0*	*21*	*0*	*0*	*0*	*0*	*0*
		CTE	Cancer @ 10^{-6}	36	*0*	*0*	*8*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-5}	365	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	3645	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	125	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Adult	RME	Cancer @ 10^{-6}	1.3	*13*	*27*	*38*	*39*	🟦	*34*	*41*	*47*
			Cancer @ 10^{-5}	13	*3*	*23*	*29*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	135	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	40	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		CTE	Cancer @ 10^{-6}	28	*0*	*0*	*27*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-5}	280	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	2800	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	152	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 81-year projection

CTE = central tendency exposure

RME = reasonable maximum exposure

IMPG = interim media protection goal

SA = EPA Risk Assessment Sediment Exposure Areas

- SA 1: Confluence to New Lenox Road
- SA 2: New Lenox Road to Woods Pond Headwaters
- SA 3: Woods Pond (6-meters from waters edge)
- SA 4: Columbia Mill Dam impoundment (6-meters from waters edge)
- SA 5: Former Eagle Mill Dam impoundment (6-meters from waters edge)
- SA 6: Willow Mill Dam impoundment (6-meters from waters edge)
- SA 7: Glendale Dam impoundment (6-meters from waters edge)
- SA 8: Rising Pond impoundment (6-meters from waters edge)

Key

⬜ = model prediction is lower than the IMPG

🟦 = model prediction exceeds the IMPG

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Table 4-45. IMPGs for human consumption of fish tissue compared to projected fillet-based fish PCBs (SED 8), including the time to achieve in years (*in italics*).

Tissue Type	Assessment Type	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average Fish Tissue (Fillet) PCB Concentration (mg/kg)[1]																	
					Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8	BBD	LL	LZ	LH
					0.17	0.15	0.11	0.29	0.13	0.34	0.82	0.96	0.67	0.21	0.41	0.17	0.36	0.19	0.008	0.006	0.004	0.004
Bass Fillets	Deterministic	RME	Cancer @ 10^{-6}	0.0019	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Cancer @ 10^{-5}	0.019	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*61*	*57*	*55*	*55*
			Cancer @ 10^{-4}	0.19	*74*	*70*	*48*	■	*51*	■	■	■	■	■	■	*63*	■	*74*	*15*	*11*	*7*	*6*
			Non-Cancer -- Child	0.026	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*56*	*54*	*53*	*53*
			Non-Cancer -- Adult	0.062	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*34*	*31*	*17*	*17*
		CTE	Cancer @ 10^{-6}	0.049	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*53*	*36*	*31*	*31*
			Cancer @ 10^{-5}	0.49	*23*	*21*	*32*	*31*	*42*	*44*	■	■	■	*44*	*49*	*45*	*47*	*53*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	4.9	*10*	*14*	*17*	*27*	*37*	*12*	*12*	*13*	*12*	*11*	*10*	*11*	*8*	*11*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.19	*74*	*70*	*48*	■	*51*	■	■	■	■	■	■	*63*	■	*74*	*15*	*11*	*7*	*6*
			Non-Cancer -- Adult	0.43	*39*	*23*	*32*	*32*	*42*	*48*	■	■	■	*44*	*64*	*46*	*48*	*53*	*0*	*0*	*0*	*0*
	Probabilistic	RME (5th percentile)	Cancer @ 10^{-6}	0.0064	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*70*	*63*	*62*
			Cancer @ 10^{-5}	0.064	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*34*	*31*	*17*	*17*
			Cancer @ 10^{-4}	0.64	*17*	*20*	*31*	*31*	*41*	*43*	■	■	■	*43*	*43*	*45*	*46*	*52*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.059	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*39*	*32*	*26*	*22*
			Non-Cancer -- Adult	0.12	■	■	*76*	■	■	■	■	■	■	■	■	■	■	■	*15*	*11*	*7*	*6*
		CTE (50th percentile)	Cancer @ 10^{-6}	0.057	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*39*	*32*	*26*	*22*
			Cancer @ 10^{-5}	0.57	*18*	*21*	*31*	*31*	*41*	*43*	■	■	■	*43*	*45*	*45*	*46*	*52*	*0*	*0*	*0*	*0*
			Cancer @ 10^{-4}	5.7	*9*	*13*	*14*	*27*	*37*	*11*	*11*	*12*	*11*	*10*	*8*	*9*	*7*	*9*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.71	*16*	*20*	*31*	*31*	*41*	*42*	■	■	*64*	*42*	*43*	*44*	*45*	*52*	*0*	*0*	*0*	*0*
			Non-Cancer -- Adult	1.5	*13*	*18*	*28*	*29*	*40*	*39*	*41*	*42*	*41*	*39*	*33*	*42*	*32*	*49*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 81-year projection (autumn average); whole body concentrations divided by a factor of 5.0 to convert to fillet basis

CTE = central tendency exposure

RME = reasonable maximum exposure

BBD: Bulls Bridge Dam Impoundment

LL: Lake Lillinonah

LZ: Lake Zoar

LH: Lake Housatonic

Key

□ = model prediction is lower than the IMPG

▨ = model prediction is lower than the cancer IMPG, but is not lower than the corresponding non-cancer IMPGs

■ = model prediction exceeds the IMPG

Table 4-46. Sediment IMPGs for benthic invertebrates compared to projected sediment PCBs (SED 8), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
			Lower End of Range	Upper End of Range
			3	**10**
5A	R5A_01	**0.11**	*1*	*1*
	R5A_02	**0.084**	*1*	*1*
	R5A_03	**0.23**	*2*	*2*
	R5A_04	**0.37**	*3*	*3*
	R5A_05	**0.067**	*3*	*3*
	R5A_06	**0.28**	*4*	*3*
	R5A_07	**0.070**	*6*	*5*
	R5A_08	**0.021**	*6*	*6*
	R5A_09	**0.027**	*7*	*7*
	R5A_10	**0.022**	*9*	*8*
	R5A_11	**0.026**	*11*	*10*
5B	R5B_01	**0.030**	*13*	*12*
	R5B_02	**0.038**	*14*	*0*
	R5B_03	**0.050**	*15*	*0*
	R5B_04	**0.11**	*15*	*0*
	R5B_05	**0.057**	*16*	*0*
5C	R5C_01	**0.077**	*19*	*0*
	R5C_02	**0.090**	*20*	*7*
	R5C_03	**0.086**	*21*	*0*
	R5C_04	**0.088**	*22*	*7*
	R5C_05	**0.14**	*24*	*23*
	R5C_06	**0.15**	*28*	*27*
6	Woods Pond	**0.16**	*37*	*33*
7A		**0.41**	*0*	*0*
7B		**1.8**	*39*	*0*
7C		**4.0**	■	*0*
7D		**0.86**	*0*	*0*
7E		**0.015**	*0*	*0*
7F		**0.56**	*0*	*0*
7G		**0.045**	*41*	*0*
7H		**0.39**	*0*	*0*
8	Rising Pond	**0.070**	*26*	*0*

Notes

[1] Exposure areas in Reach 5 represent EPA spatial bins (1/4 to 1/2-mile segments as defined in EPA's Model Validation Report)

[2] Model endpoint concentrations after 81-year projection

IMPG = interim media protection goal

Key

□ = model prediction is lower than the IMPG

■ = model prediction exceeds the IMPG

Table 4-47. Backwater sediment IMPGs for amphibians compared to projected sediment PCBs (SED 8), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Area (acres)	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
				Lower End of Range	**Upper End of Range**
				3.27	**5.6**
Small Backwaters (< 2 acres)	BWS_01	1.9	**0.20**	*3*	*3*
	BWS_02	1.8	**0.16**	*4*	*4*
	BWS_03	1.9	**0.18**	*5*	*5*
	BWS_04	0.30	**0.19**	*5*	*5*
	BWS_06	0.56	**0.13**	*14*	*11*
	BWS_07	0.12	**0.11**	*14*	*14*
	BWS_08	0.35	**0.29**	*18*	*18*
	BWS_09	0.28	**0.21**	*18*	*18*
	BWS_10	1.5	**0.27**	*19*	*19*
	BWS_11	0.11	**0.093**	*8*	*5*
	BWS_12	1.7	**0.10**	*20*	*20*
	BWS_13	0.37	**0.10**	*20*	*20*
	BWS_14	0.57	**0.20**	*20*	*20*
	BWS_15	0.90	**0.12**	*21*	*21*
	BWS_16	1.0	**0.12**	*21*	*18*
	BWS_17	0.58	**0.088**	*16*	*6*
	BWS_18	0.84	**0.074**	*19*	*11*
	BWS_19	0.99	**0.11**	*23*	*23*
	BWS_20	1.3	**0.12**	*24*	*24*
Large Backwaters (> 2 acres)	BWL_01	2.1	**0.15**	*12*	*12*
	BWL_02	5.5	**0.14**	*17*	*17*
	BWL_03	2.4	**0.10**	*19*	*18*
	BWL_04	2.1	**0.14**	*21*	*21*
	BWL_05	12	**0.11**	*23*	*23*
	BWL_07	22	**0.11**	*25*	*25*
	BWL_08	4.1	**0.10**	*26*	*26*
	BWL_09	7.0	**0.10**	*26*	*26*
	BWL_10	6.4	**0.16**	*27*	*27*
	BWL_11	4.6	**0.022**	*0*	*0*

Notes

[1] Exposure areas represent individual backwaters

[2] Model endpoint concentrations after 81-year projection

IMPG = interim media protection goal

Key

□ = model prediction is lower than the IMPG
■ = model prediction exceeds the IMPG

Table 4-48. Sediment IMPGs for insectivorous birds and piscivorous mammals compared to projected sediment PCBs (SED 8), including the time to achieve in years (*in italics*).

Insectivorous Birds (wood duck)

Reach	**Exposure Area**[1]	**Average 0-6" Sediment PCB Concentration (mg/kg)**[2]	**Sediment Target Level (mg/kg)**[3]		
			1	**3**	**5**
Reach 5A	KM 1	**0.089**	*2*	*2*	*2*
	KM 2	**0.36**	*36*	*4*	*3*
	KM 3	**0.063**	*6*	*6*	*6*
	KM 4	**0.024**	*9*	*9*	*9*
	KM 5	**0.028**	*11*	*11*	*11*
Reach 5B	KM 6	**0.051**	*13*	*13*	*13*
	KM 7	**0.062**	*15*	*15*	*14*
	KM 8	**0.095**	*19*	*18*	*17*
Reaches 5C/5D	KM 9	**0.11**	*21*	*20*	*20*
	KM 10	**0.11**	*24*	*24*	*23*
	KM 11	**0.11**	*27*	*26*	*26*
Reach 6	KM 12	**0.16**	*38*	*36*	*35*

Pisciviorous Mammals (mink)

Exposure Area[4]	**Average 0-6" Sediment PCB Concentration (mg/kg)**[2]	**Sediment Target Level (mg/kg)**[3]		
		1	**3**	**5**
Reaches 5A/5B	**0.087**	*17*	*13*	*11*
Reaches 5C/5D/6	**0.13**	*37*	*33*	*29*

Notes

[1] Exposure areas for wood ducks represent approximate 1 kilometer segments of the river channel

[2] Model endpoint concentrations after 52-year projection

[3] Sediment target levels have corresponding floodplain soil IMPGs due to mixture of aquatic and terrestrial diets for these receptors

[4] Exposure areas represent entire river reach

IMPG = interim media protection goal

Key

⬜ = model prediction is lower than the target value
🟦 = model prediction exceeds the target value

Table 4-49. IMPGs for fish protection, and consumption of fish and invertebrates by ecological receptors compared to projected biota tissue PCBs (SED 8), including the time to achieve in years (*in italics*).

Ecological Receptor			**Average Whole Body Fish Tissue PCB Concentration (mg/kg)** [1]													
			Reach 5A	**Reach 5B**	**Reach 5C**	**Reach 5D**	**Reach 6**	**Reach 7A**	**Reach 7B**	**Reach 7C**	**Reach 7D**	**Reach 7E**	**Reach 7F**	**Reach 7G**	**Reach 7H**	**Reach 8**
Fish protection			**0.68**	**0.58**	**0.43**	**1.1**	**0.50**	**1.3**	**3.2**	**3.7**	**2.6**	**0.83**	**1.6**	**0.67**	**1.4**	**0.73**
Threatened and endangered species (represented by bald eagle)			**0.31**	**0.28**	**0.26**	**0.49**	**0.24**	**1.1**	**4.5**	**3.6**	**2.6**	**0.31**	**1.3**	**0.26**	**1.1**	**0.34**
Piscivorous birds (represented by osprey)			**0.38**	**0.30**	**0.28**	**0.62**	**0.32**	**0.97**	**3.8**	**3.1**	**2.2**	**0.37**	**1.1**	**0.30**	**0.98**	**0.37**
Ecological Receptor	**Tissue Type**	**IMPG (mg/kg)**														
Fish protection	Warmwater fish tissue (whole body)	55	*3*	*6*	*0*	*24*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Coldwater fish tissue (whole body) - Trout Below PSA	14	▨	▨	▨	▨	▨	*15*	*31*	*31*	*15*	*14*	*13*	*14*	*11*	▨
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	30.41	*5*	*6*	*8*	*21*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	3.2	*12*	*17*	*28*	*28*	*39*	*34*	■	*45*	*41*	*36*	*31*	*41*	*29*	*48*

Notes

[1] Model endpoint concentrations after 81-year projection (autumn average)

IMPG = interim media protection goal

Key

▢ = model prediction is lower than the IMPG
■ = model prediction exceeds the IMPG
▨ = IMPG not applicable

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Table 4-51 – Percent Reduction in Annual PCB Load Passing Woods Pond and Rising Pond Dams, and Transported to the Reach 5/6 Floodplain for Sediment Alternatives

	Percent Reduction in Current PCB Load		
SED	**Woods Pond Dam**	**Rising Pond Dam**	**Reach 5/6 Floodplain**
1 / 2	37%	41%	50%
3	94%	87%	97%
4	96%	89%	97%
5	97%	93%	98%
6	97%	95%	98%
7	97%	95%	98%
8	98%	96%	99%

Note:

1. Load reductions computed based on 5-year averages at the start and end of the model projections.

Table 4-52 - Modeled Average Water Column PCB Concentrations at End of Projection Period for Sediment Alternatives

Reach	SED 1 / 2	SED 3	SED 4	SED 5	SED 6	SED 7	SED 8
5A	*9*	*2.6*	*2.5*	*2.5*	*2.5*	*2.6*	*1.8*
5B	***44***	*3*	*1.8*	*1.8*	*1.9*	*1.8*	*1.2*
5C	***34***	*4*	*1.6*	*1.2*	*1.3*	*1.4*	*0.9*
6	***33***	*4.4*	*1.5*	*1.2*	*1.2*	*1.3*	*0.9*
7	***14 – 29***	*2.1 – 4.1*	*1.0 – 1.5*	*0.9 – 1.2*	*0.9 – 1.2*	*1.0 – 1.4*	*0.9 – 1.0*
8	*13*	*2.3*	*1.3*	*1.0*	*0.9*	*1*	*0.9*
Connecticut	*0.6 – 1.3*	0.1 – 0.2	0.07 – 0.1	0.05 – 0.1	0.05 – 0.09	0.05 – 0.1	0.04 – 0.09

Notes:

1. All concentrations provided in nanograms per liter (ng/L).
2. Annual average water column concentrations that exceed the freshwater chronic aquatic life criterion (14 ng/L) are shown in bold.
3. Annual average water column concentrations that exceed the human health consumption criteria (0.064 ng/L or 0.17 ng/L under the Connecticut standards) are shown in italics.
4. Modeling results not included for Reach 5D (backwaters).

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Table 4-53 – Modeled Subreach-Average Fish (Fillet) PCB Concentrations at End of Projection Period for Sediment Alternatives

Reach	SED 1 / 2	SED 3	SED 4	SED 5	SED 6	SED 7	SED 8
Fish PCB Concentration (mg/kg wet weight)							
Reach 5A	7.3	0.3	0.3	0.3	0.3	0.3	0.2
Reach 5B	9.3	3	0.4	0.2	0.2	0.2	0.1
Reach 5C	7.4	1.8	0.4	0.2	0.2	0.2	0.1
Reach 5D (Backwaters)	9.5	6.3	0.4	0.4	0.4	0.4	0.3
Reach 6	8.6	0.7	0.2	0.2	0.2	0.2	0.1
Reach 7	2.8-6.4	0.7-2.1	0.5-1.6	0.4-1.6	0.4-1.1	0.3-1.0	0.2-1.0
Reach 8	3.6	1.6	1.4	0.3	0.2	0.2	0.2
Connecticut (Bulls Bridge Dam Impoundment)	0.2	0.04	0.02	0.01	0.01	0.01	0.008
Percent Reduction in Fish PCB Concentration							
Reach 5A	60%	99%	99%	99%	99%	98%	99%
Reach 5B	47%	83%	98%	99%	99%	99%	99%
Reach 5C	48%	87%	97%	99%	99%	99%	99%
Reach 5D (Backwaters)	57%	72%	98%	98%	98%	98%	99%
Reach 6	44%	95%	99%	99%	99%	99%	99%
Reach 7	45-63%	80-91%	84-96%	84-97%	90-97%	91-97%	92-98%
Reach 8	43%	75%	78%	94%	96%	97%	97%
Connecticut (Bulls Bridge Dam Impoundment)	60%	91%	95%	97%	97%	97%	98%

Notes:

1. PCB concentrations represent subreach-average values predicted by EPA's model at the end of the model projection period (52 years for SEDs 1-6, 55 years for SED 7, and 81 years for SED 8).
2. Values shown as ranges in Reach 7 represent the range of modeled PCB concentrations at the end of the projection within each of the Reach 7 subreaches.
3. Percent reduction represents the change in annual average PCB concentrations predicted by EPA's model between the beginning and the end of the projection period.

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Table 4-55 – Number of Areas in Reaches 5 Through 8 with Predicted Fish PCB Concentrations within the Range of IMPGs for Human Fish Consumption

Exposure Assumptions	SED						
	1 / 2	3	4	5	6	7	8
	Number of Areas within Range of IMPGs (total # of areas = 14)						
RME (Deterministic)	0	0	0	0	0	0	0
RME (Probabilistic)	0	0	0	0	0	0	0
CTE (Deterministic)	0	0	0	2	2	2	6
CTE (Probabilistic)	0	2	9	10	11	11	12

Notes:

1. RME = reasonable maximum exposure
2. CTE = central tendency exposure

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Table 4-57 – Number of Averaging Areas with Predicted Sediment or Fish PCB Concentrations within the Range of Ecological IMPGs for Sediment Alternatives

Receptor	Total # of Areas	SED 1 / 2	SED 3	SED 4	SED 5	SED 6	SED 7	SED 8
		Number of Areas within Range of IMPGs						
Benthic Invertebrates	32	23	32	32	32	32	32	32
Amphibians	29	10	15	27	27	29	29	29
Piscivorous Birds	14	0	6	11	13	13	13	13
Fish Protection (Warmwater)	14	14	14	14	14	14	14	14
Fish Protection (Coldwater)	8	3	8	8	8	8	8	8
Threatened and Endangered Species	14	14	14	14	14	14	14	14

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Table 4-59 – Estimated Truck Trips for Removal of Excavated Material and Delivery of Capping Material for Sediment Alternatives

SED	Truck Trips for Excavated Material	Truck Trips for Capping Material	Total Truck Trips
1 / 2	---	---	---
3	12,500	22,700	35,200
4	22,100	46,300	68,400
5	30,800	61,900	92,700
6	41,600	70,900	112,500
7	59,500	92,000	151,500
8	168,800	223,400	392,200

Notes:

1. Truck trips for excavated material estimated assuming 20-ton capacity trucks, and truck trip for capping material estimated assuming 16-ton trucks.
2. Capping material includes cap, thin-layer cap, backfill, and bank stabilization materials.

Table 4-60 - Incidence of Potential Accidents/Injuries Due to Increased Truck Traffic/Alternative Implementation

Impacts	SED						
	1 / 2	3	4	5	6	7	8
Community Impacts Due to Increased Truck Traffic							
Non-Fatal Injuries							
Number	---	0.65	1.32	1.76	2.02	2.62	6.37
Probability of Occurrence	---	48%	73%	83%	87%	93%	100%
Fatalities							
Number	---	0.03	0.06	0.07	0.09	0.11	0.27
Probability of Occurrence	---	3%	5%	7%	8%	10%	24%
Site Worker Impacts Due to Alternative Implementation							
Manhours (hours)	---	371,480	635,279	758,921	772,399	993,981	1,705,705
Construction Duration (yrs)	---	10	15	19	21	25	52
Non-Fatal Injuries							
Number	---	3.68	6.30	7.51	7.48	9.57	16.23
Probability of Occurrence	---	97%	100%	100%	100%	100%	100%
Fatalities							
Number	---	0.02	0.05	0.06	0.07	0.10	0.21
Probability of Occurrence	---	2%	5%	6%	7%	9%	19%

Notes:

1. Additional details regarding potential risks to the community due to the increased truck traffic and fatalities/non-fatal injuries to site workers from implementation of each of the sediment alternatives are presented in Appendix D.

2. Risks from truck traffic to transport excavated materials to the staging areas were evaluated as part of the risks to site workers; and the risks from truck traffic to transport such materials from the staging areas to disposition locations were evaluated under the relevant treatment/disposition alternatives.

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Table 4-61 – Required Capping Material Volumes for Sediment Alternatives

SED	Sand (cy)	Armor Stone/Rip-rap (cy)	Total Materials (cy)
1 / 2	---	---	---
3	145,000	82,000	227,000
4	302,000	161,000	463,000
5	367,000	252,000	619,000
6	424,000	285,000	709,000
7	564,000	355,000	919,000
8	2,230,000	---	2,230,000

Note:

1. Capping material includes cap, thin-layer cap, backfill materials.

5. Approach to Evaluating Remedial Alternatives for Floodplain Soils

This section provides a description of the approach that was used in evaluating the seven alternatives developed for addressing floodplain soils in the Rest of River area. The detailed evaluation of the floodplain soil alternatives is presented in Section 6.

5.1 General Approach

Overview of Alternatives

GE evaluated seven alternatives (designated FP 1 through FP 7) for remediating floodplain soils. These alternatives are summarized in Table 1-2. These alternatives (apart from FP 1, the no-action alternative) consist of two types – IMPG-based alternatives and threshold-based alternatives.

The IMPG-based alternatives, FP 2, FP 3, FP 4, and FP 7, involve the removal and backfill of soil as necessary to achieve certain specified average PCB concentrations within a given depth and averaging area in the floodplain. The average concentrations targeted for these alternatives are based on the PCB IMPGs that apply to the floodplain – or, where tissue-based IMPGs have been converted to target floodplain soil PCB levels (as discussed in Section 2.2.2.3), those target soil PCB concentrations. (In describing and evaluating the remedial alternatives in this report, these target soil levels are included within the term “IMPGs” when used generally, and are sometimes referred to as “floodplain soil IMPGs.”) Averages for this evaluation were based on the 95% upper concentration limit (UCL) of the spatially weighted mean, as described in Section 5.4 below.

Different floodplain alternatives were developed to achieve different sets of IMPG values within the ranges of the IMPGs. The alternatives were developed following a sequential approach of first evaluating the extent of remediation necessary to meet human health IMPGs, and then considering (where relevant) the additional remediation that would be needed to meet ecological IMPGs. For human direct contact with soil and consumption of agricultural products, these alternatives were based on achieving different IMPG values within the ranges of the health-based RME IMPGs (i.e., the upper bounds of the ranges, mid-range values, or the lower bounds of the ranges) in the appropriate averaging areas.[110] Next, each of these alternatives (with the exception of FP 2) includes the additional soil removal/backfill

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[110] For these IMPGs, the upper bounds of the ranges refer to the RME IMPGs based on a 10^{-4} cancer risk or non-cancer HI of 1, whichever is lower; the mid-range values refer to the RME IMPGs based on a 10^{-5} cancer risk or non-cancer HI of 1, whichever is lower; and the lower bounds of the ranges refer to the RME IMPGs based on a 10^{-6} cancer risk, except that, for human direct contact, they are no lower than 2 mg/kg, which is the CD standard for unrestricted use.

needed to achieve the upper or lower bounds of the relevant floodplain ecological receptor IMPGs within their respective averaging areas.[111]

Threshold-based alternatives, FP 5 and FP 6, involve the removal of all soils within a given depth having PCB concentrations that exceed certain concentration thresholds (50 mg/kg for FP 5 and 25 mg/kg for FP 6). Averaging areas were not used in the development of remedial alternatives FP 5 and FP 6, but only in the development of the IMPG-based alternatives.

Each of these floodplain alternatives, except FP 1 (no action), focuses on excavation and backfill of the top foot of floodplain soil, which represents the soil to which human and ecological receptors would most likely be exposed, as approved by EPA in its April 13, 2007 letter conditionally approving the CMS Proposal. However, as directed in EPA's letter of May 22, 2007, alternatives FP 3 through FP 7 also include additional removal and backfill to a depth of 3 feet in certain heavily used areas (as discussed in Section 5.2.1 below).

Evaluation Approach

To evaluate FP 2 through FP 7, GE first estimated the areal extent and volume of soil removal for each alternative (with that volume assumed to be replaced with clean backfill material). For the IMPG-based alternatives, this required determining the locations and volume of soil removal/backfill necessary to achieve the specified average concentrations in particular averaging areas. The averaging areas used for this determination, which vary depending on the human or ecological receptors being evaluated, are described in detail in

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[111] The ecological receptors considered are amphibians (represented by wood frogs), omnivorous mammals (represented by shrews), insectivorous birds (represented by wood ducks), and piscivorous mammals (represented by mink). As discussed in Section 2.2.2.3, the target floodplain soil IMPG levels developed for wood ducks and mink are dependent on the associated sediment concentrations due to the mixture of aquatic and terrestrial dietary items consumed by those receptors (i.e., separate soil IMPGs have been developed based on sediment target levels of 1, 3, and 5 mg/kg). In developing the floodplain alternatives designed to achieve these IMPGs, GE assumed that the associated average sediment concentration in the wood duck and mink averaging areas would be 1 mg/kg or below, and thus has developed these alternatives to achieve the wood duck and mink floodplain soil IMPG levels associated with a target sediment level of 1 mg/kg. However, in the detailed evaluation of these alternatives in Section 6, GE has also considered the extent to which these alternatives would achieve the floodplain soil IMPG levels associated with the higher target sediment levels and, where they would not, has identified the additional volumes of soil removal/backfill that would be necessary to achieve those IMPGs.

Section 5.2.[112] The methodology used to estimate the areal extent and volume of soil removal/backfill for both types of alternatives is summarized in Section 5.4. Each alternative was then evaluated in detail based on the nine Permit criteria (General Standards and Selection Decision Factors) described in Section 2. That evaluation is presented in Section 6.

5.2 Exposure/Averaging Areas

In the HHRA and ERA, EPA divided the floodplain into various areas, over which soil PCB concentrations were averaged to evaluate potential risk.[113] As described in the CMS Proposal, this approach is also applicable for evaluating attainment of IMPGs and thus has been used in the CMS for the assessment of floodplain soil remedial alternatives. This section describes the averaging areas used in the CMS. As discussed in Section 5.1, these averaging areas were used in the development of the IMPG-based floodplain alternatives (FP 2, 3, 4, and 7), but not the threshold-based alternatives (FP 5 and 6). In addition, they have been used in the evaluation of all alternatives in assessing the extent to which each alternative would achieve the IMPGs.

The types of floodplain averaging areas described here include human direct contact exposure areas (Section 5.2.1), farm areas evaluated based on the assessment of human consumption of agricultural products (Section 5.2.2), and separate averaging areas developed for the evaluation of the various ecological receptors (Section 5.2.3) – i.e., amphibians, omnivorous/carnivorous mammals, insectivorous birds, and piscivorous mammals. The development of these averaging areas and the detailed evaluation of IMPG attainment have focused on the floodplain areas within Reaches 5 through 8 for the human health IMPGs and Reaches 5 and 6 for the ecological IMPGs. To evaluate achievement of the IMPGs for these receptor groups in downstream reaches of the floodplain, a general screening-level approach was taken, as described in Section 5.3.

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[112] In addition, Section 5.3 presents a screening-level analysis of IMPG attainment for portions of the Rest of River floodplain where averaging areas were not developed or PCB concentrations are low and data are limited – namely, areas downstream of Rising Pond Dam for human health, and areas downstream of Woods Pond Dam for ecological receptors.

[113] The floodplain for the Rest of River is defined as the area within the 1 mg/kg PCB isopleth in Reaches 5 and 6, and the portion of the 100-year floodplain containing PCBs in reaches below Woods Pond Dam.

5.2.1 Assessment of Human Direct Contact

General Approach

EPA's HHRA divided the floodplain in Reaches 5 through 8 into 90 exposure areas for the assessment of direct human contact with floodplain soils. During the risk assessment, EPA assigned specific exposure scenarios, including assumed age groups for human receptors (e.g., adults, older children), to each of these 90 exposure areas. Several of these areas contain overlying direct contact subareas, which are typically characterized by a different and/or more frequent exposure scenario (e.g., a large exposure area considered for general recreation may contain as a subarea a stretch of soil along the River that is considered for the bank fishing scenario); EPA delineated 30 such subareas within the floodplain in Reaches 5 through 8. The 90 exposure areas and 30s subareas are referred to jointly herein as EAs. A map of the direct contact EAs delineated by EPA is provided on Figures 5-1a (Reaches 5 and 6) and 5-1b (Reaches 7 and 8). In the HHRA, EPA screened out the human direct contact pathway for floodplain soil in Reach 9, as well as reaches farther downstream, so no additional assessment of direct contact was conducted for those reaches in the CMS. Table 5-1 provides a listing of the direct contact EAs, and includes the specific exposure scenario(s) that were assigned to each by EPA. These EAs have been used in the CMS floodplain evaluation for application of the IMPGs based on direct human contact.

The CMS has evaluated all EAs (with two exceptions) based on their current use as described in EPA's HHRA and summarized in Table 5-1.[114] The two exceptions are EAs 21 and 34. EPA designated those areas as agricultural areas (which would require evaluation of direct contact by farmers). In the CMS, these two EAs were evaluated based on recreational use scenarios rather than the farmer scenario. The reason for this change is that, due to a change in ownership, these two EAs are not being used for agricultural purposes, as discussed further in Section 5.2.2. Instead, EA 21 was evaluated for high-use general recreation by adults and older children, and EA 34 was evaluated for intermediate-use general recreation by adults (see Table 5-1).

Frequently Used Areas

As noted in Table 1-2, FP 3 includes removal and backfill of soil to achieve the mid-range human health-based RME IMPGs in certain "frequently used" areas. For direct contact

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[114] Potential future uses of certain EAs (e.g., reasonably anticipated future residential uses of non-residential areas) are anticipated to be addressed, as necessary, through the use of EREs and Conditional Solutions.

exposure, these include such areas as trails, access points, and known recreational areas. The following EAs were identified in the CMS Proposal as frequently used areas:

- EAs 4 and 12 – established foot trails running through both MA Fish & Wildlife land and private land located close to residential properties;
- EA 26a – MA Fish & Wildlife land with trail access and an adjacent parking area;
- EA 35a and 37b – trail along easements running through both private property (EA 35a) and MA Fish & Wildlife land (EA 37b) with an adjacent parking area;
- EA 39 – John Decker Canoe Launch (MA Fish & Wildlife land) and parking area;
- EA 40 – MA Fish & Wildlife land adjacent to the Lenox Sportsman Club property;
- EAs 47, 52, and 53 – River access/canoe launches with corresponding parking areas located along October Mountain Road;
- EAs 57, 58, and 59 – land surrounding Woods Pond with road access; and
- EA 60a – canoe launch adjacent to Woods Pond Footbridge with an adjacent parking area.

Figure 5-2 shows the location of these areas, which are referred to in this report as "Frequent-Use EAs." These areas are also identified in Table 5-1.

In its April 13, 2007 conditional approval letter for the CMS Proposal, EPA directed GE to increase the depth of removal in these Frequent-Use EAs from 1 foot to 3 feet in alternatives FP 3 through FP 7. GE disputed this direction on the basis that, although these EAs are frequently used, it is not "reasonably anticipated" or "realistic" to expect that people would be exposed to soil in these areas to depths below the top foot. Following discussions between GE and EPA, EPA amended its direction in a May 22, 2007 letter, stating that "GE may provide justification for the reclassification of specific areas of the parcels designated as 'heavily used' that would not meet the 'heavily used' designation and therefore would not be subject to the evaluation of 3-ft removal/replacement."

Accordingly, GE delineated only certain subareas within the Frequent-Use EAs as subject to 3-foot removal in FP 3 through FP 7. These subareas (referred to as "Heavily Used Subareas") are displayed on Figures 5-2 and 5-3a-d. As stated above, the Frequent-Use EAs consist of areas such as trails, access points, and known recreational areas. For the purposes of delineating the Heavily Used Subareas, the heavily used portions of the EAs containing trails were defined as approximately 10-foot wide corridors down the center of the trails (due to scale, these are not shown on the maps on Figures 5-2 and 5-3a-d). The heavily used portions of the remaining access points and recreational areas, which consist of easily accessible areas, were defined based on observations from site reconnaissance and aerial photography, as shown on Figures 5-3a-d (e.g., paths/driveways and parking lots associated with canoe launch areas). This procedure also took into account areas mapped by EPA as "difficult access" in the HHRA (also shown on Figures 5-3a-d) by excluding such areas from the delineation. For example, the EPA "difficult access" mapping was used in part to bound the extent of the Heavily Used Subareas within the canoe access points at EAs 47, 52, and 53 (see Figure 5-3c).

In FP 3 through FP 7, the relevant removal criteria under those alternatives – namely, attainment of the pertinent set of direct contact IMPGs for FP 3, FP 4, and FP 7 and the threshold removal concentrations for FP 5 and FP 6 – were applied to the top 3 feet (as well as the top foot) of soil in these Heavily Used Subareas.

5.2.2 Assessment of Agricultural Products Consumption

There are a number of farm areas (or farm areas that are no longer in use) located fully or partially within the floodplain of the Housatonic River. The farm areas located in Reaches 5 through 8, as delineated by EPA in the HHRA, are shown on Figures 5-4a (Reaches 5 and 6) and 5-4b (Reaches 7 and 8). With several exclusions (discussed below), these are the areas that have been used in the CMS for application of the floodplain soil IMPGs based on agricultural products consumption; they are identified herein as FA 1 through FA 14, as shown on Figures 5-4a and 5-4b.

The CMS Proposal stated that the areas designated by EPA as farm areas would be used in the CMS for the evaluation of IMPGs based on agricultural products consumption, unless a given farm area is no longer used or is anticipated to no longer be used for raising farm animals or the growing of crops intended for consumption by humans. Based on these criteria, several of the designated areas in Reaches 5 and 7 have been excluded from agricultural products consumption evaluations in the CMS.

First, several "farm areas" have a use category, as identified by EPA in the HHRA, that is not associated with agricultural products consumed by humans and were therefore, not included in the CMS evaluation.[115] The use categories not associated with the production of agricultural products consumed by humans consist of those identified by EPA as “wetland,” “open land/wetland,” “open land,” “horse,” and “not in use”; farm areas with these use designations are identified on Figure 5-4b (with hatching) as “Farm Area Not in Agricultural Use.”

Second, there are three areas identified as farms in the HHRA for which GE has determined that no current or future agricultural use within the floodplain is anticipated, and which have thus been excluded from the evaluations of agricultural product consumption in the CMS:

- For the two farms located in the PSA (Figure 5-4a) that include direct contact EAs 21 and 34 (see Figure 5-1a), GE has purchased the portions of those areas located within the floodplain and will maintain those areas as open land with no agricultural use (these areas are labeled as “Not in Use” on Figure 5-4a). For the northern such farm in the PSA, the remaining area of farm field (not owned by GE) is located completely outside the floodplain, and therefore was not evaluated in the CMS.

- There is also an area located in Reach 7 that EPA classified as “beef cattle grazing” in the HHRA. GE’s discussions with the then-owner of this property in 2006 indicated that this property was actually an estate where a few cattle were raised as domesticated animals and were not intended for human consumption. Since that time, this property has been sold. In these circumstances, this property is not currently used or anticipated to be used in the future for the classification of “beef cattle grazing” that was assigned to that area by EPA in the HHRA (this area is labeled and designated as “Not in Use” on Figure 5-4b).

For the purposes of the CMS evaluation, individual farm averaging areas were defined based on land ownership and parcel boundaries. For example, one farm polygon (as defined by EPA in the HHRA) may have been split into two averaging areas if that particular polygon spanned two parcels having different ownership.[116] In contrast, if one farm polygon spanned two or more parcels with the same owner, the entire farm polygon was used as the averaging area. In some cases, two or more farm polygons are located within a single parcel boundary; in this case, all polygons having the same owner and use type were combined into a single

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[115] It is assumed that potential future use of these floodplain properties, as well as non-farm properties, for agricultural purposes associated with human consumption would be addressed, as necessary, by EREs and/or Conditional Solutions.

[116] One exception to this approach is the farm area designated FA 2 (shown on Figure 5-4a). In this case, the farmed area spans multiple parcels having different owners, but has been combined into a single averaging area since GE’s discussions with the owners has indicated that the area is farmed as one continuous field.

averaging area. In the case where separate farm polygons having the same owner had different use types (i.e., "vegetables" in one polygon versus "hay" in another), the averaging areas were separated based on use type since different IMPGs would be applied to each area. Figures 5-4a and 5-4b show the individual averaging areas (i.e., labeled as FA 1 through FA 14 and shaded in unique colors) that have been used for CMS evaluation of farm areas.

Table 5-2 provides a summary of the 14 agricultural averaging areas within Reaches 5 through 8 that have been used in the CMS. As shown in the table, all of these areas have EPA use classifications of either "hay," "corn/silage," or areas of "open land" (which is then described as either "possibly hay" or "formerly grazing" areas). Given these use classifications, for the purposes of evaluating agricultural product consumption in the CMS, all these farm areas in Reaches 5 through 8 were assigned to the "commercial dairy" IMPG category based on the assumption that all these areas provide feed (or could potentially provide feed) for commercial dairy cows.

The floodplain soil IMPG levels for commercial dairy farms were shown in Table 2-8. As discussed in Section 2.2.2.3, those levels were derived based on the assumption that the entire portion of the agricultural land is located within the floodplain. For the agricultural product consumption assessments, as described in the CMS Proposal, only the portions of agricultural fields within the floodplain are considered areas of potential exposure. To account for the fraction of a given farm area that is located outside the floodplain, the floodplain soil IMPGs shown in Table 2-8 have been adjusted by a weighting factor. For example, for a farm with 80% of the total cropland or grazing land located within the floodplain, the initially calculated soil IMPG levels shown in Table 2-8 were divided by a factor of 0.8 to determine a farm-specific IMPG value. Table 5-2 shows, for each farm area considered in the CMS, the adjusted target floodplain soil levels that have been calculated from the commercial dairy IMPGs in Table 2-8, based on application of the pertinent weighting factor for that farm area. These adjusted soil levels have been used in the CMS in the evaluation of IMPGs for the applicable farm areas.

In addition to those farm areas identified in Reaches 5 through 8, the HHRA identified several farm areas in Reach 9. A more general, screening-level evaluation has been conducted for the farms located in this reach and is described in Section 5.3.1.

5.2.3 Assessment of Ecological Receptors

This section describes the averaging areas that were used for the evaluation of the ecological receptor groups subject to IMPGs for floodplain soil – i.e., amphibians, omnivorous/carnivorous mammals, insectivorous birds, and piscivorous mammals.

5.2.3.1 Amphibians

As discussed in GE's revised IMPG Proposal (GE, 2006), the PCB IMPGs for amphibians (3.27 to 5.6 mg/kg) were based on an assessment of potential risks to wood frogs as the representative species for this receptor group. As relevant to the floodplain, these IMPGs apply to the sediments of vernal pools in the floodplain.[117] As stated in the CMS Proposal, EPA's database identifies 68 vernal pools (including both temporary and permanent pools) in the floodplain of the PSA; the vernal pools located within the PSA are shown on Figure 5-5. Two of these 68 vernal pools are located upstream of the Confluence (IDs 5-VP-1 and 5-VP-2) and therefore have not been considered in the CMS. Also, while EPA's ERA states that only 27 of these vernal pools were identified as suitable breeding habitat for wood frogs, to be conservative and since the amphibian IMPGs apply to species other than wood frogs, GE has included the 66 EPA-identified vernal pools located within the PSA in the CMS evaluation for amphibians.

In the CMS Proposal, GE proposed to use EPA's wood frog population model, with certain modifications, to evaluate which of the vernal pools would require remediation in order to protect the local amphibian population in the PSA. However, in its April 13, 2007 conditional approval letter, EPA directed GE not to use the wood frog population model for this purpose (Condition # 13), and it reaffirmed that directive in its May 22, 2007 letter.

GE does not agree with that directive.[118] However, given EPA's directive not to use the model as proposed, the amphibian IMPGs have been applied to each of the 66 vernal pools in the PSA. Thus, both for purposes of developing floodplain remedial alternatives designed to achieve the upper or lower bound of the amphibian IMPGs and for purposes of evaluating whether a given alternative would achieve the amphibian IMPGs, each of the 66 vernal pools was treated as a separate averaging area.

For reaches downstream of the PSA, EPA did not identify specific vernal pools within the floodplain of the Housatonic River. For these areas, a general screening-level evaluation of floodplain vernal pools has been performed, as described in Section 5.3.2.

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[117] As discussed in Section 4, amphibian IMPGs were also evaluated for the sediments in backwater regions of the River.

[118] As discussed in Section 2.1.1 and recognized in EPA guidance (EPA, 1999a), the objective of ecologically based remediation is to protect local populations and communities of biota. As discussed in the CMS Proposal, GE believes that use of EPA's wood frog population model, with modification and application to all 66 vernal pools, provides a reasonable method of evaluating the effects of floodplain remedial alternatives both on the local wood frog population and the broader amphibian population in the PSA. The reasons for GE's position are set forth in more detail in GE's April 27, 2007 Statement of Position in its dispute on EPA's April 13, 2007 letter.

5.2.3.2 Omnivorous/Carnivorous Mammals

As discussed in GE's revised IMPG Proposal (GE, 2006), the soil IMPGs for omnivorous and carnivorous mammals (21.1 to 34.3 mg/kg) were based on an assessment of potential risks to northern short-tailed shrews (*Blarina brevicauda*, referred to hereafter as shrews), which EPA selected as the representative species for this receptor group. The CMS Proposal noted that the habitat for shrews coincides with much of the floodplain, and thus GE proposed to use the overall portion of the floodplain in the PSA that provides suitable shrew habitat as a single averaging area for evaluating attainment of the IMPGs for shrews. In its April 13, 2007 conditional approval letter, EPA directed GE not to use the overall floodplain as a single averaging area for evaluating the effectiveness of floodplain remedial alternatives to protect shrew populations. EPA stated that, although shrew habitat is widespread throughout the floodplain, the home ranges of shrews are much smaller, and thus averaging over the entire floodplain "may result in an alternative being considered protective when, in fact, some shrew populations may remain impacted" (Condition #79). Instead, EPA directed GE to develop averaging areas that "relate specifically to the appropriate habitats, home ranges, and/or foraging ranges for the receptor species" for which the IMPGs were established (Condition #81).

Based on the habitat descriptions provided by EPA's consultants, the majority (~80%) of the floodplain within the PSA contains suitable habitat for shrews, as shown on Figure 5-6a.[119] Shrew habitat is contiguous throughout that area without significant natural boundaries. In these circumstances, GE does not agree with EPA's directive in its conditional approval letter.[120]

However, given that directive, GE has developed an alternative approach to establishing averaging areas for shrews within the PSA floodplain. As required by EPA, this approach takes into account the habitats, home ranges, and foraging ranges of shrews, but is still focused on protecting local shrew populations, consistent with EPA guidance (EPA, 1999a). This approach is based on conservation principles, in which the area necessary to sustain a "minimum viable population" (MVP) of the animals in question is determined. Specifically, this approach has involved: (1) estimating the size of the MVP of shrews; (2) determining the size

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[119] Shrew habitat is described by Woodlot (2002), pp. 6-24 - 6-25. Figure 5-6a is based on a map of shrew habitat provided by EPA to GE, modified to eliminate areas that are permanently under water.

[120] Shrews populate most of the floodplain, and the shrew population within the floodplain is not divided into biologically discrete or distinct population segments. Rather, it is one large, contiguous local population that is part of a larger population in the Appalachian Mountains (Brant and Ortí, 2003). In this situation, given the objective to protect local populations and communities of biota, GE believes that it would be appropriate to consider the entire area shown as shrew habitat on Figure 5-6a as the averaging area for evaluating protection of the local shrew population.

of areas within the floodplain that would sustain such an MVP, based on the foraging/home range of shrews; and (3) establishing defined areas of shrew habitat within the floodplain with a size equivalent to that determined in the prior step, and then using those defined areas as the averaging areas for application of the IMPGs. These concepts are discussed further below.

Area of Minimum Viable Population

As stated above, the shrew population is contiguous in the PSA. Thus, creation of spatial averaging areas to protect smaller local "population subunits" in the PSA must rely on either (1) arbitrarily defined boundaries or (2) boundaries based on conservation principles. For present purposes, we have used a conservation-based approach involving determination of the size of areas required to sustain an MVP. By definition, an MVP for any given species is the smallest isolated population having a strong (i.e., 90 to 99%) chance of remaining extant for a long period of time (i.e., 100 to 1,000 years) despite the foreseeable effects of demographic, environmental, and genetic stochasticity, and natural catastrophes (Shaffer, 1981; Thomas, 1990). The U.S. Fish and Wildlife Service (USFWS) recovery plan guidelines for threatened and endangered species require recovery goals that consider this long-term viability concept (USFWS, 1990). Many recovery plans (e.g., grizzly bear, emerald dragonfly, gray wolf) have set local population targets equivalent to general MVP sizes recommended in the conservation biology literature or developed from population viability models that are species-specific.

Using the MVP to define the size of the averaging area provides a basis for defining independent population subunits that are viable through time, even if they become isolated from the larger population by events such as fires or flooding. The use of the MVP approach in guiding remediation is extremely conservative because it assumes each MVP population subunit is isolated and must be sufficiently robust to sustain itself through major random events. In reality, each individual shrew MVP averaging area is not isolated and all would contribute to an interchangeable supply of animals. The approach essentially ensures that the large local population of shrews, which are already abundant in the floodplain (Woodlot, 2002; Boonstra and Bowman, 2003), continues throughout the floodplain.

Selection of a Minimum Viable Population Size

The MVP size for shrews was selected based on the population size needed to maintain demographic stability (i.e., to avoid crashing to low population levels), not genetic variability (which would be larger). The conservation biology literature was reviewed to determine recommended sizes of an MVP. Lehmkuhl (1984) recommended an MVP of 500 animals for vertebrates to attain long-term persistence of the population. Thomas (1990) similarly recommended no less than 500 animals, based on his model simulations of bird and mammal populations averaging a 1.2-order of magnitude variability, a magnitude frequently observed over 50-year periods. Five-hundred animals met Thomas' definition of an MVP as the geometric mean number of animals in a population that fell below 100 animals only once every 100 years during his simulations. He used 100 as the threshold because, below 100, animals frequently fall into an extinction vortex. Overall, based on empirical evidence, Thomas recommended that 1,000 animals is conservative and adequate to attain demographic stability for species that do not have extremely high fluctuations in population size through time, which appears to be true of the shrew (see Getz, 1989; Lima et al., 2002).

No recommended MVP for shrews was found in the literature, and in general MVPs were difficult to find for small, placental mammals. One was found for the spiny rat (*Tinomys eliasi*) in South America. Based on the results of a population viability model for that species, Brito and Figueiredo (2003) recommended an MVP of 200 rats to maintain demographic stability and 2000 rats to maintain genetic variability. To err on the conservative side for maintaining population viability, 500 shrews was selected as the MVP unit to be used for calculating the size of the averaging areas. This number is more appropriate than the 200 developed for the spiny rat because it is based on analyses (i.e., Lehmkuhl, 1984; Thomas, 1990) of mammals that include the omnivorous and carnivorous small mammal species that the shrew represents for application of the IMPGs.

Application of MVP Size and Foraging/Home Range To Determine Size of Averaging Areas

Having determined the size of the MVP, the next step was to determine the size of areas that would support that MVP, taking into account the foraging and home ranges of shrews. According to the ERA (EPA, 2004e, p. J-6), shrews have home range sizes of 0.024 hectares (ha) to 0.07 ha in areas of high prey density, and 0.1 to 0.2 ha in areas of low prey density during non-breeding periods in winter. Assuming that the former estimates would apply during the breeding season (spring, summer, and fall) when food is more plentiful, and that the latter estimates apply only in winter, the averages of these values can be seasonally weighted to yield a mean yearly home range size of ~0.07 ha. Assuming no overlap of home ranges (since shrews are highly territorial), this represents an estimated year-round density of approximately 14 shrews/ha. Based on this estimate, the size of an area required to support an MVP of 500 animals is about 35 ha (500 shrews/14 shrews per ha = 35.7 ha).

Establishment of Averaging Areas

Based on the above estimates, cells of ~ 35 ha each were overlaid on the floodplain in the PSA, excluding areas of unsuitable shrew habitat and bounded laterally by the 1 mg/kg PCB isopleth. These cells (as well as the excluded areas of unsuitable shrew habitat) are shown on Figure 5-6b. These cells have been used as the averaging areas in the PSA for evaluating attainment of the IMPGs for omnivorous/carnivorous mammals. For a given floodplain remedial alternative, the spatial average PCB concentration in each cell has been compared to the upper or lower bound of those IMPGs (as appropriate) to identify which cells exceed those IMPG values.

For areas downstream of the PSA, where such cells have not been defined and the floodplain PCB data are less dense, a more general comparison has been made of PCB concentrations in various portions of the floodplain to the IMPGs for omnivorous/ carnivorous mammals, as described in Section 5.3.3.

5.2.3.3 Insectivorous Birds

As discussed in GE's revised IMPG Proposal (GE, 2006), the underlying PCB IMPG for insectivorous birds was based on an assessment of potential risks to wood ducks as the representative species for this receptor group. Further, as discussed in Section 2.2.2.3, since this IMPG applies to PCB concentrations in the aquatic and terrestrial invertebrate prey of wood ducks, GE has developed target floodplain soil concentrations associated with that IMPG, based on achieving certain specified target sediment concentrations. Those target floodplain soil concentrations, which vary by subreach within the PSA (i.e., Reaches 5A, 5B, 5C/D, and 6), are described in Section 2.2.2.3 and Appendix B to this Report. This section describes the averaging areas to which those target soil concentrations have been applied in the CMS.

The CMS Proposal proposed to apply the target floodplain soil concentrations for protection of wood ducks over the entire portion of the floodplain within the PSA. However, in is April 13, 2007 conditional approval letter, EPA directed GE to use smaller averaging areas. EPA stated, based on the ERA, that "[t]he foraging range of wood duck is approximately 1 km from their nest site," that therefore averaging of PCB concentrations over the entire PSA "is inappropriate," and that GE must "use appropriately smaller subareas" in evaluating whether remedial alternatives would achieve the target levels for protection of wood ducks (Condition # 46).

Again, GE does not agree with that directive.[121] However, in response to EPA's directive, GE has developed smaller averaging areas for application of the wood duck target levels. In this

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[121] Although a few limited segments of the PSA contain poor or marginal wood duck habitat (as discussed below), given the high mobility of birds, disconnections between areas of suitable habitat within the PSA would not create boundaries between distinct local populations. Thus, it is not realistic to assume that the PSA wood duck population is divided into biologically discrete or distinct population segments. In these circumstances, given the objective to protect local populations and communities of biota, GE continues to believe that the PSA represents the most appropriate averaging area for evaluating impacts on the local wood duck population.

case, GE has developed such areas based on the foraging range of an individual wood duck. While this approach is clearly over-conservative, it has been used as a simple means of complying with EPA's directive.

Reported sizes of home ranges and foraging ranges for wood ducks are quite variable, depending upon habitat quality, season, gender, breeding status, and region.[122] However, for present purposes, GE has used the 1-km foraging range (for pre-incubating females) identified in EPA's April 13, 2007 letter based on the ERA. Based on this foraging range, GE has established averaging area boundaries every 1 km within the PSA, such that the averaging areas range from 16 to 49 ha (40 to 120 acres) and average 36 ha (90 acres). These averaging areas are shown on Figure 5-7. Even for an individual wood duck, such averaging areas are conservative compared with the estimates from the literature.[123]

Within these 1-km averaging areas, limited subareas that lack suitable wood duck habitat have been excluded. While the vast majority of the PSA offers habitat that is suitable for wood ducks, the ERA's natural area designations have been used to judge microhabitat suitability within the PSA. Attachment C (Species: Habitat Matrix) to Woodlot's (2002) Ecological Characterization Report indicates that the following types of areas are not inhabited by wood ducks (either during the breeding season or year-round): high-gradient stream, spruce-fir-Northern hardwood forest, Northern hardwoods-hemlock-white pine forest, cultural grassland, agricultural cropland, and residential development. Such areas are marked in gray on Figure 5-7 and have been excluded from consideration in the evaluations of achievement of the target levels for protection of wood ducks.

Thus, in assessing whether particular floodplain remedial alternatives would achieve the wood duck IMPG, GE has utilized the averaging areas shown on Figure 5-7 for the PSA. Specifically, for a given floodplain remedial alternative, the spatial average PCB concentration

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[122] For example, in southern Illinois, fall home ranges averaged 91 ha (225 acres) (range = 24-186 ha or 59-460 acres) (Parr et al., 1979). Costanzo et al. (1983) reported that winter home ranges were larger for males (42.3 ha or 105 acres; n = 5) than for females (12.0 ha or 30 acres; n = 5). Gilmer et al. (1978) reported an average home range of 169 ha (418 acres; n = 2) for breeding pairs and 87 ha (215 acres) for incubating females (n = 14). Cottrell et al. (1990) reported that home range of females with broods averaged 46.1 ha (114 acres) in Tennessee (n = 34), while Hepp and Hair (1977) reported average home ranges of 12.5 ha (31 acres) in South Carolina (SD = 11.0, range = 0.8–29.6 ha or 2-73 acres, n = 7). The U.S. Forest Service (USFS) (1971) reported that the daily foraging radius for wood ducks in the southeastern United States may be as much as 40 to 48 km (25 to 30 mi), which corresponds to an area of about 500,000 to 700,000 ha (1.2 to 1.8 million acres); these values are outliers relative to the other literature reports.

[123] The median of the reported average home range areas listed in the prior note, excluding the USFS outlier values, is 44 ha (109 acres), compared to a range of 16 to 49 ha for the averaging areas associated with a 1-km foraging range.

in each such averaging area has been compared to the applicable target floodplain soil level for the subreach in which that area is located, based on selected assumptions about the sediment concentration in the same averaging area. For example, using the target levels identified in Section 2.2.2.3 and Appendix B, if it is assumed that the sediment PCB concentration in a given averaging area in Reach 5A is or will be less than 1 mg/kg, then a floodplain soil concentration less than 50 mg/kg in that area would be considered to achieve the IMPG for wood ducks.

For areas downstream of the PSA, where specific averaging areas have not been identified and the floodplain PCB data are less dense, a more general comparison has been made of PCB concentrations in various portions of the floodplain to the target floodplain soil concentrations based on these IMPGs, as discussed in Section 5.3.4.

5.2.3.4 Piscivorous Mammals

As discussed in GE's revised IMPG Proposal (GE, 2006), the underlying IMPGs for piscivorous mammals were based on an assessment of potential risks to mink as the representative species for this receptor group. Further, as discussed in Section 2.2.2.3, since these IMPGs apply to PCB concentrations in the aquatic and terrestrial prey of mink, GE has developed target floodplain soil concentrations associated with the upper and lower bounds of those IMPGs, based on achieving certain specified target sediment concentrations (1, 3, and 5 mg/kg). Those target floodplain soil concentrations are described in Section 2.2.2.3 and Appendix C to this Report. As discussed there, at EPA's direction, separate target floodplain soil concentrations have been developed for: (1) Reaches 5A and 5B; and (2) Reaches 5C, 5D (the backwaters), and 6. This section describes the averaging areas to which those target soil concentrations have been applied in the CMS.

The CMS Proposal Supplement proposed to apply the target floodplain soil concentrations for protection of mink over the entire floodplain within the PSA. In addition, given that mink are wide-ranging predators and thus are likely to forage not only within the 1 mg/kg PCB isopleth, but also along tributaries and other areas outside that isopleth, GE proposed to adjust the target floodplain soil levels to account for the proportion of the mink's foraging range outside the 1 mg/kg isopleth. However, in its July 11, 2007 conditional approval letter, EPA directed GE: (1) not to use the entire PSA as the averaging area for application of these levels, but rather to use averaging areas that are no larger than subreaches; and (2) not to adjust the target levels to account for foraging outside the 1 mg/kg isopleth. GE invoked dispute resolution on these directives. In response, EPA issued a letter dated August 29, 2007, revising its first directive to require use of two averaging areas within the PSA – one consisting of Reaches 5A and 5B and the other consisting of Reaches 5C, 5D, and 6. However, EPA retained the requirement to limit the EA to the area within the 1 mg/kg isopleth.

GE continues to believe that the approach outlined in the CMS Proposal Supplement was appropriate.[124] However, given EPA's directives in its July 11 and August 29, 2007 letters, GE has used the two averaging areas specified by EPA – one consisting of Reaches 5A and 5B and one consisting of Reaches 5C, 5D, and 6 (shown on Figure 5-8) – for application of the target floodplain soil concentrations associated with the mink IMPGs, with no adjustments for foraging beyond the 1 mg/ kg isopleth. Specifically, for a given floodplain remedial alternative, the PCB concentration in each such averaging area has been compared to the applicable target floodplain soil levels, based on assumptions about the sediment concentration in the same averaging area. For example, using the target levels identified in Section 2.2.2.3 and Appendix C, if it is assumed that the sediment PCB concentration in Reaches 5A/5B is or will be less than 1 mg/kg, then a floodplain soil concentration of 16.6 mg/kg or less in that area would be considered to achieve the upper-bound IMPG for mink and a floodplain concentration of 3.4 mg/kg would be considered to achieve the lower-bound IMPG.

For areas downstream of the PSA, where specific averaging areas have not been identified and the floodplain PCB data are less dense, a more general comparison has been made of the PCB concentrations in the floodplain with the target floodplain soil concentrations based on the mink IMPGs, as described in Section 5.3.5.

5.3 Assessment of Achievement of Human and Ecological Receptor IMPGs in Downstream Reaches

In floodplain areas downstream of those described in the preceding sections, GE has conducted general screening-level evaluations of whether the floodplain soil PCB concentrations would achieve the IMPGs. This section describes those evaluations. For the human health IMPGs, this evaluation focuses on agricultural products consumption in farm areas downstream of Reach 8. (As noted above, risks associated with human direct contact with floodplain soil in reaches downstream of Reach 8 were screened out by EPA in the HHRA, and hence are not reevaluated here.) For the ecological receptor IMPGs, these screening evaluations focus primarily on Reach 7, where the majority of the downstream data

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[124] The reasons for GE's position are set forth in its July 25, 2007 Statement of Position in the dispute resolution proceeding on EPA's July 11, 2007 letter. In brief, given the fairly large foraging or home ranges of mink, the PSA could support, at most, only a subset of the local mink population. Moreover, it is reasonable to expect that mink utilizing the PSA would also use areas outside the 1 mg/kg isopleth (e.g., areas near the shoreline but outside that isopleth and areas along tributaries) as part of their foraging range. In its August 29, 2007 letter, EPA asserted that it is reasonable to limit the mink exposure area to within the 1 mg/kg isopleth because approximately 90% of the mink diet is from the aquatic environment. However, the target floodplain soil levels are based on the terrestrial, not aquatic, portion of the mink's diet.

were collected, utilizing the EPA-designated subreaches in that reach (i.e., Reaches 7A through 7H).

5.3.1 Agricultural Products Consumption

As discussed in Section 5.2.2, the HHRA identified various farm areas (approximately 65) within the floodplain of Reach 9 (downstream of Rising Pond Dam). Given the limited floodplain soil PCB data in these farm areas, a general screening-level approach was conducted to assess agricultural products consumption for the types of farms located in this reach, using all available surficial floodplain PCB data (0- to 6-inch or 0- to 12-inch) within Reach 9. Within Reach 9, these data indicate that surficial floodplain soil PCB concentrations range from 0.02 mg/kg to 1.7 mg/kg, and average approximately 0.46 mg/kg, with a 95% UCL on the mean of 0.50 mg/kg (based on the non-parametric Halls Bootstrap method).

Based on the use types identified by EPA in the HHRA, there are three types of farm areas located within the Reach 9 floodplain that are relevant to the IMPGs based on human consumption of agricultural products: “commercial dairy,” “commercial vegetable,” and “commercial poultry”; the locations of these farm areas in Reach 9 are shown on Figure 5-9. Based on the Reach 9 floodplain data summarized above, the entire range of surface soil PCB concentrations in Reach 9 are below all “commercial dairy” IMPGs, with the exception of the RME level based on a cancer risk of 10^{-6} (0.24 mg/kg; see Table 2-8), and are also below the lowest RME IMPG for human consumption of “exposed vegetables” and “root vegetables” (13.3 mg/kg and 100 mg/kg, respectively; see Table 2-8). Based on this screening comparison, floodplain soil PCB concentrations in Reach 9 are sufficiently low that the IMPGs for “commercial dairy” and “commercial vegetable” farms would be expected to be met in the applicable averaging areas within that reach.

With respect to “commercial poultry” farms, only one such farm has been identified in Reach 9 (shown on Figure 5-10); this farm sells poultry meat. A refined evaluation was conducted for this property. No floodplain soil samples have been collected within this farm property itself; therefore, samples collected within a distance of approximately one mile were selected as representative of that area. In this analysis, the data were segregated into groups of samples located within the 10-year and 100-year floodplains, as these areas are indicative of the relative depositional frequency of PCBs.[125] Spatially weighting these data by the fraction of the poultry farm within these floodplain areas resulted in an area-weighted average floodplain

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[125] Note that the 10-year floodplain was delineated in this area based on flood profile elevations published by the Federal Emergency Management Agency (FEMA) and 10-meter resolution Digital Elevation Model (DEM) data from USGS (see Figure 5-10).

soil PCB concentration of 0.21 mg/kg. This value is within the range of IMPGs (both cancer and non-cancer) considered protective for the consumption of poultry meat (see Table 2-8).

Below Reach 9 (in the Connecticut portion of the River), EPA collected seven near-shore samples from a few select areas of the floodplain. Four of these samples had non-detect PCB concentrations, and the maximum detected value was 0.037 mg/kg, which is much lower than the range of agricultural products consumption IMPGs.

Given the results described above, no additional assessment for agricultural products consumption IMPGs in the floodplain was conducted for Reach 9 and areas further downstream.

5.3.2 Amphibians

To evaluate attainment of the amphibian IMPGs for vernal pools located in floodplain reaches downstream of Woods Pond Dam, a GIS data coverage of vernal pools (compiled as part of the Natural Heritage and Endangered Species Program [NHESP]) was obtained from the State of Massachusetts MassGIS database, and used to identify vernal pools in those downstream reaches. The NHESP dataset used in this evaluation contains both "certified" and "potential" vernal pools located within Massachusetts. According to this data set, there are only three "certified" vernal pools (i.e., pools that have been field verified to function biologically as vernal pools [NHESP, 2007]) within the floodplain of Reach 7. An additional 18 "potential" vernal pools (i.e., areas that have been interpreted as vernal pools from aerial photographs, but have not been field verified [NHESP, 2007]) were also identified within the Reach 7 floodplain. Conservatively, both certified and potential vernal pools have been included in this evaluation; these are shown on Figure 5-11.[126]

As shown on Figure 5-11, the NHESP data set represents vernal pools as individual points (not polygons); therefore, they could not be treated as individual averaging areas as was done in the PSA evaluation. In addition, few floodplain soil PCB data points were located in close proximity to the vernal pools in Reach 7. Therefore, a general screening-level approach was taken, whereby all of the available surface soil (0- to 6-inch or 0- to 12-inch) floodplain PCB data within each of the Reach 7 subreaches that contain NHESP-identified certified or

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[126] While additional vernal pools were identifed in reaches downstream of Rising Pond Dam, the sparse nature of the floodplain soil PCB data in the vicinity of these pools precluded an evaluation in these further downstream reaches. In any event, the maximum surficial (0- to 6 inches) floodplain soil PCB concentration downstream of Reach 8 is 1.7 mg/kg (RFI Report, Table 5-7), which is below the lower-bound amphibian IMPG of 3.27 mg/kg. For these reasons, the evaluation of amphibians downstream of the PSA focused on Reach 7.

potential vernal pools (i.e., 7A, 7D, and 7F; see Figure 5-11) were deemed to be generally representative of the likely PCB concentrations in those subreaches, including the vernal pools within them, and were thus compared to the applicable wood frog IMPGs.

For this comparison, the 95% UCL (computed using the Halls Bootstrap method) on the mean of the floodplain data was calculated for each of these three subreaches containing vernal pools, and was compared to both the upper and lower bound of the amphibian IMPGs (5.6 mg/kg and 3.27 mg/kg, respectively) (see Table 5-3a). For all three Reach 7 subreaches containing vernal pools, the 95% UCLs were below the lower-bound amphibian IMPG. In these circumstances, no additional assessment for amphibians was conducted for floodplain reaches downstream of the PSA during the CMS.

5.3.3 Omnivorous/Carnivorous Mammals

Similar to the evaluation for amphibians, existing surficial floodplain soil PCB concentrations in Reach 7 were compared to the IMPGs for omnivorous/carnivorous mammals (represented by shrews). Since mapping of shrew habitat is not available to delineate specific averaging areas in Reach 7, this comparison was conducted for each of the Reach 7 subreaches defined by EPA (i.e., 7A through 7H). For this comparison, the 95% UCL on the mean of the floodplain data calculated for each subreach was compared to both the upper- and lower-bound IMPGs (34.3 mg/kg and 21.1 mg/kg, respectively) (see Table 5-3a). For all of the Reach 7 subreaches, the 95% UCLs were below the more conservative lower-bound shrew IMPG.[127] Accordingly, no additional assessment of attainment of the IMPGs for omnivorous/carnivorous mammals was conducted for floodplain reaches downstream of the PSA.

5.3.4 Insectivorous Birds

To assess achievement of the IMPGs for insectivorous birds (represented by wood ducks) in downstream reaches, existing surficial floodplain soil PCB concentrations in Reach 7 were compared to the target floodplain soil levels developed to achieve those IMPGs. Again, in the absence of specific wood duck averaging areas for Reach 7, this comparison was conducted for each of the Reach 7 subreaches defined by EPA. However, as described in Section 2.2.2.3 (and shown in Table 2-9), subreach-specific target soil levels were only developed for wood duck in the PSA – not for downstream reaches. Also, since wood ducks derive a portion of their diet from food sources located in both the River and the floodplain, the

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[127] As the area of floodplain within Reach 8 is relatively limited, that area was excluded from this assessment. In Reach 9, the maximum surficial floodplain soil concentration is 1.7 mg/kg, and the levels observed in the Connecticut portion of the floodplain are much lower. These levels are far below the lower bound of the IMPGs for omnivorous/carnivorous mammals (21.1 mg/kg).

floodplain soil levels that would achieve the wood duck IMPGs vary depending on the associated sediment level. In this situation, a target floodplain soil IMPG level was assigned to each of the Reach 7 subreaches by: (1) using, for each such subreach, the set of target soil IMPG levels developed for the PSA subreach that EPA considered "ecologically analogous" to that Reach 7 subreach in Table 3.6-9 of the EPA FMDR; and (2) using the EPA model end-of-validation average surface sediment (0- to 6-inch) PCB concentration in the pertinent Reach 7 subreach (rounded to the closest target sediment concentration -- i.e., 1, 3, or 5 mg/kg). For example, since EPA's FMDR considers Reach 7A analogous to Reach 5A, the target soil IMPG levels for Reach 5A were used for Reach 7A; and since the the average sediment concentration in Reach 7A was 0.41 mg/kg, the target soil IMPG level for Reach 5A that is associated with a target sediment level of 1 mg/kg was selected for Reach 7A (i.e., 50 mg/kg; see Table 5-3b).

The resulting target floodplain soil IMPG levels used for the Reach 7 subreaches (as well as the analogous subreaches and average sediment concentrations used in determining those levels) are shown in Table 5-3b. That table also gives the 95% UCL PCB concentrations for the Reach 7 subreaches. As shown in that table, the floodplain soil 95% UCLs in all of the Reach 7 subreaches are below the applicable target soil IMPG levels for wood duck.[128] Accordingly, no additional assessment of attainment of the IMPGs for insectivorous birds was conducted for floodplain reaches downstream of the PSA.

5.3.5 Piscivorous Mammals

Similar to the evaluation for wood duck in reaches downstream of the PSA, the assessment of achievement of the IMPGs for piscivorous mammals (represented by mink) in downstream reaches was made by comparing existing surficial floodplain soil PCB concentrations in Reach 7 to the target soil levels developed to achieve those IMPGs. Again, in the absence of specific averaging areas for Reach 7, this comparison was conducted for each of the Reach 7 subreaches defined by EPA. Similar to the target floodplain soil levels developed to achieve the wood duck IMPGs, the target floodplain soil levels developed to achieve the mink IMPGs were developed only for the PSA, and vary both by subreach and by the associated sediment target level. Given this, representative floodplain soil target IMPG levels for each of the Reach 7 subreaches were selected using the same procedure as for the wood duck (i.e., target soil IMPG levels were selected based on analogous PSA subreaches and on average end-of-validation surface sediment PCB concentrations predicted by the EPA model).

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[128] As noted above, for floodplain areas downstream of Reach 7, the surficial soil concentrations are all 1.7 mg/kg or less, which is well below the lowest soil IMPG level for wood duck (18 mg/kg for Reach 5B at the 5 mg/kg target sediment level).

The resulting target floodplain soil IMPG levels used for the Reach 7 subreaches (as well as the analogous subreaches and average sediment concentrations used in determining them) are shown in Table 5-3b. That table also compares the 95% UCL PCB concentrations for the Reach 7 subreaches to those levels. With the exception of one subreach in Reach 7 (7C), the 95% UCLs are below the applicable upper-bound floodplain soil IMPG levels for mink in all subreaches evaluated. In addition, the 95% UCLs in four subreaches (7A, 7D, 7E, 7F) are below the applicable lower-bound floodplain soil IMPG levels for mink. Further, the one subreach that would not achieve either bound of the range (Reach 7C) at the specified target sediment concentration (5 mg/kg) is much smaller than the EPA-specified mink averaging areas in the PSA. That subreach spans approximately 0.8 miles of River and covers an area of approximately 20 acres, whereas the mink averaging areas specified by EPA for the PSA span 4 to 7 miles of River and cover areas of 300 to 450 acres (see Figure 5-8). Given that the two subreaches adjacent to Reach 7C (i.e., 7B and 7D) have 95% UCLs within or below the range of floodplain soil IMPG levels (Table 5-3b), it is likely that those IMPG levels would be met in this region if an averaging area comparable in size to those in the PSA were used. In these circumstances, it is reasonable to conclude that floodplain soil PCB concentrations throughout Reach 7 would achieve levels within the range of the IMPGs for mink.[129]

Given the evaluations above, no additional assessment of attainment of the IMPGs for piscivorous mammals was conducted for floodplain reaches downstream of the PSA.

5.4 Determination of Areal Extent and Removal Volumes

This section provides a brief description of the approach and procedures used to estimate the areal extent and volume of floodplain soil to be removed under the floodplain remedial alternatives. A more detailed description of these procedures was provided previously as Appendix D to the CMS Proposal.

5.4.1 Overview

As described in Appendix D to the CMS Proposal, a spatially interpolated representation of the floodplain soil PCB data – based on the use of Thiessen polygons modified by natural community boundaries (EPA's "super habitats") in the PSA and by elevation in Reaches 7 and 8 – was developed to provide a continuous coverage of PCB concentrations over the floodplain within Reaches 5 through 8. The resulting floodplain soil PCB coverage

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[129] As noted previously, the surficial soil concentrations in floodplain areas downstream of Reach 7 are all 1.7 mg/kg or less. Furthermore, the surface sediment data from Reach 9 and the Connecticut portion of the river are generally 1 mg/kg or lower (i.e., see Table 4-9 of the RFI Report). Thus, the floodplain levels are below the lowest floodplain soil IMPG level for mink at that sediment level (3.42 mg/kg for Reach 5A/B; see Table 2-10).

interpolated from the 0- to 1-foot data is shown on Figures 5-12a (Reaches 5 and 6) and 5-12b (Reaches 7 and 8). Using this interpolated data coverage, the procedures used to estimate the areal extent and volume of floodplain soil to be removed under a given remedial alternative depended on the type of alternative being evaluated. As described in Section 5.1, the two types of floodplain remedial alternatives evaluated are: (1) IMPG-based alternatives; and (2) threshold-based alternatives. The procedures used for each of these two types of alternatives are summarized below, and were described in more detail in Appendix D to the CMS Proposal. It should be noted that the removals delineated through these procedures were developed solely for purposes of the evaluations in the CMS.

5.4.2 IMPG-Based Alternatives

Determination of areal extent and removal volume for the IMPG-based alternatives described in Section 5.1 (FP 2, FP 3, FP 4, and FP 7) involved identifying the extent of removal necessary to achieve the applicable IMPGs as a spatially weighted average (95% UCL) soil PCB concentration in a given area. Estimates of areas/volumes for removal in each area were based on the spatially interpolated PCB data coverage described above. These estimates were developed first for each human health averaging area (i.e., direct contact EA or farm area), using the following four steps:

(1) The specific IMPG for each averaging area of the floodplain was assigned based on the applicable human exposure scenario and target level of risk (e.g., cancer risk of 10^{-5}) specified for that alternative. For areas having multiple use types, the lowest IMPG value was used. For each farm area evaluated based on agricultural products consumption, the target PCB level was adjusted based on the portion of the agricultural field that is located within the floodplain, as described in Section 5.2.2 and shown in Table 5-2.

(2) The PCB exposure point concentration (EPC) for the given area was then calculated. The EPC was defined as the 95% UCL (computed using the modified Halls Bootstrap method) of the spatially weighted mean of the data from that area or the maximum measured value, whichever is lower, consistent with the approach utilized by EPA in the HHRA (also described in Appendix D to the CMS Proposal). Consistent with the HHRA, in computing the spatially weighted mean, the interpolated PCB concentrations were multiplied by EPA's "use accessibility factors" for all direct contact EAs.

(3) The EPC calculated for the area being evaluated was compared with the target IMPG for that area to determine if remediation of soil would be necessary to achieve the IMPG.

(4) If remediation was required to achieve the IMPG, the approximate areal extent and volume of removal was calculated using an iterative process. First, a portion of the given area was "flagged" for remediation (starting with the highest concentrations) and the

interpolated PCB values were replaced with “clean” soil assumed to have a PCB concentration of 0.021 mg/kg.[130] The EPC was then recalculated (incorporating this area of removal/backfill) and compared again with the IMPG. This sequential removal and backfill of soils and recalculation of the EPC was repeated until the amount of remediation was sufficient to reduce the EPC to a level that was at or below the target IMPG for that area.

For the floodplain alternatives in which removal to a depth of 3 feet was evaluated in the Heavily Used Subareas (FP 3 through FP 7; see Section 5.2.1), this same procedure was applied, except that the 95% UCL needed to be at or below the IMPG for both the 0- to 1-foot and 0- to 3-foot depth increments in those areas.

For FP 3, FP 4, and FP 7, this same approach was then followed to determine the areal extent and volume of removal that was required to achieve the ecologically based IMPGs (or target floodplain soil levels) in the relevant ecological averaging areas. In these applications, the human health-based removal necessary to achieve the IMPGs was first taken into account. For example, when removal of a portion of a vernal pool located within a direct contact EA was necessary to reduce the spatial mean below the target risk level for the direct contact use that removal was taken into account when the vernal pool was subsequently evaluated for the amphibian IMPGs.

The removal volume for a given floodplain alternative was calculated as the product of the total area delineated for removal using this procedure and the 1-foot removal depth, with the exception of the Heavily Used Subareas where a removal depth of 3 feet was used.

5.4.3 Threshold-Based Alternatives

Determination of areal extent and removal volume for the threshold-based alternatives (i.e., FP 5 and FP 6) was also based on the spatially interpolated PCB data coverage described above. This method consisted of identifying, from the interpolated PCB concentration coverage, the locations within the floodplain where soil PCB concentrations exceed the threshold concentration specified for the given alternative (i.e., 50 mg/kg for FP 5 and 25 mg/kg for FP 6). The use accessibility factors developed by EPA for the HHRA were not applied in the evaluation of the threshold-based alternatives. Removal volumes were calculated as the product of the total area of the locations identified to exceed the applicable threshold and a 1-foot removal depth. For the Heavily Used Subareas, where exceedances

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[130] Consistent with the approved CMS Proposal, this value represents one-half of the average PCB detection limit used to characterize backfill sources, and is consistent with the assumed backfill PCB concentration applied to areas outside the River under the CD.

of the applicable threshold were identified at depths between 1 and 3 feet, the removal areas were multiplied by 3 feet to estimate the removal volumes.

5.4.4 Outputs to Support Evaluations

For each of the floodplain alternatives evaluated (other than the no-action alternative), areas selected for removal/backfill between the Confluence and Rising Pond Dam were depicted on maps to support the evaluation of those alternatives described in Section 6. Each of these maps for the IMPG-based alternatives differentiates, via separate colors, the bases for the various removals in terms of which exposure pathway or receptor group they were designed to address – namely:

- Direct Contact (separated into areas of 1-foot and 3-foot removal to differentiate removal in Heavily Used Subareas from that in the remaining EAs and subareas);

- Agricultural (for agricultural products consumption);

- Amphibians (i.e., removal, where necessary, in vernal pool areas to achieve the amphibian IMPGs); and

- Piscivorous Mammals (i.e., removal, where necessary, to achieve the target floodplain soil IMPG levels for piscivorous mammals, assuming that the associated sediment concentration is at or below 1 mg/kg).[131]

For the threshold-based alternatives (FP 5 and FP 6), in which removals were determined based on the PCB data and therefore are not associated with a specific exposure pathway or receptor group, the above pathway/receptor categories are not shown on the figures.

In addition to these maps, results of the IMPG evaluations are presented in tabular form in Section 6. For each of the human health and ecological averaging areas described in Section 5.2, the tables include the following:

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[131] As noted above, the floodplain remediation alternatives have been developed on the assumption that the average sediment concentrations in the piscivorous mammal averaging areas (as well as the insectivorous bird averaging areas) would be at or below 1 mg/kg. However, the evaluations in Section 6 also consider the extent to which these alternatives would achieve the floodplain soil IMPG levels for these receptors if the associated sediment concentrations were higher.

It should also be noted that, based on application of the criteria for development of the various IMPG-based alternatives, no additional removal (beyond the removals to address the pathways and receptors listed in the text) would be necessary to achieve the floodplain soil IMPG levels for omnivorous/carnivorous mammals or insectivorous birds (see Section 6).

- The pre-remediation EPC calculated from the spatially interpolated data set used to delineate areas of removal;

- Removal volume and acreage within each averaging area;[132]

- The post-removal EPC (calculated for post-removal conditions using the same methods described previously – i.e., the 95% UCL on the spatially weighted mean); and

- The applicable IMPGs for each area:
    - For human health, both RME and CTE IMPG values corresponding to the various cancer risk levels (i.e., 10^{-6}, 10^{-5}, and 10^{-4}) and non-cancer impacts are shown. In areas that have multiple uses, the lowest applicable IMPGs are shown (e.g., for a subarea characterized as both "general recreation" and "dirt biking/ATVing," the lower IMPGs for "dirt biking/ATVing" are shown). Also, for areas with multiple receptors (i.e., adults and older children), the lower IMPGs are shown.
    - For ecological receptors, the upper- and lower-bound IMPGs are shown where applicable. Also, for receptors in which the floodplain soil IMPGs are tied to the PCB concentration in sediments (i.e., for insectivorous birds and piscivorous mammals), IMPGs associated with the 1, 3, and 5 mg/kg sediment target levels are shown.

To facilitate the comparisons between post-removal EPCs and the IMPGs (as discussed in Section 6), the IMPGs that are achieved by the given alternative are shaded in blue in the tables.

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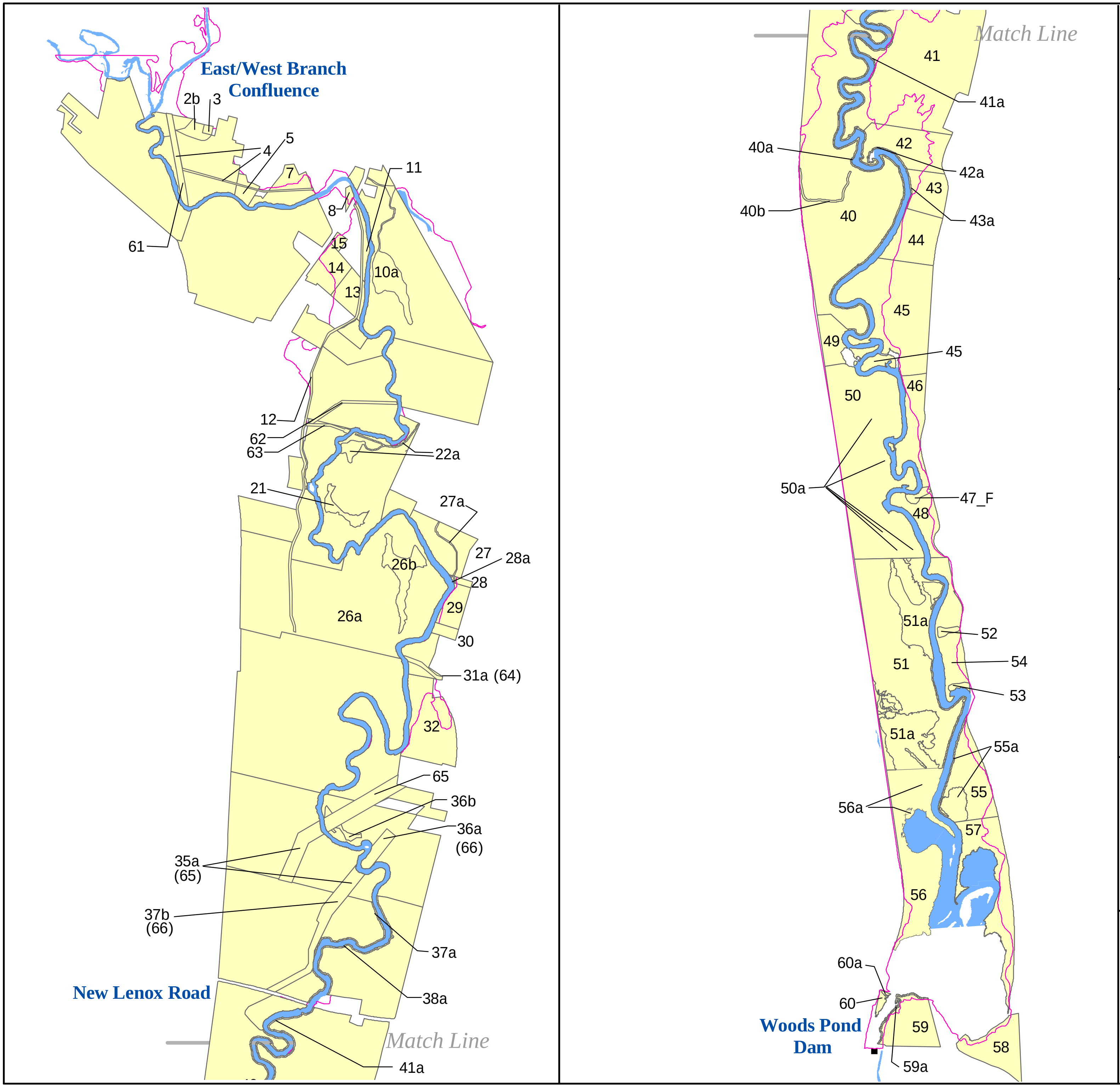
[132] Given the modified Halls Bootstrap method used to calculate the post-remediation EPCs, consecutive repetitions of the procedure described above were found to generate slightly different results. To recognize this variability, total removal volumes presented in the evaluation of floodplain alternatives in Section 6 and those shown in the tables broken down by averaging area have been rounded. As such, the volume totals shown on the tables were made to agree with those stated in the text for consistency, but they do not always agree with the sum of volumes from the smaller averaging areas. In addition, it should be noted that estimated removal volumes calculated using the methods described in this section are reliable on a total volume basis, but become uncertain in some of the relatively small exposure/averaging areas due to data limitations, data variability, and the random component inherent to the bootstrap method.



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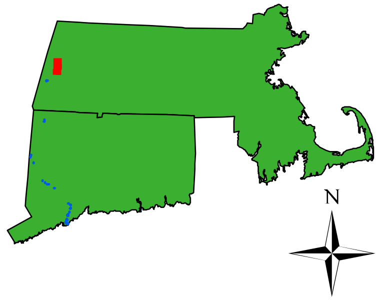

SCALE

0 0.25 0.5
Miles

LEGEND

- 🟦 Housatonic River
- ☐ 1 mg/kg PCB Isopleth
- 🟨 Exposure Areas
- ▬ Dams

Notes:
1) Labels posted represent EPA exposure area IDs.
2) Exposure areas in parentheses signify the overlapped utility corridors.

Figure 5-1a.
Map of exposure areas (EAs) for direct contact assessment in Reaches 5 & 6.

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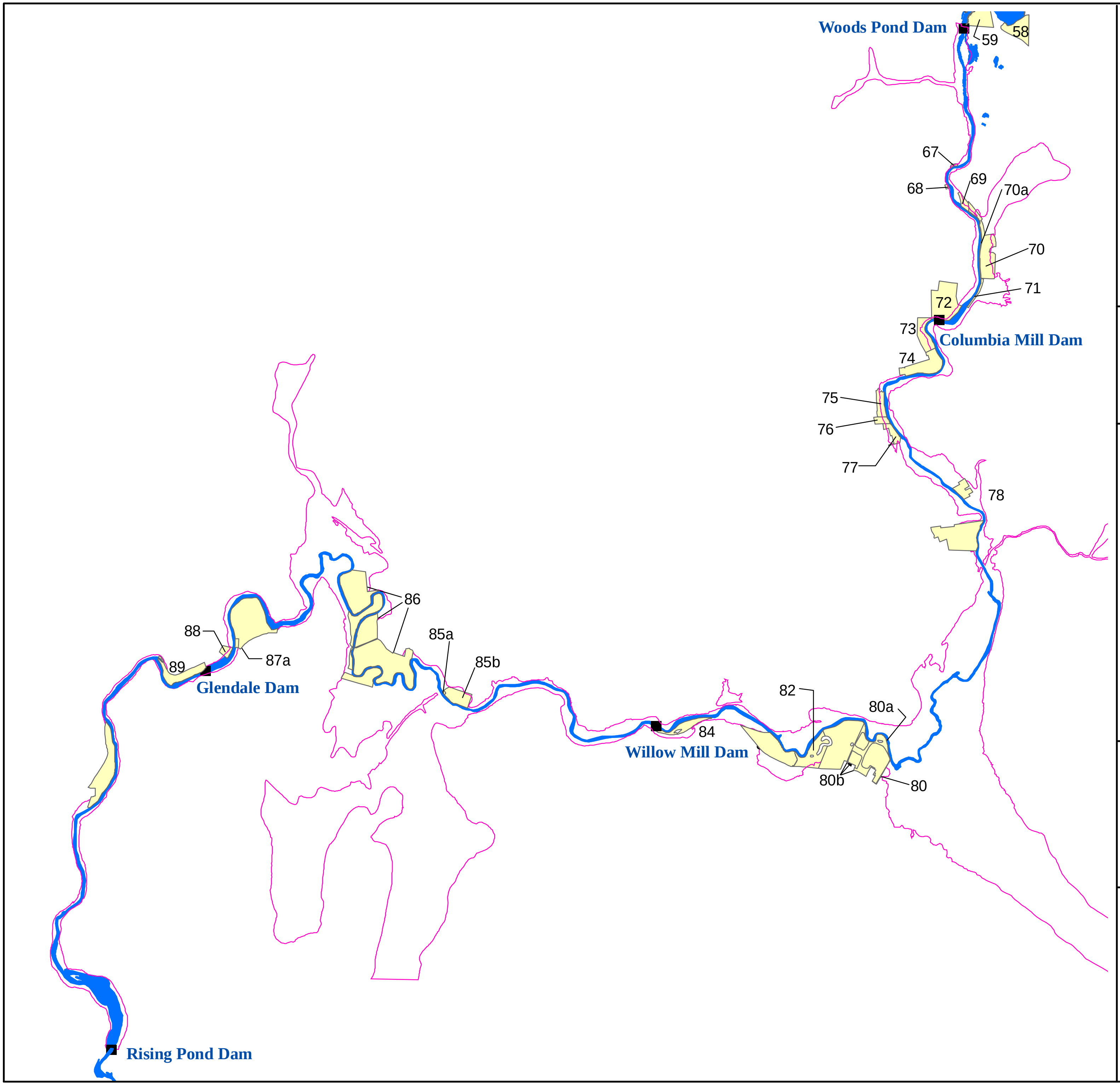

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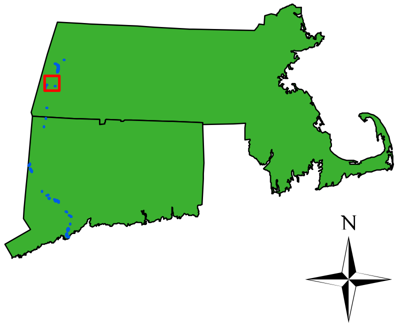

SCALE

0 0.5 1 Miles

LEGEND

🟦 Housatonic River

■ Dams

▭ 100-year Floodplain

🟨 Exposure Areas

Note:
Labels posted represent EPA exposure area IDs.

Figure 5-1b.
Map of exposure areas (EAs) for direct contact assessment in Reaches 7 & 8.

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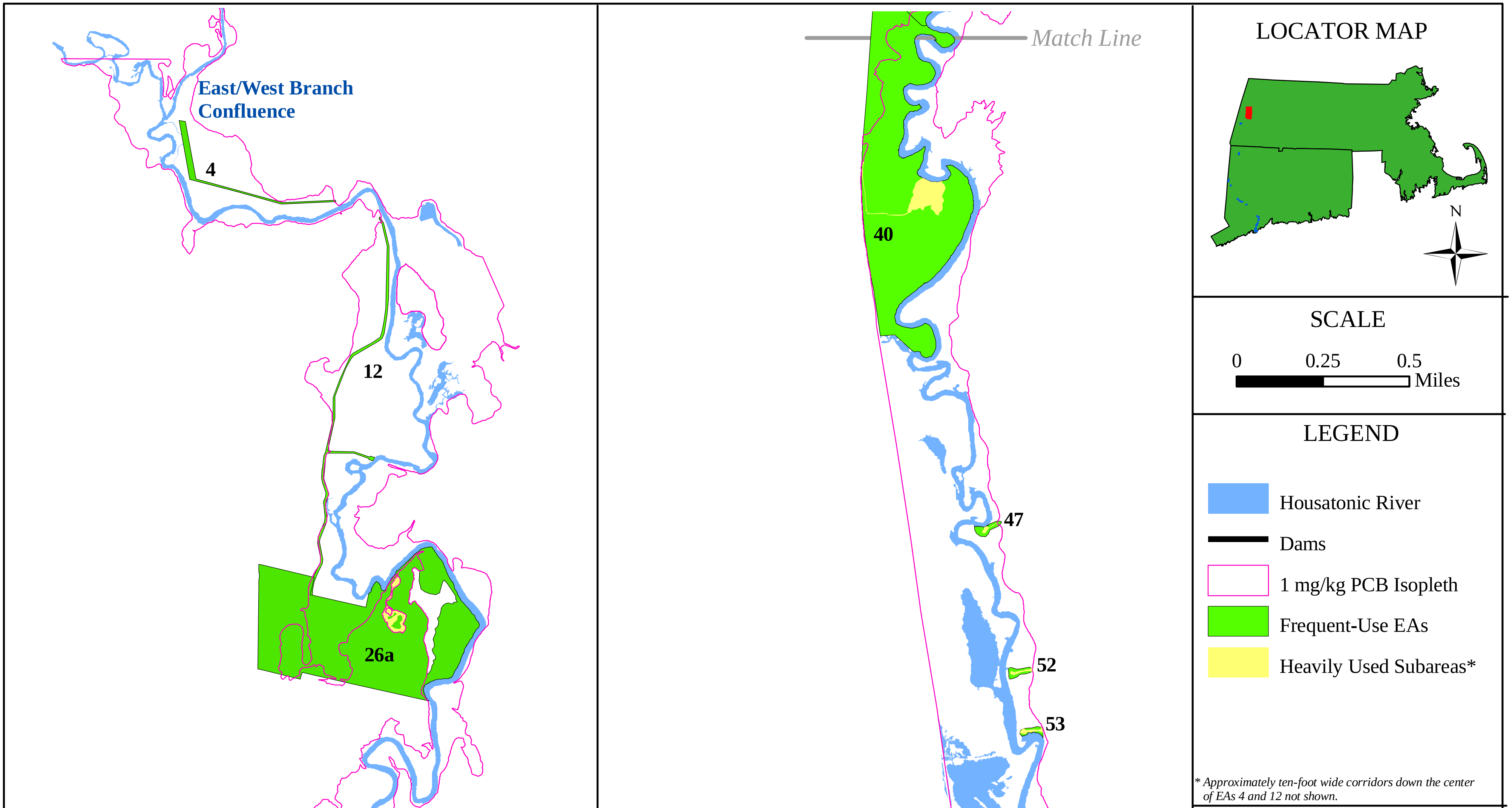

** Approximately ten-foot wide corridors down the center of EAs 4 and 12 not shown.*

Figure 5-2.
Map of Frequent-Use EAs and Heavily Used Subareas for direct contact assessment in Reaches 5 & 6.

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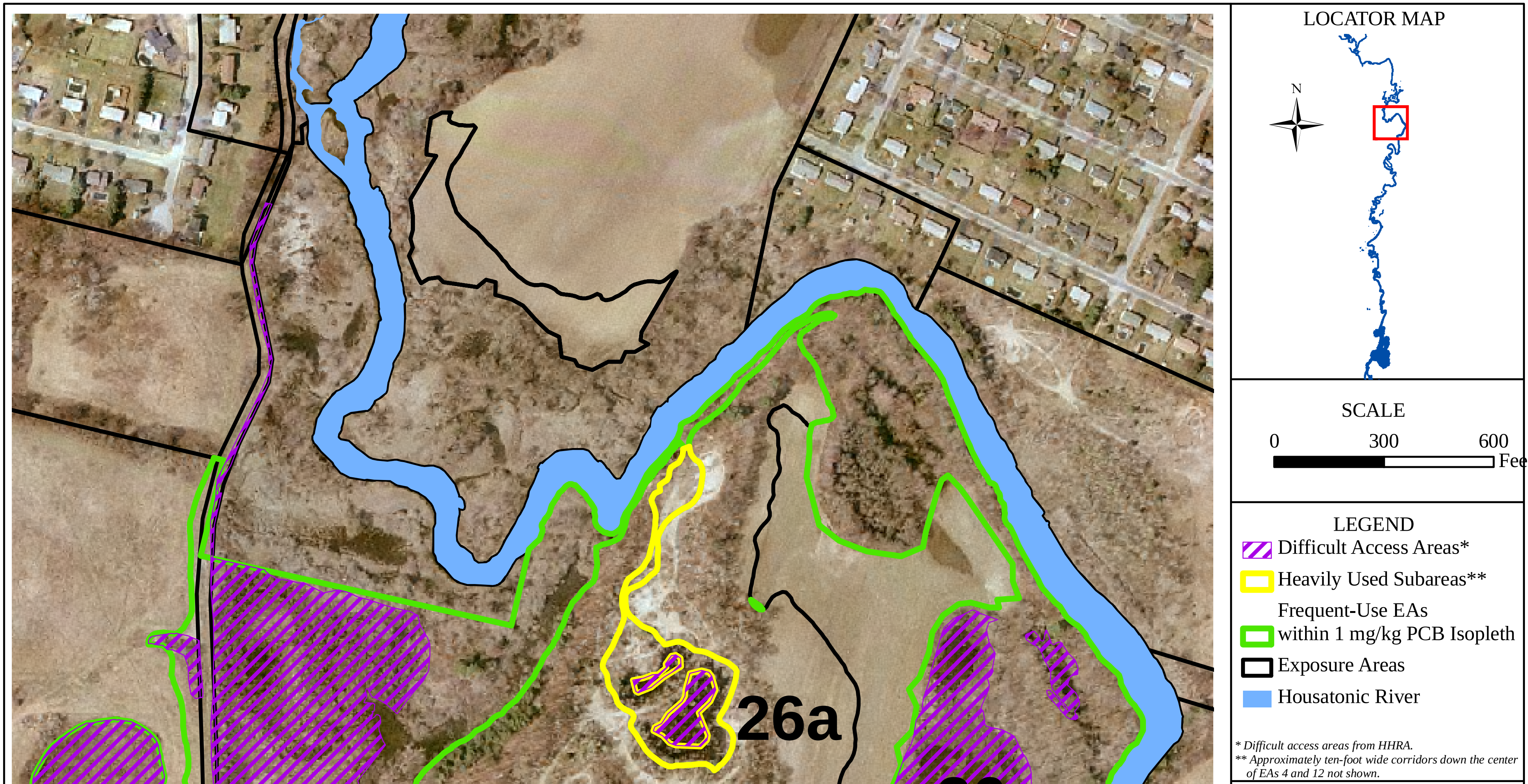

** Difficult access areas from HHRA.*

*** Approximately ten-foot wide corridors down the center of EAs 4 and 12 not shown.*

Figure 5-3a.
Map of Heavily Used Subareas in Reaches 5 & 6:
EAs 12 and 26a.

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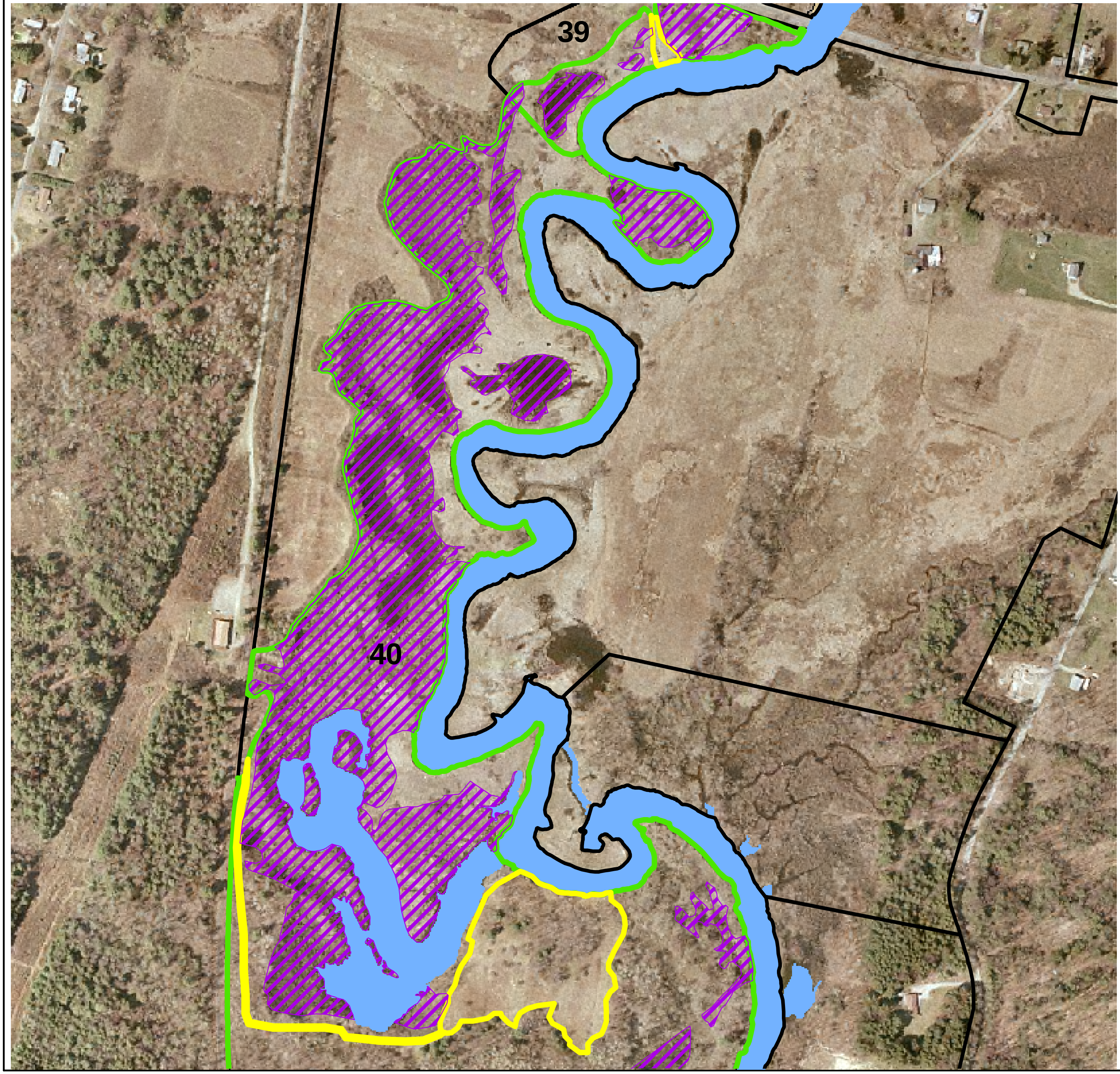

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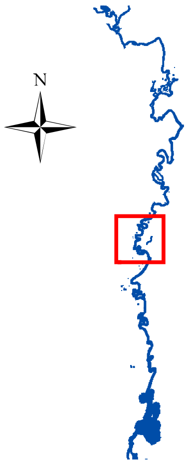

SCALE

0 290 580 Feet

LEGEND

🟦	Housatonic River
▨	Difficult Access Areas*
☐	Heavily Used Subareas
☐	Frequent-Use EAs within 1 mg/kg PCB Isopleth
☐	Exposure Areas

** Difficult access areas from HHRA.*

Figure 5-3b.
Map of Heavily Used Subareas in Reaches 5 & 6:
EAs 39 and 40.

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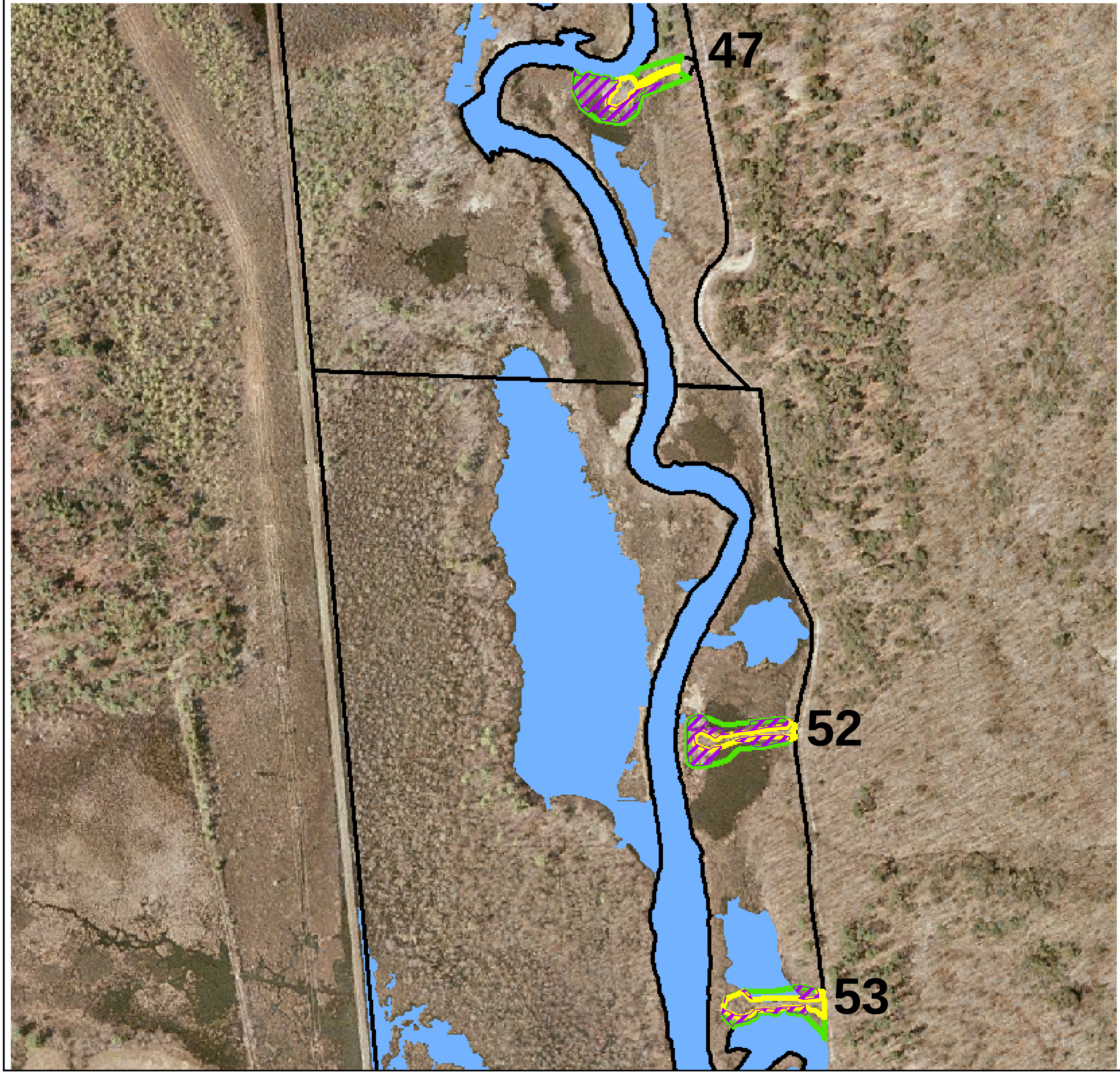

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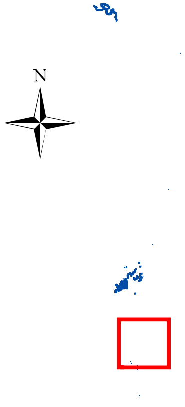

SCALE

LEGEND

- 🟦 Housatonic River
- ▨ Difficult Access Areas*
- 🟨 Heavily Used Subareas
- 🟩 Frequent-Use EAs within 1 mg/kg PCB Isopleth
- ☐ Exposure Areas

** Difficult access areas from HHRA.*

Figure 5-3c.
Map of Heavily Used Subareas in Reaches 5 & 6:
EAs 47, 52, and 53.

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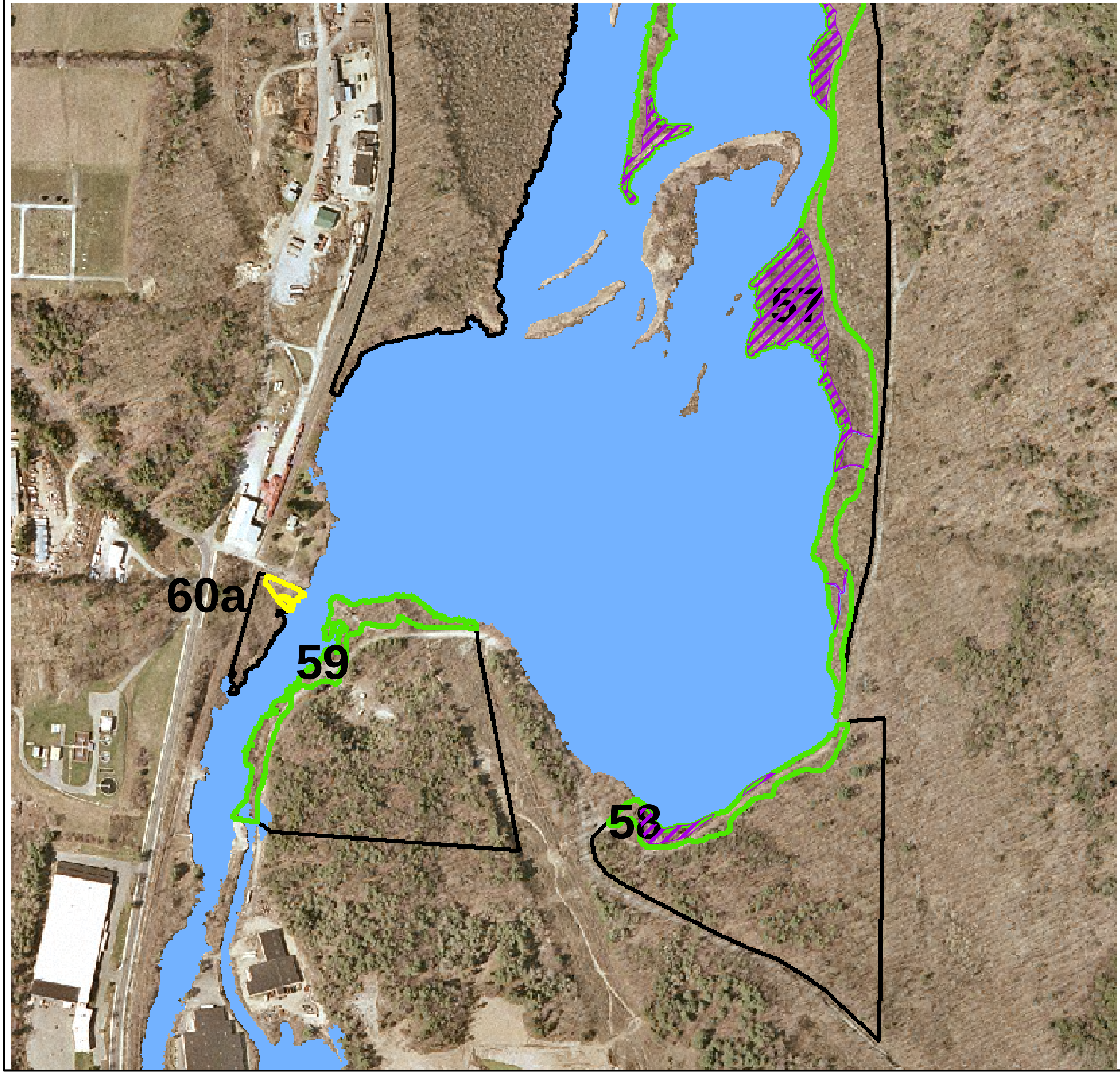

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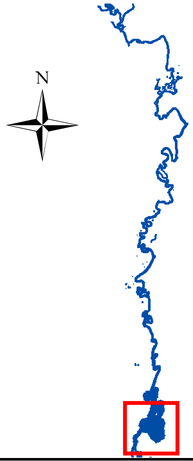

SCALE

0 290 580
Feet

LEGEND

🟦 Housatonic River
▨ Difficult Access Areas*
☐ Heavily Used Subareas
☐ Frequent-Use EAs within 1 mg/kg PCB Isopleth
☐ Exposure Areas

** Difficult access areas from HHRA.*

Figure 5-3d.
Map of Heavily Used Subareas in Reaches 5 & 6:
EAs 57, 58, 59, and 60a.

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** Farm areas included in the CMS evaluation are shown as different colors to differentiate individual farm areas. Labels (e.g., FA 2) represent farm area IDs.*

Figure 5-4a.
Farm areas evaluated for agricultural products consumption in Reaches 5 & 6.

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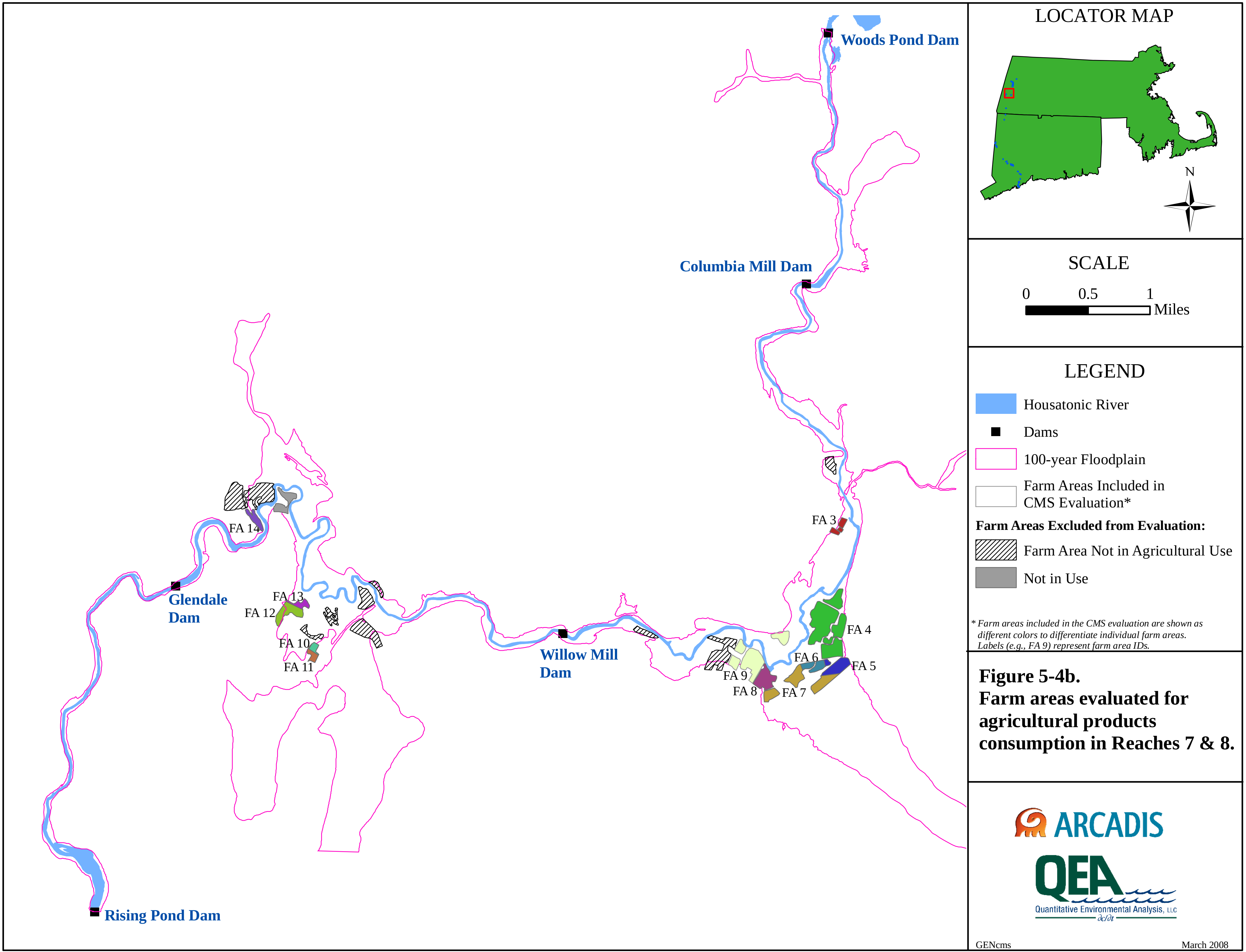

LEGEND

- 🟦 Housatonic River
- ■ Dams
- ☐ 100-year Floodplain
- ☐ Farm Areas Included in CMS Evaluation*

Farm Areas Excluded from Evaluation:

- ▨ Farm Area Not in Agricultural Use
- ◼ Not in Use

* *Farm areas included in the CMS evaluation are shown as different colors to differentiate individual farm areas. Labels (e.g., FA 9) represent farm area IDs.*

Figure 5-4b.
Farm areas evaluated for agricultural products consumption in Reaches 7 & 8.

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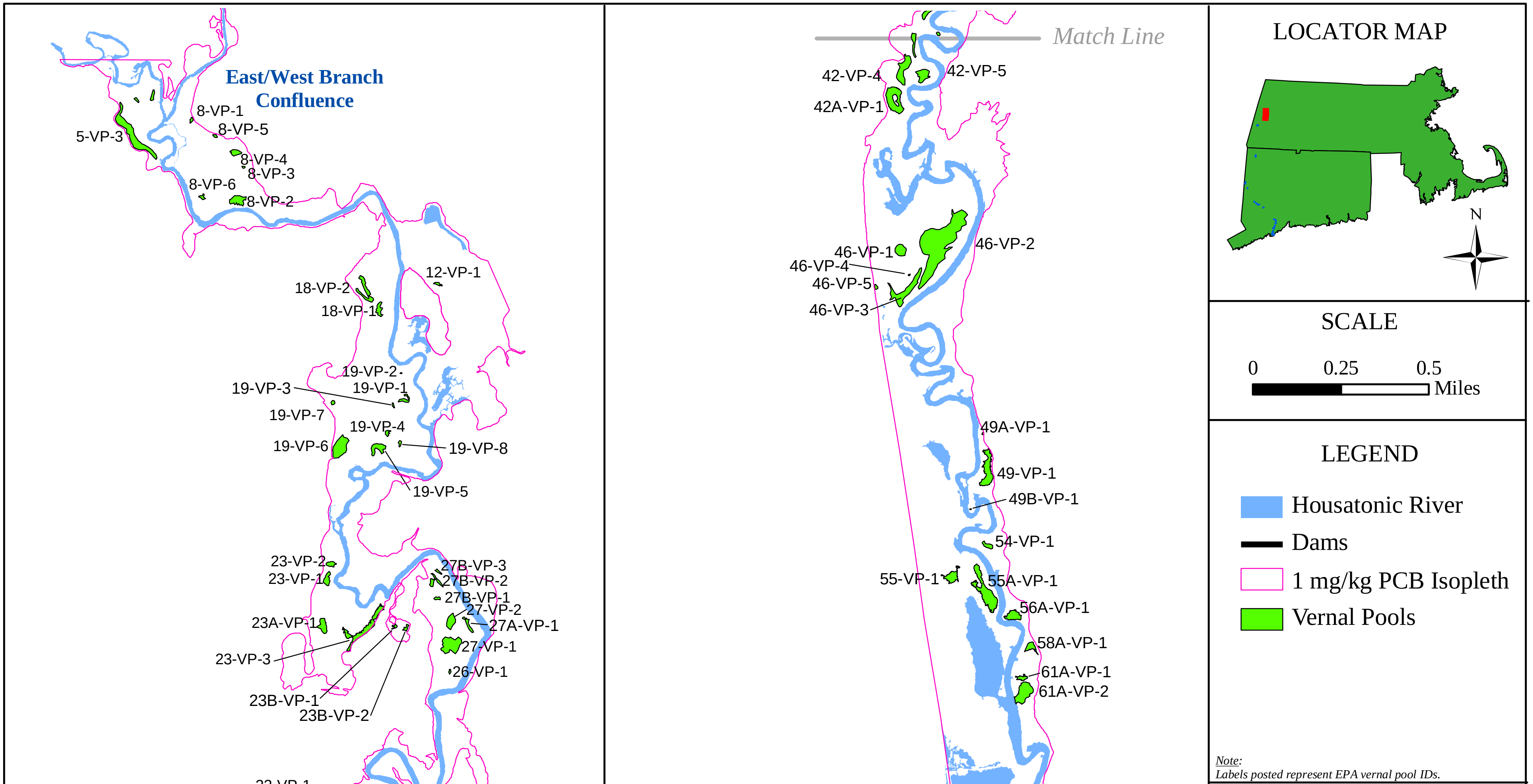

Note:
Labels posted represent EPA vernal pool IDs.

Figure 5-5.
Vernal pools evaluated for the amphibian (wood frog) assessment in Reaches 5 & 6.

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Figure 5-6a.
Areas of suitable omnivorous/carnivorous mammal (shrew) habitat in Reaches 5 & 6.

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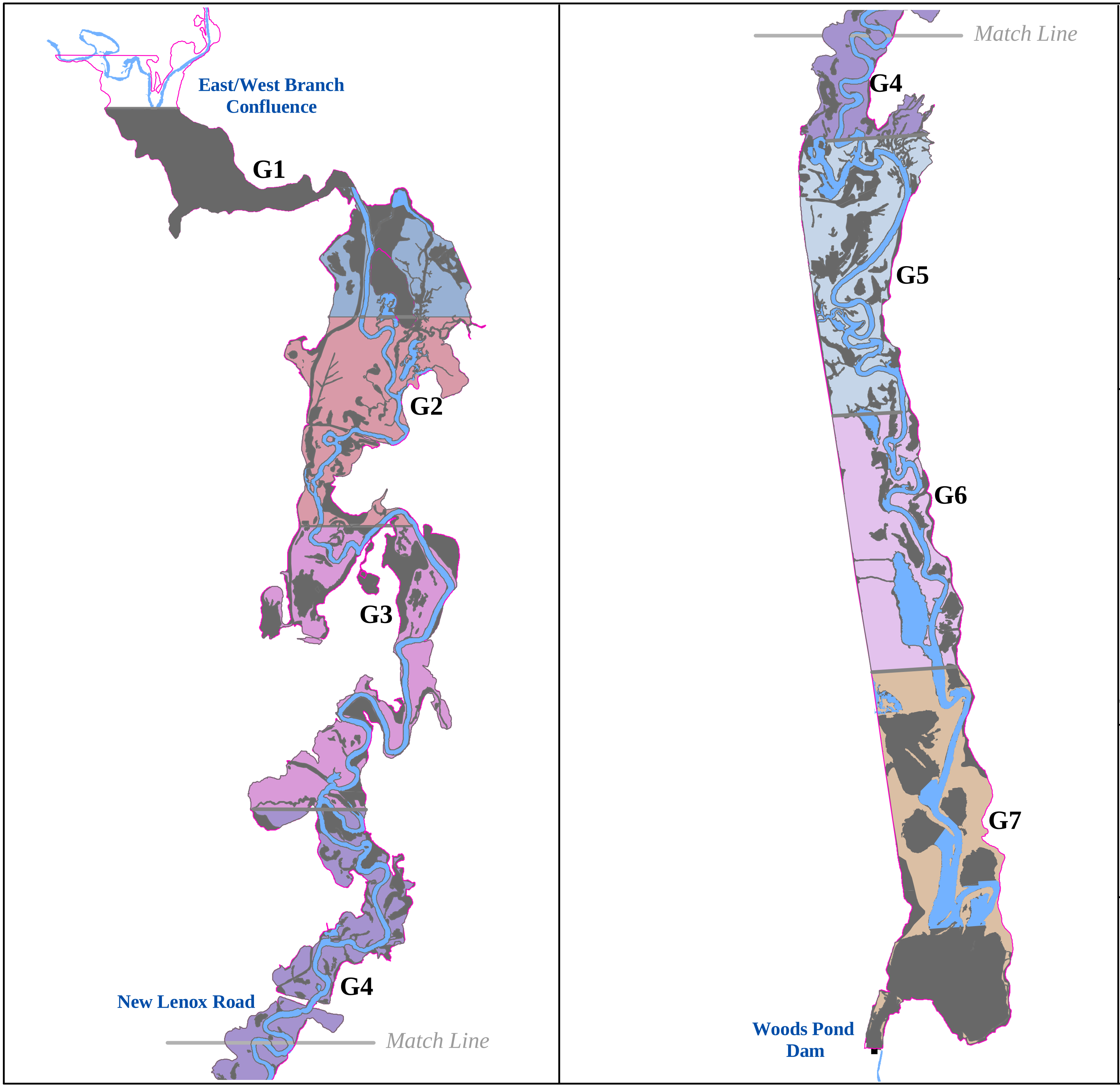

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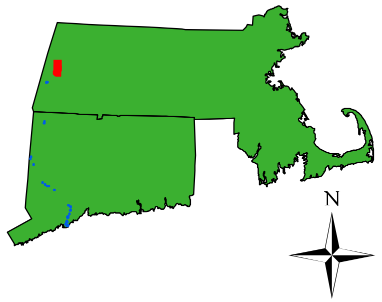

SCALE

0 0.25 0.5 Miles

LEGEND

- 🟦 Housatonic River
- ▬ Dams
- ☐ 1 mg/kg PCB Isopleth
- ☐ Shrew Averaging Areas*
- ⬛ Unsuitable Shrew Habitat

** Separate shrew averaging areas are shown as different colors, and labels (e.g., G3) represent averaging area IDs.*

**Figure 5-6b.
Averaging areas used for the omnivorous/carnivorous mammal (shrew) assessment in Reaches 5 & 6.**

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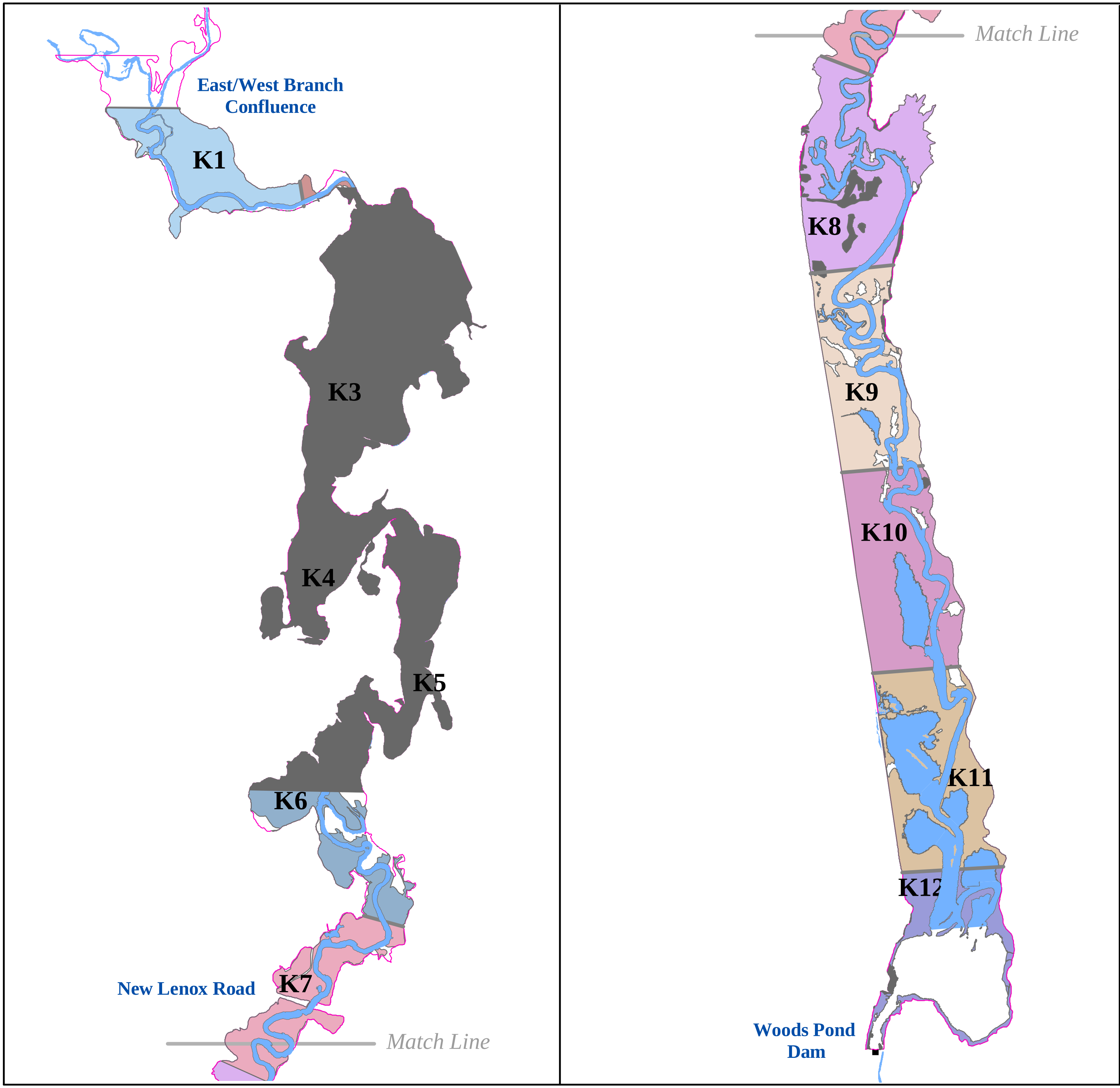

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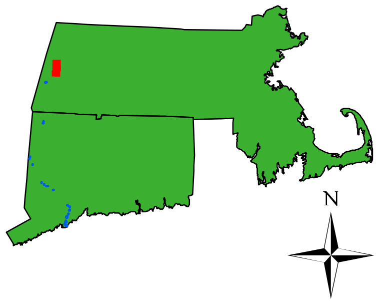

SCALE

LEGEND

- 🟦 Housatonic River
- ▬ Dams
- ☐ 1 mg/kg PCB Isopleth
- ☐ Wood Duck Averaging Areas*
- ■ Unsuitable Wood Duck Habitat

** Wood duck averaging areas were developed and provided by ENVIRON. Separate averaging areas are shown as different colors, and labels (e.g., K11) represent averaging area IDs.*

Figure 5-7.
Averaging areas used for the insectivorous bird (wood duck) assessment in Reaches 5 & 6.

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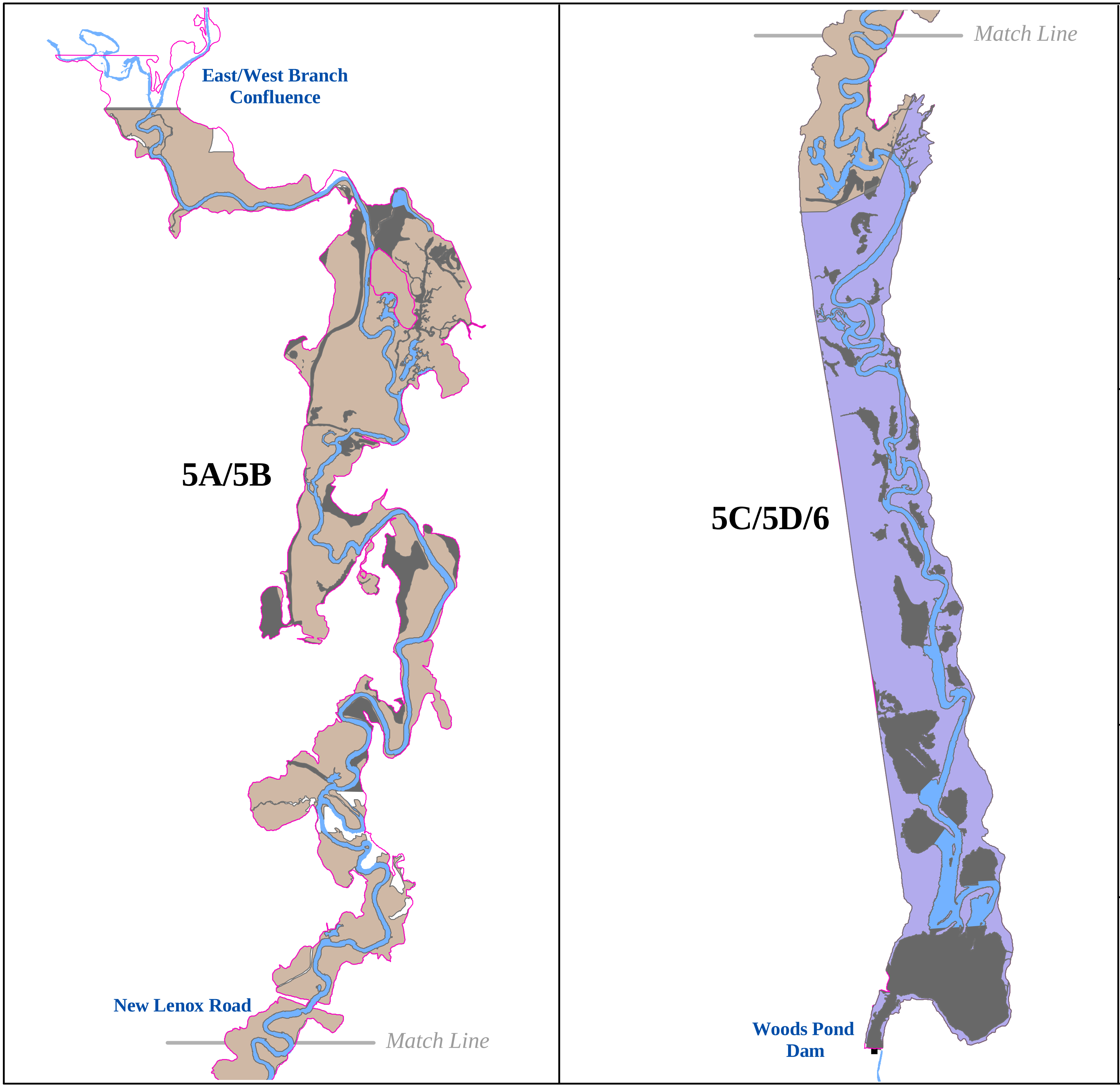
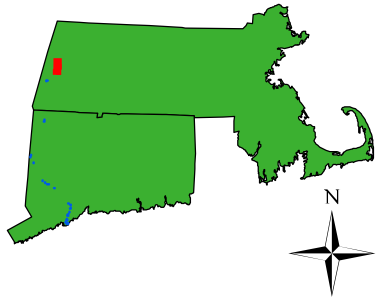


LOCATOR MAP



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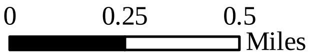

LEGEND

🟦	Housatonic River
▬	Dams
☐	1 mg/kg PCB Isopleth
☐	Mink Averaging Areas*
■	Unsuitable Mink Habitat

** Separate mink averaging areas are shown as different colors, and labels (e.g., 5A/5B) represent averaging area IDs*

Figure 5-8.
Averaging areas used for the piscivorous mammal (mink) assessment in Reaches 5 & 6.

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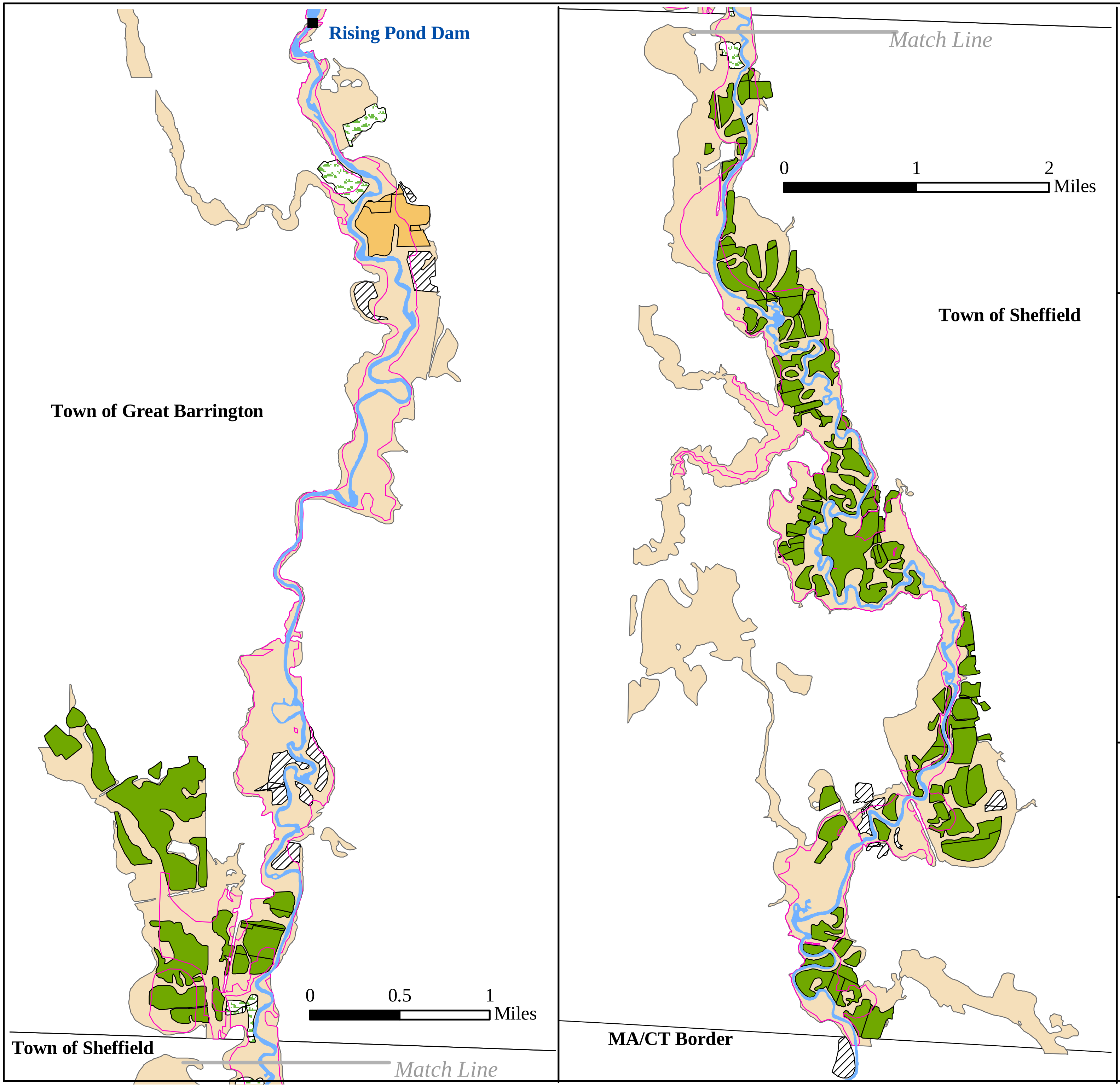

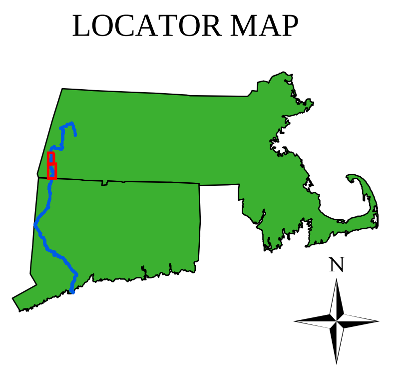

LEGEND

■	Dams
🟦	Housatonic River
☐	10-year Floodplain
▭	100-year Floodplain
☐	Town Boundaries

Farm Types:

🟩	Commercial Dairy
🟧	Commercial Poultry (meat)
▦	Commercial Vegetable
▨	Other (e.g., wetland, open land, horse farm, not in use)

Figure 5-9.
Farm areas located within Reach 9.

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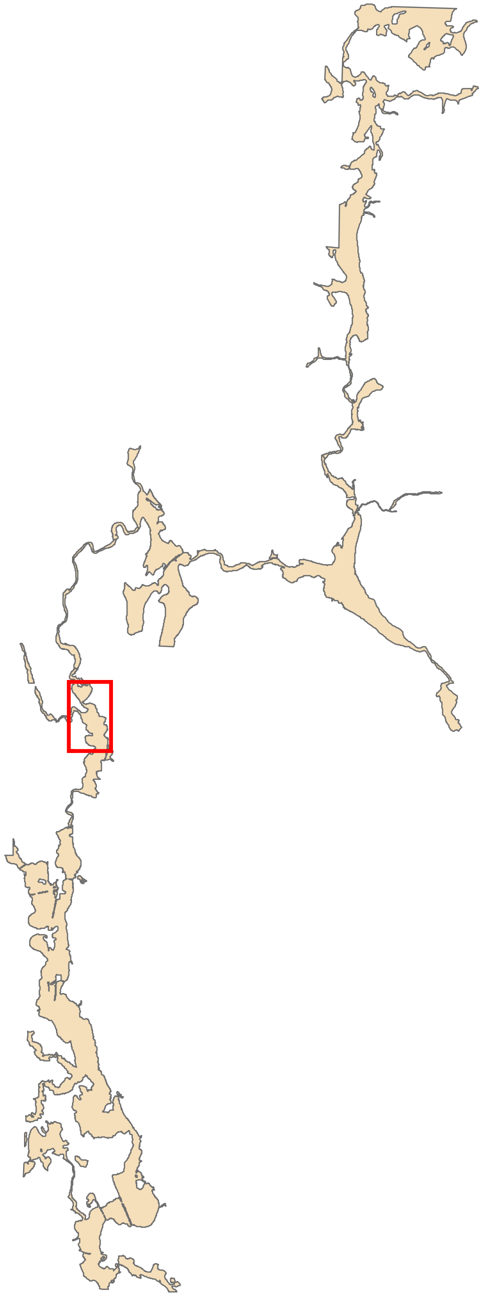
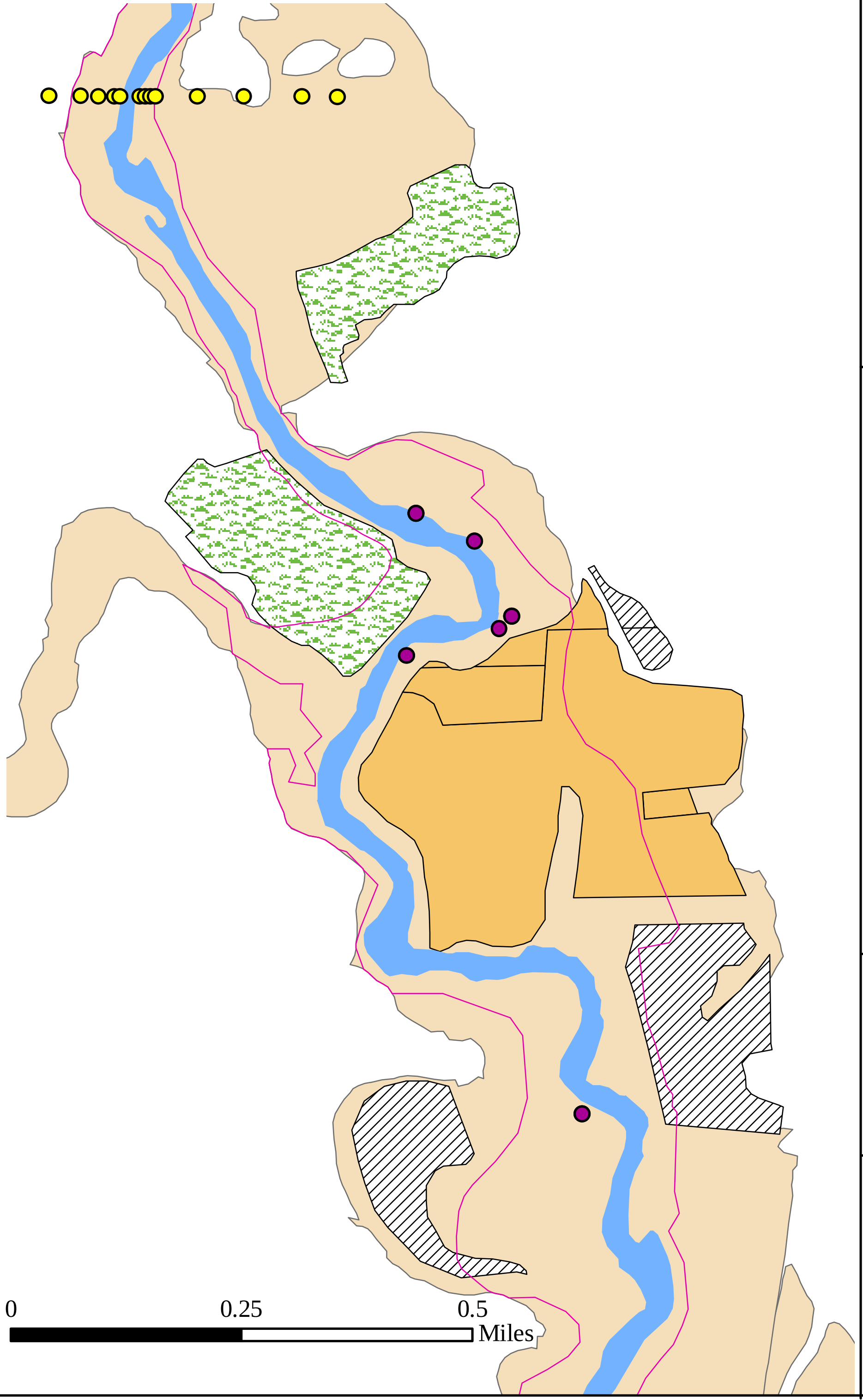
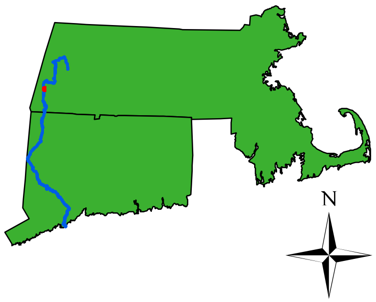
LOCATOR MAP FOR COMMERCIAL POULTRY FARM WITHIN REACH 9





LOCATOR MAP



LEGEND

🟦 Housatonic River

☐ 10-yr Floodplain

🟫 100-yr Floodplain

● GE Floodplain Sample

● EPA Floodplain or Bank Soil Sample

Farm Types:

🟧 Commercial Poultry (meat)

🟩 Commercial Vegetable

▨ Other (e.g., wetland, open land, horse farm, not in use)

**Figure 5-10.
Map of single commercial poultry (meat) farm within Reach 9.**

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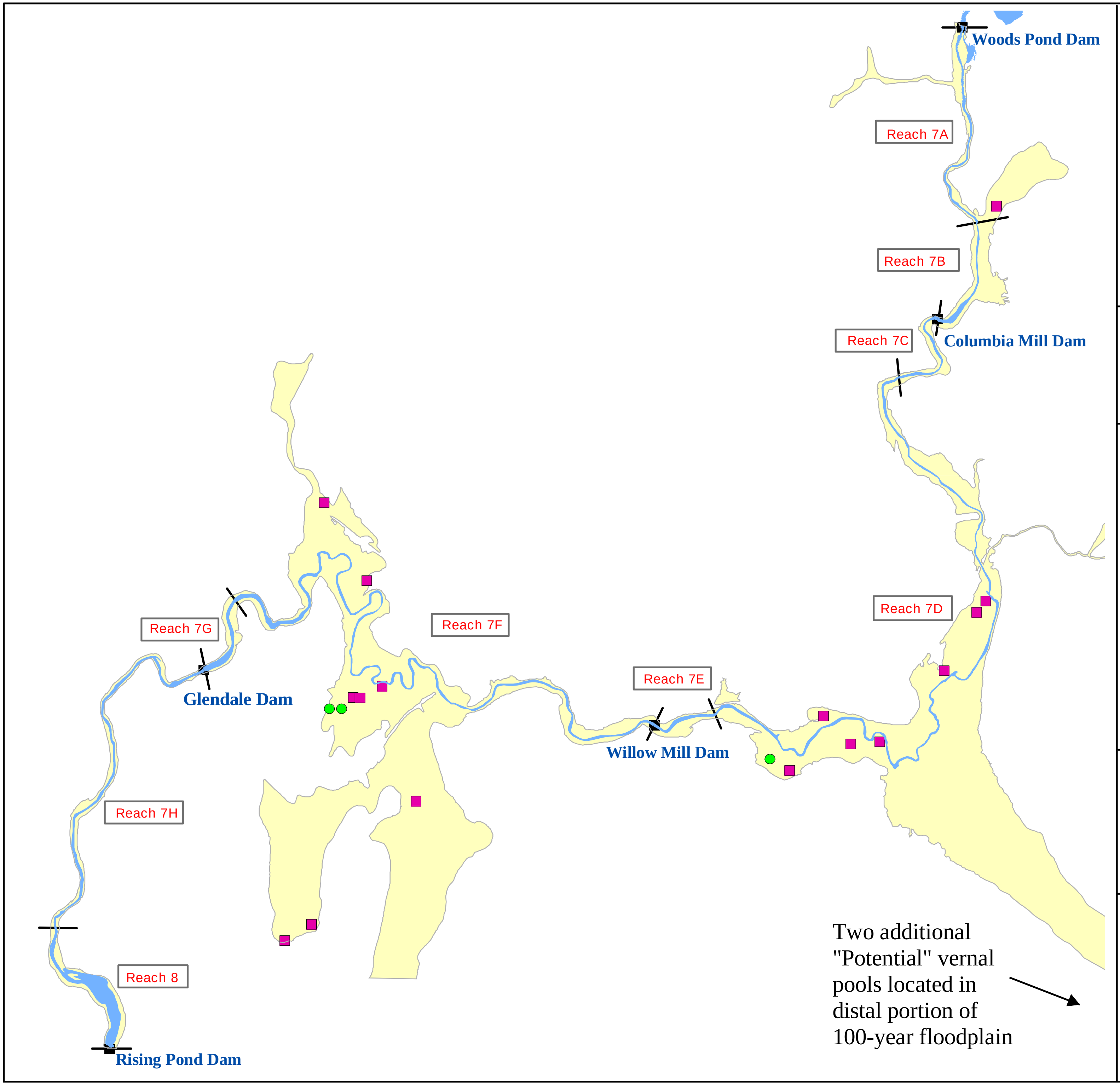
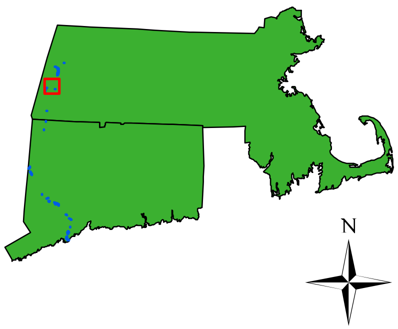


Two additional "Potential" vernal pools located in distal portion of 100-year floodplain

LOCATOR MAP



SCALE

0 0.5 1 Miles

LEGEND

- 🟦 Housatonic River
- ■ Dams
- 🟨 100-year Floodplain

Vernal Pools:

- ● "Certified"
- ■ "Potential"

Figure 5-11. "Certified" and "potential" vernal pool locations within Reaches 7 & 8.

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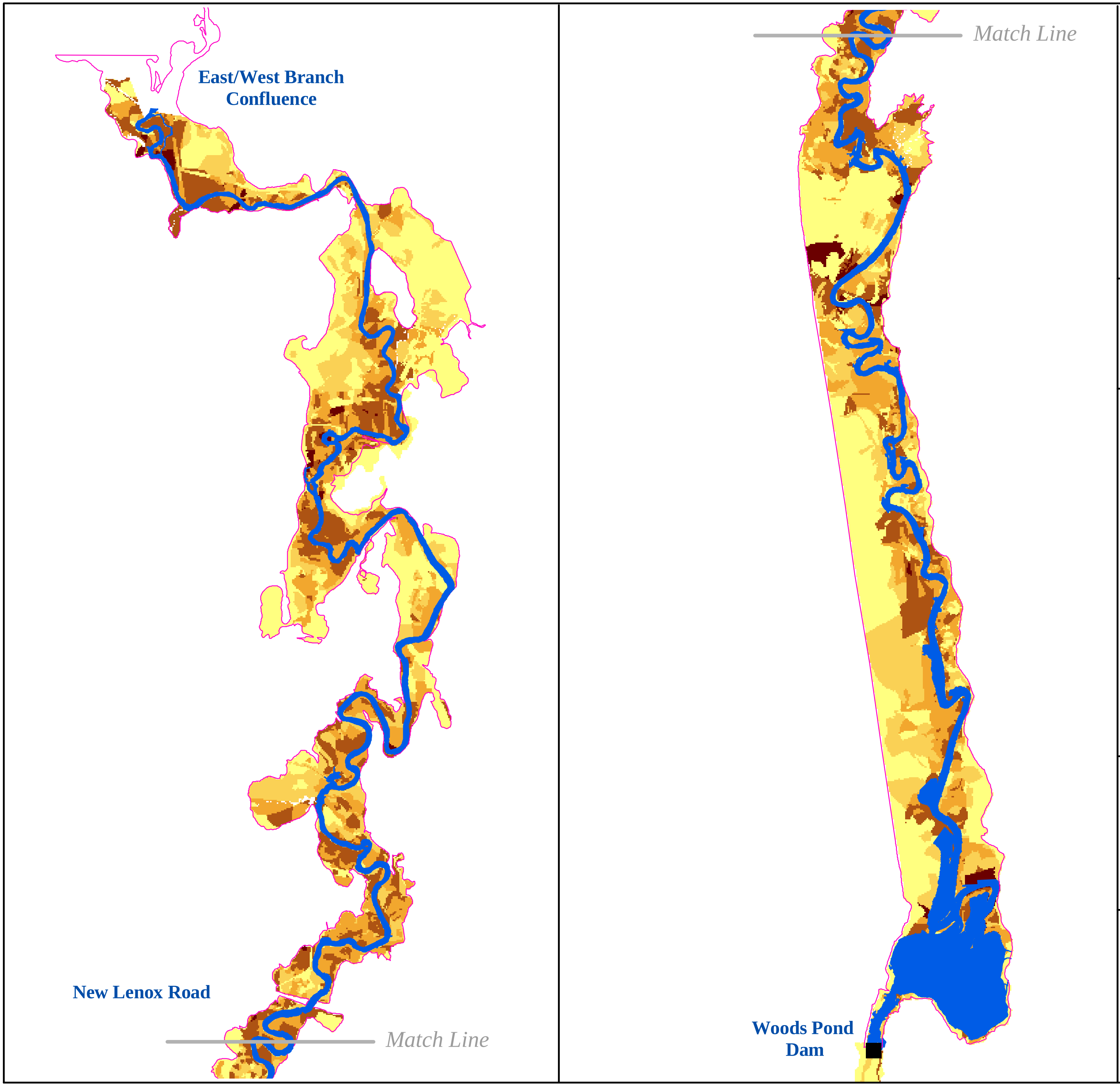
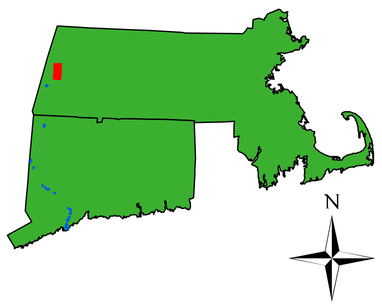


LOCATOR MAP



SCALE

LEGEND

■ Dams

🟦 Housatonic River

☐ 1 mg/kg PCB Isopleth

0-12" PCBs (mg/kg)

🟨 0 - 3

🟨 3 - 10

🟧 10 - 30

🟫 30 - 100

🟥 > 100

Figure 5-12a.
Map of 0-12" Theissen Polygon PCB concentrations in Reaches 5 & 6.

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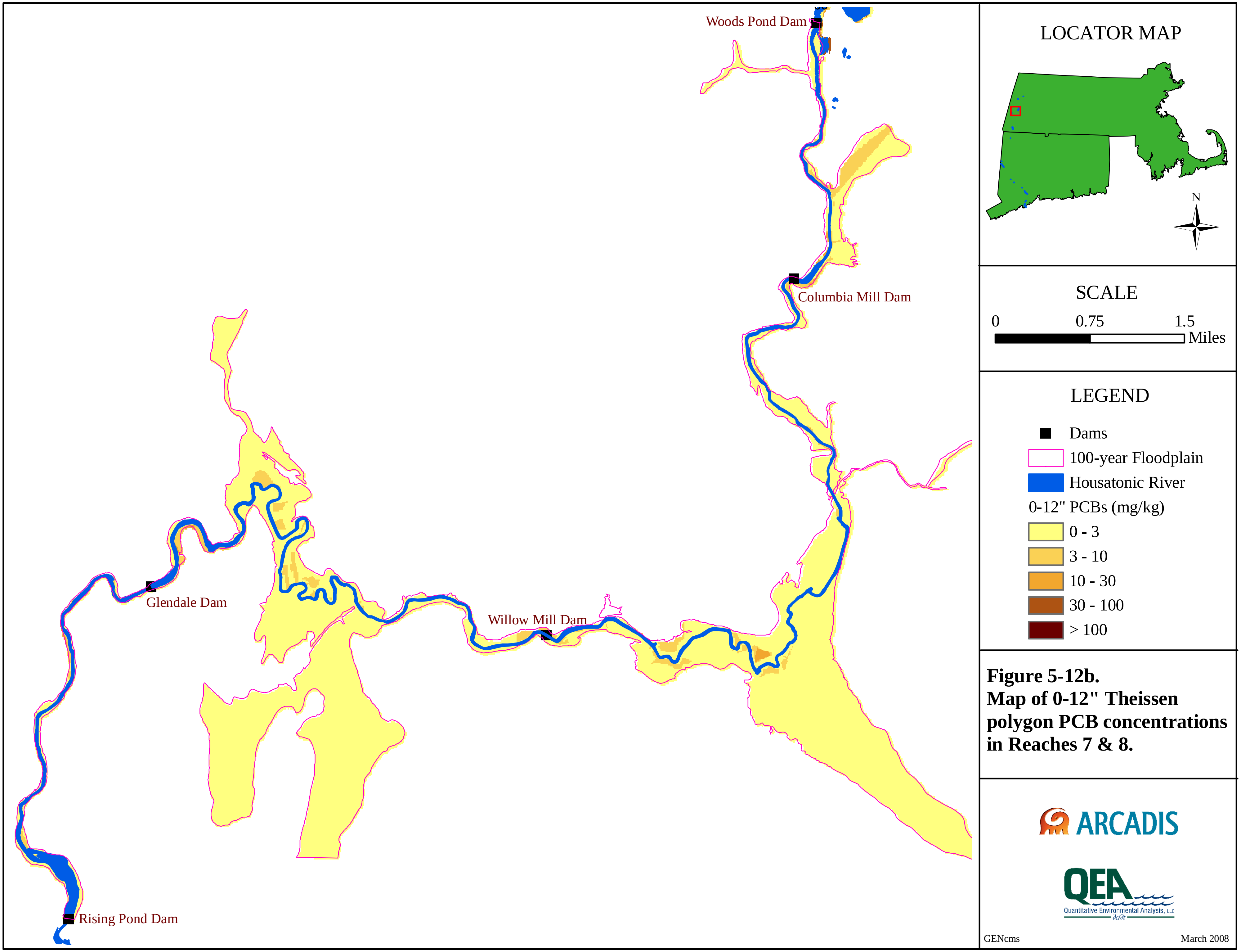

**Figure 5-12b.
Map of 0-12" Theissen polygon PCB concentrations in Reaches 7 & 8.**

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Table 5-1. Summary of exposure scenarios evaluated for each direct contact exposure area.

Exposure Area	EPA Human Health Risk Assessment[1]			Exposure Scenario in CMS Floodplain Evaluation		
	Scenario(s) Evaluated	Receptor	Exposure Frequency (day/yr)	Scenario Evaluated	Receptor	Frequent Use EA
1	General recreation	older child, adult	60	Medium-use general recreation	older child, adult	
2	General recreation	older child, adult	90	High-use general recreation	older child, adult	
2a	General recreation	older child	30	Low-use general recreation	older child	
2b	General recreation	older child	90	High-use general recreation	older child	
3	General recreation	adult	90	High-use general recreation	adult	
4	General recreation	young child, older child, adult	90/15	High-use general recreation	young child (low use), older child, adult	X
5	General recreation	older child, adult	90	High-use general recreation	older child, adult	
6	General recreation	adult	30	Low-use general recreation	adult	
	Future residential	young child, adult	---			
7	General recreation	older child, adult	90	High-use general recreation	older child, adult	
8	Rec. Canoe	older child, adult	---	Recreational canoeist	older child, adult	
9	General recreation	older child	30	Low-use general recreation	older child	
10	General recreation	young child, adult	90/30	High-use general recreation	young child (high use), adult	
10a	General recreation	young child, adult	90/30	High-use general recreation	young child (high use), adult	
11	General recreation	adult	90	High-use general recreation	adult	
12	General recreation	young child, older child, adult	90/15	High-use general recreation	young child (low use), older child, adult	X
13	General recreation	adult	90	High-use general recreation	adult	
14	General recreation	adult	90	High-use general recreation	adult	
15	General recreation	adult	90	High-use general recreation	adult	
16	General recreation	adult	90	High-use general recreation	adult	
17	General recreation	adult	90	High-use general recreation	adult	
18	General recreation	adult	60	Medium-use general recreation	adult	
	Future residential	young child, adult	---			
19	General recreation	adult	90	High-use general recreation	adult	
20	General recreation	adult	90	High-use general recreation	adult	
21	Farmer	adult	---	High-use general recreation	older child, adult	
21-22	Future residential	young child, adult	---			
22	General recreation	older child, adult	90	High-use general recreation	older child, adult	
22a	ATV/Dirt Biker	older child	---	Dirt biking/ATVing	older child	
23	General recreation	older child	60	Medium-use general recreation	older child	
24	General recreation	adult	90	High-use general recreation	adult	
25	General recreation	older child	90	High-use general recreation	older child	
26	General recreation (future)	older child, adult	90	High-use general recreation (future)	older child, adult	
26a	General recreation	older child, adult	90	High-use general recreation	older child, adult	X
26b	Farmer	adult	---	Agricultural use (based on direct contact by farmer)	adult	
27	General recreation	older child, adult	90	High-use general recreation	older child, adult	
27a	ATV/Dirt Biker	older child	---	Dirt biking/ATVing	older child	
28	General recreation	young child, older child, adult	90/15	High-use general recreation	young child (low use), older child, adult	
28a	ATV/Dirt Biker	older child	---	Dirt biking/ATVing	older child	
29	General recreation	older child, adult	30	Low-use general recreation	older child, adult	
30	General recreation	older child, adult	90	High-use general recreation	older child, adult	
31	General recreation	older child, adult	90	High-use general recreation	older child, adult	

Table 5-1. Summary of exposure scenarios evaluated for each direct contact exposure area.

Exposure Area	EPA Human Health Risk Assessment[1]			Exposure Scenario in CMS Floodplain Evaluation		
	Scenario(s) Evaluated	Receptor	Exposure Frequency (day/yr)	Scenario Evaluated	Receptor	Frequent Use EA
31a	General recreation	older child, adult	90	High-use general recreation	older child, adult	
32	General recreation	adult	90	High-use general recreation	adult	
33	General recreation	adult	90	High-use general recreation	adult	
34	Farmer	adult	---	Medium-use general recreation	adult	
	Future residential	young child, adult	---			
35	General recreation	older child, adult	90	High-use general recreation	older child, adult	
35a	General recreation	older child, adult	90	High-use general recreation	older child, adult	X
36a	Groundskeeper	adult	---	Low-use commercial (groundskeeper scenario)	adult	
36b	Farmer	adult	---	Agricultural use (based on direct contact by farmer)	adult	
37	General recreation	older child, adult	90	High-use general recreation	older child, adult	
37a	Angler	older child, adult	---	Bank fishing	older child, adult	
37b	General recreation	older child, adult	90	High-use general recreation	older child, adult	X
38	General recreation	adult	90	High-use general recreation	adult	
38a	Angler	older child, adult	---	Bank fishing	older child, adult	
39	Marathon canoe	adult	---	Marathon canoeist	adult	X
	Rec. Canoe	older child, adult	---	Recreational canoeist	older child, adult	
40	General recreation	young child, adult	90/15	High-use general recreation	young child (low use), adult	X
40a	Angler	older child, adult	---	Bank fishing	older child, adult	
40b	General recreation	young child, adult	90/15	High-use general recreation	young child (low use), adult	
41	General recreation	adult	60	Medium-use general recreation	adult	
41a	Angler	older child, adult	---	Bank fishing	older child, adult	
42	General recreation	adult	60	Medium-use general recreation	adult	
42a	Angler	older child, adult	---	Bank fishing	older child, adult	
43	General recreation	adult	60	Medium-use general recreation	adult	
43a	Angler	older child, adult	---	Bank fishing	older child, adult	
44	General recreation	adult	90	High-use general recreation	adult	
45	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	
	General recreation	adult	90	High-use general recreation	adult	
46	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	
	General recreation	adult	90	High-use general recreation	adult	
47	Rec. Canoe	older child, adult	---	Recreational canoeist	older child, adult	X
48	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	
	General recreation	adult	90	High-use general recreation	adult	
49	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	
	General recreation	adult	30	Low-use general recreation	adult	
50	General recreation	adult	30	Low-use general recreation	adult	
50a	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	
51	General recreation	adult	30	Low-use general recreation	adult	
51a	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	
52	Rec. Canoe	older child, adult	---	Recreational canoeist	older child, adult	X
53	Rec. Canoe	older child, adult	---	Recreational canoeist	older child, adult	X

Table 5-1. Summary of exposure scenarios evaluated for each direct contact exposure area.

Exposure Area	EPA Human Health Risk Assessment[1]			Exposure Scenario in CMS Floodplain Evaluation		
	Scenario(s) Evaluated	**Receptor**	**Exposure Frequency (day/yr)**	**Scenario Evaluated**	**Receptor**	**Frequent Use EA**
54	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	
	General recreation	adult	90	High-use general recreation	adult	
55	General recreation	young child, adult	90/15	High-use general recreation	young child (low use), adult	
55a	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	
56	General recreation	older child, adult	60	Medium-use general recreation	older child, adult	
56a	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	
57	Waterfowl hunter	older child, adult	---	Waterfowl hunting	older child, adult	X
	General recreation	young child, adult	90/15	High-use general recreation	young child (low use), adult	
58	Angler	older child, adult	---	Bank fishing	older child, adult	X
	General recreation	adult	90	High-use general recreation	adult	
59	General recreation	young child, adult	90/15	High-use general recreation	young child (low use), adult	X
59a	Angler	older child, adult	---	Bank fishing	older child, adult	
60	General recreation	young child, adult	90/15	High-use general recreation	young child (low use), adult	
60a	Rec. Canoe	older child, adult	---	Recreational canoeist	older child, adult	X
61	Utility Worker	adult	---	Utility worker	adult	
62	Utility Worker	adult	---	Utility worker	adult	
63	Utility Worker	adult	---	Utility worker	adult	
64	Utility Worker	adult	---	Utility worker	adult	
65	Utility Worker	adult	---	Utility worker	adult	
66	Utility Worker	adult	---	Utility worker	adult	
67	General recreation	adult	90	High-use general recreation	adult	
68	General recreation	adult	90	High-use general recreation	adult	
69	Angler	older child, adult	---	Bank fishing	older child, adult	
	General recreation	adult	90	High-use general recreation	adult	
70	General recreation	young child, adult	90/30	High-use general recreation	young child (high use), adult	
70a	Angler	older child, adult	---	Bank fishing	older child, adult	
71	Angler	older child, adult	---	Bank fishing	older child, adult	
	General recreation	adult	30	Low-use general recreation	adult	
72	Angler	older child, adult	---	Bank fishing	older child, adult	
72-73	Future residential	young child, adult	---	*Do Not Evaluate*		
73	General recreation	adult	90	High-use general recreation	adult	
74	General recreation	adult	90	High-use general recreation	adult	
75	General recreation	adult	90	High-use general recreation	adult	
76	General recreation	adult	90	High-use general recreation	adult	
	Future residential	young child, adult	---			
77	General recreation	adult	90	High-use general recreation	adult	
78	General recreation	older child	90	High-use general recreation	older child	
	Future residential	young child, adult	---			
79	General recreation	adult	90	High-use general recreation	adult	
80	Future residential	young child, adult	---	*Do Not Evaluate*		
80a	General recreation	adult	30	Low-use general recreation	adult	
80b	Farmer	adult	---	Agricultural use (based on direct contact by farmer)	adult	

Table 5-1. Summary of exposure scenarios evaluated for each direct contact exposure area.

Exposure Area	EPA Human Health Risk Assessment[1]			Exposure Scenario in CMS Floodplain Evaluation		
	Scenario(s) Evaluated	Receptor	Exposure Frequency (day/yr)	Scenario Evaluated	Receptor	Frequent Use EA
81	General recreation	adult	30	Low-use general recreation	adult	
82	General recreation	adult	30	Low-use general recreation	adult	
83	Groundskeeper	adult	---	High-use commercial (groundskeeper scenario)	adult	
	Future residential	young child, adult	---			
84	General recreation	adult	30	Low-use general recreation	adult	
85a	Rec. Canoe	older child, adult	---	Recreational canoeist	older child, adult	
85b	General recreation	older child	90	High-use general recreation	older child	
86	Groundskeeper	adult	---	High-use commercial (groundskeeper scenario)	adult	
	Future residential	young child, adult	---			
87	General recreation	young child, adult	90/30	High-use general recreation	young child (high use), adult	
87a	Angler	older child, adult	---	Bank fishing	older child, adult	
88	General recreation	older child	60	Medium-use general recreation	older child	
89	General recreation	adult	90	High-use general recreation	adult	
90	General recreation	older child, adult	90	High-use general recreation	older child, adult	

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[1] *EPA exposure scenarios from Human Health Risk Assessment Table 5-1 (Reaches 5 &6) and Table 5-325 (Reaches 7 & 8).*

Table 5-2. Summary of agricultural averaging areas and adjusted agricultural products consumption IMPGs.

Farm ID	EPA Designation	IMPG Category	Total Farm Area (acre)	Farm Area in Floodplain (acre)	Adjusted IMPG (mg/kg)[1]									
					Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @10^{-4}		Non-Cancer (Child)		Non-Cancer (Adult)	
					RME	CTE	RME	CTE	RME	CTE	RME	CTE	RME	CTE
FA 1	Corn	Commercial Dairy	22.8	8.0	0.68	3.1	6.8	31	68	312	7.7	12	36	44
FA 2	Hay		35.8	3.3	2.59	11.9	25.9	119	259	1187	29.1	46.4	138	168
FA 3	Formerly Corn		4.8	4.1	0.29	1.3	2.9	13	29	132	3.2	5.2	15	19
FA 4	Corn (Silage)		65.4	64.4	0.24	1.1	2.4	11	24	110	2.7	4.3	13	16
FA 5	Corn (Silage)		12.4	12.2	0.24	1.1	2.4	11	24	110	2.7	4.3	13	16
FA 6	Corn (Silage)		7.7	7.7	0.24	1.1	2.4	11	24	110	2.7	4.3	13	16
FA 7	Corn (Silage) / Wetland		24.1	24.1	0.24	1.1	2.4	11	24	110	2.7	4.3	13	16
FA 8	Hay		13.4	9.4	0.34	1.5	3.4	15	34	154	3.8	6.0	18	22
FA 9	Corn (Silage)		34.6	26.3	0.31	1.4	3.1	14	31	143	3.5	5.6	17	20
FA 10	Open Land (Possibly Hay)		2.7	0.3	2.1	9.5	21	95	206	946	23	37	110	134
FA 11	Open Land (Possibly Hay)		3.5	0.1	6.1	28	61	279	610	2794	69	109	325	396
FA 12	Open Land (Formerly Grazing)		12.4	8.0	0.38	1.8	3.8	18	38	176	4.3	6.9	20	25
FA 13	Open Land (Formerly Grazing)		4.1	4.0	0.24	1.1	2.4	11	24	110	2.7	4.3	13	16
FA 14	Open Land (Possibly Hay)		6	2.6	0.55	2.5	5.5	25	55	253	6.2	9.9	29	36

[1] *Agricultural products consumption IMPGs from Table 2-6 adjusted to account for the portion of the farm area located outside the floodplain.*

Table 5-3a. Summary of Reach 7 IMPGs (mg/kg) for amphibians and omnivorous/carnivorous mammals compared to average floodplain concentrations.

Subreach	0-6" Floodplain Soil PCB Concentration (95% Hall's UCL)	Amphibian IMPGs[1]		Omnivorous/Carnivorous Mammal IMPGs	
		Upper Bound	Lower Bound	Upper Bound	Lower Bound
7A	3.1	5.6	3.27	34.3	21.1
7B	6.9	--	--	34.3	21.1
7C	4.5	--	--	34.3	21.1
7D	2.4	5.6	3.27	34.3	21.1
7E	2.5	--	--	34.3	21.1
7F	2.1	5.6	3.27	34.3	21.1
7G	5.4	--	--	34.3	21.1
7H	3.8	--	--	34.3	21.1

Note:

[1] *Only subreaches 7A, 7D, and 7F are presented because vernal pools (those classified as both "certified" and "potential") were identified only in these subreaches.*

Key

🟦 = 95% UCL is lower than the IMPG

Table 5-3b. Summary of Reach 7 IMPGs (mg/kg) for insectivorous birds and piscivorous mammals compared to average floodplain concentrations.

Subreach	Analogous PSA Subreach	Average 0-6" Sediment Concentration[1]	0-6" Floodplain Soil PCB Concentration (95% Hall's UCL)	Insectivorous Bird IMPGs[2]	Piscivorous Mammal IMPGs[2]	
					Upper Bound	Lower Bound
7A	5A	0.41	3.1	50	16.63	3.42
7B	5C	5.1	6.9	46	11.78	*na*
7C	5A/5B	4.1	4.5	18	*na*	*na*
7D	5B	1.0	2.4	48	16.63	3.42
7E	5A	1.9	2.5	50	16.63	3.42
7F	5B	0.77	2.1	48	16.63	3.42
7G	6	6.1	5.4	46	11.78	*na*
7H	5A	0.40	3.8	50	16.63	3.42

Note:

[1] *This is the sediment concentration at the end of the model validation period (i.e., 2004).*

[2] *The insectivorous bird and piscivorous mammal IMPG presented for each subreach corresponds to the IMPG associated with the analogous PSA Reach (from the EPA Final Model Documentation Report, Table 3.6-9, based on habitat suitability for FCM species), and the corresponding average sediment concentration for that subreach.*

Key

░ = 95% UCL is lower than the IMPG

■ = 95% UCL exceeds the IMPG

na = receptor IMPG is not achievable at corresponding sediment concentration

6. Analysis of Remedial Alternatives for Floodplain Soils

This section provides detailed descriptions of each of the seven alternatives evaluated for addressing floodplain soils in the Rest of River area and includes a detailed evaluation of each using the nine Permit criteria described in Section 2.

As discussed in Sections 1.7 and 5.1, these alternatives (apart from FP 1, the no action alternative) are of two types: (1) IMPG-based alternatives (FP 2, FP 3, FP 4, and FP 7), which involve soil removal and backfilling as necessary to achieve different sets of IMPGs; and (2) threshold-based alternatives (FP 5 and FP 6), based on removing all soils having PCB concentrations exceeding certain thresholds. The seven floodplain soil remedial alternatives are as follows:[133]

- FP 1 – No action.
- FP 2 – Removal and backfill of soil to achieve the upper-bound health-based IMPGs in all human-use averaging areas, with no additional remediation for ecological receptors.
- FP 3 – Removal and backfill of soil to achieve the mid-range health-based IMPGs in certain frequently used areas and agricultural areas, the upper-bound health-based IMPGs in the remaining human-use averaging areas, and upper-bound IMPGs for ecological receptors.
- FP 4 – Removal and backfill of soil to achieve the mid-range health-based IMPGs in all human-use averaging areas, as well as upper-bound IMPGs for ecological receptors.
- FP 5 – Removal of all floodplain soils within the specified depth(s) that contain PCB concentrations at or above 50 mg/kg, with backfill of the excavations.

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[133] In the descriptions of these alternatives in this report, as previously noted, the following conventions are used:

- For the human health-based IMPGs, the upper bounds of the ranges refer to the RME IMPGs based on a 10^{-4} cancer risk or non-cancer HI of 1, whichever is lower; the mid-range values refer to the RME IMPGs based on a 10^{-5} cancer risk or non-cancer HI of 1, whichever is lower; and the lower bounds of the ranges refer to the RME IMPGs based on a 10^{-6} cancer risk, except that, for human direct contact, they are no lower than 2 mg/kg, which is the CD standard for unrestricted use.
- The target floodplain soil concentrations that have been derived to achieve certain tissue-based IMPGs (as described in Section 2.2.2.3) are included within the term “IMPGs” when used generally, and are sometimes referred to as “floodplain soil IMPGs.”

- FP 6 – Removal of all floodplain soils within the specified depth(s) that contain PCB concentrations at or above 25 mg/kg, with backfill of the excavations.

- FP 7 – Removal and backfill of soil to achieve the lower-bound health-based IMPGs in all human-use averaging areas (but no lower than 2 mg/kg for direct human contact, which is the CD standard for unrestricted use), as well as the lower-bound IMPGs for ecological receptors.

As also noted previously, each of these alternatives is aimed at achieving the specified target levels in the top foot of soil. FP 3 through FP 7 are also designed to achieve those levels in the top three feet of soil in the "Heavily Used Subareas" of Frequent-Use Areas (as defined in Section 5.2.1). Also included in each alternative (except the no action alternative) are associated interim soil handling, restoration, and OMM activities, as well as use of EREs and Conditional Solutions, where appropriate. This analysis of floodplain alternatives does not address the treatment or disposition of removed soils, which is addressed separately in Section 7.

Each alternative was evaluated in detail based on the nine Permit criteria. The results of these detailed evaluations are presented in Sections 6.1 through 6.7, respectively, for each of the seven floodplain alternatives. These evaluations are supported by the maps and tables described in Section 5.4.4.

Finally, a comparative evaluation of the seven floodplain alternatives was performed, using the same nine criteria considered during the detailed assessment. This comparative evaluation is presented in Section 6.8.

For the purposes of this evaluation, it is assumed that the floodplain remedial alternatives would be conducted independently from the sediment remedial alternatives, rather than conducting remediation of sediment and floodplain areas simultaneously. This assumption was made to simplify the process of evaluating the different floodplain and sediment remedial alternatives. In practice, it would be more effective and efficient to implement floodplain remediation in conjunction with sediment remediation. For example, there would likely be economies in the construction of access roads and establishment of staging areas if the floodplain soil remediation were implemented in coordination with sediment remediation. Opportunities for improving the economy and efficiency of remedial work by coordinating sediment and floodplain remediation can be considered during remedial design, after selection of sediment and floodplain remedies.

6.1 Evaluation of Floodplain Alternative 1

6.1.1 Description of Alternative

The no action alternative (FP 1) is included in the evaluation of floodplain alternatives as a baseline, consistent with the NCP (40 CFR 300.430(e)(6)). FP 1 would involve no remediation of floodplain soil in the Rest of River area to reduce human or ecological exposure. Additionally, monitoring would not be conducted under FP 1; therefore, any changes to floodplain conditions occurring through natural processes over time would not be documented or evaluated.

6.1.2 Overall Protection of Human Health and the Environment - Introduction

The first General Standard in the Permit, “Overall Protection of Human Health and the Environment,” requires an evaluation of whether a remedial alternative “would provide human health and environmental protection, taking into account EPA’s Human Health and Ecological Risk Assessments.” As discussed in Section 2.1.1, application of this standard to a particular floodplain soil remedial alternative relies heavily on the consideration of several other Permit criteria – notably: (a) a comparison of the floodplain soil PCB concentrations that would result from implementation of the alternative to the human health and ecological IMPGs, which represent the levels that EPA considers to be protective of human health and ecological receptors based on the HHRA and ERA; (b) compliance with ARARs; (c) long-term effectiveness and permanence, including long-term adverse impacts on health or the environment; and (d) short-term effectiveness. For FP 1, which involves no action, these evaluations have been based on existing floodplain soil levels, which are assumed to remain unchanged under this alternative. The overall evaluation of whether FP 1 would be protective of human health and the environment is presented at the end of Section 6.1 so that it can take into account the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

6.1.3 Control of Sources of Releases

The floodplain is predominantly depositional in nature and thus floodplain soils are not considered a significant source of PCBs to the River. The floodplain is generally flat and well vegetated (i.e., the root mat and vegetation serve to stabilize and cover the soil). During high flow events when the floodplain is inundated with water, these conditions greatly reduce the potential for PCBs in the floodplain soil to scour and be transported to the River. The conceptual site models presented in the RFI Report (BBL and QEA, 2003, Section 8) and EPA’s FMDR (EPA, 2006b, Section 1.3) both acknowledge that the floodplain is a depositional environment and thus not a significant source of PCBs to the

River. For example, EPA states in the FMDR that while “it is possible that some of the material deposited in the floodplain could be remobilized during subsequent flood or runoff events, the extent and significance of remobilization from the floodplain is expected to be small, particularly in comparison to bed sediment or bank erosion.” Furthermore, EPA’s model mass balance indicates that the annual PCB flux due to erosion of floodplain soil is less than 0.2% of the PCB deposition flux within the floodplain (EPA, 2006b, Figures 2 and 4 of the Errata). Nevertheless, to the extent that there is a limited potential for releases from the floodplain to the River, the no action alternative would not change that potential.

6.1.4 Compliance with Federal and State ARARs

The potential chemical-specific, location-specific, and action-specific ARARs identified by GE were discussed in Section 2.1.3 and are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs set forth in Table 2-1 consist of federal and state water quality criteria for PCBs and state air pollution control requirements for dust, and thus would not apply to the no action alternative for floodplain soils. Further, since FP 1 would not involve any remedial actions, the location-specific and action-specific ARARs (listed in Tables 2-2 and 2-3, respectively) also would not apply.

6.1.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness of an alternative has included evaluation of the magnitude of residual risk associated with implementation of the alternative, the adequacy and reliability of the alternative, and any potential long-term adverse impacts associated with the alternative on human health or the environment. Each of these considerations is evaluated below for FP 1.

6.1.5.1 Magnitude of Residual Risk

Evaluation of the magnitude of residual risk includes consideration of the length of time and extent to which the alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure.

Since FP 1 would not involve remediation, it would not result in reduced exposure of humans and ecological receptors to PCBs in floodplain soils in the near term. PCB concentrations in the floodplain soils would remain similar to current concentrations (shown in the tables discussed in Section 6.1.6 below), and any residual risk would remain largely the same as it is today. As discussed in Section 6.1.6, the residual risk presented by current floodplain conditions is limited. Although there could be some decrease in surface soil concentrations over time as relatively “cleaner” sediments are deposited in the floodplain during flood events (e.g., as a result of upstream remediation/source control or implementing an in-river sediment remedy), this change would be not be monitored or documented under FP 1.

6.1.5.2 Adequacy and Reliability of Alternative

The no action alternative has been adopted for use at other sites in areas where cleanup goals are already met. For example, no action was a remedy component for floodplain areas adjacent to the Upper ½-Mile and 1½-Mile Reaches of the River where PCB concentrations were below the applicable soil-related performance standards. Since this alternative would not involve any remedial activities, considerations relating to the adequacy and reliability of specific remedial technologies are not applicable.

6.1.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

Since FP 1 would not involve any construction or excavation activities, it would not cause any long-term adverse impacts.

6.1.6 Attainment of IMPGs

This section describes the extent to which FP 1 would meet the IMPGs for human health and ecological protection. Since this alternative involves no remediation, current floodplain soil PCB levels are assumed to remain largely unchanged. Current floodplain soil PCB EPCs for the pertinent human and ecological averaging areas are shown in Tables 6-1 through 6-6, along with a comparison to the applicable IMPGs.

6.1.6.1 Comparison to Human Health-Based IMPGs

As shown in Table 6-1, current floodplain soil PCB levels in the top foot achieve the RME IMPGs associated with a 10^{-4} cancer risk level in all direct contact EAs, but do not achieve the RME IMPGs associated with the non-cancer impacts in approximately 15% of the areas, and do not achieve RME IMPGs associated with 10^{-5} and 10^{-6} cancer risk levels in 30% and 90% of the EAs, respectively. For the Heavily Used Subareas, average floodplain soil PCB levels in the top 3 feet achieve the RME IMPGs associated with the 10^{-4} cancer risk level in 8 of the 9 subareas, and achieve the RME IMPGs associated with a 10^{-5} cancer risk and non-cancer impacts in 7 of the 9 subareas, but do not achieve the RME IMPGs associated with a 10^{-6} cancer risk in any of the subareas.

In addition, current PCB levels achieve the CTE IMPGs associated with a 10^{-5} cancer risk and non-cancer impacts in all EAs, and achieve the CTE IMPGs associated with a 10^{-6} cancer risk in most (more than 90%) of these areas. Further, current PCB levels in the

Heavily Used Subareas (top 3 feet) achieve the CTE IMPGs based on a 10^{-4} cancer risk in all subareas, those based on a 10^{-5} cancer risk in 8 of the 9 subareas, and those based on a 10^{-6} cancer risk and non-cancer impacts in 7 of those subareas.

For agricultural products consumption, as shown in Table 6-2, current floodplain soil PCB levels achieve the RME IMPGs associated with a 10^{-5} cancer risk and non-cancer impacts in all farm areas, and achieve those associated with the 10^{-6} cancer risk level in approximately 40% of the areas.

6.1.6.2 Comparison to Ecological IMPGs

Comparison of the EPCs in the ecological averaging areas to the relevant floodplain IMPGs for ecological receptors (amphibians, omnivorous/carnivorous mammals, insectivorous birds, and piscivorous mammals) shows the following:

- For amphibians, existing floodplain soil levels achieve the lower-bound IMPG (3.27 mg/kg) in 4 of the 66 vernal pools in the PSA (6%), are within the range of IMPGs (3.27 to 5.6 mg/kg) in 3 other vernal pools (5%), and exceed the upper-bound IMPG (5.6 mg/kg) in the remaining vernal pools (89%) (Table 6-3).

- For omnivorous/carnivorous mammals, existing floodplain soil levels achieve the lower-bound IMPG (21.1 mg/kg) in 3 of the 7 averaging areas, are within the range of IMPGs (21.1 to 34.3 mg/kg) in 3 additional averaging areas, and exceed the upper-bound IMPG (34.3 mg/kg) in one averaging area (Table 6-4).

- For insectivorous birds (for which the target floodplain soil IMPGs vary depending on the associated sediment concentrations), existing floodplain soil concentrations would meet the floodplain soil IMPGs in all 12 averaging areas in the PSA if the associated sediment concentration in those areas were 1 mg/kg, in 11 of those 12 areas if the associated sediment concentration were 3 mg/kg, and in 7 of the 12 averaging areas if the associated sediment concentration were 5 mg/kg (Table 6-5).

- For piscivorous mammals (for which the target floodplain soil IMPGs also vary depending on the associated sediment concentrations), soil concentrations under FP 1 would exceed the upper- and lower-bound floodplain soil IMPGs in both averaging areas at any of the three sediment target levels evaluated (1, 3, or 5 mg/kg), except that it would achieve the upper-bound soil IMPG level in one (Reach 5C/5D/6) of the two areas at the 1 mg/kg sediment target level (Table 6-6). As noted in Table 6-6, there are several cases where the soil IMPG levels (particularly the lower bound) could not be achieved at any floodplain soil concentration since the PCB concentrations in the aquatic food items at the target sediment level would by themselves exceed the IMPGs for mink prey.

6.1.7 Reduction of Toxicity, Mobility, or Volume

FP 1 would not result in any active reduction of toxicity, mobility, or volume of PCBs in the near term, as no remedial activities would be performed under this alternative. Any reduction would occur in the long term through naturally occurring processes; however, these reductions would not be documented via monitoring.

6.1.8 Short-Term Effectiveness

Short-term effectiveness considers short-term impacts on the environment, local communities, and the workers during remedy implementation. There would be no short-term effects associated with FP 1 as this alternative does not involve any construction or excavation activities.

6.1.9 Implementability

Since FP 1 involves no remedial action or associated activities, there would be no technical or administrative implementability issues associated with this alternative.

6.1.10 Cost

Since FP 1 does not include any remediation or monitoring of floodplain soils, there would be no cost associated with this alternative.

6.1.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 6.1.2, the evaluation of whether FP 1 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

<u>General Effectiveness</u>: Since FP 1 would not involve any remediation of floodplain soil, it would not reduce soil PCB concentrations, and would therefore not be effective in significantly reducing exposure of humans and ecological receptors to the PCBs that are currently present in floodplain soils. However, as shown in Section 6.1.6, the residual risks from exposure to floodplain soils under current conditions are limited. Further, PCB

concentrations in floodplain surface soil in certain areas may decrease over time due to deposition of cleaner sediments on top of them and other natural attenuation processes.

Compliance with ARARs: As discussed in Section 6.1.4, the ARARs that have been identified are not applicable to FP 1.

Human Health Protection: As discussed in Section 6.1.6.1, existing PCB levels in floodplain soil, which would remain generally unchanged under FP 1, are within the range of the RME IMPGs based on EPA's cancer risk range in all direct contact EAs and achieve the RME IMPGs associated with non-cancer impacts in 101 (approximately 85%) of the 120 EAs. In addition, average floodplain soil PCB levels in the top 3 feet in the Heavily Used Subareas are within the range of the RME IMPGs based on EPA's cancer risk range in 8 of those 9 subareas and are below the non-cancer RME IMPGs in 7 of those 9 subareas. Current floodplain soil PCB levels in all the farm areas evaluated based on agricultural products consumption (for commercial dairy farms) are within the range of adjusted RME IMPG levels based on EPA's cancer risk range and below the adjusted RME IMPG levels for non-cancer.

Environmental Protection: As discussed in Section 6.1.6.2, existing floodplain soil PCB EPCs (assumed to remain unchanged under FP 1) achieve some of the ecological IMPGs but not others. Specifically, these EPCs: (a) are within or below the IMPG range for omnivorous/carnivorous mammals (21.1 mg/kg to 34.3 mg/kg) in 6 of the 7 averaging areas; (b) exceed the upper bound of the amphibian IMPG range (5.6 mg/kg) in the majority (89%) of vernal pools in the PSA; (c) are below the floodplain soil IMPGs for insectivorous birds in all 12 averaging areas if the associated sediment concentrations in those areas were 1 mg/kg or less, in 11 of those areas if the associated sediment concentration were less than 3 mg/kg, and in 7 of those areas if the associated sediment concentrations were 5 mg/kg; and (d) exceed the upper- and lower-bound floodplain soil IMPGs for piscivorous mammals in both averaging areas, except that they would meet the upper-bound IMPG in the Reach 5C/5D/6 averaging area if the associated sediment concentration were 1 mg/kg or less.

Since FP 1 does not involve any remedial activities, it would not produce any short-term or long-term adverse environmental effects.

Summary: Since FP 1 does not involve any remediation of floodplain soils, it would not result in an appreciable reduction in human and ecological exposure to PCBs in the floodplain. Rather, it is assumed that current floodplain soil PCB concentrations would remain largely unchanged. Although GE does not believe that current PCB concentrations in the floodplain pose a significant risk to human health or the environment, EPA's HHRA and ERA concluded that they do. As discussed above, current concentrations in several of the direct contact EAs exceed the IMPG that EPA considers protective for human non-cancer impacts, and current concentrations exceed the IMPG that EPA considers protective for certain ecological receptors (e.g., amphibians, piscivorous mammals) in the majority of averaging areas. Accordingly, if one accepts EPA's conclusions in the HHRA and ERA, FP 1 would not be considered protective of human health and the environment.

6.2 Evaluation of Floodplain Alternative 2

6.2.1 Description of Alternative

FP 2 would involve the removal and backfill of floodplain soils to achieve average PCB concentrations that would meet upper-bound RME IMPGs for human health. Specifically, this alternative has been developed to achieve the following IMPGs:

- The upper-bound RME IMPGs for human health protection (i.e., those based on a 10^{-4} cancer risk or a non-cancer HI of 1, whichever is lower) from direct contact with floodplain soils; and

- The upper-bound RME IMPGs for human health protection (i.e., those based on a 10^{-4} cancer risk or a non-cancer HI of 1, whichever is lower) from consumption of agricultural products from the floodplain.

This alternative would involve removing and replacing floodplain soils as necessary to achieve average PCB concentrations in the relevant averaging areas that are equal to or less than the above-mentioned IMPGs. Average concentrations have been based on the 95% UCL of the spatially weighted mean, as discussed in Section 5.4.2. No additional floodplain soils would be removed to address ecological receptors.

Summary of Removal Areas and Volumes

FP 2 would involve the removal of approximately 17,000 cy of soil from approximately 11 acres of the floodplain. The locations of these removal areas are shown on Figure 6-1 and a detailed breakdown of the removal areas and volumes associated with FP 2 is included in Tables 6-7 through 6-12. All 17,000 cy of removal under FP 2 have been based on achieving the human direct contact IMPGs shown in Table 6-7. However, this remediation would also result in achieving certain other IMPGs, as discussed in Section 6.2.6 below.

Summary of Affected Habitat

FP 2 would involve the removal and backfill of floodplain soil in various types of habitats. The approximate acreages of those general habitat types, with associated removal volumes, are as follows:[134]

- 5 acres (9,000 cy) of upland forest habitat (consisting of high-terrace floodplain forest habitat, northern hardwoods-hemlock-white pine forest habitat, red oak-sugar maple transition forest habitat, successional northern hardwoods habitat, and transitional floodplain forest habitat);
- 2 acres (3,000 cy) of disturbed upland habitats (consisting of agricultural field habitat and cultural grasslands habitat);
- <1 acre (1,000 cy) of emergent marsh habitat (consisting of deep emergent marsh habitat, shallow emergent marsh habitat, and wet meadow habitat);
- <1 acre (<1,000 cy) of palustrine habitat (consisting of red maple swamp habitat and shrub swamp habitat); and
- 3 acres (4,000 cy) of habitat of currently unmapped community type(s).[135]

No vernal pools would be affected by the implementation of this remedial option. In addition to the above-described areas associated with removal/backfill activities, additional floodplain habitat would be affected by the construction and use of access roads and staging areas. Conceptual construction plans indicate that the staging areas would occupy

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[134] This detailed breakdown of removal areas and volumes by habitat type was conducted using the ecological characterization of the Housatonic River between the Confluence and Woods Pond Dam performed by Woodlot Alternatives, Inc. on behalf of EPA (Woodlot, 2002). The same source was used to describe the habitat types affected by all subsequent floodplain alternatives. Also, as discussed in Section 5.3.4, given the uncertainty in the estimated removal volumes (due to the use of the modified Halls Bootstrap method in calculating EPCs), total removal volumes presented in the text for all alternatives have been rounded. Due to this rounding, the sum of the volumes for the detailed breakdowns by habitat type does not always exactly match the total removal volume for the alternatives.

[135] The Woodlot habitat community mapping is absent in some small portions of the PSA floodplain and in all of Reaches 7 and 8. Most of the removal for this unmapped community type(s) under FP 2 occurs in Reach 7 and, based on aerial photography, appears to be in generally forested areas of the floodplain**.**

an additional 4 acres of floodplain and that 2 miles of temporary access roads would be constructed.

Conceptual Remedial Approach

The following summarizes the general remedial approach (and associated assumptions) related to implementation of FP 2. It should be noted that while details on equipment and processes are provided in this description for purposes of the evaluations in this CMS Report, modifications to these specifics would likely be made during the design and implementation phases after a more detailed assessment of engineering considerations and site conditions.

Prior to implementation of excavation activities, access roads and staging areas would be constructed. The staging areas and access roads would remain in place to support the backfill activities. Clearing and grubbing activities would be conducted in the targeted soil removal areas. It is assumed that soil removal would be conducted using conventional backhoes or similar construction equipment. Appropriate erosion control measures would be implemented prior to and during the completion of these actions, and construction in and near wetland areas would be implemented so as to minimize, to the extent practicable, impacts to wetland areas.

Material would be loaded into lined trucks and transported to temporary staging areas. Material would then be treated and/or disposed of based on the selected treatment/disposition alternative.

Following excavation, backfill material would be brought to the construction area by trucks and placed using backhoes and bulldozers. Excavated areas would be filled to the pre-existing grade using, to the extent practicable, soils suitable to support plant life typical of the different communities being restored. After backfilling, excavated areas would be graded and replanted.

If needed during construction, engineering controls would be implemented to reduce impacts to the surrounding community and environment. These would include fencing or other barricades to deter trespassers, and hay bales and silt fencing around sensitive wetland areas to provide protection from construction site runoff during storm events. Dust control measures, if needed, would include water, foam sprays, or similar approaches.

It is estimated that implementation of FP 2 could be completed within 1 year if implemented independently from River-related remedial activities. However, floodplain remediation would likely be coordinated with sediment remediation. If so, the time to complete FP 2 could be different, depending on the sediment remediation alternative selected.

Nevertheless, for purposes of the evaluations in this section, it has been assumed that implementation of FP 2 would take less than 1 year.

In addition to soil removal and backfilling, FP 2 would include institutional controls. Specifically, it would include the use of EREs and Conditional Solutions as necessary to address reasonably anticipated future uses and activities for which this alternative would not meet applicable cleanup criteria (e.g., residential use standards, where that use is reasonably anticipated and remediation would not meet those standards).

After restoration activities within a given area are completed, periodic monitoring and maintenance would be conducted for the cover and restored vegetation. For the purposes of this CMS Report, monitoring and maintenance are assumed to occur for 3 years following remedy implementation. Monitoring would include annual visual inspections of restored areas (e.g., to assess plant survivorship and evidence of erosion). Based on those inspections, maintenance would be performed, as necessary, to maintain the effectiveness of the remedy.

6.2.2 Overall Protection of Human Health and the Environment - Introduction

As discussed in Section 6.1.2, the evaluation of whether a floodplain soil remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether FP 2 would be protective of human health and the environment is presented at the end of Section 6.2 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

6.2.3 Control of Sources of Releases

Existing floodplain soil conditions are currently not a significant source of potential PCB releases to the River, nor would they be following restoration. As discussed in Section 6.1.3, the floodplain is generally flat, well vegetated, and depositional in nature, greatly reducing the potential for PCBs in the floodplain soil to scour and transport to the River. While the floodplain is thus not considered a significant source, implementation of FP 2 would further reduce the limited potential for PCBs in the floodplain to be released to the River by removing 17,000 cy over 11 acres of some of the higher-concentration floodplain soils and replacing them with clean soil and replanted vegetation.

Open excavations during construction could serve as a short-term, temporary source of some releases during an extreme weather event. Such potential releases would be controlled using conventional engineering practices.

6.2.4 Compliance with Federal and State ARARs

The potential chemical-specific, location-specific, and action-specific ARARs identified by GE are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs set forth in Table 2-1 consist of federal and state water quality criteria for PCBs and state air pollution control requirements for dust. The water quality criteria do not apply to floodplain soils, and GE believes the state air pollution control requirements for dust could be achieved.

The potential location-specific and action-specific ARARs are listed in Tables 2-2 and 2-3. Based on review of those ARARs, GE believes that FP 2 could be designed and implemented to achieve most of the ARARs that would be pertinent to this alternative, although certain EPA approval determinations may be necessary to do so. For example, it is uncertain whether the temporary on-site staging areas for PCB-containing soil would meet all the default conditions of EPA's TSCA regulations for storage of PCB remediation waste at the cleanup site or site of generation (40 CFR § 761.65(c)(9)). Thus, depending on the specific design for those areas, it may be necessary to obtain an EPA determination that these storage areas meet the TSCA regulations' substantive requirements for a risk-based approval (40 CFR § 761.61(c)).

The potential ARARs that may not be met are those that could potentially apply to the temporary staging areas in the event that the excavated soils should be found to constitute hazardous waste under RCRA or comparable state criteria. Based on prior experience at other portions of this Site (e.g., the floodplain adjacent to the 1½-Mile Reach), it is not anticipated that the excavated soils would constitute characteristic hazardous waste under RCRA. However, TCLP testing of representative soils would be conducted to determine whether they do so. In the event that any particular excavated soils should be found to constitute hazardous waste, the staging areas may not meet all the substantive requirements of EPA's RCRA regulations for hazardous waste storage facilities, as previously discussed in Section 4.3.4. For example, it is not anticipated that the temporary waste piles would be constructed with the double liner/leachate collection systems specified for new waste pile units to be used for storage of hazardous waste (40 CFR § 264.251(c)), or that they would have groundwater monitoring systems such as is required for regular hazardous waste management facilities (40 CFR Part 264, Subpart F). Additionally, depending on the locations of these facilities and site characteristics, it is possible that at least some of them would not be constructed to meet the hazardous waste facility requirements for preventing impacts from a 100-year flood (see 40 CFR § 264.18(b)), although they would include appropriate engineering controls for storm events. GE does not believe that it would be practical or necessary for the temporary staging facilities to be constructed and operated to comply with all the regular RCRA storage requirements (which are designed for more permanent storage facilities) simply due to the possibility that these facilities may be used for staging of some floodplain soils that might constitute hazardous waste. Accordingly, GE believes that, to the extent that some such soils may constitute hazardous waste, the design and operating requirements for regular RCRA hazardous waste storage facilities should be considered inapplicable[136] or, if necessary, waived as technically impracticable.

Similarly, it is possible, although not anticipated, that certain excavated floodplain soils would constitute hazardous waste under the Massachusetts hazardous waste regulations on grounds other than containing PCBs $\geq$ 50 mg/kg.[137] In the event that particular excavated soils would do so, the staging areas would likely not meet certain requirements of the Massachusetts hazardous waste regulations. For example, since these areas, which would contain waste piles, need to be located relatively close to the removal areas, it is unlikely that they could feasibly meet the requirement that waste piles used for hazardous waste storage may not be constructed within the 500-year floodplain (310 CMR 30.701(6)). In addition, depending on the locations of the staging areas, some of those areas may not meet other location standards set forth in these regulations for such waste piles (e.g., 310 CMR 30.704(3), 30.705(3) & (6)) or certain design requirements for such waste piles (e.g., that the liner must be a minimum of 4 feet above the probable high groundwater table) (310 CMR 30.641). Further, construction of groundwater monitoring systems (per 310 CMR 30.660) for these temporary staging areas is not practical. In these circumstances, to the extent that some excavated soils may constitute hazardous waste and that the Massachusetts hazardous waste regulations were deemed to apply, such requirements should be waived as technically impracticable for the temporary staging areas.

6.2.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness of FP 2 includes evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential

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[136] For example, under EPA's AOC policy (EPA, 1995), an overall area that includes discrete areas of generally dispersed contamination may be considered an AOC, within which the movement of waste is not considered "placement," such that the RCRA land disposal restrictions and other RCRA requirements, including minimum technology requirements, would not be triggered.

[137] Although wastes with PCB concentrations $\geq$ 50 mg/kg are listed hazardous wastes in Massachusetts, the Massachusetts hazardous waste regulations exempt facilities that manage such wastes so long as those facilities comply with EPA's TSCA regulations (310 CMR 30.501(3)(a)), and the staging facilities would meet substantive TSCA requirements. The other pertinent bases for characterizing a waste as hazardous under the state regulations are the same as those under RCRA.

long-term adverse impacts on human health or the environment. Each of these considerations is discussed below.

6.2.5.1 Magnitude of Residual Risk

Evaluation of the magnitude of residual risk associated with FP 2 includes consideration of the length of time and extent to which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure, such as institutional controls.

FP 2 would reduce potential exposures of humans and ecological receptors to PCBs in floodplain soil by removing approximately 17,000 cy of PCB-containing soil over 11 acres of floodplain (see Figure 6-1). The reduction in potential exposure and associated risk would occur upon completion of the remediation in a given area.

Following implementation of FP 2, the average post-remediation floodplain soil concentrations in the human health averaging areas would be equivalent to or lower than those associated, under RME assumptions, with a cancer risk of 10^{-4} and a non-cancer HI of 1. The average PCB EPCs that would remain in the top foot within the human health and ecological averaging areas are shown in Tables 6-7 through 6-12. Comparison of these EPCs to the EPA-approved IMPGs for human health and ecological receptors is discussed in Section 6.2.6.

PCBs would also remain at depths below the top foot. However, such deeper soil would not be available for exposure under current uses. Where it is reasonably anticipated that that deeper soil would become available for exposure in the future, it would be addressed by EREs and/or Conditional Solutions. Additionally, EREs and Conditional Solutions would be implemented where necessary to address potential risks from reasonably anticipated future uses.

6.2.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of FP 2 has included an assessment of the use of the technologies under similar conditions, the general reliability of those techniques, reliability of OMM, and technical component replacement requirements, as discussed below.

Use of Technology Under Similar Conditions

FP 2 relies primarily on the removal of floodplain soils, followed by backfilling and restoration activities. Of the 11 acres to be removed under FP 2, the majority (at least 5 acres) consists of upland forest areas where the vegetation would be cleared and the soil removed and replaced. Areas where removal and restoration would be more challenging include a few limited areas of wetlands (less than 1 acre of emergent marsh and palustrine habitat). Work in all these areas would likely be conducted using conventional construction techniques and equipment, with more specialized equipment such as smaller, low ground pressure excavators and access mats (to cross wetlands if not being excavated) used, as necessary, to minimize the impacts of remedy implementation.

Excavation and restoration of floodplain environments have been implemented at a number of sites across the country. Examples of sites where floodplain remediation has been conducted include the 1½-Mile Reach of the Housatonic River; Bryant Mill Pond (MI; EPA 2005e); Town Branch (KY; ARCADIS BBL, 2007); Fields Brook Superfund Site (OH; EPA, 2004b); Kress Creek/West Branch DuPage River (IL; EPA, 2005f); and Little Mississinewa River Site (EPA, 2004c). Remediation of the floodplains at these sites has included excavation of soils from the floodplain using conventional earth-moving equipment (as would be used in FP 2).

Once the floodplain soils have been remediated, common restoration techniques would be applied. For FP 2, these techniques could be applied to restore either upland areas or wetlands. The same sites listed above as examples of floodplain remediation also included restoration components for disturbed upland and/or wetland areas. For example, restoration of upland areas at Town Branch included placement of backfill and topsoil over 50 acres, with reseeding of vegetation (ARCADIS BBL, 2007). At Fields Brook, remediated floodplain areas and wetlands were similarly restored by backfilling, seeding, and planting (EPA, 2004b). The remedy for the Kress Creek/West Branch DuPage River Site included the restoration of areas disturbed by the cleanup along approximately eight miles of the creek/river channel and floodplain habitats (EPA, 2005f). At the Little Mississinewa River Site, the remedy included restoration of excavated areas within approximately 20 miles of floodplain (EPA, 2004c).

Restoration of wetland areas has also been performed successfully at several other sites. For example, at the York Oil Company site (NY; EPA, 2004f), 17 acres of intermittent ponds and wetlands (forested, shrub-scrub, and emergent wetland communities) and a 50-acre drainage channel, which were disturbed by the remediation, were restored with clean topsoil and replanted with wetlands and uplands vegetation. Further, excavation and restoration of 50 acres of floodplain (forested, shrub-scrub, and emergent wetland communities) were conducted at Loring Air Force Base (ME; Woodlot, 2007).

For the small area (11 acres) and limited wetlands that would be affected by FP 2, the technology is expected to be adequate for both removal and restoration activities.

General Reliability

The removal and backfill of material for FP 2 would reliably, effectively, and permanently reduce the concentrations of PCBs in soils in removal areas. Restoration activities would include backfilling with soil appropriate to support plant growth and replanting vegetative communities similar to those that were removed, to the extent practicable. For FP 2, these restoration activities would be performed using standard and reliable restoration techniques.

Reliability of Operation, Monitoring, and Maintenance Requirements

Following the construction phase of FP 2, a monitoring and maintenance program would be implemented for those areas restored following remediation. Both the removal areas and those portions of the floodplain disturbed during construction of access roads and staging areas would be monitored through periodic inspections to ensure that the planted vegetation is surviving and growing, and to identify areas (if any) where the backfill has eroded and needs repair. Periodic inspection of the plantings and backfill areas is considered a reliable means of tracking the restoration activities. Labor and materials needed to monitor and perform any maintenance activities required following implementation of FP 2 are readily available.

Technical Component Replacement Requirements

Restoration of the areas affected under FP 2, including access roads and staging areas, would include placement of backfill to pre-existing grade in remediated areas, removal of temporary road materials, and revegetation. If erosion or plant loss were observed in the restored floodplain areas, an assessment would be conducted to determine the cause, as well as the need for and methods of repair or replacement. It is anticipated that if repair or replacement were necessary, it could be implemented using the same types of methods and materials used during the initial backfilling/restoration activities. Periodic small-scale inspections and repairs would pose no appreciable risks to humans and ecological receptors that use/inhabit the floodplain in these areas.

6.2.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of FP 2 on human health or the environment has included consideration of the following:

Potentially Affected Populations

Implementation of FP 2 would remove and replace areas of several habitat types, as described in Section 6.2.1. Due to the relatively small size of these areas in relationship to the overall floodplain ecosystem, it is not likely that FP 2 would have significant long-term impacts on wildlife populations. Because this alternative would leave much of the floodplain undisturbed, potential long-term effects on humans and wildlife populations through changes in the natural environment and habitat would be expected to be minimal.

Adverse Impacts on Biota and Corresponding Habitat

In general, it is not expected that implementation of FP 2 would cause any significant long-term adverse impacts on biota and their habitat. FP 2 would impact approximately 5 acres of upland forest habitat, which would be replanted as a part of the restoration. Although it would take considerable time for the new trees to reach the same maturity as the existing trees, the amount of upland forest that would be affected by FP 2 is small relative to the remainder of this type of habitat in the floodplain, so the overall negative impacts on the associated wildlife community would likely be minor.

FP 2 would impact approximately 2 acres of disturbed upland habitats (consisting of agricultural field habitat and cultural grasslands habitat). As these areas support altered or early successional plant communities that have limited ecological value, no long-term impacts would be expected from the remediation in these areas.

It is also not anticipated that FP 2 would have significant long-term adverse impacts on wetlands and the biota inhabiting them, as discussed in the following section.

It should also be noted that, as part of the ecological characterization of the PSA floodplain, Woodlot (2002) identified 15 rare plant species at 27 locations within the floodplain. One of those locations is within the area targeted for soil removal under FP 2. However, the potential loss of one location of the species would not be likely to result in a permanent loss of the population of this species across the floodplain.

Adverse Impacts on Wetlands

The excavations involved in FP 2 would affect less than 1 acre of wetland habitat consisting of marshes and wooded swamps. Excavation and other construction activities in these areas would result in a loss of the wetlands vegetation and wildlife supported by the habitat, and could temporarily modify the hydrology of these wetlands. However, given the small area of wetlands affected by FP 2, these impacts would be limited, and efforts would be made to restore the wetlands vegetation and hydrology to the extent practicable. Moreover, FP 2 would not involve remediation of vernal pools and, therefore, would not have any long-term impacts on vernal pools and the amphibians that use them. In these circumstances, it is not expected that the excavations associated with FP 2 would have any significant long-term adverse impacts on wetlands or the biota they support.

Ancillary construction activities could potentially affect wetlands in areas where roads and staging areas are constructed in support of excavation. Impacts to wetlands hydrology from the construction of access roads and staging areas and use of these areas with heavy equipment could modify soil conditions, drainage patterns, or groundwater flow conditions, potentially creating a change in the characteristics of an existing wetland or converting a wetland to an upland environment. However, based on the conceptual design, the only wetlands that may be unavoidable for such ancillary construction activities are less than 1 acre of palustrine habitat in Reach 5. Because this area is so small, restoration is expected to be successful and the potential for long-term impacts arising from the placement of roadways and staging areas for FP 2 would be small.

Long-Term Impact on Aesthetics

Implementation of FP 2 would have limited long-term impacts on the aesthetic features of the natural environment. The natural appearance of the floodplain after the remediation and restoration would be altered in those areas where excavation is performed. Floodplain areas would be restored by backfilling to original elevations and reseeding/replanting vegetation that would be similar to the vegetation that was removed, to the extent practicable. As noted above, FP 2 would result in the removal and replanting of 5 acres of mature forested communities in the floodplain. These areas would be replanted with smaller caliper trees and would look markedly different following restoration. However, the area that would be affected from implementation of FP 2 is small relative to the overall floodplain environment and the remediation would thus not be significantly detrimental to the overall aesthetics of the floodplain in the long term.

Potential Measures to Mitigate Long-Term Adverse Impacts

To mitigate potential long-term impacts to the floodplain following remedy implementation, a restoration plan would be developed. Placement of backfill soil suitable to support plant growth and surface soil grading would be conducted to restore the soil elevations. Upland communities would be restored either with species currently found in those areas or with species typical of these communities. In addition, the limited wetland areas affected by FP 2 (less than 1 acre) would be replanted with hydrophytic species typical of the existing plant community, and measures would also be taken, to the extent practicable, to replace the functions of those wetlands, such as nutrient cycling, flood control, and water filtration. For work in and near wetlands, it may be appropriate to use specialized equipment and materials, such as low ground pressure excavators and special matting if needed to cross wetlands to access specific locations, in order to minimize the potential for long-term adverse effects.

6.2.6 Attainment of IMPGs

This section describes the extent to which FP 2 would achieve the IMPGs for both human health and ecological receptors. These comparisons are presented in Tables 6-7 through 6-12 for the pertinent human and ecological averaging areas. The time frame to achieve any IMPGs would be the same as that required to complete the remedy in a particular area (i.e., the reduction in soil concentrations would occur upon completion of backfill placement). For FP 2, it is estimated that the entire remediation could be completed in less than 1 year.

6.2.6.1 Comparison to Human Health-Based IMPGs

FP 2 would achieve, at a minimum, the RME IMPGs based on a 10^{-4} cancer risk and a non-cancer HI of 1 in all 120 direct contact EAs (Table 6-7). In addition, FP 2 would achieve the RME IMPGs based on a 10^{-5} cancer risk in 84 of those EAs (including the top 3 feet in 7 of the 9 Heavily Used Subareas) and the RME IMPGs based on a 10^{-6} cancer risk in 13 EAs. Further, FP 2 would achieve the CTE IMPGs based on a 10^{-5} cancer risk and non-cancer impacts in all of the direct contact EAs.

For human consumption of agricultural products, FP 2 would achieve the RME IMPGs based on a 10^{-5} cancer risk and non-cancer impacts in all 14 of the farm areas evaluated for such consumption, and would achieve the RME IMPGs based on a 10^{-6} cancer risk in 6 of those farm areas (Table 6-8).

The comparisons above are shown in detail in Tables 6-7 and 6-8 for all human exposure areas in Reaches 5 through 8.

6.2.6.2 Comparison to Ecological IMPGs

FP 2 would achieve some of the ecological IMPGs in some areas:

- For amphibians, the EPCs resulting from FP 2 would achieve the lower-bound IMPG (3.27 mg/kg) in 4 of the 66 vernal pools in the PSA (6% of the pools, covering <1% of the total vernal pool acreage), are within the range of the IMPGs (3.27 mg/kg to 5.6 mg/kg) in 3 additional vernal pools (5% of the pools, covering 1% of the total vernal pool acreage), and exceed the upper-bound IMPG (5.6 mg/kg) in the remaining vernal pools (89% of the pools, covering 98% of the total vernal pool acreage) (Table 6-9).

- For omnivorous/carnivorous mammals, FP 2 would achieve the lower-bound IMPG (21.1 mg/kg) in 4 of the 7 averaging areas and would achieve the upper-bound IMPG (34.3 mg/kg) in all of those areas (Table 6-10).

- For insectivorous birds, FP 2 would achieve the target floodplain soil IMPGs in each of the 12 averaging areas in the PSA if the associated sediment concentrations in those areas were 3 mg/kg or less, and would achieve those levels in 8 of the averaging areas (all except 1 in Reach 5A and 3 in Reach 5B) if the associated sediment concentrations were 5 mg/kg (Table 6-11).

- For piscivorous mammals, the EPCs resulting from FP 2 would exceed the upper- and lower-bound target floodplain soil IMPGs in both averaging areas at any of the three sediment target levels evaluated (1, 3, or 5 mg/kg), except that it would achieve the upper-bound soil IMPG level in one (Reach 5C/5D/6) of the two areas at the 1 mg/kg sediment target level (Table 6-12). There are several cases where the soil IMPG levels (particularly the lower bound) could not be achieved at any floodplain soil concentration since the PCB concentrations in the aquatic food items at the target sediment level would by themselves exceed the IMPGs for mink prey.

These comparisons are shown in detail in Tables 6-9 through 6-12 for all ecological averaging areas in the PSA.

6.2.7 Reduction of Toxicity, Mobility, or Volume

The degree to which FP 2 would reduce the toxicity, mobility, or volume of PCBs in floodplain soils is discussed below.

Reduction of Toxicity: FP 2 does not include any treatment processes that would reduce the toxicity of the PCBs in the floodplain soils. However, if “principal threat” wastes (e.g., NAPL, drums of liquid) should be encountered during floodplain excavation (which is not anticipated), they would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: As previously noted, the existing conditions of the floodplain are predominantly depositional and stable due to the presence of vegetation and the generally low water velocities during periods of inundation. Therefore, PCBs in existing floodplain soils do not represent a significant potential source for mobility and migration. Nevertheless, implementation of FP 2 would further reduce the limited potential for mobility of PCBs in the floodplain by removing 11 acres of soil with higher PCB concentrations from the floodplain, backfilling the excavations, and revegetating the surface.

Reduction of Volume: FP 2 would reduce the volume of PCB-containing soils and the mass of PCBs present in the floodplain by removing 17,000 cy of soils containing approximately 2,400 lbs of PCBs.

6.2.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of FP 2 has included consideration of the short-term impacts of implementing this alternative on the environment, the local communities (as well as communities along truck transport routes), and workers involved in the remedial activities. These impacts would last for the duration of the remedial activities, which are estimated to take a single construction season.

Impacts on the Environment

The short-term effects on the environment resulting from implementation of FP 2 include the temporary removal of plant and wildlife habitat in those areas of the floodplain where remediation or the construction of access roads and staging areas would occur. Short-term impacts specifically associated with each habitat type are described below.

Mature Upland Forest: The largest short-term impact would occur from the removal of at least 5 acres of mature upland forest. Birds, mammals, reptiles, and amphibians would be at least temporarily impacted by the habitat disruption associated with implementation of this alternative. The temporary loss of the plant communities would result in indirect impacts to wildlife through the loss of cover, nesting, and feeding habitat. This would be particularly disruptive to wildlife with small home ranges, which would not be likely to move out of the construction zone. Likewise, birds that are dependent on the plant community for the placement of their nests would be forced to move elsewhere during nesting season.

Disturbed Upland Habitat: The short-term impacts associated with the removal of 2 acres of disturbed upland habitat would be limited as the amount of area affected by the removal is relatively small and the quality of the habitat is low relative to the undisturbed areas of the floodplain. While these areas would be disturbed, they would, if left alone, readily return to a natural state.

Emergent Wetlands Habitat: Short-term impacts would also be associated with the loss of a limited area (less than 1 acre) of emergent wetlands. Short-term impacts from the disturbance of these wetlands as a result of the remedial action would include the inability of these areas to support mammals, birds, reptiles, and amphibians that are dependent on wetlands for nesting, breeding, and feeding. However, because the area of emergent wetlands affected by FP 2 would be limited, the adverse impacts would likewise be small.

Palustrine Habitat: Short-term impacts would also be associated with the loss of a limited area (less than 1 acre) of forested wetlands. Short-term impacts from the disturbance of these wetlands as a result of the remedial action would include the inability of these areas to support mammals, birds, reptiles, and amphibians that are dependent on wetlands for nesting, breeding, and feeding. Again, however, because the area of forested wetlands affected by FP 2 would be limited, the adverse impacts would likewise be small.

Additional Habitats Affected by Supporting Facilities: Construction of supporting facilities (e.g., roadways, staging areas) in the floodplain would result in the temporary loss of habitat in those areas and the wildlife that they support. It is anticipated that FP 2 would require a total of approximately 9 acres for access roads and staging areas. Based on the conceptual layout, these facilities would affect primarily upland forested habitat and less than 1 acre of wetlands. Development of these support facilities would affect the ability of some wildlife to nest and feed in these areas; and in some instances it would cause habitat fragmentation that could further disrupt the movement and interactions of certain wildlife species. In addition, wetlands that are not undergoing remediation could be indirectly affected by construction as a result of changes in stormwater drainage patterns and modifications to hydrology. Conventional engineering controls would be used to control siltation and runoff from the temporary surfaces.

Impacts on Local Communities and Communities Along Truck Transport Routes

FP 2 would result in short-term impacts to the local communities along the River. These short-term effects would include: changes to the appearance of the forested areas in the floodplain due to the removal and replacement of mature trees and other established vegetation; disruption of certain recreational activities along the River and within the floodplain due to the remediation as well as the construction of staging areas and roads; and increased construction traffic and noise during excavation and backfilling activities.

Most of the floodplain areas that would be remediated under FP 2 are characterized as general recreation. However, they also include canoe launch areas, a bank fishing area, and dirt biking/ATVing areas. Recreational activities in these areas would be disrupted during implementation of FP 2. These impacts would be expected to last during the remediation period (less than a full construction season), and for some time after until the areas are sufficiently restored to support such use.

Due to the need to remove excavated materials and deliver backfill materials and equipment, truck traffic would increase during the construction period. As an example, if 20-ton capacity trucks were used to transport excavated material from the staging areas, it would take approximately 1,300 truck trips to do so. Assuming the use of smaller capacity trucks for local hauling (i.e., 16-ton trucks), an additional 3,700 truck trips would be anticipated to import backfill materials, as well as materials for the construction of staging areas and access roads, to the site.

This additional traffic would increase the likelihood of accidents, noise levels, emissions of vehicle/equipment exhaust, and nuisance dust to the air. In addition, noise in and near the construction zone could affect those residents and businesses located in the immediate vicinity of work areas. Engineering controls would be implemented to mitigate short-term impacts and risks associated with implementation of FP 2. However, some impacts would be inevitable.

The increased truck traffic would also increase the risk of traffic accidents along transport routes. Appendix D includes an analysis of potential risks from the increased truck traffic that would be necessary to transport clean materials to the site for implementation of the FP alternatives.[138] The analysis for FP 2 indicates that the increased truck traffic for this alternative (an estimated 185,000 vehicle miles) would result in an estimated 0.11 non-fatal injuries due to accidents (with a probability of 10% of at least one injury) and an estimated 0.004 fatalities from accidents (with a probability of less than 1% of at least one fatality).

Risks to Remediation Workers

There would be potential health and safety risks to site workers implementing FP 2. Engineering controls and OSHA procedures designed to mitigate risks to remediation workers would be instituted. Implementation of FP 2 is estimated to involve 27,554 labor-hours over a 1-year timeframe.

Appendix D also includes an analysis of potential risks to workers from implementation of the floodplain alternatives. This analysis indicates that implementation of FP 2 would result in an estimated 0.28 non-fatal injuries to workers (with a probability of 25% of at least one injury) and an estimated 0.002 worker fatalities (with a probability of 0.2% of at least one fatality).

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[138] The risks from truck traffic to transport excavated materials from the staging areas away from the site are evaluated under the relevant treatment/disposition alternatives.

6.2.9 Implementability

6.2.9.1 Technical Implementability

The technical implementability of FP 2 has been evaluated in terms of the general availability of the technology involved (soil excavation and backfilling), the ability of this technology to be constructed and operated given site characteristics, the reliability of this technology, the availability of support facilities and resources, ease of undertaking corrective measures if necessary, and ability to monitor effectiveness.

General Availability of Technology: The equipment, materials, technology, procedures, and personnel necessary to implement FP 2 are expected to be readily available. FP 2 would use conventional heavy construction equipment to excavate and transport floodplain soils, as well as to bring in and place backfill and restoration materials. Such equipment would include excavators, bulldozers, and dump trucks. Other construction equipment might be used (e.g., roll-off containers) to assist with removal, transport, storage, and materials replacement. In some cases, it may be appropriate to use more specialized equipment and materials, such as low ground pressure excavators and special matting to access specific places or otherwise to perform construction in specific areas. These technologies have been used at other sites to access and restore sensitive areas, especially wetlands.

Given the physical characteristics of the floodplain and the availability and known reliability of construction equipment and materials, FP 2 would be technically implementable. Support areas would be constructed using commonly available construction technologies. Methods to implement monitoring and institutional controls are all considered readily available.

Ability To Be Implemented: Based on site characteristics, the excavation/backfill technology that would be used for FP 2 is suitable for implementation in the areas where it would be applied. The construction of access roads and staging areas may temporarily affect flood storage and drainage characteristics during seasonal high water conditions and during periodic storm and flood events. Engineering practices would be implemented to reduce the temporary impacts of such hydrology changes. In addition, restoration activities would be conducted to reduce the long-term impacts of such changes, including the return of removal areas to existing grade elevations to maintain the flood storage capacity of the floodplain.

Reliability: Soil removal with backfilling is considered a reliable means of remediating areas of the floodplain. Floodplain soil excavation has been successfully implemented at other PCB-impacted sites across the country, some of which are described in Section 6.2.5.2 above.

Availability of Support Facilities and Resources: Implementation of FP 2 would require construction of access roads and staging areas at various locations within the floodplain. As noted previously, an estimated 9 acres would be needed, and appear to be available to support the FP 2 activities based on a conceptual site layout. The specific locations and sizing of these access roads and support areas would be determined during design. Appropriate backfill and planting materials are expected to be readily available.

Ease of Conducting Additional Corrective Measures: If necessary, performing additional remediation at a later date would be possible using the same types of tools, equipment, and materials as in the original round of remediation. Construction equipment, personnel, and materials are commercially available and their use and effectiveness for this type of material removal and backfill project are well known and documented. Ease of implementation of the corrective measures would be directly related to the extent of the necessary additional corrective measure (i.e., area and/or volume to be addressed) and the ease of access (e.g., remoteness from roads, wetlands crossings, size and type of construction equipment).

Ability to Monitor Effectiveness: The effectiveness of FP 2 would be assessed by visual observation to evaluate such factors as vegetation growth (e.g., plant survivorship) and any signs of erosion of restored areas. Monitoring procedures would be straightforward and implementable.

6.2.9.2 Administrative Implementability

The evaluation of administrative implementability of FP 2 has included consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: Implementation of FP 2 would need to comply with the substantive requirements of applicable and appropriate regulations pertaining to the performance of the remedial action (unless waived). As discussed in Section 6.2.4, GE believes that FP 2 could be designed and implemented to meet such requirements (i.e., the location-specific and action-specific ARARs listed in Tables 2-2 and 2-3), with the exception of certain requirements that could potentially apply to the on-site staging areas if the excavated materials should constitute hazardous waste. In the latter case, if necessary, GE believes that such requirements should be waived as technically impracticable.

Access Agreements: Implementation of FP 2 would require GE to obtain permission for access to the properties where the work would be conducted or where the ancillary facilities would be located. Access to State-owned lands would be sought from the state agencies that own the land. In addition, it is currently anticipated that access agreements would be required from approximately 15 private landowners. Obtaining access to all these properties for the type of work and length of time that may be needed could be difficult and time-consuming. If GE should be unable to obtain access agreements with particular landowners, GE would request EPA and/or MDEP to provide assistance.

Coordination with Agencies: Implementation of EREs and Conditional Solutions as part of FP 2 would require coordination with EPA and MDEP. In addition, as noted above, obtaining access to State-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of FP 2, GE would need to coordinate with EPA, as well as state and local agencies, to address potential health and safety impacts and to provide as-needed support with public/community outreach programs.

6.2.10 Cost

The estimated total cost to implement FP 2 is $10.6 M (excluding the costs of treatment/disposition of excavated soil). The estimated capital cost for implementation of FP 2 is $10.3 M, assumed to occur over a 6-month construction period. Estimated annual OMM costs (for a 3-year inspection and maintenance program for restored excavation and staging/access road areas) range from $15,000 to $25,000 per year (depending on which reach is being monitored), resulting in a total cost of $255,000. The following summarizes the total costs estimated for FP 2.

FP 2	**Est. Cost**	**Description**
Total Capital Cost	$10.3 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM Cost	$0.3 M	Costs for performance of the OMM programs
Total Cost for Alternative	$10.6 M	Total cost of FP 2 in 2008 dollars

The total estimated present worth of FP 2, which was developed using a discount factor of 7%, a 6-month construction period, and an OMM period of 3 years on a reach-specific basis, is approximately $10.3 M (which, in this case, is nearly the same as the total cost in light of the assumed short duration for implementing this alternative). More detailed cost estimate information and assumptions for each of the floodplain alternatives are included in Appendix E.

As noted above, these costs do not include the costs of treatment/disposition of the removed floodplain soils. The estimated costs for combinations of FP 2 with the various treatment/disposition alternatives are presented in Section 8.

6.2.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 6.2.2, the evaluation of whether FP 2 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: FP 2 would result in a reduction in the potential for human and ecological exposure to PCBs in floodplain soils by the removal of 17,000 cy of PCB-containing soil, containing 2,400 lbs of PCBs, from the floodplain, followed by backfilling of the excavations.

Compliance with ARARs: As discussed in Section 6.2.4, based on review of the potential ARARs, GE believes that FP 2 could be designed and implemented to achieve the ARARs pertinent to this alternative, with the possible exception of certain requirements that could apply to the on-site staging areas if the excavated soils should constitute hazardous waste. In the latter case, if necessary, GE believes that such requirements should be waived as technically impracticable.

Human Health Protection: As discussed in Section 6.2.6.1, implementation of FP 2 would achieve the RME IMPGs based on a 10^{-4} cancer risk and a non-cancer HI of 1 in all direct-contact EAs. It would also achieve, in all farm areas evaluated for agricultural products consumption, PCB concentrations that are at or below the adjusted RME IMPG levels based on a 10^{-5} cancer risk and a non-cancer HI of 1. FP 2 would further ensure protection of human health through implementation of EREs and Conditional Solutions, where necessary, to address reasonably anticipated future uses. In these circumstances, FP 2 is considered protective of human health.

Environmental Protection: As discussed in Section 6.2.6.2, FP 2 would achieve some of the ecological IMPGs, but not others. Specifically, it would achieve: (a) levels within or below the IMPG range for omnivorous/carnivorous mammals in all 7 averaging areas; and (b) the target floodplain soil IMPG levels for insectivorous birds in all 12 averaging areas if the associated sediment concentration in those areas is 3 mg/kg or less, and in 8 of those areas if the associated sediment concentration is 5 mg/kg. However, FP 2 would not achieve the upper bound of the amphibian IMPGs (5.6 mg/kg) in nearly 90% of the vernal pools in the PSA, and it would not achieve levels within the range of the target floodplain soil levels for piscivorous mammals in either of the 2 averaging areas, except in the Reach 5C/5D/6 averaging area if the associated sediment concentration is 1 mg/kg or less.

As discussed in Section 2.1.1, since achievement of IMPGs is one of the Selection Decision Factors under the Permit, it is not determinative of whether an alternative would provide overall protection of the environment, but rather is a consideration to be balanced against the other Selection Decision Factors. In this case, despite the exceedances of the IMPGs for amphibians and piscivorous mammals, the impact of those IMPG exceedances on the maintenance of healthy local populations of these receptors, given their reproductive strategies and/or home ranges as well as the availability of other, unaffected habitats, is at best uncertain. Field surveys conducted by both EPA and GE indicate that local populations of these receptors continue to reproduce and inhabit the floodplain despite the long-term presence of PCBs in the floodplain soil.

In addition, as discussed in Section 6.2.8, while implementation of FP 2 would result in short-term adverse environmental impacts on the habitats where the remediation and associated activities would take place, these impacts would be limited both in areal extent and in duration (expected to be less than 1 year). Further, as discussed in Section 6.2.5.3, implementation of FP 2 would not be expected to produce any significant long-term adverse effects on the environment, both because of the short duration of the remediation and because the overall areas of sensitive habitat (mature upland forest and wetlands) subject to remediation are small relative to the same types of habitat that would remain unaffected by the remediation.

Summary: For the reasons discussed above, FP 2 would provide overall protection of human health by achieving average PCB concentrations associated with cancer risks within EPA's acceptable risk range and non-cancer impacts at or below an HI of 1 (under EPA's assumptions in the HHRA). From an environmental standpoint, FP 2 would achieve levels within the IMPG range for some ecological receptors but not others, and the impacts of the IMPG exceedances on the maintenance of local wildlife populations and communities is uncertain. Moreover, FP 2 would have fewer adverse short-term environmental impacts than the other alternatives involving removal (as discussed in subsequent sections) and no significant long-term adverse environmental impacts. Overall, while the protectiveness of FP 2 for certain ecological receptor groups is uncertain, GE believes that FP 2 would be generally protective of the environment.

6.3 Evaluation of Floodplain Alternative 3

6.3.1 Description of Alternative

FP 3 would involve the removal and backfill of floodplain soils to achieve average PCB concentrations that would meet the upper-bound RME IMPGs for human health protection in all areas and the mid-range RME IMPGs for human health protection in many such areas, including frequently used areas. In addition, soils would be removed to meet upper-bound IMPGs for ecological receptors. Specifically, this alternative has been developed to achieve the following IMPGs:

- The mid-range RME IMPGs for human health protection (i.e., those based on a 10^{-5} cancer risk or a non-cancer HI of 1, whichever is lower) from direct contact with floodplain soils in the frequently used areas (Frequent-Use EAs) identified in Section 5.2.1, and the upper-bound RME IMPGs (i.e., those based on a 10^{-4} cancer risk or a non-cancer HI of 1, whichever is lower) in the remaining direct contact EAs;

- The mid-range RME IMPGs for human health protection (i.e., those based on a 10^{-5} cancer risk or a non-cancer HI of 1, whichever is lower) from consumption of agricultural products from the floodplain; and

- The upper-bound floodplain IMPGs for protection of ecological receptors – i.e., amphibians (represented by wood frogs), omnivorous/carnivorous mammals (represented by shrews), insectivorous birds (represented by wood ducks), and piscivorous mammals (represented by mink) – using, for the latter two receptors, the floodplain soil IMPGs associated with a sediment target level of 1 mg/kg.

This alternative would involve removing and replacing floodplain soils as necessary to achieve average PCB concentrations in the top foot of the relevant averaging areas that are equal to or less than the above-mentioned IMPGs. In addition, this alternative would involve the removal and backfill of soils in the top 3 feet in the Heavily Used Subareas of Frequent-Use EAs (described in Section 5.2.1 and shown on Figures 5-3a-d) as necessary to achieve average PCB concentrations in the 0- to 3-foot depth increments in these areas that are equal to or less than the mid-range IMPGs based on human direct contact. Average concentrations have been based on the 95% UCL of the spatially weighted mean, as discussed in Section 5.4.2.

Summary of Removal Areas and Volumes

FP 3 would involve the removal of approximately 60,000 cy of floodplain soil from 38 acres of the floodplain. The locations of these removal areas are shown on Figure 6-2, and a detailed breakdown of the removal areas, volumes, and resulting EPCs associated with FP 3 are included in Tables 6-13 through 6-18. This 60,000 cy removal volume includes 19,000 cy (13 acres) associated with achieving the IMPGs for human health; 23,000 cy (14 acres) associated with achieving the upper-bound IMPG for amphibians in vernal pools; and 18,000 cy (11 acres) associated with achieving the upper-bound IMPG for piscivorous mammals (associated with a sediment target level of 1 mg/kg). (As discussed further below, these removal volumes and areas would allow achievement of the mid-range IMPGs for human consumption of agricultural products and the upper-bound IMPGs for omnivorous/carnivorous mammals and insectivorous birds [at the 1 or 3 mg/kg target levels] without the need for additional removal.)

Summary of Affected Habitat

FP 3 would involve the removal and backfill of soil across 38 acres in various types of habitats within the floodplain. The approximate acreages of those general habitat types, with associated removal volumes are as follows:[139]

- 14 acres (22,000 cy) of vernal pool habitat, which includes portions of 60 different vernal pools;
- 12 acres (19,000 cy) of upland forest habitat (consisting of high-terrace floodplain forest habitat, northern hardwoods-hemlock-white pine forest habitat, red oak-sugar maple transition forest habitat, successional northern hardwoods habitat, and transitional floodplain forest habitat);
- 5 acres (9,000 cy) of emergent marsh habitat (consisting of deep emergent marsh habitat, shallow emergent marsh habitat, and wet meadow habitat);
- 2 acres (3,000 cy) of disturbed upland habitats (consisting of agricultural field habitat and cultural grasslands habitat);
- 1 acre (2,000 cy) of palustrine habitat (consisting of red maple swamp habitat and shrub swamp habitat); and
- 3 acres (5,000 cy) of habitat of currently unmapped community type(s).[140]

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[139] This detailed breakdown of removal areas and volumes by habitat type was generally conducted using the Woodlot (2002) ecological characterization of the River between the Confluence and Woods Pond Dam, as previously noted. One exception is in vernal pool areas, where the EPA vernal pool coverage was merged with the Woodlot habitat areas; in those areas, the EPA vernal pool coverage superseded the underlying Woodlot habitat types.

[140] The Woodlot habitat community mapping is absent in some small portions of the PSA floodplain and in all of Reaches 7 and 8. Most of the removal for this unmapped community type(s) under FP 3 occurs in Reach 7 and, based on aerial photography, appears to be in generally forested areas of the floodplain.

In addition to the above-described areas associated with excavation/backfill activities, floodplain habitat would also be affected by the construction and use of access roads and staging areas. Conceptual construction plans indicate that FP 3 would require 19 staging areas, which would occupy an additional 9 acres, and 7 miles of temporary access roads in the floodplain.

Conceptual Remedial Approach

The general remedial approach for FP 3 would be essentially the same as described for FP 2. The alternative would use conventional construction equipment to excavate and transport soils and to restore the areas with soil and plantings.

The primary difference between FP 3 and FP 2 is that FP 3 would involve significantly more area as well as work in and around wetland areas and, in particular, 14 acres of vernal pools. For this work, some specialized construction equipment, materials, and specific engineering practices (e.g., use of low ground pressure excavation equipment) would be needed to mitigate the potentially negative impacts of construction to those sensitive areas. This is described in more detail in Section 6.3.9.1.

It is estimated that FP 3 would take approximately 3 years to complete if implemented independently from River-related remedial activities. However, floodplain remediation would likely be coordinated with sediment remediation. If so, the time to complete FP 3 would likely be different, depending on the sediment remediation alternative selected. Nevertheless, for purposes of the evaluations in this section, it has been assumed that implementation of FP 3 would take 3 years.

In addition to soil removal and backfill, FP 3 would include institutional controls, similar to those described for FP 2. Specifically, it would include the use of EREs and Conditional Solutions as necessary to address reasonably anticipated future uses and activities for which this alternative would not meet applicable cleanup criteria (e.g., residential use standards, where that use is reasonably anticipated and remediation would not meet those standards).

After restoration activities within a given area are completed, periodic monitoring and maintenance would be conducted of the backfilled/restored areas. For the purposes of this CMS Report, monitoring and maintenance are assumed to occur for 3 years following remedy implementation within a given area. Monitoring would include annual visual inspections of restored areas (e.g., to assess plant survivorship, evidence of erosion). The maintenance program would be implemented to address those areas where the visual inspections indicate the need for maintenance or repair to maintain the effectiveness of the remedy.

6.3.2 Overall Protection of Human Health and the Environment - Introduction

As discussed in Section 6.1.2, the evaluation of whether a floodplain soil remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether FP 3 would be protective of human health and the environment is presented at the end of Section 6.3 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

6.3.3 Control of Sources of Releases

Existing floodplain soil conditions are not a significant source of potential PCB releases to the River, nor would they be following restoration. As stated previously, the floodplain is generally flat, well vegetated, and depositional in nature, greatly reducing the potential for PCBs in the floodplain soil to scour and be transported to the River. While the floodplain is not considered a significant source, implementation of FP 3 would further reduce the limited potential for PCBs in the floodplain to be released to the River by removing 60,000 cy of PCB-containing soils over 38 acres of the floodplain, replacing them with clean soil, and revegetating.

Open excavations during construction could serve as a short-term, temporary source of some release during an extreme weather event. Such potential releases would be controlled using conventional engineering practices.

6.3.4 Compliance with Federal and State ARARs

The potential chemical-specific, location-specific, and action-specific ARARs identified by GE are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs set forth in Table 2-1 consist of federal and state water quality criteria for PCBs and state air pollution control requirements for dust. The water quality criteria do not apply to floodplain soils, and GE believes the state air pollution control requirements for dust could be met.

The potential location-specific and action-specific ARARs are listed in Tables 2-2 and 2-3. Based on review of those ARARs, GE believes, for the same reasons given for FP 2 in Section 6.2.4, that FP 3 could be designed and implemented to achieve the pertinent ARARs (provided that any necessary EPA approval determination under its TSCA regulations is obtained for the staging areas), with the following potential exception: In the event that excavated floodplain soils should be found to constitute hazardous waste (which is not anticipated), the temporary staging areas for the handling of those soils may not meet certain federal or state hazardous waste storage requirements, if they were determined to apply. In that case, as further discussed in Section 6.2.4, GE believes that such requirements should be considered inapplicable or, if necessary, waived as technically impracticable.

6.3.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for FP 3 includes evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment. Each of these considerations is discussed below.

6.3.5.1 Magnitude of Residual Risk

Evaluation of the magnitude of residual risk associated with FP 3 includes consideration of the length of time and extent to which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure, such as institutional controls.

FP 3 would reduce potential exposures of humans and ecological receptors to PCBs in floodplain soil by removing approximately 60,000 cy of PCB-containing soil over 38 acres of floodplain (see Figure 6-2). The reduction in potential exposure and associated risk would occur upon the completion of remediation in a given area.

As discussed further in Section 6.3.6.1, the average floodplain soil concentrations in the human health averaging areas following implementation of FP 3 would be equivalent to or lower than those associated, under RME assumptions, with a cancer risk of 10^{-4} and a non-cancer HI of 1 in each of the human health averaging areas. In fact, it would achieve the RME IMPGs based on a cancer risk of 10^{-5} in over 75% of the averaging areas, including all Frequent-Use EAs and all farm areas evaluated for agricultural products consumption. In addition, as discussed in Section 6.3.6.2, implementation of FP 3 would result in average concentrations equivalent to or lower than the upper-bound IMPGs for ecological receptors (depending, in some cases, on the associated sediment concentrations). The average post-remediation PCB EPCs in the top foot within the human health and ecological averaging areas are shown in Tables 6-13 through 6-18. (Table 6-13 also shows the post-remediation concentrations in the top 3 feet in Heavily Used Subareas.)

PCBs would remain at depths below those described above. Such deeper soil is generally not anticipated to be available for exposure under current uses. Where it is reasonably anticipated that that deeper soil could become available for exposure, it would be addressed by EREs and/or Conditional Solutions. Additionally, EREs and Conditional Solutions would be implemented where necessary to address potential risks from reasonably anticipated future uses.

6.3.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of FP 3 has included an assessment of the use of technologies under similar conditions, the general reliability of those techniques, reliability of OMM, and technical component replacement requirement, as discussed below. Most aspects of the evaluation for this criterion are similar to those for FP 2 in that implementation would use conventional excavation, backfilling, and planting. However, FP 3 would be more complex than FP 2 in that it would impact 14 acres of vernal pools and 24 additional acres of various other habitats.

Use of Technology Under Similar Conditions

FP 3 relies primarily on the removal of floodplain soils, including those associated with 14 acres of vernal pools, 12 acres of upland forest, and 7 acres of emergent marsh and palustrine habitat, followed by backfilling of the excavations and performance of restoration activities. Excavation and restoration of soils from floodplain environments containing various habitats have been applied at a number of sites across the country, as discussed under FP 2 in Section 6.2.5.2. For the most of the habitat areas, the construction and restoration technologies that would be applied under FP 3 are expected to be successful. However, the vernal pools that would be remediated under FP 3 (portions of 60 pools) comprise a significant proportion of this ecological habitat in the floodplain (40% of the vernal pool acreage in the PSA), and it may be difficult to fully restore the ecological function of all these pools.

Removal and restoration of vernal pools have been conducted at other sites on a smaller scale. For example, following soil excavation at Jack’s Creek (PA), the floodplain was graded with soil to create eight vernal pools within the floodplain. Initial results indicate favorable species and vegetation growth; additional long-term monitoring is ongoing to evaluate the success of restoration activities (EPA, 2006c). At other sites, especially in California, vernal pool construction and restoration have been successful when design, construction, and monitoring are effectively planned (Sutter and Francisco, 1996; Ferren and Hubbard, 1996). However, in a study of 15 vernal pool creations in New England, the projects were found to be deficient due to failure of design and construction to meet restoration objectives and lack of effective monitoring (Lichko and Calhoun, 2003). In any case, there is no indication in the technical literature or examples from other sites where such a large number of vernal pools (60) or such a large proportion of a site's vernal pools (40%) as would be involved in FP 3 has been excavated and restored.

General Reliability

The removal and backfill of material for FP 3 would reliably, effectively, and permanently reduce the concentrations of PCBs in the removal areas. Following backfilling, excavated areas would be replanted, using standard landscaping techniques to replant upland forested areas and wetland restoration techniques to restore the soils, hydrology, and vegetative communities of emergent marsh and palustrine habitats. FP 3 would impact 14 acres of vernal pools. While it is possible to restore vernal pools, there is little tolerance in terms of the topographic elevation and hydrologic parameters required to successfully complete the restoration. Vernal pools are defined as ephemeral wetlands that have very defined hydrologic cycles (saturation and drying) required to support natal amphibian populations. As discussed further below, an effort would be made to restore the affected vernal pools, but given the number and extent of vernal pool habitat that would be affected by this alternative, the reliability of that overall effort is considered uncertain.

Reliability of Operation, Monitoring, and Maintenance Requirements

Following the construction phase of FP 3, a monitoring and maintenance program would be implemented for those areas restored following remediation. Both the removal areas and those portions of the floodplain disturbed during construction of access roads and staging areas would be monitored through periodic inspections to ensure that the planted vegetation is surviving and growing, and to identify areas (if any) where the backfill has eroded and needs repair. Periodic inspection of the plantings and backfill areas is considered a reliable means of tracking the restoration activities. Labor and materials needed to monitor and perform any maintenance activities required following implementation of FP 3 are considered readily available.

Maintenance, if required, could be difficult to implement in certain areas of the floodplain, due to remoteness, wet areas, and vegetation growth. The ease of access may change based on seasonal conditions. It could be especially difficult to conduct supplemental planting activities in difficult-to-access locations, to which plant materials would have to be carried from the closest roadways.

Technical Component Replacement Requirements

If significant erosion and/or plant loss were observed as part of the OMM program in the restored floodplain areas, an assessment would be conducted to determine the cause, as well as the need for and methods of repair. Depending on the timing and location of the repair, access roads and staging areas may need to be temporarily constructed in the floodplain. It is anticipated that if small repairs or replacement were necessary, they could be implemented using the same types of methods and materials used during the initial backfilling/restoration activities. Periodic small-scale inspections and repairs would pose no appreciable risks to humans and ecological receptors that use/inhabit the floodplain in these areas. While not anticipated, the repair or replacement of larger areas could require more extensive disturbance in the floodplain.

6.3.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of FP 3 on human health or the environment has included consideration of the following:

Potentially Affected Populations

Implementation of FP 3 would have potential long-term effects on humans and wildlife populations through changes in the natural environment and habitat. For humans, implementation of FP 3 would affect the aesthetics of the floodplain, especially in forested areas where older, large trees could not be replaced in kind and would be replaced with smaller trees with less size and age diversity. For wildlife, implementation of FP 3 would remove and replace several habitat types (described in Section 6.3.1), some of which may be difficult to restore to their current functional value. Wildlife associated with these habitats includes a variety of mammals, birds, reptiles, and amphibians. The potential long-term impacts on biota are discussed in the next sections.

Adverse Impacts on Biota and Corresponding Habitat

With the exception of vernal pools and those biota that use and inhabit them (discussed below), long-term impacts on biota and the corresponding habitat from implementation of FP 3 are generally expected to be limited. While FP 3 would involve a greater area of impact than FP 2, the amount is still not large in proportion to the entire floodplain (with the exception of vernal pools as discussed below). The primary long-term impacts from implementation of FP 3 would be associated with the loss or change in habitats or the corresponding wildlife community should remediated areas not return to conditions similar to those that currently exist.

FP 3 would impact approximately 12 acres of upland forest habitat. The impacts to these areas would include loss of mature forest habitat capable of supporting a diverse wildlife community typical of a mature forest habitat.[141] Although replacement trees would be planted as a part of the restoration, the time for the forest system to reach a functional level comparable to its pre-excavation function is commensurate with the age of the system. Based on the size of the trees, the forests found within the floodplain in Reaches 5A and 5B are probably on the order of 50 to 75 years in age. The mature forests bordering Reach 5C and around Woods Pond are most likely 75 to 100 years old or older. The replanted forests would require similar time frames to provide the same level of ecological function that they currently provide. However, as the replanted forest develops, it will provide habitat for secondary successional communities prior to reaching full maturity. As the replanted forest develops, it goes through stages of supporting different communities until such time as it reaches maturity. Younger, developing plant communities support a different wildlife community that is characteristic of early and mid-level successional habitats. It is expected that a restored, replanted upland forest would take approximately 5 to 10 years to reach a stage of development that would begin to support a woodland biological community rather than an open successional habitat. In any case, the 12 acres of forest that would be affected by FP 3 is small relative to the amount of this type of habitat in the floodplain and, therefore, the long-term adverse impacts would also be small.

FP 3 would impact approximately 2 acres of disturbed upland habitats (consisting of agricultural field habitat and cultural grasslands habitat). As these areas support altered or early successional plant communities that have limited ecological value, no long-term impacts would be expected from the remediation in these areas.

Some long-term impacts to wetlands and the biota inhabiting them would also likely occur from the implementation of FP 3. These impacts are described in the following section.

Finally, it should be noted that, as part of the ecological characterization of the PSA floodplain, Woodlot (2002) identified 15 rare plant species at 27 locations within the floodplain, and 3 of those locations are within the area targeted for soil removal under FP 3. However, the potential loss of these 3 rare plant locations would not likely result in a permanent loss of the population of the species across the floodplain.

Adverse Impacts on Wetlands

The greatest potential for significant long-term impacts to wetlands would come from the remediation of 60 vernal pools in the floodplain, covering approximately 14 acres. Vernal

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[141] Changes in the forest community have a direct impact on the type of wildlife species supported by that community. Clearing of forests as part of the remedial action could result in forest fragmentation and changes in migration and dispersal routes for wildlife on a more regional basis (Biedenharn et al., 1997; Miller and Hobbs, 2007).

pools are complex wetland systems with very defined and specialized hydrologic budgets that allow for periodic or permanent saturation and often inundation of the pool. They are particularly important in supporting the life cycles of amphibians (frogs and salamanders) and invertebrates that are completely dependent on these types of ecosystems. Impacts to these habitats may include modification of hydrologic budgets and associated modifications in plant communities. This could result in changes in the ecological function of the vernal pools and a modification in the pools' ability to support specific amphibian subpopulations. Impacts from remediation on vernal pools could include reduction in local subpopulations of amphibians, as many of these species tend to be pool-specific and must return to their own pool to breed. Thus, the loss of a vernal pool, even on a temporary basis, could have long-lasting effects on the distribution of amphibians in the area and upon the predators that prey on them (Colburn, 2004).

Vernal pools are also characterized by a deep decomposing organic layer at the bottom of the pools. The loss of this organic layer in the vernal pools could lead to a change in the type of vegetative community found within the pools and could impact elemental cycling (carbon, oxygen, and sulfur) through these systems. This impact could be minimized by potential restoration activities that are outlined in the section on measures to mitigate the potential long-term effects. Although appropriate steps would be taken to restore the vernal pools, successful restoration of vernal pools would require attention to detail and is not certain, as discussed in Section 6.3.5.2. As noted above, GE is unaware of any sites where restoration of either such a large quantity or such a large proportion of the site's vernal pools has been attempted as would be included in FP 3.

In short, given the extent of vernal pools that would be remediated in FP 3 and the uncertainties in the restoration of those pools, this alternative could have long-term adverse impacts on the amphibian subpopulations that inhabit those pools and potentially on the overall local amphibian population in the area.

The excavations involved in FP 3 would also affect approximately 5 acres of emergent marsh habitats and 1 acre of palustrine wetland habitat. The impacts to such wetlands would include loss of vegetation and the wildlife supported by the habitat, and could include modifications of the hydrology of these wetlands, which could result in a loss or change in habitat. Assuming that proper wetlands restoration techniques are used to restore the emergent marsh habitat, the impacts to that habitat would primarily be short-term in nature. For the palustrine wetlands, which are wooded wetlands that support a diverse and distinct community of plant and animals, some long-term impacts could occur, since palustrine wetlands are mature systems that require an extended period of time to restore. However, since the amount of such palustrine habitat affected by FP 3 is relatively small, the potential for long-term impacts is also relatively small.

Long-term impacts to wetlands could also occur as a result of ancillary construction activities in support of excavation. Construction and use of staging area or access roads in or bordering wetlands could modify soil conditions, drainage patterns, or groundwater flow conditions, potentially creating a change in the characteristics of existing wetlands or converting wetlands to an upland environment. For FP 3, based on conceptual design, areas of shallow emergent marsh in Reaches 5A and 5B and several sections of palustrine habitat in Reach 5B would be affected by such ancillary facilities. Remedial design and construction would take steps to avoid direct impacts on wetlands where practical (i.e., a road could go around instead of through a wetlands area or culverts could be used). However, if impacts to wetlands could not be avoided, these types of effects could occur.

Long-Term Impact on Aesthetics

Implementation of FP 3 would have limited long-term impacts on the aesthetic features of the natural environment. The natural appearance of the floodplain after the remediation and restoration would not be the same as prior to remediation, with the most noticeable changes likely associated with those areas where mature trees would be cut down. As noted above, FP 3 would result in the loss of approximately 12 acres of forested communities in the floodplain and the time for a replanted forest community to develop an appearance comparable to its current appearance would be commensurate with the age of the community prior to remediation, which could range up to 50 to 75 years or more. While it would take decades for the planted trees to reach their present maturity, it would not take as long for the restored vegetative communities to reach an intermediate level of maturity that would provide a natural appearance. In summary, the presence of cleared areas would detract from the natural pre-remediation appearance of the area until such time as the restoration plantings have matured.

Potential Measures to Mitigate Long-Term Adverse Impacts

To mitigate potential long-term impacts to the floodplain following remedy implementation, a restoration plan would be developed. Placement of backfill soil suitable to support plant growth and surface soil grading would be conducted to restore the soil elevations. Upland communities would be restored either with species currently found in those areas or with species typically found in those types of environments. Wetlands would be replanted with hydrophytic species typical of the existing plant community if available, and measures would also be taken, to the extent practicable, to replace the functions of those wetlands, such as nutrient cycling, flood control, and water filtration. In the event that wetlands that are permanently lost due to the remedial construction activities, appropriate wetlands mitigation measures may be necessary in other areas.

An effort would also be made to restore the affected vernal pools following the completion of remedial activities. Topographic elevations of the pre-disturbance pools would be duplicated and vegetative communities consistent with pre-disturbance conditions would be planted. To assist in the restoration, an initial organic layer may be placed at the bottom of the pools. Nonetheless, as described above, successful restoration of vernal pools is not certain.

6.3.6 Attainment of IMPGs

This section describes the extent to which FP 3 would achieve the IMPGs for human health and ecological protection. These comparisons are presented in Tables 6-13 through 6-18 for the pertinent human and ecological averaging areas. The time frame to achieve the IMPGs would be the same as that required to complete the remedy in a particular area (i.e., the reduction in soil concentrations would occur upon completion of backfill placement). It is estimated that implementation of FP 3 would take a total of 3 years.

6.3.6.1 Comparison to Human Health-Based IMPGs

FP 3 would achieve, at a minimum, the RME IMPGs based on a 10^{-4} cancer risk and a non-cancer HI of 1 in all 120 direct contact EAs (Table 6-13). In addition, FP 3 would achieve the RME IMPGs based on a 10^{-5} cancer risk in 92 of these areas (including all the Frequent-Use EAs) and the RME IMPGs based on a 10^{-6} cancer risk in 14 of those EAs. It would also achieve the CTE IMPGs based on a 10^{-6} cancer risk in 118 of the 120 EAs. Further, FP 3 would achieve the RME IMPGs based on a 10^{-5} cancer risk and a non-cancer HI of 1 in all nine of the Heavily Used Subareas.

With respect to the farm areas, FP 3 would achieve the RME IMPGs based on a 10^{-5} cancer risk and a non-cancer HI of 1 in all 14 of the farm areas evaluated for consumption of agricultural products, and would achieve the RME IMPGs based on a 10^{-6} cancer risk in 6 of those areas and the CTE IMPGs based on a 10^{-6} cancer risk in 13 of those areas (Table 6-14).

These comparisons are shown in greater detail in Tables 6-13 and 6-14 for all of the human direct contact exposure areas and agricultural products consumption averaging areas evaluated in Reaches 5 through 8.[142]

6.3.6.2 Comparison to Ecological IMPGs

FP 3 would achieve levels within (or below) the IMPG ranges for amphibians and omnivorous/carnivorous mammals in all averaging areas and would achieve levels within the IMPG ranges for insectivorous birds and piscivorous mammals depending on the associated sediment concentrations, as described below:

- For amphibians, FP 3 would achieve the upper-bound amphibian IMPG (5.6 mg/kg) in all 66 of the vernal pools evaluated in the PSA (covering 34 acres) and would achieve the lower-bound IMPG (3.27 mg/kg) in 20 of those pools (approximately 30%, of the pools, covering 9% of the total vernal pool acreage) (Table 6-15).

- For omnivorous/carnivorous mammals, FP 3 would achieve the upper-bound IMPG (34.3 mg/kg) in all 7 of the averaging areas, and the lower-bound IMPG (21.1 mg/kg) in 5 of those areas (Table 6-16).

- For insectivorous birds, FP 3 would achieve the target floodplain soil IMPGs in all 12 of the averaging areas in the PSA if the associated sediment concentration in those areas were 3 mg/kg or less, and in 9 of those 12 areas if the associated sediment concentration were 5 mg/kg (Table 6-17). FP 3 would not achieve the IMPGs in the 3 averaging areas in Reach 5B if the associated sediment concentration were 5 mg/kg. In such a case, the removal of an additional 19,000 cy of soil from those 3 averaging areas would be needed to achieve the floodplain soil IMPG level for insectivorous birds in those areas.

- For piscivorous mammals, FP 3 would achieve the upper-bound target floodplain soil IMPG levels in both averaging areas if the associated sediment concentration in those areas were 1 mg/kg or less (Table 6-18). It would not achieve those target levels in either averaging area if the associated sediment concentration were higher. At an assumed sediment concentration of 3 mg/kg, FP 3 would require the removal/backfill of an additional 203,000 cy (approximately 126 acres) of floodplain soil to achieve the

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[142] Note that the post-remediation EPCs listed in these tables were not calculated based solely on the human health removal volumes shown on the tables. The post-remediation EPCs were calculated based on the entire removal for FP 3 (including that which occurred for ecological receptors and overlapped the human health areas). The amount of removal shown on the human health IMPG tables is only what would be needed to achieve the human health IMPGs.

upper-bound IMPGs. If the sediment concentration were 5 mg/kg, attainment of the upper-bound IMPG could be achieved in the Reach 5C/5D/6 averaging area with the removal of an additional 15,000 cy (approximately 9 acres) of floodplain soil; however, the IMPG for the Reach 5A/5B averaging area could not be achieved with any amount of additional soil removal because the PCBs levels in aquatic prey items alone would exceed the IMPG at that sediment concentration.

These comparisons are shown in detail in Tables 6-15 through 6-18 for all ecological averaging areas in the PSA.

6.3.7 Reduction of Toxicity, Mobility, or Volume

The degree to which FP 3 would reduce the toxicity, mobility, or volume of PCBs in floodplain soils is discussed below.

Reduction of Toxicity: FP 3 does not include any treatment processes that would reduce the toxicity of the PCBs in the floodplain soils. However, if "principal threat" wastes (e.g., NAPL, drums of liquid) should be encountered during the excavations (which is not anticipated), they would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: As previously noted, the existing conditions of the floodplain are predominantly depositional and stable due to generally low water velocities during inundation and the presence of vegetation. Therefore, PCBs in existing floodplain soils do not represent a significant potential source for mobility and migration. Nevertheless, implementation of FP 3 would further reduce the limited potential for mobility of PCBs in the floodplain by removing 38 acres of soils with higher PCB concentrations from the floodplain, backfilling the excavations, and revegetating the surface.

Reduction of Volume: FP 3 would reduce the volume of PCB containing soils and the mass of PCBs in the floodplain by removing 60,000 cy of soils containing approximately 8,300 lbs of PCBs from 38 acres of the floodplain.

6.3.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of FP 3 has included consideration of the short-term impacts of implementing this alternative on the environment, the local communities (as well as communities along truck transport routes), and workers involved in the remedial activities. These impacts would last for the duration of the remedial activities, which are estimated to take 3 years.

Impacts on the Environment

The short-term effects on the environment resulting from implementation of FP 3 include the temporary removal of plant and wildlife habitat in those areas of the floodplain where remediation or construction of access roads or staging areas would occur. Short-term impacts specifically associated with each habitat type are described below.

Mature Upland Forest: Short-term impacts would include the loss of 12 acres of forested habitat. Birds, mammals, reptiles, and amphibians would be at least temporarily affected by the habitat disruption associated with implementation of this alternative. The temporary loss of the plant communities would result in indirect impacts to wildlife through the loss of cover, nesting, and feeding habitat. This would be particularly disruptive to wildlife with small home ranges, which would not be likely to move out of the construction zone. Likewise, birds that are dependent on the plant community for the placement of their nests would be forced to move elsewhere during nesting season.

Wetlands: The short-term impacts on the various types of wetlands that would be affected by the excavations in FP 3 include the following:

- FP 3 would have a direct impact on 60 different vernal pools, covering an area of 14 acres. This would result in the immediate loss of habitat and of individual species found within the pools. Depending upon what time of year the pools are remediated, the loss could also include eggs or larval stages of various amphibian species. Because of the complexities in restoring vernal pools, the time required for successful restoration of this habitat type and recovery of ecological function is not certain. (The potential long-term impacts on these pools were described in Section 6.3.5.3.).

- FP 3 would cause a loss of 5 acres of emergent wetlands. Short-term impacts from the destruction of these wetlands as a result of the remedial action include the inability of these areas to support mammals, birds, reptiles, and amphibians that are dependent on wetlands for nesting, breeding, and feeding.

- Short-term impacts would also be associated with the loss of a limited area (1 acre) of palustrine wetlands. Short-term impacts from the destruction of these wetlands as a result of the remedial action could include the inability of these areas to support mammals, birds, reptiles, and amphibians that are dependent on these wetlands for nesting, breeding, and feeding. However, because the area of such wetlands affected by FP 3 would be limited, the adverse impacts would likewise be relatively small.

Other short-term impacts relate to the affected wetlands' ability to perform functions of phosphorous retention, nitrogen removal, and flood control. FP 3 would potentially change stormwater flows from wetlands undergoing remediation to neighboring wetlands that would not be remediated. In particular, increases in stormwater runoff affect water level fluctuations within a wetland. This in turn has been shown to reduce plant richness, reduce thin-stemmed plant distribution, promote the presence of invasive species, and reduce the presence of amphibians (Wright et al., 2006). Additionally, erosion and sedimentation changes brought about by construction within or near a wetland could result in unintended changes to the wetlands.

Disturbed Upland Habitat: The short-term impacts associated with the removal of 2 acres of disturbed upland habitat would be limited as the amount of area impacted by the removal is relatively small and the quality of the habitat would be low relative to the undisturbed areas of the floodplain. While these areas would be disturbed, they would, if left alone, return to a natural state.

Additional Habitats Affected by Supporting Facilities: Construction of supporting facilities (e.g., roadways, staging areas) in the floodplain would result in the temporary loss of habitat in those areas and the wildlife that they support. It is anticipated that FP 3 would require a total of approximately 25 acres for access roads and staging areas. Based on the conceptual layout, these facilities would affect primarily upland forested habitat, and 4 acres of wetlands. Development of these support facilities would affect the ability of some wildlife to nest and feed in these areas; and in some instances it would cause habitat fragmentation that could further disrupt the movement and interactions of certain wildlife species. In addition, wetlands that are not undergoing remediation could be indirectly affected by construction as a result of changes in stormwater drainage patterns and modifications to hydrology. Conventional engineering controls would be used to control siltation and runoff from the temporary surfaces.

Impacts on Local Communities and Communities Along Truck Transport Routes

FP 3 would result in short-term impacts to the local communities along the River. These short-term effects would include: changes to the appearance of the forested areas of the floodplain; disruption of activities along the River and within the floodplain due to the remediation as well as the construction of access roads and staging areas; and increased construction traffic and noise during excavation and backfilling activities.

Construction activities would affect certain recreational areas along the River. These include bank fishing, canoeing (canoe launches), hiking and general recreation, and waterfowl hunting. During the period of active construction, restrictions on recreational use of the floodplain would be imposed in the areas in which remediation-related activities are taking place. Due to safety considerations, boaters, anglers, hikers, and other recreational users would not be able to use the floodplain in the areas where remediation-related activities are being conducted. Aesthetically, the presence of heavy construction equipment and cleared areas would detract from the visually undisturbed nature of the area until such time as the restoration plantings for the cleared areas have matured.

In addition, due to the need to remove excavated materials and deliver backfill materials and equipment, truck traffic would significantly increase during the construction period. As an example, if 20-ton capacity trucks were used to transport excavated material from the staging areas, it would take 4,500 trips to do so. Assuming the use of smaller capacity trucks for local hauling (i.e., 16-ton trucks), an additional 9,500 truck trips would be anticipated to import backfill materials, as well as materials for the construction of staging areas and access roads, to the site.

This additional traffic would increase the likelihood of accidents, noise levels, emissions of vehicle/equipment exhaust, and nuisance dust to the air. In addition, noise in and near the construction zone could affect any residents and businesses located in the immediate vicinity of work areas. Engineering controls would be implemented to mitigate short-term impacts and risks associated with implementation of FP 3. However, some impacts would be inevitable.

The increased truck traffic would also increase the risk of traffic accidents along transport routes. Appendix D includes an analysis of potential risks from the increased truck traffic that would be necessary to transport clean materials to the site for implementation of FP 3.[143] This analysis indicates that the increased truck traffic associated with FP 3 (an estimated total of 475,000 vehicle miles) would result in an estimated 0.27 non-fatal injuries due to accidents (with a probability of 24% of at least one such injury) and an estimated 0.01 fatalities from accidents (with a probability of 1% of at least one such fatality).

Risks to Remediation Workers

There would be potential health and safety risks to site workers implementing FP 3. Engineering controls and OSHA procedures designed to mitigate risks to remediation workers would be instituted. Implementation of FP 3 is estimated to involve 105,334 labor-hours over a 3-year timeframe.

The analysis in Appendix D of potential risks to workers from implementation of the floodplain alternatives indicates that implementation of FP 3 would result in an estimated

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[143] The risks from truck traffic to transport excavated materials from the staging areas away from the site are evaluated under the relevant treatment/disposition alternatives.

1.08 non-fatal injuries to workers (with a probability of 66% of at least one such injury) and an estimated 0.008 worker fatalities (with a probability of 0.8% of at least one such fatality).

6.3.9 Implementability

6.3.9.1 Technical Implementability

The technical implementability of FP 3 has been evaluated in terms of the general availability of the technology involved (soil excavation and backfilling), the ability of this technology to be constructed and operated given site characteristics, the reliability of this technology, the availability of support facilities and resources, ease of undertaking corrective measures if necessary, and ability to monitor effectiveness.

General Availability of Technology: The equipment, materials, technology, procedures, and personnel necessary to implement FP 3 are expected to be readily available. FP 3 would use conventional heavy construction equipment to excavate and transport floodplain soils, as well as to bring in and place backfill and restoration materials. Such equipment would include excavators, bulldozers, and dump trucks. In wetlands and vernal pool settings, smaller pieces of excavating equipment and low ground pressure excavators that could more easily move into soft soils, or long-reach excavators able to reach from dry areas into wetlands, may be more efficient. In some settings, it may be necessary to use conventional construction equipment along with wetland mats to support the weight of the equipment.

These technologies have been used at other sites to access and restore sensitive areas, especially wetlands. Given the physical characteristics of the floodplain and the availability and known reliability of construction equipment and materials, FP 3 would be technically implementable. Further, methods to implement monitoring and institutional controls are expected to be readily available.

Ability To Be Implemented: Based on site characteristics, the excavation/backfill technology that would be utilized in FP 3 is suitable for implementation in the areas where it would be applied. The construction of access roads and staging areas may temporarily affect flood storage and drainage characteristics during seasonal high water conditions and during periodic storm and flood events. Engineering practices would be implemented to reduce the temporary impacts of such hydrology changes. In the long term, floodplain areas would be backfilled and restored to approximate original elevations, to maintain the flood storage capacity of the floodplain.

Reliability: Soil excavation with backfilling is considered a reliable means of reducing the potential for human and ecological exposure to soils containing PCBs. Floodplain soil excavation has been implemented at other PCB-impacted sites across the country, as described in Sections 6.2.5.2 and 6.3.5.2. Although wetlands restoration can be reliable with proper planning and implementation, it is not a mature science where all aspects of the restoration process are assured. In the end, the circumstances of the wetlands with respect to the restored soils and hydrology will dictate how the restored wetlands will develop, and upfront planning cannot completely assure that the restored wetlands will be the same as the pre-remediation wetlands. Vernal pools in particular are difficult to restore and whether they would be returned to full functionality is uncertain.

Availability of Support Facilities and Resources: Implementation of FP 3 would require construction of access roads and staging areas at various locations within the floodplain. As noted previously, an estimated 25 acres of space would be needed, and appear to be available to support the FP 3 activities based on a conceptual site layout. The specific locations and sizing of these access roads and support areas would be determined based on the available land resources. Appropriate backfill and planting materials are expected to be readily available for this 38-acre removal/restoration project.

Ease of Conducting Additional Corrective Measures: If necessary, performing additional remediation at a later date would be possible using the same types of tools, equipment, and materials as in the original round of remediation. Construction equipment, personnel, and materials are commercially available and their use and effectiveness for this type of material removal and backfill project are well known and documented. Ease of implementation of the corrective measures would be directly related to the extent of the necessary additional corrective measure (i.e., area and/or volume to be addressed) and the ease of access (e.g., remoteness from roads, wetlands crossings, size and type of construction equipment).

Ability to Monitor Effectiveness: The effectiveness of FP 3 would be assessed by visual observation to evaluate such factors as vegetation re-growth and any signs of erosion or disturbance of restored areas. Monitoring procedures would be straightforward and implementable.

6.3.9.2 Administrative Implementability

The evaluation of administrative implementability of FP 3 has included consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: Implementation of FP 3 would need to comply with the substantive requirements of applicable and appropriate regulations pertaining to the performance of the remedial action (unless waived). As discussed in Section 6.3.4, GE believes that FP 3 could be designed to comply with such requirements (i.e., the location-specific and action-specific ARARs listed in Tables 2-2 and 2-3), with the exception of certain requirements that could potentially apply to the on-site staging areas if the excavated materials should constitute hazardous waste. In the latter case, if necessary, GE believes that such requirements should be waived as technically impracticable.

Access Agreements: Implementation of FP 3 would require GE to obtain permission for access to the properties where the work would be conducted or where the ancillary facilities would be located. Access to State-owned lands would be sought from the state agencies that own the land. In addition, it is currently anticipated that access agreements would be required from approximately 30 private landowners. Obtaining access to all these properties for the type of work and length of time that may be needed could be difficult and time-consuming. If GE should be unable to obtain access agreements with particular landowners, GE would request EPA and/or MDEP to provide assistance.

Coordination with Agencies: Implementation of EREs and Conditional Solutions as part of FP 3 would require coordination with EPA and MDEP. In addition, as noted above, obtaining access to State-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of FP 3, GE would need to coordinate with EPA, as well as state and local agencies, to address potential health and safety impacts and to provide as-needed support with public/community outreach programs.

6.3.10 Cost

The estimated total cost for implementation of FP 3 is $27 M (excluding the costs of treatment/disposition of excavated soil). The estimated capital cost for implementation of FP 3 is $26.5 M, assumed to occur over a 3-year construction period. Estimated annual OMM costs (for a 3-year inspection and maintenance program for restored excavation and staging/access road areas) range from $15,000 to $75,000 per year (depending on which reach is being monitored), resulting in a total cost of $480,000. The following summarizes the total costs estimated for FP 3.

FP 3	**Est. Cost**	**Description**
Total Capital Cost	$26.5 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM Cost	$0.5 M	Costs for performance of the OMM programs
Total Cost for Alternative	$27 M	Total cost of FP 3 in 2008 dollars

The total estimated present worth of FP 3, which was developed using a discount factor of 7%, a 3-year construction period, and an OMM period of 3 years on a reach-specific basis, is approximately $26.2 M. More detailed cost estimate information and assumptions for each of the floodplain alternatives are included in Appendix E.

As noted above, these costs do not include the costs of treatment/disposition of the removed floodplain soils. The estimated costs for combinations of FP 3 with the various treatment/disposition alternatives are presented in Section 8.

6.3.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 6.3.2, the evaluation of whether FP 3 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: FP 3 would be effective in substantially reducing the potential for human and ecological exposure to PCBs in floodplain soils by the removal of 60,000 cy of PCB-containing soil containing 8,300 lbs of PCBs. The removed soil would be replaced with clean backfill, which would be revegetated.

Compliance with ARARs: As discussed in Section 6.3.4, based on review of the potential ARARs, GE believes that FP 3 could be designed and implemented to achieve the ARARs pertinent to this alternative, with the possible exception of certain requirements that could apply to the on-site staging areas if the excavated soils should constitute hazardous waste. In the latter case, if necessary, GE believes that such requirements should be waived as technically impracticable.

Human Health Protection: FP 3 would be protective of human health. As discussed in Section 6.3.6.1, implementation of this alternative would achieve the RME IMPGs based on a 10^{-4} cancer risk and a non-cancer HI of 1 in each direct-contact EA. It would also achieve levels that are at or below the RME IMPGs based on a 10^{-5} cancer risk and a non-cancer HI of 1 in the majority of direct contact EAs, including all Frequent-Use Areas and all Heavily Used Subareas, and in all farm areas evaluated. FP 3 would further ensure protection of human health through implementation of EREs and Conditional Solutions, where necessary, to address reasonably anticipated future uses.

Environmental Protection: As discussed in Section 6.3.6.2, FP 3 would achieve floodplain soil levels considered protective of ecological receptors, depending, in some cases, on the associated sediment concentrations. Specifically, FP 3 would achieve soil PCB levels within or below the range of the IMPGs for amphibians in all 66 vernal pools evaluated and within or below the IMPG range for omnivorous/carnivorous mammals in all seven averaging areas. In addition, FP 3 would achieve the target floodplain soil IMPG levels for insectivorous birds in all 12 averaging areas if the associated sediment concentration in those areas is 3 mg/kg or less, and it would achieve levels within the range of the target floodplain soil IMPG levels for piscivorous mammals in both of the PSA averaging areas if the associated sediment concentration in those areas is 1 mg/kg or less.

FP 3 would not achieve the IMPG for insectivorous birds in 3 of 12 averaging areas if the associated sediment concentration were 5 mg/kg, and would not achieve the IMPGs for piscivorous mammals in either of the two averaging areas if the associated sediment concentration were 3 or 5 mg/kg. However, as previously noted, achievement of IMPGs is a balancing factor under the Permit; it is not determinative of whether an alternative would provide overall environmental protection. In this case, even if there were IMPG exceedances for these receptors, GE believes that FP 3 would provide overall protection of the environment. This is true, first, because of the highly conservative nature of the averaging areas and the fact that the local populations of these receptors extend beyond the individual averaging areas.[144] Moreover, as discussed in Section 6.3.6.2, very extensive additional removals would be necessary to achieve the IMPGs (e.g., up to an additional 200,000+ cy of floodplain soil to address piscivorous mammals). These removals would cause substantial additional long-term and short-term adverse ecological impacts that GE does not believe are necessary to protect local populations of these receptors or justified to protect individual animals that may inhabit the PSA.

At the same time, as discussed in Section 6.3.8, implementation of FP 3 would result in short-term adverse impacts on the environment, as it would remove plant and wildlife habitat in those areas of the floodplain where remediation and ancillary construction activities would occur. Such impacts would include the loss of approximately 12 acres of mature upland forest and 21 acres of wetlands (including 14 acres of vernal pools), with the consequent impacts on the biota that depend on those habitats. Further, as discussed in Section 6.3.5.3, implementation of FP 3 could produce some long-term adverse effects on the environment, particularly due to the removal of 14 acres of vernal pools. While measures would be taken to restore the vernal pools, such pools are complex wetland systems with specialized hydrologic budgets, and it is uncertain whether and when they would return to their full ecological function. Given the extent of vernal pools that would be remediated and the uncertainties in the restoration of those pools, implementation of FP 3

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[144] For example, the local population of mink extends beyond the PSA to areas near the shoreline but outside the 1 mg/kg isopleth, as well as to tributaries of the River and to other riverine areas in the vicinity.

could have long-term adverse impacts on the amphibian subpopulations that inhabit those pools and potentially on the overall amphibian population in the area.

Despite these impacts, given the substantial extent to which FP 3 would address ecological risks identified by EPA in the ERA, it is concluded that FP 3 would provide overall protection of the environment relative to the existing presence of PCBs in floodplain soil. However, it may provide greater overall environmental protection, particularly to the amphibian population in the area, if it were modified to reduce the number and extent of vernal pools to be remediated. As stated by EPA (2005e, p. 6-6), “it is important to determine whether the loss of a contaminated habitat is a greater impact than the benefit of providing a new, modified but less contaminated habitat.”

Summary: Based on the above considerations, FP 3 would meet the standard of providing overall protection of human health and the environment. However, GE believes that, if this alternative were selected, consideration should be given to reducing the number and extent of vernal pools to be remediated, so as to provide better overall protection to the local amphibian population by balancing the potential impacts of PCBs against the potential long-term impacts from destroying a large number of the vernal pools in the PSA.

6.4 Evaluation of Floodplain Alternative 4

6.4.1 Description of Alternative

FP 4 would involve the removal and backfill of floodplain soils to achieve average PCB concentrations that would meet the mid-range RME IMPGs for human health protection and upper-bound IMPGs for ecological receptors. Specifically, this alternative has been developed to achieve the following IMPGs:

- The mid-range RME IMPGs for human health protection (i.e., those based on a 10^{-5} cancer risk or a non-cancer HI of 1, whichever is lower) from direct contact with floodplain soils;
- The mid-range RME IMPGs for human health protection (i.e., those based on a 10^{-5} cancer risk or a non-cancer HI of 1, whichever is lower) from consumption of agricultural products from the floodplain; and
- The upper-bound floodplain IMPGs for protection of ecological receptors – i.e., amphibians (represented by wood frogs), omnivorous/carnivorous mammals (represented by shrews), insectivorous birds (represented by wood ducks), and

piscivorous mammals (represented by mink) – using for the latter two receptors, the floodplain soil IMPGs associated with a sediment target level of 1 mg/kg.

This alternative would involve removing and replacing floodplain soils as necessary to achieve average PCB concentrations in the top foot of the relevant averaging areas that are equal to or less than the above-mentioned IMPGs. In addition, this alternative would involve the removal and backfill of soils in the top 3 feet in the Heavily Used Subareas of Frequent-Use EAs (described in Section 5.2.1 and shown on Figures 5-3a-d) as necessary to achieve average PCB concentrations in the 0- to 3-foot depth increment in these areas that are equal to or less than the mid-range IMPGs based on human direct contact. Average concentrations have been based on the 95% UCL of the spatially weighted mean, as discussed in Section 5.4.2.

Summary of Removal Areas and Volumes

FP 4 would involve the removal of approximately 99,000 cy of soil from 62 acres of the floodplain (including approximately 14 acres of vernal pools). The locations of these removal areas are shown on Figure 6-3, and a detailed breakdown of the removal areas and volumes associated with FP 4 is included in Tables 6-19 through 6-24.

The areas to be removed under FP 4 would be similar to those from FP 3 with an additional 20 acres of upland forest and 4 acres in other areas to achieve the more stringent human health IMPGs. The 99,000 cy removal volume includes 77,000 cy (48 acres) associated with achieving the mid-range human direct contact IMPGs and 22,000 cy (14 acres) associated with achieving the upper-bound IMPG for amphibians in vernal pools. (As discussed further below, the remediation for FP 4 would also allow the mid-range IMPGs for human consumption of agricultural products, the upper-bound IMPGs for omnivorous/carnivorous mammals, and the upper-bound IMPGs for insectivorous birds and piscivorous mammals [at the 1 mg/kg target level] to be met without the need for additional removal.)

Summary of Affected Habitat

FP 4 would involve the removal and backfill of soil across 62 acres in various types of habitats within the floodplain. The approximate acreages of those general habitat types, with associated removal volumes, are as follows:[145]

- 32 acres (51,000 cy) of upland forest habitat (consisting of high-terrace floodplain forest habitat, northern hardwoods-hemlock-white pine forest habitat, red oak-sugar maple transition forest habitat, successional northern hardwoods habitat, and transitional floodplain forest habitat);

- 14 acres (22,000 cy) of vernal pool habitat, including portions of 60 vernal pools;

- 8 acres (13,000 cy) of emergent marsh habitat (consisting of deep emergent marsh habitat, shallow emergent marsh habitat, and wet meadow habitat);

- 2 acres (4,000 cy) of disturbed upland habitats (consisting of agricultural field habitat and cultural grasslands habitat);

- 2 acres (3,000 cy) of palustrine habitat (consisting of red maple swamp habitat and shrub swamp habitat);

- <1 acre (1,000 cy) of black ash-red maple-tamarack calcareous seepage swamp habitat; and

- 3 acres (5,000 cy) of habitat of currently unmapped community type(s).[146]

In addition to the above-described areas associated with excavation/backfill activities, floodplain habitat would also be affected by the construction and use of access roads and staging areas. Conceptual construction plans indicate that FP 4 would require

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[145] This detailed breakdown of removal areas and volumes by habitat type was generally conducted using the Woodlot (2002) ecological characterization of the River between the Confluence and Woods Pond Dam, as previously noted. One exception is in vernal pool areas, where the EPA vernal pool coverage was merged with the Woodlot habitat areas; in those areas, the EPA vernal pool coverage superseded the underlying Woodlot habitat types.

[146] The Woodlot habitat community mapping is absent in some small portions of the PSA floodplain and in all of Reaches 7 and 8. Most of the removal for this unmapped community type(s) under FP 4 occurs in Reach 7 and, based on aerial photography, appears to be in generally forested areas of the floodplain.

approximately 26 staging areas, which would occupy an additional 12 acres, and 11 miles of temporary roadways across floodplain habitat.

Conceptual Remedial Approach

The conceptual remedial approach for FP 4 would be generally the same as that described for the previous removal/backfill alternatives, except that it would cover a greater area. Work would include the construction of access roads and staging areas. Soil removal would be conducted using conventional earth-moving equipment (i.e., backhoes, bulldozers), with material loaded into lined trucks for transport to staging areas. As described for FP 3, some specialized construction equipment, materials, and specific engineering practices would be needed to mitigate the potentially negative impacts of construction in and around vernal pools and other wetland areas. This is described in more detail in Section 6.4.9.1.

It is estimated that FP 4 would take approximately 4 years to complete if implemented independently from River-related remedial activities. However, floodplain remediation would likely be coordinated with sediment remediation. If so, the time to complete FP 4 could be different, depending on the sediment remediation alternative selected. Nevertheless, for purposes of the evaluations in this section, it has been assumed that implementation of FP 4 would take 4 years.

In addition to soil removal and backfill, FP 4 would include the use of EREs and Conditional Solutions as necessary to address reasonably anticipated future uses and activities for which this alternative would not meet applicable cleanup criteria (e.g., residential use standards, where that use is reasonably anticipated and remediation would not meet those standards).

After restoration activities within a given area are completed, periodic monitoring and maintenance would be conducted of the backfilled/restored areas. For the purposes of this CMS Report, monitoring and maintenance are assumed to occur for 3 years following remedy implementation in a given area. Monitoring would include annual visual inspections of restored areas (e.g., to assess plant survivorship, evidence of erosion). The maintenance program would be implemented to address those areas where the visual inspections indicate the need for maintenance or repair to maintain the effectiveness of the remedy.

6.4.2 Overall Protection of Human Health and the Environment - Introduction

As discussed in Section 6.1.2, the evaluation of whether a floodplain soil remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether FP 4 would be protective of human health and the environment is presented at the end of Section 6.4 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

6.4.3 Control of Sources of Releases

Existing floodplain soil conditions are not a significant source of potential PCB releases to the River, nor would they be following restoration. As stated previously, the floodplain is generally flat, well vegetated and depositional in nature, greatly reducing the potential for PCBs in the floodplain soil to scour and be transported to the River. While the floodplain is not considered a significant source, implementation of FP 4 would further reduce the limited potential for PCBs in the floodplain to be released to the River by removing approximately 99,000 cy of PCB-containing soils over 62 acres and replacing them with clean soil and vegetation.

Open excavations during construction could serve as a short-term temporary source of some releases during an extreme weather event. Such potential releases would be controlled using conventional engineering practices.

6.4.4 Compliance with Federal and State ARARs

The potential chemical-specific, location-specific, and action-specific ARARs identified by GE are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs set forth in Table 2-1 consist of federal and state water quality criteria for PCBs and state air pollution control requirements for dust. The water quality criteria do not apply to floodplain soils, and GE believes the state air pollution control requirements for dust could be met.

The potential location-specific and action-specific ARARs are listed in Tables 2-2 and 2-3. Based on review of those ARARs, GE believes, for the same reasons given for FP 2 in Section 6.2.4, that FP 4 could be designed and implemented to achieve the pertinent ARARs (provided that any necessary EPA approval determination under its TSCA regulations is obtained for the staging areas), with the following potential exception: In the event that excavated floodplain soils should be found to constitute hazardous waste (which is not anticipated), the temporary staging areas for the handling of those soils may not meet certain federal or state hazardous waste storage requirements, if they were determined to apply. In that case, as further discussed in Section 6.2.4, GE believes that such requirements should be considered inapplicable or, if necessary, waived as technically impracticable.

6.4.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for FP 4 includes evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment. Each of these considerations is discussed below.

6.4.5.1 Magnitude of Residual Risk

Evaluation of the magnitude of residual risk associated with FP 4 includes consideration of the extent to which and time over which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure, such as institutional controls.

FP 4 would reduce potential exposures of humans and ecological receptors to PCBs in floodplain soil by removing approximately 99,000 cy of PCB-containing soil over 62 acres of floodplain (see Figure 6-3). The reduction in potential exposure and associated risk would occur upon completion of the remediation in a given area.

As discussed further in Section 6.4.6.1, the average post-remediation floodplain concentrations the human health averaging areas under FP 4 are equivalent to or lower than those associated, under RME assumptions, with a cancer risk of 10^{-5} and a non-cancer HI of 1. In addition, as discussed in Section 6.4.6.2, the average post-remediation PCB concentrations in the ecological averaging areas are equivalent to or lower than the upper-bound IMPGs for ecological receptors (depending, in some cases, on the associated sediment concentrations). The average PCB EPCs in the top foot within the human health and ecological averaging areas following implementation of FP 4 are shown in Tables 6-19 through 6-24. (Table 6-19 also shows the post-remediation concentrations in the top 3 feet in Heavily Used Subareas.)

Following restoration, PCBs would also remain at depths below those described above. Such deeper soil is generally not anticipated to be available for exposure under current uses. Where it is reasonably anticipated that such deeper soil could become available for exposure, it would be addressed by EREs and/or Conditional Solutions. Additionally, EREs and Conditional Solutions would be implemented where necessary to address potential risks from reasonably anticipated future uses.

6.4.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of FP 4 has included an assessment of the use of technologies under similar conditions, the general reliability of those techniques, reliability of OMM, and technical component replacement requirement. The technology and implementation steps that would be used for FP 4 would be generally the same as described for FP 3 and would involve standard engineering equipment, practices, and controls. Access to vernal pools and some specialized equipment and material for work in and around wetlands would also be the same as described for FP 3.

Use of Technology Under Similar Conditions

FP 4 relies primarily on the removal of floodplain soils, including those associated with upland forest, vernal pools, and other wetland habitats, followed by backfilling of the excavations and performance of restoration activities. Excavation of soils from upland and wetland habitats has been effectively applied at a number of sites across the country, as discussed under FP 2 in Section 6.2.5.2 and FP 3 in Section 6.3.5.2. However, as noted for FP 3 in Section 6.3.5.2, no examples have been found where such a large number of vernal pools as would be remediated under FP 4 (60 pools) or such a large proportion of a site's vernal pool acreage (40%) has been excavated and restored.

General Reliability

The removal and backfill of material for FP 4 would reliably, effectively, and permanently reduce the concentrations of PCBs in the floodplain soils. Restoration activities would include backfilling with soil appropriate to support plant growth and planting vegetative communities similar to those that were removed, to the extent practicable. Standard landscaping techniques would be used to revegetate upland forested areas, and wetland restoration techniques would be used to restore the soils, hydrology, and vegetative communities of emergent marsh and palustrine habitats. FP 4 would impact 14 acres of vernal pools (the same as FP 3). While it is possible to restore vernal pools, there is little tolerance in terms of the topographic elevation and hydrologic parameters required to successfully complete the restorations. As discussed further below, an effort would be made to restore the affected vernal pools, but given the number and extent of vernal pool habitat that would be affected by this alternative, the reliability of that overall effort is considered uncertain.

Reliability of Operation, Monitoring, and Maintenance Requirements

Following the construction phase of FP 4, a monitoring and maintenance program would be implemented for those areas restored following remediation. Both the removal areas and those portions of the floodplain disturbed during construction of access roads and staging areas would be monitored through periodic inspections to ensure that the planted vegetation is surviving and growing, and to identify areas (if any) where the backfill is eroding and in need of repair. Periodic inspection of the plantings and backfill areas is considered a reliable means of tracking the restoration activities. Labor and materials needed to monitor and perform any maintenance activities required following implementation of FP 4 are readily available.

Maintenance, if required, could be difficult to implement in certain areas of the floodplain, due to remoteness, wet areas, and vegetation growth. The ease of access may change based on seasonal conditions. It could be especially difficult to conduct supplemental planting activities in difficult-to-access locations, to which plant materials would have to be carried from the closest roadways.

Technical Component Replacement Requirements

If significant erosion and/or plant loss were observed as part of the OMM program in the restored floodplain areas, an assessment would be conducted to determine the cause, as well as the need for and methods of repair. Depending on the magnitude, timing, and location of the repair, access roads and staging areas may need to be temporarily constructed in the floodplain. It is anticipated that if small repairs or replacement were necessary, they could be implemented using the same types of methods and materials used during the initial backfilling/restoration activities. Periodic small-scale inspections and repairs would pose no appreciable risks to humans and ecological receptors that use/inhabit the floodplain in these areas. While not anticipated, the repair or replacement of larger areas could require more extensive disturbance in the floodplain.

6.4.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of FP 4 on human health or the environment has included consideration of the items discussed below. Because FP 4 is similar to FP 3, the long-term adverse impacts and the controls to mitigate them are also similar. The primary difference between the two alternatives is that FP 4 would involve removal of 24 additional acres, thereby affecting that much more natural environment.

Potentially Affected Populations

Implementation of FP 4 would have a potential long-term effect on human and wildlife populations through changes in the natural environment and habitat. Since this alternative involves more extensive floodplain disturbance than FP 3, the potential for such impacts is correspondingly greater. For humans, implementation of FP 4 would affect the aesthetics of the floodplain, especially in forested areas where older, large trees could not be replaced in kind and would be replaced with smaller trees with less size and age diversity. For wildlife, implementation of FP 4 would remove and replace several habitat types (described in Section 6.4.1), some of which may be difficult to restore to their current functional value. Wildlife associated with these habitats includes a variety of mammals, birds, reptiles, and amphibians. The potential long-term impacts on biota are discussed in the next sections.

Adverse Impacts on Biota and Corresponding Habitat

Implementation of FP 4 could have some long-term impacts on biota and their habitat. The primary long-term impacts would be associated with the loss or change in habitats or the corresponding wildlife community should the remediated areas not return to conditions similar to those that currently exist.

The type of impacts associated with the loss of 32 acres of upland forest habitat that would be removed would be the same as described for the smaller acreage (12 acres) under FP 3, though the magnitude would be greater in proportion to the larger land area. These impacts would include the loss of mature forested habitat capable of supporting a wildlife community typical of a mature forest. Although replacement trees would be planted as a part of the restoration, the time for the forest system to reach a functional level comparable to its pre-excavation function is commensurate with the age of the system. As discussed for FP 3 in Section 6.3.5.3, based on the size of the trees, the forests found within the floodplain in Reaches 5A and 5B are probably on the order of 50 to 75 years in age, and those bordering Reach 5C and around Woods Pond are most likely 75 to 100 years old or older. The replanted forests would require similar time frames to provide the same level of ecological function that they currently provide. However, as the replanted forest develops, it will provide habitat for secondary successional communities prior to reaching full maturity. Younger, developing plant communities support a different wildlife community that is characteristic of early and mid-level successional habitats. It is expected that a restored, replanted upland forest would take approximately 5 to 10 years to reach a stage of development that would begin to support a woodland biological community rather than that of open successional habitat.

It should also be noted that, to the extent that affected areas constitute habitat for any rare, threatened, and/or endangered species, such impacts could affect those species. As part of the ecological characterization of the PSA floodplain, Woodlot (2002) identified 15 rare plant species at 27 locations and 8 rare bird species at 42 locations within the floodplain. The area targeted for soil removal by FP 4 would impact 5 locations where rare plant species have been identified and 3 locations where rare bird species have been observed. Mobile wildlife (including most birds) can avoid stresses associated with remedial activities by moving to other areas. In certain circumstances, long-term impacts may occur when the movement of a rare species from one area to another can lead to stress from competitive pressures on common resources of food and cover, as well as interspecies interactions. However, the magnitude of the potential impacts related to species movement is related directly to the amount of habitat disturbed and the number of rare species involved. As FP 4 would potentially impact only 3 locations where rare birds have been observed, it is not expected that the remedial alternative would impact the population of these species. For those rare species that are not mobile (i.e., plants), the excavation would result in removal of the locations where the plants were found in the excavation area, as well as the loss of habitat for these species. However, since FP 4 would affect only 5 of the identified rare plant locations, it would not be likely to have an impact on the overall populations of these species within the floodplain.

The marsh and other wetland habitat areas that would be affected by FP 4 are only slightly larger (4 acres more) than for FP 3 and the potential impacts to these areas would be the same as identified for FP 3. The long-term impacts to wetlands and the biota inhabiting them are described in the following section.

Adverse Impacts on Wetlands

As with FP 3, the greatest potential for significant long-term impacts to wetlands would come from the remediation of 60 vernal pools, covering approximately 14 acres. The potential long-term impacts to these vernal pools would be the same as described for FP 3 in Section 6.3.5.3. While measures would be taken to restore the vernal pools, such pools are complex wetland systems with specialized hydrologic budgets, and the time that would be needed for restoration to provide full recovery of ecological functional is uncertain. Given the extent of vernal pools that would be remediated in FP 4 and the uncertainties in the restoration of those pools, this alternative could have long-term adverse impacts on the amphibian subpopulations that inhabit those pools and potentially on the overall local amphibian population in the area.

The excavations involved in FP 4 would affect approximately 8 acres of emergent wetland habitat and 2 acres of palustrine wetland habitat. The impacts to these wetlands would include temporary loss of vegetation and the wildlife supported by the habitat, and could include modifications of the hydrology of these wetlands, which could result in a loss or change in habitat. Assuming that proper wetlands mitigation techniques are used to restore the marsh habitat, the impacts to that habitat would primarily be short-term in nature. For the palustrine wetlands, which are wooded wetlands that support a diverse and distinct community of plant and animals, long-term impacts could occur because palustrine wetlands are mature systems that would require an extended period of time to restore. However, since the amount of such wetlands habitat affected by FP 4 is relatively small, the potential for long-term impacts is relatively small.

FP 4 would also impact less than 1 acre of black ash-red maple-tamarack calcareous seepage swamp habitat, which is a type of habitat that would not be affected by FP 3. These swamps are supported by high pH groundwater originating in limestone-dominated bedrock, which support flora and fauna that are adapted to higher pH environments. As a general matter, excavation within a calcareous seepage swamp, as well as in the areas bordering the swamp, could lead to difficulty in restoring the wetland if the pH of the groundwater is affected by the excavation. Change in the hydrologic budget of these systems would not necessarily remove them from wetland status, but could modify the characteristics of the vegetation that grows within them. However, for FP 4, since the size of this affected community is very small (less than an acre), and since soil removal would be limited to the top foot and thus should not affect the groundwater, it is not expected that this alternative would have any significant adverse long-term impacts on this community in the floodplain.

Long-term impacts to wetlands could also occur as a result of ancillary construction activities in support of excavation, as described for FP 3. Construction and use of staging areas or temporary roadways in or bordering wetlands could modify soil conditions, drainage patterns, or groundwater flow conditions, potentially creating a change in the characteristics of an existing wetland or converting a wetland to an upland environment. For FP 4, based on conceptual design, the wetlands affected by such ancillary construction would include several areas in addition to those affected by FP 3, including palustrine wetlands and black ash-red maple-tamarack calcareous seepage swamp in Reach 5B. Construction design would include steps to avoid direct impacts on wetlands where practicable (e.g., a road could go around instead of though a wetland area, or culverts could be used). However, if impacts to wetlands could not be avoided, these types of effects could occur.

Long-Term Impact on Aesthetics

Implementation of FP 4 could have some long-term impacts on the aesthetic features of the natural environment. The natural appearance of the floodplain after the remediation and restoration would not be the same as prior to remediation, with the most noticeable changes likely associated with those areas where mature trees would be cut down. As noted above, FP 4 would result in the removal of approximately 32 acres of forested communities – 20 acres more than FP 3. The time for a replanted forest community to develop an appearance comparable to its current appearance would be commensurate with the age of the community prior to remediation, which could range up to 50 to 75 years or more. While it would take decades for the planted trees to reach their present maturity, it would not take that entire period of time for the restored vegetative communities to reach an intermediate level of maturity that would provide a natural appearance.

Potential Measures to Mitigate Long-Term Adverse Impacts

Measures to mitigate the potential for long-term adverse impacts would be the same as described for FP 3 in Section 6.3.5.3.

6.4.6 Attainment of IMPGs

This section describes the extent to which FP 4 would achieve the IMPGs for human health and ecological protection. These comparisons are presented in Tables 6-19 through 6-24 for the pertinent human and ecological averaging areas. The time frame to achieve any IMPGs would be the same as that required to complete the remedy in a particular area (i.e., the reduction in soil concentrations would occur upon completion of backfill placement). It is estimated that implementation of FP 4 would take a total of 4 years.

6.4.6.1 Comparison to Human Health-Based IMPGs

FP 4 would achieve the RME IMPGs based on a 10^{-5} cancer risk and a non-cancer HI of 1 in all 120 direct contact EAs, and in all Heavily Used Subareas (Table 6-19). In addition, FP 4 would achieve the RME IMPGs based on a 10^{-6} cancer risk in 17 EAs and the CTE IMPGs based on a 10^{-6} cancer risk in all but one of the EAs.

With respect to the farm areas, FP 4 would achieve the RME IMPGs based on a 10^{-5} cancer risk and a non-cancer HI of 1 in all 14 of the farm areas evaluated for consumption of agricultural products, and would achieve the RME IMPGs based on a 10^{-6} cancer risk in 6 of those areas and the CTE IMPGs based on a 10^{-6} cancer risk in 13 of those areas (Table 6-20).

These comparisons are shown in detail in Tables 6-19 and 6-20 for all human exposure areas in Reaches 5 through 8.

6.4.6.2 Comparison to Ecological IMPGs

FP 4 would achieve levels within (or below) the IMPG ranges for amphibians and omnivorous/carnivorous mammals in all averaging areas and would achieve levels within the IMPG ranges for insectivorous birds and piscivorous mammals depending on the associated sediment concentrations, as described below:

- For amphibians, FP 4 would achieve the upper-bound amphibian IMPG (5.6 mg/kg) in all 66 of the vernal pools in the PSA (covering approximately 34 acres) and would achieve the lower-bound IMPG (3.27 mg/kg) in 20 of those pools (approximately 30% of the pools; covering 9% of the total vernal pool acreage) (Table 6-21).

- For omnivorous/carnivorous mammals, FP 4 would achieve the upper-bound IMPG (34.3 mg/kg) in all of the 7 averaging areas and the lower-bound IMPG (21.1 mg/kg) in all but one of those areas (Table 6-22).

- For insectivorous birds, FP 4 would achieve the target floodplain soil IMPG levels in all averaging areas in the PSA if the associated sediment concentration in those areas were 3 mg/kg or less, and in 9 of those 12 areas if the associated sediment concentration were 5 mg/kg (Table 6-23). FP 4 would not achieve the IMPGs in the 3 averaging areas in Reach 5B if the associated sediment concentration were 5 mg/kg. In such a case, the removal of an additional 9,000 cy of soil from those 3 averaging areas would be needed to achieve the floodplain soil IMPG levels for insectivorous birds in those averaging areas.

- For piscivorous mammals, FP 4 would achieve the upper-bound floodplain soil IMPGs in both of the PSA averaging areas if the associated sediment concentration were 1 mg/kg or less (Table 6-24). It would also achieve the upper-bound floodplain soil IMPG in one of those averaging areas (Reaches 5C/5D/6), but not the other (Reaches 5A/5B), if the associated sediment concentration were 3 mg/kg. At a sediment concentration of 3 mg/kg, additional removal of 152,000 cy of floodplain soil would be necessary to achieve the upper-bound soil IMPG in the Reach 5A/5B averaging area. If the sediment concentration were 5 mg/kg, FP 4 would not achieve the upper-bound floodplain soil IMPG levels in either averaging area. In that case, attainment of the upper-bound IMPG in Reaches 5C/5D/6 would require the removal of an additional 8,000 cy of floodplain soil; and in Reaches 5A/5B, the IMPG could not be achieved with any amount of additional soil removal because the PCBs levels in aquatic prey items alone would exceed the IMPG at that sediment concentration.

These comparisons are shown in detail in Tables 6-21 through 6-24 for all ecological averaging areas in the PSA.

6.4.7 Reduction of Toxicity, Mobility, or Volume

The degree to which FP 4 would reduce the toxicity, mobility, or volume of PCBs in floodplain soils is discussed below.

Reduction of Toxicity: FP 4 does not include any treatment processes that would reduce the toxicity of the PCBs in the floodplain soils. However, if “principal threat” wastes (e.g., NAPL, drums of liquid) should be encountered during the excavations (which is not anticipated), they would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: As previously noted, the existing conditions of the floodplain are predominantly depositional and stable due to generally low water velocities during inundation and the presence of vegetation. Therefore, PCBs in existing floodplain soils do not represent a significant potential source for mobility and migration. Nevertheless, implementation of FP 4 would further reduce the limited potential for mobility of PCBs in the floodplain by removing 62 acres of soils with higher PCB concentrations from the floodplain, backfilling the excavations, and revegetating the surface.

Reduction of Volume: FP 4 would reduce the volume of PCBs in the floodplain by removing 99,000 cy of soils containing approximately 12,500 lbs of PCBs from 62 acres of the floodplain.

6.4.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of FP 4 included consideration of the short-term impacts of implementing this alternative on the environment, the local communities (as well as communities along truck transport routes), and workers involved in the remedial activities. These impacts would be the same as for FP 3 since the same type of activities and habitats would be affected. However, the geographical extent and duration would be greater for FP 4 since more area would be involved in the remedy. In addition to the removal discussed for FP 3, FP 4 would involve removal in 20 additional acres of upland forest and approximately 5 additional acres of wetland habitats. Staging areas and temporary access roads would affect an additional 39 acres of the floodplain (14 acres more than FP 3). The impacts in these areas would last for the duration of remedial activities, which is estimated to be 4 years.

Impacts on the Environment

The short-term effects on the environment resulting from implementation of FP 4 would include the temporary removal of plant and wildlife habitat in those areas of the floodplain where remediation or construction of access roads or staging areas would occur. Short-term impacts specifically associated with each habitat type are described below.

Mature Upland Forest: Short-term impacts would include the immediate loss of 32 acres of forested habitat. Birds, mammals, reptiles, and amphibians would be at least temporarily affected by the habitat disruption associated with implementation of this alternative. The temporary loss of the plant communities would result in indirect impacts to wildlife through the loss of cover, nesting, and feeding habitat. This would be particularly disruptive to wildlife with small home ranges, which would not be likely to move out of the construction zone. Likewise, birds that are dependent on the plant community for the placement of their nests would be forced to move elsewhere during nesting season.

Wetlands: The short-term impacts on the various types of wetlands that would be affected by the excavations in FP 4 include the following:

- FP 4 would have a direct impact on 60 different vernal pools, affecting a total of 14 acres of such pools. This would result in the immediate loss of habitat and of individual species found within the pools. Depending upon what time of year the pools are remediated, the loss could also include eggs or larval stages of various amphibian species. While measures would be taken to restore the vernal pools, such pools are complex wetland systems with specialized hydrologic budgets, and the time that would be required for restoration to provide full recovery of ecological functional is uncertain. (The potential long-term impacts on these pools were described in Section 6.3.5.3.).

- FP 4 would result in removal of 8 acres of emergent marsh wetlands. Short-term impacts from the removal of these wetlands as a result of the remedial action include the inability of these areas to support mammals, birds, reptiles, and amphibians that are dependent on wetlands for nesting, breeding, and feeding.

- Short-term impacts would also be associated with the loss of a limited area (2 acres) of palustrine wetlands. Short-term impacts from the removal of these wetlands as a result of the remedial action could include the inability of these areas to support mammals, birds, reptiles, and amphibians that are dependent on these wetlands for nesting, breeding, and feeding. However, because the area of such wetlands affected by this remedy would be limited, the adverse impacts would likewise be relatively small.

- FP 4 would impact less than 1 acre of black ash-red maple-tamarack calcareous seepage swamp, which is a very limited amount of habitat in relationship to the size of the floodplain. Short-term impacts would include the direct loss of plants within the construction zone and the indirect loss of habitat that the plants may provide. Short-term impacts would also potentially include wildlife with limited range of movement that are unable to move out of the construction area. However, the short-term impacts would be limited because of the small size of the affected community in comparison to the overall area of this habitat present in the PSA.

Other short-term impacts relate to the affected wetlands' ability to perform functions of phosphorous retention, nitrogen removal, and flood control. FP 4 would potentially change stormwater flows from wetlands undergoing remediation to neighboring wetlands that would not be remediated. In particular, increases in stormwater runoff affect water level fluctuations within wetlands. This in turn has been shown to reduce plant richness, reduce thin-stemmed plant distribution, promote the presence of invasive species, and reduce the presence of amphibians (Wright et al., 2006). Additionally, erosion and sedimentation changes brought about by construction within or near wetlands could result in unintended changes to the wetlands.

Disturbed Upland Habitat: The short-term impacts associated with the removal of 2 acres of disturbed upland habitat would be limited as the amount of area affected by the removal is relatively small and the quality of the habitat would be low relative to the undisturbed areas of the floodplain. While these areas would be disturbed, they would, if left alone, readily return to a natural state.

Additional Habitats Affected by Supporting Facilities: Construction of supporting facilities (e.g., roadways, staging areas) in the floodplain would result in the temporary loss of habitat in those areas and the wildlife that they support. It is anticipated that FP 4 would require a total of approximately 39 acres for access roads and staging areas. Based on the conceptual layout, these facilities would affect upland disturbed areas, forested habitat, and 4 acres of wetlands. Development of these support facilities would affect the ability of some wildlife to nest and feed in these areas; and in some instances it would cause habitat fragmentation that could further disrupt the movement and interactions of certain wildlife species. In addition, nearby wetlands that are not undergoing remediation could be indirectly adversely affected by construction as a result of changes in stormwater drainage patterns and modifications to hydrology. Conventional engineering practices and controls would be used to reduce adverse effects from construction.

Impacts on Local Communities and Communities Along Truck Transport Routes

FP 4 would result in short-term impacts to the local communities along the River. These short-term effects would be qualitatively the same as described for FP 2 and FP 3, but would affect a greater area and would last longer. These effects would include: changes to visual aesthetics of the forested areas of the floodplain; disruption of activities along the River and within the floodplain due to the remediation as well as the construction of access roads and staging areas; and increased construction traffic and noise during excavation and backfilling activities.

Recreational activities that could be affected by construction include bank fishing, canoeing (canoe launches), hiking and general recreation, and waterfowl hunting. During the period of active construction, restrictions on recreational use of the floodplain would be imposed in the areas in which remediation-related activities are taking place. Due to safety considerations, boaters, anglers, hikers, and other recreational users would not be able to use the floodplain in the areas where remediation-related activities are being conducted. Aesthetically, the presence of heavy construction equipment and cleared or disturbed areas would detract from the visually undisturbed nature of the area until such time as the restoration plantings for the disturbed areas have matured.

In addition, due to the need to remove excavated materials and deliver backfill materials and equipment, truck traffic would significantly increase during the construction period. As an example, if 20-ton capacity trucks were used to transport excavated material from the staging areas, it would take 7,400 trips to do so. Assuming the use of smaller capacity trucks for local hauling (i.e., 16-ton trucks), an additional 13,400 truck trips would be anticipated to import backfill materials, as well as materials for the construction of staging areas and access roads, to the site.

This additional traffic would increase the likelihood of accidents, noise levels, emissions of vehicle/equipment exhaust, and nuisance dust to the air. In addition, noise in and near the construction zone could affect those residents and businesses located in the immediate vicinity of work areas. Engineering controls would be implemented to mitigate short-term impacts and risks associated with implementation of FP 4. However, some impacts would be inevitable.

The increased truck traffic would also increase the risk of traffic accidents along transport routes. Appendix D includes an analysis of potential risks from the increased truck traffic that would be necessary to transport clean materials to the site for implementation of FP 4.[147] This analysis indicates that the increased truck traffic associated with FP 4 (an estimated total of 670,000 vehicle miles) would result in an estimated 0.38 non-fatal injuries due to accidents (with a probability of 32% of at least one such injury) and an estimated 0.02 fatalities from accidents (with a probability of 2% of at least one such fatality).

Risks to Remediation Workers

There would be potential health and safety risks to site workers implementing FP 4. Engineering controls and OSHA procedures designed to mitigate risks to remediation workers would be instituted. Implementation of FP 4 is estimated to involve 152,238 labor-hours over a 4-year timeframe.

The analysis in Appendix D of potential risks to workers from implementation of the floodplain alternatives indicates that implementation of FP 4 would result in an estimated 1.55 non-fatal injuries to workers (with a probability of 79% of at least one such injury) and an estimated 0.01 worker fatalities (with a probability of 1% of at least one such fatality).

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[147] The risks from truck traffic to transport excavated materials from the staging areas away from the site are evaluated under the relevant treatment/disposition alternatives.

6.4.9 Implementability

6.4.9.1 Technical Implementability

The technical implementability of FP 4 has been evaluated in terms of the general availability of the technology involved (soil excavation and backfilling), the ability of this technology to be constructed and operated given site characteristics, the reliability of this technology, the availability of support facilities and resources, ease of undertaking corrective measures if necessary, and ability to monitor effectiveness. FP 4 is similar in approach and the types of areas to FP 3 and would be technically implementable, as discussed for FP 3 and summarized below.

General Availability of Technology: As discussed for the other removal alternatives, the equipment, materials, technology, procedures, and personnel necessary to implement FP 4 are expected to be readily available. In wetlands and vernal pool settings, specialized technologies would be used, as appropriate, to mitigate adverse impacts. These technologies have been used at other sites to access and restore sensitive areas, especially wetlands. Given the physical characteristics of the floodplain and the availability and known reliability of construction equipment and materials, FP 4 would be technically implementable.

Ability To Be Implemented: Based on site characteristics, the excavation/backfill technology that would be utilized in FP 4 is suitable for implementation in the areas where it would be applied. The construction of access roads and staging areas may temporarily affect flood storage and drainage characteristics during seasonal high water conditions and during periodic storm and flood events. Engineering practices would be implemented to reduce the temporary impacts of such hydrology changes. In the long term, floodplain areas would be backfilled and restored to approximate original elevations, to maintain the flood storage capacity of the floodplain.

Reliability: Soil excavation with backfilling is considered a reliable means of reducing the potential for human and ecological exposure to soils containing PCBs. Floodplain soil excavation has been implemented at other PCB-impacted sites across the country, as described for FP 2 and FP 3 in Sections 6.2.5.2 and 6.3.5.2. Although wetlands restoration can be reliable, the characteristics of the restored soils and hydrology will determine how the restored wetlands will develop, and upfront planning cannot completely assure that the restored wetlands will be the same as the pre-remediation wetlands. Vernal pools in particular are difficult to restore because of the hydrologic budget requirements and as a result the likelihood of full restoration of ecological function is uncertain.

Availability of Support Facilities and Resources: For purposes of the CMS, it has been assumed that FP 4 would require development of approximately 39 acres for staging areas and access roads along the River. The specific locations and sizing of these access roads and staging areas would be determined based on the available land resources. Space for these roads and staging areas is not expected to be a significant limitation on construction.

Ease of Conducting Additional Corrective Measures: If necessary, performing additional remediation at a later date would be possible using the same types of tools, equipment, and materials as in the original round of remediation. Construction equipment, personnel, and materials are commercially available and their use and effectiveness for this type of material removal and backfill project are well known and documented. Ease of implementation of the corrective measures would be directly related to the extent of the necessary additional corrective measures (i.e., area and/or volume to be addressed) and the ease of access (e.g., remoteness from roads, wetlands crossings, size and type of construction equipment).

Ability to Monitor Effectiveness: The effectiveness of FP 4 would be assessed by visual observation to evaluate such factors as vegetation re-growth and any signs of erosion or disturbance of restored areas. Monitoring procedures would be straightforward and implementable.

6.4.9.2 Administrative Implementability

The evaluation of administrative implementability of FP 4 has included consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: FP 4 would need to comply with the substantive requirements of applicable and appropriate regulations pertaining to the performance of the remedial action (unless waived). As discussed in Section 6.4.4, GE believes that FP 4 could be designed to comply with such requirements (i.e., the location-specific and action-specific ARARs listed in the Tables 2-2 and 2-3), with the exception of certain requirements that could potentially apply to the on-site staging areas if the excavated materials should constitute hazardous waste. In the latter case, if necessary, GE believes that such requirements should be waived as technically impracticable.

Access Agreements: Implementation of FP 4 would require GE to obtain permission for access to the properties where the work would be conducted or where the ancillary facilities would be located. Access to State-owned lands would be sought from the state agencies that own the land. In addition, it is currently anticipated that access agreement would be required from nearly 40 private landowners. Obtaining access to all these properties for the type of work and length of time that may be needed could be difficult and time-consuming.

If GE should be unable to obtain access agreements with particular landowners, GE would request EPA and/or MDEP to provide assistance.

Coordination with Agencies: Implementation of EREs and Conditional Solutions as part of FP 4 would require coordination with EPA and MDEP. In addition, as noted above, obtaining access to State-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of FP 4, GE would need to coordinate with EPA, as well as state and local agencies, to address potential health and safety impacts and to provide as-needed support with public/community outreach programs.

6.4.10 Cost

The estimated total cost to implement FP 4 is $39.9 M (excluding the costs of treatment/disposition of excavated soils). The estimated capital cost for implementation of FP 4 is $39.2 M, assumed to occur over a 4-year construction period. Estimated annual OMM costs (for a 3-year inspection and maintenance program for restored excavation and staging/access road areas) range from $15,000 to $125,000 per year (depending on which reach is being monitored), resulting in a total cost of approximately $720,000. The following summarizes the total costs estimated for FP 4.

FP 4	Est. Cost	Description
Total Capital Cost	$39.2 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM Cost	$0.7 M	Costs for performance of the OMM programs
Total Cost for Alternative	$39.9 M	Total cost of FP 4 in 2008 dollars

The total estimated present worth of FP 4, which was developed using a discount factor of 7%, a 4-year construction period, and an OMM period of 3 years on a reach-specific basis, is approximately $36.1 M. More detailed cost estimate information and assumptions for each of the floodplain alternatives are included in Appendix E.

As noted above, these costs do not include the costs of treatment/disposition of the removed floodplain soils. The estimated costs for combinations of FP 4 with the various treatment/disposition alternatives are presented in Section 8.

6.4.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 6.4.2, the evaluation of whether FP 4 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: FP 4 would be generally effective in substantially reducing the potential for human and ecological exposure to PCBs in floodplain soils by the removal from the floodplain of 99,000 cy of PCB-containing soil containing approximately 12,500 lbs of PCBs. The removed soil would be replaced with clean backfill, which would be revegetated.

Compliance with ARARs: As discussed in Section 6.4.4, based on review of the potential ARARs, GE believes that FP 4 could be designed and implemented to achieve the ARARs pertinent to this alternative, with the possible exception of certain requirements that could apply to the on-site staging areas if the excavated soils should constitute hazardous waste. In the latter case, if necessary, GE believes that such requirements should be waived as technically impracticable.

Human Health Protection: FP 4 would provide protection of human health. As discussed in Section 6.4.6.1, implementation of this alternative would achieve the RME IMPGs based on a 10^{-5} cancer risk and a non-cancer HI of 1 in all human use exposure areas (including all Heavily Used Subareas). FP 4 would further ensure protection of human health through implementation of EREs and Conditional Solutions, where necessary, to address reasonably anticipated future uses.

Environmental Protection: As discussed in Section 6.4.6.2, FP 4 would achieve floodplain soil levels considered protective of ecological receptors, depending, in some cases, on the associated sediment concentrations. Specifically, FP 4 would achieve soil PCB levels within or below the range of the IMPGs for amphibians in all 66 vernal pools evaluated and within or below the IMPG range for omnivorous/carnivorous mammals in all 7 averaging areas. In addition, FP 4 would achieve the target floodplain soil IMPG levels for insectivorous birds in all 12 averaging areas if the associated sediment concentration in those areas is 3 mg/kg or less. It would also achieve levels within the range of the target floodplain soil IMPG levels for piscivorous mammals in both of the averaging areas if the associated sediment concentration in those areas is 1 mg/kg or less, and in one of those areas (Reaches 5C/5D/6) if the associated sediment concentration is 3 mg/kg or less.

FP 4 would not achieve the IMPG for insectivorous birds in three of 12 averaging areas if the associated sediment concentration were 5 mg/kg, and would not achieve the IMPGs for piscivorous mammals in one of the two averaging areas if the associated sediment concentration were 3 mg/kg or in either area if the sediment concentration were 5 mg/kg. However, as previously noted, achievement of IMPGs is a balancing factor under the Permit; it is not determinative of whether an alternative would provide overall environmental protection. In this case, even if there were IMPG exceedances for these receptors, GE believes that FP 4 would provide overall protection of the environment. As with FP 3, this is true, first, because of the highly conservative nature of the averaging areas and the fact that the local populations of these receptors extend beyond the individual averaging areas.[148] Moreover, as discussed in Section 6.4.6.2, extensive additional removals would be necessary to achieve the IMPGs (e.g., up to an additional 152,000 cy to address piscivorous mammals). These removals would cause substantial additional long-term and short-term adverse ecological impacts that GE does not believe are necessary to protect local populations of these receptors or justified to protect individual animals that may inhabit the PSA.

At the same time, as discussed in Section 6.4.8, implementation of FP 4 would result in considerable short-term adverse impacts on the environment, which would be greater than those under FP 2 or FP 3. FP 4 would remove plant and wildlife habitat in those areas of the floodplain where remediation and ancillary construction activities would occur. Such impacts would include the loss of approximately 32 acres of mature upland forest and 25 acres of wetlands (including 14 acres of vernal pools), with the consequent impact on the biota that depend on those habitats. Further, as discussed in Section 6.4.5.3, implementation of FP 4 would produce some long-term adverse effects on the environment, particularly due to the removal of 32 acres of mature upland forest habitat and 14 acres of vernal pools. While replacement trees would be planted, the replanted forest would be expected to take 5 to 10 years to reach a stage of development that would begin supporting a woodland biological community instead of a biological community typical of open successional habitat; and a diverse forest could take over 50 years to reach a functional level comparable to its pre-excavation function. While measures would be taken to restore the vernal pools, such pools are complex wetland systems with specialized hydrologic budgets, and it is uncertain whether and when they would return to their full ecological function. Given the extent of vernal pools that would be remediated and the uncertainties in the restoration of those pools, implementation of FP 4 could have long-term adverse

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[148] For example, the local population of mink extends beyond the PSA to areas near the shoreline but outside the 1 mg/kg isopleth, as well as to tributaries of the River and to other riverine areas in the vicinity.

impacts on the amphibian subpopulations that inhabit those pools and potentially on the overall amphibian population in the area.

Despite these impacts, given the substantial extent to which FP 4 would address ecological risks identified by EPA in the ERA, it is concluded that FP 4 would provide overall protection of the environment relative to the existing presence of PCBs in floodplain soil. However, it may provide greater overall environmental protection, particularly to the amphibian population in the area, if it were modified to reduce the number and extent of vernal pools to be remediated. As stated by EPA (2005e, p. 6-6), "it is important to determine whether the loss of a contaminated habitat is a greater impact than the benefit of providing a new, modified but less contaminated habitat."

Summary: Based on the above considerations, FP 4 would meet the standard of providing overall protection of human health and the environment. However, as with FP 3, GE believes that, if this alternative were selected, consideration should be given to reducing the number and extent of vernal pools to be remediated, so as to provide greater overall protection to the local amphibian population by balancing the potential impacts of PCBs against the potential long-term impacts from destroying a large number of vernal pools in the PSA.

6.5 Analysis of Floodplain Alternative 5

6.5.1 Description of Alternative

FP 5 would involve the removal of all floodplain soils with PCB concentrations at or above 50 mg/kg in the top foot of soil, as well as in the top 3 feet in the Heavily Used Subareas of Frequent-Use EAs (described in Section 5.2.1 and shown on Figures 5-3a-d). The excavated areas would be replaced with backfill and revegetated.

Summary of Removal Volumes

This alternative would remove and replace approximately 100,000 cy of soil over approximately 60 acres, as shown on Figure 6-4. A total of 97,000 cy would be removed from top foot of soil, and an additional 3,000 cy would be removed from depths between 1 and 3 feet in the Heavily Used Subareas. In total, FP 5 would involve removal of approximately the same acreage and volume as FP 4 (99,000 cy over 62 acres); however, because the alternatives have different removal objectives, some of the areas to be removed are different for the two alternatives (see Figures 6-3 and 6-4).

Summary of Affected Habitat

FP 5 would involve the removal and backfill of soil in various types of habitats within the floodplain. The acreages of those general habitat types, with associated removal volumes, are as follows:[149]

- 27 acres (44,000 cy) of upland forest habitat (consisting of high-terrace floodplain forest habitat, northern hardwoods-hemlock-white pine forest habitat, red oak-sugar maple transition forest habitat, successional northern hardwoods habitat, and transitional floodplain forest habitat);

- 17 acres (27,000 cy) of emergent marsh habitat (consisting of deep emergent marsh habitat, shallow emergent marsh habitat, and wet meadow habitat);

- 12 acres (21,000 cy) of palustrine habitat (consisting of red maple swamp habitat and shrub swamp habitat);

- 3 acres (5,000 cy) of vernal pool habitat;

- <1 acre (<1,000 cy) of black ash-red maple-tamarack calcareous seepage swamp habitat;

- <1 acre (<1,000 cy) of disturbed upland habitat (consisting of agricultural field habitat and cultural grasslands habitat); and

- <1 acre (1,000 cy) of habitat of currently unmapped community type.[150]

In addition to the areas subject to excavation/backfill activities, floodplain habitat would be affected by the construction and use of access roads and staging areas. Conceptual

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[149] This detailed breakdown of removal areas and volumes by habitat type was generally conducted using the Woodlot (2002) ecological characterization of the River between the Confluence and Woods Pond Dam, as previously noted. One exception is in vernal pool areas, where the EPA vernal pool coverage was merged with the Woodlot habitat areas; in those areas, the EPA vernal pool coverage superseded the underlying Woodlot habitat types.

[150] The Woodlot habitat community mapping is absent in some small portions of the PSA floodplain and in all of Reaches 7 and 8. Most of the removal for this unmapped community type under FP 5 occurs in Reach 5 and, based on aerial photography, appears to be in generally wet meadow areas of the floodplain.

construction plans indicate that FP 5 would require 20 staging areas, which would occupy an additional 9 acres, and 8 miles of temporary roadways across floodplain habitat.

Conceptual Remedial Approach

The conceptual remedial approach for FP 5 would be generally the same as described for the previously discussed alternatives. Soil removal would be conducted using conventional earth-moving equipment, with material loaded into lined trucks for transport to staging areas. As described for FP 3 and FP 4, some specialized construction equipment, materials, and engineering practices would be used to mitigate the potentially negative impacts of construction in and around vernal pools and other wetland areas.

It is estimated that FP 5 would take 4 years to complete if implemented independently from River-related remedial activities. However, floodplain remediation would likely be coordinated with sediment remediation. If so, the time to complete FP 5 would likely be different, depending on the sediment remediation alternative selected. Nevertheless, for purposes of the evaluations in this section, it has been assumed that implementation of FP 5 would take 4 years.

As described for FP 3 and FP 4, FP 5 would include the use of EREs and Conditional Solutions as necessary to address reasonably anticipated future uses and activities for which this alternative would not meet applicable cleanup criteria (e.g., residential use standards, where that use is reasonably anticipated and remediation would not meet those standards).

After restoration activities within a given area are completed, periodic monitoring and maintenance would be conducted of the backfilled/restored areas. For the purposes of this CMS Report, monitoring and maintenance are assumed to occur for 3 years following remedy implementation in a given area. Monitoring would include annual visual inspections of restored areas (e.g., to assess plant survivorship, evidence of erosion). The maintenance program would be implemented to address those areas where the visual inspections indicate the need for maintenance or repair to maintain the effectiveness of the remedy.

6.5.2 Overall Protection of Human Health and the Environment - Introduction

As discussed in Section 6.1.2, the evaluation of whether a floodplain soil remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether FP 5 would be protective of human health and the environment is presented at the end of Section 6.5 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of human health and the environment.

6.5.3 Control of Sources of Releases

Existing floodplain soil conditions are not a significant source of potential PCB releases to the River, nor would they be following restoration. As stated previously, the floodplain is generally flat, well vegetated and depositional in nature, greatly reducing the potential for PCBs in the floodplain soil to scour and transport to the River. While the floodplain is not considered a significant source, implementation of FP 5 would further reduce the limited potential for PCBs in the floodplain to be released to the River by removing all soil from the top foot of the floodplain containing PCBs at or above 50 mg/kg (approximately 60 acres), replacing that soil with clean soil, and vegetating the surface cover.

Open excavations during construction could serve as a short-term temporary source of some releases during an extreme weather event. Such potential releases would be controlled using conventional engineering practices.

6.5.4 Compliance with Federal and State ARARs

The potential chemical-specific, location-specific, and action-specific ARARs identified by GE are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs set forth in Table 2-1 consist of federal and state water quality criteria for PCBs and state air pollution control requirements for dust. The water quality criteria do not apply to floodplain soils, and GE believes the state air pollution control requirements for dust could be met.

The potential location-specific and action-specific ARARs are listed in Tables 2-2 and 2-3. Based on review of those ARARs, GE believes, for the same reasons given for FP 2 in Section 6.2.4, that FP 5 could be designed and implemented to achieve the pertinent ARARs (provided that any necessary EPA approval determination under its TSCA regulations is obtained for the staging areas), with the following potential exception: In the event that excavated floodplain soils should be found to constitute hazardous waste (which is not anticipated), the temporary staging areas for the handling of those soils may not meet certain federal or state hazardous waste storage requirements, if they were determined to apply. In that case, as further discussed in Section 6.2.4, GE believes that such requirements should be considered inapplicable or, if necessary, waived as technically impracticable.

6.5.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for FP 5 has included evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment. Each of these considerations is discussed below.

6.5.5.1 Magnitude of Residual Risk

Evaluation of the magnitude of residual risk associated with FP 5 includes consideration of the length of time and extent to which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure, such as institutional controls.

FP 5 would reduce potential exposures of humans and ecological receptors to PCBs in floodplain soil by removing approximately 100,000 cy of PCB-containing soil over 60 acres of floodplain (see Figure 6-4). The reduction in potential exposure and associated risks would occur upon completion of the floodplain remediation in a given area.

Implementation of this alternative would result in the removal of soil with PCB concentrations at or above 50 mg/kg. As discussed further in Section 6.5.6.1, the average post-remediation PCB concentrations in the human health averaging areas are equivalent to or lower than those associated, under RME assumptions, with a 10^{-4} cancer risk in all such areas and a 10^{-5} cancer risk and a non-cancer HI of 1 in most (but not all) of those areas. As discussed in Section 6.5.6.2, the average concentrations in the ecological averaging areas would achieve the IMPGs for some receptors/areas. The average post-remediation soil EPCs in the top foot within the human health and ecological averaging areas for FP 5 are shown in Tables 6-25 through 6-30. Those averages range from approximately 1 mg/kg to 42 mg/kg in the direct contact EAs, 0.2 mg/kg to 13 mg/kg in the farm areas, and 0.02 mg/kg to 48 mg/kg in the ecological averaging areas. (Table 6-25 also shows the post-remediation concentrations in the top 3 feet in Heavily Used Subareas.)

PCBs would also remain at depths below those described above. Such deeper soil is generally not anticipated to be available for exposure under current uses. Where it is reasonably anticipated that such deeper soil could become available for exposure, it would be addressed by EREs and/or Conditional Solutions. Additionally, EREs and Conditional Solutions would be implemented where necessary to address potential risks from reasonably anticipated future activities and uses.

6.5.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of FP 5 has included an assessment of the use of technologies under similar conditions, the general reliability of those techniques, reliability of OMM, and the potential need to replace technical components. The technology and implementation steps that would be used for FP 5 would be generally the same as described for alternatives FP 3 and FP 4.

Use of Technology Under Similar Conditions

FP 5 relies primarily on the removal of floodplain soils, including those in upland forest, vernal pools, and wetland habitats, followed by backfill of the excavations and restoration activities. Excavation, backfilling, and revegetation of various types of floodplain environments have been effectively applied at a number of other sites, as discussed under FP 2 in Section 6.2.5.2 and FP 3 in Section 6.3.5.2.

General Reliability

The removal and backfill of material for FP 5 would reliably, effectively, and permanently reduce the concentrations of PCBs in the floodplain. Restoration activities would include the replacement of soil appropriate to support plant growth and replanting vegetative communities similar to those that were removed, to the extent practicable. Standard landscaping techniques would be used to replant upland forested areas, and wetland restoration techniques would be used to restore the soils, hydrology, and vegetative communities of emergent marsh and palustrine habitats. Vernal pools would also be restored. Though there are fewer vernal pools to be restored in FP 5 than in FP 3 and FP 4, there would still be challenges to successful restoration. While it is possible to restore vernal pools, there is little tolerance in terms of the topographic elevation and hydrologic parameters required to successfully complete these restorations.

Reliability of Operation, Monitoring, and Maintenance Requirements

Following the construction phase of FP 5, a monitoring and maintenance program would be implemented for those areas restored following remediation. Both the removal areas and those portions of the floodplain disturbed during construction of access roads and staging areas would be monitored through periodic inspections to ensure that the planted vegetation is surviving and growing, and to identify areas (if any) where the backfill is eroding and in need of repair. Periodic inspection of the plantings and backfill areas is considered a reliable means of tracking the restoration activities. Labor and materials needed to monitor and perform any maintenance activities required following implementation of FP 5 are considered readily available.

Maintenance, if required, could be difficult to implement in certain areas of the floodplain, due to remoteness, wet areas, and vegetation growth. The ease of access may change based on seasonal conditions. It could be especially difficult to conduct supplemental planting activities in difficult-to-access locations, to which plant materials would have to be carried from the closest roadways.

Technical Component Replacement Requirements

If erosion and/or plant loss were observed as part of the OMM program in the restored floodplain areas, an assessment would be conducted to determine the need for and methods of repair. Depending on the timing and location of the repair, access roads and staging areas may need to be temporarily constructed in the floodplain. It is anticipated that if small repairs or replacement were necessary, they could be implemented using the same types of methods and materials used during the initial backfilling/restoration activities. Periodic small-scale inspections and repairs would pose no appreciable risks to humans and ecological receptors that use/inhabit the floodplain in these areas. While not anticipated, the repair or replacement of larger areas could require more extensive disturbance in the floodplain.

6.5.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of FP 5 on human health or the environment has included consideration of the items discussed below. Because the types of areas affected by FP 5 are similar to those affected by FP 3 and FP 4, the long-term adverse impacts and the controls to mitigate them are also similar. The primary difference between FP 5 and FP 4 is that FP 5 would affect more emergent marsh and palustrine habitat and less vernal pool habitat than FP 4.

Potentially Affected Populations

Implementation of FP 5 would have potential long-term effects on humans and wildlife populations through changes in the natural environment and habitat. For humans, implementation of FP 5 would affect the aesthetics of the floodplain, especially in forested areas where older, large trees could not be replaced in kind and would be replaced with smaller trees with less size and age diversity. For wildlife, implementation of FP 5 would remove and replace several habitat types (listed in Section 6.5.1), which contain a variety of mammals, birds, and herptiles. The potential long-term impacts of FP 5 on biota are discussed further in the next sections.

Adverse Impacts on Biota and Corresponding Habitat

Implementation of FP 5 could have some long-term impacts on biota and their habitat. The primary long-term impacts would be associated with the loss or change in habitats and the corresponding wildlife community should the remediated areas not return to conditions similar to those which currently exist.

The impacts to the 27 acres of upland forest habitat that would be removed under FP 5 would be the similar to those described for FP 4 (32 acres). These impacts would include the loss of mature forested habitat capable of supporting a diverse wildlife community. While the affected plant communities would be replanted as part of restoration activities, the time necessary for the forest system to reach a functional level comparable to its pre-excavation function is commensurate with the age of the system – approximately 50 to 75 years (or older adjacent to Reach 5C and Woods Pond), as noted in Sections 6.3.5.3 and 6.4.5.3. Younger, developing plant communities support a different wildlife community characteristic of successional habitats. It is expected that a restored, replanted upland forest would take approximately 5 to 10 years to reach a stage of development that would begin to support a biological community typical of a woodland rather than one typical of an open successional habitat.

Long-term impacts to wetlands and the biota inhabiting them would also likely occur from the implementation of FP 5. These impacts are described in the following section.

It should also be noted that, to the extent that affected areas constitute habitat for any rare, threatened, and/or endangered species, such impacts could affect those species. As part of the ecological characterization of the PSA floodplain, Woodlot (2002) identified 15 rare plant species at 27 locations and 8 rare bird species at 42 locations within the floodplain. The area targeted for soil removal by FP 5 would potentially impact 3 locations where rare plant species were identified and 2 locations where rare bird species were observed. Mobile wildlife (including most birds) can avoid stresses associated with remedial activities by moving to other areas. In certain circumstances, long-term impacts may occur when the movement of a rare species from one area to another can lead to stress from competitive pressures on common resources of food and cover, as well as interspecies interactions. However, the magnitude of the potential impacts related to species movement is related directly to the amount of habitat disturbed and the number of rare species involved. As FP 5 would potentially impact only 2 locations where rare birds have been observed, it is not expected that it would impact the population of these species. For those rare species that are not mobile (i.e., plants), the excavation would result in removal of the locations where the plants were found in the excavation area, as well as the loss of habitat for these species. However, since FP 5 would affect only 3 of the identified rare plant locations, it would not be likely to impact the overall population of these species within the floodplain.

Adverse Impacts on Wetlands

The excavations in FP 5 would impact approximately 33 acres of wetland habitats, including marshes, swamps, and vernal pools. These would include 17 acres of emergent marsh, 12 acres of palustrine habitat, 3 acres of vernal pools (22 pools), and <1 acre of black ash-red maple tamarack calcareous seepage swamp. In general, if the excavations should modify the hydrology of these wetlands, the loss or change in habitat supported by the wetlands could become long-term. The potential for long-term effects on each of the types of wetlands identified above is as follows:

- The remediation of the 3 acres of vernal pools (22 pools) could have some long-term effects. As discussed for FP 3 in Section 6.3.5.3, impacts to the vernal pools could result in changes in the ecological function of the pools and a modification in the pools' ability to support amphibian populations. The disturbance (excavation) of a vernal pool, even on a temporary basis, could potentially have long-lasting effects on the distribution of amphibians in the area and upon the upland predators that prey on them (Colburn, 2004). However, since the number and area of the vernal pools that would be affected under this alternative are smaller than those under FP 3 and FP 4 (removal of 3 acres from 22 pools for FP 5 versus removal of 14 acres from 60 pools for FP 3 and FP 4) and less in the context of the total area of vernal pools in the PSA (34 acres), these negative impacts would not be as likely as for those other alternatives. Under FP 5, a significant portion of the vernal pools in the PSA would not be affected by the remediation and would continue to support the wildlife dependent on this habitat.

- The impacts to the 17 acres of emergent marsh habitat are anticipated to be short-term in duration, given that these systems tend to recover within 2 to 4 years following completion of restoration.

- Some long-term impacts could occur as the result of the excavation of 12 acres of palustrine habitat (forested wetlands consisting of red maple swamp habitat and shrub swamp habitat). NRC (2001) notes that forested and shrub wetlands are more difficult to create or restore because of the length of time that is needed to establish mature woody species. Palustrine wetlands support a diverse community of plant and animals and perform a variety of distinct functions such as flood retention, nutrient recycling, and biological habitat typical of wooded wetland systems. While these systems would be restored at the completion of the remediation, palustrine wetlands are mature systems that require an extended period of time to restore, and the functional abilities of the restored wetlands would be compromised until the restored system matures.

- The impact of FP 5 on the <1 acre of black ash-red maple-tamarack calcareous seepage swamp habitat would be the same as discussed for this habitat under FP 4 in Section 6.4.5.3. Since the size of this affected community is small and the soil removal would be limited to the top foot, it is not expected that this alternative would have any significant adverse long-term impacts on this community in the floodplain.

Long-term impacts to wetlands could also occur as a result of ancillary construction activities in support of excavation, as described for FP 3 and FP 4. Construction and use of staging areas or temporary access roads in or bordering wetlands could modify soil conditions, drainage patterns, or groundwater flow conditions, potentially creating a change in the characteristics of an existing wetland or converting a wetland to an upland environment. For FP 5, based on conceptual plans, 9 acres of wetlands, including some of each wetland habitat type, would be affected by such ancillary facilities. Construction design would take steps to avoid direct impacts on wetlands where practicable (e.g., a road could go around instead of though a wetland area, or culverts could be used to allow water flow). However, if impacts to wetlands could not be avoided, these types of effects could occur.

Long-Term Impact on Aesthetics

Implementation of FP 5 could have some long-term impacts on the aesthetic features of the natural environment. The natural appearance of the floodplain after the remediation and restoration would not be the same as prior to remediation, with the most noticeable changes likely associated with those areas where mature trees would be cut down. As noted above, FP 5 would result in the removal and backfilling of approximately 27 acres of forested communities. The time for a replanted forest community to develop an appearance comparable to its pre-remediation appearance would be commensurate with the age of the community prior to remediation, which could range up to 50 to 75 years or more. While it would thus take decades for the planted trees to reach their present maturity, it would not take as long for the restored vegetative communities to reach an intermediate level of maturity that would provide a natural appearance.

Potential Measures to Mitigate Long-Term Adverse Impacts

Measures to mitigate the potential for long-term adverse impacts would be the same as described for FP 3 in Section 6.3.5.3. However, it should be noted that, although appropriate steps would be taken to restore the community in each area, some areas, in particular the 12 acres of palustrine community, could be challenging to fully restore (The Interstate Technology & Regulatory Council [ITRC], 2005). As previously mentioned, while palustrine wetlands can be replanted, it takes time for the planted community to mature and the functional abilities of the restored wetlands would be compromised until the restored system has matured. For vernal pools, the difficulties described for FP 3 and FP 4 would also apply to FP 5. However, because FP 5 would affect only 3 acres and 22 pools (as opposed to 14 acres and 60 pools in FP 3 and FP 4), there should be fewer difficulties in restoration.

6.5.6 Attainment of IMPGs

As described in Section 6.5.1 above, FP 5 is a threshold-based alternative (i.e., removal of PCBs at or above 50 mg/kg) and was therefore not designed to achieve any particular set of IMPGs. This section describes the extent to which FP 5 would nonetheless achieve the IMPGs for human health and ecological protection. These comparisons are presented in Tables 6-25 through 6-30 for the pertinent human and ecological averaging areas. The time frame to achieve any IMPGs would be the same as that required to complete the remedy in a particular area (i.e., the reduction in soil concentrations would occur upon completion of backfill placement). It is estimated that implementation of FP 5 would take a total of 4 years.

6.5.6.1 Comparison to Human Health-Based IMPGs

FP 5 would achieve the RME IMPGs based on a 10^{-4} cancer risk in all 120 direct contact EAs, and in all Heavily Used Subareas (Table 6-25). In addition, FP 5 would achieve the RME IMPGs based on a 10^{-5} cancer risk in 91 of the 120 EAs (approximately 75%) and in 7 of the 9 Heavily Used Subareas. It would also achieve the RME non-cancer IMPGs in 112 of the 120 EAs (93%) and 8 of the 9 Heavily Used Subareas. Further, FP 5 would achieve the RME IMPGs based on a 10^{-6} cancer risk in 16 of the direct contact EAs. With respect to the CTE IMPGs, FP 5 would achieve the CTE IMPGs based on a 10^{-5} cancer risk and those based on non-cancer impacts in all EAs, and it would achieve the CTE IMPGs based on a 10^{-6} cancer risk in all but 4 of those EAs.

With respect to the farm areas, FP 5 would achieve the RME IMPGs based on a 10^{-5} cancer risk and a non-cancer HI of 1 in all 14 farm areas evaluated for consumption of agricultural products (Table 6-26). Further, it would achieve the RME IMPGs based on a 10^{-6} cancer risk in 6 of those areas and the CTE IMPGs based on a 10^{-6} cancer risk in all but one of those areas.

Overall, implementation of FP 5 would achieve levels within EPA's cancer risk range in all human health exposure areas, but would not achieve the non-cancer RME IMPGs in 8 of the direct contact EAs, which together cover approximately 82 acres of the floodplain. The IMPG comparisons for FP 5 are shown in greater detail in Tables 6-25 and 6-26 for all human exposure areas in Reaches 5 through 8.

6.5.6.2 Comparison to Ecological IMPGs

FP 5 would achieve various ecological IMPGs as described below:

- For amphibians, FP 5 would achieve the lower-bound IMPG (3.27 mg/kg) in 9 of the 66 vernal pools in the PSA (approximately 14% of the pools, covering 27% of the total vernal pool acreage), would achieve concentrations between the lower-bound and the upper-bound IMPG (5.6 mg/kg) in another 5 of those pools (approximately 8% of the pools, covering approximately 3% of the total vernal pool acreage), and would not achieve either IMPG in the remaining 52 vernal pools (78% of the pools, covering 70% of the total vernal pool acreage) (Table 6-27).

- For omnivorous/carnivorous mammals, FP 5 would achieve the lower-bound IMPG (21.1 mg/kg) in all averaging areas (Table 6-28).

- For insectivorous birds, FP 5 would achieve the target floodplain soil IMPG levels in all averaging areas in the PSA if the associated sediment concentration in those areas were 3 mg/kg or less, and would achieve those levels all but one averaging area if the associated sediment concentration were 5 mg/kg (Table 6-29).

- For piscivorous mammals, FP 5 would achieve the upper-bound floodplain soil IMPGs in both of the PSA averaging areas if the associated sediment concentration in those areas were 1 mg/kg or less, but would not achieve the lower-bound IMPGs in either averaging area at this sediment target level (Table 6-30). It would also achieve the upper-bound floodplain soil IMPG in one of the two averaging areas (Reaches 5C/5D/6) if the associated sediment concentration were 3 or 5 mg/kg.

These comparisons are shown in detail in Tables 6-27 through 6-30 for all ecological averaging areas in the PSA.

6.5.7 Reduction of Toxicity, Mobility, or Volume

The degree to which FP 5 would reduce the toxicity, mobility, or volume of PCBs in floodplain soils is discussed below.

Reduction of Toxicity: FP 5 does not include treatment processes that would reduce the toxicity of the PCBs in the floodplain soils. However, if "principal threat" wastes (e.g., NAPL, drums of liquid) should be encountered during the excavations (which is not anticipated), they would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: As previously discussed, the existing conditions of the floodplain are predominantly depositional and stable due to the presence of vegetation and generally low flow velocities during inundation. Therefore, PCBs in existing floodplain soils do not represent a significant potential source for mobility and migration. Nevertheless, implementation of FP 5 would further reduce the limited potential for mobility of PCBs in the floodplain by removing 60 acres of soils with higher PCB concentrations from the floodplain, backfilling the excavations, and revegetating the surface.

Reduction of Volume: FP 5 would reduce the volume of PCBs in the soils of the floodplain by removing 100,000 cy of soils containing approximately 16,900 lbs of PCBs from 60 acres of the floodplain.

6.5.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of FP 5 has included consideration of the short-term impacts of implementing this alternative on the environment, the local communities (as well as communities along truck transport routes), and workers involved in the remedial activities. These impacts would be similar to those associated with FP 4, although the magnitude of some impacts would differ based on differences in geographical extent of some affected habitat areas. The impacts would last for the duration of remedial activities, which is assumed for this evaluation to be 4 years.

Impacts on the Environment

The short-term effects on the environment resulting from implementation of FP 5 would include the temporary removal of plant and wildlife habitat in those areas of the floodplain where remediation or construction of access roads or staging areas would occur. Short-term impacts specifically associated with each habitat type are provided below.

Mature Upland Forest: The largest short-term impact would occur from the removal of 27 acres of mature upland forest. Clearing of mature trees and construction of access roads and staging areas would result in direct impacts to upland habitat and could cause habitat fragmentation (patches of forest with reduced connectivity). The temporary loss of trees and other plant communities would result in indirect impacts to wildlife through the loss of cover, nesting, and feeding habitat. This would be particularly disruptive to wildlife with small home ranges, which would not be likely to move out of the construction zone. Likewise, birds that are dependent on the plant community for the placement of their nests would be forced to move elsewhere during nesting season.

Wetlands: Short-term impacts would also be associated with the removal and replacement of 33 acres of wetlands, including 17 acres of emergent marsh, 12 acres of palustrine habitat, 3 acres of vernal pools and <1 acre of black-ash-red maple tamarack calcaneous seepage swamp. Short-term impacts from the disturbance of wetlands as a result of the remedial action would include the inability of these areas to provide wildlife habitat that supports mammals, birds, reptiles, and amphibians that inhabit or use wetlands for nesting, breeding, and feeding. The impacts to these wetlands would be similar to those discussed for FP 4 in Section 6.4.8. However, given the substantially greater amount of palustrine habitat affected by FP 5, the impacts on that habitat would be correspondingly greater. Conversely, given the smaller amount of vernal pool habitat affected by FP 5, the impacts on that habitat would be correspondingly less.

Other short-term impacts relate to the affected wetlands' ability to perform functions of phosphorous retention, nitrogen removal, and flood control. FP 5 would potentially change stormwater flows from wetlands undergoing remediation to neighboring wetlands that would not be remediated. In particular, increases in stormwater runoff affect water level fluctuations within a wetland. This in turn has been shown to reduce plant richness, reduce thin-stemmed plant distribution, promote the presence of invasive species, and reduce the presence of amphibians (Wright et al., 2006). Additionally, erosion and sedimentation changes brought about by construction within a wetland could result in unintended changes to the wetlands.

Disturbed Upland Habitat: The short-term impacts associated with the removal of <1 acre of disturbed upland habitat would be limited as the amount of area affected by the removal is relatively small and the quality of the habitat is low relative to the undisturbed areas of the floodplain. While these areas would be disturbed, they would, if left alone, readily return to a natural state.

Additional Habitats Affected by Supporting Facilities: Construction of roadways and staging areas in the floodplain would result in the temporary loss of habitat in those areas and the wildlife that they support. It is anticipated that FP 5 would require a total of approximately 28 acres for access roads and staging areas. Based on the conceptual layout, these facilities would affect upland disturbed areas, forested habitat, and 9 acres of wetlands. Development of these support facilities would affect the ability of some wildlife to nest and feed in these areas; and in some instances it would cause habitat fragmentation that could further disrupt the movement and interactions of certain wildlife species. In addition, nearby wetlands that are not undergoing remediation could be indirectly adversely affected by construction as a result of changes in stormwater drainage patterns and modifications to hydrology. Conventional engineering practices and controls would be used to reduce adverse effects from construction.

Impacts on Local Communities and Communities Along Truck Transport Routes

FP 5 would result in short-term impacts to the local communities along the River. As described for the previous removal/backfill alternatives, these short-term effects would include changes to appearance of the forested areas of the floodplain, disruption of activities along the River and within the floodplain due to the remedial activities as well as the construction of access roads and staging areas, and increased construction traffic and noise during excavation and backfilling activities.

Recreational activities that could be affected by construction activities include bank fishing, canoeing (canoe launches), hiking and general recreation, dirt biking/ATVing, and waterfowl hunting. During the period of active construction, restrictions on recreational use of the floodplain would be imposed in the areas in which remediation-related activities are taking place. Due to safety considerations, boaters, hikers, ATV riders, anglers, hunters, and other recreational users would not be able to use the floodplain in the areas where remediation-related activities are being conducted. Aesthetically, the presence of heavy construction equipment and cleared or disturbed areas would detract from the visually undisturbed nature of the area until such time as the restoration plantings for the disturbed areas have matured.

In addition, due to the need to remove excavated materials and deliver backfill materials and equipment, truck traffic would significantly increase during the construction period. As an example, if 20-ton capacity trucks were used to transport excavated material from the staging areas, it would take approximately 7,500 truck trips to do so. Assuming the use of smaller capacity trucks for local hauling (i.e., 16-ton trucks), an additional 13,300 truck trips would also be anticipated to import backfill materials, as well as materials for the construction of staging areas and access roads, to the site.

This additional traffic would increase the likelihood of accidents, noise levels, emissions of vehicle/equipment exhaust, and nuisance dust to the air. In addition, noise in and near the construction zone could affect those residents and businesses located in the immediate vicinity of work areas. Engineering controls would be implemented to mitigate short-term impacts and risks associated with implementation of FP 5. However, some impacts would be inevitable.

The increased truck traffic would also increase the risk of traffic accidents along transport routes. Appendix D includes an analysis of potential risks from the increased truck traffic that would be necessary to transport clean materials to the site for implementation of FP

5.[151] This analysis indicates that the increased truck traffic associated with FP 5 (an estimated 665,000 vehicle miles) would result in an estimated 0.38 non-fatal injuries due to accidents (with a probability of 32% of at least one such injury) and an estimated 0.02 fatalities from accidents (with a probability of 2% of at least one such fatality).

<u>Risks to Remediation Workers</u>

There would be potential health and safety risks to site workers implementing FP 5. Engineering controls and OSHA procedures designed to mitigate risks to remediation workers would be instituted. Implementation of FP 5 is estimated to involve 154,076 labor hours over a 4-year timeframe

The analysis in Appendix D of potential risks to workers from implementation of the floodplain alternatives indicates that implementation of FP 5 would result in an estimated 1.57 non-fatal injuries to workers (with a probability of 79% of at least one such injury) and an estimated 0.01 worker fatalities (with a probability of 1% of at least one such fatality).

6.5.9 Implementability

6.5.9.1 Technical Implementability

The technical implementability of FP 5 has been evaluated in terms of the general availability of the technology involved (soil excavation and backfilling), the ability of this technology to be constructed and operated given site characteristics, the reliability of this technology, the availability of support facilities and resources, ease of undertaking corrective measures if necessary, and ability to monitor effectiveness.

<u>*General Availability of Technology:*</u> The technical methods for implementing FP 5 are basically the same as detailed for FP 4 in Section 6.4.9.1. For the reasons discussed in that section, the equipment, materials, technology, procedures, and personnel necessary to implement FP 5 are expected to be available, and this alternative should be technically implementable.

<u>*Ability To Be Implemented*</u>*:* Based on site characteristics, the excavation/backfill technology that would be utilized in FP 5 is suitable for implementation in the areas where it would be applied. The construction of haul roads and staging areas may temporarily affect flood storage and drainage characteristics during seasonal high water conditions and during

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[151] The risks from truck traffic to transport excavated materials from the staging areas away from the site are evaluated under the relevant treatment/disposition alternatives.

periodic storm and flood events. Engineering practices would be implemented to reduce the temporary impacts of such hydrology changes. In the long term, floodplain areas would be backfilled and restored to approximate original elevations to maintain the flood storage capacity of the floodplain.

Reliability: Soil excavation with backfilling is considered a reliable means of reducing the potential for human and ecological exposure to soils containing PCBs. Floodplain soil excavation has been implemented at other PCB-impacted sites across the country, as described in Sections 6.2.5.2 and 6.3.5.2. The removal and replacement of 29 acres of palustrine and emergent wetlands habitat would require specialized materials and mitigation techniques. Although specialized, these restoration efforts would likely result in successful restoration of wetland function. FP 5 would also involve removal and replacement of 3 acres of vernal pools. As detailed for FP 3, the replacement of vernal pool habitat is also highly specialized. Although replacement of soil type and vegetation is achievable, the success of the restoration of ecological function in vernal pools would be less certain.

Availability of Support Facilities and Resources: For purposes of the CMS, it has been assumed that FP 5 would require development of 28 acres of staging areas and access roads. The specific locations and sizing of these access roads and staging areas would be determined based on the available land resources. Space for these roads and staging areas is not expected to be a significant limitation on construction. The volume and duration of necessary material storage (including final disposition) would depend upon the selected treatment/disposition alternative. Backfill and planting materials should be available with sufficient planning and coordination with sources. An evaluation would be performed during design activities to confirm suitable material availability.

Ease of Conducting Additional Corrective Measures: If necessary, performing additional remediation at a later date would be possible using the same types of tools, equipment, and materials as in the original round of remediation. Construction equipment, personnel, and materials are commercially available, and their use and effectiveness for this type of material removal and backfill project are well known and documented. Ease of implementation of the corrective measures would be directly related to the extent of the necessary additional corrective measure (i.e., area and/or volume to be addressed) and the ease of access (e.g., remoteness from roads, wetlands crossings, size and type of construction equipment).

Ability to Monitor Effectiveness: The effectiveness of FP 5 would be assessed by visual observation to evaluate such factors as vegetation re-growth and any signs of erosion or disturbance of restored areas. Monitoring procedures would be straightforward and implementable.

6.5.9.2 Administrative Implementability

The evaluation of administrative implementability of FP 5 has included consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: FP 5 would need to comply with the substantive requirements of applicable and appropriate regulations pertaining to the performance of the remedial action (unless waived). As discussed in Section 6.5.4, GE believes that FP 5 could be designed to comply with such requirements (i.e., the location-specific and action-specific ARARs listed in the Tables 2-2 and 2-3), with the exception of certain requirements that could potentially apply to the on-site staging areas if the excavated materials should constitute hazardous waste. In the latter case, if necessary, GE believes that such requirements should be waived as technically impracticable.

Access Agreements: Implementation of FP 5 would require GE to obtain permission for access to the properties where the work would be conducted or where the ancillary facilities would be located. Access to State-owned lands would be sought from the state agencies that own the land. In addition, it is currently anticipated that access agreements would be required from approximately 35 private landowners. Obtaining access to all these properties for the type of work and length of time that may be needed could be difficult and time-consuming. If GE should be unable to obtain access agreements with particular landowners, GE would request that EPA and/or MDEP provide assistance.

Coordination with Agencies: Implementation of EREs and Conditional Solutions as part of FP 5 would require coordination with EPA and MDEP. In addition, as noted above, obtaining access to State-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of FP 5, GE would need to coordinate with EPA, as well as state and local agencies, to address potential health and safety impacts and to provide as-needed support with public/community outreach programs.

6.5.10 Cost

The estimated total cost to implement FP 5 is $37.7 M (excluding treatment/disposition costs). The estimated total capital cost for implementation of FP 5 is $37 M, assumed to occur over 4 years. Estimated annual OMM costs (for a 3-year inspection and maintenance program for the restored excavation and staging/access road areas) range from $15,000 to $105,000 per year (depending on which reach is being monitored), resulting in a total cost of approximately $675,000. The following summarizes the total costs estimated for FP 5.

FP 5	**Est. Cost**	**Description**
Total Capital Cost	$37 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM Cost	$0.7 M	Costs for performance of the OMM programs
Total Cost for Alternative	$37.7 M	Total cost of FP 5 in 2008 dollars

The total estimated present worth of FP 5, which was developed using a discount factor of 7%, a 4-year construction period, and an OMM period of 3 years on a reach-specific basis, is approximately $35.1 M. More detailed cost estimate information and assumptions for each of the floodplain alternatives are included in Appendix E.

As noted above, these costs do not include the costs of treatment/disposition of the removed floodplain soils. The estimated costs for combinations of FP 5 with the various treatment/disposition alternatives are presented in Section 8.

6.5.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 6.5.2, the evaluation of whether FP 5 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: FP 5 would be generally effective in substantially reducing the potential for human and ecological exposure to PCBs in floodplain soils by the removal from the floodplain of approximately 100,000 cy (60 acres) of soil with PCB concentrations greater than 50 mg/kg, resulting in the removal of 16,900 lbs of PCBs. The removed soil would be replaced with clean backfill, which would be revegetated.

Compliance with ARARs: As discussed in Section 6.5.4, based on review of the potential ARARs, GE believes that FP 5 could be designed and implemented to achieve the ARARs pertinent to this alternative, with the possible exception of certain requirements that could apply to the on-site staging areas if the excavated soils should constitute hazardous waste. In the latter case, if necessary, GE believes that such requirements should be waived as technically impracticable.

<u>Human Health Protection</u>: As discussed in Section 6.5.6.1, implementation of FP 5 would achieve the RME IMPGs based on a 10^{-4} cancer risk in all direct contact EAs and those based on a 10^{-5} cancer risk in the majority (~75%) of those EAs and in all farm areas evaluated for agricultural products consumption. With respect to the non-cancer IMPGs, FP 5 would achieve the RME IMPGs in 112 (93%) of the 120 EAs and in all farm areas, and would achieve the CTE IMPGs in all areas. However, it would not achieve the non-cancer RME IMPGs in 8 direct contact EAs (totaling approximately 82 acres). (FP 5 would also provide health protection through implementation of EREs and Conditional Solutions, where necessary, to address reasonably anticipated future uses.) In these circumstances, if one accepts EPA's assumptions and conclusions in the HHRA, FP 5 would provide substantial overall protection of human health, but would not provide protection from potential non-cancer risks for the most highly exposed individuals in a few areas of the floodplain.

<u>Environmental Protection</u>: As discussed in Section 6.5.6.2, FP 5 would achieve floodplain soil levels considered by EPA to be protective of most, but not all, ecological receptors. Specifically, FP 5 would achieve: (1) the lower-bound IMPG for omnivorous/carnivorous mammals in all 7 averaging areas; (2) the target floodplain soil IMPG levels for insectivorous birds in all 12 averaging areas if the associated sediment concentration in those areas were 3 mg/kg or less, and in 11 of those areas if the associated sediment concentration were 5 mg/kg; and (3) the upper-bound target floodplain soil IMPGs for piscivorous mammals in both averaging areas if the associated sediment concentration were 1 mg/kg or less, and in one (but not the other) of those areas if the associated sediment concentration were 3 or 5 mg/kg. However, FP 5 would not achieve levels within the amphibian IMPG range in 52 of the 66 vernal pools in the PSA (representing about 70% of the vernal pool acreage).

As previously noted, achievement of IMPGs is a balancing factor under the Permit; it is not determinative of whether an alternative would provide overall environmental protection. In this case, based on review of the above information, it is concluded that FP 5 would generally provide protection of ecological receptors, with the possible exception of amphibians, given that 70% of the vernal pool acreage in the PSA would not achieve the IMPGs based on the ERA.[152]

As discussed in Section 6.5.8, implementation of FP 5 would result in considerable short-term adverse impacts on the environment, similar to those under FP 4, as it would destroy valuable plant and wildlife habitat in the areas of the floodplain where remediation and ancillary construction activities would occur. Such impacts would include the loss of 27

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[152] The impact of these IMPG exceedances on the local amphibian populations is uncertain, especially in light of the continued presence of amphibian populations in the PSA.

acres of mature upland forest and 33 acres of wetlands, with the consequent impacts on the biota that depend on those habitats. In addition, as discussed in Section 6.5.5.3, implementation of FP 5 would produce some long-term adverse effects on the environment, particularly due to the removal of the 27 acres of mature upland forest and the 33 acres of wetlands, which include 12 acres of palustrine habitat and 3 acres of vernal pools. While the trees in the upland forest and palustrine habitat could be replaced, the replanted areas would be expected to take 5 to 10 years to reach a stage of development that would begin supporting a biological community typical of a woodland rather than one typical of an open successional habitat, and it could take over 50 years for those areas to reach a functional level comparable to their pre-excavation function. Further, while measures would be taken to restore the vernal pools, these areas are complex wetland systems with specialized hydrologic budgets, and it is possible that, despite such measures, the changes to them would persist for a long time. However, the impact of such changes on the overall vernal pool habitat in the floodplain would be less with FP 5 than with FP 3 and FP 4, since the remediation in FP 5 would affect substantially fewer vernal pools with about 5 times less acreage.

Summary: FP 5 would remove a significant mass of PCBs (16,900 lbs) and soils containing higher PCB concentrations (≥ 50 mg/kg) from the floodplain, and would address the great majority of risks asserted by EPA in the HHRA and ERA. As such, although it would cause adverse impacts, it is concluded that FP 5 would generally provide protection of human health and the environment from those risks. However, if one accepts EPA's conclusions in the HHRA and ERA, this alternative would not reduce potential non-cancer risks to acceptable levels for the most highly exposed persons in a few areas of the floodplain and may not eliminate some risks to the local amphibian population.

6.6 Analysis of Floodplain Alternative 6

6.6.1 Description of Alternative

FP 6 would involve the removal of floodplain soils with concentrations greater than or equal to 25 mg/kg in the top foot of soil, as well as in the top 3 feet in the Heavily Used Subareas (described in Section 5.2.1 and shown on Figures 5-3a-d). The excavated areas would be replaced with backfill and revegetated.

Summary of Removal Volumes

FP 6 would involve the removal of approximately 316,000 cy of floodplain soil from 194 acres of the floodplain (including approximately 105 acres of wetlands and vernal pools). The locations of these removal areas are shown on Figure 6-5. The majority of removal

(311,000 cy) would be from the top foot of the floodplain and 5,000 cy would be from the top 3 feet in the Heavily Used Subareas. This alternative would result in the removal of more than three times the volume and acreage for either FP 4 or FP 5 (approximately 100,000 cy over 60 acres).

Summary of Affected Habitat

FP 6 would involve the removal and backfill of 316,000 cy of soil in various types of habitats within the floodplain. The acreages of those general habitat types, with associated removal volumes, are as follows:[153]

- 84 acres (135,000 cy) of upland forest habitat (consisting of high-terrace floodplain forest habitat, northern hardwoods-hemlock-white pine forest habitat, red oak-sugar maple transition forest habitat, successional northern hardwoods habitat, and transitional floodplain forest habitat);

- 53 acres (86,000 cy) of emergent marsh habitat (consisting of deep emergent marsh habitat, shallow emergent marsh habitat, and wet meadow habitat);

- 39 acres (65,000 cy) of palustrine habitat (consisting of red maple swamp habitat and shrub swamp habitat);

- 9 acres (15,000 cy) of vernal pool habitat;

- 5 acres (9,000 cy) of disturbed upland habitats (consisting of agricultural field habitat and cultural grasslands habitat);

- 4 acres (6,000 cy) of black ash-red maple-tamarack calcareous seepage swamp habitat; and

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[153] This detailed breakdown of removal areas and volumes by habitat type was generally conducted using the Woodlot (2002) ecological characterization of the River between the Confluence and Woods Pond Dam, as previously noted. One exception is in vernal pool areas, where the EPA vernal pool coverage was merged with the Woodlot habitat areas; in those areas, the EPA vernal pool coverage superseded the underlying Woodlot habitat types.

- <1 acre (<1,000 cy) of habitat of currently unmapped community type.[154]

In addition, floodplain habitat would be affected by the construction and use of access roads and staging areas. Conceptual construction plans indicate that, in addition to the 194 acres of removal areas, FP 6 would require 36 acres of staging areas and temporary access roads (with many more miles of access roads also constructed within the footprint of the removal areas).

<u>Conceptual Remedial Approach</u>

The conceptual remedial approach for FP 6 would be generally the same as described for the previously discussed floodplain alternatives, although it would involve much more extensive excavations. Soil removal would be conducted using conventional earth-moving equipment, as well as some specialized construction equipment, materials, and specific engineering practices to mitigate the potentially negative impacts of construction in and around vernal pools and other wetland areas.

It is estimated that FP 6 would take approximately 13 years to complete if implemented independently from other River-related remedial activities. However, it is likely that floodplain remediation would be coordinated with sediment remediation. If so, the time to complete FP 6 would likely be different than if conducted independently, depending on the sediment remediation alternative selected. Nevertheless, for purposes of the evaluations in this section, it has been assumed that FP 6 would take 13 years.

As described for the other alternatives, FP 6 would include the use of EREs and Conditional Solutions as necessary to address reasonably anticipated future uses and activities for which this alternative would not meet applicable cleanup criteria (e.g., residential use standards, where that use is reasonably anticipated and remediation would not meet those standards).

After restoration activities within a given area are completed, periodic monitoring and maintenance would be conducted of the backfilled/restored areas. For the purposes of this CMS Report, monitoring and maintenance are assumed to occur for 3 years following remedy implementation in a given area. Monitoring would include annual visual inspections

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[154] The Woodlot habitat community mapping is absent in some small portions of the PSA floodplain and in all of Reaches 7 and 8. Most of the removal for this unmapped community type occurs under FP 6 in Reach 5 and, based on aerial photography, appears to be in generally wet meadow areas of the floodplain.

of restored areas (e.g., to assess plant survivorship, evidence of erosion). The maintenance program would be implemented to address those areas where the visual inspections indicate the need for maintenance or repair to maintain the effectiveness of the remedy.

6.6.2 Overall Protection of Human Health and the Environment - Introduction

As discussed in Section 6.1.2, the evaluation of whether a floodplain soil remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether FP 6 would be protective of human health and the environment is presented at the end of Section 6.6 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

6.6.3 Control of Sources of Releases

Existing floodplain soil conditions are not a significant source of potential PCB releases to the River, nor would they be following restoration. As stated previously, the floodplain is generally flat, well vegetated and depositional in nature, greatly reducing the potential for PCBs in the floodplain soil to scour and transport to the River. While the floodplain is not considered a significant source, implementation of FP 6 would further reduce the limited potential for PCBs in the floodplain to be released to the River by removing all the soil in the upper foot of the floodplain with PCB concentrations at or above 25 mg/kg (approximately 194 acres), replacing that soil with clean soil, and revegetating the surface cover.

Open excavations during construction could serve as a short-term temporary source of some releases during an extreme weather event. As with the other alternatives, such potential releases would be controlled using conventional engineering practices. However, because FP 6 would involve such a large area (194 acres) over such a long time (13 years), the potential for such short-term releases are that much greater.

6.6.4 Compliance with Federal and State ARARs

The potential chemical-specific, location-specific, and action-specific ARARs identified by GE are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs set forth in Table 2-1 consist of federal and state water quality criteria for PCBs and state air pollution control requirements for dust. The water quality criteria do not apply to floodplain soils, and GE believes the state air pollution control requirements for dust could be met.

The potential location-specific and action-specific ARARs are listed in Tables 2-2 and 2-3. Based on review of those ARARs, GE believes, for the same reasons given for FP 2 in Section 6.2.4, that FP 6 could be designed and implemented to achieve the pertinent ARARs (provided that any necessary EPA approval determination under its TSCA regulations is obtained for the staging areas), with the following potential exception: In the event that excavated floodplain soils should be found to constitute hazardous waste (which is not anticipated), the temporary staging areas for the handling of those soils may not meet certain federal or state hazardous waste storage requirements, if they were determined to apply. In that case, as further discussed in Section 6.2.4, GE believes that such requirements should be considered inapplicable or, if necessary, waived as technically impracticable.

6.6.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for FP 6 has included evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment. Each of these considerations is discussed below.

6.6.5.1 Magnitude of Residual Risk

Evaluation of the magnitude of residual risk associated with FP 6 includes consideration of the length of time and extent to which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure, such as institutional controls.

FP 6 would reduce potential exposures of humans and ecological receptors to PCBs in floodplain soil by removing approximately 316,000 cy of PCB-containing soil over 194 acres of floodplain (see Figure 6-5). The reduction in potential exposure and risk would occur upon completion of the remediation in a given area. As noted above, FP 6 would take a total of 13 years to complete if implemented independently of sediment remediation.

Implementation of this alternative would result in the removal of soils containing PCB concentrations at or above 25 mg/kg. As discussed further in Section 6.6.6.1, the average post-remediation EPCs in the human health averaging areas are equivalent to or lower than those associated, under RME assumptions, with a 10^{-4} cancer risk in all such areas and a 10^{-5} cancer risk and a non-cancer HI of 1 in most of those areas. As discussed in Section 6.6.6.2, the average concentrations in the ecological averaging areas would achieve the IMPGs for most, but not all, ecological receptors. The average post-remediation EPCs in the top foot within the human health and ecological averaging areas for FP 6 are shown in

Tables 6-31 through 6-36. Those averages range from 0.1 mg/kg to 24 mg/kg in the direct contact EAs, 0.2 mg/kg to 8 mg/kg in the farm areas, and 0.02 mg/kg to 24 mg/kg in the ecological averaging areas. (Table 6-31 also shows the post-remediation concentrations in the top 3 feet in Heavily Used Subareas.)

PCBs would also remain at depths below those described above. Such deeper soil is generally not anticipated to be available for exposure under current uses. Where it is reasonably anticipated that such deeper soil could become available for exposure, it would be addressed by EREs and/or Conditional Solutions. Additionally, EREs and Conditional Solutions would be implemented where necessary to address potential risks from reasonably anticipated future activities and uses.

6.6.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of FP 6 has included an assessment of the use of technologies under similar conditions, the general reliability of those techniques, reliability of OMM, and the potential need to replace technical components. The technology and implementation steps that would be used for FP 6 would be generally the same as described for the other removal/backfill alternatives. However, because FP 6 would affect so much more of the floodplain and because so much of the area affected under FP 6 is wetland, the logistical issues associated with such a large remediation project would be much more complex.

Use of Technology Under Similar Conditions

FP 6 relies primarily on the removal of floodplain soils, including those associated with upland forest, vernal pools, and other wetland habitats (total of 105 acres of wetlands, including 9 acres of vernal pools), followed by backfill of the excavations and restoration activities. Excavation, backfilling and revegetation of various types of floodplain environments have been effectively applied at a number of other sites, as discussed under FP 2 in Section 6.2.5.2 and FP 3 in Section 6.3.5.2.

However, the precedent for removing contaminated soils and then restoring natural communities on the scale required for FP 6 is very limited. FP 6 would include more than twice the amount of emergent wetlands, palustrine wetlands, and upland forests as FP 5. There are examples in the literature where large-scale restoration projects have been conducted. However, in each instance, the restoration has been based on more simplistic physical modifications of existing habitat (changing drainage patterns, planting old fields with wood species, or the herbicidal removal of invasive species). None of these examples involved the complete clearing of the habitat and removal of the substrate, followed by backfilling and restoration of such diverse habitat types over such a large area (194 acres).

For example, the Florida Department of Environmental Protection is implementing a program to restore 11,000 acres of emergent marsh; however, that is simply based on changing flow patterns in the Kissimmee River (FL) (Florida Department of Environmental Protection, 2005). In Mississippi, the Natural Resources Conservation Service restored thousands of acres of hardwood forests; however, the restoration involved simply taking cropland out of service and replanting hardwood tree species (United States Department of Agriculture, 2008). None of these examples faced the potential uncertainty of the cumulative effect of the short-term impacts from the destruction of a large area of natural habitat prior to the attempted restoration. Further, as noted in Section 6.3.5.2, no precedent was identified in the literature or from other sites where such a large number of vernal pools (42 pools over 9 acres for FP 6) has been excavated and restored.

General Reliability

The removal and backfill of material for FP 6 would reliably, effectively and permanently reduce the concentrations of PCBs in the removal areas. Restoration activities would include backfilling with soil appropriate to support plant growth and replanting vegetative communities similar to those that were removed, to the extent practicable. Standard landscaping techniques would be used to replant upland forested areas, and wetland restoration techniques would be used to restore the soils, hydrology and vegetative communities of emergent marsh and palustrine habitats. Vernal pools would also be restored. Although the acreage of vernal pools to be restored in FP 6 is smaller than in FP 3 and FP 4, the challenges to successful restoration would be similar. While it is possible to restore vernal pools, there is little tolerance in terms of the topographic elevation and hydrologic parameters required to successfully complete these restorations. As with FP 3 and FP 4, the reliability of such restoration is uncertain.

Reliability of Operation, Monitoring, and Maintenance Requirements

Following the construction phase of FP 6, a monitoring and maintenance program would be implemented for those areas restored following remediation. Both the removal areas and those portions of the floodplain disturbed during construction of access roads and staging areas would be monitored through periodic inspections to ensure that the planted vegetation is surviving and growing, and to identify areas (if any) where the backfill is eroding and in need of repair. Periodic inspection of the plantings and backfill areas is considered a reliable means of tracking the restoration activities. Labor and materials needed to monitor and perform any maintenance activities required following implementation of FP 6 are considered readily available.

Because access roadways will be removed after construction, maintenance, if required, could be difficult to implement in certain areas of the floodplain, due to remoteness, wet areas, and vegetation growth. The ease of access may change based on seasonal conditions. It could be especially difficult to conduct supplemental planting activities in difficult-to-access locations, to which plant materials would have to be carried from the closest roadways.

Technical Component Replacement Requirements

If significant erosion and/or plant loss were observed as part of the OMM program in the restored floodplain areas, an assessment would be conducted to determine the need for and methods of repair. Because of the size of the overall area that would require OMM, it is likely that some areas would require repair or replacement. Depending on the timing and location of the repair, access roads and staging areas may again need to be temporarily constructed in the floodplain. It is anticipated that if small repairs or replacement were necessary, they could be implemented using the same types of methods and materials used during the initial backfilling/restoration activities. Periodic small-scale inspections and repairs would pose no appreciable risks to humans and ecological receptors that use/inhabit the floodplain in these areas. The repair or replacement of larger areas could require more extensive disturbance in the floodplain.

6.6.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of FP 6 on human health or the environment has included consideration of the items discussed below. The types of long-term adverse impacts and the controls to mitigate them are generally similar to those noted for the prior floodplain alternatives. However, because FP 6 involves so much more area than the previous alternatives (over 3 times more than FP 4 or FP 5), those adverse effects would be much more widespread. These adverse impacts would also be more difficult to avoid or mitigate since so many of the remediated areas are large and contiguous, and thus there would be fewer undisturbed areas to offer protection and refuge to wetlands wildlife, and to serve as a native source for recovery of plant and animal species.

Potentially Affected Populations

Implementation of FP 6 would have potential long-term effects on human and wildlife populations through changes in the natural environment and habitat. Since this alternative involves more extensive floodplain disturbance than the alternatives discussed above, the potential for such impacts is correspondingly greater. For humans, implementation of FP 6 would affect the aesthetics of the floodplain, especially in forested areas where older, large trees could not be replaced in kind and would be replaced with smaller trees with less size and age diversity. For wildlife, implementation of FP 6 would remove and replace several habitat types (described in Section 6.6.1), which would affect the mammals, birds, amphibians, and reptiles inhabiting those habitats. The potential long-term impacts on biota are discussed further in the next sections.

Adverse Impacts on Biota and Corresponding Habitat

It is expected that FP 6 would result in long-term adverse impacts on biota and their habitat. The extent of the floodplain area to be remediated (194 acres) and the long time frame for implementation (13 years) would result in a high level of disturbance (stress) to the existing ecosystem. In some areas, due to the widespread extent of the excavations, displaced wildlife would have limited areas for refuge. While wildlife species with greater mobility may be able to adapt and move to other locations, species with smaller home ranges and limited mobility, such as reptiles, amphibians and small mammals, could be affected. The effect would be to shift the distribution of populations of affected wildlife from the disturbed areas to undisturbed areas.

As a result of the overall size of the affected area and the duration of the remedy, the cumulative effect of numerous short-term impacts may lead to long-term impacts. Also, implementation of FP 6 could have additional long-term adverse impacts on biota due to the loss or change in habitats should the remediated areas not return to conditions similar to those which currently exist. These impacts are described below.

FP 6 would remove approximately 84 acres of upland forest, 57 acres more of this type of habitat than would be removed for FP 5 and approximately 30% of this type of habitat in the PSA. The impacts to this habitat would be similar to those described for the smaller acreages under FP 4 and FP 5, but would be much more apparent. These impacts would be primarily associated with the long-term loss of mature forest habitat capable of supporting a diverse wildlife community. As noted previously, while the affected plant communities would be replanted as part of restoration activities, the time necessary for the forest system to reach a functional level comparable to its pre-excavation function is commensurate with the age of the system – approximately 50 to 75 years (or older adjacent to Reach 5C and Woods Pond), as noted in Sections 6.3.5.3 and 6.4.5.3. However, the restored forest community will support a diversity of early and mid-successional wildlife species as the plantings develop and grow. Younger, developing plant communities support a different wildlife community that is characteristic of successional habitats. It is expected that a restored, replanted upland forest would take approximately 5 to 10 years to reach a stage of development that would begin to support a woodland biological community rather than a biological community typical of an open successional habitat. Given the large portion of the existing upland forest habitat that would be removed under FP 6, the adverse impacts of the removal and replanting would be significant both in physical extent and in duration.

Long-term impacts to wetlands and the biota inhabiting them would also likely occur from the implementation of FP 6. These impacts are described in the following section.

It should also be noted that, to the extent that affected areas constitute habitat for any rare, threatened, and/or endangered species, such impacts could affect those species. As part of the ecological characterization of the PSA floodplain, Woodlot (2002) identified 15 rare plant species at 27 locations, 8 rare bird species at 42 locations, and 1 rare reptile at 4 locations within the floodplain. The area targeted for soil removal by FP 6 would potentially impact 7 locations where rare plant species were identified, 13 locations where rare bird species were observed, and 1 location where a rare reptile was seen. Mobile wildlife (including most birds and mammals) can avoid stresses associated with remedial activities by moving to other areas. In certain circumstances, long-term impacts may occur when the movement of a rare species from one area to another can lead to stress from competitive pressures on common resources of food and cover, as well as interspecies interactions. The magnitude of the potential impacts related to species movement is related directly to the amount of habitat disturbed and the number of rare species involved. FP 6 would impact significantly more locations (13) where rare bird species have been observed and significantly more habitat where these species may be found (194 acres) than projected for FP 5. Therefore, there is a much greater potential that long-term impacts to rare bird populations may occur as a result of the implementation of FP 6. For those rare species that have limited mobility (i.e., reptiles) or are not mobile (i.e., plants), the excavation would result in removal of the locations where they were found in the excavation area, as well as the loss of habitat for these species. For FP 6, which would affect 7 specifically identified rare plant locations as well as a significant portion of the floodplain that could serve as habitat for the rare plants and reptiles, there is a potential for the excavations to have a significant long-term adverse effect on the presence of these species in the floodplain.

Adverse Impacts on Wetlands

The excavations in FP 6 would impact approximately 105 acres of wetland habitats, including marshes, swamps, and vernal pools. These would include 53 acres of emergent marsh, 39 acres of palustrine habitat, 9 acres of vernal pools (from 42 pools), and 4 acres of black ash-red maple tamarack calcareous seepage swamp.

Based on the overall extent of wetlands impacted by FP 6, the cumulative effect of many adverse short-term impacts to the wetland systems in the floodplain may lead to long-term impacts. Cumulative impacts result in changes to habitat structure and ecosystem properties, which can have a cascading effect on many plant and animal species in the wetland. Limited research conducted on the cumulative impacts to wetland resources from multiple and disparate habitat perturbations suggests that there is the potential for long-term depression in amphibian populations and changes in plant communities that are supported by the wetlands (Wright et al., 2006).

In addition to such cumulative impacts, the potential for long-term effects on each of the types of wetlands identified above is as follows:

- The remediation of the 9 acres of vernal pools (42 pools) could have some long-term impacts for the same reasons discussed for such pools under FP 3 in Section 6.3.5.3. Vernal pools are particularly important in supporting the life cycles of amphibians (frogs and salamanders) and invertebrates that are completely dependent on these types of ecosystems. Impacts to these habitats could result in changes in the ecological function of the vernal pools and a modification in the pools' ability to support amphibians. The loss of a vernal pool, even on a temporary basis, could have long-lasting effects on the distribution of amphibians in the area and upon the upland predators that prey on them (Colburn, 2004). As noted previously, although restoration would include a replacement with similar soil type and vegetation, the success of the restoration of ecological function in vernal pools is uncertain.

- Impacts to the 53 acres of emergent marsh habitat would primarily be short-term in duration, given that these systems tend to recover within 2 to 4 years following completion of restoration. Restoration of this type of wetland habitat has been and can be implemented without great difficulty. During the remediation, the species inhabiting these marshes could move to other comparable areas. However, given the extensive area of marshland that would be affected by FP 6, it is possible that that temporary displacement could be extended for species with limited mobility and migration capabilities such as amphibians.

- Some long-term impacts could occur as the result of the excavation of 39 acres of palustrine habitat (forested wetlands). NRC (2001) notes that forested and shrub wetlands are more difficult to create or restore because of the length of time that is needed to establish mature woody species. Palustrine wetlands support a diverse community of plant and animals and perform a variety of distinct functions such as flood retention, nutrient recycling, and biological habitat typical of wooded wetland systems. While these systems would be restored at the completion of the remediation, palustrine wetlands are mature systems that require an extended period of time to restore, and the functional abilities of the restored wetlands would be compromised until the restored system matures.

- FP 6 would affect 4 acres of black ash-red maple-tamarack calcareous seepage swamps. These swamps are supported by high pH groundwater originating in limestone-dominated bedrock, which support flora and fauna that are adapted to higher pH environments. Excavation within a calcareous seepage swamp, as well as in the areas bordering the swamp, could lead to difficulty in restoring the wetland if the pH of the groundwater is affected. However, because excavation of these systems under FP 6 would only involve the top foot, it is not expected that long-term impacts to groundwater pH would occur.

Furthermore, even if the wetlands that would be affected by FP 6 would recover in time, the cumulative effects of such an extensive remediation could result in a longer recovery time than if the areas were remediated as small isolated areas.

Long-term impacts to wetlands could also occur as a result of ancillary construction activities in support of excavation. Construction and use of staging areas or temporary access roads in or bordering wetlands could modify soil conditions, drainage patterns, or groundwater flow conditions, potentially creating a change in the characteristics of an existing wetland or converting a wetland to an upland environment. For FP 6, based on conceptual design, although the majority of access roads and staging areas would overlap with areas to be removed, these facilities would affect 18 additional acres of wetlands. Construction design would take steps to avoid direct impacts on wetlands where practicable (e.g., a road could go around instead of though a wetland area, or culverts could be used). However, where impacts to wetlands could not be avoided, these types of effects could occur. Moreover, because of the size and contiguous nature of the FP 6 remediation areas, unforeseen changes to surface water drainage patterns in wetlands not directly affected by construction would be much more difficult to effectively manage or correct following remediation.

Long-Term Impact on Aesthetics

Implementation of FP 6 would have long-term impacts on the aesthetic features of the natural environment. The natural appearance of the floodplain after remediation and restoration would not be the same as prior to remediation, with the most noticeable changes likely associated with those areas where mature trees would be cut down. As noted above, FP 6 would result in the removal and backfilling of 127 acres of upland and wetland forests. The time for a replanted forest community to develop an appearance comparable to its current appearance would be commensurate with the age of the community prior to remediation, which could range up to 50 to 75 years or more. While it would thus take decades for the planted trees to reach their present maturity, it would not take that entire period of time for the restored vegetative communities to reach an intermediate level of maturity that would provide a natural appearance.

Potential Measures to Mitigate Long-Term Adverse Impacts

Measures to mitigate the potential for long-term adverse impacts would be the same as described for FP 3 in Section 6.3.5.3, but would be applied over the larger area included under FP 6. These measures would include the placement of suitable backfill soil to support plant growth, surface soil grading to restore the soil elevations, and re-planting. Upland communities would be replanted either with species currently found in those areas or with species typical of those environments. Wetlands would be replanted with hydrophytic species typical of the existing plant community, and measures would also be taken, to the extent practicable, to replace the functions of those wetlands, such as nutrient cycling, flood control, and water filtration. However, some wetland areas may be difficult to fully restore. As previously discussed in Sections 6.3.5.3 and 6.4.5.3, these areas would include the vernal pools (9 acres) and the palustrine community (39 acres).

6.6.6 Attainment of IMPGs

As described in Section 6.6.1 above, FP 6 is a threshold-based alternative (i.e., removal of PCBs at or above 25 mg/kg) and was therefore not designed to achieve any particular set of IMPGs. This section describes the extent to which FP 6 would nonetheless achieve the human health and ecological IMPGs. These comparisons are presented in Tables 6-31 through 6-36 for the pertinent human and ecological averaging areas. The time frame to achieve any IMPGs would be the same as that required to complete the remedy in a particular area (i.e., the reduction in soil concentrations would occur upon completion of backfill placement). As previously noted, it is estimated that implementation of FP 6 would take a total of 13 years.

6.6.6.1 Comparison to Human Health-Based IMPGs

FP 6 would achieve the RME IMPGs based on a 10^{-4} cancer risk in all 120 direct contact EAs, and in all Heavily Used Subareas (Table 6-31). In addition, FP 6 would achieve the RME IMPGs based on a 10^{-5} cancer risk in 114 (95%) of the 120 EAs and in 8 of the 9 Heavily Used Subareas. It would also achieve the RME non-cancer IMPGs in 116 (97%) of the EAs and in 8 of the 9 Heavily Used Subareas. Further, FP 6 would achieve the RME IMPGs based on a 10^{-6} cancer risk in 28 (~20%) of the EAs. With respect to the CTE IMPGs, FP 6 would achieve the CTE IMPGs based on a 10^{-5} cancer risk and those based on non-cancer impacts in all EAs, and would achieve the CTE IMPGs based on a 10^{-6} cancer risk in all but 2 of those areas.

With respect to the farm areas, FP 6 would achieve the RME IMPGs based on a 10^{-5} cancer risk and non-cancer impacts in all 14 farm areas evaluated for consumption of agricultural products (Table 6-32). Further, it would achieve the RME IMPGs based on a

10^{-6} cancer risk in 6 of those areas and the CTE IMPGs based on a 10^{-6} cancer risk in all 14 areas.

Overall, implementation of FP 6 would achieve levels within EPA's cancer risk range in all human health exposure areas, but would not achieve the non-cancer RME IMPGs in 4 of those direct contact areas, which together cover approximately 77 acres of the floodplain. The IMPG comparisons for FP 6 are shown in detail in Tables 6-31 and 6-32 for all human exposure areas in Reaches 5 through 8.

6.6.6.2 Comparison to Ecological IMPGs

FP 6 would achieve various ecological IMPGs, as follows:

- For amphibians, FP 6 would achieve the lower-bound IMPG (3.27 mg/kg) in 18 of the 66 vernal pools in the PSA (27% of the pools, covering 31% of the total vernal pool acreage), would achieve concentrations between the lower-bound and the upper-bound IMPG (5.6 mg/kg) in another 7 of those pools (11% of the pools, covering approximately 8% of the total vernal pool acreage), and would not achieve either IMPG in the remaining 41 vernal pools (62% of the pools, covering 62% of the total vernal pool acreage) (Table 6-33).

- For omnivorous/carnivorous mammals, FP 6 would achieve the lower-bound IMPG (21.1 mg/kg) in all averaging areas (Table 6-34).

- For insectivorous birds, FP 6 would achieve the target floodplain soil IMPG levels in all averaging areas in the PSA at any of the 3 sediment target levels evaluated (1, 3, and 5 mg/kg; Table 6-35).

- For piscivorous mammals, FP 6 would achieve the upper-bound floodplain soil IMPGs in both of the PSA averaging areas if the associated sediment concentration in those areas were 1 mg/kg or less, and would achieve the lower-bound IMPG in the Reach 5C/5D/6 averaging area (but not the Reaches 5A/5B area) at this sediment target level (Table 6-36). It would also achieve the upper-bound floodplain soil IMPG in one of the two averaging areas (Reaches 5C/5D/6) if the associated sediment concentration were 3 or 5 mg/kg.

These comparisons are shown in detail in Tables 6-33 through 6-36 for all ecological averaging areas in the PSA.

6.6.7 Reduction of Toxicity, Mobility, or Volume

The degree to which FP 6 would reduce the toxicity, mobility, or volume of PCBs in floodplain soils is discussed below.

Reduction of Toxicity: FP 6 does not include any treatment processes that would reduce the toxicity of the PCBs in the floodplain soils. However, if "principal threat" wastes (e.g., NAPL, drums of liquid) should be encountered during the excavations (which is not anticipated), they would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: As previously noted, the existing conditions of the floodplain are predominantly depositional and stable due to generally low flow velocities during inundation and the presence of vegetation. Therefore, PCBs in existing floodplain soils do not represent a significant potential source for mobility and migration. Nevertheless, implementation of FP 6 would further reduce the limited potential for mobility of PCBs in the floodplain by removing 194 acres of soils with higher PCB concentrations from the floodplain, backfilling the excavations, and revegetating the surface.

Reduction of Volume: FP 6 would reduce the volume of PCBs in the soils of the floodplain by removing 316,000 cy of soils containing approximately 33,300 lbs of PCBs from 194 acres of the floodplain.

6.6.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of FP 6 has included consideration of the short-term impacts of implementing this alternative on the environment, the local communities (as well as communities along truck transport routes), and workers involved in the remedial activities. The impacts of FP 6 would be substantially greater than those of the previously discussed floodplain alternatives since FP 6 would affect a much larger area and last a much longer time. Specifically, FP 6 would involve removal in 194 acres of floodplain, with approximately 105 of those acres consisting of different wetland habitats. Staging areas and temporary access roads would occupy an additional 36 acres. FP 6 would take approximately 13 years to complete (versus 3 to 4 years for FP 3, FP 4, and FP 5).

Impacts on the Environment

The short-term effects on the environment resulting from implementation of FP 6 would include the temporary removal of plant and wildlife habitat in those areas of the floodplain where remediation or construction of access roads or staging areas would occur. Short-term impacts specifically associated with each habitat type are provided below.

Upland Forest: Significant short-term impacts would occur from the removal of 84 acres of mature upland forest. Removal of mature trees and construction of access roads and staging areas would result in upland habitat destruction and habitat fragmentation. The temporary loss of the plant communities would result in indirect impacts to wildlife through the loss of cover, nesting, and feeding habitat. This would be particularly disruptive to wildlife that would not be likely to migrate out of the construction zone and to birds that are dependent on the plant community for the placement of their nests and thus would be forced to move elsewhere during nesting season.

Wetlands: FP 6 would have an immediate adverse effect on a large quantity of wetlands within the floodplain. Excavation activities would destroy 105 acres of wetlands, including 53 acres of emergent marsh, 39 acres of palustrine habitat, 9 acres of vernal pools, and 4 acres of black ash-red maple tamarack calcareous seepage swamp. Short-term impacts from the extensive destruction of wetlands as a result of the remedial action would include the inability of these areas to support mammals, birds, reptiles, and amphibians that are dependent on these wetlands for nesting, breeding, and feeding.

Other short-term impacts relate to the affected wetlands' ability to perform functions of phosphorous retention, nitrogen removal, and flood control. FP 6 would potentially change stormwater flows from wetlands undergoing remediation to neighboring wetlands that would not be remediated. In particular, increases in stormwater runoff affect water level fluctuations within a wetland. This in turn has been shown to reduce plant richness, reduce thin-stemmed plant distribution, promote the presence of invasive species, and reduce the presence of amphibians (Wright et al., 2006). Additionally, erosion and sedimentation changes brought about by construction within a wetland could result in unintended changes to the wetlands.

Disturbed Upland Habitat: The short-term impacts associated with the removal of 5 acres of disturbed upland habitat would be limited as the quality of the habitat is low relative to the undisturbed areas of the floodplain. While these areas would be disturbed, they would, if left alone, readily return to a natural state.

Additional Habitats Affected by Supporting Facilities: Construction of roadways and staging areas in the floodplain would result in the temporary loss of habitat in those areas and the wildlife that they support. It is anticipated that FP 6 would require a total of approximately 36 acres for access roads and staging areas. Based on the conceptual layout, these facilities would affect upland disturbed areas, forested habitat, and 18 acres of wetlands. Development of these support facilities would affect the ability of some wildlife to nest and feed in these areas; and in some instances it would cause habitat fragmentation that could further disrupt the movement and interactions of certain wildlife species. In addition, nearby wetlands that are not undergoing remediation could be indirectly adversely affected by construction as a result of changes in stormwater drainage patterns and modifications to hydrology. Conventional engineering practices and controls would be used to reduce adverse effects from construction. Although these practices can be successful in mitigating adverse impacts, the size of the area affected by FP 6 is large and, in many places, contiguous. Therefore, this alternative would have less space for the implementation of alternative practices, such as relocating a road or diverting a stream bed.

Impacts on Local Communities and Communities Along Truck Transport Routes

FP 6 would result in short-term impacts to the local communities along the River. As described for the previous removal/backfill alternatives, these short-term effects would include changes to the appearance of the forested areas of the floodplain, disruption of activities along the River and within the floodplain due to the remediation as well as the construction of access roads and staging areas, and increased construction traffic and noise during excavation and backfilling activities.

Recreational activities that could be affected by construction activities include bank fishing, canoeing (canoe launches), hiking and general recreation, dirt biking/ATVing, and waterfowl hunting. During the period of active construction, restrictions on recreational use of the floodplain would be imposed in the areas in which remediation-related activities are taking place. Due to safety considerations, boaters, hikers, ATV riders, anglers, hunters, and other recreational users would not be able to use the floodplain in the areas where remediation-related activities are being conducted. Aesthetically, the presence of heavy construction equipment and cleared or disturbed areas would detract from the visually undisturbed nature of the area until such time as the restoration plantings for the disturbed areas have matured.

In addition, due to the need to remove excavated materials and deliver backfill materials and equipment, truck traffic would increase substantially, and that increase would persist for the duration of the project (13 years). As an example, if 20-ton capacity trucks were used to transport excavated material from the staging areas, it would take approximately 23,700 truck trips to do so. Assuming the use of smaller capacity trucks for local hauling (i.e., 16-ton trucks), an additional 37,700 truck trips would also be anticipated to import backfill materials, as well as materials for the construction of staging areas and access roads, to the site.

This additional traffic would increase the likelihood of accidents, noise levels, emissions of vehicle/equipment exhaust, and nuisance dust to the air. In addition, noise in and near the construction zone could affect those residents and businesses located in the immediate vicinity of work areas. Engineering controls would be implemented to mitigate short-term impacts and risks associated with implementation of FP 6. However, some impacts would be inevitable.

The increased truck traffic would also increase the risk of traffic accidents along transport routes. Appendix D includes an analysis of potential risks from the increased truck traffic that would be necessary to transport clean materials to the site for implementation of FP 6.[155] This analysis indicates that the increased truck traffic associated with FP 6 (an estimated 1,855,000 vehicle miles) would result in an estimated 1.07 non-fatal injuries due to accidents (with a probability of 66% of at least one such injury) and an estimated 0.05 fatalities from accidents (with a probability of 4% of at least one such fatality).

<u>Risks to Remediation Workers</u>

There would be potential health and safety risks to site workers implementing FP 6. Engineering controls and OSHA procedures designed to mitigate risks to remediation workers would be instituted. Implementation of FP 6 is estimated to involve 458,216 labor hours over a 13-year timeframe.

The analysis in Appendix D of potential risks to workers from implementation of the floodplain alternatives indicates that implementation of FP 6 would result in an estimated 4.65 non-fatal injuries to workers (with a probability of 99% of at least one such injury) and an estimated 0.03 worker fatalities (with a probability of 3% of at least one such fatality).

6.6.9 Implementability

6.6.9.1 Technical Implementability

The technical implementability of FP 6 has been evaluated in terms of the general availability of the technology involved (soil excavation and backfilling), the ability of this technology to be constructed and operated given site characteristics, the reliability of this technology, the availability of support facilities and resources, ease of undertaking corrective measures if necessary, and ability to monitor effectiveness.

The differences between FP 6 and the previous alternatives are that FP 6 would involve significantly more area of remediation and also more wetlands that are logistically and technically difficult to remediate and restore. FP 6 would involve the removal and backfilling of more than 3 times the acreage and volume of soil than would be involved in FP 4 or FP

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[155] The risks from truck traffic to transport excavated materials from the staging areas away from the site are evaluated under the relevant treatment/disposition alternatives.

5. The area and volume of remediation in wetlands areas would also be more than 3-fold greater than those in the previous alternatives.

General Availability of Technology: FP 6 would use conventional construction equipment, engineering procedures, and controls to conduct the remediation and restoration efforts. The equipment, material, technology, procedures, and personnel necessary to implement such activities are expected to be readily available. Some specialized equipment and materials would be used in and around environmentally sensitive areas, including vernal pools and wetlands, but these are also commercially available. Further, methods to implement monitoring and institutional controls are expected to be readily available.

Ability To Be Implemented: Based on site characteristics, the excavation/backfill technology that would be utilized for FP 6 is suitable for implementation in the areas where it would be applied. The construction of haul roads and staging areas may temporarily affect flood storage and drainage characteristics during seasonal high water conditions and during periodic storm and flood events. Engineering practices would be implemented to reduce the temporary impacts of such hydrology changes. Although these would be designed to mitigate the potential impacts, the size and the contiguous nature of the remediation areas would make the success of such controls more uncertain than for the smaller alternatives. In the long term, floodplain areas would be backfilled and restored to approximate original elevations, thereby minimizing effects on flood storage capacity.

Reliability: Soil excavation with backfilling is considered a reliable means of reducing the potential for human and ecological exposure to soils containing PCBs. Floodplain soil excavation has been implemented at other PCB-impacted sites across the country, as described in Sections 6.2.5.2 and 6.3.5.2 for FP 2 and FP 3. However, given the quantity of wetlands that would be affected by FP 6, complete restoration could be a significant challenge. Although wetlands restoration can be reliable with proper planning and implementation, it is not a mature science where all aspects of the restoration process are assured. In the end, the circumstances of the wetlands with respect to the restored soils and hydrology would dictate how the restored wetlands will develop, and upfront planning cannot completely assure that the restored wetlands will be the same as the pre-remediation wetlands. Vernal pools in particular are difficult to restore because of the hydrologic budget requirements that must be met for the pools to perform like they did before the remediation and restoration.

Also, in many cases, removal of the various wetlands habitats would be over contiguous areas, thereby reducing the ability of neighboring areas to offer protection and refuge to wetlands wildlife, and to serve as a native source for recovery of plant and animal species. These impacts add further uncertainties to the reliability of the restoration of wetlands.

<u>Availability of Support Facilities and Resources</u>: For purposes of the CMS, it has been assumed that FP 6 would require development of 36 acres of staging areas and access roads in the floodplain. Development of access roads and staging areas would be sequenced and constructed appropriately over the implementation period for FP 6. The specific locations and sizing of these access roads and staging areas would be determined based on the available land resources. Space for these roads and staging areas is not expected to be a significant limitation on construction. The volume and duration of necessary material storage (including final disposition) would depend upon the selected treatment/disposition alternative. Backfill and planting materials should be available with sufficient planning and coordination with sources. To provide sufficient materials for FP 6, multiple suppliers of backfill and planting materials may need to be used to fully support the project. An evaluation would be performed during design activities to confirm suitable material availability.

<u>Ease of Conducting Additional Corrective Measures</u>: If necessary, performing additional remediation at a later date would be possible using the same types of tools, equipment, and materials as in the original round of remediation. Construction equipment, personnel, and materials are commercially available, and their use and effectiveness for this type of materials removal and backfill project are well known and documented. Ease of implementation of the corrective measures would be directly related to the extent of the necessary additional corrective measure (i.e., area and/or volume to be addressed) and the ease of access (e.g., remoteness from roads, wetlands crossings, size and type of construction equipment).

<u>Ability to Monitor Effectiveness</u>: The effectiveness of FP 6 would be assessed by visual observation to evaluate such factors as vegetation re-growth and any signs of erosion or disturbance of restored areas. Monitoring procedures would be straightforward and implementable, although the size of the area to be covered is large and may be difficult to access in certain areas.

6.6.9.2 Administrative Implementability

The evaluation of administrative implementability of FP 6 has included consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

<u>Regulatory Requirements</u>: FP 6 would need to comply with the substantive requirements of applicable and appropriate regulations pertaining to the performance of the remedial action (unless waived). As discussed in Section 6.6.4, GE believes that FP 6 could be designed to comply with such requirements (i.e., the location-specific and action-specific ARARs listed in the Tables 2-2 and 2-3), with the exception of certain requirements that could potentially

apply to the on-site staging areas if the excavated materials should constitute hazardous waste. In the latter case, if necessary, GE believes that such requirements should be waived as technically impracticable.

Access Agreements: Implementation of FP 6 would require GE to obtain permission for access to the properties where the work would be conducted or where the ancillary facilities would be located. Access to State-owned lands would be sought from the state agencies that own the land. In addition, it is currently anticipated that access agreements would be required from approximately 45 private landowners. Obtaining access to all these properties for the type of work and length of time that may be needed would likely be difficult and time-consuming. If GE should be unable to obtain access agreements with particular landowners, GE would request EPA and/or MDEP to provide assistance.

Coordination with Agencies: Implementation of EREs and Conditional Solutions as part of FP 6 would require coordination with EPA and MDEP. In addition, as noted above, obtaining access to State-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of FP 6, GE would need to coordinate with EPA, as well as state and local agencies, to address potential health and safety impacts and to provide as-needed support with public/community outreach programs.

6.6.10 Cost

The estimated total cost to implement FP 6 is $104 M (excluding the costs of treatment/disposition of excavated soils). The estimated capital cost for implementation of FP 6 is $102 M, assumed to occur over a 13-year construction period. Estimated annual OMM costs (for a 3-year inspection and maintenance program for the restored excavation and staging/access road areas) range from $25,000 to $300,000 per year (depending on which reach is being monitored), resulting in a total cost of $2 M. The following summarizes the total costs estimated for FP 6.

FP 6	**Est. Cost**	**Description**
Total Capital Cost	$102 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM Cost	$2 M	Costs for performance of the OMM programs
Total Cost for Alternative	$104 M	Total cost of FP 6 in 2008 dollars

The total estimated present worth of FP 6, which was developed using a discount factor of 7%, a 13-year construction period, and an OMM period of 3 years on a reach-specific basis, is approximately $70.4 M. More detailed cost estimate information and assumptions for each of the floodplain alternatives are included in Appendix E.

As noted above, these costs do not include the costs of treatment/disposition of the removed floodplain soils. The estimated costs for combinations of FP 6 with the various treatment/disposition alternatives are presented in Section 8.

6.6.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 6.6.2, the evaluation of whether FP 6 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As discussed previously, FP 6 would result in a substantial reduction in the potential for human and ecological exposure to PCBs in floodplain soils by the removal from the floodplain of approximately 316,000 cy (194 acres) of soil with PCB concentrations greater than 25 mg/kg, resulting in the removal of 33,300 lbs of PCBs. The removed soil would be replaced with clean backfill, which would be revegetated.

Compliance with ARARs: As discussed in Section 6.6.4, based on review of the potential ARARs, GE believes that FP 6 could be designed and implemented to achieve the ARARs pertinent to this alternative, with the possible exception of certain requirements that could apply to the on-site staging areas if the excavated soils should constitute hazardous waste. In the latter case, if necessary, GE believes that such requirements should be waived as technically impracticable.

Human Health Protection: As discussed in Section 6.6.6.1, implementation of FP 6 would achieve the RME IMPGs based on a 10^{-4} cancer risk in all direct contact EAs, and would achieve those based on a 10^{-5} cancer risk in most (95%) of those EAs and in all farm areas evaluated for agricultural products consumption. With respect to the non-cancer IMPGs, FP 6 would achieve the RME IMPGs in 116 (97%) of the 120 EAs and in all farm areas, and would achieve the CTE IMPGs in all areas. However, it would not achieve the non-cancer RME IMPGs in 4 direct contact EAs (totaling approximately 77 acres). (FP 6 would also provide health protection through implementation of EREs and Conditional Solutions, where necessary, to address reasonably anticipated future uses.) In these circumstances, if one accepts EPA's assumptions and conclusions in the HHRA, FP 6 would provide substantial overall protection of human health, but would not provide protection from potential non-cancer risks for the most highly exposed individuals in a few areas of the floodplain.

Environmental Protection: As discussed in Section 6.6.6.2, FP 6 would achieve floodplain soil levels considered by EPA to be protective of most, but not all, ecological receptors. Specifically, FP 6 would achieve: (1) the lower-bound IMPG for omnivorous/carnivorous mammals in all seven of the averaging areas; (2) the target floodplain soil IMPG levels for insectivorous birds in all 12 averaging areas at all target sediment levels evaluated; and (3) the upper-bound target floodplain soil IMPGs for piscivorous mammals in both averaging areas if the associated sediment concentration were 1 mg/kg or less, and in one (but not the other) of those areas if the associated sediment concentration were 3 or 5 mg/kg. However, FP 6 would not achieve levels within the amphibian IMPG range in 41 of the 66 vernal pools in the PSA (representing about 60% of the vernal pool acreage).

As previously noted, achievement of IMPGs is a balancing factor under the Permit; it is not determinative of whether an alternative would provide overall environmental protection. In this case, based on review of the above information, it is concluded that FP 6 would result in soil concentrations that would generally provide protection of ecological receptors, with the possible exception of amphibians, given that 60% of the vernal pool acreage in the PSA would not achieve the IMPGs based on the ERA.[156]

At the same time, as discussed in Section 6.6.8, implementation of FP 6 would result in substantial short-term adverse impacts on the environment. These would include the destruction of valuable plant and wildlife habitat in those areas of the floodplain where remediation and ancillary construction activities would occur. The impacts from the excavations alone would include the loss of 84 acres of mature upland forest and 105 acres of wetlands, including 39 acres of palustrine habitat and 9 acres of vernal pools, with consequent impacts on the biota that depend on those habitats.

In addition, as discussed in Section 6.6.5.3, implementation of FP 6 would produce long-term adverse effects on the environment, particularly due to the removal of the 84 acres of mature upland forest and the 105 acres of wetlands. While the trees in upland forest and palustrine habitat could be replaced, younger, developing plant communities support different wildlife fauna than mature woodlands. It is expected that a restored, replanted forest would take approximately 5 to 10 years to reach a stage of development that would begin to support a woodland biological community rather than one associated with open

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[156] As previously noted for FP 5, which would likewise not achieve the IMPGs for amphibians in a majority of the vernal pools in the PSA, the impact of these IMPG exceedances on the local amphibian populations is uncertain, especially in light of the continued presence of amphibian populations in the PSA.

successional habitat. Further, while measures would be taken to restore the impacted wetlands, some of these, such as vernal pools and palustrine wetlands, are complex systems, and it is possible that, despite such measures, the changes to them would persist for a long time. Additionally, as also noted in Section 6.6.5.3, given the overall size of the affected area and the duration of the remedy, the numerous short-term impacts may themselves, through their cumulative effect, lead to long-term impacts. Finally, ancillary construction activities in the floodplain could result in long-term impacts to wetlands in those areas. Although these would be mitigated using conventional engineering practices and controls, the size and the contiguous nature of the remediation areas would make the success of such controls more uncertain than for the smaller alternatives.

Thus, implementation of FP 6 would cause long-term and potentially permanent habitat loss that could have real population-level impacts for the biota in the floodplain. These impacts would be far greater than those under the alternatives discussed above and, in GE's opinion, would not justify any incremental ecological risk reduction that might result from the additional soil removals. As EPA guidance makes clear, the standard of "overall protection" of the environment includes a balancing of the short-term and long-term ecological impacts of the alternatives with the residual risks (EPA, 1990a, 1997, 2005e – quoted in Section 2.1.1 above). Based on such balancing, GE believes that, although FP 6 would provide protection from many of the ecological risks identified in the ERA, it would have a net negative impact on the environment.

Summary: FP 6 would remove a significant mass of PCBs (33,300 lbs) and soils containing PCB concentrations $\geq$ 25 mg/kg from the floodplain, and would address the great majority of risks asserted by EPA in the HHRA and ERA. As discussed above, FP 6 would provide general protection of human health from the asserted risks of PCBs, although, if one accepts EPA's conclusions in the HHRA, it would not reduce potential non-cancer risks to acceptable levels for the most highly exposed persons in a few areas of the floodplain. With respect to the environment, FP 6 would generally provide protection from the asserted ecological risks of PCBs, although the extent to which it would reduce risks to the local amphibian population is uncertain. However, FP 6 would cause substantial adverse short-term and long-term impacts on the environment that would not justify any incremental risk reduction. As such, GE has concluded that, on balance, this alternative would not provide overall protection of the environment.

6.7 Analysis of Floodplain Alternative 7

6.7.1 Description of Alternative

FP 7 would involve the removal and backfill of floodplain soils to achieve average PCB concentrations that would meet lower-bound RME IMPGs for human health protection and the lower-bound IMPGs for ecological receptors. Specifically, this alternative has been developed to achieve the following IMPGs:

- The lower-bound RME IMPGs for human health protection (i.e., those based on a 10^{-6} cancer risk or a non-cancer HI of 1, whichever is lower) from direct contact with floodplain soils, but not lower than 2 mg/kg, since that level has been determined to be protective for unrestricted use;

- The lower-bound RME IMPGs for human health protection (i.e., those based on a 10^{-6} cancer risk or a non-cancer HI of 1, whichever is lower) from consumption of agricultural products from the floodplain; and

- The lower-bound floodplain IMPGs for protection of ecological receptors – i.e., amphibians (represented by wood frogs), omnivorous/carnivorous mammals (represented by shrews), insectivorous birds (represented by wood ducks), and piscivorous mammals (represented by mink) – using for the latter two receptors, the floodplain soil IMPGs associated with a sediment target level of 1 mg/kg.

This alternative would involve removing and replacing floodplain soils as necessary to achieve average PCB concentrations in the top foot of the relevant averaging areas that are equal to or less than the above-mentioned IMPGs. In addition, this alternative would involve the removal and backfill of soils in the top 3 feet in the Heavily Used Subareas of the Frequent-Use EAs as necessary to achieve average PCB concentrations in the 0- to 3-foot depth increment that meet the lower-bound IMPGs based on human direct contact, but not lower than 2 mg/kg. Average concentrations would be based on the 95% UCL of the spatially weighted mean, as discussed in Section 5.4.2.

Summary of Removal Areas and Volumes

FP 7 would involve the removal of approximately 570,000 cy of floodplain soil from 350 acres of the floodplain. Approximately 270 acres of this removal would occur within the PSA, covering nearly 30% of the total PSA floodplain area; the remaining 80 acres of removal would occur in the Reach 7 floodplain. The locations of these removal areas are shown on Figure 6-6 and a detailed breakdown of the removal areas and volumes associated with FP 7 is included in Tables 6-37 through 6-42. The 570,000 cy removal volume includes 520,000 cy (319 acres) associated with achieving human health IMPGs and an additional 50,000 cy (31 acres) associated with achieving amphibian and piscivorous mammal IMPGs. (As discussed further below, this remediation would also allow the lower-bound IMPGs for omnivorous/carnivorous mammals and insectivorous birds to be met in all averaging areas without the need for additional removal.)

Summary of Affected Habitat

FP 7 would involve the removal and backfill of soil across 350 acres (including 270 acres in the PSA) in various types of habitats within the floodplain. The acreages of those general habitat types, with associated removal volumes, are as follows:[157]

- 132 acres (214,000 cy) of upland forest habitat (consisting of high-terrace floodplain forest habitat, northern hardwoods-hemlock-white pine forest habitat, red oak-sugar maple transition forest habitat, successional northern hardwoods habitat, and transitional floodplain forest habitat);

- 53 acres (86,000 cy) of emergent marsh habitat (consisting of deep emergent marsh habitat, shallow emergent marsh habitat, and wet meadow habitat);

- 38 acres (64,000 cy) of palustrine habitat (consisting of red maple swamp habitat and shrub swamp habitat);

- 17 acres (27,000 cy) of vernal pool habitat, including portions of 62 vernal pools;

- 14 acres (23,000 cy) of disturbed upland habitats (consisting of agricultural field habitat and cultural grasslands habitat);

- 13 acres (20,000 cy) of backwater areas in the floodplain that are characterized as open water stream/pond habitat;

- 7 acres (10,000 cy) of black ash-red maple-tamarack calcareous seepage swamp habitat; and

- 77 acres (125,000 cy) of habitat of currently unmapped community type (the majority of which is located in agricultural areas in Reach 7, as shown on Figure 6-6).

In addition to the areas subject to excavation/backfill activities, additional floodplain habitat would be affected by the construction and use of access roads and staging areas. Conceptual construction plans indicate that FP 7 would require 52 staging areas and 9

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[157] This detailed breakdown of removal areas and volumes by habitat type was generally conducted using the Woodlot (2002) ecological characterization of the River between the Confluence and Woods Pond Dam, as previously noted. One exception is in vernal pool areas, where the EPA vernal pool coverage was merged with the Woodlot habitat areas; in those areas, the EPA vernal pool coverage superseded the underlying Woodlot habitat types.

miles of temporary access roads within the floodplain, which together would amount to 45 acres (with many more miles of access roads also constructed within the footprint of the removal areas).

Conceptual Remedial Approach

The conceptual remedial approach for FP 7 generally would be the same as that described for the other removal alternatives, but at a much greater scale. Soil removal would be conducted using conventional earth-moving equipment (i.e., backhoes, bulldozers). As described for FP 3 through FP 6, some specialized construction equipment and materials and specific engineering practices would be needed to mitigate the potentially negative impacts of construction in and around vernal pools and other wetland areas.

It is estimated that FP 7 would take approximately 22 years to complete if implemented independently from other River-related remedial activities. However, it is likely that floodplain remediation would be coordinated with sediment remediation. Hence, the actual time to complete FP 7 might be different, depending on the sediment remediation alternative selected. Nevertheless, for the purposes of the evaluations in this section, it has been assumed that implementation of FP 7 would take 22 years.

As described for the other alternatives, FP 7 would include the use of EREs and Conditional Solutions as necessary to address reasonably anticipated future uses and activities for which this alternative would not meet applicable cleanup criteria (e.g., residential use standards, where that use is reasonably anticipated and remediation would not meet those standards).

After restoration activities within a given area are completed, periodic monitoring and maintenance would be conducted of the backfilled/restored areas. For the purposes of this CMS Report, monitoring and maintenance are assumed to occur for 3 years following remedy implementation in a given area. Monitoring would include annual visual inspections of restored areas (e.g., to assess plant survivorship, evidence of erosion). The maintenance program would be implemented to address those areas where the visual inspections indicate the need for maintenance or repair to maintain the effectiveness of the remedy.

6.7.2 Overall Protection of Human Health and the Environment - Introduction

As discussed in Section 6.1.2, the evaluation of whether a floodplain soil remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether FP 7 would be protective of human health and the environment is presented at the end of Section 6.7 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

6.7.3 Control of Sources of Releases

Existing floodplain soil conditions are not a significant source of potential PCB releases to the River, nor would they be following restoration. As stated previously, the floodplain is generally flat, well vegetated and depositional in nature, greatly reducing the potential for PCBs in the floodplain soil to scour and transport to the River. While the floodplain is not considered a significant source, implementation of FP 7 would further reduce the limited potential for PCBs in the floodplain to be released to the River by removing approximately 570,000 cy of PCB-containing soils over 350 acres, replacing them with clean soil, and revegetating.

Open excavations during construction could serve as a short-term temporary source of some releases during an extreme weather event. As with the other alternatives, such potential releases would be controlled using conventional engineering practices. However, because FP 7 would involve such a large area (350 acres) over such a long time (22 years), the potential for such short-term releases is much greater than for alternatives that would affect a smaller overall area and take less time to implement.

6.7.4 Compliance with Federal and State ARARs

The potential chemical-specific, location-specific, and action-specific ARARs identified by GE are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs set forth in Table 2-1 consist of federal and state water quality criteria for PCBs and state air pollution control requirements for dust. The water quality criteria do not apply to floodplain soils, and GE believes the state air pollution control requirements for dust could be met.

The potential location-specific and action-specific ARARs are listed in Tables 2-2 and 2-3. Based on review of those ARARs, GE believes, for the same reasons given for FP 2 in Section 6.2.4, that FP 7 could be designed and implemented to achieve the pertinent ARARs (provided that any necessary EPA approval determination under its TSCA regulations is obtained for the staging areas), with the following potential exception: In the event that excavated floodplain soils should be found to constitute hazardous waste (which is not anticipated), the temporary staging areas for the handling of those soils may not meet certain federal or state hazardous waste storage requirements, if they were determined to apply. In that case, as further discussed in Section 6.2.4, GE believes that such requirements should be considered inapplicable or, if necessary, waived as technically impracticable.

6.7.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for FP 7 includes evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment. Each of these considerations is discussed below.

6.7.5.1 Magnitude of Residual Risk

Evaluation of the magnitude of residual risk associated with FP 7 includes consideration of the length of time and extent to which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure, such as institutional controls.

FP 7 would reduce potential exposures of humans and ecological receptors to PCBs in floodplain soil by removing approximately 570,000 cy of PCB-containing soil over 350 acres of floodplain (see Figure 6-6). The reduction in potential exposure and associated risk would occur upon completion of the remediation in a given area. As noted above, FP 7 would take a total of 22 years to complete if implemented independently.

As discussed further in Section 6.7.6.1, the average post-remediation soil concentrations in the human health averaging areas following implementation of FP 7 are equivalent to or lower than those associated, under RME assumptions, with a cancer risk of 10^{-6} and a non-cancer HI of 1, but not less than 2 mg/kg in most human direct contact EAs. As discussed in Section 6.7.6.2, the average post-remediation soil concentrations in the ecological averaging areas are equivalent to or lower than the lower-bound IMPGs for ecological receptors (depending, in some cases, on the associated sediment concentrations). The average post-remediation PCB EPCs for the soil within the human health and ecological averaging areas under FP 7 are shown in Tables 6-37 through 6-42. (Table 6-37 also shows the post-remediation concentrations in the top 3 feet in Heavily Used Subareas.)

PCBs would also remain at depths below those described above. Such deeper soil is generally not anticipated to be available for exposure under current uses. Where it is reasonably anticipated that such deeper soil could become available for exposure, it would be addressed by EREs and/or Conditional Solutions. Additionally, EREs and Conditional Solutions would be implemented where necessary to address potential risks from reasonably anticipated future activities and uses.

6.7.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of FP 7 has included an assessment of the use of technologies under similar conditions, the general reliability of those techniques, reliability of OMM, and the potential need to replace components. The technology and implementation steps that would be used for FP 7 would be the same as described for the other removal/backfill alternatives. However, FP 7 would involve remediation of a much greater area, comprising a greater portion of the floodplain in the PSA and a greater area of wetlands, than the previously discussed alternatives, and would take a much longer time. These components bring additional concerns and complexity to assessing adequacy and reliability.

The primary difference between FP 7 and the other removal alternatives is the areal extent of remediation. This alternative would remediate approximately 30% of the existing surface area of the entire floodplain in the PSA, and an additional 76 acres in Reach 7. This alternative would remediate 80% more area than FP 6, approximately 6 times more area than FP 4 or FP 5, and 9 times more area than FP 3. The logistics of removal and restoration of the many different and diverse habitats from so much contiguous land area would be difficult, as would OMM over such a large area.

Use of Technology Under Similar Conditions

FP 7 relies primarily on the removal and backfill of floodplain soils, including those associated with upland forest, vernal pools, and wetland habitats. Excavation, backfilling and revegetation of various types of floodplain environments have been effectively applied at a number of other sites, as discussed under FP 2 in Section 6.2.5.2 and FP 3 in Section 6.3.5.2. However, GE is unaware of any sites similar to the Rest of River floodplain where removal and restoration have been attempted at the scale that would be involved in FP 7. As discussed in Section 6.6.5.2, a number of large-scale restoration projects have been conducted around the country, but none has involved clearing and excavation, as well as restoration, on the scale of FP 7. Moreover, as discussed previously, we have found no precedent in the literature or examples from other sites where vernal pool restoration has been performed on the number of pools (62) or the proportion of a site's vernal pool acreage (50%) as would be required for FP 7. FP 7 would thus present an unprecedented challenge in terms of the amount of habitat to be physically restored and the complexity of trying to restore so many different intertwined communities across one area.

General Reliability

The removal and backfill of material for FP 7 would reliably, effectively, and permanently reduce the concentrations of PCBs in the removal areas. Restoration activities would include backfilling with soil appropriate to support plant growth and replanting vegetative communities similar to those that were removed, to the extent practicable. Standard landscaping techniques would be used to replant upland forested areas, and wetland restoration techniques would be used to restore the soils, hydrology, and vegetative communities of emergent marsh and palustrine habitats. For vernal pools, the challenges to successful restoration would be the same as described for FP 3 and FP 4. While it is possible to restore vernal pools, there is little tolerance in terms of the topographic elevation and hydrologic parameters required to successfully complete these restorations. As with FP 3 and FP 4, the reliability of such restoration is uncertain.

Reliability of Operation, Monitoring, and Maintenance Requirements

Following the construction phase of FP 7, a monitoring and maintenance program would be implemented for those areas restored following remediation. Both the removal areas and those portions of the floodplain disturbed during construction of access roads and staging areas would be monitored through periodic inspections to ensure that the planted vegetation is surviving and growing, and to identify areas (if any) where the backfill is eroding and in need of repair. Periodic inspection of the plantings and backfill areas is considered a reliable means of tracking the restoration activities. Labor and materials needed to monitor and perform any maintenance activities required following implementation of FP 7 are considered available.

Because of the size of the area, the differing types of habitat that would be restored, access issues, and the amount of wetlands involved, maintenance and monitoring would be more difficult and time-consuming than under the other floodplain alternatives. Maintenance, if required, could be difficult to implement in certain areas of the floodplain, due to remoteness, wet areas, and vegetation growth. The ease of access may change based on seasonal conditions. It could be especially difficult to conduct supplemental planting activities in difficult-to-access locations, to which plant materials would have to be carried from the closest roadways.

Technical Component Replacement Requirements

If significant erosion and/or plant loss were observed as part of the OMM program in the restored floodplain areas, an assessment would be conducted to determine the need for and methods of repair. Because of the size of the overall area that would require OMM, it is likely that some areas would require repair or replacement. Depending on the timing and location of the repair, access roads and staging areas may again need to be temporarily constructed in the floodplain. It is anticipated that if small repairs or replacement were necessary, they could be implemented using the same types of methods and materials used during the initial backfilling/restoration activities. Periodic small-scale inspections and repairs would pose no appreciable risks to humans and ecological receptors that use/inhabit the floodplain in these areas. Replacement of larger remedy components could require more extensive disturbance in the floodplain.

6.7.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of FP 7 on human health or the environment has included consideration of the items discussed below. The types of long-term adverse impacts associated with implementation of FP 7 and the potential measures available to mitigate them are generally similar to those noted for the prior floodplain alternatives. However, FP 7 would involve removal and backfill of significantly more area and, in some cases, would affect a sizeable proportion of that habitat in the floodplain area, thereby removing significant refuge area from affected wildlife species. Accordingly, the long-term impacts would be more widespread and difficult to avoid or manage.

Potentially Affected Populations

Implementation of FP 7 would have long-term effects on human and wildlife populations through changes in the natural environment and habitat. Since this alternative involves much more extensive floodplain disturbance than the alternatives discussed above, the potential for such impacts is correspondingly greater. For humans, implementation of FP 7 would affect the aesthetics of the floodplain as large sections of the bordering forest would be removed. These actions would affect the appearance of the floodplain for decades as smaller trees that were planted to replace the older, larger forest species grow to maturity. For wildlife, implementation of FP 7 would remove and replace several habitat types (described in Section 6.7.1), which would affect the mammals, birds, amphibians, and reptiles inhabiting those habitats. The long-term impacts on biota are discussed further in the next sections.

Adverse Impacts on Biota and Corresponding Habitat

It is expected that FP 7 would result in long-term adverse impacts on biota and their habitat. The extent of the floodplain area to be remediated (350 acres) and the long time frame for implementation (22 years) would result in a high level of disturbance (stress) to the existing ecosystem. In some areas, due to the widespread extent of the excavations, displaced wildlife would have limited areas for refuge. While wildlife with greater mobility may be able to adapt and move to other locations, animals with smaller home ranges and limited mobility, such as reptiles, amphibians and small mammals, could be severely affected. The effect would be to shift the distribution of populations of affected wildlife from the disturbed areas to undisturbed areas, to the extent any are available.

As a result of the overall size of the affected area and the duration of the remedy, the cumulative effect of numerous short-term impacts may lead to long-term impacts. Also, implementation of FP 7 would have a long-term adverse impact on biota due to the loss or change in habitats and the corresponding wildlife community should the remediated areas not return to conditions similar to those which currently exist. These impacts are described below.

FP 7 would remove 132 acres of upland forest habitat. The impacts on this habitat would be more widespread than under the smaller alternatives, as this amounts to approximately 45% of the upland forested areas of the floodplain. The impacts would be primarily associated with the long-term loss of mature forest habitat capable of supporting a diverse wildlife community. As noted previously, while replacement trees would be planted, the time for the forest system to reach a functional level comparable to its pre-excavation function is commensurate with the age of the system – approximately 50 to 75 years (or older adjacent to Reach 5C and Woods Pond), as noted in Sections 6.3.5.3 and 6.4.5.3. While the restored forest community would support a diversity of early and mid-successional wildlife species as the plantings develop and grow, younger, developing plant communities support a different wildlife community that is characteristic of successional habitats. It is expected that a restored, replanted upland forest would take approximately 5 to 10 years to reach a stage of development that would begin to support a biological community typical of a woodland rather than one typical of an open successional habitat. Because FP 7 would affect 132 acres of upland forest, the adverse impacts of the removal and replanting would be significant both in physical extent and in duration.

Long-term impacts to wetlands and the biota inhabiting them would also occur from the implementation of FP 7. These impacts are described in the following section.

It should also be noted that a number of rare, threatened, and/or endangered species would be affected by this alternative. As this alternative represents the removal of habitat over a large stretch of the floodplain for a long period of time, FP 7 could substantially affect the presence of these species. As part of the ecological characterization of the PSA, Woodlot (2002) identified 15 rare plant species at 27 locations, 8 rare bird species at 42 locations, one rare mammal at 1 location, and 1 rare reptile at 4 locations within the floodplain. FP 7 would potentially impact 12 locations where rare plants were identified, 14 locations where rare bird species were observed, one location where the rare reptile was observed, and the location where the rare mammal was sighted. In certain circumstances, long-term impacts may occur when the movement of a rare species from one area to another can lead to stress from competitive pressures on common resources of food and cover, as well as interspecies interactions. The magnitude of the potential impacts related to species movement is related directly to the amount of habitat disturbed and the number of rare species involved. Of all the floodplain alternatives FP 7 would impact the greatest number of locations (14) where rare bird species have been observed, the only location where a rare mammal has been sighted, and the greatest amount of habitat where these species may be found (350 acres). Therefore, there is a significant potential that long-term impacts to rare bird or mammal species may occur as a result of the implementation of FP 7. For those endangered species that have limited mobility (i.e., reptiles) or are not mobile (i.e., plants), the excavation would result in removal of the locations where they were found in the excavation area, as well as the loss of habitat for these species. For FP 7, which would affect 12 locations where rare plants were identified as well as where large areas of the floodplain that could serve as habitat for the rare plants and reptiles, the excavations could have a significant long-term adverse effect on the presence of these species in the floodplain.

Adverse Impacts on Wetlands

The excavations in FP 7 would impact approximately 127 acres of wetland habitats, including marshes, swamps, and vernal pools. These would include 53 acres of emergent marsh, 38 acres of palustrine habitat, 17 acres of vernal pools, 7 acres of black ash-red maple-tamarack calcareous seepage swamp, and 13 acres of backwaters.

As discussed in Section 6.6.5.3, the cumulative effects of many short-term impacts to wetlands from FP 7 can lead to a long-term adverse impact. Cumulative impacts result in changes to habitat structure and ecosystem properties, which can have a cascading effect on many plant and animal species in the wetland. Limited research has been conducted on cumulative impacts to wetland resources from multiple and disparate habitat perturbations; however, the limited research suggests that there is the potential for long-term depression in amphibian populations and changes in plant communities that are supported by the wetlands (Wright et al., 2006). In particular, the cumulative impacts of the removal of 62 vernal pools could pose a significant threat to the long-term viability of the amphibian population in the area. Given that amphibians are dedicated to specific pools and the loss of a given pool could have serious effects on the subpopulation of amphibians supported by that pool, the loss of a large number of pools over an expansive area could affect the whole population of amphibians in the region.

In addition to such cumulative effects, the potential for long-term effects on each of the types of wetlands identified above is as follows:

- The remediation of the 17 acres of vernal pools, which include portions of 62 of the 66 pools in the PSA, could have long-term impacts for similar reasons to those discussed for such pools under FP 3 in Section 6.3.5.3. Vernal pools are particularly important in supporting the life cycles of amphibians (frogs and salamanders) and invertebrates that are completely dependent on these types of ecosystems. Impacts to these habitats could result in changes in the ecological function of the vernal pools and a modification in the pools' ability to support amphibians. The loss of a vernal pool, even on a temporary basis, could have long-lasting effects on the distribution of amphibians in the area and upon the predators that prey on them (Colburn, 2004). Moreover, as stated above, the cumulative impacts of the removal of 62 vernal pools could pose a significant threat to the long-term viability of the amphibian population in the area. As also discussed previously, we have found no precedent in the literature or examples from other sites where vernal pool restoration has been performed on the scale that would be required for FP 7.

- For the 53 acres of emergent marsh habitat, assuming that wetlands mitigation techniques successfully restore the marsh habitat, the impacts on particular marshes would primarily be short-term in duration, given that these systems tend to recover within 2 to 4 years following completion of restoration. During the remediation, the species inhabiting these marshes could move to other comparable areas. However, given the extensive area of marshland that would be affected by FP 7, it is possible that that temporary displacement could be extended for species with limited mobility and migration capabilities such as amphibians.

- Some long-term impacts could occur as the result of the excavation of 38 acres of palustrine habitat (forested wetlands). NRC (2001) notes that forested and shrub wetlands are more difficult to create or restore because of the length of time that is needed to establish mature woody species. Palustrine wetlands support a diverse community of plant and animals and perform a variety of distinct functions such as flood retention, nutrient recycling, and biological habitat typical of wooded wetland systems. While these systems would be restored at the completion of the remedial action, palustrine wetlands are mature systems that require an extended period of time to restore, and the functional abilities of the restored wetlands would be compromised until the restored system matures.

- FP 7 would affect 7 acres of black ash-red maple-tamarack calcareous seepage swamp habitat. As described previously, these swamps are supported by high pH groundwater originating in limestone-dominated bedrock and support flora and fauna that are adapted to higher pH environments. Excavation within a calcareous seepage swamp, as well as in the areas bordering the swamp, could lead to difficulty in restoring the wetlands if the pH of the groundwater is affected. However, because the excavations under FP 7 would only involve the top foot of these systems, it is not expected that long-term impacts to groundwater pH would occur in these areas.

Long-term impacts to wetlands could also occur as a result of ancillary construction activities in support of excavation. Construction and use of staging areas or temporary access roads in or bordering wetlands could modify soil conditions, drainage patterns, or groundwater flow conditions, potentially creating a change in the characteristics of an existing wetland or converting a wetland to an upland environment. For FP 7, based on conceptual design, although the majority of access roads and staging areas would overlap with areas to be removed, these facilities would affect 28 additional areas of wetlands. Construction design would take steps to avoid direct impacts on wetlands where practicable (i.e., a road could go around instead of though a wetland area, or culverts could be used). However, where wetlands impacts could not be avoided, these types of effects could occur. Moreover, because of the size and contiguous nature of the FP 7 remediation areas, unforeseen changes to surface water drainage patterns in wetlands that would not be directly affected by construction would be much more difficult to effectively manage or to correct following remediation than with the other alternatives.

Long-Term Impact on Aesthetics

Implementation of FP 7 would have long-term impacts on the aesthetic features of the natural environment. The natural appearance of the floodplain after the remediation and restoration would not be the same as prior to remediation, with the most noticeable changes likely associated with those areas where mature trees would be cut down. As noted above, FP 7 would result in the removal and backfilling of approximately 177 acres of upland and wetland forested communities. The time for a replanted forest community to develop an appearance comparable to its current appearance would be commensurate with the age of the community prior to remediation, which could range up to 50 to 75 years. While it would thus take decades for the planted trees to reach their present maturity, it would not take as long for the restored vegetative communities to reach an intermediate level of maturity that would provide a natural appearance.

Potential Measures to Mitigate Long-Term Adverse Impacts

Measures to mitigate the potential for long-term adverse impacts are the same as described for the other alternatives, especially those involving large areas of vernal pools and other wetlands. For FP 7, these measures would need to be applied over the much larger area included in FP 7. These measures would include the placement of suitable backfill soil to support plant growth, surface soil grading to restore the soil elevations, and re-planting. Upland communities would be replanted either with species currently found in those areas or with species typical of those environments. Wetlands would be replanted with hydrophytic species typical of the existing plant community, and measures would also be taken, to the extent practicable, to replace the functions of those wetlands, such as nutrient cycling, flood control, and water filtration. However, some wetland areas may be difficult to fully restore. As previously discussed, these areas would include the vernal pools (17 acres) and the palustrine community (38 acres). While restoration of these wetlands is possible, the size of the restoration areas and level of impacts associated with the surrounding areas create a higher level of complexity than for the smaller alternatives.

6.7.6 Attainment of IMPGs

This section describes the extent to which FP 7 would achieve the IMPGs for human health and ecological protection. These comparisons are presented in Tables 6-37 through 6-42 for the pertinent human and ecological averaging areas. The time frame to achieve any IMPGs would be the same as that required to complete the remedy in a particular area (i.e., the reduction in soil concentrations would occur upon completion of backfill placement). As previously noted, it is estimated that implementation of FP 7 would take a total of 22 years.

6.7.6.1 Comparison to Human Health-Based IMPGs

FP 7 would achieve the most restrictive set of IMPGs – namely, the RME IMPGs based on a 10^{-6} cancer risk and a non-cancer HI of 1 – in all direct contact EAs and Heavily Used Subareas, except that where those levels are below 2 mg/kg, the remediation would reduce the EPCs to (or in some cases somewhat below) 2 mg/kg (Table 6-37). The 2 mg/kg level has been determined in the Consent Decree to be protective for unrestricted (e.g., residential) use.

With respect to the farm areas, FP 7 would achieve the RME IMPGs based on a 10^{-6} cancer risk and a non-cancer HI of 1 in all 14 farm areas evaluated for consumption of agricultural products (Table 6-38).

These comparisons are shown in detail in Tables 6-37 and 6-38 for all human exposure areas in Reaches 5 through 8.

6.7.6.2 Comparison to Ecological IMPGs

FP 7 would achieve all ecological IMPGs in all averaging areas (depending, for piscivorous mammals, on the associated sediment concentrations), as described below:

- For amphibians, FP 7 would achieve the lower-bound IMPG in all 66 of the vernal pools in the PSA (covering approximately 34 acres) (Table 6-39).

- For omnivorous/carnivorous mammals, FP 7 would achieve the lower-bound IMPG in all averaging areas (Table 6-40).

- For insectivorous birds, FP 7 would achieve the target floodplain soil IMPG levels in all averaging areas for all three of the sediment target levels evaluated (Table 6-41).

- For piscivorous mammals, FP 7 would achieve the lower-bound floodplain soil IMPGs in both averaging areas if the associated sediment concentration in those areas were 1 mg/kg or less (Table 6-42). If the sediment level were 3 mg/kg, FP 7 would achieve the upper-bound soil IMPG in both averaging areas, but would not achieve the lower-bound IMPG in either. If the sediment level were 5 mg/kg, FP 7 would achieve the upper-bound soil IMPG in the Reach 5C/5D/6 averaging area, but not in the Reach 5A/5B area.[158]

These comparisons are shown in detail in Tables 6-39 through 6-42 for all ecological averaging areas in the PSA.

6.7.7 Reduction of Toxicity, Mobility, or Volume

The degree to which FP 7 would reduce the toxicity, mobility, or volume of PCBs in floodplain soils is discussed below.

Reduction of Toxicity: FP 7 does not include any treatment processes that would reduce the toxicity of the PCBs in the floodplain soils. However, if “principal threat” wastes (e.g., NAPL, drums of liquid) should be encountered during the excavations (which is not anticipated), they would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: As previously discussed, the existing conditions of the floodplain are predominantly depositional and stable due to generally low flow velocities during inundation and the presence of vegetation. Therefore, PCBs in existing floodplain soils do not represent a significant potential source for mobility and migration. Nevertheless, implementation of FP 7 would further reduce the limited potential for long-term mobility of

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[158] At a sediment level of 3 mg/kg, the lower-bound soil IMPG would not be attainable at all in the Reach 5A/5B averaging area and would require an additional removal of 63,000 cy of floodplain soil in the Reach 5C/5D/6 area to be attained. At a sediment level of 5 mg/kg, the upper-bound soil IMPG in the Reach 5A/5B area and the lower-bound soil IMPG in both averaging areas would not be attainable at all. As previously discussed, floodplain soil IMPGs for piscivorous mammals are considered not attainable when PCB levels in aquatic prey items alone would exceed the IMPG at a given sediment concentration.

PCBs in the floodplain by removing 350 acres of PCB-containing soils from the floodplain, backfilling the excavations, and revegetating the surface.

Reduction of Volume: FP 7 would reduce the volume of PCBs in the soils of the floodplain by removing 570,000 cy of PCB-containing soils containing approximately 38,500 lbs of PCBs from 350 acres of the floodplain.

6.7.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of FP 7 has included consideration of the short-term impacts of implementing this alternative on the environment, the local communities (as well as communities along truck transport routes), and workers involved in the remedial activities. These impacts would be substantially greater than those of the other floodplain remedial alternatives since FP 7 would affect a much larger area and would take much more time to implement. Specifically, FP 7 would involve removal and backfilling of 350 acres of floodplain soils, which includes approximately 30% of the floodplain in the PSA. In addition, it would require removal of much of the vegetation from the floodplain that would otherwise serve to screen activities, absorb noise, and provide alternate refuge habitat for wildlife. Increased construction and truck traffic would affect 9 miles along the floodplain and persist for approximately 22 years.

Impacts on the Environment

The short-term effects on the environment resulting from implementation of FP 7 would include the removal of plant and wildlife habitat in those areas of the floodplain where remediation or construction of access roads or staging would occur. Short-term impacts specifically associated with each habitat type are provided below.

Upland Forest: The largest short-term impact would occur from the removal of 132 acres of mature upland forests. Removal of mature trees and construction of access roads and staging areas would result in upland habitat destruction and habitat fragmentation. The temporary loss of the plant communities would result in indirect impacts to wildlife through the loss of cover, nesting, and feeding habitat. This would be particularly disruptive to wildlife that would not be likely to migrate out of the construction zone and to birds that are dependent on the plant community for the placement of their nests and thus would be forced to move elsewhere during nesting season.

Wetlands: Substantial short-term impacts would also be associated with the removal and backfilling of 127 acres of wetlands, including 53 acres of emergent marsh, 38 acres of palustrine habitat, 17 acres of vernal pools, 7 acres of black ash-red maple-tamarack calcareous seepage swamp, and 13 acres of backwaters. Short-term impacts from the extensive destruction of wetlands as a result of the remedial action would include the inability of these areas to support mammals, birds, reptiles, and amphibians that are dependent on these wetlands for nesting, breeding, and feeding.

Other short-term impacts relate to the affected wetlands' ability to perform functions of phosphorous retention, nitrogen removal, and flood control. FP 7 would potentially change stormwater flows from wetlands undergoing remediation to neighboring wetlands that would not be remediated. In particular, increases in stormwater runoff affect water level fluctuations within a wetland. This in turn has been shown to reduce plant richness, reduce thin-stemmed plant distribution, promote the presence of invasive species, and reduce the presence of amphibians (Wright et al., 2006). Additionally, erosion and sedimentation changes brought about by construction within a wetland could result in unintended changes to the wetlands.

<u>Disturbed Upland Habitat:</u> The short-term impacts associated with the removal of 14 acres of disturbed upland habitat would be limited as the quality of the habitat is low relative to the undisturbed areas of the floodplain. While these areas would be disturbed, they would, if left alone, return to a natural state.

<u>Additional Habitats Affected by Supporting Facilities</u>: Construction of roadways and staging areas in the floodplain would result in the temporary loss of habitat in those areas and the wildlife that they support. It is anticipated that FP 7 would require a total of approximately 48 acres for access roads and staging areas. Based on the conceptual layout, these facilities would affect upland disturbed areas, forested habitat, and 28 acres of wetlands. Development of these support facilities would affect the ability of some wildlife to nest and feed in these areas; and in some instances it would cause habitat fragmentation that could further disrupt the movement and interactions of certain wildlife species. In addition, nearby wetlands that are not undergoing remediation could be indirectly adversely affected by construction as a result of changes in stormwater drainage patterns and modifications to hydrology. Conventional engineering practices and controls would be used to reduce adverse effects from construction. However, because so much area is affected, these practices and controls may not be completely successful in mitigating adverse impacts.

<u>Impacts on Local Communities and Communities Along Truck Transport Routes</u>

FP 7 would result in short-term impacts to the local communities along the River for the duration of the remedy, currently estimated to be 22 years. These short-term effects would include changes to visual aesthetics of the floodplain, disruption of activities along the River and within the floodplain due to the remediation as well as the construction of access roads and staging areas, and increased construction traffic and noise during excavation and backfilling activities.

Recreational activities that could be affected by construction activities include bank fishing, canoeing (canoe launches), hiking and general recreation, dirt biking/ATVing, and waterfowl hunting. During the period of active construction, restrictions on recreational use of the floodplain would be imposed in the areas in which remediation-related activities are taking place. Due to safety considerations, boaters, hikers, ATV riders, anglers, hunters, and other recreational users would not be able to use the floodplain in the areas where remediation-related activities are being conducted. Similarly, work in other upland disturbed areas, including agricultural areas, would prevent use of these areas during construction. Aesthetically, the presence of heavy construction equipment and cleared or disturbed areas would be apparent from many vantage points on both sides of the River and would detract from the natural appearance of the area until such time as the restoration plantings for the disturbed areas have matured.

In addition, due to the need to remove excavated materials and deliver backfill materials and equipment, truck traffic would significantly increase during the construction period. As an example, if 20-ton capacity trucks were used to transport excavated material from the staging areas, it would take 42,800 truck trips to do so. Assuming the use of smaller capacity trucks for local hauling (i.e., 16-ton trucks), an additional 67,100 truck trips would also be anticipated to import backfill materials, as well as materials for the construction of staging areas and access roads, to the site.

This additional traffic would increase the likelihood of accidents, noise levels, emissions of vehicle/equipment exhaust, and nuisance dust to the air. In addition, noise in and near the construction zone could affect those residents and businesses located in the vicinity of work areas. Engineering controls would be implemented to mitigate short-term impacts and risks associated with implementation of FP 7. However, some impacts would be inevitable throughout the 22-year implementation period.

The increased truck traffic would also increase the risk of traffic accidents along transport routes. Appendix D includes an analysis of potential risks from the increased truck traffic that would be necessary to transport clean materials to the site for implementation of FP 7.[159] This analysis indicates that the increased truck traffic associated with FP 7 (an estimated 3,355,000 vehicle miles) would result in an estimated 1.91 non-fatal injuries due to accidents (with a probability of 85% of at least one such injury) and an estimated 0.08 fatalities from accidents (with a probability of 8% of at least one such fatality).

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[159] The risks from truck traffic to transport excavated materials from the staging areas away from the site are evaluated under the relevant treatment/disposition alternatives.

Risks to Remediation Workers

There would be potential health and safety risks to site workers implementing FP 7. Engineering controls and OSHA procedures designed to mitigate risks to remediation workers would be instituted. Implementation of FP 7 is estimated to involve 775,666 labor hours over a 22-year timeframe.

The analysis in Appendix D of potential risks to workers from implementation of the floodplain alternatives indicates that implementation of FP 7 would result in an estimated 7.86 non-fatal injuries to workers (with a probability of 100% of at least one such injury) and an estimated 0.06 worker fatalities (with a probability of 6% of at least one such fatality).

6.7.9 Implementability

6.7.9.1 Technical Implementability

The technical implementability of FP 7 has been evaluated in terms of the general availability of the technology involved (soil excavation and backfilling), the ability of this technology to be constructed and operated given site characteristics, the reliability of this technology, the availability of support facilities and resources, ease of undertaking corrective measures if necessary, and ability to monitor effectiveness.

The differences between FP 7 and the previous alternatives are that FP 7 would involve significantly more remediation area and also more wetlands that are logistically and technically difficult to remediate and restore. FP 7 would involve the removal and backfilling of almost twice the acreage and volume of soil as would be involved in FP 6 and over 5 times more than FP 4 or FP 5. The area and volume of remediation in wetlands areas would also be more than those in the previous alternatives.

General Availability of Technology: FP 7 would use conventional construction equipment, engineering procedures, and controls to conduct the remediation and restoration efforts. The equipment, materials, technology, procedures, and personnel necessary to implement such activities are expected to be readily available. Some specialized equipment and materials would be used in and around environmentally sensitive areas, including vernal pools and wetlands, but these are also commercially available. Further, methods to implement monitoring and institutional controls are expected to be readily available.

Ability To Be Implemented: Based on site characteristics, the excavation/backfill technology that would be utilized in FP 7 is suitable for implementation in the areas where it would be applied. The construction of access roads and staging areas may temporarily affect flood storage and drainage characteristics during seasonal high water conditions and during periodic storm and flood events. Engineering practices would be implemented to reduce the temporary impacts of such hydrology changes. Although these would be designed to mitigate the potential impacts, the size and the contiguous nature of the remediation areas would make the success of these controls more uncertain than for the smaller alternatives. In the long term, floodplain areas would be backfilled and restored to approximate original elevations, thereby minimizing effects on flood storage capacity.

<u>Reliability:</u> Soil excavation with backfilling is considered a reliable means of reducing the potential for human and ecological exposure to soils containing PCBs. Floodplain soil excavation has been implemented at other PCB-impacted sites across the country as described in Sections 6.2.5.2 and 6.3.5.2. The significant difference between FP 7 and the other alternatives is the size and associated duration of construction that would be required for FP 7. FP 7 would affect 350 acres of the existing floodplain and would take approximately 22 years. Although this area would include a variety of different habitats, as would the other alternatives, the area involved in FP 7 would be fairly contiguous, and by necessity portions of these would be used for transportation access as well as being directly affected by remediation. This would reduce the ability of neighboring areas to offer protection and refuge to wildlife and to serve as a native source for recovery of plant and animal species, and would create other logistical challenges in restoration that would be different from those associated with the smaller, more segregated alternatives. These impacts would add further uncertainties to the reliability of the restoration. Similarly, the issues of OMM and replacement, if needed, would be complicated by the physical size of the affected area. Further, given the quantity of wetlands that would be affected by FP 7, complete restoration would be a significant challenge for the same reasons given for FP 6 in Section 6.6.9.1.

<u>Availability of Support Facilities and Resources</u>: For purposes of the CMS, it has been assumed that construction of FP 7 would require development of 48 acres of staging areas and access roads. Development of access roads and staging areas would be sequenced and constructed appropriately over the implementation period for FP 7. The specific locations and sizing of these access roads and staging areas would be determined based on the available land resources. Space for roads and staging areas is not expected to be a significant limitation on construction, although it may be difficult to avoid environmentally sensitive areas for this large area. The volume and duration of necessary material storage (including final disposition) would depend upon the selected treatment/disposition alternative. To provide sufficient materials for FP 7, multiple suppliers of backfill and planting materials may need to be used to fully support the project. An evaluation would be performed during design activities to confirm suitable material availability.

<u>Ease of Conducting Additional Corrective Measures</u>: If necessary, performing additional remediation at a later date would be possible using the same types of tools, equipment, and

materials as in the original round of remediation. Construction equipment, personnel, and materials are commercially available, and their use and effectiveness for this type of materials removal and backfill project are well known and documented. Ease of implementation of the corrective measures would be directly related to the extent of the necessary additional corrective measure (i.e., area and/or volume to be addressed) and the ease of access (e.g., remoteness from roads, wetlands crossings, size and type of construction equipment).

Ability to Monitor Effectiveness: The effectiveness of FP 7 would be assessed by visual observation to evaluate such factors as vegetation re-growth and any signs of erosion or disturbance of restored areas. Monitoring procedures would be straightforward and implementable, although the amount of area to be covered is large and may be difficult to access in certain areas.

6.7.9.2 Administrative Implementability

The evaluation of administrative implementability of FP 7 has included consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: FP 7 would need to comply with the substantive requirements of applicable and appropriate regulations pertaining to the performance of the remedial action (unless waived). As discussed in Section 6.7.4, GE believes that FP 7 could be designed to comply with such requirements (i.e., the location-specific and action-specific ARARs listed in the Tables 2-2 and 2-3), with the exception of certain requirements that could potentially apply to the on-site staging areas if the excavated materials should constitute hazardous waste. In the latter case, if necessary, GE believes that such requirements should be waived as technically impracticable.

Access Agreements: Implementation of FP 7 would require GE to obtain permission for access to approximately 80 properties where the work would be conducted or where the ancillary facilities would be located. Access to State-owned lands would be sought from the state agencies that own the land. In addition, it is currently anticipated that access agreements would be required from approximately 70 private landowners. Obtaining access to all these properties for the type of work and length of time that may be needed would likely be difficult and time-consuming. If GE should be unable to obtain access agreements with particular landowners, GE would request EPA and/or MDEP to provide assistance.

Coordination with Agencies: Implementation of EREs and Conditional Solutions as part of FP 7 would require coordination with EPA and MDEP. In addition, as noted above, obtaining access to State-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of FP 7, GE would need to coordinate with EPA, as well as state and local agencies, to address potential health and safety impacts and to provide as-needed support with public/community outreach programs.

6.7.10 Cost

The estimated total cost to implement FP 7 is $168 M (excluding the costs of treatment/disposition of excavated soils). The estimated capital cost for implementation of FP 7 is $164 M, assumed to occur over a 22-year construction period. Estimated annual OMM costs (for a 3-year inspection and maintenance program for the restored excavation and staging/access road areas) range from $15,000 to $480,000 per year (depending on which reach is being monitored) resulting in a total cost of $3.6 M. The following summarizes the total costs estimated for FP 7.

FP 7	**Est. Cost**	**Description**
Total Capital Cost	$164 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM Cost	$3.6 M	Costs for performance of the OMM programs
Total Cost for Alternative	$168 M	Total cost of FP 7 in 2008 dollars

The total estimated present worth of FP 7, which was developed using a discount factor of 7%, a 22-year construction period, and an OMM period of 3 years on a reach-specific basis, is approximately $86.7 M. More detailed cost estimate information and assumptions for each of the floodplain alternatives are included in Appendix E.

As noted above, these costs do not include the costs of treatment/disposition of the removed floodplain soils. The estimated costs for combinations of FP 7 with the various treatment/disposition alternatives are presented in Section 8.

6.7.11 Overall Protectiveness of Human Health and the Environment - Conclusion

As explained in Section 6.7.2, the evaluation of whether FP 7 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As discussed previously, FP 7 would result in a substantial reduction in the potential for human and ecological exposure to PCBs in floodplain soils by the removal of 570,000 cy of PCB-containing soil over 350 acres, followed by backfilling and revegetation. It would also result in a reduction in the mass of PCBs in the floodplain through the removal of 38,500 lbs of PCBs from the floodplain.

Compliance with ARARs: As discussed in Section 6.7.4, based on review of the potential ARARs, GE believes that FP 7 could be designed and implemented to achieve the ARARs pertinent to this alternative, with the possible exception of certain requirements that could apply to the on-site staging areas if the excavated soils should constitute hazardous waste. In the latter case, if necessary, GE believes that such requirements should be waived as technically impracticable.

Human Health Protection: FP 7 would provide protection of human health. As discussed in Section 6.7.6.1, implementation of this alternative would achieve, in each human exposure area, either: (1) the RME IMPGs based on a 10^{-6} cancer risk and a non-cancer HI of 1; or (2) in certain direct contact EAs, an average of 2 mg/kg, which is considered protective for unrestricted use. FP 7 would further ensure protection of human health through implementation of EREs and Conditional Solutions, where necessary, to address reasonably anticipated future uses.

Environmental Protection: As discussed in Section 6.7.6.2, FP 7 would achieve floodplain soil levels considered by EPA to be protective of ecological receptors. Specifically, FP 7 would achieve the following: (1) the lower-bound IMPG for amphibians in all 66 vernal pools evaluated; (2) the lower-bound IMPG for omnivorous/carnivorous mammals in all averaging areas in the PSA; (3) the target floodplain soil IMPG levels for insectivorous birds in all averaging areas in the PSA; and (4) the target floodplain soil level associated with the lower-bound IMPG for piscivorous mammals in both of the PSA averaging areas if the associated sediment concentration in those areas is 1 mg/kg or less, and the upper-bound target floodplain soil level if the associated sediment concentration is at or below 3 mg/kg (or 5 mg/kg in Reaches 5C/5D/6).

At the same time, implementation of FP 7 would cause substantial and extensive short-term and long-term adverse impacts on the environment. As discussed in Section 6.7.8, the short-term adverse impacts would include the destruction of valuable plant and wildlife habitat in those areas of the floodplain where remediation and ancillary construction activities would occur. The impacts from the excavations alone would include the loss of 132 acres of mature upland forest and 127 acres of wetlands, with consequent impacts on the biota that depend on those habitats. These impacts would occur, in various parts of the floodplain, over the 22 years of construction activities.

In addition, as discussed in Section 6.7.5.3, implementation of FP 7 would produce long-term adverse environmental effects, which would be more extensive than those discussed for the other alternatives, because FP 7 would affect such a large land area (350 acres) and so much sensitive habitat. In particular, such impacts would likely result from the removal of the 132 acres of mature upland forest habitat and 127 acres of wetlands, including 38 acres of palustrine habitat and 17 acres of vernal pools. While the trees in upland forest and palustrine habitat could be replaced, the replanted areas would take 5-10 years to reach a stage of development that would begin supporting a woodland biological community rather than one associated with an open successional, habitat, and it could take over 50 years for these areas to reach a functional level comparable to their pre-excavation function. Further, while measures would be taken to restore the impacted wetlands, some of these, such as vernal pools and palustrine wetlands, are complex systems, and it is possible that, despite such measures, the changes to them would persist for a long time. Additionally, as also noted in Section 6.7.5.3, given the overall size of the affected area and the duration of the remedy, the numerous short-term impacts may themselves, through their cumulative effect, lead to long-term impacts. Finally, ancillary construction activities in the floodplain could result in long-term impacts to wetlands in those areas.

Thus, implementation of FP 7 would cause long-term and potentially permanent habitat loss that could have real population-level impacts for the biota in the floodplain. These impacts would be far greater than those under the other floodplain alternatives and, in GE's opinion, would not justify the incremental ecological risk reduction that might result from the additional soil removals. As EPA guidance makes clear, the standard of "overall protection" of the environment includes a balancing of the short-term and long-term ecological impacts of the alternatives with the residual risks (EPA, 1990a, 1997, 2005e). Based on such balancing, GE believes that, although FP 7 would provide protection from the ecological risks identified in the ERA, it would have a net negative impact on the environment.

Summary: FP 7 would remove from the floodplain a significant mass of PCBs (38,500 lbs) and a large volume (570,000 cy) of PCB-containing soils and would address the risks asserted by EPA in the HHRA and ERA. As discussed above, FP 7 would provide overall protection of human health. From an environmental standpoint, FP 7 would provide protection from the asserted ecological risks of PCBs, but would cause substantial short-term and long-term adverse impacts on the environment that would not justify the incremental risk reduction. As such, GE has concluded that, on balance, this alternative would not provide overall protection of the environment.

6.8 Comparative Evaluation of Floodplain Alternatives

The seven floodplain soil remedial alternatives have been individually evaluated in detail in Sections 6.1 through 6.7 under the three General Standards and six Selection Decision Factors specified in the Permit. This section contains a comparative evaluation of the floodplain alternatives using the same nine criteria.

This comparative analysis evaluates the relative performance of the various floodplain alternatives under the Permit criteria to identify potential advantages and disadvantages of each relative to the others. This section also addresses the requirement specified in Special Condition II.G.3 of the Permit to reach a conclusion as to which alternative, in GE's opinion, is "best suited to meet the [General Standards] in consideration of the [Selection Decision Factors], including a balancing of those factors against one another." As noted for the sediment alternatives in Section 4.9 and reflected in the Permit, a comparison of alternatives necessarily involves balancing and trade-offs. A number of alternatives might all satisfy the General Standards, but they might also present different magnitudes of short-term and long-term impacts, as well as differences in effectiveness, implementability, and costs. The goal of this balancing process is to select a remedial alternative that best achieves net risk reduction. As a result, this comparative analysis focuses primarily on differences among the alternatives with respect to each criterion.

6.8.1 Overview of Alternatives

Seven floodplain remedial alternatives (FP 1 through FP 7) have been evaluated. These alternatives (apart from FP 1, the no action alternative) are of two types: (1) IMPG-based alternatives (FP 2, FP 3, FP 4, and FP 7), which involve soil removal and backfilling as necessary to achieve different sets of IMPGs; and (2) threshold-based alternatives (FP 5 and FP 6), based on removing soils with PCB concentrations exceeding certain thresholds. Each alternative would achieve these criteria in the top foot of soil, and FP 3 through FP 7 would also achieve the criteria in the upper three feet in the Heavily Used Subareas. The removal volumes and acreage for each of the seven floodplain alternatives are summarized in Table 6-43 below, along with the estimated time for implementation of each alternative.[160] As this table shows, FP 3 would involve removal of more than three times the volume and acreage of FP 2. After that, FP 4 and FP 5 would involve approximately 60% more removal than FP 3. FP 6, however, would involve more than three times the volume and acreage of

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[160] The times listed in this table are based on estimates of the durations that would be required for implementation of the floodplain alternatives if implemented independently from sediment remediation. In fact, as noted previously, floodplain remediation would likely be coordinated with sediment remediation. If so, the times to implement the floodplain alternatives could be different from those listed in this table, depending on the selected sediment alternative.

FP 5, and FP 7 would represent nearly another doubling of volume over FP 6. The amount of time that would be necessary to implement these alternatives scales up similarly.

Table 6-43 - Overview of Volumes, Areas, and Duration for Floodplain Alternatives

	FP 1	FP 2	FP 3	FP 4	FP 5	FP 6	FP 7
Removal Volume (cy)	0	17,000	60,000	99,000	100,000	316,000	570,000
Removal Area (acres)	0	11	38	62	60	194	350
Years to Implement	0	1	3	4	4	13	22

Note: EREs and Conditional Solutions would be a component of all alternatives except FP 1.

6.8.2 Overall Protection of Human Health and the Environment - Introduction

As previously discussed, the evaluation of whether floodplain soil remedial alternatives would provide overall protection of human health and the environment relies heavily on the evaluations under several other Permit criteria – notably: (a) comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the comparative evaluation of alternatives in terms of overall protection is presented at the end of Section 6.8 so that it can take account of the comparative evaluations under those other criteria, as well as other factors relevant to the protection of human health and the environment.

6.8.3 Control of Sources of Releases

Existing floodplain soils are not a significant source of PCBs to the River. As stated previously, the floodplain is generally flat, well vegetated, and depositional in nature, greatly reducing the potential for PCBs in floodplain soil to scour and be transported to the River. To the extent that there is a limited potential for such releases, FP 1 would not change current conditions, and each of the alternatives involving soil removal would further reduce that potential by removing PCB-containing soils, backfilling, and revegetating portions of the floodplain. However, since floodplain conditions do not represent a significant source of PCB releases to the River, this factor does not provide a material basis for distinguishing among the alternatives.

In the short term, each of the removal alternatives (FP 2 through FP 7) would create the potential for releases from open excavations during construction. These could serve as short-term, temporary sources of some releases during an extreme weather event. Such potential releases would be controlled using conventional engineering practices. The potential for such short-term releases would be a function of the duration of the remedy and the overall area of open excavations. FP 2 would take less than a year, and would have the smallest area of open excavations. FP 3 through FP 5 would take somewhat longer (3 to 4 years) and would involve more area of excavations, while FP 6 and FP 7 would take 13 and 22 years, respectively, and would involve the greatest area of excavations, thus having the greatest potential for releases during remediation.

6.8.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE are listed in Tables 2-1 through 2-3. The chemical-specific ARARs consisting of water quality criteria would not apply to floodplain soils. The remaining ARARs would not apply to FP 1, since it would not involve any remedial activities. For the alternatives involving excavation and backfilling of soils, the issues associated with compliance with these ARARs are the same for each. Specifically, as discussed in prior sections, GE believes that these alternatives could be designed and implemented to achieve the pertinent ARARs (provided that any necessary EPA approval determination under its TSCA regulations is obtained for the staging areas), with the following potential exception: In the event that excavated floodplain soils should be found to constitute hazardous waste (which is not anticipated), the temporary staging areas for the handling of those soils may not meet certain federal or state hazardous waste storage requirements, if they were determined to apply. In that case, as further discussed in Section 6.2.4, GE believes that such requirements should be considered inapplicable or, if necessary, waived as technically impracticable. This consideration applies to all these alternatives and thus does not constitute a basis for distinguishing among them.

6.8.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness of the floodplain alternatives has included an evaluation of the magnitude of residual risk, the adequacy and reliability of the alternatives, and potential long-term adverse impacts on human health or the environment.

6.8.5.1 Magnitude of Residual Risk

Under FP 1, floodplain soil PCB concentrations, as well as any associated risks, are assumed to remain generally similar to current conditions. The alternatives that involve soil removal (FP 2 through FP 7) would reduce the potential risk to humans and ecological receptors from exposure to PCBs in the floodplain soil by removing PCB-containing soil and backfilling those excavations with clean soil. The reduction in potential exposure and associated risk would occur upon the completion of remediation in a given area. The removal alternatives would involve increasing amounts of soil removal over an increasing area of the floodplain and, correspondingly, would take longer to implement (except that FP 4 and FP 5 would involve approximately the same removal volume, area, and implementation time). FP 7 would provide for the greatest reduction in potential exposures, removing the largest volume of PCB-containing soils and impacting the greatest area of the floodplain over the longest (22-year) period.

Because the different parts of the floodplain are used by human and ecological receptors in different ways and with varying degrees of frequency and intensity, the IMPG-based alternatives that target specific exposure scenarios (FP 2, FP 3, FP 4, and FP 7) would be more effective at reducing risk in individual exposure areas than the threshold-based alternatives, which target certain concentrations throughout the floodplain regardless of the type or frequency of exposure (FP 5 and FP 6). Given EPA's HHRA and ERA, the extent to which each of these alternatives would reduce residual risks from PCB exposure in the floodplain is best evaluated in terms of the extent to which they would achieve the IMPGs that have been based on those risk assessments. The comparative evaluation of alternatives based on this factor is presented in Section 6.8.6.

PCBs would also remain below the depths considered in the IMPG evaluations. This deeper soil is generally not anticipated to be available for exposure under current uses. Where it is reasonably anticipated that such deeper soil could become available for exposure in the future, it would be addressed, under FP 2 through FP 7, by EREs and/or Conditional Solutions. Additionally, under those alternatives, EREs and Conditional Solutions would be implemented where necessary to address potential risks from reasonably anticipated future uses.

6.8.5.2 Adequacy and Reliability of Alternatives

Evaluation of the adequacy and reliability of the floodplain alternatives has included an assessment of the use of the technologies under similar conditions, the general reliability of those techniques, and reliability of OMM (including technical component replacement requirements).

Alternatives FP 2 through FP 7 rely primarily on the removal of floodplain soils from areas containing various types of habitats, followed by backfilling the excavations, and replanting/restoration activities. Excavation and replacement of soils from floodplain environments have been performed at a number of sites across the country, using conventional equipment. These techniques are considered reliable and effective and would not be different for the different alternatives.[161] However, as the extent of removal and restoration increases from FP 2 to FP 7, the logistical issues become more complex. GE is unaware of any sites similar to the Rest of River floodplain where removal and restoration of such a complex mosaic of floodplain habitats have been attempted at the scale that would be involved in either FP 6, which includes the removal of 316,000 cy of soil from 194 acres of the floodplain, or FP 7, which includes the removal of 570,000 cy from 350 acres.

For all alternatives, restoration activities would include revegetation using standard landscaping techniques to replant upland forested areas and standard wetlands restoration techniques to restore the soils, hydrology, and vegetation of affected wetlands. In general, these techniques are considered reliable, although it would take some time for mature upland forests and palustrine (wooded) wetlands to return to conditions similar to those that existed prior to remediation. However, for alternatives where a substantial amount of vernal pool habitat would be affected (i.e., in FP 3, FP 4, FP 6, and FP 7), the reliability of restoring that habitat is uncertain. There is no indication in the literature or examples from other sites where vernal pools have been excavated and restored in the numbers or proportion of a site’s vernal pool acreage that would be involved in these alternatives. Additionally, for FP 6 and FP 7, which would impact large amounts of different wetland habitats that in some cases encompass large contiguous areas, those factors would create significant difficulties for the reliability of restoration. In general, therefore, the reliability factor favors alternatives that disturb less of these areas that are difficult to restore.

Following the construction phase, a monitoring and maintenance program would be implemented for the backfilled/restored areas. This program would involve periodic inspections to ensure that the planted vegetation is surviving and growing, and to identify areas (if any) where the backfill is eroding or in need of repair. This is a reliable means of assessing the need for maintenance. However, monitoring and maintenance could be difficult to implement in certain areas of the floodplain, due to remoteness, the extent of standing water, and the extent of vegetation both in and around the remediated areas. For those alternatives that require more extensive remediation, a greater likelihood exists that maintenance would be required, and that such difficulties would be encountered. This is particularly true for FP 6 and FP 7 due to the very large areas involved, and particularly the large amounts of wetlands affected. Again, therefore, this factor favors the alternatives that involve less removal, particularly in wetlands.

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[161] Each of these alternatives would also involve the use of EREs and Conditional Solutions, where necessary, to address potential risks from reasonably anticipated future activities and uses. These institutional controls are considered a reliable means of addressing such potential risks.

6.8.5.3 *Potential Long-Term Adverse Impacts on Human Health or the Environment*

All of the floodplain removal alternatives would produce some level of long-term adverse impacts on ecological habitats, with the larger and more extensive removal alternatives having greater potential for such impacts. The primary long-term environmental impacts would be the loss or change in habitats and the corresponding wildlife community should remediated areas not return to conditions similar to those that currently exist. Long-term impacts are dependent on the types of habitat affected, the size of the affected areas, and the success and length of time for restoration. Table 6-44 summarizes the sizes of the different community types that would be subject to removal in each alternative. (Additional areas would be affected by staging areas and access roads as discussed below.)

Table 6-44 - Floodplain Community Types in Removal Areas

Natural Community Type	**Extent of Affected Area by Habitat Type (acres)**						
	FP 1	**FP 2**	**FP 3**	**FP 4**	**FP 5**	**FP 6**	**FP 7**
Upland forest	0	5.4	12	32	27	84	132
Wetland (including vernal pools)	0	< 1	20	25	33	105	127
Disturbed upland	0	2.0	2.1	2.3	0.5	5	14
Reach 7 floodplain (unmapped community type)	0	2.5	2.8	3	< 1	< 1	77
Total acres of removal	**0**	**11**	**38**	**62**	**60**	**194**	**350**

As discussed in the individual evaluation sections, the principal habitats that could experience adverse long-term impacts from remediation activities are mature upland forests and wetlands. In addition, remediation could have adverse impacts on any rare, threatened, and/or endangered species in the floodplain. These impacts are discussed below.

Mature Upland Forest: The impacts to upland forest habitat would include the loss of mature trees, which would have a direct impact on the type of wildlife species supported by that community. While new trees would be planted, it would take a considerable time for that habitat to be reestablished. For example, the time for an affected forested habitat to reach a functional level and an appearance comparable to current conditions would be commensurate with the age of the community prior to remediation, which, in the PSA, is 50 to 75 years or more. In the meantime, as the replanted forest develops, it will provide habitat for secondary successional communities prior to reaching full maturity. Younger, developing plant communities support a different wildlife fauna characteristic of successional habitats. It is expected that a restored, replanted upland forest community would take approximately 5 to 10 years to reach a stage of development that would begin to support a biological community reflecting a woodland habitat rather than that associated with an open successional habitat. The magnitude of these impacts is related to the extent of affected forest area, which would be the smallest for FP 2 and FP 3 (6 and 12 acres, respectively), more noticeable for FP 4 and FP 5 (~ 30 acres), and largest for FP 6 and FP 7 (84 and 132 acres), respectively.[162]

Wetlands: The removal alternatives could have long-term adverse impacts on wetlands and the biota that inhabit them. The potential for those impacts depends on the extent and types of wetlands affected and the success and time period for restoration. Each alternative in sequence would involve removal of a larger overall area of wetlands, although the alternatives would affect different amounts of wetland types. Table 6-45 summarizes the wetland types that would be removed and backfilled for each of the floodplain alternatives.

Table 6-45 –Floodplain Wetland Types in Removal Areas

Natural Community Type	Floodplain Removal Area (acres)						
	FP 1	FP 2	FP 3	FP 4	FP 5	FP 6	FP 7
Emergent marsh	0	< 1	5	8	17	53	53
Palustrine habitat	0	< 1	1	2	12	39	38
Vernal pools	0	0	14	14	3	9	17
Black ash-red maple-tamarack calcareous seepage swamp	0	0	0	< 1	< 1	4	7
Backwaters	0	0	0	0	0	0	13
Total wetland area	**0**	**1**	**20**	**25**	**33**	**105**	**127**

Vernal pools and palustrine (wooded) wetlands would be most vulnerable to long-term effects. The impacts to vernal pools could produce changes in their ecological function and a modification in their ability to support amphibians. This could result in a reduction in local subpopulations of amphibians as many of these species tend to be pool-specific and must return to their own pool to breed. Thus, the loss of a vernal pool, even on a temporary

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[162] Further, staging areas and access roads would affect additional habitat. The overall area that would be needed for such facilities would be the smallest under FP 2 and FP 3 (9 and 14 acres, respectively), compared to 30 to 48 acres for FP 4 through FP 7 (see Table 6-50 in Section 6.8.8).

basis, could have long-lasting effects on the distribution of amphibians in the area and upon the predators that prey on them (Colburn, 2004). Moreover, for those alternatives that would require large-scale restoration of vernal pools (FP 3, FP 4, FP 6, and FP 7), restoration is uncertain. As a result, for these alternatives, the remediation could have a long-term adverse impact on the amphibians that depend on those pools and potentially on the overall local amphibian population. For palustrine habitat, long-term impacts could occur because palustrine wetlands are mature forested systems that would require an extended period of time to restore. As shown in Table 6-45, FP 5, FP 6, and FP 7 would affect the greatest amount of palustrine habitat.[163]

Rare, Threatened, or Endangered Species: To the extent that affected areas constitute habitat for any rare, threatened, or endangered species, implementation of the alternatives could affect those species. As part of the ecological characterization of the PSA, Woodlot (2002) identified 15 rare plant species at 27 locations, 8 rare bird species at 42 locations, one rare reptile species at 4 locations, and one rare mammal species at one location. In general, for the more mobile species and species with a wide range of habitat requirements (including most birds and mammals), the activities would displace these species to other areas of the floodplain system. However, in certain circumstances, long-term impacts may occur when the movement of a rare species from one area to another can lead to stress from competitive pressures on common resources of food and cover, as well as interspecies interactions. The magnitude of potential movement-related impacts is related directly to the amount of habitat disturbed at any one time, as many protected species are very sensitive to habitat loss and disturbances. Moreover, for those rare species that have no mobility (i.e., plants) or limited mobility (e.g., reptiles), the loss of habitat could result in the permanent loss of these species from the floodplain. The number of locations where rare species were identified (based on Woodlot, 2002) and the number that would be affected by the floodplain alternatives are shown in Table 6-46.

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[163] In addition to the wetlands directly affected by the soil removals, construction of staging areas and temporary access roads could affect wetland areas if they are built in or bordering wetlands. These activities could modify soil conditions, drainage patterns, or groundwater flow conditions in those wetlands, potentially creating a change in the characteristics of an existing wetland or converting a wetland to an upland environment. Construction design would take steps to avoid direct impacts on wetlands where practical (e.g., a road might be routed around instead of through a wetlands area, or culverts could be used). However, if wetlands impacts could not be avoided, these types of effects could occur. As shown in Table 6-50 (in Section 6.8.8.), the staging areas and access roads in FP 2 would affect less than 1 acre of wetlands, those in FP 3 through FP 5 would affect 4 to 9 acres of wetlands, and those in FP 6 and FP 7 would affect 18 and 28 acres of wetlands, respectively.

Table 6-46 - Number of Identified Rare Species Locations Affected by Floodplain Remediation

Type (and Number) of Identified Rare Species	Total Number of Rare Species Locations	Number of Rare Species Locations Affected						
		FP 1	FP 2	FP 3	FP 4	FP 5	FP 6	FP 7
Plant (15)	27	0	1	3	5	3	7	12
Bird (8)	42	0	0	0	3	2	13	14
Reptile (1)	4	0	0	0	0	0	1	1
Mammal (1)	1	0	0	0	0	0	0	1

Overall, for FP 2 through FP 5, given the relatively few rare species locations that would be affected, the soil removal activities would not be likely to have an adverse impact on the overall populations of these species within the floodplain. However, for FP 6 and FP 7, which would affect more such locations as well as a significant portion of the overall floodplain that could serve as a habitat for these species, there is a greater potential for the excavations to have a significant long-term adverse effect on the presence of these species in the floodplain (especially for plants).

6.8.6 Attainment of IMPGs

In the assessment of IMPG attainment for each of the individual floodplain alternatives, the post-remediation EPCs were compared to the relevant human health and ecological IMPGs for the various averaging areas evaluated. The comparative evaluation in this section has focused on a comparison of the acreage of averaging areas that have post-remediation EPCs that would achieve or be within the range of applicable IMPGs, relative to the total acreage among all such averaging areas.[164] For all alternatives, the time frame to achieve IMPGs would be the same as that required to complete the remediation in a particular area (i.e., the reduction in soil concentrations would occur upon completion of backfill placement).

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[164] Comparisons among alternatives are presented in terms of percent of total area meeting IMPGs (rather than number of areas meeting IMPGs as described in the detailed evaluations) given the large differences in sizes of the floodplain exposure/averaging areas.

6.8.6.1 *Comparison to Human Health-Based IMPGs*

Human Direct Contact: Table 6-47 shows, for each alternative, the number of human direct contact EAs (on a percent of total acres basis) that meet the IMPGs associated with the various risk levels evaluated.

Table 6-47 – Percentage of Human Direct Contact Exposure Areas That Would Achieve IMPGs

Risk Range	Exposure Assumptions	Percentage (%) of Exposure Area Acreage Achieving IMPGs						
		FP 1	FP 2	FP 3	FP 4	FP 5	FP 6	FP 7
Cancer Risk 10^{-4}	RME	100	100	100	100	100	100	100
	CTE	100	100	100	100	100	100	100
Cancer Risk10^{-5}	RME	75	75	76	100	80	100	100
	CTE	100	100	100	100	100	100	100
Cancer Risk10^{-6}	RME, or 2 mg/kg	10	10	10	10	17	30	100
	CTE	97	100	100	100	100	100	100
Non-cancer	RME	87	100	100	100	94	94	100
	CTE	100	100	100	100	100	100	100

Note: Values are a percentage of the total acreage of the EAs (1,330 acres).

The information summarized in this table and other information discussed in prior sections relating to the attainment of the direct contact IMPGs indicate the following:

- Under FP 1 (no action), existing floodplain EPCs are within the range of RME IMPGs that correspond to EPA's cancer risk range in all EAs. These EPCs meet the RME IMPGs based on a 10^{-5} cancer risk in 75% of the area of those EAs and the CTE IMPGs based on a 10^{-5} cancer risk in all areas. These EPCs also achieve the RME non-cancer IMPGs in 87% of the area of the EAs and achieve the CTE non-cancer IMPGs in all of those areas.

- FP 2 and FP 3 would achieve RME IMPGs within EPA's cancer risk range as well as the RME non-cancer IMPGs in all EAs. They would also achieve the RME IMPGs based on a 10^{-5} cancer risk in about 75% of the area of those EAs. For FP 3, these areas would include all Frequent-Use EAs and the top 3 feet in all Heavily Used Subareas. These alternatives would also achieve all CTE IMPGs in all EAs.

- FP 4 would achieve the RME IMPGs based on a 10^{-5} cancer risk, as well as the RME non-cancer IMPGs, in all EAs.

- FP 5 would achieve RME IMPGs within EPA's cancer risk range in all EAs, and would achieve the RME IMPGs based on a 10^{-5} cancer risk in 80% of the area of those EAs (as well as in 7 of the 9 Heavily Use Subareas). With respect to the non-cancer IMPGs, FP 5 would achieve the RME IMPGs in 94% of the area of the EAs (and in 8 of the 9 Heavily Used Subareas), and would achieve the CTE IMPGs in all EAs and Subareas. The EAs in which the RME non-cancer IMPGs would not be achieved total approximately 82 acres.

- FP 6 is generally similar to FP 5 but would achieve somewhat more IMPGs. Specifically, it would achieve the RME IMPGs based on a 10^{-5} cancer risk in all EAs (as well as in 8 of the 9 Heavily Use Subareas) and those based on a 10^{-6} cancer risk in a somewhat greater area than FP 5. With respect to the non-cancer IMPGs, FP 6 would achieve the RME IMPGs in 94% of the area of the EAs (and in 8 of the 9 Heavily Used Subareas), and would achieve the CTE IMPGs in all EAs and Subareas. The EAs in which the RME non-cancer IMPGs would not be achieved under FP 6 total approximately 77 acres. However, compared to the prior alternatives, FP 6 would involve a significantly longer overall time to achieve the IMPGs, with the time to achieve the IMPGs increasing with distance downstream from the Confluence.

- FP 7 would achieve the RME IMPGs based on a 10^{-6} cancer risk or a level of 2 mg/kg, as well as the non-cancer IMPGs, in all EAs (as well as in all Heavily Used Subareas). However, it would involve the removal of a far greater volume of soil than any previous alternative (570,000 cy) over a much larger area (350 acres) and would take much longer to implement (22 years). As such, this alternative would involve the longest overall time to achieve the IMPGs, with the time to achieve the IMPGs increasing with distance downstream from the Confluence.

<u>Agricultural Products Consumption:</u> Table 6-48 shows, for each alternative, the number of agricultural averaging areas (on a percent of total acres basis) that meet the adjusted floodplain IMPG levels for agricultural products consumption at the various risk levels evaluated.

Table 6-48 – Percentage of Farm Areas That Would Achieve IMPGs for Agricultural Products Consumption

Risk Range	Exposure Assumptions	Percentage (%) of Farm Area Acreage Achieving IMPGs						
		FP 1	FP 2	FP 3	FP 4	FP 5	FP 6	FP 7
Cancer Risk 10^{-4}	RME	100	100	100	100	100	100	100
	CTE	100	100	100	100	100	100	100
Cancer Risk 10^{-5}	RME	100	100	100	100	100	100	100
	CTE	100	100	100	100	100	100	100
Cancer Risk 10^{-6}	RME	14	14	14	14	14	14	100
	CTE	98	98	98	98	98	100	100
Non-cancer (Child)	RME	100	100	100	100	100	100	100
	CTE	100	100	100	100	100	100	100
Cancer Risk (Adult)	RME	100	100	100	100	100	100	100
	CTE	100	100	100	100	100	100	100

Note: Values are a percentage of the total farm acreage evaluated (175 acres).

As shown above, all the alternatives would achieve the RME IMPGs based on a 10^{-5} cancer risk and the RME non-cancer IMPGs in all farm areas evaluated for agricultural products consumption. In terms of achieving the most stringent IMPGs based on a 10^{-6} cancer risk, FP 1 through FP 6 are generally the same, and FP 7 would achieve those IMPGs in all farm areas through the removal of an additional 65,000 cy over 40 acres of farm fields.

6.8.6.2 Comparison to Ecological IMPGs

In comparing the ability of the floodplain alternatives to achieve the IMPGs for ecological receptors, GE has compared the post-remediation EPCs for the relevant averaging areas to the IMPGs or range of IMPGs (or target floodplain soil levels) for those receptors.[165] Table 6-49 below shows, for each alternative, the number of averaging areas (expressed in terms

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[165] As discussed previously, since the IMPGs for insectivorous birds and piscivorous mammals are based on the prey of those receptors, which include both aquatic and terrestrial prey, target levels have been developed for both sediment and floodplain soil. Target floodplain soil levels were developed to allow achievement of the IMPGs for these receptors provided that the average sediment PCB concentrations in the same averaging areas are at or below certain selected target sediment levels. As discussed previously, the selected target sediment levels are 1, 3, and 5 mg/kg.

of percent of total acres) in which the post-remediation EPCs would achieve levels within the range of IMPGs or target floodplain soil levels for the various ecological receptor groups evaluated. (In this section, EPCs are considered to be within the range of the IMPGs if they either fall between the upper and lower bounds of the range or are below the lower bound.)

Table 6-49 – Percentage of Ecological Averaging Areas with PCB EPCs within Range of Ecological IMPGs

Receptor	Associated Sediment PCB Level	Percentage (%) of Averaging Area Acreage with EPCs within Range of IMPGs						
		FP 1	FP 2	FP 3	FP 4	FP 5	FP 6	FP 7
Amphibians	NA	2	2	100	100	30	39	100
Omnivorous/carnivorous mammals	NA	85	100	100	100	100	100	100
Insectivorous birds	1 mg/kg	100	100	100	100	100	100	100
	3 mg/kg	88	100	100	100	100	100	100
	5 mg/kg	54	66	73	73	92	100	100
Piscivorous mammals	1 mg/kg	40	40	100	100	100	100	100
	3 mg/kg	0	0	0	40	40	40	100
	5 mg/kg	0	0	0	0	40	40	40

Note: Values are a percentage of the total acreage evaluated (34 acres for amphibians, 600 acres for omnivorous/carnivorous mammals, 720 acres for insectivorous birds, and 730 acres for piscivorous mammals).

For the various alternatives, the comparison of post-remediation EPCs to the range of IMPGs (or target levels) indicates the following:

- Under FP 1, existing floodplain soil levels are within the range of the ecological IMPGs for omnivorous/carnivorous mammals in 85% of the PSA and for insectivorous birds in some or all areas, depending on the associated sediment concentrations. They are not within the IMPG range for amphibians in most vernal pools or for piscivorous mammals in the PSA except in one of the two averaging areas if the sediment level were 1 mg/kg.

- FP 2 would achieve levels within the range of the ecological IMPGs for some receptors and areas but not others. It would achieve such levels for omnivorous/carnivorous mammals in all areas and for insectivorous birds in all areas if the associated sediment PCB levels are $\leq$ 3 mg/kg and in 66% of the area if the sediment levels are 5 mg/kg. It would not achieve such levels for amphibians in most vernal pools and would not achieve such levels for piscivorous mammals except in one of the two averaging areas if the sediment level were 1 mg/kg.

- FP 3 and FP 4 would achieve levels within the ranges of the IMPGs for omnivorous/carnivorous mammals and amphibians in all averaging areas. For insectivorous birds, they would achieve the target IMPG levels in all areas if the associated sediment PCB levels are $\leq$ 3 mg/kg and in 73% of the area if the sediment levels are 5 mg/kg. For piscivorous mammals, FP 3 and FP 4 would achieve levels within the IMPG range in both averaging areas if the associated sediment levels are $\leq$ 1 mg/kg, but not if the sediment levels are higher (except in one area for FP 4 at a sediment level of 3 mg/kg).

- FP 5 and FP 6 would achieve levels within the IMPG range for omnivorous/carnivorous mammals in all averaging areas. They would also achieve the IMPG levels for insectivorous birds in all (or nearly all) averaging areas at all target sediment levels. For amphibians, they would achieve levels within the IMPG range in about 30% (FP 5) and 40% (FP 6) of the vernal pool area. For piscivorous mammals, FP 5 and FP 6 would achieve levels within the IMPG range in all areas if the associated sediment levels are $\leq$ 1 mg/kg and in one of the two areas if the associated sediment levels are 3 or 5 mg/kg.

- FP 7 would achieve levels within the IMPG ranges for all receptors in all averaging areas, with the exception of piscivorous mammals in one of the two areas at a target sediment level of 5 mg/kg. Further, as designed, FP 7 would achieve the lower bounds of the ecological IMPG ranges in all areas, except for piscivorous mammals at sediment levels of 3 and 5 mg/kg.

6.8.7 Reduction of Toxicity, Mobility, or Volume

The degree to which the alternatives would reduce the toxicity, mobility, and volume of PCBs in floodplain soils is discussed below.

Reduction of Toxicity: None of the floodplain alternatives includes any treatment processes that would reduce the toxicity of PCBs in the soils. However, if the excavations under any alternatives should remove material classified as “principal threat” wastes (e.g., free NAPL, drums of liquid waste), which is not anticipated, those wastes would be segregated and transported off-site for treatment and disposal, as appropriate. Accordingly, this factor does not provide a basis for distinguishing among the floodplain alternatives.

Reduction of Mobility: As previously noted, the existing conditions of the floodplain are predominantly depositional and stable due to generally low current velocities during inundation and the presence of vegetation. Therefore, PCBs in existing floodplain soils do not represent a significant potential source for mobility and migration. Nevertheless, implementation of the removal alternatives would further reduce the limited potential for mobility of PCBs by removing exposed PCB-containing soils from the floodplain. A comparative evaluation of this factor is the same as that discussed for control of sources of releases in Section 6.8.3 above.

Reduction of Volume: Each of the removal alternatives would reduce the volume of PCB-containing soils and the mass of PCBs in the floodplain. The volumes of soil that would be removed under these alternatives were shown in Table 6-43 (in Section 6.8.1 above). The mass of PCBs that would be removed would be 2,400 lbs for FP 2, 8,300 lbs for FP 3, 12,500 lbs for FP 4, 16,900 lbs for FP 5, 33,300 lbs for FP 6, and 38,500 lbs for FP 7.

6.8.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of the floodplain alternatives has included consideration of the short-term impacts of implementing this alternative on the environment, the local communities (as well as communities along truck transport routes), and workers involved in remedial activities. Since FP 1 would involve no excavation or construction, it would not produce any adverse short-term impacts. For FP 2 through FP 7, the short-term impacts would last, in portions of the floodplain, for the duration of the remedial activities, which is estimated to range from 1 year (for FP 2) to 22 years (for FP 7). Overall, the extent of impacts increases with the size of the remedial alternative, with significantly greater impacts resulting from FP 6 and FP 7.

Impacts on the Environment

The short-term effects of the removal alternatives on the environment include the temporary removal of plant and wildlife habitat in those areas of the floodplain where remediation and construction of access roads or staging areas would occur. The habitat types that would be affected by the removal activities are listed in Table 6-44 in Section 6.8.5.3. The most significant impacts would include the loss of upland forest habitat and the loss of wetlands, along with the wildlife that depend on those habitats.

Mature Upland Forest: Each alternative would involve some loss of upland forest habitat, which would directly affect the birds, mammals, reptiles, and amphibians that inhabit these forested areas. The temporary loss of the plant communities would also result in indirect impacts to wildlife through the loss of cover, nesting, and feeding habitat. This would be particularly disruptive to wildlife with small home ranges, which would not be likely to migrate out of the construction zone. Likewise, birds that depend on the plant community for the placement of their nests would be forced to move elsewhere during nesting season.

The extent of these impacts would depend on the amount of upland forested area affected. FP 2 would involve removal in a relatively small amount of such habitat (5 acres) and FP 3 would involve removal in about twice that area (12 acres). FP 4 and FP 5 would involve removal in considerably more forested area (32 and 27 acres, respectively). FP 6 and FP 7 would remove large amounts of upland forest (84 and 132 acres, respectively).

Wetlands: The short-term impacts on the various types of wetlands that would be affected by the alternatives are dependent on the amount of affected wetland habitats. The acres of specific wetland habitats affected by the removals for each alternative are listed in Table 6-45 in Section 6.8.5.3. In general, the excavation activities would produce at least a temporary loss of these habitats, including a destruction of the wetlands vegetation, with the consequent inability of these areas to support the mammals, birds, reptiles, and amphibians that depend on these wetlands for breeding, nesting, and feeding. In addition, the excavations could affect the wetlands' ability to perform functions of phosphorous retention, nitrogen removal, and flood control. Work in and around wetlands could potentially change stormwater flows from areas undergoing remediation to neighboring wetlands that would not be remediated, which could, in turn, have adverse effects on the latter. Again, the extent of these impacts would depend on the amount of wetlands affected. FP 2 would affect a minimal amount of wetlands (< 1 acre), FP 3 through FP 5 would affect an intermediate amount (20 to 33 acres), and FP 6 and FP 7 would affect by far the greatest amount of wetlands (105 and 127 acres, respectively).

Additional Habitats Affected by Supporting Facilities: In addition to the impacts in the soil excavation areas, the construction and use of staging areas and access roads would have adverse short-term ecological impacts. These facilities are expected primarily to affect forested and disturbed upland areas, although work in and near some wetlands would likely be unavoidable. Based on a conceptual layout of the access roads and staging areas needed to support each of the floodplain alternatives, the acreage needed for staging areas and access roads outside the removal areas,[166] and the wetlands associated with them, are shown in Table 6-50.

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[166] It should be noted that, especially for the larger alternatives (FP 6 and FP 7), many staging areas and access roads would exist in the areas subject to excavation. The impacts associated with those areas have been considered in connection with the removal activities.

Table 6-50 - Summary of Staging and Access Road Areas and Affected Wetlands

Description	FP 2	FP 3	FP 4	FP 5	FP 6	FP 7
Staging and access road area (acres)	9	25	39	28	36	45
Wetlands affected by staging areas and roads (acres)	< 1	4	4	9	18	28

As with other adverse impacts, the smaller alternatives would have the least amount of adverse impacts from support facilities. In addition, the smaller alternatives would take less time to implement and the associated support facilities would be in place for less time, reducing the possibility of short-term adverse impacts becoming cumulative and creating long-term impacts.

<u>Impacts on Local Communities and Communities Along Truck Transport Routes</u>

Implementation of the removal alternatives would result in short-term impacts to the local communities along the River. These short-term effects would include changes to the visual appearance of the forested areas of the floodplain, disruption of recreational activities along the River and within the floodplain due to the remediation as well as the construction of access roads and staging areas, and increased construction traffic and noise during excavation and backfilling activities.

Construction activities would affect recreational activities along the River and in the floodplain. These include bank fishing, canoeing (including canoe launches), hiking and general recreation, and waterfowl hunting. During the period of active construction, restrictions on recreational use of the floodplain would be imposed in the areas where remediation-related activities are taking place. Due to safety considerations, boaters, anglers, hikers, and other recreational users would not be able to use the floodplain in the remediation and related areas. The extent of these impacts on floodplain use would vary depending on the overall area affected and the length of the remediation. These impacts would be least for FP 2 (11 acres, < 1 year), modest for FP 3 (38 acres, 3 years), somewhat greater for FP 4 and FP 5 (~60 acres, 4 years). The largest areas affected over the longest time would be associated with FP 6 (194 acres, 13 years) and FP 7 (350 acres, 22 years), and thus those alternatives would have the most substantial and longest-lasting impacts on recreational uses of the floodplain.

In addition, due to the need to remove excavated materials and deliver backfill materials and equipment, truck traffic would increase substantially, and that increase would persist, in some portions of the floodplain, for the duration of the project. This additional traffic would increase the likelihood of accidents, noise levels, emissions of vehicle/equipment exhaust, and nuisance dust to the air. Since FP 2 would involve the least amount of removal, it would involve the fewest truck trips. This would be followed by FP 3, and then FP 4 and FP 5 (which would have about the same number of trips), while FP 6 and FP 7 would involve by far the greatest number of truck trips.[167]

The increased truck traffic would also increase the risk of traffic accidents along transport routes. Appendix D includes an analysis of potential traffic accident risks from the increased truck traffic that would be necessary to transport materials for implementation of each alternative. (The risks from truck traffic to transport excavated materials away from the staging area are evaluated under the treatment/disposition alternatives.) This analysis indicates that the estimated incidence of potential injuries and fatalities from accidents due to the increased truck traffic would be lowest for FP 2, followed by FP 3, and then FP 4 and FP 5, and highest for FP 6 and FP 7.

Risks to Remediation Workers

Implementation of FP 2 through FP 7 would also present health and safety risks to site workers. These risks also increase as a function of the size of the remedy. Appendix D includes an analysis of potential risks of fatalities and non-fatal injuries to workers from implementation of each of the floodplain alternatives. This analysis shows the same pattern as the transportation risk analysis. For example, it indicates that the estimated incidence of worker injuries would be lowest for FP 2 (< 1 injury), followed by FP 3 (~1 injury), and then FP 4 and FP 5 (~1.5 injuries), and highest for FP 6 and FP 7 (4.6 and 7.9 injuries), with FP 4 and FP 5 having an 80% probability of at least one injury and FP 6 and FP 7 having a probability of 100% of at least 1 injury.

6.8.9 Implementability

6.8.9.1 Technical Implementability

All floodplain alternatives except FP 1 would involve soil excavation and backfilling. The equipment, materials, technology, procedures, and personnel necessary to implement and monitor the effectiveness of these alternatives are expected to be readily available. However, as previously discussed, the reliability of restoration in certain wetlands habitats,

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[167] For example, looking only at the truck trips that would be necessary to transport backfill material to the site for implementation of the floodplain alternatives, it is estimated that the number of such truck trips would be 3,700 for FP 2, 9,500 for FP 3, 13,400 for FP 4, 13,300 for FP 5, 37,700 for FP 6, and 67,100 for FP 7. The truck trips that would be involved in transporting excavated materials from the staging areas away from the site are considered under the relevant treatment/disposition alternatives.

especially vernal pools under the alternatives that would impact a substantial amount of such habitat (i.e., FP 3, FP 4, FP 6, and FP 7), is uncertain. Moreover, the larger remedial alternatives, such as FP 6 and FP 7, would involve significantly more remediation area than the smaller alternatives, as well as more wetlands that are logistically and technically more difficult to remediate and restore. FP 6 would involve the removal and backfilling of more than 3 times the acreage and volume of soil than would be involved in FP 4 or FP 5, and FP 7 would involve an additional 80% more area than FP 6. The size of the excavation area in FP 6 and FP 7, as well as the fact that removals would be over contiguous areas in many cases, would reduce the ability of neighboring areas to offer protection and refuge to wildlife and to serve as a native source for recovery of plant and animal species, and would create other challenges in restoration that would be different from those associated with the smaller, more segregated alternatives. These issues create more uncertainties regarding successful restoration for FP 6 and FP 7 compared to the other alternatives. In addition, it is likely that the large volumes of backfill and planting material needed to support the more extensive floodplain alternatives such as FP 6 and FP 7 would be less readily available than the smaller amounts needed to support the other alternatives.

6.8.9.2 Administrative Implementability

In terms of administrative implementability, all alternatives would need to comply with the substantive requirements of applicable and appropriate regulations (i.e., ARARs) pertaining to the performance of the remedial action (unless waived). As noted in Section 6.8.4, this factor is the same for all floodplain removal alternatives.

Implementation of FP 2 through FP 7 would also require GE to obtain permission for access to the properties where the work would be conducted or where the support facilities would be located. Access to State-owned lands would be sought from the relevant state agencies. In addition, access agreements would be required from private landowners. The total estimated numbers of private landowners from whom such agreements are anticipated to be necessary are approximately 15 for FP 2, 30 for FP 3, 40 for FP 4, 35 for FP 5, 45 for FP 6, and 70 for FP 7. Obtaining access to all these properties for the type of work and length of time that may be needed would likely be difficult and time-consuming. The more properties and owners involved, the greater the potential for problems and delays in obtaining access.

Finally, all alternatives would include coordination with EPA and MDEP in implementation of institutional controls (EREs and Conditional Solutions) and public/community outreach programs. This factor does not appear to provide a significant basis for distinguishing among the alternatives.

6.8.10 Cost

Estimated costs for the floodplain alternatives, including total capital costs, estimated OMM costs, and total estimated present worth costs, were presented previously in the detailed evaluations. These costs are summarized for each floodplain alternative in Table 6-51. It is important to note that these estimates do not include the costs for treatment or disposition of the excavated floodplain soils, which are discussed separately in Section 7.

Table 6-51 - Cost Summary for Floodplain Alternatives

Remedy Component	**FP 1**	**FP 2**	**FP 3**	**FP 4**	**FP 5**	**FP 6**	**FP 7**
Total Capital Cost	0	$10.3 M	$26.5 M	$39.2 M	$37.0 M	$102 M	$164 M
Total OMM Cost	0	$0.3 M	$0.5 M	$0.7 M	$0.7 M	$2 M	$3.6 M
Total Cost for Alternative	**0**	**$ 10.6 M**	**$27.0 M**	**$39.9 M**	**$37.7 M**	**$104 M**	**$168 M**
Total Present Worth Cost	0	$10.3 M	$26.2 M	$36.1 M	$35.1 M	$70.4 M	$86.7 M

Notes:

1. All costs are in 2008 dollars. $M = Million dollars.
2. Capital Costs are for engineering, labor, equipment, and materials associated with implementation.
3. The OMM Cost was determined based on the types of OMM occurring within a given year. The OMM program is assumed to include annual inspections of the restored areas for the first 3 years following completion of construction in a given area.
4. Total Present Worth Cost is based on using a discount factor of 7%, considering the length of the construction period and an OMM period of 3 years on an area-specific basis.

For the reasons discussed in Section 2.2.6, comparison of the costs of the floodplain alternatives have focused on the total costs of those alternatives, rather then the present worth estimates, due to the substantial impact of discounting effects over long periods on present worth costs, the uncertainties associated with choice of discount rate, and the potential impact of changing the implementation durations.

For the alternatives that involve soil removal, review of these total cost estimates indicates that, based solely on the costs of the floodplain soil alternatives themselves (without considering treatment/disposition costs), FP 2 would be the least costly, followed by FP 3, that FP 4 and FP 5 would have roughly comparable costs, and that FP 6 and FP 7 would have far higher costs (2.5 to 4.5 times more than FP 4 and FP 5). The costs of these alternatives will be evaluated further after considering the combined costs of the floodplain soil alternatives with treatment/disposition alternatives, presented in Section 8.

6.8.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 6.8.2, the evaluation of whether the floodplain alternatives would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. For the Rest of River floodplain, the balancing of short-term and long-term adverse impacts with the lowering of exposure point concentrations (EPCs) is particularly important, especially for ecological receptors that would temporarily lose critical habitat as a part of the remediation.

A comparative evaluation of the alternatives under this standard is presented below. Given EPA's conclusions in the HHRA and ERA regarding current conditions in the floodplain (assumed to remain unchanged under FP 1), FP 1 would not be considered protective of human health and the environment. As a result, the comparative evaluation of this standard has focused on the alternatives that involve soil removal (FP 2 through FP 7).

General Effectiveness: FP 2 through FP 7 would involve varying amounts of removal and backfilling of floodplain soil. Each of these alternatives would effectively and permanently reduce the potential for exposure of human and ecological receptors to the PCBs in the soil in the removal areas. Each alternative would involve removal of progressively more PCB-containing soil over a larger area (although FP 4 and FP 5 would involve approximately the same amount). Although the large remediation for FP 6 and FP 7 would effectively reduce PCB concentrations over greater areas, implementation of those alternatives would impact extensive areas of diverse ecological habitats, often over contiguous land, and the degree to which and timing over which whether the restoration of ecological function would be successful for those habitats (especially wetlands) is uncertain. The extent to which each alternative would address potential risks identified by EPA is discussed further below under human health and environmental protection.

Compliance with ARARs: As discussed in Section 6.8.4, GE believes that each alternative could be designed and implemented to achieve the ARARs pertinent to the remediation, with the possible exception of certain requirements that could apply to the on-site staging areas if the excavated soils should constitute hazardous waste (which is not anticipated). If necessary, GE believes that such requirements should be waived as technically impracticable.

Human Health Protection: As shown in Section 6.8.6.1, FP 2, FP 3, and FP 4 would all be protective of human health. Those alternatives would all achieve RME IMPG levels within EPA's cancer risk range, as well as those based on non-cancer impacts, in all human exposure areas. Further, FP 2 would achieve the RME IMPGs based on a 10^{-5} cancer risk in 75% of the total area evaluated for direct contact, FP 3 would do so in 76% of that area (including all Frequent-Use EAs), and FP 4 would do so in 100% of that area (all direct contact EAs). All three alternatives would achieve those levels in all farm areas evaluated for agricultural products consumption.

FP 5 and FP 6 would provide general protection of human health, but with some qualifications. These alternatives would achieve PCB levels within the range of RME IMPGs in all human exposure areas. In fact, they would achieve the RME IMPGs based on a 10^{-5} cancer risk in the either the majority of the area evaluated for direct contact (for FP 5) or all of that area (for FP 6), and would also do so in all the agricultural products consumption areas. With respect to potential non-cancer impacts, FP 5 and FP 6 would achieve the RME non-cancer IMPGs in 94% of the area of the direct contact EAs and in all agricultural products consumption areas. Based on these estimates, if one accepts EPA's assumptions and conclusions in the HHRA, FP 5 and FP 6 would not reduce potential non-cancer risks to acceptable levels for the most highly exposed individuals in a few areas of the floodplain.

FP 7 would provide human health protection by achieving the most stringent IMPGs or a level of 2 mg/kg in all human exposure areas. However, it would require removal of an extremely large volume of floodplain soil (569,000 cy) over a very large area (350 acres) and a very long implementation period (22 years). As such, it would take the longest overall time to achieve the IMPGs and associated reduction in exposure potential.

Finally, FP 2 through FP 7 would all provide additional protection of human health through implementation of EREs and Conditional Solutions where necessary to address reasonably anticipated future uses and activities that are not addressed by the removal activities.

Environmental Protection: The floodplain alternatives involving soil removal would provide varying degrees of environmental protection. As previously discussed, in considering whether an alternative would provide "overall" protection of the environment, it is important to consider not only the reduction of EPCs, but also the implications for local populations and communities of wildlife and the short-term and long-term adverse environmental impacts from implementation. Given the greater impacts from larger remedial alternatives and the consequent difficulties and uncertainties in restoration, it is critical to assess whether those alternatives would justify any incremental benefit in protecting local populations and communities of ecological receptors. This balancing has been considered in evaluating the floodplain alternatives, as discussed below.

FP 3 and FP 4 would achieve PCB levels within the IMPG ranges for omnivorous/ carnivorous mammals in all averaging areas and for amphibians in all vernal pools in the floodplain. They would also achieve the IMPGs for insectivorous birds in all areas if the associated sediment PCB levels are $\leq$ 3 mg/kg and in 73% of the area if the sediment levels are 5 mg/kg. FP 2 would have similar results for these receptors except that it would not achieve levels within the IMPG range for amphibians in most (98%) of the vernal pool acreage. For piscivorous mammals, if the associated sediment levels are $\leq$ 1 mg/kg, FP 3 and FP 4 would achieve levels within the IMPG range in both averaging areas, while FP 2 would do so in one such area. At higher sediment levels, none of these alternatives would achieve levels within the IMPG range for piscivorous mammals (except in one area for FP 4 at a sediment level of 3 mg/kg). In these circumstances, given the greater extent of IMPG exceedances for FP 2), FP 3 and FP 4 would provide greater protection of ecological receptors than FP 2, particularly for amphibians.

As previously noted, attainment of IMPGs is a balancing factor under the Permit; it is not determinative of whether an alternative would provide overall environmental protection. For FP 3 and FP 4, even if there were IMPG exceedances for particular receptors (e.g., piscivorous mammals, insectivorous birds), GE does not believe that those exceedances would prevent the maintenance of healthy local populations of these receptors, given that the local populations extend beyond the areas of the exceedances, including to areas outside the Site.[168] Much less would such exceedances be expected to adversely impact the overall wildlife community in the Rest of River floodplain, which has been shown by EPA's and GE's field surveys to include numerous and diverse species despite the long-term presence of PCBs. Moreover, the additional removals that would be necessary to achieve the IMPGs for these receptors in such circumstances would be extensive and would likely have substantial adverse environmental impacts.[169] At the same time, even without such additional removals, FP 3 and FP 4 could have some adverse long-term impacts on the environment because they would remove a substantial portion of the vernal pool habitat in the floodplain (14 acres covering portions of 60 of the 66 vernal pools in the

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[168] For example, the local population of mink extends to areas near the shoreline but outside the 1 mg/kg isopleth, as well as to tributaries of the River and to other riverine areas in the vicinity.

[169] For example, as noted in Sections 6.3.6.2 and 6.4.6.2, the additional floodplain soil removals that would be necessary to achieve the upper-bound mink IMPG at sediment concentrations of 3 or 5 mg/kg would range up to an additional 200,000 cy+ under FP 3 and 150,000 cy+ under FP 4.

PSA) to address potential risks to amphibians and, given the extent of that removal, the ability to restore all these pools to their current function is uncertain.

Like the alternatives discussed above, FP 5 and FP 6 would achieve the IMPGs for some receptors and some areas, although they would affect the specific receptor groups differently. These alternatives would achieve the IMPGs for omnivorous/carnivorous mammals in all averaging areas, and would also generally achieve the IMPGs for insectivorous birds at all target sediment levels. For amphibians, however, they would achieve levels within the IMPG range in only about 30% (FP 5) or 40% (FP 6) of the vernal pool acreage. For piscivorous mammals, these alternatives would achieve levels within the IMPG range in all areas if the associated sediment levels are $\leq$ 1 mg/kg and in one of the two areas if the associated sediment levels are $\leq$ 5 mg/kg. At the same time, these alternatives would have some adverse effects on the environment. This is particularly true for FP 6, which would cause substantial adverse short-term and long-term impacts on the environment through the removal of a significant portion of the mature upland forested (84 acres) in the floodplain and well as the removal of large amounts of wetlands (105 acres), including vernal pool and palustrine (wooded wetland) habitats which are difficult to restore.

FP 7 would achieve the IMPG levels that EPA considers protective of ecological receptors in all areas (except for piscivorous mammals in one area at the 5 mg/kg sediment target level). However, it would cause the greatest short-term and long-term harm to the environment. This alternative would affect 350 acres of the floodplain and would take 22 years to implement. It would remove 45% (132 acres) of the mature upland forest in the floodplain, as well as large amounts (127 acres) of wetlands, including 17 acres of vernal pools (covering portions of 62 of the 66 vernal pools in the PSA) and 38 acres of palustrine habitat, which are wetland types whose successful restoration is uncertain or may take decades.

Based on the above, considering both the residual risks to local wildlife populations and the adverse ecological impacts from implementation of the alternatives, GE has concluded that: (a) FP 2 would be generally protective of the environment but with uncertainty for certain receptor groups; (b) FP 3, FP 4, and FP 5 would provide overall protection of the environment; and (c) while FP 6 and FP 7 would achieve most (FP 6) or virtually all (FP 7) of the IMPGs for the ecological receptors, the widespread and extensive environmental damage that would be caused by those alternatives would not justify the incremental risk reduction, and thus these alternatives would have a net negative impact on the environment.

Summary: Based on the above considerations, it is concluded that all the floodplain removal alternatives would provide overall protection of human health, subject to certain qualifications for FP 5 and FP 6 as described above. It is further concluded that FP 3, FP 4, and FP 5 would provide overall protection of the environment, while the remaining alternatives would be less protective (FP 2) or would create such extensive environmental harm that they would have an overall negative impact on the environment (FP 6 and FP 7).

6.8.12 Overall Conclusion

For the reasons discussed above, GE believes that FP 3 is “best suited” to meet the General Standards in the Permit, based on a consideration and balancing of the Selection Decision Factors. That alternative would: (a) achieve floodplain soil levels within the EPA-approved ranges based on human health in all areas of the floodplain (including mid-range values in frequently used areas); (b) achieve levels within the ecological IMPG ranges for some receptors and significantly reduce PCB exposures for other ecological receptors; and (c) apart from FP 2 – which would be less protective of ecological receptors – have the fewest short-term and long-term adverse impacts, the fewest implementability problems, and the lowest cost.[170] This conclusion will be reviewed further after considering the combined costs of the floodplain soil alternatives with the treatment/disposition alternatives, presented in Section 8.

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[170] As discussed in Section 6.3.11, GE believes that, in further evaluations, consideration should be given to reducing the number and extent of vernal pools to be remediated in FP 3 so as to provide better overall protection to the local amphibian population by balancing the potential impacts from PCBs against those from destroying a large number of vernal pools.

Table 6-1. Summary of pre-, post-remediation EPCs, removal volumes and acreages and IMPGs for human direct contact exposure areas under FP 1.

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal			Post-Remediation EPC (mg/kg)[3]	IMPG[4] (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
1	15	Medium-use general recreation, adult / older child	36	---	---	---	36	2.1	51	21	514	215	5143	40	176
2	27	High-use general recreation, adult / older child	31	---	---	---	31	1.4	51	14	514	143	5143	27	176
2a	2.3	Low-use general recreation, older child	56	---	---	---	56	12	103	116	1029	1165	10286	80	353
2b	2.0	High-use general recreation, older child	29	---	---	---	29	3.9	51	39	514	388	5143	27	176
3	0.4	High-use general recreation, adult	5.6	---	---	---	5.6	1.4	63	14	630	143	6305	38	234
4	3.2	High-use general recreation, young child (low use)	29	---	---	---	29	8.0	37	80	368	802	3684	27	63
5	2.5	High-use general recreation, adult / older child	48	---	---	---	48	1.4	51	14	514	143	5143	27	176
6	3.8	Low-use general recreation, adult	59	---	---	---	59	4.3	126	43	1261	429	12610	115	468
7	5.9	High-use general recreation, adult / older child	21	---	---	---	21	1.4	51	14	514	143	5143	27	176
8	0.60	Recreational canoeist	40	---	---	---	40	1.2	13	12	129	121	1286	28	73
9	0.042	Low-use general recreation, older child	27	---	---	---	27	12	103	116	1029	1165	10286	80	353
10	59	High-use general recreation, young child (high use)	10	---	---	---	10	1.3	18	13	184	134	1842	4.6	32
10a	8.0	High-use general recreation, young child (high use)	18	---	---	---	18	1.3	18	13	184	134	1842	4.6	32
11	2.5	High-use general recreation, adult	15	---	---	---	15	1.4	63	14	630	143	6305	38	234
12	4.8	High-use general recreation, young child (low use)	7.0	---	---	---	7.0	8.0	37	80	368	802	3684	27	63
13	5.9	High-use general recreation, adult	14	---	---	---	14	1.4	63	14	630	143	6305	38	234
14	4.1	High-use general recreation, adult	2.7	---	---	---	2.7	1.4	63	14	630	143	6305	38	234
15	0.87	High-use general recreation, adult	2.0	---	---	---	2.0	1.4	63	14	630	143	6305	38	234
16	2.5	High-use general recreation, adult	22	---	---	---	22	1.4	63	14	630	143	6305	38	234
17	8.5	High-use general recreation, adult	13	---	---	---	13	1.4	63	14	630	143	6305	38	234
18	17	Medium-use general recreation, adult	17	---	---	---	17	2.1	63	21	630	215	6305	58	234
19	36	High-use general recreation, adult	83	---	---	---	83	1.4	63	14	630	143	6305	38	234
20	9.1	High-use general recreation, adult	31	---	---	---	31	1.4	63	14	630	143	6305	38	234
21	2.9	High-use general recreation, adult / older child	4.9	---	---	---	4.9	1.4	51	14	514	143	5143	27	176
22	19	High-use general recreation, adult / older child	26	---	---	---	26	1.4	51	14	514	143	5143	27	176
22a	1.8	Dirt biking/ATVing	88	---	---	---	88	2.0	29	20	290	205	2901	14	99
23	0.28	Medium-use general recreation, older child	12	---	---	---	12	5.8	51	58	514	582	5143	40	176
24	10	High-use general recreation, adult	31	---	---	---	31	1.4	63	14	630	143	6305	38	234
25	0.51	High-use general recreation, older child	30	---	---	---	30	3.9	51	39	514	388	5143	27	176
26a	48	High-use general recreation, adult / older child	7.2	---	---	---	7.2	1.4	51	14	514	143	5143	27	176
26b	7.6	Agricultural use (based on direct contact by farmer)	1.7	---	---	---	1.7	1.2	42	12	419	118	4195	43	348
26_F	55	High-use general recreation, adult / older child	6.3	---	---	---	6.3	1.4	51	14	514	143	5143	27	176
27	6.3	High-use general recreation, adult / older child	2.4	---	---	---	2.4	1.4	51	14	514	143	5143	27	176
27a	0.38	Dirt biking/ATVing	4.3	---	---	---	4.3	2.0	29	20	290	205	2901	14	99
28	0.21	High-use general recreation, young child (low use)	21	---	---	---	21	8.0	37	80	368	802	3684	27	63
28a	0.071	Dirt biking/ATVing	21	---	---	---	21	2.0	29	20	290	205	2901	14	99
29	0.34	Low-use general recreation, adult / older child	21	---	---	---	21	4.3	103	43	1029	429	10286	80	353
30	0.19	High-use general recreation, adult / older child	13	---	---	---	13	1.4	51	14	514	143	5143	27	176
31	5.0	High-use general recreation, adult / older child	14	---	---	---	14	1.4	51	14	514	143	5143	27	176
31a	0.61	High-use general recreation, adult / older child	42	---	---	---	42	1.4	51	14	514	143	5143	27	176
32	6.8	High-use general recreation, adult	14	---	---	---	14	1.4	63	14	630	143	6305	38	234
33	30	High-use general recreation, adult	20	---	---	---	20	1.4	63	14	630	143	6305	38	234
34	7.8	Medium-use general recreation, adult	25	---	---	---	25	2.1	63	21	630	215	6305	58	234
35	25	High-use general recreation, adult / older child	22	---	---	---	22	1.4	51	14	514	143	5143	27	176
35a	1.2	High-use general recreation, adult / older child	39	---	---	---	39	1.4	51	14	514	143	5143	27	176
36a	16	Low-use commercial (groundskeeper scenario)	23	---	---	---	23	8.9	166	89	1664	885	16642	126	571
36b	2.2	Agricultural use (based on direct contact by farmer)	15	---	---	---	15	1.2	42	12	419	118	4195	43	348
37	20	High-use general recreation, adult / older child	17	---	---	---	17	1.4	51	14	514	143	5143	27	176
37a	1.4	Bank fishing	26	---	---	---	26	2.6	52	26	524	256	5237	42	180

Table 6-1. Summary of pre-, post-remediation EPCs, removal volumes and acreages and IMPGs for human direct contact exposure areas under FP 1.

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal			Post-Remediation EPC (mg/kg)[3]	IMPG[4] (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
37b	2.3	High-use general recreation, adult / older child	25	---	---	---	25	1.4	51	14	514	143	5143	27	176
38	13	High-use general recreation, adult	23	---	---	---	23	1.4	63	14	630	143	6305	38	234
38a	1.4	Bank fishing	33	---	---	---	33	2.6	52	26	524	256	5237	42	180
39	3.5	Marathon canoeist	32	---	---	---	32	0.78	5.8	7.8	58	78	575	13	25
40	98	High-use general recreation, young child (low use)	20	---	---	---	20	8.0	37	80	368	802	3684	27	63
40a	4.6	Bank fishing	40	---	---	---	40	2.6	52	26	524	256	5237	42	180
40b	1.1	High-use general recreation, young child (low use)	11	---	---	---	11	8.0	37	80	368	802	3684	27	63
41	20	Medium-use general recreation, adult	28	---	---	---	28	2.1	63	21	630	215	6305	58	234
41a	2.4	Bank fishing	35	---	---	---	35	2.6	52	26	524	256	5237	42	180
42	14	Medium-use general recreation, adult	12	---	---	---	12	2.1	63	21	630	215	6305	58	234
42a	0.94	Bank fishing	14	---	---	---	14	2.6	52	26	524	256	5237	42	180
43	1.5	Medium-use general recreation, adult	27	---	---	---	27	2.1	63	21	630	215	6305	58	234
43a	0.24	Bank fishing	64	---	---	---	64	2.6	52	26	524	256	5237	42	180
44	2.2	High-use general recreation, adult	24	---	---	---	24	1.4	63	14	630	143	6305	38	234
45	17	High-use general recreation, adult	39	---	---	---	39	1.4	63	14	630	143	6305	38	234
46	7.2	High-use general recreation, adult	8.2	---	---	---	8.2	1.4	63	14	630	143	6305	38	234
47	1.0	Recreational canoeist	18	---	---	---	18	1.2	13	12	129	121	1286	28	73
47_F	0.12	Recreational canoeist	8.1	---	---	---	8.1	1.2	13	12	129	121	1286	28	73
48	6.5	High-use general recreation, adult	3.4	---	---	---	3.4	1.4	63	14	630	143	6305	38	234
49	7.7	Low-use general recreation, adult	17	---	---	---	17	4.3	126	43	1261	429	12610	115	468
50	69	Low-use general recreation, adult	7.3	---	---	---	7.3	4.3	126	43	1261	429	12610	115	468
50a	11	Waterfowl hunting	15	---	---	---	15	9.0	75	90	752	904	7518	140	399
51	87	Low-use general recreation, adult	7.2	---	---	---	7.2	4.3	126	43	1261	429	12610	115	468
51a	32	Waterfowl hunting	13	---	---	---	13	9.0	75	90	752	904	7518	140	399
52	0.9	Recreational canoeist	10	---	---	---	10	1.2	13	12	129	121	1286	28	73
53	0.7	Recreational canoeist	34	---	---	---	34	1.2	13	12	129	121	1286	28	73
54	13	High-use general recreation, adult	7.1	---	---	---	7.1	1.4	63	14	630	143	6305	38	234
55	18	High-use general recreation, young child (low use)	11	---	---	---	11	8.0	37	80	368	802	3684	27	63
55a	5.0	Waterfowl hunting	47	---	---	---	47	9.0	75	90	752	904	7518	140	399
56	32	Medium-use general recreation, adult / older child	38	---	---	---	38	2.1	51	21	514	215	5143	40	176
56a	10	Waterfowl hunting	49	---	---	---	49	9.0	75	90	752	904	7518	140	399
57	13	High-use general recreation, young child (low use)	5.8	---	---	---	5.8	8.0	37	80	368	802	3684	27	63
58	1.3	High-use general recreation, adult	65	---	---	---	65	1.4	63	14	630	143	6305	38	234
59	1.9	High-use general recreation, young child (low use)	18	---	---	---	18	8.0	37	80	368	802	3684	27	63
59a	0.83	Bank fishing	22	---	---	---	22	2.6	52	26	524	256	5237	42	180
60	0.84	High-use general recreation, young child (low use)	7.0	---	---	---	7.0	8.0	37	80	368	802	3684	27	63
60a	0.16	Recreational canoeist	13	---	---	---	13	1.2	13	12	129	121	1286	28	73
61	3.3	Utility worker	42	---	---	---	42	17	209	169	2093	1694	20933	242	718
62	1.6	Utility worker	134	---	---	---	134	17	209	169	2093	1694	20933	242	718
63	0.67	Utility worker	23	---	---	---	23	17	209	169	2093	1694	20933	242	718
64	0.61	Utility worker	42	---	---	---	42	17	209	169	2093	1694	20933	242	718
65	3.9	Utility worker	17	---	---	---	17	17	209	169	2093	1694	20933	242	718
66	1.7	Utility worker	23	---	---	---	23	17	209	169	2093	1694	20933	242	718
67	0.31	High-use general recreation, adult	11	---	---	---	11	1.4	63	14	630	143	6305	38	234
68	0.090	High-use general recreation, adult	9.0	---	---	---	9.0	1.4	63	14	630	143	6305	38	234
69	1.9	High-use general recreation, adult	7.3	---	---	---	7.3	1.4	63	14	630	143	6305	38	234
70	19	High-use general recreation, young child (high use)	2.4	---	---	---	2.4	1.3	18	13	184	134	1842	4.6	32
70a	1.2	Bank fishing	3.8	---	---	---	3.8	2.6	52	26	524	256	5237	42	180
71	1.8	Bank fishing	4.6	---	---	---	4.6	2.6	52	26	524	256	5237	42	180
72	2.3	Bank fishing	10	---	---	---	10	2.6	52	26	524	256	5237	42	180

Table 6-1. Summary of pre-, post-remediation EPCs, removal volumes and acreages and IMPGs for human direct contact exposure areas under FP 1.

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal			Post-Remediation EPC (mg/kg)[3]	IMPG[4] (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
73	3.9	High-use general recreation, adult	0.50	---	---	---	0.50	1.4	63	14	630	143	6305	38	234
74	5.3	High-use general recreation, adult	5.3	---	---	---	5.3	1.4	63	14	630	143	6305	38	234
75	3.4	High-use general recreation, adult	15	---	---	---	15	1.4	63	14	630	143	6305	38	234
76	1.1	High-use general recreation, adult	0.79	---	---	---	0.79	1.4	63	14	630	143	6305	38	234
77	4.2	High-use general recreation, adult	0.89	---	---	---	0.89	1.4	63	14	630	143	6305	38	234
78	6.2	High-use general recreation, older child	5.9	---	---	---	5.9	3.9	51	39	514	388	5143	27	176
79	17	High-use general recreation, adult	2.9	---	---	---	2.9	1.4	63	14	630	143	6305	38	234
80a	9.5	Low-use general recreation, adult	2.6	---	---	---	2.6	4.3	126	43	1261	429	12610	115	468
80b	20	Agricultural use (based on direct contact by farmer)	0.76	---	---	---	0.76	1.2	42	12	419	118	4195	43	348
81	33	Low-use general recreation, adult	2.3	---	---	---	2.3	4.3	126	43	1261	429	12610	115	468
82	15	Low-use general recreation, adult	3.6	---	---	---	3.6	4.3	126	43	1261	429	12610	115	468
83	22	High-use commercial (groundskeeper scenario)	1.9	---	---	---	1.9	1.8	17	18	166	177	1664	25	57
84	8.5	Low-use general recreation, adult	4.3	---	---	---	4.3	4.3	126	43	1261	429	12610	115	468
85a	0.25	Recreational canoeist	7.9	---	---	---	7.9	1.2	13	12	129	121	1286	28	73
85b	10	High-use general recreation, older child	1.7	---	---	---	1.7	3.9	51	39	514	388	5143	27	176
86	118	High-use commercial (groundskeeper scenario)	2.5	---	---	---	2.5	1.8	17	18	166	177	1664	25	57
87	10	High-use general recreation, young child (high use)	9.4	---	---	---	9.4	1.3	18	13	184	134	1842	4.6	32
87a	0.88	Bank fishing	6.0	---	---	---	6.0	2.6	52	26	524	256	5237	42	180
88	1.1	Medium-use general recreation, older child	13	---	---	---	13	5.8	51	58	514	582	5143	40	176
89	4.3	High-use general recreation, adult	6.4	---	---	---	6.4	1.4	63	14	630	143	6305	38	234
90	8.9	High-use general recreation, adult / older child	6.8	---	---	---	6.8	1.4	51	14	514	143	5143	27	176
				Subtotal:	**0**	**0**									

Heavily Used Subareas

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal			Post-Remediation EPC (mg/kg)[3]	IMPG[4] (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
4	0.71	High-use general recreation, young child (low use)	17	---	---	---	17	8.0	37	80	368	802	3684	27	63
12	1.5	High-use general recreation, young child (low use)	9.8	---	---	---	9.8	8.0	37	80	368	802	3684	27	63
26a	2.2	High-use general recreation, adult / older child	1.9	---	---	---	1.9	1.4	51	14	514	143	5143	27	176
39	0.15	Marathon canoeist	54	---	---	---	54	0.78	5.8	7.8	58	78	575	13	25
40	5.2	High-use general recreation, young child (low use)	19	---	---	---	19	8.0	37	80	368	802	3684	27	63
47	0.18	Recreational canoeist	6.0	---	---	---	6.0	1.2	13	12	129	121	1286	28	73
52	0.25	Recreational canoeist	7.0	---	---	---	7.0	1.2	13	12	129	121	1286	28	73
53	0.35	Recreational canoeist	408	---	---	---	408	1.2	13	12	129	121	1286	28	73
60a	0.16	Recreational canoeist	7.0	---	---	---	7.0	1.2	13	12	129	121	1286	28	73
				Subtotal:	**0**	**0**									
				Total:	**0**	**0**									

Notes:

[1] *See Figures 5-1 and 5-2 for direct contact exposure areas in Reaches 5 through 8, and Heavily Used Subareas, respectively.*

[2] *Area only includes the portion of the exposure area within the 1 mg/kg PCB isopleth (Reaches 5/6) or the 100-year floodplain (Reaches 7/8).*

[3] *EPC is calculated for top 1-ft floodplain soil, except in Heavily Used Subareas where it is calculated for top 3-ft floodplain soil.*

[4] *For scenarios that contain more than one receptor (e.g. adult and older child), the lowest IMPG was utilized in the comparison to post-remediation EPCs.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-2. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for agricultural products consumption areas under FP 1.

Farm ID[1]	Area of farm (acre)[2]	IMPG Scenario	Pre-Remediation EPC[3] (mg/kg)	Removal[4]			Post-Remediation EPC[3] (mg/kg)	IMPG[5] (mg/kg)									
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @10^{-4}		Non-Cancer (Child)		Non-Cancer (Adult)	
				Depth (ft)	Volume (cy)	Area (acres)		RME	CTE	RME	CTE	RME	CTE	RME	CTE	RME	CTE
FA 1	8.0	Commercial Dairy	1.6	---	---	---	1.6	0.68	3.1	6.8	31	68	312	7.7	12.2	36.4	44.3
FA 2	3.3		13	---	---	---	13	2.59	11.9	25.9	119	259	1187	29.1	46.4	138.1	168.3
FA 3	4.1		0.20	---	---	---	0.20	0.29	1.3	2.9	13	29	132	3.2	5.2	15.4	18.7
FA 4	64		0.38	---	---	---	0.38	0.24	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 5	12		0.25	---	---	---	0.25	0.24	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 6	8		0.25	---	---	---	0.25	0.24	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 7	24		0.25	---	---	---	0.25	0.24	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 8	9.4		0.19	---	---	---	0.19	0.34	1.5	3.4	15	34	154	3.8	6.0	17.9	21.8
FA 9	26		0.89	---	---	---	0.89	0.31	1.4	3.1	14	31	143	3.5	5.6	16.6	20.3
FA 10	0.3		0.50	---	---	---	0.50	2.06	9.5	20.6	95	206	946	23.2	37.0	110.1	134.2
FA 11	0.14		0.25	---	---	---	0.25	6.10	27.9	61.0	279	610	2794	68.6	109.2	325.1	396.2
FA 12	8.0		0.25	---	---	---	0.25	0.38	1.8	3.8	18	38	176	4.3	6.9	20.5	25.0
FA 13	4.0		0.25	---	---	---	0.25	0.24	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 14	2.6		0.30	---	---	---	0.30	0.55	2.5	5.5	25	55	253	6.2	9.9	29.4	35.9
				Total:	**0**	**0**											

Notes:

Key

🟦 = post-remediation EPC is lower than the IMPG

[1] *See Figure 5-4 for farm areas in Reaches 5 through 8.*

[2] *Farm area only includes the portion within the 1 mg/kg PCB isopleth (Reaches 5/6) or the 100-year floodplain (Reaches 7/8).*

[3] *EPC is calculated for top 1 ft floodplain soil.*

[4] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[5] *IMPG values for agricultural products consumption include a multiplier to account for the areas outside the 1 mg/kg PCB isopleth/100-year floodplain (see Table 5-2).*

Table 6-3. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for wood frog averaging areas (vernal pools) under FP 1.

Vernal Pool ID[1]	Area of Vernal Pool (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal			Post-Remediation EPC[2](mg/kg)	IMPG (mg/kg)	
			Depth (ft)	Volume (cy)	Area (acre)		Lower Bound	Upper Bound
5-VP-3	1.9	29	---	---	---	29	3.27	5.6
5-VP-1	0.044	1.7	---	---	---	1.7	3.27	5.6
8-VP-5	0.043	26	---	---	---	26	3.27	5.6
8-VP-4	0.24	3.9	---	---	---	3.9	3.27	5.6
8-VP-3	0.02	7.7	---	---	---	7.7	3.27	5.6
8-VP-2	0.57	66	---	---	---	66	3.27	5.6
18-VP-2	0.61	7.2	---	---	---	7.2	3.27	5.6
18-VP-1	0.28	7.9	---	---	---	7.9	3.27	5.6
19-VP-7	0.068	0.80	---	---	---	0.80	3.27	5.6
19-VP-2	0.0080	34	---	---	---	34	3.27	5.6
19-VP-1	0.18	23	---	---	---	23	3.27	5.6
19-VP-3	0.031	10	---	---	---	10	3.27	5.6
19-VP-4	0.094	5.6	---	---	---	5.6	3.27	5.6
19-VP-8	0.057	91	---	---	---	91	3.27	5.6
19-VP-5	0.51	26	---	---	---	26	3.27	5.6
19-VP-6	1.2	22	---	---	---	22	3.27	5.6
23-VP-2	0.18	46	---	---	---	46	3.27	5.6
23-VP-1	0.30	62	---	---	---	62	3.27	5.6
23A-VP-1	0.45	26	---	---	---	26	3.27	5.6
23B-VP-1	0.068	26	---	---	---	26	3.27	5.6
23B-VP-2	0.091	0.34	---	---	---	0.34	3.27	5.6
27B-VP-2	0.28	11	---	---	---	11	3.27	5.6
27B-VP-3	0.062	16	---	---	---	16	3.27	5.6
27B-VP-1	0.072	12	---	---	---	12	3.27	5.6
27-VP-2	0.47	21	---	---	---	21	3.27	5.6
27A-VP-1	0.20	31	---	---	---	31	3.27	5.6
27-VP-1	1.3	23	---	---	---	23	3.27	5.6
26-VP-1	0.036	40	---	---	---	40	3.27	5.6
33-VP-1	0.022	10	---	---	---	10	3.27	5.6
33-VP-2	0.12	65	---	---	---	65	3.27	5.6
38-VP-1	0.43	34	---	---	---	34	3.27	5.6
38A-VP-1	0.020	5.0	---	---	---	5.0	3.27	5.6
38-VP-3	0.046	28	---	---	---	28	3.27	5.6
38-VP-2	0.17	28	---	---	---	28	3.27	5.6
40-VP-3	0.46	59	---	---	---	59	3.27	5.6
40-VP-2	0.36	17	---	---	---	17	3.27	5.6
40A-VP-1	0.11	68	---	---	---	68	3.27	5.6
40-VP-1	0.47	58	---	---	---	58	3.27	5.6
42-VP-1	0.22	63	---	---	---	63	3.27	5.6
42-VP-2	0.28	45	---	---	---	45	3.27	5.6
42-VP-3	0.050	41	---	---	---	41	3.27	5.6
42-VP-5	0.58	61	---	---	---	61	3.27	5.6
42-VP-4	1.0	33	---	---	---	33	3.27	5.6
42A-VP-1	1.5	31	---	---	---	31	3.27	5.6
46-VP-2	7.1	20	---	---	---	20	3.27	5.6
46-VP-1	0.52	51	---	---	---	51	3.27	5.6
46-VP-5	0.056	123	---	---	---	123	3.27	5.6
46-VP-3	1.4	67	---	---	---	67	3.27	5.6
46-VP-4	0.011	125	---	---	---	125	3.27	5.6
49A-VP-1	0.019	16	---	---	---	16	3.27	5.6
49-VP-1	1.2	18	---	---	---	18	3.27	5.6
49B-VP-1	0.0044	26	---	---	---	26	3.27	5.6
66A-VP-1	0.032	0.70	---	---	---	0.70	3.27	5.6
69-VP-1	0.0074	12	---	---	---	12	3.27	5.6
8-VP-6	0.086	47	---	---	---	47	3.27	5.6
12-VP-1	0.080	8.0	---	---	---	8.0	3.27	5.6
39-VP-1	2.0	32	---	---	---	32	3.27	5.6
54-VP-1	0.20	21	---	---	---	21	3.27	5.6
55-VP-1	0.59	7.7	---	---	---	7.7	3.27	5.6
55A-VP-1	2.0	79	---	---	---	79	3.27	5.6
58A-VP-1	0.32	22	---	---	---	22	3.27	5.6
67A-VP-1	0.12	13	---	---	---	13	3.27	5.6
61A-VP-1	0.19	28	---	---	---	28	3.27	5.6
61A-VP-2	1.2	35	---	---	---	35	3.27	5.6
56A-VP-1	0.58	73	---	---	---	73	3.27	5.6
23-VP-3	1.3	22	---	---	---	22	3.27	5.6
			Total	**0**	**0**			

Notes:

[1] See Figure 5-5 for locations of vernal pools.

[2] EPC is calculated for the top 1 ft of floodplain soil.

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-4. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for shrew averaging areas under FP 1.

Averaging Area ID[1]	Area of Averaging Area (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal			Post-Remediation EPC[2] (mg/kg)	IMPG (mg/kg)	
			Depth (ft)	Volume (cy)	Area (acre)		Lower Bound	Upper Bound
G1	88	22	---	---	---	22	21.1	34.3
G2	87	50	---	---	---	50	21.1	34.3
G3	86	18	---	---	---	18	21.1	34.3
G4	86	27	---	---	---	27	21.1	34.3
G5	88	28	---	---	---	28	21.1	34.3
G6	87	11	---	---	---	11	21.1	34.3
G7	73	17	---	---	---	17	21.1	34.3
			Total:	**0**	**0**			

Notes:

[1] *See Figure 5-6 for shrew averaging areas.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-5. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for wood duck averaging areas under FP 1.

Averaging Area ID[1]	Reach	Averaging Area (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal[3]			Post-Remediation EPC[2] (mg/kg)	Floodplain IMPG (mg/kg)		
				Depth (ft)	Volume (cy)	Area (acre)		Sediment Target Level		
								1 mg/kg	3 mg/kg	5 mg/kg
K1	5A	52	34	---	---	---	34	50	39	29
K2		63	8.1	---	---	---	8.1	50	39	29
K3		85	40	---	---	---	40	50	39	29
K4		60	17	---	---	---	17	50	39	29
K5		25	23	---	---	---	23	50	39	29
K6	5B	55	25	---	---	---	25	48	33	18
K7		47	29	---	---	---	29	48	33	18
K8		92	24	---	---	---	24	48	33	18
K9	5C/5D	69	25	---	---	---	25	53	49	46
K10		83	13	---	---	---	13	53	49	46
K11		61	14	---	---	---	14	53	49	46
K12	6	28	23	---	---	---	23	53	50	46
				Total:	**0**	**0**				

Notes:

[1] *See Figure 5-7 for wood duck averaging areas.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

[3] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-6. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for mink averaging areas under FP 1.

Averaging Area[1]	Area of Averaging Area (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal[3]			Post-Remediation EPC[2] (mg/kg)	Floodplain IMPG[4] (mg/kg)					
							Sediment Target Level					
							1 mg/kg		3 mg/kg		5 mg/kg	
			Depth (ft)	Volume (cy)	Area (acre)		Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
5A/5B	435	22	---	---	---	22	3.4	16.6	*n/a*	5.1	*n/a*	*n/a*
5C/5D/6	291	18	---	---	---	18	6.9	19.6	3.0	15.7	*n/a*	11.8
			Total:	**0**	**0**							

Key

🟦 = post-remediation EPC is lower than the IMPG

Notes:

[1] *See Figure 5-8 for mink averaging areas.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

[3] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[4] *(n/a) denotes IMPG values not attainable in given reach for the sediment target level.*

Table 6-7. Summary of pre-, post-remediation EPCs, removal volumes and acreages and IMPGs for human direct contact exposure areas under FP 2.

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal[4]			Post-Remediation EPC (mg/kg)[3]	IMPG[5] (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
1	15	Medium-use general recreation, adult / older child	36	---	---	---	36	2.1	51	21	514	215	5143	**40**	176
2	27	High-use general recreation, adult / older child	31	1	1000	0.79	27	1.4	51	14	514	143	5143	**27**	176
2a	2.3	Low-use general recreation, older child	56	---	---	---	56	12	103	116	1029	1165	10286	**80**	353
2b	2.0	High-use general recreation, older child	29	1	10	0.010	27	3.9	51	39	514	388	5143	**27**	176
3	0.4	High-use general recreation, adult	5.6	---	---	---	5.6	1.4	63	14	630	143	6305	**38**	234
4	3.2	High-use general recreation, young child (low use)	29	1	40	0.030	27	8.0	37	80	368	802	3684	**27**	63
5	2.5	High-use general recreation, adult / older child	48	1	400	0.28	27	1.4	51	14	514	143	5143	**27**	176
6	3.8	Low-use general recreation, adult	59	---	---	---	59	4.3	126	43	1261	429	12610	**115**	468
7	5.9	High-use general recreation, adult / older child	21	---	---	---	21	1.4	51	14	514	143	5143	**27**	176
8	0.60	Recreational canoeist	40	1	80	0.050	28	1.2	13	12	129	121	1286	**28**	73
9	0.042	Low-use general recreation, older child	27	---	---	---	27	12	103	116	1029	1165	10286	**80**	353
10	59	High-use general recreation, young child (high use)	10	1	8000	4.7	4.6	1.3	18	13	184	134	1842	**4.6**	32
10a	8.0	High-use general recreation, young child (high use)	18	1	400	0.23	4.6	1.3	18	13	184	134	1842	**4.6**	32
11	2.5	High-use general recreation, adult	15	---	---	---	15	1.4	63	14	630	143	6305	**38**	234
12	4.8	High-use general recreation, young child (low use)	7.0	---	---	---	7.0	8.0	37	80	368	802	3684	**27**	63
13	5.9	High-use general recreation, adult	14	---	---	---	14	1.4	63	14	630	143	6305	**38**	234
14	4.1	High-use general recreation, adult	2.7	---	---	---	2.7	1.4	63	14	630	143	6305	**38**	234
15	0.87	High-use general recreation, adult	2.0	---	---	---	2.0	1.4	63	14	630	143	6305	**38**	234
16	2.5	High-use general recreation, adult	22	---	---	---	22	1.4	63	14	630	143	6305	**38**	234
17	8.5	High-use general recreation, adult	13	---	---	---	13	1.4	63	14	630	143	6305	**38**	234
18	17	Medium-use general recreation, adult	17	---	---	---	17	2.1	63	21	630	215	6305	**58**	234
19	36	High-use general recreation, adult	83	1	800	0.51	38	1.4	63	14	630	143	6305	**38**	234
20	9.1	High-use general recreation, adult	31	---	---	---	31	1.4	63	14	630	143	6305	**38**	234
21	2.9	High-use general recreation, adult / older child	4.9	---	---	---	4.9	1.4	51	14	514	143	5143	**27**	176
22	19	High-use general recreation, adult / older child	26	---	---	---	25	1.4	51	14	514	143	5143	**27**	176
22a	1.8	Dirt biking/ATVing	88	1	900	0.56	14	2.0	29	20	290	205	2901	**14**	99
23	0.28	Medium-use general recreation, older child	12	---	---	---	12	5.8	51	58	514	582	5143	**40**	176
24	10	High-use general recreation, adult	31	---	---	---	31	1.4	63	14	630	143	6305	**38**	234
25	0.51	High-use general recreation, older child	30	1	90	0.050	27	3.9	51	39	514	388	5143	**27**	176
26a	48	High-use general recreation, adult / older child	7.2	---	---	---	7.2	1.4	51	14	514	143	5143	**27**	176
26b	7.6	Agricultural use (based on direct contact by farmer)	1.7	---	---	---	1.7	1.2	42	12	419	118	4195	**43**	348
26_F	55	High-use general recreation, adult / older child	6.3	---	---	---	6.3	1.4	51	14	514	143	5143	**27**	176
27	6.3	High-use general recreation, adult / older child	2.4	---	---	---	2.4	1.4	51	14	514	143	5143	**27**	176
27a	0.38	Dirt biking/ATVing	4.3	---	---	---	4.3	2.0	29	20	290	205	2901	**14**	99
28	0.21	High-use general recreation, young child (low use)	21	---	---	---	21	8.0	37	80	368	802	3684	**27**	63
28a	0.071	Dirt biking/ATVing	21	1	30	0.020	13	2.0	29	20	290	205	2901	**14**	99
29	0.34	Low-use general recreation, adult / older child	21	---	---	---	21	4.3	103	43	1029	429	10286	**80**	353
30	0.19	High-use general recreation, adult / older child	13	---	---	---	13	1.4	51	14	514	143	5143	**27**	176
31	5.0	High-use general recreation, adult / older child	14	---	---	---	13	1.4	51	14	514	143	5143	**27**	176
31a	0.61	High-use general recreation, adult / older child	42	1	200	0.11	27	1.4	51	14	514	143	5143	**27**	176
32	6.8	High-use general recreation, adult	14	---	---	---	14	1.4	63	14	630	143	6305	**38**	234
33	30	High-use general recreation, adult	20	---	---	---	20	1.4	63	14	630	143	6305	**38**	234
34	7.8	Medium-use general recreation, adult	25	---	---	---	25	2.1	63	21	630	215	6305	**58**	234
35	25	High-use general recreation, adult / older child	22	---	---	---	22	1.4	51	14	514	143	5143	**27**	176
35a	1.2	High-use general recreation, adult / older child	39	1	40	0.020	27	1.4	51	14	514	143	5143	**27**	176
36a	16	Low-use commercial (groundskeeper scenario)	23	---	---	---	23	8.9	166	89	1664	885	16642	**126**	571
36b	2.2	Agricultural use (based on direct contact by farmer)	15	---	---	---	15	1.2	42	12	419	118	4195	**43**	348
37	20	High-use general recreation, adult / older child	17	---	---	---	17	1.4	51	14	514	143	5143	**27**	176
37a	1.4	Bank fishing	26	---	---	---	26	2.6	52	26	524	256	5237	**42**	180
37b	2.3	High-use general recreation, adult / older child	25	---	---	---	25	1.4	51	14	514	143	5143	**27**	176

Table 6-7. Summary of pre-, post-remediation EPCs, removal volumes and acreages and IMPGs for human direct contact exposure areas under FP 2.

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal[4]			Post-Remediation EPC (mg/kg)[3]	IMPG[5] (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
38	13	High-use general recreation, adult	23	---	---	---	23	1.4	63	14	630	143	6305	**38**	234
38a	1.4	Bank fishing	33	---	---	---	33	2.6	52	26	524	256	5237	**42**	180
39	3.5	Marathon canoeist	32	1	900	0.57	13	0.78	5.8	7.8	58	78	575	**13**	25
40	98	High-use general recreation, young child (low use)	20	---	---	---	20	8.0	37	80	368	802	3684	**27**	63
40a	4.6	Bank fishing	40	---	---	---	40	2.6	52	26	524	256	5237	**42**	180
40b	1.1	High-use general recreation, young child (low use)	11	---	---	---	11	8.0	37	80	368	802	3684	**27**	63
41	20	Medium-use general recreation, adult	28	---	---	---	28	2.1	63	21	630	215	6305	**58**	234
41a	2.4	Bank fishing	35	---	---	---	35	2.6	52	26	524	256	5237	**42**	180
42	14	Medium-use general recreation, adult	12	---	---	---	12	2.1	63	21	630	215	6305	**58**	234
42a	0.94	Bank fishing	14	---	---	---	14	2.6	52	26	524	256	5237	**42**	180
43	1.5	Medium-use general recreation, adult	27	---	---	---	27	2.1	63	21	630	215	6305	**58**	234
43a	0.24	Bank fishing	64	1	10	0.010	42	2.6	52	26	524	256	5237	**42**	180
44	2.2	High-use general recreation, adult	24	---	---	---	24	1.4	63	14	630	143	6305	**38**	234
45	17	High-use general recreation, adult	39	1	200	0.12	38	1.4	63	14	630	143	6305	**38**	234
46	7.2	High-use general recreation, adult	8.2	---	---	---	8.2	1.4	63	14	630	143	6305	**38**	234
47	1.0	Recreational canoeist	18	---	---	---	18	1.2	13	12	129	121	1286	**28**	73
47_F	0.12	Recreational canoeist	8.1	---	---	---	8.1	1.2	13	12	129	121	1286	**28**	73
48	6.5	High-use general recreation, adult	3.4	---	---	---	3.4	1.4	63	14	630	143	6305	**38**	234
49	7.7	Low-use general recreation, adult	17	---	---	---	17	4.3	126	43	1261	429	12610	**115**	468
50	69	Low-use general recreation, adult	7.3	---	---	---	7.3	4.3	126	43	1261	429	12610	**115**	468
50a	11	Waterfowl hunting	15	---	---	---	15	9.0	75	90	752	904	7518	**140**	399
51	87	Low-use general recreation, adult	7.2	---	---	---	7.2	4.3	126	43	1261	429	12610	**115**	468
51a	32	Waterfowl hunting	13	---	---	---	13	9.0	75	90	752	904	7518	**140**	399
52	0.9	Recreational canoeist	10	---	---	---	10	1.2	13	12	129	121	1286	**28**	73
53	0.7	Recreational canoeist	34	1	100	0.090	28	1.2	13	12	129	121	1286	**28**	73
54	13	High-use general recreation, adult	7.1	---	---	---	7.1	1.4	63	14	630	143	6305	**38**	234
55	18	High-use general recreation, young child (low use)	11	---	---	---	11	8.0	37	80	368	802	3684	**27**	63
55a	5.0	Waterfowl hunting	47	---	---	---	47	9.0	75	90	752	904	7518	**140**	399
56	32	Medium-use general recreation, adult / older child	38	---	---	---	38	2.1	51	21	514	215	5143	**40**	176
56a	10	Waterfowl hunting	49	---	---	---	49	9.0	75	90	752	904	7518	**140**	399
57	13	High-use general recreation, young child (low use)	5.8	---	---	---	5.8	8.0	37	80	368	802	3684	**27**	63
58	1.3	High-use general recreation, adult	65	1	100	0.080	37	1.4	63	14	630	143	6305	**38**	234
59	1.9	High-use general recreation, young child (low use)	18	---	---	---	18	8.0	37	80	368	802	3684	**27**	63
59a	0.83	Bank fishing	22	---	---	---	22	2.6	52	26	524	256	5237	**42**	180
60	0.84	High-use general recreation, young child (low use)	7.0	---	---	---	7.0	8.0	37	80	368	802	3684	**27**	63
60a	0.16	Recreational canoeist	13	---	---	---	13	1.2	13	12	129	121	1286	**28**	73
61	3.3	Utility worker	42	---	---	---	40	17	209	169	2093	1694	20933	**242**	718
62	1.6	Utility worker	134	---	---	---	24	17	209	169	2093	1694	20933	**242**	718
63	0.67	Utility worker	23	---	---	---	23	17	209	169	2093	1694	20933	**242**	718
64	0.61	Utility worker	42	---	---	---	31	17	209	169	2093	1694	20933	**242**	718
65	3.9	Utility worker	17	---	---	---	16	17	209	169	2093	1694	20933	**242**	718
66	1.7	Utility worker	23	---	---	---	23	17	209	169	2093	1694	20933	**242**	718
67	0.31	High-use general recreation, adult	11	---	---	---	11	1.4	63	14	630	143	6305	**38**	234
68	0.090	High-use general recreation, adult	9.0	---	---	---	9.0	1.4	63	14	630	143	6305	**38**	234
69	1.9	High-use general recreation, adult	7.3	---	---	---	7.3	1.4	63	14	630	143	6305	**38**	234
70	19	High-use general recreation, young child (high use)	2.4	---	---	---	2.4	1.3	18	13	184	134	1842	**4.6**	32
70a	1.2	Bank fishing	3.8	---	---	---	3.8	2.6	52	26	524	256	5237	**42**	180
71	1.8	Bank fishing	4.6	---	---	---	4.6	2.6	52	26	524	256	5237	**42**	180
72	2.3	Bank fishing	10	---	---	---	10	2.6	52	26	524	256	5237	**42**	180
73	3.9	High-use general recreation, adult	0.50	---	---	---	0.50	1.4	63	14	630	143	6305	**38**	234

Table 6-7. Summary of pre-, post-remediation EPCs, removal volumes and acreages and IMPGs for human direct contact exposure areas under FP 2.

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal[4]			Post-Remediation EPC (mg/kg)[3]	IMPG[5] (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
74	5.3	High-use general recreation, adult	5.3	---	---	---	5.3	1.4	63	14	630	143	6305	**38**	234
75	3.4	High-use general recreation, adult	15	---	---	---	15	1.4	63	14	630	143	6305	**38**	234
76	1.1	High-use general recreation, adult	0.79	---	---	---	0.79	1.4	63	14	630	143	6305	**38**	234
77	4.2	High-use general recreation, adult	0.89	---	---	---	0.89	1.4	63	14	630	143	6305	**38**	234
78	6.2	High-use general recreation, older child	5.9	---	---	---	5.9	3.9	51	39	514	388	5143	**27**	176
79	17	High-use general recreation, adult	2.9	---	---	---	2.9	1.4	63	14	630	143	6305	**38**	234
80a	9.5	Low-use general recreation, adult	2.6	---	---	---	2.6	4.3	126	43	1261	429	12610	**115**	468
80b	20	Agricultural use (based on direct contact by farmer)	0.76	---	---	---	0.76	1.2	42	12	419	118	4195	**43**	348
81	33	Low-use general recreation, adult	2.3	---	---	---	2.3	4.3	126	43	1261	429	12610	**115**	468
82	15	Low-use general recreation, adult	3.6	---	---	---	3.6	4.3	126	43	1261	429	12610	**115**	468
83	22	High-use commercial (groundskeeper scenario)	1.9	---	---	---	1.9	1.8	17	18	166	177	1664	**25**	57
84	8.5	Low-use general recreation, adult	4.3	---	---	---	4.3	4.3	126	43	1261	429	12610	**115**	468
85a	0.25	Recreational canoeist	7.9	---	---	---	7.9	1.2	13	12	129	121	1286	**28**	73
85b	10	High-use general recreation, older child	1.7	---	---	---	1.7	3.9	51	39	514	388	5143	**27**	176
86	118	High-use commercial (groundskeeper scenario)	2.5	---	---	---	2.5	1.8	17	18	166	177	1664	**25**	57
87	10	High-use general recreation, young child (high use)	9.4	1	4000	2.5	4.6	1.3	18	13	184	134	1842	**4.6**	32
87a	0.88	Bank fishing	6.0	---	---	---	5.4	2.6	52	26	524	256	5237	**42**	180
88	1.1	Medium-use general recreation, older child	13	---	---	---	13	5.8	51	58	514	582	5143	**40**	176
89	4.3	High-use general recreation, adult	6.4	---	---	---	6.4	1.4	63	14	630	143	6305	**38**	234
90	8.9	High-use general recreation, adult / older child	6.8	---	---	---	6.8	1.4	51	14	514	143	5143	**27**	176
				Subtotal:	**17,000**	**11**									
Heavily Used Subareas															
Exposure Area ID[1]	**Area of Exposure Area (acre)[2]**	**IMPG Scenario**	**Pre-Remediation EPC (mg/kg)[3]**	**Removal[4]**			**Post-Remediation EPC (mg/kg)[3]**	**IMPG[5] (mg/kg)**							
								Cancer Risk @ 10^{-6}		**Cancer Risk @ 10^{-5}**		**Cancer Risk @ 10^{-4}**		**Non-Cancer**	
				Depth (ft)	**Volume (cy)**	**Area (acre)**		**RME**	**CTE**	**RME**	**CTE**	**RME**	**CTE**	**RME**	**CTE**
4	0.71	High-use general recreation, young child (low use)	17	---	---	---	17	8.0	37	80	368	802	3684	27	63
12	1.5	High-use general recreation, young child (low use)	9.8	---	---	---	9.8	8.0	37	80	368	802	3684	27	63
26a	2.2	High-use general recreation, adult / older child	1.9	---	---	---	1.9	1.4	51	14	514	143	5143	27	176
39	0.15	Marathon canoeist	54	---	---	---	54	0.78	5.8	7.8	58	78	575	13	25
40	5.2	High-use general recreation, young child (low use)	19	---	---	---	19	8.0	37	80	368	802	3684	27	63
47	0.18	Recreational canoeist	6.0	---	---	---	6.0	1.2	13	12	129	121	1286	28	73
52	0.25	Recreational canoeist	7.0	---	---	---	7.0	1.2	13	12	129	121	1286	28	73
53	0.35	Recreational canoeist	408	---	---	---	408	1.2	13	12	129	121	1286	28	73
60a	0.16	Recreational canoeist	7.0	---	---	---	7.0	1.2	13	12	129	121	1286	28	73
				Subtotal:	**0**	**0**									
				Total:	**17,000**	**11**									

Notes:

Key

🟦 = post-remediation EPC is lower than the IMPG

[1] *See Figures 5-1 and 5-2 for direct contact exposure areas in Reaches 5 through 8, and Heavily Used Subareas, respectively.*

[2] *Area only includes the portion of the exposure area within the 1 mg/kg PCB isopleth (Reaches 5/6) or the 100-year floodplain (Reaches 7/8).*

[3] *EPC is calculated for top 1-ft floodplain soil, except in Heavily Used Subareas where it is calculated for top 3-ft floodplain soil.*

[4] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[5] *For scenarios containing more than one receptor (e.g. adult and older child), the lowest IMPG was utilized in the comparison to post-remediation EPCs. The lowest IMPG value for which the alternative was designed to achieve is shown in bold.*

Table 6-8. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for agricultural products consumption areas under FP 2.

Farm ID[1]	Area of farm (acre)[2]	IMPG Scenario	Pre-Remediation EPC[3] (mg/kg)	Removal[4]			Post-Remediation EPC[3] (mg/kg)	IMPG[5] (mg/kg)									
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @10^{-4}		Non-Cancer (Child)		Non-Cancer (Adult)	
				Depth (ft)	Volume (cy)	Area (acres)		RME	CTE	RME	CTE	RME	CTE	RME	CTE	RME	CTE
FA 1	8.0	Commercial Dairy	1.6	---	---	---	1.6	0.68	3.1	6.8	31	68	312	**7.7**	12.2	36.4	44.3
FA 2	3.3		13	---	---	---	13	2.59	11.9	25.9	119	259	1187	**29.1**	46.4	138.1	168.3
FA 3	4.1		0.20	---	---	---	0.20	0.29	1.3	2.9	13	29	132	**3.2**	5.2	15.4	18.7
FA 4	64		0.38	---	---	---	0.38	0.24	1.1	2.4	11	24	110	**2.7**	4.3	12.8	15.6
FA 5	12		0.25	---	---	---	0.25	0.24	1.1	2.4	11	24	110	**2.7**	4.3	12.8	15.6
FA 6	7.7		0.25	---	---	---	0.25	0.24	1.1	2.4	11	24	110	**2.7**	4.3	12.8	15.6
FA 7	24		0.25	---	---	---	0.25	0.24	1.1	2.4	11	24	110	**2.7**	4.3	12.8	15.6
FA 8	9.4		0.19	---	---	---	0.19	0.34	1.5	3.4	15	34	154	**3.8**	6.0	17.9	21.8
FA 9	26		0.89	---	---	---	0.89	0.31	1.4	3.1	14	31	143	**3.5**	5.6	16.6	20.3
FA 10	0.31		0.50	---	---	---	0.50	2.06	9.5	20.6	95	206	946	**23.2**	37.0	110.1	134.2
FA 11	0.14		0.25	---	---	---	0.25	6.10	27.9	61.0	279	610	2794	**68.6**	109.2	325.1	396.2
FA 12	8.0		0.25	---	---	---	0.25	0.38	1.8	3.8	18	38	176	**4.3**	6.9	20.5	25.0
FA 13	4.0		0.25	---	---	---	0.25	0.24	1.1	2.4	11	24	110	**2.7**	4.3	12.8	15.6
FA 14	2.6		0.30	---	---	---	0.30	0.55	2.5	5.5	25	55	253	**6.2**	9.9	29.4	35.9
				Total:	**0**	**0**											

Notes:

[1] *See Figure 5-4 for farm areas in Reaches 5 through 8.*

[2] *Farm area only includes the portion within the 1 mg/kg PCB isopleth (Reaches 5/6) or the 100-year floodplain (Reaches 7/8).*

[3] *EPC is calculated for the top 1 ft of floodplain soil.*

[4] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[5] *IMPG values for agricultural products consumption include a multiplier to account for the areas outside the 1 mg/kg PCB isopleth/100-year floodplain (see Table 5-2). The lowest IMPG value for which the alternative was designed to achieve is shown in bold.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-9. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for wood frog averaging areas (vernal pools) under FP 2.

Vernal Pool ID[1]	Area of Vernal Pool (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal[3]			Post-Remediation EPC[2](mg/kg)	IMPG (mg/kg)	
			Depth (ft)	Volume (cy)	Area (acre)		Lower Bound	Upper Bound
5-VP-3	1.9	29	---	---	---	29	3.27	5.6
5-VP-1	0.044	1.7	---	---	---	1.7	3.27	5.6
8-VP-5	0.043	26	---	---	---	26	3.27	5.6
8-VP-4	0.24	3.9	---	---	---	3.9	3.27	5.6
8-VP-3	0.02	7.7	---	---	---	7.7	3.27	5.6
8-VP-2	0.57	66	---	---	---	66	3.27	5.6
18-VP-2	0.61	7.2	---	---	---	7.2	3.27	5.6
18-VP-1	0.28	7.9	---	---	---	7.9	3.27	5.6
19-VP-7	0.068	0.80	---	---	---	0.80	3.27	5.6
19-VP-2	0.0080	34	---	---	---	34	3.27	5.6
19-VP-1	0.18	23	---	---	---	23	3.27	5.6
19-VP-3	0.031	10	---	---	---	10	3.27	5.6
19-VP-4	0.094	5.6	---	---	---	5.6	3.27	5.6
19-VP-8	0.057	91	---	---	---	91	3.27	5.6
19-VP-5	0.51	26	---	---	---	26	3.27	5.6
19-VP-6	1.2	22	---	---	---	22	3.27	5.6
23-VP-2	0.18	46	---	---	---	46	3.27	5.6
23-VP-1	0.30	62	---	---	---	62	3.27	5.6
23A-VP-1	0.45	26	---	---	---	25	3.27	5.6
23B-VP-1	0.068	26	---	---	---	26	3.27	5.6
23B-VP-2	0.091	0.34	---	---	---	0.34	3.27	5.6
27B-VP-2	0.28	11	---	---	---	11	3.27	5.6
27B-VP-3	0.062	16	---	---	---	16	3.27	5.6
27B-VP-1	0.072	12	---	---	---	12	3.27	5.6
27-VP-2	0.47	21	---	---	---	21	3.27	5.6
27A-VP-1	0.20	31	---	---	---	31	3.27	5.6
27-VP-1	1.3	23	---	---	---	23	3.27	5.6
26-VP-1	0.036	40	---	---	---	40	3.27	5.6
33-VP-1	0.022	10	---	---	---	10	3.27	5.6
33-VP-2	0.12	65	---	---	---	65	3.27	5.6
38-VP-1	0.43	34	---	---	---	34	3.27	5.6
38A-VP-1	0.020	5.0	---	---	---	5.0	3.27	5.6
38-VP-3	0.046	28	---	---	---	28	3.27	5.6
38-VP-2	0.17	28	---	---	---	28	3.27	5.6
40-VP-3	0.46	59	---	---	---	59	3.27	5.6
40-VP-2	0.36	17	---	---	---	17	3.27	5.6
40A-VP-1	0.11	68	---	---	---	68	3.27	5.6
40-VP-1	0.47	58	---	---	---	58	3.27	5.6
42-VP-1	0.22	63	---	---	---	63	3.27	5.6
42-VP-2	0.28	45	---	---	---	45	3.27	5.6
42-VP-3	0.050	41	---	---	---	41	3.27	5.6
42-VP-5	0.58	61	---	---	---	61	3.27	5.6
42-VP-4	1.0	33	---	---	---	33	3.27	5.6
42A-VP-1	1.5	31	---	---	---	31	3.27	5.6
46-VP-2	7.1	20	---	---	---	20	3.27	5.6
46-VP-1	0.52	51	---	---	---	51	3.27	5.6
46-VP-5	0.056	123	---	---	---	123	3.27	5.6
46-VP-3	1.4	67	---	---	---	67	3.27	5.6
46-VP-4	0.011	125	---	---	---	125	3.27	5.6
49A-VP-1	0.019	16	---	---	---	16	3.27	5.6
49-VP-1	1.2	18	---	---	---	18	3.27	5.6
49B-VP-1	0.0044	26	---	---	---	26	3.27	5.6
66A-VP-1	0.032	0.70	---	---	---	0.70	3.27	5.6
69-VP-1	0.0074	12	---	---	---	12	3.27	5.6
8-VP-6	0.086	47	---	---	---	47	3.27	5.6
12-VP-1	0.080	8.0	---	---	---	8.0	3.27	5.6
39-VP-1	2.0	32	---	---	---	32	3.27	5.6
54-VP-1	0.20	21	---	---	---	21	3.27	5.6
55-VP-1	0.59	7.7	---	---	---	7.7	3.27	5.6
55A-VP-1	2.0	79	---	---	---	79	3.27	5.6
58A-VP-1	0.32	22	---	---	---	22	3.27	5.6
67A-VP-1	0.12	13	---	---	---	13	3.27	5.6
61A-VP-1	0.19	28	---	---	---	28	3.27	5.6
61A-VP-2	1.2	35	---	---	---	35	3.27	5.6
56A-VP-1	0.58	73	---	---	---	73	3.27	5.6
23-VP-3	1.3	22	---	---	---	22	3.27	5.6
			Total	**0**	**0**			

Notes:

[1] *See Figure 5-5 for locations of vernal pools.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

[3] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-10. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for shrew averaging areas under FP 2.

Averaging Area ID[1]	Area of Averaging Area (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal[3]			Post-Remediation EPC[2](mg/kg)	IMPG (mg/kg)	
			Depth (ft)	Volume (cy)	Area (acre)		Lower Bound	Upper Bound
G1	88	22	---	---	---	20	21.1	34.3
G2	87	50	---	---	---	23	21.1	34.3
G3	86	18	---	---	---	18	21.1	34.3
G4	86	27	---	---	---	26	21.1	34.3
G5	88	28	---	---	---	28	21.1	34.3
G6	87	11	---	---	---	11	21.1	34.3
G7	73	17	---	---	---	17	21.1	34.3
			Total:	**0**	**0**			

Notes:

[1] *See Figure 5-6 for shrew averaging areas.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

[3] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-11. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for wood duck averaging areas under FP 2.

Averaging Area ID[1]	Reach	Averaging Area (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal[3]			Post-Remediation EPC[2] (mg/kg)	Floodplain IMPG (mg/kg)		
								Sediment Target Level		
				Depth (ft)	Volume (cy)	Area (acre)		1 mg/kg	3 mg/kg	5 mg/kg
K1	5A	52	34	---	---	---	31	50	39	29
K2		63	8.1	---	---	---	6.1	50	39	29
K3		85	40	---	---	---	26	50	39	29
K4		60	17	---	---	---	17	50	39	29
K5		25	23	---	---	---	22	50	39	29
K6	5B	55	25	---	---	---	25	48	33	18
K7		47	29	---	---	---	28	48	33	18
K8		92	24	---	---	---	24	48	33	18
K9	5C/5D	69	25	---	---	---	25	53	49	46
K10		83	13	---	---	---	13	53	49	46
K11		61	14	---	---	---	14	53	49	46
K12	6	28	23	---	---	---	23	53	50	46
				Total:	**0**	**0**				

Notes:

[1] *See Figure 5-7 for wood duck averaging areas.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

[3] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-12. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for mink averaging areas under FP 2.

Averaging Area[1]	Area of Averaging Area (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal[3]			Post-Remediation EPC[2] (mg/kg)	Floodplain IMPG[4] (mg/kg)					
							Sediment Target Level					
			Depth (ft)	Volume (cy)	Area (acre)		1 mg/kg		3 mg/kg		5 mg/kg	
							Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
5A/5B	435	22	---	---	---	20	3.4	16.6	*n/a*	5.1	*n/a*	*n/a*
5C/5D/6	291	18	---	---	---	18	6.9	19.6	3.0	16	*n/a*	11.8
			Total:	**0**	**0**							

Notes:

[1] See Figure 5-8 for mink averaging areas.

[2] EPC is calculated for the top 1 ft of floodplain soil.

[3] As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.

[4] (n/a) denotes IMPG values not attainable in given reach for the sediment target level.

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-13. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for human direct contact exposure areas under FP 3.

Exposure Area ID^1	Area of Exposure Area (acre)^2	IMPG Scenario	Pre-Remediation EPC (mg/kg)^3	Removal^4			Post-Remediation EPC (mg/kg)^3	IMPG^5 (mg/kg)							
				Depth (ft)	Volume (cy)	Area (acre)		Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
								RME	CTE	RME	CTE	RME	CTE	RME	CTE
1	15	Medium-use general recreation, adult / older child	36	---	---	---	23	2.1	51	21	514	215	5143	**40**	176
2	27	High-use general recreation, adult / older child	31	1	1000	0.8	18	1.4	51	14	514	143	5143	**27**	176
2a	2.3	Low-use general recreation, older child	56	---	---	---	45	12	103	116	1029	1165	10286	**80**	353
2b	2.0	High-use general recreation, older child	29	1	10	0.01	27	3.9	51	39	514	388	5143	**27**	176
3	0.4	High-use general recreation, adult	5.6	---	---	---	5.6	1.4	63	14	630	143	6305	**38**	234
4	3.2	High-use general recreation, young child (low use)	29	1	40	0.03	23	8.0	37	80	368	802	3684	**27**	63
5	2.5	High-use general recreation, adult / older child	48	1	500	0.3	22	1.4	51	14	514	143	5143	**27**	176
6	3.8	Low-use general recreation, adult	59	---	---	---	26	4.3	126	43	1261	429	12610	**115**	468
7	5.9	High-use general recreation, adult / older child	21	---	---	---	21	1.4	51	14	514	143	5143	**27**	176
8	0.60	Recreational canoeist	40	1	80	0.05	15	1.2	13	12	129	121	1286	**28**	73
9	0.042	Low-use general recreation, older child	27	---	---	---	27	12	103	116	1029	1165	10286	**80**	353
10	59	High-use general recreation, young child (high use)	10	1	8000	5.	4.6	1.3	18	13	184	134	1842	**4.6**	32
10a	8.0	High-use general recreation, young child (high use)	18	1	400	0.2	4.6	1.3	18	13	184	134	1842	**4.6**	32
11	2.5	High-use general recreation, adult	15	---	---	---	15	1.4	63	14	630	143	6305	**38**	234
12	4.8	High-use general recreation, young child (low use)	7.0	---	---	---	7.0	8.0	37	80	368	802	3684	**27**	63
13	5.9	High-use general recreation, adult	14	---	---	---	13	1.4	63	14	630	143	6305	**38**	234
14	4.1	High-use general recreation, adult	2.7	---	---	---	2.6	1.4	63	14	630	143	6305	**38**	234
15	0.87	High-use general recreation, adult	2.0	---	---	---	2.0	1.4	63	14	630	143	6305	**38**	234
16	2.5	High-use general recreation, adult	22	---	---	---	22	1.4	63	14	630	143	6305	**38**	234
17	8.5	High-use general recreation, adult	13	---	---	---	13	1.4	63	14	630	143	6305	**38**	234
18	17	Medium-use general recreation, adult	17	---	---	---	17	2.1	63	21	630	215	6305	**58**	234
19	36	High-use general recreation, adult	83	1	800	0.5	20	1.4	63	14	630	143	6305	**38**	234
20	9.1	High-use general recreation, adult	31	---	---	---	23	1.4	63	14	630	143	6305	**38**	234
21	2.9	High-use general recreation, adult / older child	4.9	---	---	---	4.3	1.4	51	14	514	143	5143	**27**	176
22	19	High-use general recreation, adult / older child	26	---	---	---	23	1.4	51	14	514	143	5143	**27**	176
22a	1.8	Dirt biking/ATVing	88	1	900	0.6	13	2.0	29	20	290	205	2901	**14**	99
23	0.28	Medium-use general recreation, older child	12	---	---	---	10	5.8	51	58	514	582	5143	**40**	176
24	10	High-use general recreation, adult	31	---	---	---	26	1.4	63	14	630	143	6305	**38**	234
25	0.51	High-use general recreation, older child	30	1	90	0.05	27	3.9	51	39	514	388	5143	**27**	176
26a	48	High-use general recreation, adult / older child	7.2	---	---	---	7.0	1.4	51	**14**	514	143	5143	27	176
26b	7.6	Agricultural use (based on direct contact by farmer)	1.7	---	---	---	1.7	1.2	42	12	419	118	4195	**43**	348
26_F	55	High-use general recreation, adult / older child	6.3	---	---	---	6.2	1.4	51	14	514	143	5143	**27**	176
27	6.3	High-use general recreation, adult / older child	2.4	---	---	---	2.4	1.4	51	14	514	143	5143	**27**	176
27a	0.38	Dirt biking/ATVing	4.3	---	---	---	4.3	2.0	29	20	290	205	2901	**14**	99
28	0.21	High-use general recreation, young child (low use)	21	---	---	---	21	8.0	37	80	368	802	3684	**27**	63
28a	0.071	Dirt biking/ATVing	21	1	30	0.02	13	2.0	29	20	290	205	2901	**14**	99
29	0.34	Low-use general recreation, adult / older child	21	---	---	---	21	4.3	103	43	1029	429	10286	**80**	353
30	0.19	High-use general recreation, adult / older child	13	---	---	---	13	1.4	51	14	514	143	5143	**27**	176
31	5.0	High-use general recreation, adult / older child	14	---	---	---	13	1.4	51	14	514	143	5143	**27**	176
31a	0.61	High-use general recreation, adult / older child	42	1	200	0.1	27	1.4	51	14	514	143	5143	**27**	176
32	6.8	High-use general recreation, adult	14	---	---	---	14	1.4	63	14	630	143	6305	**38**	234
33	30	High-use general recreation, adult	20	---	---	---	18	1.4	63	14	630	143	6305	**38**	234
34	7.8	Medium-use general recreation, adult	25	---	---	---	25	2.1	63	21	630	215	6305	**58**	234
35	25	High-use general recreation, adult / older child	22	---	---	---	21	1.4	51	14	514	143	5143	**27**	176
35a	1.2	High-use general recreation, adult / older child	39	1	90	0.06	13	1.4	51	**14**	514	143	5143	27	176
36a	16	Low-use commercial (groundskeeper scenario)	23	---	---	---	23	8.9	166	89	1664	885	16642	**126**	571
36b	2.2	Agricultural use (based on direct contact by farmer)	15	---	---	---	15	1.2	42	12	419	118	4195	**43**	348
37	20	High-use general recreation, adult / older child	17	---	---	---	15	1.4	51	14	514	143	5143	**27**	176
37a	1.4	Bank fishing	26	---	---	---	26	2.6	52	**26**	524	256	5237	42	180
37b	2.3	High-use general recreation, adult / older child	25	---	---	---	9.8	1.4	51	14	514	143	5143	**27**	176

Table 6-13. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for human direct contact exposure areas under FP 3.

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal[4]			Post-Remediation EPC (mg/kg)[3]	IMPG[5] (mg/kg)							
				Depth (ft)	Volume (cy)	Area (acre)		Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
								RME	CTE	RME	CTE	RME	CTE	RME	CTE
38	13	High-use general recreation, adult	23	---	---	---	22	1.4	63	14	630	143	6305	**38**	234
38a	1.4	Bank fishing	33	---	---	---	33	2.6	52	26	524	256	5237	**42**	180
39	3.5	Marathon canoeist	32	1	1000	0.9	6.9	0.78	5.8	**7.8**	58	78	575	13	25
40	98	High-use general recreation, young child (low use)	20	---	---	---	19	8.0	37	80	368	802	3684	**27**	63
40a	4.6	Bank fishing	40	---	---	---	39	2.6	52	26	524	256	5237	**42**	180
40b	1.1	High-use general recreation, young child (low use)	11	---	---	---	11	8.0	37	80	368	802	3684	**27**	63
41	20	Medium-use general recreation, adult	28	---	---	---	25	2.1	63	21	630	215	6305	**58**	234
41a	2.4	Bank fishing	35	---	---	---	30	2.6	52	26	524	256	5237	**42**	180
42	14	Medium-use general recreation, adult	12	---	---	---	12	2.1	63	21	630	215	6305	**58**	234
42a	0.94	Bank fishing	14	---	---	---	14	2.6	52	26	524	256	5237	**42**	180
43	1.5	Medium-use general recreation, adult	27	---	---	---	27	2.1	63	21	630	215	6305	**58**	234
43a	0.24	Bank fishing	64	1	10	0.01	42	2.6	52	26	524	256	5237	**42**	180
44	2.2	High-use general recreation, adult	24	---	---	---	24	1.4	63	14	630	143	6305	**38**	234
45	17	High-use general recreation, adult	39	1	200	0.1	38	1.4	63	14	630	143	6305	**38**	234
46	7.2	High-use general recreation, adult	8.2	---	---	---	8.1	1.4	63	14	630	143	6305	**38**	234
47	1.0	Recreational canoeist	18	1	80	0.05	12	1.2	13	**12**	129	121	1286	28	73
47_F	0.12	Recreational canoeist	8.1	---	---	---	8.1	1.2	13	12	129	121	1286	**28**	73
48	6.5	High-use general recreation, adult	3.4	---	---	---	3.4	1.4	63	14	630	143	6305	**38**	234
49	7.7	Low-use general recreation, adult	17	---	---	---	17	4.3	126	43	1261	429	12610	**115**	468
50	69	Low-use general recreation, adult	7.3	---	---	---	7.3	4.3	126	43	1261	429	12610	**115**	468
50a	11	Waterfowl hunting	15	---	---	---	15	9.0	75	90	752	904	7518	**140**	399
51	87	Low-use general recreation, adult	7.2	---	---	---	7.2	4.3	126	43	1261	429	12610	**115**	468
51a	32	Waterfowl hunting	13	---	---	---	13	9.0	75	90	752	904	7518	**140**	399
52	0.9	Recreational canoeist	10	---	---	---	9.6	1.2	13	**12**	129	121	1286	28	73
53	0.7	Recreational canoeist	34	1	200	0.1	9.1	1.2	13	**12**	129	121	1286	28	73
54	13	High-use general recreation, adult	7.1	---	---	---	7.0	1.4	63	14	630	143	6305	**38**	234
55	18	High-use general recreation, young child (low use)	11	---	---	---	11	8.0	37	80	368	802	3684	**27**	63
55a	5.0	Waterfowl hunting	47	---	---	---	47	9.0	75	90	752	904	7518	**140**	399
56	32	Medium-use general recreation, adult / older child	38	---	---	---	38	2.1	51	21	514	215	5143	**40**	176
56a	10	Waterfowl hunting	49	---	---	---	49	9.0	75	90	752	904	7518	**140**	399
57	13	High-use general recreation, young child (low use)	5.8	---	---	---	5.8	8.0	37	80	368	802	3684	**27**	63
58	1.3	High-use general recreation, adult	65	1	200	0.1	14	1.4	63	**14**	630	143	6305	38	234
59	1.9	High-use general recreation, young child (low use)	18	---	---	---	18	8.0	37	80	368	802	3684	**27**	63
59a	0.83	Bank fishing	22	---	---	---	22	2.6	52	26	524	256	5237	**42**	180
60	0.84	High-use general recreation, young child (low use)	7.0	---	---	---	7.0	8.0	37	80	368	802	3684	**27**	63
60a	0.16	Recreational canoeist	13	1	4.	0.0	12	1.2	13	**12**	129	121	1286	28	73
61	3.3	Utility worker	42	---	---	---	31	17	209	169	2093	1694	20933	**242**	718
62	1.6	Utility worker	134	---	---	---	23	17	209	169	2093	1694	20933	**242**	718
63	0.67	Utility worker	23	---	---	---	19	17	209	169	2093	1694	20933	**242**	718
64	0.61	Utility worker	42	---	---	---	31	17	209	169	2093	1694	20933	**242**	718
65	3.9	Utility worker	17	---	---	---	16	17	209	169	2093	1694	20933	**242**	718
66	1.7	Utility worker	23	---	---	---	11	17	209	169	2093	1694	20933	**242**	718
67	0.31	High-use general recreation, adult	11	---	---	---	11	1.4	63	14	630	143	6305	**38**	234
68	0.090	High-use general recreation, adult	9.0	---	---	---	9.0	1.4	63	14	630	143	6305	**38**	234
69	1.9	High-use general recreation, adult	7.3	---	---	---	7.3	1.4	63	14	630	143	6305	**38**	234
70	19	High-use general recreation, young child (high use)	2.4	---	---	---	2.4	1.3	18	13	184	134	1842	**4.6**	32
70a	1.2	Bank fishing	3.8	---	---	---	3.8	2.6	52	26	524	256	5237	**42**	180
71	1.8	Bank fishing	4.6	---	---	---	4.6	2.6	52	26	524	256	5237	**42**	180
72	2.3	Bank fishing	10	---	---	---	10	2.6	52	26	524	256	5237	**42**	180
73	3.9	High-use general recreation, adult	0.50	---	---	---	0.50	1.4	63	14	630	143	6305	**38**	234

Table 6-13. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for human direct contact exposure areas under FP 3.

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal[4]			Post-Remediation EPC (mg/kg)[3]	IMPG[5] (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
74	5.3	High-use general recreation, adult	5.3	---	---	---	5.3	1.4	63	14	630	143	6305	**38**	234
75	3.4	High-use general recreation, adult	15	---	---	---	15	1.4	63	14	630	143	6305	**38**	234
76	1.1	High-use general recreation, adult	0.79	---	---	---	0.79	1.4	63	14	630	143	6305	**38**	234
77	4.2	High-use general recreation, adult	0.89	---	---	---	0.88	1.4	63	14	630	143	6305	**38**	234
78	6.2	High-use general recreation, older child	5.9	---	---	---	5.9	3.9	51	39	514	388	5143	**27**	176
79	17	High-use general recreation, adult	2.9	---	---	---	2.9	1.4	63	14	630	143	6305	**38**	234
80a	9.5	Low-use general recreation, adult	2.6	---	---	---	2.6	4.3	126	43	1261	429	12610	**115**	468
80b	20	Agricultural use (based on direct contact by farmer)	0.76	---	---	---	0.76	1.2	42	12	419	118	4195	**43**	348
81	33	Low-use general recreation, adult	2.3	---	---	---	2.3	4.3	126	43	1261	429	12610	**115**	468
82	15	Low-use general recreation, adult	3.6	---	---	---	3.6	4.3	126	43	1261	429	12610	**115**	468
83	22	High-use commercial (groundskeeper scenario)	1.9	---	---	---	1.9	1.8	17	18	166	177	1664	**25**	57
84	8.5	Low-use general recreation, adult	4.3	---	---	---	4.3	4.3	126	43	1261	429	12610	**115**	468
85a	0.25	Recreational canoeist	7.9	---	---	---	7.9	1.2	13	12	129	121	1286	**28**	73
85b	10	High-use general recreation, older child	1.7	---	---	---	1.7	3.9	51	39	514	388	5143	**27**	176
86	118	High-use commercial (groundskeeper scenario)	2.5	---	---	---	2.5	1.8	17	18	166	177	1664	**25**	57
87	10	High-use general recreation, young child (high use)	9.4	1	4000	3.	4.6	1.3	18	13	184	134	1842	**4.6**	32
87a	0.88	Bank fishing	6.0	---	---	---	5.3	2.6	52	26	524	256	5237	**42**	180
88	1.1	Medium-use general recreation, older child	13	---	---	---	13	5.8	51	58	514	582	5143	**40**	176
89	4.3	High-use general recreation, adult	6.4	---	---	---	6.4	1.4	63	14	630	143	6305	**38**	234
90	8.9	High-use general recreation, adult / older child	6.8	---	---	---	6.8	1.4	51	14	514	143	5143	**27**	176
				Subtotal:	**17,800**	**12**									
Heavily Used Subareas															
Exposure Area ID[1]	**Area of Exposure Area (acre)[2]**	**IMPG Scenario**	**Pre-Remediation EPC (mg/kg)[3]**	**Removal[4]**			**Post-Remediation EPC (mg/kg)[3]**	**IMPG[5] (mg/kg)**							
								Cancer Risk @ 10^{-6}		**Cancer Risk @ 10^{-5}**		**Cancer Risk @ 10^{-4}**		**Non-Cancer**	
				Depth (ft)	**Volume (cy)**	**Area (acre)**		**RME**	**CTE**	**RME**	**CTE**	**RME**	**CTE**	**RME**	**CTE**
4	0.71	High-use general recreation, young child (low use)	17	3	50	0.010	13	8.0	37	80	368	802	3684	**27**	63
12	1.5	High-use general recreation, young child (low use)	9.8	---	---	---	9.8	8.0	37	80	368	802	3684	**27**	63
26a	2.2	High-use general recreation, adult / older child	1.9	---	---	---	1.9	1.4	51	**14**	514	143	5143	27	176
39	0.15	Marathon canoeist	54	3	400	0.12	7.8	0.78	5.8	**7.8**	58	78	575	13	25
40	5.2	High-use general recreation, young child (low use)	19	3	300	0.18	18	8.0	37	80	368	802	3684	**27**	63
47	0.18	Recreational canoeist	6.0	---	---	---	0.84	1.2	13	**12**	129	121	1286	28	73
52	0.25	Recreational canoeist	7.0	3	400	0.22	1.7	1.2	13	**12**	129	121	1286	28	73
53	0.35	Recreational canoeist	408	3	100	0.030	8.9	1.2	13	**12**	129	121	1286	28	73
60a	0.16	Recreational canoeist	7.0	3	10	0.0	7.0	1.2	13	**12**	129	121	1286	28	73
				Subtotal:	**1,200**	**0.56**									
				Total:	**19,000**	**13**									

Notes:

[1] *See Figures 5-1 and 5-2 for direct contact exposure areas in Reaches 5 through 8, and Heavily Used Subareas, respectively.*

[2] *Area only includes the portion of the exposure area within the 1 mg/kg PCB isopleth (Reaches 5/6) or the 100-year floodplain (Reaches 7/8).*

[3] *EPC is calculated for top 1-ft floodplain soil, except in Heavily Used Subareas where it is calculated for top 3-ft floodplain soil.*

[4] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[5] *For scenarios containing more than one receptor (e.g. adult and older child), the lowest IMPG was utilized in the comparison to post-remediation EPCs. The lowest IMPG value for which the alternative was designed to achieve is shown in bold.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-14. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for agricultural products consumption areas under FP 3.

Farm ID[1]	Area of farm (acre)[2]	IMPG Scenario	Pre-Remediation EPC[3] (mg/kg)	Removal[4]			Post-Remediation EPC[3] (mg/kg)	IMPG[5] (mg/kg)									
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @10^{-4}		Non-Cancer (Child)		Non-Cancer (Adult)	
				Depth (ft)	Volume (cy)	Area (acres)		RME	CTE	RME	CTE	RME	CTE	RME	CTE	RME	CTE
FA 1	8.0	Commercial Dairy	1.6	---	---	---	1.6	0.68	3.1	**6.8**	31	68	312	7.7	12.2	36.4	44.3
FA 2	3.3		13	---	---	---	13	2.59	11.9	**25.9**	119	259	1187	29.1	46.4	138.1	168.3
FA 3	4.1		0.20	---	---	---	0.20	0.29	1.3	**2.9**	13	29	132	3.2	5.2	15.4	18.7
FA 4	64		0.38	---	---	---	0.38	0.24	1.1	**2.4**	11	24	110	2.7	4.3	12.8	15.6
FA 5	12		0.25	---	---	---	0.25	0.24	1.1	**2.4**	11	24	110	2.7	4.3	12.8	15.6
FA 6	7.7		0.25	---	---	---	0.25	0.24	1.1	**2.4**	11	24	110	2.7	4.3	12.8	15.6
FA 7	24		0.25	---	---	---	0.25	0.24	1.1	**2.4**	11	24	110	2.7	4.3	12.8	15.6
FA 8	9.4		0.19	---	---	---	0.19	0.34	1.5	**3.4**	15	34	154	3.8	6.0	17.9	21.8
FA 9	26		0.89	---	---	---	0.89	0.31	1.4	**3.1**	14	31	143	3.5	5.6	16.6	20.3
FA 10	0.31		0.50	---	---	---	0.50	2.06	9.5	**20.6**	95	206	946	23.2	37.0	110.1	134.2
FA 11	0.14		0.25	---	---	---	0.25	6.10	27.9	**61.0**	279	610	2794	68.6	109.2	325.1	396.2
FA 12	8.0		0.25	---	---	---	0.25	0.38	1.8	**3.8**	18	38	176	4.3	6.9	20.5	25.0
FA 13	4.0		0.25	---	---	---	0.25	0.24	1.1	**2.4**	11	24	110	2.7	4.3	12.8	15.6
FA 14	2.6		0.30	---	---	---	0.30	0.55	2.5	**5.5**	25	55	253	6.2	9.9	29.4	35.9
				Total:	**0**	**0**											

Notes:

[1] *See Figure 5-4 for farm areas in Reaches 5 through 8.*

[2] *Farm area only includes the portion within the 1 mg/kg PCB isopleth (Reaches 5/6) or the 100-year floodplain (Reaches 7/8).*

[3] *EPC is calculated for the top 1 ft of floodplain soil.*

[4] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[5] *IMPG values for agricultural products consumption include a multiplier to account for the areas outside the 1 mg/kg PCB isopleth/100-year floodplain (see Table 5-2). The lowest IMPG value for which the alternative was designed to achieve is shown in bold.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-15. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for wood frog averaging areas (vernal pools) under FP 3.

Vernal Pool ID[1]	Area of Vernal Pool (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal[3]			Post-Remediation EPC[2] (mg/kg)	IMPG[4] (mg/kg)	
			Depth (ft)	Volume (cy)	Area (acre)		Lower Bound	Upper Bound
5-VP-3	1.9	29	1	2000	1.2	5.6	3.27	**5.6**
5-VP-1	0.044	1.7	---	---	---	1.7	3.27	**5.6**
8-VP-5	0.043	26	1	60	0.040	5.6	3.27	**5.6**
8-VP-4	0.24	3.9	---	---	---	3.9	3.27	**5.6**
8-VP-3	0.02	7.7	1	40	0.020	0.021	3.27	**5.6**
8-VP-2	0.57	66	1	700	0.42	5.6	3.27	**5.6**
18-VP-2	0.61	7.2	1	70	0.040	5.5	3.27	**5.6**
18-VP-1	0.28	7.9	1	60	0.040	5.1	3.27	**5.6**
19-VP-7	0.068	0.80	---	---	---	0.80	3.27	**5.6**
19-VP-2	0.01	34	1	10	0.010	0.021	3.27	**5.6**
19-VP-1	0.18	23	1	200	0.13	5.5	3.27	**5.6**
19-VP-3	0.031	10	1	20	0.010	3.6	3.27	**5.6**
19-VP-4	0.094	5.6	1	4.	0.0	4.2	3.27	**5.6**
19-VP-8	0.057	91	1	90	0.050	0.021	3.27	**5.6**
19-VP-5	0.51	26	1	500	0.32	5.6	3.27	**5.6**
19-VP-6	1.2	22	1	600	0.40	5.6	3.27	**5.6**
23-VP-2	0.18	46	1	300	0.17	5.6	3.27	**5.6**
23-VP-1	0.30	62	1	400	0.25	5.5	3.27	**5.6**
23A-VP-1	0.45	26	1	600	0.38	5.5	3.27	**5.6**
23B-VP-1	0.068	26	1	50	0.030	5.6	3.27	**5.6**
23B-VP-2	0.091	0.34	---	---	---	0.34	3.27	**5.6**
27B-VP-2	0.28	11	1	200	0.13	5.6	3.27	**5.6**
27B-VP-3	0.062	16	1	60	0.040	5.2	3.27	**5.6**
27B-VP-1	0.072	12	1	50	0.030	5.6	3.27	**5.6**
27-VP-2	0.47	21	1	200	0.10	5.6	3.27	**5.6**
27A-VP-1	0.20	31	1	300	0.16	5.1	3.27	**5.6**
27-VP-1	1.3	23	1	400	0.24	5.6	3.27	**5.6**
26-VP-1	0.036	40	1	30	0.020	5.6	3.27	**5.6**
33-VP-1	0.022	10	1	30	0.020	0.021	3.27	**5.6**
33-VP-2	0.12	65	1	100	0.080	5.6	3.27	**5.6**
38-VP-1	0.43	34	1	500	0.31	5.6	3.27	**5.6**
38A-VP-1	0.020	5.0	---	---	---	5.0	3.27	**5.6**
38-VP-3	0.046	28	1	40	0.020	5.0	3.27	**5.6**
38-VP-2	0.17	28	1	200	0.13	5.6	3.27	**5.6**
40-VP-3	0.46	59	1	600	0.40	5.0	3.27	**5.6**
40-VP-2	0.36	17	1	200	0.15	5.6	3.27	**5.6**
40A-VP-1	0.11	68	1	200	0.090	5.6	3.27	**5.6**
40-VP-1	0.47	58	1	300	0.21	4.2	3.27	**5.6**
42-VP-1	0.22	63	1	300	0.19	5.1	3.27	**5.6**
42-VP-2	0.28	45	1	400	0.26	5.6	3.27	**5.6**
42-VP-3	0.050	41	1	60	0.040	1.9	3.27	**5.6**
42-VP-5	0.58	61	1	300	0.21	5.6	3.27	**5.6**
42-VP-4	1.0	33	1	900	0.55	5.6	3.27	**5.6**
42A-VP-1	1.5	31	1	1000	0.91	5.6	3.27	**5.6**
46-VP-2	7.1	20	1	1000	0.75	5.6	3.27	**5.6**
46-VP-1	0.52	51	1	60	0.040	4.2	3.27	**5.6**
46-VP-5	0.056	123	1	80	0.050	0.021	3.27	**5.6**
46-VP-3	1.4	67	1	900	0.57	5.6	3.27	**5.6**
46-VP-4	0.011	125	1	7.	0.0	0.021	3.27	**5.6**
49A-VP-1	0.019	16	1	30	0.020	0.021	3.27	**5.6**
49-VP-1	1.2	18	1	600	0.37	5.6	3.27	**5.6**
49B-VP-1	0.0044	26	1	7.	0.0	0.021	3.27	**5.6**
66A-VP-1	0.032	0.70	---	---	---	0.70	3.27	**5.6**
69-VP-1	0.0074	12	1	10	0.010	0.021	3.27	**5.6**
8-VP-6	0.086	47	1	100	0.080	0.70	3.27	**5.6**
12-VP-1	0.080	8.0	1	30	0.020	2.5	3.27	**5.6**
39-VP-1	2.0	32	1	2000	1.2	5.6	3.27	**5.6**
54-VP-1	0.20	21	1	300	0.17	3.0	3.27	**5.6**
55-VP-1	0.59	7.7	1	4.	0.0	4.1	3.27	**5.6**
55A-VP-1	2.0	79	1	2000	1.2	4.9	3.27	**5.6**
58A-VP-1	0.32	22	1	400	0.25	5.5	3.27	**5.6**
67A-VP-1	0.12	13	1	10	0.010	3.9	3.27	**5.6**
61A-VP-1	0.19	28	1	10	0.010	1.5	3.27	**5.6**
61A-VP-2	1.2	35	1	500	0.29	4.7	3.27	**5.6**
56A-VP-1	0.58	73	1	900	0.56	0.85	3.27	**5.6**
23-VP-3	1.3	22	1	1000	0.73	3.0	3.27	**5.6**
			Total	**23,000**	**14**			

Notes:

[1] *See Figure 5-5 for locations of vernal pools.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

[3] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[4] *The IMPG value for which the alternative was designed to achieve is shown in bold.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-16. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for shrew averaging areas under FP 3.

Averaging Area ID[1]	Area of Averaging Area (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal[3]			Post-Remediation EPC[2](mg/kg)	IMPG[4] (mg/kg)	
			Depth (ft)	Volume (cy)	Area (acre)		Lower Bound	Upper Bound
G1	88	22	---	---	---	13	21.1	**34.3**
G2	87	50	---	---	---	19	21.1	**34.3**
G3	86	18	---	---	---	17	21.1	**34.3**
G4	86	27	---	---	---	23	21.1	**34.3**
G5	88	28	---	---	---	27	21.1	**34.3**
G6	87	11	---	---	---	11	21.1	**34.3**
G7	73	17	---	---	---	17	21.1	**34.3**
			Total:	**0**	**0**			

Notes:

[1] *See Figure 5-6 for shrew averaging areas.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

[3] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[4] *The IMPG value for which the alternative was designed to achieve is shown in bold.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-17. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for wood duck averaging areas under FP 3.

Averaging Area ID[1]	**Reach**	**Averaging Area (acre)**	**Pre-Remediation EPC[2] (mg/kg)**	**Removal[3]**			**Post-Remediation EPC[2] (mg/kg)**	**Floodplain IMPG[4] (mg/kg)**		
				Depth (ft)	**Volume (cy)**	**Area (acre)**		**Sediment Target Level**		
								1 mg/kg	**3 mg/kg**	**5 mg/kg**
K1	5A	52	34	---	---	---	20	**50**	39	29
K2		63	8.1	---	---	---	6.1	**50**	39	29
K3		85	40	---	---	---	20	**50**	39	29
K4		60	17	---	---	---	15	**50**	39	29
K5		25	23	---	---	---	20	**50**	39	29
K6	5B	55	25	---	---	---	24	**48**	33	18
K7		47	29	---	---	---	22	**48**	33	18
K8		92	24	---	---	---	22	**48**	33	18
K9	5C/5D	69	25	---	---	---	24	**53**	49	46
K10		83	13	---	---	---	12	**53**	49	46
K11		61	14	---	---	---	14	**53**	49	46
K12	6	28	23	---	---	---	23	**53**	50	46
				Total:	**0**	**0**				

Notes:

[1] *See Figure 5-7 for wood duck averaging areas.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

[3] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[4] *The IMPG value for which the alternative was designed to achieve is shown in bold.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-18. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for mink averaging areas under FP 3.

Averaging Area[1]	Area of Averaging Area (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal[3]			Post-Remediation EPC[2] (mg/kg)	Floodplain IMPG[4] (mg/kg)					
							Sediment Target Level					
			Depth (ft)	Volume (cy)	Area (acre)		1 mg/kg		3 mg/kg		5 mg/kg	
							Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
5A/5B	435	22	1	18000	11	16.6	3.4	**16.6**	*n/a*	5.1	*n/a*	*n/a*
5C/5D/6	291	18	---	---	---	17	6.9	**19.6**	3.0	16	*n/a*	11.8
			Total:	**18,000**	**11**							

Notes:

[1] *See Figure 5-8 for mink averaging areas.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

[3] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[4] *(n/a) denotes IMPG values not attainable in given reach for the sediment target level. The IMPG value for which the alternative was designed to achieve is shown in bold.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-19. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for human direct contact exposure areas under FP 4.

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal[4]			Post-Remediation EPC (mg/kg)[3]	IMPG[5] (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
1	15	Medium-use general recreation, adult / older child	36	1	3000	1.9	21	2.1	51	**21**	514	215	5143	40	176
2	27	High-use general recreation, adult / older child	31	1	9000	5.5	14	1.4	51	**14**	514	143	5143	27	176
2a	2.3	Low-use general recreation, older child	56	---	---	---	23	12	103	116	1029	1165	10286	**80**	353
2b	2.0	High-use general recreation, older child	29	1	10	0.010	27	3.9	51	39	514	388	5143	**27**	176
3	0.4	High-use general recreation, adult	5.6	---	---	---	5.6	1.4	63	**14**	630	143	6305	38	234
4	3.2	High-use general recreation, young child (low use)	29	1	40	0.020	11	8.0	37	80	368	802	3684	**27**	63
5	2.5	High-use general recreation, adult / older child	48	1	600	0.36	14	1.4	51	**14**	514	143	5143	27	176
6	3.8	Low-use general recreation, adult	59	1	500	0.33	43	4.3	126	**43**	1261	429	12610	115	468
7	5.9	High-use general recreation, adult / older child	21	1	900	0.55	14	1.4	51	**14**	514	143	5143	27	176
8	0.60	Recreational canoeist	40	1	200	0.10	11	1.2	13	**12**	129	121	1286	28	73
9	0.042	Low-use general recreation, older child	27	---	---	---	27	12	103	116	1029	1165	10286	**80**	353
10	59	High-use general recreation, young child (high use)	10	1	8000	4.8	4.5	1.3	18	13	184	134	1842	**4.6**	32
10a	8.0	High-use general recreation, young child (high use)	18	1	400	0.23	4.6	1.3	18	13	184	134	1842	**4.6**	32
11	2.5	High-use general recreation, adult	15	1	60	0.040	14	1.4	63	**14**	630	143	6305	38	234
12	4.8	High-use general recreation, young child (low use)	7.0	---	---	---	4.4	8.0	37	80	368	802	3684	**27**	63
13	5.9	High-use general recreation, adult	14	---	---	---	13	1.4	63	**14**	630	143	6305	38	234
14	4.1	High-use general recreation, adult	2.7	---	---	---	2.6	1.4	63	**14**	630	143	6305	38	234
15	0.87	High-use general recreation, adult	2.0	---	---	---	2.0	1.4	63	**14**	630	143	6305	38	234
16	2.5	High-use general recreation, adult	22	1	600	0.39	14	1.4	63	**14**	630	143	6305	38	234
17	8.5	High-use general recreation, adult	13	---	---	---	13	1.4	63	**14**	630	143	6305	38	234
18	17	Medium-use general recreation, adult	17	---	---	---	17	2.1	63	**21**	630	215	6305	58	234
19	36	High-use general recreation, adult	83	1	8000	5.0	14	1.4	63	**14**	630	143	6305	38	234
20	9.1	High-use general recreation, adult	31	1	3000	2.1	14	1.4	63	**14**	630	143	6305	38	234
21	2.9	High-use general recreation, adult / older child	4.9	---	---	---	4.9	1.4	51	**14**	514	143	5143	27	176
22	19	High-use general recreation, adult / older child	26	1	5000	3.1	14	1.4	51	**14**	514	143	5143	27	176
22a	1.8	Dirt biking/ATVing	88	1	900	0.56	14	2.0	29	20	290	205	2901	**14**	99
23	0.28	Medium-use general recreation, older child	12	---	---	---	12	5.8	51	58	514	582	5143	**40**	176
24	10	High-use general recreation, adult	31	1	4000	2.5	13	1.4	63	**14**	630	143	6305	38	234
25	0.51	High-use general recreation, older child	30	1	90	0.050	27	3.9	51	39	514	388	5143	**27**	176
26a	48	High-use general recreation, adult / older child	7.2	---	---	---	7.0	1.4	51	**14**	514	143	5143	27	176
26b	7.6	Agricultural use (based on direct contact by farmer)	1.7	---	---	---	1.7	1.2	42	**12**	419	118	4195	43	348
26_F	55	High-use general recreation, adult / older child	6.3	---	---	---	6.2	1.4	51	**14**	514	143	5143	27	176
27	6.3	High-use general recreation, adult / older child	2.4	---	---	---	2.4	1.4	51	**14**	514	143	5143	27	176
27a	0.38	Dirt biking/ATVing	4.3	---	---	---	4.3	2.0	29	20	290	205	2901	**14**	99
28	0.21	High-use general recreation, young child (low use)	21	---	---	---	21	8.0	37	80	368	802	3684	**27**	63
28a	0.071	Dirt biking/ATVing	21	1	30	0.020	13	2.0	29	20	290	205	2901	**14**	99
29	0.34	Low-use general recreation, adult / older child	21	---	---	---	21	4.3	103	**43**	1029	429	10286	80	353
30	0.19	High-use general recreation, adult / older child	13	---	---	---	13	1.4	51	**14**	514	143	5143	27	176
31	5.0	High-use general recreation, adult / older child	14	---	---	---	13	1.4	51	**14**	514	143	5143	27	176
31a	0.61	High-use general recreation, adult / older child	42	1	300	0.20	13	1.4	51	**14**	514	143	5143	27	176
32	6.8	High-use general recreation, adult	14	1	2000	0.99	14	1.4	63	**14**	630	143	6305	38	234
33	30	High-use general recreation, adult	20	1	3000	2.0	14	1.4	63	**14**	630	143	6305	38	234
34	7.8	Medium-use general recreation, adult	25	1	500	0.32	21	2.1	63	**21**	630	215	6305	58	234
35	25	High-use general recreation, adult / older child	22	1	5000	3.1	14	1.4	51	**14**	514	143	5143	27	176
35a	1.2	High-use general recreation, adult / older child	39	1	90	0.060	3.4	1.4	51	**14**	514	143	5143	27	176
36a	16	Low-use commercial (groundskeeper scenario)	23	---	---	---	23	8.9	166	**89**	1664	885	16642	126	571
36b	2.2	Agricultural use (based on direct contact by farmer)	15	1	40	0.020	12	1.2	42	**12**	419	118	4195	43	348
37	20	High-use general recreation, adult / older child	17	1	2000	1.0	13	1.4	51	**14**	514	143	5143	27	176
37a	1.4	Bank fishing	26	1	4.	0.0	20	2.6	52	**26**	524	256	5237	42	180
37b	2.3	High-use general recreation, adult / older child	25	1	100	0.070	6.0	1.4	51	**14**	514	143	5143	27	176

Table 6-19. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for human direct contact exposure areas under FP 4.

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal[4]			Post-Remediation EPC (mg/kg)[3]	IMPG[5] (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
38	13	High-use general recreation, adult	23	1	2000	1.4	14	1.4	63	**14**	630	143	6305	38	234
38a	1.4	Bank fishing	33	1	200	0.14	15	2.6	52	**26**	524	256	5237	42	180
39	3.5	Marathon canoeist	32	1	1000	0.91	7.2	0.78	5.8	**7.8**	58	78	575	13	25
40	98	High-use general recreation, young child (low use)	20	---	---	---	18	8.0	37	80	368	802	3684	**27**	63
40a	4.6	Bank fishing	40	1	500	0.30	25	2.6	52	**26**	524	256	5237	42	180
40b	1.1	High-use general recreation, young child (low use)	11	---	---	---	11	8.0	37	80	368	802	3684	**27**	63
41	20	Medium-use general recreation, adult	28	1	2000	1.5	21	2.1	63	**21**	630	215	6305	58	234
41a	2.4	Bank fishing	35	1	300	0.21	25	2.6	52	**26**	524	256	5237	42	180
42	14	Medium-use general recreation, adult	12	---	---	---	12	2.1	63	**21**	630	215	6305	58	234
42a	0.94	Bank fishing	14	---	---	---	14	2.6	52	**26**	524	256	5237	42	180
43	1.5	Medium-use general recreation, adult	27	1	30	0.020	21	2.1	63	**21**	630	215	6305	58	234
43a	0.24	Bank fishing	64	1	10	0.010	21	2.6	52	**26**	524	256	5237	42	180
44	2.2	High-use general recreation, adult	24	1	700	0.46	11	1.4	63	**14**	630	143	6305	38	234
45	17	High-use general recreation, adult	39	1	5000	3.3	14	1.4	63	**14**	630	143	6305	38	234
46	7.2	High-use general recreation, adult	8.2	---	---	---	8.1	1.4	63	**14**	630	143	6305	38	234
47	1.0	Recreational canoeist	18	1	80	0.050	12	1.2	13	**12**	129	121	1286	28	73
47_F	0.12	Recreational canoeist	8.1	---	---	---	8.1	1.2	13	**12**	129	121	1286	28	73
48	6.5	High-use general recreation, adult	3.4	---	---	---	3.4	1.4	63	**14**	630	143	6305	38	234
49	7.7	Low-use general recreation, adult	17	---	---	---	17	4.3	126	**43**	1261	429	12610	115	468
50	69	Low-use general recreation, adult	7.3	---	---	---	7.3	4.3	126	**43**	1261	429	12610	115	468
50a	11	Waterfowl hunting	15	---	---	---	15	9.0	75	**90**	752	904	7518	140	399
51	87	Low-use general recreation, adult	7.2	---	---	---	7.2	4.3	126	**43**	1261	429	12610	115	468
51a	32	Waterfowl hunting	13	---	---	---	13	9.0	75	**90**	752	904	7518	140	399
52	0.9	Recreational canoeist	10	---	---	---	9.6	1.2	13	**12**	129	121	1286	28	73
53	0.7	Recreational canoeist	34	1	200	0.10	9.3	1.2	13	**12**	129	121	1286	28	73
54	13	High-use general recreation, adult	7.1	---	---	---	7.0	1.4	63	**14**	630	143	6305	38	234
55	18	High-use general recreation, young child (low use)	11	---	---	---	11	8.0	37	80	368	802	3684	**27**	63
55a	5.0	Waterfowl hunting	47	---	---	---	47	9.0	75	**90**	752	904	7518	140	399
56	32	Medium-use general recreation, adult / older child	38	1	1000	0.77	21	2.1	51	**21**	514	215	5143	40	176
56a	10	Waterfowl hunting	49	---	---	---	36	9.0	75	**90**	752	904	7518	140	399
57	13	High-use general recreation, young child (low use)	5.8	---	---	---	5.8	8.0	37	80	368	802	3684	**27**	63
58	1.3	High-use general recreation, adult	65	1	200	0.10	14	1.4	63	**14**	630	143	6305	38	234
59	1.9	High-use general recreation, young child (low use)	18	---	---	---	18	8.0	37	80	368	802	3684	**27**	63
59a	0.83	Bank fishing	22	---	---	---	22	2.6	52	**26**	524	256	5237	42	180
60	0.84	High-use general recreation, young child (low use)	7.0	---	---	---	7.0	8.0	37	80	368	802	3684	**27**	63
60a	0.16	Recreational canoeist	13	1	7.	0.0	12	1.2	13	**12**	129	121	1286	28	73
61	3.3	Utility worker	42	---	---	---	20	17	209	**169**	2093	1694	20933	242	718
62	1.6	Utility worker	134	---	---	---	12	17	209	**169**	2093	1694	20933	242	718
63	0.67	Utility worker	23	---	---	---	10	17	209	**169**	2093	1694	20933	242	718
64	0.61	Utility worker	42	---	---	---	13	17	209	**169**	2093	1694	20933	242	718
65	3.9	Utility worker	17	---	---	---	16	17	209	**169**	2093	1694	20933	242	718
66	1.7	Utility worker	23	---	---	---	9.4	17	209	**169**	2093	1694	20933	242	718
67	0.31	High-use general recreation, adult	11	---	---	---	11	1.4	63	**14**	630	143	6305	38	234
68	0.090	High-use general recreation, adult	9.0	---	---	---	9.0	1.4	63	**14**	630	143	6305	38	234
69	1.9	High-use general recreation, adult	7.3	---	---	---	7.3	1.4	63	**14**	630	143	6305	38	234
70	19	High-use general recreation, young child (high use)	2.4	---	---	---	2.4	1.3	18	13	184	134	1842	**4.6**	32
70a	1.2	Bank fishing	3.8	---	---	---	3.8	2.6	52	**26**	524	256	5237	42	180
71	1.8	Bank fishing	4.6	---	---	---	4.6	2.6	52	**26**	524	256	5237	42	180
72	2.3	Bank fishing	10	---	---	---	10	2.6	52	**26**	524	256	5237	42	180
73	3.9	High-use general recreation, adult	0.50	---	---	---	0.50	1.4	63	**14**	630	143	6305	38	234

Table 6-19. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for human direct contact exposure areas under FP 4.

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal[4]			Post-Remediation EPC (mg/kg)[3]	IMPG[5] (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
74	5.3	High-use general recreation, adult	5.3	---	---	---	5.3	1.4	63	**14**	630	143	6305	38	234
75	3.4	High-use general recreation, adult	15	1	200	0.15	14	1.4	63	**14**	630	143	6305	38	234
76	1.1	High-use general recreation, adult	0.79	---	---	---	0.79	1.4	63	**14**	630	143	6305	38	234
77	4.2	High-use general recreation, adult	0.89	---	---	---	0.89	1.4	63	**14**	630	143	6305	38	234
78	6.2	High-use general recreation, older child	5.9	---	---	---	5.9	3.9	51	39	514	388	5143	**27**	176
79	17	High-use general recreation, adult	2.9	---	---	---	2.9	1.4	63	**14**	630	143	6305	38	234
80a	9.5	Low-use general recreation, adult	2.6	---	---	---	2.6	4.3	126	**43**	1261	429	12610	115	468
80b	20	Agricultural use (based on direct contact by farmer)	0.76	---	---	---	0.76	1.2	42	**12**	419	118	4195	43	348
81	33	Low-use general recreation, adult	2.3	---	---	---	2.3	4.3	126	**43**	1261	429	12610	115	468
82	15	Low-use general recreation, adult	3.6	---	---	---	3.6	4.3	126	**43**	1261	429	12610	115	468
83	22	High-use commercial (groundskeeper scenario)	1.9	---	---	---	1.9	1.8	17	**18**	166	177	1664	25	57
84	8.5	Low-use general recreation, adult	4.3	---	---	---	4.3	4.3	126	**43**	1261	429	12610	115	468
85a	0.25	Recreational canoeist	7.9	---	---	---	7.9	1.2	13	**12**	129	121	1286	28	73
85b	10	High-use general recreation, older child	1.7	---	---	---	1.7	3.9	51	39	514	388	5143	**27**	176
86	118	High-use commercial (groundskeeper scenario)	2.5	---	---	---	2.5	1.8	17	**18**	166	177	1664	25	57
87	10	High-use general recreation, young child (high use)	9.4	1	4000	2.5	4.6	1.3	18	13	184	134	1842	**4.6**	32
87a	0.88	Bank fishing	6.0	---	---	---	5.4	2.6	52	**26**	524	256	5237	42	180
88	1.1	Medium-use general recreation, older child	13	---	---	---	13	5.8	51	58	514	582	5143	**40**	176
89	4.3	High-use general recreation, adult	6.4	---	---	---	6.4	1.4	63	**14**	630	143	6305	38	234
90	8.9	High-use general recreation, adult / older child	6.8	---	---	---	6.8	1.4	51	**14**	514	143	5143	27	176
				Subtotal:	**75,900**	**47**									

Heavily Used Subareas

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal[4]			Post-Remediation EPC (mg/kg)[3]	IMPG[5] (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
4	0.71	High-use general recreation, young child (low use)	17	3	200	0.090	17	8.0	37	80	368	802	3684	**27**	63
12	1.5	High-use general recreation, young child (low use)	9.8	---	---	---	9.7	8.0	37	80	368	802	3684	**27**	63
26a	2.2	High-use general recreation, adult / older child	1.9	---	---	---	1.9	1.4	51	**14**	514	143	5143	27	176
39	0.15	Marathon canoeist	54	3	400	0.12	7.8	0.78	5.8	**7.8**	58	78	575	13	25
40	5.2	High-use general recreation, young child (low use)	19	3	300	0.18	18	8.0	37	80	368	802	3684	**27**	63
47	0.18	Recreational canoeist	6.0	---	---	---	0.72	1.2	13	**12**	129	121	1286	28	73
52	0.25	Recreational canoeist	7.0	3	400	0.22	1.7	1.2	13	**12**	129	121	1286	28	73
53	0.35	Recreational canoeist	408	3	100	0.030	9.0	1.2	13	**12**	129	121	1286	28	73
60a	0.16	Recreational canoeist	7.0	---	---	---	6.9	1.2	13	**12**	129	121	1286	28	73
				Subtotal:	**1,400**	**0.64**									
				Total:	**77,000**	**48**									

Key

🟦 = post-remediation EPC is lower than the IMPG

Notes:

[1] *See Figures 5-1 and 5-2 for direct contact exposure areas in Reaches 5 through 8, and Heavily Used Subareas, respectively.*

[2] *Area only includes the portion of the exposure area within the 1 mg/kg PCB isopleth (Reaches 5/6) or the 100-year floodplain (Reaches 7/8).*

[3] *EPC is calculated for top 1-ft floodplain soil, except in Heavily Used Subareas where it is calculated for top 3-ft floodplain soil.*

[4] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[5] *For scenarios containing more than one receptor (e.g. adult and older child), the lowest IMPG was utilized in the comparison to post-remediation EPCs. The lowest IMPG value for which the alternative was designed to achieve is shown in bold.*

Table 6-20. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for agricultural products consumption areas under FP 4.

Farm ID[1]	Area of farm (acre)[2]	IMPG Scenario	Pre-Remediation EPC[3] (mg/kg)	Removal[4]			Post-Remediation EPC[3] (mg/kg)	IMPG[5] (mg/kg)									
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @10^{-4}		Non-Cancer (Child)		Non-Cancer (Adult)	
				Depth (ft)	Volume (cy)	Area (acres)		RME	CTE	RME	CTE	RME	CTE	RME	CTE	RME	CTE
FA 1	8.0	Commercial Dairy	1.6	---	---	---	1.6	0.68	3.1	**6.8**	31	68	312	7.7	12.2	36.4	44.3
FA 2	3.3		13	---	---	---	12	2.59	11.9	**25.9**	119	259	1187	29.1	46.4	138.1	168.3
FA 3	4.1		0.20	---	---	---	0.20	0.29	1.3	**2.9**	13	29	132	3.2	5.2	15.4	18.7
FA 4	64		0.38	---	---	---	0.38	0.24	1.1	**2.4**	11	24	110	2.7	4.3	12.8	15.6
FA 5	12		0.25	---	---	---	0.25	0.24	1.1	**2.4**	11	24	110	2.7	4.3	12.8	15.6
FA 6	8		0.25	---	---	---	0.25	0.24	1.1	**2.4**	11	24	110	2.7	4.3	12.8	15.6
FA 7	24		0.25	---	---	---	0.25	0.24	1.1	**2.4**	11	24	110	2.7	4.3	12.8	15.6
FA 8	9.4		0.19	---	---	---	0.19	0.34	1.5	**3.4**	15	34	154	3.8	6.0	17.9	21.8
FA 9	26		0.89	---	---	---	0.89	0.31	1.4	**3.1**	14	31	143	3.5	5.6	16.6	20.3
FA 10	0.3		0.50	---	---	---	0.50	2.06	9.5	**20.6**	95	206	946	23.2	37.0	110.1	134.2
FA 11	0.14		0.25	---	---	---	0.25	6.10	27.9	**61.0**	279	610	2794	68.6	109.2	325.1	396.2
FA 12	8.0		0.25	---	---	---	0.25	0.38	1.8	**3.8**	18	38	176	4.3	6.9	20.5	25.0
FA 13	4.0		0.25	---	---	---	0.25	0.24	1.1	**2.4**	11	24	110	2.7	4.3	12.8	15.6
FA 14	2.6		0.30	---	---	---	0.30	0.55	2.5	**5.5**	25	55	253	6.2	9.9	29.4	35.9
				Total:	**0**	**0**											

Notes:

[1] *See Figure 5-4 for farm areas in Reaches 5 through 8.*

[2] *Farm area only includes the portion within the 1 mg/kg PCB isopleth (Reaches 5/6) or the 100-year floodplain (Reaches 7/8).*

[3] *EPC is calculated for the top 1 ft of floodplain soil.*

[4] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[5] *IMPG values for agricultural products consumption include a multiplier to account for the areas outside the 1 mg/kg PCB isopleth/100-year floodplain (see Table 5-2). The lowest IMPG value for which the alternative was designed to achieve is shown in bold.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-21. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for wood frog averaging areas (vernal pools) under FP 4.

Vernal Pool ID[1]	Area of Vernal Pool (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal[3]			Post-Remediation EPC[2](mg/kg)	IMPG[4] (mg/kg)	
			Depth (ft)	Volume (cy)	Area (acre)		Lower Bound	Upper Bound
5-VP-3	1.9	29	1	2000	1.2	5.6	3.27	**5.6**
5-VP-1	0.044	1.7	---	---	---	1.7	3.27	**5.6**
8-VP-5	0.043	26	1	60	0.040	5.6	3.27	**5.6**
8-VP-4	0.24	3.9	---	---	---	3.9	3.27	**5.6**
8-VP-3	0.02	7.7	1	40	0.020	0.021	3.27	**5.6**
8-VP-2	0.57	66	1	700	0.42	5.6	3.27	**5.6**
18-VP-2	0.61	7.2	1	70	0.040	5.6	3.27	**5.6**
18-VP-1	0.28	7.9	1	60	0.040	5.0	3.27	**5.6**
19-VP-7	0.068	0.80	---	---	---	0.80	3.27	**5.6**
19-VP-2	0.0080	34	1	10	0.010	0.021	3.27	**5.6**
19-VP-1	0.18	23	1	200	0.13	5.5	3.27	**5.6**
19-VP-3	0.031	10	1	20	0.010	3.6	3.27	**5.6**
19-VP-4	0.094	5.6	1	4.	0.0	4.2	3.27	**5.6**
19-VP-8	0.057	91	---	---	---	0.021	3.27	**5.6**
19-VP-5	0.51	26	1	500	0.31	5.6	3.27	**5.6**
19-VP-6	1.2	22	1	500	0.29	5.6	3.27	**5.6**
23-VP-2	0.18	46	1	200	0.14	5.6	3.27	**5.6**
23-VP-1	0.30	62	1	200	0.11	5.6	3.27	**5.6**
23A-VP-1	0.45	26	1	600	0.38	5.5	3.27	**5.6**
23A-VP-1	0.068	26	1	600	0.38	5.6	3.27	**5.6**
23B-VP-2	0.091	0.34	---	---	---	0.34	3.27	**5.6**
27B-VP-2	0.28	11	1	200	0.15	5.5	3.27	**5.6**
27B-VP-3	0.062	16	1	60	0.040	5.2	3.27	**5.6**
27B-VP-1	0.072	12	1	60	0.040	5.3	3.27	**5.6**
27-VP-2	0.47	21	1	200	0.10	5.6	3.27	**5.6**
27A-VP-1	0.20	31	1	300	0.16	5.1	3.27	**5.6**
27-VP-1	1.3	23	1	400	0.24	5.5	3.27	**5.6**
26-VP-1	0.036		1	30	0.020	5.6	3.27	**5.6**
33-VP-1	0.022	10	1	30	0.020	0.021	3.27	**5.6**
33-VP-2	0.12	65	1	60	0.040	5.6	3.27	**5.6**
38-VP-1	0.43	34	1	500	0.28	5.6	3.27	**5.6**
38A-VP-1	0.020	5.0	---	---	---	5.0	3.27	**5.6**
38-VP-3	0.046	28	1	40	0.020	5.0	3.27	**5.6**
38-VP-2	0.17	28	1	200	0.13	5.6	3.27	**5.6**
40-VP-3	0.46	59	1	600	0.40	5.0	3.27	**5.6**
40-VP-2	0.36	17	1	200	0.15	5.6	3.27	**5.6**
40A-VP-1	0.11	68	1	200	0.090	5.6	3.27	**5.6**
40-VP-1	0.47	58	1	300	0.21	5.6	3.27	**5.6**
42-VP-1	0.22	63	1	300	0.19	5.1	3.27	**5.6**
42-VP-2	0.28	45	1	400	0.26	5.6	3.27	**5.6**
42-VP-3	0.050	41	1	60	0.040	1.9	3.27	**5.6**
42-VP-5	0.58	61	1	300	0.21	5.4	3.27	**5.6**
42-VP-4	1.0	33	1	900	0.55	5.6	3.27	**5.6**
42A-VP-1	1.5	31	1	1000	0.91	5.6	3.27	**5.6**
46-VP-2	7.1	20	1	1000	0.75	5.6	3.27	**5.6**
46-VP-1	0.52	51	1	60	0.040	4.2	3.27	**5.6**
46-VP-5	0.056	123	1	80	0.050	0.021	3.27	**5.6**
46-VP-3	1.4	67	1	900	0.57	5.6	3.27	**5.6**
46-VP-4	0.011	125	1	7.	0.0	0.021	3.27	**5.6**
49A-VP-1	0.019	16	1	30	0.020	0.021	3.27	**5.6**
49-VP-1	1.2	18	1	600	0.37	5.5	3.27	**5.6**
49B-VP-1	0.0044	26	1	7.	0.0	0.021	3.27	**5.6**
66A-VP-1	0.032	0.70	---	---	---	0.70	3.27	**5.6**
69-VP-1	0.0074	12	1	10	0.010	0.021	3.27	**5.6**
8-VP-6	0.086	47	1	100	0.080	0.70	3.27	**5.6**
12-VP-1	0.080	8.0	1	30	0.020	2.5	3.27	**5.6**
39-VP-1	2.0	32	1	2000	1.2	5.6	3.27	**5.6**
54-VP-1	0.20	21	1	300	0.17	3.0	3.27	**5.6**
55-VP-1	0.59	7.7	1	4.	0.0	4.0	3.27	**5.6**
55A-VP-1	2.0	79	1	2000	1.2	4.9	3.27	**5.6**
58A-VP-1	0.32	22	1	400	0.25	5.5	3.27	**5.6**
67A-VP-1	0.12	13	1	10	0.010	3.9	3.27	**5.6**
61A-VP-1	0.19	28	1	10	0.010	1.5	3.27	**5.6**
61A-VP-2	1.2	35	1	500	0.29	4.7	3.27	**5.6**
56A-VP-1	0.58	73	1	900	0.56	0.85	3.27	**5.6**
23-VP-3	1.3	22	1	1000	0.73	3.0	3.27	**5.6**
			Total:	**22,000**	**14**			

Notes:

[1] *See Figure 5-5 for locations of vernal pools.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

[3] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[4] *The IMPG value for which the alternative was designed to achieve is shown in bold.*

Key

▭ = post-remediation EPC is lower than the IMPG

Table 6-22. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for shrew averaging areas under FP 4.

Averaging Area ID[1]	Area of Averaging Area (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal[3]			Post-Remediation EPC[2] (mg/kg)	IMPG (mg/kg)	
			Depth (ft)	Volume (cy)	Area (acre)		Lower Bound	Upper Bound
G1	88	22	---	---	---	12	21.1	**34.3**
G2	87	50	---	---	---	15	21.1	**34.3**
G3	86	18	---	---	---	15	21.1	**34.3**
G4	86	27	---	---	---	21	21.1	**34.3**
G5	88	28	---	---	---	23	21.1	**34.3**
G6	87	11	---	---	---	11	21.1	**34.3**
G7	73	17	---	---	---	14	21.1	**34.3**
			Total:	**0**	**0**			

Notes:

[1] *See Figure 5-6 for shrew averaging areas.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

[3] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-23. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for wood duck averaging areas under FP 4.

Averaging Area ID[1]	Reach	Averaging Area (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal[3]			Post-Remediation EPC[2] (mg/kg)	Floodplain IMPG[4] (mg/kg)		
				Depth (ft)	Volume (cy)	Area (acre)		Sediment Target Level		
								1 mg/kg	3 mg/kg	5 mg/kg
K1	5A	52	34	---	---	---	18	**50**	39	29
K2		63	8.1	---	---	---	5.8	**50**	39	29
K3		85	40	---	---	---	19	**50**	39	29
K4		60	17	---	---	---	13	**50**	39	29
K5		25	23	---	---	---	14	**50**	39	29
K6	5B	55	25	---	---	---	20	**48**	33	18
K7		47	29	---	---	---	22	**48**	33	18
K8		92	24	---	---	---	21	**48**	33	18
K9	5C/5D	69	25	---	---	---	19	**53**	49	46
K10		83	13	---	---	---	12	**53**	49	46
K11		61	14	---	---	---	14	**53**	49	46
K12	6	28	23	---	---	---	16	**53**	50	46
				Total:	**0**	**0**				

Notes:

[1] *See Figure 5-7 for wood duck averaging areas.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

[3] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-24. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for mink averaging areas under FP 4.

Averaging Area[1]	**Area of Averaging Area (acre)**	**Pre-Remediation EPC[2] (mg/kg)**	**Removal[3]**			**Post-Remediation EPC[2] (mg/kg)**	**Floodplain IMPG[4] (mg/kg)**					
							Sediment Target Level					
			Depth (ft)	**Volume (cy)**	**Area (acre)**		**1 mg/kg**		**3 mg/kg**		**5 mg/kg**	
							Lower Bound	**Upper Bound**	**Lower Bound**	**Upper Bound**	**Lower Bound**	**Upper Bound**
5A/5B	435	22	---	---	---	15	3.4	**16.6**	*n/a*	5.12	*n/a*	*n/a*
5C/5D/6	291	18	---	---	---	15	6.9	**19.6**	3.0	15.7	*n/a*	11.8
			Total:	**0**	**0**							

Notes:

[1] *See Figure 5-8 for mink averaging areas.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

[3] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[4] *(n/a) denotes IMPG values not attainable in given reach for the sediment target level. The IMPG value for which the alternative was designed to achieve is shown in bold.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-25. Summary of IMPGs and pre- and post-remediation EPCs for human direct contact exposure areas under FP 5.

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal[4]			Post-Remediation EPC (mg/kg)[3]	IMPG[5] (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
1	15	Medium-use general recreation, adult / older child	36	---	---	---	14	2.1	51	21	514	215	5143	40	176
2	27	High-use general recreation, adult / older child	31	---	---	---	15	1.4	51	14	514	143	5143	27	176
2a	2.3	Low-use general recreation, older child	56	---	---	---	24	12	103	116	1029	1165	10286	80	353
2b	2.0	High-use general recreation, older child	29	---	---	---	25	3.9	51	39	514	388	5143	27	176
3	0.4	High-use general recreation, adult	5.6	---	---	---	5.6	1.4	63	14	630	143	6305	38	234
4	3.2	High-use general recreation, young child (low use)	29	---	---	---	11	8.0	37	80	368	802	3684	27	63
5	2.5	High-use general recreation, adult / older child	48	---	---	---	14	1.4	51	14	514	143	5143	27	176
6	3.8	Low-use general recreation, adult	59	---	---	---	25	4.3	126	43	1261	429	12610	115	468
7	5.9	High-use general recreation, adult / older child	21	---	---	---	17	1.4	51	14	514	143	5143	27	176
8	0.60	Recreational canoeist	40	---	---	---	20	1.2	13	12	129	121	1286	28	73
9	0.042	Low-use general recreation, older child	27	---	---	---	27	12	103	116	1029	1165	10286	80	353
10	59	High-use general recreation, young child (high use)	10	---	---	---	10	1.3	18	13	184	134	1842	4.6	32
10a	8.0	High-use general recreation, young child (high use)	18	---	---	---	18	1.3	18	13	184	134	1842	4.6	32
11	2.5	High-use general recreation, adult	15	---	---	---	15	1.4	63	14	630	143	6305	38	234
12	4.8	High-use general recreation, young child (low use)	7	---	---	---	5.9	8.0	37	80	368	802	3684	27	63
13	5.9	High-use general recreation, adult	14	---	---	---	14	1.4	63	14	630	143	6305	38	234
14	4.1	High-use general recreation, adult	2.7	---	---	---	2.7	1.4	63	14	630	143	6305	38	234
15	0.87	High-use general recreation, adult	2.0	---	---	---	2.0	1.4	63	14	630	143	6305	38	234
16	2.5	High-use general recreation, adult	22	---	---	---	22	1.4	63	14	630	143	6305	38	234
17	8.5	High-use general recreation, adult	13	---	---	---	13	1.4	63	14	630	143	6305	38	234
18	17	Medium-use general recreation, adult	17	---	---	---	14	2.1	63	21	630	215	6305	58	234
19	36	High-use general recreation, adult	83	---	---	---	16	1.4	63	14	630	143	6305	38	234
20	9.1	High-use general recreation, adult	31	---	---	---	17	1.4	63	14	630	143	6305	38	234
21	2.9	High-use general recreation, adult / older child	4.9	---	---	---	4.4	1.4	51	14	514	143	5143	27	176
22	19	High-use general recreation, adult / older child	26	---	---	---	16	1.4	51	14	514	143	5143	27	176
22a	1.8	Dirt biking/ATVing	88	---	---	---	15	2.0	29	20	290	205	2901	14	99
23	0.28	Medium-use general recreation, older child	12	---	---	---	10	5.8	51	58	514	582	5143	40	176
24	10	High-use general recreation, adult	31	---	---	---	17	1.4	63	14	630	143	6305	38	234
25	0.51	High-use general recreation, older child	30	---	---	---	16	3.9	51	39	514	388	5143	27	176
26a	48	High-use general recreation, adult / older child	7.2	---	---	---	7.2	1.4	51	14	514	143	5143	27	176
26b	7.6	Agricultural use (based on direct contact by farmer)	1.7	---	---	---	1.7	1.2	42	12	419	118	4195	43	348
26_F	55	High-use general recreation, adult / older child	6.3	---	---	---	6.3	1.4	51	14	514	143	5143	27	176
27	6.3	High-use general recreation, adult / older child	2.4	---	---	---	2.4	1.4	51	14	514	143	5143	27	176
27a	0.38	Dirt biking/ATVing	4.3	---	---	---	4.3	2.0	29	20	290	205	2901	14	99
28	0.21	High-use general recreation, young child (low use)	21	---	---	---	21	8.0	37	80	368	802	3684	27	63
28a	0.071	Dirt biking/ATVing	21	---	---	---	21	2.0	29	20	290	205	2901	14	99
29	0.34	Low-use general recreation, adult / older child	21	---	---	---	21	4.3	103	43	1029	429	10286	80	353
30	0.19	High-use general recreation, adult / older child	13	---	---	---	13	1.4	51	14	514	143	5143	27	176
31	5.0	High-use general recreation, adult / older child	14	---	---	---	14	1.4	51	14	514	143	5143	27	176
31a	0.61	High-use general recreation, adult / older child	42	---	---	---	42	1.4	51	14	514	143	5143	27	176
32	6.8	High-use general recreation, adult	14	---	---	---	14	1.4	63	14	630	143	6305	38	234
33	30	High-use general recreation, adult	20	---	---	---	16	1.4	63	14	630	143	6305	38	234
34	7.8	Medium-use general recreation, adult	25	---	---	---	19	2.1	63	21	630	215	6305	58	234
35	25	High-use general recreation, adult / older child	22	---	---	---	19	1.4	51	14	514	143	5143	27	176
35a	1.2	High-use general recreation, adult / older child	39	---	---	---	39	1.4	51	14	514	143	5143	27	176
36a	16	Low-use commercial (groundskeeper scenario)	23	---	---	---	23	8.9	166	89	1664	885	16642	126	571
36b	2.2	Agricultural use (based on direct contact by farmer)	15	---	---	---	15	1.2	42	12	419	118	4195	43	348
37	20	High-use general recreation, adult / older child	17	---	---	---	14	1.4	51	14	514	143	5143	27	176
37a	1.4	Bank fishing	26	---	---	---	21	2.6	52	26	524	256	5237	42	180
37b	2.3	High-use general recreation, adult / older child	25	---	---	---	4.1	1.4	51	14	514	143	5143	27	176

Table 6-25. Summary of IMPGs and pre- and post-remediation EPCs for human direct contact exposure areas under FP 5.

Exposure Area ID^1	Area of Exposure Area (acre)^2	IMPG Scenario	Pre-Remediation EPC (mg/kg)^3	Removal^4			Post-Remediation EPC (mg/kg)^3	IMPG^5 (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
38	13	High-use general recreation, adult	23	---	---	---	18	1.4	63	14	630	143	6305	38	234
38a	1.4	Bank fishing	33	---	---	---	26	2.6	52	26	524	256	5237	42	180
39	3.5	Marathon canoeist	32	---	---	---	9.1	0.78	5.8	7.8	58	78	575	13	25
40	98	High-use general recreation, young child (low use)	20	---	---	---	5.0	8.0	37	80	368	802	3684	27	63
40a	4.6	Bank fishing	40	---	---	---	16	2.6	52	26	524	256	5237	42	180
40b	1.1	High-use general recreation, young child (low use)	11	---	---	---	11	8.0	37	80	368	802	3684	27	63
41	20	Medium-use general recreation, adult	28	---	---	---	22	2.1	63	21	630	215	6305	58	234
41a	2.4	Bank fishing	35	---	---	---	27	2.6	52	26	524	256	5237	42	180
42	14	Medium-use general recreation, adult	12	---	---	---	12	2.1	63	21	630	215	6305	58	234
42a	0.94	Bank fishing	14	---	---	---	14	2.6	52	26	524	256	5237	42	180
43	1.5	Medium-use general recreation, adult	27	---	---	---	6.3	2.1	63	21	630	215	6305	58	234
43a	0.24	Bank fishing	64	---	---	---	6.7	2.6	52	26	524	256	5237	42	180
44	2.2	High-use general recreation, adult	24	---	---	---	20	1.4	63	14	630	143	6305	38	234
45	17	High-use general recreation, adult	39	---	---	---	11	1.4	63	14	630	143	6305	38	234
46	7.2	High-use general recreation, adult	8.2	---	---	---	7.7	1.4	63	14	630	143	6305	38	234
47	1.0	Recreational canoeist	18	---	---	---	18	1.2	13	12	129	121	1286	28	73
47_F	0.12	Recreational canoeist	8.1	---	---	---	8.1	1.2	13	12	129	121	1286	28	73
48	6.5	High-use general recreation, adult	3.4	---	---	---	3.4	1.4	63	14	630	143	6305	38	234
49	7.7	Low-use general recreation, adult	17	---	---	---	14	4.3	126	43	1261	429	12610	115	468
50	69	Low-use general recreation, adult	7.3	---	---	---	6.1	4.3	126	43	1261	429	12610	115	468
50a	11	Waterfowl hunting	15	---	---	---	11	9.0	75	90	752	904	7518	140	399
51	87	Low-use general recreation, adult	7.2	---	---	---	7.0	4.3	126	43	1261	429	12610	115	468
51a	32	Waterfowl hunting	13	---	---	---	10	9.0	75	90	752	904	7518	140	399
52	0.9	Recreational canoeist	10	---	---	---	9.6	1.2	13	12	129	121	1286	28	73
53	0.7	Recreational canoeist	34	---	---	---	34	1.2	13	12	129	121	1286	28	73
54	13	High-use general recreation, adult	7.1	---	---	---	6.7	1.4	63	14	630	143	6305	38	234
55	18	High-use general recreation, young child (low use)	11	---	---	---	11	8.0	37	80	368	802	3684	27	63
55a	5.0	Waterfowl hunting	47	---	---	---	27	9.0	75	90	752	904	7518	140	399
56	32	Medium-use general recreation, adult / older child	38	---	---	---	25	2.1	51	21	514	215	5143	40	176
56a	10	Waterfowl hunting	49	---	---	---	18	9.0	75	90	752	904	7518	140	399
57	13	High-use general recreation, young child (low use)	5.8	---	---	---	5.7	8.0	37	80	368	802	3684	27	63
58	1.3	High-use general recreation, adult	65	---	---	---	3.6	1.4	63	14	630	143	6305	38	234
59	1.9	High-use general recreation, young child (low use)	18	---	---	---	17	8.0	37	80	368	802	3684	27	63
59a	0.83	Bank fishing	22	---	---	---	21	2.6	52	26	524	256	5237	42	180
60	0.84	High-use general recreation, young child (low use)	7.0	---	---	---	7.0	8.0	37	80	368	802	3684	27	63
60a	0.16	Recreational canoeist	13	---	---	---	13	1.2	13	12	129	121	1286	28	73
61	3.3	Utility worker	42	---	---	---	21	17	209	169	2093	1694	20933	242	718
62	1.6	Utility worker	134	---	---	---	13	17	209	169	2093	1694	20933	242	718
63	0.67	Utility worker	23	---	---	---	19	17	209	169	2093	1694	20933	242	718
64	0.61	Utility worker	42	---	---	---	42	17	209	169	2093	1694	20933	242	718
65	3.9	Utility worker	17	---	---	---	17	17	209	169	2093	1694	20933	242	718
66	1.7	Utility worker	23	---	---	---	9.2	17	209	169	2093	1694	20933	242	718
67	0.31	High-use general recreation, adult	11	---	---	---	11	1.4	63	14	630	143	6305	38	234
68	0.090	High-use general recreation, adult	9	---	---	---	9.0	1.4	63	14	630	143	6305	38	234
69	1.9	High-use general recreation, adult	7.3	---	---	---	7.3	1.4	63	14	630	143	6305	38	234
70	19	High-use general recreation, young child (high use)	2.4	---	---	---	2.4	1.3	18	13	184	134	1842	4.6	32
70a	1.2	Bank fishing	3.8	---	---	---	3.8	2.6	52	26	524	256	5237	42	180
71	1.8	Bank fishing	4.6	---	---	---	4.6	2.6	52	26	524	256	5237	42	180
72	2.3	Bank fishing	10	---	---	---	10	2.6	52	26	524	256	5237	42	180
73	3.9	High-use general recreation, adult	0.50	---	---	---	0.50	1.4	63	14	630	143	6305	38	234

Table 6-25. Summary of IMPGs and pre- and post-remediation EPCs for human direct contact exposure areas under FP 5.

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal[4]			Post-Remediation EPC (mg/kg)[3]	IMPG[5] (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
74	5.3	High-use general recreation, adult	5.3	---	---	---	5.3	1.4	63	14	630	143	6305	38	234
75	3.4	High-use general recreation, adult	15	---	---	---	15	1.4	63	14	630	143	6305	38	234
76	1.1	High-use general recreation, adult	0.79	---	---	---	0.79	1.4	63	14	630	143	6305	38	234
77	4.2	High-use general recreation, adult	0.89	---	---	---	0.89	1.4	63	14	630	143	6305	38	234
78	6.2	High-use general recreation, older child	5.9	---	---	---	5.9	3.9	51	39	514	388	5143	27	176
79	17	High-use general recreation, adult	2.9	---	---	---	2.9	1.4	63	14	630	143	6305	38	234
80a	9.5	Low-use general recreation, adult	2.6	---	---	---	2.6	4.3	126	43	1261	429	12610	115	468
80b	20	Agricultural use (based on direct contact by farmer)	0.76	---	---	---	0.76	1.2	42	12	419	118	4195	43	348
81	33	Low-use general recreation, adult	2.3	---	---	---	2.3	4.3	126	43	1261	429	12610	115	468
82	15	Low-use general recreation, adult	3.6	---	---	---	3.6	4.3	126	43	1261	429	12610	115	468
83	22	High-use commercial (groundskeeper scenario)	1.9	---	---	---	1.9	1.8	17	18	166	177	1664	25	57
84	8.5	Low-use general recreation, adult	4.3	---	---	---	4.3	4.3	126	43	1261	429	12610	115	468
85a	0.25	Recreational canoeist	7.9	---	---	---	7.9	1.2	13	12	129	121	1286	28	73
85b	10	High-use general recreation, older child	1.7	---	---	---	1.7	3.9	51	39	514	388	5143	27	176
86	118	High-use commercial (groundskeeper scenario)	2.5	---	---	---	2.5	1.8	17	18	166	177	1664	25	57
87	10	High-use general recreation, young child (high use)	9.4	---	---	---	9.4	1.3	18	13	184	134	1842	4.6	32
87a	0.88	Bank fishing	6.0	---	---	---	6.0	2.6	52	26	524	256	5237	42	180
88	1.1	Medium-use general recreation, older child	13	---	---	---	13	5.8	51	58	514	582	5143	40	176
89	4.3	High-use general recreation, adult	6.4	---	---	---	6.4	1.4	63	14	630	143	6305	38	234
90	8.9	High-use general recreation, adult / older child	6.8	---	---	---	6.8	1.4	51	14	514	143	5143	27	176

Heavily Used Subareas

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal[4]			Post-Remediation EPC (mg/kg)[3]	IMPG[5] (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
4	0.71	High-use general recreation, young child (low use)	17	---	---	---	9.4	8.0	37	80	368	802	3684	27	63
12	1.5	High-use general recreation, young child (low use)	9.8	---	---	---	9.8	8.0	37	80	368	802	3684	27	63
26a	2.2	High-use general recreation, adult / older child	1.9	---	---	---	1.9	1.4	51	14	514	143	5143	27	176
39	0.15	Marathon canoeist	54	---	---	---	15	0.78	5.8	7.8	58	78	575	13	25
40	5.2	High-use general recreation, young child (low use)	19	---	---	---	18	8.0	37	80	368	802	3684	27	63
47	0.18	Recreational canoeist	6.0	---	---	---	6.0	1.2	13	12	129	121	1286	28	73
52	0.25	Recreational canoeist	7.0	---	---	---	7.0	1.2	13	12	129	121	1286	28	73
53	0.35	Recreational canoeist	408	---	---	---	18	1.2	13	12	129	121	1286	28	73
60a	0.16	Recreational canoeist	7.0	---	---	---	7.0	1.2	13	12	129	121	1286	28	73

Notes:

[1] *See Figures 5-1 and 5-2 for direct contact exposure areas in Reaches 5 through 8, and Heavily Used Subareas, respectively.*

[2] *Area only includes the portion of the exposure area within the 1 mg/kg PCB isopleth (Reaches 5/6) or the 100-year floodplain (Reaches 7/8).*

[3] *EPC is calculated for top 1-ft floodplain soil, except in Heavily Used Subareas where it is calculated for top 3-ft floodplain soil.*

[4] *Removal volumes for threshold-based alternatives are not shown by exposure/averaging areas.*

[5] *For scenarios containing more than one receptor (e.g. adult and older child), the lowest IMPG was utilized in the comparison to post-remediation EPCs.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-26. Summary of IMPGs and pre- and post-remediation EPCs for agricultural products consumption under FP 5.

Farm ID[1]	Area of farm (acre)[2]	IMPG Scenario	Pre-Remediation EPC[3] (mg/kg)	Removal			Post-Remediation EPC[3] (mg/kg)	IMPG[4] (mg/kg)									
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @10^{-4}		Non-Cancer (Child)		Non-Cancer (Adult)	
				Depth (ft)	Volume (cy)	Area (acres)		RME	CTE	RME	CTE	RME	CTE	RME	CTE	RME	CTE
FA 1	8.0	Commercial Dairy	1.6	---	---	---	1.6	0.68	3.1	6.8	31	68	312	7.7	12.2	36.4	44.3
FA 2	3.3		13	---	---	---	13	2.59	11.9	25.9	119	259	1187	29.1	46.4	138.1	168.3
FA 3	4.1		0.20	---	---	---	0.20	0.29	1.3	2.9	13	29	132	3.2	5.2	15.4	18.7
FA 4	64		0.38	---	---	---	0.38	0.24	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 5	12		0.25	---	---	---	0.25	0.24	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 6	8		0.25	---	---	---	0.25	0.24	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 7	24		0.25	---	---	---	0.25	0.24	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 8	9.4		0.19	---	---	---	0.19	0.34	1.5	3.4	15	34	154	3.8	6.0	17.9	21.8
FA 9	26		0.89	---	---	---	0.89	0.31	1.4	3.1	14	31	143	3.5	5.6	16.6	20.3
FA 10	0.3		0.50	---	---	---	0.50	2.06	9.5	20.6	95	206	946	23.2	37.0	110.1	134.2
FA 11	0.14		0.25	---	---	---	0.25	6.10	27.9	61.0	279	610	2794	68.6	109.2	325.1	396.2
FA 12	8.0		0.25	---	---	---	0.25	0.38	1.8	3.8	18	38	176	4.3	6.9	20.5	25.0
FA 13	4.0		0.25	---	---	---	0.25	0.24	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 14	2.6		0.30	---	---	---	0.30	0.55	2.5	5.5	25	55	253	6.2	9.9	29.4	35.9

Notes:

[1] *See Figure 5-4 for farm areas in Reaches 5 through 8.*

[2] *Farm area only includes the portion within the 1 mg/kg PCB isopleth (Reaches 5/6) or the 100-year floodplain (Reaches 7/8).*

[3] *EPC is calculated for the top 1 ft of floodplain soil.*

[4] *IMPG values for agricultural products consumption include a multiplier to account for the areas outside the 1 mg/kg PCB isopleth/100-year floodplain (see Table 5-2).*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-27. Summary of IMPGs and pre- and post-remediation EPCs for wood frog averaging areas (vernal pools) under FP 5.

Vernal Pool ID[1]	Area of Vernal Pool (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal			Post-Remediation EPC[2](mg/kg)	IMPG (mg/kg)	
			Depth (ft)	Volume (cy)	Area (acre)		Lower Bound	Upper Bound
5-VP-3	1.9	29	---	---	---	27	3.27	5.6
5-VP-1	0.044	1.7	---	---	---	1.7	3.27	5.6
8-VP-5	0.043	26	---	---	---	26	3.27	5.6
8-VP-4	0.24	3.9	---	---	---	3.9	3.27	5.6
8-VP-3	0.02	7.7	---	---	---	7.7	3.27	5.6
8-VP-2	0.57	66	---	---	---	29	3.27	5.6
18-VP-2	0.61	7.2	---	---	---	7.2	3.27	5.6
18-VP-1	0.28	7.9	---	---	---	7.9	3.27	5.6
19-VP-7	0.068	0.80	---	---	---	0.80	3.27	5.6
19-VP-2	0.0080	34	---	---	---	34	3.27	5.6
19-VP-1	0.18	23	---	---	---	23	3.27	5.6
19-VP-3	0.031	10	---	---	---	10	3.27	5.6
19-VP-4	0.094	5.6	---	---	---	5.6	3.27	5.6
19-VP-8	0.057	91	---	---	---	0.021	3.27	5.6
19-VP-5	0.51	26	---	---	---	26	3.27	5.6
19-VP-6	1.2	22	---	---	---	21	3.27	5.6
23-VP-2	0.18	46	---	---	---	37	3.27	5.6
23-VP-1	0.30	62	---	---	---	25	3.27	5.6
23A-VP-1	0.45	26	---	---	---	26	3.27	5.6
23B-VP-1	0.068	26	---	---	---	26	3.27	5.6
23B-VP-2	0.091	0.34	---	---	---	0.34	3.27	5.6
27B-VP-2	0.28	11	---	---	---	11	3.27	5.6
27B-VP-3	0.062	16	---	---	---	16	3.27	5.6
27B-VP-1	0.072	12	---	---	---	12	3.27	5.6
27-VP-2	0.47	21	---	---	---	21	3.27	5.6
27A-VP-1	0.20	31	---	---	---	31	3.27	5.6
27-VP-1	1.3	23	---	---	---	23	3.27	5.6
26-VP-1	0.036	40	---	---	---	40	3.27	5.6
33-VP-1	0.022	10	---	---	---	10	3.27	5.6
33-VP-2	0.12	65	---	---	---	46	3.27	5.6
38-VP-1	0.43	34	---	---	---	26	3.27	5.6
38A-VP-1	0.020	5.0	---	---	---	5.0	3.27	5.6
38-VP-3	0.046	28	---	---	---	28	3.27	5.6
38-VP-2	0.17	28	---	---	---	28	3.27	5.6
40-VP-3	0.46	59	---	---	---	34	3.27	5.6
40-VP-2	0.36	17	---	---	---	17	3.27	5.6
40A-VP-1	0.11	68	---	---	---	48	3.27	5.6
40-VP-1	0.47	58	---	---	---	4.2	3.27	5.6
42-VP-1	0.22	63	---	---	---	5.1	3.27	5.6
42-VP-2	0.28	45	---	---	---	45	3.27	5.6
42-VP-3	0.050	41	---	---	---	41	3.27	5.6
42-VP-5	0.58	61	---	---	---	18	3.27	5.6
42-VP-4	1.0	33	---	---	---	25	3.27	5.6
42A-VP-1	1.5	31	---	---	---	20	3.27	5.6
46-VP-2	7.1	20	---	---	---	2.6	3.27	5.6
46-VP-1	0.52	51	---	---	---	0.47	3.27	5.6
46-VP-5	0.056	123	---	---	---	5.4	3.27	5.6
46-VP-3	1.4	67	---	---	---	0.87	3.27	5.6
46-VP-4	0.011	125	---	---	---	0.021	3.27	5.6
49A-VP-1	0.019	16	---	---	---	16	3.27	5.6
49-VP-1	1.2	18	---	---	---	18	3.27	5.6
49B-VP-1	0.0044	26	---	---	---	26	3.27	5.6
66A-VP-1	0.032	0.70	---	---	---	0.70	3.27	5.6
69-VP-1	0.0074	12	---	---	---	12	3.27	5.6
8-VP-6	0.086	47	---	---	---	47	3.27	5.6
12-VP-1	0.080	8.0	---	---	---	8.0	3.27	5.6
39-VP-1	2.0	32	---	---	---	32	3.27	5.6
54-VP-1	0.20	21	---	---	---	21	3.27	5.6
55-VP-1	0.59	7.7	---	---	---	7.7	3.27	5.6
55A-VP-1	2.0	79	---	---	---	38	3.27	5.6
58A-VP-1	0.32	22	---	---	---	22	3.27	5.6
67A-VP-1	0.12	13	---	---	---	13	3.27	5.6
61A-VP-1	0.19	28	---	---	---	28	3.27	5.6
61A-VP-2	1.2	35	---	---	---	35	3.27	5.6
56A-VP-1	0.58	73	---	---	---	38	3.27	5.6
23-VP-3	1.3	22	---	---	---	22	3.27	5.6

Notes:

[1] *See Figure 5-5 for locations of vernal pools.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-28. Summary of IMPGs and pre- and post-remediation EPCs for shrew averaging areas under FP 5.

Averaging Area ID[1]	Area of Averaging Area (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal			Post-Remediation EPC[2] (mg/kg)	IMPG (mg/kg)	
			Depth (ft)	Volume (cy)	Area (acre)		Lower Bound	Upper Bound
G1	88	22	---	---	---	11	21.1	34.3
G2	87	50	---	---	---	14	21.1	34.3
G3	86	18	---	---	---	16	21.1	34.3
G4	86	27	---	---	---	21	21.1	34.3
G5	88	28	---	---	---	10	21.1	34.3
G6	87	11	---	---	---	9.3	21.1	34.3
G7	73	17	---	---	---	12	21.1	34.3

Notes:

[1] *See Figure 5-6 for shrew averaging areas.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-29. Summary of IMPGs and pre- and post-remediation EPCs for wood duck averaging areas under FP 5.

Averaging Area ID[1]	Reach	Averaging Area (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal			Post-Remediation EPC[2] (mg/kg)	Floodplain IMPG (mg/kg)		
				Depth (ft)	Volume (cy)	Area (acre)		Sediment Target Level		
								1 mg/kg	3 mg/kg	5 mg/kg
K1	5A	52	34	---	---	---	15	50	39	29
K2		63	8.1	---	---	---	8.1	50	39	29
K3		85	40	---	---	---	14	50	39	29
K4		60	17	---	---	---	14	50	39	29
K5		25	23	---	---	---	19	50	39	29
K6	5B	55	25	---	---	---	22	48	33	18
K7		47	29	---	---	---	18	48	33	18
K8		92	24	---	---	---	12	48	33	18
K9	5C/5D	69	25	---	---	---	12	53	49	46
K10		83	13	---	---	---	10	53	49	46
K11		61	14	---	---	---	12	53	49	46
K12	6	28	23	---	---	---	12	53	50	46

Notes:

[1] *See Figure 5-7 for wood duck averaging areas.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-30. Summary of IMPGs and pre- and post-remediation EPCs for mink averaging areas under FP 5.

Averaging Area[1]	Area of Averaging Area (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal			Post-Remediation EPC[2] (mg/kg)	Floodplain IMPG[3] (mg/kg)					
							Sediment Target Level					
							1 mg/kg		3 mg/kg		5 mg/kg	
			Depth (ft)	Volume (cy)	Area (acre)		Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
5A/5B	435	22	---	---	---	14	3.4	16.6	*n/a*	5.12	*n/a*	*n/a*
5C/5D/6	291	18	---	---	---	9.4	6.9	19.6	3.0	15.7	*n/a*	11.8

Notes:

[1] See Figure 5-8 for mink averaging areas.

[2] EPC is calculated for the top 1 ft of floodplain soil.

[3] (n/a) denotes IMPG values not attainable in given reach for the sediment target level.

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-31. Summary of IMPGs and pre- and post-remediation EPCs for human direct contact exposure areas under FP 6.

Exposure Area ID^1	Area of Exposure Area (acre)^2	IMPG Scenario	Pre-Remediation EPC (mg/kg)^3	Removal^4			Post-Remediation EPC (mg/kg)^3	IMPG^5 (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
1	15	Medium-use general recreation, adult / older child	36	---	---	---	5.0	2.1	51	21	514	215	5143	40	176
2	27	High-use general recreation, adult / older child	31	---	---	---	3.7	1.4	51	14	514	143	5143	27	176
2a	2.3	Low-use general recreation, older child	56	---	---	---	24	12	103	116	1029	1165	10286	80	353
2b	2.0	High-use general recreation, older child	29	---	---	---	4.2	3.9	51	39	514	388	5143	27	176
3	0.4	High-use general recreation, adult	5.6	---	---	---	5.6	1.4	63	14	630	143	6305	38	234
4	3.2	High-use general recreation, young child (low use)	29	---	---	---	6.2	8.0	37	80	368	802	3684	27	63
5	2.5	High-use general recreation, adult / older child	48	---	---	---	6.8	1.4	51	14	514	143	5143	27	176
6	3.8	Low-use general recreation, adult	59	---	---	---	7.4	4.3	126	43	1261	429	12610	115	468
7	5.9	High-use general recreation, adult / older child	21	---	---	---	6.9	1.4	51	14	514	143	5143	27	176
8	0.60	Recreational canoeist	40	---	---	---	20	1.2	13	12	129	121	1286	28	73
9	0.042	Low-use general recreation, older child	27	---	---	---	16	12	103	116	1029	1165	10286	80	353
10	59	High-use general recreation, young child (high use)	10	---	---	---	5.2	1.3	18	13	184	134	1842	4.6	32
10a	8.0	High-use general recreation, young child (high use)	18	---	---	---	12	1.3	18	13	184	134	1842	4.6	32
11	2.5	High-use general recreation, adult	15	---	---	---	12	1.4	63	14	630	143	6305	38	234
12	4.8	High-use general recreation, young child (low use)	7.0	---	---	---	4.2	8.0	37	80	368	802	3684	27	63
13	5.9	High-use general recreation, adult	14	---	---	---	5.8	1.4	63	14	630	143	6305	38	234
14	4.1	High-use general recreation, adult	2.7	---	---	---	2.7	1.4	63	14	630	143	6305	38	234
15	0.87	High-use general recreation, adult	2.0	---	---	---	2.0	1.4	63	14	630	143	6305	38	234
16	2.5	High-use general recreation, adult	22	---	---	---	8.7	1.4	63	14	630	143	6305	38	234
17	8.5	High-use general recreation, adult	13	---	---	---	7.8	1.4	63	14	630	143	6305	38	234
18	17	Medium-use general recreation, adult	17	---	---	---	14	2.1	63	21	630	215	6305	58	234
19	36	High-use general recreation, adult	83	---	---	---	5.0	1.4	63	14	630	143	6305	38	234
20	9.1	High-use general recreation, adult	31	---	---	---	7.1	1.4	63	14	630	143	6305	38	234
21	2.9	High-use general recreation, adult / older child	4.9	---	---	---	4.4	1.4	51	14	514	143	5143	27	176
22	19	High-use general recreation, adult / older child	26	---	---	---	7.0	1.4	51	14	514	143	5143	27	176
22a	1.8	Dirt biking/ATVing	88	---	---	---	12	2.0	29	20	290	205	2901	14	99
23	0.28	Medium-use general recreation, older child	12	---	---	---	10	5.8	51	58	514	582	5143	40	176
24	10	High-use general recreation, adult	31	---	---	---	7.9	1.4	63	14	630	143	6305	38	234
25	0.51	High-use general recreation, older child	30	---	---	---	8.2	3.9	51	39	514	388	5143	27	176
26a	48	High-use general recreation, adult / older child	7.2	---	---	---	5.1	1.4	51	14	514	143	5143	27	176
26b	7.6	Agricultural use (based on direct contact by farmer)	1.7	---	---	---	1.7	1.2	42	12	419	118	4195	43	348
26_F	55	High-use general recreation, adult / older child	6.3	---	---	---	4.5	1.4	51	14	514	143	5143	27	176
27	6.3	High-use general recreation, adult / older child	2.4	---	---	---	2.4	1.4	51	14	514	143	5143	27	176
27a	0.38	Dirt biking/ATVing	4.3	---	---	---	4.3	2.0	29	20	290	205	2901	14	99
28	0.21	High-use general recreation, young child (low use)	21	---	---	---	21	8.0	37	80	368	802	3684	27	63
28a	0.071	Dirt biking/ATVing	21	---	---	---	21	2.0	29	20	290	205	2901	14	99
29	0.34	Low-use general recreation, adult / older child	21	---	---	---	21	4.3	103	43	1029	429	10286	80	353
30	0.19	High-use general recreation, adult / older child	13	---	---	---	13	1.4	51	14	514	143	5143	27	176
31	5.0	High-use general recreation, adult / older child	14	---	---	---	8.0	1.4	51	14	514	143	5143	27	176
31a	0.61	High-use general recreation, adult / older child	42	---	---	---	14	1.4	51	14	514	143	5143	27	176
32	6.8	High-use general recreation, adult	14	---	---	---	6.6	1.4	63	14	630	143	6305	38	234
33	30	High-use general recreation, adult	20	---	---	---	7.4	1.4	63	14	630	143	6305	38	234
34	7.8	Medium-use general recreation, adult	25	---	---	---	12	2.1	63	21	630	215	6305	58	234
35	25	High-use general recreation, adult / older child	22	---	---	---	5.2	1.4	51	14	514	143	5143	27	176
35a	1.2	High-use general recreation, adult / older child	39	---	---	---	2.4	1.4	51	14	514	143	5143	27	176
36a	16	Low-use commercial (groundskeeper scenario)	23	---	---	---	5.9	8.9	166	89	1664	885	16642	126	571
36b	2.2	Agricultural use (based on direct contact by farmer)	15	---	---	---	3.7	1.2	42	12	419	118	4195	43	348
37	20	High-use general recreation, adult / older child	17	---	---	---	6.1	1.4	51	14	514	143	5143	27	176
37a	1.4	Bank fishing	26	---	---	---	12	2.6	52	26	524	256	5237	42	180
37b	2.3	High-use general recreation, adult / older child	25	---	---	---	2.6	1.4	51	14	514	143	5143	27	176

Table 6-31. Summary of IMPGs and pre- and post-remediation EPCs for human direct contact exposure areas under FP 6.

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal[4]			Post-Remediation EPC (mg/kg)[3]	IMPG[5] (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
38	13	High-use general recreation, adult	23	---	---	---	6.5	1.4	63	14	630	143	6305	38	234
38a	1.4	Bank fishing	33	---	---	---	11	2.6	52	26	524	256	5237	42	180
39	3.5	Marathon canoeist	32	---	---	---	5.5	0.78	5.8	7.8	58	78	575	13	25
40	98	High-use general recreation, young child (low use)	20	---	---	---	2.5	8.0	37	80	368	802	3684	27	63
40a	4.6	Bank fishing	40	---	---	---	7.5	2.6	52	26	524	256	5237	42	180
40b	1.1	High-use general recreation, young child (low use)	11	---	---	---	11	8.0	37	80	368	802	3684	27	63
41	20	Medium-use general recreation, adult	28	---	---	---	5.4	2.1	63	21	630	215	6305	58	234
41a	2.4	Bank fishing	35	---	---	---	9.0	2.6	52	26	524	256	5237	42	180
42	14	Medium-use general recreation, adult	12	---	---	---	8.1	2.1	63	21	630	215	6305	58	234
42a	0.94	Bank fishing	14	---	---	---	10	2.6	52	26	524	256	5237	42	180
43	1.5	Medium-use general recreation, adult	27	---	---	---	0.20	2.1	63	21	630	215	6305	58	234
43a	0.24	Bank fishing	64	---	---	---	0.11	2.6	52	26	524	256	5237	42	180
44	2.2	High-use general recreation, adult	24	---	---	---	7.1	1.4	63	14	630	143	6305	38	234
45	17	High-use general recreation, adult	39	---	---	---	7.3	1.4	63	14	630	143	6305	38	234
46	7.2	High-use general recreation, adult	8.2	---	---	---	4.2	1.4	63	14	630	143	6305	38	234
47	1.0	Recreational canoeist	18	---	---	---	18	1.2	13	12	129	121	1286	28	73
47_F	0.12	Recreational canoeist	8.1	---	---	---	8.1	1.2	13	12	129	121	1286	28	73
48	6.5	High-use general recreation, adult	3.4	---	---	---	2.3	1.4	63	14	630	143	6305	38	234
49	7.7	Low-use general recreation, adult	17	---	---	---	6.7	4.3	126	43	1261	429	12610	115	468
50	69	Low-use general recreation, adult	7.3	---	---	---	3.3	4.3	126	43	1261	429	12610	115	468
50a	11	Waterfowl hunting	15	---	---	---	5.2	9.0	75	90	752	904	7518	140	399
51	87	Low-use general recreation, adult	7.2	---	---	---	4.7	4.3	126	43	1261	429	12610	115	468
51a	32	Waterfowl hunting	13	---	---	---	4.6	9.0	75	90	752	904	7518	140	399
52	0.9	Recreational canoeist	10	---	---	---	3.4	1.2	13	12	129	121	1286	28	73
53	0.7	Recreational canoeist	34	---	---	---	1.3	1.2	13	12	129	121	1286	28	73
54	13	High-use general recreation, adult	7.1	---	---	---	6.7	1.4	63	14	630	143	6305	38	234
55	18	High-use general recreation, young child (low use)	11	---	---	---	6.7	8.0	37	80	368	802	3684	27	63
55a	5.0	Waterfowl hunting	47	---	---	---	13	9.0	75	90	752	904	7518	140	399
56	32	Medium-use general recreation, adult / older child	38	---	---	---	4.3	2.1	51	21	514	215	5143	40	176
56a	10	Waterfowl hunting	49	---	---	---	5.5	9.0	75	90	752	904	7518	140	399
57	13	High-use general recreation, young child (low use)	5.8	---	---	---	4.6	8.0	37	80	368	802	3684	27	63
58	1.3	High-use general recreation, adult	65	---	---	---	3.6	1.4	63	14	630	143	6305	38	234
59	1.9	High-use general recreation, young child (low use)	18	---	---	---	14	8.0	37	80	368	802	3684	27	63
59a	0.83	Bank fishing	22	---	---	---	14	2.6	52	26	524	256	5237	42	180
60	0.84	High-use general recreation, young child (low use)	7.0	---	---	---	7.0	8.0	37	80	368	802	3684	27	63
60a	0.16	Recreational canoeist	13	---	---	---	13	1.2	13	12	129	121	1286	28	73
61	3.3	Utility worker	42	---	---	---	11	17	209	169	2093	1694	20933	242	718
62	1.6	Utility worker	134	---	---	---	7.7	17	209	169	2093	1694	20933	242	718
63	0.67	Utility worker	23	---	---	---	8.7	17	209	169	2093	1694	20933	242	718
64	0.61	Utility worker	42	---	---	---	14	17	209	169	2093	1694	20933	242	718
65	3.9	Utility worker	17	---	---	---	8.9	17	209	169	2093	1694	20933	242	718
66	1.7	Utility worker	23	---	---	---	6.0	17	209	169	2093	1694	20933	242	718
67	0.31	High-use general recreation, adult	11	---	---	---	11	1.4	63	14	630	143	6305	38	234
68	0.090	High-use general recreation, adult	9.0	---	---	---	9.0	1.4	63	14	630	143	6305	38	234
69	1.9	High-use general recreation, adult	7.3	---	---	---	7.3	1.4	63	14	630	143	6305	38	234
70	19	High-use general recreation, young child (high use)	2.4	---	---	---	2.4	1.3	18	13	184	134	1842	4.6	32
70a	1.2	Bank fishing	3.8	---	---	---	3.8	2.6	52	26	524	256	5237	42	180
71	1.8	Bank fishing	4.6	---	---	---	4.6	2.6	52	26	524	256	5237	42	180
72	2.3	Bank fishing	10	---	---	---	10	2.6	52	26	524	256	5237	42	180
73	3.9	High-use general recreation, adult	0.50	---	---	---	0.50	1.4	63	14	630	143	6305	38	234

Table 6-31. Summary of IMPGs and pre- and post-remediation EPCs for human direct contact exposure areas under FP 6.

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal[4]			Post-Remediation EPC (mg/kg)[3]	IMPG[5] (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
74	5.3	High-use general recreation, adult	5.3	---	---	---	5.3	1.4	63	14	630	143	6305	38	234
75	3.4	High-use general recreation, adult	15	---	---	---	15	1.4	63	14	630	143	6305	38	234
76	1.1	High-use general recreation, adult	0.79	---	---	---	0.79	1.4	63	14	630	143	6305	38	234
77	4.2	High-use general recreation, adult	0.89	---	---	---	0.89	1.4	63	14	630	143	6305	38	234
78	6.2	High-use general recreation, older child	5.9	---	---	---	5.9	3.9	51	39	514	388	5143	27	176
79	17	High-use general recreation, adult	2.9	---	---	---	2.9	1.4	63	14	630	143	6305	38	234
80a	9.5	Low-use general recreation, adult	2.6	---	---	---	2.6	4.3	126	43	1261	429	12610	115	468
80b	20	Agricultural use (based on direct contact by farmer)	0.76	---	---	---	0.76	1.2	42	12	419	118	4195	43	348
81	33	Low-use general recreation, adult	2.3	---	---	---	2.3	4.3	126	43	1261	429	12610	115	468
82	15	Low-use general recreation, adult	3.6	---	---	---	3.6	4.3	126	43	1261	429	12610	115	468
83	22	High-use commercial (groundskeeper scenario)	1.9	---	---	---	1.9	1.8	17	18	166	177	1664	25	57
84	8.5	Low-use general recreation, adult	4.3	---	---	---	4.3	4.3	126	43	1261	429	12610	115	468
85a	0.25	Recreational canoeist	7.9	---	---	---	7.9	1.2	13	12	129	121	1286	28	73
85b	10	High-use general recreation, older child	1.7	---	---	---	1.7	3.9	51	39	514	388	5143	27	176
86	118	High-use commercial (groundskeeper scenario)	2.5	---	---	---	2.5	1.8	17	18	166	177	1664	25	57
87	10	High-use general recreation, young child (high use)	9.4	---	---	---	9.4	1.3	18	13	184	134	1842	4.6	32
87a	0.88	Bank fishing	6.0	---	---	---	6.0	2.6	52	26	524	256	5237	42	180
88	1.1	Medium-use general recreation, older child	13	---	---	---	12	5.8	51	58	514	582	5143	40	176
89	4.3	High-use general recreation, adult	6.4	---	---	---	6.4	1.4	63	14	630	143	6305	38	234
90	8.9	High-use general recreation, adult / older child	6.8	---	---	---	6.8	1.4	51	14	514	143	5143	27	176

Heavily Used Subareas

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal[4]			Post-Remediation EPC (mg/kg)[3]	IMPG[5] (mg/kg)							
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	CTE	RME	CTE	RME	CTE	RME	CTE
4	0.71	High-use general recreation, young child (low use)	17	---	---	---	4.6	8.0	37	80	368	802	3684	27	63
12	1.5	High-use general recreation, young child (low use)	9.8	---	---	---	2.4	8.0	37	80	368	802	3684	27	63
26a	2.2	High-use general recreation, adult / older child	1.9	---	---	---	1.9	1.4	51	14	514	143	5143	27	176
39	0.15	Marathon canoeist	54	---	---	---	16	0.78	5.8	7.8	58	78	575	13	25
40	5.2	High-use general recreation, young child (low use)	19	---	---	---	17	8.0	37	80	368	802	3684	27	63
47	0.18	Recreational canoeist	6.0	---	---	---	6.0	1.2	13	12	129	121	1286	28	73
52	0.25	Recreational canoeist	7.0	---	---	---	7.0	1.2	13	12	129	121	1286	28	73
53	0.35	Recreational canoeist	408	---	---	---	6.8	1.2	13	12	129	121	1286	28	73
60a	0.16	Recreational canoeist	7.0	---	---	---	7.0	1.2	13	12	129	121	1286	28	73

Notes:

[1] *See Figures 5-1 and 5-2 for direct contact exposure areas in Reaches 5 through 8, and Heavily Used Subareas, respectively.*

[2] *Area only includes the portion of the exposure area within the 1 mg/kg PCB isopleth (Reaches 5/6) or the 100-year floodplain (Reaches 7/8).*

[3] *EPC is calculated for top 1-ft floodplain soil, except in Heavily Used Subareas where it is calculated for top 3-ft floodplain soil.*

[4] *Removal volumes for threshold-based alternatives are not shown by exposure/averaging areas.*

[5] *For scenarios containing more than one receptor (e.g. adult and older child), the lowest IMPG was utilized in the comparison to post-remediation EPCs.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-32. Summary of IMPGs and pre- and post-remediation EPCs for agricultural products consumption areas under FP 6.

Farm ID[1]	Area of farm (acre)[2]	IMPG Scenario	Pre-Remediation EPC[3] (mg/kg)	Removal[4]			Post-Remediation EPC[3] (mg/kg)	IMPG[4] (mg/kg)									
				Depth (ft)	Volume (cy)	Area (acres)		Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @10^{-4}		Non-Cancer (Child)		Non-Cancer (Adult)	
								RME	CTE	RME	CTE	RME	CTE	RME	CTE	RME	CTE
FA 1	8.0	Commercial Dairy	1.6	---	---	---	1.6	0.68	3.1	6.8	31	68	312	7.7	12.2	36.4	44.3
FA 2	3.3		13	---	---	---	8.3	2.59	11.9	25.9	119	259	1187	29.1	46.4	138.1	168.3
FA 3	4.1		0.20	---	---	---	0.20	0.29	1.3	2.9	13	29	132	3.2	5.2	15.4	18.7
FA 4	64		0.38	---	---	---	0.38	0.24	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 5	12		0.25	---	---	---	0.25	0.24	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 6	7.7		0.25	---	---	---	0.25	0.24	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 7	24		0.25	---	---	---	0.25	0.24	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 8	9.4		0.19	---	---	---	0.19	0.34	1.5	3.4	15	34	154	3.8	6.0	17.9	21.8
FA 9	26		0.89	---	---	---	0.89	0.31	1.4	3.1	14	31	143	3.5	5.6	16.6	20.3
FA 10	0.31		0.50	---	---	---	0.50	2.06	9.5	20.6	95	206	946	23.2	37.0	110.1	134.2
FA 11	0.14		0.25	---	---	---	0.25	6.10	27.9	61.0	279	610	2794	68.6	109.2	325.1	396.2
FA 12	8.0		0.25	---	---	---	0.25	0.38	1.8	3.8	18	38	176	4.3	6.9	20.5	25.0
FA 13	4.0		0.25	---	---	---	0.25	0.24	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 14	2.6		0.30	---	---	---	0.30	0.55	2.5	5.5	25	55	253	6.2	9.9	29.4	35.9

Notes:

[1] *See Figure 5-4 for farm areas in Reaches 5 through 8.*

[2] *Farm area only includes the portion within the 1 mg/kg PCB isopleth (Reaches 5/6) or the 100-year floodplain (Reaches 7/8).*

[3] *EPC is calculated for the top 1 ft of floodplain soil.*

[4] *IMPG values for agricultural products consumption include a multiplier to account for the areas outside the 1 mg/kg PCB isopleth/100-year floodplain (see Table 5-2).*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-33. Summary of IMPGs and pre- and post-remediation EPCs for wood frog averaging areas (vernal pools) under FP 6.

Vernal Pool ID[1]	Area of Vernal Pool (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal[3]			Post-Remediation EPC[2](mg/kg)	IMPG (mg/kg)	
			Depth (ft)	Volume (cy)	Area (acre)		Lower Bound	Upper Bound
5-VP-3	1.9	29	---	---	---	5.8	3.27	5.6
5-VP-1	0.044	1.7	---	---	---	1.7	3.27	5.6
8-VP-5	0.043	26	---	---	---	21	3.27	5.6
8-VP-4	0.24	3.9	---	---	---	3.9	3.27	5.6
8-VP-3	0.02	7.7	---	---	---	7.7	3.27	5.6
8-VP-2	0.57	66	---	---	---	3.9	3.27	5.6
18-VP-2	0.61	7.2	---	---	---	7.2	3.27	5.6
18-VP-1	0.28	7.9	---	---	---	7.9	3.27	5.6
19-VP-7	0.068	0.80	---	---	---	0.80	3.27	5.6
19-VP-2	0.0080	34	---	---	---	0.021	3.27	5.6
19-VP-1	0.18	23	---	---	---	23	3.27	5.6
19-VP-3	0.031	10	---	---	---	10	3.27	5.6
19-VP-4	0.094	5.6	---	---	---	5.6	3.27	5.6
19-VP-8	0.057	91	---	---	---	0.021	3.27	5.6
19-VP-5	0.51	26	---	---	---	10	3.27	5.6
19-VP-6	1.2	22	---	---	---	7.3	3.27	5.6
23-VP-2	0.18	46	---	---	---	16	3.27	5.6
23-VP-1	0.30	62	---	---	---	8.3	3.27	5.6
23A-VP-1	0.45	26	---	---	---	22	3.27	5.6
23B-VP-1	0.068	26	---	---	---	0.15	3.27	5.6
23B-VP-2	0.091	0.34	---	---	---	0.34	3.27	5.6
27B-VP-2	0.28	11	---	---	---	11	3.27	5.6
27B-VP-3	0.062	16	---	---	---	16	3.27	5.6
27B-VP-1	0.072	12	---	---	---	12	3.27	5.6
27-VP-2	0.47	21	---	---	---	21	3.27	5.6
27A-VP-1	0.20	31	---	---	---	11	3.27	5.6
27-VP-1	1.3	23	---	---	---	23	3.27	5.6
26-VP-1	0.036	40	---	---	---	15	3.27	5.6
33-VP-1	0.022	10	---	---	---	10	3.27	5.6
33-VP-2	0.12	65	---	---	---	0.78	3.27	5.6
38-VP-1	0.43	34	---	---	---	11	3.27	5.6
38A-VP-1	0.020	5.0	---	---	---	5.0	3.27	5.6
38-VP-3	0.046	28	---	---	---	5.0	3.27	5.6
38-VP-2	0.17	28	---	---	---	12	3.27	5.6
40-VP-3	0.46	59	---	---	---	15	3.27	5.6
40-VP-2	0.36	17	---	---	---	17	3.27	5.6
40A-VP-1	0.11	68	---	---	---	17	3.27	5.6
40-VP-1	0.47	58	---	---	---	4.2	3.27	5.6
42-VP-1	0.22	63	---	---	---	0.021	3.27	5.6
42-VP-2	0.28	45	---	---	---	3.6	3.27	5.6
42-VP-3	0.050	41	---	---	---	1.9	3.27	5.6
42-VP-5	0.58	61	---	---	---	24	3.27	5.6
42-VP-4	1.0	33	---	---	---	5.4	3.27	5.6
42A-VP-1	1.5	31	---	---	---	10	3.27	5.6
46-VP-2	7.1	20	---	---	---	2.6	3.27	5.6
46-VP-1	0.52	51	---	---	---	0.47	3.27	5.6
46-VP-5	0.056	123	---	---	---	0.021	3.27	5.6
46-VP-3	1.4	67	---	---	---	0.87	3.27	5.6
46-VP-4	0.011	125	---	---	---	0.021	3.27	5.6
49A-VP-1	0.019	16	---	---	---	16	3.27	5.6
49-VP-1	1.2	18	---	---	---	11	3.27	5.6
49B-VP-1	0.0044	26	---	---	---	0.021	3.27	5.6
66A-VP-1	0.032	0.70	---	---	---	0.72	3.27	5.6
69-VP-1	0.0074	12	---	---	---	12	3.27	5.6
8-VP-6	0.086	47	---	---	---	0.021	3.27	5.6
12-VP-1	0.080	8.0	---	---	---	8.0	3.27	5.6
39-VP-1	2.0	32	---	---	---	7.7	3.27	5.6
54-VP-1	0.20	21	---	---	---	21	3.27	5.6
55-VP-1	0.59	7.7	---	---	---	2.2	3.27	5.6
55A-VP-1	2.0	79	---	---	---	23	3.27	5.6
58A-VP-1	0.32	22	---	---	---	22	3.27	5.6
67A-VP-1	0.12	13	---	---	---	13	3.27	5.6
61A-VP-1	0.19	28	---	---	---	18	3.27	5.6
61A-VP-2	1.2	35	---	---	---	13	3.27	5.6
56A-VP-1	0.58	73	---	---	---	20	3.27	5.6
23-VP-3	1.3	22	---	---	---	22	3.27	5.6

Notes:

[1] See Figure 5-5 for locations of vernal pools.

[2] EPC is calculated for the top 1 ft of floodplain soil.

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-34. Summary of IMPGs and pre- and post-remediation EPCs for shrew averaging areas under FP 6.

Averaging Area ID^1	Area of Averaging Area (acre)	Pre-Remediation EPC^2 (mg/kg)	Removal			Post-Remediation EPC^2(mg/kg)	IMPG (mg/kg)	
			Depth (ft)	Volume (cy)	Area (acre)		Lower Bound	Upper Bound
G1	88	22	---	---	---	4.0	21.1	34.3
G2	87	50	---	---	---	5.5	21.1	34.3
G3	86	18	---	---	---	6.9	21.1	34.3
G4	86	27	---	---	---	6.2	21.1	34.3
G5	88	28	---	---	---	6.4	21.1	34.3
G6	87	11	---	---	---	4.5	21.1	34.3
G7	73	17	---	---	---	6.5	21.1	34.3

Notes:

[1] *See Figure 5-6 for shrew averaging areas.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-35. Summary of IMPGs and pre- and post-remediation EPCs for wood duck averaging areas under FP 6.

Averaging Area ID[1]	Reach	Averaging Area (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal			Post-Remediation EPC[2] (mg/kg)	Floodplain IMPG (mg/kg)		
				Depth (ft)	Volume (cy)	Area (acre)		Sediment Target Level		
								1 mg/kg	3 mg/kg	5 mg/kg
K1	5A	52	34	---	---	---	4.3	50	39	29
K2		63	8.1	---	---	---	4.8	50	39	29
K3		85	40	---	---	---	5.4	50	39	29
K4		60	17	---	---	---	6.4	50	39	29
K5		25	23	---	---	---	8.1	50	39	29
K6	5B	55	25	---	---	---	7.0	48	33	18
K7		47	29	---	---	---	6.5	48	33	18
K8		92	24	---	---	---	5.1	48	33	18
K9	5C/5D	69	25	---	---	---	7.7	53	49	46
K10		83	13	---	---	---	5.2	53	49	46
K11		61	14	---	---	---	6.6	53	49	46
K12	6	28	23	---	---	---	4.9	53	50	46

Notes:

[1] *See Figure 5-7 for wood duck averaging areas.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-36. Summary of IMPGs and pre- and post-remediation EPCs for mink averaging areas under FP 6.

Averaging Area[1]	Area of Averaging Area (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal			Post-Remediation EPC[2] (mg/kg)	Floodplain IMPG[3] (mg/kg)					
			Depth (ft)	Volume (cy)	Area (acre)		Sediment Target Level					
							1 mg/kg		3 mg/kg		5 mg/kg	
							Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
5A/5B	435	22	---	---	---	5.3	3.4	16.6	*n/a*	5.12	*n/a*	*n/a*
5C/5D/6	291	18	---	---	---	5.1	6.9	19.6	3.0	15.7	*n/a*	11.8

Notes:

[1] See Figure 5-8 for mink averaging areas.

[2] EPC is calculated for the top 1 ft of floodplain soil.

[3] (n/a) denotes IMPG values not attainable in given reach for the sediment target level.

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-37. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for human direct contact exposure areas under FP 7.

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal[4]			Post-Remediation EPC (mg/kg)[3]	IMPG[5] (mg/kg)								
								Cancer Risk @ 10^{-6}			Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	RME*[6]	CTE	RME	CTE	RME	CTE	RME	CTE
1	15	Medium-use general recreation, adult / older child	36	1	9000	5.6	1.4	**2.1**	**2.1**	51	21	514	215	5143	40	176
2	27	High-use general recreation, adult / older child	31	1	20000	12	2.0	1.4	**2.0**	51	14	514	143	5143	27	176
2a	2.3	Low-use general recreation, older child	56	1	2000	1.5	0.47	**12**	**12**	103	116	1029	1165	10286	80	353
2b	2.0	High-use general recreation, older child	29	1	300	0.21	3.8	**3.9**	**3.9**	51	39	514	388	5143	27	176
3	0.4	High-use general recreation, adult	5.6	1	300	0.18	2.0	1.4	**2.0**	63	14	630	143	6305	38	234
4	3.2	High-use general recreation, young child (low use)	29	1	400	0.24	1.8	**8.0**	**8.0**	37	80	368	802	3684	27	63
5	2.5	High-use general recreation, adult / older child	48	1	2000	1.5	1.6	1.4	**2.0**	51	14	514	143	5143	27	176
6	3.8	Low-use general recreation, adult	59	1	5000	3.1	1.3	**4.3**	**4.3**	126	43	1261	429	12610	115	468
7	5.9	High-use general recreation, adult / older child	21	1	5000	2.8	1.9	1.4	**2.0**	51	14	514	143	5143	27	176
8	0.60	Recreational canoeist	40	1	200	0.14	1.0	1.2	**2.0**	13	12	129	121	1286	28	73
9	0.042	Low-use general recreation, older child	27	1	20	0.010	12	**12**	**12**	103	116	1029	1165	10286	80	353
10	59	High-use general recreation, young child (high use)	10	1	14000	8.5	2.0	1.3	**2.0**	18	13	184	134	1842	4.6	32
10a	8.0	High-use general recreation, young child (high use)	18	1	400	0.24	2.0	1.3	**2.0**	18	13	184	134	1842	4.6	32
11	2.5	High-use general recreation, adult	15	1	2000	1.5	1.9	1.4	**2.0**	63	14	630	143	6305	38	234
12	4.8	High-use general recreation, young child (low use)	7.0	---	---	---		**8.0**	**8.0**	37	80	368	802	3684	27	63
13	5.9	High-use general recreation, adult	14	1	3000	1.6	2.0	1.4	**2.0**	63	14	630	143	6305	38	234
14	4.1	High-use general recreation, adult	2.7	1	1000	0.91	1.6	1.4	**2.0**	63	14	630	143	6305	38	234
15	0.87	High-use general recreation, adult	2.0	---	---	---	2.0	1.4	**2.0**	63	14	630	143	6305	38	234
16	2.5	High-use general recreation, adult	22	1	2000	1.5	2.0	1.4	**2.0**	63	14	630	143	6305	38	234
17	8.5	High-use general recreation, adult	13	1	5000	3.2	2.0	1.4	**2.0**	63	14	630	143	6305	38	234
18	17	Medium-use general recreation, adult	17	1	6000	3.5	1.6	**2.1**	**2.1**	63	21	630	215	6305	58	234
19	36	High-use general recreation, adult	83	1	27000	17	1.7	1.4	**2.0**	63	14	630	143	6305	38	234
20	9.1	High-use general recreation, adult	31	1	10000	6.4	2.0	1.4	**2.0**	63	14	630	143	6305	38	234
21	2.9	High-use general recreation, adult / older child	4.9	1	1000	0.67	2.0	1.4	**2.0**	51	14	514	143	5143	27	176
22	19	High-use general recreation, adult / older child	26	1	18000	11	1.6	1.4	**2.0**	51	14	514	143	5143	27	176
22a	1.8	Dirt biking/ATVing	88	1	3000	1.7	2.0	**2.0**	**2.0**	29	20	290	205	2901	14	99
23	0.28	Medium-use general recreation, older child	12	1	100	0.070	5.4	**5.8**	**5.8**	51	58	514	582	5143	40	176
24	10	High-use general recreation, adult	31	1	11000	6.7	1.1	1.4	**2.0**	63	14	630	143	6305	38	234
25	0.51	High-use general recreation, older child	30	1	500	0.31	3.9	**3.9**	**3.9**	51	39	514	388	5143	27	176
26a	48	High-use general recreation, adult / older child	7.2	1	14000	8.5	1.8	1.4	**2.0**	51	14	514	143	5143	27	176
26b	7.6	Agricultural use (based on direct contact by farmer)	1.7	---	---	---	0.73	1.2	**2.0**	42	12	419	118	4195	43	348
26_F	55	High-use general recreation, adult / older child	6.3	---	---	---	1.6	1.4	**2.0**	51	14	514	143	5143	27	176
27	6.3	High-use general recreation, adult / older child	2.4	1	500	0.28	2.0	1.4	**2.0**	51	14	514	143	5143	27	176
27a	0.38	Dirt biking/ATVing	4.3	1	100	0.080	2.0	**2.0**	**2.0**	29	20	290	205	2901	14	99
28	0.21	High-use general recreation, young child (low use)	21	1	100	0.060	8.0	**8.0**	**8.0**	37	80	368	802	3684	27	63
28a	0.071	Dirt biking/ATVing	21	1	80	0.050	1.8	**2.0**	**2.0**	29	20	290	205	2901	14	99
29	0.34	Low-use general recreation, adult / older child	21	1	200	0.10	2.6	**4.3**	**4.3**	103	43	1029	429	10286	80	353
30	0.19	High-use general recreation, adult / older child	13	1	100	0.090	2.0	1.4	**2.0**	51	14	514	143	5143	27	176
31	5.0	High-use general recreation, adult / older child	14	1	3000	2.0	1.3	1.4	**2.0**	51	14	514	143	5143	27	176
31a	0.61	High-use general recreation, adult / older child	42	1	300	0.20	2.0	1.4	**2.0**	51	14	514	143	5143	27	176
32	6.8	High-use general recreation, adult	14	1	2000	1.5	2.0	1.4	**2.0**	63	14	630	143	6305	38	234
33	30	High-use general recreation, adult	20	1	28000	17	2.0	1.4	**2.0**	63	14	630	143	6305	38	234
34	7.8	Medium-use general recreation, adult	25	1	9000	5.5	2.0	**2.1**	**2.1**	63	21	630	215	6305	58	234
35	25	High-use general recreation, adult / older child	22	1	22000	13	2.0	1.4	**2.0**	51	14	514	143	5143	27	176
35a	1.2	High-use general recreation, adult / older child	39	1	400	0.22	2.0	1.4	**2.0**	51	14	514	143	5143	27	176
36a	16	Low-use commercial (groundskeeper scenario)	23	1	6000	3.8	6.4	**8.9**	**8.9**	166	89	1664	885	16642	126	571
36b	2.2	Agricultural use (based on direct contact by farmer)	15	1	2000	0.98	2.0	1.2	**2.0**	42	12	419	118	4195	43	348
37	20	High-use general recreation, adult / older child	17	1	14000	8.7	1.8	1.4	**2.0**	51	14	514	143	5143	27	176
37a	1.4	Bank fishing	26	1	2000	0.94	1.8	**2.6**	**2.6**	52	26	524	256	5237	42	180
37b	2.3	High-use general recreation, adult / older child	25	1	1000	0.66	1.9	1.4	**2.0**	51	14	514	143	5143	27	176
38	13	High-use general recreation, adult	23	1	10000	5.9	1.2	1.4	**2.0**	63	14	630	143	6305	38	234

Table 6-37. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for human direct contact exposure areas under FP 7.

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal[4]			Post-Remediation EPC (mg/kg)[3]	IMPG[5] (mg/kg)								
								Cancer Risk @ 10^{-6}			Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	RME*[6]	CTE	RME	CTE	RME	CTE	RME	CTE
38a	1.4	Bank fishing	33	1	2000	1.2	1.5	**2.6**	**2.6**	52	26	524	256	5237	42	180
39	3.5	Marathon canoeist	32	1	3000	2.0	1.5	0.78	**2.0**	5.8	7.8	58	78	575	13	25
40	98	High-use general recreation, young child (low use)	20	1	9000	5.5	4.0	**8.0**	**8.0**	37	80	368	802	3684	27	63
40a	4.6	Bank fishing	40	1	5000	3.0	2.5	**2.6**	**2.6**	52	26	524	256	5237	42	180
40b	1.1	High-use general recreation, young child (low use)	11	1	90	0.050	8.0	**8.0**	**8.0**	37	80	368	802	3684	27	63
41	20	Medium-use general recreation, adult	28	1	17000	11	2.1	**2.1**	**2.1**	63	21	630	215	6305	58	234
41a	2.4	Bank fishing	35	1	3000	1.9	2.6	**2.6**	**2.6**	52	26	524	256	5237	42	180
42	14	Medium-use general recreation, adult	12	1	9000	5.3	2.1	**2.1**	**2.1**	63	21	630	215	6305	58	234
42a	0.94	Bank fishing	14	1	900	0.55	2.6	**2.6**	**2.6**	52	26	524	256	5237	42	180
43	1.5	Medium-use general recreation, adult	27	1	1000	0.77	1.5	**2.1**	**2.1**	63	21	630	215	6305	58	234
43a	0.24	Bank fishing	64	1	200	0.13	0.11	**2.6**	**2.6**	52	26	524	256	5237	42	180
44	2.2	High-use general recreation, adult	24	1	2000	1.4	2.0	1.4	**2.0**	63	14	630	143	6305	38	234
45	17	High-use general recreation, adult	39	1	15000	9.3	2.0	1.4	**2.0**	63	14	630	143	6305	38	234
46	7.2	High-use general recreation, adult	8.2	1	2000	1.4	2.0	1.4	**2.0**	63	14	630	143	6305	38	234
47	1.0	Recreational canoeist	18	1	4.	0.0	2.0	1.2	**2.0**	13	12	129	121	1286	28	73
47_F	0.12	Recreational canoeist	8.1	1	500	0.31	1.3	1.2	**2.0**	13	12	129	121	1286	28	73
48	6.5	High-use general recreation, adult	3.4	1	1000	0.78	2.0	1.4	**2.0**	63	14	630	143	6305	38	234
49	7.7	Low-use general recreation, adult	17	1	3000	2.2	4.3	**4.3**	**4.3**	126	43	1261	429	12610	115	468
50	69	Low-use general recreation, adult	7.3	1	4000	2.5	4.3	**4.3**	**4.3**	126	43	1261	429	12610	115	468
50a	11	Waterfowl hunting	15	1	3000	2.0	6.1	**9.0**	**9.0**	75	90	752	904	7518	140	399
51	87	Low-use general recreation, adult	7.2	1	5000	3.4	4.3	**4.3**	**4.3**	126	43	1261	429	12610	115	468
51a	32	Waterfowl hunting	13	1	11000	6.6	4.6	**9.0**	**9.0**	75	90	752	904	7518	140	399
52	0.9	Recreational canoeist	10	1	400	0.25	2.0	1.2	**2.0**	13	12	129	121	1286	28	73
53	0.7	Recreational canoeist	34	1	200	0.11	1.6	1.2	**2.0**	13	12	129	121	1286	28	73
54	13	High-use general recreation, adult	7.1	1	6000	3.5	1.9	1.4	**2.0**	63	14	630	143	6305	38	234
55	18	High-use general recreation, young child (low use)	11	1	400	0.23	7.6	**8.0**	**8.0**	37	80	368	802	3684	27	63
55a	5.0	Waterfowl hunting	47	1	4000	2.4	9.0	**9.0**	**9.0**	75	90	752	904	7518	140	399
56	32	Medium-use general recreation, adult / older child	38	1	7000	4.2	2.0	**2.1**	**2.1**	51	21	514	215	5143	40	176
56a	10	Waterfowl hunting	49	1	6000	3.6	1.6	**9.0**	**9.0**	75	90	752	904	7518	140	399
57	13	High-use general recreation, young child (low use)	5.8	---	---	---	5.6	**8.0**	**8.0**	37	80	368	802	3684	27	63
58	1.3	High-use general recreation, adult	65	1	600	0.34	2.0	1.4	**2.0**	63	14	630	143	6305	38	234
59	1.9	High-use general recreation, young child (low use)	18	1	300	0.21	8.0	**8.0**	**8.0**	37	80	368	802	3684	27	63
59a	0.83	Bank fishing	22	1	700	0.43	2.6	**2.6**	**2.6**	52	26	524	256	5237	42	180
60	0.84	High-use general recreation, young child (low use)	7.0	---	---	---	7.0	**8.0**	**8.0**	37	80	368	802	3684	27	63
60a	0.16	Recreational canoeist	13	1	200	0.11	2.0	1.2	**2.0**	13	12	129	121	1286	28	73
61	3.3	Utility worker	42	1	2000	1.0	1.8	**17**	**17**	209	169	2093	1694	20933	242	718
62	1.6	Utility worker	134	1	500	0.34	6.6	**17**	**17**	209	169	2093	1694	20933	242	718
63	0.67	Utility worker	23	1	60	0.040	3.3	**17**	**17**	209	169	2093	1694	20933	242	718
64	0.61	Utility worker	42	1	300	0.19	2.7	**17**	**17**	209	169	2093	1694	20933	242	718
65	3.9	Utility worker	17	---	---	---	17	**17**	**17**	209	169	2093	1694	20933	242	718
66	1.7	Utility worker	23	1	80	0.050	5.8	**17**	**17**	209	169	2093	1694	20933	242	718
67	0.31	High-use general recreation, adult	11	1	300	0.16	2.0	1.4	**2.0**	63	14	630	143	6305	38	234
68	0.090	High-use general recreation, adult	9.0	1	100	0.070	1.1	1.4	**2.0**	63	14	630	143	6305	38	234
69	1.9	High-use general recreation, adult	7.3	1	1000	0.78	2.0	1.4	**2.0**	63	14	630	143	6305	38	234
70	19	High-use general recreation, young child (high use)	2.4	1	2000	0.97	2.0	1.3	**2.0**	18	13	184	134	1842	4.6	32
70a	1.2	Bank fishing	3.8	1	400	0.22	2.6	**2.6**	**2.6**	52	26	524	256	5237	42	180
71	1.8	Bank fishing	4.6	1	900	0.59	2.6	**2.6**	**2.6**	52	26	524	256	5237	42	180
72	2.3	Bank fishing	10	1	300	0.20	2.6	**2.6**	**2.6**	52	26	524	256	5237	42	180
73	3.9	High-use general recreation, adult	0.50	---	---	---	0.50	1.4	**2.0**	63	14	630	143	6305	38	234
74	5.3	High-use general recreation, adult	5.3	1	400	0.25	2.0	1.4	**2.0**	63	14	630	143	6305	38	234
75	3.4	High-use general recreation, adult	15	1	1000	0.72	2.0	1.4	**2.0**	63	14	630	143	6305	38	234

Table 6-37. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for human direct contact exposure areas under FP 7.

Exposure Area ID[1]	Area of Exposure Area (acre)[2]	IMPG Scenario	Pre-Remediation EPC (mg/kg)[3]	Removal[4]			Post-Remediation EPC (mg/kg)[3]	IMPG[5] (mg/kg)								
								Cancer Risk @ 10^{-6}			Cancer Risk @ 10^{-5}		Cancer Risk @ 10^{-4}		Non-Cancer	
				Depth (ft)	Volume (cy)	Area (acre)		RME	RME*[6]	CTE	RME	CTE	RME	CTE	RME	CTE
76	1.1	High-use general recreation, adult	0.79	---	---	---	0.79	1.4	**2.0**	63	14	630	143	6305	38	234
77	4.2	High-use general recreation, adult	0.89	---	---	---	0.89	1.4	**2.0**	63	14	630	143	6305	38	234
78	6.2	High-use general recreation, older child	5.9	1	200	0.13	3.9	**3.9**	**3.9**	51	39	514	388	5143	27	176
79	17	High-use general recreation, adult	2.9	1	3000	1.9	2.0	1.4	**2.0**	63	14	630	143	6305	38	234
80a	9.5	Low-use general recreation, adult	2.6	---	---	---	2.6	**4.3**	**4.3**	126	43	1261	429	12610	115	468
80b	20	Agricultural use (based on direct contact by farmer)	0.76	---	---	---	0.11	1.2	**2.0**	42	12	419	118	4195	43	348
81	33	Low-use general recreation, adult	2.3	---	---	---	2.3	**4.3**	**4.3**	126	43	1261	429	12610	115	468
82	15	Low-use general recreation, adult	3.6	---	---	---	3.6	**4.3**	**4.3**	126	43	1261	429	12610	115	468
83	22	High-use commercial (groundskeeper scenario)	1.9	---	---	---	1.9	1.8	**2.0**	17	18	166	177	1664	25	57
84	8.5	Low-use general recreation, adult	4.3	1	30	0.020	4.2	**4.3**	**4.3**	126	43	1261	429	12610	115	468
85a	0.25	Recreational canoeist	7.9	1	300	0.16	2.0	1.2	**2.0**	13	12	129	121	1286	28	73
85b	10	High-use general recreation, older child	1.7	---	---	---	1.7	**3.9**	**3.9**	51	39	514	388	5143	27	176
86	118	High-use commercial (groundskeeper scenario)	2.5	1	18000	11	2.0	1.8	**2.0**	17	18	166	177	1664	25	57
87	10	High-use general recreation, young child (high use)	9.4	1	16000	9.8	2.0	1.3	**2.0**	18	13	184	134	1842	4.6	32
87a	0.88	Bank fishing	6.0	1	800	0.51	2.6	**2.6**	**2.6**	52	26	524	256	5237	42	180
88	1.1	Medium-use general recreation, older child	13	1	800	0.49	5.8	**5.8**	**5.8**	51	58	514	582	5143	40	176
89	4.3	High-use general recreation, adult	6.4	1	4000	2.6	2.0	1.4	**2.0**	63	14	630	143	6305	38	234
90	8.9	High-use general recreation, adult / older child	6.8	1	10000	6.0	2.0	1.4	**2.0**	51	14	514	143	5143	27	176
				Subtotal:	**446,100**	**277**										
Heavily Used Subareas																
Exposure Area ID[1]	**Area of Exposure Area (acre)[2]**	**IMPG Scenario**	**Pre-Remediation EPC (mg/kg)[3]**	**Removal[4]**			**Post-Remediation EPC (mg/kg)[3]**	**IMPG[5] (mg/kg)**								
								Cancer Risk @ 10^{-6}			**Cancer Risk @ 10^{-5}**		**Cancer Risk @ 10^{-4}**		**Non-Cancer**	
				Depth (ft)	**Volume (cy)**	**Area (acre)**		**RME**	**RME*[6]**	**CTE**	**RME**	**CTE**	**RME**	**CTE**	**RME**	**CTE**
4	0.71	High-use general recreation, young child (low use)	17	3	400	0.12	4.8	**8.0**	**8.0**	37	80	368	802	3684	27	63
12	1.5	High-use general recreation, young child (low use)	9.8	3	800	0.20	6.0	**8.0**	**8.0**	37	80	368	802	3684	27	63
26a	2.2	High-use general recreation, adult / older child	1.9	3	400	0.14	0.83	1.4	**2.0**	51	14	514	143	5143	27	176
39	0.15	Marathon canoeist	54	3	600	0.13	2.0	0.78	**2.0**	5.8	7.8	58	78	575	13	25
40	5.2	High-use general recreation, young child (low use)	19	3	4000	0.85	0.25	**8.0**	**8.0**	37	80	368	802	3684	27	63
47	0.18	Recreational canoeist	6.0	---	---	---	0.71	1.2	**2.0**	13	12	129	121	1286	28	73
52	0.25	Recreational canoeist	7.0	3	1000	0.22	2.0	1.2	**2.0**	13	12	129	121	1286	28	73
53	0.35	Recreational canoeist	408	3	1000	0.30	0.74	1.2	**2.0**	13	12	129	121	1286	28	73
60a	0.16	Recreational canoeist	7.0	3	200	0.070	1.09	1.2	**2.0**	13	12	129	121	1286	28	73
				Subtotal:	**8,700**	**2**										
				Total:	**454,800**	**279**										

Notes:

[1] *See Figures 5-1 and 5-2 for direct contact exposure areas in Reaches 5 through 8, and Heavily Used Subareas, respectively.*

[2] *Area only includes the portion of the exposure area within the 1 mg/kg PCB isopleth (Reaches 5/6) or the 100-year floodplain (Reaches 7/8).*

[3] *EPC is calculated for top 1-ft floodplain soil, except in Heavily Used Subareas where it is calculated for top 3-ft floodplain soil.*

[4] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[5] *For scenarios containing more than one receptor (e.g. adult and older child), the lowest IMPG was utilized in the comparison to post-remediation EPCs. The lowest IMPG value for which the alternative was designed to achieve is shown in bold.*

[6] *Same as 10^{-6} RME IMPGs, with no values less than 2 mg/kg, for which this alternative was designed to achieve.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-38. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for agricultural products consumption areas under FP 7.

Farm ID[1]	Area of farm (acre)[2]	IMPG Scenario	Pre-Remediation EPC[3] (mg/kg)	Removal[4]			Post-Remediation EPC[3] (mg/kg)	IMPG[5] (mg/kg)									
								Cancer Risk @ 10^{-6}		Cancer Risk @ 10^{-5}		Cancer Risk @10^{-4}		Non-Cancer (Child)		Non-Cancer (Adult)	
				Depth (ft)	Volume (cy)	Area (acres)		RME	CTE	RME	CTE	RME	CTE	RME	CTE	RME	CTE
FA 1	8.0	Commercial Dairy	1.6	1	1000	0.81	0.68	**0.68**	3.1	6.8	31	68	312	7.7	12.2	36.4	44.3
FA 2	3.3		13	1	1000	0.75	0.55	**0.55**	2.5	5.5	25	55	253	6.2	9.9	29.4	35.9
FA 3	4.1		0.20	---	---	---	0.20	**0.29**	1.3	2.9	13	29	132	3.2	5.2	15.4	18.7
FA 4	64		0.38	---	29000	18	0.23	**0.24**	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 5	12		0.25	1	6000	3.5	0.24	**0.24**	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 6	8		0.25	1	9000	5.7	0.13	**0.24**	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 7	24		0.25	1	4000	2.3	0.22	**0.24**	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 8	9.4		0.19	---	---	---	0.19	**0.34**	1.5	3.4	15	34	154	3.8	6.0	17.9	21.8
FA 9	26		0.89	1	8000	5.0	0.31	**0.31**	1.4	3.1	14	31	143	3.5	5.6	16.6	20.3
FA 10	0.3		0.50	---	---	---	0.50	**2.06**	9.5	21	95	206	946	23.2	37.0	110.1	134.2
FA 11	0.14		0.25	---	---	---	0.25	**6.10**	27.9	61	279	610	2794	68.6	109.2	325.1	396.2
FA 12	8.0		0.25	---	---	---	0.25	**0.38**	1.8	3.8	18	38	176	4.3	6.9	20.5	25.0
FA 13	4.0		0.25	---	7000	4.0	0.021	**0.24**	1.1	2.4	11	24	110	2.7	4.3	12.8	15.6
FA 14	2.6		0.30	---	---	---	0.30	**0.55**	2.5	5.5	25	55	253	6.2	9.9	29.4	35.9
				Total:	**65,000**	**40**											

Notes:

[1] See Figure 5-4 for farm areas in Reaches 5 through 8.

[2] Farm area only includes the portion within the 1 mg/kg PCB isopleth (Reaches 5/6) or the 100-year floodplain (Reaches 7/8).

[3] EPC is calculated for the top 1 ft of floodplain soil.

[4] As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.

[5] IMPG values for agricultural products consumption include a multiplier to account for the areas outside the 1 mg/kg PCB isopleth/100-year floodplain (see Table 5-2). The lowest IMPG value for which the alternative was designed to achieve is shown in bold.

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-39. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for wood frog averaging areas (vernal pools) under FP 7.

Vernal Pool ID[1]	Area of Vernal Pool (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal[3]			Post-Remediation EPC[2](mg/kg)	IMPG[4] (mg/kg)	
			Depth (ft)	Volume (cy)	Area (acre)		Lower Bound	Upper Bound
5-VP-3	1.9	29	1	2000	1.2	3.27	**3.27**	5.6
5-VP-1	0.044	1.7	---	---	---	1.7	**3.27**	5.6
8-VP-5	0.043	26	1	60	0.040	0.45	**3.27**	5.6
8-VP-4	0.24	3.9	1	20	0.010	3.27	**3.27**	5.6
8-VP-3	0.02	7.7	1	40	0.020	0.021	**3.27**	5.6
8-VP-2	0.57	66	1	30	0.020	3.1	**3.27**	5.6
18-VP-2	0.61	7.2	1	60	0.040	3.27	**3.27**	5.6
18-VP-1	0.28	7.9	1	90	0.060	3.27	**3.27**	5.6
19-VP-7	0.068	0.80	---	---	---	0.80	**3.27**	5.6
19-VP-2	0.0080	34	---	---	---	0.021	**3.27**	5.6
19-VP-1	0.18	23	1	200	0.14	1.8	**3.27**	5.6
19-VP-3	0.031	10	1	50	0.030	2.8	**3.27**	5.6
19-VP-4	0.094	5.6	1	50	0.030	3.27	**3.27**	5.6
19-VP-8	0.057	91	---	---	---	0.021	**3.27**	5.6
19-VP-5	0.51	26	1	600	0.35	3.27	**3.27**	
19-VP-6	1.2	22	1	700	0.42	3.27	**3.27**	5.6
23-VP-2	0.18	46	1	200	0.10	3.27	**3.27**	5.6
23-VP-1	0.30	62	---	---	---	0.021	**3.27**	5.6
23A-VP-1	0.45	26	1	600	0.39	2.4	**3.27**	5.6
23B-VP-1	0.068	26	1	50	0.030	0.15	**3.27**	5.6
23B-VP-2	0.091	0.34	---	---	---	0.34	**3.27**	5.6
27B-VP-2	0.28	11	1	200	0.10	3.27	**3.27**	5.6
27B-VP-3	0.062	16	---	---	---	0.021	**3.27**	5.6
27B-VP-1	0.072	12	1	60	0.040	3.27	**3.27**	5.6
27-VP-2	0.47	21	1	300	0.16	3.27	**3.27**	5.6
27A-VP-1	0.20	31	1	300	0.16	3.27	**3.27**	5.6
27-VP-1	1.3	23	1	900	0.57	3.27	**3.27**	5.6
26-VP-1	0.036	40	1	40	0.030	1.4	**3.27**	5.6
33-VP-1	0.022	10	---	---	---	0.021	**3.27**	5.6
33-VP-2	0.12	65	---	---	---	0.78	**3.27**	5.6
38-VP-1	0.43	34	1	200	0.11	3.27	**3.27**	5.6
38A-VP-1	0.020	5.0	1	30	0.020	0.021	**3.27**	5.6
38-VP-3	0.046	28	1	40	0.020	0.021	**3.27**	5.6
38-VP-2	0.17	28	1	200	0.10	3.27	**3.27**	5.6
40-VP-3	0.46	59	1	100	0.070	3.1	**3.27**	5.6
40-VP-2	0.36	17	1	400	0.23	3.27	**3.27**	5.6
40A-VP-1	0.11	68	1	200	0.10	3.27	**3.27**	5.6
40-VP-1	0.47	58	1	70	0.040	3.27	**3.27**	5.6
42-VP-1	0.22	63	1	10	0.010	1.4	**3.27**	5.6
42-VP-2	0.28	45	1	400	0.27	2.6	**3.27**	5.6
42-VP-3	0.050	41	1	70	0.040	0.021	**3.27**	5.6
42-VP-5	0.58	61	1	500	0.29	3.27	**3.27**	5.6
42-VP-4	1.0	33	1	1000	0.67	3.27	**3.27**	5.6
42A-VP-1	1.5	31	1	2000	1.1	3.27	**3.27**	5.6
46-VP-2	7.1	20	1	1000	0.66	2.6	**3.27**	5.6
46-VP-1	0.52	51	1	60	0.040	3.27	**3.27**	5.6
46-VP-5	0.056	123	1	20	0.050	0.021	**3.27**	5.6
46-VP-3	1.4	67	1	700	0.46	0.87	**3.27**	5.6
46-VP-4	0.011	125	---	---	---	0.021	**3.27**	5.6
49A-VP-1	0.019	16	1	7.	0.0	0.021	**3.27**	5.6
49-VP-1	1.2	18	1	900	0.57	3.27	**3.27**	5.6
49B-VP-1	0.0044	26	---	---	---	0.021	**3.27**	5.6
66A-VP-1	0.032	0.70	---	---	---	0.70	**3.27**	5.6
69-VP-1	0.0074	12	1	10	0.010	0.021	**3.27**	5.6
8-VP-6	0.086	47	---	---	---	0.021	**3.27**	5.6
12-VP-1	0.080	8.0	1	30	0.020	2.5	**3.27**	5.6
39-VP-1	2.0	32	1	2000	1.5	2.3	**3.27**	5.6
54-VP-1	0.20	21	1	300	0.17	3.0	**3.27**	5.6
55-VP-1	0.59	7.7	1	4.	0.0	3.27	**3.27**	5.6
55A-VP-1	2.0	79	1	2000	1.0	3.2	**3.27**	5.6
58A-VP-1	0.32	22	1	400	0.22	3.27	**3.27**	5.6
67A-VP-1	0.12	13	1	200	0.12	0.021	**3.27**	5.6
61A-VP-1	0.19	28	1	10	0.010	1.5	**3.27**	5.6
61A-VP-2	1.2	35	1	1000	0.61	3.0	**3.27**	5.6
56A-VP-1	0.58	73	1	800	0.48	0.85	**3.27**	5.6
23-VP-3	1.3	22	1	1000	0.73	3.0	**3.27**	5.6
			Total:	**22,000**	**14**			

Notes:

[1] *See Figure 5-5 for locations of vernal pools.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

[3] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[4] *The IMPG value for which the alternative was designed to achieve is shown in bold.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-40. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for shrew averaging areas under FP 7.

Averaging Area ID[1]	Area of Averaging Area (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal[3]			Post-Remediation EPC[2](mg/kg)	IMPG[4] (mg/kg)	
			Depth (ft)	Volume (cy)	Area (acre)		Lower Bound	Upper Bound
G1	88	22	---	---	---	2.4	**21.1**	34.3
G2	87	50	---	---	---	2.6	**21.1**	34.3
G3	86	18	---	---	---	3.3	**21.1**	34.3
G4	86	27	---	---	---	4.9	**21.1**	34.3
G5	88	28	---	---	---	7.8	**21.1**	34.3
G6	87	11	---	---	---	7.1	**21.1**	34.3
G7	73	17	---	---	---	7.9	**21.1**	34.3
			Total:	**0**	**0**			

Notes:

[1] *See Figure 5-6 for shrew averaging areas.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

[3] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[4] *The IMPG value for which the alternative was designed to achieve is shown in bold.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-41. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for wood duck averaging areas under FP 7.

Averaging Area ID[1]	Reach	Averaging Area (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal[3]			Post-Remediation EPC[2] (mg/kg)	Floodplain IMPG[4] (mg/kg)		
								Sediment Target Level		
				Depth (ft)	Volume (cy)	Area (acre)		1 mg/kg	3 mg/kg	5 mg/kg
K1	5A	52	34	---	---	---	2.5	**50**	39	29
K2		63	8.1	---	---	---	3.0	**50**	39	29
K3		85	40	---	---	---	2.3	**50**	39	29
K4		60	17	---	---	---	4.8	**50**	39	29
K5		25	23	---	---	---	4.3	**50**	39	29
K6	5B	55	25	---	---	---	5.6	**48**	33	18
K7		47	29	---	---	---	4.8	**48**	33	18
K8		92	24	---	---	---	4.8	**48**	33	18
K9	5C/5D	69	25	---	---	---	9.7	**53**	49	46
K10		83	13	---	---	---	7.5	**53**	49	46
K11		61	14	---	---	---	7.2	**53**	49	46
K12	6	28	23	---	---	---	8.8	**53**	50	46
				Total:	**0**	**0**				

Notes:

[1] *See Figure 5-7 for wood duck averaging areas.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

[3] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[4] *The IMPG value for which the alternative was designed to achieve is shown in bold.*

Key

🟦 = post-remediation EPC is lower than the IMPG

Table 6-42. Summary of IMPGs, pre- and post-remediation EPCs, and removal volumes and acreages for mink averaging areas under FP 7.

Averaging Area[1]	Area of Averaging Area (acre)	Pre-Remediation EPC[2] (mg/kg)	Removal[3]			Post-Remediation EPC[2] (mg/kg)	Floodplain IMPG[4] (mg/kg)					
							Sediment Target Level					
							1 mg/kg		3 mg/kg		5 mg/kg	
			Depth (ft)	Volume (cy)	Area (acre)		Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
5A/5B	435	22	1	21000	13	3.4	**3.4**	16.6	*n/a*	5.12	*n/a*	*n/a*
5C/5D/6	291	18	1	7000	4.1	6.9	**6.9**	19.6	3.0	15.7	*n/a*	11.8
			Total:	**28,000**	**17**							

Notes:

[1] *See Figure 5-8 for mink averaging areas.*

[2] *EPC is calculated for the top 1 ft of floodplain soil.*

[3] *As stated in Section 5.4.4, the total and subtotal volumes shown are consistent with those described in the text, but due to roundoff for the individual averaging areas, do not always agree with the sum of the individual averaging areas.*

[4] *(n/a) denotes IMPG values not attainable in given reach for the sediment target level. The IMPG value for which the alternative was designed to achieve is shown in bold.*

Key

▨ = post-remediation EPC is lower than the IMPG

7. Analysis of Remedial Alternatives for Treatment/Disposition of Removed Sediments and Soils

This section describes and evaluates the five alternatives developed for treatment and/or disposition of removed sediments, riverbank soils, and floodplain soils from the Rest of River area. As described in the CMS Proposal, the five treatment/disposition alternatives were selected for detailed evaluation based on the review and screening of a wide range of potential technologies and process options.[171] The treatment/disposition alternatives approved by EPA for evaluation are:

- TD 1 – Disposal in an off-site permitted landfill or landfills;
- TD 2 – Disposition in a local in-water Confined Disposal Facility (CDF) or Facilities;
- TD 3 – Disposition in a local on-site Upland Disposal Facility;
- TD 4 – Chemical extraction of PCBs from removed sediment/soil; and
- TD 5 – Thermal desorption of PCBs from removed sediment/soil.

Each treatment/disposition alternative has been evaluated in detail based on the General Standards and Selection Decision Factors specified in the Permit (described in Sections 2.1 and 2.2), excluding the factor of attainment of IMPGs, which is not relevant to the treatment/disposition alternatives. The results of these detailed evaluations are presented in Sections 7.1 though 7.5. A comparative evaluation of these five alternatives was then performed using the same criteria, as presented in Section 7.6.

7.1 Evaluation of Off-Site Disposal in Permitted Landfill(s) (TD 1)

7.1.1 Description of Alternative

Implementation of TD 1 would involve the transportation and disposal of removed sediment and floodplain soil at an existing commercial solid waste and/or TSCA-permitted landfill. Off-site disposal in permitted landfills is the most widely used method for disposition of sediments from environmental remediation projects (EPA, 2005e). It has been employed at

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[171] As noted in Section 1.6, the process options identified and retained in the CMS Proposal for dewatering and *ex situ* stabilization/solidification of removed sediment and soil have been evaluated as part of the sediment and floodplain soil remediation alternatives, and hence are not discussed in this section.

a multitude of sites, including for a portion of the sediments/soils removed from the Upper ½-Mile and 1½-Mile Reaches of the Housatonic River. Permitted landfills are subject to design, operation, and monitoring in accordance with established regulatory standards and requirements designed to assure their long-term effectiveness.

Sediments and soils would be loaded into trucks at the staging areas (following dewatering where necessary) and transported over public roadways to an appropriate off-site permitted landfill. The trucks would be manifested, covered, and labeled in accordance with federal and state regulations.

For purposes of evaluation in the CMS, this alternative has been evaluated for the range of potential volumes of sediments and floodplain soils that could be removed from the River and floodplain under the array of sediment and floodplain soil alternatives discussed in Sections 4 and 6. Specifically, this range extends from 185,000 *in situ* cy, based on a combination of SED 3 and FP 2, to 2.8 million *in situ* cy, based on a combination of SED 8 and FP 7. Similarly, the assumed duration for implementation of TD 1 has based on a range from 8 years (the duration of removal activities if SED 3 were selected) to 51 years (the duration of removal under SED 8). (It is assumed that the floodplain remediation could be implemented within these same periods.)

For disposal purposes, it is anticipated that the removed sediments and soils would be segregated into one of two principal classifications based on PCB concentrations – material with PCB concentrations $\geq$ 50 mg/kg and material with PCB concentrations < 50 mg/kg. The material with PCB concentrations $\geq$ 50 mg/kg would be transported to and disposed of at a TSCA-permitted landfill, while the remaining material would be transported to and disposed of at a permitted solid waste landfill. These classifications assume that the removed sediments and soils would not constitute hazardous waste under RCRA, and thus would not be subject to the separate requirements under RCRA and comparable state regulations for disposal of hazardous waste.[172] Based on prior experience at other portions of the GE-Pittsfield/Housatonic River Site (e.g., the 1½-Mile Reach and floodplain), it is not anticipated that the removed sediments and soils would constitute hazardous waste. However, representative testing of those materials would be conducted using the TCLP to

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[172] For purposes of evaluating TD 1, it has been assumed that the determination of whether excavated material would be subject to state regulation as hazardous waste would be based on the same criteria used in the RCRA regulations, and that wastes would not be subject to such regulation solely by virtue of having PCB concentrations $\geq$ 50 mg/kg, provided that such materials are disposed of in accordance with TSCA requirements. For example, in Massachusetts, although wastes with PCB concentrations $\geq$ 50 mg/kg are listed hazardous wastes, the Massachusetts hazardous waste regulations exempt facilities that manage such wastes so long as they comply with EPA's TSCA regulations (310 CMR 30.501(3)(a)). The other relevant criteria in the Massachusetts regulations for determining whether wastes are hazardous are comparable to those under RCRA.

determine whether they would do so. In the event that any particular sediments or soils would constitute hazardous waste, they would be segregated from the remaining materials and transported to an off-site facility authorized to receive those materials. Additionally, should any of the removed materials constitute "principal threat" wastes (e.g., free NAPL, drums of liquid waste), which is not anticipated, those wastes would be segregated and transported off-site separately for treatment and disposal, as appropriate.

7.1.2 Overall Protection of Human Health and the Environment – Introduction

The first General Standard in the Permit requires an evaluation of whether a remedial alternative would provide overall protection of human health and the environment. In accordance with the NCP, application of this standard to a particular treatment/disposal alternative draws primarily on the consideration of several other Permit criteria – long-term effectiveness and permanence, including long-term adverse impacts on health or the environment, short-term effectiveness, and compliance with ARARs. In these circumstances, the evaluation of whether TD 1 would be protective of human health and the environment is presented at the end of Section 7.1 so that it can take account of the evaluations under those other criteria.

7.1.3 Control of Sources of Releases

Placement of PCB-containing sediments and soils into off-site permitted landfills would eliminate the potential for those materials to be released and transported within the River or onto the floodplain. Once placed in an off-site landfill and covered, the material would be permanently isolated from the environment.

7.1.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE are listed in Tables 2-1 through 2-3. ARARs apply only to on-site activities and thus are not relevant to the off-site transport and disposal of sediments and soils. To the extent that ARARs are relevant to the construction of access roads and staging areas, those requirements are addressed in the consideration of alternatives for sediments and floodplain soils (Sections 4 and 6, respectively). The off-site transport and disposal activities would comply with all applicable federal, state, and local laws and regulations relating to such activities.

7.1.5 Long-Term Reliability and Effectiveness

An assessment of long-term reliability and effectiveness of an alternative includes an evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts associated with the alternative on human health or the environment. Each of these considerations is evaluated below for TD 1.

7.1.5.1 Magnitude of Residual Risk

As required by applicable regulations, the materials disposed in off-site permitted landfills under TD 1 would be isolated from underlying soils and groundwater and from surface receptors, which would effectively eliminate the potential for exposure by human and ecological receptors to those materials.

7.1.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of TD 1 has included an assessment of the factors discussed below.

Use of Technology under Similar Conditions

Landfill disposal is commonly used to dispose of soils and sediments containing PCBs. State and federal regulations governing the use of off-site permitted landfills are in place to help promote long-term reliability and effectiveness. Off-site permitted landfills were selected as part of a final remedy for a number of sites that have sediments or soils containing PCBs, including the New Bedford Harbor hot spots in Massachusetts; Burnt Fly Bog Site in Marlboro, New Jersey; General Motors Central Foundry Division in Massena, New York; and Consolidated Edison Arthur Kill Generating Station in Staten Island, New York. More recently, the Record of Decision (ROD) for the Fox River in Wisconsin also includes off-site disposal of sediments and soils at permitted facilities as part of the final remedy.

Overall Effectiveness and Reliability

Permitted landfills are subject to design, operation, and monitoring in accordance with regulatory standards and requirements designed to assure their long-term effectiveness and reliability. As a result, implementation of TD 1 is considered an effective and reliable means of permanently disposing of the removed sediment/soil.

Reliability of Operation, Monitoring, and Maintenance Requirements

The operators of the off-site permitted landfills would be responsible for operating, monitoring, and maintaining the facilities in accordance with their permits. TD 1 would involve no long-term OMM requirements as part of the Rest of River remedy.

Technical Component Replacement Requirements

These responsibilities would also apply to the off-site landfill operator, and would not be part of the Rest of River remedy for TD 1.

7.1.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts resulting from TD 1 on human health or the environment has included an assessment of several components, as described below. It should be noted that access roads would be necessary to facilitate transportation of excavated/dredged materials from the staging areas located along the River to the local roads for transportation off-site. These access roads would be constructed as part of the sediment and floodplain alternatives previously described. As such, long-term adverse impacts associated with construction of these roads are not included in this section, but have been considered in the evaluations of the sediment and floodplain soil alternatives (Sections 4 and 6, respectively).

Potentially Affected Populations

Under TD 1, the PCB-containing sediments and soils placed in the off-site permitted landfills would remain in place indefinitely. There would be no long-term impacts to humans or ecological populations in the Rest of River resulting from this alternative.

Adverse Impacts on Biota and Corresponding Habitat

As the PCB-containing materials would be managed at an off-site location, there would be no impacts to biota in the Rest of River resulting from off-site disposal.

Adverse Impacts on Wetlands

No impacts on wetlands or other environmentally sensitive areas would be expected.

Long-Term Impacts on Aesthetics

Implementation of TD 1 would not be anticipated to produce long-term impacts on the aesthetics of the Rest of River area.

Potential Measures to Mitigate Long-Term Adverse Impacts

No potential measures are anticipated to be needed to mitigate long-term adverse impacts.

7.1.6 Reduction of Toxicity, Mobility, or Volume

The degree to which TD 1 would reduce the toxicity, mobility, or volume of PCBs is discussed below.

Reduction of Toxicity: TD 1 would not include any treatment processes that would reduce the toxicity of the PCBs in the removed sediment and soil. These materials would be transferred to secure off-site locations for permanent containment. However, as noted in Section 2.2.3, should any removed material constitute “principal threat” wastes, which is not anticipated, those wastes would be segregated and transported off-site for treatment and disposal, as appropriate.

Reduction of Mobility: TD 1 would result in the reduced mobility of PCBs by permanently containing the removed sediments and soils within off-site permitted landfill(s). Once disposed of, these materials would be isolated from surface water infiltration, leaching to groundwater, or otherwise mobilizing.

Reduction of Volume: TD 1 would not reduce the volume of PCB-containing material.

7.1.7 Short-Term Effectiveness

Evaluation of the short-term effectiveness of TD 1 has included consideration of the short-term impacts that implementing this alternative would have on the environment, local communities and communities along the truck transportation corridor, and the workers involved in the disposition activities. The time to implement TD 1, and thus the duration of short-term impacts, would be dependent upon the sediment and floodplain alternatives selected, and could range from approximately 8 years (if SED 3 were implemented) to 51 years (if SED 8 were implemented).

Impacts on the Environment

Implementation of TD 1 could have short-term effects on the environment if there were accidental releases of PCB-containing sediments or soils from trucks transporting the materials to the off-site landfill(s). Reasonable and appropriate controls would be implemented to minimize the potential for releases during transportation activities, such as the use of lined and tarped trucks. The establishment of truck loading and equipment decontamination procedures would reduce the potential for releases and exposure during loading.

Impacts on Local Communities and Communities Along Transport Routes

TD 1 would result in short-term impacts to the local communities along the River and the truck transportation corridor. These short-term effects would consist primarily of increased truck traffic, with resultant noise and emissions, and the potential for traffic accidents. Truck traffic to transport material removed from the River or floodplain would persist for the duration of the project. To estimate the relative short-term impacts related to such truck traffic, it was assumed that 20-ton trucks (approximate 16-cy capacity) would be used to transport material off-site for disposal. To calculate the number of truck trips necessary, the *in situ* removal volumes were bulked by 20%. Using these assumptions, the number of truck trips would range from approximately 14,100 truck trips to transport 185,000 *in situ* cy of material for alternatives SED 3 and FP 2 to approximately 211,800 truck trips to transport 2.8 million *in situ* cy of material for alternatives SED 8 and FP 7. This additional traffic would increase the likelihood of accidents, noise levels, and emissions of vehicle/equipment exhaust and nuisance dust to the air. Transportation would be conducted in accordance with applicable Department of Transportation (DOT) guidelines and regulations, which would minimize short-term risks. However, compliance with those regulations cannot eliminate the possibility of accidents or impacts from noise and emissions.

Appendix D includes an analysis of potential accident risks from the increased truck traffic that would be associated with the treatment/disposition alternatives. For TD 1, this analysis focuses on the increased truck traffic that would be necessary to transport materials to off-site disposal facilities. Risk estimates from increased truck traffic were made for the range of truck trips described above These estimates were also based on an assumed split between TSCA-regulated and non-TSCA materials, as described in Appendix D. Based on the lower and upper bounds of the truck trip estimates, this analysis indicates that the increased truck traffic associated with TD 1 would result in an estimated 4.74 to 71.08 non-fatal injuries due to accidents (with a probability of 99% to 100% of at least one such injury) and an estimated 0.2 to 2.99 fatalities from accidents (with a probability of 18% to 95% of at least one such fatality).

Risks to Remediation Workers

Since TD 1 involves off-site transportation and disposal of the staged excavated/dredged materials, the risks to workers would consist solely of risks to the truck drivers and to the employees of the off-site disposal facilities, rather than to on-site remediation workers. As such, no quantitative evaluation has been made of the risks to remediation workers for TD 1.

7.1.8 Implementability

7.1.8.1 Technical Implementability

The technical implementability of TD 1 has been evaluated in terms of the following factors:

General Availability of Technology: At present, there are a number of existing permitted TSCA and solid waste landfills that are believed to have the required capacity to accept all of the material removed during implementation of the sediment and floodplain alternatives. However, the time to implement TD 1, and therefore the time over which landfill space is needed, would be dependent upon the sediment and floodplain alternatives selected by EPA and could range from approximately 8 years to 51 years, as noted above. Given the potential length of time required to implement TD 1, it is possible that current off-site landfill capacity would be exhausted before the remediation was complete. Further, given the potential difficulties associated with expansion of such facilities, it is uncertain whether the capacity needed for the disposal of sediments/soils from the potential array of removal alternatives would be available in the future.

Ability To Be Implemented: Material is routinely transported to off-site permitted landfills. Regulations are in place for transporting such materials and for designing and operating landfills to enable effective containment of waste materials. As noted previously, a number of the sediment remedial alternatives are estimated to take more than 20 years to complete, including SED 8 at 51 years. To implement TD 1, sufficient landfill capacity must be available at the time the material is being removed, which for many of the sediment alternatives is currently uncertain.

Reliability: As noted previously, landfill disposal is commonly used to dispose of soils and sediments containing PCBs. State and federal regulations governing the operation of off-site permitted landfills are in place to help promote long-term reliability and effectiveness.

Availability of Space for Support Facilities: As noted in the evaluations of the sediment and floodplain soil alternatives (Sections 4 and 6, respectively), sufficient space is expected to be available to construct the access roads and staging areas needed to support the sediment and soil removal activities.

Availability of Equipment, Materials, and Personnel: Equipment, materials, and personnel necessary to load and transport soil/sediment to off-site permitted landfills are considered readily available.

Ability to Monitor Effectiveness: Under TD 1, no OMM would be necessary at the site, since the material would all be transported to off-site landfills.

7.1.8.2 Administrative Implementability

The evaluation of the administrative implementability of TD 1 has included consideration of regulatory requirements, need for access agreements, and coordination with government agencies.

Regulatory Requirements: Implementation of TD 1 would require meeting the requirements of applicable federal, state, and local rules and regulations relating to the off-site transport and disposal of the sediments and soils. It is anticipated that such requirements would be met.

Access Agreements: Implementation of TD 1 would not require GE to obtain access permission since materials would be transported off-site for disposal.

Coordination with Agencies: Both prior to and during implementation of TD 1, GE would need to coordinate with EPA, as well as state and local agencies, to address potential health and safety impacts related to off-site transport of materials, to provide as-needed support with public/community outreach programs, and to fulfill the requirements for transporting material to the off-site permitted landfills. GE would also have to provide required notice to environmental agencies in any state where a receiving landfill is located.

7.1.9 Cost

The range of estimated total costs to implement TD 1 is $50 M to $790 M (not including costs associated with sediment or floodplain soil removal). The low end of this range is based on the transport and disposal of dewatered and stabilized materials for a combination of SED 3 and FP 2 (approximately 185,000 *in situ* cy). The high end of the range represents the estimated costs for the transport and disposal of dewatered and stabilized materials for SED 8 and FP 7 (approximately 2.8 million *in situ* cy). An assumed bulking factor (20% by volume) and drying agents (10% by weight to account for the potential need for stabilization prior to transport) were included in the sediment volumes for the cost estimates. Note that the costs assume that the removed materials would be segregated based on TSCA classification as described in Section 3.1.5, and that no additional material stabilization activities beyond what was included and discussed in the analysis of sediment and floodplain soil alternatives would be needed prior to transport. There are no capital costs associated with TD 1. Annual operations costs would be approximately $6 M to $15 M. There are no post-construction monitoring and maintenance costs associated with TD 1. The following summarizes the total project costs estimated for TD 1.

TD 1	Minimum Est. Cost	Maximum Est. Cost	Description
Total Capital Cost	$0	$0	N/A
Total Operations Cost	$50 M	$790 M	Total cost for the transport and off-site disposal of removed materials at an off-site regulated facility(ies)
Total Post-Construction Monitoring and Maintenance Cost	$0	$0	N/A
Total Cost of Alternative	$50 M	$790 M	Total cost of TD 1 in 2008 dollars

The range of total estimated present worth costs for TD 1, which was developed using a discount factor of 7% and an anticipated 8- to 51-year operations period, is $39 M to $220 M. More detailed cost estimate information and assumptions for each of the treatment/disposition alternatives are included in Appendix E.

7.1.10 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 7.1.2, the evaluation of whether TD 1 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: Landfill disposal is commonly used to dispose of soils and sediments containing PCBs. State and federal regulations governing the siting and use of off-site permitted landfills are in place to promote long-term reliability and effectiveness. TD 1 would provide permanent disposal of the PCB-containing sediments and soils. However, due to the potential volume of materials that could require disposal and the potential length of time required to implement TD 1, it is uncertain whether off-site permitted facilities would have the required capacity available for the disposal of these materials at the relevant times in the future.

Compliance with ARARs: In general, as discussed in Section 7.1.4, ARARs are not relevant to the off-site transport and disposal of the sediments and soils, since those activities would take place largely away from the River. The off-site transport and disposal activities would comply with all applicable federal, state, and local laws and regulations.

Human Health Protection: TD 1 would provide human health protection through disposal of the removed PCB-containing materials in off-site permitted landfills. Implementation of this alternative would not be expected to have any significant long-term or short-term adverse effects on human health at the site. However, it would result in some short-term safety risks due to a substantial increase in truck traffic to transport the materials from the site.

Environmental Protection: Implementation of TD 1 would have no long-term or short-term adverse impacts on the environment at the site, although it could have some short-term impacts if there were accidental releases of PCB-containing materials from trucks during transport to the off-site disposal facilities.

Summary: Based on the foregoing considerations, TD 1 would provide overall protection of human health and the environment.

7.2 Evaluation of Local Disposal in CDF (TD 2)

7.2.1 Description of Alternative

Alternative TD 2 would involve the placement of dredged sediments in a CDF or CDFs located within a waterbody. A CDF is an engineered structure consisting of dikes or other structures that extend above an adjacent water surface and enclose a disposal area for containment of dredged sediments. Containing the dredged material effectively isolates it from the adjacent waters or land (EPA, 1992). CDFs are typically constructed within a waterbody at location(s) selected to receive materials from as wide a segment of the waterbody as possible, while transporting the material over as short a distance as practical. Three objectives inherent in the design and operation of CDFs are to: (1) provide adequate storage capacity for the dredged sediments; (2) capture the solids within the CDF; and (3) control contaminant releases. The basic guidance for design, operation, and management of CDFs can be found in various engineering manuals issued by the USACE (1983, 1987, 2003). These manuals were developed for CDFs used for navigational dredging, but the same concepts have been applied to the use of a CDF for the disposal of material that is removed via environmental dredging.

For purposes of the CMS, it has been assumed that only hydraulically dredged sediments would be placed in a CDF. (Hydraulic dredging removes sediments in the form of a slurry, which can then be pumped into a CDF, unlike mechanically dredged sediments which require additional handling/processing steps prior to placement.) As noted in Section 4, hydraulic dredging has been assumed in Reaches 5C and 6 for sediment alternatives SED 6 and SED 7, and in Reaches 5C, 6, 7, and 8 for SED 8. Further, the use of a CDF requires that a location or locations be identified in the Housatonic River basin where relatively large open water areas exist, preferably not within the main channel flow and preferably in close proximity to areas where larger volumes of sediments would be hydraulically removed, since direct filling with hydraulically dredged sediments is the most efficient means of using a CDF. Based on these criteria, four locations were identified as potential locations for a CDF: a portion of Woods Pond (see Figure 7-1) and three large backwaters BWL_05, BWL_07, and BWL_09 (see Figure 7-2). Given these locations, TD 2 could be used only for hydraulically dredged sediments from Reaches 5C and 6 under alternatives SED 6 through SED 8. Due to these limitations, TD 2 could not be the only treatment/disposition alternative selected; another treatment/disposition alternative would be necessary for other removed sediments and for floodplain soil.

With regard to the four potential CDF locations, the southeastern portion of Woods Pond contains an area with water depths up to 17 feet, which could provide significant storage capacity for sediments dredged from Reaches 5C and 6. This “deep hole” in Woods Pond is separated from the main flow channel by a relatively shallow water zone, which makes it a favorable location for sediment disposal. Furthermore, the sediments in that area, which would otherwise be subject to removal under alternatives SED 6 through SED 8, could remain in place, thereby increasing the efficiency of those alternatives and somewhat reducing associated dredging volumes, time, dredging-related impacts, and costs. The three identified backwater areas would provide a similar function, although the volume of sediment that could be contained in those backwaters would be smaller as the water depths in these areas are much shallower.

The primary advantage of an in-water CDF is the ability to handle large volumes of water (generated through the hydraulic dredging process) while containing the sediment and associated contaminants. To achieve this, the CDF or CDFs would be created by isolating a portion of Woods Pond and/or the backwater areas from the main channel using sealed sheetpiles and then constructing a soil berm around the land-side perimeter of the area. Hydraulically dredged sediment would then be pumped into the confined area where the sediments would settle out of suspension and consolidate while the excess water would filter through the permeable soil berms and return to the River. As the water passes through the permeable soil berms, the solids would be filtered out and contained within the CDF.

The filter core of the permeable dike would be constructed using fine to medium sand and filter fabric. This material can be placed at a 2:1 slope and supported along the slopes by gravel or crushed stone. The berm would be constructed in lifts, with larger armor stone placed along the outer slopes as the berm is raised. It has been assumed that, during the filling process, the top of the sheetpile wall and berms would be 5 feet above the mean water elevation in Woods Pond and the backwaters, both to provide sufficient capacity to accommodate the sediment/water slurry and to allow sufficient surface area for the water to seep through the berms during placement of the dredged materials. Once the CDF(s)' capacity is reached and the sediment has consolidated, the berm and sheeting elevations would be lowered to the extent practicable, and the CDF(s) would be closed through the construction of an 18-inch soil cover over the consolidated sediments. The surface of the CDF(s) would then be planted with appropriate vegetation depending on final design elevations and site-specific conditions.

To determine the appropriate capacity for the CDF(s), the volume of sediment that would be hydraulically dredged in Reaches 5C and 6 has been estimated for alternatives SED 6, SED 7, and SED 8. Those volumes are:

- SED 6 – 300,000 cy;
- SED 7 – 385,000 cy; and
- SED 8 – 1,240,000 cy.

These sediment removal volumes would be reduced to account for the sediments within the footprint of the CDF(s) that would remain in place.

Potential CDF Configurations for SED 6, SED 7, and SED 8

Several potential configurations exist for construction of CDFs in Woods Pond and the backwaters identified above. In Woods Pond, two options that have been evaluated are to place the sheetpile wall at locations A or B, as shown on Figure 7-1. The corresponding confined areas would cover 17 and 36 acres, respectively. In the backwaters, CDFs could be constructed within the areas shown on Figure 7-2. The corresponding confined areas for backwaters BWL_05, BWL_07, and BWL_09 are 15.4 acres, 23.8 acres, and 8.5 acres, respectively.

Based on the estimated volumes and potential configurations described above, conceptual locations for CDF(s) have been selected for SED 6, SED 7, and SED 8, as described below:

SED 6: Under SED 6, the estimated sediment removal volume for Reaches 5C and 6 is 300,000 cy. It is assumed that these hydraulically dredged sediments would be placed in a CDF in Woods Pond within the area encompassed by sheetpile location A. The sediment volume targeted for removal within the footprint of that CDF location is 7,000 cy. Since that sediment would not have to be dredged, the net volume of sediment to be hydraulically dredged and placed in the Woods Pond CDF would be 293,000 cy. This would fill the CDF location to a final elevation approximately 5 feet above the mean surface water elevation (including the thickness of the final cover).

SED 7: Under SED 7, the estimated sediment removal volume for Reaches 5C and 6 is 385,000 cy. It is assumed that these hydraulically dredged sediments would be placed in two CDFs – one within the area of Woods Pond encompassed by sheetpile location A, and the other in backwater BWL_09. The sediment volumes within those footprints, which would otherwise be targeted for removal, are 12,000 cy in the CDF portion of Woods Pond and 2,000 cy in backwater BWL_09. Since those sediments would not have to be dredged, the net volume of sediment to be hydraulically dredged and placed in these CDFs would be 371,000 cy. This volume would fill the Woods Pond CDF and the backwater BWL_09 CDF to a final elevation of approximately 5 feet above the mean surface water elevation, including the thickness of the final covers.

SED 8: Under SED 8, the estimated sediment removal volume for Reaches 5C and 6 is 1,240,000 cy. It is assumed that these hydraulically dredged sediments would be placed in two CDFs – one within the area of Woods Pond encompassed by sheetpile location B, and the other in backwater BWL_07. The sediment volumes within those footprints, which would otherwise be targeted for removal, are 347,000 cy and 94,000 cy, respectively. Since those sediments would not have to be dredged, the net volume of sediment to be hydraulically dredged and placed in these CDFs would be approximately 800,000 cy. This volume would fill the Woods Pond CDF and the backwater BWL_07 CDF to a final elevation of approximately 5 feet above the mean surface water elevation, including the thickness of the final covers.

Remedial Approach

The following summarizes the general remedial approach (and associated assumptions) related to the implementation of TD 2. It should be noted that while details on the CDF configuration, construction, operation, and closure are provided in this description for purposes of the evaluations in the CMS, the specific methods and CDF components for implementation of this alternative would be determined during the design process based on engineering considerations and site conditions.

Site Preparation: The first step in implementing TD 2 would be clearing and grubbing along the shore as necessary for access, followed by the construction of access roads and staging areas. It has been assumed that there would be no water treatment plant associated with the CDF(s) because the permeable berms would allow for passive dewatering of the hydraulically dredged sediments.

Sheetpile Cutoff Wall and Permeable Berm Construction: The second step in implementing TD 2 would be the construction of the CDF(s), including driving a sealed sheetpile wall along the water side of the CDF(s) to isolate the CDF area(s) from the main channel, followed by construction of a permeable soil berm around the land-side perimeter. In both Woods Pond and the backwaters, the sheetpile would be installed using water-based construction techniques from a barge, and the soil berm would be constructed from the shore using conventional land-based equipment. Water flowing through the berm would be directed back to the River through a perimeter diversion ditch with additional filter dams installed, if needed.

CDF Operations: Once the CDF(s) are constructed, the hydraulically dredged sediment would be pumped to the CDF(s) as a slurry via piping connected to the dredge. Booster pump stations would be placed along the length of the pipe, as necessary, to allow the sediment to stay in suspension before reaching the CDF. Passive dewatering would be accomplished in the CDF(s) using gravity settling and filtration through the permeable berms. A minimum freeboard would be maintained at all times.

For purposes of the CMS, it has been assumed that dredging would be conducted for 9 months per year. Activities would be shut down for 3 months, which would also allow consolidation to occur. Depending on the sediment alternative that is selected, hydraulic dredging of Reaches 5C and 6 is expected to be performed for an estimated period of 5 years (for SED 6) to 9 years (for SED 8). At the completion of sediment removal activities, it could take several months for the dewatered sediment to become firm enough to support low ground-pressure equipment that would be used to place the cover. Additional measures such as installation of wick drains and/or a surface drainage system combined with surcharge loading could be required to promote consolidation of the sediment prior to cover placement.

Operations Monitoring and Maintenance: Monitoring and maintenance would be performed during CDF operations. These activities would include routine air and surface water monitoring for PCBs. They would also include visual monitoring of the dredge discharge pipe, the booster pumps, the sheetpiles, the permeable berms, and the perimeter diversion ditch to promote the integrity and proper functioning of these components.

Engineering/Institutional Controls: During construction and operation of the CDF(s), access restrictions would be established, such as installation of fencing and signs. Following construction, deed restrictions would be put in place to prohibit interference with the CDF(s) and restrict future use.

Final Cover Installation: Once all hydraulically dredged sediments have been placed and consolidated in the CDF, an 18-inch soil cover would be constructed over the area. Following placement, the CDF would be planted with appropriate vegetative species.

Flood Storage Compensation: Construction of the CDF(s) in Woods Pond and/or the backwaters would permanently reduce the existing flood storage capacity in those areas (by an amount ranging from 164,600 cy if SED 6 were selected to 580,800 cy for SED 8). As discussed further in Section 7.2.4, provision of some flood storage compensation may be required to minimize the impact of the CDF(s) on the elevation and extent of a large flood event. If this alternative were selected, GE would discuss with EPA the need for and feasibility of obtaining such flood storage compensation. If necessary, the locations and methods for obtaining such compensation would be addressed during design.

Long-Term Post-Closure Monitoring and Maintenance: A long-term monitoring and maintenance plan would be developed and implemented following closure of the CDF(s). It is anticipated that this plan would provide for long-term groundwater monitoring (five locations assumed per CDF), visual inspections and maintenance of the facility components, continuation and maintenance of access restrictions (e.g., fences), and appropriate deed restrictions on the land. For purposes of the CMS, it is assumed that this long-term program would consist of annual monitoring and inspections for a period of 30 years.

Restoration of Affected Areas: Under TD 2, support areas outside the CDF area that are disturbed by the construction or operation of the facility would be restored to the extent practicable. For the area within or adjacent to the footprint of the CDF(s), the final restoration would be dependent on the final design elevations and site-specific conditions. Depending on these factors, mitigation measures may be needed to compensate for areas that are permanently modified or removed from the ecosystem. It should be noted that while the final elevations have been assumed to be 5 feet above the mean surface water elevation in Woods Pond and the backwaters, consolidation of the sediment and underlying materials may alter the final elevation and ultimately have an effect on the restoration options for the CDF location(s).

Note Regarding Evaluations

As previously noted, since the CDF(s) would be used only for the disposition of hydraulically dredged sediments from Reaches 5C and 6 under SED 6 through SED 8, another treatment/disposition alternative would be needed for all other removed sediments, as well as for excavated floodplain soil. The evaluations presented below for TD 2 are limited to the use of the CDF(s) for the hydraulically dredged sediments described above, and do not cover the disposition of the remaining materials, with the exception of the cost estimates.

As such, those evaluations (excluding the cost evaluation) are not directly comparable to the evaluations of the other treatment/disposition alternatives. The cost estimates, however, have taken into account the costs for off-site disposal of the sediments that would removed from other reaches under SED 6 through SED 8, as well as excavated floodplain soil, as discussed in Section 7.2.9.

7.2.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 7.1.2, the evaluation of whether a treatment/disposal alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably, long-term effectiveness and permanence (including long-term adverse impacts), short-term effectiveness, and compliance with ARARs. For that reason, the evaluation of whether TD 2 would be protective of human health and the environment is presented at the end of Section 7.2 so that it can take account of the evaluations under those other criteria.

7.2.3 Control of Sources of Releases

Placement of PCB-containing sediments removed from Reaches 5C and 6 into CDF(s) would minimize the potential for those PCB-containing materials to be released and transported within the River or onto the floodplain in the future. The CDF(s) would be designed to permanently contain the dredged sediments. Since the CDF(s) would be constructed adjacent to the main channel of the River, the berms, sheeting, and cover would be designed to withstand high flow events. This would help ensure that the materials remain in place. A long-term monitoring and maintenance program would be implemented for the CDF(s) to promote long-term reliability and effectiveness of the structure(s).

Research on dredged material has shown there is a potential for some loss of contaminants from CDFs (EPA, 1992; Myers et al., 1996). The greatest potential for contaminant loss is via the effluent pathway (i.e., seepage through the berms) during filling operations. Research has also shown, however, that most organic contaminants are tightly bound to the sediment particles and not readily released in a soluble form. This is especially true for PCBs. A CDF that retains a high percentage of sediment particles will therefore be effective in containing the associated contaminants (USACE, 1978). Monitoring and control of this pathway would help control the potential for effluent releases from the CDF(s).

Several studies have been conducted to evaluate losses of contaminants during placement of hydraulically dredged sediments in CDFs (EPA, 1996). Hoeppel et al. (1978) studied influent and effluent samples from nine CDFs (four on the Atlantic coast, two on the Gulf coast, one on the Pacific coast, one in the Great Lakes, and one inland site). This study showed that most chemical constituents in dredged material were associated with the solid fraction, and that the efficiency of contaminant containment during filling operations was directly related to the efficiency of solids retention. For PCBs, very efficient containment was observed when adequate solids retention was maintained. Lu et al. (1978) carried out similar studies at the Grassy Island CDF in the Detroit River in Michigan and at the Pinto Island CDF in Mobile Bay, Alabama. At the Grassy Island CDF, the retention efficiency for PCBs was very close to the total solids retention (99.7%) and at the Pinto Island CDF, PCB retention efficiencies for Aroclors 1242, 1254, and 1260 were 96%, 97%, and 99%, respectively. Similarly, Myers (1991) measured PCB congener concentrations in influent and pond water in the Saginaw CDF in Michigan and found that the containment efficiency for PCBs was 99.82%.

There is also a potential for PCB releases to the air via volatilization during filling. The New Bedford Harbor CDF was covered with a floating cover to address such volatilization (Foster Wheeler Environmental Corporation, 2001; EPA, 2005d). A similar floating cover could be used during the implementation of TD 2 if PCB volatilization controls were deemed necessary.

It is also possible that the CDF cover could be damaged by ice or flooding, resulting in the release of PCB-containing materials from the CDF(s). However, the cover system would be designed to withstand impacts from ice and flooding, which would help ensure that the materials remain in place. A long-term monitoring and maintenance program would be implemented for the CDF(s) to promote long-term reliability and effectiveness of the structure(s).

7.2.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs presented in Table 2-1 include the federal and state water quality criteria for PCBs and state air pollution control requirements for particulate matter. Since the CDF(s) would be separated from the River via sheetpiles and berms, it is not expected that placement or presence of the PCB-containing sediments in the CDF(s) would have an appreciable impact on the water column PCB concentrations in the River and thus on attainment of the water quality criteria. The construction activities associated with TD 2 could be designed and implemented to meet the state particulate control requirements.

The location-specific ARARs are listed in Table 2-2, and the action-specific ARARs for local disposal in a CDF are presented in Part H of Table 2-3. Based on review of those ARARs, it appears that TD 2 could be designed and implemented to achieve many of those ARARs, but that there are some potential ARARs that would require specific EPA approval or would likely not be met, as discussed below:

- The in-water CDF(s) would not meet all the substantive requirements of EPA's TSCA regulations for a chemical waste landfill (40 CFR § 761.75). Thus, it would be necessary to obtain from EPA a determination that the CDF(s) meet(s) the substantive criteria for a waiver of some of those requirements under 40 CFR § 761.75(4) or risk-based approval under 40 CFR § 761.61(c).

- The Massachusetts water quality certification regulations on confined disposal of dredged sediment provide that no in-water CDF may be allowed if there is a practicable alternative with less impact on the aquatic ecosystem (314 CMR 9.07(8)(a)3.). Thus, for TD 2 to be implemented, EPA would need to find that there is no such practicable alternative. In addition, it is not anticipated that the CDF(s), as designed and constructed, would meet all the substantive design and/or siting requirements of those regulations relating to the use of an in-water CDF for dredged material (314 CMR 9.07(8)(d)). For example, it is not anticipated that the CDF(s) would have an impervious cover or would prevent run-on from a 25-year storm, since it is not the purpose of the CDF(s) to prevent any infiltration of precipitation or run-on water into the CDF(s). Thus, if this disposition alternative were selected, it is likely that a waiver would be necessary for these requirements.

- The Massachusetts Wetlands Protection Act regulations provide that remedial projects must, to the maximum extent practicable, minimize hydrological changes to resource areas and provide compensatory flood storage in accordance with 310 CMR 10.57(4)(a)1. for all lost flood storage capacity (310 CMR 10.53(3)(q)2.). Section 10.57(4)(a)1., in turn, requires flood storage compensation for flood storage capacity that would be lost as a result of projects within Bordering Land Subject to Flooding, which includes floodplain areas but does not include the waterbodies themselves. In these circumstances, it is not clear whether or to what extent these regulations would affect the construction of the CDF(s) and/or require flood storage compensation for the resulting loss of flood storage capacity. To the extent that these regulations would prohibit the CDF(s), a waiver would be necessary. To the extent that they would require obtaining flood storage compensation, it may not be feasible to meet that requirement due to the large volume required and the potential lack of any suitable places to obtain that volume of compensation at the appropriate elevations/areas. If so, a waiver of that requirement as technically impracticable would be necessary to allow this alternative to be implemented.

- As previously discussed, based on prior experience at other portions of this Site, it is not anticipated that the sediments to be placed in the CDF(s) would constitute characteristic hazardous waste under RCRA. However, representative TCLP testing would be conducted to determine whether they would do so. In the event that particular sediments to be placed in a CDF should constitute hazardous waste under RCRA, that facility would not meet some of the substantive requirements of EPA's RCRA regulations for such a hazardous waste disposal facility. For example, the CDF(s) would not be constructed with the double liner/leachate collection system required for hazardous waste surface impoundments (40 CFR §§ 264.221, 264.301). If this disposition alternative were selected, GE would first determine whether sediments to be placed in the CDF(s) would constitute hazardous waste. If so, GE would resolve with EPA the applicability of the RCRA regulations.[173] To the extent such requirements are deemed applicable, GE would explore with EPA a waiver of those requirements that would be technically impracticable to meet.

- Similarly, if any sediment to be placed in the CDF(s) would constitute hazardous waste under the Massachusetts hazardous waste regulations on grounds other than containing PCBs $\geq$ 50 mg/kg,[174] it is uncertain whether the hazardous waste management requirements of those regulations would be considered to apply.[175] If they did, the CDF(s) would not meet many of the location and design requirements of those regulations – e.g., the requirements that hazardous waste surface impoundments or landfills not be located within the 500-year floodplain or within wetlands (310 CMR 30.701(6), 30.705(6)), that there can be no disposal of hazardous waste into waterbodies (310 CMR 30.706), and that surface impoundments or landfills have double liners (310 CMR 30.612(1), 30.622(1)). Accordingly, if TD 2 was selected and the Massachusetts hazardous waste regulations were considered to apply to the CDF(s), a waiver of such requirements would be necessary.

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[173] For example, at least some of those requirements would not apply if the CDF is considered to be within the same AOC as the excavated sediments. Under EPA's AOC policy (EPA, 1995), an overall area that includes discrete areas of generally dispersed contamination may be considered an AOC, within which the movement of waste is not considered "placement," in which case the RCRA land disposal restrictions and other RCRA requirements, including minimum technology requirements, would not be triggered.

[174] As noted above, although wastes with PCB concentrations $\geq$ 50 mg/kg are listed hazardous wastes in Massachusetts, the Massachusetts hazardous waste regulations exempt facilities that manage such wastes so long as they comply with EPA's TSCA regulations (310 CMR 30.501(3)(a)).

[175] The Massachusetts hazardous waste regulations exempt dredged material that is placed in a confined disposal facility pursuant to 314 CMR 9.07(8) and managed in accordance with a state water quality certification and the requirements of a permit under § 404 of the Clean Water Act (310 CMR 30.104(3)(f)). In addition, the Massachusetts Contingency Plan (MCP) provides that the on-site disposal of hazardous waste as part of a remedial action under the MCP (which would include the Rest of River remedial action due to the MCP's "adequately regulated" provisions) is exempt from the State's hazardous waste regulations unless the MDEP determines that compliance with those regulations is required (310 CMR 40.0033(5)).

7.2.5 Long-Term Reliability and Effectiveness

An assessment of long-term reliability and effectiveness of TD 2 has included an evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts associated with the alternative on human health or the environment.

7.2.5.1 Magnitude of Residual Risk

The CDF, once covered, would isolate the PCB-containing sediments from direct contact with human and ecological receptors, mitigating the potential for long-term exposure of those receptors to those sediments. Although the CDF(s) would not be constructed in the main channel of the River, it/they would be designed to withstand high flow events. However, the potential would exist for portions of the CDF to be compromised and for material in the CDF to be released back to the River or the adjacent floodplain. Periodic visual inspections would be conducted to confirm the integrity of the sheetpile, cover, and berms, which would be repaired in the event that any damage or erosion was identified. Seepage of PCBs from the CDF(s) to the underlying groundwater would be monitored through a periodic groundwater monitoring program. A long-term monitoring and maintenance program would be implemented to promote long-term reliability and effectiveness, and institutional controls such as deed restrictions would further limit the potential for human exposure and help maintain the long-term effectiveness of this alternative.

7.2.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of TD 2 has included an assessment of the factors discussed below.

Use of Technology under Similar Conditions

In-water CDFs have been used to dispose of dredged sediments containing PCBs at several environmental dredging sites. For example, CDFs have been used for disposal of PCB-containing sediment at the Commencement Bay Nearshore/Tideflats Superfund Site in Tacoma, Washington, the Channel/Shelter Island Diked Facility in Saginaw Bay, Michigan, and Waukegan Harbor in Illinois, as described below:

- The Commencement Bay Site consists of several waterways where sediments containing PCBs, PAHs, and metals were placed into CDFs. Sediments from various waterways at that site were placed into three different CDFs (one of which has since been converted into a marine terminal after being capped). All three of these CDFs have permeable berms and clean sediment caps (EPA, 2004h).

- The Channel/Shelter Island Diked Facility in Saginaw Bay, Michigan, was constructed to hold contaminated sediments dredged from the Saginaw River for navigation purposes. A two-year study was conducted to evaluate facility performance in confining contaminants associated with dredged sediments. The objective of the study was to determine whether contaminants were transported through dike walls and whether biota in the surrounding environment received increased exposure from the transport of contaminants through the dike wall. Biomonitoring/bioassessment and modeling approaches were used. Water, biota, and sediments were collected from inside and outside of the diked facility during active dredging and pumping operations. Results from both years indicated that only a negligible amount of PCBs was transported through the dike wall. The study determined that the dike wall performed well in confining PCBs (http://www.epa.gov/med/grosseile_site/cdf.html).

- At the Waukegan Harbor Site, under the Superfund program, the remediation effort resulted in the removal of approximately 30,000 cy of PCB-containing sediments, which were disposed of in a CDF constructed in a boat slip within the harbor (http://www.epa.gov/glnpo/aoc/waukegan.html).

At other sites, in-water CDFs have been selected as part of the remedies. For example, for the Kinnickinnic River Environmental Restoration Project in Milwaukee, Wisconsin, the selected remedy calls for dredging up to 170,000 cy of PCB-containing sediments (with concentrations up to 36 mg/kg) and placing them in a CDF constructed by USACE (http://dnr.wi.gov/org/water/wm/sms/kkriver/index.html). At the Port of Portland, Oregon, the selected remedy calls for placement of sediments containing PAHs, PCBs, pesticides, metals, and other contaminants in a CDF that is being designed at the mouth of an existing slip in the Willamette River (http://yosemite.epa.gov/R10/CLEANUP.NSF/sites/T4)

In-water CDFs with permeable berms or dikes have also been successfully used for placement of hydraulically dredged material at many federal navigation projects throughout the Great Lakes for the past 40 years (USACE, 2003).[176] In general, the concentrations of contaminants in dredged material from navigation projects are much lower (except in hot spots) than concentrations observed at environmental dredging projects. In many of these

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[176] These include the Bolles Harbor CDF in Michigan on Lake Erie, the Buffalo Harbor Dike 4 CDF in New York on Lake Erie, the Cleveland Harbor Dike 14 CDF in Ohio on Lake Erie, the Detroit River-Pointe Mouillee CDF in Michigan on Lake Erie, the Erie Harbor CDF in Pennsylvania on Lake Erie, the Kenosha Harbor CDF in Wisconsin on Lake Michigan, the Manitowoc Harbor CDF in Wisconsin on Lake Michigan, and the Milwaukee Harbor CDF in Wisconsin on Lake Michigan.

CDFs, dewatering is performed by seepage through the dike and/or discharge through an overflow weir. Intended post-closure use for these sites includes a variety of purposes such as marina expansion, wildlife areas, parks, and industrial development.

Overall Effectiveness and Reliability

TD 2 would provide long-term effectiveness by permanently isolating the hydraulically dredged PCB-containing sediments in a covered CDF, so that human and ecological receptors are not exposed to those materials. In-water CDFs have been successfully used to dispose of dredged sediments at both environmental and navigational dredging sites for many years, and this technology has been shown to be both effective and reliable. In the Great Lakes, there are more than 25 CDFs in both the United States and Canada.

A breach in the berms, the sheetpiles, or the final vegetated soil cover of the CDFs could occur due to damage caused by floods or ice. However, regular monitoring and inspections, as described previously in Section 7.2.1, would limit the potential release from any of these locations and repairs would be conducted as provided below. Thus, OMM activities would promote the long-term stability of the facility.

Reliability of Operation, Monitoring, and Maintenance Requirements

A combination of OMM techniques would be implemented during and after active use of the CDF(s). As described in Section 7.2.1, it is anticipated that the long-term OMM program would include groundwater monitoring, inspections, maintenance of the facility components, and appropriate deed restrictions on the land. Labor and materials needed to perform the OMM activities are expected to be readily available. Similar OMM programs have been successfully implemented to monitor and maintain CDFs at other sites identified above. It is expected that this program would provide a reliable means of determining that the CDF(s) continue to contain and isolate the PCB-containing sediments over the long term.

Technical Component Replacement Requirements

The technologies that comprise TD 2 are expected to be effective at isolating the dredged sediments from the surrounding environment. OMM activities would be implemented to monitor the effectiveness of the CDF and provide for early detection should a breach occur. Depending on the location and extent of a breach, PCB-containing sediment could be released back to the River or onto the adjacent floodplain, where human or ecological receptors could be exposed to them. If damage were observed, repairs could be made using readily available labor and materials.

7.2.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of TD 2 on human health or the environment has included an assessment of several components, as described below.

Potentially Affected Populations

Under TD 2, the PCB-containing sediments placed in the CDF(s) would be isolated from human and ecological receptors. The potential for exposure of such receptors to those sediments would be further limited by the institutional controls and monitoring and maintenance program described above.

Depending on the final elevation of the CDF(s), implementation of TD 2 would alter the habitat type, and thus affect the types of biota which reside and use the areas. The most dramatic impacts would occur from the conversion of areas which currently support aquatic life to a near-shore or an upland environment. Further discussions of the long-term impacts associated with TD 2 are provided below.

Adverse Impacts on Biota and Corresponding Habitat

The placement of an in-water CDF in Woods Pond and/or one or more of the three backwaters would have a permanent impact on the aquatic habitat afforded by these areas. The placement of the CDF in Woods Pond would permanently impact 17 to 36 acres of open water habitat. For Woods Pond, the loss of a portion of the pond would have a direct impact on the benthic invertebrate community by removing that area as benthic habitat. Additionally, deep pools in lakes typically provide important support functions to the fisheries community by providing thermal stratification. During winter months, deep pools serve as a refuge for fish from the colder, often frozen waters at the surface of the pond. During summer months, deep pools serve as a source of cooler, more oxygenated water for fish. The loss of the deep pool in Woods Pond would directly impact the ability of the pond to provide those functions.

Similarly, for the backwaters, construction of the CDF would lead to a shift in the habitat of those areas from aquatic to terrestrial. Construction in the backwaters would also have the potential to affect any rare, threatened, and/or endangered species of birds and plants in these areas.

Adverse Impacts on Wetlands

The placement of an in-water CDF in the “deep hole” of Woods Pond would be expected to create a significant long-term impact to any shoreline wetlands that would fall within the

CDF footprint. As noted above, this area would be permanently lost from aquatic productivity. Similarly, placement of a CDF in one or more of the backwaters would permanently impact the wetlands at those locations by removing them from aquatic productivity and converting them to uplands. There would also be some potential that wetlands could be impacted through the construction of ancillary roadways or support areas for the CDF(s). However, it is expected that these would be largely short-term impacts and that any wetlands impacted as a result of the construction of the CDF would be restored at the conclusion of the CDF operations.

Long-Term Impacts on Aesthetics

Construction of in-water CDFs would produce long-term impacts to the aesthetics of the area. The aesthetic view of a previously undisturbed area would be permanently lost and the area in the vicinity of the CDFs could lose appeal to recreational users such as canoeists and hikers. From the River, one would see the sheetpile walls installed along the River-side of the CDFs. Rather than open water and/or large tracts of wetland vegetation, one would see an elevated mound of soil which would be covered with vegetation.

Long-Term Impacts on River Hydrology and Flood Storage Capacity

Construction of CDF(s) in Woods Pond and/or the backwaters would reduce the existing flood storage capacity, with losses during a 100-year storm event of 164,600 cy if SED 6 were selected to 580,800 cy for SED 8. If compensatory flood storage capacity were not added elsewhere in Reaches 5C and 6, an increase in the surface water elevation (of unknown magnitude) would be anticipated during high flow events. While the “deep hole” in Woods Pond and/or the backwaters where the CDF(s) would be constructed are not part of the main flow channel of the River, localized impacts to the hydraulics of the River would be expected during certain high flow events.

Potential Measures to Mitigate Long-Term Adverse Impacts

Measures could be taken to mitigate the potential long-term impacts associated with implementation of TD 2. A mitigation program may be required to restore, enhance, or create wetlands at another location to offset losses. Consideration may also be given to mitigating habitat loss by implementing enhanced vegetative plantings on top of the cover within Woods Pond or the backwaters. The details of a mitigation plan, if necessary, would be determined during design. In addition, as discussed above, GE would discuss with EPA the need for and extent of flood storage compensation to mitigate the effects of the loss in flood storage capacity.

As previously mentioned in Section 7.2.1, the implementation of OMM activities and institutional controls would help minimize the potential for a release from and exposure to PCBs present in the CDFs.

7.2.6 Reduction of Toxicity, Mobility, or Volume

The degree to which TD 2 would reduce the toxicity, mobility, or volume of PCBs is discussed below.

Reduction of Toxicity: TD 2 would not include any treatment processes that would reduce the toxicity of the PCBs in the removed sediment. However, if material is encountered during dredging that would constitute “principal threat” waste (e.g., free NAPL, drums of liquid waste), which is not anticipated, that material would be segregated and transported off-site for treatment and disposal, as appropriate.

Reduction of Mobility: TD 2 would result in reduced mobility of PCBs by permanently containing the PCBs in the removed sediments within the CDF(s).

Reduction of Volume: TD 2 would not reduce the volume of PCB-containing material.

7.2.7 Short-Term Effectiveness

Evaluation of the short-term effectiveness of TD 2 has included consideration of the short-term impacts of implementing this alternative on the environment, local communities (as well as communities along truck transport routes), and the workers involved in the disposition activities. As noted previously, implementation of TD 2 would include site preparation, CDF construction, placement and consolidation of the hydraulically dredged sediments, and construction of a vegetated soil cover once consolidation is complete. Depending on the alternative selected, the duration of the short-term impacts could last for a period of 5 years (for SED 6) to 9 years (for SED 8).

Impacts on the Environment

The short-term effects on the environment resulting from implementation of TD 2 would include the destruction of the habitat and destruction or displacement of the aquatic biota residing in the portions of Woods Pond and the three backwaters where the CDF(s) would be constructed. In addition, short-term effects would include impacts to the adjacent floodplain and upland areas disturbed during construction of the supporting access roads and staging areas. Birds, mammals, reptiles, and amphibians would be at least temporarily affected by the habitat disruption associated with implementation of this alternative.

As noted previously, a monitoring and inspection program would be implemented to reduce the potential for releases during the placement of sediment into the CDF.

Impacts on Local Communities and Communities Along Truck Transport Routes

Implementation of TD 2 would also result in short-term impacts to the local communities along Reaches 5C and 6. These short-term effects would include increased noise levels from operation of dredges and booster pumps during construction and filling activities. Truck traffic to deliver sheetpile and berm materials would increase substantially during the initial stages of the project, and also to deliver cover materials for closure.

The increased truck traffic would affect not only local communities but also areas along the routes used to transport materials to the site for implementation of TD 2 (i.e., for construction and closure of the CDF[s]). Assuming that 16-ton trucks would be used to transport such materials to the site, the number of truck trips for the implementation of TD 2 would range from approximately 11,200 truck trips (for SED 6) to approximately 22,900 truck trips (for SED 8). (Note that these truck trip estimates do not account for the off-site transport of removed sediments and floodplain soils that would not be placed in the CDF[s].) This additional traffic would increase noise levels, vehicle emissions, and the potential for traffic accidents.

Appendix D includes an analysis of potential accident risks from such increased truck traffic. These risk estimates were based on a range of potential sizes of the CDF(s), which would depend on the volumes of material to be disposed of in the CDF(s). Based on the lower and upper bounds of this range, this analysis indicates that this increased truck traffic would result in an estimated 0.32 to 0.65 non-fatal injuries due to accidents (with a probability of 27% to 48% of at least one such injury) and an estimated 0.01 to 0.03 fatalities from accidents (with a probability of 1% to 3% of at least one such fatality).

Risks to Remediation Workers

Implementation of TD 2 would also result in health and safety risks to site workers. Construction, operation, and closure of the CDF(s) are estimated to involve 101,226 to 300,808 man-hours over the 5 to 9 year timeframes (depending on the selected sediment alternative). Appendix D includes an analysis of potential accident-related risks to workers from implementation of the treatment/disposition alternatives, with estimates based on the range of potential years that the CDF would be in operation (from 5 to 9 years). Based on the lower and upper bounds of this range, this analysis indicates that implementation of TD 2 would result in an estimated 1.08 to 3.26 non-fatal injuries to workers (with a probability of 66% to 96% of at least one such injury) and an estimated 0.01 to 0.03 worker fatalities (with a probability of 1% to 3% of at least one such fatality).

7.2.8 Implementability

7.2.8.1 Technical Implementability

The technical implementability of TD 2 has been evaluated in terms of the following factors:

General Availability of Technology: The labor, materials, and equipment needed to implement TD 2 are considered readily available. As noted previously, construction would include driving sheetpile along the water side of the CDF and constructing the permeable soil berm around the land-side perimeter. In Woods Pond and the backwaters, the sheetpile would be installed using water-based construction techniques from a barge, and the soil berm would be constructed from the shore using conventional land-based equipment. Once the support facilities are in place, the hydraulically dredged sediment would be pumped as a slurry via piping extending from the dredge to the CDF, and once filled, the CDF would be covered with soil and vegetated.

Ability To Be Implemented: CDFs are routinely constructed and operated by USACE as a means to contain dredged materials in the Great Lakes and other areas. CDFs have also been constructed and operated at some contaminated sediment sites, as described in Section 7.2.5.2. However, as also noted previously, given the size of the assumed CDFs, it is expected that existing flood storage capacity would be lost through implementation of TD 2. In this situation, as discussed in Section 7.2.4, substantive regulatory requirements might affect the ability to construct a CDF(s) sufficiently large to hold the sediment volumes that would be subject to hydraulic dredging in Reaches 5C and 6 in alternatives SED 6 through SED 8.

Reliability: Experience at other sites indicates that, if properly designed, the CDF could be a reliable means of containing sediments dredged from Reaches 5C and 6. A discussion of CDF use at other sites was provided in Section 7.2.5.2. Technical manuals from EPA and the USACE are available which provide technical and design considerations that would help promote the reliability of a CDF in containing the dredged sediments (EPA, 2005e; USACE, 1983, 1987, 2003).

Availability of Space for Facilities: The preliminary engineering analysis described in Section 7.2.1 has shown that the deep hole in Woods Pond and/or one of the three designated backwaters could be used for the construction of in-water CDFs to permanently contain hydraulically dredged sediment from Reaches 5C and 6 of the River for SED 6, SED 7, or SED 8.

Availability of Equipment, Materials, and Personnel: As noted above, equipment, materials, and personnel necessary to construct access roads and staging areas, and to construct, operate, and monitor CDFs are considered readily available.

Ease of Conducting Additional Corrective Measures: As noted previously, if damage to the berm or the final vegetated soil cover of the CDFs were observed during monitoring, repairs could be made using readily available labor and materials. Ease of implementation would be directly related to the location of the damage and the extent of the necessary corrective measures.

Ability to Monitor Effectiveness: The effectiveness of TD 2 would be determined over time through implementation of readily available monitoring techniques, including periodic inspections of the facility components and periodic groundwater sampling. Additionally, during construction, filling, and consolidation activities, air and surface water monitoring and visual inspections of CDF components would be performed. The operations and post-closure monitoring programs assumed for purposes of the CMS are summarized in 7.2.1 and were developed based on programs proposed for CDFs by EPA and USACE (1983, 1987, 2003).

7.2.8.2 Administrative Implementability

The evaluation of the administrative implementability of TD 2 has included consideration of regulatory requirements, need for access agreements, and coordination with government agencies.

Regulatory Requirements: It is anticipated that implementation of TD 2 would be considered to be an “on-site” activity for purposes of the permit exemption set forth in Section 121(e) of CERCLA and Paragraph 9.a of the CD. As such, no federal, state, or local permits or approvals would be required. However, this alternative would be required to meet the substantive requirements of applicable regulations that are designated as ARARs (unless waived). As discussed in Section 7.2.4, it is currently anticipated that TD 2 could be designed and implemented to achieve many of the identified ARARs, but that some might well not be met. Thus, in the event that this alternative were selected, it seems likely that a waiver of some ARARs would be necessary.

Access Agreements: Implementation of TD 2 would require GE to obtain permanent access to the locations selected for the CDFs and any permanent associated support facilities. In addition, access agreements would be needed for the temporary use of other areas to support construction and operation of the facility until those activities are completed. If GE should be unable to obtain access agreements with property owners, GE would request EPA and/or MDEP to provide assistance.

Coordination with Agencies: Both prior to and during implementation of TD 2, GE would need to coordinate with EPA, as well as state and local agencies, to address potential health and safety impacts and to provide as-needed support with public/community outreach programs.

7.2.9 Cost

The range of estimated total costs to implement TD 2 is $93 M to $460 M (not including the cost of the sediment and floodplain soil removal activities). Since the CDF(s) would be used only for hydraulically dredged sediments from Reaches 5C and 6 under SED 6 through SED 8, the cost estimates have also included costs for disposition of the remaining sediments under those alternatives, as well as costs for disposition of floodplain soil. For purposes of the CMS, it has been assumed that those remaining materials would be transported to off-site facilities for disposal. Specifically, the low end of the range for TD 2 represents the estimated costs for: (a) the construction, operation, closure, and post-closure of CDFs containing hydraulically dredged sediments from Reaches 5C and 6 for SED 6; and (b) off-site disposal of the remaining sediments (not hydraulically dredged) for SED 6, as well as floodplain soils for FP 2 (a total of approximately 566,000 *in situ* cy). The upper end of the range represents the estimates costs for: (a) construction, operation, closure, and post-closure of CDFs containing hydraulically dredged sediments from Reaches 5C and 6 for SED 8; and (b) off-site disposal of the remaining sediments (not hydraulically dredged) for SED 8, as well as floodplain soils for FP 7 (a total of approximately 2.8 million *in situ* cy).

The capital costs associated with this range of estimated volumes (which include construction and closure of the CDF[s]) are $8 M to $17 M as determined by the size and number of the CDF(s). Annual operations costs estimated for the placement of sediments in the CDF(s) are approximately $1.3M, resulting in a total operations cost of approximately $7 M to $28 M. Annual post-closure monitoring and maintenance costs related to the CDF range from approximately $200,000 to $400,000 per year, resulting in total post-closure monitoring and maintenance costs of approximately $6 M to $12 M. The total off-site transport and disposal costs for materials that would not be placed in the CDF range from approximately $72 M to $403 M. The following summarizes the total costs estimated for TD 2.[177]

TD 2	Minimum Est. Cost	Maximum Est. Cost	Description
Total Capital Cost	$8 M	$17 M	Total cost for engineering, labor, equipment, materials associated with construction, and closure
Total Operations Cost	$7 M	$28 M	Total operations cost for placement of sediments
Total Post-Closure Monitoring and Maintenance Cost	$6 M	$12 M	Total cost for performance of the 30-year post-closure Monitoring and Maintenance Program
Total Off-Site Transport and Disposal Cost	$72 M	$403 M	Total costs associated with the off-site disposal of sediments and/or floodplain soils not placed in the CDF
Total Cost for Alternative	$93 M	$460 M	Total cost of TD 2 in 2008 dollars

The range of total estimated present worth costs for TD 2, which was developed using a discount factor of 7%, an anticipated 21- to 51-year construction period, and a post-closure OMM period of 30 years, is approximately $47 M to $122 M. Note that, although the CDF would be open only while sediments are being hydraulically dredged, the present worth has been assessed over the entire duration of this alternative to create a more comparable alternative. More detailed cost estimate information and assumptions for each of the treatment/disposition alternatives are included in Appendix E.

7.2.10 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 7.2.2, the evaluation of whether TD 2 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections.

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[177] It should be noted that since the lower end of the cost range for TD 2 is based on the CDF costs plus off-site disposal costs for SED 6 (along with FP 2), it is not comparable to the lower ends of the cost ranges for the other treatment/disposition alternatives, which are based on costs for materials that would be removed under SED 3 (a lesser volume) (plus FP 2). The upper end of the cost range for TD 2, however, is comparable to the upper ends of the cost ranges for the other treatment/disposition alternatives.

General Effectiveness: As discussed in Section 7.2.5, TD 2 would provide long-term effectiveness by permanently isolating the hydraulically dredged PCB-containing sediments in a covered CDF(s), so that human and ecological receptors are not exposed to those materials. OMM activities would promote the long-term stability of the facility.

Compliance with ARARs: As discussed above in Section 7.2.4, GE believes that TD 2 could be designed and implemented to achieve many of the ARARs listed in Tables 2-1, 2-2, and 2-3, but that some of them would require specific EPA approval or might not be met. If this alternative were selected, it seems likely that a waiver would be necessary for some ARARs.

Human Health Protection: The use of CDF(s) would provide human health protection by permanently isolating the sediment from human receptors. In addition, implementation of this alternative would not be expected to have any significant long-term or short-term adverse impacts on human health given the engineering/institutional controls and monitoring/maintenance program that would be implemented as part of TD 2.

Environmental Protection: The CDF(s) would provide protection for ecological receptors by permanently isolating the PCB-containing sediment from those receptors. At the same time, the placement of an in-water CDF in Woods Pond and/or one of the three backwaters would have a permanent impact on the environment by removing the aquatic habitat in the area of the CDF(s). Construction of the CDF(s) would also produce long-term impacts to the natural appearance of the area, with the degree of impact dependent on the size and number of the CDF(s). In addition, construction of a CDF in Woods Pond and/or the backwaters would permanently reduce the existing flood storage capacity in those areas. If sufficient flood storage compensation could not be obtained, an increase in the surface water elevation would be expected in these areas during high flow events.

Summary: Based on the above considerations, TD 2 would provide overall protection of human health and the environment by permanently isolating PCB-containing sediment from human and ecological receptors. At the same time, construction of the CDF(s) would have significant environmental impacts in Woods Pond and/or the backwaters by permanently altering the aquatic habitat and the flood storage capacity of the area(s) where the CDF(s) would be located.

7.3 Evaluation of Local Disposition in On-Site Upland Disposal Facility (TD 3)

7.3.1 Description of Alternative

Implementation of TD 3 would involve the permanent disposition of removed sediment/soil at an Upland Disposal Facility constructed in close proximity to the River, but outside the 100-year floodplain. The removed sediment and soil would be loaded into trucks at the staging areas, covered, and transported over on-site roadways, and potentially local roads, to a nearby Upland Disposal Facility. Upland Disposal Facilities have been constructed to manage removed sediments and soils containing PCBs at a number of other sites, including the St. Lawrence River in New York, the Kalamazoo River in Michigan, and the Ashtabula River in Ohio. Such on-site facilities are subject to design, operation, and monitoring in accordance with regulatory standards and requirements designed to assure their long-term reliability.

The location for a potential Upland Disposal Facility has not been determined at this time. For purposes of the CMS Report, it is assumed that a suitable location could be identified relatively close to the River along Reaches 5 through 8, outside the 100-year floodplain. It is assumed that the facility would be designed with a capacity appropriate to hold all of the material that would be removed during implementation of the sediment and floodplain alternatives (which would vary depending on the alternatives selected). It is also assumed that the Upland Disposal Facility would be designed and constructed for the disposition both of materials that contain PCB concentrations under 50 mg/kg and those that contain PCB concentrations at or above 50 mg/kg and thus would be subject to substantive TSCA requirements.

The following summarizes the general remedial approach (and associated assumptions) for implementation of TD 3. It should be noted that while a description of the configuration, construction, operation, and closure of the Upland Disposal Facility has been provided in this CMS Report for evaluation purposes, the specific methods and components of this alternative (if selected) would be determined during the design process based on more detailed engineering considerations and site conditions.

<u>Site Selection and Procurement</u>: The first step in implementing TD 3 would be to select a site to construct the Upland Disposal Facility. Factors that would be considered during the location selection process would likely include proximity to the River, the hydrogeology of the area, and the current use of the property. Following selection of the site, it would be necessary to obtain access to it for construction of the facility.

Site Preparation: Site preparation activities would include clearing and grubbing vegetation, followed by the earth work necessary to prepare the site for landfill construction. Site preparation would also include building the necessary infrastructure, including access roads and support facilities.

Facility Construction: The liner and sidewall system of the Upland Disposal Facility would be constructed to hold the removed materials. During construction of the facility, a base liner would be installed over a re-graded surface. The base liner would incorporate a primary leachate collection system. For purposes of the CMS, it was assumed that the base liner system would include 6 inches of fill, a flexible impermeable membrane liner, a geosynthetic drainage layer, a primary leachate collection layer (which would include piping and a granular drainage layer), and a layer of geotextile fabric. The Upland Disposal Facility would be constructed with sloped surfaces that would allow for precipitation drainage to appropriate collection points, and would include other appropriate stormwater management features, including surface water diversion berms, stormwater detention basins, and drainage swales.

For purposes of the CMS, it was assumed that leachate generated during placement of materials in the Upland Disposal Facility would be collected and temporarily stored in on-site tanks and subsequently transported to GE's water treatment facility in Pittsfield. In addition, monitoring wells would be installed upgradient and downgradient of the facility and would be used for monitoring groundwater during placement of removed materials and after the cap is constructed on the Upland Disposal Facility (i.e., during OMM).

Upland Disposal Facility Operations: Once the support facilities are in place, trucks would transport the dewatered sediment/soil to the Upland Disposal Facility, which would be segregated into cells to efficiently manage the materials. The dewatered sediment/soil would be placed in 2-foot lifts within the cells and compacted prior to placing the next lift. A temporary cover would be placed over the active portions of the facility at the end of each work day to minimize: (1) the amount of precipitation entering the consolidated materials and thus the generation of leachate; and (2) airborne dust. Once a cell reaches the design capacity, an interim cover would be installed over that cell. The final cover would be installed over all the cells once placement of all material into the facility is complete.

It has been assumed that any leachate generated during placement of sediments and soils in the Upland Disposal Facility and following closure, would be collected and temporarily stored in on-site tanks and subsequently transported to GE's water treatment facility in Pittsfield for treatment.

Operations Monitoring and Maintenance: Monitoring and maintenance would be performed during facility operations. For purposes of the CMS, it has been assumed that these activities would include monthly air monitoring for PCBs and daily air monitoring for particulate matter (during facility operations), as well as semi-annual groundwater monitoring of upgradient and downgradient wells. It would also include periodic leachate collection and treatment/disposal, stormwater management, routine inspections, and maintenance of the stormwater diversion berms, stormwater detention basins, and drainage swales.

The time period over which the placement of removed materials in the Upland Disposal Facility would occur would depend on the selected sediment and floodplain remediation alternatives. This time period would range from approximately 8 years (duration of sediment removal if SED 3 were selected) to approximately 51 years (removal duration if SED 8 were selected). (It is anticipated that any floodplain remediation would also be completed within those time frames.)

Engineering/Institutional Controls: During construction and operation of the Upland Disposal Facility, access restrictions would be established (i.e., fencing, signs) to prevent unauthorized access to the area. The fences and signs would remain following closure of the facility. In addition, deed restrictions would be established to prohibit interference with the Upland Disposal Facility and prevent a change in use of that area.

Final Cover Installation: Once all of the sediments and soils have been placed and compacted in the Upland Disposal Facility, an impermeable final cover would be installed over the entire facility to prevent infiltration of water. For purposes of the CMS, it was assumed that the final cover system would include 12 inches of soil, a geosynthetic clay liner, a flexible impermeable membrane liner, a geosynthetic drainage layer, 18 inches of general fill/soil, and a 6-inch layer of topsoil with a vegetative cover.

Long-Term Post-Closure Monitoring and Maintenance: A post-closure long-term monitoring and maintenance program would be implemented for the Upland Disposal Facility. It is anticipated that this program would include performance of long-term groundwater and stormwater runoff monitoring, as well as inspection and maintenance activities, on a semi-annual basis. The inspection and maintenance activities would focus on the cover system and other associated components, including surface water drainage system, leachate management system, fences, and warning signs. Maintenance and/or repairs would be performed as necessary. Leachate treatment/disposal would also be performed on a routine basis. Appropriate deed restrictions would be maintained on the land. For purposes of the CMS, it was assumed that this long-term monitoring and maintenance program would last for 30 years.

Restoration of Affected Areas: Under TD 3, the cover of the Upland Disposal Facility would be planted with herbaceous vegetation. Support areas outside the Upland Disposal Facility area that are disturbed by the construction or operation of the facility, such as materials staging areas and access roads which are no longer needed, would be restored to the extent practicable.

7.3.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 7.1.2, the evaluation of whether a treatment/disposal alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably, long-term effectiveness and permanence (including long-term adverse impacts), short-term effectiveness, and compliance with ARARs. For that reason, the evaluation of whether TD 3 would be protective of human health and the environment is presented at the end of Section 7.3 so that it can take account of the evaluations under those other criteria.

7.3.3 Control of Sources of Releases

Placement of PCB-containing sediments and soils into an Upland Disposal Facility located outside the 100-year floodplain would minimize the potential for those PCB-containing materials to be released and transported within the River or onto the floodplain. The Upland Disposal Facility would be designed to permanently contain the sediments and soils. The cover system with its associated components would be designed, monitored, and maintained to minimize the potential for releases from the Upland Disposal Facility through erosion of the surface cover and subsequent migration through surface water or wind-driven transport in the air. In addition, the base liner system (described above) would be designed to prevent any release of PCBs to the ground beneath the structure, with a leachate collection system in place to remove leachate which accumulates above the liner following closure. This system would be designed, monitored, and maintained to prevent releases from the Upland Disposal Facility to groundwater.

In summary, the design of the Upland Disposal Facility, together with implementation of a long-term monitoring and maintenance program (including components such as the collection and treatment/disposal of leachate), would promote the long-term reliability and effectiveness of the facility by minimizing any potential for future release of PCBs to the surrounding area.

7.3.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs presented in Table 2-1 include state air pollution control requirements for particulate matter. The construction activities associated with TD 3 could be designed and implemented to meet those requirements. The federal and state water quality criteria for PCBs listed in Table 2-1 are not applicable to TD 3.

The location-specific ARARs are listed in Table 2-2, and the action-specific ARARs for local upland disposal of excavated/dredged sediments and soils are presented in Part G of Table 2-3. While the specific location for a potential Upland Disposal Facility has not been determined, GE believes that, in general, TD 3 could be designed and implemented to achieve those ARARs. However, there are a few potential ARARs that might require specific EPA approval or might not be met, as discussed below:

- Since the location and specific design for the Upland Disposal Facility have not been determined, it is uncertain whether it would meet all the requirements of EPA's TSCA regulations for the location and design of a chemical waste landfill (40 CFR § 761.75). Depending on the selected location and design, it may be necessary to obtain from EPA a determination that the Upland Disposal Facility meets the substantive criteria for a waiver of some of those requirements under 40 CFR § 761.75(4) or a risk-based approval of the facility location or design under 40 CFR § 761.61(c).

- As previously discussed, it is not anticipated that the removed sediments and soils would constitute characteristic hazardous waste under RCRA (or under state regulations on grounds other than containing PCBs $\geq$ 50 mg/kg). However, representative TCLP testing would be conducted to determine whether they would do so. In the event that particular sediments or soils to be placed in the Upland Disposal Facility should be determined to constitute such hazardous waste, that facility would likely not meet some of the substantive requirements of EPA's RCRA regulations for a hazardous waste landfill. For example, it is not anticipated that this facility would be designed and constructed with the double liner/leachate collection system required for hazardous waste landfills (40 CFR § 264.301). In addition, to the extent the Massachusetts hazardous waste regulations were deemed to apply,[178] the facility may not meet certain location standards set forth in those regulations for hazardous waste landfills – e.g., the requirement that such landfills may not be located in the 500-year floodplain (310 CMR 30.701(6)). Further, the facility would not be anticipated to meet certain design requirements of those regulations – e.g., the double liner/leachate collection system requirement for landfills (310 CMR 30.622).

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[178] As noted above, the MCP provides that the on-site disposal of hazardous waste as part of a remedial action under the MCP is exempt from the State's hazardous waste regulations unless the MDEP determines that compliance with those regulations is required (310 CMR 40.0033(5)). This discussion assumes that that exemption does not apply.

If this disposition alternative were selected, GE would first determine whether sediments or soils to be placed in the Upland Disposal Facility would constitute hazardous waste under RCRA or comparable state criteria. If so, GE would resolve with EPA the applicability of federal and state hazardous waste regulations.[179] To the extent such requirements were deemed applicable, GE would evaluate several options, including: (a) segregating such waste and disposing of it off-site; (b) determining whether the Upland Disposal Facility could practicably be designed to meet the applicable requirements; or (c) exploring with EPA a potential waiver of any requirements that would be technically impracticable to meet.

7.3.5 Long-Term Reliability and Effectiveness

An assessment of long-term reliability and effectiveness of TD 3 has included an evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts associated with the alternative on human health or the environment.

7.3.5.1 Magnitude of Residual Risk

TD 3 would include the disposal of PCB-containing sediments/soils removed from the Rest of River in an Upland Disposal Facility, assumed to be located outside the 100-year floodplain of the Housatonic River. The materials placed in this facility would be isolated from underlying soils and groundwater and from surface receptors, which would prevent contact by human and ecological receptors with those materials. To address potential risks, such as exposure resulting from erosion of the cover or exposure to collected leachate, a long-term monitoring and maintenance program would be implemented; and engineering/institutional controls, such as signs, fencing, and deed restrictions, would be in place to further limit the potential for human exposure.

7.3.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of TD 3 has included an assessment of the factors discussed below.

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[179] For example, at least some of those requirements would not apply if the Upland Disposal Facility is considered to be within the same AOC as the excavated sediments and soils. Under EPA's AOC policy (EPA, 1995), an overall area that includes discrete areas of generally dispersed contamination may be considered an AOC, within which the movement of waste is not considered "placement," in which case the RCRA land disposal restrictions and other RCRA requirements, including minimum technology requirements, would not be triggered.

Use of Technology under Similar Conditions

Landfill disposal is commonly used as a remedy component for removed soil and sediment containing PCBs. Treatment/disposal facilities with leachate collection and impermeable base liner and cover systems have been constructed and used as part of a final remedy for a number of sediment sites containing PCBs, including the Alcoa Grasse River Study Area in Massena, New York; Ormet Corporation Site in Hannibal, Ohio; Allied Paper/Portage Creek/Kalamazoo River Superfund Site in Kalamazoo, Michigan; Bennington Municipal Sanitary Landfill in Bennington, Vermont; Fields Brook Site in Ashtabula, Ohio; and River Raisin at the Ford Outfall in Monroe, Michigan. While the designs differ based on location-specific factors, the general landfill components and objectives are similar to those assumed for TD 3.

Overall Effectiveness and Reliability

The Upland Disposal Facility, as designed, would have a capacity sufficient to hold all of the material that would be removed as part of the selected sediment and floodplain alternatives, and is assumed to be constructed outside the 100-year floodplain with a liner and cover system. Following closure, leachate would be collected and temporarily stored in on-site tanks and subsequently transported to GE’s water treatment facility in Pittsfield. This technology has been effectively and reliably implemented at many sites as identified above and would effectively isolate the placed sediments and soils from the underlying soils and groundwater.

Reliability of Operation, Monitoring, and Maintenance Requirements

A combination of OMM techniques would be implemented during and after active use of the Upland Disposal Facility, as described in Section 7.3.1. Once constructed, periodic mowing of the cap would be required to help maintain the cap integrity. During operations and following closure, leachate would be collected and temporarily stored in on-site tanks and subsequently transported to GE’s water treatment facility in Pittsfield. Periodic visual inspections would be conducted to identify any areas of erosion or damage to the cap. Groundwater and stormwater runoff would be monitored to track the long-term effectiveness of TD 3. Maintenance activities at the facility would include, as necessary, periodic repairs to the cap, including cleaning and repair of the stormwater conveyance and collection system and re-seeding of the cover areas; maintenance of vegetation along the perimeter of the facility; and maintenance and repair of the fences and signs. Such monitoring and maintenance techniques are commonly applied at other landfill sites, and are considered a reliable means of ensuring long-term protection against exposure to the contained materials within the facility. Labor and materials needed to perform the OMM activities are expected to be readily available.

Technical Component Replacement Requirements

TD 3 would be effective at isolating the excavated/dredged sediment and soil from the surrounding environment. The impermeable base liner and cap system would permanently contain the soil/sediment. OMM activities would be implemented to monitor the effectiveness of the facility.

In the unlikely event that the cap or liner system did not provide adequate containment, an assessment would be conducted to determine the need for and methods of repair. The effort required would depend on the nature and extent of the deficiency. Risks posed to site workers performing maintenance activities would be mitigated through development and implementation of a facility-specific health and safety plan.

7.3.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of TD 3 on human health or the environment has included an assessment of several components, as described below. Overall, the extent to which TD 3 would have such long-term impacts would depend on the location of the facility.

Potentially Affected Populations

Under TD 3, the PCB-containing sediments and soils placed in the Upland Disposal Facility would remain in place indefinitely. The presence of a bottom liner and cap would prevent contact by human and ecological receptors with the contained materials, and implementation of engineering/institutional controls and a monitoring and maintenance program would help ensure the long-term integrity and effectiveness of the facility. Hence, it is not expected that this alternative would have a significant adverse effect on human health. The ecological populations affected by the implementation of TD 3 would depend upon the type of habitat present at the location selected for construction of the facility. The potential long-term impacts of TD 3 on biota and their habitat are discussed further below.

Adverse Impacts on Biota and Corresponding Habitat

The primary long-term impact to biota would be the removal of habitat (potentially tens of acres) from productive use by wildlife species. Specific impacts would depend on the location selected for the facility. For example, if the habitat is upland forest, then the lost habitat would impact the individual mammals, birds, and reptiles that inhabit that area. However, as most of the populations of these organisms are very adaptable, the loss of habitat over such a relatively small area would not be expected to impact the overall population. In cropland areas and barren areas, the existing wildlife community would be limited, and therefore, the loss of tens of acres of habitat would not be significant.

Placement of the Upland Disposal Facility outside of the 100-year floodplain of the River and away from wetlands would avoid long-term impacts to species that inhabit those types of areas and would thus reduce the potential for significant long-term ecological impacts from TD 3.

Adverse Impacts on Wetlands

The potential for adverse impacts to wetlands can only be determined once the location of the Upland Disposal Facility is selected. When selecting a location to site that facility, an effort would be made to avoid constructing that facility and associated support facilities within wetlands.

Long-Term Impacts on Aesthetics

The long-term impacts on aesthetics from the construction of an Upland Disposal Facility depend on the location and current use of the area. While the Upland Disposal Facility would be capped and vegetated, the presence of the facility, as well as the need to construct and maintain roads and stormwater structures at the site could have some permanent impact on the aesthetics of the area, depending on the location selected for the facility.

Potential Measures to Mitigate Long-Term Adverse Impacts

Measures would be implemented to mitigate the potential long-term adverse impacts associated with the implementation of TD 3. As previously mentioned in Section 7.3.1, the implementation of OMM activities and engineering/institutional controls would minimize the potential for a release from and exposure to PCBs present in the Upland Disposal Facility. Placement of the disposal facility outside of the 100-year floodplain and away from wetlands would avoid long-term impacts to those types of habitats. If such impacts to wetlands could not be avoided or minimized, a wetlands mitigation program could be required at another location to offset losses.

7.3.6 Reduction of Toxicity, Mobility, or Volume

The degree to which TD 3 would reduce the toxicity, mobility, or volume of PCBs is discussed below.

Reduction of Toxicity: This alternative would not include any treatment processes that would reduce the toxicity of the PCBs in the removed sediments and soils. However, leachate collected in the leachate collection system would be temporarily stored in on-site tanks and subsequently transported to GE's water treatment facility in Pittsfield. In addition, in the event that any material removed from the River or floodplain should constitute "principal threat" waste (e.g., free NAPL, drums of liquid waste), which is not anticipated, that waste would not be placed in the Upland Disposal Facility, but would be segregated and transported off-site for treatment and disposal, as appropriate.

Reduction of Mobility: TD 3 would result in the reduced mobility of PCBs by permanently containing the PCBs in the sediment and soil removed from the River and floodplain within an impermeable liner and cover system. A long-term maintenance and monitoring program would be implemented to help ensure that the materials containing PCBs in the Upland Disposal Facility are effectively immobilized.

Reduction of Volume: TD 3 would not reduce the volume of PCB-containing material.

7.3.7 Short-Term Effectiveness

Evaluation of the short-term effectiveness of TD 3 has included consideration of the short-term impacts of implementing this alternative on the environment, local communities (as well as communities along truck transport routes), and the workers involved in the disposition activities. The time to implement the active construction and consolidation portions of TD 3, and thus the duration of short-term impacts, would be dependent upon the sediment and floodplain alternatives selected, and could range from approximately 8 years (if SED 3 were implemented) to 51 years (if SED 8 were implemented).

Impacts on the Environment

The short-term effects on the environment resulting from implementation of TD 3 would include the destruction of the habitat and destruction or displacement of the wildlife residing in the location selected for construction of the Upland Disposal Facility. In addition, short-term impacts would occur to the upland areas disturbed during construction of the supporting access roads and staging areas. Specific impacts would depend on the location/habitat area selected for the facility. Birds, mammals, reptiles, and amphibians could be at least temporarily affected by the habitat disruption associated with implementation of this alternative.

Impacts on Local Communities and Communities Along Truck Transport Routes

Implementing TD 3 would also result in short-term impacts to the local communities. These short-term effects would include increased truck traffic and noise from construction. Truck traffic to deliver construction materials, equipment, and sediments/soils to the Upland Disposal Facility would persist for the duration of the project. This additional traffic and equipment would increase the likelihood of noise levels and the emissions of vehicle/equipment exhaust and nuisance dust to the air. These factors would especially affect any residents and businesses located in the immediate vicinity of the Upland Disposal Facility.

The increased truck traffic would affect not only local communities, but areas along the routes used to transport construction materials to the site for construction and closure of the Upland Disposal Facility. Based on a range of potential facility sizes, which would depend on the volume of material to be disposed of in the facility (from a combination of SED 3 and FP 2 to a combination of SED 8 and FP 7), and assuming that 16-ton trucks would be used to transport construction materials to the site, the number of truck trips for the implementation of TD 3 would range from approximately 1,400 truck trips to approximately 13,200 truck trips. Appendix D includes an analysis of potential accident risks from such increased truck traffic.[180] Based on the lower and upper bounds of the truck trip range, this analysis indicates that this increased truck traffic would result in an estimated 0.04 to 0.38 non-fatal injuries due to accidents (with a probability of 4% to 31% of at least one such injury) and an estimated 0.002 to 0.02 fatalities from accidents (with a probability of 0.2% to 2% of at least one such fatality).

Risks to Remediation Workers

Implementation of TD 3 would also result in health and safety risks to site workers during the construction, filling, and closure of the Upland Disposal Facility process. Implementation of this alternative is estimated to involve 834,283 to 2,205,243 man-hours over an 8- to 51-year timeframe. Appendix D includes an analysis of potential accident-related risks to workers from implementation of TD 3 based on the potential 8- to 51-year duration that the Upland Disposal Facility would be in operation. Based on the lower and upper bounds of this range, this analysis indicates that implementation of TD 3 would result in an estimated 8.26 to 22.34 non-fatal injuries to workers (with a probability of 100% of at least one such injury) and an estimated 0.05 to 0.15 worker fatalities (with a probability of 5% to 14% of at least one such fatality).

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[180] The risks from truck traffic to transport sediments and soils to the Upland Disposal Facility are evaluated as part of risks to remediation workers, discussed below.

7.3.8 Implementability

7.3.8.1 Technical Implementability

The technical implementability of TD 3 has been evaluated in terms of the following factors:

General Availability of Technology: The labor, materials, and equipment needed to implement TD 3 are considered readily available. These include equipment, such as mechanical excavators and bulldozers, transport equipment such as trucks and conveyors, and other common landfill construction materials (i.e., geosynthetic clay liner, flexible impermeable membrane liner, leachate piping).

Ability To Be Implemented: Upland landfills are routinely constructed and operated as a means to contain contaminated material. For the CMS, it has been assumed that a suitable location could be found.

Reliability: Experience at other sites indicates that an Upland Disposal Facility would be a reliable means of containing sediments and soils containing PCBs. A discussion of on-site landfill use at other sites was previously provided in Section 7.3.5.2.

Availability of Space for Facilities: Although a specific location has not been determined as part of this CMS, it is currently anticipated that a site of sufficient size to support construction of the Upland Disposal Facility could be identified. The required size of the Upland Disposal Facility and any support areas would be developed based on the sediment and soil volumes for the selected remedy.

Availability of Equipment, Materials, and Personnel: As noted above, equipment, materials, and personnel necessary to construct, operate, monitor and maintain an Upland Disposal Facility are considered readily available.

Ease of Conducting Additional Corrective Measures: Should the cap or liner systems fail to provide adequate containment, an assessment would be conducted to determine the need for and methods of repair. The effort required would depend on the nature and extent of the deficiency. As noted previously, it is currently anticipated that repairs could be made using labor and materials that are readily available.

Ability to Monitor Effectiveness: The effectiveness of TD 3 would be maintained over time through visual inspections and periodic groundwater and stormwater monitoring. The standard approaches for monitoring the effectiveness of TD 3 are considered proven and readily available.

7.3.8.2 Administrative Implementability

The evaluation of the administrative implementability of TD 3 has included consideration of regulatory requirements, need for access agreements, and coordination with government agencies.

Regulatory Requirements: It is anticipated that implementation of TD 3 would be considered to be an "on-site" activity for purposes of the permit exemption set forth in Section 121(e) of CERCLA and Paragraph 9.a of the CD. As such, no federal, state, or local permits or approvals would be required. However, this alternative would be required to meet the substantive requirements of applicable regulations that are designated as ARARs (unless waived). As discussed in Section 7.3.4, it is currently anticipated that TD 3 could be designed and implemented to achieve the ARARs that have been identified (provided that any necessary risk-based determination under EPA's TSCA regulations is obtained), with the possible exception of certain requirements that could apply if materials to be placed in the Upland Disposal Facility should constitute hazardous waste (which is not anticipated). In the latter event, to the extent that any such specific requirements were considered applicable, GE would evaluate the options identified in Section 7.3.4.

Access Agreements: Implementation of TD 3 would require GE to obtain permanent access to the location selected for the Upland Disposal Facility and the associated support facilities. In addition, access agreements may be needed for the temporary use of other areas to support construction and operation of the facility until those activities are completed. If GE should be unable to obtain access agreements with property owners, GE would request EPA and/or MDEP to provide assistance. Evaluation of any issues relating to obtaining such agreements would depend on the location selected for the facility.

Coordination with Agencies: Both prior to and during implementation of TD 3, GE would need to coordinate with EPA, as well as state and local agencies, to address potential health and safety impacts and to provide support with public/community outreach programs.

7.3.9 Cost

The range of estimated total costs to implement TD 3 is $22 M to $121 M (not including costs associated with sediment and floodplain soil removal activities). These costs represent the range of estimated labor, equipment, and materials for the construction, operation, closure, and post-closure care of an Upland Disposal Facility sufficiently sized for the receipt of the removed materials, ranging from a low end based on the combination of SED 3 and FP 2 (combined 185,000 *in situ* cy) to a high end based on the combination of SED 8 and FP 7 (combined 2.8 million *in situ* cy). The capital costs associated with this range of estimated volumes (which include construction and closure of the Upland Disposal

Facility) are $9 M to $66 M, as determined by the size of the Upland Disposal Facility and associated appurtenances. Annual operations costs estimated for the placement of sediments and soils in the Upland Disposal Facility range from $475,000 to $742,000 per year, resulting in total operations costs of approximately $3 M to $38 M. Annual monitoring and maintenance costs assumed to be incurred after closure of the Upland Disposal Facility range from approximately $330,000 to $590,000 per year, resulting in total post-closure monitoring and maintenance costs of approximately $10 M to $17 M. The following summarizes the total costs estimated for TD 3.

TD 3	**Minimum Est. Cost**	**Maximum Est. Cost**	**Description**
Total Capital Cost	$9 M	$66 M	Total cost for engineering, labor, equipment, materials associated with construction, and closure
Total Operations Cost	$3 M	$38 M	Total operations cost for placement of sediments and soils
Total Post-Closure Monitoring and Maintenance Cost	$10 M	$17 M	Total cost for performance of the 30-year post-closure Monitoring and Maintenance Program
Total Cost for Alternative	$22 M	$121 M	Total cost for TD 3 in 2008 dollars

The range of total estimated present worth costs for TD 3, which was developed using a discount factor of 7%, an anticipated 8- to 51-year construction period, and a post-closure OMM period of 30 years, is approximately $11 M to $30 M. More detailed cost estimate information and assumptions for each of the treatment/disposition alternatives are included in Appendix E.

7.3.10 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 7.3.2, the evaluation of whether TD 3 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections.

General Effectiveness: As discussed in Section 7.3.5, TD 3 would provide long-term effectiveness by permanently isolating the PCB-containing sediments and soils in an Upland Disposal Facility with appropriate liner and cover systems. The materials placed in the facility would be isolated from underlying soils and groundwater and from surface receptors, which would prevent contact by human and ecological receptors with those materials. OMM activities for the Upland Disposal Facility would promote the long-term stability of the facility. In addition, access restrictions would prohibit interference with the facility or any change in land use and thus help maintain the long-term effectiveness of this alternative.

Compliance with ARARs: As discussed in Section 7.3.4, it is anticipated that TD 3 would meet the pertinent chemical-specific, action-specific, and location-specific ARARs (provided that any necessary risk-based determination under EPA's TSCA regulations is obtained), with the possible exception of certain requirements that could apply if materials to be placed in the Upland Disposal Facility should constitute hazardous waste (which is not anticipated). In the latter event, to the extent that any such specific requirements were considered applicable, GE would evaluate the options identified in Section 7.3.4.

Human Health Protection: An Upland Disposal Facility would provide protection of human receptors by permanently isolating the PCB-containing sediments and soils from those receptors. Access and deed restrictions would be employed to limit use of the facility site, and long-term monitoring and maintenance would be conducted to protect against future releases of and exposures to the contained PCBs. As such, TD 3 would provide protection of human health and would not be expected to cause long-term adverse impacts on human health.

Environmental Protection: An Upland Disposal Facility would provide protection of ecological receptors by permanently isolating the PCB-containing sediments and soils from those receptors. At the same time, implementation of TD 3 would result in the loss of the habitat within the footprint of the Upland Disposal Facility (plus adjacent areas for support facilities and transportation access) and could have some impact on the natural appearance of the area. The significance and extent of these impacts would depend on the location selected for the facility. The Upland Disposal Facility would be placed outside of the 100-year floodplain of the River, and would also be placed away from wetlands to the extent practicable, to limit the impacts on such habitats.

Summary: Based on the above considerations, it is concluded that TD 3 would provide overall protection of human health and the environment.

7.4 Evaluation of Chemical Extraction (TD 4)

7.4.1 Description of Alternative

TD 4 involves treatment of the removed sediments and soils by chemical extraction. In general terms, chemical extraction is the process of mixing an extraction fluid/solvent with removed sediment and soil, so that PCBs are preferentially transferred from the solid media into the extraction fluid. The resulting PCB-containing fluid is then treated or disposed of.

The specific solvent fluid and the equipment and processes used to separate the solvent from the treated materials vary and are vendor-specific. Although several vendors have historically developed and used various solvents and equipment with varying degrees of success, no commercially available chemical extraction processes for use in extracting PCBs from soils and sediments comparable to those from the Rest of River have been identified.

At EPA's request, a bench-scale study of chemical extraction was performed to more fully evaluate this alternative in the CMS. The BioGenesis^{SM} Soil Washing process was selected as the representative chemical extraction treatment technology, and a bench-scale study of this process was conducted in accordance with a work plan approved by EPA on July 31, 2007. The study was conducted during October and November 2007 using sediments and floodplain soils from the Rest of River area. A detailed description of the bench-scale study and its findings is provided in the Bench-Scale Treatability Study Report included as Appendix A to this CMS Report.

Section 7.4.1.1 describes the overall remedial approach based on the assumption that the BioGenesis^{SM} process would be used for chemical extraction if TD 4 were implemented. Section 7.4.1.2 then describes the results of the bench-scale study of the BioGenesis^{SM} process, as well as some implications for the use of that process at this site.

7.4.1.1 General Remedial Approach

This section summarizes the general remedial approach for implementation of TD 4, based on the assumption that the BioGenesis^{SM} process would be used. It should be noted that while details on facility configuration, construction, operation, and disposal are provided in this description for purposes of the evaluations in this CMS Report, the specific methods and facility components for implementation of this alternative would be determined during the design process based on engineering considerations and site conditions.

Site Selection, Procurement, and Preparation: The first step in implementing TD 4 would be to select a site to construct the treatment facility. It is anticipated that the facility would be located outside the 100-year floodplain, away from any wetlands, and would be readily accessible and in relatively close proximity to the removal areas. It would be necessary to obtain access to the site from the property owner(s).

Site preparation activities would include clearing, grubbing, and the construction of site infrastructure. For purposes of the CMS, it has been assumed that this would include construction of an approximately 30,000-square-foot (sf) building to house the chemical extraction and water treatment facilities. For the purposes of the CMS, it has been assumed that a treatment facility capable of treating 20 to 40 cy per hour (depending on the combined size of the selected sediment and floodplain alternatives) would be constructed for the processing of material. Additional facilities would include access roads and materials staging areas. Although most of these would already be in place as a component of the sediment and floodplain alternatives, the space for the building and additional staging area to manage both untreated and treated materials would be in addition to that needed for the selected sediment or floodplain alternatives.

<u>Treatment Process</u>: Once the facilities are in place, dredged/excavated materials would be transported to the treatment facility and staged for processing. The BioGenesis^{SM} Soil/Sediment Washing Technology is a patented process, which uses impact forces and proprietary chemicals to remove organic and inorganic contamination from soil and sediment particles. The technology is designed to treat both coarse-grained (sand- and gravel-sized) and fine-grained (silt- and clay-sized) materials. The BioGenesis^{SM} Soil/Sediment Washing Technology would involve a total of nine individual steps. A schematic diagram of the BioGenesis^{SM} Soil/Sediment Washing Process is presented on Figure 2-1 in the BioGenesis' Report included in Appendix A. The steps involved in this process are described in detail in that report and summarized briefly below.

1. <u>Soil/Sediment Preparation</u> – The initial step in the process involves preparation of the removed soil and sediment, screening of those materials, and storage of fine-grained materials before processing. Rocks and debris are removed, rinsed, and recycled or appropriately disposed. Coarse sand and gravel (> 1 mm) are separated from the fine-grained solids (< 1 mm) for treatment.

2. <u>Attrition Scrubbing/Aeration</u> – In this step, the coarse sands and gravels are treated using proprietary washing chemicals to reduce the affinity between the contaminants and the soil/sediment particles in an attrition scrubber. Aeration/flotation is then used to separate the lighter fine-grained silts/clays and the organic material from the washed coarse sand and gravel.

3. <u>Bulk Organics Removal</u> – In this step, the fine-grained solids (< 1 mm) from Step 1 and the wash water (containing silts, clays and organic material) from Step 2 are processed through a two-stage preprocessing step. The soil/sediment slurry is subjected to high-pressure water and then pumped to a series of hydrocyclones to concentrate the soil/sediment particles and remove the light naturally occurring organic material. At the end of this step, a significant portion of the naturally occurring organic material is removed from the system in an aqueous phase and the clumped soil/sediment particles are disaggregated.

4. <u>Chemical Addition and Mixing</u> - Next, proprietary chemicals (surfactants and defoamers) are added to the concentrated soil/sediment slurry, which is then pumped

to a second preprocessor unit that utilizes high-pressure water to mix the washing chemicals with the soil/sediment particles and prepare them for Step 5.

5. Application of Collision Impact Forces – In this step, the soil/sediment slurry from Step 4 is pumped to the collision chamber where high-pressure water is used to create impact forces to strip the biofilm layer and adsorbed contaminants from the individual solid/sediment particles. At the end of this step, contaminants that were adsorbed to the individual solid particles, as well as the naturally occurring organic material and biofilm, are transferred to the aqueous phase.

6. Organic Contaminant Oxidation – In this step, hydrogen peroxide, a strong oxidizing agent, is added to the sediment slurry upstream of a cavitation/oxidation unit. In this unit, air bubbles created in the slurry implode and enhance the ability of hydrogen peroxide to oxidize and potentially destroy organic contaminants.

7. Solid/Liquid Separation – The solid/liquid separation step includes several devices (screens, hydrocyclones, and a centrifuge) operated in series to separate the solids into fractions with decreasing grain sizes. The treated soil/sediment solids separated from the aqueous phase are then temporarily stockpiled.

8. Wastewater Treatment – The liquid fraction from Step 7 contains inorganic and organic contaminants, naturally occurring organic material, and residual fine-grained soil/sediment particles. In Step 8, standard wastewater treatment processes are used to treat the contaminants in this wastewater prior to discharge (if allowed under an applicable NPDES permit or other appropriate authorization) or disposal at a permitted off-site facility. The water treatment sludge from this process must be separately disposed of.

9. Preparation for Disposition of Treated Solids – In this step, the coarse-grained treated solids from Step 2 (Attrition Scrubbing/Aeration) and the fine-grained solids from Step 7 (Solid/Liquid Separation) are re-combined into the treated soil/sediment. The treated soil/sediment retains some of the physical characteristics of the untreated soil/sediment (i.e., grain size distribution, mineralogy, etc.) without the naturally occurring organic material and contaminants. The ultimate disposition of the treated sediment/soil is dependent on the residual concentration of the material and regulatory requirements. (The implications of the bench-scale treatability study for disposition of this material are discussed in Section 7.4.1.2.)

The duration of the treatment process operations would depend on the selected sediment and floodplain remediation alternatives. This time period would range from approximately 8 years if SED 3 were selected to approximately 51 years if SED 8 were selected.

Restoration: Under TD 4, following completion of treatment operations, facility structures, staging areas, and access roads would be removed, and areas disturbed by the construction activities would be restored, to the extent practicable. The treatment system itself would be decontaminated, dismantled, and transported off site.

Post-Treatment Monitoring and Maintenance: Following restoration of the disturbed areas, monitoring and maintenance of the restored areas would be conducted. For purposes of this CMS, it is assumed that this monitoring and maintenance would be conducted for 3 years following completion of restoration.

7.4.1.2 Bench-Scale Treatability Study

Bench-scale testing was performed to further evaluate the potential for chemical extraction to be used as a treatment for sediments and soils from the Rest of River, as requested by EPA. A detailed description of the testing and results is included in the BioGenesis Report included as Appendix A. A summary of the bench-scale testing is provided here, and key findings as they pertain to the CMS evaluation are discussed, where relevant, under the individual evaluation criteria in the following sections.

Bench-scale testing was performed using the BioGenesis^{SM} process on three types of representative materials from the River and floodplain:

- Coarse-grained sediment (TS-SED-A) – Sediment collected from the beginning of Reach 5A, with PCB concentrations ranging from 63 to 80 mg/kg. TS-SED-A contained 23% gravel, 72.8% sand, and 4.2% silt and clay.

- Fine-grained sediment (TS-SED-B) – Sediment collected from the eastern shore of the headwaters of Woods Pond (Reach 6), with PCB concentrations ranging from 110 to 180 mg/kg. TS-SED-B contained 0.2% gravel, 14.1% sand, 67.6% silt and 18.1% clay.

- Fine-grained soils (TS-SO-A) – Soils collected from the floodplain of the River south of New Lenox Road, with PCB concentrations ranging from 45 to 55 mg/kg. TS-SO-A contained 0.1% gravel, 24.0% sand, 55.1% silt, and 20.8% clay.

As part of the bench-scale study, BIoGenesis performed jar tests and optimization tests on TS-SED-A, TS-SED-B, and TS-SO-A in accordance with the Work Plan. Certain process steps described in Section 7.4.1.1 above were omitted by BioGenesis for the TS-SED-B and TS-SO-A during the bench-scale study to better accommodate the various material types.

In general, each material was tested three times using the optimized proportions of reagents and conditions determined from their respective jar tests. However, for TS-SED-A, material greater than 425 microns was processed once through the system and for TS-SED-B and TS-SO-A material greater than 850 microns was screened out as a waste. After the first treatment cycle, treated solids from the Solid/Liquid Separation step were recombined and processed two additional times and analyzed, and the mass balance calculations were repeated to evaluate the extent of any reductions in PCB concentrations associated with multiple processing cycles. Samples were collected before and after various steps of the process. Samples of wastewater were also collected following treatment activities. Samples were analyzed for PCB Aroclors and certain samples were also analyzed for PCB congeners and dioxins and furans. Samples were also collected and analyzed for grain size, TOC, TSS, and total dissolved solids (TDS) to provide additional information on the process.

The results of the bench-scale testing are presented in Tables 4-1 through 4-3 of the BioGenesis Report (provided as Appendix A). In summary, they show the following:

- In the fine-grained sediment (TS-SED-B), initial concentrations ranged from 110 to 180 mg/kg. The treated sediment was sampled in two grain size fractions. PCB concentrations in those treated sediments after the first treatment cycle were in the range of 16 to 21 mg/kg and 9 to 60 mg/kg, respectively, with overall weighted averages of12 to 48 mg/kg in the combined material. Somewhat lower concentrations were obtained after additional treatment cycles, with overall weighted average PCB concentrations after the third treatment cycle of 11 to 18 mg/kg.

- In the fine-grained floodplain soil (TS-SO-A), initial concentrations ranged from 45 to 55 mg/kg. The treated soil was sampled in two grain size fractions. PCB concentrations in those treated soils after the first treatment cycle were in the range of 5 to 7 mg/kg and 7 to 44 mg/kg, respectively, with overall weighted averages of7 to 19 mg/kg in the combined material. Somewhat lower concentrations were obtained after additional treatment cycles, with overall weighted average PCB concentrations after the third treatment cycle of 4 to 8 mg/kg.

- In the coarse-grained sediment (TS-SED-A), initial concentrations ranged from 63 to 80 mg/kg. The treated sediment was sampled in five grain size fractions. PCB concentrations in the treated sediments after the first treatment cycle were lower in the larger grain-size material (< 1 mg/kg to 2.8 mg/kg in the two largest grain-size fractions [> 425 microns]), intermediate in the intermediate grain-size fraction (~ 40 to 50 mg/kg), and highest in the two smallest grain-size fractions (55 to 143 mg/kg); and the overall weighted averages in the combined material ranged from 13 to 30 mg/kg. Lower concentrations were obtained after additional treatment cycles, with the overall weighted average PCB concentrations after the third treatment cycle ranging from 5 to 22 mg/kg. The material greater than 425 microns was only treated once, but was included in the calculations of the weighted concentration of all the treated sediment for the second and third treatment cycles to provide a complete data set for the purposes of calculating a final weighted average concentration for each treatment cycle.

EPA collected split samples of untreated and treated materials for PCB Aroclor analysis. As noted in Appendix A, the EPA split sample data correlated fairly well with the original sample results.

Selected samples were also analyzed for PCB congeners as well as dioxins and furans. On a sample-by-sample basis, the concentrations of total PCB congeners were comparable to the total PCB Aroclor concentrations. The concentrations of dioxins/furans and PCBs were generally lower in treated materials than in untreated materials. These data suggest that the process does not create dioxins or furans; however, as noted below, insufficient data were collected to provide definitive mass balance information for these compounds.

The data from the bench-scale testing did not allow for a PCB mass balance to be completed between the material going into the system and that coming out. BioGenesis has stated that the poor mass balance is attributable to the batch sequence process used for bench-scale testing. Significant amounts of aqueous mixture and fine-grained particulate material remained in the equipment and piping between each piece of equipment used in the bench-scale process. Subsequent cleaning and rinsing of the lines between each run effectively removed these materials and prevented cross-contamination between runs. Because this rinse water was not representative of the treatment process, it was not analyzed and was disposed of separately. Therefore, the amount of solids and the PCBs associated with those solids could not be determined at bench scale. This would not be expected at full-scale, since equipment would be operated in a continuous mode rather than in batch mode.

Based on the results discussed above, the BioGenesis^{SM} process did not reduce the PCB concentrations in the site-specific materials to an extent that would allow on-site reuse of the material. In general, the process was able to reduce the weighted average PCB concentrations in the combined treated solids materials to concentrations that ranged from 7 to 48 mg/kg after one treatment cycle. However, the individual results from the various outputs, and particularly the smaller grain-size fractions for the coarse-grained sediment, did not achieve these relatively low concentrations at bench scale. For soils and sediments that contained initial PCB concentrations at or above 50 mg/kg prior to treatment, the ability to dispose of the treated material in a solid waste (non-TSCA-permitted) landfill would require an EPA determination that such disposal would satisfy the substantive requirements of EPA's TSCA regulations for a risk-based approval (40 CFR § 761.61(c)) (hereafter referred to as a "risk-based TSCA determination"). Given that the BioGenesis^{SM} process reduced the weighted average PCB concentrations in the combined solid materials to less than 50 mg/kg, it is possible that such a risk-based determination could be obtained for some or all of those materials. For the purposes of the CMS, it has been assumed that all the treated solid materials could be transported to and disposed of in an off-site non-TSCA solid waste landfill.

7.4.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 7.1.2, the evaluation of whether a treatment/disposal alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably, long-term effectiveness and permanence (including long-term adverse impacts), short-term effectiveness, and compliance with ARARs. For that reason, the evaluation of whether TD 4 would be protective of human health and the environment is presented at the end of Section 7.4 so that it can take account of the evaluations under those other criteria.

7.4.3 Control of Sources of Releases

The chemical extraction process itself would not control sources of releases. However, as noted above, it is assumed that the treated PCB-containing sediments and soils would be transported to an off-site permitted landfill for disposal. Such disposal would effectively eliminate the potential for those PCB-containing materials to be released and transported within the River or onto the floodplain. Once placed in an off-site landfill and covered, the material would be permanently isolated from the environment. In the event that such material should be inadvertently released (e.g., from spill during transport), it would have a lower PCB concentration that it would have if the material had not been treated.

In addition, the wastewater generated by the treatment process be treated using conventional methods prior to discharge, and the sludge from that treatment process would be transported off-site for disposal, which would prevent future releases of that material (unless there were a spill during transport).

7.4.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs presented in Table 2-1 include state air pollution control requirements for particulate matter. TD 4 could be designed and implemented to meet those requirements. The federal and state water quality criteria for PCBs listed in Table 2-1 are not applicable to TD 4.

The location-specific ARARs are listed in Table 2-2, and the action-specific ARARs for chemical extraction are presented in Part D of Table 2-3. GE believes that, in general, TD 4 could be designed and implemented to achieve those ARARs. However, there are a few potential ARARs that would likely require specific EPA approval or might not be met, as discussed below:

- There are no specific TSCA regulations relating to chemical treatment of PCB-containing wastes. Hence, it is likely that it would be necessary to obtain EPA's determination that the chemical extraction process meets the substantive criteria for a risk-based approval under 40 CFR § 761.61(c). (In addition, although requirements relating to off-site disposal are not ARARs, it should be noted, as mentioned above, that a risk-based TSCA determination from EPA would be needed to allow disposal of treated materials that originally contained PCBs $\geq$ 50 mg/kg in a non-TSCA landfill.)

- As previously noted for TD 1, TD 2, and TD 3, it is not anticipated that the removed sediments and floodplain soils would constitute characteristic hazardous waste under RCRA (or under state regulations on grounds other than containing PCBs $\geq$ 50 mg/kg). However, representative TCLP testing would be conducted to determine whether they would do so. In the event that any particular sediments or soils that would be subject to treatment should be determined to constitute such hazardous waste, it is likely that the chemical treatment facility and associated staging/storage areas (including waste piles) would not meet some of the substantive requirements of EPA's RCRA regulations for such a hazardous waste storage and treatment facility. For example, it is not anticipated that this facility would be designed and constructed with the double liner/leachate collection system or the groundwater monitoring system required for storage of hazardous waste in waste piles (40 CFR § 264.301 & Subpart F), and it is uncertain whether the containment building would meet all the RCRA design requirements for containment buildings used for treatment or storage of hazardous waste (40 CFR § 264.1101). In addition, to the extent that the Massachusetts hazardous waste regulations were deemed to apply,[181] the facility may not meet certain location standards set forth in those regulations for hazardous waste treatment/storage facilities (e.g., the requirement that waste piles used for such storage not be located within the 500-year floodplain [310 CMR 30.701(6)]); and it would not be anticipated to meet certain design requirements of those regulations (e.g., the requirements relating to liners and groundwater monitoring systems [310 CMR 30.641, 30.660]).

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[181] The MCP provides that the on-site treatment of hazardous waste as part of a remedial action under the MCP is exempt from the State's hazardous waste regulations unless the MDEP determines that compliance with those regulations is required (310 CMR 40.0033(5)). This discussion assumes that that exemption does not apply.

If TD 4 were selected, GE would first determine whether any sediments or soils that would be subject to treatment would constitute hazardous waste. If so, GE would resolve with EPA the applicability of federal and state hazardous waste regulations. To the extent such requirements were deemed applicable, GE would evaluate several options, including: (a) segregating such waste and disposing of it separately off-site; (b) determining whether the treatment facility and supporting areas could practicably be designed to meet the applicable requirements; or (c) exploring with EPA a potential waiver of any requirements that would be technically impracticable to meet.[182]

7.4.5 Long-Term Reliability and Effectiveness

An assessment of long-term reliability and effectiveness of TD 4 has included an evaluation of the magnitude of residual risk associated with implementation of the alternative, the adequacy and reliability of the alternative, and any potential long-term adverse impacts associated with the alternative on human health or the environment.

7.4.5.1 Magnitude of Residual Risk

As discussed previously, the bench-scale results of the BioGenesis^{SM} process indicate that the weighted average concentrations of PCBs in the combined treated solids materials would be reduced to concentrations that could range from 7 to 48 mg/kg. The treated materials would then be disposed of in an off-site landfill. For those materials which contain PCBs at or above 50 mg/kg prior to treatment, a risk-based TSCA determination from EPA would be required to dispose of those materials in a permitted solid waste (non-TSCA) landfill. As required by the regulations governing the landfills, the materials in the off-site permitted landfills would be isolated from underlying soils and groundwater and from surface receptors, which would mitigate the potential for exposure by human and ecological receptors to those materials.

Minimal residual risks are anticipated in the location where the chemical extraction process is constructed and operated, since all operations would be performed within secured staging areas, and the staging areas and any residual PCBs associated with the operations would be removed following completion of the chemical extraction operations.

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[182] In addition, if the treated material were found to constitute hazardous waste, it would need to be sent to a facility authorized to receive and dispose of such waste.

7.4.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of TD 4 has included an assessment of the factors discussed below. In this regard, it should be noted that this evaluation focuses primarily on the BioGenesis^{SM} process (the process selected to represent the chemical extraction process option in the CMS), largely based on the results from the bench-scale study using Rest of River sediments and soils.

Use of Technology under Similar Conditions

The use of chemical extraction for the treatment of PCBs in sediments and soils has not been demonstrated at full scale under conditions that could be considered typical of the sediment and floodplain alternative volumes or PCB concentrations present in the River. A full-scale demonstration using the BioGenesis^{SM} process at 40 cy/hr was completed using 14,500 cy of sediment from NY/NJ Harbor and the Lower Passaic River (Sontag, pers. comm., 2008), where PCB concentrations in sediments ranged up to 3 mg/kg prior to treatment and less than 0.3 mg/kg after treatment. The BioGenesis^{SM} process was also used at the BASF Chemical Site in Kearny, New Jersey, to process 19,000 cy of soil containing phthalates and PCBs at a processing rate of 10 tons/hr. The PCB concentrations in soil ranged from 10 to 27 mg/kg before treatment and less than 0.49 mg/kg after treatment. The treated soil was placed on-site and the wastewater was treated on-site and then sent to a local publicly owned treatment works (POTW).

In addition to the BioGenesis^{SM} process, other chemical extraction systems have been developed and used; however, most are no longer commercially available. These processes are somewhat different from the BioGenesis^{SM} process in that they use organic solvents to extract the contaminants rather than the aqueous, surfactant-based BioGenesis^{SM} process. Also, as noted in the following examples, the volumes were relatively small and the concentrations were in some cases low compared to conditions in the Housatonic River. *Ex situ* chemical treatment was applied at the Sparrevohn Long Range Radar Station Site (AK), where solvent extraction was used to reduce average PCB concentrations from 80 mg/kg in the untreated soils to 3.27 mg/kg in the treated soil (EPA, 1998). Terra Kleen Response Group treated a total of 288 cy of stockpiled soil in 85-cy batches using solvent extraction in lined treatment cells. The solvent was reclaimed and burned on site (EPA, 1998). Full-scale demonstration of chemical extraction using B.E.S.T. Solvent Technology for sludge-mpacted with PCBs was also conducted at the General Refining, Inc. Superfund site (EPA, 1993). The PCB concentrations in the 3,700 tons of sludge were reportedly reduced by approximately 99%; however, the initial concentrations in the untreated sludge ranged up to only approximately 14 mg/kg. The Springfield Township Superfund Site reportedly successfully remediated more than 12,000 tons of

PCB-impacted soil with concentrations greater than 50 mg/kg by implementing a chemical extraction treatment (vendor ART International, Inc.) (EPA, 2004d). The final cleanup goal for the site was 1 mg/kg PCBs in soil and it does not appear from site documents that all of the treated soil met this goal; however, treated soils containing residual levels up to 5 mg/kg of PCBs were backfilled into the excavation areas and covered with a 1-foot thick layer of clean soil and re-vegetated (EPA, 2004d).

Overall Effectiveness and Reliability

While chemical extraction has been used in the past at various sites using the specific processes that have been described above, these processes are not in commercial operation in the United States or have not been applied under circumstances similar to the size, sediment characteristics, or concentration levels of the River. For most projects, the volumes of PCB-impacted soils and/or sediments have been relatively small and the duration of the treatment operation has been relatively short. Thus, there is no precedent for the use of chemical extraction for a project of the size or duration, and with the range of PCB concentrations, that would be involved at the Rest of River. This creates uncertainties as to the long-term reliability of a full-scale system for this site.

One of the challenges posed by the use of chemical extraction, especially processes that use organic solvents, has been the potentially toxic, carcinogenic, flammable, and/or corrosive nature of the solvent selected for extraction. In general, the BioGenesis^{SM} process uses relatively non-hazardous chemicals that are also typical of water treatment processes. The BioGenesis^{SM} process does use hydrogen peroxide, a strong oxidizer, which must be stored and handled appropriately due to associated health and safety issues. Other issues with chemical extraction processes include difficulties with designing full-scale equipment capable of processing and treating large volumes of PCB-containing materials, especially fine-grained sediments – which are present in parts of the River. Mechanical difficulties have historically arisen as a result of the high organic, high moisture content, fine-grained sediments, which tend to clump and can clog equipment, or otherwise be physically difficult to treat.

For the BioGenesis^{SM} process, there is considerable uncertainty regarding the extent to which the PCB concentrations in sediments and soils can be reduced. Results from the bench-scale treatability study using Rest of River sediments and soils indicate that the concentrations cannot be reduced to levels that would allow reuse. Bench-scale testing indicates that the process can treat materials so that the resulting mass-weighted average of the treated material is less than 50 mg/kg (results ranged from 7 to 48 mg/kg). In that case, a risk-based TSCA determination from EPA would be required (for materials that contained $\geq$ 50 mg/kg prior to treatment) to dispose of those materials in a permitted solid waste landfill. However, the treated material in some of the individual process outputs (prior to combining the outputs to calculate a mass-weighted average) had concentrations above 50 mg/kg. In particular, the concentrations in the smaller-grained material separated from the coarse-grained sediment ranged from 55 to 143 mg/kg after the first treatment cycle. It is uncertain whether a risk-based determination could be obtained that would allow this material to be combined with other treated material and be disposed of as non-TSCA material, or whether this material would require segregation and separate disposal. It is possible that with an additional size separation and treatment step, the concentration of these outputs could be treated to less than 50 mg/kg, if needed. However, whether the additional treatment would be required for all material or only certain types of materials (e.g., only coarse-grained sediment) is not understood.

Further, BioGenesis ^{SM} was unable to complete the PCB mass balance for the bench-scale testing. This leaves some uncertainties regarding the amount of solids and the concentrations of those solids in the aqueous wastewater and subsequent water treatment sludge that would also require treatment and/or disposal. This factor, in turn, creates further uncertainties regarding the effectiveness and reliability of the process if applied full-scale.

Consistent with the removal operations, if the BioGenesis^{SM} process were selected as a remedy component, it would be operated for 9 months per year, and shut down in the winter for 3 months. Depending upon the sediment and soil alternatives selected, the duration of treatment could range from approximately 8 years (if SED 3 were selected) to approximately 51 years (if SED 8 were selected). Due to the operation of the processing/treatment equipment over such a long period of time, periodic equipment failure and down time would be unavoidable. Since the BioGenesis^{SM} process has not been operated full scale over such a long duration before, it is difficult to predict the reliability of the equipment in the long term.

Placement of treated soils and sediments in off-site permitted landfills is considered an effective and reliable means of disposing of the treated materials. This has been demonstrated at many sites. However, as discussed for TD 1, depending on the selected remedy for sediments and floodplain soils, there is uncertainty as to the availability of the required landfill capacity approximately 10 to 50 years in the future.

Reliability of Operation, Monitoring, and Maintenance Requirements

Following completion of treatment operations, the areas of the site disturbed by the construction activities (e.g., treatment facility area, staging areas, and access roads) would be restored to the extent practicable. A monitoring and maintenance program would then be implemented to address those areas. This program would be similar to that implemented for other upland areas and would be in place for three years following completion of restoration. Standard equipment and materials considered reliable for performing such activities would be used.

Technical Component Replacement Requirements

TD 4 would be used in combination with sediment or floodplain soil removal alternatives and would require a final disposition alternative for the treated material. Therefore, under TD 4, there would be no separate need or requirement for replacing components of the alternative under post-remediation conditions. However, during the first three years following completion of the treatment process, there may be a need for replacing soils or vegetation in the restored support areas, which should be readily implementable.

7.4.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of TD 4 on human health or the environment has included an assessment of several components, as described below. This evaluation focuses only on the potential long-term adverse impacts from the treatment facility. The long-term impacts associated with the removal alternatives and off-site transport/disposal, including those stemming from access roads, staging areas, and truck transport, are discussed under each of those alternatives.

Potentially Affected Populations

Implementation of TD 4 would require construction of a large (~30,000 square feet [sf]) building for the chemical extraction equipment, and staging and handling areas to segregate, store and manage both untreated and treated materials. Overall, however, the area affected would be relatively small. As such, no long-term impacts to populations of organisms would be expected beyond those that would occur in the immediate area during operation of the facility and for a temporary period following restoration of the associated support areas.

Adverse Impacts on Biota and Corresponding Habitat

TD 4 would not be expected to have a long-term impact on biota or corresponding habitat, beyond any temporary impacts that might exist following restoration of the associated support areas.

Adverse Impacts on Wetlands

TD 4 would not be expected to have a long-term impact on wetlands, beyond any temporary impacts which might exist following restoration of the associated support areas.

When selecting a site to construct the treatment facility, consideration would be given to the presence and extent of such areas, so such impacts could be minimized to the extent practicable.

Long-Term Impacts on Aesthetics

TD 4 would not be expected to have a long-term aesthetic impact, beyond any temporary impacts which might exist following restoration of the associated support areas.

Potential Measures to Mitigate Long-Term Adverse Impacts

As discussed above, no significant long-term adverse impacts from the chemical extraction facility would be expected.

7.4.6 Reduction of Toxicity, Mobility, or Volume

TD 4 would involve the treatment of between 185,000 cy of sediments/soils containing 12,800 lbs of PCBs (if SED 3 and FP 2 were implemented) and approximately 2.8 million cy of material containing 83,100 lbs of PCBs (if SED 8 and FP 7 were implemented). The process would separate some of the PCBs from the sediments/soils and transfer them into an aqueous stream for wastewater treatment. The degree to which TD 4 would reduce the toxicity, mobility, and volume of PCBs is discussed below.

Reduction of Toxicity: The chemical treatment process would reduce the toxicity of soil and sediment by permanently removing some PCBs from these materials. As discussed above, bench-scale testing indicates that the BioGenesis^{SM} process would reduce the concentrations of PCBs in the treated soil and sediment by varying amounts, depending on the type of material and the number of treatment cycles. For water generated during the treatment process which would contain PCBs, water treatment processes would be used to treat the PCBs and reduce the toxicity of the water prior to discharge.

In addition, in the event that any material removed from the River or floodplain should constitute “principal threat” waste (e.g., free NAPL, drums of liquid waste), which is not anticipated, that waste would not treated in the on-site chemical extraction facility, but would be segregated and transported separately off-site for treatment and disposal, as appropriate.

Reduction of Mobility: Bench-scale data suggest that the BioGenesis^{SM} process would reduce the mobility of PCBs by removing the PCBs from the sediments/soils through the use of a proprietary blend of chemicals and surfactants. The bench-scale results indicate that the first treatment cycle removed more of the PCBs than the subsequent rounds, possibly because the PCBs that remain on the material after one treatment cycle are entrained in the material and difficult to remove. This, in turn, would suggest that the mobility of PCBs in treated material is less than for the untreated material.

Ultimately, placement of the treated materials in a permitted landfill would result in the reduced mobility of PCBs by permanently isolating the PCB-containing sediments and soils from surface water infiltration, leaching to groundwater, or otherwise mobilizing.

Reduction of Volume: Treatment using the BioGenesis^{SM} process would reduce the volume of PCBs present in the removed sediments and floodplain soils; however, the extent to which PCB volumes are reduced when considering all process waste streams is questionable. During treatment, some of the finer particulate material containing PCBs would be transferred to the aqueous phase, which would ultimately require treatment prior to discharge. The process would generate approximately 1.2 to 1.4 volumes of water for each volume of sediment and would generate more than 3 times the water for each volume of floodplain soil. Although this water would be treated to meet applicable discharge limits, the treatment would generate volumes of spent carbon and water treatment sludge that would require disposal as PCB-containing material. In addition, the extent, if any, to which actual destruction of PCBs occurs during the process is unclear, since a mass balance could not be completed for the bench-scale testing.

7.4.7 Short-Term Effectiveness

Evaluation of the short-term effectiveness of TD 4 has included consideration of the short-term impacts of implementing this alternative on the environment, local communities and communities along truck transport routes, and the workers involved in the treatment and disposition activities. The time to implement TD 4, including construction of the building and setting up the chemical extraction process equipment, conducting the treatment operations, and dismantling the treatment system – and thus the duration of short-term impacts – would be dependent upon the sediment and floodplain alternatives selected. Such impacts could last for periods ranging from approximately 8 to 51 years.

Impacts on the Environment

The short-term effects on the environment resulting from the implementation of TD 4 would include potential impacts during construction of the building and setting up the chemical extraction process equipment, conducting the treatment operations (which would include moving, storage, and handling of large volumes of treated and untreated materials using heavy construction equipment), and dismantling of the treatment system. Specific impacts would depend on the area selected for construction of the treatment facility and the types of habitat affected. Construction of the chemical extraction treatment system and support facilities could potentially result in the destruction of wildlife habitat if the treatment facility is placed in a forest or shrubland. Birds, mammals, reptiles, and amphibians could be at least temporarily affected by the habitat disruption associated with implementation of this alternative.

The BioGenesis^{SM} and water treatment processes use some chemicals that are in common commercial use and are generally non-toxic, if used safely. The process does use hydrogen peroxide, a strong oxidizer. These chemicals require appropriate handling, storage, and care. The potential for accidents (e.g., spills, leaks) would exist due to the storage of these chemicals at the site. In addition, due to the length of time required to implement this alternative (8 to 51 years), there would be a greater potential than under shorter-term applications for failure of process and control equipment and the consequent release of PCB-containing wastewaters and sludges into the environment.

Short-term effects on the environment associated with subsequent disposal of the treated material at an off-site disposal facility were discussed under TD 1 in Section 7.1.7.

Impacts on Local Communities and Communities Along Truck Transport Routes

Implementation of TD 4 would result in short-term impacts to local communities. These short-term effects could include potential releases of chemicals used in the treatment process and/or PCB-containing wastewaters due to failure of process and control equipment, as well as increased truck traffic and noise from construction and treatment activities. Truck traffic to deliver construction materials, equipment, and sediments/soils to the treatment facility and to remove treated materials from that facility would persist for the duration of the project. This additional traffic and equipment would increase noise levels and emissions of vehicle/equipment exhaust and nuisance dust to the air. These factors would especially affect those residents and businesses located in the immediate vicinity of the treatment facility.

The increased truck traffic would affect not only local communities, but areas along the routes used to transport treated material from the site to off-site disposal facilities. Assuming that 20-ton trucks (approximate 16-cy capacity) would be used to transport treated material off-site for disposal and that *in situ* removal volumes would be bulked by 20% for such transport, the number of truck trips for implementation of TD 4 would range from approximately 14,100 truck trips (for SED 3 plus FP 2) to approximately 211,800 truck trips (for SED 8 plus FP 7). The short-term impacts from this increased truck traffic would include an increased risk of injuries from accidents, as well as potential spills of concentrated PCB-containing materials due to accidents as they are being transported. Appendix D includes an analysis of potential accident-related injury risks from the increased truck traffic to transport the treated materials from the chemical extraction facility to an off-site disposal facility.[183] This analysis indicates that, based on the lower and upper bounds of the truck trip range, the increased truck traffic would result in an estimated 4.42 to 66.40 non-fatal injuries due to accidents (with a probability of 99% to 100% of at least one such injury) and an estimated 0.19 to 2.80 fatalities from accidents (with a probability of 17% to 94% of at least one such fatality).

Risks to Remediation Workers

Implementation of TD 4 would also result in health and safety risks to site workers during the treatment process. Appendix D includes an analysis of potential accident-related risks to on-site workers from implementation of this alternative. These potential risks were estimated for the range of potential years that the treatment facility could be in operation (from 8 to 51 years). Based on the lower and upper bounds of this range, this analysis indicates that implementation of TD 4 would result in an estimated 1.48 to 14.51 non-fatal injuries to workers (with a probability of 77% to 100% of at least one such injury) and an estimated 0.008 to 0.08 worker fatalities (with a probability of 0.8% to 8% of at least one such fatality).

7.4.8 Implementability

7.4.8.1 Technical Implementability

The technical implementability of TD 4 has been evaluated in terms of the following factors:

General Availability of Technology: A full-scale BioGenesis plant would use a combination of commercially available equipment (pumps, hydrocyclones, centrifuges) and some specialized equipment (collision chamber, cavitation/oxidation unit) fabricated or modified by BioGenesis. The availability of the specialized equipment over an 8- to 51-year period is uncertain. Due to the relatively long duration of the treatment operations, almost all of this equipment would have to be repaired and/or replaced during operations due to wear and tear, which would require that parts and the appropriate labor be available for the specialized equipment.

Ability To Be Implemented: For the purposes of the CMS, it has been assumed that a suitable location could be found to construct and operate the treatment facility. This would need to be more thoroughly assessed during design. Depending on the selected sediment

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[183] This analysis assumed that the treated materials would be transported for disposal at a non-TSCA solid waste permitted facility. The risks from truck traffic to transport removed sediments and soils to the treatment facility are evaluated as part of risks to remediation workers, discussed below.

and floodplain remedy, the chemical extraction treatment facility would have to be operated for periods ranging from approximately 8 to 51 years. There would be a greater potential than with shorter-term applications for failure of process and control equipment and the resultant incomplete treatment of the sediments/soils and/or release of PCB-containing wastewaters into the environment.

Reliability: For the BioGenesis^{SM} process, there is some uncertainty regarding the extent to which the PCB concentrations in sediments and soils can be reduced in full-scale operations. Results from the bench-scale treatability study using site-specific sediments and soils indicate that the concentrations would not be reduced to levels which would allow reuse. Further, as discussed in Section 7.4.5.2, the reliability of the process at full scale has not been demonstrated for PCBs in materials representative of those from the Rest of River area.

Availability of Space for Facilities: Implementation of this alternative depends on obtaining sufficient and appropriate space for construction of the treatment facility and support areas. The specific locations and required size of the support areas would be developed in consideration of the available land resources and the specific removal/treatment volumes for the selected remedy. The facility would include a large building (~30,000 sf) and also staging and handling areas for untreated and treated material. It is assumed that space would be available for implementation of TD 4.

Availability of Equipment, Materials, and Personnel: As noted above, equipment, materials, and personnel would be provided by BioGenesis and are expected to be available. Much of the BioGenesis equipment is commercially available (i.e., hydrocyclones, centrifuges, pumps). Other pieces of equipment (i.e., cavitation/oxidation unit, collision chamber) would be fabricated or modified by BioGenesis and are specific to its proprietary process. Trained personnel are expected to be available to set up and optimize full-scale equipment.

Ease of Conducting Additional Corrective Measures: Additional corrective measures would be required if treated materials did not meet minimum criteria for disposal or discharge. Corrective measures could include re-treating material using the same process as used for the first cycle. Based on bench-scale test results, additional cycles appear to release a higher proportion of fine-grained material to the wastewater, and also appear to be less effective at PCB removal (i.e., final concentrations after sequential cycles appear to decrease asymptotically). If EPA approval were obtained for disposal of treated materials with PCB concentrations less than 50 mg/kg at a non-TSCA landfill, and that level could not be achieved after subsequent treatment cycles, the use of an alternate off-site disposal facility licensed to receive TSCA material would be required.

Depending on water treatment discharge requirements, treated water may require subsequent treatment or alternate disposal. Accumulation of water for discharge or disposal may result in the need for significant storage space, and if not readily available, could become a rate-limiting step in the process.

Ability to Monitor Effectiveness: As noted during the bench-study, monitoring the effectiveness of the BioGenesis^{SM} process can be performed by sampling the various treated materials for chemical analysis, using standard sampling and analytical methods.

7.4.8.2 Administrative Implementability

The evaluation of the administrative implementability of TD 4 has included consideration of any regulatory requirements, the need for access agreements, and coordination with government agencies.

Regulatory Requirements: It is anticipated that implementation of TD 4 would be considered to be an “on-site” activity for purposes of the permit exemption set forth in Section 121(e) of CERCLA and Paragraph 9.a of the CD. As such, no federal, state, or local permits or approvals would be required. However, this alternative would be required to meet the substantive requirements of applicable regulations that are designated as ARARs (unless waived). As discussed in Section 7.4.4, it is currently anticipated that TD 4 could be designed and implemented to achieve the ARARs that have been identified (provided that the necessary risk-based TSCA determination from EPA is obtained), except that the treatment facility and associated storage areas might not meet certain requirements that could apply if the materials to be treated should constitute hazardous waste (which is not anticipated). In the latter event, to the extent that any such specific requirements were considered applicable, GE would evaluate the options identified in Section 7.4.4.

Access Agreements: Implementation of TD 4 would require GE to obtain long-term access to the location selected for the treatment facility and the associated support facilities. If GE should be unable to obtain access agreements with property owners, GE would request EPA and/or MDEP to provide assistance. Evaluation of any issues relating to obtaining such agreements would depend on the location selected for the facility.

Coordination with Agencies: Both prior to and during implementation of TD 4, GE would need to coordinate with EPA, as well as state and local agencies, to address potential health and safety impacts and to provide support with public/community outreach programs.

7.4.9 Cost

The range of estimated total costs to implement TD 4 is $90 M to $958 M (not including the cost of the sediment and floodplain removal alternatives). These costs include all labor, equipment, and materials, necessary for the chemical treatment process as well as the associated post-treatment off-site disposal. The costs presented for TD 4 were based in part on cost information provided by BioGenesis (included in Appendix A) regarding the construction and operation of the chemical treatment process and the disposal of the water treatment sludge. Additional costs that were added include estimated costs for pre-design investigation activities; the transport of excavated materials from the staging areas to the treatment facility; project/construction management, engineering, and administration; and the post-treatment off-site disposal of treated sediments and soils. The range of estimated costs for TD 4 is represented by: (a) a lower bound based on the minimum volume of sediment/soil that could be treated (185,000 *in situ* cy assuming implementation of SED 3 and FP 2); and (b) an upper bound based on the maximum volume of sediment/soil that could be treated (2.8 million *in situ* cy assuming implementation of SED 8 and FP 7). In both cases, the estimated costs assume that one treatment cycle would allow off-site disposal of all treated materials at a non-TSCA solid waste landfill in accordance with an EPA risk-based TSCA determination.

The range of estimated capital costs associated with construction of the facility is $17 M for a 20 cy/hr facility to $20 M for a 40 cy/hr facility. The range of annual operations costs related to the chemical treatment of sediments and soils over the course of the entire project is from $4 M to $7 M per year (depending on the anticipated annual volume of materials to be treated), resulting in total operations costs of approximately $36 M to $367 M. The estimated total post-treatment disposal costs range from $37 M to $571 M.[184] As mentioned in Section 7.4.1.1, there would be a small component of post-treatment monitoring and maintenance costs associated with monitoring of the restoration of the facility area. For purposes of this CMS, restoration and the associated monitoring and maintenance and costs are assumed to consist of monitoring and maintenance of the restored area for a period of three years at $25,000 per year, resulting in a total cost of $75,000. The following summarizes the total costs estimated for TD 4.

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[184] These estimated costs assume that all treated solid materials may be disposed of as non-TSCA-regulated wastes. If those materials must be disposed of based on their pre-treatment TSCA classification, there would be significant additional costs beyond those discussed above. For instance, the off-site transport/disposal costs would add an additional $120 M to the costs associated with the maximum potential disposal volumes.

TD 4	Minimum Est. Cost	Maximum Est. Cost	Description
Total Capital Cost	$17 M	$20 M	Total cost for engineering, labor, equipment, materials associated with construction of treatment facility
Total Operations Cost	$36 M	$367 M	Total estimated cost for the operation and maintenance of the chemical treatment facility over total operations period (8 years to 51 years)
Total Associated Off-site Disposal Costs	$37 M	$571 M	Total estimated post-treatment off-site disposal costs, assuming all treated materials may be disposed of as non-TSCA materials
Total Post-Treatment Monitoring and Maintenance Cost	$0.075 M	$0.075 M	Total estimated post-treatment monitoring and maintenance costs for 3 years after completion of restoration of facility area
Total Cost of Alternative	$90 M	$958 M	Total cost of TD 4 in 2008 dollars

The range of estimated present worth costs for TD 4 was developed using a discount factor of 7% applied over the anticipated 8- to 51-year operations period and a post-closure monitoring period of 3 years. That range is approximately $70 M to $265 M. More detailed cost estimate information and assumptions for each of the treatment/disposition alternatives are included in Appendix E.

7.4.10 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 7.4.2, the evaluation of whether TD 4 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As discussed in Section 7.4.5.2, the reliability of the chemical extraction process at full scale has not been demonstrated for PCBs in soils and sediments representative of those from the Rest of River area. However, bench-scale testing has indicated that use of the BioGenesis^{SM} process could reduce the concentrations of PCBs in treated sediments/soils. Based on that testing, it appears that the BioGenesis^{SM} process could reduce the PCB concentrations in the treated material to weighted average concentrations in the range of 7 to 48 mg/kg in the combined solids from the treatment outputs, but not to a sufficient degree to allow on-site reuse. Accordingly, it is assumed that the treated material would be disposed of in an off-site landfill, which would isolate the material from underlying soils and groundwater and from surface receptors. In this regard, however, TD 4 would not offer more effectiveness or permanence than disposal of untreated material. In addition, the BioGenesis^{SM} process would generate large volumes of wastewater that would also have to be treated, with off-site disposal of the PCB-containing water treatment sludge.

Compliance with ARARs: As discussed in Section 7.4.4, GE anticipates that TD 4, if selected, could be designed and implemented to meet the pertinent ARARs listed in Tables 2-1, 2-2, and 2-3 (provided that the necessary risk-based TSCA determinations were obtained from EPA), with the exception of certain requirements that could potentially apply if the materials to be treated should constitute hazardous waste (which is not anticipated). In the latter event, to the extent that any such specific requirements were considered applicable, GE would evaluate the options identified in Section 7.4.4.

Human Health Protection: TD 4 would provide human health protection through treatment and subsequent off-site disposal of the removed PCB-containing material. Implementation of this alternative would not be expected to have any significant long-term or short-term adverse effects on human health.

Environmental Protection: Implementation of TD 4 would provide protection for ecological receptors for the same reason discussed above for human receptors. At the same time, this alternative would produce short-term effects on the environment due to the loss of habitat in the area where the treatment facility would be located. In addition, given the length of time required to implement this alternative (8 to 51 years), there is a potential for accidental spills or releases of: (a) the chemicals (e.g., hydrogen peroxide) used in the process and stored at the site; (b) PCB-containing wastewaters and sludges in the event of a failure of process and control equipment; and/or (c) PCB-containing materials during accidents as they are being transported off-site for treatment/disposal. No long-term adverse effects on the environment following completion of the treatment operations and restoration of the treatment facility area would be anticipated.

Summary: Based on the above considerations, it is concluded that TD 4 would provide overall protection of human health and the environment.

7.5 Evaluation of Thermal Desorption (TD 5)

7.5.1 Description of Alternative

TD 5 involves treatment of the removed sediments and soils by thermal desorption. Thermal desorption removes organic contaminants from solid materials by raising the temperature of the contaminated material to a sufficiently high level to cause volatilization of the organics and water to transfer them from the sediment/soil to a gas stream. Various thermal desorption technologies employ differing combinations of temperature, time, and mixing to perform this transfer. The gas stream is then treated to remove particulates and the organics. The particulates are removed from the gas stream by scrubbers or filters, and the organics are treated by being condensed in a single- or multi-stage condenser, captured by carbon adsorption beds, and/or burned in an afterburner. The liquid condensate is then sent to an appropriate treatment/disposal facility, and the treated solids material may be disposed of in an appropriate disposal facility or may potentially be reused, depending on its chemical concentrations and physical characteristics.

7.5.1.1 Thermal Desorption Process Evaluated

There are two classes of thermal desorbers: direct fired and indirect fired. In either approach, heat from the combustion of fuel in burners is applied to the solid material to volatilize the organic contaminants. In a direct fired unit, the burner gases are mixed directly with the solids and the waste gases. The direct fired unit can be operated either to completely oxidize the desorbed organic contaminants or to recover most or part of them from the gas stream. In an indirect fired unit, the heat is conducted to the solids through metal walls or with a medium such as heated gas.

Two significant differences exist between direct and indirect fired units: (1) the degree to which air emissions can be controlled and (2) their operating production rate and corresponding cost of operation. Direct fired units require monitoring throughout the operations to verify that off-gas specifications are being met; therefore numerous monitored parameters can result in shutting down operations for not meeting these specifications. For safety purposes, there is a maximum organic material feed rate for direct fired units to prevent the potential for equipment failure and uncontrolled off-gas release. In addition, direct fired units generally have a higher percentage of solids that require re-treatment, which may cause more difficult air emissions issues. When large volumes of soil are subjected to thermal desorption treatment, the heat input required to volatilize the organic contaminants yields a very large volume of combustion gases from the burners.

In a direct fired unit, mixing the burner gases with the contaminated soil results in high heat rates (i.e., efficient use of heat energy, BTUs) and correspondingly high production rates of treated material. The entire gas stream must be controlled prior to being emitted to the ambient air, which can become very expensive. In an indirect fired unit, managing the low volume gas stream becomes more cost-effective while achieving stringent control of emissions. Recovery of the organic contaminants is simpler for an indirect fired unit, because the high volume of combustion gas is not present and only the small volume of organic contaminants and process gas must be managed in the recovery system. Further, control of the oxygen concentration can be more easily maintained in an indirect fired unit, minimizing or eliminating oxidation of the organic contaminants and allowing its complete recovery. Even though the indirect fired units are typically less energy efficient than the direct fired units, the smaller control devices can be operated at higher efficiency and lower cost because burner gases are kept separate. Based on these reasons, indirect fired thermal desorption treatment was selected as the representative technology for purposes of the CMS.

The thermal desorption system would consist of an indirect fired rotary desorber with collection of off-gas organics by condensation. Water from the system would be processed through a water treatment system that would remove, concentrate, and collect PCBs. Treated water would be used to cool and remoisturize the treated soil/sediment, thereby providing a closed loop for the process water. The off-gas generated during the indirect fired thermal desorption treatment process would be filtered and condensed as a liquid stream. It is anticipated that treatment of the dredged/excavated materials would be preceded by dewatering to reduce the treatment costs and improve treatment efficiency. The dewatered material would undergo screening and/or size reduction so particles could be heated sufficiently to volatilize organic compounds and to minimize potential difficulties with the mechanical equipment.

PCB condensate resulting from the thermal desorption process would be transported off-site for incineration in accordance with TSCA requirements. Depending on the chemical and/or physical characteristics of the treated solid material, that material would ultimately either be reused or be disposed of off-site. Based on a review of available information regarding the use of thermal treatment to address PCBs in sediments and soils at other sites (see Section 7.5.5.2), it is anticipated that the concentrations of PCBs in the treated sediments/soils would be substantially reduced. For purposes of the CMS, it has been assumed that PCB levels in treated materials would be reduced to at least approximately 1 to 2 mg/kg. In light of this assumption, it has also been assumed that some of the treated solid material would be amended and could be reused on-site as backfill in the floodplain, with the rest of the treated solid material transported for disposal in an off-site permitted facility, as discussed further in Section 7.5.1.2. For those materials which contained PCBs at or above 50 mg/kg prior to treatment, a risk-based TSCA determination from EPA would be required both to reuse such material on-site and to dispose of such materials in a permitted solid waste (non-TSCA) landfill.

7.5.1.2 General Remedial Approach

The following summarizes the general remedial approach related to implementation of TD 5. It should be noted that while details on facility configuration, construction, operation, and disposal are provided in this description for purposes of the evaluations in this CMS, the specific methods and facility components for implementation of this alternative would be determined during the design process based on engineering considerations and site conditions.

Site Selection, Procurement and Preparation: The first step in implementing TD 5 would be to select a site to construct the thermal desorption facility. Factors that would be considered during the site selection process include proximity and accessibility to the removal areas, the potential for the area to flood, current use of the area, and the ecological habitat of the area. It is anticipated that the site would be located outside the 100-year floodplain, away from wetlands, and would be readily accessible and in relatively close proximity to the removal areas. It would then be necessary to obtain access to the selected site for the thermal treatment facility.

Site preparation activities would include clearing, grubbing, and the construction of site infrastructure. This would include construction of access roads and support facilities, such as materials staging areas and screening/size reduction facilities. The thermal desorption system could be a fixed base unit or a transportable unit, which would be determined during the design process based on engineering considerations and site conditions. System components would either be constructed/installed in the fixed base thermal desorption unit or brought to the site in trailers that make up the transportable thermal desorption unit.

Thermal Desorption Treatment Process: Once the support facilities are in place, dewatered excavated/dredged materials would be transported via trucks to the pre-treatment staging areas to undergo screening and/or size reduction. Dewatered and screened materials would be staged and then pre-heated by the hot exhaust gas stream to reduce the moisture content below 18 to 20%. This drier material would be fed to the indirectly fired thermal desorber, which has been assumed for purposes of the CMS, to have an estimated capacity range of 10 to 40 tons per hour. As the sediments and soils are heated to temperatures up to 1,400°F in the thermal desorber, the PCBs would volatilize off of the soil. In addition to volatilizing PCBs, the thermal desorption process can lead to the volatilization and emission of certain metals (e.g., mercury), and the emission of dioxin/furans which can be formed during the process (ITRC, 1998). Box dioxins/furans and volatilized metals in the gas stream would require additional technical and monitoring requirements (ITRC, 1998). The gas stream would enter a quench chamber where it would be cooled with water; and PCBs would be further removed in condensers. The gas stream exiting the condensers then would enter an air pollution control system, where the gas stream would be treated to further remove PCBs. The gas stream would be filtered to remove suspended oil mist and particulates. A liquid treatment system would treat condensate from the quench chamber and condensers.

As noted previously, it has been assumed that some of the treated solid material would be amended and reused on-site as backfill in the floodplain. Specifically, for purposes of the CMS, it has been assumed that approximately 50% of the treated floodplain soils would be mixed/amended with topsoil (at an approximate 1:1 ratio) and reused on-site as backfill in the floodplain as part of the selected floodplain soil remedial alternative. That would provide all of the necessary backfill for floodplain areas. Since GE is unaware of any precedent for the use of such thermally treated materials as backfill in a riverine environment, it has further been assumed that none of treated materials would be used as backfill or capping material in the River. Rather, it has been assumed that all the treated sediments, as well as the remaining 50% of treated floodplain soils, would be disposed of in an off-site permitted facility. In this regard, it has been assumed that this material would be disposed of as non-TSCA material at a permitted solid waste landfill, in accordance with a risk-based TSCA determination from EPA. While the leachability of certain metals that may be present in the soils/sediment could be altered by thermal desorption treatment (for example, thermal desorption can oxidize lead, increasing toxicity and mobility [ITRC, 1998]) and thereby affect the ultimate end use and/or disposal costs of the treated soil/sediment, it has been assumed, for purposes of the CMS, that metals leachability would not affect end use and/or disposal costs. The treatment by-products (PCB-containing condensate and air filter media) would be transported to a TSCA-licensed facility for appropriate disposition, including incineration of the liquid condensate.

The time period over which the thermal desorption facility would be operated would depend on the selected sediment and floodplain remediation alternatives. This time period would range from approximately 8 years if SED 3 were selected to approximately 51 years if SED 8 were selected. (It is assumed that the floodplain remediation could be completed within those time frames.)

Restoration: Under TD 5, following completion of the treatment process, facility structures, staging areas, and access roads would be removed, and areas disturbed by the construction activities would be re-graded and re-vegetated, to the extent practicable. The treatment system itself would be decontaminated, dismantled, and transported off-site.

Post-Treatment Monitoring and Maintenance: Following restoration of those areas disturbed by the construction activities, monitoring and maintenance of those restored areas would be conducted. For purposes of the CMS, it is assumed that monitoring and maintenance of those areas would be conducted for 3 years following completion of restoration.

7.5.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 7.1.2, the evaluation of whether a treatment/disposal alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably, long-term effectiveness and permanence (including long-term adverse impacts), short-term effectiveness, and compliance with ARARs. For that reason, the evaluation of whether TD 5 would be protective of human health and the environment is presented at the end of Section 7.5 so that it can take account of the evaluations under those other criteria.

7.5.3 Control of Sources of Releases

The thermal desorption process itself would not control sources of releases. However, thermal desorption would reduce the concentration of PCBs in treated materials by separating the PCBs from the sediments/soils. Therefore, if treated materials were released, the PCB concentration of the released material would be less than for untreated material. For those treated materials that would be reused as backfill on-site, sampling would be performed to determine the chemical characteristics of the treated materials and ensure that no concerns exist regarding future release or exposure. Subsequent off-site disposal/treatment of the remaining treated material (as well as the liquid condensate) would permanently isolate this PCB-containing material from the environment and eliminate the potential for a future release to the Rest of River.

7.5.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE are listed in Tables 2-1 through 2-3. The potential chemical-specific ARARs presented in Table 2-1 include state air pollution control requirements for particulate matter. TD 5 could be designed and implemented to meet those requirements. The federal and state water quality criteria for PCBs listed in Table 2-1 are not applicable to TD 5.

The location-specific ARARs are listed in Table 2-2, and the action-specific ARARs for thermal desorption are presented in Part E of Table 2-3. GE believes that, in general, TD 5 could be designed and implemented to achieve those ARARs. However, there are a few potential ARARs that would likely require specific EPA approval or might not be met, as discussed below:

- The thermal desorption unit would not meet the definition of an incinerator under EPA's TSCA regulations (40 CFR § 761.3) and thus would not be designed to meet the requirements of EPA's TSCA regulations for a PCB incinerator (40 CFR § 761.70). In this situation, to allow use of the thermal desorption facility consistent with EPA's TSCA regulations, it would likely be necessary to obtain from EPA a determination that the location, design, and operation of the facility meet the substantive criteria for a risk-based approval under 40 CFR § 761.61(c). In addition, as noted above, a risk-based TSCA determination from EPA would be needed to allow on-site reuse of treated materials that originally contained PCBs ≥ 50 mg/kg.[185]

- As previously noted, it is not anticipated that the removed sediments and floodplain soils would constitute characteristic hazardous waste under RCRA (or under state regulations on grounds other than containing PCBs ≥ 50 mg/kg). However, representative TCLP testing would be conducted to determine whether they would do so. In the event that particular sediments or soils that would be treated in the thermal desorption facility should be determined to constitute such hazardous waste, it is likely that the staging area associated with the thermal desorption facility would not meet some of the substantive requirements of EPA's RCRA regulations. For example, it is not anticipated that the area in which the removed materials would be held in piles pending treatment would be designed and constructed with the double liner/leachate collection system or the groundwater monitoring system required for storage of hazardous waste in waste piles (40 CFR § 264.301 & Subpart F). In addition, to the extent that the Massachusetts hazardous waste regulations were deemed to apply,[186] the facility staging area may not meet certain location standards in those regulations for hazardous waste treatment facilities (e.g., the requirement that waste piles used for such storage not be located within the 500-year floodplain [310 CMR 30.701(6)]); and they would not be anticipated to meet certain design requirements of those regulations (e.g., the requirements relating to liners and groundwater monitoring systems [310 CMR 30.641, 30.660]).

  If TD 5 were selected, GE would first determine whether any sediments or soils to be subject to thermal desorption would constitute hazardous waste. If so, GE would resolve with EPA the applicability of federal and state hazardous waste regulations. To the extent such requirements were deemed applicable, GE would evaluate several options, including: (a) segregating such waste and disposing of it separately off-site; (b) determining whether the thermal desorption facility staging areas could practicably be

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[185] Further, although requirements relating to off-site disposal are not ARARs, it should be noted, as previously mentioned, that a risk-based TSCA determination from EPA would also be needed to allow disposal of other such treated materials that originally contained PCBs ≥ 50 mg/kg in a non-TSCA landfill.

[186] As noted above, the MCP exempts the on-site treatment of hazardous waste as part of an MCP remedial action from the State's hazardous waste regulations unless MDEP determines that compliance with those regulations is required (310 CMR 40.0033(5)). This discussion assumes that that exemption does not apply.

designed to meet the applicable requirements; or (c) exploring with EPA a potential waiver of any requirements that would be technically impracticable to meet.

7.5.5 Long-Term Reliability and Effectiveness

An assessment of long-term reliability and effectiveness of TD 5 has included evaluation of the magnitude of residual risk associated with implementation of the alternative, the adequacy and reliability of the alternative, and any potential long-term adverse impacts associated with the alternative on human health or the environment.

7.5.5.1 Magnitude of Residual Risk

Under TD 5, most of the PCBs present in the removed sediments/soils would be volatilized using an indirect fired thermal desorption system and transferred to the off-gas from which they would be condensed into a liquid stream. Based on a review of available information regarding the use of thermal treatment to address PCBs in sediments and soils at other sites (see Section 7.5.5.2), it is anticipated that the concentrations of PCBs in the treated sediments/soils would be reduced to low levels – assumed, for purposes of this CMS, to be 1 to 2 mg/kg. As stated previously, for those treated materials which are reused as backfill on-site, chemical characterization sampling would be performed to ensure that there are no concerns regarding future exposure. Subsequent off-site disposal of the remaining treated material (and treatment by-products) would permanently isolate the treated material from the environment and thereby eliminate the potential for human or ecological exposure.

Minimal residual risks are anticipated in the location where the thermal desorption process is constructed and operated, since all operations would be performed within secured staging areas, and the staging areas and any residual PCBs associated with the operations would be removed following completion of the thermal desorption operations.

7.5.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of TD 5 included an assessment of the factors discussed below.

Use of Technology under Similar Conditions

Historically, thermal desorption to treat materials containing PCBs at other sites has primarily been used on soils, with limited application on sediments, likely due in part to the increased time and costs to sufficiently dewater the sediments as a pretreatment step. Several examples where thermal desorption was used for PCB-containing materials are as follows:

- A low temperature thermal desorption treatment facility was used at the Sangamo Weston/Twelve-Mile Creek/Lake Hartwell site in Pickens, South Carolina, to treat approximately 40,000 cy of PCB-impacted soil to a cleanup level of 2 mg/kg (EPA, 2003). The treated soil was backfilled on-site, capped with top soil, graded, and restored.

- Thermal desorption was used to treat 53,685 cy of PCB-impacted soil at the Industrial Latex Site in Wallington, New Jersey (i.e., up to 4,000 mg/kg of Aroclor 1260) (Federal Remediation Technologies Roundtable Technology Cost and Performance Database, 2003, web site accessed at: http://costperformance.org/profile.cfm?ID=348&CaseID=348). The treated soil, with an average PCB concentration of 1 mg/kg, was backfilled on-site and compacted.

- At the Re-Solve, Inc. site in North Dartmouth, Massachusetts, 36,200 cy of PCB-impacted soil were treated to a cleanup level of < 25 mg/kg using low-temperature thermal desorption, with PCB concentrations ranging from 0.59 to 21 mg/kg in treated material (EPA, 2003).

- At the Outboard Marine Corporation Site along Lake Michigan in Waukegan, Illinois, thermal desorption was used to treat 12,755 tons of PCB-impacted soil and sediment to concentrations ranging from 0.4 mg/kg to 8.9 mg/kg with a PCB destruction and removal efficiency of 99.9999% (Federal Remediation Technologies Roundtable Technology Cost and Performance Database, 1995, web site accessed at: http://costperformance.org/profile.cfm?ID=209&CaseID=209).

- At the Wide Beach Development Site in Brandt, New York, thermal desorption was used in combination with alkaline polyethylene glycol (APEG) dehalogenation technology to treat 42,000 tons of PCB-impacted soil to the cleanup level of < 2 mg/kg (EPA, 1992). The treated soils were not as stable as the pre-treated soils, and were sent off-site for disposal.

Overall Effectiveness and Reliability

Thermal desorption has been used in only limited instances to treat PCB-containing sediments and has been used at several sites to treat PCB-containing soils. However, at most of these sites, the volumes of PCB-impacted soils and/or sediments have been relatively small, the duration of the treatment operation has been relatively short, and when on-site reuse has occurred, the material has typically been placed back in a small area and covered with clean backfill. If thermal treatment were selected as a remedy component for the Rest of River, it would be operated for 9 months per year, and shut down in the winter for 3 months. Depending upon the sediment and soil alternatives selected, the duration of treatment could range from approximately 8 years (if SED 3 were selected) to approximately 51 years (if SED 8 were selected). Due to the operation of the treatment equipment over such a long period of time, periodic equipment failure and down-time would be unavoidable. Moreover, mechanical problems can result from treatment of high-organic, high-moisture-content, fine-grained materials, which can clump and clog equipment or otherwise be physically difficult to treat. These types of materials are present in parts of the River. Since no thermal treatment unit has been operated full scale at a PCB site over such a long duration before, it is difficult to predict the reliability of the equipment in the long term.

While reuse as backfill, following mixture with an organic amendment, does not seem complicated to implement, it relies upon effective operation of the thermal treatment unit. Given the long time frames and volumes of materials being considered for removal and treatment, consistent effective operation of the thermal treatment unit may be difficult to achieve, particularly given the mechanical problems with high-organic, high-moisture-content, fine-grained materials. Further, with long-term use of the equipment, there would be a greater potential for failure of process and control equipment, which could lead to the release of PCBs, metals, and/or dioxin/furans (if formed during the process) into the atmosphere, as well as incomplete treatment of the sediments/soils.

Placement of treated soils and sediments that are not reused into off-site permitted landfills is considered an effective and reliable means of disposing of such treated materials. This has been demonstrated at many sites. However, as discussed for TD 1, depending on the selected remedy for sediments and floodplain soils, there is uncertainty as to availability of the required landfill capacity decades in the future.

Reliability of Operation, Monitoring, and Maintenance Requirements

Following completion of treatment operations, the areas of the site disturbed by the construction activities (e.g., treatment facility area, staging areas, and access roads) would be restored to the extent practicable. A monitoring and maintenance program would then be implemented to address those areas. This program would be similar to that implemented for other upland areas and would be in place for three years following completion of restoration. Standard equipment and materials considered reliable for performing such activities would be used. For those locations where the treated material is amended and reused on-site as backfill in the floodplain, a monitoring and maintenance program would be in place as covered by the floodplain alternatives described in Section 6.

Technical Component Replacement Requirements

TD 5 would be used in combination with sediment or floodplain soil removal alternatives and would need to be implemented with reuse or a final disposition alternative for the treated material. Therefore, under TD 5, there would no separate need for replacing components of this alternative under post-remediation conditions. However, during the first three years following completion of the treatment process, there may be a need for replacing soils and vegetation in the restored support areas, which should be readily implementable.

7.5.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of TD 5 on human health or the environment has included an assessment of several components, as described below. This evaluation focuses only on the potential long-term adverse impacts from the thermal desorption facility and support areas, as well as reuse of the treated material as backfill in the floodplain. The long-term impacts associated with the removal alternatives and off-site transportation/disposal, including those stemming from access roads, staging areas, and truck transport, are discussed under each of those alternatives.

Potentially Affected Populations

Implementation of TD 5 would require construction of an area for the thermal desorption unit, and staging and handling areas to segregate, store, and manage both untreated and treated materials. Overall, the area affected would be relatively small. As such, no long-term impacts to populations of organisms would be expected in that area beyond those that would occur in the immediate area during operation of the facility and for a temporary period following restoration of the associated staging areas. In addition, the reuse of treated material as backfill in the floodplain would not be expected to have any long-term adverse impacts on human health or the environment, because the material would be sampled to ensure that it contains sufficiently low PCB concentrations to avoid potential adverse health and environmental effects, and would be amended with organic material to support vegetative growth.

Adverse Impacts on Biota and Corresponding Habitat

TD 5 would not be expected to have a long-term impact on biota or corresponding habitat, beyond any temporary impacts which might exist following restoration of the associated staging areas.

Adverse Impacts on Wetlands

TD 5 would not be expected to have a long-term impact on wetlands, beyond any temporary impacts which might exist following restoration of the associated staging areas. When selecting a site to construct the treatment facility, consideration would be given to the presence and extent of such areas, so such impacts could be minimized to the extent practicable.

Long-Term Impacts on Aesthetics

TD 5 would not be expected to have a long-term aesthetic impact, beyond any temporary impacts which might exist following restoration of the associated staging areas.

Potential Measures to Mitigate Long-Term Adverse Impacts

As discussed above, no significant long-term adverse impacts from the thermal desorption facility would be expected.

7.5.6 Reduction of Toxicity, Mobility, or Volume

TD 5 would involve the treatment of between 185,000 cy of sediments/soils containing 12,800 lbs of PCBs (if SED 3 and FP 2 were implemented) and 2.8 million cy of material containing 83,100 lbs of PCBs (if SED 8 and FP 7 were implemented). PCBs present in the removed sediments and soils would be volatilized and transferred to the off-gas from which they would be condensed into a liquid stream. The degree to which TD 5 would reduce the toxicity, mobility, and volume of PCBs is discussed below.

Reduction of Toxicity: The indirect fired thermal desorption system would reduce the toxicity of PCB-containing soil and sediment by permanently removing PCBs from these materials. In addition, the PCBs in the liquid stream sent to a permitted off-site disposal facility would be destroyed.

Further, in the event that any material removed from the River or floodplain should constitute “principal threat” waste (e.g., free NAPL, drums of liquid waste), which is not anticipated, that waste would not be treated in the on-site thermal desorption unit, but would be segregated and transported separately off-site for treatment and disposal, as appropriate.

Reduction of Mobility: TD 5 would reduce the mobility of PCBs present in the removed sediment and soil by permanently removing PCBs from these materials. The treatment process would transfer the PCBs into the off-gas and then into the liquid stream that would be sent to a permitted off-site facility for destruction. A portion of the treated material would be reused on-site in the floodplain (assuming that, following sampling, the material is deemed suitable for reuses), with the remainder disposed of at a permitted off-site disposal facility. Placement of the treated materials in a permitted landfill would result in the reduced mobility of PCBs by permanently isolating the PCB-containing sediments and soils from surface water infiltration, leaching to groundwater, or otherwise mobilizing.

Reduction of Volume: Treatment of removed sediment and soil in the indirect fired thermal desorption system would reduce the volume of PCB-containing material. Experience at other sites indicates that PCB concentrations on the order of 1 to 2 mg/kg in treated solids can be achieved using thermal desorption. Thermal desorption would also remove the naturally occurring organic matter present in the river sediment and floodplain soils, resulting in a slightly lower volume for the treated sediment/soil.

7.5.7 Short-Term Effectiveness

Evaluation of the short-term effectiveness of TD 5 has included consideration of the short-term impacts of implementing this alternative on the environment, local communities and communities along truck transport routes, and the workers involved in the treatment and disposition activities. The time to implement TD 5, including setting up the indirect fired thermal desorption system, conducting the treatment operations, and dismantling the treatment system – and thus the duration of short-term impacts – would be dependent upon the sediment and floodplain alternatives selected. Such impacts could last for periods ranging from approximately 8 to 51 years.

Impacts on the Environment

The short-term effects on the environment resulting from the implementation of TD 5 would include potential impacts during construction of the support areas, set-up of the thermal desorption system, conducting the treatment operations (which would include moving, storage, and handling of large volumes of treated and untreated materials using heavy construction equipment), and dismantling of the treatment system. Specific impacts would depend on the location selected for the thermal desorption facility and the types of habitat affected. Construction of the thermal desorption system and support facilities could potentially result in the destruction of wildlife habitat if the treatment facility is placed in a forest or shrubland. Birds, mammals, reptiles, and amphibians could be at least temporarily affected by the habitat disruption associated with implementation of this alternative.

In addition, due to the lengthy duration of operation of the thermal desorption facility, there would be a greater potential than in shorter-term applications for failure of process and control equipment and a consequent release of PCBs, and metals and/or dioxin/furans (if formed during the process) into the atmosphere. Similarly, there would be a greater likelihood of spillage of the highly concentrated PCB-containing liquids during accidents as these materials are being transported off-site for treatment/disposal.

The reuse of treated material as backfill in the floodplain would not be expected to have any short-term adverse environmental impacts for the same reasons given for long-term effects in Section 7.5.5.3.

Impacts on Local Communities and Communities Along Truck Transport Routes

Implementation of TD 5 would also result in short-term impacts to local communities. These short-term effects could include potential emissions of PCBs, metals and/or dioxin/furans (if formed during the process), into the atmosphere due to process and control equipment failure, as well as increased truck traffic and noise from construction and treatment activities. Truck traffic to deliver construction materials, equipment, and dewatered sediments/soils to the thermal desorption facility and to remove treated material from that facility would persist for the duration of the project. This additional traffic and equipment would increase noise levels and emissions of vehicle/equipment exhaust and nuisance dust to the air. These factors would especially affect any residents and businesses located in the immediate vicinity of the thermal desorption facility.

The increased truck traffic would affect not only local communities, but areas along the routes used to transport treated material to an off-site disposal facility. To estimate the amount of such truck traffic, it has been assumed that 20-ton trucks (approximate 16-cy capacity) would be used to transport the treated material off-site and that the *in situ* removal volumes would be bulked by 20% for such transport. Using these assumptions, the number of truck trips has been estimated for two scenarios: (1) assuming on-site reuse of 50% of the treated floodplain soils as backfill in the floodplain and off-site disposal of all other treated materials; and (2) assuming off-site disposal of all treated materials. Using these assumptions, the estimated numbers of truck trips, based on the lower and upper bounds of the range of potential volumes to be transported, are: (1) 11,600 to 158,500 truck trips for the first scenario (assuming some reuse); and (2) 12,600 to 190,600 truck trips for the second scenario (assuming no reuse). The short-term impacts from this increased truck traffic would include an increased risk of injuries from accidents, as well as potential spills of concentrated PCB-containing liquids due to accidents as they are being transported.

Appendix D includes an analysis of potential accident-related injury risks from the increased truck traffic to transport treated materials from the thermal desorption facility to an off-site disposal facility.[187] This analysis has been developed for the same two scenarios described above, based on the above-mentioned ranges of truck trips. The results are as follows:

- Under the first scenario (partial reuse), the analysis indicates that the increased truck traffic would result in an estimated 3.64 to 49.69 non-fatal injuries due to accidents (with a probability of 97% to 100% of at least one such injury) and an estimated 0.15 to 2.09 fatalities from accidents (with a probability of 14% to 88% of at least one such fatality).

- Under the second scenario (no reuse), the analysis indicates that such increased truck traffic would result in an estimated 3.95 to 59.75 non-fatal injuries due to accidents (with a probability of 98% to 100% of at least one such injury) and an estimated 0.17 to 2.52 fatalities from accidents (with a probability of 15% to 92% of at least one such fatality).

Risks to Remediation Workers

Implementation of TD 5 would also result in health and safety risks to site workers during the treatment process. Appendix D includes an analysis of potential accident-related risks to on-site workers from implementation of this alternative. These potential risks were estimated for the range of potential years that the treatment facility could be in operation (from approximately 8 to 51 years). Based on the lower and upper bounds of this range, this analysis indicates that implementation of TD 5 would result in an estimated 1.48 to 16.17 non-fatal injuries to workers (with a probability of 77% to 100% of at least one such injury) and an estimated 0.008 to 0.09 worker fatalities (with a probability of 0.8% to 8% of at least one such fatality).

7.5.8 Implementability

7.5.8.1 Technical Implementability

The technical implementability of TD 5 has been evaluated in terms of the following factors:

General Availability of Technology: While the technologies involved in implementation of TD 5 are specialized, they are available. There are thermal desorption vendors that have the equipment required to implement this technology. Methods to implement access restrictions are also available. Due to the relatively long duration of the treatment

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[187] The risks from truck traffic to transport sediments and soils to the thermal desorption facility are evaluated as part of risks to remediation workers, discussed below.

operations, almost all of this equipment would have to be repaired and/or replaced as necessary due to excessive wear and tear.

Ability To Be Implemented: Fixed-base and mobile indirect fired thermal desorption treatment systems have been used at other Superfund sites for the treatment of PCBs. For the purposes of the CMS, it has been assumed that a suitable location could be found to install and operate such a treatment facility. This would need to be more thoroughly assessed during design.

Reliability: Thermal desorption has been shown to be reliable at other sites for projects involving relatively small volumes and short durations, as discussed in Section 7.5.5.2. However, there is only limited precedent for implementation of thermal desorption for treatment of sediment. As previously noted, mechanical problems can arise as a result of the high-organic, high-moisture-content, fine-grained sediments, which tend to clump and can clog equipment or otherwise be physically difficult to treat. Moreover, depending on the selected sediment and floodplain alternatives, the thermal desorption treatment facility would have to be operated for long periods that would range from approximately 8 years to over 50 years. As a result, there would be a greater potential than with shorter-term applications for failure of process and control equipment, which could lead to the release of PCBs, metals, and/or dioxin/furans (if formed during the process) into the atmosphere, as well as incomplete treatment of the sediments/soils. There would also be a greater potential for spillage of the highly concentrated PCB-containing liquids during accidents as they are being transported off-site for treatment/disposal.

Availability of Space for Facilities: Implementation of this alternative depends on obtaining sufficient and appropriate space for construction of the thermal desorption facility and support areas. The specific locations and required size of the support areas would be developed in consideration of the available land resources and the specific removal/treatment volumes for the selected remedy. It is expected that space would be available for implementation of TD 5.

Availability of Equipment, Materials, and Personnel: As noted above, equipment, materials, and personnel necessary to construct, operate, and monitor an indirect fired thermal desorption treatment facility are available. In addition to that facility, implementation of TD 5 would require the development of staging and support areas and construction of access roads. To the extent possible, existing roadways would be used to transport equipment and dredged/excavated sediment/soil to and from the staging and support areas. Staging and support areas would be adequately and individually sized to accommodate equipment staging and necessary temporary material storage. The equipment and personnel required for these efforts would be available to support implementation of TD 5.

Ease of Conducting Additional Corrective Measures: Additional corrective measures would be required if treated materials did not meet minimum criteria for disposal or reuse. Corrective measures could include re-treating material or implementation of alternate disposal techniques.

Ability to Monitor Effectiveness: The effectiveness of TD 5 would be determined over time through periodic monitoring activities at the facility, including monitoring of the dewatered PCB-containing feed material, the desorber temperature, the off-gas, the PCB-containing liquid stream, and the treated soil/sediment to assess the effectiveness of the remedy. Standard approaches to monitoring the effectiveness of TD 5 are proven and readily available.

7.5.8.2 Administrative Implementability

The evaluation of the administrative implementability of TD 5 has included consideration of regulatory requirements, need for access agreements, and coordination with government agencies.

Regulatory Requirements: It is anticipated that implementation of TD 5 would be considered to be an “on-site” activity for purposes of the permit exemption set forth in Section 121(e) of CERCLA and Paragraph 9.a of the CD. As such, no federal, state, or local permits or approvals would be required. However, this alternative would be required to meet the substantive requirements of applicable regulations that are designated as ARARs. As discussed in Section 7.5.4, it is currently anticipated that TD 5 could be designed and implemented to achieve the ARARs that have been identified (provided that the necessary risk-based TSCA determinations from EPA are obtained), except that the staging/storage area at the treatment facility might not meet certain requirements that could apply if the materials held in that area should constitute hazardous waste (which is not anticipated). In the latter event, to the extent that any such specific requirements were considered applicable, GE would evaluate the options identified in Section 7.5.4.

Access Agreements: Implementation of TD 5 would require GE to obtain long-term access to the location selected for the thermal desorption facility and the associated support facilities. If GE should be unable to obtain access agreements with property owners, GE would request EPA and/or MDEP to provide assistance. Evaluation of any issues relating to obtaining such agreements would depend on the location selected for the facility.

Coordination with Agencies: Both prior to and during implementation of TD 5, GE would need to coordinate with EPA, as well as state and local agencies, to address potential health and safety impacts and to provide as-needed support with public/community outreach programs.

7.5.9 Cost

The overall range of estimated total costs to implement TD 5 is $64 M to $969 M (not including the cost of the sediment or floodplain removal alternatives). These costs include all labor, and equipment and materials, necessary for the thermal treatment process as well as the associated post-treatment off-site disposal. Costs have been estimated for two scenarios: (1) assuming on-site reuse of 50% of the treated floodplain soils as backfill in the floodplain, and off-site disposal of remaining treated soils and all treated sediments; and (2) assuming off-site disposal of all treated materials. For both scenarios, the range of estimated costs is represented by: (a) a lower bound based on the minimum volume of sediment/soil that could be treated (185,000 *in situ* cy assuming implementation of SED 3 and FP 2); and (b) an upper bound based on the maximum volume of sediment/soil that could be treated (2.8 million *in situ* cy assuming implementation of SED 8 and FP 7). In all cases, the estimated costs assume that the treated solid materials to be transported off-site would be disposed of at a non-TSCA solid waste landfill, and that the liquid condensate would be transported to an appropriate TSCA incineration facility.

The range of estimated capital costs associated with construction/set-up of the thermal desorption facility is $12 M to $148 M (depending on the size of the facility). Annual operations costs related to the thermal treatment facility over the course of the entire project range from $2 M to $5 M per year, depending on the volume of materials to be treated, resulting in total operations costs of $18 M to $266 M. The estimated total post-treatment disposal costs range from $34 M to $555 M, depending on the volume of material being disposed of and the method of disposition.[188] As mentioned in Section 7.5.1.2, there would be a small component of post-treatment monitoring and maintenance costs associated with monitoring of the restoration of the facility area. For purposes of this CMS, restoration and the associated monitoring and maintenance costs are assumed to consist of monitoring and maintenance of the restored area for a period of three years at $25,000 per year, resulting in a total cost of $75,000. The following summarizes the total costs estimated for TD 5.

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[188] As noted above, these estimated costs assume that all treated solid materials may be disposed of as non-TSCA-regulated wastes. If those materials must be disposed of based on their pre-treatment TSCA classification, there would be significant additional costs beyond those discussed above. For instance, the off-site transport/disposal costs would add an additional $120 M to the costs associated with the maximum potential disposal volumes.

TD 5	Minimum Est. Cost		Maximum Est. Cost		Description
	w/ reuse	w/o reuse	w/ reuse	w/o reuse	
Total Capital Cost	$12 M	$12 M	$148M	$148 M	Total cost for engineering, labor, equipment, materials associated with construction of treatment facility
Total Operations Cost	$18 M	$18 M	$266 M	$266 M	Total estimated cost for the operation and maintenance of the thermal treatment facility over total operations period (8 year to 51 years)
Total Associated Off-site Disposal Costs	$34 M	$36 M	$498 M	$555M	Total estimated post-treatment off-site disposal costs, assuming all treated materials may be disposed of as non-TSCA materials
Total Post-Treatment Monitoring and Maintenance Cost	$0.075 M	$0.075 M	$0.075 M	$0.075 M	Total estimated post-treatment monitoring and maintenance costs for 3 years from completion of restoration of facility area
Total Cost for Alternative	$64 M	$66 M	$912 M	$969 M	Total cost of TD 5 in 2008 dollars

The overall range of estimated present worth costs for TD 5 was developed using a discount factor of 7% applied over the anticipated 8- to 51-year operations period and a post-closure monitoring period of 3 years. That overall range is $50 M (based on the minimum volume and assumed combination of reuse and off-site disposal of treated materials) to $364 M (based on the maximum volume and assumed off-site disposal of all treated materials). More detailed cost estimate information and assumptions for each of the treatment/disposition alternatives are included in Appendix E.

7.5.10 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 7.5.2, the evaluation of whether TD 5 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As discussed in Section 7.5.5.2, the thermal desorption technology has been demonstrated to be an effective remedial technology for the treatment of PCB-impacted soil at several sites, but has only limited precedents for use on sediments. As discussed previously, most of the PCBs present in the sediments/soils would be volatilized using an indirect fired thermal desorption system and transferred to the off-gas from which they would be condensed into a liquid stream. The condensed PCBs would then be transported to a permitted off-site facility for destruction. However, to date, the volumes of PCB-impacted materials treated at other sites have generally been relatively small, the duration of the treatment operation has been relatively short, and when on-site reuse has occurred, the material has typically been placed into a small area and covered with clean backfill. While it has been assumed for purposes of the CMS that metals leachability would not affect end use and/or disposal costs, the leachability of certain metals that may be present in the soils/sediment could be altered by the thermal desorption process (for example, thermal desorption can oxidize lead, increasing toxicity and mobility [ITRC, 1998]) and thereby affect the ultimate end use and/or disposal costs of the treated soil/sediment. Thus, the reliability of this process for a long-term treatment operation involving a large volume of sediments and soils, and the ability to use the treated solids, amended by organic material, as backfill in the floodplain are unknown.

Compliance with ARARs: As discussed in Section 7.5.4, GE anticipates that TD 5, if selected, could be designed and implemented to meet the pertinent ARARs listed in Tables 2-1, 2-2, and 2-3 (provided that the necessary risk-based TSCA determinations from EPA are obtained), with the exception of certain requirements that could potentially apply if the materials to be subject to thermal desorption should constitute hazardous waste (which is not anticipated). In the latter event, to the extent that any such specific requirements were considered applicable, GE would evaluate the options identified in Section 7.5.4.

Human Health Protection: TD 5 would provide human health protection by substantially reducing the PCB concentrations in the treated solids materials, followed by on-site reuse (after amendment with organics) and/or off-site disposal of those materials and off-site disposal/destruction of the liquids containing the condensed PCBs. Implementation of this alternative would not be expected to produce any significant short-term or long-term adverse impacts on human health. The treated materials that would be used on-site as backfill in the floodplain (if any) would have sufficiently low PCB concentrations that they would not be expected to have any adverse health effects.

Environmental Protection: Implementation of TD 5 would provide protection of ecological receptors for the same reasons discussed for human receptors. It would produce short-term effects on the environment due to the loss of habitat in the area where the thermal desorption facility would be located. In addition, given the relatively long duration of the operation of the thermal desorption treatment facility (8 to 51 years), there would be a greater potential than under shorter-term applications for failure of process and control equipment and consequent release of PCBs, metals, dioxins/furans (if formed during the process) into the atmosphere. There would also be a greater likelihood of spillage of the highly concentrated PCB-containing liquids during accidents as they are being transported off-site for treatment/disposal. No long-term adverse effects on the environment following completion of the treatment operations and restoration of the staging areas would be anticipated

Summary: Based on the above considerations, it is concluded that TD 5 would provide overall protection of human health and the environment.

7.6 Comparative Evaluation of Treatment/Disposition Alternatives

In Sections 7.1 through 7.5, the five treatment/disposition alternatives have been individually evaluated under the three General Standards and five of the six Selection Decision Factors specified in the Permit (attainment of IMPGs was excluded, since it is not relevant to the treatment/disposition alternatives). This section contains a comparative evaluation of the five alternatives using the same criteria.

This comparative analysis evaluates the relative performance of the various treatment/disposition alternatives under the Permit criteria to identify potential advantages and disadvantages of each alternative relative to the others. This analysis also addresses the requirement specified in the Permit (Special Condition II.G.3) to identify which alternative, in GE's opinion, is "best suited to meet the [General Standards] in consideration of the [Selection Decision Factors], including a balancing of those factors against one another." As this language reflects, and as discussed previously in Sections 4.9 and 6.8, a comparison of alternatives necessarily involves balancing and trade-offs; and the goal of this balancing process is to select remedial alternatives that best achieve net risk reduction. As a result, this comparative analysis focuses primarily on differences among the alternatives with respect to each criterion.

7.6.1 Overview of Alternatives

The five alternatives include three that involve disposition of the removed sediments and floodplain soils in disposal facilities. These are: (1) disposal in off-site permitted landfills (TD 1); (2) disposition in on-site CDF(s) in a local waterbody (TD 2); and (3) disposition in an on-site Upland Disposal Facility (TD 3).

The other two alternatives would involve treatment, either by a chemical extraction process (TD 4) or by thermal desorption (TD 5). These alternatives would also need to include some provision for disposition of the sediments and soils remaining after treatment. As previously discussed, since the results from the bench-scale tests of the representative chemical extraction process (the BioGenesis^{SM} process) indicate that PCB concentrations in the treated solid material would not be sufficiently low to allow reuse on-site, it has been assumed for TD 4 that the treated solid material would be transported to an off-site facility for disposal. For TD 5, it is assumed for purposes for the CMS that the concentrations of PCBs in the solid material resulting from the thermal desorption process would be reduced to sufficiently low levels (around 1-2 mg/kg), and that metals leachability would not be significantly altered, such that some of the materials could potentially be reused. Thus, it has been assumed that some of the treated solid material would be amended through the addition of organic-rich material and reused on-site as backfill in the floodplain, with the rest transported for off-site disposal. However, due to uncertainties regarding the ultimate effectiveness of the treatment process, TD 5 has also been evaluated based on the alternate assumption that all the treated material would be transported to an off-site disposal facility.

All of the treatment/disposition alternatives except TD 2 have been evaluated considering the same range of sediment and soil volumes that could be removed under the sediment and floodplain alternatives. This range extends from 185,000 cy, based on a combination of SED 3 and FP 2, to 2.8 million cy, based on a combination of SED 8 and FP 7. With the exception of the cost comparison, TD 2 has been evaluated only for the disposition of hydraulically dredged sediments from Reaches 5C and 6, which would occur only under SED 6, SED 7, or SED 8 (i.e., a range of hydraulically dredged volumes from 293,000 cy for SED 6 to 800,000 cy for SED 8). Since TD 2 would not provide for the disposition of other sediments or of floodplain soils, it would have to be coupled with another treatment/disposition alternative for those other materials. As a result, the evaluations of TD 2 alone are not comparable to the evaluations of the other alternatives, since they do not take account of the disposition of those remaining materials. For cost comparison purposes, however, the TD 2 analysis assumes that the remaining materials not placed in the CDF(s) would be transported off-site for disposal – with the lower-bound costs based on the combined volumes from SED 6 and FP 2 and the upper-bound costs based on the combined volumes from SED 8 and FP 7 (see Section 7.6.9).

7.6.2 Overall Protection of Human Health and the Environment – Introduction

As discussed previously, the evaluation of whether the treatment/disposition alternatives would provide overall human health and environmental protection draws on the evaluations under several other Permit criteria – notably long-term effectiveness and permanence (including long-term adverse impacts), short-term effectiveness, and compliance with ARARs. For that reason, the comparative evaluation of the treatment/disposition alternatives under this standard is presented at the end of Section 7.6 so that it can take account of the comparative evaluations under those other criteria, as well as other factors relevant to the protection of human health and the environment.

7.6.3 Control of Sources of Releases

All the treatment/disposition alternatives would control future releases and transport of removed PCB-containing sediments and soils within the River or onto the floodplain, although some alternatives would provide more effective control of such releases than others.

TD 1 would eliminate the potential for future releases of the removed materials by disposing of them off-site. TD 2 would minimize the potential for such releases through placement of the removed materials into CDF(s), coupled with the implementation of a long-term monitoring and maintenance program. Under TD 2, there is a potential for releases of sediments into the River during the filling process and through releases of PCBs in the water that permeates out of the CDF(s) through the berms, although, by design, the PCBs suspended in the water should be filtered out by the berms during this process. It is also possible that releases from the CDF(s) could occur after CDF closure due to damage caused by ice or floods. TD 3 would address future releases through the placement of the materials in an Upland Disposal Facility and the implementation of a long-term monitoring and maintenance program. Placement of the PCB-containing sediments and soils into an Upland Disposal Facility would provide a greater degree of control of potential releases than TD 2 and should effectively eliminate the potential for the removed materials to be released to the River or the floodplain. This is because: (1) the Upland Disposal Facility would be located outside the River and the 100-year floodplain; (2) the materials would be dewatered prior to placement in that facility; and (3) the facility would include an impermeable subsurface liner, a leachate collection system, and an impermeable surface cover. Further, PCBs are tightly bound to the sediment and soil particles and not readily released in soluble form.

Under TD 4 and TD 5, the potential for the PCB-containing sediments and soils to be released within the River or onto the floodplain during treatment operations would be minimized by locating the treatment facilities outside the floodplain and by using appropriate engineering control systems. Moreover, under TD 4, the treated solid materials would be transported off-site for disposal and the wastewater would be subject to treatment prior to discharge to the River. Under TD 5, to the extent that a portion of the treated solids is used as backfill in the floodplain, chemical characterization sampling would be performed to ensure that those materials would not present concerns regarding future releases or exposure. The remainder of the treated solids – or all such solids if none are reused as backfill – would be transported off-site for disposal, and the concentrated PCB-containing liquid condensate from the thermal desorption process would be sent off-site for incineration.

During implementation of TD 4 or TD 5, however, the potential exists for the release of PCBs and other constituents (e.g., metals and dioxins/furans [if formed]) to the air, with TD 5 having the greatest potential due to the treatment process used (application of heat to transfer PCBs into the vapor phase). The potential also exists for PCBs to be released to the environment through the spillage or incomplete treatment of water generated during implementation of TD 4 and TD 5, with TD 4 having the greatest potential for such a release given the significant volume of water generated during the treatment process. Under both alternatives, releases of PCB-containing materials during implementation would be controlled using conventional engineering practices.

In short, all the treatment/disposition alternatives would control the potential for future releases of PCBs from the removed materials within the River or onto the floodplain, although there would be a somewhat greater potential for such releases under TD 2 than under the other alternatives.

7.6.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE are listed in Tables 2-1 through 2-3. These ARARs are not relevant to TD 1, since that alternative would involve off-site transport and disposal. For TD 3 through TD 5, GE believes the alternatives could be designed and implemented to meet the pertinent ARARs (provided that any necessary risk-based TSCA determination from EPA is obtained), with the exception of certain requirements that could potentially apply if the materials involved should constitute hazardous waste, which is not expected. In the latter case, to the extent that any such specific requirements were considered applicable, GE would evaluate various options, including off-site disposal of such materials, determining whether the facilities could practicably be designed to meet the applicable requirements, or seeking a waiver of any requirements that could not practicably be met. For TD 2, while GE believes that the CDF(s) could achieve many of the identified ARARs (provided that a risk-based TSCA determination from EPA is obtained), some of those ARARs may not be met,[189] and it seems likely that a waiver of some ARARs would be necessary for TD 2 to be implemented.

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[189] Such ARARs may include some of the substantive requirements of the Massachusetts water quality certification requirements relating to use of a CDF, the requirements of the Massachusetts Wetlands Protection Act relating to flood storage (if it is not feasible to obtain appropriate flood storage compensation), and requirements that could apply to the CDF(s) if the sediments were determined to constitute hazardous waste.

7.6.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for the treatment/disposition alternatives has included an evaluation of the magnitude of residual risk, the adequacy and reliability of the alternatives, and potential long-term adverse impacts on human health or the environment.

7.6.5.1 Magnitude of Residual Risk

Placement of PCB-containing sediments/soils in off-site permitted landfills (TD 1), in one or more CDF(s) (TD 2), or in an Upland Disposal Facility (TD 3) would permanently isolate those materials from direct contact with human and ecological receptors, thus minimizing the potential for long-term exposure to those sediments/soils. Under TD 1, the off-site disposal of those materials would eliminate any residual risk to on-site receptors. Under TD 2, as noted above, there is a potential for releases due to damage to the CDF(s), which could pose a future risk, but the CDF(s) would be designed to withstand adverse weather and high flow events and monitoring and maintenance would be performed to minimize any releases. With the Upland Disposal Facility in TD 3, the potential for future risks should be minimal for the reasons given in Section 7.6.3.

Under TD 4 and TD 5, it is not expected that there would be any significant residual risks, because: (a) all treatment operations would be performed within secured areas, and any residual PCBs associated with the operations would be removed following completion of the treatment operations; (b) all treated material would be transported off-site for disposal, except for any such material reused on-site under TD 5; and (c) any such treated materials reused on-site under TD 5 would be sampled to ensure that the material to be reused would not pose a residual risk.

In summary, all the treatment/disposition alternatives would minimize any future residual risk from exposure to the PCB-containing materials, although there would appear to be a somewhat greater potential for such exposure under TD 2 than under the other alternatives, for the reasons noted above.

7.6.5.2 Adequacy and Reliability of Alternatives

There are considerable differences in the adequacy and reliability of the five treatment/disposition alternatives.

Use of off-site disposal facilities (TD 1) is a commonly used and effective means for permanent disposition of PCB-containing material. However, due to the potential time required to implement this alternative, which could range from approximately 8 years (if

SED 3 were implemented) to 51 years (if SED 8 were implemented), it is uncertain whether the capacity needed for the disposal of excavated materials from the potential array of removal alternatives for the sediments and floodplain soils would be available.

In-water CDFs (TD 2) have been used to dispose of dredged PCB-containing sediments at some environmental dredging sites, but have been used more widely for navigational dredging, where contaminant concentrations are generally lower. In this case, as discussed above, there is somewhat greater potential for releases from the CDF(s), which would be constructed within waterways, than from upland disposal facilities.

On-site disposal of PCB-containing materials in an upland facility (TD 3) has been used as part of a final remedy at a number of sites and is considered a reliable means of isolating materials in the long term, provided that the facility is properly constructed, monitored, and maintained.

The use of chemical extraction (TD 4), including the BioGenesis^{SM} process, has not been demonstrated at full scale on sediments and soils that could be considered representative of those in the Rest of River. As a result, there are uncertainties about the long-term reliability and effectiveness of operating such a system for a project of the size and duration, and with the range of PCB concentrations, that would be involved at the Rest of River. As discussed in Section 7.4.1.2, results from the site-specific BioGenesis bench-scale study indicate that the process would not reduce PCB concentrations in the treated materials to levels that would allow reuse of those materials. Further, while the test data indicate that the process could reduce PCB concentrations to levels where the resulting mass-weighted average PCB concentrations in the combined process outputs are less than 50 mg/kg, those levels were not achieved in all the individual outputs, and the extent to which the treated materials could be disposed of as non-TSCA material is uncertain. These and other factors (described in Section 7.4.5.2) create uncertainties regarding the effectiveness and reliability of using the chemical extraction process in a full-scale application for treatment of sediments and soils from the Rest of River.

Thermal desorption (TD 5) has been used at several sites to treat PCB-containing soils and, to a lesser degree, sediments to concentrations on the order of 1 to 2 mg/kg. However, there is only limited precedent for use of this technology on sediments, due in part to the time and cost of removing moisture from the sediments prior to treatment. Mechanical problems can result from treatment of high-organic, high-moisture-content, fine-grained materials, which can clump and clog equipment or otherwise be physically difficult to treat. Moreover, at the sites where thermal desorption has been used, the volumes of materials that were treated were substantially smaller and the duration of the treatment operations was substantially shorter than the volumes and duration that could be required at the Rest of River. Further, when on-site reuse of treated materials has occurred, the materials have typically been placed in a small area and covered with clean backfill. While it has been assumed for the CMS that metals leachability would not affect end use and/or disposal costs, the thermal desorption process could alter the leachability of certain metals that may be present in the soils/sediments (e.g., by oxidizing lead, increasing its toxicity and mobility) and thereby affect the ultimate end use and/or disposal costs of the treated soils/sediment. For these reasons, the reliability of this process for a long-term treatment operation with a large volume of materials like sediments/soils from the Rest of River is unknown, as is the ability to use the treated solids, amended by organic material, as backfill in the floodplain without being covered by other material.

Based on these differences, the adequacy and reliability criterion favors TD 3.

7.6.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

Implementation of TD 1, TD 2, and TD 3 would isolate the removed sediments/soils from potential human and ecological exposure since the material would be contained in structures designed specifically for that purpose. Under TD 4, removed material would first be treated, and then disposed of off-site. For TD 5, materials would be treated, and then a portion might be reused in the floodplain assuming it has acceptable PCB levels for such use, with the remainder disposed of off-site. Thus, under all the treatment/disposition alternatives, no long-term adverse impacts on humans or ecological receptors from exposure to the PCB-containing materials would be expected.

TD 1, TD 4, and TD 5 would not be expected to cause any significant adverse long-term environmental impacts. TD 1 would involve off-site transport and disposal of the PCB-containing materials. Under TD 4 and TD 5, the treatment operations would affect only relatively small areas and should not produce impacts beyond any that might exist for a short period following restoration of the associated treatment/staging areas; and the treated material would be disposed of off-site (with a portion potentially reused under TD 5 at levels that would not create adverse environmental impacts).

For TD 2, however, the placement of an in-water CDF in Woods Pond and/or one or more of the three backwaters would result in a permanent loss of the aquatic habitat in those areas and thus have a long-term adverse impact on the biota in those areas. In addition, the CDF(s) would permanently alter the previously undisturbed appearance of the area(s) where the CDF(s) would be located. Further, construction of the CDF(s) in Woods Pond and/or the backwaters would produce a loss of the existing flood storage capacity of those areas if adequate compensatory flood storage capacity is not provided elsewhere in Reaches 5C and 6 (which could be impractical).

For TD 3, the Upland Disposal Facility would remove the existing habitat present in the area of that facility, although that facility would be capped and planted with grass. The significance of any such change in habitat would depend on the existing habitat at the location of the facility. For example, placement of the facility outside of the 100-year floodplain of the River and away from wetlands would avoid long-term impacts to species that inhabit those types of areas.

Thus, of the treatment/disposition alternatives, TD 2 would have the greatest long-term adverse environmental impacts.

7.6.6 Reduction of Toxicity, Mobility, or Volume

The degree to which the treatment/disposition alternatives would reduce the toxicity, mobility, and volume of PCBs is discussed below.

Reduction of Toxicity: TD 1 through TD 3 would not include any treatment processes that would reduce the toxicity of, or directly affect, PCB concentrations in the removed sediment and soil. TD 4 and TD 5 would. The latter alternatives would involve the treatment of between approximately 185,000 cy of sediments/soils containing 12,800 lbs of PCBs (if SED 3 and FP 2 were implemented) to approximately 2.8 million cy of material containing 83,100 lbs of PCBs (if SED 8 and FP 7 were implemented). Under TD 4, the chemical treatment process would reduce the toxicity of the sediment and soil by permanently removing some PCBs from these materials. As discussed in Section 7.4.1.2, bench-scale testing indicates that the BioGenesis^{SM} process would reduce the concentrations of PCBs in the treated sediment and soil by varying amounts, depending on the type of material and the number of passes through the system, although not to a sufficient extent to allow on-site reuse of that material. The waters generated during the process would contain PCBs and these would be treated by wastewater treatment methods prior to discharge. Under TD 5, the indirect fired thermal desorption system would reduce the toxicity of the PCB-containing sediment and soil by permanently removing PCBs from these materials, with the PCBs in the liquid stream sent to a permitted off-site disposal facility for destruction. As noted above, experience at other sites indicates that this process can reduce PCB concentrations in the treated solids to levels on the order of 1 to 2 mg/kg and potentially support reuse of that material as backfill following amendment.[190]

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[190] It should also be noted that, under all alternatives, if “principal threat” wastes (e.g., NAPL) should be encountered (which is not anticipated), those wastes would be segregated from the remaining materials subject to disposition or treatment, and would be separately sent off-site for treatment and disposal.

<u>Reduction of Mobility</u>: All the alternatives would reduce the mobility of PCBs in the sediment and soil. TD 1 through TD 3 would do so by removing these materials to off-site permitted landfill(s) (TD 1), or by permanently containing the materials within on-site CDF(s) (TD 2) or an Upland Disposal Facility (TD 3). TD 4 and TD 5 would reduce the mobility of PCBs present in the sediment/soil by permanently removing PCBs from these materials, and then either sending the treated materials to a permitted off-site landfill, or for TD 5, possibly amending some of the treated solids with organic-rich materials and then reusing them in the floodplain (with reduced PCB concentrations, and thus reduced mobility for the PCBs).

<u>Reduction of Volume</u>: TD 1, TD 2, and TD 3 would not reduce the volume of PCB-containing material. For TD 4, treatment of sediment/soil using the BioGenesis^{SM} process would reduce the volume of PCBs present in those materials by transferring some of the PCBs to an aqueous waste stream for subsequent treatment. Since BioGenesis was unable to complete the PCB mass balance for the sediment and soil samples that were bench tested, the extent of any PCB destruction associated with TD 4 (i.e., in the Oxidation step using hydrogen peroxide) cannot be determined. For TD 5, treatment of sediment/soil in the thermal desorption system would reduce the volume of PCBs present in those materials, with the liquid condensate transported to an off-site facility for destruction. As noted previously, thermal desorption at other sites indicates that low PCB concentrations (e.g., 1 mg/kg to 2 mg/kg) may be achieved in the treated solids.

7.6.7 Short-Term Effectiveness

Evaluation of the short-term effectiveness of the treatment/disposition alternatives has included consideration of the short-term impacts of implementing these alternatives on the environment, local communities (as well as communities along truck transportation corridors), and the workers involved in the treatment and disposition activities. Short-term impacts from the implementation of these alternatives would last for the duration of these activities, which would depend on the duration of the selected combination of sediment and floodplain soil alternatives, estimated to range from 8 to 51 years.

<u>Impacts on the Environment</u>

All the treatment/disposition alternatives would produce some short-term impacts on the environment, but to varying degrees. The short-term impacts of TD 2 through TD 5 would include loss of habitat and loss or displacement of aquatic biota or wildlife in the areas where the disposition or treatment facilities are located, as well as in adjacent areas, during construction and operations. TD 2 would affect a large portion of Woods Pond, one or more of the three backwaters where the CDF(s) would be constructed, and the adjacent floodplain. Specific impacts associated with TD 3 through TD 5 would depend on the habitat at the selected location.

TD 1, TD 4, and TD 5 could also have short-term effects on the environment due to the potential for accidental releases of PCB-containing materials (i.e., PCB-containing sediments/soils [TD 1, TD 4, and TD 5], PCB-containing wastewaters and sludges [TD 4], and PCB-containing liquid concentrate [TD 5]) during transportation to off-site facilities. In addition, TD 4 and TD 5 have a potential for failure of process and control equipment during operations, which could result in a release of PCB-containing materials to the environment, such as PCB-containing wastewaters and sludges (TD 4) and PCB-containing liquid concentrate and vapors (TD 5). Failure of process and control equipment during operations under TD 5 could also result in the formation and release of dioxins/furans, and/or the release of metals (e.g., mercury) to the atmosphere. Further, under TD 4, there is a potential for accidental spills of the chemicals used in the extraction process. The potential for these types of effects would increase with the length of the implementation period.

Impacts on Local Communities and Communities Along Truck Transportation Routes

All the alternatives would also result in short-term impacts to the local communities in the Rest of River area. These impacts would include disruption, noise, and other impacts resulting from the increased truck traffic and from the construction and operation of the on-site disposition or treatment facilities, and would last for the duration of the project (8 to > 50 years).

The truck traffic required for implementation of all the alternatives would create potential short-term impacts not only for the local communities, but also for communities along off-site transportation routes. TD 1, TD 4, and TD 5 would result in an increase in off-site truck traffic due to the transport of excavated or treated materials to off-site disposal facilities. For TD 2 and TD 3, there would be no off-site transport of excavated materials, and there would be a more limited amount of off-site truck traffic overall, resulting from the transport of materials and equipment to the site for construction and closure of the CDF(s) or Upland Disposal Facility. The estimated numbers of off-site truck trips for each alternative, based on the estimated range of volumes that could be involved and an assumption that 20-ton capacity trucks would be used for off-site transport of excavated materials and smaller (16-ton) capacity trucks would be used for importation of materials and equipment to the site, are shown in Table 7-1.

Table 7-1 – Estimated Off-Site Truck Trips for Treatment/Disposition Alternatives

Alternative	Truck Trips for Lower-Bound Volume	Truck Trips for Upper-Bound Volume
TD 1	14,100	211,800
TD 2	See Note 2	See Note 2
TD 3	1,400	13,200
TD 4	14,100	211,800
TD 5 (w/ reuse)	11,600	158,500
TD 5 (w/o reuse)	12,600	190,600

Notes:

1. Truck trips estimated assuming 16-ton capacity trucks for importing material and equipment to the site, 20-ton capacity trucks for exporting material off-site, and 20% bulking factor in the trucks.
2. Truck trips estimated for TD 2 range from 11,200 to 22,900 and do not include the truck trips that would be necessary for off-site transport and disposal of materials that are not placed in the CDF(s). As such, these estimates are not comparable to the numbers of truck trips listed for the other alternatives.
3. A 10% volume reduction of sediment/soil after treatment has been assumed for thermal desorption treatment process (TD 5).
4. For TD 5 with reuse, it is assumed that approximately 50% of the floodplain soils treated by thermal desorption would be reused on-site and that all remaining materials would be transported off-site for disposal.

As shown in this table, the greatest number of truck trips would be needed for TD 1 and TD 4, followed by TD 5. TD 3 would involve by far the fewest number of truck trips, since the only off-site truck transport would be for importation of materials to the site for construction and closure of the Upland Disposal Facility.

This additional truck traffic would also increase the risk of traffic accidents along the transport routes. Appendix D presents an analysis of the potential risks from the increased off-site truck traffic that would be associated with the treatment/disposition alternatives in terms of potential fatalities and non-fatal injuries from truck accidents. The resulting estimates, based on the above range of truck trips, are shown in Table 7-2.

Table 7-2 – Estimated Risks of Accidents from Increased Truck Traffic for Treatment/Disposition Alternatives

Alternative	Estimated Fatalities From Truck Traffic Accidents	Probability of at Least One Fatality	Estimated Non-Fatal Injuries From Truck Traffic Accidents	Probability of at Least One Injury
TD 1	0.2 – 2.99	18% - 95%	4.74 – 71.08	99% - 100%
TD 2	See Note below			
TD 3	0.002 – 0.02	0.2% - 2%	0.04 - 0.38	4% - 31%
TD 4	0.19 – 2.8	17% - 94%	4.42 – 66.4	99% - 100%
TD 5 (w/ reuse)	0.15 – 2.09	14% - 88%	3.64 – 49.69	97% - 100%
TD 5 (w/o reuse)	0.17 – 2.52	15% - 92%	3.95 – 59.75	98% - 100%

Note:

The estimated risks of accidents for TD 2 are based only on the truck trips necessary to transport materials to the site for the construction of the CDF(s) and do not consider the truck trips for off-site transport of the materials that would not be placed in the CDF(s). As such, those risks are not comparable to the estimated risks for the other treatment/disposition alternatives (which consider all removed materials). Under the scenario evaluated, the risks estimated for TD 2 are 0.01 to 0.03 fatalities (with a 1% to 3% probability of at least one fatality) and 0.32 to 0.65 non-fatal injuries (with a 27% to 48% probability of at least one injury).

These estimates show that the incidence of fatalities and injuries resulting from these truck trips would be greatest for TD 1, followed by TD 4 and then TD 5, and would be far lower for TD 3.

Risks to Remediation Workers

There would also be health and safety risks to workers for these alternatives. For TD 1, these risks would consist of risks to the truck drivers and to the employees of the off-site disposal facilities, rather than to on-site remediation workers, and hence have not been quantified. For TD 2 through TD 5, Appendix D contains an analysis of risks to site workers from implementation of those alternatives, with the range of potential risks based on the range of total labor hours for implementation of the alternatives. The following table shows the range of estimated fatalities and non-fatal injuries for alternatives TD 2 through TD 5:

Table 7-3 – Estimated Risks to Site Remediation Workers for Alternatives TD 2 – TD 5

Alternative	Estimated Fatalities From Work Accidents	Probability of at Least One Fatality	Estimated Non-Fatal Injuries From Work Accidents	Probability of at Least One Injury
TD 2	0.01 – 0.03	1% - 3%	1.08 – 3.26	66% - 96%
TD 3	0.05 – 0.15	5% - 14%	8.26 - 22.34	100%
TD 4	0.008 – 0.08	0.8% - 8%	1.48 – 14.51	77% - 100%
TD 5	0.008 – 0.09	0.8% - 8%	1.48 – 16.17	77% - 100%

This analysis indicates that the estimated range of worker fatalities and injuries would be highest for TD 3 and somewhat lower for the other alternatives.

7.6.8 Implementability

7.6.8.1 Technical Implementability

All the treatment/disposition alternatives are considered technically implementable, subject to certain qualifications:

- For TD 1, while there are currently a number of existing permitted TSCA and solid waste landfills with the necessary capacity to accept all of the removed material, it is uncertain at this time whether the capacity needed for off-site disposal of the removed materials would be available in the future given the potential duration for implementation of TD 1 (8 to > 50 years).

- For TD 2, while CDFs have been constructed at a number of sites, it is expected that the CDF(s) in Woods Pond and/or the backwaters would result in a loss of flood storage capacity. It may not be feasible to obtain sufficient flood storage compensation, if required, to offset construction of a CDF(s) sufficiently large to hold the necessary sediment volumes.

- For TD 3, construction and use of an Upland Disposal Facility would be readily implementable provided that a suitable location is found. That facility would be sized to accommodate the necessary volumes of material.

- TD 4 and TD 5 would be implementable provided that a suitable location for the treatment facility is found and that vendors are available to operate the treatment process. However, there are several uncertainties regarding full-scale application of the

BioGenesis^{SM} process to the Rest of River materials; and with thermal desorption, problems with handling high-organic, high-moisture-content, fine-grained sediments could reduce the efficiency of the process. Further, implementation of these treatment remedies over long time periods would have greater potential than with shorter-term applications for failure of process and control equipment.

7.6.8.2 Administrative Implementability

Administrative implementability has been evaluated in consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

For TD 1, ARARs are not relevant because that alternative would involve off-site transport and disposal; however, these activities would be conducted in accordance with the requirements of applicable federal, state, and local regulations relating to the off-site transport and disposal. It is anticipated that the other alternatives would be considered to be “on-site” activities for purposes of the permit exemption set forth in Section 121(e) of CERCLA and Paragraph 9.a of the CD. As such, no federal, state, or local permits or approvals would be required. However, these alternatives would need to comply with the substantive requirements of applicable and appropriate regulations (i.e., ARARs) (unless waived). As noted previously, GE believes that alternatives TD 3 through 5 could be designed and implemented to meet such requirements (provided that any necessary risk-based TSCA determination from EPA is obtained), with the possible exception of certain requirements that could potentially apply if the materials to be placed in the Upland Disposal Facility or to be treated should constitute hazardous waste (which is not anticipated). In the latter case, to the extent that any such specific requirements were considered applicable, GE would evaluate the options identified in Section 7.6.4. While TD 2 could be designed and implemented to achieve many of the identified ARARs, it is expected that some of those substantive requirements may not be met, and that hence a waiver of some ARARs would likely be necessary for that alternative.

Implementation of TD 1 would not require GE to obtain access agreements. Implementation of TD 2 and TD 3 would require GE to obtain permanent access to the location(s) selected for the disposal facility(ies). Implementation of TD 4 and TD 5 would require GE to obtain long-term access to the location selected for the treatment facility. In addition, for TD 2 through TD 5, access agreements would be needed to construct and utilize support areas. It is possible that obtaining access agreements could be problematic in some cases. If GE should be unable to obtain access agreements with particular property owners, GE would request EPA and/or MDEP to provide assistance.

Finally, all alternatives would require coordination with EPA, as well as state and local agencies, to address potential health and safety impacts and to provide as-need support with public/community outreach programs. This factor does not provide a clear basis for distinguishing among the alternatives.

7.6.9 Cost

Estimated cost ranges for each treatment/disposition alternative, including total capital cost, estimated annual OMM cost, and total estimated present worth cost, were presented in the detailed evaluation of each alternative. These cost ranges are summarized in Table 7-4, based on the potential range of volumes that could be involved, although they do not include the cost of implementing the sediment or floodplain removal alternatives. Note that, in this case, the costs presented for TD 2 include not only the costs for disposition in the CDF(s) of the hydraulically dredged sediments from Reaches 5C and 6 under SED 6 through SED 8, but also the estimated costs for off-site transport and disposal of the remaining sediments removed under those alternatives, as well as excavated floodplain soils (lower-bound costs consider SED 6 and FP 2 and upper-bound costs consider SED 8 and FP 7).

Table 7-4 – Cost Summary for Treatment/Disposition Alternatives

	TD 1	TD 2	TD 3	TD 4	TD 5 (with reuse)	TD 5 (without reuse)
Total Capital Costs	$0	$8 – 17 M	$9 – 66 M	$17 – 20 M	$12 – 148 M	$12 – 148 M
Total Operations Cost	$0	$7 – 28 M	$3 – 38 M	$36 – 367 M	$18 – 266 M	$18 – 266 M
Total Off-Site Disposal Costs	$50 – 790 M	$72 – 403 M	$0	$37 – $571 M	$34 – 498 M	$36 – 555 M
Total Monitoring and Maintenance Costs	$0	$6 – 12 M	$10 – 17 M	$0.075 M	$0.075 M	$0.075 M
Total Cost for Alternative	**$50 – 790 M**	**$93 – 460 M**	**$22 – 121 M**	**$90 – 958 M**	**$64 – 912 M**	**$66 – 969 M**
Total Present Worth	$39 – 220 M	$47-122 M	$11 – 30 M	$70 – 265 M	$50 – 349 M	$51 – 364 M

Notes:

1. All costs are in 2008 dollars. $ M = Million dollars.
2. With the exception of TD 2, the ranges of costs presented are the minimum and maximum anticipated costs based on the potential range of volumes that would be potentially removed under the sediment and floodplain soil alternatives evaluated (185,000 cy to 2.8 M cy). For TD 2, the lower-bound costs are based on the combined volume of SED 6 and FP 2 and the upper-bound costs are based on the combined volume of SED 8 and FP 7, with material not placed in the CDF(s) assumed to be transported off-site for non-TSCA disposal. Thus, the upper-bound costs, but not the lower-bound costs, for TD 2 are comparable to the costs for the other alternatives.
3. Total Capital Costs are for engineering, labor, equipment, and materials associated with implementation.
4. Total Operations Costs consist of the total of the average annual costs for operation, placement, and/or treatment of sediments and/or soils, estimated for the range of durations for implementing the alternatives.
5. Total Monitoring and Maintenance Costs are for performance of post-closure monitoring and maintenance programs of 30 years for TD 2 and TD 3 and 3 years for TD 4 and TD 5.

6. Total Present Worth cost is based on using a discount factor of 7%, considering the length of the operations period and post-closure monitoring and maintenance periods of 30 years for TD 2 and TD 3 and 3 years for TD 4 and TD 5.
7. For TD 5 with reuse, it is assumed that approximately 50% of the floodplain soils treated by thermal desorption would be reused on-site and that all remaining materials would be transported off-site for disposal.

For the reasons discussed in Section 2.2.6, comparison of the costs of the treatment/disposition alternatives have focused on the total costs of those alternatives, rather than the present worth estimates, due to the substantial impact of discounting over long periods on present worth costs, the uncertainties associated with choice of discount rate, and the potential impact of changing the implementation durations.

As shown in Table 7-4, TD 3 is the least costly alternative. At the low end of the volume range, it would cost about 2 to 4 times less than the other alternatives; and at the high end of the range, it would cost about 4 to 8 times less. Thus, TD 3 would provide for permanent and effective isolation of the removed sediments and soils for a fraction of the costs of the other alternatives. As such, based on the costs of the treatment/disposition alternatives (i.e., without considering the costs of the sediment and floodplain soil removal alternatives), TD 3 is clearly the most cost-effective alternative. The costs will be evaluated further after considering the combined cost estimates presented in Section 8.

7.6.10 Overall Protection of Human Health and the Environment – Conclusions

As explained above, the evaluation of whether the treatment/disposition alternatives would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. Based upon review of those evaluations and factors, it is concluded that all five treatment/disposition alternatives would provide overall protection of human health and the environment, subject to certain qualifications for TD 2. The principal reasons are discussed below.

TD 1 (off-site disposal) would provide effective long-term protection of human health and the environment by providing for permanent disposal of the PCB-containing sediments and soils removed from the Rest of River area in permitted off-site landfills.

TD 2 (disposition in on-site CDF[s]) would provide health and environmental protection by permanently isolating the hydraulically dredged sediments from Reaches 5C and 6 in covered in-water CDF(s), which would be subject to monitoring and maintenance activities to ensure the long-term integrity of the CDF(s). However, this alternative would not provide for disposition of the remaining sediments or the excavated floodplain soils, which would need to be disposed of elsewhere. Moreover, implementation of TD 2 would cause significant long-term environmental impacts, because the CDF(s) would result in a permanent loss of the aquatic habitat in a large portion of Woods Pond and/or one or more of the backwaters where the CDF(s) would be constructed, would change the natural appearance of those areas, and would result in a loss of flood storage capacity in those areas if compensatory flood storage cannot be provided.

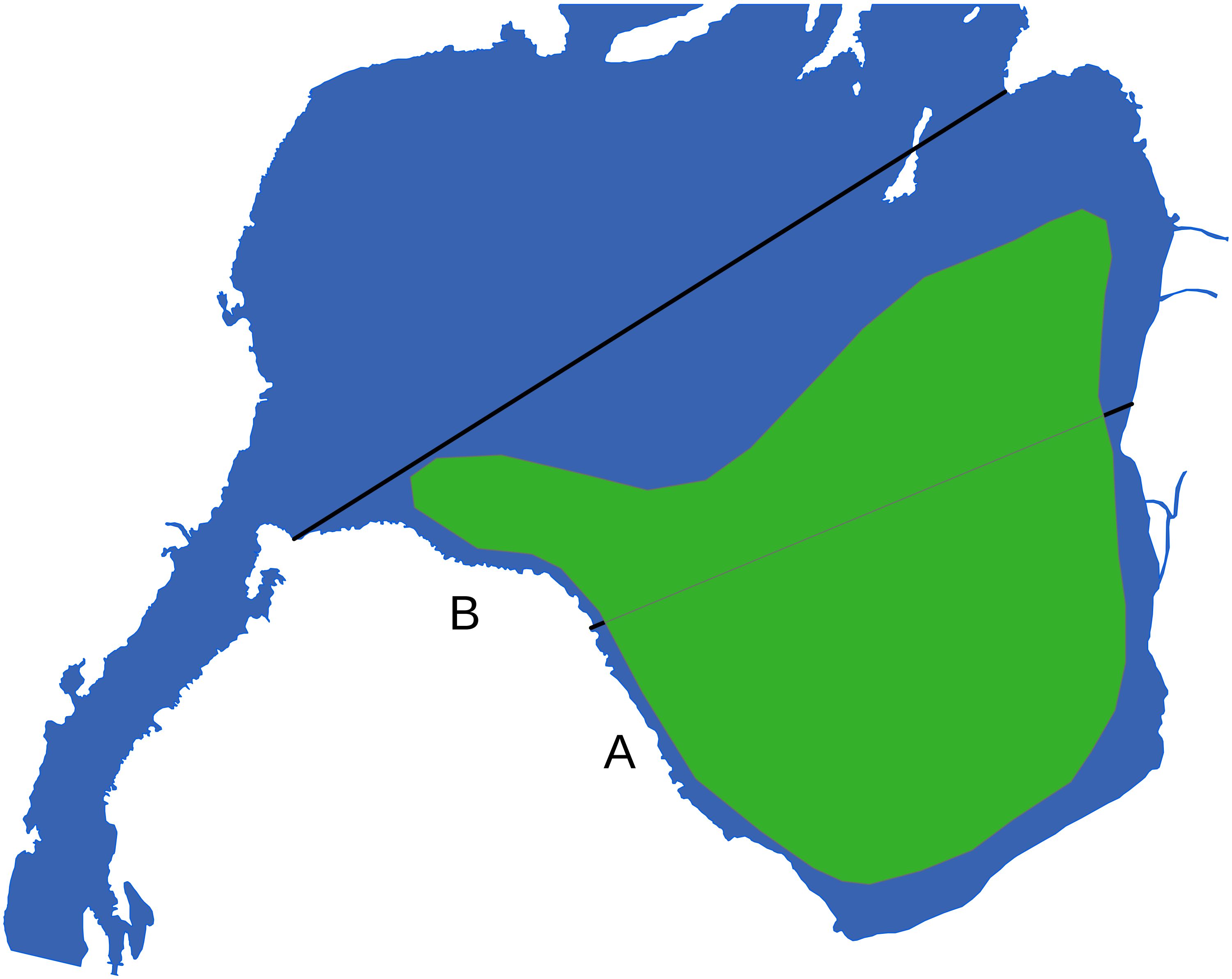
TD 3 (on-site upland disposal) would provide protection of human health and the environment by permanently isolating the PCB-containing sediments and soils in an Upland Disposal Facility, which would be constructed with appropriate liner, cover, leachate collection, and monitoring systems, and would be subject to long-term monitoring and maintenance, to ensure the effectiveness of the isolation. While this alternative would cause a loss of any existing habitat in the area of the Upland Disposal Facility, the impacts would be limited to that area, the facility would be replanted with grass, and the significance of any impacts would depend on the location selected for the facility.

TD 4 (chemical extraction) would provide human health and environmental protection by reducing the PCB concentrations in the sediments and soils, followed by appropriate disposition of the treated material. Based on bench-scale study results, the chemical extraction process could not reduce PCB concentrations in the treated material to levels that would allow on-site reuse. Thus, the treated solid material would have to be transported off-site for disposal. Moreover, it should be recognized that the long-term reliability and effectiveness of the chemical extraction process have not been demonstrated at full scale for PCBs in sediments and soils representative of those from the Rest of River.

TD 5 (thermal desorption) would provide human health and environmental protection by reducing the PCB concentrations in the sediments and soils, followed by on-site reuse of a portion of the treated solids as backfill in the floodplain (if feasible) and off-site disposal of the remainder. The on-site reuse would be protective because the treated solids would be sufficiently characterized to ensure that they would not cause adverse human health or environmental effects, and would be amended with organic material to promote plant growth. However, it should be recognized that, since thermal desorption has not to date been used for the large volumes and long duration that could be involved at the Rest of River site, the reliability of this process for such a large-scale, long-term operation is unknown.

7.6.11 Overall Conclusion

For the reasons discussed above, it is concluded that all the treatment/disposition alternatives, with the possible exception of TD 2, would meet the General Standards in the Permit. Further, GE believes, based on a consideration and balancing of the Selection Decision Factors, that TD 3 is “best suited” to meet the General Standards, primarily because it would permanently isolate the PCB-containing sediments and soils from human and ecological receptors, would have the highest degree of reliability, would not have significant long-term or short-term adverse impacts, would be fully implementable, and would have the lowest cost. Indeed, the NCP requires that when more than one alternative would achieve the threshold criteria, the most cost-effective alternative must be selected (see 40 CFR § 300.430(f)(1)(ii)(D)). Standing alone (i.e., without considering the costs of the sediment and floodplain soil removal alternatives), TD 3 is clearly the most cost-effective of the treatment/disposition alternatives. This conclusion will be reviewed further after considering the combined cost estimates presented in Section 8.



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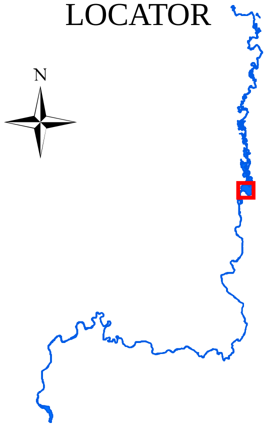


SCALE

200 100 0 200 Feet

LEGEND

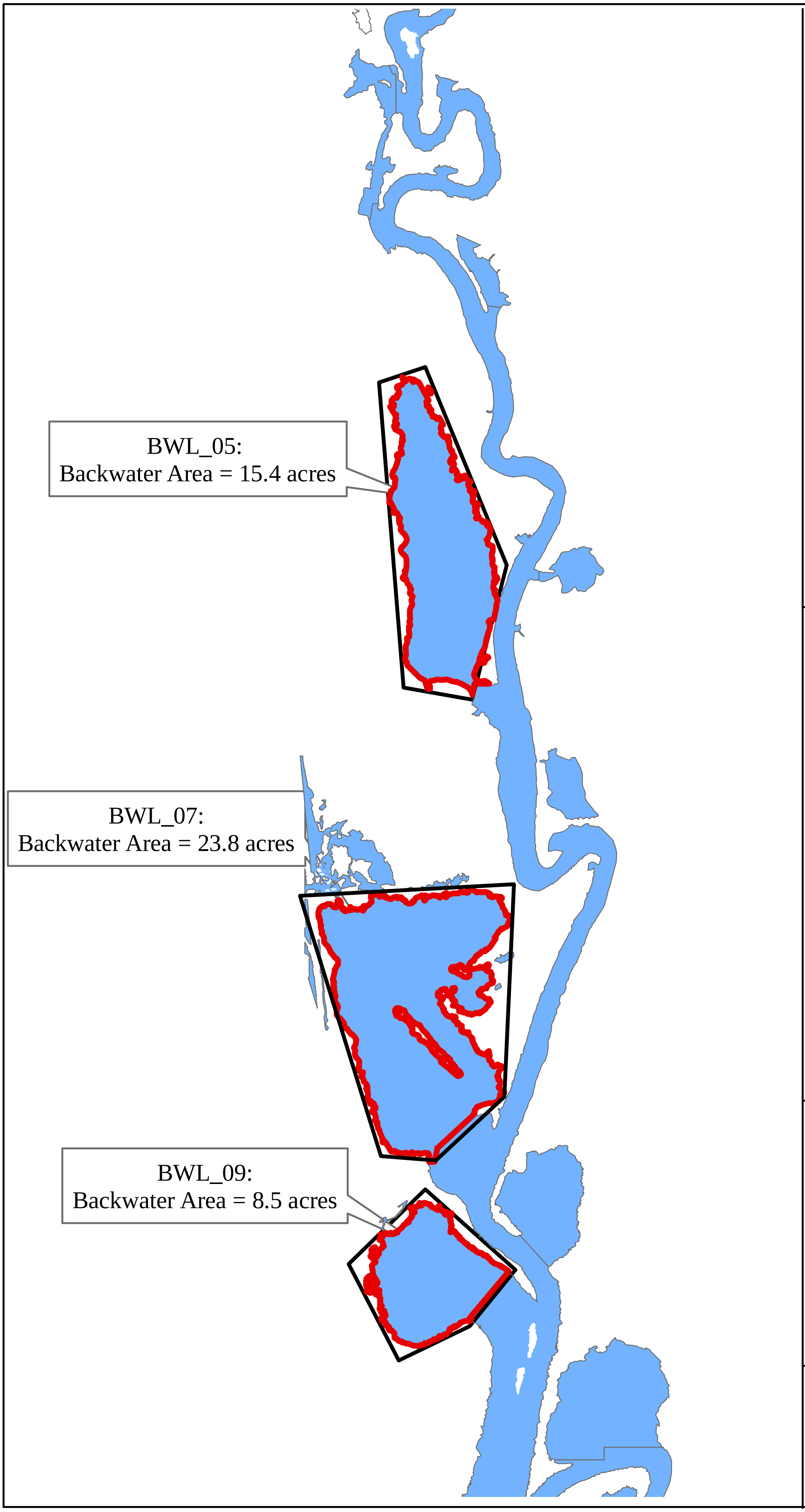
— Sheet Pile

🟩 "Deep Hole"

Note: Sheet pile locations from 1996 Harrington CDF survey

Figure 7-1. Potential locations for in-water CDFs within Woods Pond.

QEA
Quantitative Environmental Analysis, LLC



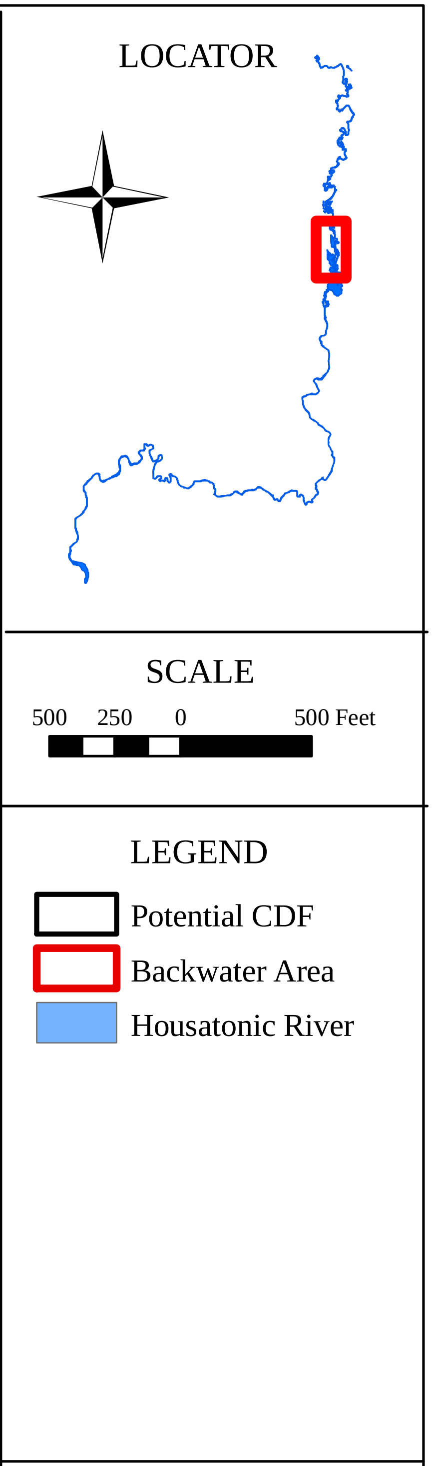


Figure 7-2. Potential backwaters for in-water CDFs.

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8. Combined Cost Estimates

As presented in previous sections, cost estimates have been developed for the individual sediment, floodplain soil, and treatment/disposition alternatives (Sections 4, 6, and 7, respectively). To develop the combined cost estimates discussed in this section, the eight sediment alternatives were paired with the appropriate treatment/disposition alternatives, creating a total of 32 cost estimates. Likewise, the seven floodplain soil alternatives were paired with the appropriate treatment/disposition alternatives, resulting in 30 cost estimates for those combinations. A summary of the combined cost estimates and related assumptions is presented below, with more detailed information provided in Appendix E to this CMS Report.

8.1 Sediment Alternative and Treatment/Disposition Combinations

Table 8-1 presents the total cost estimates for the SED/TD combinations (including capital and OMM costs). For the SED/TD combinations involving removal, total cost estimates range from $154 million for combining SED 3 with TD 3 (local upland disposal) to approximately $1.4 billion for combining SED 8 with TD 5 (thermal desorption).

Table 8-1 – Total Cost Estimates for SED/TD Combinations

	Cost Estimates for SED/TD Combinations[1,2]				
Alternative	**TD 1 Off-Site Disposal**	**TD 2 Confined Disposal Facility**	**TD 3 Upland Disposal Facility**	**TD 4 Chemical Extraction**	**TD 5 Thermal Desorption**
SED 1[3]	NA	NA	NA	NA	NA
SED 2[4]	$10 M	NA	$10 M	$10 M	$10 M
SED 3	$195 M	NA	$154 M	$238M	$216 M
SED 4	$304 M	NA	$232 M	$357 M	$324 M
SED 5	$372 M	NA	$273 M	$436 M	$399 M
SED 6	$482 M	$396 M	$334 M	$499 M	$502 M
SED 7	$614 M	$497 M	$399 M	$624 M	$629 M

	Cost Estimates for SED/TD Combinations[1,2]				
Alternative	**TD 1** **Off-Site Disposal**	**TD 2** **Confined Disposal Facility**	**TD 3** **Upland Disposal Facility**	**TD 4** **Chemical Extraction**	**TD 5** **Thermal Desorption**
SED 8	$1,260 M	$875 M	$695 M	$1,366 M	$1,385 M

Notes:

1. Costs presented represent the sum of estimated capital/labor costs of implementation and the costs of post-remediation OMM and/or long-term monitoring.
2. Costs are presented in 2008 dollars. $ M = million dollars.
3. There are no costs associated with SED 1 as that alternative would not involve remedial activities in the Rest of River.
4. There are no treatment/disposition costs for SED 2; the cost listed represents the long-term monitoring costs associated with monitored natural recovery.

The following key assumptions were made in developing the combined costs of SED/TD alternatives:

- In developing the remedial combinations that involve TD 1, it was assumed that, following removal and processing/dewatering at the staging areas (which are considered under the sediment and floodplain alternatives), no additional material handling activities would be necessary before off-site transport and disposal – i.e. that removed materials would be sufficiently stabilized for off-site transport as part of the removal alternatives. It was also assumed that removed materials, regardless of the removal method, would be appropriately segregated with respect to TSCA classification as part of the removal alternatives. Therefore, no extra costs for material handling were either added to or subtracted from the combined cost estimates for the remedial combinations involving TD 1.

- As discussed in Section 7.2, it has been assumed that the CDF(s) that are part of TD 2 would be used only for disposition of hydraulically dredged sediments from Reaches 5C and 6 under SED 6, SED 7, and SED 8. Since SED 3, SED 4, and SED 5 do not include hydraulic dredging of sediments, no combined costs are presented for combinations of those sediment alternatives with TD 2. For the combined cost estimates for SED 6, SED 7, and SED 8 with TD 2, it was assumed that all sediments removed from reaches other than Reaches 5C and 6 would be transported off-site for disposal. In addition, it was assumed that sediment dewatering and stabilization –

activities that were part of the individual sediment alternatives – would not be necessary for the materials to be placed in the CDF(s); and hence costs for sediment dewatering and stabilization were backed out of the costs for the combinations that involve TD 2. Additionally, some sediments that would otherwise be removed from Reaches 5C and 6 are located within the conceptual footprint of the CDF(s). Construction of the CDF(s) would make the removal of these sediments unnecessary; thus, the sediment removal volumes in Reaches 5C and 6 were reduced in SED 6, SED 7, and SED 8 by the volumes of sediments located within the footprint of the CDF(s), and the costs were adjusted accordingly.

- For the combinations of sediment alternatives with TD 3, adjustments were made to the individual sediment alternative cost estimates presented in Section 4 to account for the fact that, following remediation, the access road and staging area materials would be placed in the Upland Disposal Facility, rather than transported for off-site disposal.

- Where relevant in the combinations of sediment alternatives with TD 4, it was assumed that hydraulically dredged sediments from Reaches 5C and 6 could be pumped directly to the chemical treatment facility without being dewatered. In these cases, the following costs were not included in the combined cost estimates: (1) costs for dewatering and associated water treatment (activities that were part of the original sediment alternatives); and (2) costs for transporting removed sediments hydraulically dredged from Reaches 5C and 6 to the on-site chemical treatment facility. In general, the cost estimates for the combinations that involve TD 4 were based on cost estimates provided by BioGenesis, with certain adjustments and additions to incorporate costs associated with non-treatment activities, as discussed in Section 7.4.9. The costs that were added to the BioGenesis estimates include the costs for off-site transport and disposal of the treated solid materials. These costs were based on the assumption that the treated materials would contain average PCB concentrations less than 50 mg/kg and would be disposed of off-site at a non-TSCA solid waste landfill pursuant to a risk-based TSCA determination from EPA.

- For the combinations of sediment alternatives with TD 5, it was assumed that the thermal desorption process would reduce the PCB concentrations in the treated materials to levels of 1 to 2 mg/kg. Because there is no known precedent for the reuse of such thermally treated materials as backfill in riverine environments, it was assumed that these materials would be transported off-site for disposal in a non-TSCA landfill.

- For all combinations, it was assumed that none of the removed materials would constitute hazardous waste under RCRA criteria or comparable state criteria.

For the reasons discussed in Section 2.2.6, comparison of the combined costs of these alternatives have focused on the total costs (presented above in Table 8-1), rather than present worth estimates. However, as required by the Permit, the present worth cost for each combination of SED/TD alternatives is also presented below, using the recommended 7% discount rate.

Table 8-2 – Present Worth Cost Estimates for SED/TD Combinations

	Present Worth Cost Estimates for SED/TD Combinations[1,2,3]				
Alternative	TD 1 Off-Site Disposal	TD 2 Confined Disposal Facility	TD 3 Upland Disposal Facility	TD 4 Chemical Extraction	TD 5 Thermal Desorption
SED 1[4]	NA	NA	NA	NA	NA
SED 2[5]	$4 M	NA	$4 M	$4M	$4 M
SED 3	$141 M	NA	$105 M	$170 M	$157 M
SED 4	$193 M	NA	$138 M	$223 M	$207 M
SED 5	$216 M	NA	$150 M	$249 M	$236 M
SED 6	$261 M	$212 M	$174 M	$269 M	$278 M
SED 7	$293 M	$235 M	$184 M	$297 M	$311 M
SED 8	$374 M	$274M	$190 M	$384 M	$456 M

Notes:

1. Costs presented represent the sum of estimated capital/labor costs of implementation and the costs of post-remediation OMM and/or long-term monitoring.
2. Costs are presented in 2008 dollars. $ M = million dollars.
3. Costs have been assessed for present worth, assuming a constant 7% discount factor.
4. There are no costs associated with SED 1 as that alternative would not involve remedial activities in the Rest of River.
5. There are no treatment/disposition costs for SED 2; the cost listed represents the long-term monitoring costs associated with monitored natural recovery.

8.2 Floodplain Soil Alternative and Treatment/Disposition Combinations

Table 8-3 presents the total costs for the FP/TD combinations (including capital and OMM costs). For the FP/TD combinations involving removal, the total costs range from $15 million for combining FP 2 with TD 3 (local upland disposal) to $403 million for combining FP 7 with TD 4 (chemical extraction).

Table 8-3 – Total Cost Estimates for FP/TD Combinations

	Cost Estimates for FP/TD Combinations[1,2]					
Alternative	**TD 1 Off-Site Disposal**	**TD 2[4] Confined Disposal Facility**	**TD 3 Upland Disposal Facility**	**TD 4 Chemical Extraction**	**TD 5A Thermal Desorption (w/ Reuse)**	**TD 5B Thermal Desorption (w/o Reuse)**
FP 1[3]	NA	NA	NA	NA	NA	NA
FP 2	$15 M	NA	$15 M	$34 M	$22 M	$23 M
FP 3	$46 M	NA	$30 M	$65 M	$42 M	$49 M
FP 4	$71M	NA	$49 M	$92 M	$64 M	$75 M
FP 5	$82 M	NA	$47 M	$90 M	$62 M	$73 M
FP 6	$193 M	NA	$128 M	$242 M	$180 M	$215 M
FP 7	$310 M	NA	$202 M	$403 M	$311 M	$374 M

Notes:

1. Costs presented represent the sum of estimated capital/labor costs of implementation and the costs of post-remediation OMM and/or long-term monitoring.
2. Costs are presented in 2008 dollars. $ M = million dollars.
3. There are no costs associated with FP 1 as that alternative would not involve remedial activities in the Rest of River.
4. Floodplain alternatives have not been combined with TD 2 as the CDF has been assumed to be available only for the placement of hydraulically dredged sediments.

The following key assumptions were made in developing the combined FP/TD cost table:

- For the combinations of floodplain alternatives with TD 3, adjustments were made to the individual FP cost estimates presented in Section 6, to account for the fact that the access road and staging area materials would be placed in the Upland Disposal Facility rather than transported for off-site disposal.

- For the combinations of floodplain alternatives with TD 4, the cost estimates were generally based on cost information provided by BioGenesis, with certain adjustments and additions to incorporate costs associated with non-treatment activities, as discussed in Section 7.4.9. The costs that were added to the BioGenesis estimates include the costs for off-site transport and disposal of the treated solid materials. These costs were based on the assumption that the treated materials would contain average PCB concentrations less than 50 mg/kg and would be disposed of off-site at a non-TSCA solid waste landfill pursuant to a risk-based TSCA determination from EPA.

- The combinations of floodplain alternatives with TD 5 were evaluated under two scenarios: (1) assuming that a portion of the treated floodplain soils (approximately 50%) would be reused as backfill in the floodplain after being amended with organic material, and that the remainder would be transported off-site for disposal in a non-TSCA landfill (TD 5A); and (2) assuming that all treated soils would be transported off-site for disposal in a non-TSCA landfill (TD 5B). For the combinations that involve TD 5A, given the assumed reuse of treated material as backfill, the floodplain backfill costs were removed from the estimates; however, costs associated with the purchase and placement of topsoil were not removed from the combined cost estimates, and instead were assumed to represent the costs associated with the amendment of the thermally treated materials prior to use as backfill.

- For all combinations, it was assumed that none of the removed materials would constitute hazardous waste under RCRA criteria or comparable state criteria.

For the reasons discussed in Section 2.2.6, comparison of the combined costs of these alternatives have focused on the total costs (presented above in Table 8-3), rather than present worth estimates. However, as required by the Permit, the present worth cost for each combination of FP/TD alternatives is also presented below, using the recommended 7% discount rate.

Table 8-4 – Present Worth Cost Estimates for FP/TD Combinations

Alternative	Net Present Worth Cost Estimates for FP/TD Combinations[1,2,3]					
	TD 1 Off-Site Disposal	TD 2[5] Confined Disposal Facility	TD 3 Upland Disposal Facility	TD 4 Chemical Extraction	TD 5A Thermal Desorption (w/ Reuse)	TD 5B Thermal Desorption (w/o Reuse)
FP 1[4]	NA	NA	NA	NA	NA	NA
FP 2	$15 M	NA	$12 M	$34 M	$21 M	$21 M
FP 3	$44 M	NA	$26 M	$61 M	$39 M	$46 M
FP 4	$64 M	NA	$40 M	$82 M	$56 M	$66 M
FP 5	$74 M	NA	$38 M	$79 M	$55 M	$66 M
FP 6	$130 M	NA	$80 M	$163 M	$121 M	$146 M
FP 7	$161 M	NA	$100 M	$210 M	$162 M	$201 M

Notes:

1. Costs presented represent the sum of estimated capital/labor costs of implementation and the costs of post-remediation OMM and/or long-term monitoring.
2. Costs are presented in 2008 dollars. $ M = million dollars.
3. Costs have been assessed for present worth assuming a constant 7% discount factor.
4. There are no costs associated with FP 1 as that alternative would not involve remedial activities in the Rest of River.
5. Floodplain alternatives have not been combined with TD 2 as the CDF has been assumed to be available only for the placement of hydraulically dredged sediments.

9. Conclusions and Recommendations

Previous sections of this report have presented detailed evaluations of each of the eight sediment remedial alternatives, seven floodplain soil remedial alternatives, and five treatment/disposition alternatives under the three General Standards and six Selection Decision Factors specified in the Permit, as well as comparative evaluations of those alternatives using the same criteria. This report has also considered the estimated combined costs of the sediment and floodplain alternatives when paired with the treatment/disposition alternatives. The Permit requires that GE "shall conclude the CMS Report with a recommendation as to which corrective measure or combination of corrective measures, in [GE's] opinion, is best suited to meet the [General Standards] in consideration of the [Selection Decision Factors], including a balancing of those factors against one another" (Special Condition II.G.3).

As noted in Section ES.1 of this CMS Report, GE believes that, apart from monitoring the natural processes, additional remediation is not necessary or appropriate for the Rest of River; and it has reserved its rights (including its appeal rights under the CD and the Permit) on this issue and all other issues on which GE has presented its position to EPA during the process to date. Nevertheless, as required by the Permit, GE has conducted the evaluations in the CMS taking into account EPA's HHRA and ERA and using assumptions, procedures, and other inputs that EPA directed GE to use in the CMS.

In this context, the comparative evaluations presented in prior sections have addressed the Permit requirement quoted above for each specific type of alternatives, providing GE's conclusions on this issue for the sediment alternatives in Section 4.9, for the floodplain soil alternatives in Section 6.8, and for the treatment/disposition alternatives in Section 7.6. Those sections concluded, subject to further review after consideration of the combined cost estimates, that the alternatives that best meet the Permit requirement are SED 3, FP 3, and TD 3. Review of the combined cost information in Section 8 confirms those conclusions, including the conclusion that a combination of SED 3 with TD 3 (estimated to cost $154 million) and a combination of FP 3 with TD 3 (estimated to cost $30 million) are the most cost-effective combinations of alternatives. For those reasons and based on the detailed analyses in the specific comparative evaluation sections, GE has concluded that – taking into account EPA's HHRA and ERA and using EPA's directives for the CMS, as required – a combination of alternatives SED 3, FP 3, and TD 3 is best suited to meet the General Standards of the Permit in consideration of the Selection Decision Factors, including balancing of those factors against one another.

This combination of alternatives would involve the removal of approximately 167,000 cy of river sediments and erodible bank soils over 42 acres of the River, thin-layer capping of another 97 acres of river bottom, removal of approximately 60,000 cy of floodplain soil over

38 acres, and disposition of the removed materials within a secure Upland Disposal Facility that would be constructed in an area, to be selected, near the River but outside the 100-year floodplain. It is estimated that, following design and preparatory work, this combination of alternatives could be implemented within a 10-year period and, based on the cost estimates presented in Section 8, would cost approximately $184 million.[191] However, given GE's reservations of rights noted above, this Report does not constitute a proposal to implement these alternatives.

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[191] In Section 8, the costs were estimated separately for (1) combinations of sediment and associated treatment/disposition alternatives and (2) combinations of floodplain soil and associated treatment/disposition alternatives. If the sediment and floodplain soil remediation were implemented in coordination, it is likely that additional efficiencies would be realized.

10. References

AMEC and BBL. 2003. Comments of the General Electric Company on the U.S. Environmental Protection Agency's Human Health Risk Assessment for the Housatonic River Site - Rest of River. Prepared by AMEC Earth and Environmental, Inc. and BBL Sciences, Inc. July 28.

AMEC and BBL. 2005. Comments of the General Electric Company on the Human Health Risk Assessment for the General Electric/Housatonic River Site, Rest of River (February 2005). Prepared by AMEC Earth and Environmental, Inc. and BBL Sciences, Inc. April.

ARCADIS BBL. 2007. Site Characterization Report, Former Rockwell Facility, Russellville, Kentucky, October 2007.

ARCADIS BBL. 2008. Pilot Study Report for Silver Lake Sediments. January 2008.

ARCADIS BBL and QEA. 2007a. Housatonic Rest of River Corrective Measures Study Proposal, February 2007.

ARCADIS BBL and QEA. 2007b. Housatonic Rest of River Model Input Addendum, April 2007.

ARCADIS BBL and QEA. 2007c. Housatonic Rest of River Model Input Addendum Supplement, August 2007.

BBL. 1995. Construction Documentation Report Ruck Pond Sediment Removal Action, Mercury Marine, Fond du Lac, Wisconsin, August 1995.

BBL. 1998. Feasibility Study Report – Volume I, Sheboygan River and Harbor Site, Sheboygan, Wisconsin, April 1998.

BBLES. 1996. St. Lawrence River Sediment Removal Project Remedial Action Completion Report, General Motors Powertrain, Massena, New York, June 1996.

BBL and QEA. 2003. RCRA Facility Investigation Report — Rest of River (RFI Report). Prepared for General Electric Company, Pittsfield, MA, September 2003.

BBL Sciences, ARCADIS G&M, Branton Environmental Consulting and LWB Environmental Services. 2003. Comments of General Electric Company on the Ecological Risk Assessment for the General Electric/Housatonic River Site, Rest of River (July 2003 Draft). September.

BBL Sciences, ARCADIS G&M, Branton Environmental Consulting, and LWB Environmental Services. 2005. Comments of General Electric Company on the Ecological Risk Assessment for the General Electric/Housatonic River Site. Rest of River (November 2004 Draft). January.

Biedenharn, D.S., C.M. Elliot, and C.C. Watson. 1997. The WES Stream Investigation and Streambank Stabilization Handbook. U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS.

Blossey, B. 2003. A framework for evaluating potential ecological effects of implementing biological control of *Phragmites australis*. Estuaries, 26: 607-617.

Boonstra, R., and L. Bowman. 2003. Demography of short-tailed shrew populations living on polychlorinated biphenyl–contaminated sites. Environmental Toxicology and Chemistry, 22:1394–1403.

Brannon, J., and M. E. Poindexter-Rollings. 1990. Consolidation and contaminant migration in a capped dredged material deposit. The Science of the Total Environment, 91: 115-126.

Brant, S.V. and G. Ortí. 2003. Phylogeography of the northern short-tailed shrew, *Blarina brevicauda* (Insectivora: Soricidae): Past fragmentation and post-glacial recolonization. Molecular Ecology, 12:1435-1449.

Brito, D., and M.D.L. Figueiredo. 2003. Minimum viable population and conservation status of the Atlantic Forest spiny rat (*Trinomys eliasi*). Biological Conservation, 112:153-158.

Burke, M.J.W., and J.P. Grime. 1996. An experimental study of plant community invisibility. Ecology. 77(3): 776–790.

Colburn, E.A. 2004. Vernal Pools, Natural History and Conservation. The McDonald & Woodward Publishing Company, Granville. OH.

Costanzo, G.R., T.T. Fendley, and J.R. Sweeney. 1983. Winter movements and habitat use by Wood Ducks in South Carolina. Proceedings Annual Conference of Southeast Association of Fish and Wildlife Agencies, 37: 67–78.

Cottrell, S.D., H. H. Prince, and P. I. Padding. 1990. Nest success, duckling survival, and brood habitat selection of Wood Ducks in a Tennessee riverine system. Proceedings 1988 North American Wood Duck Symposium (L. H. Fredrickson et al., eds.), St. Louis, MO, pp. 191–197.

Derrick, D.L. 2008. A Very Innovative Missouri River Stabilization/Habitat Restoration Project. Personal Communication, ERDC-U.S. Army Corps of Engineers, Vicksburg, MS.

EPA. 1988. CERCLA Compliance with Other Laws Manual: Interim Final. Office of Emergency and Remedial Response, Washington, DC. EPA/540/G-89/006. August 1988.

EPA. 1989. CERCLA Compliance with Other Laws Manual: Part II. Clean Air Act and other Environmental Statutes and State Requirements. Interim Final. Office of Emergency and Remedial Response, Washington, DC. EPA/540/G-89/009, OSWER Directive 9234.1-02. August 1989.

EPA. 1990a. National Oil and Hazardous Substances Pollution Contingency Plan. April 1990.

EPA. 1990b. ARAR Q's and A's: Compliance with Federal Water Quality Criteria. OSWER Publication 9234.2-09/FS. June 1990

EPA. 1992. EPA SITE Demonstration Bulletin EPA/540/MR-92/008. March 1992.

EPA. 1993. Resources Conservation Company B.E.S.T. Solvent Extraction Technology Applications Analysis Report EPA/540/AR-92/079. June 1993.

EPA. 1994a. Final Record of Decision for the Sangamo Weston/Twelvemile Creek/Lake Hartwell PCB Contamination Superfund Site – Operable Unit Two, Pickens, Pickens County, SC. June 1994.

EPA. 1994b. Record of Decision for Wyckoff/Eagle Harbor Superfund Site. East Harbor, WA. September 1994.

EPA. 1995. Placement Within Area of Contamination Guidance. EPA 530-R-95-002G. June 1995.

EPA. 1996. Assessment and Remediation of Contaminated Sediments (ARCS) Program, Estimating contaminant losses from components of remediation alternatives for contaminated sediments. EPA-905-R96-001, USEPA Great Lakes National Program Office, Chicago, IL.

EPA. 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. Office of Solid Waste and Emergency Response. EPA 540-R-97-006, OSWER Directive 9285.7-25. June 1997.

EPA. 1998. Abstracts of Remediation Case Studies EPA 542-R-98-010. September 1998.

EPA. 1999a. Issuance of Final Guidance: Ecological Risk Assessment and Risk Management Principles for Superfund. OSWER Directive 9285.7-28 P. October 1999.

EPA. 1999b. The Benefits and Costs of the Clean Air Act: EPA Report to Congress. November 1999.

EPA. 2000. Final Supplemental Investigation Work Plan for the Lower Housatonic River. Prepared by Weston Solutions, Inc., West Chester, PA, for the U.S. Army Corps of Engineers, New England District, and the U.S. Environmental Protection Agency, New England Region, February 2000.

EPA. 2003. SITE Technology Profiles, 11th Edition, EPA/540/R-03/501. September 2003.

EPA. 2004a. Modeling Framework Design: Modeling Study of PCB Contamination in the Housatonic River. Prepared by Weston Solutions, Inc., West Chester, PA, for the U.S. Army Corps of Engineers, New England District, and the U.S. Environmental Protection Agency, New England Region, April 2004.

EPA. 2004b. First Five-Year Review Report for the Fields Brook Superfund Site, June 2004.

EPA. 2004c. Record of Decision for Little Mississinewa River. Union City, IN, July 2004.

EPA. 2004d. Five-Year Review Report for Springfield Township Dump Superfund Site, September 2004.

EPA. 2004e. Ecological Risk Assessment for General Electric (GE)/Housatonic River Site, Rest of River. Prepared by Weston Solutions, Inc., West Chester, PA, for the U.S. Army Corps of Engineers, New England District, and the U.S. Environmental Protection Agency, New England Region. November 2004.

EPA, 2004f. Five-Year Review Report York Oil Superfund Site Moira, New York. November 2004.

EPA. 2004g. Model Calibration: Modeling Study of PCB Contamination in the Housatonic River. Prepared by Weston Solutions, Inc., West Chester, PA, for the U.S. Army Corps of Engineers, New England District, and the U.S. Environmental Protection Agency, New England Region, December 2004.

EPA. 2004h. Five-Year Review Report, Commencement Bay Nearshore/Tideflats Superfund Site, Tacoma, Washington, EPA Region 10, December 2004.

EPA. 2005a . Human Health Risk Assessment - GE/Housatonic River Site - Rest of River. Prepared by Weston Solutions, Inc., West Chester, PA, for the U.S. Army Corps of Engineers, New England District, and the U.S. Environmental Protection Agency, New England Region. February 2005.

EPA. 2005b. Responsiveness Summary to Public Comments on New Information – Ecological Risk Assessment for the GE/Housatonic River Site, Rest of River. Prepared by Weston Solutions, Inc., West Chester, PA, for the U.S. Army Corps of Engineers, New England District, and the U.S. Environmental Protection Agency, New England Region. March 2005.

EPA. 2005c. Responsiveness Summary to Public Comments on New Information – Human Health Risk Assessment for the GE/Housatonic River Site, Rest of River. Prepared by Weston Solutions, Inc., West Chester, PA, for the U.S. Army Corps of Engineers, New England District, and the U.S. Environmental Protection Agency, New England Region, June 2005.

EPA. 2005d. First Five-Year Review Report for the New Bedford Harbor Superfund Site, Bristol County, Massachusetts. Region 1, New England, September 2005.

EPA. 2005e. Contaminated Sediment Remediation Guidance for Hazardous Waste Sites. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. Washington, DC. EPA-540-R-05-012, December 2005.

EPA. 2005f. Fact Sheet: Cleanup Schedule Announced for Contaminated River and Creek. Kerr-McGee Kress Creek/West Branch DuPage River Site Kerr-McGee Sewage Treatment Plant Site, DuPage County, Illinois. August 2005.

EPA. 2005g. Regulatory Impact Analysis for the Final Clean Air Interstate Rule. March 2005.

EPA. 2006a. Model Validation: Modeling Study of PCB Contamination in the Housatonic River. Prepared by Weston Solutions, Inc., West Chester, PA, for the U.S. Army Corps of Engineers, New England District, and the U.S. Environmental Protection Agency, New England Region, March 2006.

EPA. 2006b. Final Model Documentation Report: Modeling Study of PCB Contamination in the Housatonic River. Prepared by Weston Solutions, Inc., West Chester, PA, for the

U.S. Army Corps of Engineers, New England District, and the U.S. Environmental Protection Agency, New England Region, November 2006.

EPA. 2006c. First Five-Year Review Report for Jack's Creek/Sitkin & Refining, Inc., Maitland, Mifflin County, PA. April 2006.

EPA. 2007. Citizens Coordinating Council Meeting Presentation, September 2007.

EPA and WDNR. 2007. Record of Decision Amendment, Operable Unit 2 (Deposit DD), Operable Unit 3, Operable Unit 4, and Operable Unit 5 (River Mouth), Lower Fox River and Green Bay Superfund Site, June 2007.

Federal Interagency Stream Restoration Working Group. 1998. Stream Corridor Restoration: Principles, Processes, and Practices. By the Federal Interagency Stream Restoration Working Group (15 Federal agencies of United States government), October 1998.

Federal Remediation Technologies Roundtable Technology Cost and Performance Database. 1995. Thermal Desorption at the Outboard Marine Corporation Superfund Site, Waukegan, IL, (http://costperformance.org/profile.cfm?ID=209&CaseID=209)

Federal Remediation Technologies Roundtable Technology Cost and Performance Database. 2003. Thermal Desorption at Industrial Latex Superfund Site, Wallington, New Jersey, (http://costperformance.org/profile.cfm?ID=348&CaseID=348).

Ferren, W.R. Jr. and D.M. Hubbard. 1996. Review of Ten Years of Vernal Pool Restoration and Creation in Santa Barbara, California. Pages 206 – 216 in Ecology, Conservation, and Management of Vernal Pool Ecosystems—proceedings from a 1996 conference. edited by C.W. Witham, E.T. Bauder, W.R. Ferren, Jr., and R. Ornduff. California Native Plant Society, Sacramento.

Fischenich, J. C. 2003. Effects of riprap on riverine and riparian ecosystems, ERDC/EL TR-03-4, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Florida Department of Environmental Protection. 2005. Kissimmee River Restoration Continues. June 24, 2005. Accessed at: <http://www.dep.state.fl.us/secretary/news/2005/06/0617_03.htm>.

Foster Wheeler Environmental Corporation. 2001. Final Annual Report – Baseline Ambient Air Sampling and Analysis, OU 1, New Bedford Harbor Superfund Site, March 2001.

Fredette, T. J., J.D. Germano, P.G. Kullberg, D.A. Carey, and P. Murray. 1992. Chemical Stability of Capped Dredged Material Disposal Mounds in Long Island Sound, USA. 1st International Ocean Pollution Symposium, Mayaguez, Puerto Rico. Chemistry and Ecology.

GE. 2003. Comments of the General Electric Company on EPA's Human Health Risk Assessment for the GE - Housatonic River Site - Rest of River. Presentation to the Peer Review Panel. General Electric Company, Pittsfield, MA. November 18.

GE. 2004a. Comments of the General Electric Company on the U.S. Environmental Protection Agency's Ecological Risk Assessment for the Housatonic River Site - Rest of River. Presentation to the Peer Review Panel. General Electric Company, Pittsfield, MA. January 13.

GE. 2004b. Caged Mussel Study – Upper ½-Mile Reach of the Housatonic River (GECD800). October 2004.

GE. 2006. Interim Media Protection Goals Proposal for the Housatonic River, Rest of River. Submitted by General Electric Company, Pittsfield, MA. Revised March 9, 2006.

Gernes, M.C. and J.C. Helgen. 2002. Indexes of Biological Integrity (IBI) for Large Depressional Wetlands in Minnesota. Minnesota Pollution Control Agency, St. Paul, MN.

Getz, L.L. 1989. A 14-year study of *Blarina brevicauda* populations in east-central Illinois. Journal of Mammalogy, 70:58-66.

Gilmer, D.S., I.J. Ball, L.M. Cowardin, J.E. Mathisen, and J.H. Riechmann. 1978. Natural cavities used by Wood Ducks in north-central Minnesota, Journal of Wildlife Management, 42: 288–298.

Hepp, G.R. and J. D. Hair. 1977. Wood Duck brood mobility and utilization of beaver pond habitats. Proceedings Annual Conference Southeast Association of Fish and Wildlife Agencies, 31: 216–225.

Hoeppel, R.E., T.E. Myers, and R.M. Engler. 1978. Physical and Chemical characterization of dredged material influents and effluents in confined land disposal areas, Technical Report D-78-24, USACE Waterways Experimental Station, Vicksburg, MS.

ITRC. 1998. Technical Requirements for On-site Thermal Desorption of Solid Media and Low Level Mixed Waste Contaminated with Mercury and/or Hazardous Chlorinated Organics, September 2.

ITRC. 2005. Characterization, Design, Construction, and Monitoring of Mitigation Wetlands. WTLND-2. Washington, D.C.

Jodoin, Y., C. Lavoie, P. Villeneuve, Theriault, J. Beaulieu, and F. Belzile. 2007. Highways as corridors and habitats for the invasive common reed *Phragmites australis* in Quebec, Canada. Journal of Applied Ecology (Online Early Articles). Doi:10.1111/j.1365-2664.2007.01362.x.

Jurik, T. W., S.-C. Wang, and A. G. van der Valk. 1994. Effects of sediment load on seedling emergence from wetland seed banks. Wetlands 14:159-165

Konig, C. 2004. Impacts of small amounts of sandy sediments on wetland soils and vegetation: Results from field and greenhouse studies. Wetlands 24:295-308

Lehmkuhl, J. 1984. Determining size and dispersion of minimum viable populations for land management planning and species conservation. Environmental Management 8:167-176.

Leonard, L., M. Posey, T. Alphin, L. Cahoon, and R. Laws. 2002. Sediment Recycling: Marsh Renourishment Through Dredge Material Disposal. NOAA/UNH Cooperative Institute for Coastal and Estuarine Environmental Technology

Lichko, L.E., and A.J.K. Calhoun. 2003. An Evaluation of Vernal Pool Creation Projects in New England: Project Documentation from 1991–2000. Environmental Management Vol. 32 (1): 141–151.

Lima, M., J.F. Merritt, and F. Bozinovic. 2002. Numerical fluctuations in the northern short-tailed shrew: evidence of non-linear feedback signatures on population dynamics and demography. Journal of Animal Ecology 71:159-172.

Lu, J.C.S., B. Eichenberger, M. Knezevic, and K.Y. Chen. 1978. Characterization of confined disposal area influent and effluent particulate and petroleum fractions, Technical Report D-78-16, USACE Waterways Experimental Station, Vicksburg, MS.

Malcolm Pirnie, Inc. and TAMS Consultants, Inc. 2004. Hudson River PCBs Superfund Site, Engineering Performance Standards, Appendix: Case Studies of Environmental Dredging Projects (Volume 5 of 5), April 2004.

Miller, J.R., and R.J. Hobbs. 2007. Habitat Restoration - Do We Know What We Are Doing? Restoration Ecology 15(3): 382-390.

Myers, T.E. 1991. Polychlorinated biphenyl levels in the Saginaw confined disposal facility during disposal operations, Fall 1987, Miscellaneous Paper EL-91-4, USACE Waterways Experimental Station, Vicksburg, MS.

Myers, T.E., D.E. Averett, T.J.Olin, M.R. Palermo, D.D. Reible, J.L. Martin, and S.C. McCutcheon. 1996. Estimating contaminant losses from components of remediation alternatives for contaminated sediments, EPA-905-R96-001, USEPA Great Lakes National Program Office, Chicago, IL.

NHESP. 2007. Photo Survey of Potential Vernal Pools in Massachusetts Natural Heritage and Endangered Species Program.

NRC. 2001. A Risk-Management Strategy for PCB-Contaminated Sediments. The National Academies Press., Washington, D.C.

NRC. 2007. Sediment Dredging at Superfund Megasites: Assessing the Effectiveness. The National Academies Press. Washington, D.C. June 2007.

OMB. 2003. Circular A-4: Regulatory Analysis. September 17.

ORDEQ. 2001. Record of Decision of Soil and Sediment at the Charleston Boatyard, Charleston, OR, May 2001.

Parr, D.E., M. D. Scott, and D.D. Kennedy. 1979. Autumn movements and habitat use by Wood Ducks in southern Illinois. Journal of Wildlife Management 43: 102–108.

QEA. 2007. Technical Memorandum: EFDC Remediation Code. May 14, 2007.

Ray, G. L. 2007. Thin layer disposal of dredged material on marshes: A review of the technical and scientific literature. ERDC/EL Technical Notes Collection (ERDC/EL TN-07-1), Vicksburg, MS: U.S. Army Engineer Research and Development Center

Rogers, T., and M.J. Costello. 2007. Wetland Caps, Remediation with Re-Use, Mitigation and Restoration.

Shaffer, M. L. 1981. Minimum population sizes for species conservation, BioScience 31: 131-134.

Sontag, J. 2008. BioGenesis Enterprises, Inc. Personal communication to Helen Douglas, ARCADIS, January 17, 2008.

Sumeri, A., T.J. Fredette, P.G.Kullberg, J.D. Germano, D.A. Carey, and P. Pechko. 1994. Sediment Chemistry Profiles of Capped Dredged Material Deposits Taken 3 to 11 Years after Capping. Dredging Research Technical Note DRP-5-09, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Sutter, G., and R. Francisco. 1996. Vernal pool creation in the Sacramento Valley: a review of the issues surrounding its role as a conservation tool. Pages 190 -194 in Ecology, Conservation, and Management of Vernal Pool Ecosystems—proceedings from a 1996 conference, edited by C.W. Witham, E.T. Bauder, W.R. Ferren, Jr., and R. Ornduff. California Native Plant Society, Sacramento.

Talbert, B., L.J. Thibodeaux and K.T. Valsaraj. 2001. Effectiveness of very thin soil layers in chemical release from bed sediment. Environmental Progress 20(2):103-107.

Thomas, C.D. 1990. What do real population dynamics tell us about minimum viable population sizes? Conservation Biology 4:324-327.

United States Department of Agriculture. 2008. Vegetation Restoration Recommendations Bottomland Hardwood Forests. Natural Resources Conservation Service. March 17, 2008 Accessed at: <http://www.pwrc.usgs.gov/wli/wrts1.htm>.

USACE. 1978. Executive Overview and Detailed Summary, Dredged Material Research Program Technical Report DS-78-22, USACE Waterways Experimental Station, Vicksburg, MS.

USACE. 1983. Engineering and Design – Dredging and Dredged Material Disposal, Engineer Manual EM-1110-2-5025, United States Army Corps of Engineers.

USACE. 1987. Engineering and Design – Confined Disposal of Dredged Material, Engineer Manual EM-1110-2-5027, United States Army Corps of Engineers. September 1987.

USACE. 2003. Great Lakes Confined Disposal Facilities. United States Army Corps of Engineers and United States Environmental Protection Agency. April 2003.

USACE. 2008. The Four Rs of Environmental Dredging: Resuspension, Release, Residual, and Risk. U.S. Army Corps of Engineers Engineer Research and Development Center. Environmental Laboratory ERDC/EL TR-08-4. January 2008.

USACE/EPA. 2000. Guide to Developing and Documenting Cost Estimates during the Feasibility Study.

USFS. 1971. Wildlife habitat management handbook, Southern Region. U.S. Department of Agriculture, U.S. Forest Service. FSH 2609.23 R.

USFWS. 1990. Policy and Guidelines for Planning and Coordinating Recovery of Threatened and Endangered Species. U.S. Department of Interior, Washington DC.

Weinstein, M.P. and J.H. Balletto. 1999. Does the common reed, *Phragmites australis*, affect essential fish habitat? Estuaries, 22: 793-802.

Weston. 2007. 2006 Annual Restoration Monitoring Report. 1½ -Mile Removal Reach, General Electric (GE)/Housatonic River Site, Environmental Remediation Contract, GE/Housatonic River Project, Pittsfield, Massachusetts. DCN: GE-021207-ADME. USACE and EPA. Contract No. DACW33-00-D-0006. February 2007.

Woodlot. 2002. Ecological Characterization of the Housatonic River. Prepared for U.S. Environmental Protection Agency, Region 1. Environmental Remediation Contract, General Electric (GE)/Housatonic River Project, Pittsfield, MA. September 2002.

Woodlot. 2007. Presentation to the Citizens Coordinating Council - Ecological Restoration Following a Sediment and Soil Removal Action, Lenox, MA. June 2007.

Wright, J. Tomlinson, T. Schueler, K. Cappiella, A. Kitchell, and D. Hirschman. 2006. Direct and Indirect Impacts of Urbanization on Wetland Quality. Office of Wetlands, Oceans and Watersheds. U.S. Environmental Protection Agency. Washington, DC

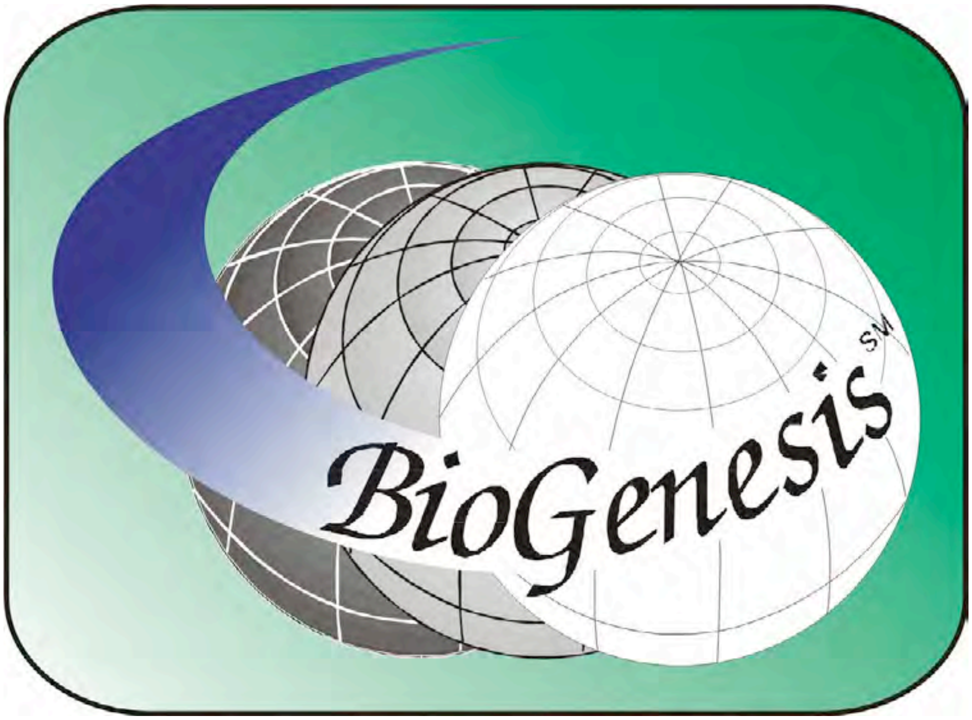
ARCADIS QEA

Appendix A

Chemical Extraction Treatability Study Report

BIOGENESIS^{SM} SEDIMENT WASHING TECHNOLOGY

Bench-Scale Treatability Study Report
Housatonic River – Rest-of-River Site



FINAL REPORT

13 March 2008

Prepared for:

ARCADIS
Syracuse, New York

BioGenesis Enterprises, Inc.
7420 Alban Station Blvd. Suite B-208 • Springfield, Virginia 22150 USA • TEL (703) 913-9700 • FAX (703) 913-9704

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1 INTRODUCTION

Presented in this Bench-Scale Treatability Study Report are the results of a bench-scale treatability test of the BioGenesis^{SM} Soil/Sediment Washing Technology on soil and sediment samples from the Housatonic River – Rest-of-River site. The work described in this Report was conducted by BioGenesis Enterprises, Inc. (BioGenesis) for ARCADIS (formerly ARCADIS BBL) on behalf of the General Electric Company (GE).

1.1 Background

The Housatonic River is located in the northeastern United States, in the western portion of Massachusetts and Connecticut. Numerous sampling and investigative activities conducted over the past 25 to 30 years have identified the presence of polychlorinated biphenyls (PCBs) at varying concentrations in the Housatonic River (River) and floodplains downstream of the GE facility in Pittsfield, Massachusetts. These activities have included investigations of the portion of the River known as the Rest-of-River area, which begins at the confluence of the East and West Branches of the River (the Confluence) (about two miles downstream of the GE facility) and flows through western Massachusetts and Connecticut. GE previously developed a *RCRA Facility Investigation Report* (RFI Report) for the Rest-of-River area to document the nature, extent, fate, and transport of PCBs that have potentially migrated from the GE facility in Pittsfield into the surface water, sediments, floodplain soils, and biota of the Rest-of-River area. GE is performing a Corrective Measures Study (CMS) to evaluate potential corrective measures (remedial actions) to address PCBs within the Rest-of-River area.

As part of the CMS, GE determined that it would be appropriate to conduct a bench-scale treatability study of a potential chemical extraction technology for sediment and soils of various types that may be removed from the River and/or floodplain in the Rest-of-River area. BioGenesis was contracted to perform bench-scale treatability tests of the BioGenesis^{SM} Soil/Sediment Washing Technology on two sediment samples and one floodplain soil sample containing PCBs from the Rest-of-River area.

The bench-scale testing was conducted in accordance with the BioGenesis Bench-Scale Treatability Study Work Plan (GE, 2007) and EPA's conditional approval letter dated July 31, 2007 (Work Plan). Testing include the following three stages:

- Preliminary examination and chemical formulation (jar testing);
- Process optimization testing; and
- Validation testing.

The results of this bench-scale treatability test are presented in this Report.

1.2 Objectives

The objectives of this bench-scale treatability study were to:

1. Evaluate the extent to which the BioGenesis^{SM} Soil/Sediment Washing Technology can reduce PCB concentrations in soil and sediment from the Rest-of-River area.

2. Provide an understanding of the disposition of PCBs through the various stages of the BioGenesis^{SM} Soil/Sediment Washing Process and of the process relationships and dependencies with other project factors (e.g., percent solids, storage capacity, and water treatment), so as to assist in evaluating this technology.

3. Provide sufficient information on the BioGenesis^{SM} Soil/Sediment Washing Technology to support the evaluation of the technology for full-scale implementation, including operational uptime, equipment needs and availability for the full-scale system, effectiveness and implementability of the technology at full-scale, and health and safety considerations, and to provide a basis for developing estimates of full-scale implementation costs.

2 BioGenesis^{SM} Soil/Sediment Washing Technology

The BioGenesis^{SM} Soil/Sediment Washing Technology is a patented low temperature decontamination process, which uses impact forces and a proprietary blend of chemicals to remove organic and inorganic contamination from soil and sediment particles. The technology, which was patented by BioGenesis in December 2001, is designed to decontaminate both coarse-grained (sand- and gravel-sized) and fine-grained (silt- and clay-sized) particles, by isolating individual particles and removing contaminants and naturally occurring organic material adsorbed to the particles. The result of the BioGenesis^{SM} process is a treated soil/sediment that can be disposed of or potentially used as a fill material or as a raw material in the production of topsoil or other construction grade products, depending on the results achieved and on obtaining any necessary regulatory approvals. A general schematic of the overall BioGenesis^{SM} Soil/Sediment Washing Process is illustrated in Figure 2-1. The following is a description of the individual processing steps:

1. **Soil/Sediment Preparation** – The initial step in the BioGenesis^{SM} Soil/Sediment Washing Process involves the preparation of the soil/sediment. The soil/sediment is screened to remove any rocks and debris greater than 25.4 mm (1 inch) in size using a shaker screen. The oversized material is rinsed on top of the screen and can be sorted and potentially recycled or disposed of appropriately. The material that passes through the 25.4-mm screen is then screened again to separate out the coarse sand and gravel (greater than 1 mm). The coarse-grained solids captured on the second screen are stored for processing through the Attrition Scrubbing/Aeration step, and the fine-grained solids (less than 1 mm) are stored separately for processing through the Bulk Organics Removal, Chemical Addition and Mixing, Application of Collision Forces, Organic Contaminant Oxidation, and Solid/Liquid Separation processing steps.

2. **Attrition Scrubbing/Aeration –** The coarse sand and gravel (greater than 1 mm) removed in the first step are treated using proprietary washing chemicals in an attrition scrubber. This unit uses powerful mixing blades to create particle-on-particle scrubbing

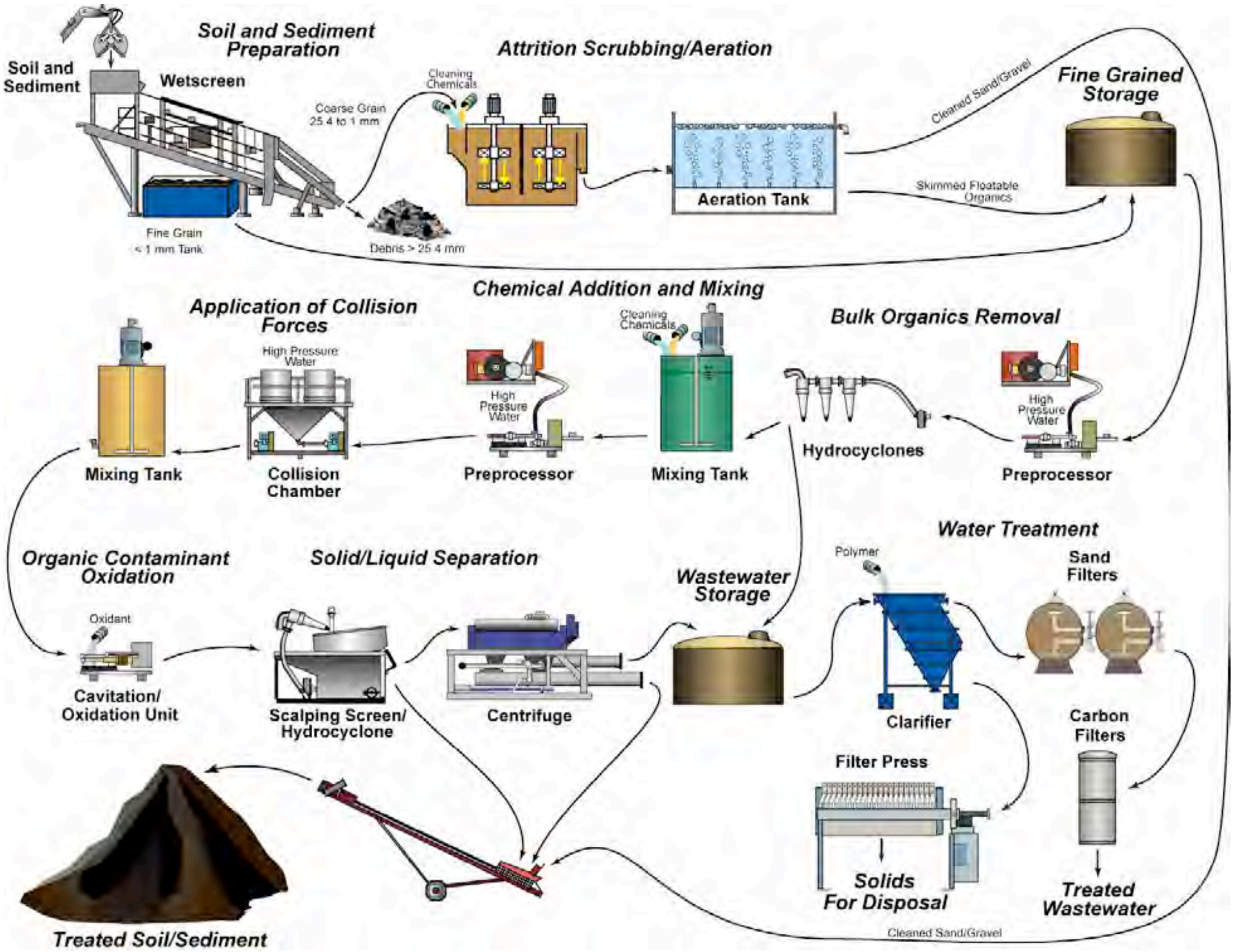

Figure 2-1 BioGenesis^{SM} Soil/Sediment Washing Technology

to remove fine silt/clays as well as adsorbed contaminants from the coarse sand and gravel. The proprietary washing chemicals are used to reduce the affinity between the contaminants and the soil/sediment particles. Aeration/flotation is then used to separate the lighter fine-grained silts/clays and the organic material from the washed coarse sand and gravel. The wash water containing the removed fine-grained silts/clays and organic material is added to the fine-grained solids from the first process step. The treated coarse sand and gravel is stockpiled prior to re-combining with the treated fine-grained material for final disposition.

3. **Bulk Organics Removal –** The material that passes through the 1-mm screen in the Soil/Sediment Preparation step and the wash water (containing silts, clays and organic material) from the Attrition Scrubbing/Aeration step are placed in a storage system before being processed through the Bulk Organics Removal step. In this step, the soil/sediment slurry is pumped to a BioGenesis Preprocessor unit, which uses physical forces applied through high-pressure water (up to 10,000 psi) to disaggregate the soil/sediment particles from each other and from the naturally occurring organic material. From the Preprocessor, the slurry is pumped to a series of hydrocyclones to concentrate the soil/sediment particles and remove the light naturally occurring organic material in an aqueous phase. The result at the end of the Bulk Organics Removal step is that a significant portion of the naturally occurring organic material has been removed from the system and that the clumped soil/sediment particles are disaggregated into the soil/sediment slurry along with any remaining naturally occurring organic material.

4. **Chemical Addition and Mixing –** The concentrated fine-grained soil/sediment slurry from the Bulk Organics Removal step is then mixed with proprietary specialty chemicals, such as surfactants and defoamers, to decrease the affinity among the contaminants, soil/sediment solids, and remaining naturally occurring organic material. The soil/sediment slurry with the washing chemicals is then pumped to a second BioGenesis Preprocessor unit in the Chemical Addition and Mixing step. The second Preprocessor uses physical forces applied through high-pressure water (up to 10,000 psi) from a second high pressure pump to aggressively mix the washing chemicals with the soil/sediment particles and prepare them for the Collision Chamber.

5. **Application of Collision Impact Forces –** The core-processing step of the BioGenesis^{SM} Soil/Sediment Washing Technology is the Application of Collision Impact Forces. The soil/sediment slurry from the Chemical Addition and Mixing step is pumped to the BioGenesis Collision Chamber where high-pressure water (up to 10,000 psi) from a third high pressure pump is used to create impact forces to strip the biofilm layer and adsorbed contaminants from the individual solid/sediment particles. After the BioGenesis

Collision Chamber, contamination that was adsorbed to the individual solid particles, as well as the naturally occurring organic material and biofilm, has been transferred to the aqueous phase.

6. **Organic Contaminant Oxidation –** Next, the soil/sediment slurry is pumped to the BioGenesis Cavitation/Oxidation unit where organic contaminants are destroyed using enhanced oxidation. Hydrogen peroxide, a strong oxidizing agent, is added to the sediment slurry upstream of the Cavitation/Oxidation unit. Cavitation, created within the BioGenesis Cavitation/Oxidation unit, occurs when air bubbles that are created in the slurry implode. The implosion of the air bubbles enhances the ability of hydrogen peroxide to oxidize organic molecules.

   Immediately after the Organic Contaminant Oxidation step, the slurry consists of:

   - Washed soil/sediment particles;
   - Residual organic materials in the aqueous phase that may still contain some organic and inorganic contaminants; and
   - Water that contains the un-oxidized organic contaminants desorbed from the soil/sediment solids and any remaining naturally occurring organic material.

7. **Solid/Liquid Separation –** Following the BioGenesis Organic Contaminant Oxidation step, the soil/sediment slurry is ready for Liquid/Solid Separation, which results in a treated solid fraction and a liquid fraction that contains residual un-oxidized organic contaminants, naturally occurring organic material, and residual fine-grained soil/sediment particles. Unless liquid/solid separation is performed shortly after the Organic Contaminant Oxidation step, the contaminant partitioning process will reinitiate between the treated solids and any remaining contaminants in the liquid. This means that any un-oxidized organic contaminants, which are suspended in the liquid fraction, are candidates to be re-adsorbed/scavenged onto the cleaned solid particles.

The Solid/Liquid Separation step includes several separation devices operated in series to remove different fractions of solids in decreasing order of grain sizes. First a scalping screen is used to remove the fine sand, then hydrocyclones in combination with a shaker screen are used to remove medium and coarse silt, and finally a centrifuge is used to remove fine silt and clay. The treated soil/sediment solids separated from the aqueous phase are then stockpiled prior to re-combining with the treated coarse-grained material for final disposition.

8. **Wastewater Treatment –** The wastewater from the solid/liquids separation step contains residual un-oxidized organic contaminants, naturally occurring organic material, and residual fine-grained soil/sediment particles. In a full-scale system, standard wastewater treatment processes are used to remove the contaminants from the wastewater to meet the applicable permit requirements prior to discharge to a local publicly owned treatment works or to a surface water body, if allowed under an applicable NPDES permit or other appropriate authorization. Alternatively, this wastewater could be containerized and transported for treatment and/or disposal at an appropriate off-site facility. (The treatment and disposal of wastewater generated during the bench-scale treatability study is discussed in Section 3.7)

9. **Disposition of Treated Solids –** The coarse-grained treated solids from the Attrition Scrubbing/Aeration step and the fine-grained treated solids from the Solid/Liquid Separation step are re-combined into the treated soil/sediment. The treated soil/sediment retains some of the physical characteristics of the untreated soil/sediment (i.e., grain size distribution, mineralogy, etc.) without the naturally occurring organic material and contaminants. Depending on the concentrations of residual contaminants in the treated soil/sediment, and obtaining necessary regulatory approvals, this material potentially may be suitable for re-use (e.g., as fill materials), or would be subject to other appropriate disposition. (The disposition of the treated soil/sediment from the bench-scale treatability study is discussed in Section 3.7).

3 Bench-Scale Testing

The bench-scale treatability testing of the BioGenesis^{SM} Soil/Sediment Washing Technology was conducted in the fall of 2007, in accordance with the Work Plan. The activities performed during the treatability study are discussed in the following subsections. The results of the bench-scale treatability study are discussed in Section 4 of this report.

3.1 Collection of Untreated Soil/Sediment Samples

In August 2007, ARCADIS collected samples of soil/sediment material from three separate locations in the Rest-of-River area as described in GE's *Materials Collection/Management Plan for Bench-Scale Treatability Study*. The sample locations were chosen to be representative of the range of physical characteristics typical of the Rest-of-River area sediments and floodplain soils and to generally contain higher concentrations of PCBs. The three samples were collected from:

- Coarse-grained sediment (TS-SED-A) – Sediment collected from Reach 5A just downstream of the confluence of the East and West Branches of the Housatonic River.
- Fine-grained sediment (TS-SED-B) – Sediment collected from Reach 6 (Woods Pond) near the eastern shore of the headwaters of Woods Pond.
- Fine-grained soils (TS-SO-A) – Soils collected from the eastern floodplain of the Housatonic River south of New Lenox Road.

The three samples were each collected in a 55-gallon drum, and transported to Building 12 at the GE Pittsfield Facility. Each sample was homogenized using a mortar mixer and returned to the 55-gallon drum for use in the bench-scale treatability tests. Samples were collected from each drum by advancing a sediment corer through the material and homogenizing the length of the core. Samples were analyzed for PCBs, total organic carbon (TOC), and grain size to provide a preliminary indication of the material characteristics. The analytical results for these initial samples are summarized in Table 3-1.

Table 3-1 Initial Untreated Soil/Sediment Characterization Sample Results

Sample Type: **Sample ID:** **Date Collected:**	**Coarse-grained Sediment** **TS-SED-A** **08/30/07**	**Fine-grained Sediment** **TS-SED-B** **08/30/07**	**Floodplain Soil** **TS-SO-A** **08/30/07**
PCBs (mg/kg)			
Aroclor-1248	5.6	22	ND (2.2)
Aroclor-1254	ND (1.2)	ND (4.6)	ND (2.2)
Aroclor-1260	30	85	50
Total PCBs	**35.6**	**107**	**50**
Total Organic Carbon (mg/kg)			
TOC - Replicate 1	4,800	91,000	44,000
TOC - Replicate 2	11,000	120,000	44,000
TOC - Replicate 3	6,000	81,000	45,000
TOC - Replicate 4	11,000	86,000	-
TOC - Average	**8,400**	**93,000**	**44,000**
TOC - % RSD	42%	18%	1.1%
Sieve and Hydrometer Analysis			
Gravel (> 2 mm)	23.0%	0.2%	0.1%
Sand (75 microns to 2 mm)	72.8%	14.1%	24.0%
Silt (3.9 to 75 microns)	4.2%	67.6%	55.1%
Clay (< 3.9 microns)		18.1%	20.8%

Note: Analytical results of additional samples of the untreated soil/sediment collected prior to each validation test run are discussed in Section 4

The grain size analysis showed the coarse-grained sediment (TS-SED-A) to be predominantly sand and gravel with 4.2% silt and clay. The fine-grained sediment (TS-SED-B) and floodplain soil (TS-SO-A) were predominantly silt with some sand and gravel (14.3% sand/gravel in the fine-grained sediment, and 24.1% in the floodplain soil) and some clay (18.1% clay in the fine-grained sediment and 20.8% clay in the floodplain soil). The analytical results showed PCB concentrations of 35.6 mg/kg in the coarse-grained sediment sample, 107 mg/kg in the fine-grained sediment sample, and 50 mg/kg in the floodplain soil sample. TOC results showed higher TOC concentrations in the fine-grained sediment sample (93,000 mg/kg) and floodplain soil sample (44,000 mg/kg) and lower TOC concentrations in the coarse-grained sediment sample (8,400 mg/kg). Additional samples were collected of the untreated soil/sediment prior to each test run during the bench scale study. These results are discussed in Section 4.

3.2 Bench-Scale Equipment Setup

Bench-scale testing was conducted by BioGenesis at Building 12 at the GE Pittsfield Facility from September 12, 2007 through November 17, 2007. Building 12 is a covered and enclosed building which has a cement floor with 6 inch concrete berms to prevent potential runoff, and which meets the TSCA PCB storage requirements set forth in 40 CFR 761.65(b).

The following bench-scale testing equipment was delivered to, and set up in, Building 12 at the GE Pittsfield Facility:

- processing tanks,
- attrition scrubber,
- aeration unit,
- feed pump,
- pre-processor,
- hydrocyclones,
- 10,000 psi water blaster,
- collision chamber,
- cavitation/oxidation unit,
- shaker screen,
- centrifuge,
- air compressor, and
- pressure filter.

Photographs of the equipment setup in Building 12 at the GE Pittsfield Facility are provided in Appendix A.

The bench-scale equipment has been designed by BioGenesis to perform tests on a limited volume of material (typically three to five gallons) for each run. The overall system is operated in batch mode with each processing step operated in a continuous mode. For example, in the Chemical Addition and Mixing step, the entire batch is pumped through the Preprocessor and into a holding tank. Then the entire batch is pumped through the Collision Chamber in the Application of Collision Forces step. This operational mode allows the individual processing steps to emulate full-scale operations without requiring a significant amount of material to operate the entire bench-scale system continuously. An effect of this operational mode is a loss of material (solids and liquids) during each processing step. This loss occurs when small quantities of material are left in the bottom of tanks, process equipment, pipes, hoses, etc. and would not occur in a full-scale, flow through operation. Calculations are conducted on the total amount of recovered material from the bench-scale treatability tests (i.e., without accounting for material loss) in order to represent the respective percentages of the processed material expected in a full-scale operation.

3.3 Preliminary Examination and Chemical Formulation

The initial step of the bench-scale treatability study was to perform jar tests using sub-samples from each soil/sediment source. These tests were performed to provide a qualitative evaluation of the interaction of the soil or sediment with cleaning chemicals. The evaluation gave insight to the settling characteristics of the soil/sediment particles, which is important to the operation of the liquid-solid separation process. In addition, the compatibility of cleaning chemicals with the mineralogy of the soil/sediment was observed.

The jar testing was performed by mixing the BioGenesis washing chemicals and soil or sediment in a beaker with a mechanical mixer, decanting the aqueous mixture from soil/sediment, chemically extracting treated and untreated material using hexane, and visually comparing the extractions to assess relative amounts of the organic components in each material. Based on the visual observations from the initial jar tests; BioGenesis selected the washing chemicals for evaluation during the optimization test runs. No samples were collected for chemical analysis during this step.

3.4 Process Optimization Testing

A total of 15 process optimization test runs were conducted to test the selected chemical formulations in the bench-scale equipment on the three soil/sediment sources. Process optimization test runs were conducted during two testing events; runs 1 through 8 were conducted between September 15th and September 21st, 2007, and runs 9 through 15 were conducted between October 2nd and October 10th, 2007. Each process optimization test run was conducted using three (3) to ten (10) gallons of soil/sediment test material, and varying amounts of water and washing chemicals. A total of four (4) test runs were conducted on TS-SED-A sediment, five (5) test runs on TS-SED-B sediment, and six (6) test runs on TS-SO-A soil.

BioGenesis collected samples of the untreated and treated soil/sediment solids and wastewater during the process optimization test runs. These samples were analyzed by Northeastern Analytical, Inc. (NEA) using EPA Method 8082 for PCB Aroclors and the Lloyd Kahn Method for TOC. A summary of the analytical results of samples collected during the process optimization test runs are presented in Appendix B.

The results of the process optimization test runs were used by BioGenesis to optimize the soil/sediment washing process in anticipation of conducting reproducible validation test runs. The data collected during the process optimization test runs were not used to evaluate the effectiveness of the BioGenesis^{SM} process.

3.5 Validation Test Runs

Based on the results of the process optimization test runs, BioGenesis determined the washing chemical doses and run conditions for the validation test runs. The purpose of the validation runs was to provide the data to be used to evaluate the effectiveness of the BioGenesis^{SM} Soil/Sediment Washing Technology at treating PCB concentrations in soil and sediment from the Rest-of-River area. Validation test runs consisted of three (3) treatment runs of each of the three test materials for a total of nine (9) test runs. To evaluate the effects of multiple treatment cycles on PCB concentrations, each test run consisted of three treatment cycles where the treated solids from the Liquid/Solid Separation step were recombined and processed two additional times. Test runs for each type of material were conducted the same way, under the same operating conditions and using the same proportions of water and washing chemicals (i.e., the three test runs for TS-SED-A were each run the same way).

During the preliminary examination and process optimization testing, it was determined that the three materials (TS-SED-A, TS-SED-B and TS-SO-A) had different physical characteristics, primarily grain size distribution. Based on these differences, certain process steps in the BioGenesis^{SM} Soil/Sediment Washing Process were omitted for the finer-grained material during the bench-scale treatability study because they were not required. For example, the Attrition Scrubbing/Aeration step was not included for the fine-grain sediment (TS-SED-B) and the floodplain soils (TS-SO-A) because there was very little medium/coarse sand and gravel (> 250 microns) present in these materials. Also, during the Solid/Liquid Separation step, the initial screening step to 75 microns was not needed for the fine-grain sediment (TS-SED-B) and floodplain soils (TS-SO-A) because there was very little fine sand present in these materials. In a full-scale system, if the three types of material were mixed into a single feed, all of the process steps would be conducted on the mixed feed material. The operating differences in the bench-scale treatability tests are illustrated in the process flow diagrams for each of the three materials (TS-SED-A, TS-SED-B, and TS-SO-A) presented in Figures 3-1, 3-2, and 3-3, respectively.

3.5.1 Sample Collection and Identification

To provide data for the evaluation process, samples were collected at various stages of each validation test run. Presented in Table 3-2 are the samples that were collected during the validation test runs, including the analyses and quality control (QC) samples. Sample results are presented and discussed in Section 4.

Approximately 10% of the samples collected during the validation test runs were split by USEPA representatives and sent to an independent laboratory for PCB analyses. The samples that were split are indicated on Table 3-2.

Untreated solids were homogenized using a mortar mixer and initial characterization samples were collected by advancing a sediment corer through the material and homogenizing the length of the core. Prior to each validation test run, the test material was removed from the homogenized drum into plastic containers and untreated solids samples were collected from the

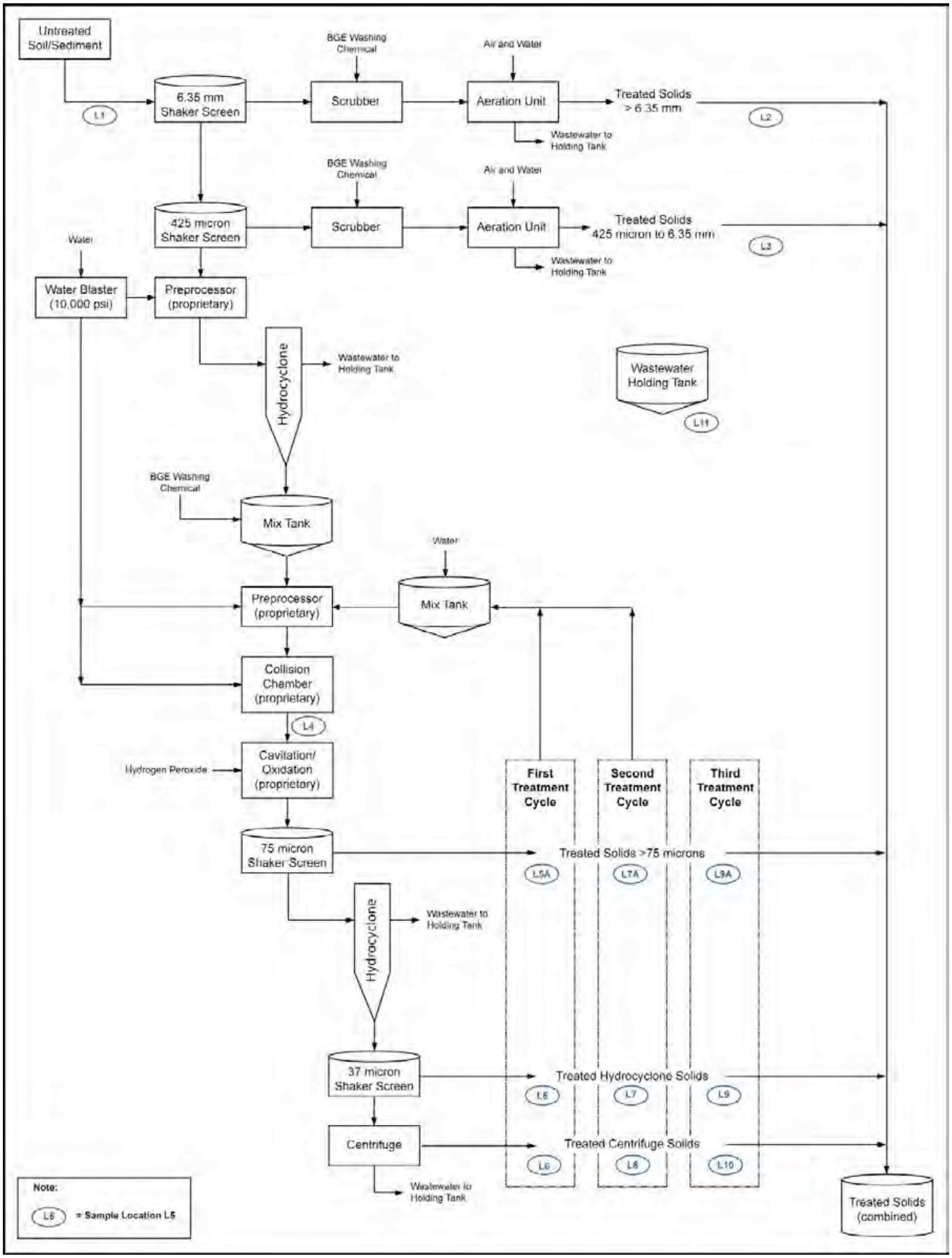

Figure 3-1 Bench-Scale Process Flow Diagram – Coarse-grained Sediment (TS-SED-A)

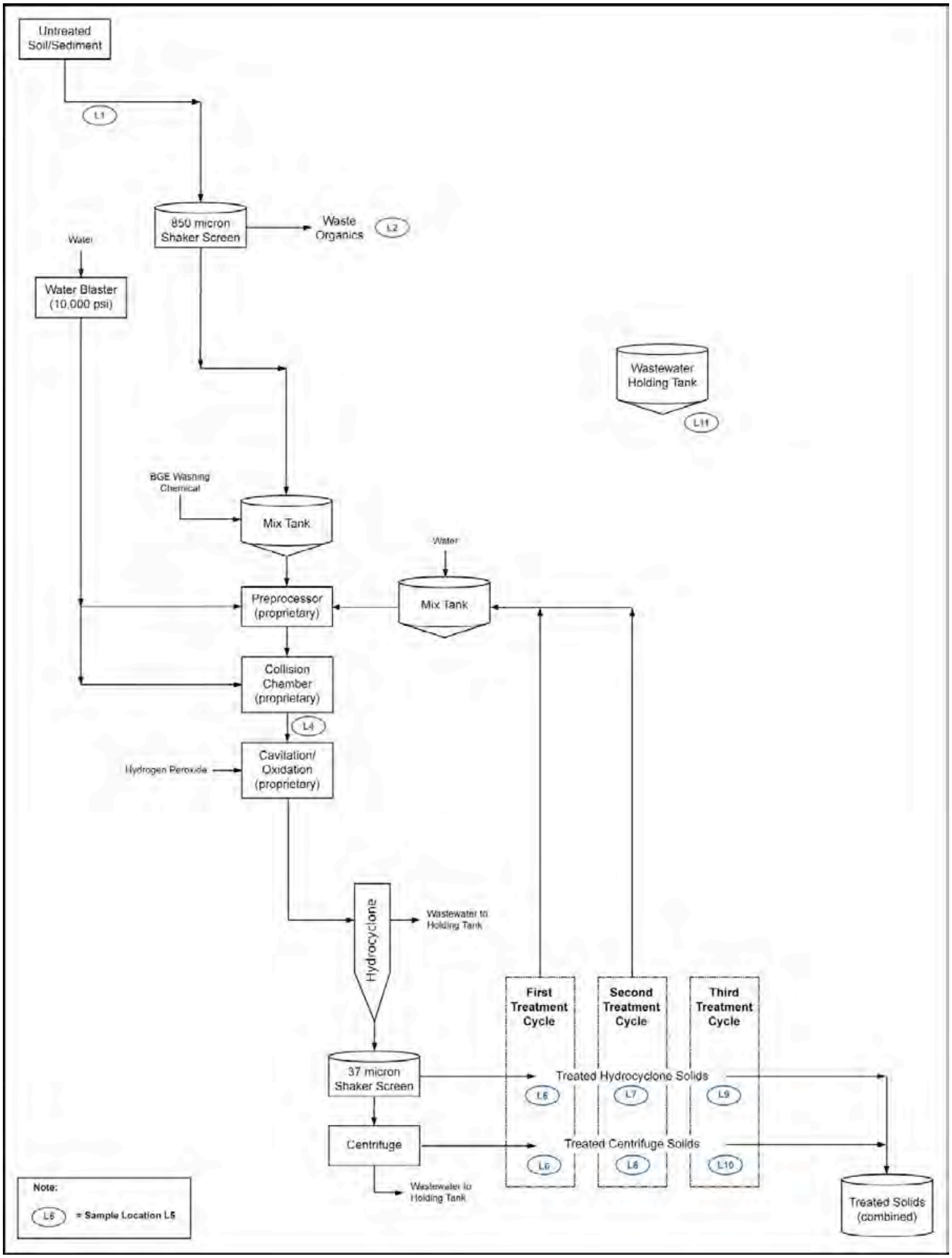

Figure 3-2 Bench-Scale Process Flow Diagram – Fine-grained Sediment (TS-SED-B)

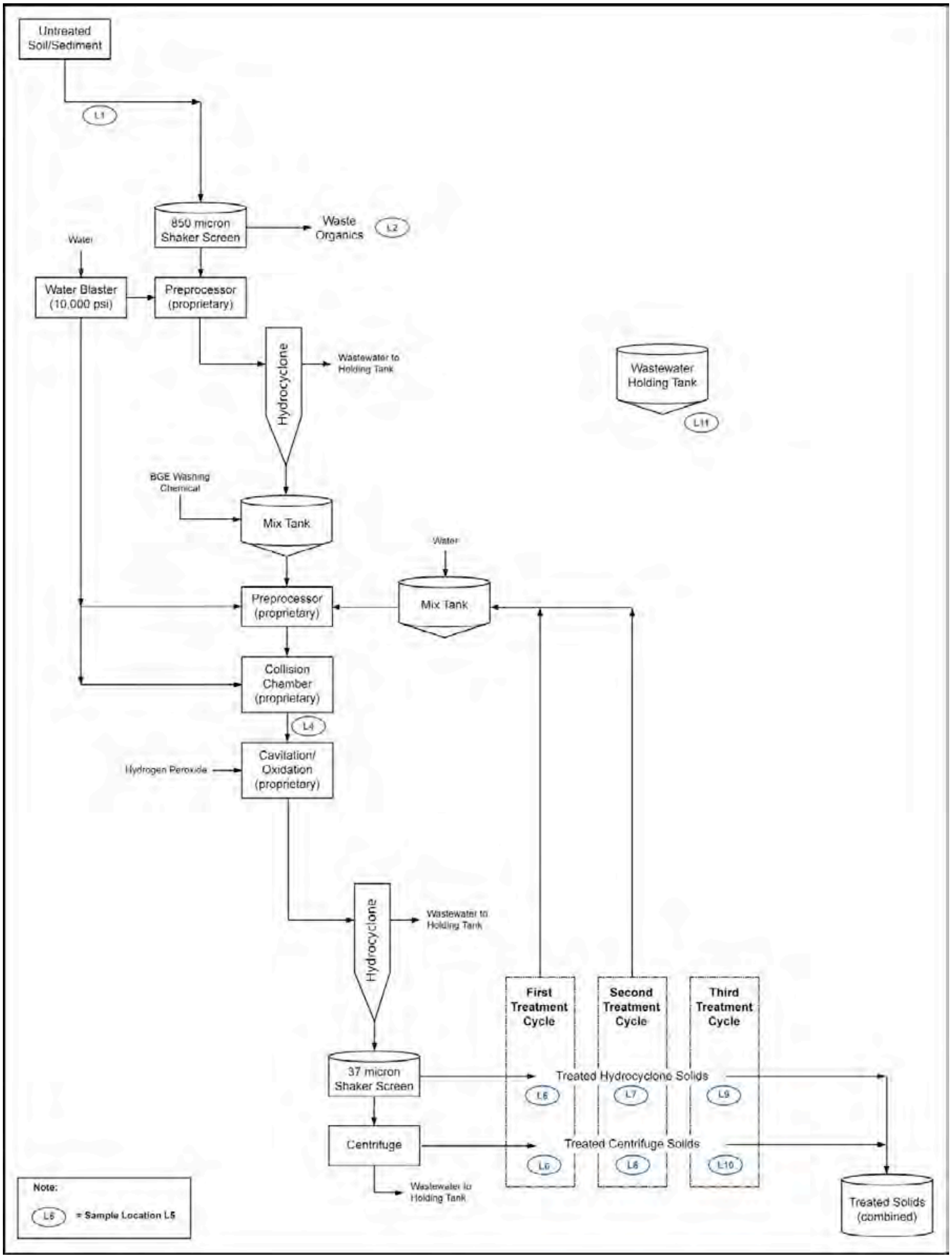

Figure 3-3 Bench-Scale Process Flow Diagram – Floodplain Soils (TS-SO-A)

Table 3-2 Validation Test Run Sampling and Analysis

						Solids Analyses					Aqueous Analyses			
Soil/Sediment Source	**Validation Run**	**Sample Location**	**Sample ID**	**Matrix**	**EPA SPLIT SAMPLE**	**PCB Aroclors SW846 Method 8082**	**PCB Congeners Green Bay Method**	**PCDD/DF SW 846 Method 8290**	**Grain Size Distribution ASTM Method D422**	**TOC Lloyd Kahn**	**PCB Aroclors SW846 Method 8082**	**TOC SW846 Method 9060**	**TSS EPA Method 160.1**	**TDS EPA Method 160.2**
1 - Coarse-grained sediment (TS-SED-A)	1	Untreated Soil/Sediment	B-S1-R1-L1-S	S		X	X	X	X	X				
		Treated Sediment - >6.35 mm	B-S1-R1-L2-S	S		X			X	X				
		Treated Sediment - 6.35 mm to 425 microns	B-S1-R1-L3-S	S		X			X	X				
		Treated Sediment - 6.35 mm to 425 microns	B-S1-R1-L3-2	QC - DUP		X			X	X				
		Treated Sediment - 6.35 mm to 425 microns	B-S1-R1-L3-S MS/MSD	QC - MS/MSD		X				X				
		Collision Chamber Solids - Solid Fraction	B-S1-R1-L4-S	S		X			X	X				
		Collision Chamber Solids - Aqueous Fraction	B-S1-R1-L4-A	A							X	X	X	X
		Collision Chamber Solids - Aqueous Fraction (filtered)	B-S1-R1-L4-AF	A							X			
		Treated Sediment - 75 to 425 microns	B-S1-R1-L5A-S	S		X			X	X				
		Treated Sediment - Hydrocyclone Solids	B-S1-R1-L5-S	S		X			X	X				
		Treated Sediment - Centrifuge Solids	B-S1-R1-L6-S	S	X	X			X	X				
		Treated Sediment - 75 to 425 microns	B-S1-R1-L7A-S	S		X			X	X				
		Treated Sediment - Hydrocyclone Solids	B-S1-R1-L7-S	S		X			X	X				
		Treated Sediment - Centrifuge Solids	B-S1-R1-L8-S	S		X			X	X				
		Treated Sediment - 75 to 425 microns	B-S1-R1-L9A-S	S		X	X	X	X	X				
		Treated Sediment - Hydrocyclone Solids	B-S1-R1-L9-S	S		X			X	X				
		Treated Sediment - Centrifuge Solids	B-S1-R1-L10-S	S		X			X	X				
		Wastewater - Aqueous	B-S1-R1-L11-A	A							X	X	X	X
		Wastewater - Aqueous	B-S1-R1-L11-2	QC - DUP							X		X	X
		Wastewater - Aqueous	B-S1-R1-L11-A MS/MSD	QC - MS/MSD							X			
		Wastewater - Aqueous (filtered)	B-S1-R1-L11-AF	A							X	X		
		Rinse Blank	B-S1-R1-L12-A	QC-EB							X		X	X
	2	Untreated Soil/Sediment	B-S1-R2-L1-S	S		X			X	X				
		Treated Sediment - >6.35 mm	B-S1-R2-L2-S	S		X			X	X				
		Treated Sediment - 6.35 mm to 425 microns	B-S1-R2-L3-S	S		X			X	X				
		Collision Chamber Solids - Solid Fraction	B-S1-R2-L4-S	S		X			X	X				
		Collision Chamber Solids - Aqueous Fraction	B-S1-R2-L4-A	A							X	X	X	X
		Collision Chamber Solids - Aqueous Fraction (filtered)	B-S1-R2-L4-AF	A							X			
		Treated Sediment - 75 to 425 microns	B-S1-R2-L5A-S	S		X				X				
		Treated Sediment - Hydrocyclone Solids	B-S1-R2-L5-S	S		X				X				
		Treated Sediment - Centrifuge Solids	B-S1-R2-L6-S	S		X				X				
		Treated Sediment - 75 to 425 microns	B-S1-R2-L7A-S	S		X				X				
		Treated Sediment - Hydrocyclone Solids	B-S1-R2-L7-S	S		X				X				
		Treated Sediment - Centrifuge Solids	B-S1-R2-L8-S	S		X				X				
		Treated Sediment - 75 to 425 microns	B-S1-R2-L9A-S	S	X	X	X	X	X	X				
		Treated Sediment - Hydrocyclone Solids	B-S1-R2-L9-S	S		X			X	X				
		Treated Sediment - Centrifuge Solids	B-S1-R2-L10-S	S		X			X	X				
		Treated Sediment - Centrifuge Solids	B-S1-R2-L10-2	QC - DUP		X								
		Treated Sediment - Centrifuge Solids	B-S1-R2-L10-S MS/MSD	QC - MS/MSD		X								
		Wastewater - Aqueous	B-S1-R2-L11-A	A							X	X	X	X
		Wastewater - Aqueous	B-S1-R2-L11-2	QC - DUP							X	X	X	X
		Wastewater - Aqueous	B-S1-R2-L11-A MS/MSD	QC - MS/MSD							X	X		
		Wastewater - Aqueous (filtered)	B-S1-R2-L11-AF	A							X	X		
		Rinse Blank	B-S1-R2-L11-AF	QC-EB							X		X	X
	3	Untreated Soil/Sediment	B-S1-R3-L1-S	S		X			X	X				
		Treated Sediment - >6.35 mm	B-S1-R3-L2-S	S		X				X				
		Treated Sediment - 6.35 mm to 425 microns	B-S1-R3-L3-S	S		X				X				
		Collision Chamber Solids - Solid Fraction	B-S1-R3-L4-S	S		X				X				
		Collision Chamber Solids - Aqueous Fraction	B-S1-R3-L4-A	A							X	X	X	X
		Collision Chamber Solids - Aqueous Fraction (filtered)	B-S1-R3-L4-AF	A							X			
		Treated Sediment - 75 to 425 microns	B-S1-R3-L5A-S	S		X				X				
		Treated Sediment - Hydrocyclone Solids	B-S1-R3-L5-S	S		X				X				
		Treated Sediment - Centrifuge Solids	B-S1-R3-L6-S	S		X				X				
		Treated Sediment - 75 to 425 microns	B-S1-R3-L7A-S	S		X				X				
		Treated Sediment - Hydrocyclone Solids	B-S1-R3-L7-S	S		X				X				
		Treated Sediment - Centrifuge Solids	B-S1-R3-L8-S	S		X				X				
		Treated Sediment - 75 to 425 microns	B-S1-R3-L9A-S	S		X	X	X	X	X				
		Treated Sediment - 75 to 425 microns	B-S1-R3-L9A-2	QC - DUP		X				X				
		Treated Sediment - 75 to 425 microns	B-S1-R3-L9A-S MS/MSD	QC - MS/MSD		X				X				
		Treated Sediment - Hydrocyclone Solids	B-S1-R3-L9-S	S		X			X	X				
		Treated Sediment - Centrifuge Solids	B-S1-R3-L10-S	S	X	X			X	X				
		Wastewater - Aqueous	B-S1-R3-L11-A	A							X	X	X	X
		Wastewater - Aqueous (filtered)	B-S1-R3-L11-AF	A							X	X		
		Wastewater - Aqueous	B-S1-R3-L11-2	QC - DUP							X			
		Wastewater - Aqueous	B-S1-R3-L11-A MS/MSD	QC - MS/MSD							X			
		Rinse Blank	B-S1-R3-L12-A	QC-EB							X		X	X

Table 3-2 Validation Test Run Sampling and Analysis (continued)

						Solids Analyses					Aqueous Analyses			
Soil/Sediment Source	Validation Run	Sample Location	Sample ID	Matrix	EPA SPLIT SAMPLE	PCB Aroclors SW846 Method 8082	PCB Congeners Green Bay Method	PCDD/DF SW 846 Method 8290	Grain Size Distribution ASTM Method D422	TOC Lloyd Kahn	PCB Aroclors SW846 Method 8082	TOC SW846 Method 9060	TSS EPA Method 160.1	TDS EPA Method 160.2
2 - Fine-grained sediment (TS-SED-B)	1	Untreated Soil/Sediment	B-S2-R1-L1-S	S		X	X	X	X	X				
		Waste Oversized - >850 microns	B-S2-R1-L2-S	S		X			X	X				
		Collision Chamber Solids - Solid Fraction	B-S2-R1-L4-S	S		X				X				
		Collision Chamber Solids - Aqueous Fraction	B-S2-R1-L4-A	A							X	X	X	X
		Collision Chamber Solids - Aqueous Fraction (filtered)	B-S2-R1-L4-AF	A							X	X		
		Treated Sediment - Hydrocyclone Solids	B-S2-R1-L5-S	S		X			X	X				
		Treated Sediment - Centrifuge Solids	B-S2-R1-L6-S	S		X			X	X				
		Treated Sediment - Hydrocyclone Solids	B-S2-R1-L7-S	S		X			X	X				
		Treated Sediment - Centrifuge Solids	B-S2-R1-L8-S	S		X			X	X				
		Treated Sediment - Hydrocyclone Solids	B-S2-R1-L9-S	S		X	X	X	X	X				
		Treated Sediment - Hydrocyclone Solids	B-S2-R1-L9-2	QC - DUP		X				X				
		Treated Sediment - Hydrocyclone Solids	B-S2-R1-L9-S MS/MSD	QC - MS/MSD		X				X				
		Treated Sediment - Centrifuge Solids	B-S2-R1-L10-S	S		X			X	X				
		Treated Sediment - Centrifuge Solids	B-S2-R1-L10-2	S		X			X	X				
		Treated Sediment - Centrifuge Solids	B-S2-R1-L10-S MS/MSD	S		X			X	X				
		Wastewater - Aqueous	B-S2-R1-L11-A	A							X	X	X	X
		Wastewater - Aqueous	B-S2-R1-L11-2	QC - DUP							X			
		Wastewater - Aqueous	B-S2-R1-L11-A MS/MSD	QC - MS/MSD							X			
		Wastewater - Aqueous (filtered)	B-S2-R1-L11-AF	A							X	X		
		Rinse Blank	B-S2-R1-L12-A	A							X		X	X
	2	Untreated Soil/Sediment	B-S2-R2-L1-S	S		X			X	X				
		Waste Oversized - >850 microns	B-S2-R1-L2-S	S		X				X				
		Collision Chamber Solids - Solid Fraction	B-S2-R2-L4-S	S		X			X	X				
		Collision Chamber Solids - Aqueous Fraction	B-S2-R2-L4-A	A							X	X	X	X
		Collision Chamber Solids - Aqueous Fraction (filtered)	B-S2-R2-L4-AF	A							X			
		Treated Sediment - Hydrocyclone Solids	B-S2-R2-L5-S	S	X	X				X				
		Treated Sediment - Centrifuge Solids	B-S2-R2-L6-S	S		X				X				
		Treated Sediment - Hydrocyclone Solids	B-S2-R2-L7-S	S		X				X				
		Treated Sediment - Centrifuge Solids	B-S2-R2-L8-S	S		X				X				
		Treated Sediment - Hydrocyclone Solids	B-S2-R2-L9-S	S	X	X	X	X	X	X				
		Treated Sediment - Centrifuge Solids	B-S2-R2-L10-S	S		X			X	X				
		Treated Sediment - Centrifuge Solids	B-S2-R2-L10-2	QC - DUP		X								
		Treated Sediment - Centrifuge Solids	B-S2-R2-L10-S MS/MSD	QC - MS/MSD		X								
		Wastewater - Aqueous	B-S2-R2-L11-A	A							X	X	X	X
		Wastewater - Aqueous (filtered)	B-S2-R2-L11-AF	A							X	X	X	X
		Wastewater - Aqueous (filtered)	B-S2-R2-L11-2	QC - DUP							X	X		
		Wastewater - Aqueous (filtered)	B-S2-R2-L11-AF MS/MSD	QC - MS/MSD							X	X		
		Rinse Blank	B-S2-R2-L12-A	QC-EB							X		X	X
	3	Untreated Soil/Sediment	B-S2-R3-L1-S	S		X			X	X				
		Waste Oversized - >850 microns	B-S2-R3-L2-S	S		X				X				
		Collision Chamber Solids - Solid Fraction	B-S2-R3-L4-S	S		X			X	X				
		Collision Chamber Solids - Aqueous Fraction	B-S2-R3-L4-A	A							X	X	X	X
		Collision Chamber Solids - Aqueous Fraction (filtered)	B-S2-R3-L4-AF	A							X			
		Treated Sediment - Hydrocyclone Solids	B-S2-R3-L5-S	S		X				X				
		Treated Sediment - Centrifuge Solids	B-S2-R3-L6-S	S		X				X				
		Treated Sediment - Hydrocyclone Solids	B-S2-R3-L7-S	S		X				X				
		Treated Sediment - Centrifuge Solids	B-S2-R3-L8-S	S		X				X				
		Treated Sediment - Hydrocyclone Solids	B-S2-R3-L9-S	S		X	X	X	X	X				
		Treated Sediment - Centrifuge Solids	B-S2-R3-L10-S	S	X	X			X	X				
		Treated Sediment - Centrifuge Solids	B-S2-R3-L10-2	QC - DUP		X			X					
		Treated Sediment - Centrifuge Solids	B-S2-R3-L10-MS/MSD	QC - MS/MSD		X								
		Wastewater - Aqueous	B-S2-R3-L11-A	A							X	X	X	X
		Wastewater - Aqueous (filtered)	B-S2-R3-L11-AF	A							X	X		
		Wastewater - Aqueous (filtered)	B-S2-R3-L11-2F	QC - DUP							X			
		Wastewater - Aqueous	B-S2-R3-L11-A MS/MSD	QC - MS/MSD							X			
		Rinse Blank	B-S2-R3-L12-A	QC-EB							X		X	X

Table 3-2 Validation Test Run Sampling and Analysis (continued)

						Solids Analyses					Aqueous Analyses			
Soil/Sediment Source	**Validation Run**	**Sample Location**	**Sample ID**	**Matrix**	**EPA SPLIT SAMPLE**	**PCB Aroclors SW846 Method 8082**	**PCB Congeners Green Bay Method**	**PCDD/DF SW 846 Method 8290**	**Grain Size Distribution ASTM Method D422**	**TOC Lloyd Kahn**	**PCB Aroclors SW846 Method 8082**	**TOC SW846 Method 9060**	**TSS EPA Method 160.1**	**TDS EPA Method 160.2**
3 - Floodplain soil (TS-SO-A)	1	Untreated Soil/Sediment	B-S3-R1-L1-S	S		X	X	X	X	X				
		Waste Oversized - >850 microns	B-S3-R1-L2-S	S		X				X				
		Collision Chamber Solids - Solid Fraction	B-S3-R1-L4-S	S		X			X	X				
		Collision Chamber Solids - Aqueous Fraction	B-S3-R1-L4-A	A							X	X	X	X
		Collision Chamber Solids - Aqueous Fraction (filtered)	B-S3-R1-L4-AF	A							X			
		Treated Sediment - Hydrocyclone Solids	B-S3-R1-L5-S	S		X	X	X	X	X				
		Treated Sediment - Hydrocyclone Solids	B-S3-R1-L5-S MS/MSD	QC - MS/MSD		X				X				
		Treated Sediment - Centrifuge Solids	B-S3-R1-L6-S	S		X			X	X				
		Treated Sediment - Centrifuge Solids	B-S3-R1-L6-2	QC - DUP		X			X	X				
		Treated Sediment - Hydrocyclone Solids	B-S3-R1-L7-S	S		X			X	X				
		Treated Sediment - Centrifuge Solids	B-S3-R1-L8-S	S		X			X	X				
		Treated Sediment - Hydrocyclone Solids	B-S3-R1-L9-S	S		X			X	X				
		Treated Sediment - Centrifuge Solids	B-S3-R1-L10-S	S		X			X	X				
		Wastewater - Aqueous	B-S3-R1-L11-A	A							X	X	X	X
		Wastewater - Aqueous	B-S3-R1-L11-2	QC - DUP							X		X	X
		Wastewater - Aqueous	B-S3-R1-L11-A MS/MSD	QC - MS/MSD							X			
		Wastewater - Aqueous (filtered)	B-S3-R1-L11-AF	A							X	X		
		Rinse Blank	B-S3-R1-L12-A	QC-EB							X		X	X
	2	Untreated Soil/Sediment	B-S3-R2-L1-S	S		X			X	X				
		Waste Oversized - >850 microns	B-S2-R1-L2-S	S		X				X				
		Collision Chamber Solids - Solid Fraction	B-S3-R2-L4-S	S		X			X	X				
		Collision Chamber Solids - Aqueous Fraction	B-S3-R2-L4-A	A							X	X	X	X
		Collision Chamber Solids - Aqueous Fraction (filtered)	B-S3-R2-L4-AF	A							X			
		Treated Sediment - Hydrocyclone Solids	B-S3-R2-L5-S	S		X	X	X	X	X				
		Treated Sediment - Hydrocyclone Solids	B-S3-R2-L5-2	QC - DUP		X	X	X						
		Treated Sediment - Hydrocyclone Solids	B-S3-R2-L5-S MS/MSD	QC - MS/MSD		X	X	X						
		Treated Sediment - Centrifuge Solids	B-S3-R2-L6-S	S		X			X	X				
		Treated Sediment - Hydrocyclone Solids	B-S3-R2-L7-S	S		X				X				
		Treated Sediment - Centrifuge Solids	B-S3-R2-L8-S	S	X	X				X				
		Treated Sediment - Hydrocyclone Solids	B-S3-R2-L9-S	S		X				X				
		Treated Sediment - Centrifuge Solids	B-S3-R2-L10-S	S		X				X				
		Wastewater - Aqueous	B-S3-R2-L11-A	A							X	X	X	X
		Wastewater - Aqueous	B-S3-R2-L11-2	QC - DUP							X		X	X
		Wastewater - Aqueous	B-S3-R2-L11-A MS/MSD	QC - MS/MSD							X			
		Wastewater - Aqueous (filtered)	B-S3-R2-L11-AF	A							X	X		
		Rinse Blank	B-S3-R2-L12-A	QC-EB							X		X	X
	3	Untreated Soil/Sediment	B-S3-R3-L1-S	S		X			X	X				
		Treated Sediment - >850 microns	B-S2-R1-L2-S	S		X				X				
		Collision Chamber Solids - Solid Fraction	B-S3-R3-L4-S	S		X			X	X				
		Collision Chamber Solids - Aqueous Fraction	B-S3-R3-L4-A	A							X	X	X	X
		Collision Chamber Solids - Aqueous Fraction (filtered)	B-S3-R3-L4-AF	A							X			
		Treated Sediment - Hydrocyclone Solids	B-S3-R3-L5-S	S	X	X	X	X	X	X				
		Treated Sediment - Centrifuge Solids	B-S3-R3-L6-S	S		X			X	X				
		Treated Sediment - Centrifuge Solids	B-S3-R3-L6-2	QC - DUP		X								
		Treated Sediment - Centrifuge Solids	B-S3-R3-L6-MS/MSD	QC - MS/MSD		X								
		Treated Sediment - Hydrocyclone Additional Treatment	B-S3-R3-L7-S	S	X	X				X				
		Treated Sediment - Centrifuge Additional Treatment	B-S3-R3-L8-S	S		X				X				
		Treated Sediment - Hydrocyclone Additional Treatment	B-S3-R3-L9-S	S		X				X				
		Treated Sediment - Centrifuge Additional Treatment	B-S3-R3-L10-S	S		X				X				
		Wastewater - Aqueous	B-S3-R3-L11-A	A							X	X	X	X
		Wastewater - Aqueous (filtered)	B-S3-R3-L11-AF	A							X	X		
		Wastewater - Aqueous	B-S3-R3-L11-2	QC - DUP							X			
		Wastewater - Aqueous	B-S3-R3-L11-A MS/MSD	QC - MS/MSD							X			
		Rinsate Blank	B-S3-R3-L12-A	QC-EB							X		X	X
Total Number of Samples					**11**	**117**	**16**	**16**	**63**	**105**	**67**	**34**	**34**	**34**

Table 3-2 Validation Test Run Sampling and Analysis
(continued)

Notes:

1. Matrix: S = Solid, A = Aqueous
2. PCB and TOC for solids will be reported with percent solids and on a dry weight basis.
3. One bottle blank will be collected for solids PCBs and TOC and one bottle blank will be collected for aqueous PCBs and TOC.
4. NEA will perform chemical analyses; Geotechnics will perform grain size analysis using sieve and hydrometer.
5. For TS-SED-A and TS-SED-B, wastewater sample (L11) will be taken following three treatment cycles (i.e., after samples L9 and L10). For TS-SO-A, wastewater sample (L11) will be taken following one treatment cycle (i.e., after samples L5 and L6).
6. The following sample identification system was used to label samples during sample collection: **B – S# – R# – L# – M**
   Where:
   - **B** = BioGenesis bench-scale treatability study
   - **S#** = Soil/sediment source (S1 = TS-SED-A, S2 = TS-SED-B, S3 = TS-SO-A)
   - **R#** = Run number (1 through 3) for each soil/sediment source
   - **L#** = Sample location (L1 through L12, see Figures 3-1, 3-2, and 3-3)
   - **M** = Sample matrix (S = solid, A = aqueous, AF = aqueous filtered, 2 = duplicate, MS/MSD = QC sample for MS/MSD)
7. Each sample location in the process (L1 through L12) is further described as follows:
   - **L1** – Untreated feed material (soil/sediment)
   - **L2** (for S1) – Treated solids greater than 6.35 mm [S1 = TS-SED-A]
   - **L2** (for S2 and S3) – Waste solids/organics [S2 = TS-SED-B, S3 = TS-SO-A]
   - **L3** – Treated solids greater than 425 microns and less than 6.35 mm
   - **L4** – Sample after the Collision Chamber (slurry separated into solid and aqueous portions using a pressure filter)
     - S – Solid fraction
     - A – Aqueous fraction
     - AF – Filtered aqueous fraction
   - **L5A** – Treated solids >75 microns after the first treatment cycle
   - **L7A** – Treated solids >75 microns after the second treatment cycle
   - **L9A** – Treated solids >75 microns after the third treatment cycle
   - **L5** – Treated solids from the hydrocyclones after the first treatment cycle
   - **L7** – Treated solids from the hydrocyclones after the second treatment cycle
   - **L9** – Treated solids from the hydrocyclones after the third treatment cycle
   - **L6** – Treated solids from the centrifuge after the first treatment cycle
   - **L8** – Treated solids from the centrifuge after the second treatment cycle
   - **L10** – Treated solids from the centrifuge after the third treatment cycle
   - **L11** – Wastewater for each run collected in a single tank (see Figures 3-1, 3-2, and 3-3)
     - A – Aqueous fraction
     - AF – Filtered aqueous fraction
   - **L12** – Rinse water collected prior to each test run

plastic containers prior to processing. Treated solid samples were collected after mixing and processing in the bench-scale equipment. The treated solids were collected in plastic buckets at each sample location, and samples were collected directly from these buckets into the collection containers.

Samples of the wastewater (L11) were collected after mixing the wastewater in the holding tank with a recirculation pump. An aliquot of the wastewater was collected in plastic buckets from the pump discharge and the samples were collected from these buckets directly into the sample collection containers. For the rinse water sample (L12) approximately 5 to 10 gallons of clean tap water was pumped through the cleaned process equipment in succession. The rinse water was collected in plastic buckets and the samples were collected from these buckets directly into the sample collection containers.

3.5.2 Laboratory Analyses

As mentioned earlier, three validation runs were conducted on the soil/sediment from each of the three locations. A total of 102 samples, excluding quality control samples, were collected during the validation test runs. Additional details regarding the numbers, locations, and analytes for these samples are provided in Table 3-2. Samples were collected and packaged in accordance with the project *Field Sampling Plan/Quality Assurance Project Plan* (FSP/QAPP) (ARCADIS BBL, 2007), and sent to GE's independent laboratories for analyses.

Solid samples were analyzed for the following and reported on a dry weight basis:

- PCB Aroclors – by EPA SW846 Method 8082
- PCB Congeners – by Green Bay Method
- Polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/DFs) – by EPA Method 8290
- Grain Size Distribution – by ASTM Method D422
- Total Organic Carbon (TOC) – by the Lloyd Kahn Method

Aqueous samples (filtered and unfiltered) were analyzed for:

- PCB Aroclors – by EPA SW846 Method 8082
- Total Suspended Solids (TSS) – by EPA Method 160.1
- Total Dissolved Solids (TDS) – by EPA Method 160.2
- TOC – by EPA SW846 Method 9060

Samples were analyzed on behalf of GE for PCBs, PCB Congeners, TOC, TSS, and TDS by Northeast Analytical, Inc. (NEA); for PCDD/DF by SGS Environmental Services; and for grain size with sieve and hydrometer by Geotechnics, Inc.

The analytical results for the USEPA split samples, as well as the results of the analyses performed on GE's behalf on the corresponding samples, are presented in Table 3-3.

3.5.3 QA/QC Samples

To provide measures of the quality of the data from the validation test runs, Quality Control (QC) samples were collected during the validation test runs. Laboratory quality control procedures, including reagent blanks, matrix spike and duplicate samples, instrument calibrations, internal and surrogate spiking solutions, were implemented in accordance with the project FSP/QAPP. The field duplicate and MS/MSD QC samples are identified in Table 3-2, and the results of the QA/QC samples are included in Appendix C.

Data were validated by ARCADIS in accordance with the FSP/QAPP and the final results are included in the Tables in Appendix C. Overall QC results indicate reproducibility between sample collection and analytical methods. Field duplicates for the same analyses agreed well and Aroclor results agreed well with the total homologue results and moderately well with EPA split sample data. In addition, a comparison of the analytical data collected during the three validation test runs on each material (discussed in Section 4) shows good repeatability between the runs.

Table 3-3 USEPA Split Sample Results and Corresponding GE Results

EPA Sample ID:	**H3-OT000492-0-7G30**	**H3-OT000491-0-7G30**	**H3-OT000490-0-7G30**	**H3-OT000495-0-7C26**	**H3-OT000498-0-7C31**	**H3-OT000501-0-7N01**
Location ID:	**TS-SED-A**	**TS-SED-B**	**TS-SO-A**	**B-S1-R1-L6-S**	**B-S1-R2-L9A-S**	**B-S1-R3-L10-S**
Date Collected:	**08/30/07**	**08/30/07**	**08/30/07**	**10/26/07**	**10/31/07**	**11/01/07**
EPA Split Sample Results – PCBs (mg/kg)						
Aroclor-1016, 1221, 1232, and 1242	ND (<6.5)	ND (<5.6)	ND (<4.9)	ND (<4.9)	ND (<2.2)	ND (<5.5)
Aroclor-1248	ND (<6.5)	8.5	ND (<4.9)	ND (<4.9)	ND (<2.2)	ND (<5.5)
Aroclor-1254	ND (<6.5)	24	8.3	ND (<4.9)	ND (<2.2)	9.3
Aroclor-1260	66	57	37	64	29	63
Total PCBs	**66**	**89.5**	**45.3**	**64**	**29**	**72.3**
Corresponding GE Sample Results – PCBs (mg/kg)						
Aroclor-1016, 1221, 1232, and 1242	ND (<1.2)	ND (<4.6)	ND (<2.2)	ND (<4.0)	ND (<0.62)	ND (<1.4)
Aroclor-1248	5.6	22	ND (<2.2)	ND (<4.0)	ND (<0.62)	ND (<1.4)
Aroclor-1254	ND (<1.2)	ND (<4.6)	ND (<2.2)	23	2.4	5.8
Aroclor-1260	30	85	50	120	22	36
Total PCBs	**35.6**	**107**	**50**	**143**	**24.4**	**41.8**

EPA Sample ID:	**H3-OT000493-0-7C25**	**H3-OT000494-0-7C26**	**H3-OT000497-0-7C30**	**H3-OT000496-0-7C29**	**H3-OT000499-0-7N02**	**H3-OT000500-0-7N02**
Location ID:	**B-S2-R2-L5-S**	**B-S2-R2-L9-S**	**B-S2-R3-L10-S**	**B-S3-R2-L8-S**	**B-S3-R3-L7-S**	**B-S3-R3-L5-S**
Date Collected:	**10/25/07**	**10/26/07**	**10/30/07**	**10/29/07**	**11/02/07**	**11/02/07**
EPA Split Sample Results – PCBs (mg/kg)						
Aroclor-1016, 1221, 1232, and 1242	ND (<1.4)	ND (<0.83)	ND (<1.6)	ND (<2.7)	ND (<0.43)	ND (<0.64)
Aroclor-1248	2.8	1.7	ND (<1.6)	ND (<2.7)	ND (<0.43)	ND (<0.64)
Aroclor-1254	7.4	4.0	9.7	5.3	0.90	1.3
Aroclor-1260	16	7.8	20	25	3.9	6.0
Total PCBs	**26.2**	**13.5**	**29.7**	**30.3**	**4.8**	**7.3**
Corresponding GE Sample Results – PCBs (mg/kg)						
Aroclor-1016, 1221, 1232, and 1242	ND (<0.81)	ND (<0.42)	ND (<0.90)	ND (<0.43)	ND (<0.19)	ND (<0.25)
Aroclor-1248	ND (<0.81)	ND (<0.42)	ND (<0.90)	ND (<0.43)	ND (<0.19)	ND (<0.25)
Aroclor-1254	4.2	2.2	4.9	ND (<0.43)	ND (<0.19)	ND (<0.25)
Aroclor-1260	16	8.5	18	12	4.2	6.5
Total PCBs	**20.2**	**10.7**	**22.9**	**12**	**4.2**	**6.5**

3.6 Equipment Decontamination

The bench-scale equipment was cleaned between test runs by removing visible liquids and solids from the process equipment, and flushing the equipment with BioGenesis’ proprietary washing chemicals and water. After decontamination, and prior to each validation test run, approximately 5 to 10 gallons of clean tap water were run through the bench-scale equipment, and a sample was collected of this rinse water. The rinse water sample was identified as sample location L12 and the results of these samples are summarized in Table C-1 in Appendix C. Very low concentrations of PCBs (less than 4 µg/L) were detected in the rinse water samples indicating that adequate decontamination was performed between test runs.

Following the completion of the bench-scale treatability tests, the non-disposable equipment was decontaminated prior to demobilization by flushing with BioGenesis' proprietary washing chemicals and water. After decontamination, the equipment was tested by collecting one wipe sample from each piece of equipment. The wipe samples were labeled "TS-W#" with W# being a unique number assigned to each piece of equipment. Samples were analyzed for PCBs by GE's independent laboratory.

The analytical results of the wipe sampling, summarized in Table 3-4, showed all wipe samples were less than 10 µg/100 cm^2. Based on these results, the equipment was determined to be decontaminated and acceptable for transportation from the site.

3.7 Residuals Disposal

Solids generated during the bench-scale treatability study, including untreated soil/sediment, treated soil/sediment, oversized material removed during screening, and other miscellaneous PCB-containing materials used in or resulting from the study, were sent for off-site disposal.

All water and wastewater generated during the bench-scale testing was treated in the Building 64G Groundwater Treatment Facility (GWTF) with EPA approval.

3.8 Health and Safety

The bench-scale treatability tests were conducted under the BioGenesis field Health and Safety Plan (HSP). No OSHA reportable incidents occurred during the bench-scale treatability tests.

Table 3-4 Equipment Decontamination Sampling Results

Sample ID	Sample Date	Sample Location	Matrix	Aroclor 1248 (ug/100 cm^2)	Aroclor 1260 (ug/100 cm^2)	Total PCBs (ug/100 cm^2)
TS-W2	11/02/07	Tank 2 - 30 gallon Collision Chamber Feed Tank	Wipe	ND (<0.50)	0.86	**0.86**
TS-W3	11/02/07	Tank 7 - 60 gallon Wastewater Tank and Prewash Cyclone Feed Tank	Wipe	ND (<0.50)	1.8	**1.8**
TS-W4	11/02/07	Tank 6 - 60 gallon Wastewater Tank and Prewash Cyclone Feed Tank	Wipe	ND (<0.50)	0.59	**0.59**
TS-W5	11/03/07	Tank 3 - 60 gallon Collision Chamber Feed Tank and Screener Underflow Tank	Wipe	ND (<0.50)	ND (<0.50)	**ND** (< 0.50)
TS-W6	11/03/07	Tank 4 - 60 gallon Cav/Ox Tank	Wipe	0.83	3.8	**4.63**
TS-W7	11/03/07	Tank 1 - 30 gallon Preprocessor Feed Tank	Wipe	1.6	7.5	**9.1**
TS-W8	11/03/07	Tank 5 - 60 gallon Screener Underflow Tank	Wipe	ND (<0.50)	2.2	**2.2**
TS-W9	11/03/07	Collision Chamber	Wipe	ND (<0.50)	ND (<0.50)	**ND (< 0.50)**
TS-W10	11/03/07	Shaker Screen	Wipe	ND (<0.50)	ND (<0.50)	**ND (< 0.50)**
TS-W11	11/03/07	Centrifuge	Wipe	ND (<0.50)	ND (<0.50)	**ND (< 0.50)**
TS-W12	11/03/07	Pressure Filter	Wipe	ND (<0.50)	ND (<0.50)	**ND (< 0.50)**
TS-W13	11/03/07	Tank 8 - 1000 L Wastewater Tank	Wipe	ND (<0.50)	ND (<0.50)	**ND (< 0.50)**
TS-W14	11/03/07	Pump	Wipe	ND (<0.50)	0.59	**0.59**

4 Discussion of Results

Between October 23rd and November 1, 2007, three validation test runs were conducted on each of the three soil/sediment aliquots for a total of nine validation test runs. Samples were collected to determine PCB concentrations in the soil/sediment at various stages throughout each validation run as described in Section 3. Operational data was also collected to monitor operating conditions and track mass flow during the validation test runs. The results are discussed in the following subsections.

4.1 Coarse-Grained Sediment (TS-SED-A)

4.1.1 Process Conditions

Three validation test runs, identified as **B–S1–R1**, **–R2**, and **–R3,** were conducted on the coarse-grained sediment (TS-SED-A). For each validation test run, 38 to 44 liters of untreated sediment were processed through the BioGenesis^{SM} Soil/Sediment Washing Process (see the process flow diagram in Figure 3-1). This sample volume was larger than the volumes used for testing the other two types of material to ensure a sufficient amount of fine-grained material (silts/clays) was present in the sample to have a representative amount of material in the Solid/Liquid Separation step.

The untreated sediment was sampled prior to each test run (sample location L1) and then screened using a 6.35 mm screen. The solids captured on the screen (>6.35 mm) were rinsed on the screen, then collected in plastic buckets and weighed. Due to the size limitation of the bench-scale attrition scrubber and aeration unit, a two (2) kg representative sample of the greater than 6.35 mm solids was treated during the bench-scale treatability tests. The material was processed with BioGenesis specialty washing chemicals in the attrition scrubber and was then rinsed and aerated in the aeration unit to remove fines, organic contaminants, and naturally occurring organic material. The treated solids were weighed and sampled (sample location L2). The rinse water with the fines, organic contaminants, and naturally occurring organic material was placed in the wastewater tank.

The material that passed through the 6.35-mm screen was screened again using a 425-micron screen (40 mesh). The solids captured on the screen (<6.35 mm and >425 microns) were rinsed on the screen, then collected in plastic buckets and weighed. Again, due to the size limitation of the bench-scale attrition scrubber and aeration unit, a two (2) kg representative sample of the less than 6.35 mm and greater than 425 micron solids was treated during the bench-scale treatability tests. The material was processed with BioGenesis specialty washing chemicals in the attrition scrubber and was then rinsed and aerated in the aeration unit to remove fines, organic contaminants, and naturally occurring organic material. The treated solids were weighed and sampled (sample location L3). The rinse water with the fines, organic contaminants, and naturally occurring organic material was added to other wastewater in the wastewater tank.

The solids and liquids passing through the 425-micron screen were processed through the Bulk Organics Removal step. The BioGenesis Preprocessor and a series of hydrocyclones are used in this step to concentrate the solids and remove the light organic materials in an aqueous phase. The slurry with the concentrated solids from the underflow of the hydrocyclones was processed through the Chemical Addition and Mixing, Application of Collision Forces, and Organic Contaminant Oxidation steps. The cleaned solids were then separated from the aqueous phase in the Solid/Liquid Separation step. This consists of a 75-micron (200 mesh) shaker screen (sample location L5A), followed by hydrocyclones over a 37-micron (400 mesh) shaker screen (sample location L5), and then a centrifuge (sample location L6). The recovered solids from each unit were weighed and sampled. Wastewater from the Solid/Liquid Separation step (hydrocyclones overflow and centrifuge centrate) was added to other wastewater in the wastewater tank.

To evaluate the effects of multiple treatment cycles on the PCB concentrations, the treated solids from the Liquid/Solid Separation step were recombined and processed two additional times. The solids recovered from the 75-micron (200 mesh) shaker screen (sample location L5A), hydrocyclones (sample location L5), and centrifuge (sample location L6) were weighed, recombined into a single sample, and mixed with water. The recombined slurry was processed through the BioGenesis Preprocessor and through the Application of Collision Forces, Organic Contaminant Oxidation, and Solid/Liquid Separation steps two more times. The treated solids from the second treatment cycle were weighed and sampled (sample locations L7A, L7, and L8), and the process was repeated for the third treatment cycle (sample locations L9A, L9, and L10). The wastewater from the Solid/Liquid Separation steps from the second and third treatment cycles was placed in the wastewater tank with the wastewater from the first treatment cycle and the Attrition Scrubbing/Aeration step. The wastewater was mixed by pumping it in a recirculation mode and sampled (sample location L11).

4.1.2 Analytical Data and Mass Balance Calculations

Presented in Tables 4-1, 4-2, and 4-3 are summaries of the analytical results and mass balance calculations for each of the three validation test runs on the coarse-grained sediment (TS-SED-A). The untreated sediment (sample location L1) ranged in PCB concentrations from 62.6 to 80 mg/kg.

Following one treatment cycle, the treated sediment was sampled as described above in five grain size fractions: greater than 6.35 mm (sample location L2), 425 microns to 6.35 mm (sample location L3), 75 to 425 microns (sample location L5A), the hydrocyclone solids (sample location L5), and the centrifuge solids (sample location L6). The analytical results and weights of recovered material for each of these fractions are provided in the tables. The results of the calculations of the mass of recovered solids in each fraction, the mass of PCBs in each fraction, and the weighted concentration of the combined treated sediment are also provided. The concentration of PCBs in the fraction greater than 6.35 mm (sample location L2) ranged from 0.079 to 0.68 mg/kg. The concentration of PCBs in the 425 micron to 6.35 mm fraction (sample location L3) ranged from 2.68 to 24.69 mg/kg. The concentration of PCBs in the 75 and 425 microns fraction (sample location L5A) ranged from 40.3 to 49.8 mg/kg. The concentration of PCBs in the hydrocyclone fraction (sample location L5) ranged from 54.7 to 60 mg/kg. The concentration of PCBs and in the centrifuge fraction (sample location L6) ranged from 133 to 143 mg/kg. On average, approximately 92% of the solids recovered from treatment of the coarse-grained sediment (TS-SED-A) were sand and gravel (>75 microns) as measured after one treatment cycle. Approximately 7% of the solids recovered were less than 75 microns; and

Table 4-1 Coarse-grained Sediment (TS-SED-A) Validation Test Run 1

	Sample ID	PCB Concentration[1]		Percent Solids[1]	Total Weight[1] (kg)	Total Volume[1] (L)	Mass of Solids[2] (kg)	Percent of Recovered Solids[3]	Mass of PCBs[4] (mg)
Run B-S1-R1 (Reach 5A Sediment)									
Untreated Sediment	B-S1-R1-L1-S	**74**	mg/kg	77%	68.0	38.0	52.4	-	3,874.6
Calculated Density of Untreated Sediment (Mass of Solids/Total Volume)							1.79	kg/L	
Treated Sediment after First Treatment Cycle									
greater than 6.35 mm	B-S1-R1-L2-S	0.079	mg/kg	98%	2.4	-	2.4	5.5%	0.2
425 microns to 6.35 mm	B-S1-R1-L3-S	2.68	mg/kg	81%	41.7	-	33.8	78.6%	90.5
75 to 425 micron	B-S1-R1-L5A-S	40.3	mg/kg	75%	5.3	-	4.0	9.2%	160.2
hydrocyclone solids	B-S1-R1-L5-S	60	mg/kg	67%	1.5	-	1.0	2.3%	60.3
centrifuge solids	B-S1-R1-L6-S	143	mg/kg	62%	2.5	-	1.6	3.6%	221.7
Totals		**12.5**	**mg/kg (weighted)**			-	**42.7**	**99.2%**	**532.9**
Total Solids/PCBs Recovered after One Treatment Cycle[5]							43.0	-	930.4
Amount of Solids/PCBs Lost (-) Across Bench Equipment after One Treatment Cycle[6]							-17.9%	-	-76.0%
Treated Sediment after Second Treatment Cycle									
greater than 6.35 mm[7]	B-S1-R1-L2-S	0.079	mg/kg	98%	2.4	-	2.4	5.8%	0.2
425 microns to 6.35 mm[7]	B-S1-R1-L3-S	2.68	mg/kg	81%	41.7	-	33.8	83.7%	90.5
75 to 425 micron	B-S1-R1-L7A-S	34.7	mg/kg	73%	3.0	-	2.2	5.4%	76.0
hydrocyclone solids	B-S1-R1-L7-S	207	mg/kg	62%	0.5	-	0.3	0.8%	64.1
centrifuge solids	B-S1-R1-L8-S	96	mg/kg	62%	1.7	-	1.1	2.6%	101.2
Totals		**8.4**	**mg/kg (weighted)**			-	**39.7**	**98.4%**	**332.0**
Total Solids/PCBs Recovered after Two Treatment Cycles[5]							40.3	-	1,127.1
Estimated Amount of Solids/PCBs Lost (-) Across Bench Equipment after Two Treatment Cycles[6]							-23.0%	-	-70.9%
Treated Sediment after Third Treatment Cycle									
greater than 6.35 mm[7]	B-S1-R1-L2-S	0.079	mg/kg	98%	2.4	-	2.4	6.0%	0.2
425 microns to 6.35 mm[7]	B-S1-R1-L3-S	2.68	mg/kg	81%	41.7	-	33.8	86.9%	90.5
75 to 425 micron	B-S1-R1-L9A-S	23.9	mg/kg	62%	1.5	-	0.9	2.4%	22.2
hydrocyclone solids	B-S1-R1-L9-S	79	mg/kg	73%	0.420	-	0.3	0.8%	24.2
centrifuge solids	B-S1-R1-L10-S	73	mg/kg	72%	0.735	-	0.5	1.4%	38.6
Totals		**4.6**	**mg/kg (weighted)**			-	**37.9**	**97.5%**	**175.8**
Total Solids/PCBs Recovered after Three Treatment Cycles[5]							38.9	-	1,368.5
Estimated Amount of Solids/PCBs Lost (-) Across Bench Equipment after Three Treatment Cycles[6]							-25.7%	-	-64.7%
Waste Streams									
oversized organics	Not Sampled	-		-	-	-	-	-	-
wastewater	B-S1-R1-L11-A/AF	1,520	ug/L	1,260 mg/L TSS		784.7	1.0	-	1,192.7
Totals							**1.0**	**-**	**1,192.7**

Notes:

1. Measured value (not calculated).
2. Mass of Solids = Total Weight x Percent Solids, or Total Volume x TSS.
3. Percent of Solids Recovered = Mass of solids/Total Mass of solids recovered after treatment cycle.
4. Mass of PCBs = PCB concentration x Mass of Solids.
5. Total Mass of Solids/PCBs Recovered after One Treatment Cycle = Sum of Mass of Solids/PCBS in Treated Sediment + 1/3 of Total Mass of Solids/PCBs in Waste Streams. Total Mass of Solids/PCBs Recovered after Two Treatment Cycles = Sum of Mass of Solids/PCBS in Treated Sediment + 2/3 of Total Mass of Solids/PCBs in Waste Streams. Total Mass of Solids/PCBs Recovered after Three Treatment Cycles = Sum of Mass of Solids/PCBs in Treated Sediment + 3/3 of Total Mass of Solids/PCBs in Waste Streams.
6. Amount of Solids/PCBs Lost Across Bench Equip. = (Total Solids/PCBs Recovered after Treatment cycle - Mass of Solids/PCBs in Untreated Sediment) divided by Mass of Solids/PCBs in Untreated Sediment.
7. Treated Sediment in the >6.35 mm and 425 micron to 6.35 mm fractions were processed through One Treatment Cycle only. Data from the first treatment cycle is included in the total mass balance calculations for Second and Third Treatment cycles.

Table 4-2 Coarse-grained Sediment (TS-SED-A) Validation Test Run 2

	Sample ID	PCB Concentration[1]		Percent Solids[1]	Total Weight[1] (kg)	Total Volume[1] (L)	Mass of Solids[2] (kg)	Percent of Recovered Solids[3]	Mass of PCBs[4] (mg)
Run B-S1-R2 (Reach 5A Sediment)									
Untreated Sediment	B-S1-R2-L1-S	**62.6**	mg/kg	81%	73.3	40.0	59.4	-	3,716.7
Calculated Density of Untreated Sediment (Mass of Solids/Total Volume)							1.83	kg/L	
Treated Sediment after First Treatment Cycle									
greater than 6.35 mm	B-S1-R2-L2-S	0.38	mg/kg	96%	2.9	-	2.8	6.8%	1.1
425 microns to 6.35 mm	B-S1-R2-L3-S	2.8	mg/kg	78%	38.0	-	29.6	72.7%	83.0
75 to 425 micron	B-S1-R2-L5A-S	49.8	mg/kg	79%	6.1	-	4.8	11.8%	240.0
hydrocyclone solids	B-S1-R2-L5-S	55.3	mg/kg	74%	1.9	-	1.4	3.4%	77.8
centrifuge solids	B-S1-R2-L6-S	133	mg/kg	70%	2.6	-	1.8	4.5%	242.1
Totals		**15.9**	**mg/kg (weighted)**			-	**40.5**	**99.2%**	**643.8**
Total Solids/PCBs Recovered after One Treatment Cycle[5]							40.8	-	1,441.3
Amount of Solids/PCBs Lost (-) Across Bench Equipment after One Treatment Cycle[6]							-31.3%	-	-61.2%
Treated Sediment after Second Treatment Cycle									
greater than 6.35 mm[7]	B-S1-R2-L2-S	0.38	mg/kg	96%	2.9	-	2.8	7.3%	1.1
425 microns to 6.35 mm[7]	B-S1-R2-L3-S	2.8	mg/kg	78%	38.0	-	29.6	77.6%	83.0
75 to 425 micron	B-S1-R2-L7A-S	25.6	mg/kg	76%	4.7	-	3.6	9.4%	91.4
hydrocyclone solids	B-S1-R2-L7-S	53.2	mg/kg	72%	1.4	-	1.0	2.6%	53.6
centrifuge solids	B-S1-R2-L8-S	300	mg/kg	27%	2.1	-	0.6	1.5%	170.1
Totals		**10.6**	**mg/kg (weighted)**			-	**37.6**	**98.4%**	**399.2**
Total Solids/PCBs Recovered after Two Treatment Cycles[5]							38.2	-	1,994.2
Estimated Amount of Solids/PCBs Lost (-) Across Bench Equipment after Two Treatment Cycles[6]							-35.7%	-	-46.3%
Treated Sediment after Third Treatment Cycle									
greater than 6.35 mm[7]	B-S1-R2-L2-S	0.38	mg/kg	96%	2.9	-	2.8	7.5%	1.1
425 microns to 6.35 mm[7]	B-S1-R2-L3-S	2.8	mg/kg	78%	38.0	-	29.6	79.7%	83.0
75 to 425 micron	B-S1-R2-L9A-S	24.4	mg/kg	76%	2.8	-	2.1	5.7%	51.9
hydrocyclone solids	B-S1-R2-L9-S	34.1	mg/kg	75%	1.2	-	0.9	2.4%	30.7
centrifuge solids	B-S1-R2-L10-S	92	mg/kg	67%	1.2	-	0.8	2.2%	74.0
Totals		**6.6**	**mg/kg (weighted)**			-	**36.3**	**97.5%**	**240.6**
Total Solids/PCBs Recovered after Three Treatment Cycles[5]							37.2	-	2,633.1
Estimated Amount of Solids/PCBs Lost (-) Across Bench Equipment after Three Treatment Cycles[6]							-37.4%	-	-29.2%
Waste Streams									
oversized organics	Not Sampled	-		-	-	-	-	-	-
Wastewater	B-S1-R2-L11-A/AF	3,340	ug/L	1,310 mg/L TSS		716.3	0.9	-	2,392.4
Totals							**0.9**	**-**	**2,392.4**

Notes:

1. Measured value (not calculated).
2. Mass of Solids = Total Weight x Percent Solids, or Total Volume x TSS.
3. Percent of Solids Recovered = Mass of solids/Total Mass of solids recovered after treatment cycle.
4. Mass of PCBs = PCB concentration x Mass of Solids.
5. Total Mass of Solids/PCBs Recovered after One Treatment Cycle = Sum of Mass of Solids/PCBS in Treated Sediment + 1/3 of Total Mass of Solids/PCBs in Waste Streams. Total Mass of Solids/PCBs Recovered after Two Treatment Cycles = Sum of Mass of Solids/PCBS in Treated Sediment + 2/3 of Total Mass of Solids/PCBs in Waste Streams. Total Mass of Solids/PCBs Recovered after Three Treatment Cycles = Sum of Mass of Solids/PCBs in Treated Sediment + 3/3 of Total Mass of Solids/PCBs in Waste Streams.
6. Amount of Solids/PCBs Lost Across Bench Equip. = (Total Solids/PCBs Recovered after Treatment cycle - Mass of Solids/PCBs in Untreated Sediment) divided by Mass of Solids/PCBs in Untreated Sediment.
7. Treated Sediment in the >6.35 mm and 425 micron to 6.35 mm fractions were processed through One Treatment Cycle only. Data from the first treatment cycle is included in the total mass balance calculations for Second and Third Treatment cycles.

Table 4-3 Coarse-grained Sediment (TS-SED-A) Validation Test Run 3

	Sample ID	PCB Concentration[1]		Percent Solids[1]	Total Weight[1] (kg)	Total Volume[1] (L)	Mass of Solids[2] (kg)	Percent of Recovered Solids[3]	Mass of PCBs[4] (mg)
Run B-S1-R3 (Reach 5A Sediment)									
Untreated Sediment	B-S1-R3-L1-S	**80**	mg/kg	84%	82.1	44.0	69.0	-	5,517.1
Calculated Density of Untreated Sediment (Mass of Solids/Total Volume)							1.87	kg/L	
Treated Sediment after First Treatment Cycle									
greater than 6.35 mm	B-S1-R3-L2-S	0.68	mg/kg	94%	4.8	-	4.5	9.8%	3.1
425 microns to 6.35 mm	B-S1-R3-L3-S (ave)	24.69	mg/kg	91%	35.1	-	31.9	69.2%	788.6
75 to 425 micron	B-S1-R3-L5A-S	40.6	mg/kg	84%	7.3	-	6.1	13.3%	249.0
hydrocyclone solids	B-S1-R3-L5-S	54.7	mg/kg	72%	1.8	-	1.3	2.8%	70.9
centrifuge solids	B-S1-R3-L6-S	134	mg/kg	64%	2.9	-	1.9	4.0%	248.7
Totals		**29.7**	**mg/kg (weighted)**			-	**45.7**	**99.1%**	**1,360.2**
Total Solids/PCBs Recovered after One Treatment Cycle[5]							46.1	-	1,895.5
Amount of Solids/PCBs Lost (-) Across Bench Equipment after One Treatment Cycle[6]							-33.1%	-	-65.6%
Treated Sediment after Second Treatment Cycle									
greater than 6.35 mm[7]	B-S1-R3-L2-S	0.68	mg/kg	94%	4.8	-	4.5	10.3%	3.1
425 microns to 6.35 mm[7]	B-S1-R3-L3-S (ave)	24.69	mg/kg	91%	35.1	-	31.9	73.2%	788.6
75 to 425 micron	B-S1-R3-L7A-S	50.8	mg/kg	78%	5.1	-	4.0	9.1%	202.1
hydrocyclone solids	B-S1-R3-L7-S	33.4	mg/kg	72%	1.3	-	0.9	2.1%	31.3
centrifuge solids	B-S1-R3-L8-S	96	mg/kg	65%	2.3	-	1.5	3.4%	143.5
Totals		**27.3**	**mg/kg (weighted)**			-	**42.9**	**98.2%**	**1,168.6**
Total Solids/PCBs Recovered after Two Treatment Cycles[5]							43.6	-	2,239.2
Estimated Amount of Solids/PCBs Lost (-) Across Bench Equipment after Two Treatment Cycles[6]							-36.7%	-	-59.4%
Treated Sediment after Third Treatment Cycle									
greater than 6.35 mm[7]	B-S1-R3-L2-S	0.68	mg/kg	94%	4.8	-	4.5	10.8%	3.1
425 microns to 6.35 mm[7]	B-S1-R3-L3-S (ave)	24.69	mg/kg	91%	35.1	-	31.9	76.2%	788.6
75 to 425 micron	B-S1-R3-L9A-S	10.1	mg/kg	77%	3.4	-	2.6	6.2%	26.4
hydrocyclone solids	B-S1-R3-L9-S	40.4	mg/kg	67%	1.0	-	0.7	1.6%	27.1
centrifuge solids	B-S1-R3-L10-S	41.8	mg/kg	71%	1.4	-	1.0	2.4%	41.5
Totals		**21.8**	**mg/kg (weighted)**			-	**40.7**	**97.2%**	**886.8**
Total Solids/PCBs Recovered after Three Treatment Cycles[5]							41.9	-	2,492.7
Estimated Amount of Solids/PCBs Lost (-) Across Bench Equipment after Three Treatment Cycles[6]							-39.2%	-	-54.8%
Waste Streams									
oversized organics	Not Sampled	-		-	-	-	-	-	-
Wastewater	B-S1-R3-L11-A/AF	2,310	ug/L	1,700 mg/L TSS		695.2	1.2	-	1,605.9
Totals							**1.2**	**-**	**1,605.9**

Notes:

1. Measured value (not calculated).
2. Mass of Solids = Total Weight x Percent Solids, or Total Volume x TSS.
3. Percent of Solids Recovered = Mass of solids/Total Mass of solids recovered after treatment cycle.
4. Mass of PCBs = PCB concentration x Mass of Solids.
5. Total Mass of Solids/PCBs Recovered after One Treatment Cycle = Sum of Mass of Solids/PCBS in Treated Sediment + 1/3 of Total Mass of Solids/PCBs in Waste Streams. Total Mass of Solids/PCBs Recovered after Two Treatment Cycles = Sum of Mass of Solids/PCBS in Treated Sediment + 2/3 of Total Mass of Solids/PCBs in Waste Streams. Total Mass of Solids/PCBs Recovered after Three Treatment Cycles = Sum of Mass of Solids/PCBs in Treated Sediment + 3/3 of Total Mass of Solids/PCBs in Waste Streams.
6. Amount of Solids/PCBs Lost Across Bench Equip. = (Total Solids/PCBs Recovered after Treatment cycle - Mass of Solids/PCBs in Untreated Sediment) divided by Mass of Solids/PCBs in Untreated Sediment.
7. Treated Sediment in the >6.35 mm and 425 micron to 6.35 mm fractions were processed through One Treatment Cycle only. Data from the first treatment cycle is included in the total mass balance calculations for Second and Third Treatment cycles.

approximately 1% were in the wastewater. The weighted concentration of all the treated sediment after one treatment cycle ranged from 12.5 to 29.7 mg/kg.

After the first treatment cycle, the treated solids from the Liquid/Solid Separation step were recombined and processed two additional times, and the mass balance calculations were repeated. The weighted concentration of the whole treated sediment ranged from 8.4 to 27.3 mg/kg after two treatment cycles, and from 4.6 to 21.8 mg/kg after three treatment cycles. Note that the fractions that were greater than 425 microns (sample locations L1 and L2) were only treated once but were included in the calculations of the weighted concentration of all the treated sediment for the second and third treatment cycles to provide a complete data set for the purposes of calculating a final weighted average concentration for each treatment cycle.

A comparison of the total solids in the untreated sediment sample to the total solids recovered in the treated sediment and wastewater shows a loss of solids of 18 to 33% through the bench-scale equipment after the first treatment cycle, and 26 to 39% after three treatment cycles. As discussed previously, this is understandable since the bench-scale equipment is run in batch mode and there are some residual solids and liquids in the tanks and hoses after each processing step. This loss of solids is compounded by multiple treatment cycles performed during the validation test runs because there were residual solids and liquids in the tanks and hoses after each processing step and multiple treatment cycles increases the processing steps. Since the full-scale equipment is run in a continuous flow-through mode, there would be no residual solids and liquids in the processing tanks and equipment.

A comparison of the total mass of PCBs in the untreated sediment to the total mass of PCBs in the treated sediment and the wastewater shows a reduction of PCBs by 61 to 76% after the first treatment cycle and 29 to 65% after three treatment cycles. This reduction is due partially to the loss of residual solids and liquids in the tanks and hoses after each processing step and partially due to oxidation in the Organic Contamination Oxidation step.

Samples were collected for PCDD/DF and PCB congener analyses at select locations during the validation test runs on the coarse-grained sediment (TS-SED-A). The analytical results for the PCDD/DF samples are presented in Table C-2 in Appendix C. These results indicate that lower concentrations of PCDD/DFs were detected in the treated sediment than in the untreated sediment; however there is insufficient data to perform mass balance calculations. The analytical results for the PCB congeners are presented in Table C-3 in Appendix C, and the results for the total PCB congeners are summarized in Table C-1 in Appendix C with the PCB Aroclor results. As shown on Table C-1, the total PCB Aroclor and total PCB congener results agree.

4.2 Fine-Grained Sediment (TS-SED-B)

4.2.1 Process Conditions

Three validation test runs, identified as **B–S2–R1**, **–R2**, and **–R3,** were conducted on the fine-grained sediment (TS-SED-B). For each validation test run, 26 to 27 liters of untreated sediment were processed through the BioGenesis^{SM} Soil/Sediment Washing (see the process flow diagram in Figure 3-2). The untreated sediment was sampled prior to each test run (sample Location L1).

During process optimization testing it was determined that there was little or no sand and gravel present in the sample of the fine-grained sediment (TS-SED-B); therefore, the Attrition Scrubbing/Aeration Step was not needed for this material. In order to protect the pump and equipment from twigs, leaves, roots, debris, etc. present in the fine-grained sediment sample, the material was screened using an 850-micron screen (20 mesh). The organic material recovered on the screen (>850 microns), which was considered a waste based on the visual observation of this being primarily organic matter, was rinsed on the screen, collected in plastic buckets, weighed, and sampled (sample location L2).

Also during the process optimization testing, it was determined that a significant amount of the solids in the fine-grained sediment sample (TS-SED-B) was being discharged to the wastewater stream in the Bulk Organics Removal step. This is due to the fine-grained nature of the sediment and the limitation of the size of the hydrocyclones used in the bench-scale equipment. This process step was therefore omitted for the fine-grained sediment (TS-SED-B) during the validation test runs. In full-scale operations, finer hydrocyclones would be used to capture the finer solids.

The solids and liquids passing through the 850-micron screen were processed through the Chemical Addition and Mixing, Application of Collision Forces, and Organic Contamination Oxidation steps. The cleaned solids were then separated from the aqueous phase in the Solid/Liquid Separation step. As mentioned earlier, it was determined during the process optimization testing that there was very little sand and gravel in the fine-grained sediment (TS-SED-B), so the Solid/Liquid Separation step consisted of hydrocyclones over a 37-micron (400 mesh) shaker screen (sample location L5) and then a centrifuge (sample location L6). The recovered solids from each unit were weighed and sampled. Wastewater from the Solid/Liquid Separation step (hydrocyclones overflow and centrifuge centrate) was combined in the wastewater tank.

To evaluate the effects of multiple treatment cycles on the PCB concentrations, the treated solids were recombined and processed two additional times. The solids recovered from the hydrocyclones (sample location L5) and centrifuge (sample location L6) were weighed, recombined into a single sample, and mixed with water. The recombined slurry was processed through the BioGenesis Preprocessor and through the Application of Collision Forces, Organic Contaminant Oxidation, and Solid/Liquid Separation steps two more times. The treated solids from the second treatment cycle were weighed and sampled (sample locations L7 and L8), and the process was repeated for a third treatment cycle (sample locations L9 and L10). The wastewater from the Solid/Liquid Separation steps from the second and third treatment cycles was placed in the wastewater tank with the wastewater from the first treatment cycle. The wastewater was mixed by pumping it in a recirculation mode and sampled (sample location L11).

4.2.2 Analytical Data and Mass Balance Calculations

Presented in Tables 4-4, 4-5, and 4-6 are summaries of the analytical results and mass balance calculations for each of the three validation test runs on the fine-grained sediment (TS-SED-B). The untreated sediment (sample location L1) ranged in PCB concentrations from 110 to 177 mg/kg.

Following one treatment cycle, the treated sediment was sampled as described above in two grain size fractions: the hydrocyclone solids (sample location L5), and the centrifuge solids (sample location L6). The analytical results and weights of recovered material for each of these fractions are provided in the tables. The results of the calculations of the mass of recovered solids in each fraction, the mass of PCBs in each fraction, and the weighted concentration of the combined treated sediment are also provided. The concentration of PCBs in the hydrocyclone fraction (sample location L5) ranged from 16.3 to 21.6 mg/kg. The concentration of PCBs in the centrifuge fraction (sample location L6) ranged from 8.6 to 60 mg/kg. On average, approximately 92% of the solids recovered from the treatment of the fine-grained sediment (TS-SED-B) were recovered in the hydrocyclones and centrifuge as measured after one treatment cycle. Less than 1% of the solids recovered were in the oversized organics, and approximately 8% were in the wastewater. The weighted concentration of all the treated sediment after one treatment cycle ranged from 11.5 to 48.4 mg/kg.

After the first treatment cycle, the treated solids from the Solid/Liquid Separation step were recombined and processed two additional times, and the mass balance calculations were repeated. The weighted concentration of the whole treated sediment ranged from 18.1 to 25.2 mg/kg after two treatment cycles, and from 11.3 to 18.4 mg/kg after three treatment cycles.

A comparison of the total solids in the untreated sediment sample to the total solids recovered in the treated sediment and wastewater shows a loss of solids of 10 to 31% through the bench-scale equipment after the first treatment cycle, and 51 to 60% after three treatment cycles. As discussed previously, this is understandable since the bench-scale equipment is run in batch mode and there are some residual solids and liquids in the tanks and hoses after each processing

Table 4-4 Fine-grained Sediment (TS-SED-B) Validation Test Run 1

	Sample ID	PCB Concentration[1]		Percent Solids[1]	Total Weight[1] (kg)	Total Volume[1] (L)	Mass of Solids[2] (kg)	Percent of Recovered Solids[3]	Mass of PCBs[4] (mg)
Run B-S2-R1 (Woods Pond Sediment)									
Untreated Sediment	B-S2-R1-L1-S	**177**	mg/kg	29%	28.0	27.0	8.1	-	1,437.2
Calculated Density of Untreated Sediment (Mass of Solids/Total Volume)							1.04	kg/L	
Treated Sediment after First Treatment Cycle									
hydrocyclone solids	B-S2-R1-L5-S	21.6	mg/kg	65%	3.156	-	2.1	28.2%	44.3
centrifuge solids	B-S2-R1-L6-S	60	mg/kg	58%	8.141	-	4.7	65.0%	283.3
Totals		**48.4**	**mg/kg (weighted)**			-	**6.8**	**93.3%**	**327.6**
Total Solids/PCBs Recovered after One Treatment Cycle[5]							7.3	-	407.4
Amount of Solids/PCBs Lost (-) Across Bench Equipment after One Treatment Cycle[6]							-10.6%	-	-71.7%
Treated Sediment after Second Treatment Cycle									
hydrocyclone solids	B-S2-R1-L7-S	12.9	mg/kg	61%	1.6	-	1.0	20.8%	12.6
centrifuge solids	B-S2-R1-L8-S	29.6	mg/kg	57%	4.8	-	2.7	58.3%	81.0
Totals		**25.2**	**mg/kg (weighted)**			-	**3.7**	**79.2%**	**93.6**
Total Solids/PCBs Recovered after Two Treatment Cycles[5]							4.7	-	253.1
Estimated Amount of Solids/PCBs Lost (-) Across Bench Equipment after Two Treatment Cycles[6]							-42.3%	-	-82.4%
Treated Sediment after Third Treatment Cycle									
hydrocyclone solids	B-S2-R1-L9-S	11.1	mg/kg	61%	0.587	-	0.4	9.7%	4.0
centrifuge solids	B-S2-R1-L10-S	15.3	mg/kg	60%	3.1	-	1.9	50.5%	28.5
Totals		**14.6**	**mg/kg (weighted)**			-	**2.2**	**60.2%**	**32.4**
Total Solids/PCBs Recovered after Three Treatment Cycles[5]							3.7	-	271.7
Estimated Amount of Solids/PCBs Lost (-) Across Bench Equipment after Two Treatment Cycles[6]							-54.6%	-	-81.1%
Waste Streams									
oversized organics	B-S2-R1-L2-S	119	mg/kg	14%	0.301	-	0.0	-	5.0
Wastewater	B-S2-R1-L11-A/AF	660	ug/L	4,010 mg/L TSS		355.0	1.4	-	243.3
Totals							**1.5**	**-**	**239.3**

Notes:

1. Measured value (not calculated).
2. Mass of Solids = Total Weight x Percent Solids, or Total Volume x TSS.
3. Percent of Solids Recovered = Mass of solids/Total Mass of solids recovered after treatment cycle.
4. Mass of PCBs = PCB concentration x Mass of Solids.
5. Total Mass of Solids/PCBs Recovered after One Treatment Cycle = Sum of Mass of Solids/PCBS in Treated Sediment + 1/3 of Total Mass of Solids/PCBs in Waste Streams. Total Mass of Solids/PCBs Recovered after Two Treatment Cycles = Sum of Mass of Solids/PCBS in Treated Sediment + 2/3 of Total Mass of Solids/PCBs in Waste Streams. Total Mass of Solids/PCBs Recovered after Three Treatment Cycles = Sum of Mass of Solids/PCBs in Treated Sediment + 3/3 of Total Mass of Solids/PCBs in Waste Streams.
6. Amount of Solids/PCBs Lost Across Bench Equip. = (Total Solids/PCBs Recovered after Treatment cycle - Mass of Solids/PCBs in Untreated Sediment) divided by Mass of Solids/PCBs in Untreated Sediment.

Table 4-5 Fine-grained Sediment (TS-SED-B) Validation Test Run 2

	Sample ID	PCB Concentration[1]	Percent Solids[1]	Total Weight[1] (kg)	Total Volume[1] (L)	Mass of Solids[2] (kg)	Percent of Recovered Solids[3]	Mass of PCBs[4] (mg)
Run B-S2-R2 (Woods Pond Sediment)								
Untreated Sediment	B-S2-R2-L1-S	**110** mg/kg	33%	31.2	26.0	10.3	-	1,132.6
Calculated Density of Untreated Sediment (Mass of Solids/Total Volume)						1.20	kg/L	
Treated Sediment after First Treatment Cycle								
hydrocyclone solids	B-S2-R2-L5-S	20.2 mg/kg	59%	3.1	-	1.8	23.3%	36.9
centrifuge solids	B-S2-R2-L6-S	8.6 mg/kg	68%	8.0	-	5.4	69.4%	46.8
Totals		**11.5 mg/kg (weighted)**			-	**7.3**	**92.7%**	**83.7**
Total Solids/PCBs Recovered after One Treatment Cycle[5]						7.8	-	263.4
Amount of Solids/PCBs Lost (-) Across Bench Equipment after One Treatment Cycle[6]						-23.9%	-	-76.7%
Treated Sediment after Second Treatment Cycle								
hydrocyclone solids	B-S2-R2-L7-S	11.9 mg/kg	58%	1.7	-	1.0	20.7%	11.7
centrifuge solids	B-S2-R2-L8-S	21.5 mg/kg	55%	4.8	-	2.6	55.4%	56.8
Totals		**18.9 mg/kg (weighted)**			-	**3.6**	**76.1%**	**68.5**
Total Solids/PCBs Recovered after Two Treatment Cycles[5]						4.8	-	427.8
Estimated Amount of Solids/PCBs Lost (-) Across Bench Equipment after Two Treatment Cycles[6]						-53.7%	-	-62.2%
Treated Sediment after Third Treatment Cycle								
hydrocyclone solids	B-S2-R2-L9-S	10.7 mg/kg	57%	0.9	-	0.5	12.2%	5.5
centrifuge solids	B-S2-R2-L10-S	11.4 mg/kg	57%	3.5	-	2.0	47.3%	22.7
Totals		**11.3 mg/kg (weighted)**			-	**2.5**	**59.5%**	**28.2**
Total Solids/PCBs Recovered after Three Treatment Cycles[5]						4.2	-	567.3
Estimated Amount of Solids/PCBs Lost (-) Across Bench Equipment after Three Treatment Cycles[6]						-59.1%	-	-49.9%
Waste Streams								
oversized organics	B-S2-R2-L2-S	94 mg/kg	13%	0.219	-	0.0	-	2.7
Wastewater	B-S2-R2-L11-A/AF	1,450 ug/L	4,540 mg/L TSS		369.9	1.7	-	536.4
Totals						**1.7**	**-**	**539.0**

Notes:

1. Measured value (not calculated).
2. Mass of Solids = Total Weight x Percent Solids, or Total Volume x TSS.
3. Percent of Solids Recovered = Mass of solids/Total Mass of solids recovered after treatment cycle.
4. Mass of PCBs = PCB concentration x Mass of Solids.
5. Total Mass of Solids/PCBs Recovered after One Treatment Cycle = Sum of Mass of Solids/PCBS in Treated Sediment + 1/3 of Total Mass of Solids/PCBs in Waste Streams. Total Mass of Solids/PCBs Recovered after Two Treatment Cycles = Sum of Mass of Solids/PCBS in Treated Sediment + 2/3 of Total Mass of Solids/PCBs in Waste Streams. Total Mass of Solids/PCBs Recovered after Three Treatment Cycles = Sum of Mass of Solids/PCBs in Treated Sediment + 3/3 of Total Mass of Solids/PCBs in Waste Streams.
6. Amount of Solids/PCBs Lost Across Bench Equip. = (Total Solids/PCBs Recovered after Treatment cycle - Mass of Solids/PCBs in Untreated Sediment) divided by Mass of Solids/PCBs in Untreated Sediment.

Table 4-6 Fine-grained Sediment (TS-SED-B) Validation Test Run 3

	Sample ID	PCB Concentration[1]	Percent Solids[1]	Total Weight[1] (kg)	Total Volume[1] (L)	Mass of Solids[2] (kg)	Percent of Recovered Solids[3]	Mass of PCBs[4] (mg)
Run B-S2-R3 (Woods Pond Sediment)								
Untreated Sediment	B-S2-R3-L1-S	**139** mg/kg	34%	32.0	27.0	10.9	-	1,512.3
Calculated Density of Untreated Sediment (Mass of Solids/Total Volume)						1.19	kg/L	
Treated Sediment after First Treatment Cycle								
hydrocyclone solids	B-S2-R3-L5-S	16.3 mg/kg	61%	4.4	-	2.7	35.9%	43.7
centrifuge solids	B-S2-R3-L6-S	43.8 mg/kg	48%	8.3	-	4.0	53.2%	174.5
Totals		**32.7 mg/kg (weighted)**			-	**6.7**	**89.1%**	**218.2**
Total Solids/PCBs Recovered after One Treatment Cycle[5]						7.5	-	316.4
Amount of Solids/PCBs Lost (-) Across Bench Equipment after One Treatment Cycle[6]						-31.2%	-	-79.1%
Treated Sediment after Second Treatment Cycle								
hydrocyclone solids	B-S2-R3-L7-S	8.4 mg/kg	66%	3.1	-	2.0	32.5%	17.2
centrifuge solids	B-S2-R3-L8-S	25.7 mg/kg	57%	4.6	-	2.6	41.6%	67.4
Totals		**18.1 mg/kg (weighted)**			-	**4.7**	**74.1%**	**84.6**
Total Solids/PCBs Recovered after Two Treatment Cycles[5]						6.3	-	280.8
Estimated Amount of Solids/PCBs Lost (-) Across Bench Equipment after Two Treatment Cycles[6]						-42.1%	-	-81.4%
Treated Sediment after Third Treatment Cycle								
hydrocyclone solids	B-S2-R3-L9-S	8.6 mg/kg	65%	1.38	-	0.9	16.8%	7.7
centrifuge solids	B-S2-R3-L10-S	22.9 mg/kg	55%	3.6	-	2.0	37.2%	45.3
Totals		**18.4 mg/kg (weighted)**			-	**2.9**	**54.0%**	**53.1**
Total Solids/PCBs Recovered after Three Treatment Cycles[5]						5.3	-	347.4
Estimated Amount of Solids/PCBs Lost (-) Across Bench Equipment after Three Treatment Cycles[6]						-51.0%	-	-77.0%
Waste Streams								
oversized organics	B-S2-R3-L2-S	144 mg/kg	12%	0.524	-	0.1	-	9.1
Wastewater	B-S2-R3-L11-A/AF	720 ug/L	6,030 mg/L TSS		396.3	2.4	-	285.3
Totals						**2.5**	**-**	**294.4**

Notes:

1. Measured value (not calculated).
2. Mass of Solids = Total Weight x Percent Solids, or Total Volume x TSS.
3. Percent of Solids Recovered = Mass of solids/Total Mass of solids recovered after treatment cycle.
4. Mass of PCBs = PCB concentration x Mass of Solids.
5. Total Mass of Solids/PCBs Recovered after One Treatment Cycle = Sum of Mass of Solids/PCBS in Treated Sediment + 1/3 of Total Mass of Solids/PCBs in Waste Streams. Total Mass of Solids/PCBs Recovered after Two Treatment Cycles = Sum of Mass of Solids/PCBS in Treated Sediment + 2/3 of Total Mass of Solids/PCBs in Waste Streams. Total Mass of Solids/PCBs Recovered after Three Treatment Cycles = Sum of Mass of Solids/PCBs in Treated Sediment + 3/3 of Total Mass of Solids/PCBs in Waste Streams.
6. Amount of Solids/PCBs Lost Across Bench Equip. = (Total Solids/PCBs Recovered after Treatment cycle - Mass of Solids/PCBs in Untreated Sediment) divided by Mass of Solids/PCBs in Untreated Sediment.

step. This loss of solids is compounded by multiple treatment cycles performed during the validation test runs because there were residual solids and liquids in the tanks and hoses after each processing step and multiple treatment cycles increases the processing steps. Since the full-scale equipment is run in a continuous flow-through mode, there would be no residual solids and liquids in the processing tanks and equipment.

A comparison of the total mass of PCBs in the untreated sediment to the total mass of PCBs in the treated sediment and the wastewater shows a reduction of PCBs of 72 to 79% after the first treatment cycle and 50 to 81% after three treatment cycles. This reduction is due partially to the loss of residual solids and liquids in the tanks and hoses after each processing step and partially due to oxidation in the Organic Contaminant Oxidation step.

Samples were collected for PCDD/DF and PCB congener analyses at select locations during the validation test runs on the fine-grained sediment (TS-SED-B). The analytical results for the PCDD/DF samples are presented in Table C-2 in Appendix C. These results indicate that lower concentrations of PCDD/DFs were detected in the treated sediment than in the untreated sediment; however there is insufficient data to perform mass balance calculations. The analytical results for the PCB congeners are presented in Table C-3 in Appendix C, and the results for the total PCB congeners are summarized in Table C-1 in Appendix C with the PCB Aroclor results. As shown on Table C-1, the total PCB Aroclor and total PCB congener results agree.

4.3 Floodplain Soils (TS-SO-A)

4.3.1 Process Conditions

Three validation test runs, identified as **B–S3–R1**, **–R2**, and **–R3,** were conducted on the floodplain soils (TS-SO-A). For each validation test run, 20 to 30 liters of untreated soil were processed through the BioGenesis^{SM} Soil/Sediment Washing Process (see the process flow diagram in Figure 3-3). The untreated soil was sampled prior to each test run (sample location L1).

During process optimization testing it was determined that there was little or no sand and gravel present in the sample of the floodplain soils (TS-SO-A); therefore, the Attrition Scrubbing/Aeration Step was not needed for this material. Water was added to the untreated soil sample in five (5) gallon buckets and mixed to create a slurry. In order to protect the pump and equipment from twigs, leaves, roots, debris, etc. present in the floodplain soils sample, the slurry was screened using an 850-micron screen (20 mesh). The organic material recovered on the screen (>850 microns), which was considered a waste based on the visual observation of this being primarily organic matter, was rinsed on the screen, collected in plastic buckets, weighed, and sampled (sample location L2).

The solids and liquids passing through the 850-micron screen were processed through the Bulk Organics Removal step. The BioGenesis Preprocessor and a series of hydrocyclones are used in this step to concentrate the solids and remove the light organic materials in an aqueous phase. The slurry with the concentrated solids from the underflow of the hydrocyclones was processed through the Chemical Addition and Mixing, Application of Collision Forces, and Organic Contaminant Oxidation steps. The cleaned solids were then separated from the aqueous phase in the Solid/Liquid Separation step. As mentioned earlier, it was determined during process optimization testing that there was very little sand and gravel in the floodplain soils (TS-SO-A), so the Solid/Liquid Separation step consisted of hydrocyclones over a 37-micron (400 mesh) shaker screen (sample location L5) and a centrifuge (sample location L6). The recovered solids from each unit were weighed and sampled. Wastewater from the Solid/Liquid Separation step (hydrocyclones overflow and centrifuge centrate) from the first treatment cycle was combined in the wastewater collection tank. The wastewater was mixed by pumping it in a recirculation mode and sampled (sample location L11).

To evaluate the effects of multiple treatment cycles on the PCB concentrations, the treated solids were recombined and processed two additional times. The solids recovered from the hydrocyclones (sample location L5) and centrifuge (sample location L6) were weighed, recombined into a single sample, and mixed with water. The recombined slurry was processed through the BioGenesis Preprocessor and through the Application of Collision Forces, Organic

Contaminant Oxidation, and Solid/Liquid Separation steps two more times. The treated solids from the second treatment cycle were weighed and sampled (sample locations L7 and L8), and the process was repeated for a third treatment cycle (sample locations L9 and L10). Wastewater from the second and third treatment cycles was not sampled.

4.3.2 Analytical Data and Mass Balance Calculations

Presented in Tables 4-7, 4-8, and 4-9 are summaries of the analytical results and mass balance calculations for each of the validation test runs on the floodplain soils (TS-SO-A). The untreated soil (sample location L1) ranged in PCB concentrations from 45 to 55 mg/kg.

Following one treatment cycle, the treated soils were sampled as described above in two grain size fractions: the hydrocyclone solids (sample location L5), and the centrifuge solids (sample location L6). The analytical results and weights of recovered material for each of these fractions are provided in the tables. The results of the calculations of the mass of recovered solids in each fraction, the mass of PCBs in each fraction, and the weighted concentration of the combined treated soil are also provided. The concentration of PCBs in the hydrocyclone fraction (sample location L5) ranged from 4.8 to 6.5 mg/kg. The concentration of PCBs in the centrifuge fraction (sample location L6) ranged from 7.4 to 44 mg/kg. On average, approximately 88% of the solids recovered from the treatment of the floodplain soils (TS-SO-A) were recovered in the hydrocyclones and centrifuge as measured after one treatment cycle. Less than 1% of the solids recovered were in the oversized organics, and approximately 12% were in the wastewater. The weighted concentration of all the treated soil after one treatment cycle ranged from 6.8 to 19.2 mg/kg.

After the first treatment cycle, the treated solids from the Solid/Liquid Separation step were recombined and processed two additional times, and the mass balance calculations were repeated. The weighted concentration of the whole treated soil ranged from 5.7 to 12.6 mg/kg after two treatment cycles, and from 4.2 to 8.5 mg/kg after three treatment cycles.

Table 4-7 Floodplain Soil (TS-SO-A) Validation Test Run 1

	Sample ID	PCB Concentration[1]	Percent Solids[1]	Total Weight[1] (kg)	Total Volume[1] (L)	Mass of Solids[2] (kg)	Percent of Recovered Solids[3]	Mass of PCBs[4] (mg)
Run B-S3-R1 (Floodplain Soils)								
Untreated Soil	B-S3-R1-L1-S	**55** mg/kg	67%	25.6	20.0	17.2	-	943.4
Calculated Density of Untreated Soil (Mass of Solids/Total Volume)						1.28	kg/L	
Treated Soil after First Treatment Cycle								
hydrocyclone solids	B-S3-R1-L5-S	5.4 mg/kg	73%	7.8	-	5.7	54.9%	30.7
centrifuge solids	B-S3-R1-L6-S	40 mg/kg	63%	6.0	-	3.8	36.4%	151.2
Totals		**19.2 mg/kg (weighted)**			-	**9.5**	**91.3%**	**181.9**
Total Solids/PCBs Recovered after One Treatment Cycle[5]						10.4	-	237.4
Amount of Solids/PCBs Lost (-) Across Bench Equipment after One Treatment Cycle[6]						-39.5%	-	-74.8%
Treated Soil after Second Treatment Cycle								
hydrocyclone solids	B-S3-R1-L7-S	4.4 mg/kg	70%	5.2	-	3.6	45.8%	16.0
centrifuge solids	B-S3-R1-L8-S	24 mg/kg	64%	3.9	-	2.5	31.4%	59.9
Totals		**12.4 mg/kg (weighted)**			-	**6.1**	**77.2%**	**75.9**
Total Solids/PCBs Recovered after Two Treatment Cycles[5]						7.9	-	186.9
Estimated Amount of Solids/PCBs Lost (-) Across Bench Equipment after Two Treatment Cycles[6]						-53.7%	-	-80.2%
Treated Soil after Third Treatment Cycle								
hydrocyclone solids	B-S3-R1-L9-S	3.9 mg/kg	73%	3.5	-	2.6	37.0%	10.0
centrifuge solids	B-S3-R1-L10-S	15 mg/kg	65%	2.5	-	1.6	23.6%	24.4
Totals		**8.2 mg/kg (weighted)**			-	**4.2**	**60.6%**	**34.3**
Total Solids/PCBs Recovered after Three Treatment Cycles[5]						6.9	-	200.8
Estimated Amount of Solids/PCBs Lost (-) Across Bench Equipment after Three Treatment Cycles[6]						-59.8%	-	-78.7%
Waste Streams								
oversized organics	B-S3-R1-L2-S	96 mg/kg	13%	0.053	-	0.0	-	0.7
Wastewater	B-S3-R1-L11-A/AF	280 ug/L	4,590 mg/L TSS		195.8	0.9	-	54.8
Totals						**0.9**	**-**	**55.5**

Notes:

1. Measured value (not calculated).
2. Mass of Solids = Total Weight x Percent Solids, or Total Volume x TSS.
3. Percent of Solids Recovered = Mass of solids/Total Mass of solids recovered after treatment cycle.
4. Mass of PCBs = PCB concentration x Mass of Solids.
5. Total Mass of Solids/PCBs Recovered after One Treatment Cycle = Sum of Mass of Solids/PCBS in Treated Soil + Total Mass of Solids/PCBs in Waste Streams. Total Mass of Solids/PCBs Recovered after Two Treatment Cycles = Sum of Mass of Solids/PCBS in Treated soil + 2 times the Total Mass of Solids/PCBs in Waste Streams. Total Mass of Solids/PCBs Recovered after Three Treatment Cycles = Sum of Mass of Solids/PCBs in Treated soil + 3 times the Total Mass of Solids/PCBs in Waste Streams.
6. Amount of Solids/PCBs Lost Across Bench Equip. = (Total Solids/PCBs Recovered after Treatment cycle - Mass of Solids/PCBs in Untreated Sediment) divided by Mass of Solids/PCBs in Untreated Soil.

Table 4-8 Floodplain Soils (TS-SO-A) Validation Test Run 2

	Sample ID	PCB Concentration[1]		Percent Solids[1]	Total Weight[1] (kg)	Total Volume[1] (L)	Mass of Solids[2] (kg)	Percent of Recovered Solids[3]	Mass of PCBs[4] (mg)
Run B-S3-R2 (Floodplain Soils)									
Untreated Soil	B-S3-R2-L1-S	**45**	mg/kg	66%	37.6	30.0	24.8	-	1,116.7
Calculated Density of Untreated Soil (Mass of Solids/Total Volume)							1.25	kg/L	
Treated Soil after First Treatment Cycle									
hydrocyclone solids	B-S3-R2-L5-S	4.8	mg/kg	77%	13.6	-	10.5	56.2%	50.3
centrifuge solids	B-S3-R2-L6-S	44	mg/kg	63%	7.8	-	4.9	26.4%	216.2
Totals		**17.3**	**mg/kg (weighted)**			-	**15.4**	**82.6%**	**266.5**
Total Solids/PCBs Recovered after One Treatment Cycle[5]							18.6	-	307.4
Amount of Solids/PCBs Lost (-) Across Bench Equipment after One Treatment Cycle[6]							-24.9%	-	-72.5%
Treated Soil after Second Treatment Cycle									
hydrocyclone solids	B-S3-R2-L7-S	2.6	mg/kg	75%	9.9	-	7.4	42.1%	19.3
centrifuge solids	B-S3-R2-L8-S	12	mg/kg	69%	5.4	-	3.7	21.1%	44.7
Totals		**5.7**	**mg/kg (weighted)**			-	**11.2**	**63.2%**	**64.0**
Total Solids/PCBs Recovered after Two Treatment Cycles[5]							17.6	-	145.9
Estimated Amount of Solids/PCBs Lost (-) Across Bench Equipment after Two Treatment Cycles[6]							-28.9%	-	-86.9%
Treated Soil after Third Treatment Cycle									
hydrocyclone solids	B-S3-R2-L9-S	2.6	mg/kg	76%	8.1	-	6.2	32.3%	16.0
centrifuge solids	B-S3-R2-L10-S	7.3	mg/kg	70%	4.5	-	3.2	16.5%	23.0
Totals		**4.2**	**mg/kg (weighted)**			-	**9.3**	**48.9%**	**39.0**
Total Solids/PCBs Recovered after Three Treatment Cycles[5]							19.0	-	161.8
Estimated Amount of Solids/PCBs Lost (-) Across Bench Equipment after Three Treatment Cycles[6]							-23.3%	-	-85.5%
Waste Streams									
oversized organics	B-S3-R2-L2-S	60	mg/kg	13%	0.064	-	0.0	-	0.5
Wastewater	B-S3-R2-L11-A/AF	160	ug/L	12,800 mg/L TSS		252.8	3.2	-	40.4
Totals							**3.2**	**-**	**40.9**

Notes:

1. Measured value (not calculated).
2. Mass of Solids = Total Weight x Percent Solids, or Total Volume x TSS.
3. Percent of Solids Recovered = Mass of solids/Total Mass of solids recovered after treatment cycle.
4. Mass of PCBs = PCB concentration x Mass of Solids.
5. Total Mass of Solids/PCBs Recovered after One Treatment Cycle = Sum of Mass of Solids/PCBS in Treated Soil + Total Mass of Solids/PCBs in Waste Streams. Total Mass of Solids/PCBs Recovered after Two Treatment Cycles = Sum of Mass of Solids/PCBS in Treated soil + 2 times the Total Mass of Solids/PCBs in Waste Streams. Total Mass of Solids/PCBs Recovered after Three Treatment Cycles = Sum of Mass of Solids/PCBs in Treated soil + 3 times the Total Mass of Solids/PCBs in Waste Streams.
6. Amount of Solids/PCBs Lost Across Bench Equip. = (Total Solids/PCBs Recovered after Treatment cycle - Mass of Solids/PCBs in Untreated Sediment) divided by Mass of Solids/PCBs in Untreated Soil.

Table 4-9 Floodplain Soils (TS-SO-A) Validation Test Run 3

	Sample ID	PCB Concentration[1]		Percent Solids[1]	Total Weight[1] (kg)	Total Volume[1] (L)	Mass of Solids[2] (kg)	Percent of Recovered Solids[3]	Mass of PCBs[4] (mg)
Run B-S3-R3 (Floodplain Soils)									
Untreated Soil	B-S3-R3-L1-S	**50**	mg/kg	67%	31.5	26.0	21.1	-	1,055.3
Calculated Density of Untreated Soil (Mass of Solids/Total Volume)							1.21	kg/L	
Treated Soil after First Treatment Cycle									
hydrocyclone solids	B-S3-R3-L5-S	6.5	mg/kg	78%	12.2	-	9.5	65.0%	61.9
centrifuge solids	B-S3-R3-L6-S	7.4	mg/kg	63%	5.9	-	3.7	25.4%	27.5
Totals		**6.8**	**mg/kg (weighted)**			-	**13.2**	**90.4%**	**89.4**
Total Solids/PCBs Recovered after One Treatment Cycle[5]							14.6	-	140.4
Amount of Solids/PCBs Lost (-) Across Bench Equipment after One Treatment Cycle[6]							-30.6%	-	-86.7%
Treated Soil after Second Treatment Cycle									
hydrocyclone solids	B-S3-R3-L7-S	4.2	mg/kg	76%	9.0	-	6.8	58.2%	28.7
centrifuge solids	B-S3-R3-L8-S	40	mg/kg	51%	4.1	-	2.1	17.8%	83.6
Totals		**12.6**	**mg/kg (weighted)**			-	**8.9**	**76.0%**	**112.4**
Total Solids/PCBs Recovered after Two Treatment Cycles[5]							11.7	-	214.5
Estimated Amount of Solids/PCBs Lost (-) Across Bench Equipment after Two Treatment Cycles[6]							-52.7%	-	-80.8%
Treated Soil after Third Treatment Cycle									
hydrocyclone solids	B-S3-R3-L9-S	3.1	mg/kg	76%	7.6	-	5.8	48.1%	17.9
centrifuge solids	B-S3-R3-L10-S	24	mg/kg	59%	3.4	-	2.0	16.7%	48.1
Totals		**8.5**	**mg/kg (weighted)**			-	**7.8**	**64.8%**	**66.0**
Total Solids/PCBs Recovered after Three Treatment Cycles[5]							12.0	-	219.2
Estimated Amount of Solids/PCBs Lost (-) Across Bench Equipment after Three Treatment Cycles[6]							-51.6%	-	-80.4%
Waste Streams									
oversized organics	B-S3-R3-L2-S	86	mg/kg	19%	0.063	-	0.0	-	1.0
Wastewater	B-S3-R3-L11-A/AF	200	ug/L	5,580 mg/L TSS		250.1	1.4	-	50.0
Totals							**1.4**	**-**	**51.0**

Notes:

1. Measured value (not calculated).
2. Mass of Solids = Total Weight x Percent Solids, or Total Volume x TSS.
3. Percent of Solids Recovered = Mass of solids/Total Mass of solids recovered after treatment cycle.
4. Mass of PCBs = PCB concentration x Mass of Solids.
5. Total Mass of Solids/PCBs Recovered after One Treatment Cycle = Sum of Mass of Solids/PCBS in Treated Soil + Total Mass of Solids/PCBs in Waste Streams. Total Mass of Solids/PCBs Recovered after Two Treatment Cycles = Sum of Mass of Solids/PCBS in Treated soil + 2 times the Total Mass of Solids/PCBs in Waste Streams. Total Mass of Solids/PCBs Recovered after Three Treatment Cycles = Sum of Mass of Solids/PCBs in Treated soil + 3 times the Total Mass of Solids/PCBs in Waste Streams.
6. Amount of Solids/PCBs Lost Across Bench Equip. = (Total Solids/PCBs Recovered after Treatment cycle - Mass of Solids/PCBs in Untreated Sediment) divided by Mass of Solids/PCBs in Untreated Soil.

A comparison of the total solids in the untreated soil sample to the total solids recovered in the treated soil and wastewater shows a loss of solids of 25 to 40% through the bench-scale equipment after one treatment cycle and an estimated 23 to 60% after three treatment cycles. As discussed previously, this is understandable since the bench-scale equipment is run in batch mode and there are some residual solids and liquids in the tanks and hoses after each processing step. This loss of solids is compounded by multiple treatment cycles performed during the validation test runs because there were residual solids and liquids in the tanks and hoses after each processing step and multiple treatment cycles increases the processing steps. Since the full-scale equipment is run in a continuous flow-through mode, there would be no residual solids and liquids in the processing tanks and equipment.

A comparison of the total mass of PCBs in the untreated soil to the total mass of PCBs in the treated soil and the wastewater shows a reduction of PCBs of 73 to 87% after the first treatment cycle and an estimated 79 to 86% after three treatment cycles. This reduction is due partially to the loss of residual solids and liquids in the tanks and hoses and partially due to oxidation in the Organic Contaminant Oxidation step.

Samples were collected for PCDD/DF and PCB congener analyses at select locations during the validation test runs on the floodplain soils (TS-SO-A). The analytical results for these samples are presented in Table C-2 in Appendix C. These results indicate that lower concentrations of PCDD/DFs were detected in the treated soil than in the untreated soil; however there is insufficient data to perform mass balance calculations. The analytical results for the PCB congeners are presented in Table C-3 in Appendix C, and the results for the total PCB congeners are summarized in Table C-1 in Appendix C with the PCB Aroclor results. As shown on Table C-1, the total PCB Aroclor and total PCB congener results agree.

4.4 Summary of Results

The results of the validation test runs of the BioGenesis^{SM} Soil/Sediment Washing Process on the soils/sediment from the Rest-of-River area showed reproducible reductions in PCB concentrations after one treatment cycle. Additional treatment cycles can produce further reductions in PCB concentrations. A summary of the validation test run results are provided in Table 4-10.

Table 4-10 Summary of Validation Test Runs

Type of Material	PCB Concentrations in Untreated Soil/Sediment	Weighted PCB Concentrations in Treated Soil/Sediment			Average Distribution of Recovered Solids after One Treatment Cycle[1]	
		After One Treatment Cycle	After Two Treatment Cycles	After Three Treatment Cycles	Solids in the Treated Soil/Sediment	Solids in the Waste Streams
	mg/kg	mg/kg	mg/kg	mg/kg	%	%
Coarse-grained Sediment (TS-SED-A)	62.6 to 80	12.5 to 29.7	8.4 to 27.3	4.6 to 21.8	> 75 microns 92.3% < 75 microns 6.9% Total 99.2%	Wastewater 0.8%
Fine-grained Sediment (TS-SED-B)	110 to 177	11.5 to 48.4	18.1 to 25.2	11.3 to 18.4	Total 91.7%	Organics 0.2% Wastewater 8.1% Total 8.3%
Floodplain Soils (TS-SO-A)	45 to 55	6.8 to 19.2	5.7 to 12.6	4.2 to 8.5	Total 88.1%	Organics 0.1% Wastewater 11.9% Total 11.9%

Notes:
1. The "Average Distribution of Recovered Solids" values are averages of data from the three validation runs. See Tables 4-1 through 4-9 for calculations on each validation run.

The amount of solids recovered in the treated soil/sediment is related to the grain-size distribution of the untreated soil/sediment. As shown in Table 4-10, for the coarse-grained sediment (TS-SED-A), on average 99% of the recovered solids were in the treated sediment and less than 1% were in the wastewater and waste oversized material after one treatment cycle. This is compared to the fine-grained sediment (TS-SED-B), where on average 92% of the recovered solids were in the treated sediment and 8% were in the wastewater and waste oversized material, and the floodplain soils (TS-SO-A), where approximately 88% of the recovered solids were in the treated solids and 12% were in the wastewater and waste oversized material.

A review of the results of treatment on the silts and clays (hydrocyclone solids and centrifuge solids) indicates that lower concentrations were achieved when treating the fine-grained sediment (TS-SED-B) and floodplain soils (TS-SO-A) than was achieved on the silts and clays in the coarse-grained sediment (TS-SED-A). (See Tables 4-1 through 4-9 for the analytical results of the individual fractions from the hydrocyclones and centrifuge). The explanation for this difference is in the amount of sand in the coarse-grained sediment (TS-SED-A) that was processed through the Application of Collision Forces step, specifically the BioGenesis Collision Chamber. The distribution of sand/silt/clay in the soil/sediment treated in the BioGenesis Collision Chamber, as measured at the Collision Chamber outlet, is represented in Figure 4-1. This shows that the majority of the coarse-grained sediment (TS-SED-A) treated in the Collision Chamber is sand with smaller amounts of silt and clay, while the majority of fine-grained sediment (TS-SED-B) and floodplain soils (TS-SO-A) that was treated in the Collision Chamber is silt and clay with very little sand. Treatment in the Collision Chamber is achieved through impact forces created by accelerating individual soil/sediment particles against a renewable surface. The amount of impact forces applied to an individual soil/sediment particle is related to the particle's mass. In general, larger particles absorb more impact forces than smaller particles. Thus, the sand in the coarse-grained sediment (SED-A) absorbed a significant portion of the energy in the Collision Chamber leaving less energy for cleaning the finer grained material (silts and clays). In the fine-grained sediment (TS-SED-A) and the floodplain soil (TS-SO-A), there was little or no sand so the full effect of the Collision Chamber is focused on the silts/clays.

Since the amount of silts and clays in the coarse-grained sediment (TS-SED-A) is very low (approximately 7% of the recovered solids), additional treatment of these fines was not pursued during the bench-scale treatability study. The impact of this higher concentration fraction on the weighted concentration of the recombined treated sediment is relatively low. Additional treatment of this fraction could be achieved, if desired, by removing the sand fraction after the Collision Chamber and then processing the silts and clays in a second Collision Chamber. Similar reductions in concentrations to those observed in treating the fine-grained sediment (TS-SED-B) and floodplain soils (TS-SO-A) would be expected.

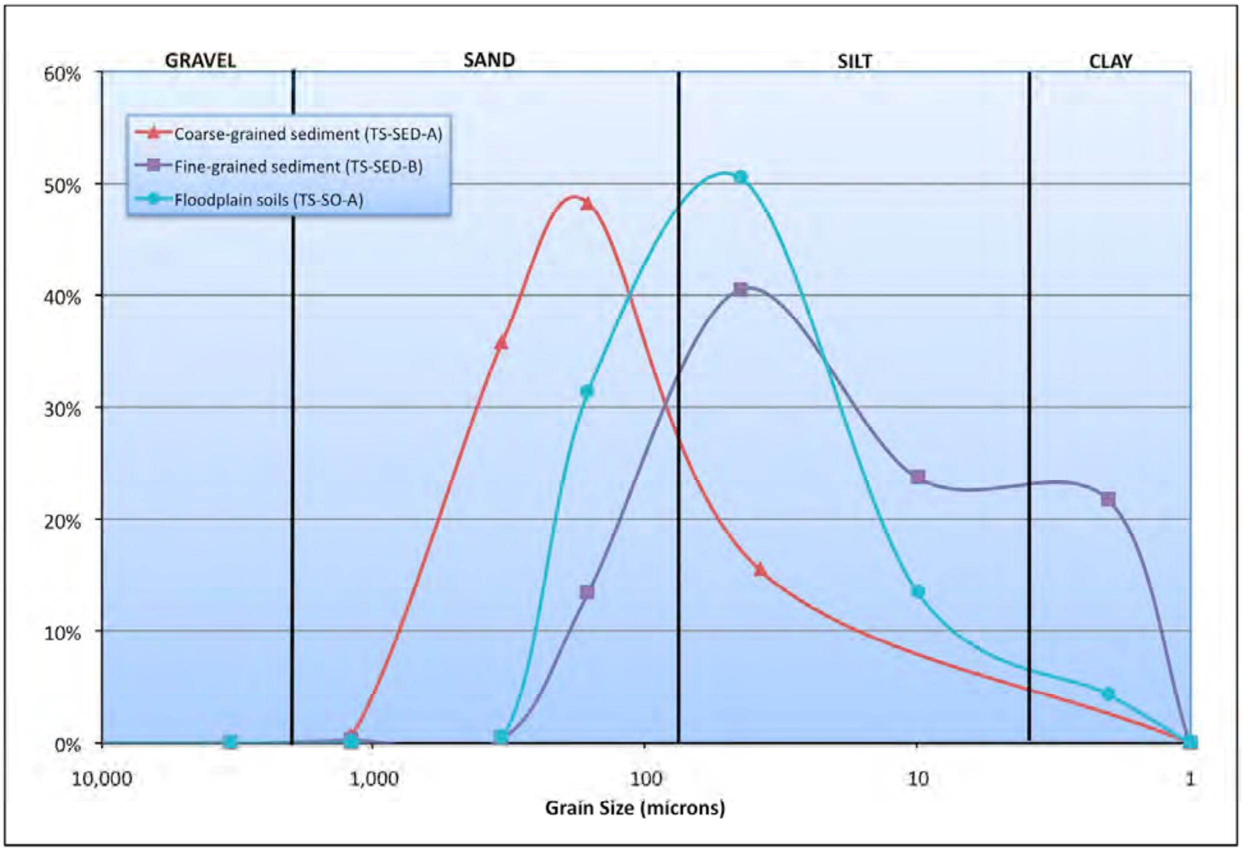

Figure 4-1 Comparison of Grain Size Data for Material Processed Through the BioGenesis Collision Chamber

5 Full-Scale Facility

The BioGenesis^{SM} Soil/Sediment Washing Process can reduce PCB concentrations in the soils/sediment from the Rest-of-River site. Based on the results of the bench-scale treatability study and conversations with GE and ARCADIS, BioGenesis has prepared a conceptual plan and cost estimate for the treatment of soil/sediment from the Rest-of-River site using one treatment cycle through the BioGenesis^{SM} Soil/Sediment Washing Technology. Implemented at full-scale, the treatment facility would follow the general flow schematic illustrated in Figure 5-1.

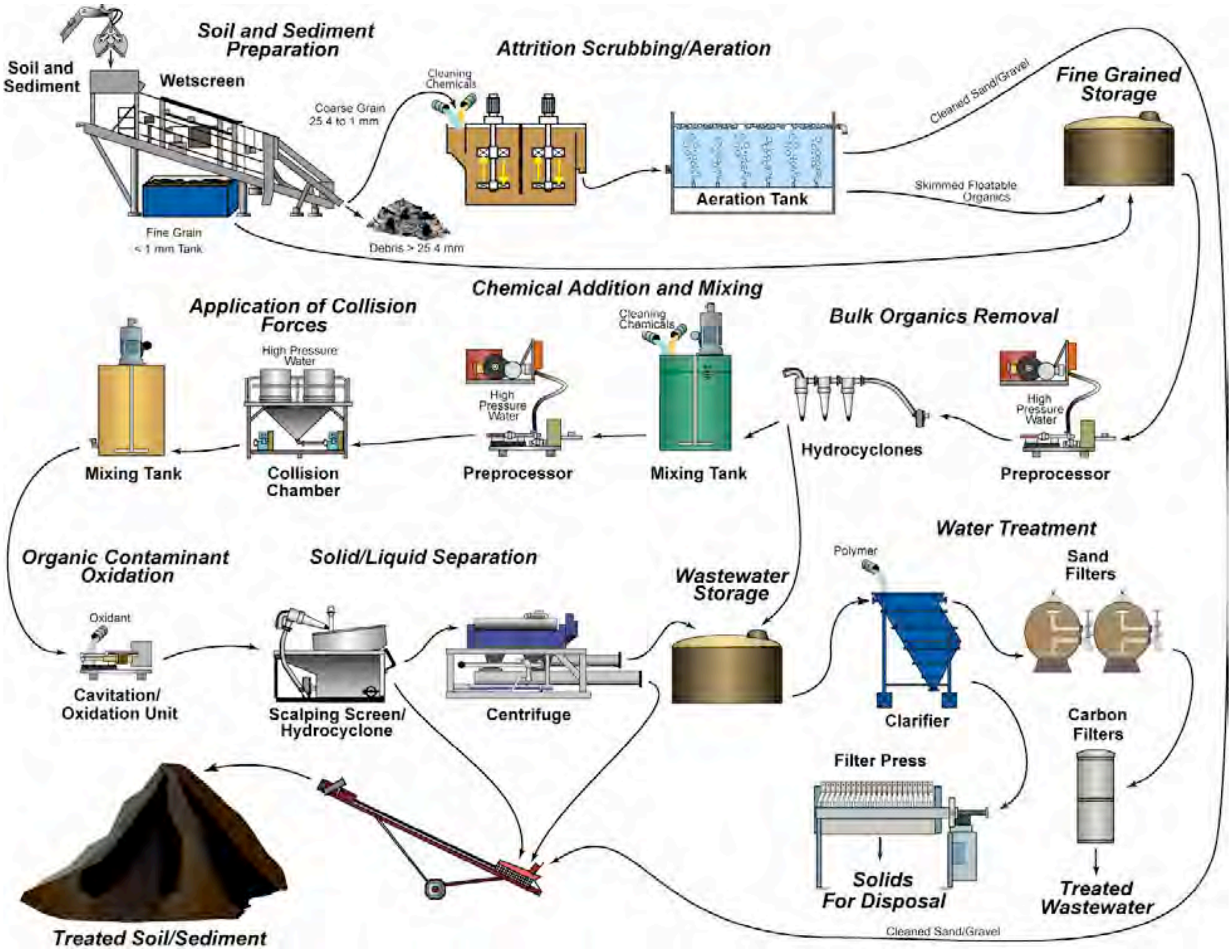

Figure 5-1 Full-Scale BioGenesis Soil/Sediment Washing Facility

As discussed earlier, certain process steps would result in little or no recovered material for the fine-grained sediment (TS-SED-B) and the floodplain soils (TS-SO-A); however, these process steps would be installed to treat the coarse-grained sediment and could be bypassed during treatment of the fine-grained sediment and floodplain soils if these were segregated as separate feed materials. In addition, since there are very little fines in the coarse-grain sediment (TS-SED-A), only one pass through the BioGenesis Collision Chamber has been included.

To provide a range of estimated treatment costs, two removal scenarios were considered: a minimum removal scenario and a maximum removal scenario. The volumes of soil/sediment to be treated using the BioGenesis^{SM} Soil/Sediment Washing Process under these two scenarios and the schedule for excavating these volumes are presented in Table 5-1.

Under the minimum removal scenario, a total of approximately 217,600 cubic yards (cy) of soil/sediment from the Housatonic Rest-of-River area river bottom and floodplain would be treated over an 8.1-year period. To match these potential removal rates, a 20-cy/hr treatment facility would be constructed. An estimated budgetary capital cost for the facility is provided in Table 5-2. The estimated budgetary operating cost and labor hours by labor category for the minimum removal project are presented in Table 5-3.

Under the maximum removal scenario, a total of approximately 3,325,900 cy of soil/sediment from the Housatonic Rest-of-River area river bottom and floodplain would be treated over a 51.5-year period. To match these potential removal rates, a 40-cy/hr treatment facility would be constructed. An estimated budgetary capital cost for the facility is provided in Table 5-4. The estimated budgetary operating cost and labor hours by labor category for the maximum removal project are presented in Table 5-5.

Table 5-1 Estimated Project Volumes and Schedules

	MINIMUM REMOVAL PROJECT				
Location	**Coarse-grained Sediment (SED-A)** (cy)	**Fine-grained Sediment (SED-B)** (cy)	**Flood Plain Soils (SO-A)** (cy)	**Totals** (cy)	**Duration** (years)
Reach 5A	188,688	-	14,501	203,189	7.5
TSCA Material	*45,600*	-	*4,104*		
Non-TSCA Material	*143,088*	-	*10,397*		
Reach 5B and 5C	11,713	-	1,471	13,184	0.4
TSCA Material	-	-	*1,300*		
Non-TSCA Material	*11,713*	-	*172*		
Reach 6 (Woods Pond) & Reach 7	-	-	4,669	4,669	0.2
TSCA Material	-	-	*139*		
Non-TSCA Material	-	-	*4,530*		
Totals	**200,401**	**-**	**20,641**	**221,042**	**8.1**

	MAXIMUM REMOVAL PROJECT				
Location	**Coarse Grained Sediment (SED-A)** (cy)	**Fine Grained Sediment (SED-B)** (cy)	**Flood Plain Soils (SO-A)** (cy)	**Totals** (cy)	**Duration** (years)
Reach 5A	349,488	-	270,736	620,224	11.5
TSCA Material	*127,200*	-	*57,832*		
Non-TSCA Material	*222,288*	-	*212,904*		
Reach 5B	195,313	-	134,787	330,100	6.5
TSCA Material	*18,000*	-	*20,619*		
Non-TSCA Material	*177,313*	-	*114,168*		
Reach 5C & Backwaters	334,800	464,640	122,245	921,685	9.6
TSCA Material	*148,800*	*86,400*	*49,735*		
Non-TSCA Material	*186,000*	*378,240*	*72,509*		
Reach 6 (Woods Pond)	-	693,168	8,460	701,628	4.2
TSCA Material	-	*237,600*	*2,766*		
Non-TSCA Material	-	*455,568*	*5,694*		
Plant Downtime	-	-	-	-	6.6
Reach 7 (inc. Impoundments)	-	103,200	146,582	249,782	4.4
TSCA Material	-	-	-		
Non-TSCA Material	-	*103,200*	*146,582*		
Reach 8 (Rising Pond)	-	561,600	-	561,600	8.7
TSCA Material	-	*22,800*	-		
Non-TSCA Material	-	*538,800*	-		
Totals	**879,601**	**1,822,608**	**682,809**	**3,385,018**	**51.5**

Notes:

1. Removal volumes and duration provided by ARCADIS on March 11, 2008.
2. Sediment and floodplain soil volumes include a 20% bulking factor.
3. The duration is presented in terms of construction years. One construction year includes 9 months at 22 days per month.
4. Area 5C and the backwaters will operate concurrently.
5. Downtime includes time when backfill will be performed after excavation is entirely complete and no new materials will be excavated and treated until operations progress in the next reach.

Table 5-2 Estimated Capital Cost Breakdown - 20 cy/hr Facility

Cost Component	**Quantity**	**Unit Cost**	**Total Cost ($)**
Upfront Storage			
Storage Cells (precast concrete)	150	$1,000	$150,000
Screening Facilities			
Screening Equipment	1	$110,000	$110,000
Transfer Pumps	2	$9,000	$18,000
Attrition Scrubbing	2	$64,000	$128,000
Aeration/Flotation Unit	1	$90,000	$90,000
Preprocessing Facilities			
Mix Tanks	1	$24,000	$24,000
Mixers	2	$15,000	$30,000
Preprocessors (1skid w/1+1)	1	$68,000	$68,000
Blaster Pump (350 Hp)	1	$94,000	$94,000
Prewash Cyclone Facilities			
Mix Tanks	1	$24,000	$24,000
Mixers	2	$15,000	$30,000
Feed Pump	1	$9,000	$9,000
Cyclone/Shaker Screen	1	$75,000	$75,000
Preprocessing Facilities			
Mix Tanks	1	$24,000	$24,000
Mixers	2	$15,000	$30,000
Preprocessors (1skid w/1+1)	1	$68,000	$68,000
Blaster Pump (350 Hp)	1	$94,000	$94,000
Collision Facilities			
Surge Tank	1	$24,000	$24,000
Mixers	2	$15,000	$30,000
Collision Chamber	1	$410,000	$410,000
Blaster Pump (350 Hp)	1	$94,000	$94,000
Cav/Ox Facilities			
Mix Tank	1	$24,000	$24,000
Mixers	2	$15,000	$30,000
Cav/Ox Units	4	$61,000	$244,000
Liquid/Solid Separation			
Hydrocyclone unit (tanks, pumps, screeners, mixers)	1	$190,000	$190,000
Mix Tank	1	$24,000	$24,000
Mixers	2	$15,000	$30,000
Centrifuges	1	$340,000	$340,000
Wastewater Treatment			
Centrifuges	1	$340,000	$340,000
Tank	1	$24,000	$24,000
Mixers	2	$15,000	$30,000
Clarifier Feed Pumps	2	$8,000	$16,000
Solids Contact Clarifier	1	$75,000	$75,000
Sludge Blowdown Pumps	1	$11,000	$11,000
Thickening Tank w/Rake	1	$38,000	$38,000
Chemical Modifier Feed Tank	1	$2,000	$2,000

Table 5-2 Estimated Capital Cost Breakdown - 20 cy/hr Facility (continued)

Cost Component	**Quantity**	**Unit Cost**	**Total Cost ($)**
Wastewater Treatment (continued)			
Chemical Feed Pump	1	$1,000	$1,000
Press Feed Pumps	1	$11,000	$11,000
Filter Press	1	$375,000	$375,000
Filtrate Tank	1	$2,000	$2,000
Filtrate Return Pumps	1	$2,000	$2,000
Clarifier Overflow Tank	1	$1,000	$1,000
Mixers	2	$4,000	$8,000
Pressure Filters	1	$90,000	$90,000
Filter Feed pumps	2	$9,000	$18,000
Filter Backwash Pumps	1	$8,000	$8,000
Effluent Pumps	2	$8,000	$16,000
Chemical Feed Systems			
Surfactant Tank	1	$3,000	$3,000
Mixer	1	$2,000	$2,000
Surfactant Feed Pumps	2	$1,000	$2,000
Defoamer Feed Pumps	2	$1,000	$2,000
Peroxide Storage Tank	1	$7,000	$7,000
Peroxide Feed Pumps	4	$1,000	$4,000
Polyblend Unit	1	$6,000	$6,000
Treated Sediment Storage			
Storage Cells (precast concrete walls)	150	$1,000	$150,000
Transfer Conveyor to Storage	1	$35,000	$35,000
Stacker Conveyor (into storage area)	1	$25,000	$25,000
Plant Air Compressor	1	$20,000	$20,000
Equipment Capital Cost			**$3,830,000**
Engineering and Installation Costs			
Engineering/Procurement	15%		$574,500
Equipment Installation	20%		$766,000
Mechanical	20%		$766,000
Electrical and Instrumentation	20%		$766,000
Subtotal Equipment and Installation Costs			**$6,702,500**
Profit	20%		$1,340,500
Contingency	25%		$1,675,625
Total Capital Cost			**$9,718,625**

Table 5-3 Operations Cost Estimate - Minimum Removal Project

	Reach 5A	Reach 5B	Reach 6 (Woods Pond) & Reach 7	TOTALS
Removal Volumes				
Coarse Grained Sediment (cy)	188,688	11,713	0	200,401
Fine Grained Sediment (cy)	0	0	0	0
Floodplain Soils (cy)	14,501	1,471	4,669	20,641
Total Removal Volume (cy)	**203,189**	**13,184**	**4,669**	**221,042**
Operational Schedule				
Duration (years)	7.5	0.4	0.2	8.1
Total Months	67.5	3.6	1.8	72.9
Total Operating Hours	10,544	729	602	11,874
Processing Rates				
Monthly Processing Rate (cy/month)	2,653	3,433	5,642	2,766
Daily Processing Rate (cy/day)	121	156	256	126
Operator hours	52,718	3,643	3,010	59,370
Laborer hours	21,087	1,457	1,204	23,748
Total Project Hours	115,979	7,730	5,766	129,474
Plant Labor Costs	$4,777,523	$332,096	$242,540	$5,352,159
Utility Costs				
Power Costs	$1,726,506	$119,315	$98,565	$1,944,386
Water Costs	$167,930	$11,742	$10,775	$190,447
Wastewater Costs	$0	$0	$0	$0
Waste Disposal Costs				
Oversized Debris T&D	$458,798	$28,641	$1,307	$488,746
WWTP TSCA Sludge T&D	$566,658	$50,463	$5,405	$622,526
WWTP Non TSCA T&D	$764,441	$50,584	$79,955	$894,980
Chemical Costs	$4,581,061	$316,148	$259,770	$5,156,978
Overhead Costs	$4,178,642	$230,590	$122,944	$4,532,177
Subtotal Operating Costs	**$17,221,558**	**$1,139,580**	**$821,261**	**$19,182,400**
Profit	$3,444,312	$227,916	$164,252	$3,836,480
Contingency	$4,305,390	$284,895	$205,315	$4,795,600
Total Operating Costs	**$24,971,260**	**$1,652,391**	**$1,190,829**	**$27,814,480**

Table 5-4 Estimated Capital Cost Breakdown - 40 cy/hr Facility

Cost Component	**Quantity**	**Unit Cost**	**Total Cost ($)**
Upfront Storage			
Storage Cells (precast concrete)	150	$1,000	$150,000
Screening Facilities			
Screening Equipment	1	$150,000	$150,000
Transfer Pumps	2	$12,000	$24,000
Attrition Scrubbing	2	$85,000	$170,000
Aeration/Flotation Unit	1	$120,000	$120,000
Preprocessing Facilities			
Mix Tanks	1	$32,000	$32,000
Mixers	2	$19,400	$38,800
Preprocessors (1skid w/1+1)	1	$91,000	$91,000
Blaster Pump (350 Hp)	1	$125,000	$125,000
Prewash Cyclone Facilities			
Mix Tanks	1	$32,000	$32,000
Mixers	2	$19,400	$38,800
Feed Pump	1	$12,000	$12,000
Cyclone/Shaker Screen	1	$100,000	$100,000
Preprocessing Facilities			
Mix Tanks	1	$32,000	$32,000
Mixers	2	$19,400	$38,800
Preprocessors (1skid w/1+1)	1	$91,000	$91,000
Blaster Pump (350 Hp)	1	$125,000	$125,000
Collision Facilities			
Surge Tank	1	$32,000	$32,000
Mixers	2	$19,400	$38,800
Collision Chamber	1	$540,000	$540,000
Blaster Pump (350 Hp)	1	$125,000	$125,000
Cav/Ox Facilities			
Mix Tank	1	$32,000	$32,000
Mixers	2	$19,400	$38,800
Cav/Ox Units	4	$81,000	$324,000
Liquid/Solid Separation			
Hydrocyclone unit (tanks, pumps, screeners, mixers)	1	$250,000	$250,000
Mix Tank	1	$32,000	$32,000
Mixers	2	$19,400	$38,800
Centrifuges	1	$450,000	$450,000
Wastewater Treatment			
Centrifuges	1	$450,000	$450,000
Tank	1	$32,000	$32,000
Mixers	2	$19,400	$38,800
Clarifier Feed Pumps	2	$10,000	$20,000
Solids Contact Clarifier	1	$100,000	$100,000
Sludge Blowdown Pumps	1	$15,000	$15,000
Thickening Tank w/Rake	1	$50,000	$50,000
Chemical Modifier Feed Tank	1	$3,000	$3,000

Table 5-4 Estimated Capital Cost Breakdown - 40 cy/hr Facility (continued)

Cost Component	**Quantity**	**Unit Cost**	**Total Cost ($)**
Wastewater Treatment (continued)			
Chemical Feed Pump	1	$1,500	$1,500
Press Feed Pumps	1	$15,000	$15,000
Filter Press	1	$500,000	$500,000
Filtrate Tank	1	$3,000	$3,000
Filtrate Return Pumps	1	$3,000	$3,000
Clarifier Overflow Tank	1	$1,000	$1,000
Mixers	2	$5,000	$10,000
Pressure Filters	1	$125,000	$125,000
Filter Feed pumps	2	$12,000	$24,000
Filter Backwash Pumps	1	$10,000	$10,000
Effluent Pumps	2	$10,000	$20,000
Chemical Feed Systems			
Surfactant Tank	1	$4,500	$4,500
Mixer	1	$2,500	$2,500
Surfactant Feed Pumps	2	$1,560	$3,120
Defoamer Feed Pumps	2	$1,560	$3,120
Peroxide Storage Tank	1	$9,000	$9,000
Peroxide Feed Pumps	4	$1,560	$6,240
Polyblend Unit	1	$8,000	$8,000
Treated Sediment Storage			
Storage Cells (precast concrete walls)	150	$1,000	$150,000
Transfer Conveyor to Storage	1	$35,000	$35,000
Stacker Conveyor (into storage area)	1	$25,000	$25,000
Plant Air Compressor	1	$30,000	$30,000
Equipment Capital Cost			**$4,969,580**
Engineering and Installation Costs			
Engineering/Procurement	15%		$745,437
Equipment Installation	20%		$993,916
Mechanical	20%		$993,916
Electrical and Instrumentation	20%		$993,916
Subtotal Equipment and Installation Costs			**$8,696,765**
Profit	20%		$1,739,353
Contingency	25%		$2,174,191
Total Capital Cost			**$12,610,309**

Table 5-5 Operations Cost Estimate - Maximum Removal Project

	Reach 5A	Reach 5B	Reach 5C & Backwaters	Reach 6 (Woods Pond)
Removal Volumes				
Coarse Grained Sediment (cy)	349,488	195,313	334,800	0
Fine Grained Sediment (cy)	0	0	464,640	693,168
Floodplain Soils (cy)	270,736	134,787	122,245	8,460
Total Removal Volume (cy)	**620,224**	**330,100**	**921,685**	**701,628**
Operational Schedule				
Duration (years)	11.5	6.5	9.6	4.2
Total Months	103.5	58.5	86.4	37.8
Total Operating Hours	25,502	13,256	28,892	20,518
Processing Rates				
Monthly Processing Rate (cy/month)	8,330	7,622	11,335	18,311
Daily Processing Rate (cy/day)	379	346	515	796
Plant Labor Hours by Category				
Plant Manager hours	18,216	10,296	15,206	6,653
Engineer hours	18,216	10,296	15,206	6,653
Clerk hours	18,216	10,296	15,206	6,653
Shift Supervisor hours	25,502	13,256	28,892	20,518
Operator hours	178,517	92,793	202,245	143,625
Laborer hours	51,005	26,512	57,784	41,036
Total Project Hours	309,672	163,449	334,541	225,137
Plant Labor Costs	$14,254,020	$7,356,210	$14,289,739	$9,924,454
Utility Costs				
Power Costs	$5,285,182	$2,747,228	$5,987,684	$4,252,169
Water Costs	$873,828	$450,230	$805,326	$444,162
Wastewater Costs	$0	$0	$0	$0
Waste Disposal Costs				
Oversized Debris T&D	$918,072	$508,445	$1,449,775	$910,419
WWTP TSCA Sludge T&D	$3,381,751	$961,393	$4,307,640	$2,987,591
WWTP Non TSCA T&D	$4,660,245	$2,734,957	$4,119,053	$2,610,679
Chemical Costs	$16,190,471	$8,373,559	$18,390,944	$12,998,201
Overhead Costs	$8,165,736	$4,545,375	$7,055,688	$3,531,320
Subtotal Operating Costs	**$53,729,306**	**$27,677,397**	**$56,405,850**	**$37,658,994**
Profit	$10,745,861	$5,535,479	$11,281,170	$7,531,799
Contingency	$13,432,326	$6,919,349	$14,101,462	$9,414,749
Total Operating Costs	**$77,907,493**	**$40,132,226**	**$81,788,482**	**$54,605,542**

Table 5-5 Operations Cost Estimate - Maximum Removal Project (continued)

	Plant Downtime	Reach 7 (inc. Impoundments)	Reach 8 (Rising Pond)	TOTALS
Removal Volumes				
Coarse Grained Sediment (cy)	0	0	0	879,601
Fine Grained Sediment (cy)	0	103,200	561,600	1,822,608
Floodplain Soils (cy)	0	146,582	0	682,809
Total Removal Volume (cy)	**0**	**249,782**	**561,600**	**3,385,018**
Operational Schedule				
Duration (years)	6.6	4.4	8.7	51.5
Total Months	0	39.6	78.3	404.1
Total Operating Hours	0	12,371	16,365	116,904
Processing Rates				
Monthly Processing Rate (cy/month)	0	10,584	6,972	9,761
Daily Processing Rate (cy/day)	0	481	317	442
Plant Labor Hours by Category				
Plant Manager hours	0	6,970	13,781	71,122
Engineer hours	0	6,970	13,781	71,122
Clerk hours	0	6,970	13,781	71,122
Shift Supervisor hours	0	12,371	16,365	116,904
Operator hours	0	86,597	114,553	818,330
Laborer hours	0	24,742	32,729	233,808
Total Project Hours	0	144,619	204,989	1,382,407
Plant Labor Costs	$0	$6,163,141	$9,012,697	$61,000,262
Utility Costs				
Power Costs	$0	$2,563,806	$3,391,462	$24,227,530
Water Costs	$0	$401,493	$344,039	$3,319,078
Wastewater Costs	$0	$0	$0	$0
Waste Disposal Costs				
Oversized Debris T&D	$0	$176,235	$735,696	$4,698,642
WWTP TSCA Sludge T&D	$0	$0	$276,382	$11,914,757
WWTP Non TSCA T&D	$0	3,155,811	$2,968,788	$20,249,533
Chemical Costs	$0	$7,870,868	$10,251,095	$74,075,138
Overhead Costs	$0	$3,195,225	$6,000,479	$32,493,822
Subtotal Operating Costs	**$0**	**$23,526,579**	**$32,980,637**	**$231,978,763**
Profit	$0	$4,705,316	$6,596,127	$46,395,753
Contingency	$0	$5,881,645	$8,245,159	$57,994,691
Total Operating Costs	**$0**	**$34,113,539**	**$47,821,924**	**$336,369,206**

A summary of the total costs for treatment of the soil/sediment from the Rest-of-River area under each potential removal scenario are provided below:

	Minimum Removal Project	**Maximum Removal Project**
Removal Volumes		
Coarse-grained sediment (TS-SED-A)	200,401 cy	879,601 cy
Fine-grained sediment (TS-SED-B)	0 cy	1,822,608 cy
Floodplain soils (TS-SO-A)	20,641 cy	682,809 cy
Total	**221,042 cy**	**3,385,018 cy**
Capital Costs	$ 9,718,625	$ 12,610,309
Operating Costs	$ 27,814,480	$ 336,369,206
Total Costs	**$ 37,533,105**	**$ 348,979,515**
Unit Operating costs		
Coarse-grained sediment (TS-SED-A)	$ 107.55/cy	$ 67.91/cy
Fine-grained sediment (TS-SED-B)	(none)	$ 81.13/cy
Floodplain soils (TS-SO-A)	$ 303.30/cy	$ 188.58/cy
Average cost (weighted)	$ 125.83/cy	$ 99.37/cy

The following assumptions were used in developing these costs estimates:

- Costs include a 25% contingency on the capital costs and operating costs.
- Cost estimates have been prepared to provide budgetary planning costs. The accuracy of the estimates is +30%, -15%.
- Costs are based on current (2008) costs. No provision is made for price inflation during the life of the project.
- Capital costs do not include costs for land or a building. A constructed prefab metal building for the process facility could cost an estimated $ 3,000,000.
- Soil/sediment will be delivered to the facility with the following characteristics:
  - Coarse-grained sediment with a density of 1.54 tons/cy and a solids content of 80.7% solids by weight.
  - Fine-grained sediment with a density of 0.96 tons/cy and a solids content of 30.6% solids by weight.

    - Floodplain soils with a density of 1.02 tons/cy and a solids content of 67.1%.

- If the material is dewatered prior to delivery to the facility, it is assumed that no stabilization chemicals will be used to dewater the soil/sediment. Costs have been included to prepare the dewatered soil/sediment for treatment by the BioGenesis Soil/Sediment Washing Process.

- In order to process the excavated soil/sediment through the BioGenesis Soil/Sediment Washing Process, water will be added throughout the process. The full-scale facility includes a water treatment component that will treat the wastewater to meet applicable discharge criteria. The volumes of wastewater generated during the treatment of the Rest-of-River area soils/sediment are:

    - Coarse-grained sediment (TS-SED-A): 240 gal/cy

    - Fine-grained sediment (TS-SED-B): 280 gal/cy

    - Floodplain soils (TS-SO-A): 650 gal/cy

- The operating schedule is based on 9 months per year and 22 days per month

- Utility costs are based on \$0.11/kw-hr for electricity and \$3.50/thousand gallons for potable water. It is assumed that treated wastewater will meet applicable discharge requirements and be discharged to the river.

- The following breakdown of treated solids and waste solids were used in the cost estimate using data from the bench-scale treatability study and assuming one treatment cycle:

Distribution of Solids Following BioGenesis Treatment

	Coarse-grained sediment (TS-SED-A)	Fine-grained sediment (TS-SED-B)	Flood-plain soils (TS-SO-A)
Treated Solids	96.2%	88.2%	84.4%
Waste Oversized	1.9%	0.6%	0.1%
Wastewater Treatment Sludge	1.9%	11.2%	15.5%

- Transportation and disposal costs for oversized materials/debris and non-TSCA wastewater treatment sludge are based on \$100.00/ton. Transportation and disposal costs for TSCA wastewater treatment sludge are based on \$220.00/ton.

- Overhead costs include costs for project management, fuel, equipment maintenance, rental equipment, safety equipment, and process control analytical analyses. Analytical costs associated with the disposition of treated soil/sediment are not included.

- Costs for the disposition or reuse of the treated soil/sediment are not included. For each cubic yard of soil/sediment excavated and processed with the BioGenesis Soil/Sediment Washing Process, the treated soil/sediment will have the following characteristics:
  - Coarse-grained sediment (TS-SED-A): 1.32 tons of washed sediment at 90% solids by weight.
  - Fine-grained sediment (TS-SED-B): 0.44 tons of washed sediment at 59% solids by weight.
  - Floodplain soils (TS-SO-A): 0.81 tons of washed soil at 71% solids by weight.

APPENDIX A

BENCH-SCALE EQUIPMENT PHOTOS

Photo 1 – Bench-Scale System Overview

Photo 2 – Sediment Slurry in Preprocessor Mix Tank

Photo 3 – Pump Skid, Centrifuge, Shaker Screen, and Collision Chamber

Photo 4 – Hydrocyclones/Shaker Screen

Photo 5 – Centrifuge

Photo 6 – Pressure Filter

APPENDIX B

OPTIMIZATION DATA SUMMARY

Table B-1
Summary of Analytical Data from Optimization Test Runs

			SOLIDS ANALYSES				AQUEOUS ANALYSES			
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Total PCBs (ppm)**	**TOC Relative Percent Diff. (%)**	**Average TOC (ppm)**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Filtered Total PCBs (ug/L)**	**Unfiltered Total PCBs (ug/L)**
Run 1 - Coarse-grained Sediment (TS-SED-A)										
	No Samples	-	-	-	-	-	-	-	-	-
Run 2 - Flood Plain Soils (TS-SO-A)										
BTS-R2-S1	Untreated Sediment	S	68.1%	49.5	4.44%	44,600	-	-	-	-
BTS-R2-S2	Screenings	S	69.6%	8.280	21.8 %	12,800	-	-	-	-
BTS-R2-S3	Centrifuge Cake	S	66.7%	46.5	11.8 %	39,000	-	-	-	-
BTS-R2-S4	Centrate	AQ	-	-	-	-	1,910	4,610	-	-
Run 3 - Fine-grained Sediment (TS-SED-B)										
BTS-R3-S1	Untreated Sediment	S	25.6%	136.0	7.66%	98,200	-	-	-	-
BTS-R3-S2	Screenings	S	50.2%	14.72	5.49%	53,100	-	-	-	-
BTS-R3-S3	Centrifuge Cake	S	66.6%	15.23	27.3 %	49,500	-	-	-	-
BTS-R3-S4	Centrate	AQ	-	-	-	-	1,260	6,340	-	-
BTS-R3-S5	Screenings	S	43.2%	24.96	4.69%	80,900	-	-	-	-
BTS-R3-S6	Centrifuge Cake	S	47.7%	45.0	14.9 %	51,200	-	-	-	-
BTS-R3-S7	Centrifuge Cake	S	54.7%	34.59	36.7 %	34,000	-	-	-	-
Run 4 - Flood Plain Soils (TS-SO-A)										
BTS-R4-S1	Untreated Sediment	S	67.3%	51.7	3.82%	48,700	-	-	-	-
BTS-R4-S2	Screenings	S	69.6%	5.19	47.1 %	24,500	-	-	-	-
BTS-R4-S3	Centrifuge Cake	S	62.1%	47.5	34.6 %	58,400	-	-	-	-
BTS-R4-S4	Screenings	S	70.1%	5.00	7.32%	17,400	-	-	-	-
BTS-R4-S5	Centrifuge Cake	S	54.6%	53.1	16.9 %	81,400	-	-	-	-

Table B-1
Summary of Analytical Data from Optimization Test Runs

			SOLIDS ANALYSES				AQUEOUS ANALYSES			
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Total PCBs (ppm)**	**TOC Relative Percent Diff. (%)**	**Average TOC (ppm)**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Filtered Total PCBs (ug/L)**	**Unfiltered Total PCBs (ug/L)**
Run 5 - Coarse-grained Sediment (TS-SED-A)										
BTS-R5-S1	Untreated Sediment	S	65.9%	105.6	21.8 %	8,330	-	-	-	-
BTS-R5-S2	Screenings	S	94.7%	19.33	15.9 %	42,000	-	-	-	-
BTS-R5-S3	Screenings	S	77.0%	10.59	24.4 %	5,790	-	-	-	-
BTS-R5-S4	Screenings	S	63.8%	78.4	20.3 %	21,000	-	-	-	-
BTS-R5-S5	Centrate	AQ	-	-	-	-	ND	647	47.3	1,733
BTS-R5-S6	Centrifuge Cake	S	77.4%	137.3	39.1 %	17,800	-	-	-	-
BTS-R5-S7	Screenings	S	62.2%	32.94	46.5 %	16,700	-	-	-	-
BTS-R5-S8	Screenings	S	67.0%	32.50	9.52%	9,940	-	-	-	-
BTS-R5-S9	Centrate	AQ	-	-	-	-	ND	460	96.6	602.7
BTS-R5-S10	Centrifuge Cake	S	56.9%	140.7	7.04%	18,600	-	-	-	-
Run 6 - Coarse-grained Sediment (TS-SED-A)										
BTS-R6-S1	Untreated Sediment	S	72.8%	63.31	55.5 %	11,600	-	-	-	-
BTS-R6-S2	Screenings	S	98.4%	13.33	70.2 %	87,100	-	-	-	-
BTS-R6-S3	Screenings	S	96.4%	3.100	130 %	256,000	-	-	-	-
BTS-R6-S4	Screenings	S	94.9%	24.95	91.4 %	30,900	-	-	-	-
BTS-R6-S5	Screenings	S	82.2%	22.69	43.3 %	7,130	-	-	-	-
BTS-R6-S6	Screenings	S	69.3%	18.51	12.7 %	8,660	-	-	-	-
BTS-R6-S7	Centrate	AQ	-	-	-	-	265	179	24.4	1,376
BTS-R6-S8	Centrifuge Cake	S	58.4%	141.7	1.58%	25,300	-	-	-	-
BTS-R6-S9	Screenings	S	79.7%	31.18	13.5 %	3,940	-	-	-	-

Table B-1
Summary of Analytical Data from Optimization Test Runns

			SOLIDS ANALYSES				AQUEOUS ANALYSES			
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Total PCBs (ppm)**	**TOC Relative Percent Diff. (%)**	**Average TOC (ppm)**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Filtered Total PCBs (ug/L)**	**Unfiltered Total PCBs (ug/L)**
BTS-R6-S10	Screenings	S	70.6%	18.81	3.92%	13,800	-	-	-	-
BTS-R6-S11	Centrate	AQ	-	-	-	-	70.0	164	4.57	198.3
BTS-R6-S12	Centrifuge Cake	S	55.6%	100.7	3.46%	23,800	-	-	-	-
Run 7 - Fine-grained Sediment (TS-SED-B)										
BTS-R7-S1	Untreated Sediment	S	32.5%	138.4	2.99%	93,800	-	-	-	-
BTS-R7-S2	Screenings	S	15.2%	82.0	17.9 %	352,000	-	-	-	-
BTS-R7-S3	Screenings	S	59.8%	19.90	11.4 %	39,300	-	-	-	-
BTS-R7-S4	Centrate	AQ	-	-	-	-	564	2,500	6.13	1,911
BTS-R7-S5	Centrifuge Cake	S	47.0%	35.74	16.7 %	91,900	-	-	-	-
BTS-R7-S6	Screenings	S	60.6%	14.10	35.3 %	45,200	-	-	-	-
BTS-R7-S7	Centrate	AQ	-	-	-	-	128	2,510	1.12	944
BTS-R7-S8	Centrifuge Cake	S	53.0%	49.3	5.49%	69,000	-	-	-	-
Run 8 - Flood Plain Soils (TS-SO-A)										
BTS-R8-S1	Untreated Sediment	S	67.7%	32.2	4.95%	43,900	-	-	-	-
BTS-R8-S2	Screenings	S	72.1%	6.05	6.63%	18,000	-	-	-	-
BTS-R8-S3	Centrate	AQ	-	-	-	-	773	6,690	2.14	428
BTS-R8-S4	Centrifuge Cake	S	64.7%	57.6	24.8 %	65,400	-	-	-	-
BTS-R8-S5	Screenings	S	70.1%	6.57	4.23%	19,300	-	-	-	-
BTS-R8-S6	Centrate	AQ	-	-	-	-	300	2,070	0.324	198
BTS-R8-S7	Centrifuge Cake	S	63.6%	39.7	34.8 %	32,200	-	-	-	-

Table B-1
Summary of Analytical Data from Optimization Test Runs

			SOLIDS ANALYSES				AQUEOUS ANALYSES			
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Total PCBs (ppm)**	**TOC Relative Percent Diff. (%)**	**Average TOC (ppm)**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Filtered Total PCBs (ug/L)**	**Unfiltered Total PCBs (ug/L)**
Run 9 - Fine-grained Sediment (TS-SED-B)										
BTS-R9-S1	Untreated Sediment	S	30.7%	101.2	8.28%	75,100	-	-	-	-
BTS-R9-S2	Waste Oversized (Organics)	S	16.3%	98.1	33.5 %	228,000	-	-	-	-
BTS-R9-S3	Wastewater	AQ	-	-	-	-	347	17,500	ND	105.9
BTS-R9-S4	Intermediate Soil	S	41.3%	97.8	10.1 %	118,000	-	-	-	-
BTS-R9-S5	Wastewater	AQ	-	-	-	-	687	3,950	ND	164.5
BTS-R9-S6	Wastewater	AQ	-	-	-	-	852	4,760	8.00	199.3
BTS-R9-S7	Wastewater	AQ	-	-	-	-	556	996	4.57	145.1
BTS-R9-S8	Intermediate Soil	S	54.8%	16.64	2.05%	39,600	-	-	-	-
BTS-R9-S9	Intermediate Soil	S	69.5%	3.792	6.35%	24,500	-	-	-	-
BTS-R9-S10	Wastewater	AQ	-	-	-	-	241	353	0.602	54.6
BTS-R9-S11	Intermediate Soil	S	57.6%	9.34	9.37%	44,700	-	-	-	-
BTS-R9-S12	Outlet > 37 microns	S	68.4%	7.38	21.8 %	14,500	-	-	-	-
BTS-R9-S13	Wastewater	AQ	-	-	-	-	207	221	0.271	14.89
BTS-R9-S14	Outlet Centrifuge Cake	S	54.9%	4.068	4.15%	41,400	-	-	-	-
BTS-R9-S15	Wastewater	AQ	-	-	-	-	210	297	0.238	30.00
BTS-R9-S16	Intermediate Soil	S	34.7%	25.83	5.30%	92,900	-	-	-	-
BTS-R9-S17	Intermediate Soil	S	69.9%	5.30	2.04%	26,200	-	-	-	-
Run 10 - Fine-grained Sediment (TS-SED-B)										
BTS-R10-S1	Untreated Sediment	S	29.7%	61.9	7.18%	85,000	-	-	-	-
BTS-R10-S2	Waste Oversized (Organics)	S	15.8%	186.1	14.4 %	215,000	-	-	-	-

Table B-1
Summary of Analytical Data from Optimization Test Runs

			SOLIDS ANALYSES				AQUEOUS ANALYSES			
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Total PCBs (ppm)**	**TOC Relative Percent Diff. (%)**	**Average TOC (ppm)**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Filtered Total PCBs (ug/L)**	**Unfiltered Total PCBs (ug/L)**
BTS-R10-S3	Wastewater	AQ	-	-	-	-	720	19,100	1.60	73.0
BTS-R10-S4	Wastewater	AQ	-	-	-	-	550	6,210	16.51	87.3
BTS-R10-S5	Intermediate Soil	S	70.4%	4.82	7.99%	25,800	-	-	-	-
BTS-R10-S6	Intermediate Soil	S	55.0%	15.98	9.31%	41,600	-	-	-	-
BTS-R10-S7	Wastewater	AQ	-	-	-	-	1,020	1,160	13.33	515
BTS-R10-S8	Wastewater	AQ	-	-	-	-	326	3,430	0.243	110.9
BTS-R10-S9	Intermediate Soil	S	67.9%	4.64	4.39%	28,200	-	-	-	-
BTS-R10-S10	Wastewater	AQ	-	-	-	-	166	367	0.463	46.45
BTS-R10-S11	Intermediate Soil	S	58.4%	7.56	14.6 %	56,300	-	-	-	-
BTS-R10-S12	Wastewater	AQ	-	-	-	-	107	1,810	0.0969	32.04
BTS-R10-S13	Outlet > 37 microns	S	63.1%	5.49	7.79%	47,300	-	-	-	-
BTS-R10-S14	Outlet Centrifuge Cake	S	52.7%	6.85	3.98%	33,100	-	-	-	-
BTS-R10-S15	Wastewater	AQ	-	-	-	-	92.0	474	0.172	16.44
BTS-R10-S16	Outlet > 37 microns (Dup)	S	66.8%	5.32	25.4 %	26,500	-	-	-	-
Run 11 - Flood Plain Soils (TS-SO-A)										
BTS-R11-S1	Untreated Sediment	S	66.2%	32.2	9.50%	45,400	-	-	-	-
BTS-R11-S2	Waste Oversized (Organics)	S	23.4%	17.5	11.8 %	162,000	-	-	-	-
BTS-R11-S3	Wastewater	AQ	-	-	-	-	227	26,400	2.35	17.5
BTS-R11-S4	Intermediate Soil	S	40.9%	77.4	9.18%	115,000	-	-	-	-
BTS-R11-S5	Wastewater	AQ	-	-	-	-	180	8,930	2.10	67.6

Table B-1
Summary of Analytical Data from Optimization Test Runs

			SOLIDS ANALYSES				AQUEOUS ANALYSES			
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Total PCBs (ppm)**	**TOC Relative Percent Diff. (%)**	**Average TOC (ppm)**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Filtered Total PCBs (ug/L)**	**Unfiltered Total PCBs (ug/L)**
BTS-R11-S6	Intermediate Soil	S	74.3%	4.57	29.7 %	14,700	-	-	-	-
BTS-R11-S7	Intermediate Soil	S	73.1%	5.99	7.55%	12,700	-	-	-	-
BTS-R11-S8	Intermediate Soil	S	52.2%	29.4	24.1 %	49,200	-	-	-	-
BTS-R11-S9	Wastewater	AQ	-	-	-	-	953	13,800	2.56	145
BTS-R11-S10	Intermediate Soil	S	68.7%	11.5	24.2 %	20,100	-	-	-	-
BTS-R11-S11	Wastewater	AQ	-	-	-	-	167	2,850	3.17	61.8
BTS-R11-S12	Intermediate Soil	S	69.8%	2.02	22.9 %	4,240	-	-	-	-
BTS-R11-S13	Wastewater	AQ	-	-	-	-	125	5,460	0.739	164
BTS-R11-S14	Intermediate Soil	S	74.3%	4.16	8.25%	12,900	-	-	-	-
BTS-R11-S15	Intermediate Soil	S	65.4%	10.5	14.5 %	17,200	-	-	-	-
BTS-R11-S16	Wastewater	AQ	-	-	-	-	294	848	0.675	77.4
BTS-R11-S17	Outlet > 37 microns	S	71.0%	1.34	37.0 %	10,100	-	-	-	-
BTS-R11-S18	Wastewater	AQ	-	-	-	-	151	3,940	0.311	50.8
BTS-R11-S19	Outlet > 37 microns	S	74.7%	2.20	24.2 %	11,600	-	-	-	-
BTS-R11-S20	Wastewater	AQ	-	-	-	-	141	1,370	0.322	19.1
BTS-R11-S21	Outlet Centrifuge Cake	S	63.0%	9.22	21.9 %	21,300	-	-	-	-
BTS-R11-S22	Wastewater	AQ	-	-	-	-	668	10,900	4.86	346
BTS-R11-S23	Intermediate Soil	S	43.1%	14.7	17.1 %	51,800	-	-	-	-
BTS-R11-S24	Intermediate Soil	S	48.4%	67.1	14.0 %	91,000	-	-	-	-
BTS-R11-S25	Wastewater	AQ	-	-	-	-	880	1,660	4.07	288

Table B-1
Summary of Analytical Data from Optimization Test Runs

			SOLIDS ANALYSES				AQUEOUS ANALYSES			
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Total PCBs (ppm)**	**TOC Relative Percent Diff. (%)**	**Average TOC (ppm)**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Filtered Total PCBs (ug/L)**	**Unfiltered Total PCBs (ug/L)**
BTS-R11-S26	Wastewater	AQ	-	-	-	-	0	2,020	0.731	389
BTS-R11-S27	Intermediate Soil	S	37.6%	110	9.64%	104,000	-	-	-	-
Run 12 - Coarse-grained Sediment (TS-SED-A)										
BTS-R12-S1	Untreated Sediment	S	76.9%	91.4	101 %	20,200	-	-	-	-
BTS-R12-S2	Intermediate Soil	S	93.5%	46.57	26.9 %	1,280	-	-	-	-
BTS-R12-S3	Intermediate Soil	S	88.8%	36.44	61.4 %	2,590	-	-	-	-
BTS-R12-S4	Wastewater	AQ	-	-	-	-	0	4,160	2.562	3,662
BTS-R12-S5	Intermediate Soil	S	84.2%	9.72	-	-	-	-	-	-
BTS-R12-S6	Intermediate Soil	S	94.0%	18.79	160 %	28,300	-	-	-	-
BTS-R12-S7	Intermediate Soil	S	80.2%	33.47	52.4 %	6,490	-	-	-	-
BTS-R12-S8	Intermediate Soil	S	95.5%	41.5	42.3 %	2,220	-	-	-	-
BTS-R12-S9	Wastewater	AQ	-	-	-	-	346	2,550	494	2,590
BTS-R12-S10	Intermediate Soil	S	74.8%	45.8	5.46%	13,700	-	-	-	-
BTS-R12-S11	Intermediate Soil	S	56.8%	159.8	2.39%	27,300	-	-	-	-
BTS-R12-S12	Wastewater	AQ	-	-	-	-	698	682	202.3	2,162
BTS-R12-S13	Intermediate Soil	S	78.0%	56.7	74.7 %	4,380	-	-	-	-
BTS-R12-S14	Outlet > 850 microns	S	81.9%	4.461	143 %	5,240	-	-	-	-
BTS-R12-S15	Intermediate Soil	S	69.8%	10.83	-	-	-	-	-	-
BTS-R12-S16	Outlet > 1/4 inch	S	98.4%	0.221	-	-	-	-	-	-
BTS-R12-S17	Intermediate Soil	S	77.1%	11.88	99.6 %	4,470	-	-	-	-

Table B-1
Summary of Analytical Data from Optimization Test Runns

			SOLIDS ANALYSES				AQUEOUS ANALYSES			
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Total PCBs (ppm)**	**TOC Relative Percent Diff. (%)**	**Average TOC (ppm)**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Filtered Total PCBs (ug/L)**	**Unfiltered Total PCBs (ug/L)**
BTS-R12-S18	Intermediate Soil	S	79.3%	3.512	90.5 %	12,100	-	-	-	-
BTS-R12-S19	Outlet > 75 microns	S	74.8%	20.50	11.8 %	5,920	-	-	-	-
BTS-R12-S20	Intermediate Soil	S	95.7%	0.731	-	-	-	-	-	-
BTS-R12-S21	Outlet > 425 microns	S	75.6%	6.14	169 %	9,050	-	-	-	-
BTS-R12-S22	Outlet > 37 microns	S	73.1%	39.93	27.2 %	13,800	-	-	-	-
BTS-R12-S23	Wastewater	AQ	-	-	-	-	1,450	1,290	3.80	148.1
BTS-R12-S24	Outlet Centrifuge Cake	S	62.1%	49.9	9.11%	24,200	-	-	-	-
BTS-R12-S25	Wastewater	AQ	-	-	-	-	48.0	233	3.35	107
BTS-R12-S26	Intermediate Soil	S	81.1%	1.805	23.3 %	2,050	-	-	-	-
BTS-R12-S27	Intermediate Soil	S	79.6%	6.03	17.8 %	4,260	-	-	-	-
BTS-R12-S28	Intermediate Soil	S	73.7%	45.39	55.0 %	12,400	-	-	-	-
BTS-R12-S29	Wastewater	AQ	-	-	-	-	302	884	35.94	65.2
Run 13 - Flood Plain Soils (TS-SO-A)										
BTS-R13-S1	Untreated Sediment	S	67.3%	39.6	8.90%	46,800	-	-	-	-
BTS-R13-S2	Waste Oversized (Organics)	S	14.2%	75.6	11.2 %	443,000	-	-	-	-
BTS-R13-S3	Intermediate Liquid	AQ	-	-	-	-	160	547,000	-	341
BTS-R13-S4	Wastewater	AQ	-	-	-	-	0	38,300	-	210
BTS-R13-S5	Wastewater	AQ	-	-	-	-	110	30,300	-	171
BTS-R13-S6	Intermediate Liquid	AQ	-	-	-	-	100	102,000	-	116
BTS-R13-S7	Wastewater	AQ	-	-	-	-	250	8,070	-	157

Table B-1
Summary of Analytical Data from Optimization Test Runs

			SOLIDS ANALYSES				AQUEOUS ANALYSES			
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Total PCBs (ppm)**	**TOC Relative Percent Diff. (%)**	**Average TOC (ppm)**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Filtered Total PCBs (ug/L)**	**Unfiltered Total PCBs (ug/L)**
BTS-R13-S8	Intermediate Liquid	AQ	-	-	-	-	200	29,600	-	103
BTS-R13-S9	Wastewater	AQ	-	-	-	-	230	22,300	0.241	117
BTS-R13-S10	Intermediate Liquid	AQ	-	-	-	-	210	32,600	-	224
BTS-R13-S11	Intermediate Soil	S	40.3%	96.4	22.5 %	136,000	-	-	-	-
BTS-R13-S12	Wastewater	AQ	-	-	-	-	910	7,260	5.92	215
BTS-R13-S13	Wastewater	AQ	-	-	-	-	1,620	4,530	3.55	65.7
BTS-R13-S14	Intermediate Soil	S	76.8%	4.38	5.4 %	12,900	-	-	-	-
BTS-R13-S15	Wastewater	AQ	-	-	-	-	260	1,970	4.677	71.8
BTS-R13-S16	Intermediate Soil	S	64.3%	23.3	18.6 %	60,600	-	-	-	-
BTS-R13-S17	Wastewater	AQ	-	-	-	-	190	3,070	4.57	164
BTS-R13-S18	Intermediate Soil	S	76.7%	3.22	2.85 %	14,600	-	-	-	-
BTS-R13-S19	Wastewater	AQ	-	-	-	-	316	567	1.06	89.3
BTS-R13-S20	Intermediate Soil	S	61.8%	13.3	5.81 %	32,100	-	-	-	-
BTS-R13-S21	Wastewater	AQ	-	-	-	-	167	12,800	3.41	94.8
BTS-R13-S22	Intermediate Soil	S	19.4%	78.5	2.68 %	159,000	-	-	-	-
BTS-R13-S23	Wastewater	AQ	-	-	-	-	173	1,930	5.81	124
BTS-R13-S24	Intermediate Soil	S	44.5%	87.0	2.45 %	92,800	-	-	-	-
BTS-R13-S25	Wastewater	AQ	-	-	-	-	432	1,250	39.68	144
BTS-R13-S26	Outlet > 37 microns	S	73.9%	3.39	103 %	26,000	-	-	-	-
BTS-R13-S27	Wastewater	AQ	-	-	-	-	510	192	19.4	64.5

Table B-1
Summary of Analytical Data from Optimization Test Runns

			SOLIDS ANALYSES				AQUEOUS ANALYSES			
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Total PCBs (ppm)**	**TOC Relative Percent Diff. (%)**	**Average TOC (ppm)**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Filtered Total PCBs (ug/L)**	**Unfiltered Total PCBs (ug/L)**
BTS-R13-S28	Outlet Centrifuge Cake	S	65.1%	10.1	16.7 %	25,300	-	-	-	-
Run 14 - Fine-grained Sediment (TS-SED-B)										
BTS-R14-S1	Untreated Sediment	S	30.9%	112.3	0.348 %	86,600	-	-	-	-
BTS-R14-S2	Waste Oversized (Organics)	S	19.2%	167.2	6.17 %	267,000	-	-	-	-
BTS-R14-S3	Wastewater	AQ	-	-	-	-	773	1,570	-	218.8
BTS-R14-S4	Intermediate Liquid	AQ	-	-	-	-	0	31,000	-	140.0
BTS-R14-S5	Wastewater	AQ	-	-	-	-	310	6,040	-	206.6
BTS-R14-S6	Intermediate Liquid	AQ	-	-	-	-	0	61,700	-	174.8
BTS-R14-S7	Wastewater	AQ	-	-	-	-	0	21,900	-	262.7
BTS-R14-S8	Intermediate Liquid	AQ	-	-	-	-	0	46,300	-	155.0
BTS-R14-S9	Wastewater	AQ	-	-	-	-	0	12,300	0.823	163.5
BTS-R14-S10	Wastewater	AQ	-	-	-	-	567	4,450	13.47	428.7
BTS-R14-S11	Wastewater	AQ	-	-	-	-	232	912	18.19	562
BTS-R14-S12	Intermediate Soil	S	56.1%	18.05	3.36 %	39,900	-	-	-	-
BTS-R14-S13	Intermediate Soil	S	64.2%	7.68	3.19 %	37,000	-	-	-	-
BTS-R14-S14	Wastewater	AQ	-	-	-	-	388	1,430	54.7	163.7
BTS-R14-S15	Outlet > 37 microns	S	54.4%	9.89	27.60 %	33,100	-	-	-	-
BTS-R14-S16	Wastewater	AQ	-	-	-	-	272	215	25.25	97.9
BTS-R14-S17	Outlet > 37 microns	S	51.6%	14.60	6.07 %	68,800	-	-	-	-
BTS-R14-S18	Wastewater	AQ	-	-	-	-	907	5,130	99.8	998

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			SOLIDS ANALYSES				AQUEOUS ANALYSES			
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Total PCBs (ppm)**	**TOC Relative Percent Diff. (%)**	**Average TOC (ppm)**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Filtered Total PCBs (ug/L)**	**Unfiltered Total PCBs (ug/L)**
BTS-R14-S19	Intermediate Soil	S	10.4%	122.1	6.48 %	310,000	-	-	-	-
BTS-R14-S20	Wastewater	AQ	-	-	-	-	1,010	1,360	5.774	3,116
BTS-R14-S21	Intermediate Soil	S	53.9%	31.52	7.83 %	77,100	-	-	-	-
Run 15 - Flood Plain Soils (TS-SO-A)										
BTS-R15-S1	Untreated Sediment	S	66.9%	45.7	11.7 %	40,500	-	-	-	-
BTS-R15-S2	Wastewater	AQ	-	-	-	-	1,540	33,800	-	142
BTS-R15-S3	Intermediate Liquid	AQ	-	-	-	-	1,240	504,000	-	204
BTS-R15-S4	Wastewater	AQ	-	-	-	-	1,030	14,100	-	155
BTS-R15-S5	Intermediate Liquid	AQ	-	-	-	-	190	56,700	-	371
BTS-R15-S6	Wastewater	AQ	-	-	-	-	860	17,800	-	85.3
BTS-R15-S7	Intermediate Liquid	AQ	-	-	-	-	810	38,100	-	967
BTS-R15-S8	Wastewater	AQ	-	-	-	-	930	16,800	0.498	139
BTS-R15-S9	Intermediate Liquid	AQ	-	-	-	-	430	28,200	-	284
BTS-R15-S10	Wastewater	AQ	-	-	-	-	2,130	4,380	62.0	170
BTS-R15-S11	Outlet > 37 microns	S	72.9%	5.27	3.75 %	16,700	-	-	-	-
BTS-R15-S12	Wastewater	AQ	-	-	-	-	551	1,210	ND	139
BTS-R15-S13	Outlet Centrifuge Cake	S	54.5%	31.6	11.0 %	46,500	-	-	-	-

APPENDIX C

VERIFICATION DATA SUMMARY

Table C-1
Summary of Analytical Data from Validation Test Runs

			SOLIDS ANALYSES														
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Aroclor 1248 (ppm)**	**Aroclor 1260 (ppm)**	**Total PCBs (ppm)**	**Total PCB Con-geners (See Table C-3) (ppm)**	**% Gravel > 2 mm**	**% Sand 75 microns - 2 mm**	**% Silt 3.9 - 75 microns**	**% Clay < 3.9 microns**	**TOC Rep. 1 (ppm)**	**TOC Rep. 2 (ppm)**	**TOC Rep. 3 (ppm)**	**TOC Rep. 4 (ppm)**	**Average TOC (ppm)**	**TOC Rel. % Diff. (%)**
Run B-S1-R1 (Reach 5A Sediment)																	
B-S1-R1-L1-S	Untreated Sediment	S	77%	10	64	74	78	18.7%	77.0%	4.2%		8,000	6,900	8,500	-	7,800	10%
B-S1-R1-L2-S	Treated Sediment - Greater than 6.35 mm	S	98%	ND	0.079	0.079	-	99.8%	0.2%	0.0%		-	-	-	-	-	-
B-S1-R1-L3-S	Treated Sediment - 425 microns to 6.35 mm	S	81%	0.88	1.8	2.68	-	24.7%	75.2%	0.1%		1,200	1,400	4,200	660	1,900	87%
B-S1-R1-L3-2	Treated Sediment - 425 microns to 6.35 mm (Dup)	S	82%	0.82	1.1	1.92	-	19.9%	79.9%	0.2%		1,700	590	2,300	1,800	1,600	45%
B-S1-R1-L4-S	Collision Chamber Outlet	S	95%	2.9	20	22.9	-	0.0%	87.8%	12.2%		4,100	4,400	2,900	-	3,800	21%
B-S1-R1-L4-A/AF	Collision Chamber Outlet	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R1-L5A-S	Treated Sediment - 75 to 425 microns (First Treatment Cycle)	S	75%	5.3	35	40.3	-	0.0%	96.6%	3.4%		8,500	11,000	10,000	-	9,800	12%
B-S1-R1-L5-S	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle)	S	67%	13	47	60	-	0.0%	21.6%	78.4%		15,000	11,000	14,000	-	13,000	13%
B-S1-R1-L6-S	Treated Sediment - Centrifuge Solids (First Treatment Cycle)	S	62%	23	120	143	-	0.0%	0.2%	86.6%	13.2%	14,000	11,000	10,000	-	12,000	18%
B-S1-R1-L7A-S	Treated Sediment - 75 to 425 microns (Second Treatment Cycle)	S	73%	4.7	30	34.7	-	0.0%	96.2%	3.8%		11,000	5,600	11,000	6,900	8,600	32%
B-S1-R1-L7-S	Treated Sediment - Hydrocyclone Solids (Second Treatment Cycle)	S	62%	37	170	207	-	-	-	-	-	57,000	32,000	29,000	54,000	43,000	34%
B-S1-R1-L8-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	62%	16	80	96	-	0.0%	0.6%	90.9%	8.5%	16,000	37,000	19,000	16,000	22,000	45%
B-S1-R1-L9A-S	Treated Sediment - 75 to 425 microns (Third Treatment Cycle)	S	62%	2.9	21	23.9	27	0.0%	97.9%	2.1%		10,000	5,500	6,900	8,300	7,700	25%
B-S1-R1-L9-S	Treated Sediment - Hydrocyclone Solids (Third Treatment Cycle)	S	73%	15	64	79	-	0.0%	53.7%	46.3%		18,000	22,000	13,000	16,000	17,000	24%
B-S1-R1-L10-S	Treated Sediment - Centrifuge Solids (Third Treatment Cycle)	S	72%	12	61	73	-	0.0%	0.3%	94.7%	5.0%	12,000	13,000	35,000	11,000	18,000	66%
B-S1-R1-L11-A/AF	Wastewater	AQ	65%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R1-L11-2	Wastewater (Dup)	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R1-L12-A	Rinse Blank	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C-1
Summary of Analytical Data from Validation Test Runs

			AQUEOUS ANALYSES												
Sample ID	**Sample Location**	**Matrix**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Total Aroclor 1221 (ug/L)**	**Total Aroclor 1248 (ug/L)**	**Total Aroclor 1260 (ug/L)**	**Total PCBs (ug/L)**	**Total TOC (mg/L)**	**Filtered Aroclor 1242 (ug/L)**	**Filtered Aroclor 1248 (ug/L)**	**Filtered Aroclor 1254 (ug/L)**	**Filtered Aroclor 1260 (ug/L)**	**Filtered PCBs (ug/L)**	**Filtered TOC (mg/L)**
Run B-S1-R1 (Reach 5A Sediment)															
B-S1-R1-L1-S	Untreated Sediment	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R1-L2-S	Treated Sediment - Greater than 6.35 mm	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R1-L3-S	Treated Sediment - 425 microns to 6.35 mm	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R1-L3-2	Treated Sediment - 425 microns to 6.35 mm (Dup)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R1-L4-S	Collision Chamber Outlet	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R1-L4-A/AF	Collision Chamber Outlet	AQ	380	22.4	ND	100	890	990	140	ND	ND	ND	1,100	1,100	-
B-S1-R1-L5A-S	Treated Sediment - 75 to 425 microns (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R1-L5-S	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R1-L6-S	Treated Sediment - Centrifuge Solids (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R1-L7A-S	Treated Sediment - 75 to 425 microns (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R1-L7-S	Treated Sediment - Hydrocyclone Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R1-L8-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R1-L9A-S	Treated Sediment - 75 to 425 microns (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R1-L9-S	Treated Sediment - Hydrocyclone Solids (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R1-L10-S	Treated Sediment - Centrifuge Solids (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R1-L11-A/AF	Wastewater	AQ	170	1,260	ND	220	1,300	1,520	129	ND	3.0	ND	33	36	47
B-S1-R1-L11-2	Wastewater (Dup)	AQ	250	500	ND	130	900	1,030	-	-	-	-	-	-	-
B-S1-R1-L12-A	Rinse Blank	AQ	200	5.86	ND	0.71	1.5	2.21	-	-	-	-	-	-	-

Table C-1
Summary of Analytical Data from Validation Test Runs

			SOLIDS ANALYSES														
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Aroclor 1248 (ppm)**	**Aroclor 1260 (ppm)**	**Total PCBs (ppm)**	**Total PCB Con-geners (See Table C-3) (ppm)**	**% Gravel > 2 mm**	**% Sand 75 microns - 2 mm**	**% Silt 3.9 - 75 microns**	**% Clay < 3.9 microns**	**TOC Rep. 1 (ppm)**	**TOC Rep. 2 (ppm)**	**TOC Rep. 3 (ppm)**	**TOC Rep. 4 (ppm)**	**Average TOC (ppm)**	**TOC Rel. % Diff. (%)**
Run B-S1-R2 (Reach 5A Sediment)																	
B-S1-R2-L1-S	Untreated Sediment	S	81%	7.6	55	62.6	-	23.8%	72.3%	4.0%		6,200	5,800	7,100	-	6,300	11%
B-S1-R2-L2-S	Treated Sediment - Greater than 6.35 mm	S	96%	0.14	0.24	0.38	-	99.0%	1.0%	0.0%		-	-	-	-	-	-
B-S1-R2-L3-S	Treated Sediment - 425 microns to 6.35 mm	S	78%	1.2	1.6	2.8	-	28.0%	71.9%	0.1%		1,500	1,900	2,000	-	1,800	14%
B-S1-R2-L4-S	Collision Chamber Outlet	S	94%	3.4	24	27.4	-	0.0%	78.7%	21.3%		6,300	1,700	2,700	8,000	4,700	63%
B-S1-R2-L4-A/AF	Collision Chamber Outlet	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R2-L5A-S	Treated Sediment - 75 to 425 microns (First Treatment Cycle)	S	79%	4.8	45	49.8	-	-	-	-	-	8,100	8,800	4,800	5,200	6,700	30%
B-S1-R2-L5-S	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle)	S	74%	9.3	46	55.3	-	-	-	-	-	13,000	14,000	13,000	-	13,000	5.9%
B-S1-R2-L6-S	Treated Sediment - Centrifuge Solids (First Treatment Cycle)	S	70%	23	110	133	-	-	-	-	-	19,000	19,000	21,000	-	19,000	6.5%
B-S1-R2-L7A-S	Treated Sediment - 75 to 425 microns (Second Treatment Cycle)	S	76%	2.6	23	25.6	-	-	-	-	-	4,500	3,000	3,700	-	3,700	19%
B-S1-R2-L7-S	Treated Sediment - Hydrocyclone Solids (Second Treatment Cycle)	S	72%	9.2	44	53.2	-	-	-	-	-	12,000	14,000	11,000	-	13,000	11%
B-S1-R2-L8-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	27%	50	250	300	-	-	-	-	-	42,000	35,000	42,000	-	39,000	9.6%
B-S1-R2-L9A-S	Treated Sediment - 75 to 425 microns (Third Treatment Cycle)	S	76%	2.4	22	24.4	22.4	0.0%	97.8%	2.2%		2,300	4,400	9,000	6,300	5,500	51%
B-S1-R2-L9-S	Treated Sediment - Hydrocyclone Solids (Third Treatment Cycle)	S	75%	5.1	29	34.1	-	0.0%	32.3%	67.7%		12,000	9,000	8,900	-	10,000	19%
B-S1-R2-L10-S	Treated Sediment - Centrifuge Solids (Third Treatment Cycle)	S	67%	14	78	92	-	0.0%	0.5%	91.4%	8.1%	12,000	20,000	24,000	23,000	20,000	27%
B-S1-R2-L10-2	Treated Sediment - Centrifuge Solids (Third Treatment Cycle) (Dup)	S	71%	12	62	74	-	-	-	-	-	-	-	-	-	-	-
B-S1-R2-L11-A/AF	Wastewater	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R2-L11-2	Wastewater (Dup)	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R2-L12-A	Rinse Blank	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C-1
Summary of Analytical Data from Validation Test Runs

			AQUEOUS ANALYSES												
Sample ID	**Sample Location**	**Matrix**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Total Aroclor 1221 (ug/L)**	**Total Aroclor 1248 (ug/L)**	**Total Aroclor 1260 (ug/L)**	**Total PCBs (ug/L)**	**Total TOC (mg/L)**	**Filtered Aroclor 1242 (ug/L)**	**Filtered Aroclor 1248 (ug/L)**	**Filtered Aroclor 1254 (ug/L)**	**Filtered Aroclor 1260 (ug/L)**	**Filtered PCBs (ug/L)**	**Filtered TOC (mg/L)**
Run B-S1-R2 (Reach 5A Sediment)															
B-S1-R2-L1-S	Untreated Sediment	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R2-L2-S	Treated Sediment - Greater than 6.35 mm	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R2-L3-S	Treated Sediment - 425 microns to 6.35 mm	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R2-L4-S	Collision Chamber Outlet	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R2-L4-A/AF	Collision Chamber Outlet	AQ	240	104	ND	210	1,100	1,310	110	ND	5.3	ND	32	37.3	-
B-S1-R2-L5A-S	Treated Sediment - 75 to 425 microns (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R2-L5-S	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R2-L6-S	Treated Sediment - Centrifuge Solids (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R2-L7A-S	Treated Sediment - 75 to 425 microns (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R2-L7-S	Treated Sediment - Hydrocyclone Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R2-L8-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R2-L9A-S	Treated Sediment - 75 to 425 microns (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R2-L9-S	Treated Sediment - Hydrocyclone Solids (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R2-L10-S	Treated Sediment - Centrifuge Solids (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R2-L10-2	Treated Sediment - Centrifuge Solids (Third Treatment Cycle) (Dup)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R2-L11-A/AF	Wastewater	AQ	400	1,310	ND	540	2,800	3,340	100	ND	2.7	ND	28	30.7	47
B-S1-R2-L11-2	Wastewater (Dup)	AQ	320	1,330	ND	420	3,200	3,620	100	-	-	-	-	-	-
B-S1-R2-L12-A	Rinse Blank	AQ	150	24.6	ND	0.62	2.1	2.72	-	-	-	-	-	-	-

Table C-1
Summary of Analytical Data from Validation Test Runs

			SOLIDS ANALYSES														
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Aroclor 1248 (ppm)**	**Aroclor 1260 (ppm)**	**Total PCBs (ppm)**	**Total PCB Con-geners (See Table C-3) (ppm)**	**% Gravel > 2 mm**	**% Sand 75 microns - 2 mm**	**% Silt 3.9 - 75 microns**	**% Clay < 3.9 microns**	**TOC Rep. 1 (ppm)**	**TOC Rep. 2 (ppm)**	**TOC Rep. 3 (ppm)**	**TOC Rep. 4 (ppm)**	**Average TOC (ppm)**	**TOC Rel. % Diff. (%)**
Run B-S1-R3 (Reach 5A Sediment)																	
B-S1-R3-L1-S	Untreated Sediment	S	84%	12	68	80	-	19.9%	76.1%	4.1%		11,000	3,600	8,000	7,600	7,500	39%
B-S1-R3-L2-S	Treated Sediment - Greater than 6.35 mm	S	94%	0.39	0.29	0.68	-	98.2%	1.7%	0.1%		-	-	-	-	-	-
B-S1-R3-L3-S	Treated Sediment - 425 microns to 6.35 mm	S	91%	ND	59	59	-	26.4%	73.5%	0.1%		1,000	8,600	1,300	870	3,000	130%
B-S1-R3-L3-S-RE1	Treated Sediment - 425 microns to 6.35 mm	S	-	0.37	1.7	2.07	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L3-S-RE2	Treated Sediment - 425 microns to 6.35 mm	S	-	ND	13	13	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L3-S (ave)	Treated Sediment - 425 microns to 6.35 mm	S	91%	-	-	24.69	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L4-S	Collision Chamber Outlet	S	93%	5.4	39	44.4	-	0.1%	87.2%	12.7%		2,100	3,100	6,700	4,500	4,100	48%
B-S1-R3-L4-A/AF	Collision Chamber Outlet	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L5A-S	Treated Sediment - 75 to 425 microns (First Treatment Cycle)	S	84%	4.6	36	40.6	-	-	-	-	-	4,900	7,100	7,600	-	6,600	22%
B-S1-R3-L5-S	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle)	S	72%	9.7	45	54.7	-	-	-	-	-	14,000	13,000	21,000	19,000	17,000	23%
B-S1-R3-L6-S	Treated Sediment - Centrifuge Solids (First Treatment Cycle)	S	64%	24	110	134	-	-	-	-	-	48,000	43,000	44,000	-	45,000	6.0%
B-S1-R3-L7A-S	Treated Sediment - 75 to 425 microns (Second Treatment Cycle)	S	78%	8.8	42	50.8	-	-	-	-	-	6,600	4,900	6,000	-	5,800	15%
B-S1-R3-L7-S	Treated Sediment - Hydrocyclone Solids (Second Treatment Cycle)	S	72%	3.4	30	33.4	-	-	-	-	-	10,000	9,800	13,000	-	11,000	18%
B-S1-R3-L8-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	65%	15	81	96	-	-	-	-	-	13,000	18,000	15,000	-	16,000	16%
B-S1-R3-L9A-S	Treated Sediment - 75 to 425 microns (Third Treatment Cycle)	S	77%	1.3	8.8	10.1	12	0.0%	96.5%	3.5%		2,900	3,700	3,700	-	3,400	14%
B-S1-R3-L9A-2	Treated Sediment - 75 to 425 microns (Third Treatment Cycle) (Dup)	S	78%	2.1	19	21.1	-	-	-	-	-	6,600	3,300	4,600	3,900	4,600	31%
B-S1-R3-L9-S	Treated Sediment - Hydrocyclone Solids (Third Treatment Cycle)	S	67%	6.4	34	40.4	-	0.0%	11.6%	88.4%		10,000	16,000	7,300	18,000	13,000	39%
B-S1-R3-L10-S	Treated Sediment - Centrifuge Solids (Third Treatment Cycle)	S	71%	5.8	36	41.8	-	0.0%	0.1%	92.0%	7.9%	42,000	43,000	41,000	-	42,000	3.3%
B-S1-R3-L11-A/AF	Wastewater	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L11-2	Wastewater (Dup)	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L12-A	Rinse Blank	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C-1
Summary of Analytical Data from Validation Test Runs

			AQUEOUS ANALYSES												
Sample ID	**Sample Location**	**Matrix**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Total Aroclor 1221 (ug/L)**	**Total Aroclor 1248 (ug/L)**	**Total Aroclor 1260 (ug/L)**	**Total PCBs (ug/L)**	**Total TOC (mg/L)**	**Filtered Aroclor 1242 (ug/L)**	**Filtered Aroclor 1248 (ug/L)**	**Filtered Aroclor 1254 (ug/L)**	**Filtered Aroclor 1260 (ug/L)**	**Filtered PCBs (ug/L)**	**Filtered TOC (mg/L)**
Run B-S1-R3 (Reach 5A Sediment)															
B-S1-R3-L1-S	Untreated Sediment	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L2-S	Treated Sediment - Greater than 6.35 mm	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L3-S	Treated Sediment - 425 microns to 6.35 mm	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L3-S-RE1	Treated Sediment - 425 microns to 6.35 mm	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L3-S-RE2	Treated Sediment - 425 microns to 6.35 mm	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L3-S (ave)	Treated Sediment - 425 microns to 6.35 mm	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L4-S	Collision Chamber Outlet	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L4-A/AF	Collision Chamber Outlet	AQ	240	35.7	ND	180	1,200	1,380	110	-	-	-	-	-	-
B-S1-R3-L5A-S	Treated Sediment - 75 to 425 microns (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L5-S	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L6-S	Treated Sediment - Centrifuge Solids (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L7A-S	Treated Sediment - 75 to 425 microns (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L7-S	Treated Sediment - Hydrocyclone Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L8-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L9A-S	Treated Sediment - 75 to 425 microns (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L9A-2	Treated Sediment - 75 to 425 microns (Third Treatment Cycle) (Dup)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L9-S	Treated Sediment - Hydrocyclone Solids (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L10-S	Treated Sediment - Centrifuge Solids (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S1-R3-L11-A/AF	Wastewater	AQ	270	1,700	ND	310	2,000	2,310	160	ND	ND	ND	27	27	60
B-S1-R3-L11-2	Wastewater (Dup)	AQ	-	-	ND	400	2,100	2,500	-	-	-	-	-	-	-
B-S1-R3-L12-A	Rinse Blank	AQ	ND	6.6	0.89	0.56	1.7	3.15	-	-	-	-	-	-	-

Table C-1
Summary of Analytical Data from Validation Test Runs

			SOLIDS ANALYSES														
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Aroclor 1248 (ppm)**	**Aroclor 1260 (ppm)**	**Total PCBs (ppm)**	**Total PCB Con-geners (See Table C-3) (ppm)**	**% Gravel > 2 mm**	**% Sand 75 microns - 2 mm**	**% Silt 3.9 - 75 microns**	**% Clay < 3.9 microns**	**TOC Rep. 1 (ppm)**	**TOC Rep. 2 (ppm)**	**TOC Rep. 3 (ppm)**	**TOC Rep. 4 (ppm)**	**Average TOC (ppm)**	**TOC Rel. % Diff. (%)**
Run B-S2-R1 (Woods Pond Sediment)																	
B-S2-R1-L1-S	Untreated Sediment	S	29%	37	140	177	180	0.0%	14.9%	63.4%	21.7%	100,000	95,000	91,000	-	9,600	5.6%
B-S2-R1-L2-S	Oversized Organics > 850 microns	S	14%	31	88	119	-	-	-	-	-	390,000	270,000	500,000	110,000	320,000	30%
B-S2-R1-L4-S	Collision Chamber Outlet	S	66%	20	76	96	-	0.0%	16.4%	66.4%	17.2%	45,000	22,000	51,000	38,000	39,000	40%
B-S2-R1-L4-A/AF	Collision Chamber Outlet	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R1-L5-S	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle)	S	65.0 %	4.6	17	21.6	-	0.0%	49.7%	50.3%		40,000	36,000	43,000	-	40,000	8.9%
B-S2-R1-L6-S	Treated Sediment - Centrifuge Solids (First Treatment Cycle)	S	58.0 %	13	47	60	-	0.0%	0.3%	81.4%	18.3%	65,000	69,000	63,000	-	66,000	5.3%
B-S2-R1-L7-S	Treated Sediment - Hydrocyclone Solids (Second Treatment Cycle)	S	61.0 %	2.9	10	12.9	-	0.0%	23.7%	75.0%	1.3%	38,000	40,000	38,000	-	38,000	3.0%
B-S2-R1-L8-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	57.0 %	6.6	23	29.6	-	0.0%	0.4%	83.0%	16.6%	34,000	45,000	33,000	-	38,000	19%
B-S2-R1-L9-S	Treated Sediment - Hydrocyclone Solids (Third Treatment Cycle)	S	61.0 %	2.6	8.5	11.1	13	0.0%	13.7%	85.0%	1.3%	37,000	45,000	47,000	-	43,000	12%
B-S2-R1-L10-S	Treated Sediment - Centrifuge Solids (Third Treatment Cycle)	S	60.0 %	3.3	12	15.3	-	0.0%	0.3%	90.1%	9.6%	45,000	63,000	61,000	-	56,000	17%
B-S2-R1-L10-2	Treated Sediment - Centrifuge Solids (Third Treatment Cycle) (Dup)	S	55.0 %	7.4	26	33.4	-	-	-	-	-	53,000	53,000	52,000	-	53,000	0.9%
B-S2-R1-L11-A/AF	Wastewater	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R1-L11-2	Wastewater (Dup)	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R1-L12-A	Rinse Blank	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C-1
Summary of Analytical Data from Validation Test Runs

			AQUEOUS ANALYSES												
Sample ID	**Sample Location**	**Matrix**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Total Aroclor 1221 (ug/L)**	**Total Aroclor 1248 (ug/L)**	**Total Aroclor 1260 (ug/L)**	**Total PCBs (ug/L)**	**Total TOC (mg/L)**	**Filtered Aroclor 1242 (ug/L)**	**Filtered Aroclor 1248 (ug/L)**	**Filtered Aroclor 1254 (ug/L)**	**Filtered Aroclor 1260 (ug/L)**	**Filtered PCBs (ug/L)**	**Filtered TOC (mg/L)**
Run B-S2-R1 (Woods Pond Sediment)															
B-S2-R1-L1-S	Untreated Sediment	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R1-L2-S	Oversized Organics > 850 microns	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R1-L4-S	Collision Chamber Outlet	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R1-L4-A/AF	Collision Chamber Outlet	AQ	280	134	ND	3	12	15	1,300	ND	0.57	ND	2.5	3.07	1,310
B-S2-R1-L5-S	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R1-L6-S	Treated Sediment - Centrifuge Solids (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R1-L7-S	Treated Sediment - Hydrocyclone Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R1-L8-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R1-L9-S	Treated Sediment - Hydrocyclone Solids (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R1-L10-S	Treated Sediment - Centrifuge Solids (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R1-L10-2	Treated Sediment - Centrifuge Solids (Third Treatment Cycle) (Dup)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R1-L11-A/AF	Wastewater	AQ	620	4,010	ND	140	520	660	1,480	0.58	ND	0.35	ND	0.93	980
B-S2-R1-L11-2	Wastewater (Dup)	AQ	-	-	ND	40	150	190	-	-	-	-	-	-	-
B-S2-R1-L12-A	Rinse Blank	AQ	49	ND	ND	0.24	0.85	1.09	-	-	-	-	-	-	-

Table C-1
Summary of Analytical Data from Validation Test Runs

			SOLIDS ANALYSES													
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Aroclor 1248 (ppm)**	**Aroclor 1260 (ppm)**	**Total PCBs (ppm)**	**Total PCB Con-geners (See Table C-3) (ppm)**	**% Gravel > 2 mm**	**% Sand 75 microns - 2 mm**	**% Silt 3.9 - 75 microns**	**% Clay < 3.9 microns**	**TOC Rep. 1 (ppm)**	**TOC Rep. 2 (ppm)**	**TOC Rep. 3 (ppm)**	**TOC Rep. 4 (ppm)**	**Average TOC (ppm)**	**TOC Rel. % Diff. (%)**
Run B-S2-R2 (Woods Pond Sediment)																	
B-S2-R2-L1-S	Untreated Sediment	S	33%	ND	110	110	-	0.0%	13.7%	65.3%	21.0%	99,000	91,000	96,000	-	95,000	3.9%
B-S2-R2-L2-S	Oversized Organics > 850 microns	S	13%	26	68	94	-	-	-	-	-	510,000	350,000	590,000	250,000	430,000	36%
B-S2-R2-L4-S	Collision Chamber Outlet	S	54%	11	42	53	-	0.0%	14.7%	64.5%	20.8%	77,000	74,000	77,000	-	76,000	1.9%
B-S2-R2-L4-A/AF	Collision Chamber Outlet	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R2-L5-S	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle)	S	59%	4.2	16	20.2	-	-	-	-	-	48,000	52,000	43,000	-	48,000	9.0%
B-S2-R2-L6-S	Treated Sediment - Centrifuge Solids (First Treatment Cycle)	S	68%	1.7	6.9	8.6	-	-	-	-	-	18,000	19,000	22,000	-	20,000	11%
B-S2-R2-L7-S	Treated Sediment - Hydrocyclone Solids (Second Treatment Cycle)	S	58%	2.4	9.5	11.9	-	-	-	-	-	48,000	41,000	47,000	-	45,000	7.8%
B-S2-R2-L8-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	55%	4.5	17	21.5	-	-	-	-	-	56,000	71,000	81,000	-	69,000	18%
B-S2-R2-L9-S	Treated Sediment - Hydrocyclone Solids (Third Treatment Cycle)	S	57%	2.2	8.5	10.7	15	0.0%	11.5%	86.0%	2.5%	47,000	44,000	100,000	49,000	60,000	46%
B-S2-R2-L10-S	Treated Sediment - Centrifuge Solids (Third Treatment Cycle)	S	57%	2.3	9.1	11.4	-	0.0%	0.3%	86.8%	12.9%	61,000	46,000	45,000	-	51,000	18%
B-S2-R2-L10-2	Treated Sediment - Centrifuge Solids (Third Treatment Cycle) (Dup)	S	61%	2.1	7.9	10	-	-	-	-	-	-	-	-	-	-	-
B-S2-R2-L11-A/AF	Wastewater	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R2-L11-2	Wastewater (Dup)	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R2-L12-A	Rinse Blank	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C-1
Summary of Analytical Data from Validation Test Runs

			AQUEOUS ANALYSES												
Sample ID	**Sample Location**	**Matrix**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Total Aroclor 1221 (ug/L)**	**Total Aroclor 1248 (ug/L)**	**Total Aroclor 1260 (ug/L)**	**Total PCBs (ug/L)**	**Total TOC (mg/L)**	**Filtered Aroclor 1242 (ug/L)**	**Filtered Aroclor 1248 (ug/L)**	**Filtered Aroclor 1254 (ug/L)**	**Filtered Aroclor 1260 (ug/L)**	**Filtered PCBs (ug/L)**	**Filtered TOC (mg/L)**
Run B-S2-R2 (Woods Pond Sediment)															
B-S2-R2-L1-S	Untreated Sediment	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R2-L2-S	Oversized Organics > 850 microns	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R2-L4-S	Collision Chamber Outlet	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R2-L4-A/AF	Collision Chamber Outlet	AQ	280	7.2	ND	0.12	0.44	0.56	80	ND	ND	ND	ND	ND	-
B-S2-R2-L5-S	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R2-L6-S	Treated Sediment - Centrifuge Solids (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R2-L7-S	Treated Sediment - Hydrocyclone Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R2-L8-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R2-L9-S	Treated Sediment - Hydrocyclone Solids (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R2-L10-S	Treated Sediment - Centrifuge Solids (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R2-L10-2	Treated Sediment - Centrifuge Solids (Third Treatment Cycle) (Dup)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R2-L11-A/AF	Wastewater	AQ	950	4,540	ND	250	1,200	1,450	830	ND	1.1	ND	ND	1.1	210
B-S2-R2-L11-2	Wastewater (Dup)	AQ	-	-	ND	150	600	750	740	-	-	-	-	-	-
B-S2-R2-L12-A	Rinse Blank	AQ	250	10.9	ND	0.27	1.1	1.37	-	-	-	-	-	-	-

Table C-1
Summary of Analytical Data from Validation Test Runs

			SOLIDS ANALYSES														
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Aroclor 1248 (ppm)**	**Aroclor 1260 (ppm)**	**Total PCBs (ppm)**	**Total PCB Con-geners** (See Table C-3) **(ppm)**	**% Gravel > 2 mm**	**% Sand 75 microns - 2 mm**	**% Silt 3.9 - 75 microns**	**% Clay < 3.9 microns**	**TOC Rep. 1 (ppm)**	**TOC Rep. 2 (ppm)**	**TOC Rep. 3 (ppm)**	**TOC Rep. 4 (ppm)**	**Average TOC (ppm)**	**TOC Rel. % Diff. (%)**
Run B-S2-R3 (Woods Pond Sediment)																	
B-S2-R3-L1-S	Untreated Sediment	S	34%	29	110	139	-	0.0%	12.6%	64.3%	23.1%	96,000	110,000	84,000	-	95,000	11%
B-S2-R3-L2-S	Oversized Organics > 850 microns	S	12%	34	110	144	-	-	-	-	-	430,000	520,000	390,000	-	450,000	15%
B-S2-R3-L4-S	Collision Chamber Outlet	S	49%	23	85	108	-	0.0%	11.1%	61.7%	27.2%	90,000	99,000	86,000	-	91,000	7.5%
B-S2-R3-L4-A/AF	Collision Chamber Outlet	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R3-L5-S	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle)	S	61%	3.3	13	16.3	-	-	-	-	-	38,000	39,000	38,000	-	38,000	1.8%
B-S2-R3-L6-S	Treated Sediment - Centrifuge Solids (First Treatment Cycle)	S	48%	9.8	34	43.8	-	-	-	-	-	96,000	55,000	86,000	62,000	75,000	26%
B-S2-R3-L7-S	Treated Sediment - Hydrocyclone Solids (Second Treatment Cycle)	S	66%	1.7	6.7	8.4	-	-	-	-	-	27,000	29,000	31,000	-	29,000	7.0%
B-S2-R3-L8-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	57%	5.7	20	25.7	-	-	-	-	-	36,000	55,000	57,000	-	49,000	23%
B-S2-R3-L9-S	Treated Sediment - Hydrocyclone Solids (Third Treatment Cycle)	S	65%	1.7	6.9	8.6	9.7	0.0%	25.1%	74.9%		27,000	33,000	22,000	-	27,000	19%
B-S2-R3-L10-S	Treated Sediment - Centrifuge Solids (Third Treatment Cycle)	S	55%	4.9	18	22.9	-	0.0%	0.2%	92.8%	7.0%	37,000	37,000	39,000	-	38,000	2.2%
B-S2-R3-L10-2	Treated Sediment - Centrifuge Solids (Third Treatment Cycle) (Dup)	S	60%	5.5	19	24.5	-	0.0%	0.2%	87.2%	12.6%	46,000	52,000	52,000	-	50,000	7.3%
B-S2-R3-L11-A/AF	Wastewater	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R3-L11-2F	Wastewater (Dup)	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R3-L12-A	Rinse Blank	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C-1
Summary of Analytical Data from Validation Test Runs

			AQUEOUS ANALYSES												
Sample ID	**Sample Location**	**Matrix**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Total Aroclor 1221 (ug/L)**	**Total Aroclor 1248 (ug/L)**	**Total Aroclor 1260 (ug/L)**	**Total PCBs (ug/L)**	**Total TOC (mg/L)**	**Filtered Aroclor 1242 (ug/L)**	**Filtered Aroclor 1248 (ug/L)**	**Filtered Aroclor 1254 (ug/L)**	**Filtered Aroclor 1260 (ug/L)**	**Filtered PCBs (ug/L)**	**Filtered TOC (mg/L)**
Run B-S2-R3 (Woods Pond Sediment)															
B-S2-R3-L1-S	Untreated Sediment	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R3-L2-S	Oversized Organics > 850 microns	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R3-L4-S	Collision Chamber Outlet	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R3-L4-A/AF	Collision Chamber Outlet	AQ	210	49.3	ND	4.3	16	20.3	44	ND	0.22	ND	0.48	0.7	-
B-S2-R3-L5-S	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R3-L6-S	Treated Sediment - Centrifuge Solids (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R3-L7-S	Treated Sediment - Hydrocyclone Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R3-L8-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R3-L9-S	Treated Sediment - Hydrocyclone Solids (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R3-L10-S	Treated Sediment - Centrifuge Solids (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R3-L10-2	Treated Sediment - Centrifuge Solids (Third Treatment Cycle) (Dup)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S2-R3-L11-A/AF	Wastewater	AQ	570	6,030	ND	140	580	720	480	ND	ND	ND	ND	ND	230
B-S2-R3-L11-2F	Wastewater (Dup)	AQ	-	-	ND	160	650	810	-	-	-	-	-	-	-
B-S2-R3-L12-A	Rinse Blank	AQ	84	217	ND	0.17	0.54	0.71	-	-	-	-	-	-	-

Table C-1
Summary of Analytical Data from Validation Test Runs

			SOLIDS ANALYSES														
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Aroclor 1248 (ppm)**	**Aroclor 1260 (ppm)**	**Total PCBs (ppm)**	**Total PCB Con-geners (See Table C-3) (ppm)**	**% Gravel > 2 mm**	**% Sand 75 microns - 2 mm**	**% Silt 3.9 - 75 microns**	**% Clay < 3.9 microns**	**TOC Rep. 1 (ppm)**	**TOC Rep. 2 (ppm)**	**TOC Rep. 3 (ppm)**	**TOC Rep. 4 (ppm)**	**Average TOC (ppm)**	**TOC Rel. % Diff. (%)**
Run B-S3-R1 (Floodplain Soils)																	
B-S3-R1-L1-S	Untreated Soil	S	67%	ND	55	55	52	0.0%	22.9%	60.5%	16.6%	48,000	47,000	46,000	-	47,000	1.8%
B-S3-R1-L2-S	Oversized Organics > 850 microns	S	13%	ND	96	96	-	-	-	-	-	280,000	530,000	110,000	540,000	360,000	58%
B-S3-R1-L4-S	Collision Chamber Outlet	S	82%	ND	17	17	-	0.0%	31.8%	63.9%	4.3%	12,000	17,000	13,000	-	14,000	20%
B-S3-R1-L4-A/AF	Collision Chamber Outlet	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R1-L5-S	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle)	S	73%	ND	5.4	5.4	5.7	0.0%	38.8%	60.2%	1.0%	22,000	20,000	21,000	-	21,000	5.3%
B-S3-R1-L6-S	Treated Sediment - Centrifuge Solids (First Treatment Cycle)	S	63%	ND	40	40	-	0.0%	1.0%	86.2%	12.8%	35,000	39,000	40,000	-	38,000	7.1%
B-S3-R1-L6-2	Treated Sediment - Centrifuge Solids (First Treatment Cycle) (Dup)	S	59%	ND	45	45	-	0.0%	0.8%	83.2%	16.0%	43,000	32,000	43,000	-	39,000	16%
B-S3-R1-L7-S	Treated Sediment - Hydrocyclone Solids (Second Treatment Cycle)	S	70%	ND	4.4	4.4	-	0.0%	33.3%	65.6%	1.1%	8,200	13,000	12,000	-	11,000	23%
B-S3-R1-L8-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	64%	ND	24	24	-	0.0%	0.8%	92.2%	7.0%	58,000	64,000	74,000	-	65,000	13%
B-S3-R1-L9-S	Treated Sediment - Hydrocyclone Solids (Third Treatment Cycle)	S	73%	ND	3.9	3.9	-	0.0%	27.2%	71.5%	1.3%	17,000	17,000	15,000	-	16,000	6.4%
B-S3-R1-L10-S	Treated Sediment - Centrifuge Solids (Third Treatment Cycle)	S	65%	ND	15	15	-	0.0%	0.6%	92.9%	6.5%	33,000	28,000	31,000	-	30,000	8.0%
B-S3-R1-L11-A/AF	Wastewater	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R1-L11-2	Wastewater (Dup)	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R1-L12-A	Rinse Blank	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C-1
Summary of Analytical Data from Validation Test Runs

			AQUEOUS ANALYSES												
Sample ID	**Sample Location**	**Matrix**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Total Aroclor 1221 (ug/L)**	**Total Aroclor 1248 (ug/L)**	**Total Aroclor 1260 (ug/L)**	**Total PCBs (ug/L)**	**Total TOC (mg/L)**	**Filtered Aroclor 1242 (ug/L)**	**Filtered Aroclor 1248 (ug/L)**	**Filtered Aroclor 1254 (ug/L)**	**Filtered Aroclor 1260 (ug/L)**	**Filtered PCBs (ug/L)**	**Filtered TOC (mg/L)**
Run B-S3-R1 (Floodplain Soils)															
B-S3-R1-L1-S	Untreated Soil	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R1-L2-S	Oversized Organics > 850 microns	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R1-L4-S	Collision Chamber Outlet	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R1-L4-A/AF	Collision Chamber Outlet	AQ	570	15,800	ND	ND	190	190	1,200	ND	ND	ND	76	76	-
B-S3-R1-L5-S	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R1-L6-S	Treated Sediment - Centrifuge Solids (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R1-L6-2	Treated Sediment - Centrifuge Solids (First Treatment Cycle) (Dup)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R1-L7-S	Treated Sediment - Hydrocyclone Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R1-L8-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R1-L9-S	Treated Sediment - Hydrocyclone Solids (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R1-L10-S	Treated Sediment - Centrifuge Solids (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R1-L11-A/AF	Wastewater	AQ	4,600	4,590	ND	ND	280	280	780	1.1	ND	ND	2.1	3.2	240
B-S3-R1-L11-2	Wastewater (Dup)	AQ	260	9,130	ND	ND	170	170	-	-	-	-	-	-	-
B-S3-R1-L12-A	Rinse Blank	AQ	100	11	ND	0.72	2.9	3.62	-	-	-	-	-	-	-

Table C-1
Summary of Analytical Data from Validation Test Runs

			SOLIDS ANALYSES														
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Aroclor 1248 (ppm)**	**Aroclor 1260 (ppm)**	**Total PCBs (ppm)**	**Total PCB Con-geners (See Table C-3) (ppm)**	**% Gravel > 2 mm**	**% Sand 75 microns - 2 mm**	**% Silt 3.9 - 75 microns**	**% Clay < 3.9 microns**	**TOC Rep. 1 (ppm)**	**TOC Rep. 2 (ppm)**	**TOC Rep. 3 (ppm)**	**TOC Rep. 4 (ppm)**	**Average TOC (ppm)**	**TOC Rel. % Diff. (%)**
Run B-S3-R2 (Floodplain Soils)																	
B-S3-R2-L1-S	Untreated Soil	S	66%	ND	45	45	-	0.0%	24.4%	58.6%	17.0%	48,000	45,000	56,000	-	50,000	11%
B-S3-R2-L2-S	Oversized Organics > 850 microns	S	13%	ND	60	60	-	-	-	-	-	430,000	490,000	310,000	-	410,000	23%
B-S3-R2-L4-S	Collision Chamber Outlet	S	82%	ND	15	15	-	3.7%	35.2%	61.1%		12,000	12,000	14,000	-	12,000	9.6%
B-S3-R2-L4-A/AF	Collision Chamber Outlet	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R2-L5-S	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle)	S	77%	ND	4.8	4.8	5.5	0.0%	36.4%	63.6%		18,000	20,000	18,000	-	19,000	6.3%
B-S3-R2-L5-2	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle) (Dup)	S	76%	ND	5.0	5.0	4.4	-	-	-	-	-	-	-	-	-	-
B-S3-R2-L6-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	63%	ND	44	44	-	0.0%	0.1%	91.4%	8.5%	26,000	49,000	36,000	26,000	34,000	32%
B-S3-R2-L7-S	Treated Sediment - Hydrocyclone Solids (Second Treatment Cycle)	S	75%	ND	2.6	2.6	-	-	-	-	-	11,000	14,000	20,000	14,000	15,000	25%
B-S3-R2-L8-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	69%	ND	12	12	-	-	-	-	-	26,000	26,000	36,000	-	29,000	19%
B-S3-R2-L9-S	Treated Sediment - Hydrocyclone Solids (Third Treatment Cycle)	S	76%	ND	2.6	2.6	-	-	-	-	-	13,000	12,000	13,000	-	13,000	5.6%
B-S3-R2-L10-S	Treated Sediment - Centrifuge Solids (Third Treatment Cycle)	S	70%	ND	7.3	7.3	-	-	-	-	-	38,000	22,000	14,000	11,000	21,000	58%
B-S3-R2-L11-A/AF	Wastewater	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R2-L11-2	Wastewater (Dup)	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R2-L12-A	Rinse Blank	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C-1
Summary of Analytical Data from Validation Test Runs

			AQUEOUS ANALYSES												
Sample ID	**Sample Location**	**Matrix**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Total Aroclor 1221 (ug/L)**	**Total Aroclor 1248 (ug/L)**	**Total Aroclor 1260 (ug/L)**	**Total PCBs (ug/L)**	**Total TOC (mg/L)**	**Filtered Aroclor 1242 (ug/L)**	**Filtered Aroclor 1248 (ug/L)**	**Filtered Aroclor 1254 (ug/L)**	**Filtered Aroclor 1260 (ug/L)**	**Filtered PCBs (ug/L)**	**Filtered TOC (mg/L)**
Run B-S3-R2 (Floodplain Soils)															
B-S3-R2-L1-S	Untreated Soil	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R2-L2-S	Oversized Organics > 850 microns	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R2-L4-S	Collision Chamber Outlet	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R2-L4-A/AF	Collision Chamber Outlet	AQ	570	43	ND	ND	230	230	200	ND	ND	ND	83	83	-
B-S3-R2-L5-S	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R2-L5-2	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle) (Dup)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R2-L6-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R2-L7-S	Treated Sediment - Hydrocyclone Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R2-L8-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R2-L9-S	Treated Sediment - Hydrocyclone Solids (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R2-L10-S	Treated Sediment - Centrifuge Solids (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R2-L11-A/AF	Wastewater	AQ	950	12,800	ND	ND	160	160	1,000	0.65	ND	ND	1.8	2.45	71
B-S3-R2-L11-2	Wastewater (Dup)	AQ	740	10,100	ND	ND	140	140	-	-	-	-	-	-	-
B-S3-R2-L12-A	Rinse Blank	AQ	87	6	ND	0.79	1.6	2.39	-	-	-	-	-	-	-

Table C-1
Summary of Analytical Data from Validation Test Runs

			SOLIDS ANALYSES															
Sample ID	**Sample Location**	**Matrix**	**Percent Solids (%)**	**Aroclor 1248 (ppm)**	**Aroclor 1260 (ppm)**	**Total PCBs (ppm)**	**Total PCB Con-geners (See Table C-3) (ppm)**	**% Gravel > 2 mm**	**% Sand 75 microns - 2 mm**	**% Silt 3.9 - 75 microns**	**% Clay < 3.9 microns**	**TOC Rep. 1 (ppm)**	**TOC Rep. 2 (ppm)**	**TOC Rep. 3 (ppm)**	**TOC Rep. 4 (ppm)**	**Average TOC (ppm)**	**TOC Rel. % Diff. (%)**
Run B-S3-R3 (Floodplain Soils)																	
B-S3-R3-L1-S	Untreated Soil	S	67%	ND	50	50	-	0.0%	24.3%	58.0%	17.7%	46,000	55,000	45,000	-	49,000	12%
B-S3-R3-L2-S	Oversized Organics > 850 microns	S	19%	ND	86	86	-	-	-	-	-	370,000	350,000	330,000	-	350,000	4.7%
B-S3-R3-L4-S	Collision Chamber Outlet	S	76%	ND	21	21	-	3.5%	28.9%	67.6%		29,000	17,000	20,000	28,000	23,000	25%
B-S3-R3-L4-A/AF	Collision Chamber Outlet	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R3-L5-S	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle)	S	78%	ND	6.5	6.5	5.8	0.0%	36.6%	63.4%		15,000	16,000	16,000	-	16,000	3.3%
B-S3-R3-L6-S	Treated Sediment - Centrifuge Solids (First Treatment Cycle)	S	63%	ND	7.4	7.4	-	0.0%	0.1%	85.3%	14.6%	29,000	27,000	27,000	-	28,000	3.7%
B-S3-R3-L6-2	Treated Sediment - Centrifuge Solids (First Treatment Cycle) (Dup)	S	61%	ND	35	35	-	-	-	-	-	-	-	-	-	-	-
B-S3-R3-L7-S	Treated Sediment - Hydrocyclone Solids (Second Treatment Cycle)	S	76%	ND	4.2	4.2	-	-	-	-	-	33,000	16,000	15,000	14,000	20,000	46%
B-S3-R3-L8-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	51%	ND	40	40	-	-	-	-	-	54,000	59,000	55,000	-	56,000	4.7%
B-S3-R3-L9-S	Treated Sediment - Hydrocyclone Solids (Third Treatment Cycle)	S	76%	ND	3.1	3.1	-	-	-	-	-	15,000	15,000	15,000	-	15,000	0.4%
B-S3-R3-L10-S	Treated Sediment - Centrifuge Solids (Third Treatment Cycle)	S	59%	ND	24	24	-	-	-	-	-	62,000	65,000	60,000	-	62,000	4.4%
B-S3-R3-L11-A/AF	Wastewater	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R3-L11-2	Wastewater (Dup)	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R3-L12-A	Rinse Blank	AQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C-1
Summary of Analytical Data from Validation Test Runs

			AQUEOUS ANALYSES												
Sample ID	**Sample Location**	**Matrix**	**Total Diss'd Solids (mg/L)**	**Total Susp'd Solids (mg/L)**	**Total Aroclor 1221 (ug/L)**	**Total Aroclor 1248 (ug/L)**	**Total Aroclor 1260 (ug/L)**	**Total PCBs (ug/L)**	**Total TOC (mg/L)**	**Filtered Aroclor 1242 (ug/L)**	**Filtered Aroclor 1248 (ug/L)**	**Filtered Aroclor 1254 (ug/L)**	**Filtered Aroclor 1260 (ug/L)**	**Filtered PCBs (ug/L)**	**Filtered TOC (mg/L)**
Run B-S3-R3 (Floodplain Soils)															
B-S3-R3-L1-S	Untreated Soil	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R3-L2-S	Oversized Organics > 850 microns	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R3-L4-S	Collision Chamber Outlet	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R3-L4-A/AF	Collision Chamber Outlet	AQ	260	12.5	ND	ND	180	180	110	-	-	-	-	-	-
B-S3-R3-L5-S	Treated Sediment - Hydrocyclone Solids (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R3-L6-S	Treated Sediment - Centrifuge Solids (First Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R3-L6-2	Treated Sediment - Centrifuge Solids (First Treatment Cycle) (Dup)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R3-L7-S	Treated Sediment - Hydrocyclone Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R3-L8-S	Treated Sediment - Centrifuge Solids (Second Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R3-L9-S	Treated Sediment - Hydrocyclone Solids (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R3-L10-S	Treated Sediment - Centrifuge Solids (Third Treatment Cycle)	S	-	-	-	-	-	-	-	-	-	-	-	-	-
B-S3-R3-L11-A/AF	Wastewater	AQ	1,800	5,580	ND	ND	200	200	980	ND	ND	ND	0.36	0.36	82
B-S3-R3-L11-2	Wastewater (Dup)	AQ	-	-	ND	ND	80	80	-	-	-	-	-	-	-
B-S3-R3-L12-A	Rinse Blank	AQ	130	7.2	1.3	0.7	1.9	3.9	-	-	-	-	-	-	-

Table C-2
Summary of PCDD/DF Analytical Data from Verification Test Runs

Soil/Sediment Source:	**Coarse-grained Sediment, Reach 5A (TS-SED-A)**				**Fine-grained Sediment, Woods Pond (TS-SED-B)**			
Sample ID:	B-S1-R1-L1-S	B-S1-R1-L9A-S	B-S1-R2-L9A-S	B-S1-R3-L9A-S	B-S2-R1-L1-S	B-S2-R1-L9-S	B-S2-R2-L9-S	B-S2-R3-L9-S
Sample Location:	Untreated Sediment	Treated Sediment - 75 to 425 microns (Third Treat. Cycle)	Treated Sediment - 75 to 425 microns (Third Treat. Cycle)	Treated Sediment - 75 to 425 microns (Third Treat. Cycle)	Untreated Sediment	Treated Sediment - Hydrocyclone Solids (Third Treat. Cycle)	Treated Sediment - Hydrocyclone Solids (Third Treat. Cycle)	Treated Sediment - Hydrocyclone Solids (Third Treat. Cycle)
Furans (mg/kg)								
2,3,7,8-TCDF	0.00014	0.000024	0.000031	0.000022	0.00028	0.000088	0.000071	0.000072
TCDFs (total)	0.00071	0.00015	0.00021	0.00012	0.0034	0.00088	0.00067	0.00076
1,2,3,7,8-PeCDF	0.000040	0.0000075	0.0000056	0.0000055	0.00012	0.000048	0.000026	0.000030
2,3,4,7,8-PeCDF	0.000072	0.000015	0.000014	0.000011	0.00039	0.000066	0.00007	0.000077
PeCDFs (total)	0.00054	0.000069	0.00011	0.000053	0.0020	0.00041	0.00073	0.00082
1,2,3,4,7,8-HxCDF	0.00014	0.000051	0.000034	0.000033	0.00032	0.000084	0.000072	0.000077
1,2,3,6,7,8-HxCDF	0.000051	0.0000082	0.0000055	0.0000051	0.00027	0.000059	0.000047	0.000051
1,2,3,7,8,9-HxCDF	0.000026	0.0000050	0.0000043	0.0000032	0.000047	0.000015	0.000015	0.000016
2,3,4,6,7,8-HxCDF	0.000052	0.0000086	0.0000056	0.0000052	0.00016	0.000069	0.000056	0.000062
HxCDFs (total)	0.00061	0.00015	0.00011	0.000097	0.0049	0.0011	0.00097	0.0011
1,2,3,4,6,7,8-HpCDF	0.00025	0.000050	0.000036	0.000034	0.0048	0.0008	0.00069	0.00071
1,2,3,4,7,8,9-HpCDF	0.000056	0.000025	0.000016	0.000017	0.00018	0.000033	0.000028	0.000031
HpCDFs (total)	0.00051	0.00017	0.00011	0.00011	0.0093	0.0016	0.0014	0.0014
OCDF	0.00048	0.00023	0.00014	0.00015	0.0029	0.00039	0.00033	0.00042
Dioxins (mg/kg)								
2,3,7,8-TCDD	ND (0.0000081)	0.00000088	0.00000067	ND (0.0000012)	0.000013	0.0000043	0.0000035	0.0000033
TCDDs (total)	ND (0.0000081)	0.0000070	0.0000037	0.0000014	0.00021	0.000028	0.000029	0.000035
1,2,3,7,8-PeCDD	ND (0.0000097)	ND (0.0000020)	ND (0.0000017)	ND (0.0000018)	0.000034	ND (0.000013)	0.0000062	ND (0.000011)
PeCDDs (total)	0.000044	0.0000061	0.0000018	0.0000021	0.00022	0.000018	0.000059	0.000040
1,2,3,4,7,8-HxCDD	ND (0.000010)	0.0000012	0.00000065	0.00000082	0.000047	0.000010	0.0000087	0.0000086
1,2,3,6,7,8-HxCDD	0.000015 J	0.0000018	0.0000011	0.0000014	0.00018	0.000041	0.000034	0.000035
1,2,3,7,8,9-HxCDD	ND (0.000014)	0.0000016	0.0000011	0.0000011	0.00012	0.000028	0.000023	0.000024
HxCDDs (total)	0.00019	0.000026	0.000010	0.000020	0.0017	0.00031	0.00027	0.00030
1,2,3,4,6,7,8-HpCDD	0.00012	0.000015	0.000010	0.000010	0.0037	0.00071	0.00057	0.00066
HpCDDs (total)	0.00023	0.000030	0.000023	0.000021	0.0069	0.0013	0.0010	0.0012
OCDD	0.00060	0.000065	0.000040	0.000041	0.024	0.0032	0.0024	0.0039
Total TEQs (mg/kg) (WHO TEFs)	**0.000095**	**0.000021**	**0.000018**	**0.000015**	**0.00048**	**0.00010**	**0.000092**	**0.000097**

Table C-2
Summary of PCDD/DF Analytical Data from Verification Test Runs

Soil/Sediment Source:	**Floodplain Soil (TS-SO-A)**				
Sample ID:	B-S3-R1-L1-S	B-S3-R1-L5-S	B-S3-R2-L5-S	B-S3-R2-L5-2	B-S3-R3-L5-S
Sample Location:	Untreated Soil	Treated Sediment - Hydrocyclone Solids (First Treat. Cycle)	Treated Sediment - Hydrocyclone Solids (First Treat. Cycle)	Treated Sediment - Hydrocyclone Solids (First Treat. Cycle) DUP	Treated Sediment - Hydrocyclone Solids (First Treat. Cycle)
Furans (mg/kg)					
2,3,7,8-TCDF	0.00037	0.000048	0.000040	0.000042	0.000055
TCDFs (total)	0.0021	0.00025	0.00020	0.00021	0.00030
1,2,3,7,8-PeCDF	0.00026	0.000028	0.000025	0.000024	0.000033
2,3,4,7,8-PeCDF	0.00031	0.000036	0.000034	0.000033	0.000041
PeCDFs (total)	0.0020	0.00033	0.00028	0.00028	0.00035
1,2,3,4,7,8-HxCDF	0.00027	0.000023	0.000023	0.000023	0.000029
1,2,3,6,7,8-HxCDF	0.00013	0.000012	0.000012	0.000010	0.000015
1,2,3,7,8,9-HxCDF	0.000029	0.0000042	0.0000037	ND (0.0000026)	0.0000043
2,3,4,6,7,8-HxCDF	0.00016	0.000014	0.000013	0.000012	0.000016
HxCDFs (total)	0.0024	0.00021	0.00021	0.00017	0.00024
1,2,3,4,6,7,8-HpCDF	0.0012	0.000066	0.00010	0.000063	0.000083
1,2,3,4,7,8,9-HpCDF	0.000085	0.000006	0.0000055	0.0000061	0.0000075
HpCDFs (total)	0.0027	0.00015	0.00021	0.00014	0.00019
OCDF	0.0014	0.000058	0.000075	0.000062	0.000081
Dioxins (mg/kg)					
2,3,7,8-TCDD	0.0000068	0.0000011	ND (0.00000080)	0.00000095	ND (0.0000010)
TCDDs (total)	0.000064	0.0000080	0.0000042	0.0000055	0.0000032
1,2,3,7,8-PeCDD	ND (0.000033)	ND (0.00000082)	0.0000019	0.0000018	0.0000028
PeCDDs (total)	0.000029	0.000015	0.000014	0.000013	0.000012
1,2,3,4,7,8-HxCDD	0.000022	0.0000017	0.0000017	0.0000019	0.0000016
1,2,3,6,7,8-HxCDD	0.000088	0.0000067	0.0000064	0.0000066	0.0000072
1,2,3,7,8,9-HxCDD	0.000048	0.0000035	0.0000038	0.0000040	0.0000045
HxCDDs (total)	0.00067	0.000050	0.000050	0.000052	0.000058
1,2,3,4,6,7,8-HpCDD	0.0022	0.00012	0.00012	0.00012	0.00015
HpCDDs (total)	0.0040	0.00022	0.00022	0.00022	0.00028
OCDD	0.018	0.00078	0.00084	0.00079	0.0011
Total TEQs (mg/kg) (WHO TEFs)	**0.00034**	**0.000034**	**0.000033**	**0.000032**	**0.000041**

Table C-3
Summary of PCB Congener Analytical Data from Verification Test Runs

Soil/Sediment Source:	**Coarse-grained Sediment, Reach 5A (TS-SED-A)**				**Fine-grained Sediment, Woods Pond (TS-SED-B)**			
Sample ID:	B-S1-R1-L1-S	B-S1-R1-L9A-S	B-S1-R2-L9A-S	B-S1-R3-L9A-S	B-S2-R1-L1-S	B-S2-R1-L9-S	B-S2-R2-L9-S	B-S2-R3-L9-S
Sample Location:	Untreated Sediment	Treated Sediment - 75 to 425 microns (Third Treat. Cycle)	Treated Sediment - 75 to 425 microns (Third Treat. Cycle)	Treated Sediment - 75 to 425 microns (Third Treat. Cycle)	Untreated Sediment	Treated Sediment - Hydrocyclone Solids (Third Treat. Cycle)	Treated Sediment - Hydrocyclone Solids (Third Treat. Cycle)	Treated Sediment - Hydrocyclone Solids (Third Treat. Cycle)
PCB Congeners (mg/kg)								
PCB 1	0.22	ND (0.012)	ND (0.011)	ND (0.0057)	ND (0.063)	0.066	ND (0.0031)	ND (0.0068)
PCB 4,10	3.0	0.76	0.56	0.39	ND (0.019)	0.23	0.011	0.021
PCB 5,8	0.33	0.068	0.065	0.034	0.34	0.077	0.065	0.031
PCB 6	0.14	0.035	0.025	0.012	0.11	0.010	0.014	0.012
PCB 7,9	0.011	0.0085	0.0030	0.0023	ND (0.0075)	0.0019	0.0012	0.0030
PCB 12,13	0.044	0.016	0.0059	ND (0.0012)	ND (0.014)	ND (0.0011)	ND (0.00066)	ND (0.0015)
PCB 15,18	0.21	0.059	0.042	0.026	0.36	0.044	0.039	0.028
PCB 16,32	0.78	0.24	0.17	0.10	0.60	0.057	0.052	0.040
PCB 17	2.1	0.69	0.47	0.32	0.46	0.082	0.048	0.038
PCB 19	3.3	0.95	0.68	0.46	0.081	ND (0.0012)	0.014	0.010
PCB 20,21,33,53	0.59	0.19	0.13	0.088	1.0	0.096	0.10	0.067
PCB 22,51	1.6	0.48	0.33	0.23	0.80	0.082	0.088	0.053
PCB 23,34,54	0.55	0.16	0.13	0.086	ND (0.011)	ND (0.00084)	0.0056	ND (0.0012)
PCB 24,27	0.49	0.15	0.11	0.070	0.067	0.030	0.0051	0.0052
PCB 25	0.30	0.085	0.058	0.034	0.41	0.037	0.044	0.027
PCB 26	0.32	0.089	0.055	0.034	0.97	0.079	0.092	0.059
PCB 28,50	0.21	0.063	0.048	0.028	0.64	0.069	0.082	0.051
PCB 29	ND (0.00090)	0.0075	0.0035	0.0020	ND (0.0024)	ND (0.00019)	ND (0.00012)	ND (0.00026)
PCB 31	0.20	0.060	0.042	0.028	0.49	0.047	0.049	0.035
PCB 37,42,59	0.16	0.044	0.027	0.020	0.92	0.071	0.085	0.059
PCB 38,47	1.6	0.48	0.33	0.23	1.4	0.11	0.12	0.081
PCB 40	0.0093	0.0043	0.0062	0.0015	0.11	0.0083	0.011	0.0076
PCB 41,64,71,72	0.14	0.052	0.039	0.025	0.91	0.069	0.087	0.053
PCB 43,49	1.0	0.32	0.21	0.15	2.7	0.20	0.23	0.15
PCB 45	0.022	0.012	0.011	0.0047	0.055	0.0081	0.0076	0.0064
PCB 46	0.062	0.018	0.011	0.0084	0.18	0.020	0.018	0.014
PCB 48,75	0.042	0.018	0.0099	0.0090	0.095	0.0083	0.0099	0.007
PCB 52,69,73	1.1	0.38	0.25	0.18	4.6	0.36	0.41	0.28
PCB 55,91,121	0.79	0.28	0.21	0.13	1.4	0.095	0.12	0.075
PCB 56,60	0.013	0.0048	0.0032	0.0017	0.12	0.011	0.018	0.0075
PCB 57,103	0.23	0.083	0.062	0.035	0.56	0.033	0.039	0.026
PCB 58,67,100	0.49	0.17	0.12	0.079	0.33	0.021	0.025	0.016
PCB 63	0.014	0.0046	0.0047	ND (0.0011)	0.10	0.0087	0.0088	0.0080
PCB 66,76,98,80,93,95,102,88	0.88	0.36	0.29	0.17	7.3	0.54	0.66	0.43

Table C-3
Summary of PCB Congener Analytical Data from Verification Test Runs

Soil/Sediment Source:	**Coarse-grained Sediment, Reach 5A (TS-SED-A)**				**Fine-grained Sediment, Woods Pond (TS-SED-B)**			
Sample ID:	B-S1-R1-L1-S	B-S1-R1-L9A-S	B-S1-R2-L9A-S	B-S1-R3-L9A-S	B-S2-R1-L1-S	B-S2-R1-L9-S	B-S2-R2-L9-S	B-S2-R3-L9-S
Sample Location:	Untreated Sediment	Treated Sediment - 75 to 425 microns (Third Treat. Cycle)	Treated Sediment - 75 to 425 microns (Third Treat. Cycle)	Treated Sediment - 75 to 425 microns (Third Treat. Cycle)	Untreated Sediment	Treated Sediment - Hydrocyclone Solids (Third Treat. Cycle)	Treated Sediment - Hydrocyclone Solids (Third Treat. Cycle)	Treated Sediment - Hydrocyclone Solids (Third Treat. Cycle)
PCB Congeners (mg/kg) con't								
PCB 68,96	0.19	0.066	0.047	0.028	0.32	0.020	0.025	0.015
PCB 70	0.043	0.018	0.018	0.0093	0.87	0.077	0.096	0.065
PCB 74,94,61	0.096	0.028	0.025	0.016	0.30	0.024	0.031	0.021
PCB 77,110,148	0.57	0.26	0.19	0.11	6.0	0.45	0.56	0.36
PCB 78,83,112,108	0.038	0.015	0.014	0.0058	0.37	0.023	0.031	0.017
PCB 79,99,113	0.40	0.15	0.13	0.065	2.3	0.15	0.19	0.12
PCB 81,87,117,125,115,145	0.20	0.074	0.052	0.036	0.93	0.078	0.094	0.062
PCB 82	0.0067	0.0028	0.0029	0.0016	0.12	0.010	0.016	0.0091
PCB 84,92,155	0.87	0.32	0.26	0.15	7.4	0.52	0.63	0.41
PCB 89	0.0095	0.0011	0.0041	0.0016	0.031	0.0021	0.0032	0.0030
PCB 90,101	1.0	0.40	0.33	0.18	6.7	0.45	0.55	0.35
PCB 97,152,86	0.11	0.045	0.030	0.019	0.76	0.056	0.068	0.044
PCB 104,44	0.095	0.025	0.018	0.013	1.4	0.11	0.13	0.088
PCB 105,132,161	0.62	0.25	0.21	0.11	3.2	0.23	0.28	0.18
PCB 106,118,1	3.2	1.2	1.1	0.57	13	0.86	1.0	0.68
PCB 107,109,147	0.95	0.37	0.25	0.17	1.1	0.077	0.11	0.063
PCB 114,134,143	0.16	0.063	0.053	0.029	0.56	0.039	0.050	0.030
PCB 116,85	0.028	0.016	0.0059	0.0067	0.55	0.042	0.051	0.036
PCB 119,150	0.087	0.033	0.026	0.015	0.23	0.015	0.019	0.012
PCB 120,136	0.52	0.21	0.17	0.097	1.9	0.13	0.17	0.11
PCB 122,131,142	0.060	0.026	0.021	0.011	0.20	0.013	0.016	0.010
PCB 123	ND (0.0045)	ND (0.0023)	ND (0.0022)	ND (0.0011)	ND (0.012)	0.0018	ND (0.00059)	ND (0.0013)
PCB 124,135	0.43	0.17	0.14	0.079	1.4	0.094	0.12	0.077
PCB 126,129	0.0099	0.0038	0.0035	0.0015	0.042	0.0036	0.0040	0.0026
PCB 128,162	0.11	0.045	0.037	0.018	0.63	0.045	0.056	0.038
PCB 130,176	0.30	0.11	0.097	0.048	0.92	0.062	0.072	0.048
PCB 137	0.067	0.027	0.026	0.012	0.31	0.025	0.025	0.018
PCB 138,163,164	3.5	1.3	1.2	0.60	11	0.77	0.91	0.61
PCB 140	ND (0.0044)	0.035	0.023	ND (0.0011)	ND (0.012)	ND (0.00091)	ND (0.00058)	ND (0.0013)
PCB 141	1.4	0.51	0.47	0.23	4.2	0.30	0.34	0.24
PCB 144	0.37	0.13	0.12	0.059	1.1	0.077	0.090	0.053
PCB 146,165,188	1.0	0.40	0.31	0.18	3.3	0.21	0.25	0.16
PCB 151	1.8	0.70	0.59	0.33	4.9	0.32	0.39	0.25
PCB 153	3.2	1.2	1.1	0.54	10	0.67	0.77	0.53

Table C-3
Summary of PCB Congener Analytical Data from Verification Test Runs

Soil/Sediment Source:	**Coarse-grained Sediment, Reach 5A (TS-SED-A)**				**Fine-grained Sediment, Woods Pond (TS-SED-B)**			
Sample ID:	B-S1-R1-L1-S	B-S1-R1-L9A-S	B-S1-R2-L9A-S	B-S1-R3-L9A-S	B-S2-R1-L1-S	B-S2-R1-L9-S	B-S2-R2-L9-S	B-S2-R3-L9-S
Sample Location:	Untreated Sediment	Treated Sediment - 75 to 425 microns (Third Treat. Cycle)	Treated Sediment - 75 to 425 microns (Third Treat. Cycle)	Treated Sediment - 75 to 425 microns (Third Treat. Cycle)	Untreated Sediment	Treated Sediment - Hydrocyclone Solids (Third Treat. Cycle)	Treated Sediment - Hydrocyclone Solids (Third Treat. Cycle)	Treated Sediment - Hydrocyclone Solids (Third Treat. Cycle)
PCB Congeners (mg/kg) con't								
PCB 156,171	1.1	0.37	0.34	0.17	2.7	0.18	0.22	0.14
PCB 157,202	0.049	0.017	0.015	0.0075	0.080	0.0048	0.0059	0.0038
PCB 158,160,186	0.29	0.11	0.099	0.048	0.90	0.068	0.076	0.052
PCB 166,178	1.3	0.49	0.40	0.22	2.3	0.14	0.17	0.11
PCB 167	0.065	0.022	0.017	0.0090	0.25	0.019	0.022	0.012
PCB 170	1.7	0.58	0.52	0.26	3.5	0.24	0.29	0.19
PCB 172,204	0.70	0.25	0.22	0.11	1.6	0.10	0.12	0.081
PCB 173	0.042	0.012	0.013	0.0060	0.077	0.0053	0.0058	0.004
PCB 174,181	3.0	1.0	0.94	0.46	6.3	0.40	0.48	0.32
PCB 175,159	0.20	0.07	0.052	0.029	0.36	0.023	0.028	0.017
PCB 177	2.0	0.71	0.61	0.32	4.1	0.26	0.32	0.21
PCB 179	1.4	0.49	0.44	0.23	2.6	0.16	0.20	0.13
PCB 180	6.2	2.2	2.0	0.99	12	0.80	0.94	0.63
PCB 182,187	3.7	1.4	1.2	0.61	6.7	0.42	0.49	0.32
PCB 183	1.7	0.55	0.50	0.25	3.3	0.20	0.24	0.16
PCB 185	0.35	0.12	0.12	0.055	0.61	0.04	0.048	0.033
PCB 189	0.11	0.040	0.031	0.017	0.19	0.017	0.017	0.018
PCB 190	0.54	0.19	0.17	0.087	0.97	0.065	0.079	0.051
PCB 191	0.15	0.067	0.049	0.021	0.31	0.018	0.024	0.017
PCB 192,197	0.086	0.043	0.037	0.014	0.15	0.0092	0.0071	0.0081
PCB 193	0.47	0.19	0.16	0.073	0.88	0.060	0.070	0.049
PCB 194	1.5	0.52	0.46	0.24	2.2	0.14	0.17	0.12
PCB 195	0.53	0.18	0.16	0.081	0.75	0.048	0.060	0.041
PCB 196,203	3.5	1.2	1.1	0.53	4.9	0.30	0.36	0.25
PCB 198	0.11	0.048	0.029	0.020	0.16	0.011	0.0093	0.017
PCB 199	3.1	1.0	0.94	0.48	4.5	0.28	0.33	0.22
PCB 200,169	0.31	0.11	0.098	0.047	0.46	0.029	0.036	0.024
PCB 201	0.30	0.10	0.085	0.047	0.45	0.024	0.027	0.021
PCB 205	0.10	0.042	0.035	0.020	0.18	0.010	0.013	0.0077
PCB 206	0.41	0.14	0.13	0.063	0.54	0.032	0.033	0.024
PCB 208	0.13	0.050	0.043	0.022	0.17	0.013	0.011	0.0072
Total PCB Congeners (mg/kg)	**78**	**27**	**22**	**12**	**180**	**13**	**15**	**9.7**

Table C-3
Summary of PCB Congener Analytical Data from Verification Test Runs

Soil/Sediment Source:	**Floodplain Soil (TS-SO-A)**				
Sample ID:	B-S3-R1-L1-S	B-S3-R1-L5-S	B-S3-R2-L5-S	B-S3-R2-L5-2	B-S3-R3-L5-S
Sample Location:	Untreated Soil	Treated Sediment - Hydrocyclone Solids (First Treat. Cycle)	Treated Sediment - Hydrocyclone Solids (First Treat. Cycle)	Treated Sediment - Hydrocyclone Solids (First Treat. Cycle) DUP	Treated Sediment - Hydrocyclone Solids (First Treat. Cycle)
PCB Congeners (mg/kg)					
PCB 1	ND (0.027)	ND (0.0025)	ND (0.0023)	ND (0.0024)	ND (0.0023)
PCB 4,10	ND (0.0080)	ND (0.00072)	ND (0.00068)	0.014	0.010
PCB 5,8	0.027	0.0054	0.022	0.0074	0.0041
PCB 6	0.014	0.0019	0.0012	0.0023	0.0022
PCB 7,9	0.0058	ND (0.00029)	ND (0.00027)	ND (0.00028)	ND (0.00027)
PCB 12,13	ND (0.0059)	ND (0.00053)	ND (0.00050)	ND (0.00052)	ND (0.00050)
PCB 15,18	ND (0.010)	0.0021	0.0038	0.0035	0.0025
PCB 16,32	0.010	0.0015	0.0027	0.0055	0.0052
PCB 17	ND (0.0059)	0.0031	0.0058	0.0014	0.0084
PCB 19	ND (0.0065)	0.0026	0.0055	0.0094	0.0099
PCB 20,21,33,53	ND (0.011)	0.0019	0.0039	0.0045	0.0047
PCB 22,51	0.0084	0.0025	0.0044	0.0070	0.0056
PCB 23,34,54	ND (0.0047)	ND (0.00043)	ND (0.00040)	ND (0.00041)	ND (0.00040)
PCB 24,27	ND (0.00066)	0.0010	0.0014	0.0028	0.0022
PCB 25	0.0064	0.00093	ND (0.000066)	0.0029	0.0027
PCB 26	0.012	0.0016	ND (0.00018)	0.0038	0.0040
PCB 28,50	ND (0.012)	0.0024	0.0026	0.0035	0.0036
PCB 29	ND (0.0011)	ND (0.000095)	ND (0.000089)	ND (0.000092)	ND (0.000090)
PCB 31	ND (0.011)	0.0023	0.0019	0.0033	0.0024
PCB 37,42,59	0.017	0.0034	0.0032	0.0024	0.0035
PCB 38,47	0.04	0.0067	0.0074	0.0080	0.0082
PCB 40	ND (0.0025)	0.00048	ND (0.00021)	0.0015	0.00050
PCB 41,64,71,72	0.018	0.0042	0.0046	0.0037	0.0046
PCB 43,49	0.063	0.0094	0.0095	0.011	0.010
PCB 45	0.011	0.0019	0.0015	0.0014	0.0032
PCB 46	0.012	0.0020	ND (0.00078)	0.0018	ND (0.00078)
PCB 48,75	0.0068	0.0010	0.00070	0.00052	0.00064
PCB 52,69,73	0.14	0.024	0.025	0.027	0.024
PCB 55,91,121	0.13	0.016	0.015	0.013	0.015
PCB 56,60	0.0094	0.0012	0.00092	0.0012	0.0016
PCB 57,103	0.032	0.0033	0.0038	0.0042	0.0034
PCB 58,67,100	0.018	0.0027	0.0020	0.0014	0.0035
PCB 63	ND (0.0054)	0.00098	ND (0.00046)	0.0010	0.00075
PCB 66,76,98,80,93,95,102,88	1.3	0.15	0.15	0.12	0.16

Table C-3
Summary of PCB Congener Analytical Data from Verification Test Runs

Soil/Sediment Source:	**Floodplain Soil (TS-SO-A)**				
Sample ID:	B-S3-R1-L1-S	B-S3-R1-L5-S	B-S3-R2-L5-S	B-S3-R2-L5-2	B-S3-R3-L5-S
Sample Location:	Untreated Soil	Treated Sediment - Hydrocyclone Solids (First Treat. Cycle)	Treated Sediment - Hydrocyclone Solids (First Treat. Cycle)	Treated Sediment - Hydrocyclone Solids (First Treat. Cycle) DUP	Treated Sediment - Hydrocyclone Solids (First Treat. Cycle)
PCB Congeners (mg/kg) con't					
PCB 68,96	0.013	0.00077	ND (0.00064)	0.0021	0.0013
PCB 70	0.053	0.0088	0.0087	0.0078	0.0087
PCB 74,94,61	0.015	0.0029	0.0030	0.0024	0.0024
PCB 77,110,148	1.2	0.15	0.14	0.12	0.16
PCB 78,83,112,108	0.039	0.0051	0.0044	0.0035	0.0055
PCB 79,99,113	0.28	0.033	0.031	0.026	0.035
PCB 81,87,117,125,115,145	0.33	0.042	0.038	0.032	0.047
PCB 82	0.043	0.007	0.0057	0.0059	0.0066
PCB 84,92,155	0.90	0.11	0.10	0.084	0.12
PCB 89	0.0036	0.00088	0.00085	0.00040	0.00066
PCB 90,101	1.3	0.16	0.15	0.12	0.16
PCB 97,152,86	0.12	0.015	0.014	0.011	0.018
PCB 104,44	0.022	0.0051	0.0048	0.0046	0.0058
PCB 105,132,161	1.0	0.11	0.11	0.087	0.12
PCB 106,118,1	3.9	0.42	0.40	0.32	0.42
PCB 107,109,147	0.11	0.013	0.012	0.011	0.014
PCB 114,134,143	0.15	0.016	0.016	0.013	0.018
PCB 116,85	0.13	0.017	0.015	0.013	0.018
PCB 119,150	0.016	0.0022	0.0024	0.0017	0.0025
PCB 120,136	0.55	0.060	0.056	0.045	0.059
PCB 122,131,142	0.046	0.0046	0.0051	0.0045	0.0054
PCB 123	0.0085	0.0014	0.00077	0.0011	0.00094
PCB 124,135	0.40	0.045	0.042	0.034	0.045
PCB 126,129	0.016	0.0017	0.0016	0.0013	0.0021
PCB 128,162	0.23	0.027	0.025	0.020	0.027
PCB 130,176	0.30	0.033	0.030	0.025	0.033
PCB 137	0.12	0.011	0.011	0.0082	0.013
PCB 138,163,164	4.3	0.47	0.45	0.36	0.47
PCB 140	ND (0.0051)	ND (0.00046)	ND (0.00044)	ND (0.00045)	ND (0.00044)
PCB 141	2.1	0.23	0.22	0.17	0.23
PCB 144	0.59	0.065	0.061	0.051	0.064
PCB 146,165,188	0.75	0.084	0.079	0.064	0.084
PCB 151	1.7	0.18	0.17	0.14	0.18
PCB 153	3.6	0.40	0.37	0.30	0.39

Table C-3
Summary of PCB Congener Analytical Data from Verification Test Runs

Soil/Sediment Source:	**Floodplain Soil (TS-SO-A)**				
Sample ID:	B-S3-R1-L1-S	B-S3-R1-L5-S	B-S3-R2-L5-S	B-S3-R2-L5-2	B-S3-R3-L5-S
Sample Location:	Untreated Soil	Treated Sediment - Hydrocyclone Solids (First Treat. Cycle)	Treated Sediment - Hydrocyclone Solids (First Treat. Cycle)	Treated Sediment - Hydrocyclone Solids (First Treat. Cycle) DUP	Treated Sediment - Hydrocyclone Solids (First Treat. Cycle)
PCB Congeners (mg/kg) con't					
PCB 156,171	0.84	0.096	0.091	0.073	0.096
PCB 157,202	0.034	0.0034	0.0033	0.0027	0.0032
PCB 158,160,186	0.36	0.041	0.039	0.032	0.043
PCB 166,178	0.83	0.090	0.089	0.067	0.091
PCB 167	0.078	0.010	0.0083	0.0075	0.0097
PCB 170	1.4	0.15	0.14	0.11	0.15
PCB 172,204	0.57	0.061	0.058	0.047	0.060
PCB 173	0.031	0.0033	0.003	0.0031	0.0028
PCB 174,181	2.6	0.27	0.26	0.21	0.27
PCB 175,159	0.20	0.020	0.020	0.015	0.020
PCB 177	1.6	0.17	0.16	0.13	0.16
PCB 179	1.0	0.098	0.096	0.077	0.10
PCB 180	5.0	0.53	0.50	0.40	0.52
PCB 182,187	2.6	0.28	0.27	0.21	0.27
PCB 183	1.3	0.14	0.13	0.11	0.14
PCB 185	0.28	0.033	0.029	0.024	0.032
PCB 189	0.079	0.0075	0.0089	0.0071	0.0096
PCB 190	0.41	0.046	0.042	0.034	0.044
PCB 191	0.14	0.014	0.010	0.0094	0.012
PCB 192,197	0.094	0.0071	0.0062	0.0066	0.0063
PCB 193	0.38	0.037	0.034	0.029	0.037
PCB 194	0.88	0.091	0.087	0.070	0.091
PCB 195	0.34	0.034	0.033	0.026	0.033
PCB 196,203	2.1	0.22	0.21	0.16	0.21
PCB 198	0.12	0.0058	0.0098	0.0058	0.0064
PCB 199	1.9	0.19	0.19	0.15	0.20
PCB 200,169	0.20	0.019	0.018	0.015	0.020
PCB 201	0.18	0.019	0.019	0.014	0.016
PCB 205	0.054	0.0077	0.0070	0.0048	0.0066
PCB 206	0.23	0.022	0.023	0.017	0.023
PCB 208	0.074	0.0079	0.011	0.0063	0.0072
Total PCB Congeners (mg/kg)	**52**	**5.7**	**5.5**	**4.4**	**5.8**

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Appendix B

Basis for Target Floodplain Soil Concentrations Associated with PCB IMPG for Insectivorous Birds

Appendix B: Basis for Target Floodplain Soil Concentrations Associated with PCB IMPG for Insectivorous Birds

The Interim Media Protection Goals (IMPGs) specified in General Electric's (GE's) revised IMPG Proposal (GE. 2006) and approved by the United States Environmental Protection Agency (EPA) for insectivorous birds were based on EPA's assessment of potential risks to the wood duck (which was selected as a representative species for the insectivorous birds that reside and breed in the Rest of River area), as described in EPA's Ecological Risk Assessment (ERA; EPA, 2004). Those IMPGs apply to concentrations in wood duck invertebrate prey, which consists of both aquatic and terrestrial organisms. The IMPGs for wood duck invertebrate prey are 4.4 milligrams per kilogram (mg/kg) for polychlorinated biphenyls (PCBs) and 14 to 22 nanograms per kilogram (ng/kg) for dioxin toxicity equivalents (TEQs). Consistent with EPA's April 13, 2007 conditional approval letter for GE's Corrective Measures Study (CMS) Proposal (Condition 27), GE's evaluations in the CMS have focused on the IMPGs for total PCBs. Therefore, the IMPGs for TEQs are not further discussed.

As discussed in the text of this CMS Report, in order to be used to evaluate remedial alternatives, the IMPG for PCBs in wood duck invertebrate prey needed to be converted into corresponding PCB concentrations in media subject to evaluation in the CMS – namely, sediments and floodplain soils. This procedure was complicated by the fact that the invertebrate portion of the wood duck's diet consists of an aquatic invertebrate component (related to sediment and water column) and a terrestrial invertebrate component (related to floodplain soil). Thus, when calculating target sediment and floodplain soil concentrations associated with the prey-based IMPGs, the concentration in one component affects the allowable concentration in the other components – i.e., a higher concentration in sediments will require a lower concentration in soil in order to achieve the IMPG, and vice versa. Thus, it is not possible to derive a target concentration in one medium without knowing the concentration in the other.

In these circumstances, GE first selected a range of target sediment PCB concentrations that fall within the range of other sediment IMPGs (e.g., based on human direct contact and other ecological receptors). Those selected target PCB concentrations were 1, 3, and 5 mg/kg. GE then calculated target floodplain soil concentrations associated with achieving the PCB IMPG of 4.4 mg/kg in wood duck invertebrate prey assuming that the sediment PCB concentrations are equal to the selected target values. These calculations were initially presented in Appendix A to the CMS Proposal. However, EPA's April 13, 2007 conditional approval letter provided several comments on those calculations and directed GE to revise the calculations of target floodplain soil levels.

Based on those comments, this appendix describes the revised procedure used to calculate the target floodplain soil levels and presents revised calculations and target levels. These revised calculations were based on assumed target sediment concentrations of 1, 3, and 5 mg/kg. In accordance with EPA's comments, revised target floodplain soil concentrations have been calculated separately for each of the four subreaches of the Primary Study Area (PSA) (i.e., Reaches 5A, 5B, 5C/5D, and 6), due to subreach-specific differences in the total organic carbon content (TOC) of the surface sediments and in the biota-sediment accumulation factors (BSAFs).[1] The underlying equations, input variables, and results of this analysis are summarized in Table B-1 and are detailed below.

Derivation of Equation for Target Soil PCB Concentrations

As detailed in Attachment 29 of the revised IMPG Proposal, the prey-based IMPG is related to PCB concentrations in aquatic and terrestrial invertebrates as follows:

$$C_i = [(P_{ai} \times C_{ai}) + (P_{ti} \times C_{ti})] / (P_{ai} + P_{ti}) \qquad \text{Eqn. 1}$$

Where:

C_i = concentration of PCBs in invertebrate prey of wood ducks (mg/kg)

P_{ai} = proportion of wood duck diet comprised of aquatic invertebrates (unitless)

C_{ai} = concentration of PCBs in aquatic invertebrates (mg/kg)

P_{ti} = proportion of wood duck diet comprised of terrestrial invertebrates (unitless)

C_{ti} = concentration of PCBs in terrestrial invertebrates (mg/kg).

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[1] These target floodplain soil concentrations have been applied in a more general way to the floodplain in further downstream reaches, as described in the text of this Report.

In order to differentiate between aquatic invertebrate prey that primarily reside in the water column and those that inhabit both the water column and the sediment (epibenthic organisms), Equation 1 is further broken out as:

$$C_i = [(P_{ei} \times C_{ei}) + (P_{wi} \times C_{wi}) + (P_{ti} \times C_{ti})] / (P_{ei} + P_{wi} + P_{ti}) \qquad \text{Eqn. 2}$$

Where:

P_{ei} = proportion of wood duck diet comprised of epibenthic invertebrates (unitless)

C_{ei} = concentration of PCBs in epibenthic invertebrates (mg/kg)

P_{wi} = proportion of wood duck diet comprised of water column invertebrates (unitless)

C_{wi} = concentration of PCBs in water column invertebrates (mg/kg)

P_{ti} = proportion of wood duck diet comprised of terrestrial invertebrates (unitless)

C_{ti} = concentration of PCBs in terrestrial invertebrates (mg/kg).

The lipid-normalized concentration of PCBs in epibenthic and water column invertebrates may be related to the organic carbon-normalized concentration of PCBs in sediment as follows (Ankley et al., 1992):

$$BSAF = (C_i / L) / (C_{sed} / TOC) \qquad \text{Eqn. 3}$$

Where:

BSAF = biota-sediment accumulation factor (unitless)

L = lipid content of invertebrates (%)

C_{sed} = concentration of PCBs in sediment (mg/kg)

TOC = total organic carbon content of sediment (%)

As detailed further below, separate BSAFs have been calculated for epibenthic and water column invertebrates and for different subreaches of the river. One would not expect a strong correlation between PCB concentrations in water column invertebrates and those in sediments given that such invertebrates are not in direct contact with sediment.

Nonetheless, because water column invertebrates are about 20% of the wood duck pre-laying diet (Drobney and Fredrickson, 1979, as tabulated in the ERA at Vol. 5, Table G.2-35), use of a BSAF specific to water column invertebrates allows more complete consideration of bioaccumulation of PCBs from sediment into all components of the wood duck diet.

Equation 3 can be rearranged to:

$$C_i = BSAF \times C_{sed} \times 1/TOC \times L \qquad \text{Eqn. 4}$$

For the terrestrial component of the wood duck diet, the concentration of PCBs can be expressed as:

$$C_{ti} = BAF_{ti} \times C_{soil} \qquad \text{Eqn. 5}$$

Where:

BAF_{ti} = soil-to-terrestrial invertebrate bioaccumulation factor (unitless)

C_{soil} = concentration of PCBs in floodplain soil (mg/kg)

Unlike the calculations of BSAFs, this relationship has not been normalized based on TOC and/or lipid content or varied by subreach due to the limited available empirical data on co-located soil and terrestrial invertebrate PCB concentrations, as further discussed below. In this situation, Equation 5 is the simplest model that yields the strongest relationship between the soil and terrestrial invertebrate PCB concentrations.

Equations 4 and 5 may be substituted into Equation 2 to yield:

$$C_i = [(P_{ei} \times BSAF_{ei} \times C_{sed} \times 1/TOC \times L_{ei}) + (P_{wi} \times BSAF_{wi} \times C_{sed} \times 1/TOC \times L_{ei})$$

$$+ (P_{ti} \times BAF \times C_{soil})] / (P_{ei} + P_{wi} + P_{ti}) \qquad \text{Eqn. 6}$$

Solving Equation 6 for C_{soil} yields:

$$C_{soil} = C_i \times (P_{ti} + P_{wi} + P_{ei}) – [(P_{wi} \times BSAF_{wi} \times L_{wi} \times C_{sed} \times 1/TOC) +$$

$$(P_{ei} \times BSAF_{ei} \times L_{ei} \times C_{sed} \times 1/TOC)] / P_{ti} \times BAF_{ti} \qquad \text{Eqn. 7}$$

As shown in Table B-1, Equation 7 was used to calculate subreach-specific target floodplain soil concentrations associated with the IMPG of 4.4 mg/kg for wood duck prey and sediment concentrations of 1, 3, and 5 mg/kg, based on the following assumptions regarding each of the equation's variables.

Assumptions

Input values for Equation 7 were preferentially selected based on site-specific data, as presented in the ERA and supporting studies and datasets. The bases for all input assumptions are detailed below.

C_i – The target PCB concentration in the wood duck invertebrate prey was set equal to the EPA-approved IMPG of 4.4 mg/kg, derived in the revised IMPG Proposal (GE 2006, Appendix D, Attachment 29).

P_{ei} – The proportion of wood duck diet composed of epibenthic invertebrates was set equal to 0.367, based on Drobney and Fredrickson's (1979) diet data for the wood duck's pre-laying period (and as tabulated in the ERA at Vol. 5, Table G.2-35). Assignment of individual taxa in the wood duck's diet to the category of epibenthic or water column groups followed EPA's Food Chain Model (FCM) designations (EPA, 2006, pp. 2.4-1, 2.4-2 and Table 2.4-1).

P_{wi} - The proportion of wood duck diet composed of water column invertebrates was set equal to 0.197, also based on Drobney and Fredrickson's (1979) diet data for the wood duck's pre-laying period (and as tabulated in the ERA at Vol. 5, Table G.2-35). Assignment of individual taxa in the wood duck's diet to the category of epibenthic or water column groups followed EPA's FCM designations (EPA 2006, pp. 2.4-1, 2.4-1 and Table 2.4-1). P_{ei} and P_{wi} sum to 0.564, consistent with the ERA's assumption regarding the proportion of the wood duck diet composed of aquatic invertebrates (Vol. 5, Table G.2-33).

P_{ti} – The proportion of wood duck diet composed of terrestrial invertebrates was set equal to 0.196, consistent with the ERA (Vol. 5, Table G.2-33) and based on the diet during the pre-laying period (Drobney and Fredrickson, 1979; Drobney, 1980).

C_{sed} - Given the inter-related but unknown values of C_{sed} and C_{soil}, it was necessary to hold C_{sed} at fixed target levels in order to generate the C_{soil} values that are associated with each sediment concentration. Values of 1, 3, and 5 mg/kg were selected as example target sediment concentrations as discussed above.

BSAF – Biota-sediment accumulation factors for epibenthic invertebrates and water column invertebrates in Reaches 5A, 5B, 5C/5D, and 6 were calculated using EPA's FCM (EPA, 2006), based on simulations for 26 years (1979 through 2004) and average BSAFs for April through July of each year. The April through July period was selected because it encompasses the range from earliest nest initiation date to latest nest initiation date in Massachusetts (Grice and Rogers, 1965) and thus reflects the most active period of the wood duck's breeding season. Modeled BSAFs for water column feeders and epibenthic organisms are plotted in Figures B-1 and B-2, respectively, for each subreach of the PSA. BSAFs are also tabulated in Table B-1.

L_{ei} – The lipid content of epibenthic invertebrates was set equal to 1.5%, consistent with the findings of the FCM (EPA, 2006, Appendix C.1, pp. 1-5).

L_{wi} – The lipid content of water column invertebrates was set equal to 2%, consistent with the findings of the FCM (EPA, 2006, Appendix C.1, pp. 1-5).

TOC – As shown in Table B-1, subreach-specific values for the total organic carbon content of surface sediments (top 6 inches) were employed, based on the approved RCRA Facility Investigation (RFI) Report (QEA and BBL. 2003, Table 4-3).

BAF – A bioaccumulation factor of 0.31 was calculated from EPA's dataset for concentrations of PCBs in eight co-located litter invertebrate and composite soil samples collected from three sampling stations (13, 14, and 15) within the PSA (ERA, Vol 6, Appendix L). The underlying data are reproduced in Table B-2. Although EPA contractors had sampled both earthworms and litter invertebrates from these three stations, earthworm data were excluded from the BAF calculation because they are not a component of wood ducks' pre-laying diet (ERA, Vol. 5, Table G.2-35). The BAF of 0.31 reflects the median of BAFs calculated from all litter invertebrate results. Reach-specific BAFs were not calculated or applied due to the very low sample sizes per subreach (n = 0 to 3). However, as discussed below, the BAF of 0.31 is quite conservative compared to BAFs reported in the literature for terrestrial invertebrates.

Results

The target floodplain soil concentrations calculated using the above approach for each subreach and target sediment concentration are detailed in Table B-1 and summarized below:

Target Floodplain Soil Concentrations (mg/kg) Associated with IMPG for Wood Ducks

Assumed Sediment Concentration	Reach 5A	Reach 5B	Reach 5C/5D	Reach 6
1 mg/kg	50	48	53	53
3 mg/kg	39	33	49	50
5 mg/kg	29	18	46	46

Discussion

Of the input variables used to generate the target soil concentrations, the most significant uncertainty and variability are associated with the BSAF and the BAFs. In order to verify the appropriateness of the BSAF and BAFs applied, published papers and site-specific studies on bioaccumulation of PCBs by aquatic and terrestrial invertebrates that form significant portions of the wood duck diet were reviewed. As further detailed below, the literature review confirmed the appropriateness of the selected values.

The BSAFs used in the analysis (0.20 to 1.3) were derived from the FCM and vary according to prey type and river subreach. Other sources of BSAFs considered but rejected for this analysis include empirical data from the ERA (tree swallow stomach content data, D-net invertebrate data, and a 7-day *Lumbriculus* bioaccumulation study), BSAFs generated for the Kalamazoo River site, and theoretical predictions based on equilibrium partitioning. These potential sources are discussed below.

Data from ERA: Empirically derived BSAFs require consideration of co-located data on concentrations of PCBs in sediment and invertebrates, as well as invertebrate lipid content and sediment TOC. The tree swallow stomach contents analyzed for PCBs as part of the ERA cannot be used to generate BSAFs because it is not possible to link the tree swallow prey samples to specific sediment sampling locations from which the prey were harvested by individual tree swallows. Although assumptions could theoretically be made through spatial averaging of sediment concentrations within foraging distance of each tree swallow's nest box, considerable variability would result because prey concentrations differ among collections from closely located nest boxes (which would share virtually the same foraging area). Similarly, co-located sediment samples also were lacking for the invertebrates collected for the ERA using D-nets. While the 7-day *Lumbriculus variegatus* bioaccumulation study conducted as part of the ERA does have co-located sediment and invertebrate data, that study is limited for purposes of generating wood duck target levels because *Lumbriculus* is not a component of the wood duck diet and because seven days is not likely a sufficient test duration to achieve steady state.

<u>Data from Kalamazoo River</u>: Kay et al. (2005) used empirical data to generate BSAFs for benthic invertebrates, aquatic emergent insects, and several other types of organisms for total PCBs for the Kalamazoo River site and a reference site. The lipid-normalized BSAF for benthic invertebrates and aquatic emergent insects from the Kalamazoo River were 0.439 and 0.18, respectively, while those from the reference site were somewhat higher (1.15 and 0.597, respectively) (Kay et al., 2005). Because these BSAFs are not specific to the Housatonic River, they are less applicable to this analysis than those generated by the FCM. However, they do offer a bounding range of BSAFs that illustrates that the BSAFs generated by the FCM are within the range supported by empirically derived BSAFs for total PCBs.

<u>Equilibrium Partitioning</u>: The ERA (Vol. 4, p. D-39) reported that equilibrium partitioning theory for PCBs yields a BSAF of approximately 2 for benthic invertebrates (Parkerton 1993, McFarland 1994). The RFI Report (QEA and BBL, 2003, p. 8-51) noted that average or median BSAFs for benthic organisms generally lie between 1.5 and 3 for PCBs with logarithm of octanol-water partitioning coefficients (log Kow) in the range of 6 to 7 (Tracey and Hansen, 1996; QEA, 1999; Wong et al., 2001). However, equilibrium partitioning theory alone may not be sufficient to explain variability in uptake of PCBs by aquatic organisms, especially water column and epibenthic species. Furthermore, Di Toro et al. (1991) noted that equilibrium partitioning theory is a relatively poor predictor of uptake when sediment TOC is very low (i.e., less than 0.2%). Although TOC in the different subreaches of the PSA is at least an order of magnitude higher than that minimum threshold (see Table B-1), it is possible that this limitation of equilibrium partitioning theory would cause it to perform less well in subreaches with relatively low TOC than in those with much higher TOC.

For all of these reasons, the model-derived BSAFs were judged most applicable to the estimation of target floodplain soil concentrations protective of wood ducks.

The BAF used in the analysis (0.31) is the median of calculated BAFs from eight co-located litter invertebrate and floodplain soil samples collected within the PSA as part of the ERA. The majority of published studies on bioaccumulation of PCBs by terrestrial invertebrates focus on earthworms. As previously discussed, because earthworms are not a significant portion of the wood duck's diet, they were excluded from the calculation of site-specific BAFs. Published earthworm bioaccumulation studies were excluded from the literature review for the same reason, which left two pertinent articles (Blankenship et al., 2005. and Paine et al.. 1993).

Blankenship et al. (2005) reported total PCB concentrations for above-ground terrestrial invertebrates (excluding earthworms) and co-located soil samples collected from the Kalamazoo River Superfund Site. Arithmetic mean concentrations of total PCBs in terrestrial invertebrates and soil were reported to be 0.34 and 6.5 mg/kg, respectively, which yield a BAF of 0.05. Geometric mean concentrations in invertebrates and soil were 0.10 and 4.7 mg/kg, respectively, which yield a BAF of 0.02. In a 14-day bioaccumulation test on uptake of Aroclor 1254 in soil by house crickets, Paine et al. (1993) observed BAFs ranging from 0.07 to 0.19 for soil concentrations ranging from 100 to 2,000 mg/kg. The BAF associated with the lowest soil concentration (100 mg/kg) was 0.11. Relative to these two studies, the site-specific BAF of 0.31 is quite conservative.[2] Use of the highest of the literature-derived BAF (0.19) would increase the target soil levels by 1.6-fold.

In conclusion, target floodplain soil PCB concentrations that are associated with the four selected target sediment concentrations and based on the PCB IMPG of 4.4 mg/kg in the invertebrate prey of wood ducks range from 18 to 53 mg/kg, depending on the subreach and target sediment concentration.[3] This analysis is based on site-specific data and is conservative relative to available data published in the peer-reviewed literature.

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[2] The BAF and the target soil concentration are inversely related, such that higher BAFs will yield lower target soils concentrations.

[3] See Section 5.2.3.3 of text for discussion of the application of these target concentrations to the subreaches within the PSA and to further downstream reaches.

References

Ankley, G.T. P.M. Cook, A.R. Carlson, D.J. Call, J.A. Sorensen, H.F. Corcoran, R.A. Hoke. 1992. Bioaccumulation of PCBs from sediments by oligochaetes and fishes: Comparison of laboratory and field studies. Can. J. Fish. Aquat. Sci. 49:2080-2085.

Blankenship, A.L., M.J. Zwiernik, K.K. Coady, D.P. Kay, J.L. Newsted, K. Strause, C. Park, P.W. Bradley, A.M. Neigh, S.D. Millsap, P.D. Jones, J.P. Giesy. 2005. Differential accumulation of polychlorinated biphenyl congeners in the terrestrial food web of the Kalamazoo River Superfund Site, Michigan. Environ. Sci. Technol. 39:5954-5963.

Di Toro, D.M., C.S. Zarba, D.J. Hansen, W.J. Berry, R.C. Swartz, C.E. Cowan, S.P. Pavlov, H.E. Allen, N.A. Thomas, and P.A. Paquin. 1991. Technical basis for establishing sediment quality criteria for nonionic organic chemicals using equilibrium portioning. Environ. Toxicol. Chem. 10:1541-1583.

Drobney, R.D. 1980. Reproductive bioenergetics of wood ducks. Auk 97:480-490.

Drobney, R.D., L.H. Fredrickson. 1979. Food selection by wood ducks in relation to breeding status. Journal of Wildlife Management 43:109-120.

EPA. 2004. Ecological Risk Assessment for General Electric (GE)/Housatonic River Site, Rest of River. Prepared by Weston Solutions, Inc., West Chester, PA, for the U.S. Army Corps of Engineers, New England District, and the U.S. Environmental Protection Agency, New England Region. November 12.

EPA. 2006. Final Model Documentation Report: Modeling Study of PCB Contamination in the Housatonic River. Prepared by Weston Solutions, Inc., West Chester, PA, for the U.S. Army Corps of Engineers, New England District, and the U.S. Environmental Protection Agency, New England Region. November.

EPA. 2007. Letter to Andrew T. Silfer, RE: EPA's Conditional Approval of the Corrective Measures Study Proposal. U.S. Environmental Protection Agency. Boston, MA. April 13.

GE. 2006. Interim Media Protection Goals Proposal for the Housatonic River, Rest of River. Submitted by General Electric Company, Pittsfield, MA. Revised March 9.

Grice, D. and J. P. Rogers 1965. The Wood Duck in Massachusetts. Mass. Div. Fish and Game, Pittman-Robertson Proj. Rep. W–19–R, Westboro, MA.

Kay, D.P., A.L. Blankenship, K.K. Coady, A.M. Neigh, M.J. Zwiernik, S.D. Millsap, K. Strause, C. Parek, P. Bradley, J.L. Newsted, P.D. Jones, and J.P. Giesy. 2005. Differential accumulation of polychlorinated biphenyls congeners in the aquatic food web at the Kalamazoo River Superfund site, Michigan. Environ. Sci. Technol. 39:5964-5974.

McFarland, V.A. 1994. Activity-Based Evaluation of Potential Bioaccumulation for Sediments. In: Dredging and Dredged Disposal, Volume 1, R.L. Montgomery, J.W. Leach, Eds. American Society of Civil Engineers, NY, pp. 461-467.

Paine, J.M., M.J. McKee, M.E. Ryan. 1993. Toxicity and bioaccumulation of soil PCBs in crickets: Comparison of laboratory and field studies. Environ. Toxicol. Chem. 12:2097-2103.

Parkerton, T.F. 1993. Estimating Toxicokinetic parameters for modeling the bioaccumulation of non-ionic organic chemicals in aquatic organisms. PhD dissertation, Rutgers, the State University of New Jersey, Graduate Program of Environmental Science, New Brunswick, New Jersey. 335 pp.

QEA. 1999. PCBs in the Upper Hudson River. Volume 2: A Model of PCB Fate, Transport, and Bioaccumulation. Prepared for General Electric Company, Albany, NY.

QEA and BBL. 2003. Housatonic River – Rest of River RCRA Facility Investigation Report. Quantitative Environmental Analysis, LLC and Blasland, Bouck & Lee, Inc. Prepared for General Electric Company, Pittsfield, MA. January.

Tracey, G.A., D.J. Hansen. 1996. Use of biota-sediment accumulation factors to assess similarity of non-ionic organic chemical exposure to benthically-coupled organisms of differing trophic mode. Arch. Environ. Contam. Toxicol. 30:467-475.

Wong, C.S., P.D. Capel, L.H. Nowell. 2001. National-scale, field-based evaluation of the biota-sediment accumulation factor model. Environ. Sci. Technol. 35:1709-1715.

Table B-1. Derivation of Target Floodplain Soil Concentrations Associated with PCB IMPG for Wood Ducks

Subreach	Sediment Concentration C_{sed} (mg/kg)	Organic Carbon Concentration TOC_{sed} (%)	Biota-Sediment Accumulation Factor (Water Column Organisms) $BSAF_{wi}$	Biota-Sediment Accumulation Factor (Epibenthic Organisms) $BSAF_{ei}$	Lipids (Water Column Organisms) L_{wi} (%)	Lipids (Epibenthic Organisms) L_{ei} (%)	Target Soil Concentration C_{soil} (mg/kg)
5A	1	1.4	0.202	0.665	2.0	1.5	50
5A	3	1.4	0.202	0.665	2.0	1.5	39
5A	5	1.4	0.202	0.665	2.0	1.5	29
5B	1	1.4	0.409	0.849	2.0	1.5	48
5B	3	1.4	0.409	0.849	2.0	1.5	33
5B	5	1.4	0.409	0.849	2.0	1.5	18
5C/5D	1	8.0	0.608	1.226	2.0	1.5	53
5C/5D	3	8.0	0.608	1.226	2.0	1.5	49
5C/5D	5	8.0	0.608	1.226	2.0	1.5	46
6	1	8.0	0.469	1.267	2.0	1.5	53
6	3	8.0	0.469	1.267	2.0	1.5	50
6	5	8.0	0.469	1.267	2.0	1.5	46

Notes:

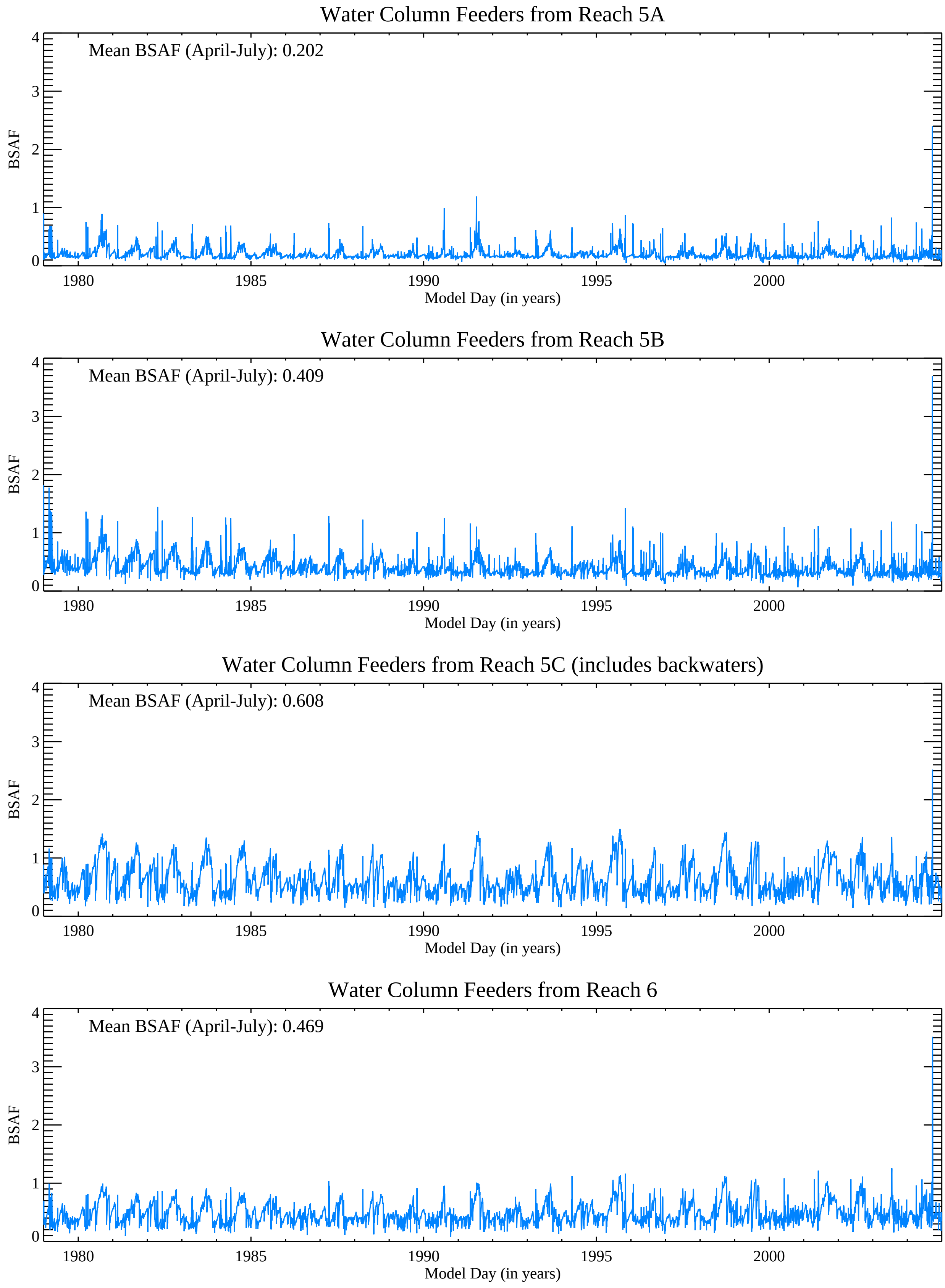
$$IMPG\quad C_{soil}\quad \frac{\left\{C_i \times \left(P_{ti} + P_{wi} + P_{ei}\right) - \left[\left(P_{wi} \times BSAF_{wi} \times L_{wi} \times C_{sed} \times \frac{1}{TOC}\right) + \left(P_{ei} \times BSAF_{ei} \times L_{ei} \times C_{sed} \times \frac{1}{TOC}\right)\right]\right\}}{P_{ti} \times BAF_{ti}}$$

Basis for all assumptions detailed in text.

P_{ti} = 0.196	C_i = 4.4 mg/kg
P_{wi} = 0.197	BAF_{ti} = 0.31
P_{ei} = 0.367	

Table B-2. Litter Invertebrate-Floodplain Soil PCB Bioaccumulation Factors

Field Sample ID	Date Collected	Sample Plot	Litter Invert. PCB Conc. (mg/kg)	Co-located Surface (0-6") Soil PCB Conc. (mg/kg)	Bioaccumulation Factor
H3-TW13LI01-0-0G10	08/10/00	13-1 and 13-3	4.1	9.6	0.42
H3-TW13LI02-0-0G10	08/10/00	13-9	3.6	10.8	0.33
H3-TW13LI03-0-0G11	08/11/00	13-7	4.9	16.3	0.30
H3-TW14LI01-0-0G15	08/15/00	14-4, 14-5, and 14-6	3.8	34.9	0.11
H3-TW14LI02-0-0G15	08/15/00	14-1, 14-2, and 14-3	3.5	66.1	0.05
H3-TW14LI03-0-0G16	08/16/00	14-1 and 14-8	2.3	69.8	0.03
H3-TW15LI01-0-0G09	08/09/00	15	1.4	0.8	1.81
H3-TW15LI02-0-0G10	08/10/00	15	2.8	0.8	3.58


Water Column Feeders from Reach 5A

Water Column Feeders from Reach 5B

Water Column Feeders from Reach 5C (includes backwaters)

Water Column Feeders from Reach 6

Figure B-1. Biota-Sediment Accumulation Factors Derived from Food Chain Model

Notes: Values for mean BSAF were calculated from all years (1979 to 2004) from days between Apr. 1st through July. 31st.

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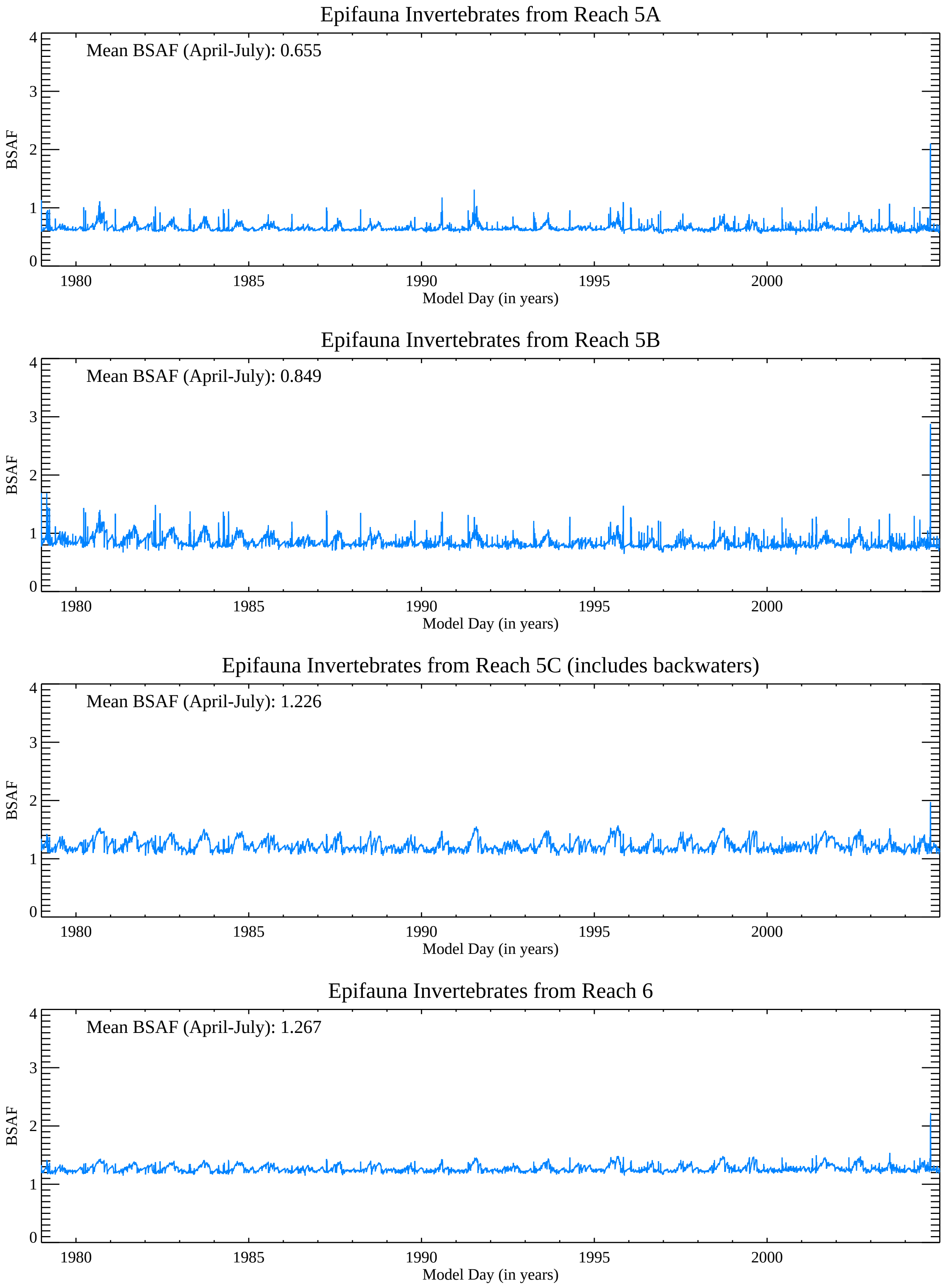

Figure B-2. Biota-Sediment Accumulation Factors Derived from Food Chain Model

Notes: Values for mean BSAF were calculated from all years (1979 to 2004) from days between Apr. 1st through July. 31st.

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Appendix C

Methodology for Developing Target Floodplain Soil PCB Concentrations Associated with the IMPGs for Mink

Appendix C: Methodology for Developing Target Floodplain Soil PCB Concentrations Associated with the IMPGs for Mink

1. Introduction

The Interim Media Protection Goals (IMPGs) approved by the U.S. Environmental Protection Agency (EPA) for piscivorous mammals (mink and otter) include a range of 0.984 to 2.43 milligrams per kilogram (mg/kg) for polychlorinated biphenyls (PCBs), applicable to the dietary items of those mammals (GE, 2006). These IMPGs were based on an assessment of potential risks to the American mink (*Mustela vison*), as described in EPA's Ecological Risk Assessment (ERA; EPA, 2004). EPA directed GE, in its conditional approval letter for the CMS Proposal, to use mink as the representative species for evaluating achievement of these IMPGs in the Corrective Measures Study (CMS). However, because the IMPGs apply to PCB concentrations in the tissue of the mink's prey, these IMPGs cannot be applied directly in the CMS, but need to be translated into media that are subject to evaluation in the CMS. This is complicated by the fact that the mink's prey consists of a highly diverse mixture of aquatic and terrestrial organisms. As a result, the total PCB concentration in the mink's diet is affected by sediment PCB concentrations and floodplain soil PCB concentrations, and the concentrations in one such medium will affect the allowable concentration in the other medium. In its conditional approval letter for the CMS Proposal, EPA directed GE to develop a methodology for determining target floodplain soil concentrations associated with the mink IMPGs based on a range of assumed sediment concentrations.

GE initially proposed such a methodology in the CMS Proposal Supplement (ARCADIS BBL and QEA, 2007b). In its July 11, 2007 conditional approval letter for that Supplement, EPA directed GE to make a number of changes in that methodology. After GE invoked dispute resolution on several of those directives, EPA modified some of its directives in a letter dated August 29, 2007. This Appendix describes the revised methodology that has been used, in accordance with EPA's July 11, 2007 conditional approval letter (as modified in its August 29, 2007 letter), to develop target floodplain soil levels associated with the IMPGs for mink.

To convert the dietary IMPG values into target floodplain soil concentrations, the first step was to select a range of target sediment PCB concentrations that fall within the range of other sediment IMPGs (e.g., based on human direct contact and other ecological receptors). The target sediment concentrations selected were 1, 3, and 5 mg/kg. Using these target sediment concentrations (i.e., assuming that the sediment concentrations are at these levels), the floodplain soil concentrations associated with achieving the high and low ends of the dietary IMPG range (rounded to 0.98 and 2.4 mg/kg) in mink prey were then calculated.

The underlying equations, assumptions, and results of this analysis are detailed below. The target PCB concentrations have been developed for the Housatonic River floodplain from data obtained in the Primary Study Area (PSA), which consists of subreaches 5A, 5B, 5C, and 6, as well as the backwaters in the lower part of Reach 5 (referred to as Reach 5D). Based on EPA's letter dated August 29, 2007, these subreaches have been combined into the following two averaging areas: Reach 5A/5B and Reach 5C/5D/6. Although GE considers that the habitat contained in these two areas is too small to support a local population of mink, GE has used this approach in accordance with EPA's directive. Consequently, separate target PCB soil concentrations protective of mink have been developed for these two averaging areas; these target concentrations vary depending on the assumed sediment PCB concentration in the same area. As further directed by EPA, the target soil concentrations conservatively assume that the mink forage exclusively within the defined Rest of River floodplain (i.e., the 1 mg/kg PCB isopleth), rather than also in areas outside that isopleth, even though foraging in tributaries and uncontaminated areas outside the isopleth is likely. The resulting target floodplain soil concentrations have been used in evaluating the ability of floodplain remedial alternatives to achieve the mink IMPGs in the PSA, and have also been used in making such evaluations on a screening-level basis for further downstream areas.

2. Derivation of Equation for Target Soil PCB Concentrations

The objective was to derive an equation that estimates target soil PCB concentrations protective of mink at a given target sediment PCB concentration. Such an equation must account for the uptake of PCBs by mink prey from both the river sediments and floodplain soils. The equation must subtract the PCB contribution of the aquatic prey items (based on target sediment levels of 1, 3, or 5 mg/kg) from the allowable PCB concentration in the total prey (based on the IMPGs) to determine the allowable concentration of PCBs from terrestrial prey items. The derivation of such an equation requires first quantifying the fraction of each prey item in the mink's diet and each item's associated PCB tissue concentrations to estimate the total PCB concentration in the prey.

The diet-based IMPG is related to PCB concentrations in the aquatic and terrestrial prey of mink as follows:

$$C_p = (P_i \times C_i) + (P_f \times C_f) + (P_a \times C_a) + (P_{ab} \times C_{ab}) + (P_{tb} \times C_{tb}) + (P_{am} \times C_{am}) + (P_{tm} \times C_{tm}) \qquad \text{Eqn. 1}$$

where

C_p = target PCB concentration in total mink prey, set equal to the EPA-approved IMPG values (mg PCBs/kg diet)

P_i= proportion of diet from aquatic invertebrates

P_f = proportion of diet from fish

P_a= proportion of diet from amphibians and reptiles

P_{ab}= proportion of diet from aquatic birds

P_{tb}= proportion of diet from terrestrial birds

P_{am}= proportion of diet from aquatic mammals

P_{tm}= proportion of diet from terrestrial mammals

C_i= PCB concentration in aquatic invertebrates (mg PCBs/kg invertebrate)

C_f = PCB concentration in fish (mg PCBs/kg fish)

C_a= PCB concentration in amphibians and reptiles (mg PCBs/kg amphibian/reptile)

C_{ab}= PCB concentration in aquatic birds (mg PCBs/kg bird)

C_{tb}= PCB concentration in terrestrial birds (mg PCBs/kg bird)

C_{am}= PCB concentration in aquatic mammals (mg PCBs/kg mammal)

C_{tm}= PCB concentration in terrestrial mammals (mg PCBs/kg mammal)

This equation is similar to the one used in Section 3.7 of the revised IMPG Proposal (GE, 2006), except that birds and mammals are split into aquatic and terrestrial components to account for the separate source of PCBs for these groups.

Having defined the relationship between the mink’s total dietary exposure and the tissue concentrations in the individual prey items, it is necessary to define the relationships between the prey and the PCB concentrations in the sediments and soils to which they are exposed. For organisms exposed to sediment, multiplication factors (known as biota-sediment accumulation factors [BSAFs]) represent the relationship between the lipid-normalized concentration of PCBs in aquatic prey and the organic carbon (OC)-normalized concentration of PCBs in sediment (Ankley et al. 1992). Using aquatic invertebrate prey of the mink as an example, the BSAF is as follows:

$$BSAF_i = (C_i / LIPID_i) / (C_{sed} / FOC_{sed}) \qquad \text{Eqn. 2}$$

where

$BSAF_i$ = biota-sediment accumulation factor for aquatic invertebrates (kg OC/kg lipid)

C_i = PCB concentration in aquatic invertebrates (mg PCBs/kg invertebrate)

$LIPID_i$ = fraction of body weight in lipids for aquatic invertebrates (kg lipid/kg invertebrate)

C_{sed} = PCB concentration in sediment (mg PCBs/kg sediment)

FOC_{sed} = fraction of total organic carbon in sediment (kg total OC/kg sediment)

Solving Equation 2 for the PCB concentration in aquatic invertebrate prey, C_i, yields:

$$C_i = BSAF_i \times C_{sed} \times (LIPID_i / FOC_{sed}) \qquad \text{Eqn. 3}$$

For organisms exposed to soil, the relationship between the soil and tissue concentrations is usually described by bioaccumulation factors (BAFs) instead of BSAFs. BAFs are typically not based on lipid-normalized tissue and OC-normalized soil concentrations. Using terrestrial mammalian prey as an example, the BAF is calculated as follows:

$$BAF_{tm} = C_{tm} / C_{soil} \qquad \text{Eqn. 4}$$

where

BAF_{tm} = soil-to-terrestrial mammal bioaccumulation factor (kg soil/kg mammal)

C_{tm} = PCB concentration in terrestrial mammal tissue (mg PCBs/kg mammal)

C_{soil} = PCB concentration in floodplain soil (mg PCBs/kg soil)

Solving Equation 4 for concentration of PCBs in terrestrial mammalian prey yields

$$C_{tm} = BAF_{tm} \times C_{soil} \qquad \text{Eqn. 5}$$

After developing a relationship similar to Equation 3 for each aquatic prey item and a relationship similar to Equation 5 for each terrestrial prey item, all the sediment-prey and soil-prey relationships can be substituted into Equation 1 as follows:

$$C_p = [(P_i \times BSAF_i \times C_{sed} \times LIPID_i / FOC_{sed}) + (P_f \times BSAF_f \times C_{sed} \times LIPID_f / FOC_{sed}) + (P_a \times BSAF_a \times C_{sed} \times LIPID_a / FOC_{sed}) + (P_{ab} \times BSAF_{ab} \times C_{sed} \times LIPID_{ab} / FOC_{sed}) + (P_{tb} \times BAF_{tb} \times C_{soil}) + (P_{am} \times BSAF_{am} \times C_{sed} \times LIPID_{am} / FOC_{sed}) + (P_{tm} \times BAF_{tm} \times C_{soil})] \quad \text{Eqn. 6}$$

where

$BSAF_i$= biota-sediment accumulation factor for aquatic invertebrates (kg OC/kg lipid)

$BSAF_f$ = biota-sediment accumulation factor for fish (kg OC/kg lipid)

$BSAF_a$= biota-sediment accumulation factor for amphibians and reptiles (kg OC/kg lipid)

$BSAF_{ab}$= biota-sediment accumulation factor for aquatic birds (kg OC/kg lipid)

BAF_{tb}= bioaccumulation factor from soil for terrestrial birds (kg soil/kg birds)

$BSAF_{am}$= biota-sediment accumulation factor for aquatic mammals (kg OC/kg lipid)

BAF_{tm}= bioaccumulation factor from soil for terrestrial mammals (kg soil/kg mammal)

$LIPID_i$= lipid content of aquatic invertebrates (kg lipid/kg invertebrate)

$LIPID_f$ = lipid content of fish (kg lipid/kg fish)

$LIPID_a$= lipid content of amphibians and reptiles (kg lipid/kg amphibian/reptile)

$LIPID_{ab}$= lipid content of aquatic birds (kg lipid/kg bird)

$LIPID_{am}$= lipid content of aquatic mammals (kg lipid/kg mammal)

Solving Equation 6 for C_{soil} yields:

$$C_{soil} = \{C_p - [(C_{sed} / FOC_{sed}) \times [(P_i \times BSAF_i \times LIPID_i) + (P_f \times BSAF_f \times LIPID_f) + (P_a \times BSAF_a \times LIPID_a) + (P_{ab} \times BSAF_{ab} \times LIPID_{ab}) + (P_{am} \times BSAF_{am} \times LIPID_{am})]]\} / [(P_{tb} \times BAF_{tb}) + (P_{tm} \times BAF_{tm})] \quad \text{Eqn. 7}$$

However, this equation does not completely represent the relationship between the mink's dietary exposure and the sediment and soil concentrations of PCBs because aquatic birds in the mink's diet (mainly waterfowl) feed not only on aquatic invertebrates (as indicated in Equations 6 and 7) but also on terrestrial invertebrates (e.g., as shown for wood duck [*Aix sponsa*] in Vol. 5, Table G.2-33 of the ERA). To account for this, the total PCB concentration in the aquatic bird must be split into two components, one defined by uptake from sediments using a BSAF and one defined by uptake from soils using a BAF. It was assumed that the total concentration in the aquatic bird (C_{ab}) could be represented by the following equation:

$$C_{ab} = C_{aba} + C_{abt} \qquad \text{Eqn. 8}$$

where

C_{aba} = concentration of PCBs in aquatic birds that is derived from the aquatic portion of their diet (mg PCBs/kg bird)

C_{abt} = concentration of PCBs in aquatic birds that is derived from the terrestrial portion of their diet (mg PCBs/kg bird)

Data are unavailable for C_{aba} and C_{abt} in aquatic bird tissue, but these terms can be calculated if $BSAF_{ab}$ and BAF_{ab} are known; details on calculation of $BSAF_{ab}$ and BAF_{ab} and associated assumptions are described in Section C.3 (Input Data and Assumptions) below. Conceptually, C_{aba} and C_{abt} are equal to the proportion of the diet consisting of aquatic or terrestrial prey multiplied by the estimated concentration of PCBs in a theoretical aquatic bird feeding exclusively (100%) on aquatic or terrestrial prey items, respectively, as follows:

$$C_{aba} = P_{aba} \times C_{ab,100\%aquatic\ prey} \qquad \text{Eqn. 9}$$

$$C_{abt} = P_{abt} \times C_{ab,100\%terrestrial\ prey} \qquad \text{Eqn. 10}$$

where

P_{aba} = the proportion of the aquatic bird invertebrate diet consisting of aquatic invertebrates = 0.74

P_{abt} = the proportion of the aquatic bird invertebrate diet consisting of terrestrial invertebrates = 0.26

$C_{ab,100\%aquatic\ prey}$ = PCB concentration in aquatic bird feeding exclusively on aquatic prey

$C_{ab,100\%terrestrialprey}$ = PCB concentration in aquatic bird feeding exclusively on terrestrial prey

The proportions, P_{aba} and P_{abt} , were obtained from the diet of the wood duck (Table G.2-33 of the ERA), the species used to represent aquatic birds. The proportion of the wood duck's diet that is vegetation (24% during pre-egg laying period) was not included because it was assumed that PCB accumulation through that route is minimal compared to bioaccumulation from consumption of invertebrates.

Using the approach in Equation 3 for aquatic prey-derived PCB concentrations and Equation 5 for terrestrial prey-derived PCB concentrations, it follows that:

$C_{ab100\%aquatic\ prey} = BSAF_{ab} \ x\ C_{sed} \ x\ (LIPID_{ab} /FOC_{sed}$ Eqn. 11

$C_{ab100\%terrestrial\ prey} = BAF_{ab} \ x\ C_{soil}$ Eqn. 12

Substituting Equations 11 and 12 into Equations 9 and 10 yields:

$C_{aba} = P_{aba} \ x\ [BSAF_{ab} \ x\ C_{sed} \ x\ (LIPID_{ab} /FOC_{sed})]$ Eqn. 13

$C_{abt} = P_{abt} \ x\ [BAF_{ab} \ x\ C_{soil}]$ Eqn. 14

The aquatic bird PCB concentration, C_{ab}, can be calculated by substituting Equations 13 and 14 into Equation 8:

$C_{ab} = [P_{aba} \ x\ BSAF_{ab} \ x\ C_{sed} \ x\ (LIPID_{ab} /FOC_{sed})] + [P_{abt} \ x\ BAF_{ab} \ x\ C_{soil}]$ Eqn. 15

Finally, substituting Equation 15 for C_{ab} in Equation 1, followed by the derivation of Equations 6 and 7 using the same approach outlined previously, yields the final correct equation for calculating the target soil concentration (revised version of Equation 7):

$C_{soil} = \{C_p – (C_{sed} /FOC_{sed}) \ x\ [(P_i \ x\ BSAF_i \ x\ LIPID_i) + (P_f \ x\ BSAF_f \ x\ LIPID_f) + (P_a \ x\ BSAF_a \ x\ LIPID_a) + (P_{ab} \ x\ P_{aba} \ x\ BSAF_{ab} \ x\ LIPID_{ab}) +(P_{am} \ x\ BSAF_{am} \ x\ LIPID_{am})]\} / [(P_{ab} \ x\ P_{abt} \ x\ BAF_{ab}) + (P_{tb} \ x\ BAF_{tb}) + (P_{tm} \ xBAF_{tm})]$ Eqn. 16

Equation 16 was used to calculate the target soil concentration associated with the high and low IMPG values of 0.98 and 2.4 mg/kg for the prey of mink, based on the following input data and assumptions regarding each of the equation's variables.

3. Input Data and Assumptions

Input values were selected based on site-specific data from the combined Reaches 5A/5B and 5C/5D/6, as presented in the ERA, the RCRA Facility Investigation Report (RFI Report; BBL and QEA, 2003), and supporting studies and datasets. In a few cases, where site-specific data were not available, data from another PCB river/floodplain site, the Kalamazoo River in Michigan, were used. The input values used in Equation 16 are listed in Table C-1, with more detailed supporting information provided in Tables C-2 through C-8. The input data and assumptions used to derive these values are described below.

Foraging Range of Mink

As directed by EPA, the method conservatively assumes that 100% of the foraging range of mink is contained within the 1 mg PCBs/kg soil isopleth, even though the percentage most likely is lower.

Acceptable PCB Concentration in Diet (C_p)

The target PCB concentrations in the mink diet were set equal to the high and low ends of the EPA-approved IMPG range, 0.98 and 2.4 mg/kg, as described in the revised IMPG Proposal (GE, 2006).

Dietary Composition (P)

As previously noted, the ERA indicated that the mink diet is diverse and includes aquatic invertebrates, fish, mammals, birds, and amphibians and reptiles. In addition, the mammal and bird portions of the diet include both aquatic and terrestrial species. Representative species for each of these prey groups were chosen to develop bioaccumulation factors. The species chosen were selected based on both known preferences in the mink diet and availability of data for those species, preferably in the PSA. For example, crayfish were selected to represent aquatic invertebrates because they are listed as the primary aquatic invertebrate in the mink diet for many studies (Table I-2.1 of the ERA) and because tissue data from the PSA were available. The short-tailed shrew (*Blarina brevicauda*) and white-footed mouse (*Peromyscus leucopus*) were selected to represent the terrestrial mammals in the diet. The wood duck represented the aquatic birds, and the house wren (*Troglodytes aedon*), black-capped chickadee (*Poecile atricapilla*), and American robin (*Turdus migratorius*) represented the terrestrial birds. The muskrat (*Ondatra zibethicus*) represented aquatic mammals. Tissue PCB concentration data were available from the PSA for each of those species except the muskrat. The muskrat was selected even though data from the PSA were not available because it is a primary aquatic mammal in the mink diet (based on volumetric data in Table I.2-2 of the ERA).

The assumed proportions of fish, mammals, birds, invertebrates, and amphibians and reptiles in the mink diet were derived from the values used in the ERA (Vol. 6, Table I.2-2). The further delineation of aquatic versus terrestrial birds and mammals was derived based on the mean percentages averaged across diet studies reported in Table I.2-1 of the ERA. The specific species and proportions of each dietary item were set as follows:

P_i – proportion of mink diet consisting of aquatic invertebrates (represented by crayfish) = 0.36

P_f – proportion of mink diet consisting of fish (represented by fish in the size class of 7 to 20 cm) = 0.23

P_a – proportion of mink diet consisting of amphibians and reptiles (represented by wood frogs, leopard frogs, and bullfrogs) = 0.15

P_{ab} – proportion of mink diet consisting of aquatic birds (represented by the wood duck) = 0.08[1]

P_{tb} – proportion of mink diet consisting of terrestrial birds (represented by chickadees, robins, and wrens) = 0.03

P_{am} – proportion of mink diet consisting of aquatic mammals (represented by the muskrat) = 0.07

P_{tm} – proportion of mink diet consisting of terrestrial mammals (represented by shrews and mice) = 0.08

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[1] The proportion in the aquatic bird diet is further split into aquatic-feeding and terrestrial-feeding components.

Concentration in Sediment (C_{sed})

It was necessary to assume a range of target concentrations of sediment to calculate protective soil concentrations. For the purpose of this assessment, C_{sed} was fixed at 1, 3, and 5 mg/kg, and Equation 16 was solved for the corresponding C_{soil} values.

Biota-Sediment Accumulation Factors (BSAFs)

BSAFs were calculated for each of the aquatic prey types represented in the mink's diet. For aquatic invertebrates, amphibians and reptiles, and aquatic mammals, BSAFs were calculated for each tissue sample in the database, which represented an individual animal, except for some frog samples. For some frog samples (i.e., all 7 wood frog tissue samples and for 8 of the 15 leopard frog samples in Table C-4), the tissue samples in the database represented tissue composites of more than one individual from the same pond. In accordance with EPA's letter of August 29, 2007, the higher of the median or geometric mean of the individual BSAFs was used to represent bioaccumulation for each of these prey types. In contrast, for the fish and aquatic birds, a single BSAF was calculated for each averaging area rather than using individual BSAFs. For fish, the food chain model (FCM) previously developed by EPA for the Rest of River (EPA, 2006) was used to calculate the BSAF. For aquatic birds, individual BSAFs were not used because of high overlap in home ranges of individual ducks and lack of information about specific feeding locations. Details on these methods and the derivation of BSAFs for each prey item are discussed below. In all analyses, half of the reported detection limit was used for non-detects of analytes.

$BSAF_i$ - The BSAF for aquatic invertebrates was based on BSAFs reported in the RFI Report (Figure 8.34 in that report). Those values were developed using PCB concentrations and lipid measurements in site-specific crayfish tissue. Concentrations of OC-normalized PCBs in river sediment (0 to 6 inches) were averaged by river mile and co-located with crayfish tissue concentrations to calculate individual BSAF values. The higher of the median or geometric mean of these individual BSAFs (Table C-2) for each averaging area (i.e., Reach 5A/5B and Reach 5C/5D/6) was used in the final target soil calculation.

$BSAF_f$ – The FCM developed by EPA for the Rest of River modeling (EPA, 2006) was used to calculate the $BSAF_f$. The FCM calculates PCB concentrations in fish of multiple trophic levels as a function of dissolved- and particulate-phase PCB exposure concentrations from sediment and the water column, and accounts for many factors, including the lipid content in fish and fraction of total organic carbon (FOC) in the sediments. Because mink feed frequently in backwater areas, PCBs and FOC in the backwater areas of each subreach were included when calculating predicted concentrations in the fish tissue for each averaging area. Fish sizes were limited to age classes that correspond to the sizes eaten by mink, 7 to 20 cm (as specified in the ERA). The fish species simulated by the FCM were averaged to produce a weighted composite mink exposure concentration based on an assumed mink fish diet of 2/3 predatory fish (largemouth bass in the model) and 1/3 bottom and forage fish (average of model results for brown bullhead, sunfish, white sucker, and cyprinids), based on Alexander (1977).

The calculation of the $BSAF_f$ with FCM involved several steps. Sediment PCB concentrations (specified on an OC-normalized basis) change daily in the FCM based on inputs from the PCB fate and transport model (EPA, 2006). Annual estimates of OC-normalized surface sediment (averaged over reach-specific exposure depths that were in the range of 3 to 6 inches) and lipid-normalized fish tissue concentrations in each subreach were calculated by averaging the daily modeled concentrations over the autumn period (when the majority of fish tissue data were collected) for each year of the 26-year model validation period (1979 through 2004). The autumn estimate was assumed to represent an annual estimate (a comparison of these two values indicated they were very similar). Each annual subreach estimate was combined into one value for each averaging area, weighting the average by subreach length. A regression line (with the intercept forced through zero) was fit through the resultant 26 annual estimates of lipid-normalized fish PCB concentrations and OC-normalized sediment PCB concentrations for each averaging area. The slope of each regression was used as the final $BSAF_f$ for each averaging area (Table C-3).

$BSAF_a$ – Each of the frog species assumed to represent the amphibian and reptile portion of the mink diet is potentially exposed to sediments and soils. However, for the purpose of this analysis, it was assumed that each frog’s primary route of exposure was from aquatic sources. Site-specific tissue data for each of these frog species were compiled and paired with sediment data to derive individual BSAFs. The wood frog and leopard frog tissue samples were collected from discrete, small ponds, and the individual BSAFs for those species were developed by matching each individual (or composite) frog tissue concentration with the spatially weighted average surface sediment concentration (0 to 6 inches) in the pond from which that frog tissue sample was collected. For the bullfrogs (which were collected from the larger Woods Pond and from backwaters of the river), individual tissue concentrations were matched with the co-located or closest available surface (0- to 6-inch) sediment sample to derive individual BSAFs (Table C-4). For all bullfrogs and some individual leopard frogs, it was necessary to calculate the whole-body concentration from a tissue-mass weighted average of the concentrations reported for individual body parts (e.g., ovary, leg, and offal) before estimating the individual sample

$BSAF_a$. The final BSAF for amphibians for each averaging area was the higher of the median or geometric mean of these individual BSAFs, after combining data for all three frog species from that area.

$BSAF_{ab}$ – Because measured aquatic bird PCB concentrations are a mixture of PCB uptake from terrestrial and aquatic sources, the derivation of the $BSAF_{ab}$ and the BAF_{ab} for aquatic birds differs from that used for the other species. The $BSAF_{ab}$ represents the bioaccumulation of PCBs by the wood duck based on consumption of only aquatic invertebrates, whereas the BAF_{ab} represents the bioaccumulation by the wood duck based on consumption of only terrestrial invertebrates.

To calculate the $BSAF_{ab}$, first it was assumed that $BSAF_{ab}$ for the sediment equals the bioaccumulation factor for the soil (BAF_{ab}) when the BAF_{ab} is lipid- and OC-normalized in the same manner that the $BSAF_f$ was normalized. This requires multiplying the BAF_{ab} by $FOC_{soil}/LIPID_{ab}$ (see section on Bioaccumulation Factors for Soil, below, for the derivation of lipid- and OC-normalized BAF_{ab}). Thus, it is assumed that:

$$BSAF_{ab} = BAF_{ab} \text{ x } FOC_{soil}/LIPID_{ab} \qquad \text{Eqn. 17}$$

The justification for this assumption is that the dominant type of food was the same for both aquatic- and terrestrial-feeding waterfowl (invertebrates), and thus the relative bioaccumulation of PCBs in the bird should be similar in both aquatic and terrestrial habitats, as long as both bioaccumulation factors are normalized for lipid content and FOC. Also, this assumption was required to solve for $BSAF_{ab}$ because it reduces the number of unknown variables in Equation 18 below.

The equation used to calculate the $BSAF_{ab}$ for aquatic birds feeding on aquatic invertebrates was derived from the following equation, which is similar to Equation 15 except that lipid and FOC terms are added (that could cancel out) to create a lipid- and OC-normalized BAF_{ab}:

$$C_{ab} = [P_{aba} \text{ x } BSAF_{ab} \text{ x } C_{sed} \text{ x } (LIPID_{ab}/FOC_{sed})] + [P_{abt} \text{ x } (BAF_{ab} \text{ x } FOC_{soil}/LIPID_{ab}) \text{ x } C_{soil} \text{ x } LIPID_{ab}/FOC_{soil}] \qquad \text{Eqn. 18}$$

Based on the assumption in Equation 17, $BSAF_{ab}$ can be substituted for the lipid- and OC-normalized BAF_{ab} (BAF_{ab} x $FOC_{soil}/LIPID_{ab}$) in Equation 18 and factored out to yield:

$$C_{ab} = BSAF_{ab} \times \{[P_{aba} \times C_{sed} \times (LIPID_{ab}/FOC_{sed})] + [P_{abt} \times C_{soil} \times (LIPID_{ab}/FOC_{soil})]$$

Eqn. 19

Solving for $BSAF_{ab}$ in Equation 19 yields:

$$BSAF_{ab} = C_{ab}/\{LIPID_{ab} \times [(P_{aba} \times C_{sed}/FOC_{sed}) + (P_{abt} \times C_{soil}/FOC_{soil})]\} \qquad \text{Eqn. 20}$$

Data used to calculate the $BSAF_{ab}$ included: (1) the average PCB concentration (C_{ab}) and average lipid content of wood ducks ($LIPID_{ab}$) in Reaches 5 and 6; and (2) the spatially weighted average PCB (C_{sed}, C_{soil}) and FOC (FOC_{sed}, FOC_{soil}) concentrations in the sediment and soil (top 0-6 inches) in wood duck habitat in Reaches 5 and 6 (see Appendix B, Table B-4 of the CMS Proposal [ARCADIS BBL and QEA, 2007a] for total organic carbon [TOC] polygon data in sediment). It was assumed all of the river and its backwaters in these reaches were potential aquatic bird habitat and that suitable aquatic bird habitat in the floodplain excluded areas defined as unsuitable wood duck habitat in Figure 5-7 in Section 5.2.3.3 of the main CMS Report (based on criteria defined by Woodlot Alternatives 2002). It is important to note that the tissue data for wood duck in the EPA database were identified by reach (i.e., Reaches 5 and 6), not by subreach (i.e., Reaches 5A, 5B, 5C, and 5D) (Table C-5); thus, it was not possible to calculate tissue concentrations associated with Reach 5A/5B versus Reach 5C/5D/6. In addition, it was not possible to co-locate tissue and sediment data other than by reach. Therefore, the available tissue and lipid data were averaged across each of the reaches, and the averages were paired with the average sediment data for each reach to derive a single $BSAF_{ab}$ for each reach. Accordingly, the BSAFs for this species reflect the relationship between the lipid-normalized average concentration in tissue and the OC-normalized average concentration in soils in Reach 5 (including 5C and 5D) and Reach 6, rather than the median or geometric mean of individual BSAFs. The resultant $BSAF_{ab}$ for Reach 5 was applied to Reach 5A/5B, and the $BSAF_{ab}$ for Reach 6 was applied to Reach 5C/5D/6. This reach adjustment provided an approximated aquatic bird BSAF (and BAF) and lipid content for each averaging area. In this connection, it should be noted that, in developing the PCB target soil concentrations, the FOC in the sediment for each averaging area was the same value for all species, including the aquatic bird (i.e., only one FOC value was used in Equation 16).

Because only duck breast and liver tissue data were available, the ERA presented three methods for estimating whole-body PCB tissue concentrations (Appendix I, Section I.2.1.5.3). For the purpose of this evaluation and to be consistent with whole-body data presented in Appendix L of the ERA, whole-body tissue concentrations were based on the assumption that the lipid-normalized PCB concentrations of the breast tissue are the same as the lipid-normalized concentrations of the offal.

$BSAF_{am}$ – Given the absence of site-specific data on aquatic mammals, the BSAF for aquatic mammals was derived from data collected for the Kalamazoo River, Michigan (Table C-6), in an area that has PCBs in sediments and floodplain soils (Kay et al. 2005). Individual BSAFs were calculated by pairing the tissue concentration of each muskrat trapped with the average sediment concentration (top 6 inches) of samples located within the muskrat foraging range (~ 300 m distance of the trapping location or, in the absence of data within 300 m, the closest sediment sample). The higher of the median or geometric mean of these individual BSAFs was used for both averaging areas.

Bioaccumulation Factors for Soil (BAFs)

BAFs, representing the ratio of the PCB concentration in tissue to the PCB concentration in soil, were calculated for each of the terrestrial-feeding taxonomic groups included in the mink's diet, specifically songbirds, small mammals, and terrestrial-feeding aquatic birds. Similar to the method used for the aquatic species, BAFs were derived for each individual terrestrial animal and then combined by taxonomic group for each averaging area to develop one BAF for each such group in each averaging area. Except for the aquatic birds, the median or geometric mean of the individual BAFs, whichever was higher, was used as the BAF for each prey component in each averaging area. A more detailed description of the methods used for each prey type is provided below.

BAF_{tb} - The bioaccumulation factor for adult terrestrial birds could not be calculated directly from site-specific data because PCB tissue concentrations in adults were unavailable. However, PCB concentrations in eggs were available for three species: American robins, house wrens, and black-capped chickadees. To estimate PCB concentrations in adults, an adult-to-egg ratio observed in house wrens from the Kalamazoo River (0.51; Neigh et al. 2006) was applied to the PCB estimates in eggs for the Housatonic River floodplain.

The house wren and black-capped chickadee eggs were obtained from tree swallow boxes in three main nest box locations described in the ERA. A buffer with a distance of 56 m (to approximate 1-hectare foraging areas) was placed around the cluster of nests in each of the three locations, and the spatially weighted average surface soil PCB concentrations (0 to 6 inches) were calculated for the soils within each of the three buffers. The estimated adult-tissue PCB concentrations developed from an egg in each nest found in each area were paired with the average soil PCB concentrations in the buffer (Table C-7) to develop individual BAFs. The robin eggs were collected from nests identified during a robin productivity study (Arcadis G&M 2002). To derive BAFs for robins, the tissue concentrations for these birds were paired with the average soil PCB concentration estimated from samples within 25 m of the nest (or with the PCB concentration in the closest soil sample if no soil samples were available within 25 m of the nest). To develop the final terrestrial bird BAF for each averaging area, the data for all three species were pooled (Table C-7), and the higher of the geometric mean or median value of the individual BAFs for that area was selected.

BAF_{tm} - The bioaccumulation factor for terrestrial mammals (BAF_{tm}) was based on site-specific tissue data for the short-tailed shrew and white-footed mouse and on spatially weighted surface-soil PCB concentrations (0 to 6 inches) within 35 m of the sampling location for each animal. Individual BAFs were calculated for each of the available tissue samples (Table C-8). To develop the final BAF for terrestrial mammals in each averaging area, the data for both species were combined and the higher of the geometric mean or median value of the individual BAFs for that area was selected.

BAF_{ab} - The calculation of the bioaccumulation factor for aquatic birds feeding on terrestrial prey (BAF_{ab}) differs from the calculation of BAFs for the other terrestrial species because the PCB concentration in the aquatic bird is a composite of PCBs coming from aquatic and terrestrial prey – unlike the PCB concentrations in terrestrial birds and mammals, which are assumed to bioaccumulate PCBs exclusively from terrestrial prey. Therefore, the PCB accumulation that comes from aquatic prey ($BSAF_{ab}$) must be accounted for before the BAF_{ab} can be calculated.

To derive BAF_{ab}, it was assumed that uptake of PCBs from terrestrial invertebrates by an aquatic bird is a process similar to that same bird's uptake of PCBs from aquatic invertebrates. Consequently, unlike the BAFs for the other terrestrial species, BAF_{ab} was assumed to be affected by the lipid content and soil FOC as follows:

$$\text{Lipid- and OC-normalized } BAF_{ab} = (C_{ab}/LIPID_{ab}) / (C_{soil} / FOC_{soil}) \qquad \text{Eqn. 21}$$

where

FOC_{soil} = fraction of total organic carbon in soil (kg total OC/kg soil)

Substituting the un-normalized BAF_{ab} for C_{ab}/C_{soil} (by definition $BAF_{ab} = C_{ab}/C_{soil}$ for an aquatic bird feeding 100% on terrestrial invertebrates) into Equation 21 yields:

$$\text{Lipid- and OC-normalized } BAF_{ab} = BAF_{ab} \times (FOC_{soil} / LIPID_{ab}) \qquad \text{Eqn. 22}$$

Based on the assumption stated previously that the $BSAF_{ab}$ equals the normalized BAF_{ab}

$$BSAF_{ab} = BAF_{ab} \times FOC_{soil}/LIPID_{ab} \qquad \text{Eqn. 23}$$

the un-normalized BAF_{ab} can be calculated after re-arranging Equation 23 as follows:

$$BAF_{ab} = BSAF_{ab} \times LIPID_{ab}/FOC_{soil} \qquad \text{Eqn. 24}$$

The un-normalized BAF_{ab} also can be calculated using the following equation:

$$BAF_{ab} = C_{abt}/(C_{soil} \times P_{abt}) \qquad \text{Eqn. 25}$$

This shows that the BAF_{ab} represents the bioaccumulation of PCBs into an aquatic bird feeding 100% on terrestrial food sources. In Equation 25, P_{abt} is the proportion of the bird diet that is terrestrial, which is required in the equation to mathematically increase the intake rate of terrestrial food from the actual partial rate to the theoretical rate of 100% of the diet.

As noted previously in the discussion of the $BSAF_{ab}$, the available wood duck tissue concentrations could not be separated by subreach; therefore, the BAFs for aquatic birds reflect the relationships between the reach-specific average PCB and lipid concentrations in tissue and the average PCB and FOC concentrations in soils across Reaches 5 (including 5C and 5D) and 6, rather than the median or geometric mean of individual BAFs. Areas containing unsuitable wood duck habitat (as shown on Figure 5-7 in Section 5.2.3.3 of the main CMS Report, based on criteria defined by Woodlot Alternatives, 2002) were excluded from the calculation of the average soil PCB and FOC concentrations because the ducks would not feed in those areas. The resultant BAF for Reach 5 was applied to Reach 5A/5B and the BAF for Reach 6 was applied to Reach 5C/5D/6.

Lipid ($LIPID_i$, $LIPID_f$, $LIPID_a$, $LIPID_{ab}$, $LIPID_{am}$)

The lipid content of each aquatic prey species used in Equation 16 was derived by averaging the available tissue data across all individuals on which the BSAF calculations for an averaging area were based. The lipid data for each individual for each species are presented in Tables C-2 to C-6, except Table C-3, where an average from the FCM is reported.

Fraction Organic Carbon (FOC)

The estimate of the FOC in sediments that was used in Equation 16 was the spatially weighted average FOC value for surface sediments within Reaches 5A/5B and 5C/5D/6, including the mainstream of the river and its adjacent backwaters.

4. Results

Estimated target floodplain soil PCB concentrations associated with the upper and lower bounds of the mink IMPGs at the three target sediment PCB concentrations are presented in Table C-9 for each averaging area. In cases where the calculated value was negative, the target floodplain soil concentration is listed as “not achievable,” indicating that, at that target sediment PCB concentration, the PCB contribution from aquatic prey alone would exceed the IMPG, and thus the IMPG cannot be attained regardless of the floodplain soil PCB concentration. For Reach 5A/5B, the estimated target floodplain soil PCB concentrations associated with the three target sediment concentrations range from not achievable to approximately 3.4 mg/kg for the low-end IMPG of 0.98 mg/kg and from not achievable to approximately 17 mg/kg for the high-end IMPG of 2.4 mg/kg, depending on the sediment concentration. For Reach 5C/5D/6, the target soil concentrations range from not achievable to approximately 7 mg/kg for the low-end IMPG and from approximately 12 mg/kg to 20 mg/kg for the high-end IMPG, depending on the sediment concentration.

Table C-9. Target Floodplain Soil PCB Concentrations Associated with Mink IMPG.

Target Sediment PCB Concentration (mg/kg)	Target Soil PCB Concentration (mg/kg) for IMPG = 0.98 mg/kg	Target Soil PCB Concentration (mg/kg) for IMPG = 2.4 mg/kg
Reach 5A/5B		
1	3.42	16.63
3	not achievable	5.12
5	not achievable	not achievable
Reach 5C/5D/6		
1	6.87	19.55
3	2.98	15.66
5	not achievable	11.78

5. Sensitivities, Uncertainties, and Conservatism in Model

The model used in these calculations is sensitive to changes in the BAFs and BSAFs. At low target sediment concentrations, the model output is more sensitive to estimates of the terrestrial BAFs than the aquatic BSAFs, particularly considering that tissue concentrations of PCBs in terrestrial birds and mammals are higher on average than for aquatic animals (Tables C-2 to C-8). However, at higher sediment concentrations, the aquatic animals, particularly the fish, have a stronger influence. The model is also sensitive to large changes in the sediment FOC, which varies greatly between the river and backwaters. For this reason, it was important to include the backwater habitat of the mink in the model. Uncertainty exists with the terrestrial passerine data, because only nest (eggs and chicks) data were available, and the proportionality factor that was multiplied by the egg PCB concentrations to obtain adult PCB concentrations was obtained from data from the Kalamazoo River floodplain (Neigh et al., 2006). Additionally, BSAFs for muskrat were based on data from the Kalamazoo River.

Use of the FCM to obtain fish tissue concentrations of PCBs has some limitations. First, for many of the fish species included in the analysis (e.g., sunfish), tissue concentrations are more closely correlated with PCB concentrations in the water column than with those in sediment. As a result, actual PCB concentrations in tissue samples from these species may be lower than those predicted by the linear relationship with sediment in the predictive model. Second, the range of sediment PCB concentrations in Reaches 5 and 6 for which the FCM was calibrated is much higher than the target sediment concentrations of 1 to 5 mg/kg. Supplemental analyses suggest the model could underestimate bottom-fish concentrations (e.g., suckers, bullheads) at low sediment concentrations by up to a factor of two. Third, the accuracy of the model in predicting fish tissue concentrations in the backwaters is unknown because no fish have been collected in those areas to compare to model results.

As noted above, the model assumes that mink forage exclusively within the 1 mg/kg PCB isopleth. In fact, however, very few mink likely forage entirely within that area without also foraging in tributaries and other areas outside the 1 mg/kg isopleth. Thus, this model is highly conservative.

References

Alexander, G.R. 1977. Food of vertebrate predators on trout waters of north central lower Michigan. *Michigan Academician* 10:187-195.

Ankley, G.T. P.M. Cook, A.R. Carlson, D.J. Call, J.A. Sorensen, H.F. Corcoran, R.A. Hoke. 1992. Bioaccumulation of PCBs from sediments by oligochaetes and fishes: Comparison of laboratory and field studies. *Can. J. Fish. Aquat. Sci.* 49:2080-2085.

ARCADIS BBL and QEA. 2007a. Corrective Measures Study Proposal. Prepared on behalf of the General Electric Company, Pittsfield, MA. February 2007.

ARCADIS BBL and QEA. 2007b. Corrective Measures Study Proposal Supplement. Prepared on behalf of the General Electric Company, Pittsfield, MA. May 2007.

ARCADIS G&M, Inc. 2002. Robin Productivity in the Housatonic River Watershed, Berkshire County, Massachusetts. Prepared for General Electric Company.

BBL and QEA. 2003. Housatonic River, Rest of River, RCRA Facility Investigation Report (RFI Report). Prepared on behalf of the General Electric Company, Pittsfield, MA. September 2003.

EPA. 2004. Ecological Risk Assessment for General Electric (GE)/Housatonic River Site, Rest of River (ERA). Prepared by Weston Solutions, Inc., West Chester, PA, for the U.S. Army Corps of Engineers, New England District, and the U.S. Environmental Protection Agency, New England Region. November 2004.

EPA. 2006. Final Model Documentation Report: Modeling Study of PCB Contamination in the Housatonic River. Prepared by Weston Solutions, Inc., West Chester, PA, for the U.S. Army Corps of Engineers, New England District, and the U.S. Environmental Protection Agency, New England Region. November 2006.

GE. 2006. Interim Media Protection Goals Proposal for the Housatonic River, Rest of River. Submitted to EPA by General Electric Company, Pittsfield, MA. Revised March 9.

Kay, D.P., A.L. Blankenship, K.K. Coady, A.M. Neigh, M.J. Zwiernik, S.D. Millsap, K. Strause, C. Park, P. Bradley, J. L. Newsted, P.D. Jones, and J.P. Giesy. 2005. Differential accumulation of polychlorinated biphenyl congeners in the aquatic food web at the Kalamazoo River Superfund site, Michigan. *Environ. Sci. Technol.* 39:5964-5974.

Neigh, A.A., M. J. Zwiernik, P.W. Bradley, D.P. Kay, P.D. Jones, R.R.Holem, A.L. Blankenship, K.D. Strause, J.L. Newsted, and J. P. Giesy. 2006. Accumulation of polychlorinated biphenyls from floodplain soils by passerine birds. *Environmental Toxicology and Chemistry* 25(6):1503-1511.

Woodlot Alternatives. 2002. Ecological Characterization of the Housatonic River. Prepared for EPA. September 2002.

Table C-1 – Description of Variables in Equation 16, which Predicts Target Soil Concentrations Protective of Mink

Variable	Description (units in parentheses)	Value for Reach 5A/5B	Value for Reach 5C/5D/6	Basis
C_p	Target concentration of PCBs in prey (mg/kg)	0.98-2.4		IMPG Proposal
P_i	Proportion of mink diet comprised of aquatic invertebrates	0.36		ERA
P_f	Proportion of mink diet comprised of fish	0.23		ERA
P_a	Proportion of mink diet comprised of amphibians and reptiles	0.15		ERA
P_{ab}	Proportion of mink diet comprised of aquatic birds	0.08		Table I.1-2, ERA
P_{tb}	Proportion of mink diet comprised of terrestrial birds	0.03		Table I.1-2, ERA
P_{am}	Proportion of mink diet comprised of aquatic mammals	0.07		Table I.2-2, ERA
P_{tm}	Proportion of mink diet comprised of terrestrial mammals	0.08		Table I.2-2, ERA
P_{aba}	Proportion of aquatic bird diet comprised of aquatic prey	0.74		ERA
P_{abt}	Proportion of aquatic bird diet comprised of terrestrial prey	0.26		ERA
C_{sed}	Target concentrations of PCBs in sediment (mg/kg)	1,3,5		Range assumed
$BSAF_i$	Biota-sediment accumulation factor for aquatic invertebrates (kg organic carbon/kg lipid)	0.56	1.23	Table C-2
$BSAF_f$	Biota-sediment accumulation factor for fish (kg organic carbon/kg lipid)	1.32	1.33	Table C-3
$BSAF_a$	Biota-sediment accumulation factor for amphibians and reptiles (kg organic carbon/kg lipid)	0.55	2.36	Table C-4
$BSAF_{ab}$	Biota-sediment accumulation factor for aquatic birds feeding on aquatic prey (kg organic carbon/kg lipid)	1.72	0.318	Table C-5
$BSAF_{am}$	Biota-sediment accumulation factor for aquatic mammals (kg organic carbon/kg lipid)	0.57		Table C-6
BAF_{tb}	Bioaccumulation factor from soil for terrestrial birds (kg soil/kg bird)	2.43	1.13	Table C-7
BAF_{tm}	Bioaccumulation factor from soil for terrestrial mammals (kg soil/kg bird)	0.339	0.918	Table C-8
BAF_{ab}	Bioaccumulation factor from soil for aquatic birds feeding on terrestrial prey (kg soil/kg bird)	0.348	0.208	Table C-5
$LIPID_i$	Proportion of lipids in invertebrates	0.011	0.009	Table C-2
$LIPID_f$	Proportion of lipids in fish	0.030	0.030	Table C-3
$LIPID_a$	Proportion of lipids in amphibians and reptiles	0.017	0.011	Table C-4
$LIPID_{ab}$	Proportion of lipids in aquatic birds	0.017	0.062	Table C-5
$LIPID_{am}$	Proportion of lipids in aquatic mammals	0.024		Table C-6
FOC_{sed}	Fraction of organic carbon in sediment (kg total carbon/kg sediment)	0.025	0.089	Spatially-weighted value for averaging areas

Note:

1. Values are unitless unless specified.

Table C-2 – Data Used to Calculate $BSAF_i$ and Average Lipid Content of Aquatic Invertebrates (Crayfish)

Field Sample ID	River Mile	Tissue PCB (mg/kg)	Lipid Fraction	Sediment PCB (mg /kg OC)	Individual $BSAF_i$
Reach 5A/5B					
H3-TD05OVWB-F002	132.07	40.35	0.019	3567	0.60
H3-TD05OVWB-M023	132.07	9.94	0.004	3567	0.70
H3-TD05OVWB-M022	132.07	52.14	0.011	3567	1.33
H3-TD05OVWB-M021	132.07	9.42	0.009	3567	0.29
H3-TD05OVWB-M020	132.07	8.08	0.008	3567	0.28
H3-TD05OVWB-M014	132.07	15.93	0.01	3567	0.45
H3-TD05OVWB-M008	132.07	13.12	0.008	3567	0.46
H3-TD05OVWB-M007	132.07	21.85	0.014	3567	0.44
H3-TD05OVWB-M001	132.07	20.09	0.011	3567	0.51
H3-TD05OVWB-F005	132.07	25.79	0.028	3567	0.26
H3-TD07OVWB-F002	130.07	31.59	0.02	1708	0.92
H3-TD07OVWB-M001	130.07	6.63	0.007	1708	0.55
H3-TD07OVWB-M003	130.07	4.35	0.002	1708	1.27
H3-TD07OVWB-M004	130.07	9.67	0.014	1708	0.40
H3-TD07OVWB-M006	130.07	14.84	0.012	1708	0.72
H3-TD07OVWB-M007	130.07	20.40	0.012	1708	1.00
H3-TD07OVWB-M008	130.07	7.40	0.014	1708	0.31
H3-TD07OVWB-M011	130.07	13.67	0.008	1708	1.00
H3-TD07OVWB-M014	130.07	6.81	0.008	1708	0.50
H3-TD07OVWB-M021	130.07	7.47	0.008	1708	0.55
H3-TD11OVWB-F004	126.07	7.22	0.014	1127	0.46
H3-TD11OVWB-F013	126.07	7.51	0.015	1127	0.44
H3-TD11OVWB-F023	126.07	8.08	0.012	1127	0.60
H3-TD11OVWB-F026	126.07	12.68	0.013	1127	0.87
H3-TD11OVWB-F027	126.07	14.73	0.018	1127	0.73
H3-TD11OVWB-M001	126.07	8.64	0.003	1127	2.56
H3-TD11OVWB-M003	126.07	6.83	0.006	1127	1.01
H3-TD11OVWB-M005	126.07	8.21	0.006	1127	1.21
H3-TD11OVWB-M014	126.07	2.59	0.004	1127	0.57
H3-TD11OVWB-M024	126.07	5.75	0.007	1127	0.73
Reach 5C/5D/6					
H3-TD12OVWB-M018	125.07	5.45	0.005	602	1.81
H3-TD12OVWB-M017	125.07	5.65	0.005	602	1.88
H3-TD12OVWB-M015	125.07	5.98	0.008	602	1.24
H3-TD12OVWB-M014	125.07	3.95	0.004	602	1.64
H3-TD12OVWB-M013	125.07	8.51	0.007	602	2.02
H3-TD12OVWB-M011	125.07	6.63	0.008	602	1.38
H3-TD12OVWB-M010	125.07	4.59	0.003	602	2.54
H3-TD12OVWB-F009	125.07	15.84	0.020	602	1.32
H3-TD12OVWB-F007	125.07	6.74	0.009	602	1.25
H3-TD12OVWB-F006	125.07	4.64	0.007	602	1.10

Notes:

1. Data from RFI Report (BBL and QEA, 2003)
2. The average tissue PCB concentration for Reach 5A/5B is 16.98 mg /kg and for Reach 5C/5D/6 is 7.51 mg/kg.
3. The geometric mean of the individual BSAFs is 0.56 in Reach 5A/5B and 1.12 in Reach 5C/5D/6. The median of individual BSAFs is 0.53 in Reach 5A/5B and 1.23 in Reach 5C/5D/6. The higher of the geometric mean or median for the averaging area was used as $BSAF_i$ in the target soil equation (see Table C-1).

Table C-3 – Fish PCB Tissue Concentration, Lipid Fraction, and $BSAF_f$ Predicted from the Food Chain Model (FCM)

Tissue PCB (mg/kg)	Lipid fraction	Sediment PCB (mg/kg)	Sediment FOC	$BSAF_f$
Reach 5A/5B				
33.5	0.030	12.1	0.025	1.32
Reach 5C/5D/6				
39.7	0.030	23.2	0.089	1.33

Note:

1. $BSAF_f$ was derived from the slope of regressions of lipid-normalized PCB concentrations against OC-normalized sediment PCB concentrations obtained from 26 years of estimates produced by the FCM as described in Section C.3. Other data shown are averages of 26 years of inputs and outputs from the FCM.

Table C-4 – Data Used to Calculate BSAF$_a$ and Average Lipid Content of Amphibians

Field Sample ID	Location (Pond ID or State Plane coordinates)	Tissue PCB (mg/kg)	Lipid Fraction	Sediment PCB (mg/kg)	Sediment FOC	Individual BSAF$_a$
Leopard Frog						
Reach 5A/5B						
H3-TO04RP32-0-F003*	W-9A	2.96	0.030	7.5	0.0169	0.22
H3-TA03RP31-0-F001*	E-5	1.31	0.006	19.6	0.0492	0.55
H3-TA04RP32-0-C001	W-9A	3.59	0.016	7.5	0.0169	0.51
H3-TA04RP33-0-C001	W-8	5.39	0.016	43.5	0.0938	0.73
H3-TO04RP32-0-F006*	W-9A	1.18	0.004	7.5	0.0169	0.69
H3-TO08RP35-0-F003*	W-6	0.81	0.019	21.0	0.0505	0.10
H3-TA08RP35-0-C001	W-6	1.76	0.013	21.0	0.0505	0.32
H3-TA08RP34-0-C001	W-7A	2.11	0.019	27.6	0.0492	0.20
H3-TO08RP34-0-F005*	W-7A	0.53	0.018	27.6	0.0492	0.05
H3-TO08RP34-0-F006*	W-7A	7.74	0.015	27.6	0.0492	0.94
Reach 5C/5D/6						
H3-TO12RP39-0-F008*	W-1	0.04	0.007	0.4	0.2630	3.29
H3-TA12RP39-0-C001	W-1	0.15	0.004	0.4	0.2630	25.38
H3-TA10RP36-0-C001	W-4	0.34	0.010	0.4	0.0670	5.75
H3-TA12RP38-0-C001	E-1	3.09	0.013	26.6	0.1110	0.99
H3-TO12RP39-0-F001*	W-1	0.05	0.014	0.4	0.2630	2.23
Wood Frog						
Reach 5A/5B						
H3-TA04RS27-0-C001	18-VP-2	2.92	0.039	4.9	0.0476	0.73
H3-TA05RS28-0-C001	23B-VP-1	0.30	0.018	0.2	0.0763	6.14
H3-TA05RS29-0-C001	23B-VP-2	1.22	0.020	0.3	0.0887	17.98
H3-TA08RS30-0-C001	38-VP-1	1.60	0.008	28.5	0.0023	0.02
H3-TA08RS21-0-C001	38-VP-2	5.34	0.011	32.3	0.0919	1.38
Reach 5C/5D/6						
H3-TA08RS32-0-C001	46-VP-1	0.13	0.015	0.8	0.1196	1.38
H3-TA10RS22-0-C001	46-VP-5	0.59	0.010	1.4	0.0303	1.32
Bullfrog						
Reach 5C/5D/6						
H3-TA12BFTO-0-M004*	56693N,902875E	7.25	0.009	6.1	0.0078	1.05
H3-TA12BFTO-0-M001*	56644N,902903E	6.13	0.011	16.4	0.1031	3.63
H3-TA12BFTO-0-F002*	56634N,903109E	3.48	0.011	2.9	0.0713	7.87
H3-TA12BFTO-0-F003*	56659N,903175E	5.09	0.011	79.2	0.1274	0.78
H3-TA12BFTO-0-F009*	56598N,903768E	5.37	0.018	39.7	0.2671	2.04
H3-TA12BFTO-0-M011*	56557N,903833E	7.56	0.012	0.4	0.0199	28.19
H3-TA12BFTO-0-M010*	56611N,903445E	9.22	0.010	6.7	0.0339	4.82
H3-TA12BFTO-0-M007*	56729N,903326E	2.44	0.006	10.6	0.0295	1.10
H3-TA12BFTO-0-F005*	56675N,903040E	4.49	0.008	68.6	0.0536	0.46
H3-TA12BFTO-0-F008*	56557N,902085E	4.25	0.011	0.4	0.0260	28.81
H4-TA13BFTO-0-M004*	56584N,901272E	6.01	0.007	0.5	0.0254	44.06
H4-TA13BFTO-0-F001*	56576N,901644E	4.27	0.011	54.0	0.0798	0.57
H4-TA13BFTO-0-M003*	56576N,901664E	5.55	0.008	40.0	0.0559	0.99
H4-TA13BFTO-0-M002*	56543N,901693E	5.25	0.007	76.0	0.0820	0.83
H4-TA13BFTO-0-F006*	56751N,901711E	1.48	0.007	205.0	0.1447	0.15
H4-TA13BFTO-0-M011*	56353N,901531E	3.04	0.005	37.9	0.1100	1.62
H4-TA13BFTO-0-F009*	56370N,901448E	3.89	0.016	70.3	0.0751	0.25
H4-TA13BFTO-0-M010*	56254N,901251E	4.35	0.022	11.8	0.0836	1.42
H4-TA13BFTO-0-M008*	56558N,901321E	5.45	0.018	0.5	0.0252	15.65

Notes:

1. * Estimated whole-body PCB and lipid concentrations came from two body part samples of one frog (ovary + offal for leopard frog and leg + offal for bullfrog). All other samples are whole-body composites of more than one individual. For reconstituted whole body samples, field sample ID shown is chain of custody ID for offal. Data are from EPA database for ERA.
2. Sediment PCB and FOC data are spatially weighted by pond for all but bullfrogs (many bullfrogs were from Woods Pond and large backwaters). PCB and FOC values for bullfrogs came from the co-located or nearest sediment sample.
3. The average tissue PCB concentration for Reach 5A/5B is 2.58 mg/kg and 3.81 mg/kg for Reach 5C/5D/6.

4. The geometric mean of the individual BSAFs is 0.48 in Reach 5A/5B and 2.36 in Reach 5C/5D/6. The median of individual BSAFs is 0.55 in Reach5A/5B and 1.52 in Reach 5C/5D/6. The higher of the geometric mean or median for the averaging area was used as $BSAF_a$ in the soil target equation (see Table C-1).

Table C-5 – Data Used to Calculate the $BSAF_{ab}$, BAF_{ab} and Average Lipid Content of Aquatic Birds (Wood Duck)

Appendix L Location ID	Tissue PCB (mg/kg)	Lipid Fraction	Sediment Spatially-Weighted PCB (mg/kg)	Sediment Spatially-Weighted FOC	Soil Spatially-Weighted PCB (mg/kg)	Soil Spatially-Weighted FOC	$BSAF_{ab}$	BAF_{ab}
Reach 5								
TS002	5.12	0.014	17.1	0.064	17.58	0.084		
TS004	7.16	0.010	17.1	0.064	17.58	0.084		
TS005	6.81	0.008	17.1	0.064	17.58	0.084		
TS007	6.87	0.007	17.1	0.064	17.58	0.084		
TS008	11.16	0.024	17.1	0.064	17.58	0.084		
TS003	4.79	0.024	17.1	0.064	17.58	0.084		
TS001	12.26	0.024	17.1	0.064	17.58	0.084		
TS006	4.87	0.025	17.1	0.064	17.58	0.084		
Average	7.38	0.017	17.1	0.064	17.58	0.084	1.72	0.348
Reach 6								
TS044	1.04	0.023	28.4	0.083	25.04	0.095		
TS039	3.18	0.092	28.4	0.083	25.04	0.095		
TS037	6.09	0.053	28.4	0.083	25.04	0.095		
TS038	17.51	0.073	28.4	0.083	25.04	0.095		
TS041	10.38	0.071	28.4	0.083	25.04	0.095		
TS042	8.70	0.089	28.4	0.083	25.04	0.095		
TS040	5.81	0.131	28.4	0.083	25.04	0.095		
TS010	5.28	0.003	28.4	0.083	25.04	0.095		
TS009	3.89	0.003	28.4	0.083	25.04	0.095		
TS036	3.05	0.044	28.4	0.083	25.04	0.095		
TS043	3.62	0.161	28.4	0.083	25.04	0.095		
TS011	7.75	0.003	28.4	0.083	25.04	0.095		
Average	6.36	0.062	28.4	0.083	25.04	0.095	0.318	0.208

Notes:

1. Data are from EPA database for ERA, which only identifies location for tissue samples as Reach 5 or 6. Thus, for aquatic birds only, the BSAF and the BAF were each calculated for Reach 5 and Reach 6, instead of for reach 5A/5B and 5C/5D/6.
2. Reconstituted whole body lipid and PCBs are from GC (gas chromatograph) values in Appendix L in ERA.
3. The estimate of FOC and PCBs in soil and sediment for each tissue sample is the spatially weighted average for Reach 5 or 6 (excluding unsuitable duck habitat for floodplain soil) and assumes each duck has a large foraging area that encompasses the entire reach.
4. BSAFs for individual ducks were not calculated but rather an average $BSAF_{ab}$ was calculated by entering the average concentration of tissue PCBs (C_{ab}) and lipids ($LIPID_{ab}$) and sediment PCBs (C_{sed}) and FOC (FOC_{sed}) for each reach into the equation: $BSAF_{ab} = C_{ab} / \{LIPID_{ab} \times [(P_{aba} \times C_{sed} / FOC_{sed}) + (P_{abt} \times C_{soil} / FOC_{soil})]\}$. BAF_{ab} was calculated by entering the average concentration of tissue PCBs (C_{ab}) and lipids ($LIPID_{ab}$) and soil PCBs (C_{soil}) and FOC (FOC_{soil}) for each reach into the equation: $BAF_{ab} = BSAF \times (LIPID_{ab} / FOC_{soil})$. See text for derivation of equations.
5. The PCB concentration in duck tissue from aquatic prey (C_{aba}) in Reach 5 averaged 5.79 mg/kg (calculated using equation 13 in text) and from terrestrial prey (C_{abt}) averaged 1.59 mg/kg (calculated using equation 14 in text), which sums to the measured average PCB concentration in the tissue (C_{ab}) of 7.38 mg/kg. Similarly for Reach 6, the PCB concentration from aquatic prey averaged 4.99 mg/kg and from terrestrial prey averaged 1.37 mg/kg, which sums to the measured average PCB concentration (C_{ab}) in the tissue of 6.36 mg/kg.

Table C-6 – Kalamazoo River Data (Trowbridge Area) Used to Calculate the $BSAF_{am}$ and Average Lipid Content of Aquatic Mammals (Muskrat)

Field Sample ID	Tissue PCB (mg/kg)	Lipid Fraction	Sediment Average PCB (mg/kg)	Sediment Average FOC	Individual $BSAF_{am}$
MT0018	0.082	0.020	2.177	0.055	0.10
MT0020	0.036	0.007	2.502	0.069	0.14
MT0021	0.059	0.026	0.011	0.057	11.48
MT0024	0.076	0.019	2.177	0.055	0.10
MT0025	0.014	0.013	2.502	0.069	0.03
MT0026	0.112	0.044	0.017	0.057	8.62
MT0027	0.079	0.043	0.017	0.039	4.24

Notes:

1. Data are from Kalamazoo River PCB database.
2. The geometric mean of the individual BSAFs is 0.14. The median of individual BSAFs is 0.57. The higher of the geometric mean or median was used as $BSAF_{tm}$ for both averaging areas when applied to the target soil equation (see Table C-1).

Table C-7 – Data Used to Calculate the BAF_{tb} for Terrestrial Birds

Field Sample ID	Location (Site or State Plane Coordinate)	Egg Tissue PCB (mg/kg)	Estimated Adult Tissue PCB (mg/kg) [2]	Soil Average PCB (mg/kg)[3]	Individual BAF_{tb}
House Wren					
Reach 5A/5B					
MCM812-E	Canoe Meadows	57.57	29.36	13.8	2.13
MCM815-E	Canoe Meadows	149.44	76.21	13.8	5.52
MCM828-E	Canoe Meadows	45.94	23.43	13.8	1.70
MCM809-E	Canoe Meadows	63.16	32.21	13.8	2.33
MCM816-E	Canoe Meadows	43.30	22.08	13.8	1.60
Black-Capped Chickadee					
Reach 5A/5B					
MCM830-E	Canoe Meadows	17.58	8.97	13.8	0.65
MLR881-P	New Lennox Road	18.18	9.27	24.2	0.38
Reach 5C/5D/6					
MRB842-P	Roaring Brook Road	24.98	12.74	27.6	0.46
American Robin					
Reach 5A/5B					
043-E	56295N, 905724E	162.00	82.62	37.8	2.19
069-E	56261N, 905926E	51.40	26.21	15.0	1.75
009-E	56261N, 905956E	37.50	19.13	0.4	49.80
108-E	56412N, 905970E	86.30	44.01	10.0	4.40
056-E	56497N, 906053E	103.00	52.53	17.0	3.09
110-E	56434N, 906115E	170.00	86.70	40.8	2.13
Reach 5C/5D/6					
022-E	56354N, 903376E	6.70	3.42	0.7	4.88
023-E	56539N, 903474E	18.40	9.38	49.0	0.19
012-E	56215N, 904242E	7.38	3.76	3.7	1.03
049-E	56487N, 905410E	150.00	76.50	18.4	4.16

Notes:

1. Wren and chickadee data from EPA database for ERA. Robin tissue data from GE database for robin productivity study (ARCADIS G&M, Inc., 2002).
2. Soil data were spatially-weighted for wrens and chickadees.
3. The estimated average tissue PCB concentration for adult tissue in Reach 5A/5B is 39.44 mg/kg and for Reach 5C/5D/6 is 18.06 mg/kg (assuming adult concentrations are 0.51 of egg concentrations, Neigh et al., 2006).
4. The geometric mean of the individual BAFs is 2.43 in Reach 5A/5B and 1.13 in Reach 5C/5D/6. The median of individual BAFs is 2.13 in Reach 5A/5B and 1.03 in Reach 5C/5D/6. The higher of the geometric mean or median for the averaging area was used as BAF_{tb} in the target soil equation (see Table C-1).

Table C-8 – Data Used to Calculate the BAF_{tm} for Terrestrial Mammals

Field Sample ID	Location (State Plane coordinates)	Tissue PCB (mg/kg)	Soil Spatially-Weighted Average PCB (mg/kg)	Individual BAF_{tm}
Short-Tailed Shrew				
Reach 5A/5B				
H3-TM05SS13-0-F001	57072N, 909134E	135.77	26.07	5.21
H3-TM05SS13-0-F002	57061N, 909173E	102.25	28.78	3.55
H3-TM05SS13-0-F003	57024N, 909166E	59.41	37.65	1.58
H3-TM05SS13-0-F004	57090N, 909185E	93.37	24.60	3.80
H3-TM05SS13-0-M001	57099N, 909188E	127.60	23.56	5.42
H3-TM05SS13-0-M002	57099N, 909188E	91.93	23.56	3.90
H3-TM05SS13-0-M003	57064N, 909172E	139.27	28.32	4.92
H3-TM05SS13-0-M004	57039N, 909168E	117.67	32.59	3.61
H3-TM05SS13-0-M005	57057N, 909172E	131.95	29.23	4.51
H3-TM05SS13-0-M006	57087N, 909183E	130.78	24.98	5.24
H3-TM07SS14-0-F001	56803N, 907074E	19.82	36.58	0.54
H3-TM07SS14-0-F002	56802N, 907070E	87.13	37.38	2.33
H3-TM07SS14-0-F004	56802N, 907084E	80.15	33.92	2.36
H3-TM07SS14-0-F005	56848N, 907068E	49.47	31.36	1.58
H3-TM07SS14-0-F009	56797N, 907087E	80.46	33.05	2.43
H3-TM07SS14-0-M001	56810N, 907079E	147.93	35.24	4.20
H3-TM07SS14-0-M003	56802N, 907070E	54.40	37.38	1.46
H3-TM07SS14-0-M004	56769N, 907014E	14.81	27.98	0.53
H3-TM07SS14-0-M005	56807N, 907083E	99.47	34.33	2.90
H3-TM07SS14-0-M006	56821N, 907076E	85.54	35.47	2.41
Reach 5C/5D/6				
H3-TM15SS15-0-F001	56256N, 904032E	7.45	1.25	5.94
H3-TM15SS15-0-F002	56294N, 904065E	4.45	1.27	3.52
H3-TM15SS15-0-M001	56322N, 904094E	5.46	1.12	4.88
H3-TM15SS15-0-M002	56297N, 904140E	10.68	0.71	15.13
White-Footed Mouse				
Reach 5A/5B				
H3-TM05WO13-0-F001	57035N, 909232E	19.98	28.43	0.70
H3-TM05WO13-0-F002	57005N, 909160E	2.44	45.27	0.05
H3-TM05WO13-0-F003	57031N, 909167E	10.10	35.62	0.28
H3-TM05WO13-0-F004	57106N, 909191E	27.39	23.14	1.18
H3-TM05WO13-0-F005	57030N, 909254E	12.43	24.56	0.51
H3-TM05WO13-0-F006	57010N, 909161E	1.63	42.92	0.04
H3-TM05WO13-0-F007	57080N, 909180E	1.92	25.92	0.07
H3-TM05WO13-0-F008	57065N, 909164E	2.10	27.86	0.08
H3-TM05WO13-0-F009	57043N, 909168E	2.15	31.60	0.07
H3-TM05WO13-0-F010	56999N, 909158E	2.00	47.47	0.04
H3-TM05WO13-0-M001	57029N, 909260E	6.02	23.37	0.26
H3-TM05WO13-0-M002	57031N, 909251E	6.76	25.14	0.27
H3-TM05WO13-0-M003	57043N, 909168E	15.38	31.60	0.49
H3-TM05WO13-0-M004	57070N, 909148E	2.38	26.50	0.09
H3-TM05WO13-0-M005	57031N, 909251E	15.98	25.14	0.64
H3-TM05WO13-0-M007	57106N, 909191E	4.50	23.14	0.19
H3-TM05WO13-0-M008	57072N, 909134E	2.42	26.07	0.09
H3-TM05WO13-0-M009	57031N, 909251E	7.94	25.14	0.32
H3-TM05WO13-0-M011	57019N, 909164E	3.61	39.48	0.09
H3-TM05WO13-0-M012	57067N, 909157E	16.72	27.35	0.61
H3-TM07WO14-0-F002	56860N, 907064E	5.56	33.48	0.17
H3-TM07WO14-0-F003	56769N, 907014E	3.72	27.98	0.13

Field Sample ID	Location (State Plane coordinates)	Tissue PCB (mg/kg)	Soil Spatially-Weighted Average PCB (mg/kg)	Individual BAF_{tm}
H3-TM07WO14-0-F004	56812N, 907080E	34.98	35.13	1.00
H3-TM07WO14-0-F005	56764N, 907002E	3.94	20.83	0.19
H3-TM07WO14-0-F007	56830N, 907068E	4.64	35.50	0.13
H3-TM07WO14-0-F010	56808N, 907078E	2.49	35.54	0.07
H3-TM07WO14-0-F011	56794N, 907089E	1.13	32.72	0.03
H3-TM07WO14-0-F013	56830N, 907068E	1.03	35.50	0.03
H3-TM07WO14-0-F014	56803N, 907074E	1.07	36.58	0.03
H3-TM07WO14-0-F018	56860N, 907022E	5.33	50.35	0.11
H3-TM07WO14-0-M003	56846N, 907069E	0.15	31.38	0.00
H3-TM07WO14-0-M004	56920N, 907017E	5.60	34.62	0.16
H3-TM07WO14-0-M005	56846N, 907069E	2.17	31.38	0.07
H3-TM07WO14-0-M006	56821N, 907076E	1.72	35.47	0.05
H3-TM07WO14-0-M007	56921N, 907014E	8.78	33.27	0.26
H3-TM07WO14-0-M009	56800N, 907062E	2.36	38.73	0.06
H3-TM07WO14-0-M010	56851N, 907069E	1.62	31.09	0.05
H3-TM07WO14-0-M011	56855N, 907015E	3.19	52.80	0.06
H3-TM07WO14-0-M017	56906N, 907036E	1.51	40.28	0.04
H3-TM07WO14-0-M018	56765N, 907004E	4.02	22.16	0.18
Reach 5C/5D/6				
H3-TM15WO15-0-F001	56300N, 904144E	0.35	0.69	0.51
H3-TM15WO15-0-F002	56320N, 904088E	0.45	1.18	0.38
H3-TM15WO15-0-F003	56291N, 904155E	1.01	0.66	1.53
H3-TM15WO15-0-F004	56342N, 904064E	0.54	1.96	0.27
H3-TM15WO15-0-F005	56339N, 904064E	0.19	1.97	0.10
H3-TM15WO15-0-F006	56272N, 904045E	0.40	1.33	0.30
H3-TM15WO15-0-M001	56256N, 904032E	1.81	1.25	1.44
H3-TM15WO15-0-M002	56297N, 904140E	0.61	0.71	0.86
H3-TM15WO15-0-M003	56291N, 904155E	0.44	0.66	0.67
H3-TM15WO15-0-M004	56287N, 904059E	0.21	1.29	0.16
H3-TM15WO15-0-M005	56333N, 904075E	1.61	1.73	0.93
H3-TM15WO15-0-M006	56305N, 904136E	0.38	0.71	0.54

Notes:

1. Data from EPA database for ERA.
2. The average tissue PCB concentration for Reach 5A/5B is 35.13 mg/kg and for Reach 5C/5D/6 is 2.25 mg /kg.
3. The geometric mean of the individual BAFs is 0.34 in Reach 5A/5B and 0.92 in Reach 5C/5D/6. The median of individual BAFs is 0.27 in Reach 5A/5B and 0.16 in Reach 5C/5D/6. The higher of the geometric mean or median for the averaging area was used as BAF_{tm} in the target soil equation (see Table C-1).

ARCADIS QEA

Appendix D

Estimation of Work Site and Transportation Accident Risks

Appendix D
Estimation of Work Site and Transportation Accident Risks

Prepared for:

General Electric Company
Pittsfield, Massachusetts

Prepared by:
ENVIRON International Corporation
Arlington, Virginia

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Contents

D.1 Introduction

The CMS Report describes and evaluates various alternatives for addressing PCB-containing sediments and floodplain soils in different sections (Reaches) of the Housatonic River and floodplain, as well as alternatives for treatment and/or disposition of sediments and soils that are removed. These alternatives are evaluated in accordance with the three General Standards and six Selection Decision Factors set out in the RCRA Permit issued by the U.S. Environmental Protection Agency (EPA) to the General Electric Company (GE) for the Rest of River. One of the Selection Decision Factors is Short-Term Effectiveness, which involves consideration of the impacts to nearby communities, workers, and the environment during implementation of the alternatives. These impacts include the potential for worker accidents during on-site construction/remediation activities and the potential for transportation accidents during the transport of materials to and from the site, which could affect the general public. GE has requested ENVIRON to develop quantitative estimates of these short-term worker and transport accident risks for the various remedial alternatives that involve removal and/or capping of sediments or floodplain soil, as well as the treatment/disposition alternatives for removed sediments and soils.

This appendix describes the methodology used to estimate the short-term risks of work site and transportation accidents associated with these alternatives, and presents the resulting estimates. Short-term accident risks associated with the remedial alternatives include:
(a) possible worker injuries and fatalities during on-site construction, excavation, and materials handling operations (similar to the risks experienced in the construction and general materials handling industries); and (b) potential injuries and/or fatalities that result from traffic accidents on public roads involving trucks transporting raw materials to the site or removing sediments and soils from the site.

D.2 Risk Estimation Methodologies

The short-term risks of injuries and fatalities resulting from work site and traffic accidents on public roads were quantified by combining “rate estimates” of injuries and fatalities arising from work site operations and material transportation with estimates of the number of worker hours or vehicle miles traveled associated with each alternative. For work site accidents, estimates were first developed of the probability of such an accident resulting in an injury or fatality for each hour of work conducted during remediation. Once these probabilities were developed, estimates of the number of work hours involved in each remedial alternative were used to calculate the risk of accident-related injuries or fatalities associated with the various alternatives. Similarly, for transportation-related risks, the probability of a transportation accident (resulting in injury or fatality) was developed for each on-road mile traveled by trucks hauling materials to or from the site, and then estimates of the number of vehicle miles that would need to be traveled for each remedial alternative were used to calculate the risk of accident-related injuries or fatalities associated with the alternatives. Transportation risks on the site’s unpaved access roads were calculated as work site accident risks. Risk estimation methods are outlined below.

D.2.1 Methodology for Estimating Work Site Accident Risks

All work site activities involve some risk of accidents, which may result in injuries or fatalities, and which vary with the work being done. The probability of a work site accident was evaluated for each sediment remedial alternative that involves sediment removal and/or capping (i.e., SED-3 through SED-8), each floodplain remedial alternative that involves soil removal (i.e., FP-2 through FP-7), and each treatment/disposition alternative that involves on-site work (i.e., TD-2 through TD-5), as described in the text of this CMS Report. These probabilities were calculated using methods similar to those developed by Hoskin et al. (1994)[1], site-specific information regarding the type and duration of activities taking place during each remedial alternative, and published fatal and non-fatal accident statistics.

Because accident rates vary by work task and occupation, site-specific information on work hours for different occupations is required for the work site accident risk analysis. For the alternatives identified above, site-specific estimates of labor time were developed for 20 different labor categories, though each alternative did not involve labor time in each category. These categories are:

- Construction Manager,
- Field Technician,
- Foreman—Land,
- Foreman—Water,
- Laborer—Land,
- Laborer—Water,
- Mechanic,
- Operator—Land,
- Operator—Water,
- Superintendent,
- Survey Technician,
- Wastewater Treatment System (WWTS) Technician,
- Gate Attendant,

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[1] Hoskin et al. (1994) quantified the risks of occupational fatalities associated with three remedial alternatives for a typical hazardous waste site. The authors first calculated fatality rates for workers in 17 specific occupations that were selected based on the types of work that would be performed under the various remedial alternatives. The authors then estimated the number of hours required during the remedial alternatives for each occupation and calculated the percentage of total work time that was contributed by each occupation. The calculated fatality rates and percentage of total worker hours contributed by a particular occupation were multiplied to produce a weighted fatality rate for the remedial alternative, which was then used with the number of person-years worked during each remedial alternative to arrive at the predicted fatality rate for each remedial alternative.

- Health and Safety Officer,
- Treatment Plant Engineer,
- Treatment Plant Laborer,
- Treatment Plant Manager,
- Treatment Plant Operator,
- Treatment Plant Shift Supervisor, and
- Unpaved Road Truck Driver.[2]

Tables D-1, D-2, and D-3 list the estimated labor hours for on-site remediation workers in each of the above categories required to implement the relevant sediment remedial alternatives, floodplain remedial alternatives, and treatment/disposition alternatives, respectively.[3] These estimates were provided to ENVIRON by ARCADIS and were taken from the cost estimates for each alternative.

D.2.1.1 Work Site Accidents Resulting in Fatality

In order to develop fatal accident rates for these labor categories, information on the total number of fatal accidents per year for Standard Occupational Classification (SOC) System occupations that correlate to the labor categories were obtained from the Bureau of Labor Statistics (BLS), United States Department of Labor (USDOL) (2003a, 2004a, 2005a).[4] For example, the SOC occupation “Surveying and mapping technicians” was used to represent the labor category “Survey Technician,” and the SOC occupation “Sailors and marine oilers” was used to represent the labor category “Laborer – Water.” Table D-4 lists the SOC occupation selected to represent each labor category.

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[2] Truck driver hours for the selected sediment and floodplain alternatives were calculated for the movement of excavated materials from the removal areas to the on-site staging areas along unpaved roads. These truck driver hour estimates do not include the movement of imported clean fill and building materials on the site’s unpaved roads. For the treatment/disposition alternatives, the truck driver hours include only the movement of excavated material along on-site, unpaved roads for on-site disposal, treatment, or re-use. The movement of excavated materials bound for off-site disposal from the staging areas to the closest paved, publicly accessible road is not included. Therefore, these estimates will slightly underestimate the risk of work site accidents related to unpaved road truck transport.

[3] Labor hours are not provided for treatment/disposition alternative TD-1 (off-site disposal) because it is assumed that the risks to workers would consist solely of risks to the truck drivers and employees of the off-site disposal facilities, rather than to on-site remediation workers. The estimated labor hours for the remaining treatment/disposition alternatives are provided as a range from the minimum to the maximum hours, based on, respectively, the smallest and largest potential volumes of removed materials that could be subject to that alternative (depending on the sediment and floodplain alternatives selected). For all types of alternatives, support service hours are not included in the categories listed in these tables, so this analysis will slightly underestimate potential work site accident risks associated with each remedial alternative.

[4] In 2003, BLS began using the SOC system to classify workers into occupational categories when publishing fatal occupational injury data. Due to this change, injury and fatality rate data by occupation from 2003 and later cannot be compared directly with data from previous years.

Using BLS data and information on the total numbers of workers in each SOC occupation obtained from the U.S. Census Bureau's Current Population Survey (U.S. Census Bureau 2008), the estimated average annual rate of fatal accidents for each occupation was calculated for 2003–2005. This was done by dividing the sum of fatalities for each occupation for years 2003–2005 by the sum of workers in each occupation for years 2003–2005. To obtain the hourly fatal accident rate, this yearly result was divided by an assumed 2000 work-hours per year.

Table D-4 summarizes the results of these calculations and shows the hourly fatality rate calculated for each of the 20 labor categories. Using these rates, and the labor hour estimates developed for each remedial alternative, the predicted number of fatalities for each labor category during the implementation of each alternative was calculated using Equation 1.

$$\mu_{lc} = H \times F_R \qquad \text{Equation 1}$$

where

μ_{lc} = Estimated number of fatalities for a given labor category

H = Estimated work hours within a given labor category, and

F_R = Calculated hourly fatality rate.

The overall number of work site accident related fatalities predicted to be associated with a given alternative, μ, is equal to the sum of the predicted fatalities for each individual labor category.[5]

In addition to calculating the estimated number of fatalities likely to occur during implementation of each alternative, the probability that at least one fatality would occur during implementation of each of the alternatives was calculated by applying the Poisson distribution function. The Poisson distribution is useful for evaluating the number of events (fatalities in this case) that may occur in a given period, assuming that the events are rare and occur independently of one another (e.g., the occurrence of one event does not affect the probability of a subsequent event). It is reasonable to assume that fatality events meet these requirements. In the Poisson distribution, the probability of an individual event occurring during a given time period is related to the number of times the event will likely occur during that same period. As described by Hoskin et al. (1994), the probability, or risk, of exactly x events occurring can be calculated using the Poisson function, described quantitatively using Equation 2 (Snedecor and Cochran 1980).

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[5] This procedure is mathematically equivalent to the method used by Hoskin et al. (1994), but follows a slightly different calculation order. Specifically, Hoskin et al. combined the fatality rates for the different labor categories with the relative number of hours worked in each category to derive a single weighted average fatality rate for a remedial alternative. This single rate was then multiplied by the total number of worker years to establish an estimate of fatalities.

$$P(x) = (e^{-\mu} \times \mu^{x})/x! \qquad \text{Equation 2}$$

where

$P(x)$ = Probability, or risk, of x numbers of fatalities occurring,

x = Number of fatalities occurring, and

μ = The mean of the Poisson distribution, equal to the estimated number of fatalities during implementation of an alternative.

The probability of at least one fatality occurring during the implementation of a remedial alternative can be calculated by first calculating the probability that no fatalities occur ($x = 0$ in Equation 2) and then calculating the probability of at least one fatality $P(\geq 1)$ using Equation 3.

$$P(\geq 1) = 1 - P(0) \qquad \text{Equation 3}$$

D.2.1.2 Work Site Accidents Resulting in Lost-Time Injury

Non-fatal injury/illness rates are not available from BLS for the various labor categories used in the fatal accident analysis. Rather, BLS provides non-fatal injury rate data[6] at the industry level, as identified by the North American Industry Classification System (NAICS). Therefore, in order to evaluate the risk of non-fatal accidents during site remediation, each of the 20 labor categories was assigned to a NAICS industry. For example, the “Construction Manager” labor category was best represented by the “Heavy and civil engineering construction” NAICS industry, while the “Foreman – Water” category was assessed to the “Water transportation” industry. Table D-5 shows the industry classifications for each of the 20 labor categories.[7] Accident rates for years 2003–2005 were averaged to obtain the overall recent rate of non-fatal injuries/illnesses in each of the selected industries (USDOL 2003b, 2004b, 2005b).[8]

The non-fatal injury rates shown in Table D-5 were used with estimated labor hour data for each alternative and Equation 1 to calculate the expected number of non-fatal injuries for each labor category. As with the fatality risk estimate, these labor category values were summed to estimate the total number of non-fatal worker injuries expected during the implementation of each alternative. The probability of at least one non-fatal injury during implementation of each alternative was calculated in the same way that the probability of at least one fatality was calculated, using Equations 2 and 3.

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[6] For purposes of this analysis, non-fatal injuries include only those that result in days away from work.

[7] It is important to note that these non-fatal injury rates are relatively similar across industries, varying by only a factor of 2.3 from the lowest (4.79×10^{-6} injuries per worker hour) to the highest (1.09×10^{-5} injuries per worker hour) rate.

[8] Accident rate data are reported at different industrial classification levels from year to year. Table D-5 lists the most detailed classification level for which data are consistently available from 2003–2005.

D.2.2 Methodology for Estimating Traffic Accident Risks

As discussed in the text of this CMS Report, construction materials and excavated sediments and soils would be transported to or from the site during implementation of the remedial alternatives, though different material disposition methods and locations are used in the different treatment/disposition alternatives. Inherent in the transport of materials to and from the site is the risk of an accident during transit, which may result in fatality or injury.

To quantify the risk of transportation accidents on public roads associated with each alternative, publicly available accident rate data collected by government agencies were combined with site- and project-specific information to estimate the number of accidents involving remediation-related vehicles and the associated fatalities and injuries. For simplicity, the estimates of potential transport-related accidents were based on the following scenarios.

For the sediment and floodplain remedial alternatives involving removal (i.e., SED-3 through SED-8 and FP-2 through FP-7), transport-related risks were quantified only for trucks used to import clean backfill and other materials (e.g., riprap) to the site over off-site, publicly accessible, paved roads. Risks associated with the transport of materials on the site’s unpaved access roads (e.g., to move sediments and soils from their place of removal to the on-site staging areas) were calculated as work site accident risks, and risks associated with the transport of these materials from the on-site staging areas to off-site disposal areas (where relevant) were assessed under the relevant treatment/disposition alternatives.

For the treatment/disposition alternatives, the risks were calculated for the transportation of the following materials:

- TD-1 (disposal at off-site disposal facilities): Truck transport of excavated materials (after dewatering where necessary) over off-site paved roads to off-site disposal locations.
- TD-2 (disposition at local in-water Confined Disposal Facility [CDF]): Truck transport to import materials over off-site paved roads for construction and closure of the CDF(s).[9]
- TD-3 (disposition at local Upland Disposal Facility): Truck transport to import materials over off-site paved roads for construction and closure of the Upland Disposal Facility.
- TD-4 (chemical extraction): Truck transport for off-site disposal of treated materials from the chemical extraction facility over off-site paved roads to off-site disposal locations.

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[9] As noted in the CMS Report, it is assumed that the CDF(s) would be used only for the disposition of hydraulically dredged sediments from Reaches 5C and 6 under sediment alternatives SED-6, SED-7, or SED-8, and that all other sediments and all excavated floodplain soil would be transported off-site for disposal. The risks associated with the off-site transport of those remaining materials were not estimated as part of TD-2. Thus, the risk estimates calculated for TD-2 are not comparable to those calculated for the other treatment/disposition alternatives, because they do not reflect the risks that would be associated with disposition of all removed materials.

- TD-5 (thermal desorption): Alternative estimates depending on method of disposition of treated materials from the thermal desorption facility – specifically: (a) assuming on-site reuse of some treated materials in the floodplain and truck transport of the remaining treated material over off-site paved roads to off-site disposal locations; and (b) assuming off-site truck transport of all treated materials over off-site paved roads to off-site disposal locations.[10]

As noted above, the risks associated with on-site truck transport of materials as part of these alternatives – i.e., transport of materials from on-site staging areas to the Upland Disposal Facility, the chemical extraction facility, or the thermal desorption facility, or from the thermal desorption facility for on-site reuse – were calculated as worker risks for these alternatives and are not calculated as transportation risks.

D.2.2.1 Traffic Accident Frequency Information for Paved Road Transport

To estimate the number of injuries and fatalities arising from truck transportation accidents on off-site paved roads, publicly available data on large trucks[11] from the United States Federal Highway Administration, the National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System, and the NHTSA General Estimates System (USDOT 2007) were used to calculate the rate of fatalities and injuries. This accident frequency information was combined with estimates of the vehicle-miles traveled on paved roads by trucks transporting remediation-related materials to calculate the risk of fatalities and injuries arising from paved road truck transportation.

Data regarding the number of injuries and fatalities per mile driven by large trucks in the United States are available for several years. The average of the most recent five years of data (2001–2005) was used in our estimates. This analysis of federal large truck statistics indicates that fatalities occur at a rate of 2.4×10^{-8} per truck mile traveled, while injuries occur at a rate of 5.7×10^{-7} per truck mile traveled. These rates were used in the calculation of traffic accident risks from transport on paved public roads.

D.2.2.2 Estimation of Traffic Accident Risks for Sediment and Floodplain Alternatives

As noted in Section D.2.2 above, transport-related risks for the sediment and floodplain remedial alternatives were quantified only for truck transport used to import clean backfill and other materials (e.g., riprap) to the site over paved public roads. For each of these alternatives,

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[10] Though alternative TD-5 would also generate treatment residuals (e.g., liquid condensate) that would be transported off-site for destruction, the transportation of these materials was not considered in the risk calculation, since the volume of these materials is low relative to the volume of other materials transported off-site under this alternative. Therefore, the transportation risk assessment will slightly underestimate risks associated with this alternative.

[11] A large truck, as referred to here, is defined by the Federal Motor Carrier Safety Administration as a truck with a gross vehicle weight rating greater than 10,000 pounds.

the estimated number of truck trips that would be required to import such materials was based on the estimated volume (in cubic yards) of the materials needed to implement the alternative, with an assumed 20% bulking factor added, and an assumption that 16-ton trucks would be used for this purpose. The imported material volume estimates (provided by ARCADIS) and the calculated number of material importation truck trips are shown in Tables D-6 and D-7 for the sediment and floodplain remedial alternatives, respectively.

To determine the distance of each such truck trip, it was assumed that clean backfill and other imported materials would be available from suppliers within 25 miles of the site. Thus, a round-trip distance of 50 miles was assumed for each truck trip. This travel distance was then combined with the estimated number of truck trips, using Equation 4, to calculate the total vehicle miles traveled (VMT) for each sediment and floodplain alternative.

$$VMT = D \times N \qquad \text{Equation 4}$$

where

VMT = Total vehicle miles traveled,

D = Distance traveled (vehicle miles/trip), and

N = Number of vehicle trips on the designated route.

This overall estimated VMT on paved roads (see Tables D-6 and D-7) was then combined with the above-described rates of fatalities and injuries predicted per truck mile traveled on paved public roads to calculate the potential number of fatalities and injuries associated with truck transport for each sediment and floodplain alternative, as follows:

$$A = VMT \times A_R \qquad \text{Equation 5}$$

where

A = Number of fatalities or injuries involving trucks carrying remediation materials on paved roads,

VMT = Round-trip vehicle-miles traveled on paved roads by trucks carrying remediation materials, and

A_R = Fatality or injury rate (per VMT)

In addition to these calculations, an estimate was made of the probability of at least one fatality or injury arising from truck transport for each remedial alternative using the Poisson distribution, as described above.

D.2.2.3 Estimation of Traffic Accident Risks for Treatment/Disposition Alternatives

As noted in Section D.2.2 above, transport-related risks for the treatment/disposition alternatives were quantified for the truck transport of different materials, depending on the alternative. A range of material volumes was also used for each alternative (from the smallest potential volume to the largest potential volume), resulting in a range of truck trips and vehicle miles traveled for each alternative. Estimated vehicle miles traveled for each of the selected alternatives were calculated as follows:

- For TD-1, the estimated number of truck trips that would be required to transport excavated materials over paved roads to off-site disposal locations was first calculated using material disposal weights provided by ARCADIS, which were based on in-situ volumes and the application of a 20% bulking factor, with the incorporation of stabilization/drying agents (where necessary), and assuming that the material would be transported in 20-ton loads in over-the-road haul trucks. Based on these inputs, truck trip estimates were prepared for a range of disposal quantities – from a combination of SED-3 and FP-2 (at the low end of the range) to a combination of SED-8 and FP-7 (at the high end of the range). Once truck trip estimates were prepared, vehicle miles traveled were estimated by assuming, for present purposes, that materials regulated under the Toxic Substances Control Act (TSCA) would be transported to the CWM Chemical Services facility in Model City, New York (a distance of 720 miles roundtrip), and that non-TSCA materials would be transported to the High Acres Landfill in Fairport, New York (a distance of 550 miles roundtrip). The ranges of assumed volumes (both TSCA and non-TSCA), disposal weights, truck trips, and vehicle miles traveled are shown in Table D-8.
- For TD-2, the estimated number of truck trips required to import materials over off-site paved roads for construction and closure of the CDF(s) was calculated based on a range of material volumes, with the low end based on the estimated size of the CDF for SED-6 and the high end based on the size of the CDFs for SED-8 (with an assumed 20% bulking factor added), and an assumption that 16-ton trucks would be used to import these materials.[12] In order to calculate the vehicle miles traveled by these trucks, it was estimated that materials for construction and closure of the CDF(s) would be available within 25 miles of the site, resulting in a round trip distance of 50 miles per truck trip. The range of estimated volumes of materials to import and the associated number of truck trips and vehicles miles traveled under alternative TD-2 are shown in Table D-9.
- For TD-3, the estimated number of truck trips to import materials over off-site paved roads for construction and closure of the Upland Disposal Facility (UDF) was calculated based on the assumption that 16-ton trucks would be used to import these materials and a range of volumes to construct the UDF for various sediment and floodplain soil remedial alternatives

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[12] As noted above, it is assumed that the CDF(s) would be used only for the disposition of hydraulically dredged sediments from Reaches 5C and 6 under SED-6 through SED-8, not as part of any other remedial alternative or for any other sediment or soil.

(with an assumed 20% bulking factor added). The range of volumes extends from that necessary to construct the UDF for the excavated materials under SED-3 and FP-2 to that necessary to construct the UDF to handle the excavated materials under SED-8 and FP-7. To calculate the range of vehicle miles traveled under alternative TD-3, it was estimated that materials for construction and closure of the UDF would be available within 25 miles of the site, resulting in a round trip distance of 50 miles per truck trip. The range of volumes of materials to import and the associated number of truck trips and vehicle miles traveled under alternative TD-3 are shown in Table D-9.

- For TD-4, the materials to be transported off-site would be the treated solid materials resulting from the treatment process. For this alternative, it was assumed that the volume of such materials (and thus the number of truck trips) would be equal to the volume transported under alternative TD-1, but that all such treated materials could be transported to a non-TSCA regulated landfill pursuant to an EPA determination under the TSCA regulations. As with TD-1, truck trip estimates were prepared for a range of material volumes – from the volume that would be excavated under SED-3 and FP-2 to the volume that would be excavated under SED-8 and FP-7. Estimates of the vehicle miles traveled were prepared by assuming that the treated materials would be transported to the High Acres Landfill in Fairport, New York (a distance of 550 miles roundtrip). The ranges of material volumes, truck trips, and vehicle miles traveled associated with alternative TD-4 are shown in Table D-8.
- For TD-5, two separate transportation alternatives were considered, depending on the method selected for disposition of treated solid materials. The two alternatives were: (a) on-site reuse of some treated materials in the floodplain areas and off-site disposal of the remaining materials (alternative TD-5a); and (b) off-site disposal of all such treated materials (alternative TD-5b).[13] For both TD-5a and TD-5b, a range of treated material volumes and truck trips were considered – from the volume that would be excavated under SED-3 and FP-2 to the volume that would be excavated under SED-8 and FP-7. Estimates of the vehicle miles traveled were prepared by assuming that all treated solid materials to be transported off-site would be considered non-TSCA materials and would be transported to the High Acres Landfill in Fairport, New York (a distance of 550 miles roundtrip). Note that for TD-5 it was assumed that there would be a 10% reduction in the total mass as a result of the thermal treatment; as such, there is an associated reduction in the number of truck trips relative to TD-4. It was further assumed that, under alternative TD-5a, a portion of the treated materials would be reused as backfill in the floodplain and thus would not need off-site disposal; as a result, there is a further reduction in the number of truck trips associated with TD-5a. The estimated volumes of materials to transport under alternatives TD-5a and TD-5b, the number of truck trips, and the associated vehicle miles traveled are presented in Table D-8.

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[13] Treatment residuals (e.g., liquid condensate from the thermal desorption process) were excluded from the analysis, as previously discussed.

For each TD alternative, the lower and upper bounds of the estimated VMT range were then combined with the above-described rates of fatalities and injuries predicted per truck mile traveled on public roads, using Equation 5 (above), to calculate a range of potential fatalities and injuries associated with truck transport for each TD alternative. As noted above, the risks calculated for TD-2 are not comparable to those calculated for the other treatment/disposition alternatives, because they do not include the risks that would be associated with off-site transport of the material that would not be placed in the CDF(s).

In addition, for each TD alternative, based on the lower and upper bounds of the fatality and injury estimates, estimates were made of the probability of at least one fatality or injury, using the Poisson distribution, as described above.

D.3 Estimated Risks

The estimated number of work site fatalities for the various sediment and floodplain soil remedial alternatives and treatment/disposition alternatives are summarized in Tables D-10 through D-12, respectively. These tables show that the estimated numbers of fatalities for the various alternatives range from 0.03 to 0.26 for the sediment remedial alternatives, 0.002 to 0.06 for the floodplain soil alternatives, and 0.008 to 0.15 for the treatment/disposition alternatives. The probability of at least one worker fatality during each alternative is predicted to be less than 25% in all cases and much less for most alternatives.

The estimated number of non-fatal work site injuries for the various sediment and floodplain soil remedial alternatives and treatment/disposition alternatives are summarized in Tables D-13 through D-15, respectively. These tables indicate that the estimated numbers of non-fatal injuries for the various remedial and treatment/disposition alternatives range from 3.7 to 16.2 for the sediment remedial alternatives, 0.3 to 7.9 for the floodplain soil alternatives, and 1.1 to 22.3 for the treatment/disposition alternatives. The probability of a non-fatal injury from the implementation of some of the alternatives is effectively 100%.[14]

The estimated number of fatalities and non-fatal injuries associated with traffic accidents during the importation of materials to support the implementation of sediment and floodplain soil remedial alternatives are summarized in Table D-16, while the estimated number of fatalities and non-fatal injuries associated with truck transportation during the treatment/disposition alternatives are listed in Table D-17.

For the importation of materials to support implementation of sediment and floodplain soil remedial alternatives, the estimated number of transportation-related fatalities ranges from 0.03 to 0.27 for the sediment alternatives and 0.004 to 0.08 for the floodplain alternatives. The probability of a fatality from importation of materials is less than 25% in all cases. The number

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[14] The probability of at least one non-fatal injury from implementation of SED, FP, and TD alternatives is as high as 99.96%, or effectively 100%. Hereafter, very high probabilities (i.e., greater than 99.5%) will be referred to as effectively 100%.

of non-fatal injuries predicted to be associated with the transport of these materials ranges from 0.65 to 6.37 for the sediment alternatives and 0.11 to 1.91 for the floodplain alternatives. The probability of a non-fatal injury from the implementation of the alternatives ranges from 10% to effectively 100% (see Table D-16).

The estimated number of transportation-related fatalities for the treatment/disposition alternatives (based on the ranges of potential volumes and thus truck trips) ranges from 0.002-0.02 (for TD-3) to 0.2-2.99 (for TD-1), while the probability of at least one traffic accident related fatality during the alternatives ranges from 0.2-2% (for TD-3) to 18-95% (for TD-1). The estimated number of non-fatal injuries resulting from material transportation along public, paved roads ranges from 0.04-0.38 (for TD-3) to 4.7-71.1 (for TD-1). The probability of at least one non-fatal injury resulting from the implementation of the alternatives is effectively 100% for all the alternatives except TD-2 and TD-3 (see Table D-17).

D.4 References

Hoskin, A.F., J.P. Leigh, and T.W. Planek. 1994. Estimated risk of occupational fatalities associated with hazardous waste site remediation. *Risk Analysis*. 14(6): 1011-1017.

Snedecor, G.W. and W.G. Cochran. 1980. *Statistical Methods*. Iowa State University Press. Ames, Iowa.

U.S. Census Bureau. Employed persons by detailed occupation and sex for 2000 – 2007. Unpublished table generated using data from the Current Population Survey. Received Feb. 20, 2008.

U.S. Department of Labor (USDOL), Bureau of Labor Statistics (BLS). 2003a. *Census of Fatal Occupational Injuries, 2003: Fatal occupational injuries by occupation and event or exposure, All United States, 2003*.

U.S. Department of Labor, Bureau of Labor Statistics. 2003b. *Incidence rates for nonfatal occupational injuries and illnesses involving days away from work per 10,000 full-time workers by industry and selected sources of injury or illness, 2003.*

U.S. Department of Labor, Bureau of Labor Statistics. 2004a. *Census of Fatal Occupational Injuries, 2004: Fatal occupational injuries by occupation and event or exposure, All United States, 2004*.

U.S. Department of Labor, Bureau of Labor Statistics. 2004b. *Incidence rates for nonfatal occupational injuries and illnesses involving days away from work per 10,000 full-time workers by industry and selected sources of injury or illness, 2004.*

U.S. Department of Labor, Bureau of Labor Statistics. 2005a. *Census of Fatal Occupational Injuries, 2005: Fatal occupational injuries by occupation and event or exposure, All United States, 2005*.

U.S. Department of Labor, Bureau of Labor Statistics. 2005b. *Incidence rates for nonfatal occupational injuries and illnesses involving days away from work per 10,000 full-time workers by industry and selected sources of injury or illness, 2005.*

U.S. Department of Transportation (USDOT). 2007. *Large Truck Crash Facts 2005*. Federal Motor Carrier Safety Administration (FMCSA) Analysis Division.

Table D-1
Estimated Labor Hours for Sediment Remedial Alternatives

Corrective Measures Study for The Housatonic River
General Electric Company - Pittsfield, Massachusetts

Labor Category	SED 1	SED 2	SED 3	SED 4	SED 5	SED 6	SED 7	SED 8
Construction Manager	--	--	22,612	35,013	37,112	34,610	47,995	86,674
Field Technician	--	--	45,442	75,197	95,419	105,910	128,243	274,148
Foreman - Land	--	--	22,663	34,897	42,462	34,803	40,155	47,246
Foreman - Water	--	--	1,423	7,403	9,894	19,764	31,022	108,414
Laborer - Land	--	--	80,601	125,207	144,346	125,615	141,629	214,755
Laborer - Water	--	--	5,691	22,447	39,574	56,471	93,013	273,050
Mechanic	--	--	22,612	35,013	37,112	43,326	58,291	130,416
Operator - Land	--	--	55,406	98,480	119,065	88,563	98,740	117,961
Operator - Water	--	--	3,207	28,922	24,957	68,155	111,661	87,482
Superintendent	--	--	20,212	32,453	34,232	31,730	45,115	83,794
Survey Technician	--	--	25,439	32,906	39,218	39,170	48,646	57,140
Unpaved Road Truck Driver	--	--	36,938	65,653	79,377	59,042	65,826	78,641
WWTS Technician	--	--	29,236	41,685	56,154	65,243	83,643	145,982
Total	**--**	**--**	**371,480**	**635,279**	**758,921**	**772,399**	**993,981**	**1,705,705**

Table D-2
Estimated Labor Hours for Floodplain Soils Remedial Alternatives

Corrective Measures Study for The Housatonic River
General Electric Company - Pittsfield, Massachusetts

Labor Category	FP-1	FP-2	FP-3	FP-4	FP-5	FP-6	FP-7
Construction Manager	--	1,129	4,217	6,306	6,374	20,230	35,008
Field Technician	--	1,129	4,217	6,306	6,374	20,230	35,008
Foreman - Land	--	1,749	10,048	13,286	13,392	34,869	57,774
Laborer - Land	--	9,238	37,383	52,428	52,919	152,682	259,080
Mechanic	--	1,129	4,217	6,306	6,374	20,230	35,008
Operator - Land	--	5,337	17,173	25,566	25,820	77,364	132,336
Superintendent	--	1,129	4,217	6,306	6,374	20,230	35,008
Survey Technician	--	2,257	8,433	12,612	12,861	40,573	70,128
Unpaved Road Truck Driver	--	3,558	11,449	17,044	17,213	51,576	88,224
WWTS Technician	--	900	3,983	6,077	6,374	20,230	28,093
Total	**--**	**27,554**	**105,334**	**152,238**	**154,076**	**458,216**	**775,666**

Table D-3
Estimated Labor Hours for Treatment/Disposition Alternatives

Corrective Measures Study for The Housatonic River
General Electric Company - Pittsfield, Massachusetts

Labor Category	TD-1	TD-2		TD-3		TD-4		TD-5	
		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Construction Manager	--	1,463	1,640	36,352	100,467	--	--	--	--
Field Technician	--	1,463	1,640	36,352	100,467	--	--	--	--
Foreman - Land	--	1,463	1,640	43,623	120,560	--	--	--	--
Laborer	--	67,225	225,230	214,478	592,753	16,804	152,377	16,804	152,377
Mechanic	--	1,463	1,640	65,434	180,840	--	--	--	--
Operator - Land	--	22,294	62,458	74,522	205,957	--	--	--	--
Unpaved Road Truck Driver	--	--	--	181,761	502,333	33,608	304,755	33,608	457,132
Superintendent	--	1,463	1,640	36,352	100,467	--	--	--	--
Survey Technician	--	2,927	3,280	72,704	100,467	--	--	--	--
Gate Attendant	--	--	--	36,352	100,467	--	--	--	--
Health and Safety Officer	--	1,463	1,640	36,352	100,467	--	--	--	--
Treatment Plant Engineer	--	--	--	--	--	12,089	71,122	12,089	71,122
Treatment Plant Laborer	--	--	--	--	--	25,205	228,563	25,205	228,563
Treatment Plant Manager	--	--	--	--	--	12,089	71,122	12,089	71,122
Treatment Plant Operator	--	--	--	--	--	63,014	799,974	63,014	799,974
Treatment Plant Shift Supervisor	--	--	--	--	--	12,603	114,283	12,603	114,283
Total		**101,226**	**300,808**	**834,283**	**2,205,243**	**175,412**	**1,742,196**	**175,412**	**1,894,573**

Table D-4
Remediation Labor Categories and Associated SOC Occupations and Average Hourly Fatality Rates

Corrective Measures Study for The Housatonic River
General Electric Company - Pittsfield, Massachusetts

Labor Category	SOC Occupation[(1)]	Average Hourly Fatality Rate (2003-2005) (fatalities/worker-hr)
Construction Manager	First-line supervisors/managers of construction trades and extraction workers	6.26E-08
Field Technician	Engineering technicians, except drafters	1.81E-08
Foreman - Land	First-line supervisors/managers of construction trades and extraction workers	6.26E-08
Foreman - Water	Ship and boat captains and operators	1.47E-07
Laborer - Land	Construction laborers	1.20E-07
Laborer - Water	Sailors and marine oilers	5.83E-07
Mechanic	Heavy vehicle and mobile equipment service technicians and mechanics	6.28E-08
Operator - Land	Dredge, excavating, and loading machine operators	8.66E-08
Operator - Water	Dredge, excavating, and loading machine operators	8.66E-08
Superintendent	First-line supervisors/managers of construction trades and extraction workers	6.26E-08
Survey Technician	Surveying and mapping technicians	1.20E-08
WWTS Technician	Water and liquid waste treatment plant and system operators	4.59E-08
Gate Attendant	Security guards and gaming surveillance officers	4.18E-08
Health and Safety Officer	Civil engineer	1.12E-08
Treatment Plant Engineer	Civil engineer	1.12E-08
Treatment Plant Laborer	Laborers and freight, stock, and material movers, hand	3.49E-08
Treatment Plant Manager	Civil engineer	1.12E-08
Treatment Plant Operator	Miscellaneous plant and system operators	4.39E-08
Treatment Plant Shift Supervisor	Miscellaneous plant and system operators	4.39E-08
Unpaved Road Truck Driver	Industrial truck and tractor operators	3.74E-08

Notes:
1 SOC = Standard Occupational Classification

Table D-5
Remediation Labor Categories and Associated NAICS Industries and Average Hourly Non-fatal Injury Rates

Corrective Measures Study for The Housatonic River
General Electric Company - Pittsfield, Massachusetts

Labor Category	NAICS Industry[(1)]	Average Hourly Non-fatal Injury Rate (2003-2005) (injuries/worker-hr)
Construction Manager	Heavy and civil engineering construction	1.09E-05
Field Technician	Remediation services	7.40E-06
Foreman - Land	Heavy and civil engineering construction	1.09E-05
Foreman - Water	Water transportation	9.12E-06
Laborer - Land	Heavy and civil engineering construction	1.09E-05
Laborer - Water	Water transportation	9.12E-06
Mechanic	Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance	9.40E-06
Operator - Land	Heavy and civil engineering construction	1.09E-05
Operator - Water	Water transportation	9.12E-06
Superintendent	Heavy and civil engineering construction	1.09E-05
Survey Technician	Surveying and mapping (except geophysical) services	4.79E-06
WWTS Technician	Water, sewage and other systems	1.06E-05
Gate Attendant	Investigation and security services	5.68E-06
Health and Safety Officer	Heavy and civil engineering construction	1.09E-05
Treatment Plant Engineer	Remediation services	7.40E-06
Treatment Plant Laborer	Remediation services	7.40E-06
Treatment Plant Manager	Remediation services	7.40E-06
Treatment Plant Operator	Remediation services	7.40E-06
Treatment Plant Shift Supervisor	Remediation services	7.40E-06
Unpaved Road Truck Driver	Heavy and civil engineering construction	1.09E-05

Notes:
1 NAICS = North American Industry Classification System

Table D-6

Estimated Volumes, Truck Trips, and Vehicle Miles Traveled for Sediment Remedial Alternatives Material Importation

Corrective Measures Study for the Housatonic River
General Electric Company - Pittsfield, Massachusetts

	SED-3	SED- 4	SED-5	SED-6	SED-7	SED-8
Volume of material in (1)	226,798	462,774	618,894	708,791	919,165	2,233,391
with 20% Bulking	272,158	555,328	742,672	850,549	1,102,998	2,680,070
Number of Truck Trips (2)	22,700	46,300	61,900	70,900	92,000	223,400
Number of Vehicle Miles Traveled (3)	1,135,000	2,315,000	3,095,000	3,545,000	4,600,000	11,170,000

Notes:
1. Volume (cubic yards [cy]) of material "in" includes sand, stone and riprap used for backfill, capping and stabilization.
2. Assumes 16-ton trucks with a capacity of 12-cy.
3. Assumes a 50 mile round trip.

Table D-7

Estimated Volumes, Truck Trips, and Vehicle Miles Traveled for Floodplain Soil Remedial Alternatives Material Importation

Corrective Measures Study for the Housatonic River

General Electric Company - Pittsfield, Massachusetts

	FP-2	**FP-3**	**FP-4**	**FP-5**	**FP-6**	**FP-7**
Volume of material in (1)	36,285	94,899	133,757	132,485	376,972	670,434
with 20% Bulking	43,542	113,879	160,508	158,982	452,366	804,521
Number of Truck Trips (2)	3,700	9,500	13,400	13,300	37,700	67,100
Number of Vehicle Miles Traveled (3)	185,000	475,000	670,000	665,000	1,885,000	3,355,000

Notes:

1. Volume of material (cubic yards [cy]) "in" includes common fill and topsoil used for backfill.
2. Assumes 16-ton trucks with a capacity of 12-cy.
3. Assumes a 50 mile round trip.

Table D-8

Estimated Export Volumes for Treatment/Disposition Alternatives

Corrective Measures Study for the Housatonic River

General Electric Company - Pittsfield, Massachusetts

Waste Classification	Parameter	TD-1		TD-2	TD-3	TD-4		TD-5a (with reuse) (1)		TD-5b (without reuse)	
		Minimum (SED-3 and FP-2)	Maximum (SED-8 and FP-7)			Minimum (SED-3 and FP-2)	Maximum (SED-8 and FP-7)	Minimum (SED-3 and FP-2)	Maximum (SED-8 and FP-7)	Minimum (SED-3 and FP-2)	Maximum (SED 8 and FP 7)
TSCA	In-Situ Volume (cy)	42,900	643,000	--	--	--	--	--	--	--	--
	Transport (tons) (2)	64,400	964,500	--	--	--	--	--	--	--	--
	Number of Truck Trips (3,4)	3,300	48,300	--	--	--	--	--	--	--	--
	Vehicle Miles Traveled (5)	2,376,000	34,776,000	--	--	--	--	--	--	--	--
Non-TSCA	In-Situ Volume (cy)	143,500	2,179,300	--	--	186,400	2,822,300	153,900	2,112,300	167,800	2,540,100
	Transport (tons) (2)	215,200	3,268,900	--	--	279,600	4,233,400	230,900	3,168,400	251,700	3,810,100
	Number of Truck Trips (3,4)	10,800	163,500	--	--	14,100	211,800	11,600	158,500	12,600	190,600
	Vehicle Miles Traveled (6)	5,940,000	89,925,000	--	--	7,755,000	116,490,000	6,380,000	87,175,000	6,930,000	104,830,000

Notes:
1. TD-5a volumes assume a 10% loss of material mass following treatment.
2. Transport weight includes a 20% bulking factor and an assumed density of 1.25 tons/cy.
3. Only the transport of non-TSCA materials was considered for alternatives TD-4 and TD-5. Treatment residuals, a limited volume component, were not included.
4. Assumes 20-ton capacity trucks will be used.
5. Assumes a 720 mile round trip for all trucks carrying TSCA materials.
6. Assumes a 550 mile round trip for all trucks carrying non-TSCA materials.

Table D-9
Estimated Import Volumes for Treatment/Disposition Alternatives

Corrective Measures Study for the Housatonic River
General Electric Company - Pittsfield, Massachusetts

TD Alternatives	TD-1	TD-2		TD-3		TD-4	TD-5
		Minimum (SED-6)	Maximum (SED-8)	Minimum (SED-3 and FP-2)	Maximum (SED-8 and FP-7)		
In-Place Volume (cy) (1)	--	111,136	228,149	13,500	131,700	--	--
Bulked Volume (cy) (2)	--	133,364	273,778	16,200	158,040	--	--
Number of Truck Trips (3)	--	11,200	22,900	1,400	13,200	--	--
Number of Vehicle Miles Traveled (4)	--	560,000	1,145,000	70,000	660,000	--	--

Notes:

1. In-place volume includes sand and stone for staging/decontamination area setup; sand, stone, common fill and topsoil used for backfill/capping; and riprap for stabilization.
2. Bulked volume includes a 20% bulking factor to account for the difference between the shipped volume and the in-place, compacted volume.
3. Assumes 16-ton trucks with a capacity of 12-cy.
4. Assumes a 50 mile round trip.

Table D-10
Estimated Worker Fatalities by Occupation for Sediment Remedial Alternatives

Corrective Measures Study for The Housatonic River
General Electric Company - Pittsfield, Massachusetts

Labor Category	SED 1	SED 2	SED 3	SED 4	SED 5	SED 6	SED 7	SED 8
Construction Manager	--	--	1.4E-03	2.2E-03	2.3E-03	2.2E-03	3.0E-03	5.4E-03
Field Technician	--	--	8.2E-04	1.4E-03	1.7E-03	1.9E-03	2.3E-03	5.0E-03
Foreman - Land	--	--	1.4E-03	2.2E-03	2.7E-03	2.2E-03	2.5E-03	3.0E-03
Foreman - Water	--	--	2.1E-04	1.1E-03	1.5E-03	2.9E-03	4.6E-03	1.6E-02
Laborer - Land	--	--	9.7E-03	1.5E-02	1.7E-02	1.5E-02	1.7E-02	2.6E-02
Laborer - Water	--	--	3.3E-03	1.3E-02	2.3E-02	3.3E-02	5.4E-02	1.6E-01
Mechanic	--	--	1.4E-03	2.2E-03	2.3E-03	2.7E-03	3.7E-03	8.2E-03
Operator - Land	--	--	4.8E-03	8.5E-03	1.0E-02	7.7E-03	8.6E-03	1.0E-02
Operator - Water	--	--	2.8E-04	2.5E-03	2.2E-03	5.9E-03	9.7E-03	7.6E-03
Superintendent	--	--	1.3E-03	2.0E-03	2.1E-03	2.0E-03	2.8E-03	5.2E-03
Survey Technician	--	--	3.1E-04	3.9E-04	4.7E-04	4.7E-04	5.8E-04	6.9E-04
Unpaved Road Truck Driver	--	--	1.4E-03	2.5E-03	3.0E-03	2.2E-03	2.5E-03	2.9E-03
WWTS Technician	--	--	1.3E-03	1.9E-03	2.6E-03	3.0E-03	3.8E-03	6.7E-03
Total Estimated Fatalities(1)	**--**	**--**	**0.03**	**0.05**	**0.07**	**0.08**	**0.12**	**0.26**
Probability of At Least One Fatality(2)	**--**	**--**	**0.03**	**0.05**	**0.07**	**0.08**	**0.11**	**0.23**

Notes:
1. Sum of the estimated number of fatal injuries in each labor category.
2. Assuming a Poisson probability distribution.

Table D-11
Estimated Worker Fatalities by Occupation for Floodplain Soil Remedial Alternatives

Corrective Measures Study for The Housatonic River
General Electric Company - Pittsfield, Massachusetts

Labor Category	FP-1	FP-2	FP-3	FP-4	FP-5	FP-6	FP-7
Construction Manager	--	7.1E-05	2.6E-04	3.9E-04	4.0E-04	1.3E-03	2.2E-03
Field Technician	--	2.0E-05	7.6E-05	1.1E-04	1.2E-04	3.7E-04	6.3E-04
Foreman - Land	--	1.1E-04	6.3E-04	8.3E-04	8.4E-04	2.2E-03	3.6E-03
Laborer - Land	--	1.1E-03	4.5E-03	6.3E-03	6.3E-03	1.8E-02	3.1E-02
Mechanic	--	7.1E-05	2.6E-04	4.0E-04	4.0E-04	1.3E-03	2.2E-03
Operator - Land	--	4.6E-04	1.5E-03	2.2E-03	2.2E-03	6.7E-03	1.1E-02
Superintendent	--	7.1E-05	2.6E-04	3.9E-04	4.0E-04	1.3E-03	2.2E-03
Survey Technician	--	2.7E-05	1.0E-04	1.5E-04	1.5E-04	4.9E-04	8.4E-04
Unpaved Road Truck Driver	--	1.3E-04	4.3E-04	6.4E-04	6.4E-04	1.9E-03	3.3E-03
WWTS Technician	--	4.1E-05	1.8E-04	2.8E-04	2.9E-04	9.3E-04	1.3E-03
Total Estimated Fatalities(1)	**--**	**0.002**	**0.008**	**0.01**	**0.01**	**0.03**	**0.06**
Probability of At Least One Fatality(2)	**--**	**0.002**	**0.008**	**0.01**	**0.01**	**0.03**	**0.06**

Notes:
1. Sum of the estimated number of fatal injuries in each labor category.
2. Assuming a Poisson probability distribution.

Table D-12
Estimated Worker Fatalities by Occupation for Treatment/Disposition Alternatives

Corrective Measures Study for The Housatonic River
General Electric Company - Pittsfield, Massachusetts

Labor Category	TD-1	TD-2		TD-3		TD-4		TD-5	
		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Construction Manager	--	9.2E-05	1.0E-04	2.3E-03	6.3E-03	--	--	--	--
Field Technician	--	2.6E-05	3.0E-05	6.6E-04	1.8E-03	--	--	--	--
Foreman - Land	--	9.2E-05	1.0E-04	2.7E-03	7.5E-03	--	--	--	--
Laborer	--	8.1E-03	2.7E-02	2.6E-02	7.1E-02	2.0E-03	1.8E-02	2.0E-03	1.8E-02
Mechanic	--	9.2E-05	1.0E-04	4.1E-03	1.1E-02	--	--	--	--
Operator - Land	--	1.9E-03	5.4E-03	6.5E-03	1.8E-02	--	--	--	--
Unpaved Road Truck Driver	--	--	--	6.8E-03	1.9E-02	1.3E-03	1.1E-02	1.3E-03	1.7E-02
Superintendent	--	9.2E-05	1.0E-04	2.3E-03	6.3E-03	--	--	--	--
Survey Technician	--	3.5E-05	3.9E-05	8.7E-04	1.2E-03	--	--	--	--
Gate Attendant	--	--	--	1.5E-03	4.2E-03	--	--	--	--
Health and Safety Officer	--	1.6E-05	1.8E-05	4.1E-04	1.1E-03	--	--	--	--
Treatment Plant Engineer	--	--	--	--	--	1.4E-04	8.0E-04	1.4E-04	8.0E-04
Treatment Plant Laborer	--	--	--	--	--	8.8E-04	8.0E-03	8.8E-04	8.0E-03
Treatment Plant Manager	--	--	--	--	--	1.4E-04	8.0E-04	1.4E-04	8.0E-04
Treatment Plant Operator	--	--	--	--	--	2.8E-03	3.5E-02	2.8E-03	3.5E-02
Treatment Plant Shift Supervisor	--	--	--	--	--	5.5E-04	5.0E-03	5.5E-04	5.0E-03
Total Estimated Fatalities(1)	**--**	**0.01**	**0.03**	**0.05**	**0.15**	**0.008**	**0.08**	**0.008**	**0.09**
Probability of At Least One Fatality(2)	**--**	**0.01**	**0.03**	**0.05**	**0.14**	**0.008**	**0.08**	**0.008**	**0.08**

Notes:
1. Sum of the estimated number of fatal injuries in each labor category.
2. Assuming a Poisson probability distribution.

Table D-13
Estimated Worker Non-fatal Injuries by Labor Category for Sediment Remedial Alternatives

Corrective Measures Study for The Housatonic River
General Electric Company - Pittsfield, Massachusetts

Labor Category	SED 1	SED 2	SED 3	SED 4	SED 5	SED 6	SED 7	SED 8
Construction Manager	--	--	2.5E-01	3.8E-01	4.1E-01	3.8E-01	5.2E-01	9.5E-01
Field Technician	--	--	3.4E-01	5.6E-01	7.1E-01	7.8E-01	9.5E-01	2.0E+00
Foreman - Land	--	--	2.5E-01	3.8E-01	4.6E-01	3.8E-01	4.4E-01	5.2E-01
Foreman - Water	--	--	1.3E-02	6.7E-02	9.0E-02	1.8E-01	2.8E-01	9.9E-01
Laborer - Land	--	--	8.8E-01	1.4E+00	1.6E+00	1.4E+00	1.5E+00	2.3E+00
Laborer - Water	--	--	5.2E-02	2.0E-01	3.6E-01	5.1E-01	8.5E-01	2.5E+00
Mechanic	--	--	2.1E-01	3.3E-01	3.5E-01	4.1E-01	5.5E-01	1.2E+00
Operator - Land	--	--	6.1E-01	1.1E+00	1.3E+00	9.7E-01	1.1E+00	1.3E+00
Operator - Water	--	--	2.9E-02	2.6E-01	2.3E-01	6.2E-01	1.0E+00	8.0E-01
Superintendent	--	--	2.2E-01	3.5E-01	3.7E-01	3.5E-01	4.9E-01	9.2E-01
Survey Technician	--	--	1.2E-01	1.6E-01	1.9E-01	1.9E-01	2.3E-01	2.7E-01
Unpaved Road Truck Driver	--	--	4.0E-01	7.2E-01	8.7E-01	6.5E-01	7.2E-01	8.6E-01
WWTS Technician	--	--	3.1E-01	4.4E-01	6.0E-01	6.9E-01	8.9E-01	1.5E+00
Total Estimated Non-fatal Injuries(1)	**--**	**--**	**3.68**	**6.30**	**7.51**	**7.48**	**9.57**	**16.23**
Probability of At Least One Non-fatal Injury(2)	**--**	**--**	**0.97**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Notes:
1. Sum of the estimated number of non-fatal injuries in each labor category.
2. Assuming a Poisson probability distribution.

Table D-14
Estimated Worker Non-fatal Injuries by Labor Category for Floodplain Soil Remedial Alternatives

Corrective Measures Study for The Housatonic River
General Electric Company - Pittsfield, Massachusetts

Labor Category	FP-1	FP-2	FP-3	FP-4	FP-5	FP-6	FP-7
Construction Manager	--	1.2E-02	4.6E-02	6.9E-02	7.0E-02	2.2E-01	3.8E-01
Field Technician	--	8.3E-03	3.1E-02	4.7E-02	4.7E-02	1.5E-01	2.6E-01
Foreman - Land	--	1.9E-02	1.1E-01	1.5E-01	1.5E-01	3.8E-01	6.3E-01
Laborer - Land	--	1.0E-01	4.1E-01	5.7E-01	5.8E-01	1.7E+00	2.8E+00
Mechanic	--	1.1E-02	4.0E-02	5.9E-02	6.0E-02	1.9E-01	3.3E-01
Operator - Land	--	5.8E-02	1.9E-01	2.8E-01	2.8E-01	8.5E-01	1.4E+00
Superintendent	--	1.2E-02	4.6E-02	6.9E-02	7.0E-02	2.2E-01	3.8E-01
Survey Technician	--	1.1E-02	4.0E-02	6.0E-02	6.2E-02	1.9E-01	3.4E-01
Unpaved Road Truck Driver	--	3.9E-02	1.3E-01	1.9E-01	1.9E-01	5.6E-01	9.6E-01
WWTS Technician	--	9.5E-03	4.2E-02	6.4E-02	6.8E-02	2.1E-01	3.0E-01
Total Estimated Non-fatal Injuries[(1)]	**--**	**0.28**	**1.08**	**1.55**	**1.57**	**4.65**	**7.86**
Probability of At Least One Non-fatal Injury[(2)]	**--**	**0.25**	**0.66**	**0.79**	**0.79**	**0.99**	**1.00**

Notes:
1. Sum of the estimated number of non-fatal injuries in each labor category.
2. Assuming a Poisson probability distribution.

Table D-15
Estimated Worker Non-fatal Injuries by Occupation for Treatment/Disposition Alternatives

Corrective Measures Study for The Housatonic River
General Electric Company - Pittsfield, Massachusetts

Labor Category	TD-1	TD-2		TD-3		TD-4		TD-5	
		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Construction Manager	--	1.6E-02	1.8E-02	4.0E-01	1.1E+00	--	--	--	--
Field Technician	--	1.1E-02	1.2E-02	2.7E-01	7.4E-01	--	--	--	--
Foreman - Land	--	1.6E-02	1.8E-02	4.8E-01	1.3E+00	--	--	--	--
Laborer	--	7.4E-01	2.5E+00	2.3E+00	6.5E+00	1.8E-01	1.7E+00	1.8E-01	1.7E+00
Mechanic	--	1.4E-02	1.5E-02	6.1E-01	1.7E+00	--	--	--	--
Operator - Land	--	2.4E-01	6.8E-01	8.1E-01	2.3E+00	--	--	--	--
Unpaved Road Truck Driver	--	--	--	2.0E+00	5.5E+00	3.7E-01	3.3E+00	3.7E-01	5.0E+00
Superintendent	--	1.6E-02	1.8E-02	4.0E-01	1.1E+00	--	--	--	--
Survey Technician	--	1.4E-02	1.6E-02	3.5E-01	4.8E-01	--	--	--	--
Gate Attendant	--	--	--	2.1E-01	5.7E-01	--	--	--	--
Health and Safety Officer	--	1.6E-02	1.8E-02	4.0E-01	1.1E+00	--	--	--	--
Treatment Plant Engineer	--	--	--	--	--	8.9E-02	5.3E-01	8.9E-02	5.3E-01
Treatment Plant Laborer	--	--	--	--	--	1.9E-01	1.7E+00	1.9E-01	1.7E+00
Treatment Plant Manager	--	--	--	--	--	8.9E-02	5.3E-01	8.9E-02	5.3E-01
Treatment Plant Operator	--	--	--	--	--	4.7E-01	5.9E+00	4.7E-01	5.9E+00
Treatment Plant Shift Supervisor	--	--	--	--	--	9.3E-02	8.5E-01	9.3E-02	8.5E-01
Total Estimated Non-fatal Injuries(1)		**1.08**	**3.26**	**8.26**	**22.34**	**1.48**	**14.51**	**1.48**	**16.17**
Probability of At Least One Non-fatal Injury(2)		**0.66**	**0.96**	**1.00**	**1.00**	**0.77**	**1.00**	**0.77**	**1.00**

Notes:
1. Sum of the estimated number of non-fatal injuries in each labor category.
2. Assuming a Poisson probability distribution.

Table D-16
Estimated Fatalities and Non-fatal Injuries Related to Truck Transportation of Imported Materials for Sediment and Floodplain Soil Remedial Alternatives

Corrective Measures Study for the Housatonic River
General Electric Company - Pittsfield, Massachusetts

Remedial Alternative	Fatality Estimate (1)	Probability of at Least One Fatality	Injury Estimate (2)	Probability of at Least One Injury
SED-3	0.03	0.03	0.65	0.48
SED-4	0.06	0.05	1.32	0.73
SED-5	0.07	0.07	1.76	0.83
SED-6	0.09	0.08	2.02	0.87
SED-7	0.11	0.10	2.62	0.93
SED-8	0.27	0.24	6.37	1.00
FP-2	0.004	0.004	0.11	0.10
FP-3	0.01	0.01	0.27	0.24
FP-4	0.02	0.02	0.38	0.32
FP-5	0.02	0.02	0.38	0.32
FP-6	0.05	0.04	1.07	0.66
FP-7	0.08	0.08	1.91	0.85

Notes:
1. Assumes a fatality rate of 2.4×10^{-8} fatalities per vehicle mile traveled.
2. Assumes a non-fatal injury rate of 5.7×10^{-7} injuries per vehicle mile traveled.

Table D-17

Estimated Fatalities and Non-fatal Injuries Related to Truck Transportation of Imported and Excavated Materials for Various Combinations of Treatment/Disposition and Sediment and Floodplain Soil Remedial Alternatives

Corrective Measures Study for the Housatonic River
General Electric Company - Pittsfield, Massachusetts

Treatment/Disposition Alternative	Remediation Alternatives	Fatality Estimate (1)		Probability of at Least One Fatality		Injury Estimate (2)		Probability of at Least One Injury	
		Minimum	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
TD-1	SED-3 and FP-2 to SED-8 and FP-7	0.20	2.99	0.18	0.95	4.74	71.08	0.99	1.00
TD-2	SED-6 and SED-8	0.01	0.03	0.01	0.03	0.32	0.65	0.27	0.48
TD-3	SED-3 and FP-2 to SED-8 and FP-7	0.002	0.02	0.002	0.02	0.04	0.38	0.04	0.31
TD-4	SED-3 and FP-2 to SED-8 and FP-7	0.19	2.80	0.17	0.94	4.42	66.40	0.99	1.00
TD-5A	SED-3 and FP-2 to SED-8 and FP-7	0.15	2.09	0.14	0.88	3.64	49.69	0.97	1.00
TD-5B	SED-3 and FP-2 to SED-8 and FP-7	0.17	2.52	0.15	0.92	3.95	59.75	0.98	1.00

Notes:

1. Assumes a fatality rate of $2.4x10^{-8}$ fatalities per vehicle mile traveled.
2. Assumes a non-fatal injury rate of $5.7x10^{-7}$ injuries per vehicle mile traveled.

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Appendix E

Cost Estimate Supporting Information

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Appendix E - Cost Estimate

GENERAL NOTES AND ASSUMPTIONS

- All costs include equipment, material, and labor, unless otherwise noted.
- Costs do not include fees for legal services, permitting, obtaining access, negotiations, or agency oversight.
- Unit costs are in 2008 dollars and are estimated from standard estimating guides (e.g., Means Site Work and Landscape Cost Data, vendors, professional judgment, and experience from other similar projects).
- All items and unit quantities based on GIS interpretation and manipulation performed by ARCADIS from data files provided by QEA and current site information project understanding.
- Additional guidance in preparing these costs was found in the USACE/EPA publication titled "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study."
- The information in this cost estimate is based on available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is being provided for the purpose of comparing potential remedial alternatives. Utilization of this cost estimate information beyond the stated purpose is at the risk of the user.

Sediment Alternative

Cost Estimates

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Appendix E
Table 1 - Cost Summary for SED 1

Item #	Description	Reach 5A	Reach 5B	Reach 5C	Reach 5 Large Backwaters	Reach 5 Small Backwaters	Reach 6 - Woods Pond	Reach 7 Channel	Reach 7 Impoundments	Reach 8 - Rising Pond	Long-Term Monitoring	Total
1.0	**Pre-Design Investigation (5%)**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
2.0	**Mobilization/Site Preparation/Demobilization**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
3.0	**Removal**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
4.0	**Backfill/Capping/Restoration**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
5.0	**Transportation and Disposal (Staging/Access)**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
6.0	**Environmental Monitoring**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
	Subtotal	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
	Project/Construction Management (5%)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
	Engineering and Administration (5%)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
	Contingency (25%)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
	SUBTOTAL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
7.0	**Annual OMM Program**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
	TOTAL OMM	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

- ***There are no costs associated with this alternative.***

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Table 2 - Cost Summary for SED 2

Item #	Description	Reach 5A	Reach 5B	Reach 5C	Reach 5 Large Backwaters	Reach 5 Small Backwaters	Reach 6 - Woods Pond	Reach 7 Channel	Reach 7 Impoundments	Reach 8 - Rising Pond	Long Term Monitoring	Total
1.0	**Pre-Design Investigation (5%)**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
2.0	**Mobilization/Site Preparation/Demobilization**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
3.0	**Removal**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
4.0	**Backfill/Capping/Restoration**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
5.0	**Transportation and Disposal (Staging/Access)**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
6.0	**Environmental Monitoring**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
	Subtotal	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
	Project/Construction Management (5%)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
	Engineering and Administration (5%)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
	Contingency (25%)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
	SUBTOTAL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
7.0	**Annual O & M/Long Term Monitoring Program**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$519,740	**$519,740**
	TOTAL OMM	$0	$0	$0	$0	$0	$0	$0	$0	$0	$10,252,580	**$10,252,580**
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$10,300,000**	**$10,300,000**

- ***The net present value of this alternative is estimated to be $4,470,000***

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Appendix E
Table 3 - Cost Summary for SED 3

Item #	Description	Reach 5A	Reach 5B	Reach 5C	Reach 5 Large Backwaters	Reach 5 Small Backwaters	Reach 6 - Woods Pond	Reach 7 Channel	Reach 7 Impoundments	Reach 8 - Rising Pond	Long Term Monitoring	Total
1.0	**Pre-Design Investigation (5%)**	$3,231,344	$402,412	$173,531	$0	$0	$235,950	$0	$0	$0	$0	**$4,043,237**
2.0	**Mobilization/Site Preparation/Demobilization**	$8,043,969	$2,742,508	$1,232,327	$0	$0	$483,950	$0	$0	$0	$0	**$12,502,754**
3.0	**Removal**	$39,115,342	$759,725	$0	$0	$0	$0	$0	$0	$0	$0	**$39,875,067**
4.0	**Backfill/Capping/Restoration**	$17,945,406	$4,709,665	$2,169,999	$0	$0	$3,997,360	$0	$0	$0	$0	**$28,822,430**
5.0	**Transportation and Disposal (Staging/Access)**	$5,445,179	$3,121,669	$2,107,650	$0	$0	$0	$0	$0	$0	$0	**$10,674,498**
6.0	**Environmental Monitoring**	$2,753,515	$238,762	$241,826	$0	$0	$473,630	$0	$0	$0	$0	**$3,707,734**
	Subtotal	$76,534,756	$11,974,741	$5,925,333	$0	$0	$5,190,889	$0	$0	$0	$0	**$99,625,720**
	Project/Construction Management (5%)	$3,826,738	$598,737	$296,267	$0	$0	$259,544	$0	$0	$0	$0	**$4,981,286**
	Engineering and Administration (5%)	$3,826,738	$598,737	$296,267	$0	$0	$259,544	$0	$0	$0	$0	**$4,981,286**
	Contingency (25%)	$19,133,689	$2,993,685	$1,481,333	$0	$0	$1,297,722	$0	$0	$0	$0	**$24,906,430**
	SUBTOTAL	$103,321,920	$16,165,901	$7,999,200	$0	$0	$7,007,700	$0	$0	$0	$0	**$134,494,721**
7.0	**Annual O & M/Long Term Monitoring Program**	$275,000	$250,000	$40,000	$0	$0	$25,000	$0	$0	$0	$541,840	**$1,131,840**
	TOTAL OMM	$1,375,000	$1,250,000	$200,000	$0	$0	$125,000	$0	$0	$0	$10,407,280	**$13,357,280**
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$105,000,000**	**$17,400,000**	**$8,200,000**	**$0**	**$0**	**$7,130,000**	**$0**	**$0**	**$0**	**$10,400,000**	**$148,000,000**

- ***The net present value of this alternative is estimated to be $106,000,000***

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Table 4 - Cost Summary for SED 4

Item #	Description	Reach 5A	Reach 5B	Reach 5C	Reach 5 Large Backwaters	Reach 5 Small Backwaters	Reach 6 - Woods Pond	Reach 7 Channel	Reach 7 Impoundments	Reach 8 - Rising Pond	Long Term Monitoring	Total
1.0	**Pre-Design Investigation (5%)**	$3,239,867	$1,363,413	$592,205	$249,471	$42,016	$723,807	$0	$0	$0	$0	**$6,210,778**
2.0	**Mobilization/Site Preparation/Demobilization**	$8,052,492	$3,774,909	$2,877,993	$496,471	$137,016	$971,807	$0	$0	$0	$0	**$16,310,686**
3.0	**Removal**	$39,115,342	$15,055,533	$203,000	$189,000	$24,500	$5,794,534	$0	$0	$0	$0	**$60,381,909**
4.0	**Backfill/Capping/Restoration**	$18,115,861	$8,729,274	$8,608,417	$4,001,056	$579,581	$7,552,277	$0	$0	$0	$0	**$47,586,466**
5.0	**Transportation and Disposal (Staging/Access)**	$5,445,179	$3,307,936	$4,161,019	$0	$0	$0	$0	$0	$0	$0	**$12,914,134**
6.0	**Environmental Monitoring**	$2,753,515	$1,071,948	$746,894	$552,356	$141,231	$881,326	$0	$0	$0	$0	**$6,147,270**
	Subtotal	$76,722,256	$33,303,012	$17,189,528	$5,488,353	$924,344	$15,923,750	$0	$0	$0	$0	**$149,551,243**
	Project/Construction Management (5%)	$3,836,113	$1,665,151	$859,476	$274,418	$46,217	$796,188	$0	$0	$0	$0	**$7,477,562**
	Engineering and Administration (5%)	$3,836,113	$1,665,151	$859,476	$274,418	$46,217	$796,188	$0	$0	$0	$0	**$7,477,562**
	Contingency (25%)	$19,180,564	$8,325,753	$4,297,382	$1,372,088	$231,086	$3,980,938	$0	$0	$0	$0	**$37,387,811**
	SUBTOTAL	$103,575,045	$44,959,067	$23,205,863	$7,409,277	$1,247,864	$21,497,063	$0	$0	$0	$0	**$201,894,179**
7.0	**Annual O & M/Long Term Monitoring Program**	$275,000	$275,000	$25,000	$25,000	$25,000	$25,000	$0	$0	$0	$581,000	**$1,230,840**
	TOTAL OMM	$1,375,000	$1,375,000	$125,000	$125,000	$125,000	$125,000	$0	$0	$0	$10,680,280	**$13,930,280**
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$105,000,000**	**$46,300,000**	**$23,300,000**	**$7,530,000**	**$1,370,000**	**$21,600,000**	**$0**	**$0**	**$0**	**$10,700,000**	**$216,000,000**

- ***The net present value of this alternative is estimated to be $136,000,000***

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Appendix E
Table 5 - Cost Summary for SED 5

Item #	Description	Reach 5A	Reach 5B	Reach 5C	Reach 5 Large Backwaters	Reach 5 Small Backwaters	Reach 6 - Woods Pond	Reach 7 Channel	Reach 7 Impoundments	Reach 8 - Rising Pond	Long Term Monitoring	Total
1.0	**Pre-Design Investigation (5%)**	$3,231,344	$1,978,688	$916,227	$256,108	$42,876	$761,052	$0	$0	$205,147	$0	**$7,391,443**
2.0	**Mobilization/Site Preparation/Demobilization**	$8,043,969	$4,632,365	$3,684,204	$503,108	$137,876	$1,009,052	$0	$0	$808,458	$0	**$18,819,033**
3.0	**Removal**	$39,115,342	$25,697,703	$4,359,664	$0	$0	$5,875,034	$0	$0	$143,500	$0	**$75,191,243**
4.0	**Backfill/Capping/Restoration**	$17,945,406	$9,453,551	$9,983,719	$4,322,806	$621,290	$8,141,238	$0	$0	$3,007,157	$0	**$53,475,167**
5.0	**Transportation and Disposal (Staging/Access)**	$5,445,179	$4,391,369	$4,597,780	$0	$0	$0	$0	$0	$685,804	$0	**$15,120,132**
6.0	**Environmental Monitoring**	$2,753,515	$1,768,829	$1,213,177	$552,356	$141,231	$956,771	$0	$0	$348,981	$0	**$7,734,861**
	Subtotal	$76,534,756	$47,922,505	$24,754,772	$5,634,378	$943,273	$16,743,147	$0	$0	$5,199,047	$0	**$177,731,878**
	Project/Construction Management (5%)	$3,826,738	$2,396,125	$1,237,739	$281,719	$47,164	$837,157	$0	$0	$259,952	$0	**$8,886,594**
	Engineering and Administration (5%)	$3,826,738	$2,396,125	$1,237,739	$281,719	$47,164	$837,157	$0	$0	$259,952	$0	**$8,886,594**
	Contingency (25%)	$19,133,689	$11,980,626	$6,188,693	$1,408,595	$235,818	$4,185,787	$0	$0	$1,299,762	$0	**$44,432,970**
	SUBTOTAL	$103,321,920	$64,695,382	$33,418,942	$7,606,411	$1,273,419	$22,603,249	$0	$0	$7,018,713	$0	**$239,938,036**
7.0	**Annual O & M/Long Term Monitoring Program**	$275,000	$275,000	$25,000	$25,000	$25,000	$25,000	$0	$0	$25,000	$602,940	**$1,277,940**
	TOTAL OMM	$1,375,000	$1,375,000	$125,000	$125,000	$125,000	$125,000	$0	$0	$125,000	$10,834,980	**$14,209,980**
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$105,000,000**	**$66,100,000**	**$33,500,000**	**$7,730,000**	**$1,400,000**	**$22,700,000**	**$0**	**$0**	**$7,140,000**	**$10,800,000**	**$254,000,000**

- ***The net present value of this alternative is estimated to be $148,000,000***

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Table 6 - Cost Summary for SED 6

Item #	Description	Reach 5A	Reach 5B	Reach 5C	Reach 5 Large Backwaters	Reach 5 Small Backwaters	Reach 6 - Woods Pond	Reach 7 Channel	Reach 7 Impoundments	Reach 8 - Rising Pond	Long Term Monitoring	Total
1.0	**Pre-Design Investigation (5%)**	$3,239,867	$1,978,688	$2,256,812	$415,715	$117,639	$793,275	$0	$233,033	$233,924	$0	**$9,268,954**
2.0	**Mobilization/Site Preparation/Demobilization**	$8,052,492	$4,632,365	$4,433,200	$662,715	$212,639	$1,041,275	$0	$1,796,266	$851,242	$0	**$21,682,195**
3.0	**Removal**	$39,115,342	$25,697,703	$34,467,663	$3,604,264	$888,813	$6,217,712	$0	$0	$0	$0	**$109,991,497**
4.0	**Backfill/Capping/Restoration**	$18,115,861	$9,453,551	$7,101,172	$3,799,930	$1,150,767	$8,442,014	$0	$2,663,159	$3,712,180	$0	**$54,438,633**
5.0	**Transportation and Disposal (Staging/Access)**	$5,445,179	$4,391,369	$4,053,759	$0	$0	$0	$0	$1,634,247	$686,863	$0	**$16,211,417**
6.0	**Environmental Monitoring**	$2,753,515	$1,768,829	$1,391,016	$663,107	$218,208	$957,779	$0	$434,267	$348,981	$0	**$8,535,701**
	Subtotal	$76,722,256	$47,922,505	$53,703,622	$9,145,732	$2,588,066	$17,452,055	$0	$6,760,972	$5,833,190	$0	**$220,128,398**
	Project/Construction Management (5%)	$3,836,113	$2,396,125	$2,685,000	$457,300	$129,500	$872,603	$0	$338,049	$291,659	$0	**$11,006,349**
	Engineering and Administration (5%	$3,836,113	$2,396,125	$2,685,000	$457,300	$129,500	$872,603	$0	$338,049	$291,659	$0	**$11,006,349**
	Contingency (25%)	$19,180,564	$11,980,626	$13,425,000	$2,286,500	$647,500	$4,363,014	$0	$1,690,243	$1,458,297	$0	**$55,031,744**
	SUBTOTAL	$103,575,045	$64,695,382	$72,498,622	$12,346,832	$3,494,566	$23,560,274	$0	$9,127,312	$7,874,806	$0	**$297,172,840**
7.0	**Annual O & M/Long Term Monitoring Program**	$275,000	$275,000	$25,000	$40,000	$25,000	$25,000	$0	$25,000	$25,000	$626,340	**$1,341,340**
	TOTAL OMM	$1,375,000	$1,375,000	$125,000	$200,000	$125,000	$125,000	$0	$125,000	$125,000	$10,998,780	**$14,573,780**
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$105,000,000**	**$66,100,000**	**$72,600,000**	**$12,500,000**	**$3,620,000**	**$23,700,000**	**$0**	**$9,250,000**	**$8,000,000**	**$11,000,000**	**$312,000,000**

- ***The net present value of this alternative is estimated to be $168,000,000***

Appendix E

Table 7 - Cost Summary for SED 7

Item #	Description	Reach 5A	Reach 5B	Reach 5C	Reach 5 Large Backwaters	Reach 5 Small Backwaters	Reach 6 - Woods Pond	Reach 7 Channel	Reach 7 Impoundments	Reach 8 - Rising Pond	Long Term Monitoring	Total
1.0	**Pre-Design Investigation (5%)**	$3,947,621	$2,272,677	$2,257,460	$525,301	$128,613	$1,064,800	$0	$418,765	$291,697	$0	**$10,906,933**
2.0	**Mobilization/Site Preparation/Demobilization**	$8,913,443	$5,020,276	$4,446,799	$772,301	$223,613	$1,560,800	$0	$2,057,649	$915,265	$0	**$23,910,146**
3.0	**Removal**	$48,036,633	$29,240,766	$34,467,663	$5,116,404	$1,073,318	$8,239,100	$0	$2,462,410	$738,274	$0	**$129,374,569**
4.0	**Backfill/Capping/Restoration**	$22,512,474	$11,320,602	$7,101,172	$4,369,825	$1,171,740	$11,500,774	$0	$3,527,454	$4,056,192	$0	**$65,560,232**
5.0	**Transportation and Disposal (Staging/Access)**	$6,040,594	$4,681,754	$4,131,965	$0	$0	$0	$0	$1,905,872	$701,823	$0	**$17,462,007**
6.0	**Environmental Monitoring**	$3,437,493	$2,144,567	$1,391,016	$772,789	$232,204	$1,060,125	$0	$746,547	$415,898	$0	**$10,200,637**
	Subtotal	$92,888,258	$54,680,640	$53,796,074	$11,556,620	$2,829,488	$23,425,599	$0	$11,118,696	$7,119,148	$0	**$257,414,525**
	Project/Construction Management (5%)	$4,644,413	$2,734,032	$2,689,804	$577,831	$141,474	$1,171,280	$0	$555,935	$355,957	$0	**$12,870,726**
	Engineering and Administration (5%	$4,644,413	$2,734,032	$2,689,804	$577,831	$141,474	$1,171,280	$0	$555,935	$355,957	$0	**$12,870,726**
	Contingency (25%)	$23,222,065	$13,670,160	$13,449,019	$2,889,155	$707,372	$5,856,400	$0	$2,779,674	$1,779,787	$0	**$64,353,631**
	SUBTOTAL	$125,399,149	$73,818,865	$72,624,700	$15,601,437	$3,819,809	$31,624,558	$0	$15,010,240	$9,610,850	$0	**$347,509,608**
7.0	**Annual O & M/Long Term Monitoring Program**	$275,000	$275,000	$40,000	$25,000	$25,000	$25,000	$0	$25,000	$25,000	$602,940	**$1,317,940**
	TOTAL OMM	$1,375,000	$1,375,000	$200,000	$125,000	$125,000	$125,000	$0	$125,000	$125,000	$10,834,980	**$14,409,980**
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$127,000,000**	**$75,200,000**	**$72,800,000**	**$15,700,000**	**$3,940,000**	**$31,700,000**	**$0**	**$15,100,000**	**$9,740,000**	**$10,800,000**	**$362,000,000**

- ***The net present value of this alternative is estimated to be $172,000,000***

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Table 8 - Cost Summary for SED 8

Item #	Description	Reach 5A	Reach 5B	Reach 5C	Reach 5 Large Backwaters	Reach 5 Small Backwaters	Reach 6 - Woods Pond	Reach 7 Channel	Reach 7 Impoundments	Reach 8 - Rising Pond	Long Term Monitoring	Total
1.0	**Pre-Design Investigation**	$4,542,654	$2,584,938	$2,881,753	$1,976,351	$373,159	$3,204,198	$0	$781,607	$2,650,925	$0	**$18,995,586**
2.0	**Mobilization/Site Preparation/Demobilization**	$9,666,564	$5,417,191	$5,294,511	$2,223,351	$468,159	$3,700,198	$0	$3,948,603	$4,128,741	$0	**$34,847,318**
3.0	**Removal**	$56,208,020	$32,889,013	$37,903,816	$17,574,051	$3,788,213	$25,164,689	$0	$5,328,781	$21,841,618	$0	**$200,698,200**
4.0	**Backfill/Capping/Restoration**	$25,363,316	$13,603,452	$14,774,927	$18,719,861	$2,984,944	$34,517,872	$0	$5,797,391	$26,519,755	$0	**$142,281,518**
5.0	**Transportation and Disposal (Staging/Access)**	$6,667,661	$5,083,186	$7,186,791	$0	$0	$0	$0	$4,906,430	$3,490,771	$0	**$27,334,838**
6.0	**Environmental Monitoring**	$4,157,832	$2,374,049	$2,543,557	$2,986,114	$595,032	$3,905,400	$0	$1,338,965	$3,179,313	$0	**$21,080,263**
	Subtotal	$106,606,045	$61,951,830	$70,585,355	$43,479,729	$8,209,508	$70,492,358	$0	$22,101,777	$61,811,123	$0	**$445,237,724**
	Project/Construction Management (5%)	$5,330,302	$3,097,592	$3,529,250	$2,174,000	$410,500	$3,524,618	$0	$1,105,089	$3,090,556	$0	**$22,261,907**
	Engineering and Administration (5%)	$5,330,302	$3,097,592	$3,529,250	$2,174,000	$410,500	$3,524,618	$0	$1,105,089	$3,090,556	$0	**$22,261,907**
	Contingency (25%)	$26,651,511	$15,487,958	$17,646,250	$10,870,000	$2,052,500	$17,623,089	$0	$5,525,444	$15,452,781	$0	**$111,309,533**
	SUBTOTAL	$143,918,161	$83,634,971	$95,290,105	$58,697,729	$11,083,008	$95,164,683	$0	$29,837,399	$83,445,016	$0	**$601,071,070**
7.0	**Annual O & M/Long Term Monitoring Program**	$275,000	$275,000	$40,000	$40,000	$40,000	$80,000	$0	$25,000	$30,000	$519,740	**$1,324,740**
	TOTAL OMM	$1,375,000	$1,375,000	$200,000	$200,000	$200,000	$400,000	$0	$125,000	$150,000	$10,252,580	**$14,277,580**
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$145,000,000**	**$85,000,000**	**$95,500,000**	**$58,900,000**	**$11,300,000**	**$95,600,000**	**$0**	**$30,000,000**	**$83,600,000**	**$10,300,000**	**$615,000,000**

- ***The net present value of this alternative is estimated to be $190,000,000***

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SEDIMENT ALTERNATIVE NOTES AND ASSUMPTIONS

1. Pre-design investigation includes a 5% allowance for costs related to preparing, performing, and reporting pre-design investigation activities.
2. Mobilization/site preparation/demobilization includes costs related to mobilizing and demobilizing of equipment and personnel to and from the site; material, labor, and equipment costs related to the construction and maintenance of staging areas for the duration of construction; and other construction-related controls, such as water trucks, silt fence, oil booms, and silt curtains, are also included.
3. Removal costs include labor and equipment costs to remove sediment from the designated areas, including costs for debris removal; sheeting installation; dewatering; water treatment; and blending removed material with 5% stabilization agent for mechanical removal in the dry and 10% stabilization agent for mechanical removal in the wet and hydraulic removal.
4. Backfill/capping/restoration costs include material, labor, and equipment costs to place fill material in removal areas, palce capping material in capping areas, and perform bank stabilization (one-third of the bank would be stabilized by each of three methods: rip rap, revetment mats, and bioengineering). Backfilling and engineered capping include placing sand over the surface to within 1 foot of the original grade with up to 1 foot of stone over the sand. Thin-layer capping includes placing 6 inches of sand over the surface. Material placement would be conducted with a shore-based excavator in the dry or a barge-mounted excavator in the wet. Also includes costs for restoring areas disturbed areas disturbed for staging areas and access roads (grading, placement of topsoil, seeding, mulching, and tree/shrub planting) and survey (two full-time onsite surveyors plus office support for the duration of construction).
5. Transportation and disposal includes costs to transport and dispose of materials generated during the removal of staging areas and access roads after construction is complete. Transportation and disposal of removed sediment/soil is included separately in the treatment/disposition alternatives.
6. Environmental monitoring costs include equipment and labor for environmental and health and safety monitoring for the duration of the project. Air monitoring consists of three monitors operating continuously throughout the duration of construction. Air monitoring parameters include particulates and PCBs. Laboratory analysis would be performed once per month for each monitor. Water monitoring consists of one monthly grab sample for laboratory analytical testing and four continuous turbidity monitors.
7. A 5% allowance is included to provide for project and construction management costs during construction.
8. A 5% allowance is included to provide for engineering design and engineering administration costs during construction.
9. A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, and unit costs.
10. Annual O & M costs include equipment and labor to inspect and maintain the restored bank and sediment cap areas. Costs are incurred once annually for 5 years starting with the year following the end of construction.
11. Long-term monitoring costs include performing long-term, post-closure monitoring and maintenance activities for 30 years following the completion of construction, including the MNR programs. The MNR program involves collecting sediment (once every 5 years for 30 years), water (quarterly for 30 years), and fish (once every 5 years for 30 years) samples for laboratory analysis.

Floodplain Alternative

Cost Estimates

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Appendix E
Table 9 - Cost Summary for FP 1

Item #	Description	Reach 5A	Reach 5B	Reach 5C	Reach 6	Reach 7	Total
1.0	**Pre-Design Investigation (10%)**	$0	$0	$0	$0	$0	**$0**
2.0	**Mobilization/Site Preparation/Demobilization**	$0	$0	$0	$0	$0	**$0**
3.0	**Removal**	$0	$0	$0	$0	$0	**$0**
4.0	**Backfill/Restoration**	$0	$0	$0	$0	$0	**$0**
5.0	**Transportation and Disposal (Staging/Access)**	$0	$0	$0	$0	$0	**$0**
6.0	**Environmental Monitoring**	$0	$0	$0	$0	$0	**$0**
	Subtotal	$0	$0	$0	$0	$0	**$0**
	Project/Construction Management (5%)	$0	$0	$0	$0	$0	**$0**
	Engineering and Administration (5%)	$0	$0	$0	$0	$0	**$0**
	Contingency (25%)	$0	$0	$0	$0	$0	**$0**
	SUBTOTAL	$0	$0	$0	$0	$0	**$0**
7.0	**Annual O & M**	$0	$0	$0	$0	$0	**$0**
	TOTAL OMM	$0	$0	$0	$0	$0	**$0**
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

- ***There are no costs associated with this alternative.***

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Table 10 - Cost Summary for FP 2

Item #	Description	Reach 5A	Reach 5B	Reach 5C	Reach 6	Reach 7	Total
1.0	**Pre-Design Investigation (10%)**	$298,370	$44,788	$30,256	$9,300	$75,314	**$458,028**
2.0	**Mobilization/Site Preparation/Demobilization**	$619,240	$196,029	$139,972	$8,503	$188,451	**$1,152,196**
3.0	**Removal**	$1,137,711	$90,262	$48,248	$37,513	$234,987	**$1,548,721**
4.0	**Backfill/Restoration**	$1,264,862	$165,481	$114,991	$38,183	$323,055	**$1,906,571**
5.0	**Transportation and Disposal (Staging/Access)**	$1,085,262	$443,890	$395,676	$810	$446,441	**$2,372,080**
6.0	**Environmental Monitoring**	$111,074	$18,502	$14,477	$13,452	$44,302	**$201,806**
	Subtotal	$4,516,519	$958,953	$743,619	$107,761	$1,312,549	**$7,639,401**
	Project/Construction Management (5%)	$225,826	$47,948	$37,181	$5,388	$65,627	**$381,970**
	Engineering and Administration (5%)	$225,826	$47,948	$37,181	$5,388	$65,627	**$381,970**
	Contingency (25%)	$1,129,130	$239,738	$185,905	$26,940	$328,137	**$1,909,850**
	SUBTOTAL	$6,097,300	$1,294,587	$1,003,886	$145,478	$1,771,941	**$10,313,192**
7.0	**Annual O & M**	$25,000	$15,000	$15,000	$15,000	$15,000	**$85,000**
	TOTAL OMM	$75,000	$45,000	$45,000	$45,000	$45,000	**$255,000**
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$6,170,000**	**$1,340,000**	**$1,050,000**	**$190,000**	**$1,820,000**	**$10,600,000**

- ***The net present value of this alternative is estimated to be $10,300,000***

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Appendix E
Table 11 - Cost Summary for FP 3

Item #	Description	Reach 5A	Reach 5B	Reach 5C	Reach 6	Reach 7	Total
1.0	**Pre-Design Investigation (10%)**	$754,290	$309,758	$204,995	$11,093	$76,508	**$1,356,645**
2.0	**Mobilization/Site Preparation/Demobilization**	$1,588,241	$718,193	$509,436	$15,693	$186,232	**$3,017,796**
3.0	**Removal**	$2,391,912	$1,021,781	$629,308	$40,930	$243,476	**$4,327,406**
4.0	**Backfill/Restoration**	$3,581,703	$1,355,276	$913,873	$46,085	$328,422	**$6,225,359**
5.0	**Transportation and Disposal (Staging/Access)**	$1,432,953	$1,123,140	$1,030,280	$29,564	$434,536	**$4,050,472**
6.0	**Environmental Monitoring**	$358,189	$157,213	$99,831	$13,771	$45,202	**$674,207**
	Subtotal	$10,107,289	$4,685,361	$3,387,723	$157,135	$1,314,377	**$19,651,885**
	Project/Construction Management (5%)	$505,364	$234,268	$169,386	$7,857	$65,719	**$982,594**
	Engineering and Administration (5%)	$505,364	$234,268	$169,386	$7,857	$65,719	**$982,594**
	Contingency (25%)	$2,526,822	$1,171,340	$846,931	$39,284	$328,594	**$4,912,971**
	SUBTOTAL	$13,644,840	$6,325,237	$4,573,426	$212,133	$1,774,409	**$26,530,044**
7.0	**Annual O & M**	$75,000	$35,000	$20,000	$15,000	$15,000	**$160,000**
	TOTAL OMM	$225,000	$105,000	$60,000	$45,000	$45,000	**$480,000**
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$13,870,000**	**$6,430,000**	**$4,630,000**	**$257,000**	**$1,820,000**	**$27,000,000**

- ***The net present value of this alternative is estimated to be $26,200,000***

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Appendix E
Table 12 - Cost Summary for FP 4

Item #	Description	Reach 5A	Reach 5B	Reach 5C	Reach 6	Reach 7	Total
1.0	**Pre-Design Investigation (10%)**	$1,262,758	$455,583	$346,550	$23,897	$70,723	**$2,159,511**
2.0	**Mobilization/Site Preparation/Demobilization**	$2,746,271	$971,093	$739,487	$24,995	$125,879	**$4,607,726**
3.0	**Removal**	$3,835,369	$1,500,082	$1,075,579	$77,631	$245,321	**$6,733,984**
4.0	**Backfill/Restoration**	$6,101,250	$2,089,462	$1,661,152	$130,974	$325,988	**$10,308,827**
5.0	**Transportation and Disposal (Staging/Access)**	$1,683,301	$1,197,970	$1,101,563	$33,683	$161,610	**$4,178,128**
6.0	**Environmental Monitoring**	$576,070	$222,985	$162,554	$17,314	$45,408	**$1,024,331**
	Subtotal	$16,205,019	$6,437,176	$5,086,886	$308,495	$974,929	**$29,012,506**
	Project/Construction Management (5%)	$810,251	$321,859	$254,344	$15,425	$48,746	**$1,450,625**
	Engineering and Administration (5%)	$810,251	$321,859	$254,344	$15,425	$48,746	**$1,450,625**
	Contingency (25%)	$4,051,255	$1,609,294	$1,271,722	$77,124	$243,732	**$7,253,126**
	SUBTOTAL	$21,876,776	$8,690,188	$6,867,296	$416,468	$1,316,154	**$39,166,883**
7.0	**Annual O & M**	$125,000	$50,000	$35,000	$15,000	$15,000	**$240,000**
	TOTAL OMM	$375,000	$150,000	$105,000	$45,000	$45,000	**$720,000**
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$22,300,000**	**$8,840,000**	**$6,970,000**	**$461,000**	**$1,360,000**	**$39,900,000**

- ***The net present value of this alternative is estimated to be $36,100,000***

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Appendix E
Table 13 - Cost Summary for FP 5

Item #	Description	Reach 5A	Reach 5B	Reach 5C	Reach 6	Reach 7	Total
1.0	**Pre-Design Investigation (10%)**	$938,464	$377,879	$670,238	$41,397	$0	**$2,027,977**
2.0	**Mobilization/Site Preparation/Demobilization**	$1,663,540	$824,674	$1,256,060	$39,363	$0	**$3,783,636**
3.0	**Removal**	$3,204,936	$1,249,813	$2,206,196	$166,556	$0	**$6,827,501**
4.0	**Backfill/Restoration**	$4,509,575	$1,704,171	$3,244,727	$202,883	$0	**$9,661,354**
5.0	**Transportation and Disposal (Staging/Access)**	$1,538,872	$1,145,214	$1,335,656	$41,617	$0	**$4,061,359**
6.0	**Environmental Monitoring**	$475,825	$189,069	$330,512	$25,863	$0	**$1,021,269**
	Subtotal	$12,331,212	$5,490,818	$9,043,388	$517,678	$0	**$27,383,096**
	Project/Construction Management (5%)	$616,561	$274,541	$452,169	$25,884	$0	**$1,369,155**
	Engineering and Administration (5%)	$616,561	$274,541	$452,169	$25,884	$0	**$1,369,155**
	Contingency (25%)	$3,082,803	$1,372,705	$2,260,847	$129,419	$0	**$6,845,774**
	SUBTOTAL	$16,647,137	$7,412,604	$12,208,574	$698,865	$0	**$36,967,179**
7.0	**Annual O & M**	$105,000	$35,000	$70,000	$15,000	$0	**$225,000**
	TOTAL OMM	$315,000	$105,000	$210,000	$45,000	$0	**$675,000**
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$17,000,000**	**$7,520,000**	**$12,400,000**	**$744,000**	**$0**	**$37,700,000**

- ***The net present value of this alternative is estimated to be $35,100,000***

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Appendix E
Table 14 - Cost Summary for FP 6

Item #	Description	Reach 5A	Reach 5B	Reach 5C	Reach 6	Reach 7	Total
1.0	**Pre-Design Investigation (10%)**	$2,765,890	$1,613,138	$1,418,192	$181,669	$0	**$5,978,890**
2.0	**Mobilization/Site Preparation/Demobilization**	$3,373,581	$2,190,124	$1,985,341	$214,726	$0	**$7,763,771**
3.0	**Removal**	$11,815,672	$6,230,534	$5,328,607	$729,196	$0	**$24,104,008**
4.0	**Backfill/Restoration**	$12,428,532	$7,593,204	$6,778,918	$854,129	$0	**$27,654,784**
5.0	**Transportation and Disposal (Staging/Access)**	$2,535,687	$2,020,957	$1,857,803	$218,111	$0	**$6,632,558**
6.0	**Environmental Monitoring**	$1,424,063	$924,092	$798,149	$109,477	$0	**$3,255,781**
	Subtotal	$34,343,425	$20,572,049	$18,167,010	$2,307,309	$0	**$75,389,793**
	Project/Construction Management (5%)	$1,717,171	$1,028,602	$908,350	$115,365	$0	**$3,769,490**
	Engineering and Administration (5%)	$1,717,171	$1,028,602	$908,350	$115,365	$0	**$3,769,490**
	Contingency (25%)	$8,585,856	$5,143,012	$4,541,752	$576,827	$0	**$18,847,448**
	SUBTOTAL	$46,363,624	$27,772,266	$24,525,463	$3,114,867	$0	**$101,776,220**
7.0	**Annual O & M**	$300,000	$185,000	$160,000	$25,000	$0	**$670,000**
	TOTAL OMM	$900,000	$555,000	$480,000	$75,000	$0	**$2,010,000**
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$47,300,000**	**$28,300,000**	**$25,000,000**	**$3,190,000**	**$0**	**$104,000,000**

- ***The net present value of this alternative is estimated to be $70,400,000***

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Table 15 - Cost Summary for FP 7

Item #	Description	Reach 5A	Reach 5B	Reach 5C	Reach 6	Reach 7	Total
1.0	**Pre-Design Investigation (10%)**	$3,832,004	$1,997,163	$1,878,367	$121,437	$1,879,370	**$9,708,340**
2.0	**Mobilization/Site Preparation/Demobilization**	$4,307,067	$2,435,730	$2,533,747	$111,928	$2,466,830	**$11,855,303**
3.0	**Removal**	$14,665,434	$7,838,880	$7,044,902	$489,457	$7,483,323	**$37,521,997**
4.0	**Backfill/Restoration**	$19,083,134	$9,527,962	$9,092,213	$597,071	$8,667,939	**$46,968,319**
5.0	**Transportation and Disposal (Staging/Access)**	$3,278,140	$2,238,348	$2,122,155	$84,822	$2,260,136	**$9,983,601**
6.0	**Environmental Monitoring**	$2,180,401	$1,167,634	$1,051,991	$76,635	$1,115,288	**$5,591,949**
	Subtotal	$47,346,180	$25,205,717	$23,723,375	$1,481,350	$23,872,885	**$121,629,508**
	Project/Construction Management (5%)	$2,367,309	$1,260,286	$1,186,169	$74,068	$1,193,644	**$6,081,475**
	Engineering and Administration (5%)	$2,367,309	$1,260,286	$1,186,169	$74,068	$1,193,644	**$6,081,475**
	Contingency (25%)	$11,836,545	$6,301,429	$5,930,844	$370,338	$5,968,221	**$30,407,377**
	SUBTOTAL	$63,917,343	$34,027,719	$32,026,556	$1,999,823	$32,228,395	**$164,199,836**
7.0	**Annual O & M**	$480,000	$240,000	$215,000	$15,000	$260,000	**$1,210,000**
	TOTAL OMM	$1,440,000	$720,000	$645,000	$45,000	$780,000	**$3,630,000**
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$65,400,000**	**$34,700,000**	**$32,700,000**	**$2,040,000**	**$33,000,000**	**$168,000,000**

- ***The net present value of this alternative is estimated to be $86,700,000***

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FLOODPLAIN ALTERNATIVE NOTES AND ASSUMPTIONS

1. Pre-design investigation includes a 10% allowance for costs related to preparing, performing, and reporting pre-design investigation activities.
2. Mobilization/site preparation/demobilization includes costs related to mobilizing and demobilizing of equipment and personnel to and from the site; material, labor, and equipment costs related to the construction and maintenance of staging areas for the duration of construction; and other construction-related controls, such as water trucks and silt fence, are also included.
3. Removal costs include labor and equipment costs to remove soil from the designated areas. Assumes wet soils would be gravity dewatered in the staging areas and no additional blending or dewatering costs are necessary. Includes costs for dewatering and water treatment, as appropriate.
4. Backfill/restoration costs include material, labor, and equipment costs to place fill and topsoil in removal areas. Assumes fill would be placed to within 6 inches of the original grade with 6 inches of topsoil over the fill. Also includes costs for restoring disturbed areas (grading, placement of topsoil, seeding, mulching, and tree/shrub planting) and survey (two full-time onsite surveyors plus office support for the duration of construction).
5. Transportation and disposal includes costs to transport and dispose of materials generated during the removal of staging areas and access roads once construction is complete. Transportation and disposal of removed soil is included separately in the treatment/disposition alternatives.
6. Environmental monitoring costs include equipment and labor for environmental and health and safety monitoring for the duration of the project. Air monitoring consists of three monitors operating continuously through the duration of construction. Air monitoring parameters include particulates and PCBs and laboratory analysis would be performed once per month for each monitor.
7. A 5% allowance is included to provide for project and construction management costs during construction.
8. A 5% allowance is included to provide for engineering design and engineering administration costs during construction.
9. A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, and unit costs.
10. Annual O & M costs include equipment and labor to inspect and maintain the restored areas. Costs are incurred once annually for 3 years starting with the year following the end of construction.

Treatment and Disposition Alternative

Cost Estimates

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Appendix E
Table 16 - Cost Summary for TD 1

Item #	Description	Minimum (SED 3 & FP 2)	Maximum (SED 8 & FP 7)
1.0	**Off-Site Transport and Disposal**	$38,490,859	$581,974,752
	Subtotal	$38,490,859	$581,974,752
	Project/Construction Management (5%)	$1,924,543	$29,098,738
	Engineering and Administration (5%)	$1,924,543	$29,098,738
	Contingency (25%)	$9,622,715	$145,493,688
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$50,000,000**	**$790,000,000**

- ***The net present value of these alternatives are estimated to be $39,000,000 and $220,000,000, respectivley.***

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TD 1 NOTES AND ASSUMPTIONS

1. Includes costs to transport and dispose of TSCA materials at a licensed facility in Model City, New York. Includes costs to transport and dispose of non-TSCA materials at a licensed facility in High Acres, New York.
2. A 5% allowance is included to provide for project and construction management costs during construction.
3. A 5% allowance is included to provide for engineering and administration costs during construction.
4. A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, and unit costs.

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Table 17 - Cost Summary for TD 2

Item #	Description	Minimum (SED 6 & FP 2)	Maximum (SED 8 & FP 7)
1.0	**Pre-Design Investigation**	$252,771	$559,555
2.0	**Mobilization/Demobilization**	$252,771	$559,555
3.0	**CDF Construction**	$5,055,421	$11,191,093
	Subtotal	$5,560,964	$12,310,202
	Project/Construction Management (5%)	$278,048	$615,510
	Engineering and Administration (5%)	$278,048	$615,510
	Contingency (25%)	$1,390,241	$3,077,551
	SUBTOTAL	$7,507,301	$16,618,773
4.0	**Annual Operations**	$1,341,005	$1,341,005
	Total Operations	$7,428,480	$27,422,039
5.0	**Annual O & M**	$202,400	$402,400
	Total O & M	$6,072,000	$12,072,000
6.0	**Total Transportation and Disposal**	$71,948,844	$403,694,341
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$93,000,000**	**$460,000,000**

- ***The net present value of these alternatives are estimated to be $47,000,000 and $122,000,000, respectivley.***

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TD 2 NOTES AND ASSUMPTIONS

1. Pre-design investigation includes a 5% allowance for costs related to preparing, performing, and summarizing pre-design investigation activities for the CDF.
2. Mobilization/demobilization includes a 5% allowance for costs related to mobilizing and demobilizing equipment and personnel to and from the site.

3. CDF construction costs include equipment, labor, and material costs to construct CDF and support facilities in selected Reach 5 Backwaters and/or Reach 6 (Woods Pond). Includes costs to construct a final cover for the facility.
4. A 5% allowance is included to provide for project and construction management costs during construction.
5. A 5% allowance is included to provide for engineering and administration costs during construction.
6. A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, and unit costs.
7. Daily operation costs include equipment and labor for daily tasks during the facility's operation. Tasks include material placement and environmental and health and safety monitoring for the duration of the project. Monitored parameters include, but are not limited to, particulates and PCBs.
8. Annual O & M costs include equipment and labor to inspect and maintain the facility following construction. Includes a part-time care taker. Costs are incurred once annually for 30 years starting with the year following the end of construction.
9. Transportation and disposal costs include costs to transport and dispose of removed materials that are not placed in the CDF at an appropriately-licensed off-site facility.

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Table 18 - Cost Summary for TD 3

Item #	Description	Minimum (SED 3 & FP 2)	Maximum (SED 8 & FP 7)
1.0	**Pre-Design Investigation**	$286,962	$2,219,117
2.0	**Mobilization/Demobilization**	$286,962	$2,219,117
3.0	**Upland Disposal Facility Construction**	$5,739,231	$44,382,331
	Subtotal	$6,313,154	$48,820,564
	Project/Construction Management (5%)	$315,658	$2,441,028
	Engineering and Administration (5%)	$315,658	$2,441,028
	Contingency (25%)	$1,578,289	$12,205,141
	SUBTOTAL	$8,522,758	$65,907,761
4.0	**Annual Operations**	$475,471	$742,367
	Total Operations	$2,947,918	$37,668,220
5.0	**Annual O & M**	$330,634	$588,000
	Total O & M	$9,919,015	$17,640,000
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$22,000,000**	**$121,000,000**

- ***The net present value of these alternatives are estimated to be $11,000,000 to $30,000,000, respectively.***

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TD 3 NOTES AND ASSUMPTIONS

1. Pre-design investigation includes a 5% allowance for costs related to preparing, performing, and summarizing pre-design investigation activities for the Upland Disposal Facility.
2. Mobilization/demobilization includes a 5% allowance for costs related to mobilizing and demobilizing of equipment and personnel to and from the site.
3. Upland Disposal Facility construction costs include equipment, labor, and material costs to construct the Upland Disposal Facility at a location near the site. Includes separate support and security facilities from the remedial construction. Includes costs to construct a final cover for the facility.
4. A 5% allowance is included to provide for project and construction management costs during construction.
5. A 5% allowance is included to provide for engineering and administration costs during construction.
6. A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, and unit costs.
7. Daily operation costs include equipment and labor for daily tasks during the facility's operation. Tasks include placing/removing tarps, grading, and environmental and health and safety monitoring for the duration of the project. Monitored parameters include, but are not limited to, particulates and PCBs.
8. Annual O & M costs include equipment and labor to inspect and maintain the facility following construction. Includes activities such as mowing and reseeding. Includes a part-time care taker. Costs are incurred once annually for 30 years starting with the year following the end of construction.

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Appendix E
Table 19 - Cost Summary for TD 4

Item #	Description	Minimum (SED 3 & FP 2)	Maximum (SED 8 & FP 7)
1.0	**Pre-Design Investigation**	$597,625	$697,338
2.0	**Treatment System**	$11,952,500	$13,946,765
	Subtotal	$12,550,125	$14,644,103
	Project/Construction Management (5%)	$627,506	$732,205
	Engineering and Administration (5%)	$627,506	$732,205
	Contingency (25%)	$3,137,531	$3,661,026
	SUBTOTAL	$16,942,669	$19,769,539
4.0	**Annual Operations**	$4,398,021	$7,128,043
	Total Operations	$35,623,971	$367,094,192
5.0	**Annual O & M**	$25,000	$25,000
	Total O & M	$75,000	$75,000
6.0	**Total Transportation and Disposal**	$37,300,853	$571,220,214
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$90,000,000**	**$958,000,000**

- ***The net present value of these alternatives are estimated to be $70,000,000 and $265,000,000, respectively.***

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TD 4 NOTES AND ASSUMPTIONS

1. Treatment facility costs include labor, materials, and equipment costs to construct and operate an onsite treatment facility. Includes costs to handle and treat water generated during the liquid/solid separation process. Includes costs to install and transfer sediment to storage facilities.
2. A 5% allowance is included to provide for project and construction management costs during construction.
3. A 5% allowance is included to provide for engineering and administration costs during construction.
4. A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, and unit costs.
5. Chemical extraction treatment facility operation and maintenance costs include labor, material, and utility costs for operating and maintaining the facility throughout the project. Also assumes that all treated material would be classified as non-TSCA regulated waste and includes costs for transportion to and disposal at a licensed facility in High Acres, New York

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Table 20 - Cost Summary for TD 5A (with Reuse)

Item #	Description	Minimum (SED 3 & FP 2)	Maximum (SED 8 & FP 7)
1.0	**Pre-Design Investigation**	$437,233	$6,041,163
2.0	**Treatment System**	$8,744,668	$120,823,252
	Subtotal	$9,181,901	$126,864,414
	Project/Construction Management (5%)	$382,579	$6,343,221
	Engineering and Administration (5%)	$382,579	$6,343,221
	Contingency (25%)	$1,821,806	$31,716,104
	SUBTOTAL	$11,695,993	$147,783,382
4.0	**Annual Operations**	$2,188,177	$5,222,452
	Total Operations	$17,724,237	$266,345,044
5.0	**Annual O & M**	$25,000	$25,000
	Total O & M	$75,000	$75,000
6.0	**Total Transportation and Disposal**	$34,872,734	$497,526,737
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$64,000,000**	**$912,000,000**

- ***The net present value of these alternatives are estimated to be $50,000,000 and $349,000,000, respectively.***

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Appendix E

TD 5A NOTES AND ASSUMPTIONS

1. Thermal treatment facility fixed costs include labor, materials, and equipment costs to construct an onsite treatment facility.
2. A 5% allowance is included to provide for project and construction management costs during construction.
3. A 5% allowance is included to provide for engineering and administration costs during construction.
4. A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, and unit costs.
5. Thermal treatment facility operation and maintenance costs include labor, material, and utility costs for operating and maintaining the facility throughout the project.
6. Transportation and disposal costs assume that all treated material would be non-TSCA regulated wastes and would be transported to and disposed of at a licensed facility in High Acres, New York. Total disposal cost based on the assumption that there is an approximate 10% loss of mass as a result of the thermal treatement process. Costs also assume that a portion of the treated materials could be used as floodplain backfill and would not require disposal.

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Appendix E
Table 21 - Cost Summary for TD 5B (without Reuse)

Item #	Description	Minimum (SED 3 & FP 2)	Maximum (SED 8 & FP 7)
1.0	**Pre-Design Investigation**	$437,233	$6,041,163
2.0	**Treatment System**	$8,744,668	$120,823,252
	Subtotal	$9,181,901	$126,864,414
	Project/Construction Management (5%)	$459,095	$6,343,221
	Engineering and Administration (5%)	$459,095	$6,343,221
	Contingency (25%)	$2,295,475	$31,716,104
	SUBTOTAL	$11,695,993	$147,783,382
4.0	**Annual Operations**	$2,188,177	$5,222,452
	Total Operations	$17,724,237	$266,345,044
5.0	**Annual O & M**	$25,000	$25,000
	Total O & M	$75,000	$75,000
6.0	**Total Transportation and Disposal**	$36,614,353	$555,137,987
	TOTAL COST OF ALTERNATIVE (ROUNDED)	**$66,000,000**	**$969,000,000**

- ***The net present value of these alternatives are estimated to be $51,000,000 and $364,000,000, respectively.***

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TD 5B NOTES AND ASSUMPTIONS

1. Thermal treatment facility fixed costs include labor, materials, and equipment costs to construct an onsite treatment facility.
2. A 5% allowance is included to provide for project and construction management costs during construction.
3. A 5% allowance is included to provide for engineering and administration costs during construction.
4. A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, and unit costs.
5. Thermal treatment facility operation and maintenance costs include labor, material, and utility costs for operating and maintaining the facility throughout the project.
6. Transportation and disposal costs assume that all treated material would be non-TSCA regulated wastes and would be transported to and disposed of at a licensed facility in High Acres, New York. Total disposal cost based on the assumption that there is an approximate 10% loss of mass as a result of the thermal treatement process.

ARCADIS QEA

Recommended Alternative

Combined Cost Estimates

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Appendix E
Table 22 - Cost Summary for SED 3 / TD 3 Combination

Item #	Description	Amount
1.0	**Pre-Design Investigation (5%)**	$4,043,237
2.0	**Mobilization/Site Preparation/Demobilization**	$12,502,754
3.0	**Removal**	$39,875,066
4.0	**Backfill/Capping/Restoration**	$28,822,430
5.0	**Upland Disposal Facility Construction**	$6,591,392
6.0	**Environmental Monitoring**	$3,707,734
	Subtotal	$95,542,614
	Project/Construction Management (5%)	$4,777,131
	Engineering and Administration (5%)	$4,777,131
	Contingency (25%)	$23,885,654
	SUBTOTAL	$128,982,529
7.0	**Annual O & M**	$1,436,840
8.0	**Upland Disposal Facility Annual Operations**	$488,131
	TOTAL OMM	$25,510,474
	TOTAL COST OF ALTERNATIVE (ROUNDED)	$154,000,000

- ***The net present value of this alternative is estimated to be $105,000,000***

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SED 3 / TD 3 COMBINED ALTERNATIVE NOTES AND ASSUMPTIONS

1. Pre-design investigation includes a 5% allowance for costs related to preparing, performing, and reporting pre-design investigation activities.
2. Mobilization/site preparation/demobilization includes costs related to mobilizing and demobilizing of equipment and personnel to and from the site; material, labor, and equipment costs related to the construction and maintenance of staging areas for the duration of construction; and other construction-related controls, such as water trucks, silt fence, oil booms, and silt curtains, are also included.
3. Removal costs include labor and equipment costs to remove sediment from the designated areas, including costs for debris removal; sheeting installation; dewatering; water treatment; and blending removed material with 5% stabilization agent for mechanical removal in the dry and 10% stabilization agent for mechanical removal in the wet and hydraulic removal.
4. Backfill/capping/restoration costs include material, labor, and equipment costs to place fill material in removal areas, place capping material in capping areas, and perform bank stabilization (one-third of the bank would be stabilized by each of three methods: rip rap, revetment mats, and bioengineering). Backfilling and engineered capping include placing sand over the surface to within 1 foot of the original grade with up to 1 foot of stone over the sand. Thin-layer capping includes placing 6 inches of sand over the surface. Material placement would be conducted with a shore-based excavator in the dry or a barge-mounted excavator in the wet. Also includes costs for restoring areas disturbed areas disturbed for staging areas and access roads (grading, placement of topsoil, seeding, mulching, and tree/shrub planting) and survey (two full-time onsite surveyors plus office support for the duration of construction).
5. Upland Disposal Facility construction costs include equipment, labor, and material costs to construct the Upland Disposal Facility at a location near the site. Includes separate support and security facilities from the remedial construction. Includes costs to construct a final cover for the facility.
6. Environmental monitoring costs include equipment and labor for environmental and health and safety monitoring for the duration of the project. Air monitoring consists of three monitors operating continuously throughout the duration of construction. Air monitoring parameters include particulates and PCBs. Laboratory analysis would be performed once per month for each monitor. Water monitoring consists of one monthly grab sample for laboratory analytical testing and four continuous turbidity monitors.
7. A 5% allowance is included to provide for project and construction management costs during construction.
8. A 5% allowance is included to provide for engineering design and engineering administration costs during construction.
9. A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, and unit costs.

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10. Annual O & M costs include equipment and labor to inspect and maintain the restored bank, sediment cap, and Upland Disposal Facility areas and to perform the monitored natural recovery (MNR) program. Bank and sediment costs are incurred once annually for five years starting with the year following the end of construction. Long-term monitoring costs include performing long-term, post-closure monitoring and maintenance activities for 30 years following the completion of construction. Upland Disposal Facility costs include equipment and labor to inspect and maintain the Upland Disposal Facility following construction. Includes activities such as mowing and reseeding. Includes a part-time care taker. Costs are incurred once annually for 30 years starting with the year following the end of construction. The MNR program involves collecting sediment, water, and fish samples for laboratory analysis. Sediment samples will be collected and analyzed once every five years for 30 years. Water samples will be collected and analyzed quarterly for 30 years. Fish samples will be collected and analyzed once every five years for 30 years.
11. Daily operation costs include equipment and labor for daily tasks during the Upland Disposal Facility's operation. Tasks include placing/removing tarps, grading, and environmental and health and safety monitoring for the duration of the project. Monitored parameters include, but are not limited to, particulates and PCBs.

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Appendix E
Table 23 - Cost Summary for FP 3 / TD 3 Combination

Item #	Description	Total
1.0	**Pre-Design Investigation (10%)**	$990,895
2.0	**Mobilization/Site Preparation/Demobilization**	$2,951,895
3.0	**Removal**	$4,327,406
4.0	**Backfill/Restoration**	$6,225,359
5.0	**Upland Disposal Facility Construction**	$3,240,134
6.0	**Environmental Monitoring**	$674,207
	Subtotal	$18,409,897
	Project/Construction Management (5%)	$888,304
	Engineering and Administration (5%)	$886,784
	Contingency (25%)	$4,602,474
	SUBTOTAL	$24,787,460
7.0	**Annual O & M**	$309,000
8.0	**Upland Disposal Facility Annual Operations**	$269,201
	TOTAL OMM	$5,620,823
	TOTAL COST OF ALTERNATIVE (ROUNDED)	$30,000,000

- ***The net present value of this alternative is estimated to be $26,000,000***

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FP 3 / TD 3 COMBINED ALTERNATIVE NOTES AND ASSUMPTIONS

1. Pre-design investigation includes a 10% allowance for costs related to preparing, performing, and reporting pre-design investigation activities.
2. Mobilization/site preparation/demobilization includes costs related to mobilizing and demobilizing of equipment and personnel to and from the site; material, labor, and equipment costs related to the construction and maintenance of staging areas for the duration of construction; and other construction-related controls, such as water trucks and silt fence, are also included.
3. Removal costs include labor and equipment costs to remove soil from the designated areas. Assumes wet soils would be gravity dewatered in the staging areas and no additional blending or dewatering costs are necessary. Includes costs for dewatering and water treatment, as appropriate.
4. Backfill/restoration costs include material, labor, and equipment costs to place fill and topsoil in removal areas. Assumes fill would be placed to within 6 inches of the original grade with 6 inches of topsoil over the fill. Also includes costs for restoring disturbed areas (grading, placement of topsoil, seeding, mulching, and tree/shrub planting) and survey (two full-time onsite surveyors plus office support for the duration of construction).
5. Upland Disposal Facility construction costs include equipment, labor, and material costs to construct the Upland Disposal Facility at a location near the site. Includes separate support and security facilities from the remedial construction. Includes costs to construct a final cover for the facility.
6. Environmental monitoring costs include equipment and labor for environmental and health and safety monitoring for the duration of the project. Air monitoring consists of three monitors operating continuously through the duration of construction. Air monitoring parameters include particulates and PCBs and laboratory analysis would be performed once per month for each monitor.
7. A 5% allowance is included to provide for project and construction management costs during construction.
8. A 5% allowance is included to provide for engineering design and engineering administration costs during construction.
9. A 25% contingency allowance is included to provide for unforeseen circumstances or variability in estimated areas, volumes, and unit costs.
10. Annual O & M costs include equipment and labor to inspect and maintain the restored floodplain and Upland Disposal Facility areas. Floodplain costs are incurred once annually for three years starting with the year following the end of construction. Long-term monitoring costs include performing long-term, post-closure monitoring and maintenance activities for 30 years following the completion of construction. Upland Disposal Facility costs include equipment and labor to inspect and maintain the Upland Disposal Facility following construction. Includes activities such as mowing and reseeding. Includes a part-time care taker. Costs are incurred once annually for 30 years starting with the year following the end of construction.
11. Daily operation costs include equipment and labor for daily tasks during the Upland Disposal Facility's operation. Tasks include placing/removing tarps, waste grading, and environmental and health and safety monitoring for the duration of the project. Monitored parameters include, but are not limited to, particulates and PCBs.

Appendix F

Connecticut 1D Analysis

Appendix F – CT 1-D Analysis

The polychlorinated biphenyl (PCB) fate, transport, and bioaccumulation model developed by the U.S. Environmental Protection Agency (EPA) does not extend below Rising Pond Dam, and therefore, cannot be used to predict the response of the River to various potential remedial scenarios below that impoundment. For this reason, GE developed a semi-quantitative one-dimensional (1-D) framework (hereafter referred to as the Connecticut [CT] 1-D Analysis) that incorporates the available data from the CT section of the River, as well as predictions from the EPA Downstream Model (i.e., the model developed by EPA for the portion of the river between Woods Pond Dam and Rising Pond Dam), to provide estimates of future changes in PCB concentrations in the water column, surface sediment, and fish in the four major impoundments in the CT portion of the River (i.e. Bulls Bridge Dam impoundment, Lake Lillinonah, Lake Zoar, and Lake Housatonic).

1. Overview of Approach

As described in the Corrective Measures Study (CMS) Proposal (ARCADIS BBL and Quantitative Environmental Analysis, LLC [QEA], 2007), the CT 1-D Analysis focused on the Bulls Bridge Dam impoundment, since this location contains high-resolution (i.e., finely-segmented) sediment cores with radionuclide dating, and is one of the routine fish sampling sites used in GE's biennial fish sampling in the CT portion of the River (Blasland, Bouck & Lee, Inc. [BBL] and QEA, 2003). The CT 1-D Analysis described in this Appendix simulates the response of water column, surface sediment, and fish PCB concentrations in the Bulls Bridge Dam impoundment to changes in PCB loads passing over Rising Pond Dam based on the following approach:

- Water column PCB concentrations passing over Rising Pond Dam, as predicted by the EPA model, were used in conjunction with an "attenuation factor" to estimate the particulate-phase PCB concentrations of sediments depositing in the Bulls Bridge Dam impoundment in the future. In this analysis, the term "attenuation factor" refers to an empirical multiplier that accounts for decreases in PCB concentrations from upstream to downstream in the River that result from dilution (due to inputs of flow and sediment from the watershed) as well as other loss mechanisms such as deposition and volatilization (details are described in Section 2.2.3 below).

- These estimated particulate-phase PCB concentrations were then used in conjunction with a sediment deposition rate for the Bulls Bridge Dam impoundment (as determined from a high-resolution sediment core) as input to a 1-D model of the sediment column that calculates surficial sediment PCB concentrations in that impoundment. This model is similar in structure to the bed component of the Environmental Fluid Dynamics Code (EFDC) model developed by EPA for the River between the Confluence and Rising Pond Dam (see Section 2 below for a description of the setup and calibration of the 1-D bed model) and uses the principle of mass balance to simulate the fate and transport of PCBs in the system.

- The 1-D bed model performs a time-variable mass balance calculation to predict future changes in surface sediment PCB concentrations based on future changes in PCB deposition (i.e., reductions in the PCB load passing Rising Pond Dam that result from the implementation of remediation in Reaches 5 through 8 for the various sediment alternatives).

- The water column and sediment PCB concentrations computed for the Bulls Bridge Dam impoundment in this analysis were then multiplied by an impoundment specific attenuation factor (as described in Section 3 below) to provide estimates of PCB concentrations in the three impoundments downstream of Bulls Bridge Dam: Lake Lillinonah, Lake Zoar, and Lake Housatonic.

For fish, the EPA food chain model (FCM) developed for Reach 8 was then used to simulate the bioaccumulation of contaminants by fish in the CT impoundments based on the computed water column and sediment concentrations (as directed by EPA in its conditional approval of the CMS Proposal). PCB concentrations in smallmouth bass (i.e., the species for which the most robust temporal and spatial data coverage exist in CT) were extrapolated from the existing FCM predator model. Development and calibration of the CT FCM is described in Section 4 below.

2. Bulls Bridge Sediments

2.1 Model Description

As described above, a 1-D sediment bed model (similar in structure to the bed component of the EFDC model developed by EPA for Reaches 5 through 8) was developed to simulate changes in surficial sediment PCB concentrations in the Bulls Bridge Dam impoundment over time. This model represents a single column of sediment, for which solids fluxes and water column PCB concentration time-series are specified as boundary conditions, and uses a mass balance to calculate sediment PCB concentrations and fluxes over time. This model was developed by QEA, and has been used previously at other sites to evaluate sediment mixing depths and diffusive transport rates of contaminants through sediment and sediment capping materials (e.g., Alcoa 2003).

The 1-D bed model developed in this application simulates sediment PCB concentrations over a total depth of 150 cm. The bed was segmented into 150 1-cm layers at the beginning of the simulation. The thickness of the top-most and bottom-most layers in the model vary over time based on the magnitude of sediment deposition. As additional sediments are deposited, the thickness of the top layer increases until reaching a critical value (i.e., 1.1 cm), at which point this surface layer is split into two; at the same time, the bottom two layers are combined into a “deep reservoir.”

Fate processes simulated by the 1-D bed model include sediment mixing (due to biological activity), diffusion of dissolved-phase PCBs within the pore water and to the water column, and three-phase equilibrium partitioning among dissolved-phase, dissolved organic carbon (DOC)-bound, and particulate-phase PCBs. In this model, the water column compartment is not simulated (water column concentrations are provided as inputs); therefore short-term sediment erosion and deposition processes are not calculated, but rather are accounted for as a net solids flux (i.e. the combined effect of erosion and deposition) to the bed over time.

The sediment bed model calibration spanned the 42-year period between 1963 and 2004. The 1963 date represents the assumed date of peak Cesium-137 observed in a finely-segmented sediment core collected from the Bulls Bridge Dam impoundment; only one finely-segmented sediment core has been collected from this impoundment that has a Cesium-137 depth profile sufficient for dating of the deposited sediments (core BBD-CS-02 collected in 1998; BBL and QEA, 2003). The 2004 date represents the end of the EPA model validation period.

As described above, this model requires solids fluxes and water column PCB concentration time-series as inputs. These inputs were derived over the 42-year model calibration period as follows:

1963 – 1980: Due to a lack of data over this time period, water column particulate-phase PCB concentrations were assumed to remain constant, and were estimated based on the average sediment concentration from core sections corresponding to this time period in the dated high resolution sediment core collected from this impoundment (i.e., core BBD-CS-02).

1980 – 1990: Due to a lack of data over this time period, water column particulate-phase PCB concentrations were again considered to be constant, and were based on the average sediment concentration from core sections corresponding to this time period in the same dated high resolution core collected from the Bulls Bridge Dam impoundment, as discussed further below.

1990 – 2004: This time period corresponds to the calibration period used in the EPA Downstream Model; therefore, water column PCB concentrations in the Bulls Bridge Dam impoundment were estimated based on the water column PCB concentration passing Rising Pond Dam (predicted by the EPA model), modified by an attenuation factor that accounts for reductions in PCB concentration between Rising Pond and Bulls Bridge. The development of this attenuation factor (which was refined during calibration of the 1-D model) is described below.

2.2 Inputs

A summary of the non-time-variable inputs/coefficients used in the 1-D bed model is provided in Table F-1. When available, site-specific data from the Bulls Bridge Dam impoundment were used to develop the necessary inputs;[1] Figure F-1 shows the sediment sampling locations within this impoundment. However, there were several inputs for which no impoundment-specific data existed. In these cases, inputs from the calibrated and validated EPA model of Rising Pond were used (as noted in Table F-1).

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[1] Since the extent of this impoundment is not well defined, aerial photography was used to identify the likely depositional region upstream of Bulls Bridge Dam. The extent of this area is shown in Figure F-1 and defines the Bulls Bridge Dam impoundment for this analysis.

Table F-1. Non-Time-Variable Inputs/Coefficients Used in the 1-D Bed Model

Model Input	Parameter	Value	Units	Data Source
Sediment	Bulk Density	0.99	g/cm^3	Site-specific data
	Porosity	0.61	---	Site-specific data
	Organic carbon fraction (f_{oc})	0.99	%	Site-specific data
	Dissolved Organic Carbon	16.5	mg/L	Same as Primary Study Area (PSA) and Downstream Models
	Sediment A_{doc} (DOC-binding effectiveness coefficient)	0.10	---	Same as PSA and Downstream Models
	Sediment-water mass transfer coefficient (K_f)	1.52	cm/d	Same as PSA and Downstream Models
	Diffusion coefficient in porewater	0.86	cm^2/d	Same as PSA and Downstream Models
	Sediment mixing rate (top 7 cm)	1.4E-09	m/s	Same as Downstream Model
	Sediment mixing rate (7 to 14 cm)	1.4E-10	m/s	Same as Downstream Model
	Sediment mixing rate (below 14 cm)	0	m/s	Same as Downstream Model
	Net settling rate	1.3	cm/yr	Site-specific data
Water Column	log K_{oc}	6.5	L/kg	Same as PSA and Downstream Models
	Water column A_{doc}	0.01	---	Same as PSA and Downstream Models
	Dissolved Organic Carbon (DOC)	6.5	mg/L	Same as PSA and Downstream Models
	Organic carbon fraction (f_{oc})	8.2	%	Site-specific data

Notes:
g/cm^3 = gram(s) per cubic centimeter
--- = not applicable
% = percent
mg/L = milligram(s) per liter
cm/d = centimeter(s) per day
cm^2/d = squared centimeter(s) per day
m/s = meter(s) per second
cm/yr = centimeter(s) per year
L/kg = liter(s) per kilogram

2.2.1 Sediment Bed Inputs

Sediment bed parameters that were derived from site-specific data collected within the Bulls Bridge Dam impoundment include bulk density, porosity, and sediment total organic carbon (TOC). These values were assumed to be constant with depth, and were assumed to remain constant over the duration of the model simulation. Bulk density and porosity were estimated from historical sediment data collected from the surficial 6 inches of sediment in the Bulls Bridge Dam impoundment by first calculating a length-weighted average for each individual core, and then averaging over the impoundment. This resulted in an average bulk density equal to 0.99 g/cm^3. Similarly, the average sediment organic carbon fraction (f_{oc}) was calculated using the same method, resulting in an average f_{oc} used in the model of approximately 1%. Average bed porosity (0.61) was calculated based on the average dry bulk density and an assumed solids specific density of 2.65 g/cm^3.

As discussed in the model description, PCB data from the GE high resolution core BBD-CS-02 were used to estimate the average sediment PCB concentrations in sediments deposited between 1963 and 1980. The average concentration from the dated core sections corresponding to this period (i.e., 1.77 milligrams/kilogram [mg/kg] from the 32-45 cm depth interval; see Figure F-2) was used as the sediment PCB initial condition for all layers in the model. This value also was used for the water column particulate-phase PCB inputs over this time period, as described below.

In addition to the bed parameters described above, the 1-D model requires the specification of a sedimentation rate to simulate sediment deposition in the model. The sedimentation rate calculated for high resolution core BBD-CS-02 (1.3 cm/yr, as described in the RCRA Facility Investigation Report [RFI Report; BBL and QEA, 2003]) was used in the 1-D bed model.

2.2.2 Water Column Inputs

The 1-D bed model requires specification of a time series of total suspended solids (TSS) and water column PCB concentrations, which are used to calculate the PCB concentration of depositing sediments. Water column PCB and solids inputs were specified differently over the 42-year calibration period for each of the three time periods described above (i.e., 1963-1980, 1980-1990, and 1990-2004). Figures F-3 and F-4 present the water column TSS and PCB boundary conditions for the 42-year calibration period, respectively. The TSS and PCB concentrations shown in these figures have been scaled by attenuation factors that account for changes in TSS and PCB concentrations between Rising Pond and Bulls Bridge Dam, as discussed below.

During the periods from 1963-1980 and 1980-1990, few water column PCB data were collected from the Bulls Bridge Dam impoundment (only four samples, all of which were non-detect at a detection limit of 22 nanograms per liter [ng/L]); further, only a limited amount of TSS and sediment PCB data exist from this time period. Consequently, water column particulate-phase PCB concentrations were derived from average sediment concentrations in core sections corresponding to each respective time period in the dated high resolution core described above (1998 GE core BBD-CS-02). This approach assumes that particulate-phase PCBs in the water column prior to 1990 were consistent with sediments deposited over the same period as determined by core dating. Three-phase partitioning was used to back-calculate average whole-water PCB concentrations using the particulate-phase concentrations for both periods. The average whole-water PCB concentrations calculated in this manner were 42 ng/L for the period from 1963-1980 and 8.3 ng/L for the period from 1980–1990 (Figure F-4).

In addition, only four samples collected during this (pre-1990) time period from Bulls Bridge were analyzed for TSS and water column particulate organic carbon (POC). Based on these data, an average value of 8.2% was specified for the water column organic carbon fraction (f_{oc}; equal to POC divided by TSS) during this time period. While these four samples were the only available information to estimate water column f_{oc}, it was judged that the use of these four samples was insufficient for estimating an average TSS concentration for this pre-1990 period. Therefore, TSS data collected by the U.S. Geological Survey (USGS) at Gaylordsville (located approximately 2.5 miles downstream of Bulls Bridge Dam) during 1979 were used to estimate an average TSS concentration of 20 mg/L, which was used in the model to represent pre-1990 conditions.[2] This assumes that TSS concentrations at Gaylordsville are representative of those observed at Bulls Bridge; this assumption was deemed sufficient for this analysis given the proximity of these two locations.

During the period from 1990-2004 (corresponding to the calibration period used in the EPA Downstream Model), water column PCB and TSS concentrations in the Bulls Bridge Dam impoundment were estimated based on the water column concentrations passing Rising Pond Dam as predicted by the EPA model, multiplied by an attenuation factor as described below.

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[2] The 1979 USGS study is the only comprehensive TSS study that has been conducted at the Gaylordsville gaging station. During this study, 218 TSS samples were collected, a majority of which were collected over a 6-month period (from April to September 1979).

2.2.3 Model Calibration Attenuation Factors

Attenuation factors were developed to account for gains/losses of TSS and PCBs between Rising Pond and the Bulls Bridge Dam impoundment to facilitate 1-D sediment model calibration. Two attenuation factors were needed:

- A TSS attenuation factor to reflect the observed increase in sediment yield (load per unit watershed area) between Rising Pond and Bulls Bridge Dam.

- A water column PCB attenuation factor to account for reductions in PCB concentration between Rising Pond and Bulls Bridge Dam (due to increased flows resulting in dilution, and loss of PCBs due to volatilization and sorption, and the subsequent settling of particulate-bound PCBs).

Development of the TSS attenuation factor was achieved by comparing flows at these two locations (using the USGS flow records from Great Barrington (USGS Gage #01197500) and Gaylordsville (USGS Gage #01200500), which were assumed to be representative of flow conditions at Rising Pond Dam and Bulls Bridge Dam, respectively), in conjunction with a comparison of the available TSS data from just downstream of Bulls Bridge Dam (USGS TSS data collected in 1979 at Gaylordsville) with the EPA model-predicted TSS concentrations exiting Rising Pond. As described above, this method implicitly assumes that TSS concentrations at Gaylordsville are similar to those at Bulls Bridge Dam, which was deemed sufficient for this analysis given the proximity of these two locations. The method used to determine the TSS attenuation factor was as follows:

- USGS daily average flow data were used to compute average yearly flows at the two locations described above (Gaylordsville and Great Barrington; top panel of Figure F-5). The ratio of annual average flow at these two stations averaged over the period of 1979-2006 yielded a flow increase factor of 3.2 (bottom panel of Figure F-5).

- A separate comparison of daily average flow values from 1979 and other years between 1990 and 2004 (i.e., the EPA model calibration period) was conducted to find a year containing flows that were similar in magnitude to those observed in 1979. A comparison of the distribution of daily average flows in 1979 at Gaylordsville to those predicted by the EPA model in 2003 is shown in Figure F-6 (note that flows shown for 2003 represent model-predicted flows at Rising Pond Dam that have been scaled up based on the factor of 3.2 estimated from Figure F-5). This comparison was used to establish that flow conditions in 1979 and 2003 were generally similar (i.e., flow conditions during the 1979 TSS sampling were similar to those in 2003, indicating that any observed differences in solids between the USGS data collected in 1979 and the model-predicted TSS in 2003 are likely the result of an increased solids yield between Rising Pond and Gaylordsville, and not a difference in flow conditions).

- TSS at both locations (binned according to flow in 500 cubic feet per second [cfs] increments) are plotted versus flow in Figure F-7. The left panel shows that at a given flow rate, the TSS concentrations predicted by the EPA model at Rising Pond Dam are lower than those measured at Gaylordsville, especially for flows exceeding 5,000 cfs. This indicates that the solids yield from the watershed between Great Barrington and Gaylordsville must increase. This is consistent with the observations by the USGS in its 1994-1996 loading study (USGS 2000), which concluded that an approximately three-fold increase in solids yield occurred between Great Barrington (20.6 tons/yr/mi^2) and Ashley Falls (58.4 tons/yr/mi^2), a USGS gaging station near the Massachusetts (MA)/CT border. Application of a multiplication factor of four to the Rising Pond TSS values (to account for the increase solids yield) is needed to obtain agreement between the two TSS data sets, particularly at higher flows (Figure F-7, right panel). Given that Bulls Bridge Dam is further downstream than Ashley Falls, this 4X increase is not inconsistent with the USGS study.

Based on this analysis, the TSS attenuation factor used to calibrate the Bulls Bridge Dam 1-D model was set to four – i.e., TSS concentrations in the Bulls Bridge Dam impoundment for years including and after 1990 were calculated by multiplying the model-predicted concentrations at Rising Pond Dam by a factor of four.

Similarly, water column PCBs exiting Rising Pond were multiplied by an attenuation factor to account for the reduction in PCB concentrations between Rising Pond and Bulls Bridge that result from the PCB loss mechanisms described above. While PCBs in the Bulls Bridge Dam impoundment were expected to be lower for these reasons, no data are available to estimate the PCB attenuation factor; therefore, this factor was used as the primary calibration parameter in the 1-D model.

2.3 Calibration

The results from the 1-D sediment model calibration are shown on Figure F-8, in which a time-series of surface sediment PCB concentrations in the Bulls Bridge Dam impoundment is shown. This figure demonstrates that there is a reasonably good agreement between the surface sediment PCB data in the Bulls Bridge Dam impoundment and the model output using a calibrated value of 0.1 for the PCB attenuation factor (described above).[3]

Accordingly, the 1-D model for the Bulls Bridge Dam impoundment based on this calibration was used to project future PCB concentrations in this location under the various sediment alternatives studied in the CMS – i.e., future PCB concentrations predicted by the EPA model at Rising Pond Dam were multiplied by 0.1 to estimate water column PCB concentrations in the Bulls Bridge Dam impoundment.

3. Development of Attenuation Factors for Downstream CT Impoundments

Surface sediment PCB concentrations in the impoundments downstream of Bulls Bridge Dam are relatively low and appear to be largely affected by dilution of PCBs that originate from upstream. Therefore, PCB concentrations in the three impoundments downstream of Bulls Bridge Dam (i.e., Lake Lillinonah, Lake Zoar, and Lake Housatonic; see Figure F-9) were estimated from PCB concentrations calculated at Bulls Bridge Dam (Section 2.2.3), reduced by impoundment-specific dilution factors that reflect the flow increase at each impoundment relative to the Bulls Bridge Dam impoundment. Subsequently, the resulting water column and sediment PCB concentrations calculated for each impoundment were then used in the EPA Food Chain Model to evaluate fish PCB concentrations in these downstream CT impoundments (as described in Section 4 below).

The attenuation factors for Lake Lillinonah and Lake Zoar were estimated from the flows measured by the USGS gaging stations between Bulls Bridge and the Stevenson Dam (at the downstream end of Lake Housatonic) (Table F-2). Daily average flow data collected between 2003 and 2007 were used in this flow analysis, as these were the only years containing a complete data set at each gaging station. Daily average flow within each impoundment was determined as follows:

- Bulls Bridge Dam flow was calculated by subtracting the Tenmile River flow (USGS Gage #01200000) from the Housatonic River flow at Gaylordsville (Figure F-9).

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[3] Note that the calibrated PCB attenuation factor (0.1) produces a greater reduction in surface sediment PCB concentrations than it would if only dilution due to increases in flow were considered (0.37). This difference likely results from a combination of increasing solids yield and PCB loss via deposition and/or volatilization.

- Lake Lillinonah flow was calculated by summing flow in the Housatonic River at Gaylordsville with flow from the Still River (USGS Gage #01201487) and Shepaug River (USGS Gage #01202501) (Figure F-9).

- Lake Zoar flow was set equal to the flow measured in the Housatonic River at the Stevenson Dam (USGS Gage #01205500) (Figure F-9).

The average flow representative of each impoundment was calculated by averaging the daily average flows described above over the period from 2003 to 2007. These average flows were subsequently divided by the average flow at Bulls Bridge to calculate the impoundment-specific attenuation factors. Table F-2 below summarizes the average flows and the corresponding attenuation factors within each impoundment.

The Lake Housatonic attenuation factor could not be estimated from the flow data because there were no USGS gaging stations within or just downstream of that impoundment. Therefore, the Lake Housatonic attenuation factor was estimated based on changes in drainage area in that region. Geographic Information System (GIS) analysis determined that the ratio of drainage areas for Lake Housatonic and Lake Zoar is approximately 1.075; this value was therefore multiplied by the Lake Zoar attenuation factor to estimate the attenuation factor for Lake Housatonic.

Table F-2. Summary of Gaging Stations, Average Flows and Attenuation Coefficients for CT Impoundments

Impoundment	**Bulls Bridge**	**Lake Lillinonah**	**Lake Zoar**	**Lake Housatonic**
Gaging Station(s)	Housatonic River at Gaylordsville, Tenmile River	Housatonic River at Gaylordsville, Still River, Shepaug River	Housatonic River at Stevenson	---
Average Flow (cfs)	1666	2295	3261	3506[1]
Attenuation Factor[2]	1	1.4	2.0	2.1

Notes:

[1] Flow estimated from drainage area increase.

[2] Attenuation factors are relative to Bulls Bridge (i.e., concentrations are estimated by multiplying the results for the Bulls Bridge Dam impoundment by the attenuation factors listed above).

4. Food Chain Model (FCM) Development and Calibration

As directed by EPA in its April 13, 2007 conditional approval letter for the CMS Proposal, GE used EPA's FCM from Reach 8 (Rising Pond) to simulate the bioaccumulation of PCBs in fish within the CT impoundments. Fish species used in EPA's model include largemouth bass, brown bullhead, white sucker, sunfish, and cyprinids. Largemouth bass are the modeled predatory species in the FCM; however, for the CT portion of the river, smallmouth bass data are most prevalent. Therefore, model predictions of largemouth bass were used as a surrogate for smallmouth bass for calibration of the model.

4.1 Inputs

FCM parameters, including food energy parameters, growth rates, respiration rates, assimilation efficiencies, elimination rates, and feeding preferences for modeled species, were unchanged in this application of the model, and are described in detail in EPA's Final Model Documentation Report (EPA, 2006).

Exposures to the modeled biota include PCBs from the water column and surface sediment, both on a dissolved-phase and particulate organic-carbon normalized basis. These concentrations were developed in the 1-D Analysis as described in Section 2. Attenuation factors derived from flow differences, as described in Section 3, were applied to the Bulls Bridge Dam impoundment water column and sediment PCB concentrations to simulate exposure concentrations to the biota in the downstream CT impoundments (Lake Lillinonah, Lake Zoar, and Lake Housatonic).

FCM simulations were performed for the time period between 1990 and 2004 (the same as the calibration period for the EPA Downstream Model) to predict PCB concentrations in biota in the four CT impoundments. The resulting PCB concentrations were compared to fish data collected by GE from the same timeframe at each impoundment. These data were measured on a fillet basis, and therefore needed to be converted to whole-body concentrations (which the model computes). For purposes of this comparison, the measured fillet PCB concentrations were multiplied by a factor of 2.3 to convert the data to a whole-body basis, consistent with the method used by EPA in the Ecological Risk Assessment (ERA; EPA, 2004a) and in the FCM calibration (EPA 2004b; EPA 2006).[4]

4.2 Results

The calibration results were graphically compared to site-specific fish PCB data (converted to a whole-body equivalent) to evaluate the reasonableness of the calculation. The model simulation results were compared to measured PCB data for smallmouth bass, bullhead, and sunfish at Bulls Bridge, Lake Lillinonah, Lake Zoar, and Lake Housatonic (where available) on both a wet-weight basis (Figures F-10 through F-12) and a lipid-normalized basis (Figures F-13 through F-15). Cyprinid data from CT were not available.

The calculated wet-weight PCB concentrations in smallmouth bass are somewhat lower than the measured concentrations (converted to whole-body concentrations) in 1990-1996 and 2004 at Bulls Bridge, but are within the range of the data for other years at that location and for all years at Lake Lillinonah and Lake Zoar (Figure F-10). Generally, the predicted lipid-normalized PCB concentrations in smallmouth bass are somewhat lower than observed concentrations (converted to whole-body concentrations) at Bulls Bridge and Lake Zoar, but are within the range of the data at those locations and at Lake Lillinonah (Figure F-13). These comparisons indicate that the FCM-calculated concentrations provide a fairly reasonable representation of measured smallmouth bass PCB concentrations (converted to whole-body concentrations) at these three locations. There are no contemporary smallmouth bass PCB data within Lake Housatonic to assess the FCM performance in that impoundment.

While very few bullhead data were collected in the CT portion of the River since 1990, the modeled concentrations appear to provide a reasonable representation of PCB concentrations on a wet-weight and lipid-normalized basis at Bulls Bridge and Lakes Lillinonah and Zoar (Figures F-11 and F-14, respectively). There are insufficient data to make this comparison for Lake Housatonic.

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[4] It is noted that the factor of 2.3 used by EPA during model calibration (as well as in this analysis) to convert fillet-based data to whole-body results is different from the factor of 5 that EPA directed GE to use in the CMS to convert model predictions of whole-body concentrations to fillet-based estimates. In its letters of April 13 and May 22, 2007, directing GE to use that factor of 5, EPA did not discuss the inconsistency between that factor and the factor that EPA used during model calibration.

For sunfish, there are also limited measured data since 1990. However, based on the data that exist, FCM predictions are within the range of the measured PCB concentrations (converted to whole-body concentrations) on both a wet-weight and a lipid-normalized basis at Bulls Bridge and Lakes Lillinonah and Zoar (Figures F-12 and F-15, respectively). The model slightly over-predicts the measured PCB concentrations (converted to whole-body concentrations) on a wet-weight basis at Bulls Bridge and Lake Lillinonah in 2004, but not on a lipid-normalized basis. Again, there are insufficient data to make this comparison for Lake Housatonic.

White sucker data were only available from the CT reaches in 1979 and, therefore, could not be compared to the modeled PCB concentrations for the calibration period of 1990 through 2004.

Overall, the application of FCM to the CT impoundments based on the exposure concentrations estimated using the CT 1-D analysis appears to provide a sufficient fit to the data such that the model can be used to develop future predictions in the CT portion of the river.

5. Summary

Although much less sophisticated than EPA's model for the Confluence to Rising Pond Dam, the CT 1-D analysis described above provides a means of estimating future changes in PCB concentrations within the four major CT impoundments of the River in response to remedial actions performed upstream. The method predicts water column, surface sediment, and fish PCB concentrations within Bulls Bridge Dam impoundment, Lake Lillinonah, Lake Zoar, and Lake Housatonic based on the PCB loading passing over the Rising Pond Dam as predicted by the EPA model. The method is based on the first principle of conservation of mass, maximizes the use of available sediment and fish data collected from these impoundments, and leverages the fish bioaccumulation modeling work performed by EPA in the Massachusetts reaches of the River to predict responses in CT.

It should be recognized, however, that the results from the CT 1-D Analysis are very uncertain due to the empirical, semi-quantitative nature of the analysis, as well as the significant data limitations. For example, the sediment bed model was calibrated against a single sediment core collected from the Bulls Bridge Dam impoundment, which yielded a single deposition rate and average PCB concentration in sediments deposited between 1963 and 1980 (see Section 2.2.1). While this core exhibited an interpretable Cesium-137 profile that supported the model application, it likely does not represent the full range of sediment deposition conditions in the impoundment. Likewise, extrapolation of the EPA model predictions of water column TSS and PCB concentrations at Rising Pond Dam to the Bulls Bridge Dam impoundment was accomplished using simple attenuation factors that were parameterized based on data from 1979 or by calibration (see Sections 2.2.3 and 2.3). A similar approach based on flow dilution was used to extrapolate the results from the Bulls Bridge Dam impoundment to downstream impoundments. This simplified approach does not account for the myriad of processes affecting PCB fate and transport and consequently adds to the uncertainty in the calculation. For these reasons, while the CT 1-D Analysis provides a means of generally assessing the impact of the different sediment alternatives on the CT impoundments, the resulting estimates cannot be regarded as reliable predictions of specific PCB concentrations and thus cannot be used as a reliable way of making fine distinctions among the alternatives, particularly when the concentrations are low and generally similar.

6. References

Alcoa. 2003. Update to the Cap Modeling Studies Presented in the June 2002 Analysis of Alternatives Report, Alcoa, May 2003.

ARCADIS BBL and QEA. 2007. Housatonic Rest of River Corrective Measures Study Proposal (CMS Proposal), February 2007.

BBL and QEA. 2003. Housatonic River, Rest of River, RCRA Facility Investigation Report (RFI Report). Prepared on behalf of the General Electric Company, Pittsfield, MA. September 2003.

EPA. 2004a. Ecological Risk Assessment for General Electric (GE)/Housatonic River Site, Rest of River (ERA). Prepared by Weston Solutions, Inc., West Chester, PA, for the U.S. Army Corps of Engineers, New England District, and the U.S. Environmental Protection Agency, New England Region. November 2004.

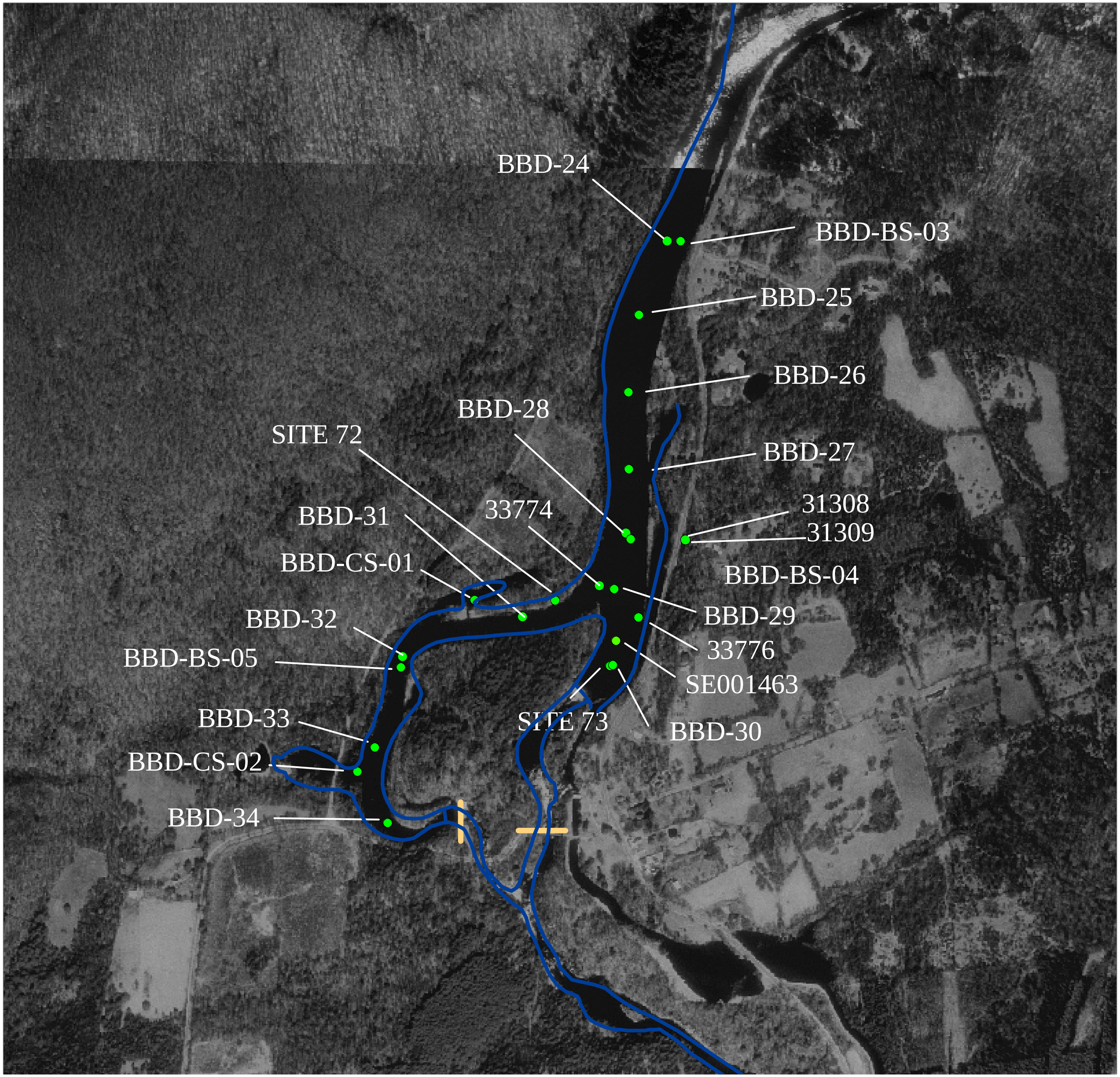
EPA. 2004b. Model Calibration: Modeling Study of PCB Contamination in the Housatonic River. Prepared by Weston Solutions, Inc., West Chester, PA, for the U.S. Army Corps of Engineers, New England District, and the U.S. Environmental Protection Agency, New England Region, December 2004.

EPA. 2006. Model Validation: Modeling Study of PCB Contamination in the Housatonic River. Prepared by Weston et al. for the U.S. Environmental Protection Agency, Region I, and the U.S. Army Corps of Engineers. March 2006.

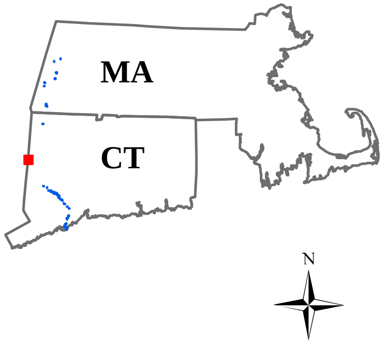
USGS. 2000. Suspended Sediment Characteristics in the Housatonic River Basin, Western Massachusetts and Parts of Eastern New York and Northwestern CT, 1994-96. Water-Resources Investigations Report 00-4059, Northborough, Massachusetts, 2000.

Appendix F

CT 1-D Analysis



Locator



Scale

0 0.1 0.2 Miles

Legend

● Sampling Locations

Shoreline

Notes:
Data collected by: BBL (1998), LMS (1992, 1986), USGS, CAES (1980) and USEPA (2001).
Sampling locations (labeled with sample IDs) are areas where samples were collected from top 6 in of sediments.

Figure F-1.
Sediment sampling locations within the BBD impoundment.

QEA
Quantitative Environmental Analysis, LLC

GENcms

March 08

IF - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_F\maps\FIG1_BBD_sampling_locations.mxd

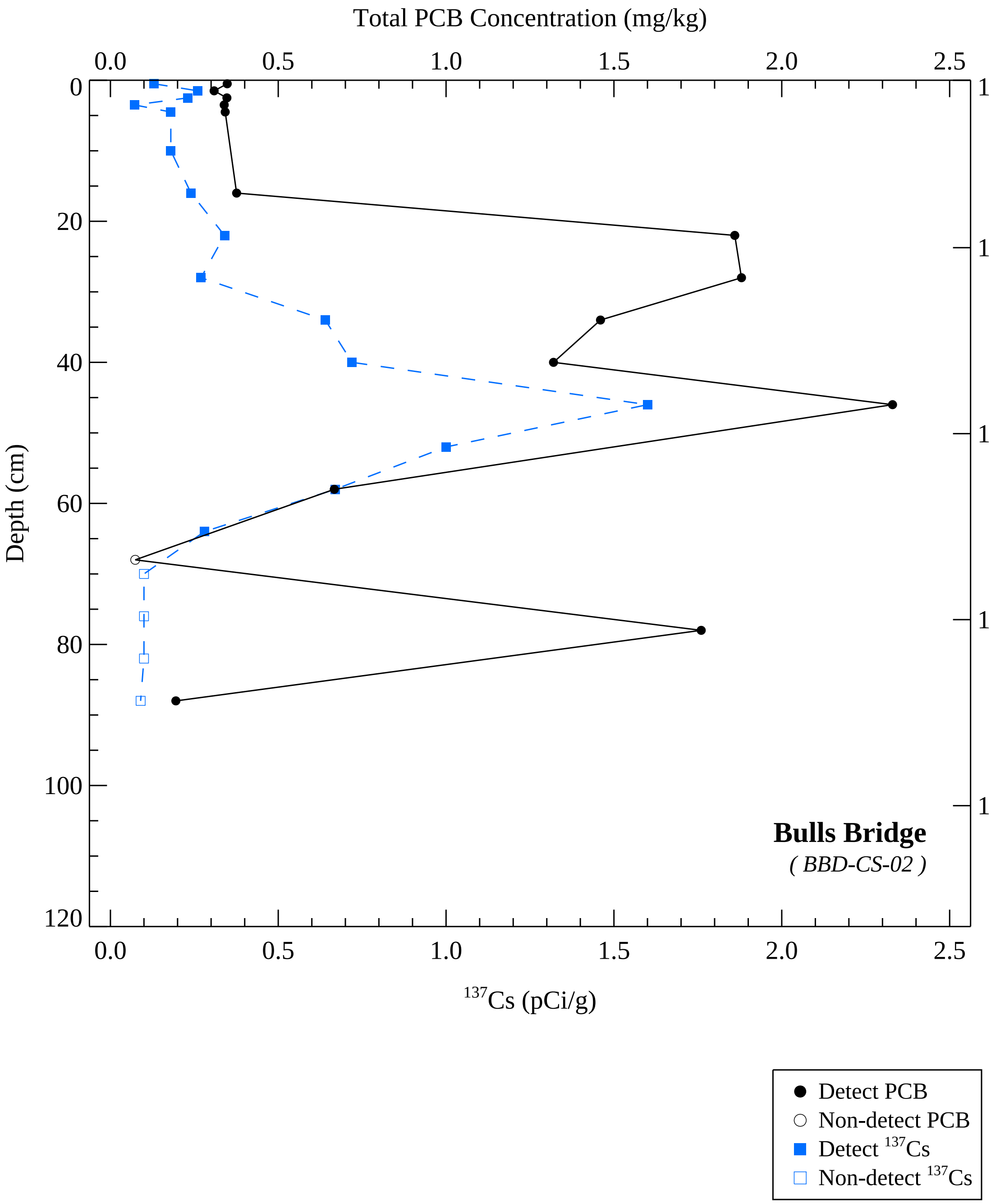


Figure F-2. PCB and ^{137}Cesium data from GE high resolution core (BBD-CS-02) collected at Bulls Bridge.

Notes: Sample (BBLID 7771) collected from 9-11 cm depth interval with total PCB=0 mg/kg was excluded from analysis. Non-detect data plotted at 1/2 MDL.

IF - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_F\FigureF_2_HighRes_coreBBD_CS_02.pro
Fri Mar 14 11:05:07 2008

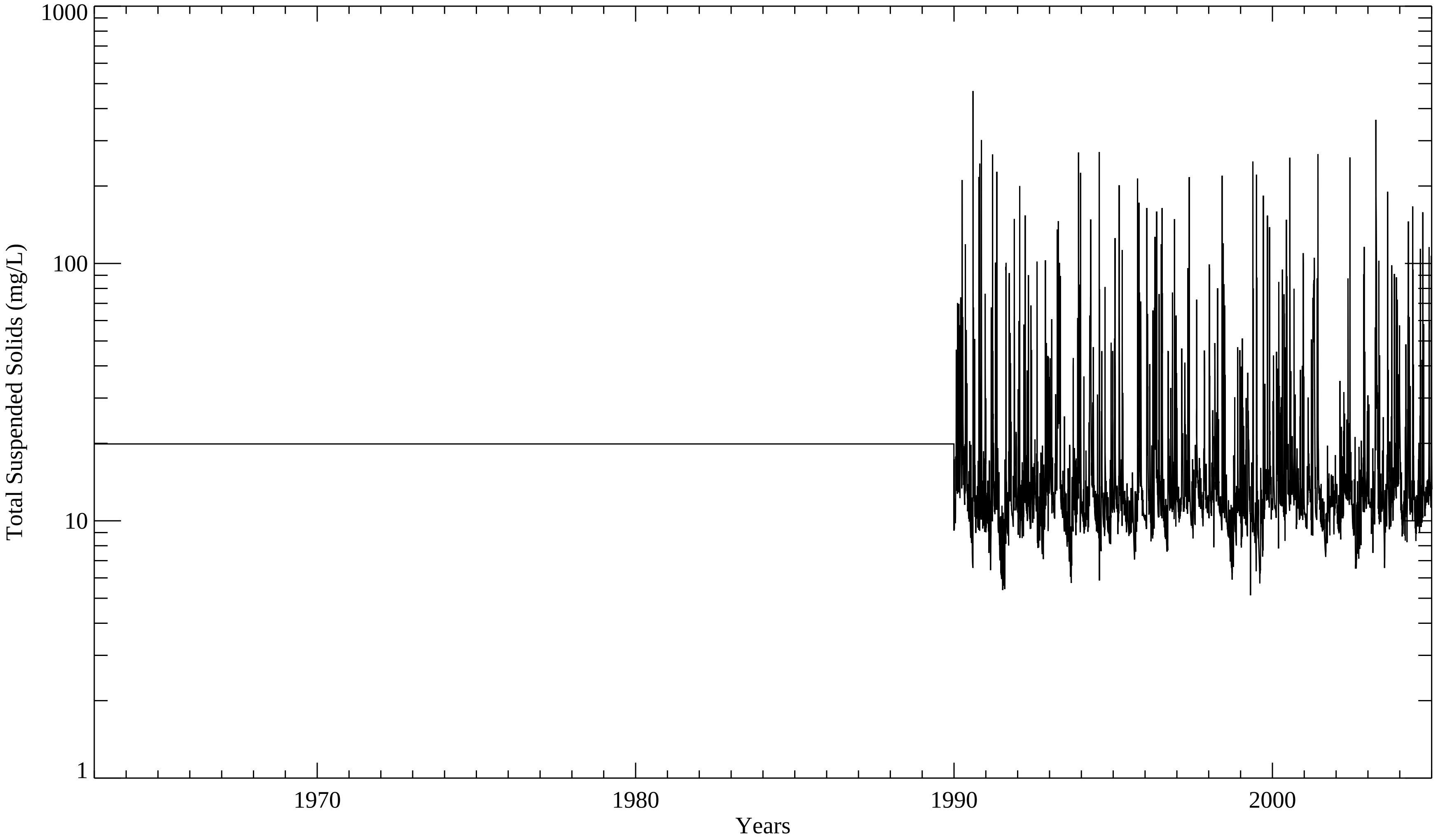


Figure F-3. Temporal profile of calculated water column TSS concentrations at Bulls Bridge from 1963 to 2004.

1963-1990 TSS concentration is an average of USGS data collected in 1979 at Gaylordsville.
1990-2004 TSS concentrations were calculated from downstream model output for Rising Pond and mutliplied by four to account for increased solids yield.

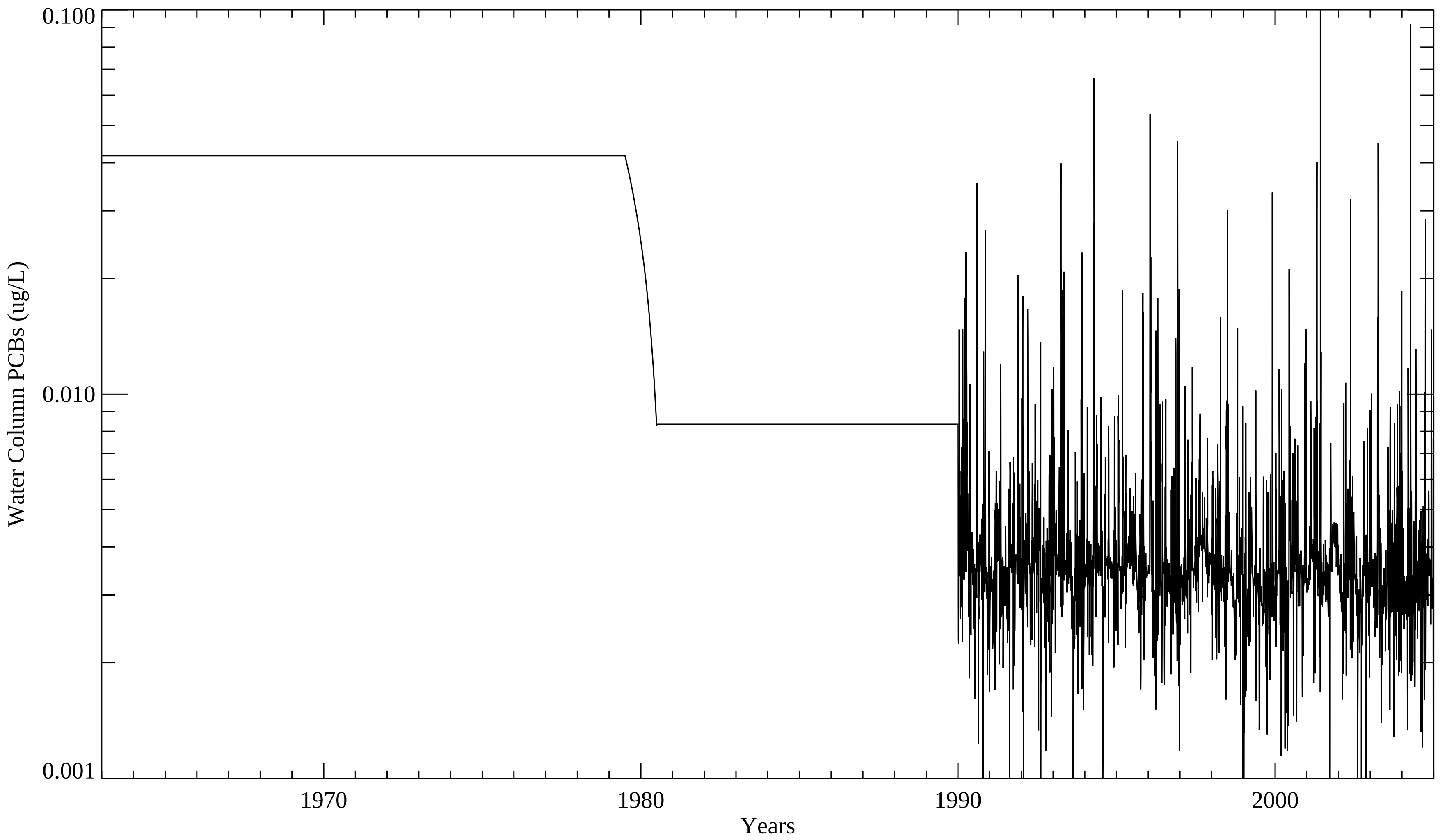


Figure F-4. Temporal profile of calculated water column PCB concentrations at Bulls Bridge between 1963 and 2004.

1963-1990 PCBs were calculated from high resolution core data (BBD-CS-02).
1990-2004 PCBs were calculated from downstream model output for Rising Pond divided by 10 to account for dilution.

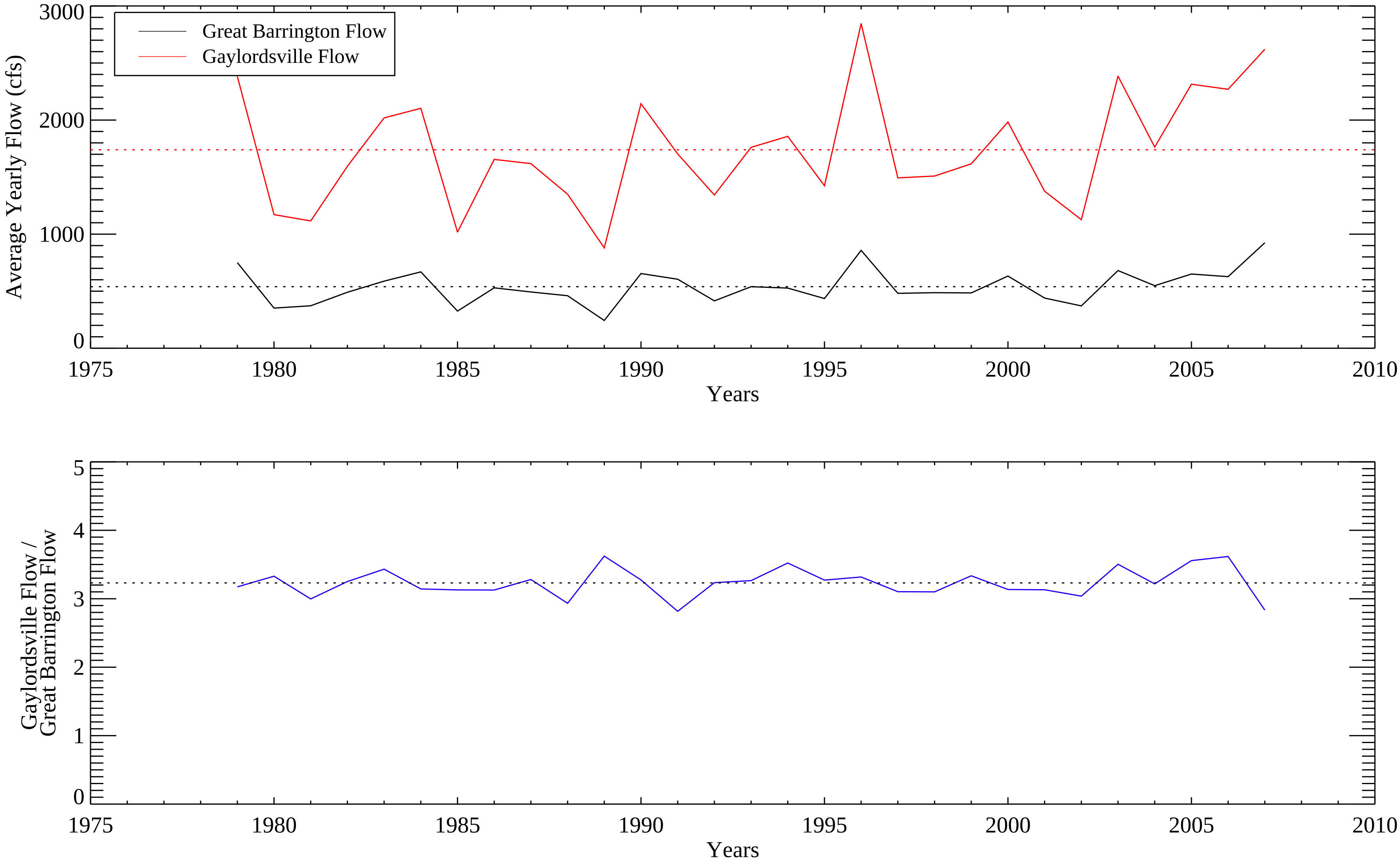


Figure F-5. Temporal plots of annual average USGS flow data at Great Barrington and Gaylordsville.

Note: Dotted lines represent average of annual flows (top panel) and ratios (bottom panel).

IF - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_F\FigureF-5_USGSdailyAverageFlowData\Figure5_dilution_factors.pro
Fri Mar 14 11:24:09 2008

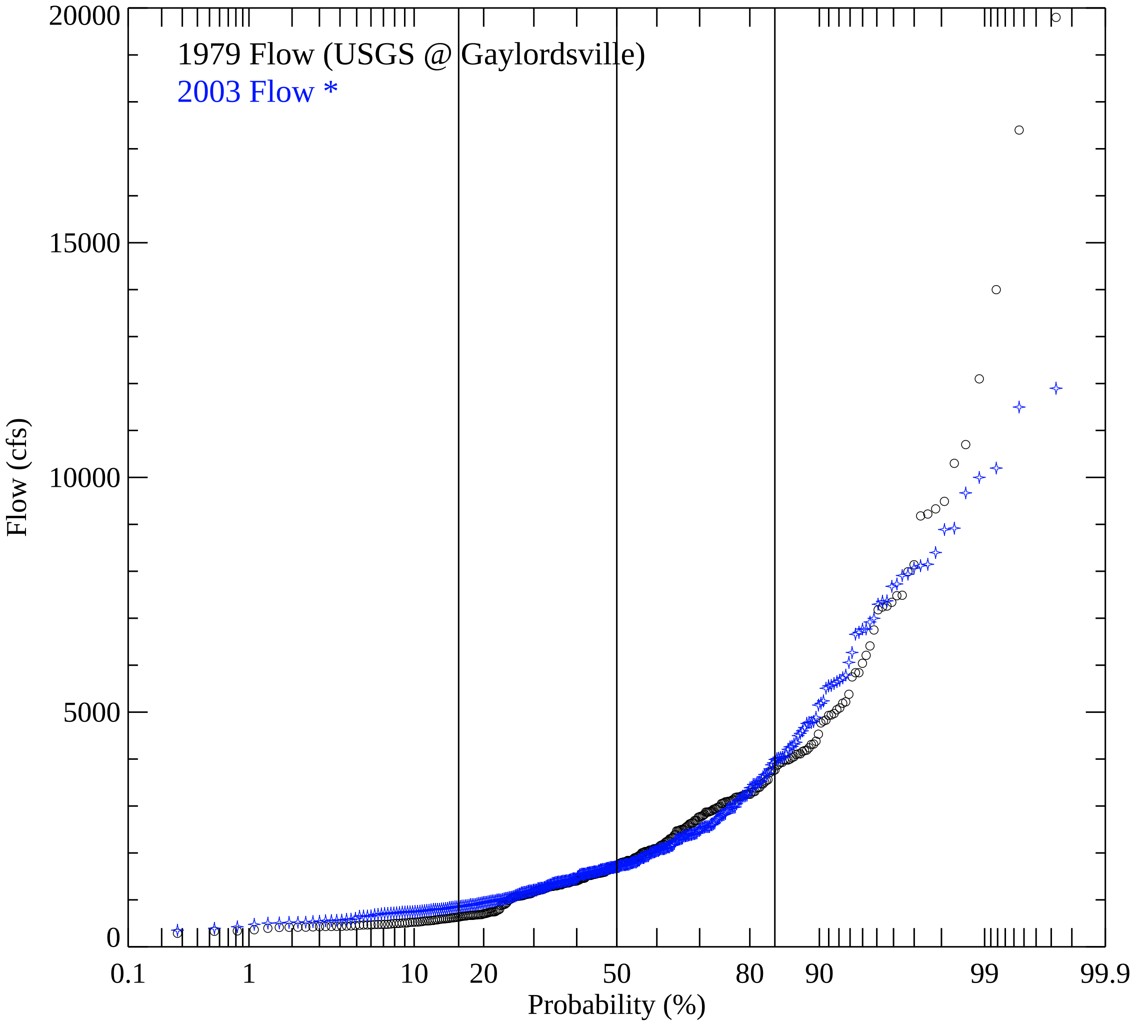


Figure F-6. Comparison of daily average flows at Gaylordsville between 1979 and 2003.

* 2003 flows are EPA Downstream model flows at Rising Pond multiplied by 3.2 to account for the flow difference between Rising Pond and Bulls Bridge.

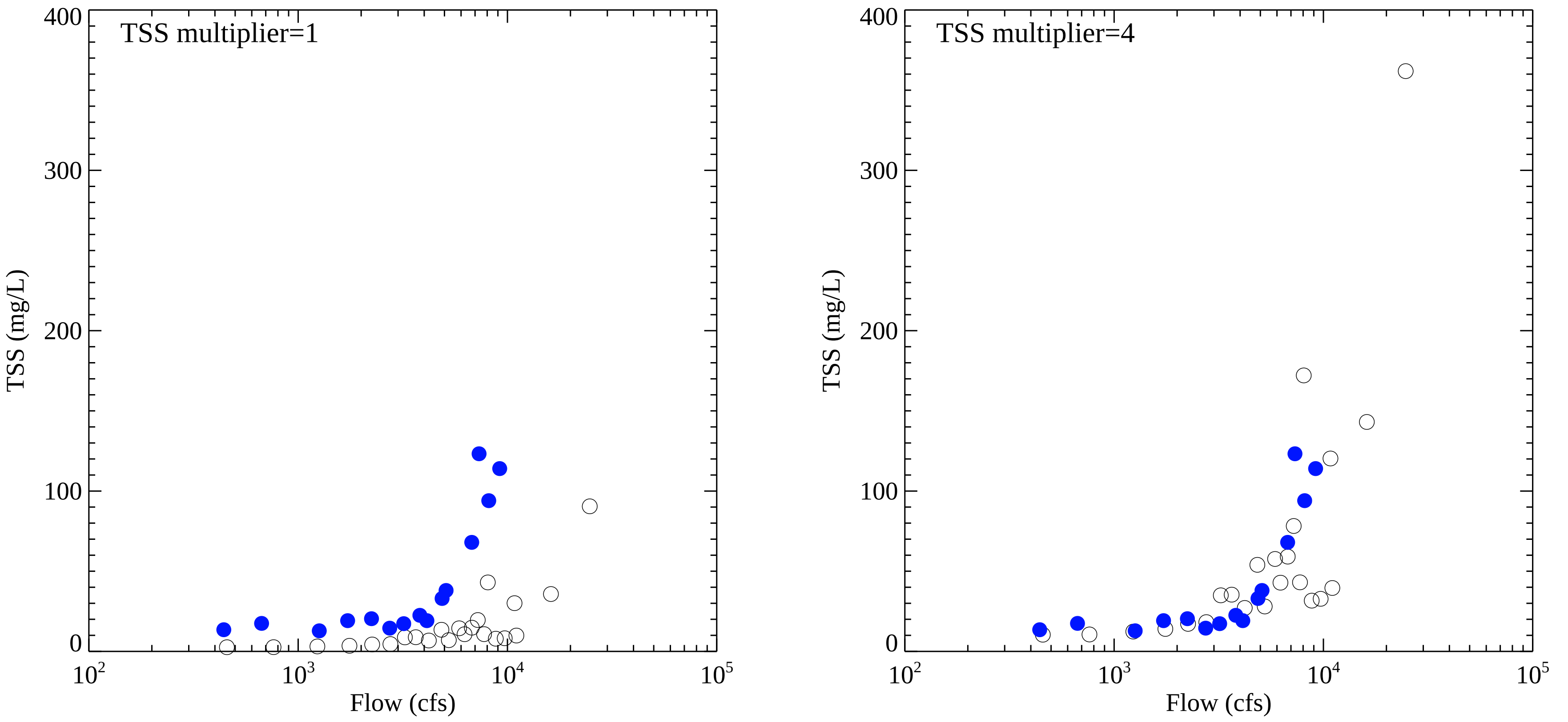


Figure F-7. Comparison of TSS and flow at Bulls Bridge between data and the relationship estimated from Downstream model results.

○ Estimated From Downstream Model (2003)
● 1979 USGS Data at Gaylordsville

Rising Pond flows calculated by the Downstream model were multiplied by 3.2 to approximate Bulls Bridge conditions. For both data sets the TSS values were averaged in 500 cfs bins.

if - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_F\FigureF_7_Crossplot_TSS_Q_10panel.pro
Fri Mar 14 11:09:43 2008

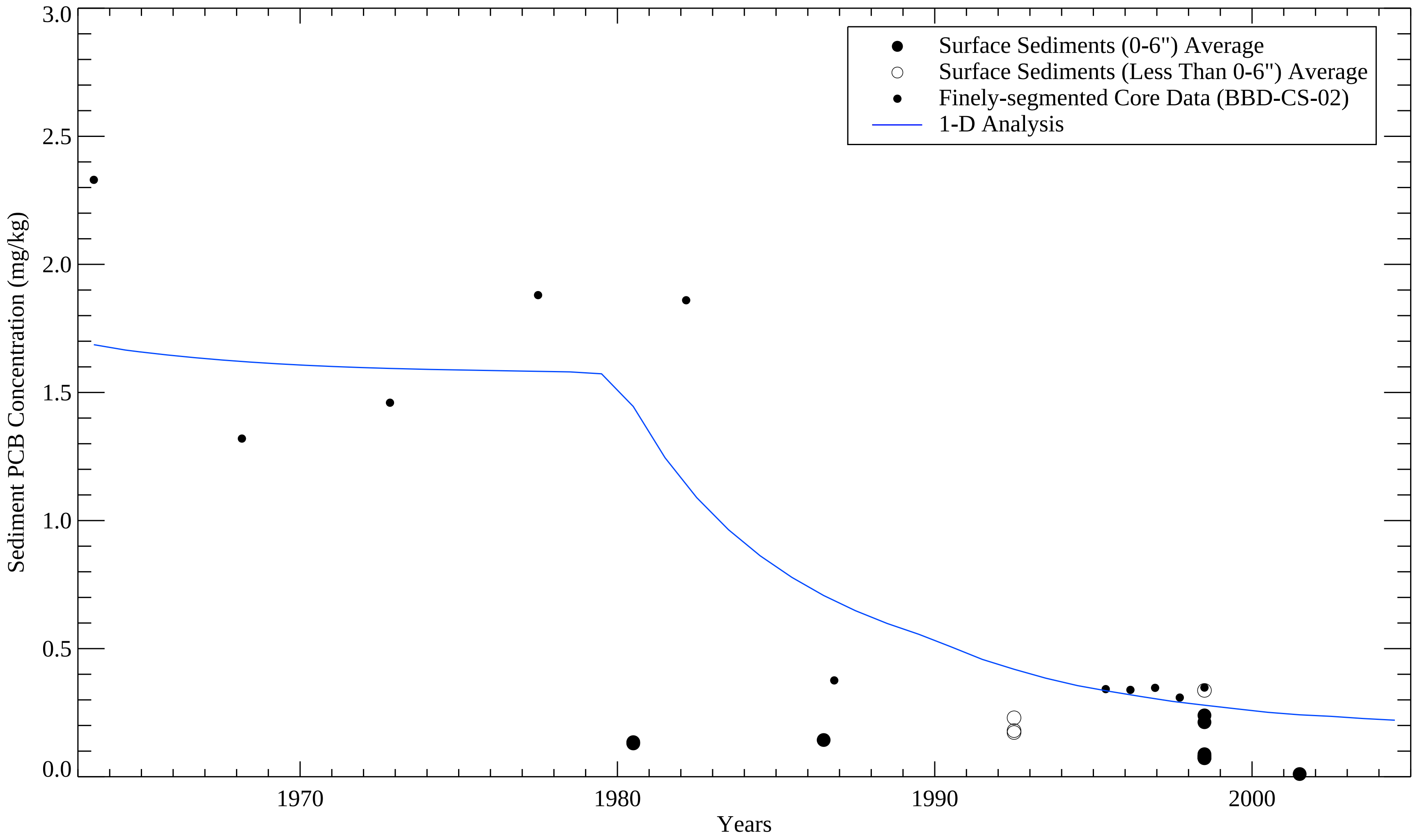


Figure F-8. Comparison of surface (0-6") sediment PCB concentrations calculated from the 1-D Analysis with data collected at Bulls Bridge.

if - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_F\IDL\FigureF_8_6in_temporal_notAveraged.pro
Fri Mar 14 13:06:53 2008

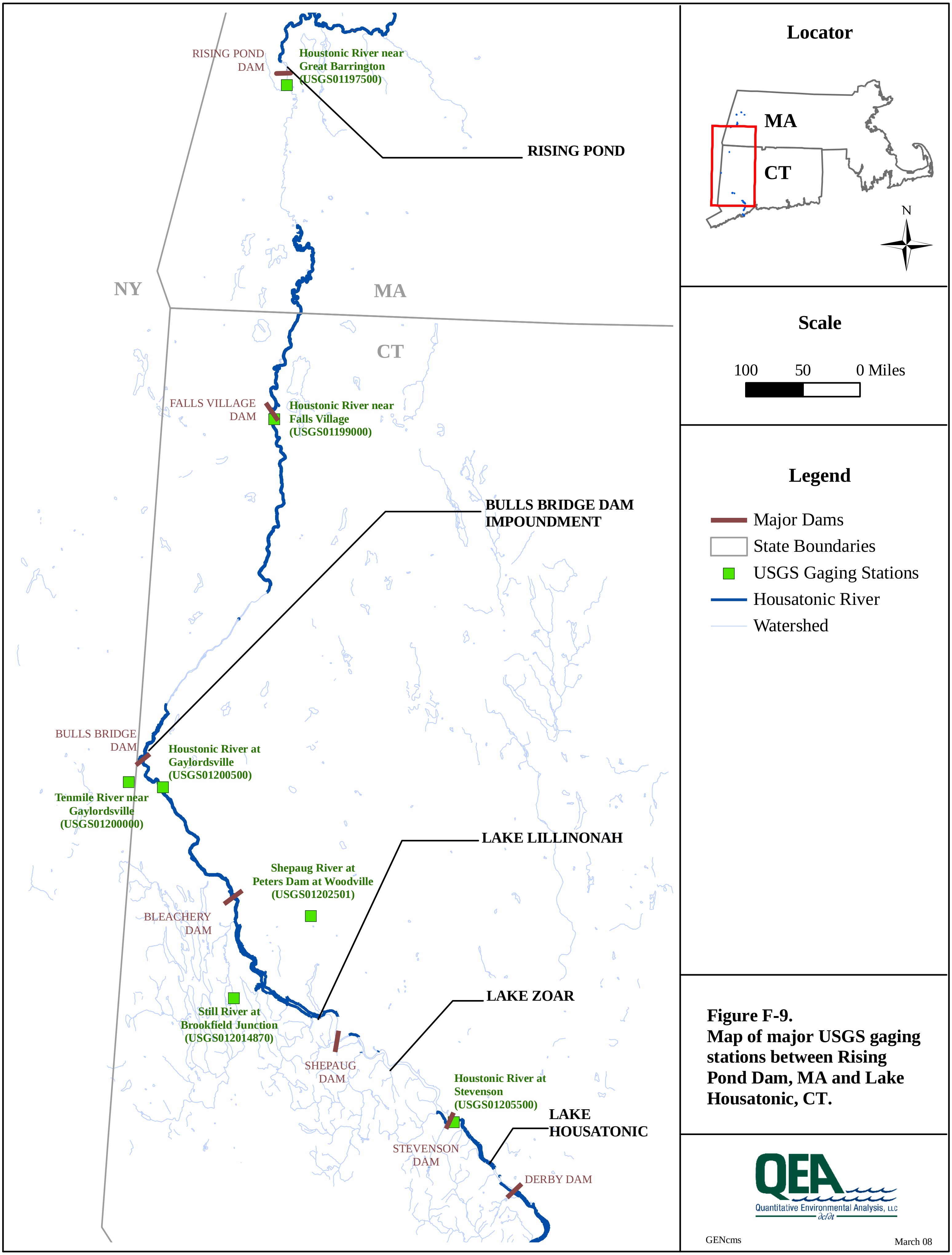


Figure F-9.
Map of major USGS gaging stations between Rising Pond Dam, MA and Lake Housatonic, CT.

wk -Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_F\maps\Appendix_F-9_map.mxd

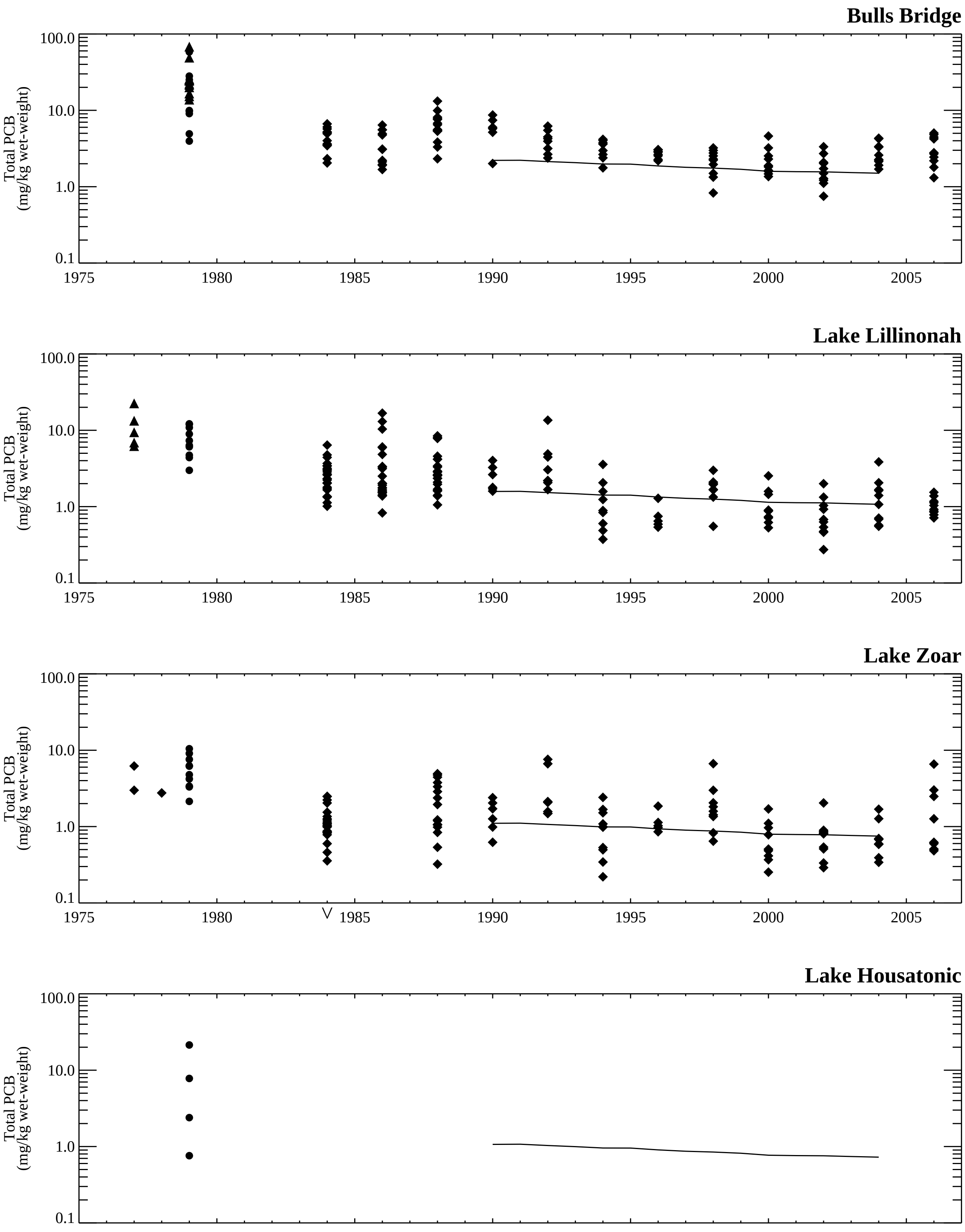


Figure F-10. Wet-weight PCB concentrations in smallmouth bass estimated from the CT 1-D Analysis.

Notes: FCM run TV_EPA037; Deposition model run 35
Model output is autumn averaged PCB concentration (Aug. 28 - Oct. 26) for game fish, age 6+.
Fillet to whole body conversion factor = 2.3. SMB fish ages > 3 (when determined);
Prep for 2004 and 2006 individual samples assumed to be fillet.

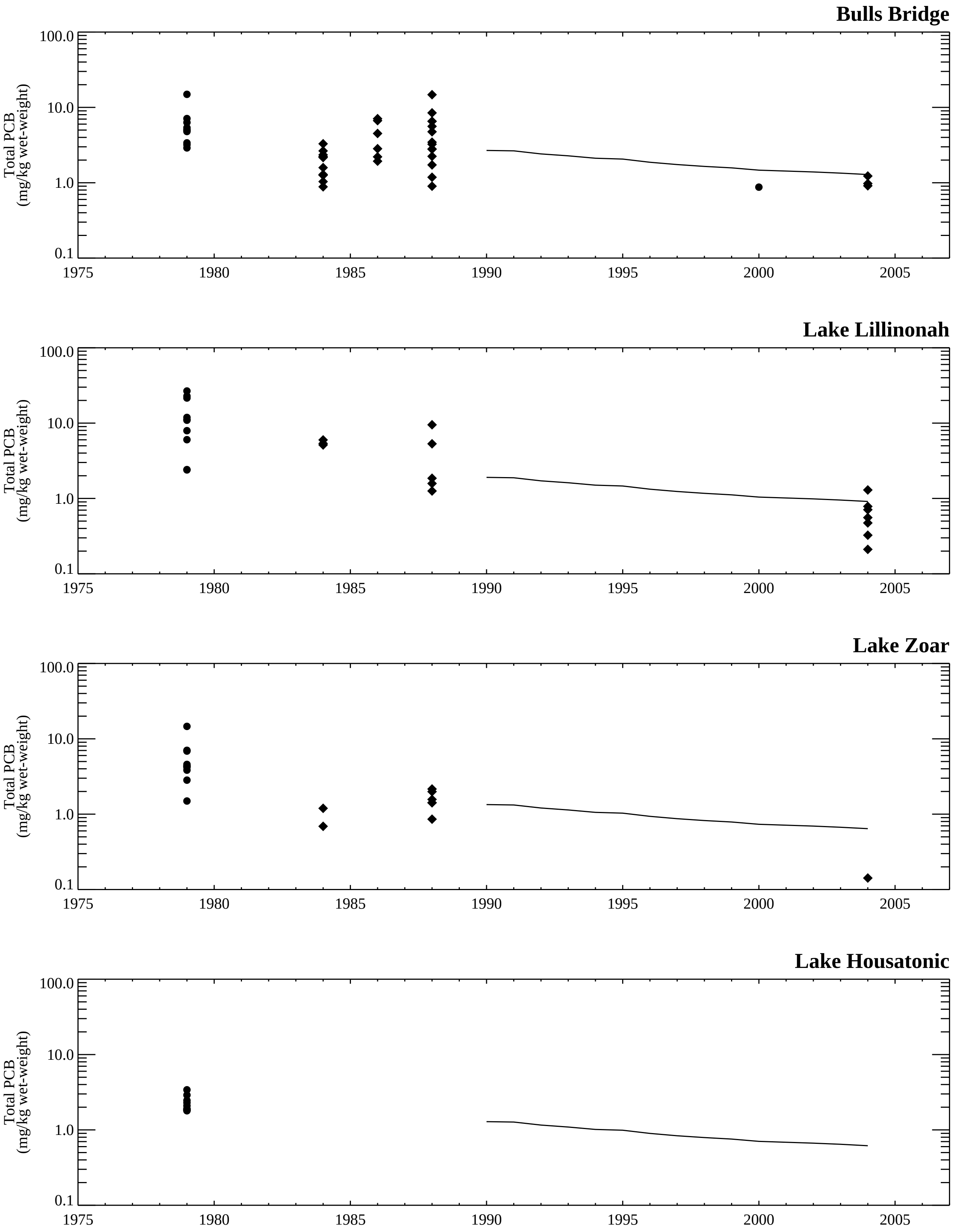


Figure F-11. Wet-weight PCB concentrations in bullhead (brown and yellow bullhead, where available) estimated from the CT 1-D Analysis.

Notes: FCM run TV_EPA037; Deposition model run 35
Model output is autumn averaged PCB concentration (Aug. 28 - Oct. 26) for game fish, age 6+.
Fillet to whole body conversion factor = 2.3. SMB fish ages > 3 (when determined);
Prep for 2004 and 2006 individual samples assumed to be fillet.

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Fri Mar 14 13:58:27 2008

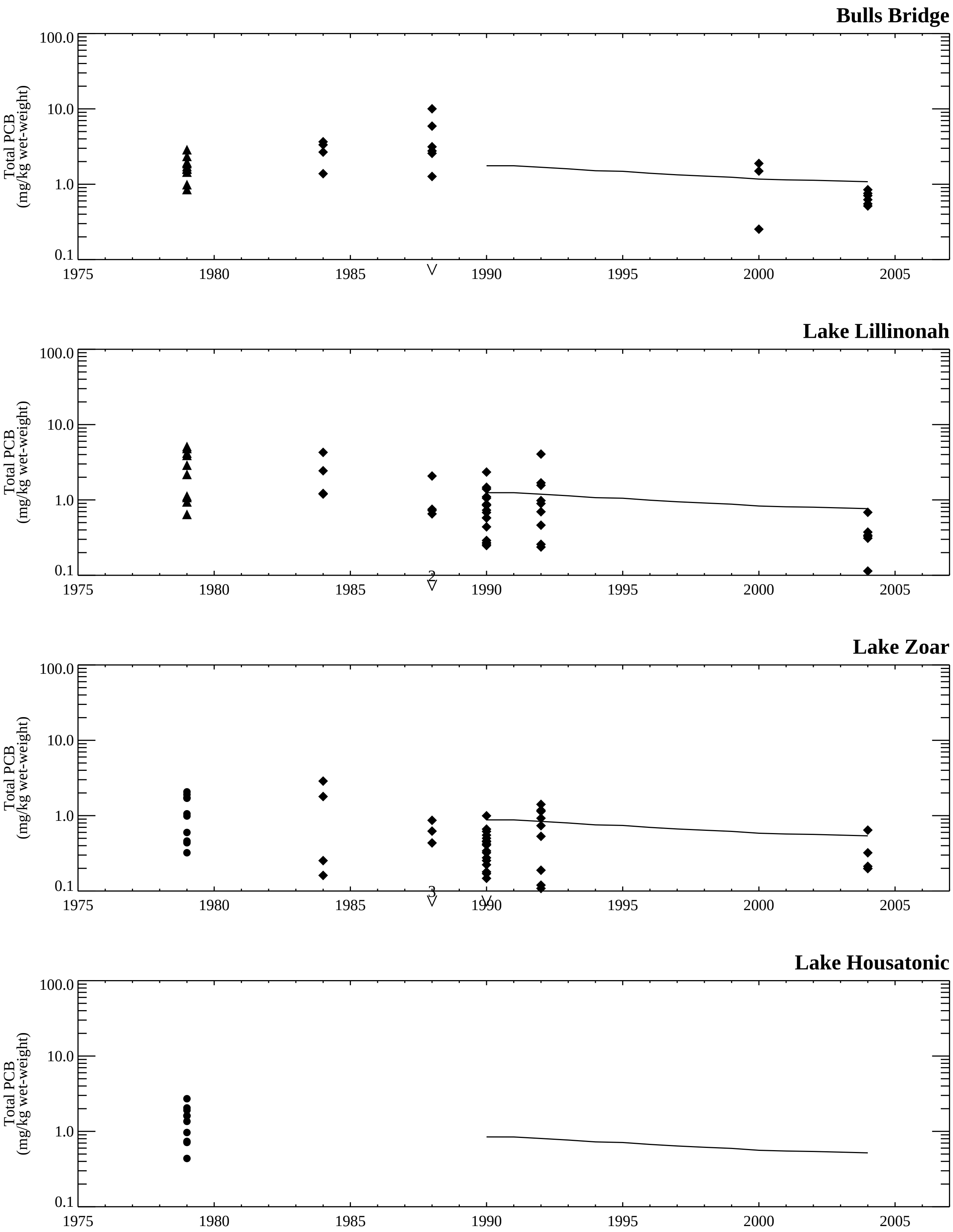

Figure F-12. Wet-weight PCB concentrations in sunfish (pumpkinseed, bluegill, redbreast sunfish, and redear sunfish, where available) estimated from the CT 1-D Analysis.

Notes: FCM run TV_EPA037; Deposition model run 35
Model output is autumn averaged PCB concentration (Aug. 28 - Oct. 26) for game fish, age 6+.
Fillet to whole body conversion factor = 2.3. SMB fish ages > 3 (when determined);
Prep for 2004 and 2006 individual samples assumed to be fillet.

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Fri Mar 14 13:58:29 2008

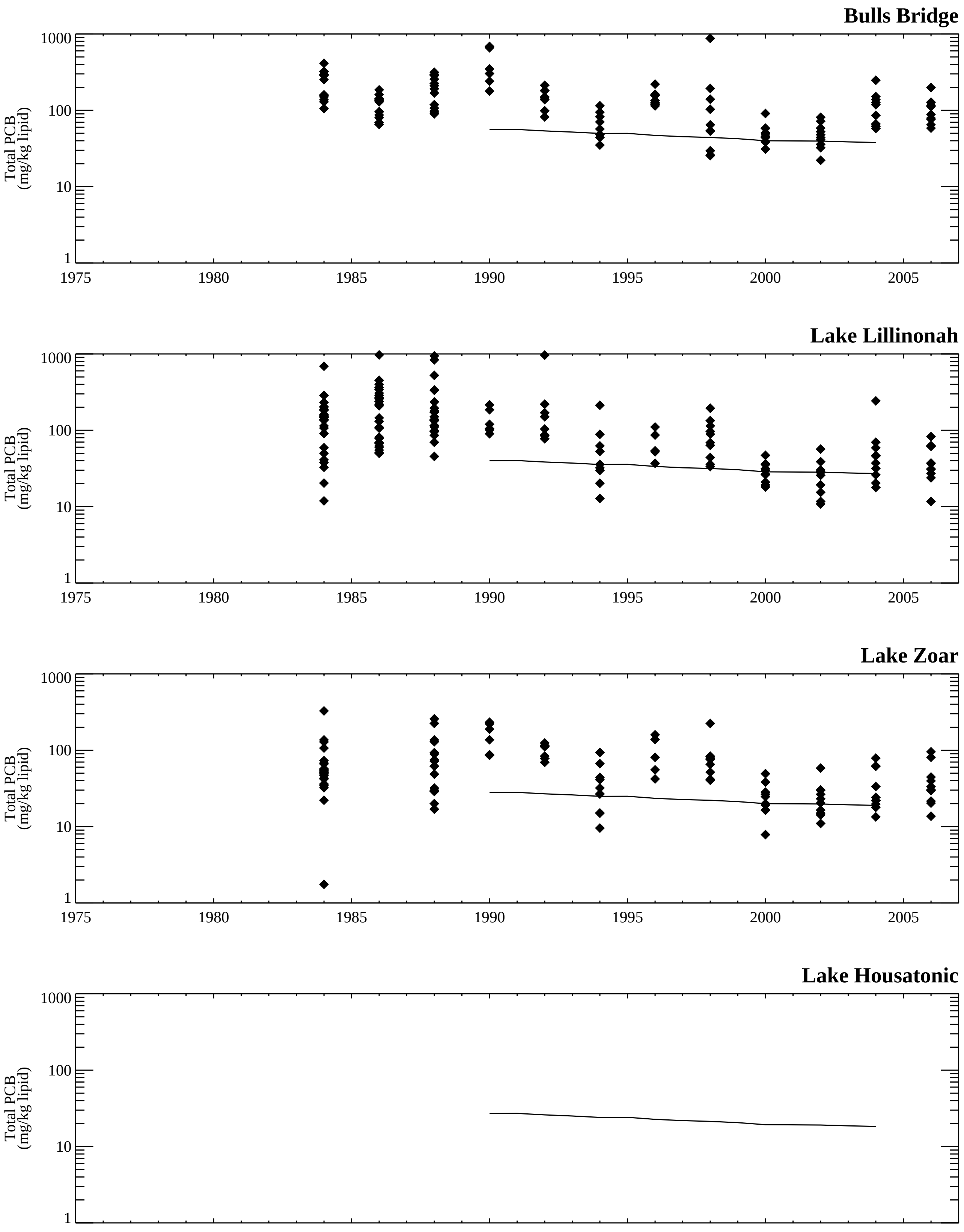

Figure F-13. Lipid-normalized PCB concentrations in smallmouth bass estimated from the CT 1-D Analysis.

Notes: FCM run TV_EPA037; Deposition model run 35
Model output is autumn averaged PCB concentration (Aug. 28 - Oct. 26) for game fish, age 6+.
SMB fish ages > 3 (when determined);
Prep for 2004 and 2006 individual samples assumed to be fillet.

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Fri Mar 14 13:59:13 2008

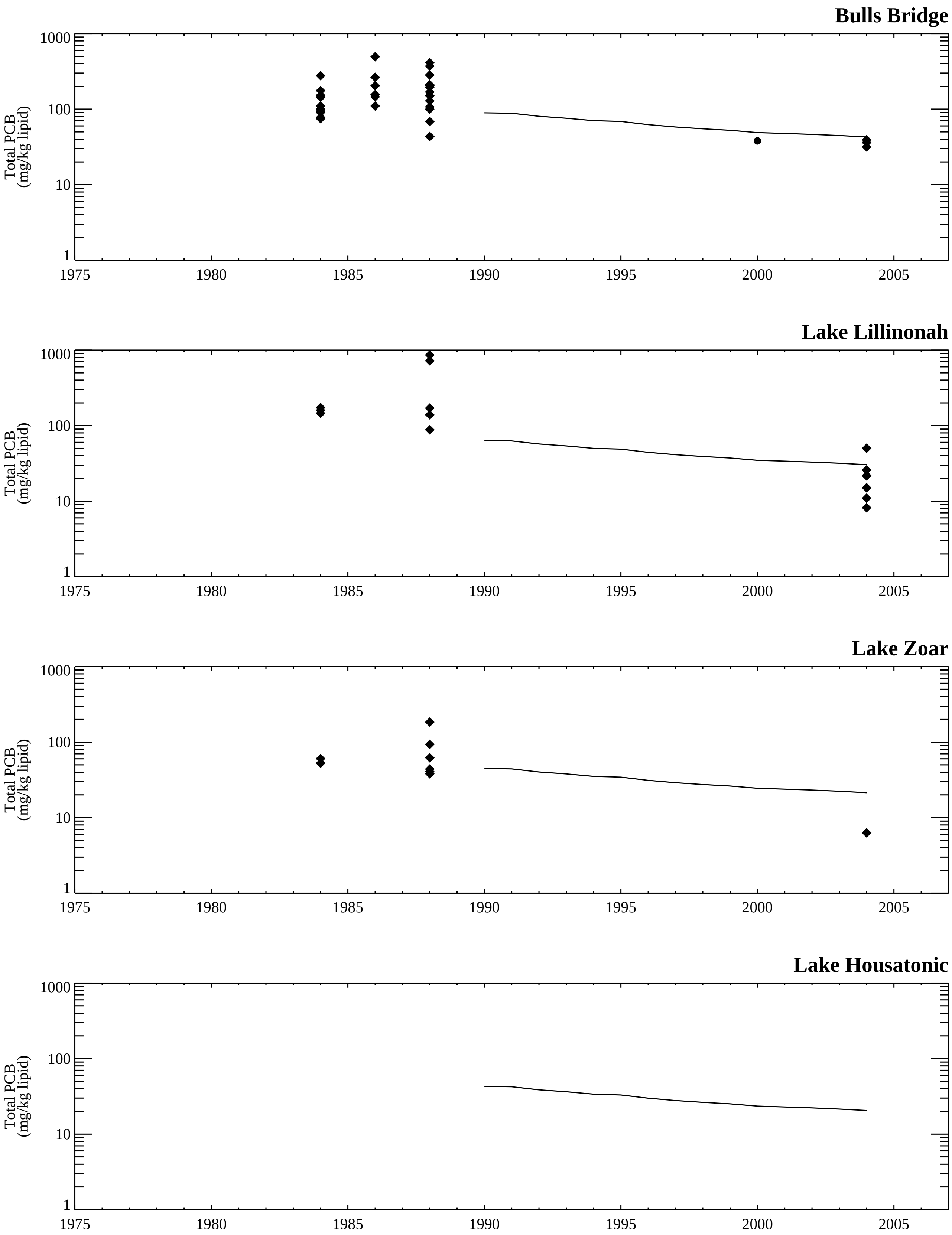

Figure F-14. Lipid-normalized PCB concentrations in bullhead (brown and yellow bullhead, where available) estimated from the CT 1-D Analysis.

Notes: FCM run TV_EPA037; Deposition model run 35
Model output is autumn averaged PCB concentration (Aug. 28 - Oct. 26) for game fish, age 6+.
SMB fish ages > 3 (when determined);
Prep for 2004 and 2006 individual samples assumed to be fillet.

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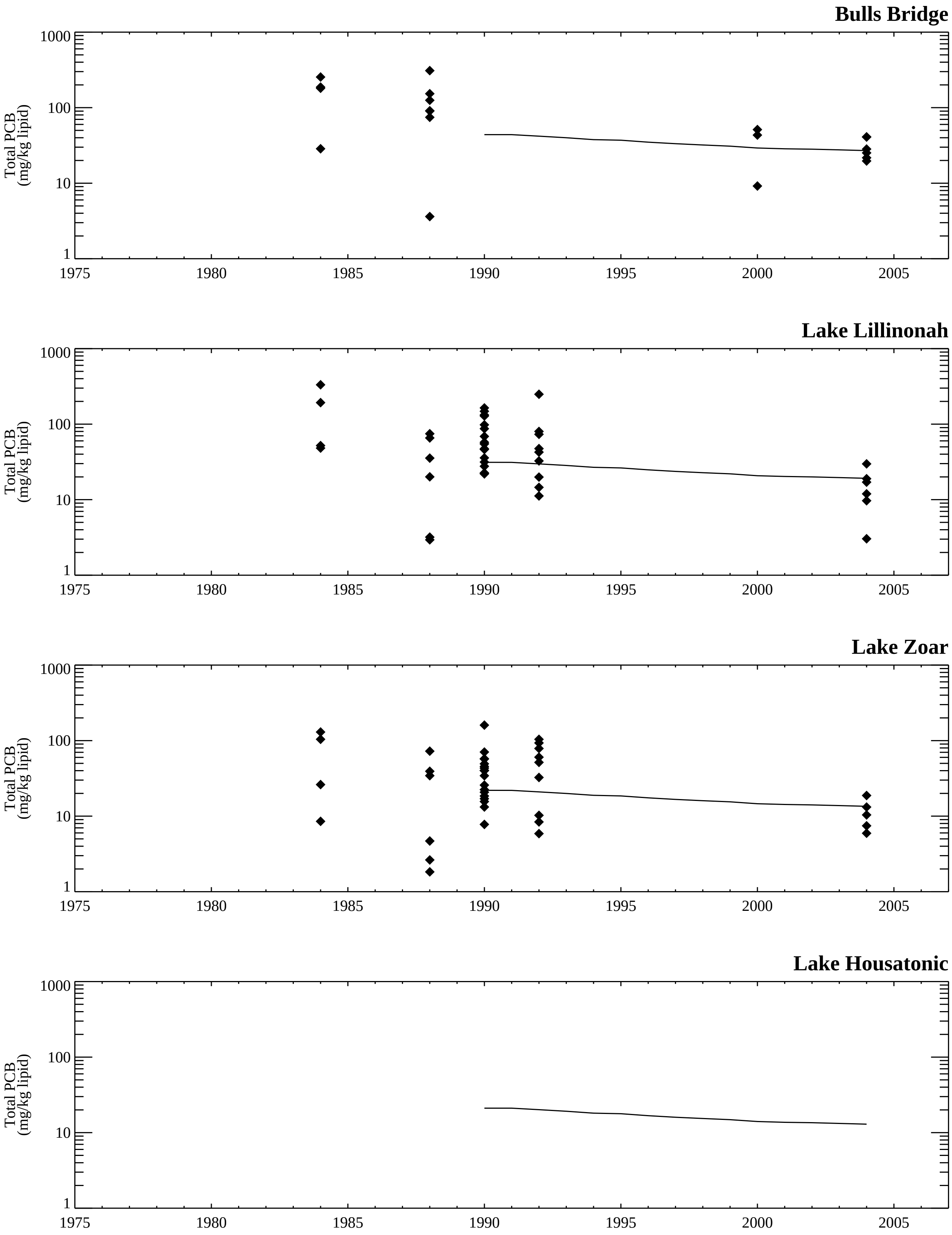

Figure F-15. Lipid-normalized PCB concentrations in sunfish (pumpkinseed, bluegill, redbreast sunfish, and redear sunfish, where available) estimated from the CT 1-D Analysis.

Notes: FCM run TV_EPA037; Deposition model run 35
Model output is autumn averaged PCB concentration (Aug. 28 - Oct. 26) for game fish, age 6+.
SMB fish ages > 3 (when determined);
Prep for 2004 and 2006 individual samples assumed to be fillet.

DR\LD - Z:\GENcms\MODEL\FDCHN\Analysis\CT_Calibration\Model_results\pcb_temporal_ct_smb.pro
Fri Mar 14 13:59:17 2008

ARCADIS QEA

Appendix G

Model Output Graphics

SED 1 / SED 2; Base Case

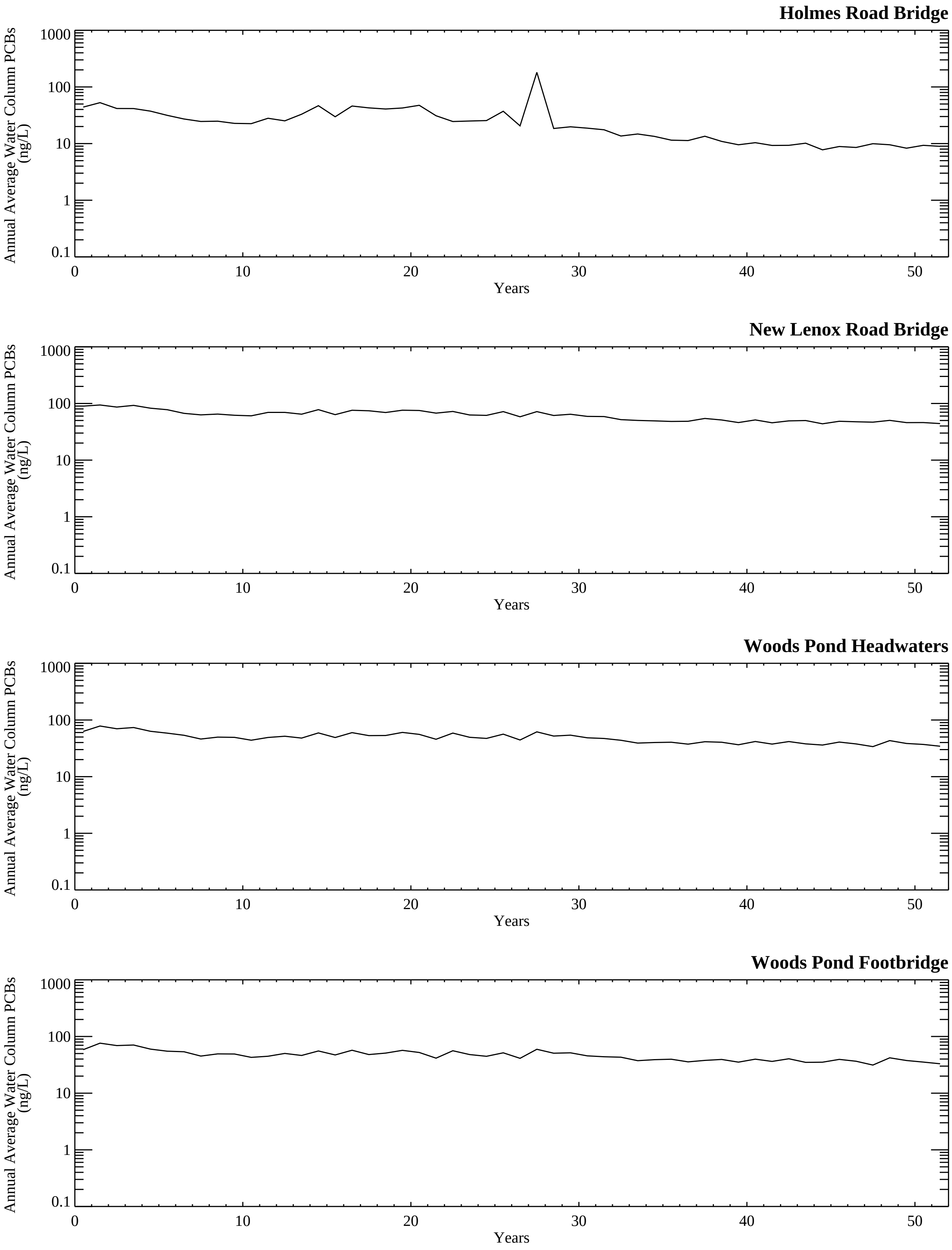

Figure G-1.1-1a. Temporal profiles of model-predicted water column PCB concentrations (SED 1 / SED 2; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED1CMSBS_0712-01

RRM - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\figure_g1_1_7_plot_wc.pro
Tue Mar 18 20:31:16 2008

SED 1 / SED 2; Base Case

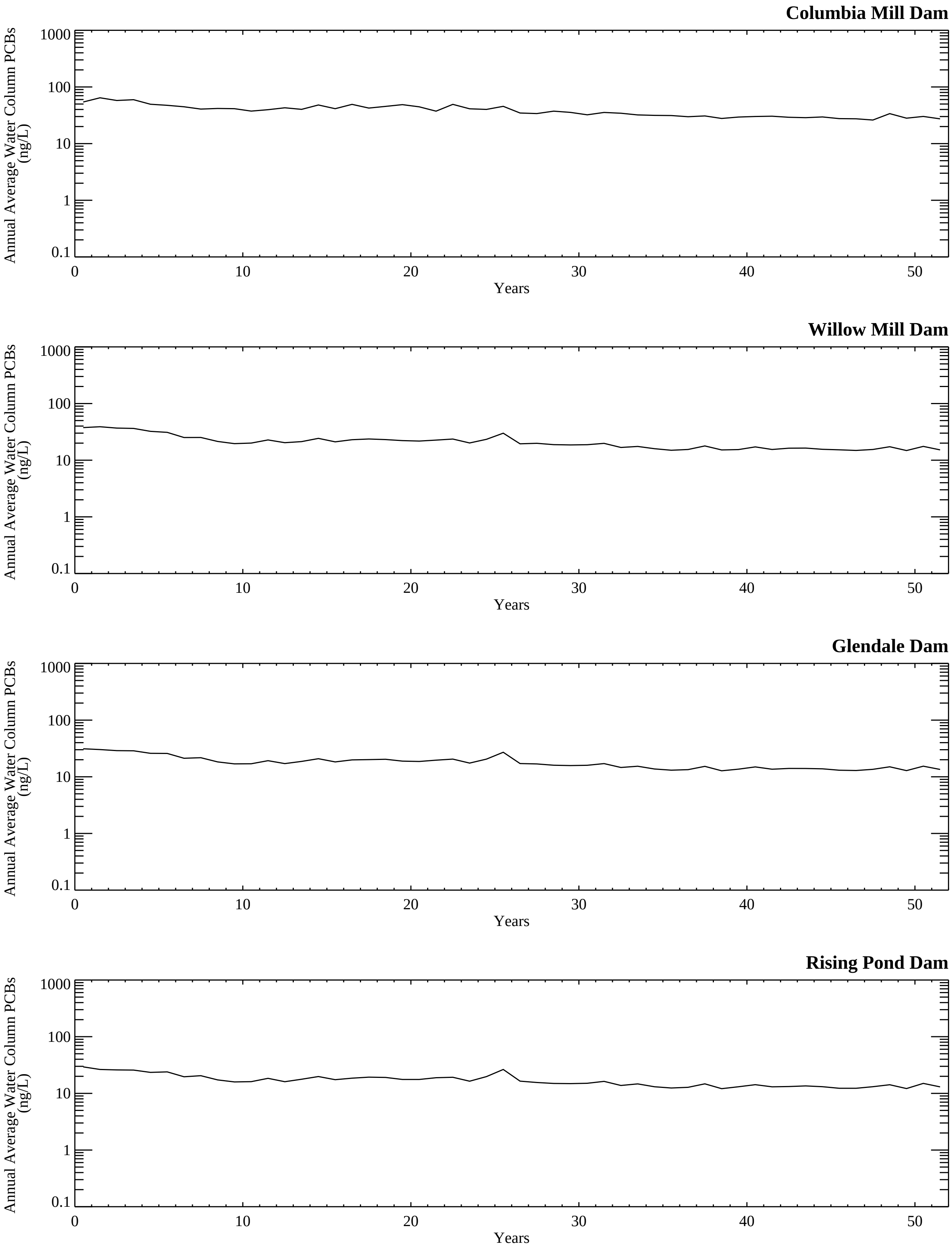

Figure G-1.1-1b. Temporal profiles of model-predicted water column PCB concentrations (SED 1 / SED 2; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED1CMSBS_0712-28

SED 1 / SED 2; Base Case

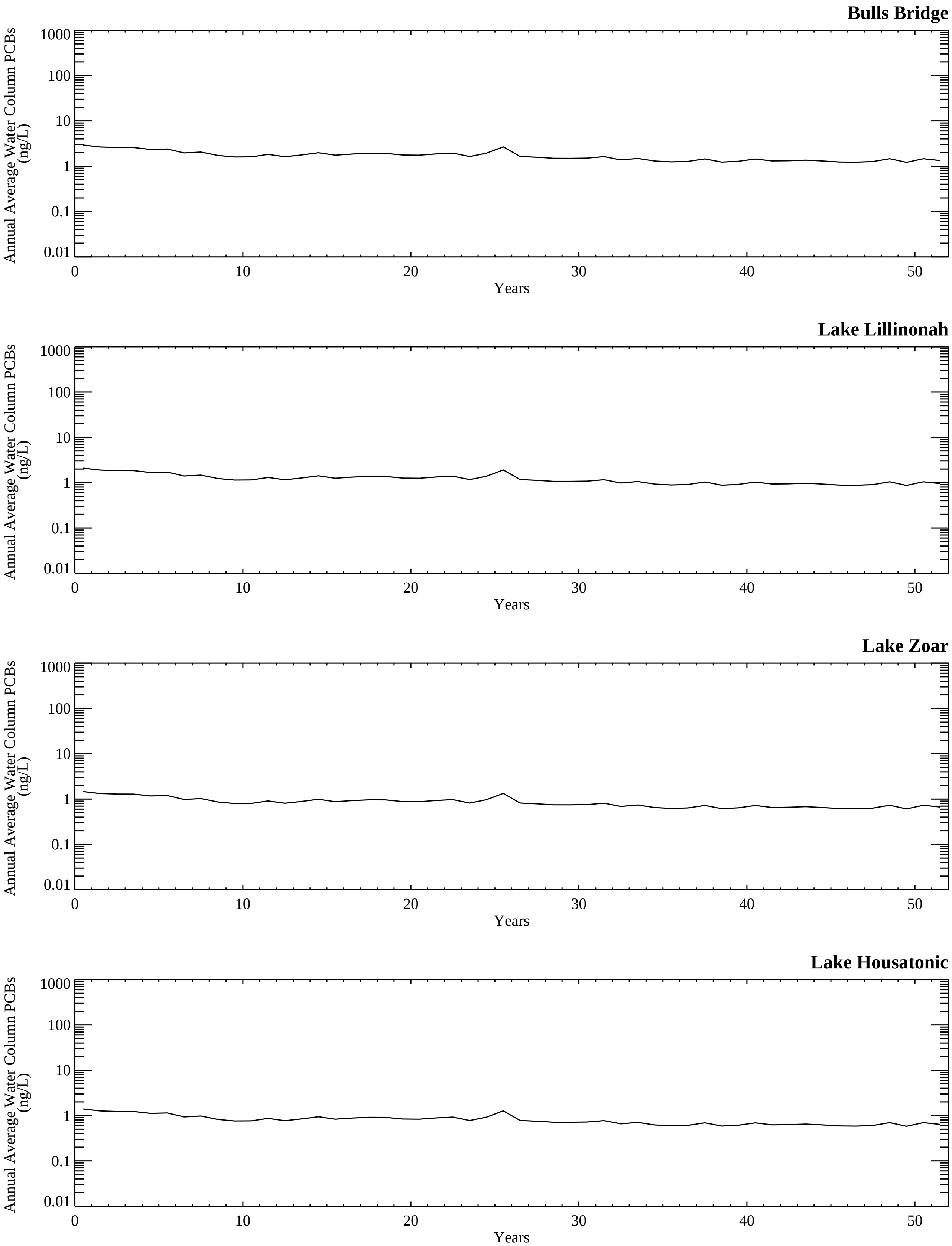

Figure G-1.1-1c. Temporal profiles of water column PCB concentrations estimated from the CT 1-D Analysis (SED 1 / SED 2; CT; Base Case).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED01_0712-28_base

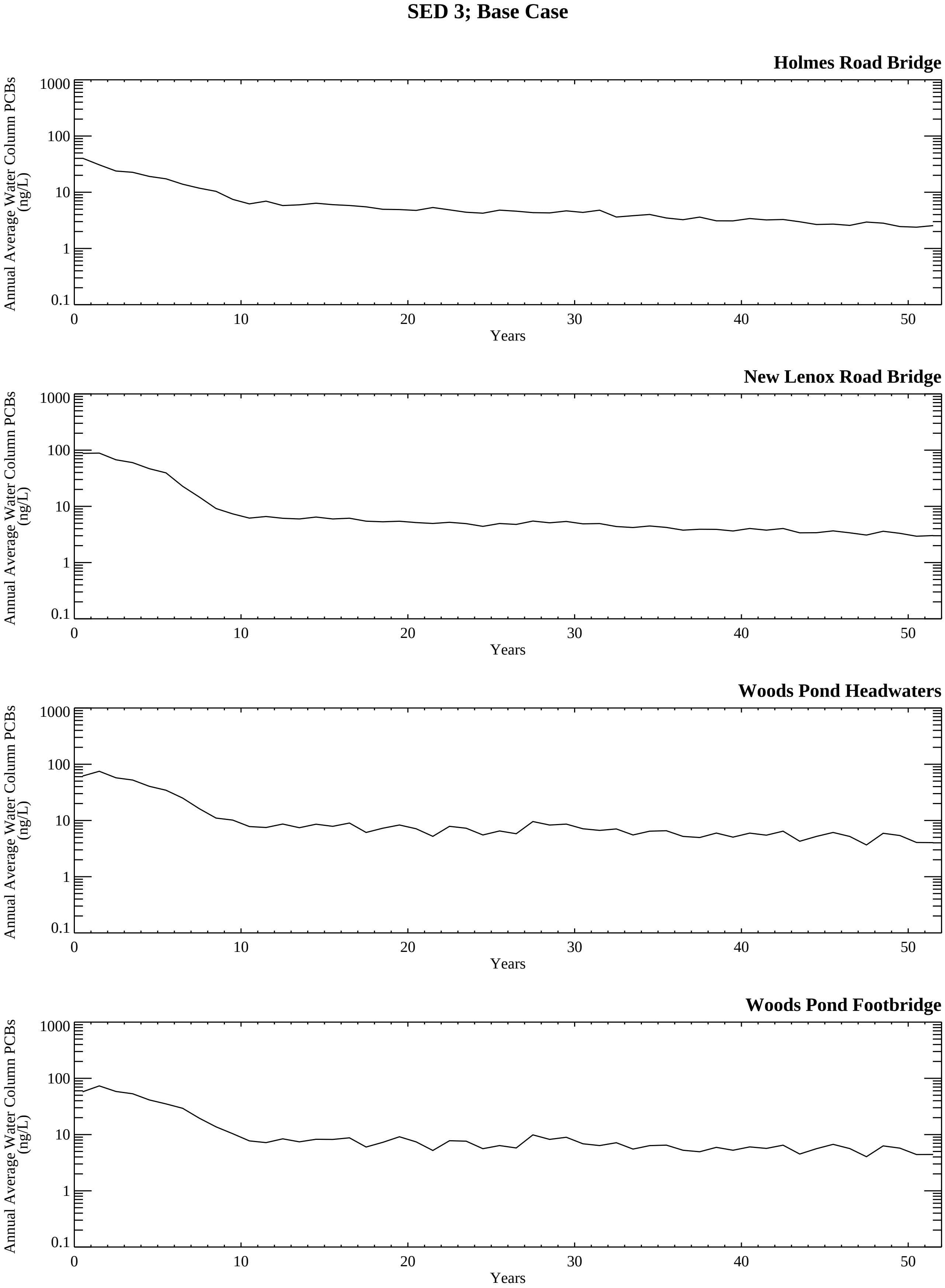

Figure G-1.1-2a. Temporal profiles of model-predicted water column PCB concentrations (SED 3; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED3CMSBS_0712-13

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Tue Mar 18 20:31:17 2008

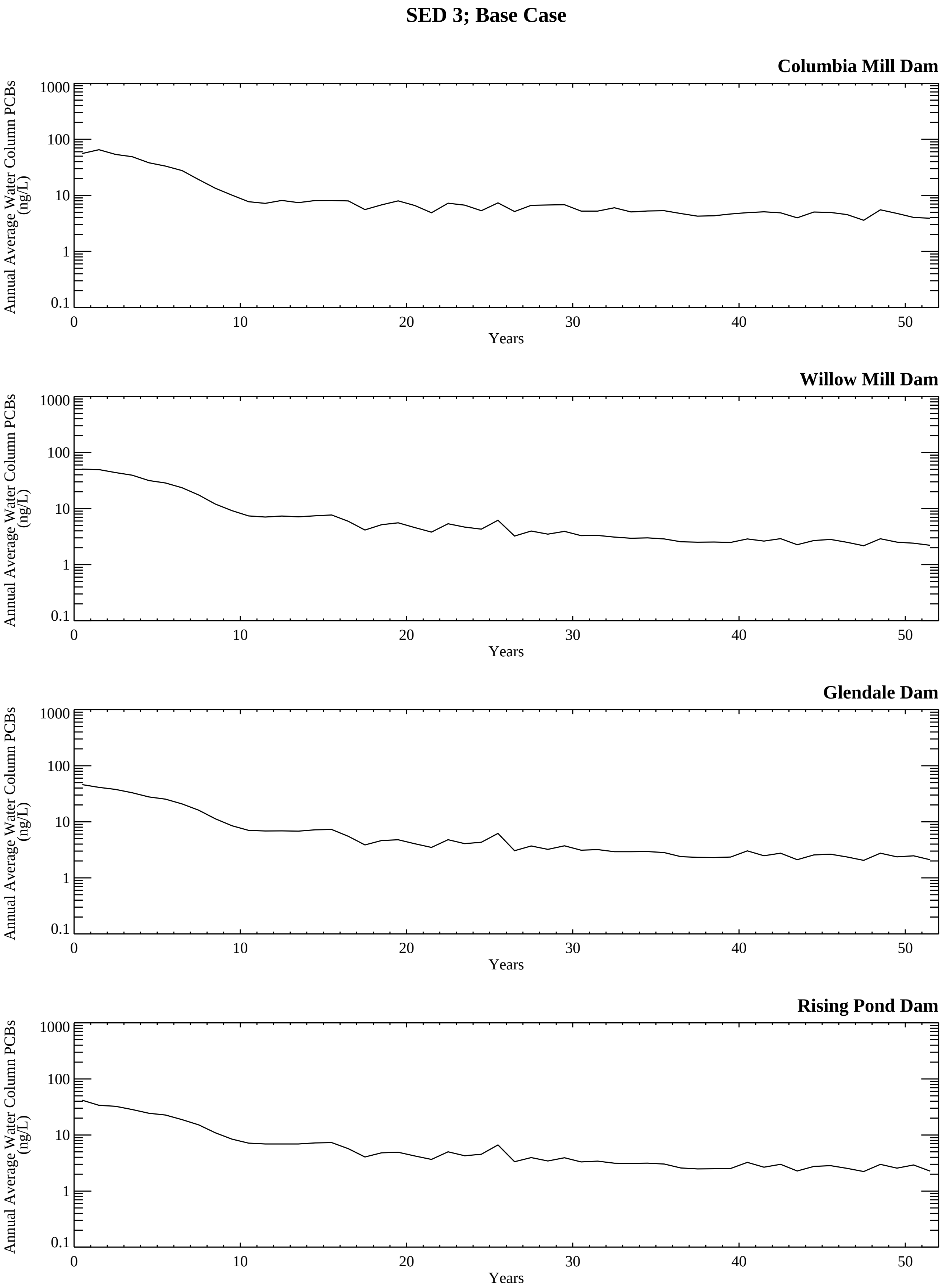

Figure G-1.1-2b. Temporal profiles of model-predicted water column PCB concentrations (SED 3; Reach 7/8; Base Case).

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RRM - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\figure_g1_1_7_plot_wc.pro
Tue Mar 18 20:30:06 2008

SED 3; Base Case

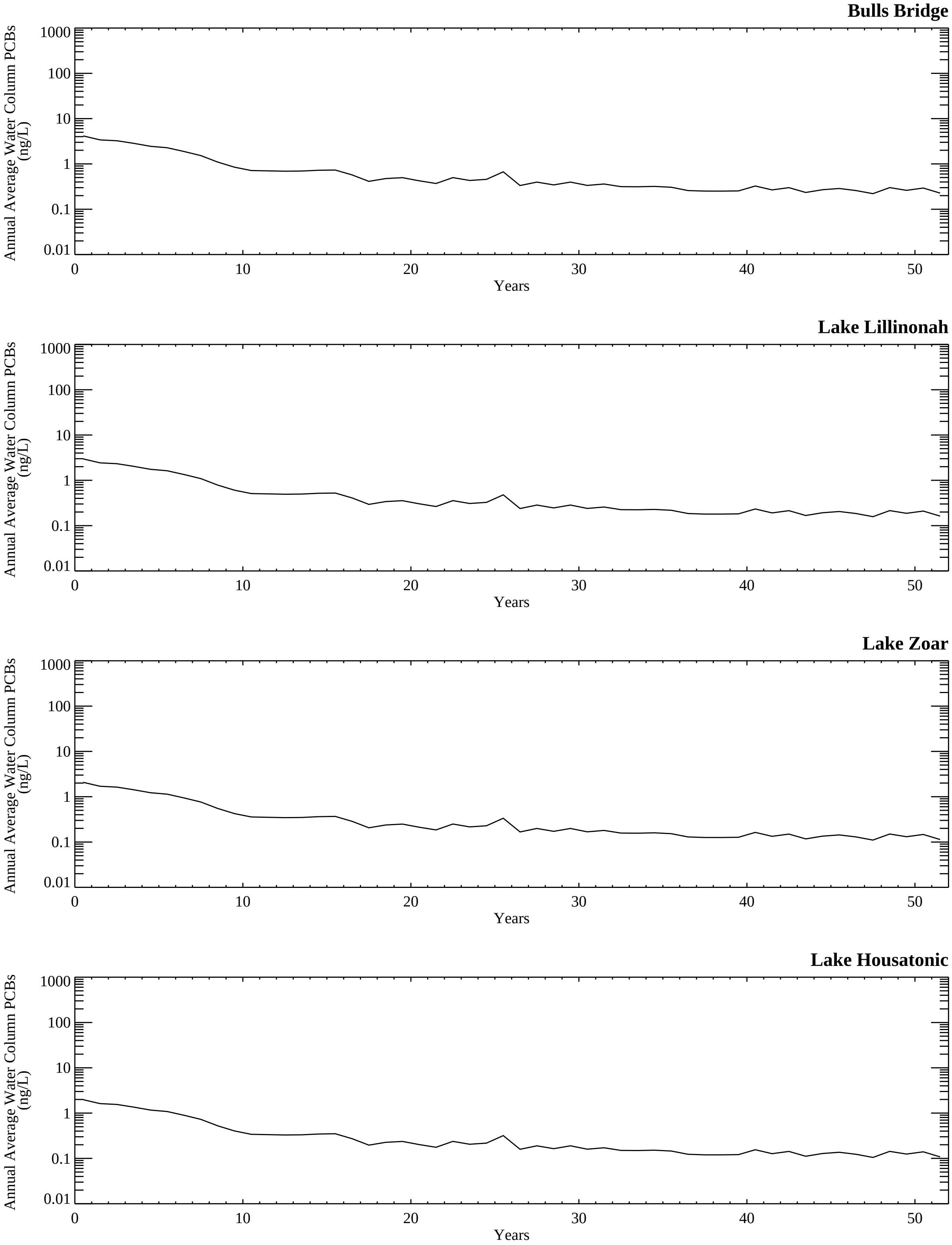

Figure G-1.1-2c. Temporal profiles of water column PCB concentrations estimated from the CT 1-D Analysis (SED 3; CT; Base Case).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED03_0712-29_base

SED 4; Base Case

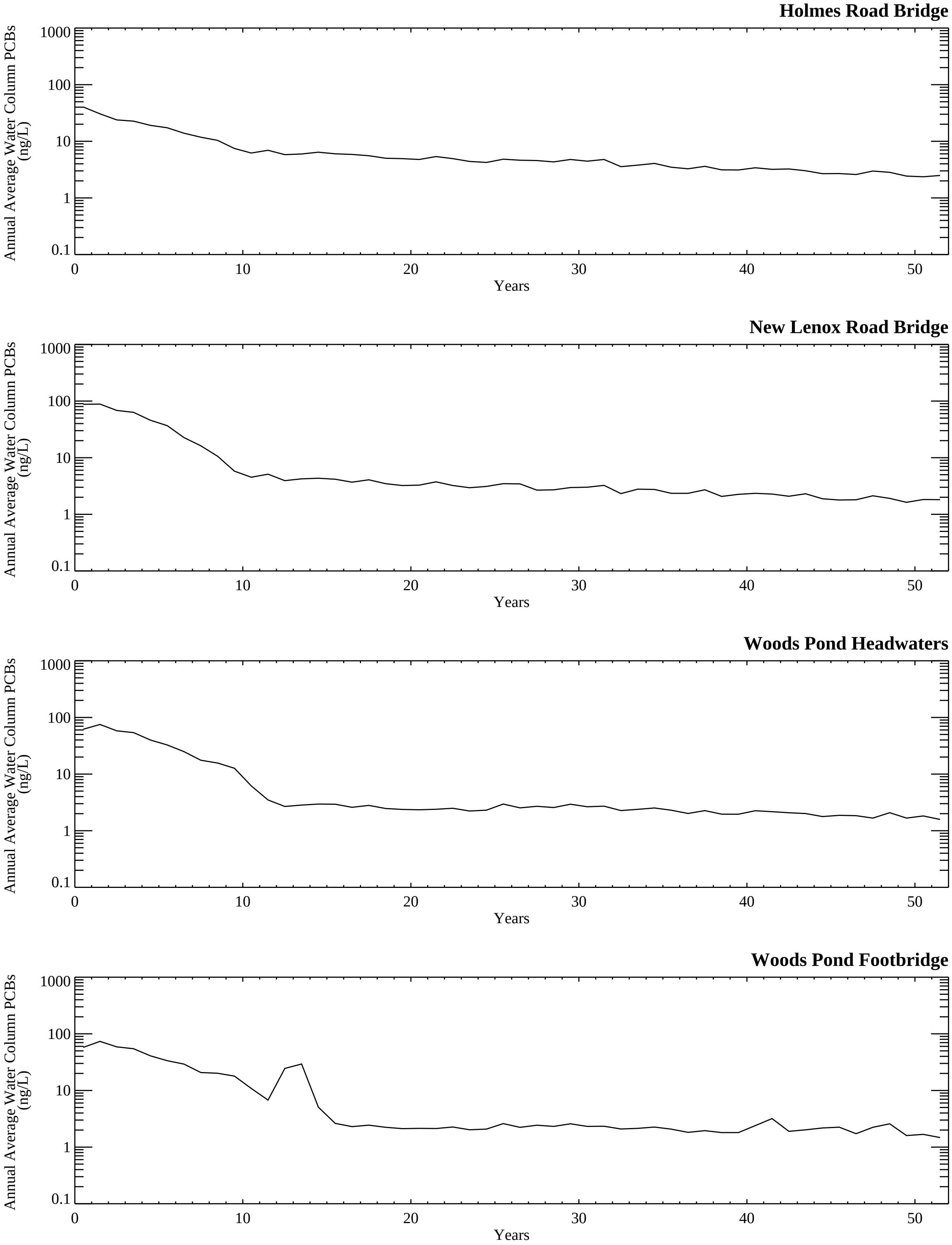

Figure G-1.1-3a. Temporal profiles of model-predicted water column PCB concentrations (SED 4; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED4CMSBS_0801-01

RRM - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\figure_g1_1_7_plot_wc.pro
Tue Mar 18 20:31:18 2008

SED 4; Base Case

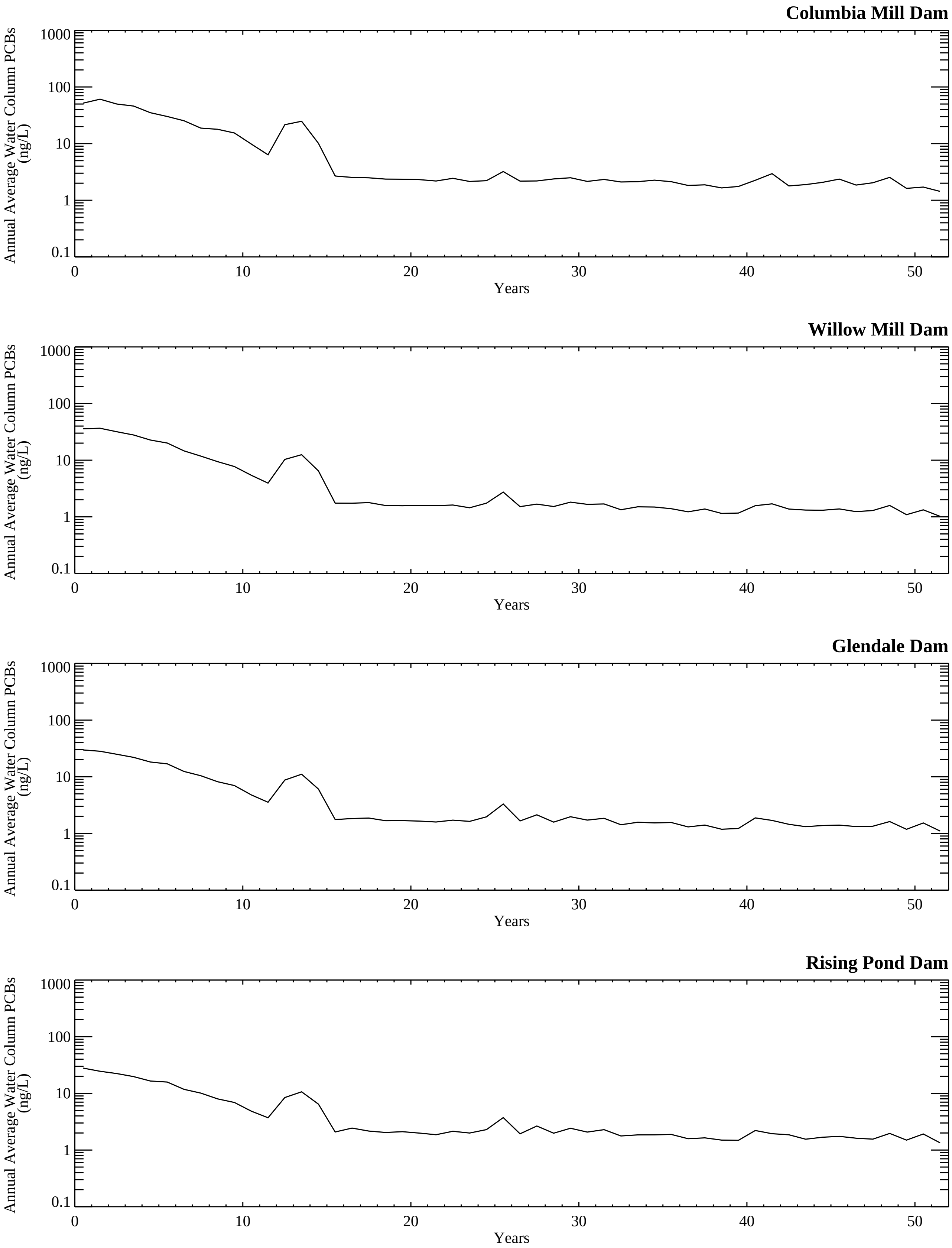

Figure G-1.1-3b. Temporal profiles of model-predicted water column PCB concentrations (SED 4; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED4CMSBS_0802-01

RRM - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\figure_g1_1_7_plot_wc.pro
Tue Mar 18 20:30:07 2008

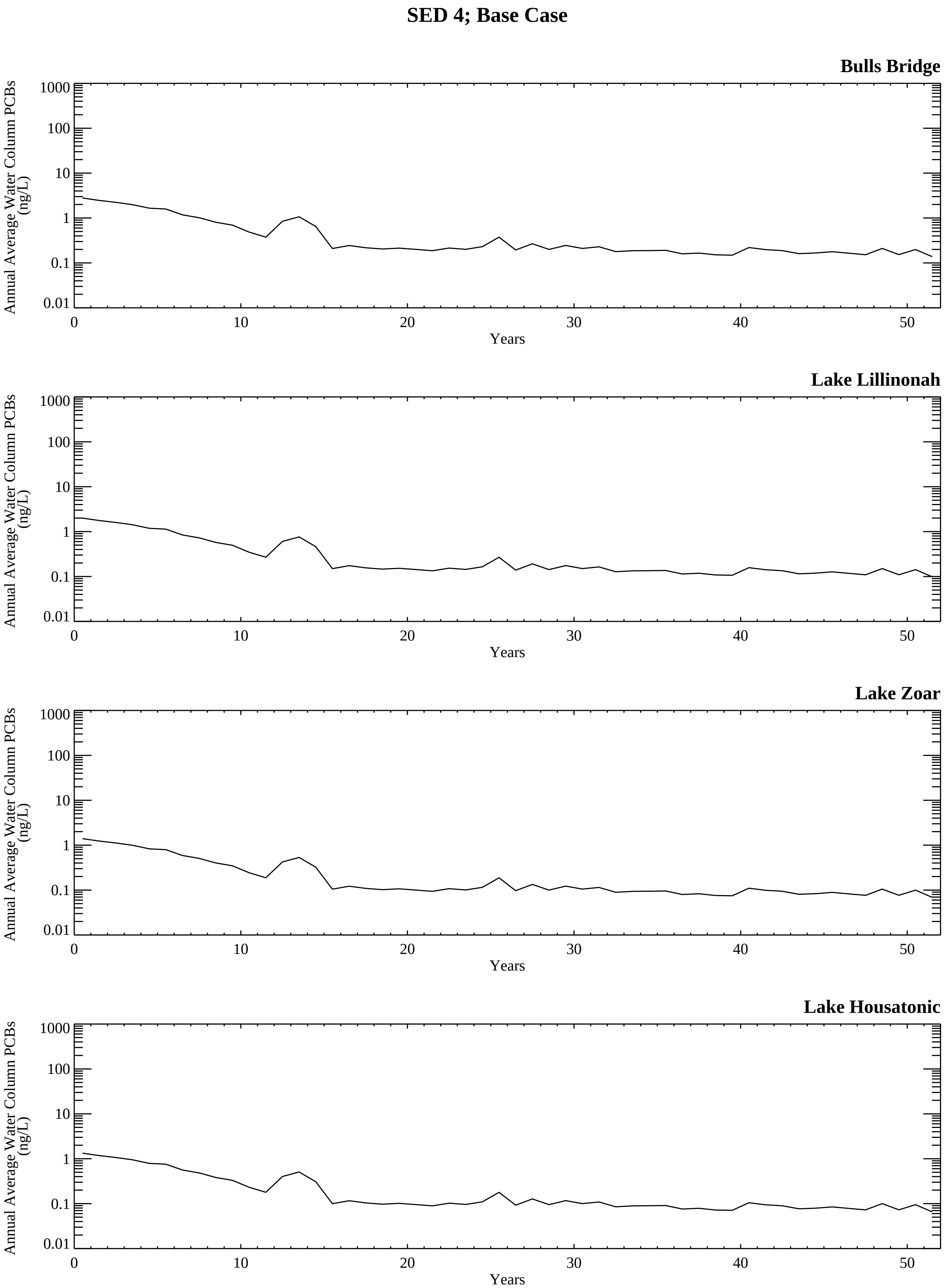

Figure G-1.1-3c. Temporal profiles of water column PCB concentrations estimated from the CT 1-D Analysis (SED 4; CT; Base Case).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED04_0802-01_base

SED 5; Base Case

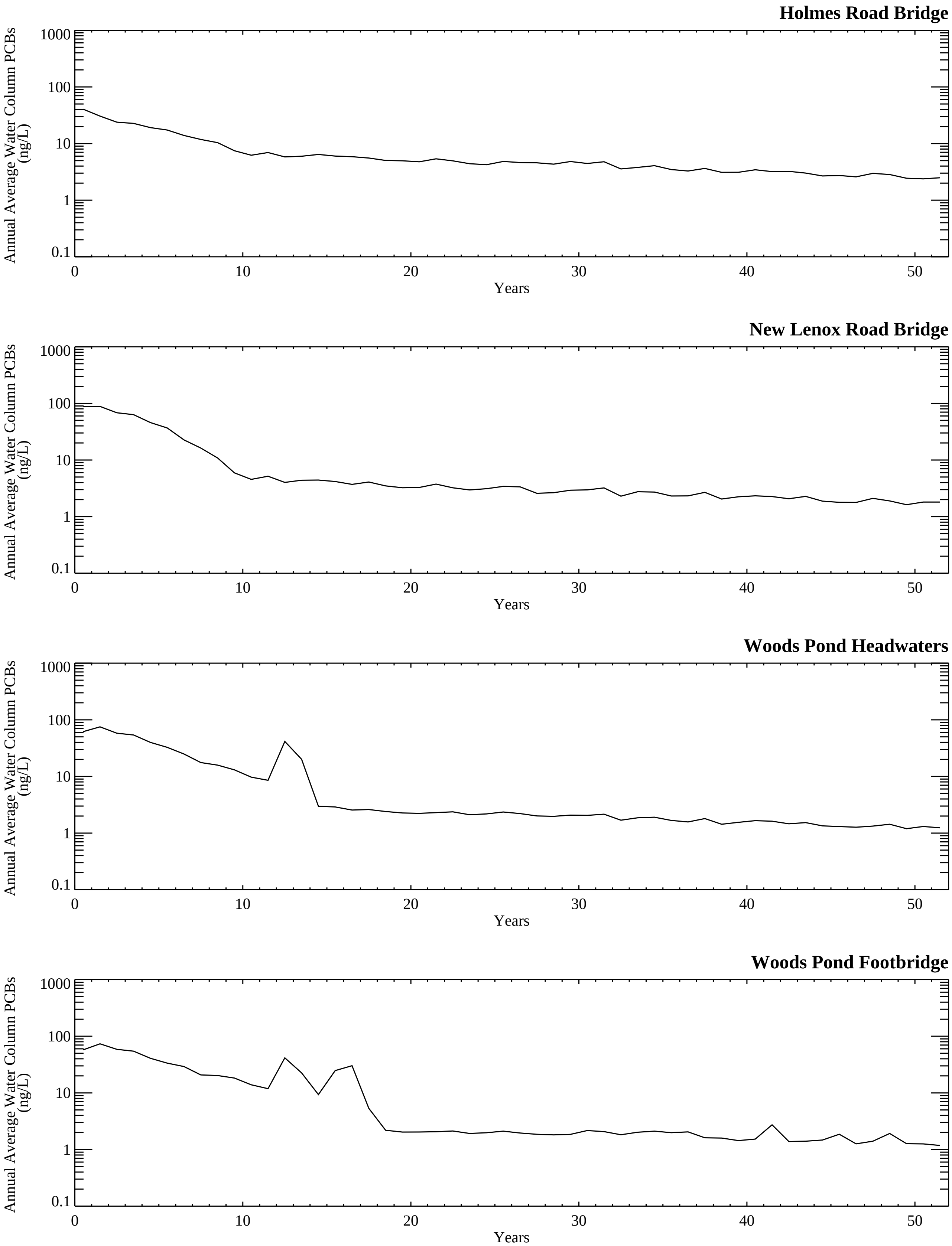

Figure G-1.1-4a. Temporal profiles of model-predicted water column PCB concentrations (SED 5; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED5CMSBS_0801-02

RRM - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\figure_g1_1_7_plot_wc.pro
Tue Mar 18 20:31:20 2008

SED 5; Base Case

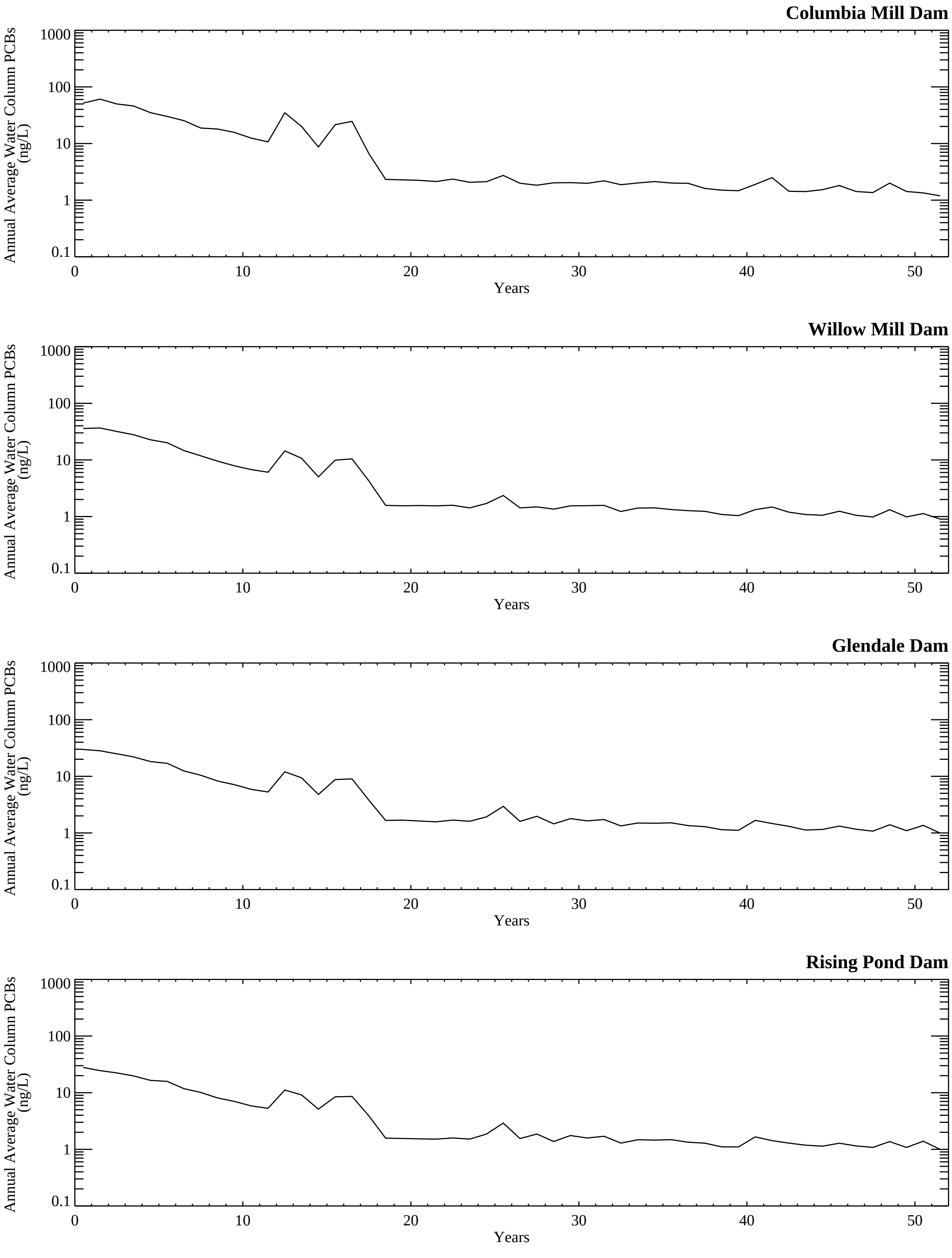

Figure G-1.1-4b. Temporal profiles of model-predicted water column PCB concentrations (SED 5; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\proj_R78_SED5CMSBS_0802-02

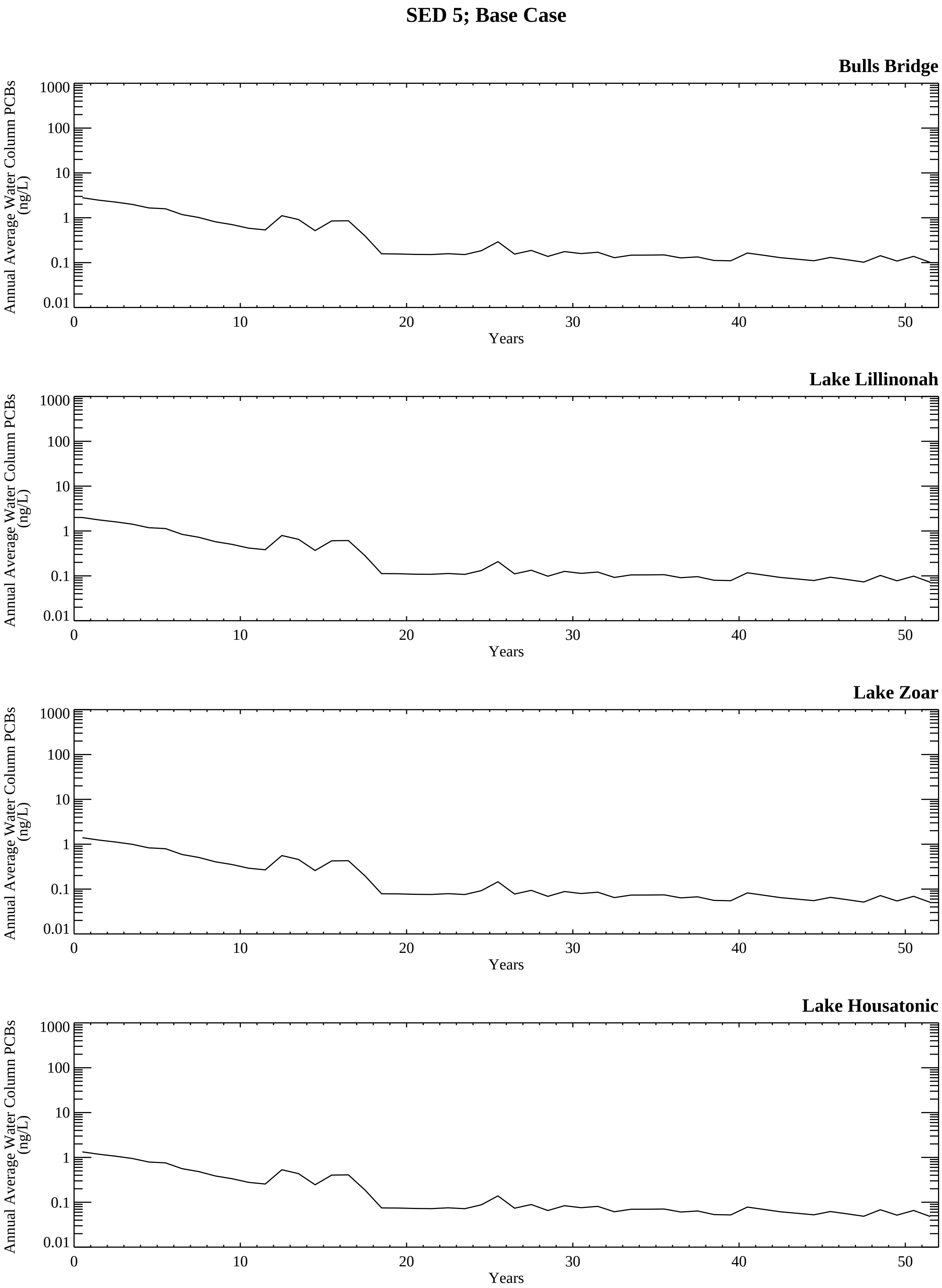

Figure G-1.1-4c. Temporal profiles of water column PCB concentrations estimated from the CT 1-D Analysis (SED 5; CT; Base Case).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED05_0802-02_base

SED 6; Base Case

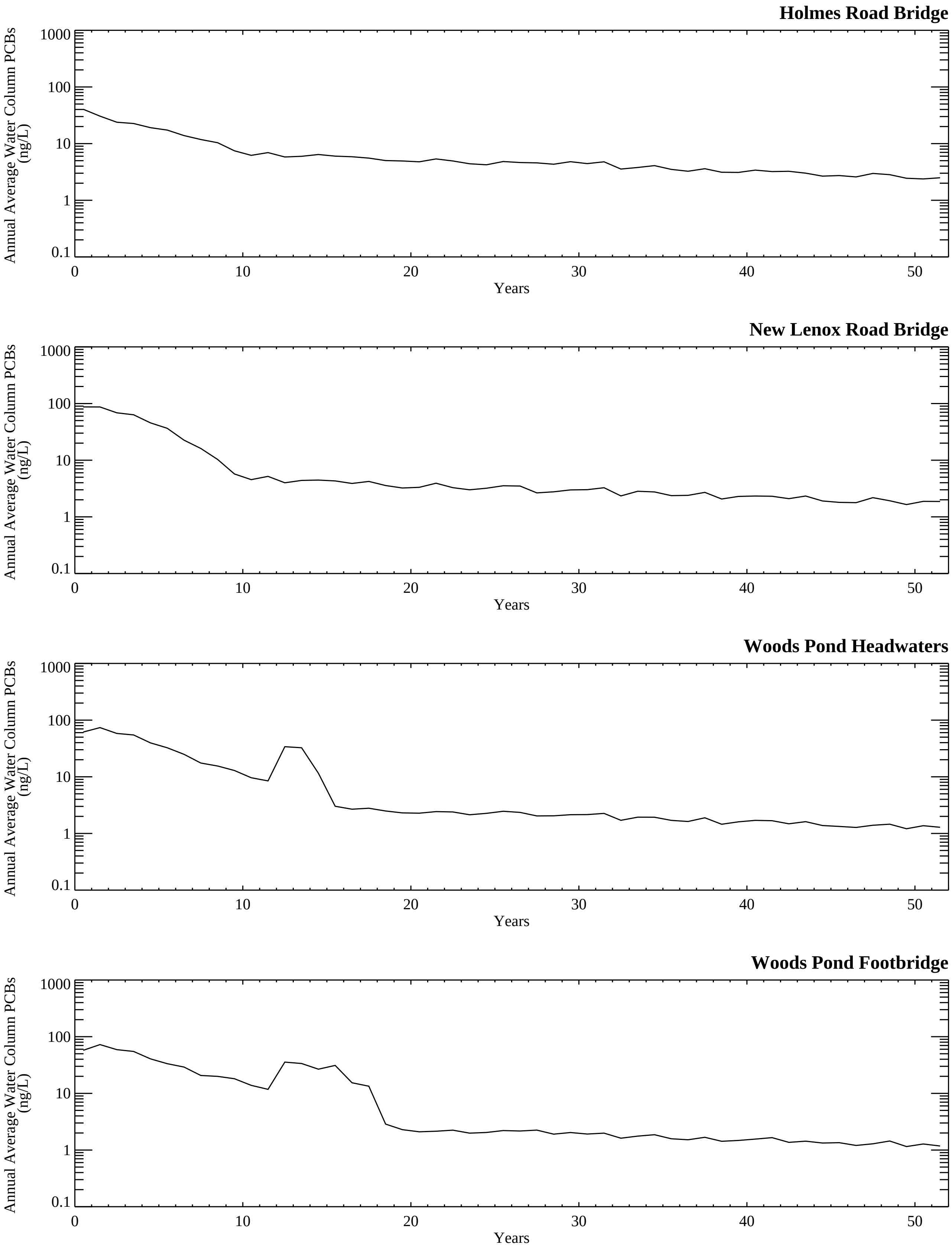

Figure G-1.1-5a. Temporal profiles of model-predicted water column PCB concentrations (SED 6; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED6CMSBS_0712-16

RRM - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\figure_g1_1_7_plot_wc.pro
Tue Mar 18 20:31:21 2008

SED 6; Base Case

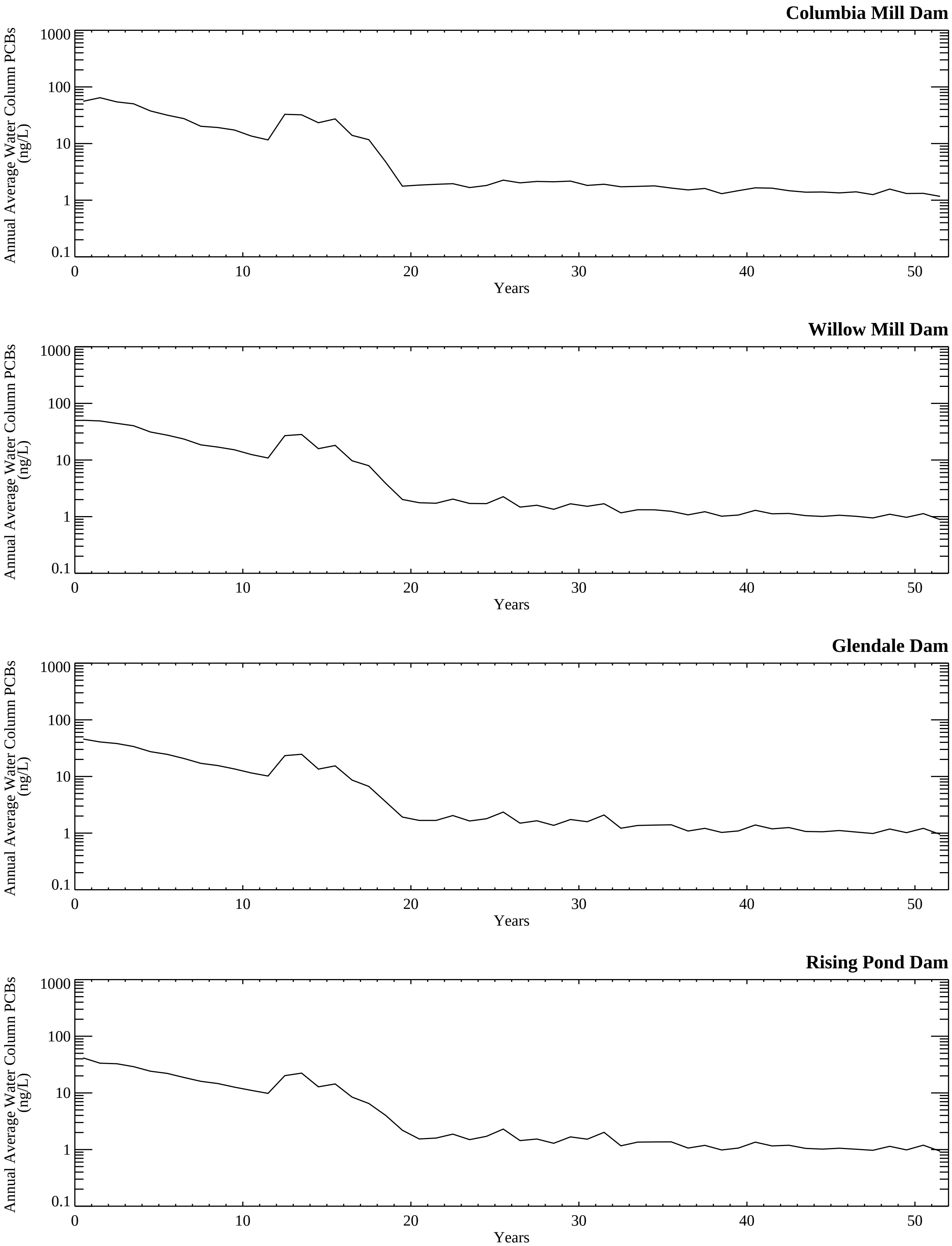

Figure G-1.1-5b. Temporal profiles of model-predicted water column PCB concentrations (SED 6; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED6CMSBS_0712-32

RRM - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\figure_g1_1_7_plot_wc.pro
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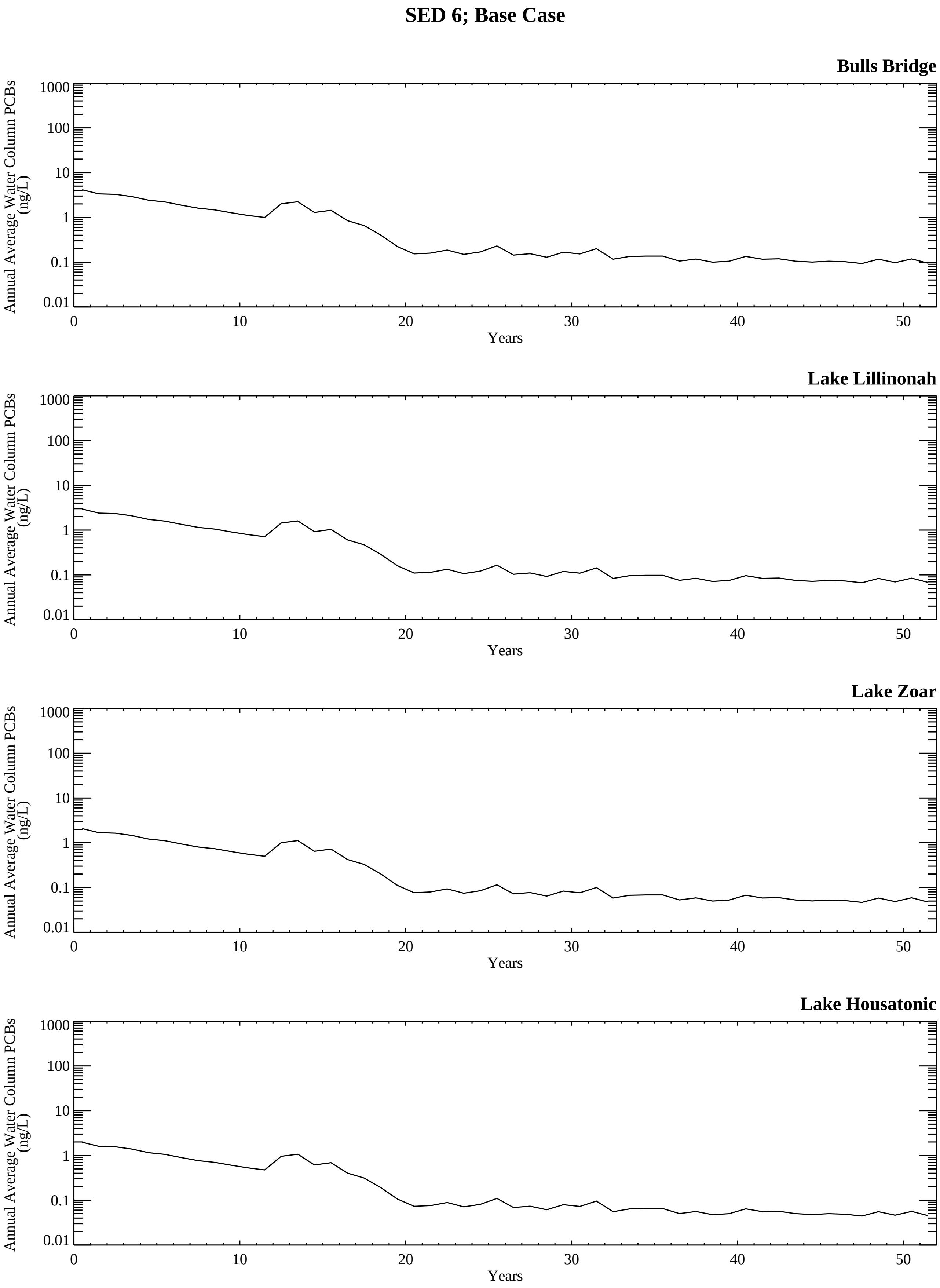

Figure G-1.1-5c. Temporal profiles of water column PCB concentrations estimated from the CT 1-D Analysis (SED 6; CT; Base Case).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED06_0712-32_base

if/wk - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\figure_g1_1_g1_5_temporal_wc_CT.pro
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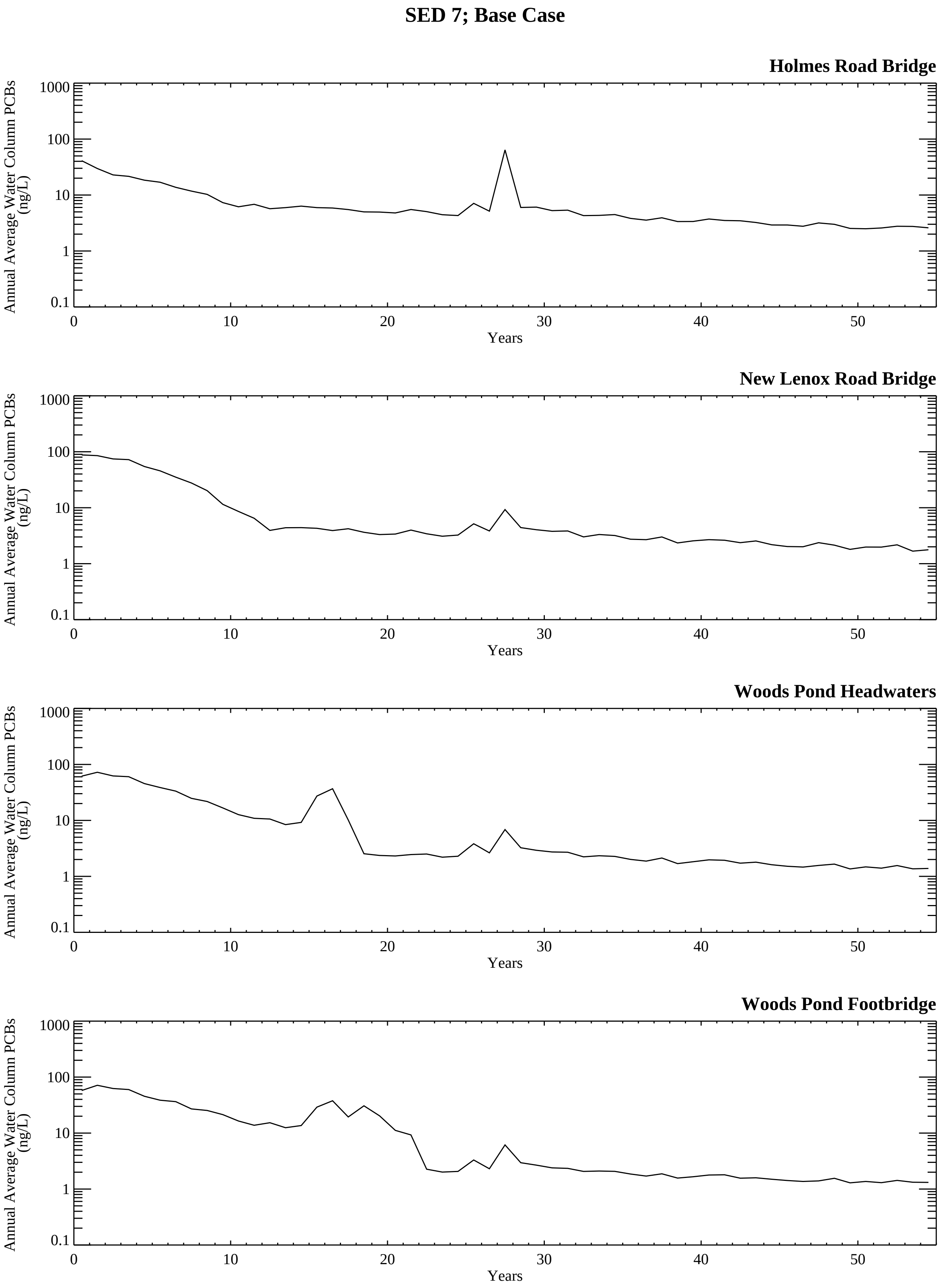

Figure G-1.1-6a. Temporal profiles of model-predicted water column PCB concentrations (SED 7; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED7CMSBS_0712-03

RRM - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\figure_g1_1_7_plot_wc.pro
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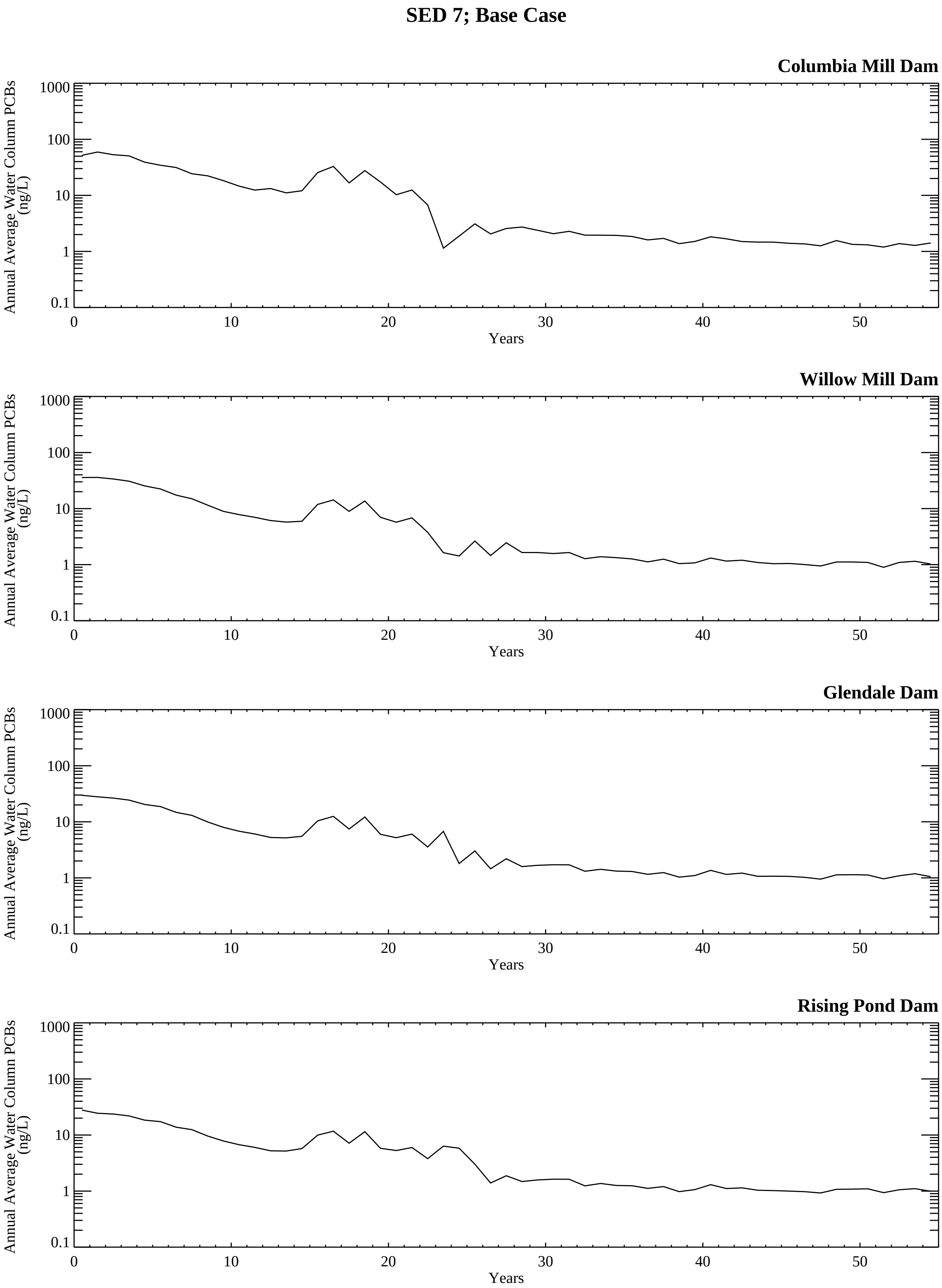

Figure G-1.1-6b. Temporal profiles of model-predicted water column PCB concentrations (SED 7; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED7CMSBS_0712-33

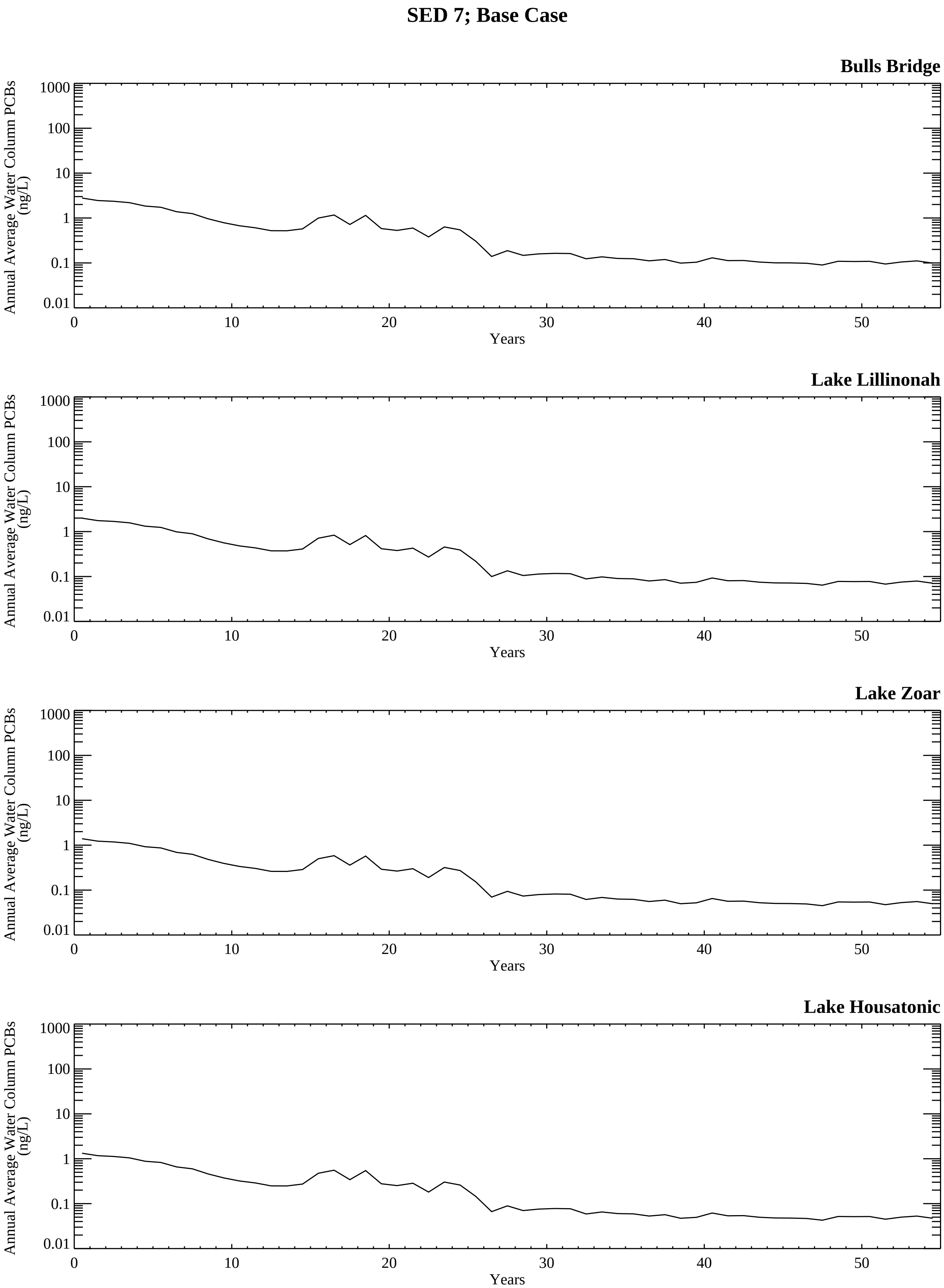

Figure G-1.1-6c. Temporal profiles of water column PCB concentrations estimated from the CT 1-D Analysis (SED 7; CT; Base Case).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED07_0712-33_base

if/wk - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\figure_g1_1_g1_5_temporal_wc_CT.pro
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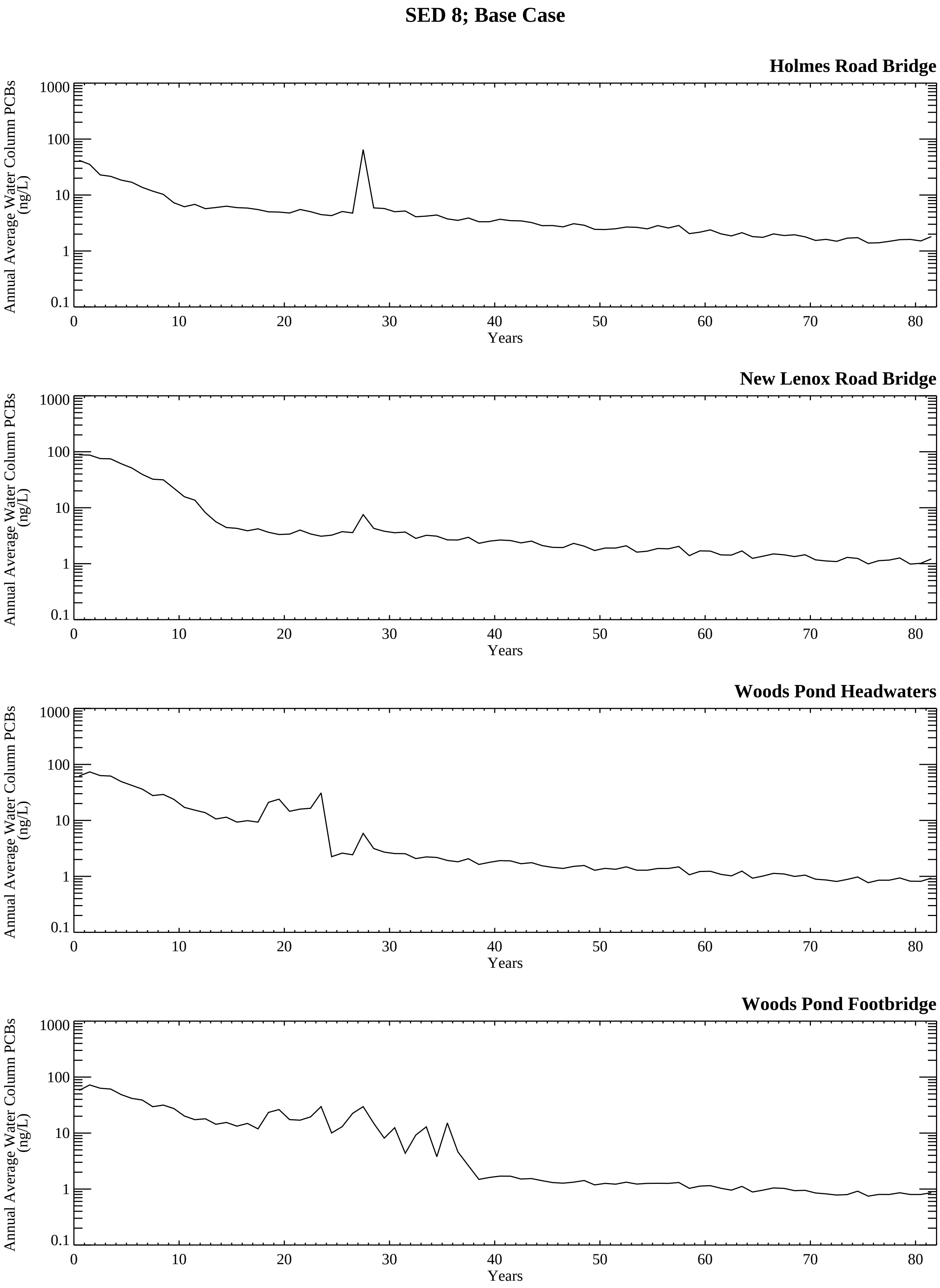
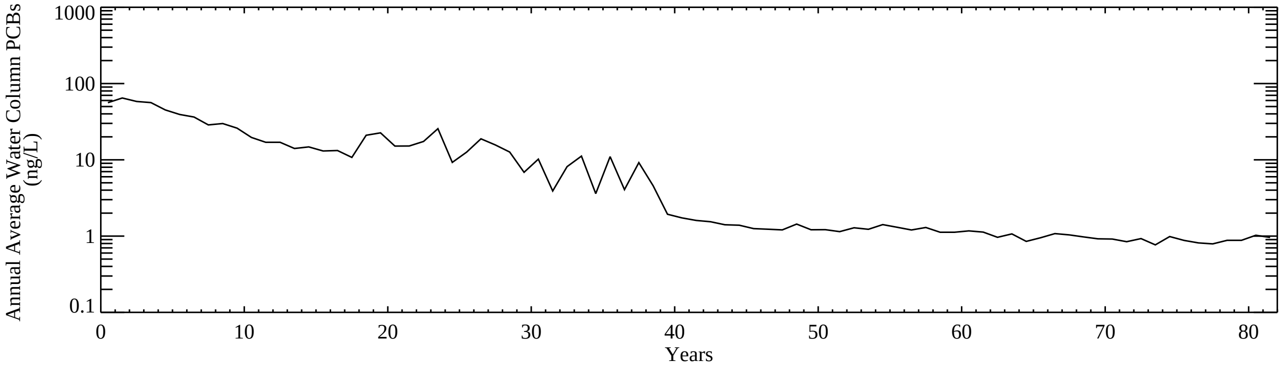


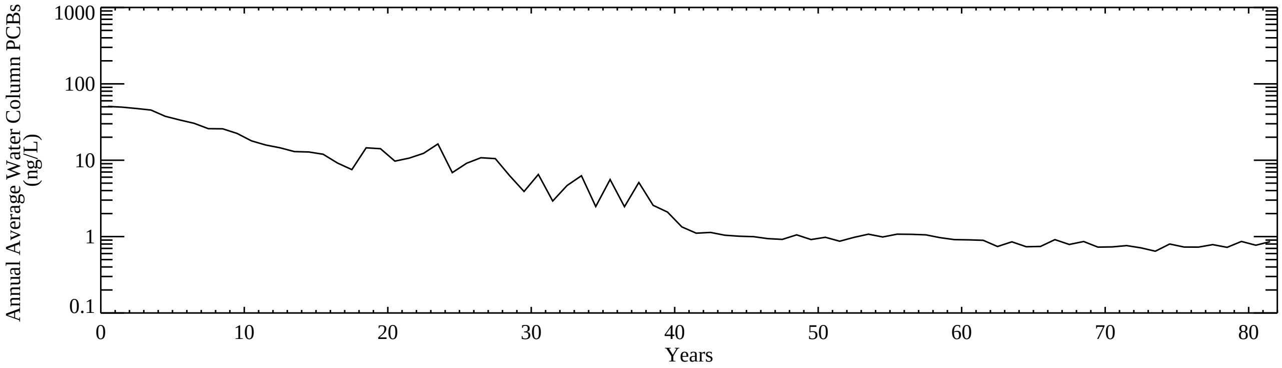
Figure G-1.1-7a. Temporal profiles of model-predicted water column PCB concentrations (SED 8; Reach 5/6; Base Case).

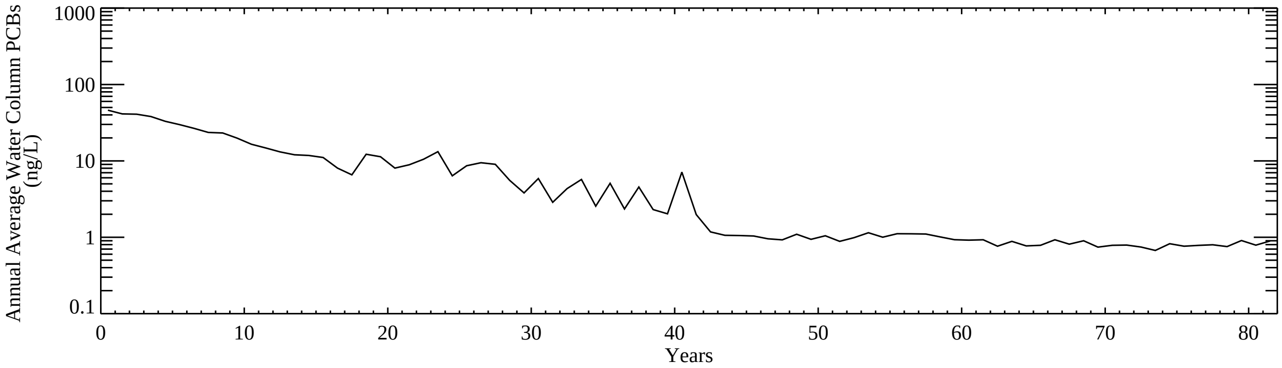
Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED8CMSBS_0712-18

RRM - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\figure_g1_1_7_plot_wc.pro
Tue Mar 18 20:31:25 2008

SED 8; Base Case


Columbia Mill Dam


Willow Mill Dam


Glendale Dam

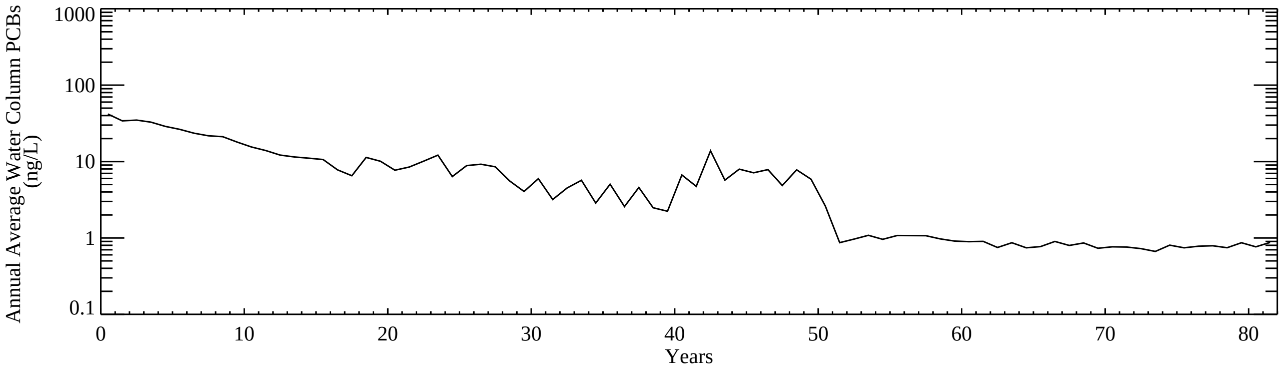

Rising Pond Dam

Figure G-1.1-7b. Temporal profiles of model-predicted water column PCB concentrations (SED 8; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED8CMSBS_0712-34

SED 8; Base Case

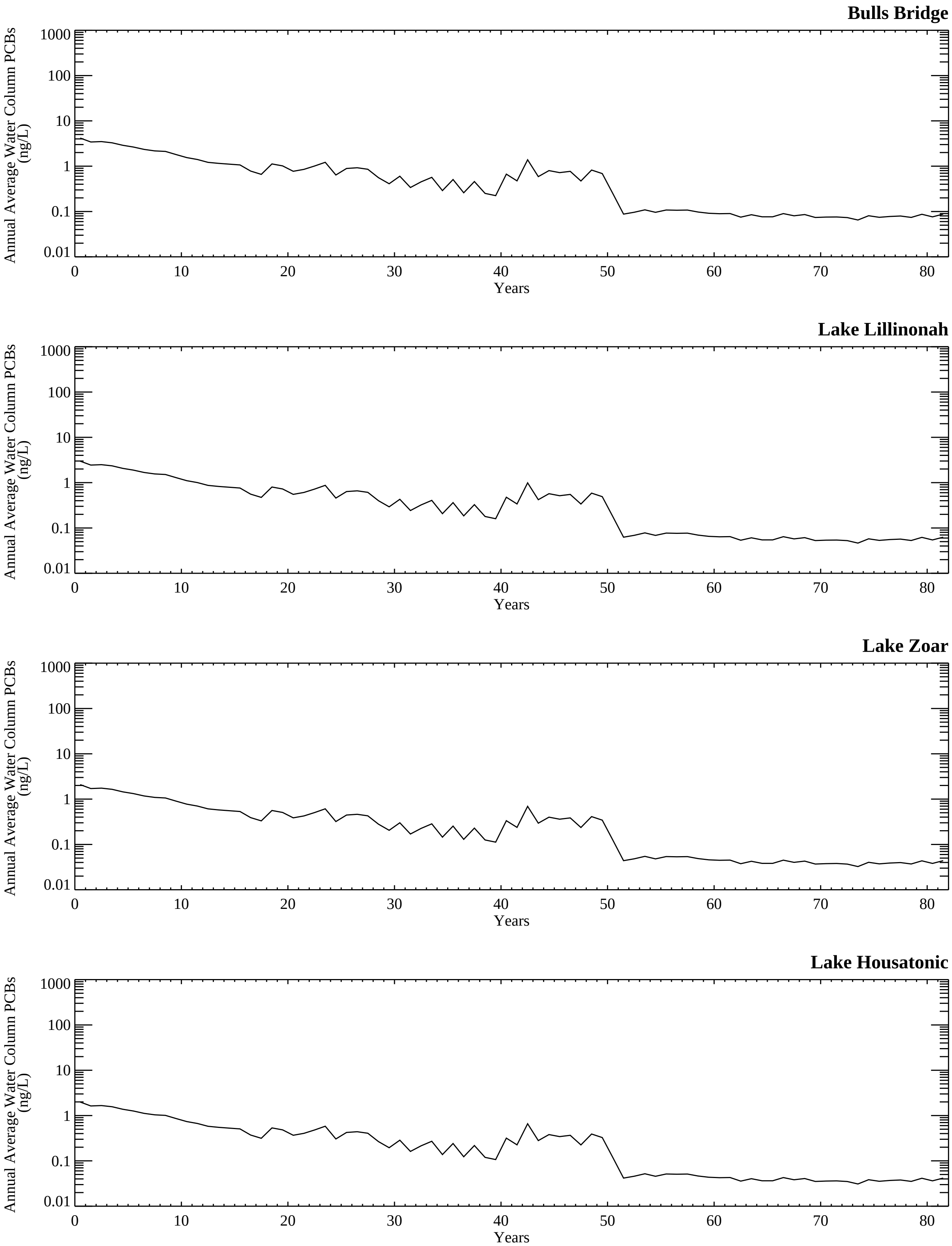
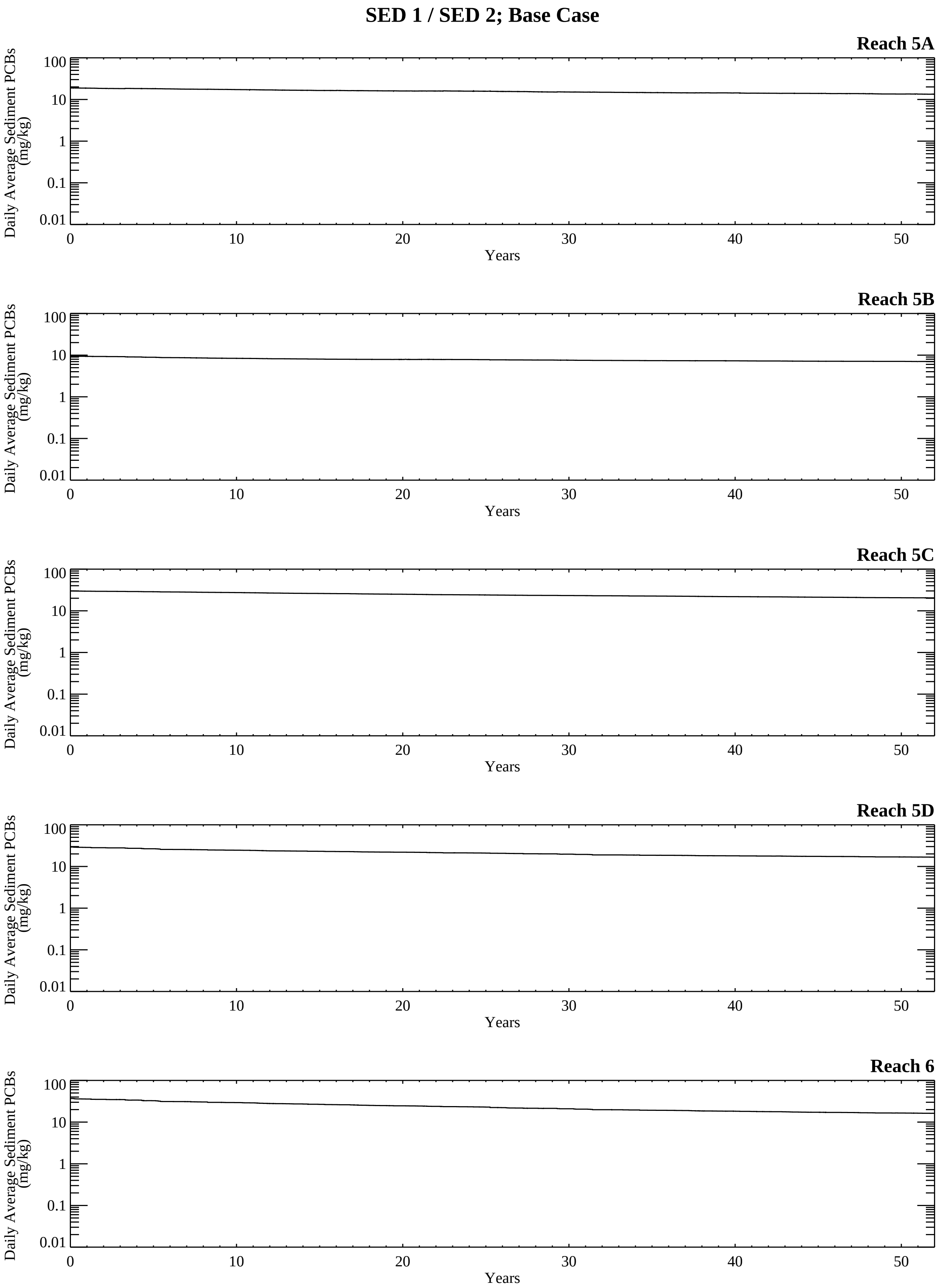


Figure G-1.1-7c. Temporal profiles of water column PCB concentrations estimated from the CT 1-D Analysis (SED 8; CT; Base Case).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED08_0712-34_base

if/wk - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\figure_g1_1_g1_5_temporal_wc_CT.pro
Wed Mar 19 10:57:34 2008



SED 1 / SED 2; Base Case

Reach 5A

Reach 5B

Reach 5C

Reach 5D

Reach 6

Figure G-1.2-1a. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 1 / SED 2; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED1CMSBS_0712-01\\bins

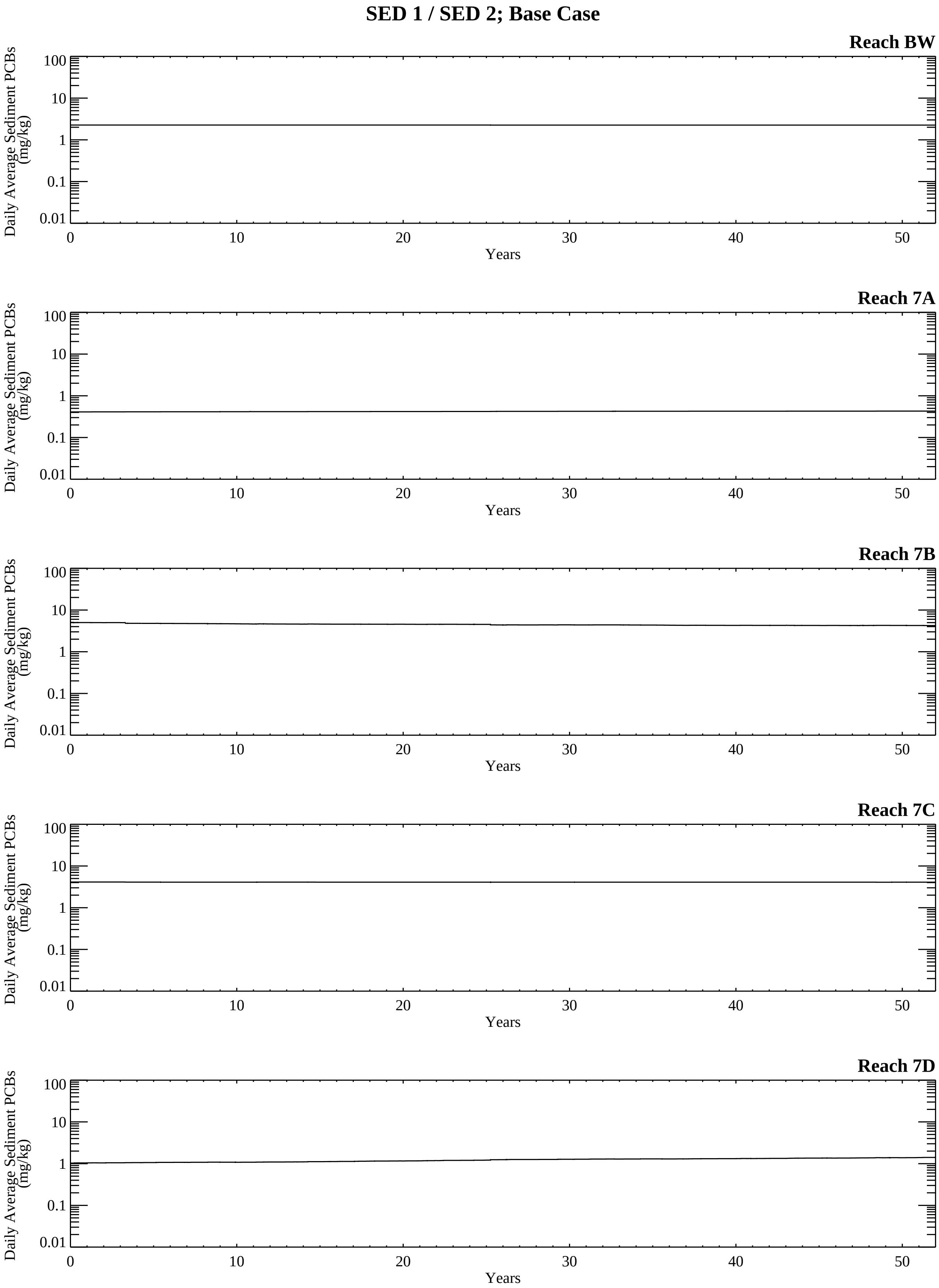


Figure G-1.2-1b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 1 / SED 2; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED1CMSBS_0712-28\\bins

SED 1 / SED 2; Base Case

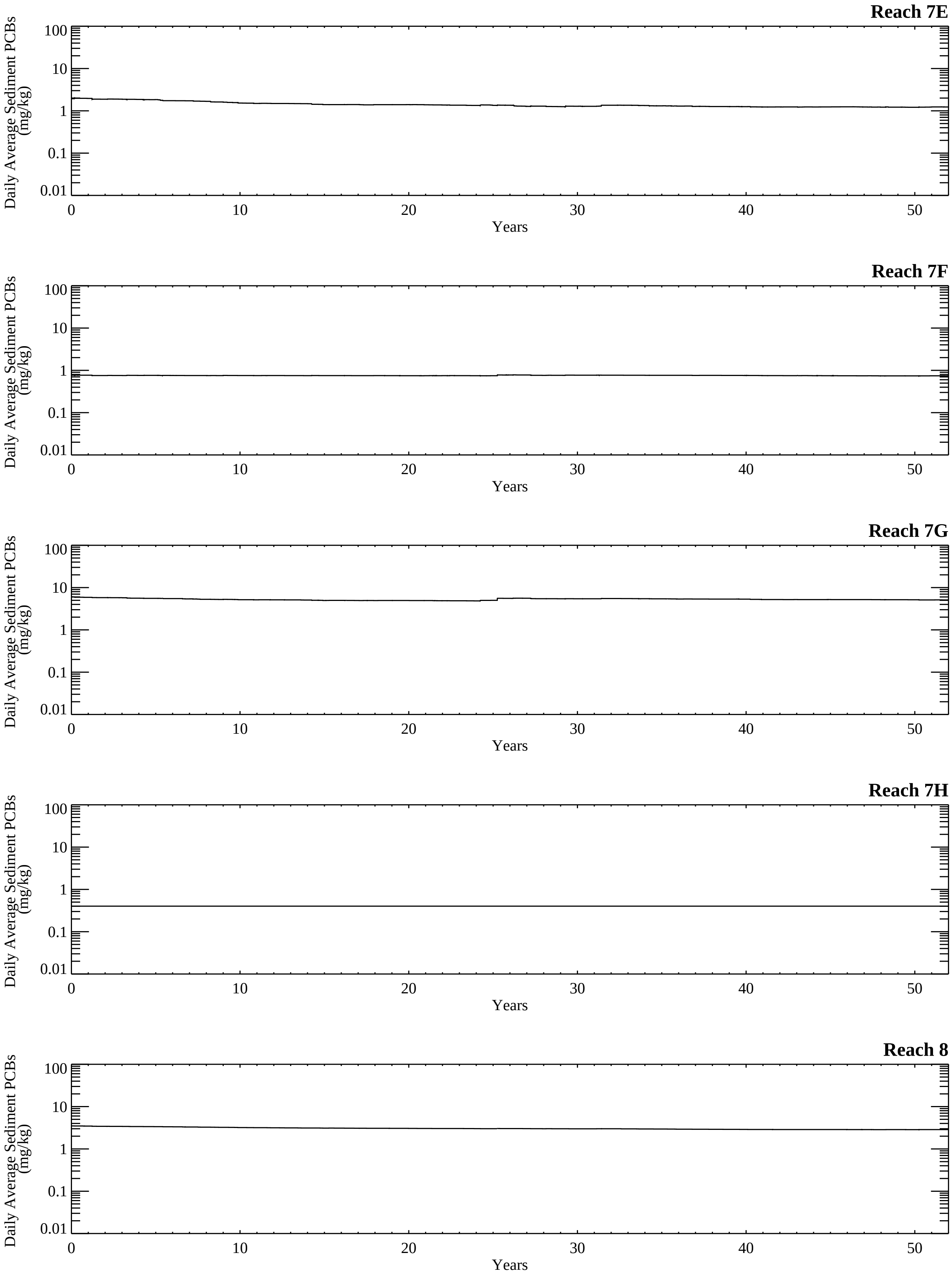


Figure G-1.2-1b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 1 / SED 2; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED1CMSBS_0712-28\\bins

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Wed Mar 19 11:21:46 2008

SED 1 / SED 2; Base Case

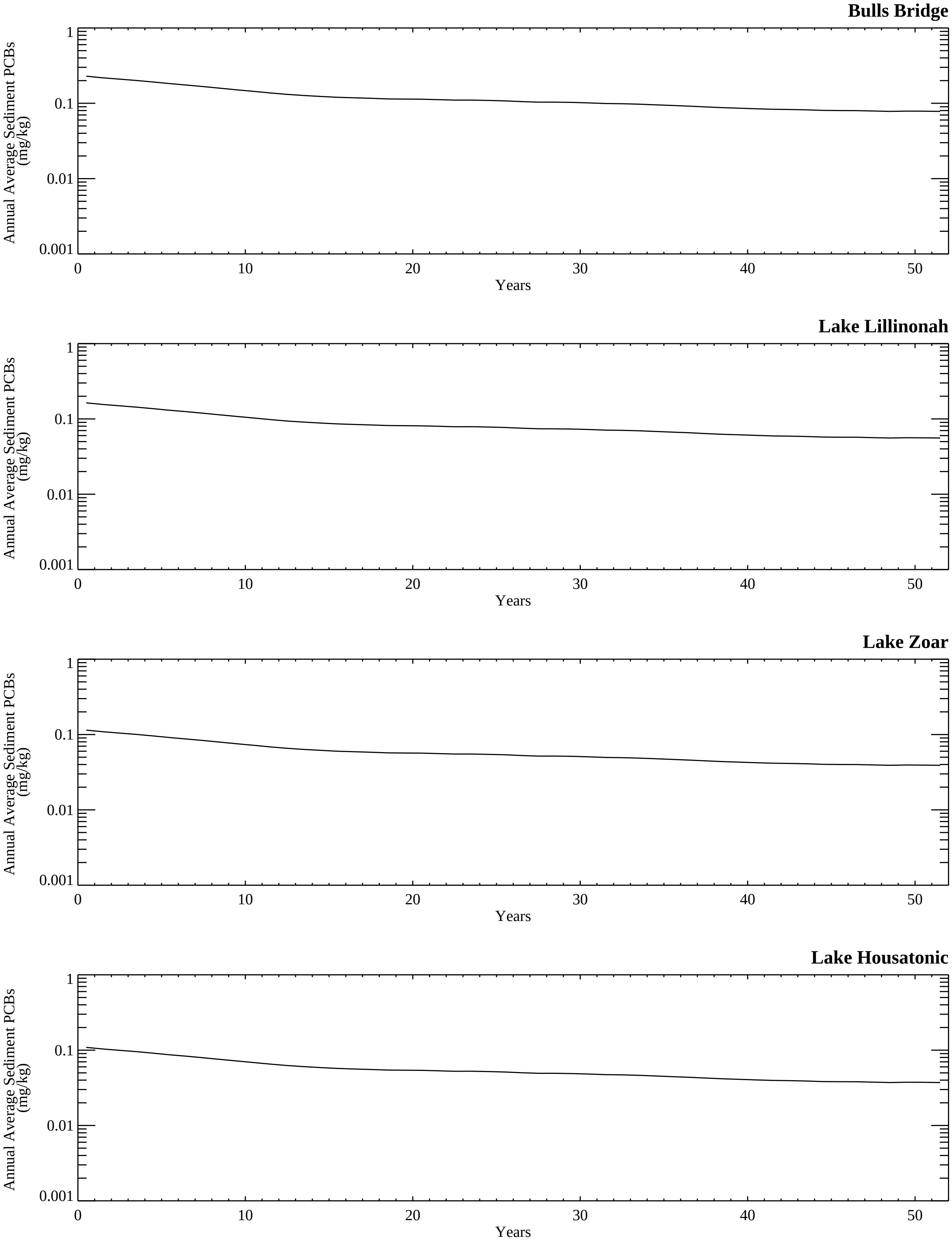


Figure G-1.2-1c. Temporal profiles of average surface sediment (0-6") PCB concentrations estimated from the CT 1-D Analysis (SED 1 / SED 2; CT; Base Case).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED01_0712-28_base

if/wk - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\figure_g1_2_g1_6_temporal_sed_CT.pro
Wed Mar 19 10:58:33 2008

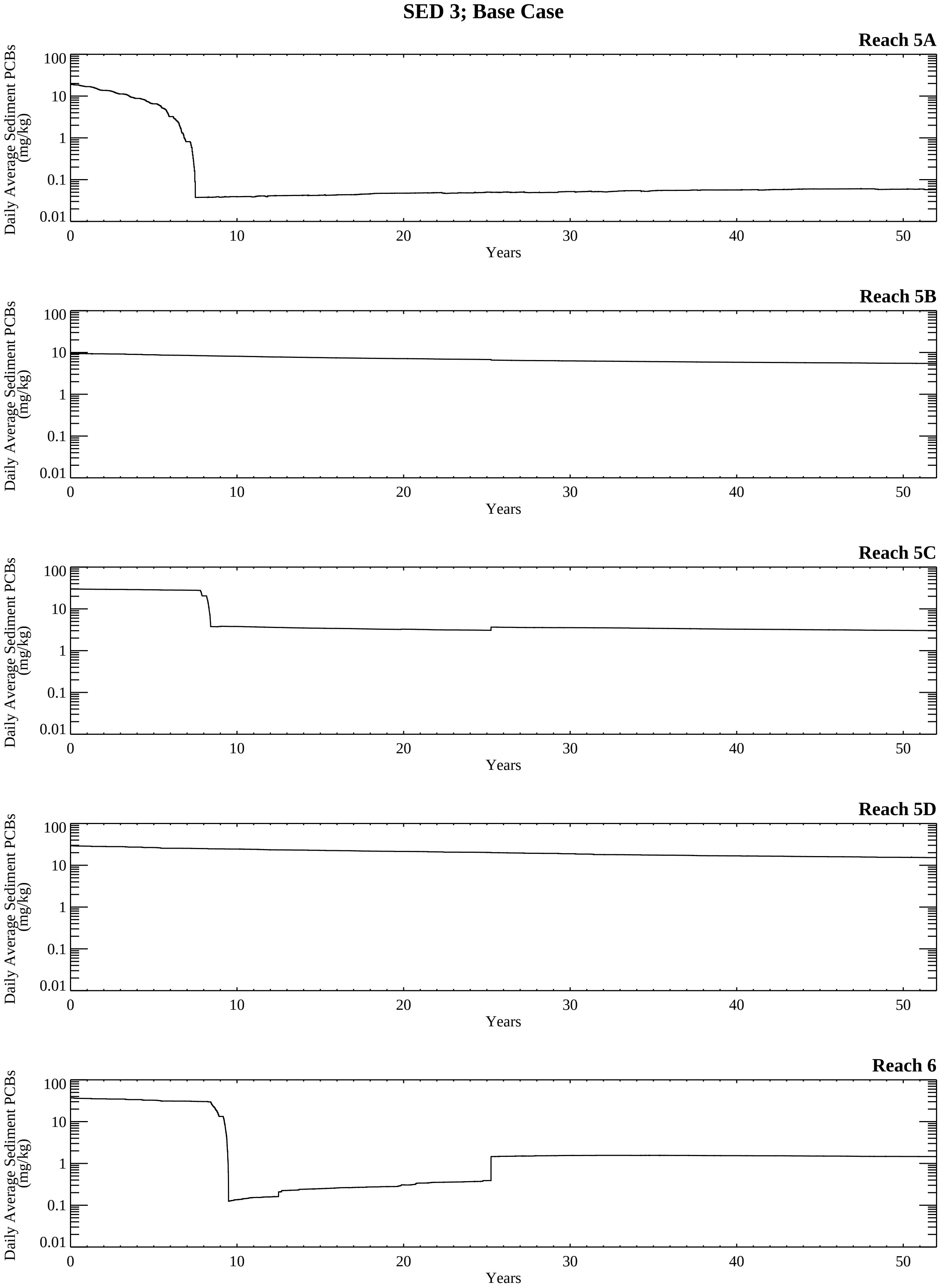


Figure G-1.2-2a. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 3; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED3CMSBS_0712-13\\bins

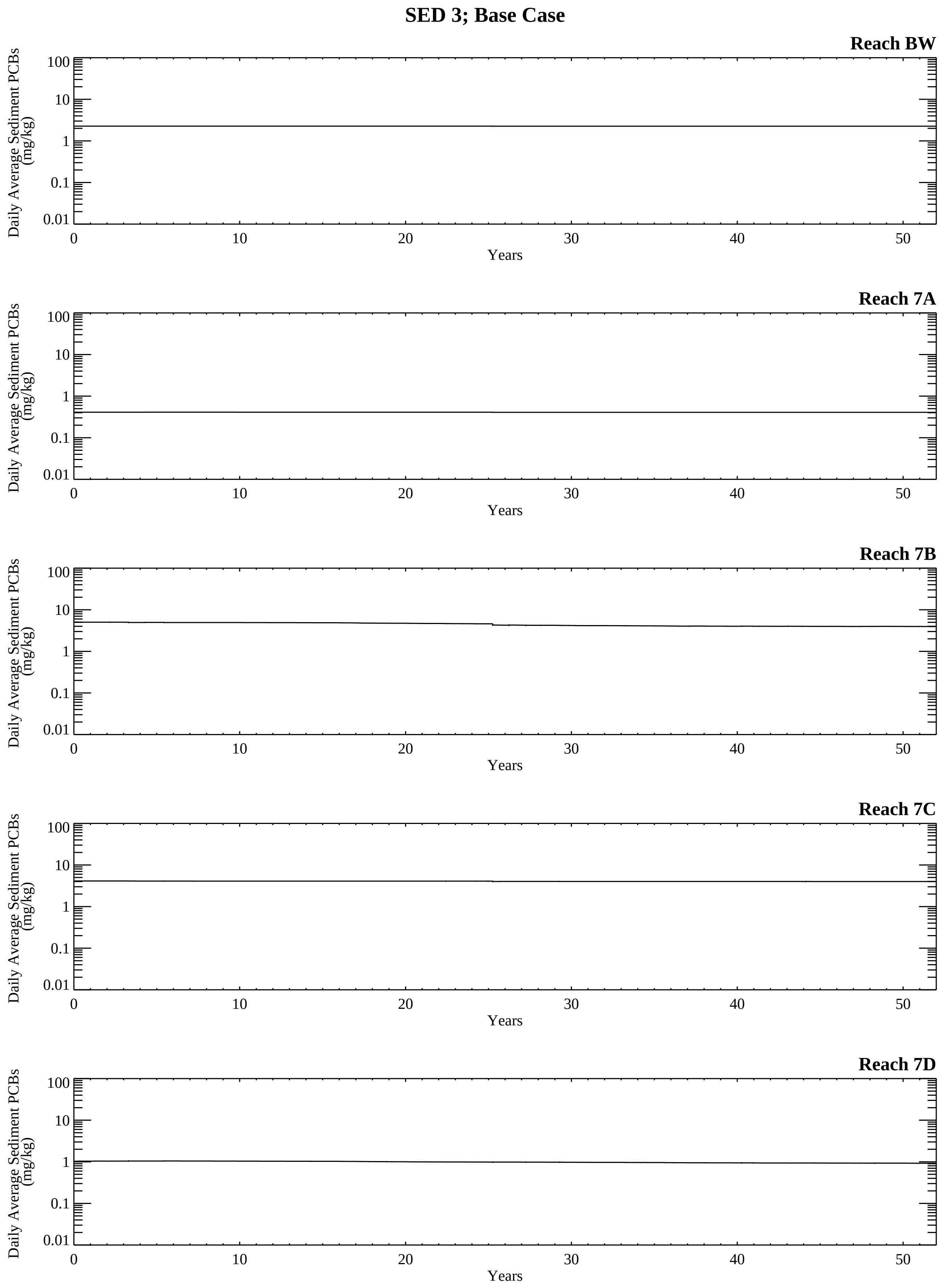


Figure G-1.2-2b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 3; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED3CMSBS_0712-29\\bins

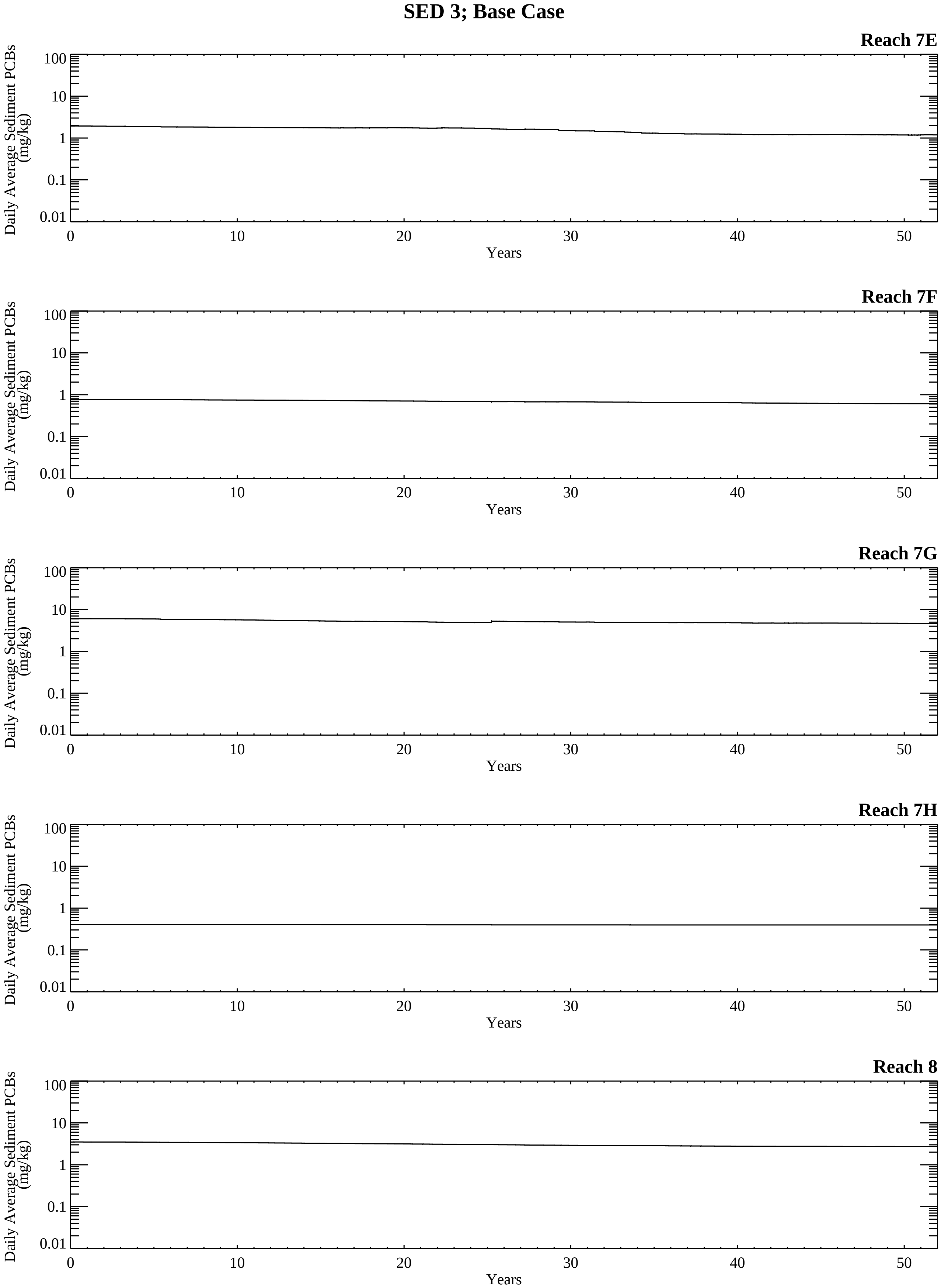


Figure G-1.2-2b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 3; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED3CMSBS_0712-29\\bins

SED 3; Base Case

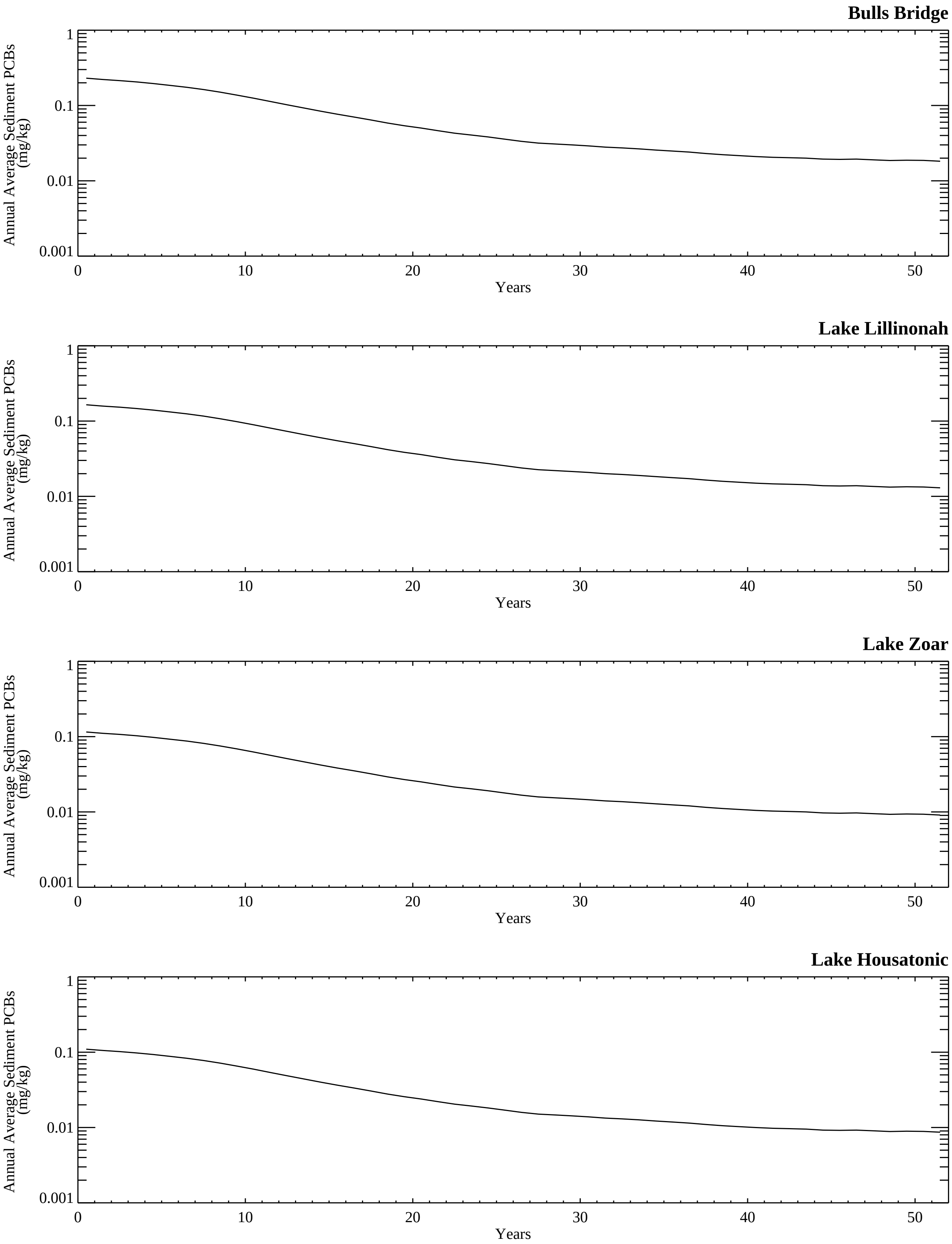


Figure G-1.2-2c. Temporal profiles of average surface sediment (0-6") PCB concentrations estimated from the CT 1-D Analysis (SED 3; CT; Base Case).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED03_0712-29_base

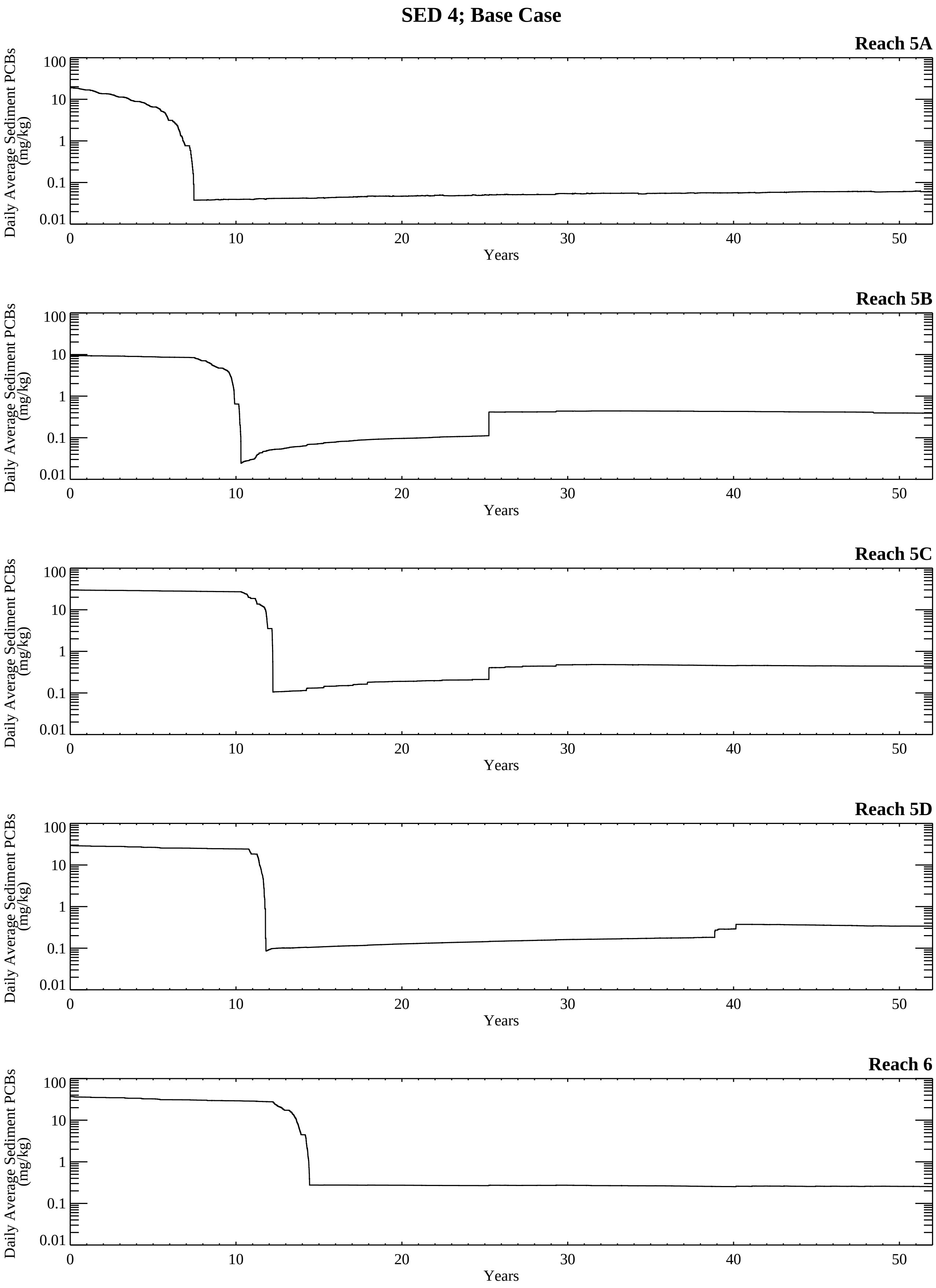


Figure G-1.2-3a. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 4; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED4CMSBS_0801-01\\bins

SED 4; Base Case

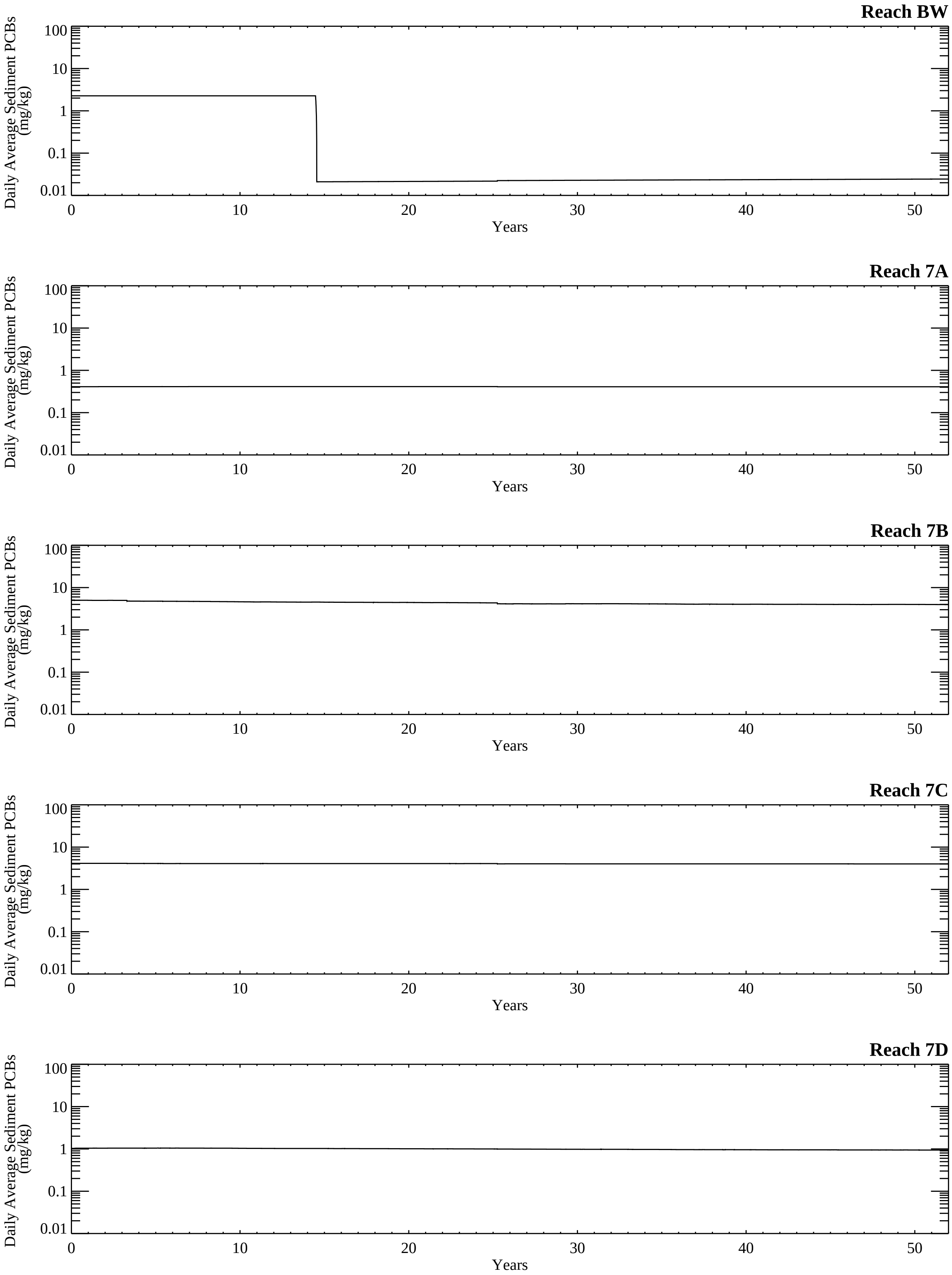


Figure G-1.2-3b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 4; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED4CMSBS_0802-01\\bins

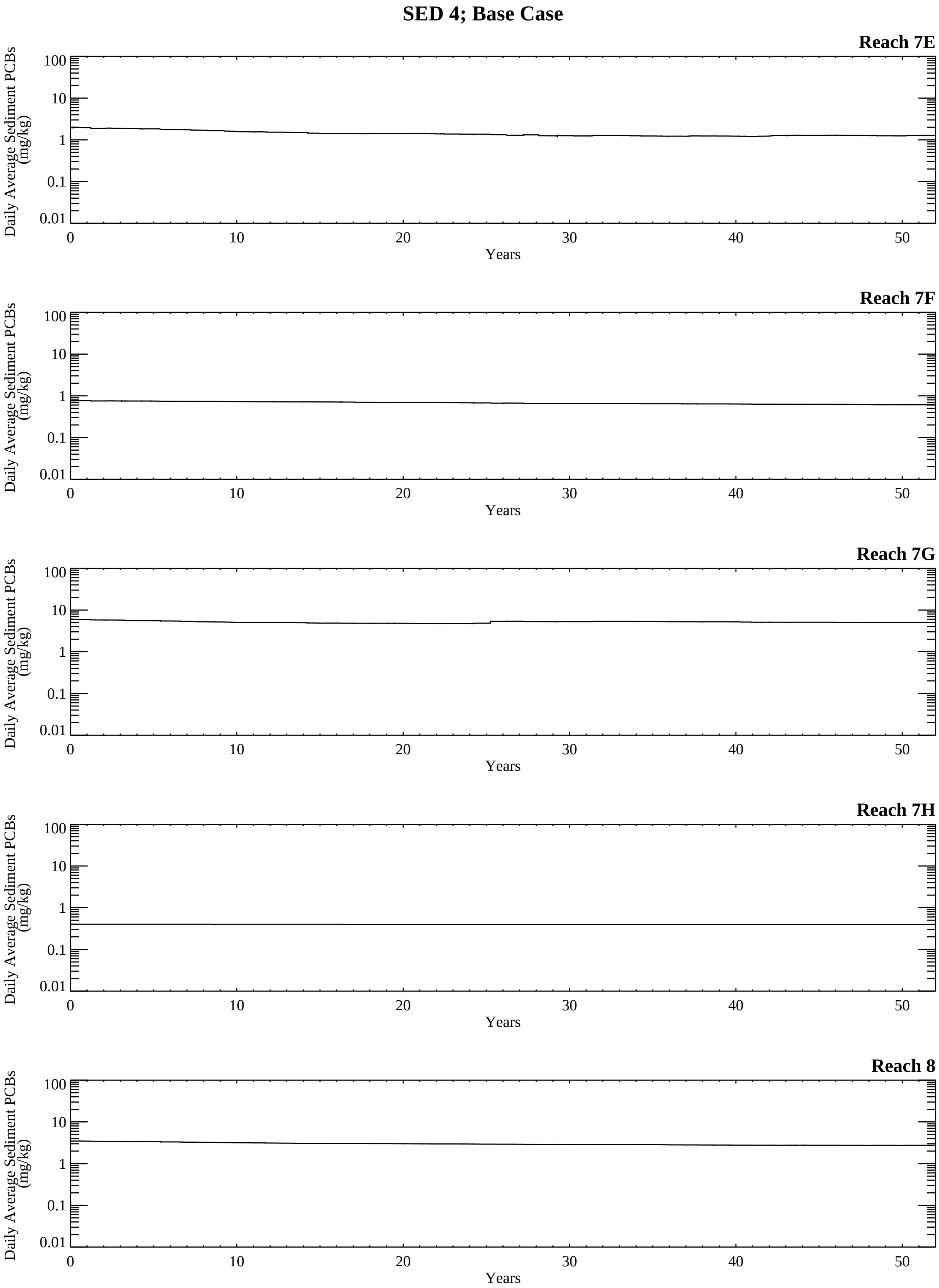


Figure G-1.2-3b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 4; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED4CMSBS_0802-01\\bins

SED 4; Base Case

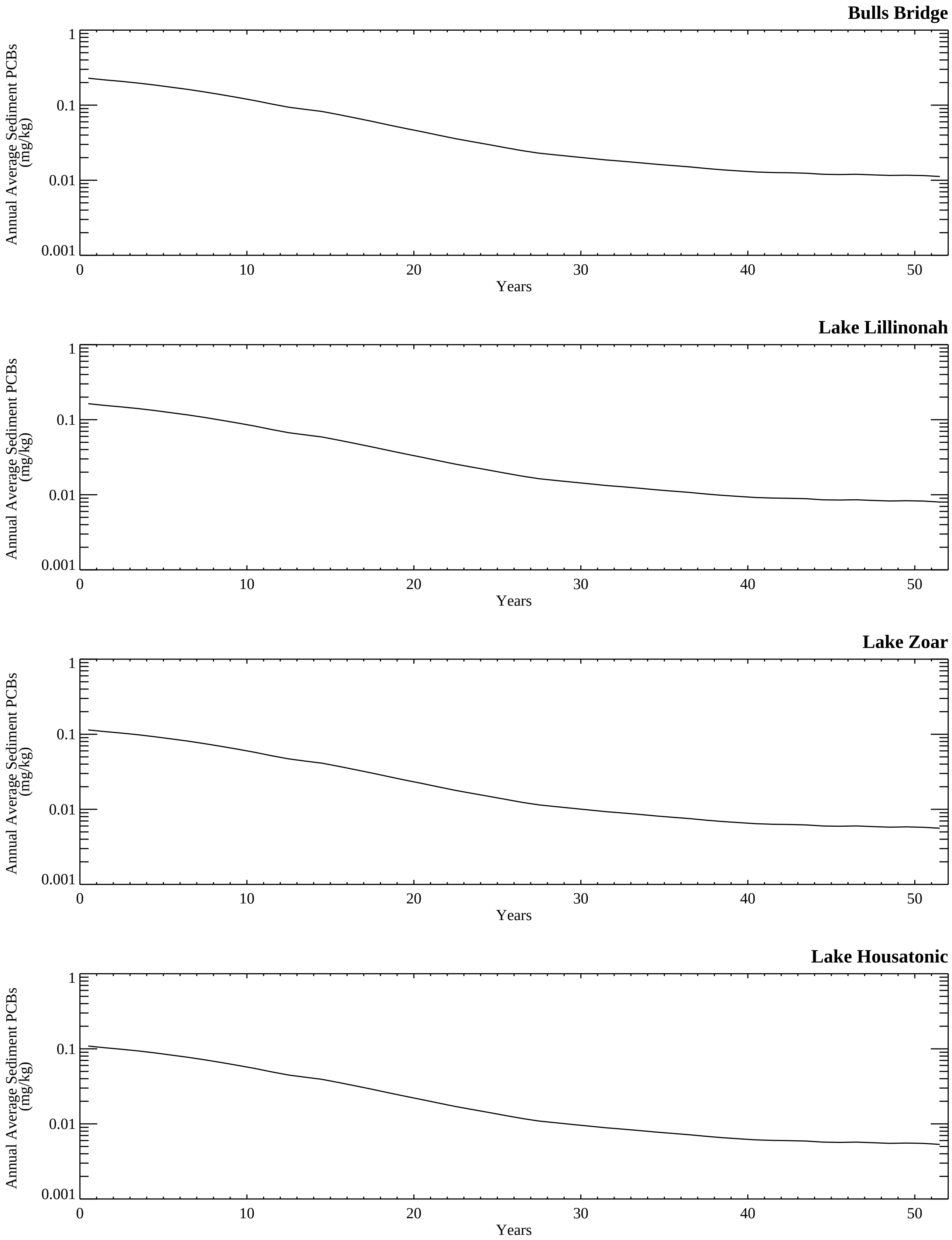
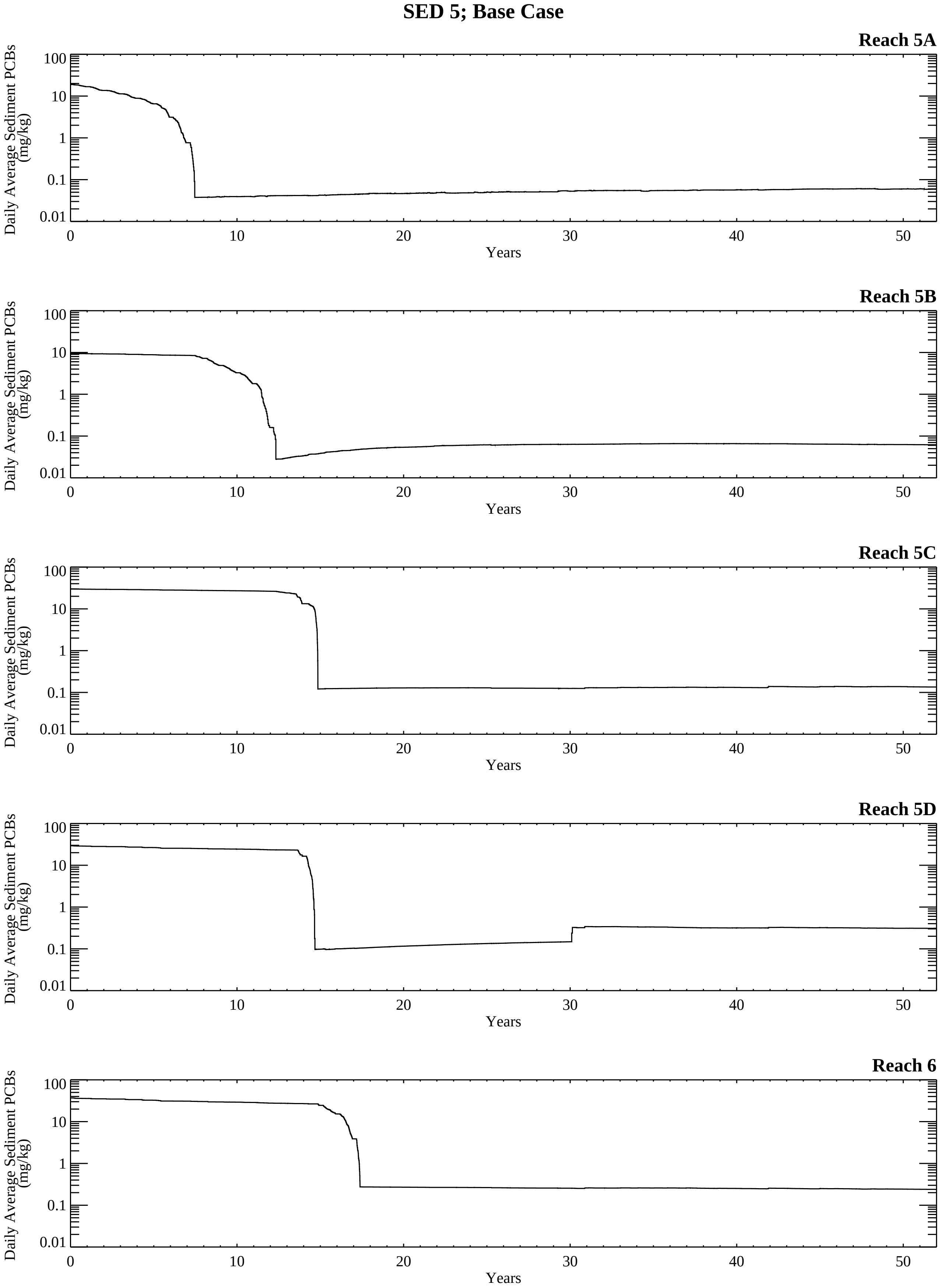


Figure G-1.2-3c. Temporal profiles of average surface sediment (0-6") PCB concentrations estimated from the CT 1-D Analysis (SED 4; CT; Base Case).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED04_0802-01_base


SED 5; Base Case

Reach 5A

Reach 5B

Reach 5C

Reach 5D

Reach 6

Figure G-1.2-4a. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 5; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED5CMSBS_0801-02\\bins

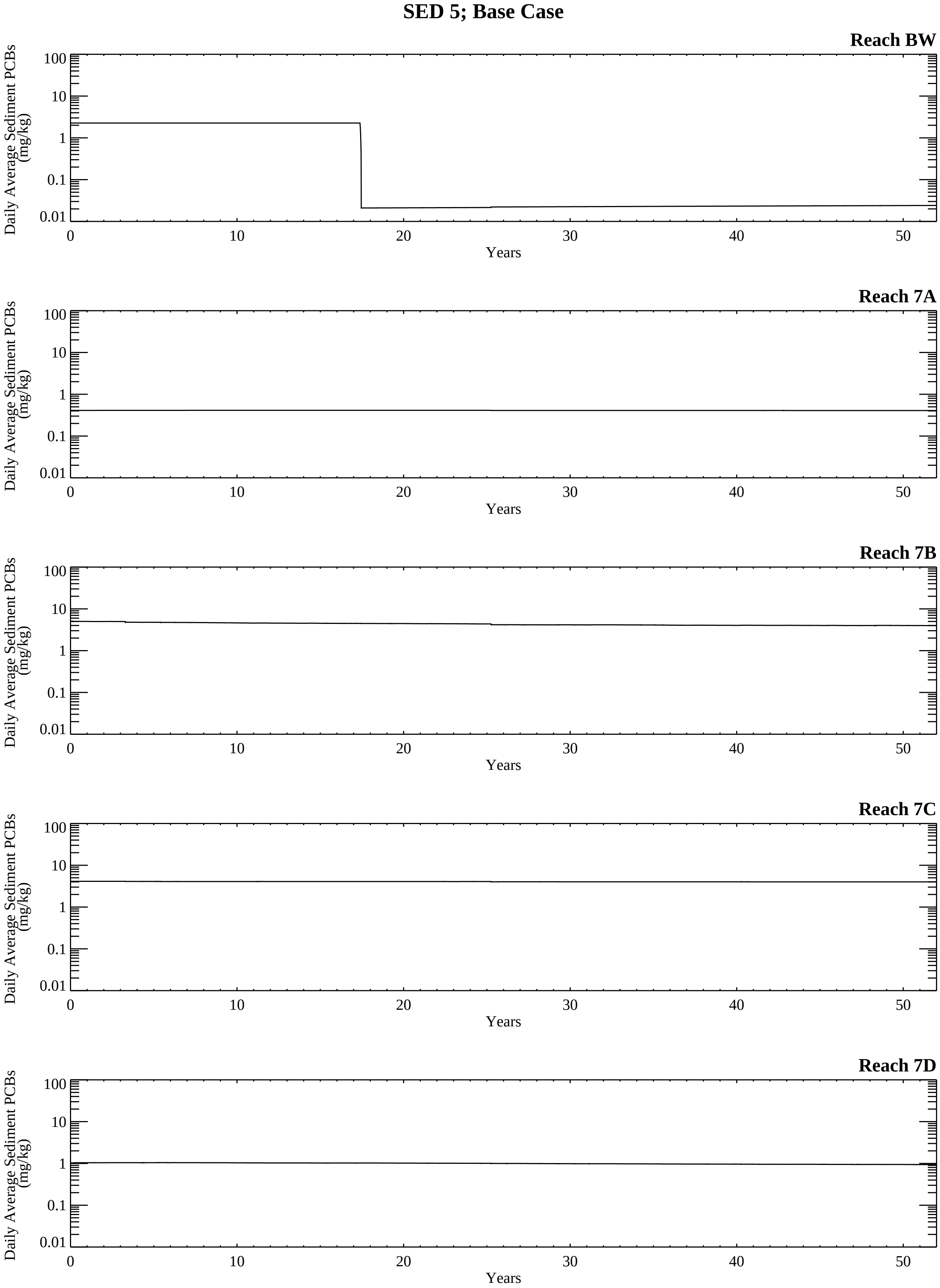


Figure G-1.2-4b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 5; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\proj_R78_SED5CMSBS_0802-02\\bins

SED 5; Base Case

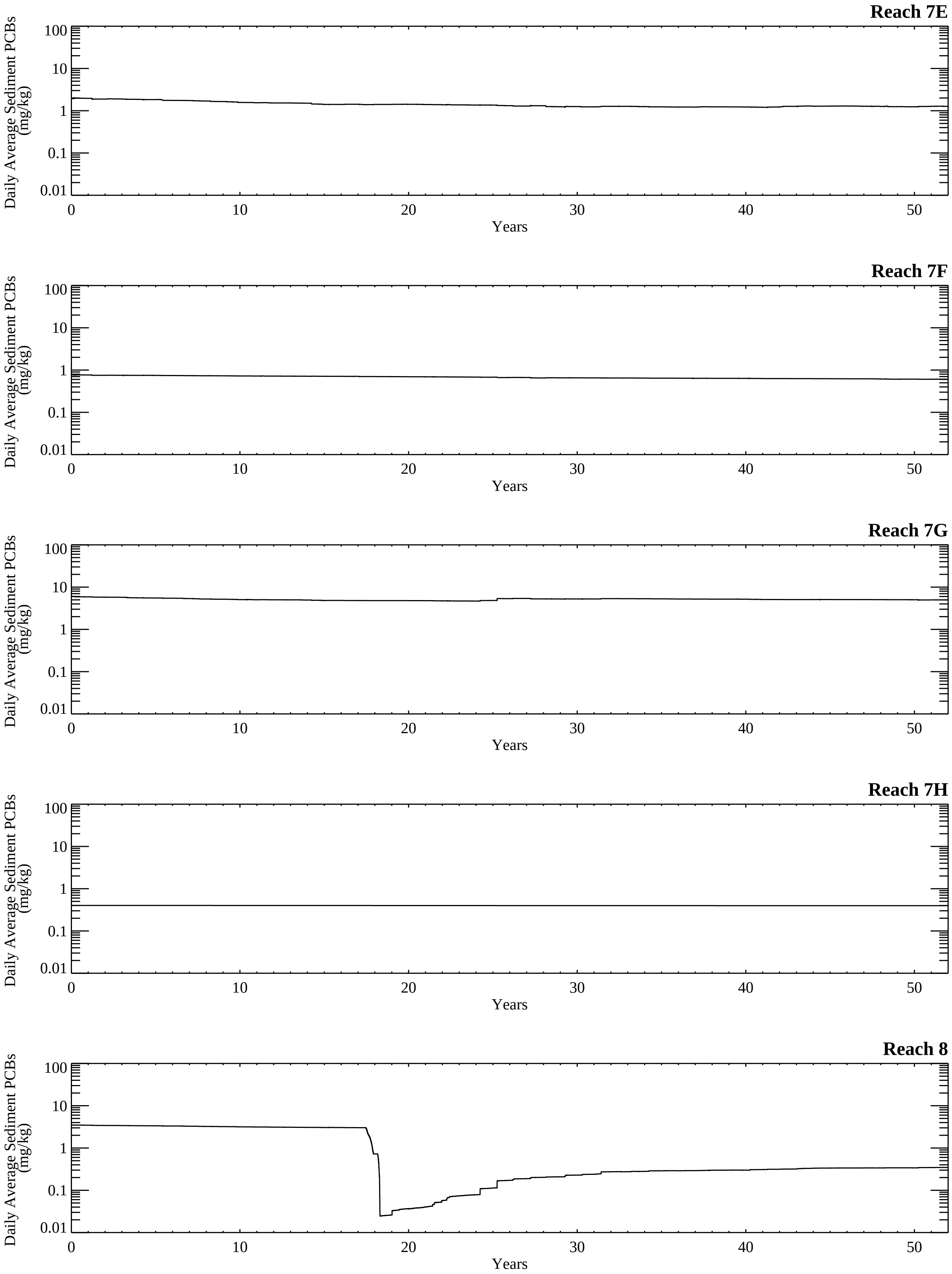


Figure G-1.2-4b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 5; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\proj_R78_SED5CMSBS_0802-02\\bins

SED 5; Base Case

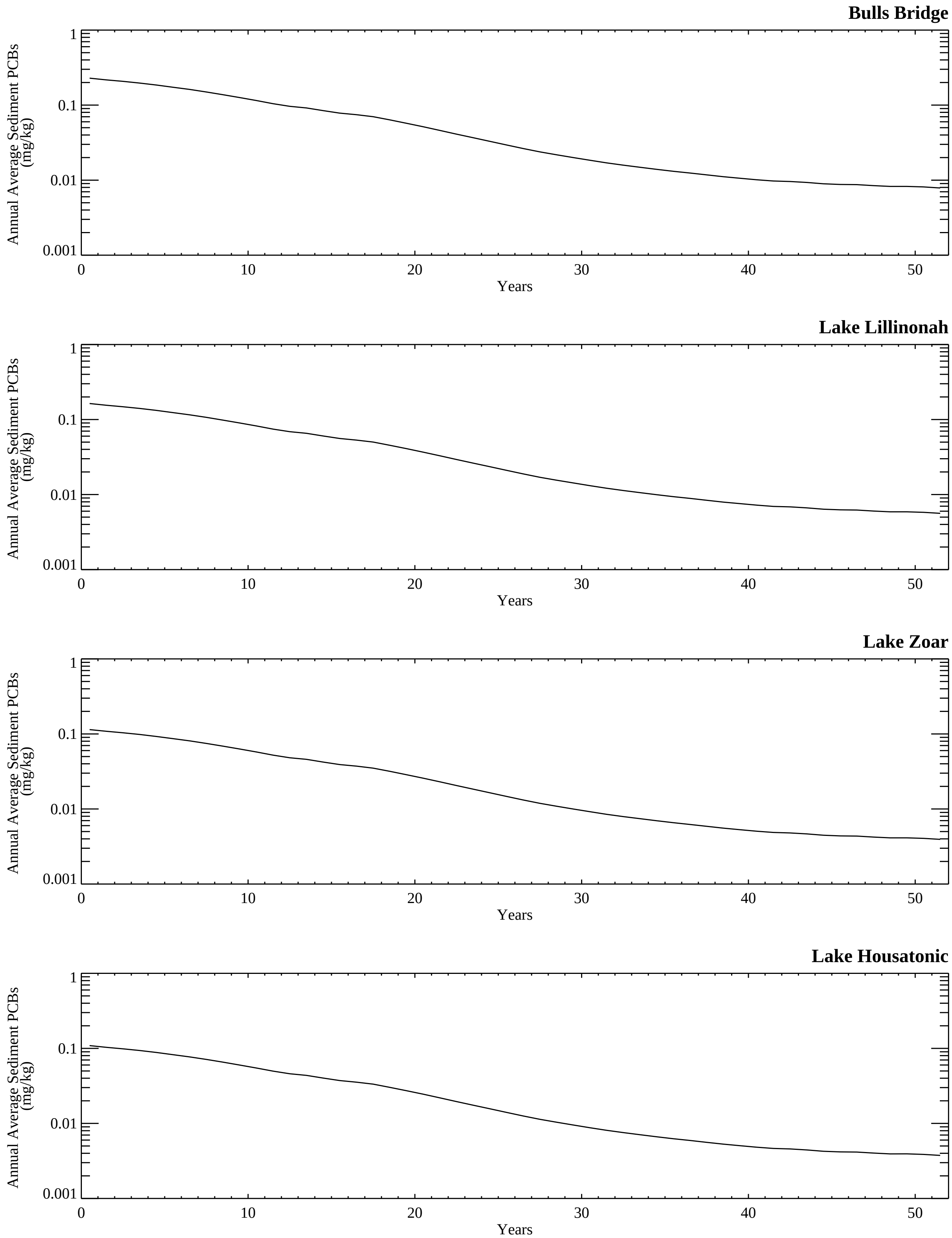


Figure G-1.2-4c. Temporal profiles of average surface sediment (0-6") PCB concentrations estimated from the CT 1-D Analysis (SED 5; CT; Base Case).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED05_0802-02_base

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Wed Mar 19 10:58:35 2008

SED 6; Base Case

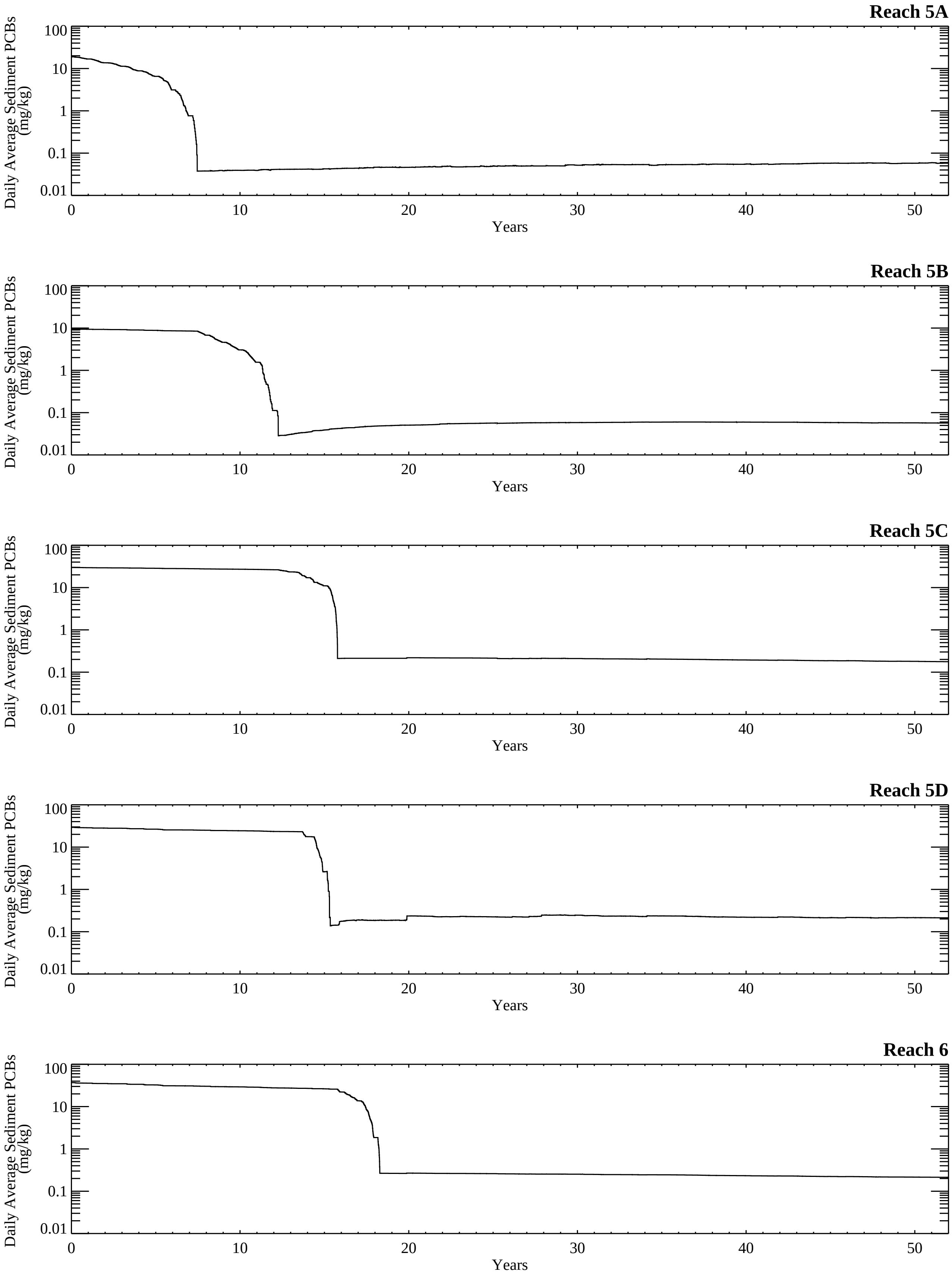

Figure G-1.2-5a. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 6; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED6CMSBS_0712-16\\bins

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Wed Mar 19 11:05:02 2008

SED 6; Base Case

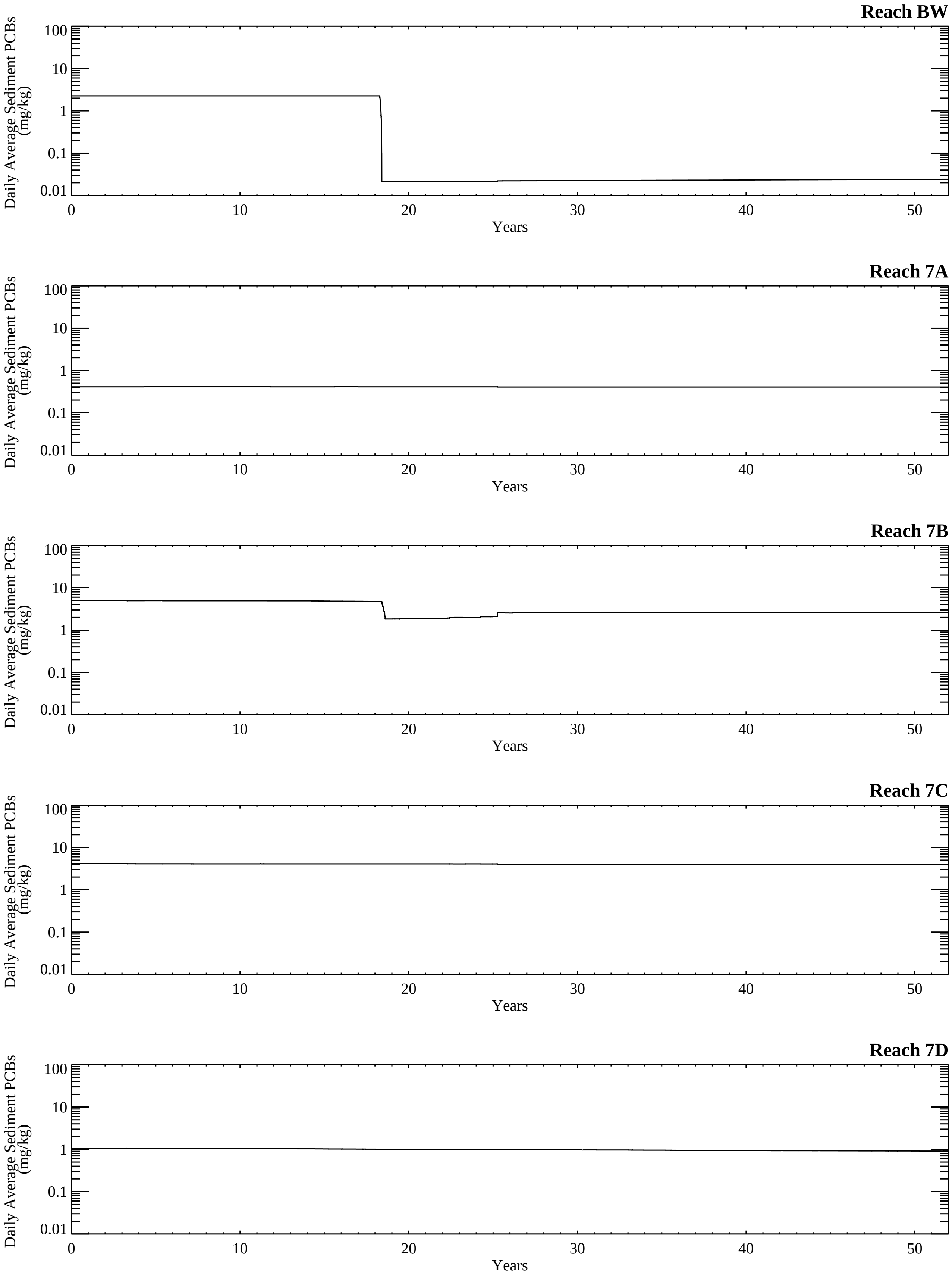

Figure G-1.2-5b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 6; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED6CMSBS_0712-32\\bins

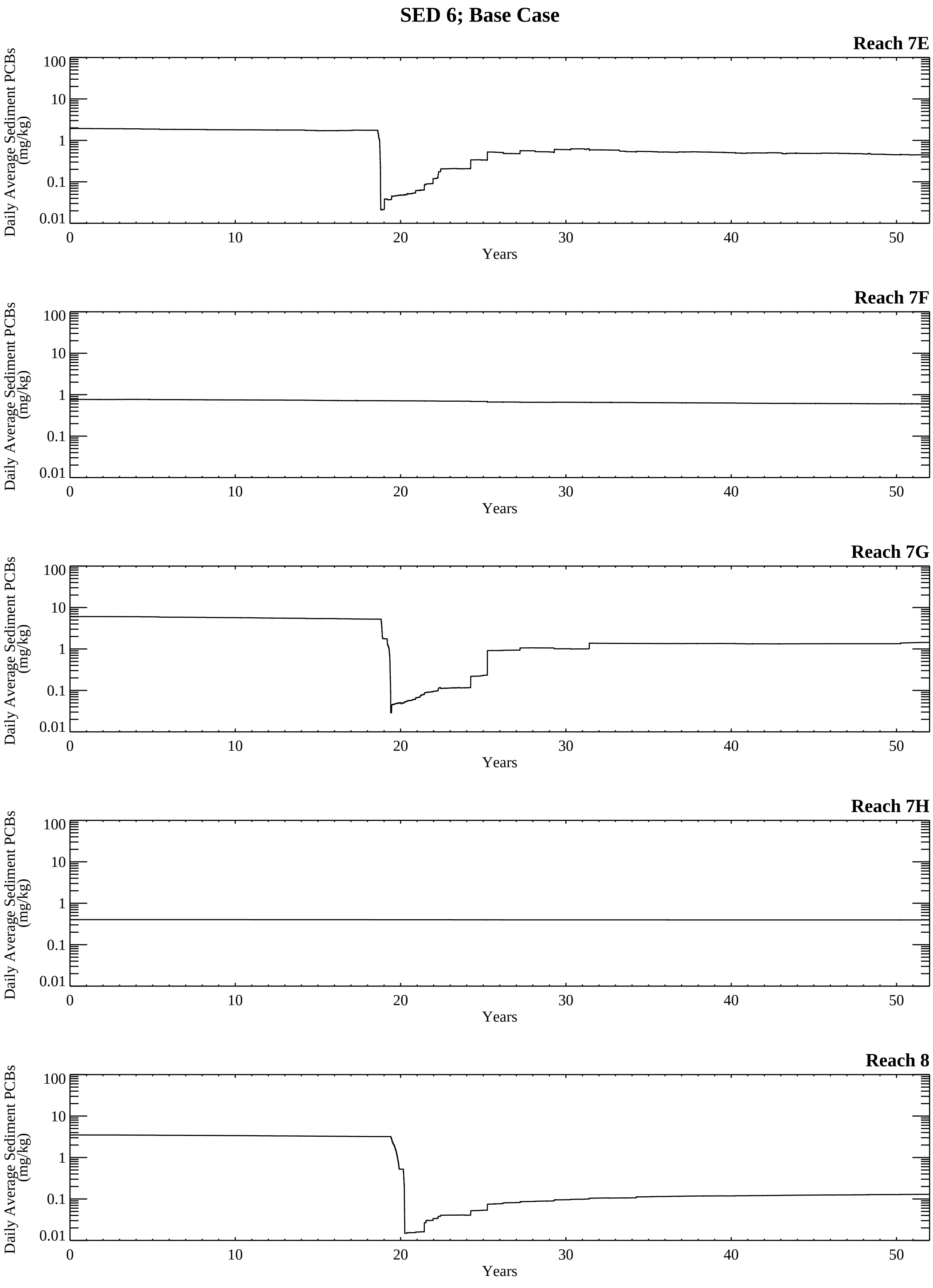

Figure G-1.2-5b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 6; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED6CMSBS_0712-32\\bins

SED 6; Base Case

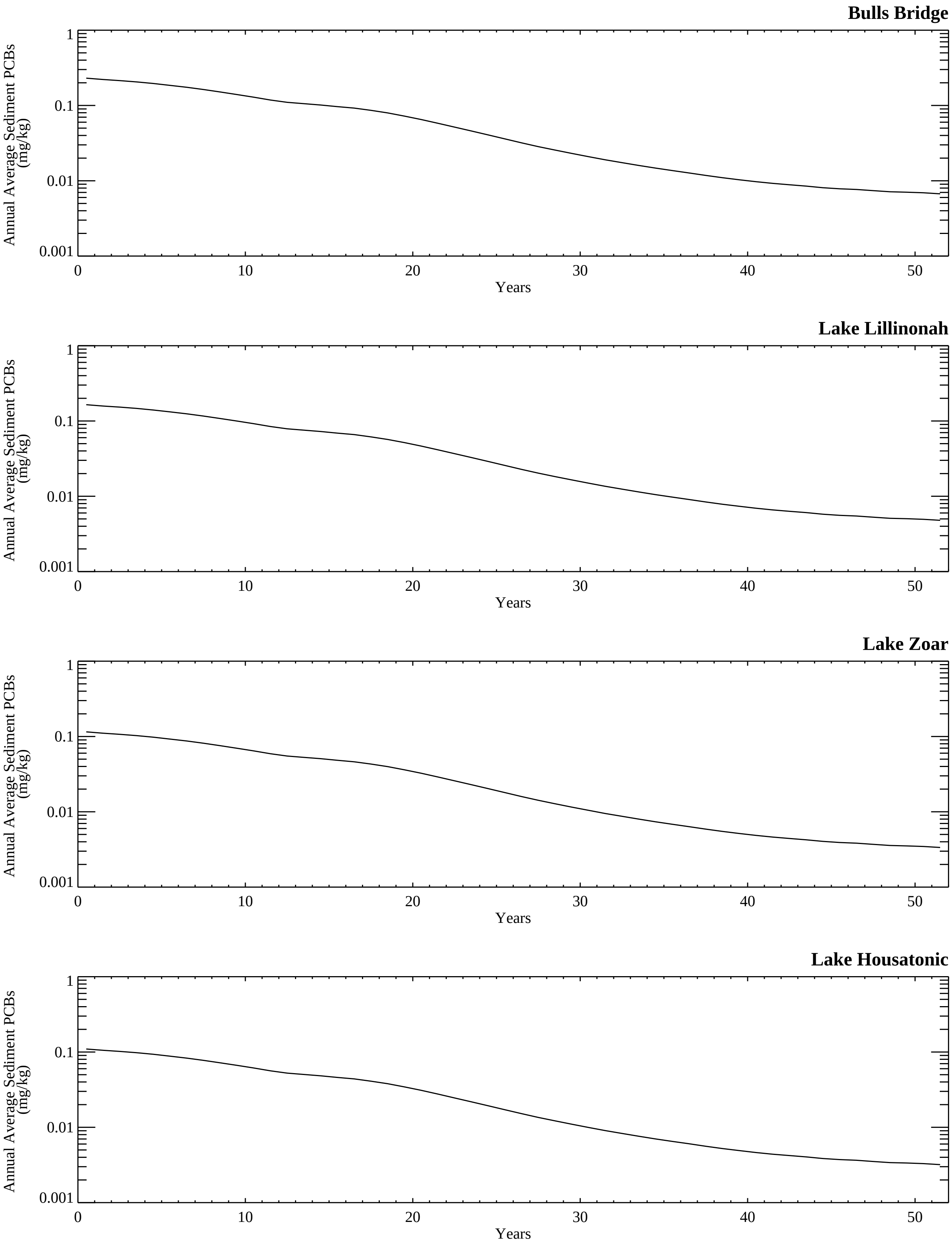

Figure G-1.2-5c. Temporal profiles of average surface sediment (0-6") PCB concentrations estimated from the CT 1-D Analysis (SED 6; CT; Base Case).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED06_0712-32_base

if/wk - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\figure_g1_2_g1_6_temporal_sed_CT.pro
Wed Mar 19 10:58:36 2008

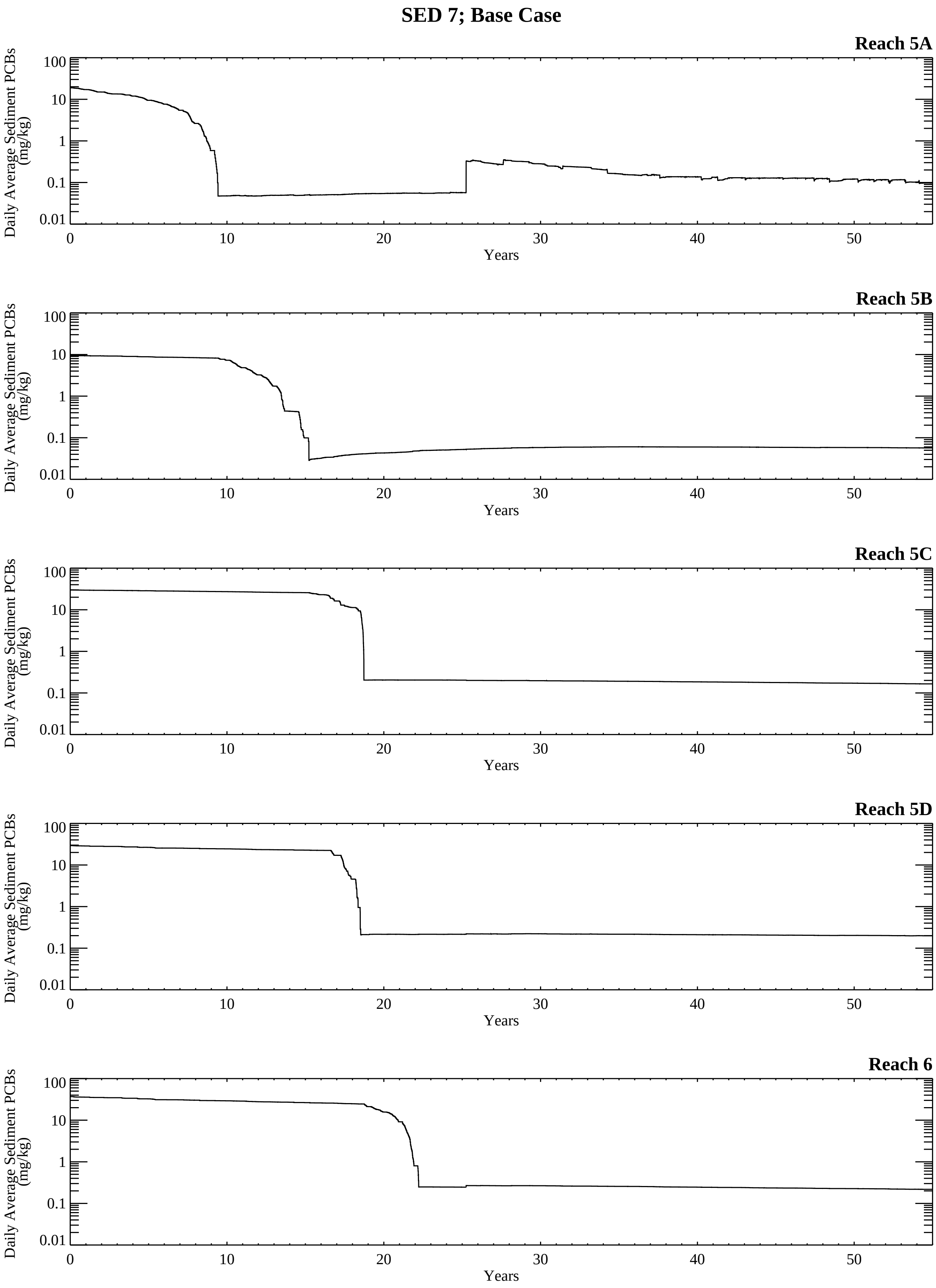

Figure G-1.2-6a. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 7; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED7CMSBS_0712-03\\bins

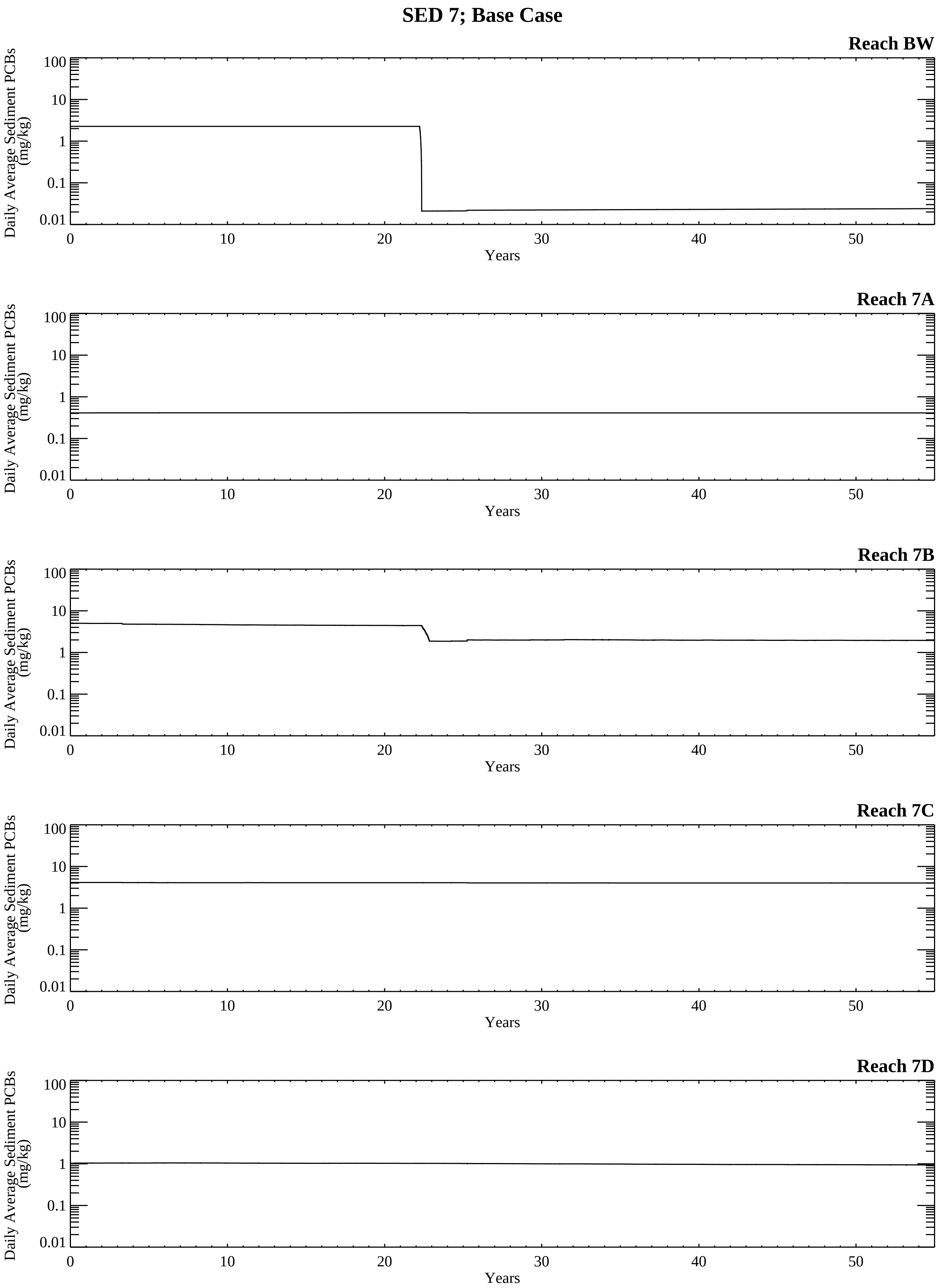

Figure G-1.2-6b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 7; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED7CMSBS_0712-33\\bins

SED 7; Base Case

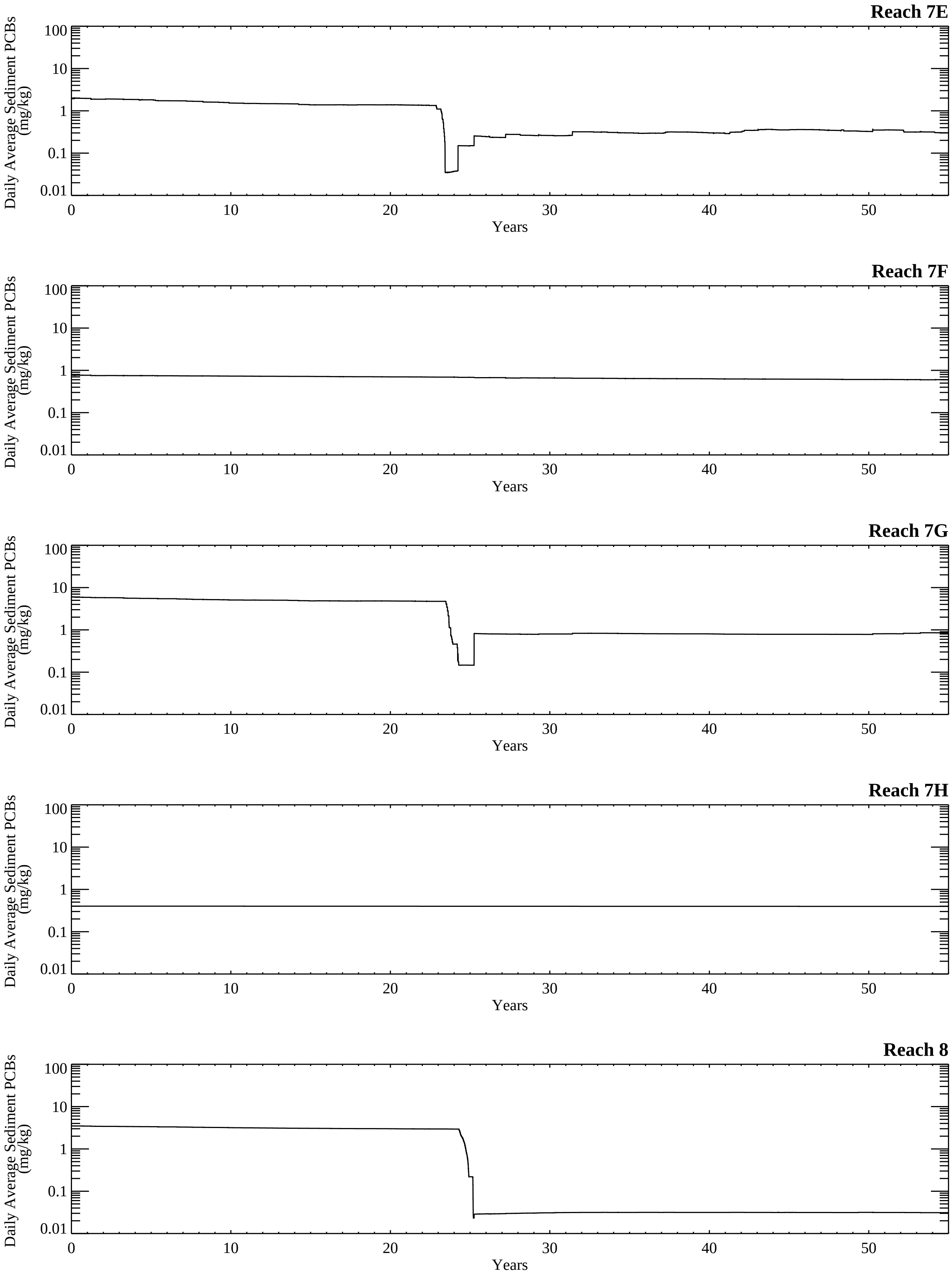

Figure G-1.2-6b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 7; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED7CMSBS_0712-33\\bins

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Wed Mar 19 11:26:03 2008

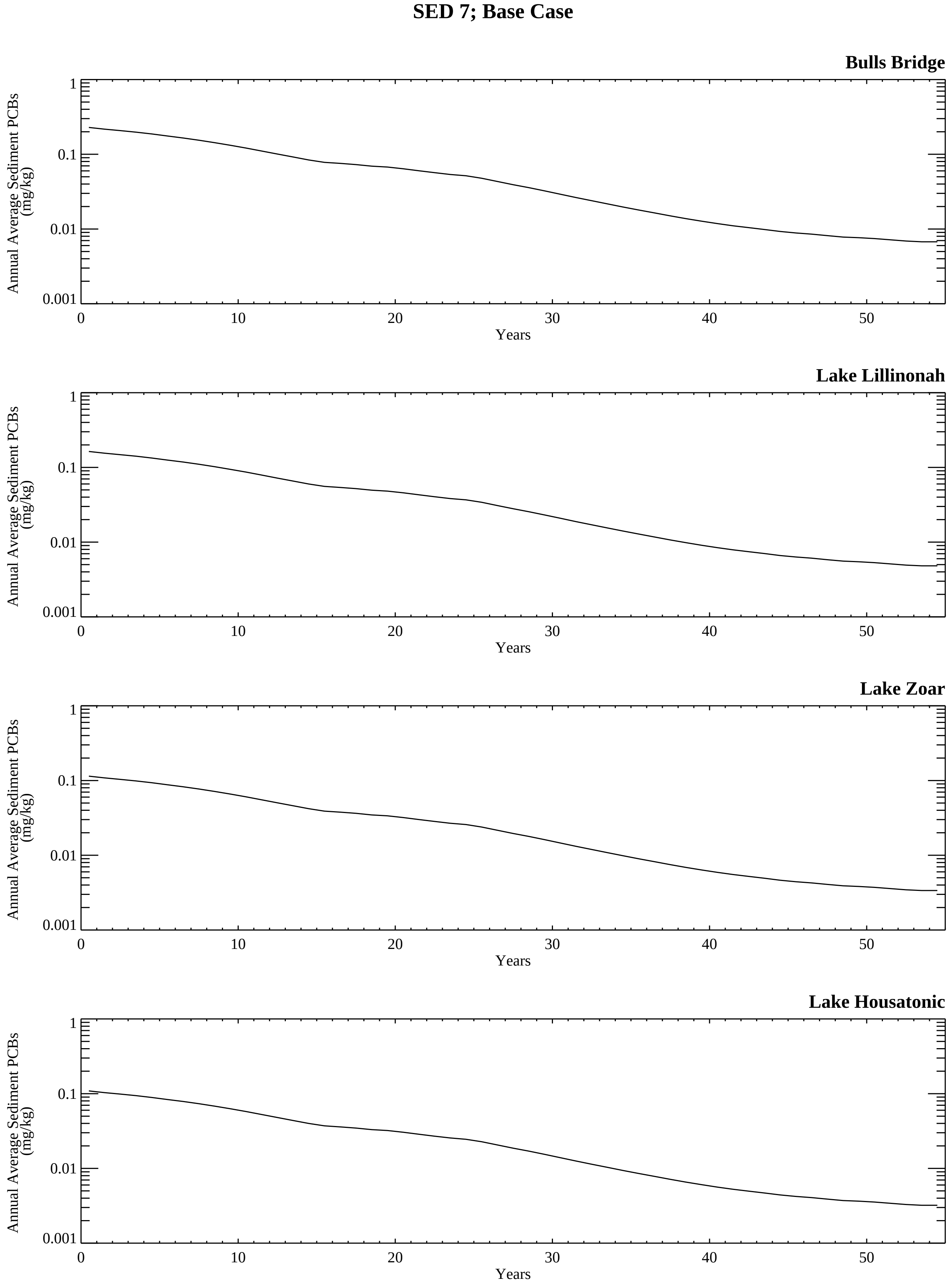

Figure G-1.2-6c. Temporal profiles of average surface sediment (0-6") PCB concentrations estimated from the CT 1-D Analysis (SED 7; CT; Base Case).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED07_0712-33_base

if/wk - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\figure_g1_2_g1_6_temporal_sed_CT.pro
Wed Mar 19 10:58:37 2008

SED 8; Base Case

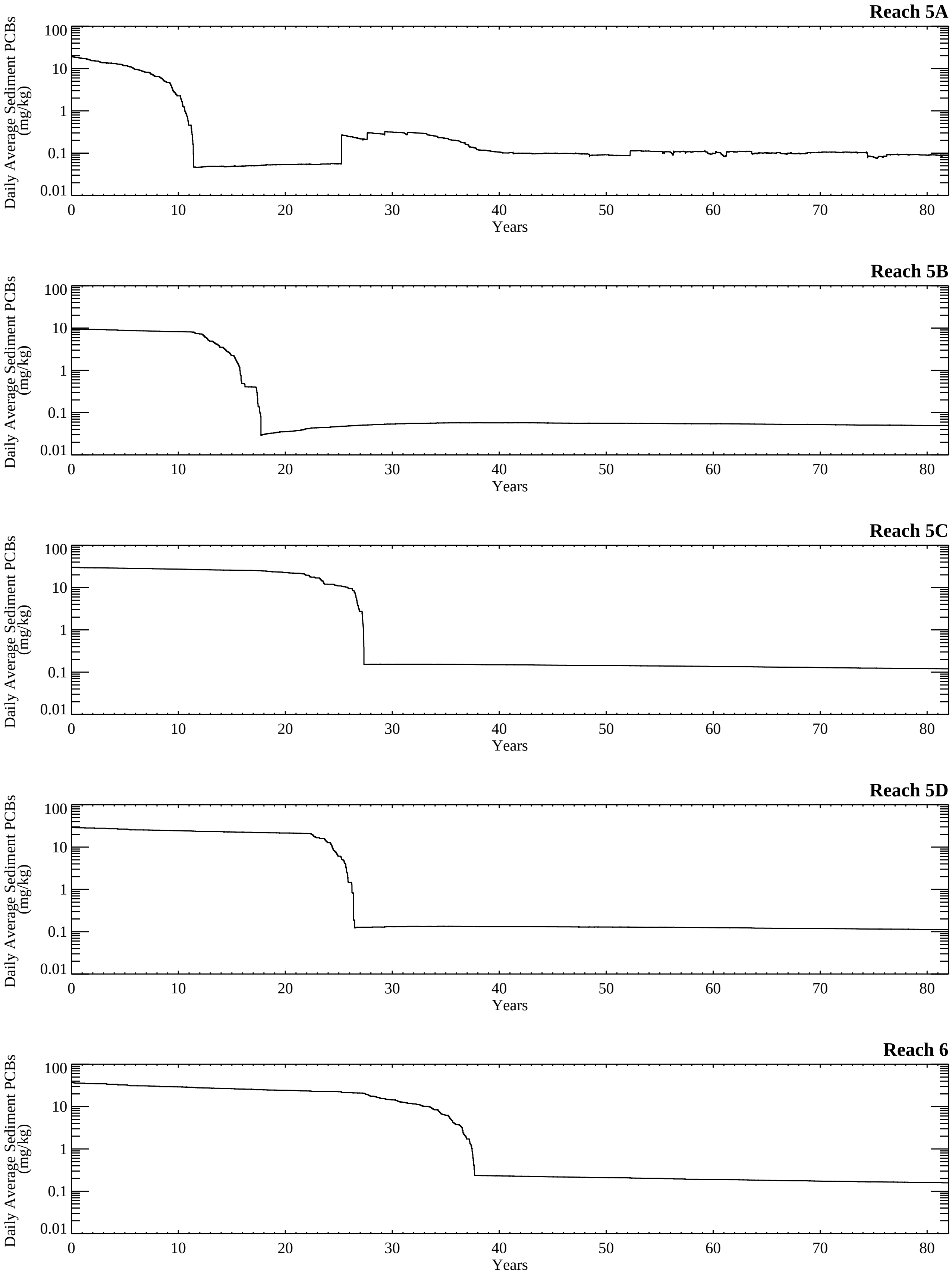

Figure G-1.2-7a. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 8; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED8CMSBS_0712-18\\bins

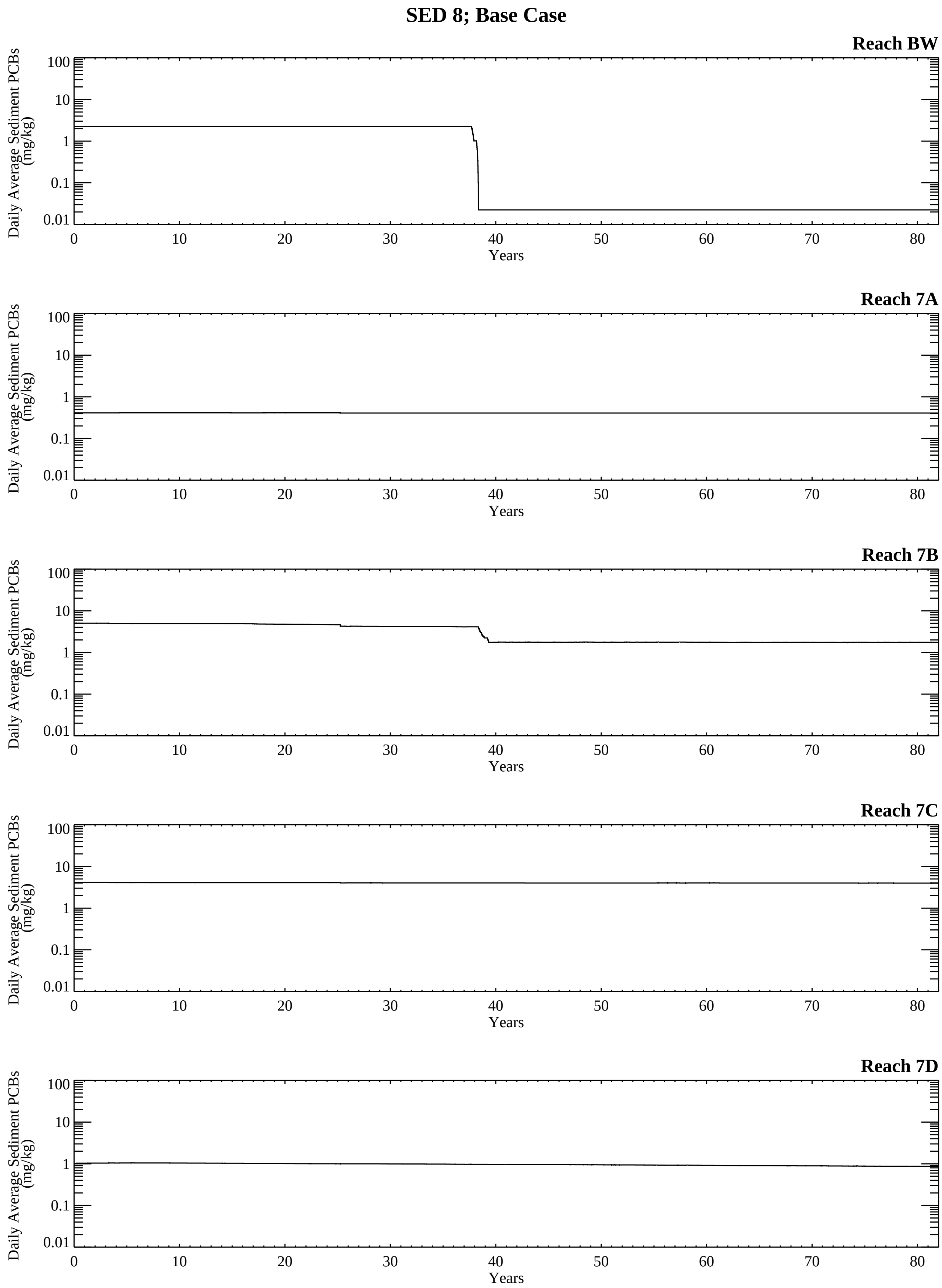

Figure G-1.2-7b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 8; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED8CMSBS_0712-34\\bins

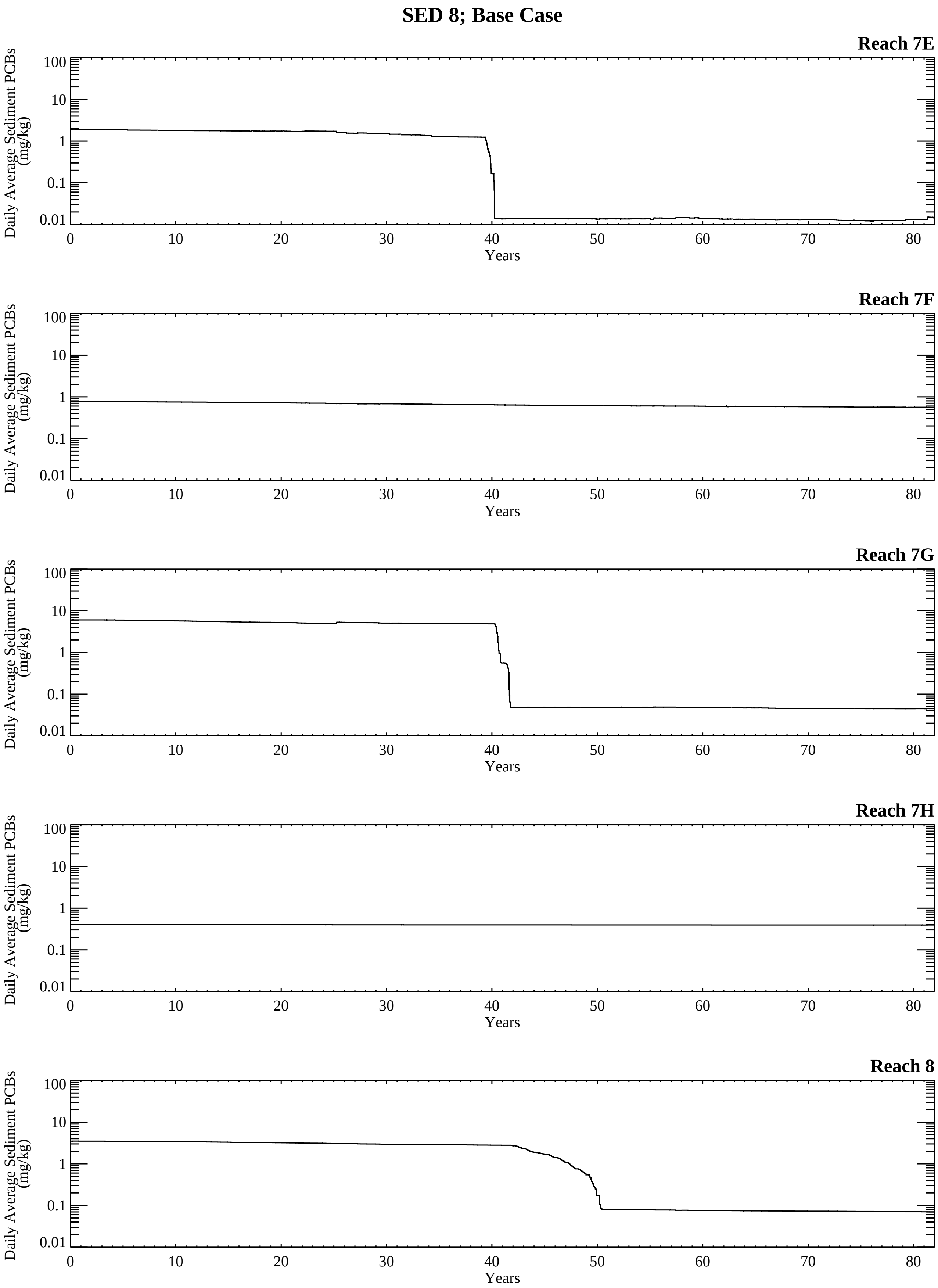

Figure G-1.2-7b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 8; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED8CMSBS_0712-34\\bins

RRM - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\Figure_G1_2_temp_reach.pro
Wed Mar 19 11:27:21 2008

SED 8; Base Case

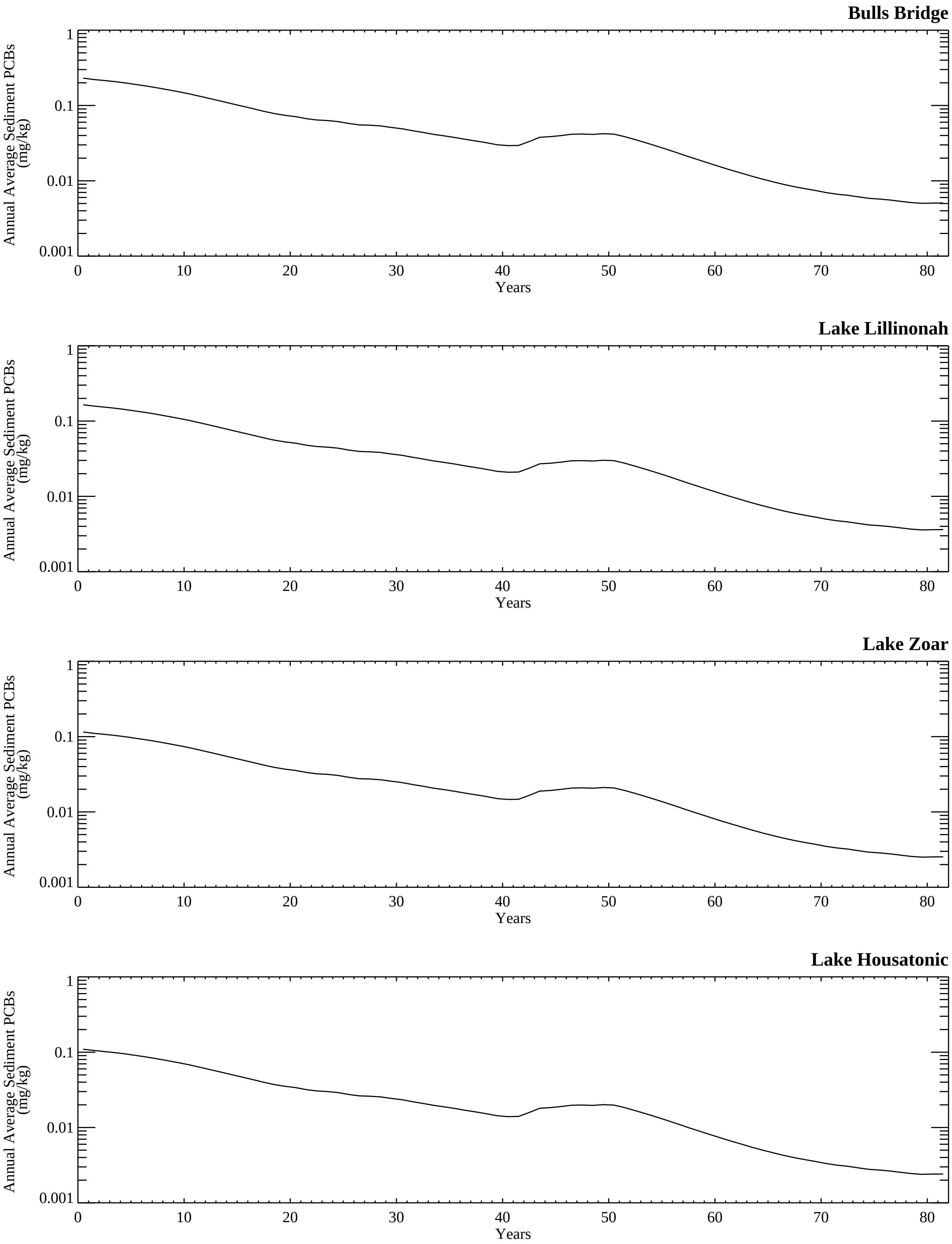

Figure G-1.2-7c. Temporal profiles of average surface sediment (0-6") PCB concentrations estimated from the CT 1-D Analysis (SED 8; CT; Base Case).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED08_0712-34_base

SED 1 / SED 2; Base Case

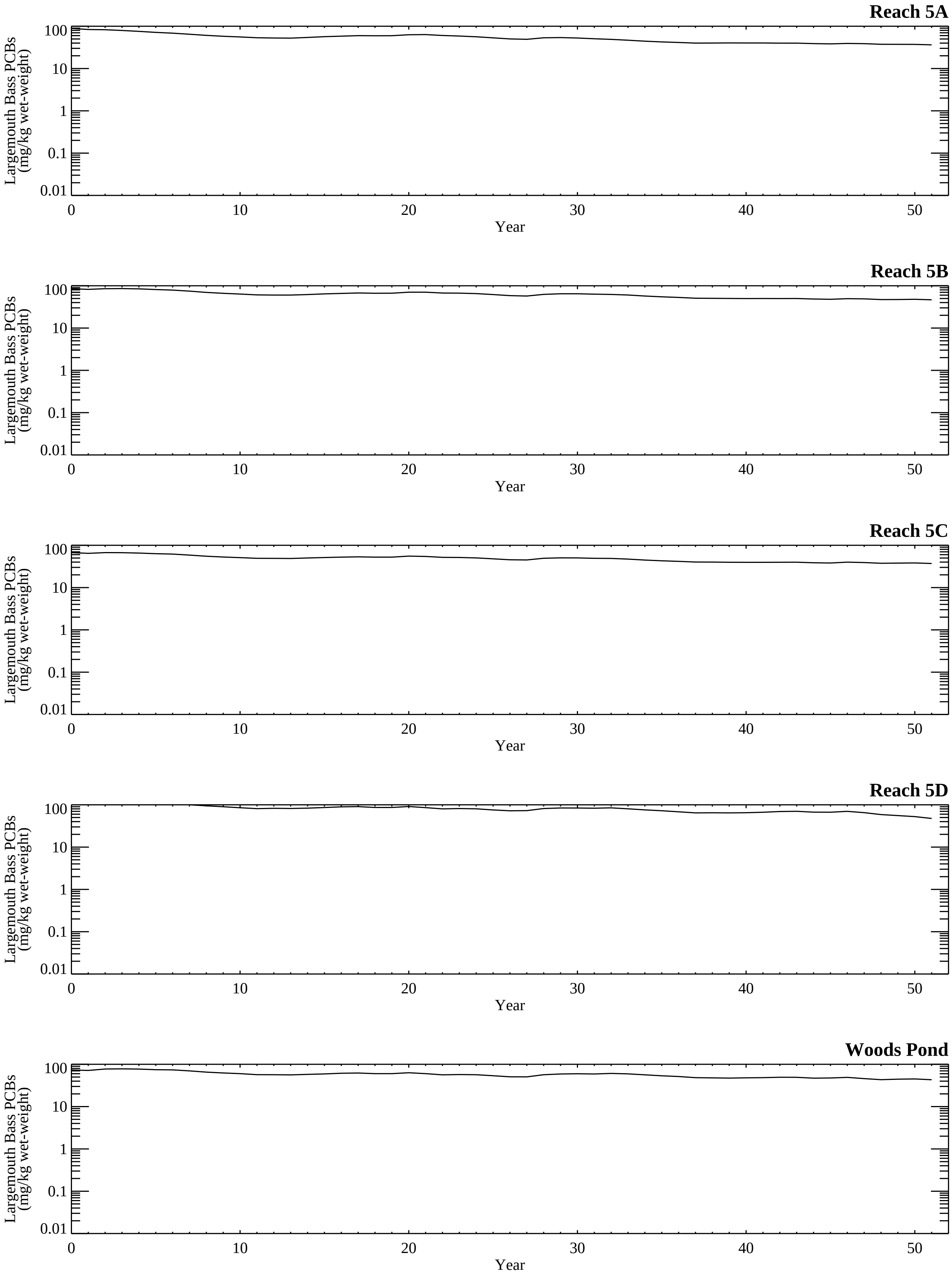

Figure G-1.3-1a. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 1 / SED 2; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

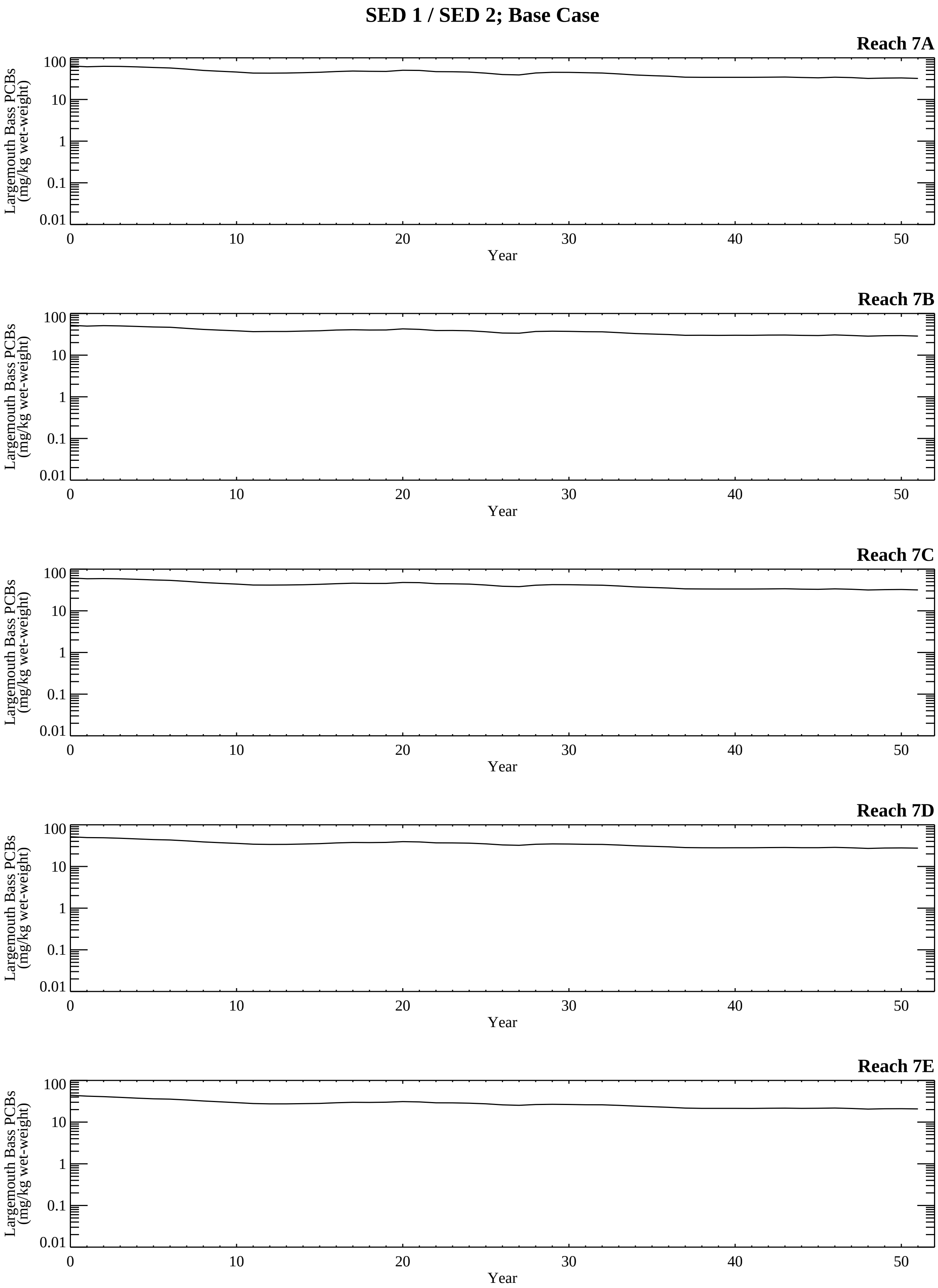

Figure G-1.3-1b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 1 / SED 2; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

SED 1 / SED 2; Base Case

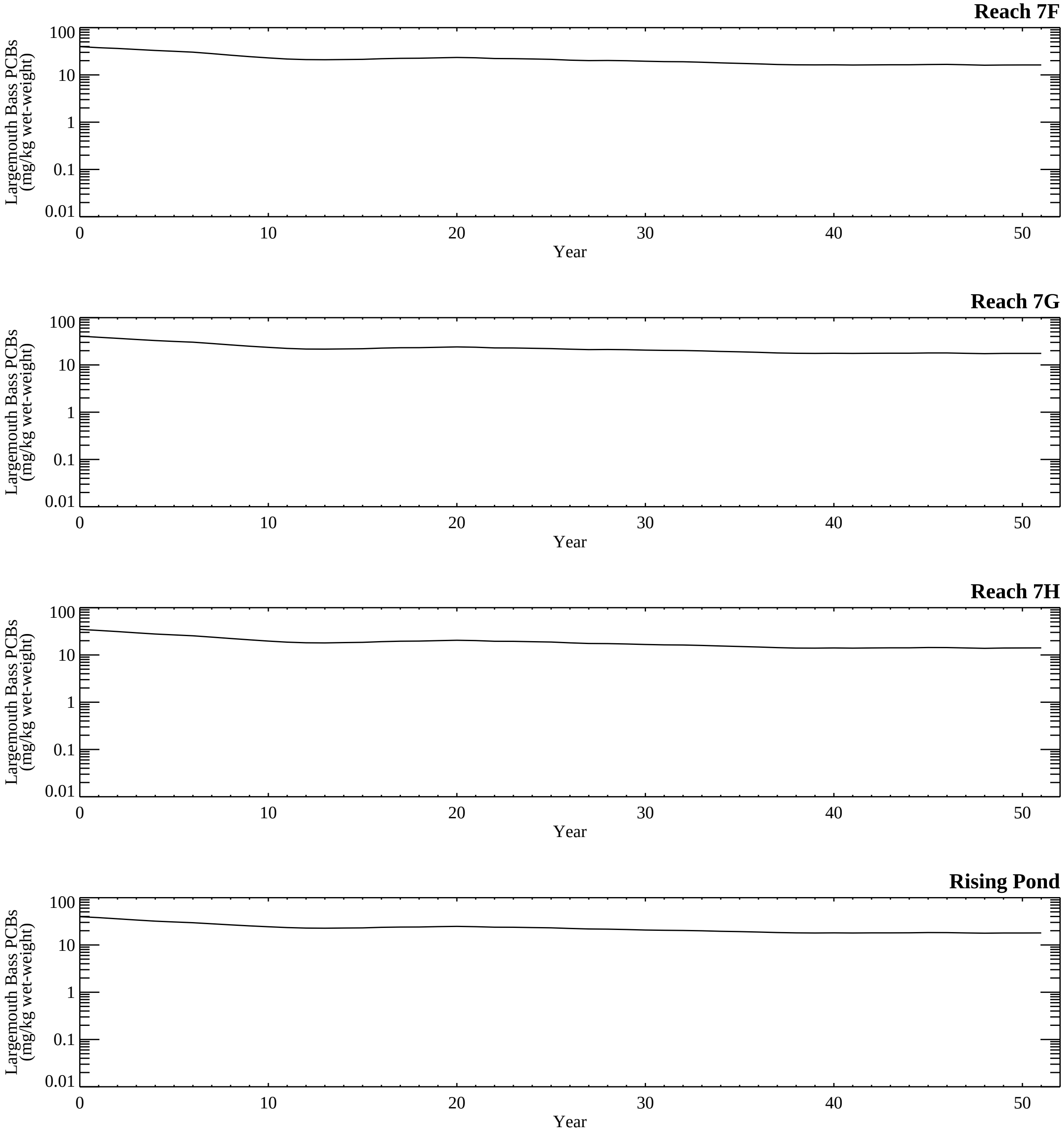

Figure G-1.3-1b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 1 / SED 2; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

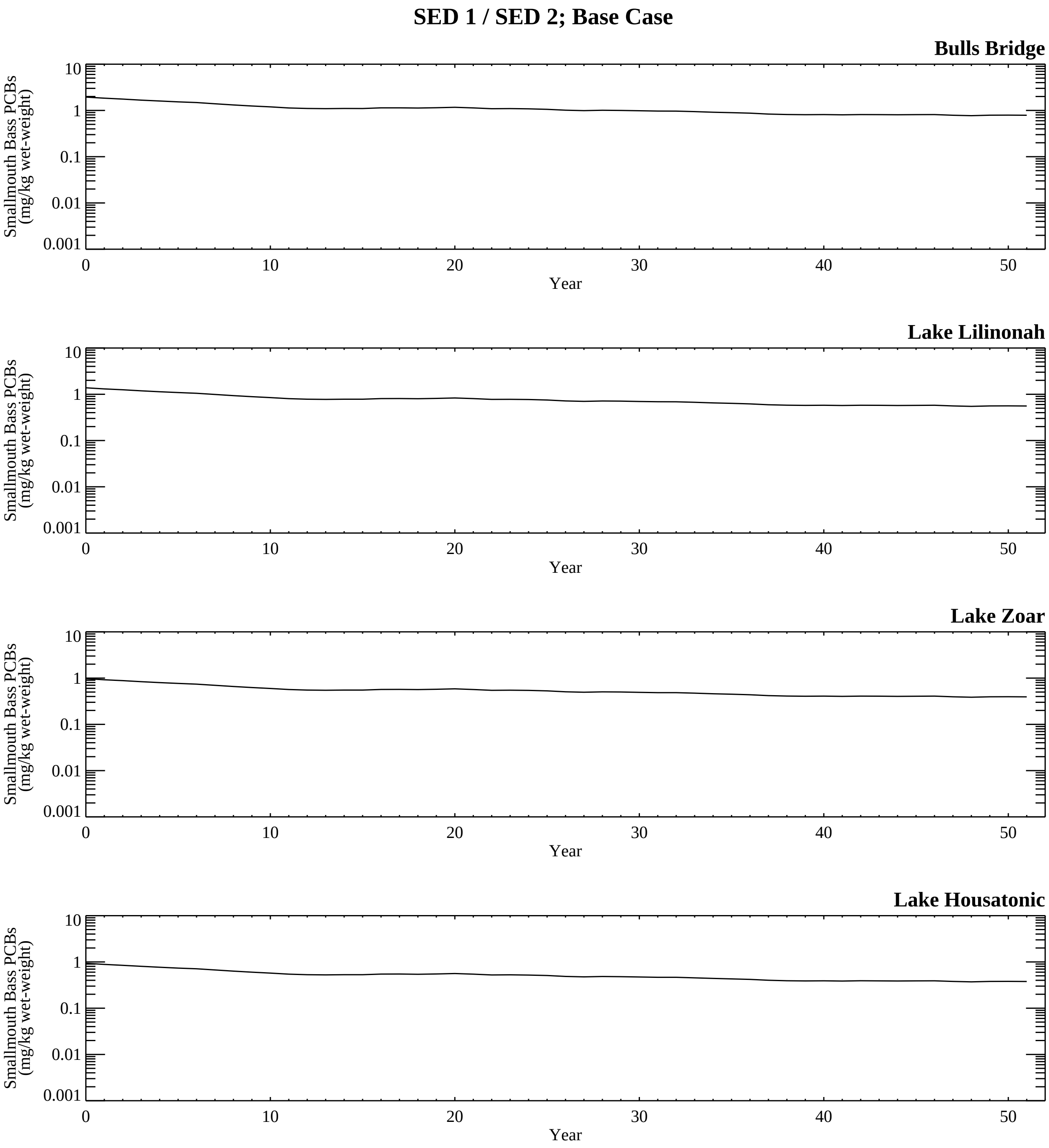

Figure G-1.3-1c. Temporal profiles of PCB concentrations in whole body smallmouth bass (SED 1 / SED 2; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

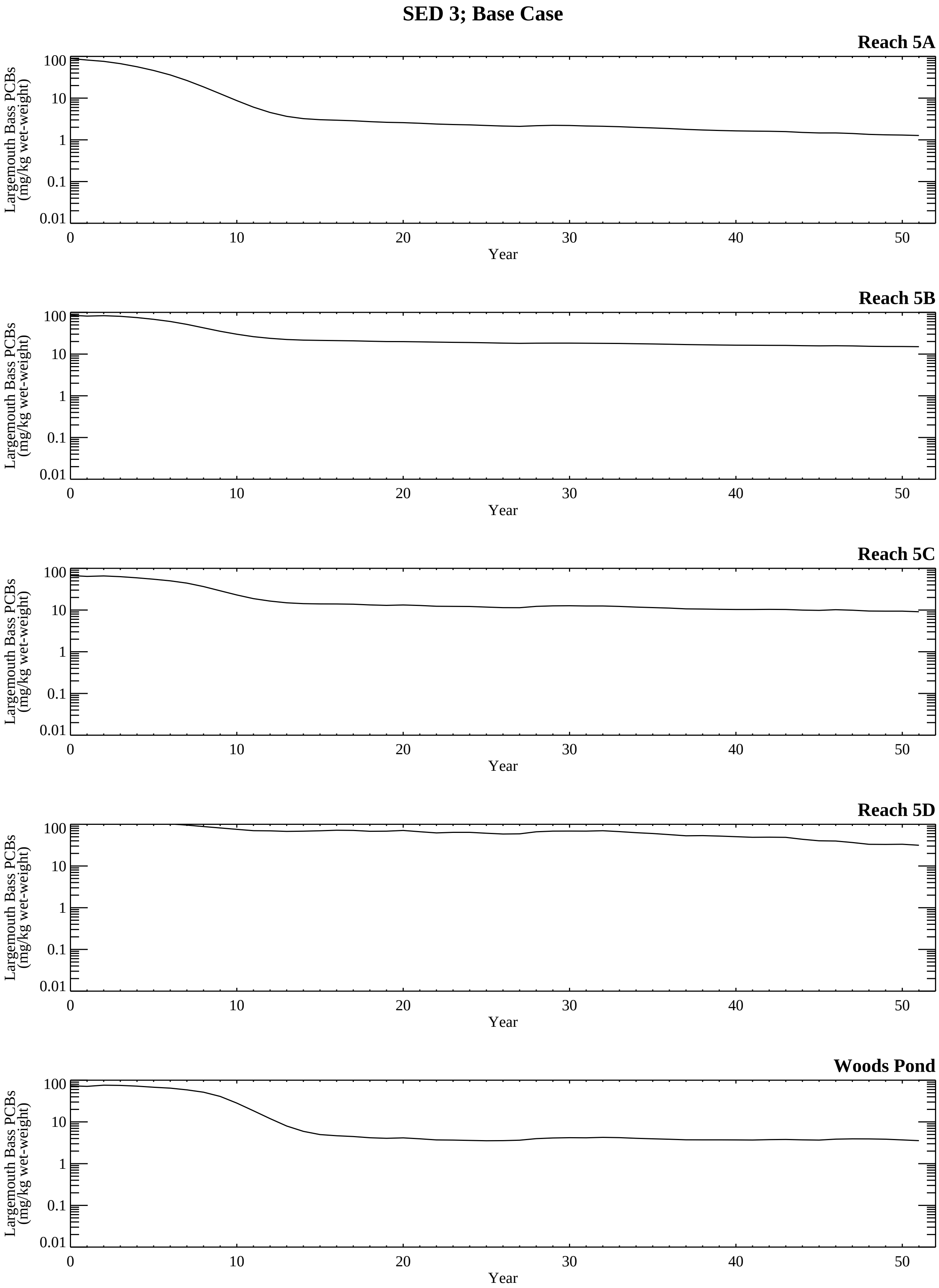

Figure G-1.3-2a. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 3; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

SED 3; Base Case

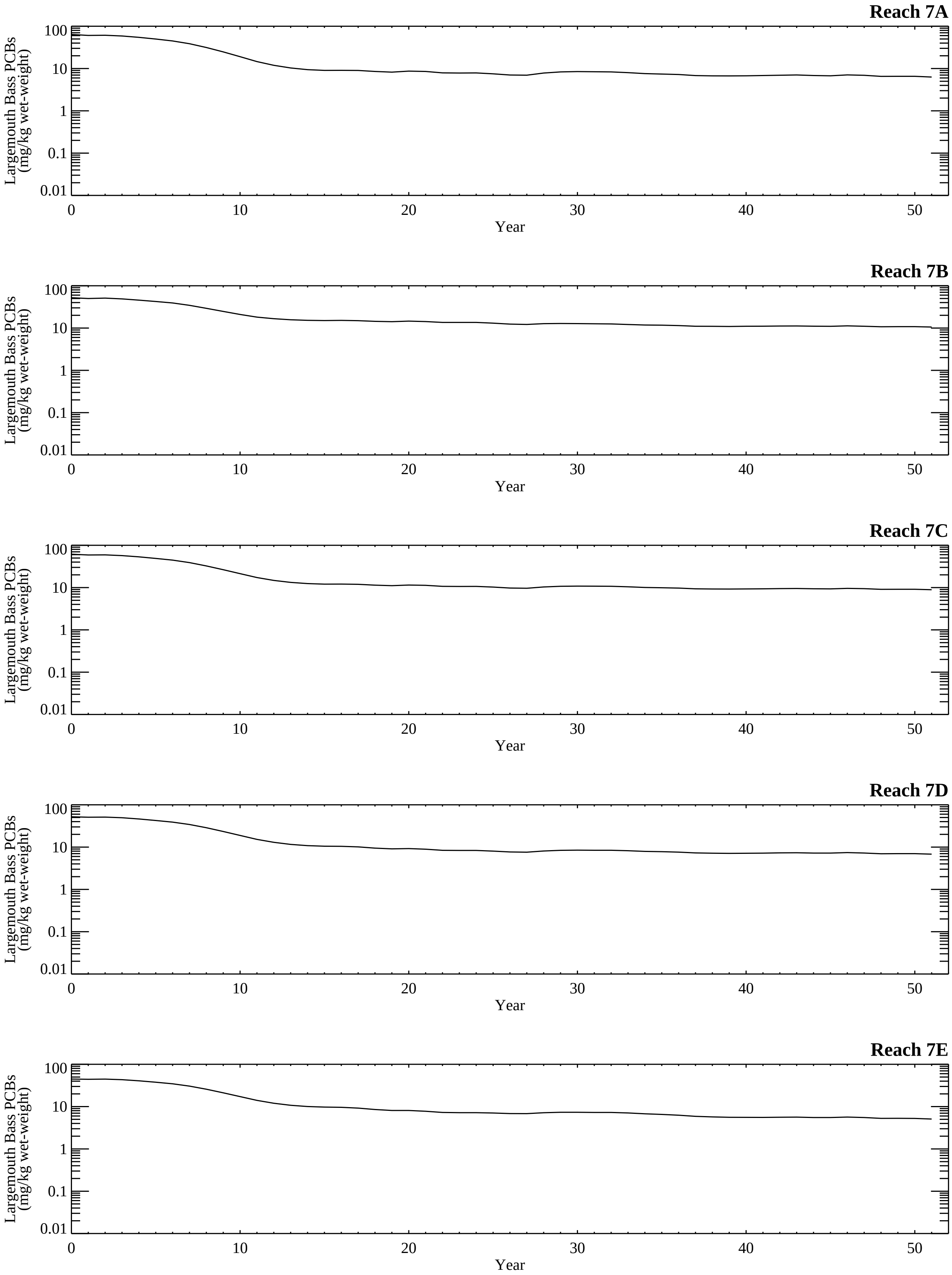

Figure G-1.3-2b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 3; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

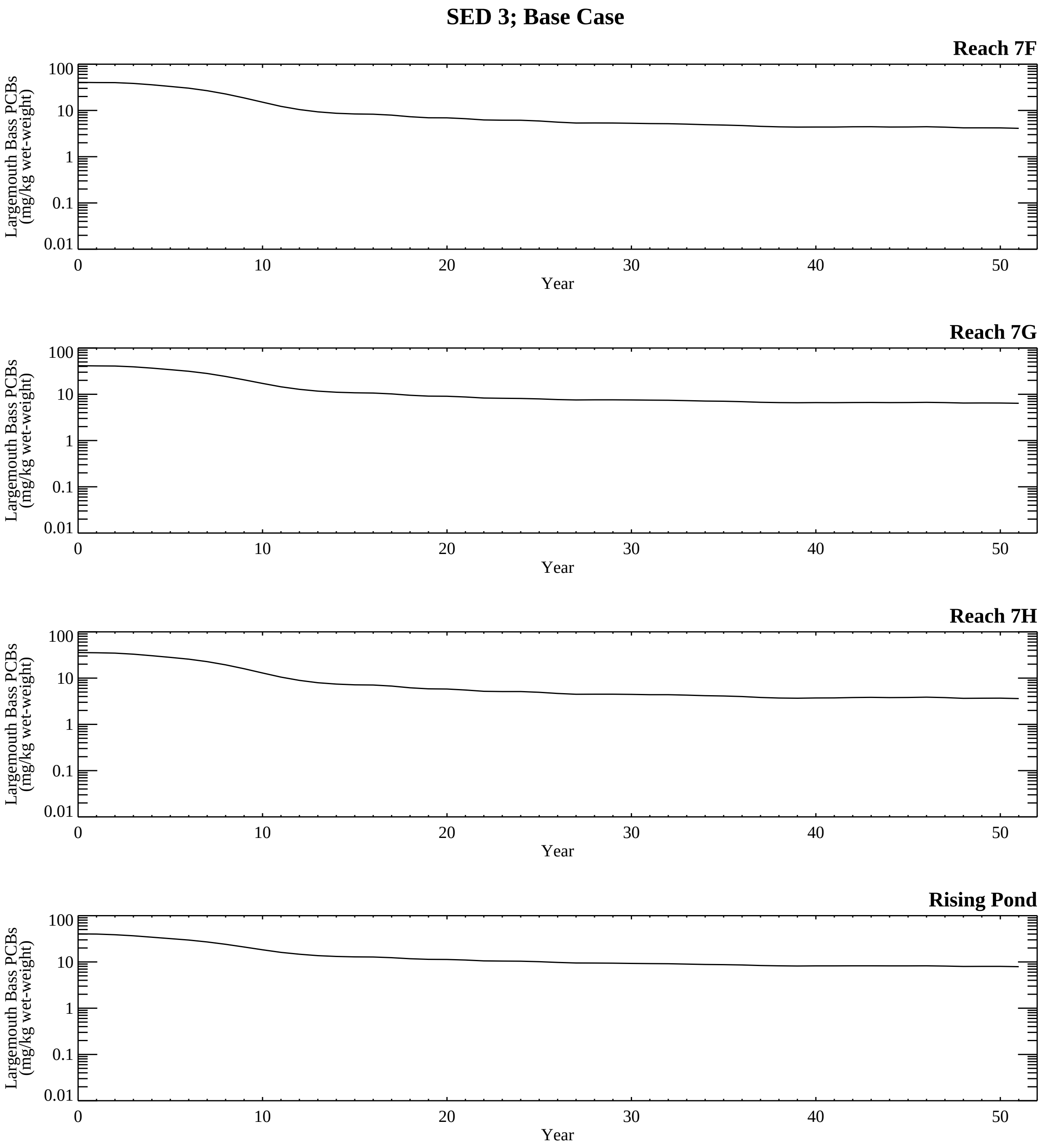

Figure G-1.3-2b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 3; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

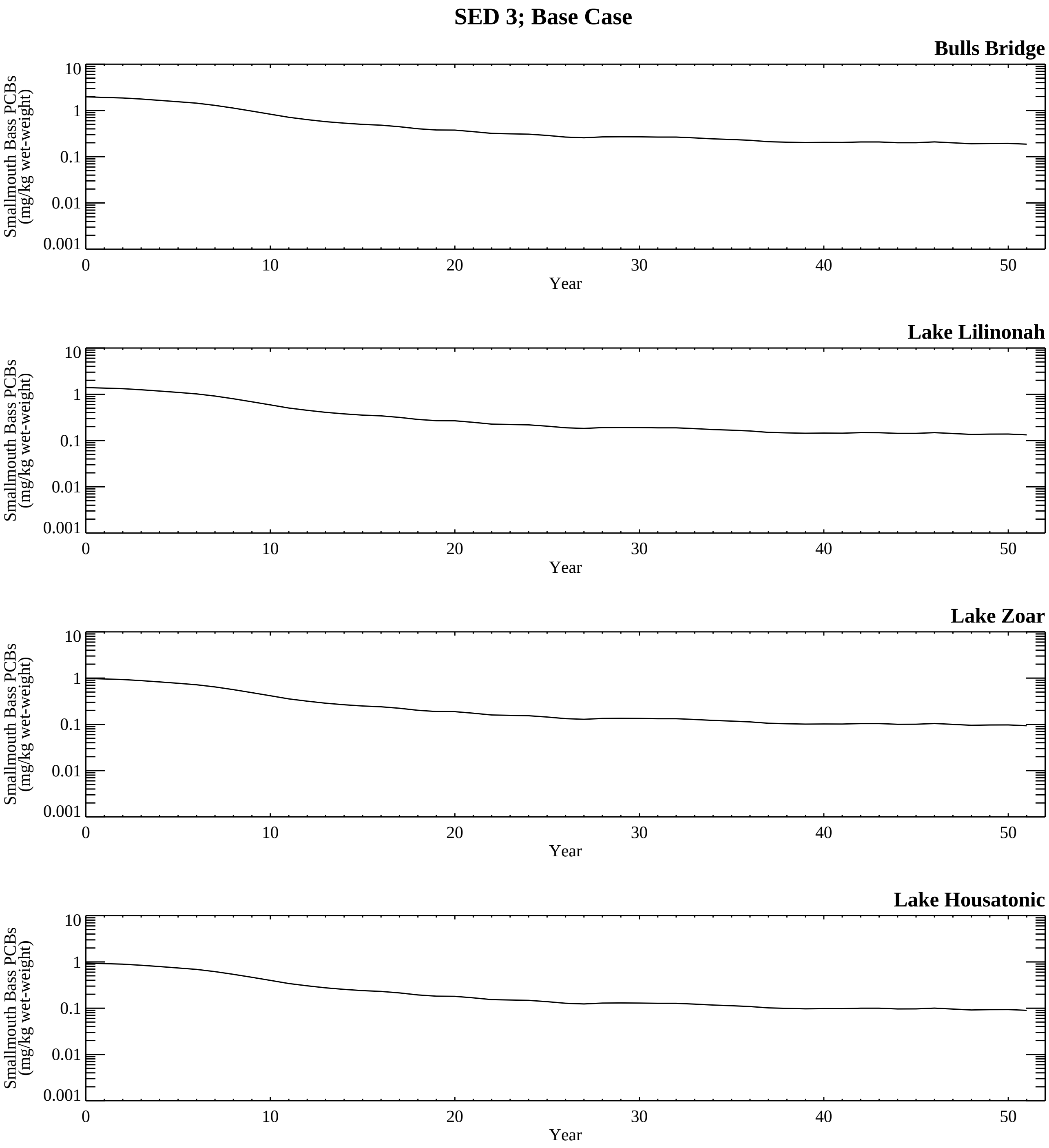

Figure G-1.3-2c. Temporal profiles of PCB concentrations in whole body smallmouth bass (SED 3; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

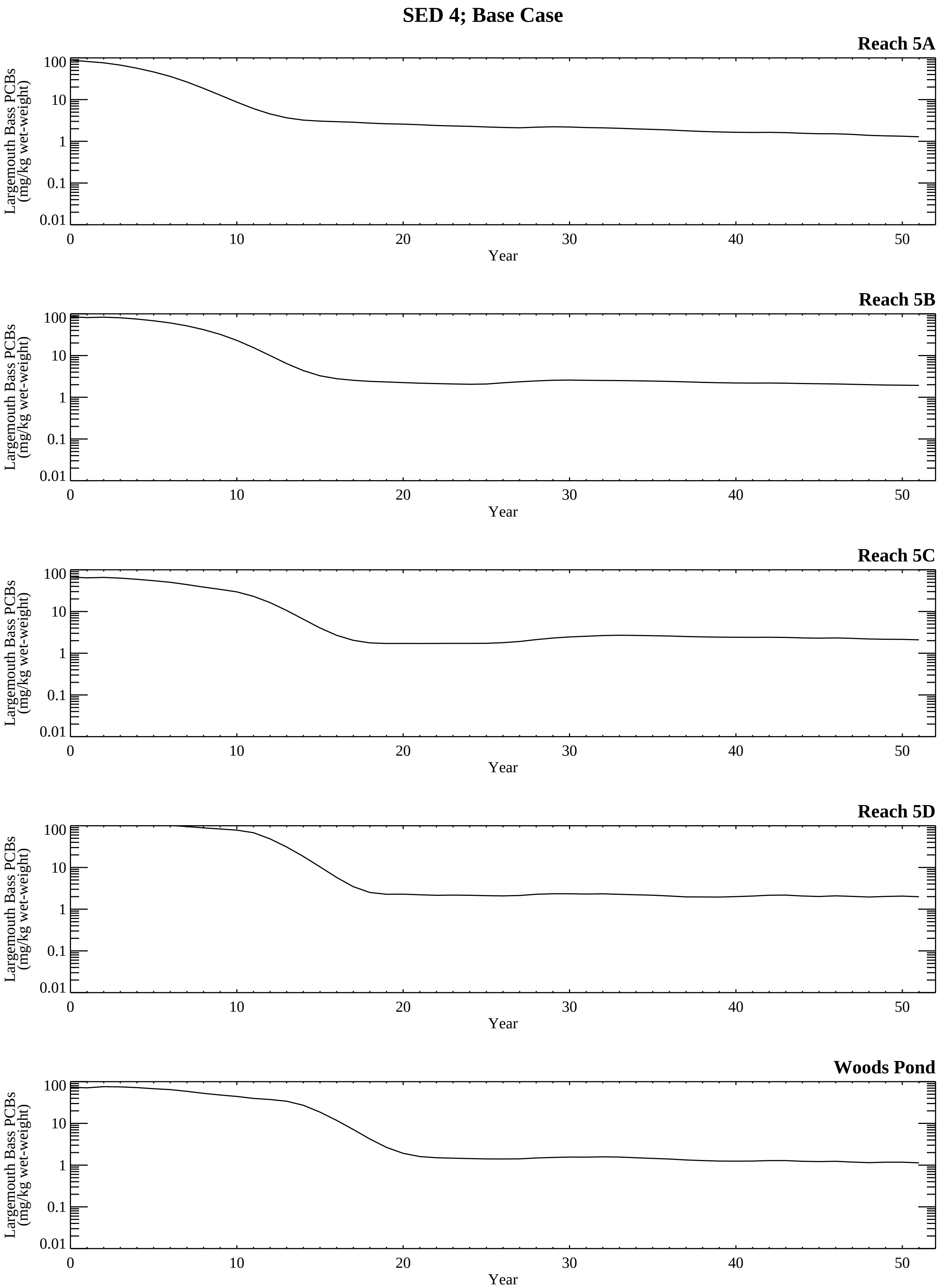

Figure G-1.3-3a. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 4; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

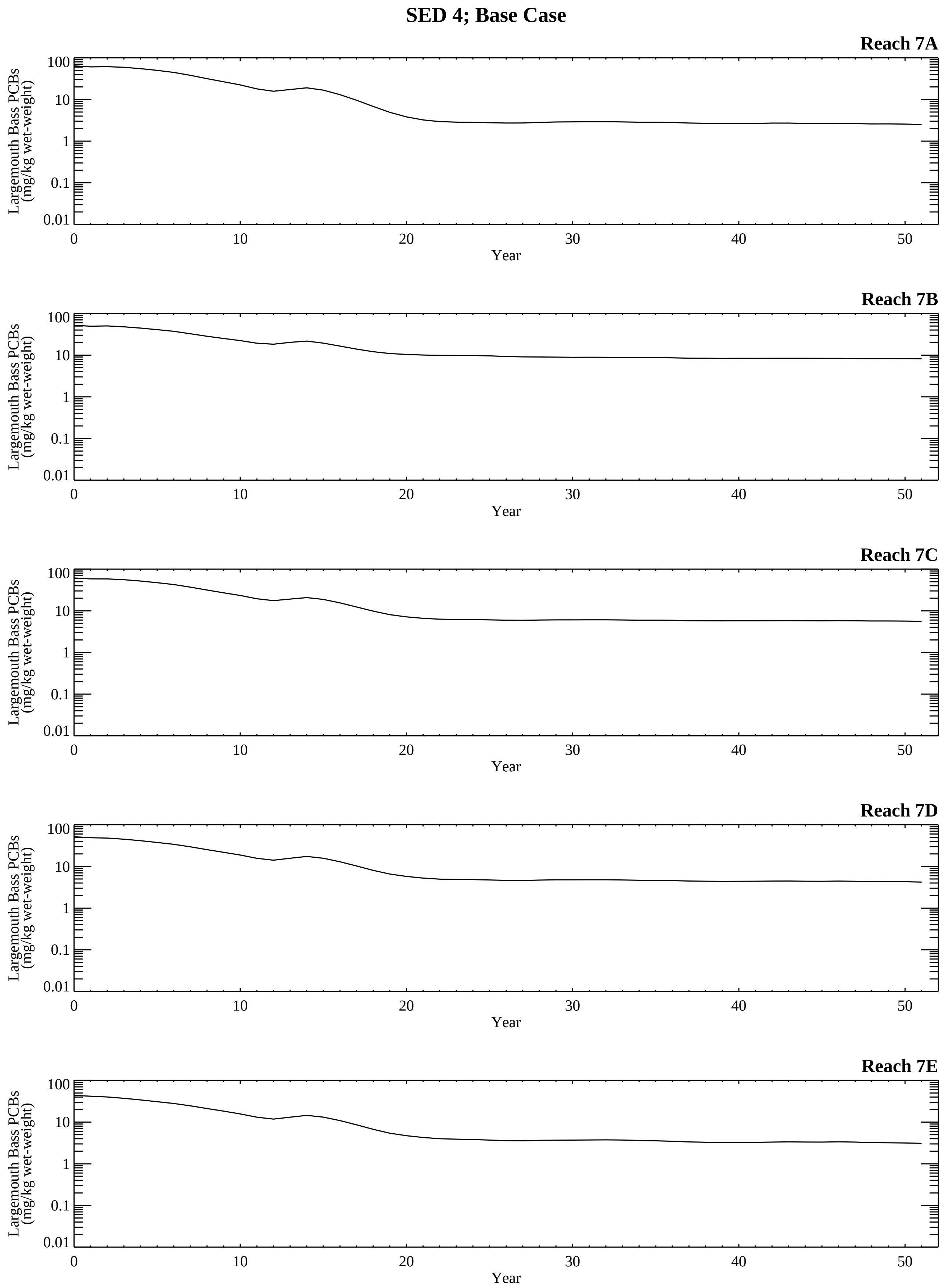

Figure G-1.3-3b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 4; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

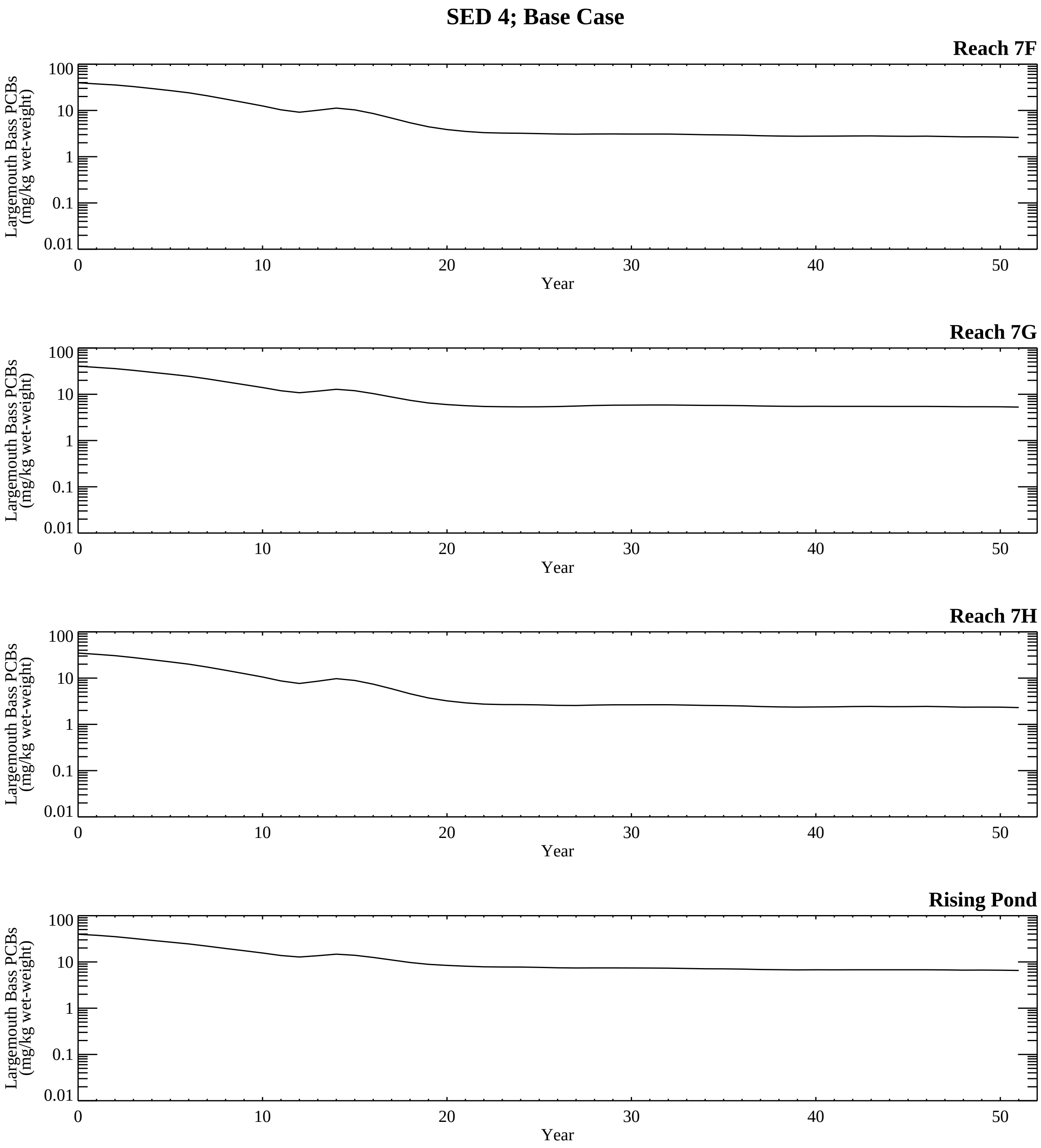

Figure G-1.3-3b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 4; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

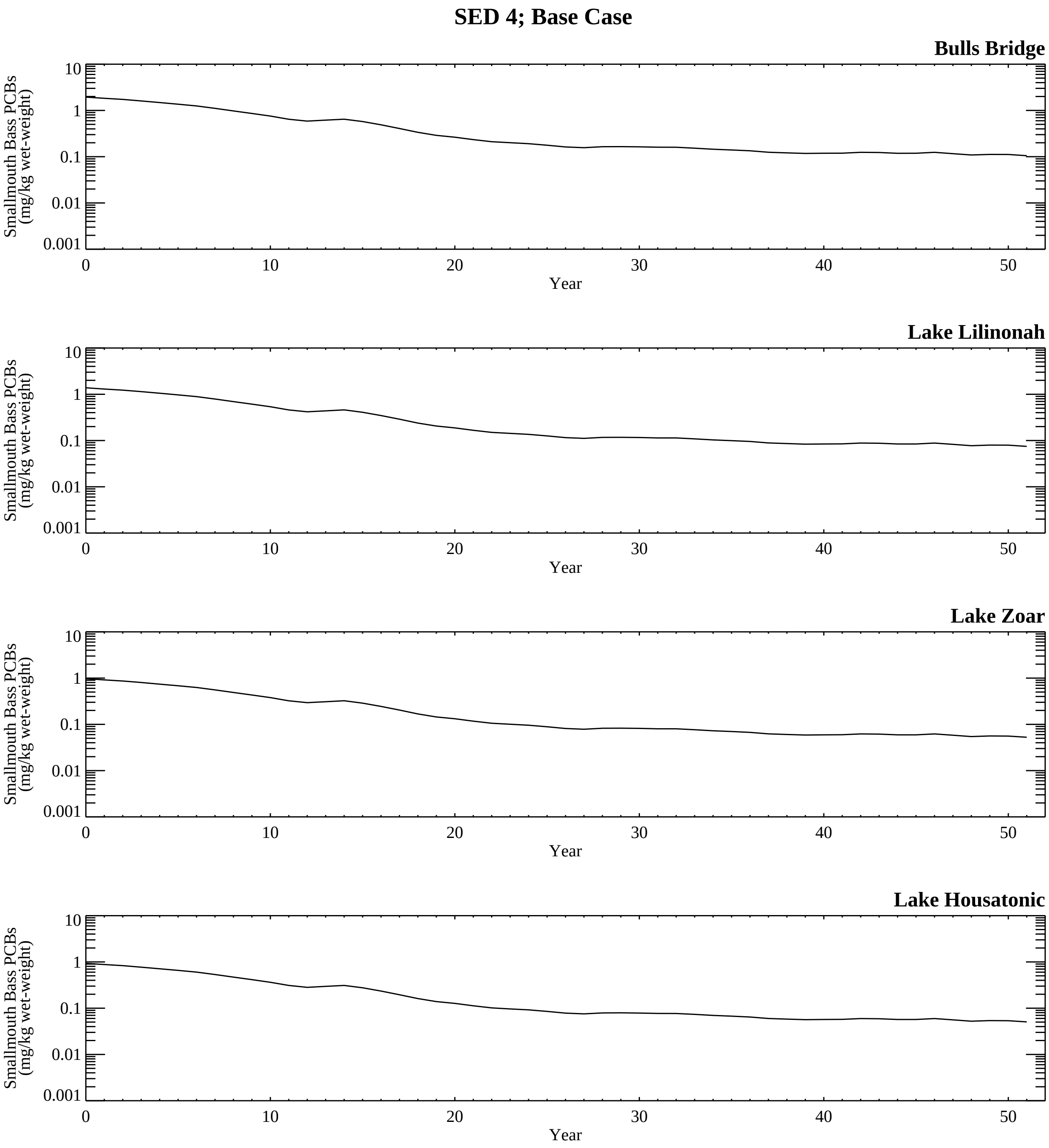

Figure G-1.3-3c. Temporal profiles of PCB concentrations in whole body smallmouth bass (SED 4; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

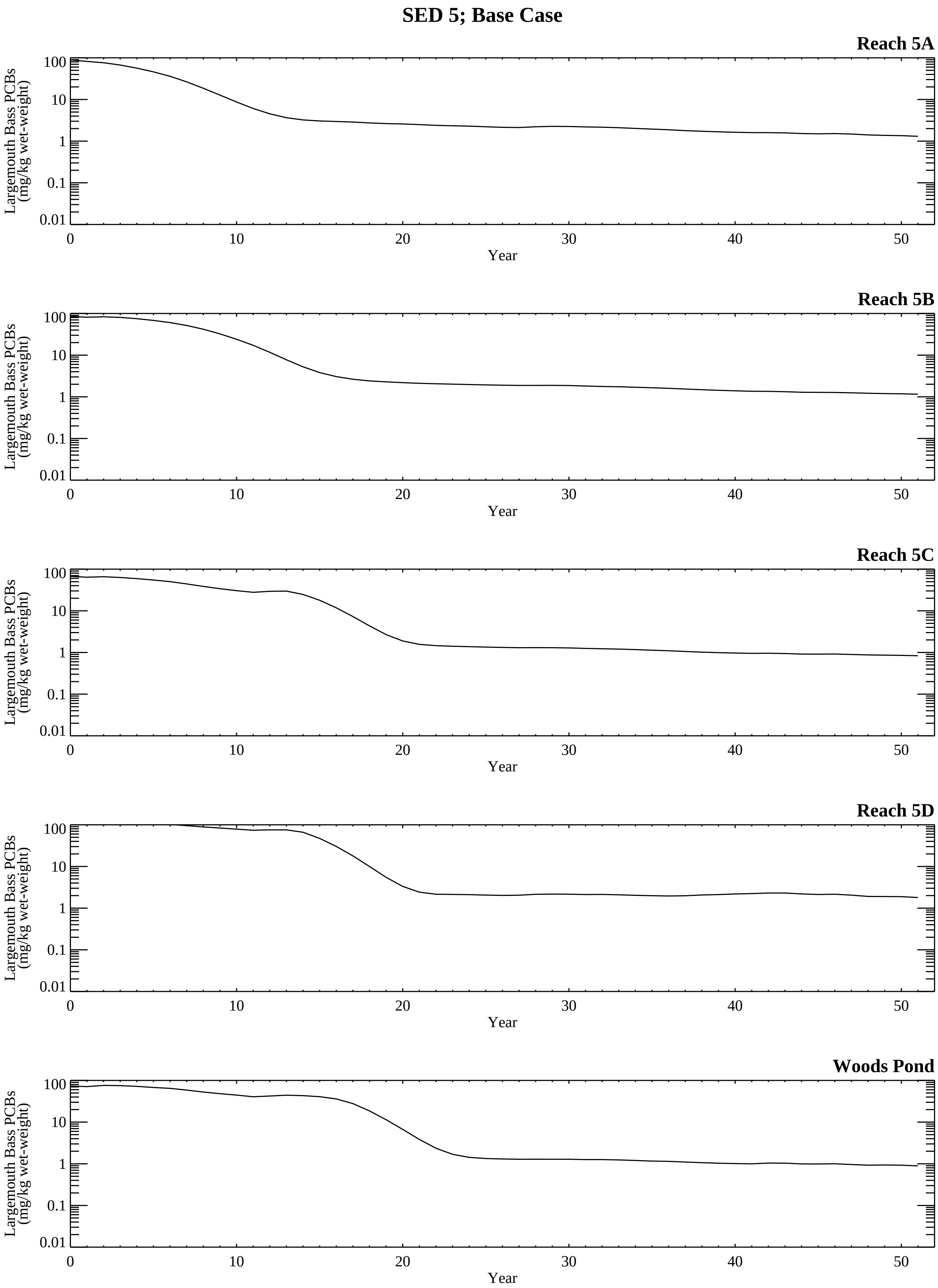

Figure G-1.3-4a. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 5; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

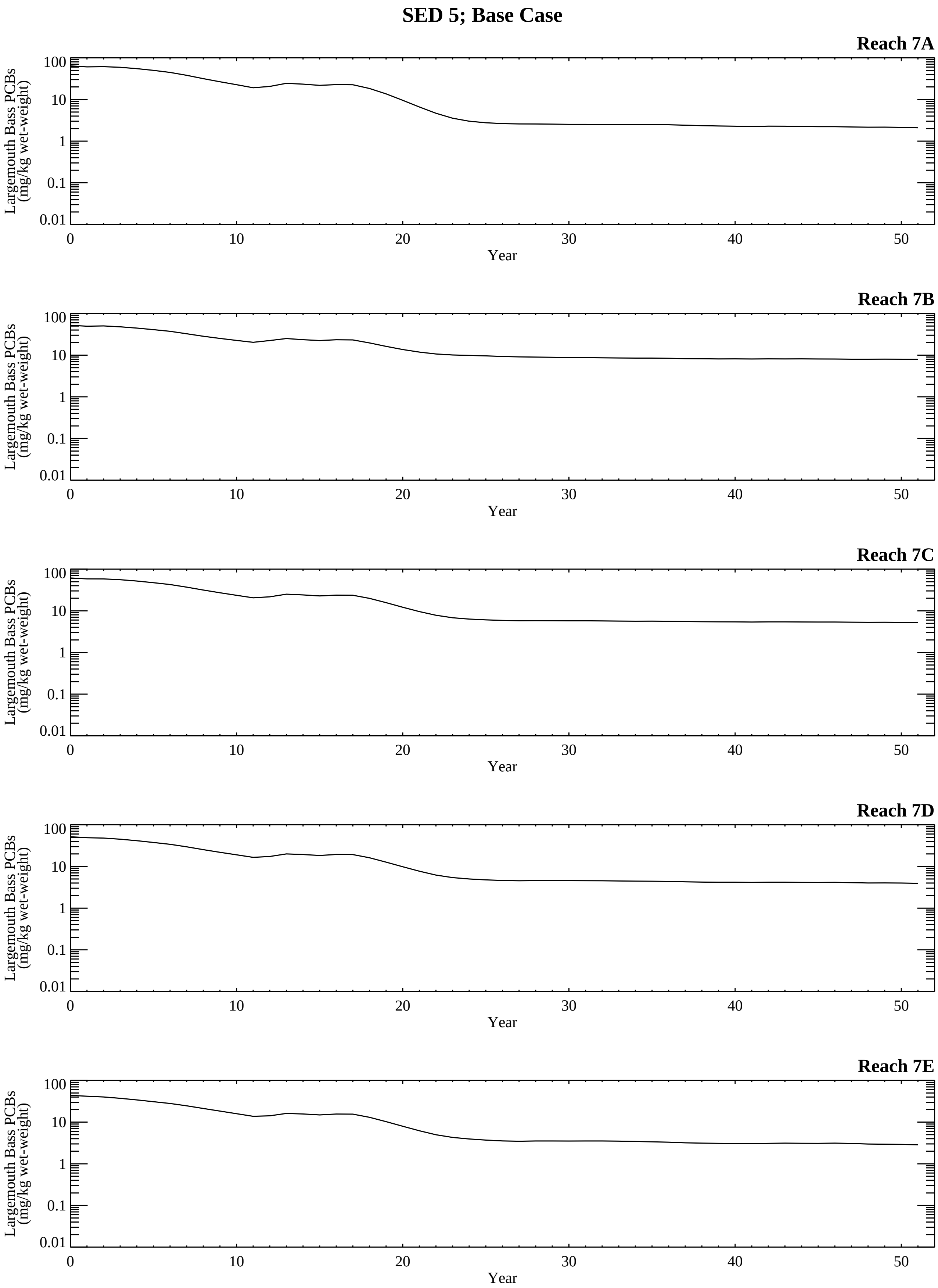

Figure G-1.3-4b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 5; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

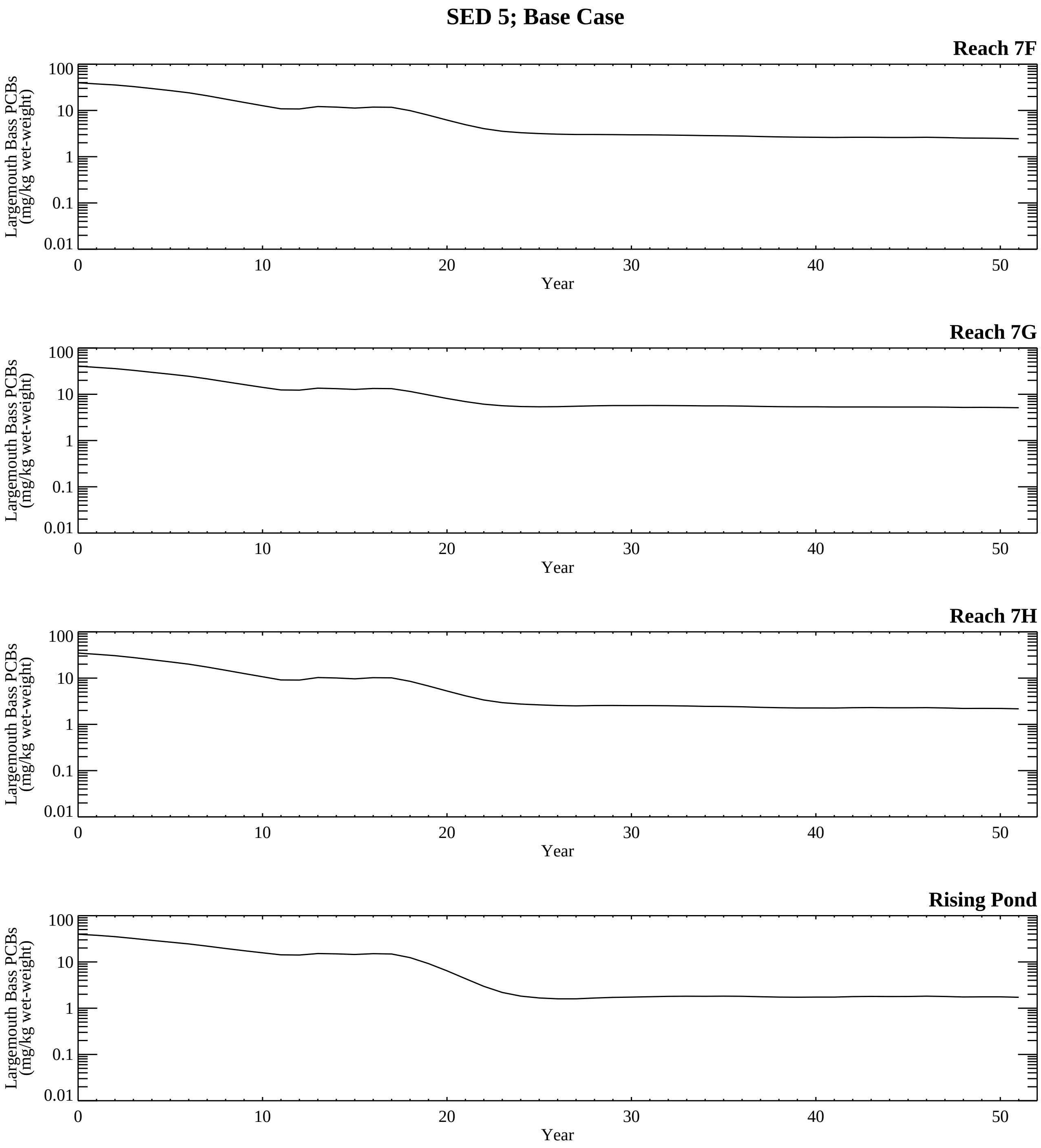

Figure G-1.3-4b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 5; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

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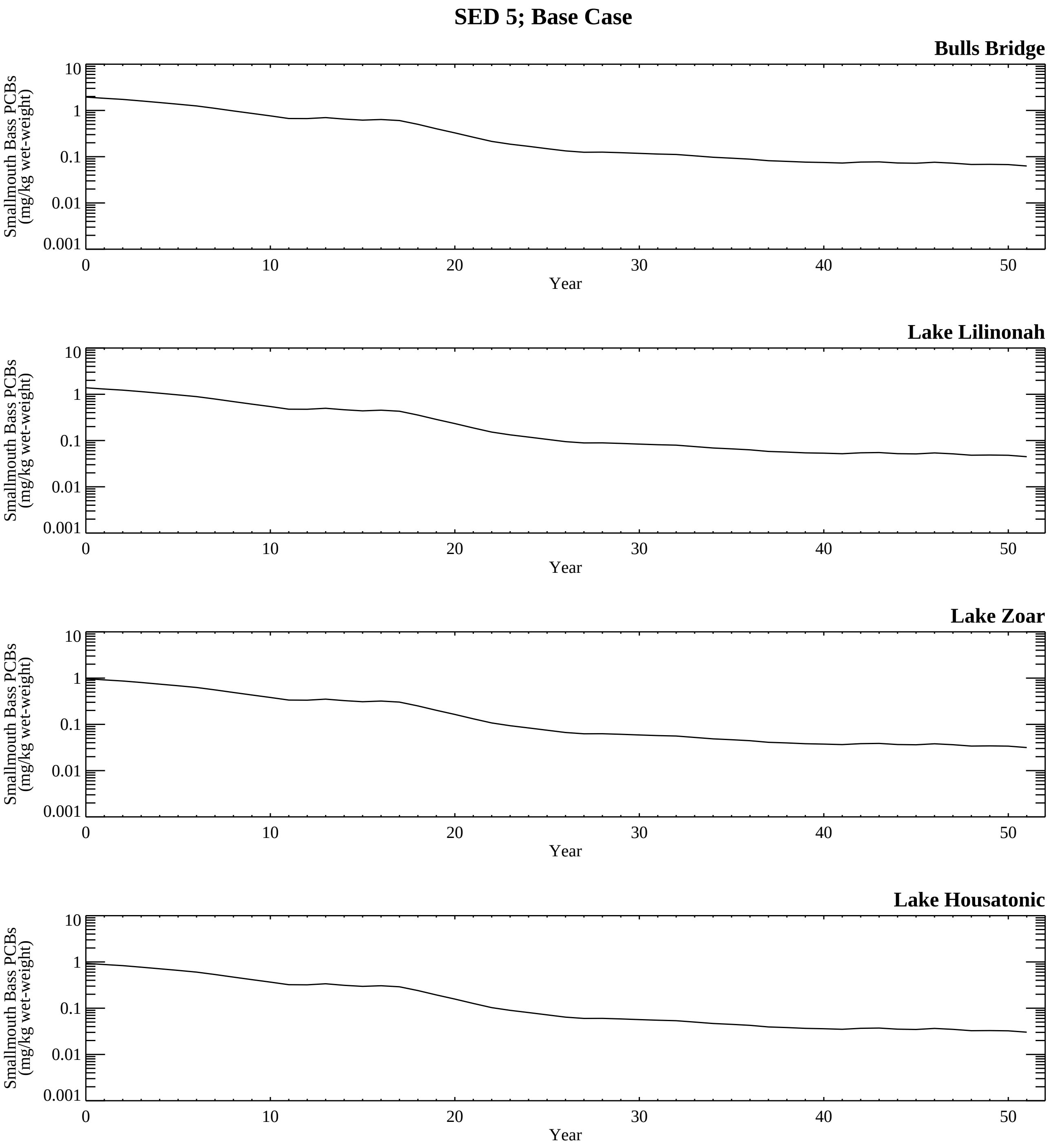

Figure G-1.3-4c. Temporal profiles of PCB concentrations in whole body smallmouth bass (SED 5; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

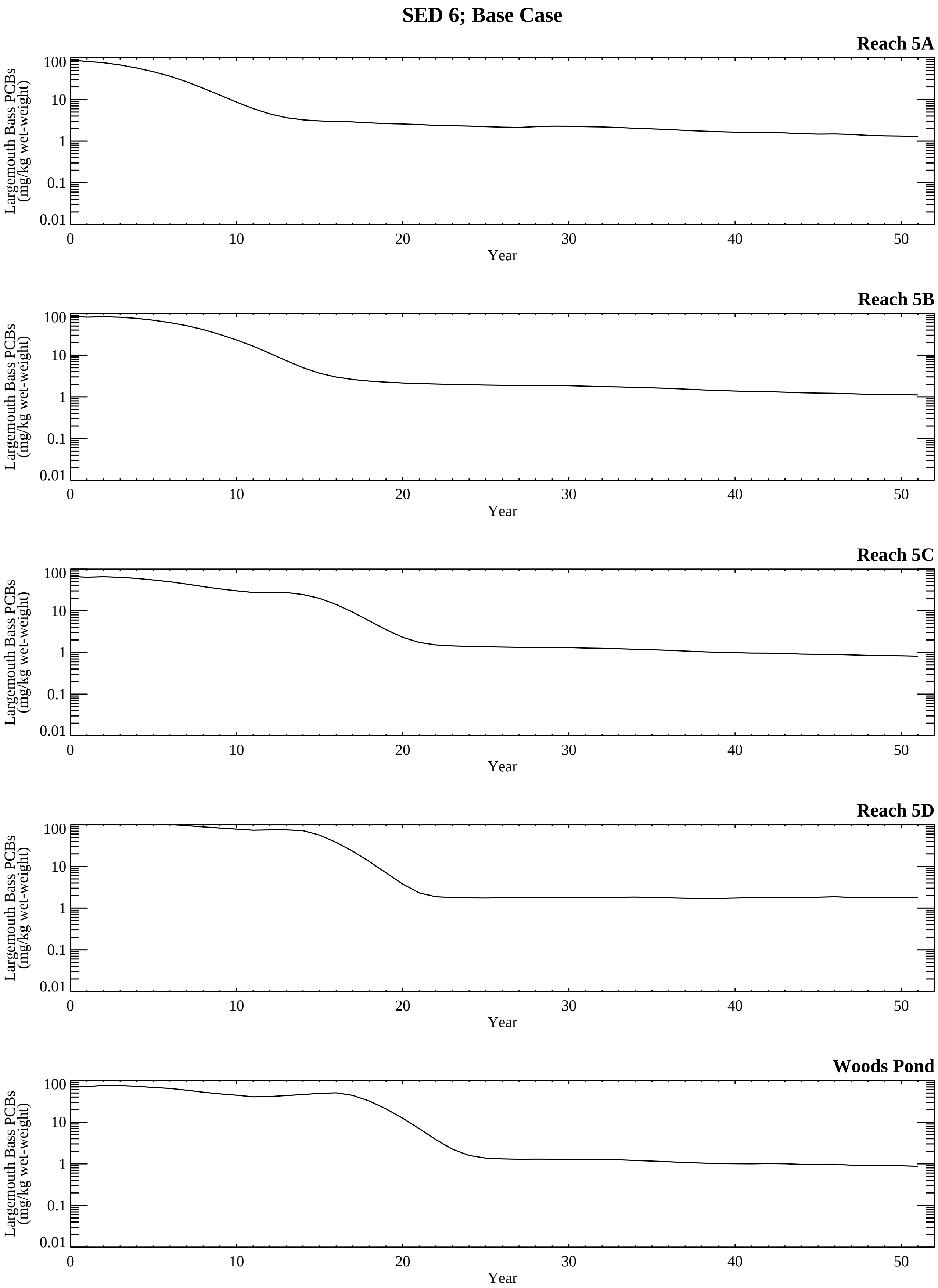

Figure G-1.3-5a. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 6; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

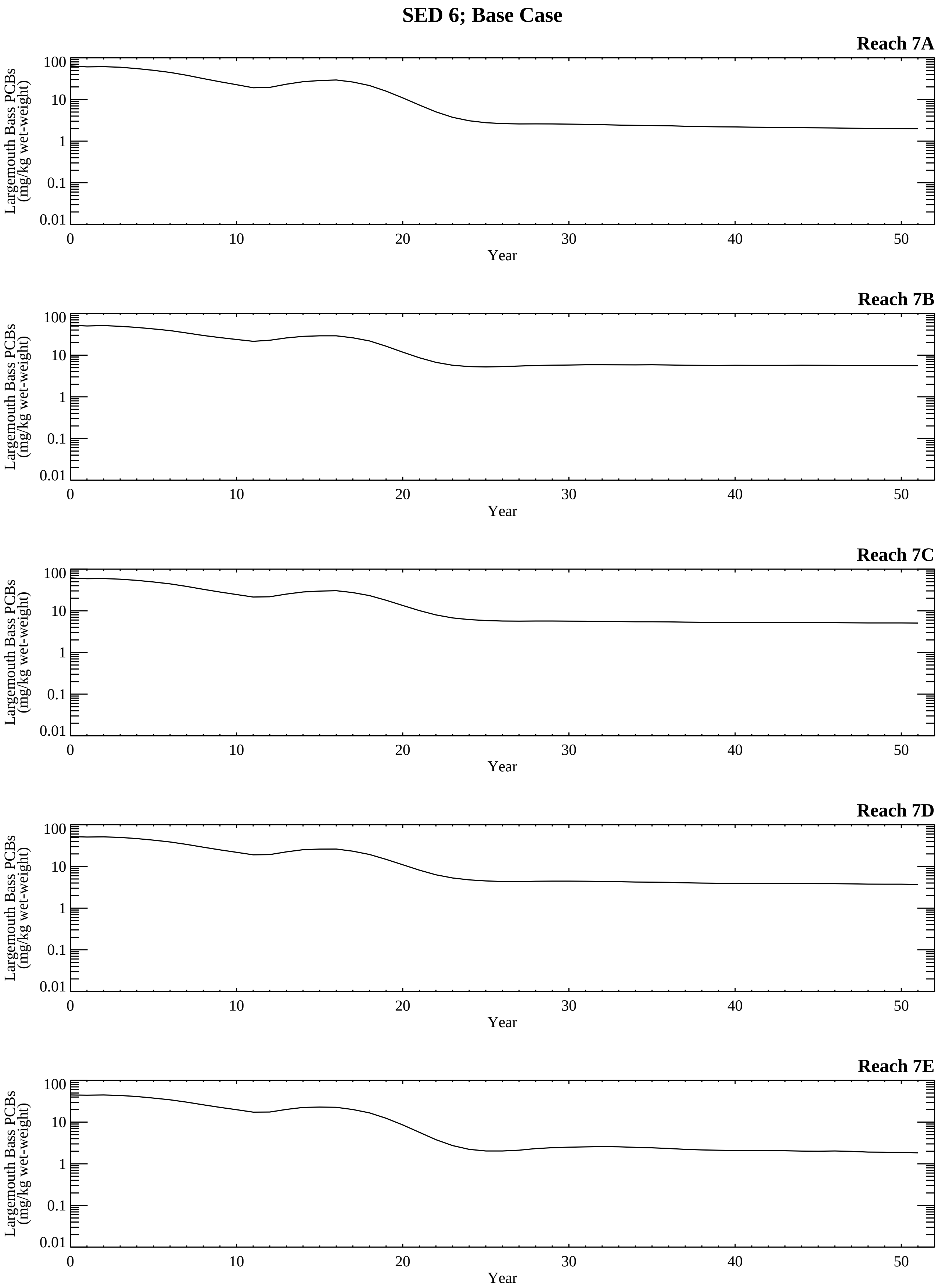

Figure G-1.3-5b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 6; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

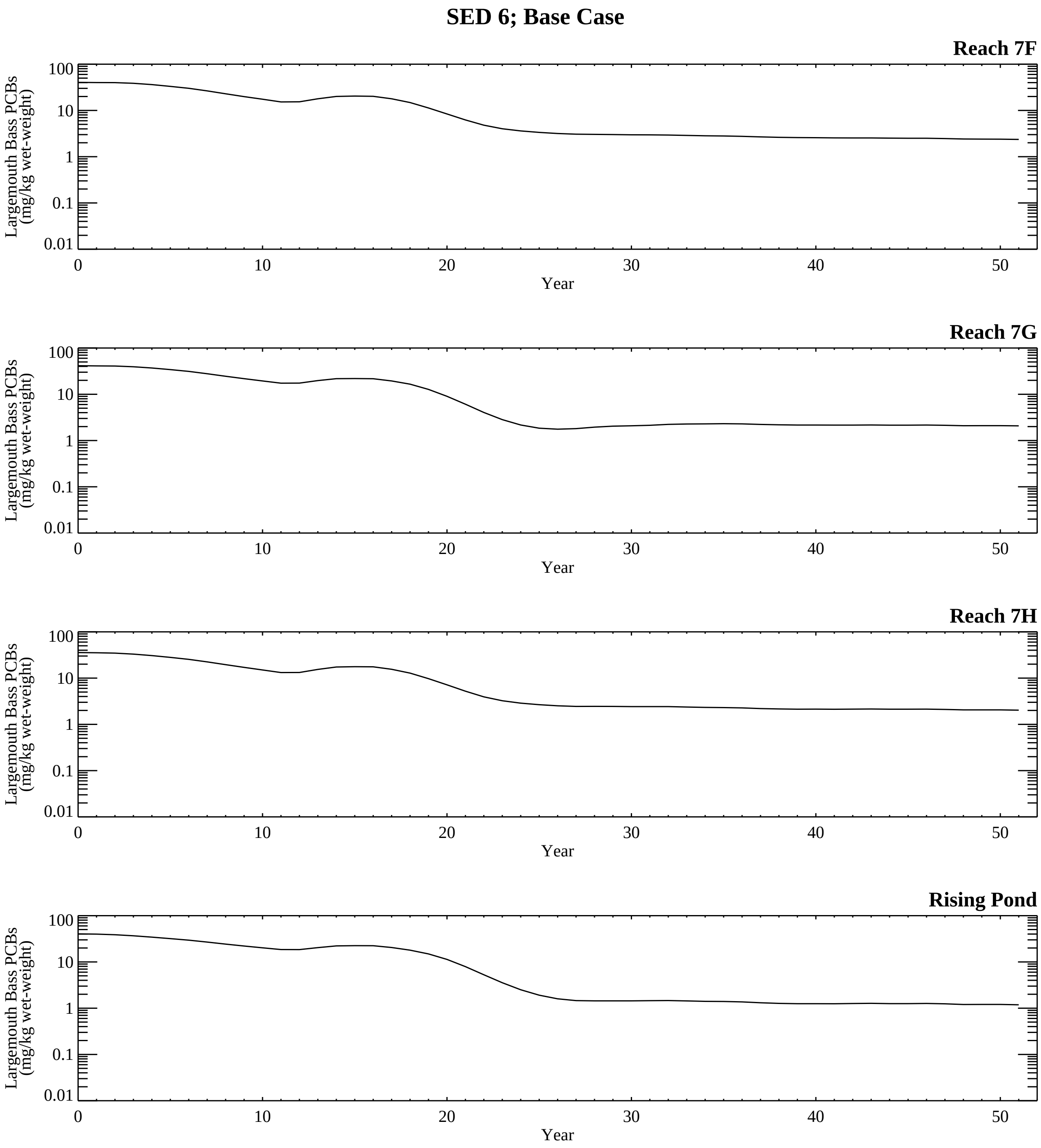

Figure G-1.3-5b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 6; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

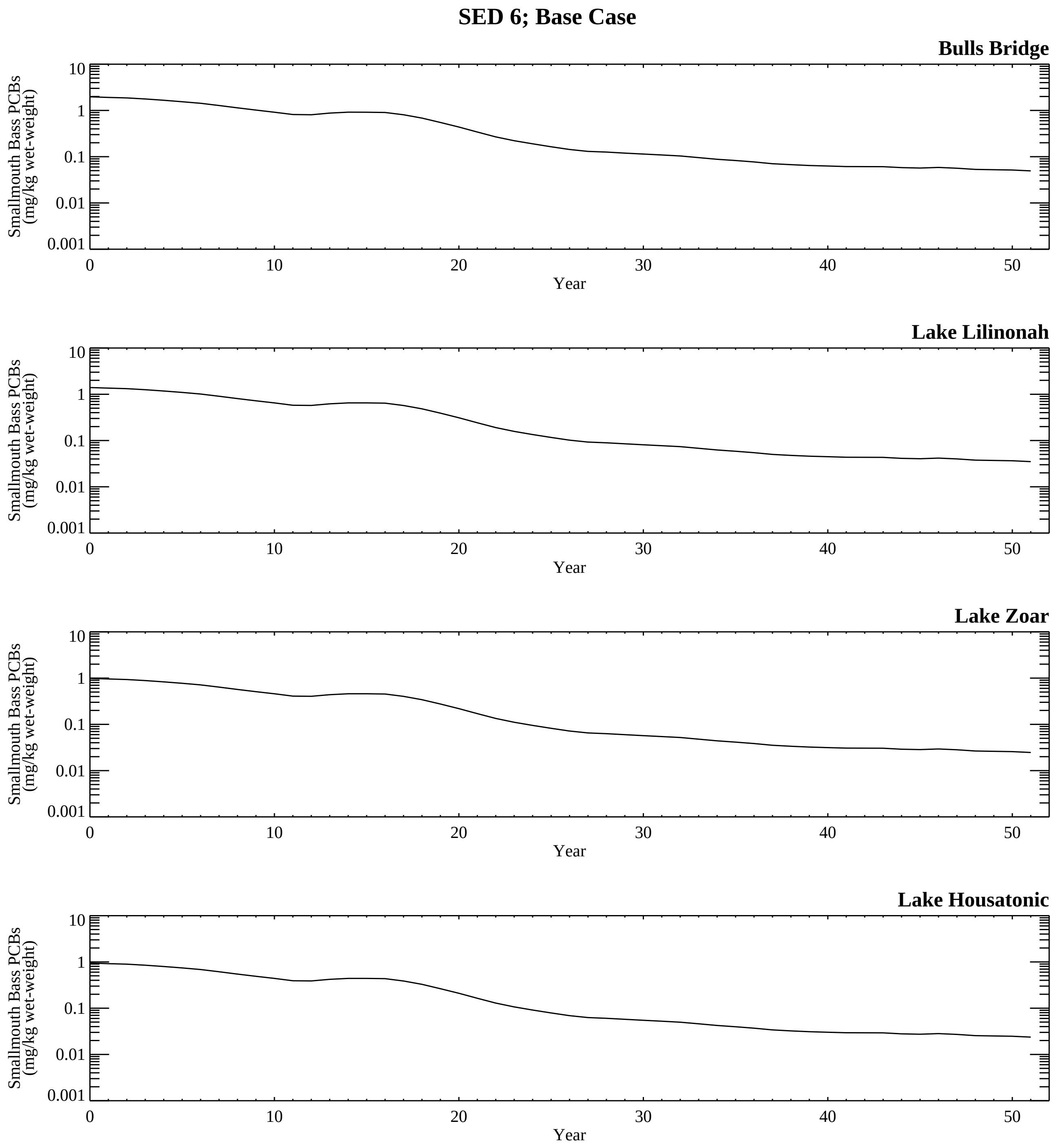

Figure G-1.3-5c. Temporal profiles of PCB concentrations in whole body smallmouth bass (SED 6; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

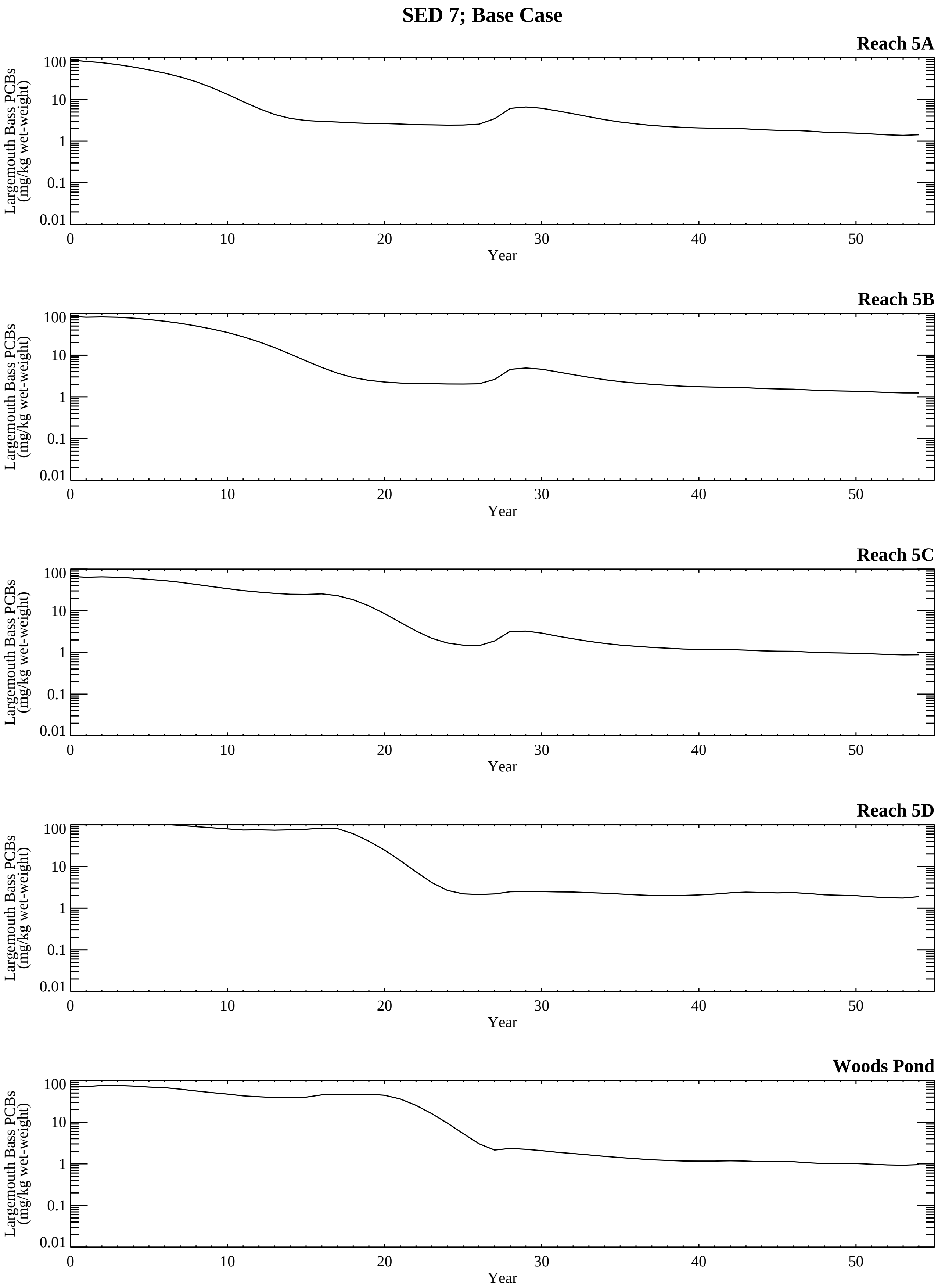

Figure G-1.3-6a. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 7; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

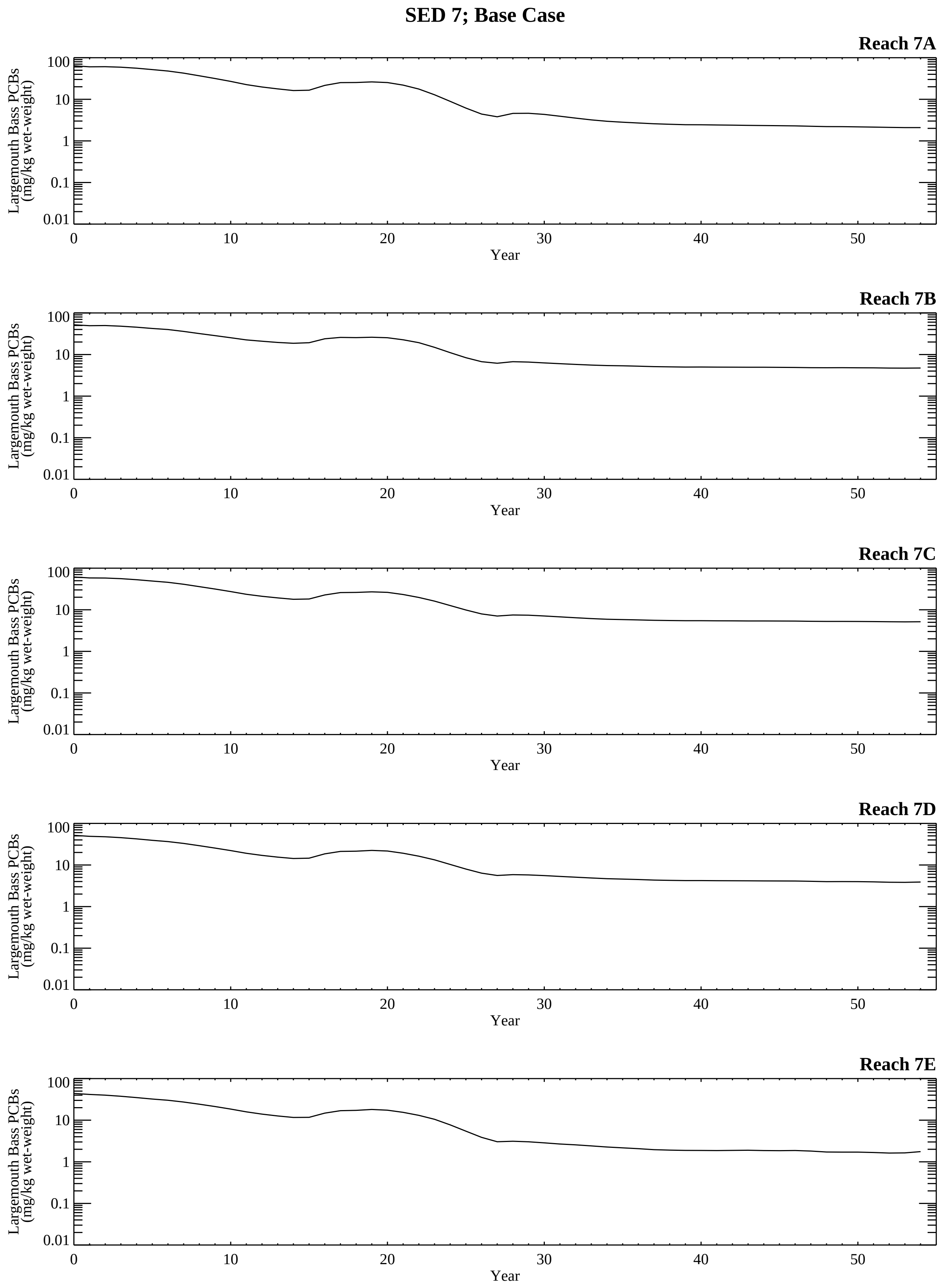

Figure G-1.3-6b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 7; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

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SED 7; Base Case

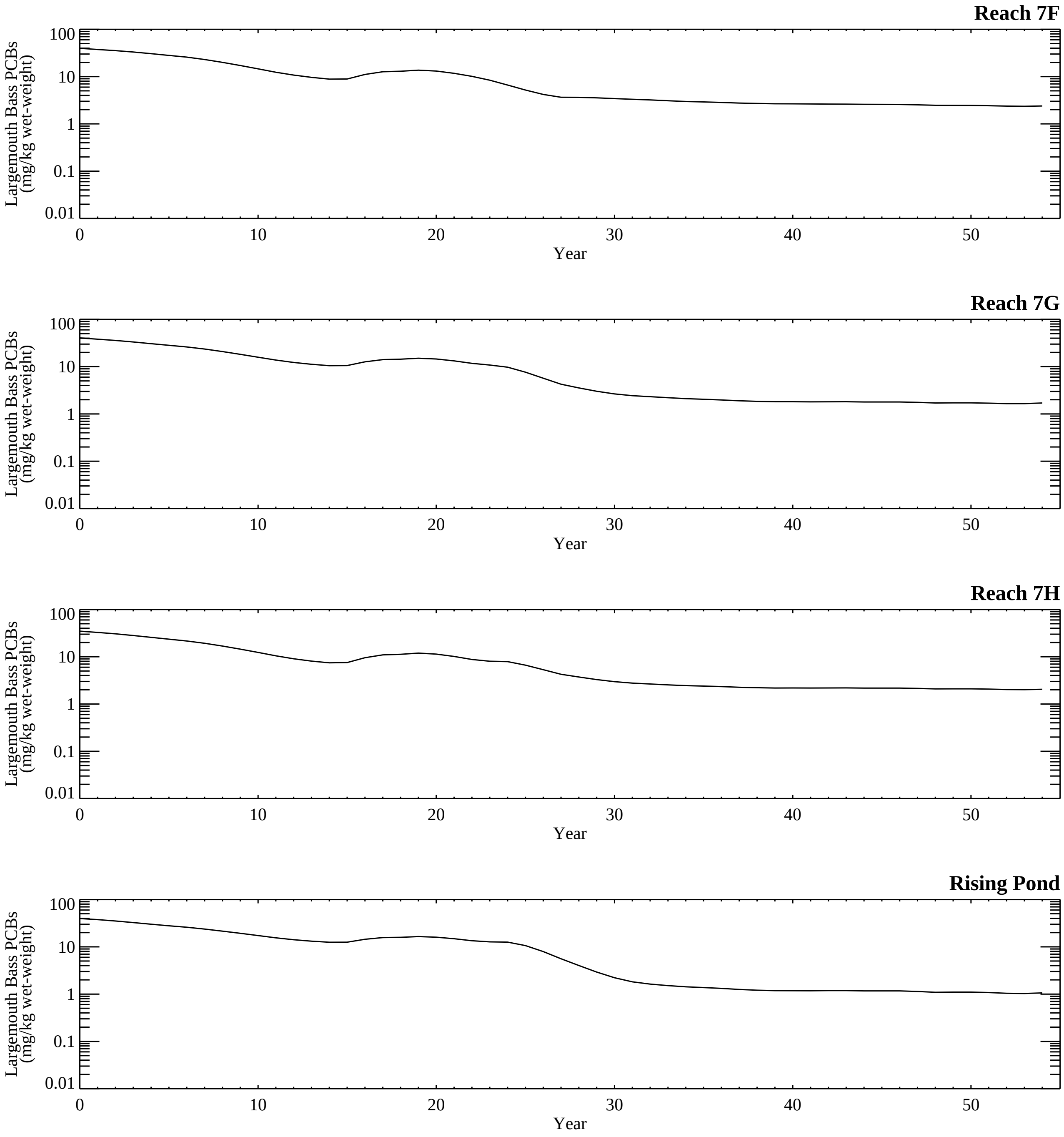

Figure G-1.3-6b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 7; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

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SED 7; Base Case

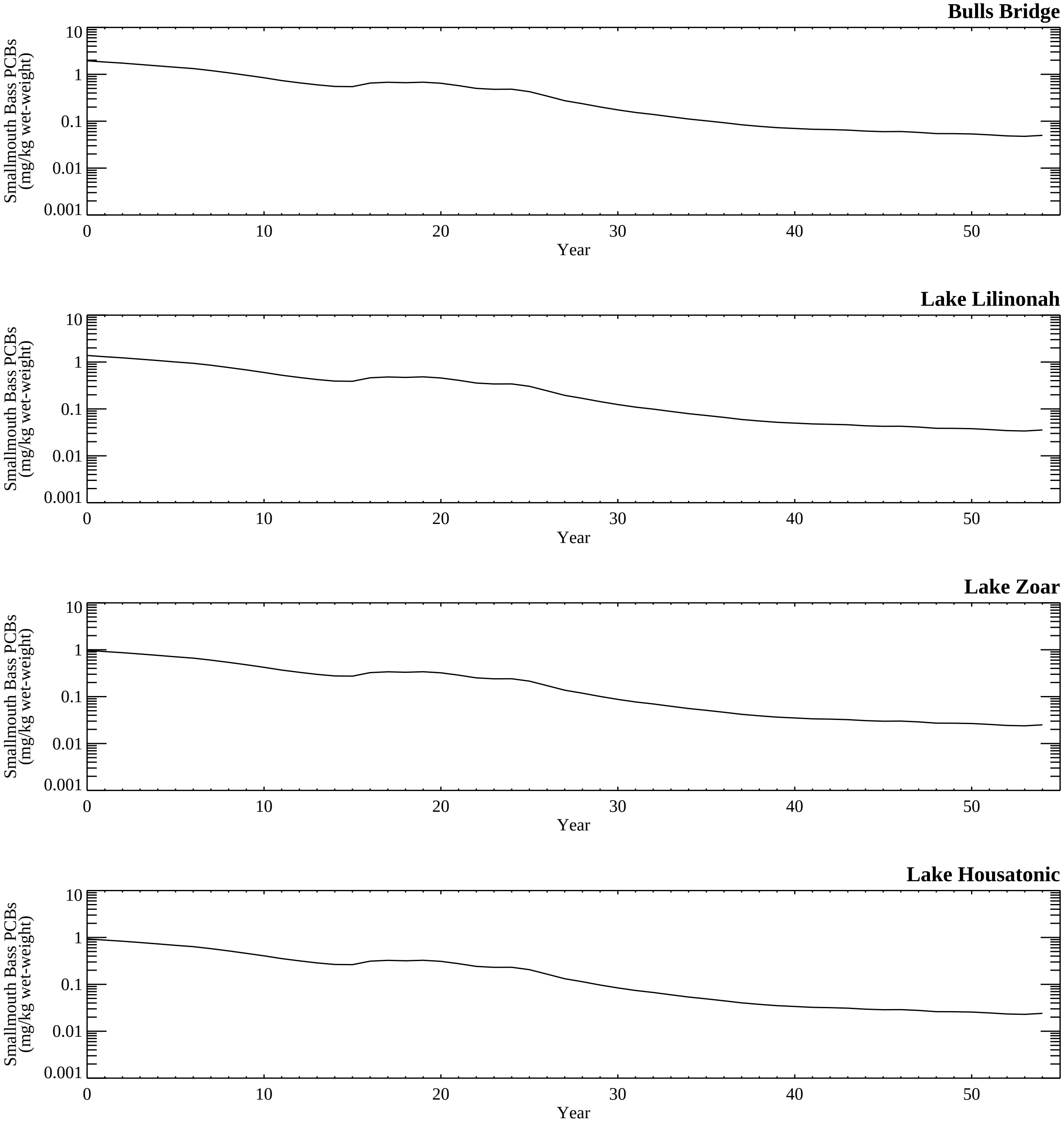

Figure G-1.3-6c. Temporal profiles of PCB concentrations in whole body smallmouth bass (SED 7; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

SED 8; Base Case

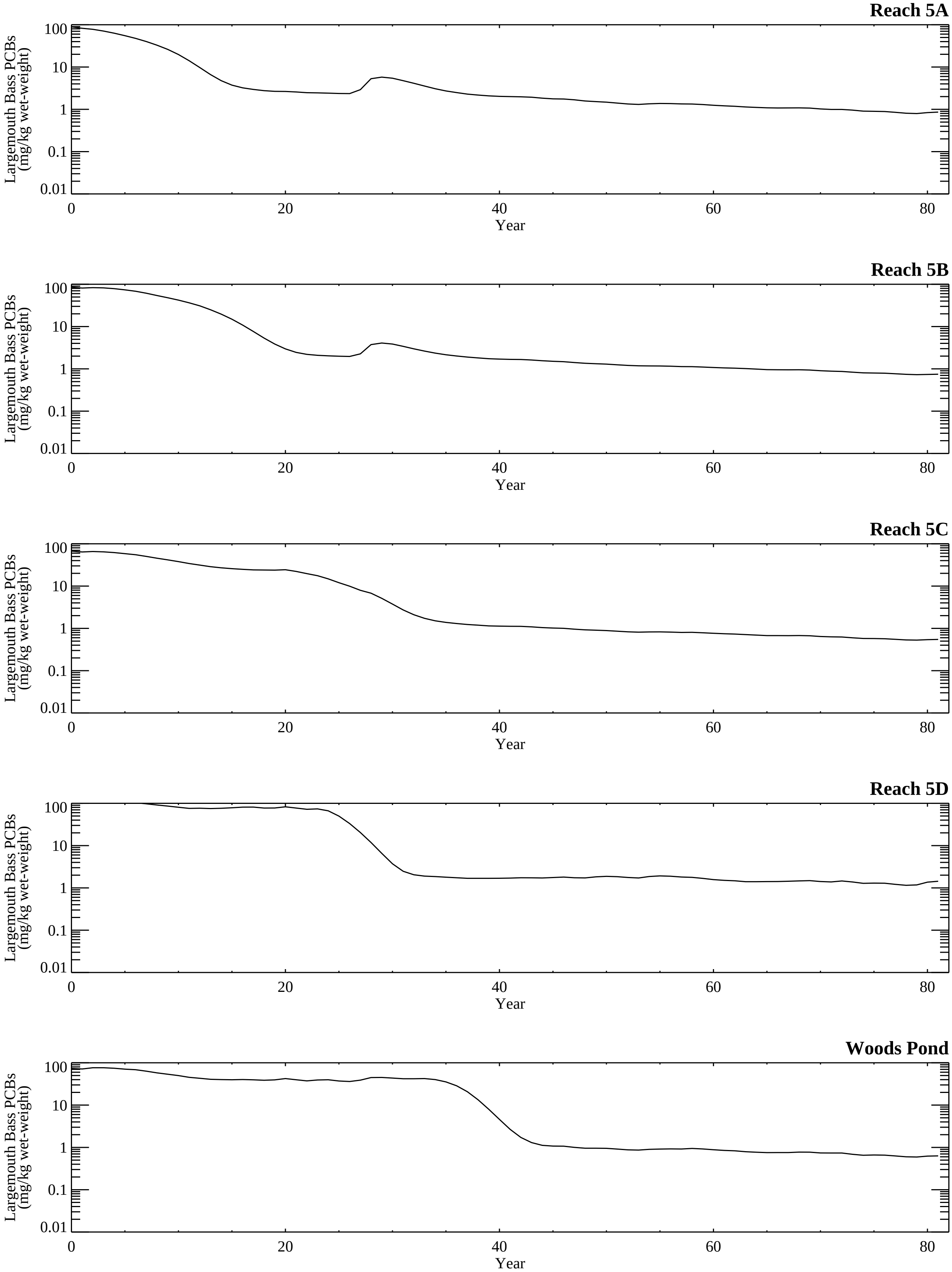

Figure G-1.3-7a. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 8; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

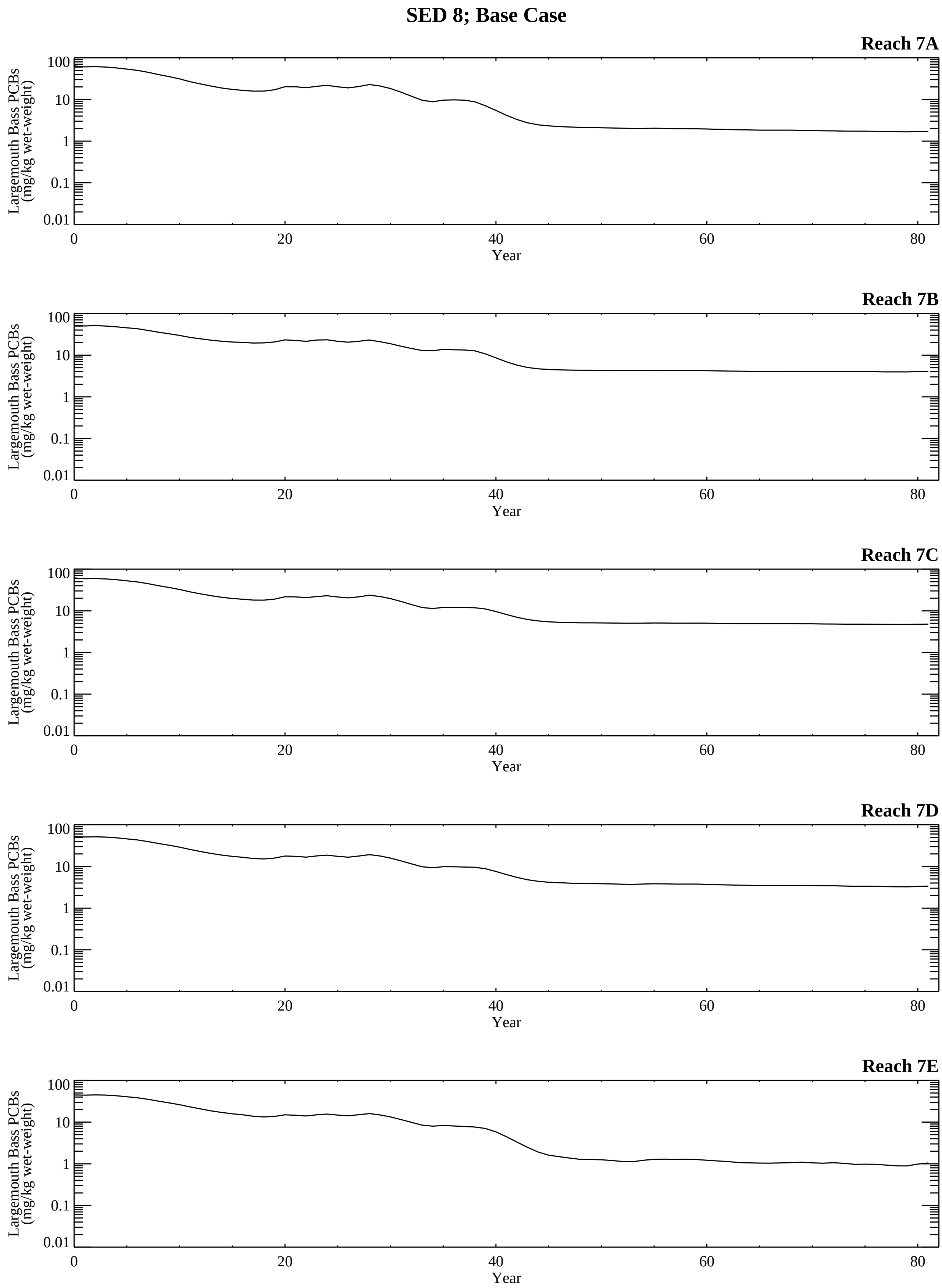

Figure G-1.3-7b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 8; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

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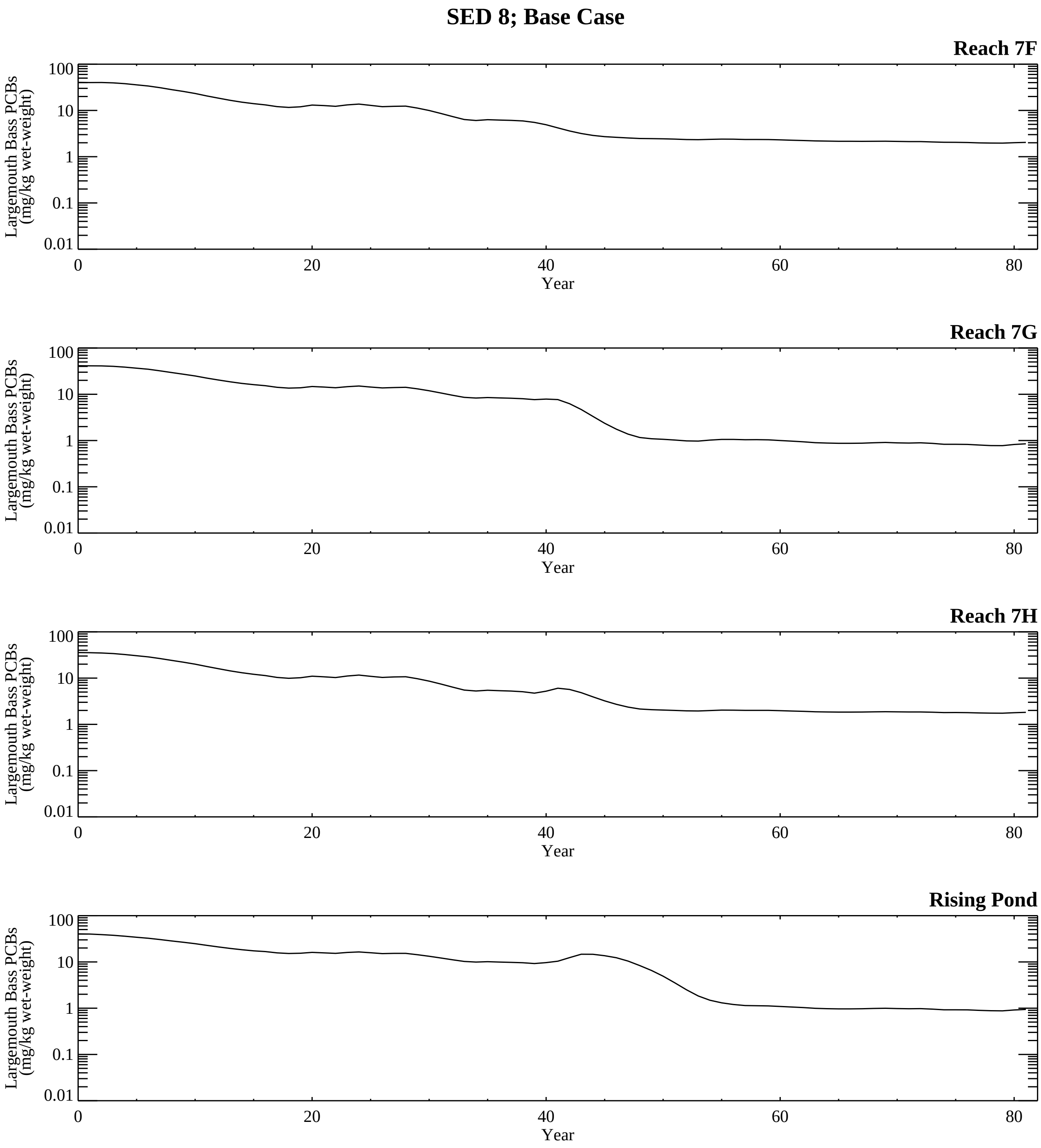

Figure G-1.3-7b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 8; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

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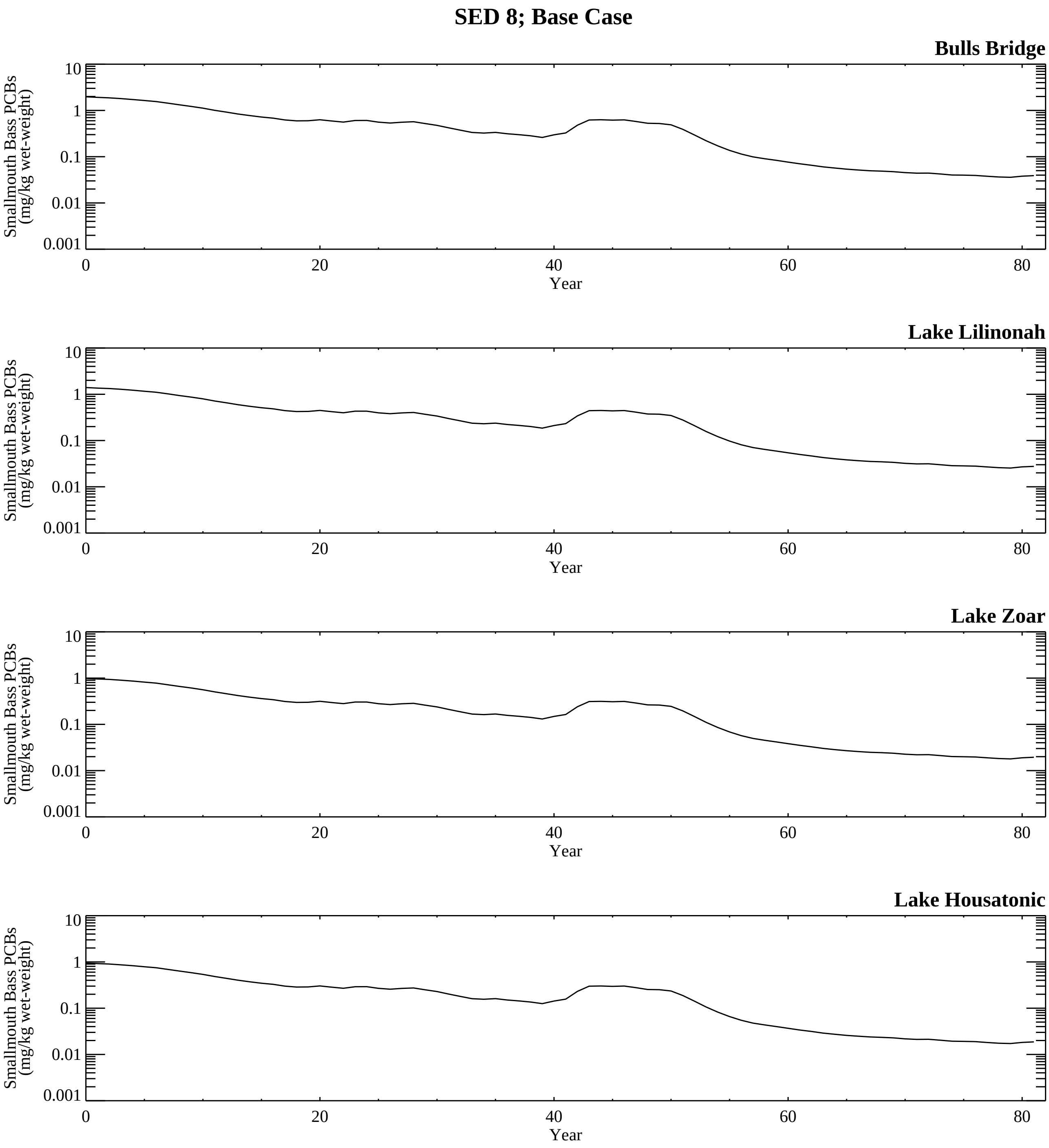

Figure G-1.3-7c. Temporal profiles of PCB concentrations in whole body smallmouth bass (SED 8; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

SED 1 / SED 2; Base Case

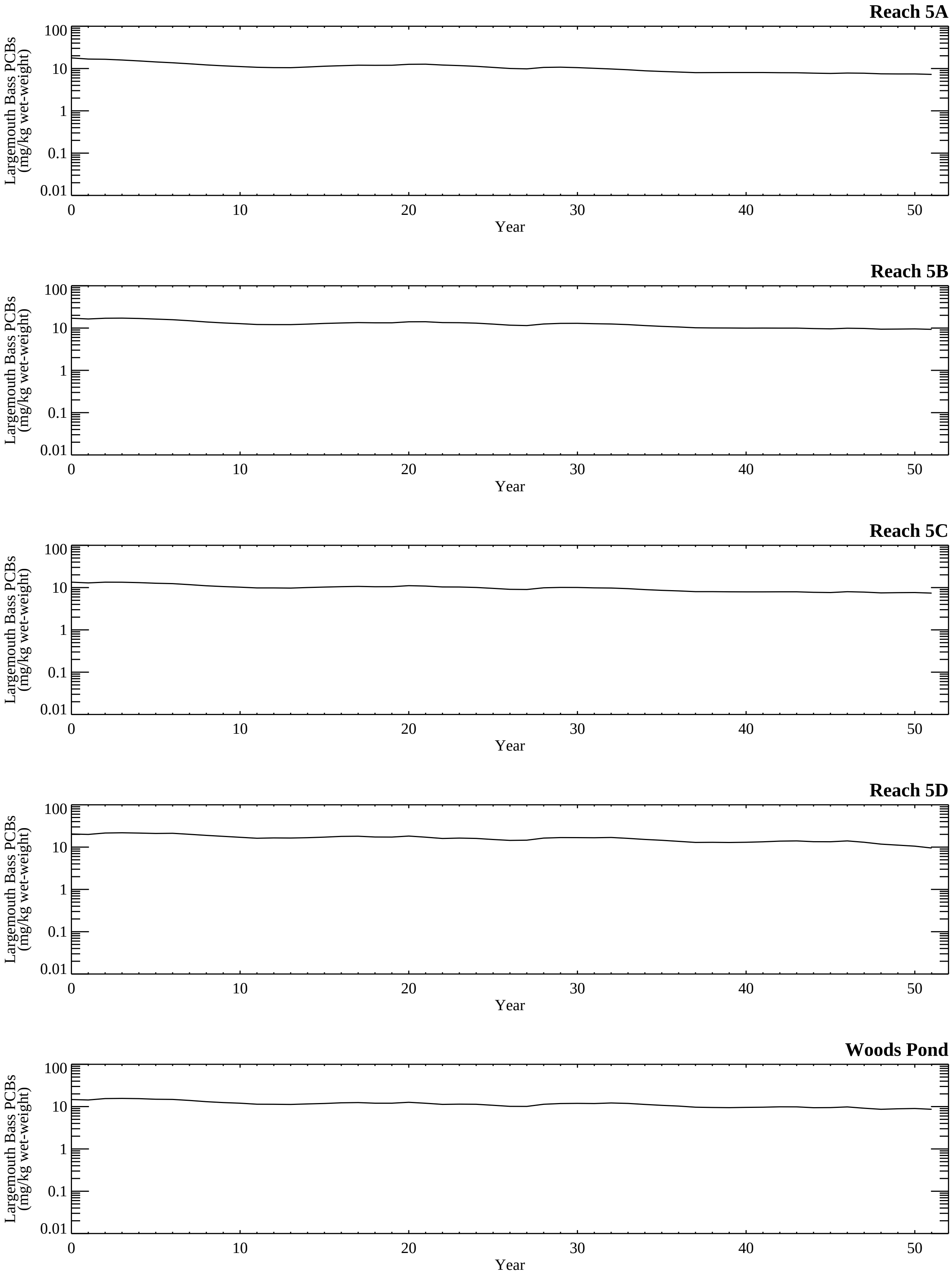

Figure G-1.4-1a. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 1 / SED 2; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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Mon Mar 17 19:25:14 2008

SED 1 / SED 2; Base Case

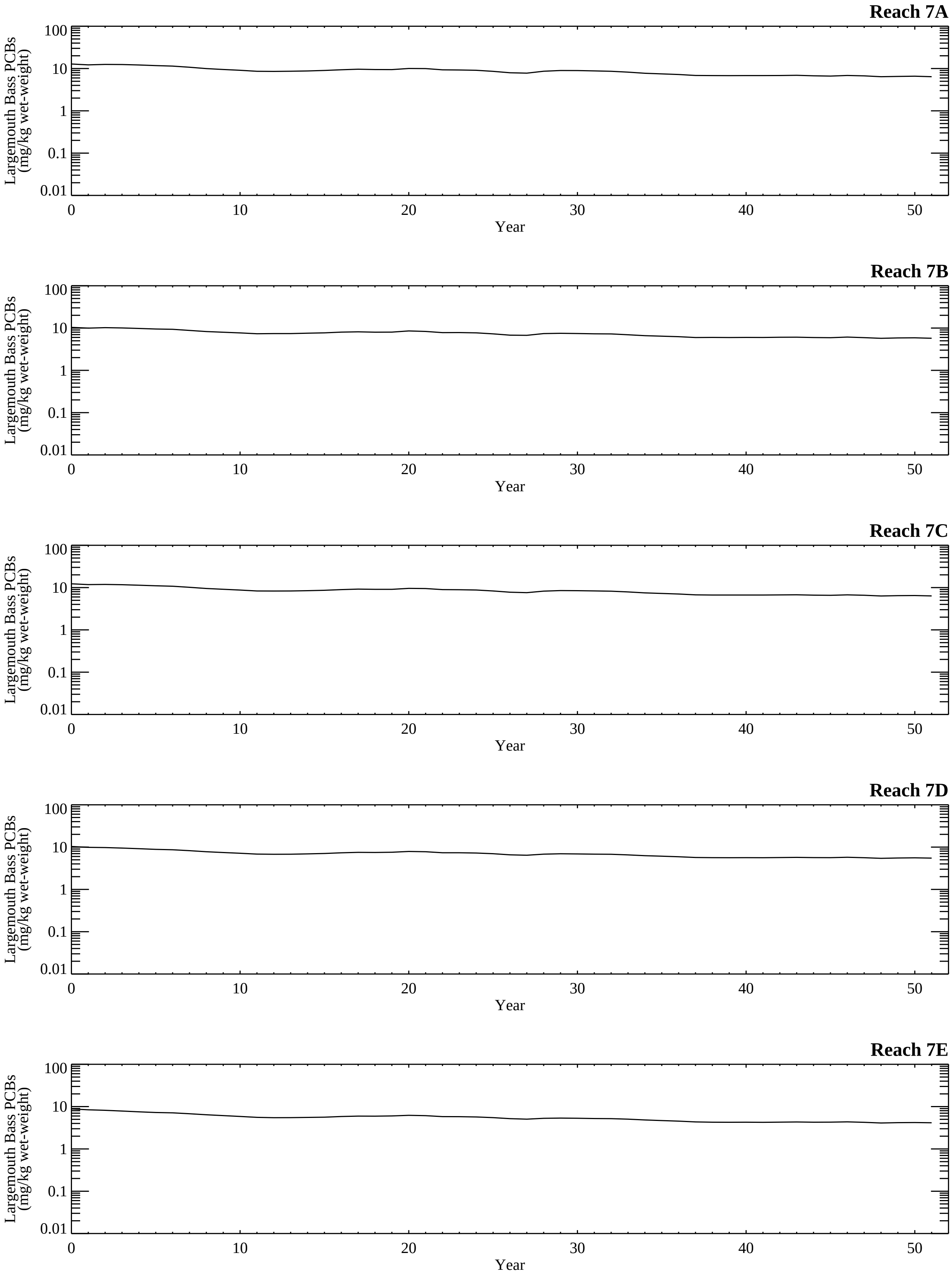

Figure G-1.4-1b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 1 / SED 2; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

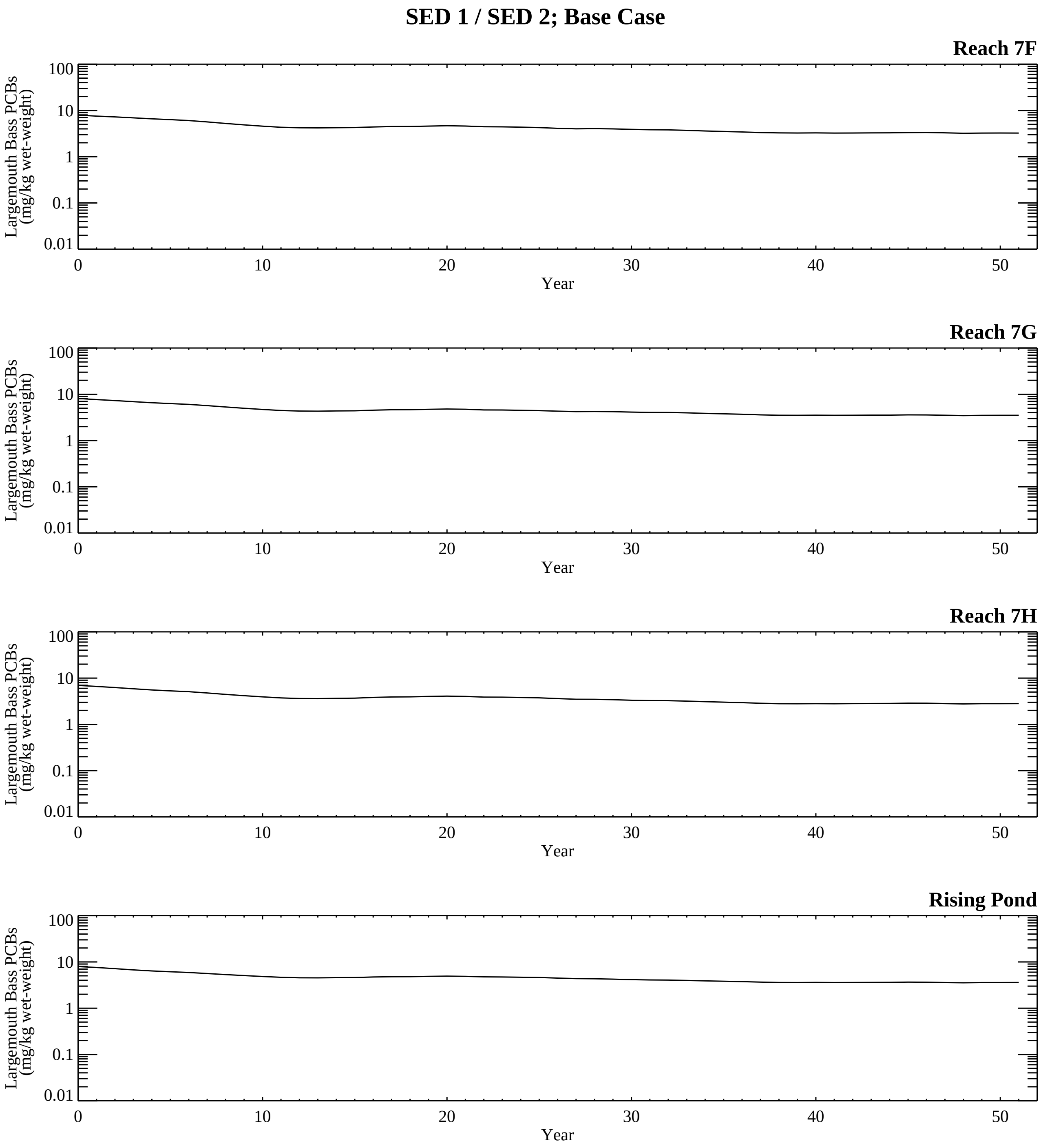

Figure G-1.4-1b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 1 / SED 2; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

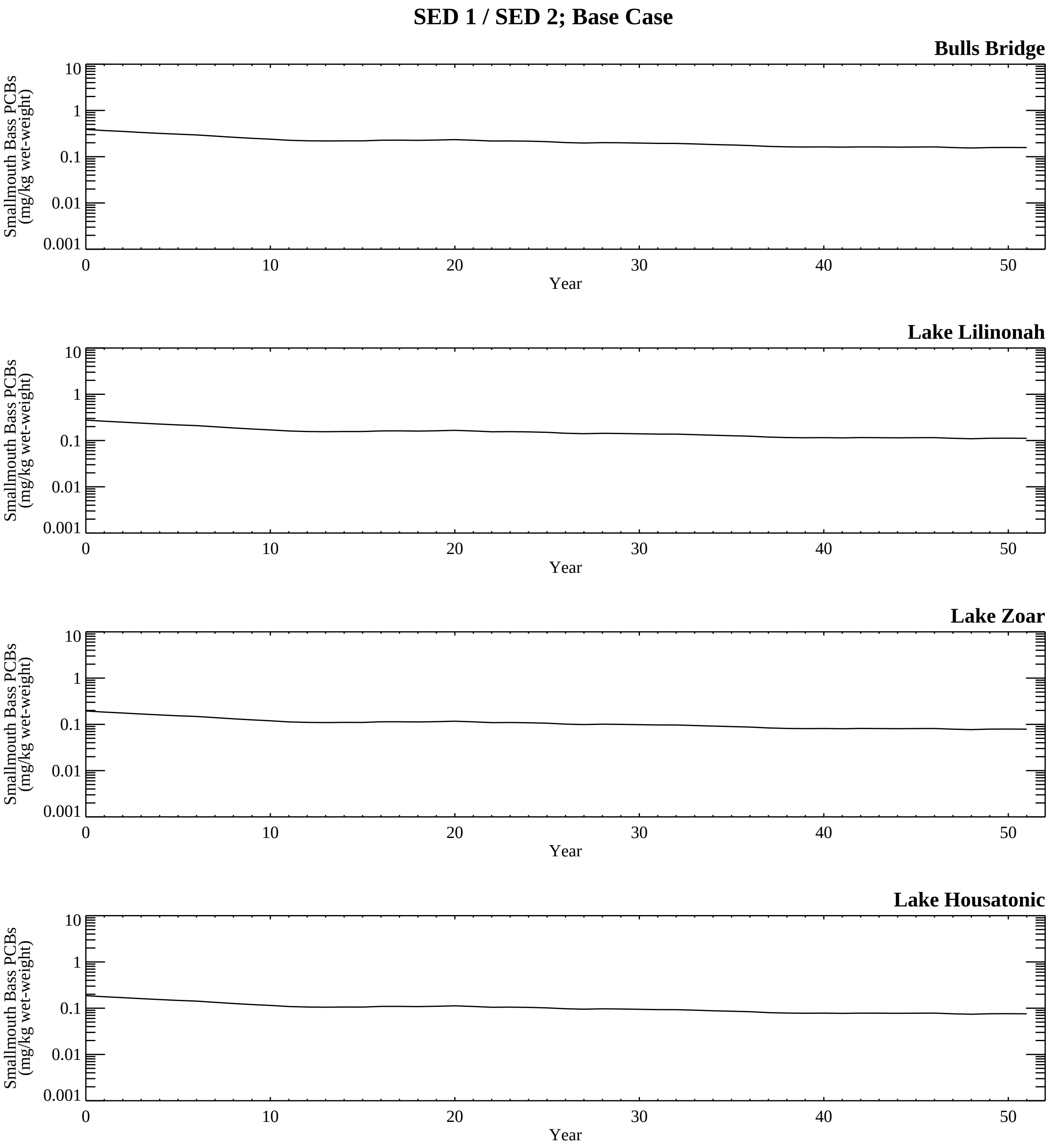

Figure G-1.4-1c. Temporal profiles of PCB concentrations in smallmouth bass fillets (SED 1 / SED 2; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

SED 3; Base Case

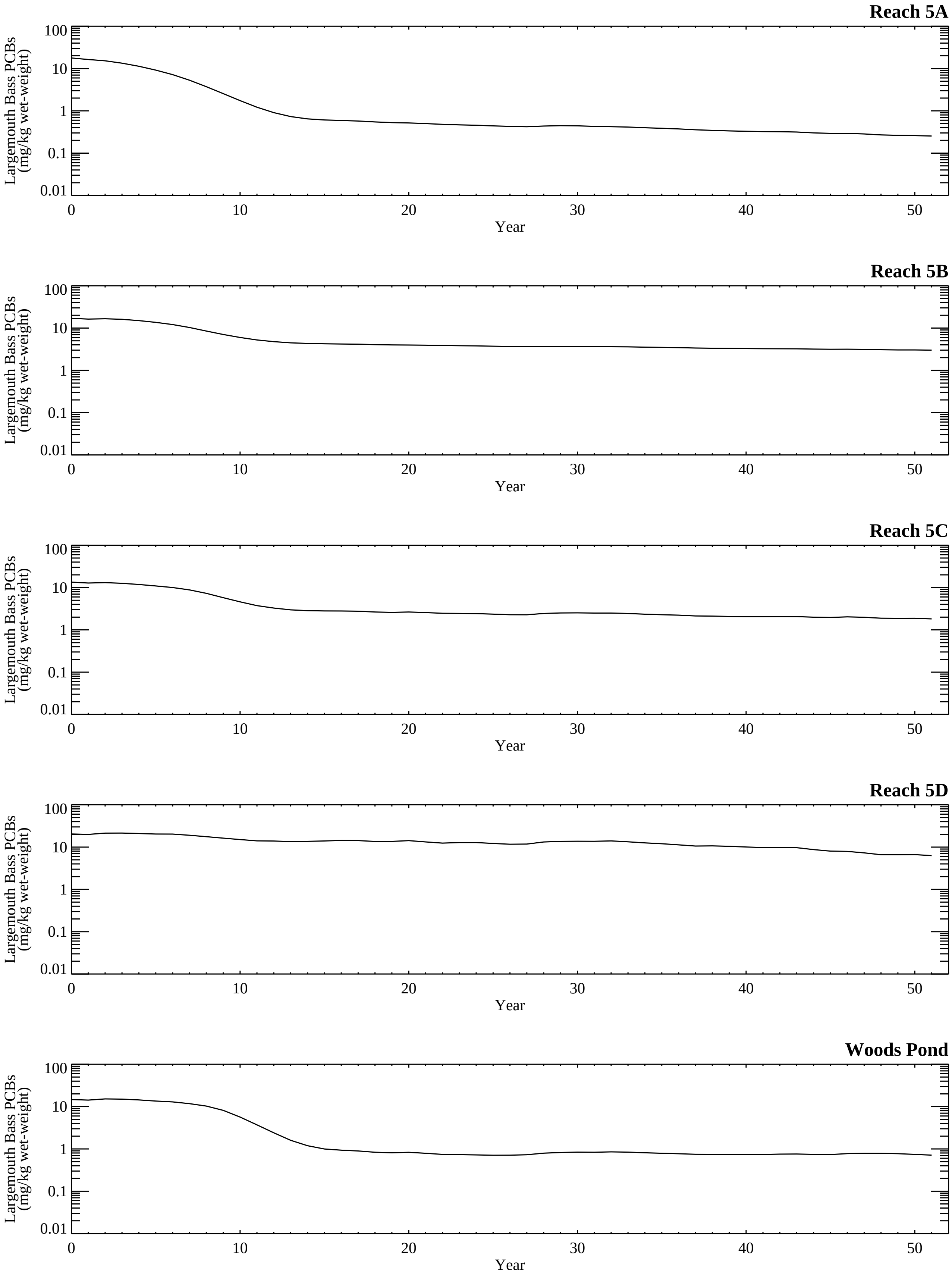

Figure G-1.4-2a. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 3; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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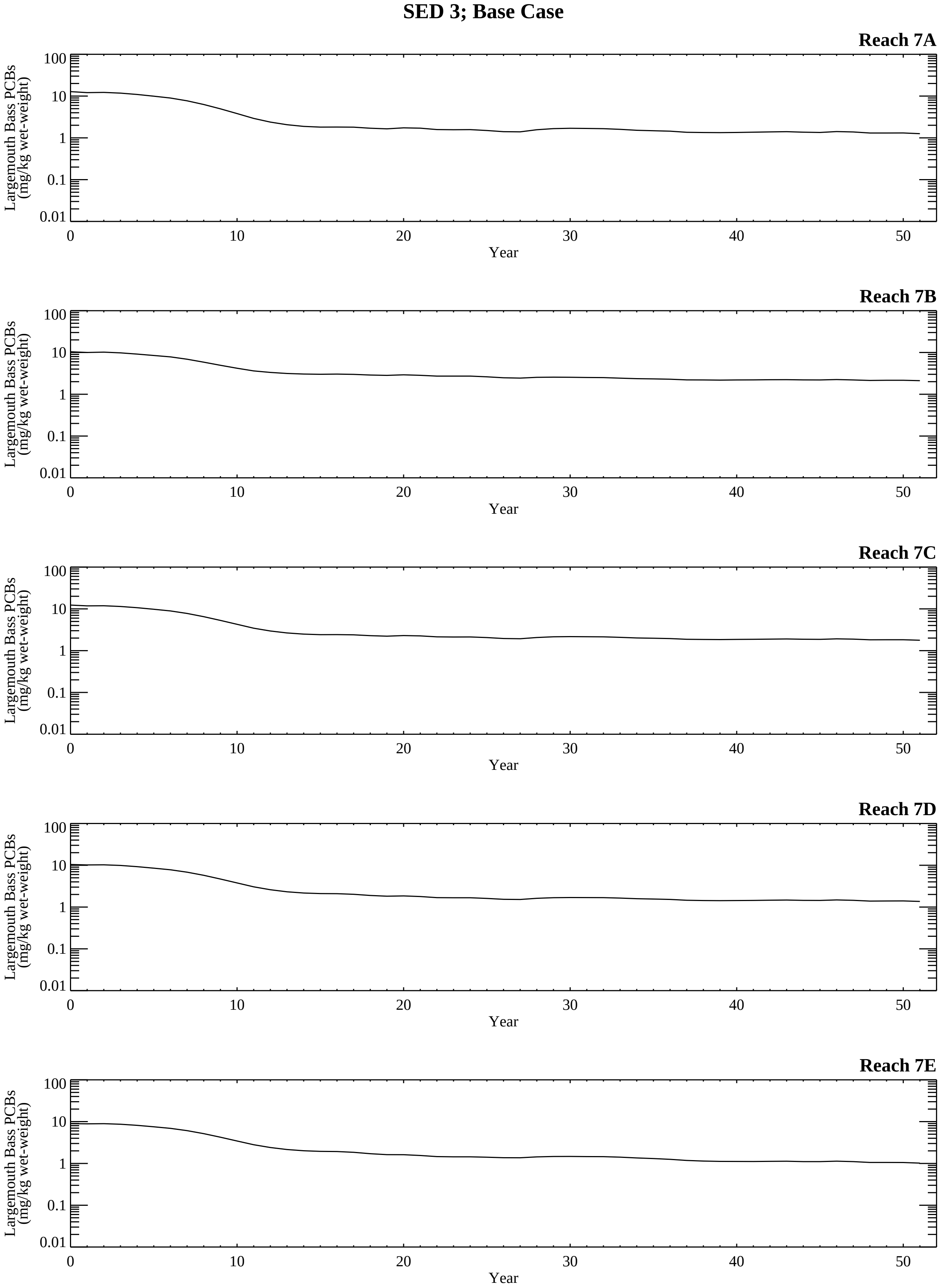


Figure G-1.4-2b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 3; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

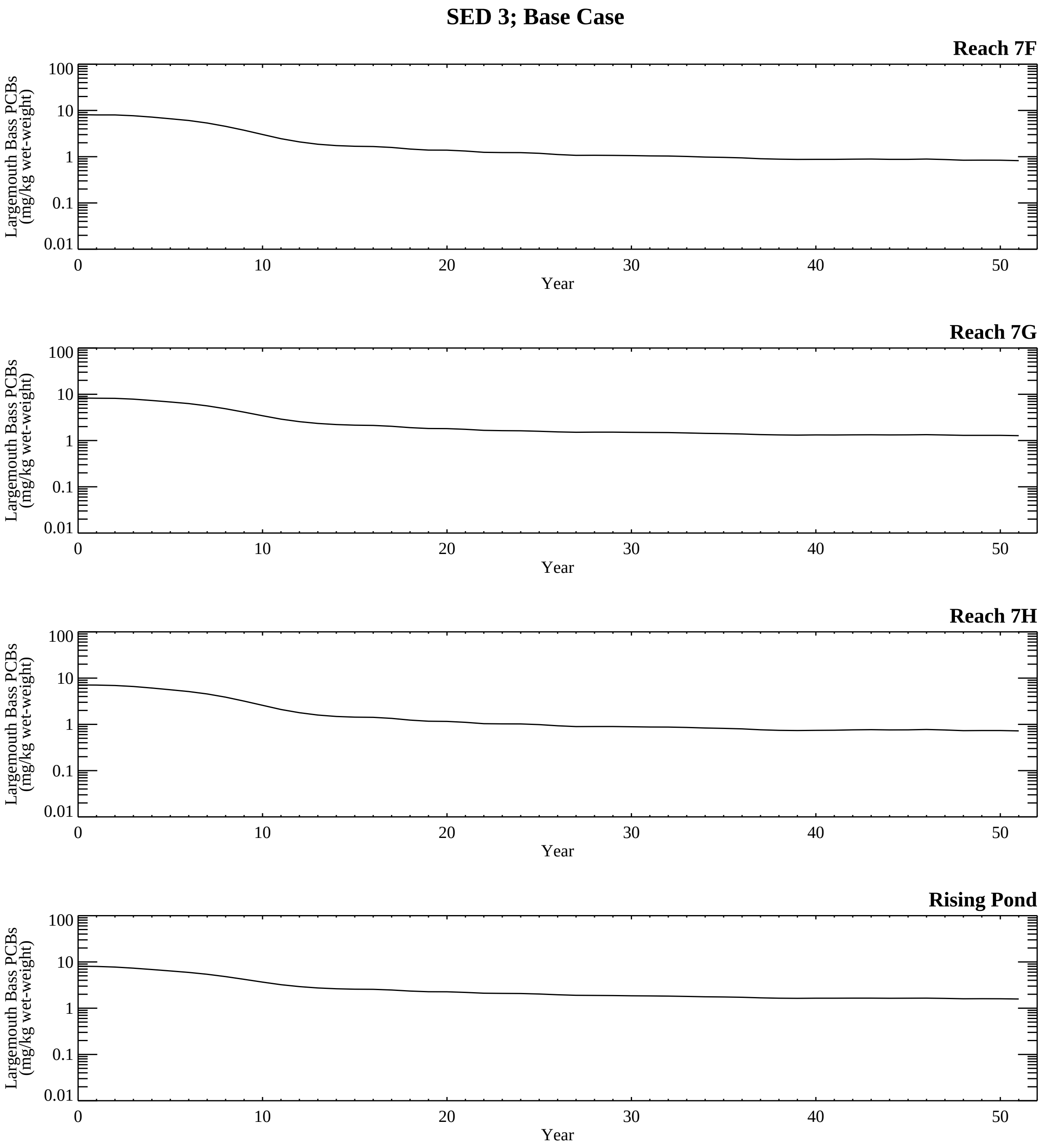
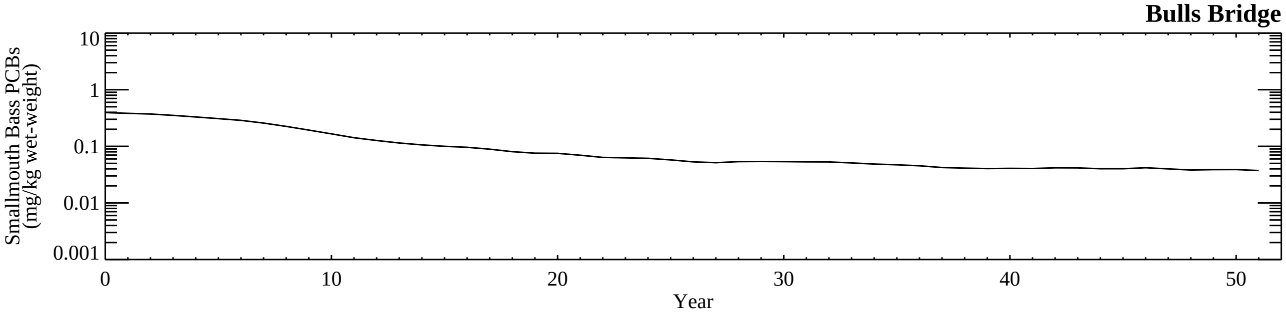
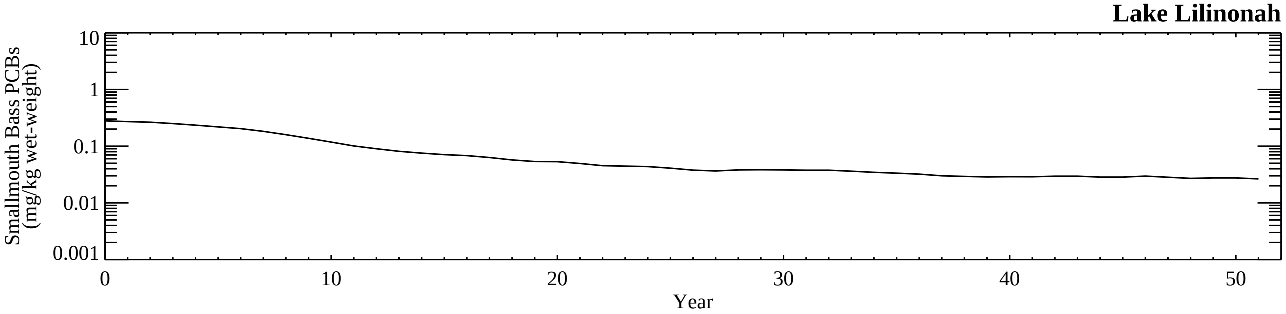


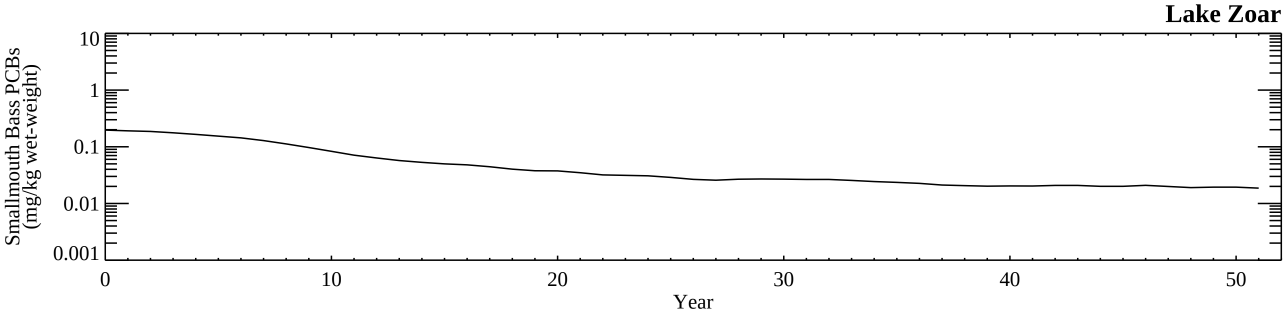
Figure G-1.4-2b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 3; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

SED 3; Base Case







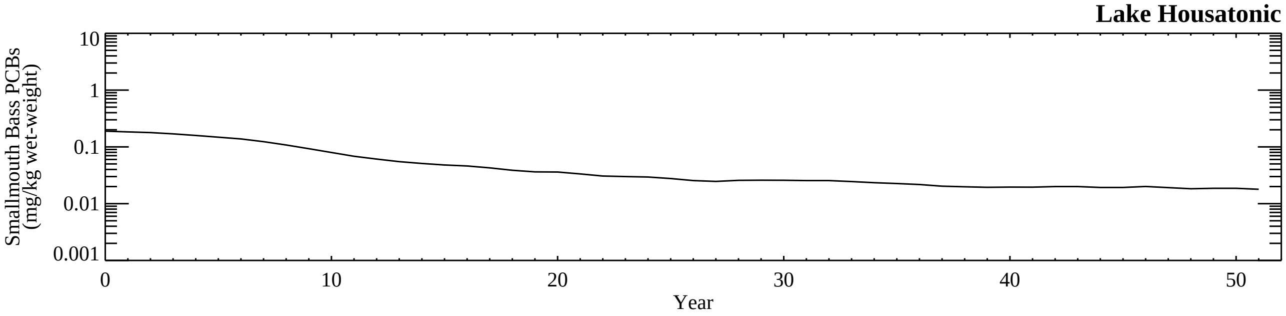


Figure G-1.4-2c. Temporal profiles of PCB concentrations in smallmouth bass fillets (SED 3; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

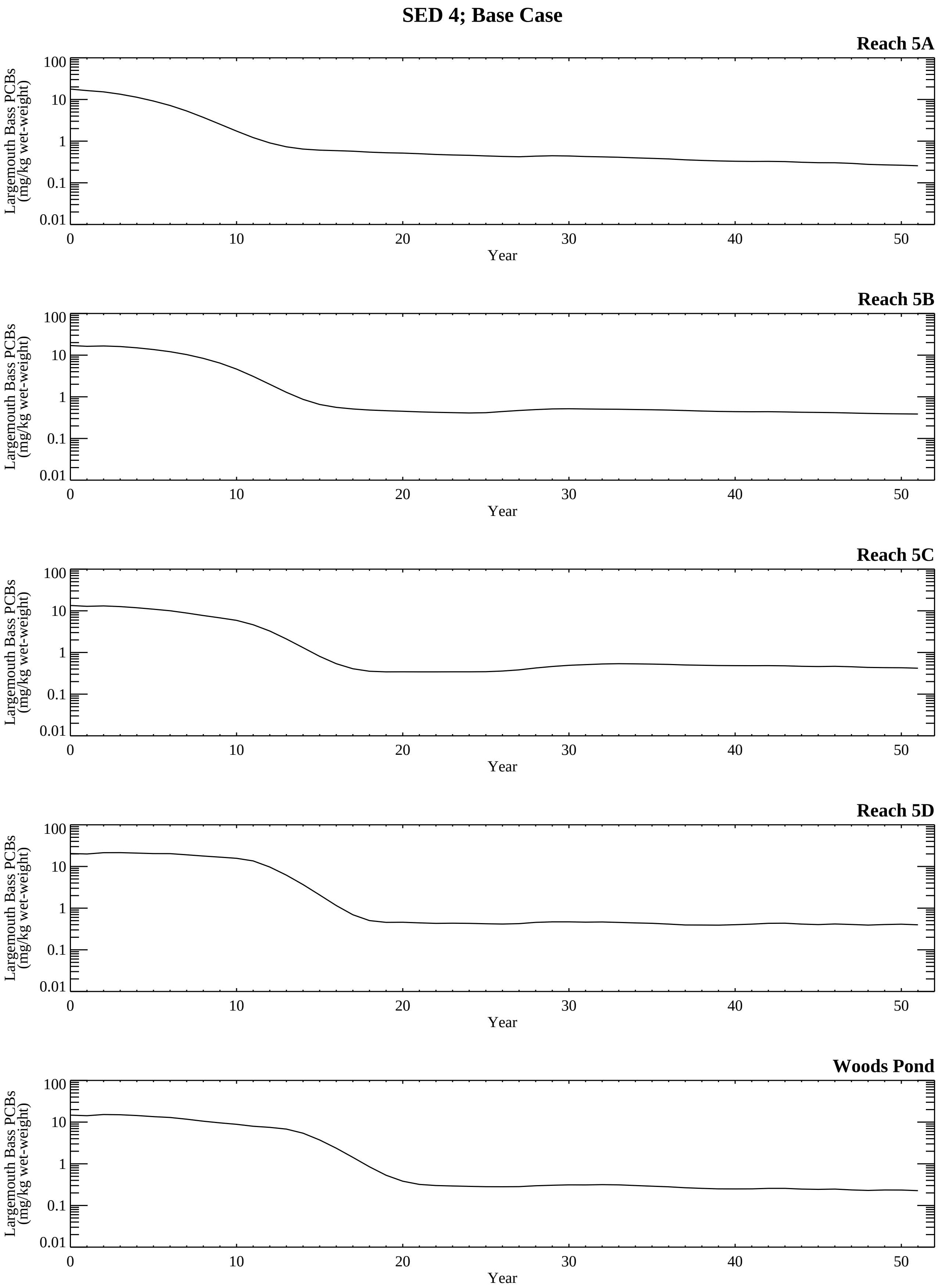


Figure G-1.4-3a. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 4; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

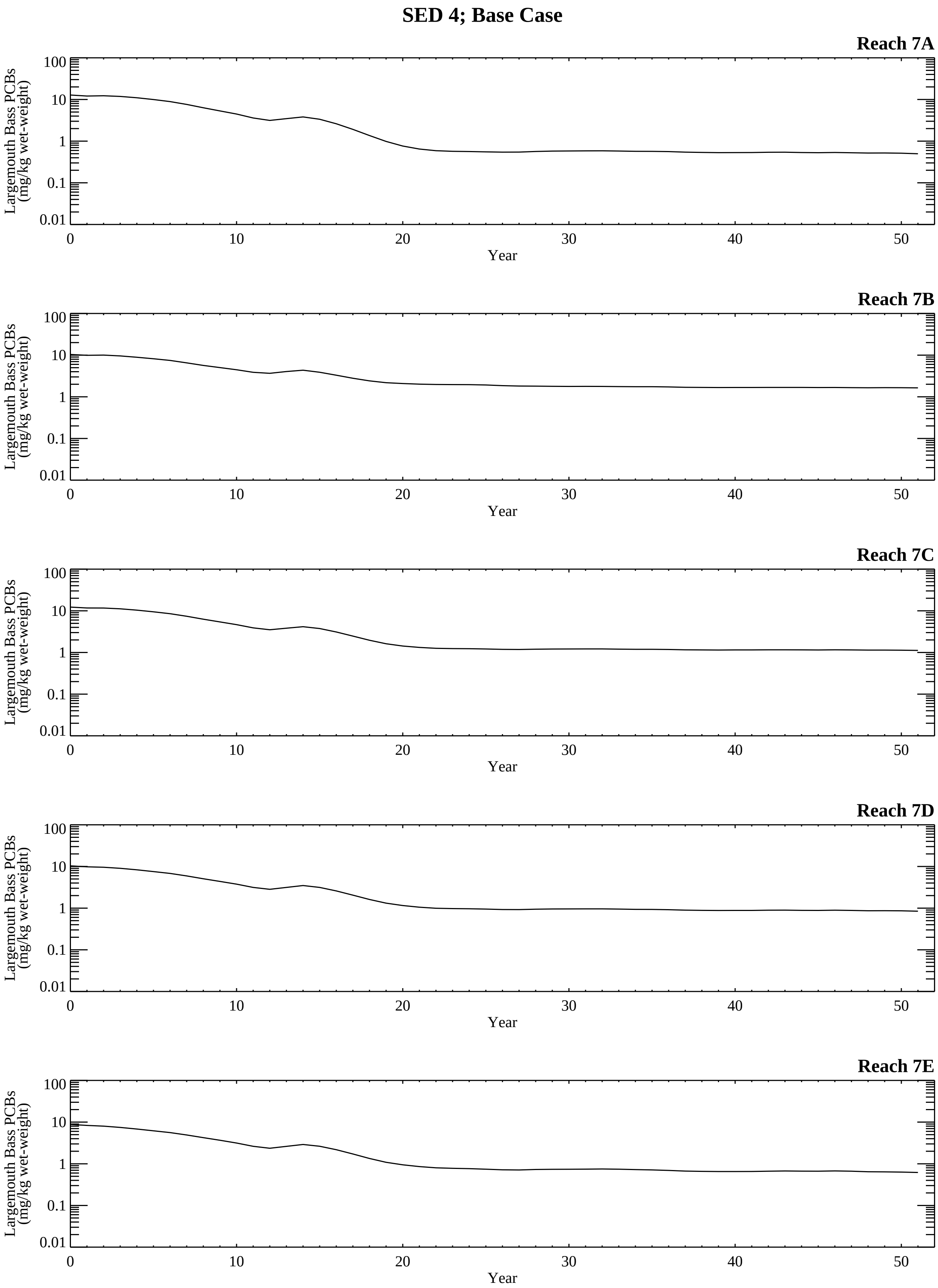


Figure G-1.4-3b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 4; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

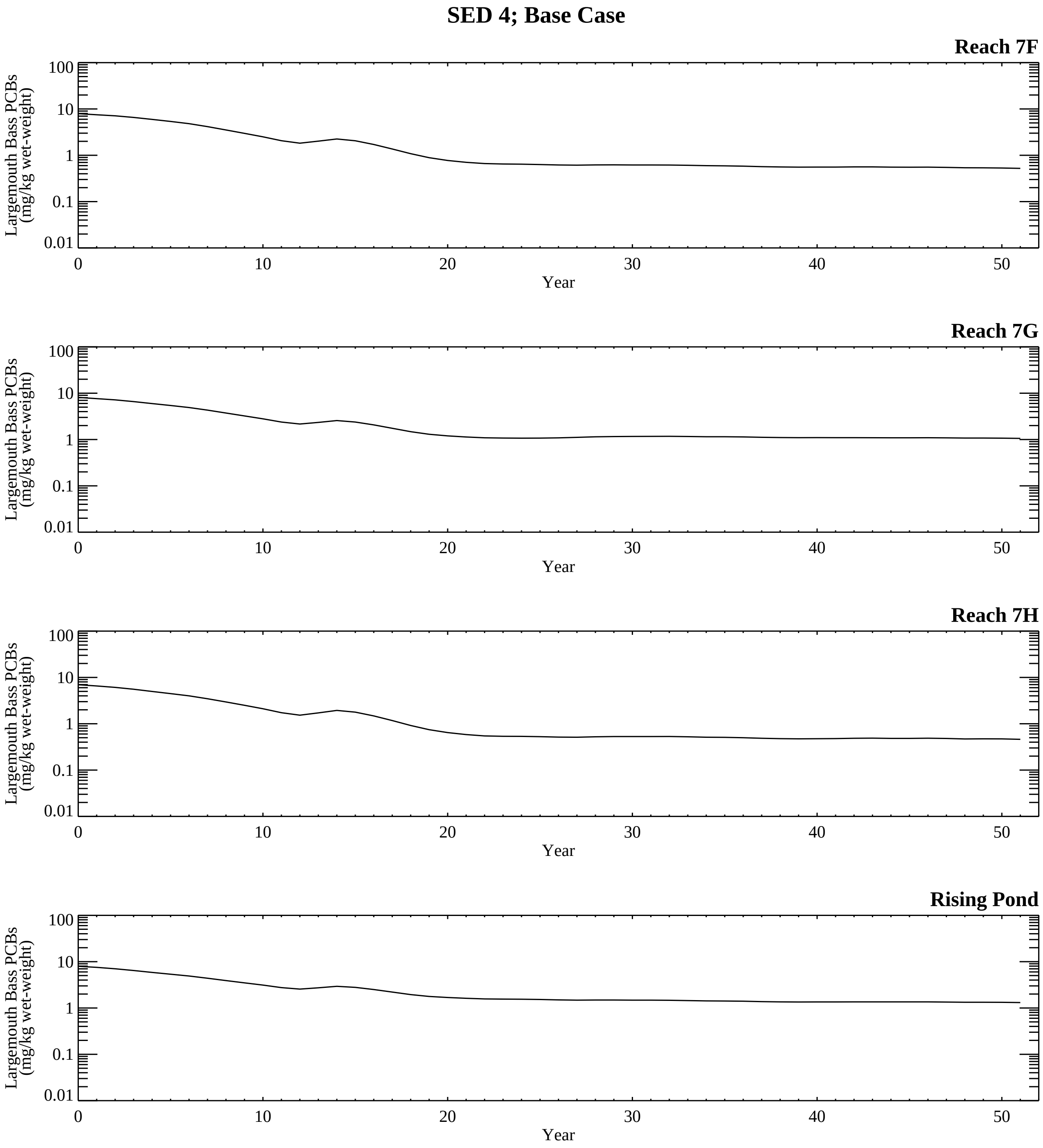


Figure G-1.4-3b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 4; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

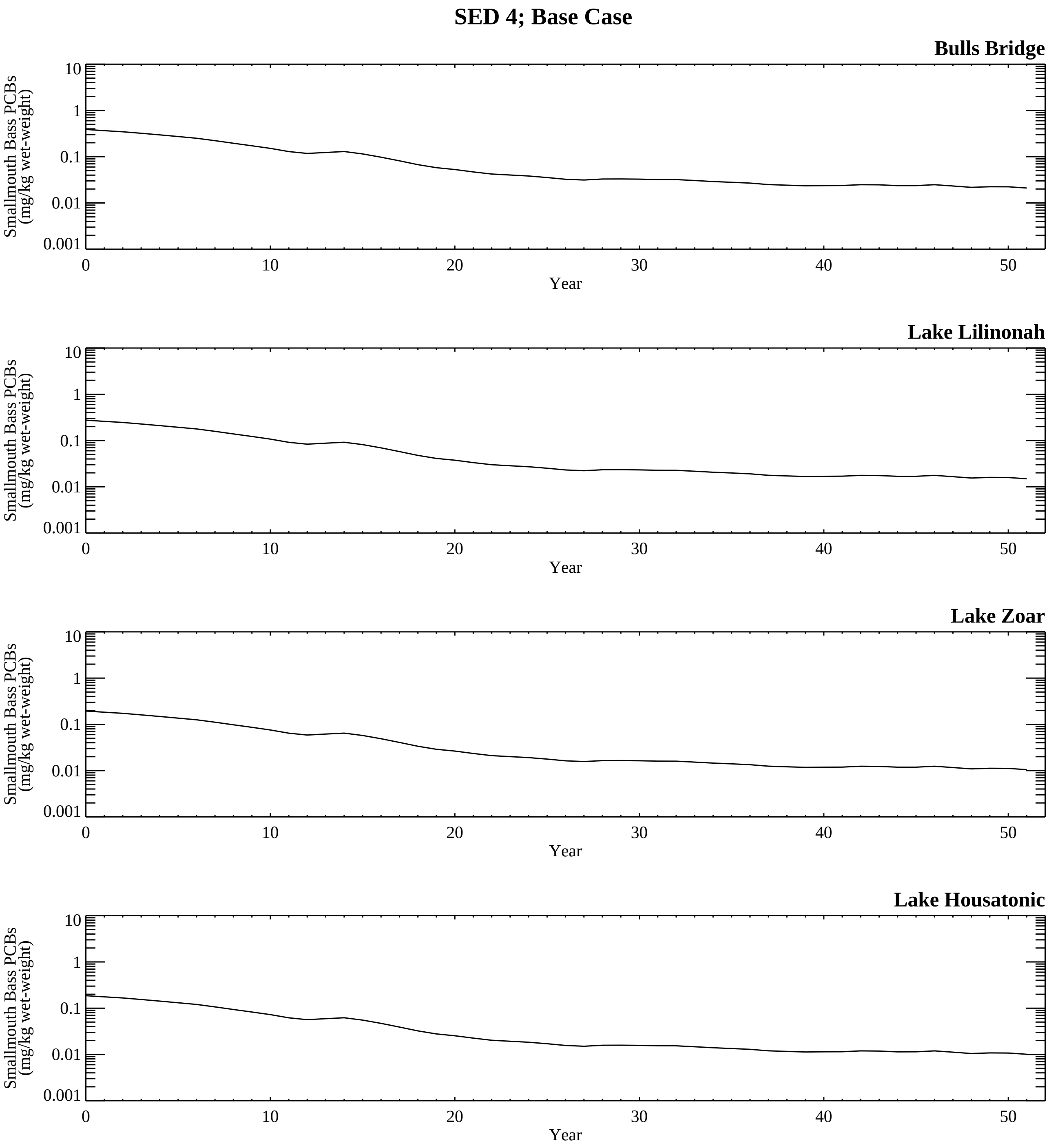


Figure G-1.4-3c. Temporal profiles of PCB concentrations in smallmouth bass fillets (SED 4; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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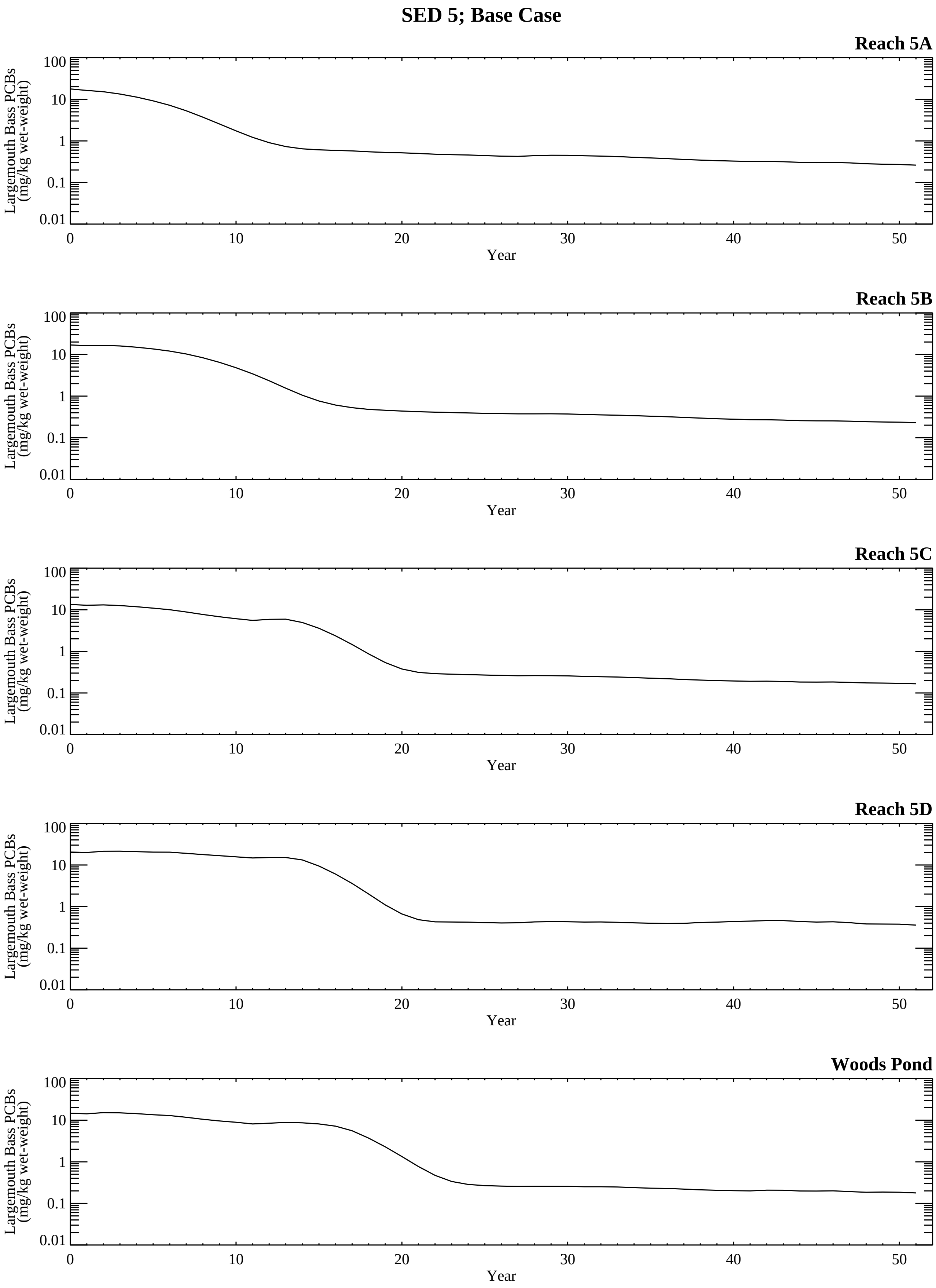

Figure G-1.4-4a. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 5; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

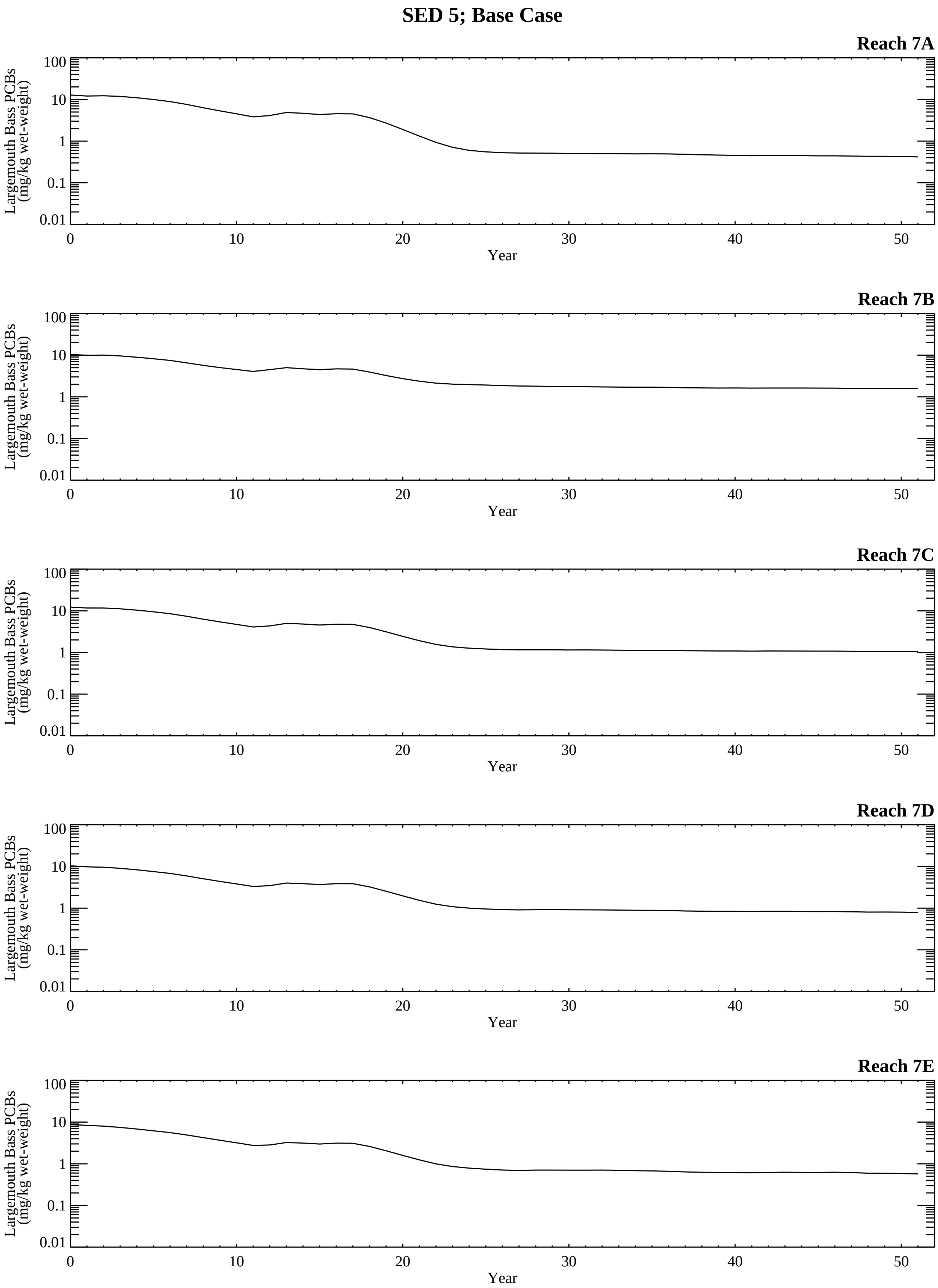

Figure G-1.4-4b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 5; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

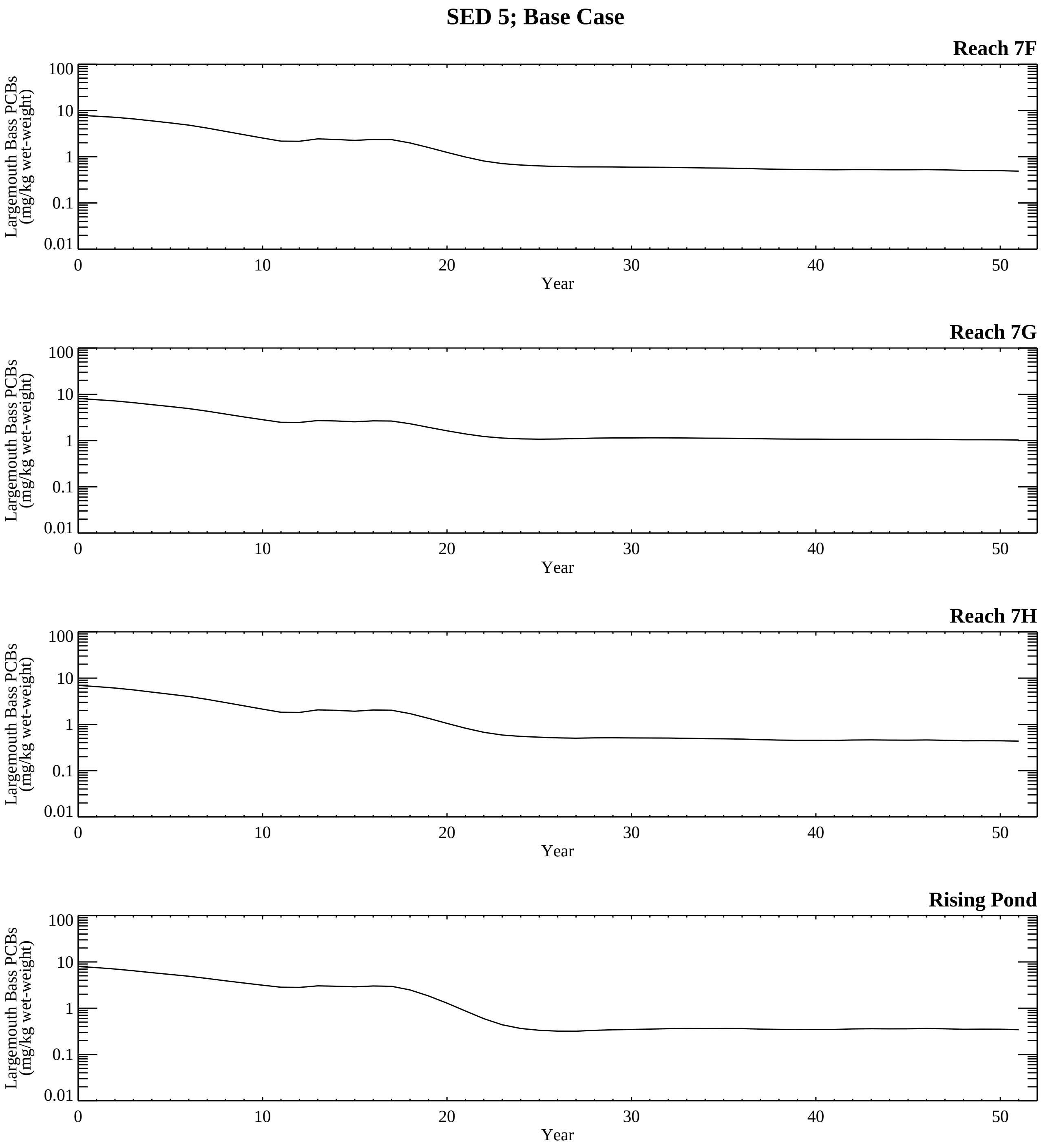

Figure G-1.4-4b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 5; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

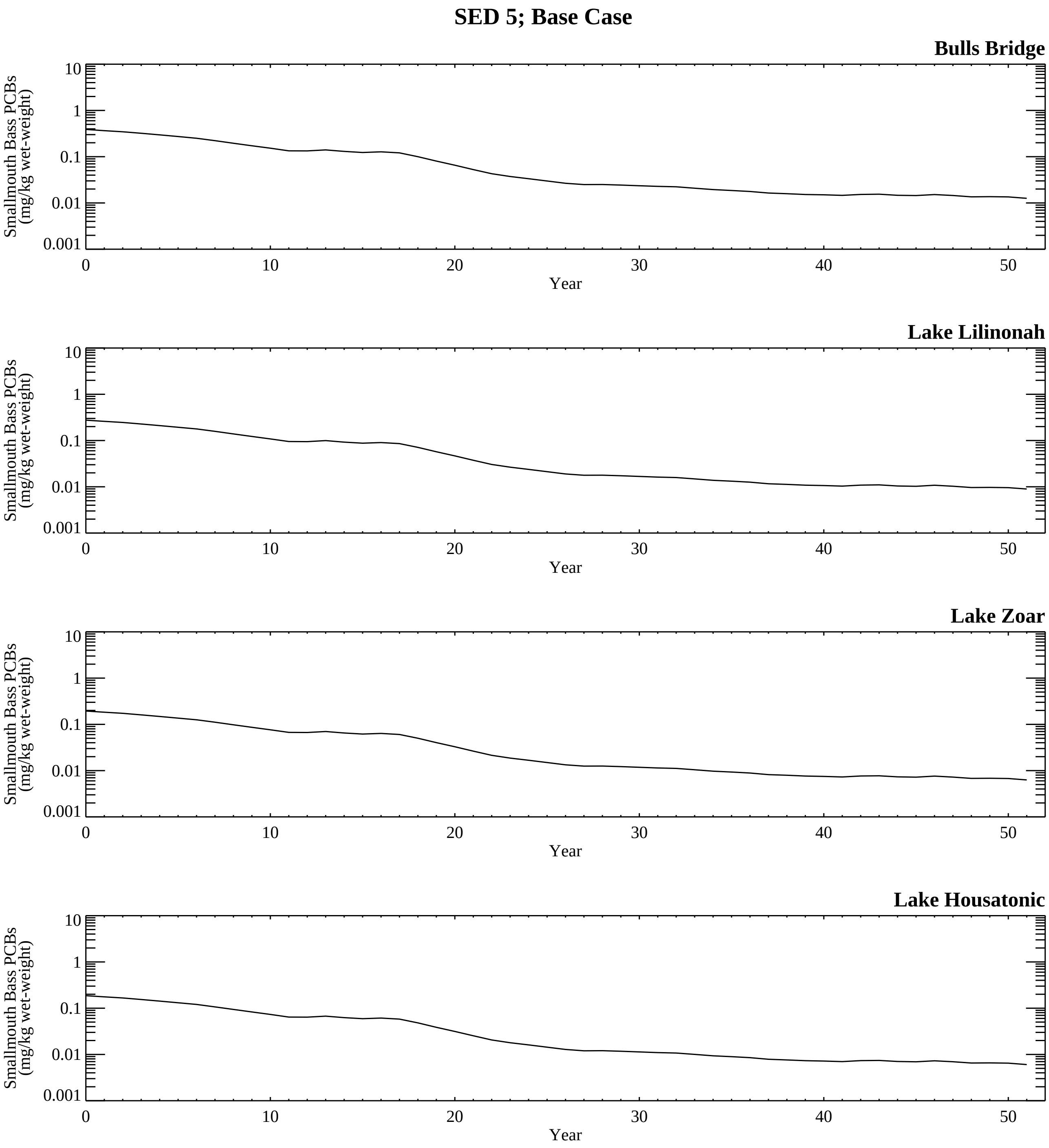

Figure G-1.4-4c. Temporal profiles of PCB concentrations in smallmouth bass fillets (SED 5; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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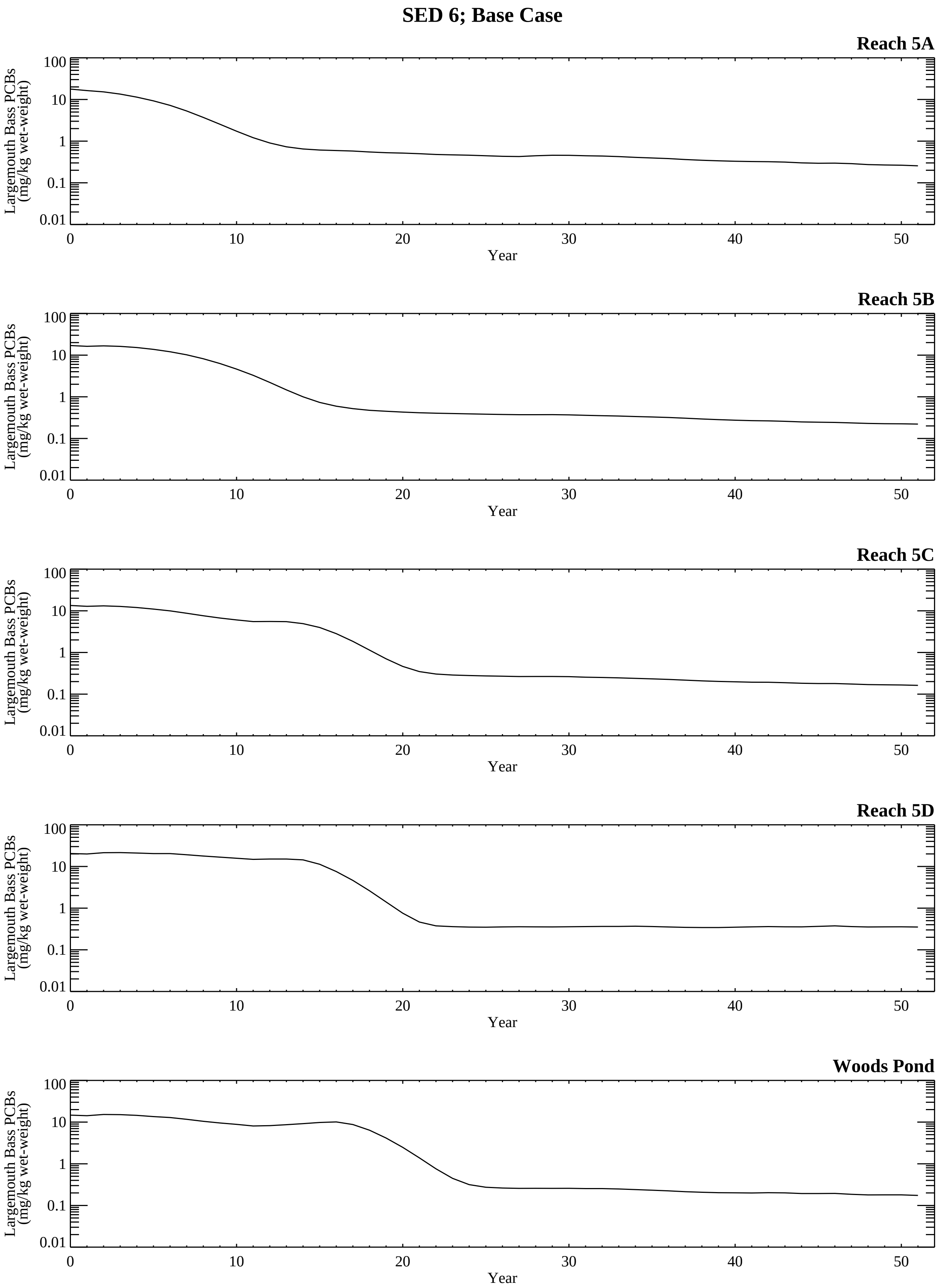

Figure G-1.4-5a. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 6; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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Mon Mar 17 19:33:46 2008

SED 6; Base Case

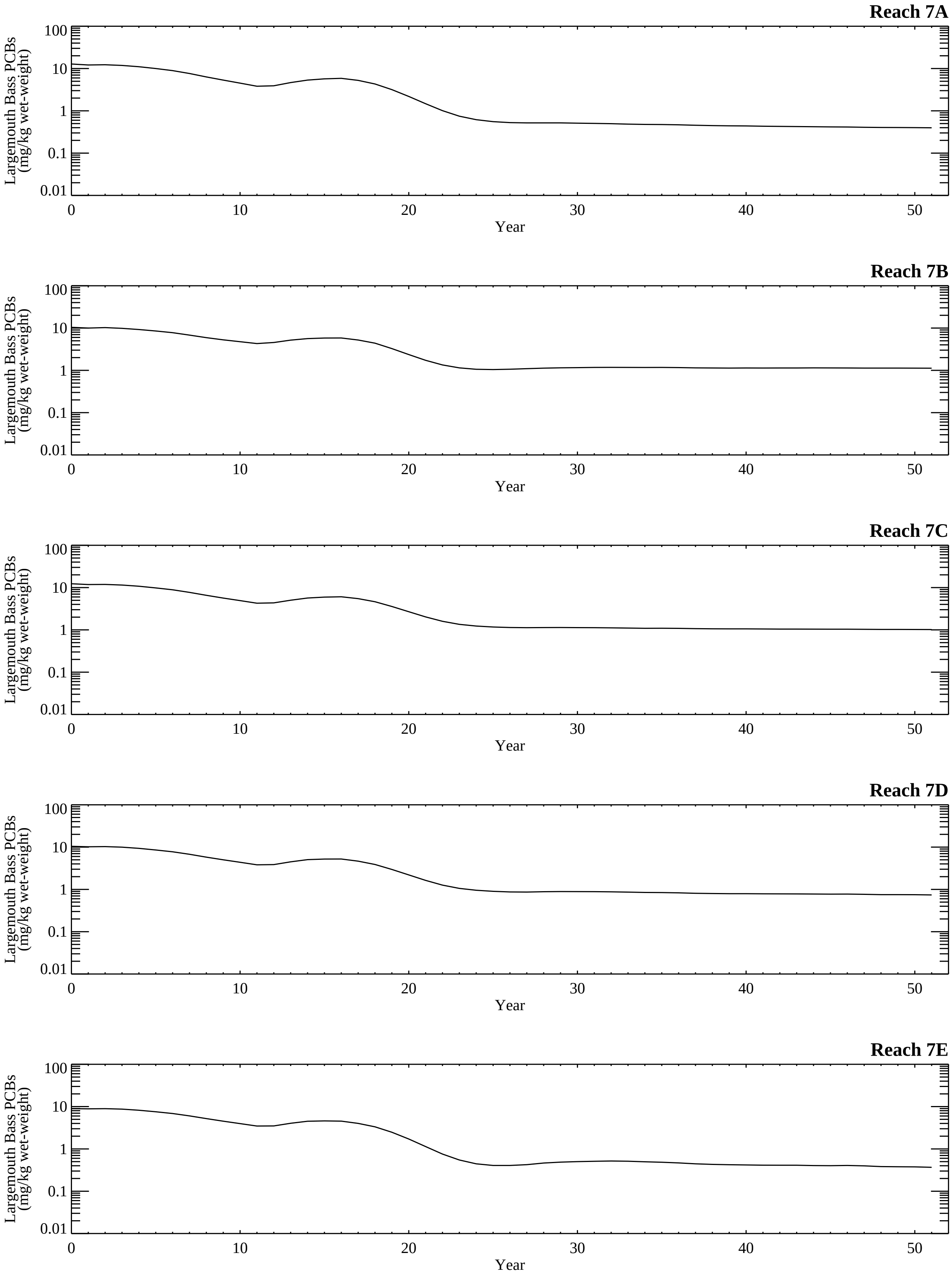

Figure G-1.4-5b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 6; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

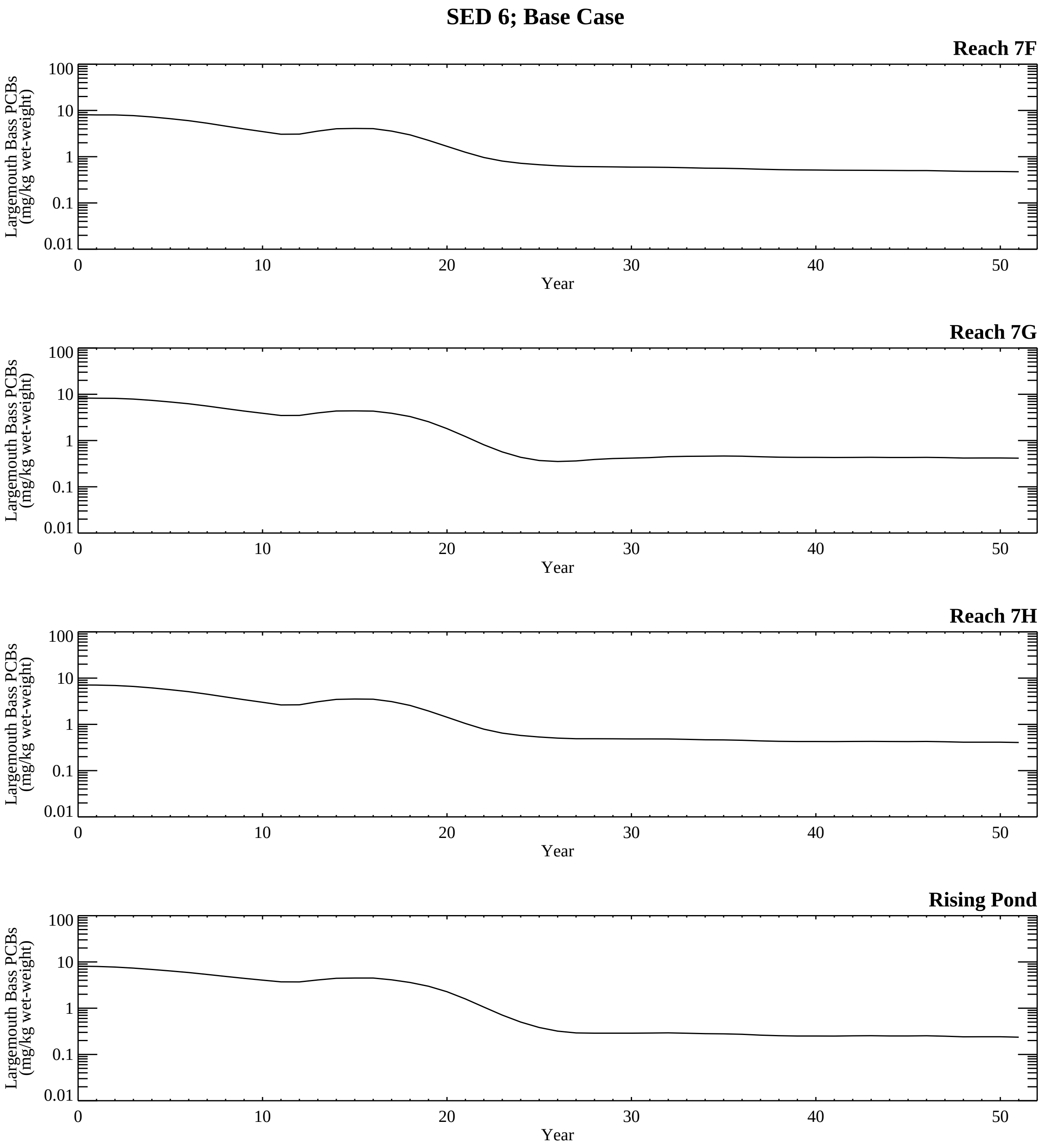

Figure G-1.4-5b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 6; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

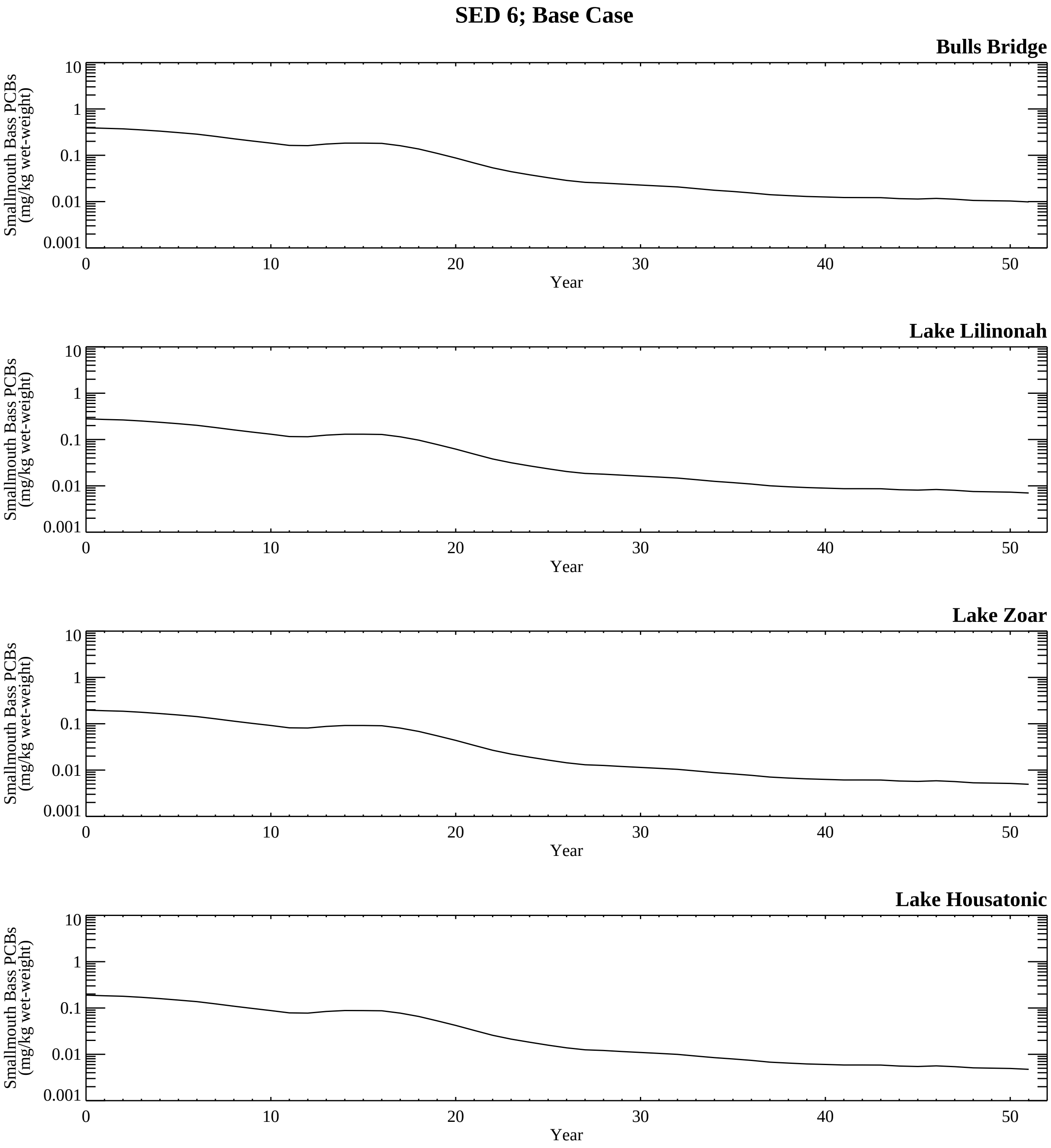

Figure G-1.4-5c. Temporal profiles of PCB concentrations in smallmouth bass fillets (SED 6; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

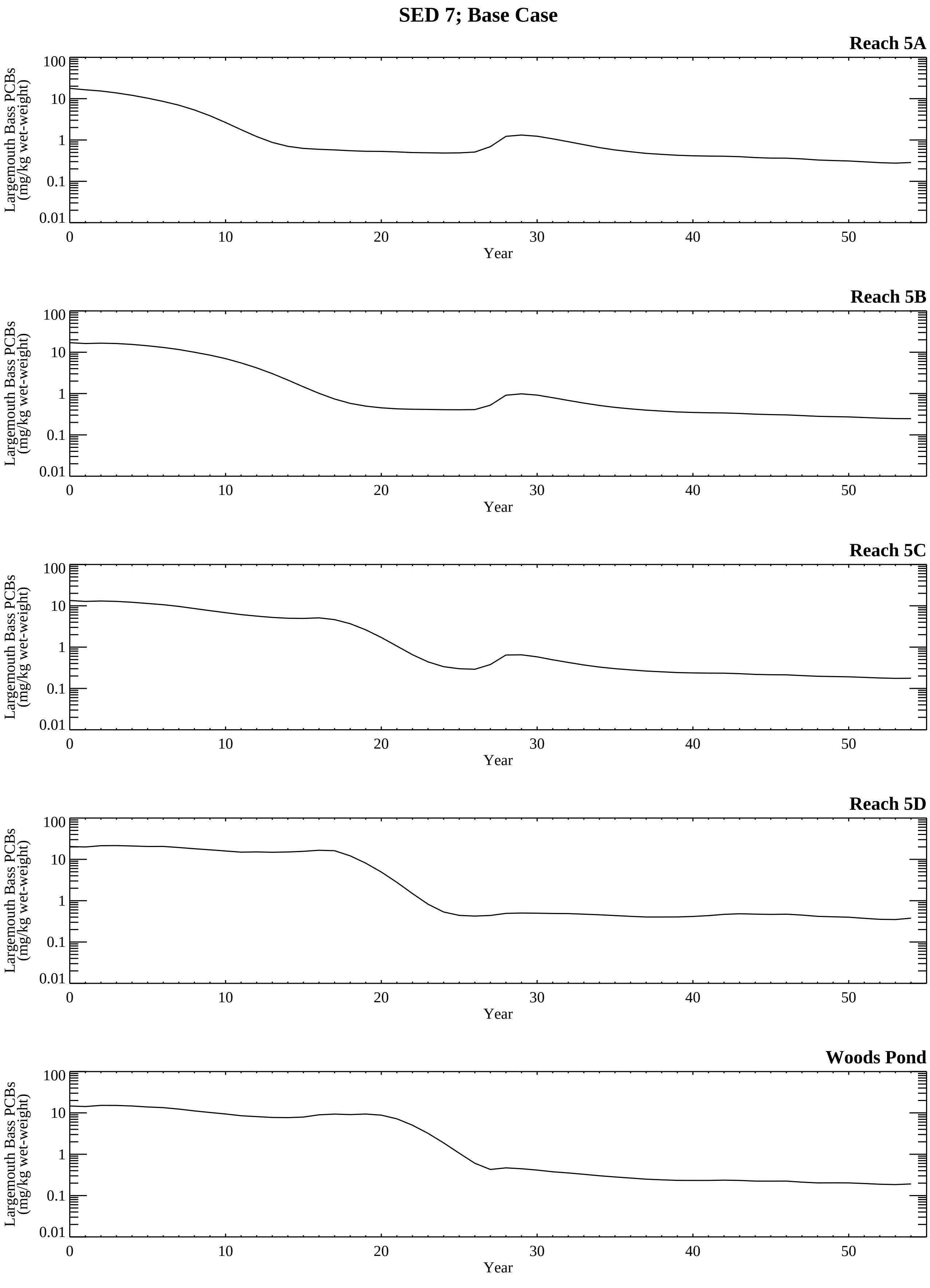

Figure G-1.4-6a. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 7; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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Mon Mar 17 19:35:55 2008

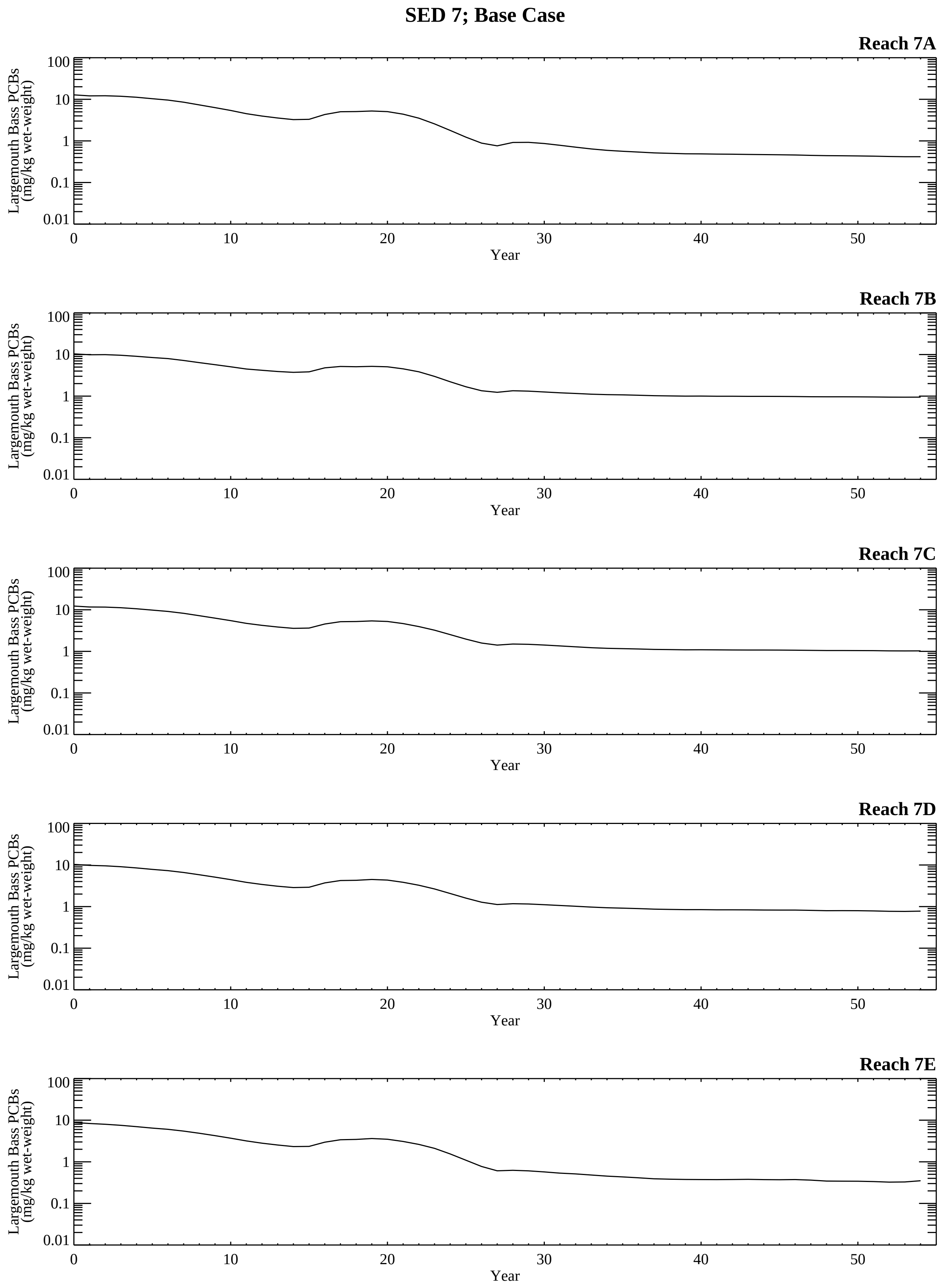

Figure G-1.4-6b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 7; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

SED 7; Base Case

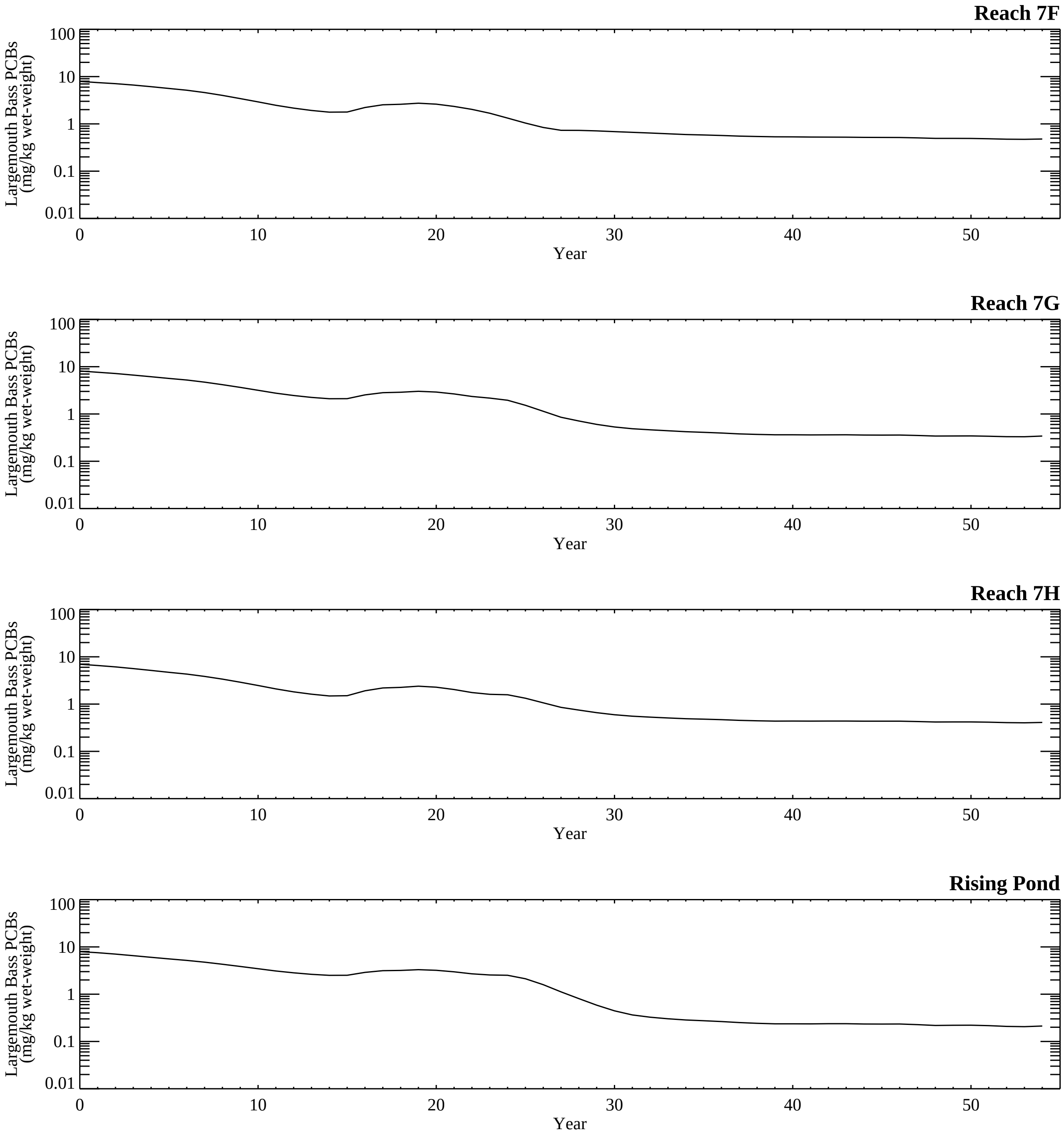

Figure G-1.4-6b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 7; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

SED 7; Base Case

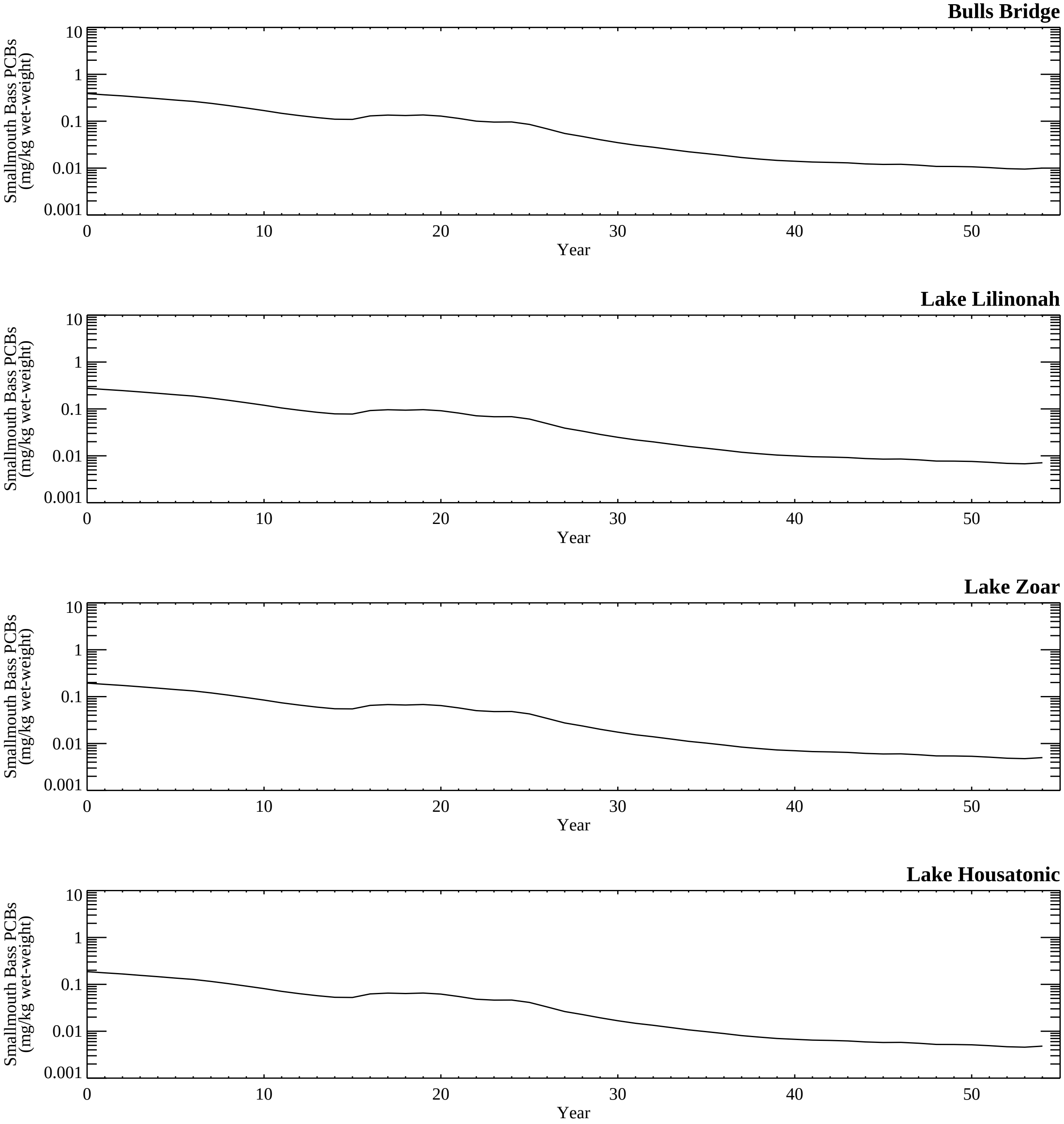

Figure G-1.4-6c. Temporal profiles of PCB concentrations in smallmouth bass fillets (SED 7; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

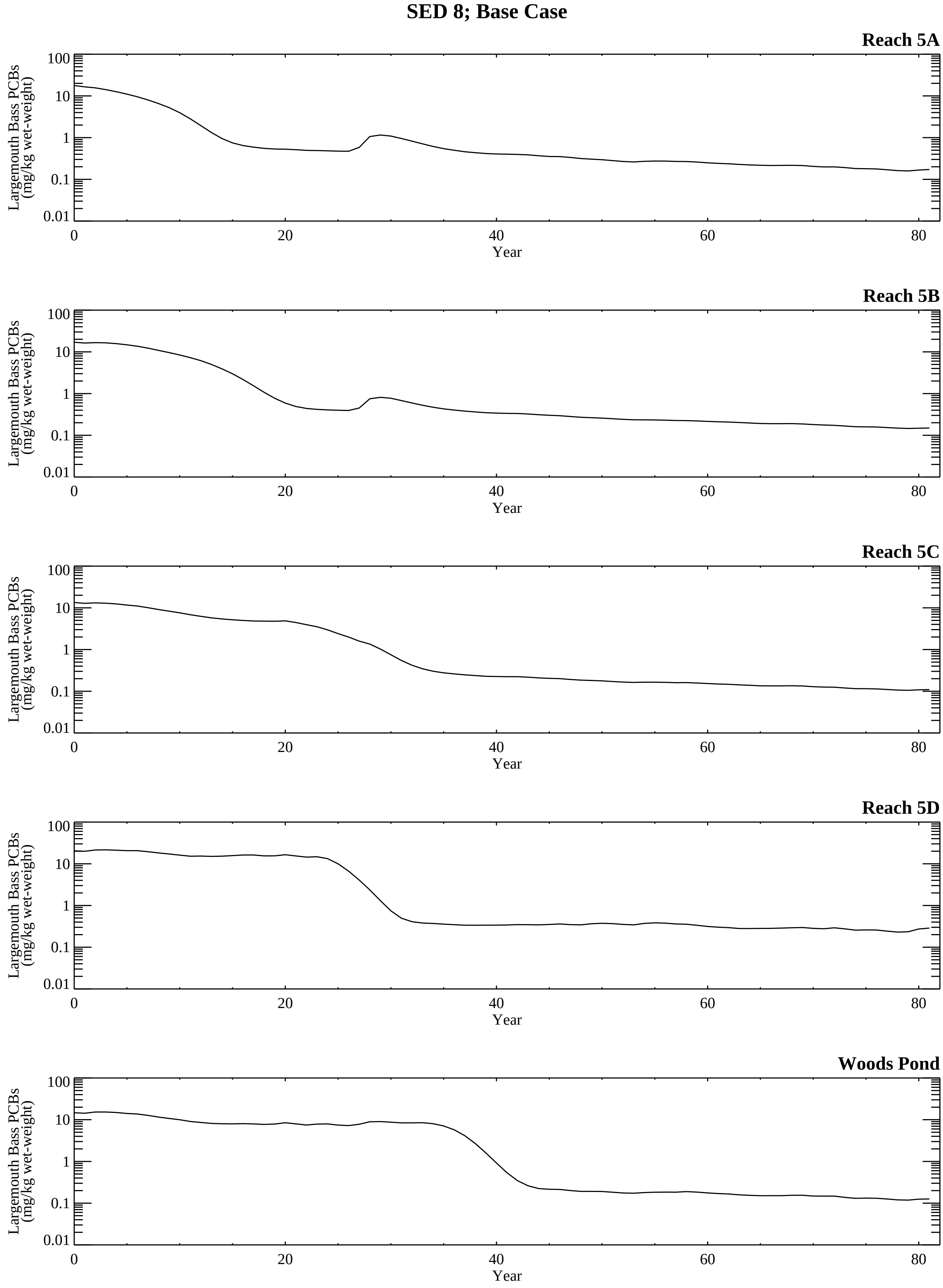

Figure G-1.4-7a. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 8; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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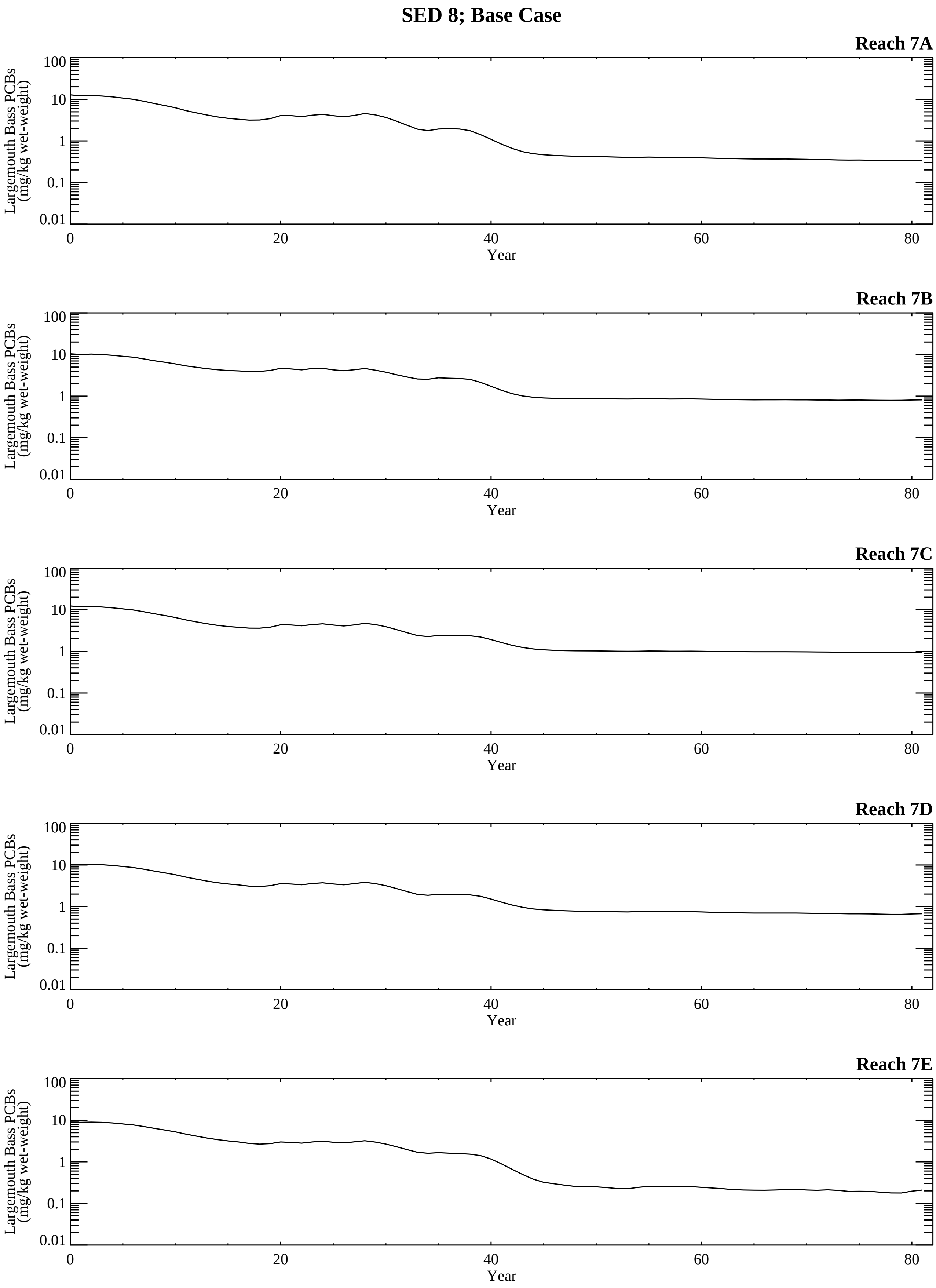

SED 8; Base Case

Reach 7A

Reach 7B

Reach 7C

Reach 7D

Reach 7E

Figure G-1.4-7b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 8; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

SED 8; Base Case

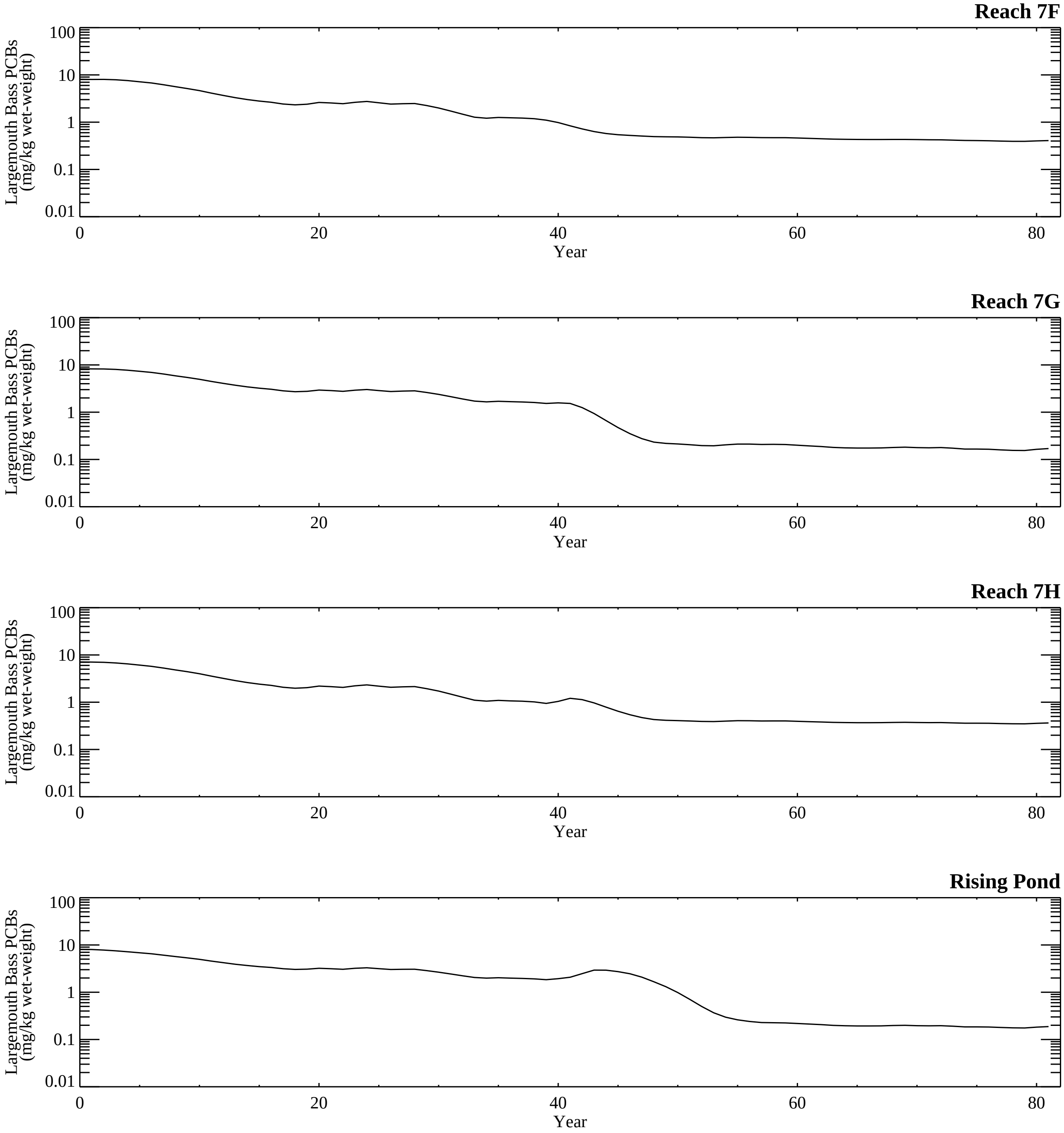


Figure G-1.4-7b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 8; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

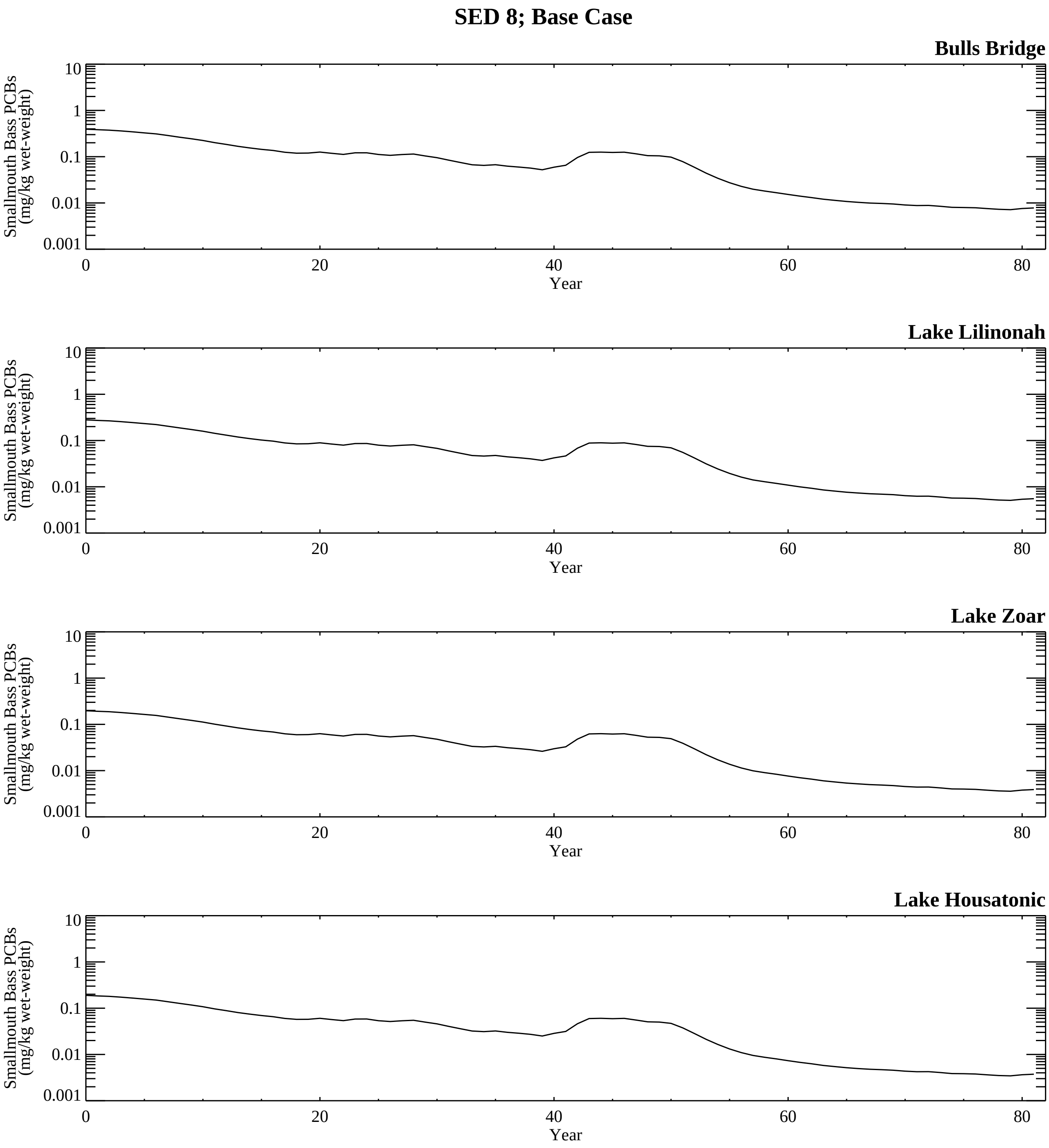


Figure G-1.4-7c. Temporal profiles of PCB concentrations in smallmouth bass fillets (SED 8; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

DR - Z:\GENcms\MODEL\FDCHN\Analysis\Time_Series\Programs\Projection\CMS_Alternatives\NewCode\cms_alternatives_one_sed_plot.pro
Mon Mar 17 20:50:54 2008

SED 1 / SED 2; Lower Bound

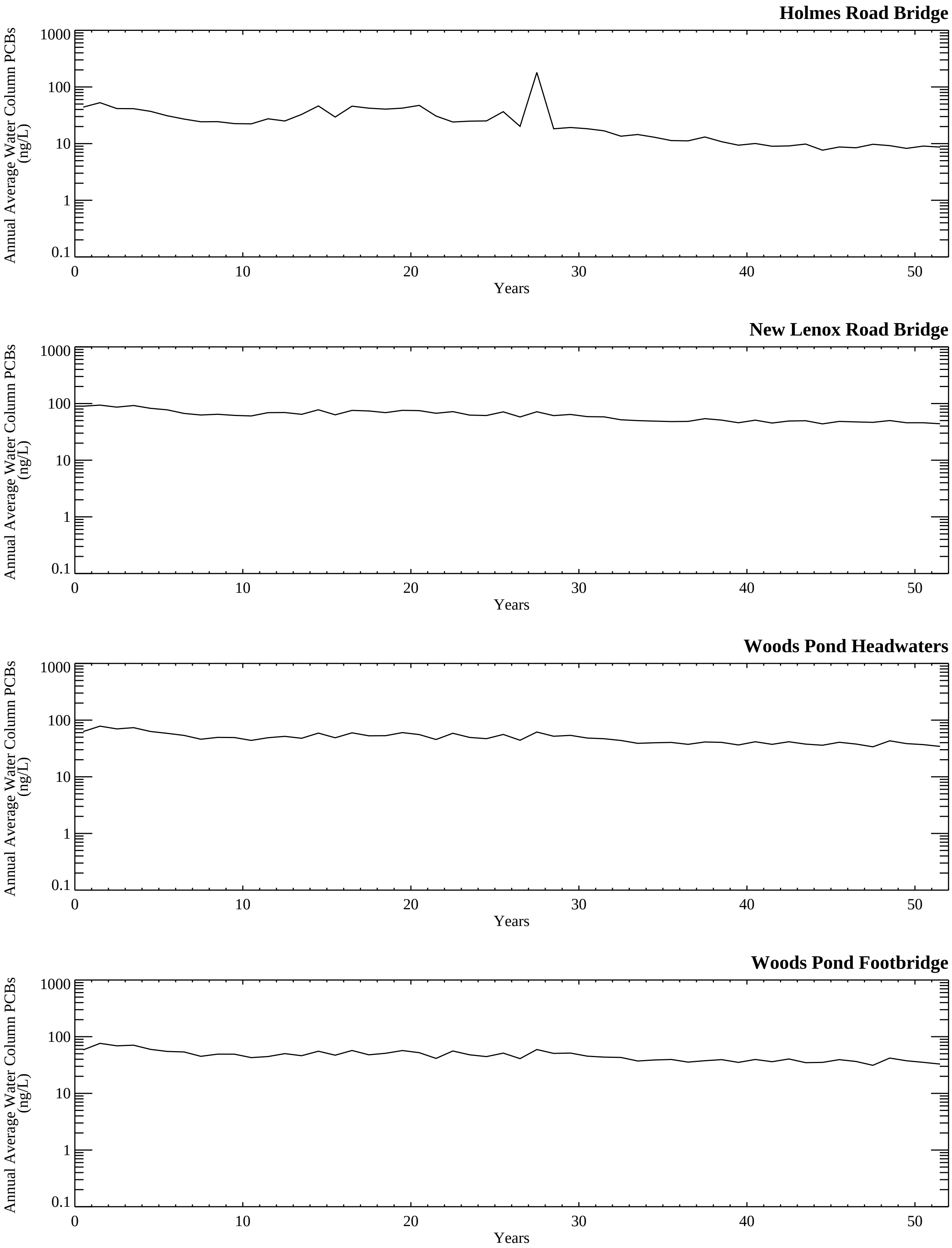


Figure G-1.5-1a. Temporal profiles of model-predicted water column PCB concentrations (SED 1 / SED 2; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED1CMSLB_0712-19

RRM - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\figure_g1_1_7_plot_wc.pro
Tue Mar 18 20:31:26 2008

SED 1 / SED 2; Lower Bound

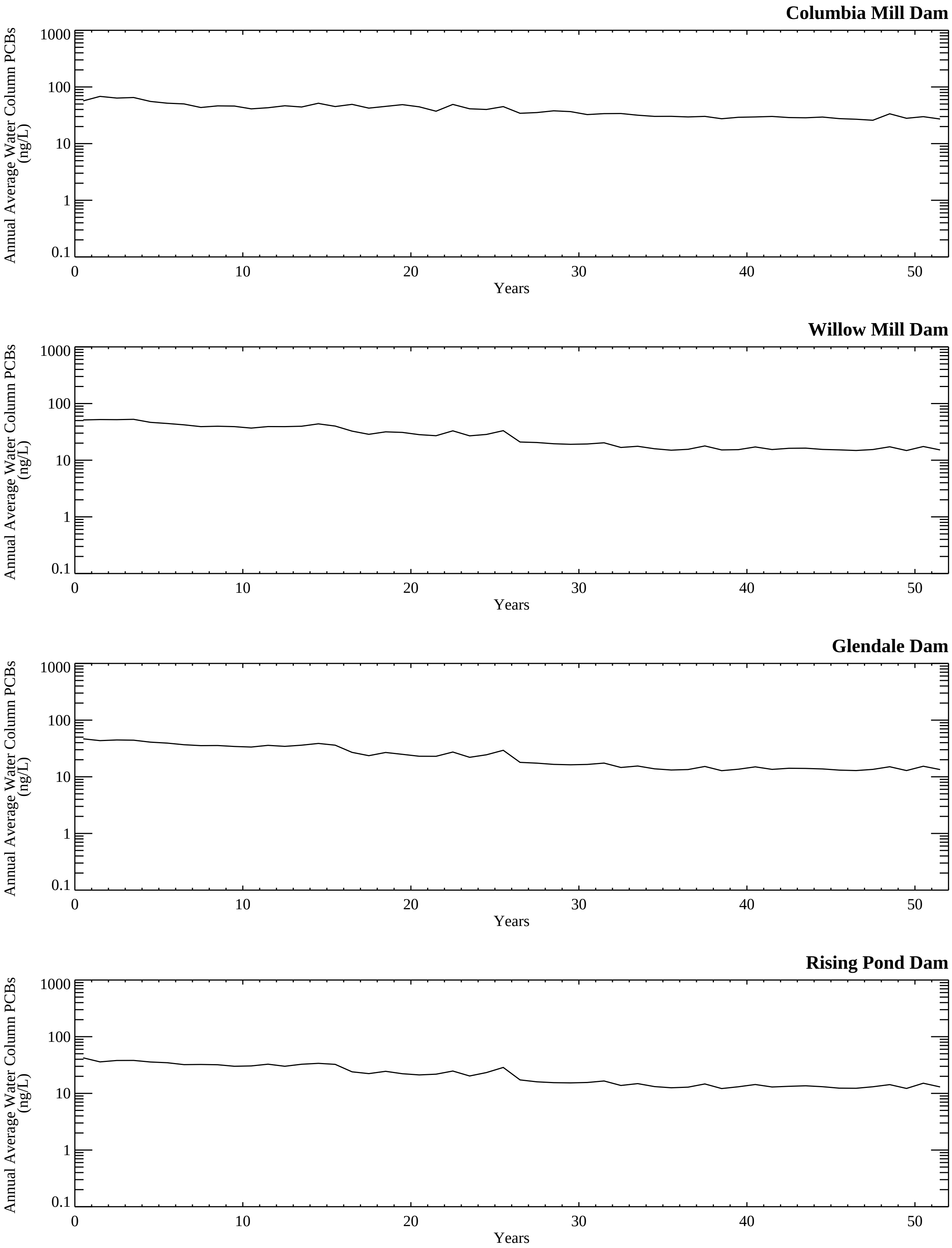


Figure G-1.5-1b. Temporal profiles of model-predicted water column PCB concentrations (SED 1 / SED 2; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED1CMSLB_0712-35

SED 1 / SED 2; Lower Bound

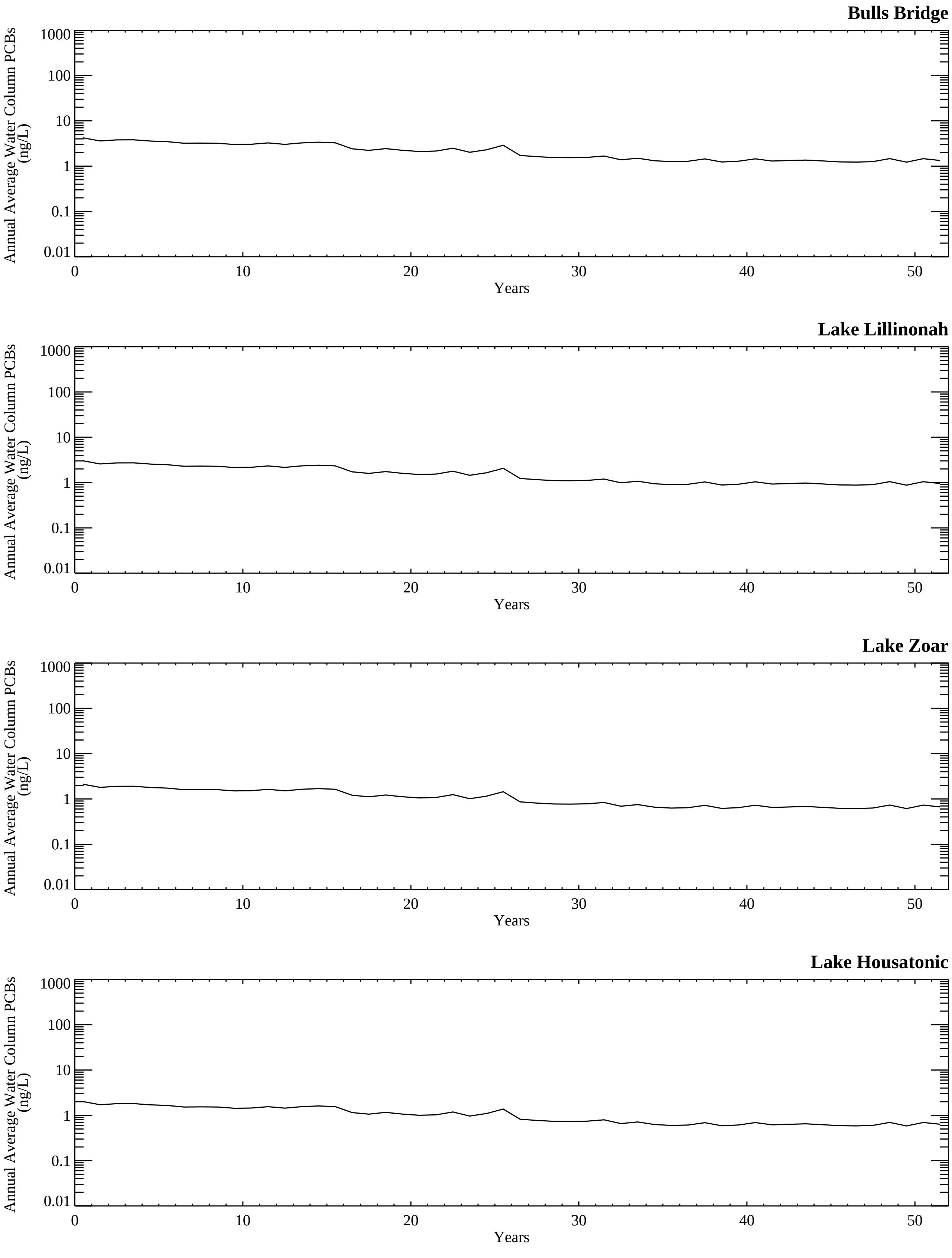
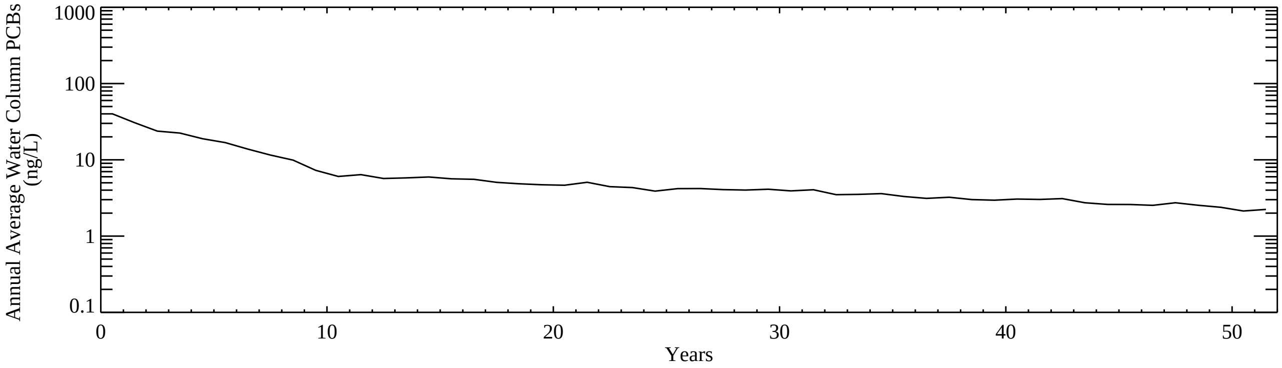


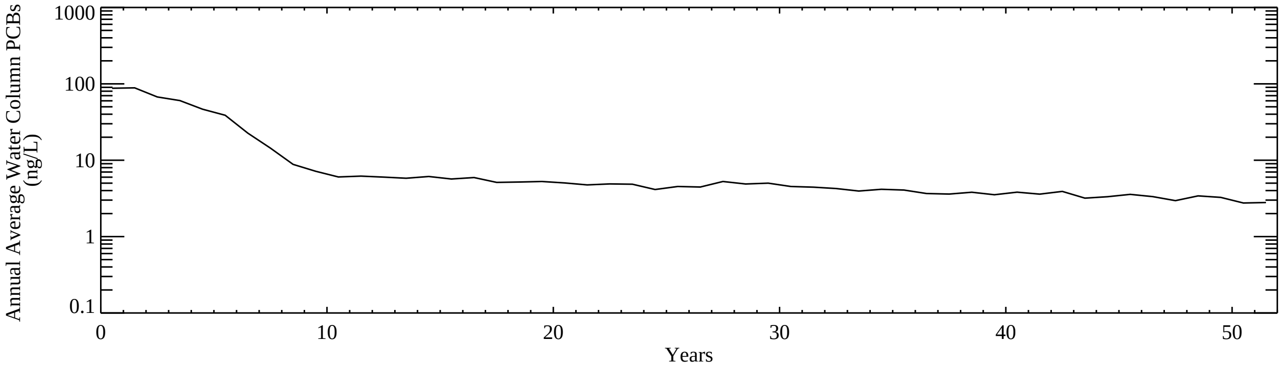
Figure G-1.5-1c. Temporal profiles of water column PCB concentrations estimated from the CT 1-D Analysis (SED 1 / SED 2; CT; Lower Bound).

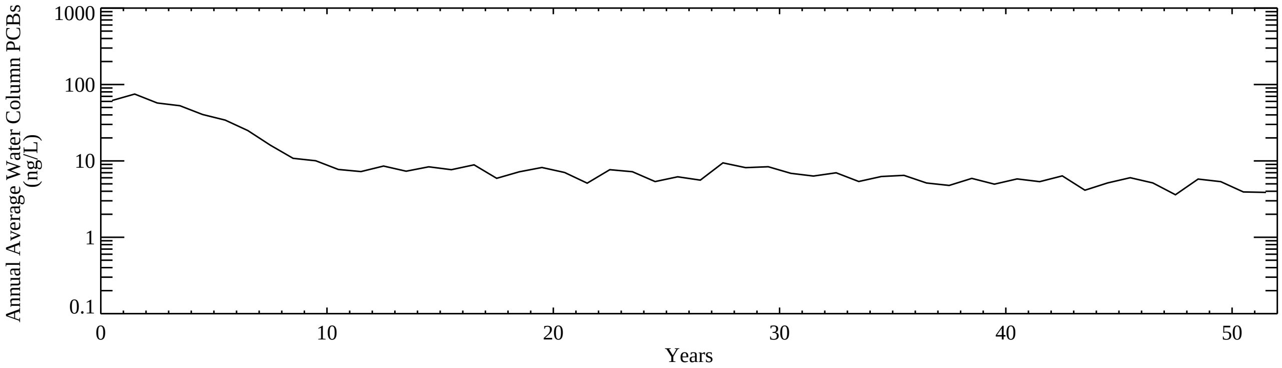
Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED01_0712-35_low_bound

if/wk - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\figure_g1_1_g1_5_temporal_wc_CT.pro
Wed Mar 19 10:57:35 2008

SED 3; Lower Bound


Holmes Road Bridge


New Lenox Road Bridge


Woods Pond Headwaters

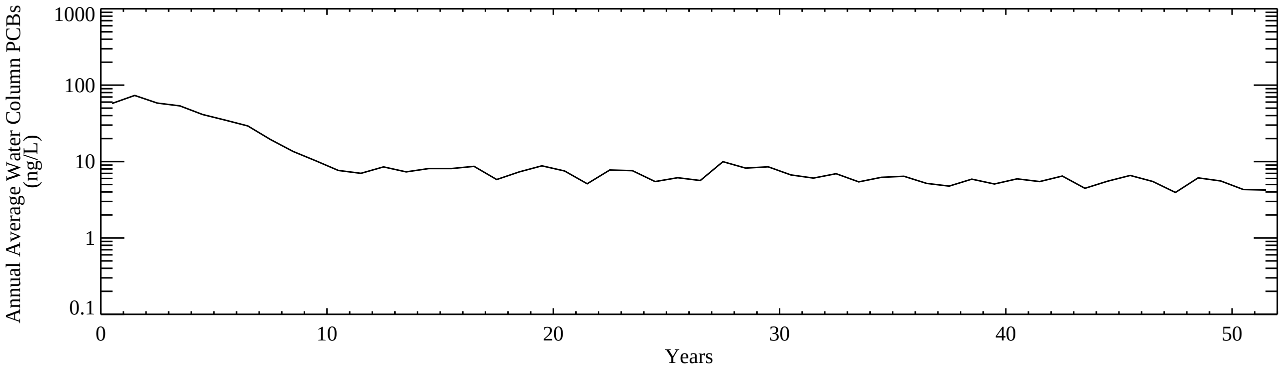

Woods Pond Footbridge

Figure G-1.5-2a. Temporal profiles of model-predicted water column PCB concentrations (SED 3; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED3CMSLB_0712-20

SED 3; Lower Bound

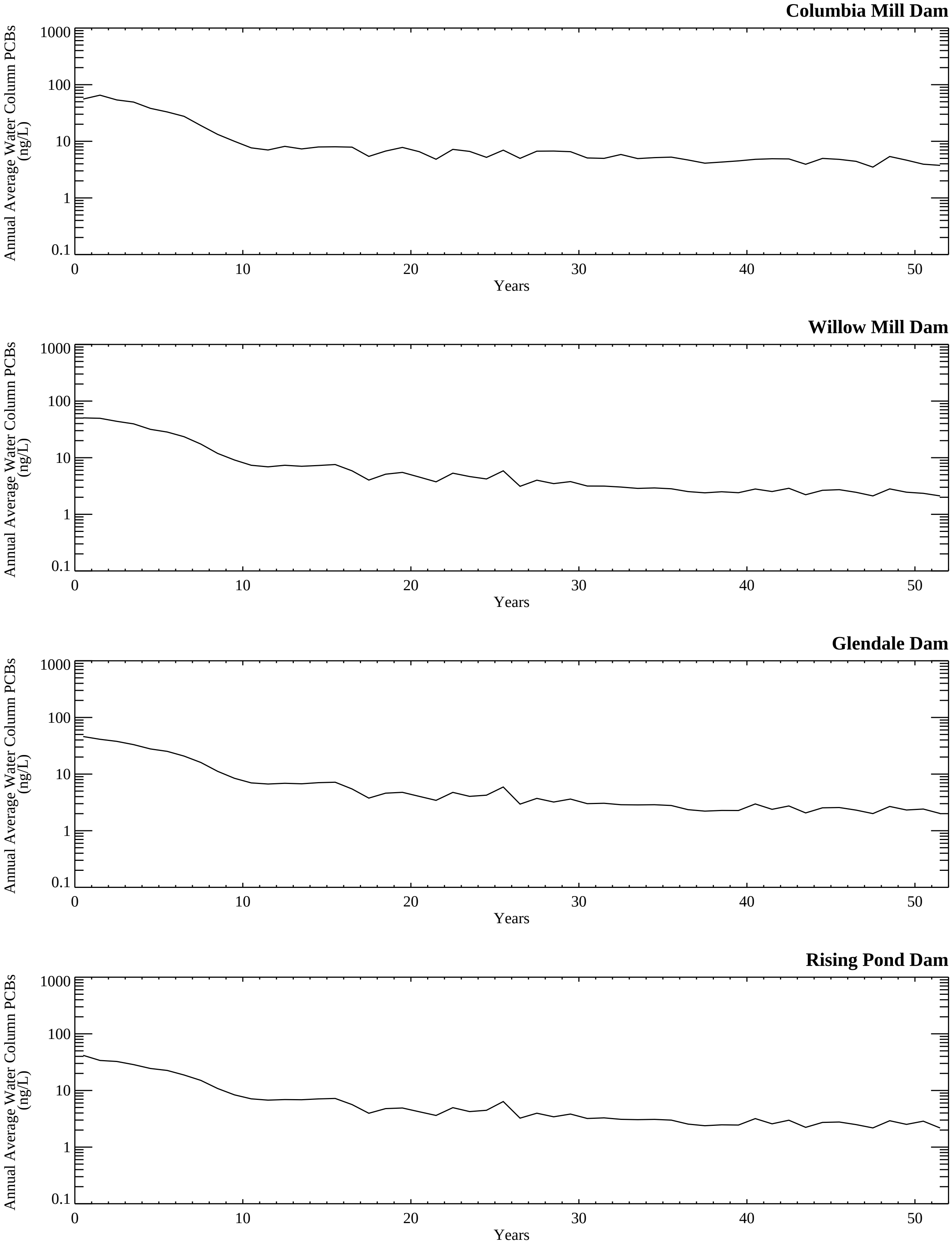


Figure G-1.5-2b. Temporal profiles of model-predicted water column PCB concentrations (SED 3; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED3CMSLB_0712-36

SED 3; Lower Bound

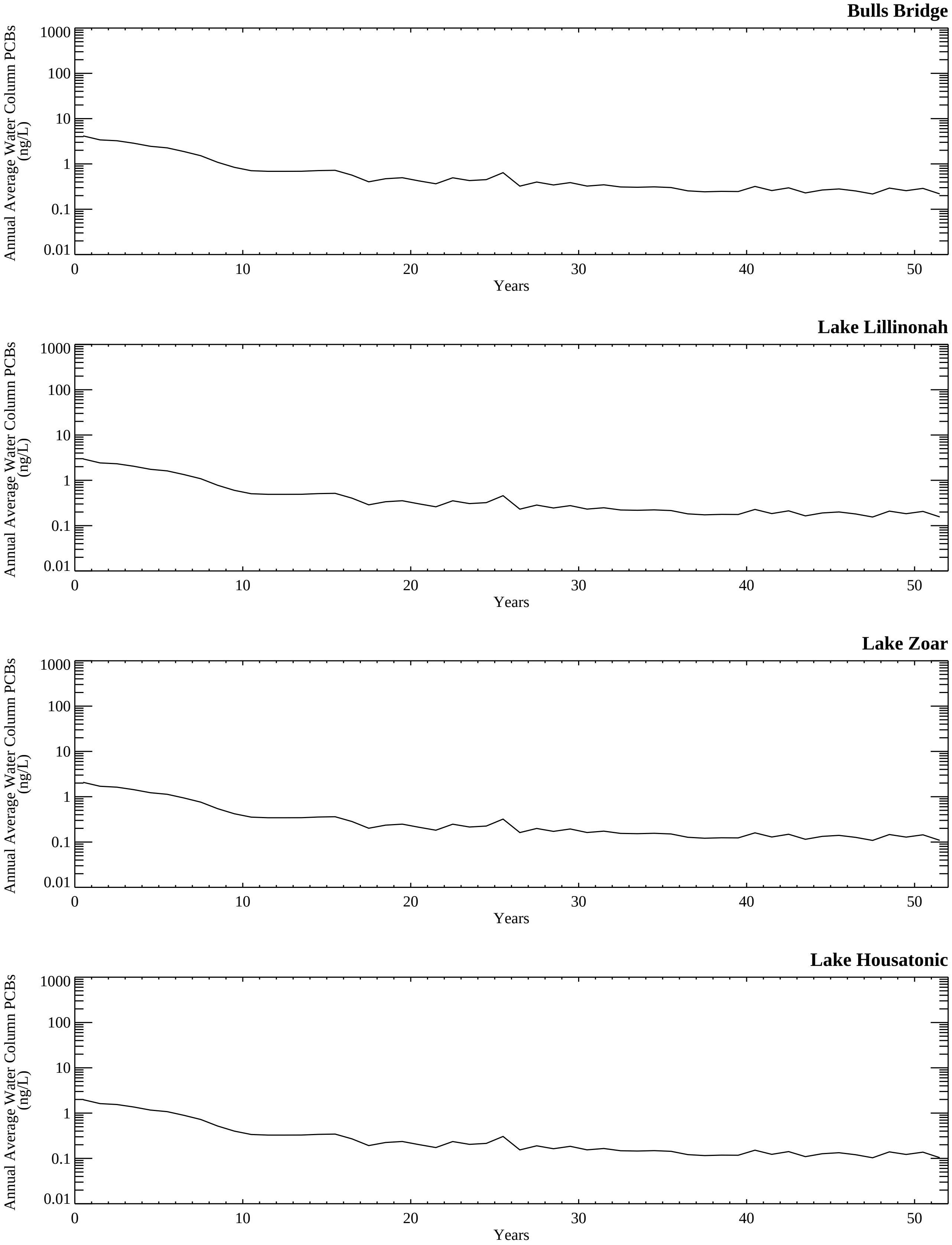


Figure G-1.5-2c. Temporal profiles of water column PCB concentrations estimated from the CT 1-D Analysis (SED 3; CT; Lower Bound).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED03_0712-36_low_bound

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Wed Mar 19 10:57:36 2008

SED 4; Lower Bound

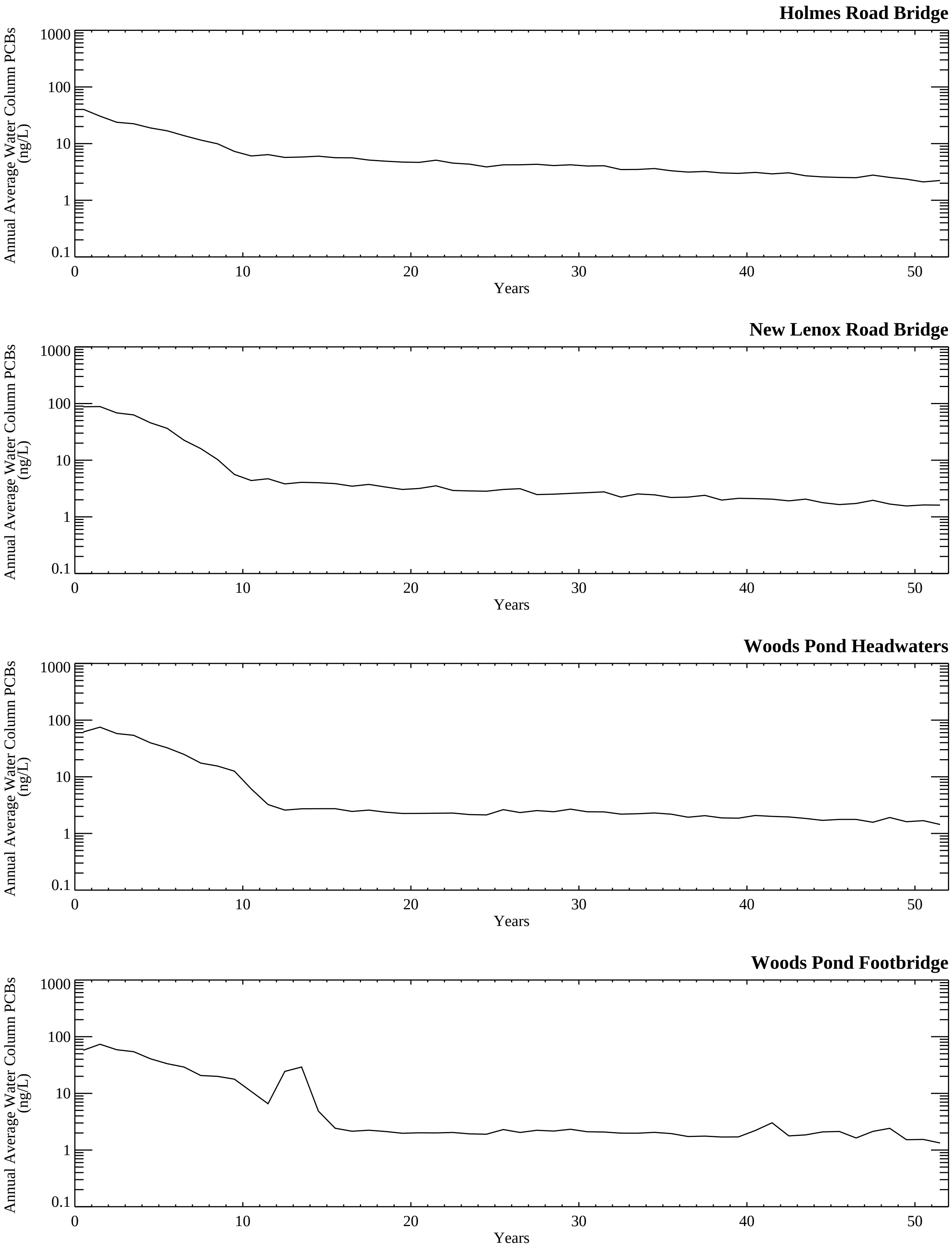


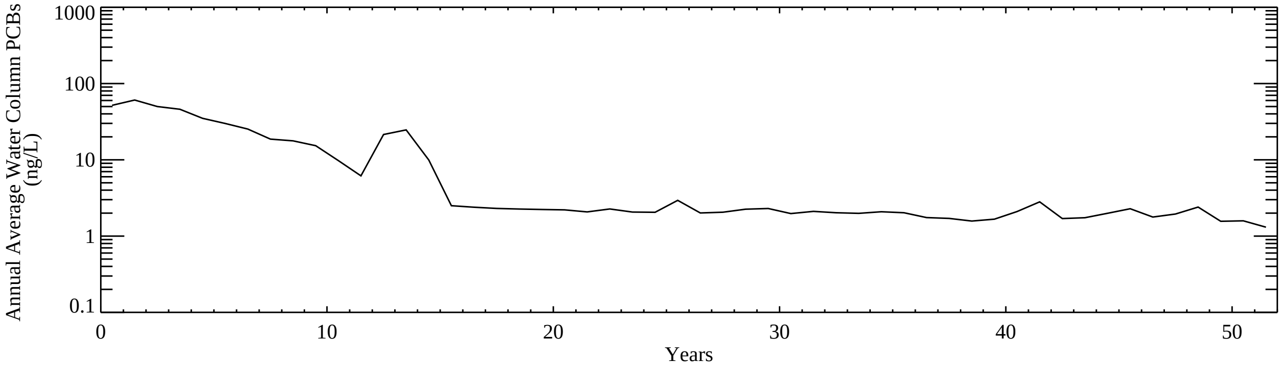
Figure G-1.5-3a. Temporal profiles of model-predicted water column PCB concentrations (SED 4; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED4CMSLB_0801-03

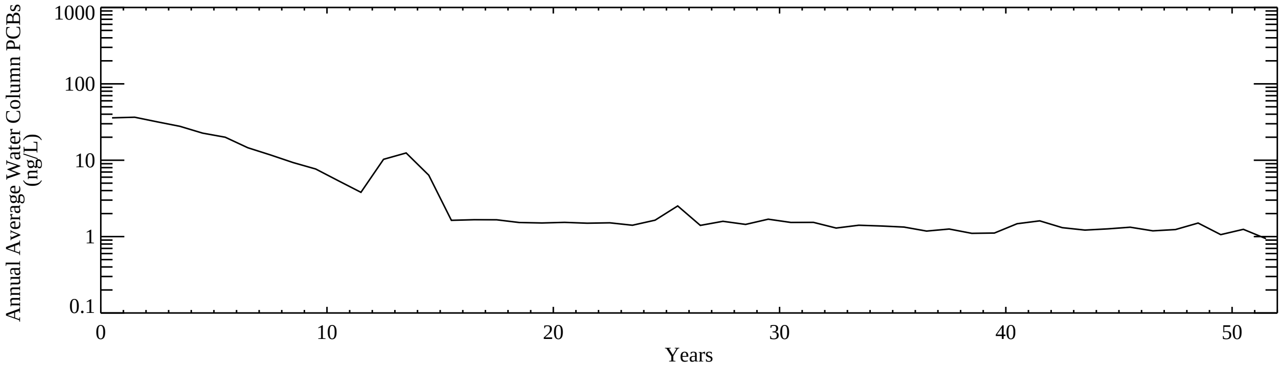
RRM - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\figure_g1_1_7_plot_wc.pro
Tue Mar 18 20:31:29 2008

SED 4; Lower Bound

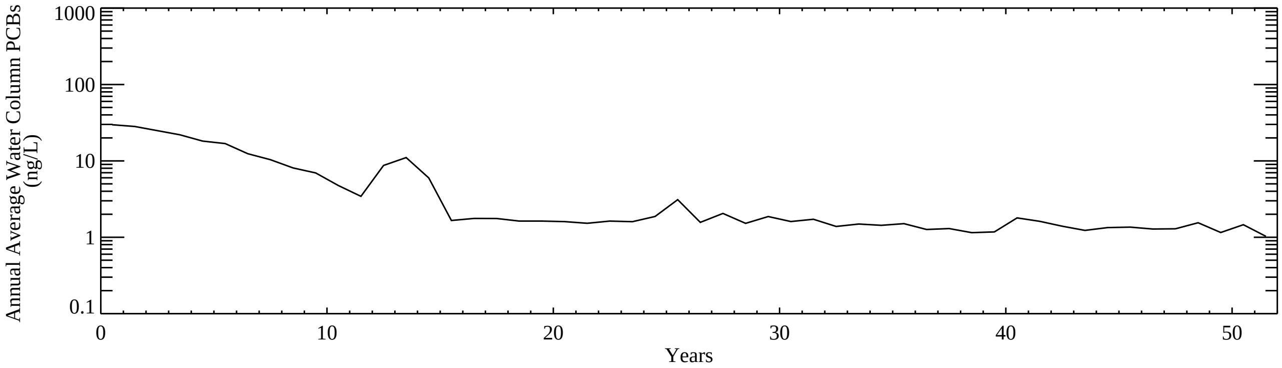
Columbia Mill Dam



Willow Mill Dam



Glendale Dam



Rising Pond Dam

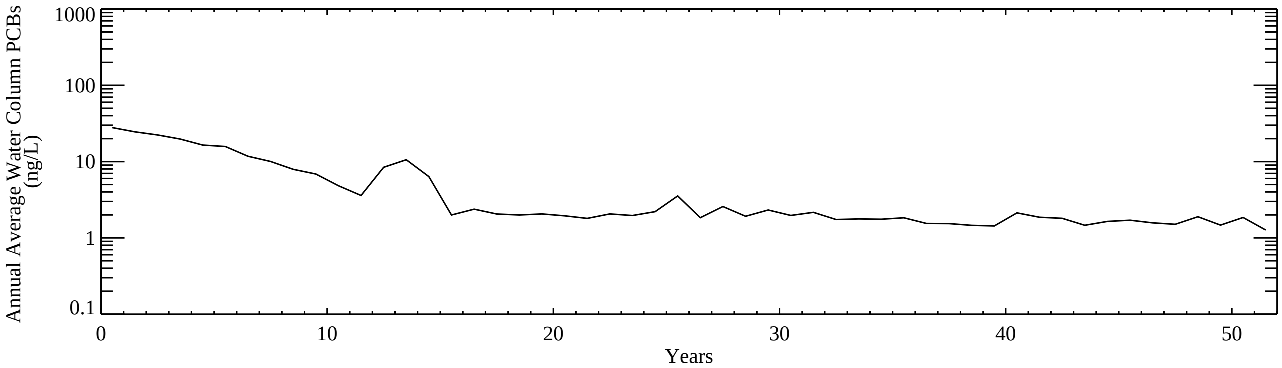


Figure G-1.5-3b. Temporal profiles of model-predicted water column PCB concentrations (SED 4; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED4CMSLB_0802-03

SED 4; Lower Bound

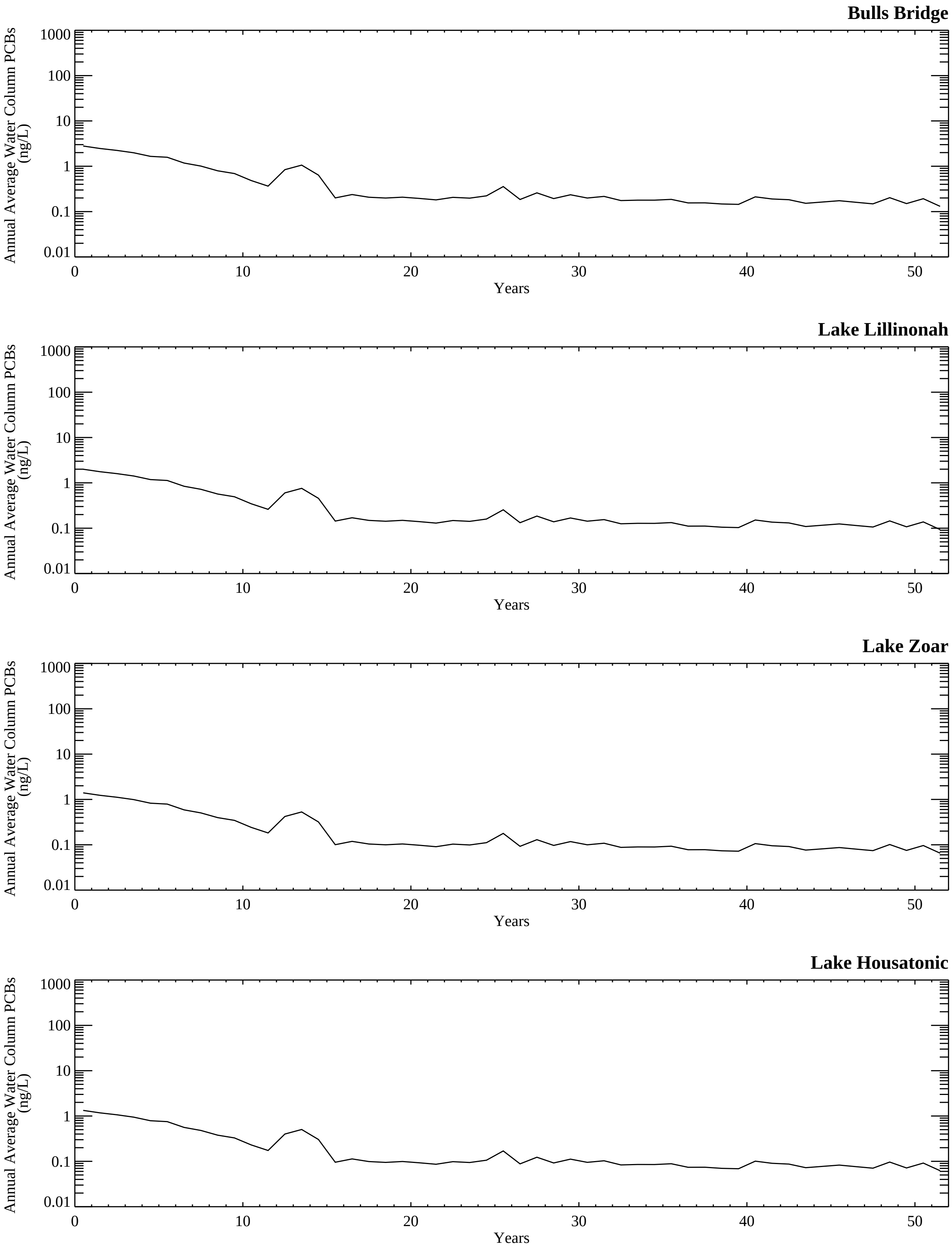


Figure G-1.5-3c. Temporal profiles of water column PCB concentrations estimated from the CT 1-D Analysis (SED 4; CT; Lower Bound).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED04_0802-03_low_bound

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Wed Mar 19 10:57:36 2008

SED 5; Lower Bound

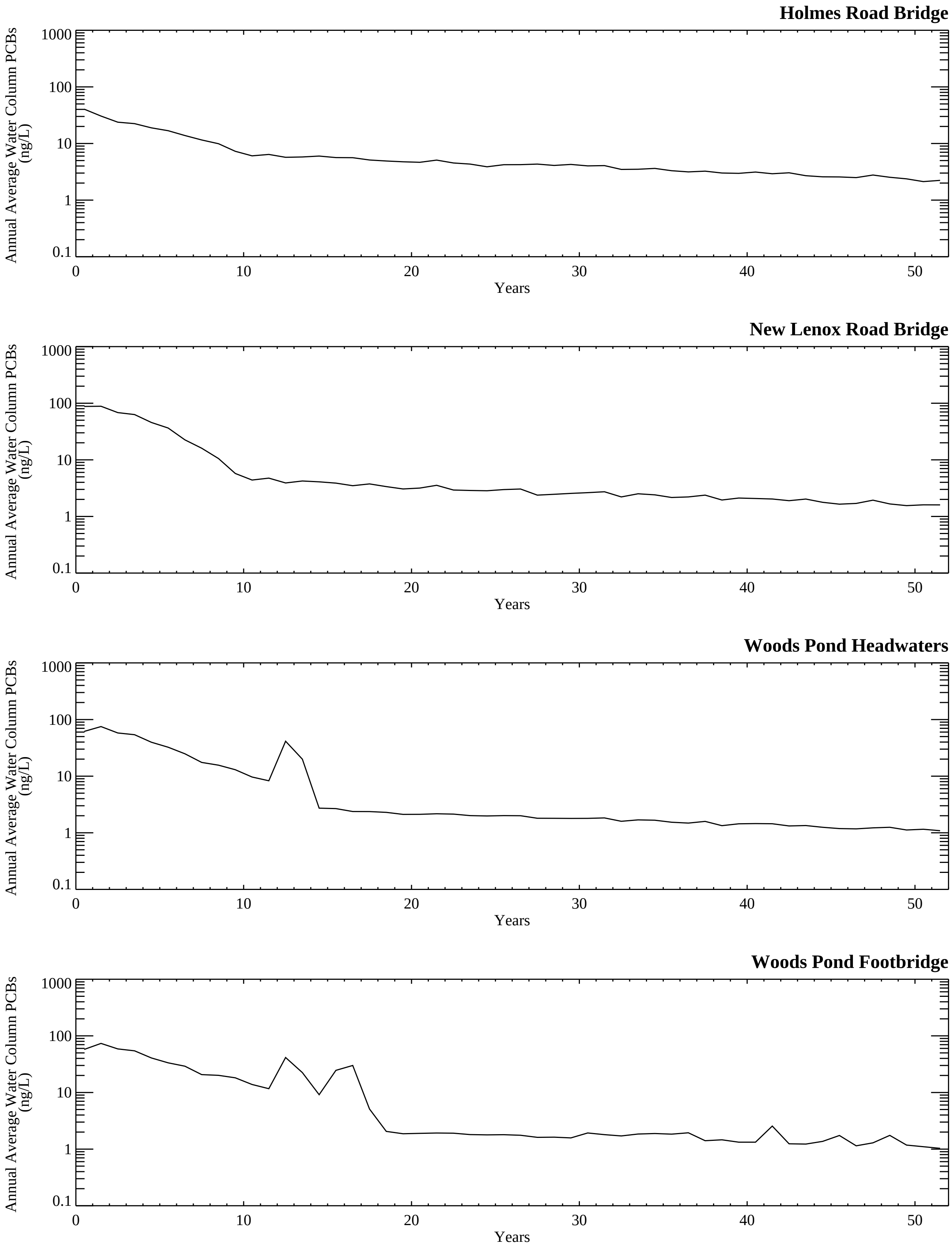


Figure G-1.5-4a. Temporal profiles of model-predicted water column PCB concentrations (SED 5; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED5CMSLB_0801-04

SED 5; Lower Bound

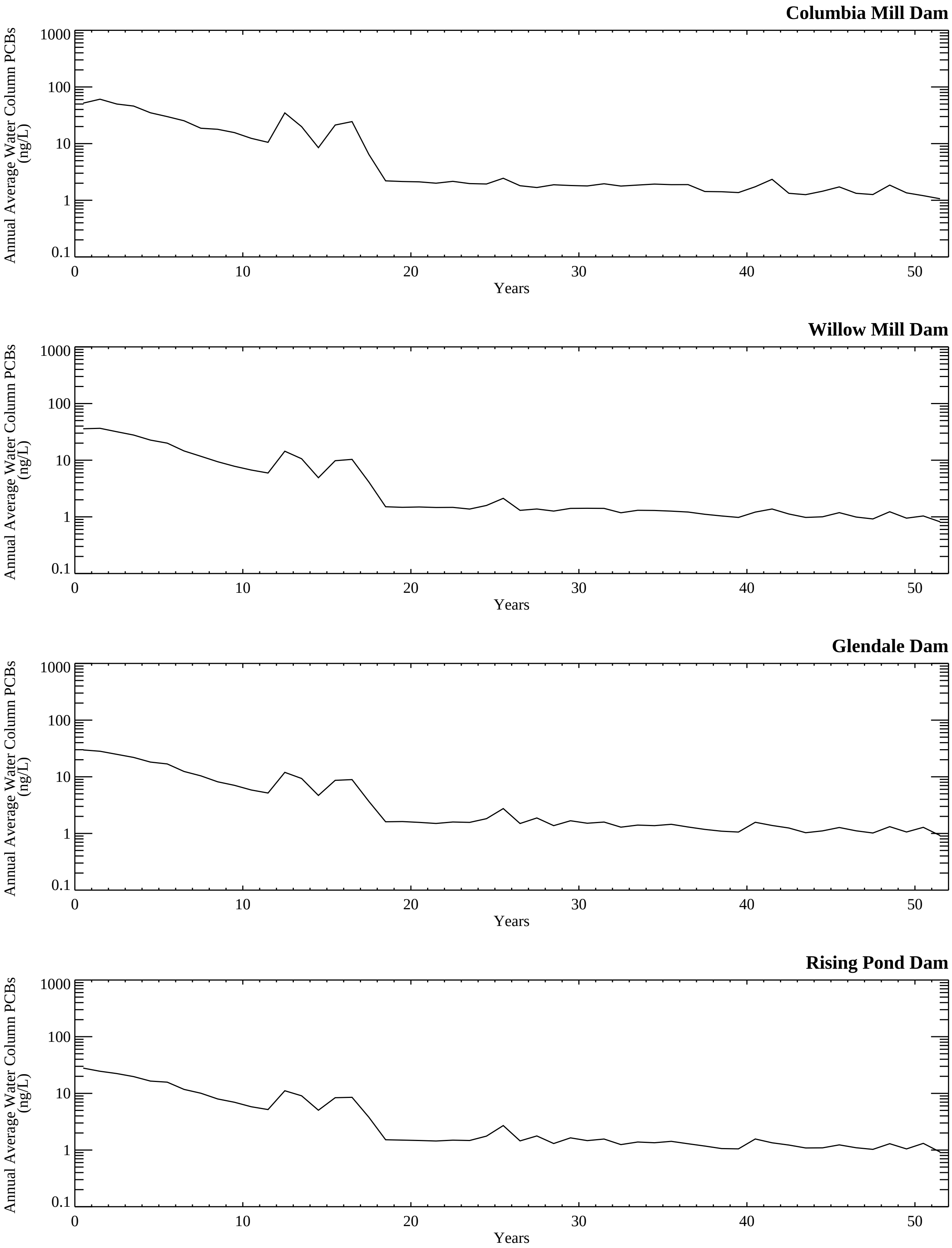
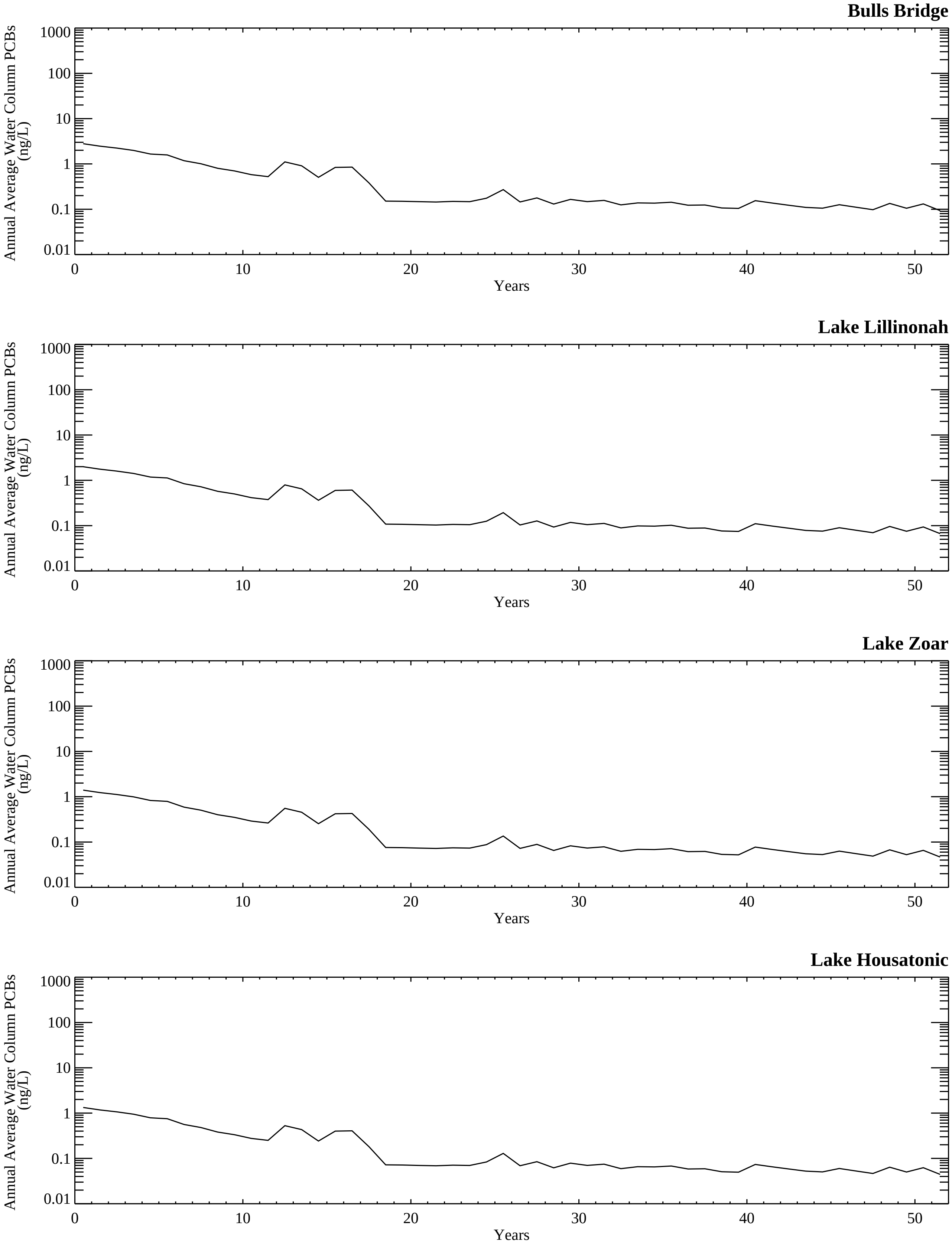


Figure G-1.5-4b. Temporal profiles of model-predicted water column PCB concentrations (SED 5; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\proj_R78_SED5CMSLB_0802-04

SED 5; Lower Bound



Bulls Bridge

Lake Lillinonah

Lake Zoar

Lake Housatonic

Figure G-1.5-4c. Temporal profiles of water column PCB concentrations estimated from the CT 1-D Analysis (SED 5; CT; Lower Bound).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED05_0802-04_low_bound

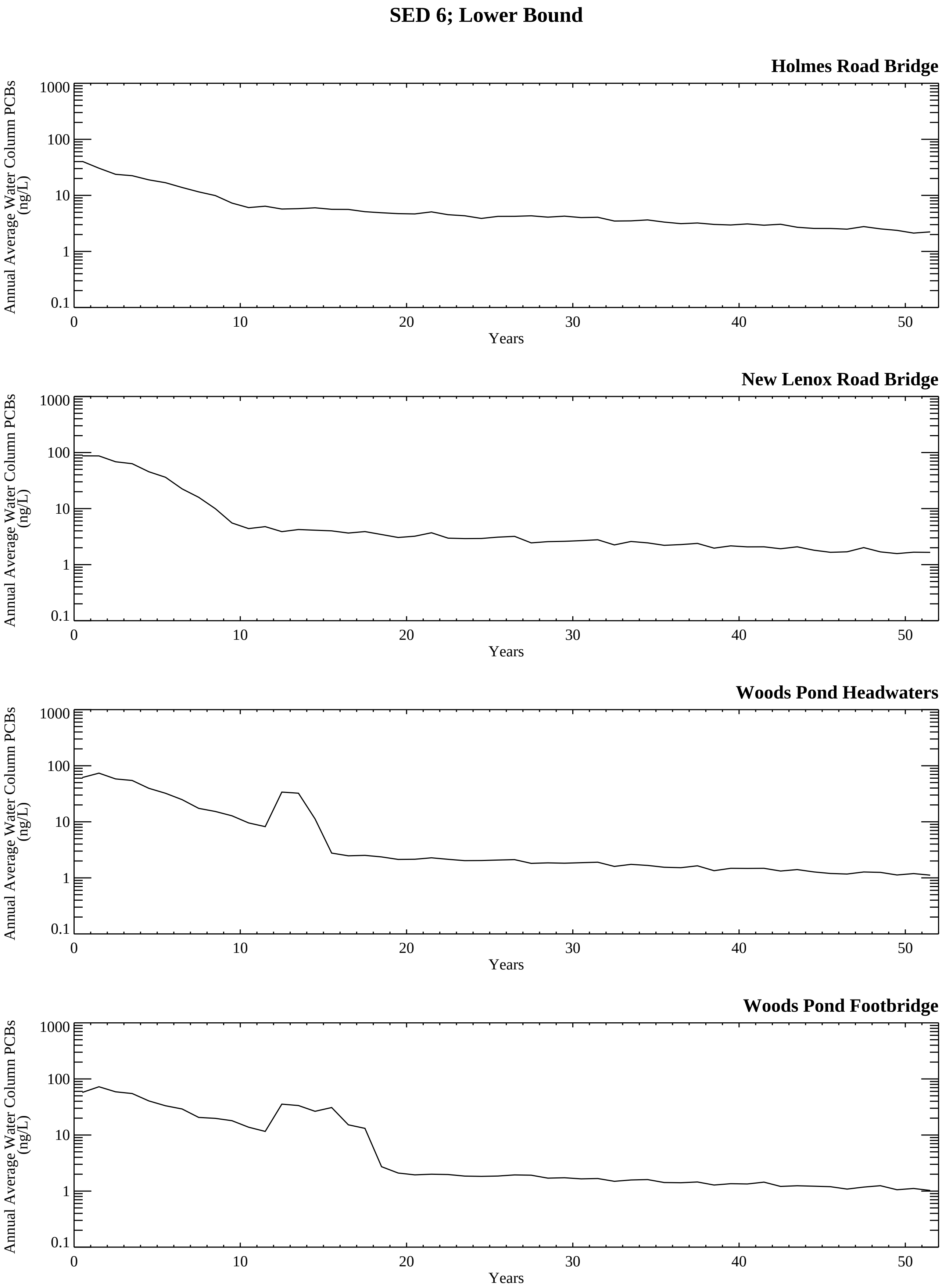
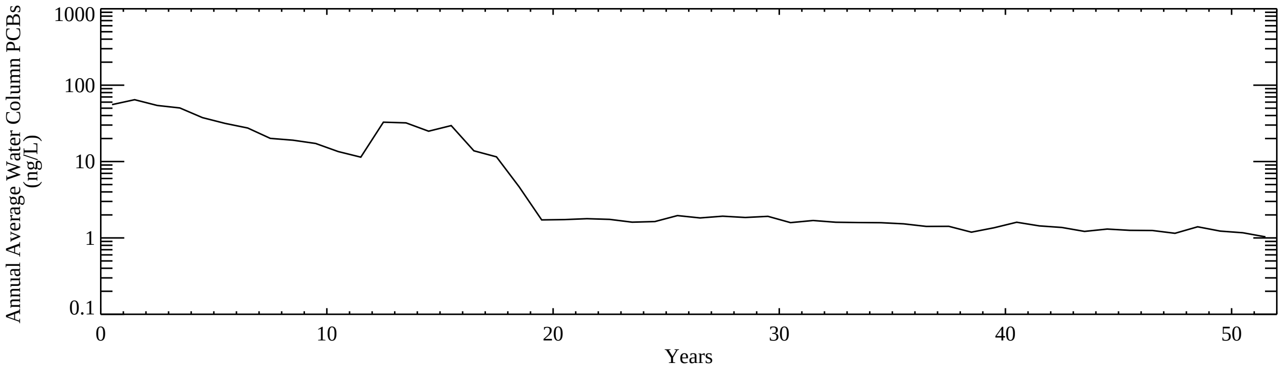


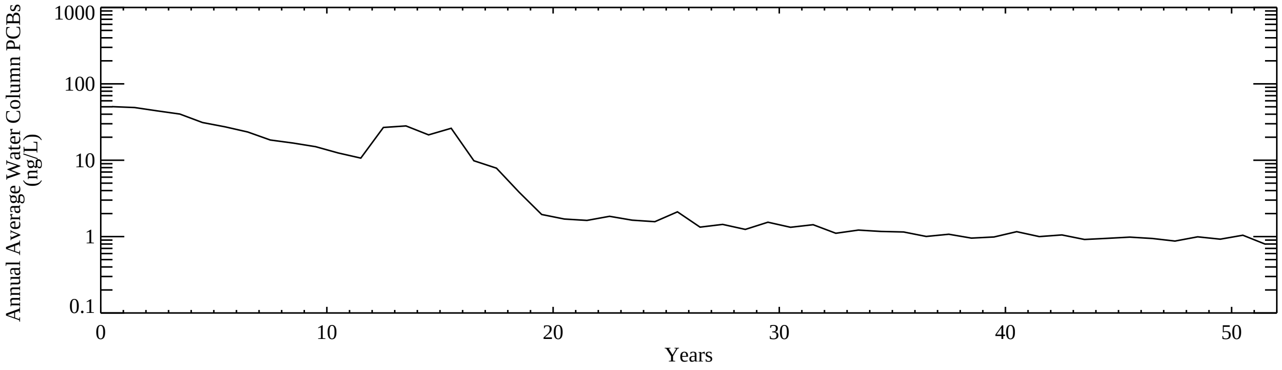
Figure G-1.5-5a. Temporal profiles of model-predicted water column PCB concentrations (SED 6; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED6CMSLB_0712-23

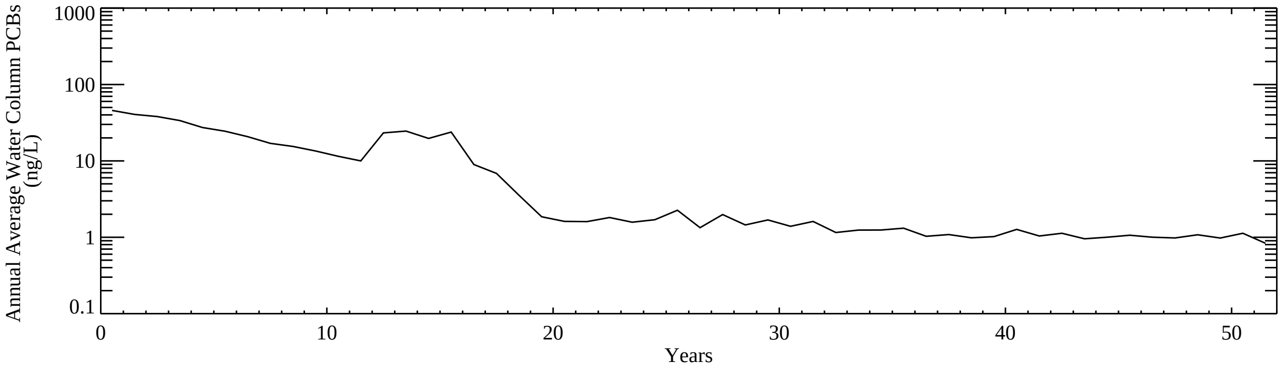
SED 6; Lower Bound



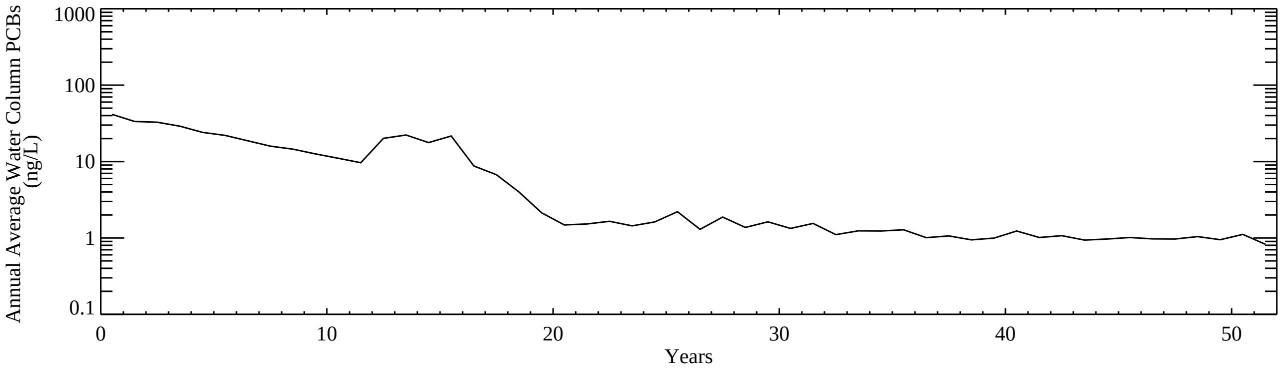
Columbia Mill Dam



Willow Mill Dam



Glendale Dam



Rising Pond Dam

Figure G-1.5-5b. Temporal profiles of model-predicted water column PCB concentrations (SED 6; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED6CMSLB_0712-39

SED 6; Lower Bound

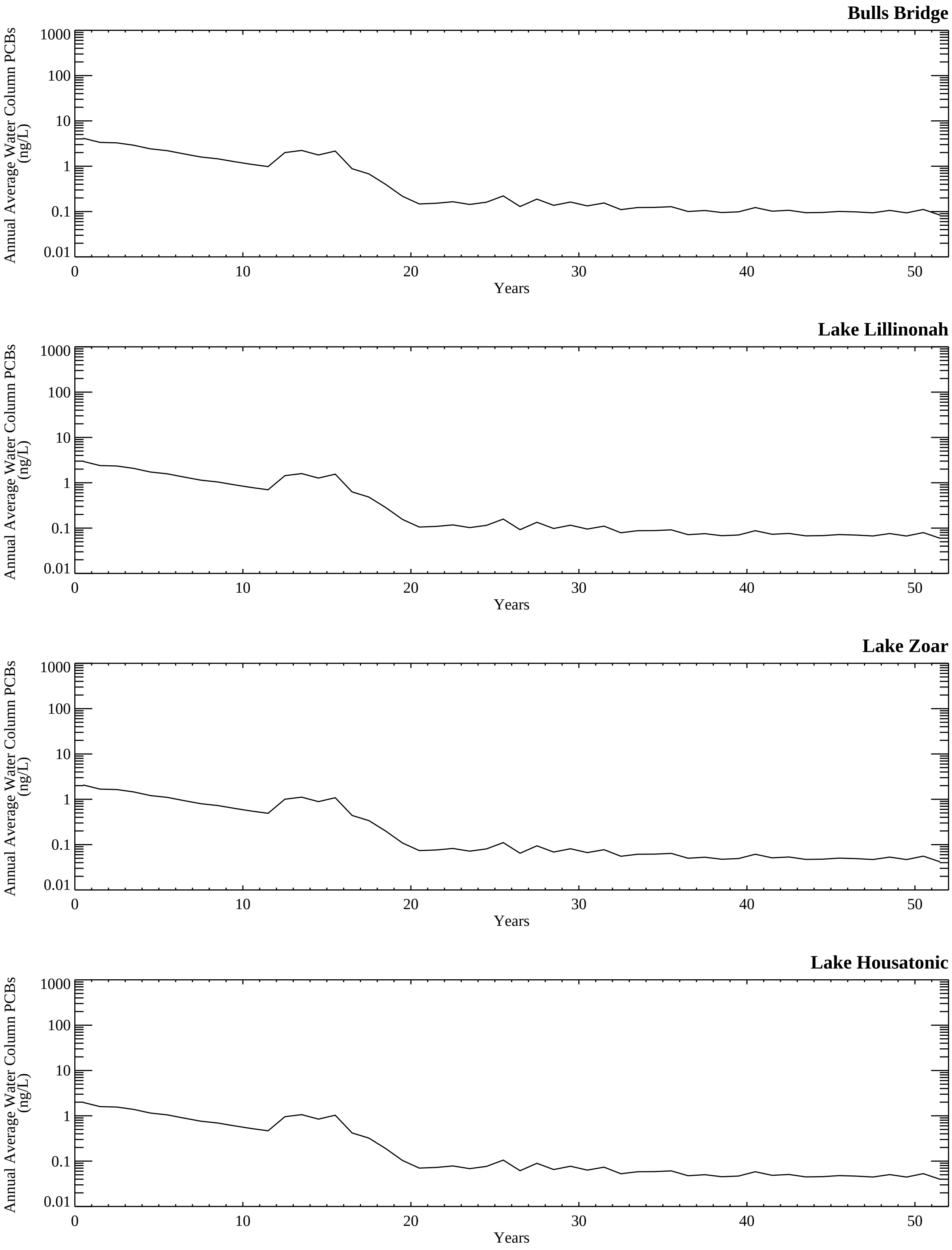
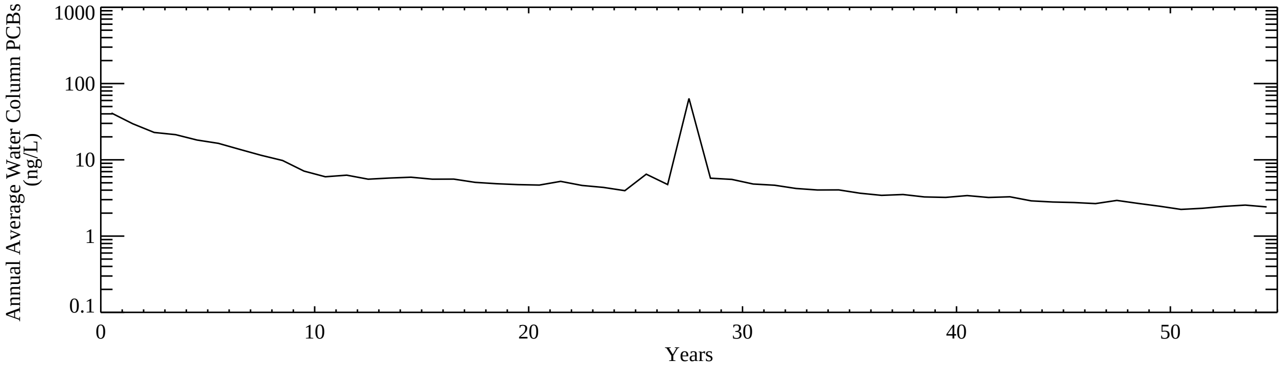


Figure G-1.5-5c. Temporal profiles of water column PCB concentrations estimated from the CT 1-D Analysis (SED 6; CT; Lower Bound).

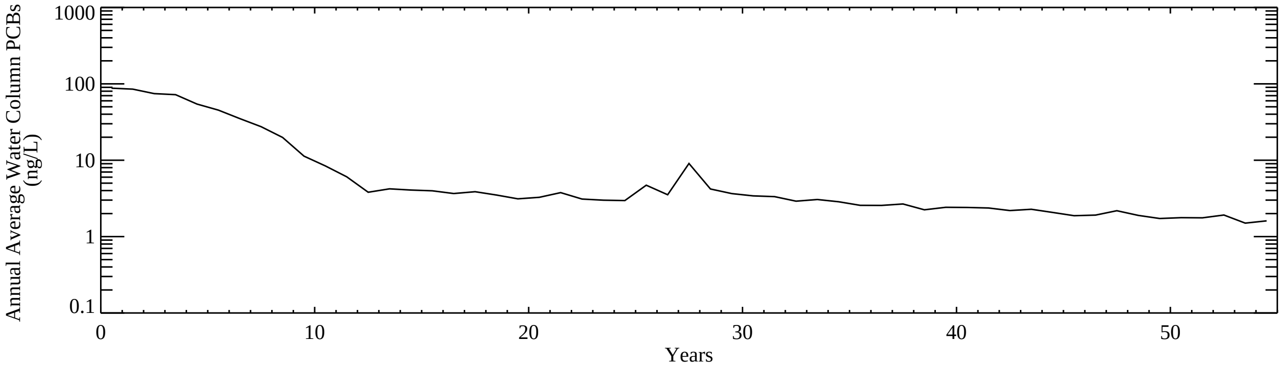
Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED06_0712-39_low_bound

SED 7; Lower Bound

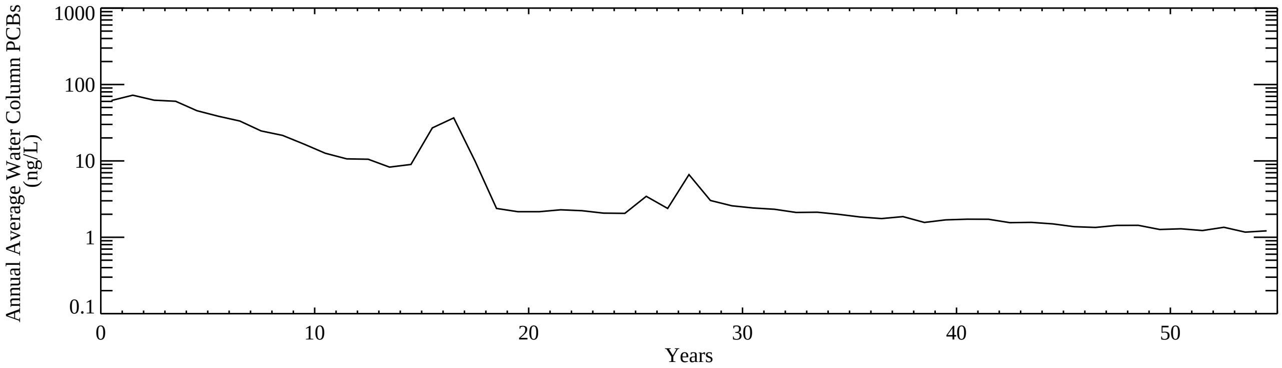
Holmes Road Bridge



New Lenox Road Bridge



Woods Pond Headwaters



Woods Pond Footbridge

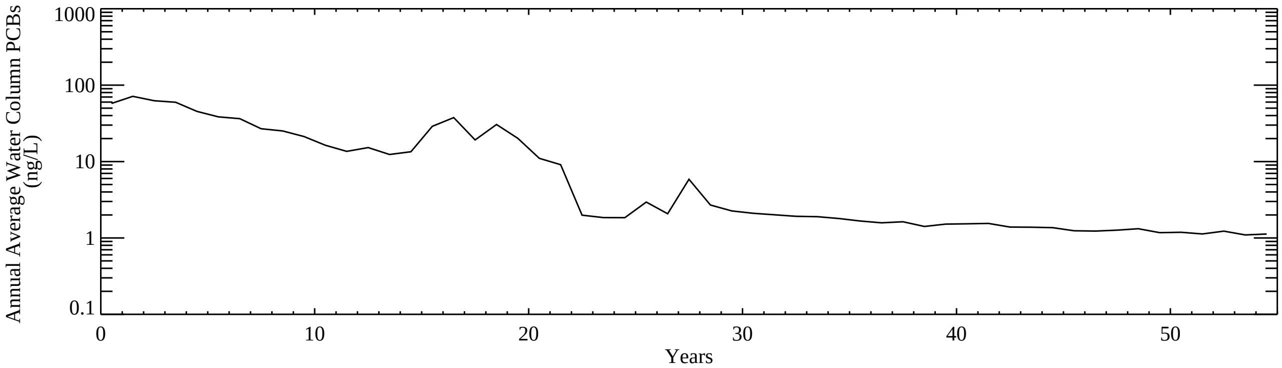


Figure G-1.5-6a. Temporal profiles of model-predicted water column PCB concentrations (SED 7; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED7CMSLB_0712-24

SED 7; Lower Bound

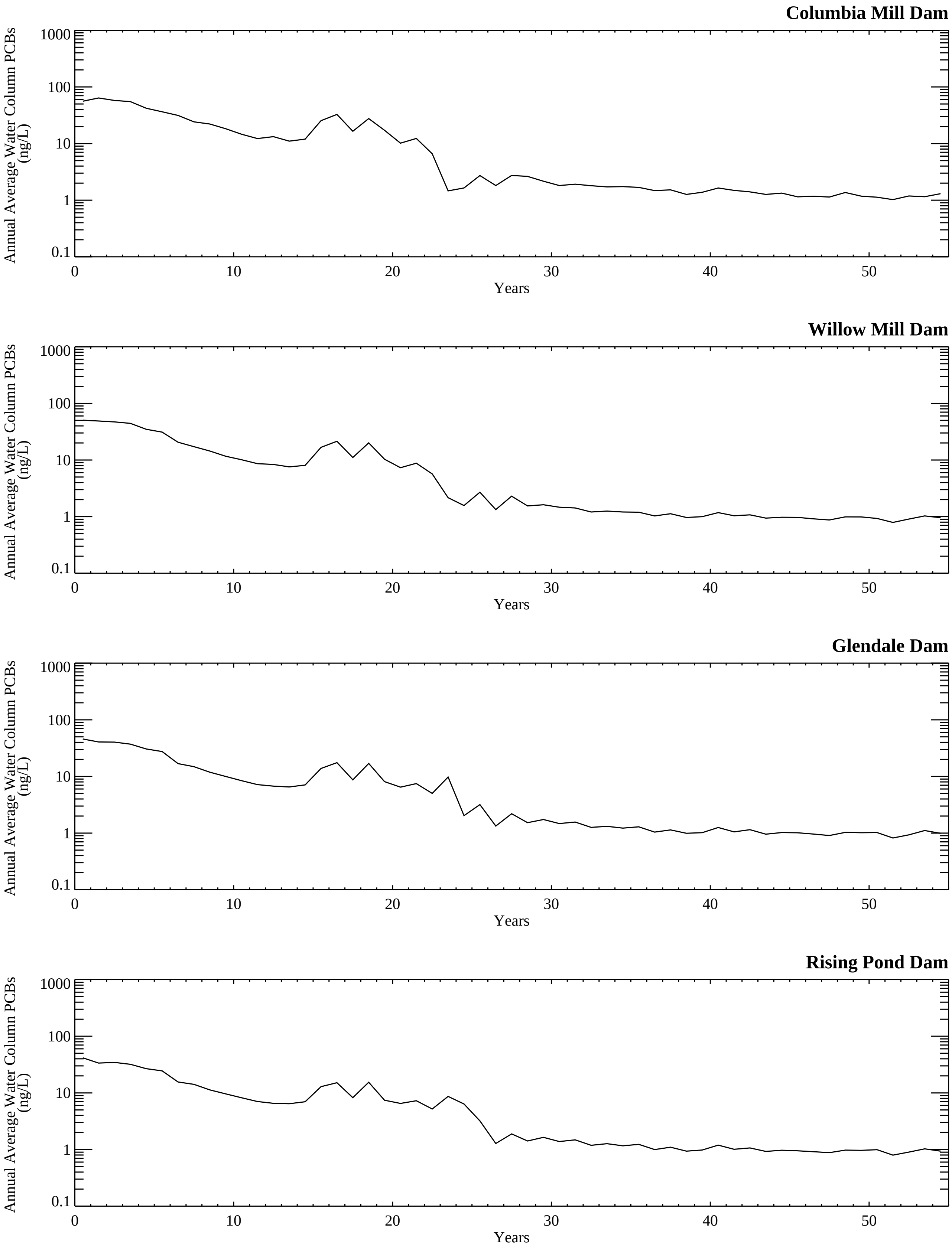


Figure G-1.5-6b. Temporal profiles of model-predicted water column PCB concentrations (SED 7; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED7CMSLB_0712-40

SED 7; Lower Bound

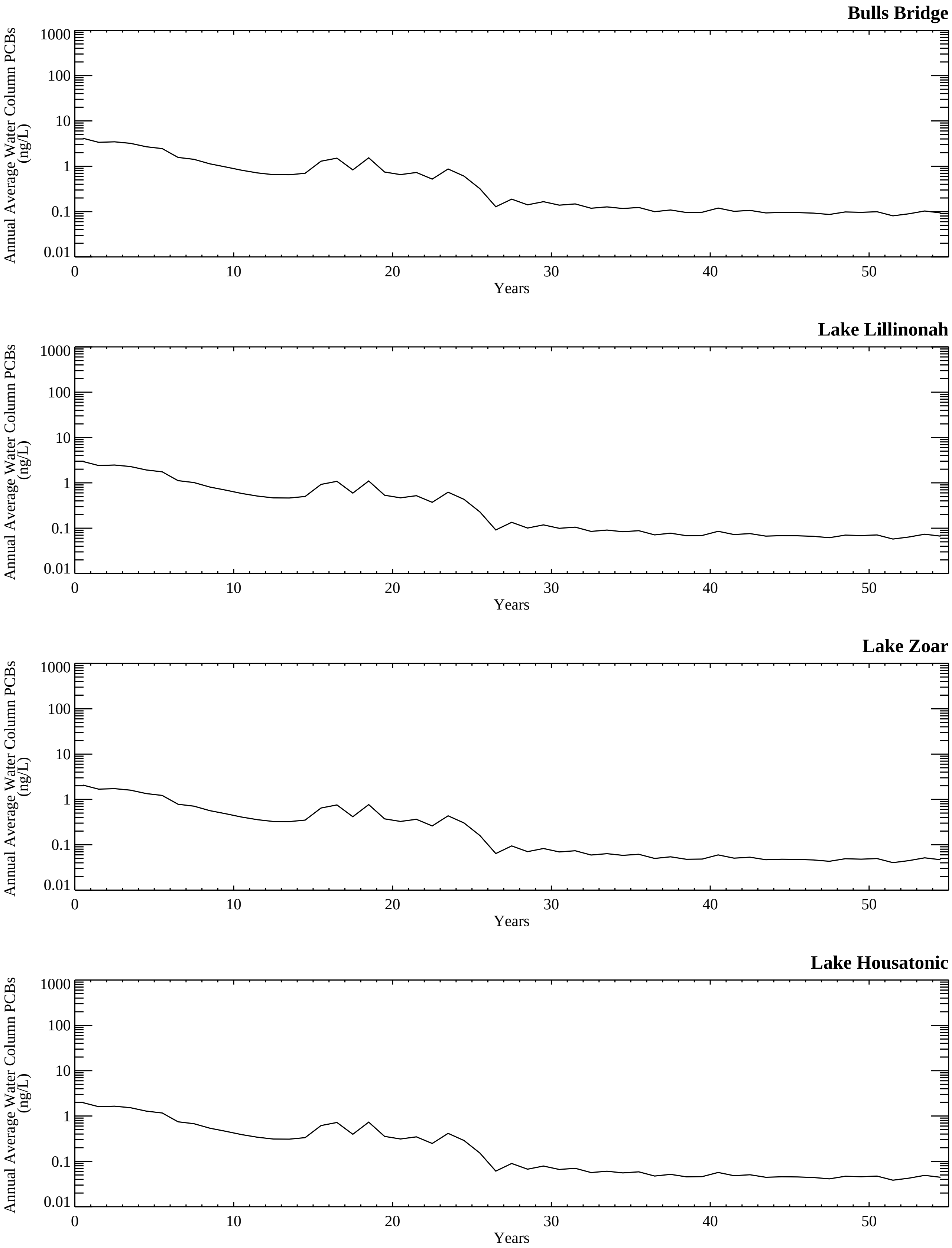


Figure G-1.5-6c. Temporal profiles of water column PCB concentrations estimated from the CT 1-D Analysis (SED 7; CT; Lower Bound).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED07_0712-40_low_bound

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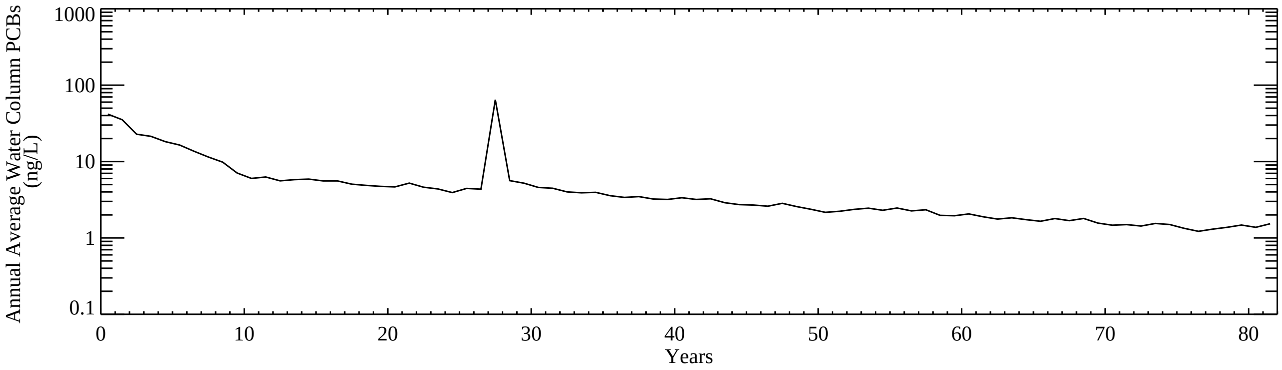
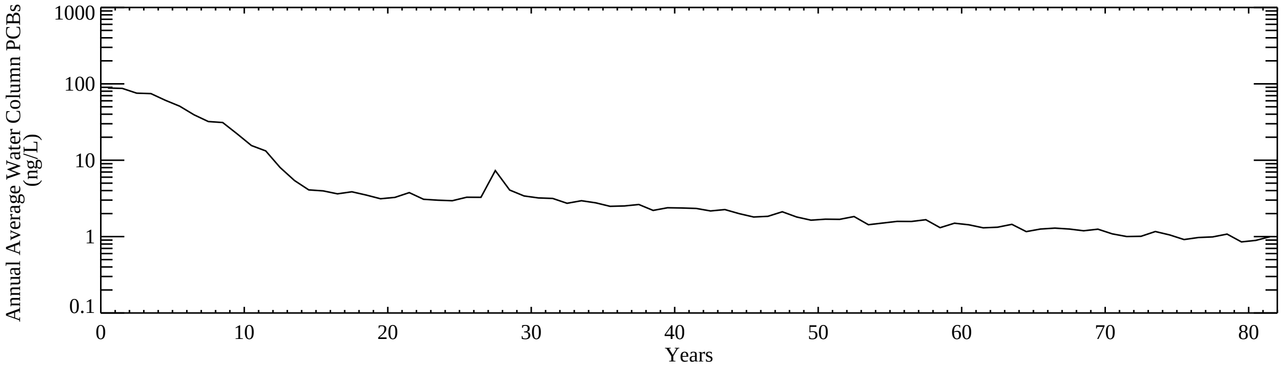
Wed Mar 19 10:57:38 2008

SED 8; Lower Bound

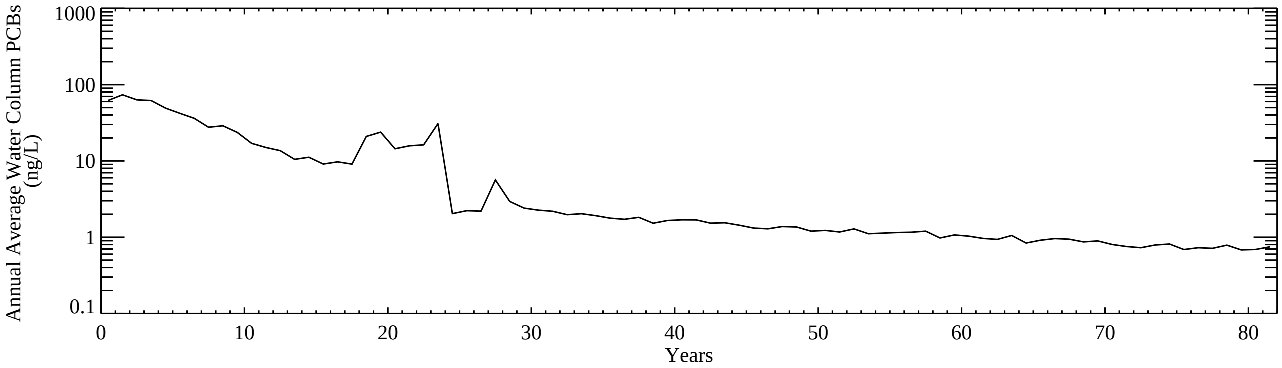
Holmes Road Bridge



New Lenox Road Bridge



Woods Pond Headwaters



Woods Pond Footbridge

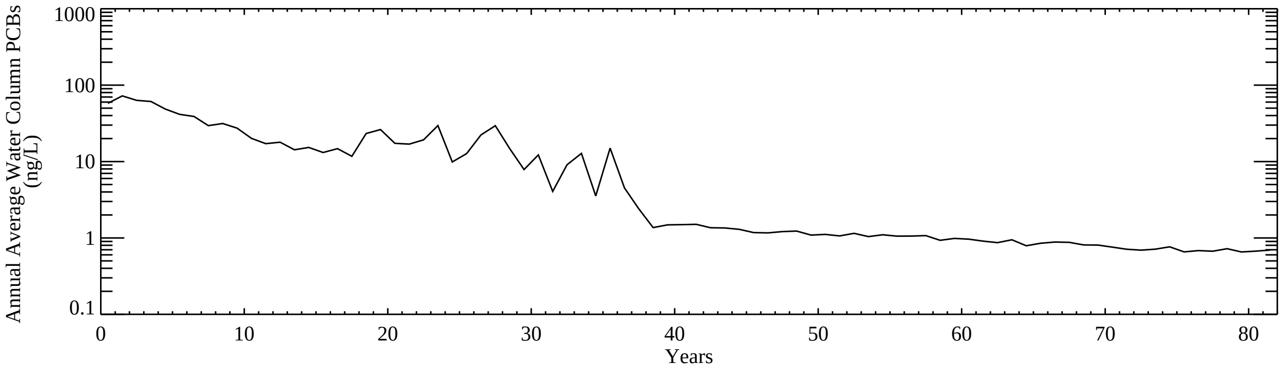
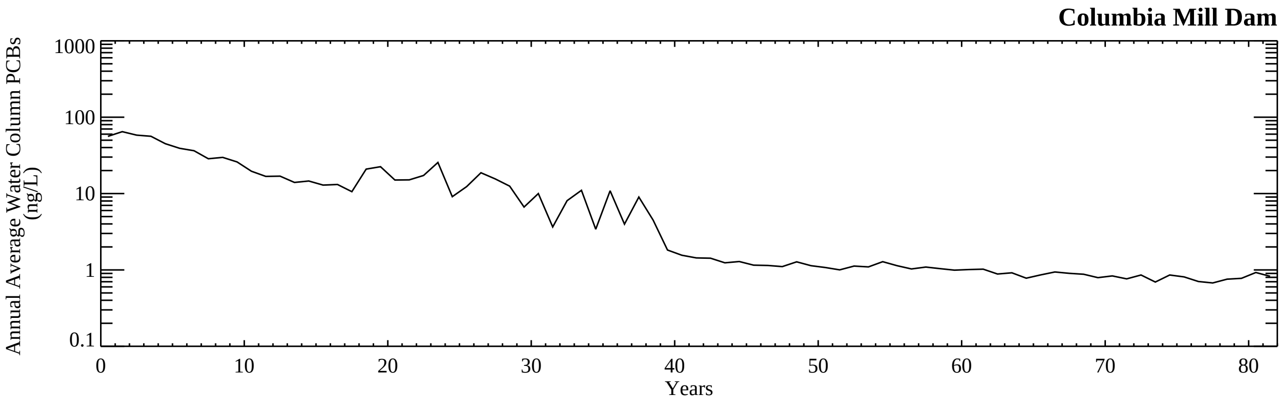
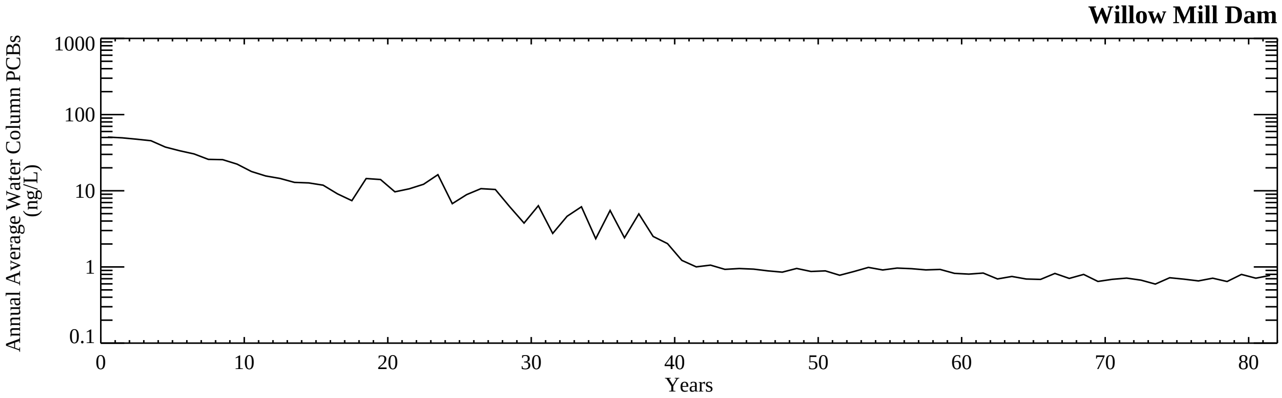


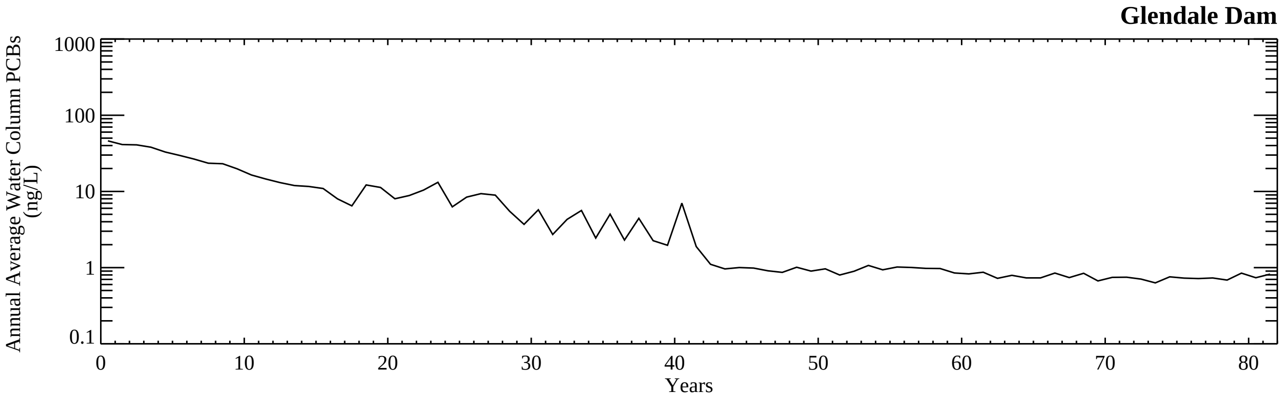
Figure G-1.5-7a. Temporal profiles of model-predicted water column PCB concentrations (SED 8; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED8CMSLB_0712-25

SED 8; Lower Bound







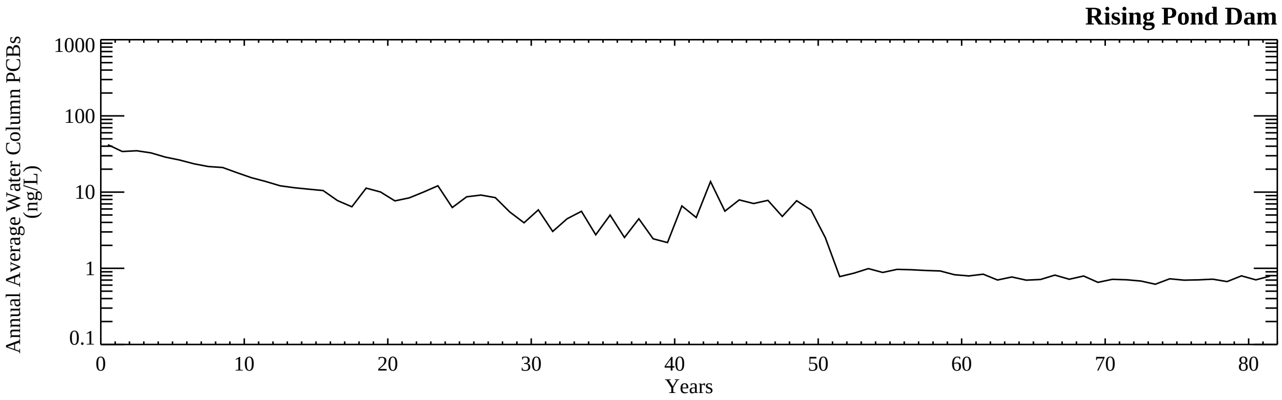


Figure G-1.5-7b. Temporal profiles of model-predicted water column PCB concentrations (SED 8; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED8CMSLB_0712-41

SED 8; Lower Bound

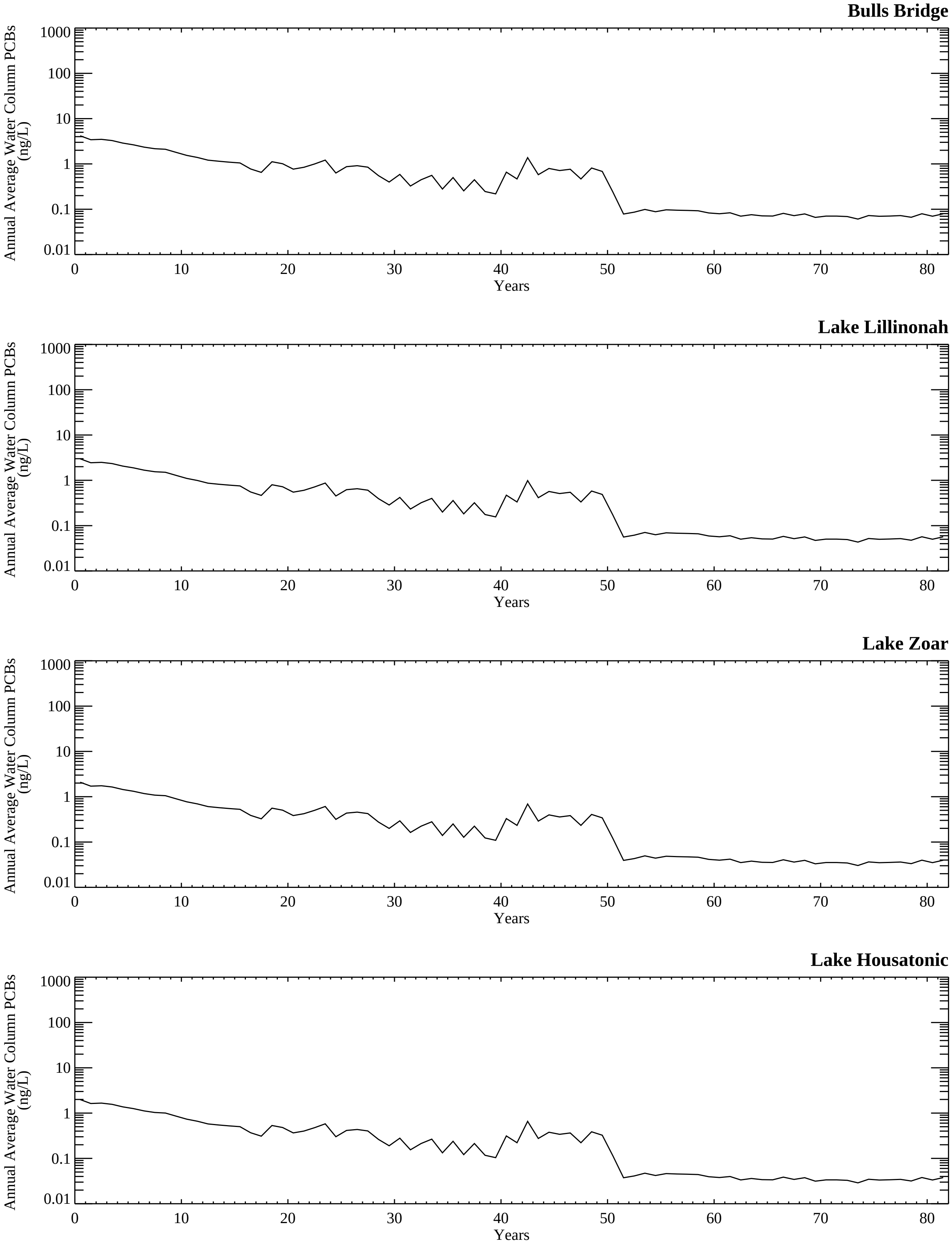


Figure G-1.5-7c. Temporal profiles of water column PCB concentrations estimated from the CT 1-D Analysis (SED 8; CT; Lower Bound).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED08_0712-41_low_bound

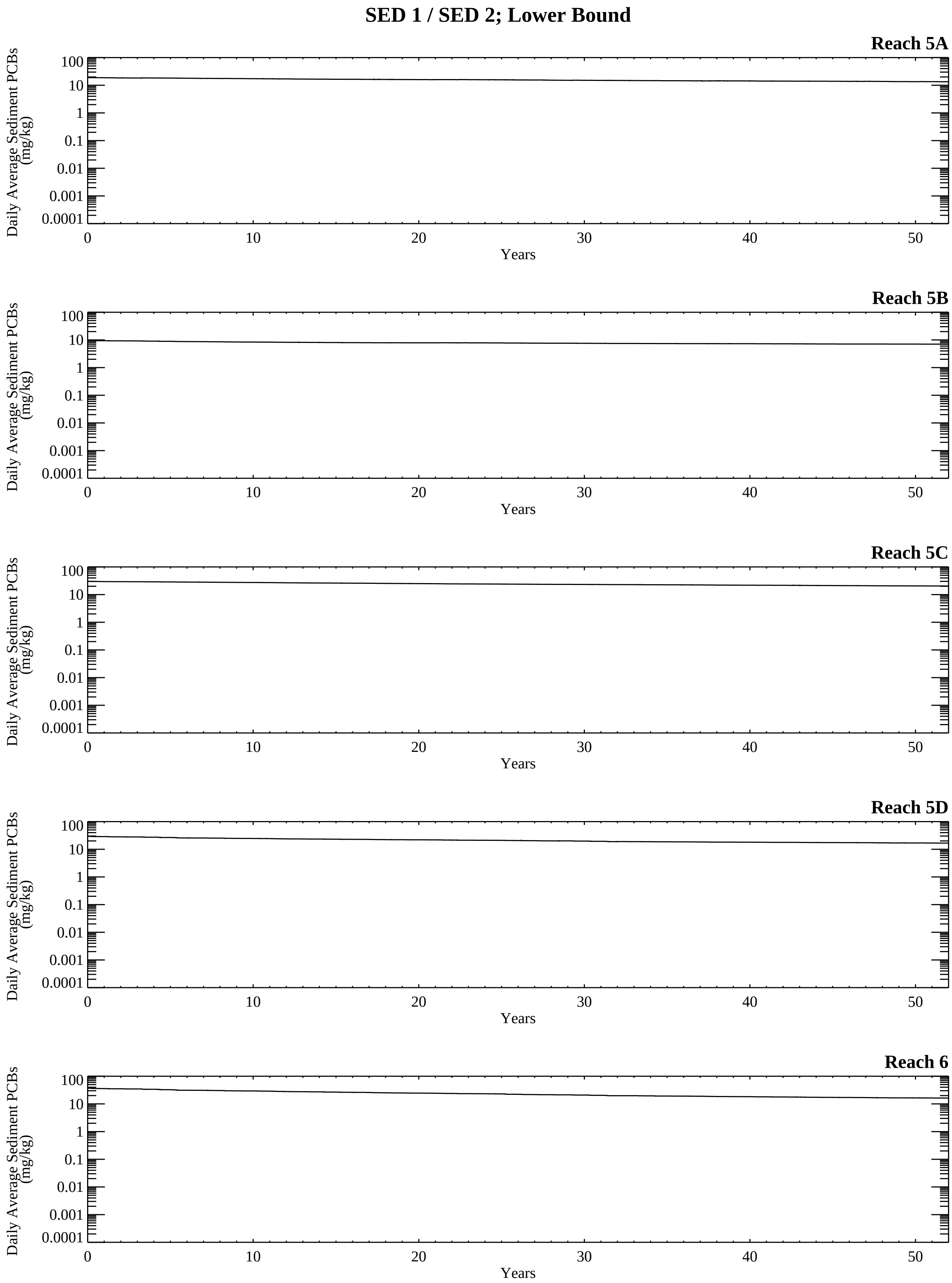


Figure G-1.6-1a. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 1 / SED 2; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED1CMSLB_0712-19\\bins

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Wed Mar 19 11:10:33 2008

SED 1 / SED 2; Lower Bound

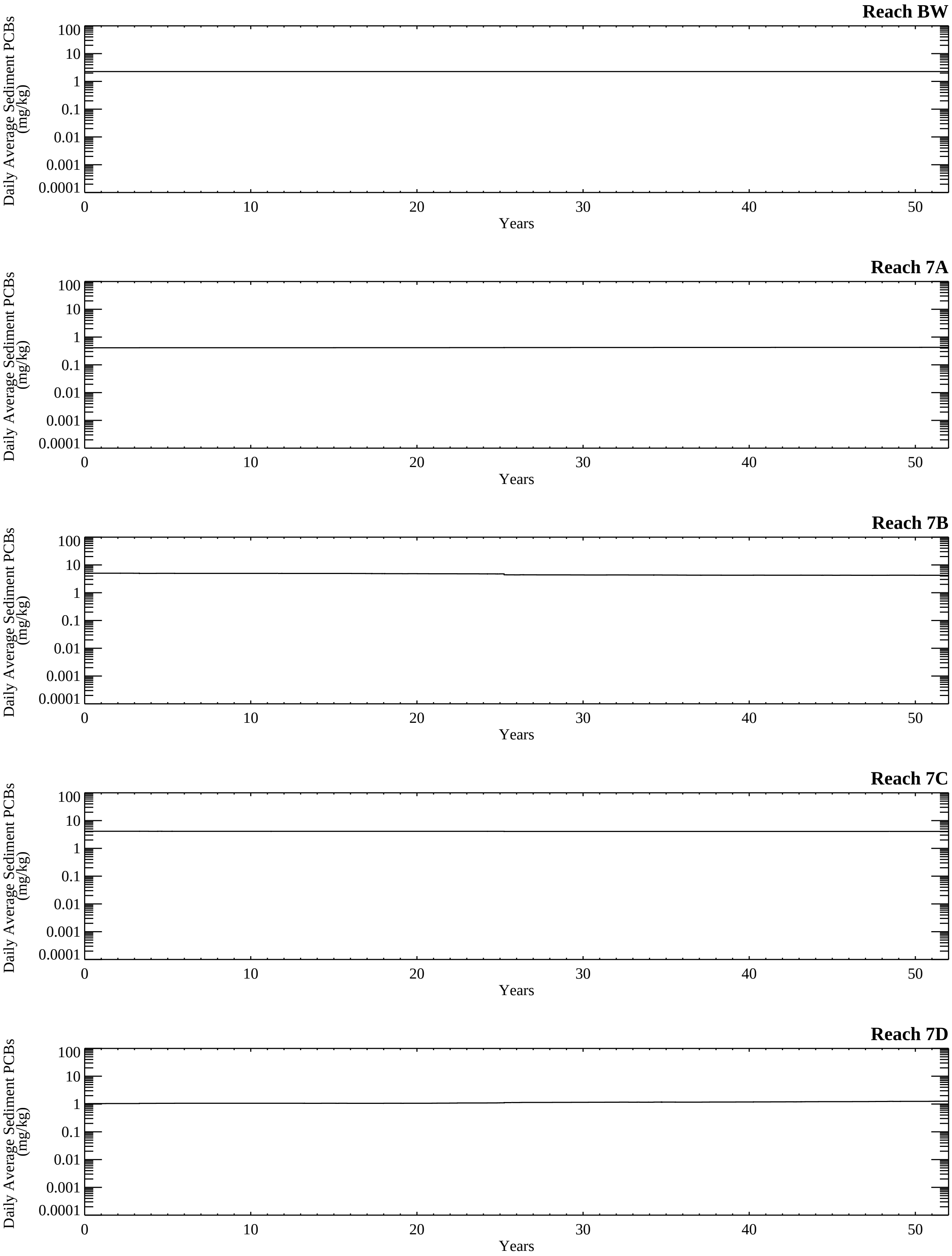

Figure G-1.6-1b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 1 / SED 2; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED1CMSLB_0712-35\\bins

SED 1 / SED 2; Lower Bound

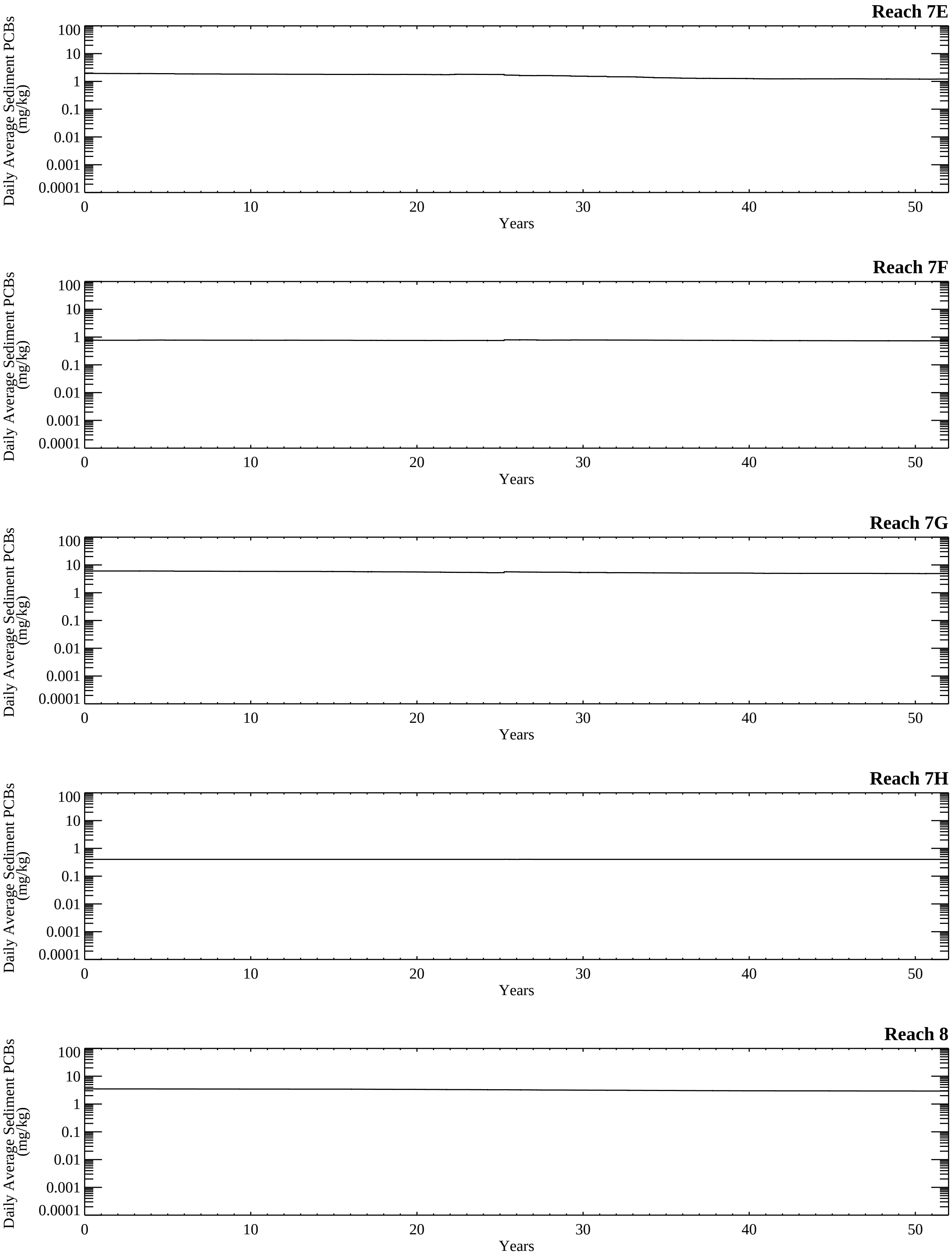

Figure G-1.6-1b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 1 / SED 2; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED1CMSLB_0712-35\\bins

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Wed Mar 19 11:28:13 2008

SED 1 / SED 2; Lower Bound

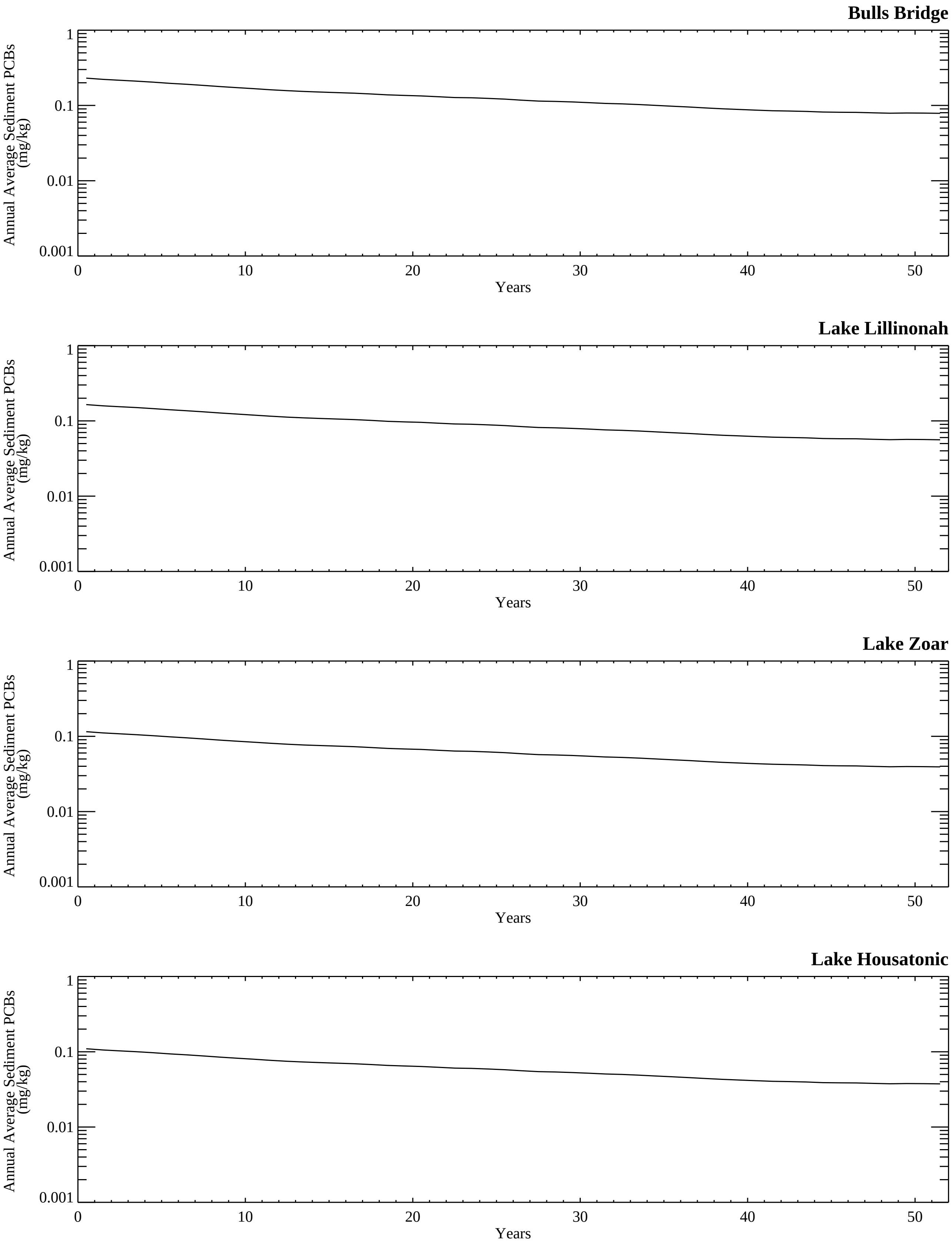

Figure G-1.6-1c. Temporal profiles of average surface sediment (0-6") PCB concentrations estimated from the CT 1-D Analysis (SED 1 / SED 2; CT; Lower Bound).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED01_0712-35_low_bound

SED 3; Lower Bound

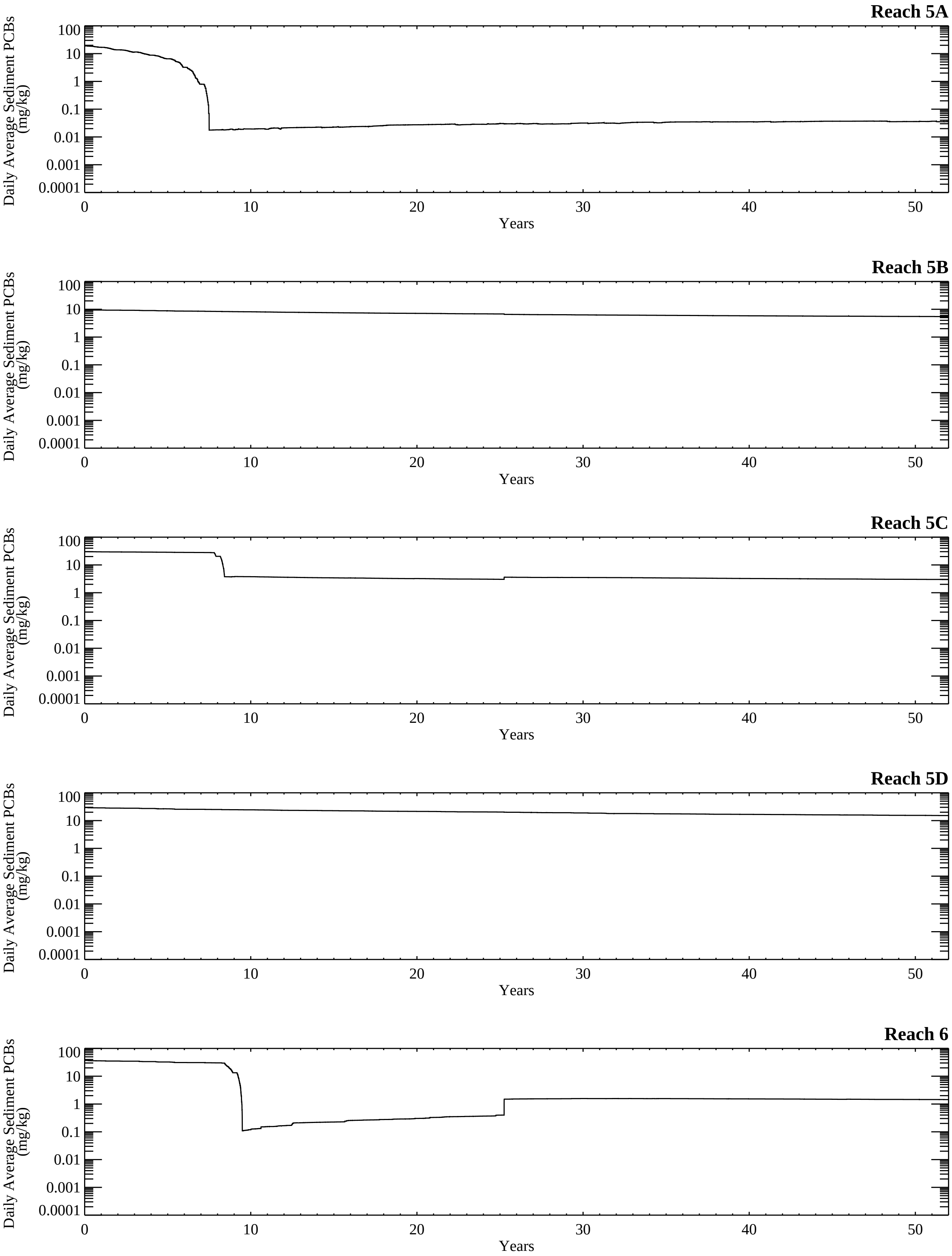

Figure G-1.6-2a. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 3; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED3CMSLB_0712-20\\bins

RRM - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\Figure_G1_2_temp_reach.pro
Wed Mar 19 11:11:55 2008

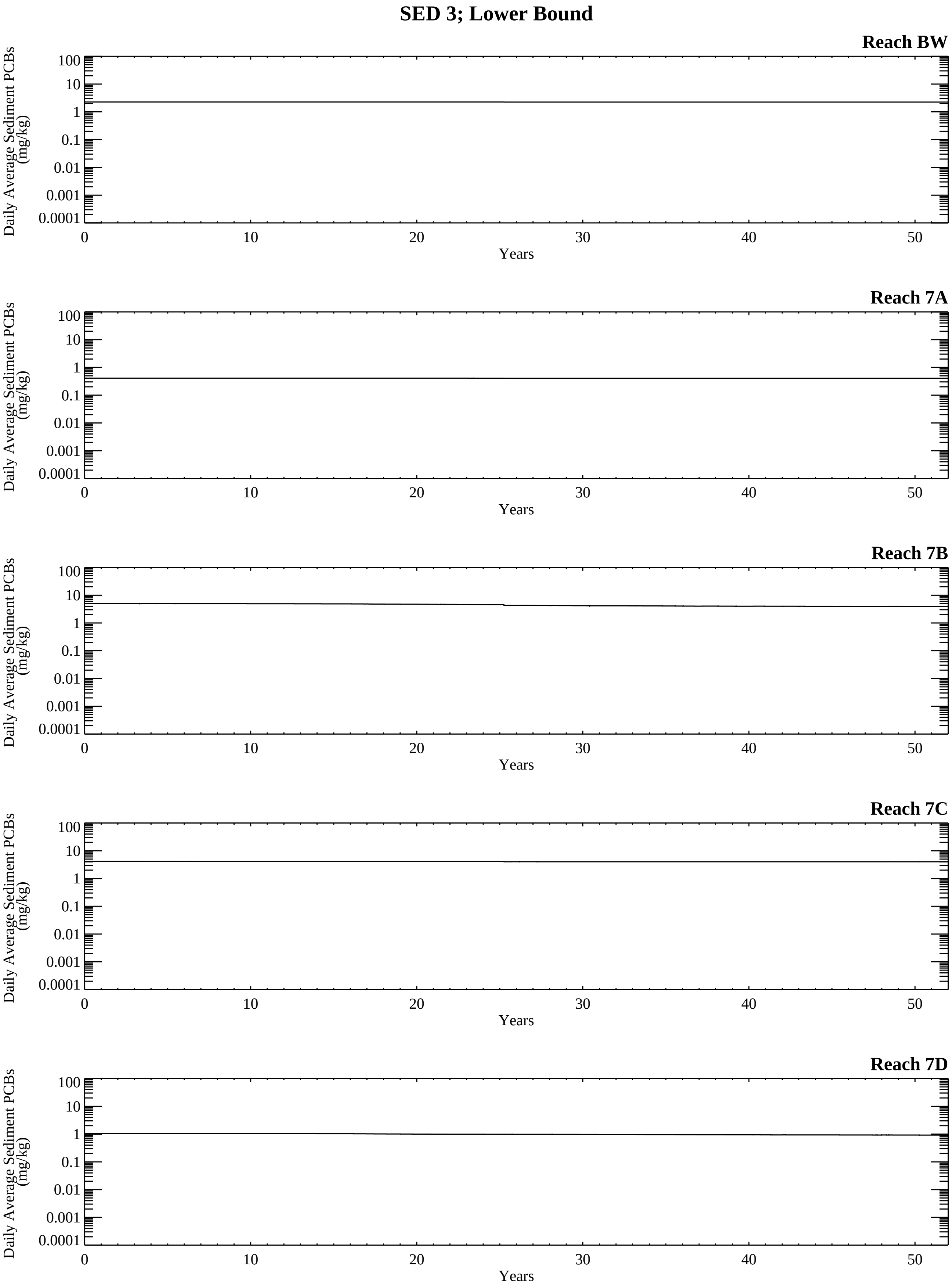

Figure G-1.6-2b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 3; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED3CMSLB_0712-36\\bins

SED 3; Lower Bound

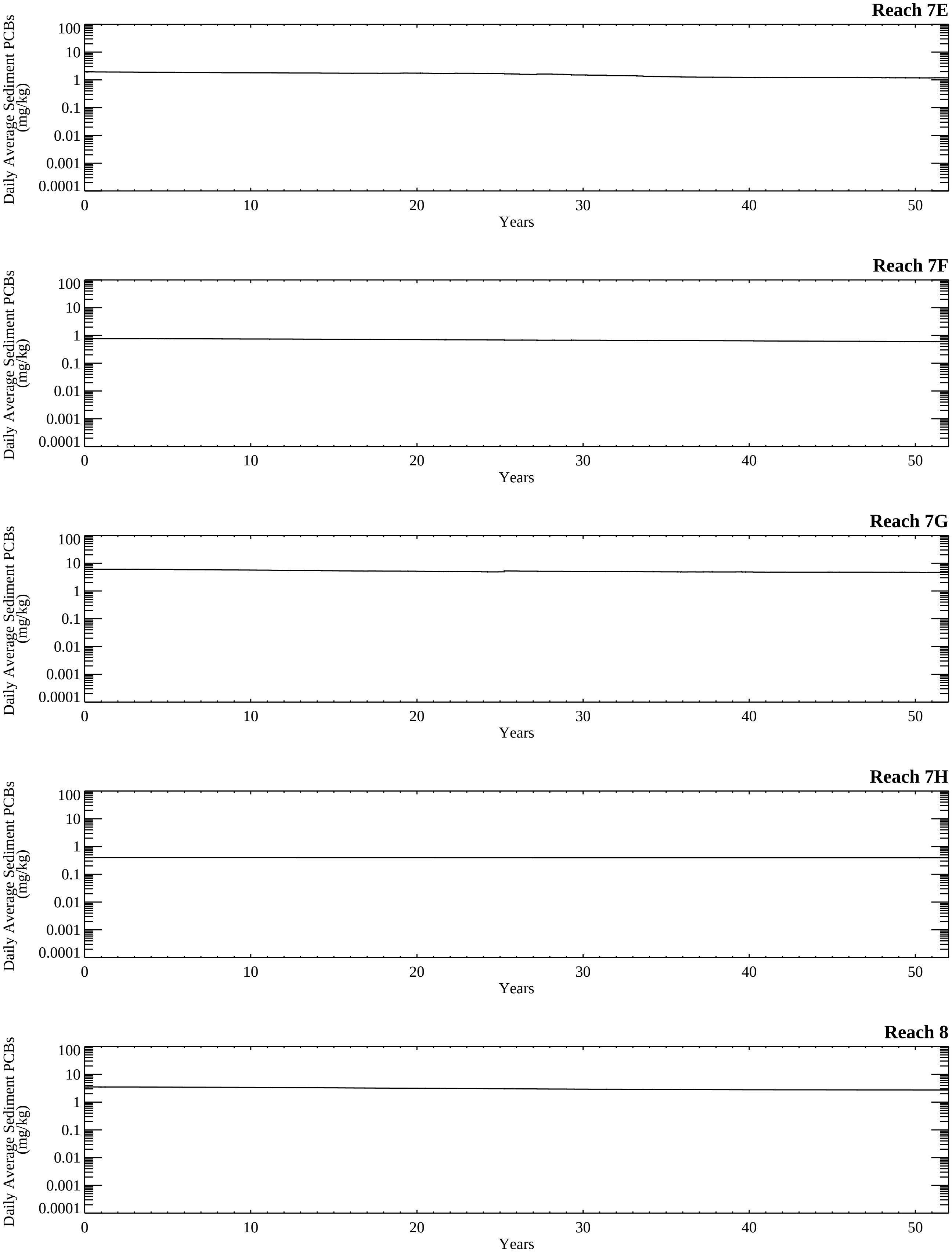

Figure G-1.6-2b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 3; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED3CMSLB_0712-36\\bins

SED 3; Lower Bound

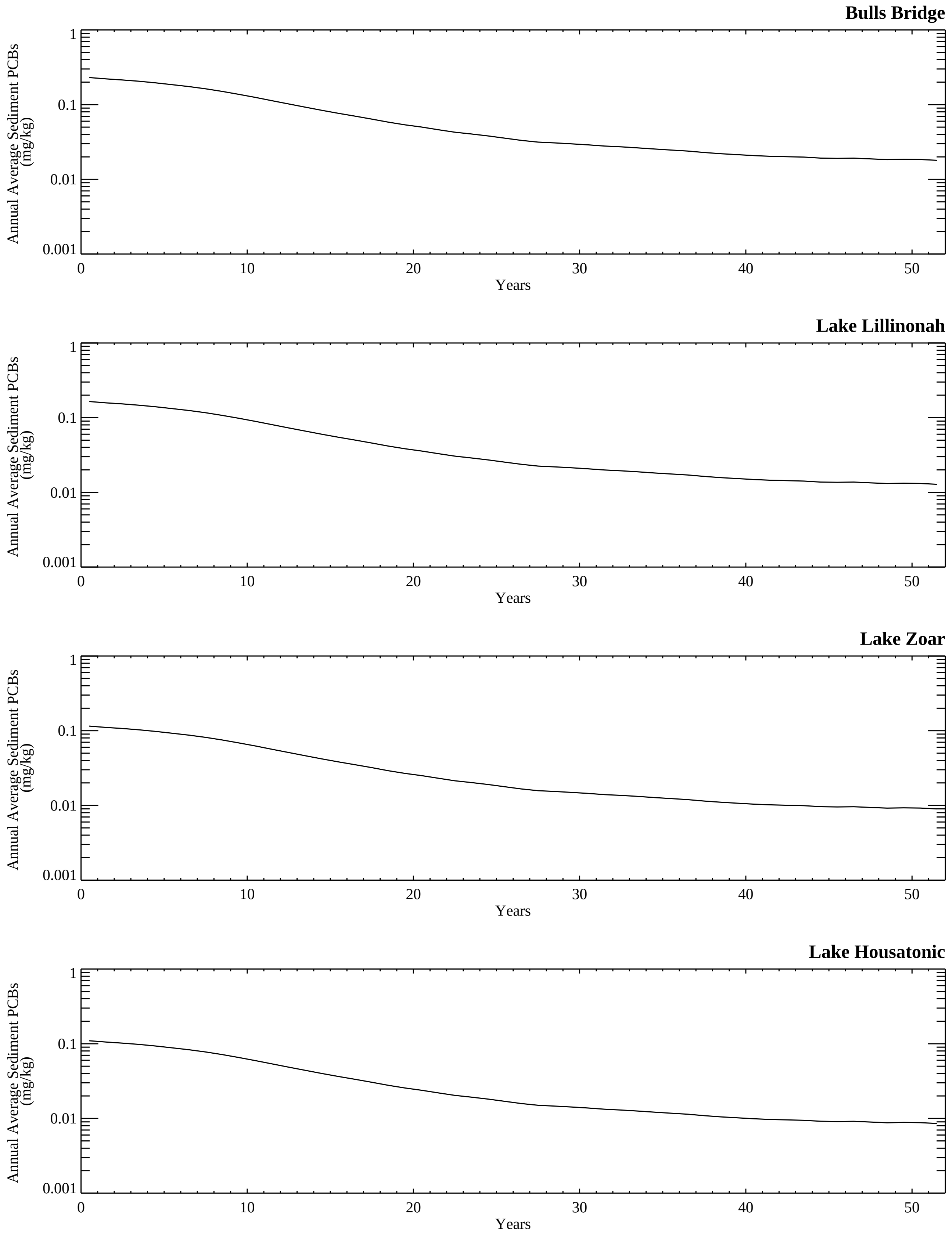

Figure G-1.6-2c. Temporal profiles of average surface sediment (0-6") PCB concentrations estimated from the CT 1-D Analysis (SED 3; CT; Lower Bound).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED03_0712-36_low_bound

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Wed Mar 19 10:58:40 2008

SED 4; Lower Bound

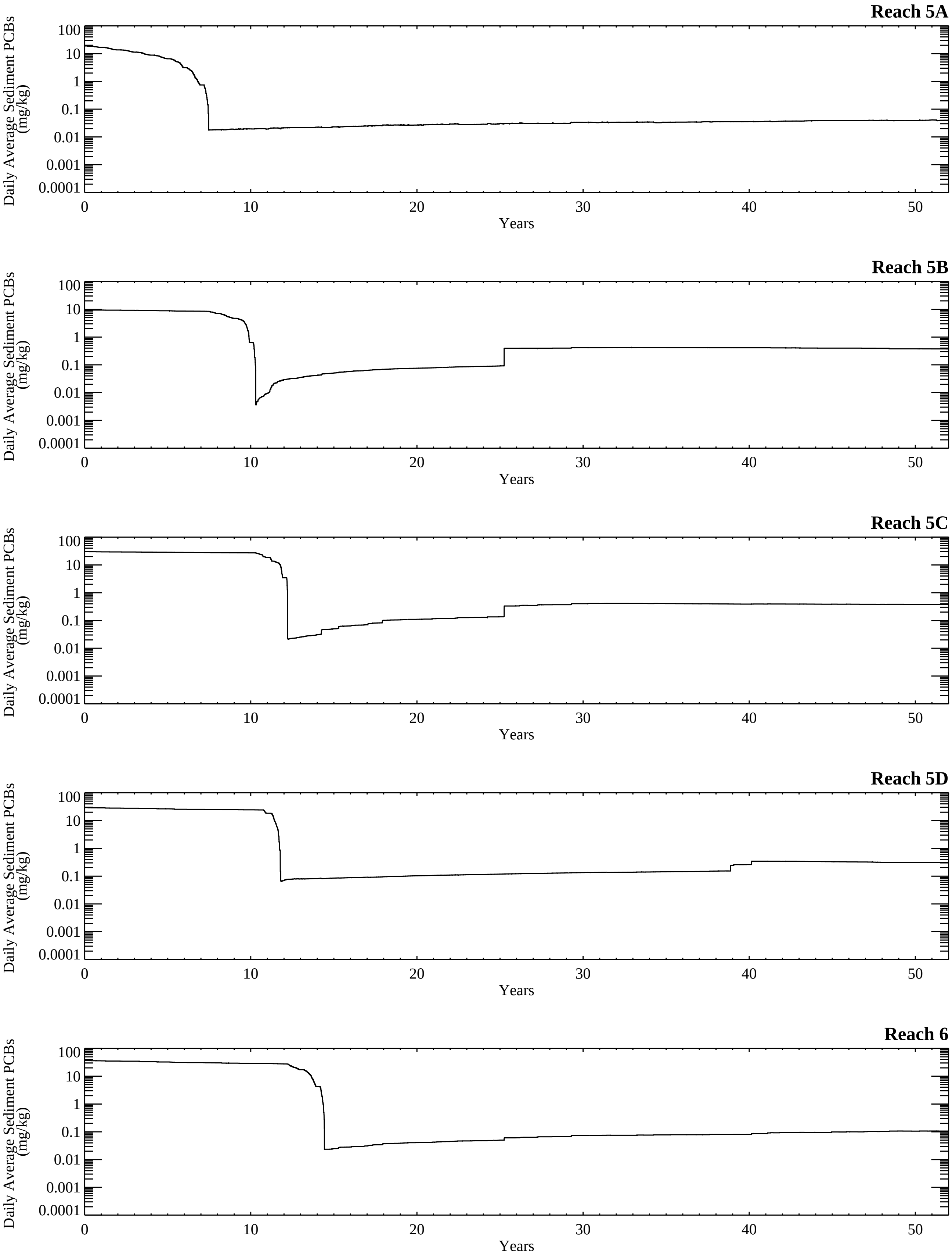

Figure G-1.6-3a. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 4; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED4CMSLB_0801-03\\bins

SED 4; Lower Bound

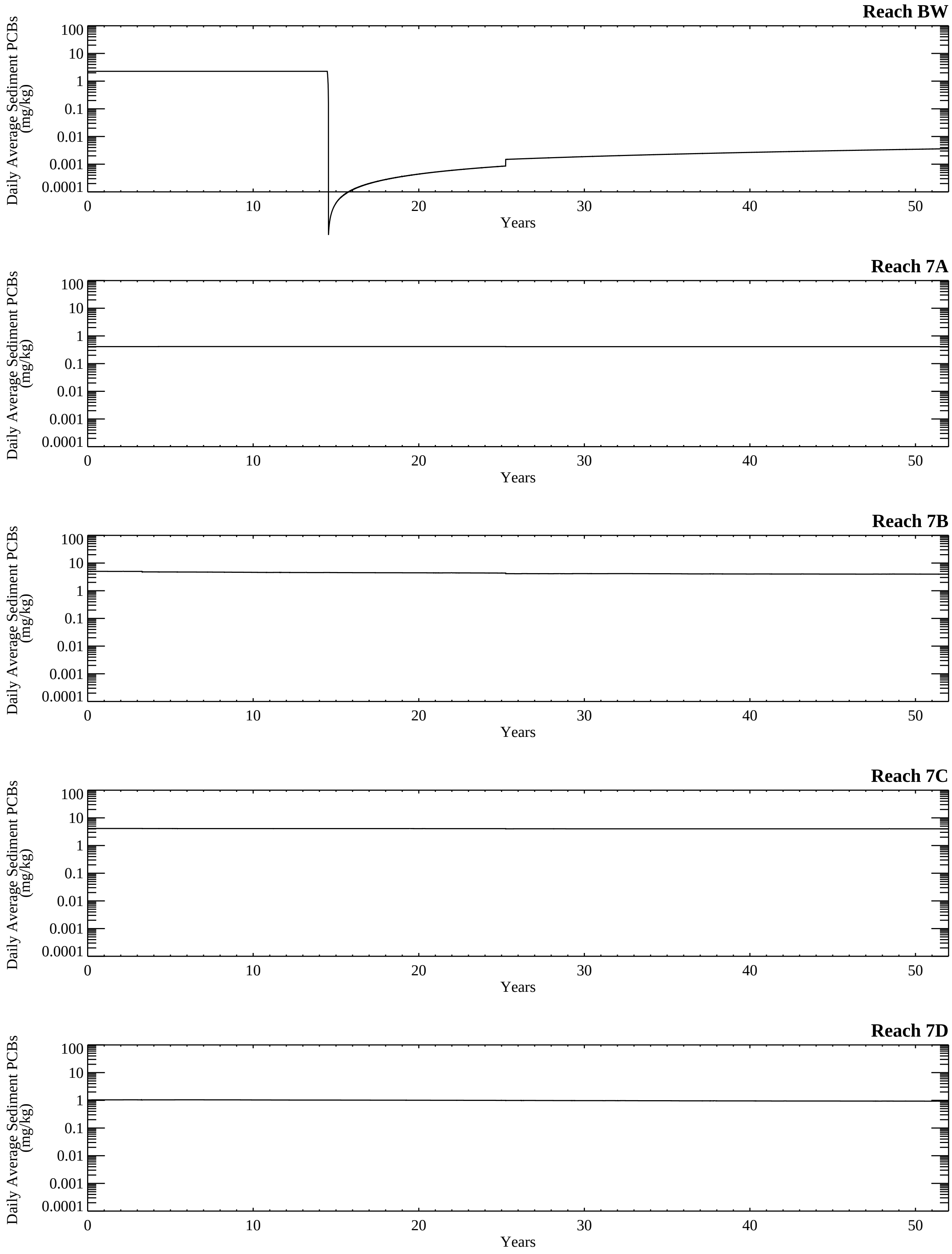

Figure G-1.6-3b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 4; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED4CMSLB_0802-03\\bins

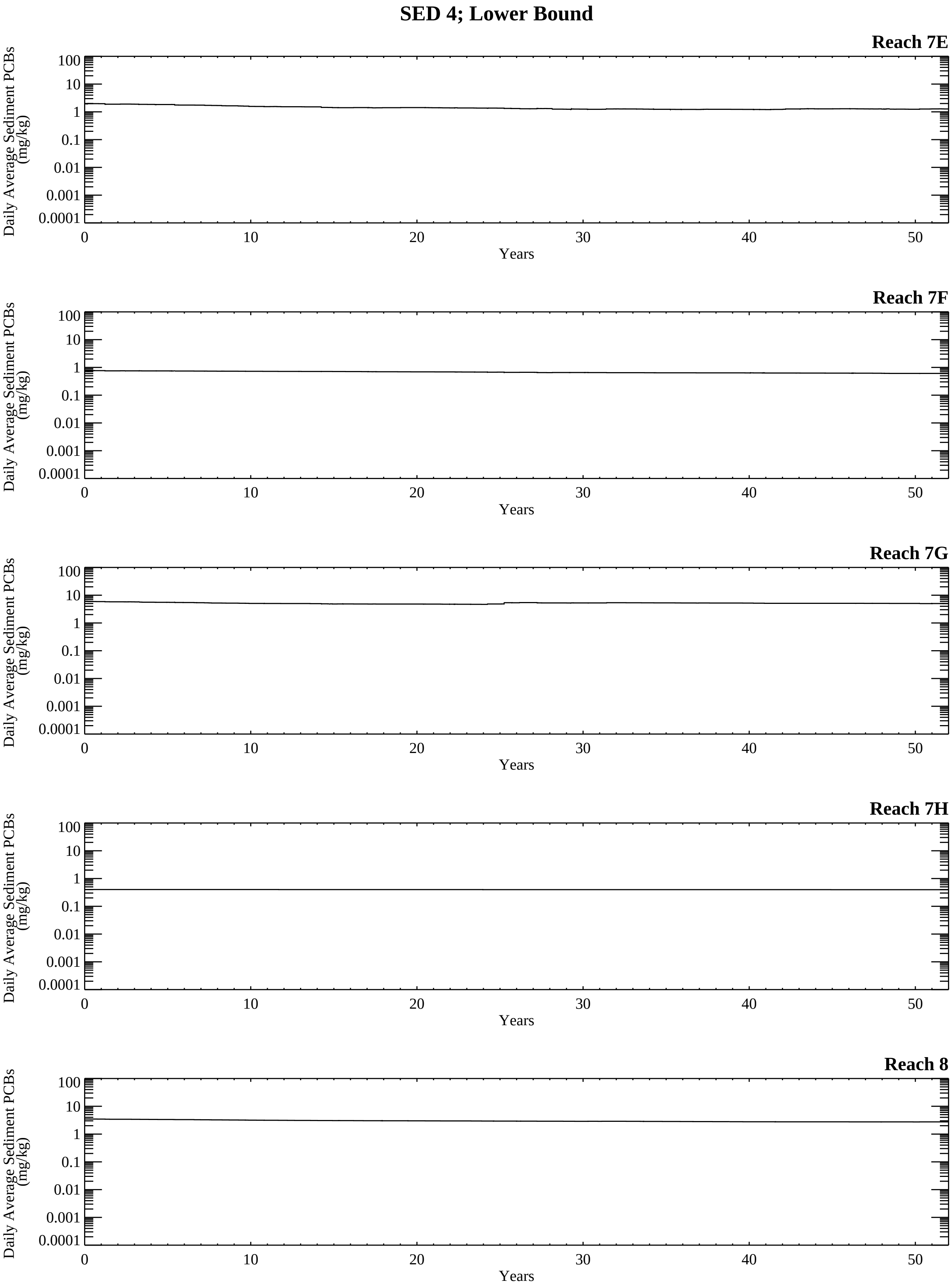

Figure G-1.6-3b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 4; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED4CMSLB_0802-03\\bins

SED 4; Lower Bound

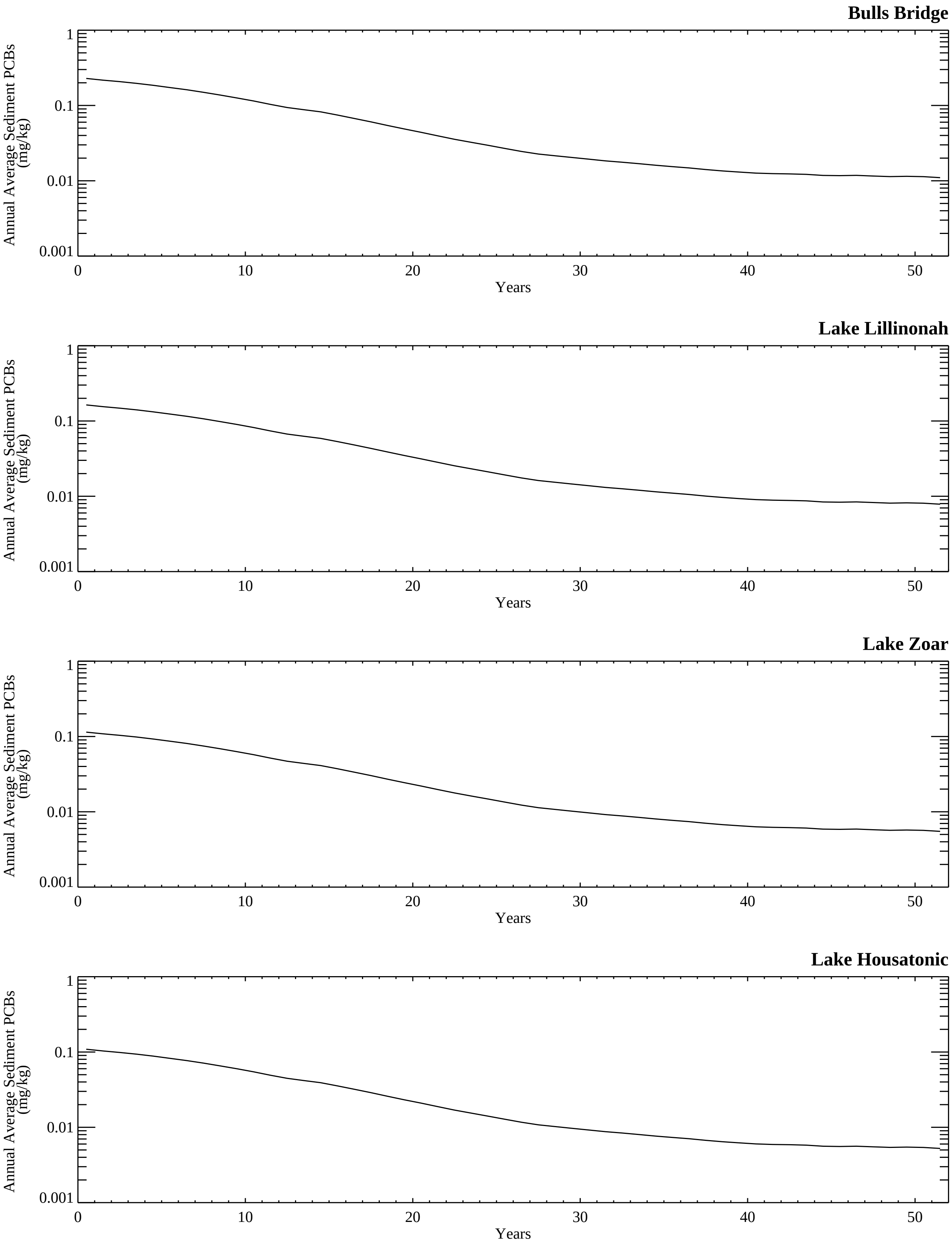

Figure G-1.6-3c. Temporal profiles of average surface sediment (0-6") PCB concentrations estimated from the CT 1-D Analysis (SED 4; CT; Lower Bound).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED04_0802-03_low_bound

SED 5; Lower Bound

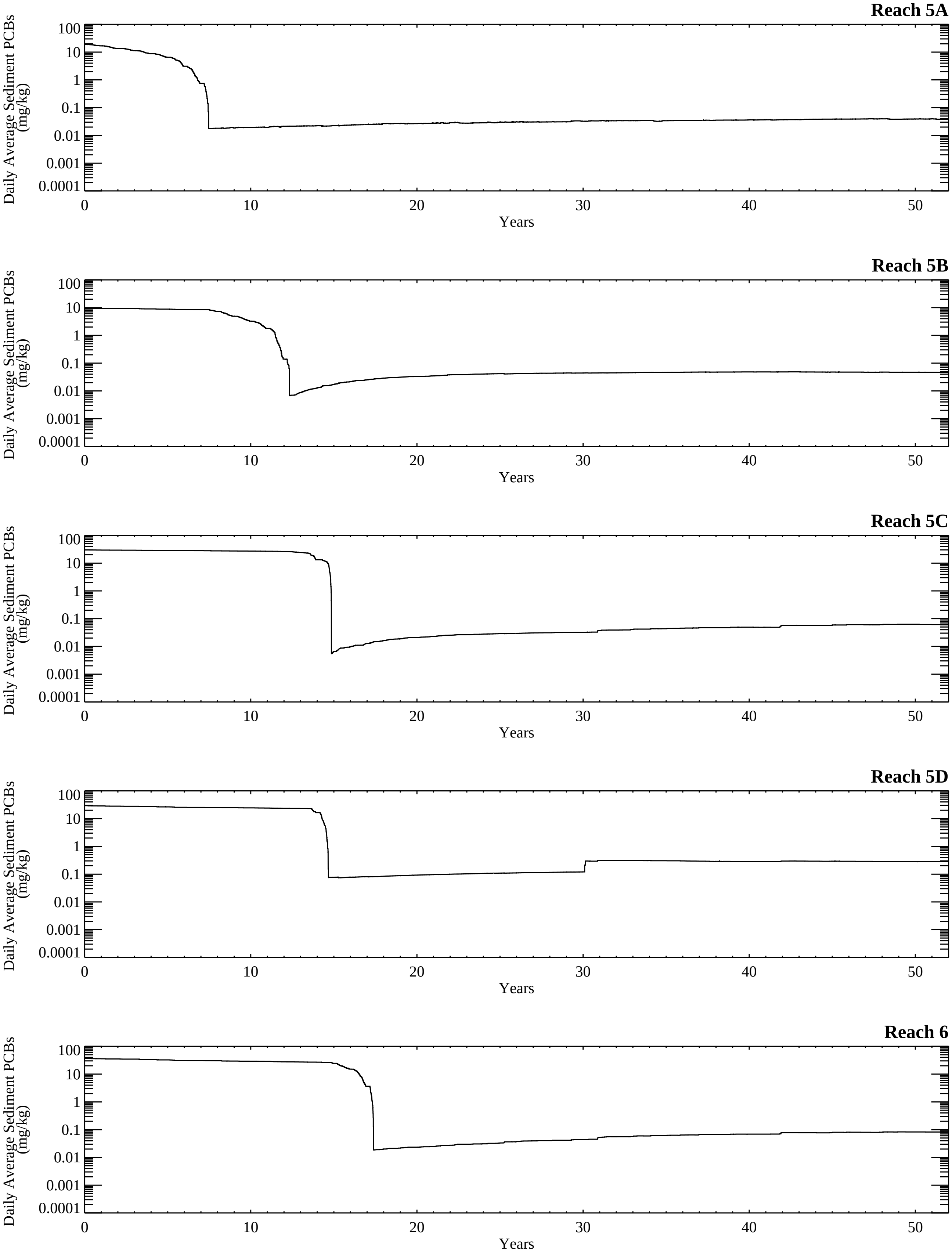

Figure G-1.6-4a. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 5; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED5CMSLB_0801-04\\bins

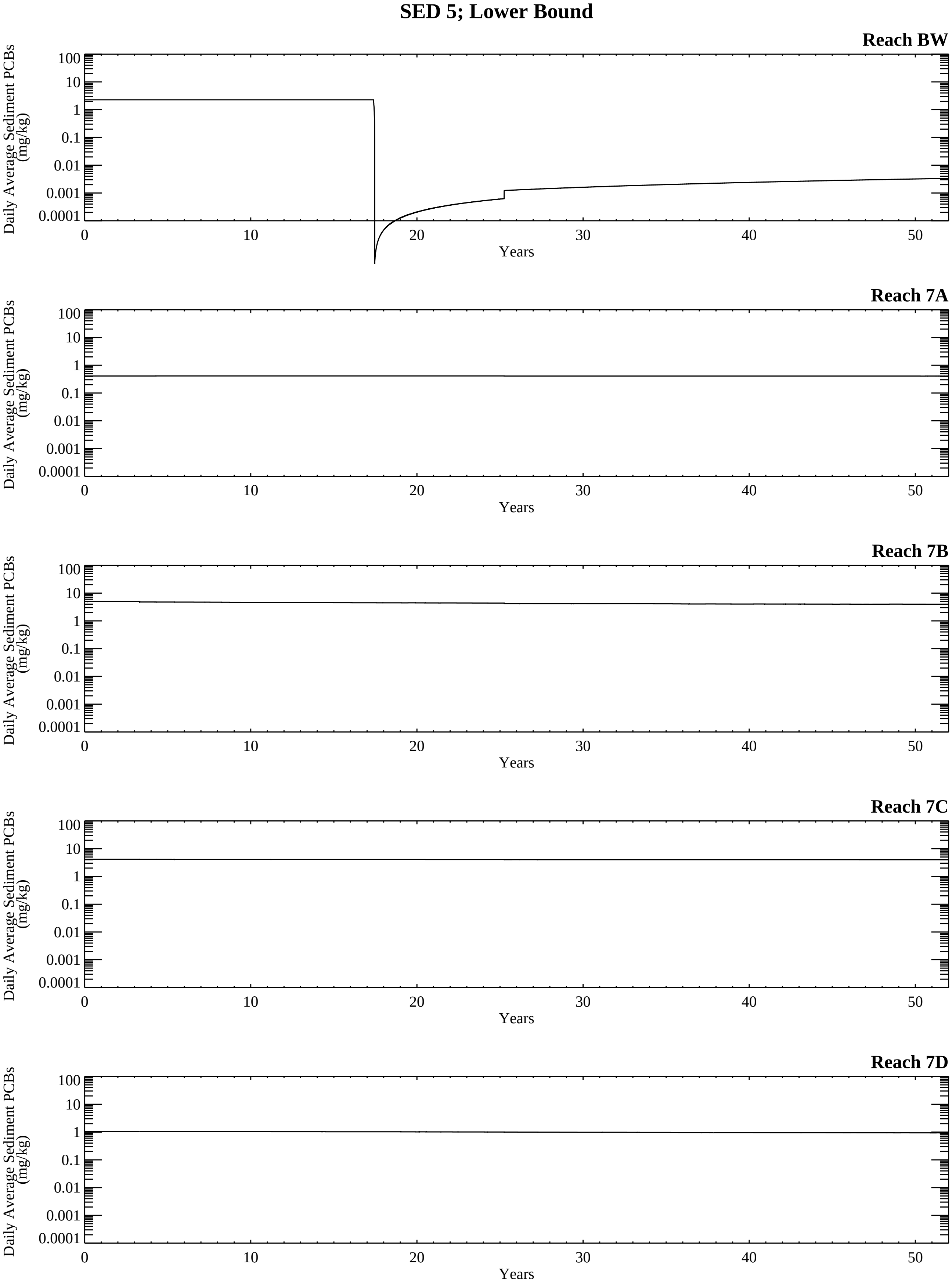

Figure G-1.6-4b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 5; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\proj_R78_SED5CMSLB_0802-04\\bins

SED 5; Lower Bound

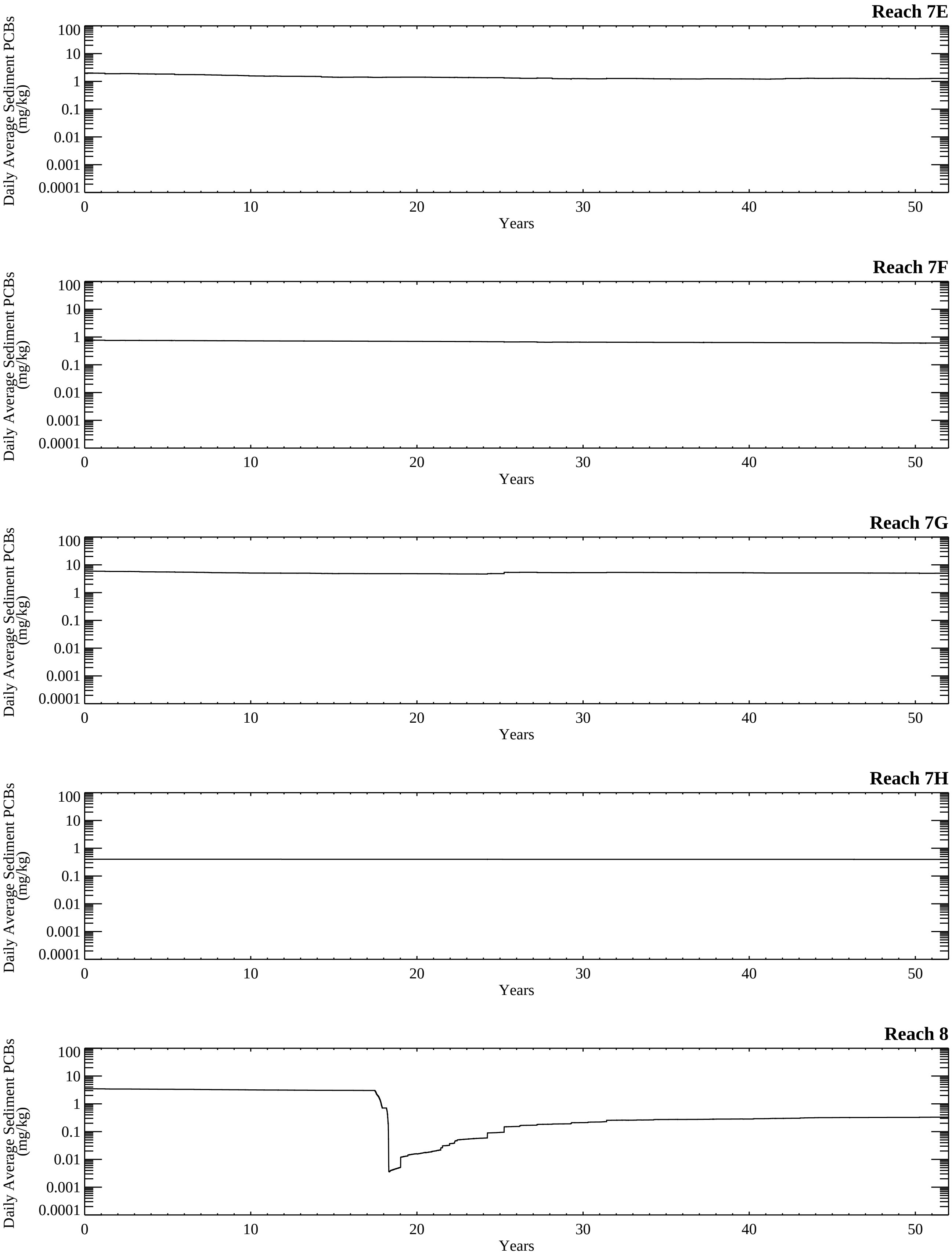

Figure G-1.6-4b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 5; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\proj_R78_SED5CMSLB_0802-04\\bins

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Wed Mar 19 11:30:35 2008

SED 5; Lower Bound

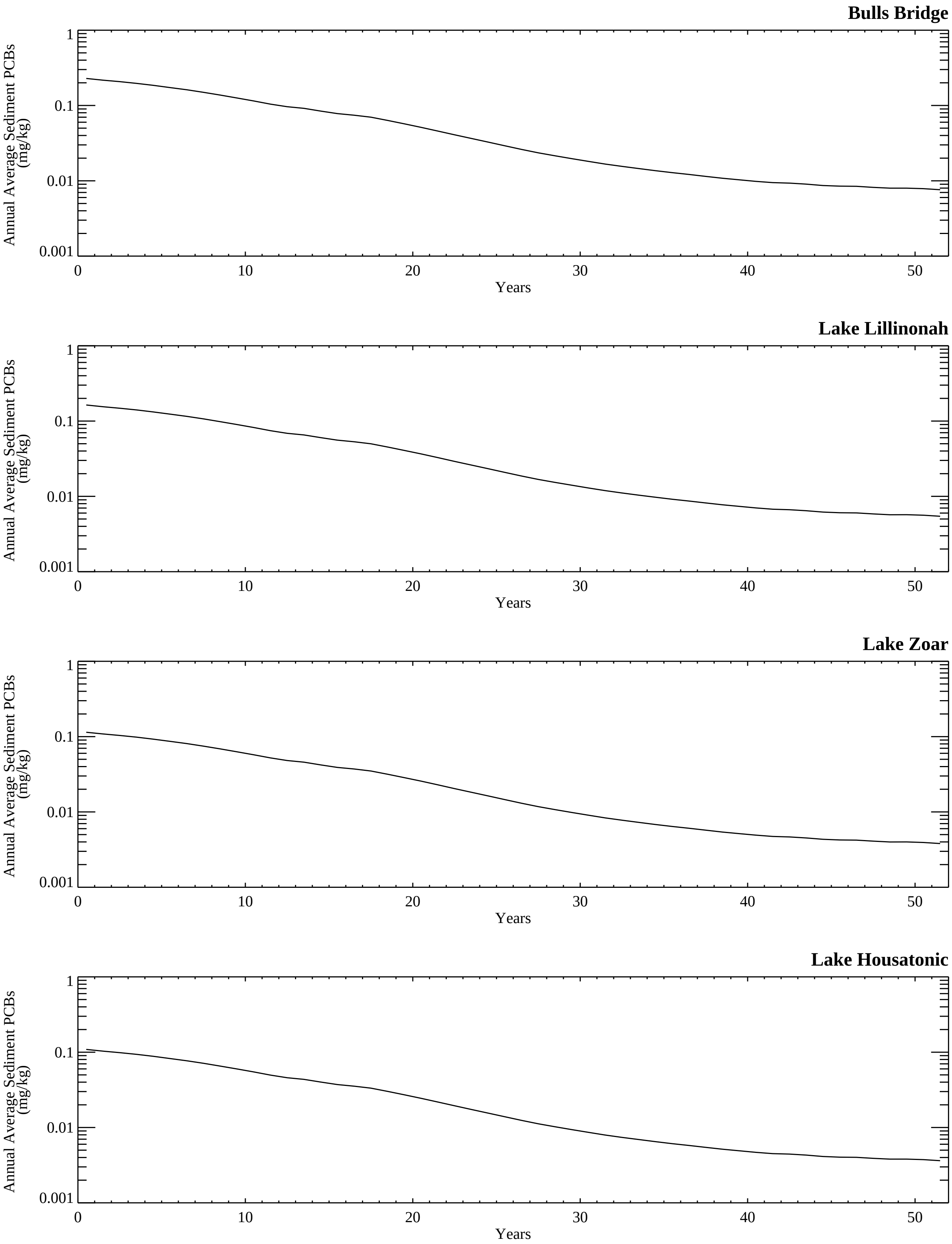

Figure G-1.6-4c. Temporal profiles of average surface sediment (0-6") PCB concentrations estimated from the CT 1-D Analysis (SED 5; CT; Lower Bound).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED05_0802-04_low_bound

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Wed Mar 19 10:58:42 2008

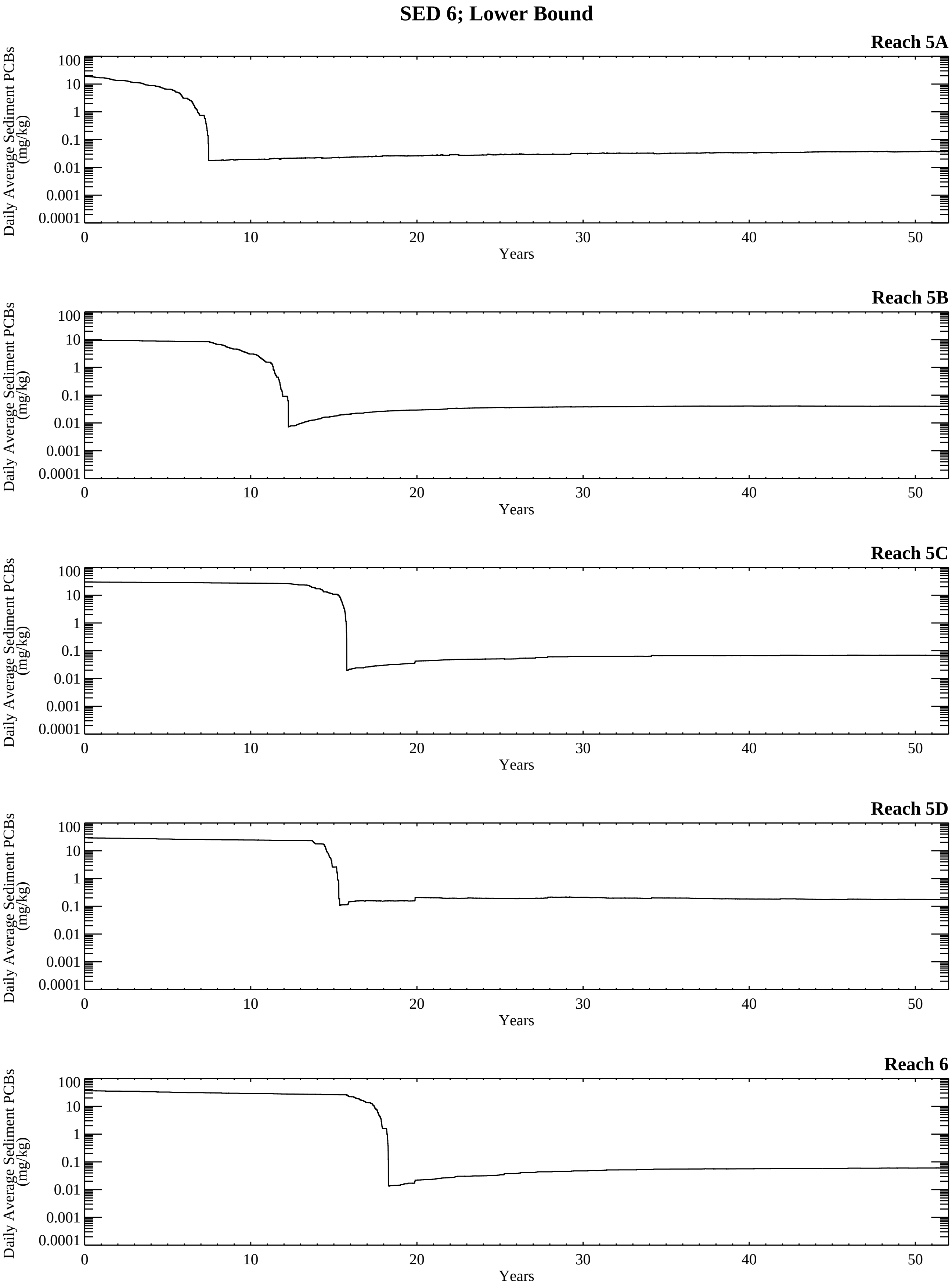

Figure G-1.6-5a. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 6; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED6CMSLB_0712-23\\bins

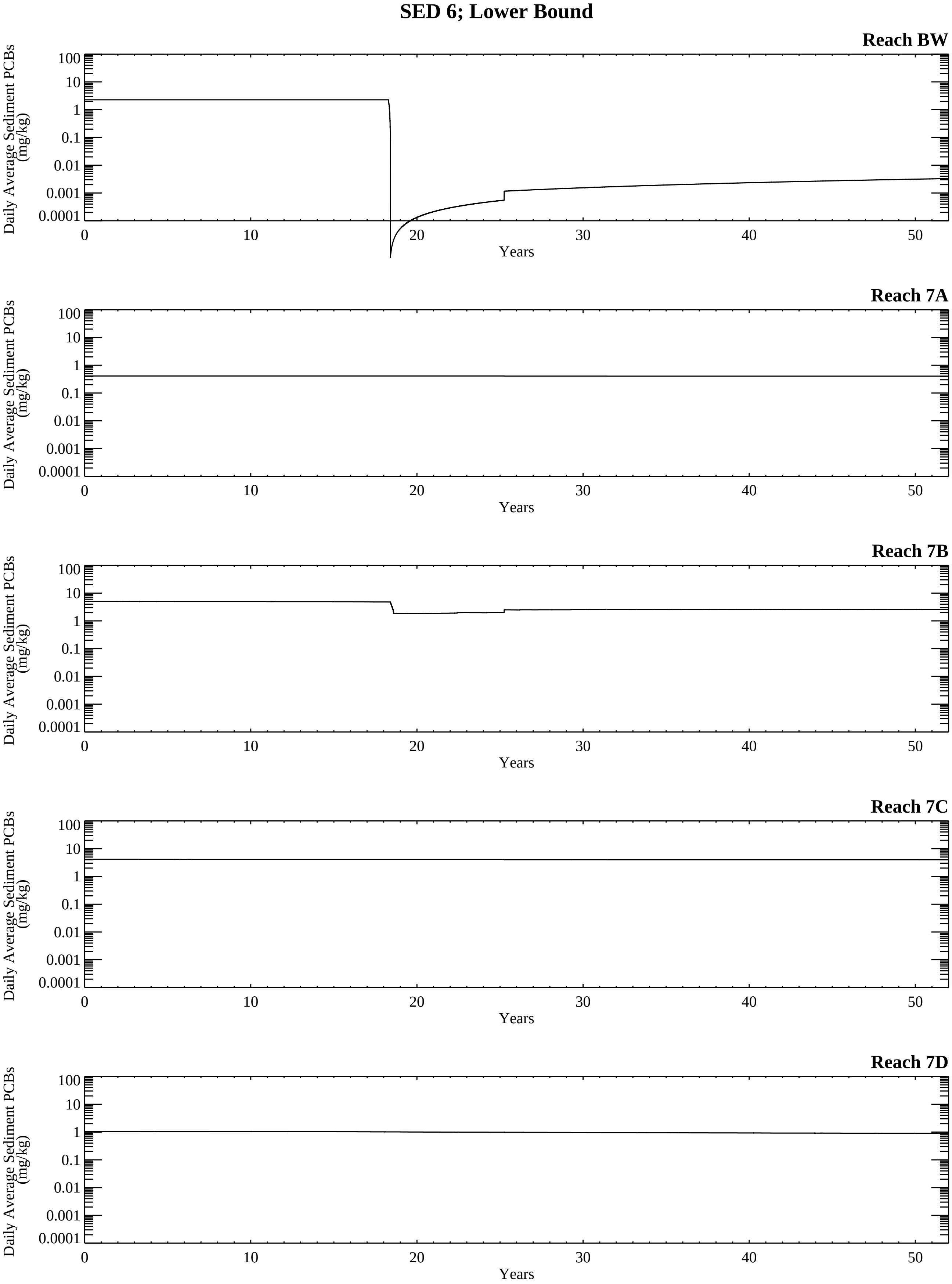

Figure G-1.6-5b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 6; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED6CMSLB_0712-39\\bins

SED 6; Lower Bound

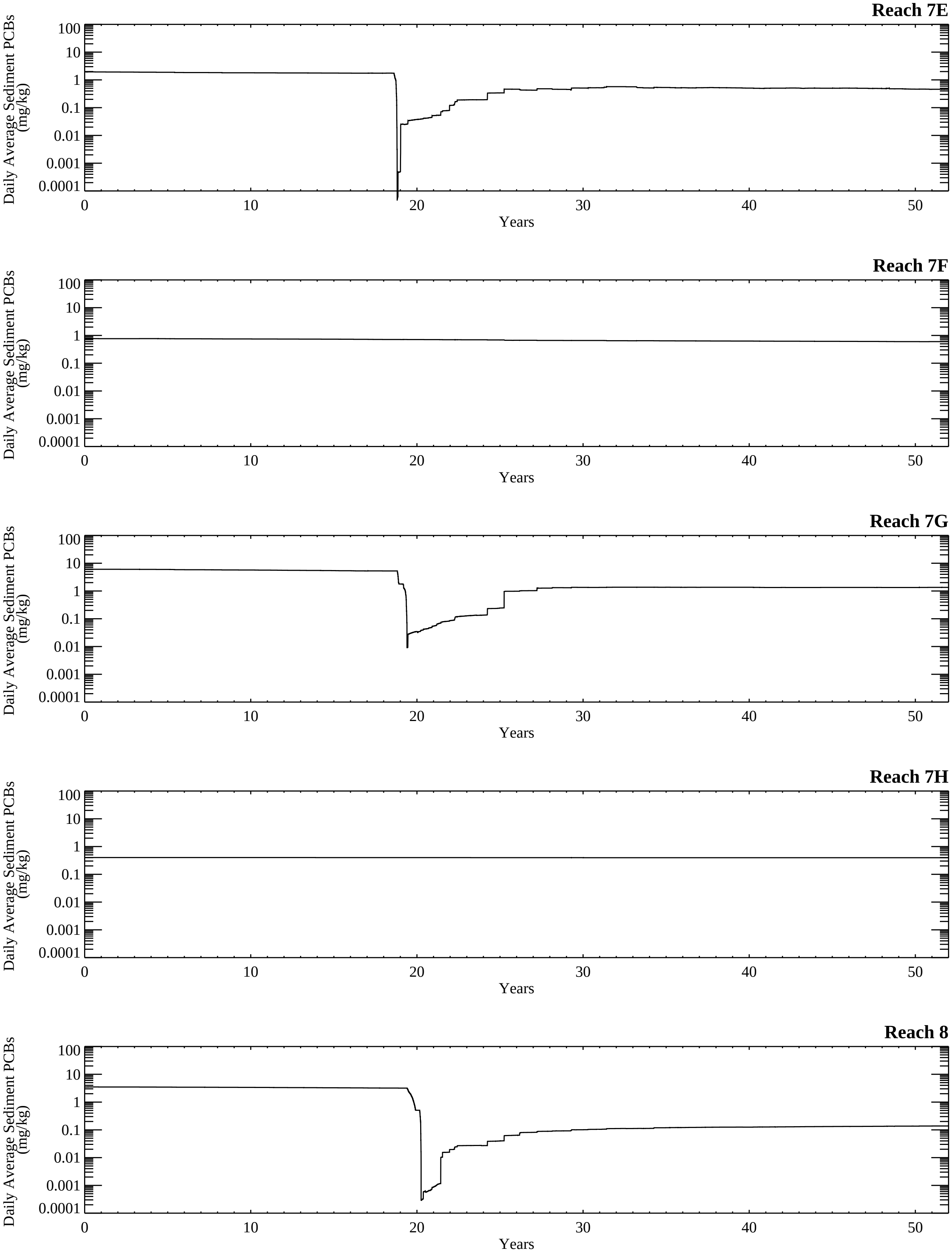

Figure G-1.6-5b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 6; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED6CMSLB_0712-39\\bins

SED 6; Lower Bound

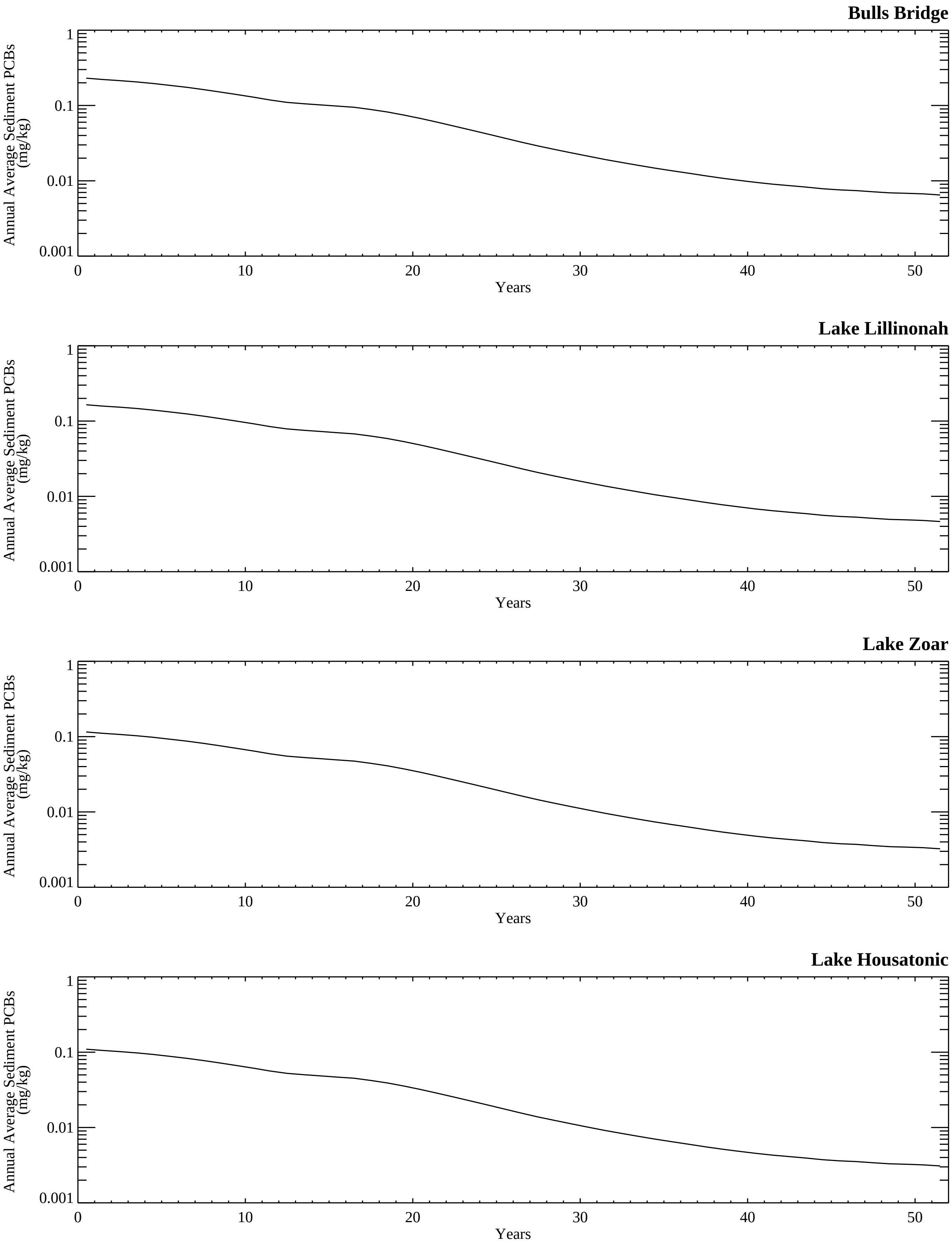

Figure G-1.6-5c. Temporal profiles of average surface sediment (0-6") PCB concentrations estimated from the CT 1-D Analysis (SED 6; CT; Lower Bound).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED06_0712-39_low_bound

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Wed Mar 19 10:58:43 2008

SED 7; Lower Bound

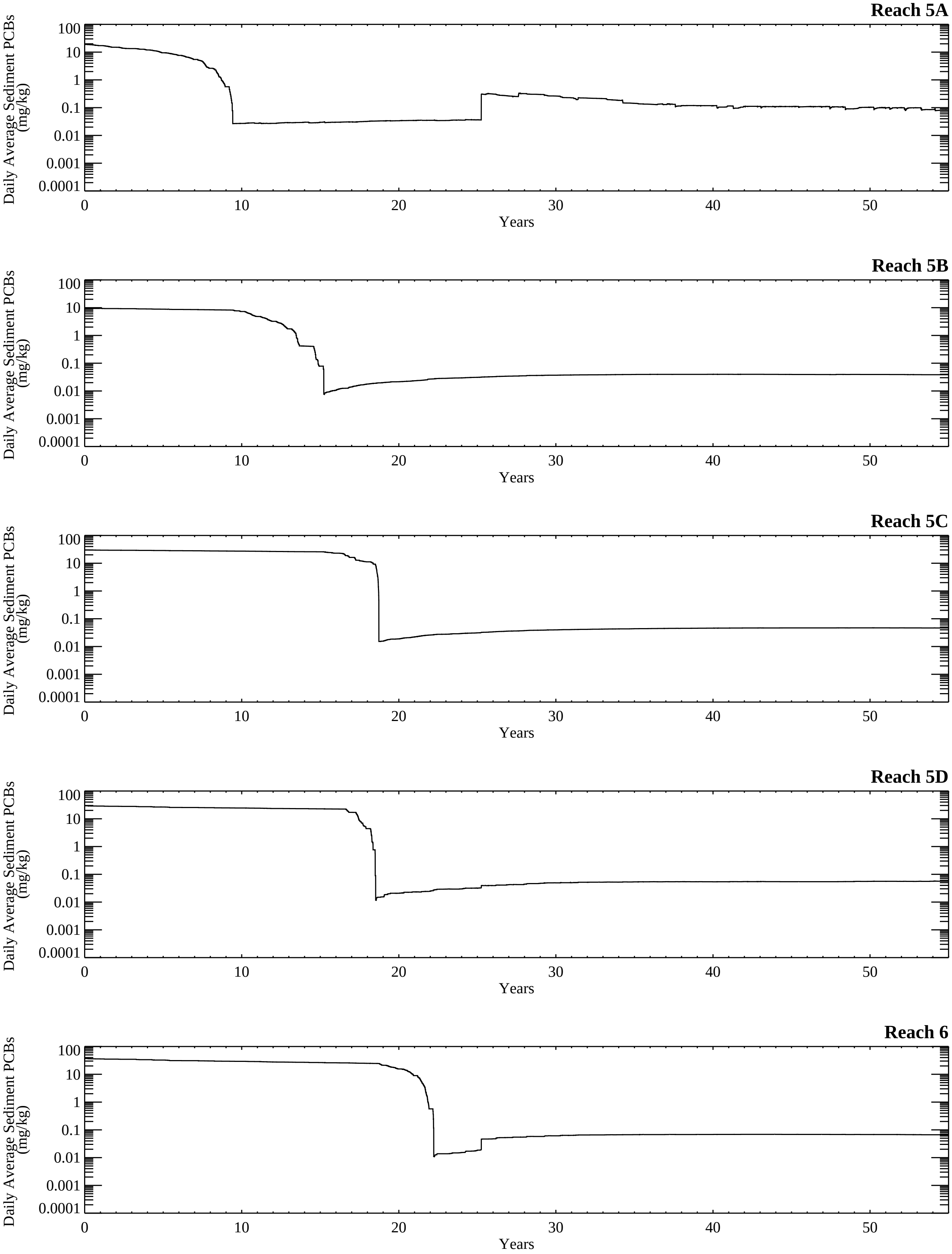

Figure G-1.6-6a. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 7; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED7CMSLB_0712-24\\bins

SED 7; Lower Bound

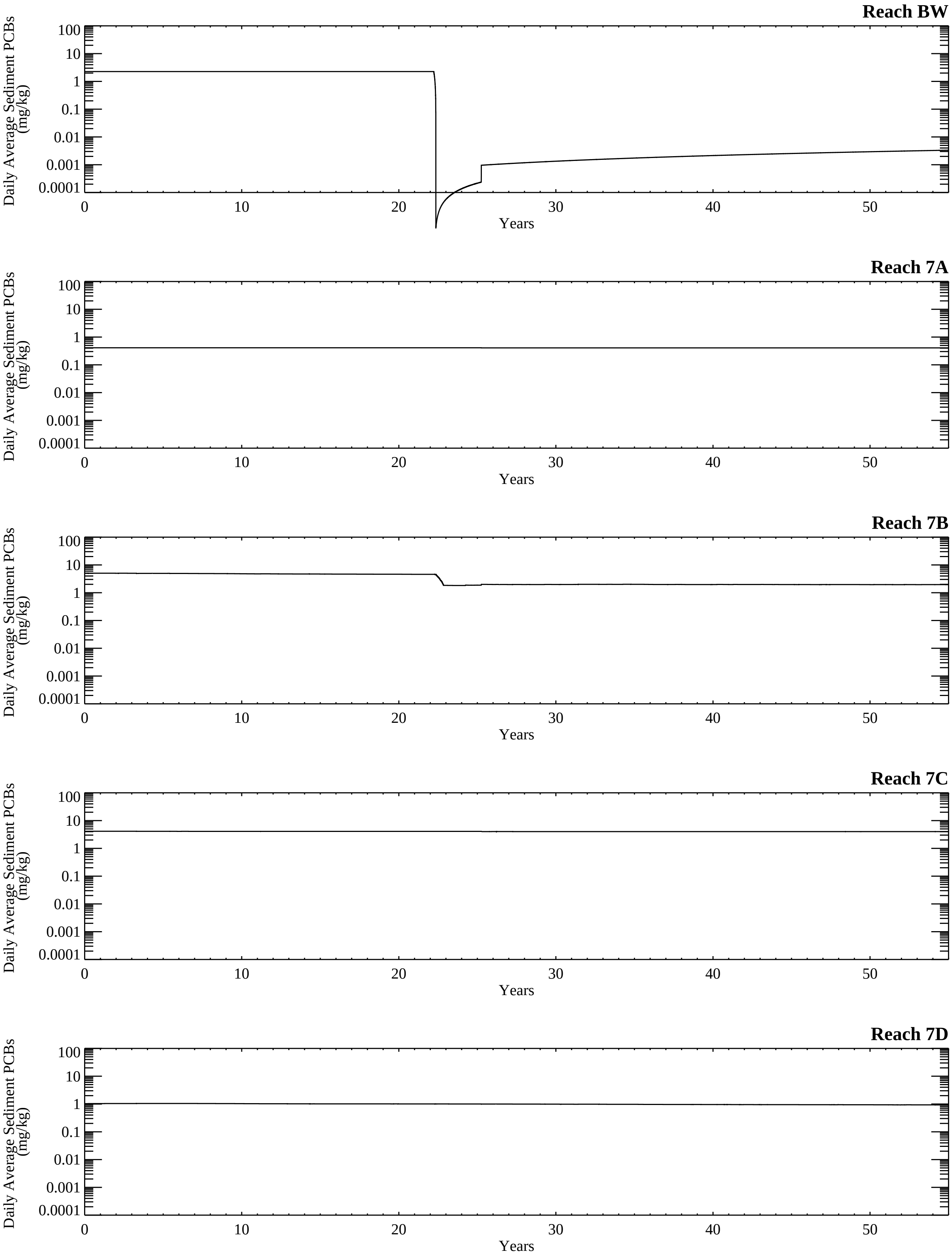

Figure G-1.6-6b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 7; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED7CMSLB_0712-40\\bins

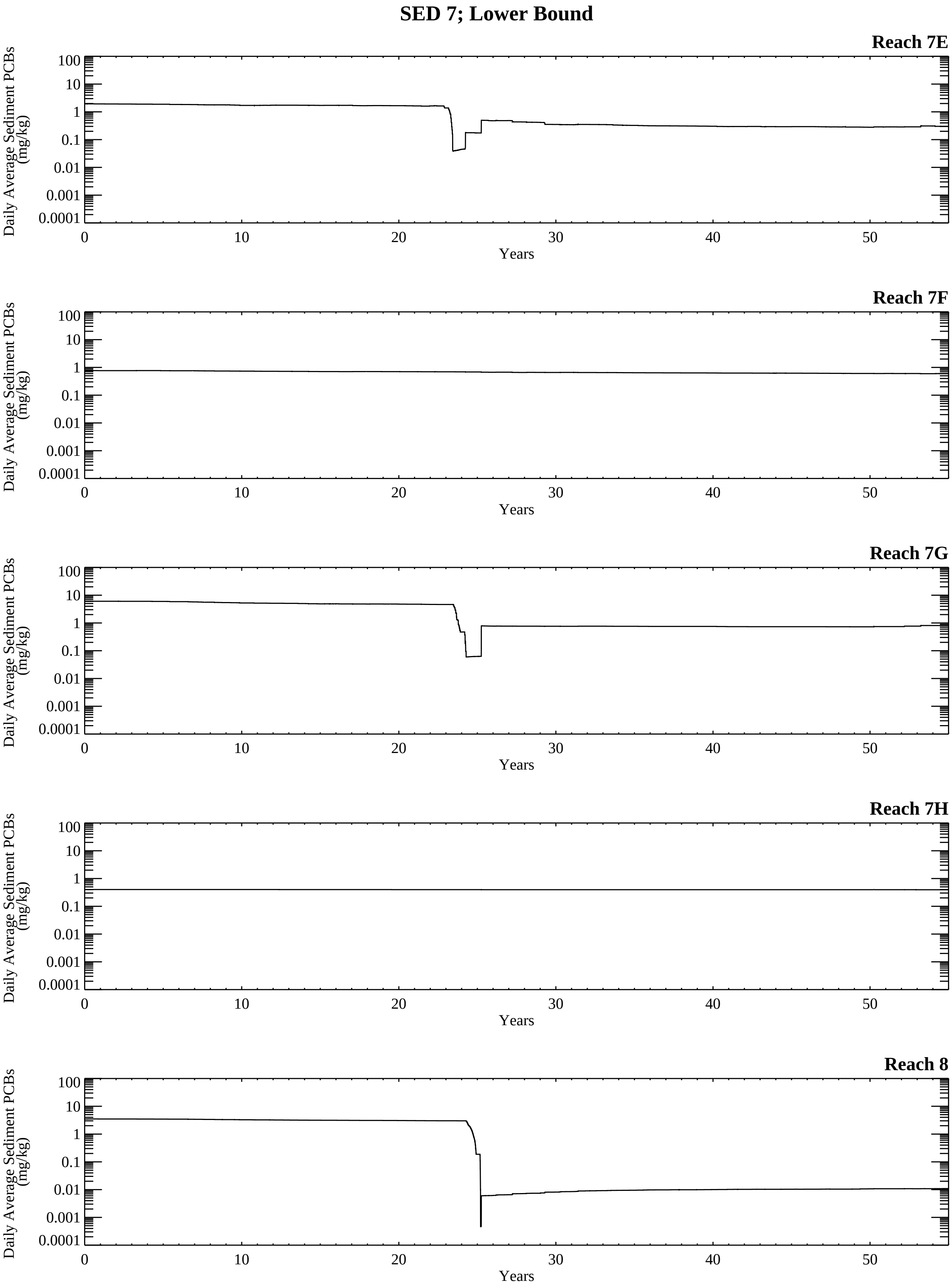

Figure G-1.6-6b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 7; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED7CMSLB_0712-40\\bins

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Wed Mar 19 11:32:38 2008

SED 7; Lower Bound

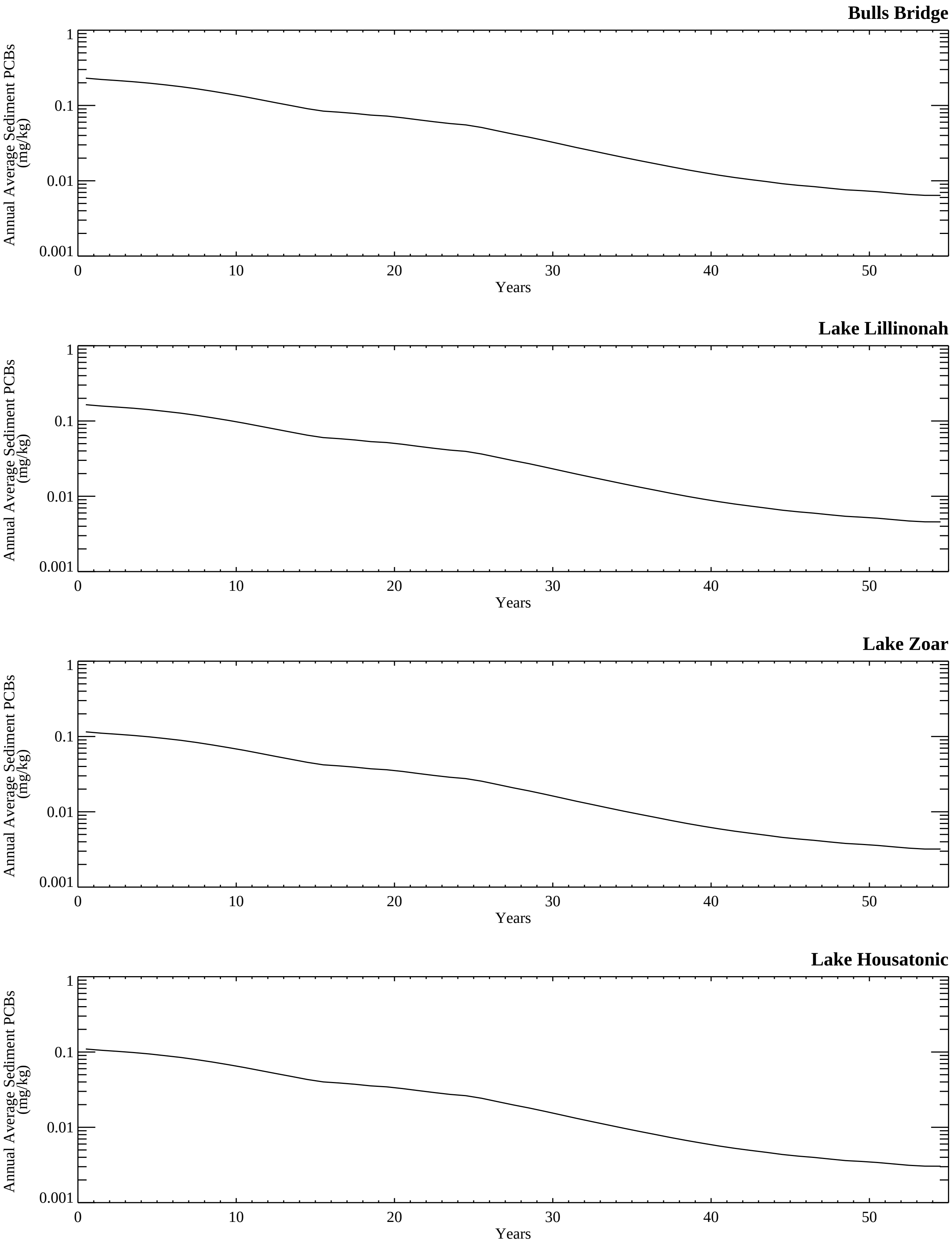

Figure G-1.6-6c. Temporal profiles of average surface sediment (0-6") PCB concentrations estimated from the CT 1-D Analysis (SED 7; CT; Lower Bound).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED07_0712-40_low_bound

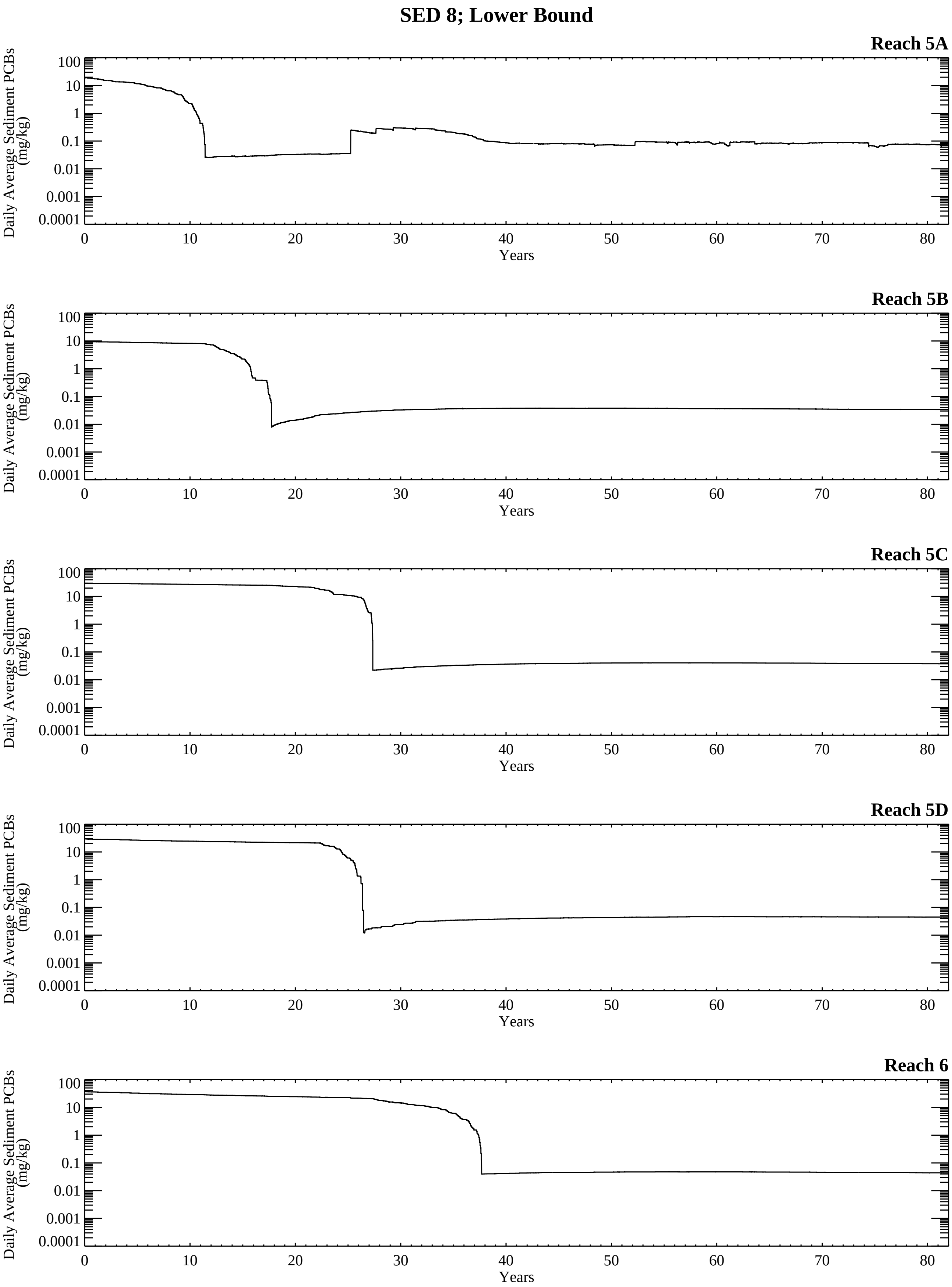

Figure G-1.6-7a. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 8; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED8CMSLB_0712-25\\bins

SED 8; Lower Bound

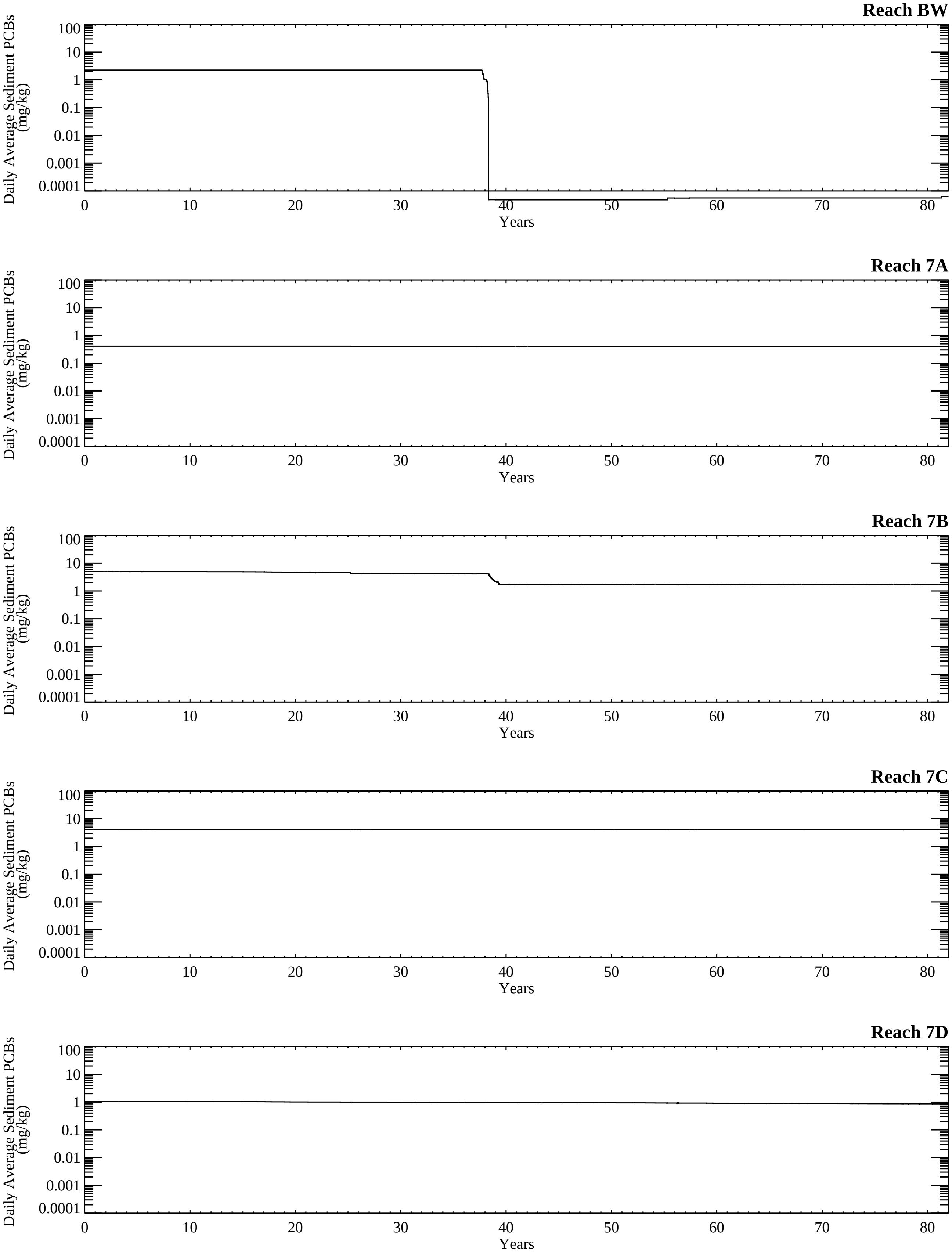

Figure G-1.6-7b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 8; Reach 7/8; Lower Bound).

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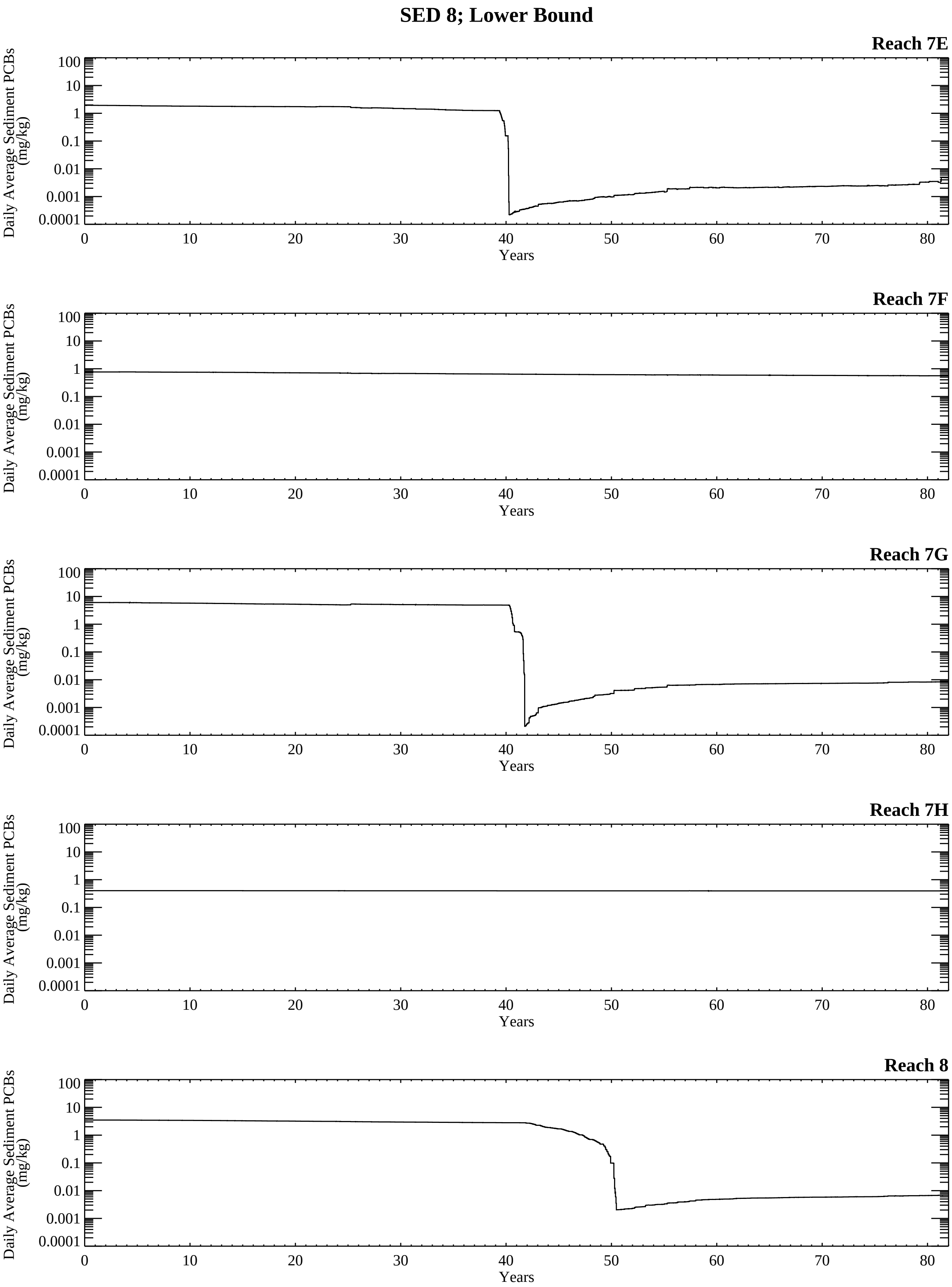

Figure G-1.6-7b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (SED 8; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED8CMSLB_0712-41\\bins

SED 8; Lower Bound

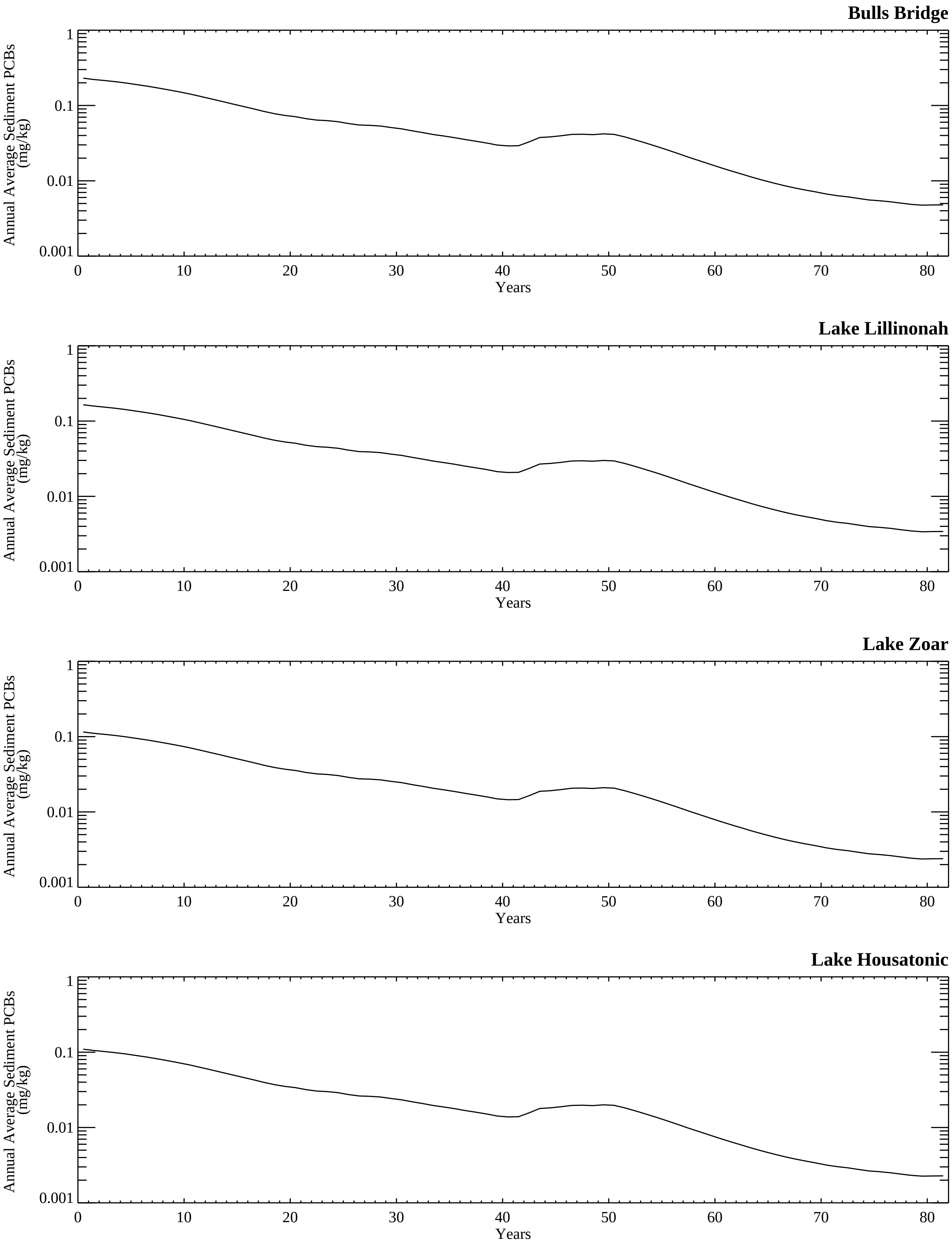

Figure G-1.6-7c. Temporal profiles of average surface sediment (0-6") PCB concentrations estimated from the CT 1-D Analysis (SED 8; CT; Lower Bound).

Run path: Z:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED08_0712-41_low_bound

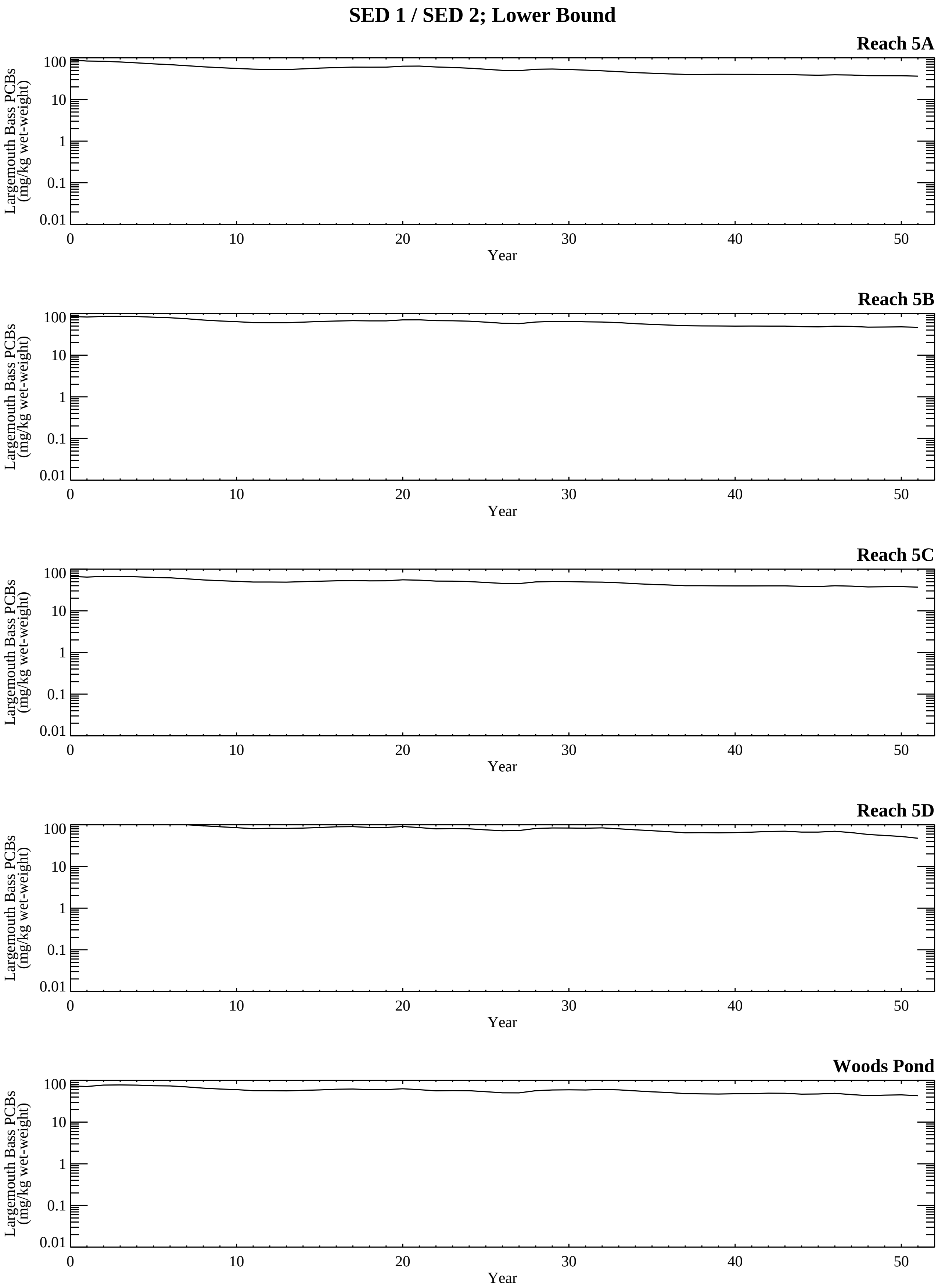

Figure G-1.7-1a. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 1 / SED 2; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

DR - Z:\GENcms\MODEL\FDCHN\Analysis\Time_Series\Programs\Projection\CMS_Alternatives\NewCode\cms_alternatives_one_sed_plot.pro
Mon Mar 17 20:52:54 2008

SED 1 / SED 2; Lower Bound

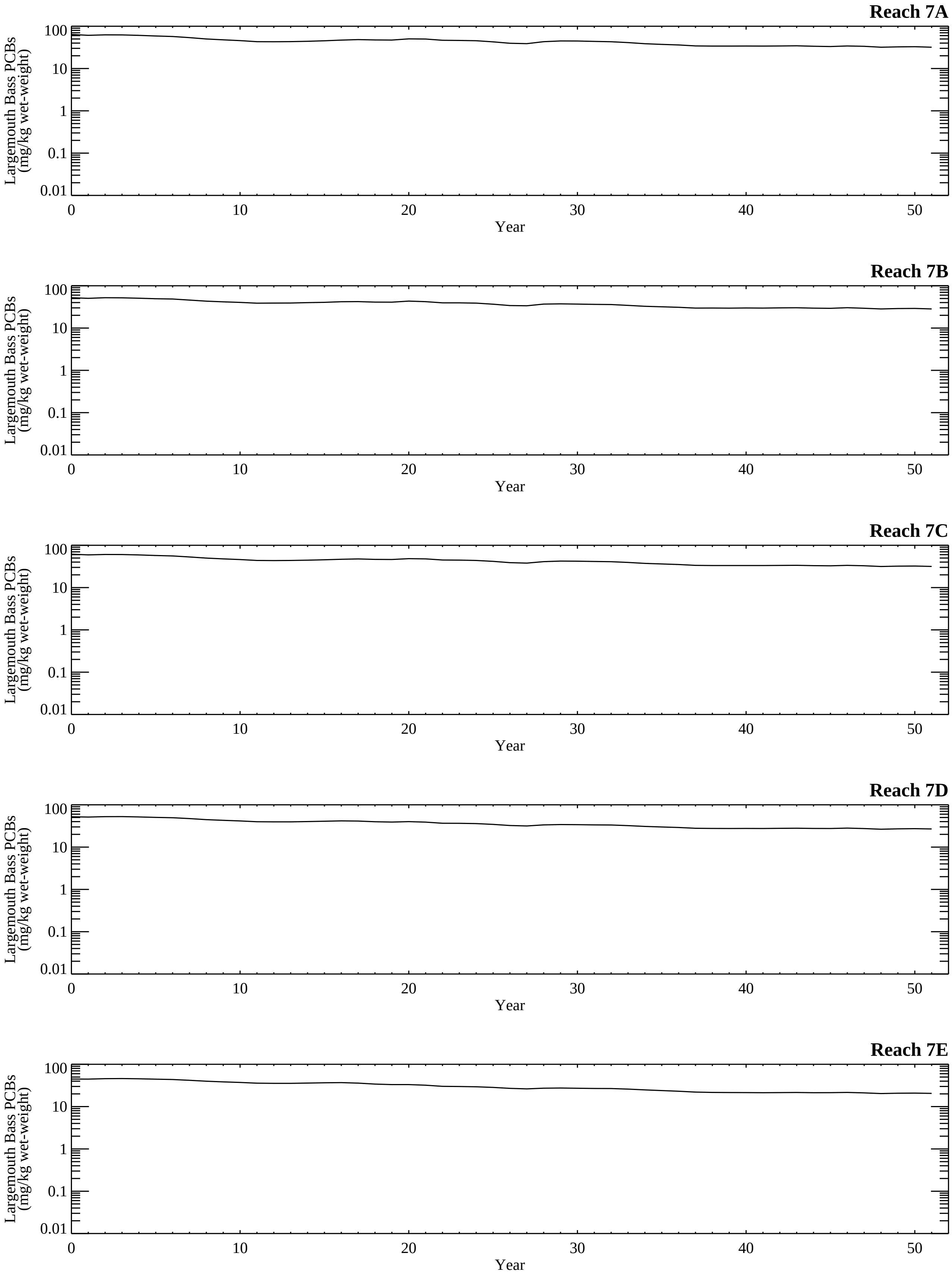

Figure G-1.7-1b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 1 / SED 2; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

DR - Z:\GENcms\MODEL\FDCHN\Analysis\Time_Series\Programs\Projection\CMS_Alternatives\NewCode\cms_alternatives_one_sed_plot.pro
Mon Mar 17 21:24:27 2008

SED 1 / SED 2; Lower Bound

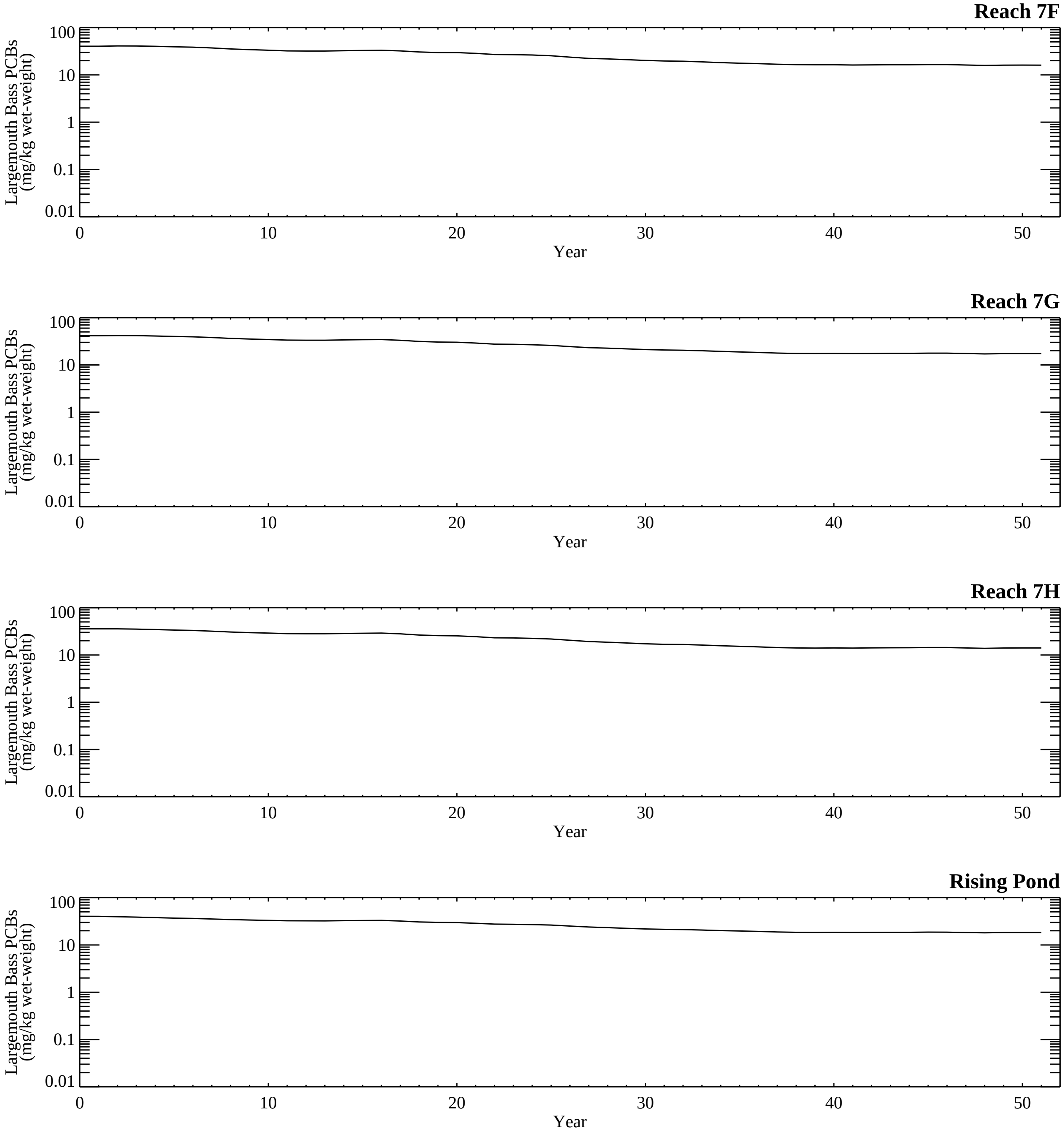

Figure G-1.7-1b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 1 / SED 2; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

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Mon Mar 17 21:26:18 2008

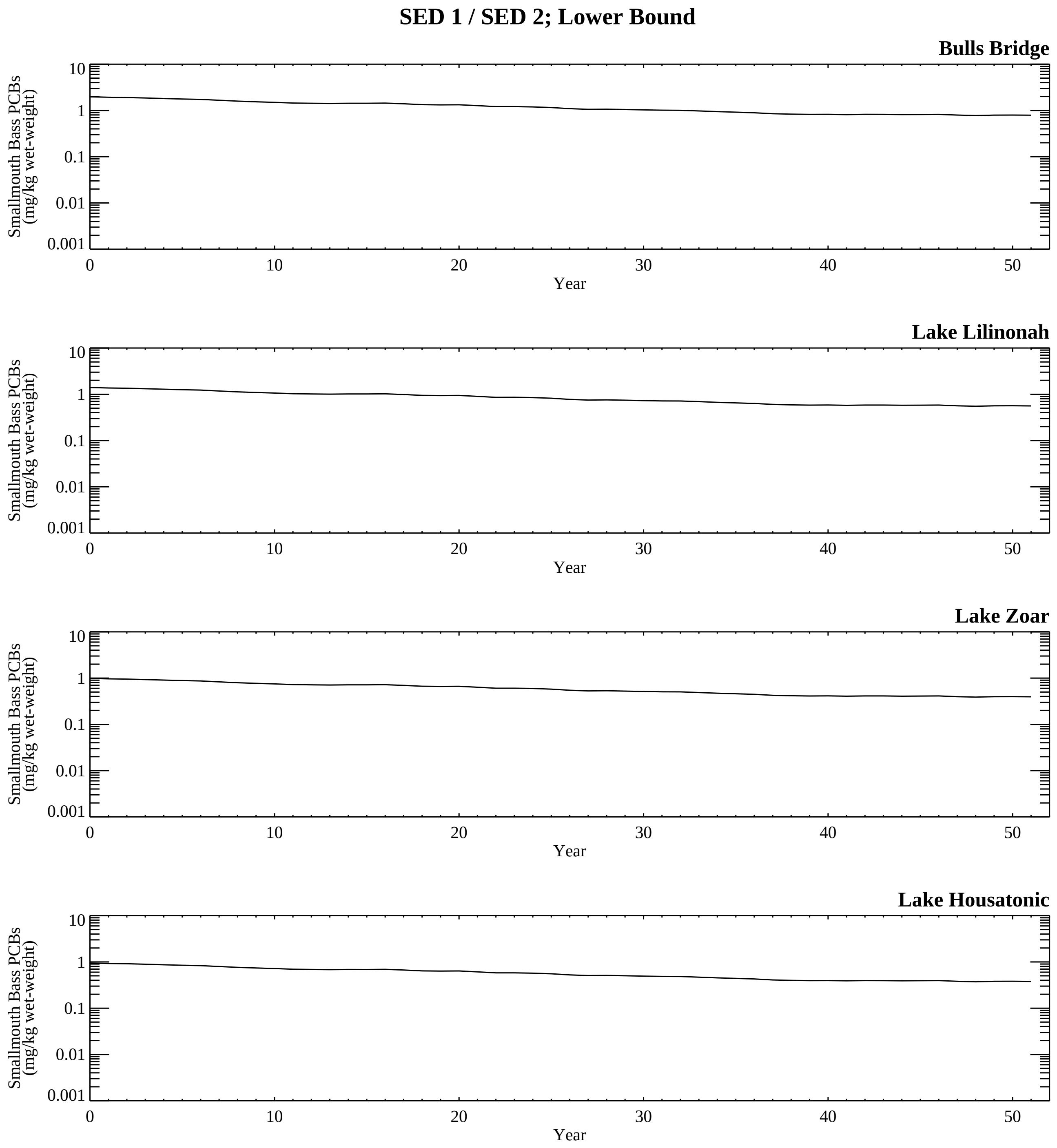

Figure G-1.7-1c. Temporal profiles of PCB concentrations in whole body smallmouth bass (SED 1 / SED 2; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

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Mon Mar 17 22:14:11 2008

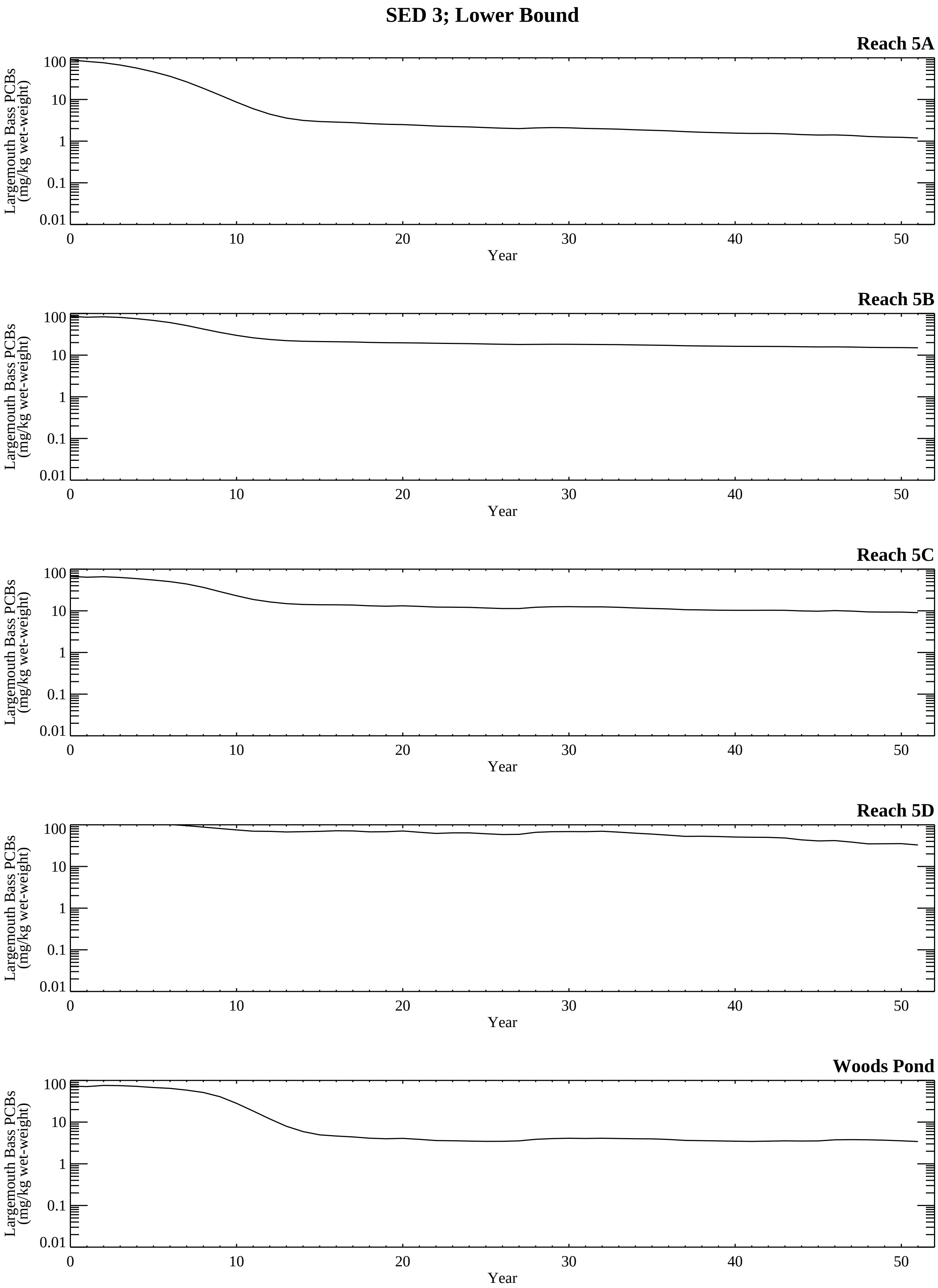


Figure G-1.7-2a. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 3; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

SED 3; Lower Bound

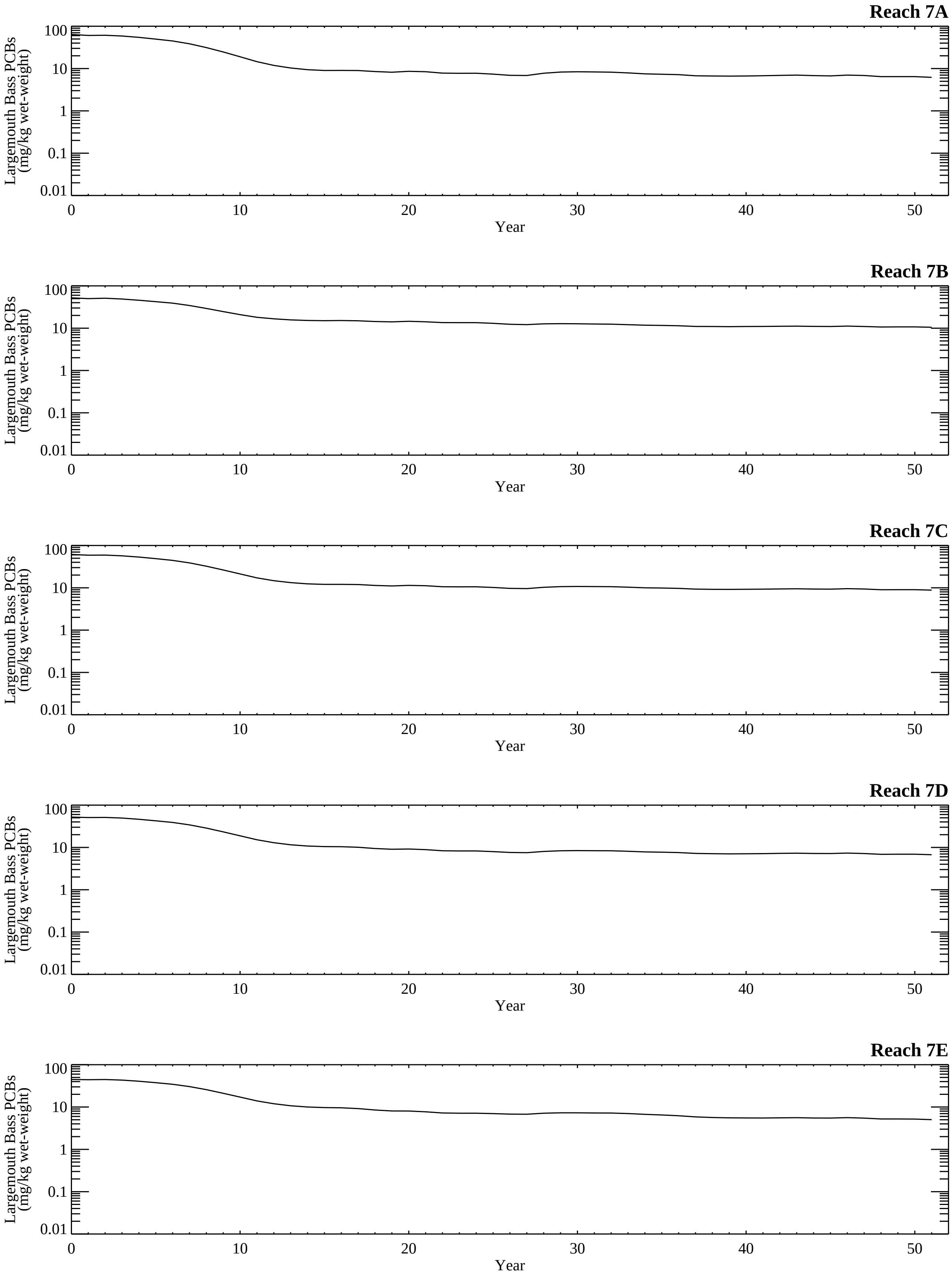
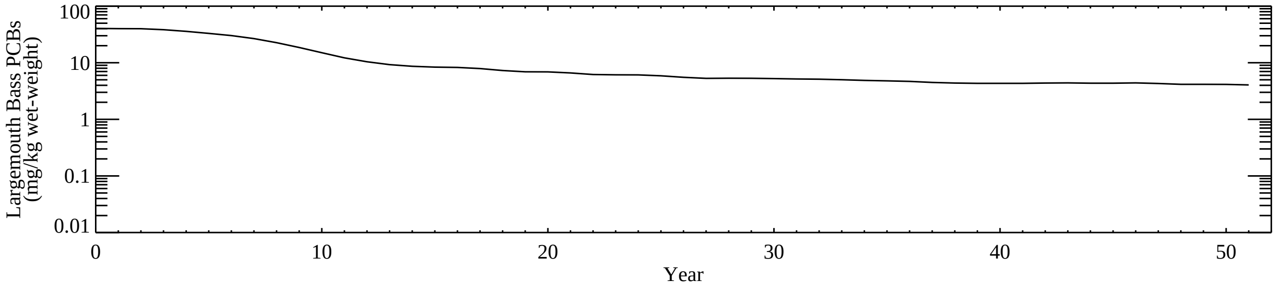


Figure G-1.7-2b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 3; Reach 7/8; Lower Bound).

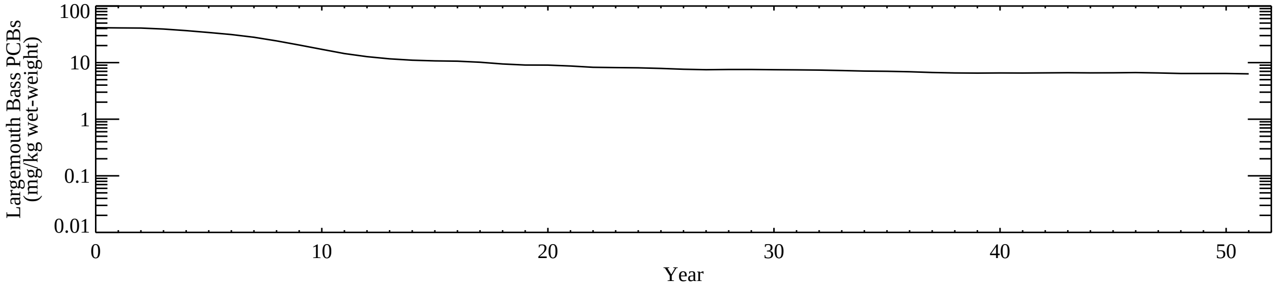
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

SED 3; Lower Bound

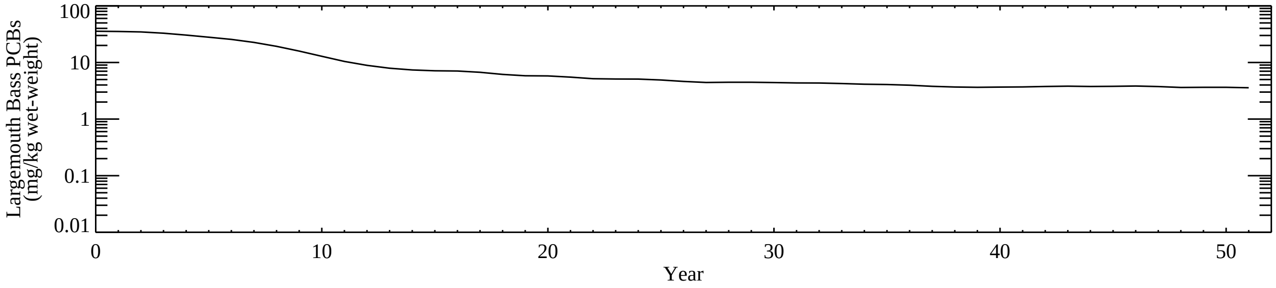
Reach 7F



Reach 7G



Reach 7H



Rising Pond

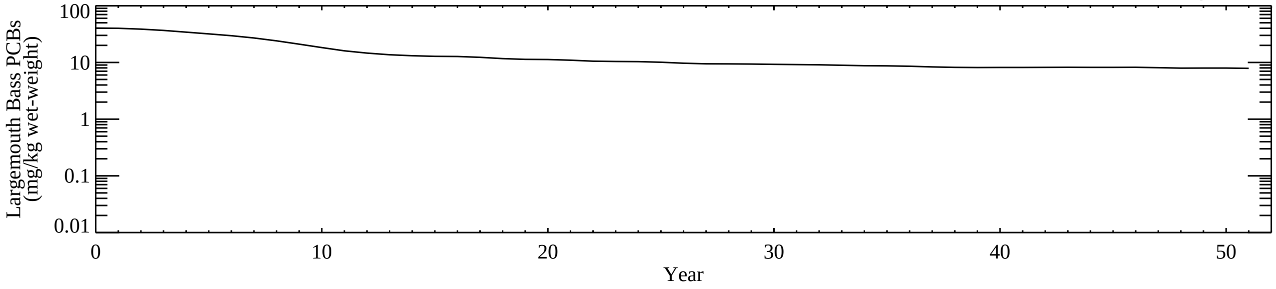


Figure G-1.7-2b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 3; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

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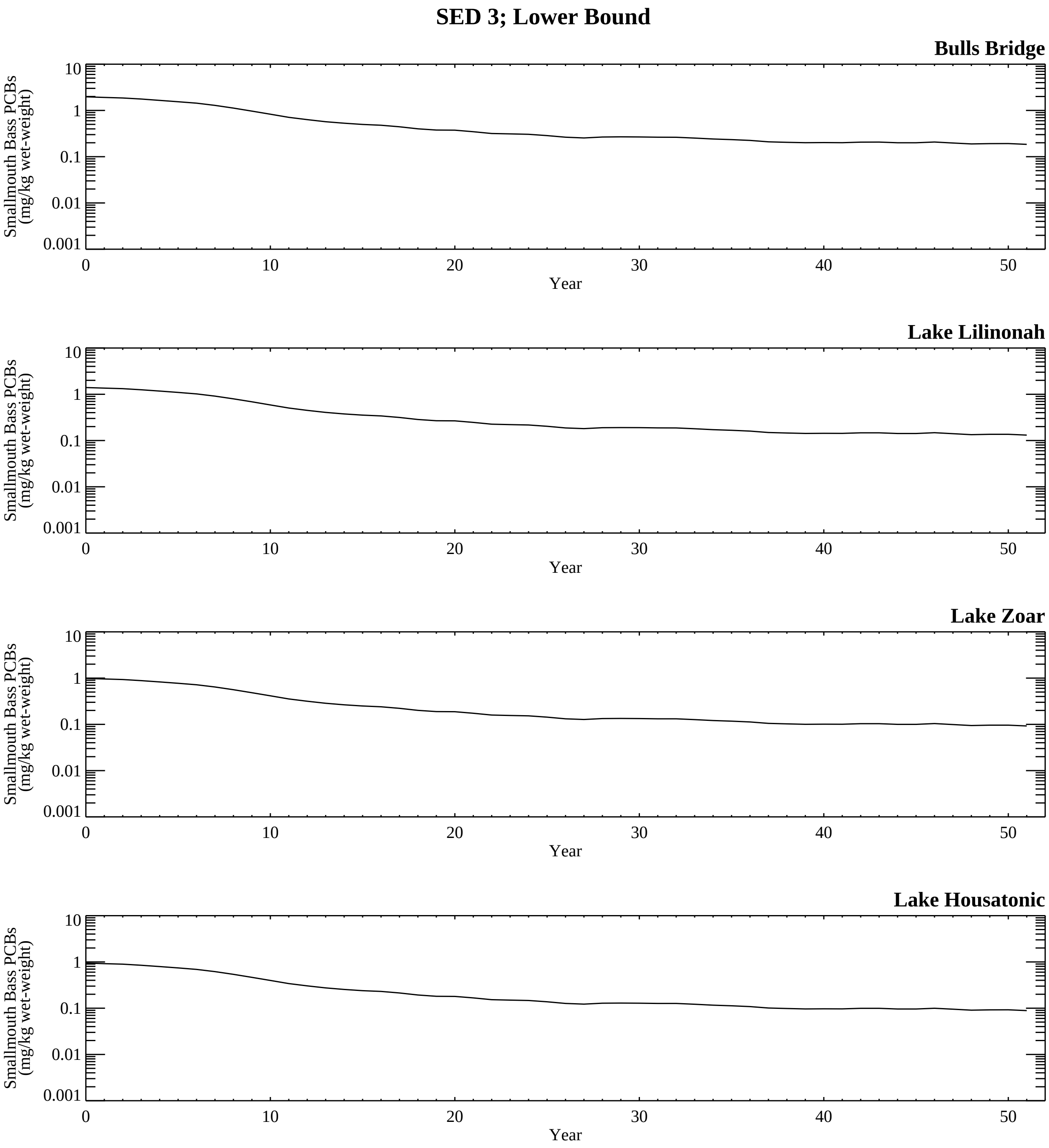

Figure G-1.7-2c. Temporal profiles of PCB concentrations in whole body smallmouth bass (SED 3; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

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Mon Mar 17 22:15:39 2008

SED 4; Lower Bound

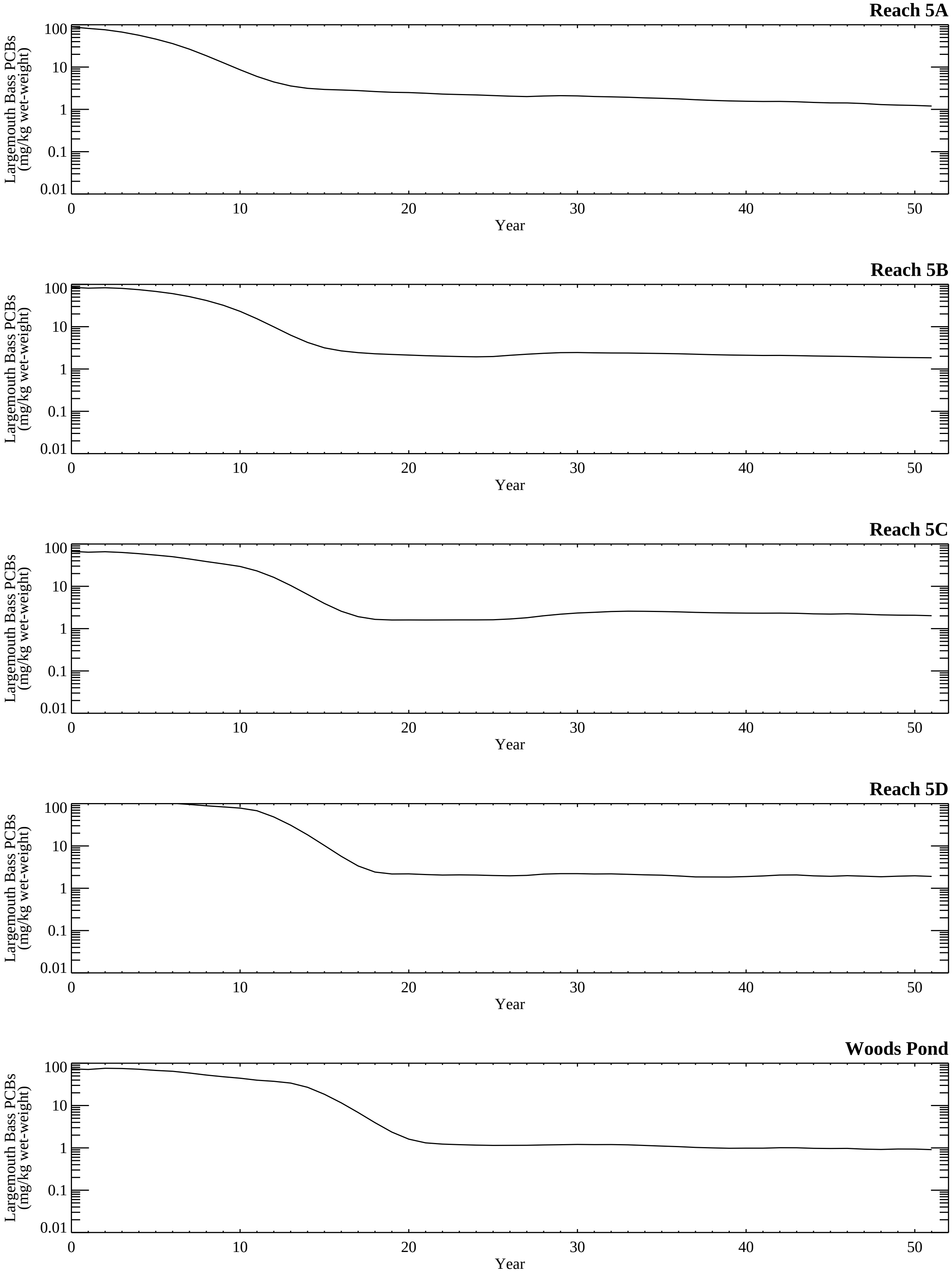

Figure G-1.7-3a. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 4; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

SED 4; Lower Bound

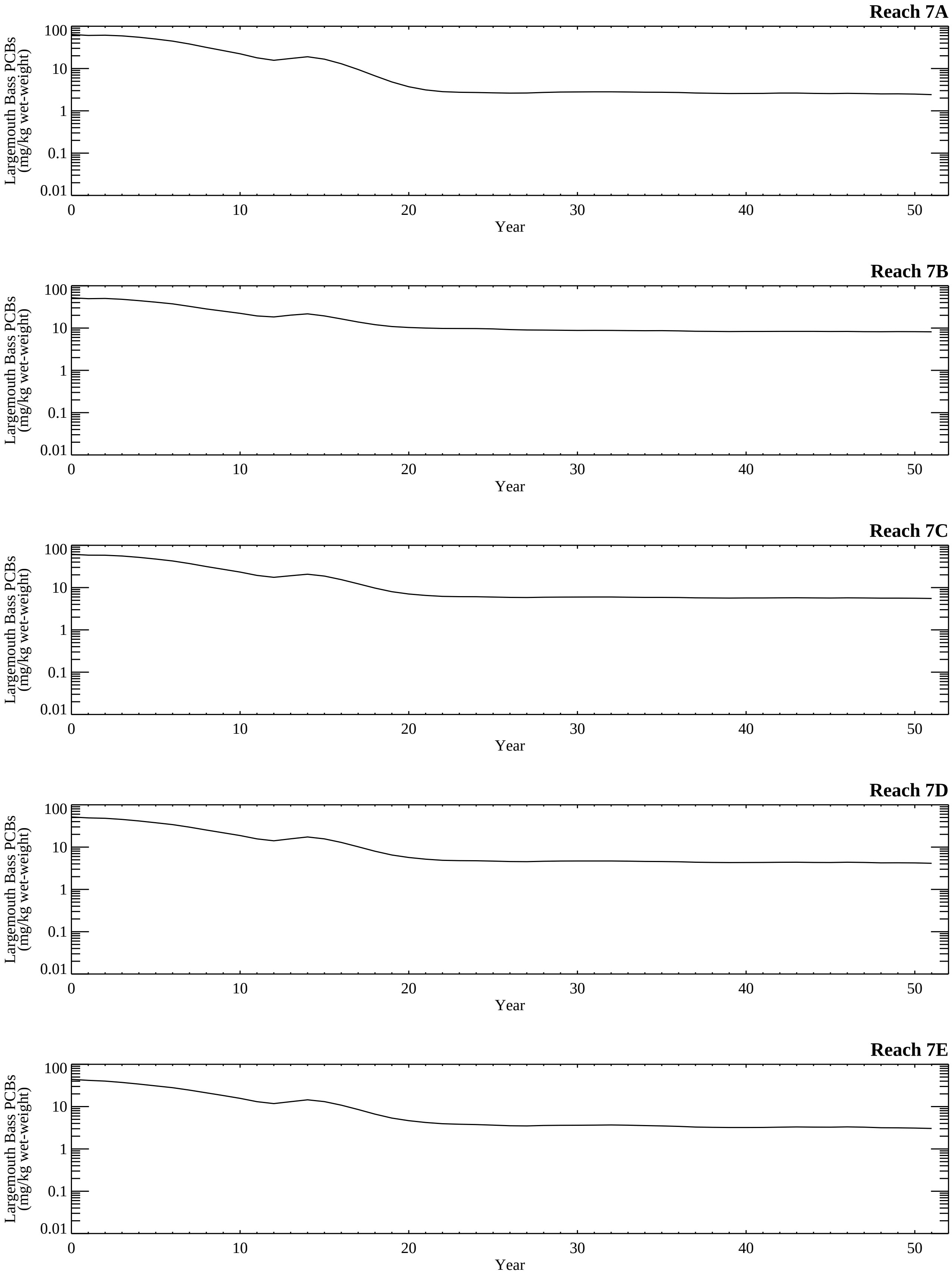

Figure G-1.7-3b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 4; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

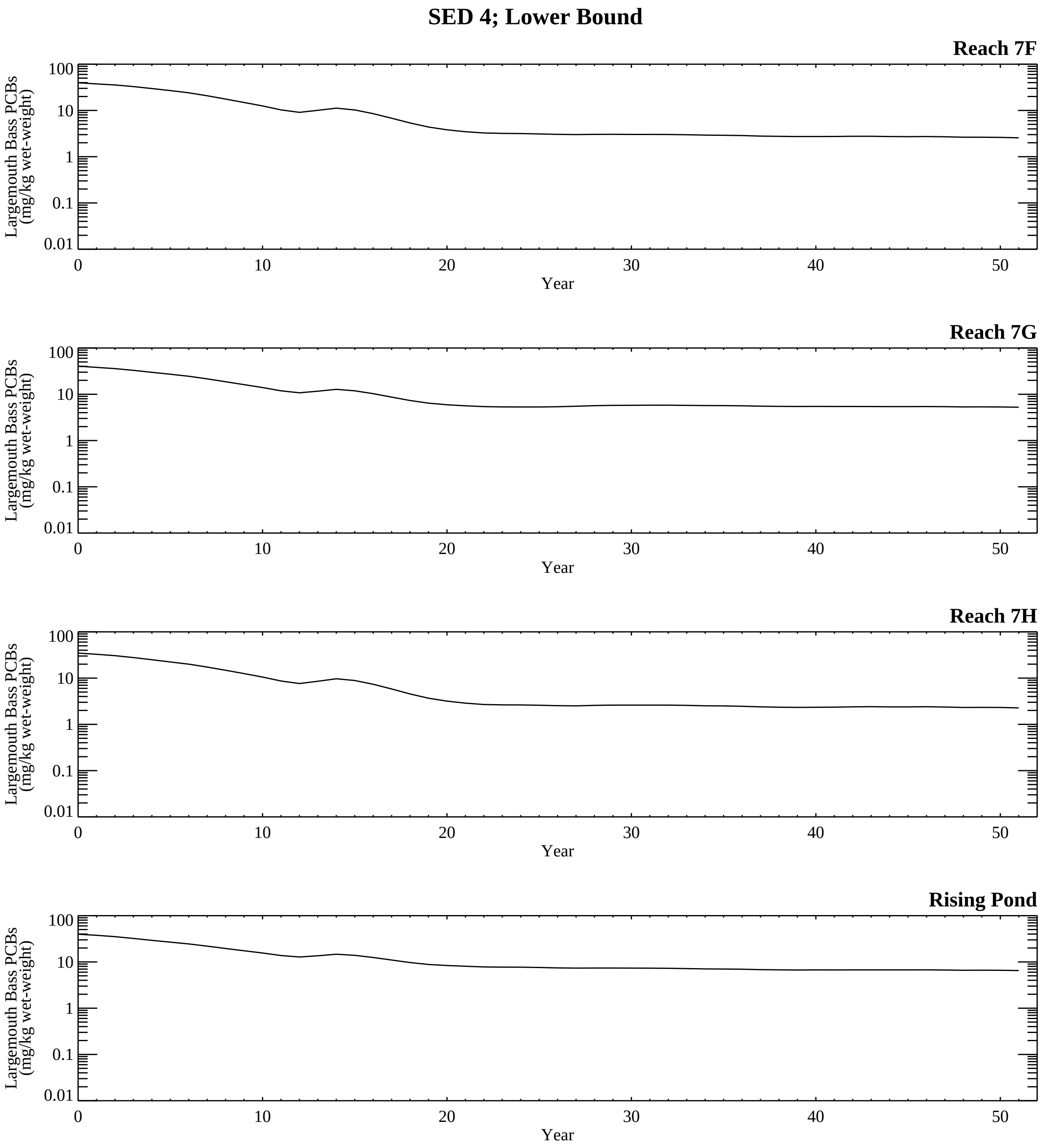

Figure G-1.7-3b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 4; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

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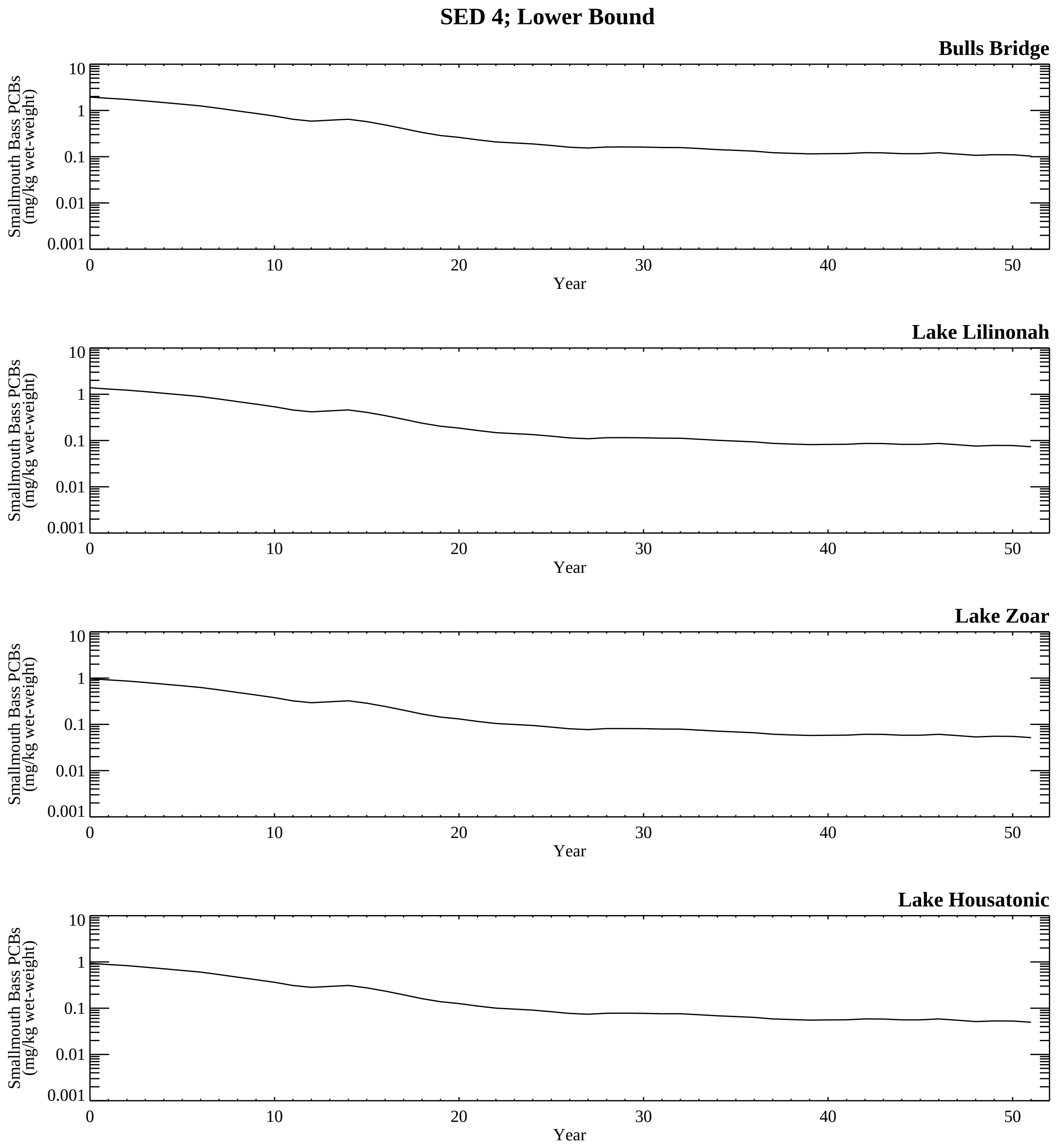

Figure G-1.7-3c. Temporal profiles of PCB concentrations in whole body smallmouth bass (SED 4; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

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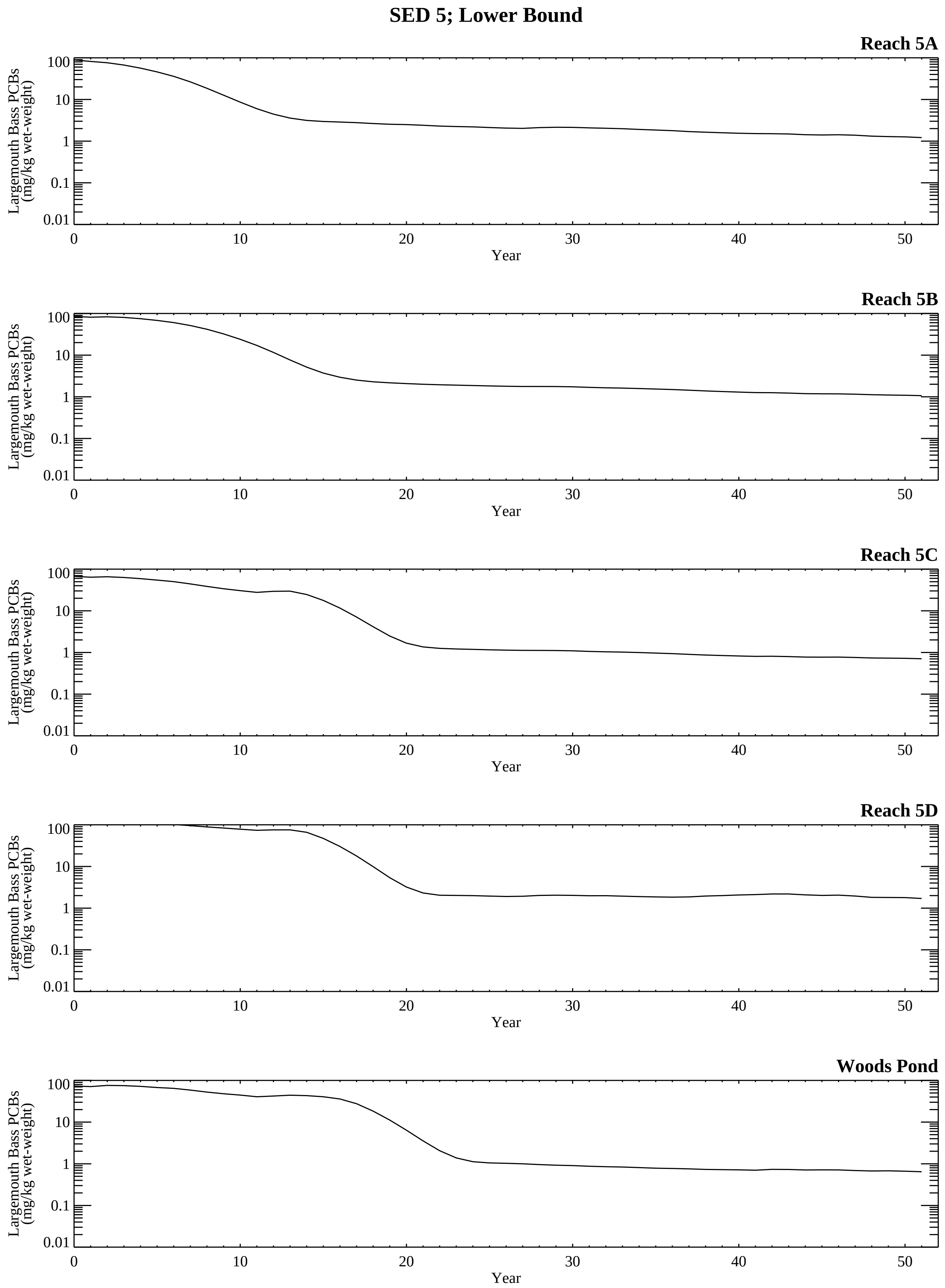

SED 5; Lower Bound

Reach 5A

Reach 5B

Reach 5C

Reach 5D

Woods Pond

Figure G-1.7-4a. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 5; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

SED 5; Lower Bound

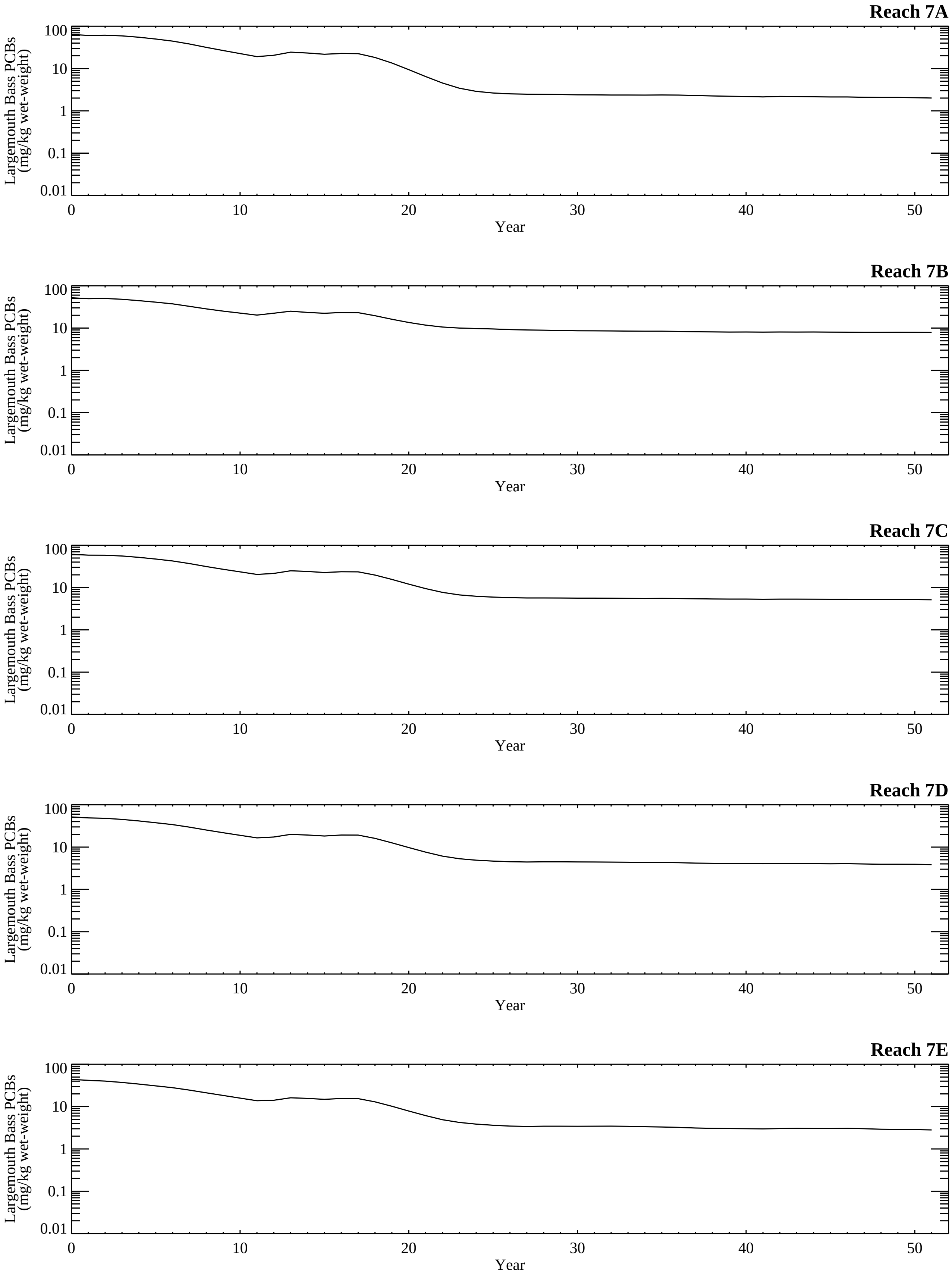

Figure G-1.7-4b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 5; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

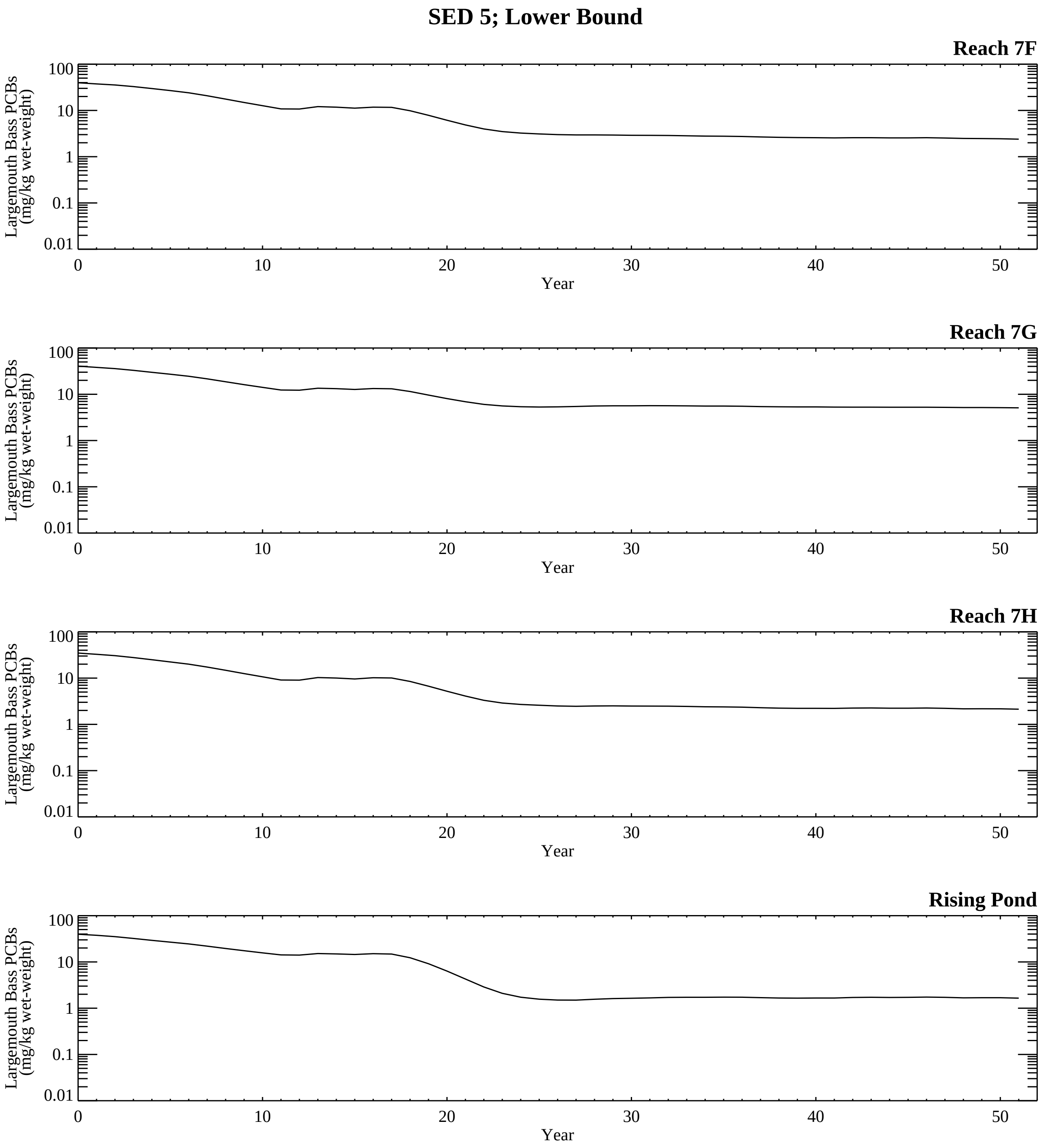

Figure G-1.7-4b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 5; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

SED 5; Lower Bound

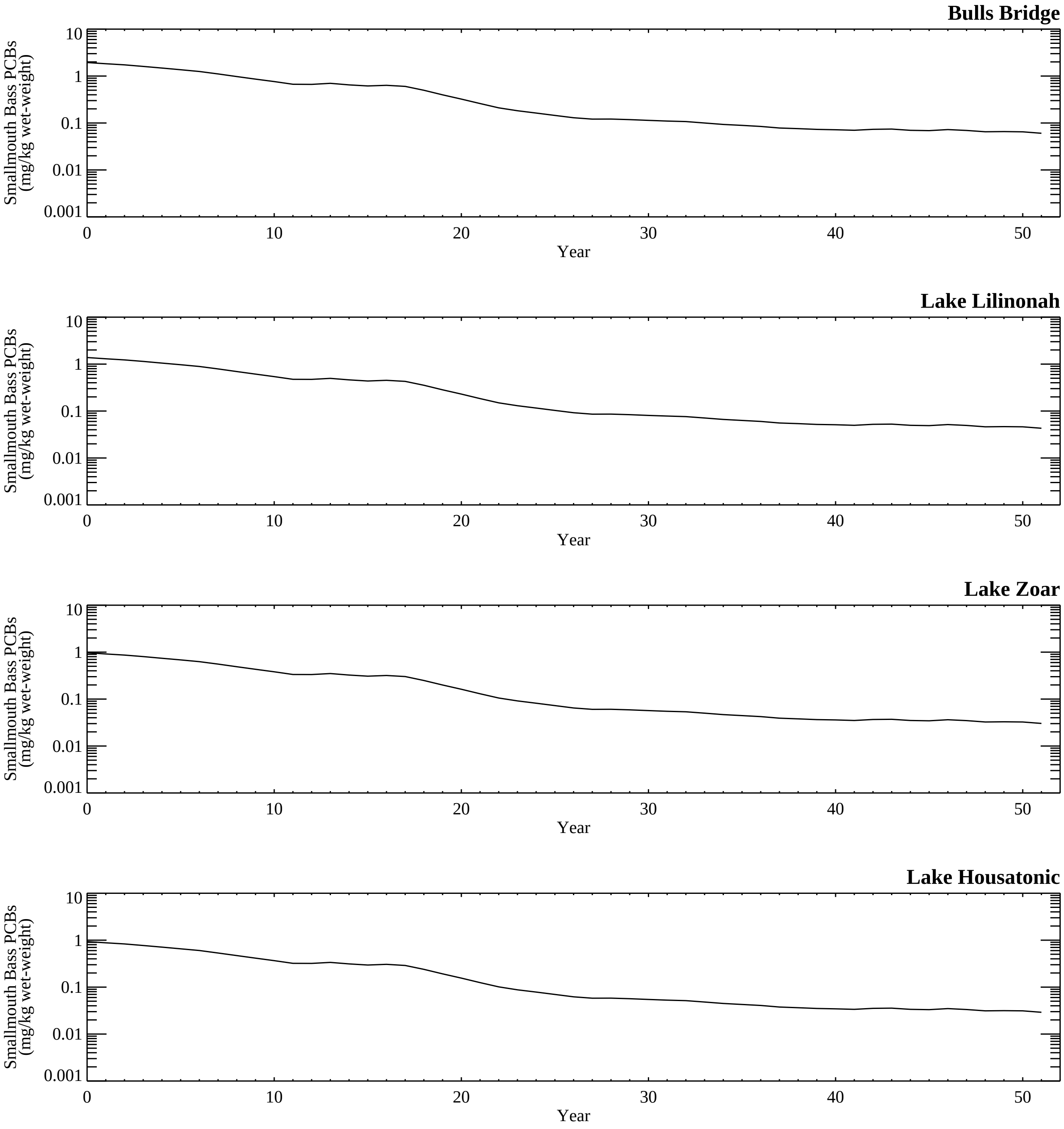

Figure G-1.7-4c. Temporal profiles of PCB concentrations in whole body smallmouth bass (SED 5; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

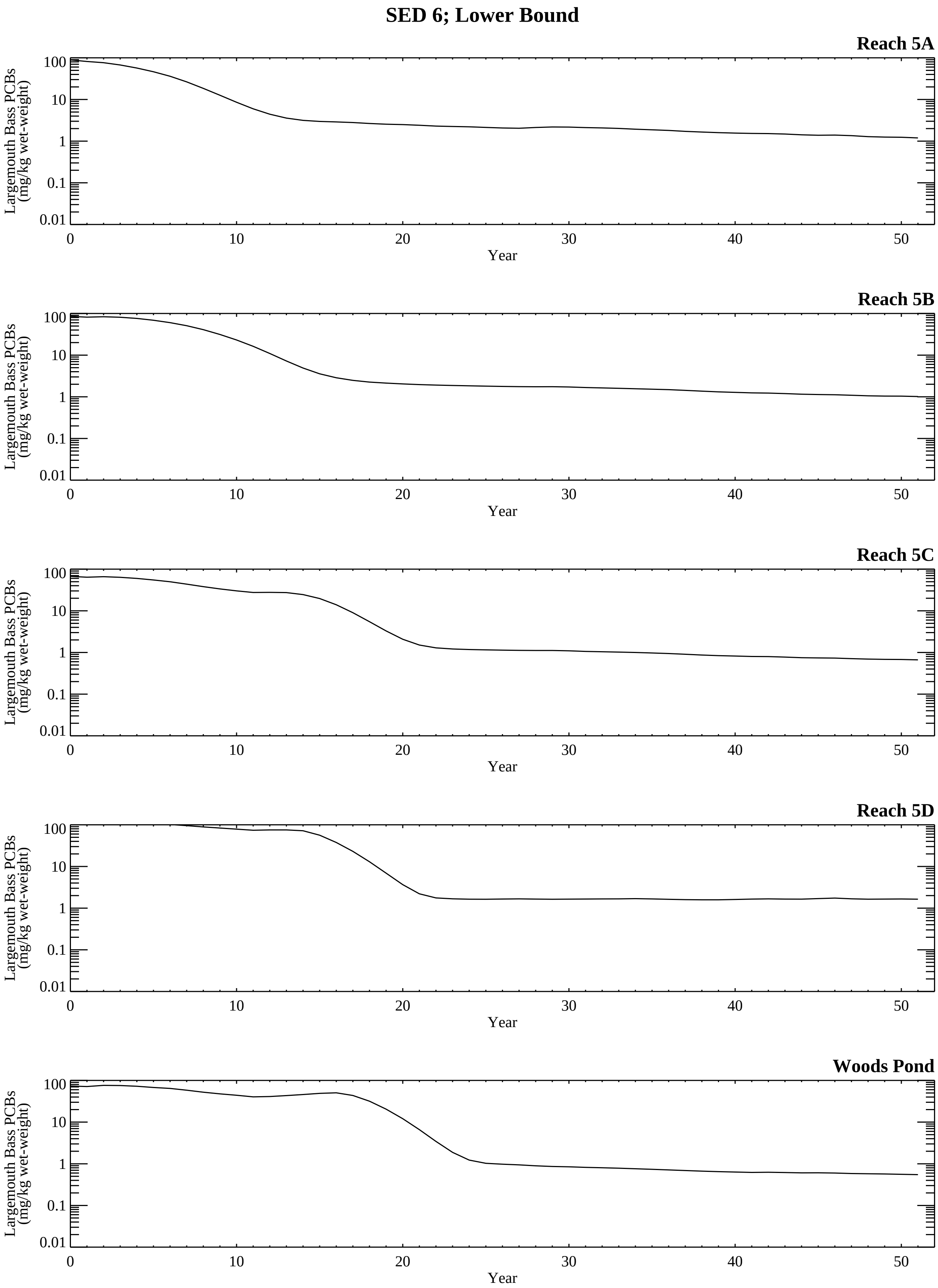

Figure G-1.7-5a. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 6; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

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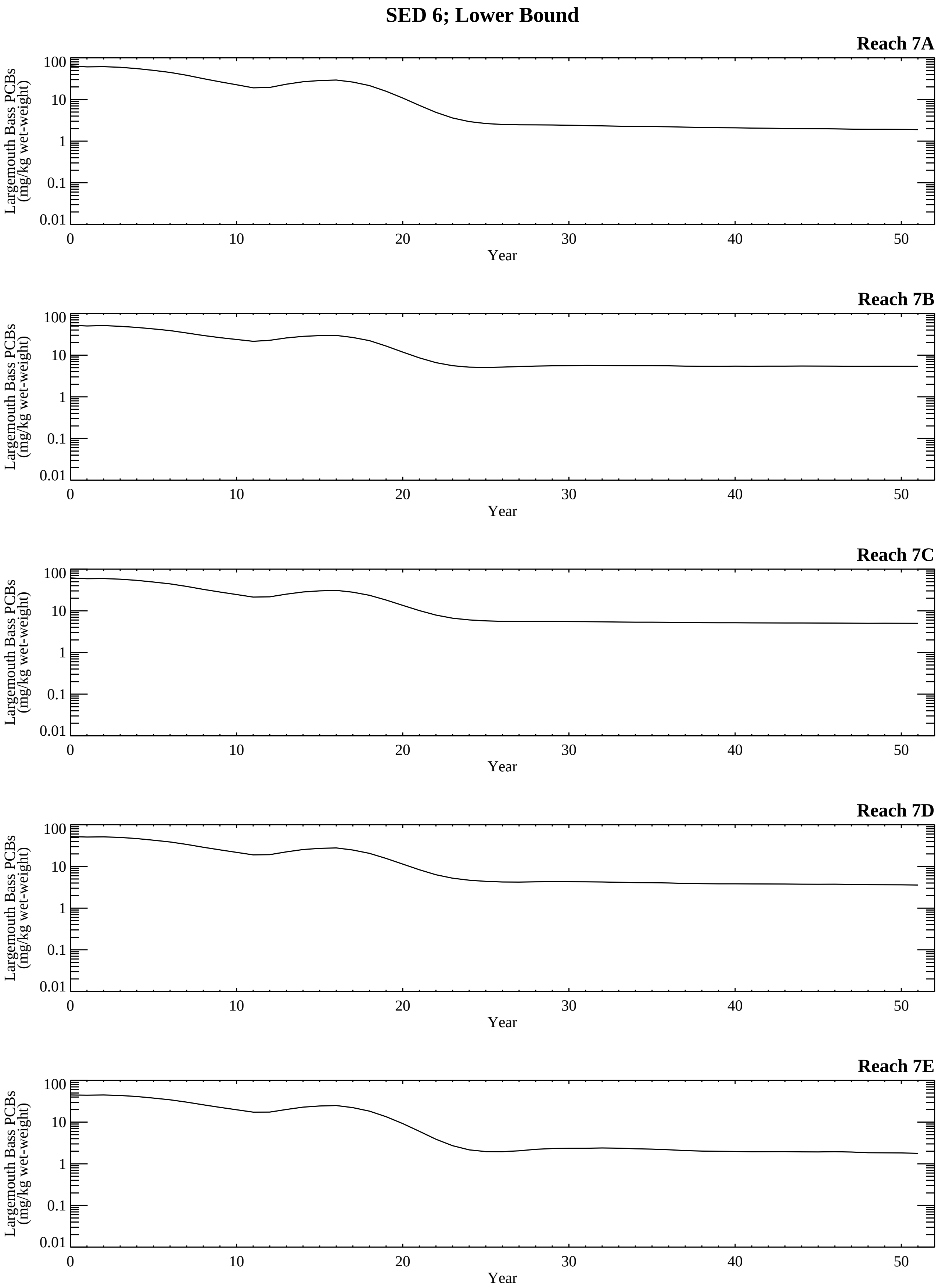


Figure G-1.7-5b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 6; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

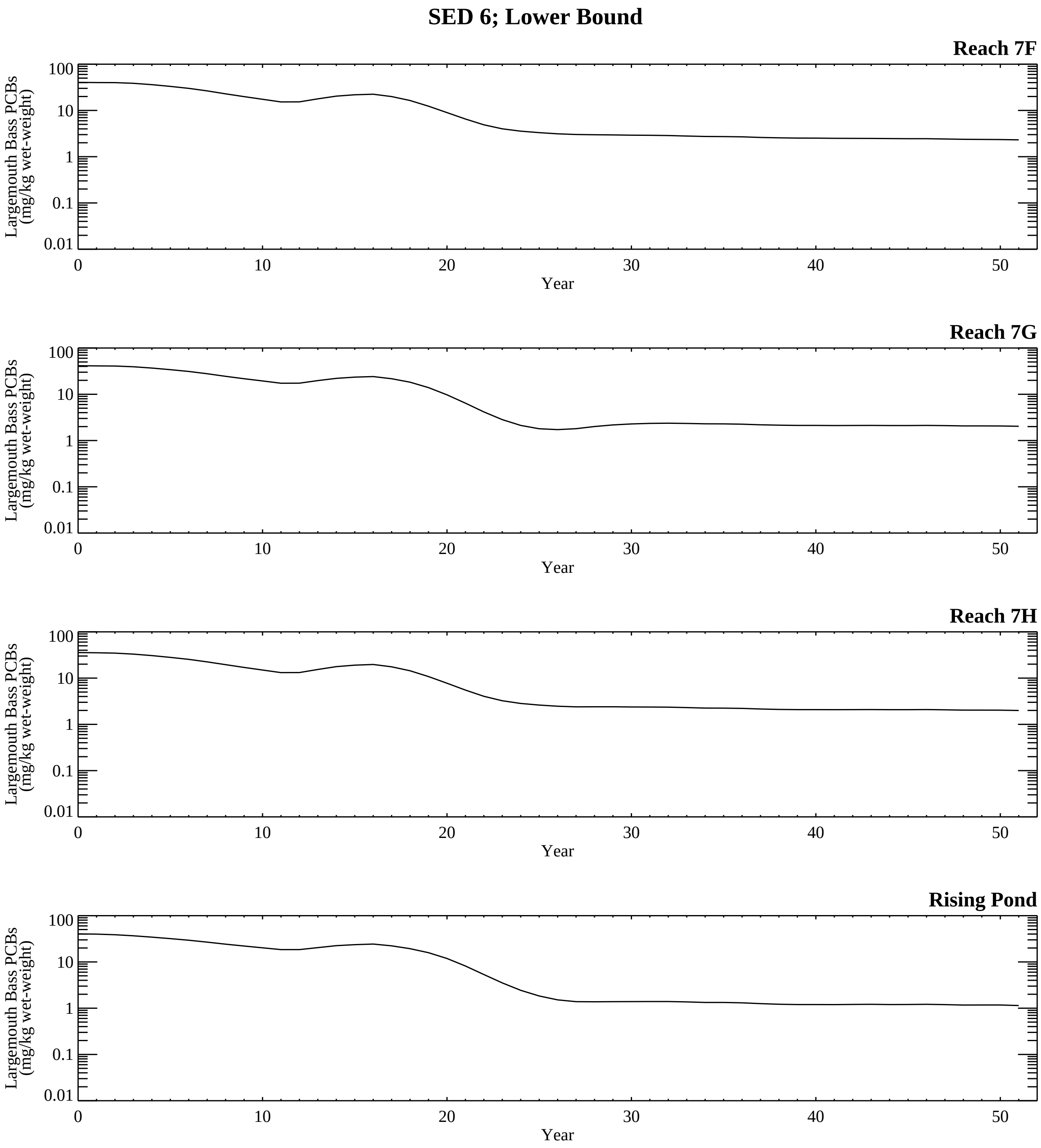


Figure G-1.7-5b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 6; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

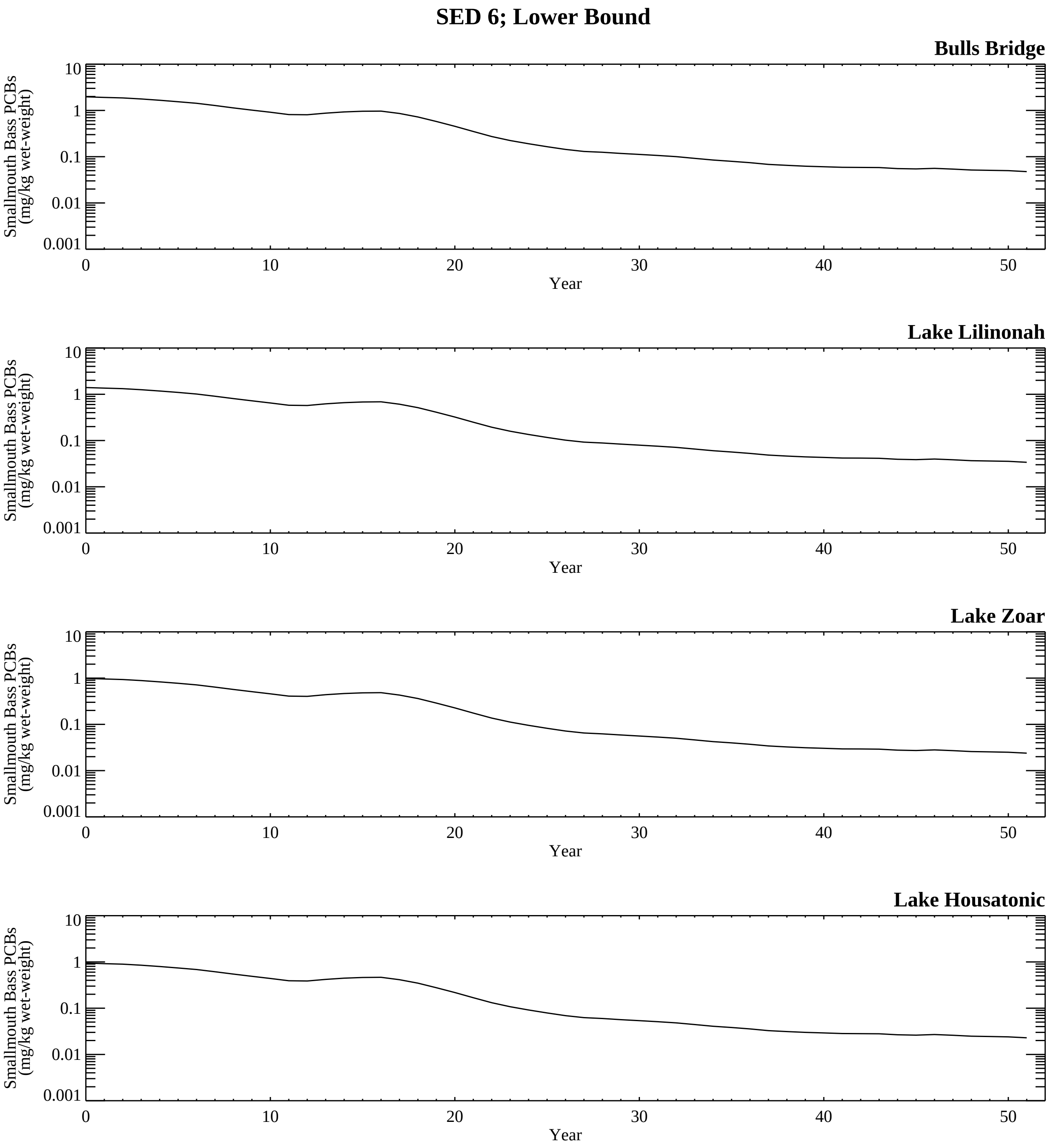


Figure G-1.7-5c. Temporal profiles of PCB concentrations in whole body smallmouth bass (SED 6; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

SED 7; Lower Bound

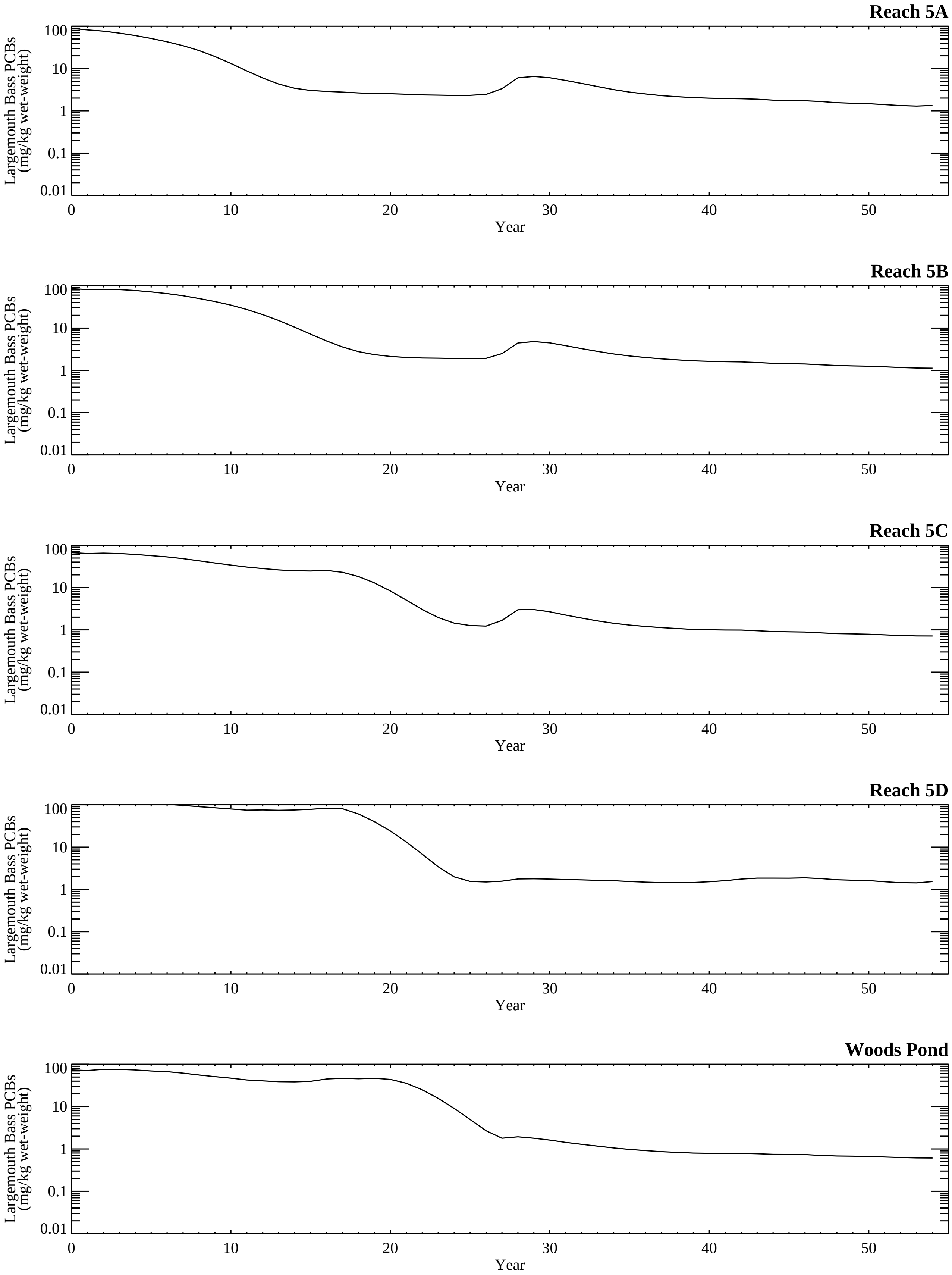
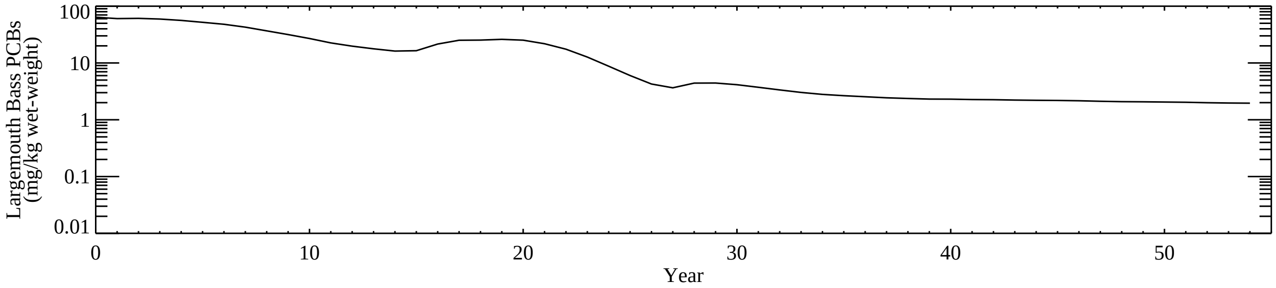


Figure G-1.7-6a. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 7; Reach 5/6; Lower Bound).

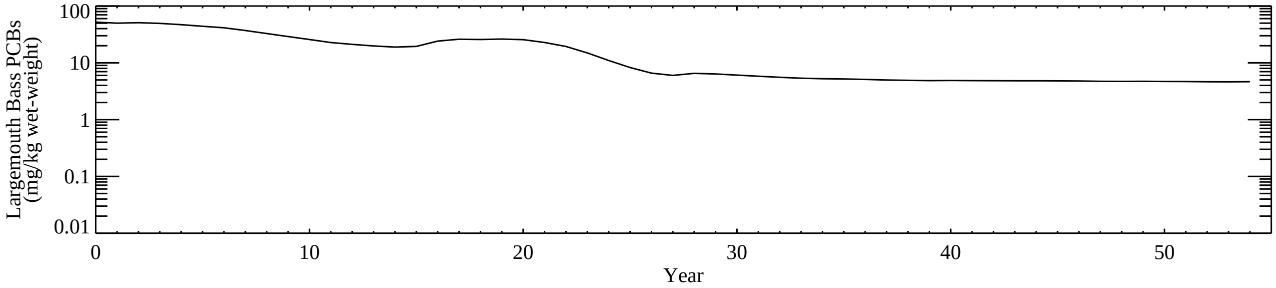
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

SED 7; Lower Bound

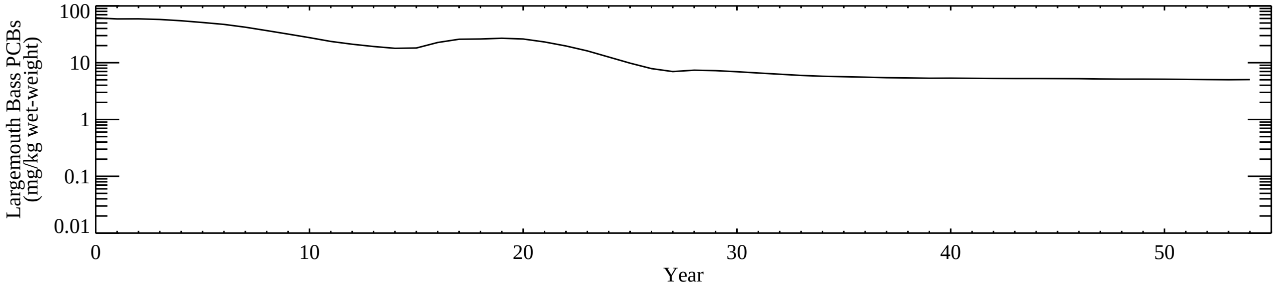
Reach 7A



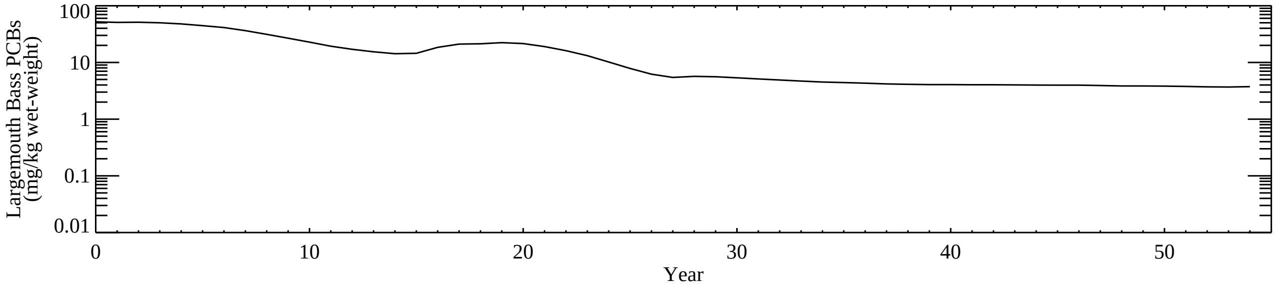
Reach 7B



Reach 7C



Reach 7D



Reach 7E

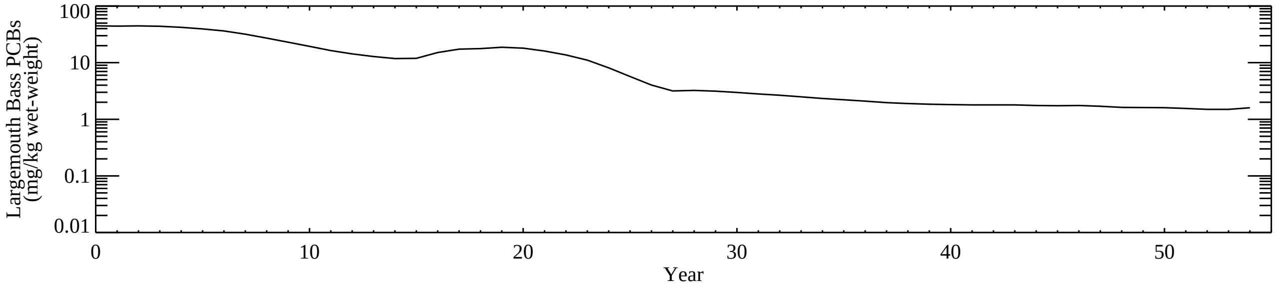


Figure G-1.7-6b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 7; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

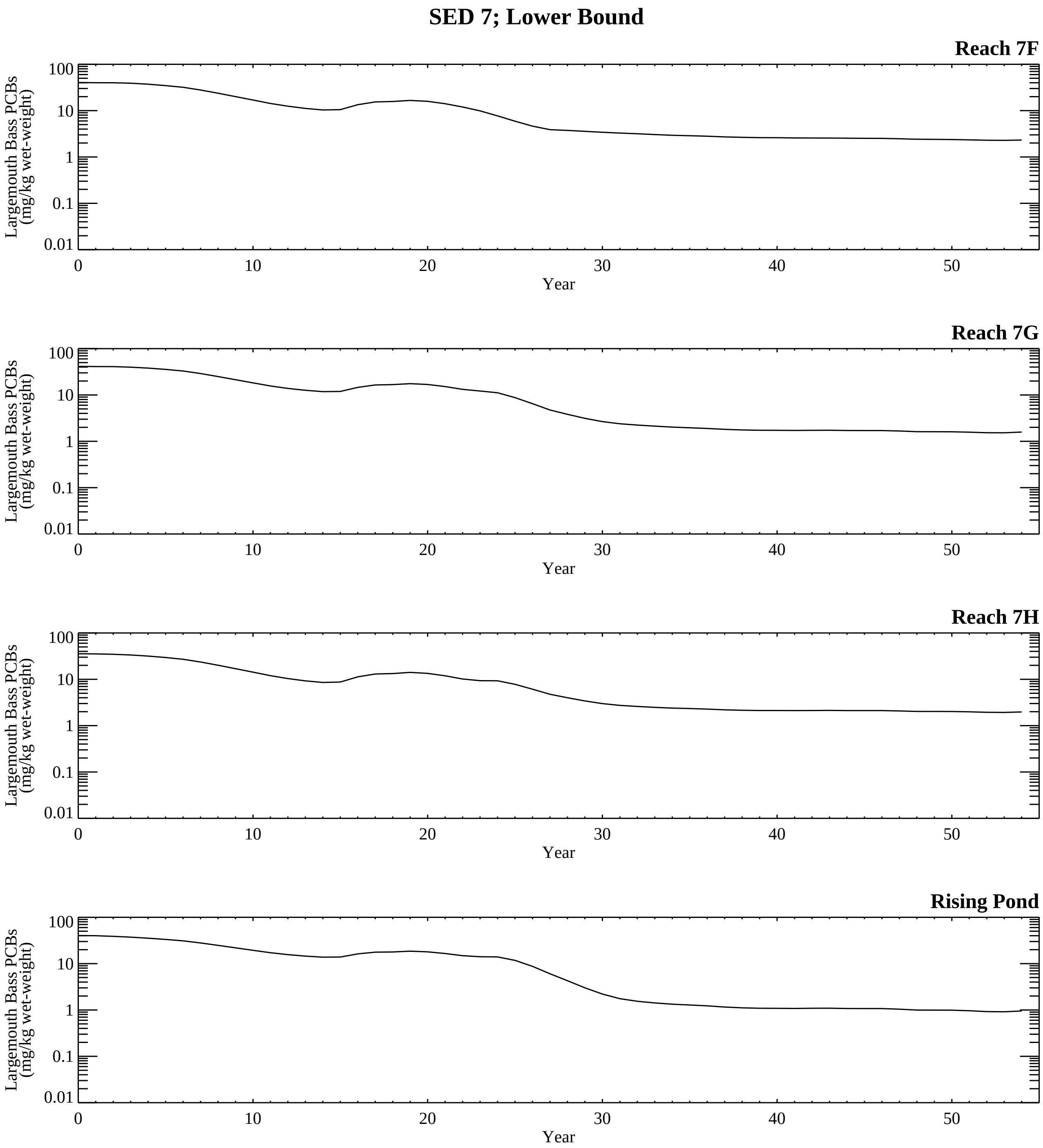


Figure G-1.7-6b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 7; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

SED 7; Lower Bound

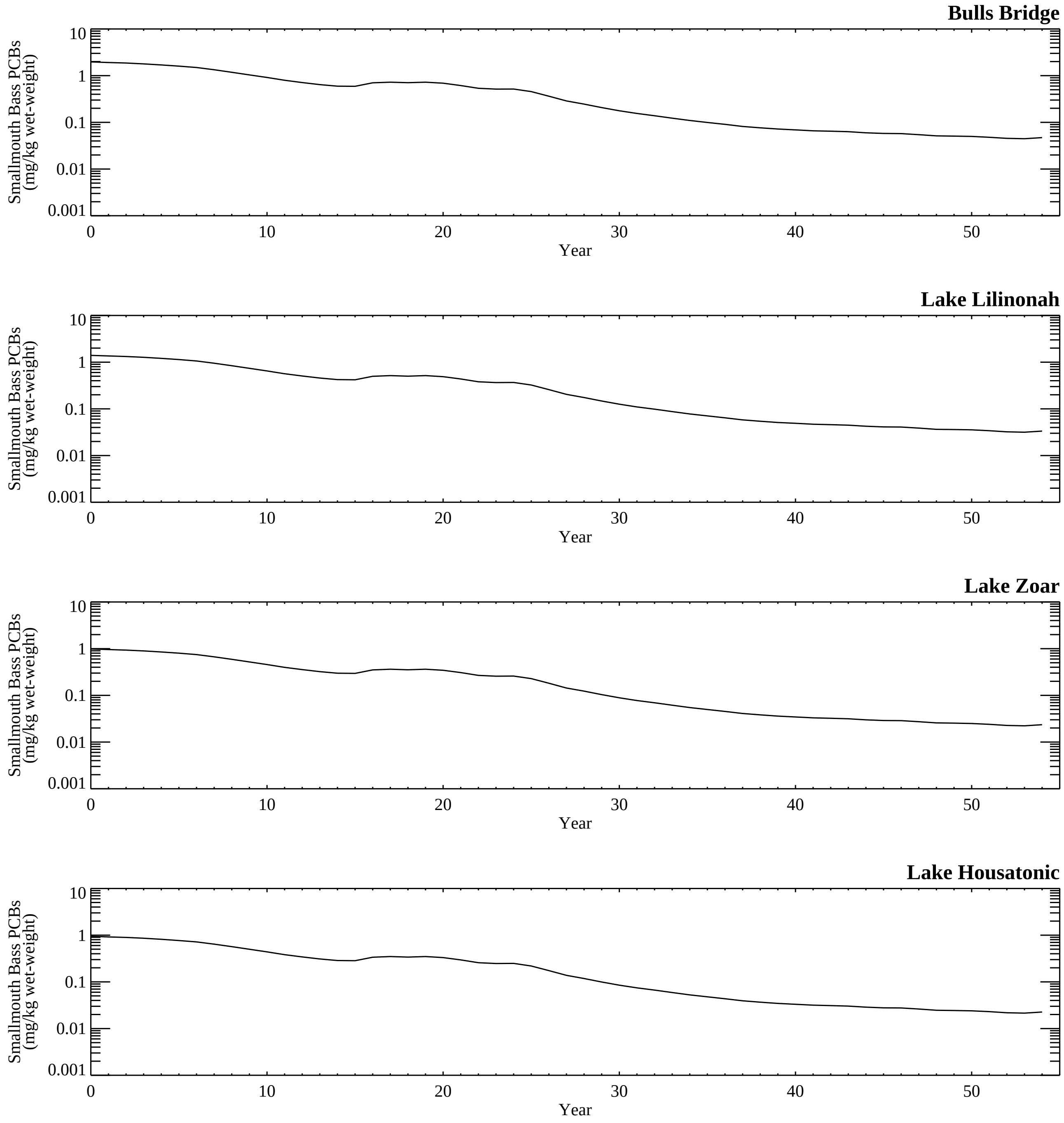


Figure G-1.7-6c. Temporal profiles of PCB concentrations in whole body smallmouth bass (SED 7; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

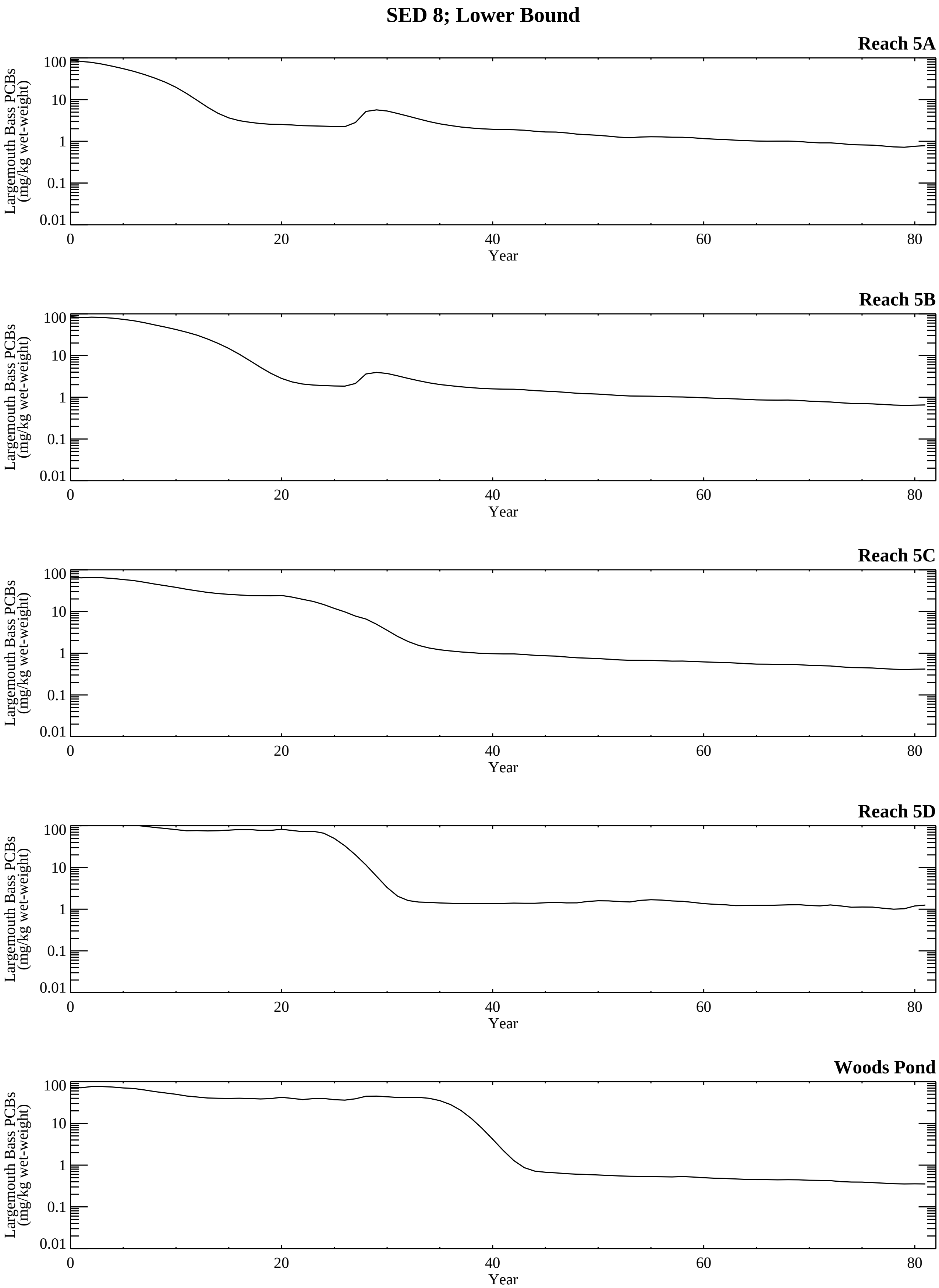


Figure G-1.7-7a. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 8; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

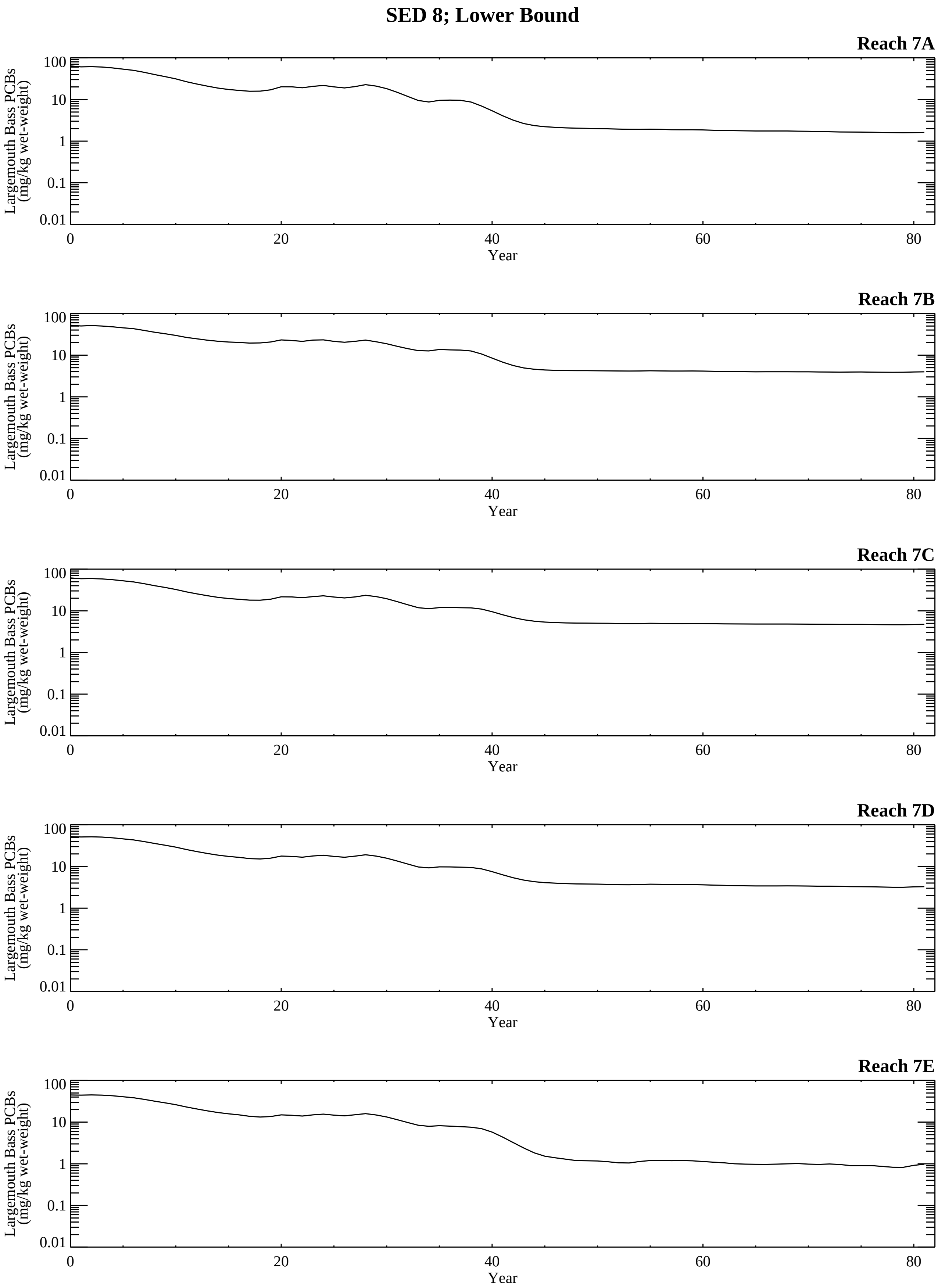


Figure G-1.7-7b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 8; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

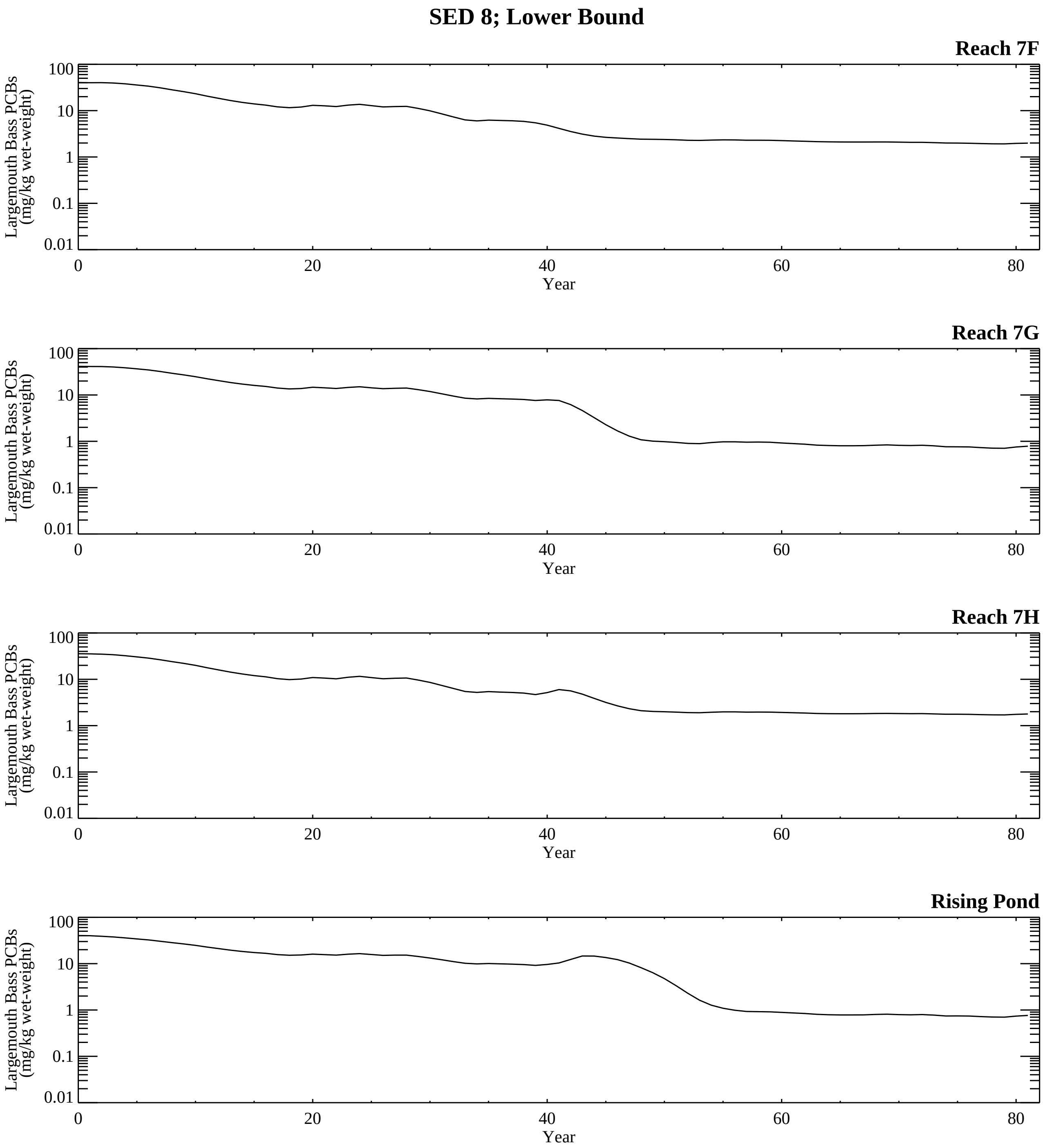


Figure G-1.7-7b. Temporal profiles of PCB concentrations in whole body largemouth bass (SED 8; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

SED 8; Lower Bound

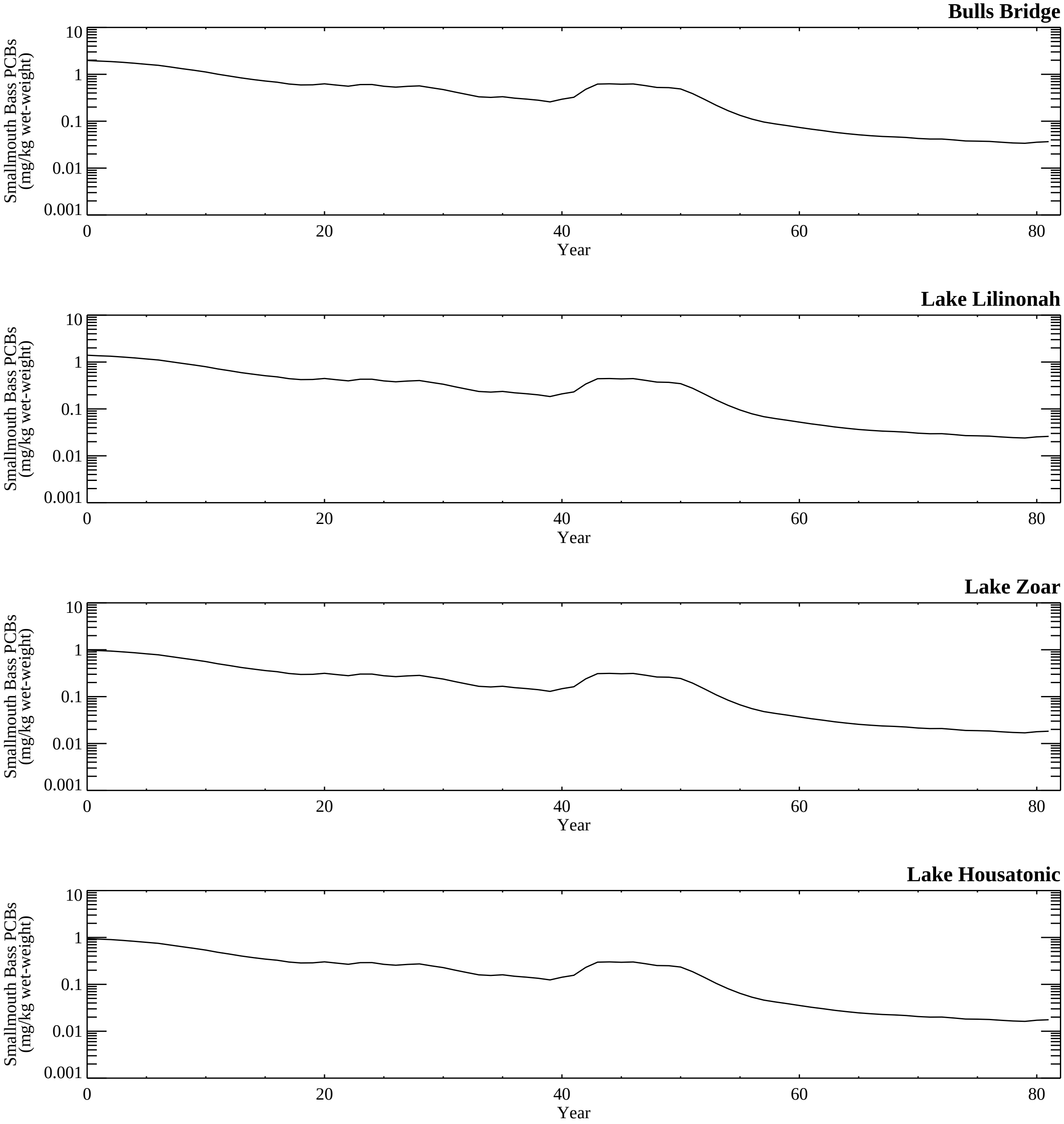


Figure G-1.7-7c. Temporal profiles of PCB concentrations in whole body smallmouth bass (SED 8; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.

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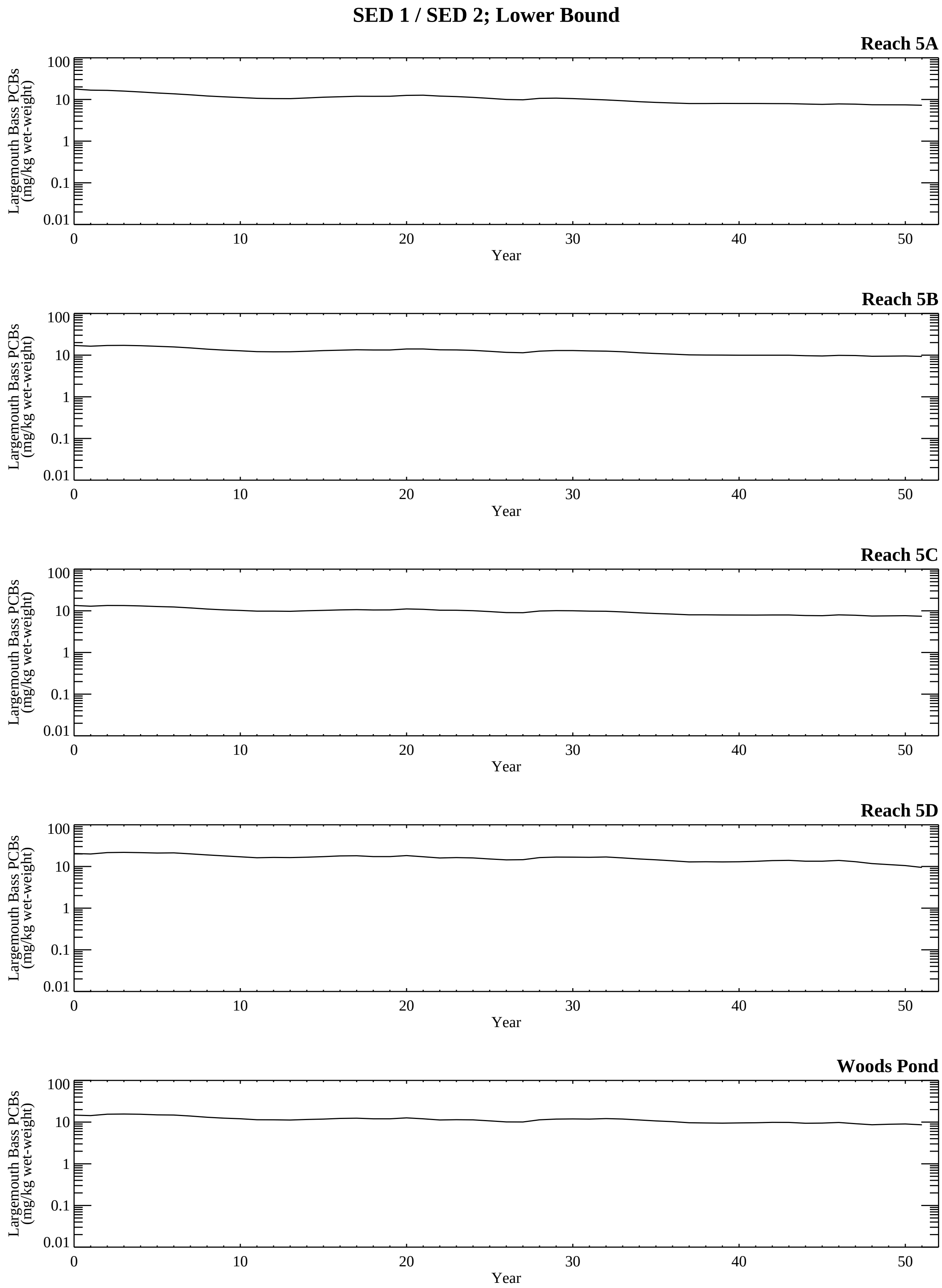

Figure G-1.8-1a. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 1 / SED 2; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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Mon Mar 17 21:08:45 2008

SED 1 / SED 2; Lower Bound

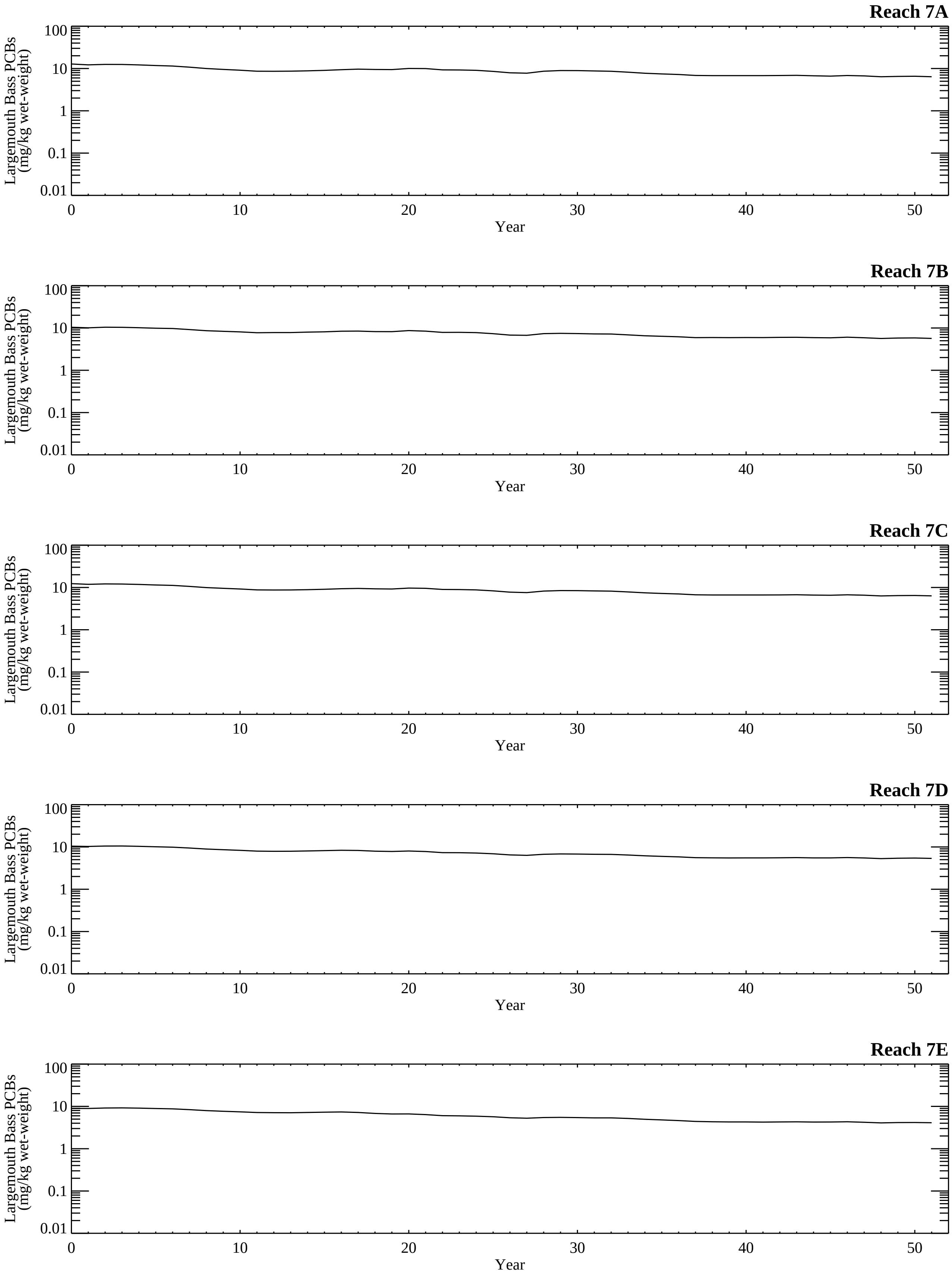

Figure G-1.8-1b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 1 / SED 2; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

SED 1 / SED 2; Lower Bound

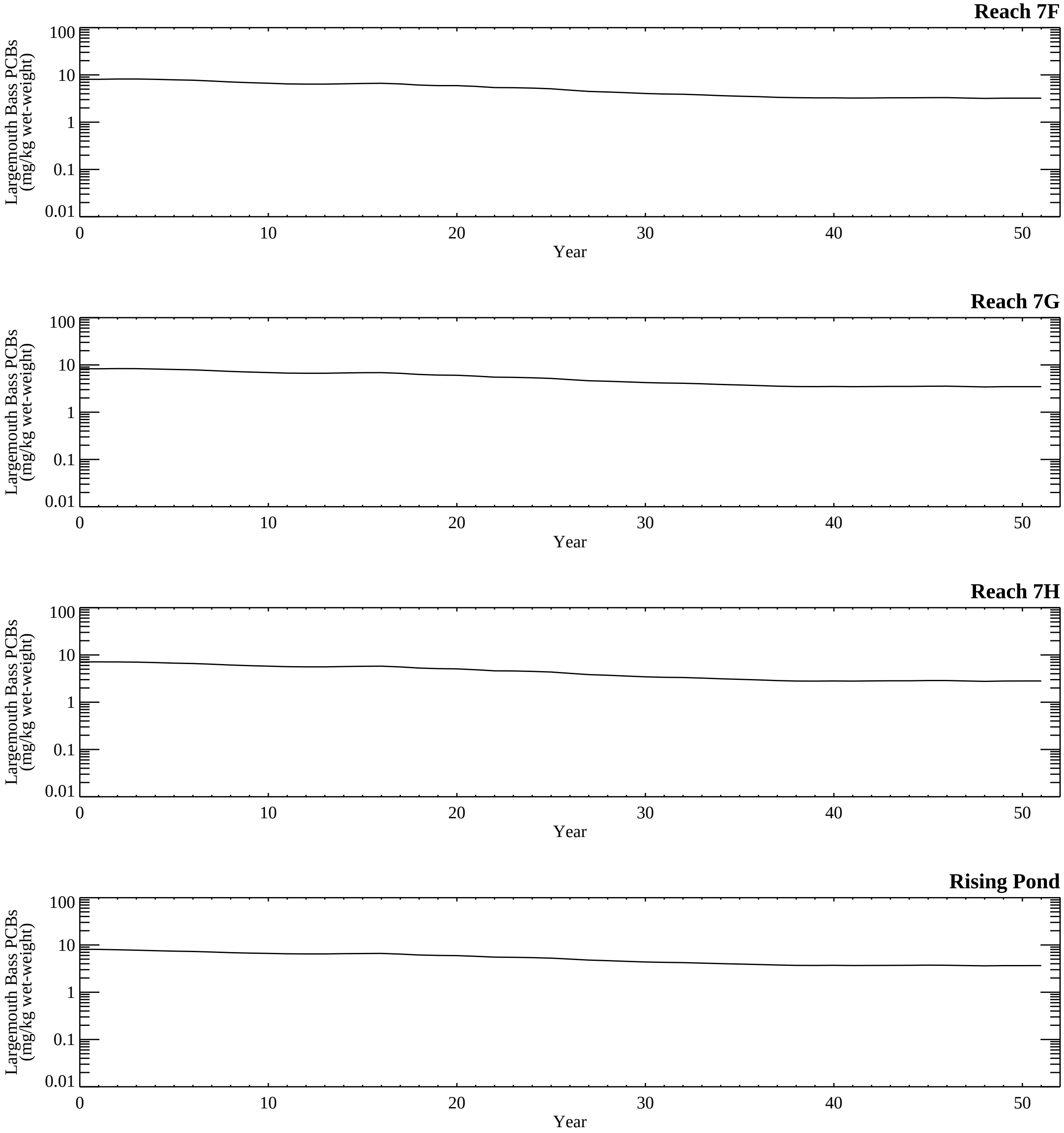

Figure G-1.8-1b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 1 / SED 2; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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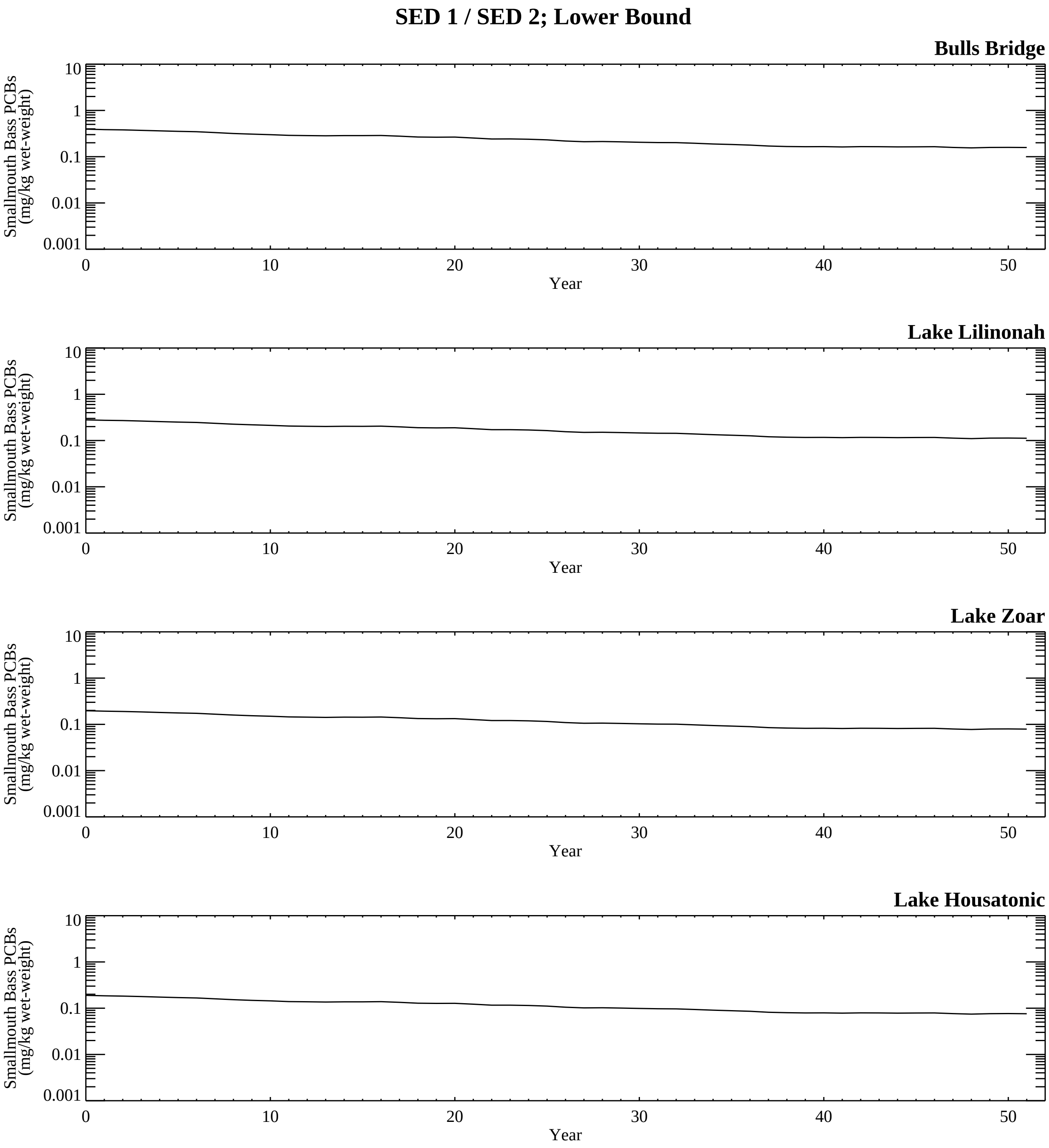

Figure G-1.8-1c. Temporal profiles of PCB concentrations in smallmouth bass fillets (SED 1 / SED 2; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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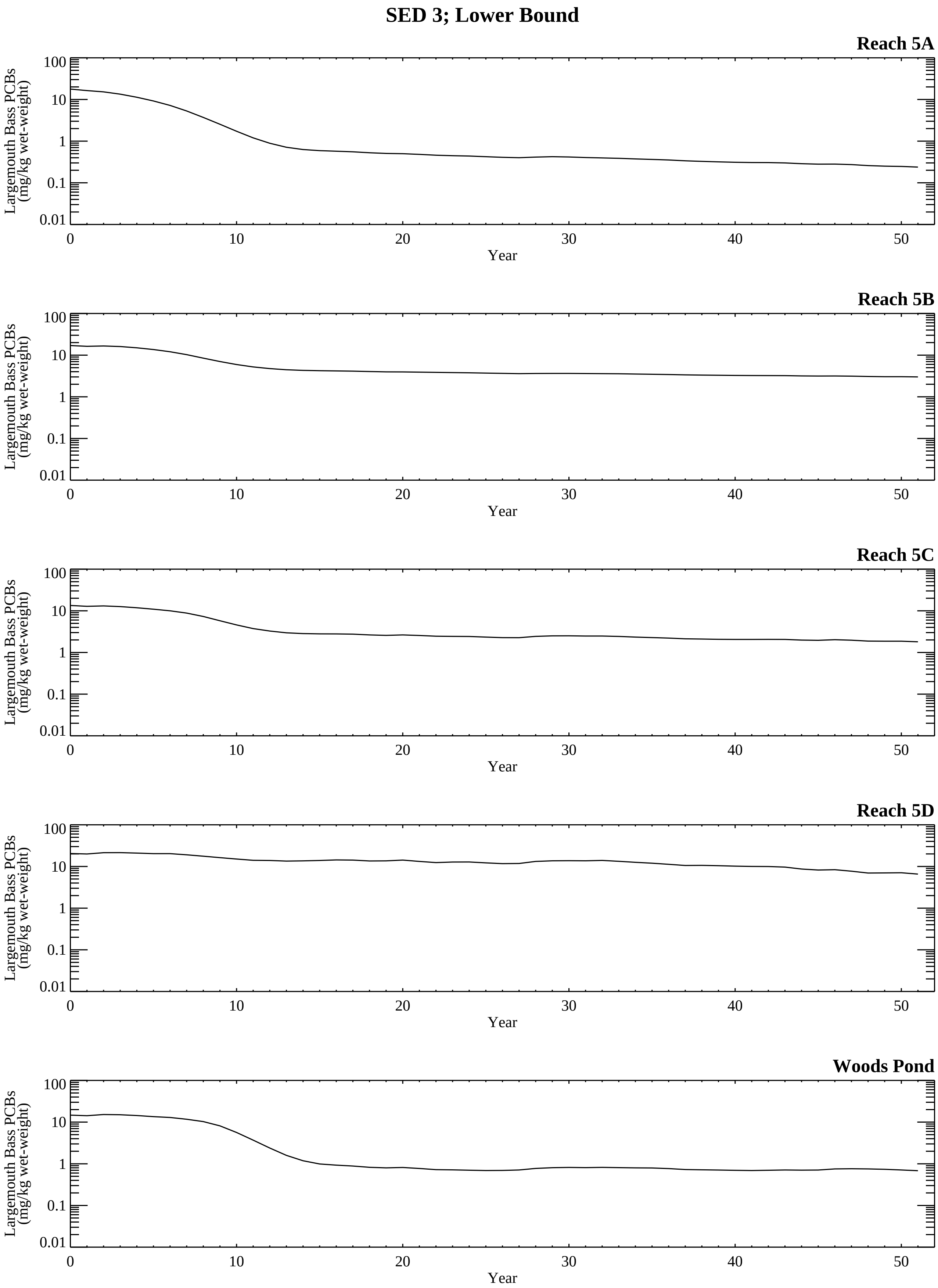
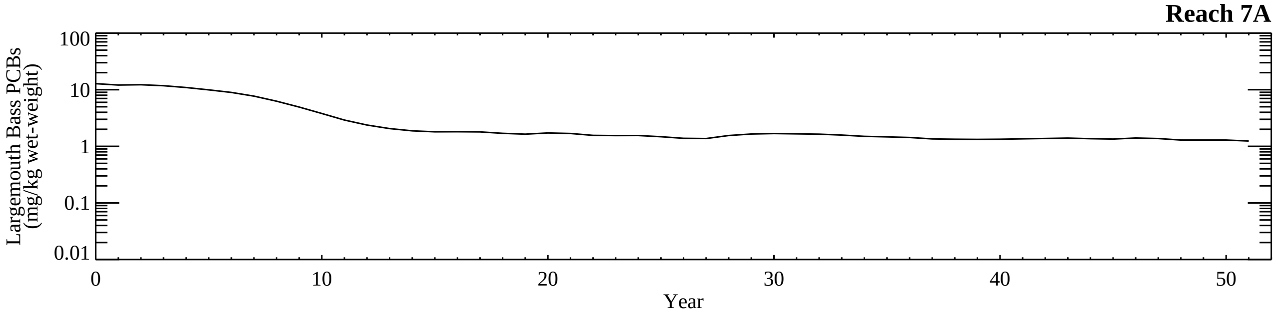
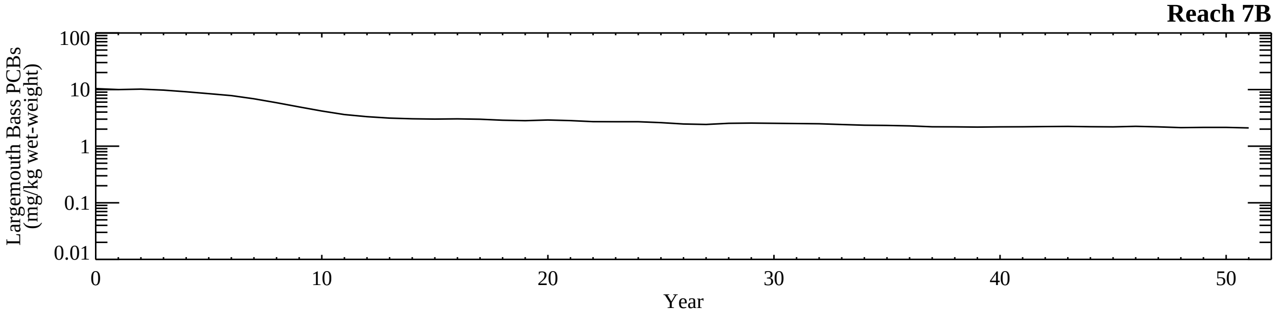


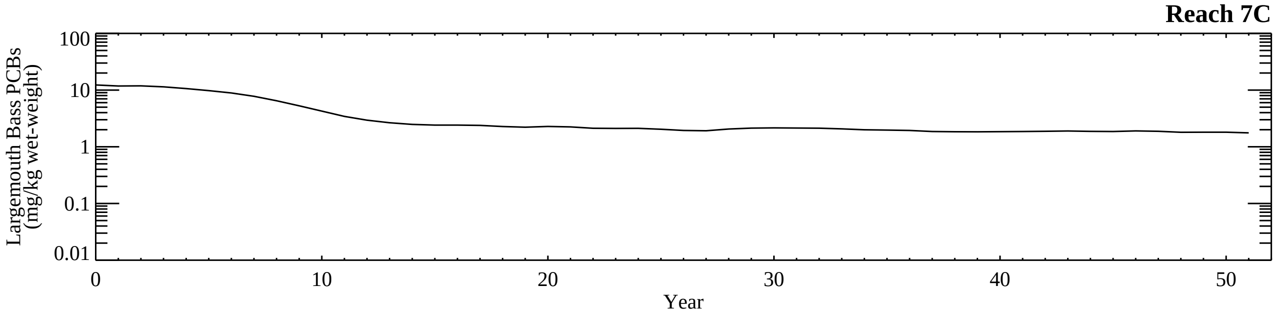
Figure G-1.8-2a. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 3; Reach 5/6; Lower Bound).

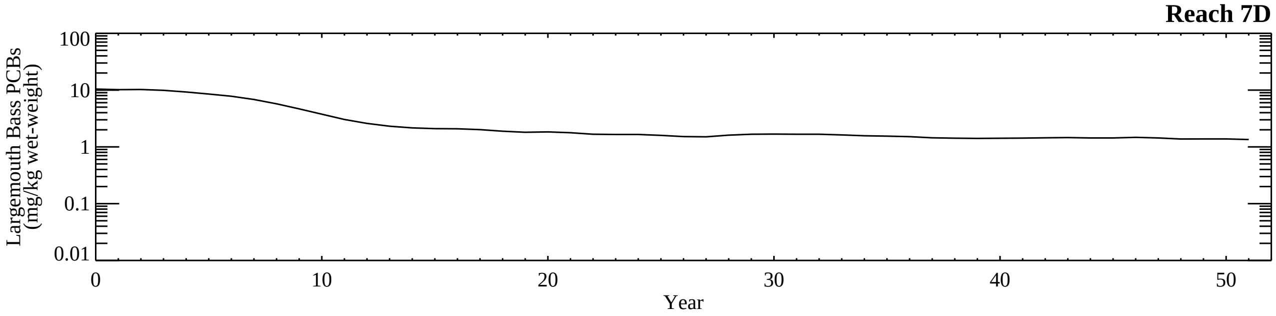
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

SED 3; Lower Bound









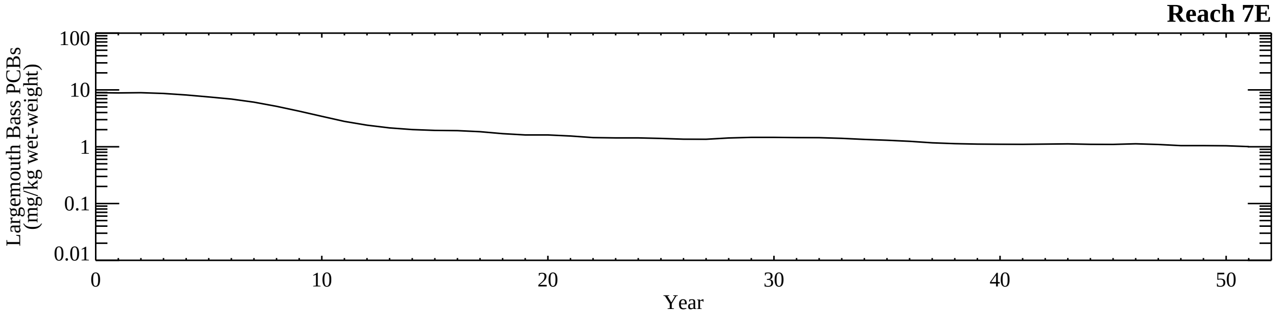


Figure G-1.8-2b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 3; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

SED 3; Lower Bound

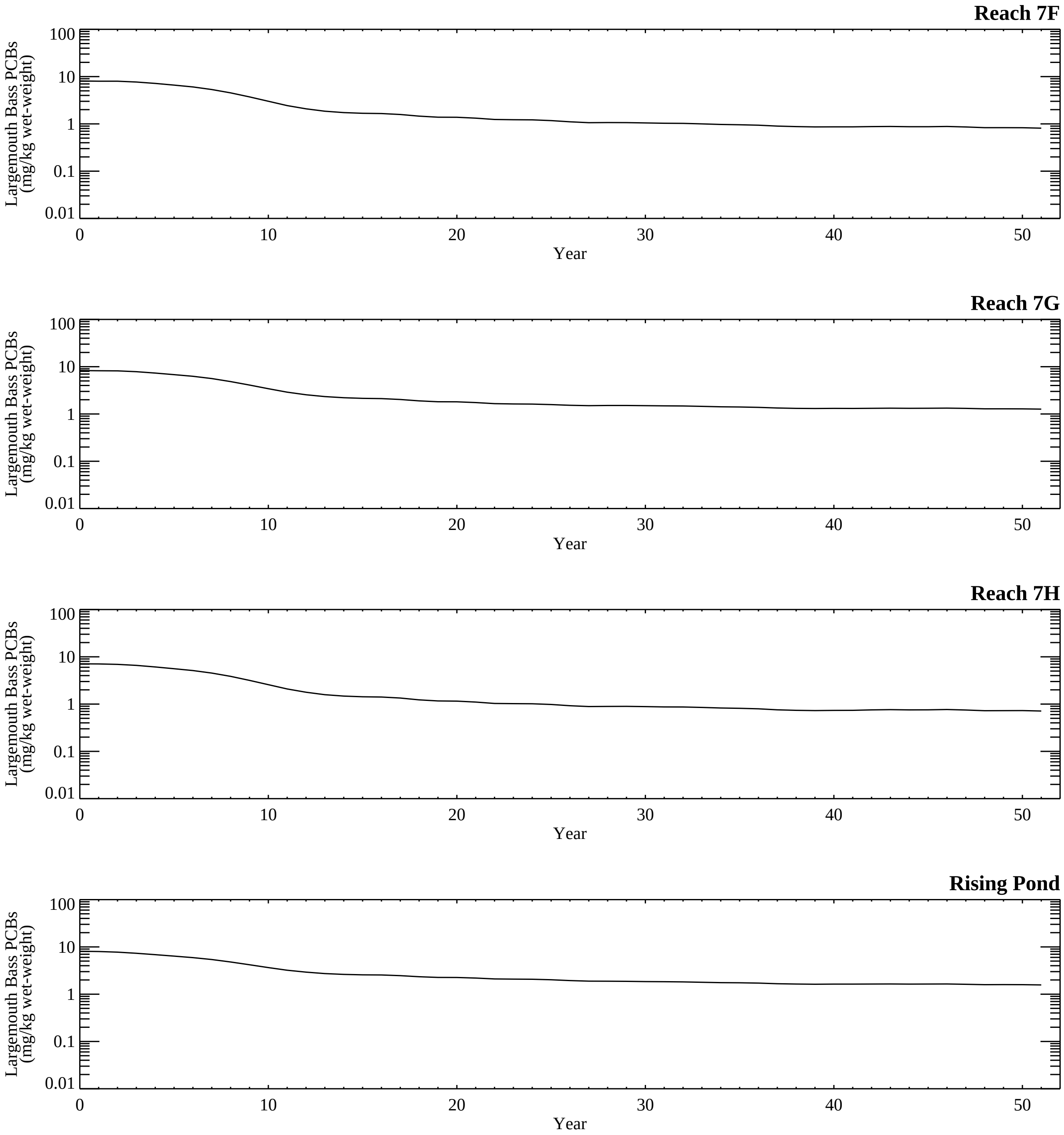


Figure G-1.8-2b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 3; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

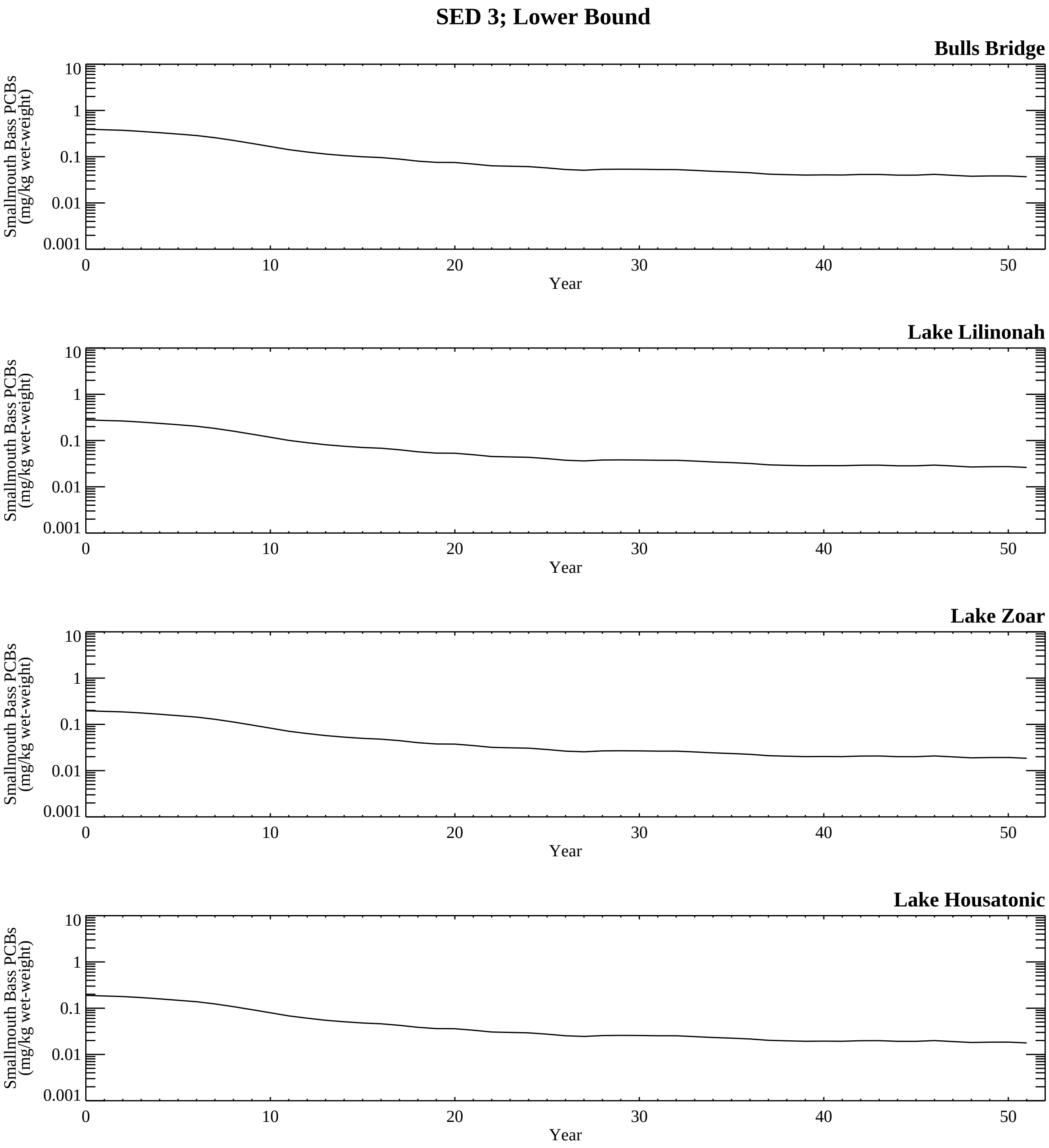


Figure G-1.8-2c. Temporal profiles of PCB concentrations in smallmouth bass fillets (SED 3; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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Mon Mar 17 22:26:37 2008

SED 4; Lower Bound

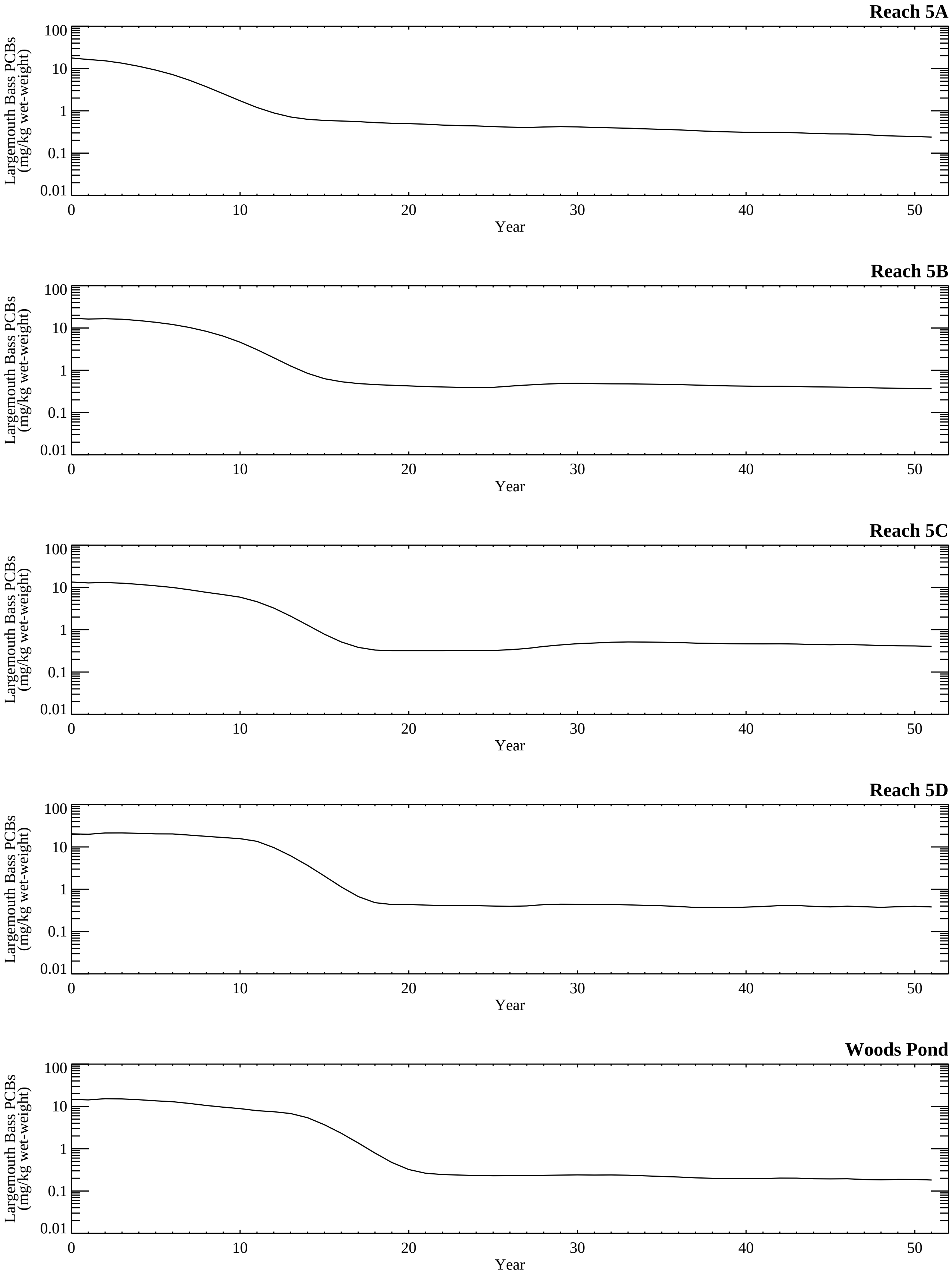


Figure G-1.8-3a. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 4; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

SED 4; Lower Bound

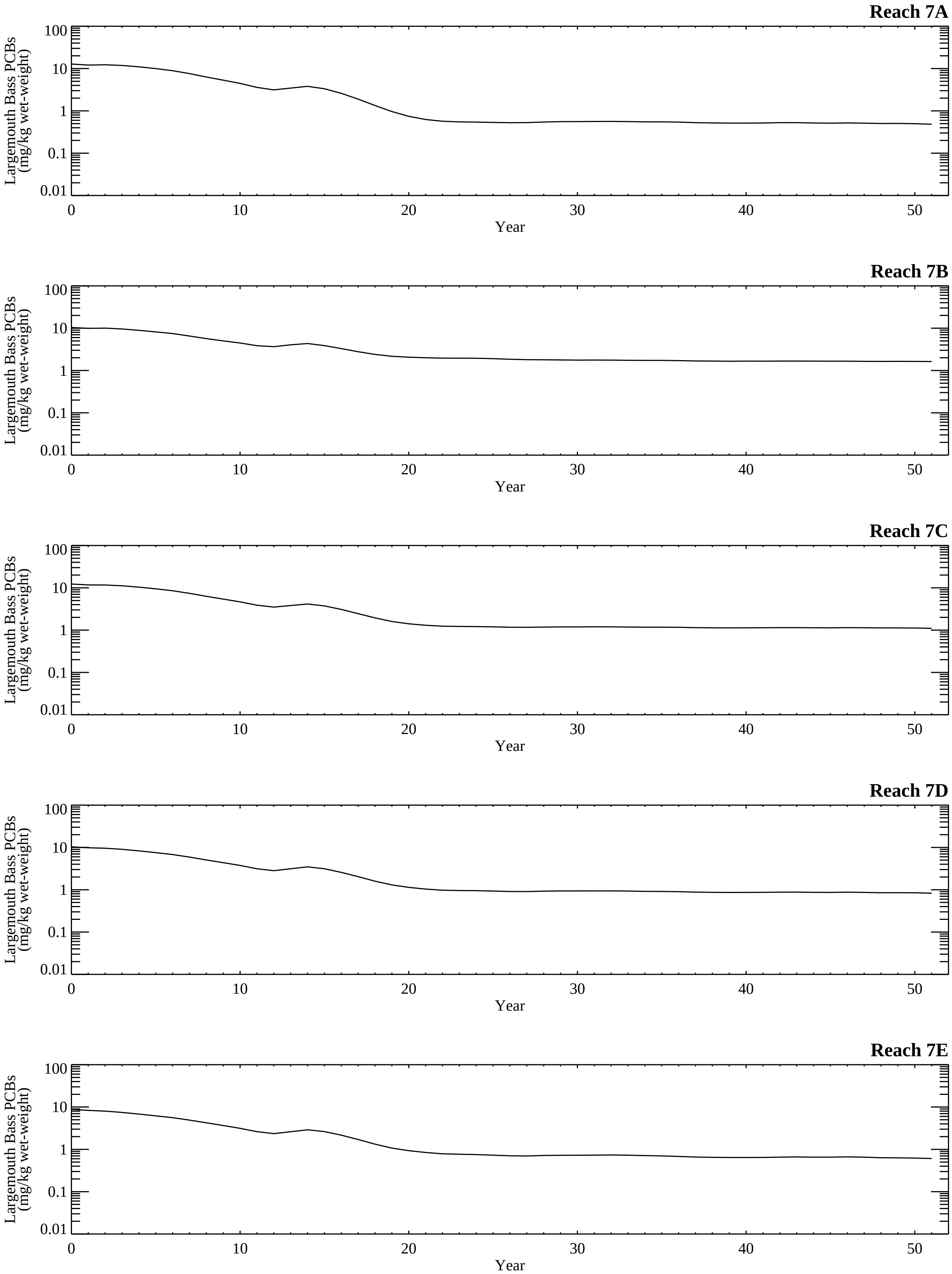


Figure G-1.8-3b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 4; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

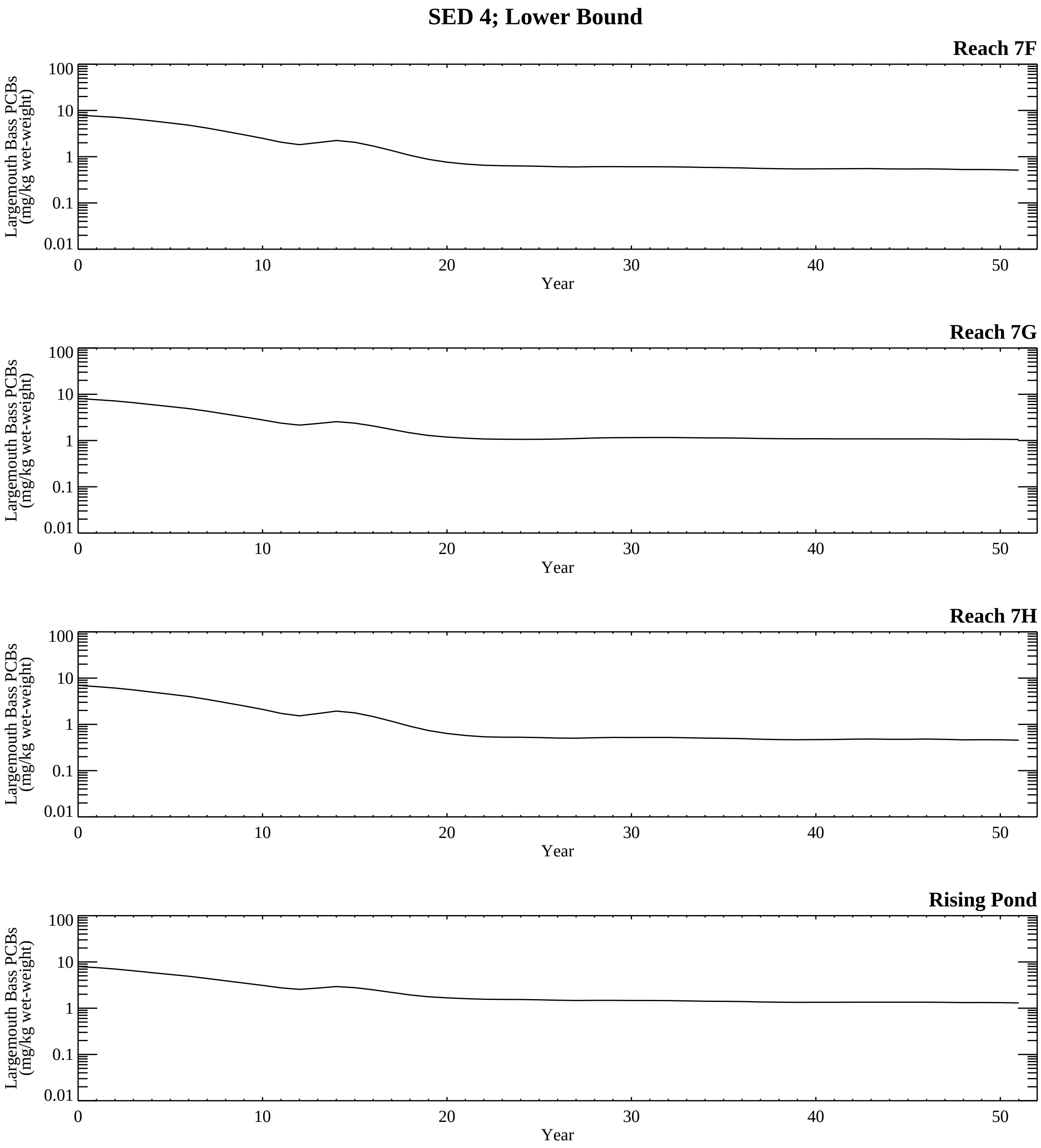


Figure G-1.8-3b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 4; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

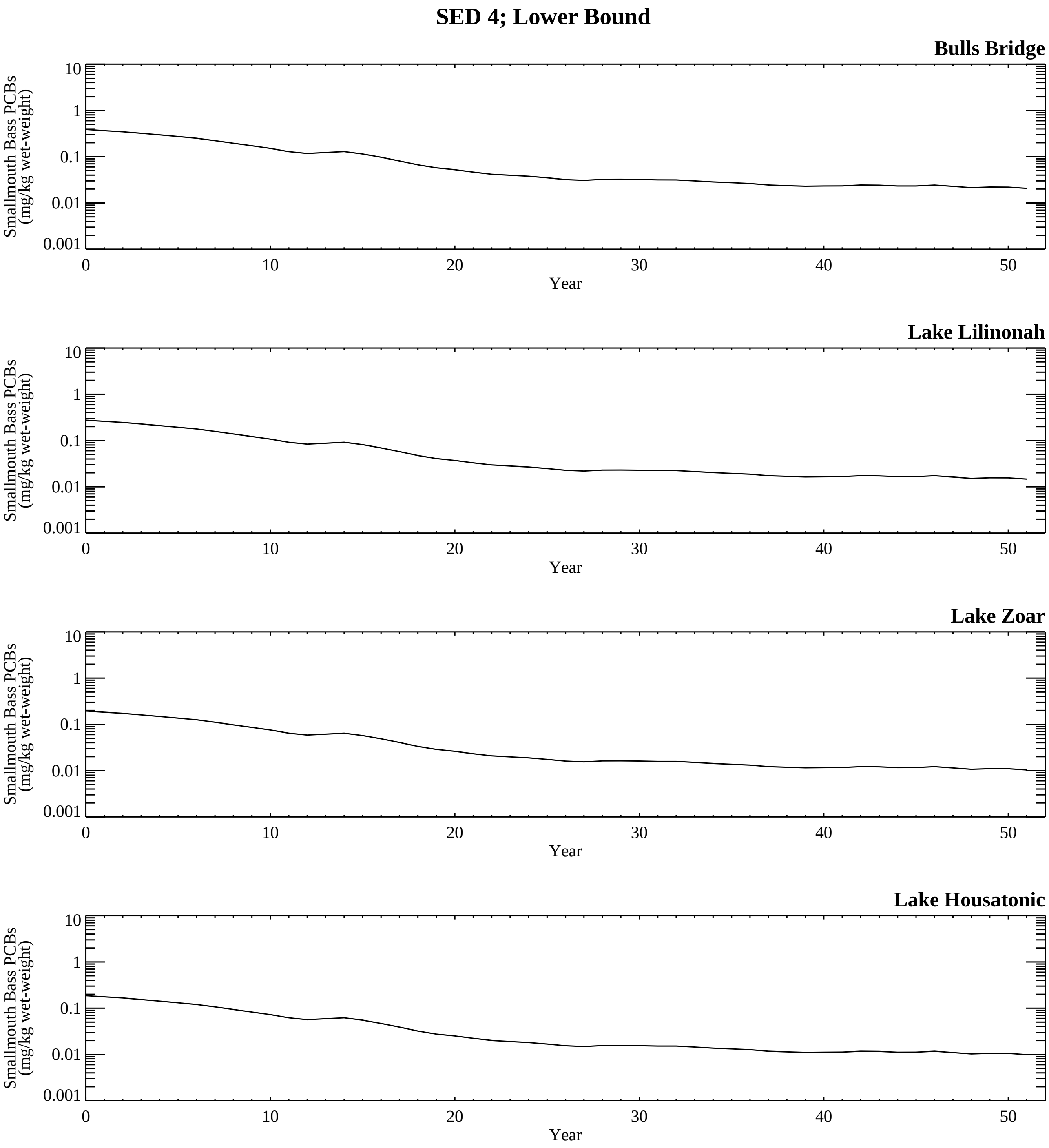
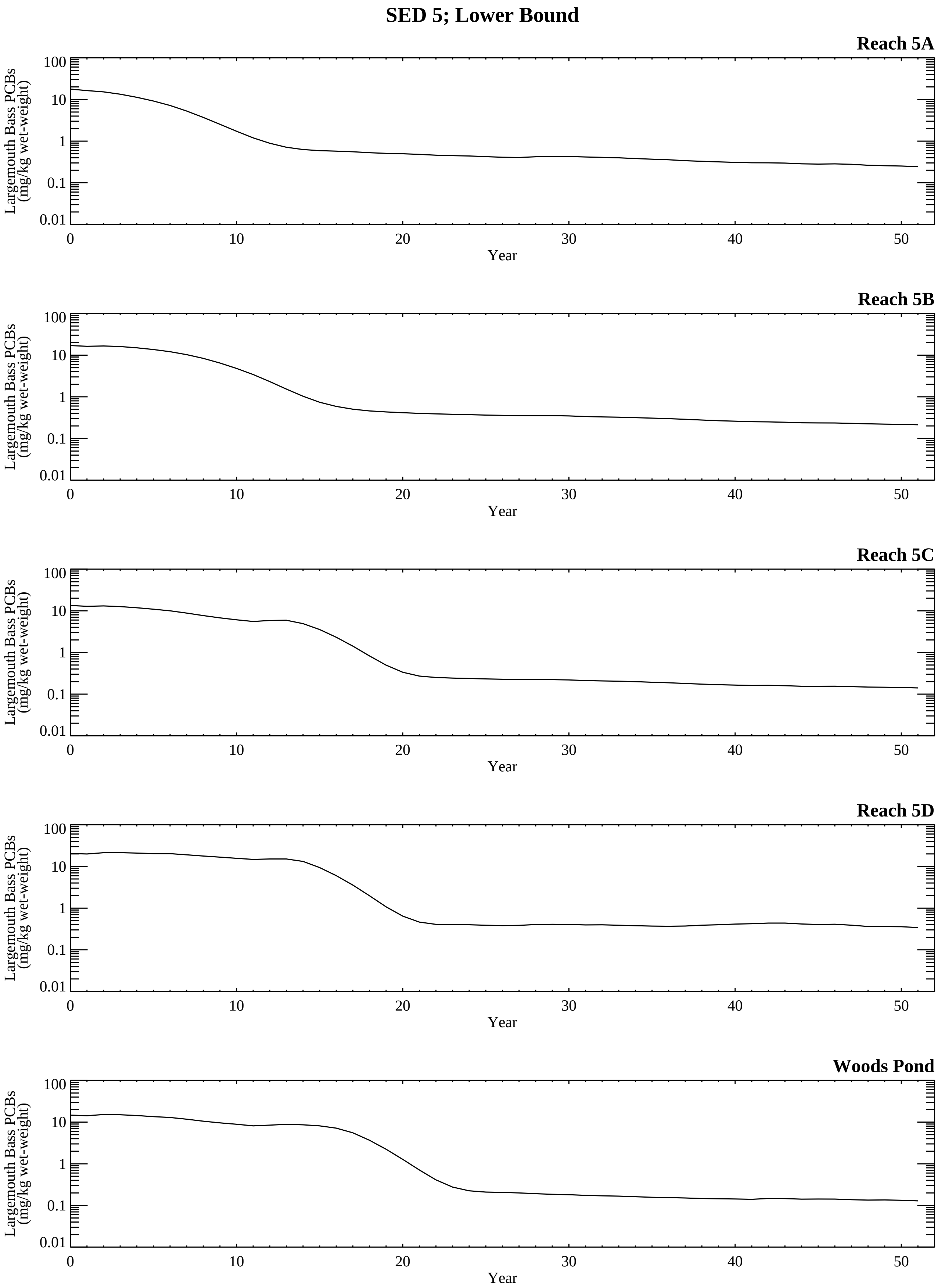


Figure G-1.8-3c. Temporal profiles of PCB concentrations in smallmouth bass fillets (SED 4; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.



SED 5; Lower Bound

Reach 5A

Reach 5B

Reach 5C

Reach 5D

Woods Pond

Figure G-1.8-4a. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 5; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

SED 5; Lower Bound

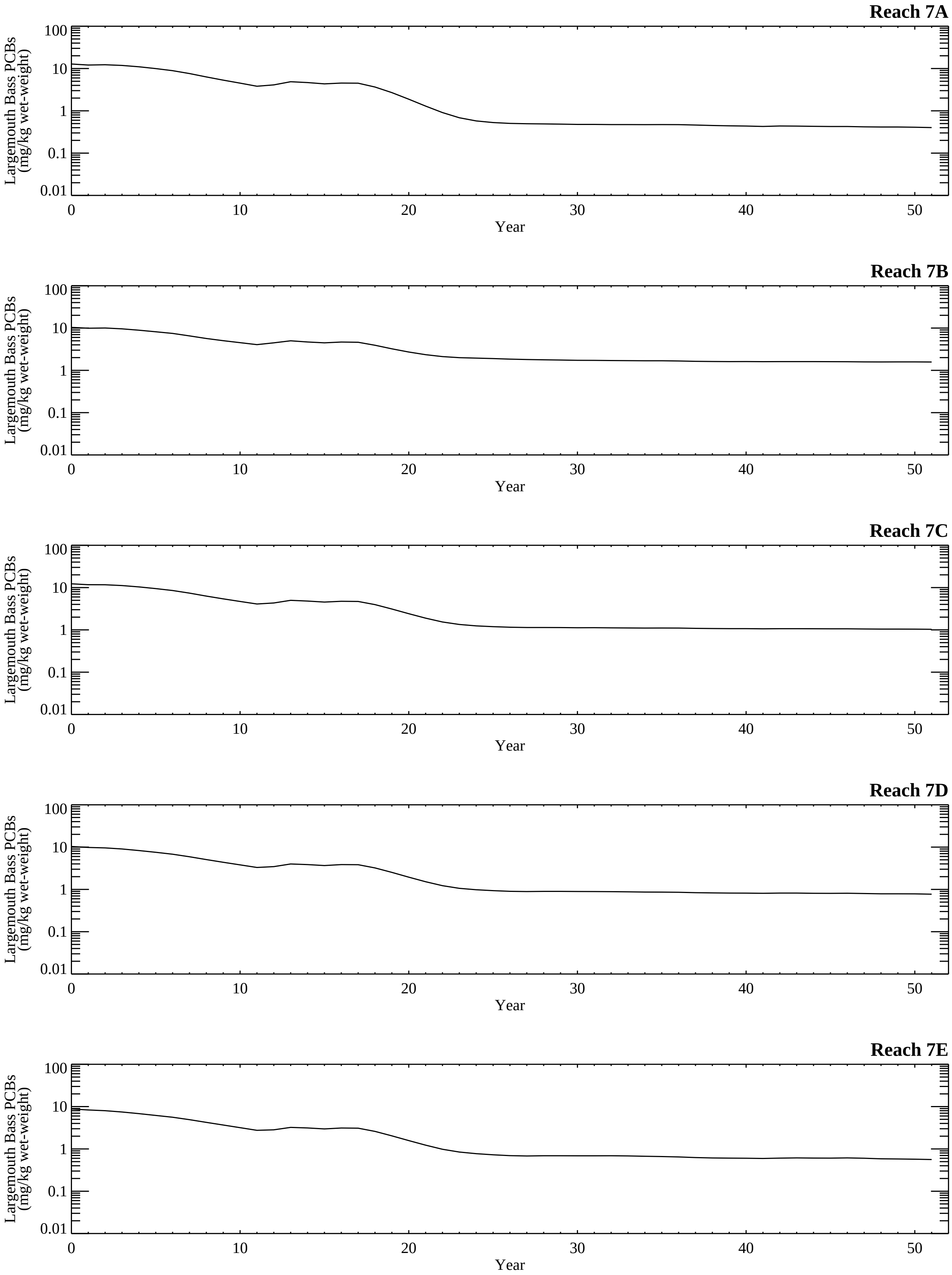


Figure G-1.8-4b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 5; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

SED 5; Lower Bound

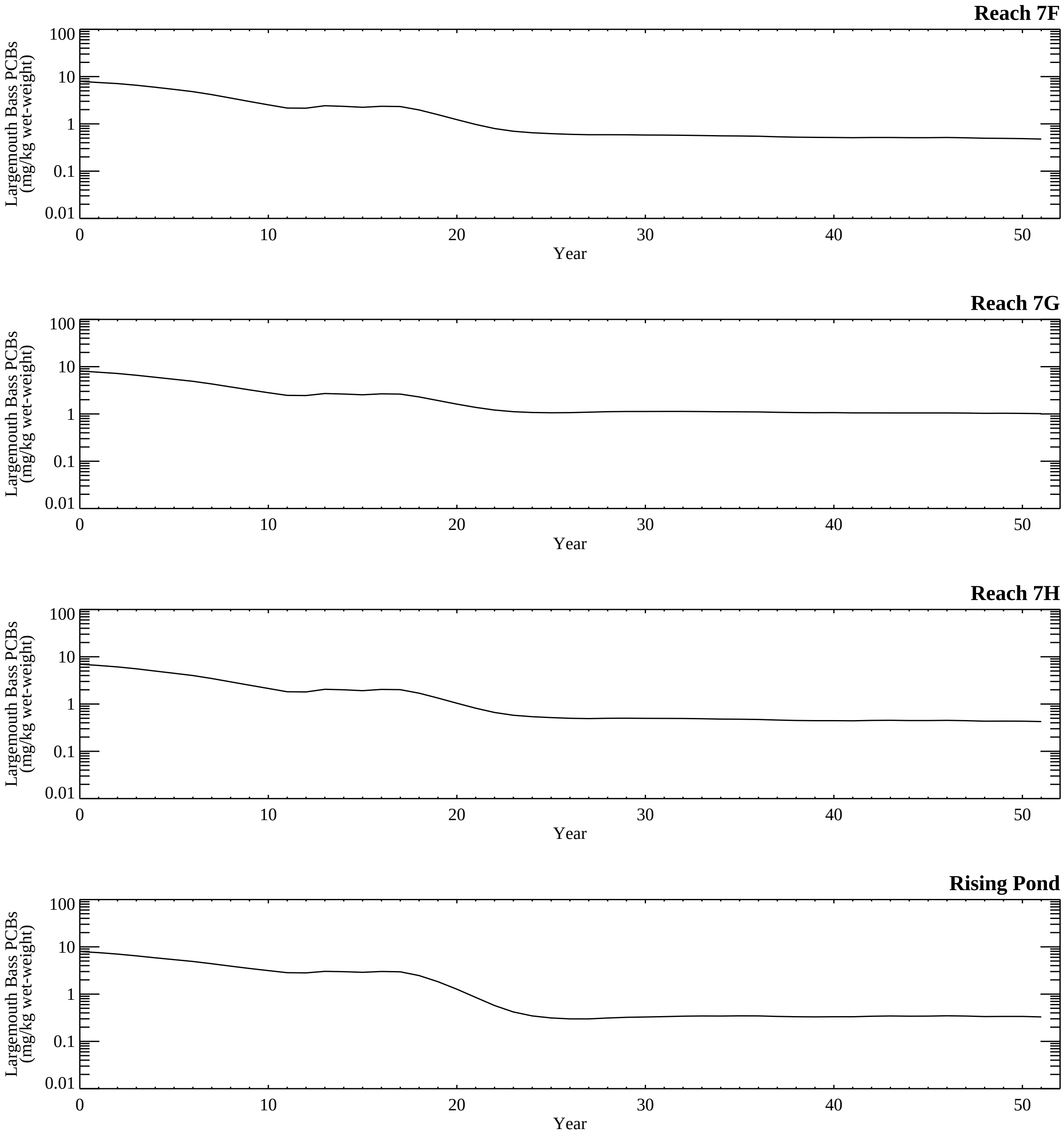


Figure G-1.8-4b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 5; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

SED 5; Lower Bound

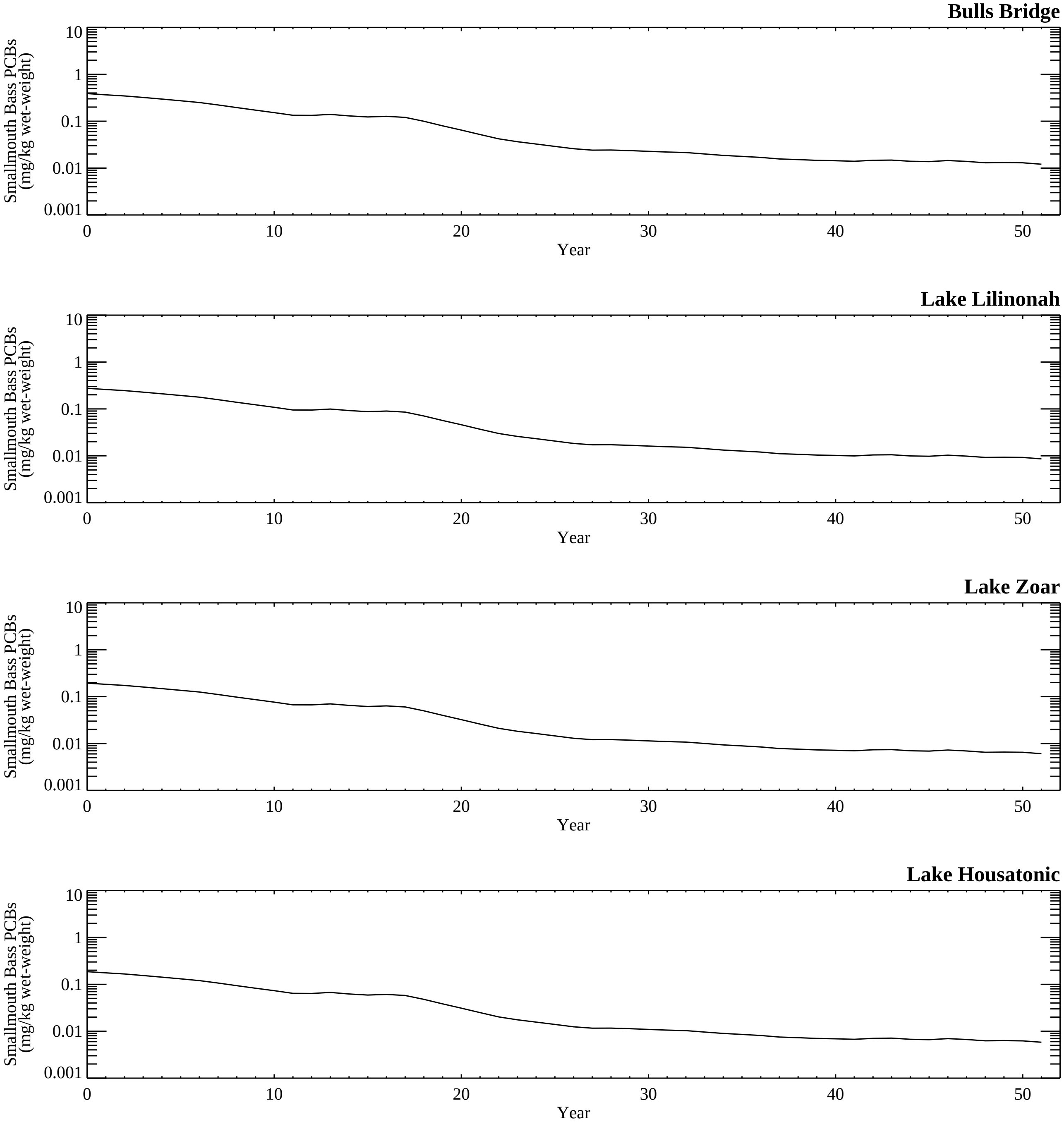


Figure G-1.8-4c. Temporal profiles of PCB concentrations in smallmouth bass fillets (SED 5; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

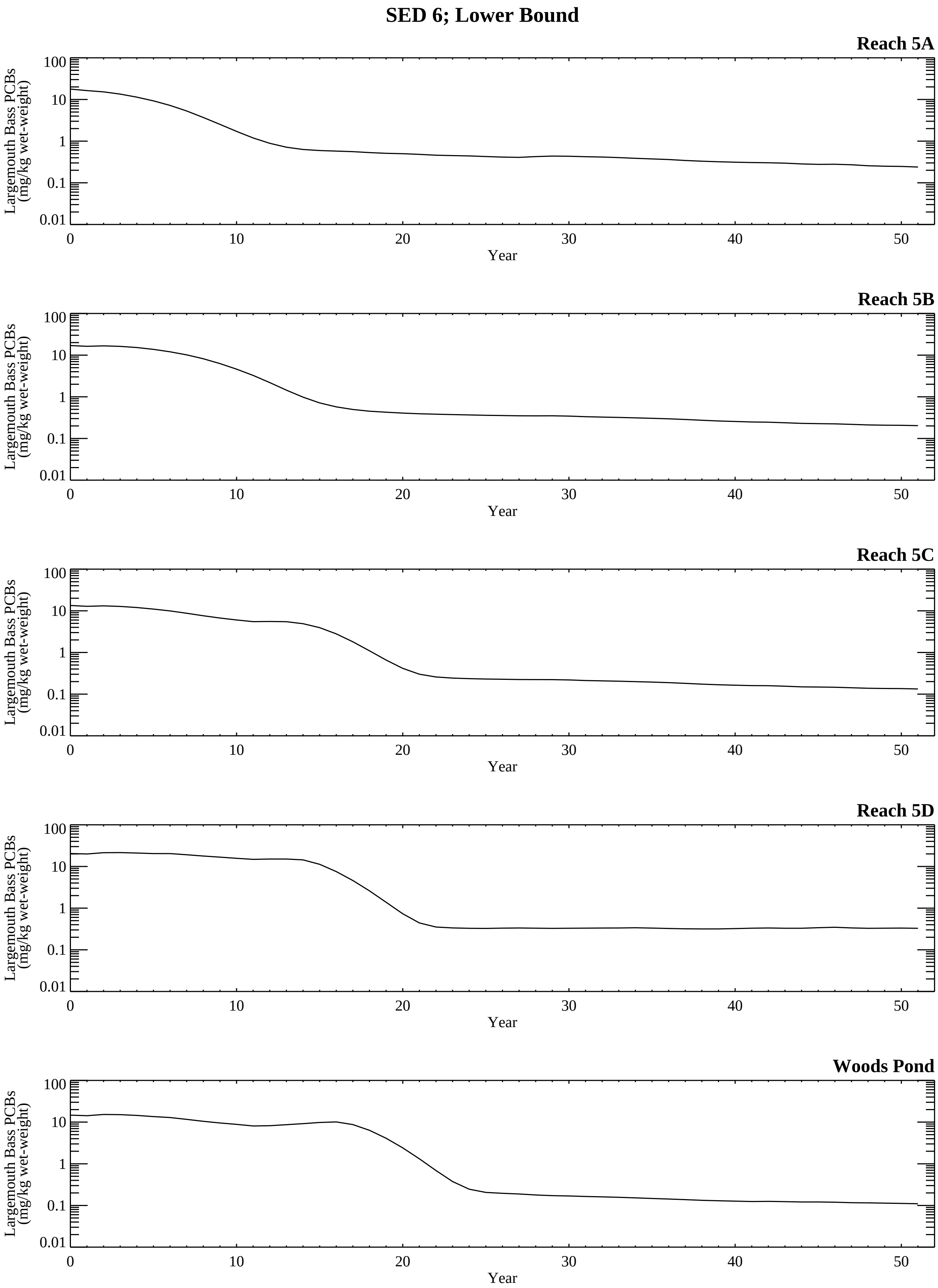


Figure G-1.8-5a. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 6; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

SED 6; Lower Bound

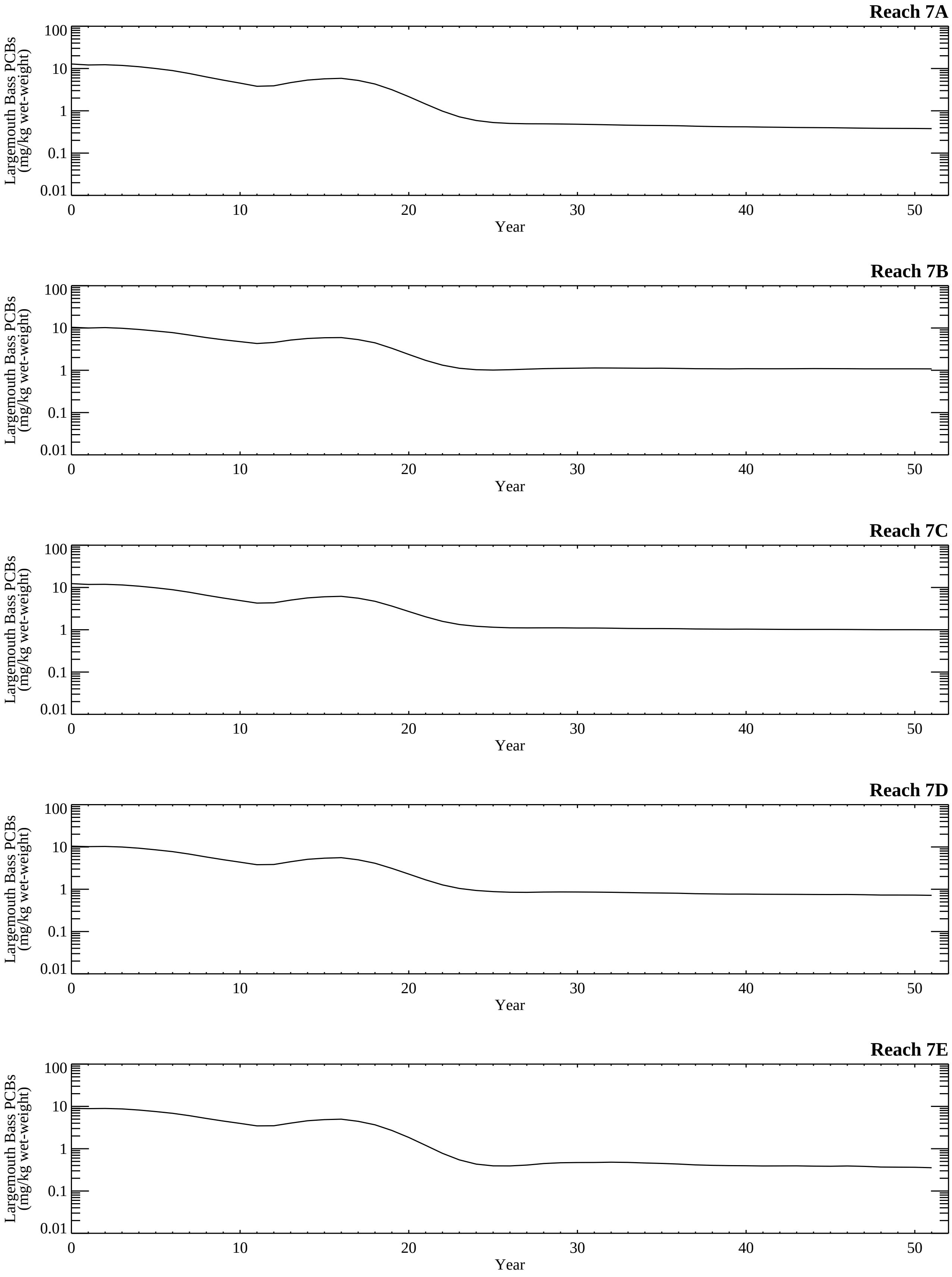


Figure G-1.8-5b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 6; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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Mon Mar 17 22:02:41 2008

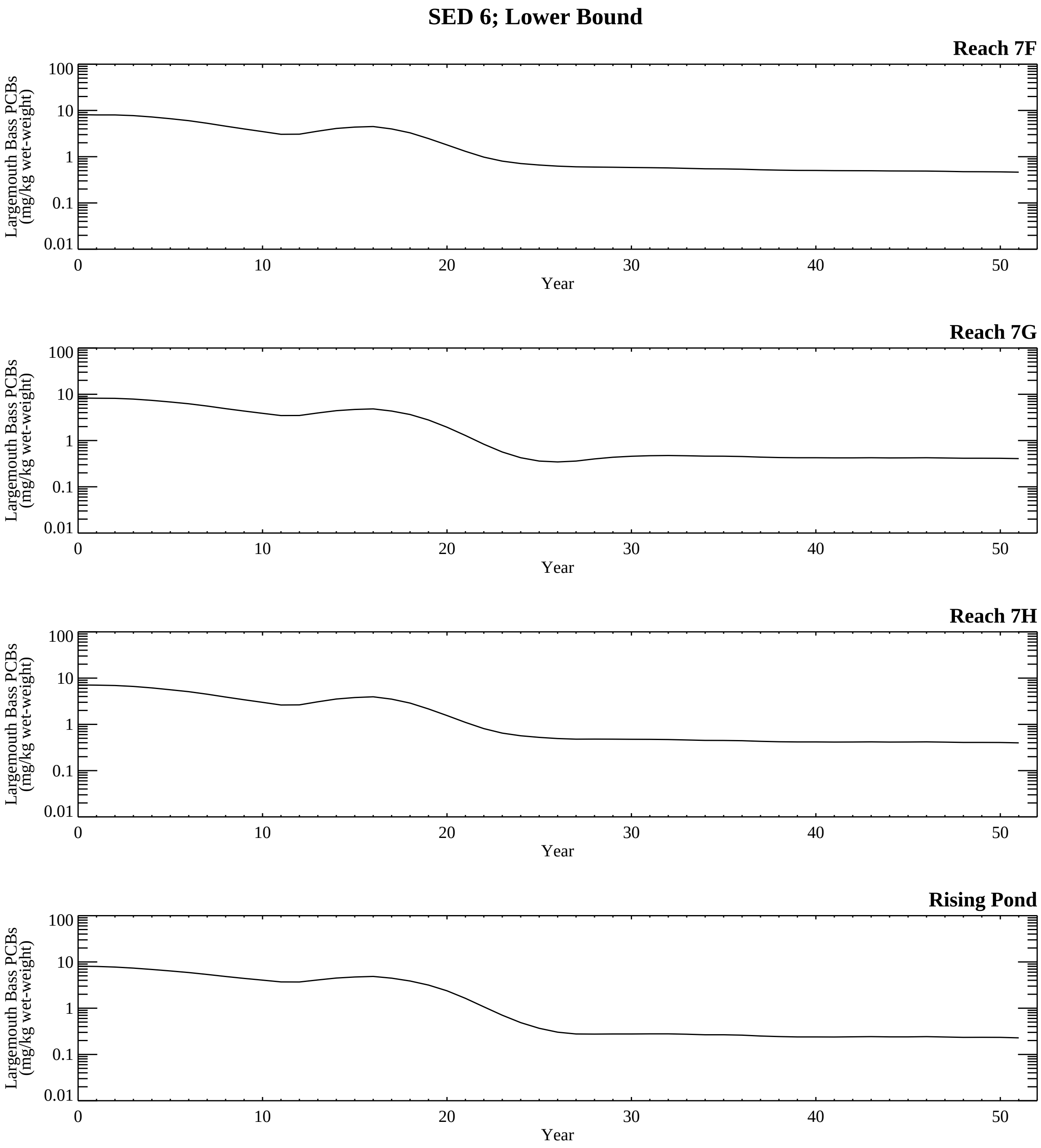

Figure G-1.8-5b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 6; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

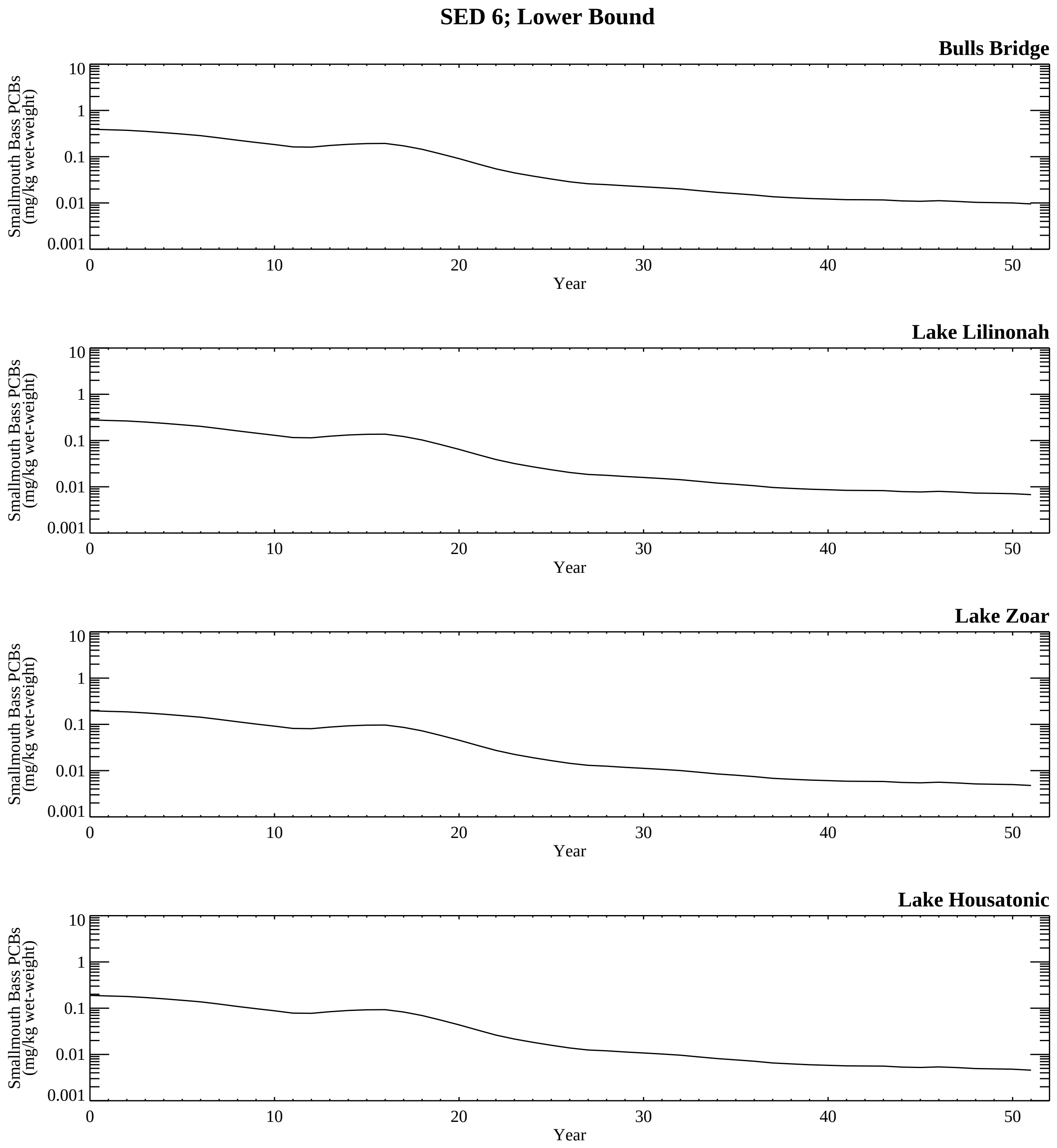

Figure G-1.8-5c. Temporal profiles of PCB concentrations in smallmouth bass fillets (SED 6; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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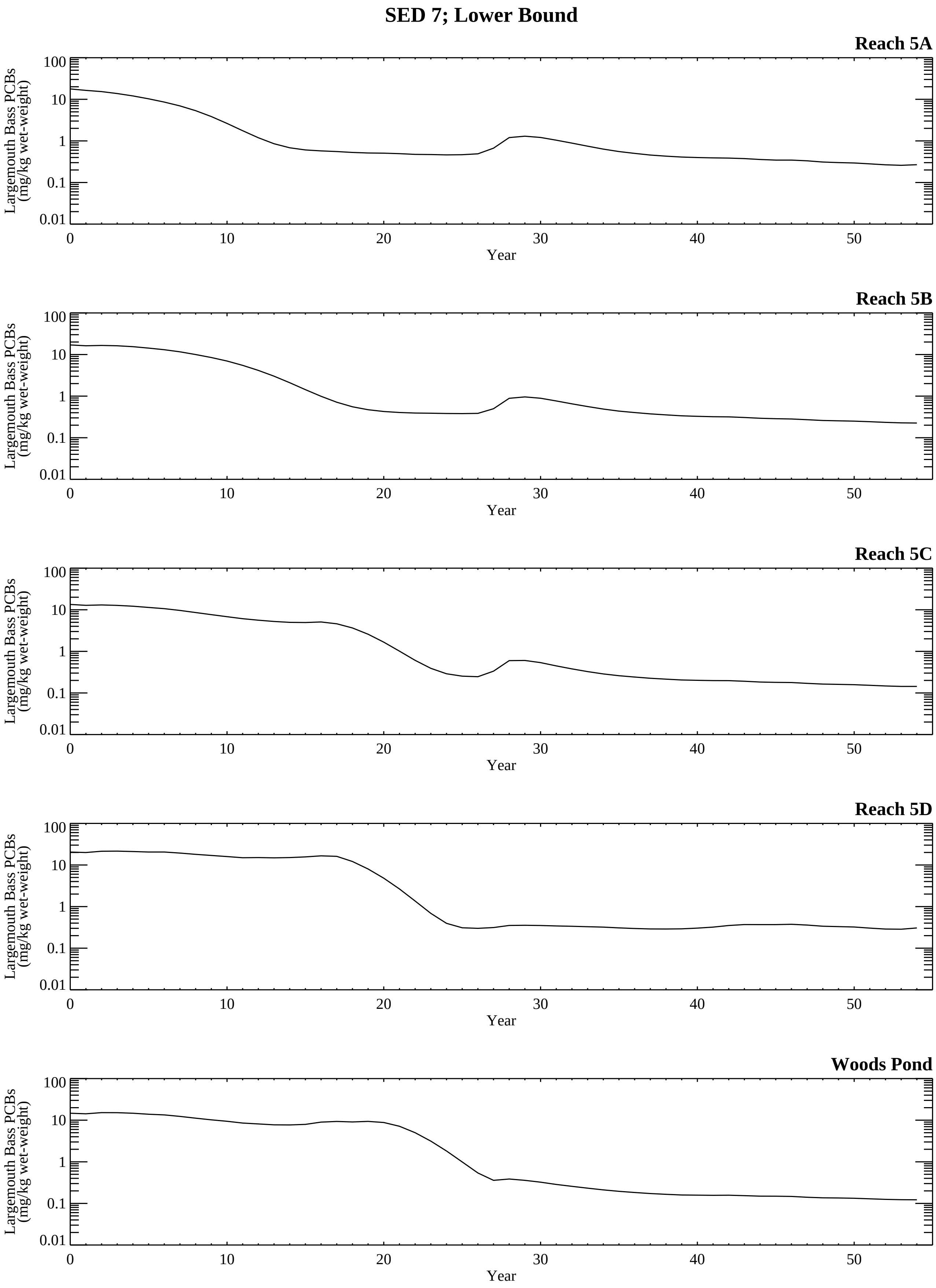

Figure G-1.8-6a. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 7; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

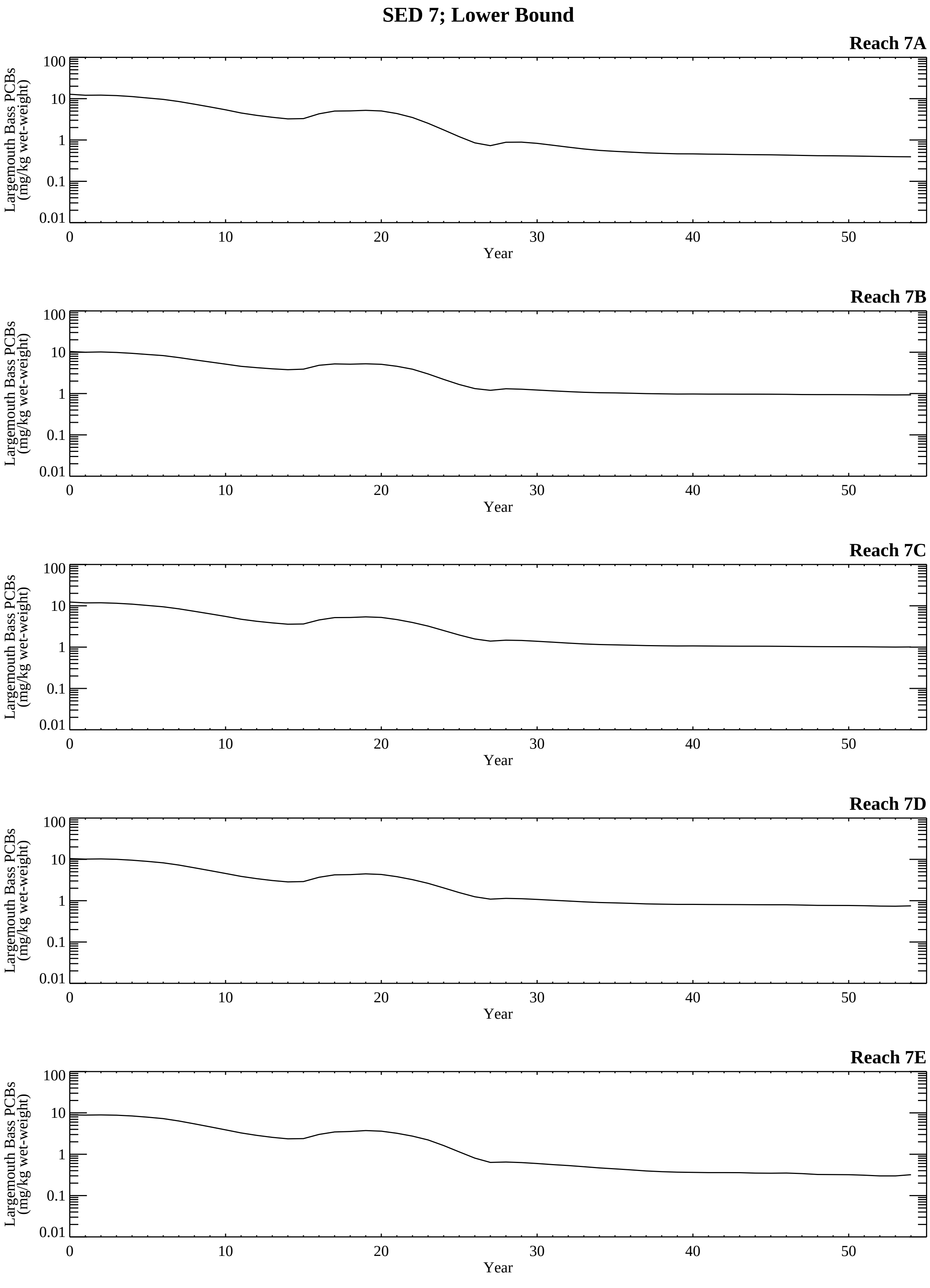

Figure G-1.8-6b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 7; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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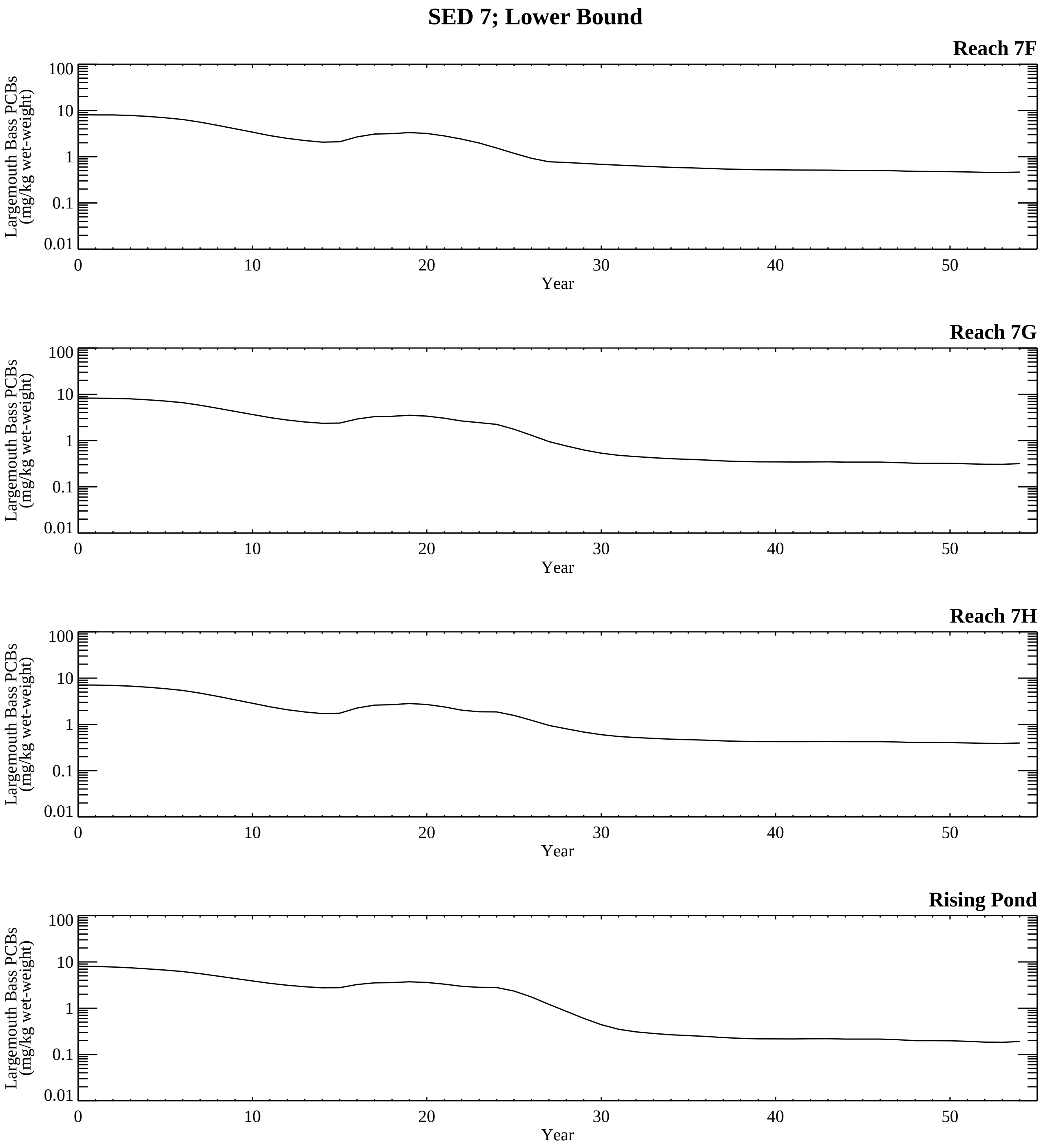

Figure G-1.8-6b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 7; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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Mon Mar 17 22:07:56 2008

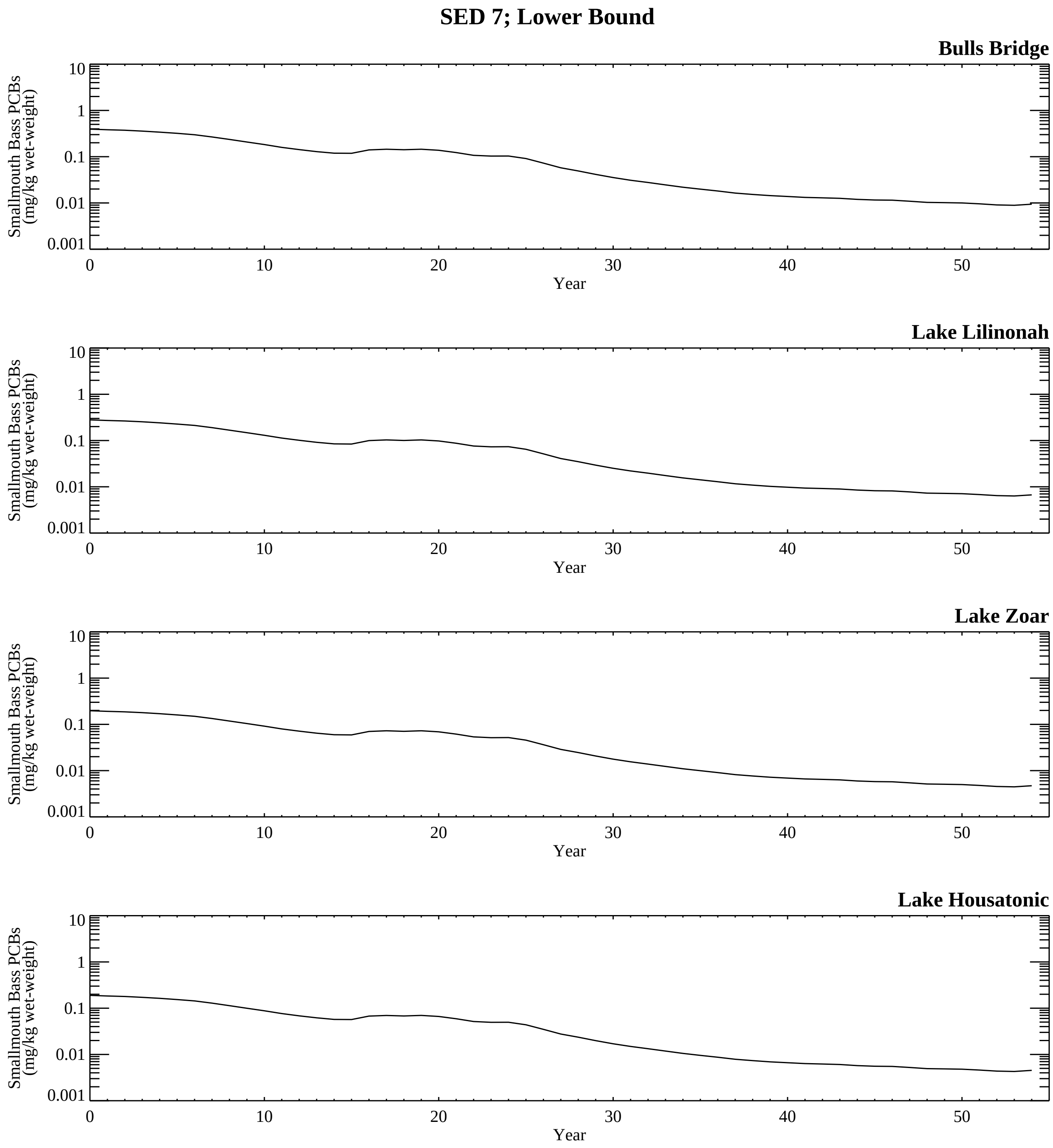

Figure G-1.8-6c. Temporal profiles of PCB concentrations in smallmouth bass fillets (SED 7; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

SED 8; Lower Bound

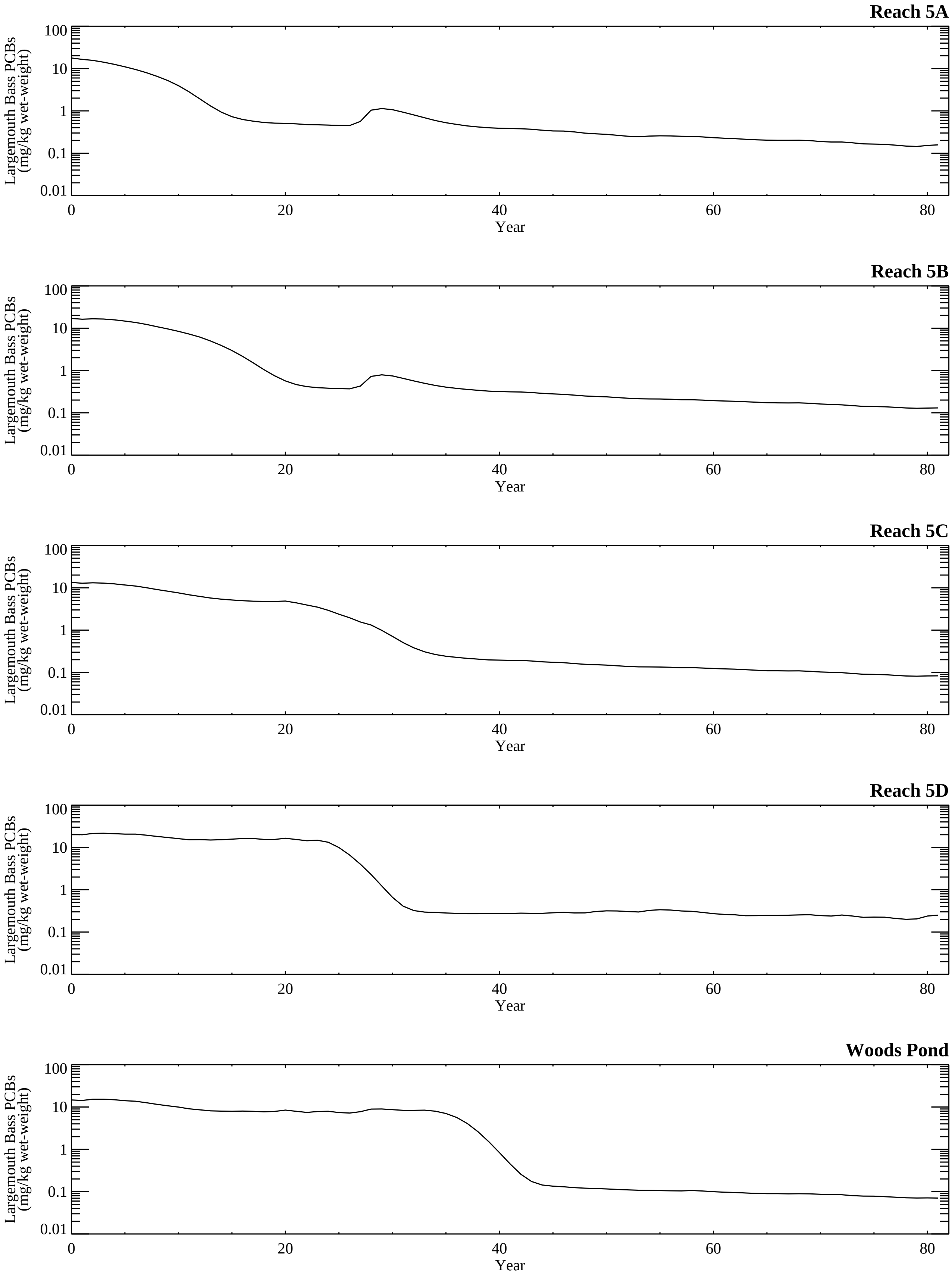

Figure G-1.8-7a. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 8; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

SED 8; Lower Bound

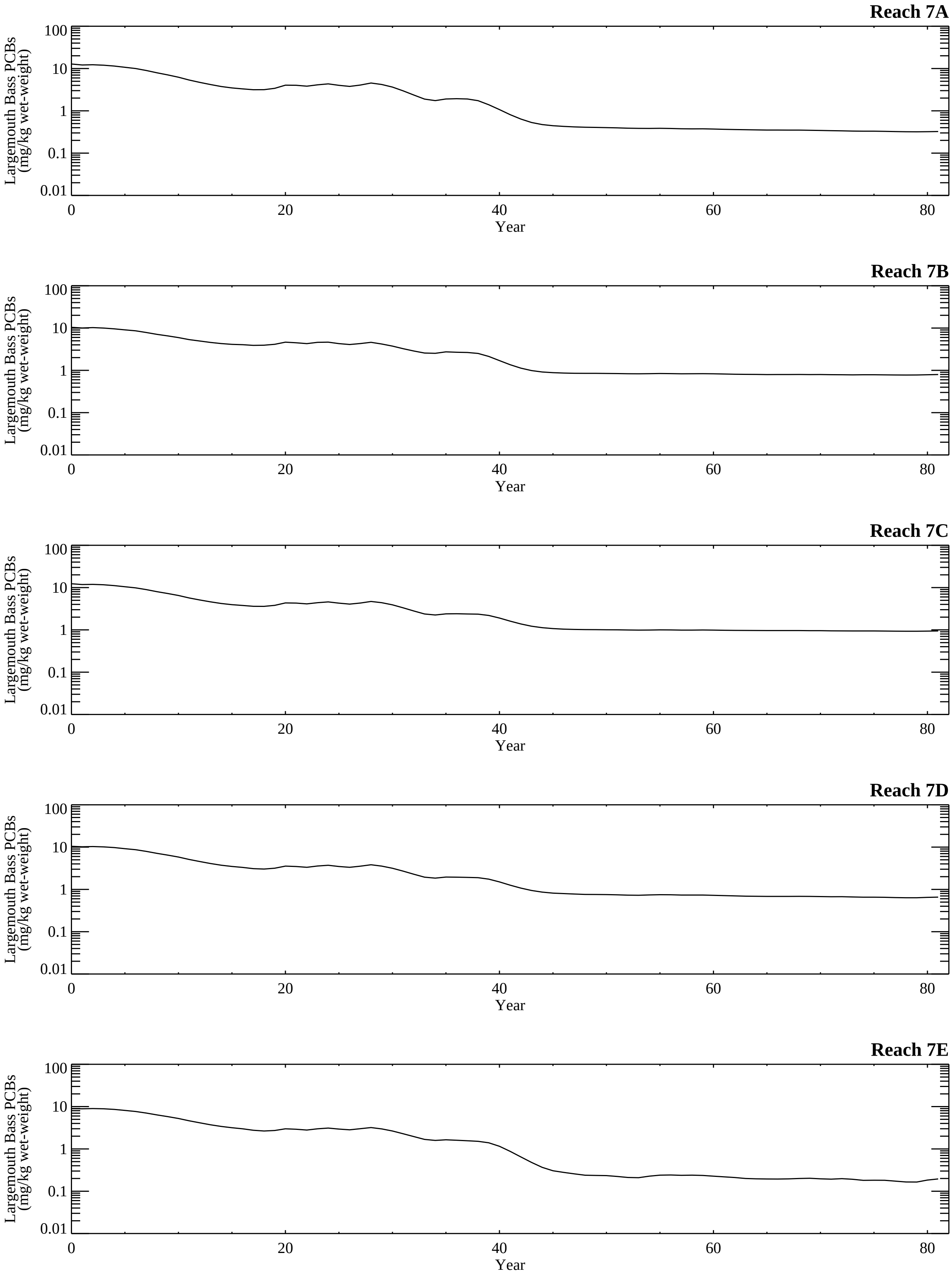

Figure G-1.8-7b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 8; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

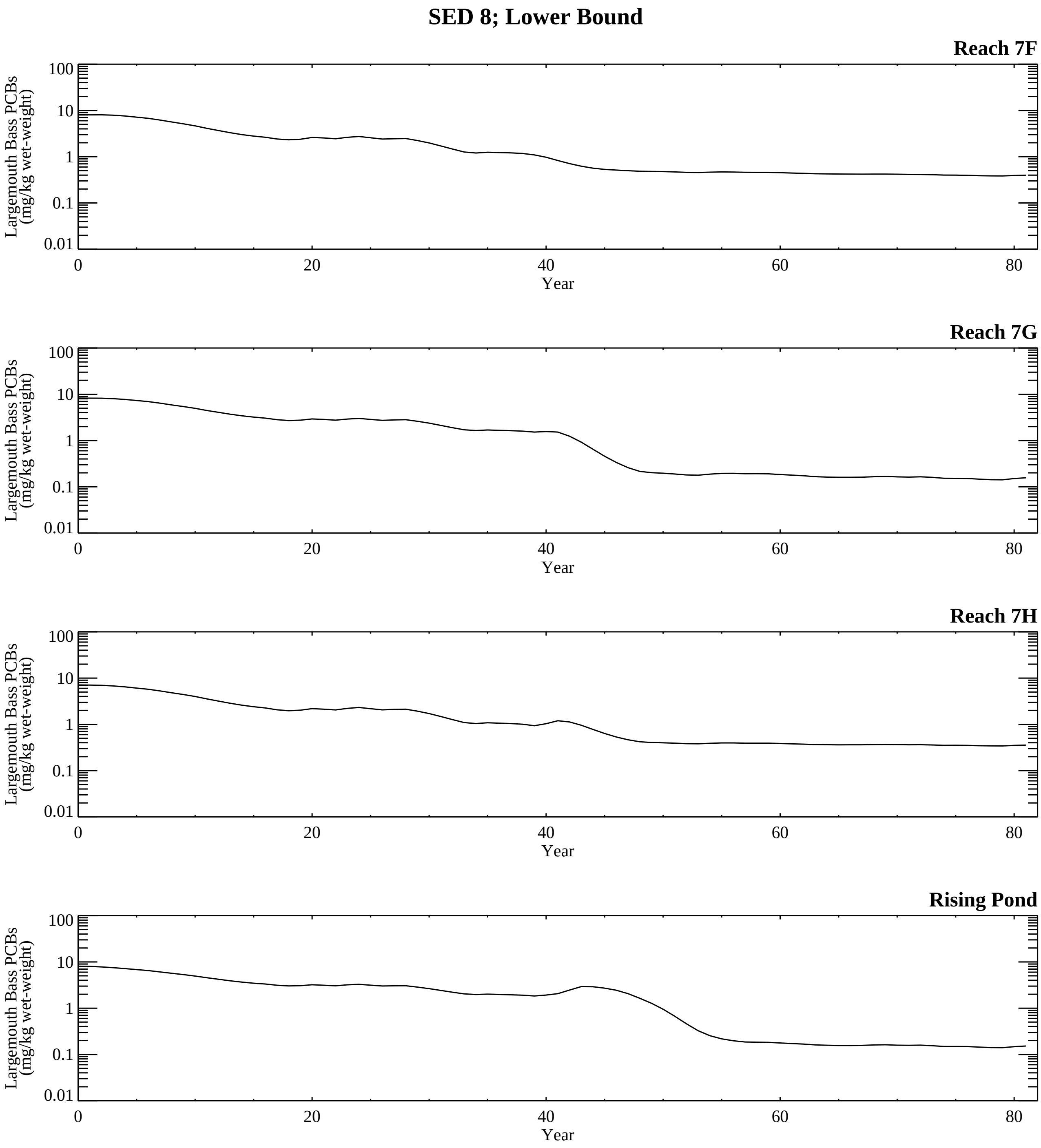

Figure G-1.8-7b. Temporal profiles of PCB concentrations in largemouth bass fillets (SED 8; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

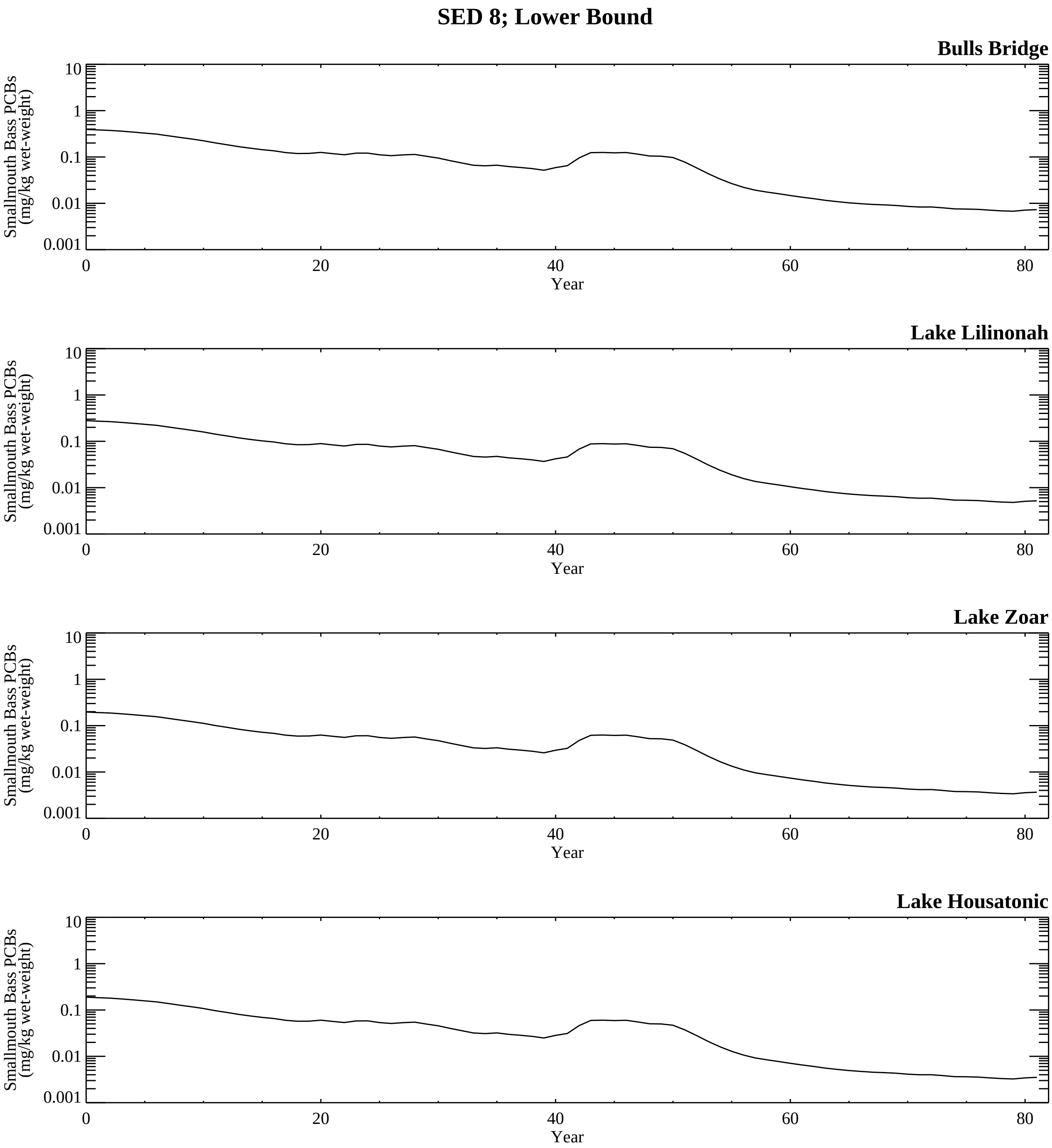

Figure G-1.8-7c. Temporal profiles of PCB concentrations in smallmouth bass fillets (SED 8; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

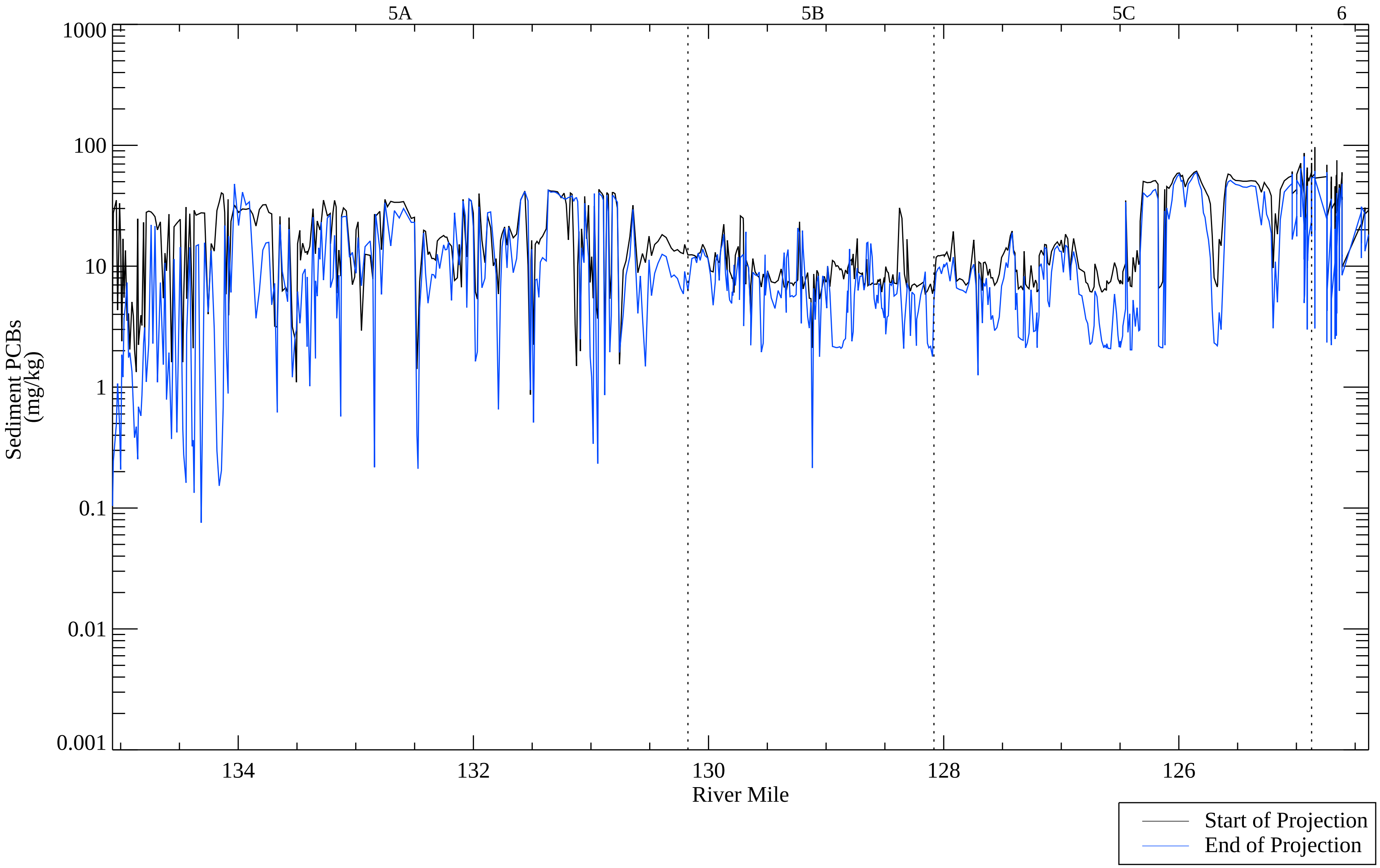

Figure G-2.1-1a. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 1 / SED 2; Reach 5/6; Base Case).

Run path:\\Tenmile\efdc_output\r56\CMS\Proj_R56_SED1CMSBS_0712-01\bins

Note: Sediment PCB profiles are plotted using individual grid cells

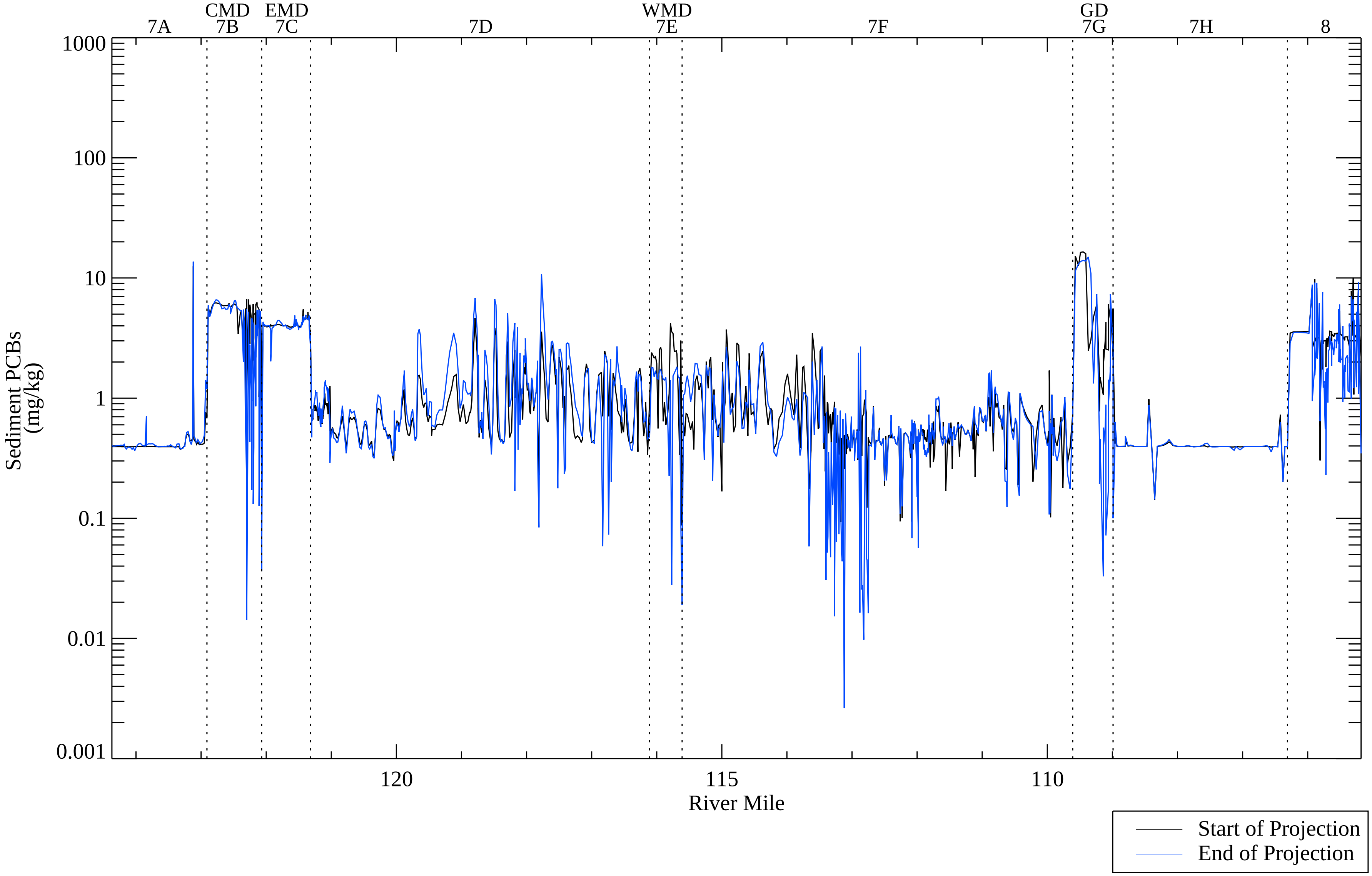

Figure G-2.1-1b. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 1 / SED 2; Reach 7/8; Base Case).

Run path:\\Tenmile\efdc_output\r78\CMS\Proj_R78_SED1CMSBS_0712-28\bins

Note: Sediment PCB profiles are plotted using individual grid cells
Abbreviations: CMD=Columbia Mill Dam; EMD=Former Eagle Mill Dam; WMD=Willow Mill Dam; GD=Glendale Dam

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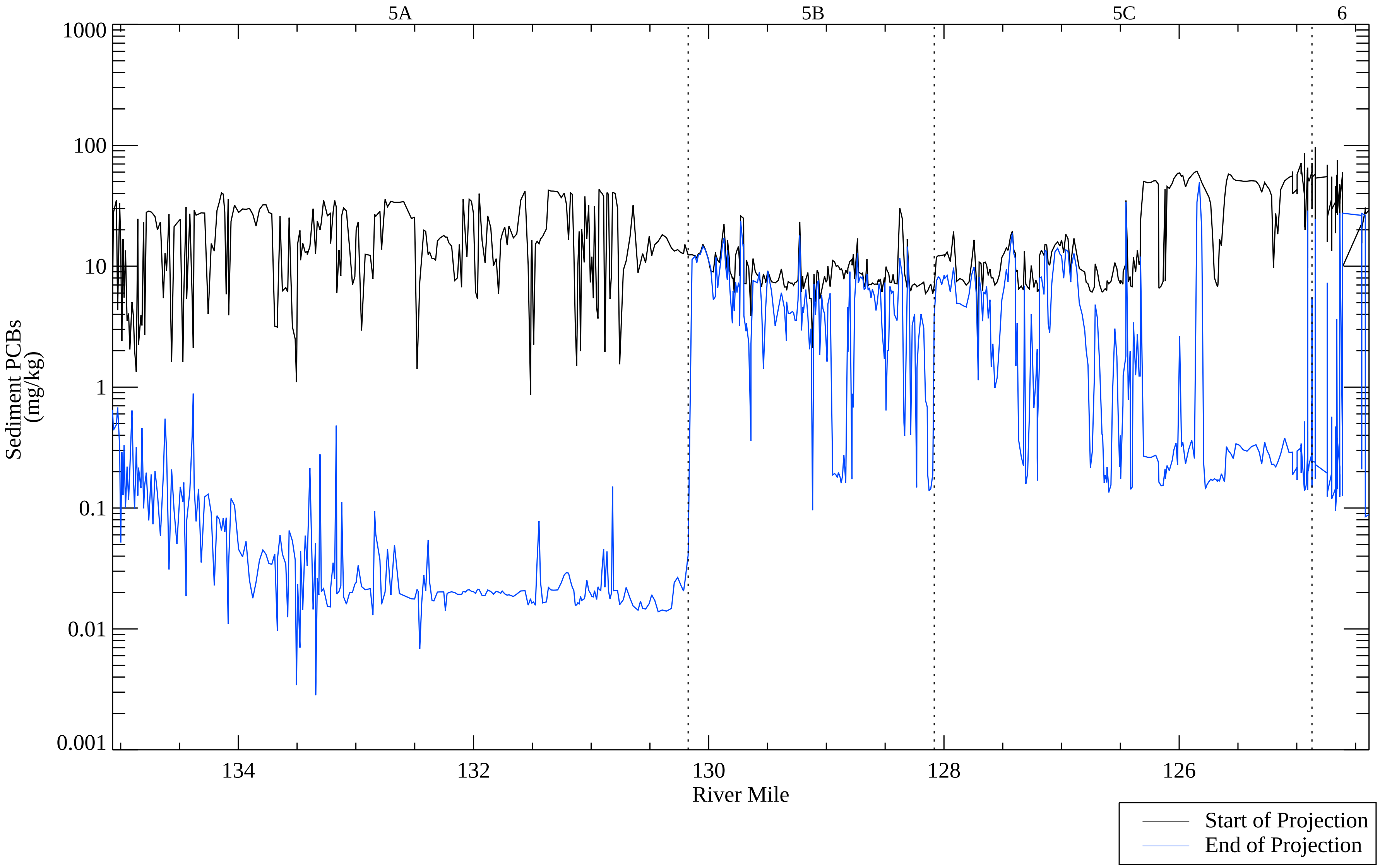

Figure G-2.1-2a. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 3; Reach 5/6; Base Case).

Run path:\\Tenmile\efdc_output\r56\CMS\Proj_R56_SED3CMSBS_0712-13\bins

Note: Sediment PCB profiles are plotted using individual grid cells

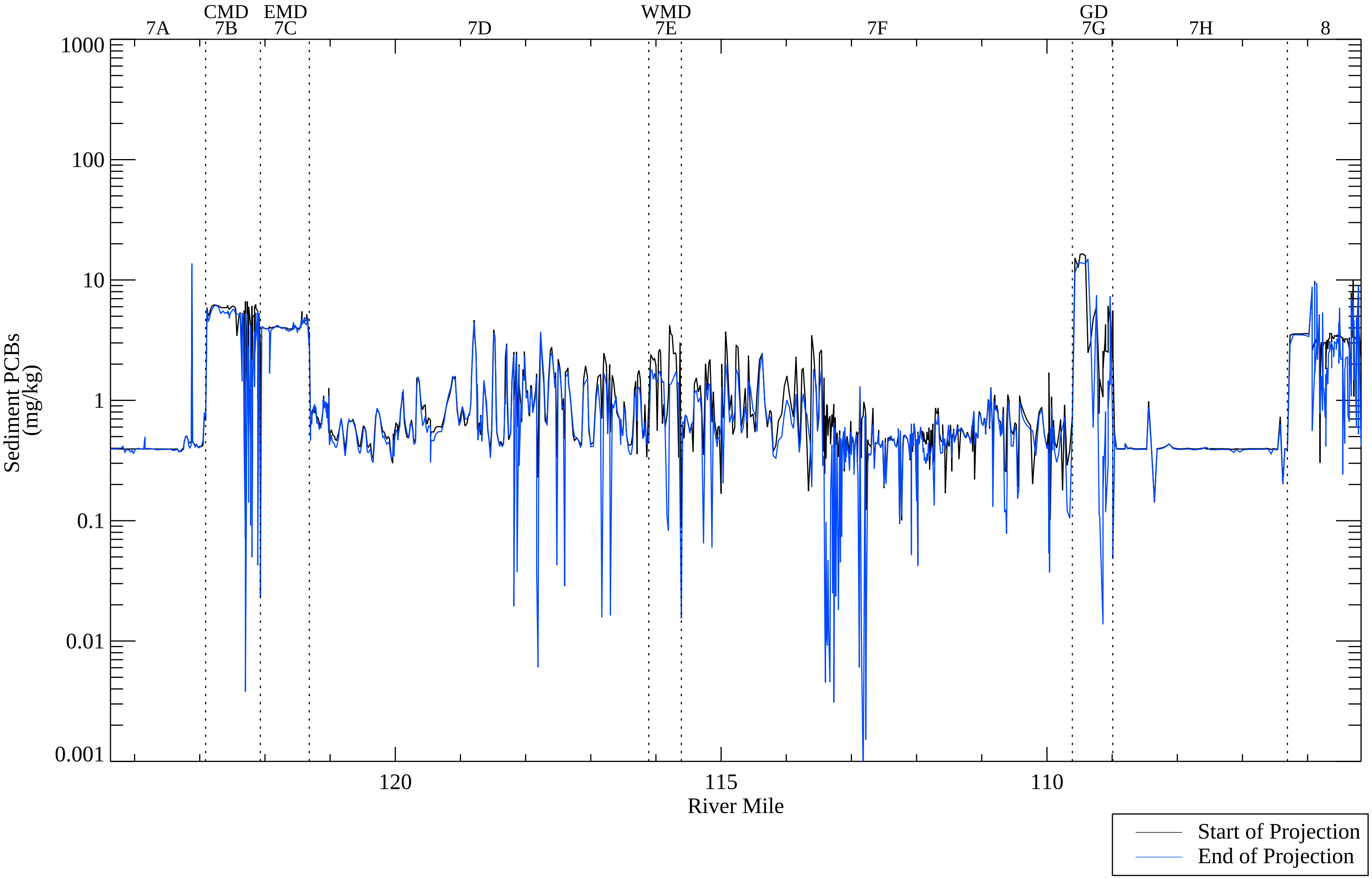

Figure G-2.1-2b. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 3; Reach 7/8; Base Case).

Run path:\\Tenmile\efdc_output\r78\CMS\Proj_R78_SED3CMSBS_0712-29\bins

Note: Sediment PCB profiles are plotted using individual grid cells
Abbreviations: CMD=Columbia Mill Dam; EMD=Former Eagle Mill Dam; WMD=Willow Mill Dam; GD=Glendale Dam

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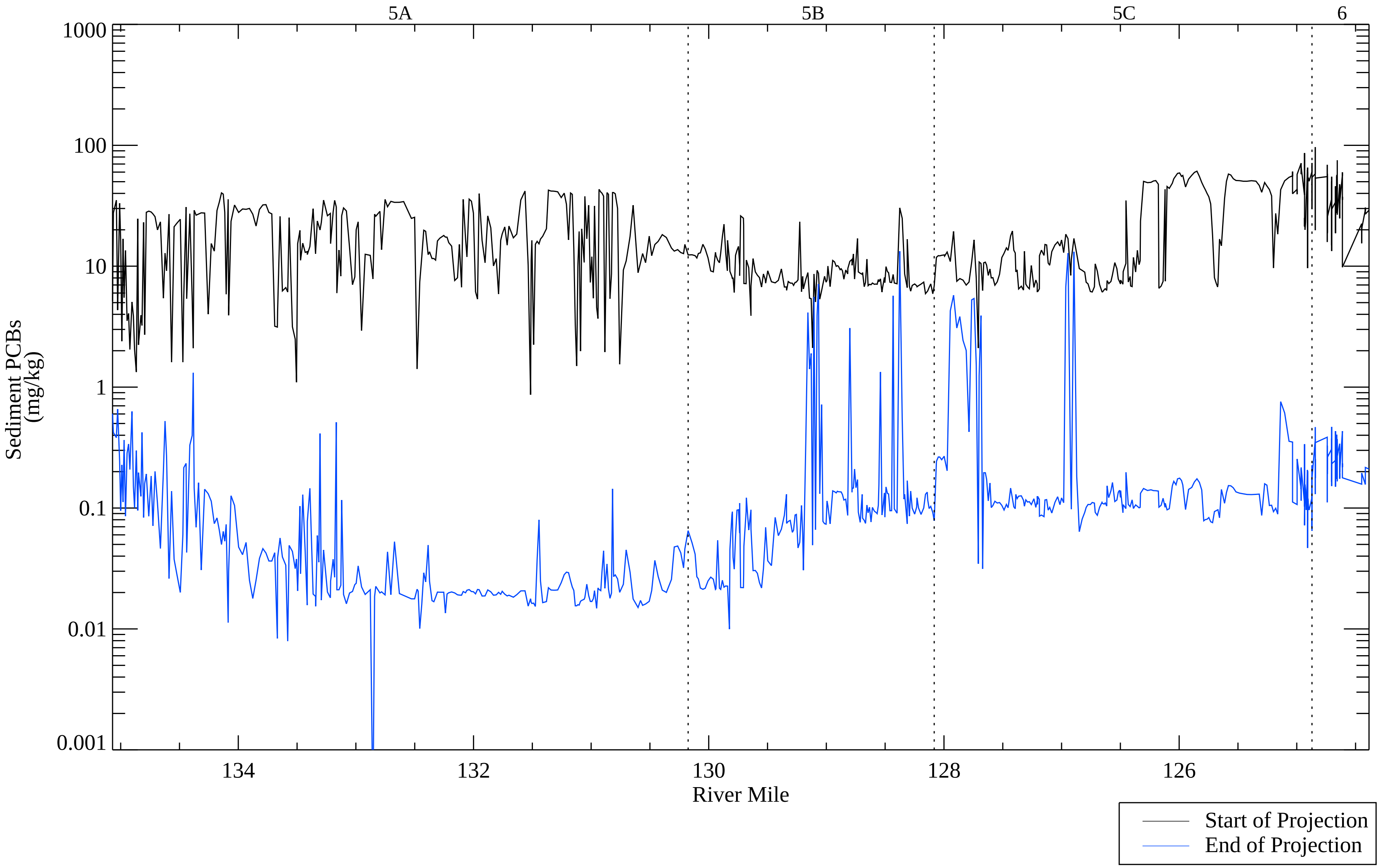

Figure G-2.1-3a. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 4; Reach 5/6; Base Case).

Run path:\\Tenmile\efdc_output\r56\CMS\Proj_R56_SED4CMSBS_0801-01\bins

Note: Sediment PCB profiles are plotted using individual grid cells

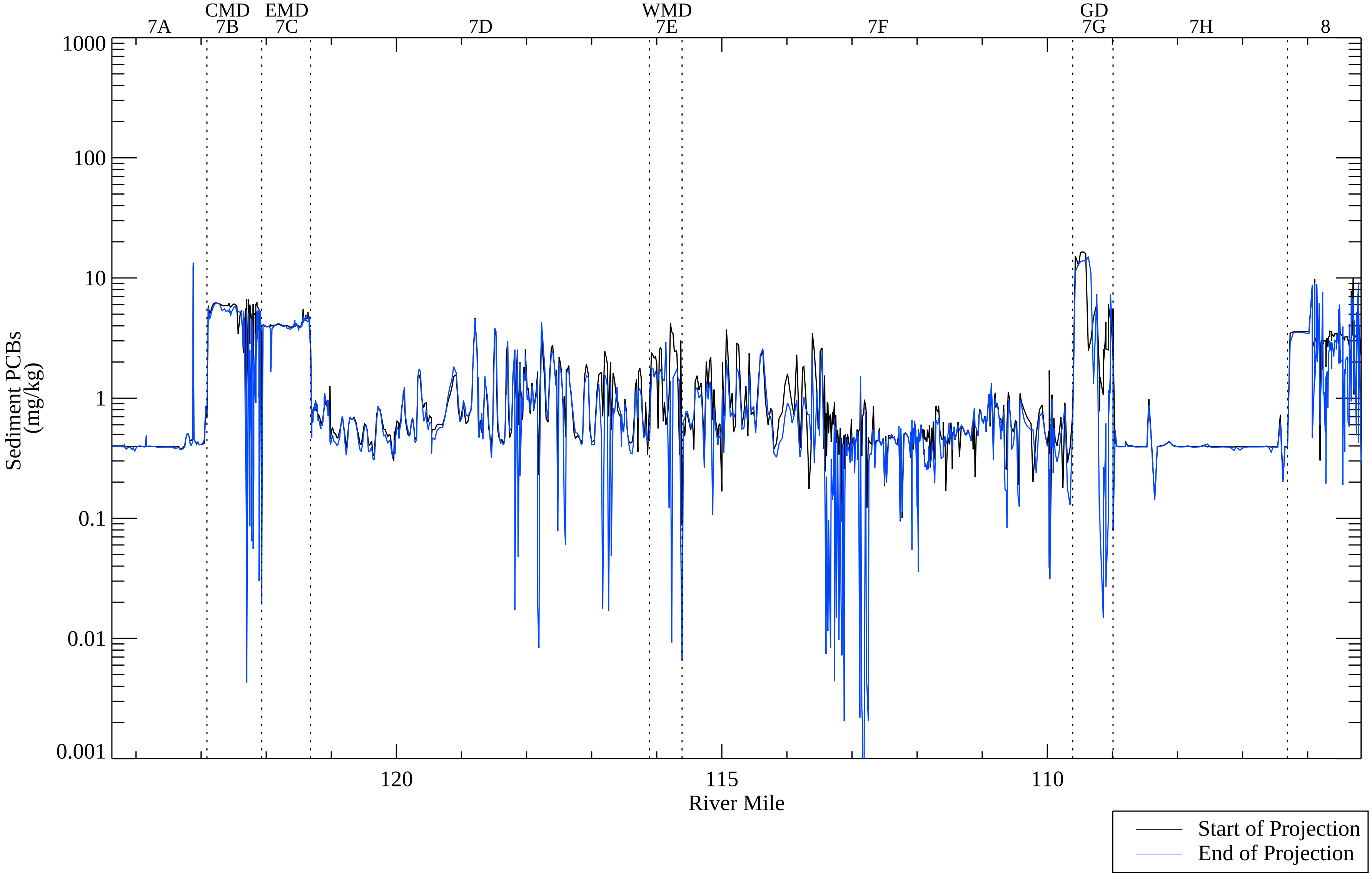

Figure G-2.1-3b. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 4; Reach 7/8; Base Case).

Run path:\\Tenmile\efdc_output\r78\CMS\Proj_R78_SED4CMSBS_0802-01\bins

Note: Sediment PCB profiles are plotted using individual grid cells
Abbreviations: CMD=Columbia Mill Dam; EMD=Former Eagle Mill Dam; WMD=Willow Mill Dam; GD=Glendale Dam

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Tue Mar 18 21:08:00 2008

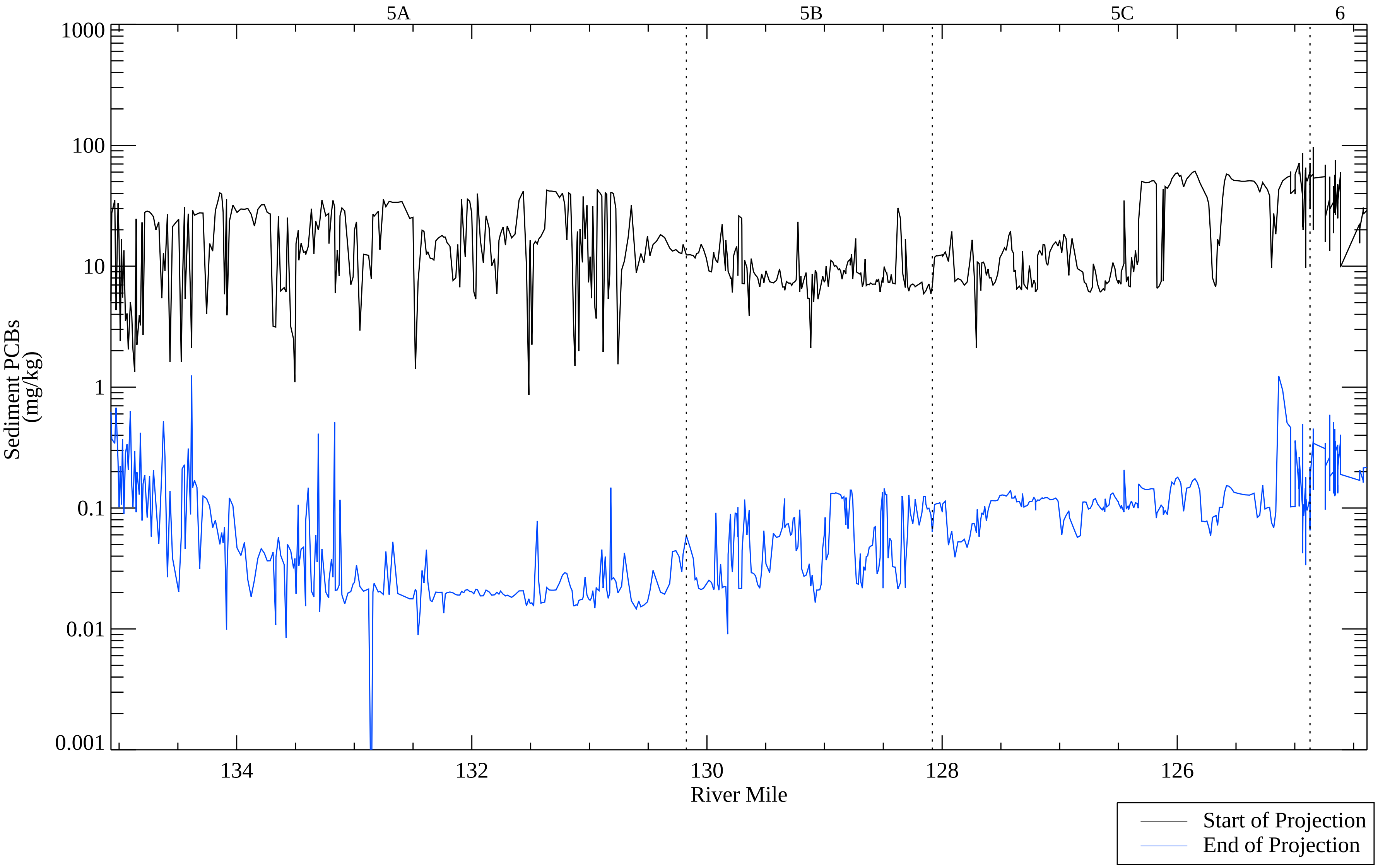

Figure G-2.1-4a. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 5; Reach 5/6; Base Case).

Run path:\\Tenmile\efdc_output\r56\CMS\Proj_R56_SED5CMSBS_0801-02\bins

Note: Sediment PCB profiles are plotted using individual grid cells

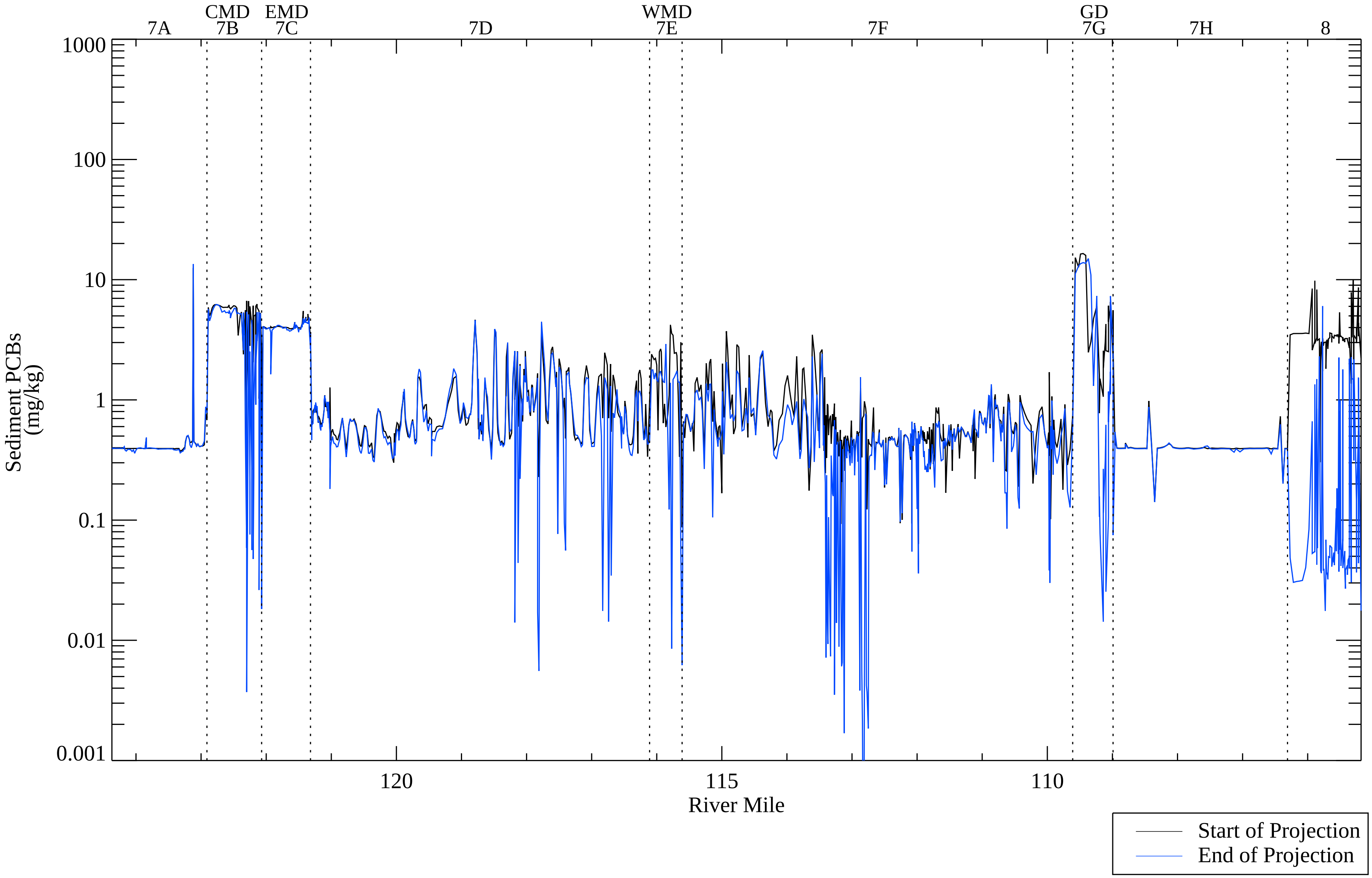

Figure G-2.1-4b. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 5; Reach 7/8; Base Case).

Run path:\\Tenmile\efdc_output\r78\CMS\proj_R78_SED5CMSBS_0802-02\bins

Note: Sediment PCB profiles are plotted using individual grid cells
Abbreviations: CMD=Columbia Mill Dam; EMD=Former Eagle Mill Dam; WMD=Willow Mill Dam; GD=Glendale Dam

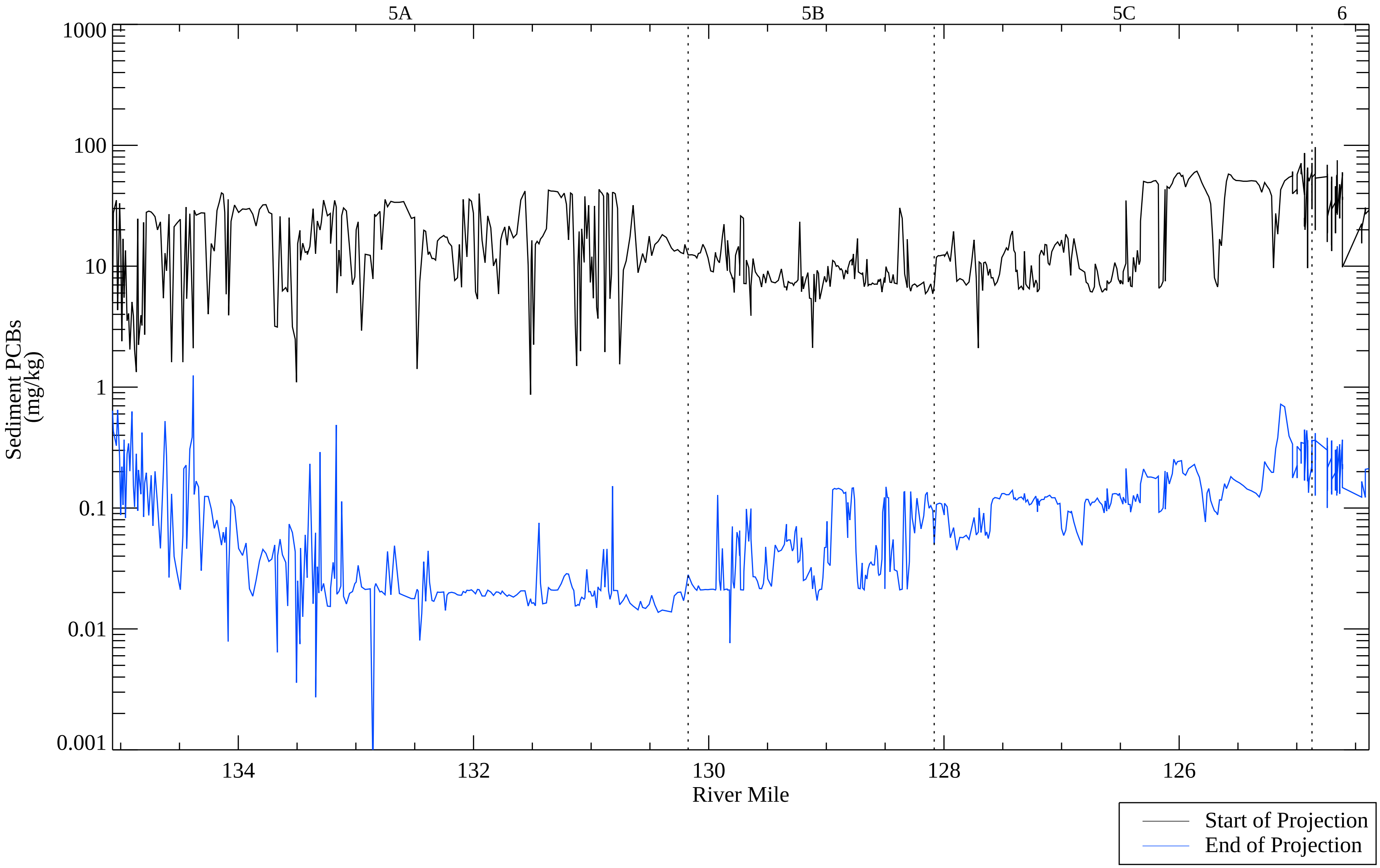

Figure G-2.1-5a. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 6; Reach 5/6; Base Case).

Run path:\\Tenmile\efdc_output\r56\CMS\Proj_R56_SED6CMSBS_0712-16\bins

Note: Sediment PCB profiles are plotted using individual grid cells

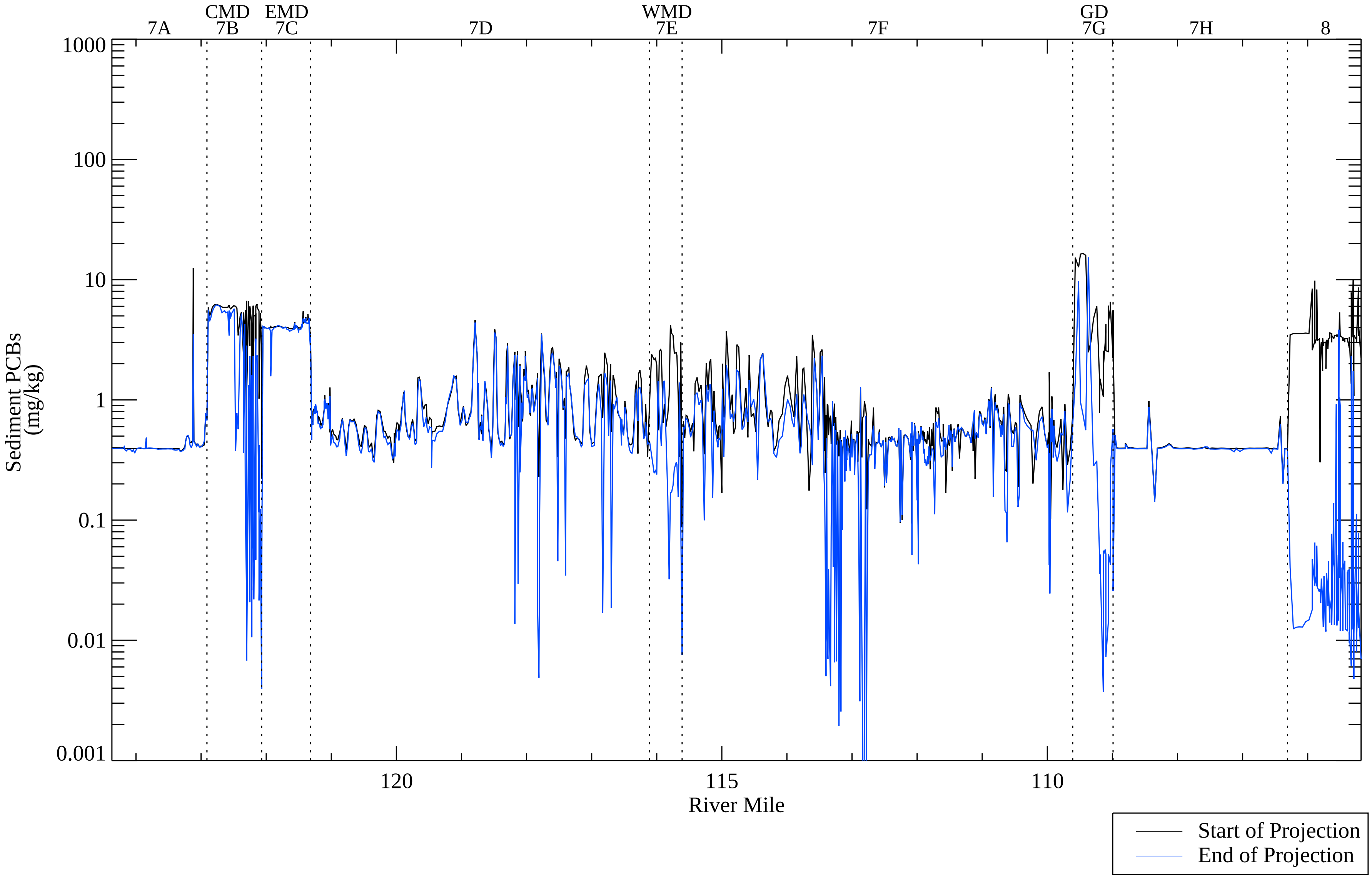

Figure G-2.1-5b. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 6; Reach 7/8; Base Case).

Run path:\\Tenmile\efdc_output\r78\CMS\Proj_R78_SED6CMSBS_0712-32\bins

Note: Sediment PCB profiles are plotted using individual grid cells
Abbreviations: CMD=Columbia Mill Dam; EMD=Former Eagle Mill Dam; WMD=Willow Mill Dam; GD=Glendale Dam

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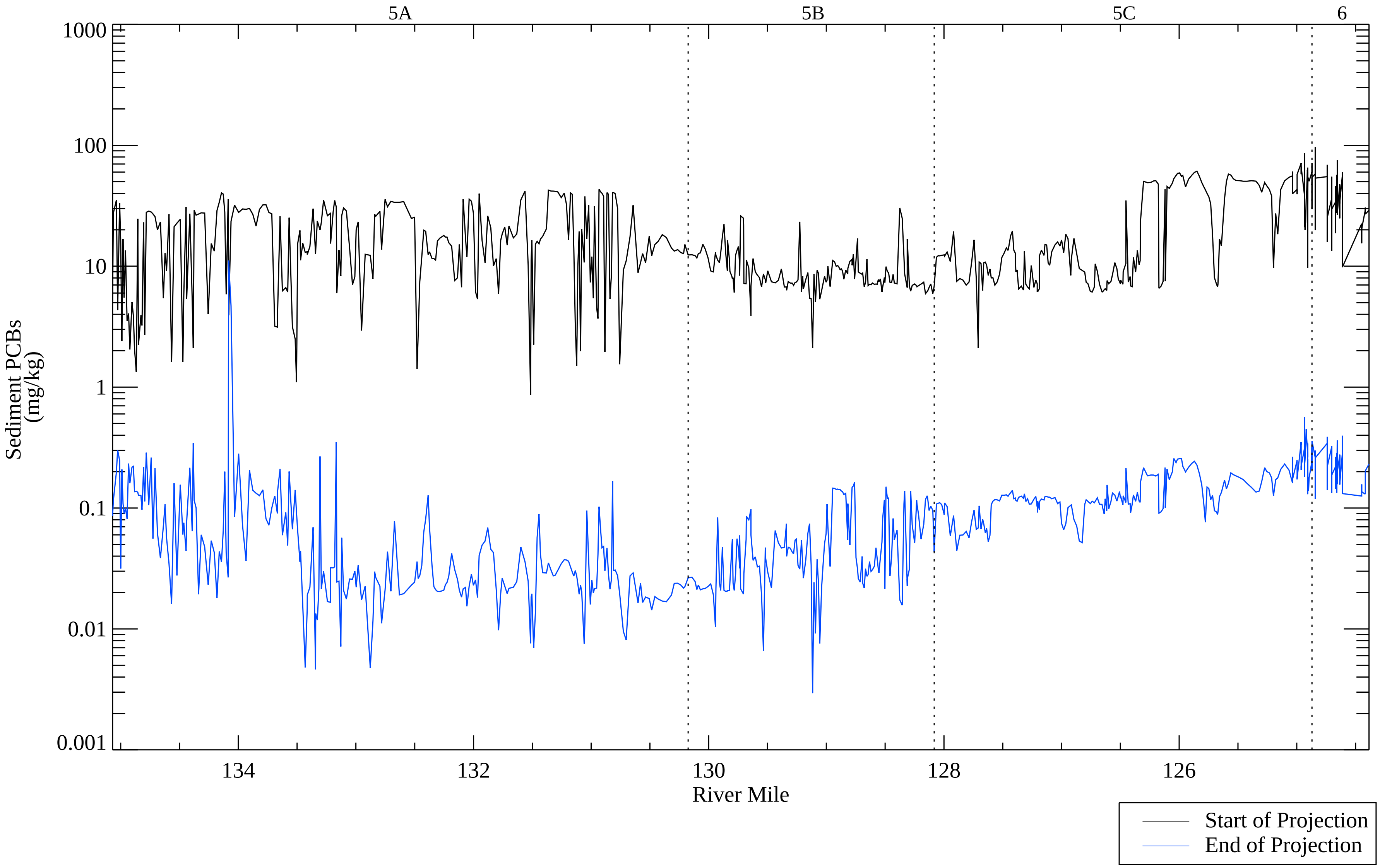

Figure G-2.1-6a. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 7; Reach 5/6; Base Case).

Run path:\\Tenmile\efdc_output\r56\CMS\Proj_R56_SED7CMSBS_0712-03\bins

Note: Sediment PCB profiles are plotted using individual grid cells

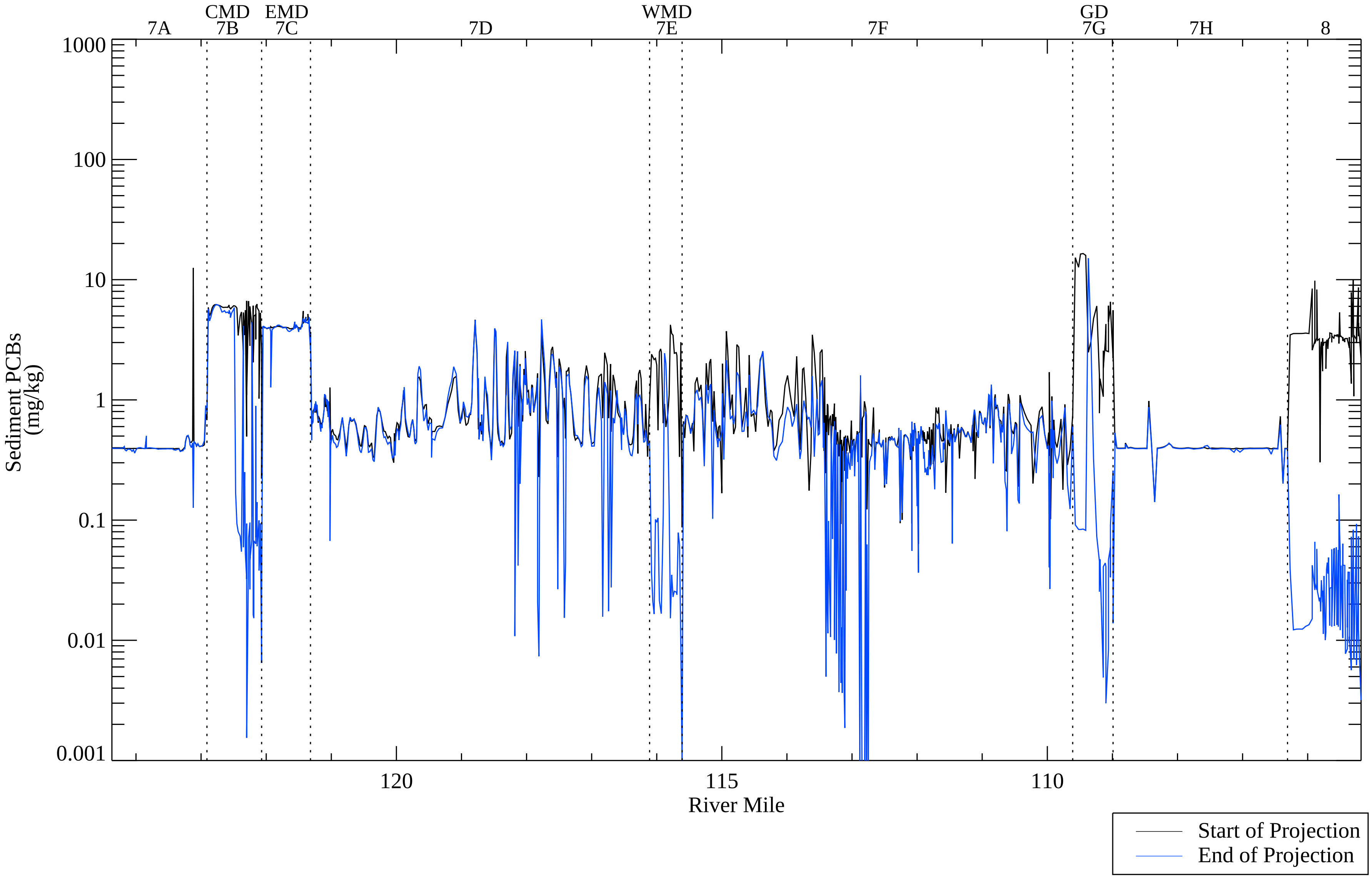

Figure G-2.1-6b. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 7; Reach 7/8; Base Case).

Run path:\\Tenmile\efdc_output\r78\CMS\Proj_R78_SED7CMSBS_0712-33\bins

Note: Sediment PCB profiles are plotted using individual grid cells
Abbreviations: CMD=Columbia Mill Dam; EMD=Former Eagle Mill Dam; WMD=Willow Mill Dam; GD=Glendale Dam

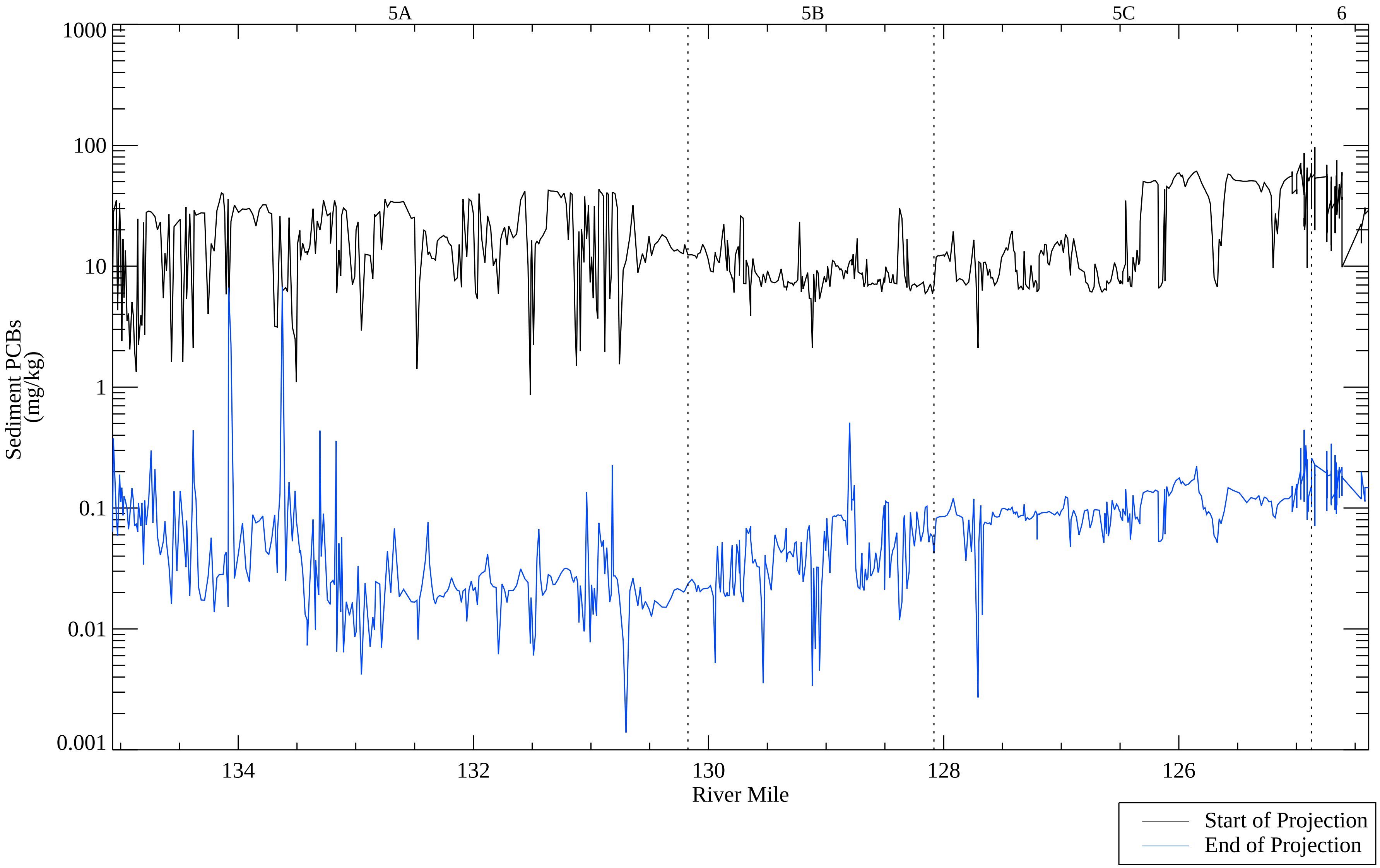

Figure G-2.1-7a. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 8; Reach 5/6; Base Case).

Run path:\\Tenmile\efdc_output\r56\CMS\Proj_R56_SED8CMSBS_0712-18\bins

Note: Sediment PCB profiles are plotted using individual grid cells

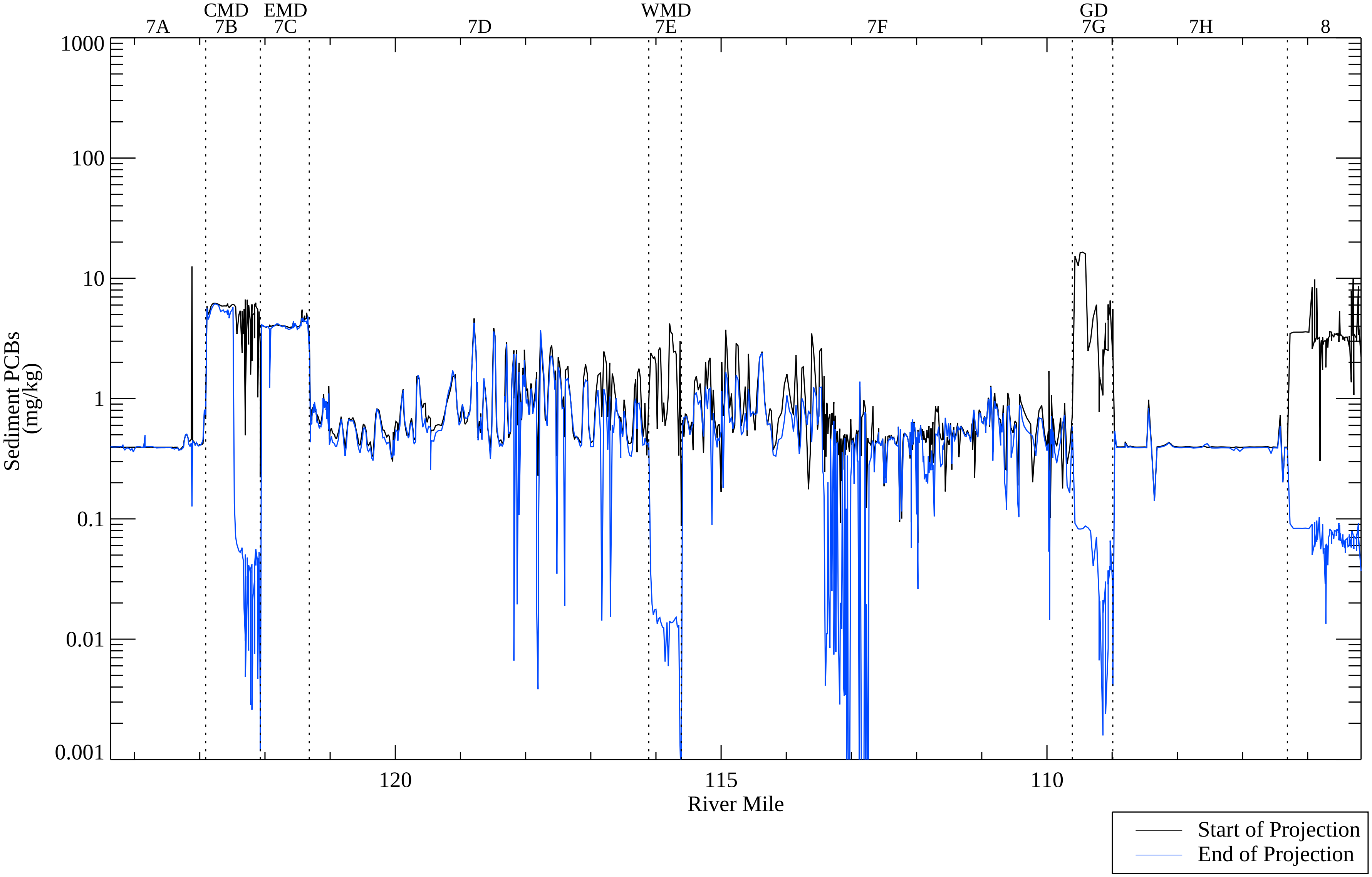

Figure G-2.1-7b. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 8; Reach 7/8; Base Case).

Run path:\\Tenmile\efdc_output\r78\CMS\Proj_R78_SED8CMSBS_0712-34\bins

Note: Sediment PCB profiles are plotted using individual grid cells
Abbreviations: CMD=Columbia Mill Dam; EMD=Former Eagle Mill Dam; WMD=Willow Mill Dam; GD=Glendale Dam

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Tue Mar 18 21:08:11 2008

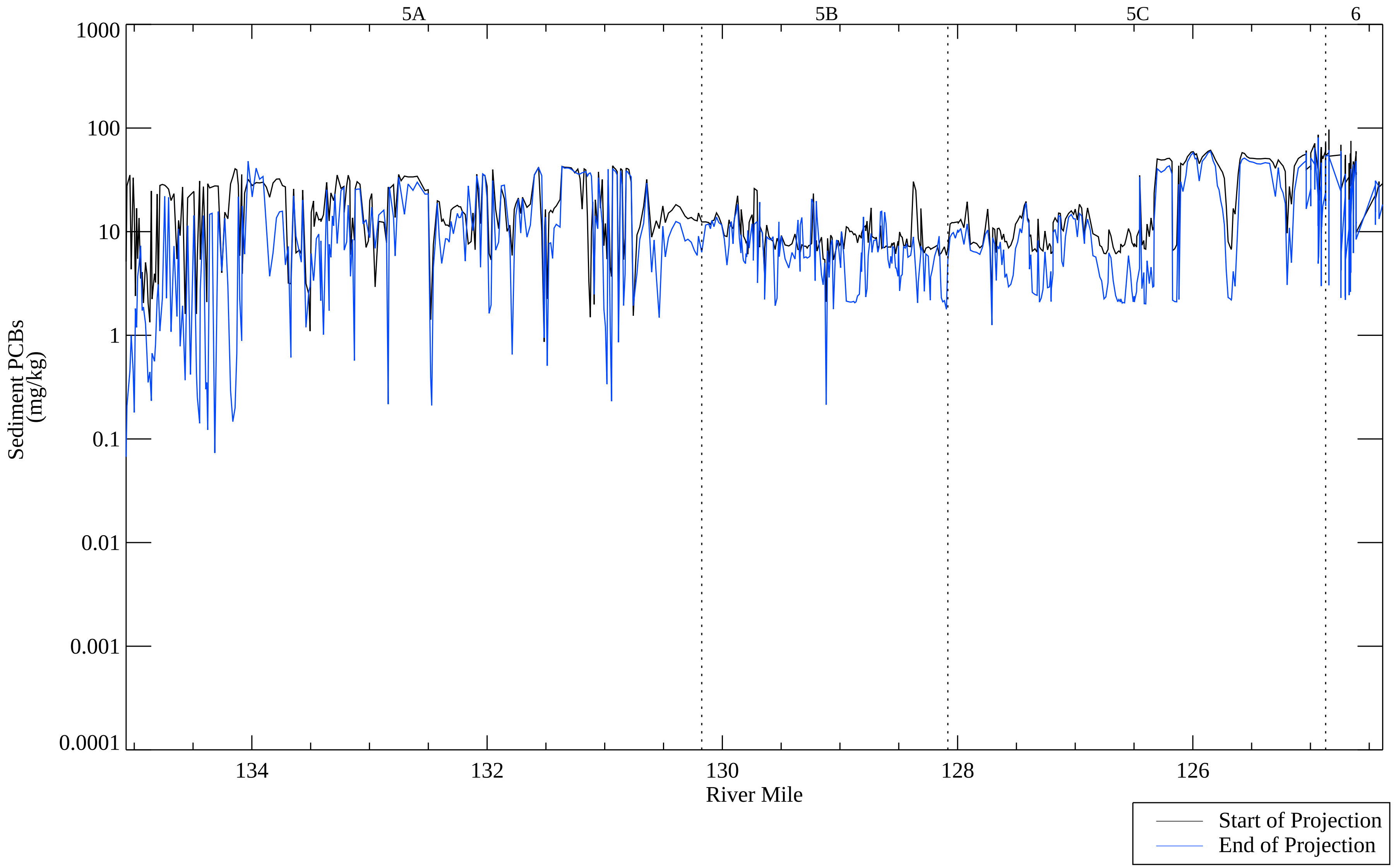

Figure G-2.2-1a. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 1 / SED 2; Reach 5/6; Lower Bound).

Run path:\\Tenmile\efdc_output\r56\CMS\Proj_R56_SED1CMSLB_0712-19\bins

Note: Sediment PCB profiles are plotted using individual grid cells

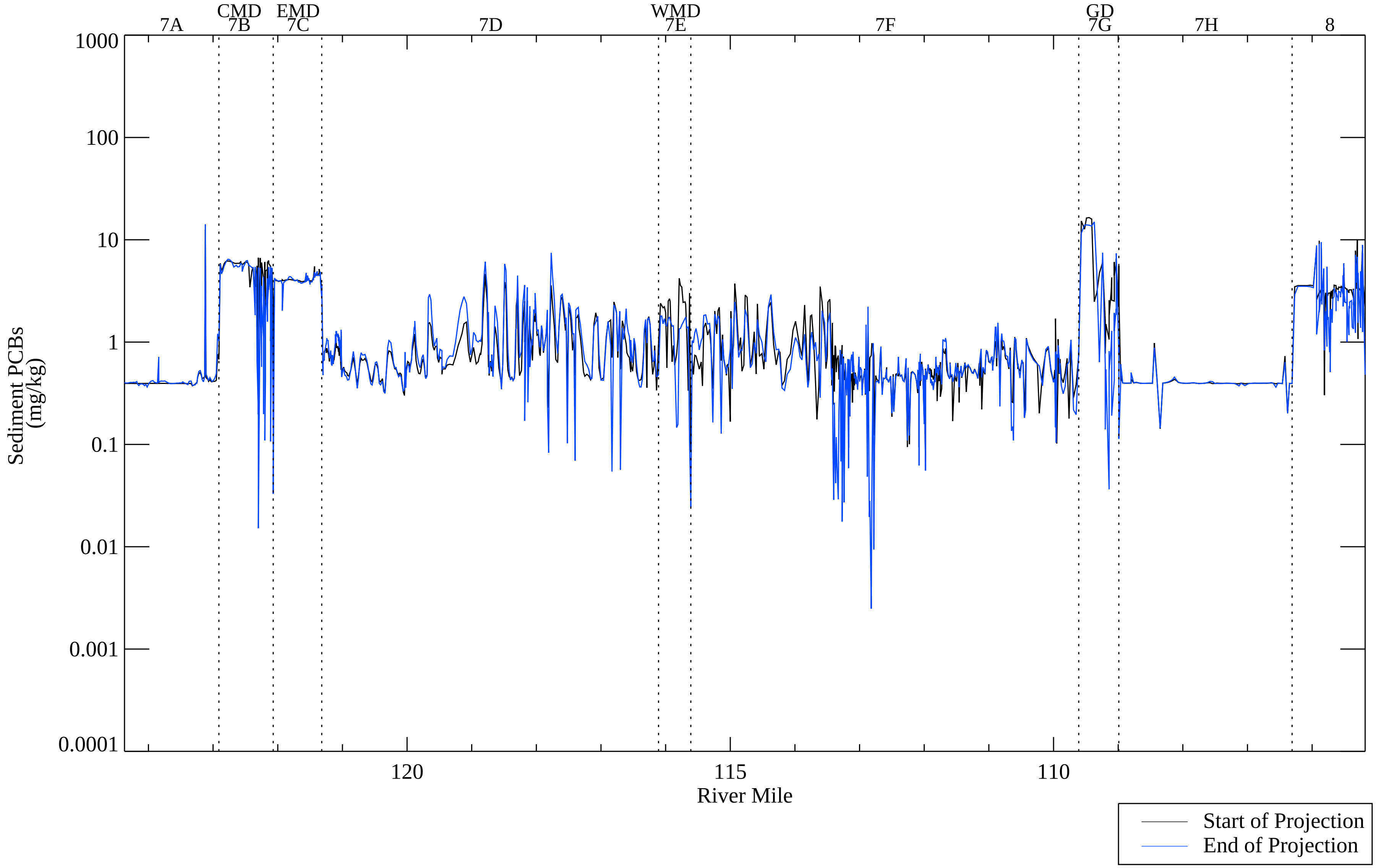

Figure G-2.2-1b. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 1 / SED 2; Reach 7/8; Lower Bound).

Run path:\\Tenmile\efdc_output\r78\CMS\Proj_R78_SED1CMSLB_0712-35\bins

Note: Sediment PCB profiles are plotted using individual grid cells
Abbreviations: CMD=Columbia Mill Dam; EMD=Former Eagle Mill Dam; WMD=Willow Mill Dam; GD=Glendale Dam

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Tue Mar 18 21:08:13 2008

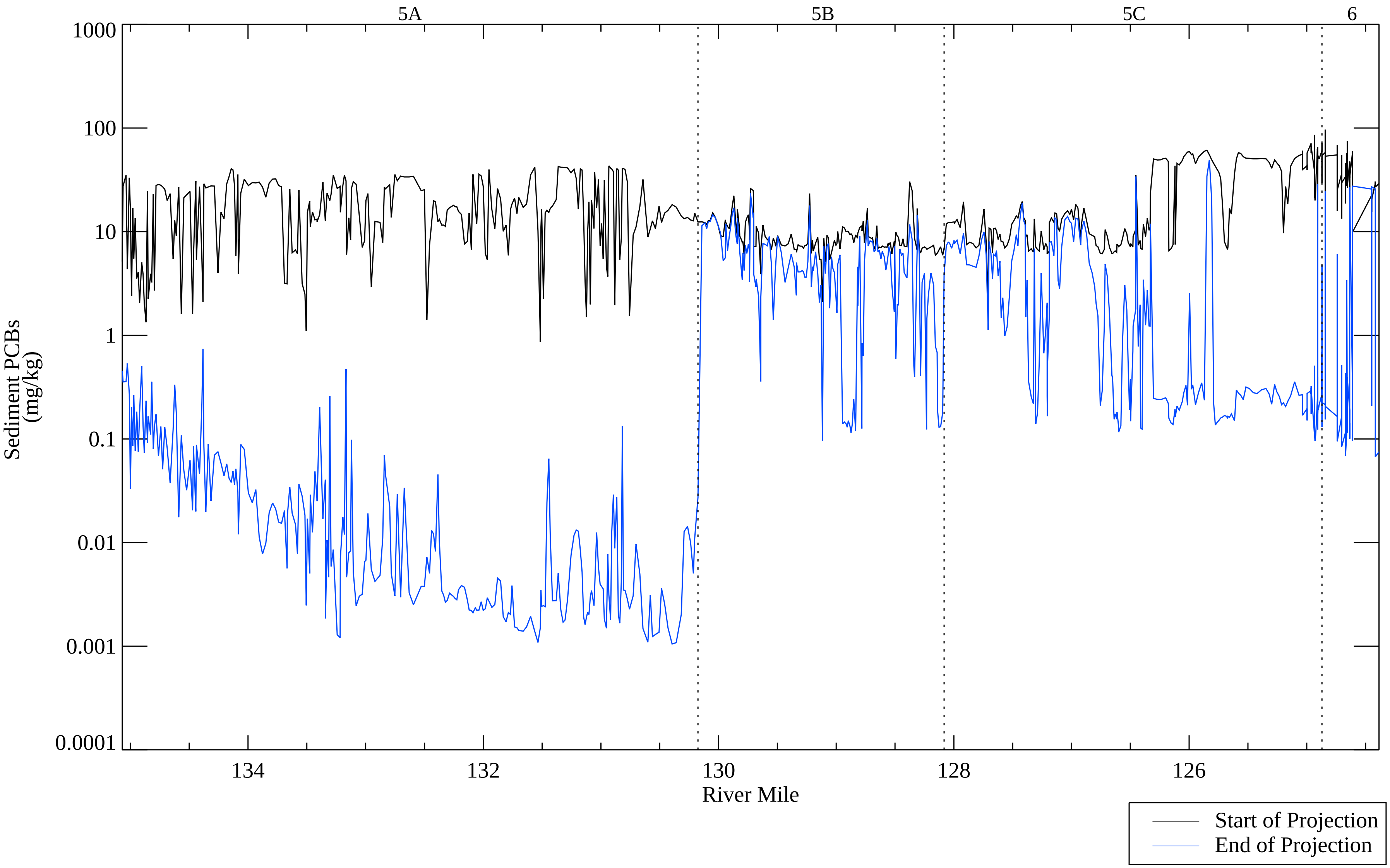

Figure G-2.2-2a. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 3; Reach 5/6; Lower Bound).

Run path:\\Tenmile\efdc_output\r56\CMS\Proj_R56_SED3CMSLB_0712-20\bins
Note: Sediment PCB profiles are plotted using individual grid cells

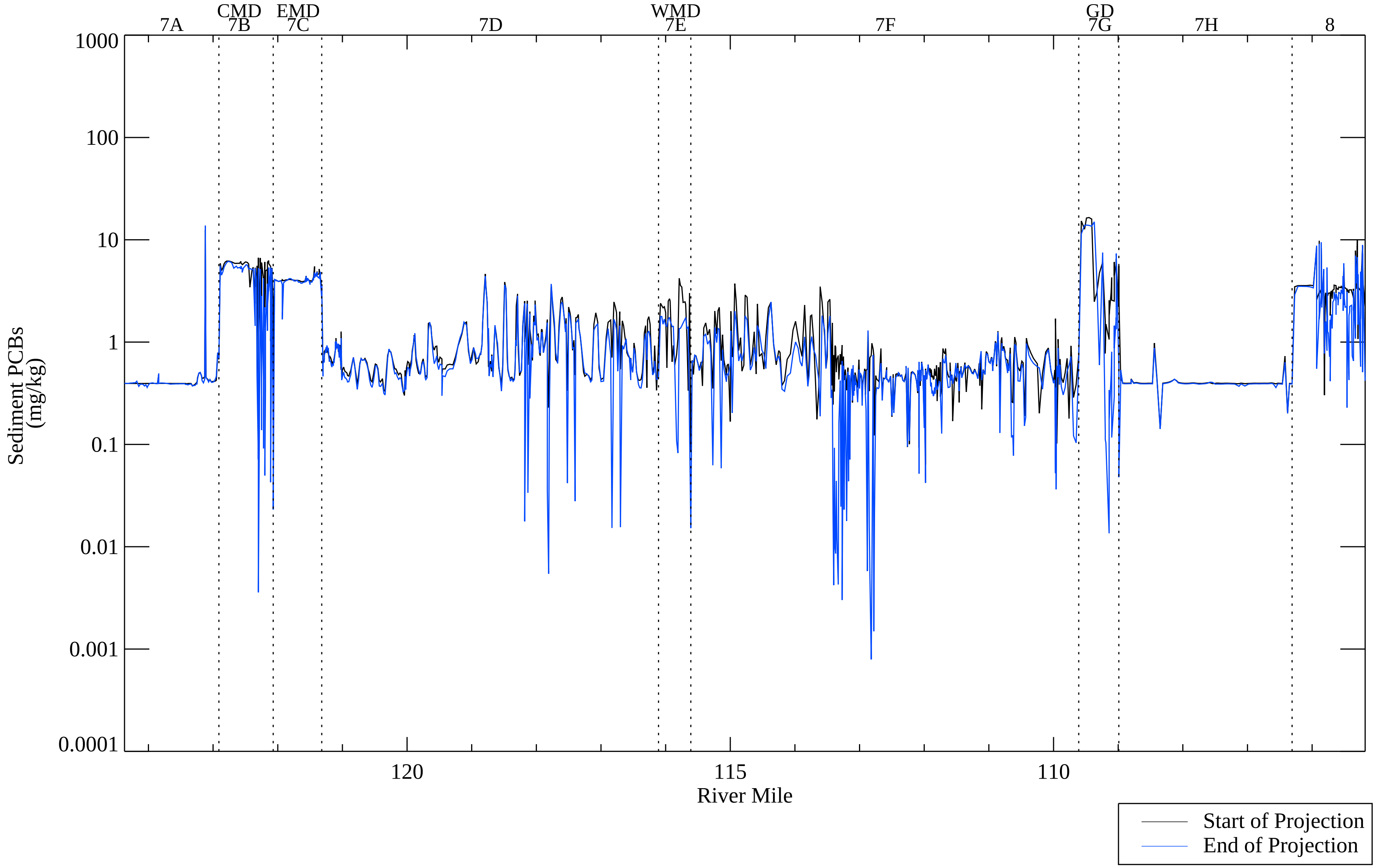

Figure G-2.2-2b. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 3; Reach 7/8; Lower Bound).

Run path:\\Tenmile\efdc_output\r78\CMS\Proj_R78_SED3CMSLB_0712-36\bins

Note: Sediment PCB profiles are plotted using individual grid cells
Abbreviations: CMD=Columbia Mill Dam; EMD=Former Eagle Mill Dam; WMD=Willow Mill Dam; GD=Glendale Dam

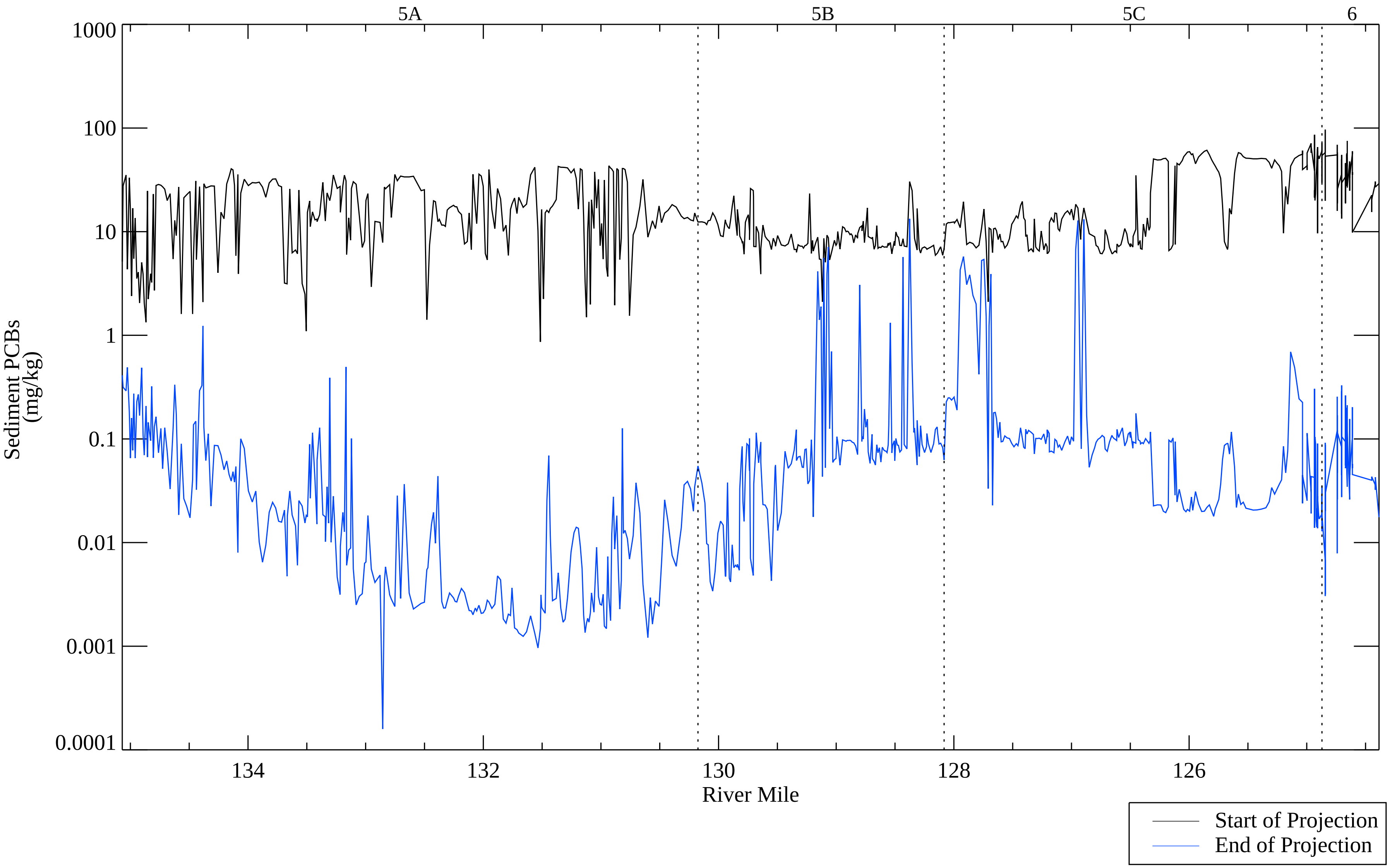

Figure G-2.2-3a. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 4; Reach 5/6; Lower Bound).

Run path:\\Tenmile\efdc_output\r56\CMS\Proj_R56_SED4CMSLB_0801-03\bins

Note: Sediment PCB profiles are plotted using individual grid cells

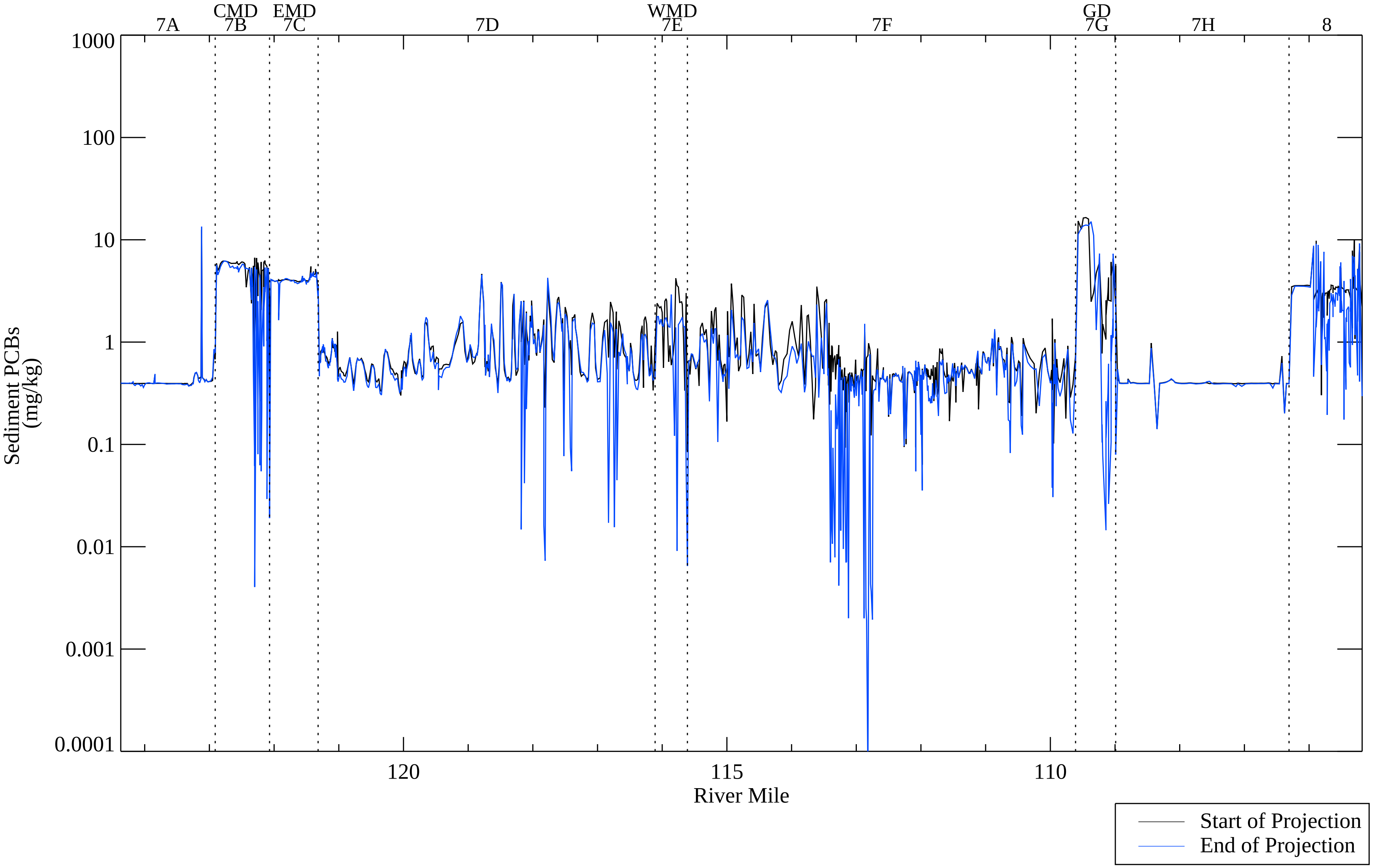

Figure G-2.2-3b. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 4; Reach 7/8; Lower Bound).

Run path:\\Tenmile\efdc_output\r78\CMS\Proj_R78_SED4CMSLB_0802-03\bins

Note: Sediment PCB profiles are plotted using individual grid cells
Abbreviations: CMD=Columbia Mill Dam; EMD=Former Eagle Mill Dam; WMD=Willow Mill Dam; GD=Glendale Dam

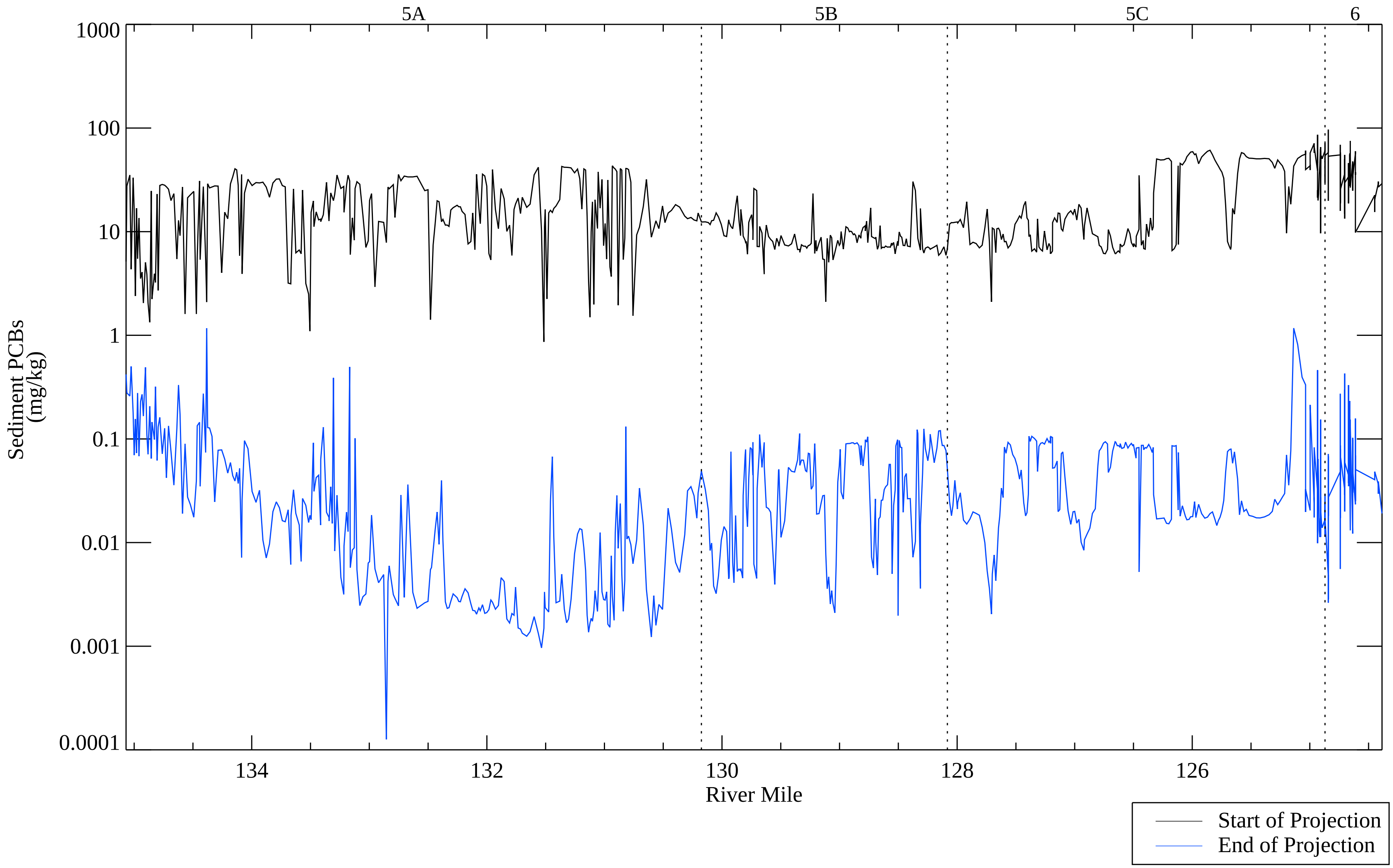

Figure G-2.2-4a. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 5; Reach 5/6; Lower Bound).

Run path:\\Tenmile\efdc_output\r56\CMS\Proj_R56_SED5CMSLB_0801-04\bins

Note: Sediment PCB profiles are plotted using individual grid cells

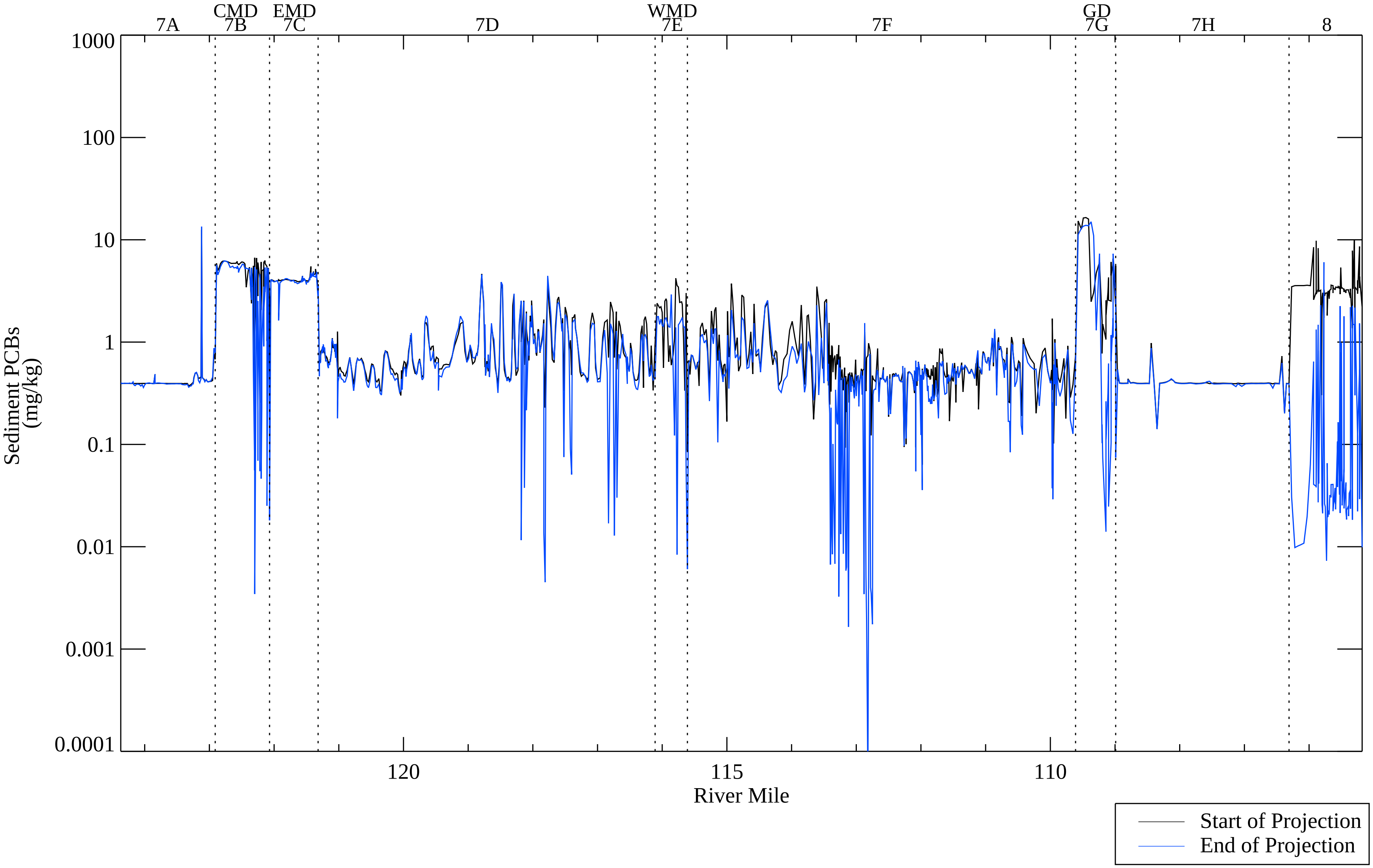

Figure G-2.2-4b. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 5; Reach 7/8; Lower Bound).

Run path:\\Tenmile\efdc_output\r78\CMS\proj_R78_SED5CMSLB_0802-04\bins

Note: Sediment PCB profiles are plotted using individual grid cells
Abbreviations: CMD=Columbia Mill Dam; EMD=Former Eagle Mill Dam; WMD=Willow Mill Dam; GD=Glendale Dam

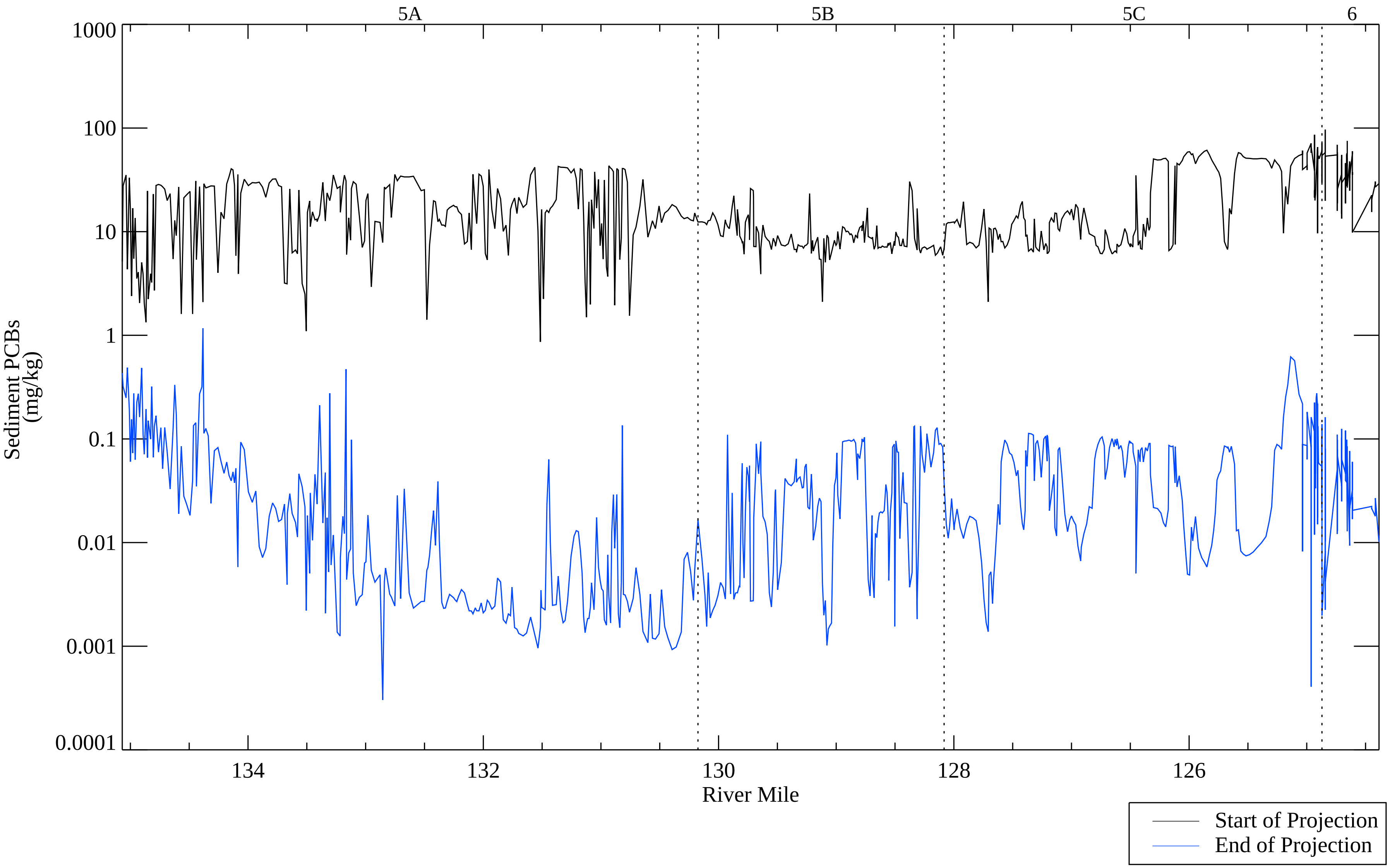

Figure G-2.2-5a. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 6; Reach 5/6; Lower Bound).

Run path:\\Tenmile\efdc_output\r56\CMS\Proj_R56_SED6CMSLB_0712-23\bins

Note: Sediment PCB profiles are plotted using individual grid cells

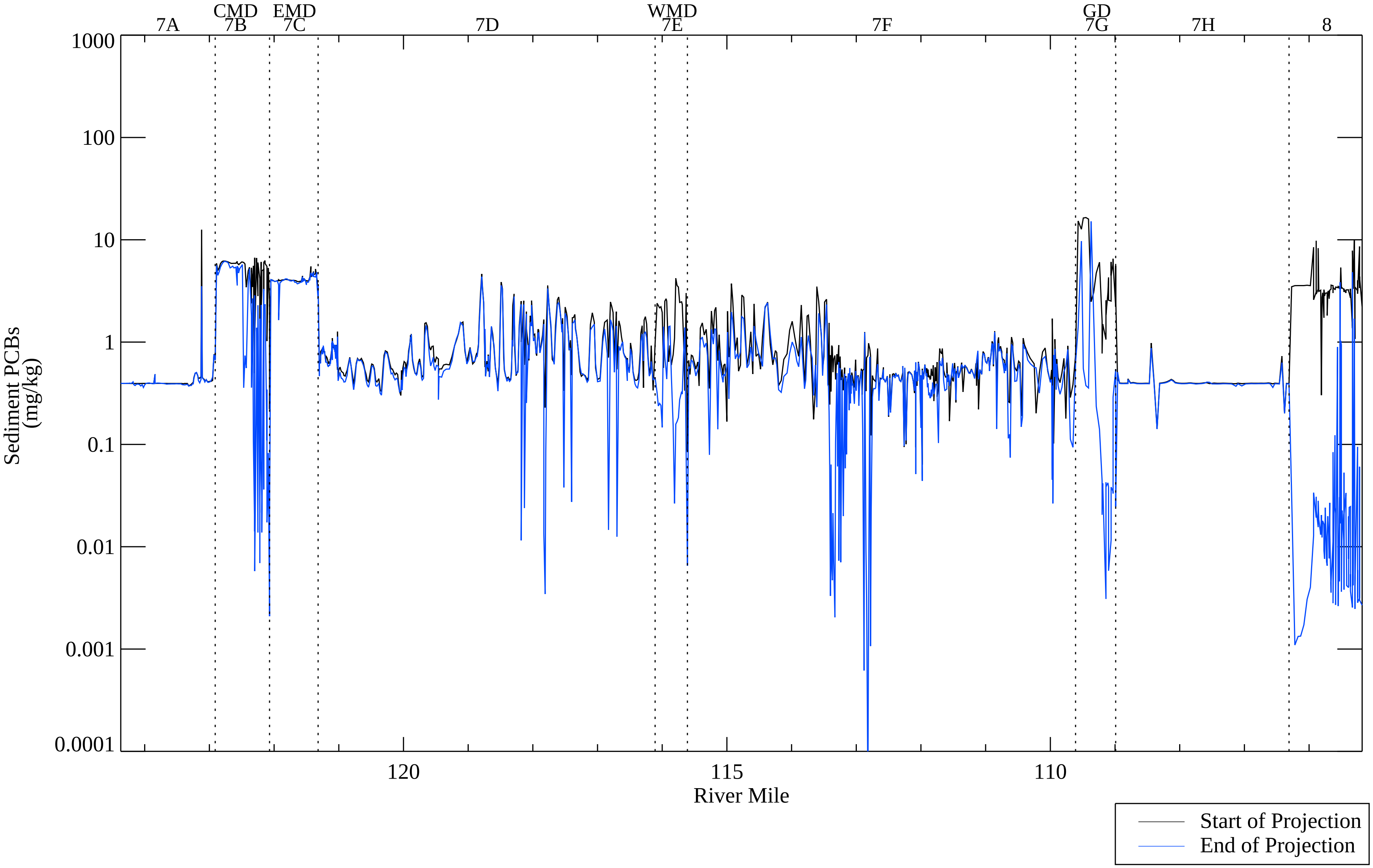

Figure G-2.2-5b. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 6; Reach 7/8; Lower Bound).

Run path:\\Tenmile\efdc_output\r78\CMS\Proj_R78_SED6CMSLB_0712-39\bins

Note: Sediment PCB profiles are plotted using individual grid cells
Abbreviations: CMD=Columbia Mill Dam; EMD=Former Eagle Mill Dam; WMD=Willow Mill Dam; GD=Glendale Dam

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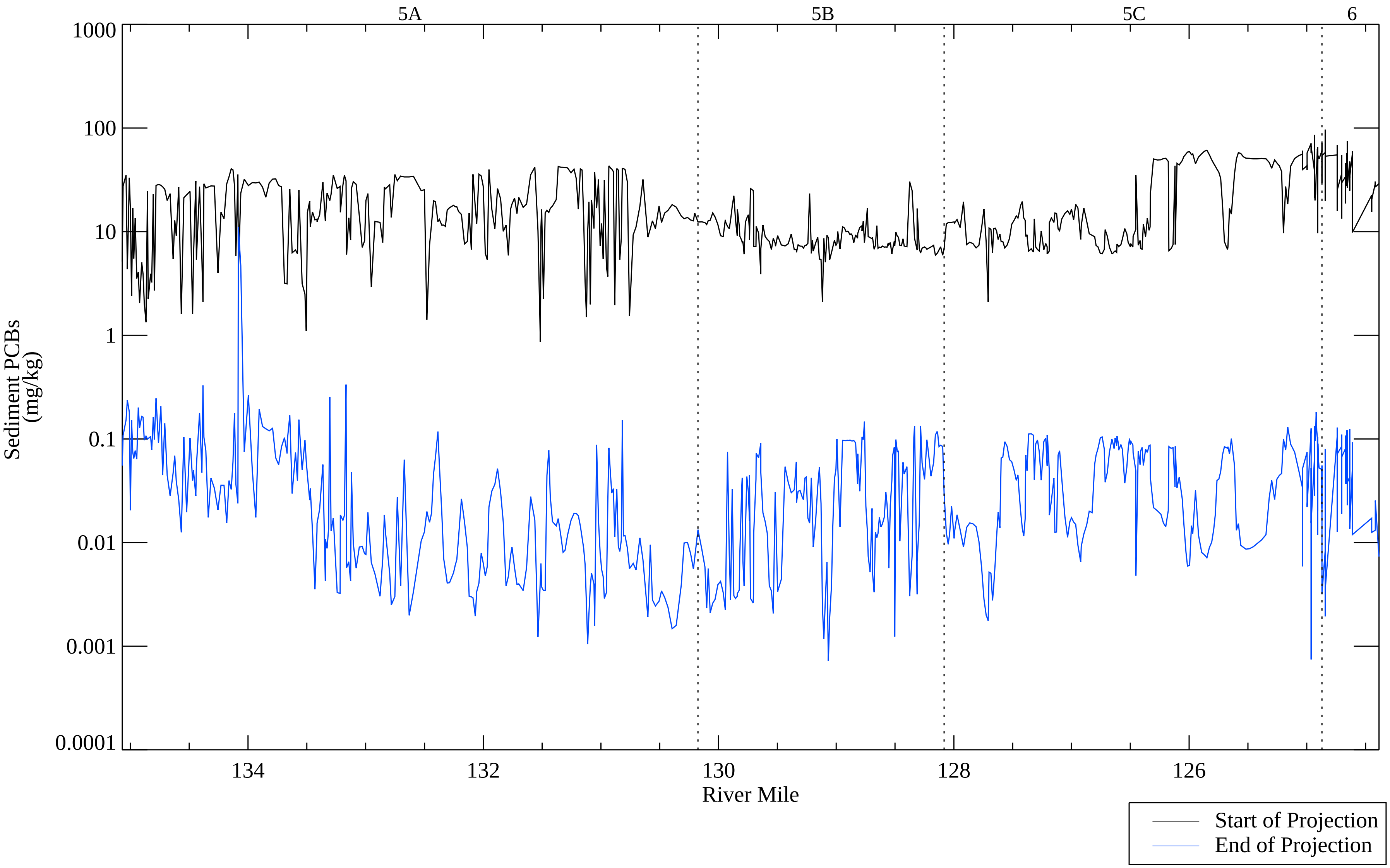

Figure G-2.2-6a. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 7; Reach 5/6; Lower Bound).

Run path:\\Tenmile\efdc_output\r56\CMS\Proj_R56_SED7CMSLB_0712-24\bins

Note: Sediment PCB profiles are plotted using individual grid cells

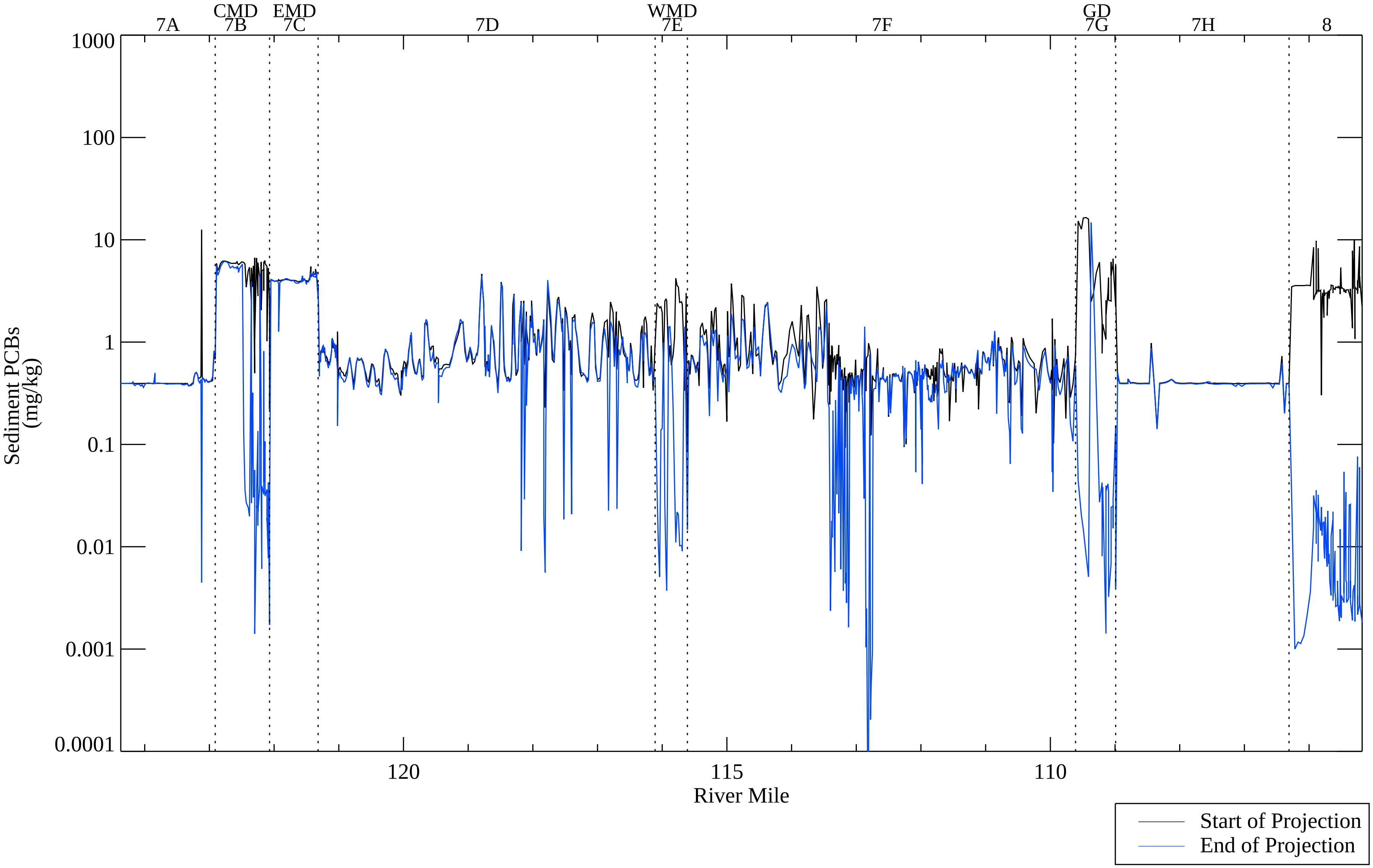

Figure G-2.2-6b. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 7; Reach 7/8; Lower Bound).

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Note: Sediment PCB profiles are plotted using individual grid cells
Abbreviations: CMD=Columbia Mill Dam; EMD=Former Eagle Mill Dam; WMD=Willow Mill Dam; GD=Glendale Dam

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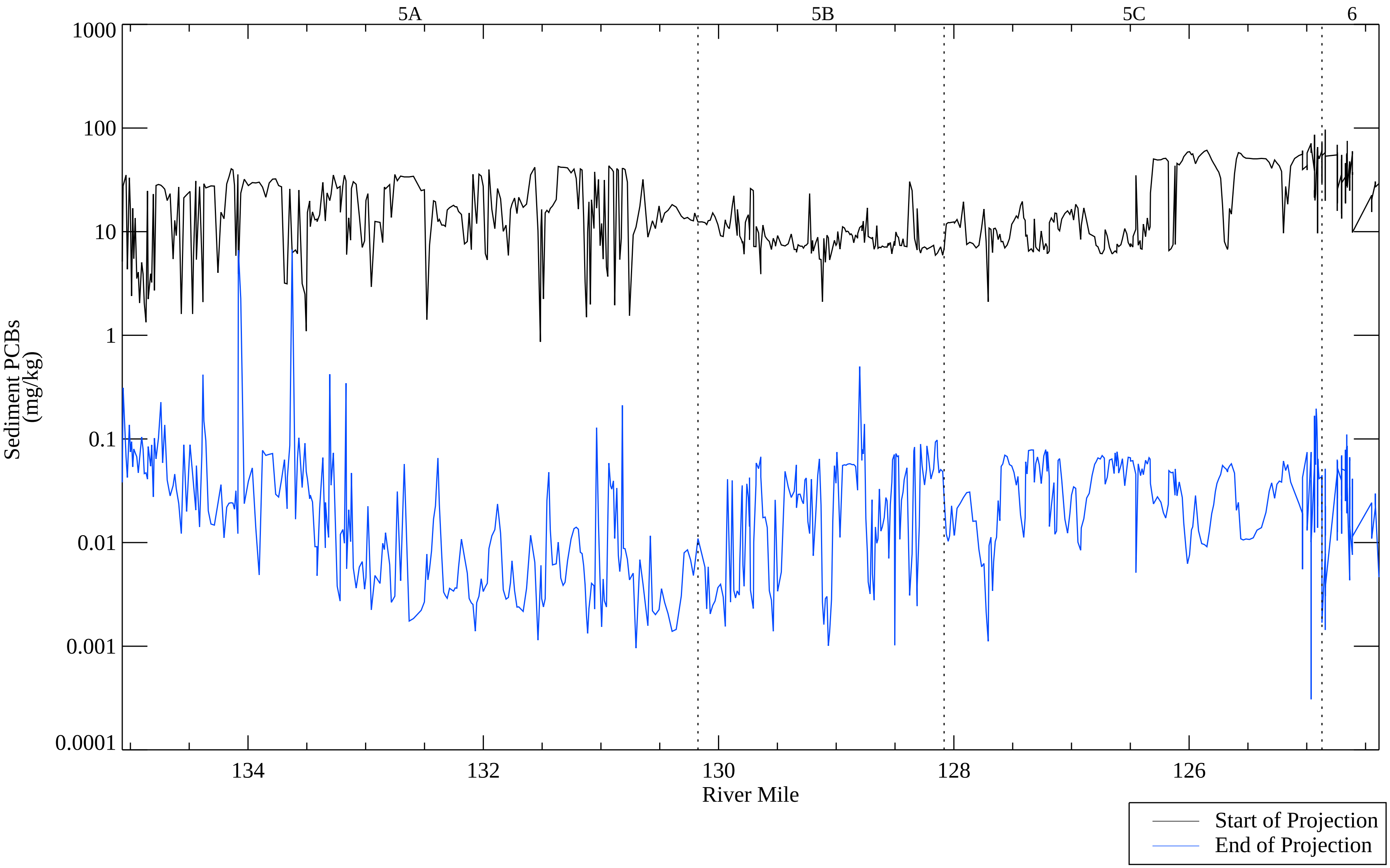

Figure G-2.2-7a. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 8; Reach 5/6; Lower Bound).

Run path:\\Tenmile\efdc_output\r56\CMS\Proj_R56_SED8CMSLB_0712-25\bins

Note: Sediment PCB profiles are plotted using individual grid cells

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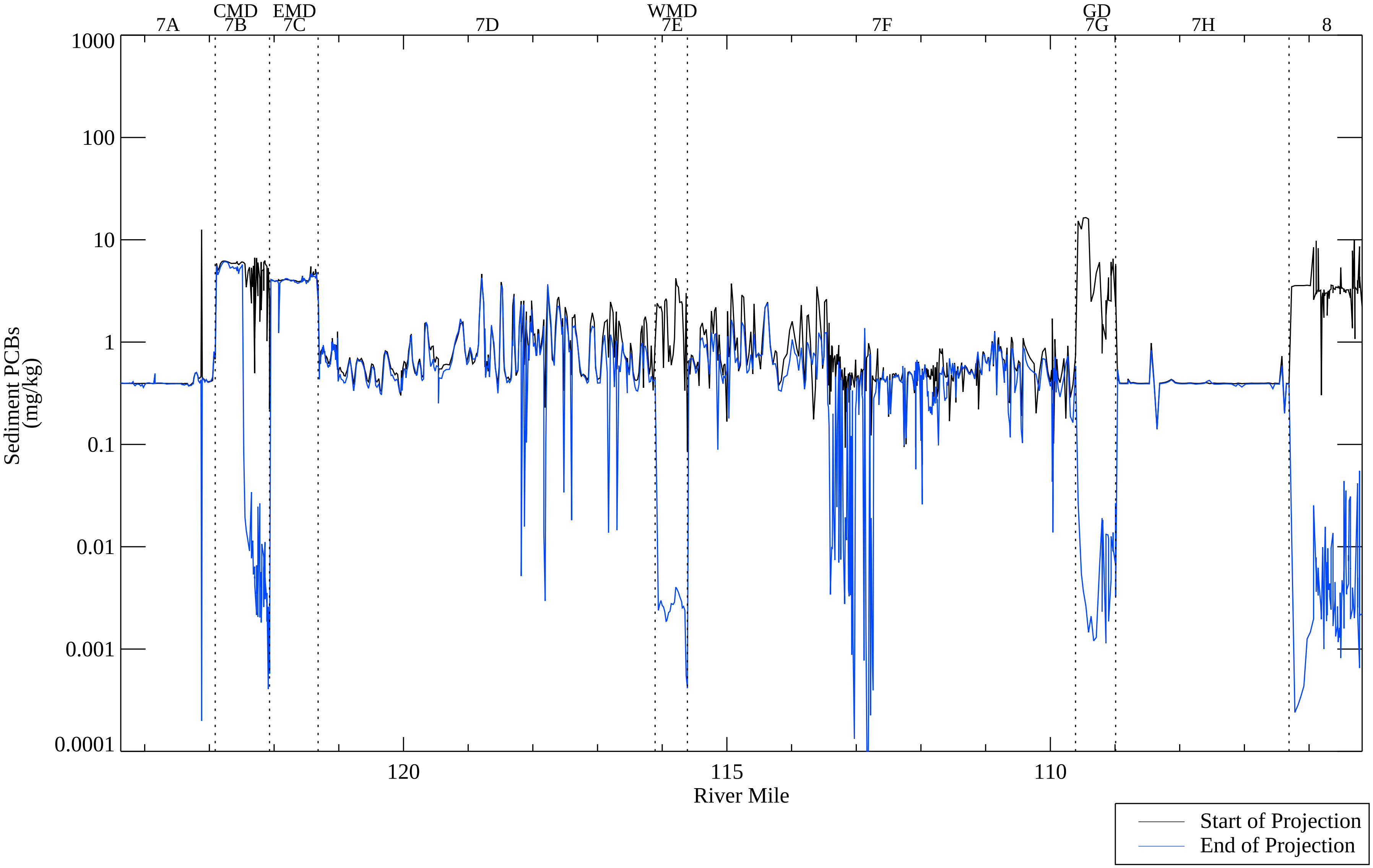

Figure G-2.2-7b. Spatial profiles of surface sediment (0-6") PCB concentrations (SED 8; Reach 7/8; Lower Bound).

Run path:\\Tenmile\efdc_output\r78\CMS\Proj_R78_SED8CMSLB_0712-41\bins

Note: Sediment PCB profiles are plotted using individual grid cells
Abbreviations: CMD=Columbia Mill Dam; EMD=Former Eagle Mill Dam; WMD=Willow Mill Dam; GD=Glendale Dam

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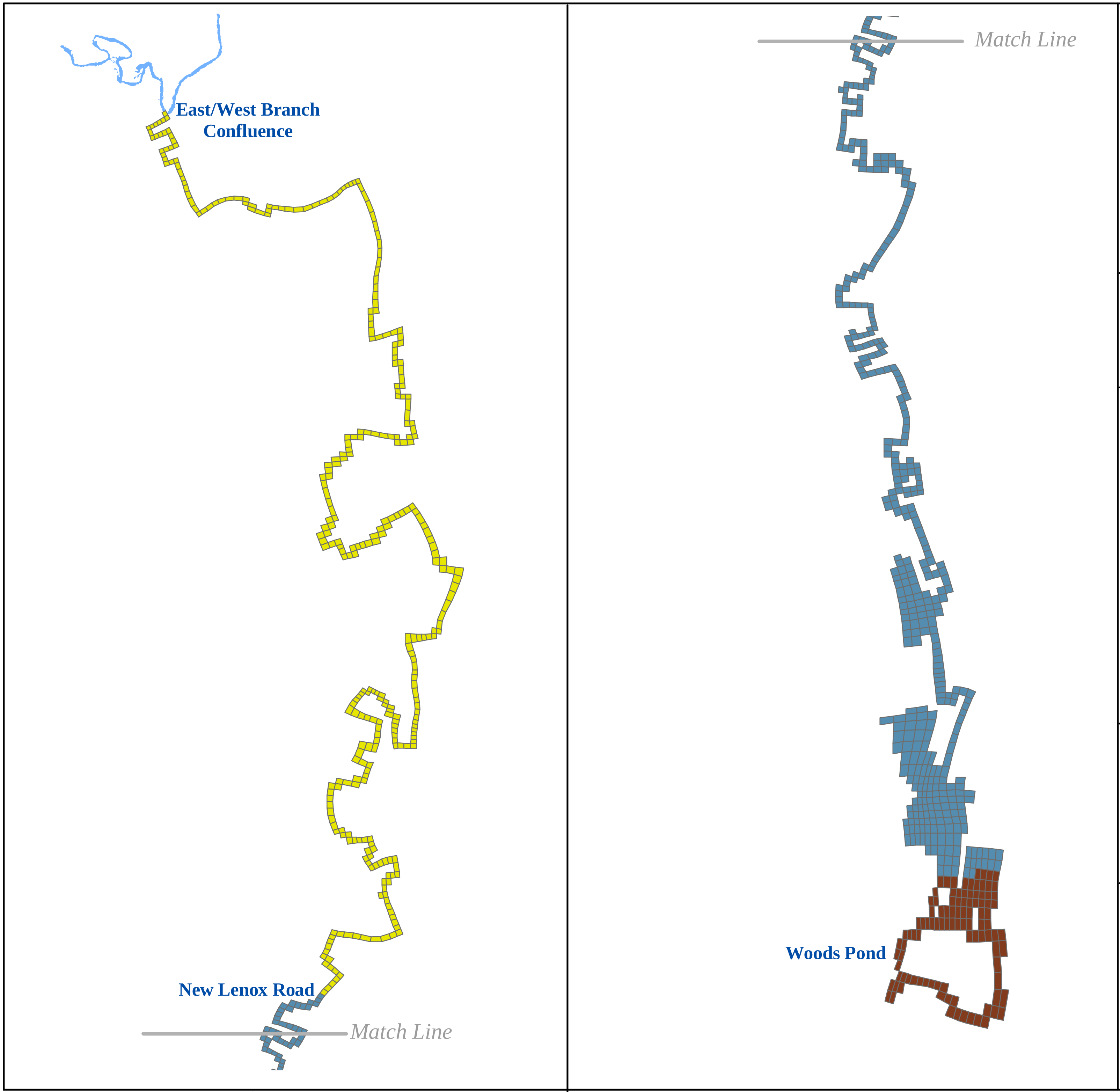
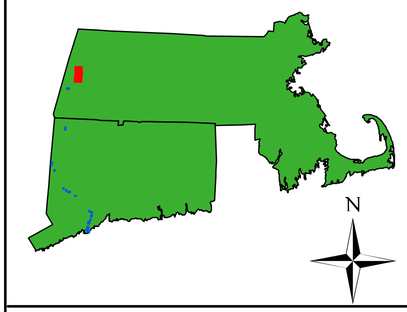


LOCATOR MAP



SCALE

LEGEND

Human Direct Contact

Sediment Exposure Areas

🟨 SA 1

🟦 SA 2

🟫 SA 3

Figure G-3.1a.
Model grid cells selected to represent the sediment human direct contact exposure areas in Reaches 5 & 6.

ARCADIS

QEA
Quantitative Environmental Analysis, LLC

GENcms

March 2008

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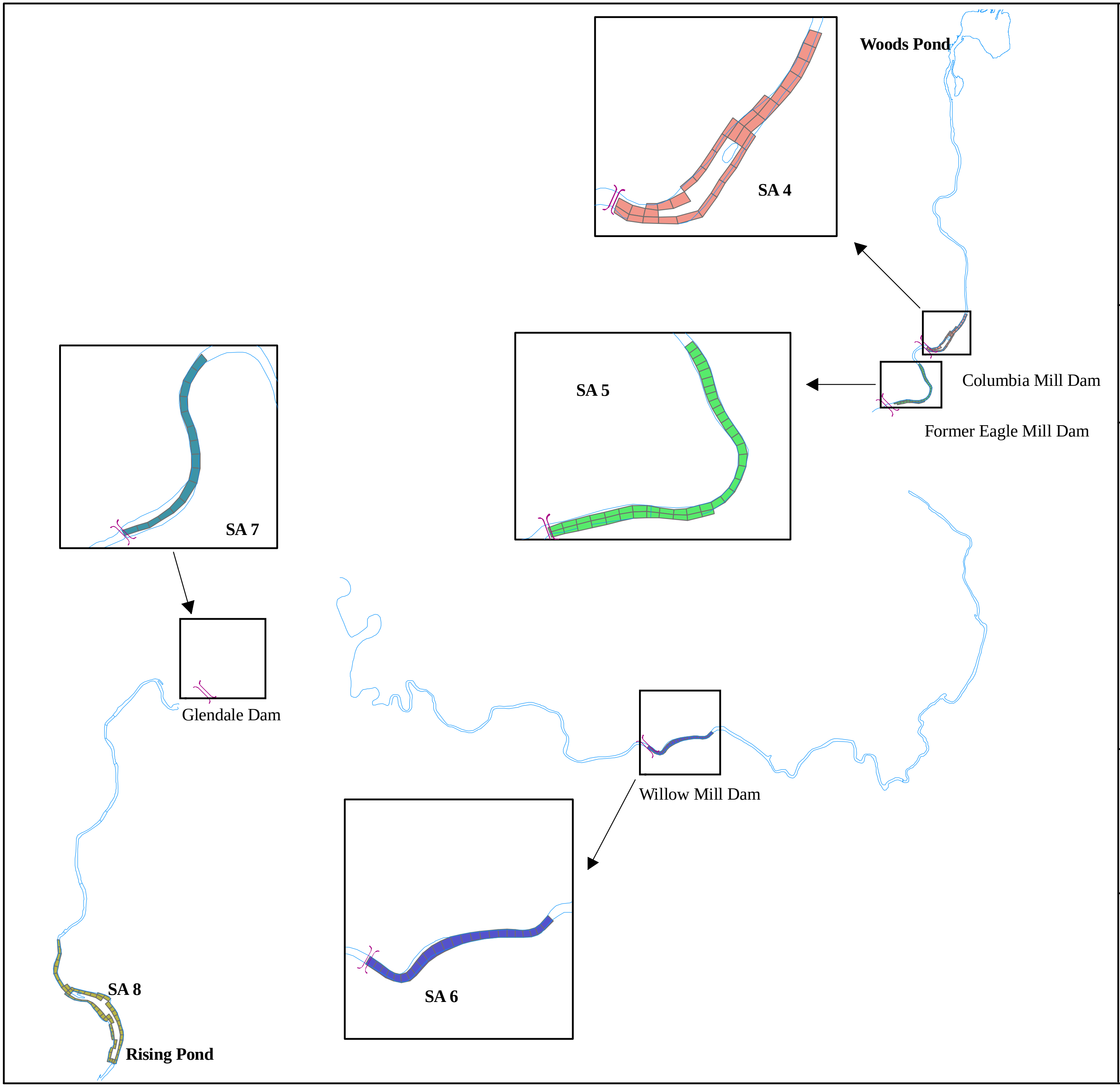
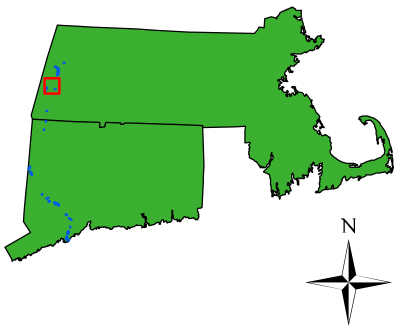


LOCATOR



SCALE

0 0.5 1 Miles

LEGEND

Human Direct Contact

Sediment Exposure Areas

🟧 SA 4

🟩 SA 5

🟦 SA 6

🟦 SA 7

🟨 SA 8

— Housatonic River

)(Dams

Figure G-3.1b.
Model grid cells selected to represent the sediment human direct contact exposure areas in Reaches 7 & 8.

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Quantitative Environmental Analysis, LLC

GENcms March 2008

Human Direct Contact
(SED 1 / SED 2; Base Case)

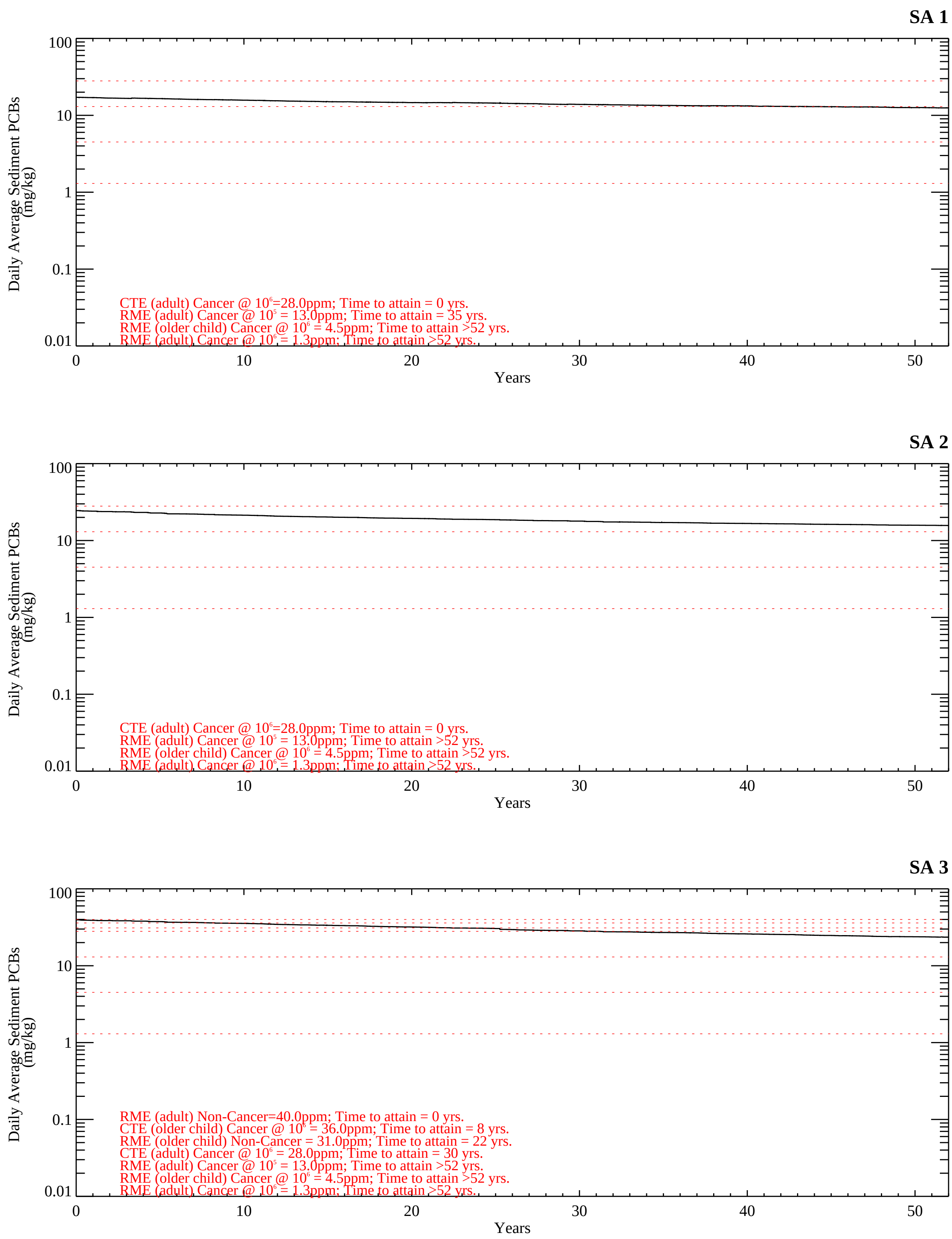

Figure G-3.2-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 1 / SED 2; Reach 5/6; Base Case).

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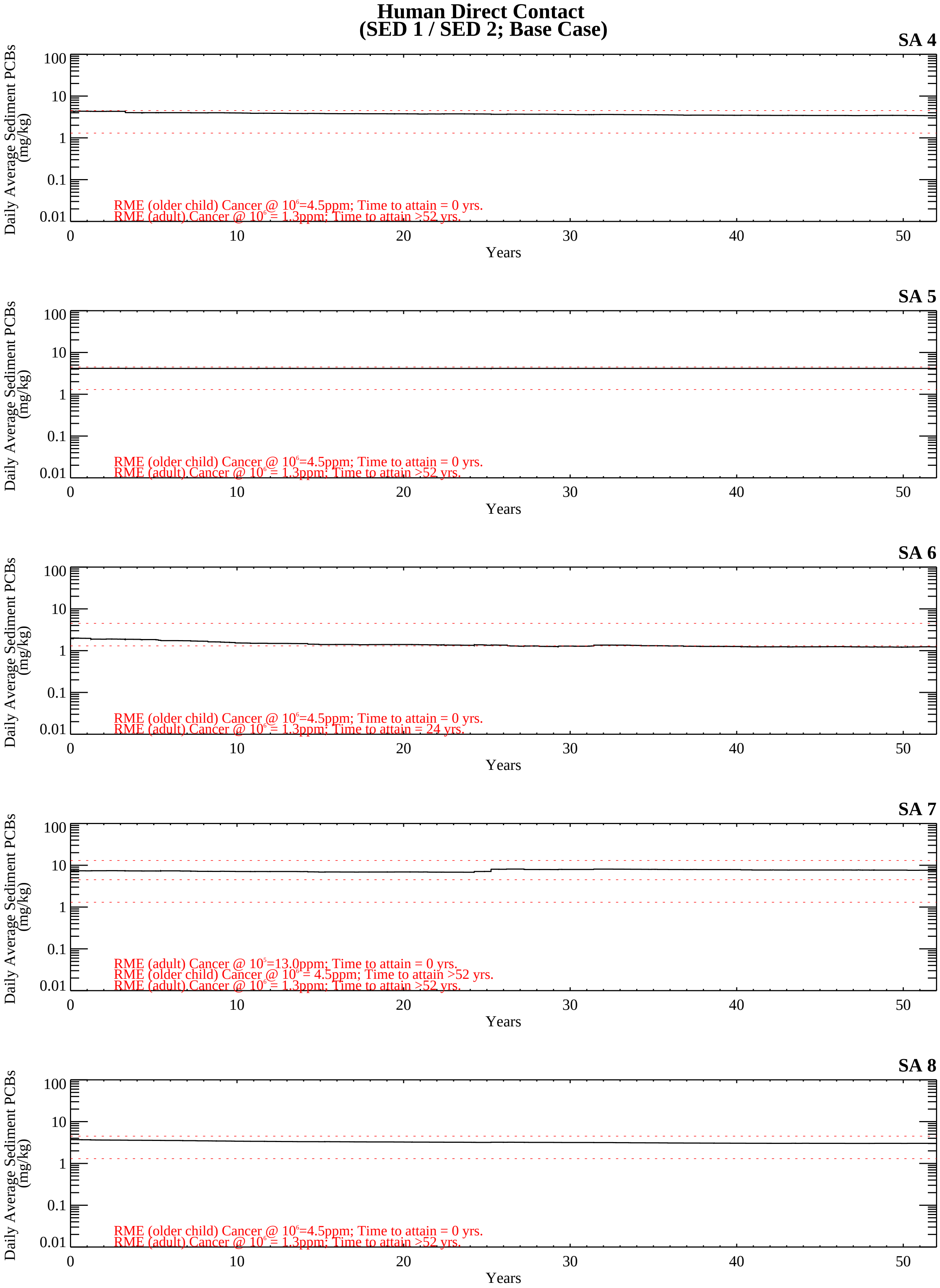

Figure G-3.2-1b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 1 / SED 2; Reach 7/8; Base Case).

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Human Direct Contact
(SED 3; Base Case)

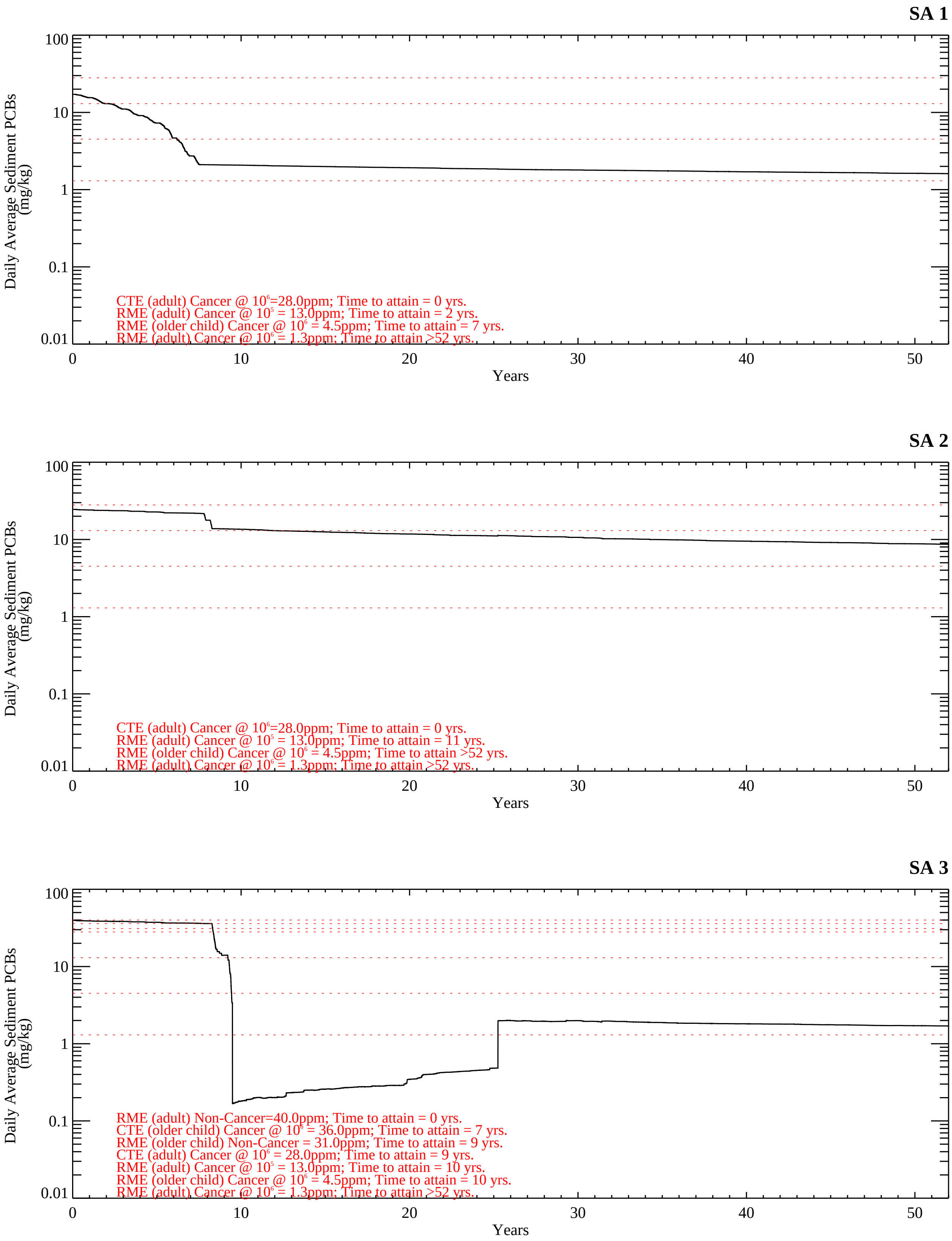

Figure G-3.2-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 3; Reach 5/6; Base Case).

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Human Direct Contact
(SED 3; Base Case)

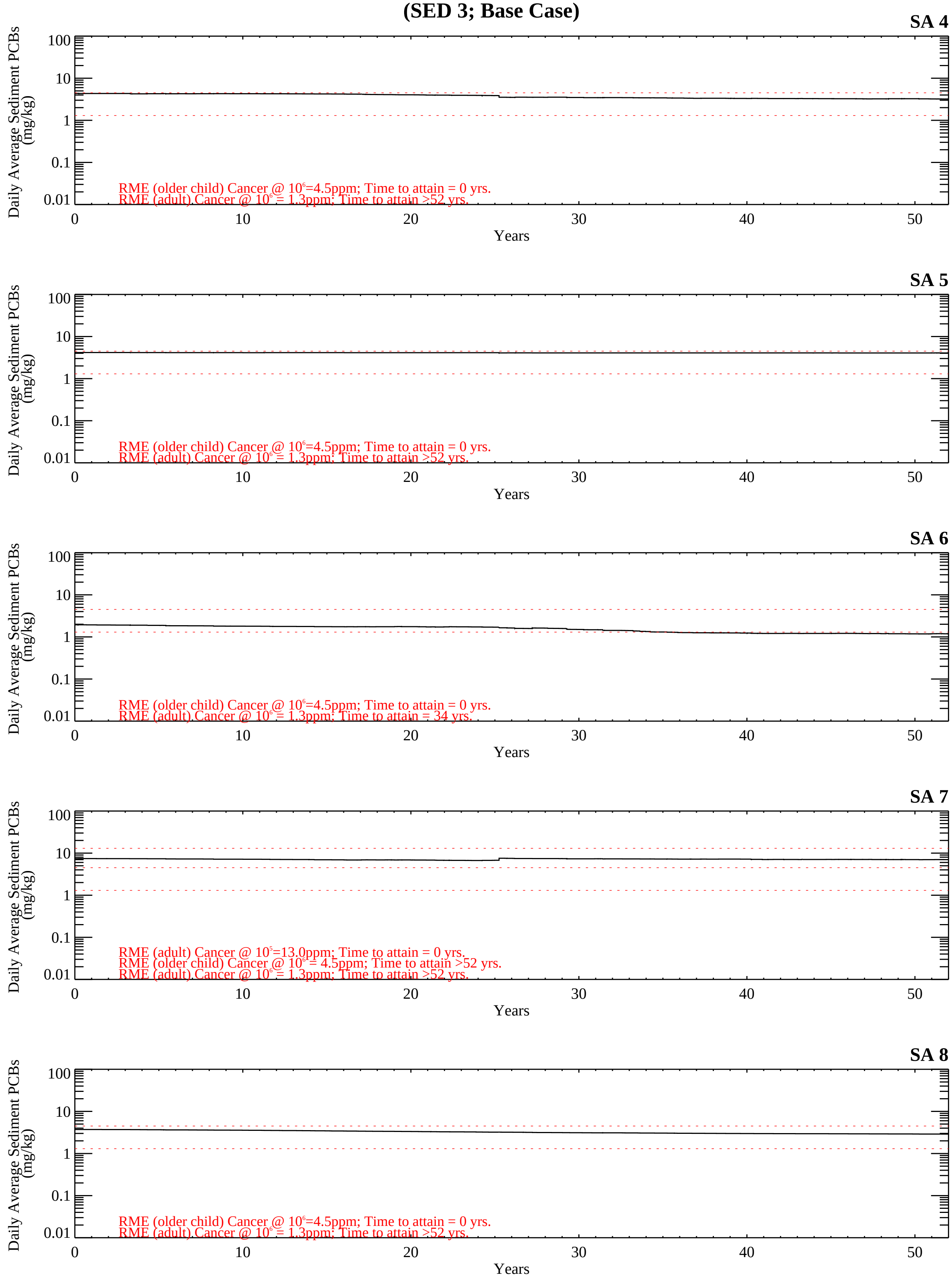

Figure G-3.2-2b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 3; Reach 7/8; Base Case).

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Human Direct Contact
(SED 4; Base Case)

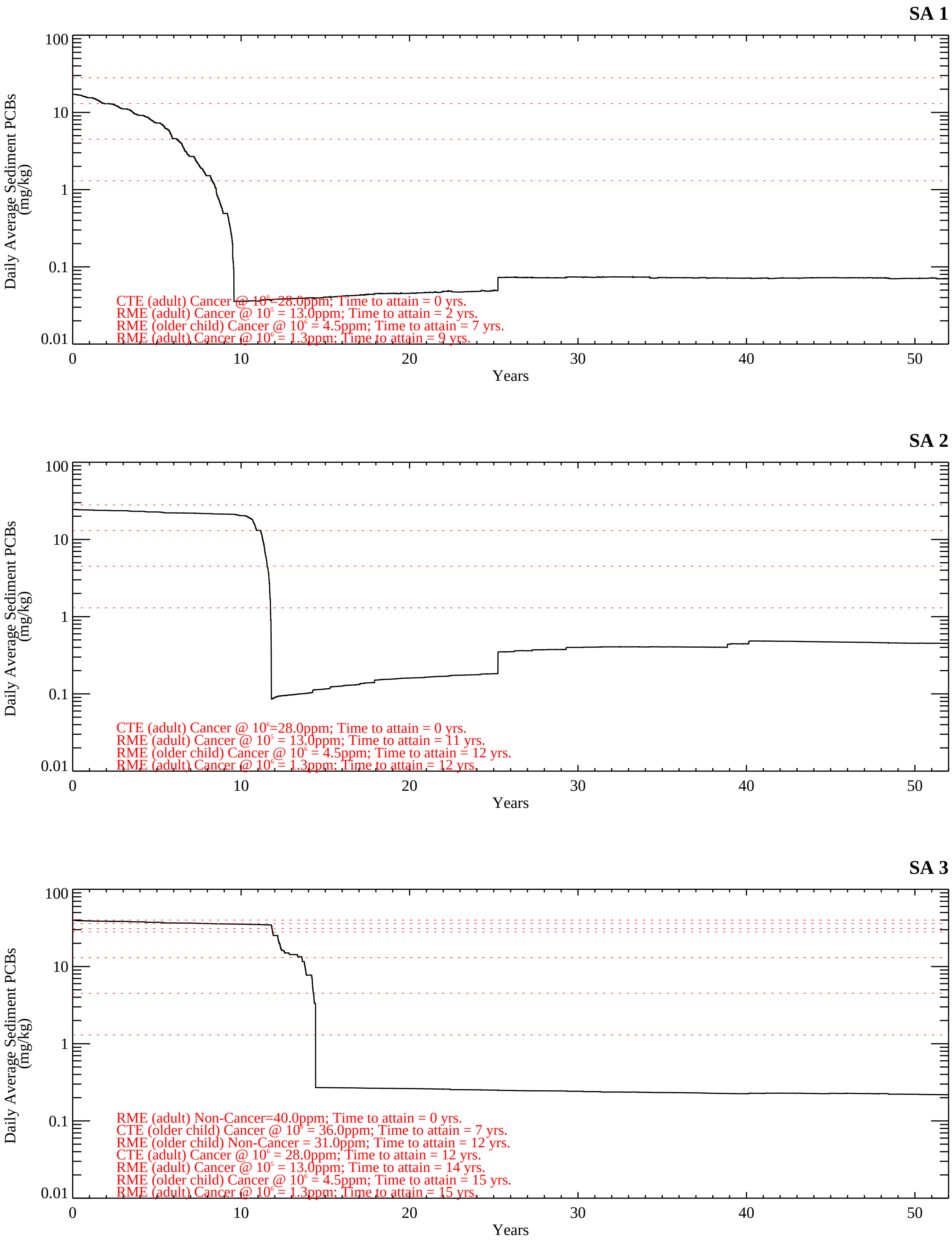

Figure G-3.2-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 4; Reach 5/6; Base Case).

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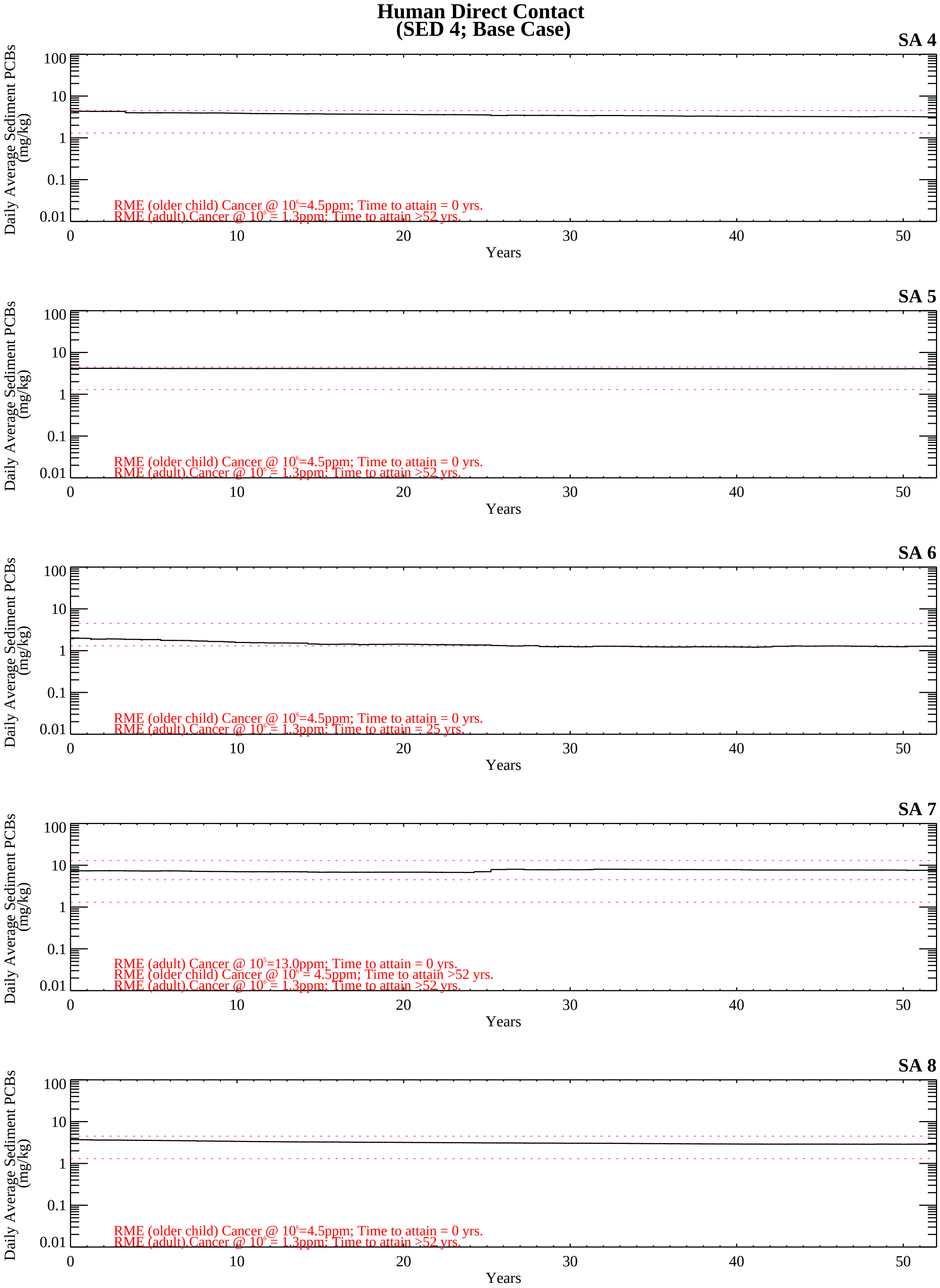

Figure G-3.2-3b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 4; Reach 7/8; Base Case).

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Human Direct Contact
(SED 5; Base Case)

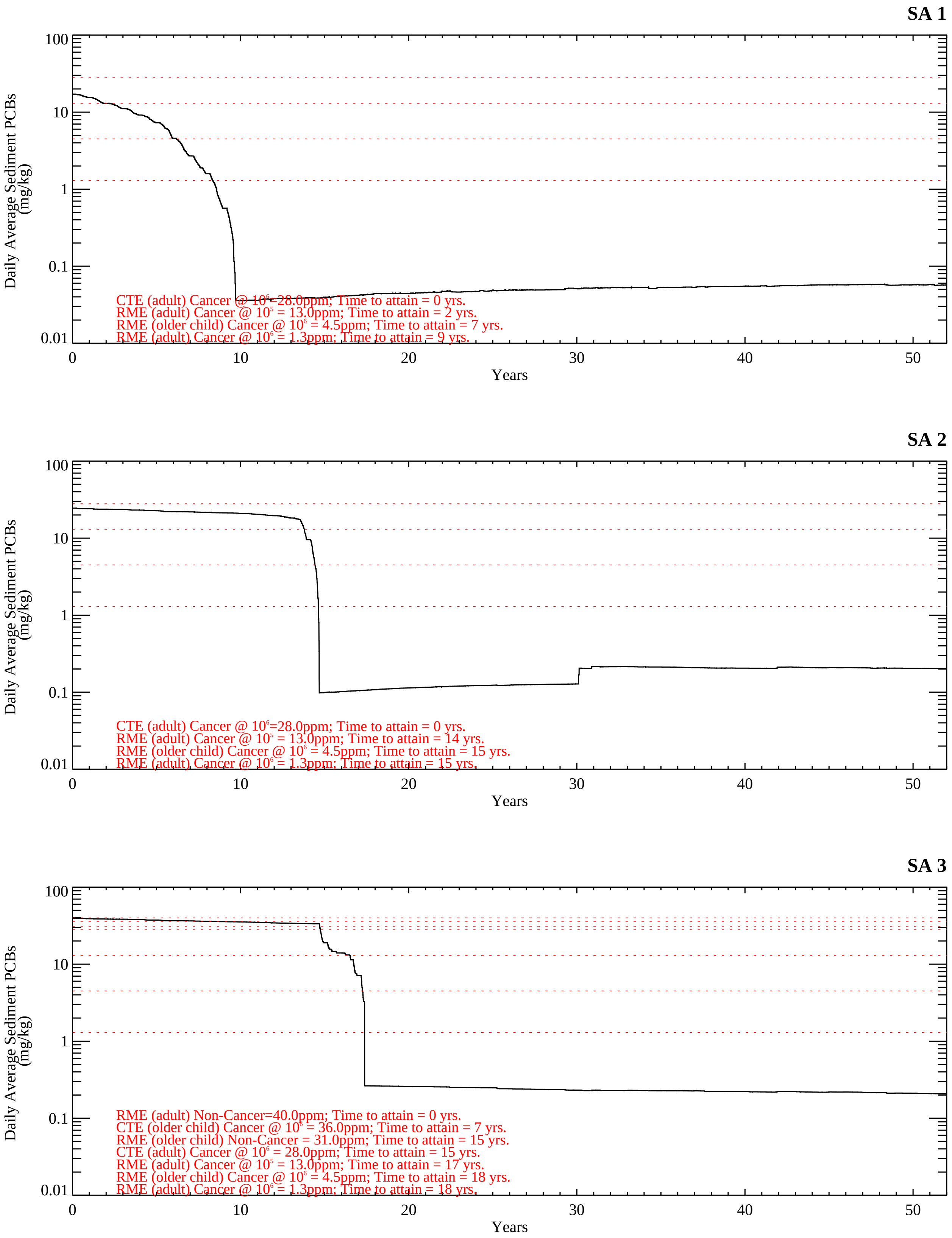

Figure G-3.2-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 5; Reach 5/6; Base Case).

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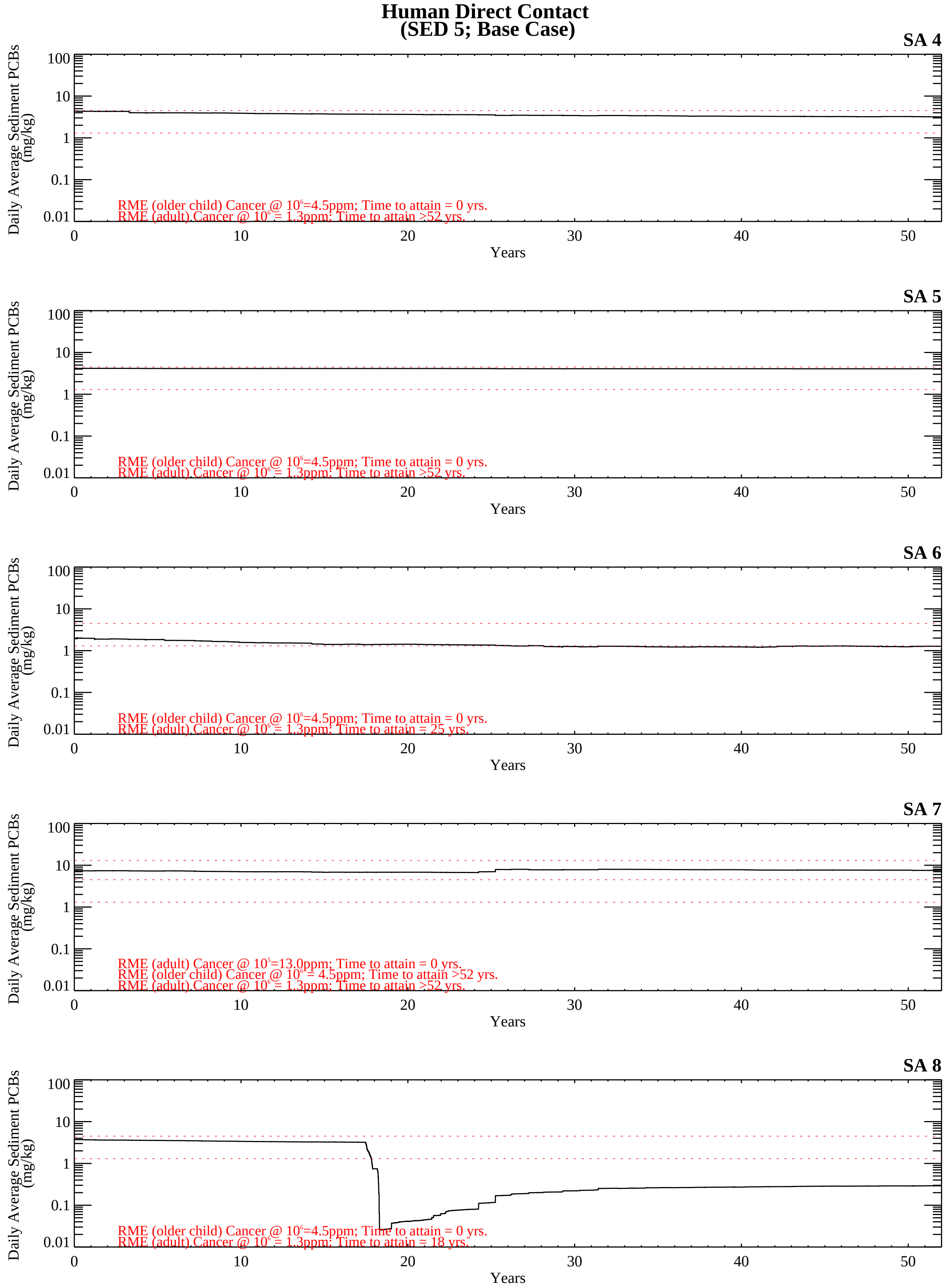

Figure G-3.2-4b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 5; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\proj_R78_SED5CMSBS_0802-02\\bins

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Human Direct Contact
(SED 6; Base Case)

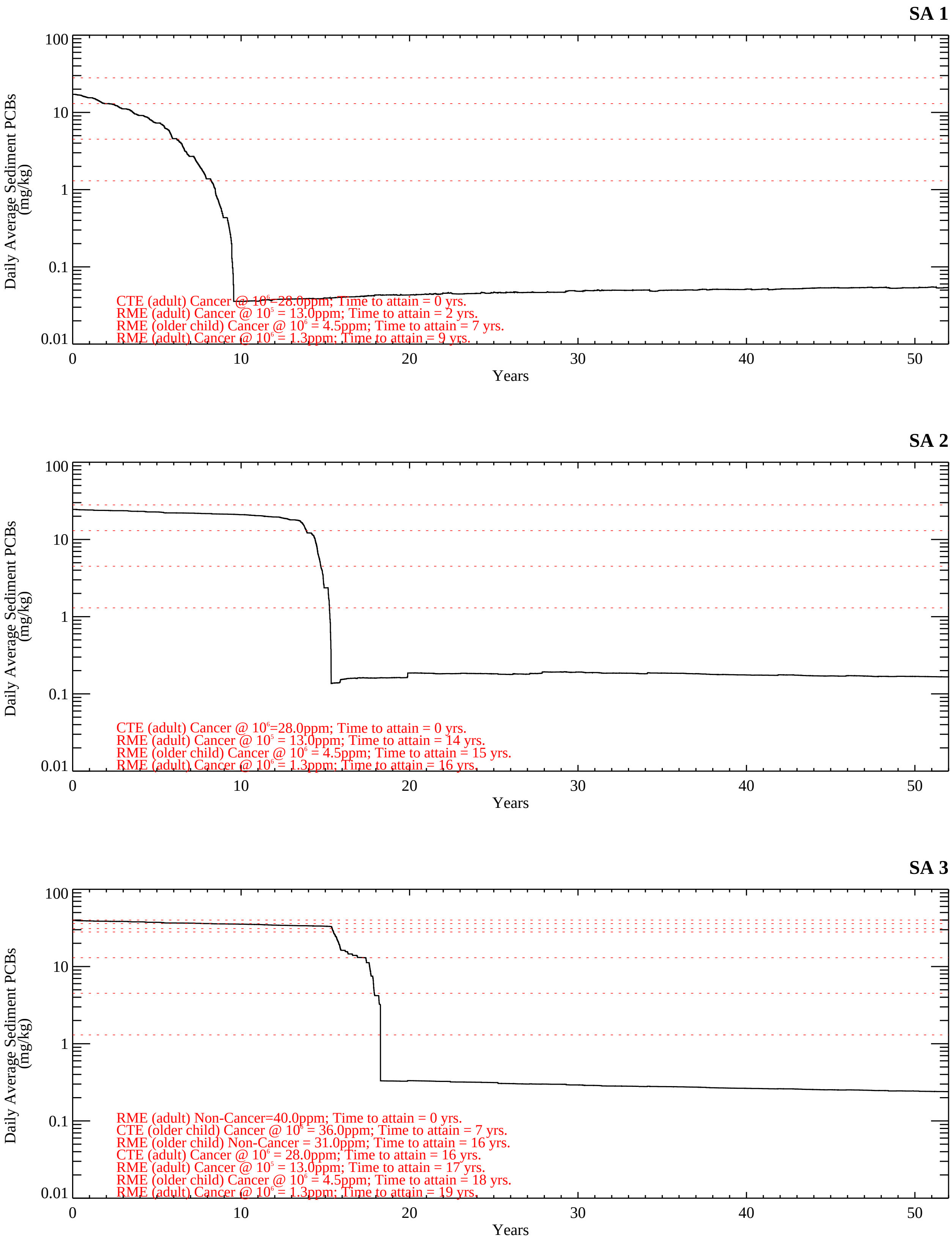

Figure G-3.2-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 6; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED6CMSBS_0712-16\\bins

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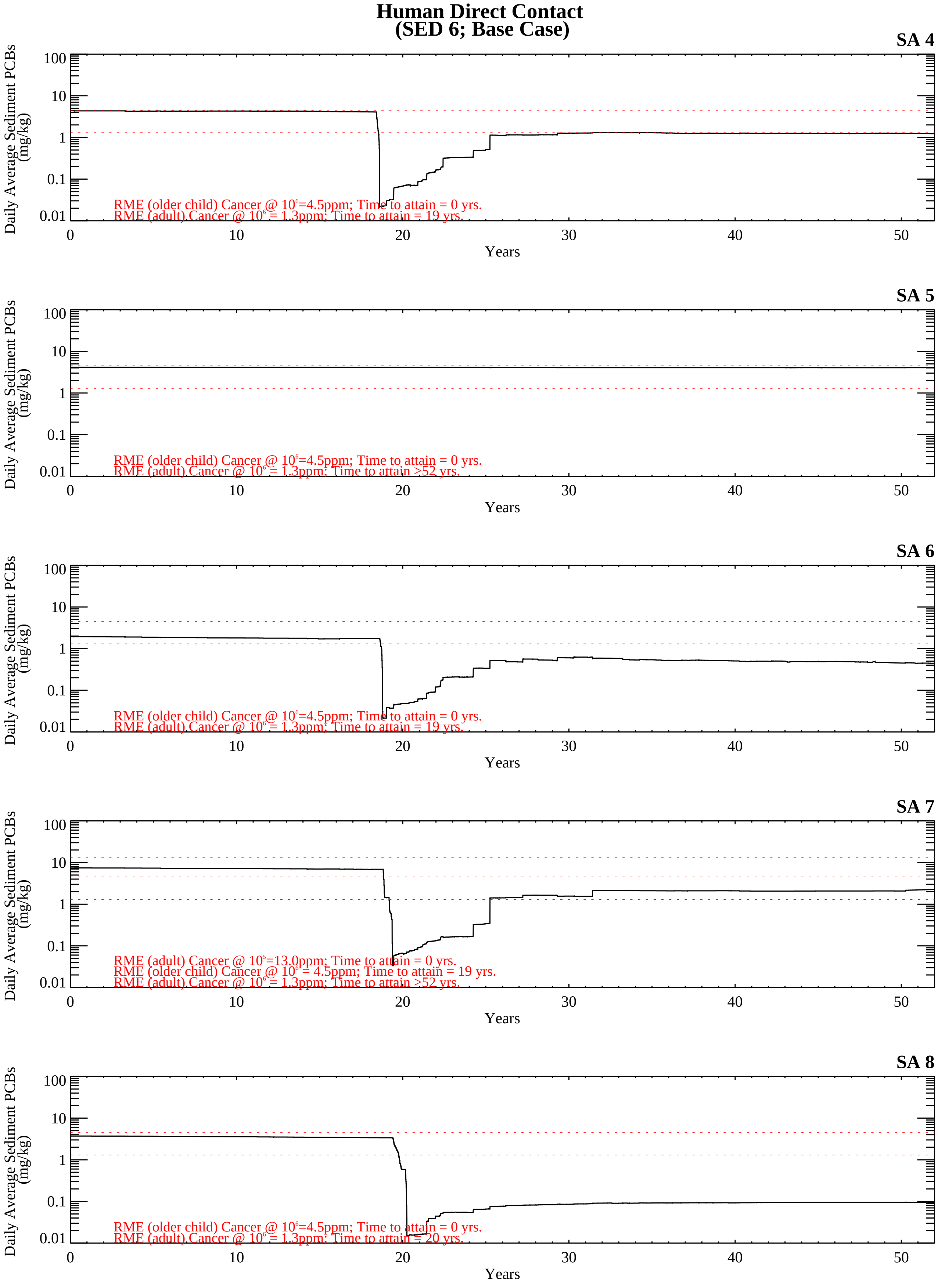

Figure G-3.2-5b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 6; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED6CMSBS_0712-32\\bins

RRM - Z:\GENcms\DOCUMENTS\reports\CMS Report\final\Appendix\Appendix_G\IDL_decks\Figure_G1_2_temp_reach.pro
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Human Direct Contact
(SED 7; Base Case)

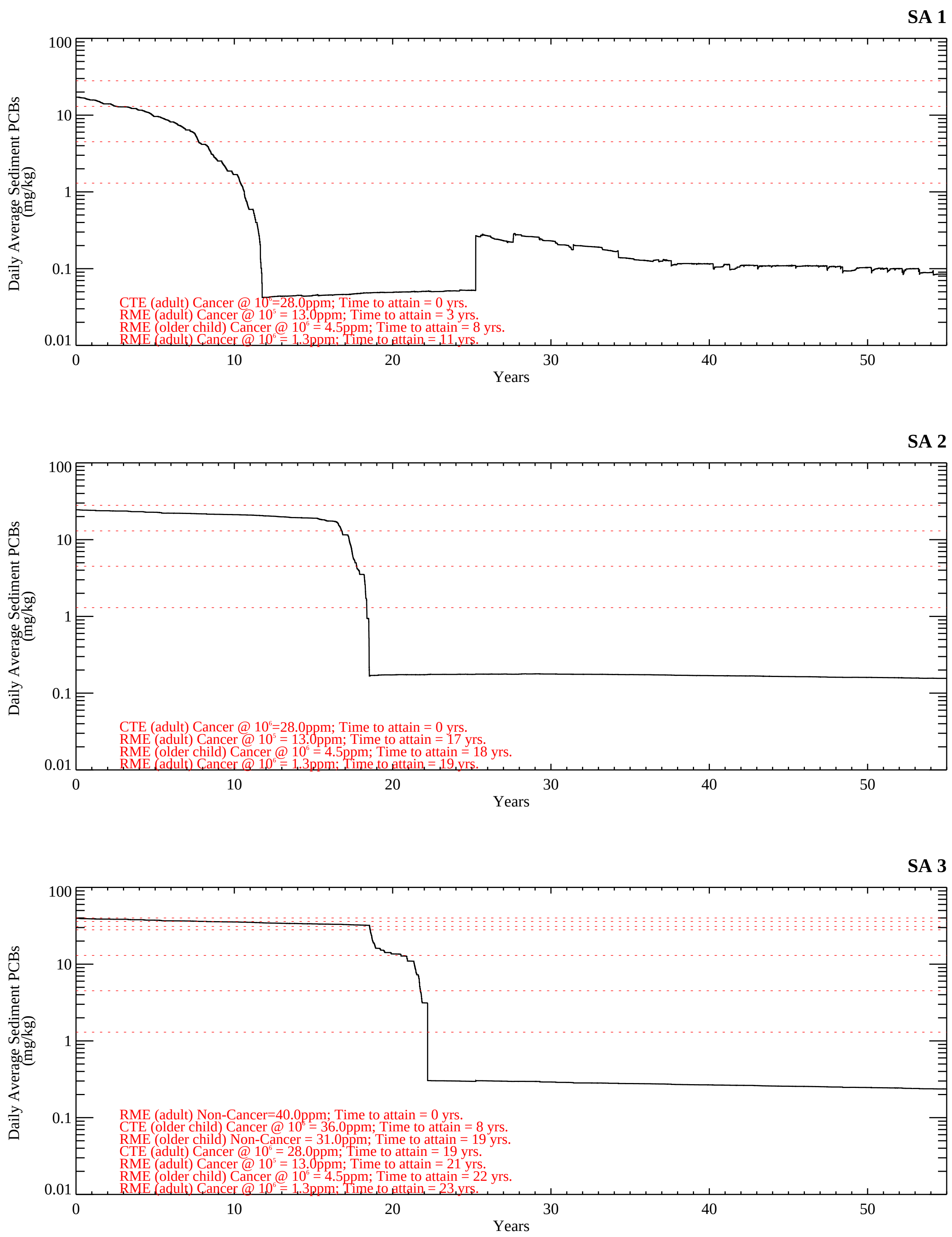

Figure G-3.2-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 7; Reach 5/6; Base Case).

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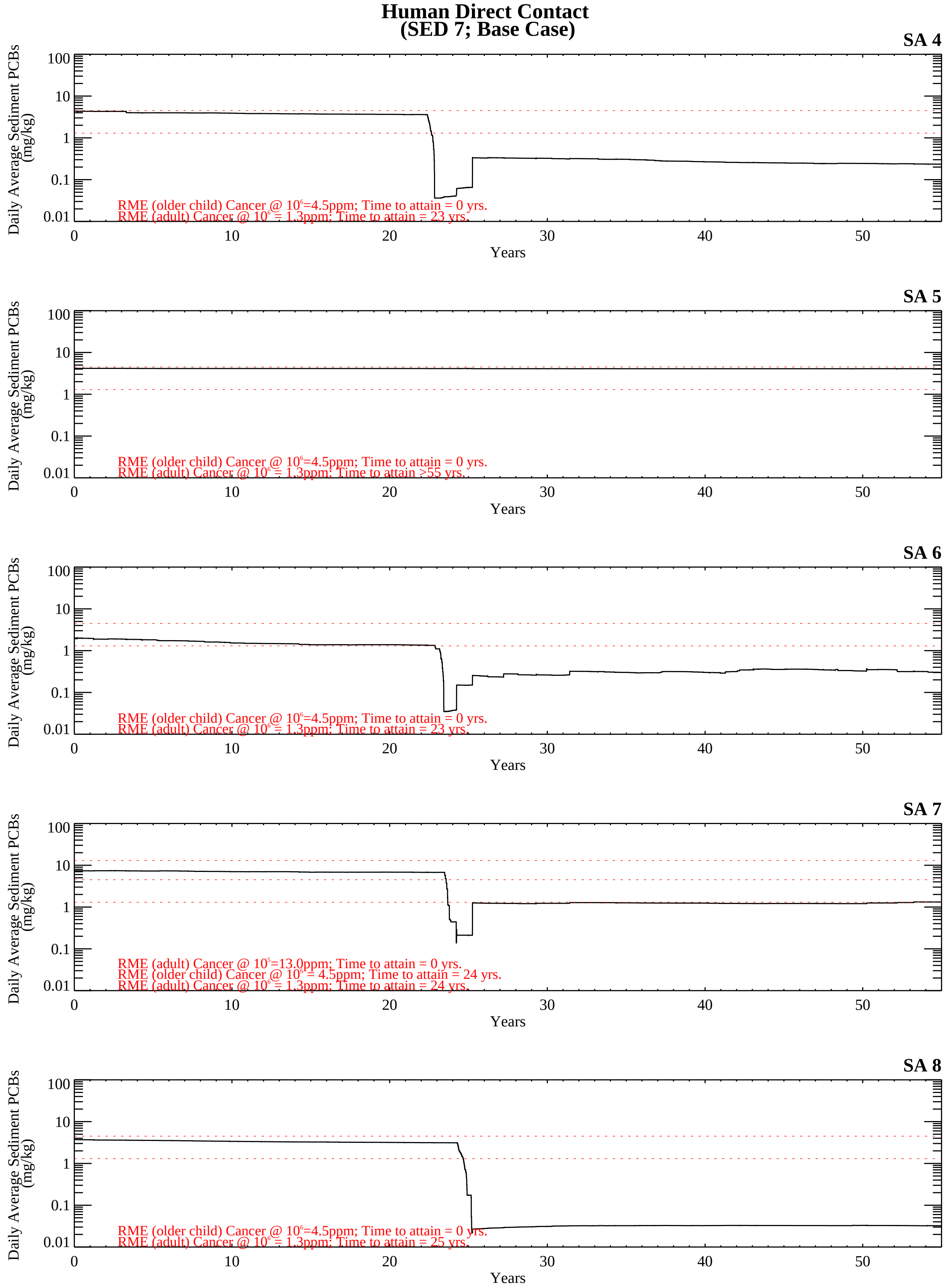

Figure G-3.2-6b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 7; Reach 7/8; Base Case).

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Human Direct Contact
(SED 8; Base Case)

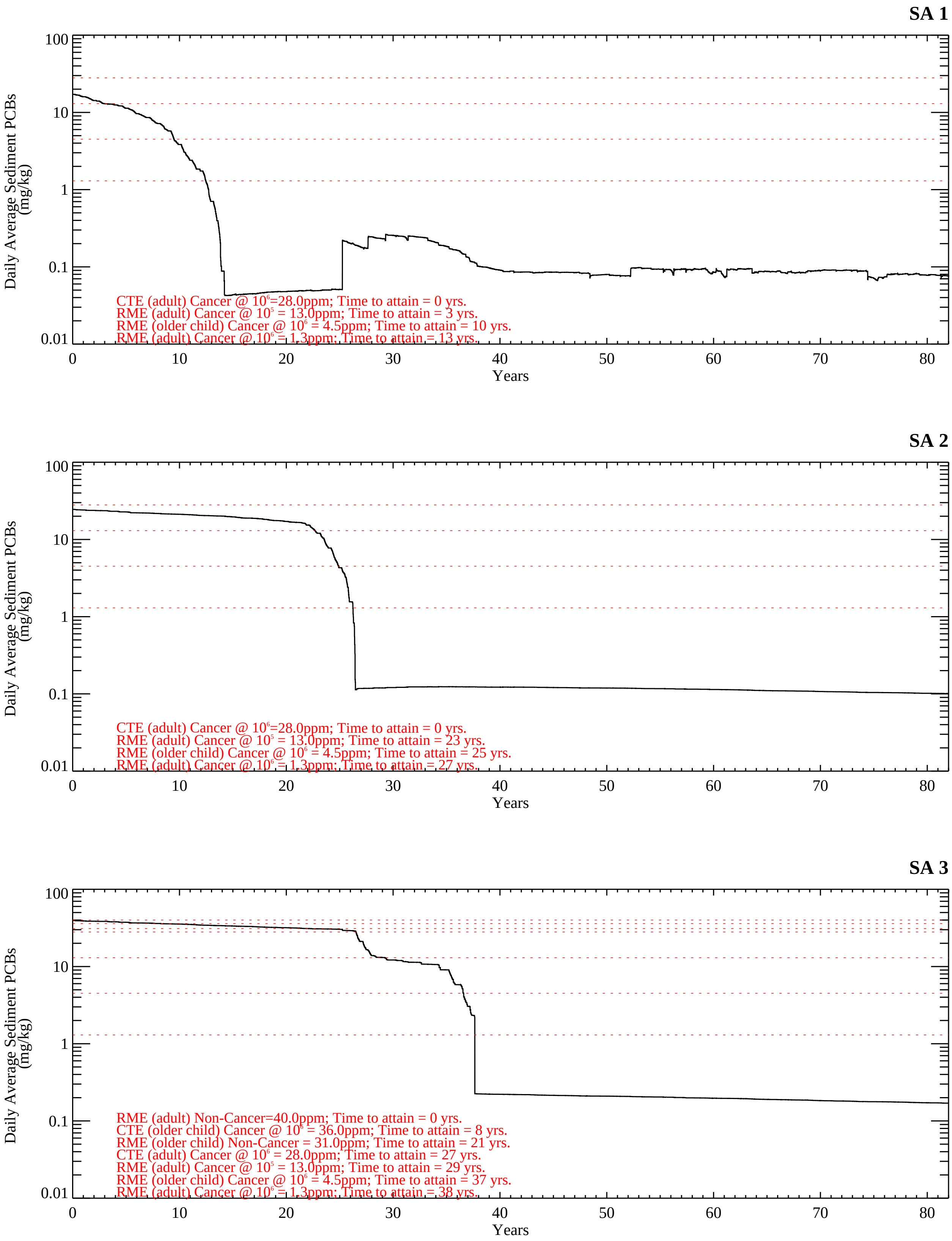

Figure G-3.2-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 8; Reach 5/6; Base Case).

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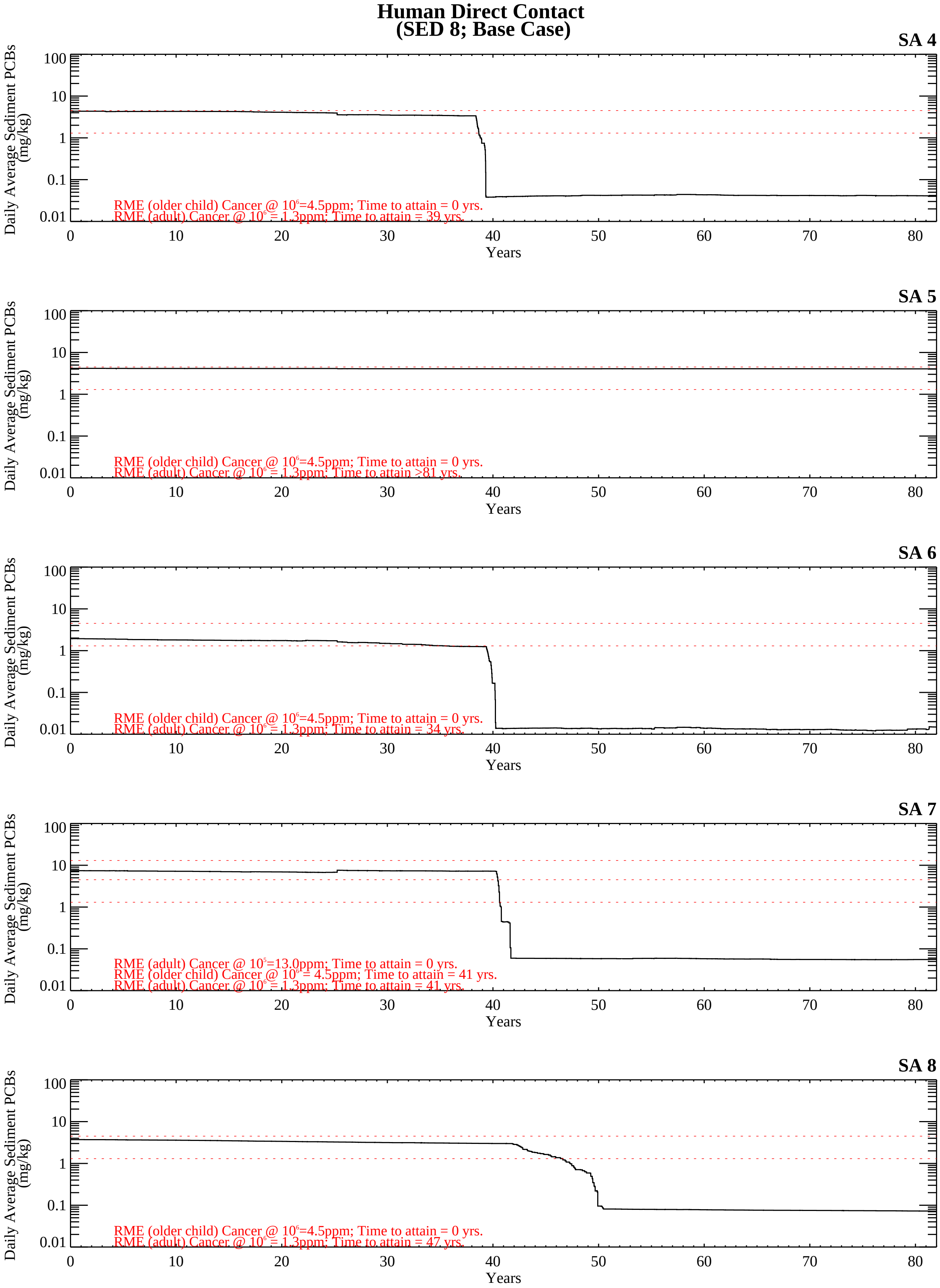

Figure G-3.2-7b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 8; Reach 7/8; Base Case).

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Human Direct Contact
(SED 1/SED 2; Base Case (Extrapolated))

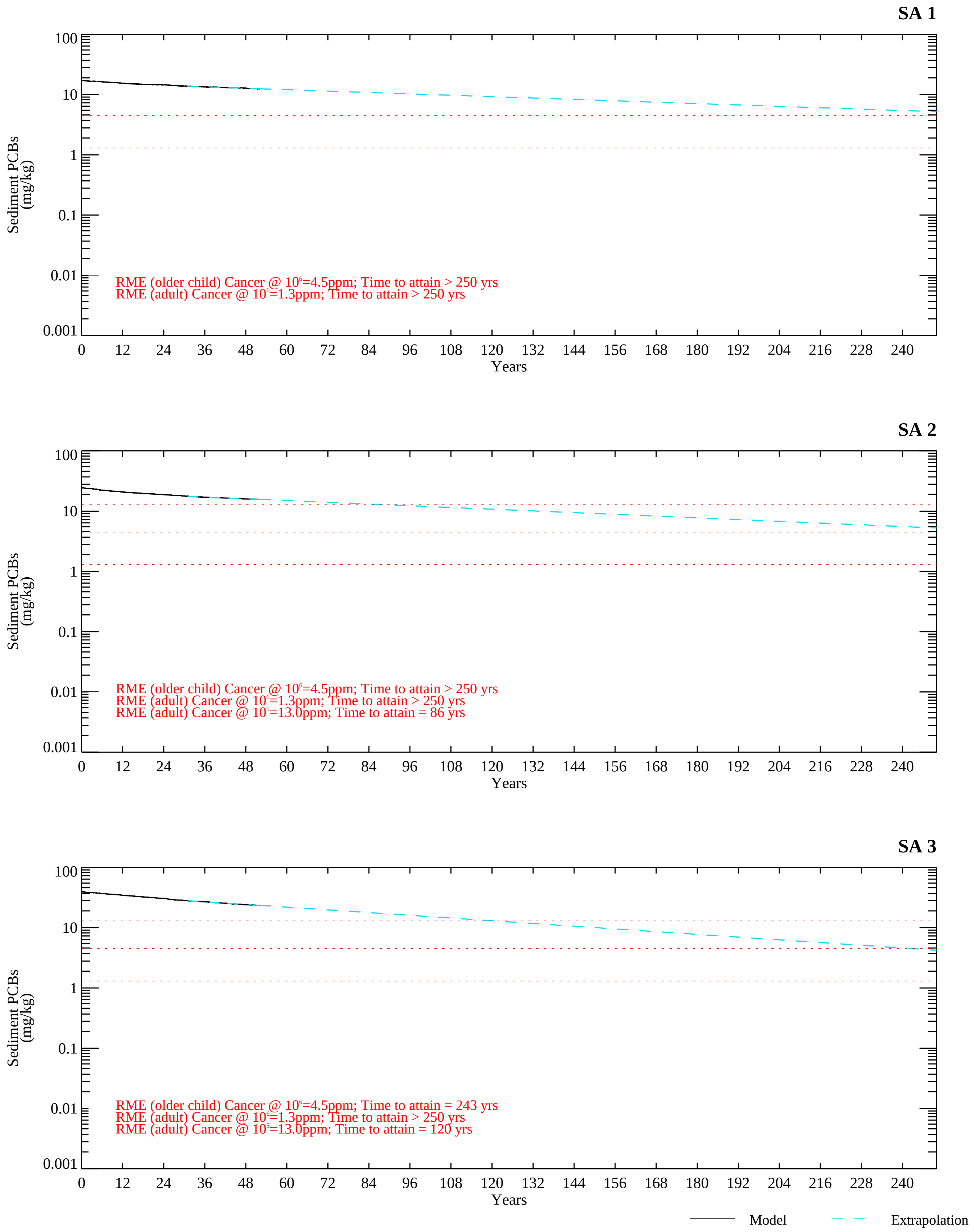

Figure G-3.3-1a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for human direct contact with sediments (SED 1/SED 2; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED1CMSBS_0712-01\bins

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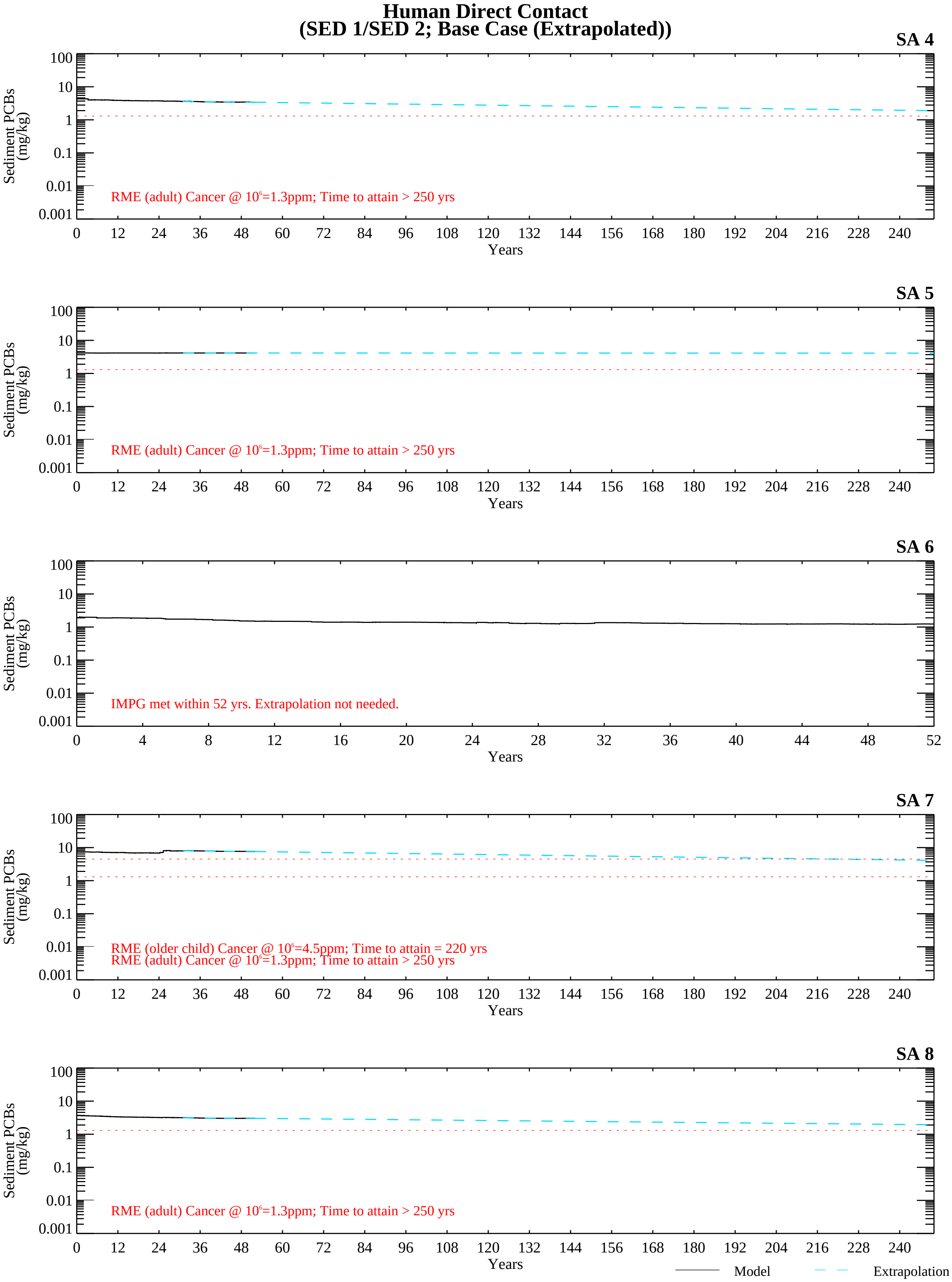

Figure G-3.3-1b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for human direct contact with sediments (SED 1/SED 2; Reach 7/8; Base Case).

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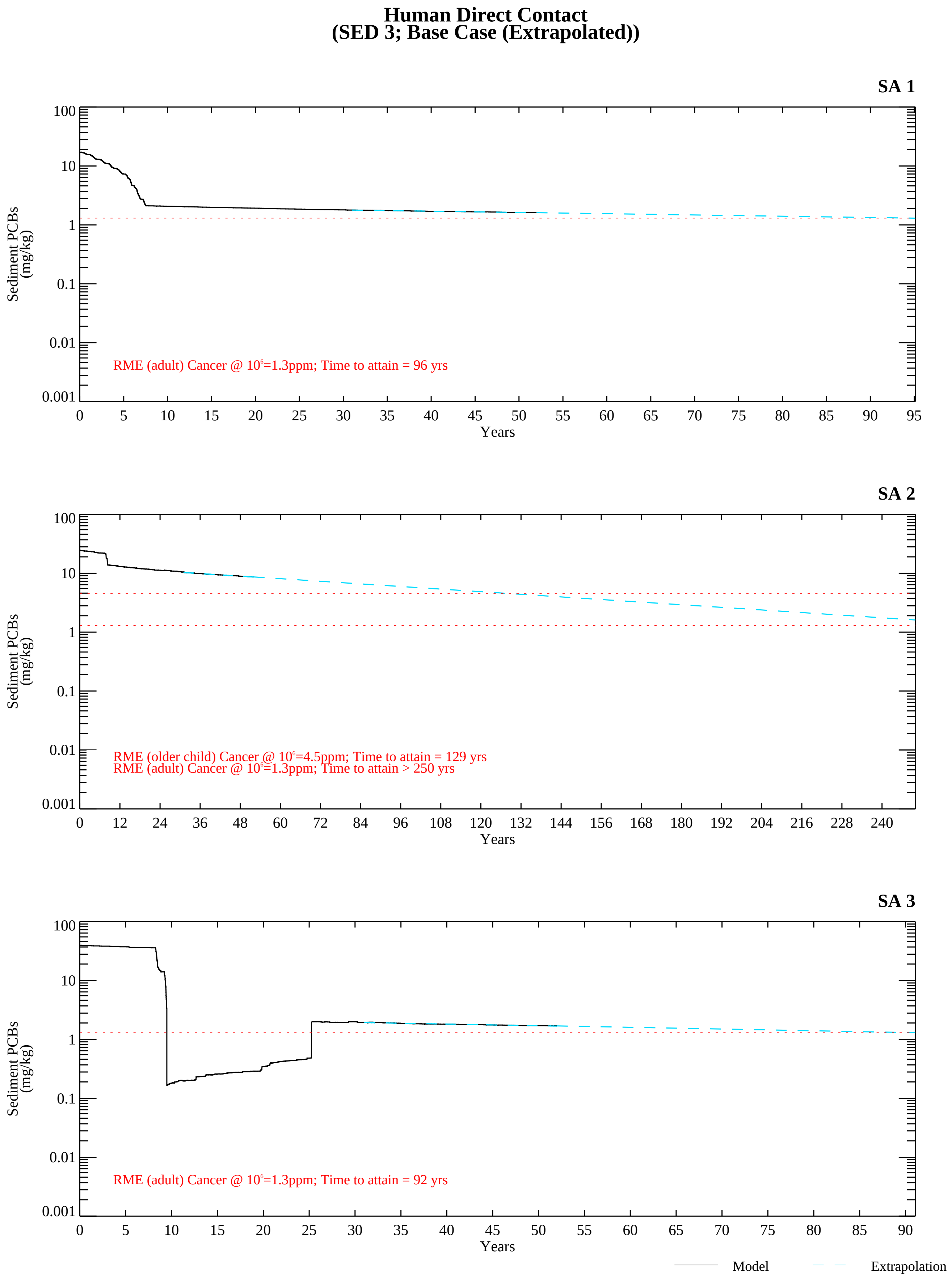

Figure G-3.3-2a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for human direct contact with sediments (SED 3; Reach 5/6; Base Case).

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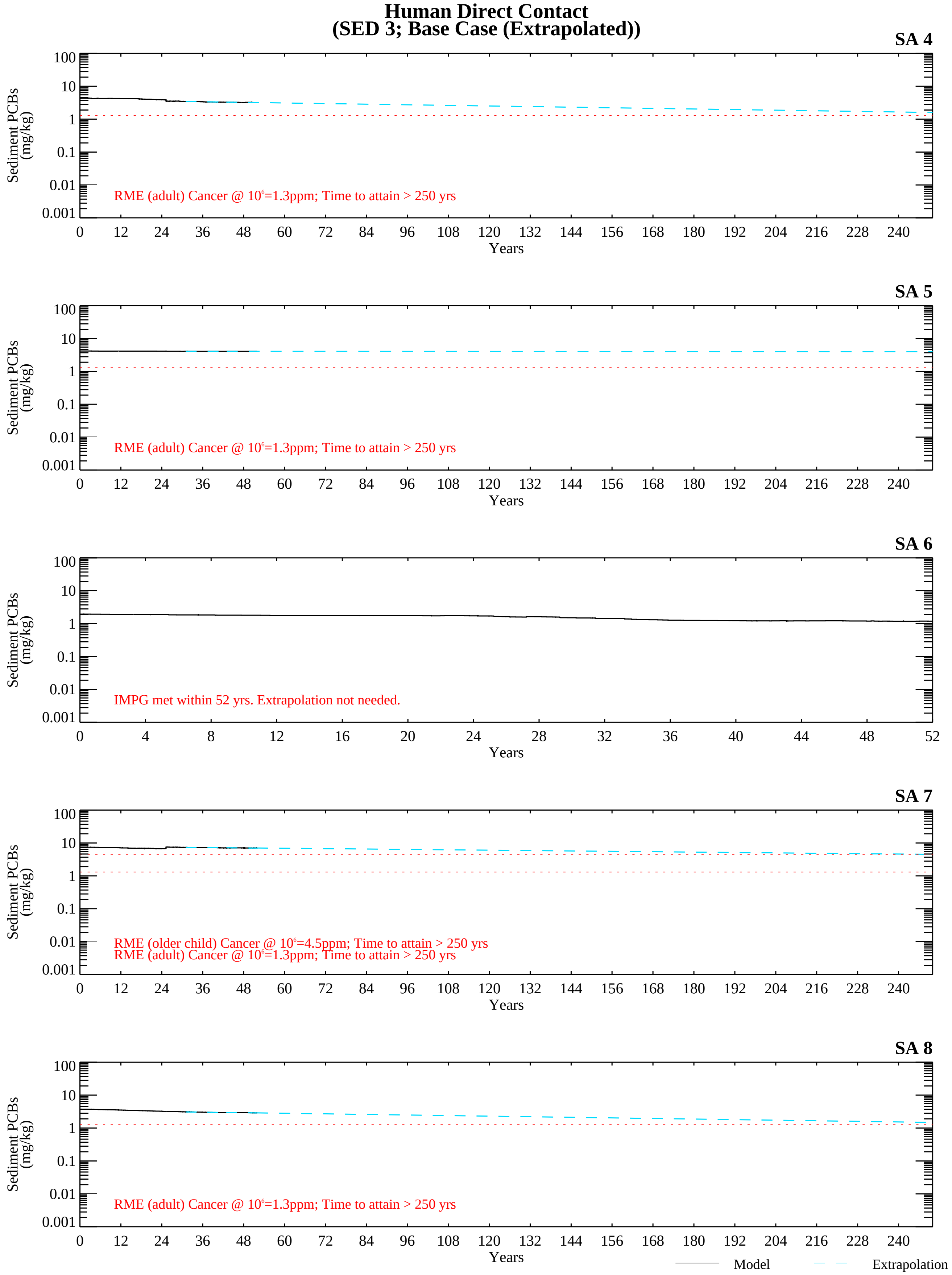

Figure G-3.3-2b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for human direct contact with sediments (SED 3; Reach 7/8; Base Case).

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Human Direct Contact
(SED 4; Base Case (Extrapolated))

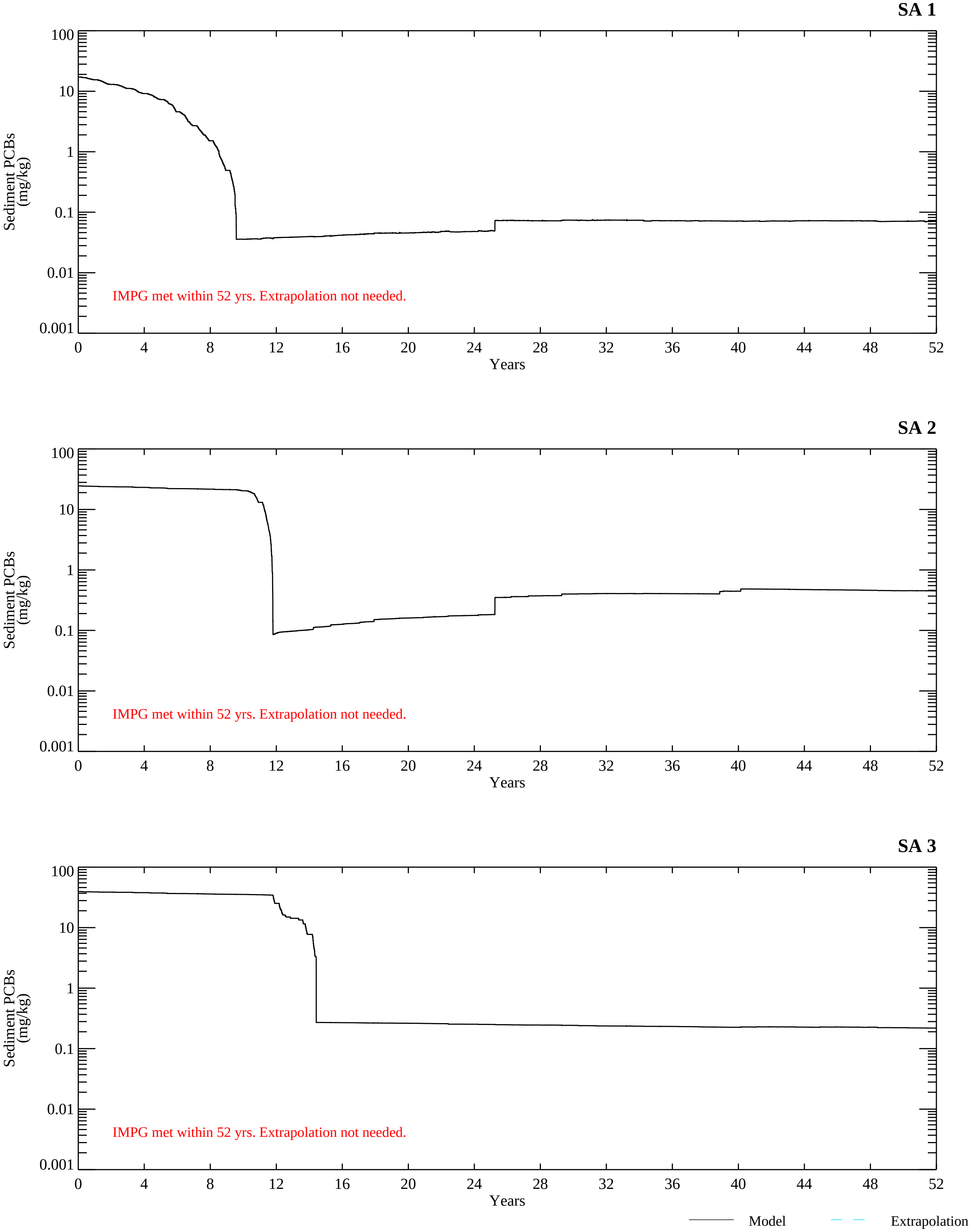

Figure G-3.3-3a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for human direct contact with sediments (SED 4; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED4CMSBS_0801-01\bins

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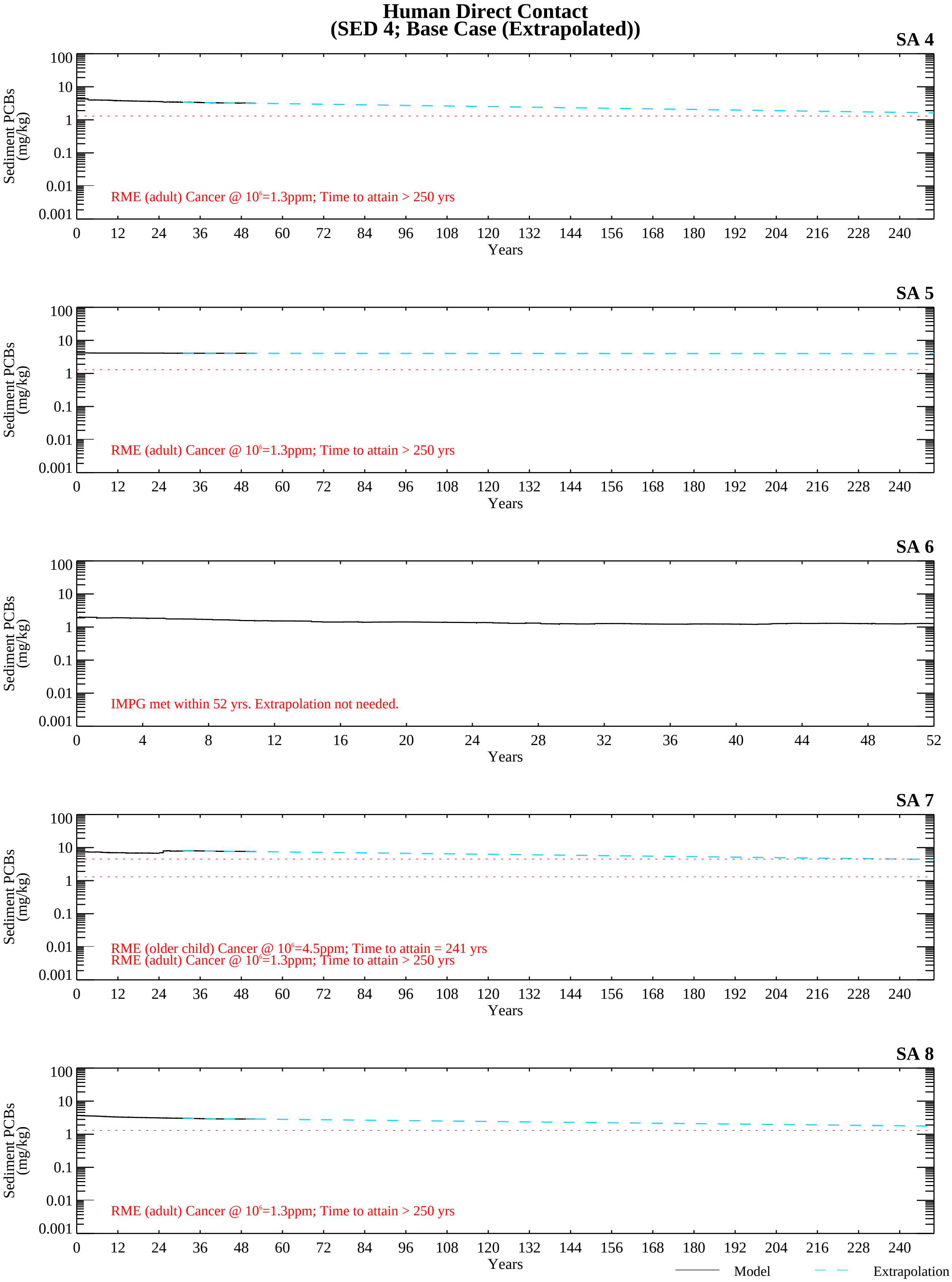

Figure G-3.3-3b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for human direct contact with sediments (SED 4; Reach 7/8; Base Case).

Run path:\\Tenmile\EFDC_Output\R78\CMS\Proj_R78_SED4CMSBS_0802-01\bins

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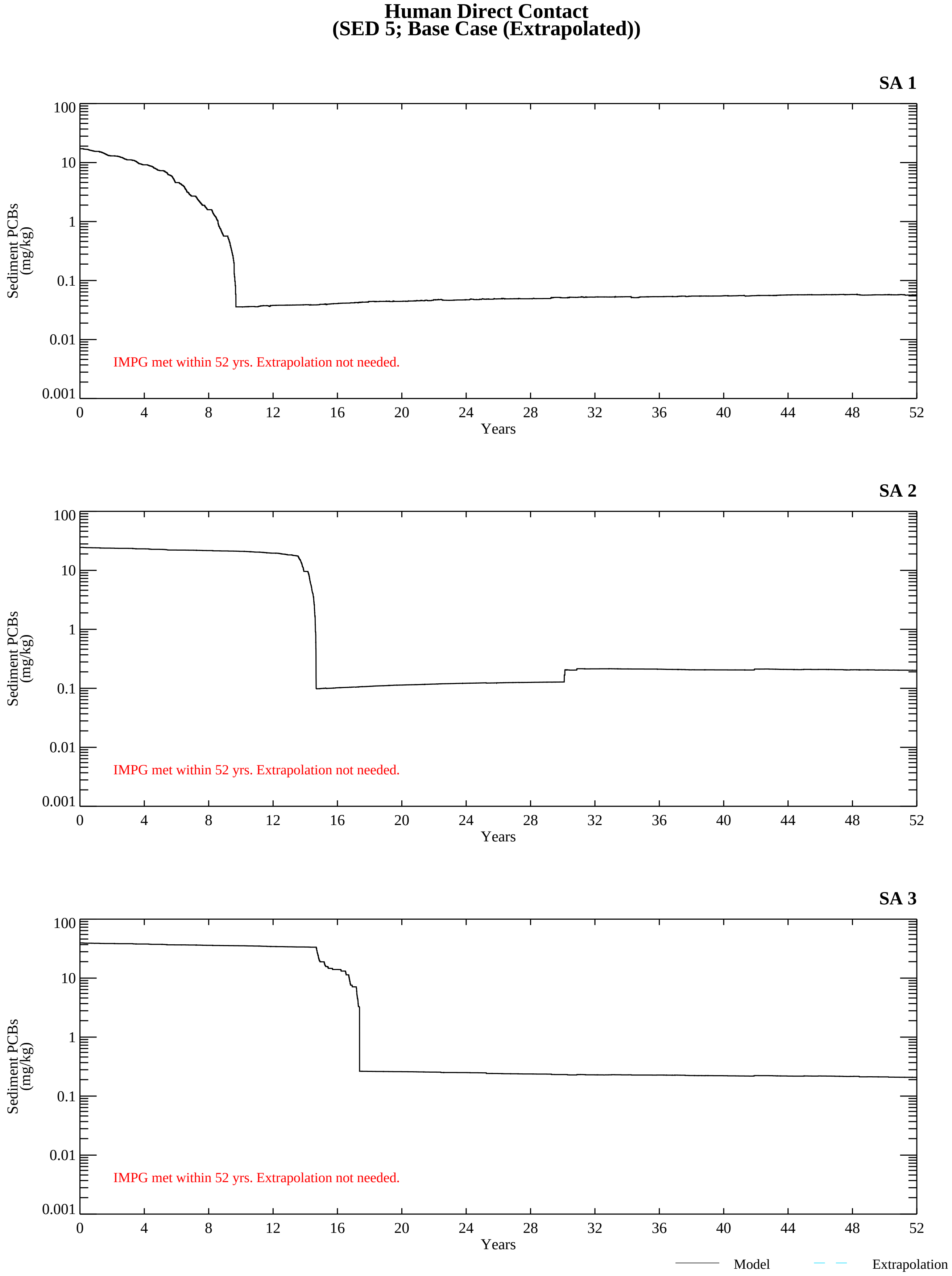

Figure G-3.3-4a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for human direct contact with sediments (SED 5; Reach 5/6; Base Case).

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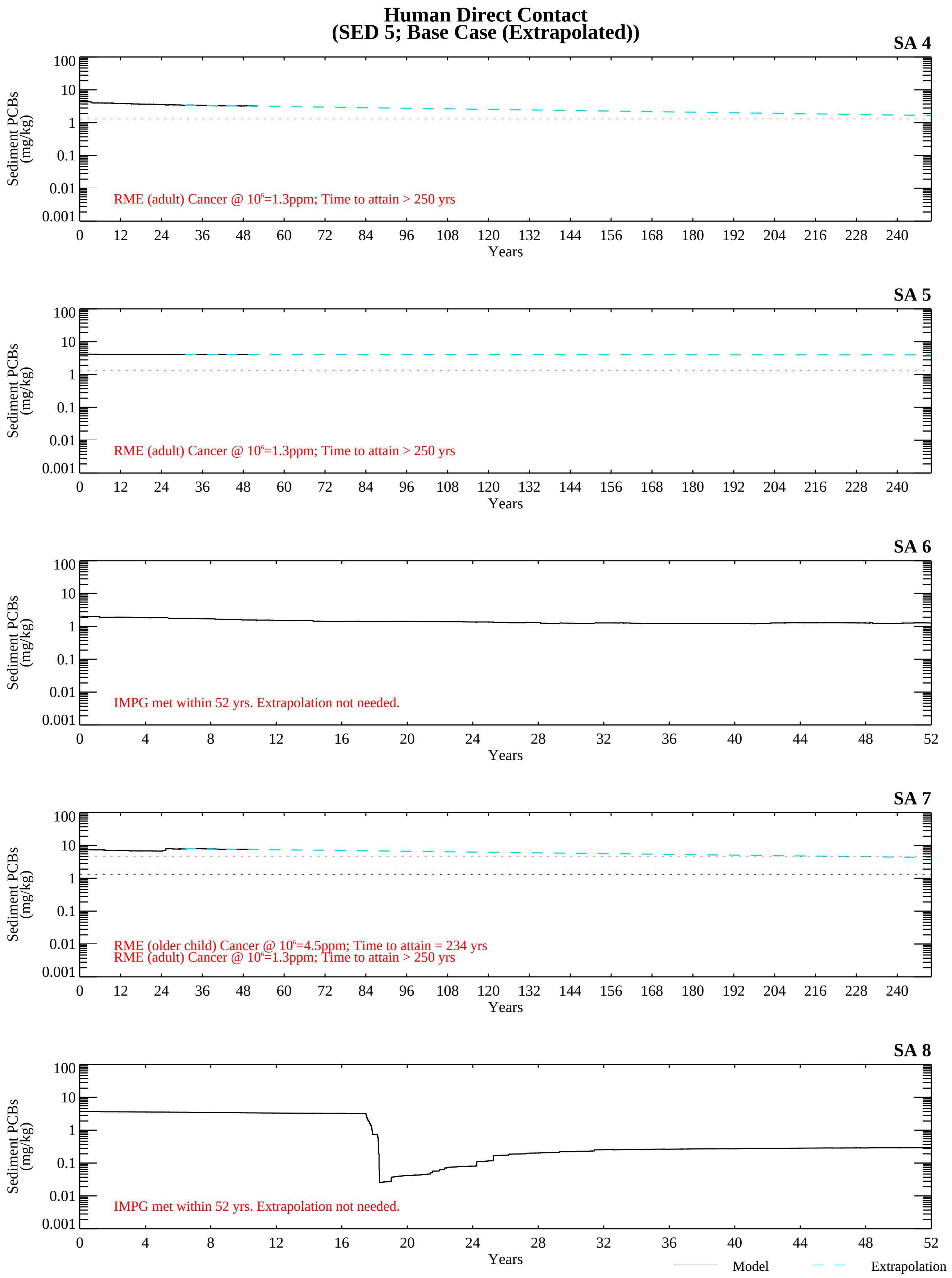

Figure G-3.3-4b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for human direct contact with sediments (SED 5; Reach 7/8; Base Case).

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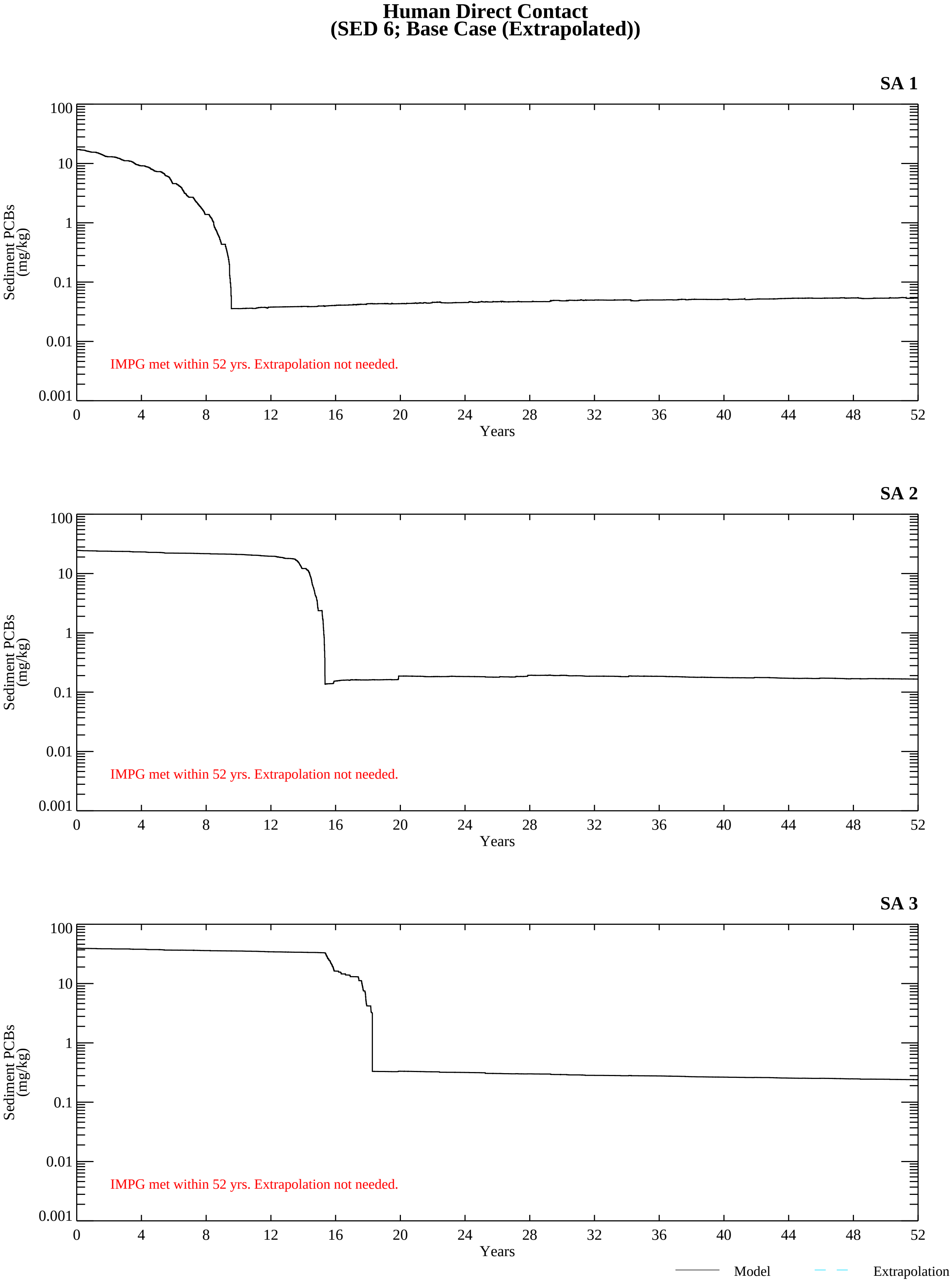

Figure G-3.3-5a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for human direct contact with sediments (SED 6; Reach 5/6; Base Case).

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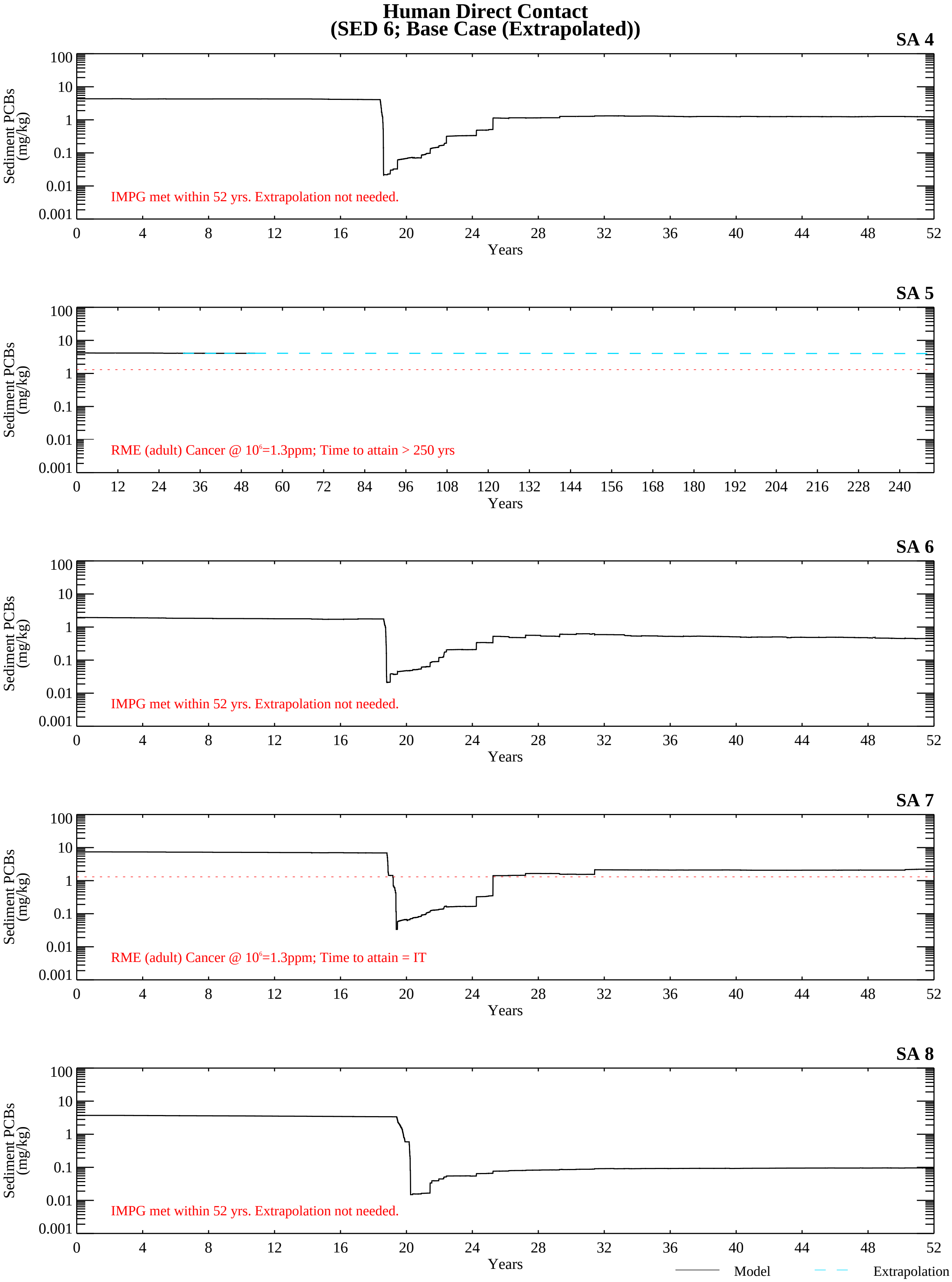

Figure G-3.3-5b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for human direct contact with sediments (SED 6; Reach 7/8; Base Case).

Run path:\\Tenmile\EFDC_Output\R78\CMS\Proj_R78_SED6CMSBS_0712-32\bins
Notes: IT = No extrapolation performed due to an increasing trend.

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Human Direct Contact
(SED 7; Base Case (Extrapolated))

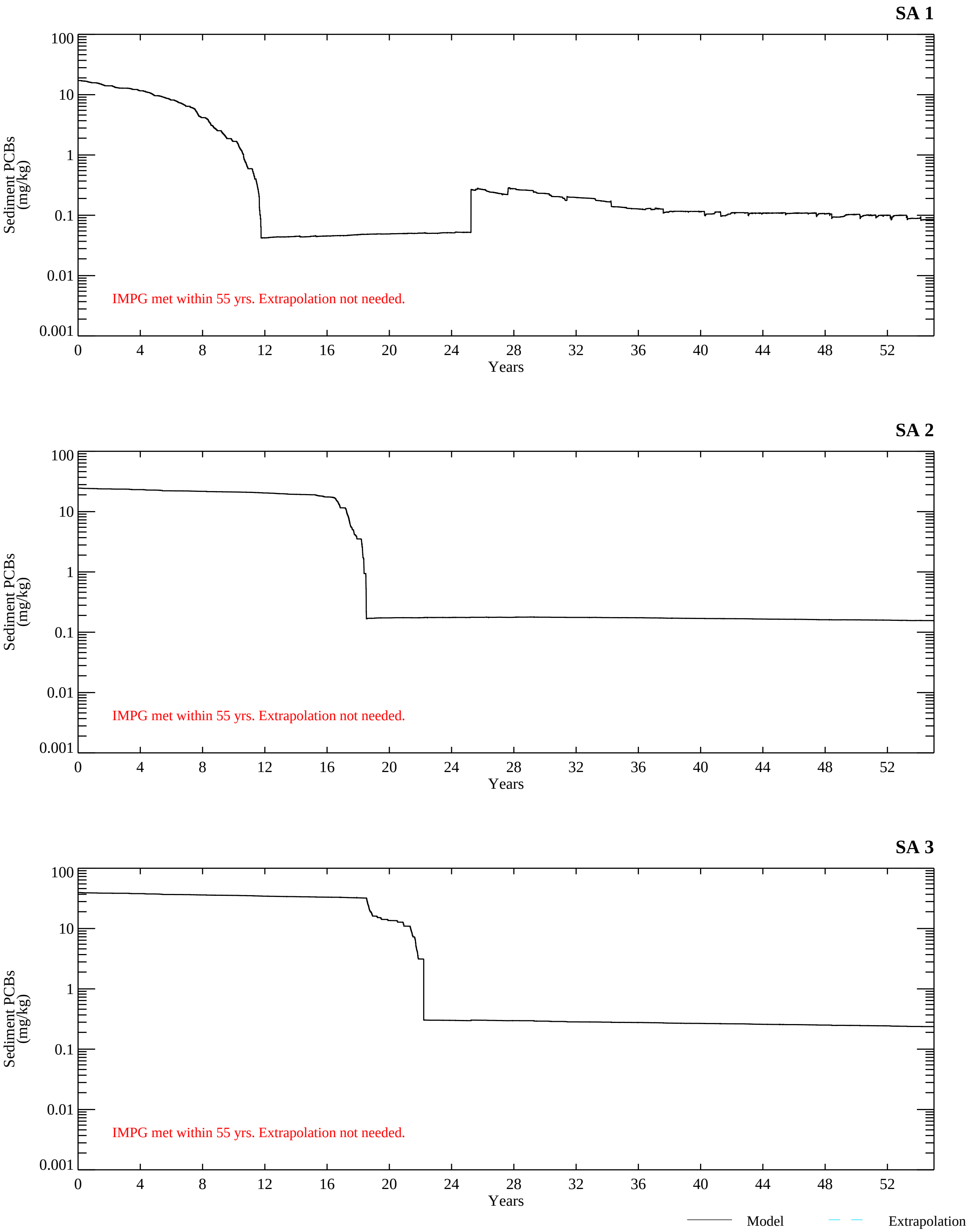

Figure G-3.3-6a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for human direct contact with sediments (SED 7; Reach 5/6; Base Case).

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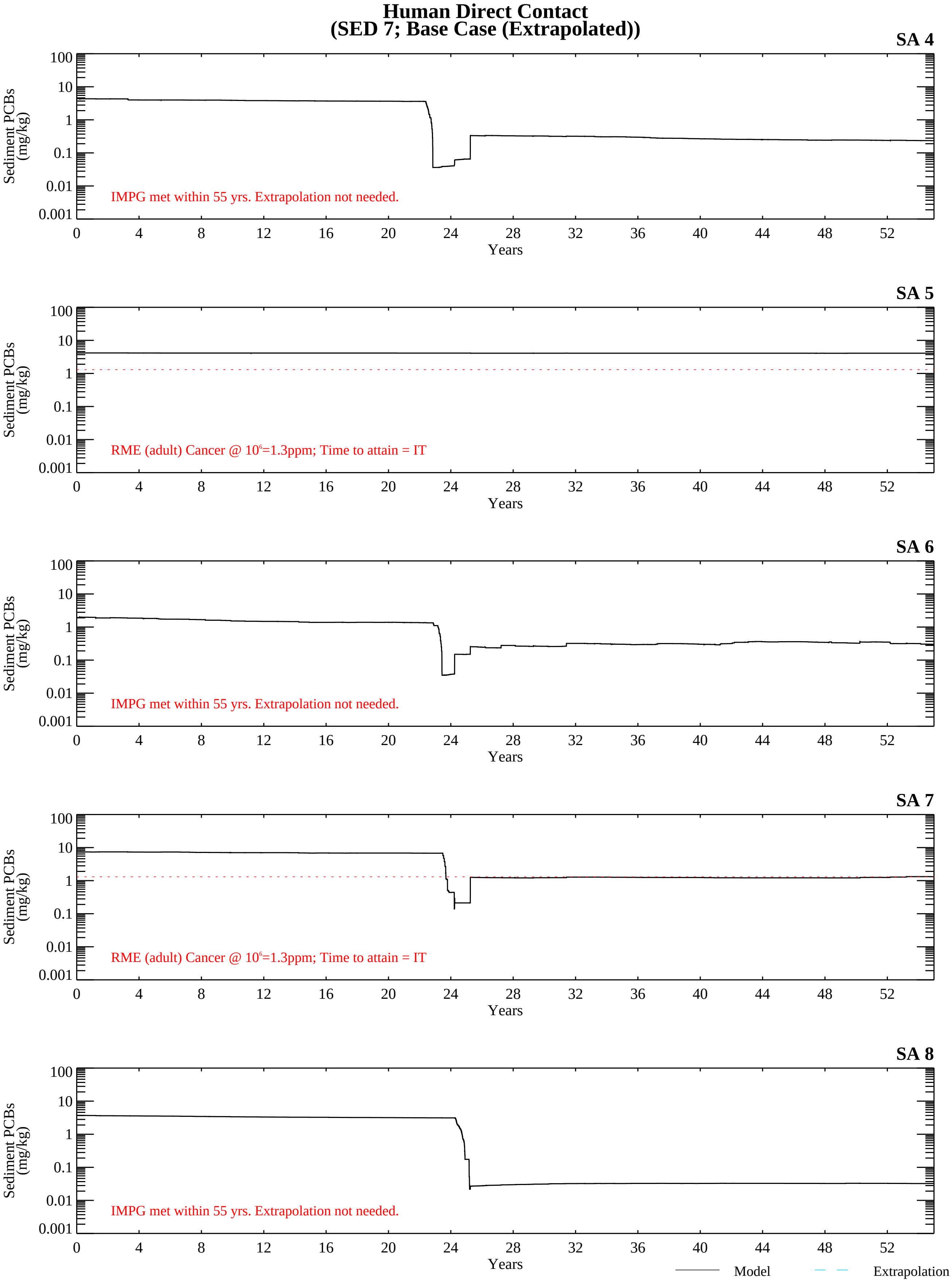
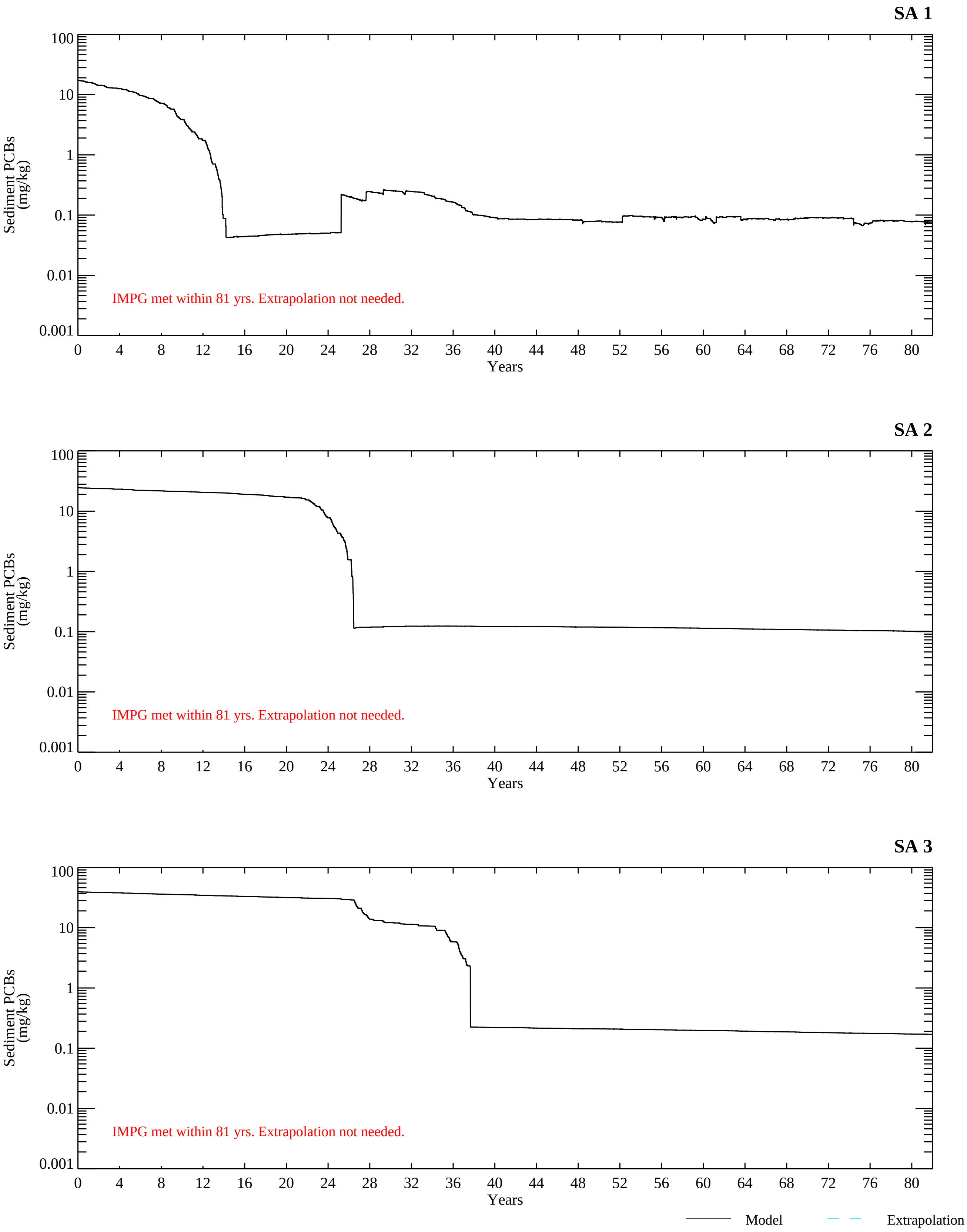


Figure G-3.3-6b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for human direct contact with sediments (SED 7; Reach 7/8; Base Case).

Run path:\\Tenmile\EFDC_Output\R78\CMS\Proj_R78_SED7CMSBS_0712-33\bins
Notes: IT = No extrapolation performed due to an increasing trend.

Human Direct Contact
(SED 8; Base Case (Extrapolated))



IMPG met within 81 yrs. Extrapolation not needed.

IMPG met within 81 yrs. Extrapolation not needed.

IMPG met within 81 yrs. Extrapolation not needed.

Figure G-3.3-7a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for human direct contact with sediments (SED 8; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED8CMSBS_0712-18\bins

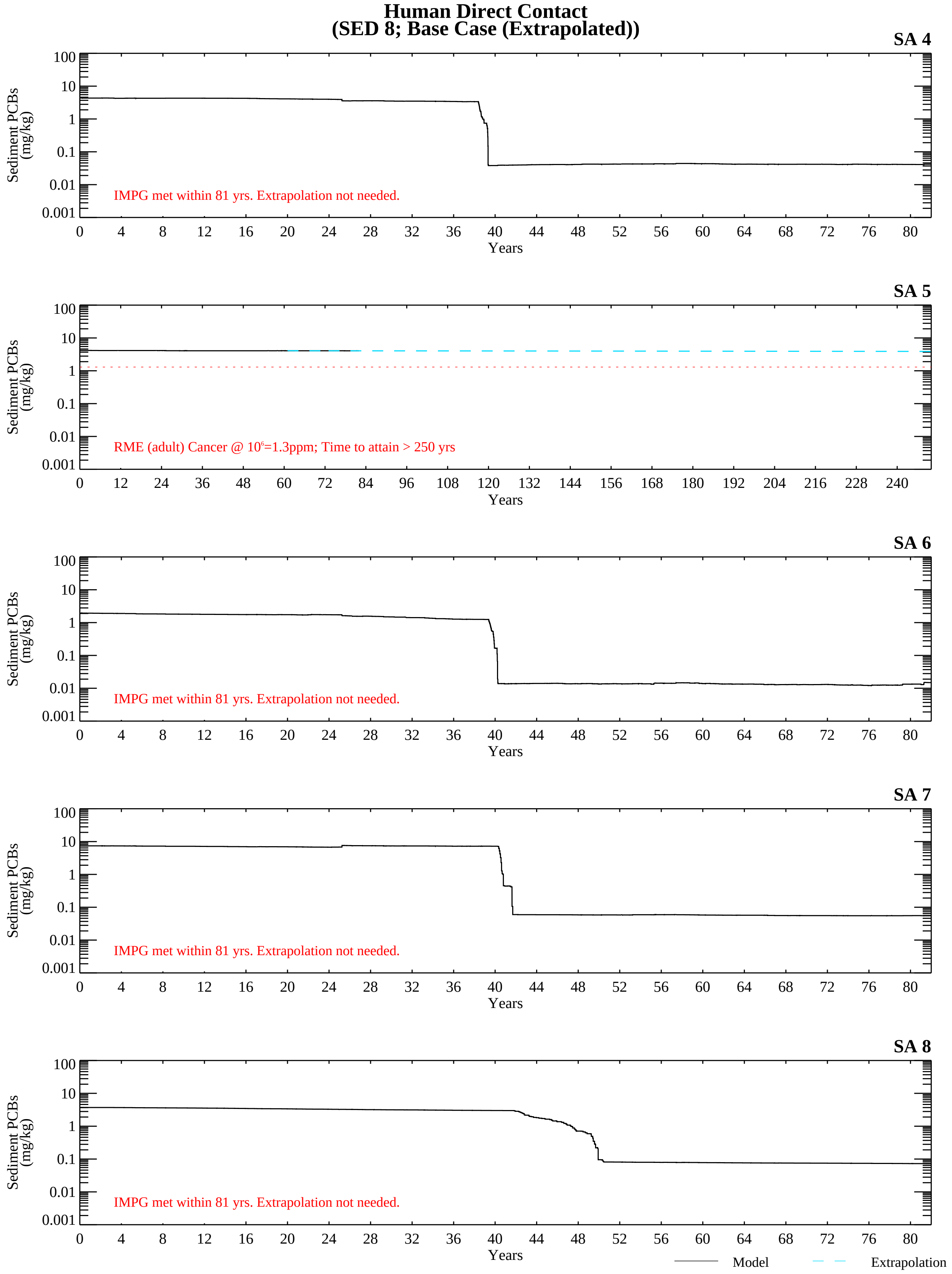


Figure G-3.3-7b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for human direct contact with sediments (SED 8; Reach 7/8; Base Case).

Run path:\\Tenmile\EFDC_Output\R78\CMS\Proj_R78_SED8CMSBS_0712-34\bins

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Human Direct Contact
(SED 1 / SED 2; Lower Bound)

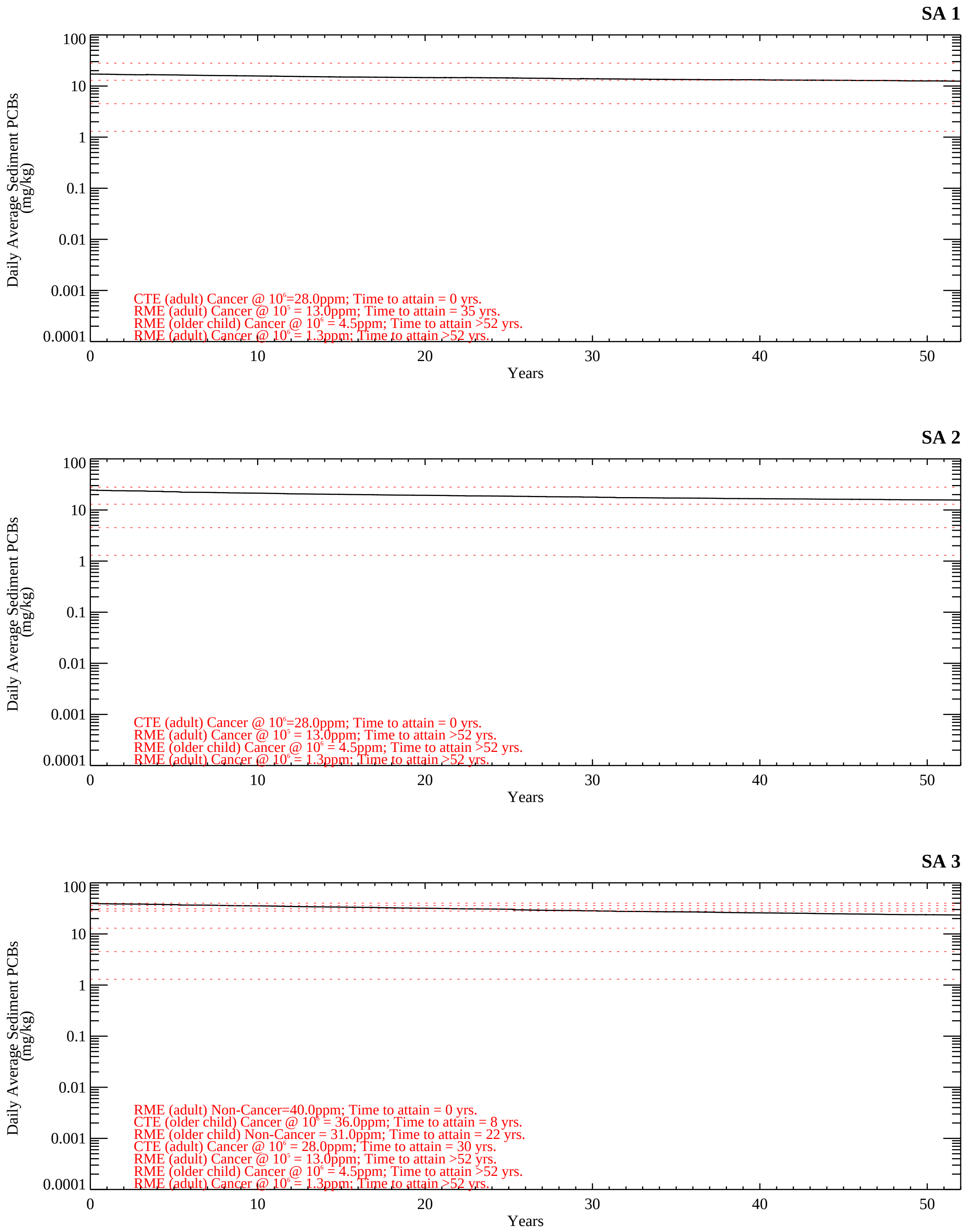

Figure G-3.4-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 1 / SED 2; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED1CMSLB_0712-19\\bins

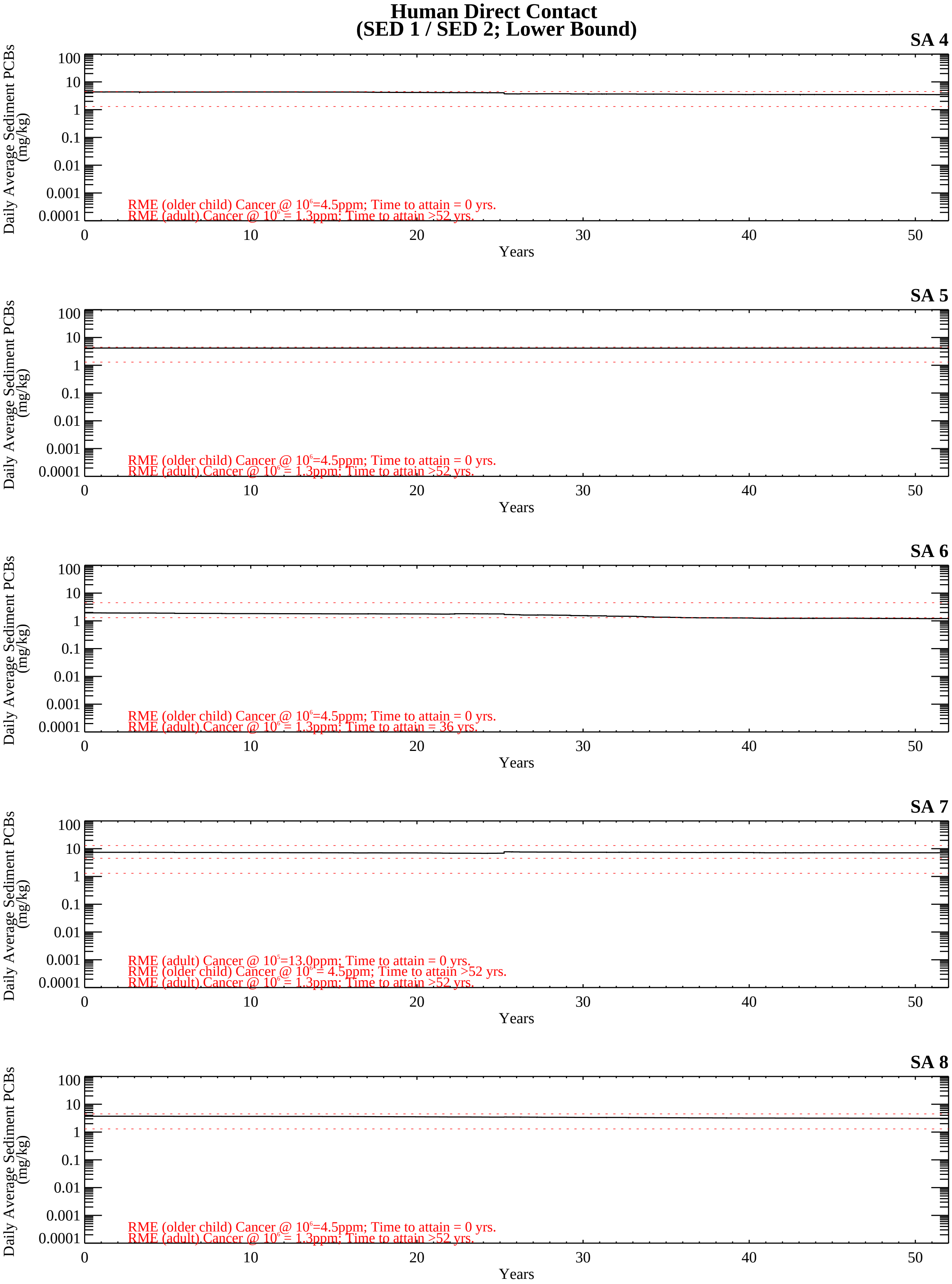

Figure G-3.4-1b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 1 / SED 2; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED1CMSLB_0712-35\\bins

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Human Direct Contact
(SED 3; Lower Bound)

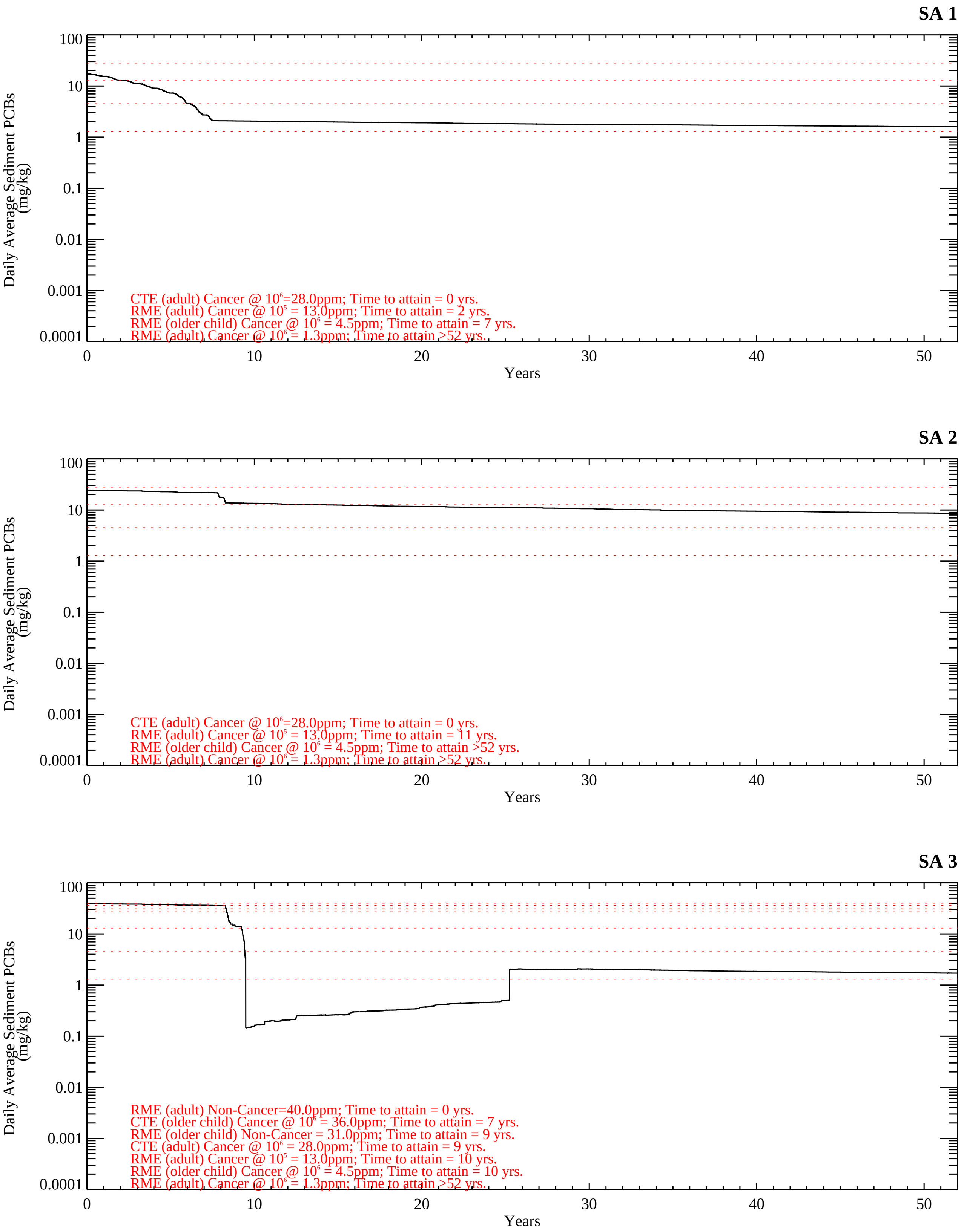

Figure G-3.4-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 3; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED3CMSLB_0712-20\\bins

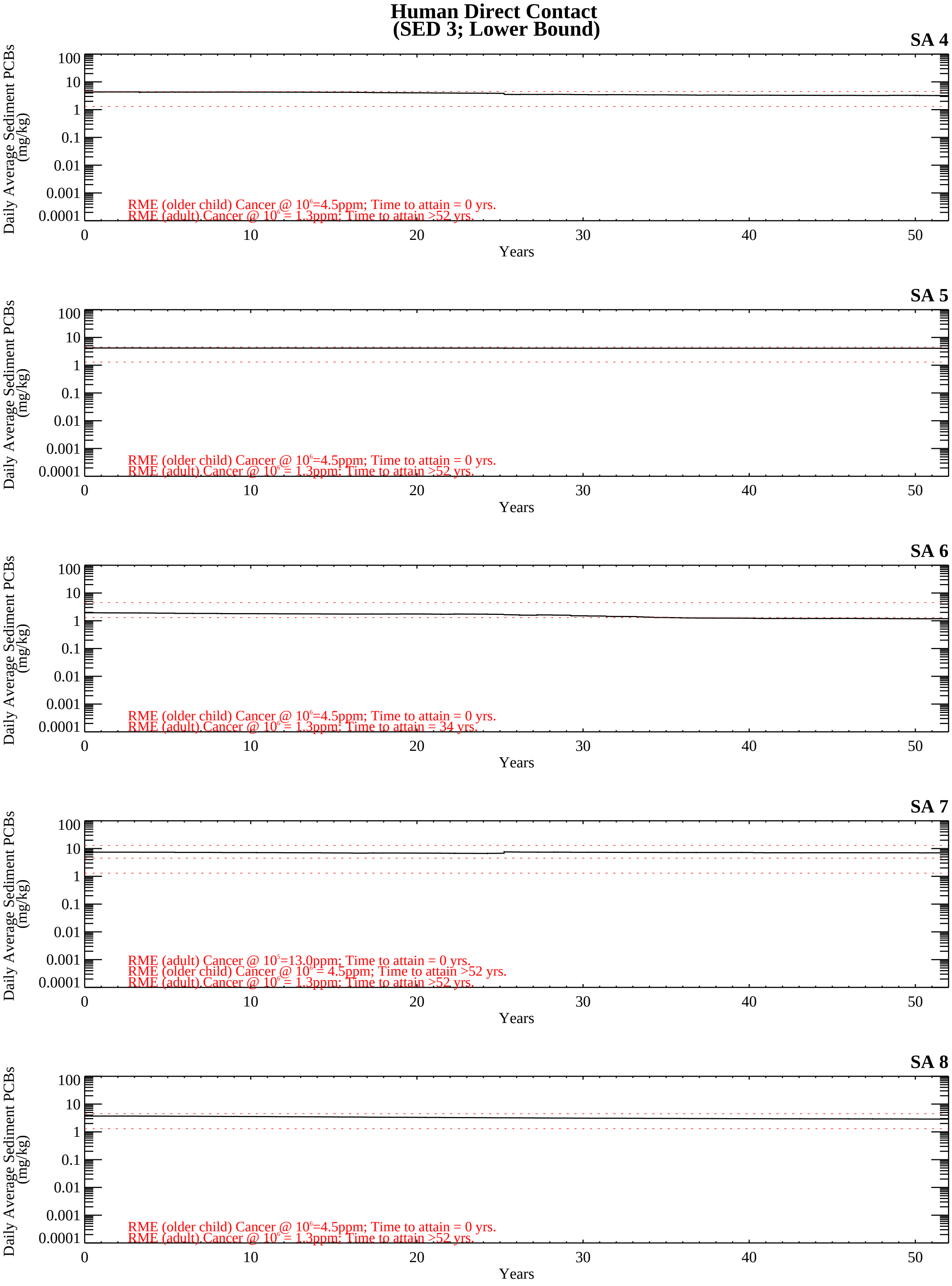

Figure G-3.4-2b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 3; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED3CMSLB_0712-36\\bins

Human Direct Contact
(SED 4; Lower Bound)

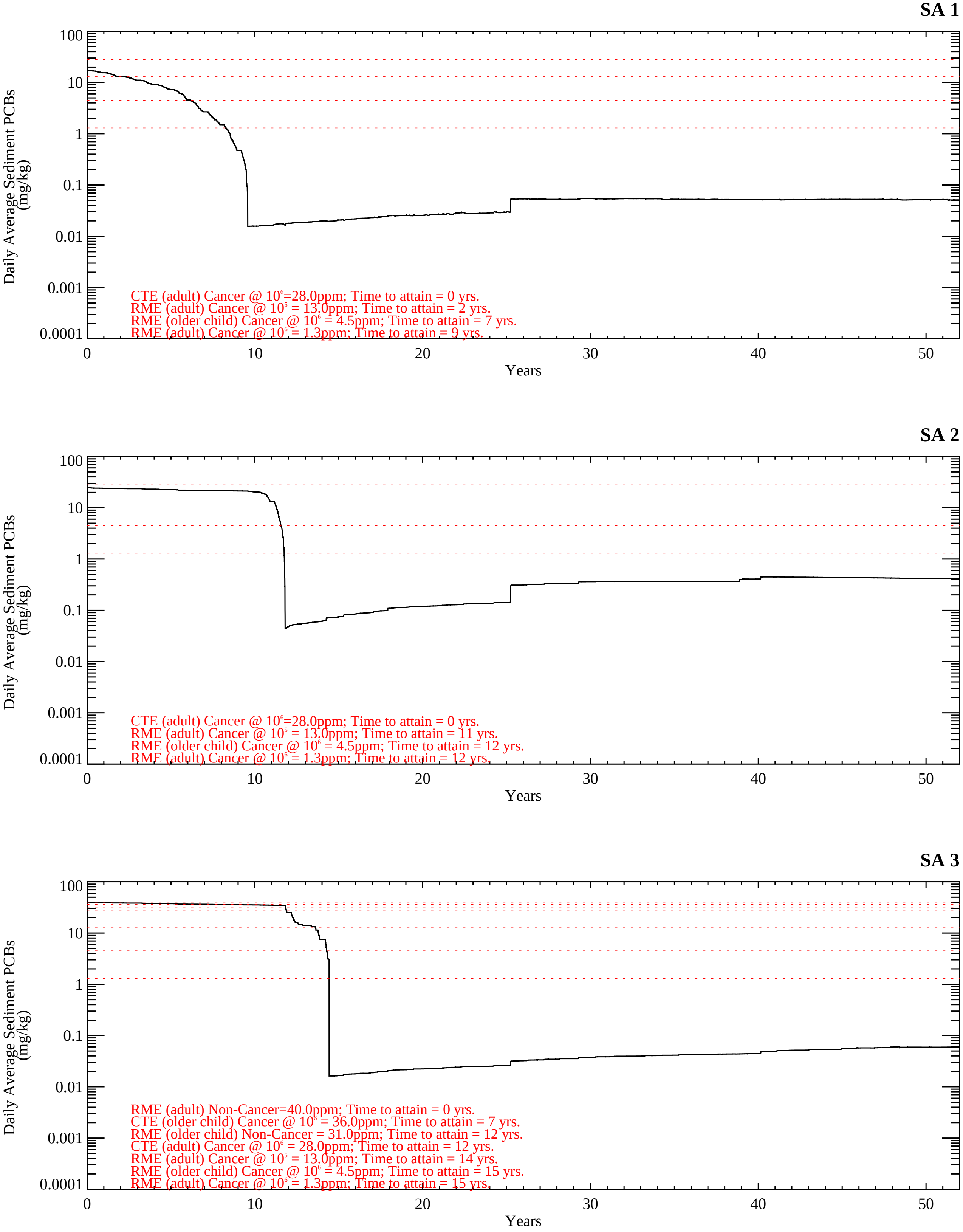

Figure G-3.4-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 4; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED4CMSLB_0801-03\\bins

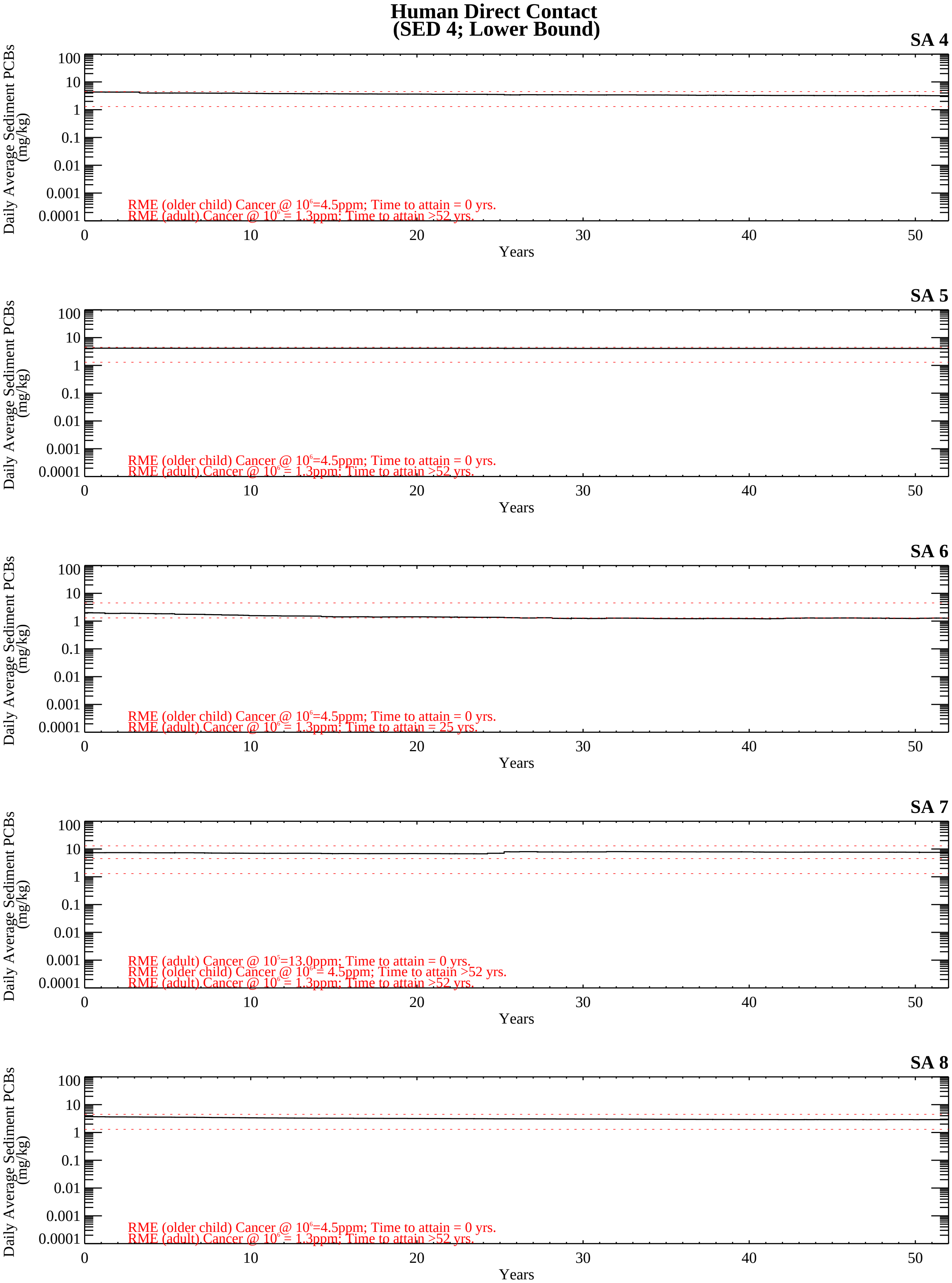

Figure G-3.4-3b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 4; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED4CMSLB_0802-03\\bins

Human Direct Contact
(SED 5; Lower Bound)

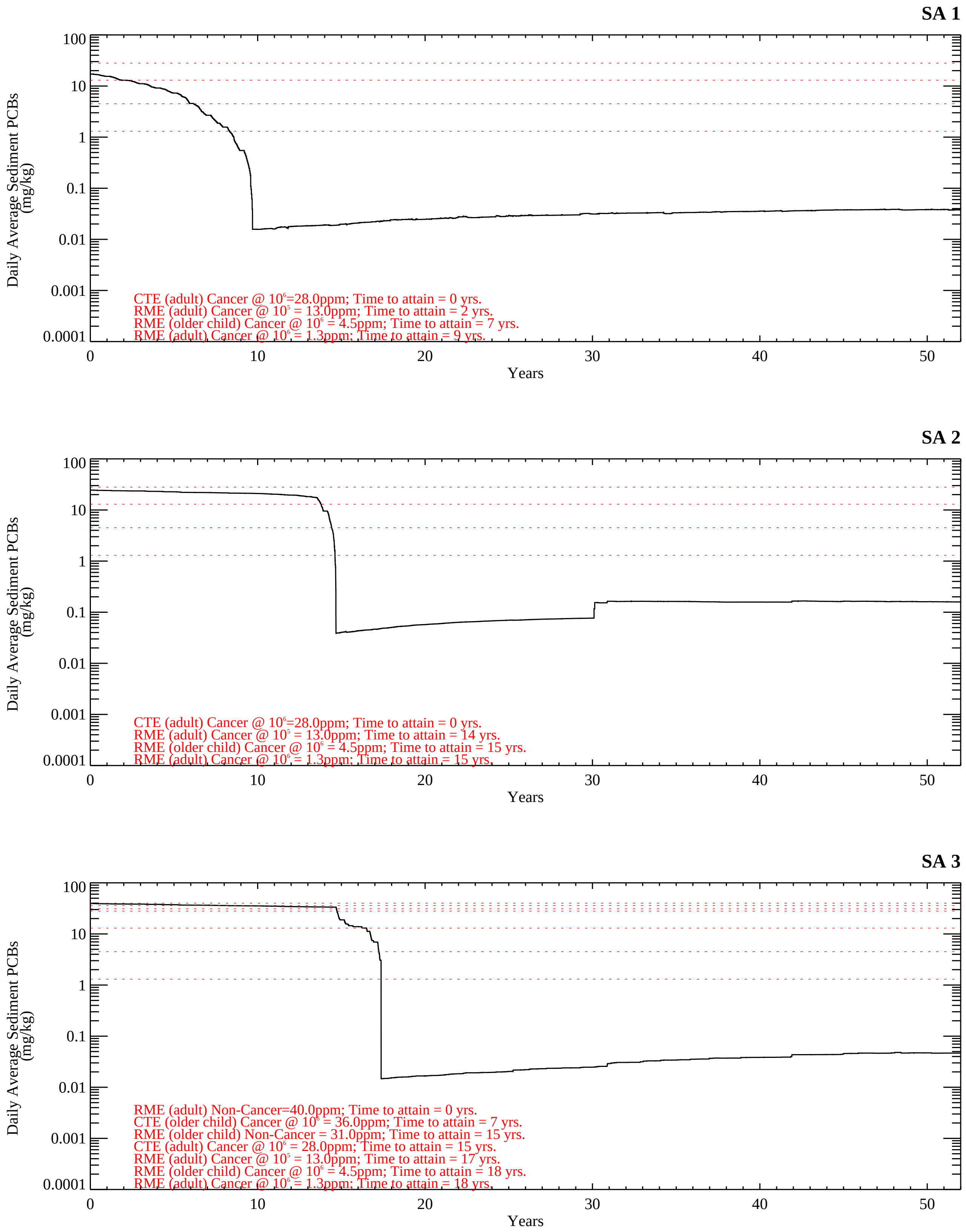

Figure G-3.4-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 5; Reach 5/6; Lower Bound).

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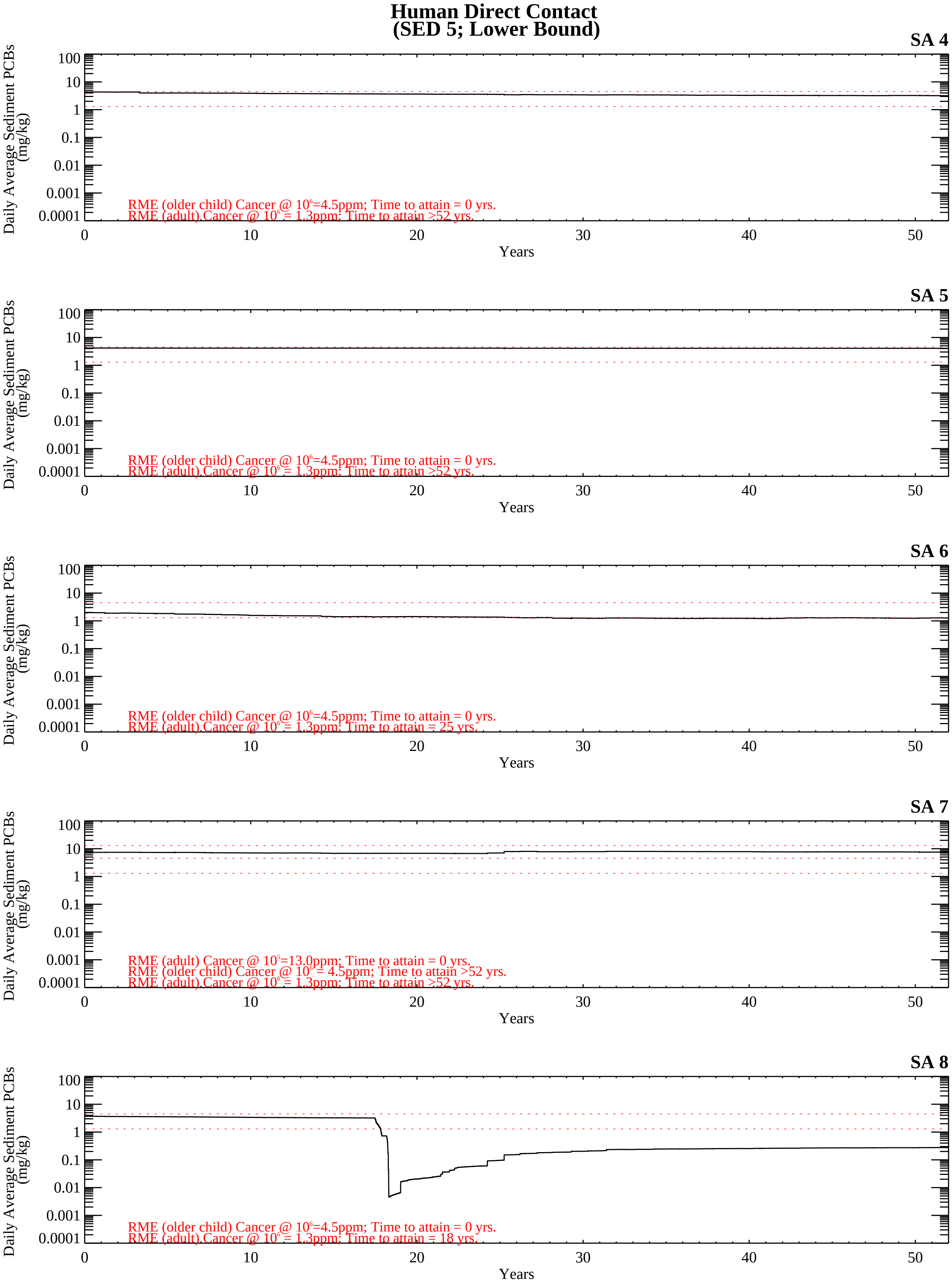

Figure G-3.4-4b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 5; Reach 7/8; Lower Bound).

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Human Direct Contact
(SED 6; Lower Bound)

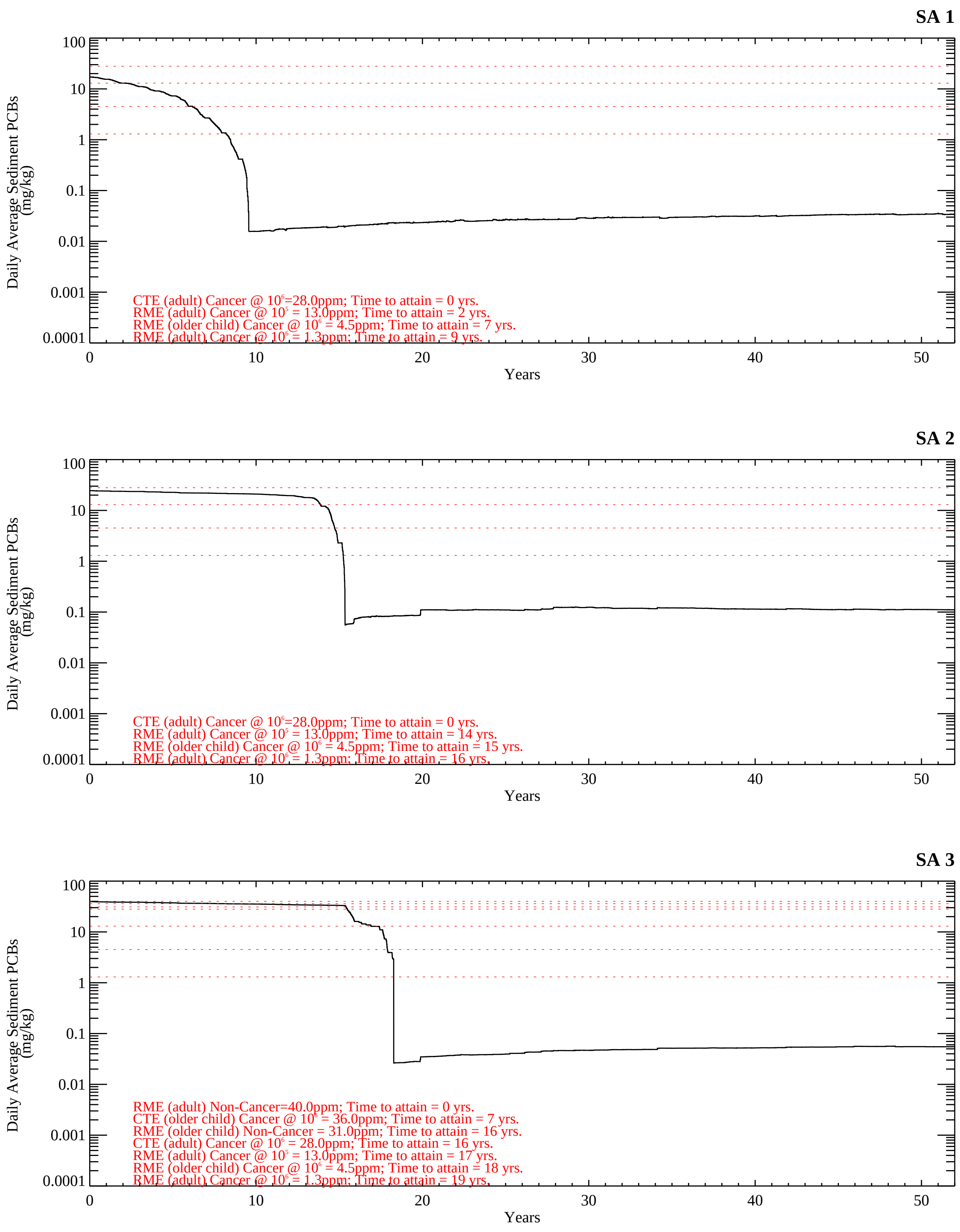
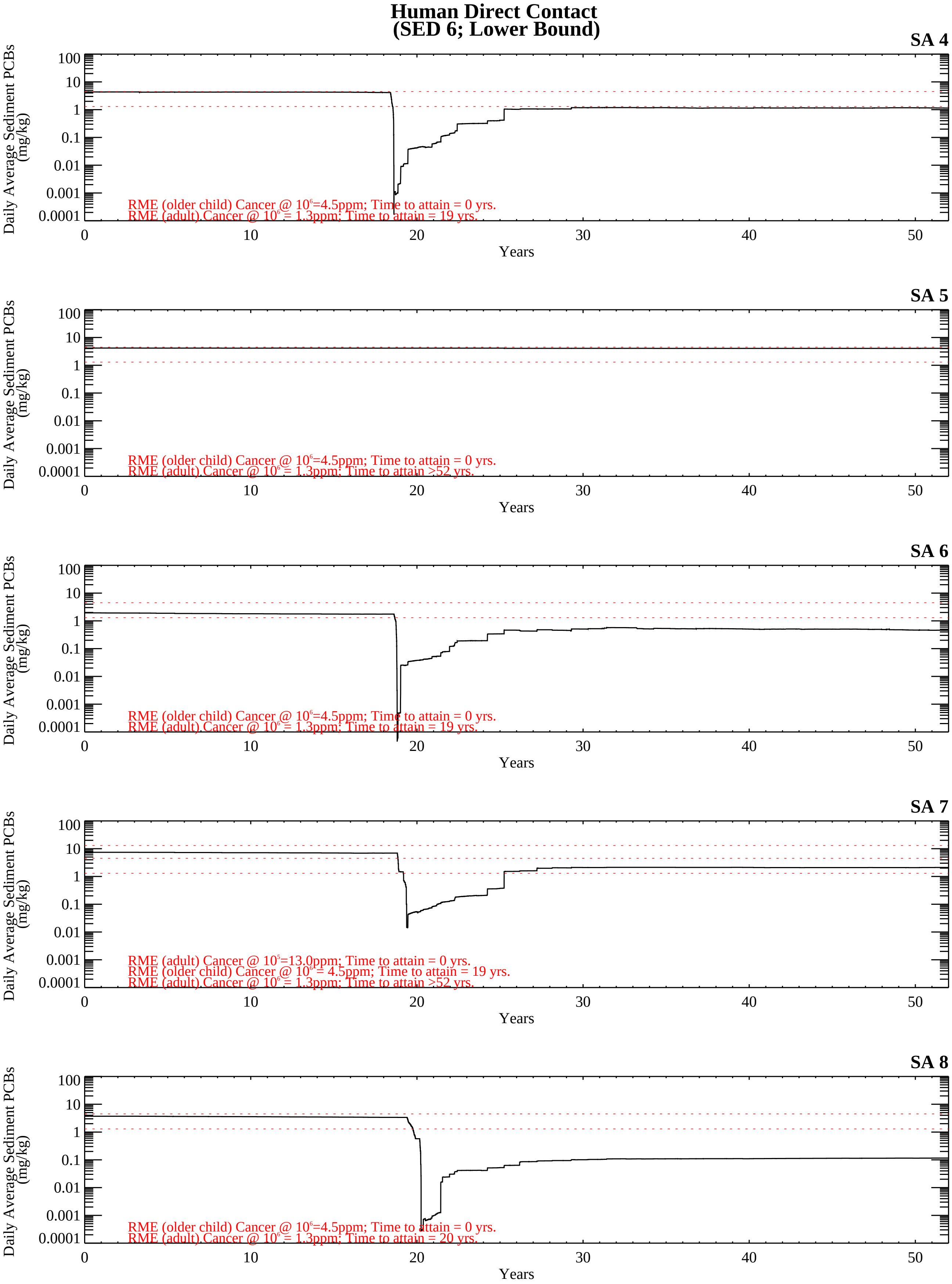


Figure G-3.4-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 6; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED6CMSLB_0712-23\\bins



Human Direct Contact
(SED 6; Lower Bound)

Figure G-3.4-5b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 6; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED6CMSLB_0712-39\\bins

Human Direct Contact
(SED 7; Lower Bound)

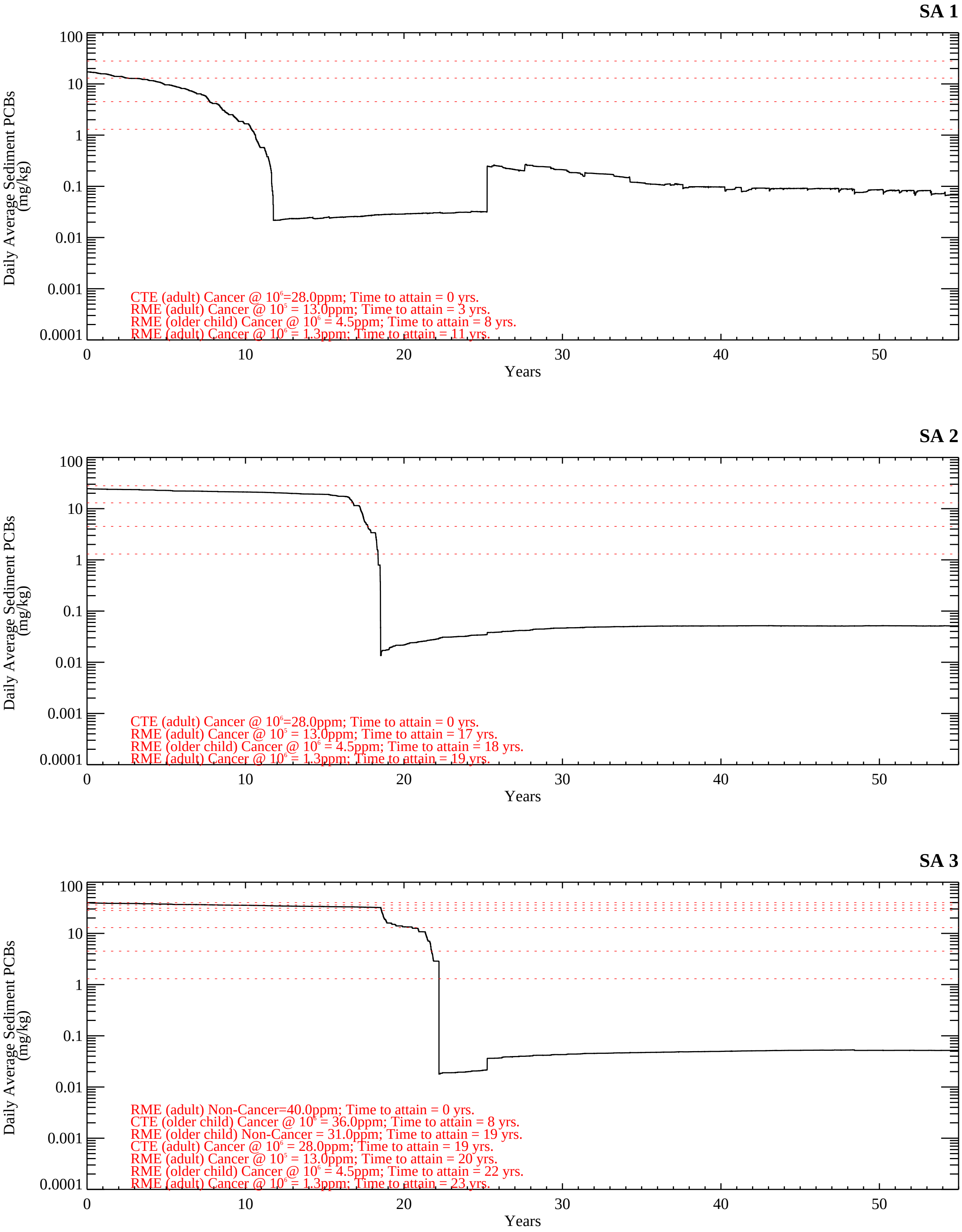


Figure G-3.4-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 7; Reach 5/6; Lower Bound).

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Human Direct Contact
(SED 7; Lower Bound)

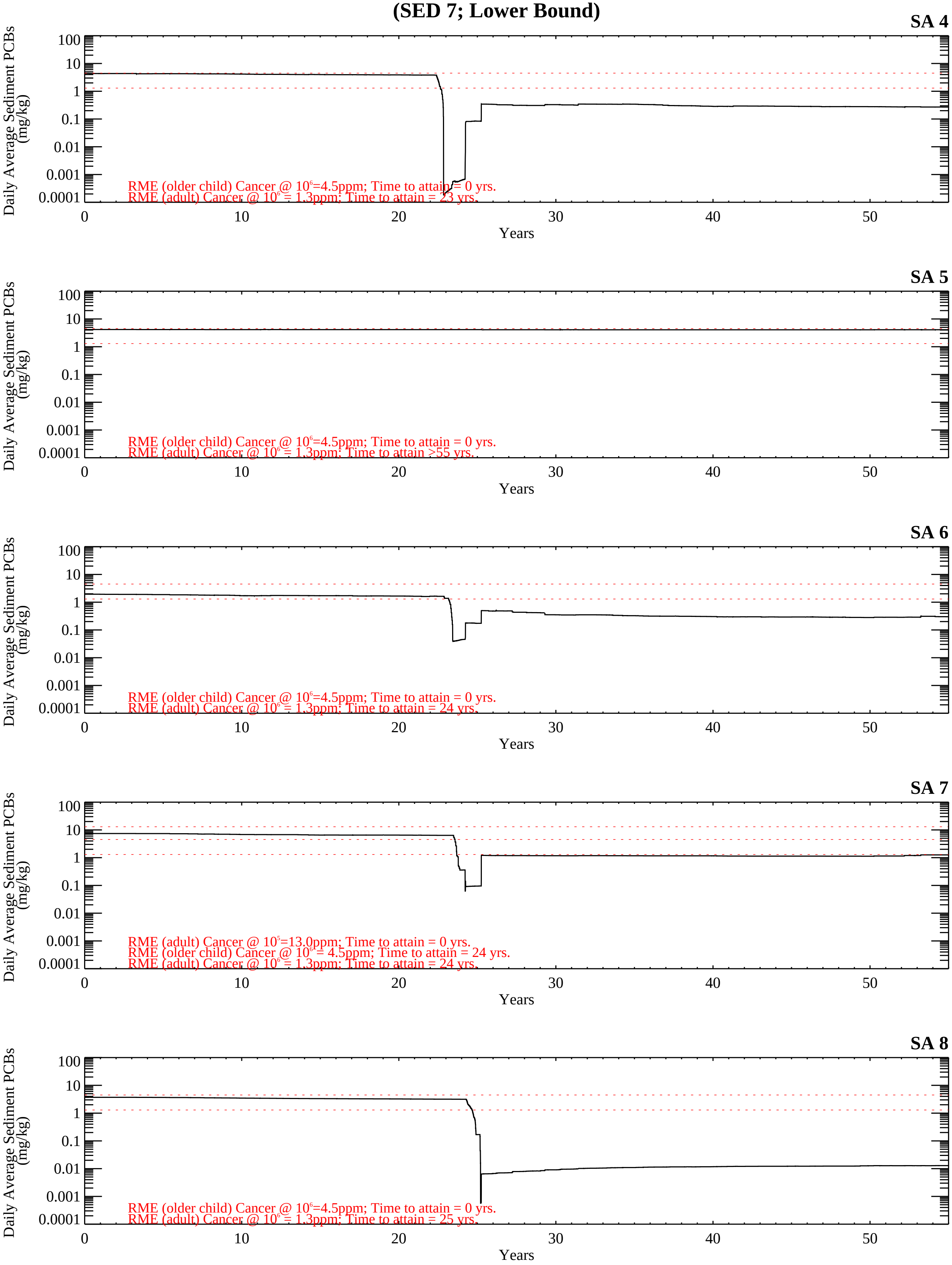

Figure G-3.4-6b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 7; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED7CMSLB_0712-40\\bins

Human Direct Contact
(SED 8; Lower Bound)

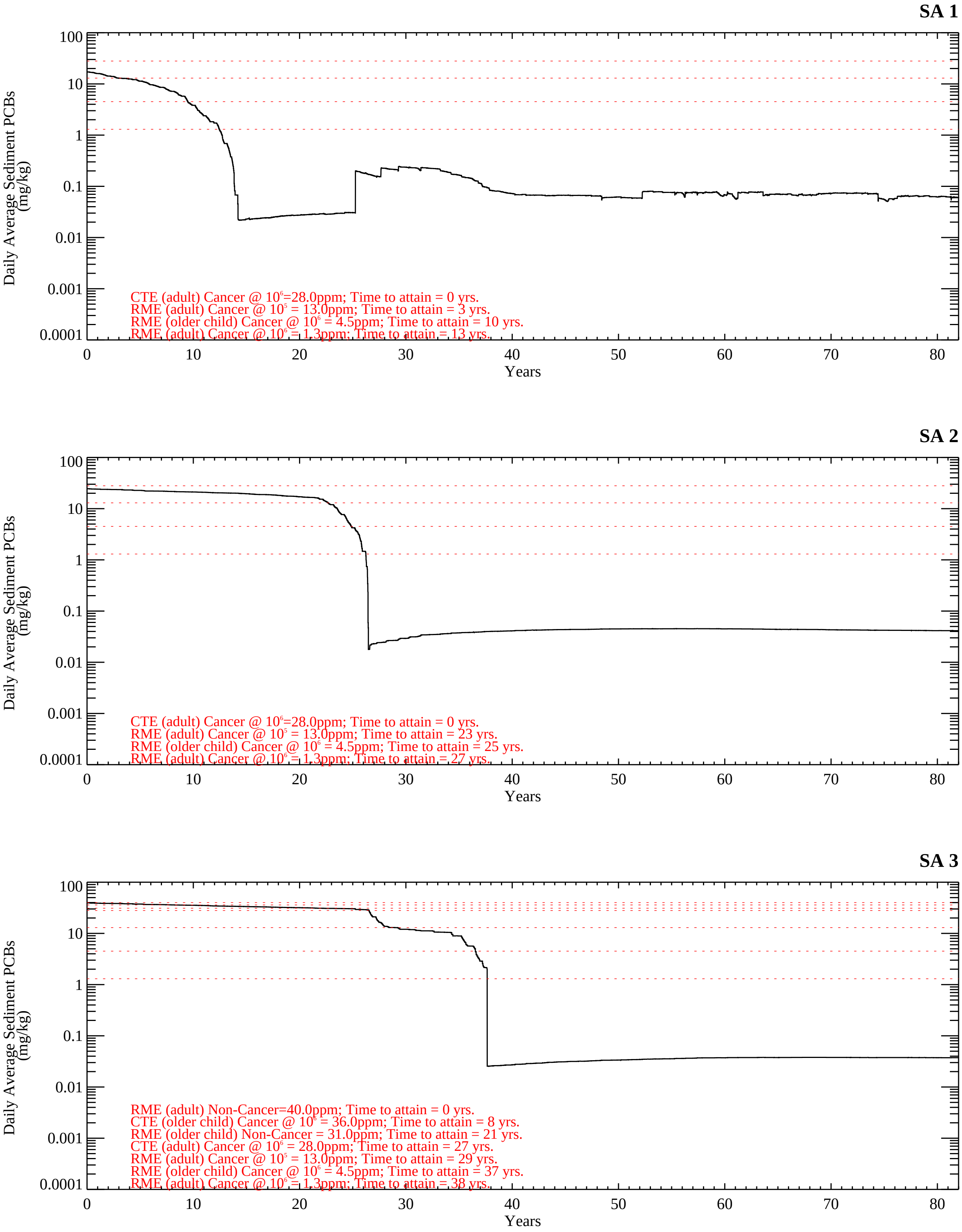

Figure G-3.4-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 8; Reach 5/6; Lower Bound).

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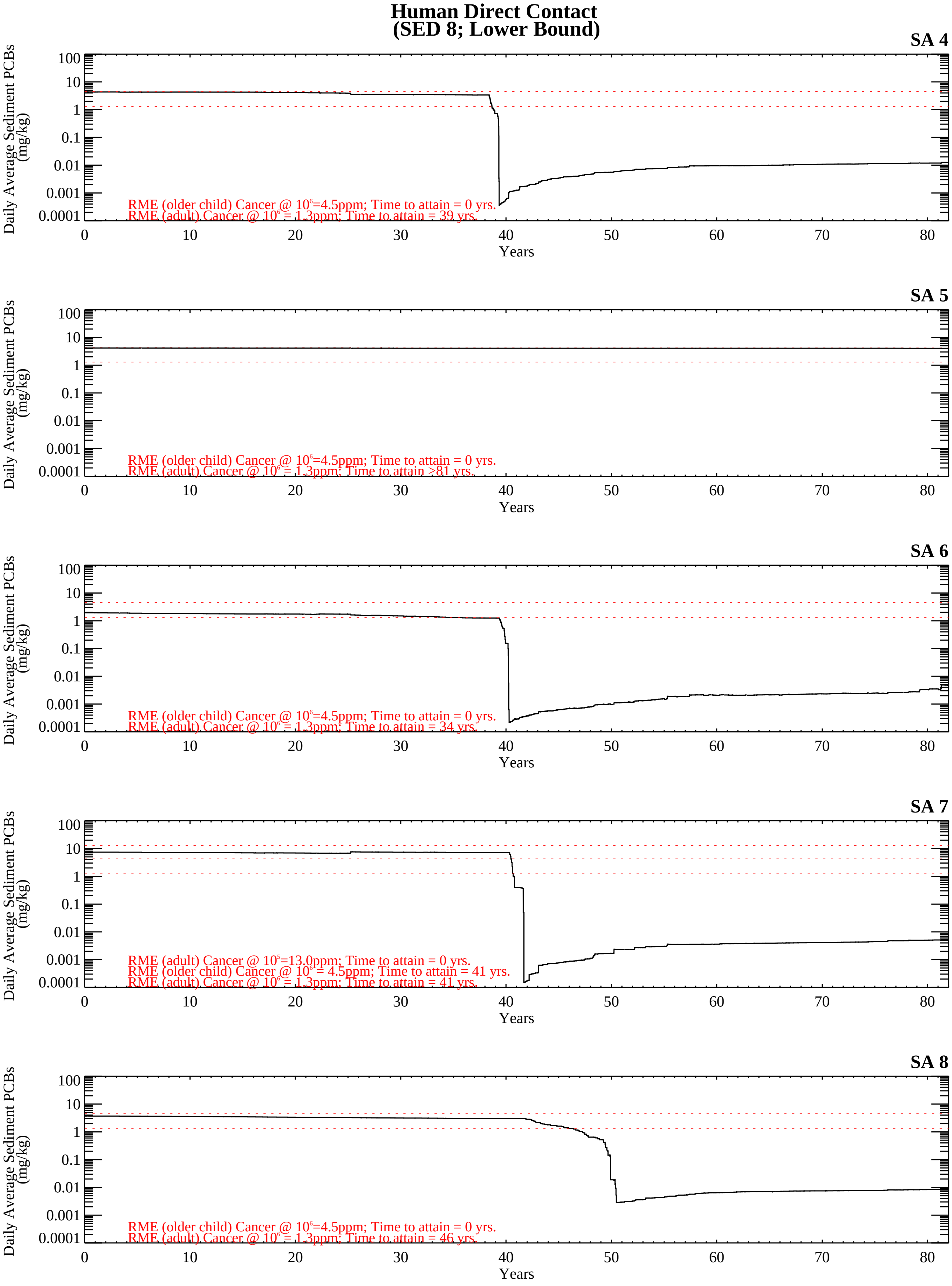

Figure G-3.4-7b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for human direct contact with sediments (SED 8; Reach 7/8; Lower Bound).

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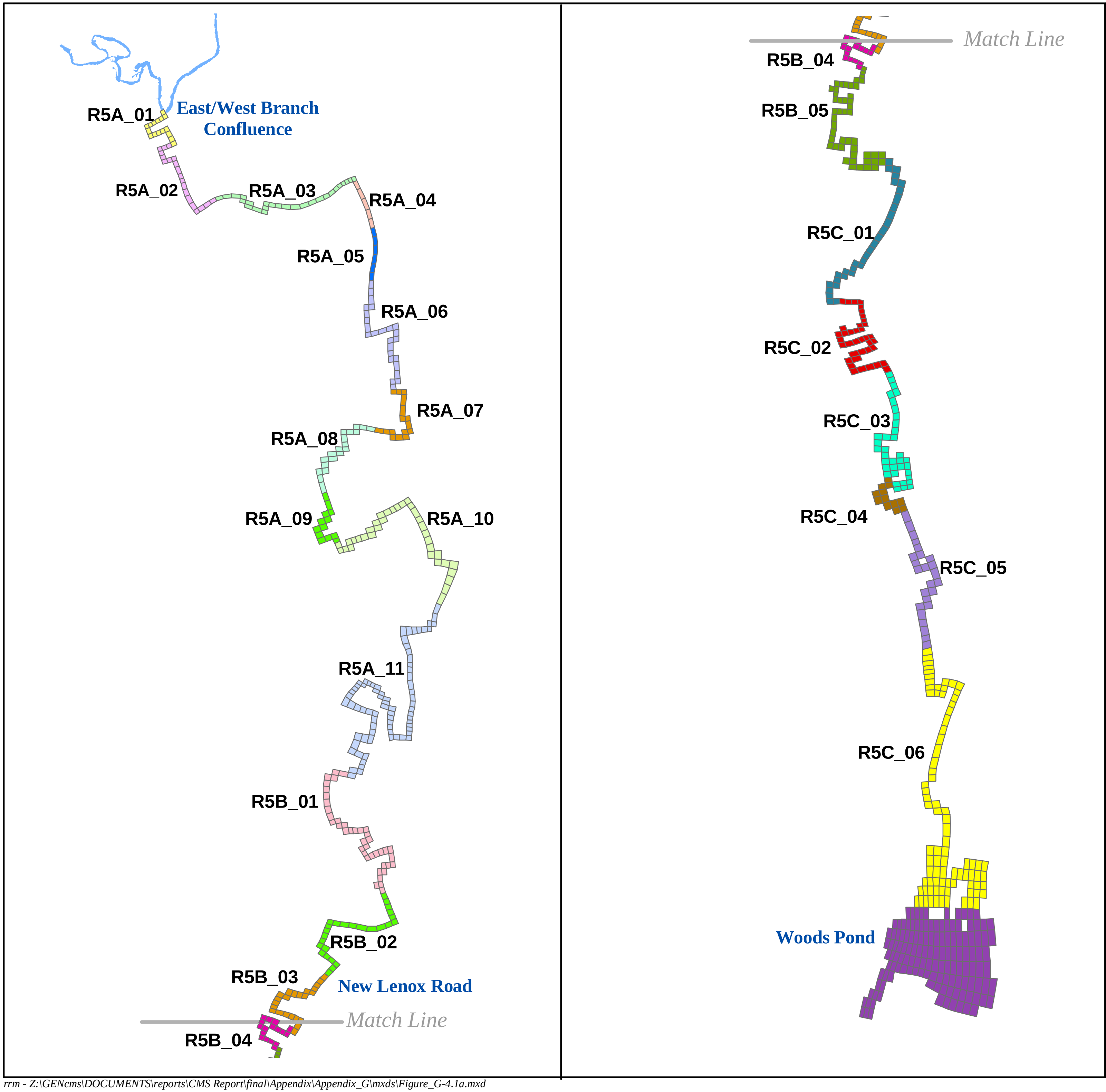
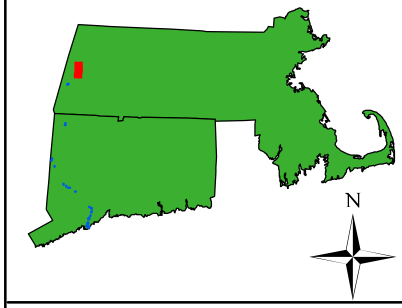


LOCATOR MAP



SCALE

LEGEND

☐ Averaging Area

NOTES:
Benthic invertebrate averaging areas are EPA "spatial bins" in Reaches 5/6, and are subreaches in Reaches 7/8.

Separate averaging areas are shown as different colors, and labels (e.g., R5C_01) represent averaging area IDs.

Figure G-4.1a.
Averaging areas used for benthic invertebrate sediment IMPG comparisons in Reaches 5 & 6.

ARCADIS

QEA
Quantitative Environmental Analysis, LLC
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March 2008

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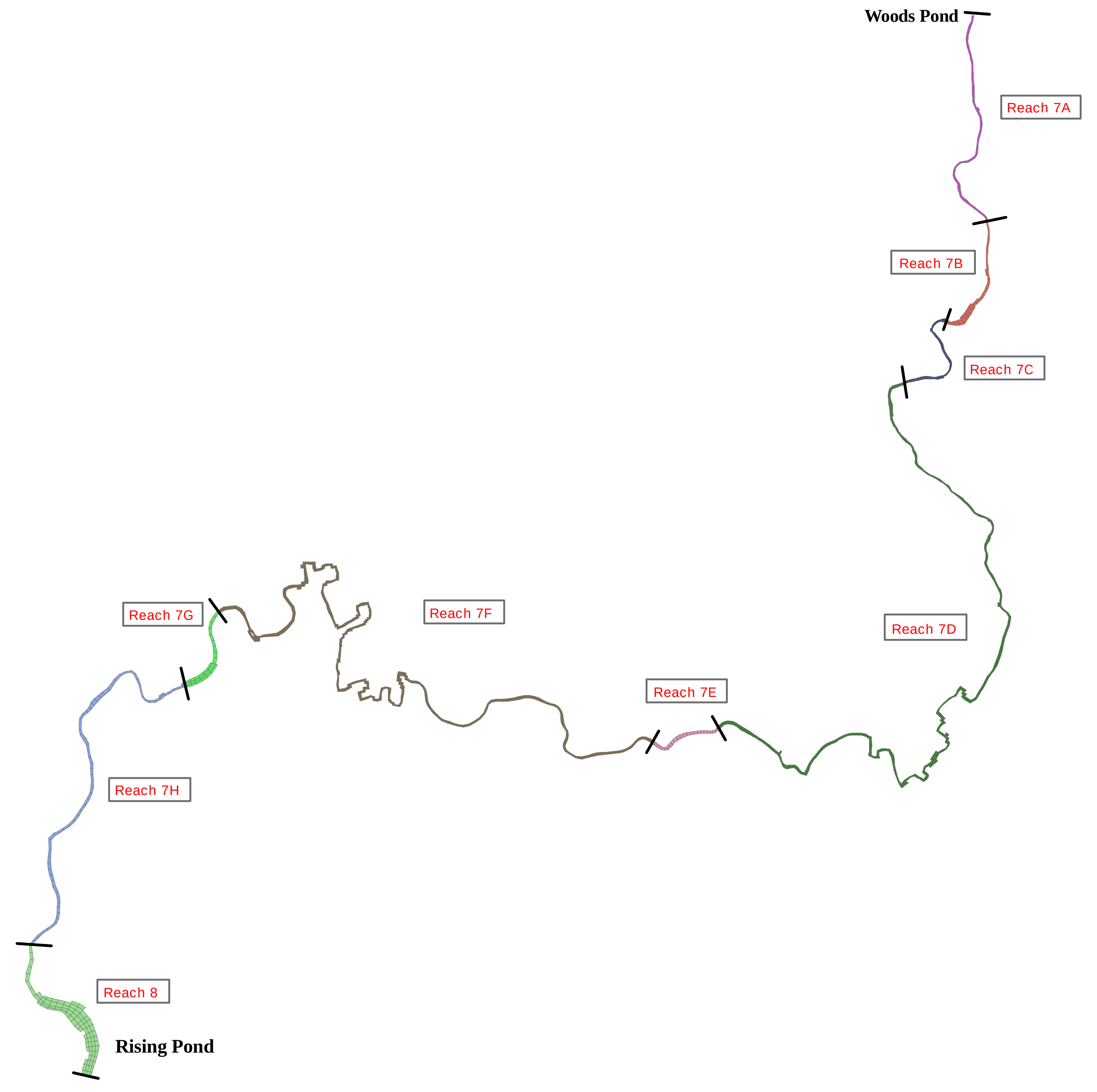

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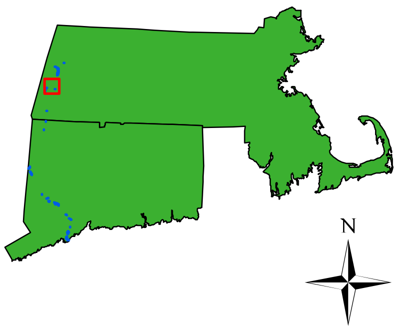

SCALE

0 0.5 1 Miles

LEGEND

☐ Averaging Area

NOTES:

Benthic invertebrate averaging areas are EPA "spatial bins" in Reaches 5/6, and are subreaches in Reaches 7/8.

Separate averaging areas are shown as different colors.

Figure G-4.1b. Averaging areas used for benthic invertebrate sediment IMPG comparisons in Reaches 7 & 8.

ARCADIS

QEA Quantitative Environmental Analysis, LLC

GENcms March 2008

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Benthic Invertebrates
(SED 1 / SED 2; Base Case)

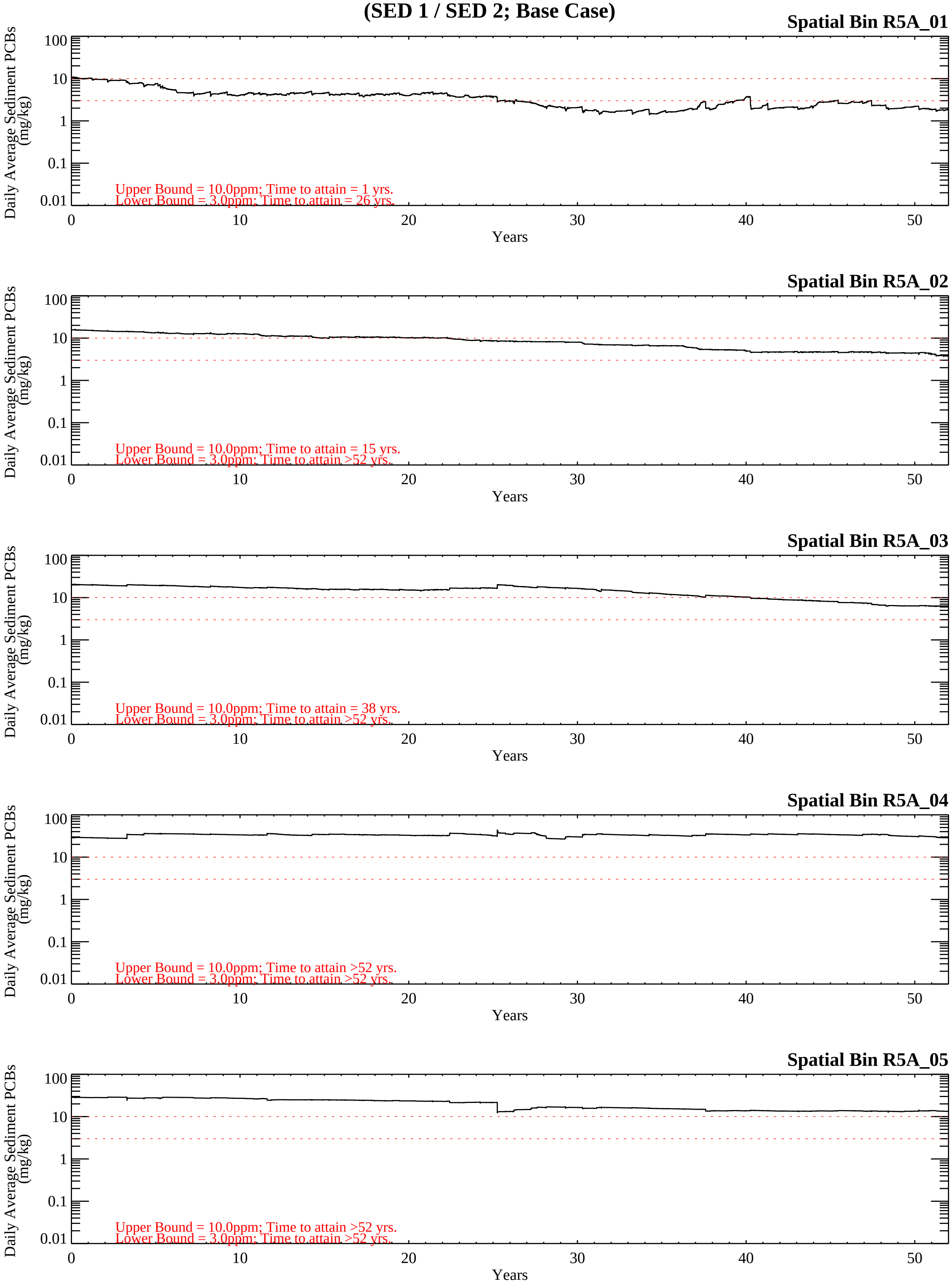

Figure G-4.2-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 1 / SED 2; Reach 5/6; Base Case).

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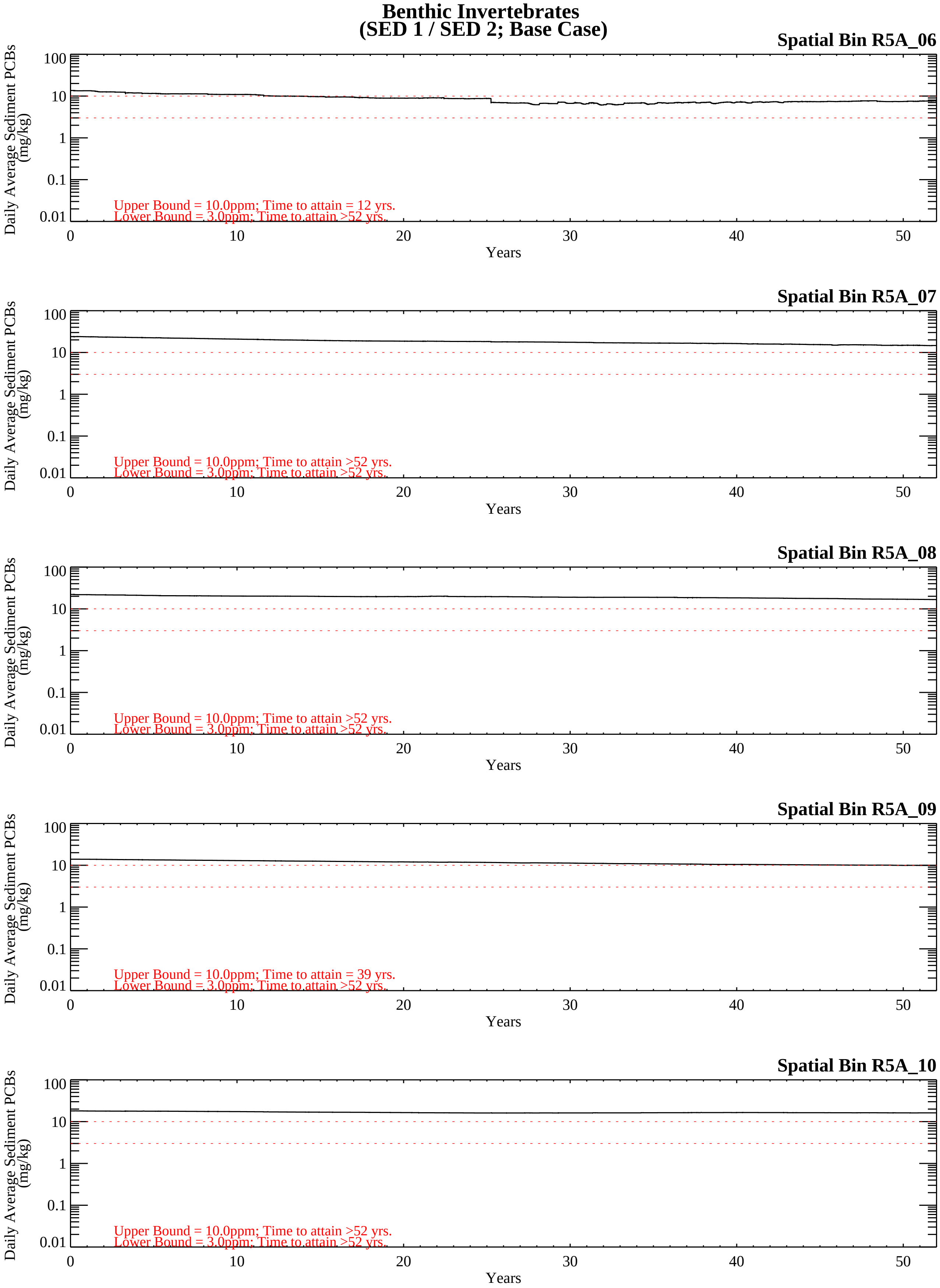

Figure G-4.2-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 1 / SED 2; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED1CMSBS_0712-01\\bins

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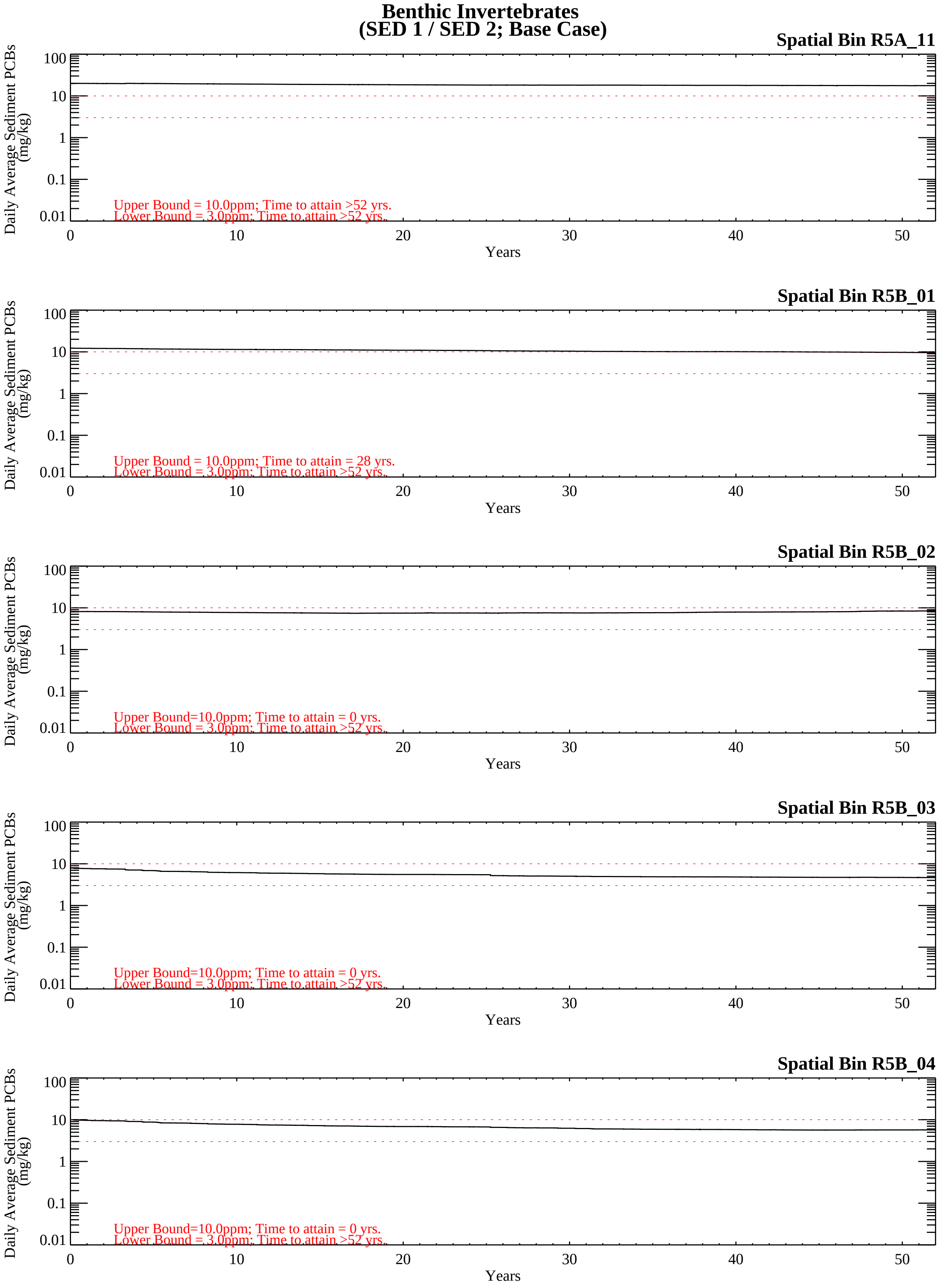

Figure G-4.2-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 1 / SED 2; Reach 5/6; Base Case).

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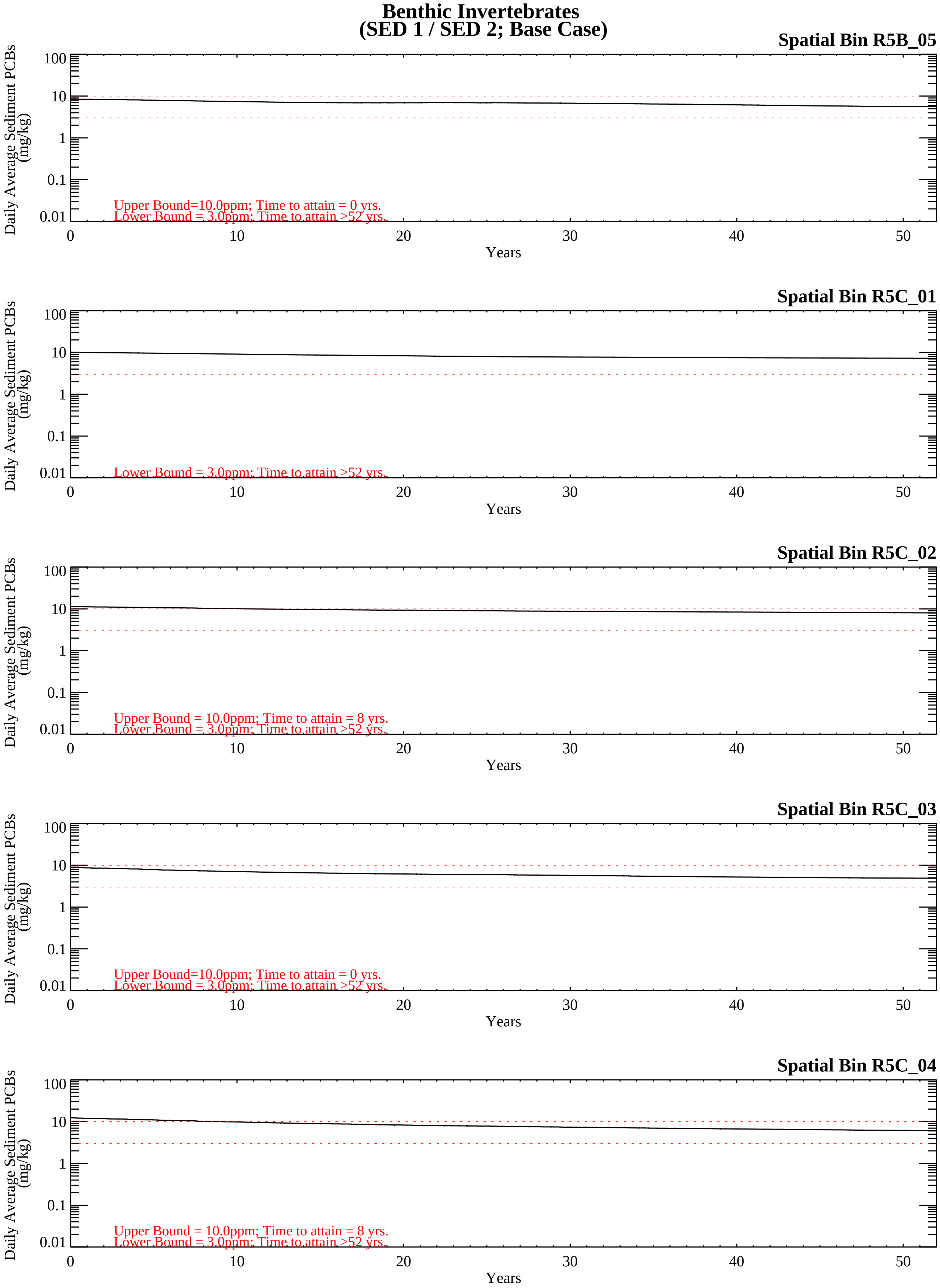

Figure G-4.2-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 1 / SED 2; Reach 5/6; Base Case).

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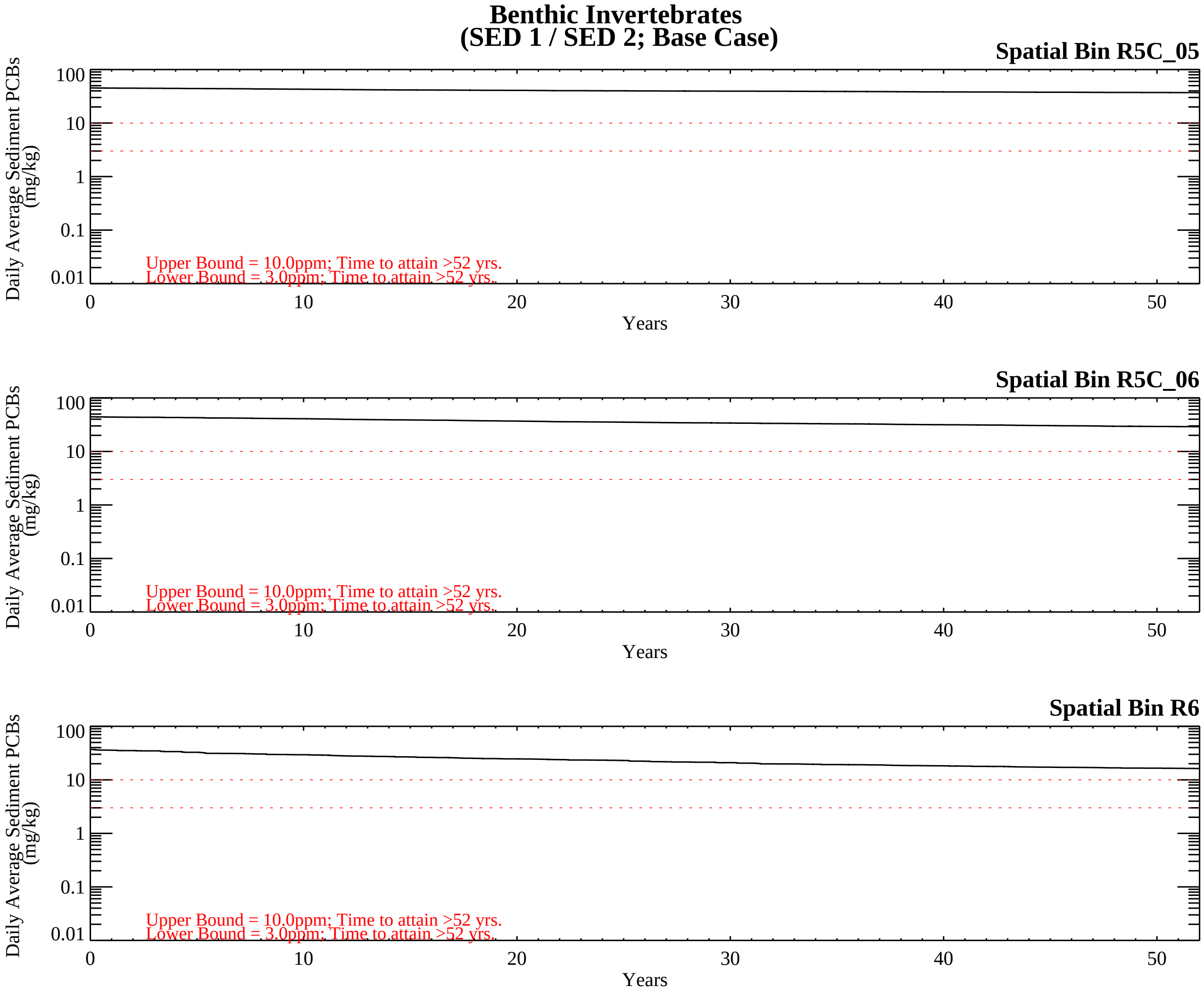

Figure G-4.2-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 1 / SED 2; Reach 5/6; Base Case).

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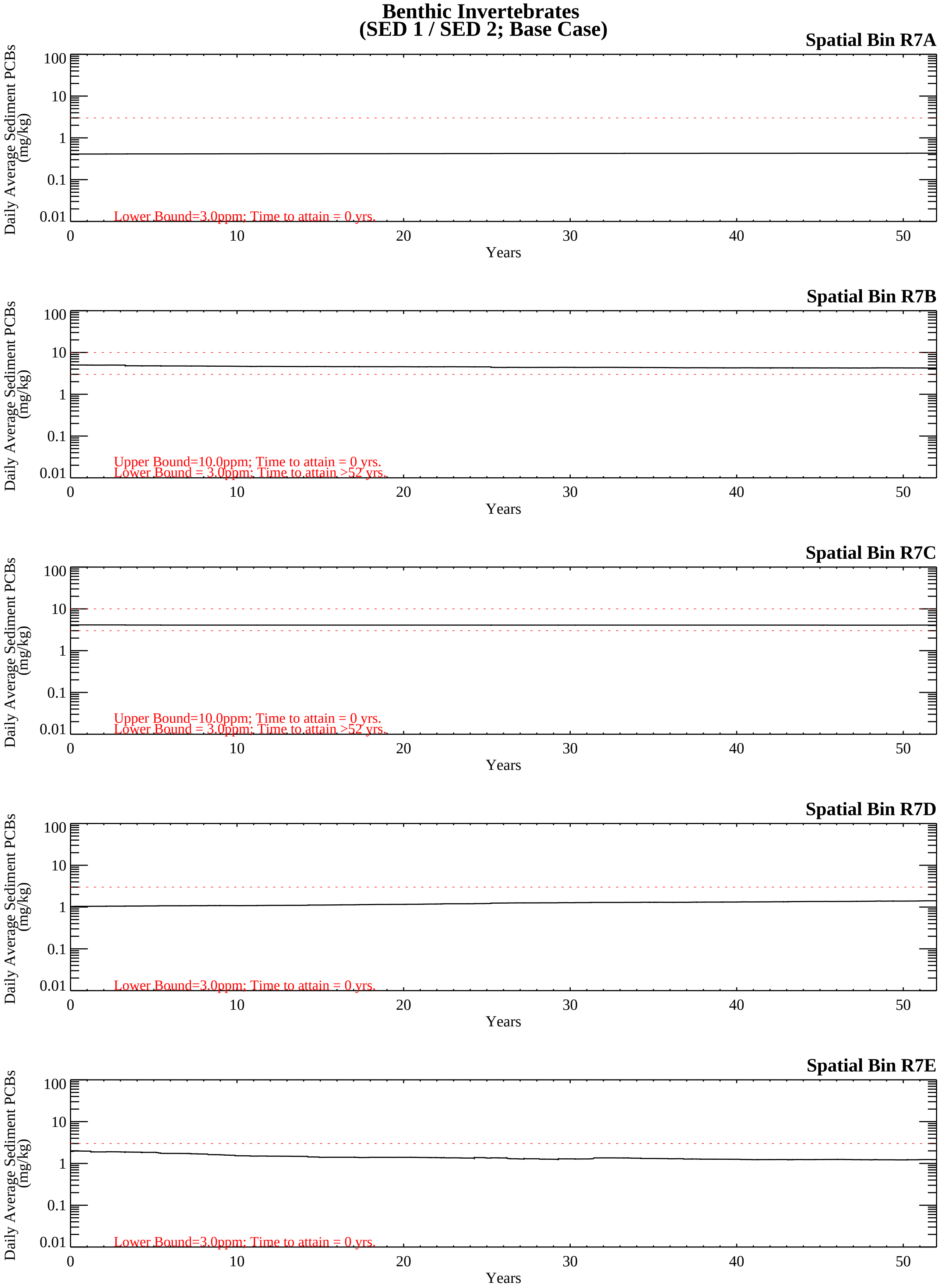

Figure G-4.2-1b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 1 / SED 2; Reach 7/8; Base Case).

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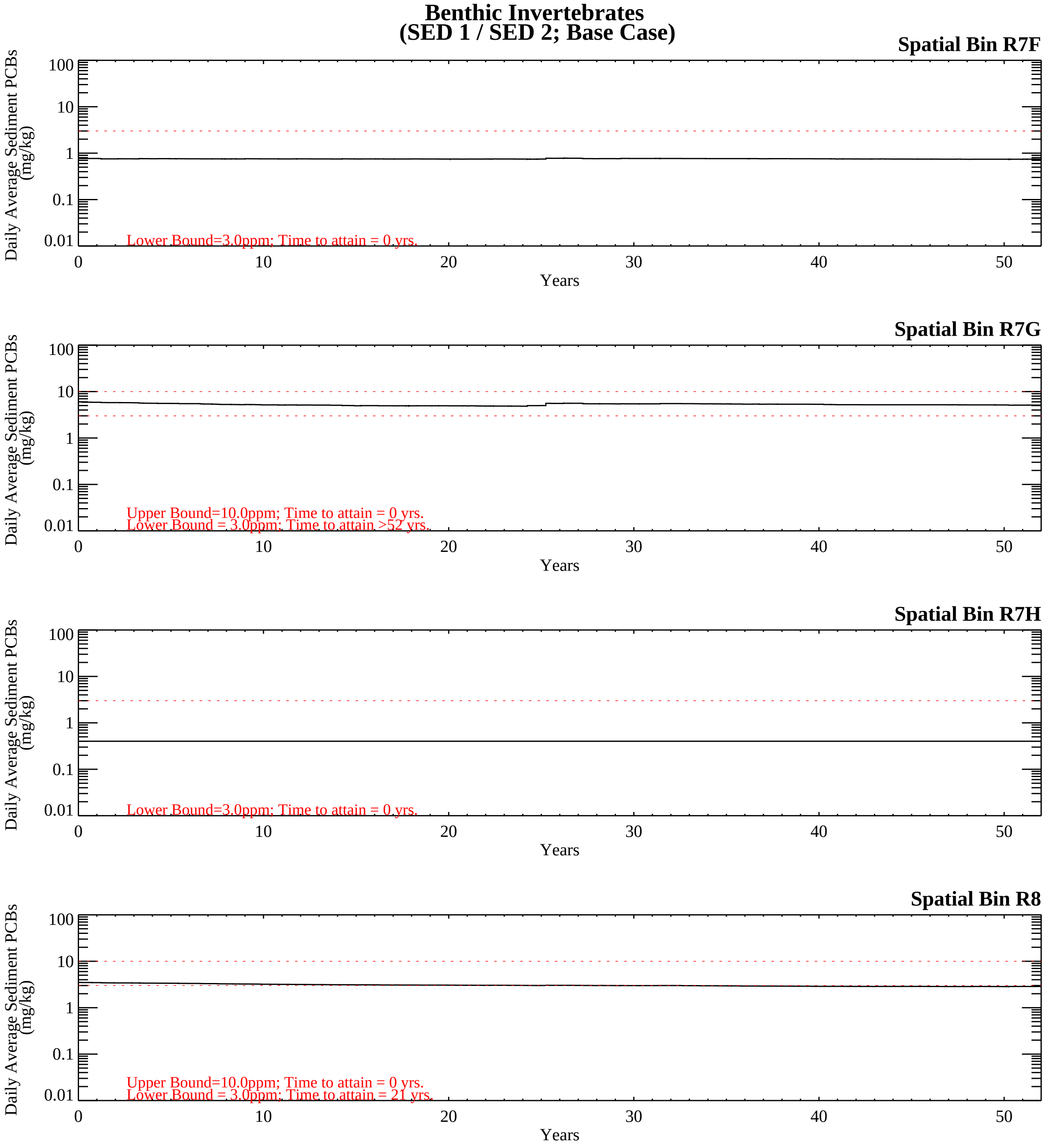

Figure G-4.2-1b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 1 / SED 2; Reach 7/8; Base Case).

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Benthic Invertebrates
(SED 3; Base Case)

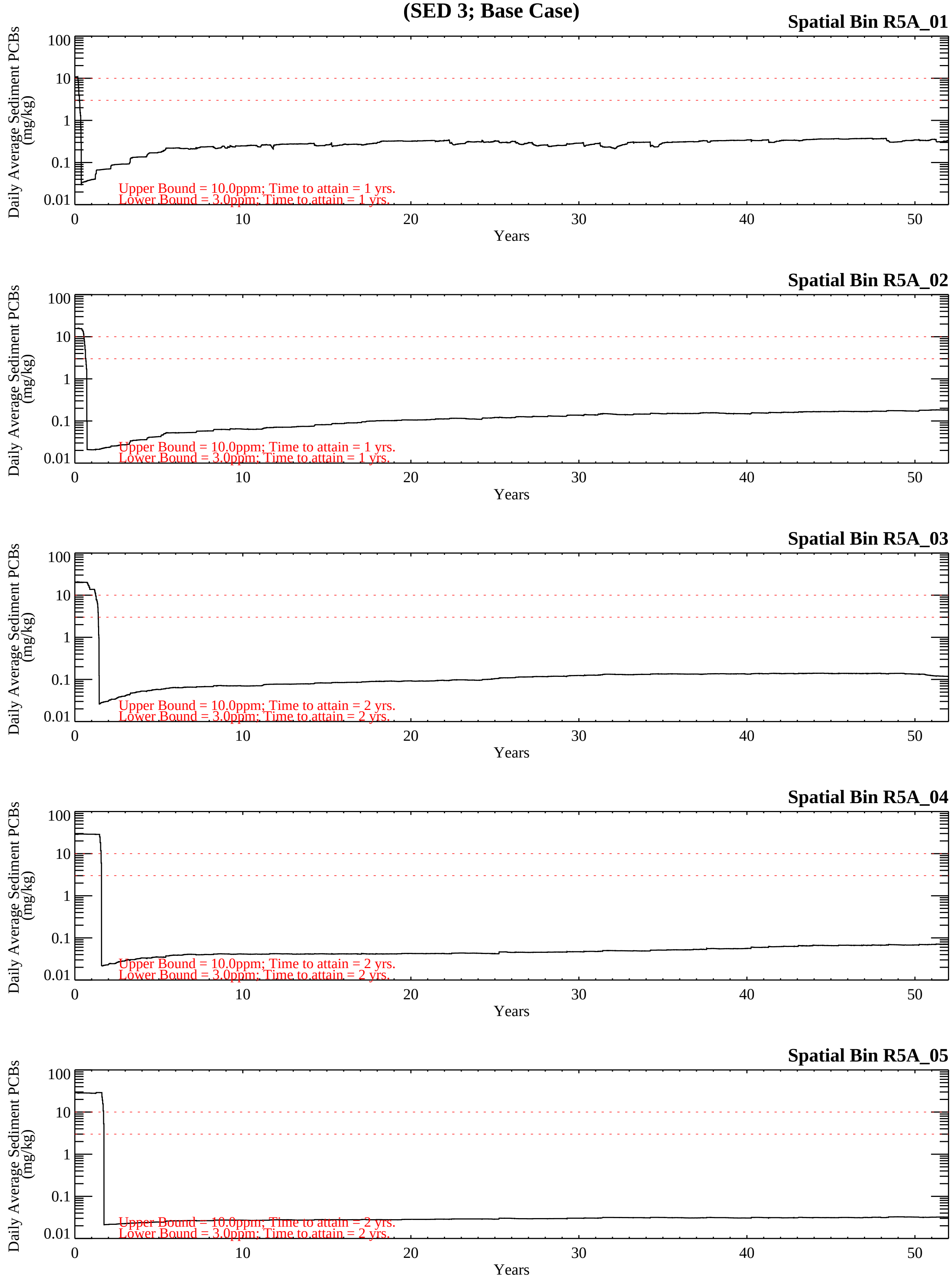

Figure G-4.2-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 3; Reach 5/6; Base Case).

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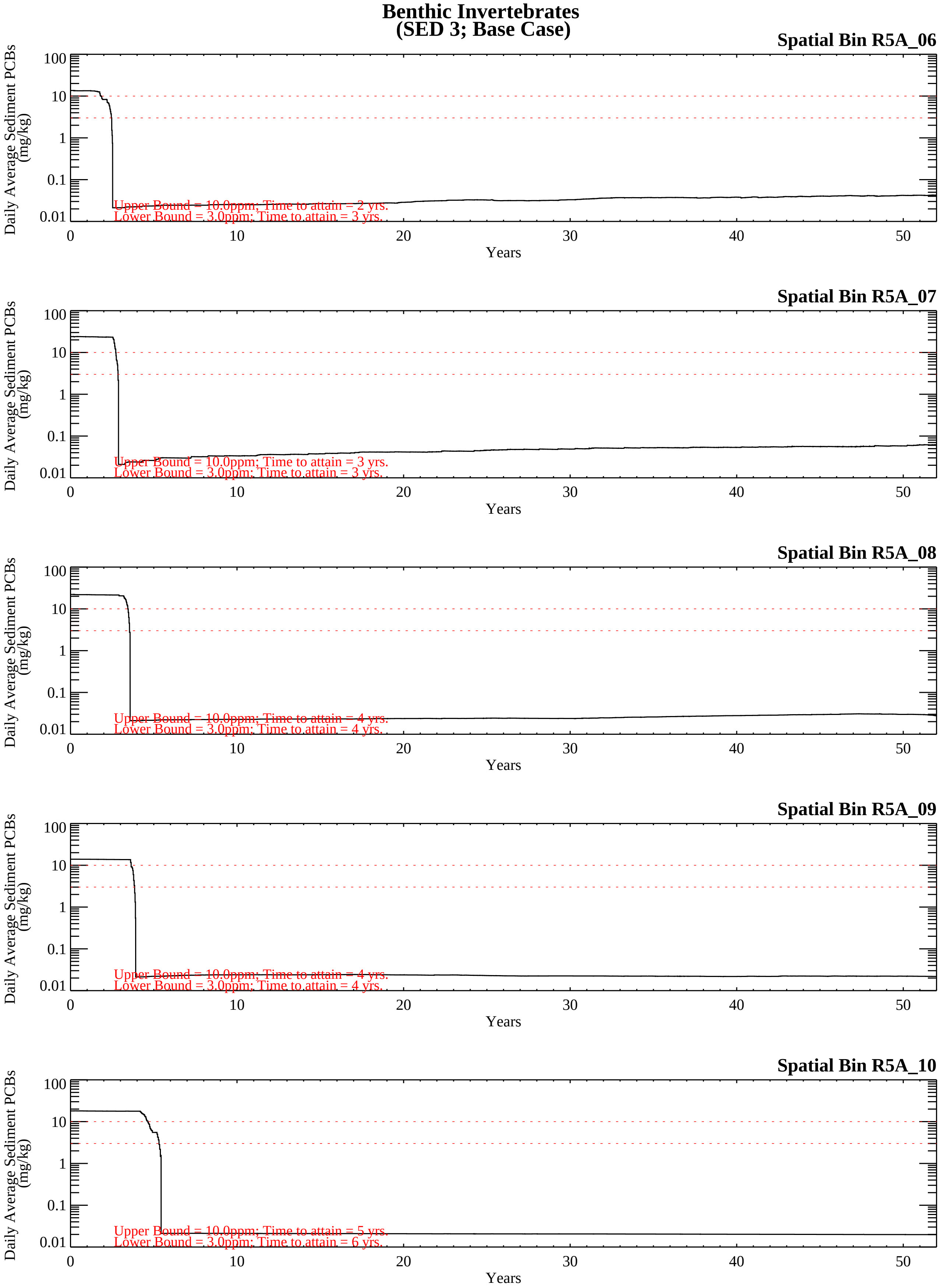

Figure G-4.2-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 3; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED3CMSBS_0712-13\\bins

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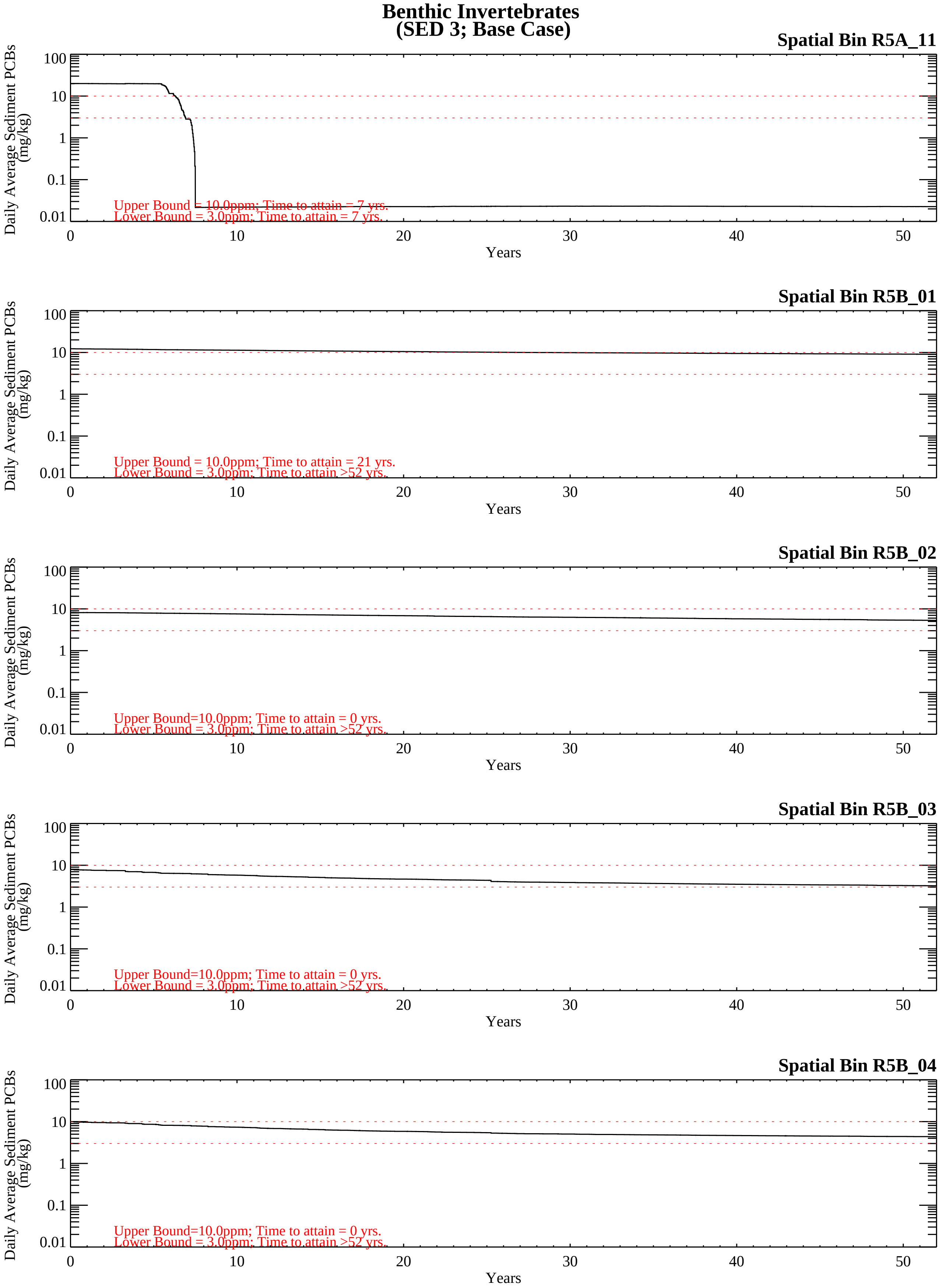

Figure G-4.2-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 3; Reach 5/6; Base Case).

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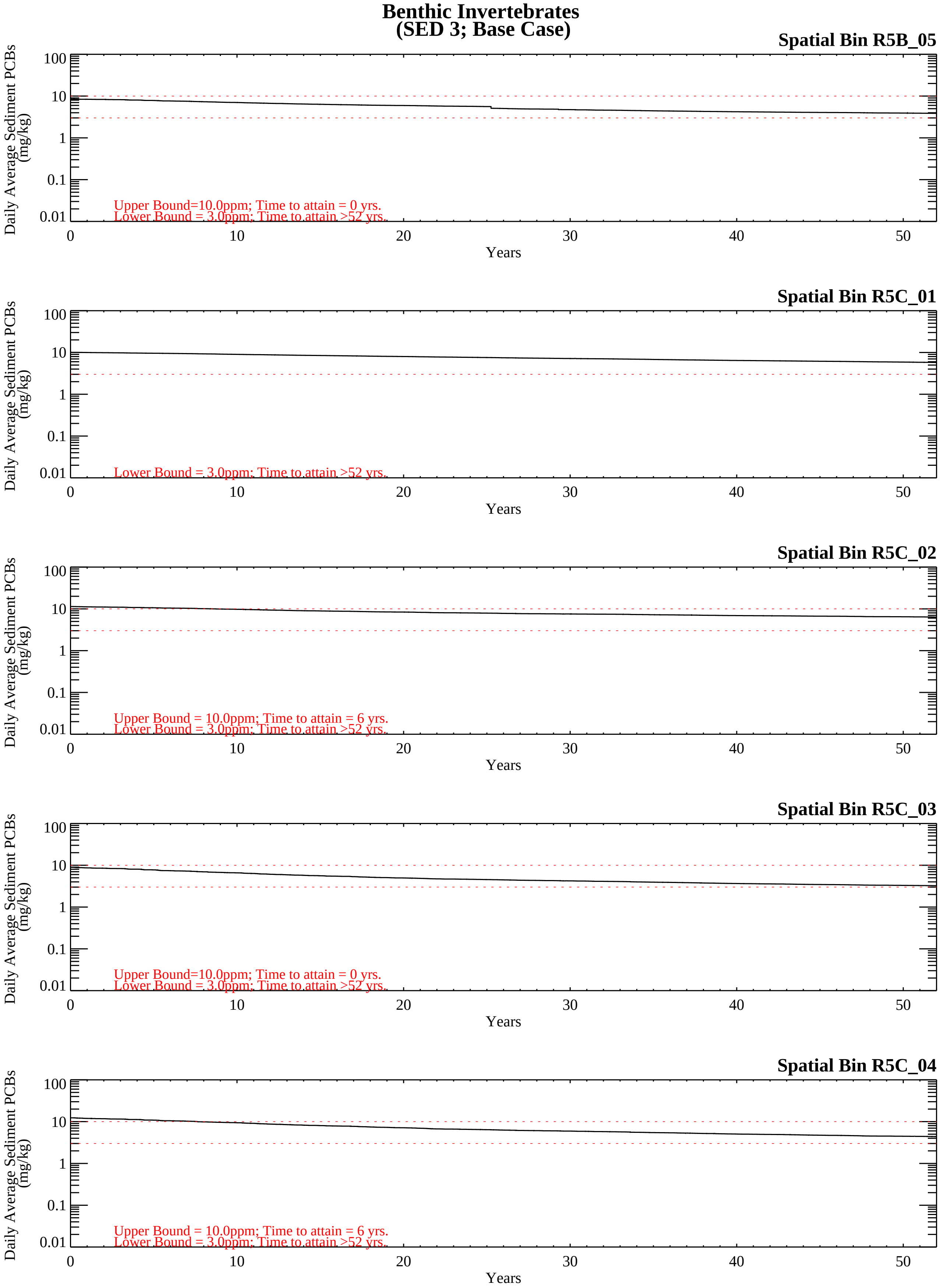

Figure G-4.2-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 3; Reach 5/6; Base Case).

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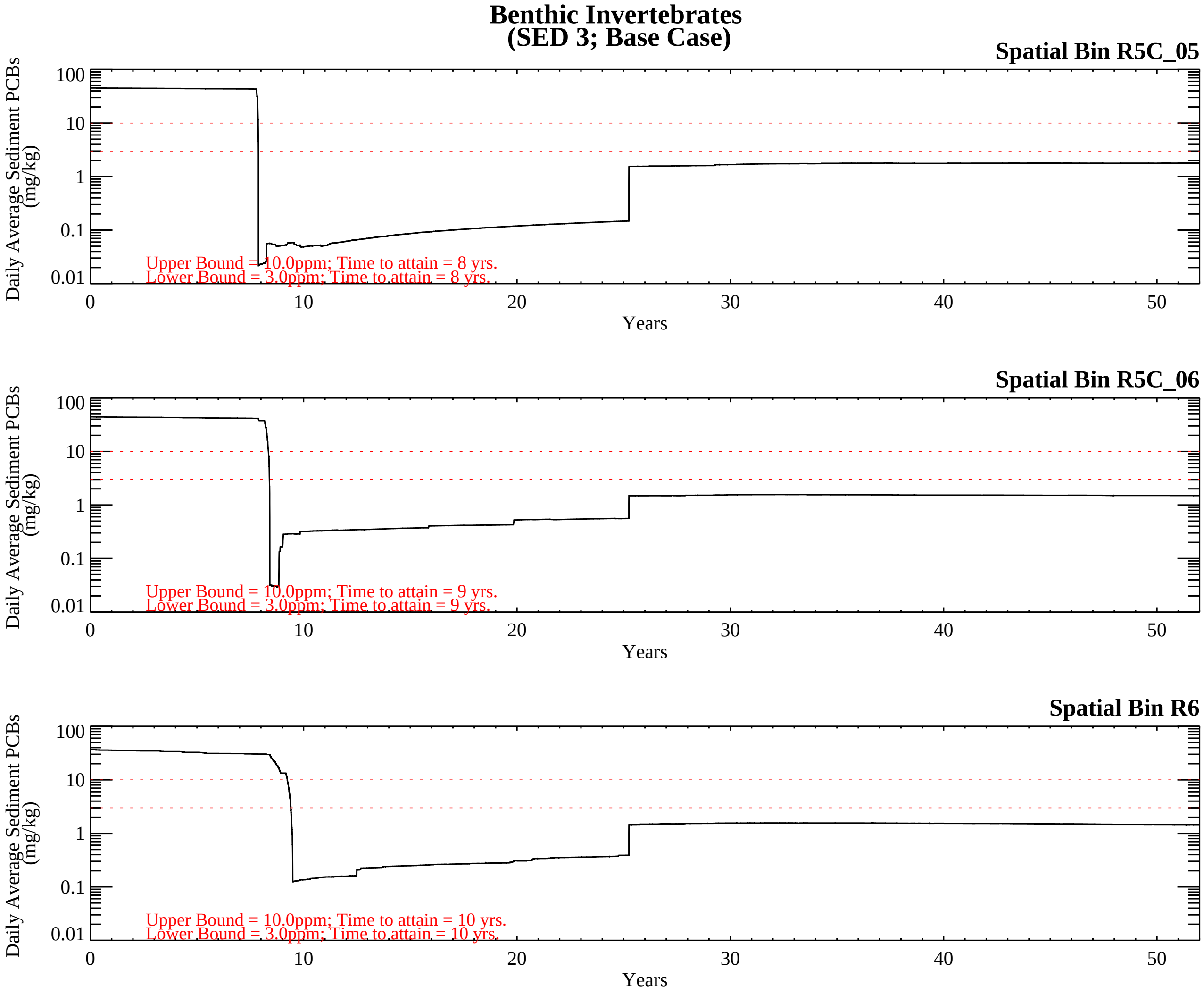

Figure G-4.2-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 3; Reach 5/6; Base Case).

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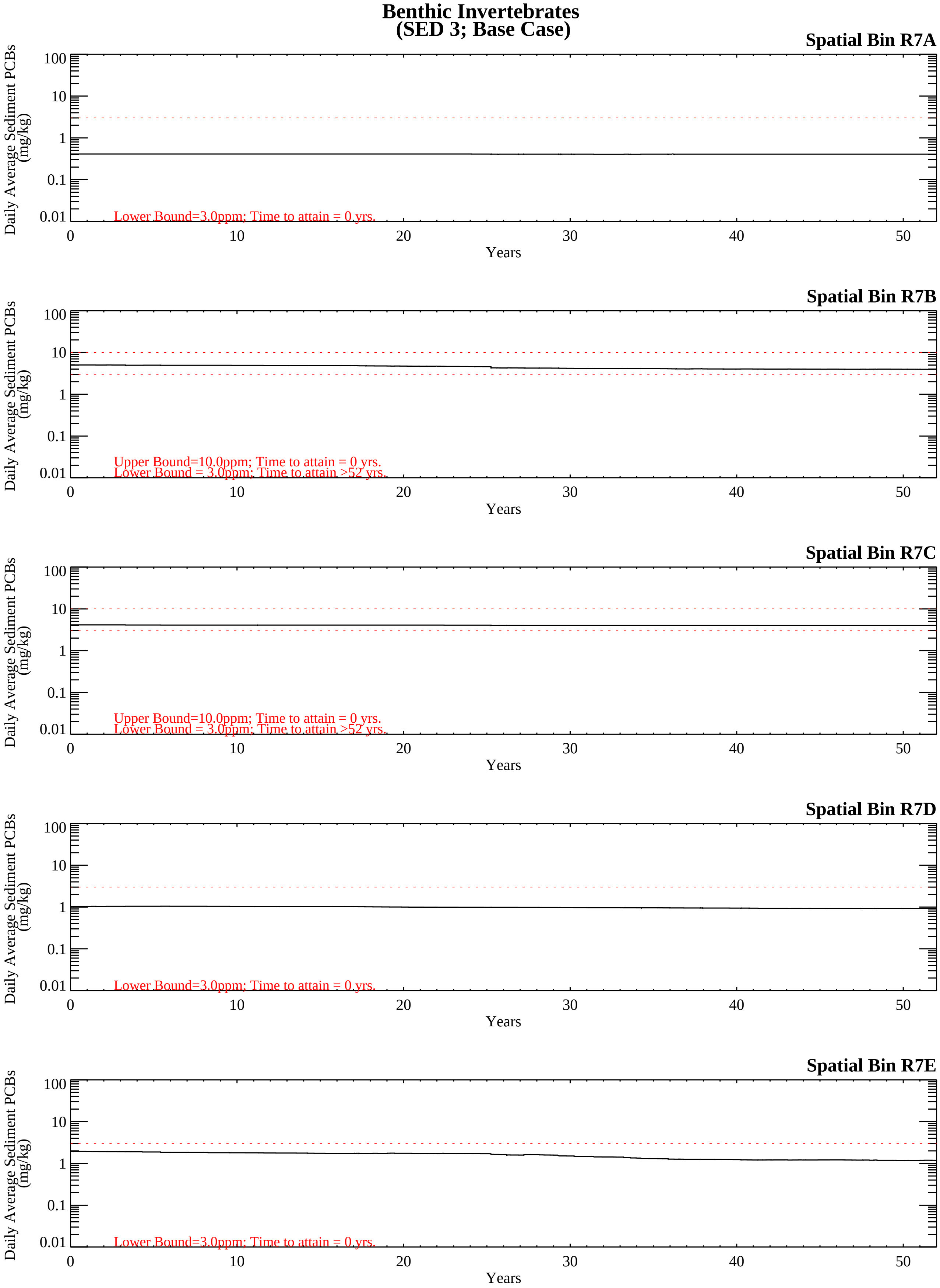
Benthic Invertebrates
(SED 3; Base Case)

Figure G-4.2-2b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 3; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED3CMSBS_0712-29\\bins

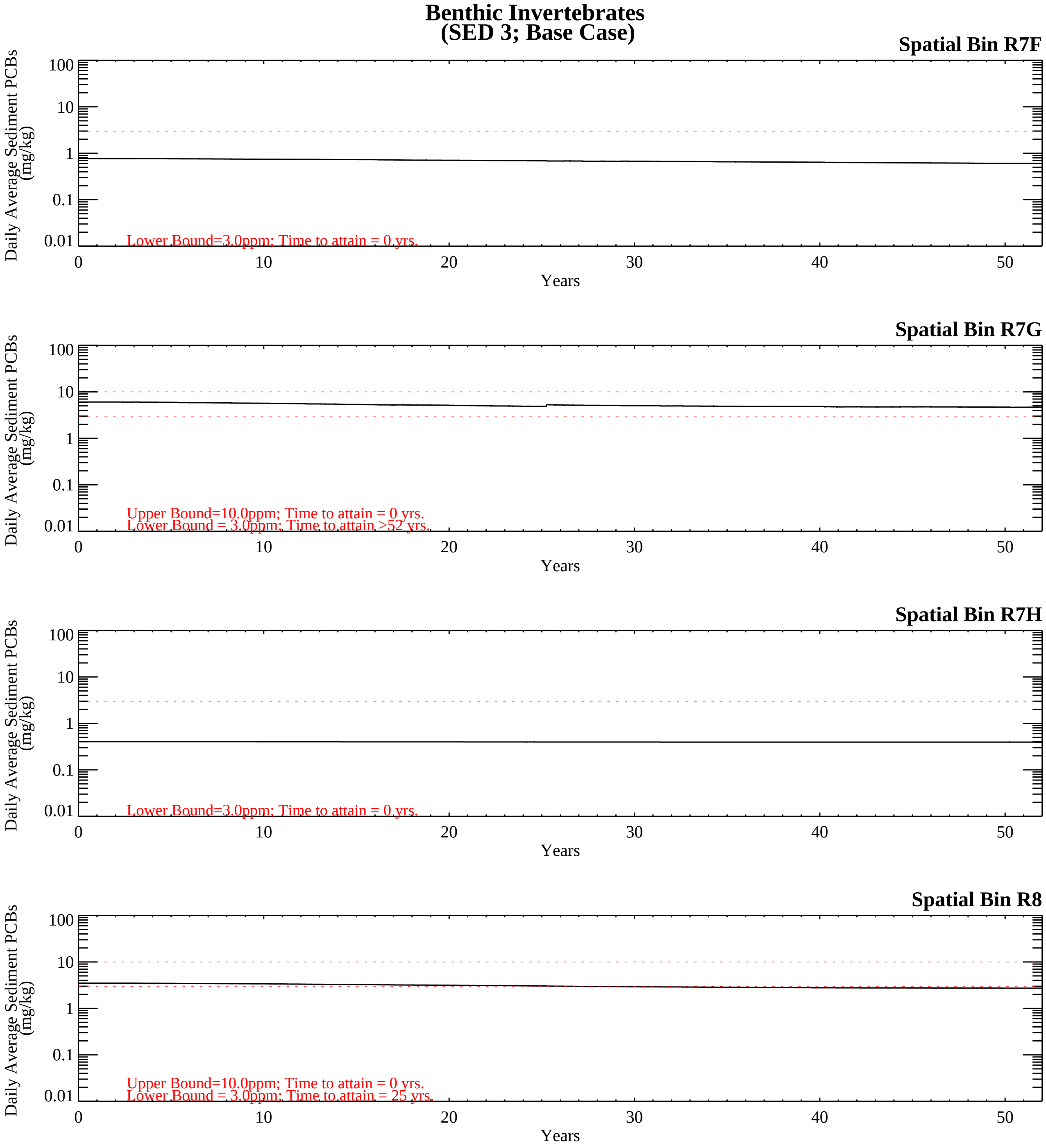

Figure G-4.2-2b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 3; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED3CMSBS_0712-29\\bins

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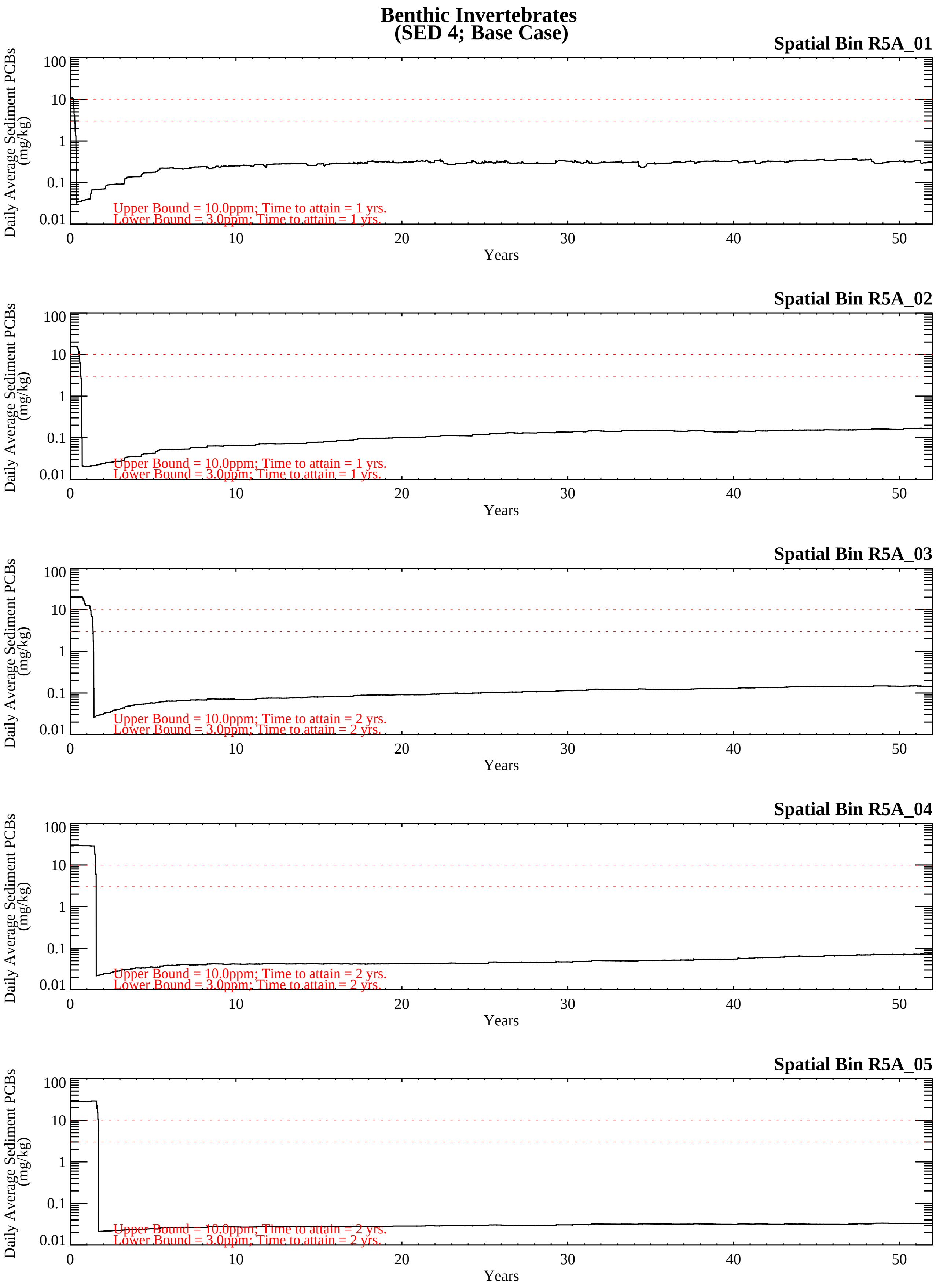

Figure G-4.2-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 4; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED4CMSBS_0801-01\\bins

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Benthic Invertebrates
(SED 4; Base Case)

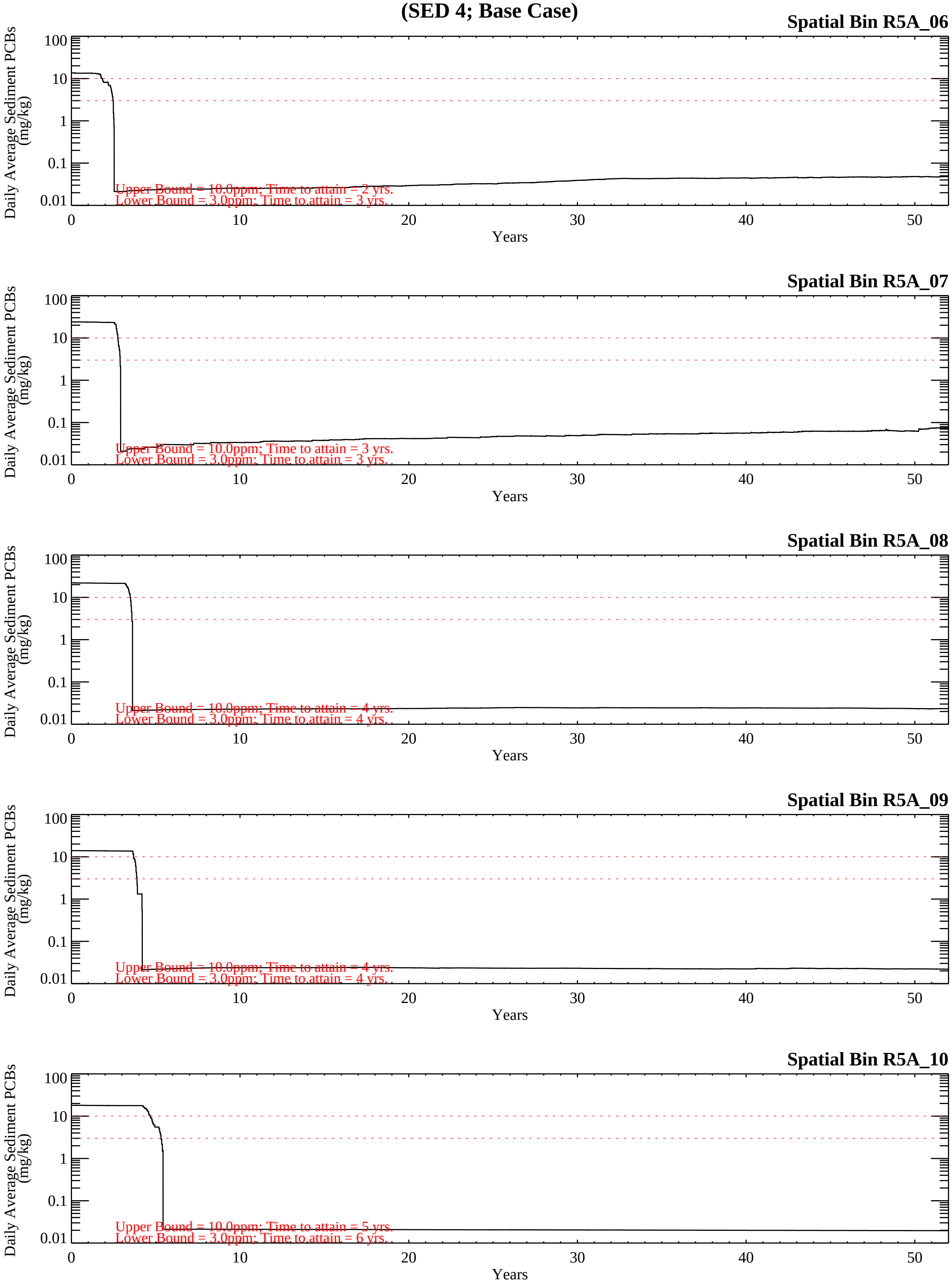

Figure G-4.2-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 4; Reach 5/6; Base Case).

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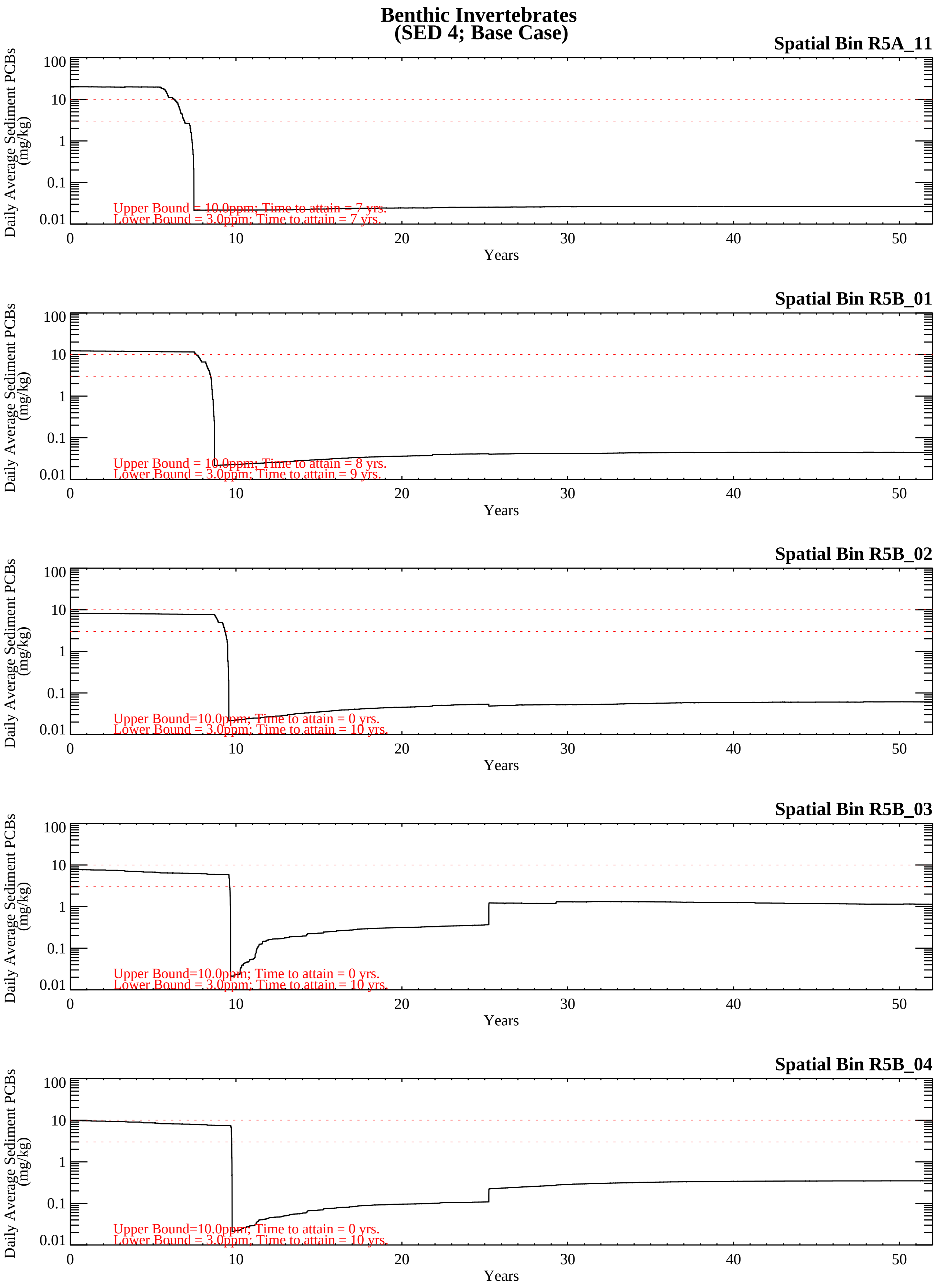

Figure G-4.2-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 4; Reach 5/6; Base Case).

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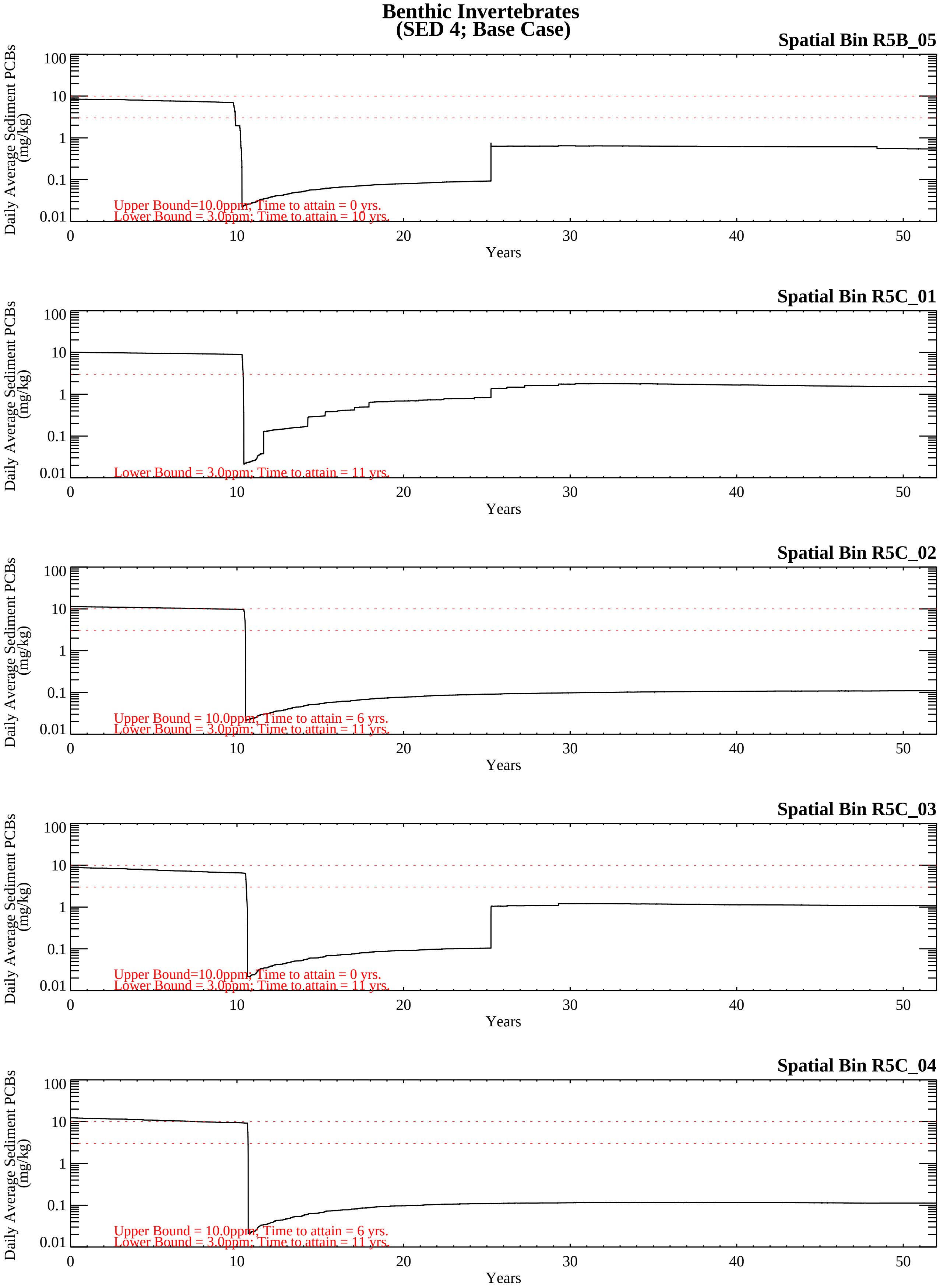

Figure G-4.2-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 4; Reach 5/6; Base Case).

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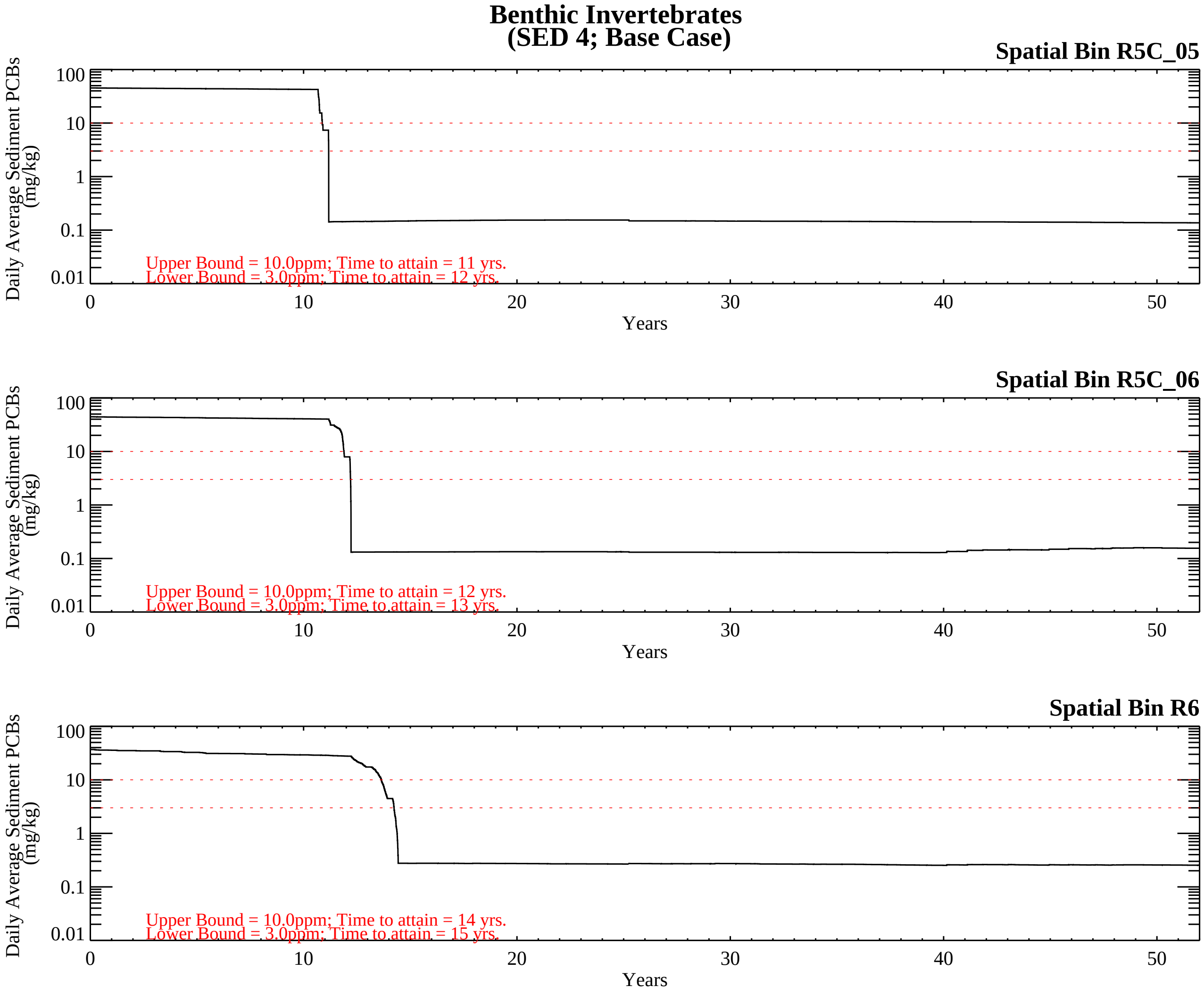

Figure G-4.2-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 4; Reach 5/6; Base Case).

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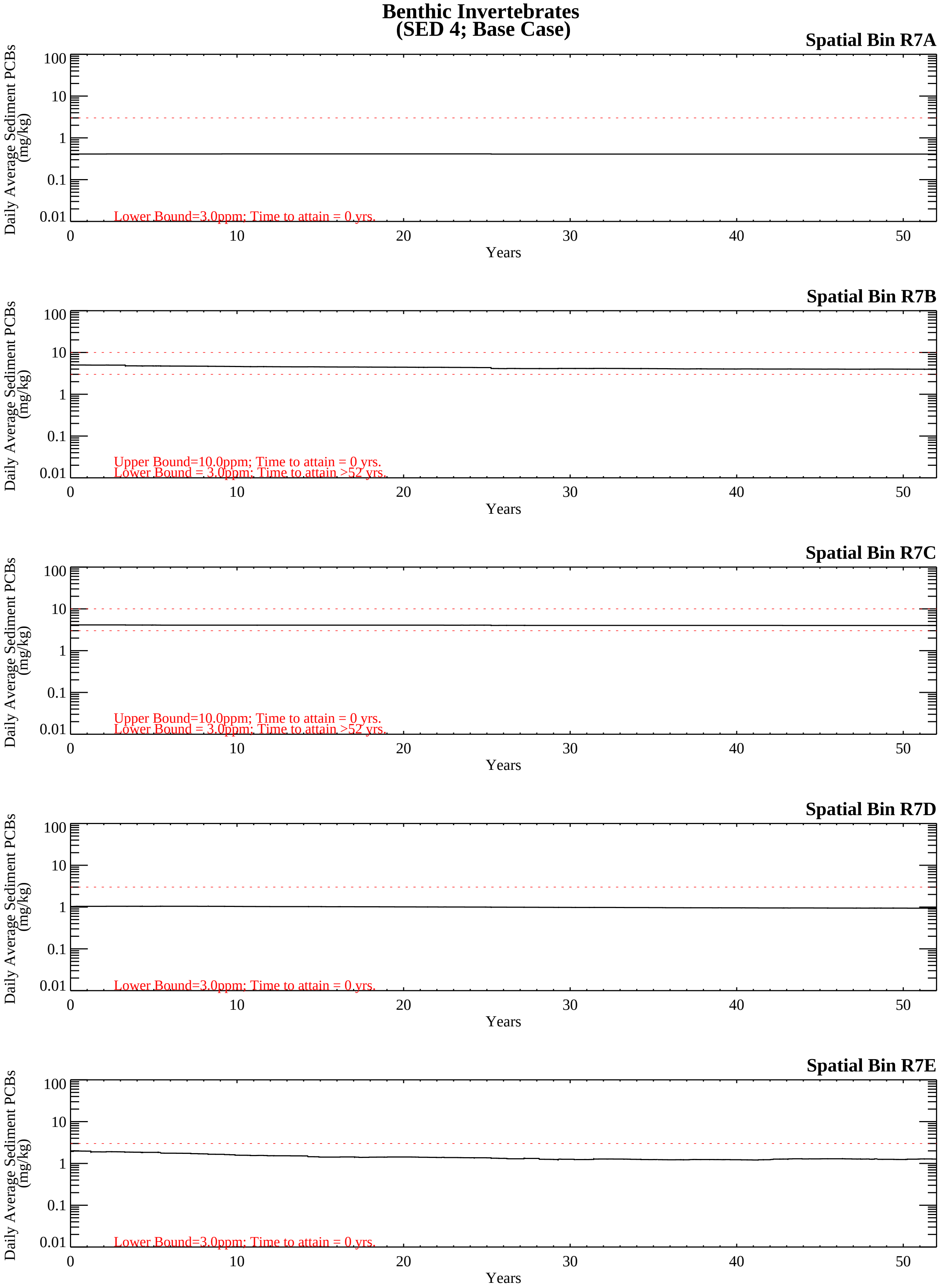

Figure G-4.2-3b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 4; Reach 7/8; Base Case).

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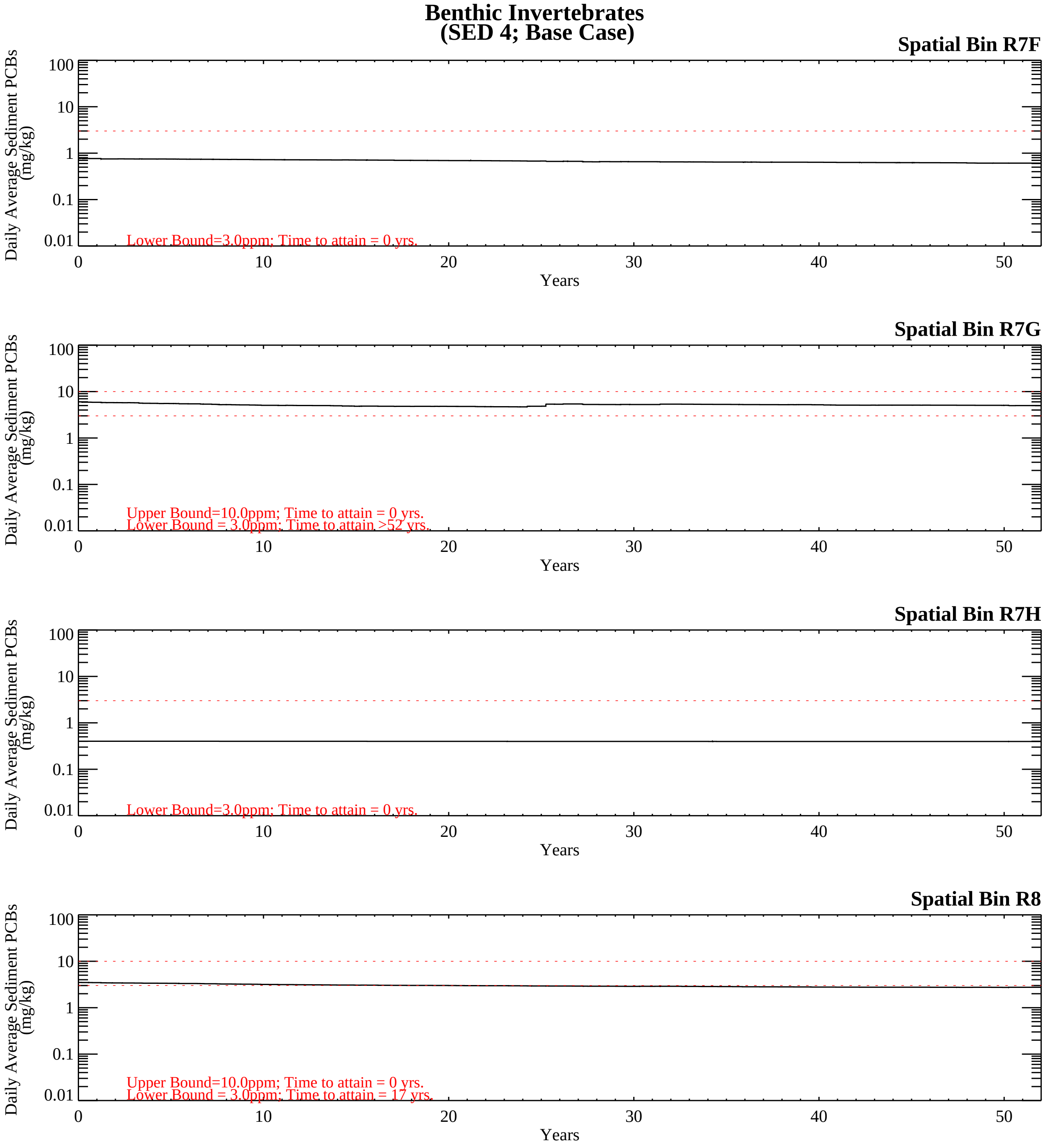

Figure G-4.2-3b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 4; Reach 7/8; Base Case).

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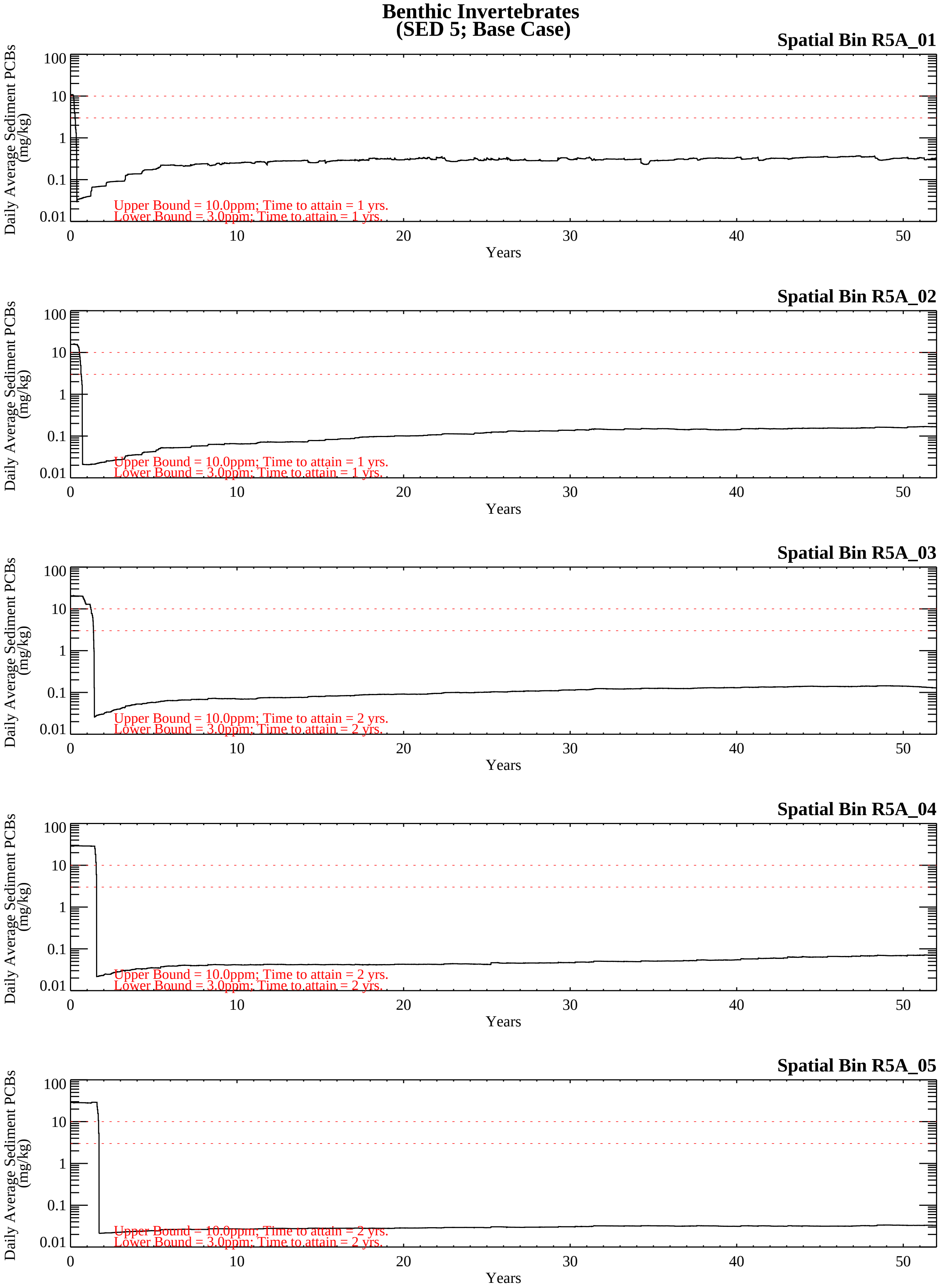

Figure G-4.2-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 5; Reach 5/6; Base Case).

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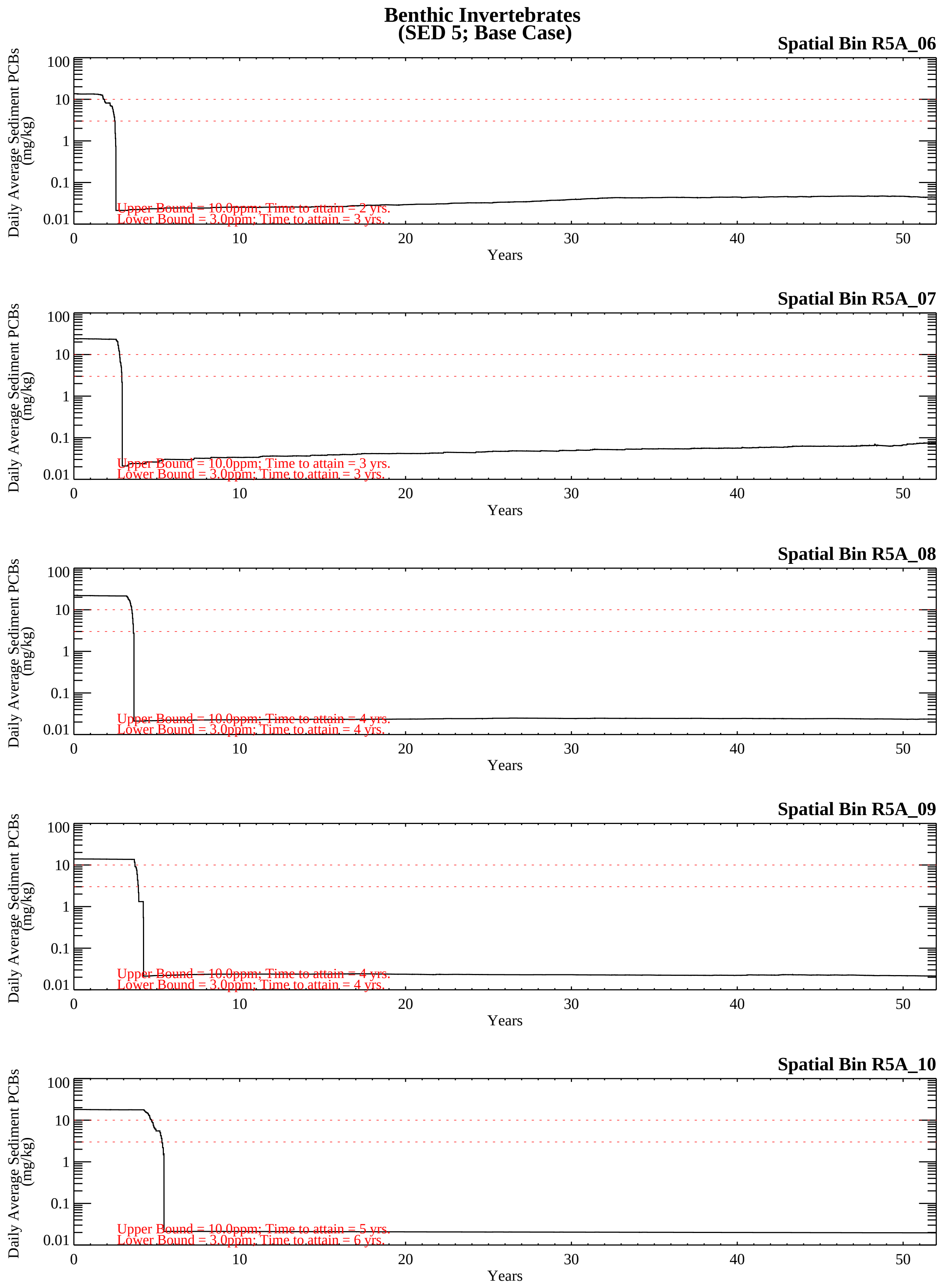

Figure G-4.2-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 5; Reach 5/6; Base Case).

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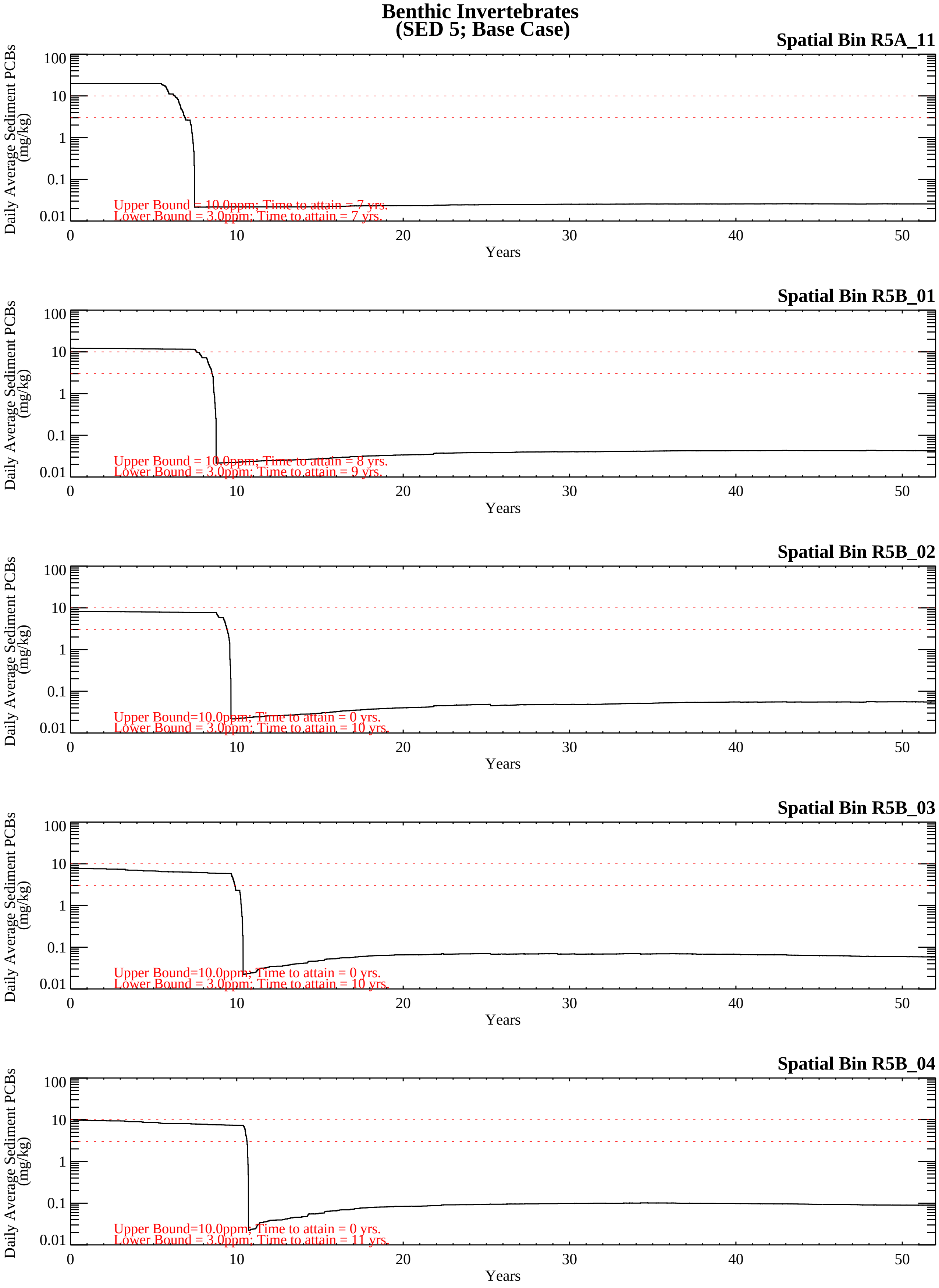

Figure G-4.2-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 5; Reach 5/6; Base Case).

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Benthic Invertebrates
(SED 5; Base Case)

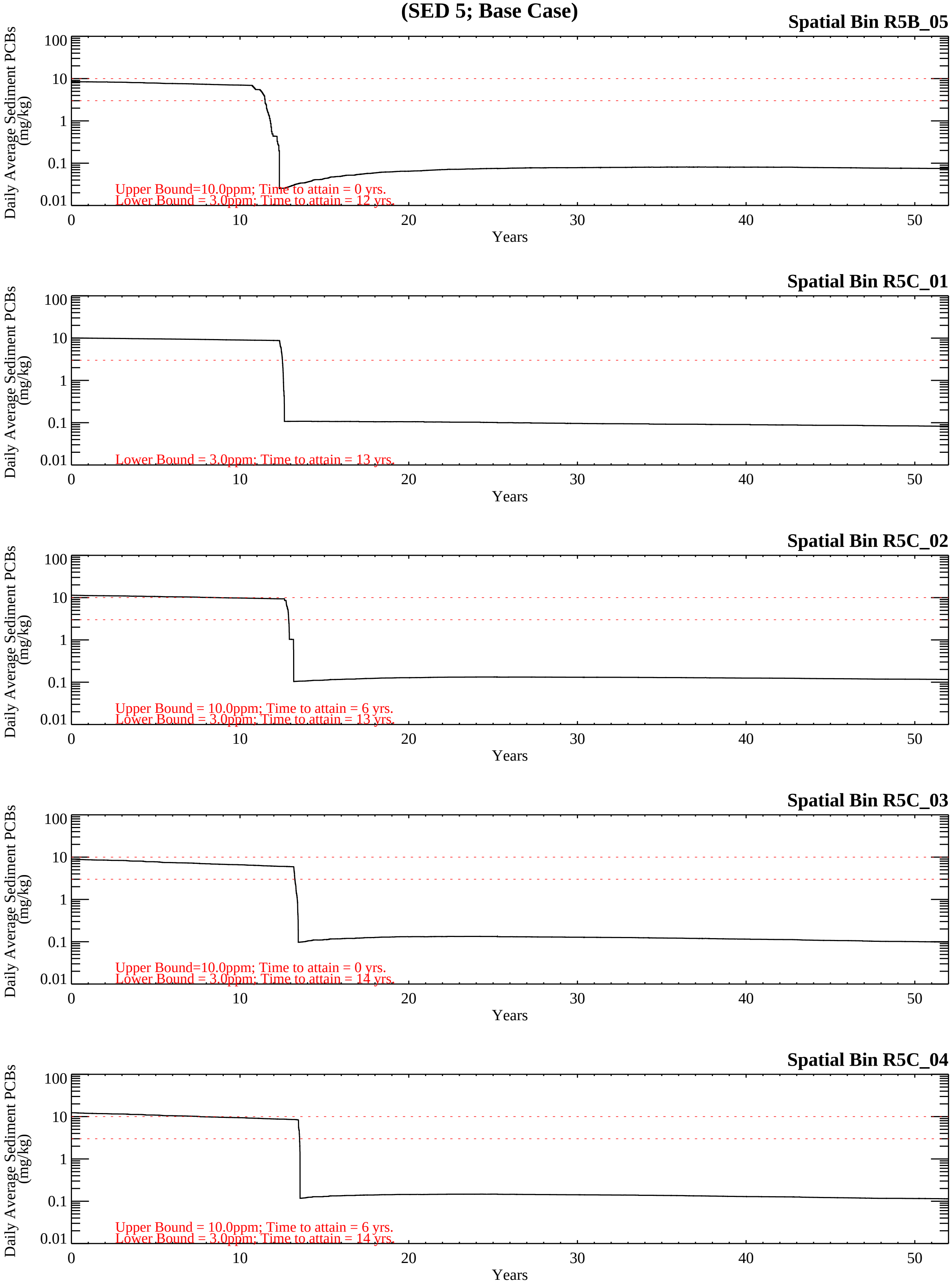

Figure G-4.2-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 5; Reach 5/6; Base Case).

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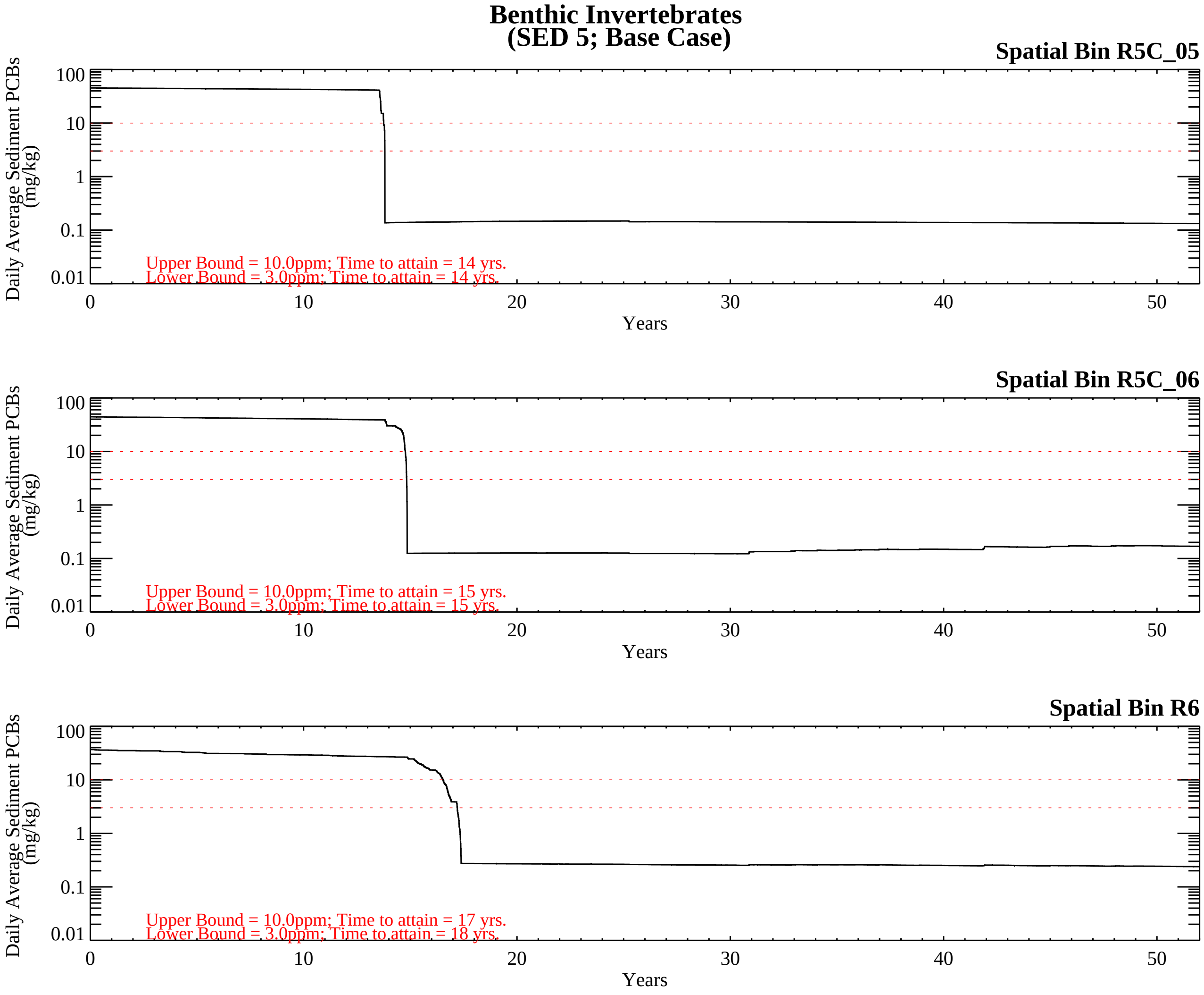

Figure G-4.2-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 5; Reach 5/6; Base Case).

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Benthic Invertebrates
(SED 5; Base Case)

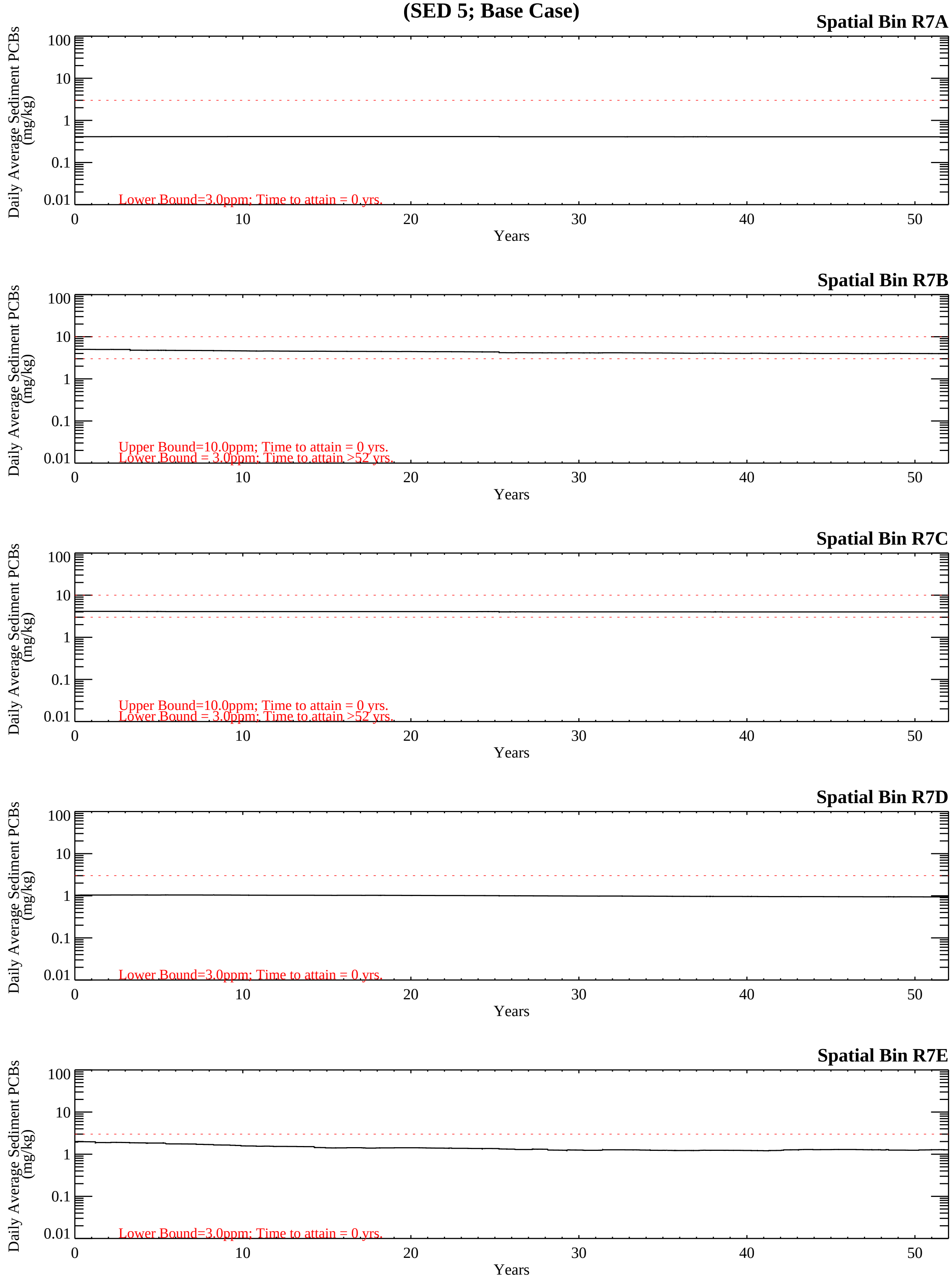

Figure G-4.2-4b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 5; Reach 7/8; Base Case).

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Benthic Invertebrates
(SED 5; Base Case)

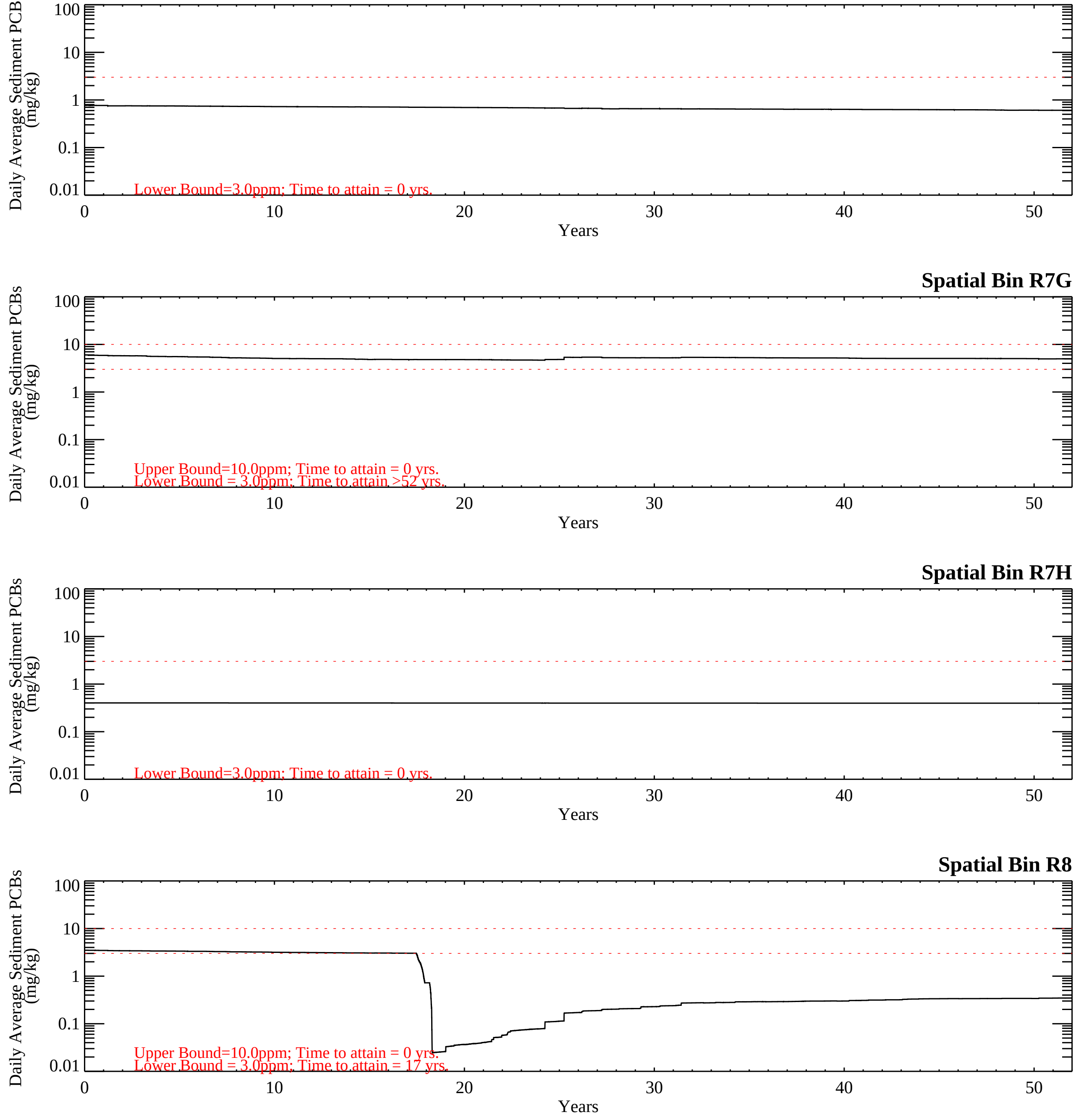

Figure G-4.2-4b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 5; Reach 7/8; Base Case).

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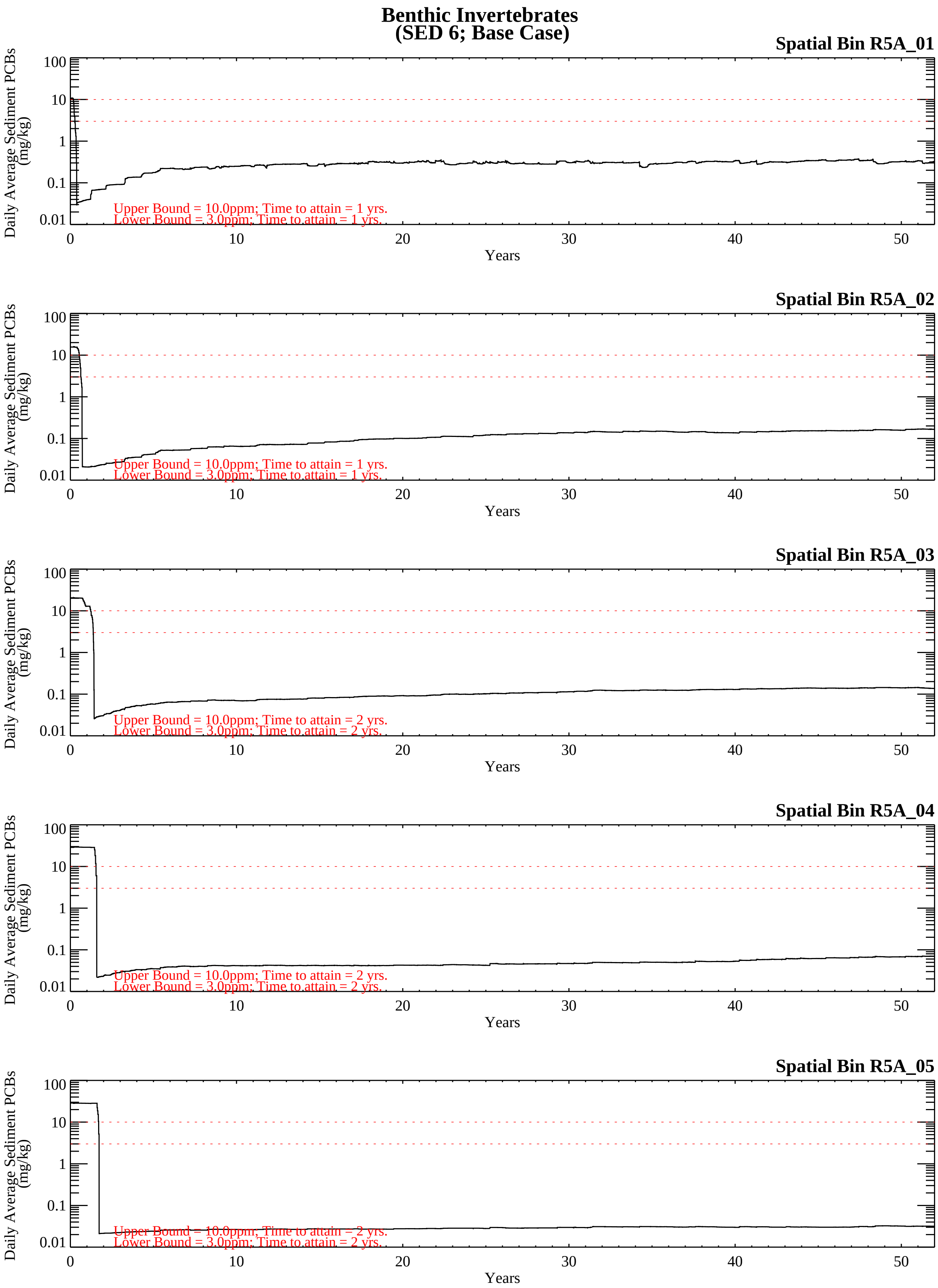

Figure G-4.2-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 6; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED6CMSBS_0712-16\\bins

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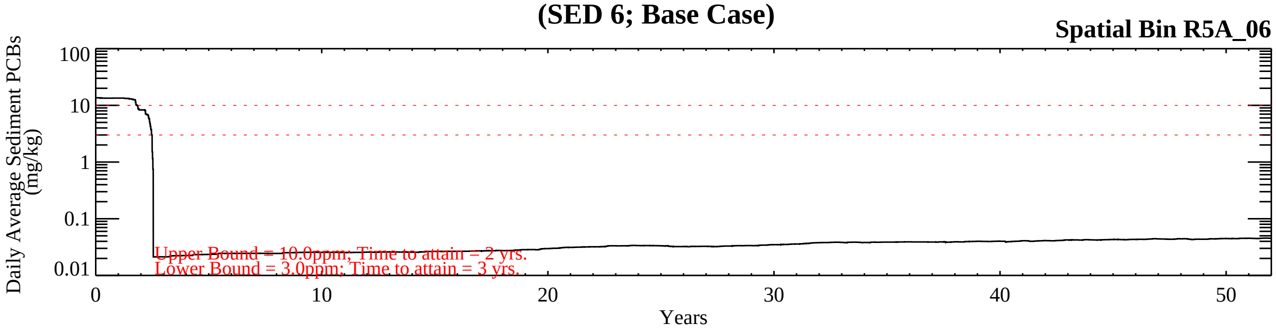
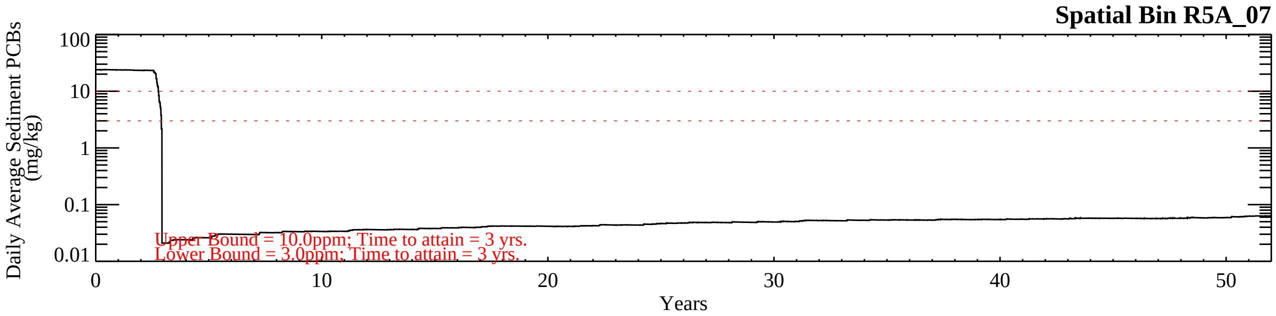
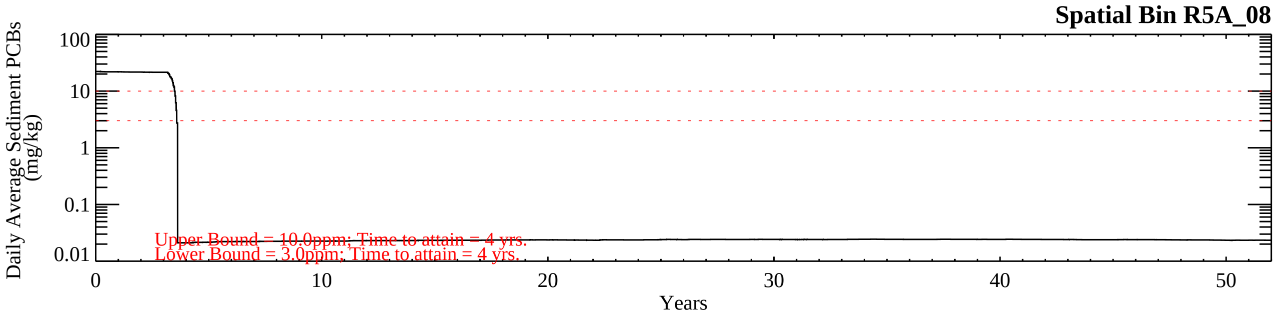
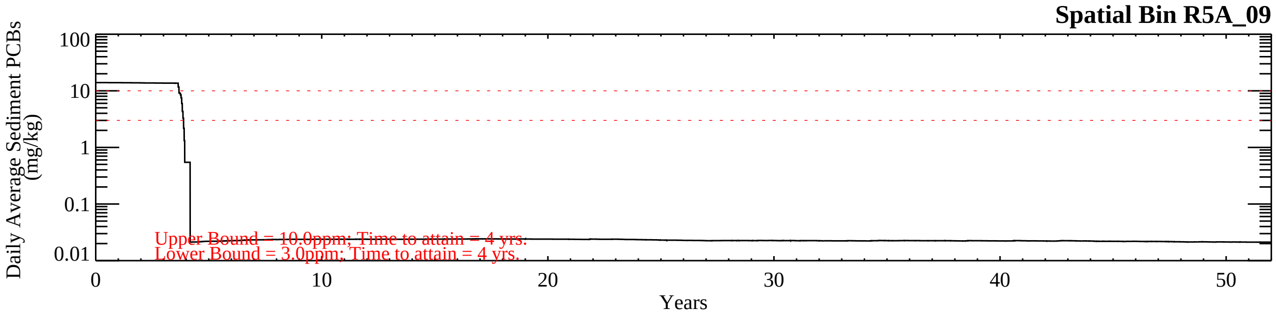
Benthic Invertebrates
(SED 6; Base Case)









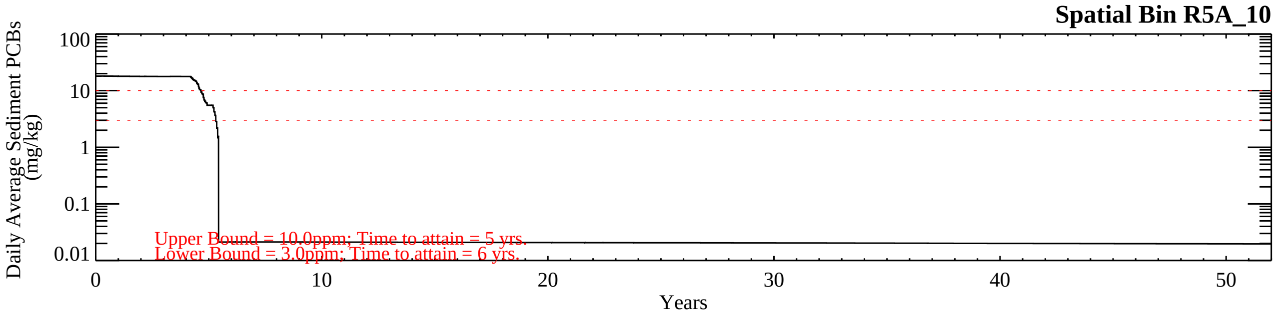


Figure G-4.2-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 6; Reach 5/6; Base Case).

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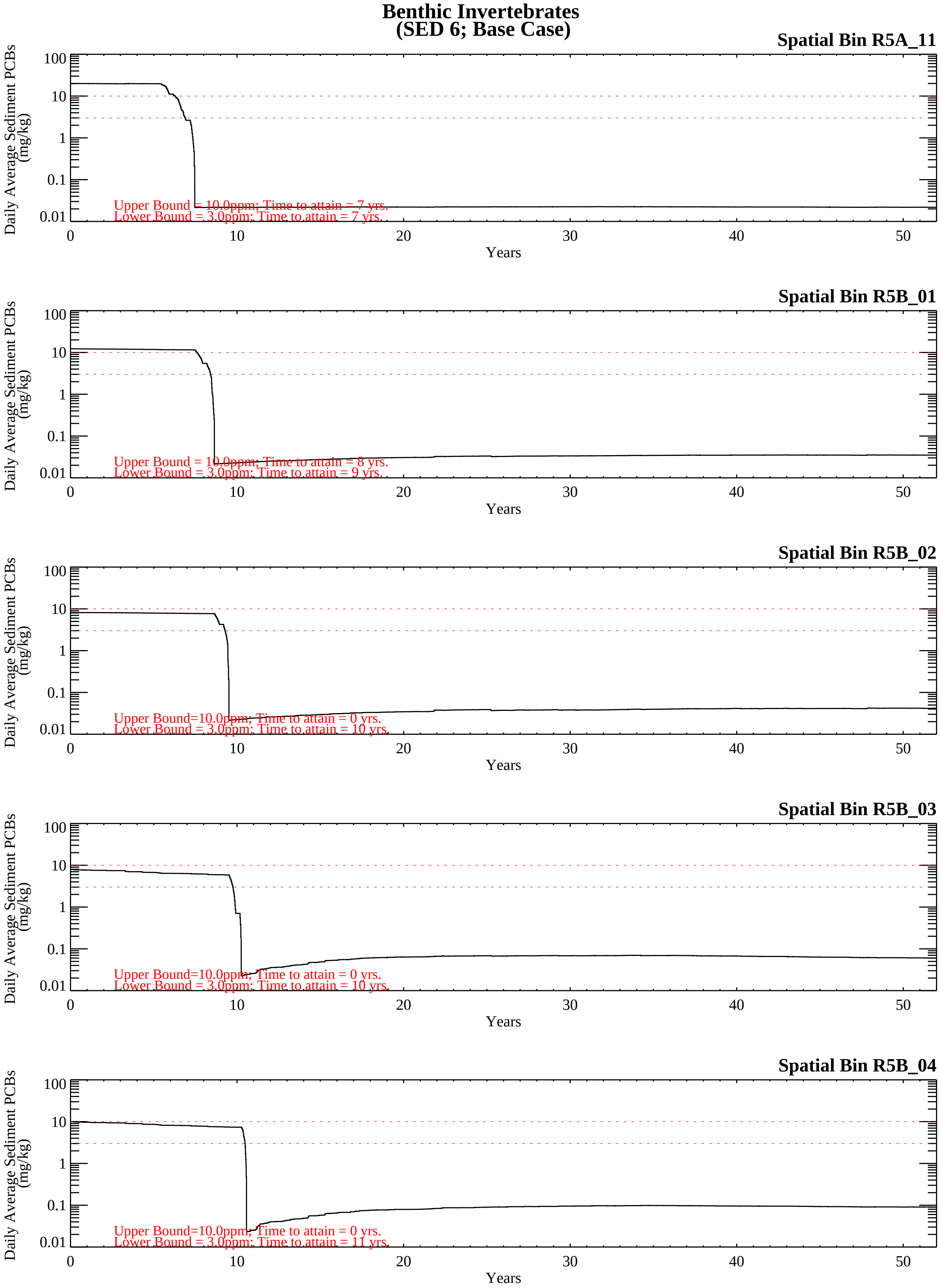

Figure G-4.2-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 6; Reach 5/6; Base Case).

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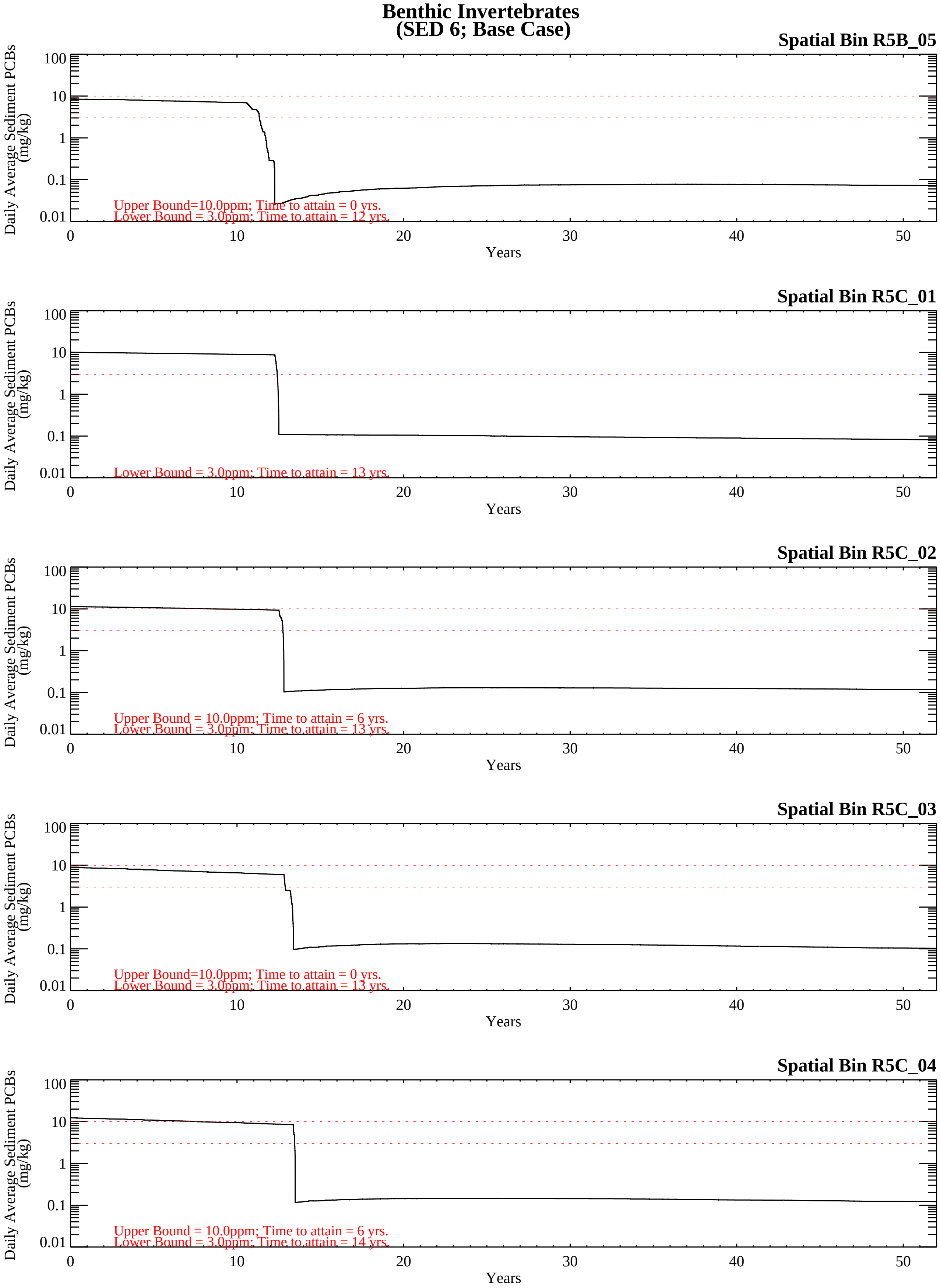

Figure G-4.2-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 6; Reach 5/6; Base Case).

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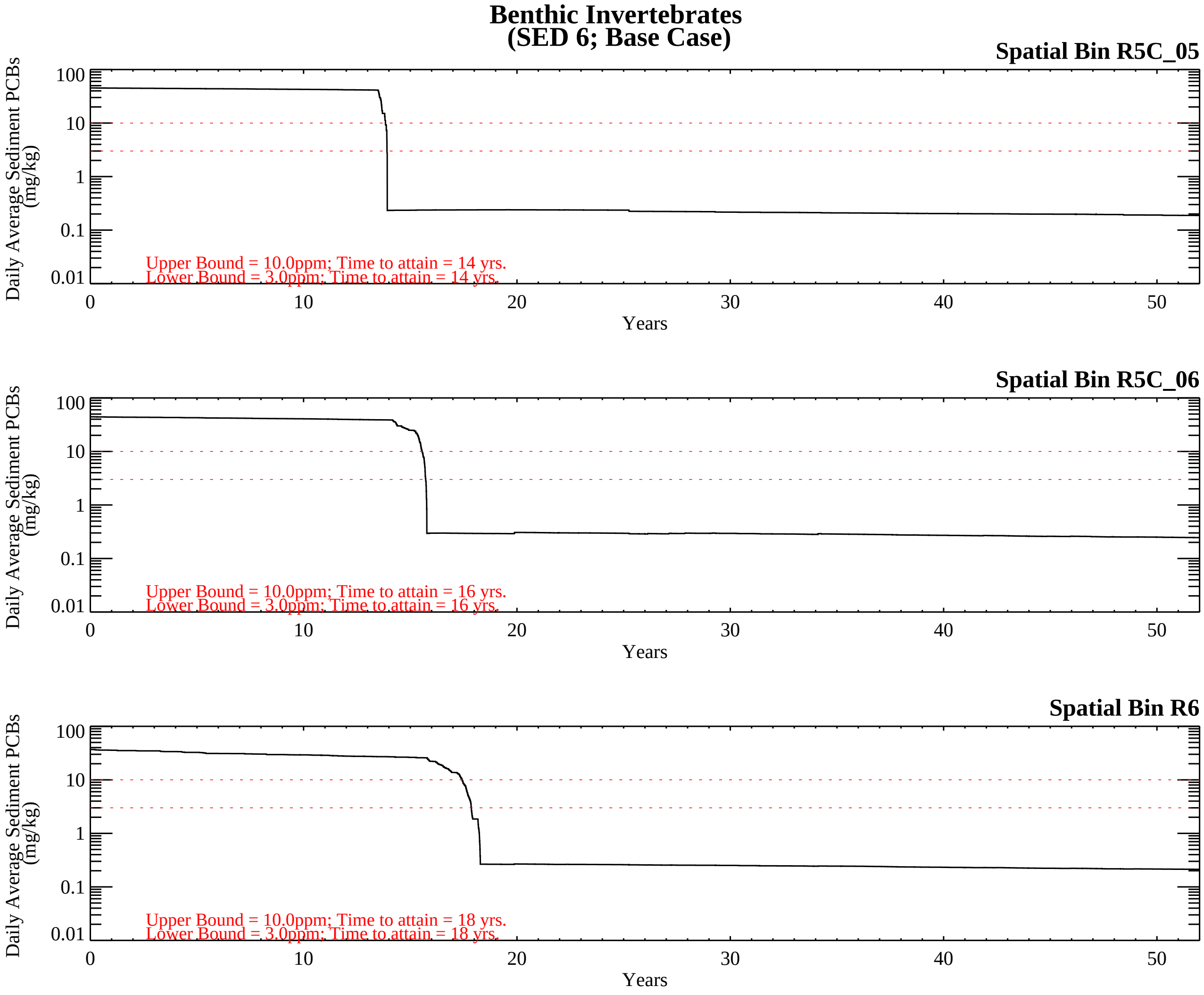

Figure G-4.2-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 6; Reach 5/6; Base Case).

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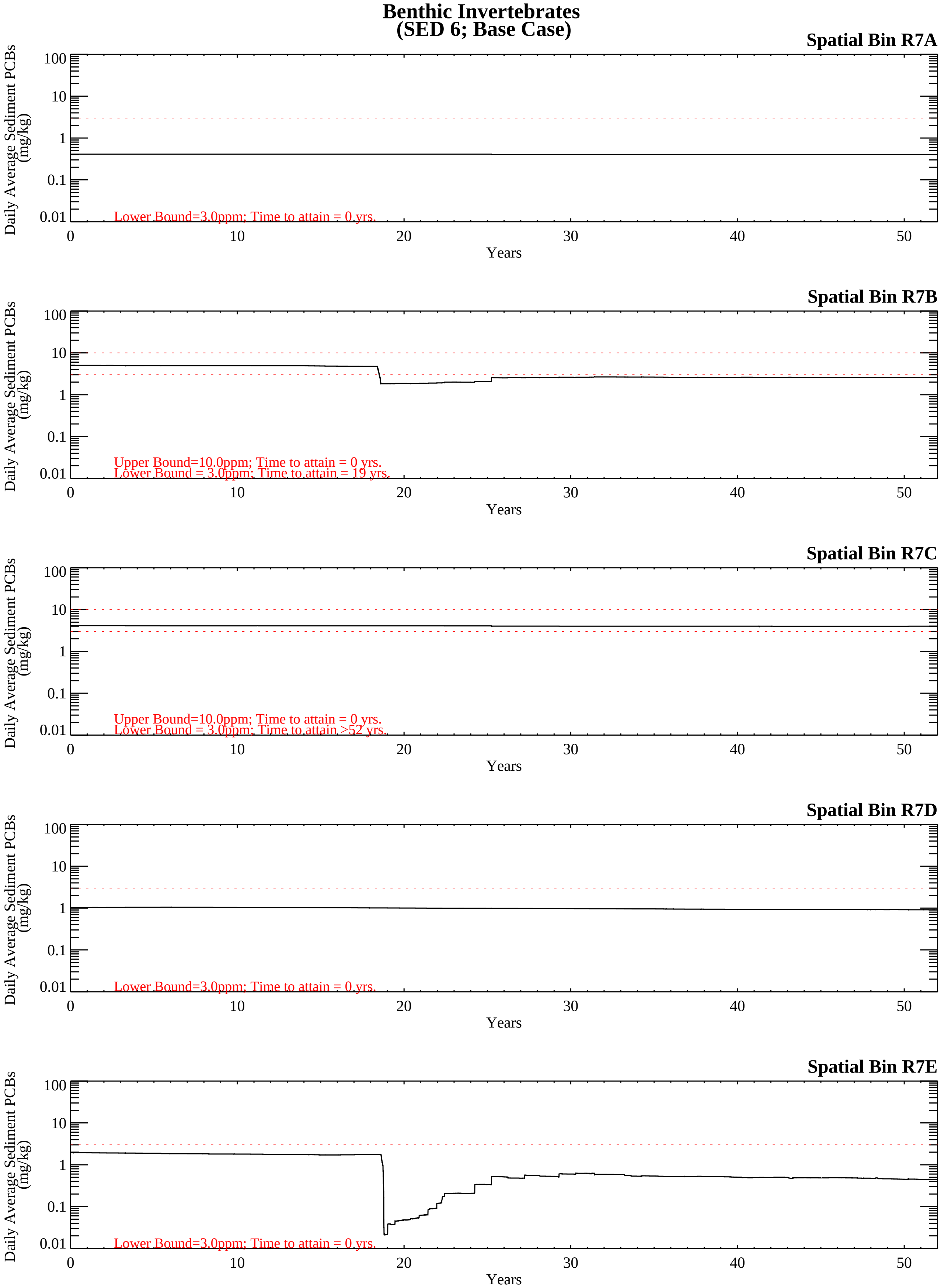

Figure G-4.2-5b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 6; Reach 7/8; Base Case).

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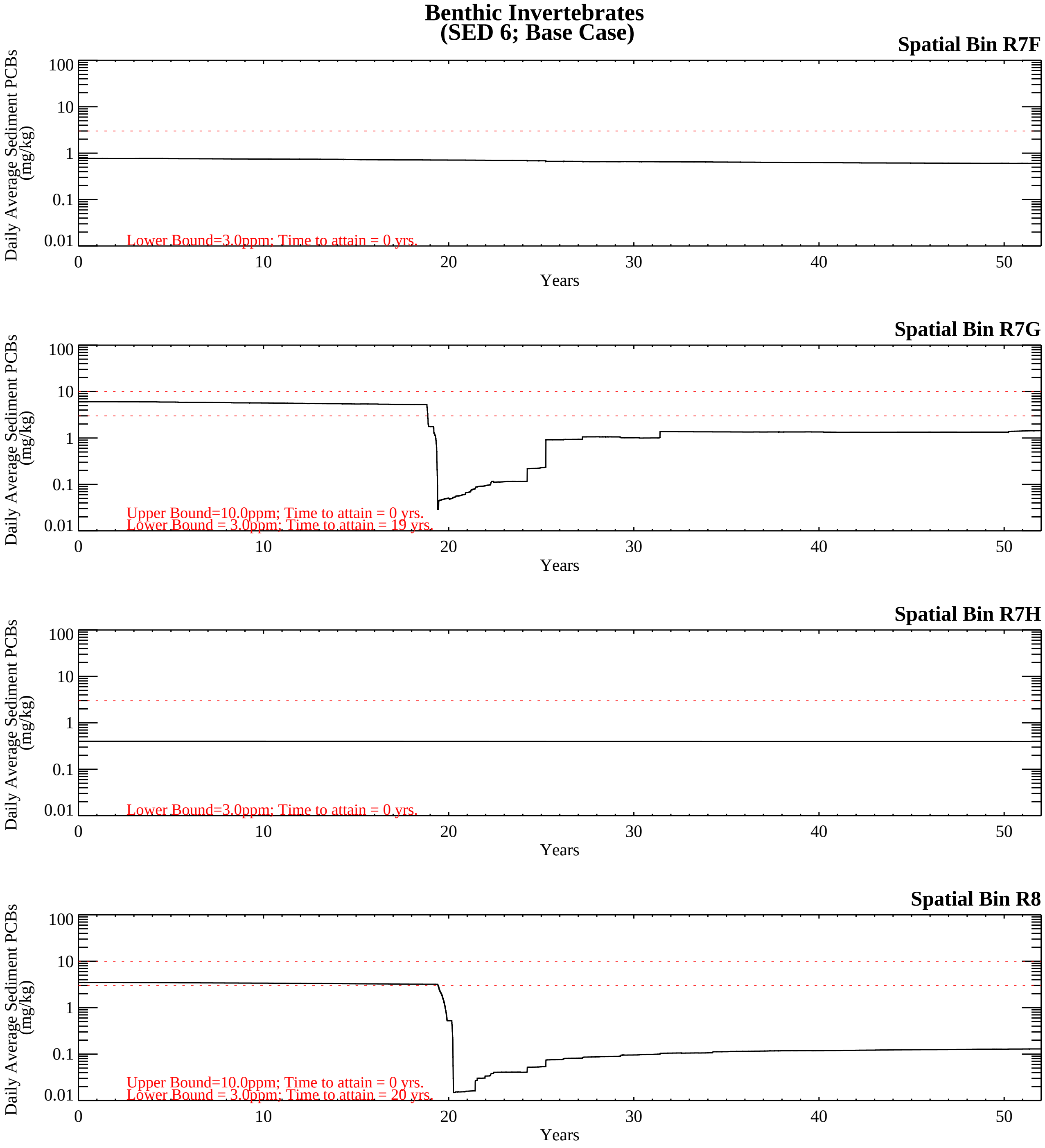

Figure G-4.2-5b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 6; Reach 7/8; Base Case).

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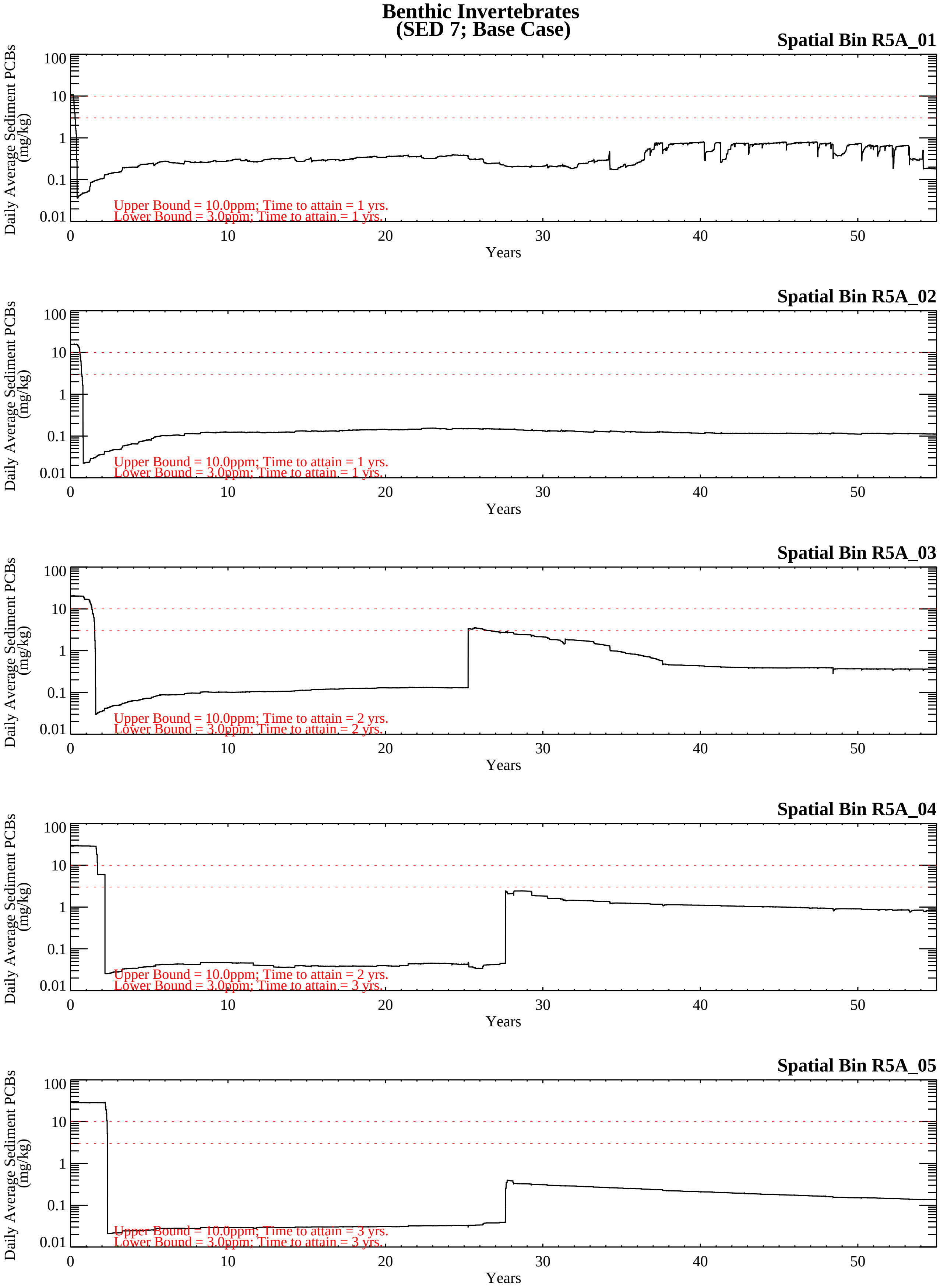

Figure G-4.2-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 7; Reach 5/6; Base Case).

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Benthic Invertebrates
(SED 7; Base Case)

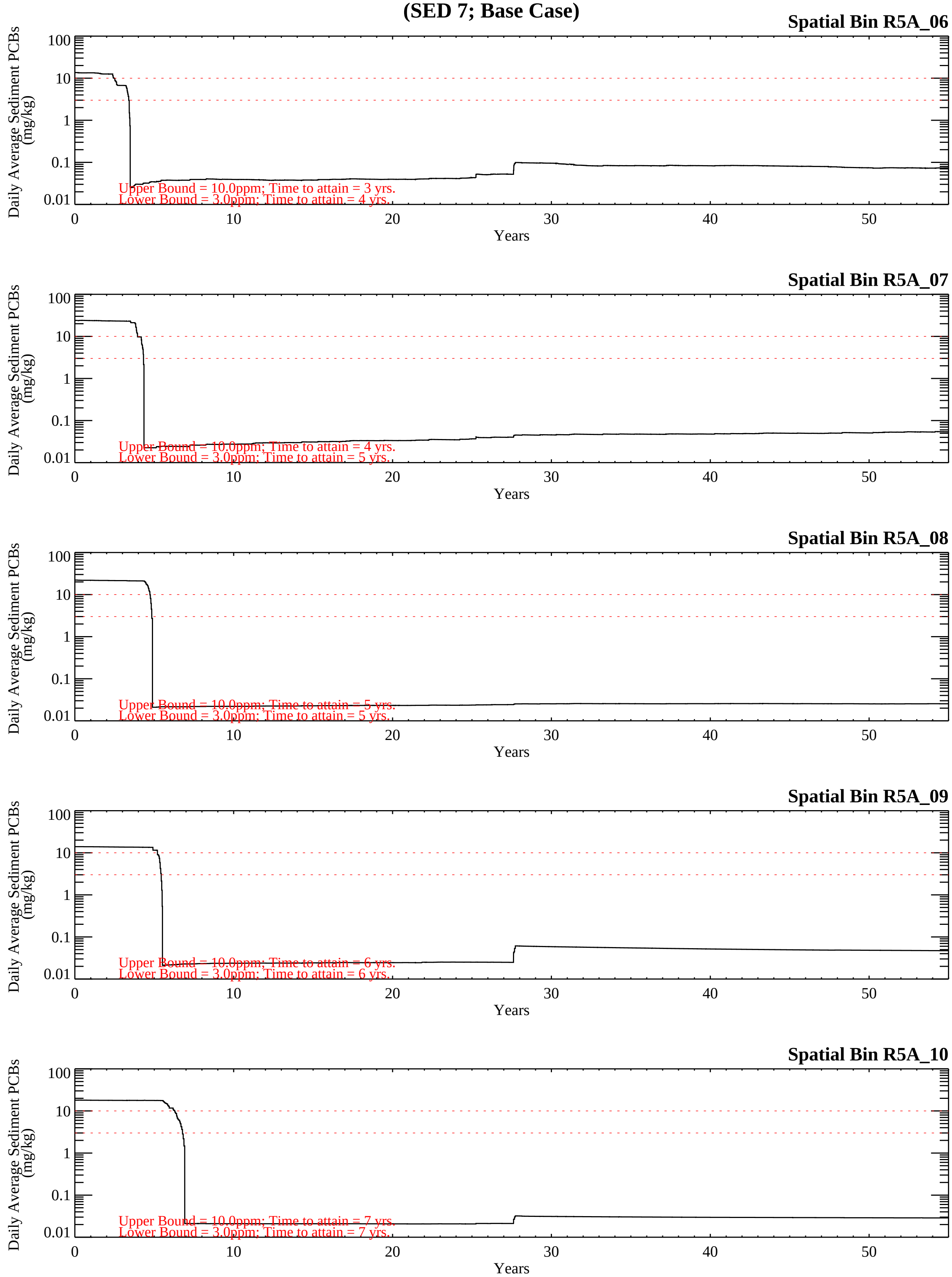

Figure G-4.2-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 7; Reach 5/6; Base Case).

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Benthic Invertebrates
(SED 7; Base Case)

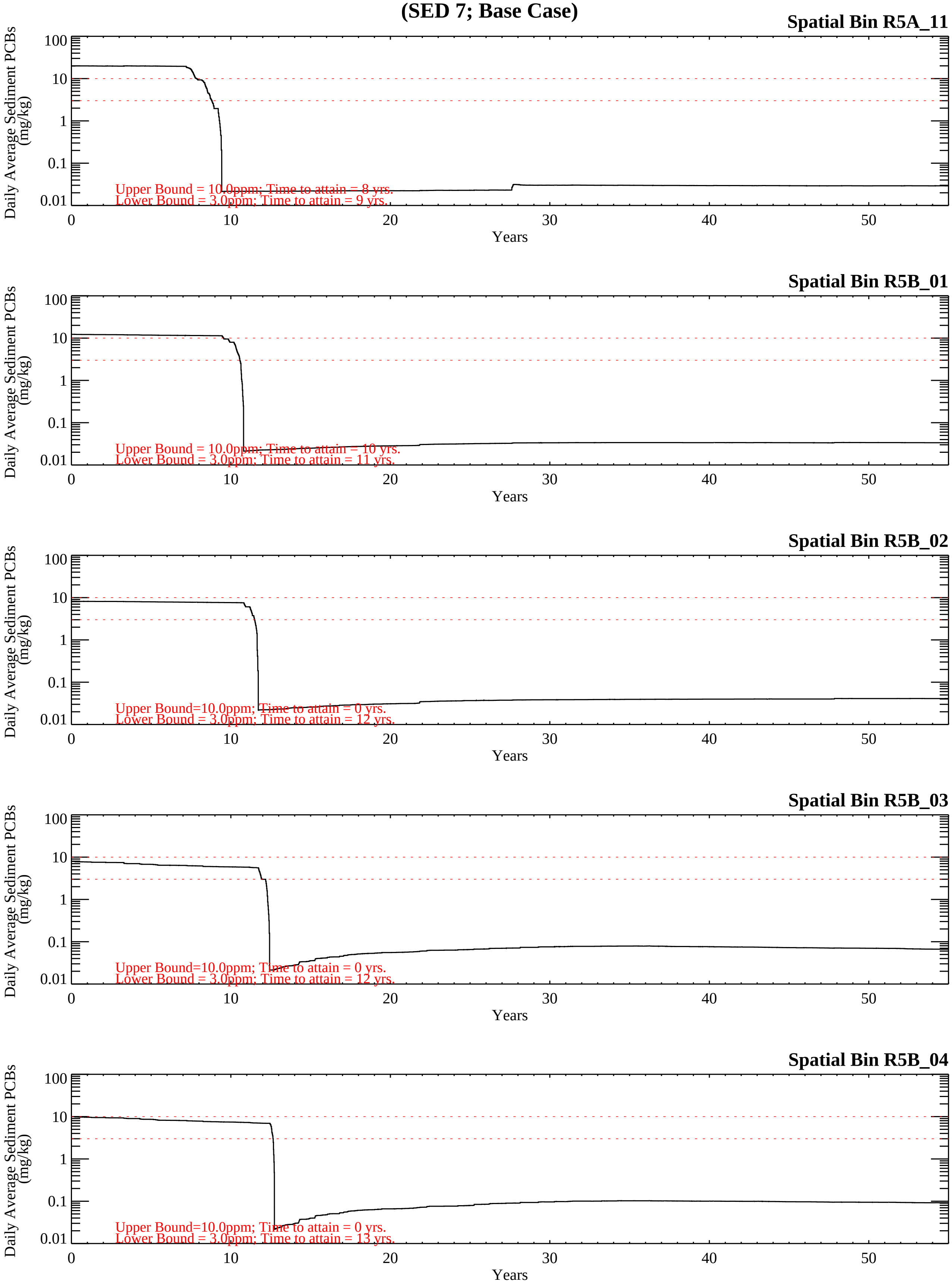

Figure G-4.2-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 7; Reach 5/6; Base Case).

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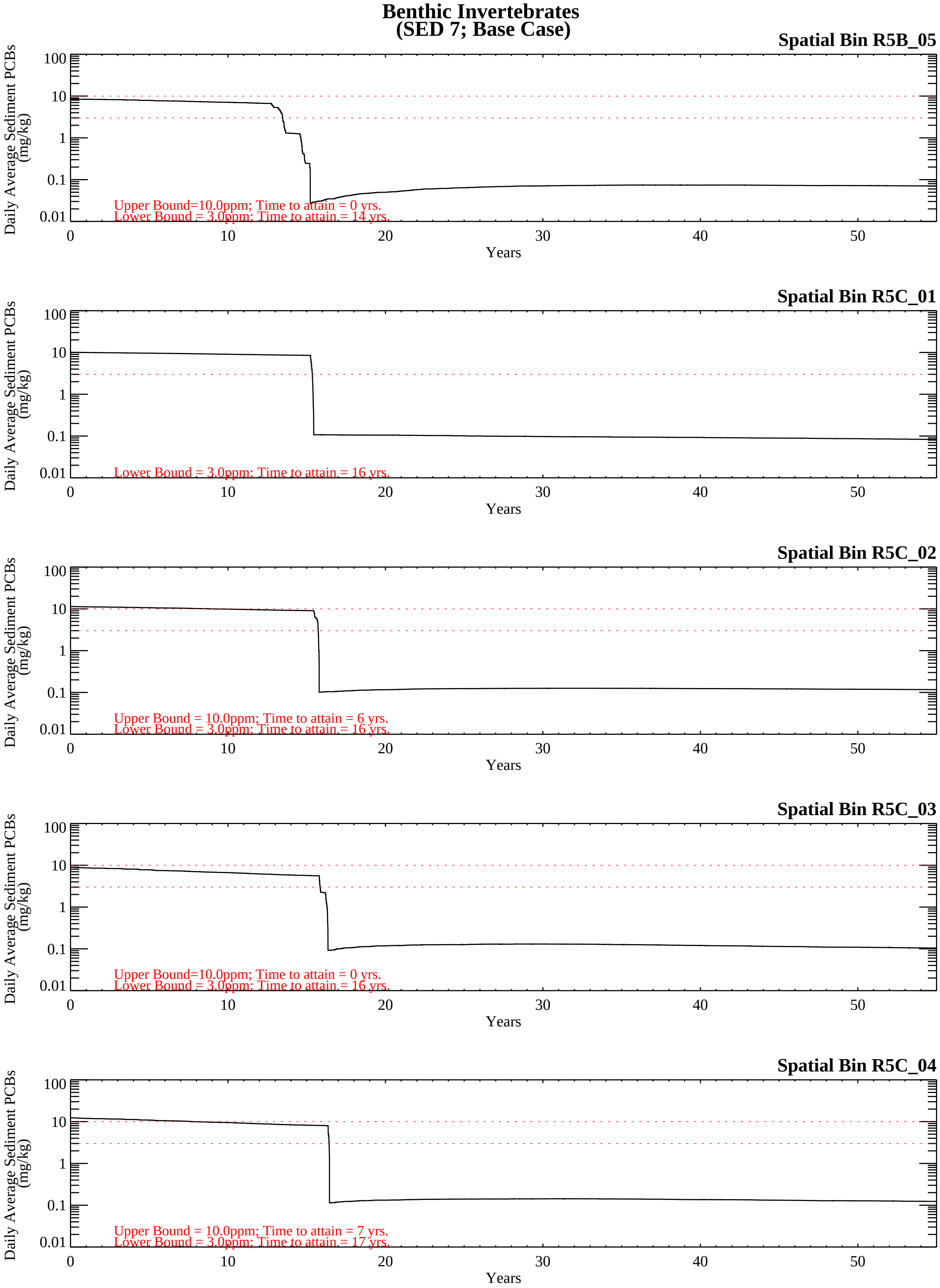

Figure G-4.2-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 7; Reach 5/6; Base Case).

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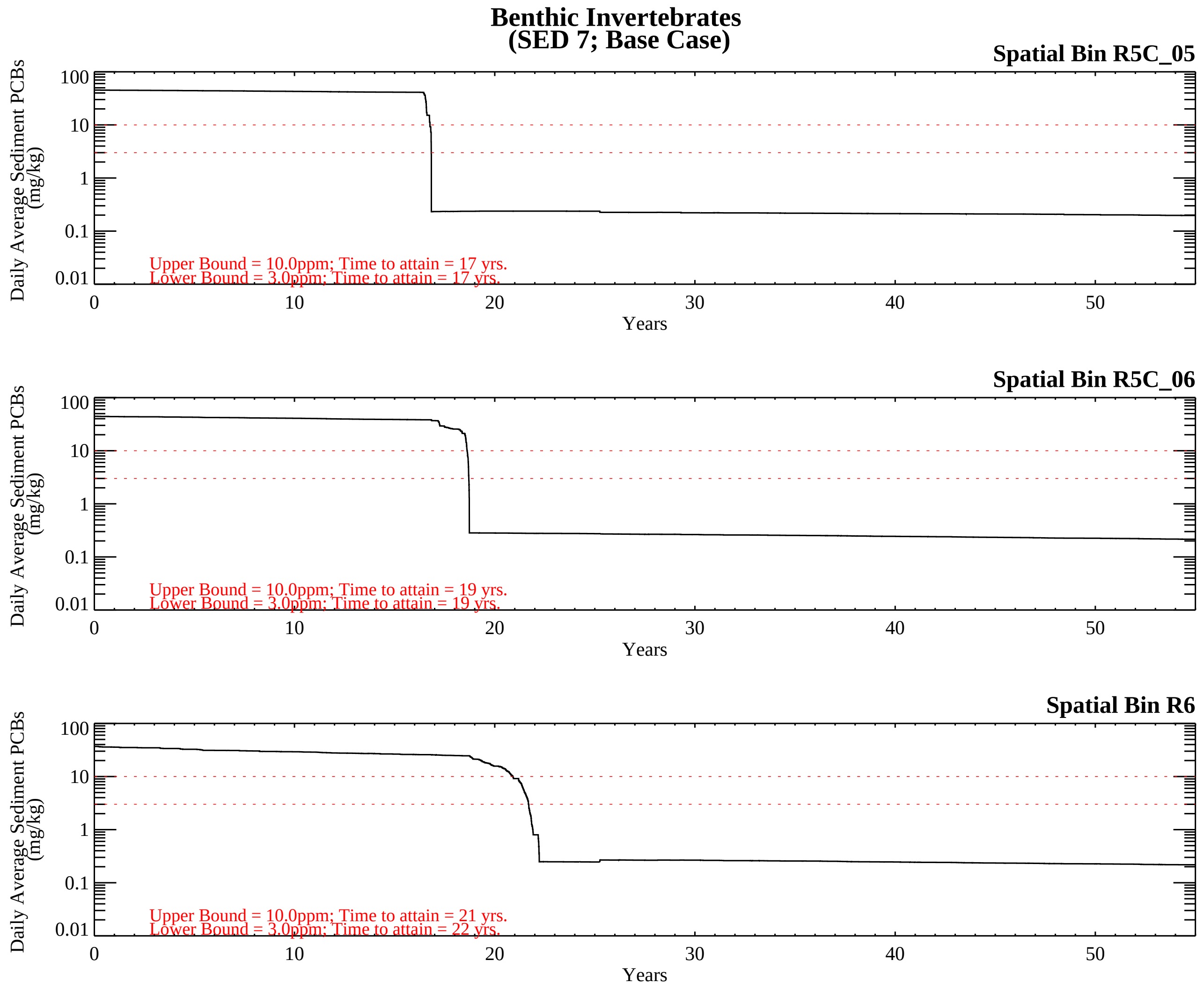

Figure G-4.2-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 7; Reach 5/6; Base Case).

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Benthic Invertebrates
(SED 7; Base Case)

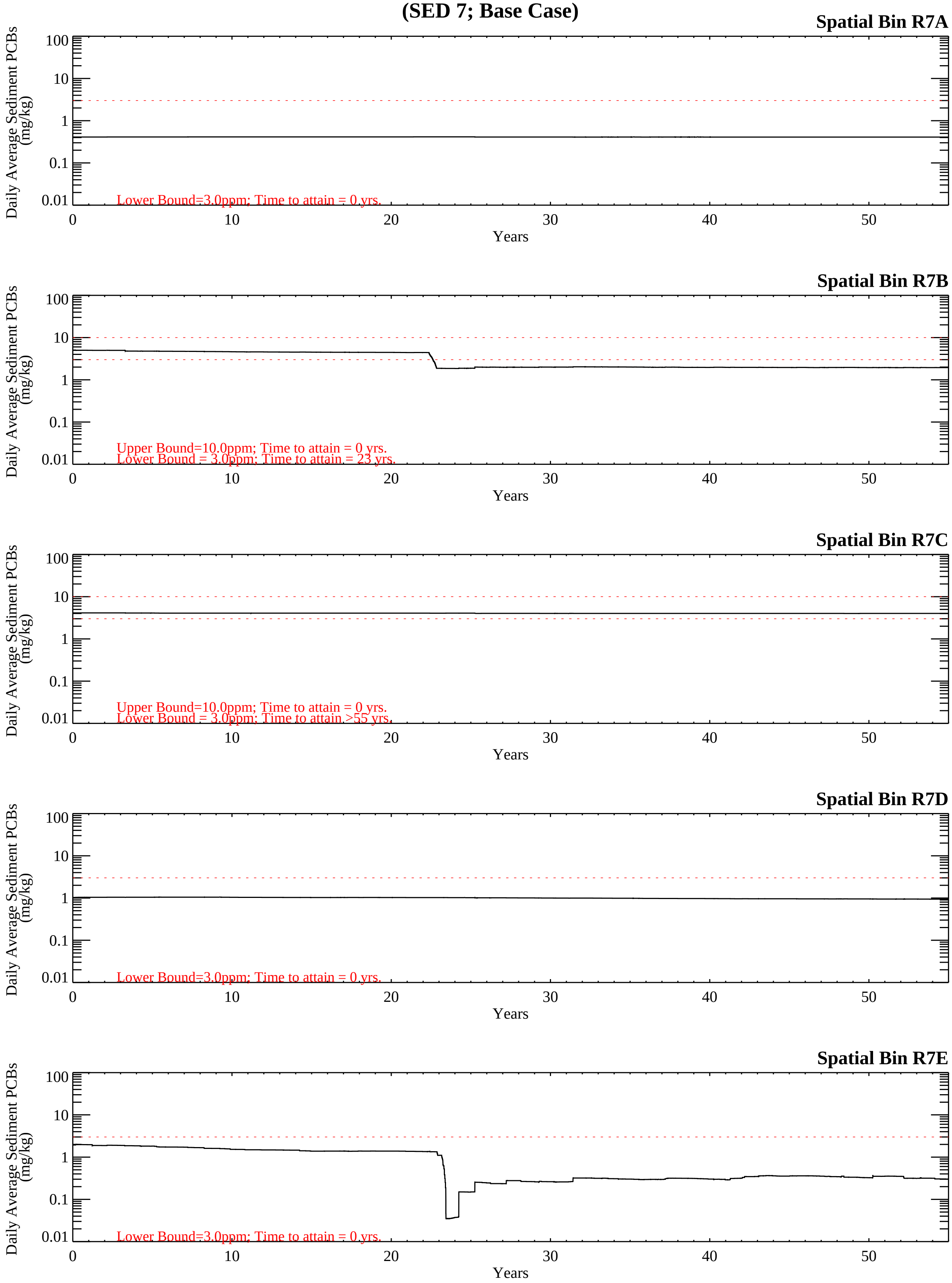

Figure G-4.2-6b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 7; Reach 7/8; Base Case).

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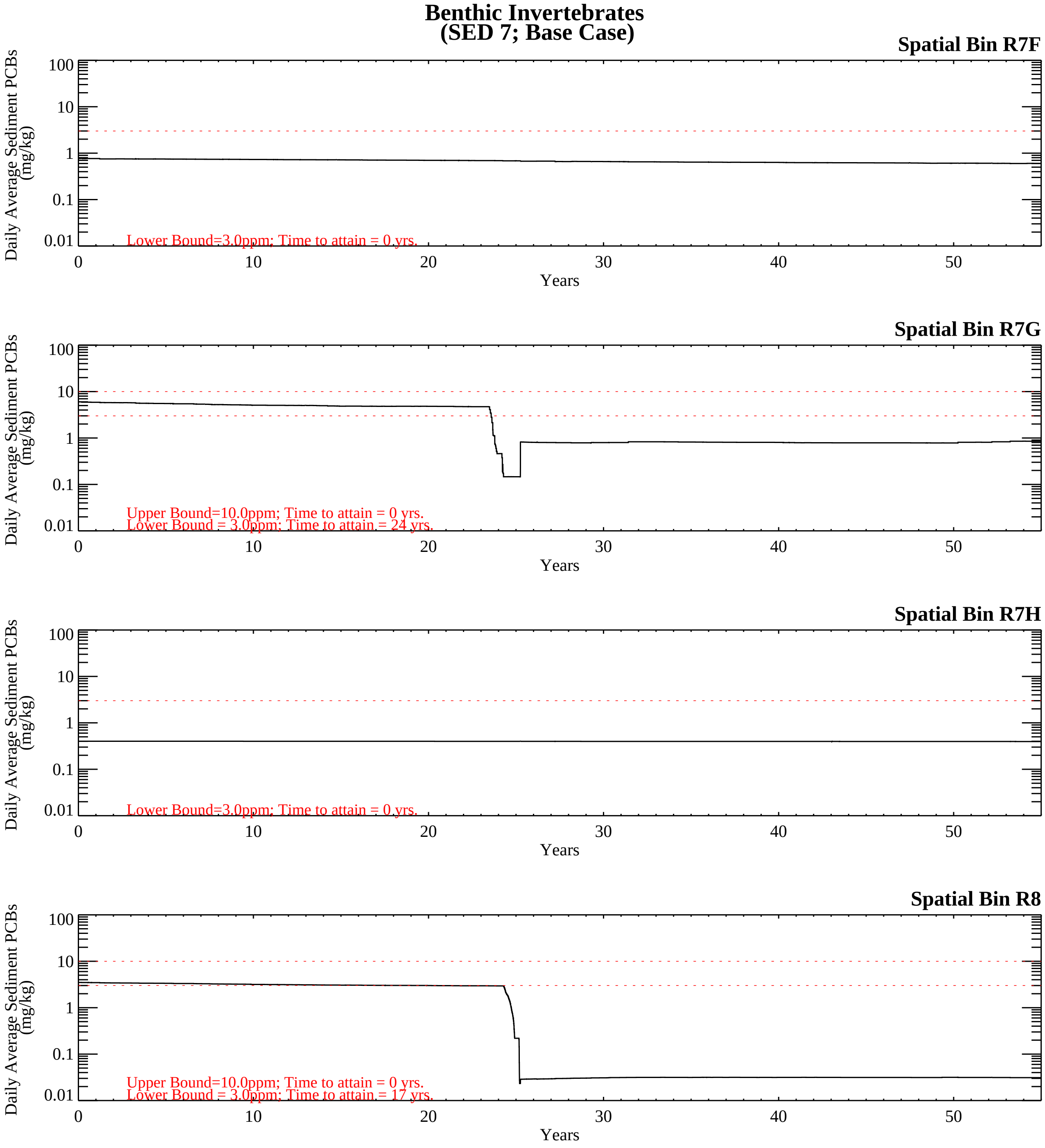

Figure G-4.2-6b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 7; Reach 7/8; Base Case).

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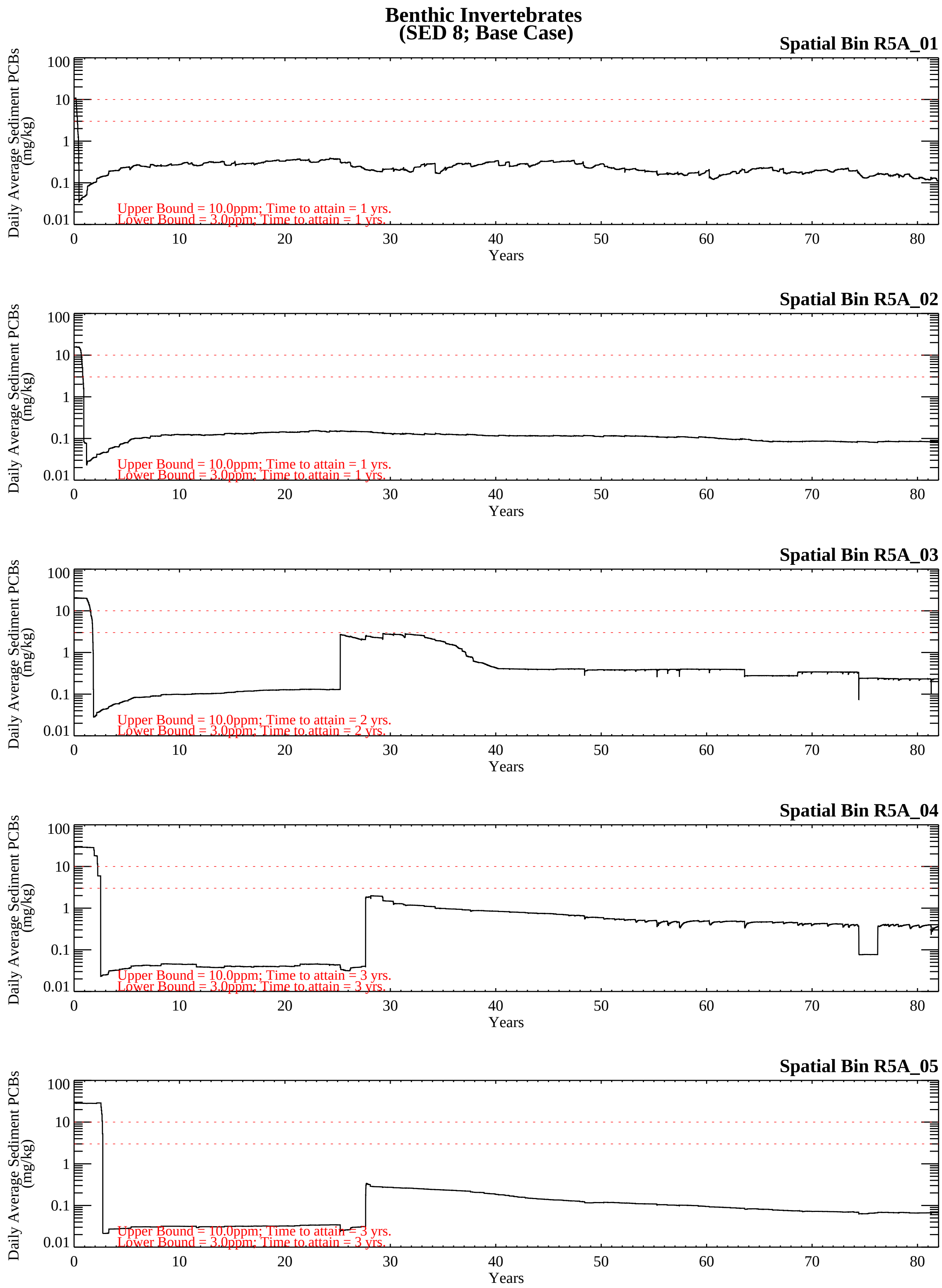

Figure G-4.2-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 8; Reach 5/6; Base Case).

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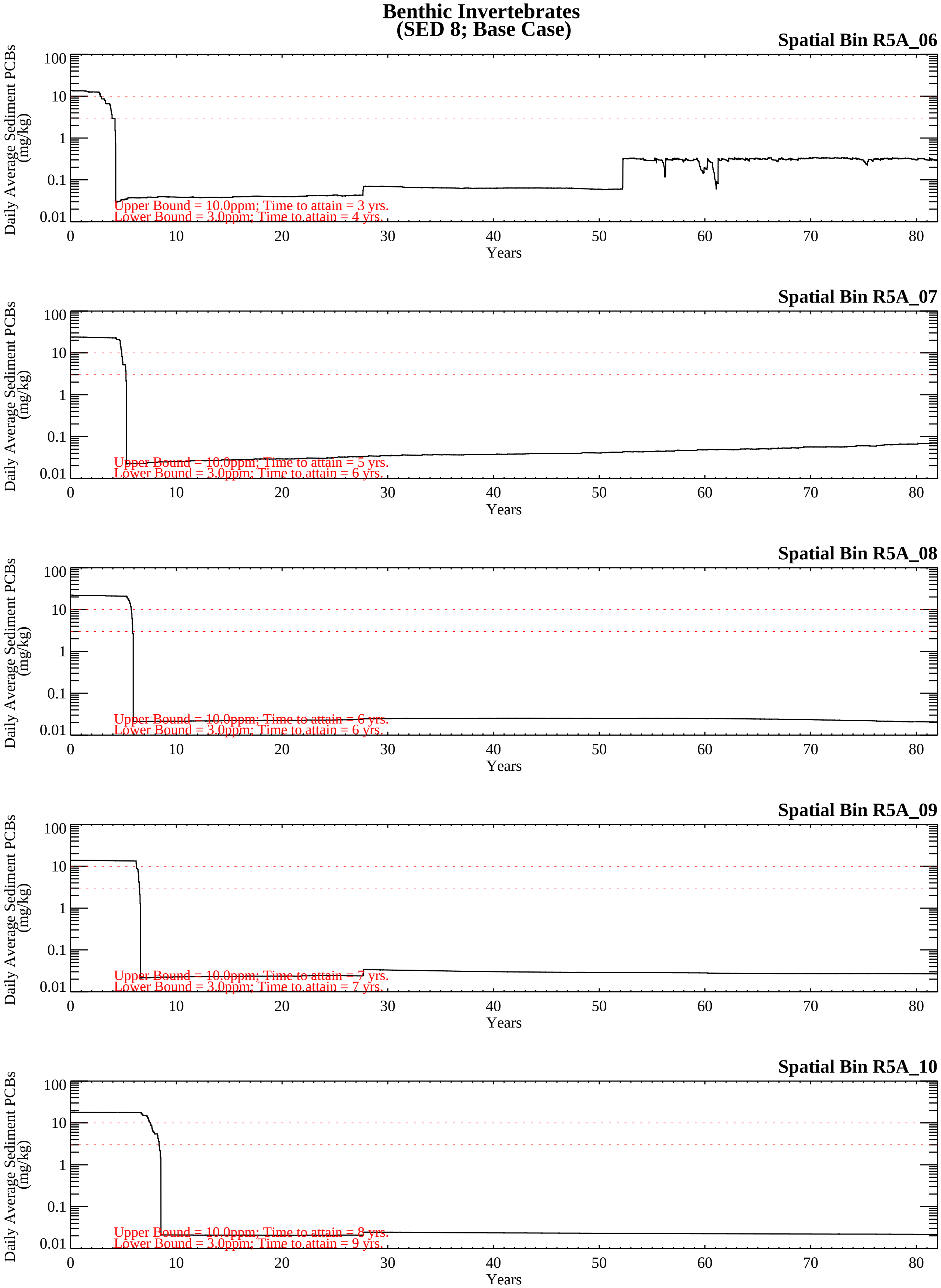

Figure G-4.2-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 8; Reach 5/6; Base Case).

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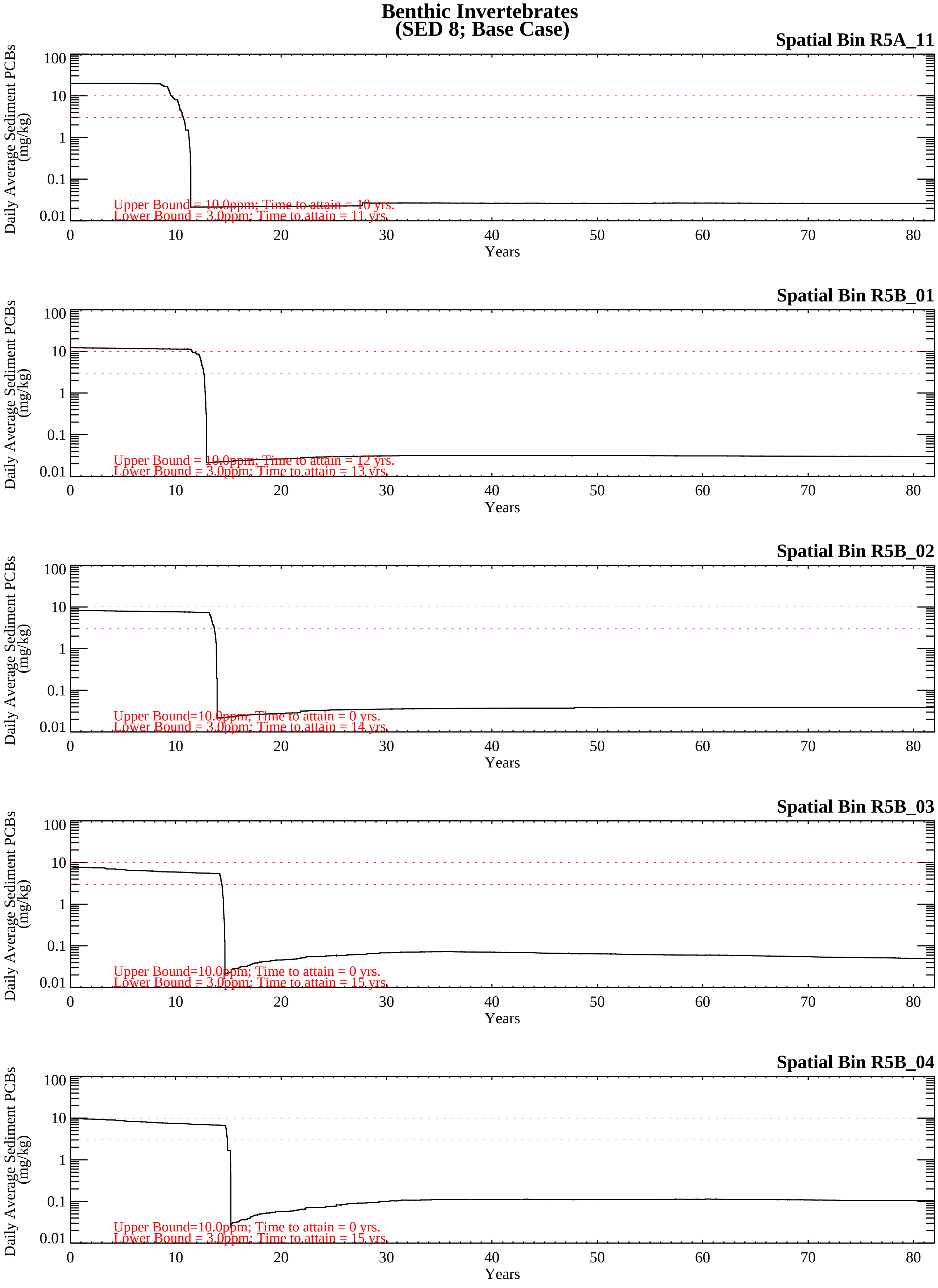

Figure G-4.2-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 8; Reach 5/6; Base Case).

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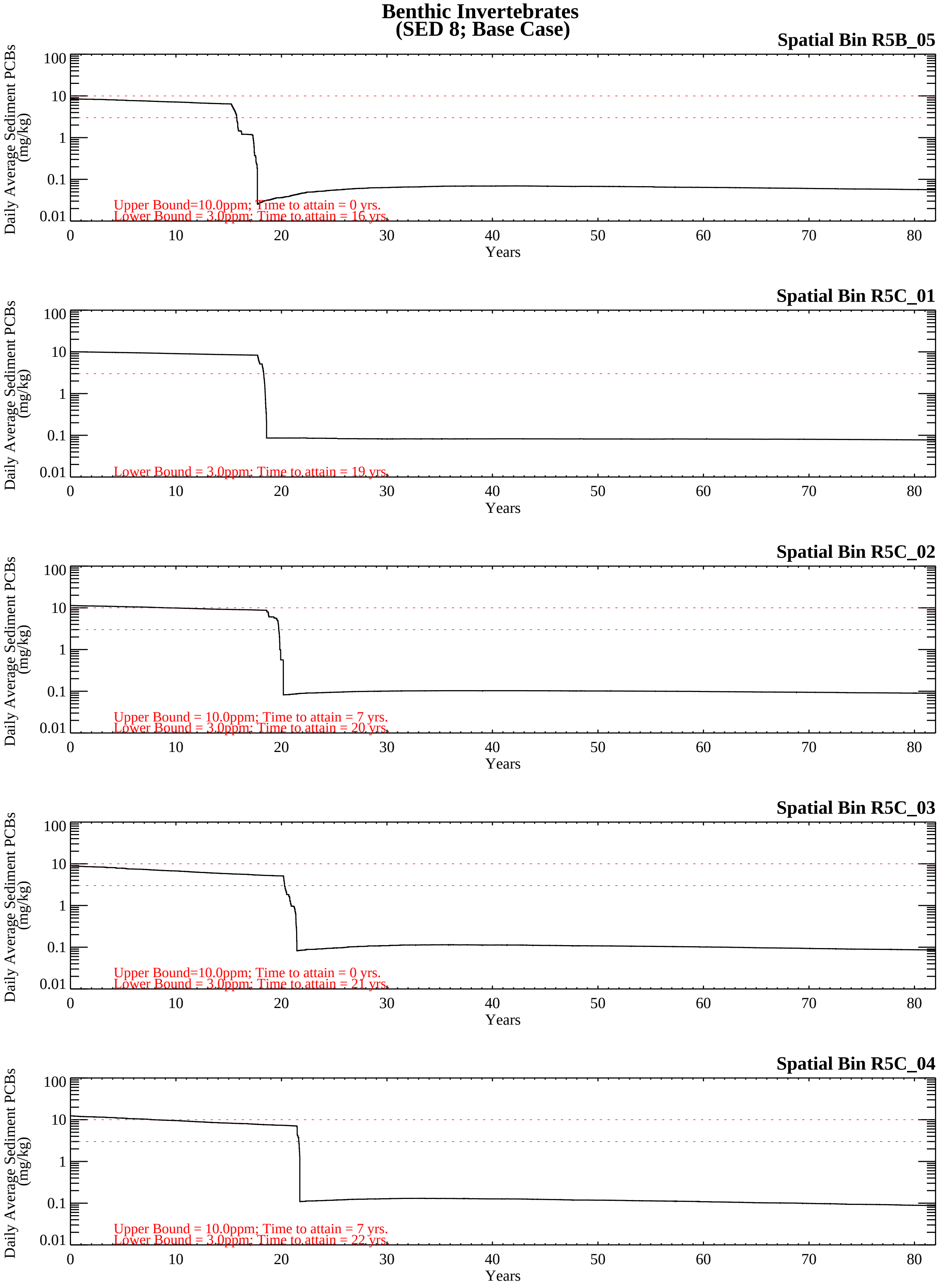

Figure G-4.2-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 8; Reach 5/6; Base Case).

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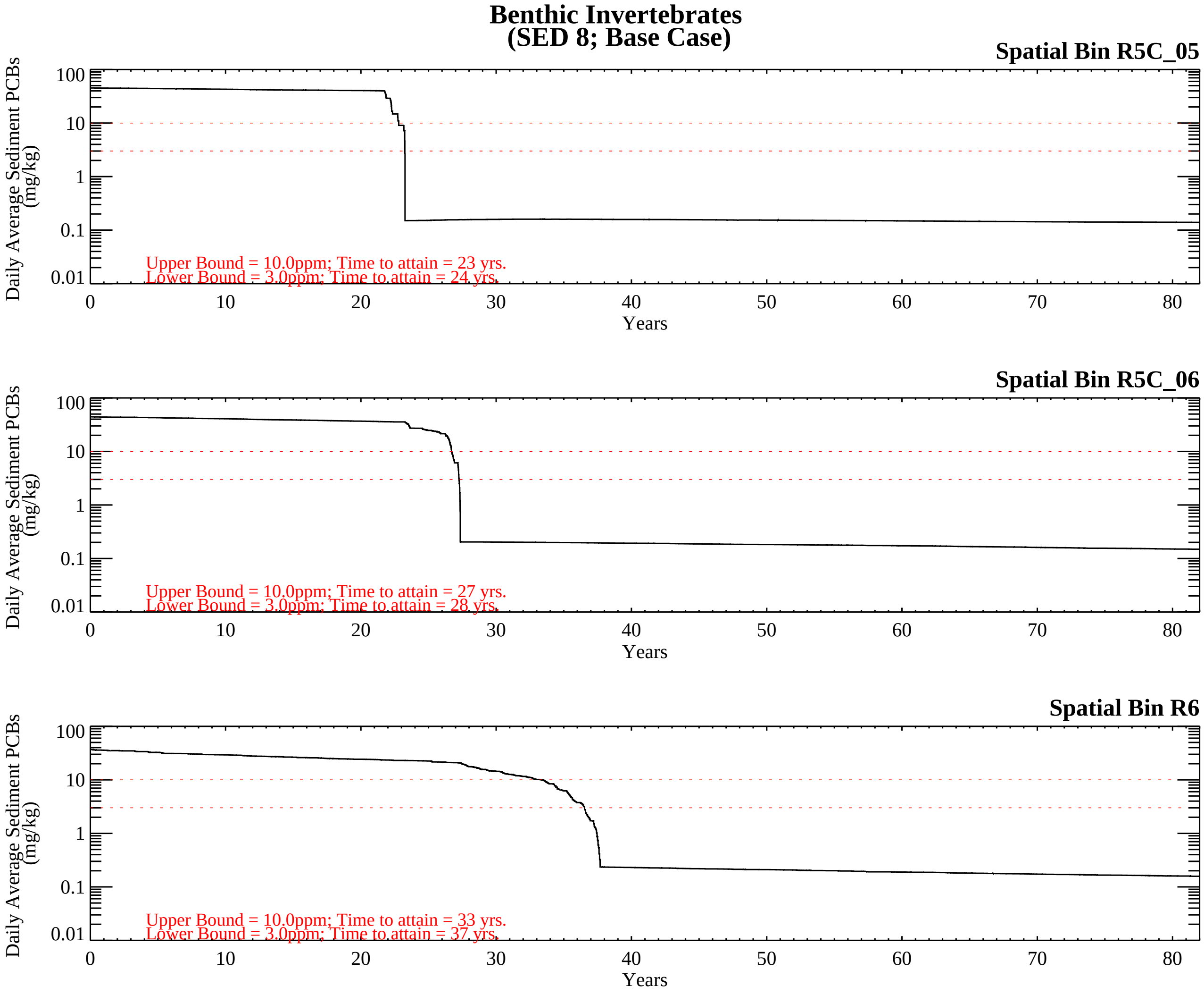

Figure G-4.2-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 8; Reach 5/6; Base Case).

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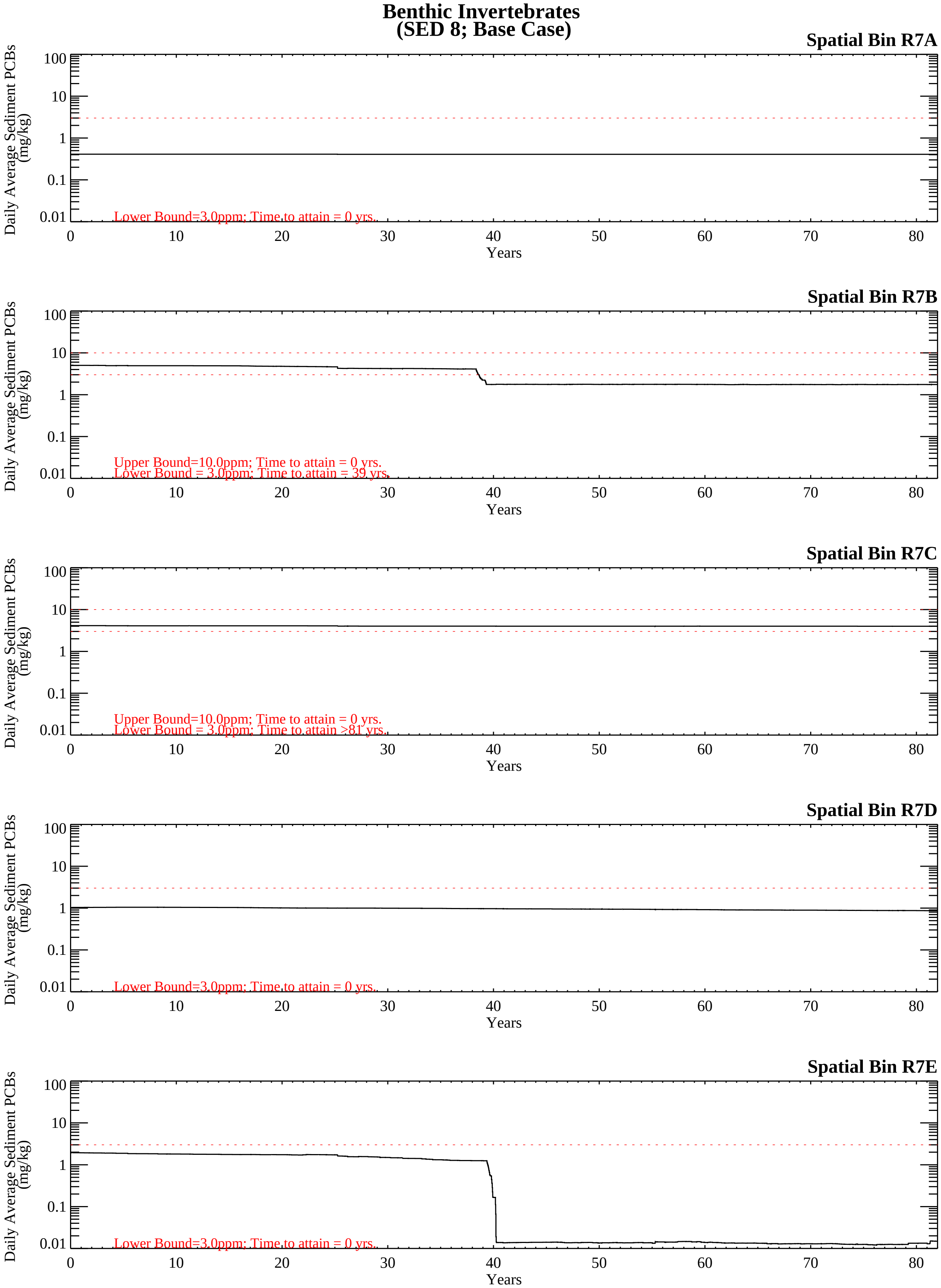

Figure G-4.2-7b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 8; Reach 7/8; Base Case).

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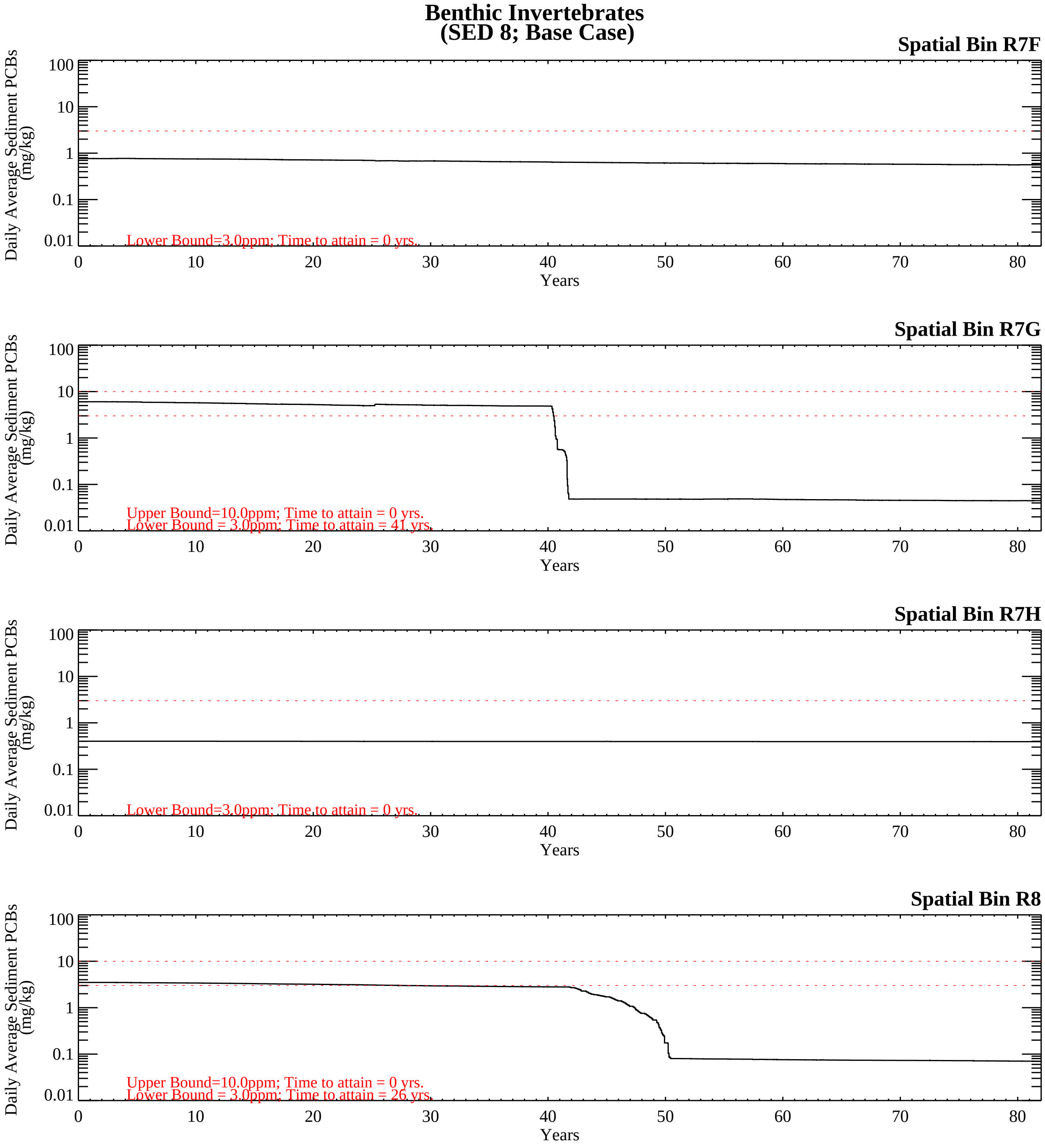

Figure G-4.2-7b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 8; Reach 7/8; Base Case).

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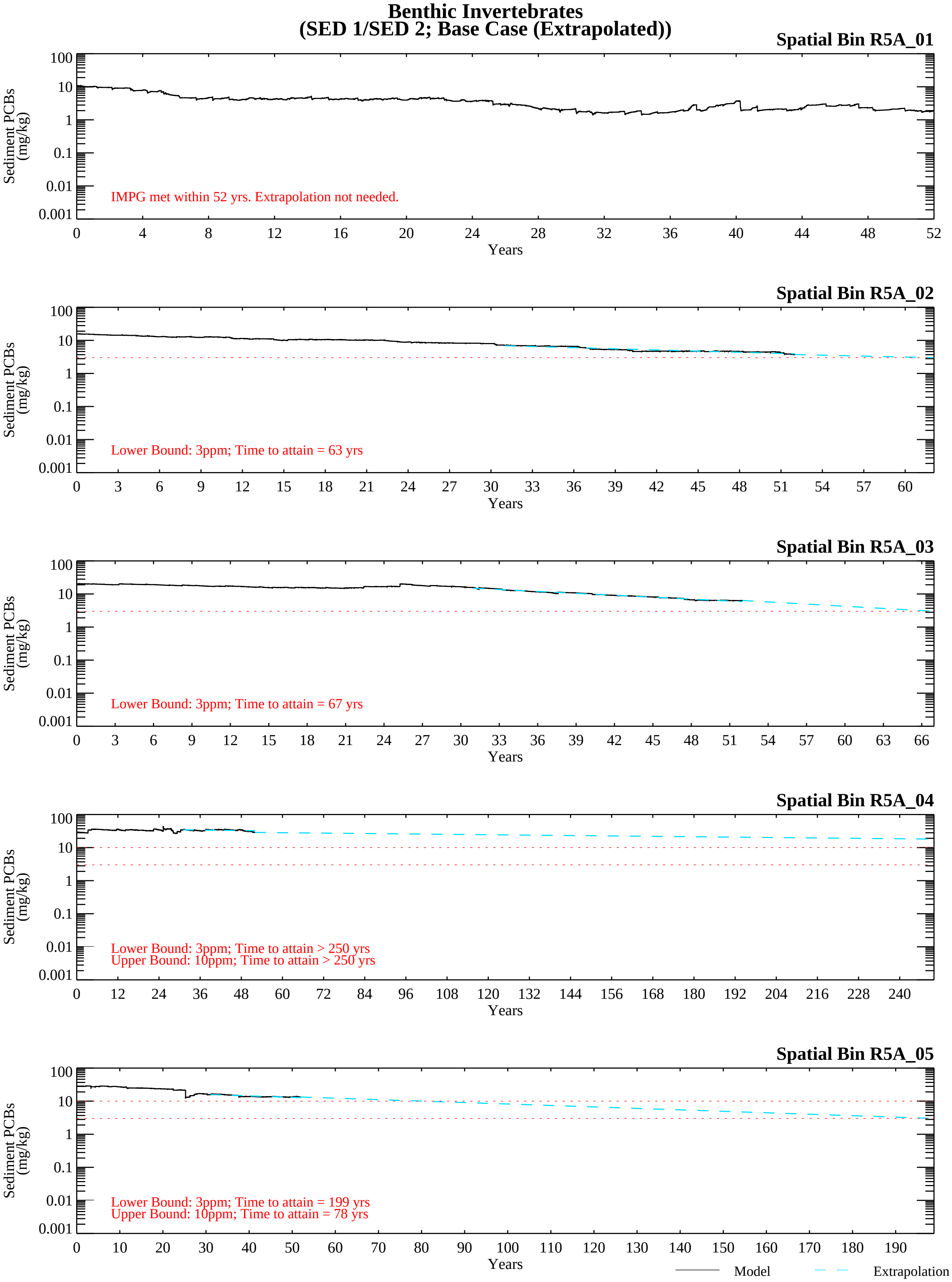

Figure G-4.3-1a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 1/SED 2; Reach 5/6; Base Case).

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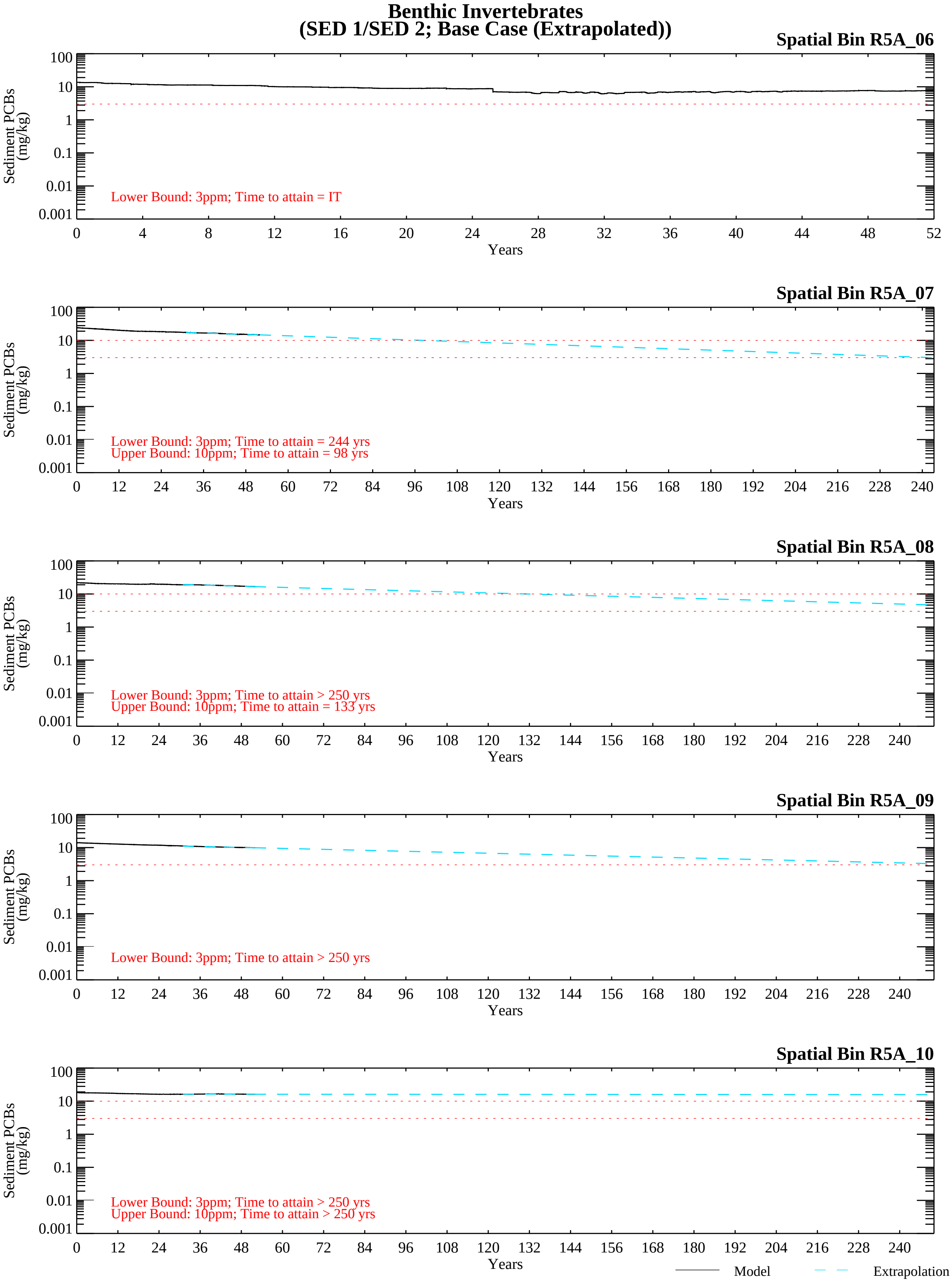

Figure G-4.3-1a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 1/SED 2; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED1CMSBS_0712-01\bins
Notes: IT = No extrapolation performed due to an increasing trend.

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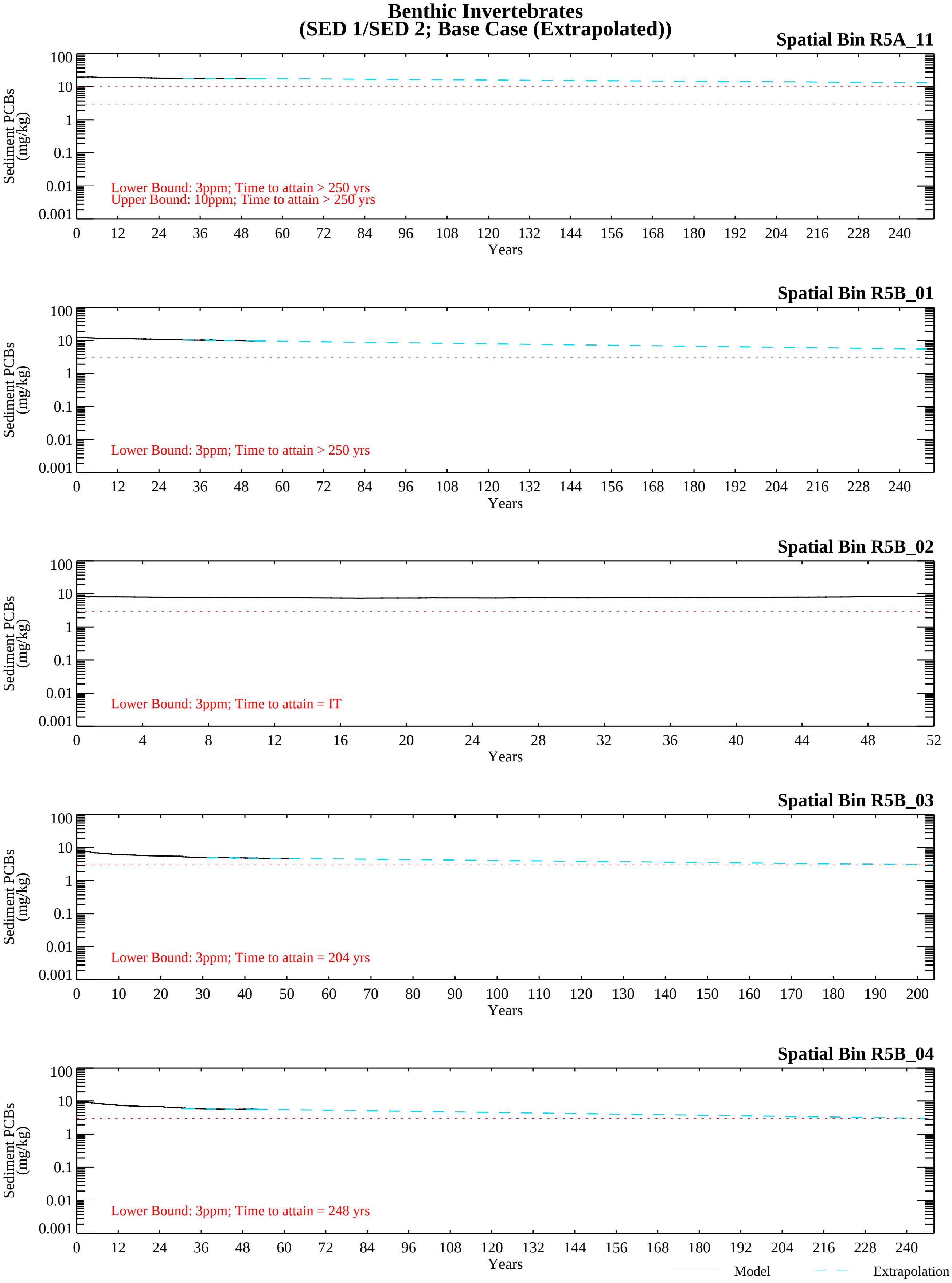

Benthic Invertebrates
(SED 1/SED 2; Base Case (Extrapolated))

Spatial Bin R5A_11

Spatial Bin R5B_01

Spatial Bin R5B_02

Spatial Bin R5B_03

Spatial Bin R5B_04

Figure G-4.3-1a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 1/SED 2; Reach 5/6; Base Case).

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Notes: IT = No extrapolation performed due to an increasing trend.

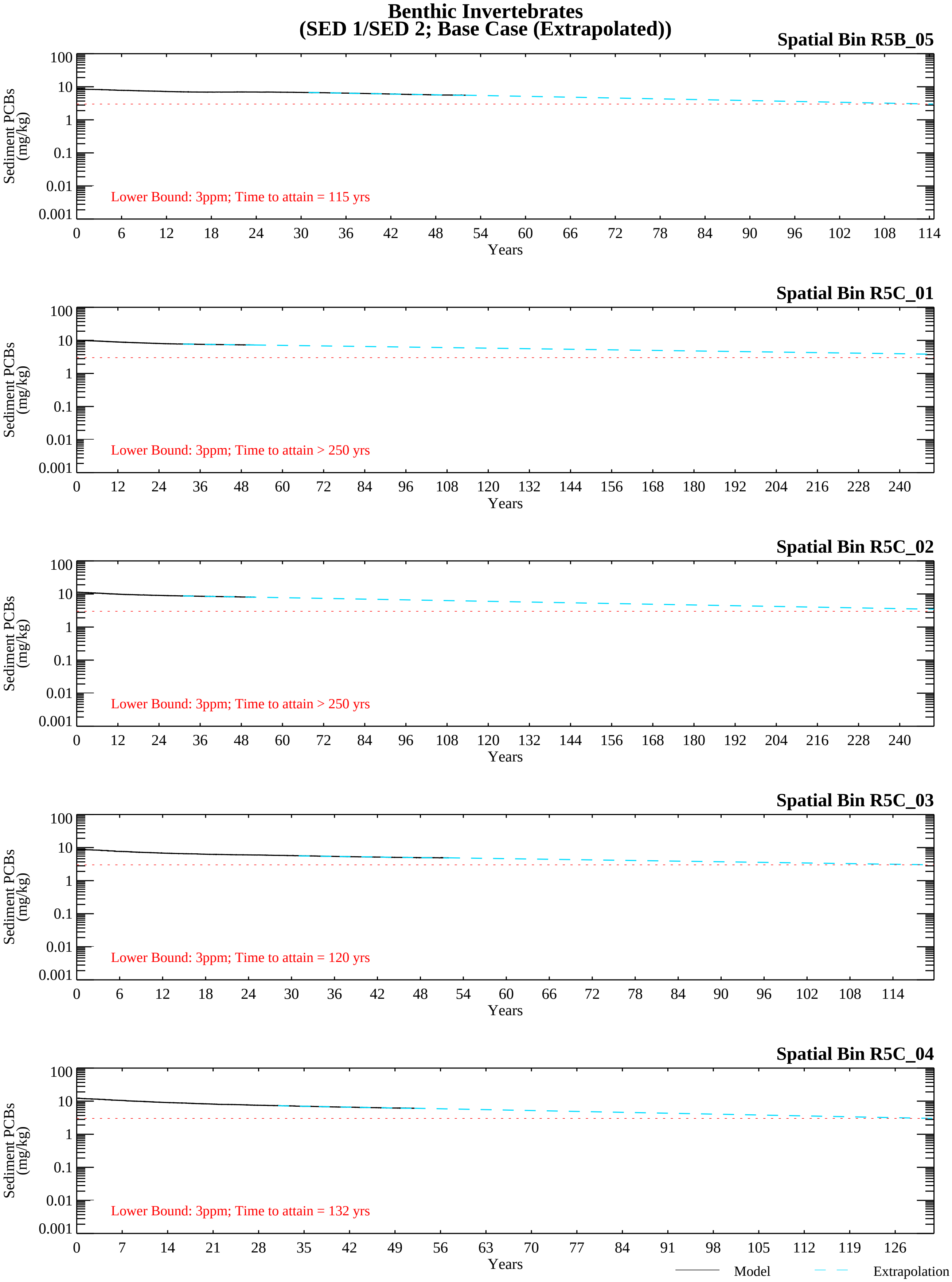

Figure G-4.3-1a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 1/SED 2; Reach 5/6; Base Case).

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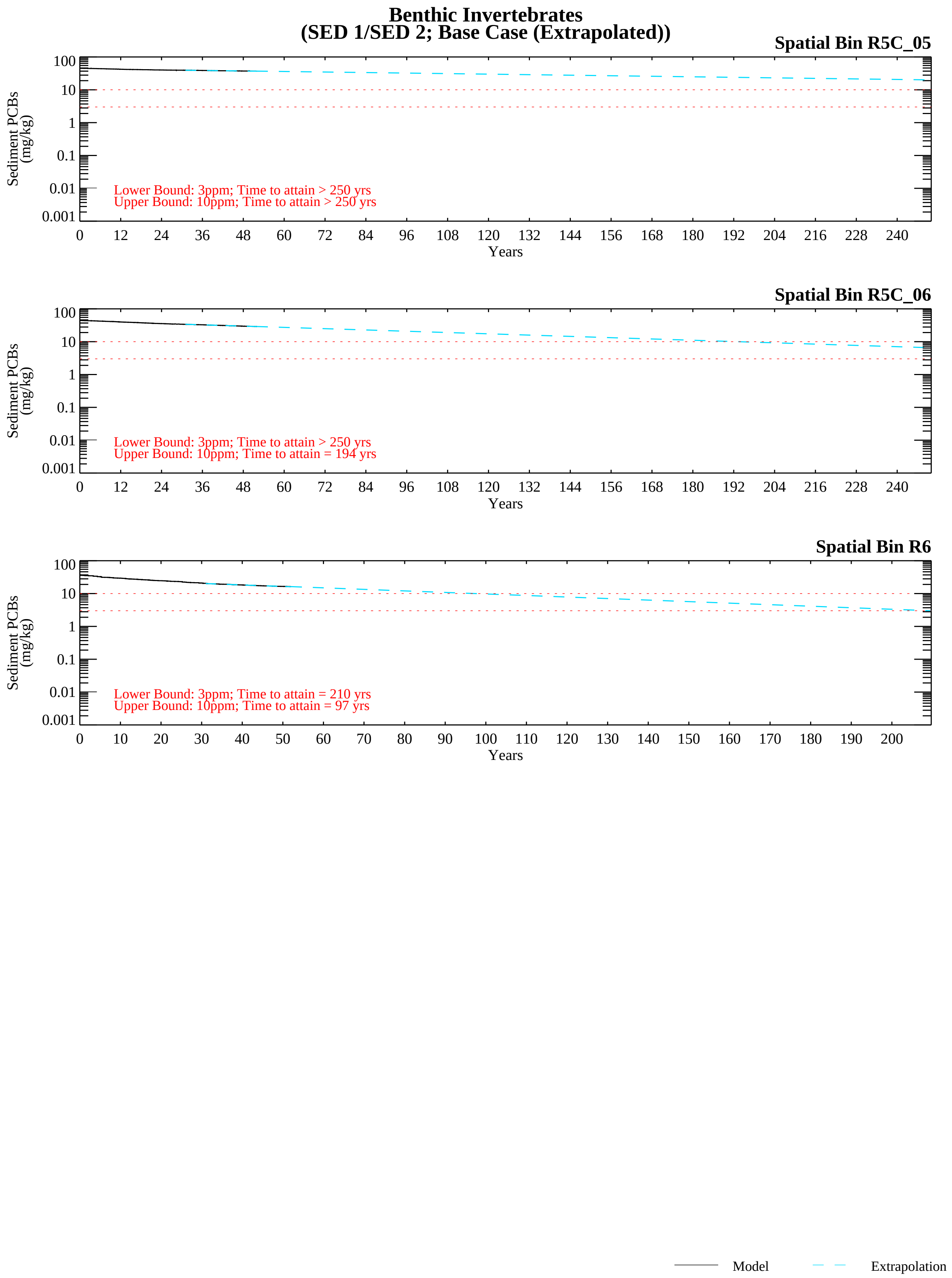

Figure G-4.3-1a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 1/SED 2; Reach 5/6; Base Case).

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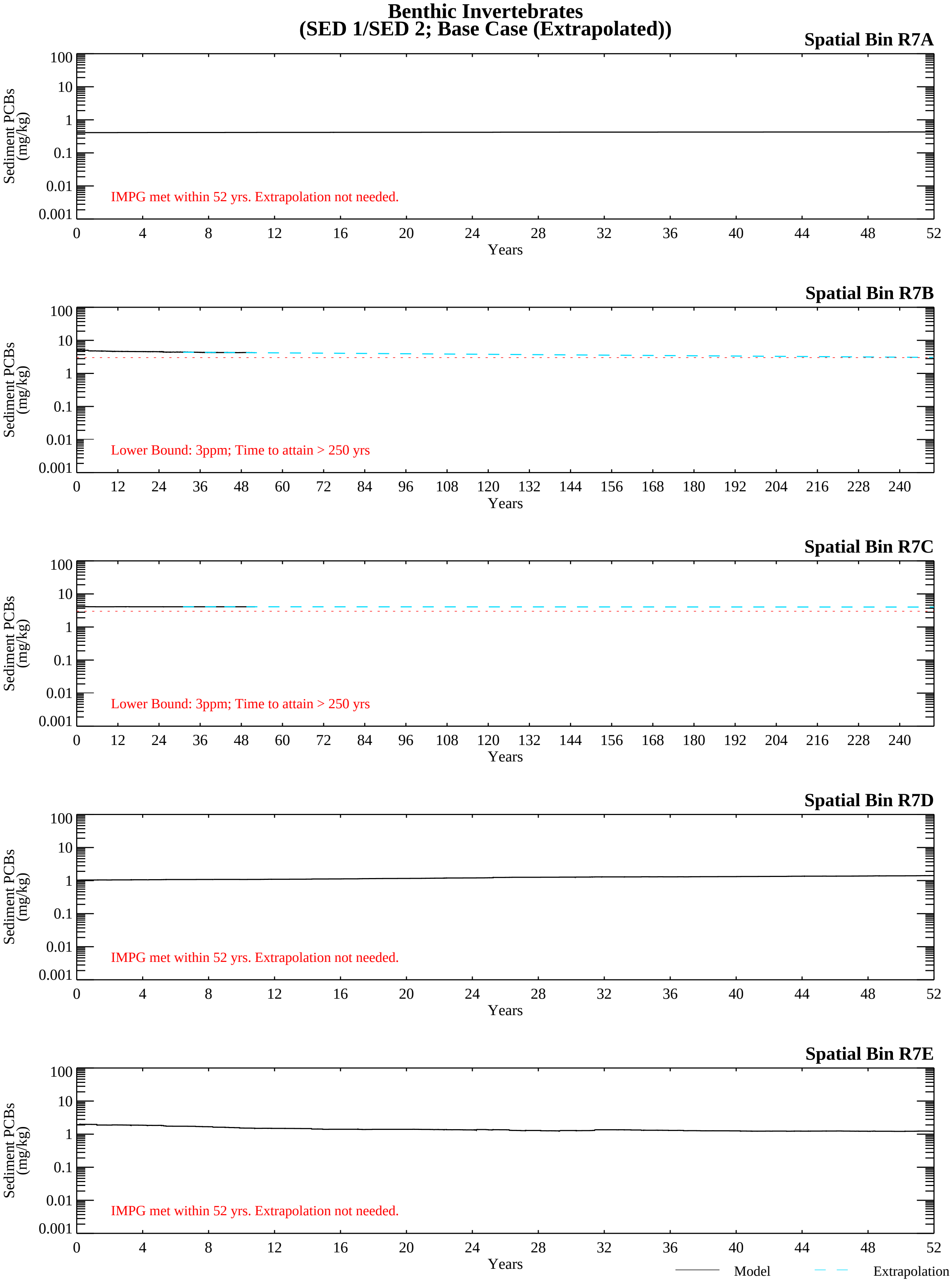

Figure G-4.3-1b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 1/SED 2; Reach 7/8; Base Case).

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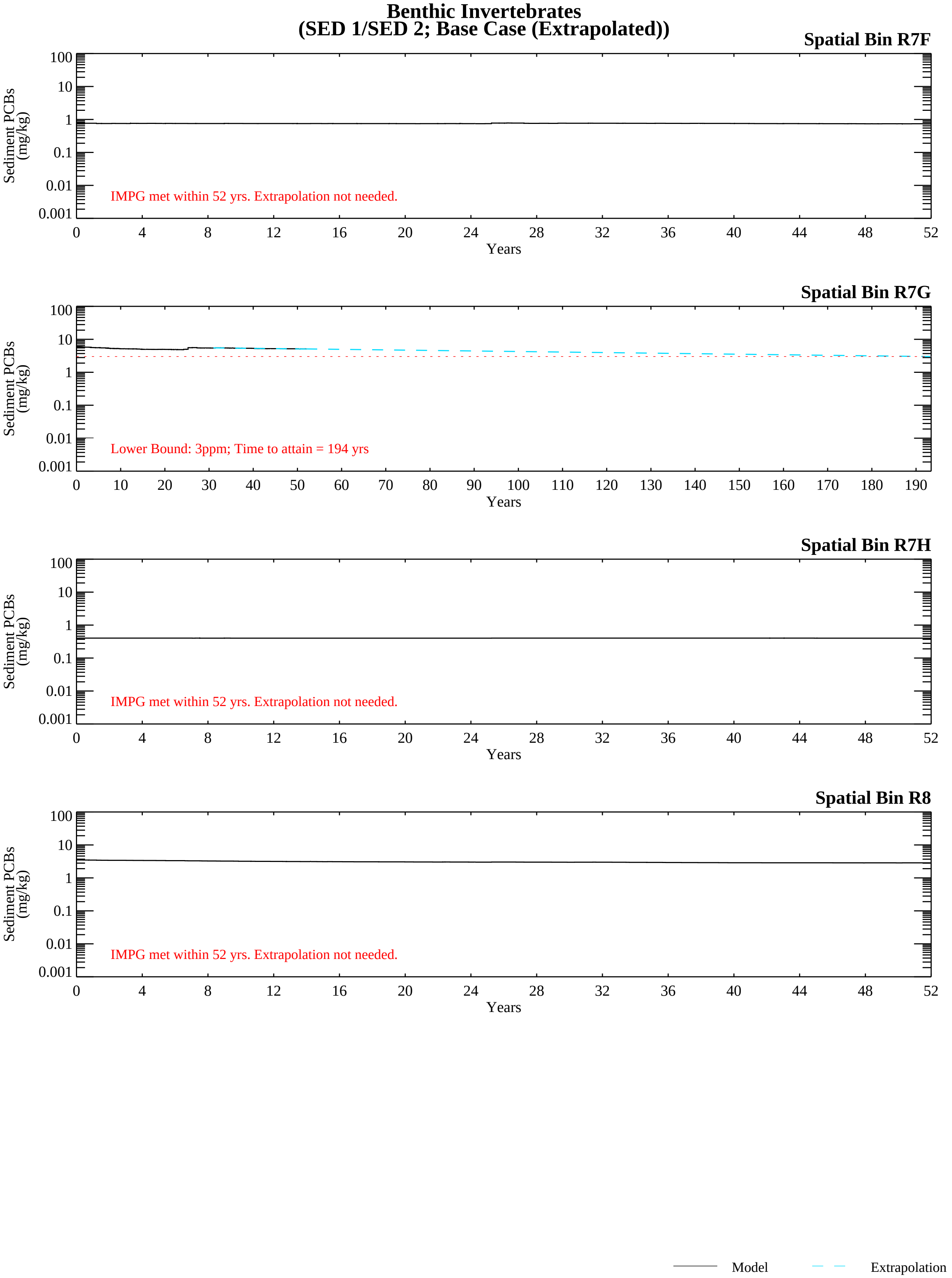

Figure G-4.3-1b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 1/SED 2; Reach 7/8; Base Case).

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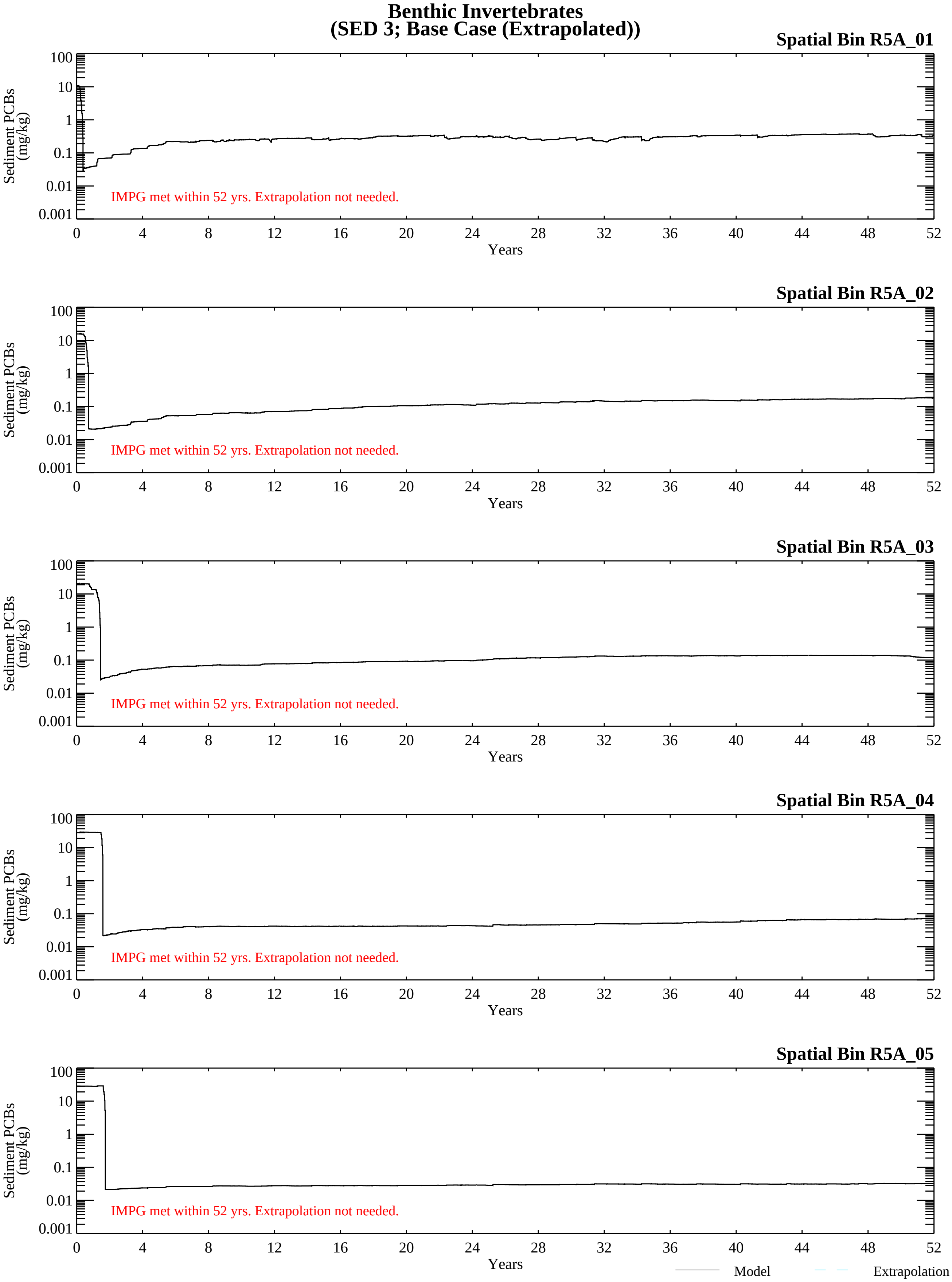

Figure G-4.3-2a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 3; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED3CMSBS_0712-13\bins

NDK - Z:\GENcms\MODEL\EPA_EFDC\Post_Processors\IMPG_attain\plot_temp_toppcb_071012_impgatt_fff.pro
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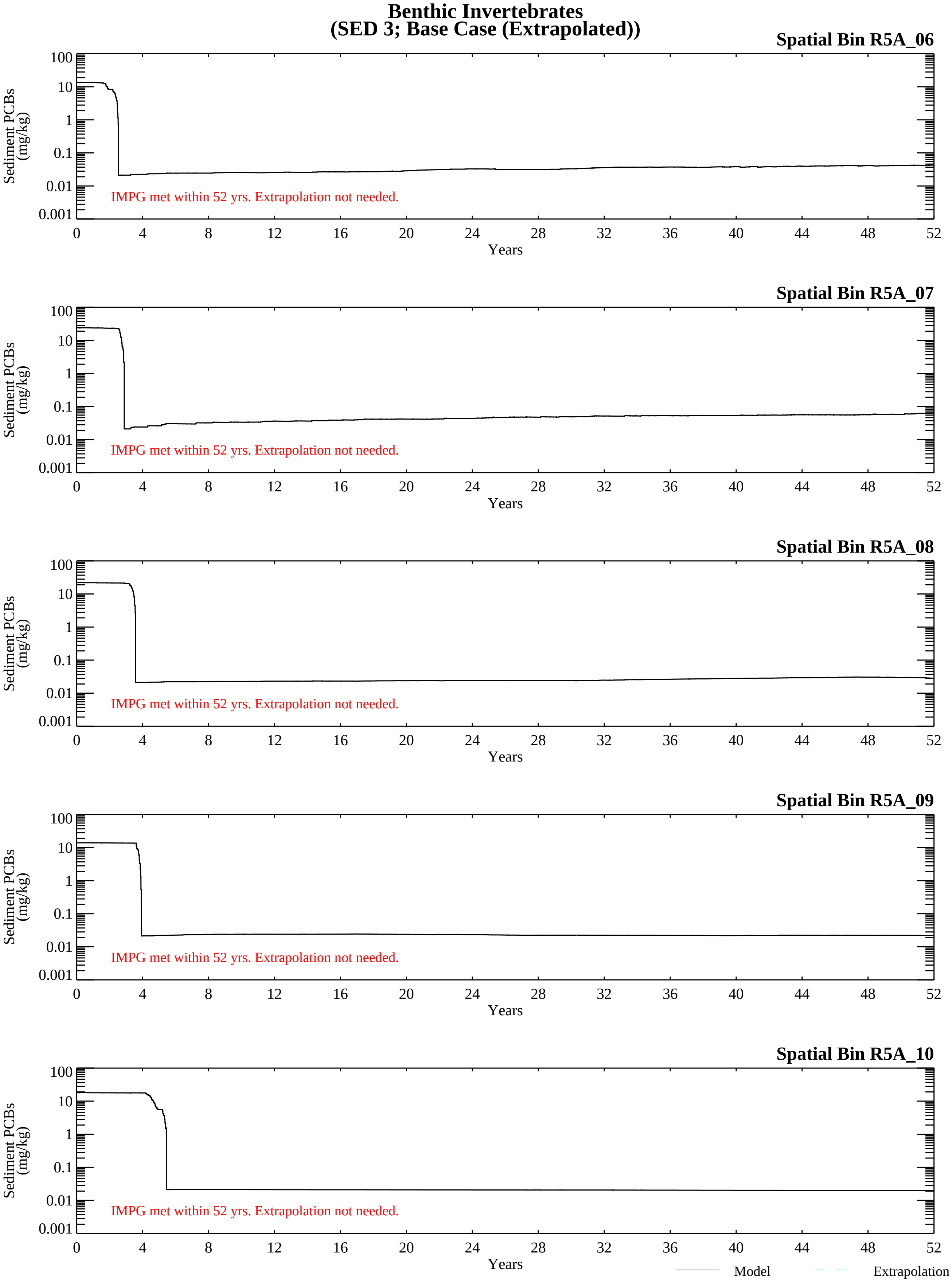

Figure G-4.3-2a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 3; Reach 5/6; Base Case).

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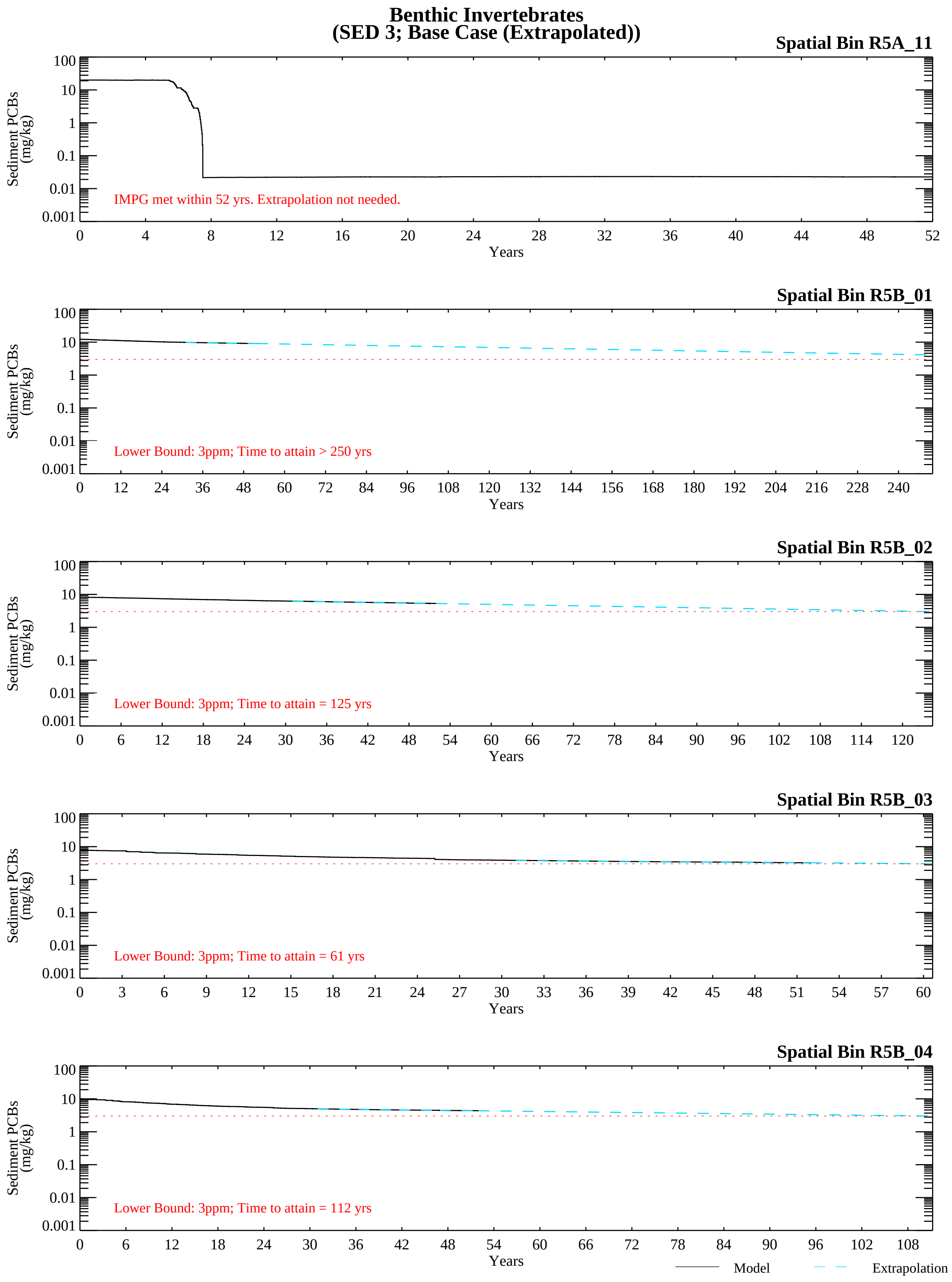

Figure G-4.3-2a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 3; Reach 5/6; Base Case).

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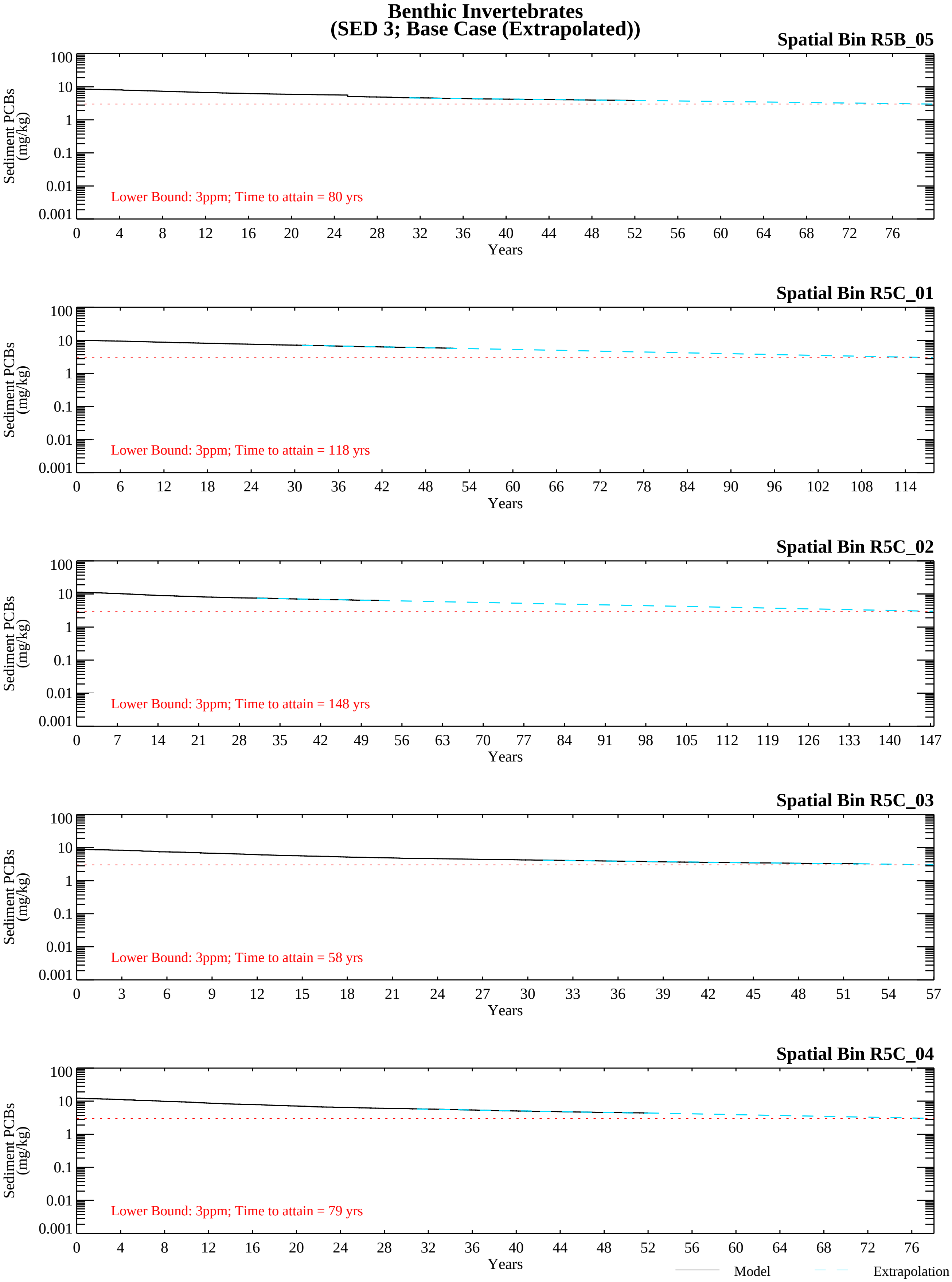

Figure G-4.3-2a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 3; Reach 5/6; Base Case).

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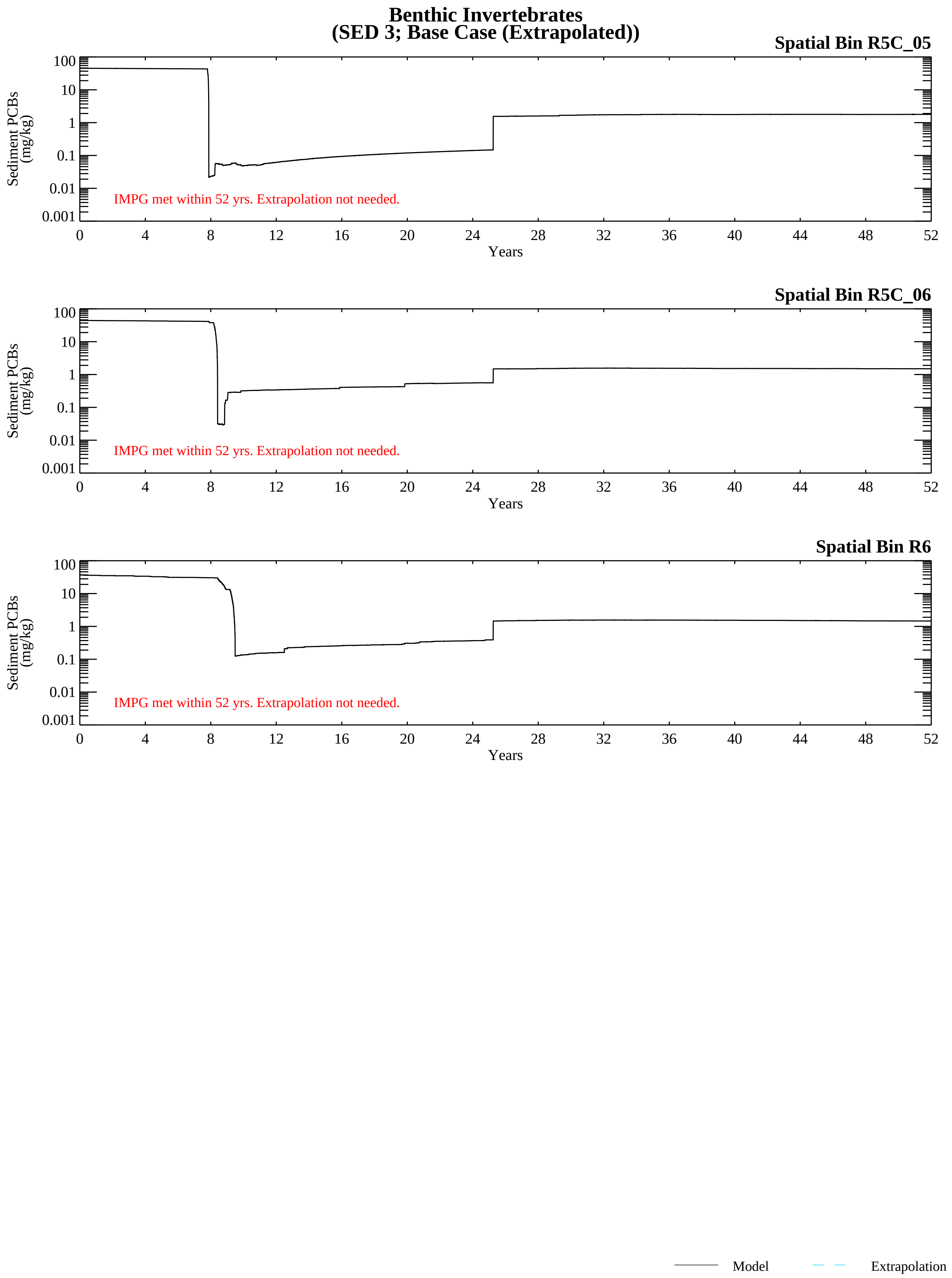

Figure G-4.3-2a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 3; Reach 5/6; Base Case).

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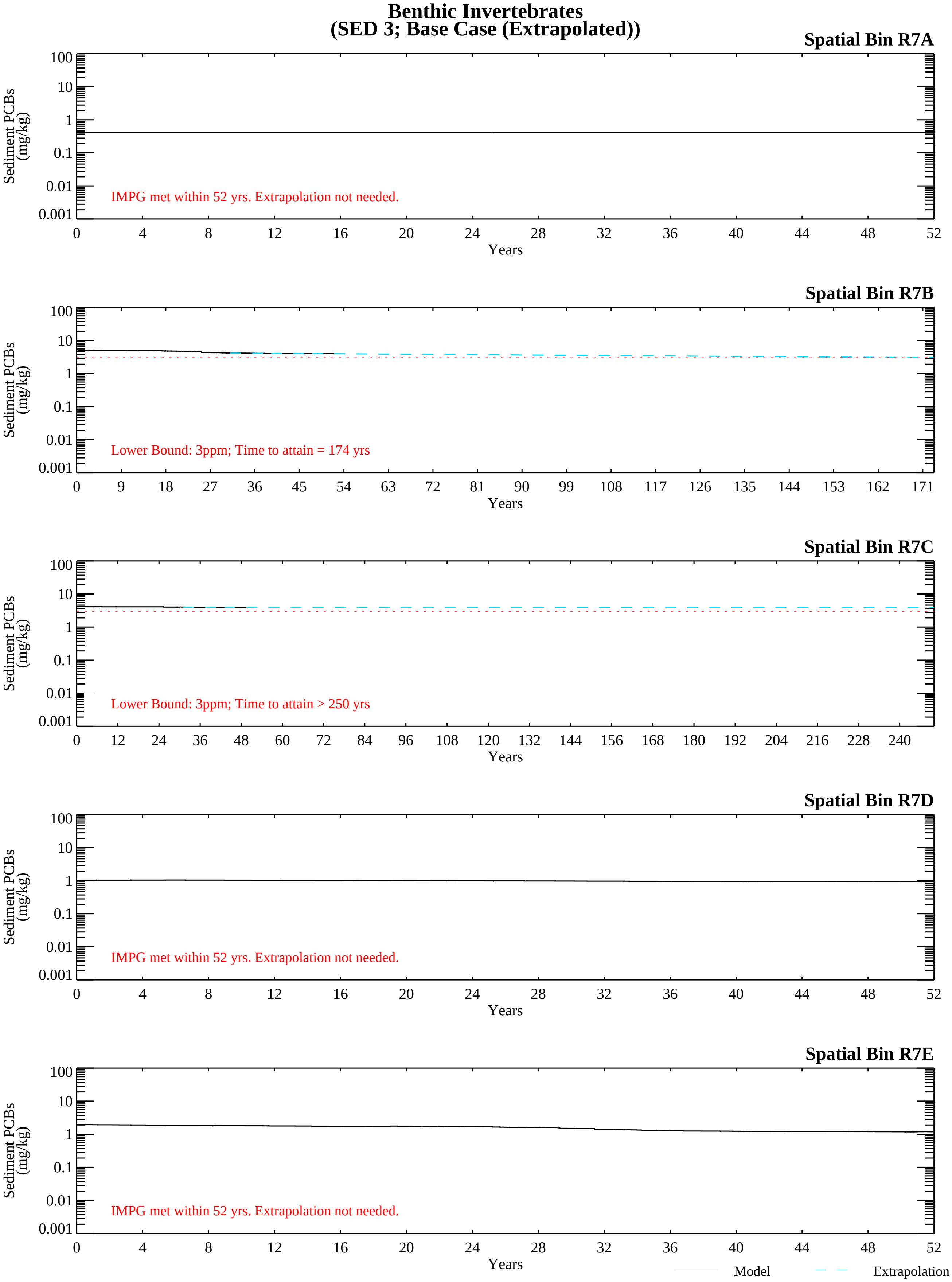

Figure G-4.3-2b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 3; Reach 7/8; Base Case).

Run path:\\Tenmile\EFDC_Output\R78\CMS\Proj_R78_SED3CMSBS_0712-29\bins

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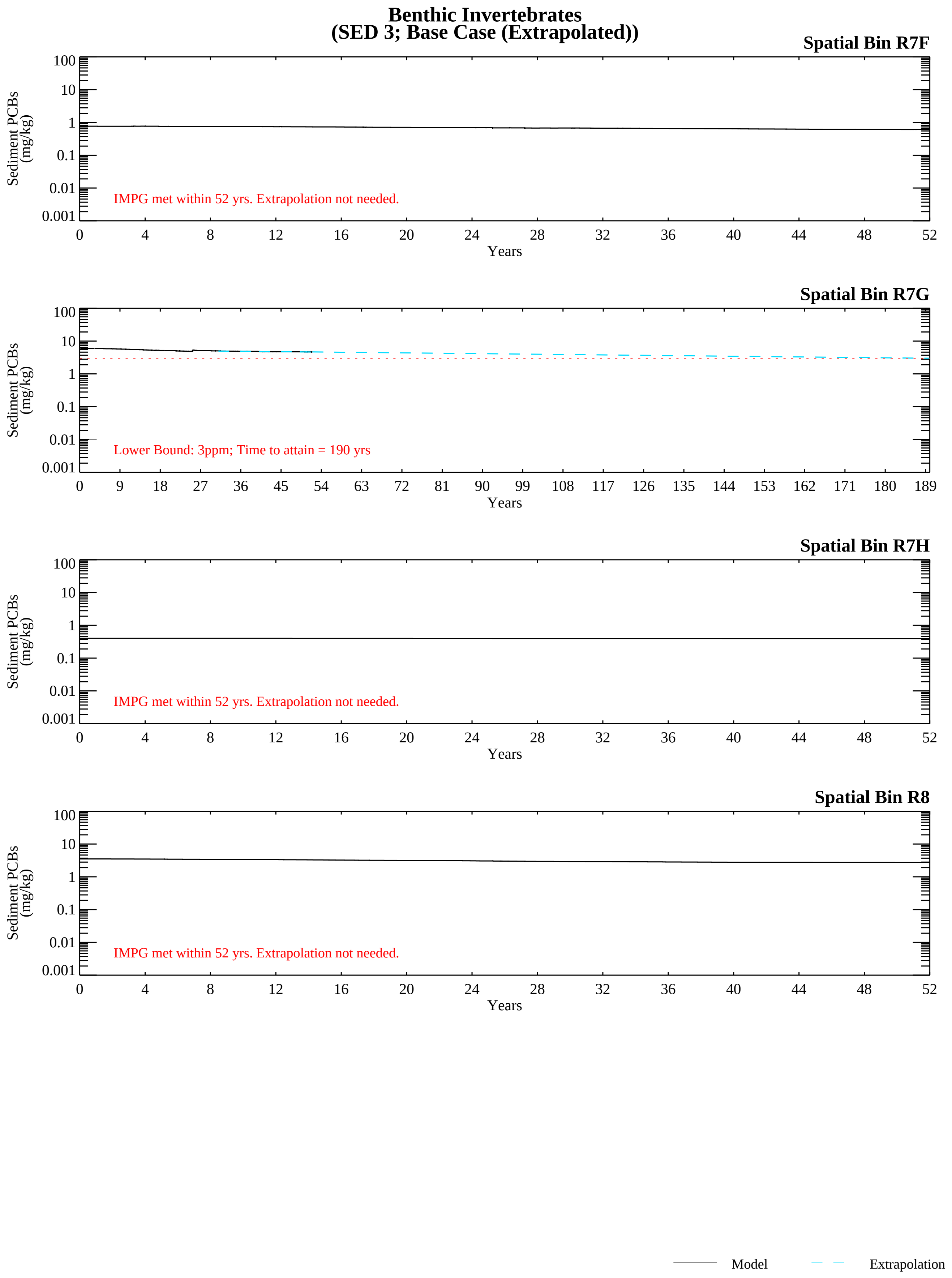

Figure G-4.3-2b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 3; Reach 7/8; Base Case).

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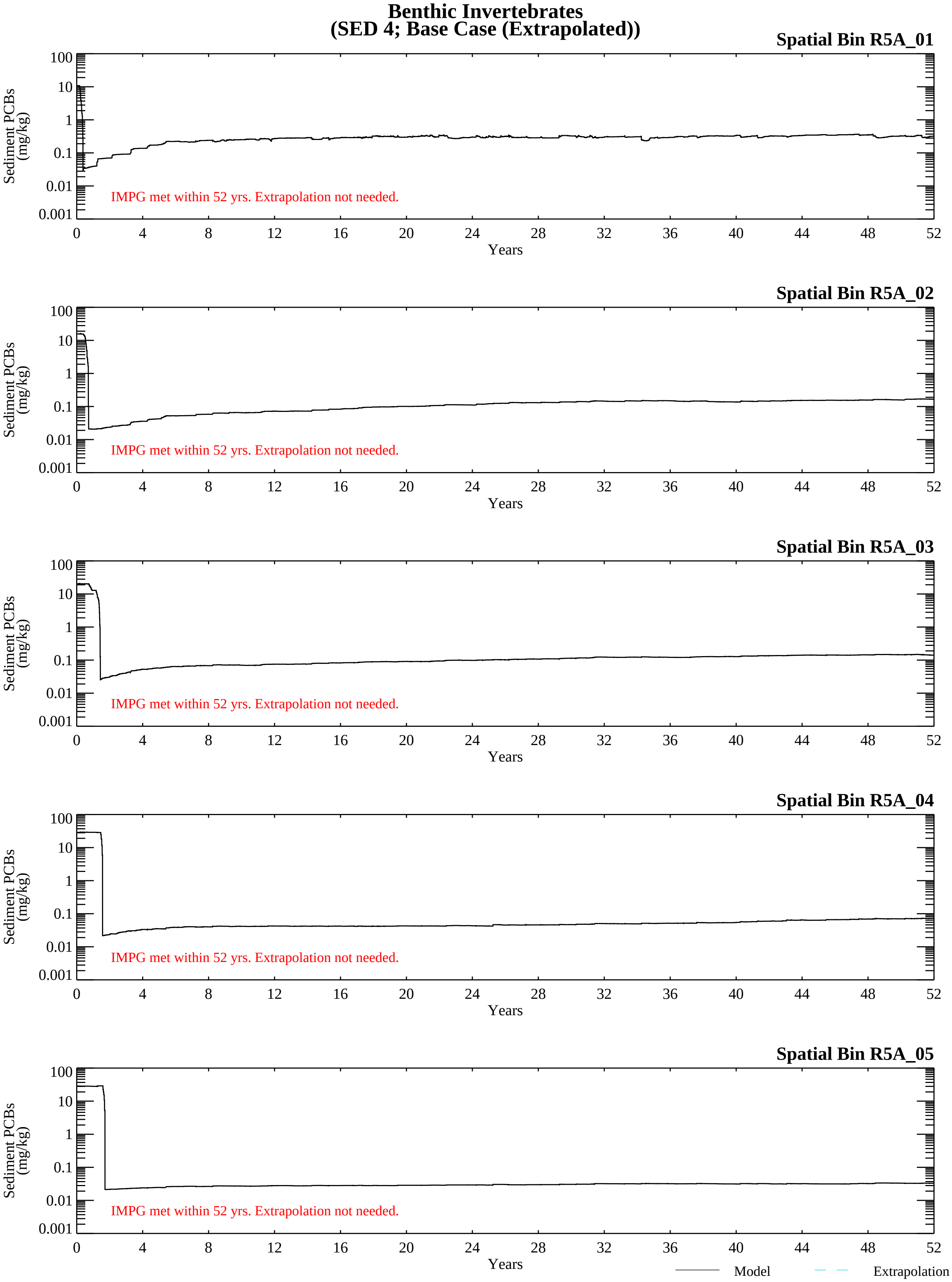

Figure G-4.3-3a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 4; Reach 5/6; Base Case).

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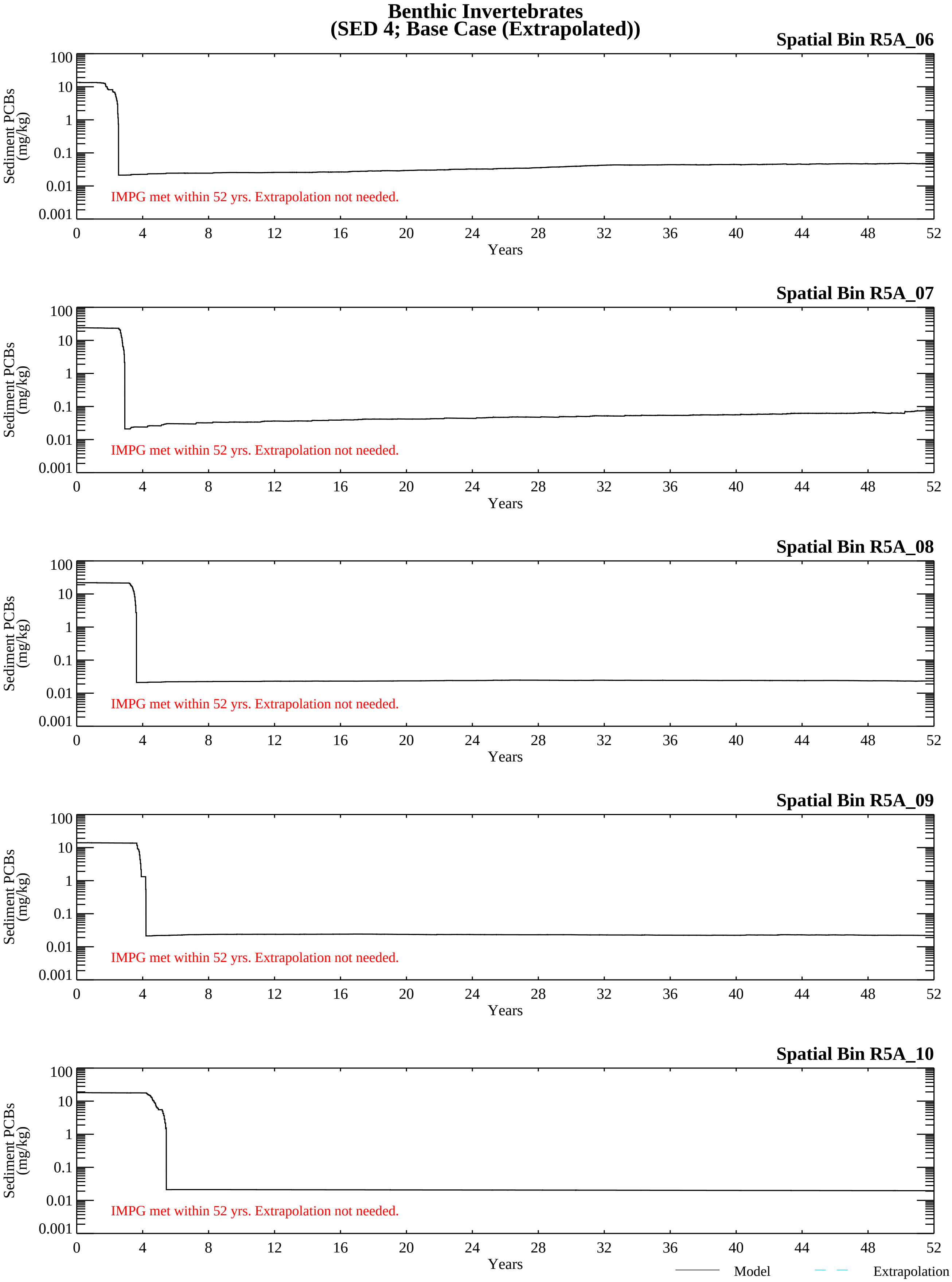

Figure G-4.3-3a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 4; Reach 5/6; Base Case).

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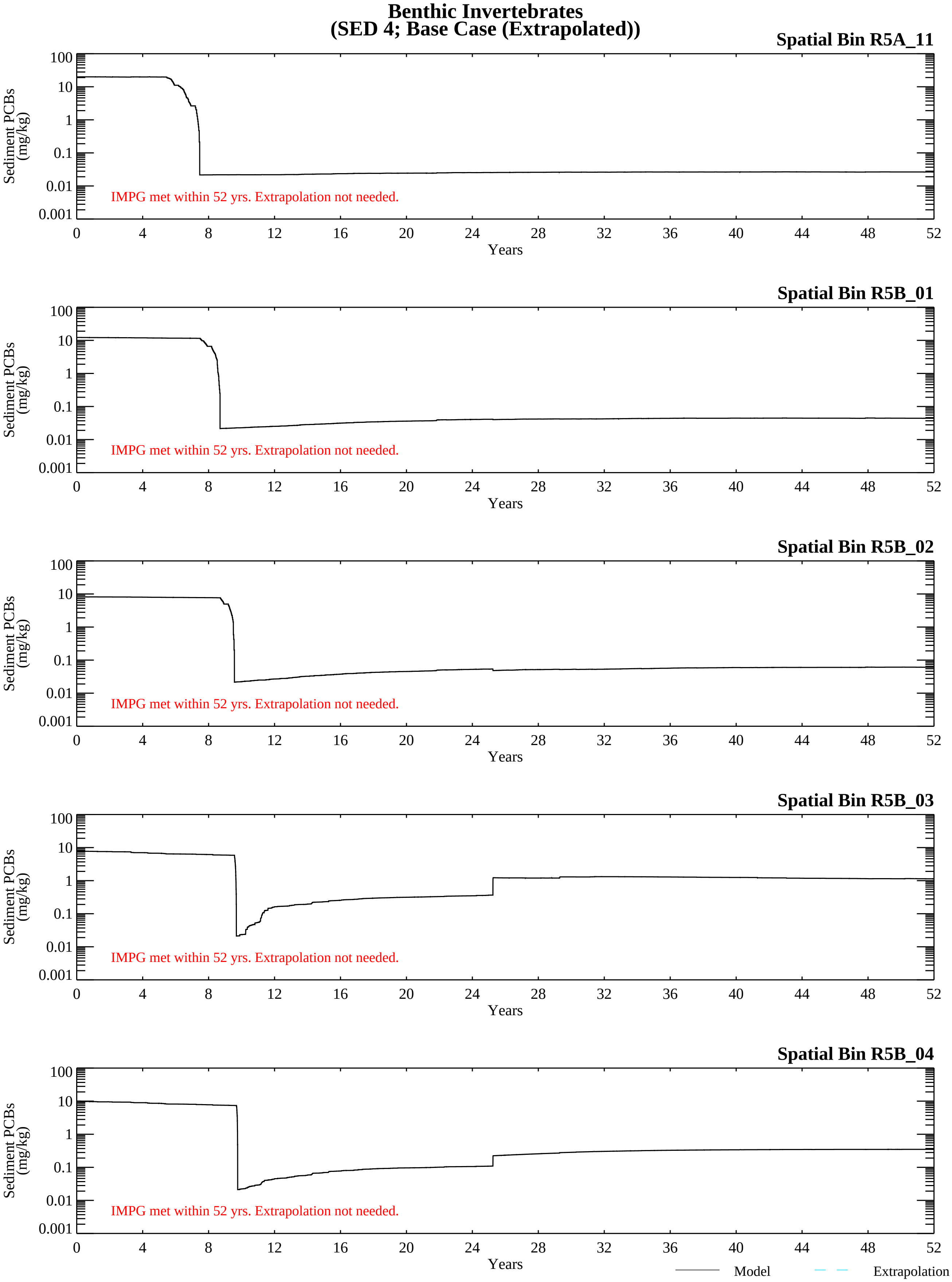

Figure G-4.3-3a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 4; Reach 5/6; Base Case).

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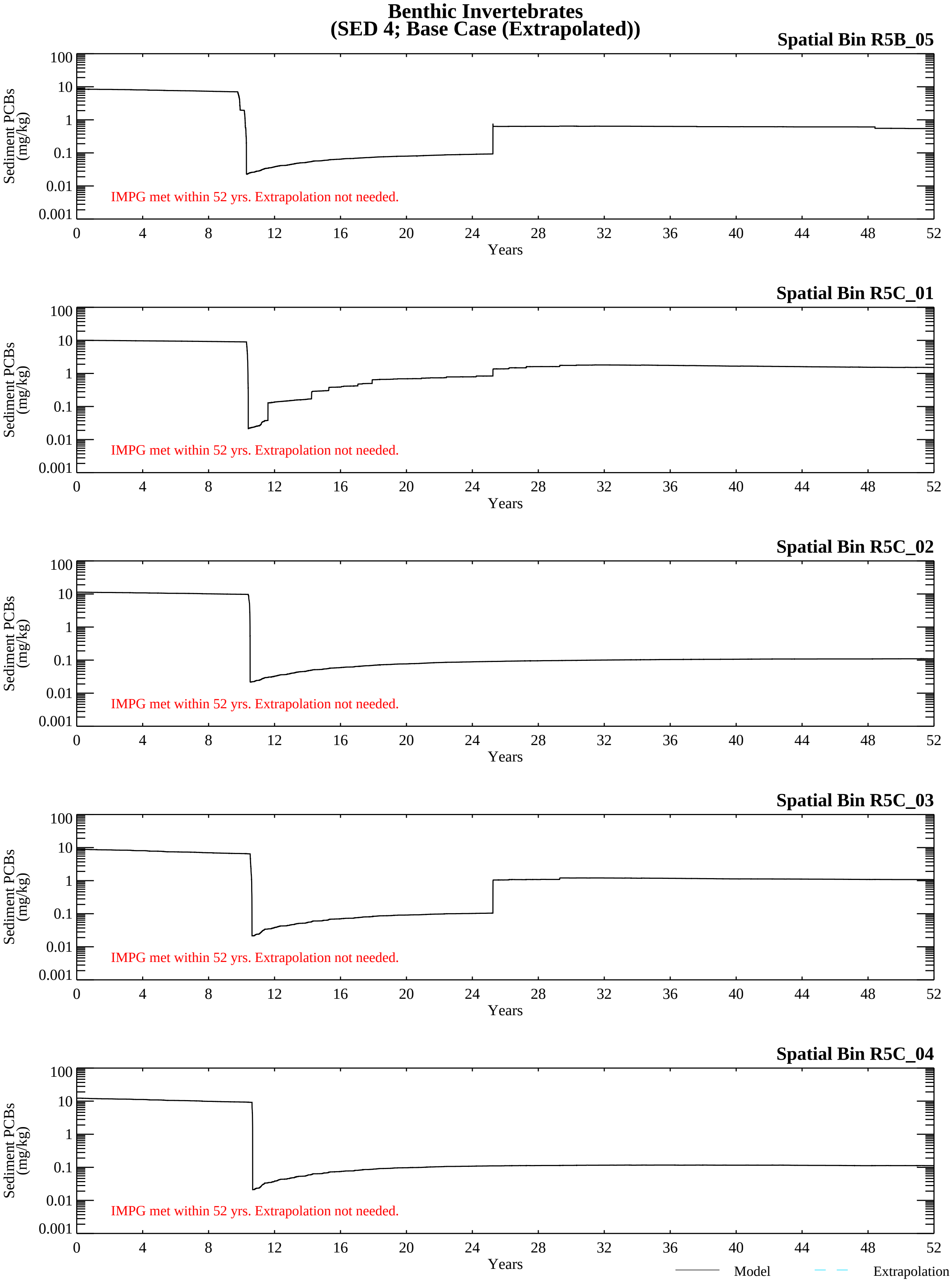

Figure G-4.3-3a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 4; Reach 5/6; Base Case).

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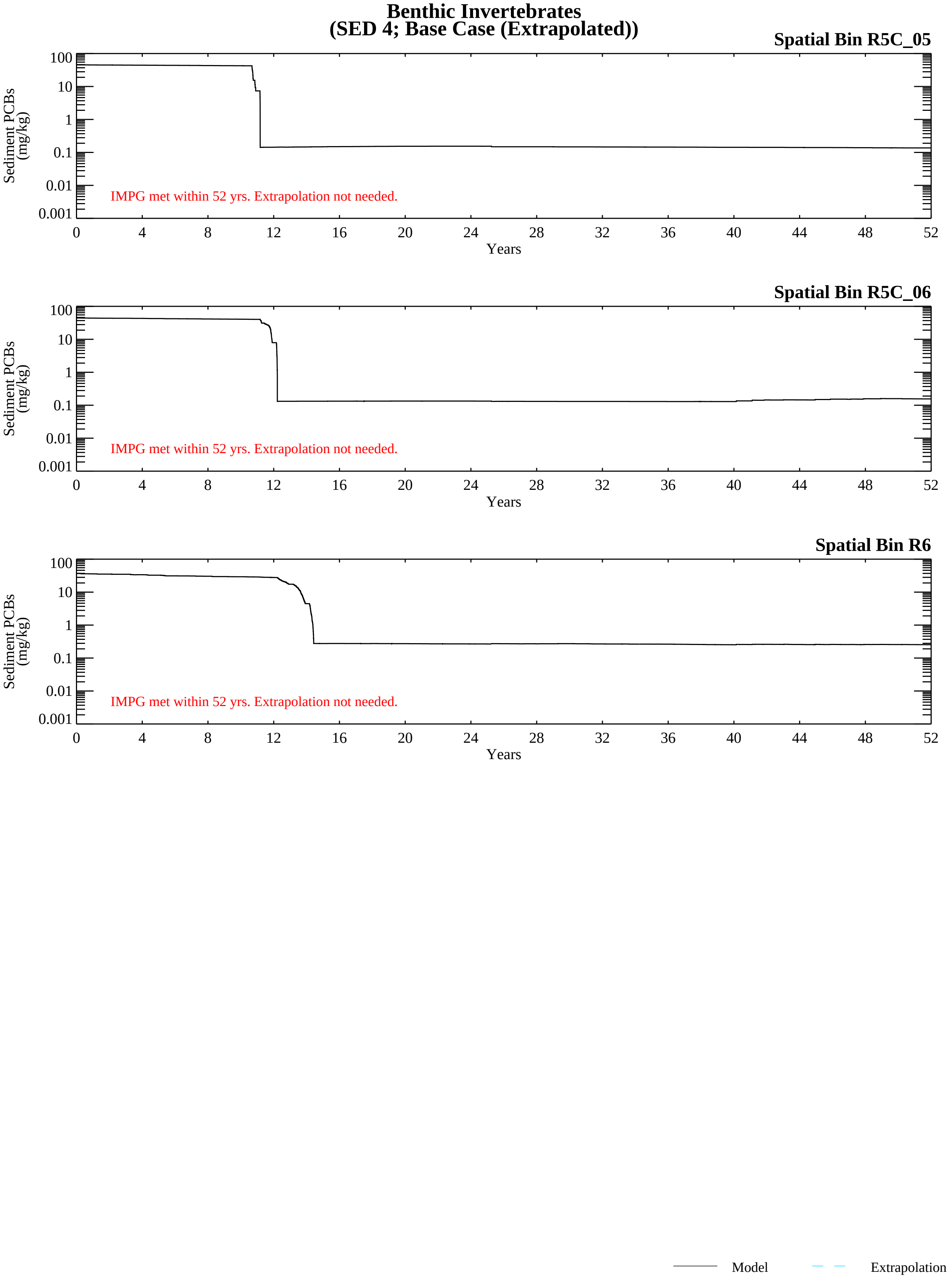

Figure G-4.3-3a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 4; Reach 5/6; Base Case).

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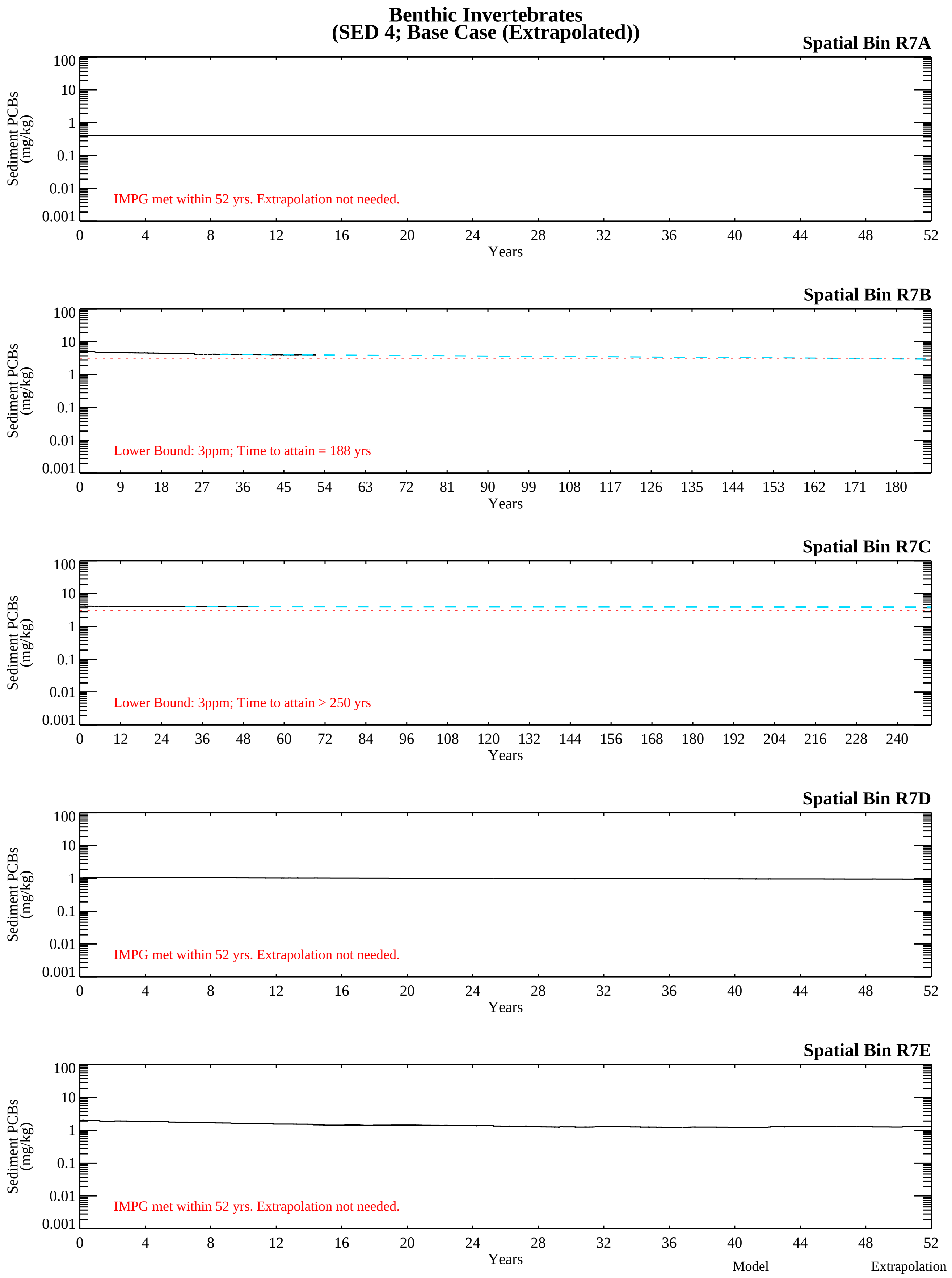

Figure G-4.3-3b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 4; Reach 7/8; Base Case).

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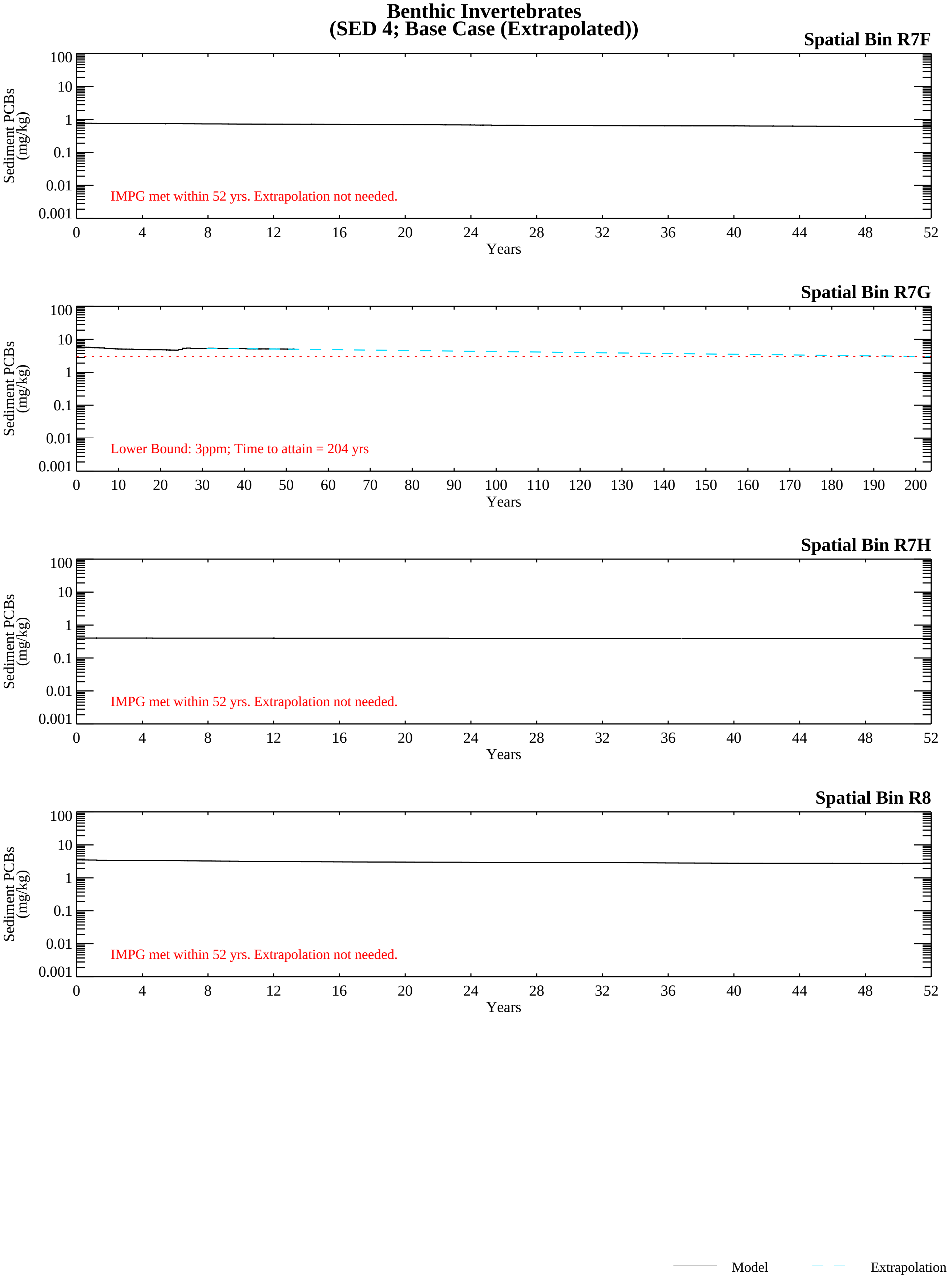
Benthic Invertebrates
(SED 4; Base Case (Extrapolated))

Spatial Bin R7F

IMPG met within 52 yrs. Extrapolation not needed.

Spatial Bin R7G

Lower Bound: 3ppm; Time to attain = 204 yrs

Spatial Bin R7H

IMPG met within 52 yrs. Extrapolation not needed.

Spatial Bin R8

IMPG met within 52 yrs. Extrapolation not needed.

Figure G-4.3-3b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 4; Reach 7/8; Base Case).

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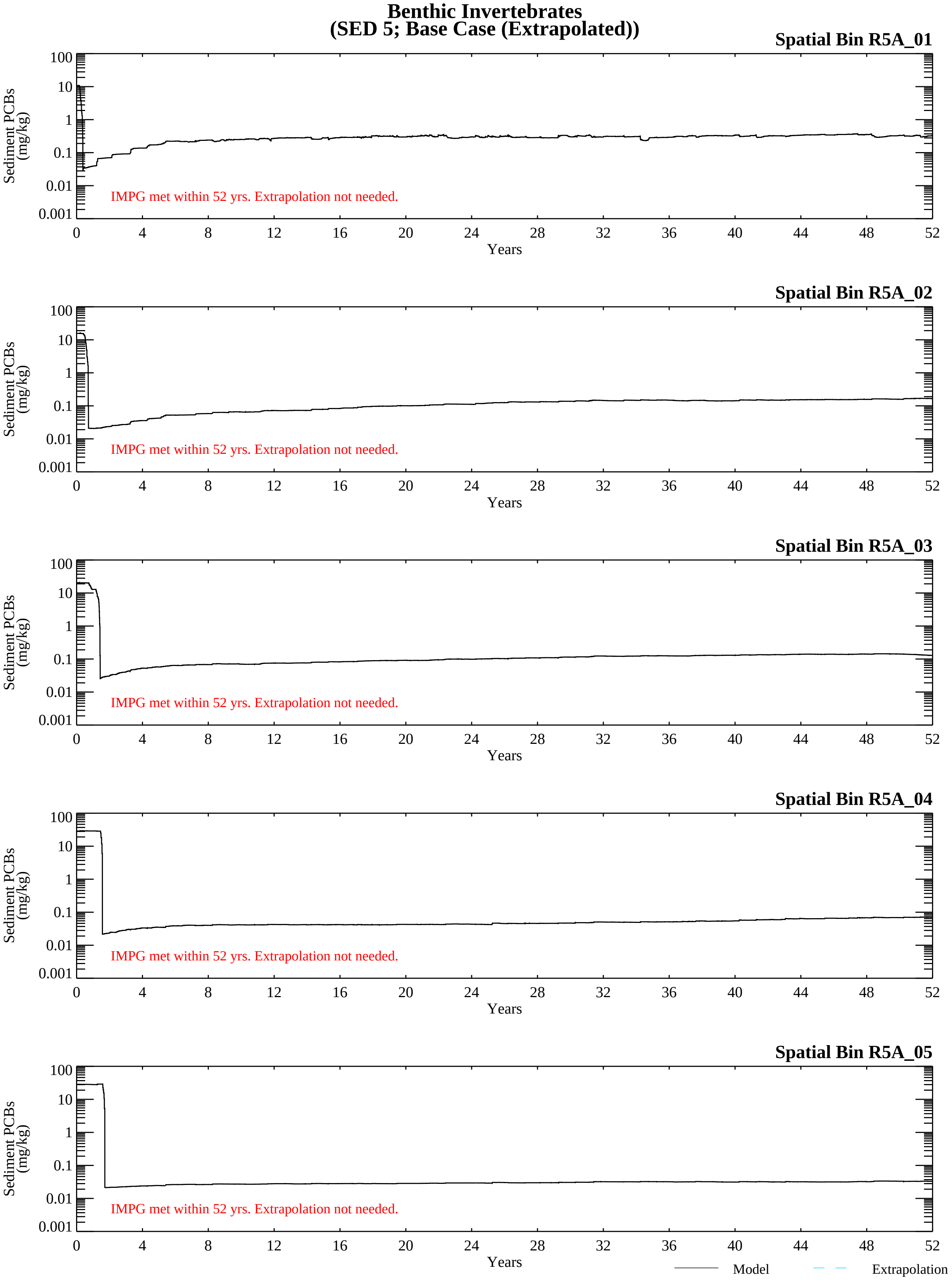

Figure G-4.3-4a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 5; Reach 5/6; Base Case).

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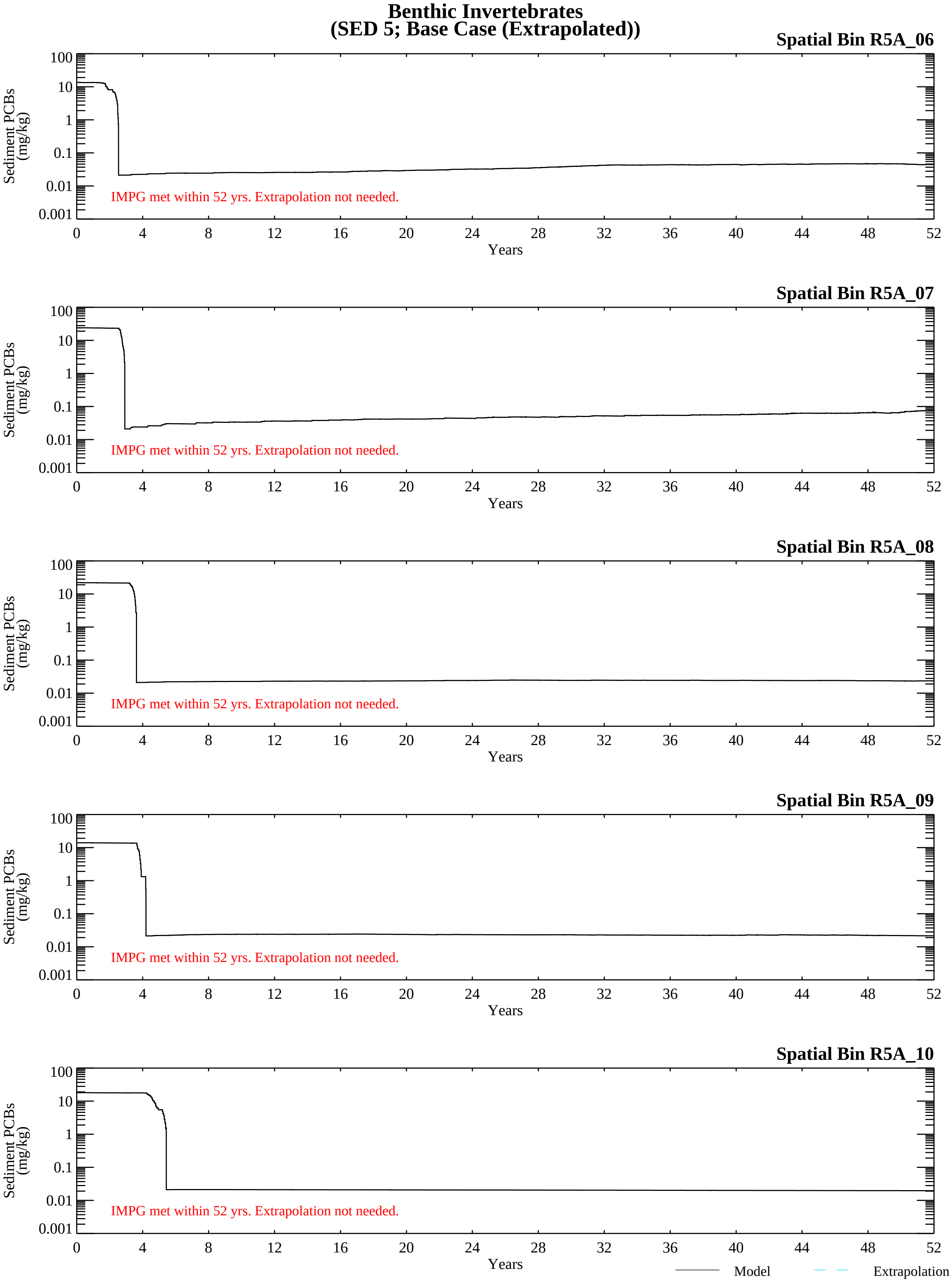

Figure G-4.3-4a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 5; Reach 5/6; Base Case).

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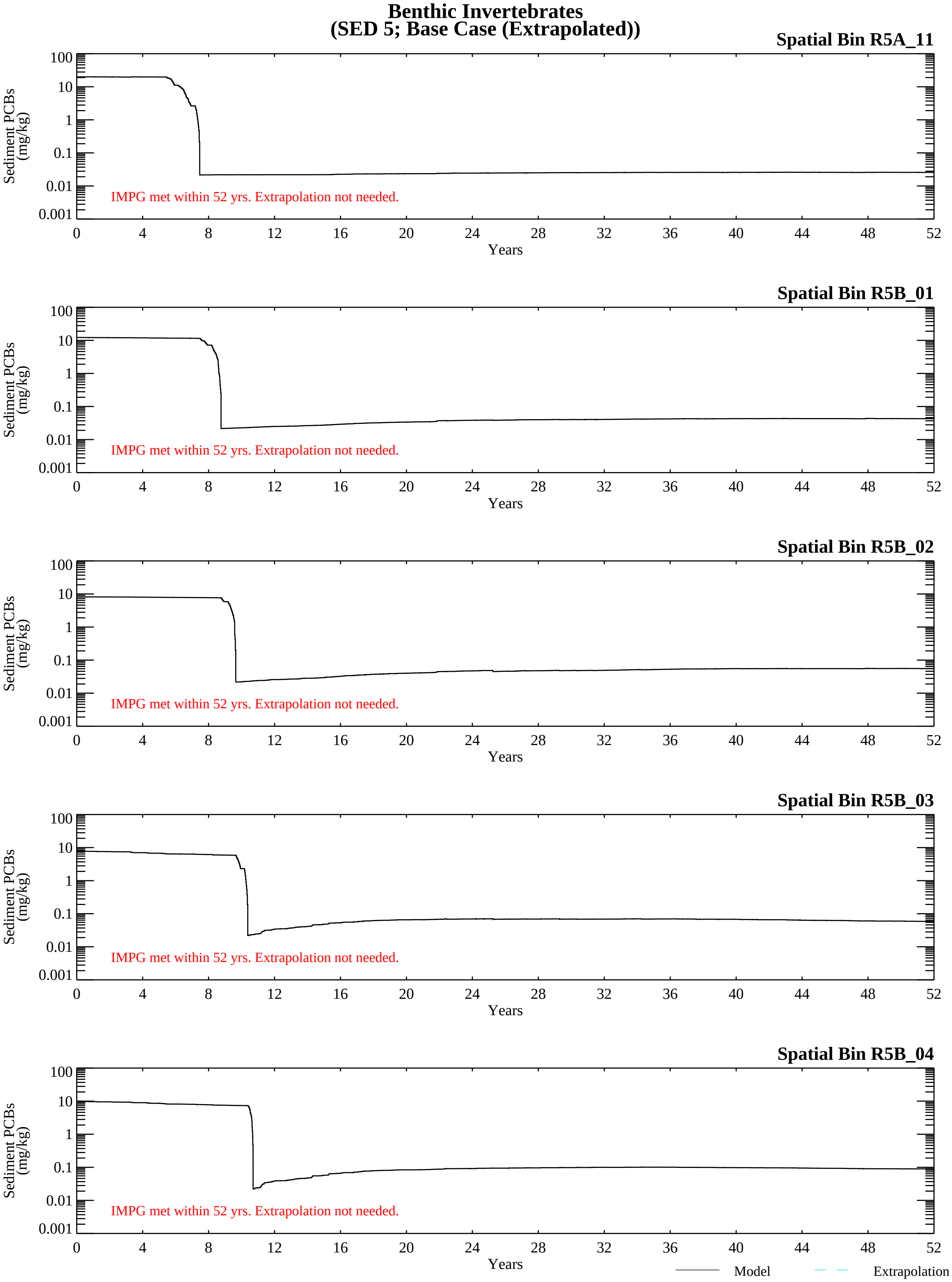

Figure G-4.3-4a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 5; Reach 5/6; Base Case).

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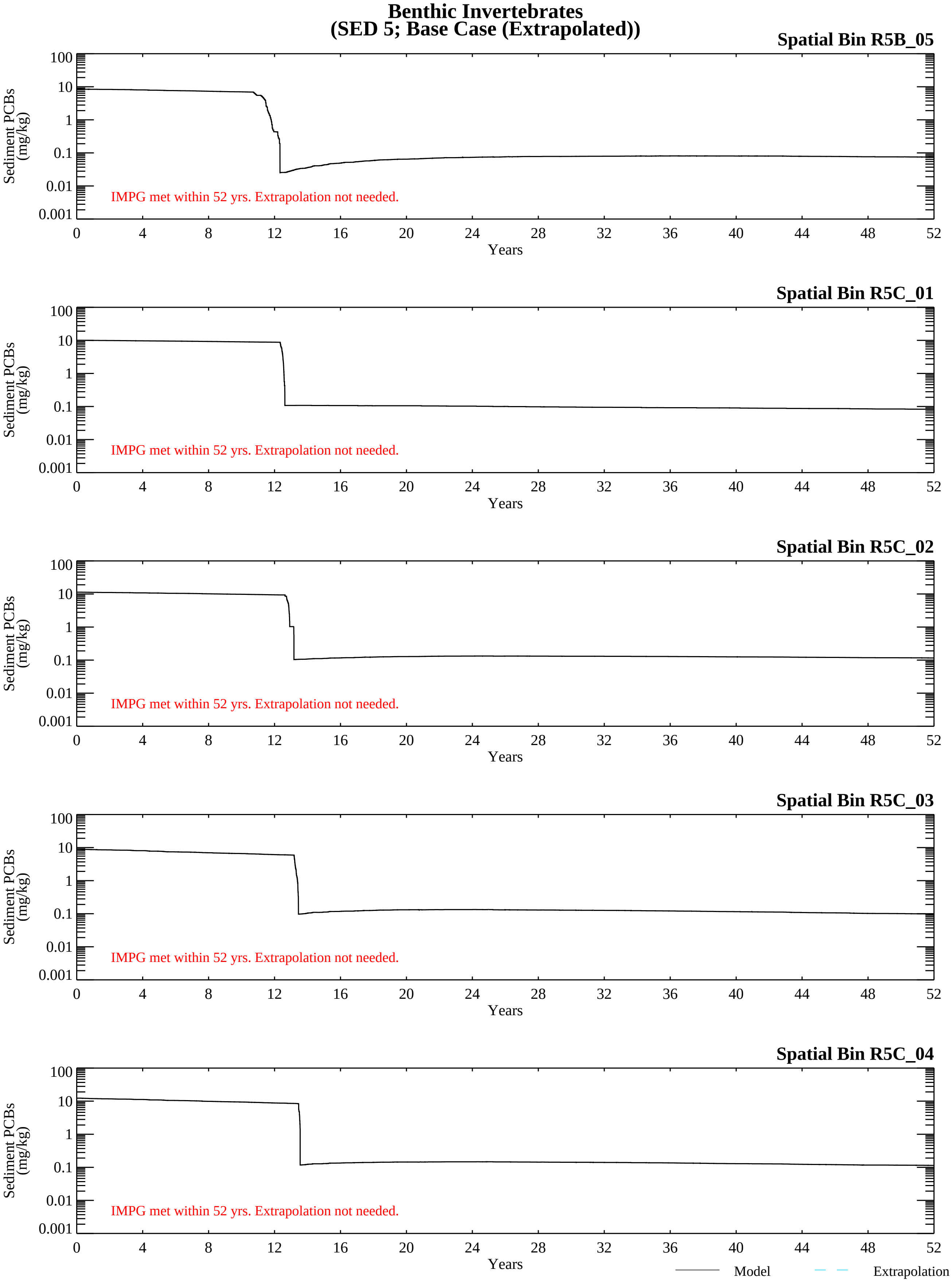

Figure G-4.3-4a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 5; Reach 5/6; Base Case).

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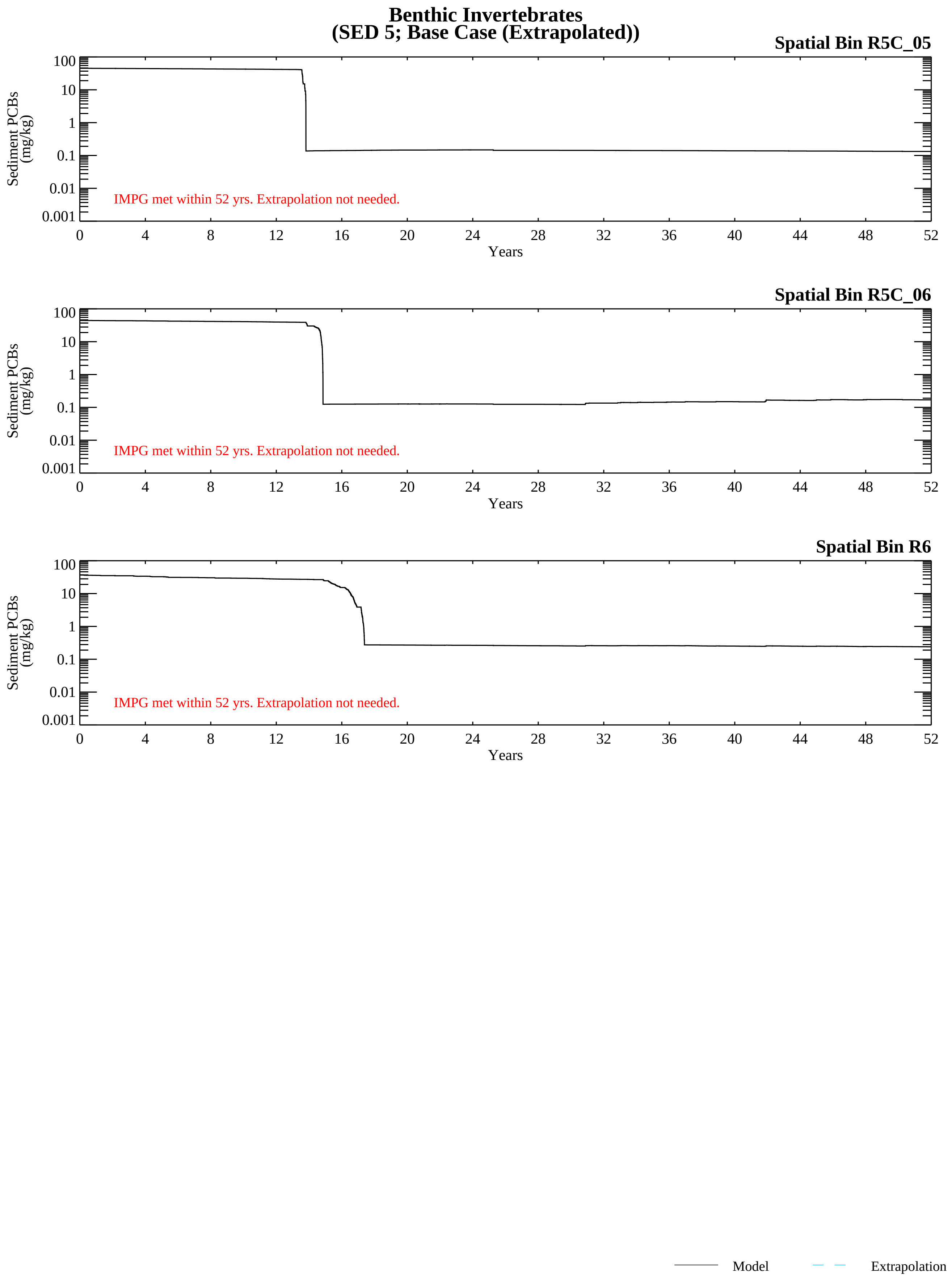

Figure G-4.3-4a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 5; Reach 5/6; Base Case).

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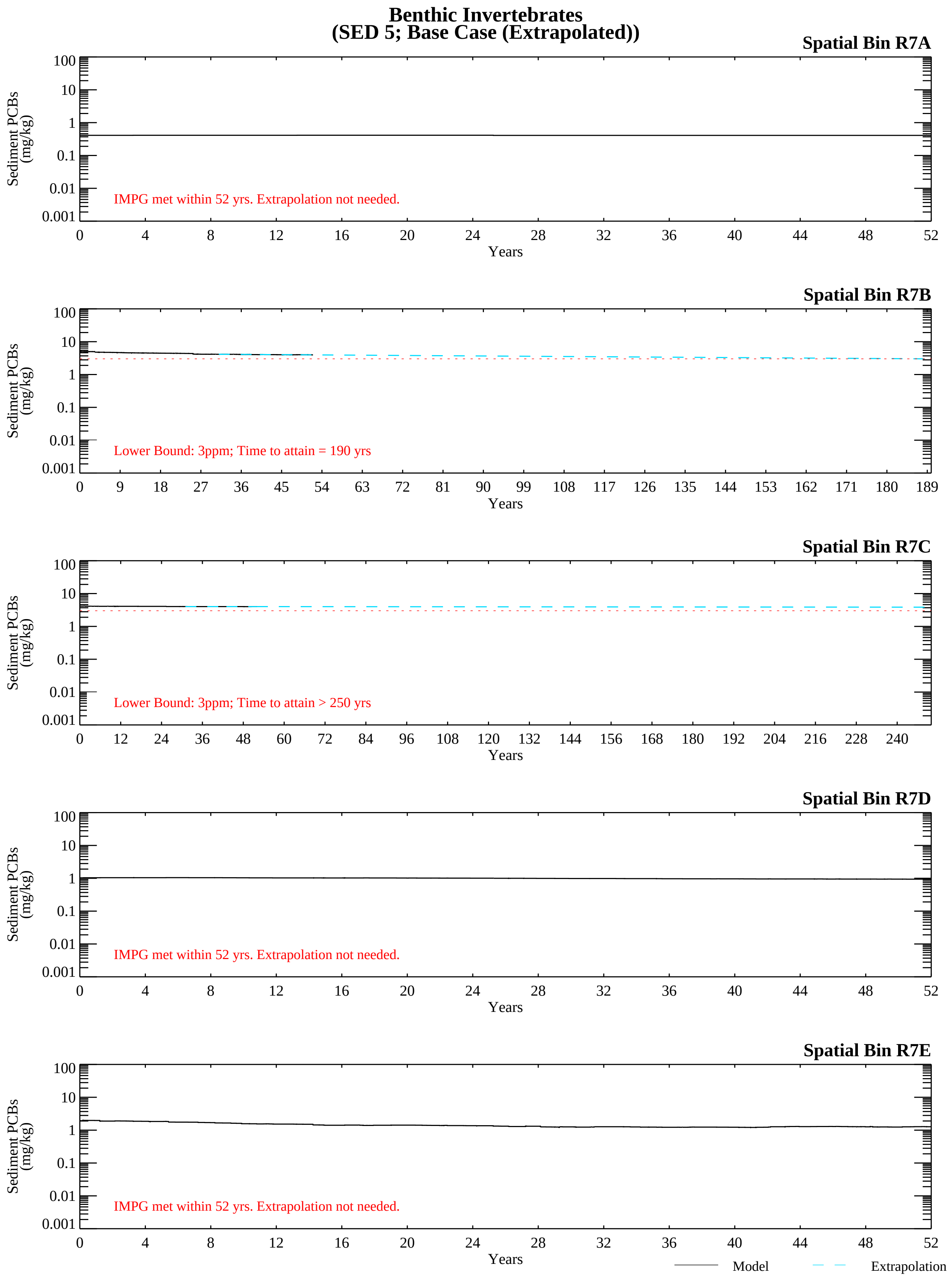

Figure G-4.3-4b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 5; Reach 7/8; Base Case).

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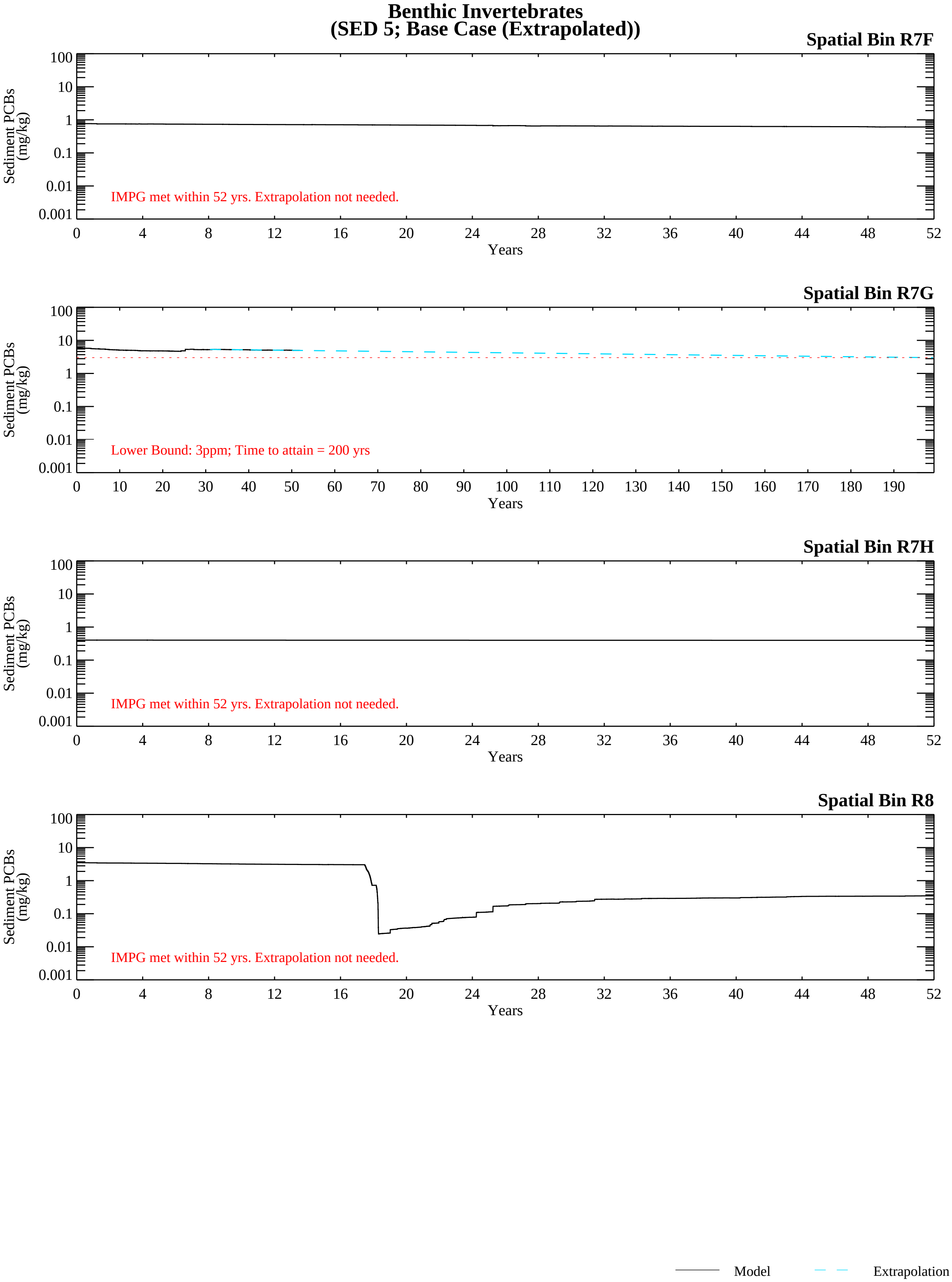

Figure G-4.3-4b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 5; Reach 7/8; Base Case).

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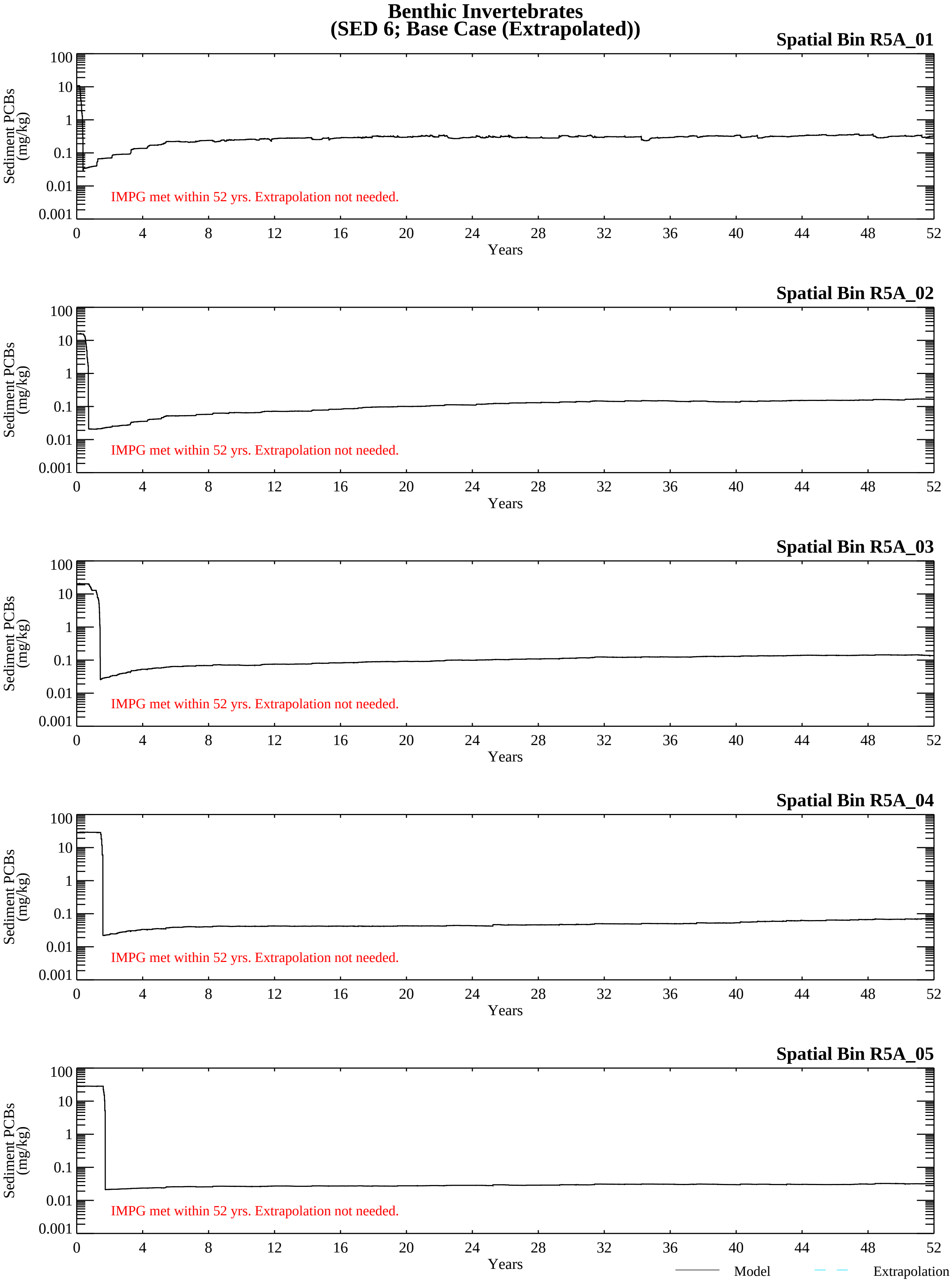

Figure G-4.3-5a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 6; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED6CMSBS_0712-16\bins

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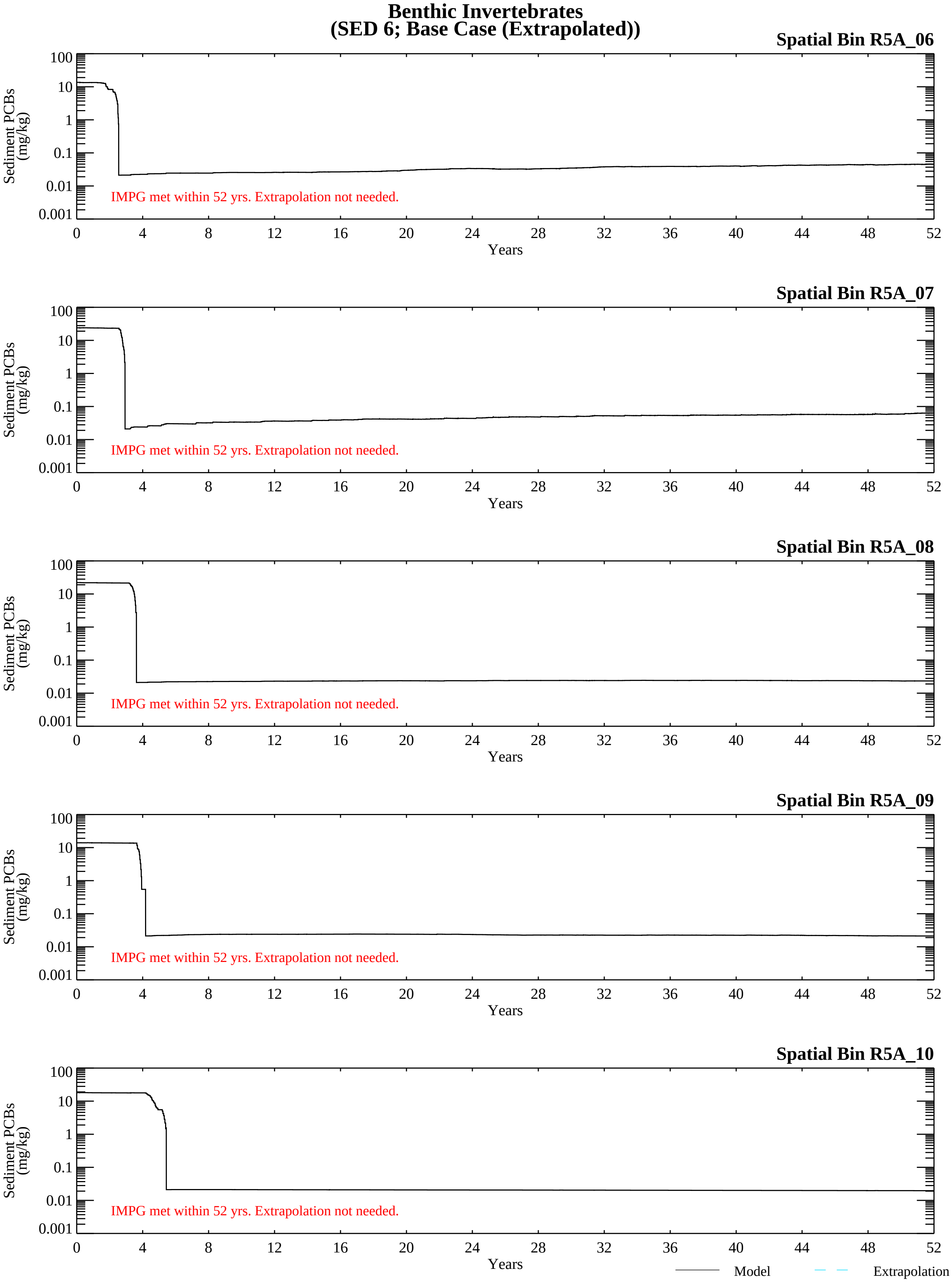

Figure G-4.3-5a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 6; Reach 5/6; Base Case).

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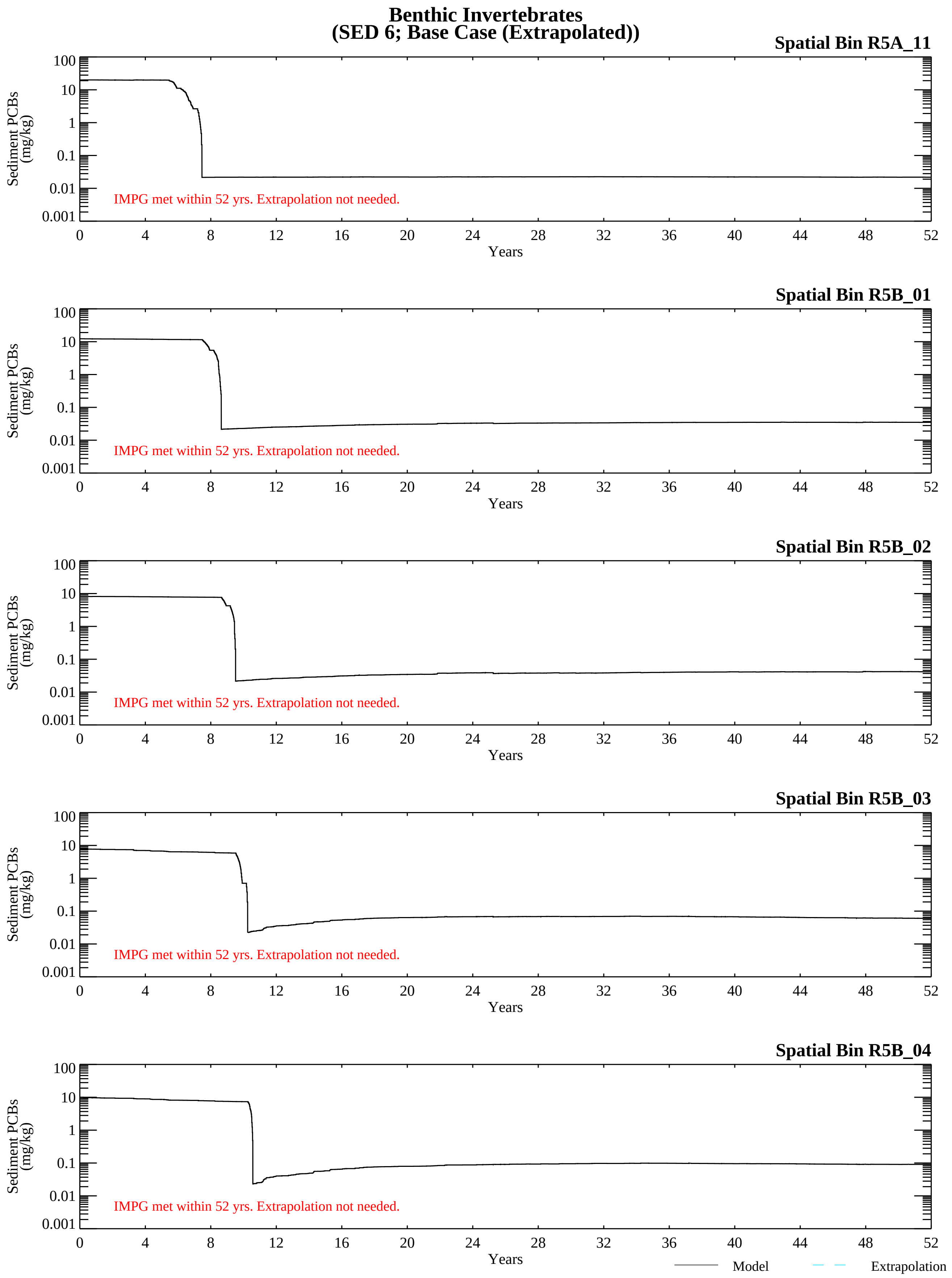

Figure G-4.3-5a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 6; Reach 5/6; Base Case).

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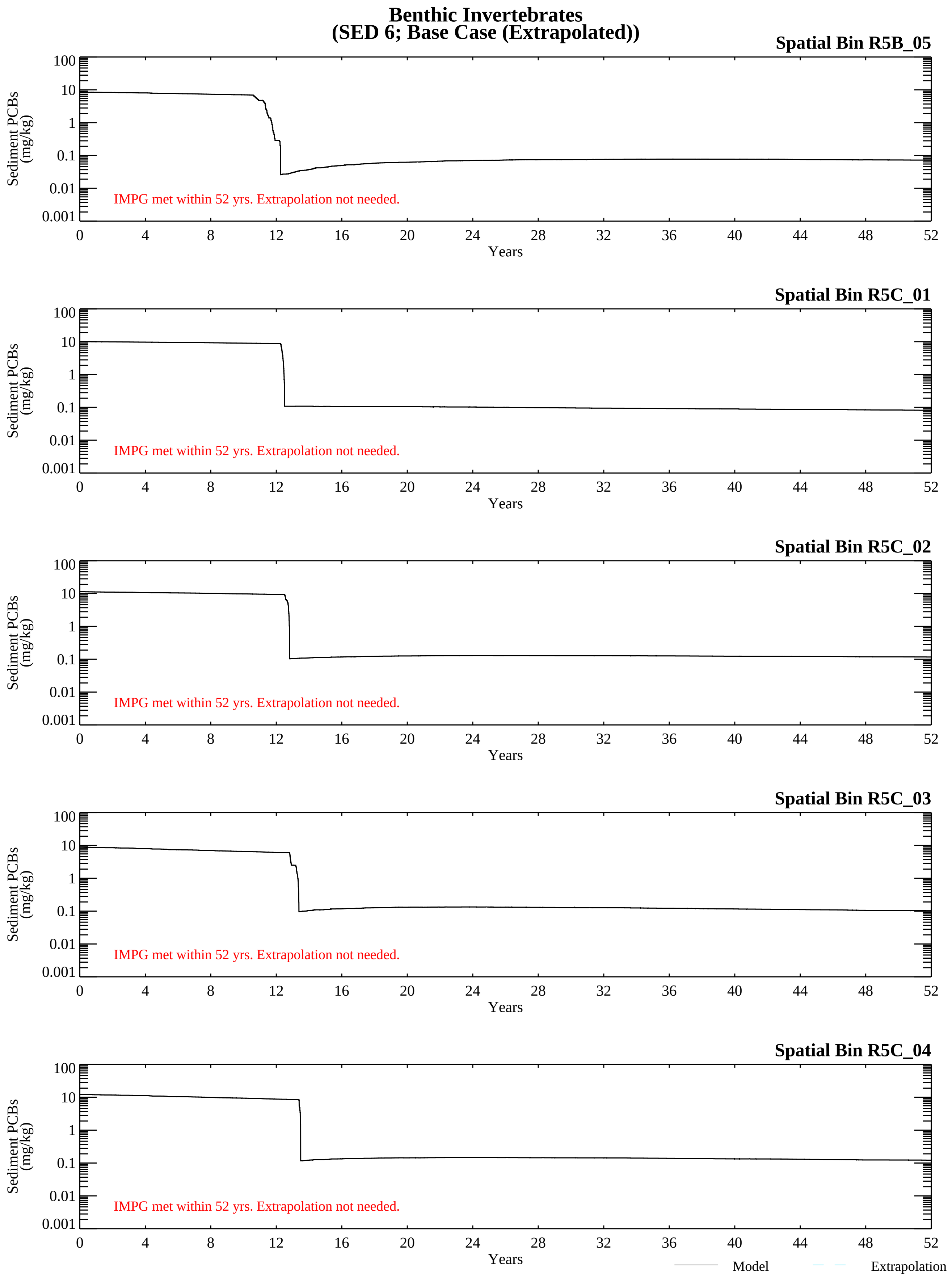
Benthic Invertebrates
(SED 6; Base Case (Extrapolated))

Spatial Bin R5B_05

Spatial Bin R5C_01

Spatial Bin R5C_02

Spatial Bin R5C_03

Spatial Bin R5C_04

Figure G-4.3-5a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 6; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED6CMSBS_0712-16\bins

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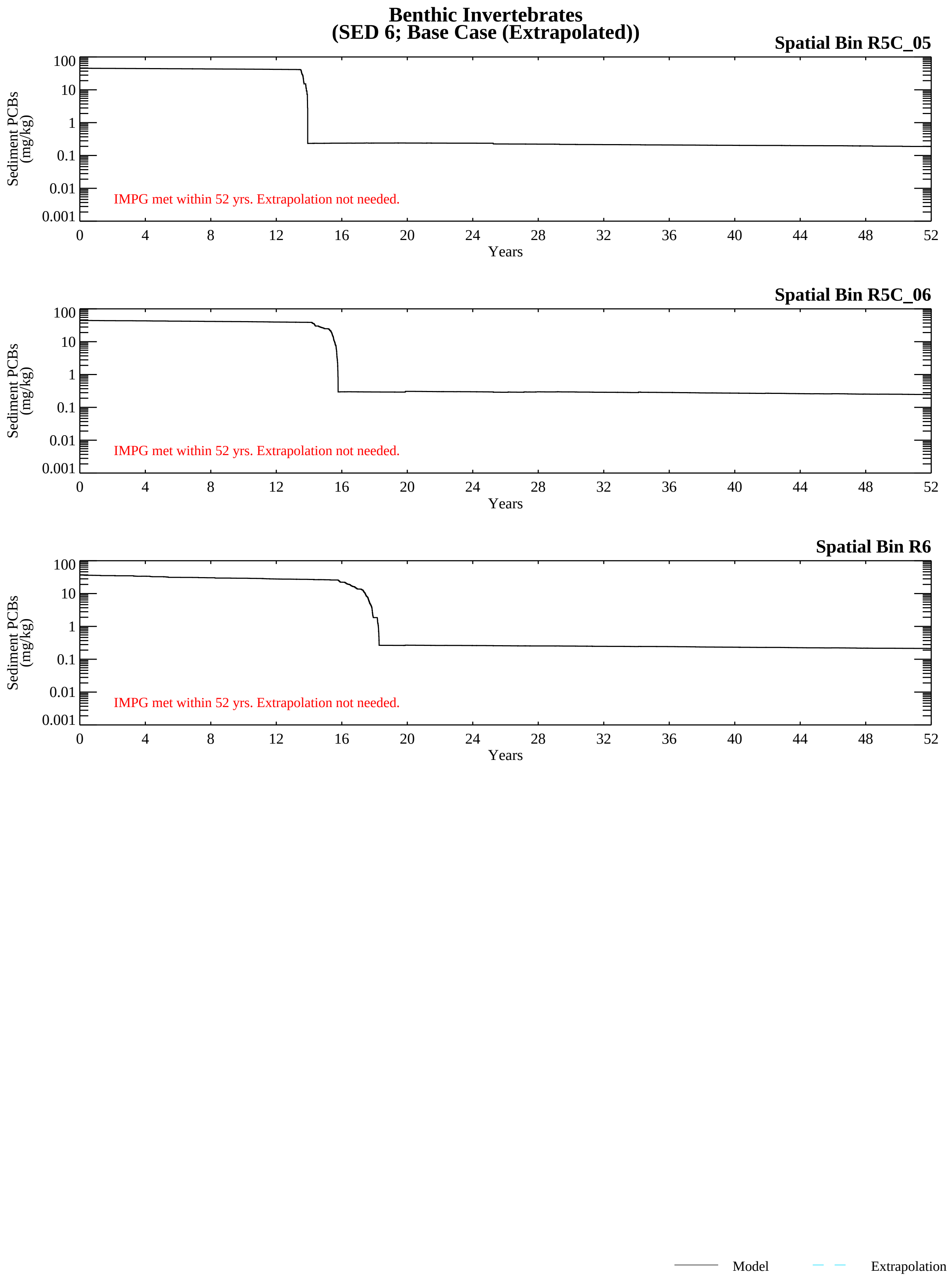

Figure G-4.3-5a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 6; Reach 5/6; Base Case).

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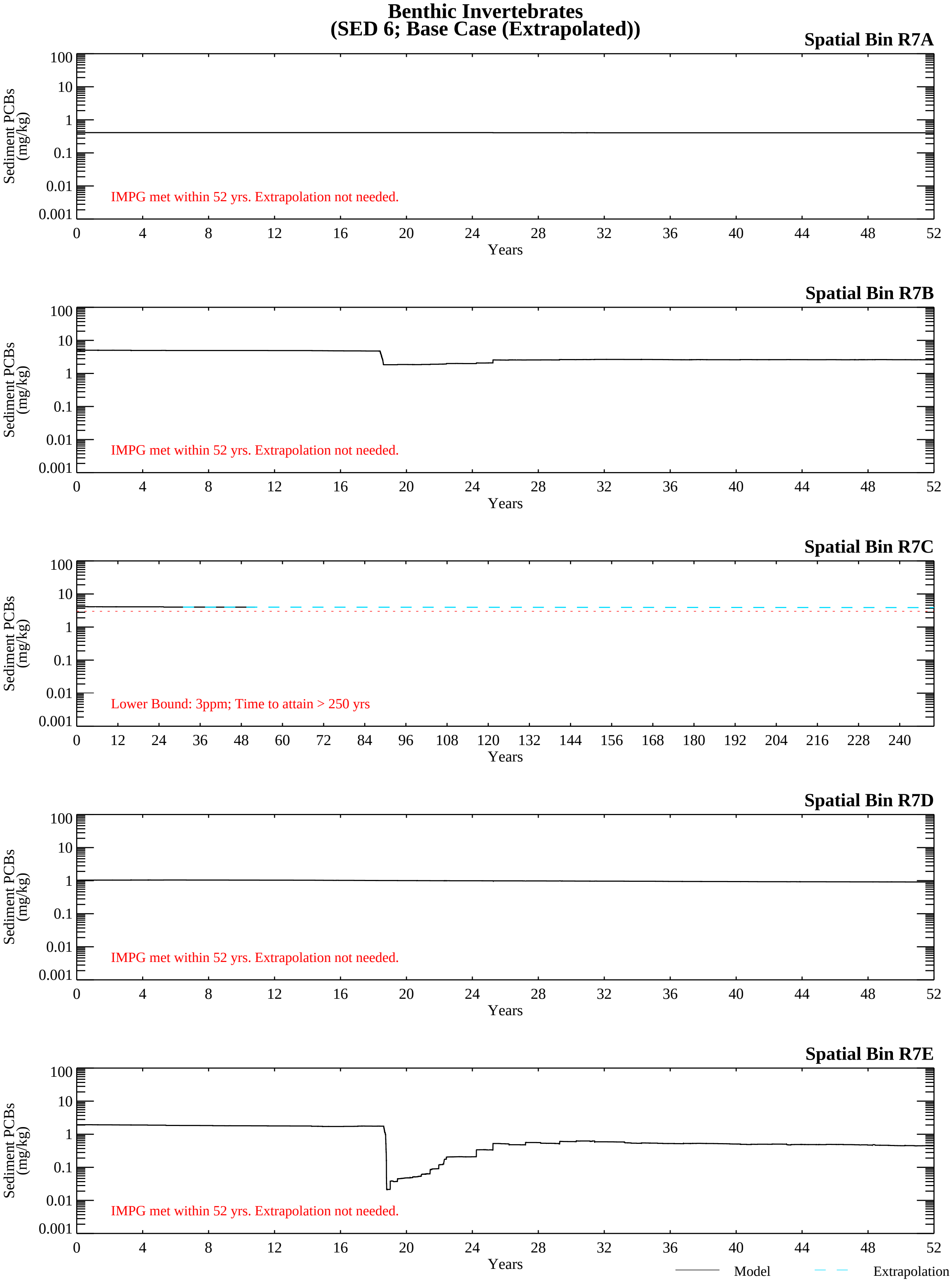

Figure G-4.3-5b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 6; Reach 7/8; Base Case).

Run path:\\Tenmile\EFDC_Output\R78\CMS\Proj_R78_SED6CMSBS_0712-32\bins

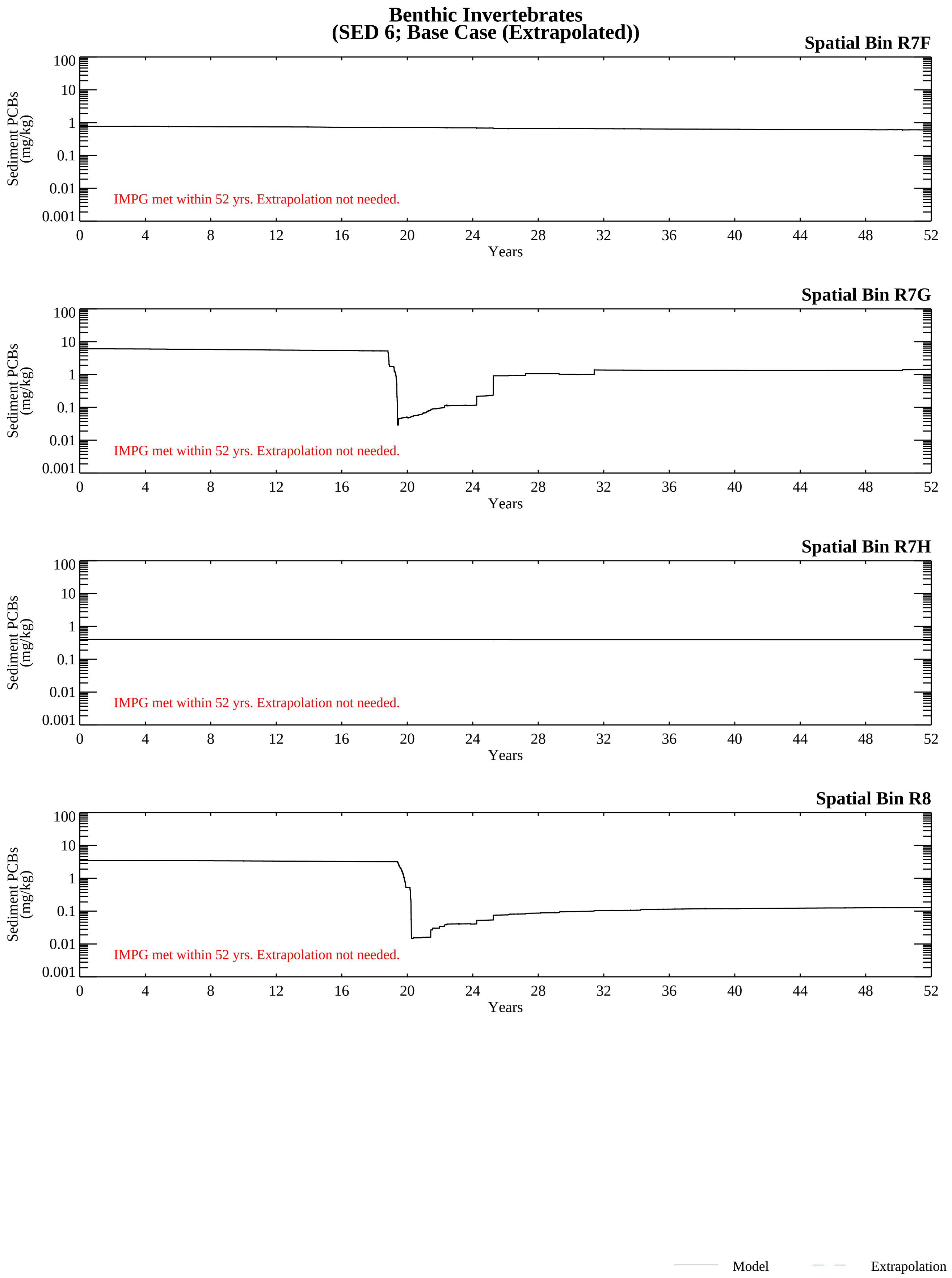

Figure G-4.3-5b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 6; Reach 7/8; Base Case).

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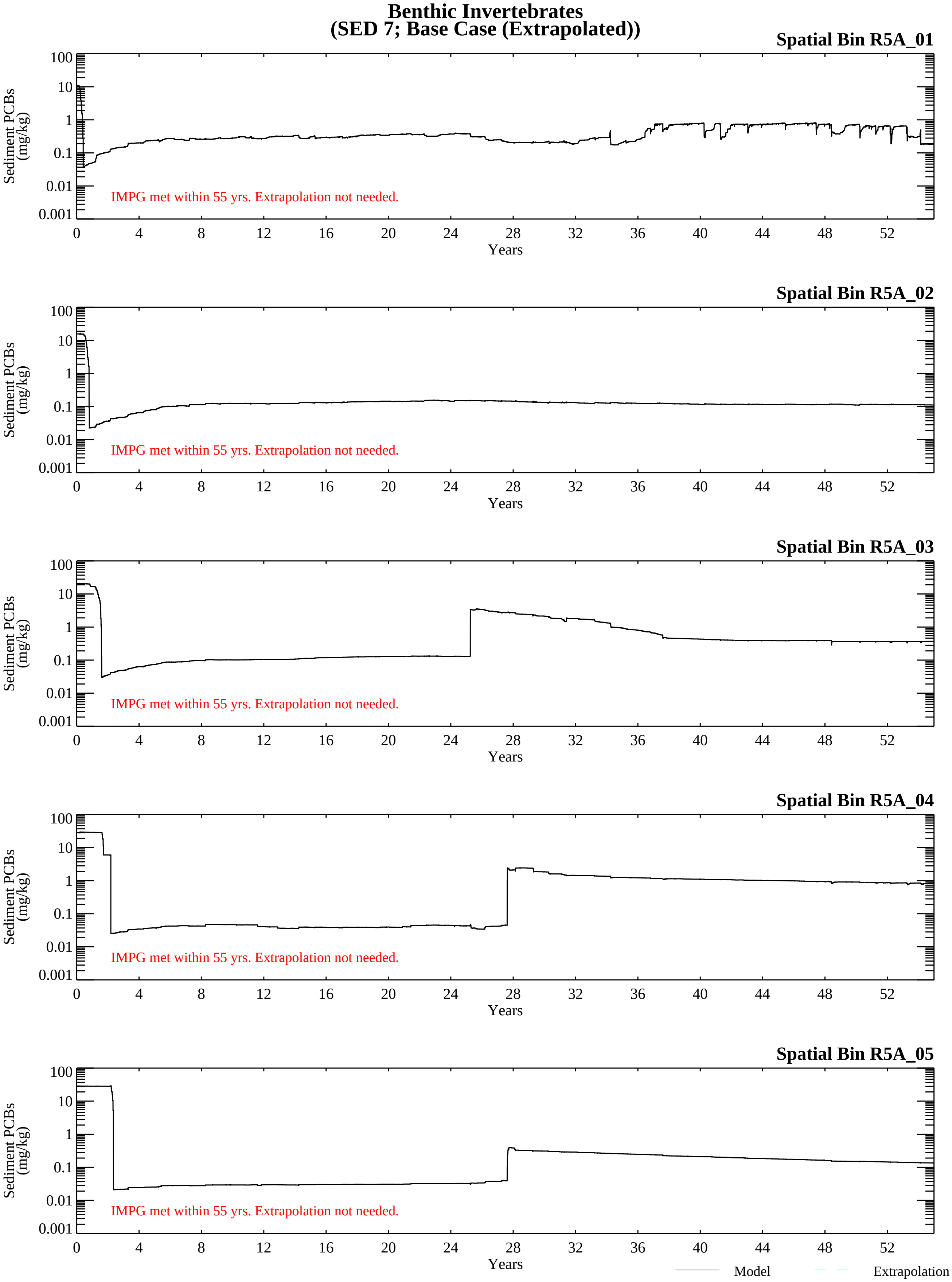

Figure G-4.3-6a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 7; Reach 5/6; Base Case).

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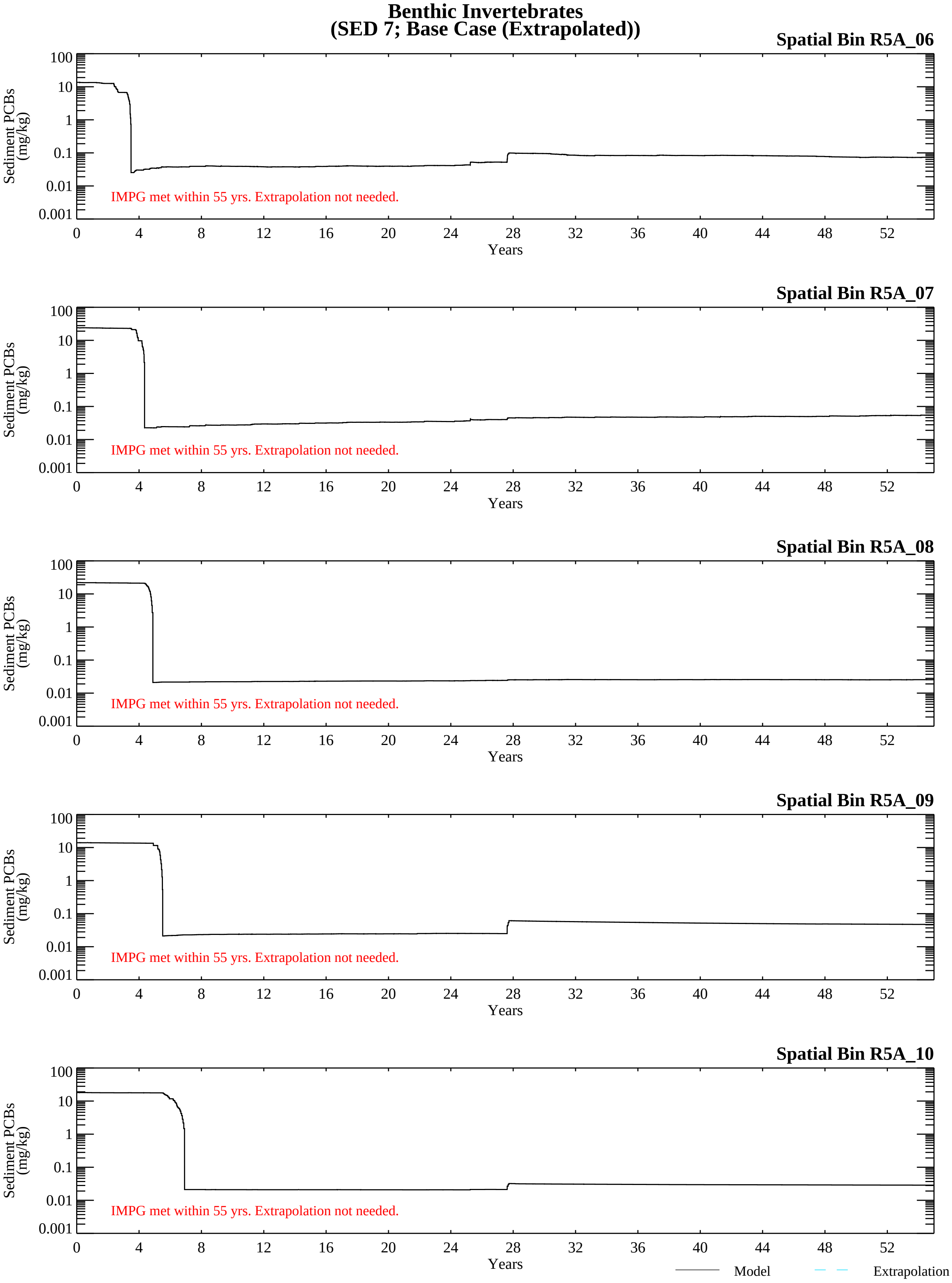

Figure G-4.3-6a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 7; Reach 5/6; Base Case).

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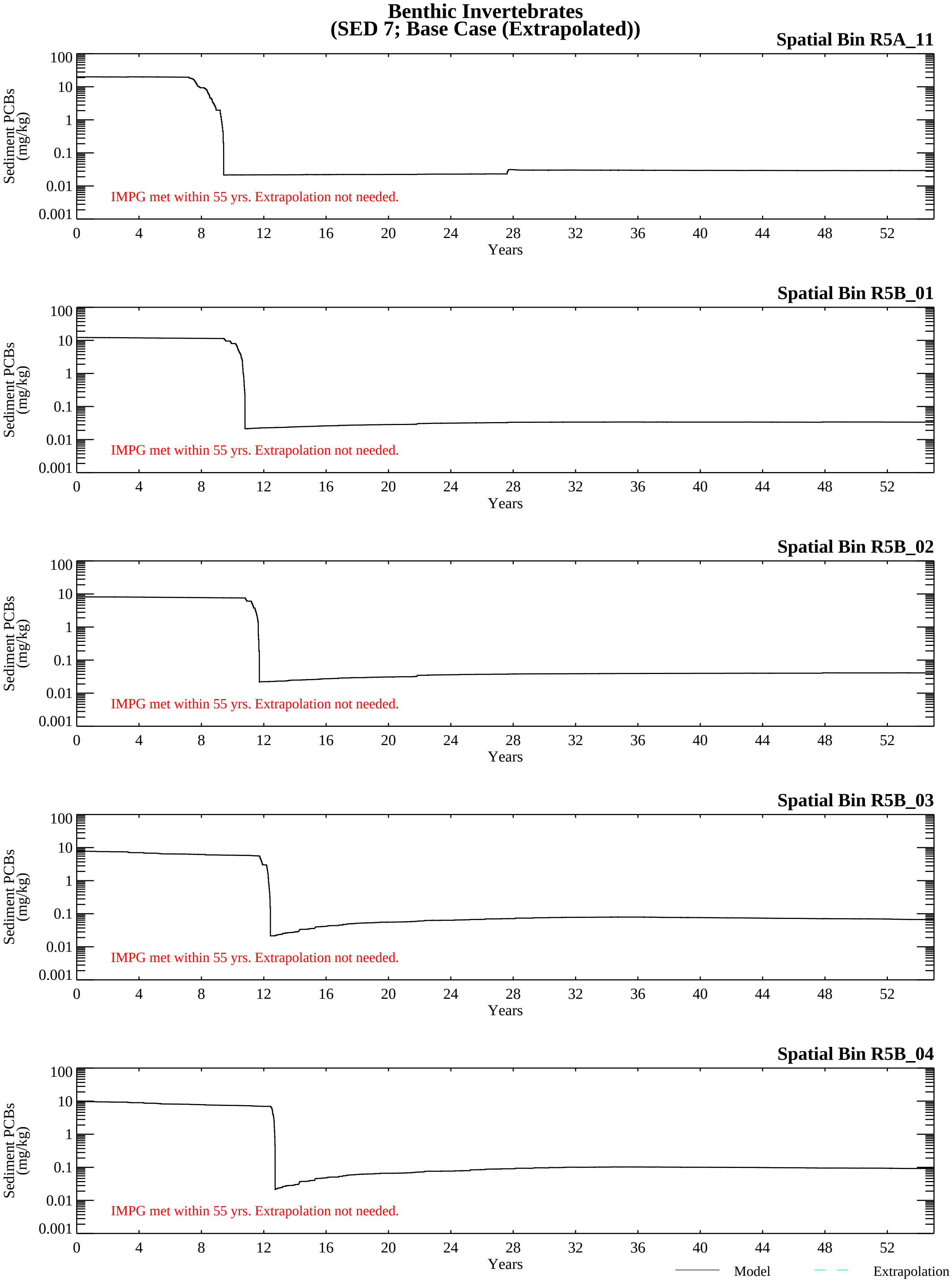

Figure G-4.3-6a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 7; Reach 5/6; Base Case).

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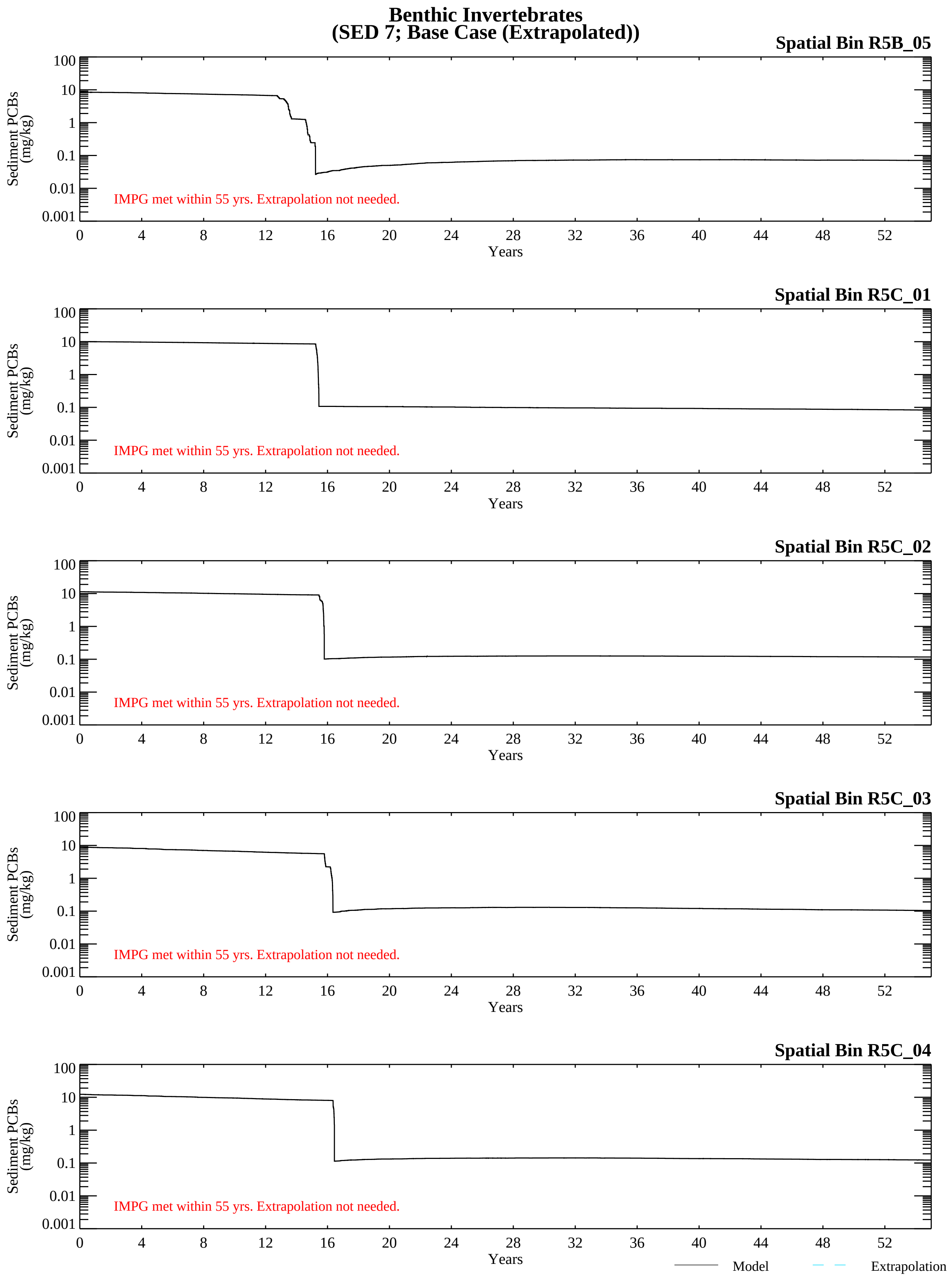

Figure G-4.3-6a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 7; Reach 5/6; Base Case).

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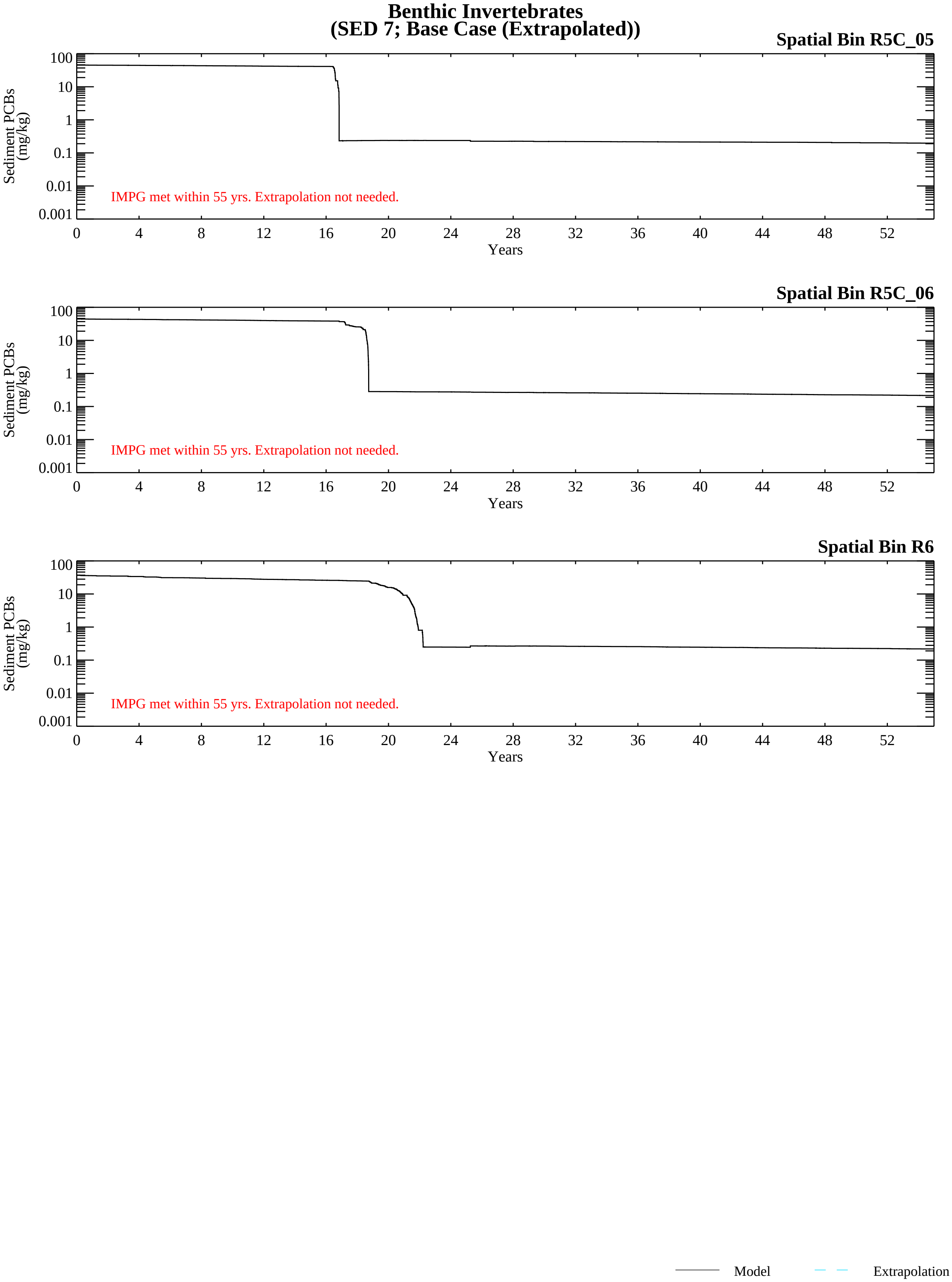

Figure G-4.3-6a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 7; Reach 5/6; Base Case).

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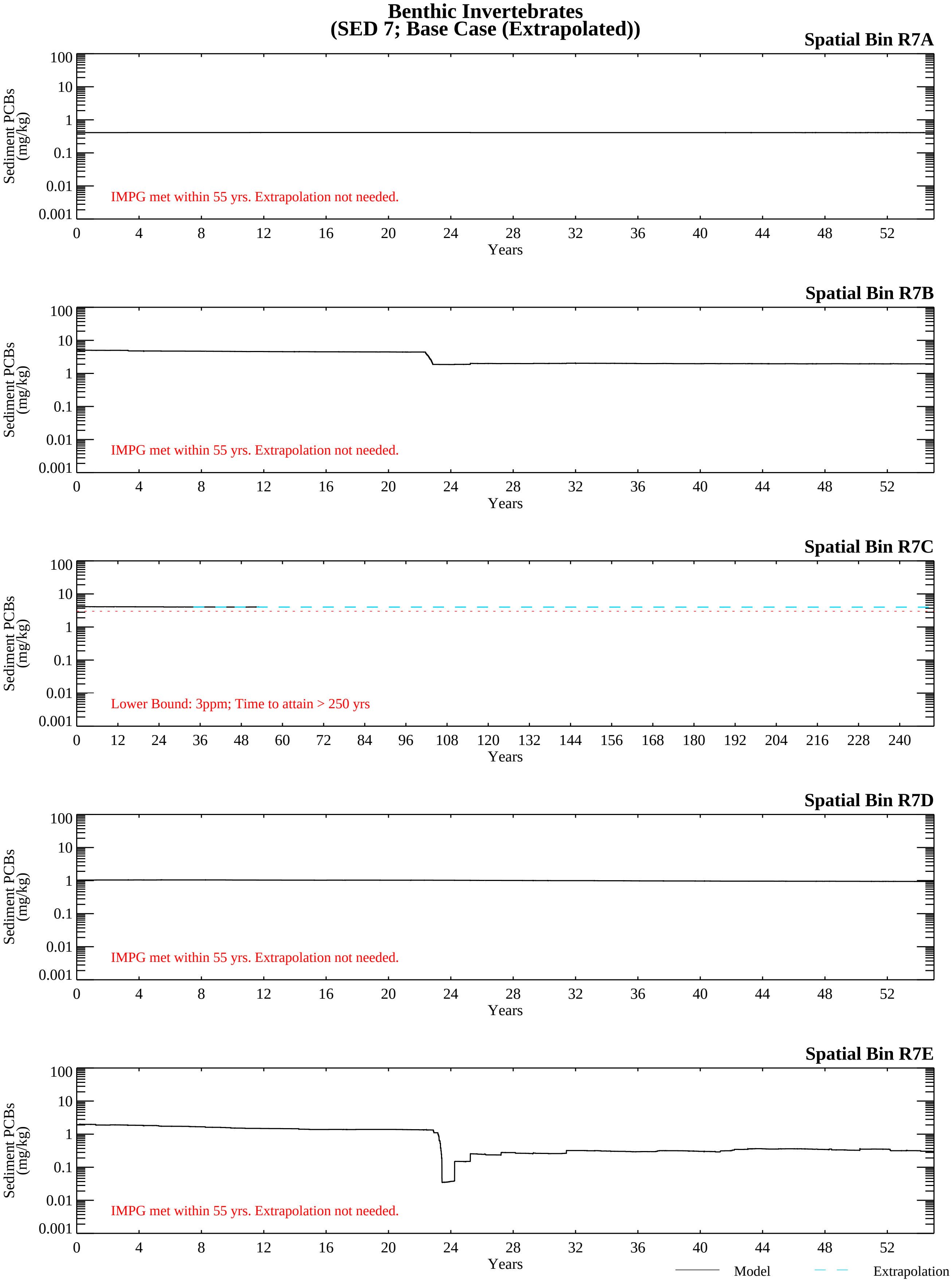

Figure G-4.3-6b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 7; Reach 7/8; Base Case).

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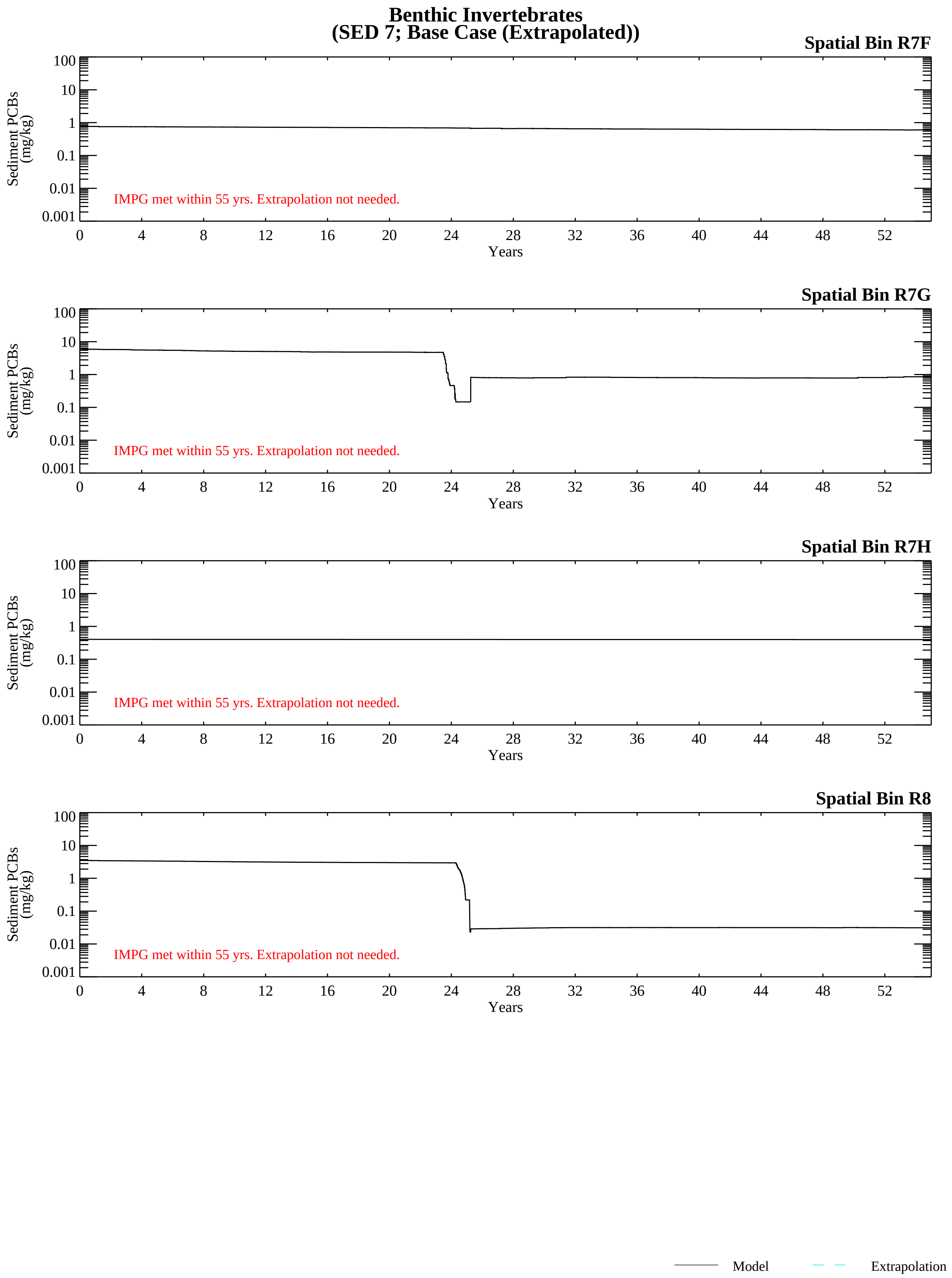

Figure G-4.3-6b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 7; Reach 7/8; Base Case).

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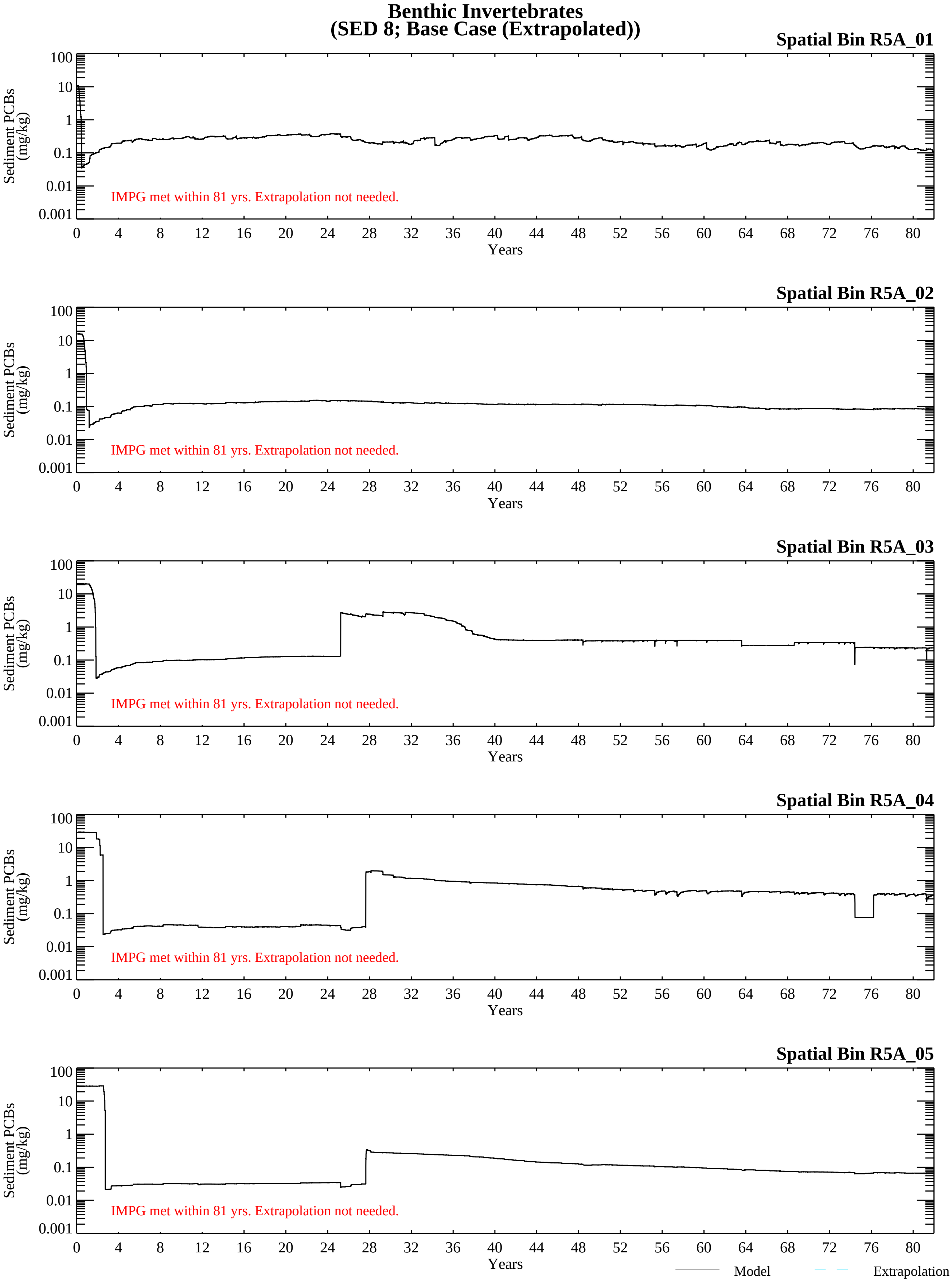

Figure G-4.3-7a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 8; Reach 5/6; Base Case).

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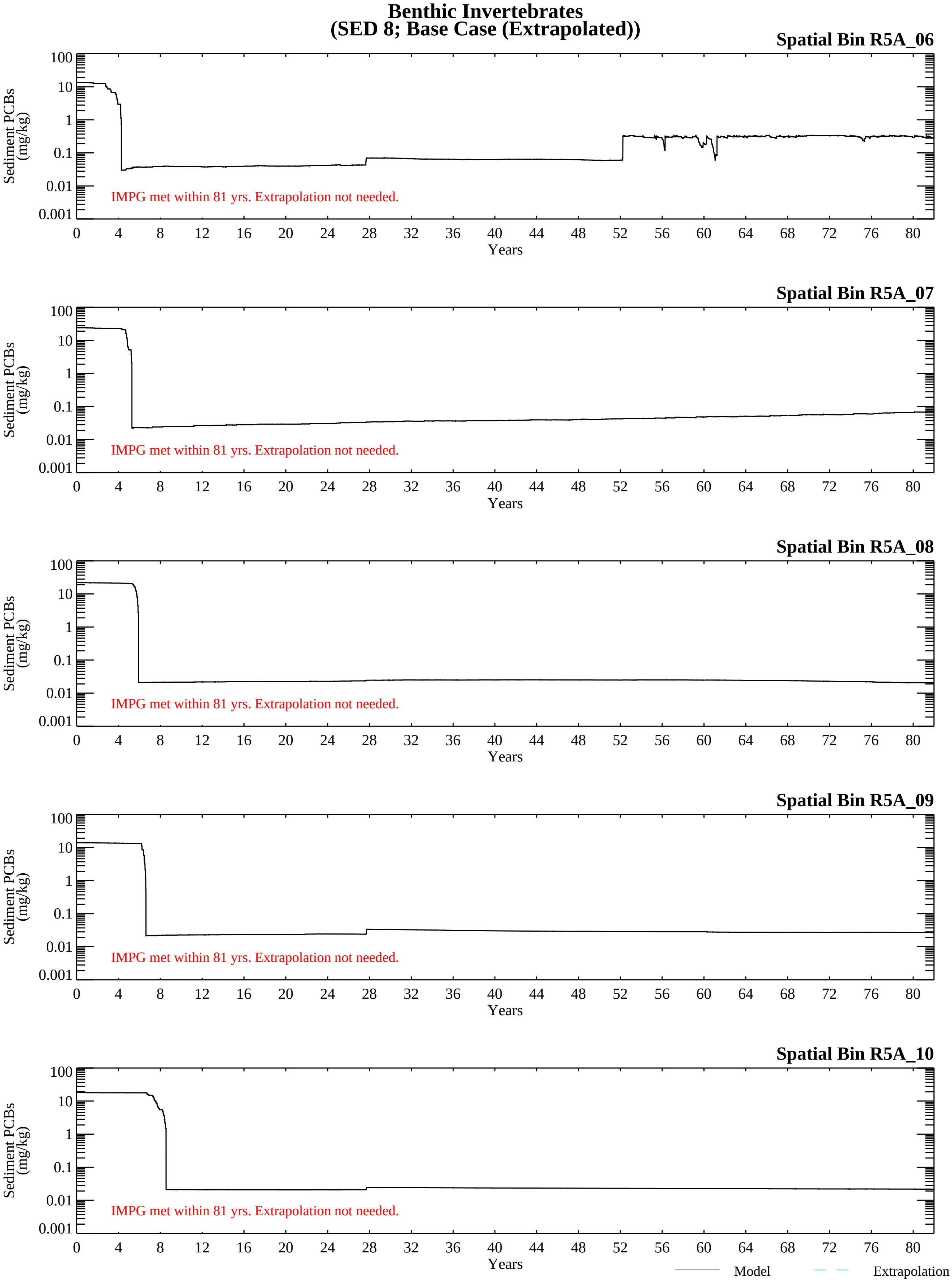

Figure G-4.3-7a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 8; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED8CMSBS_0712-18\bins

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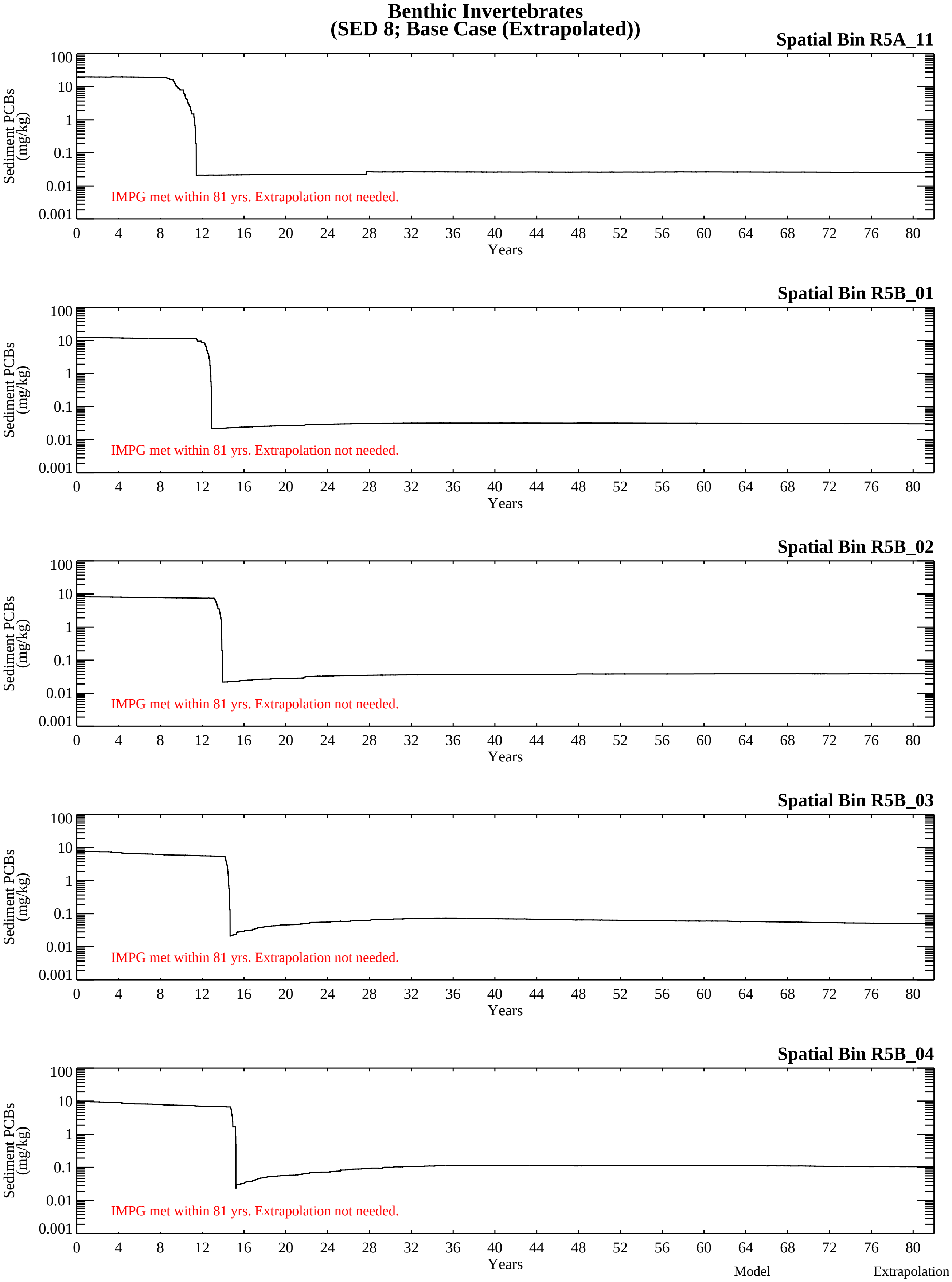

Figure G-4.3-7a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 8; Reach 5/6; Base Case).

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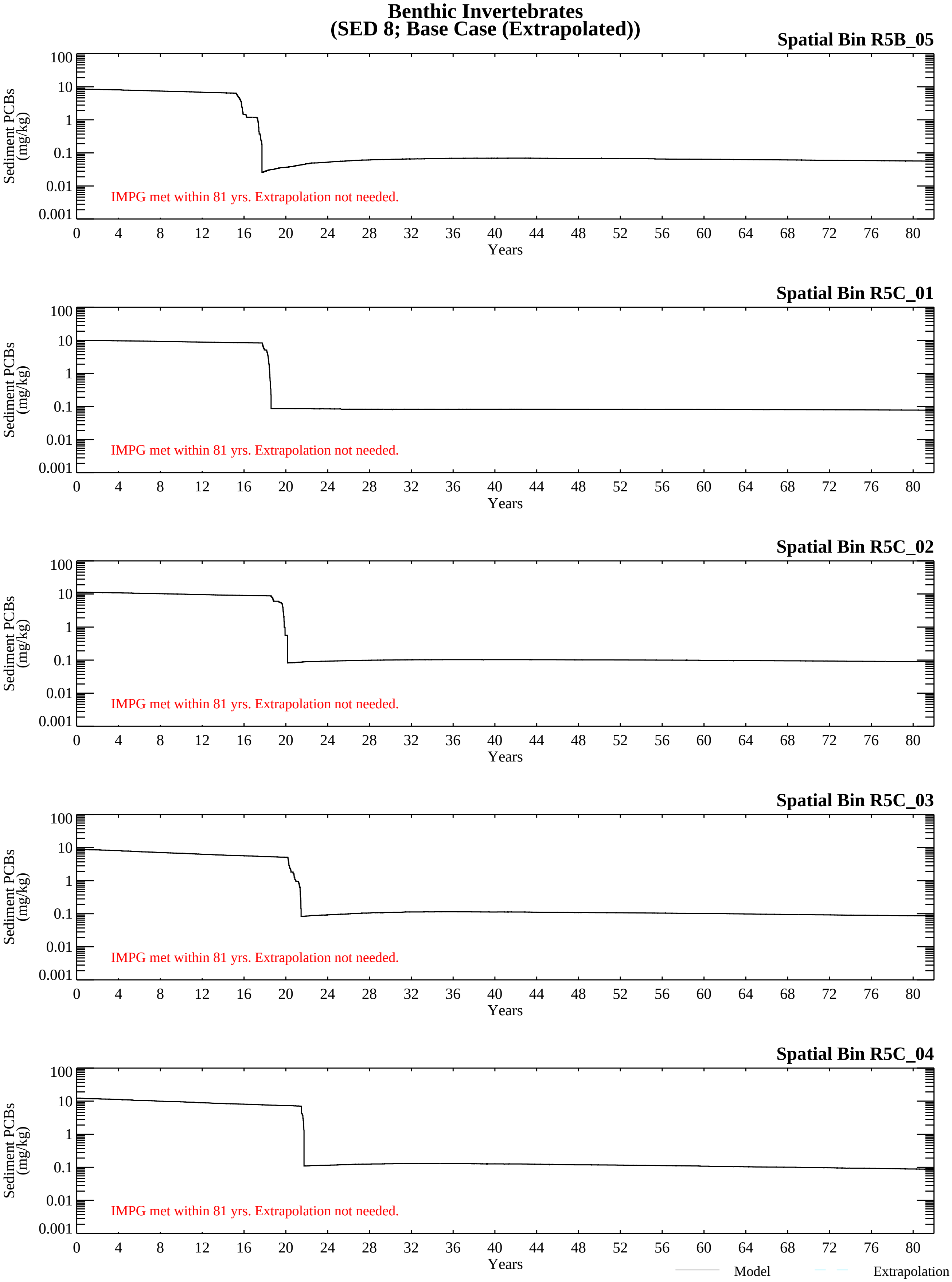

Figure G-4.3-7a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 8; Reach 5/6; Base Case).

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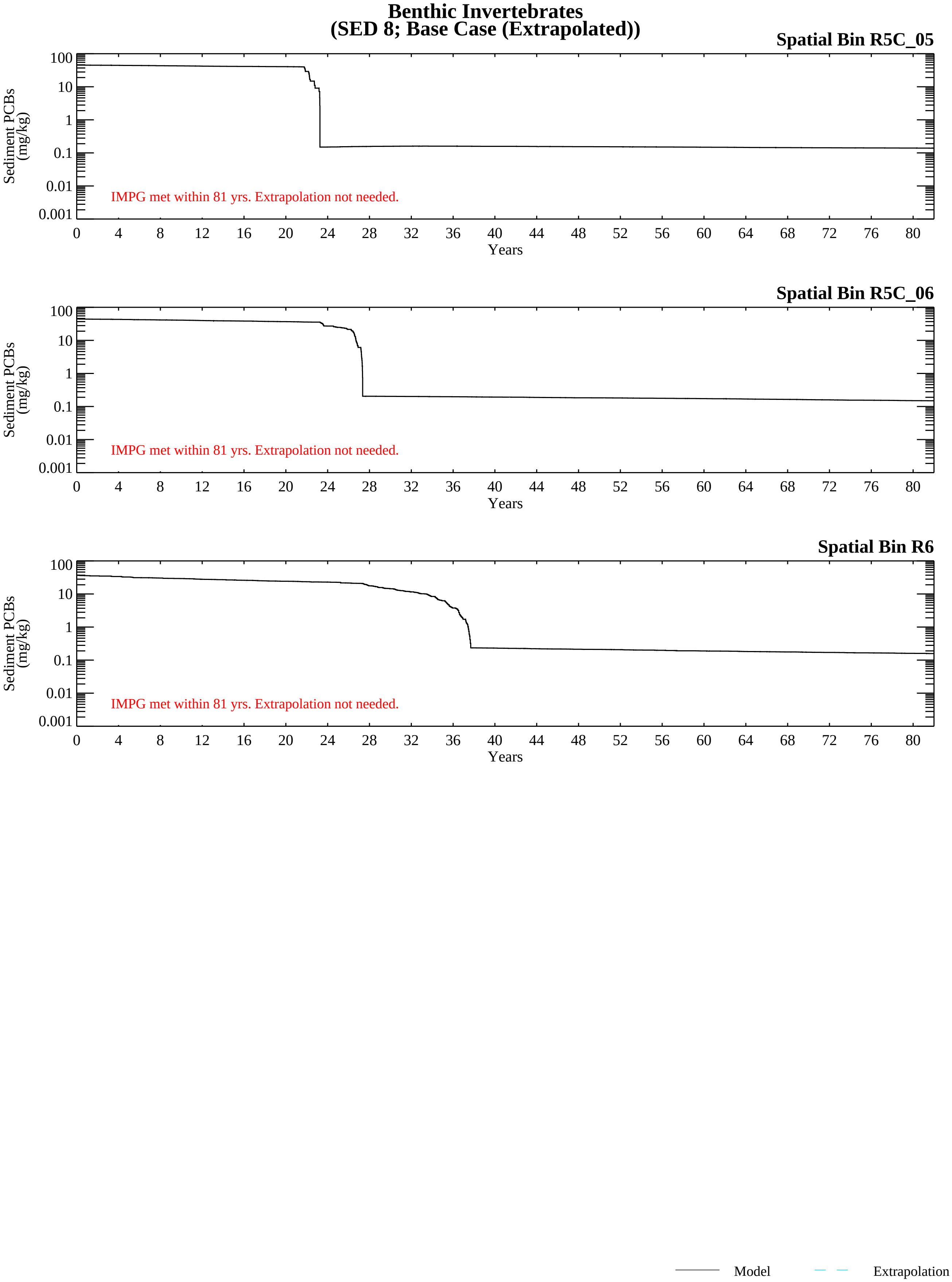

Figure G-4.3-7a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 8; Reach 5/6; Base Case).

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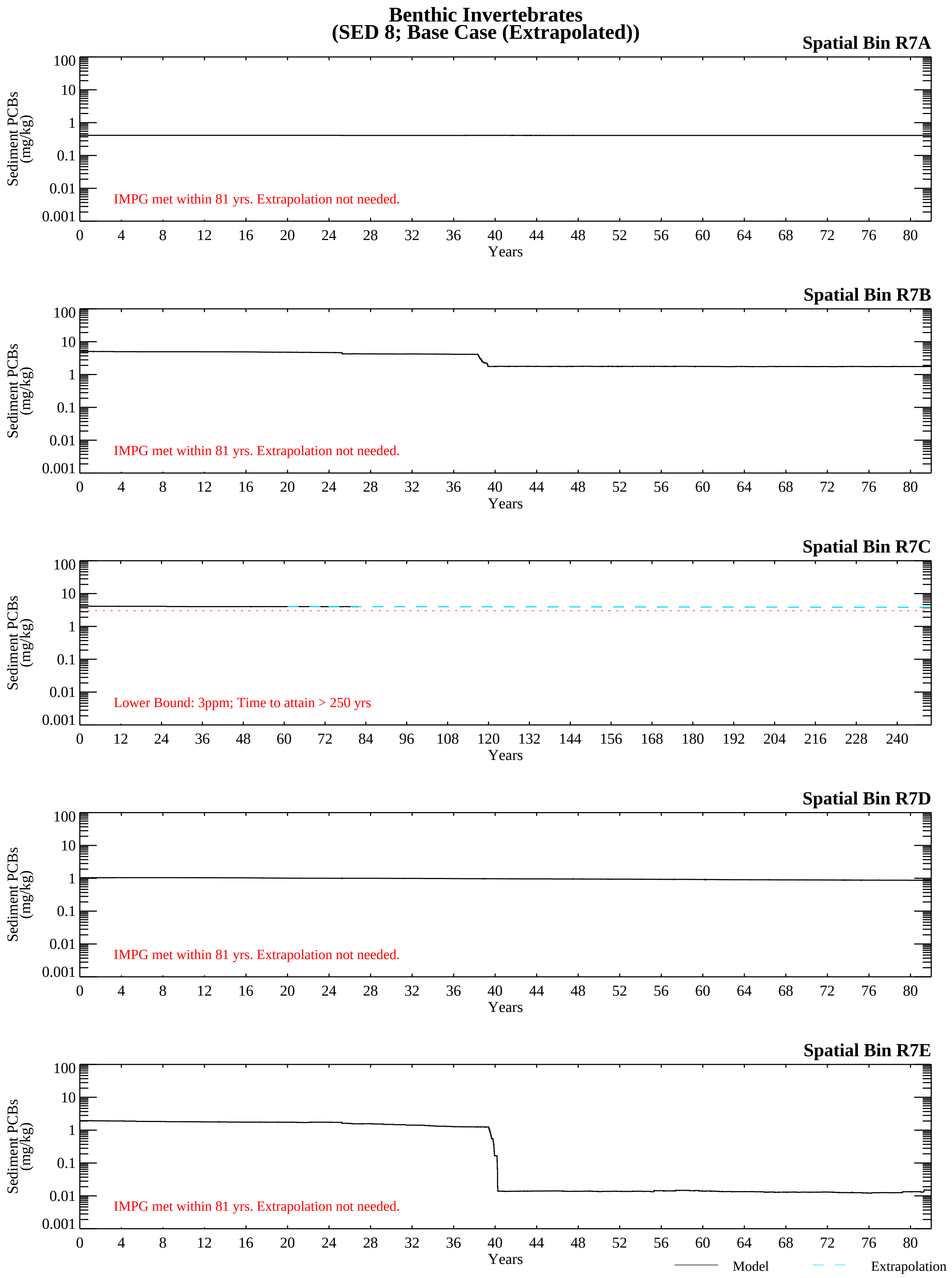

Figure G-4.3-7b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 8; Reach 7/8; Base Case).

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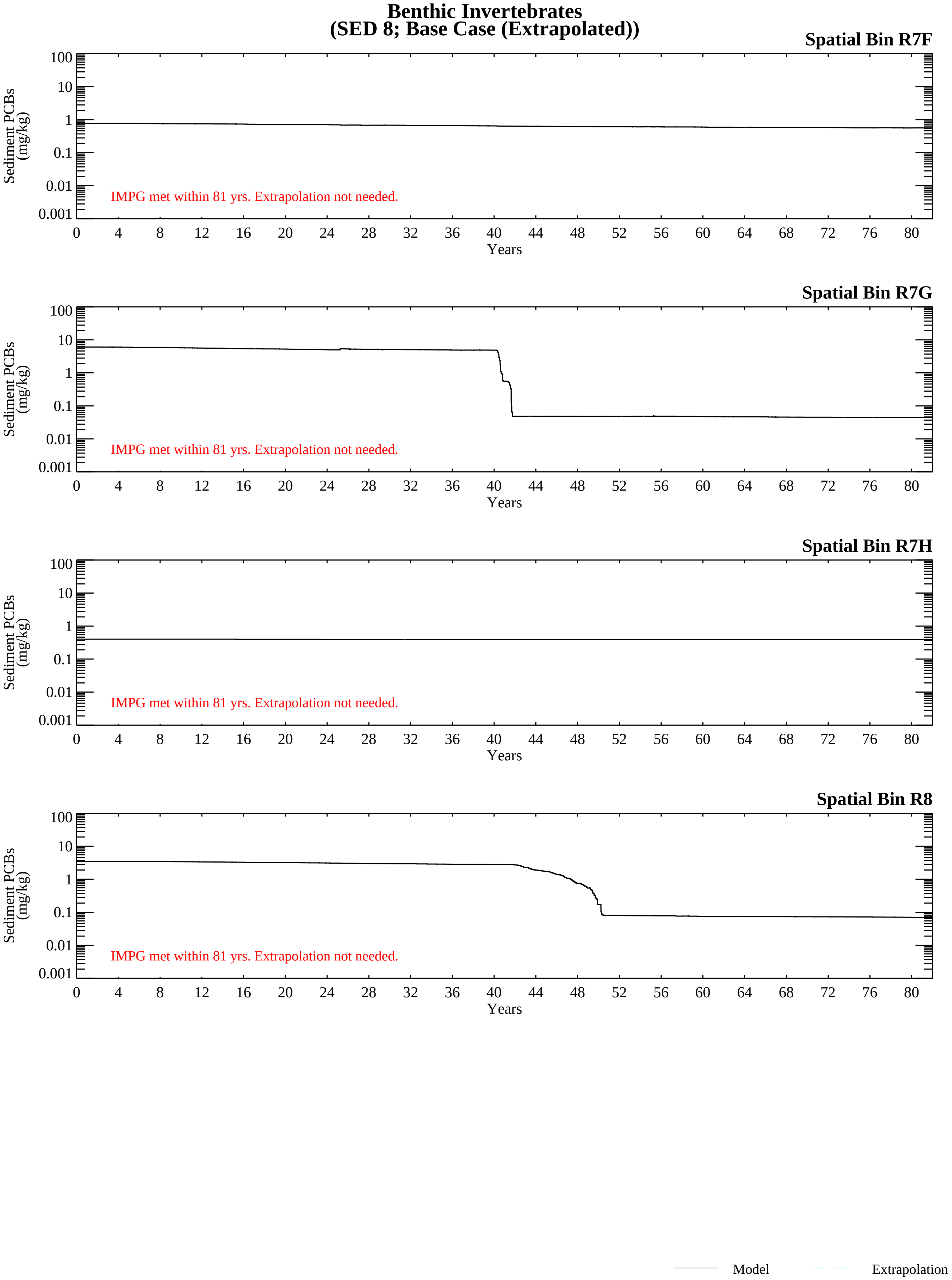

Figure G-4.3-7b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for benthic invertebrates (SED 8; Reach 7/8; Base Case).

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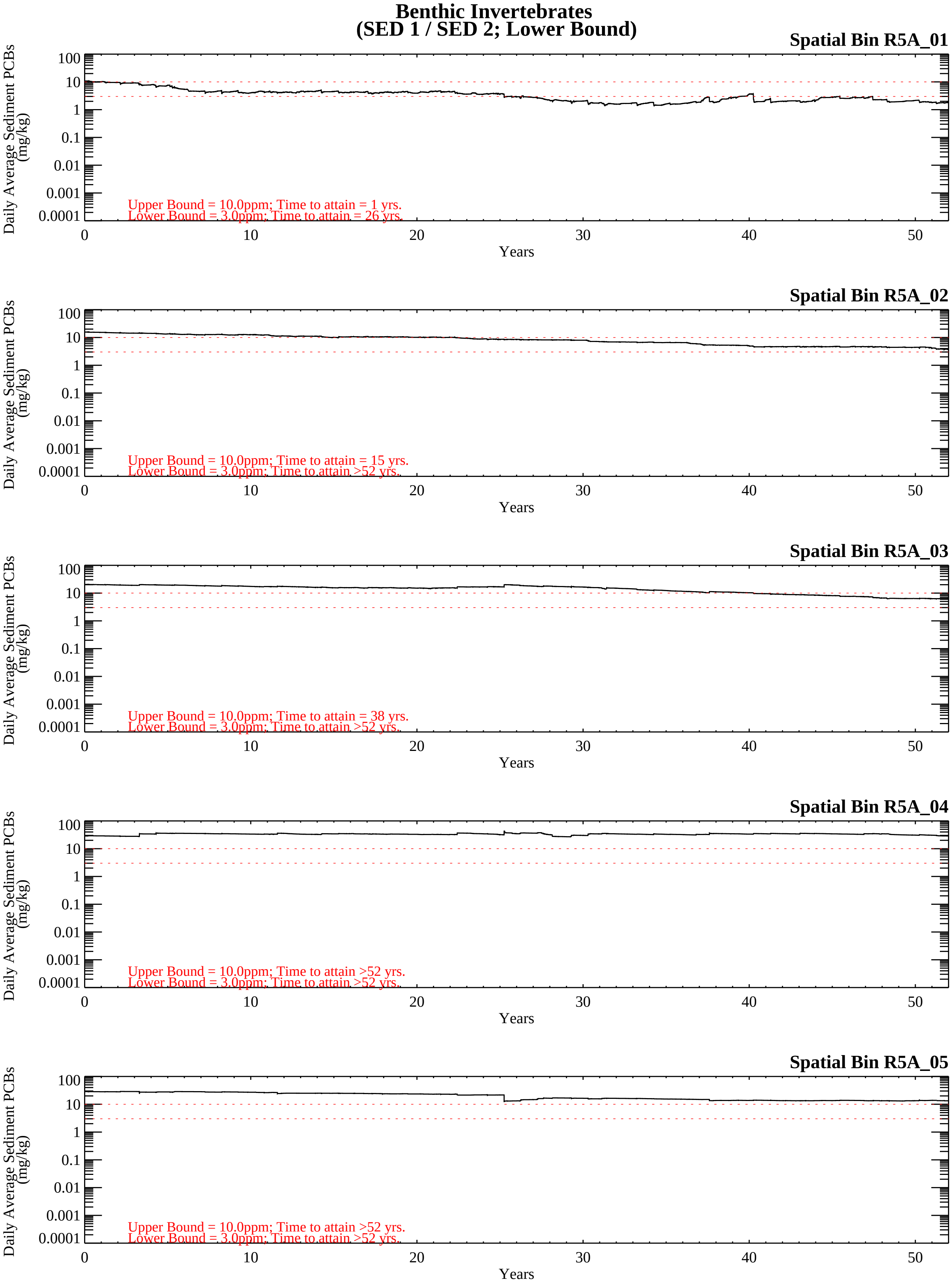

Figure G-4.4-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 1 / SED 2; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED1CMSLB_0712-19\\bins

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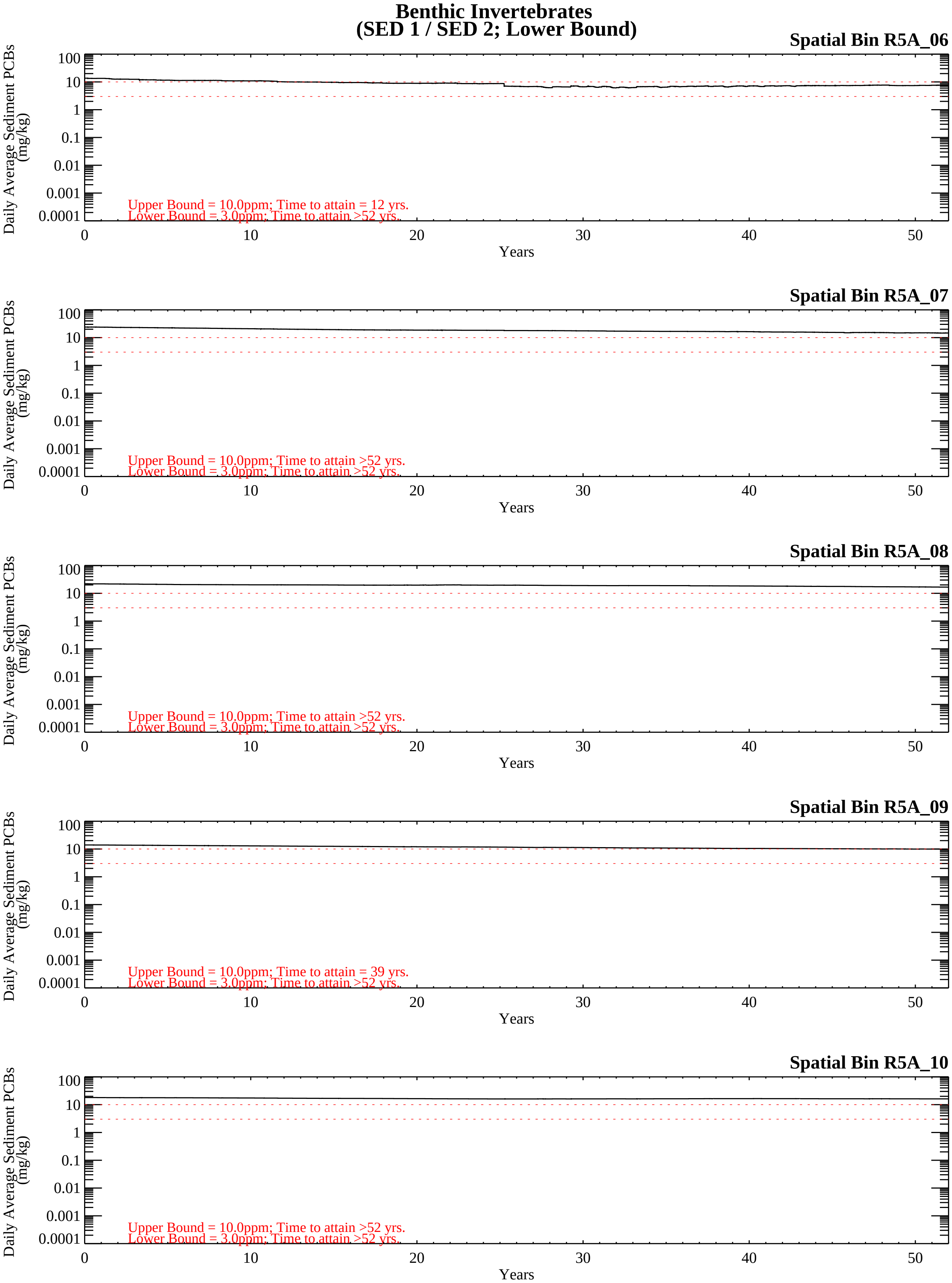

Figure G-4.4-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 1 / SED 2; Reach 5/6; Lower Bound).

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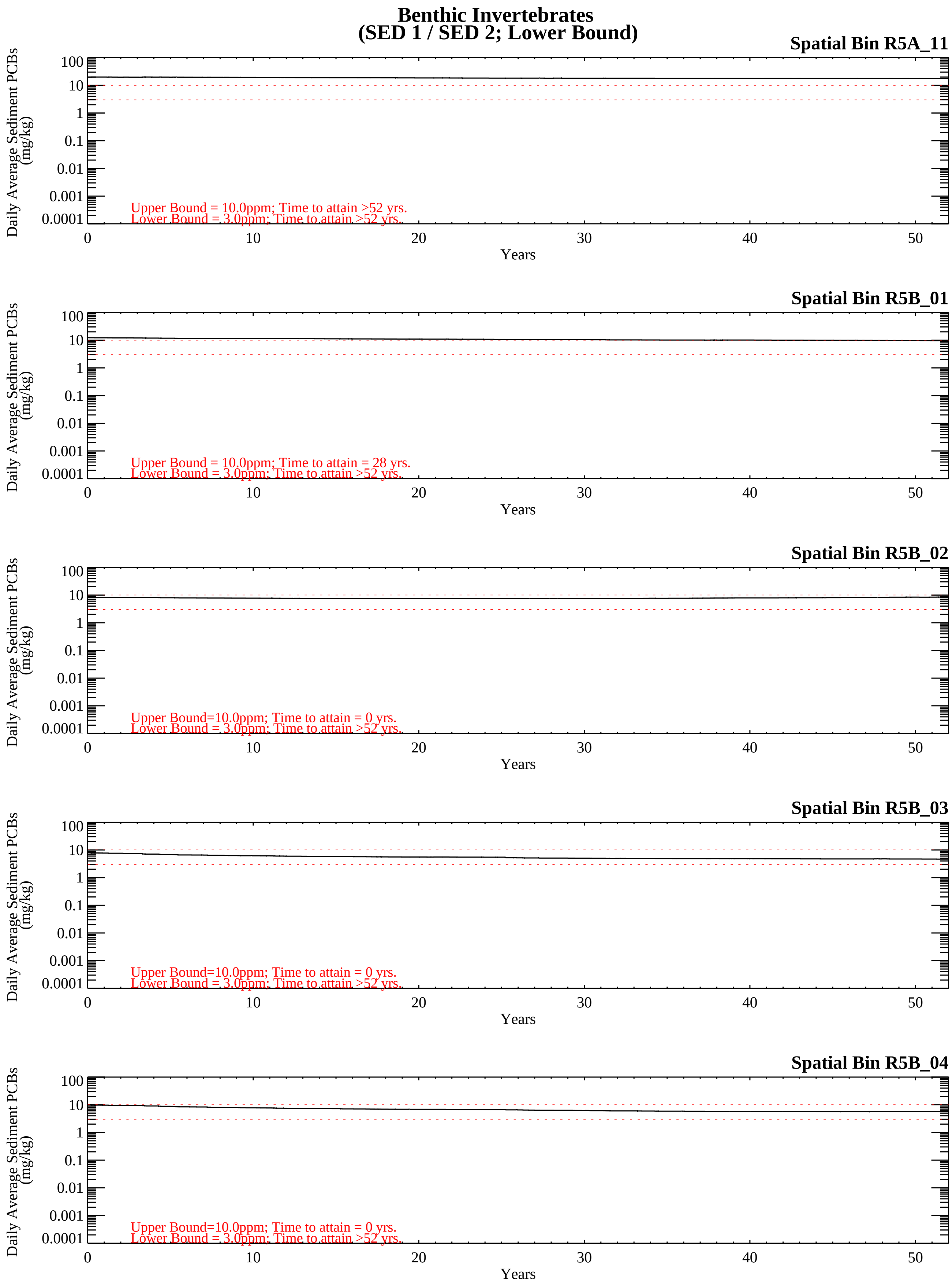

Figure G-4.4-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 1 / SED 2; Reach 5/6; Lower Bound).

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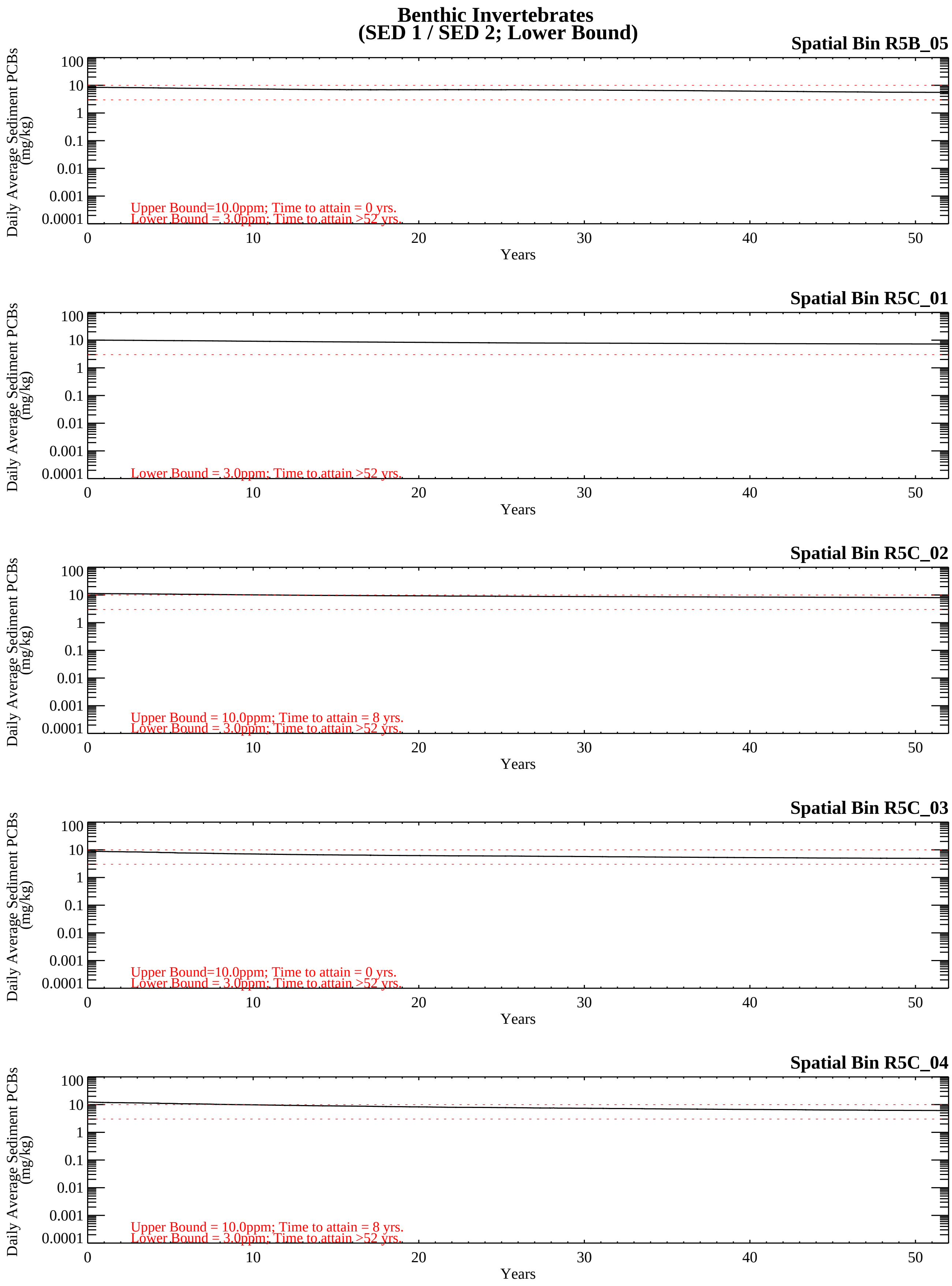
Benthic Invertebrates
(SED 1 / SED 2; Lower Bound)

Spatial Bin R5B_05

Spatial Bin R5C_01

Spatial Bin R5C_02

Spatial Bin R5C_03

Spatial Bin R5C_04

Figure G-4.4-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 1 / SED 2; Reach 5/6; Lower Bound).

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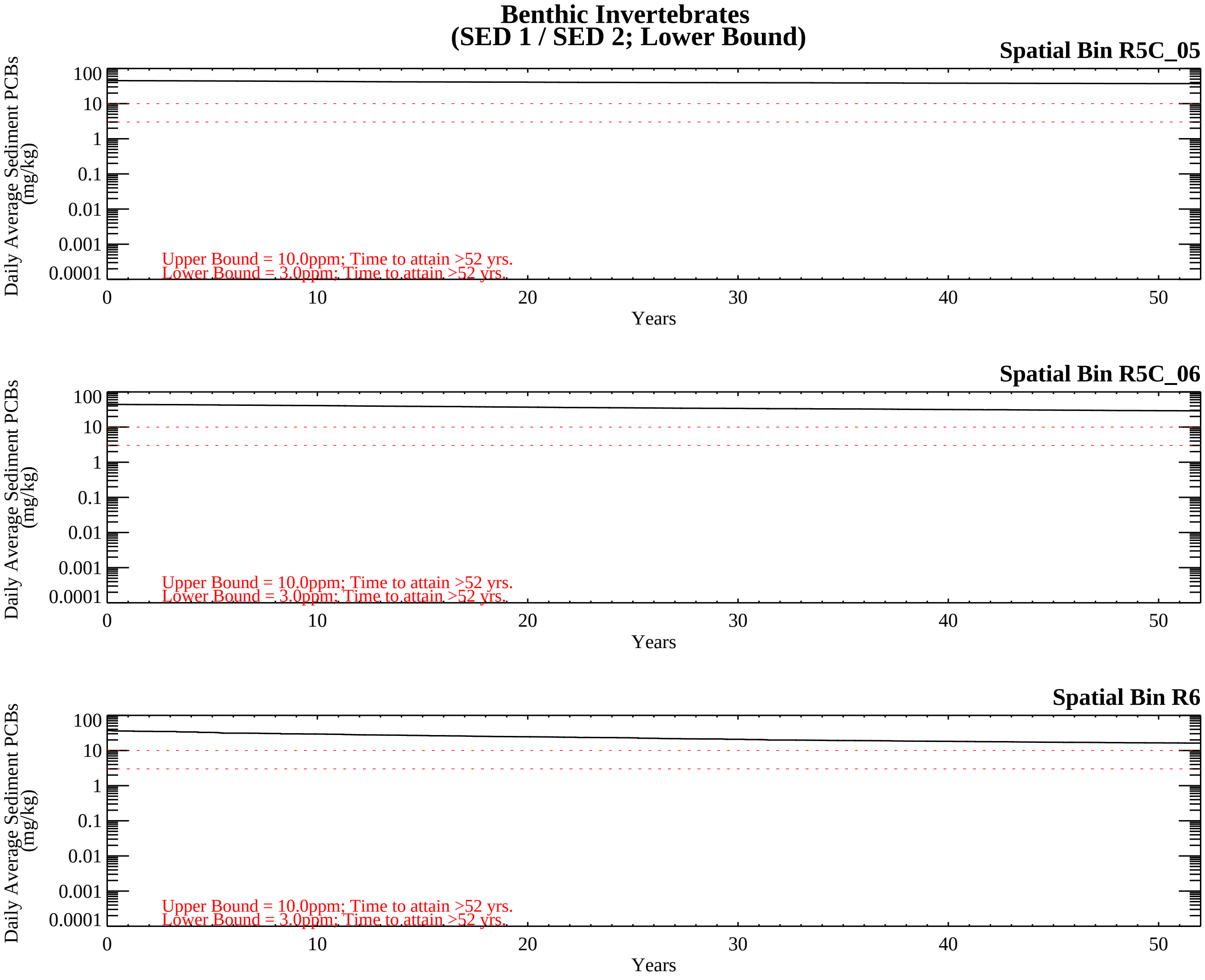

Benthic Invertebrates
(SED 1 / SED 2; Lower Bound)

Spatial Bin R5C_05

Spatial Bin R5C_06

Spatial Bin R6

Figure G-4.4-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 1 / SED 2; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED1CMSLB_0712-19\\bins

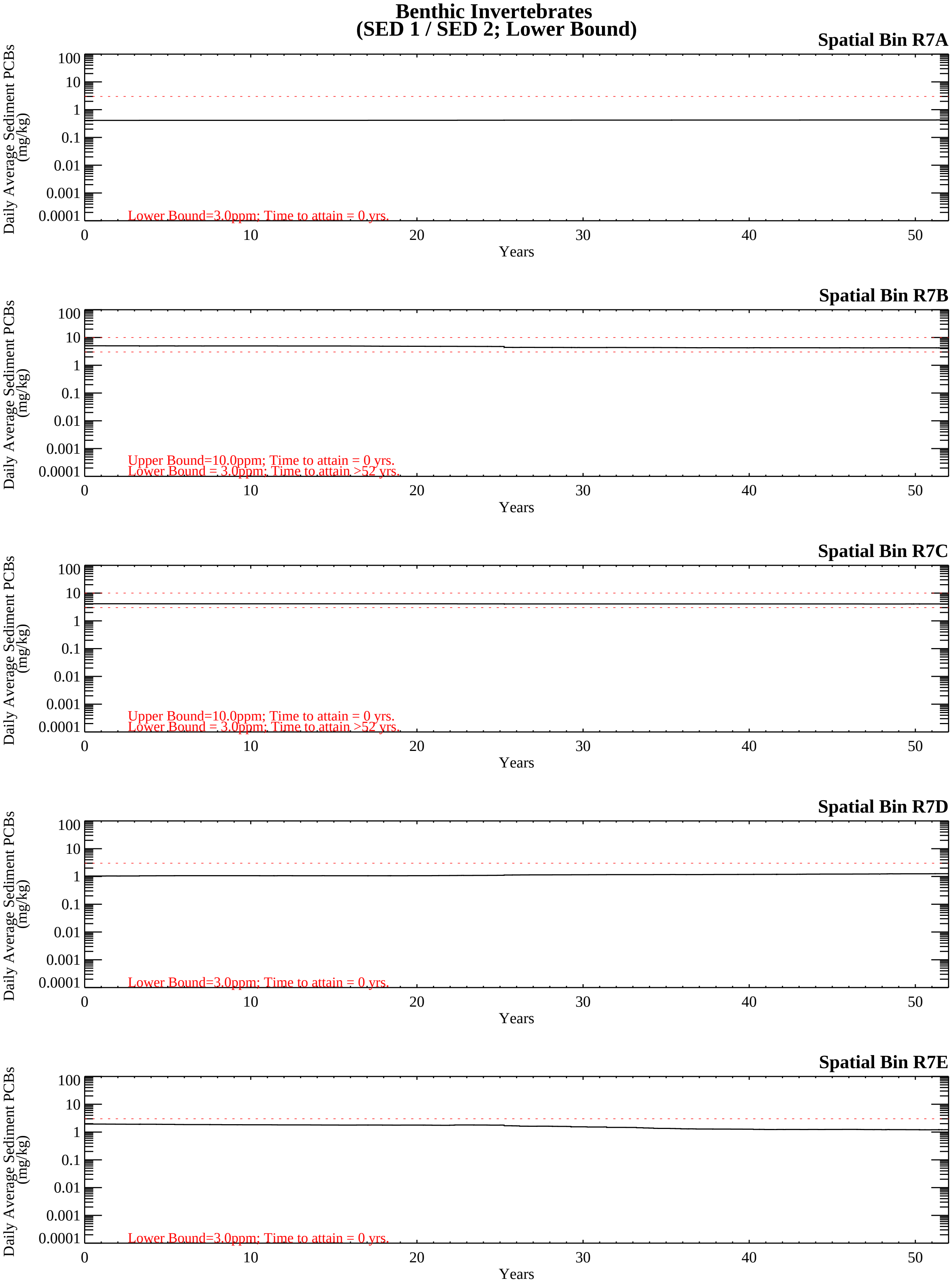

Figure G-4.4-1b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 1 / SED 2; Reach 7/8; Lower Bound).

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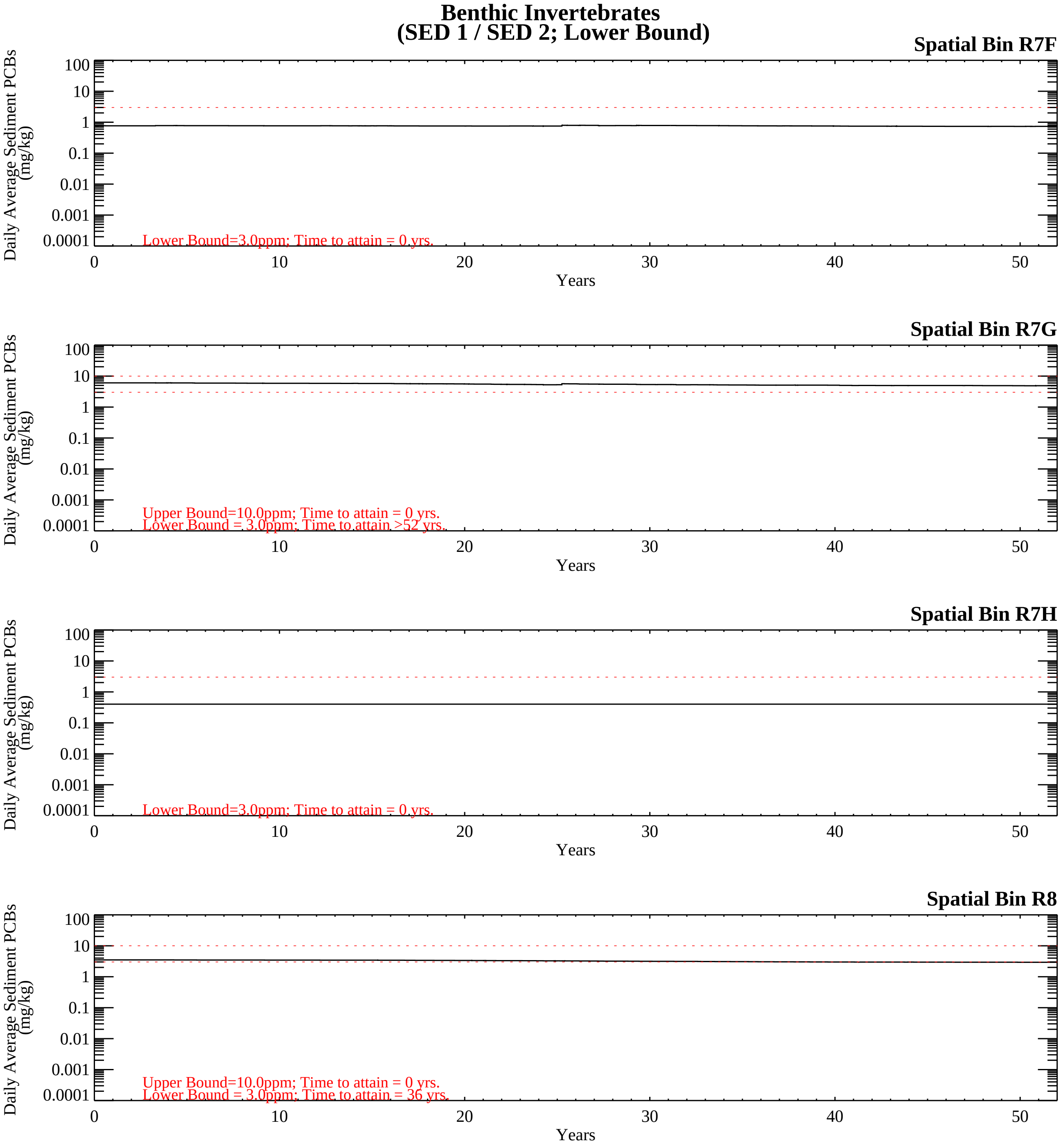

Figure G-4.4-1b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 1 / SED 2; Reach 7/8; Lower Bound).

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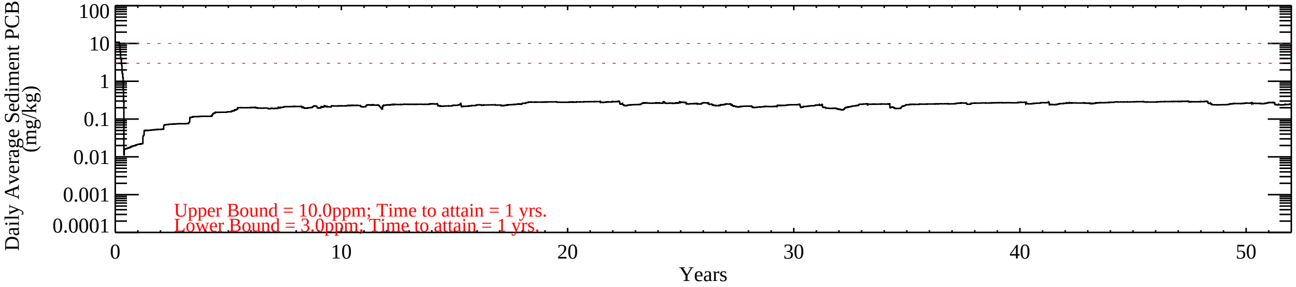
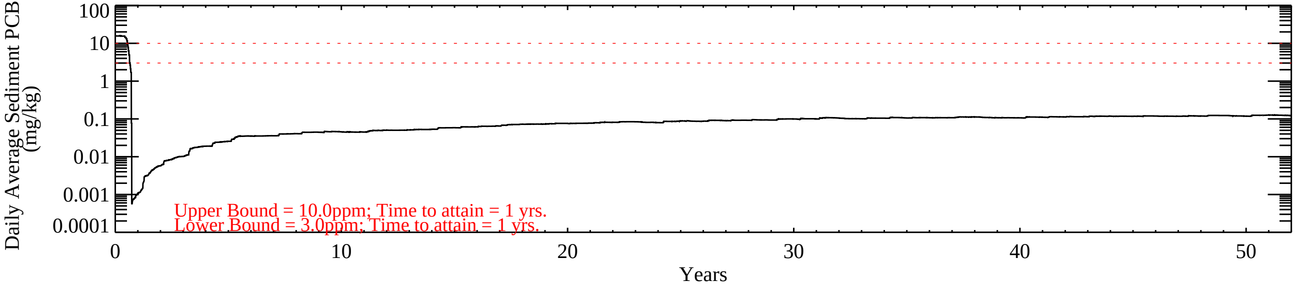
Benthic Invertebrates
(SED 3; Lower Bound)

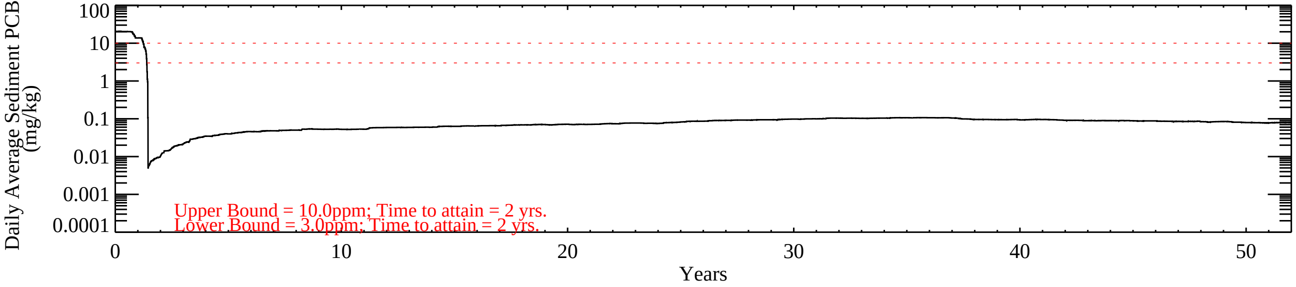
Spatial Bin R5A_01



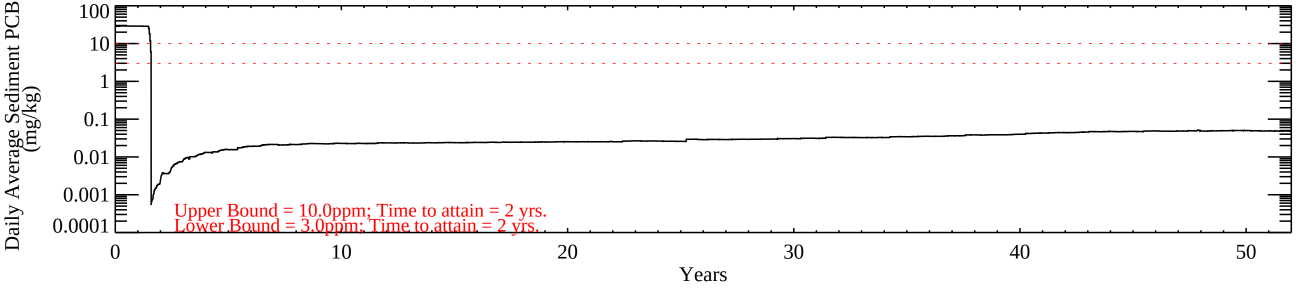
Spatial Bin R5A_02



Spatial Bin R5A_03



Spatial Bin R5A_04



Spatial Bin R5A_05

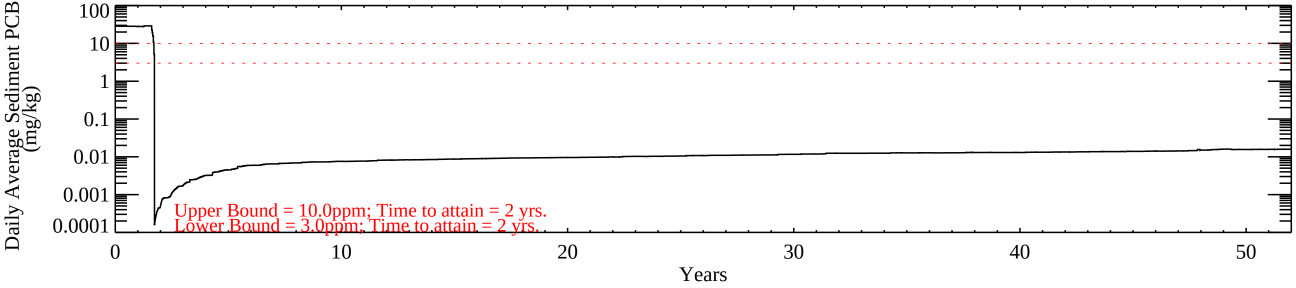


Figure G-4.4-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 3; Reach 5/6; Lower Bound).

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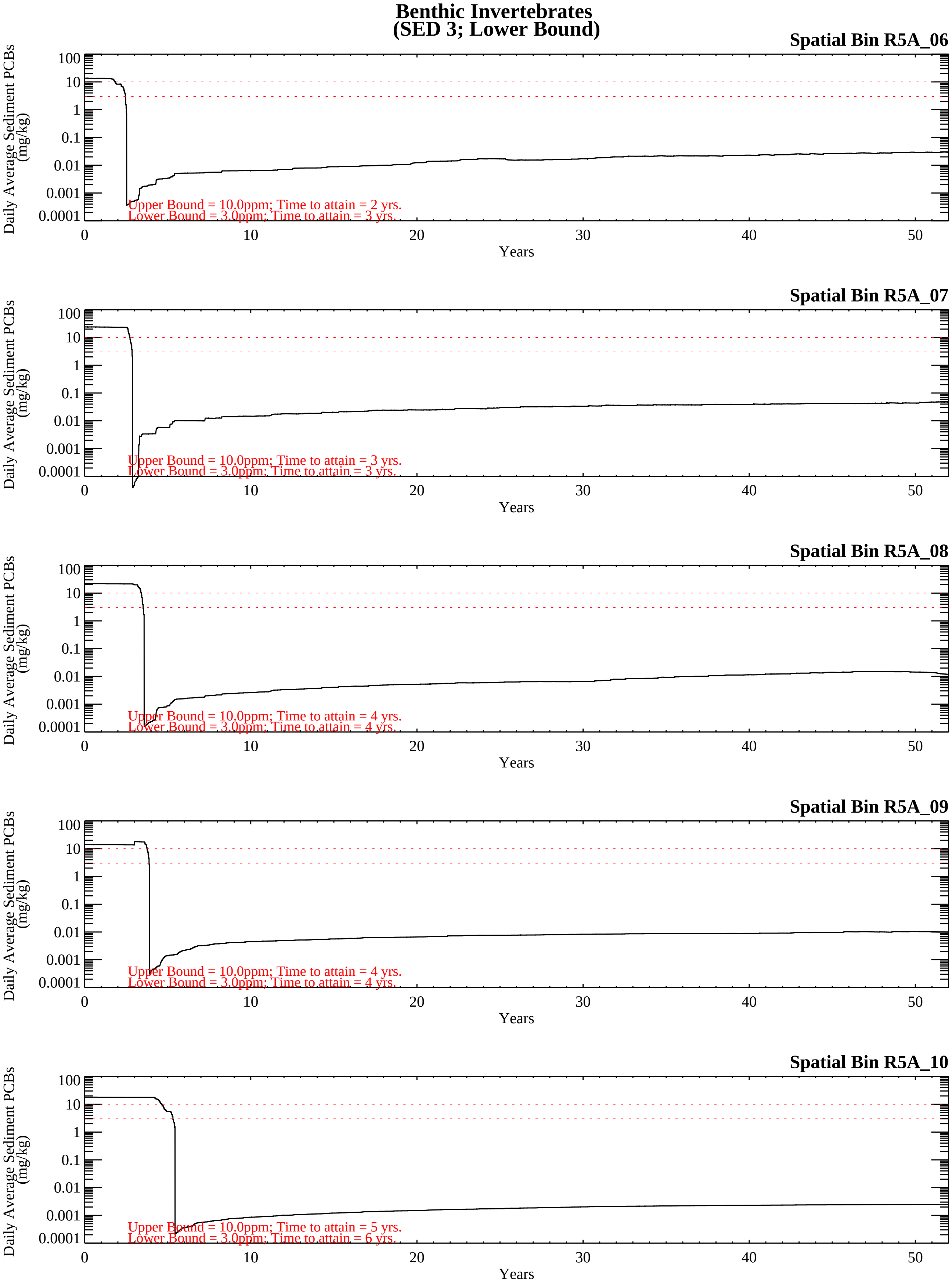

Figure G-4.4-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 3; Reach 5/6; Lower Bound).

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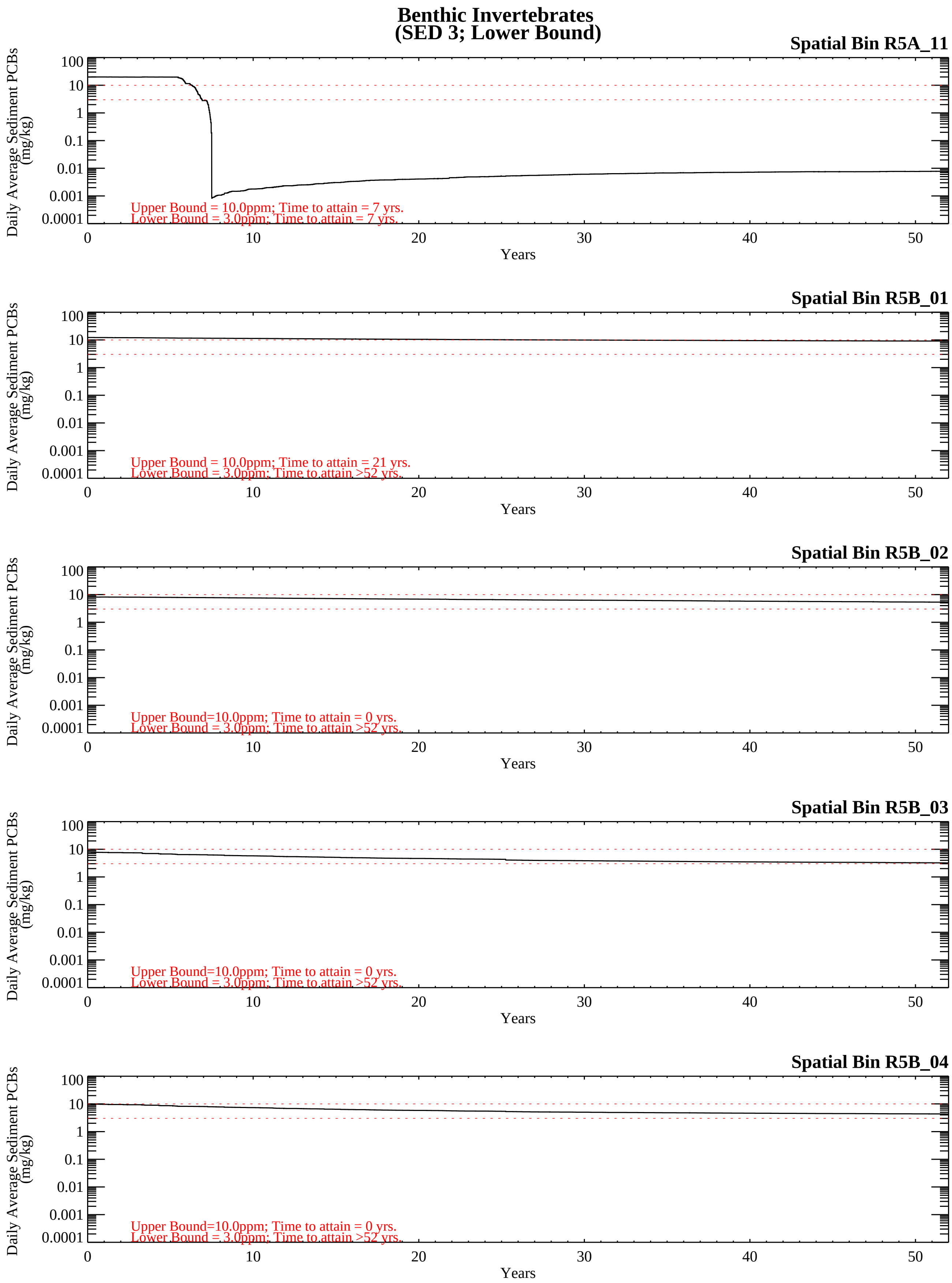

Figure G-4.4-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 3; Reach 5/6; Lower Bound).

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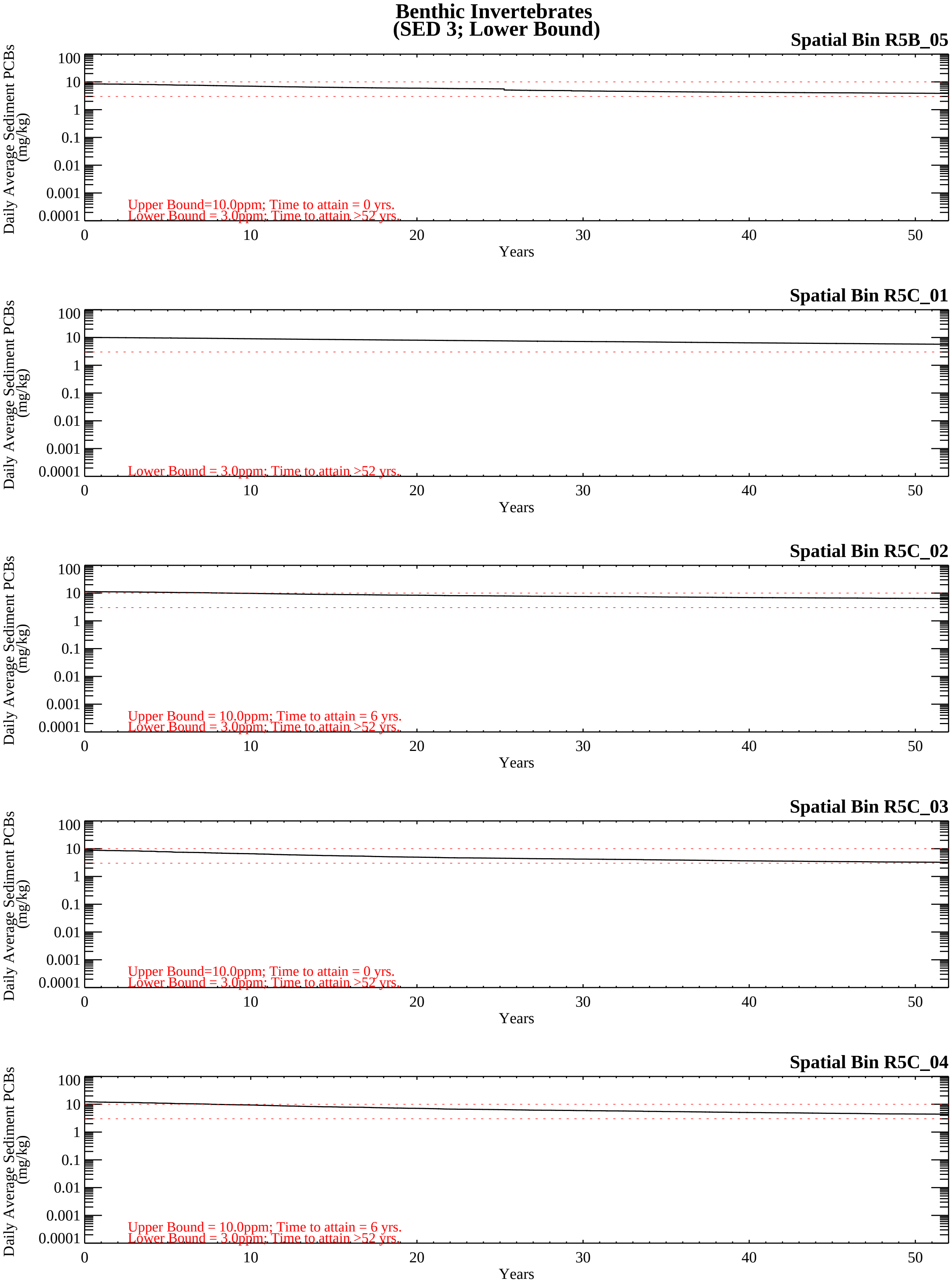

Figure G-4.4-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 3; Reach 5/6; Lower Bound).

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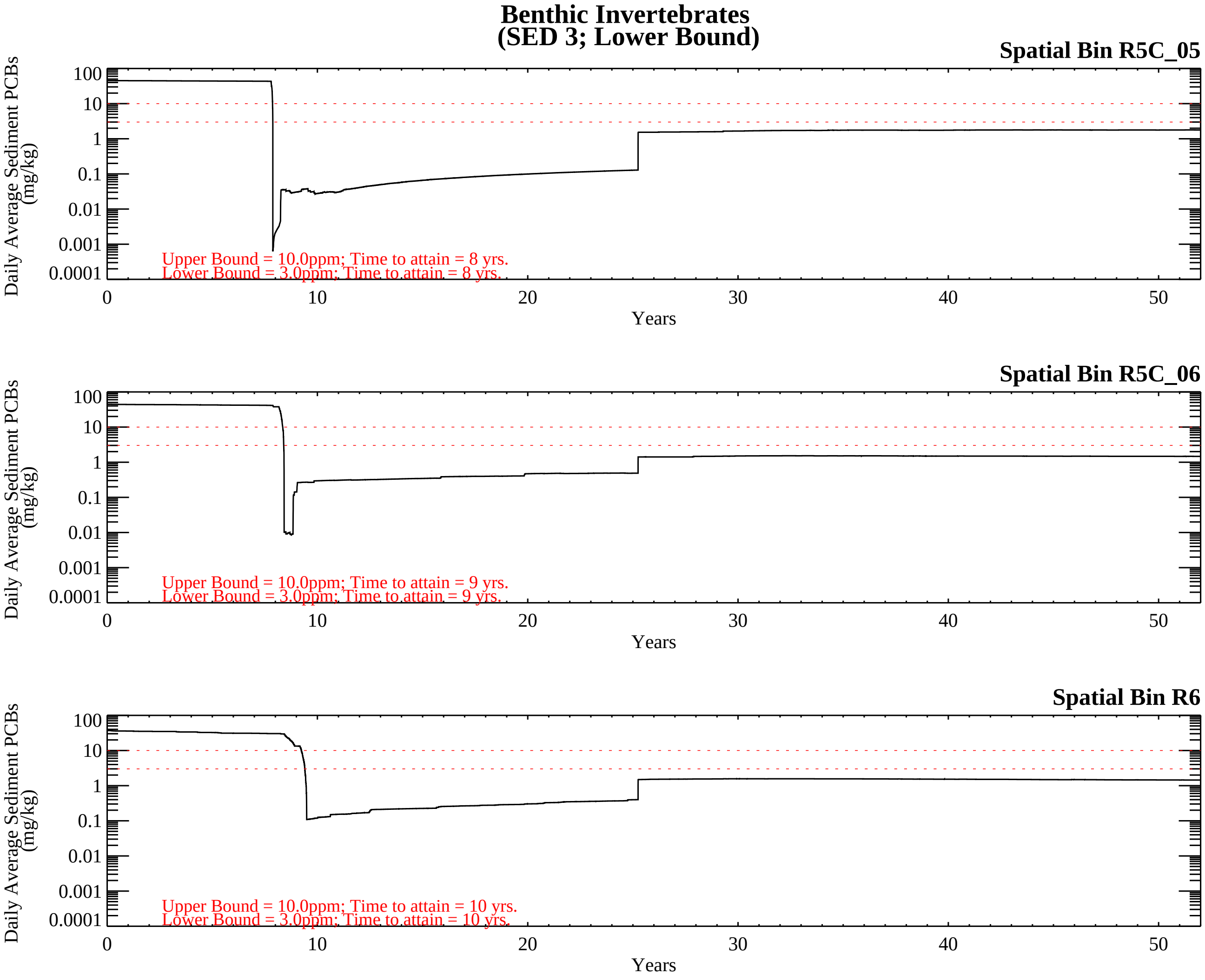

Benthic Invertebrates
(SED 3; Lower Bound)

Spatial Bin R5C_05

Upper Bound = 10.0ppm; Time to attain = 8 yrs.
Lower Bound = 3.0ppm; Time to attain = 8 yrs.

Spatial Bin R5C_06

Upper Bound = 10.0ppm; Time to attain = 9 yrs.
Lower Bound = 3.0ppm; Time to attain = 9 yrs.

Spatial Bin R6

Upper Bound = 10.0ppm; Time to attain = 10 yrs.
Lower Bound = 3.0ppm; Time to attain = 10 yrs.

Figure G-4.4-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 3; Reach 5/6; Lower Bound).

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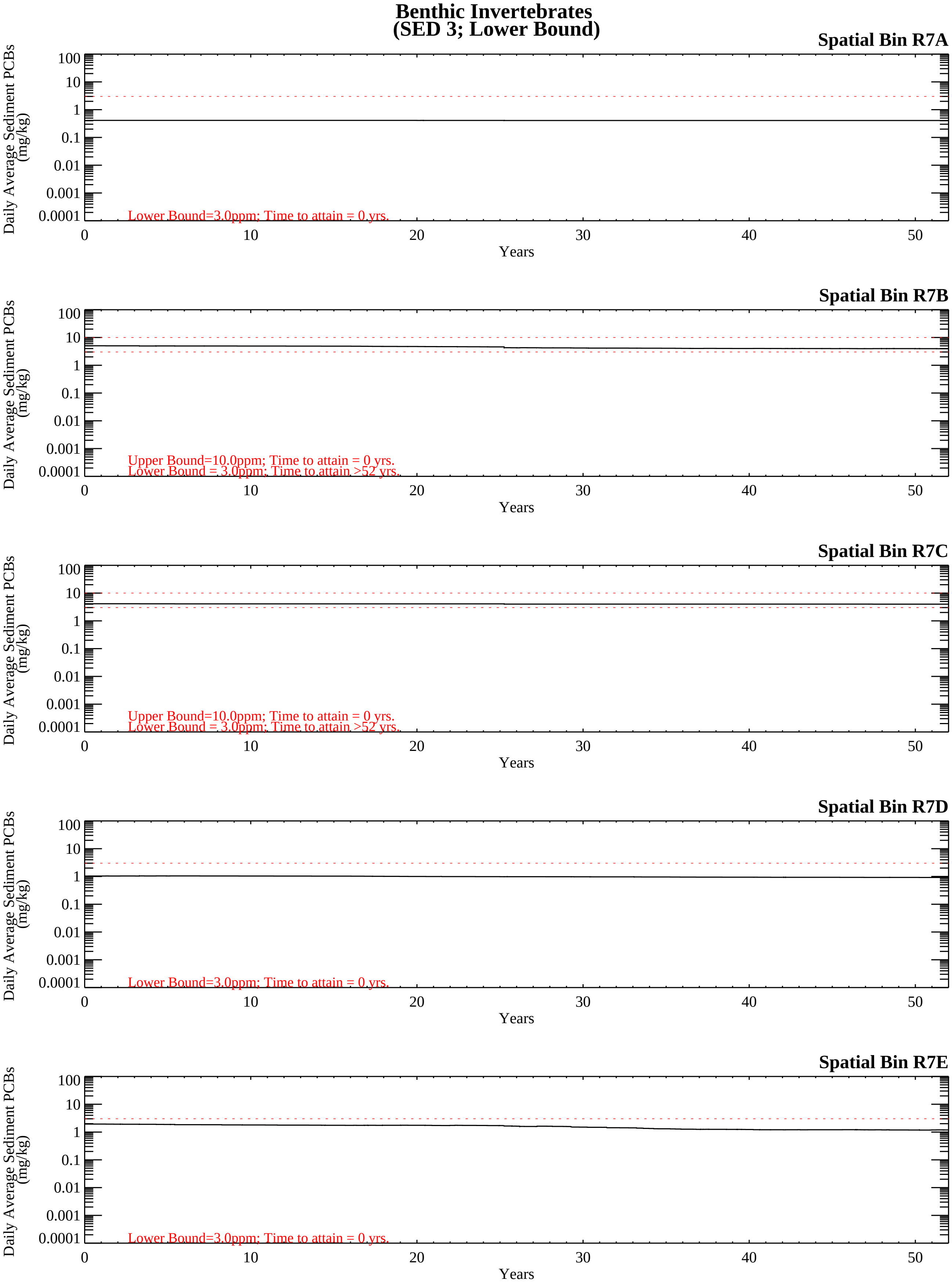

Figure G-4.4-2b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 3; Reach 7/8; Lower Bound).

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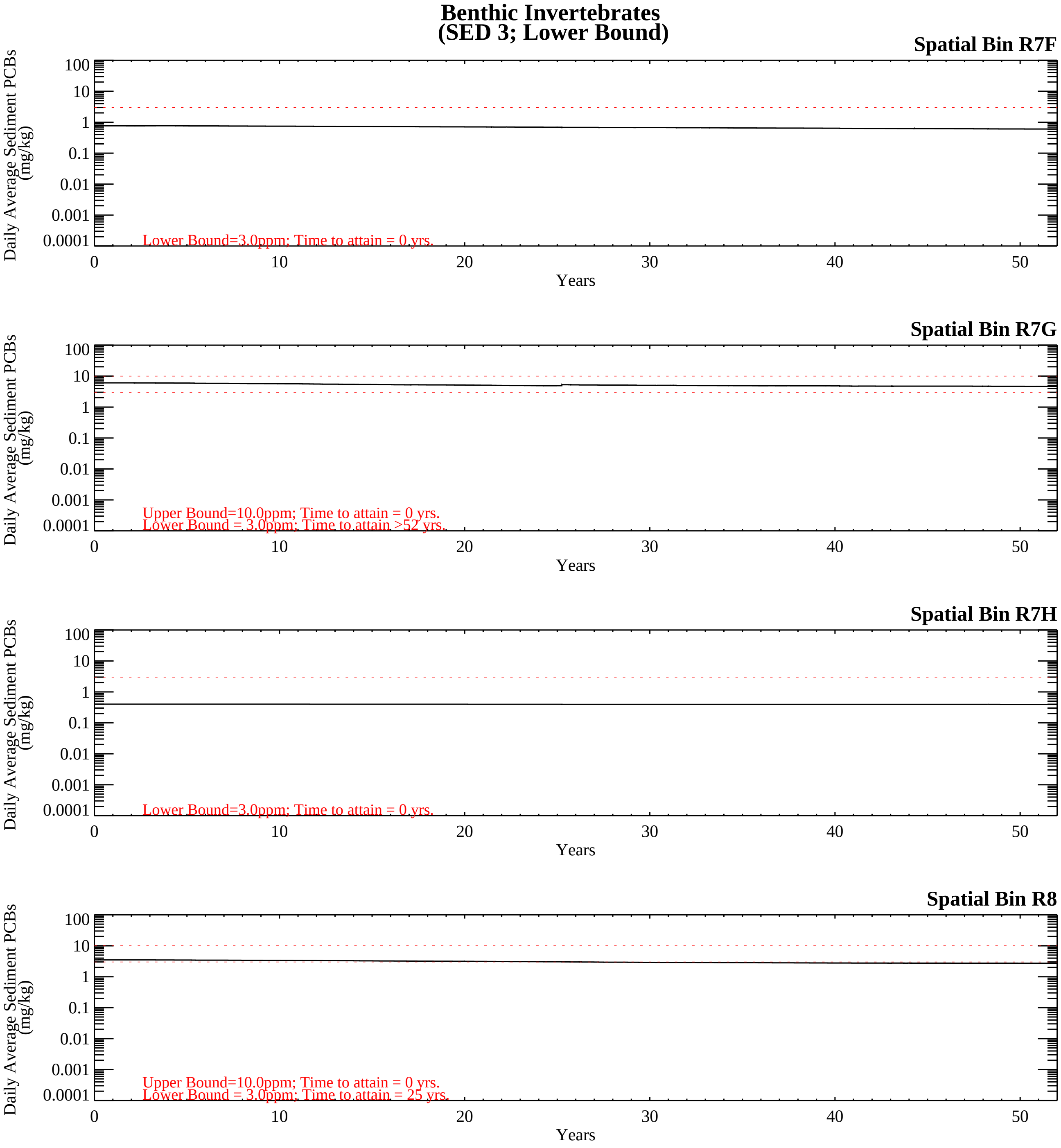

Figure G-4.4-2b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 3; Reach 7/8; Lower Bound).

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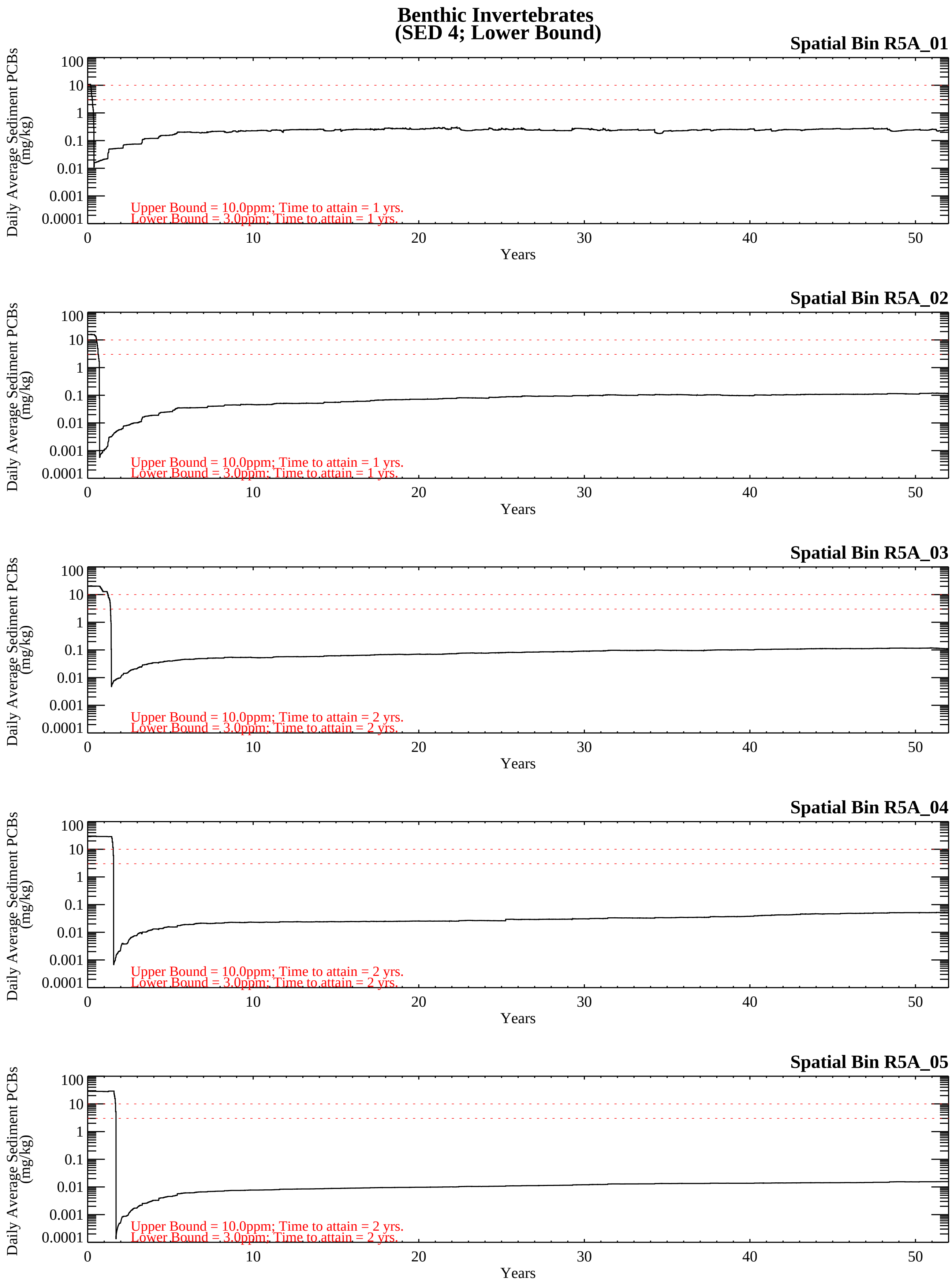

Figure G-4.4-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 4; Reach 5/6; Lower Bound).

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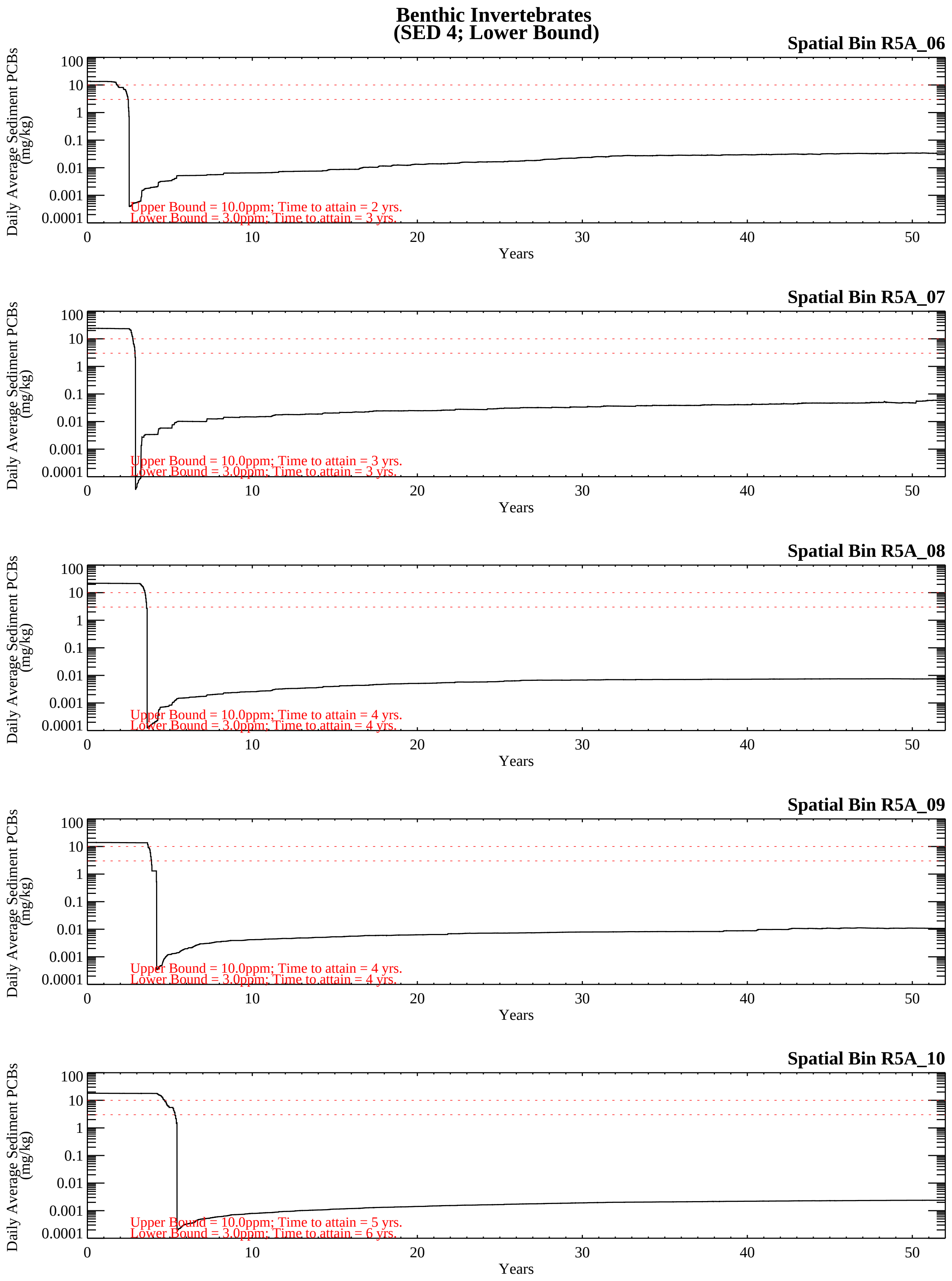

Figure G-4.4-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 4; Reach 5/6; Lower Bound).

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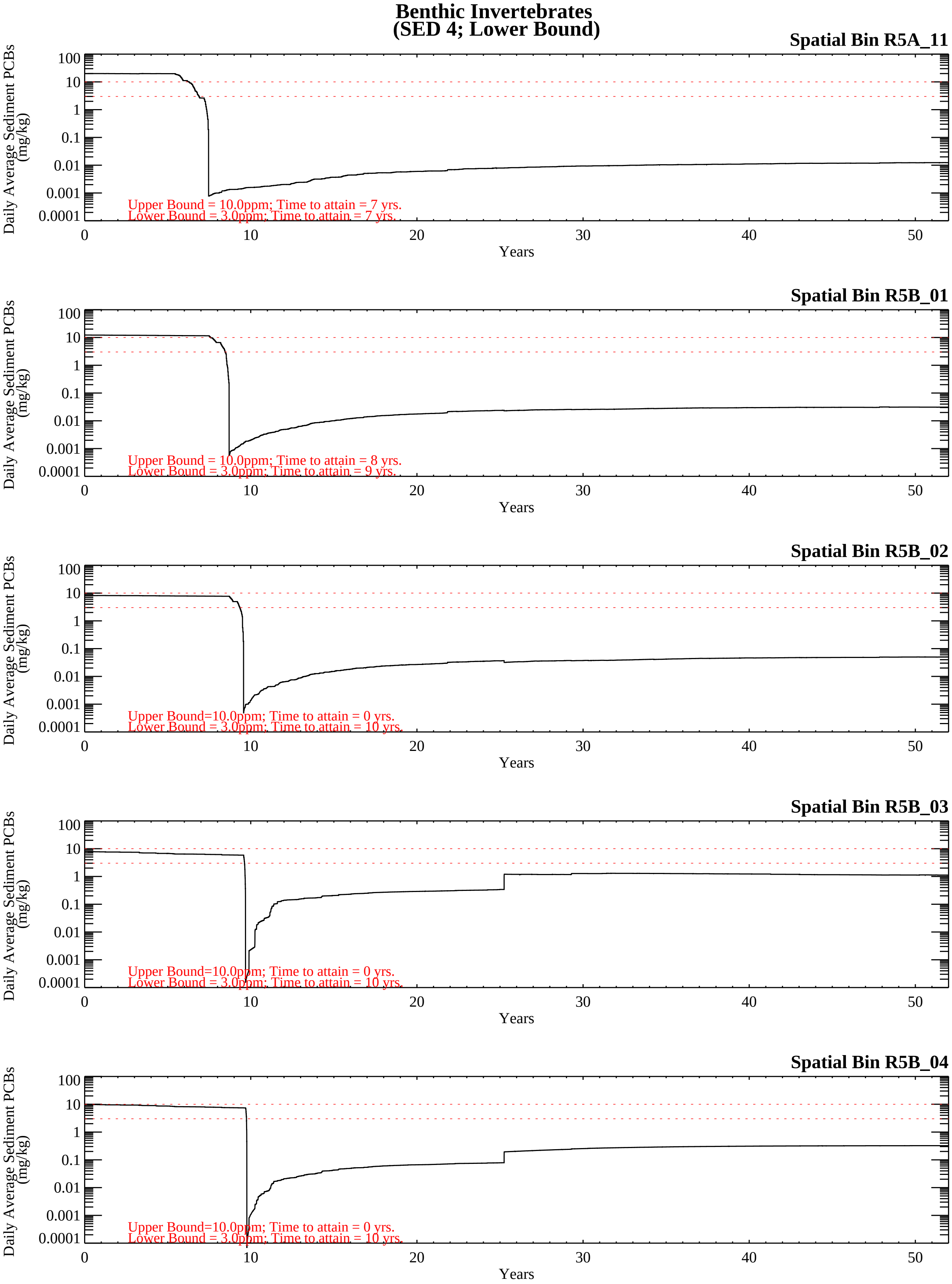

Figure G-4.4-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 4; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED4CMSLB_0801-03\\bins

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Benthic Invertebrates
(SED 4; Lower Bound)

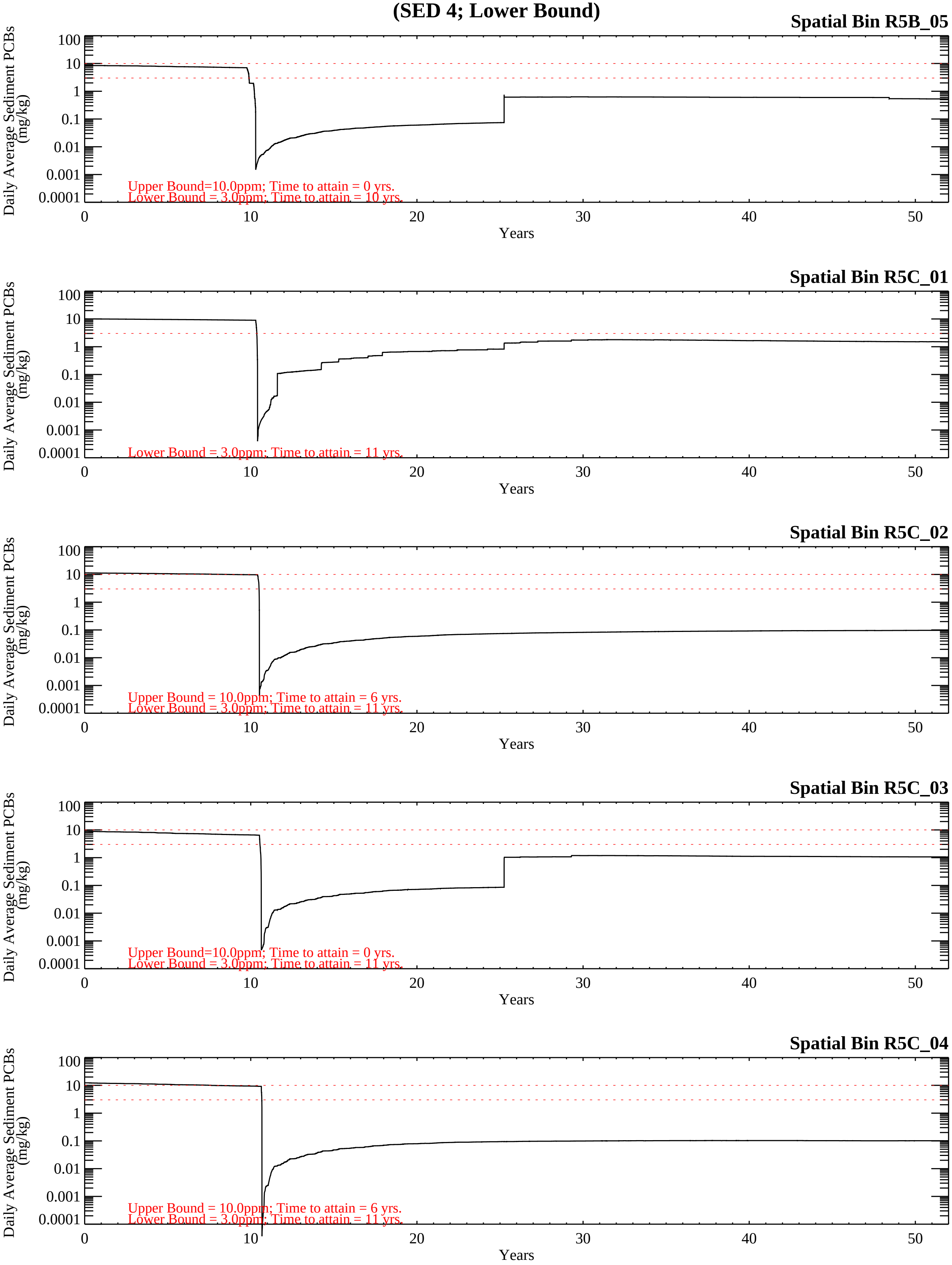

Figure G-4.4-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 4; Reach 5/6; Lower Bound).

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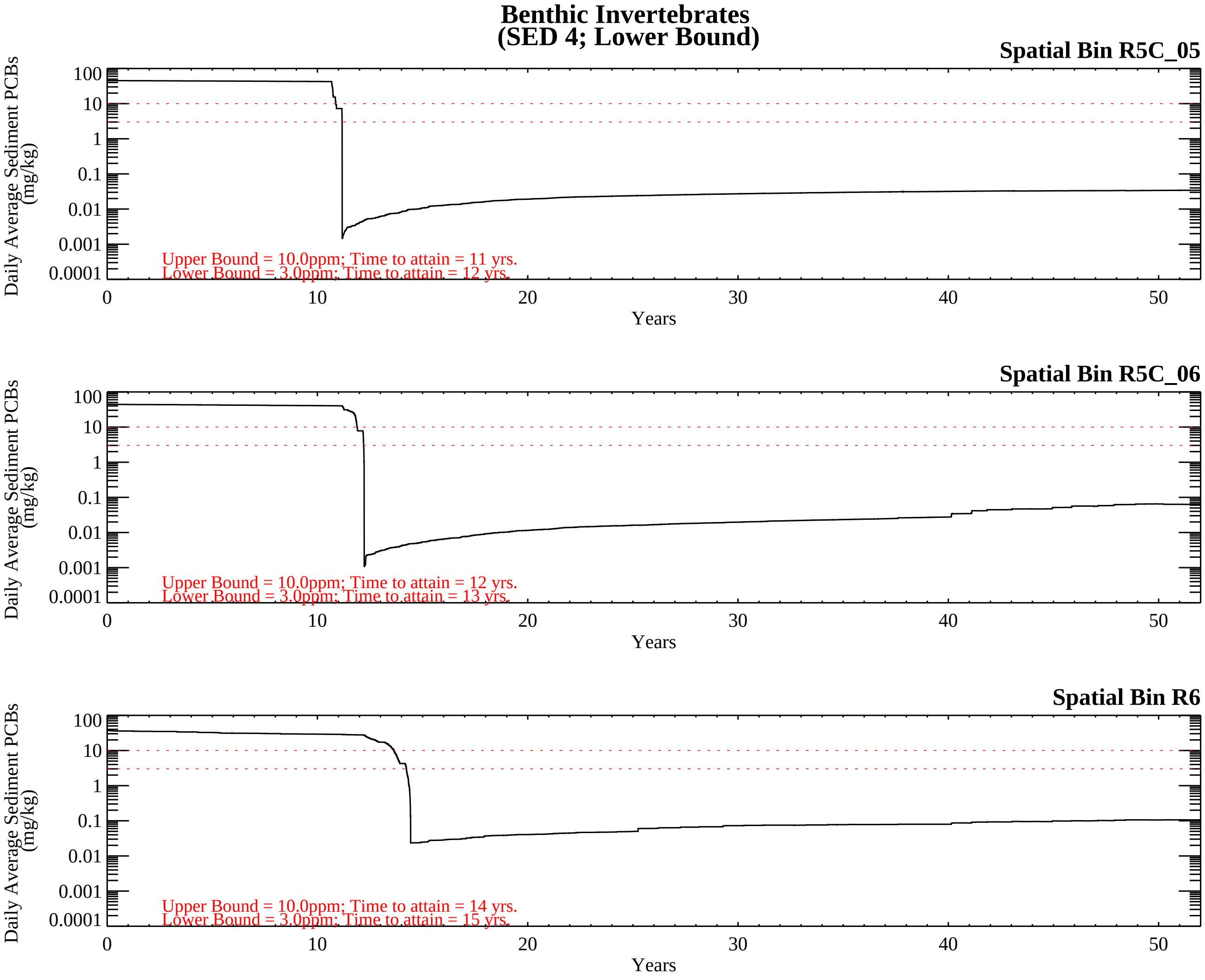

Figure G-4.4-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 4; Reach 5/6; Lower Bound).

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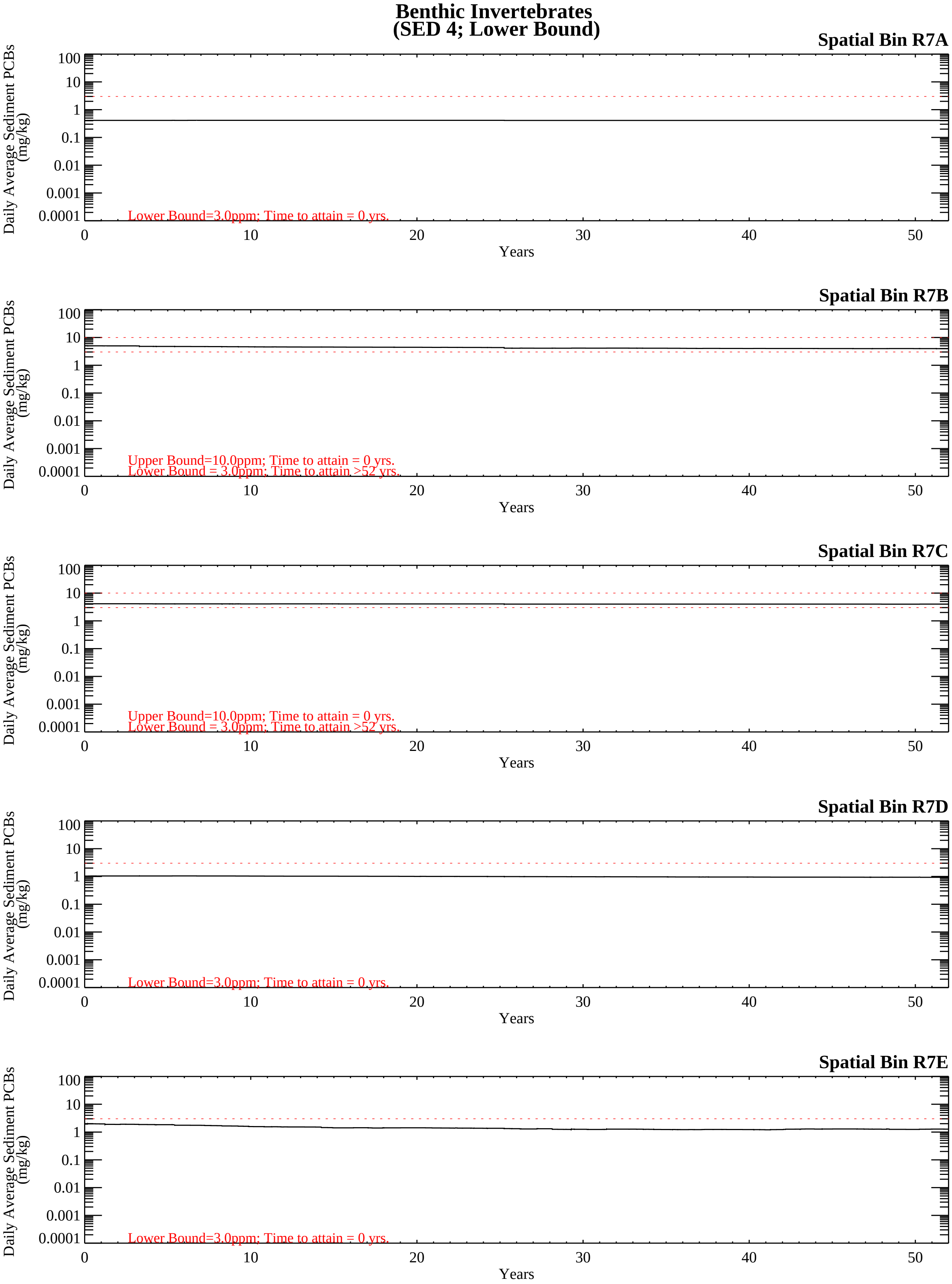

Figure G-4.4-3b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 4; Reach 7/8; Lower Bound).

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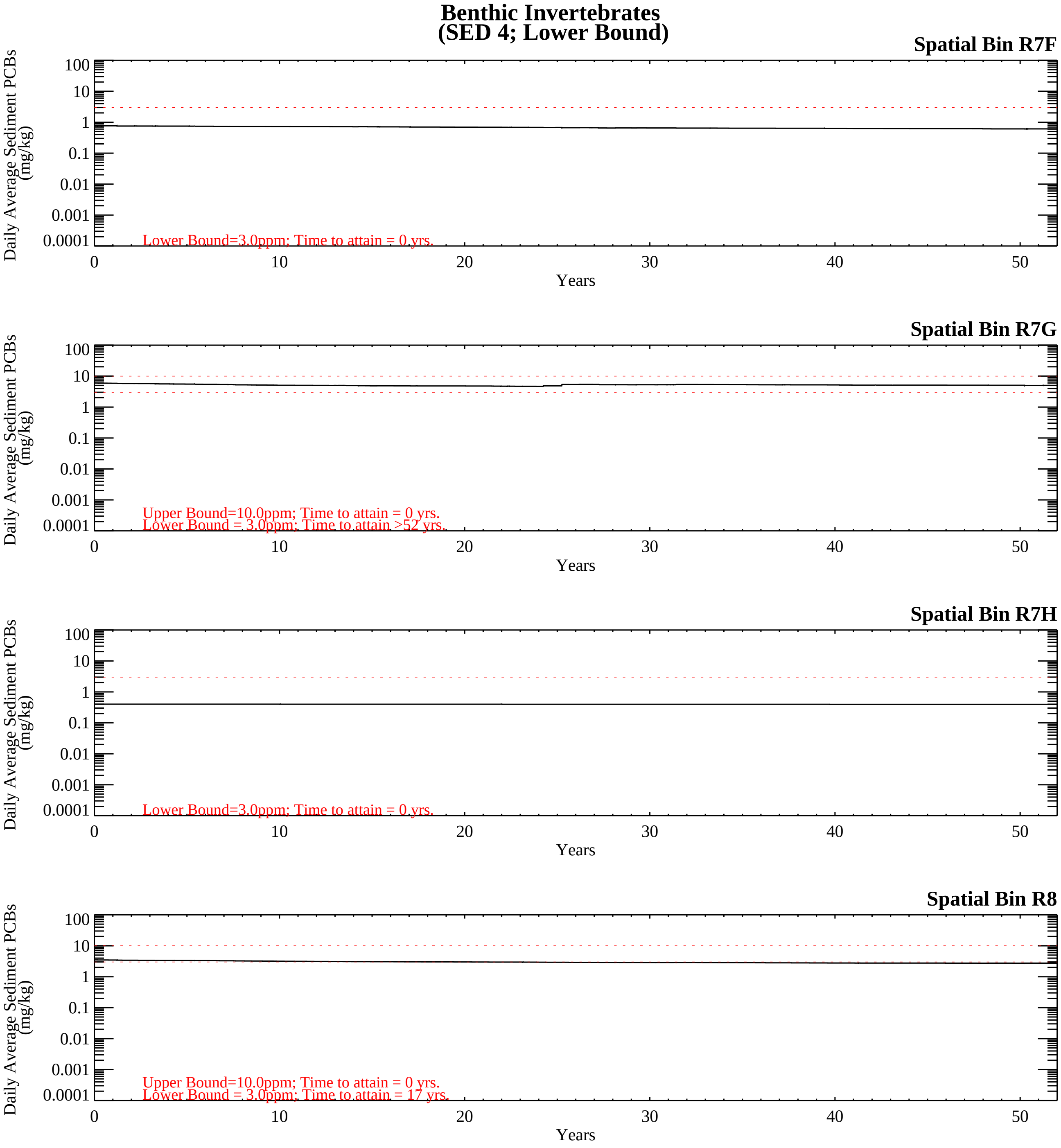
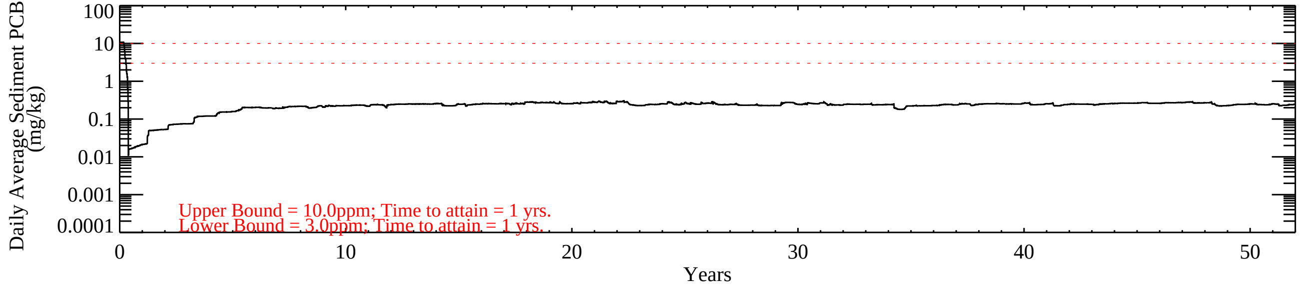


Figure G-4.4-3b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 4; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED4CMSLB_0802-03\\bins

Benthic Invertebrates
(SED 5; Lower Bound)

Spatial Bin R5A_01



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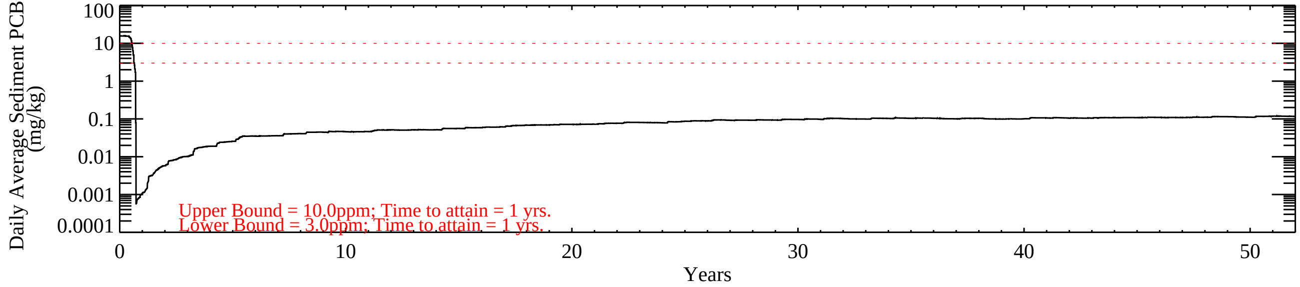
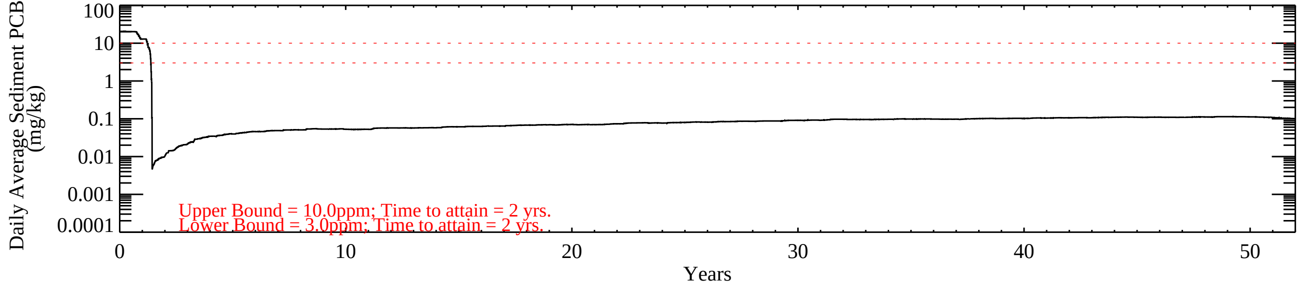
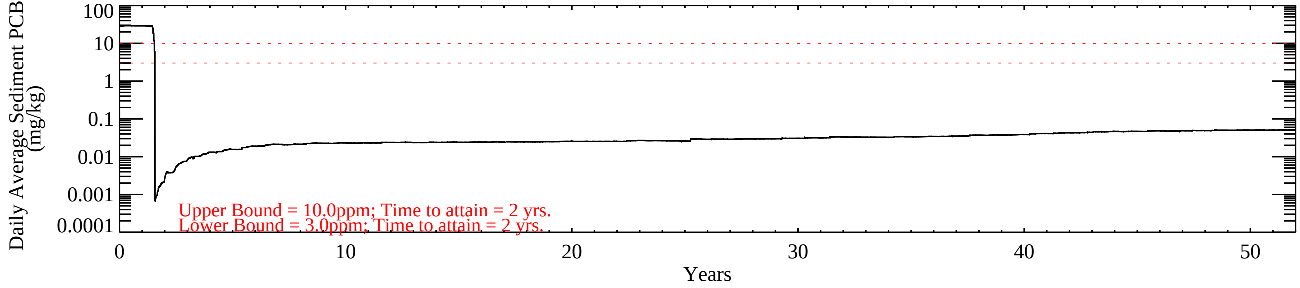


Spatial Bin R5A_03



Spatial Bin R5A_04



Spatial Bin R5A_05

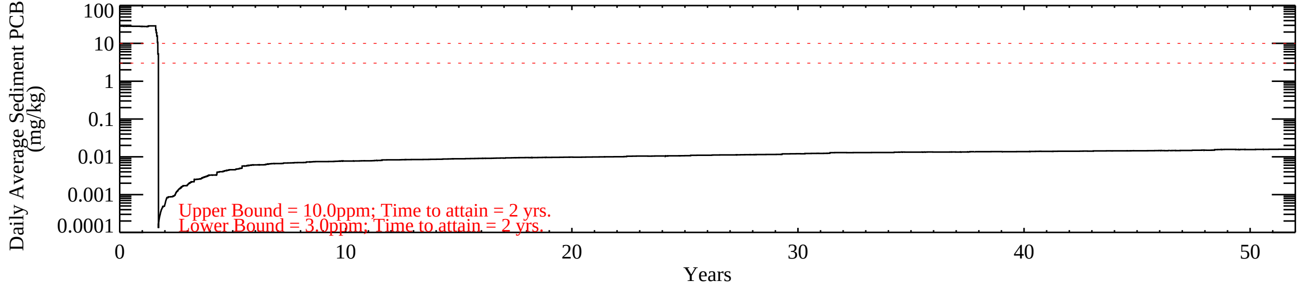


Figure G-4.4-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 5; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED5CMSLB_0801-04\\bins

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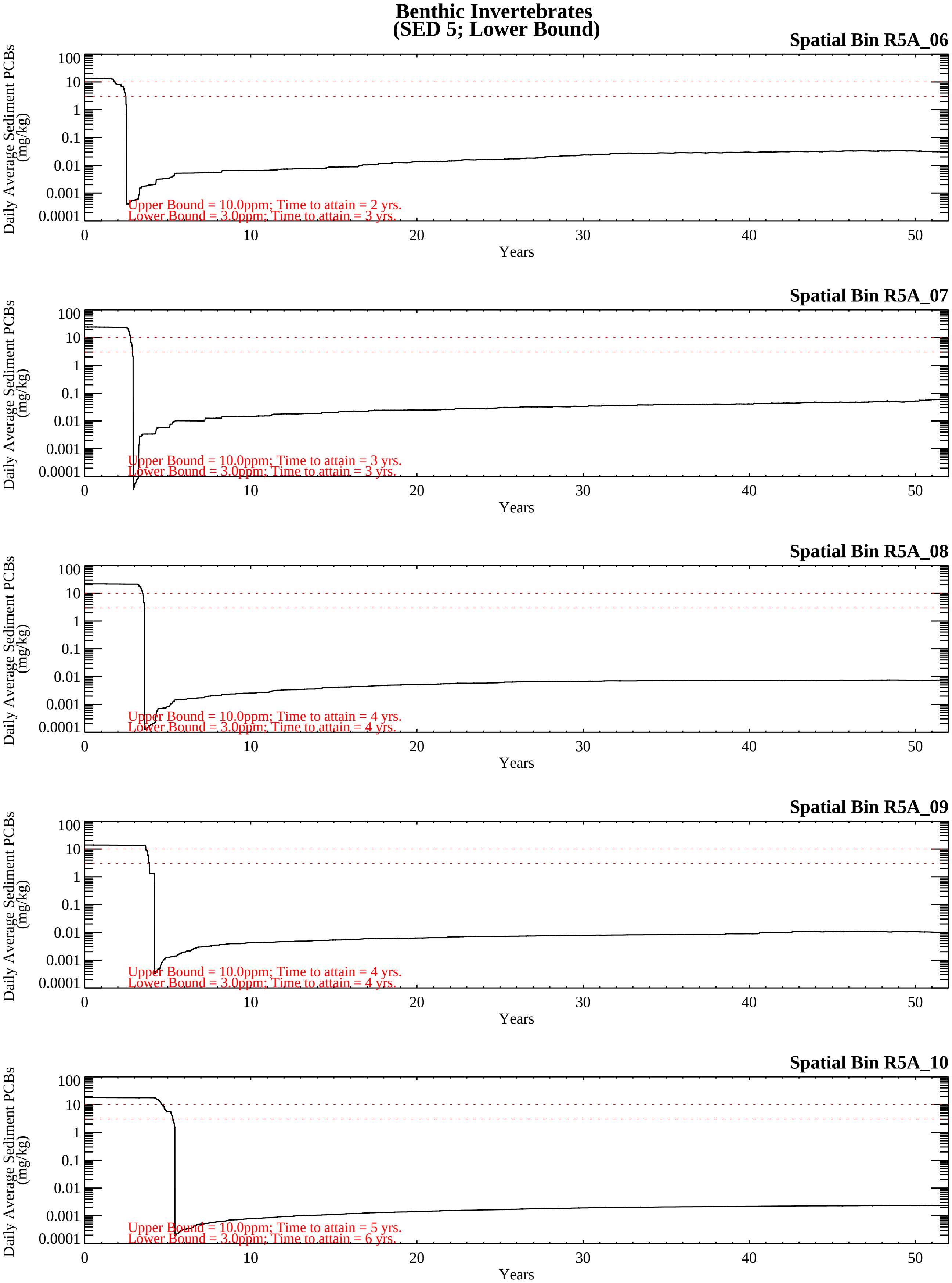

Figure G-4.4-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 5; Reach 5/6; Lower Bound).

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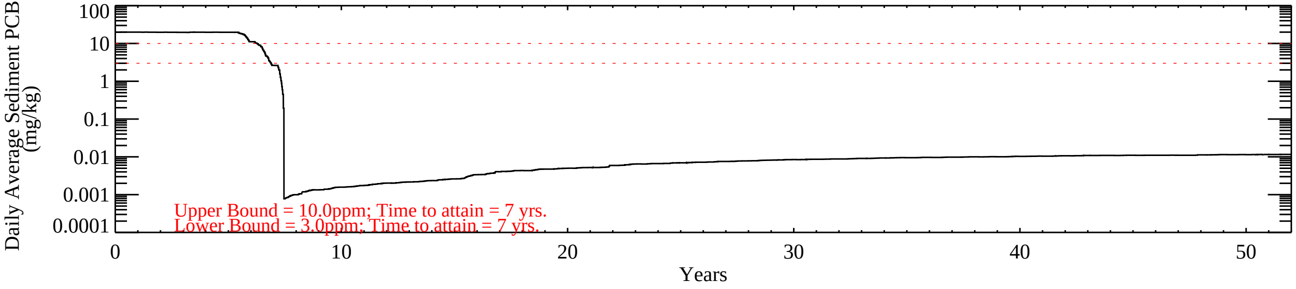
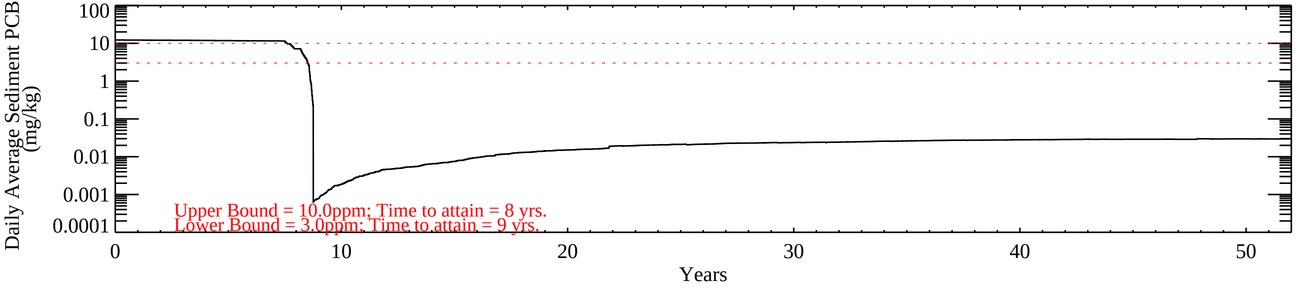
Benthic Invertebrates
(SED 5; Lower Bound)

Spatial Bin R5A_11



Spatial Bin R5B_01



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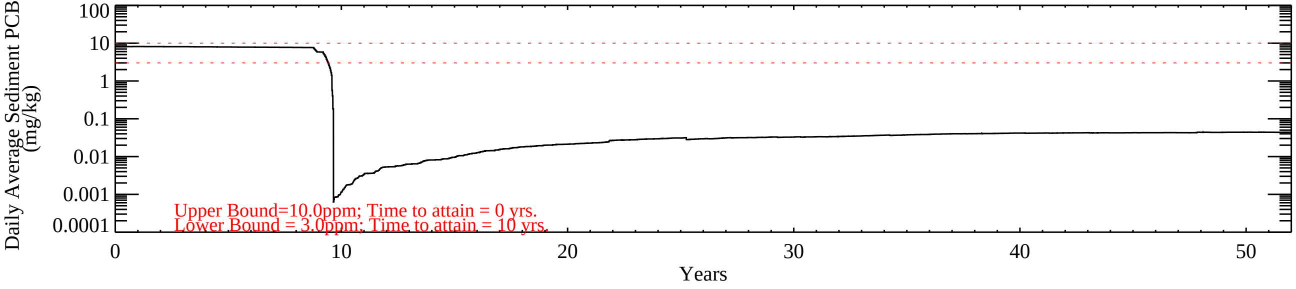
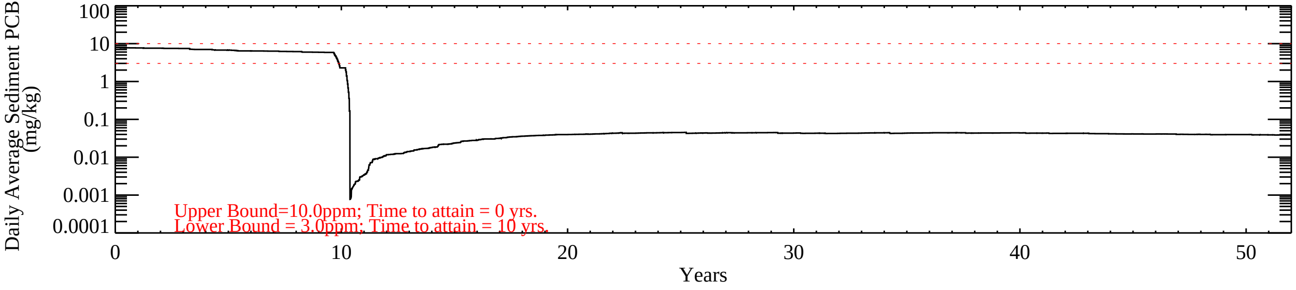


Spatial Bin R5B_03



Spatial Bin R5B_04

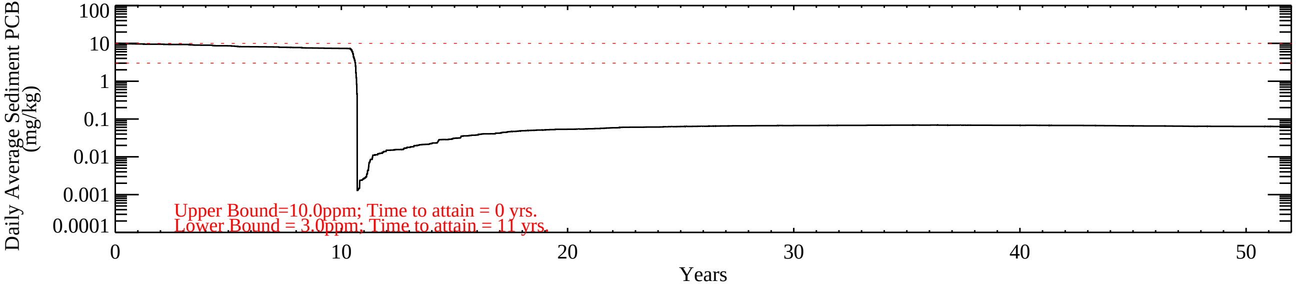


Figure G-4.4-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 5; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED5CMSLB_0801-04\\bins

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Benthic Invertebrates
(SED 5; Lower Bound)

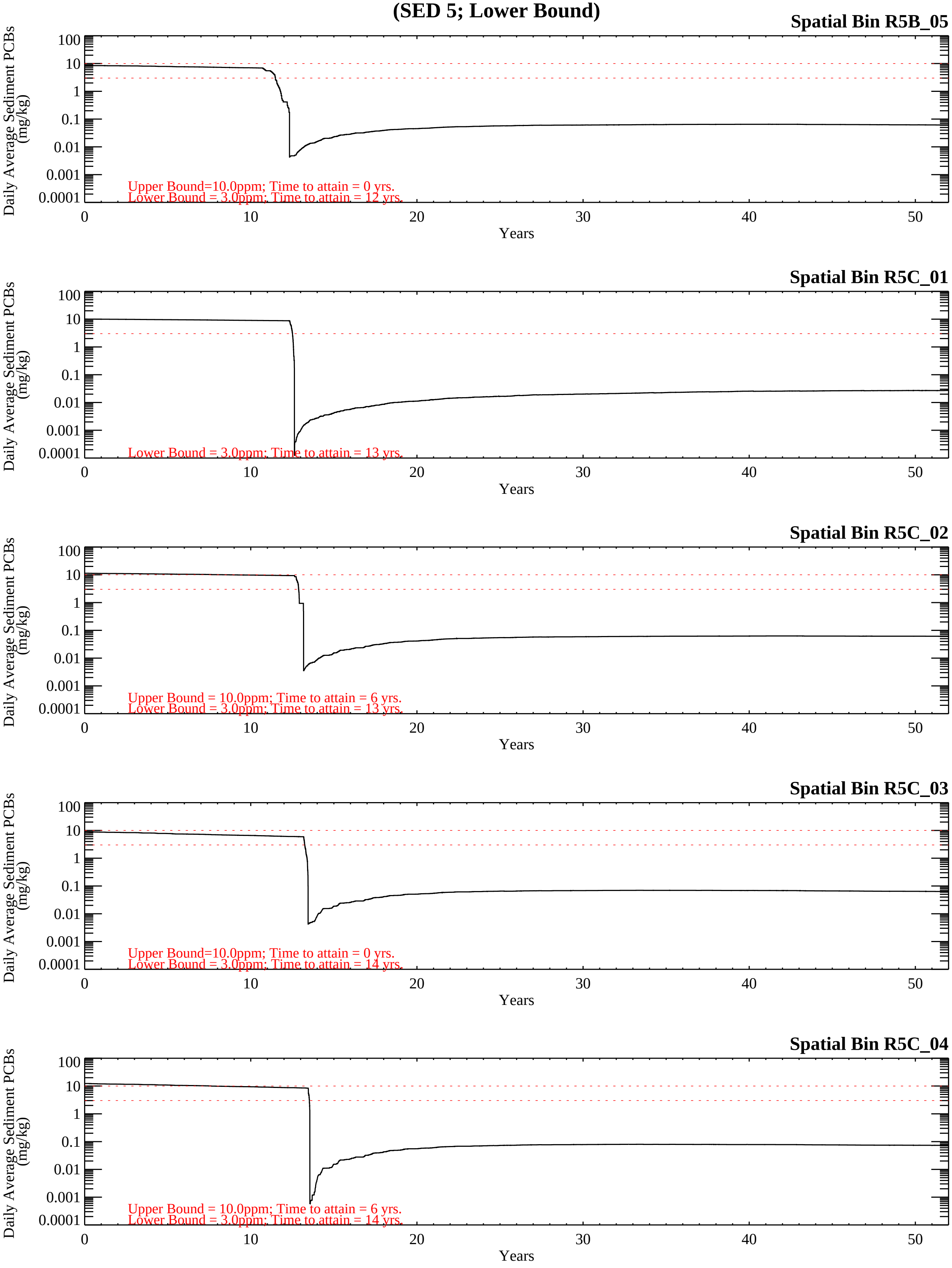

Figure G-4.4-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 5; Reach 5/6; Lower Bound).

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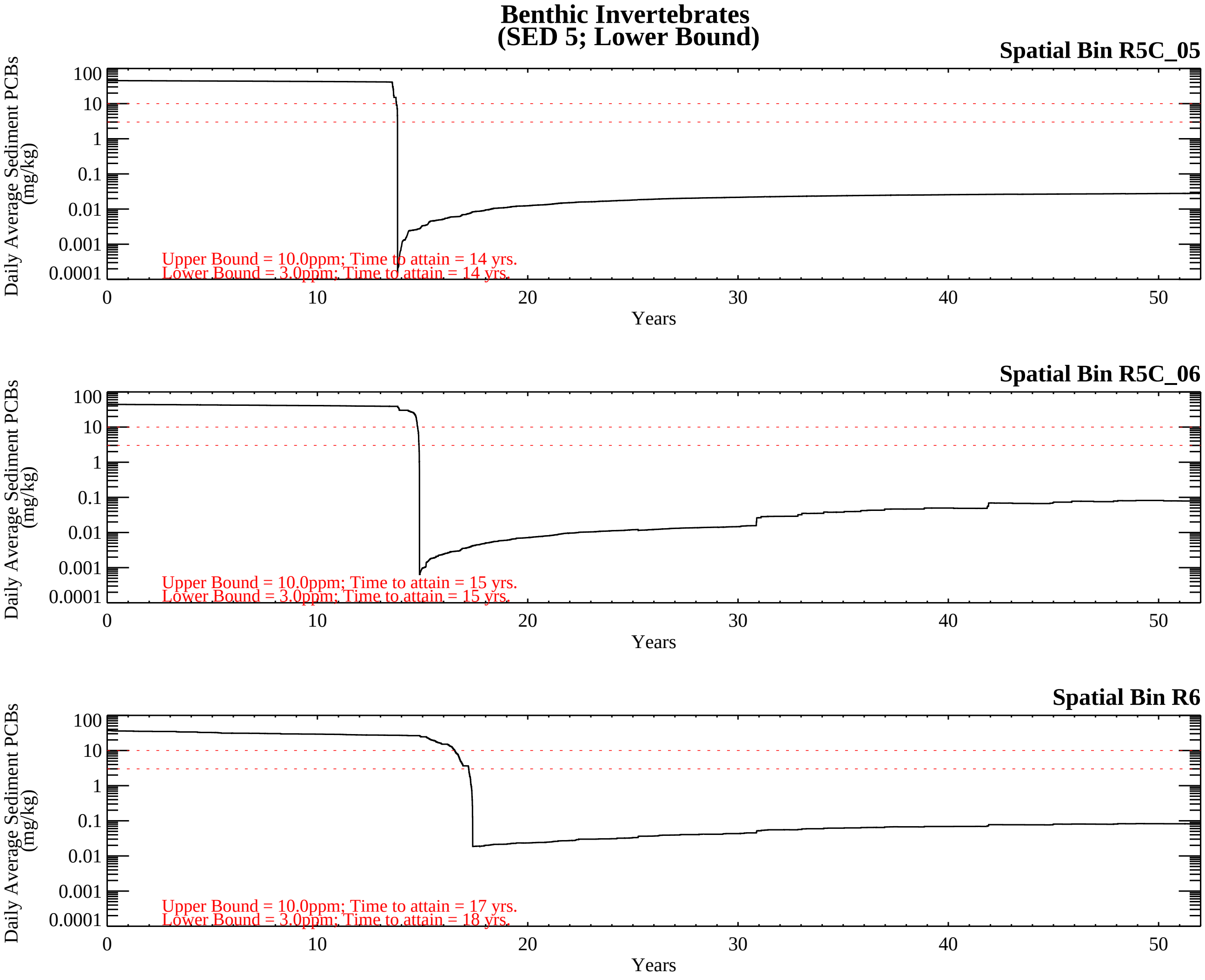

Figure G-4.4-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 5; Reach 5/6; Lower Bound).

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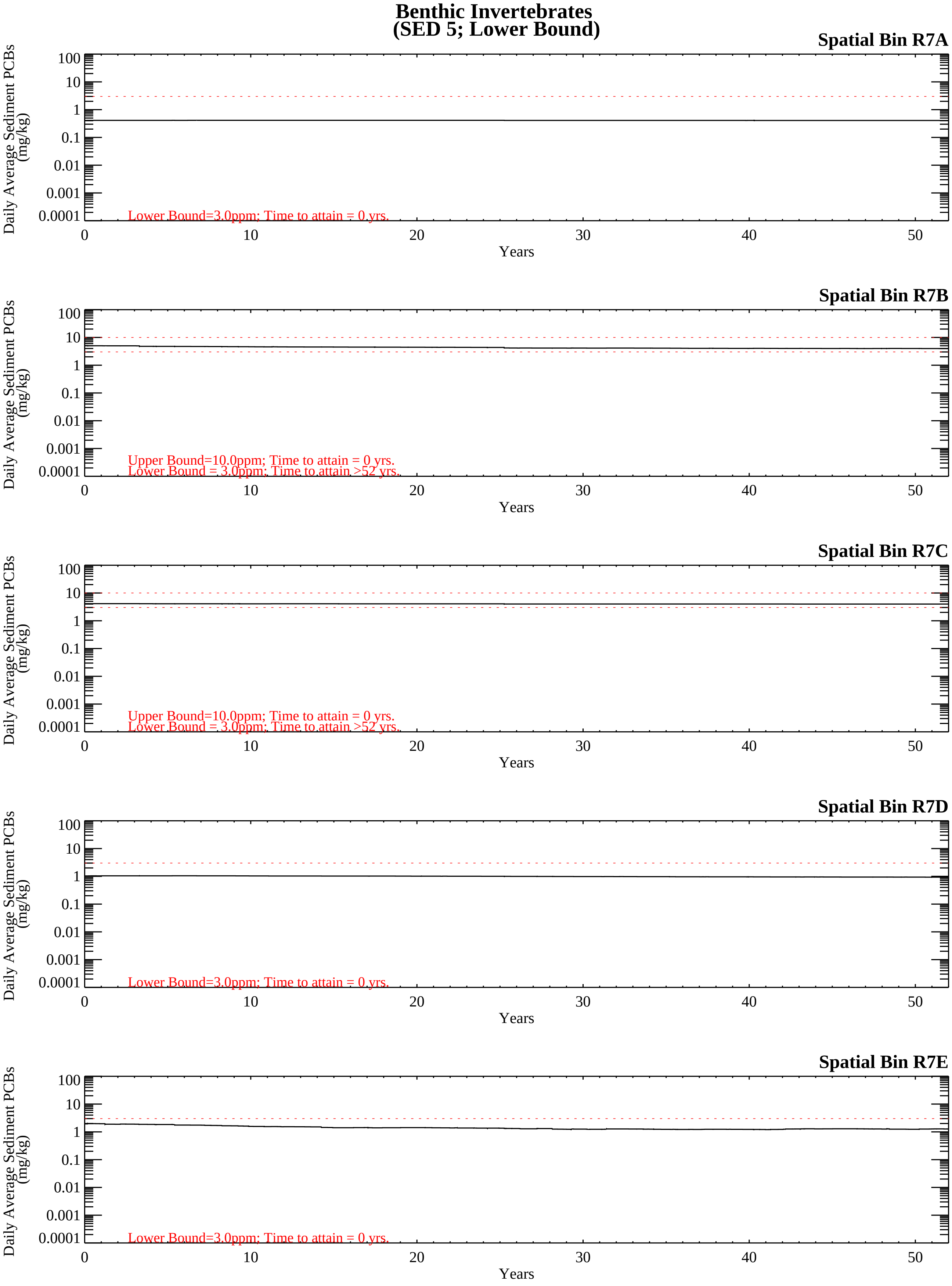

Figure G-4.4-4b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 5; Reach 7/8; Lower Bound).

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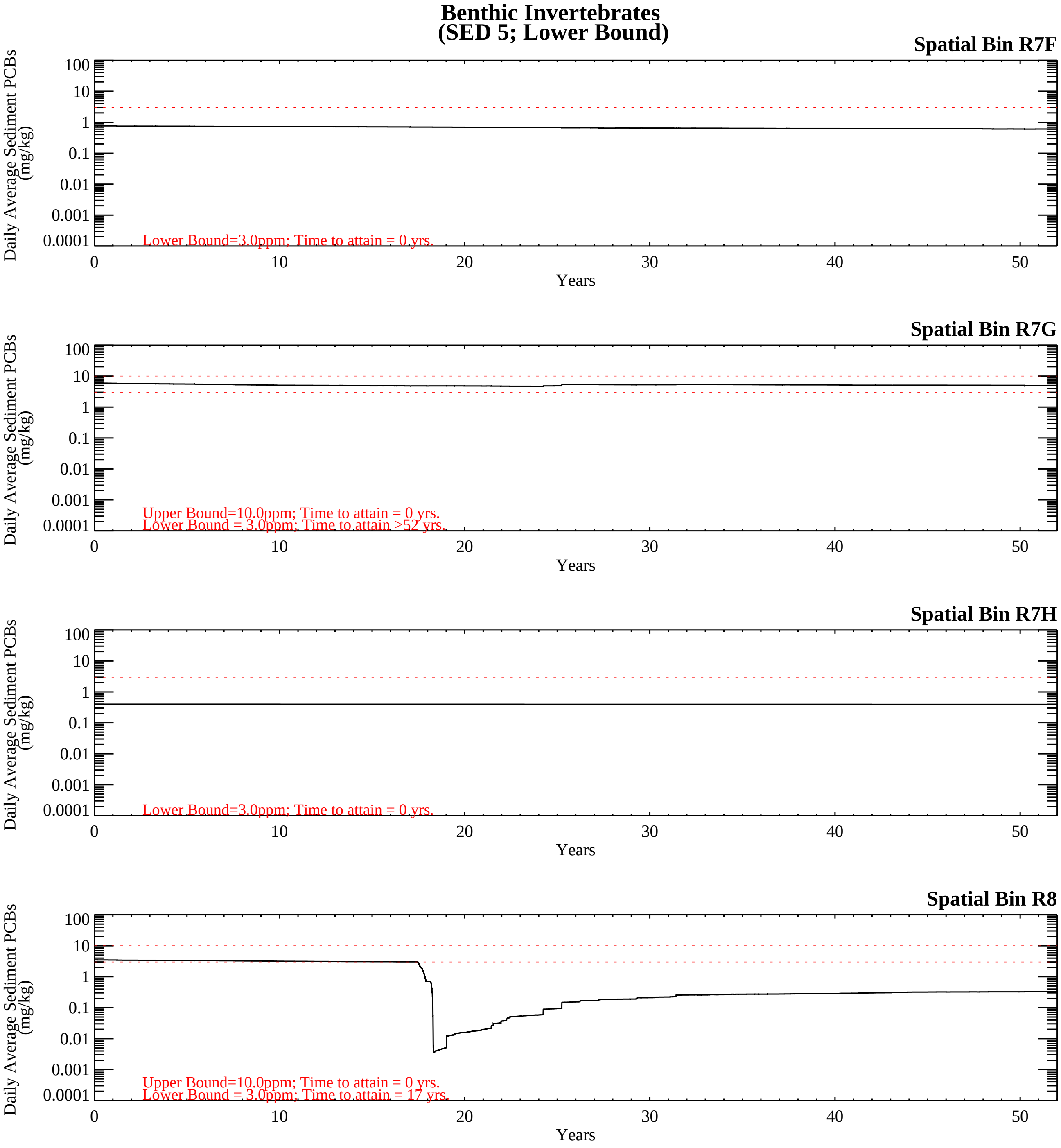

Figure G-4.4-4b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 5; Reach 7/8; Lower Bound).

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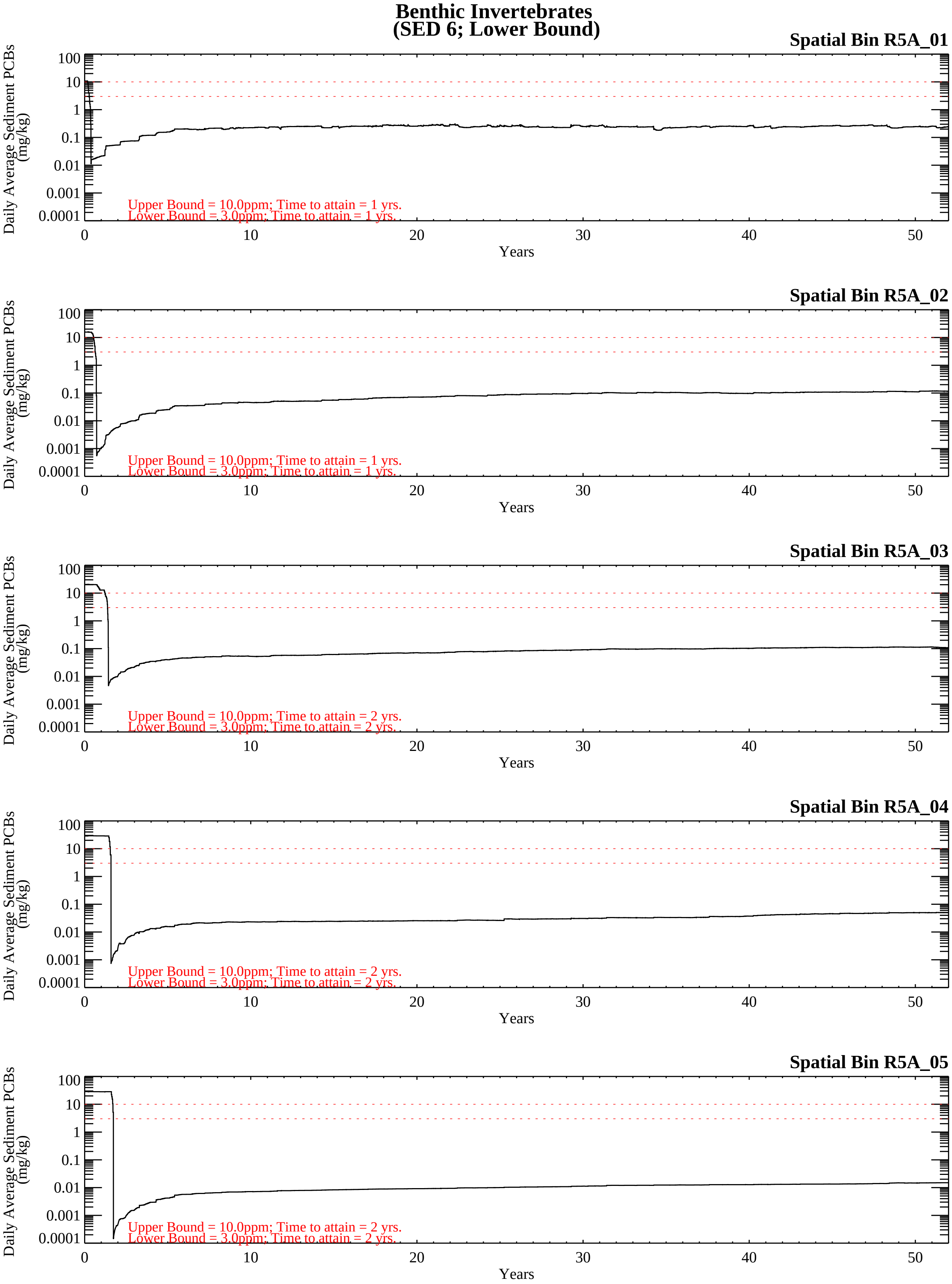

Figure G-4.4-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 6; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED6CMSLB_0712-23\\bins

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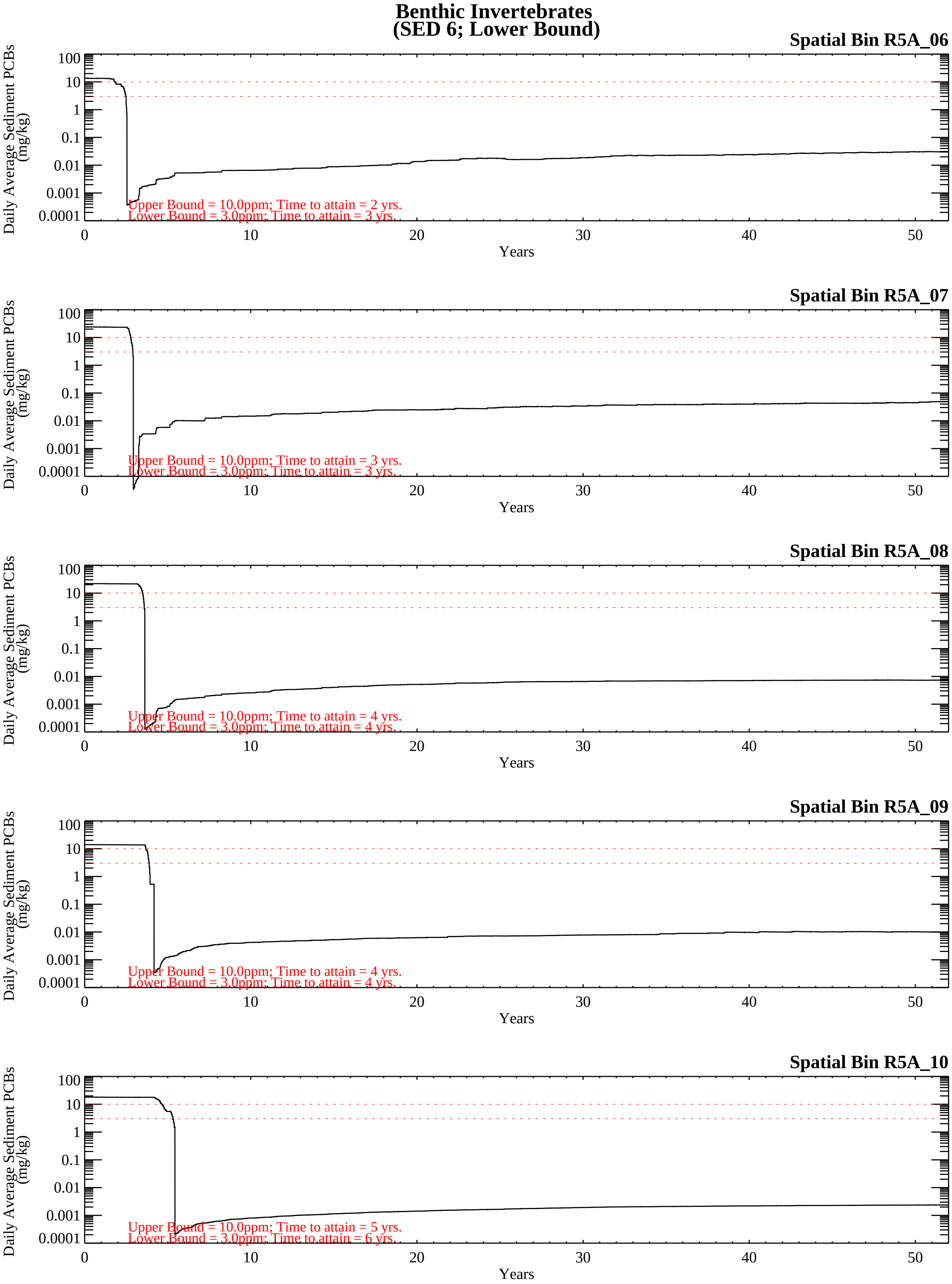

Figure G-4.4-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 6; Reach 5/6; Lower Bound).

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Benthic Invertebrates
(SED 6; Lower Bound)

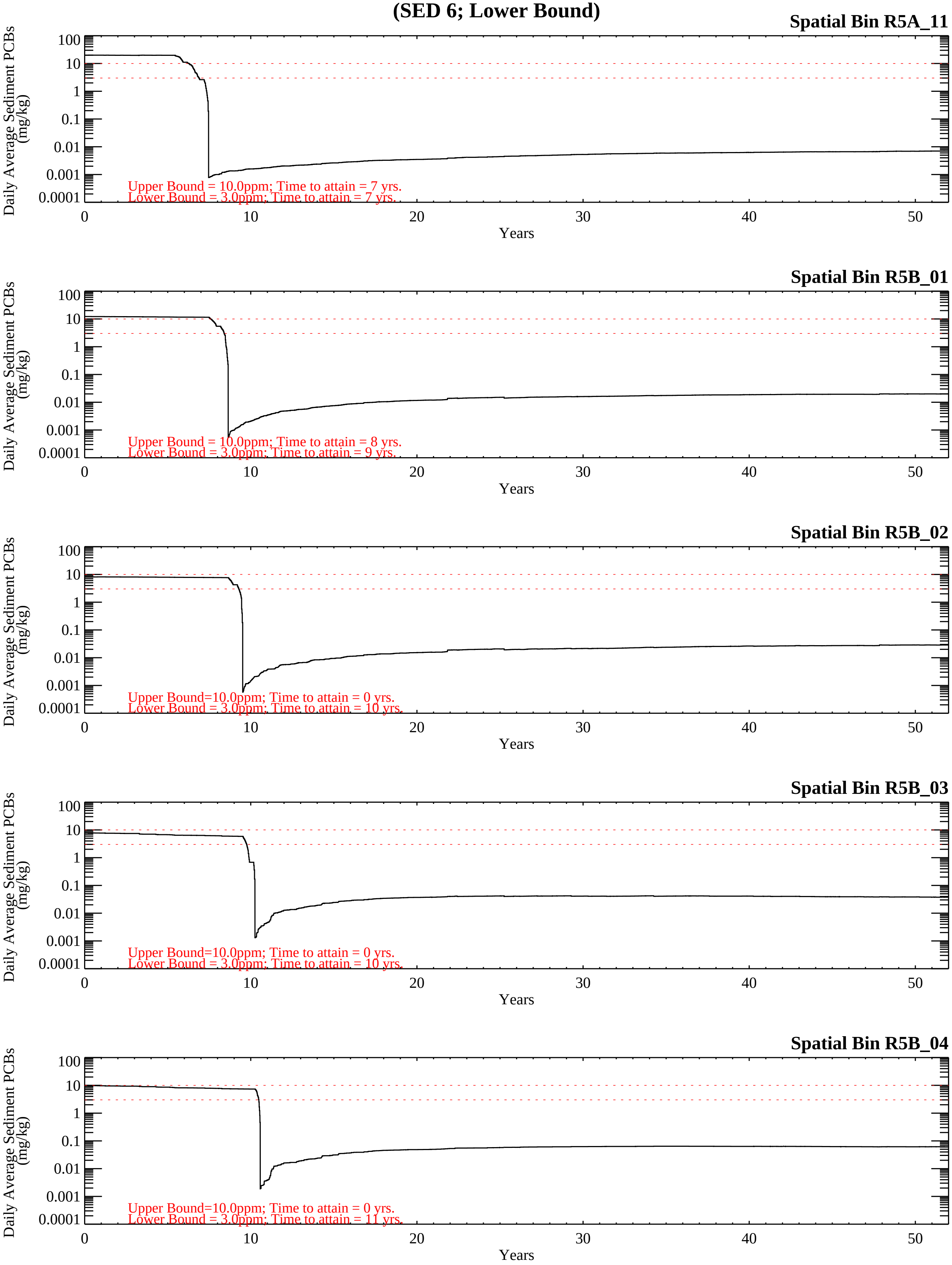

Figure G-4.4-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 6; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED6CMSLB_0712-23\\bins

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Benthic Invertebrates
(SED 6; Lower Bound)

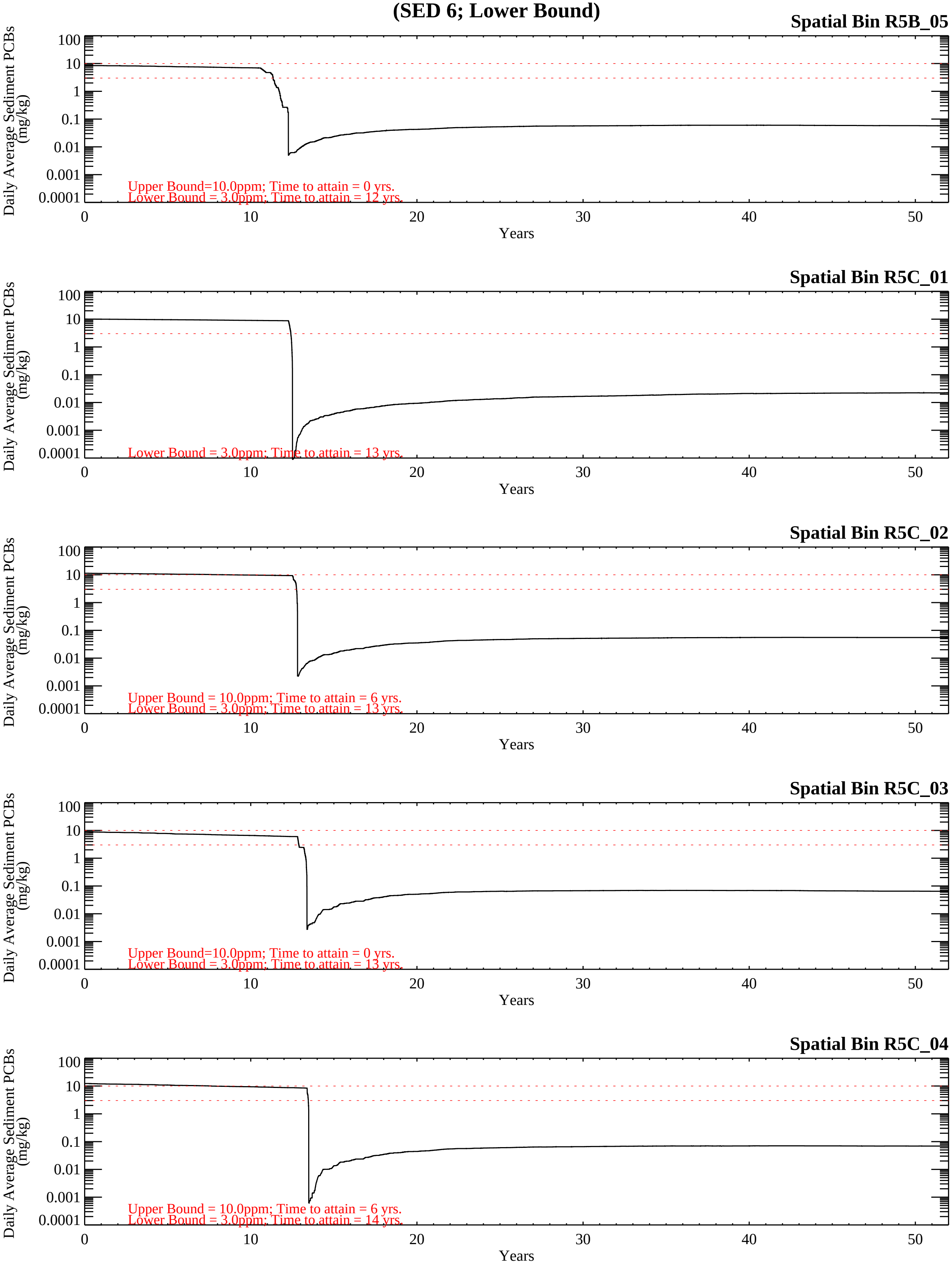

Figure G-4.4-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 6; Reach 5/6; Lower Bound).

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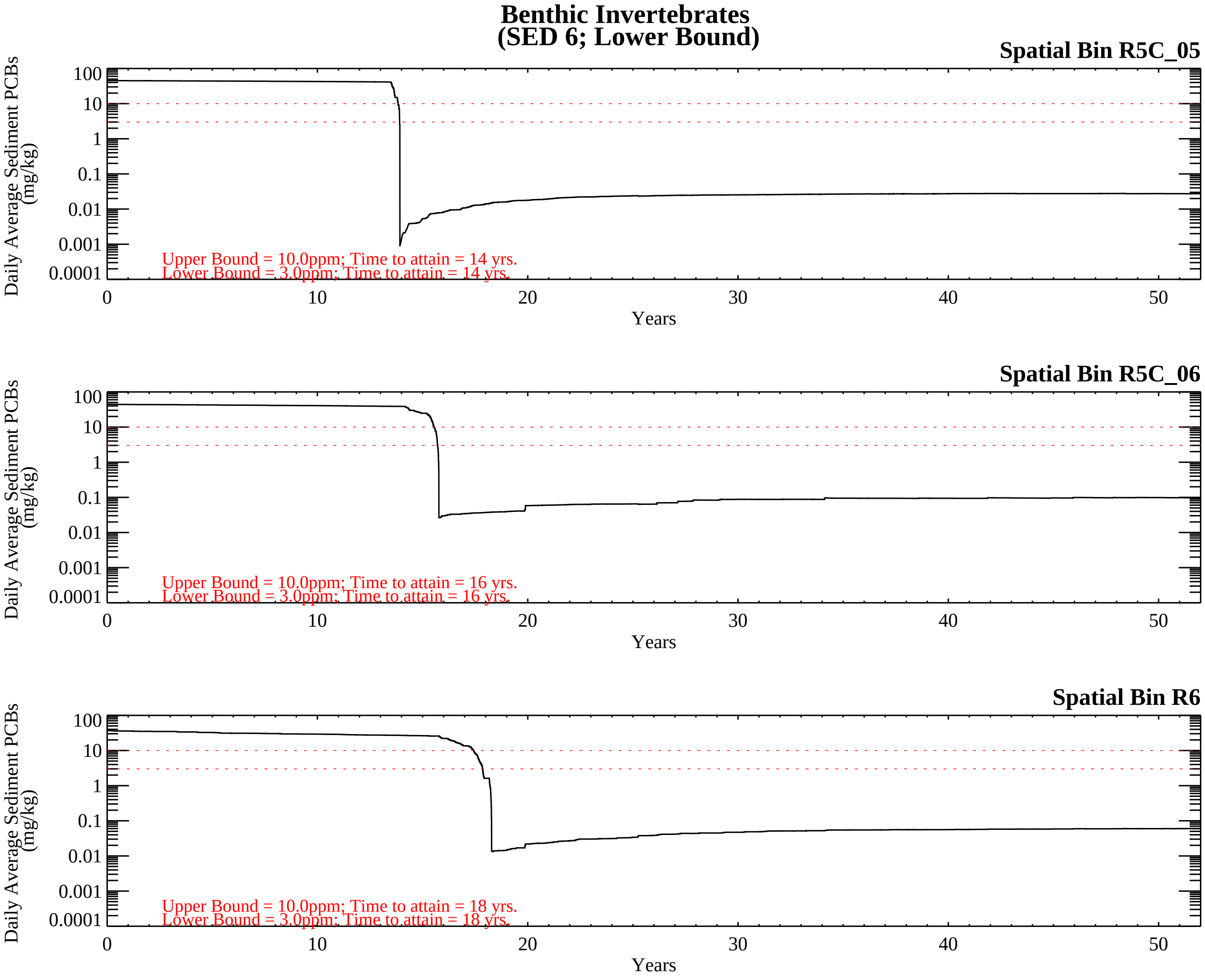

Figure G-4.4-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 6; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED6CMSLB_0712-23\\bins

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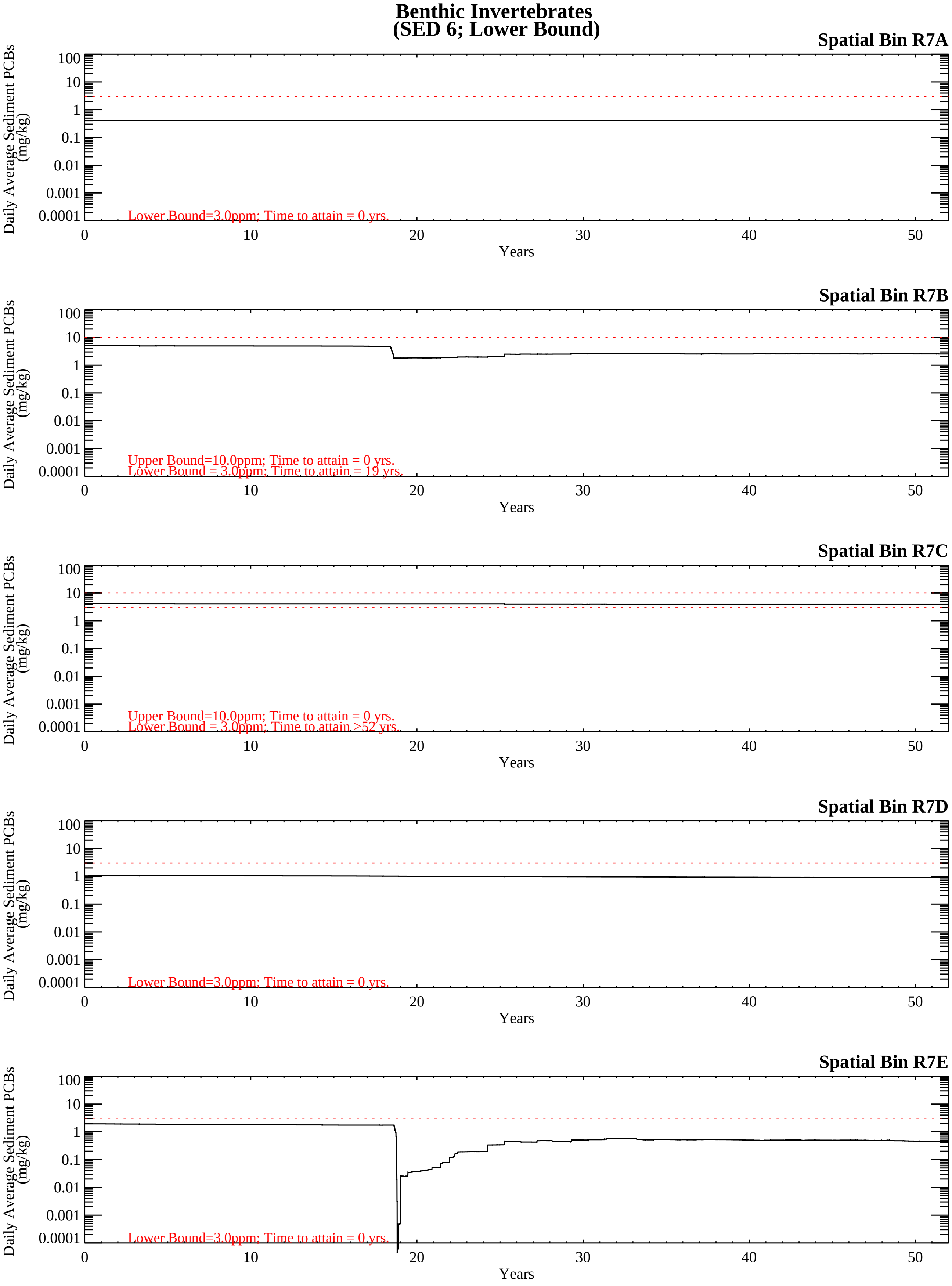

Figure G-4.4-5b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 6; Reach 7/8; Lower Bound).

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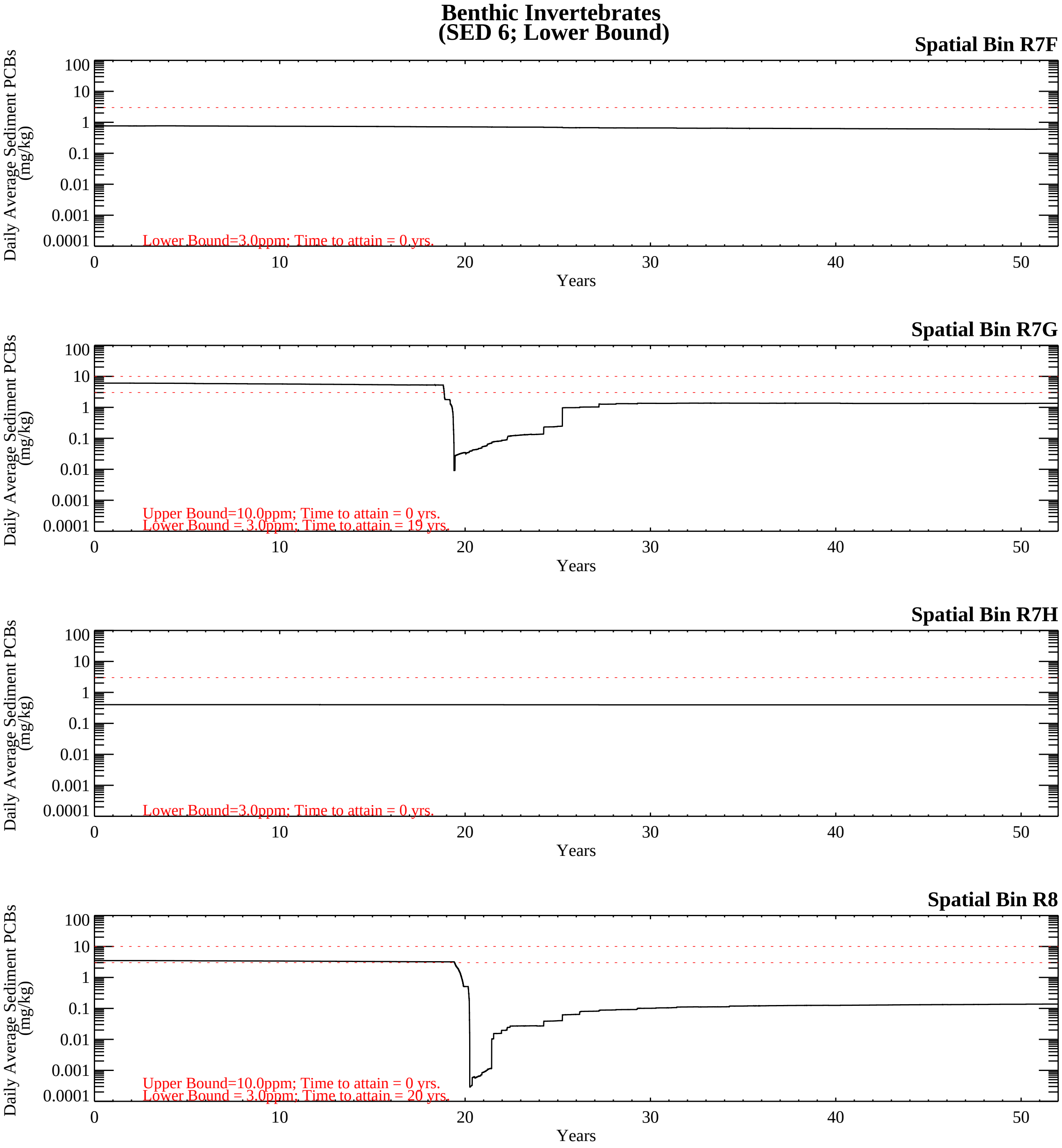

Figure G-4.4-5b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 6; Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED6CMSLB_0712-39\\bins

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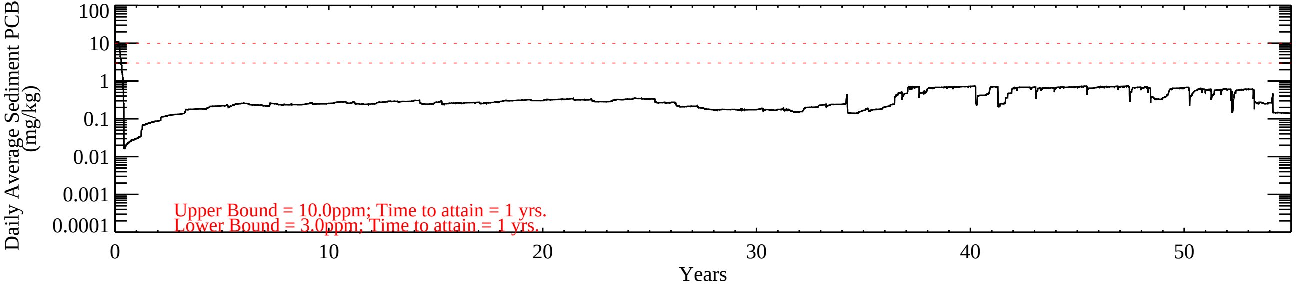
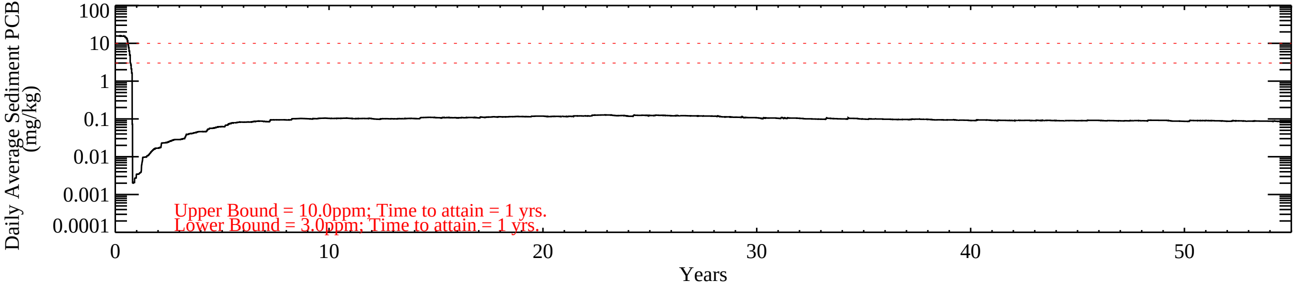
Benthic Invertebrates
(SED 7; Lower Bound)

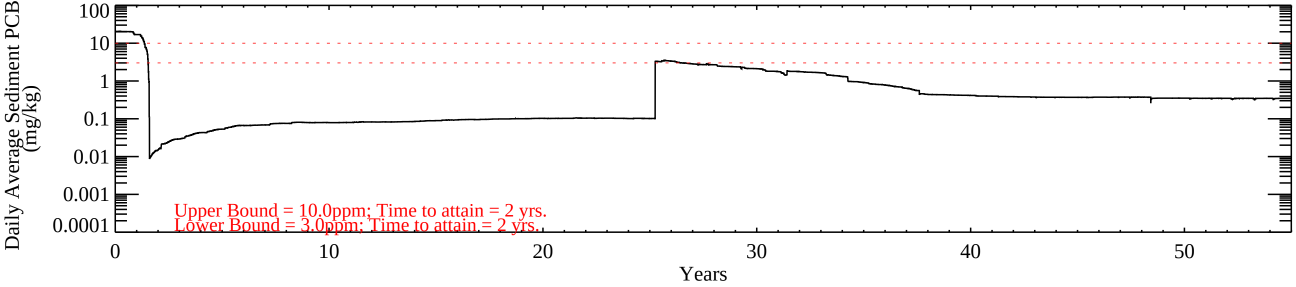
Spatial Bin R5A_01



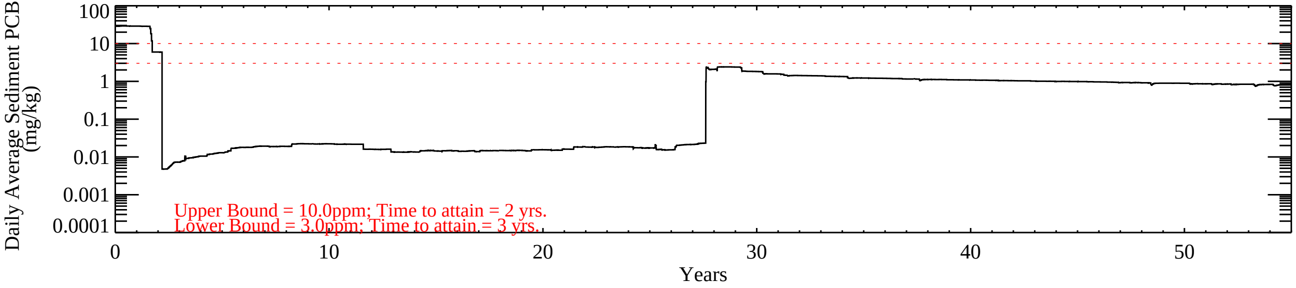
Spatial Bin R5A_02



Spatial Bin R5A_03



Spatial Bin R5A_04



Spatial Bin R5A_05

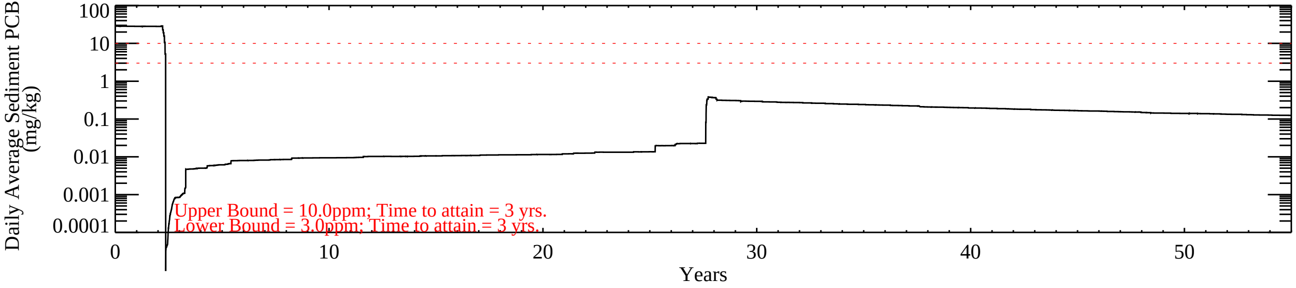
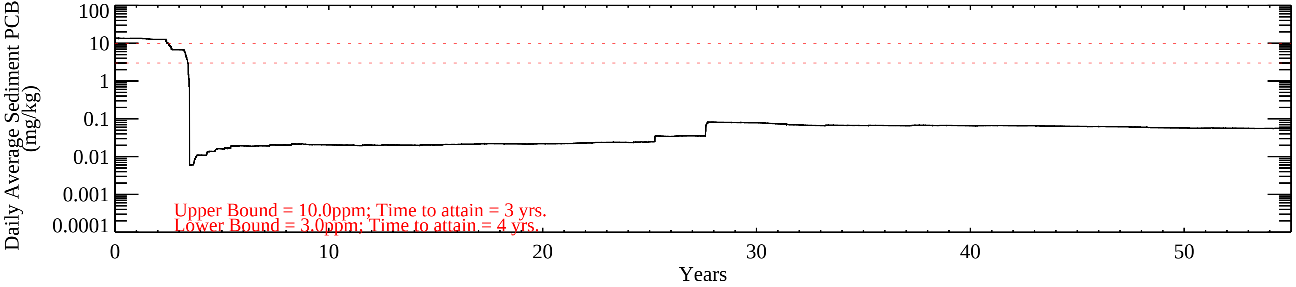


Figure G-4.4-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 7; Reach 5/6; Lower Bound).

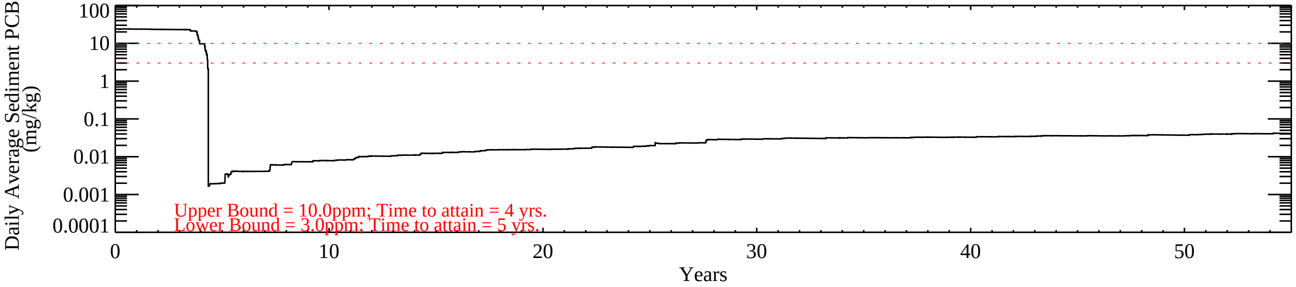
Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED7CMSLB_0712-24\\bins

Benthic Invertebrates
(SED 7; Lower Bound)

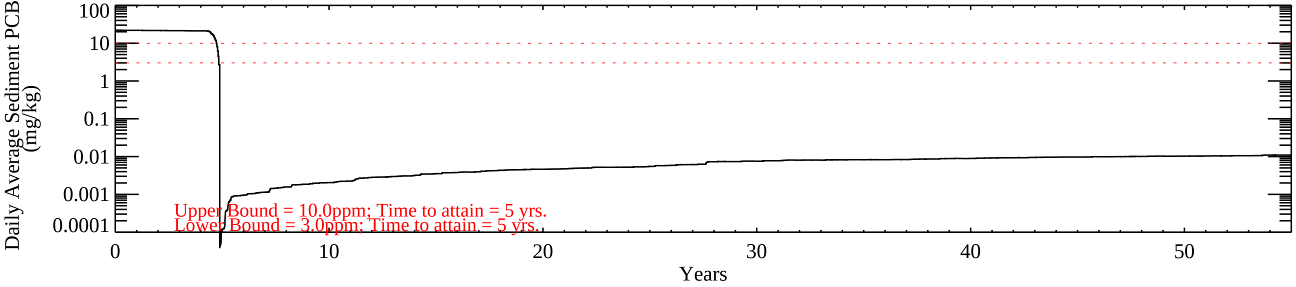
Spatial Bin R5A_06



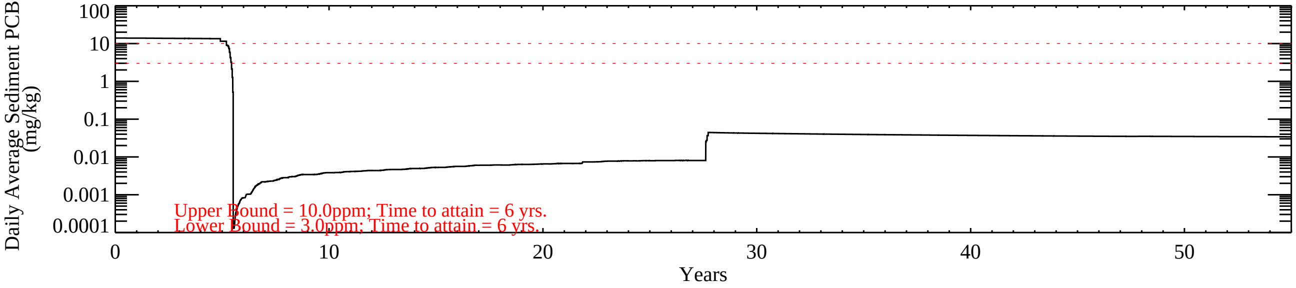
Spatial Bin R5A_07



Spatial Bin R5A_08



Spatial Bin R5A_09



Spatial Bin R5A_10

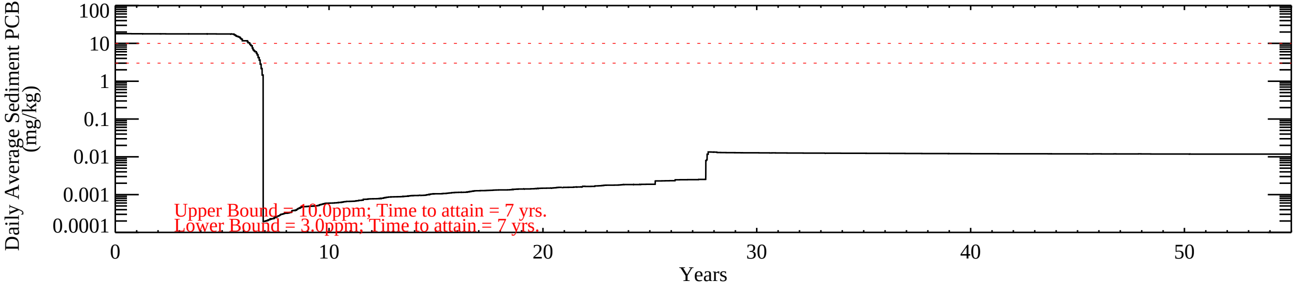


Figure G-4.4-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 7; Reach 5/6; Lower Bound).

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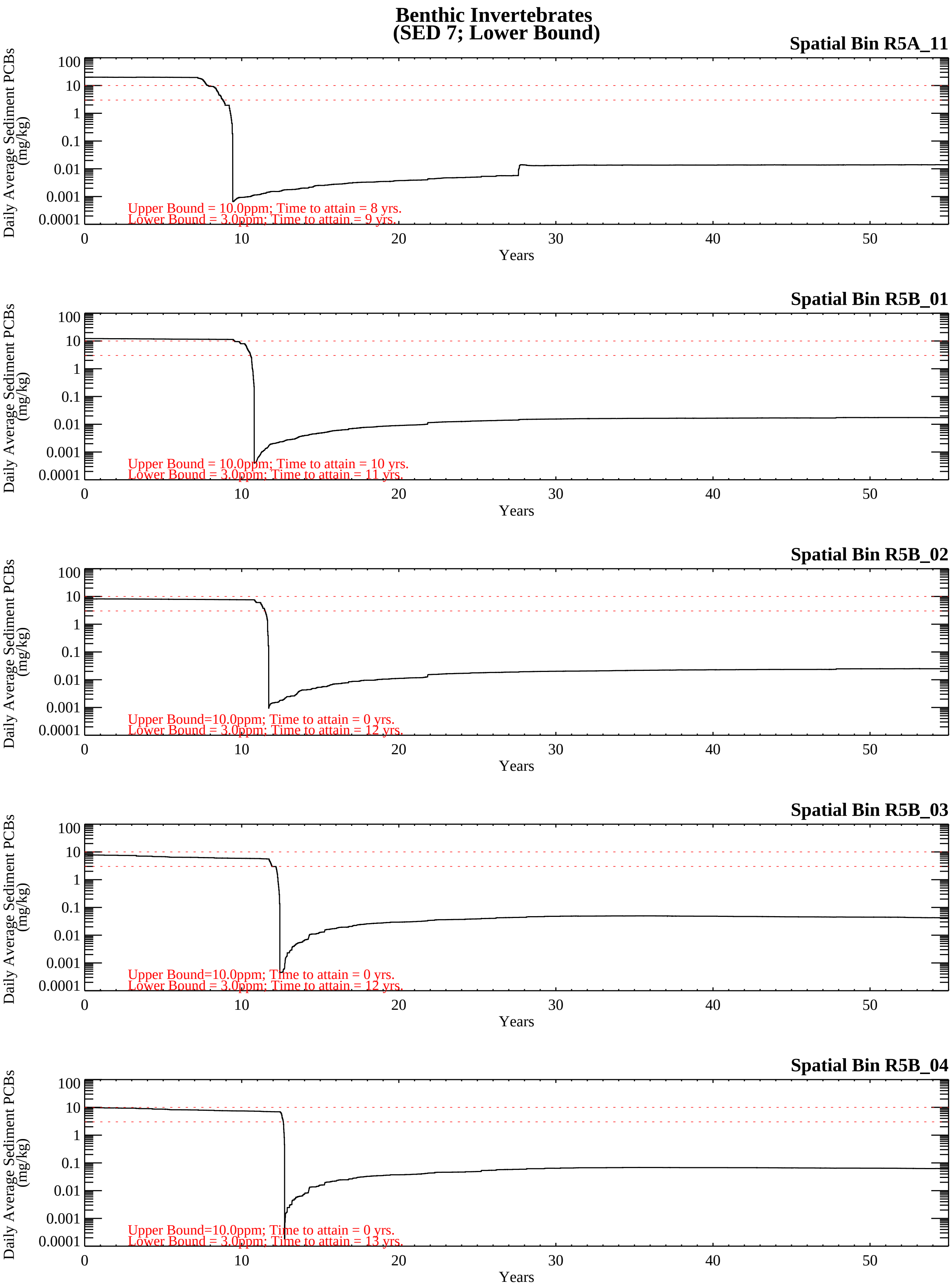
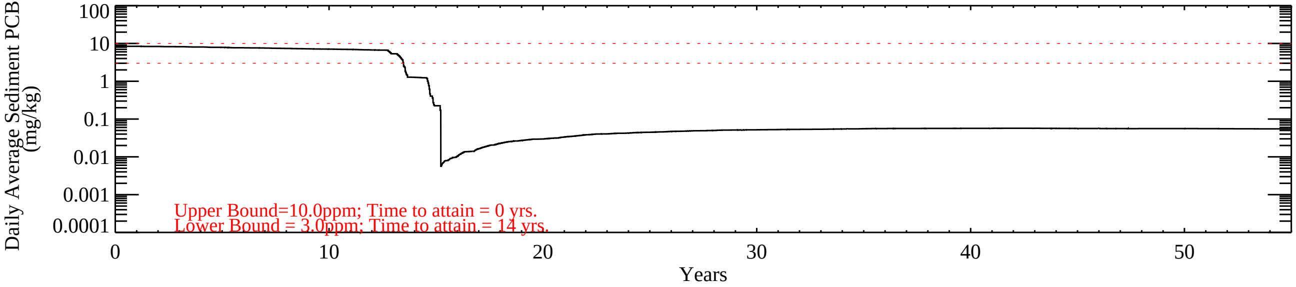


Figure G-4.4-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 7; Reach 5/6; Lower Bound).

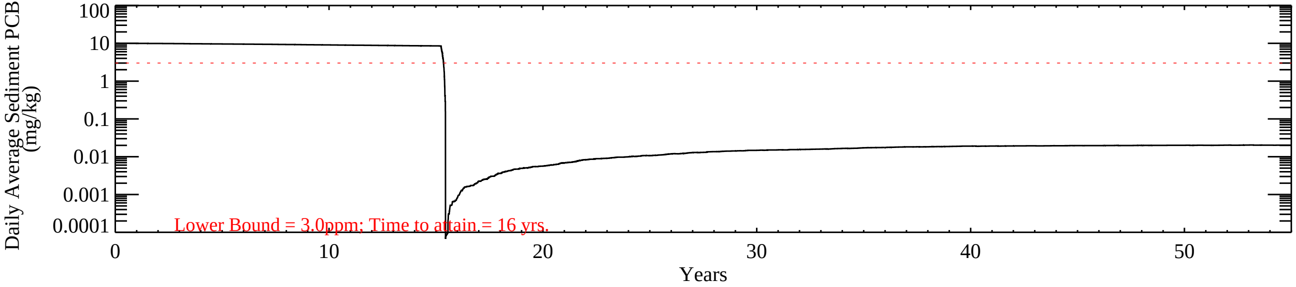
Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED7CMSLB_0712-24\\bins

Benthic Invertebrates
(SED 7; Lower Bound)

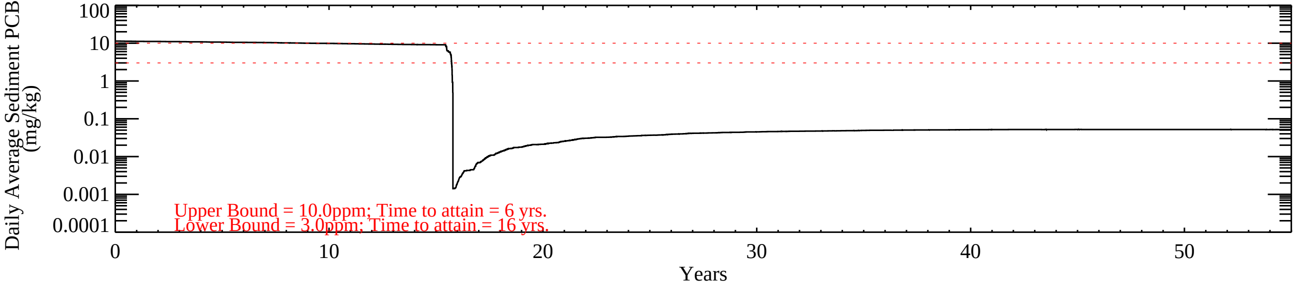
Spatial Bin R5B_05



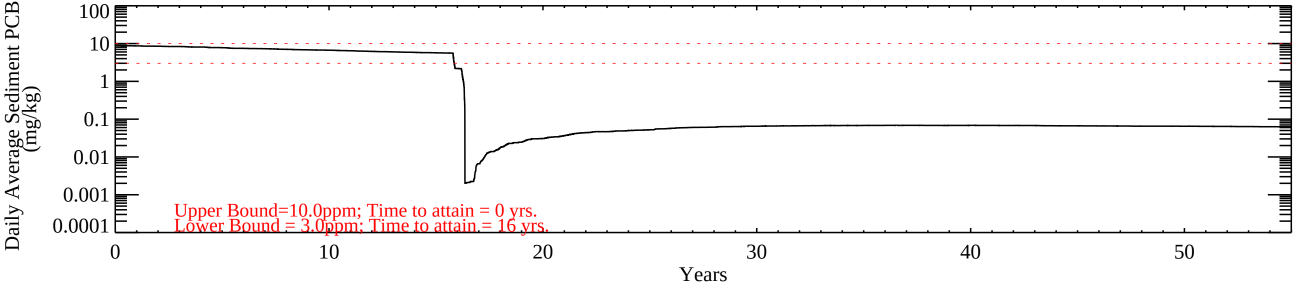
Spatial Bin R5C_01



Spatial Bin R5C_02



Spatial Bin R5C_03



Spatial Bin R5C_04

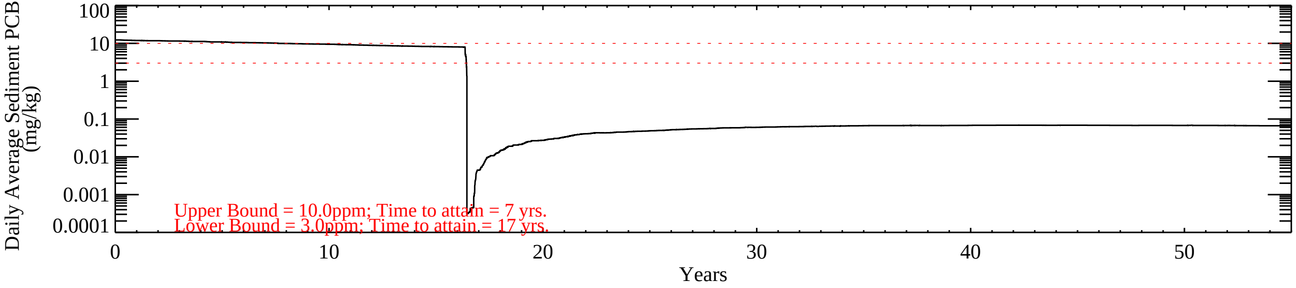


Figure G-4.4-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 7; Reach 5/6; Lower Bound).

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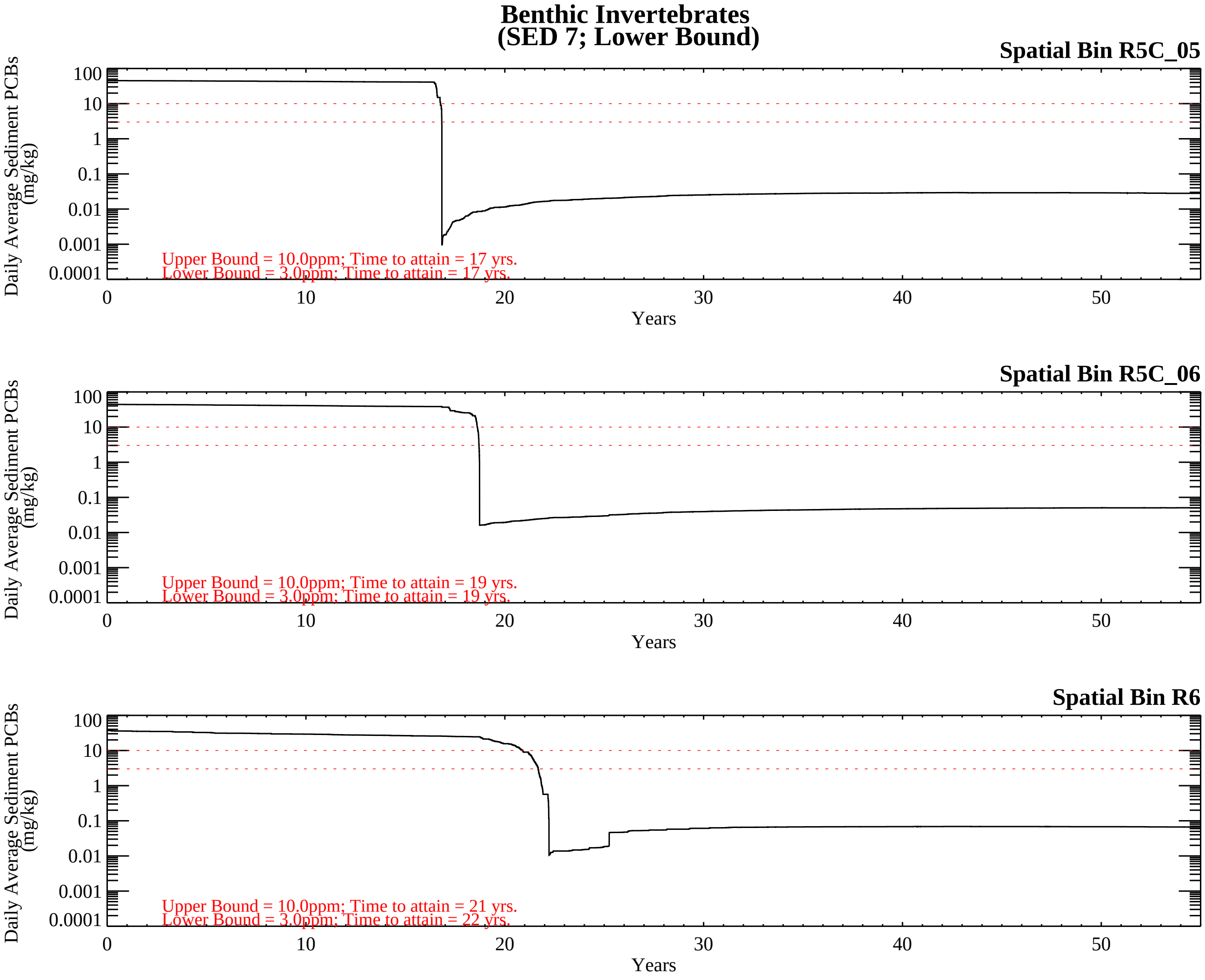

Figure G-4.4-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 7; Reach 5/6; Lower Bound).

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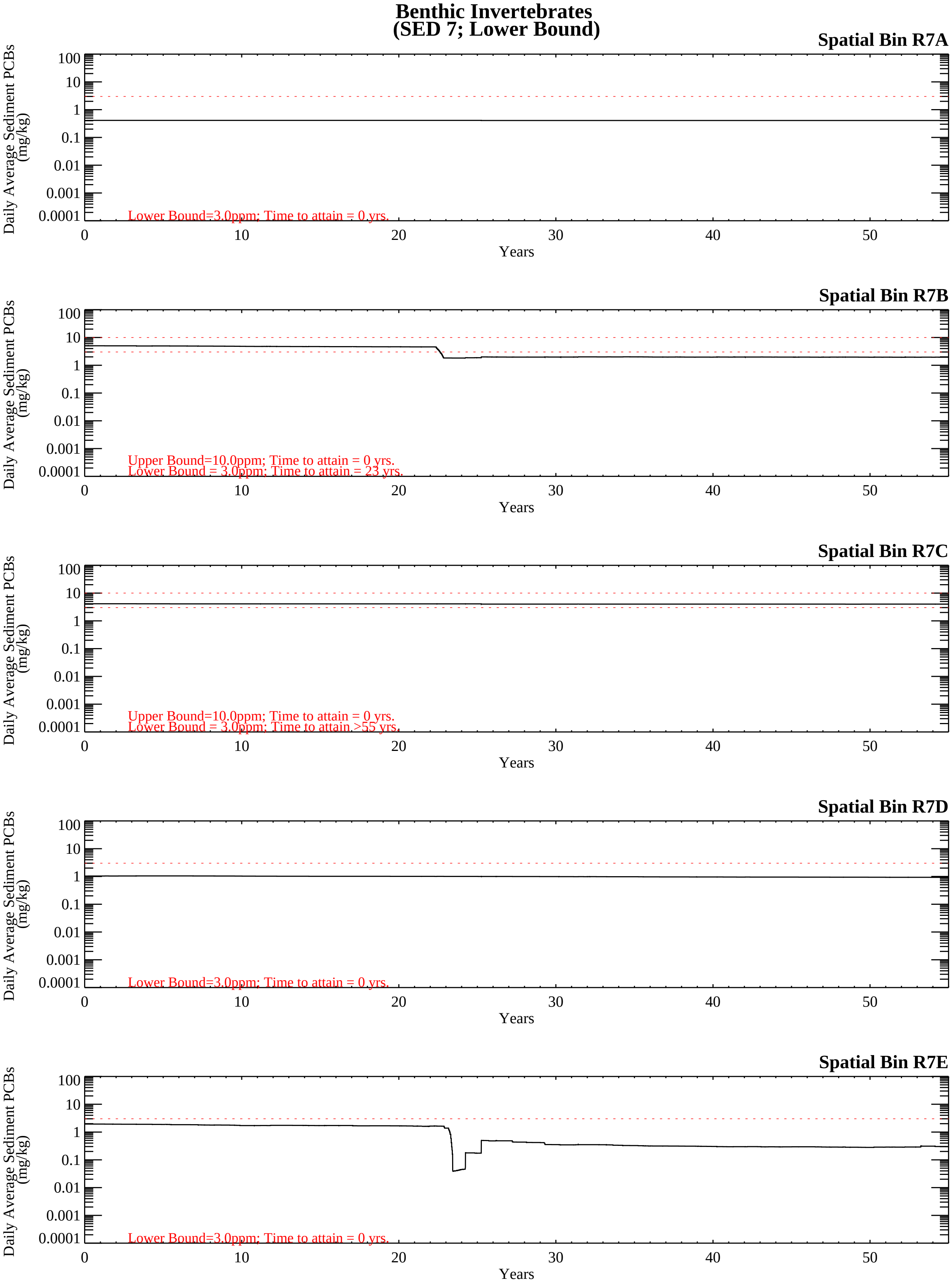

Figure G-4.4-6b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 7; Reach 7/8; Lower Bound).

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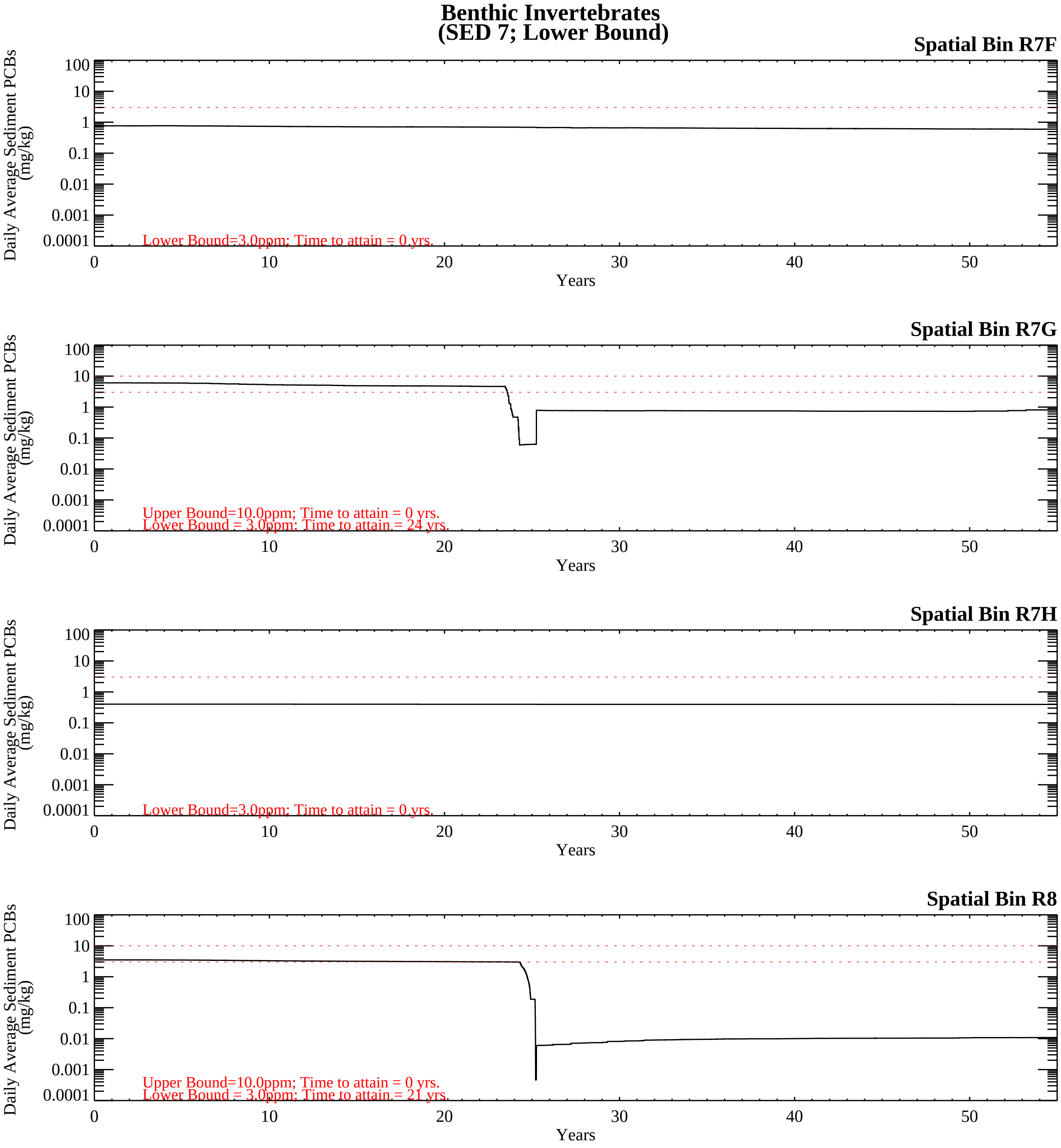

Figure G-4.4-6b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 7; Reach 7/8; Lower Bound).

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Benthic Invertebrates
(SED 8; Lower Bound)

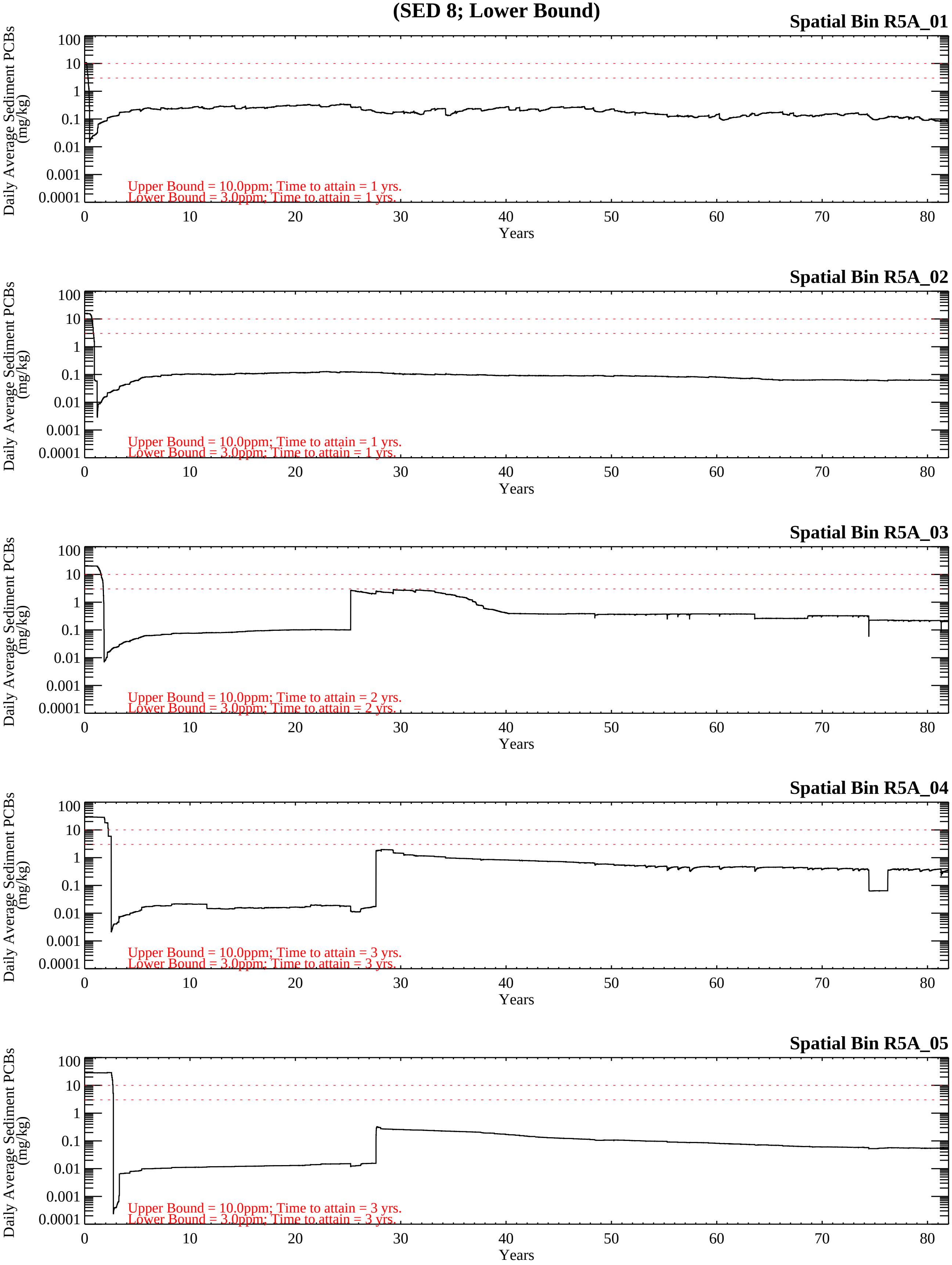

Figure G-4.4-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 8; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED8CMSLB_0712-25\\bins

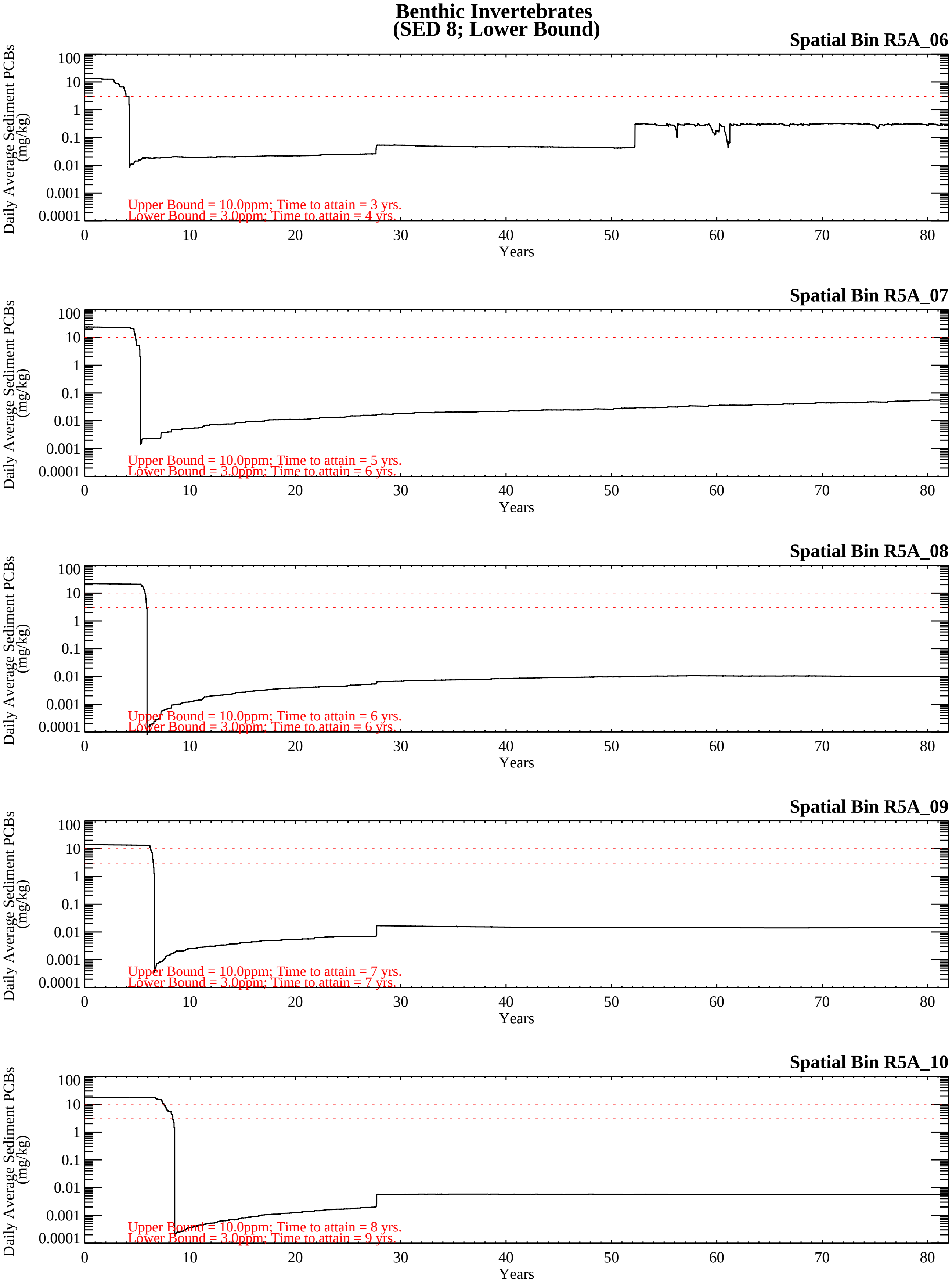

Figure G-4.4-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 8; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED8CMSLB_0712-25\\bins

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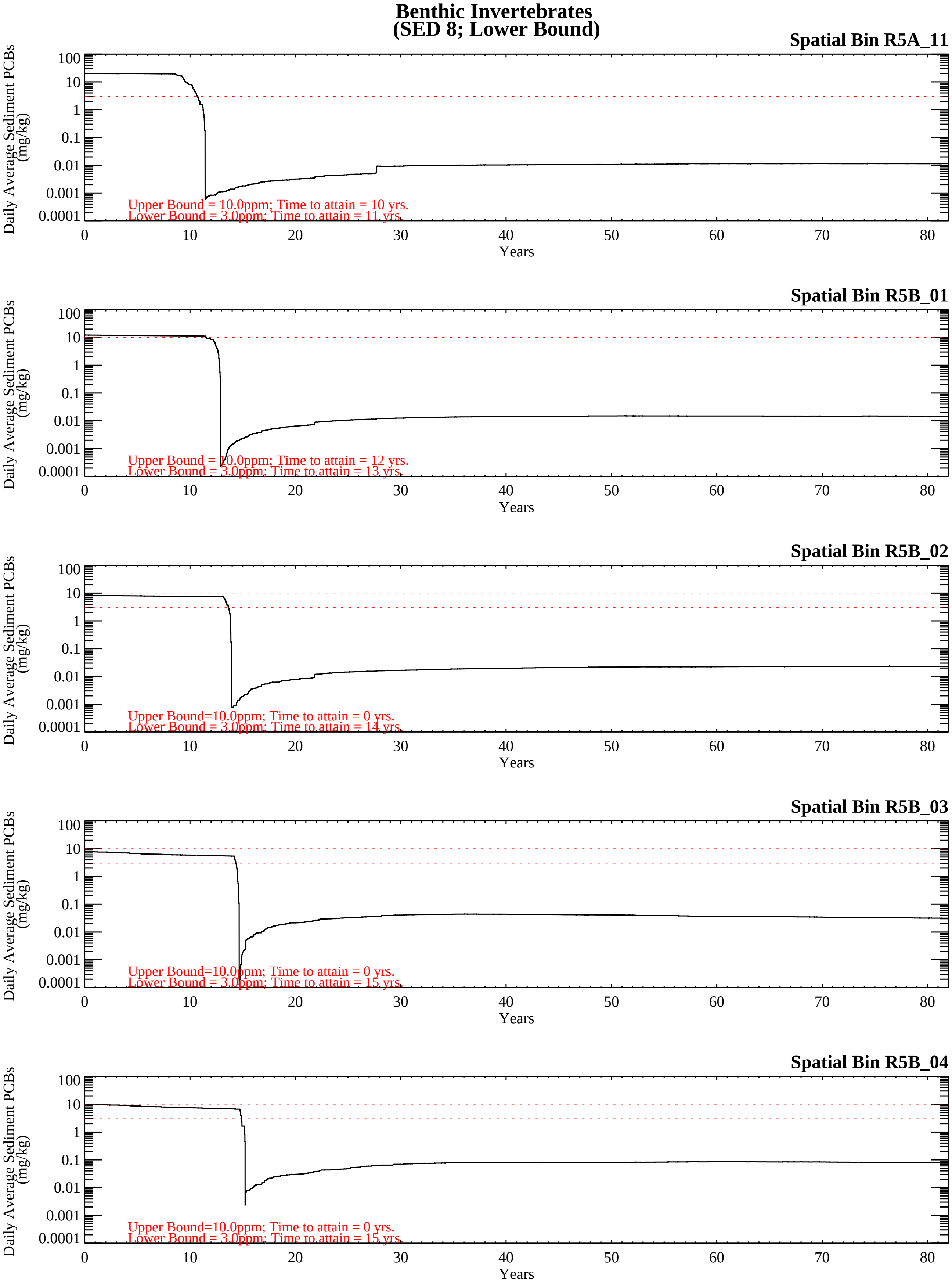

Figure G-4.4-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 8; Reach 5/6; Lower Bound).

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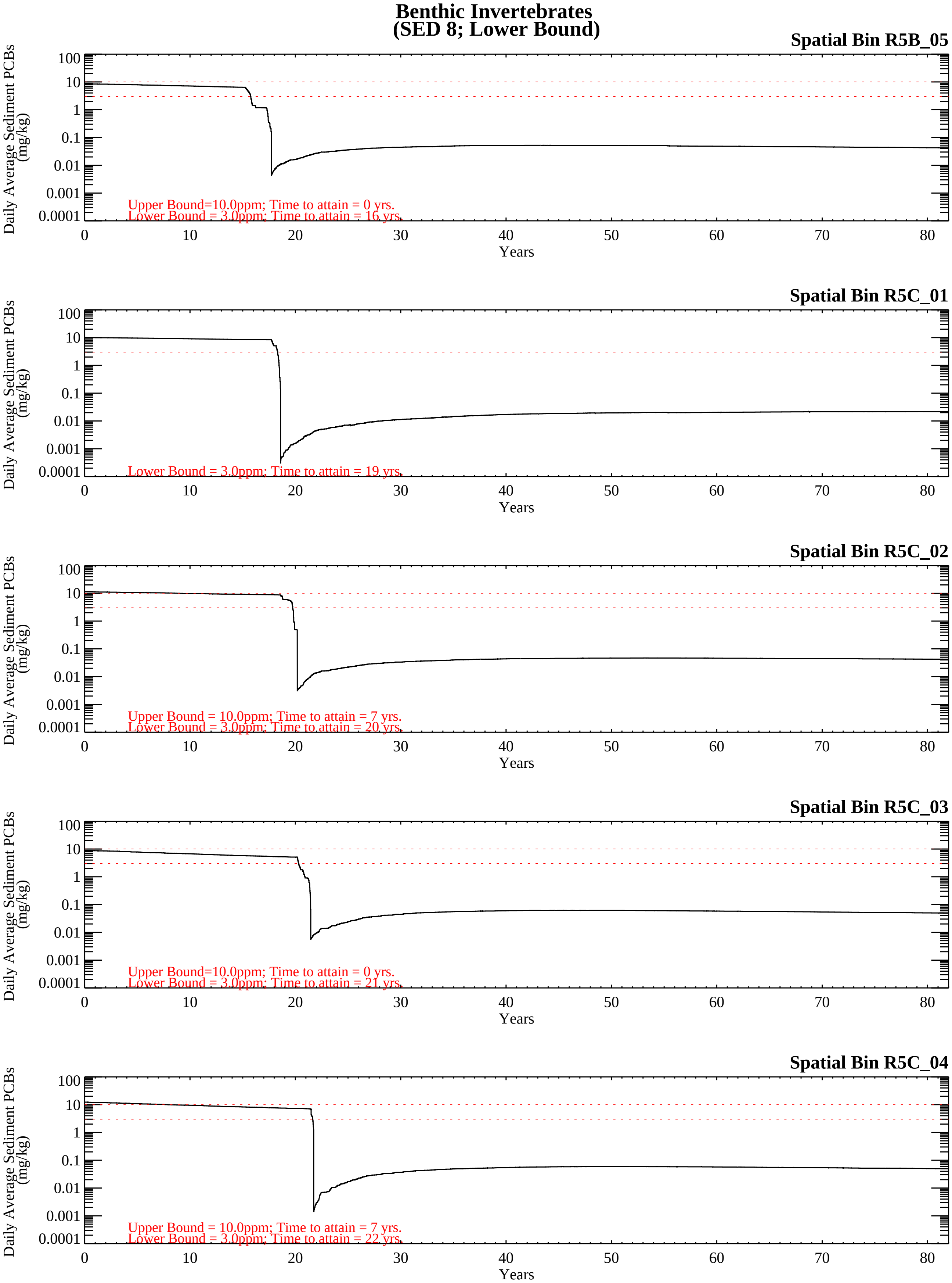

Figure G-4.4-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 8; Reach 5/6; Lower Bound).

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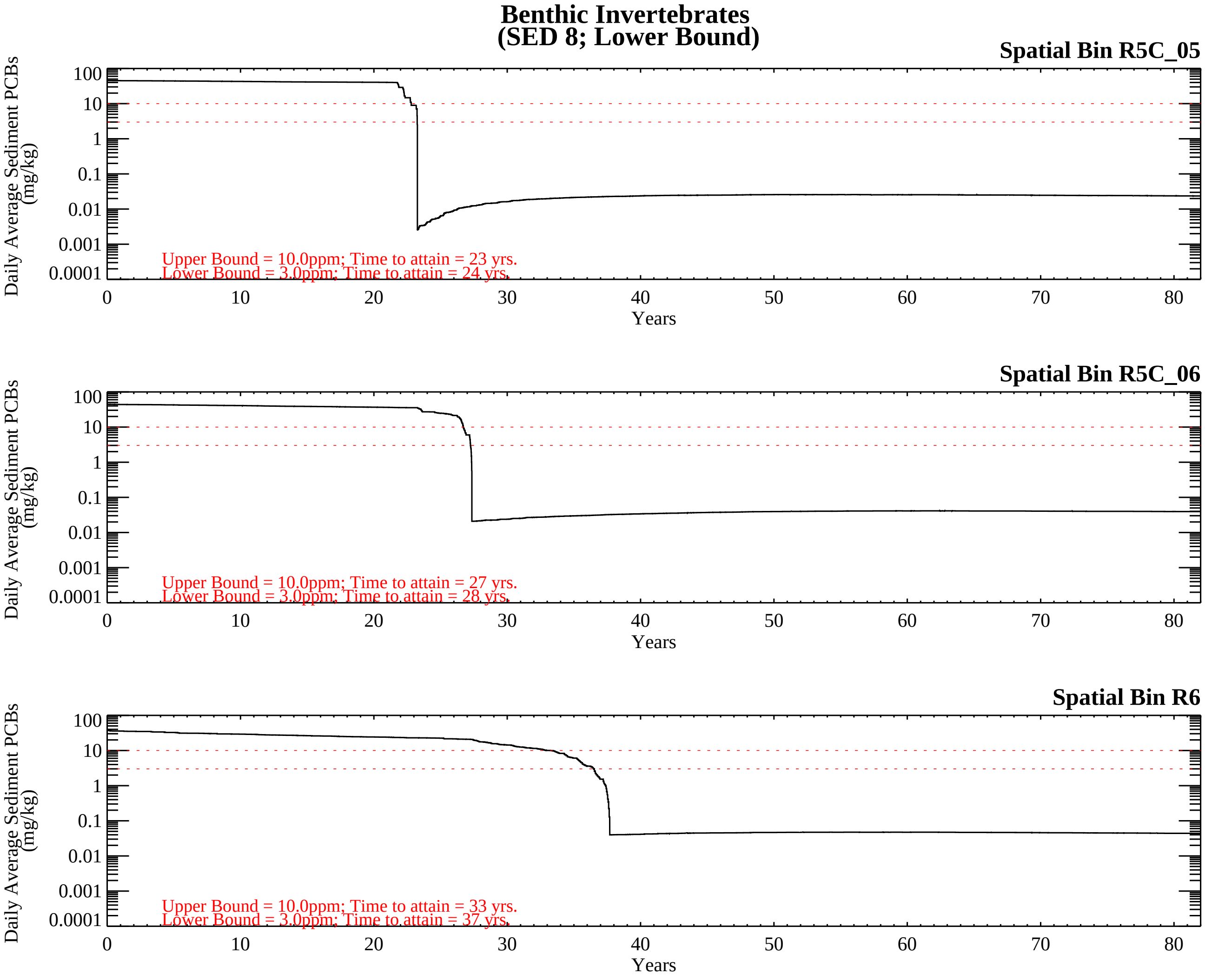

Figure G-4.4-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 8; Reach 5/6; Lower Bound).

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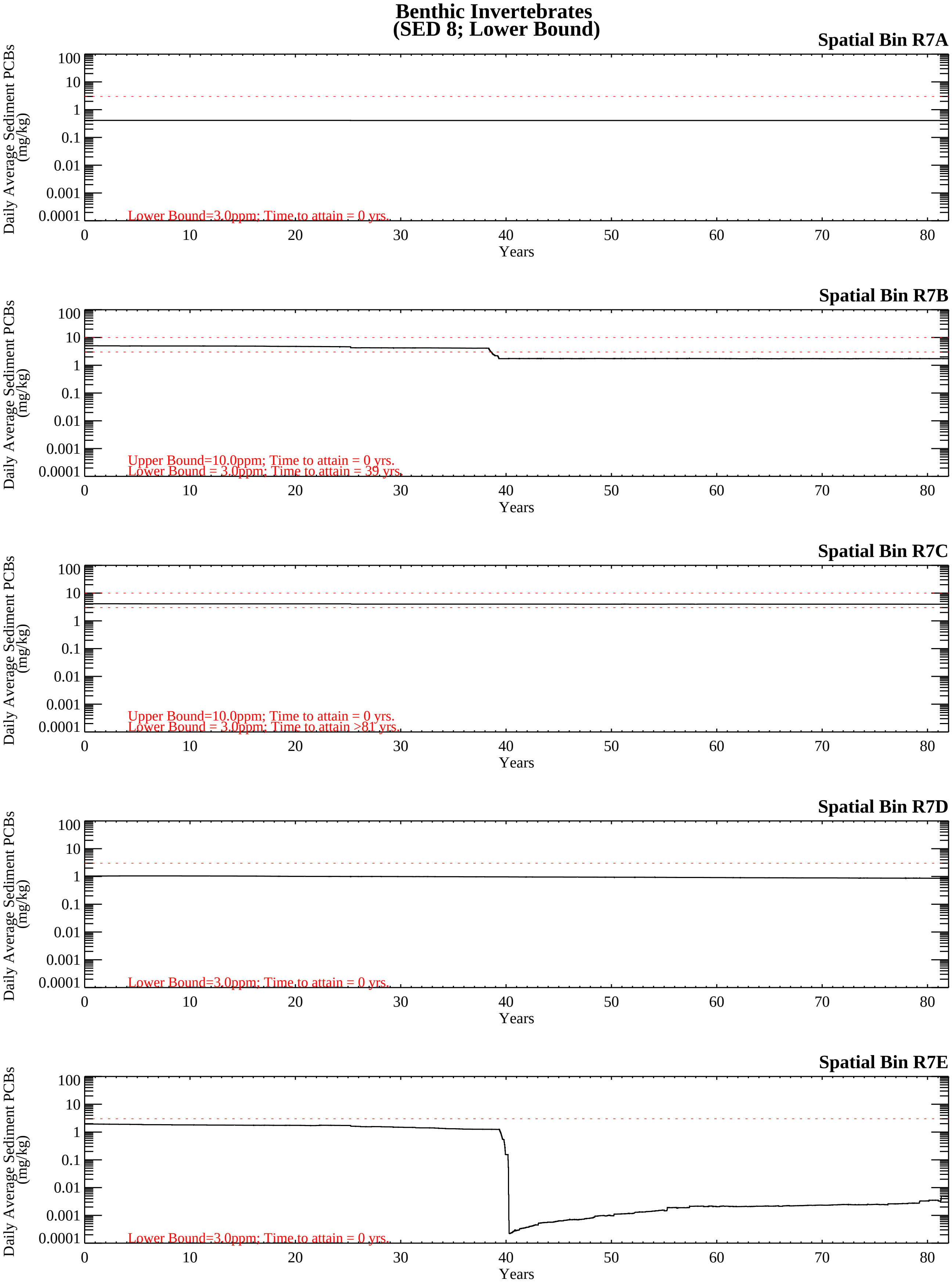

Figure G-4.4-7b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 8; Reach 7/8; Lower Bound).

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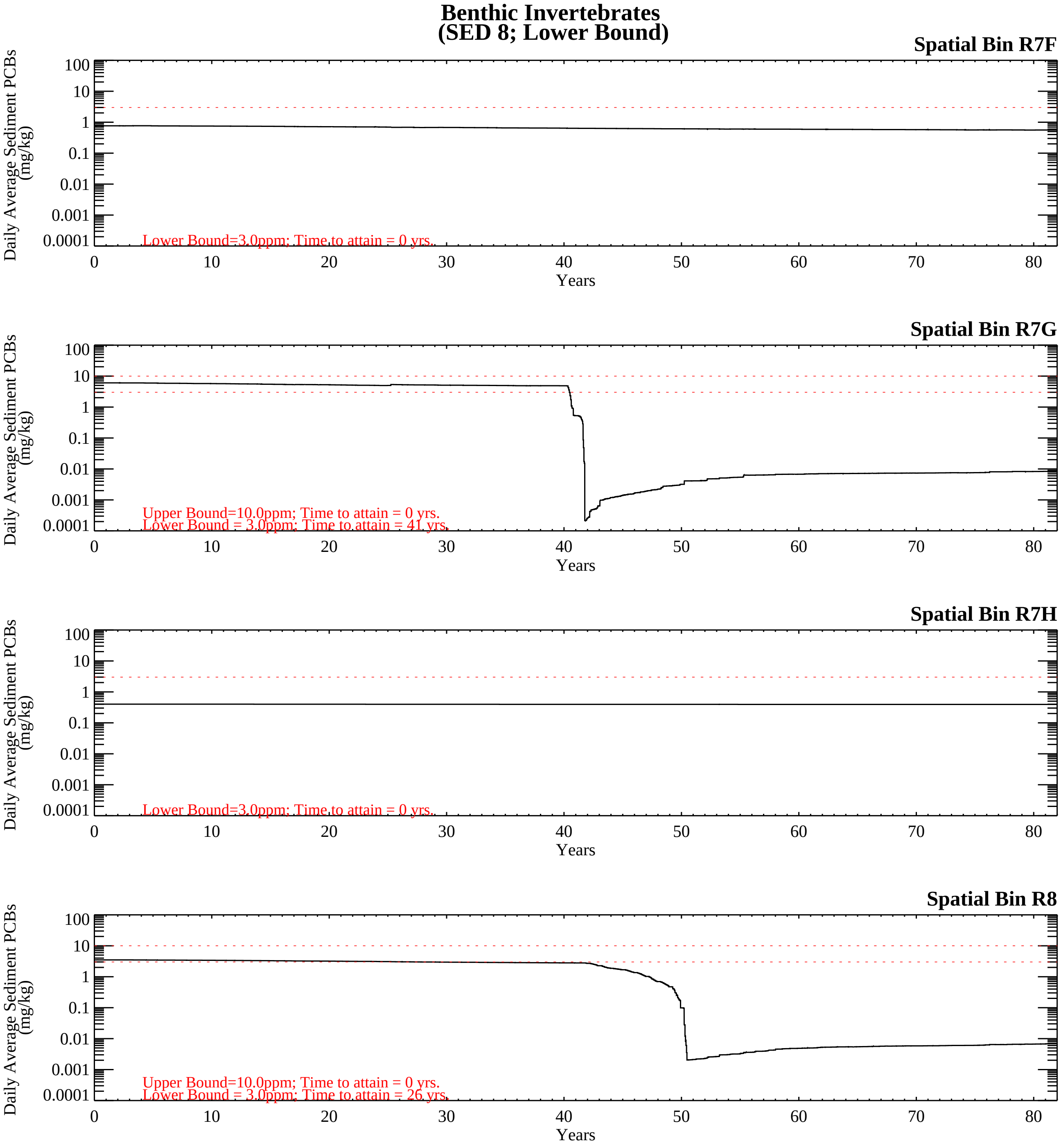

Figure G-4.4-7b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for benthic invertebrates (SED 8; Reach 7/8; Lower Bound).

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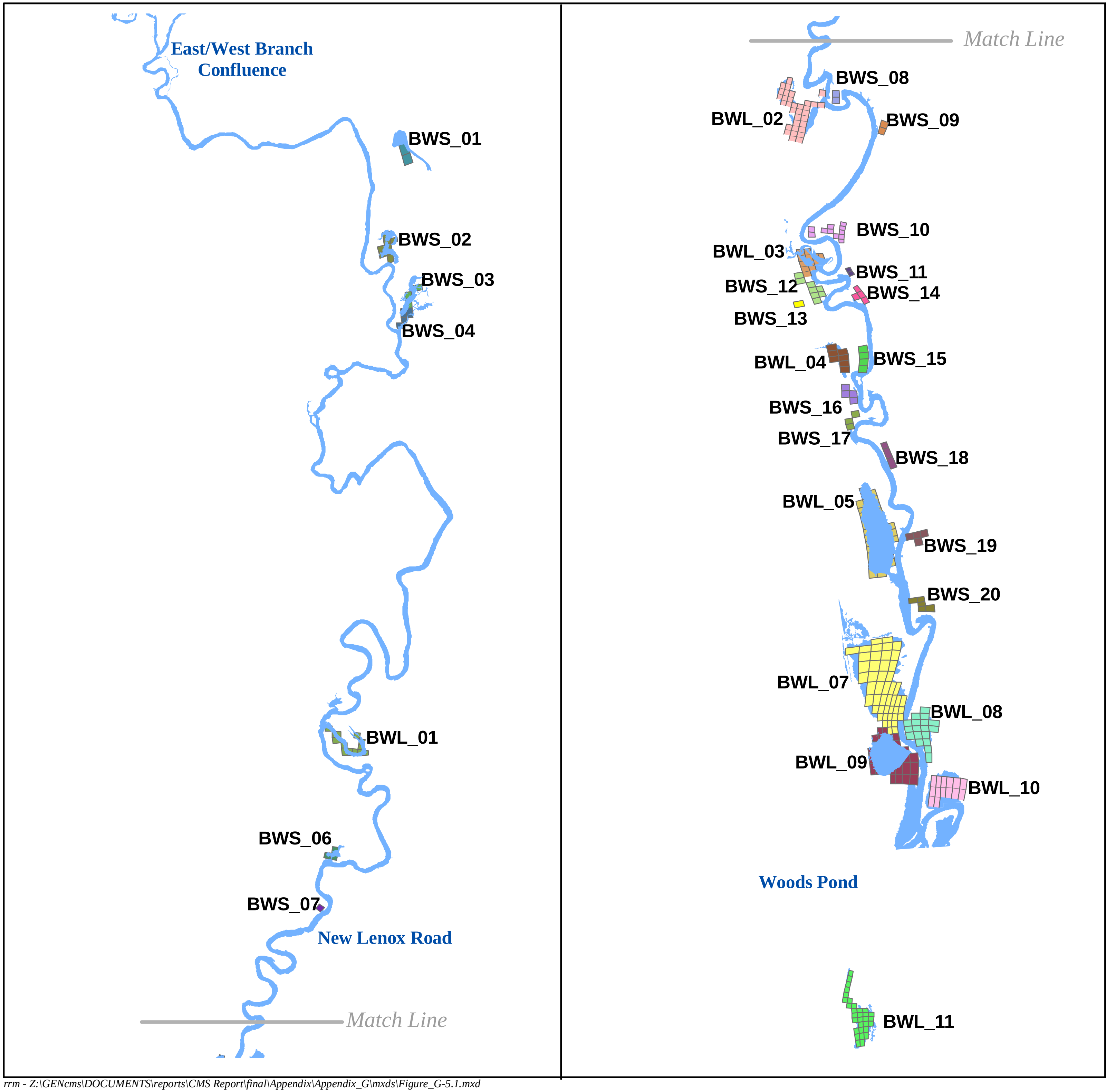
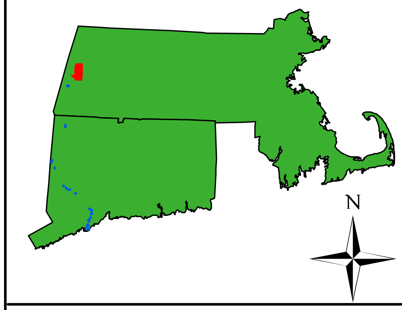


LOCATOR MAP



SCALE

0 0.25 0.5 Miles

LEGEND

☐ Averaging Area

🟦 Housatonic River

NOTE:
Separate averaging areas are shown as different colors, and labels (e.g., BWL_11) represent averaging area IDs.

Figure G-5.1.
Averaging areas used for amphibian sediment IMPG comparisons.

ARCADIS

QEA
Quantitative Environmental Analysis, LLC
∂c/∂t

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March 2008

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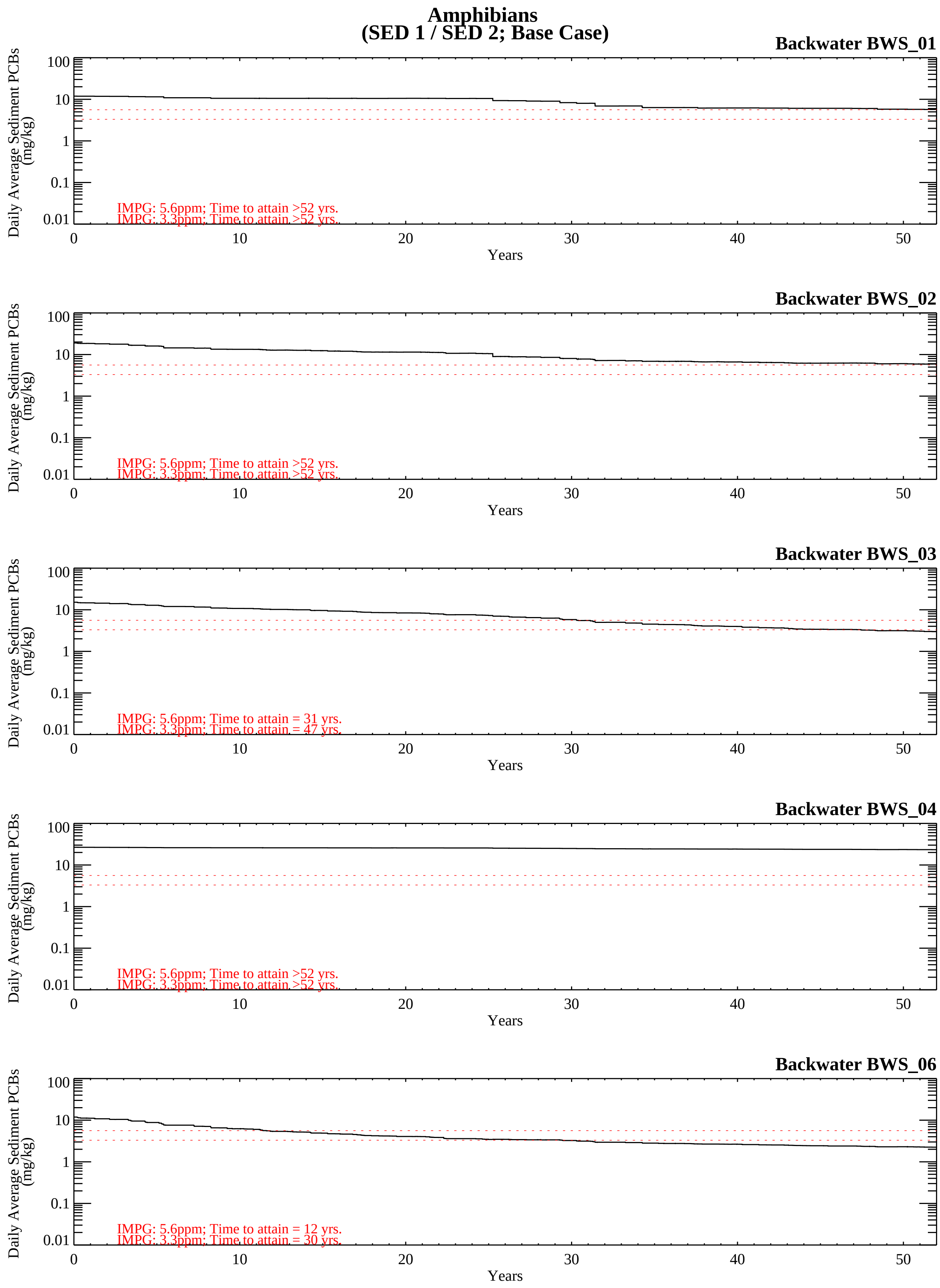

Figure G-5.2-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 1 / SED 2; Reach 5/6; Base Case).

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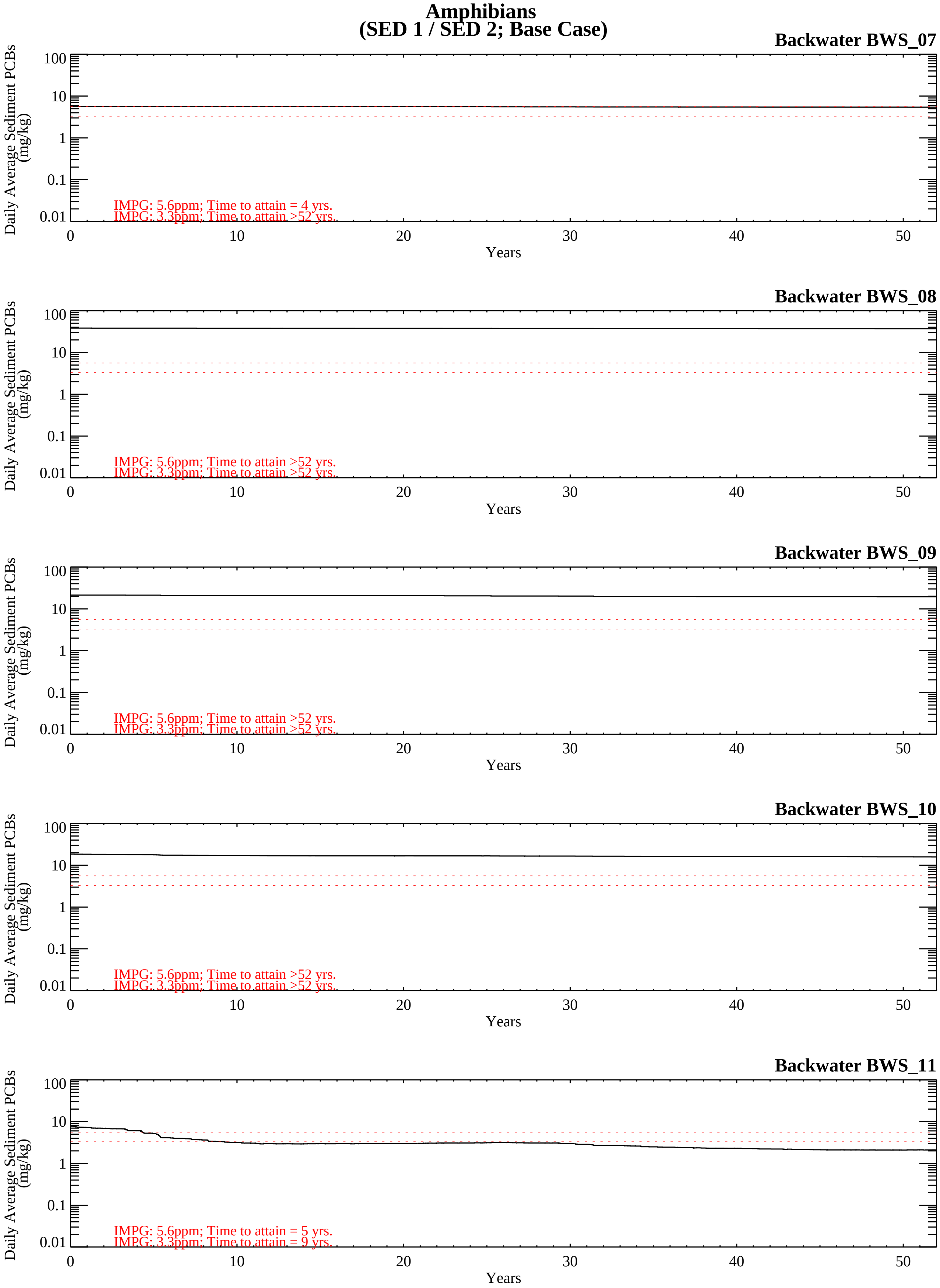

Figure G-5.2-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 1 / SED 2; Reach 5/6; Base Case).

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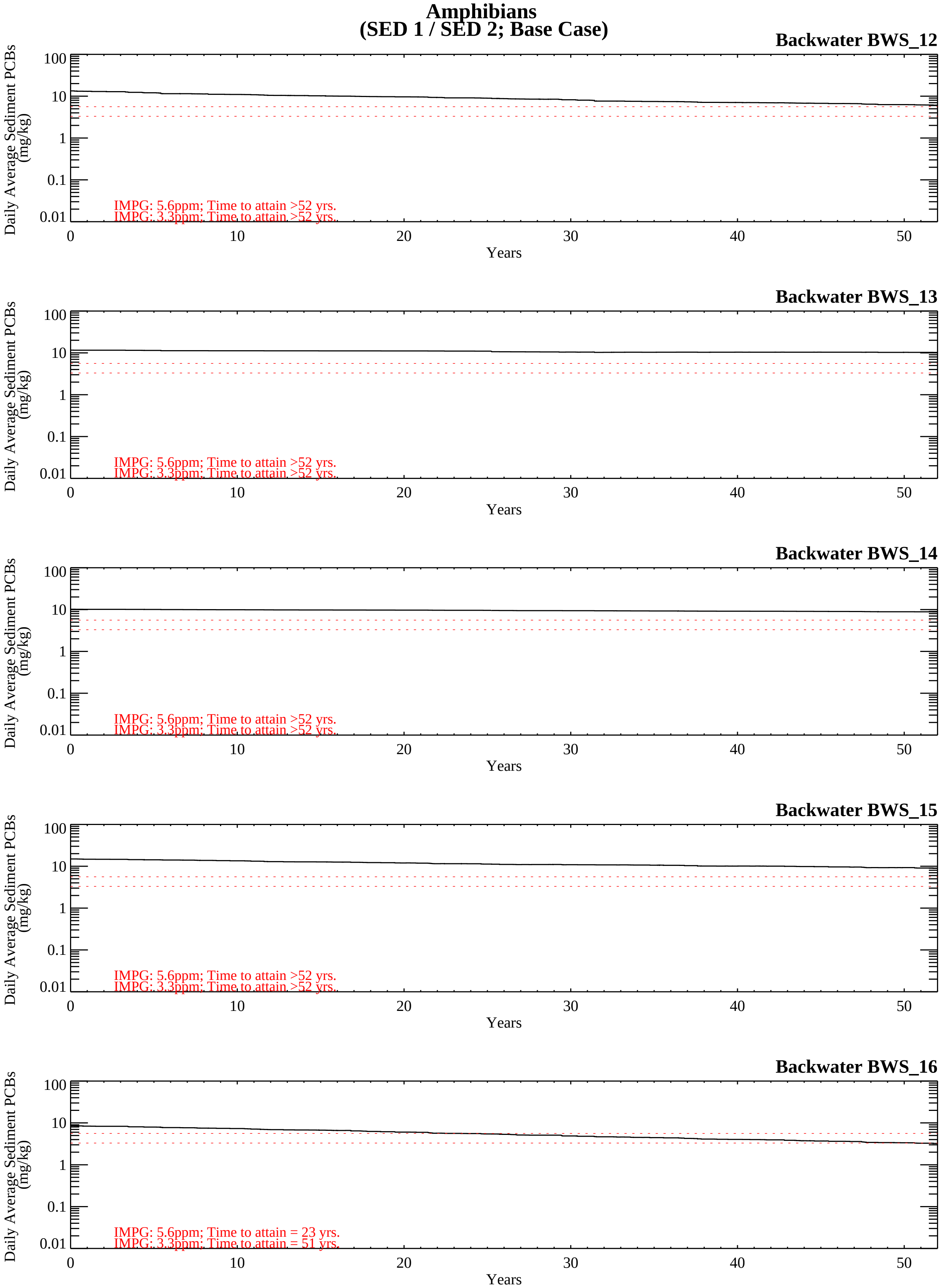

Figure G-5.2-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 1 / SED 2; Reach 5/6; Base Case).

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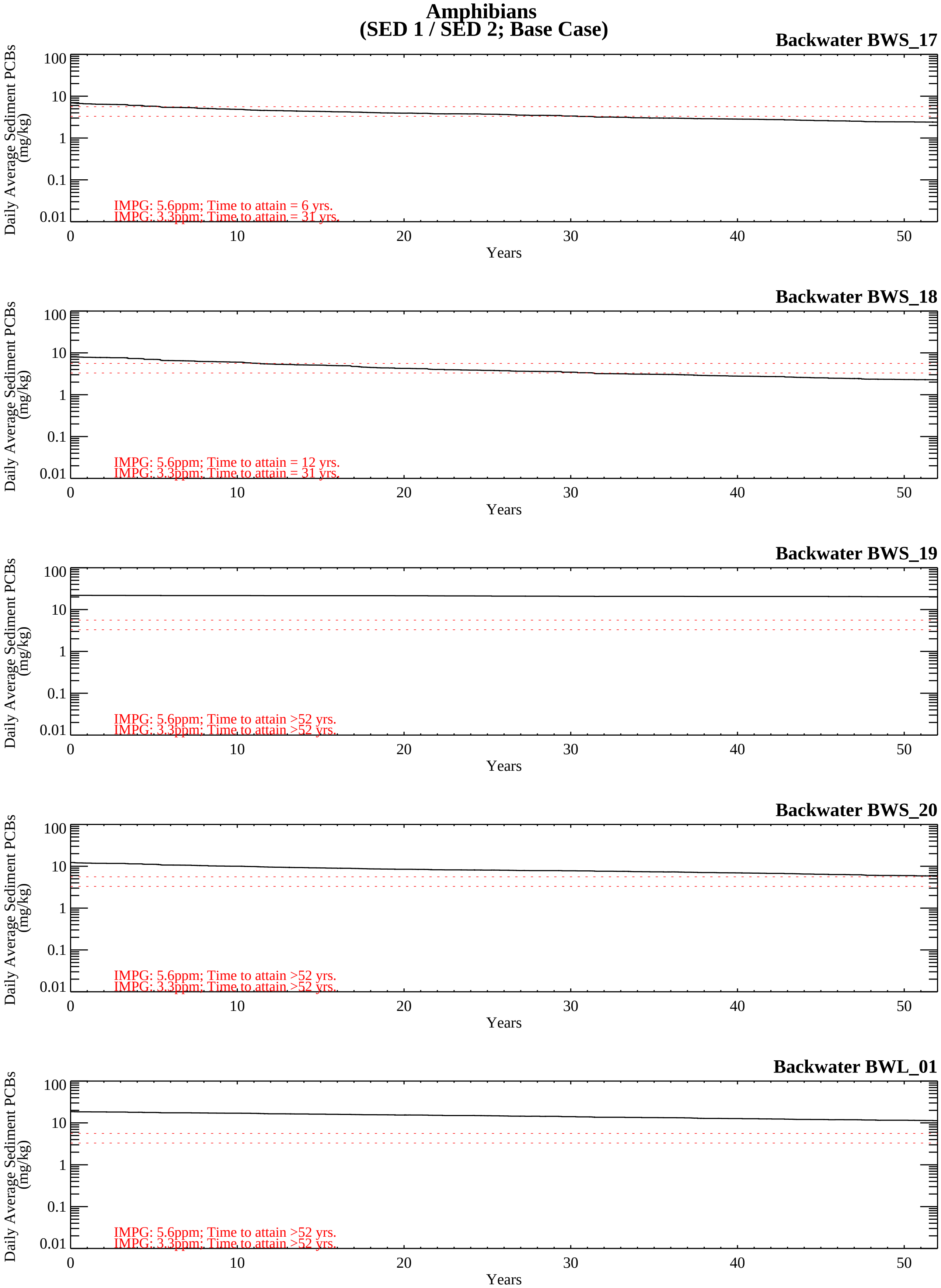

Figure G-5.2-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 1 / SED 2; Reach 5/6; Base Case).

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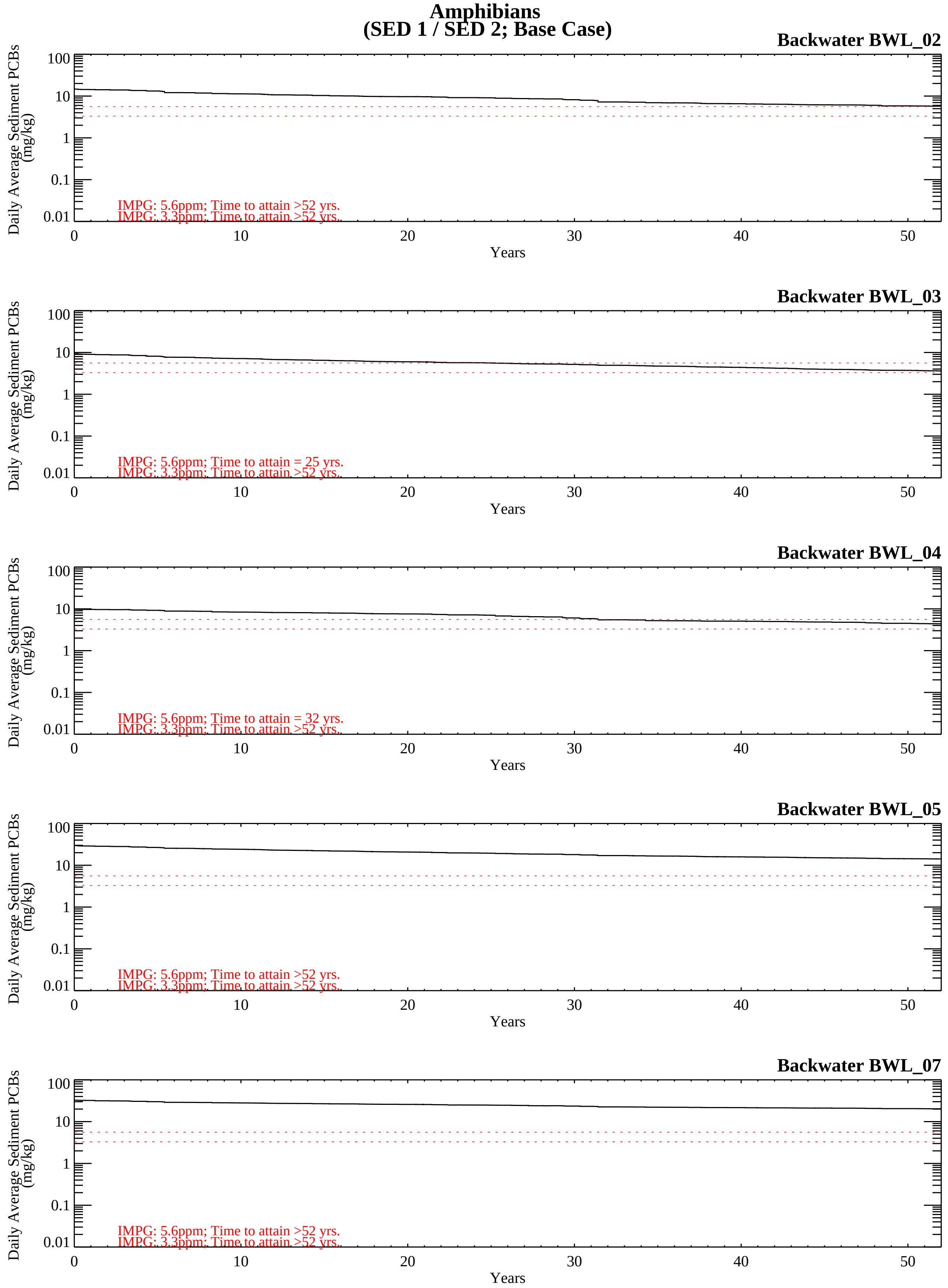

Figure G-5.2-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 1 / SED 2; Reach 5/6; Base Case).

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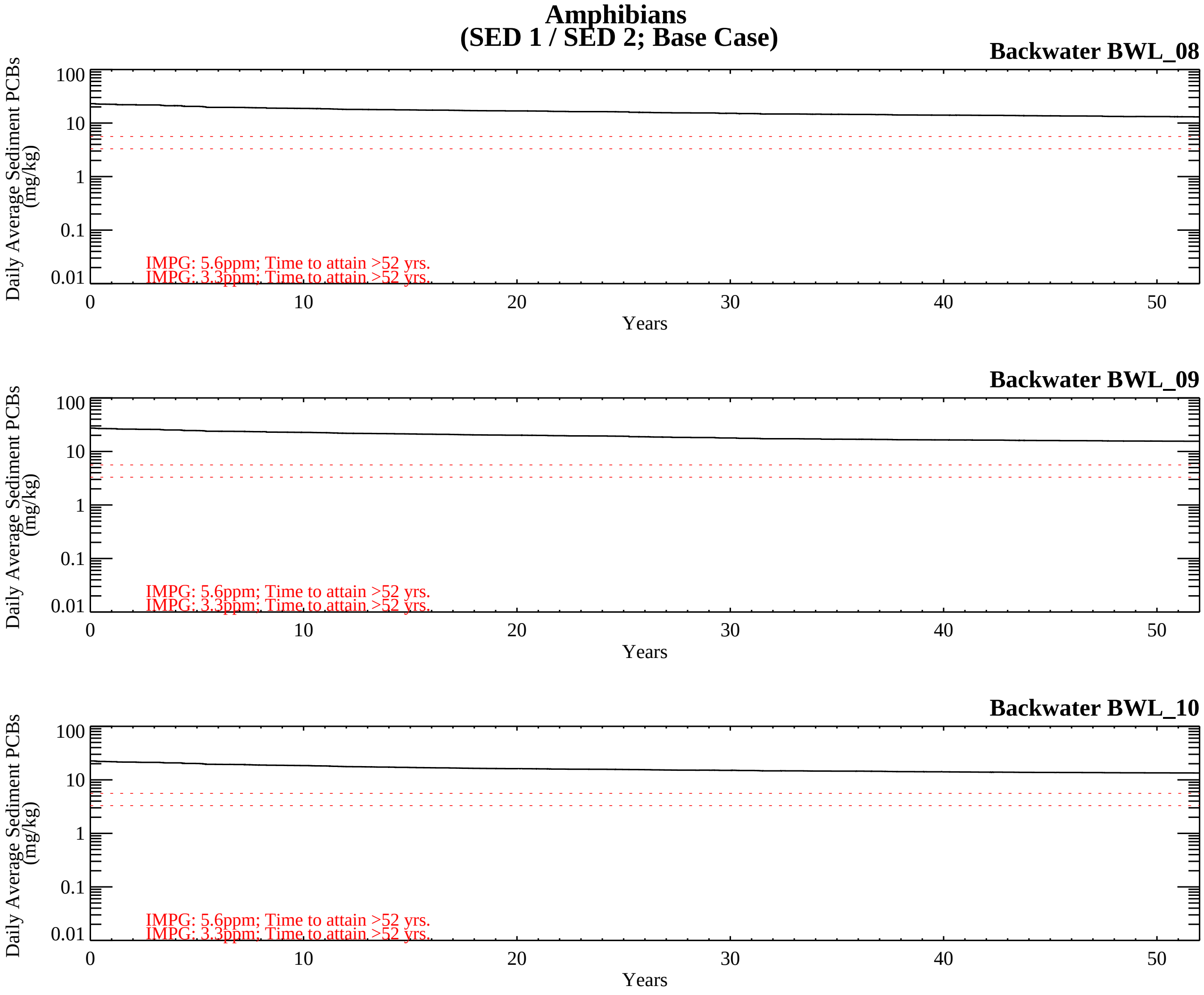

Figure G-5.2-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 1 / SED 2; Reach 5/6; Base Case).

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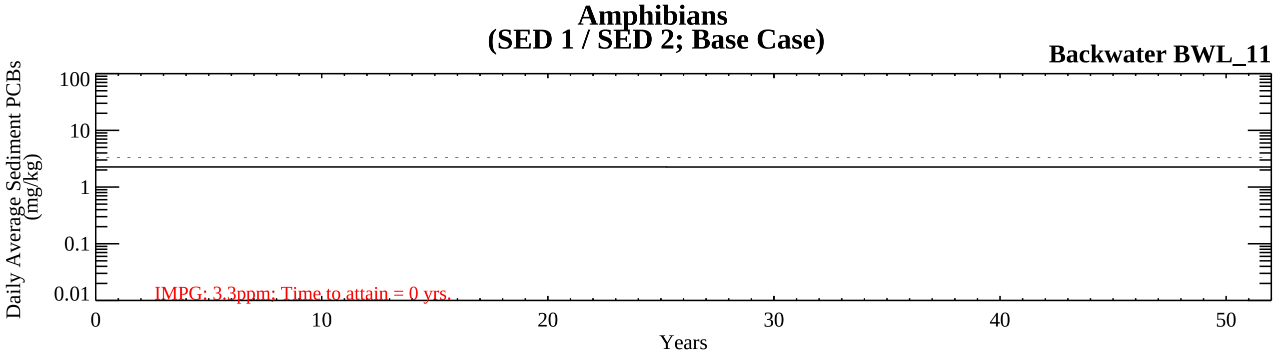

Figure G-5.2-1b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 1 / SED 2; Reach 7/8; Base Case).

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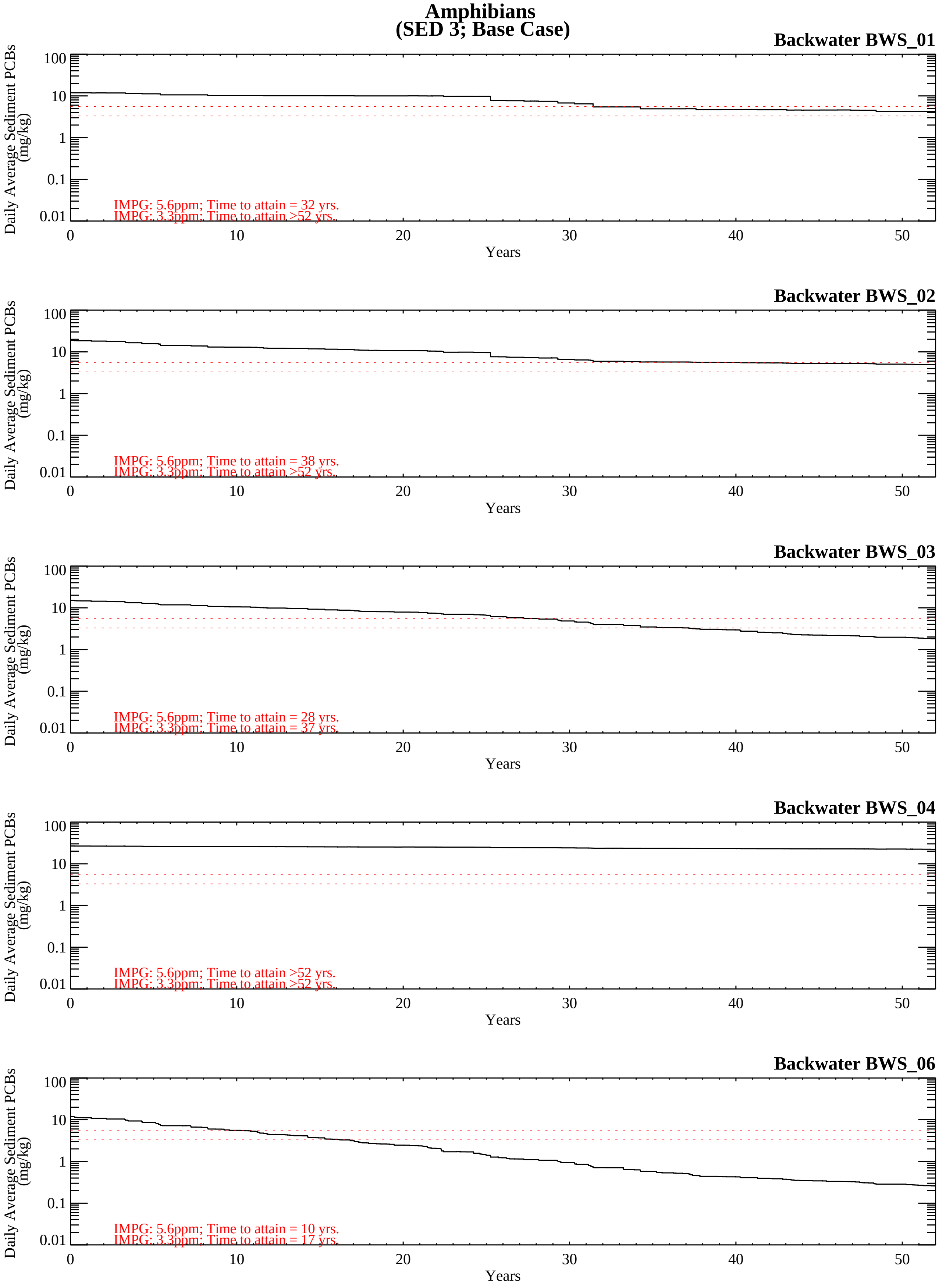

Figure G-5.2-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 3; Reach 5/6; Base Case).

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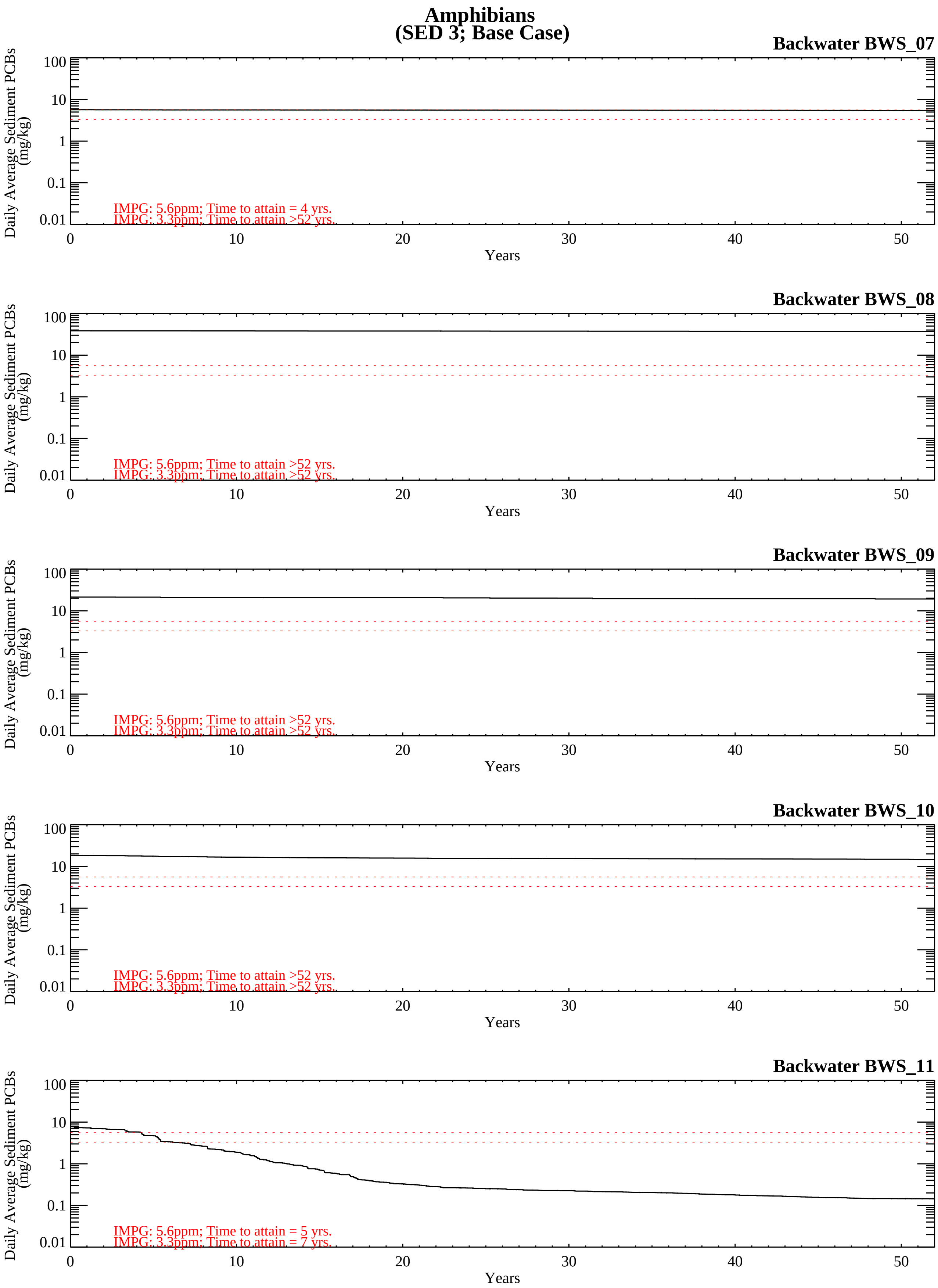

Figure G-5.2-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 3; Reach 5/6; Base Case).

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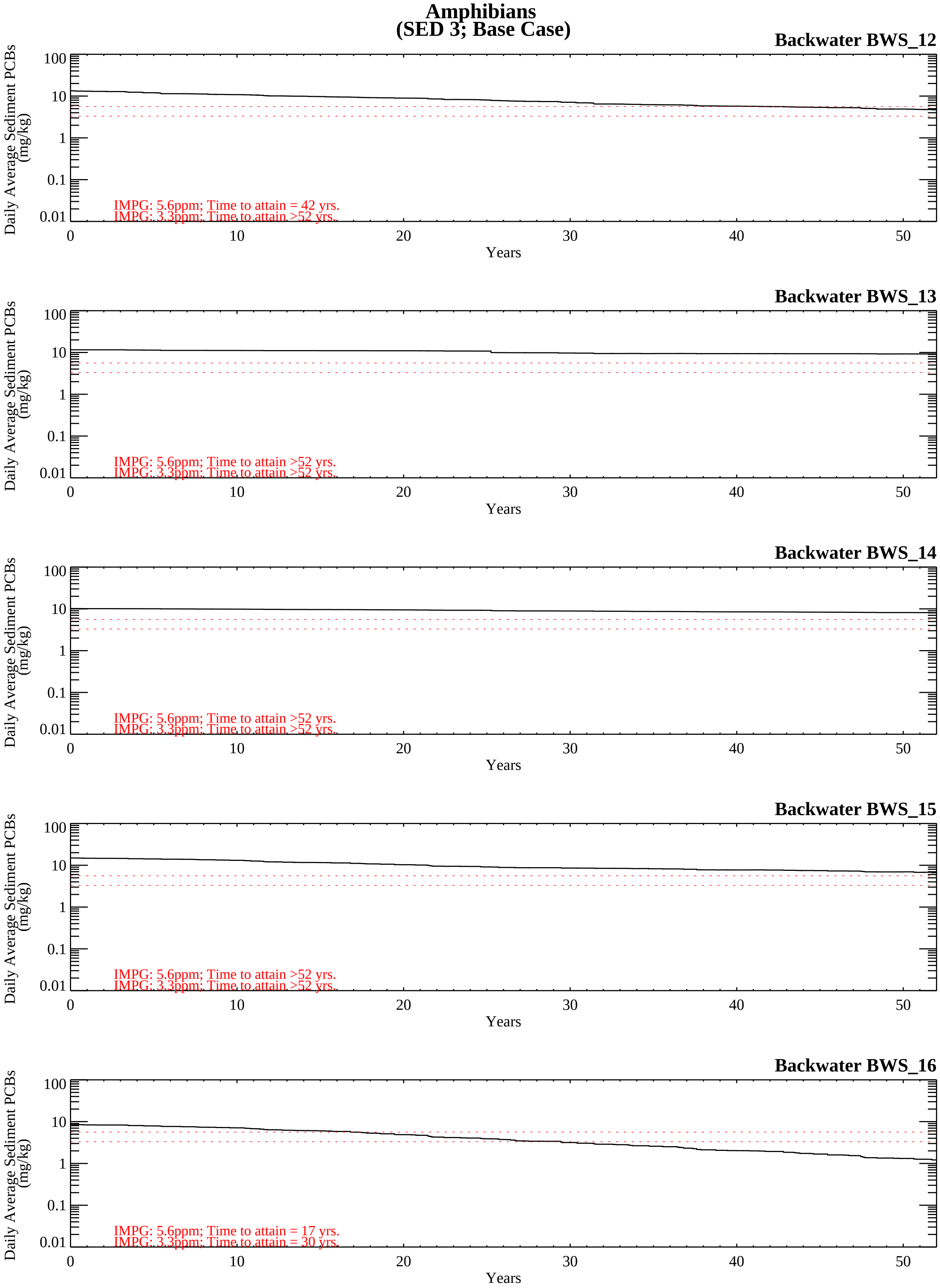

Figure G-5.2-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 3; Reach 5/6; Base Case).

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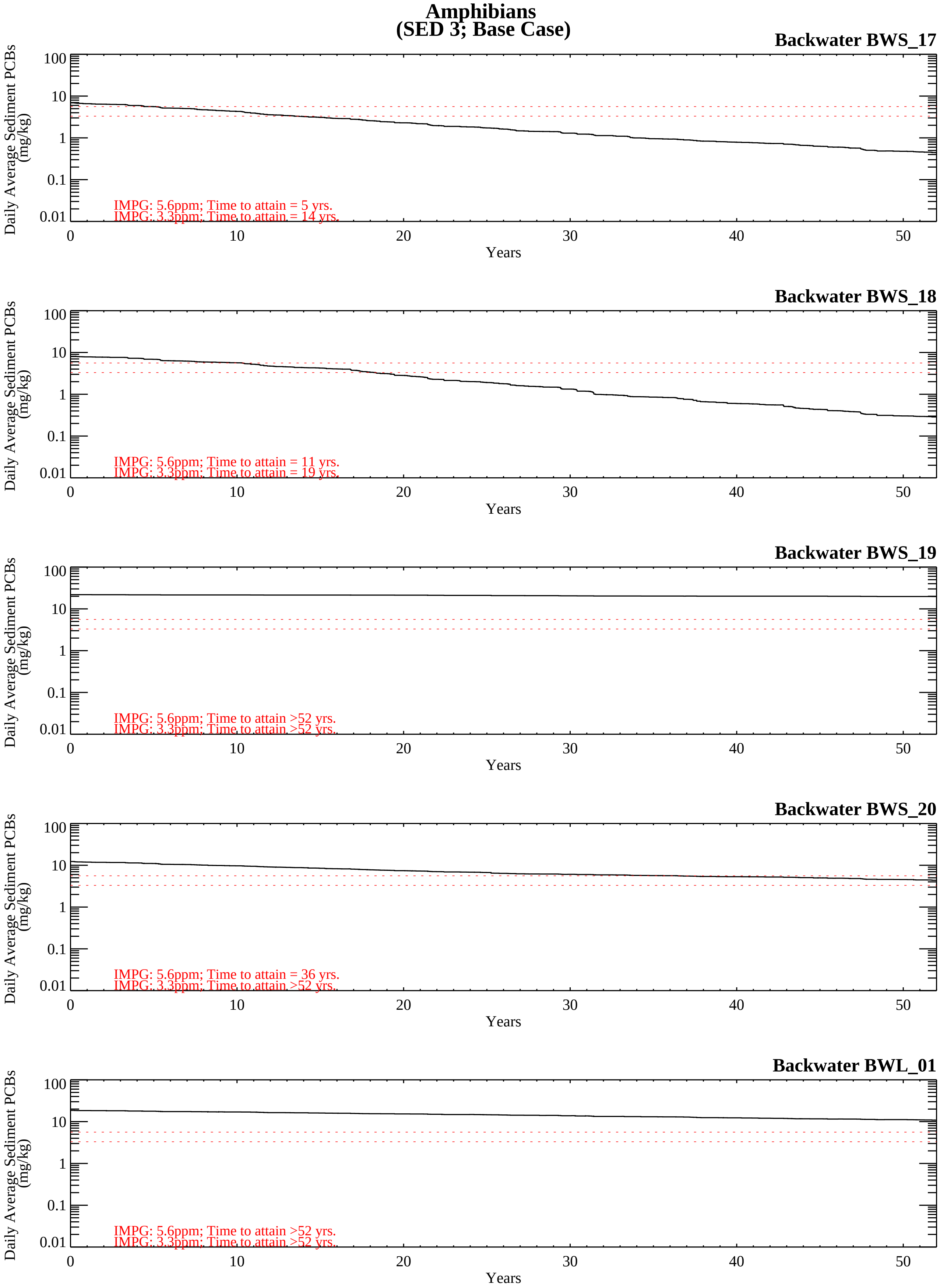

Figure G-5.2-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 3; Reach 5/6; Base Case).

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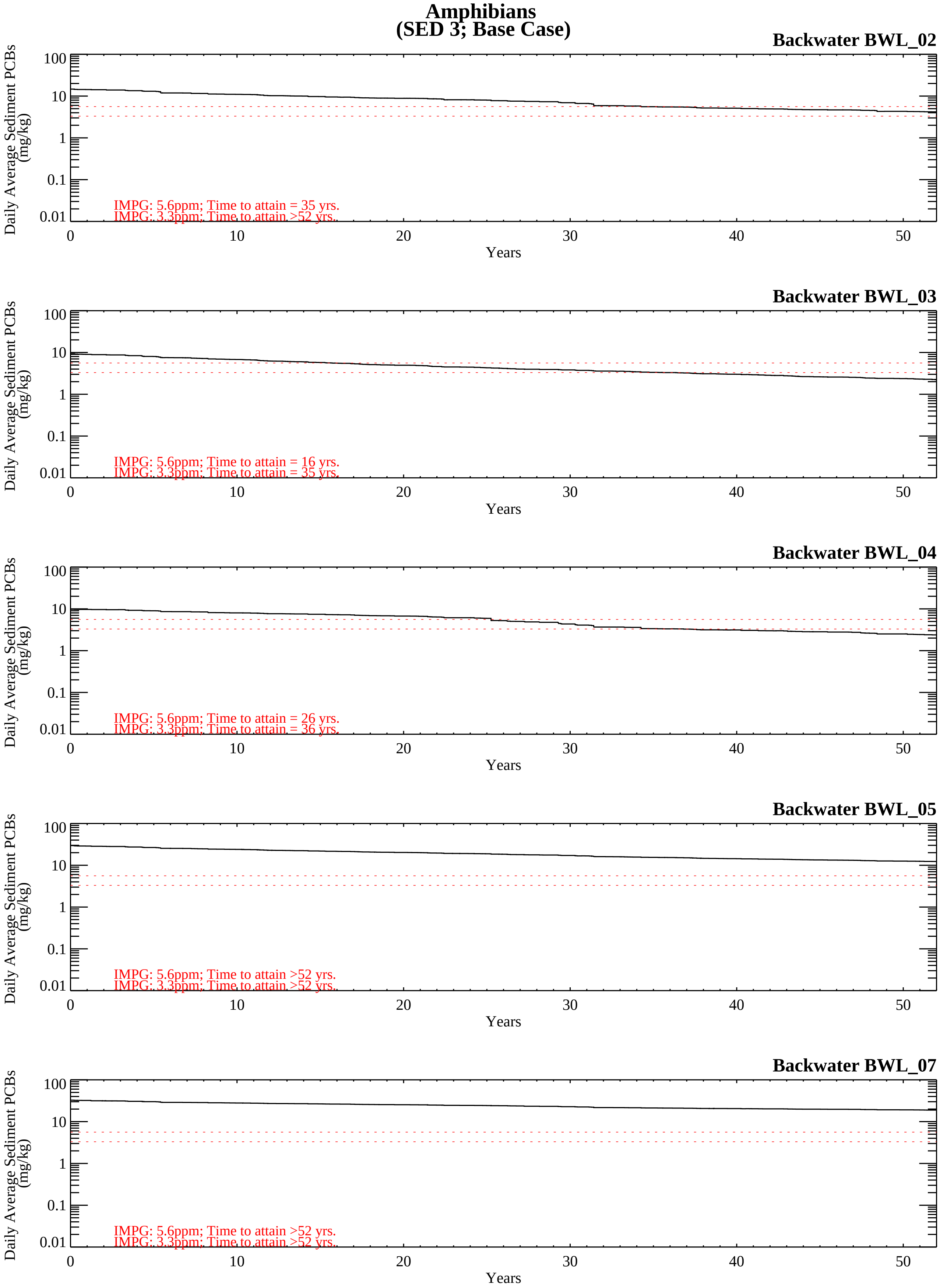

Figure G-5.2-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 3; Reach 5/6; Base Case).

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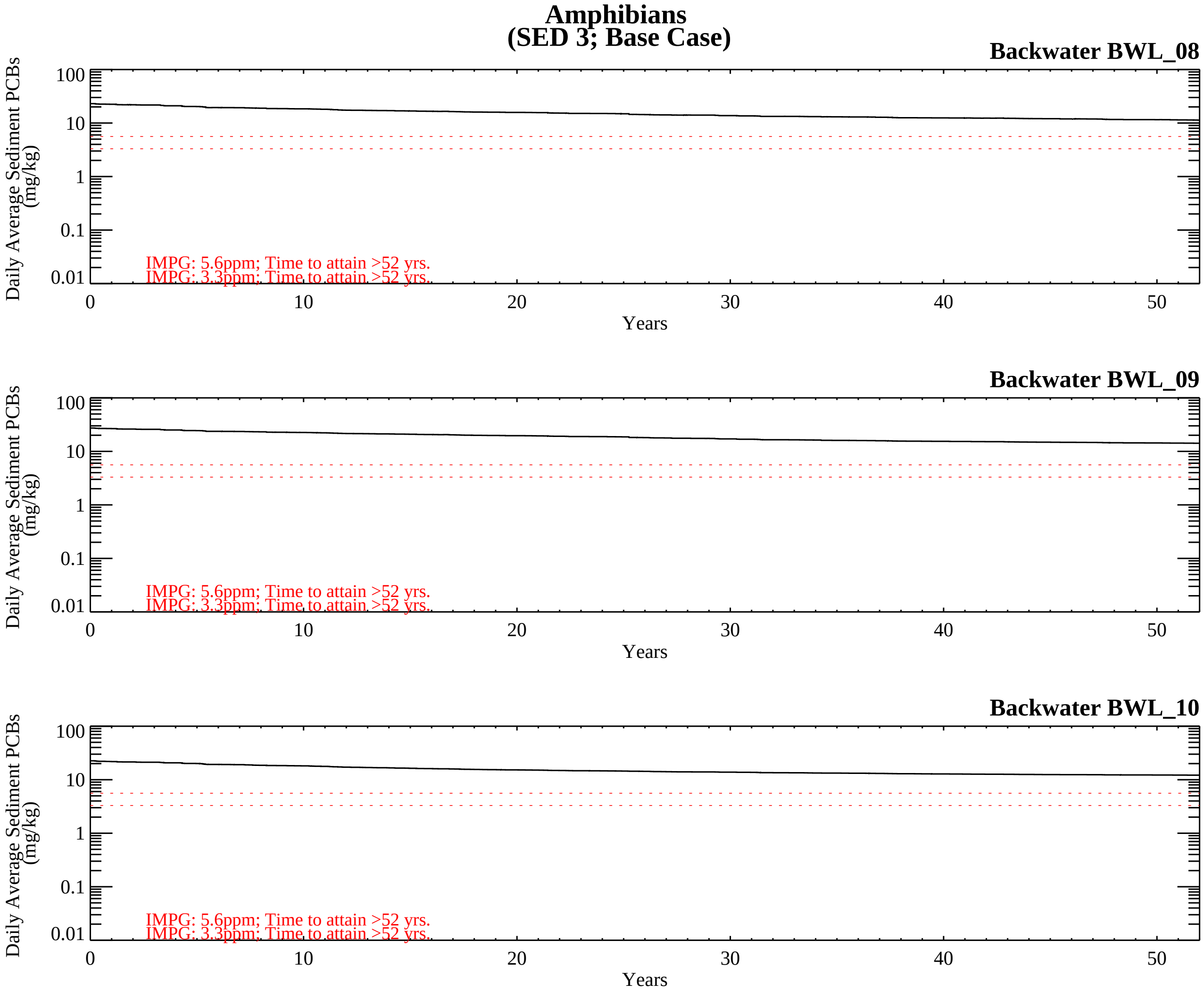

Figure G-5.2-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 3; Reach 5/6; Base Case).

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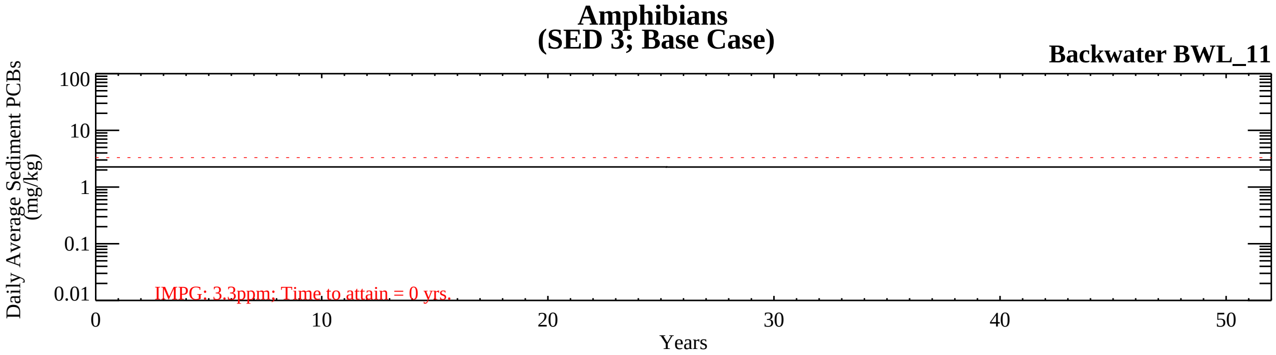

Figure G-5.2-2b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 3; Reach 7/8; Base Case).

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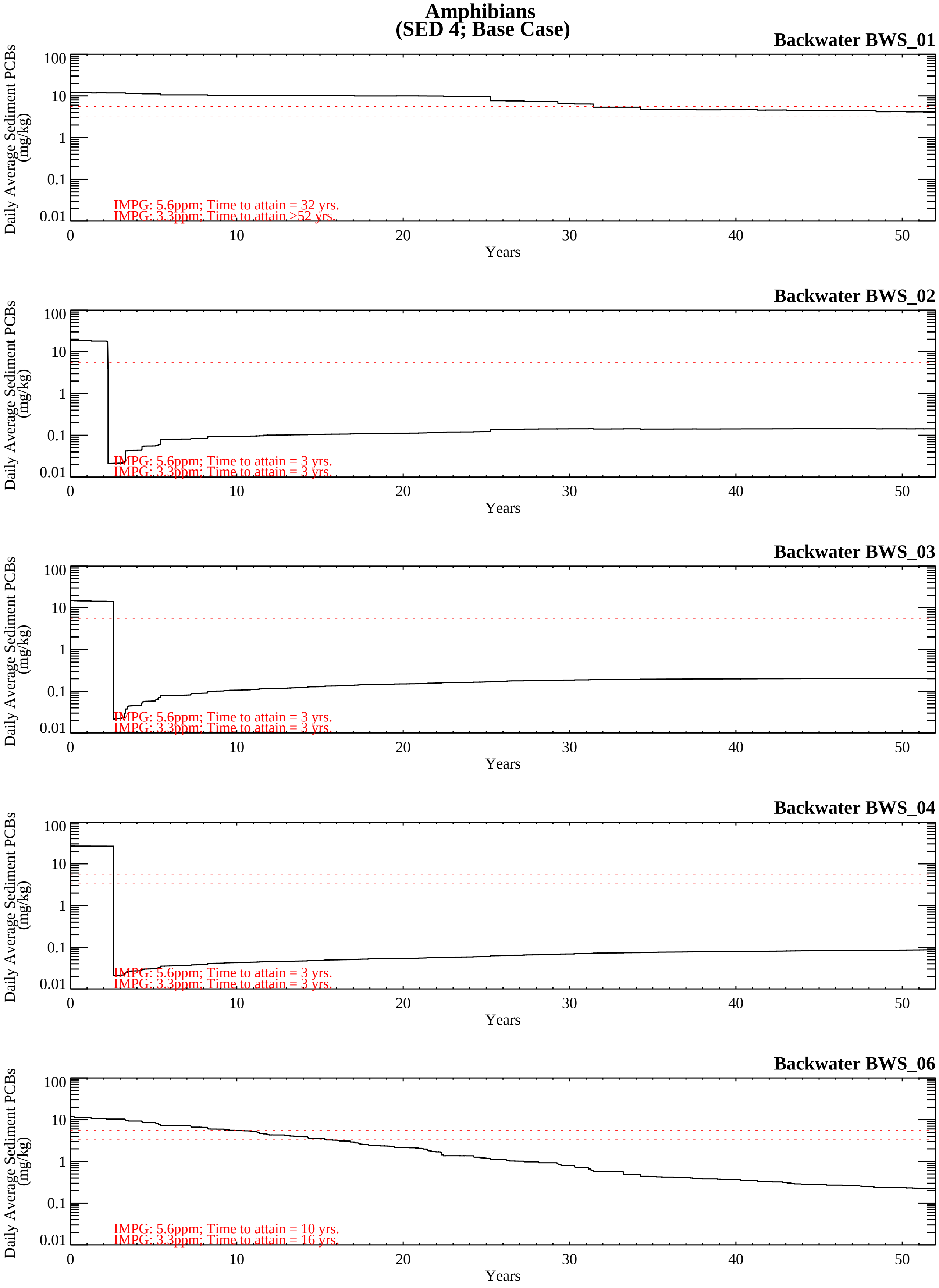

Figure G-5.2-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 4; Reach 5/6; Base Case).

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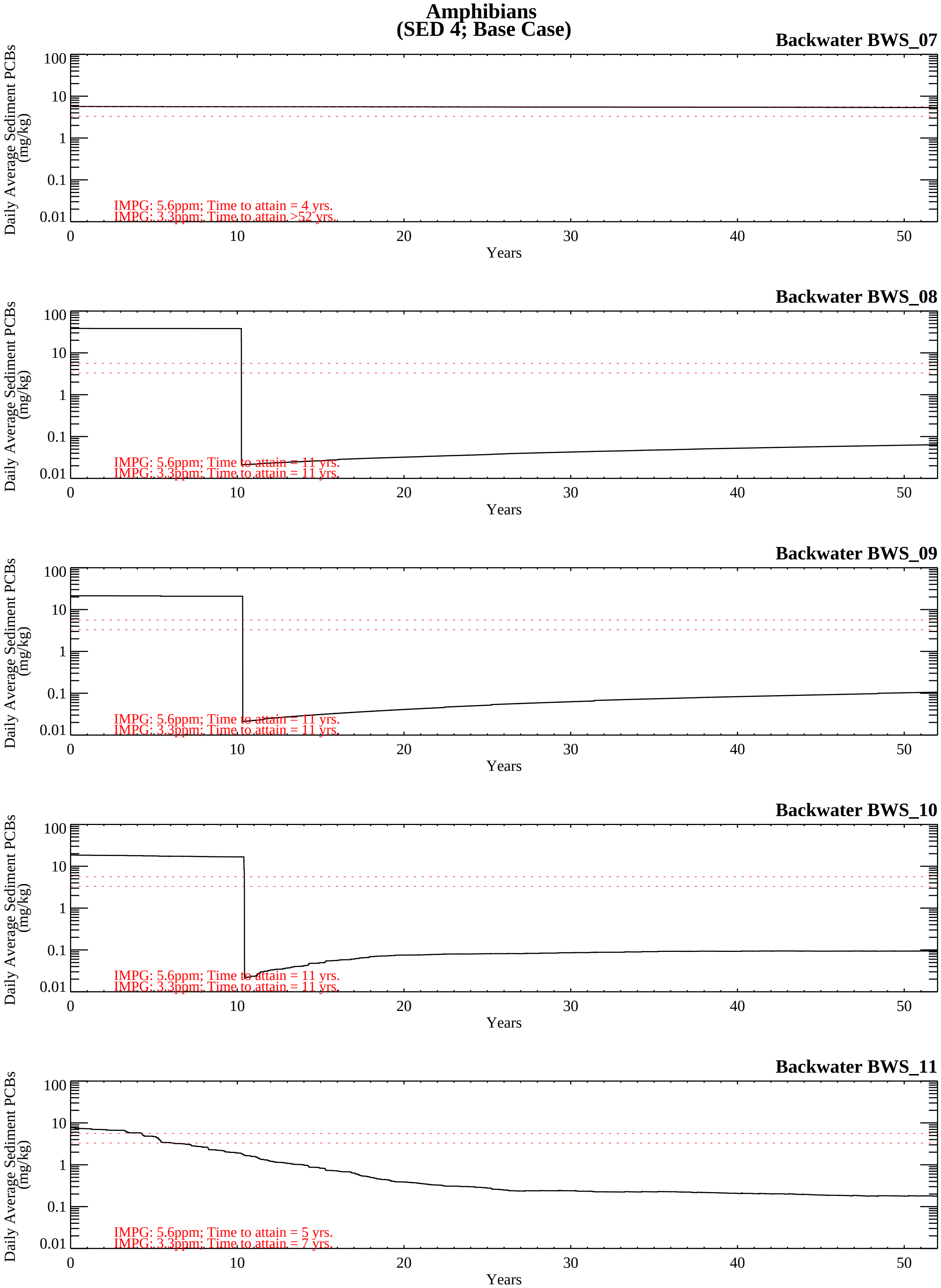

Figure G-5.2-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 4; Reach 5/6; Base Case).

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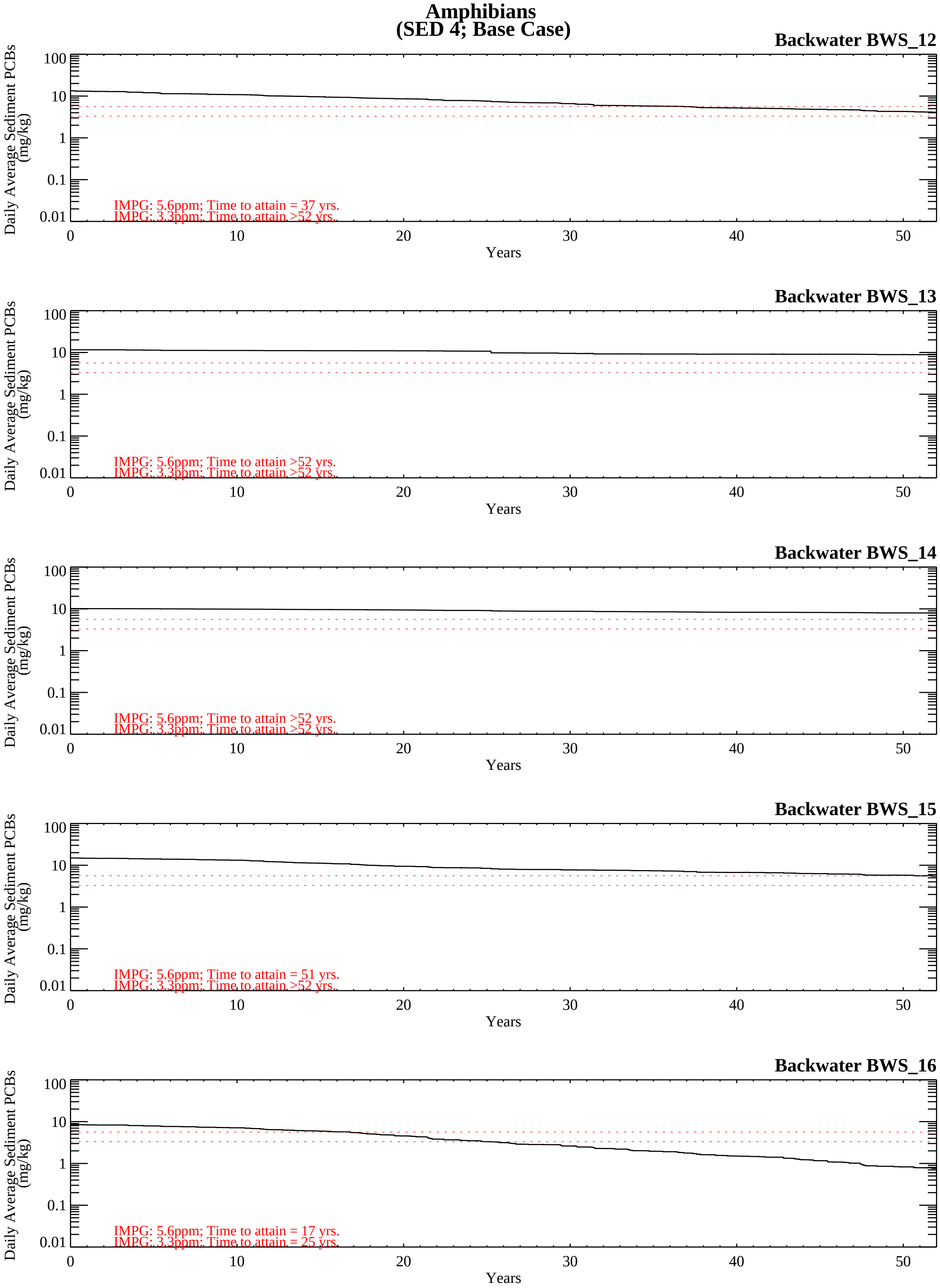

Figure G-5.2-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 4; Reach 5/6; Base Case).

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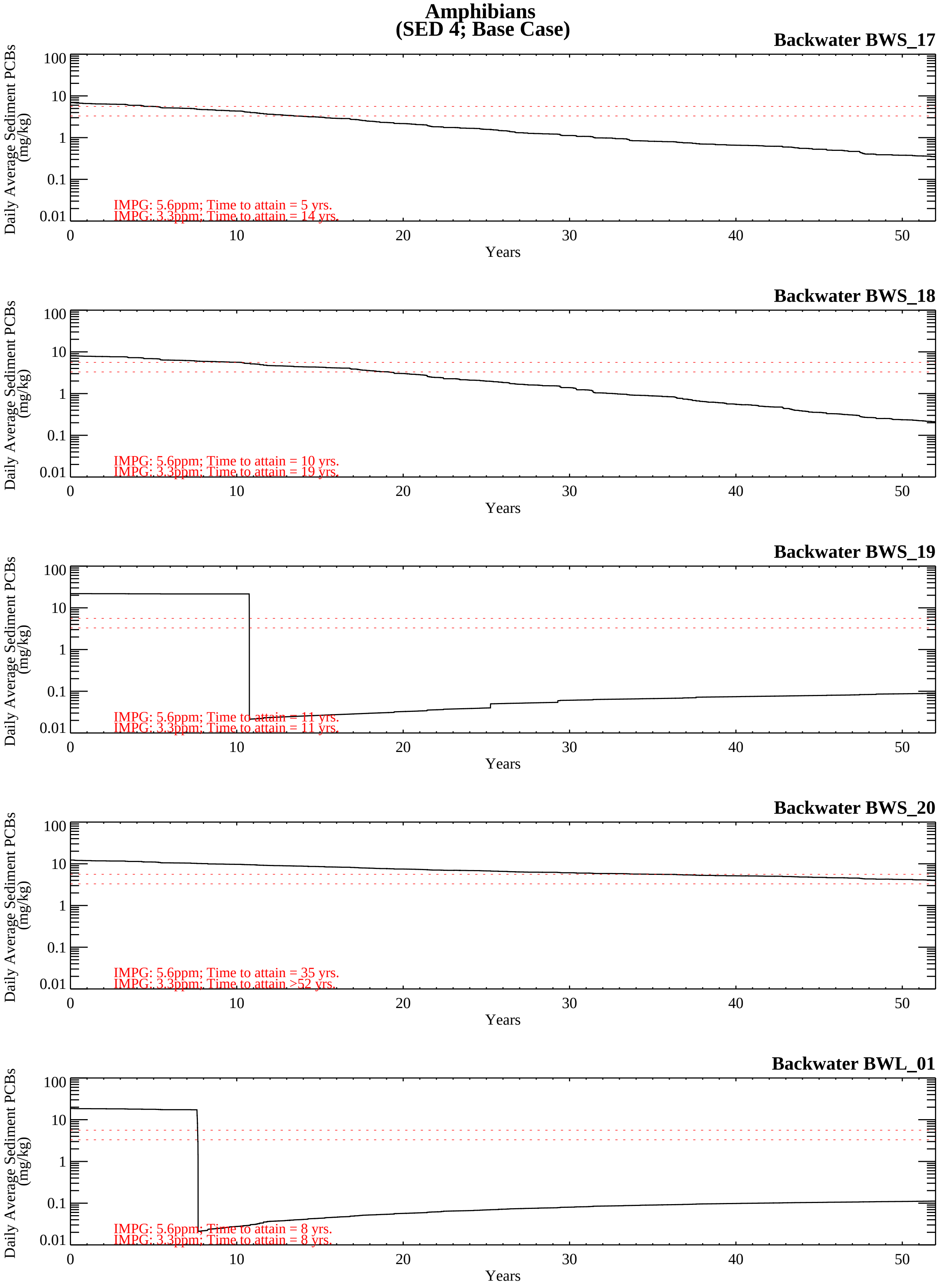

Figure G-5.2-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 4; Reach 5/6; Base Case).

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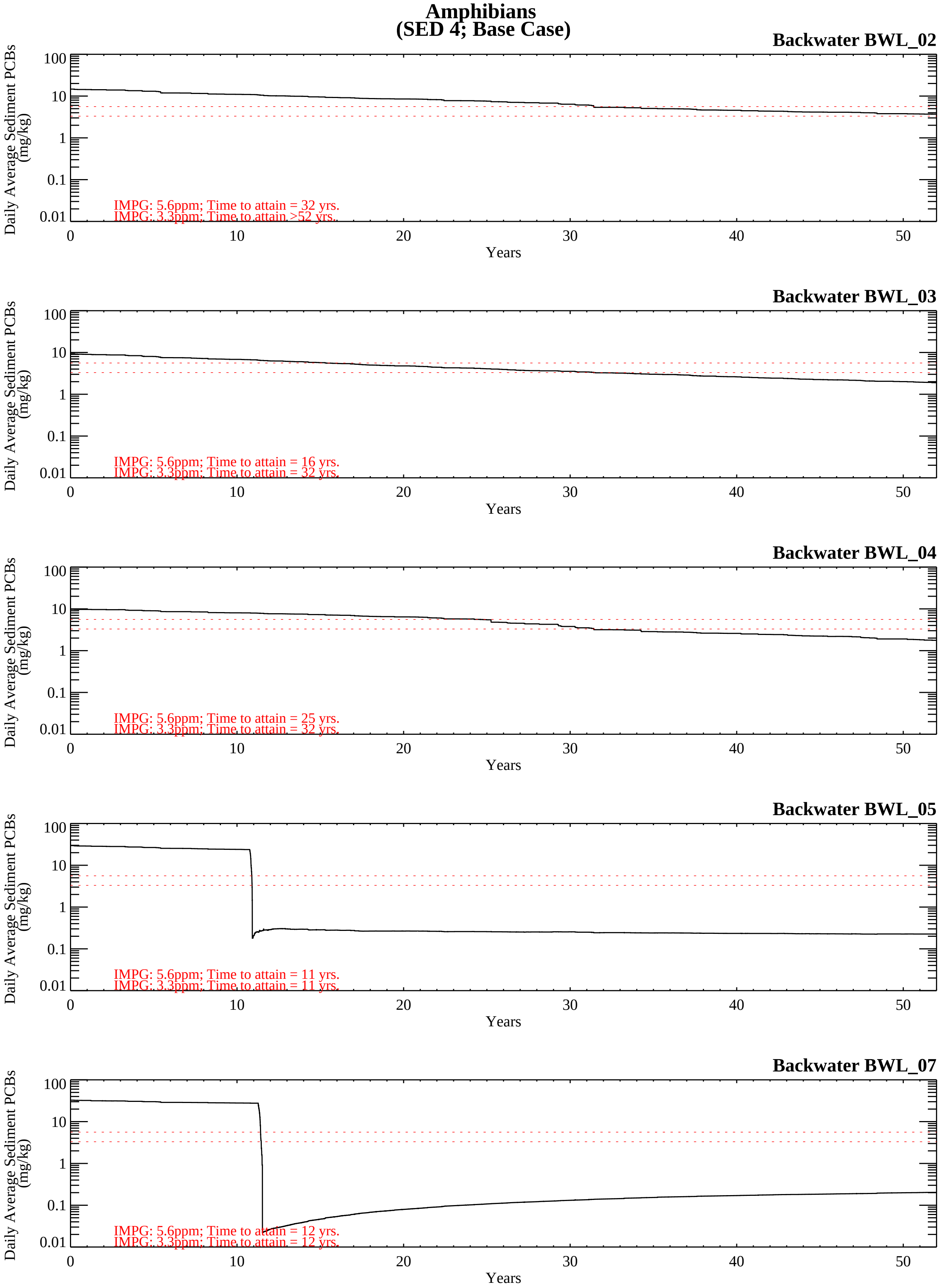

Figure G-5.2-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 4; Reach 5/6; Base Case).

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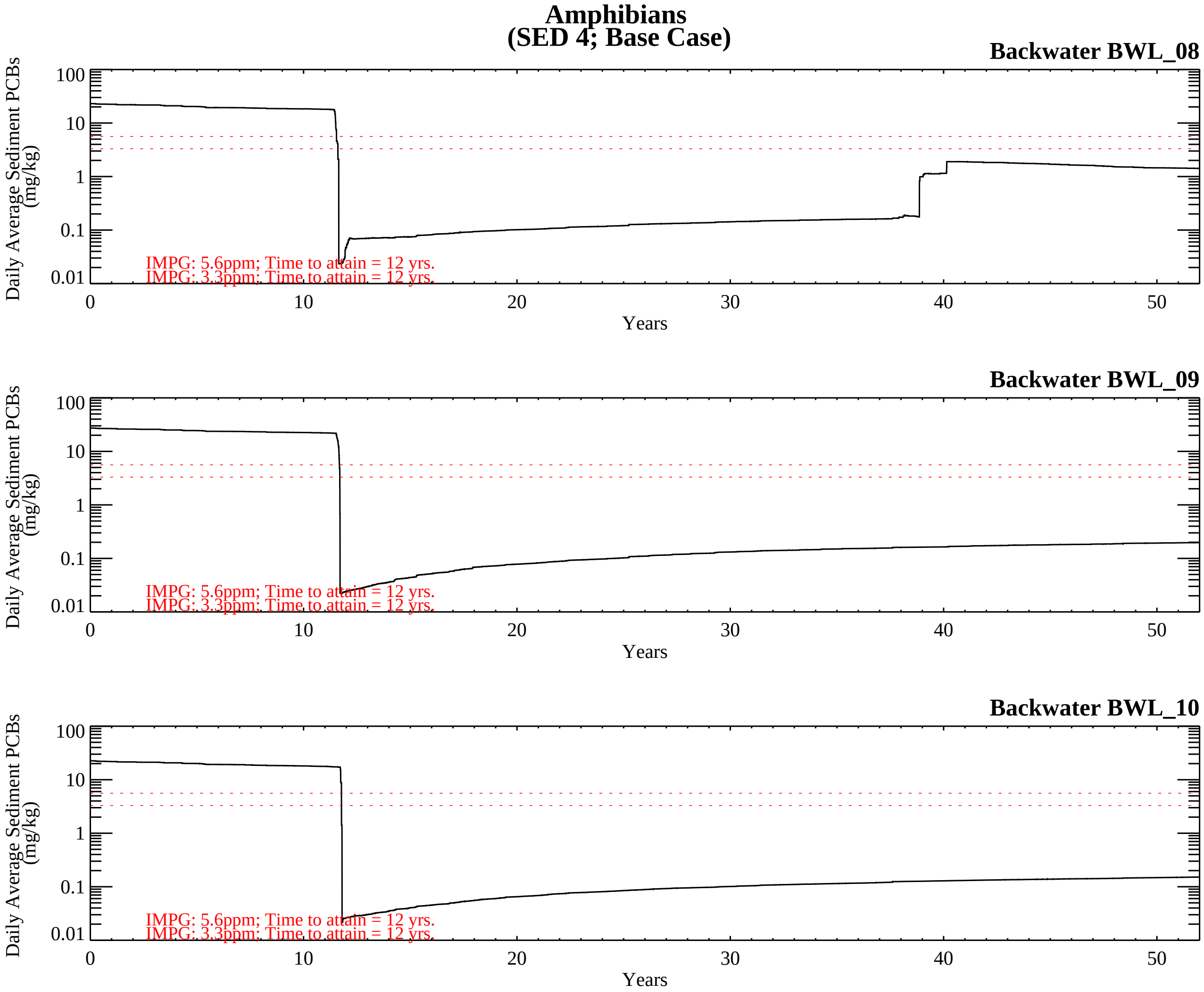

Figure G-5.2-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 4; Reach 5/6; Base Case).

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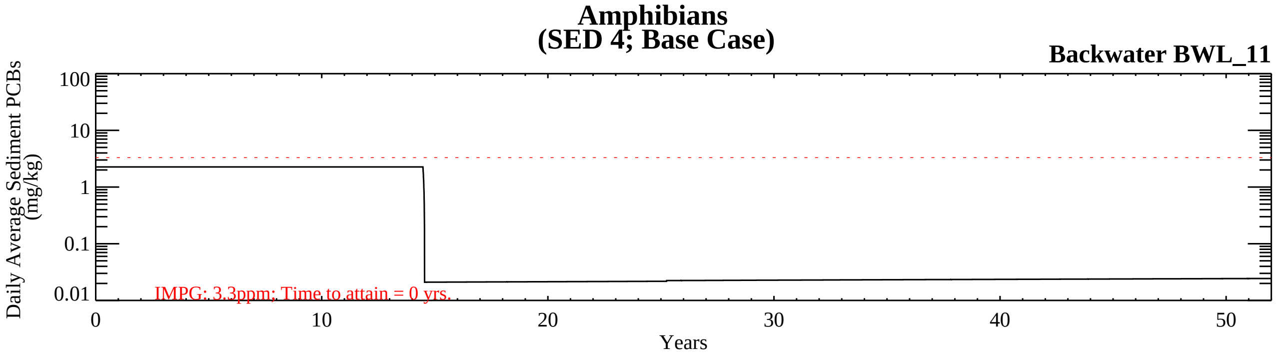

Figure G-5.2-3b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 4; Reach 7/8; Base Case).

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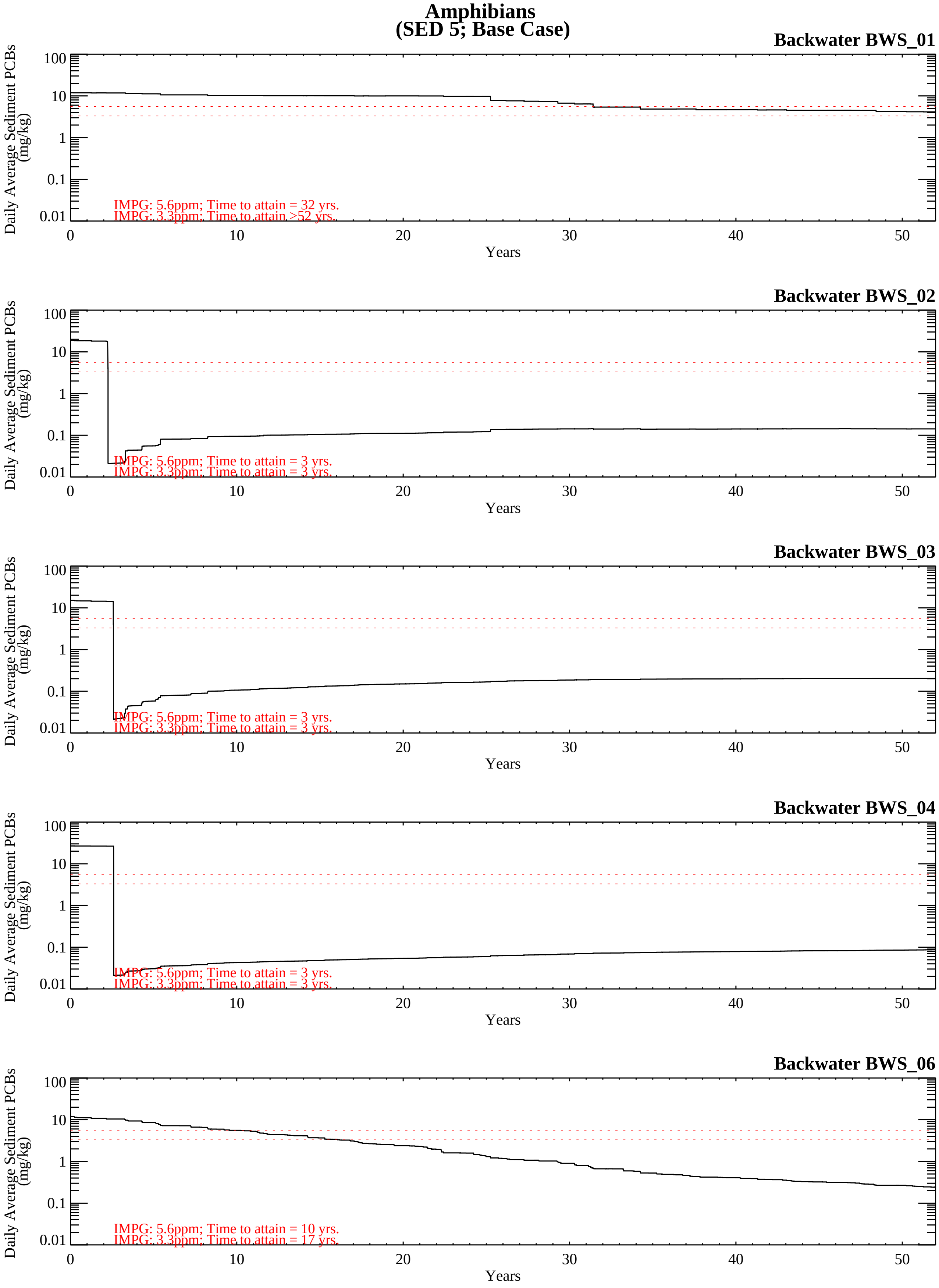

Figure G-5.2-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 5; Reach 5/6; Base Case).

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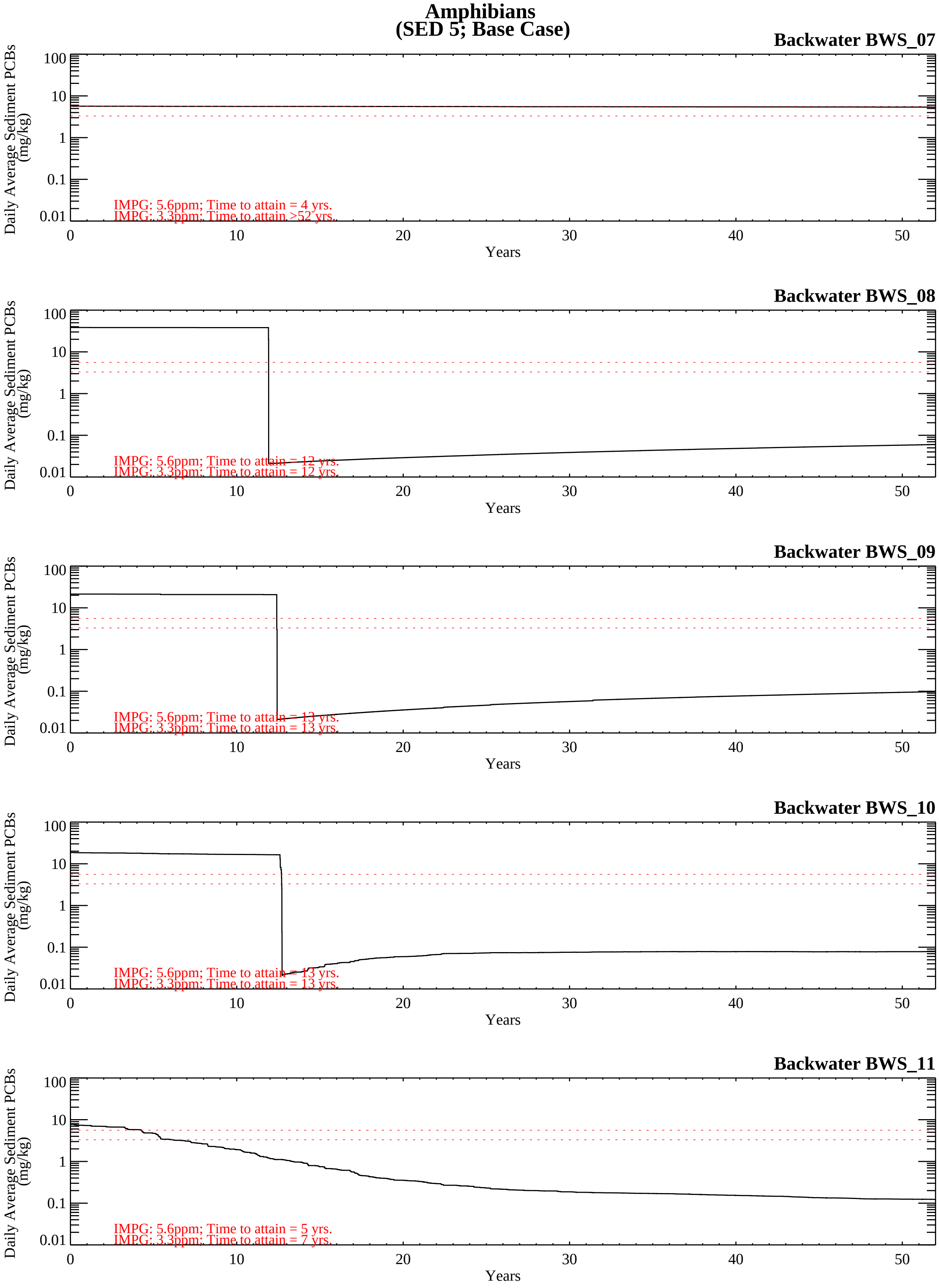

Figure G-5.2-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 5; Reach 5/6; Base Case).

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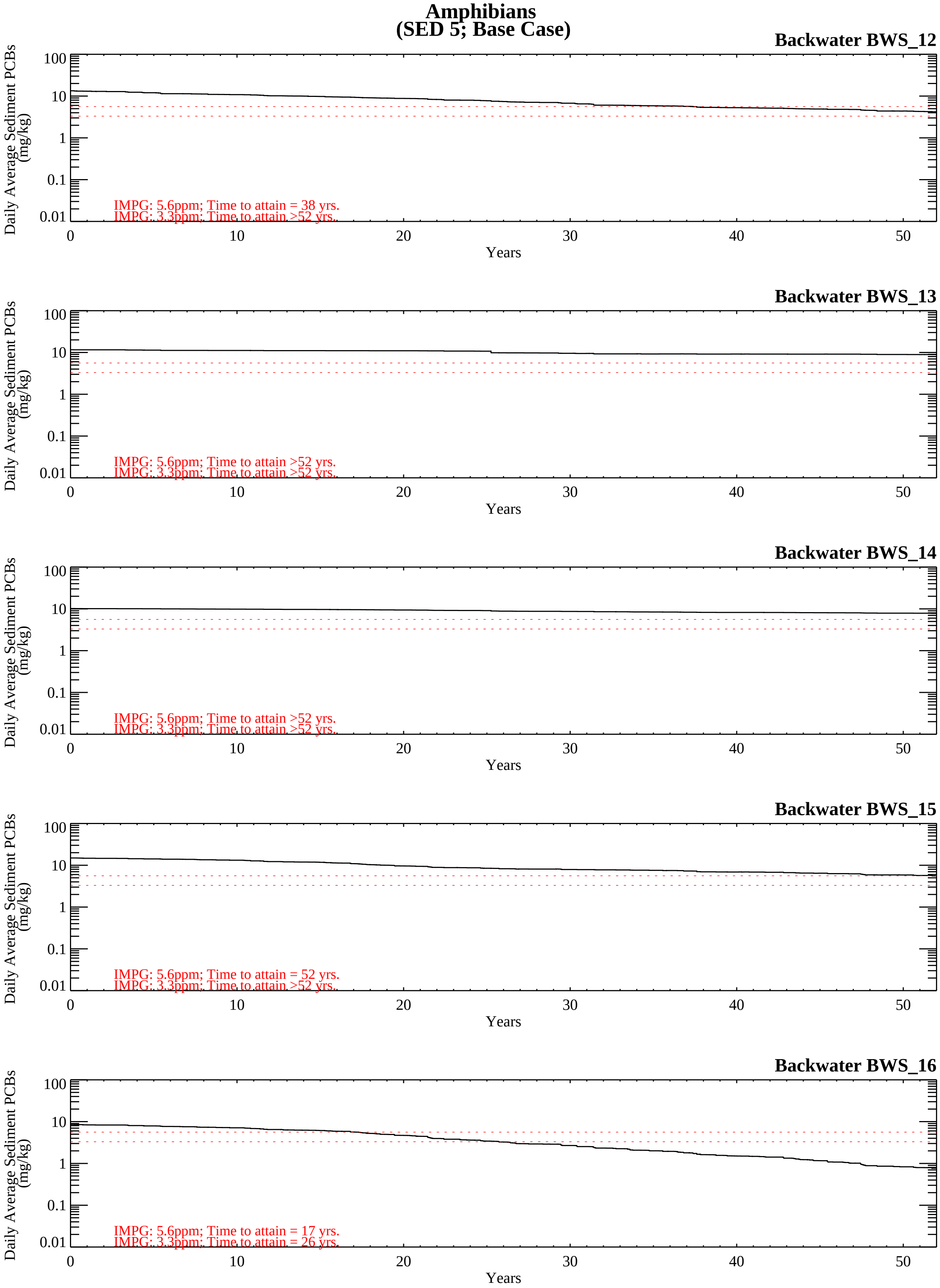

Figure G-5.2-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 5; Reach 5/6; Base Case).

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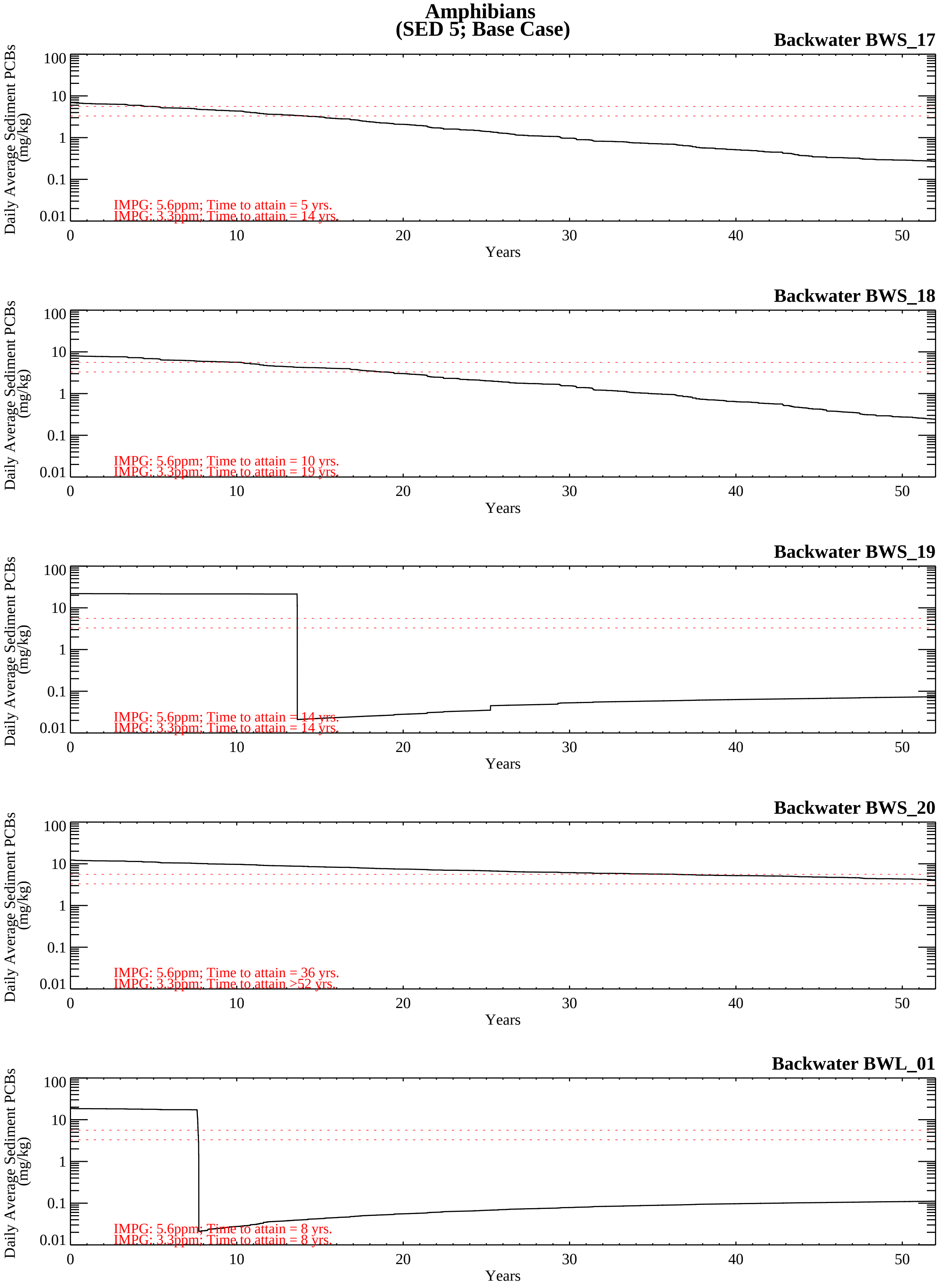

Figure G-5.2-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 5; Reach 5/6; Base Case).

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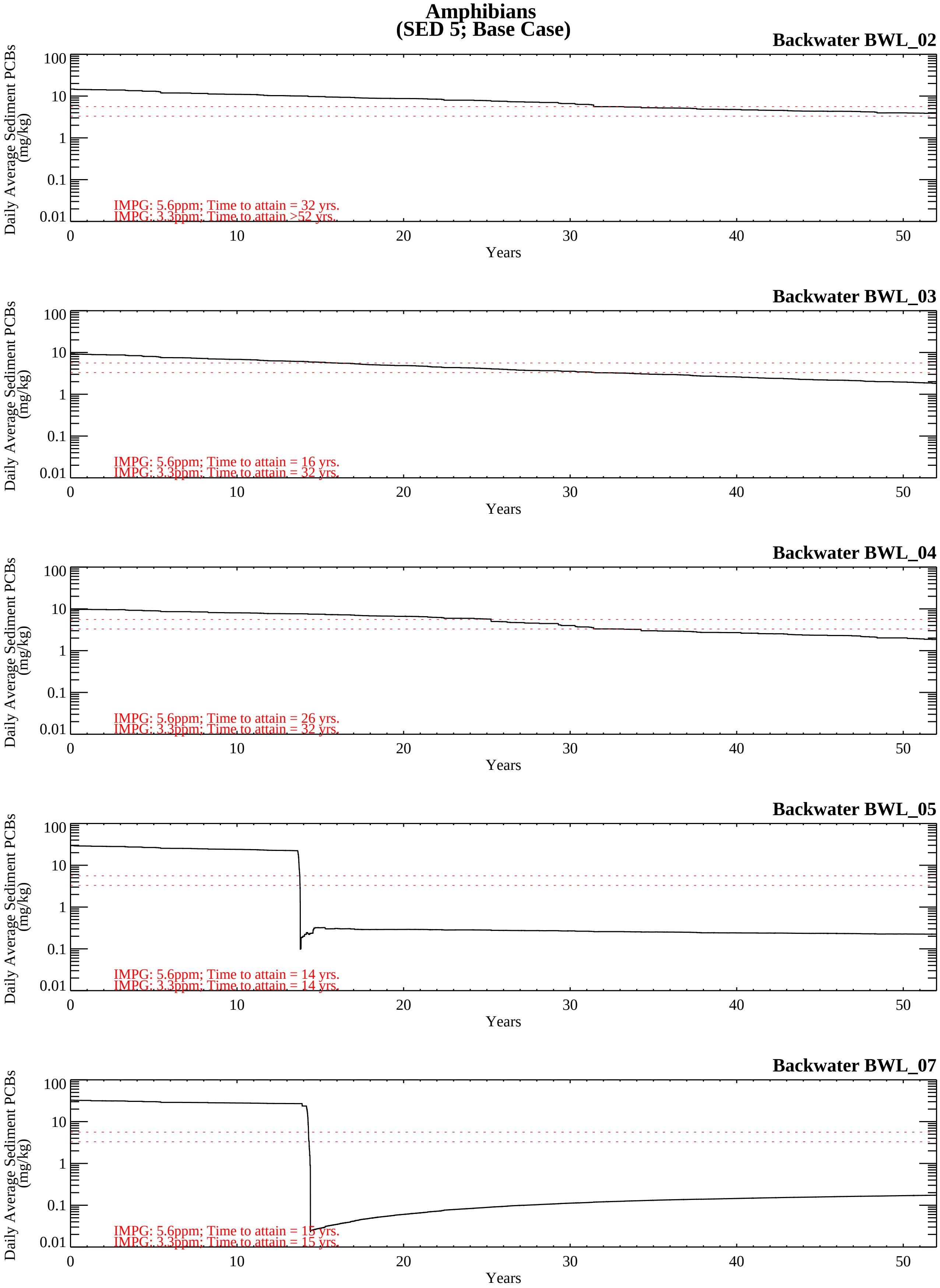

Figure G-5.2-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 5; Reach 5/6; Base Case).

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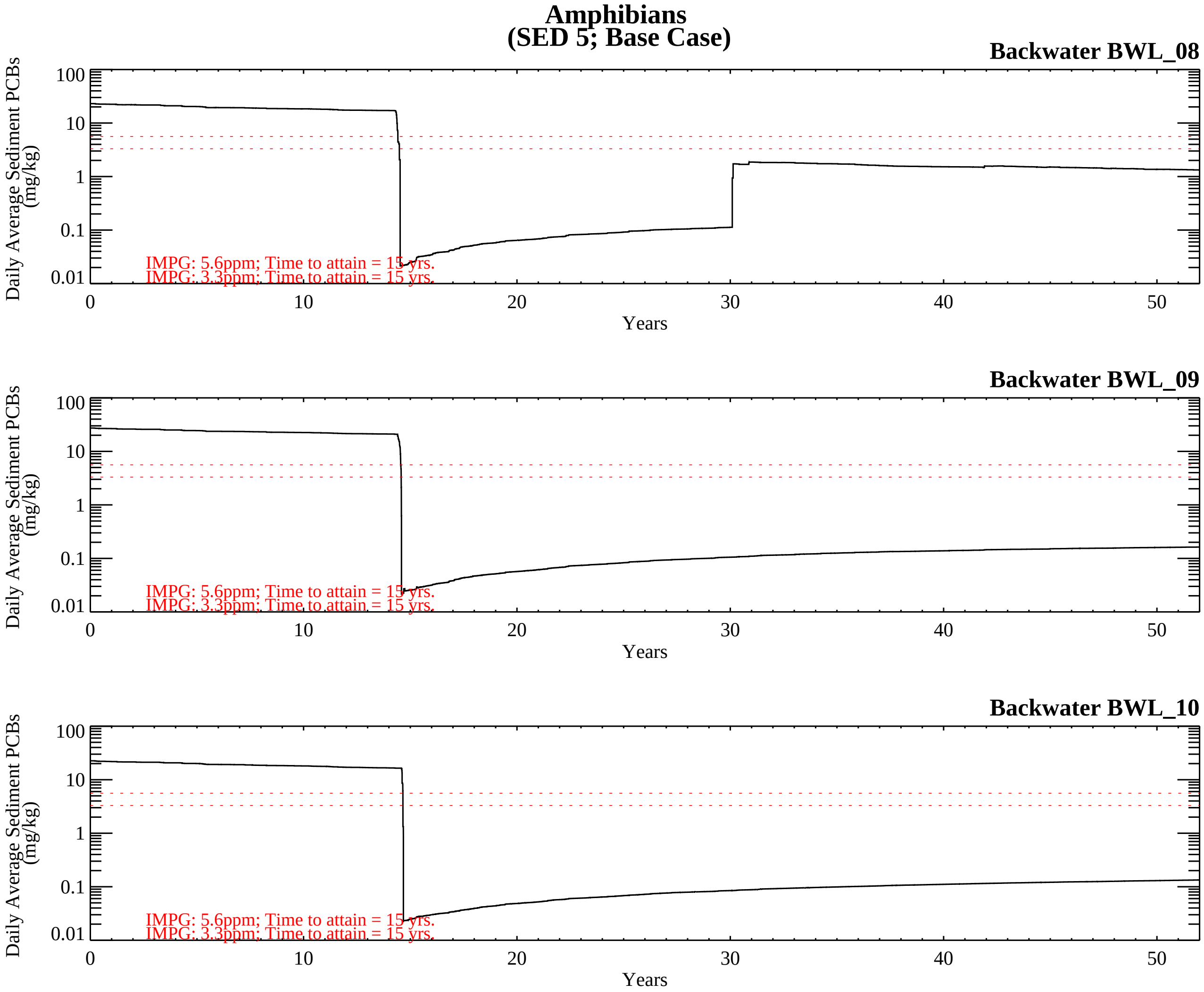

Figure G-5.2-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 5; Reach 5/6; Base Case).

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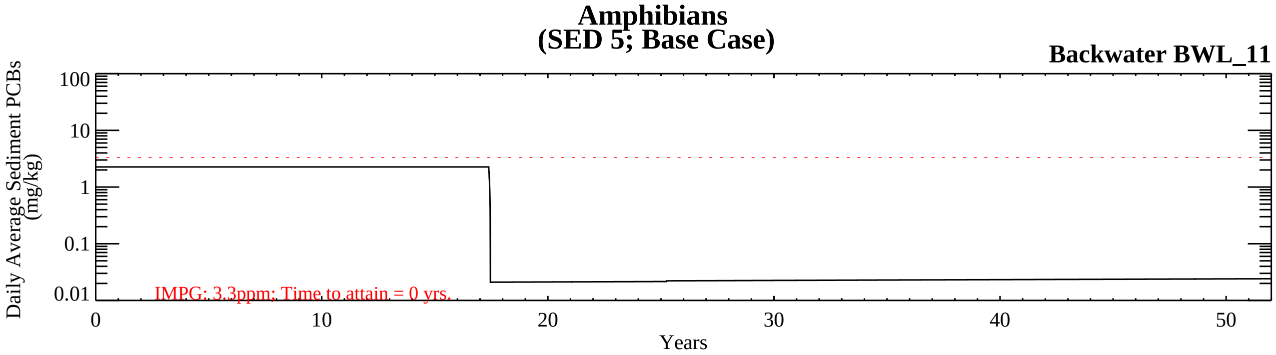

Figure G-5.2-4b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 5; Reach 7/8; Base Case).

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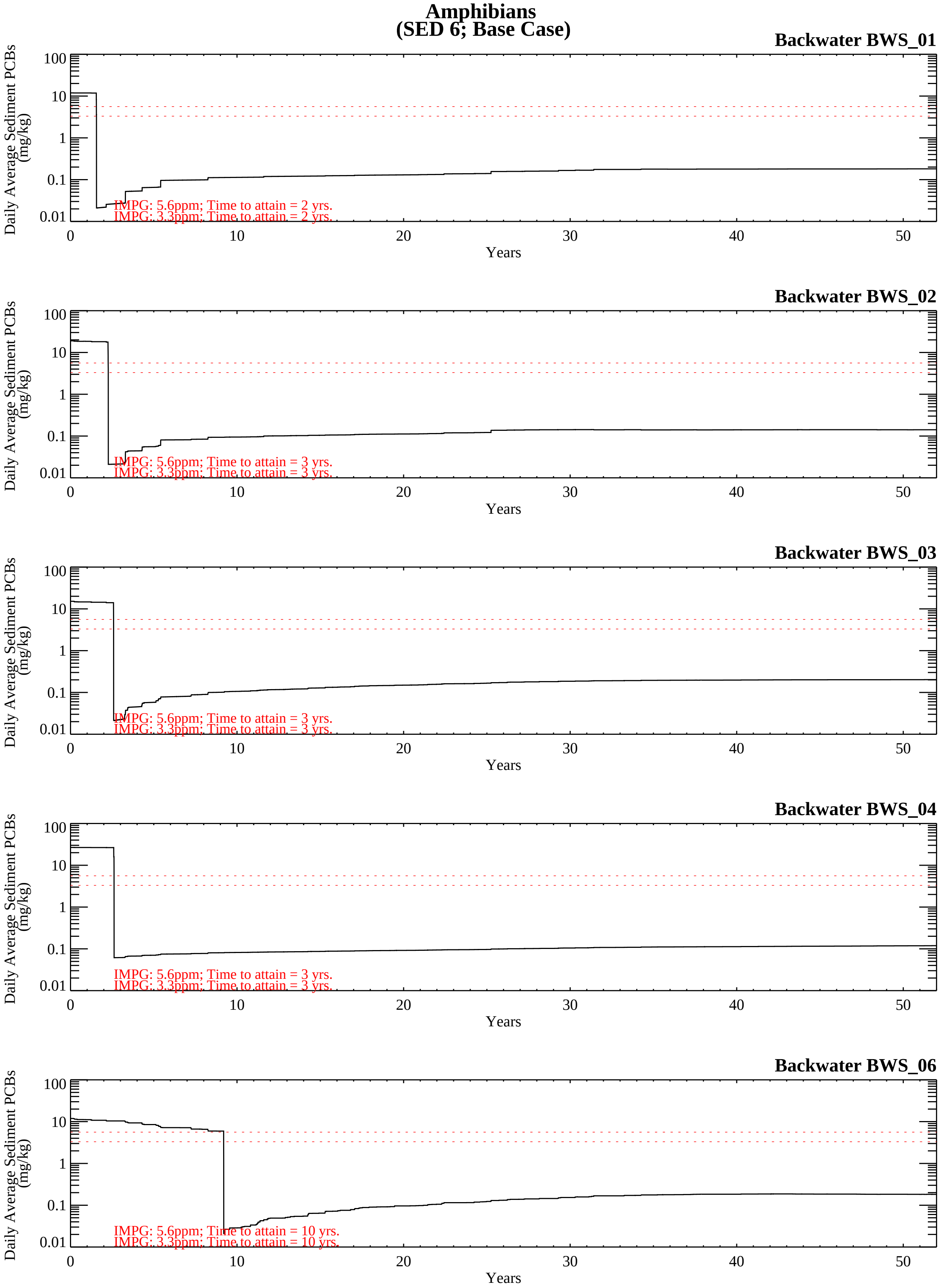

Figure G-5.2-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 6; Reach 5/6; Base Case).

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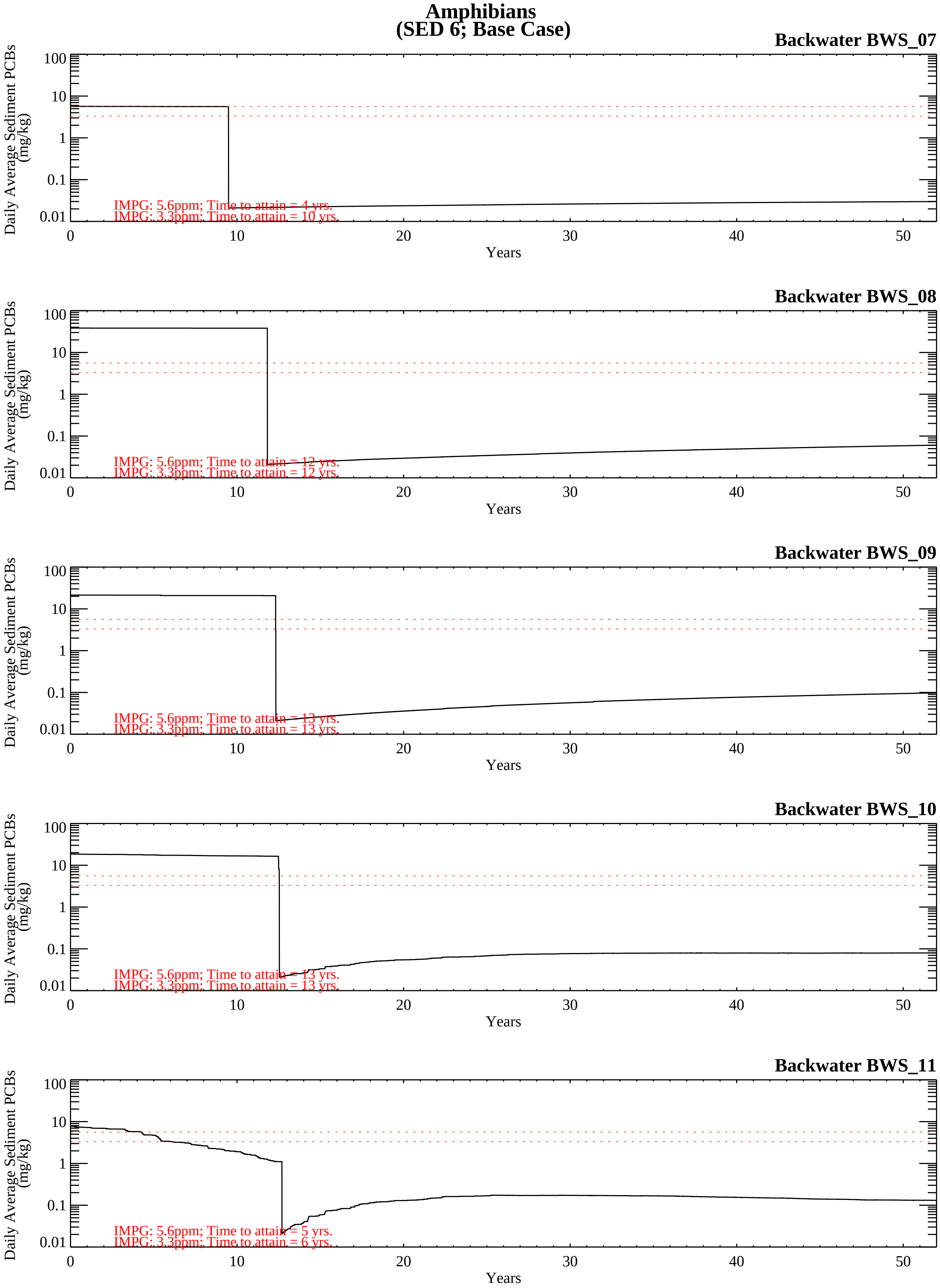

Figure G-5.2-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 6; Reach 5/6; Base Case).

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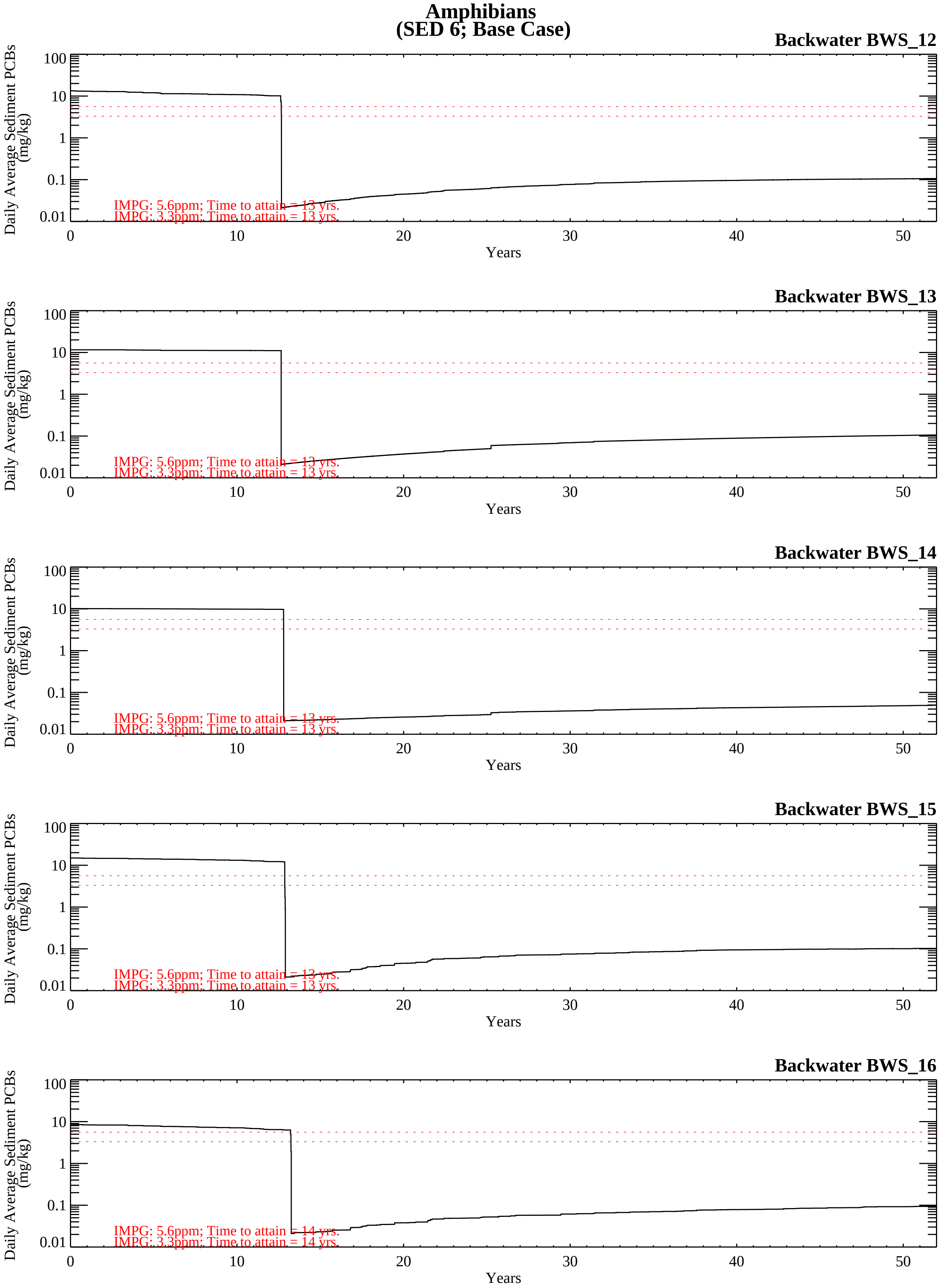

Figure G-5.2-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 6; Reach 5/6; Base Case).

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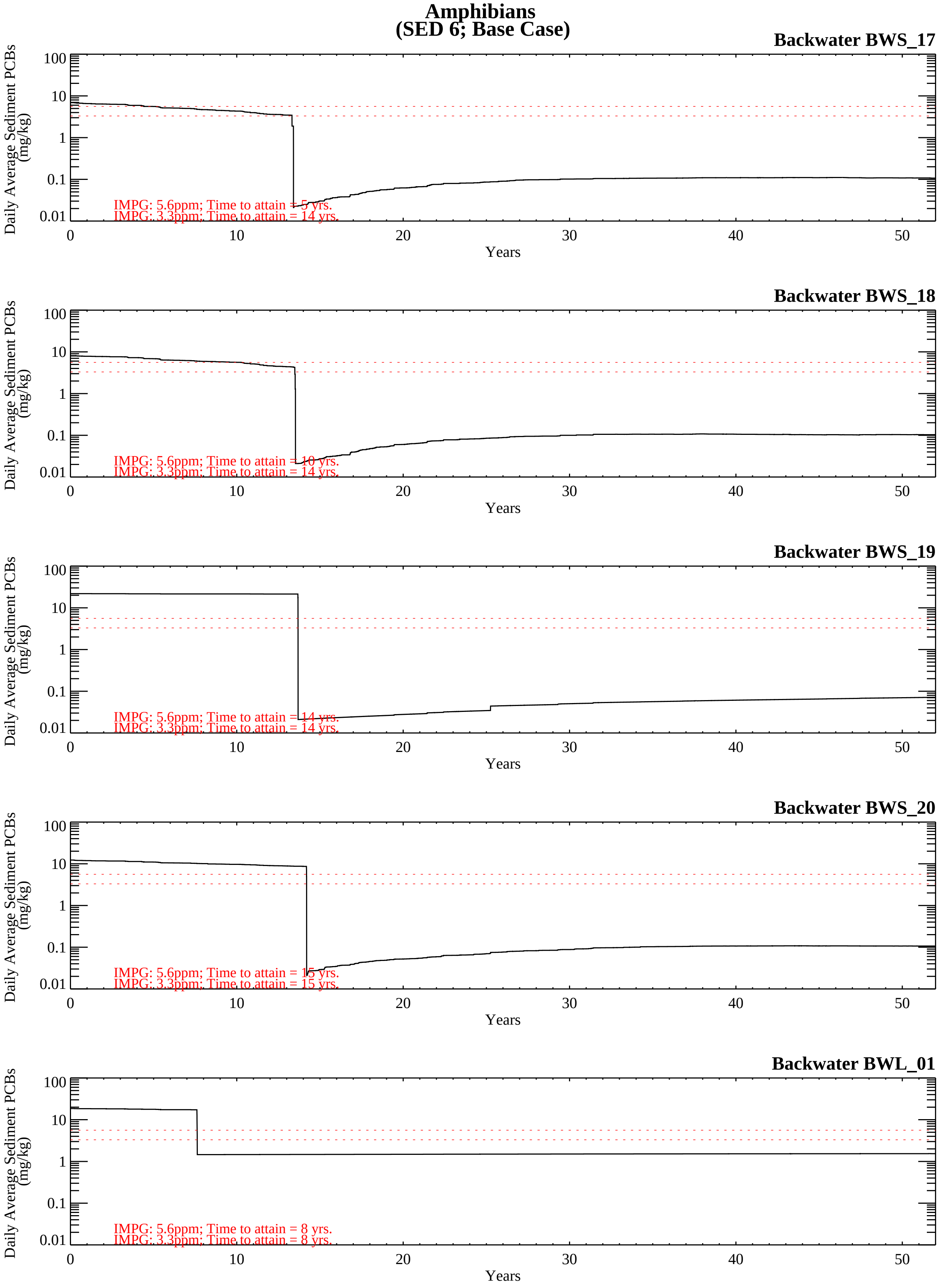

Figure G-5.2-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 6; Reach 5/6; Base Case).

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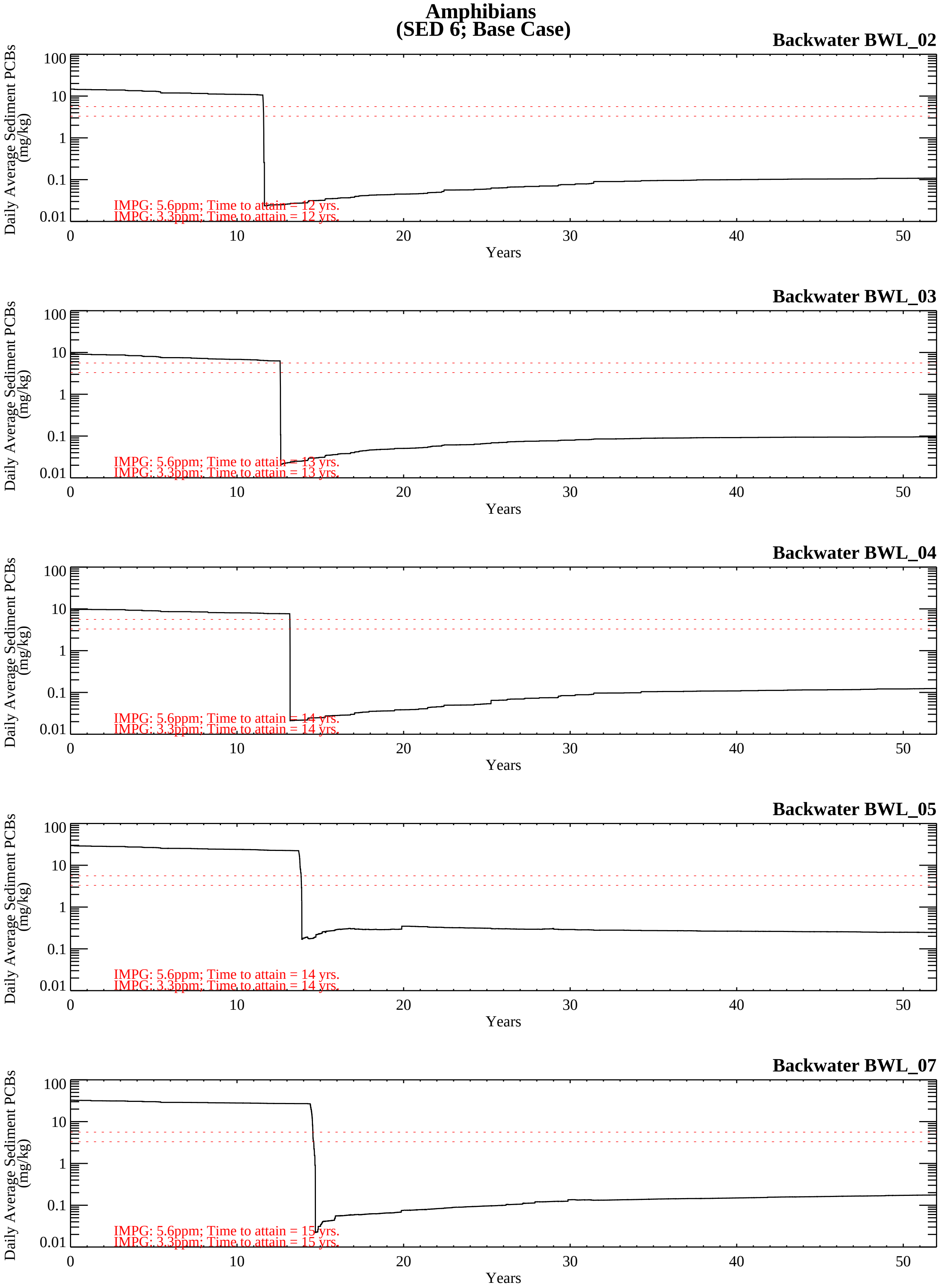

Figure G-5.2-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 6; Reach 5/6; Base Case).

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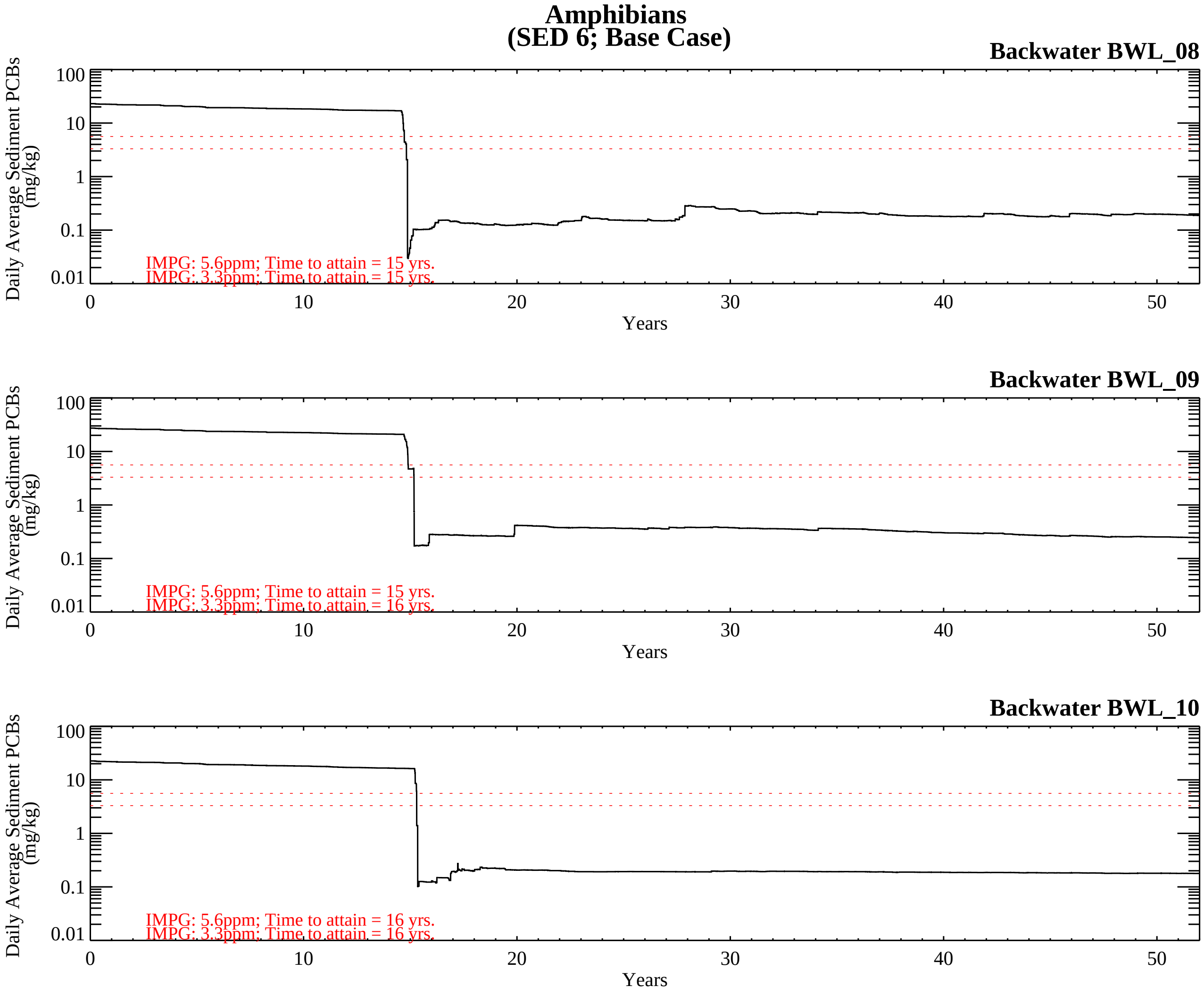

Figure G-5.2-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 6; Reach 5/6; Base Case).

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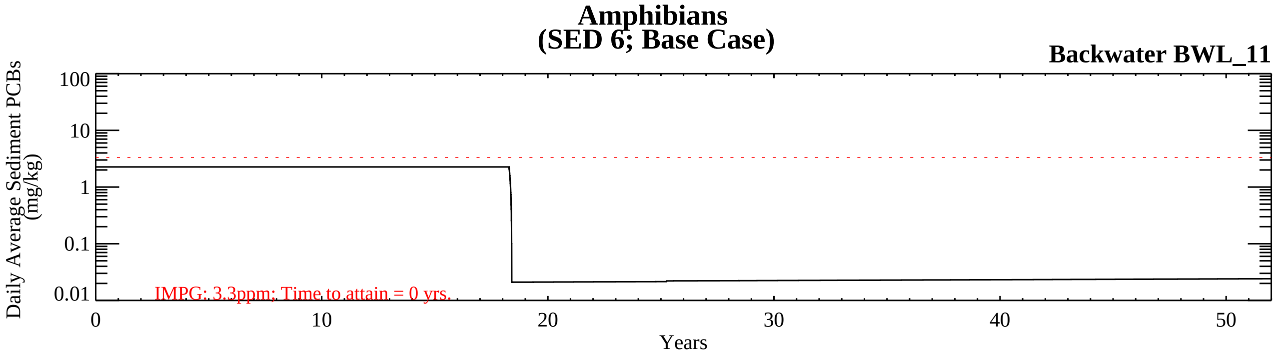

Figure G-5.2-5b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 6; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED6CMSBS_0712-32\\bins

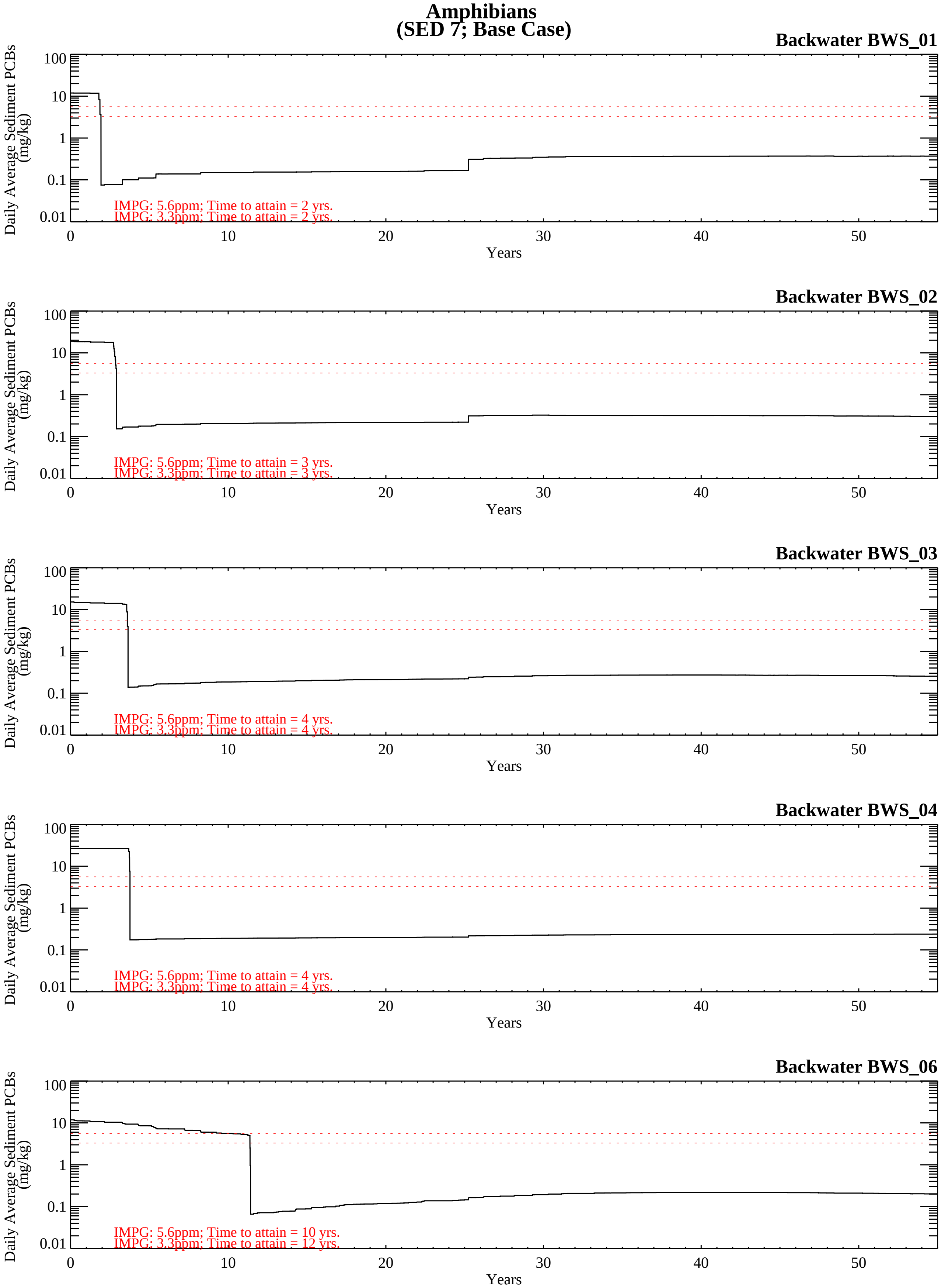

Figure G-5.2-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 7; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED7CMSBS_0712-03\\bins

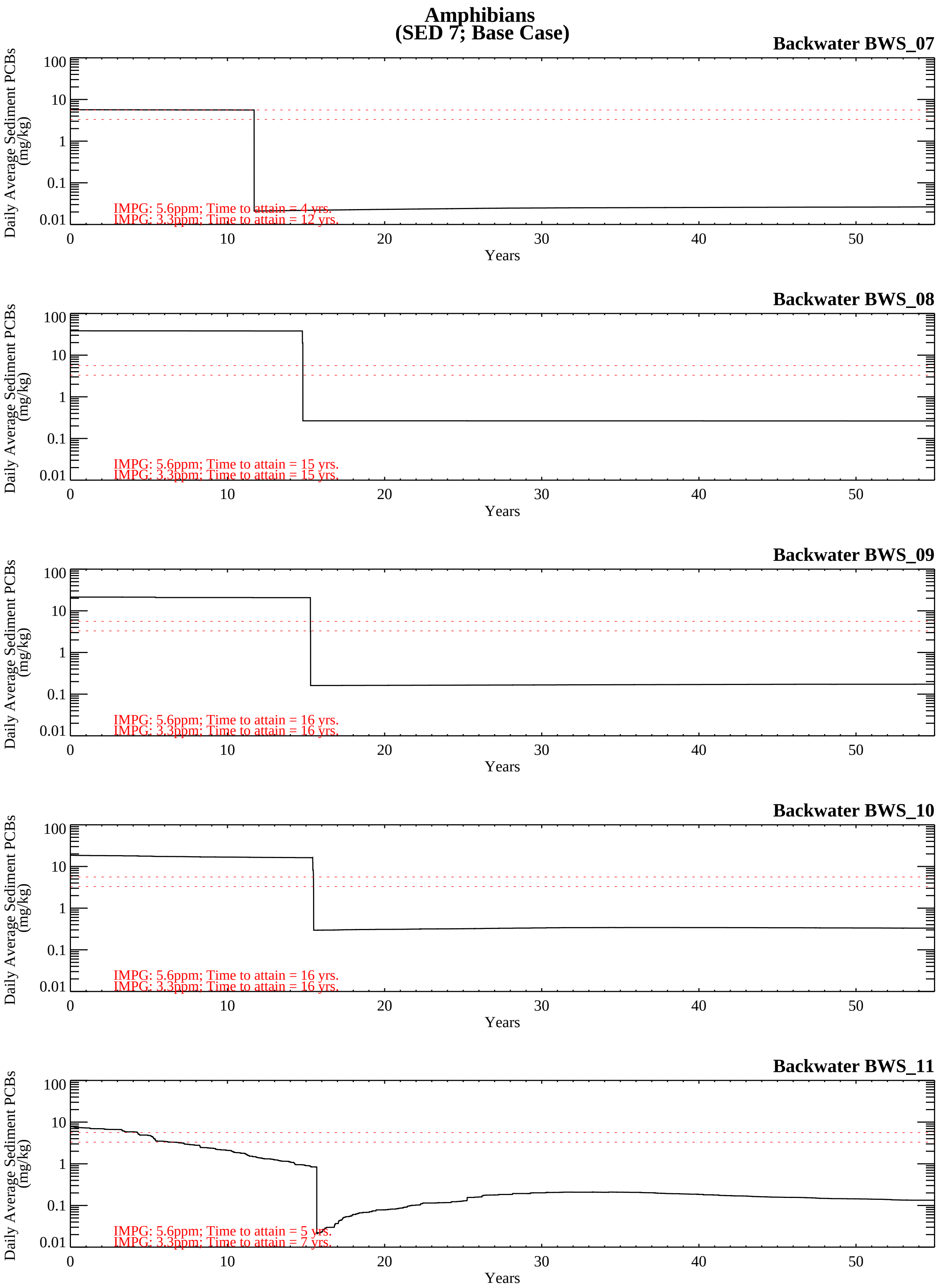

Figure G-5.2-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 7; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED7CMSBS_0712-03\\bins

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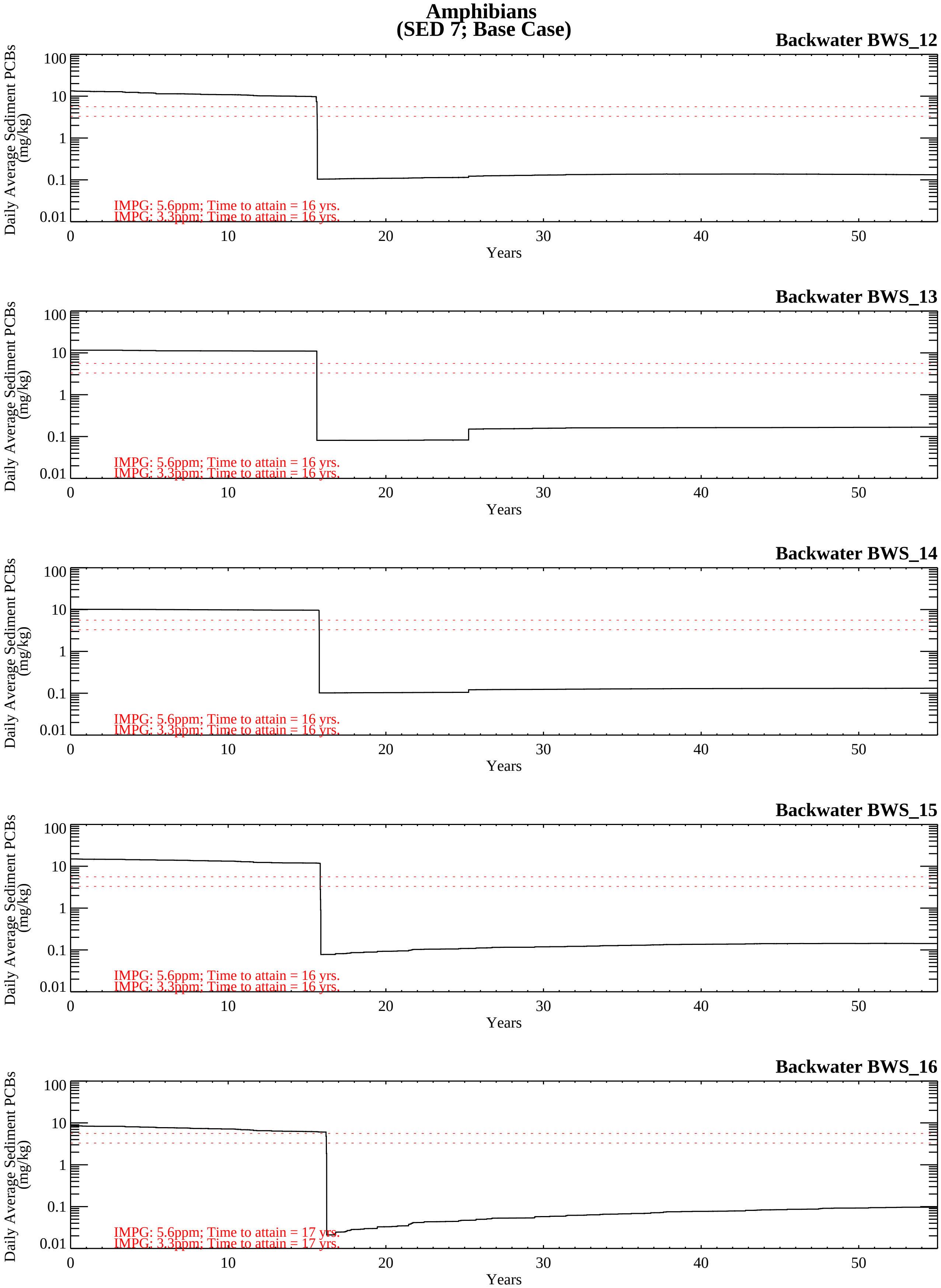

Figure G-5.2-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 7; Reach 5/6; Base Case).

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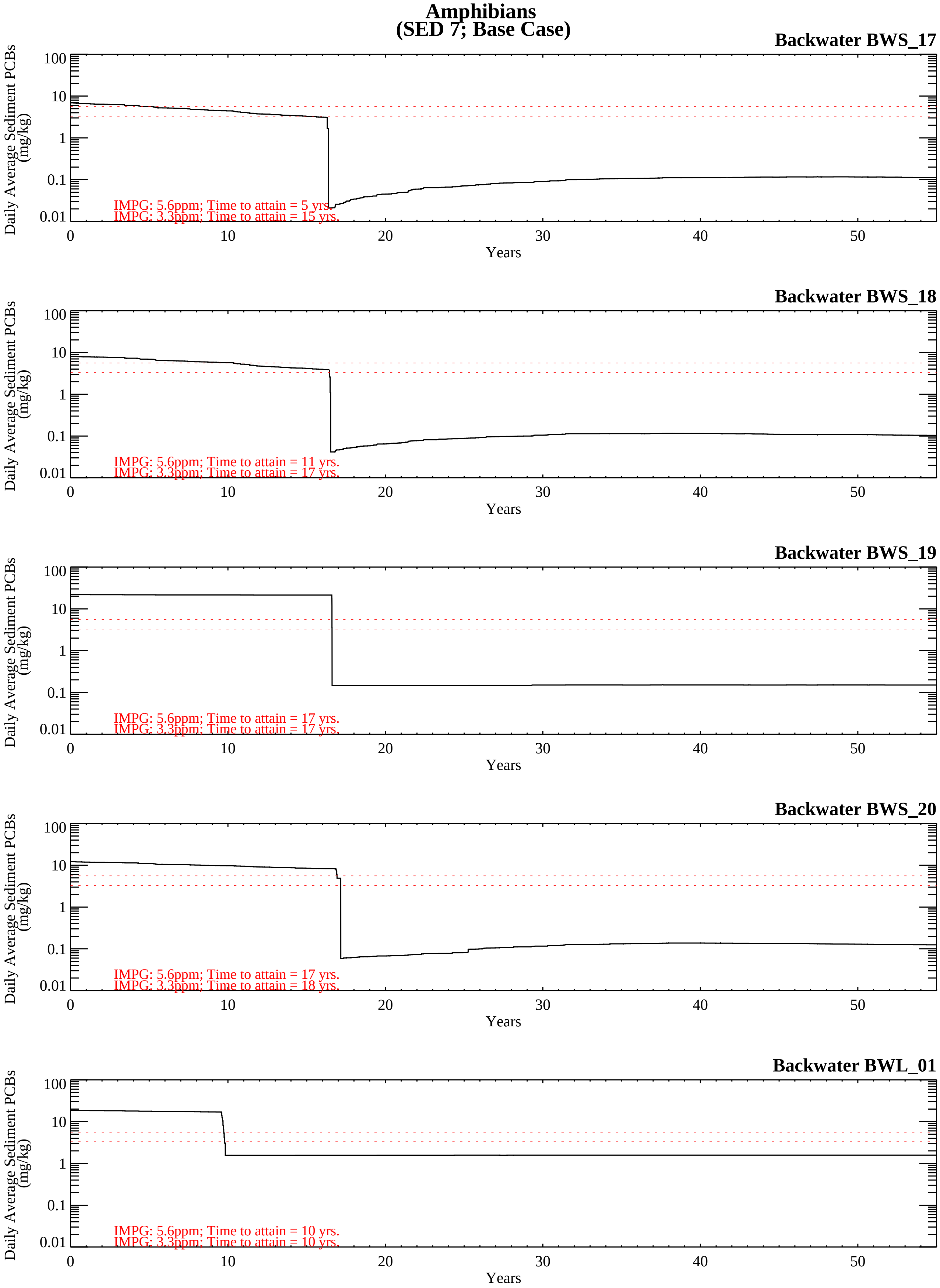

Figure G-5.2-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 7; Reach 5/6; Base Case).

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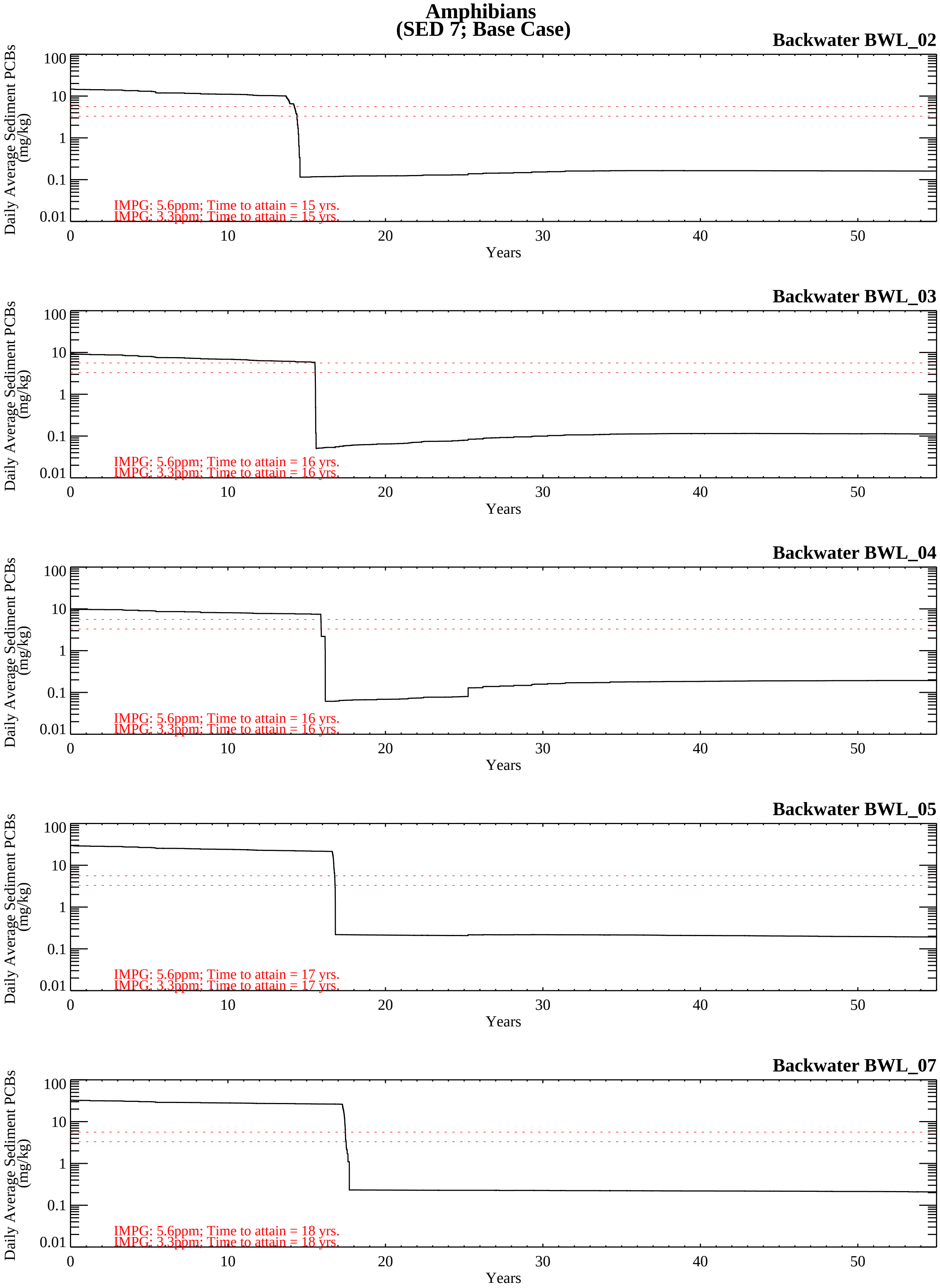

Figure G-5.2-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 7; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED7CMSBS_0712-03\\bins

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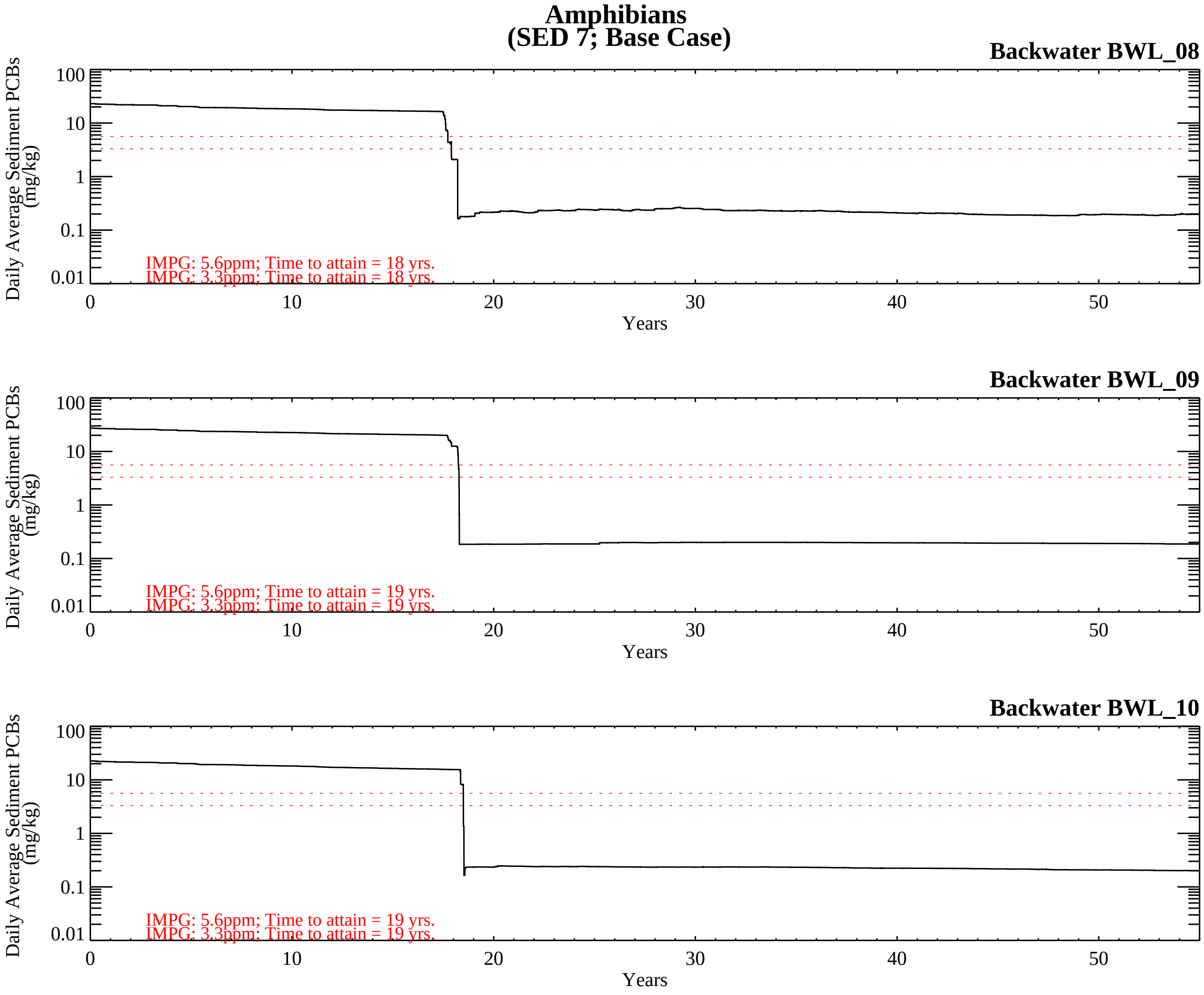

Figure G-5.2-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 7; Reach 5/6; Base Case).

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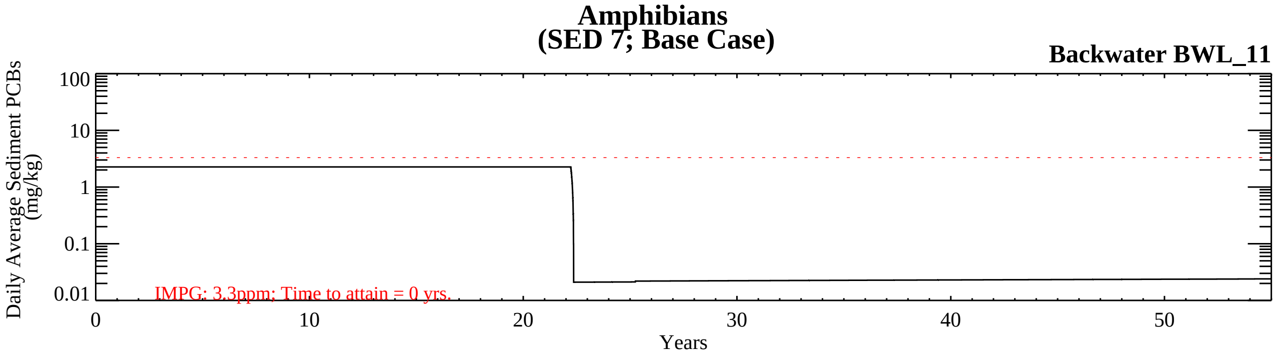


Figure G-5.2-6b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 7; Reach 7/8; Base Case).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED7CMSBS_0712-33\\bins

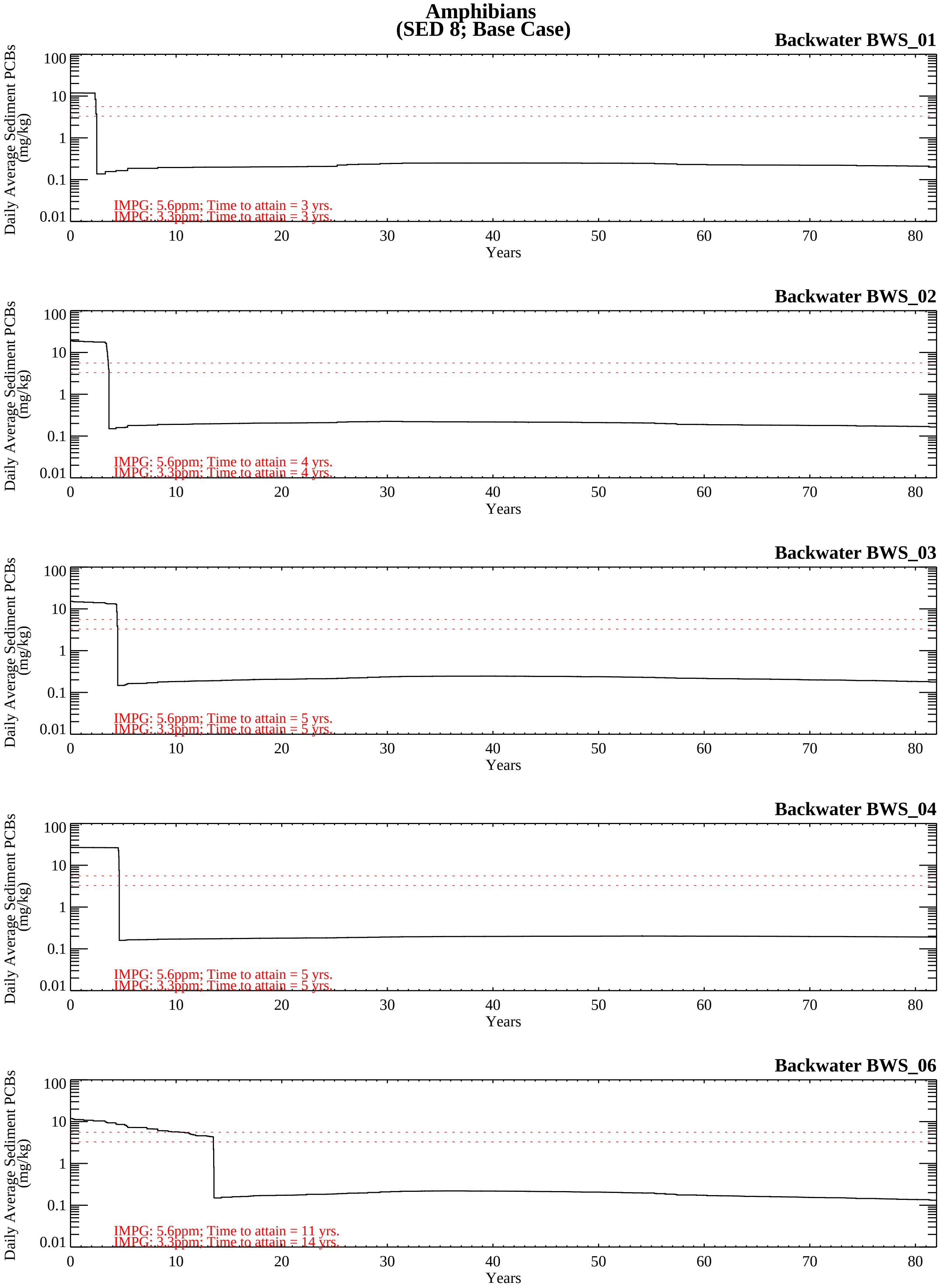
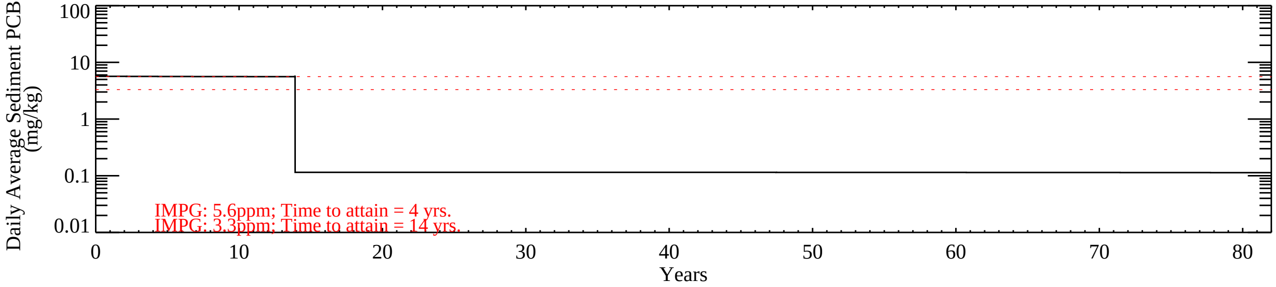


Figure G-5.2-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 8; Reach 5/6; Base Case).

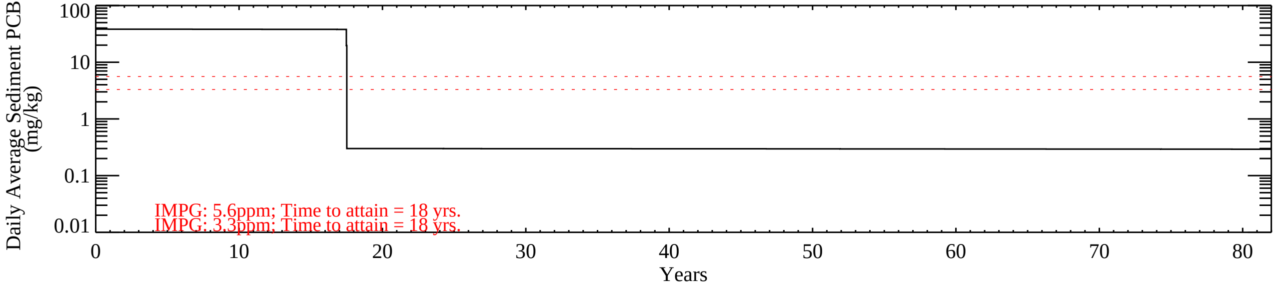
Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED8CMSBS_0712-18\\bins

Amphibians
(SED 8; Base Case)

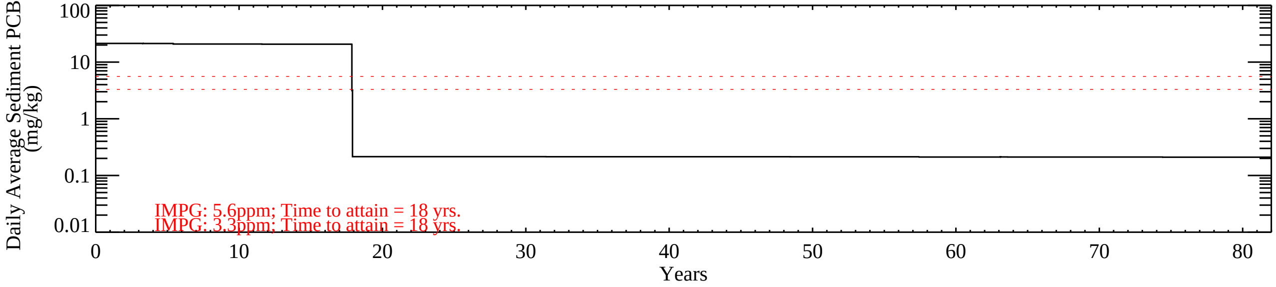
Backwater BWS_07



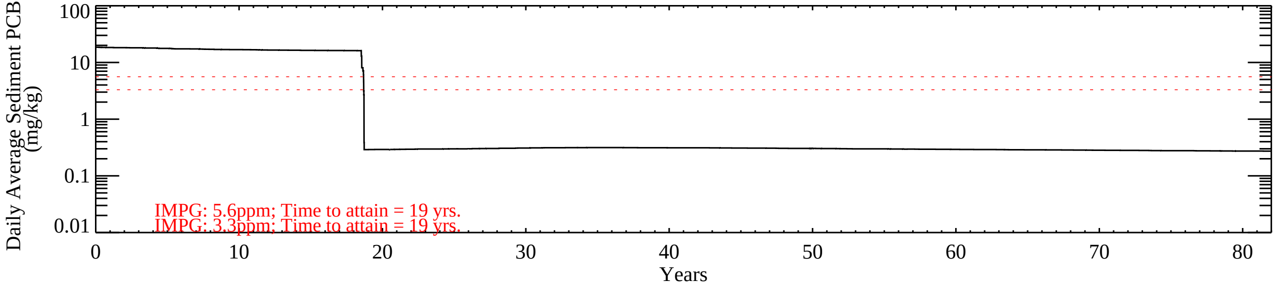
Backwater BWS_08



Backwater BWS_09



Backwater BWS_10



Backwater BWS_11

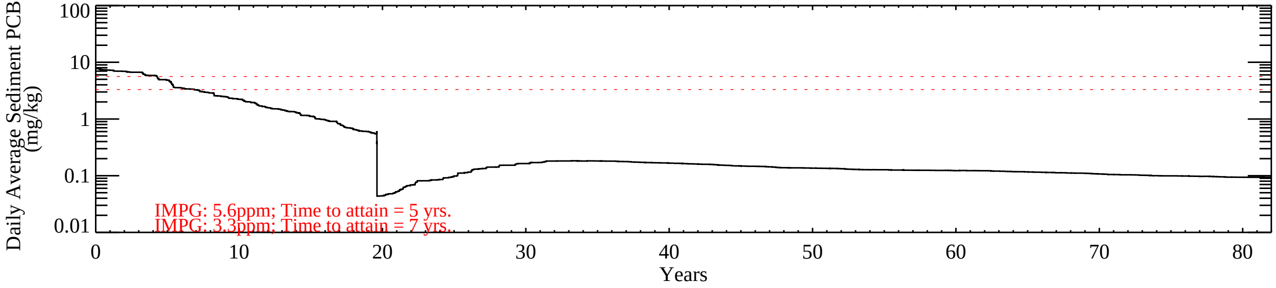


Figure G-5.2-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 8; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED8CMSBS_0712-18\\bins

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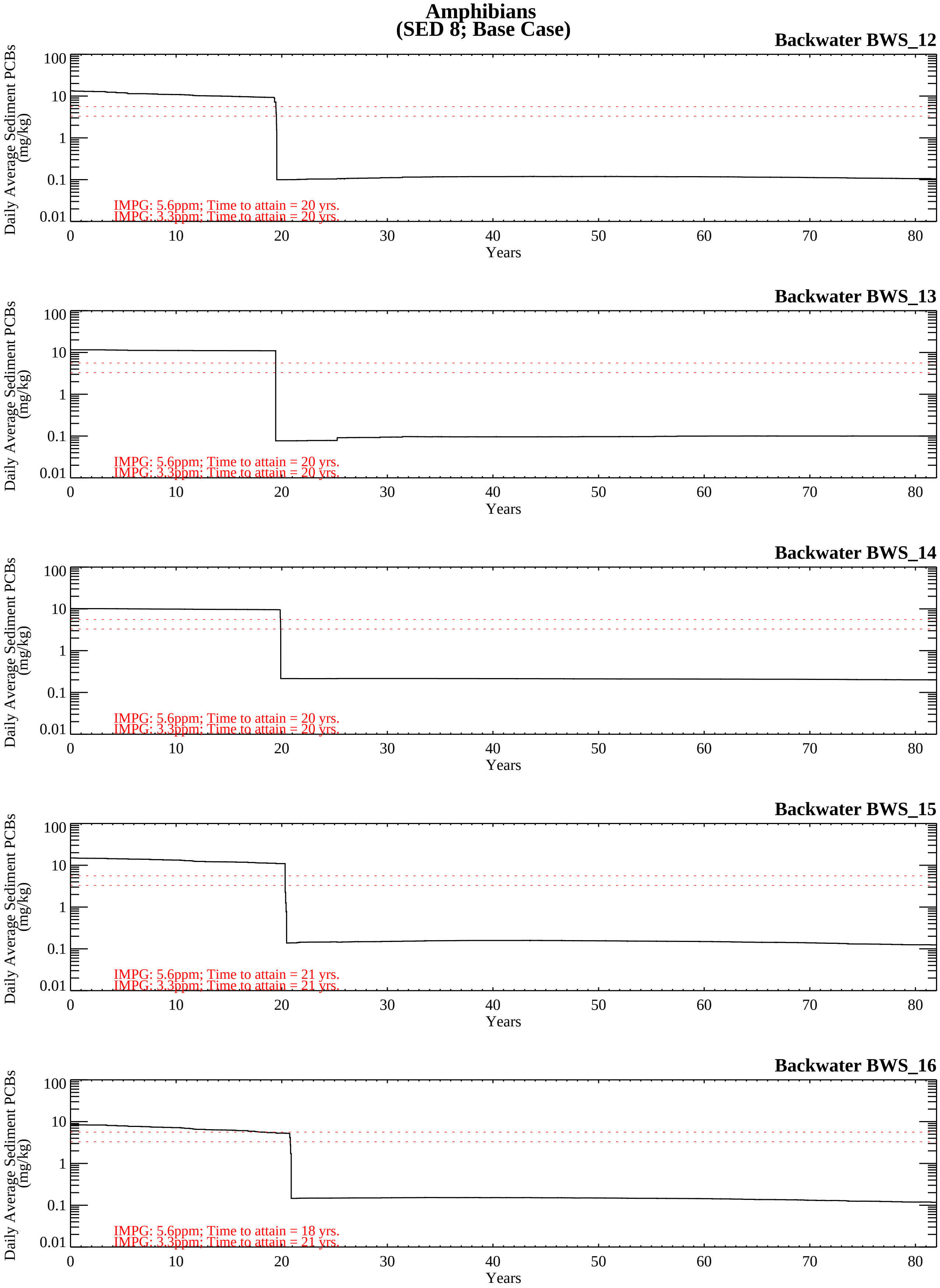


Figure G-5.2-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 8; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED8CMSBS_0712-18\\bins

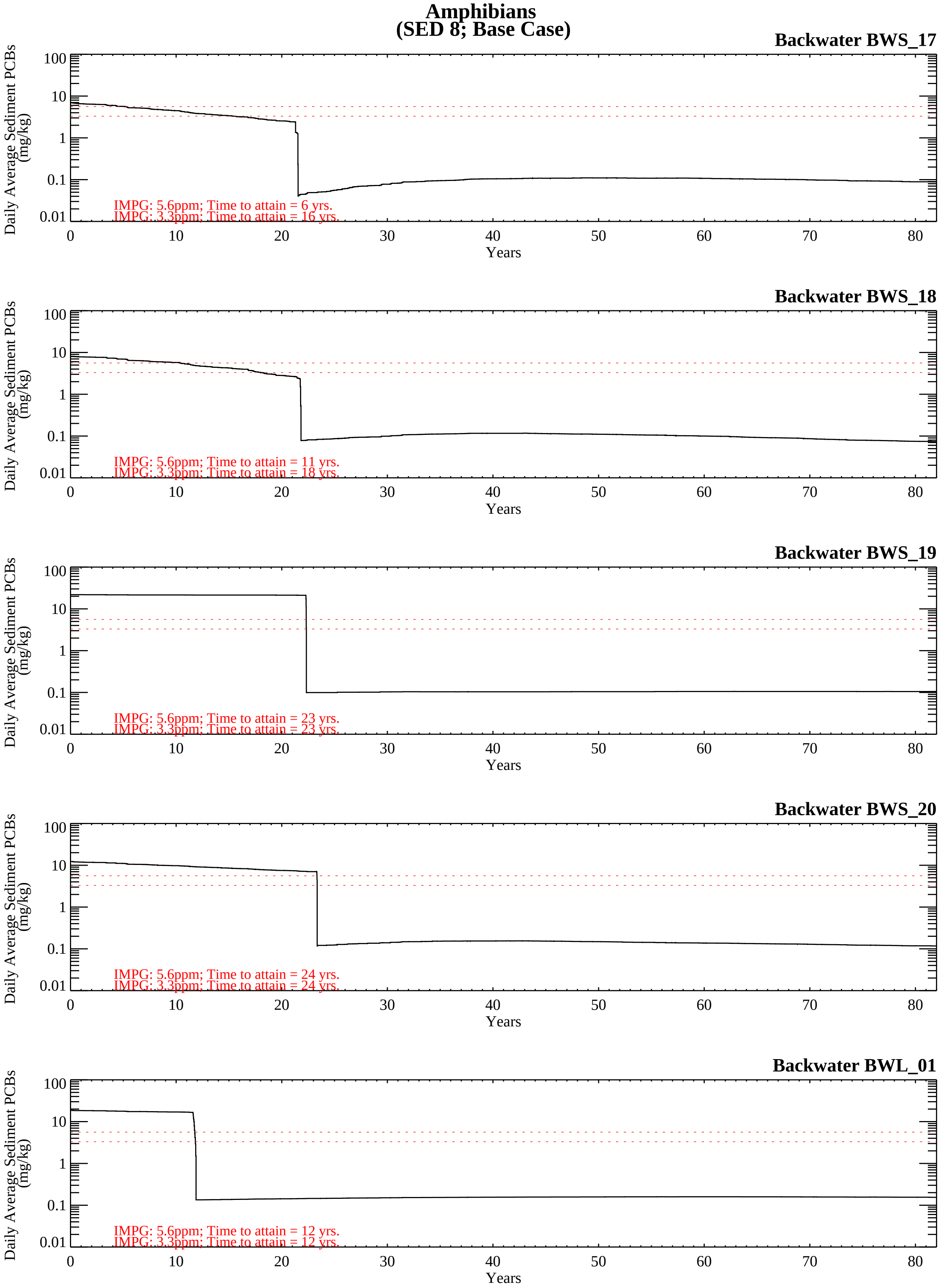
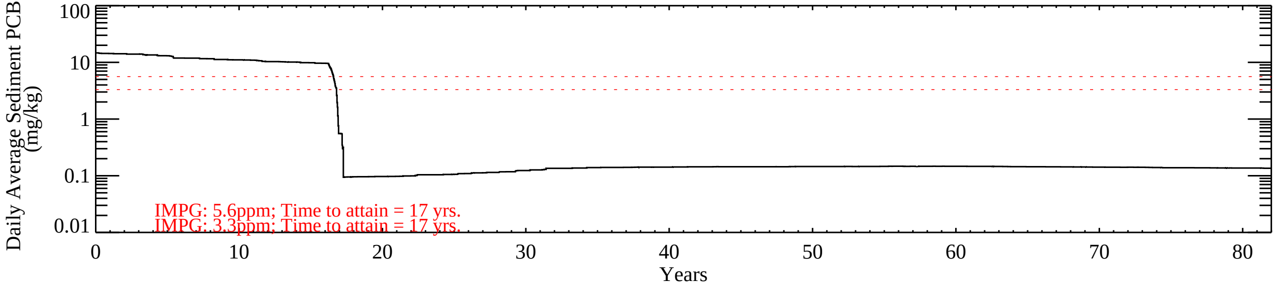


Figure G-5.2-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 8; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED8CMSBS_0712-18\\bins

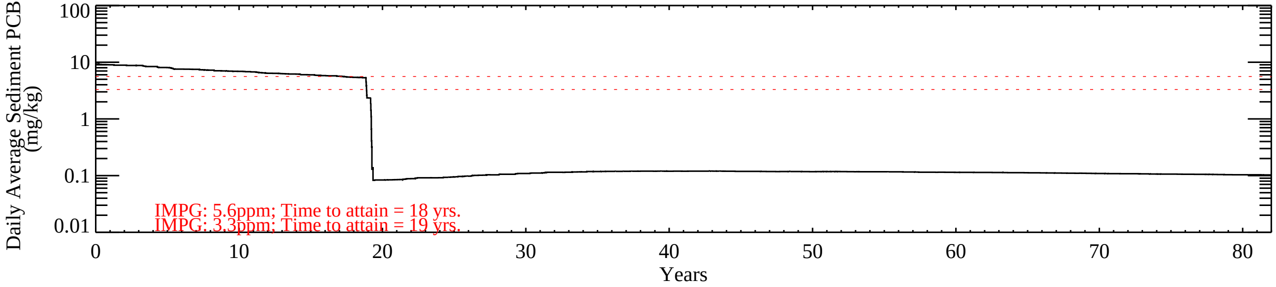
Amphibians
(SED 8; Base Case)

Backwater BWL_02



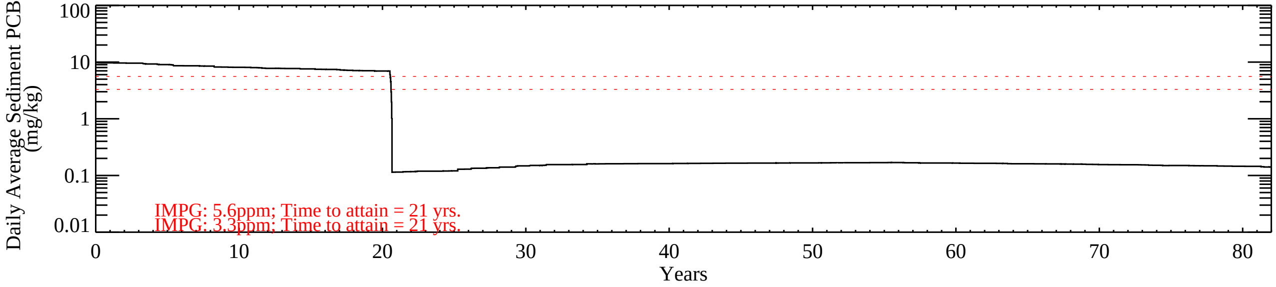
IMPG: 5.6ppm; Time to attain = 17 yrs.
IMPG: 3.3ppm; Time to attain = 17 yrs.

Backwater BWL_03



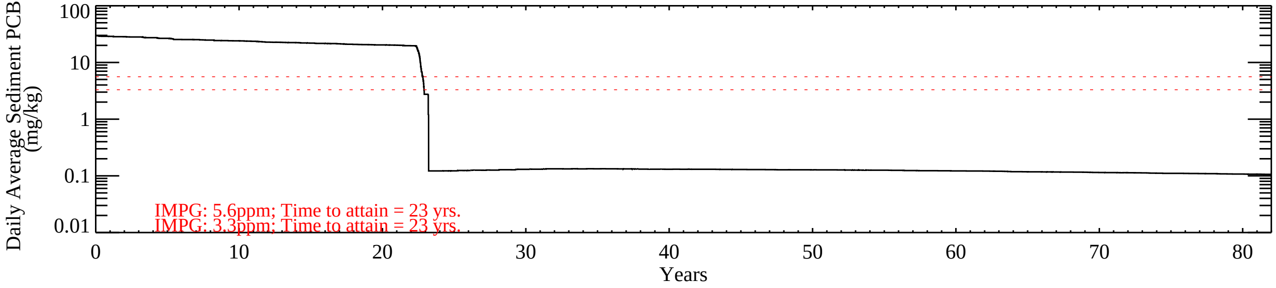
IMPG: 5.6ppm; Time to attain = 18 yrs.
IMPG: 3.3ppm; Time to attain = 19 yrs.

Backwater BWL_04



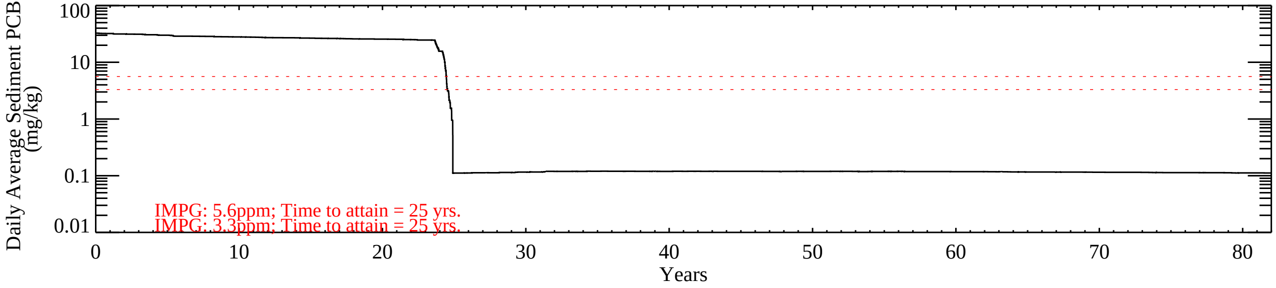
IMPG: 5.6ppm; Time to attain = 21 yrs.
IMPG: 3.3ppm; Time to attain = 21 yrs.

Backwater BWL_05



IMPG: 5.6ppm; Time to attain = 23 yrs.
IMPG: 3.3ppm; Time to attain = 23 yrs.

Backwater BWL_07



IMPG: 5.6ppm; Time to attain = 25 yrs.
IMPG: 3.3ppm; Time to attain = 25 yrs.

Figure G-5.2-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 8; Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED8CMSBS_0712-18\\bins

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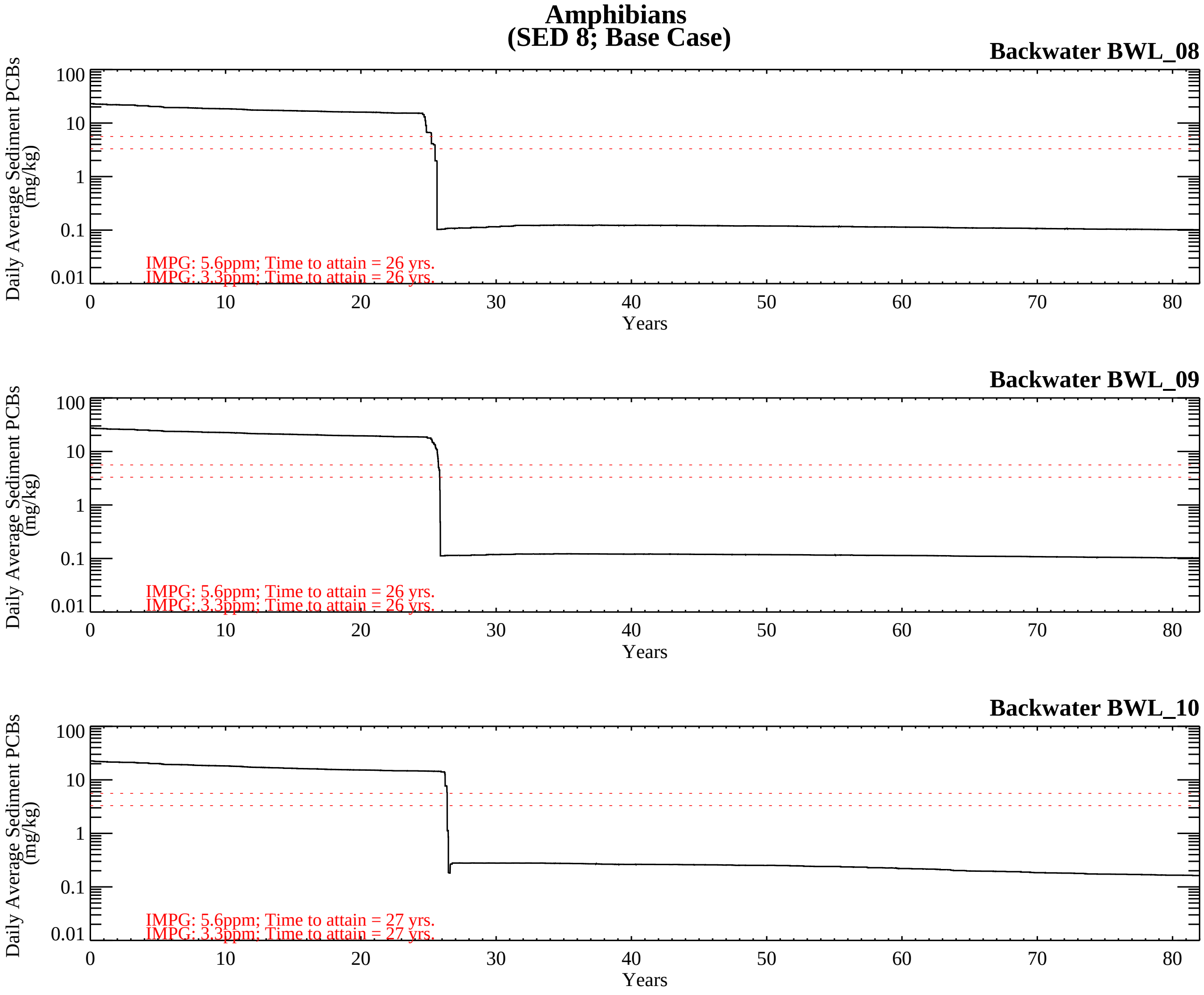

Figure G-5.2-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 8; Reach 5/6; Base Case).

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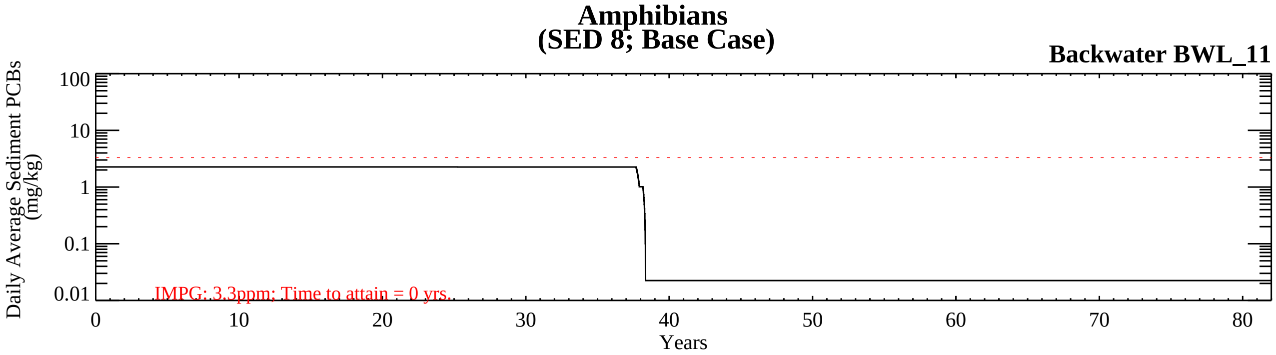

Figure G-5.2-7b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 8; Reach 7/8; Base Case).

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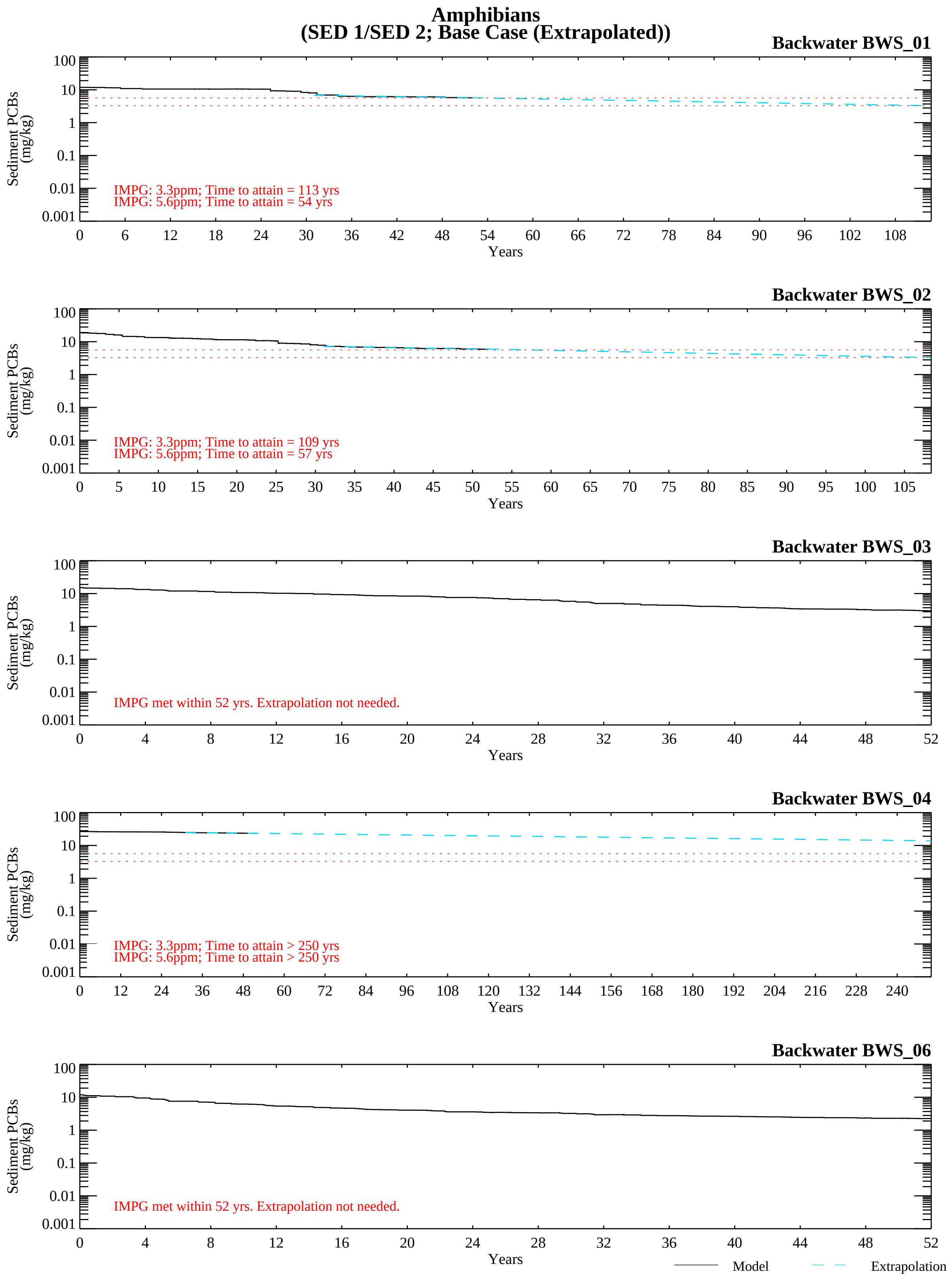

Figure G-5.2-1a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 1/SED 2; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED1CMSBS_0712-01\bins

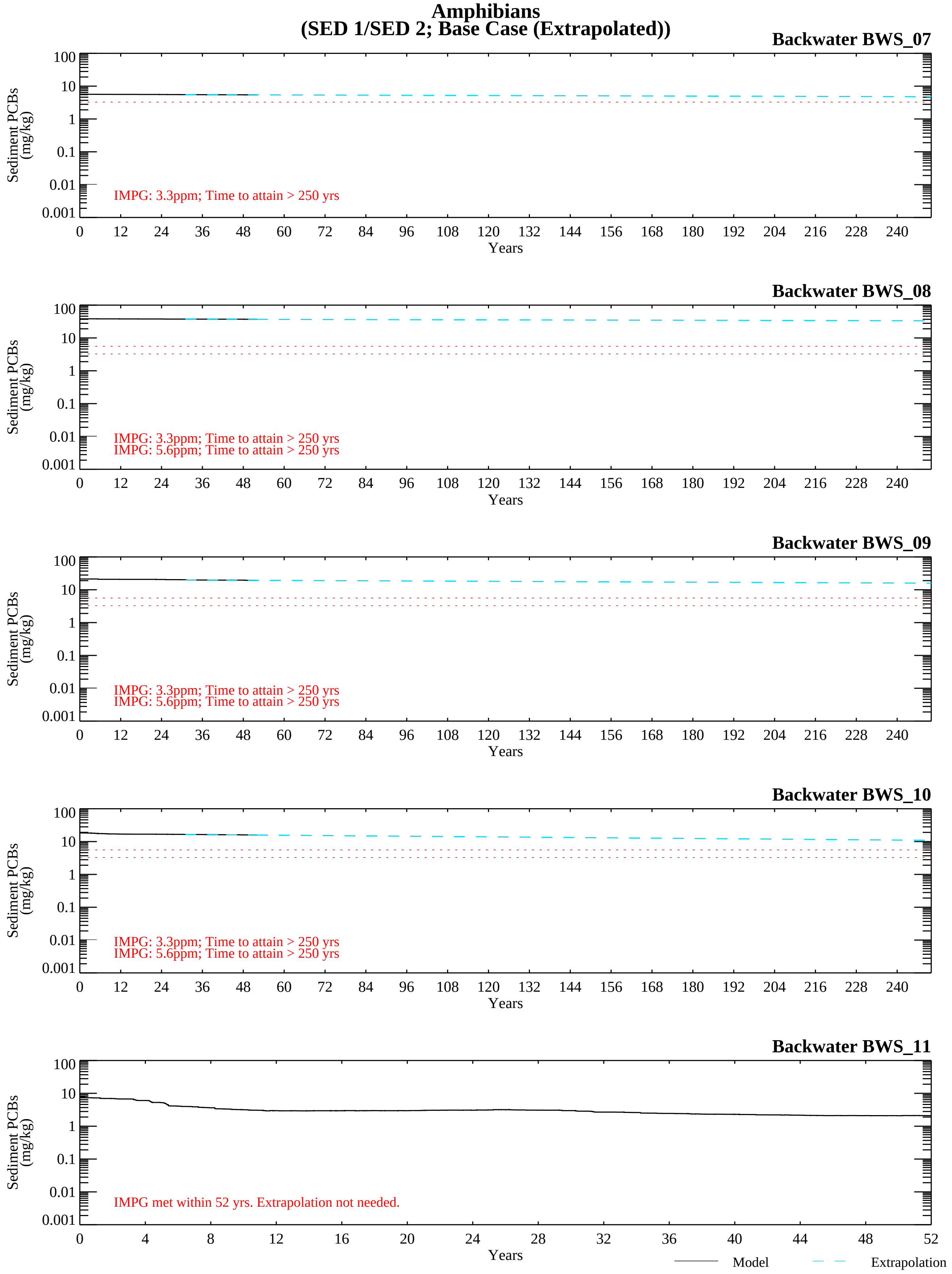

Figure G-5.2-1a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 1/SED 2; Reach 5/6; Base Case).

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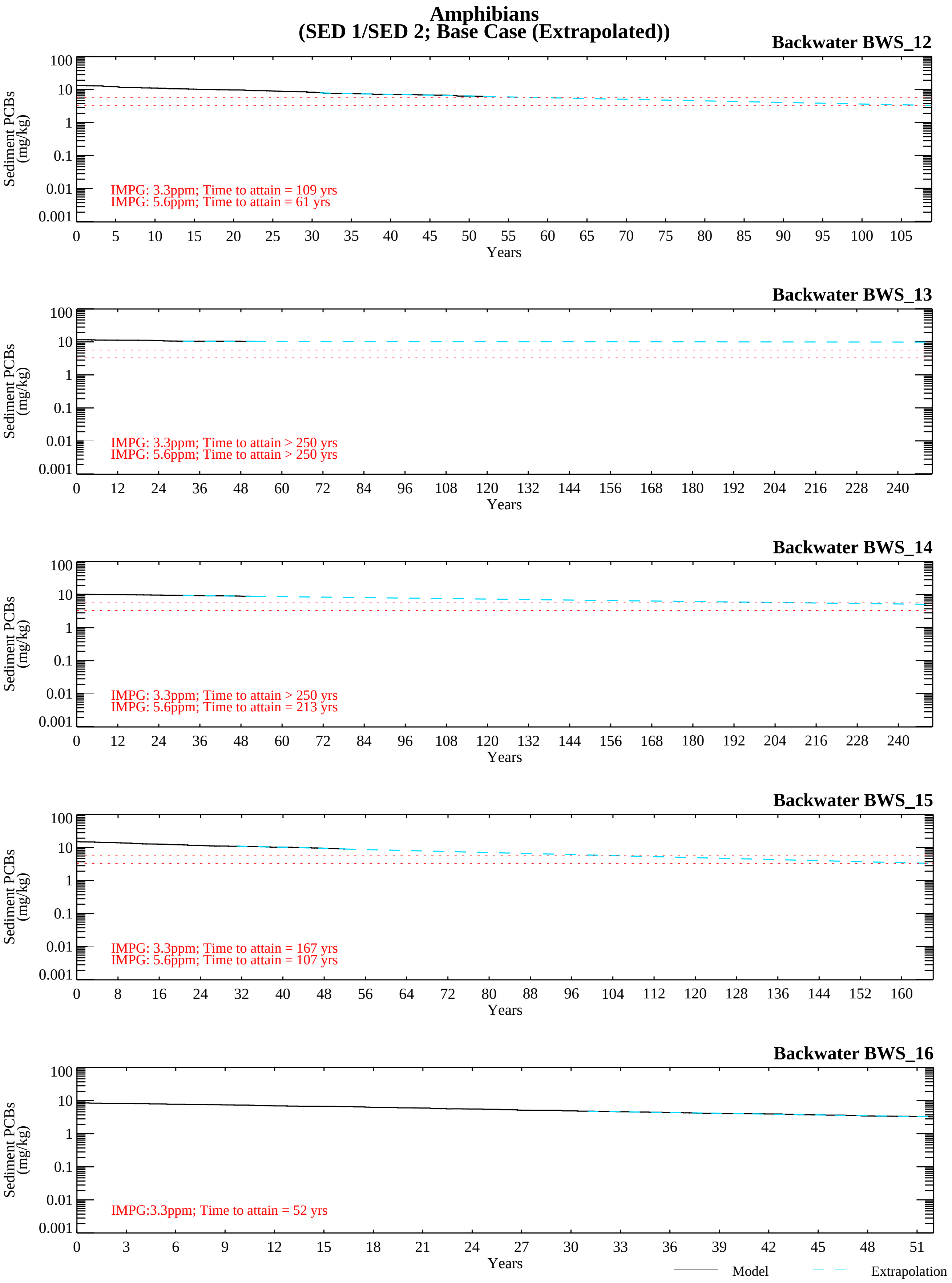

Figure G-5.2-1a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 1/SED 2; Reach 5/6; Base Case).

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Amphibians
(SED 1/SED 2; Base Case (Extrapolated))

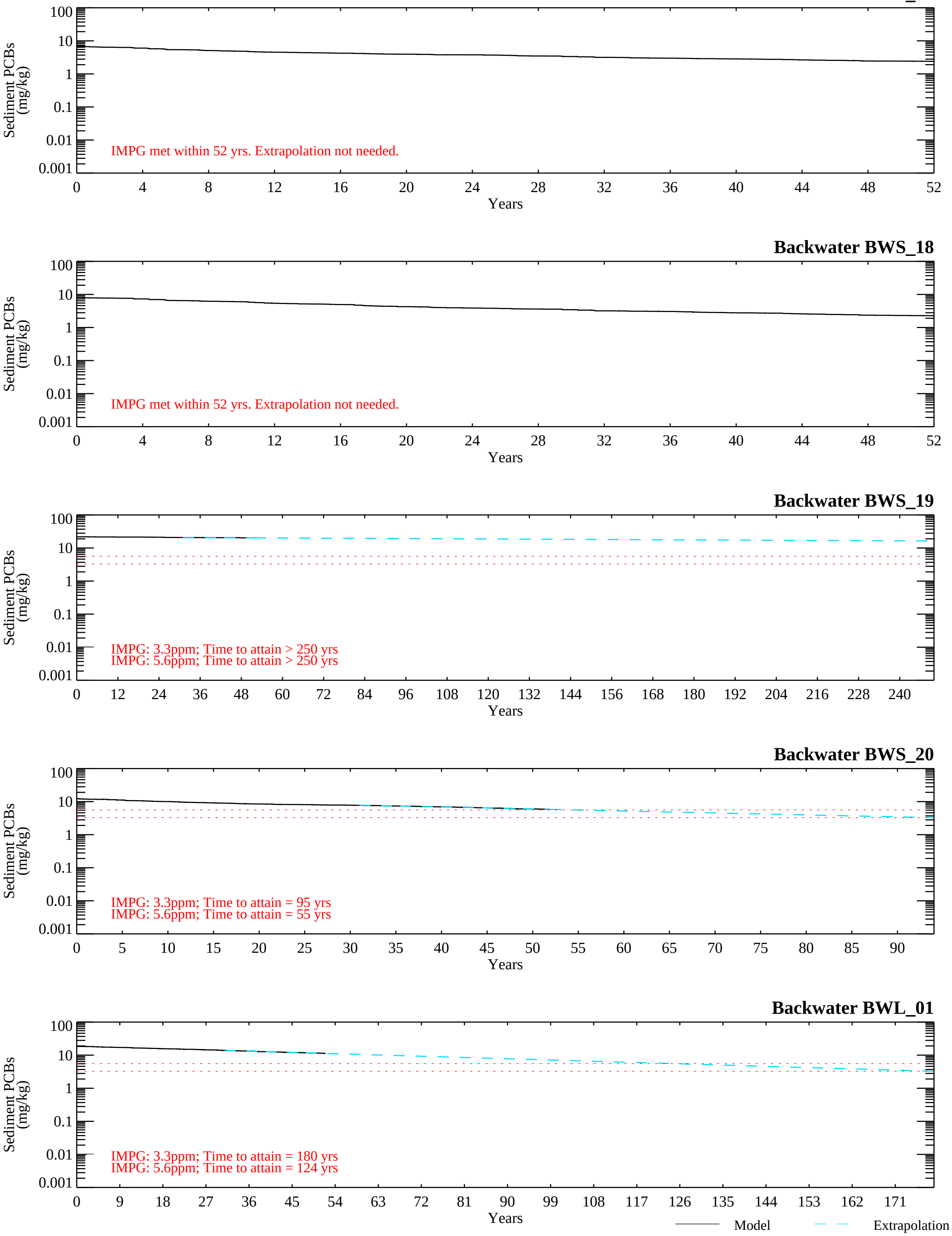

Figure G-5.3-1a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 1/SED 2; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED1CMSBS_0712-01\bins

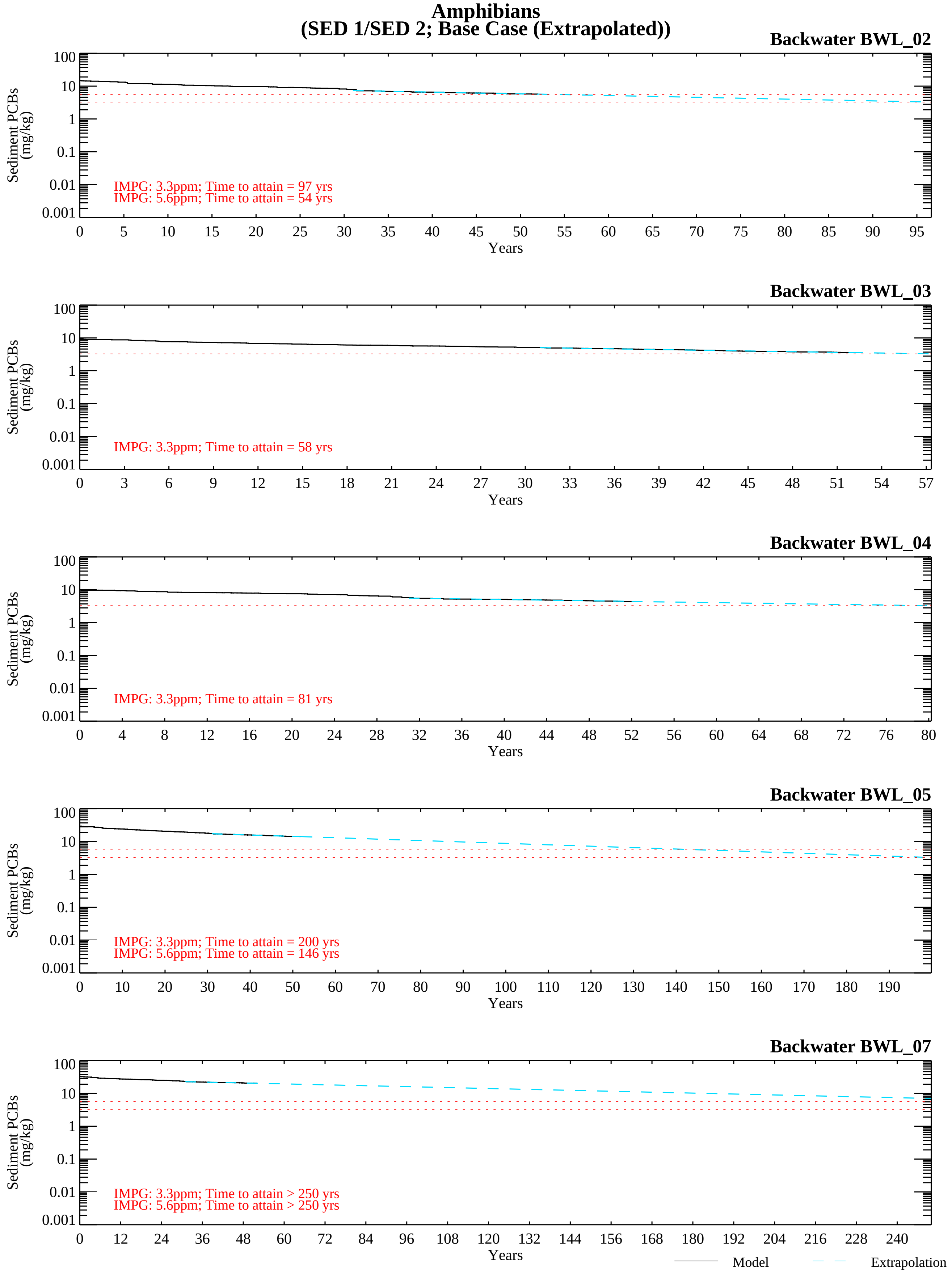

Figure G-5.2-1a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 1/SED 2; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED1CMSBS_0712-01\bins

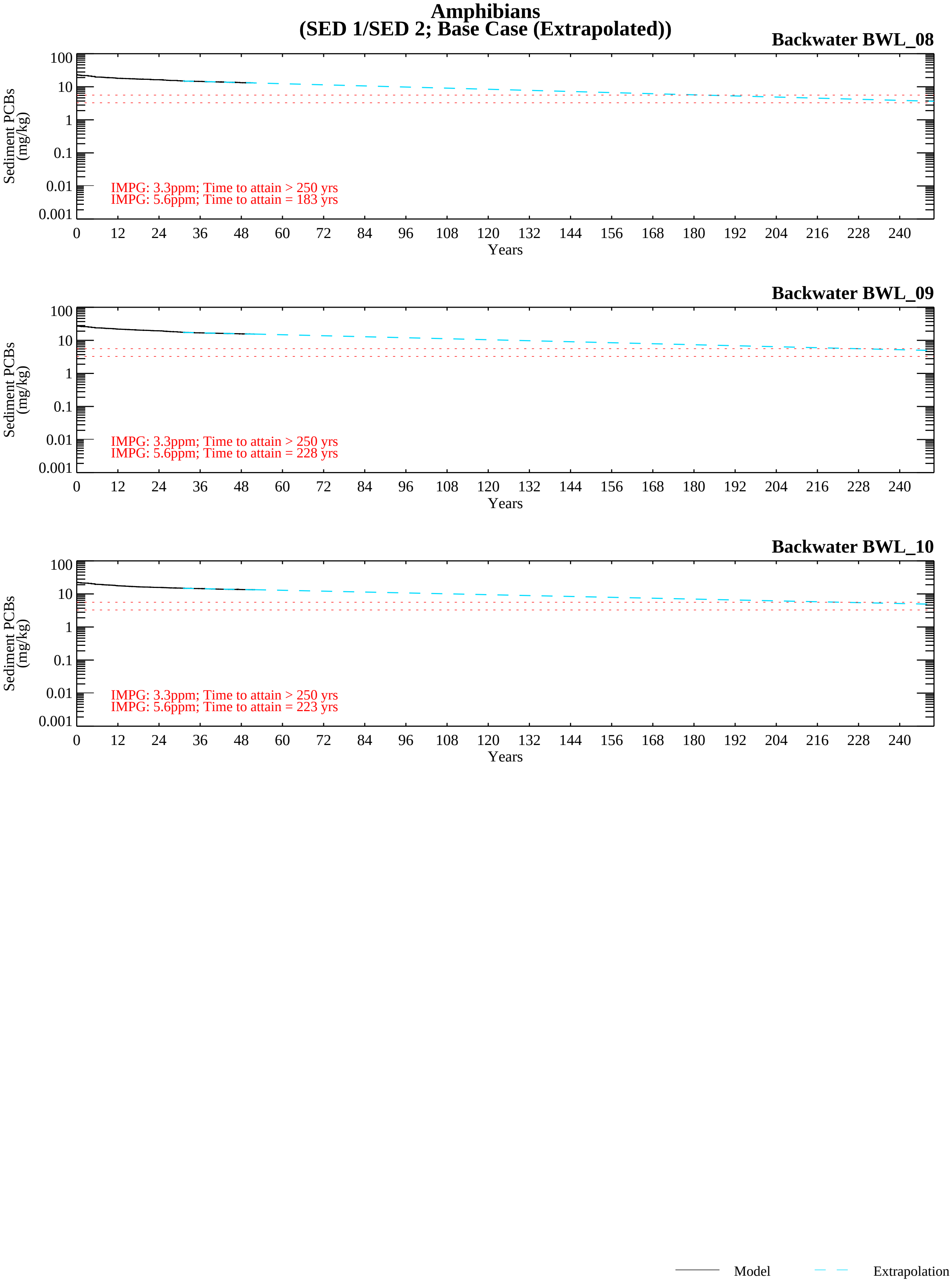

Figure G-5.2-1a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 1/SED 2; Reach 5/6; Base Case).

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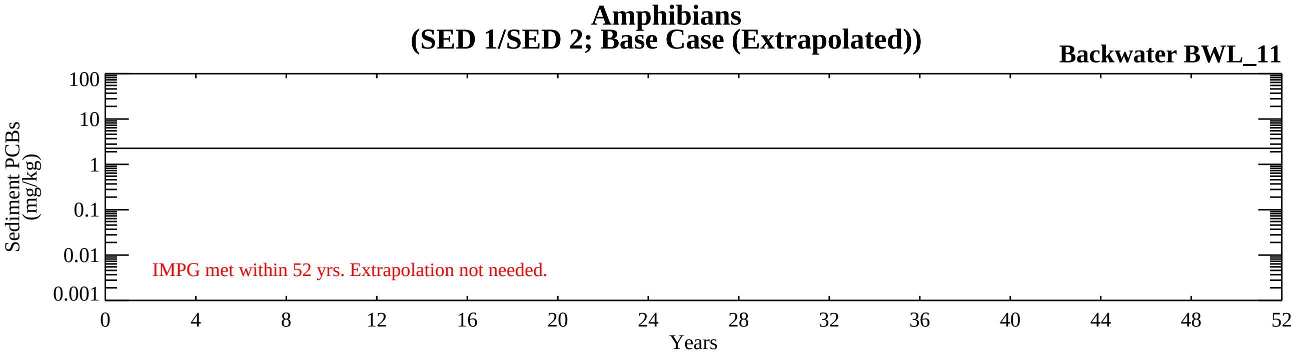

Figure G-5.3-1b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 1/SED 2; Reach 7/8; Base Case).

Run path:\\Tenmile\EFDC_Output\R78\CMS\Proj_R78_SED1CMSBS_0712-28\bins

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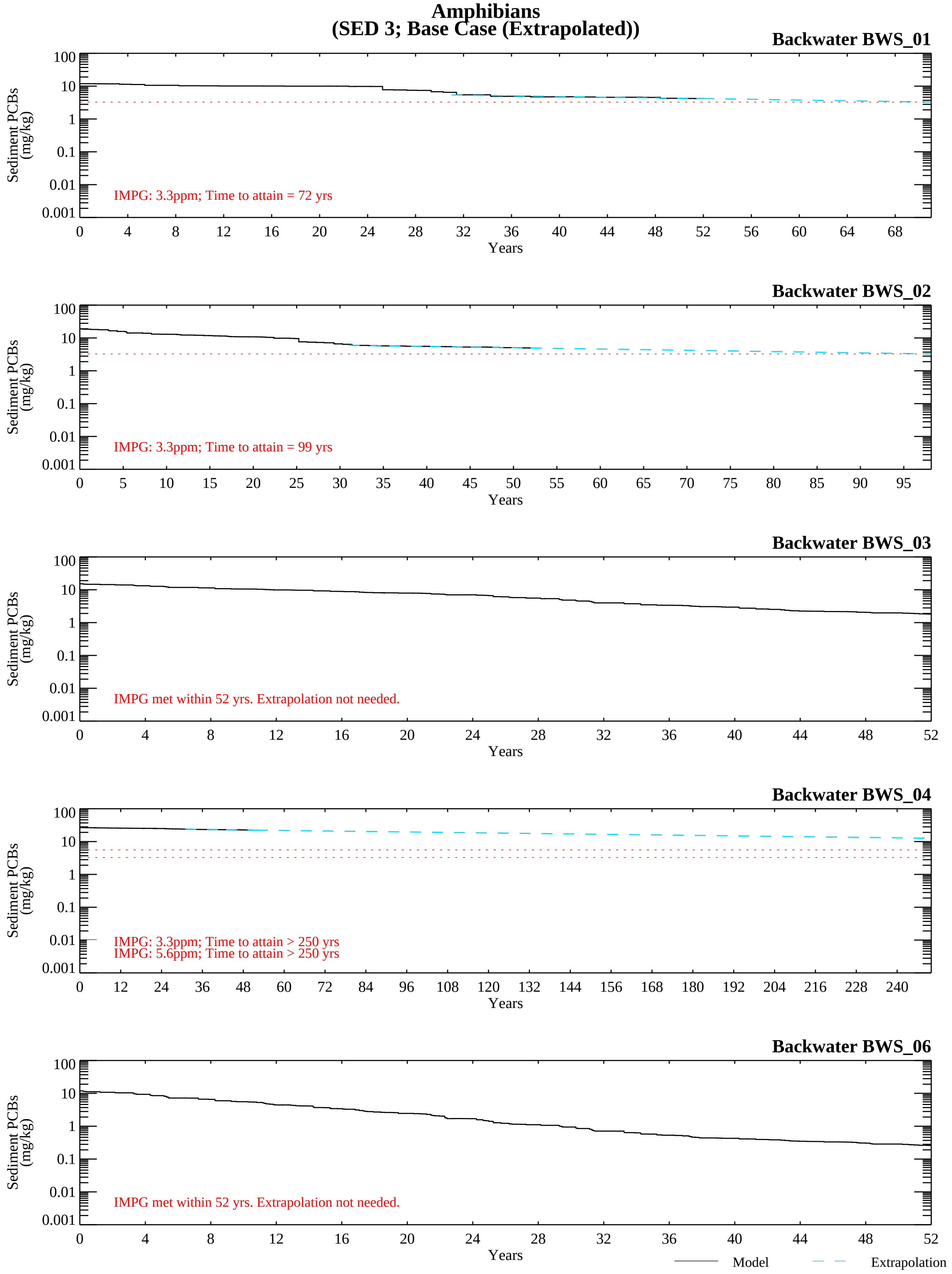

Figure G-5.2-2a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 3; Reach 5/6; Base Case).

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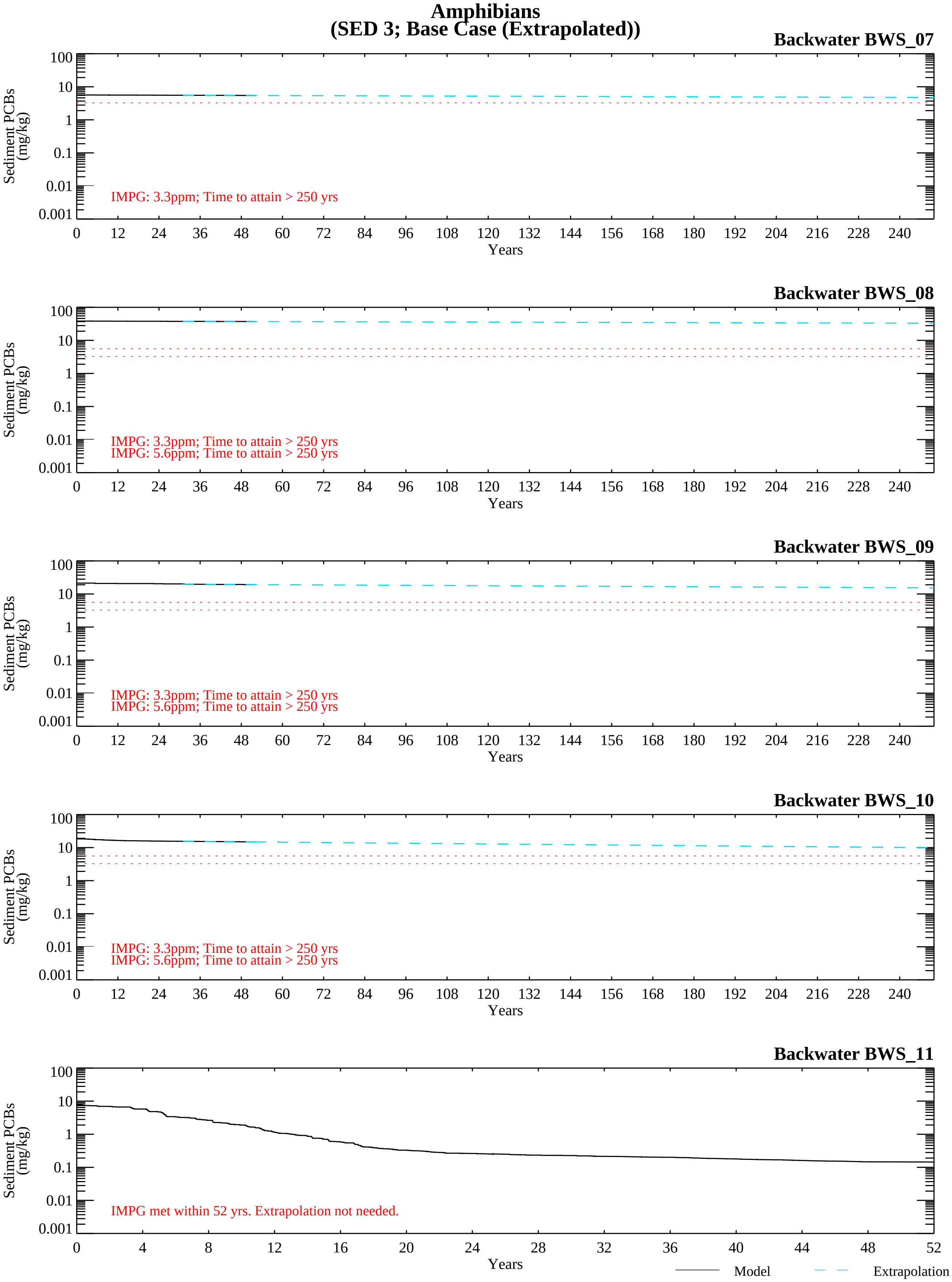

Figure G-5.2-2a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 3; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED3CMSBS_0712-13\bins

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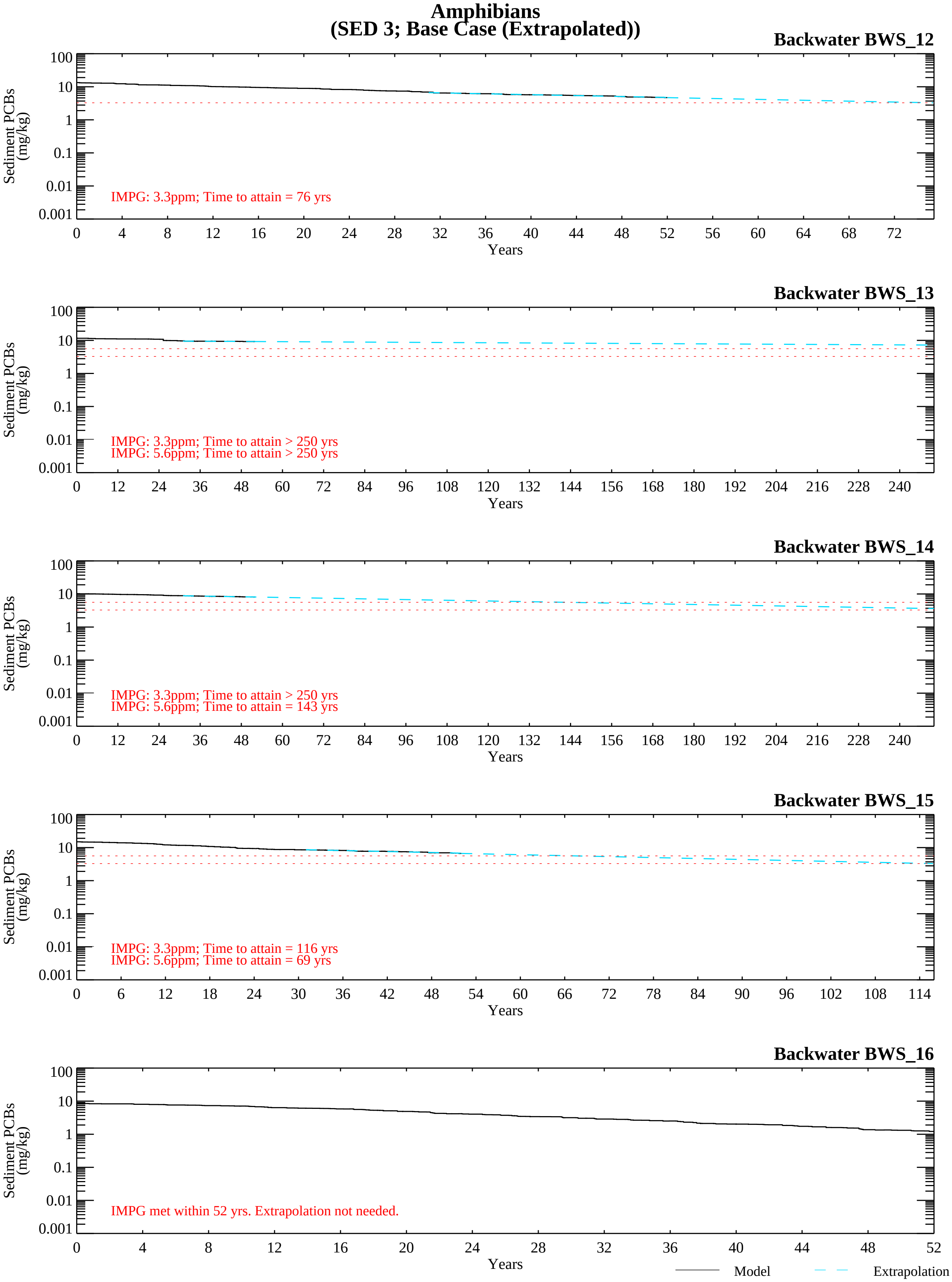

Figure G-5.2-2a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 3; Reach 5/6; Base Case).

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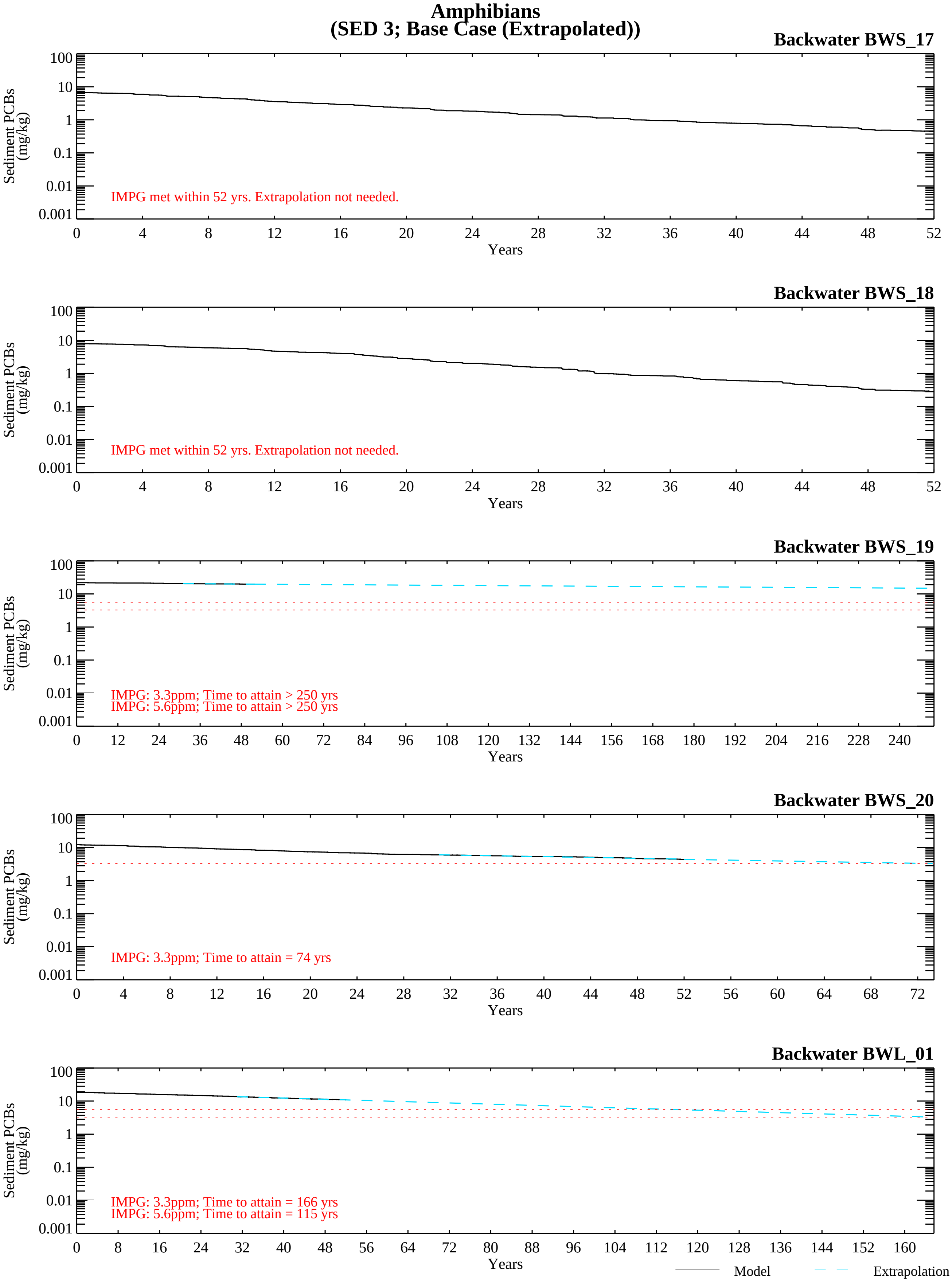

Figure G-5.3-2a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 3; Reach 5/6; Base Case).

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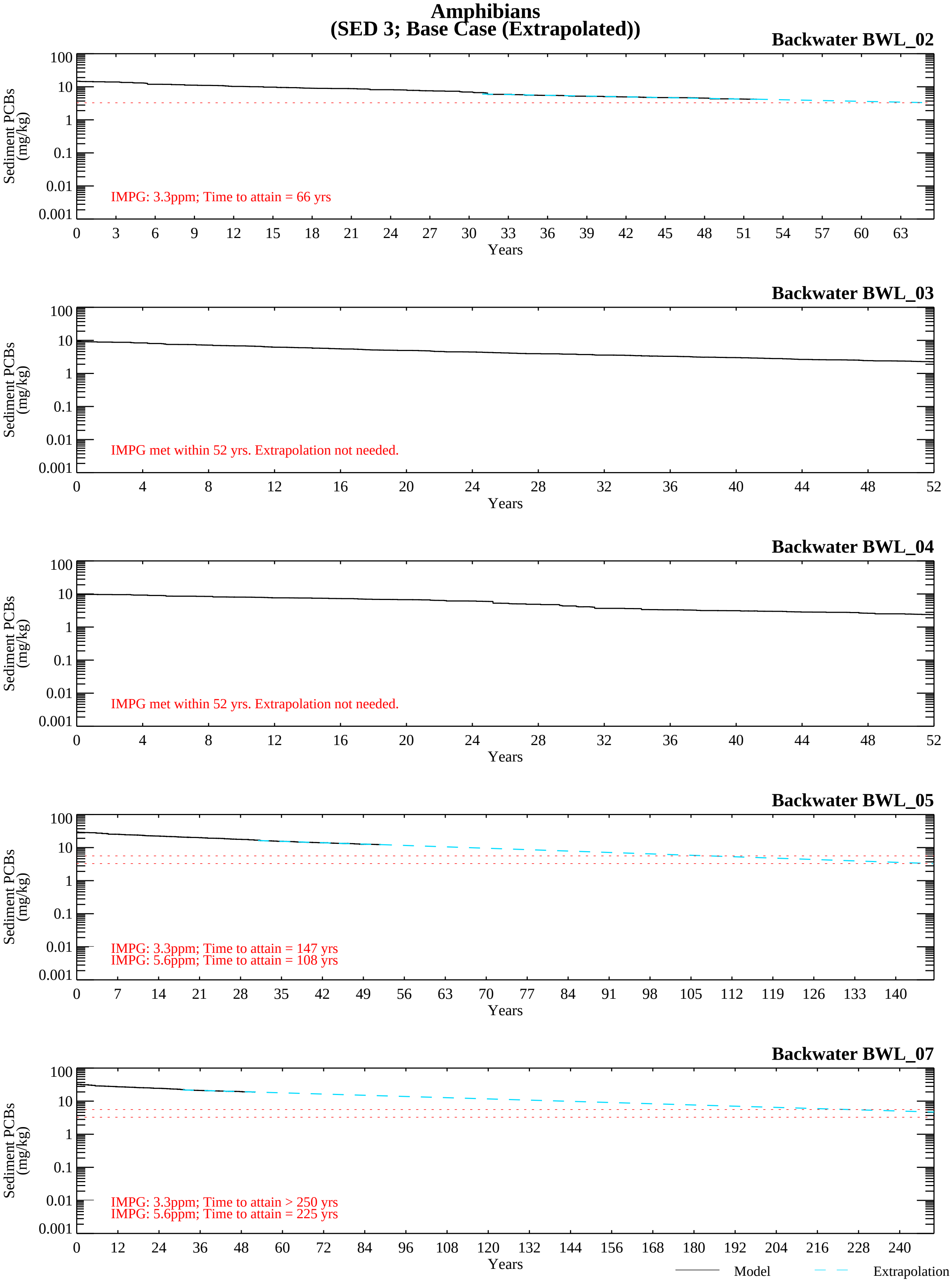

Figure G-5.2-2a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 3; Reach 5/6; Base Case).

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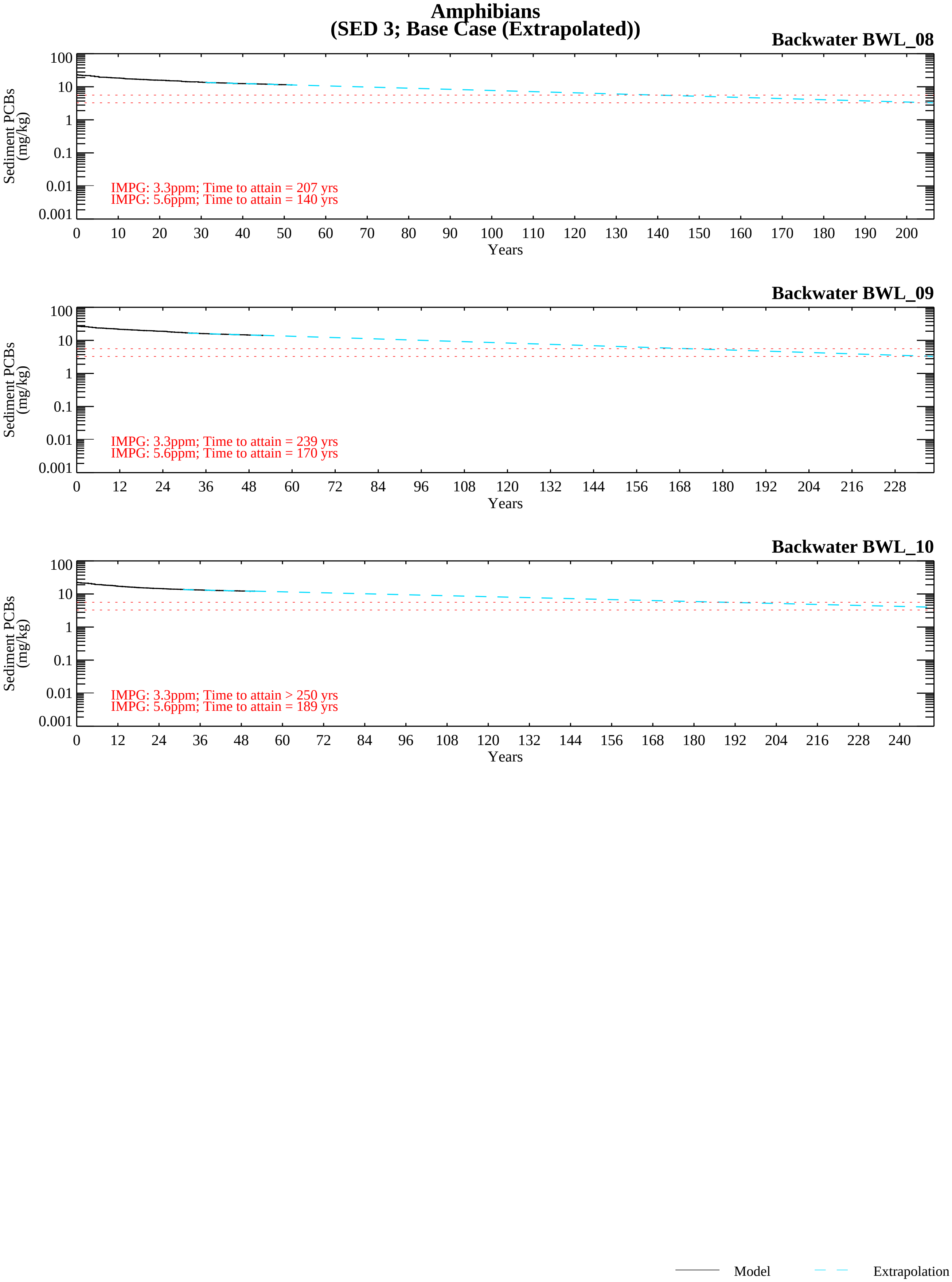

Figure G-5.2-2a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 3; Reach 5/6; Base Case).

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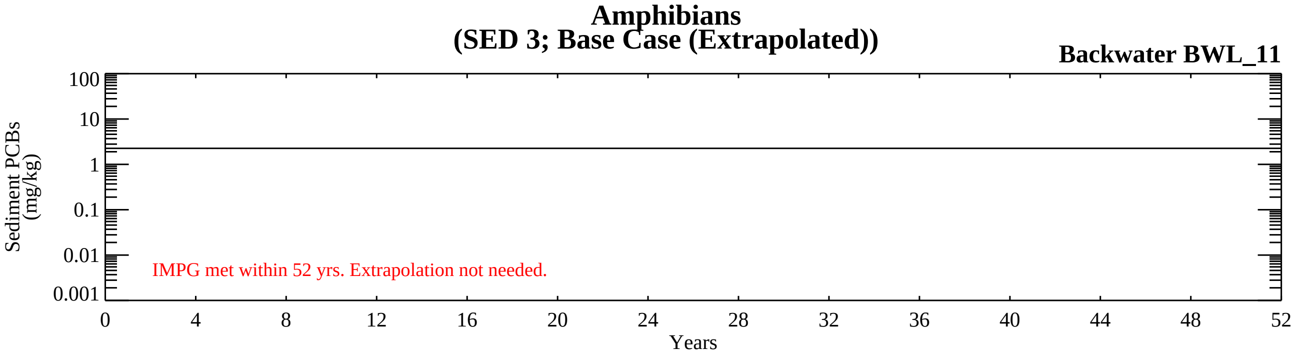

Figure G-5.3-2b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 3; Reach 7/8; Base Case).

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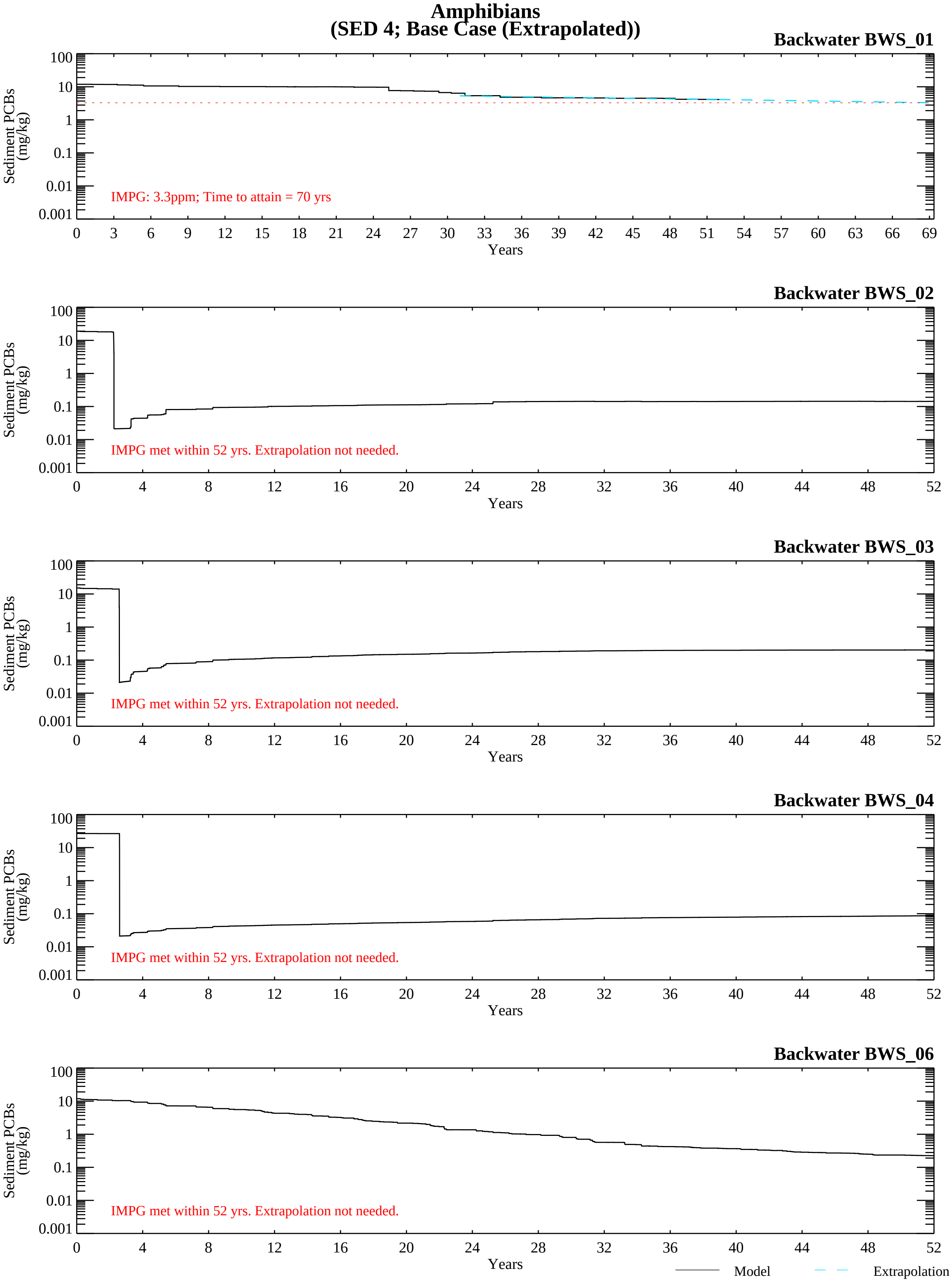

Amphibians
(SED 4; Base Case (Extrapolated))

Backwater BWS_01

Backwater BWS_02

Backwater BWS_03

Backwater BWS_04

Backwater BWS_06

IMPG: 3.3ppm; Time to attain = 70 yrs

IMPG met within 52 yrs. Extrapolation not needed.

Figure G-5.2-3a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 4; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED4CMSBS_0801-01\bins

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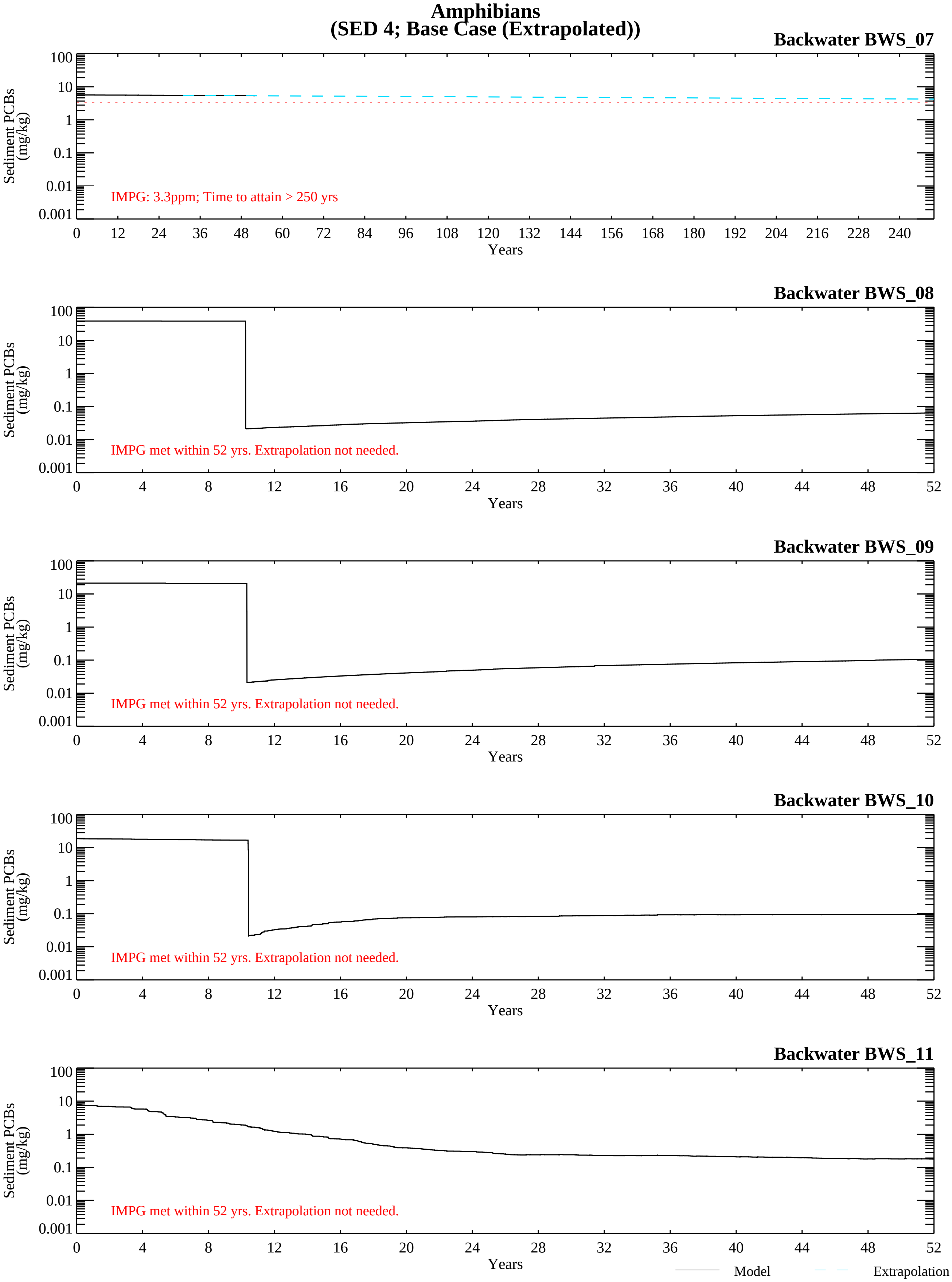

Figure G-5.2-3a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 4; Reach 5/6; Base Case).

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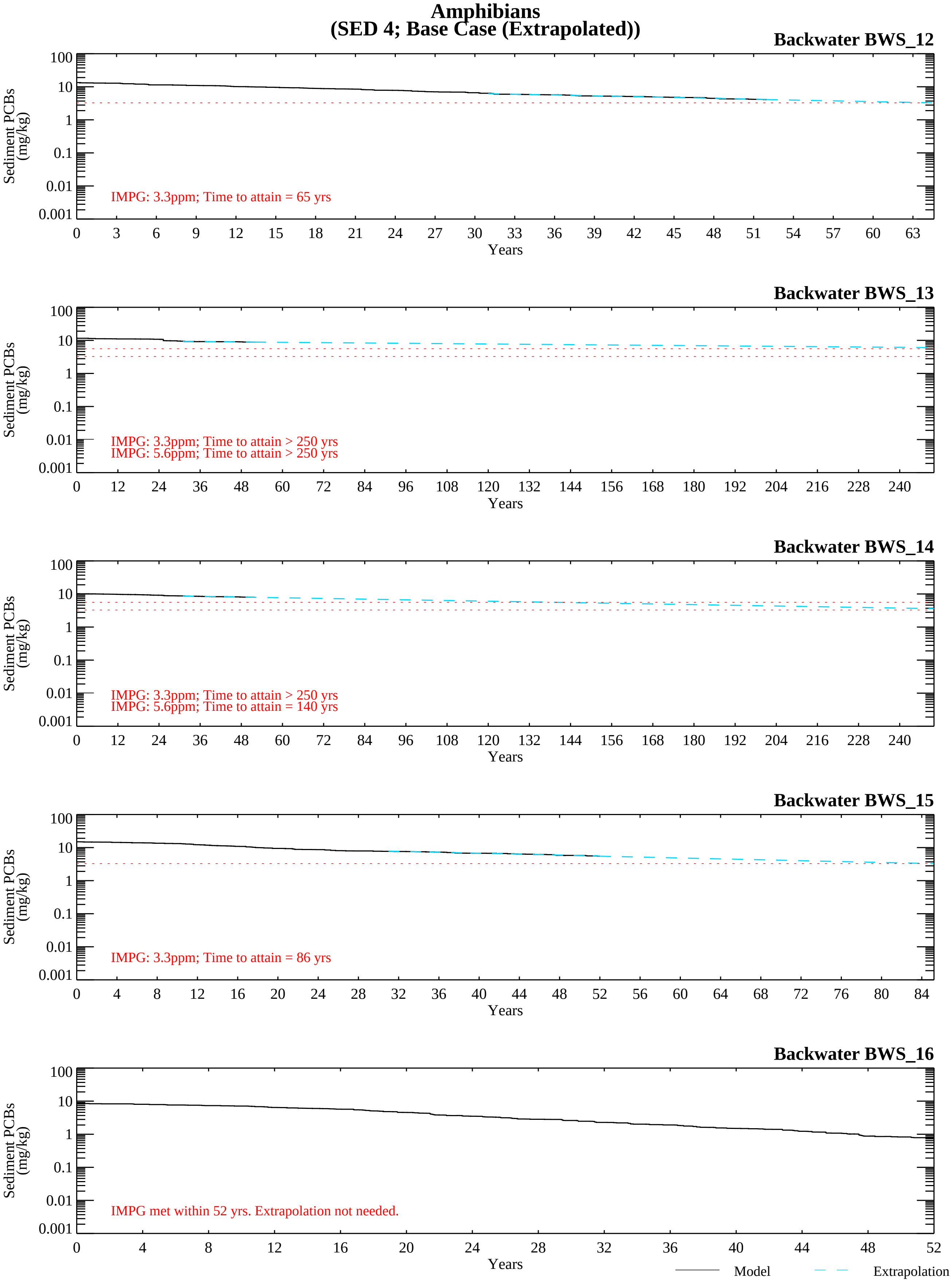

Figure G-5.2-3a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 4; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED4CMSBS_0801-01\bins

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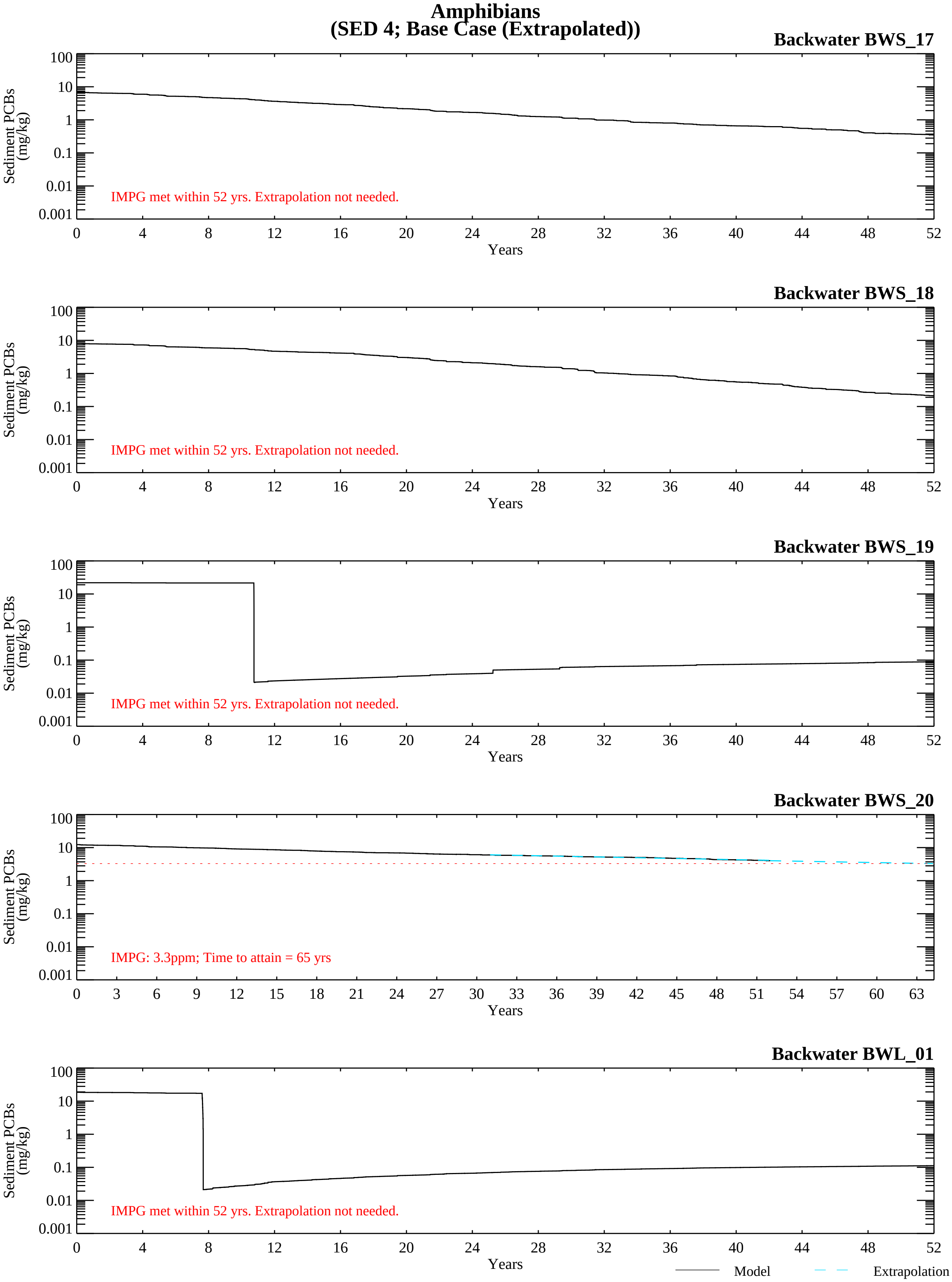

Figure G-5.3-3a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 4; Reach 5/6; Base Case).

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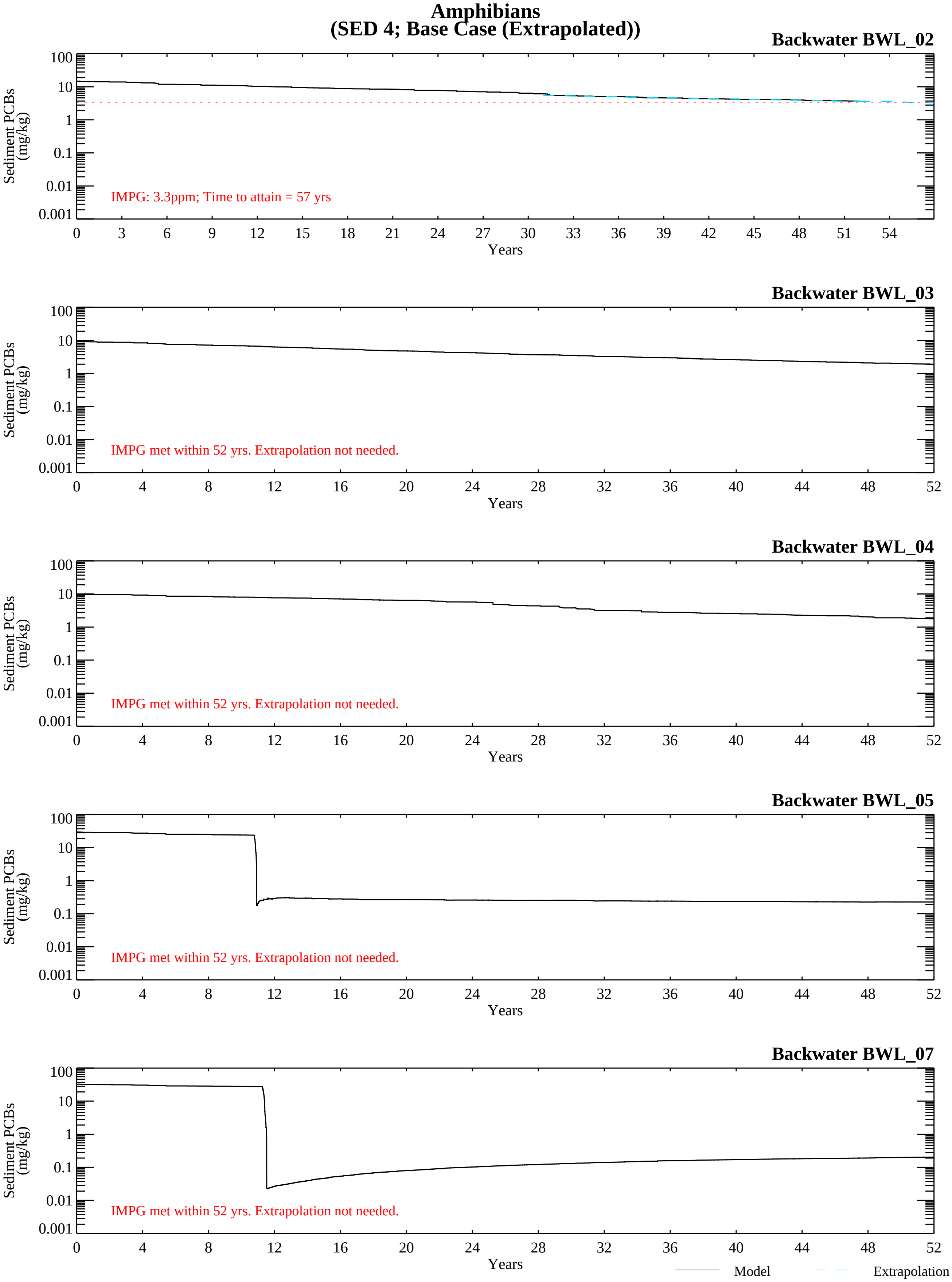

Figure G-5.2-3a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 4; Reach 5/6; Base Case).

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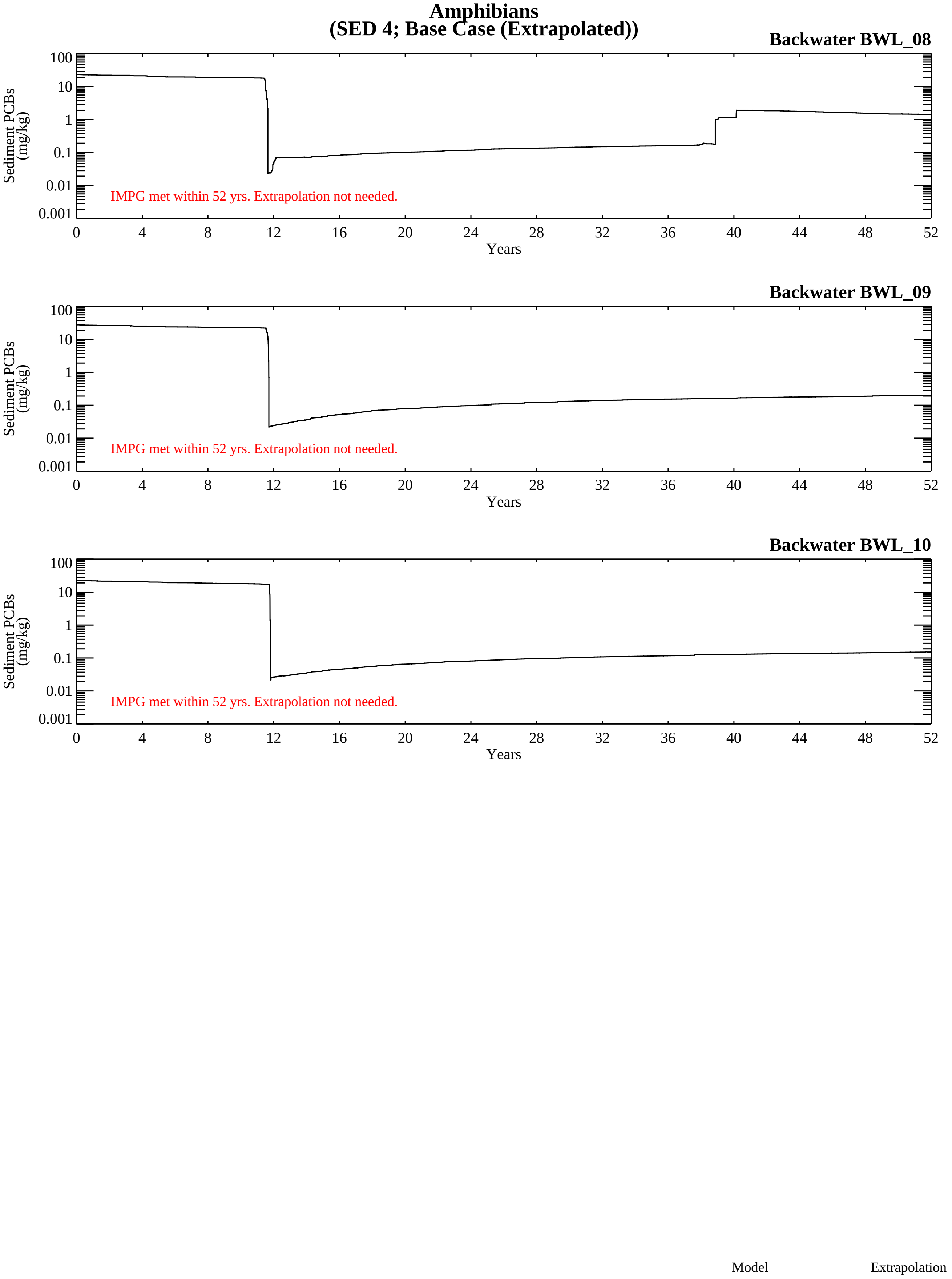

Figure G-5.3-3a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 4; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED4CMSBS_0801-01\bins

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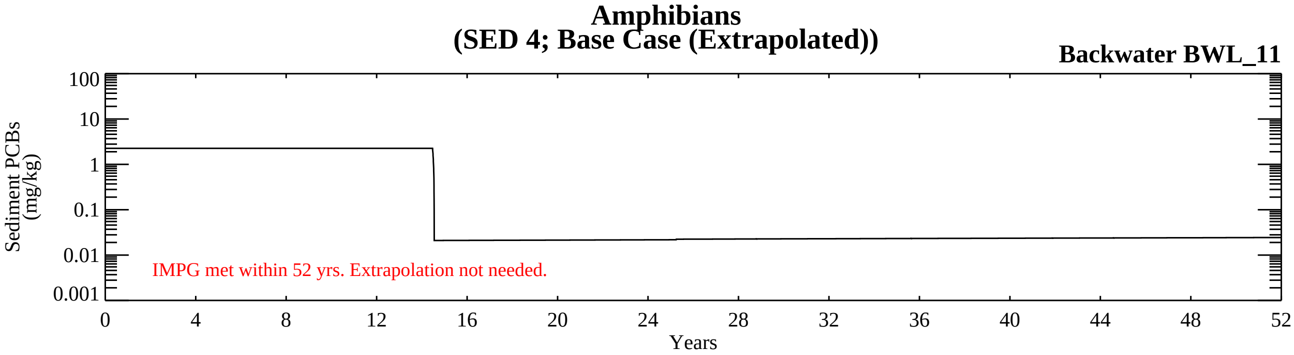

Figure G-5.3-3b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 4; Reach 7/8; Base Case).

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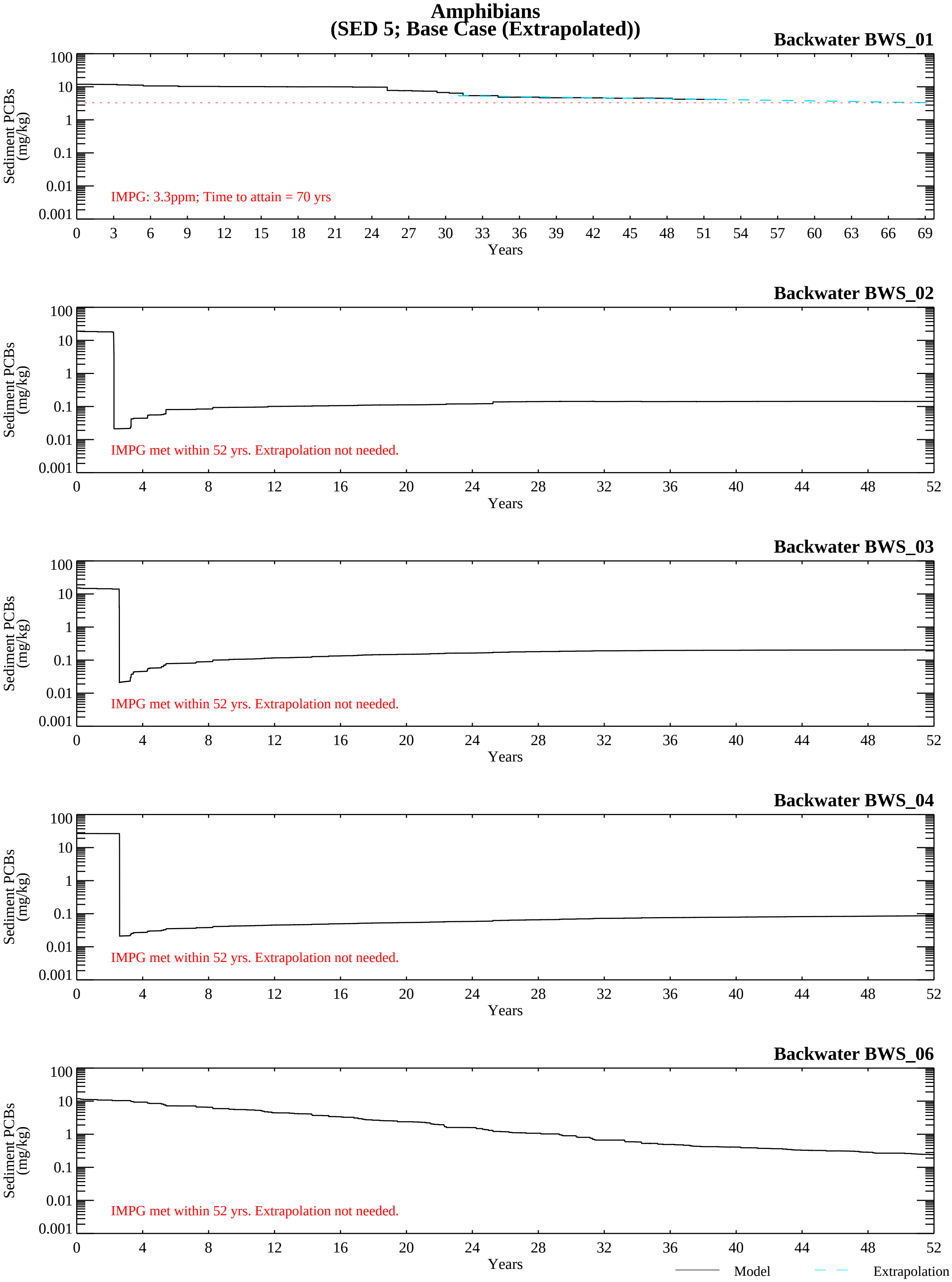

Figure G-5.2-4a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 5; Reach 5/6; Base Case).

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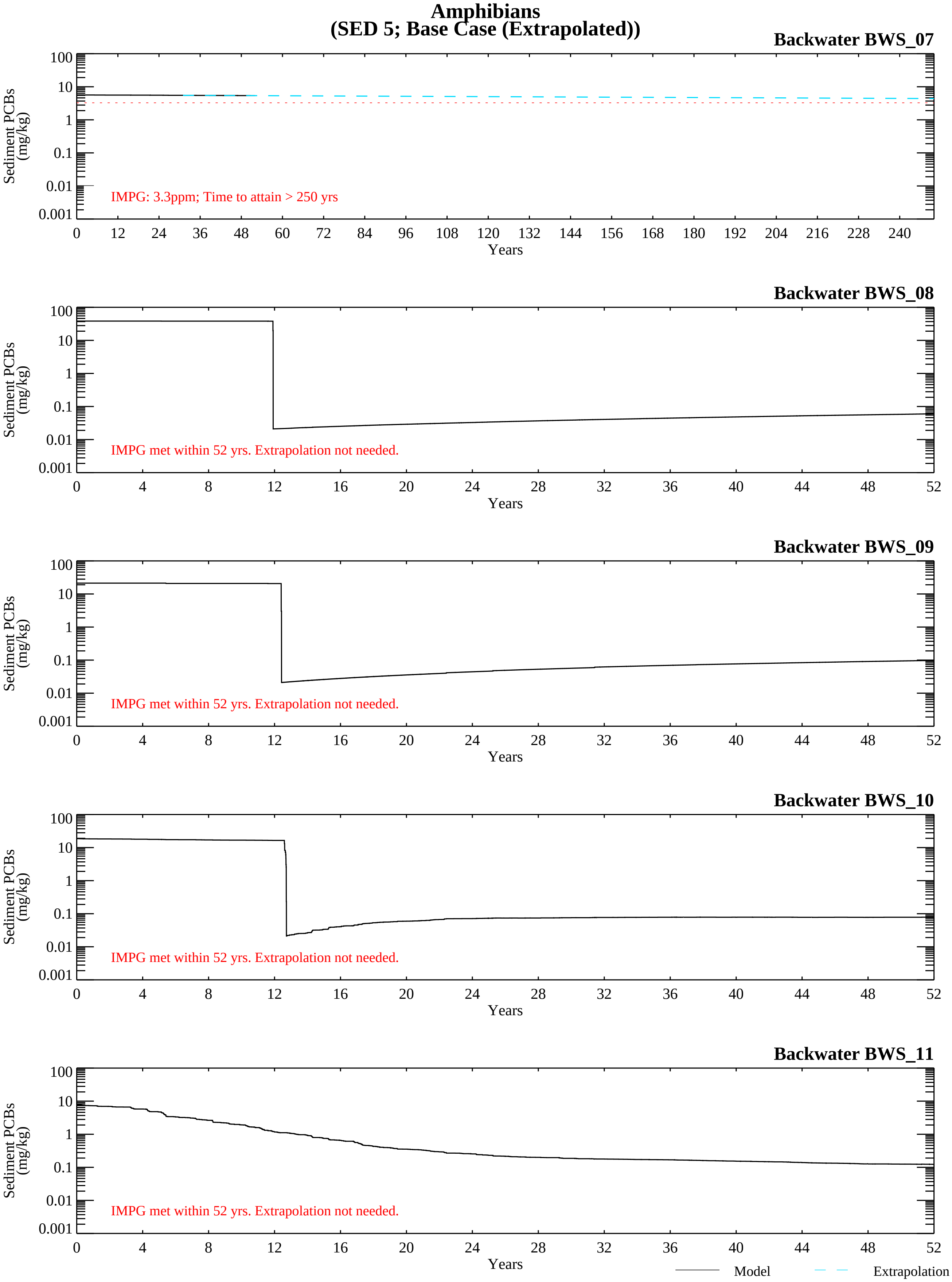

Figure G-5.2-4a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 5; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED5CMSBS_0801-02\bins

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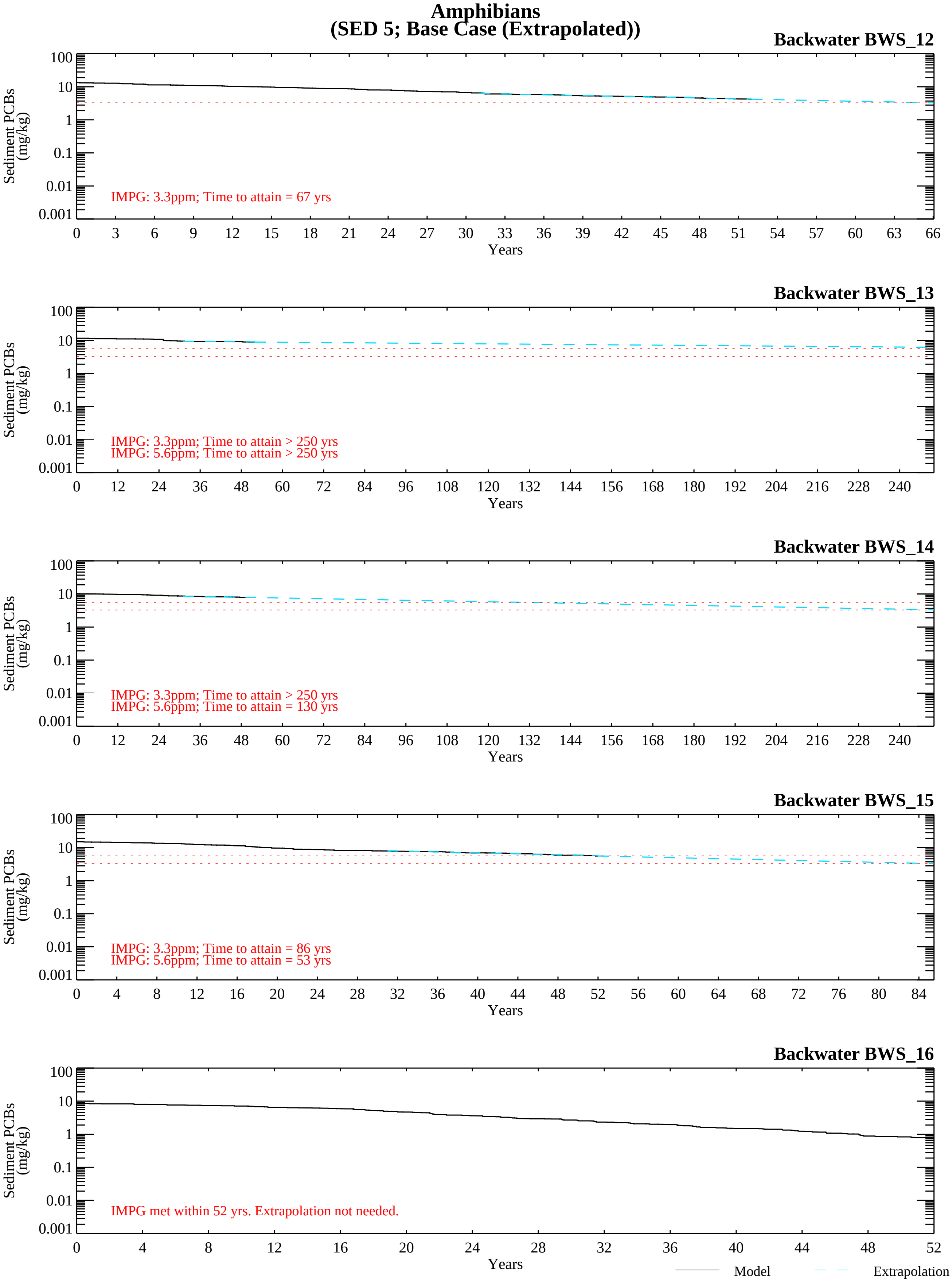

Figure G-5.2-4a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 5; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED5CMSBS_0801-02\bins

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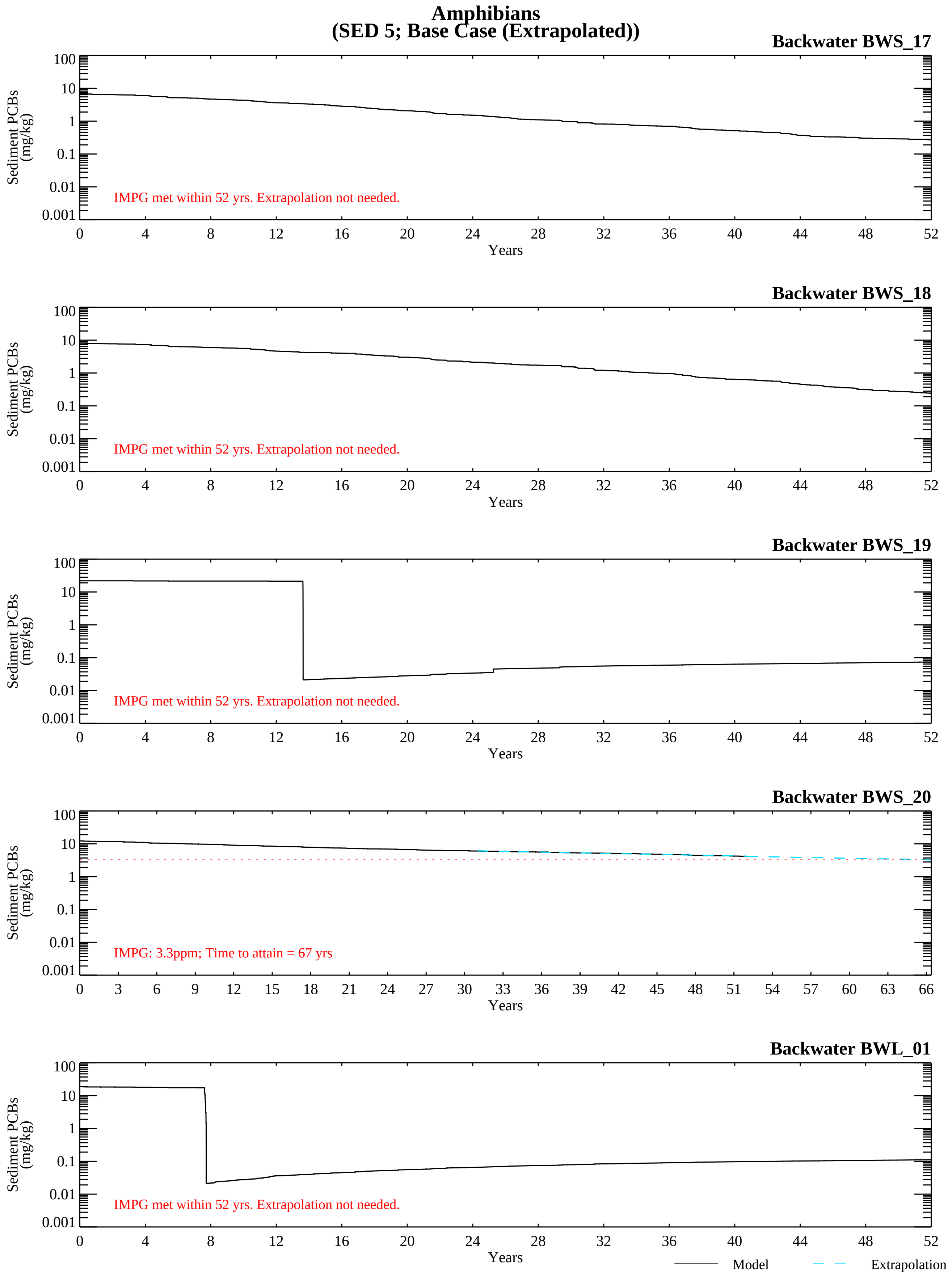

Figure G-5.3-4a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 5; Reach 5/6; Base Case).

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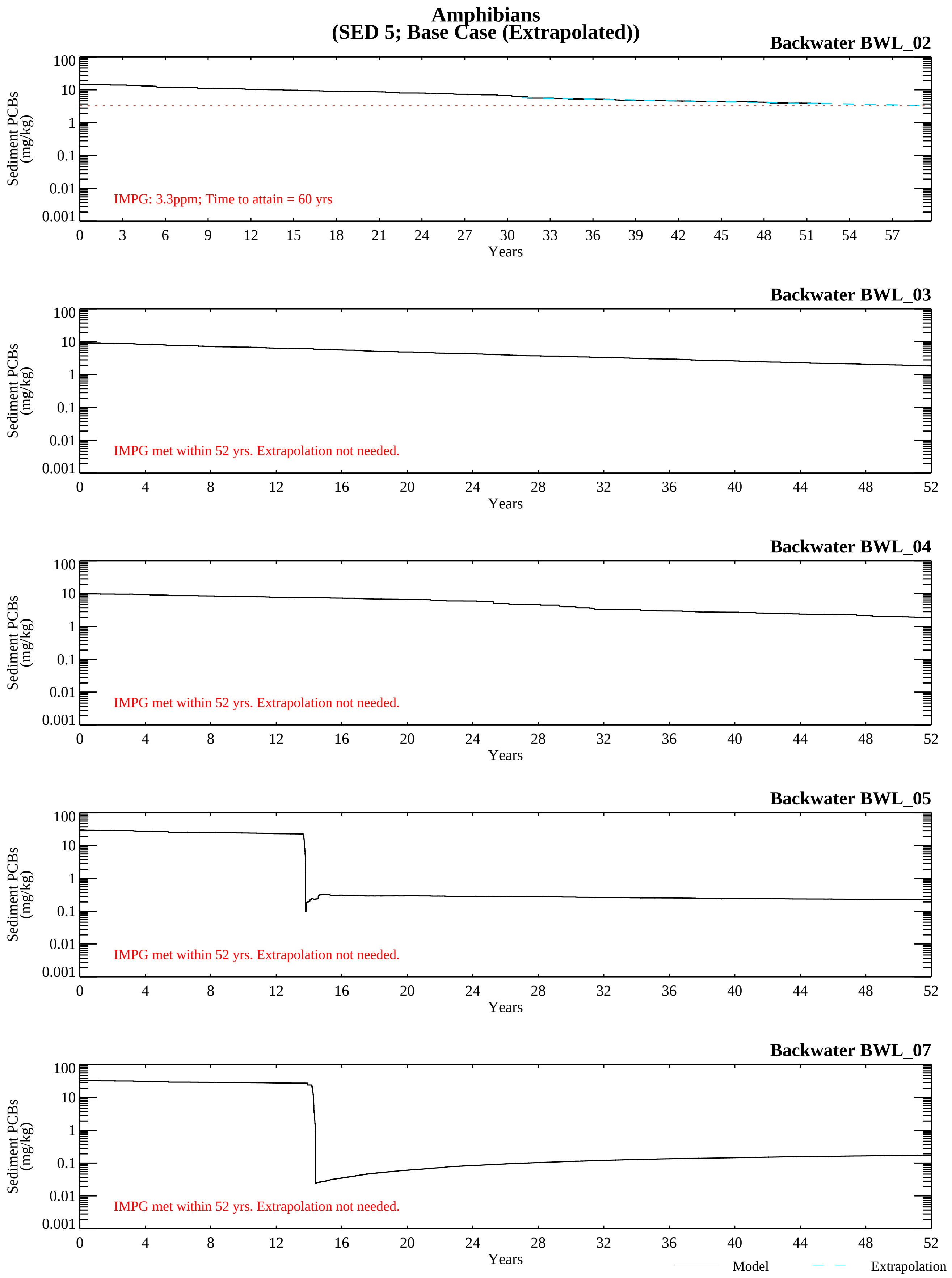

Figure G-5.2-4a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 5; Reach 5/6; Base Case).

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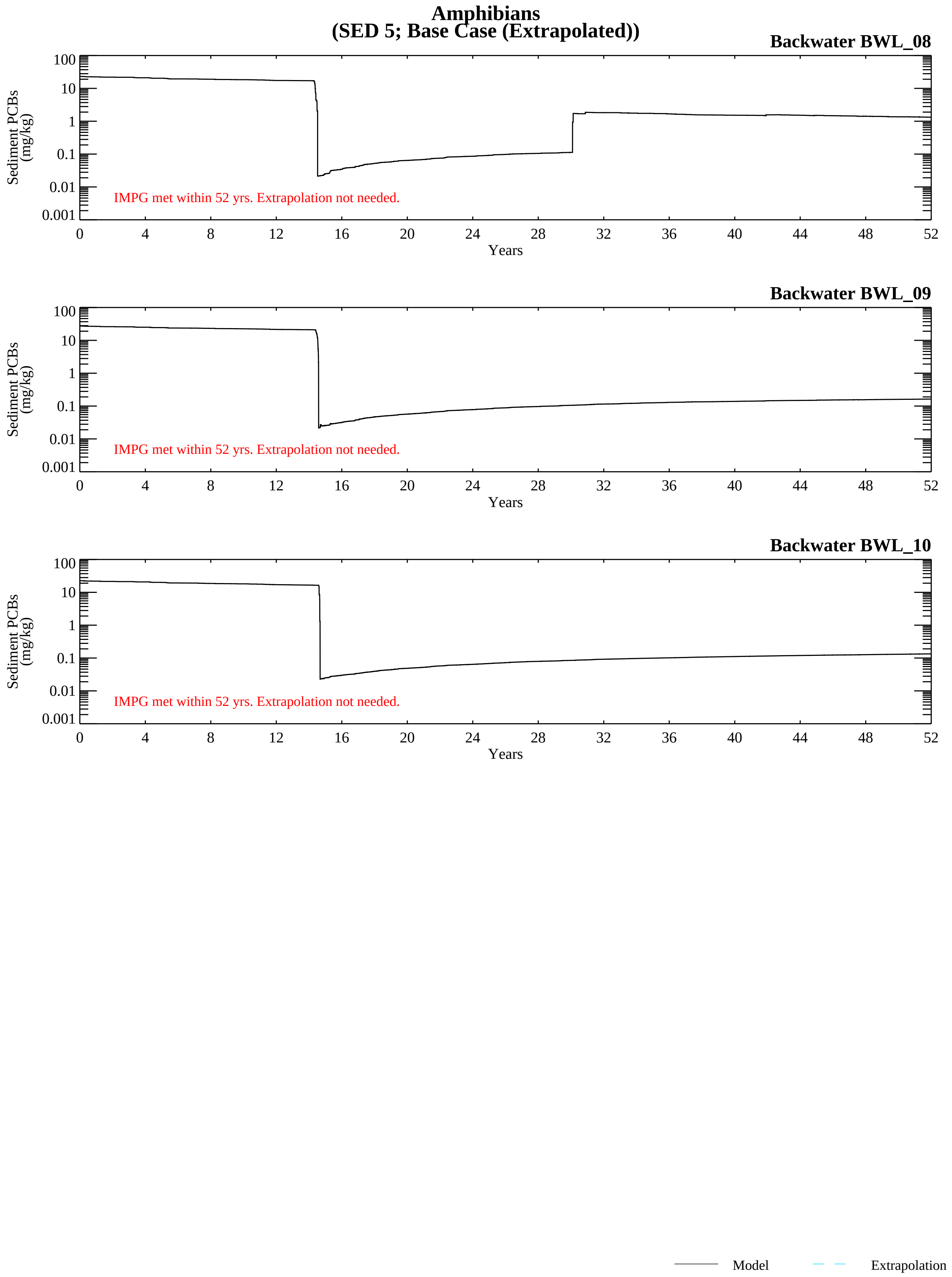

Figure G-5.3-4a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 5; Reach 5/6; Base Case).

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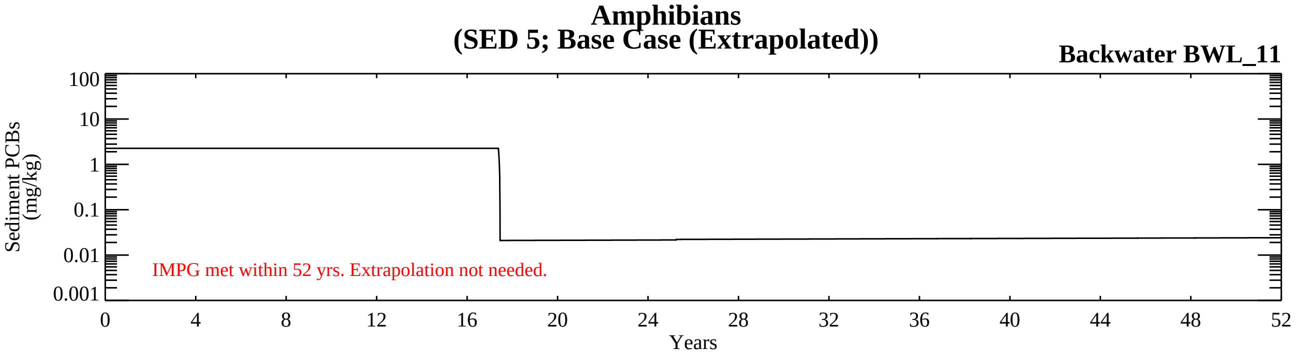

Figure G-5.3-4b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 5; Reach 7/8; Base Case).

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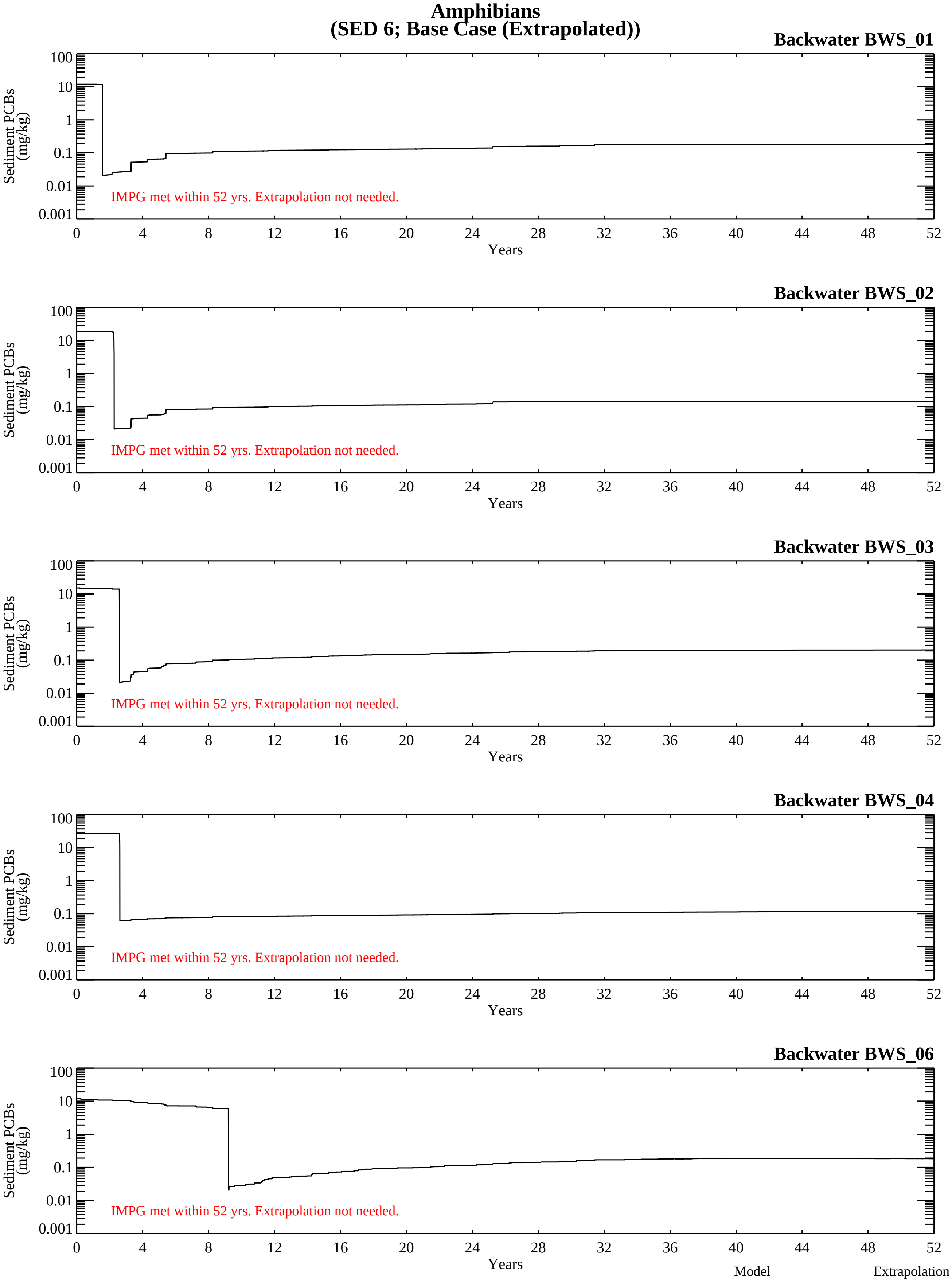

Figure G-5.3-5a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 6; Reach 5/6; Base Case).

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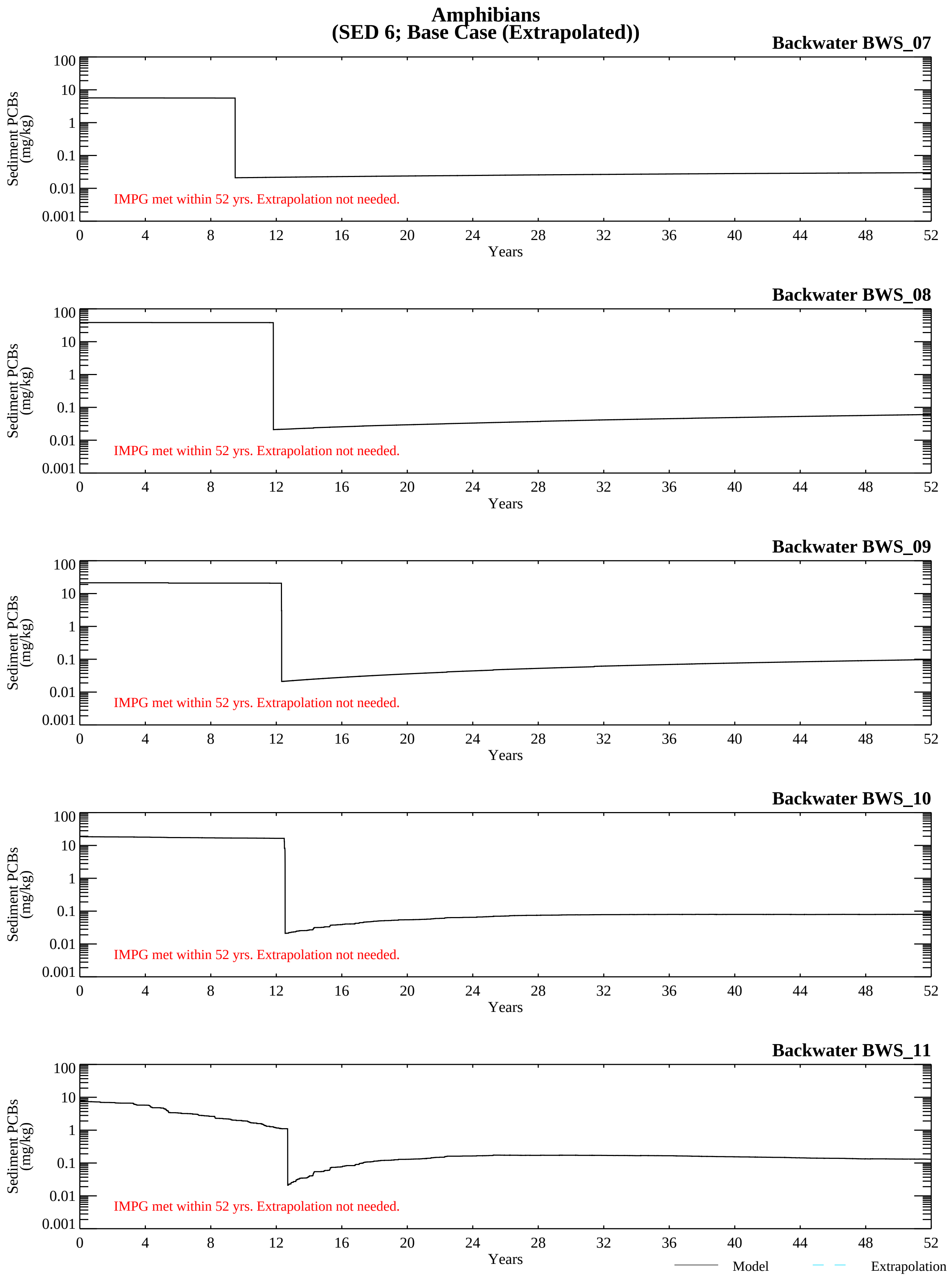

Amphibians
(SED 6; Base Case (Extrapolated))

Backwater BWS_07

Backwater BWS_08

Backwater BWS_09

Backwater BWS_10

Backwater BWS_11

Figure G-5.3-5a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 6; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED6CMSBS_0712-16\bins

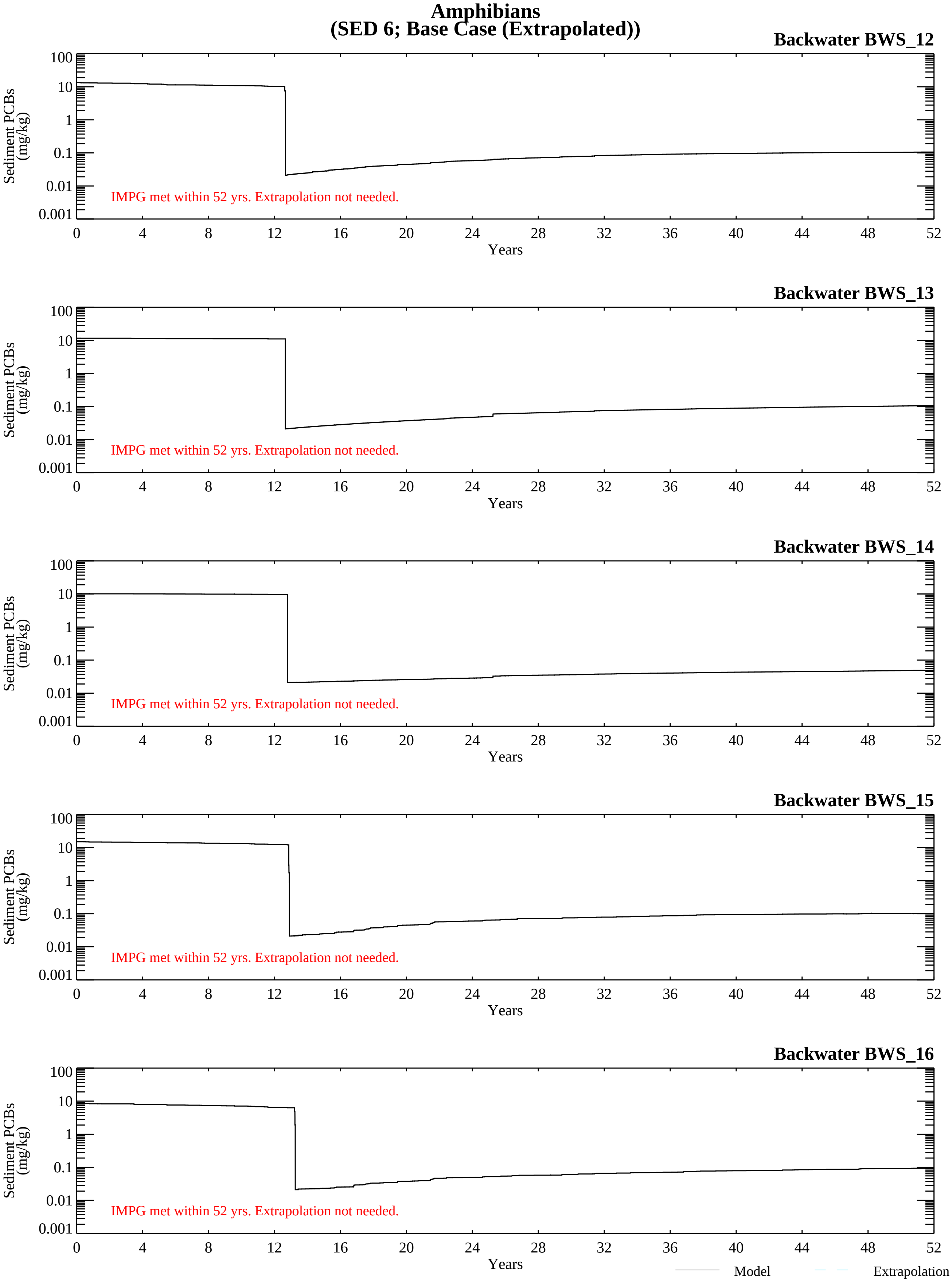

Figure G-5.3-5a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 6; Reach 5/6; Base Case).

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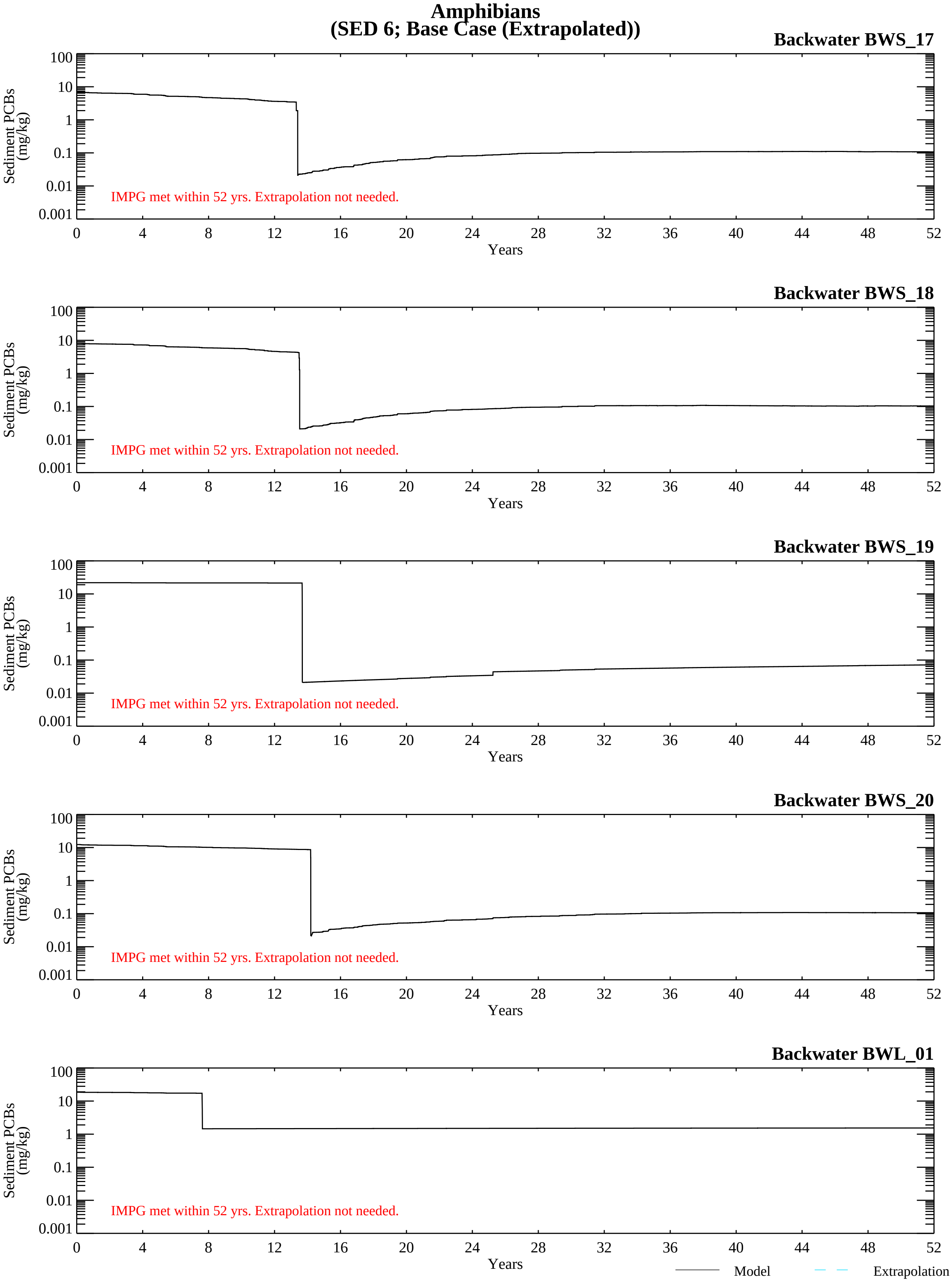

Figure G-5.3-5a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 6; Reach 5/6; Base Case).

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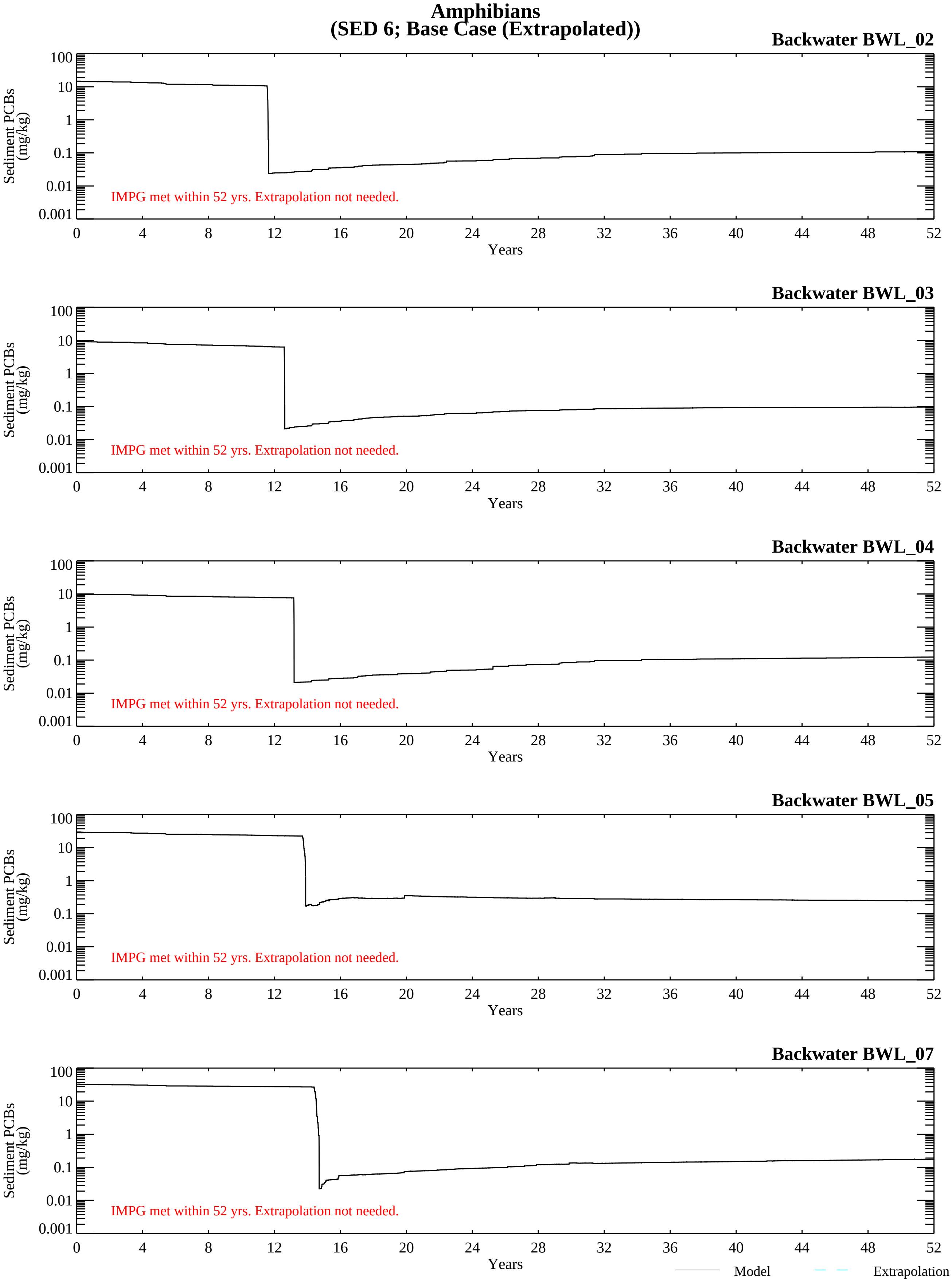

Figure G-5.3-5a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 6; Reach 5/6; Base Case).

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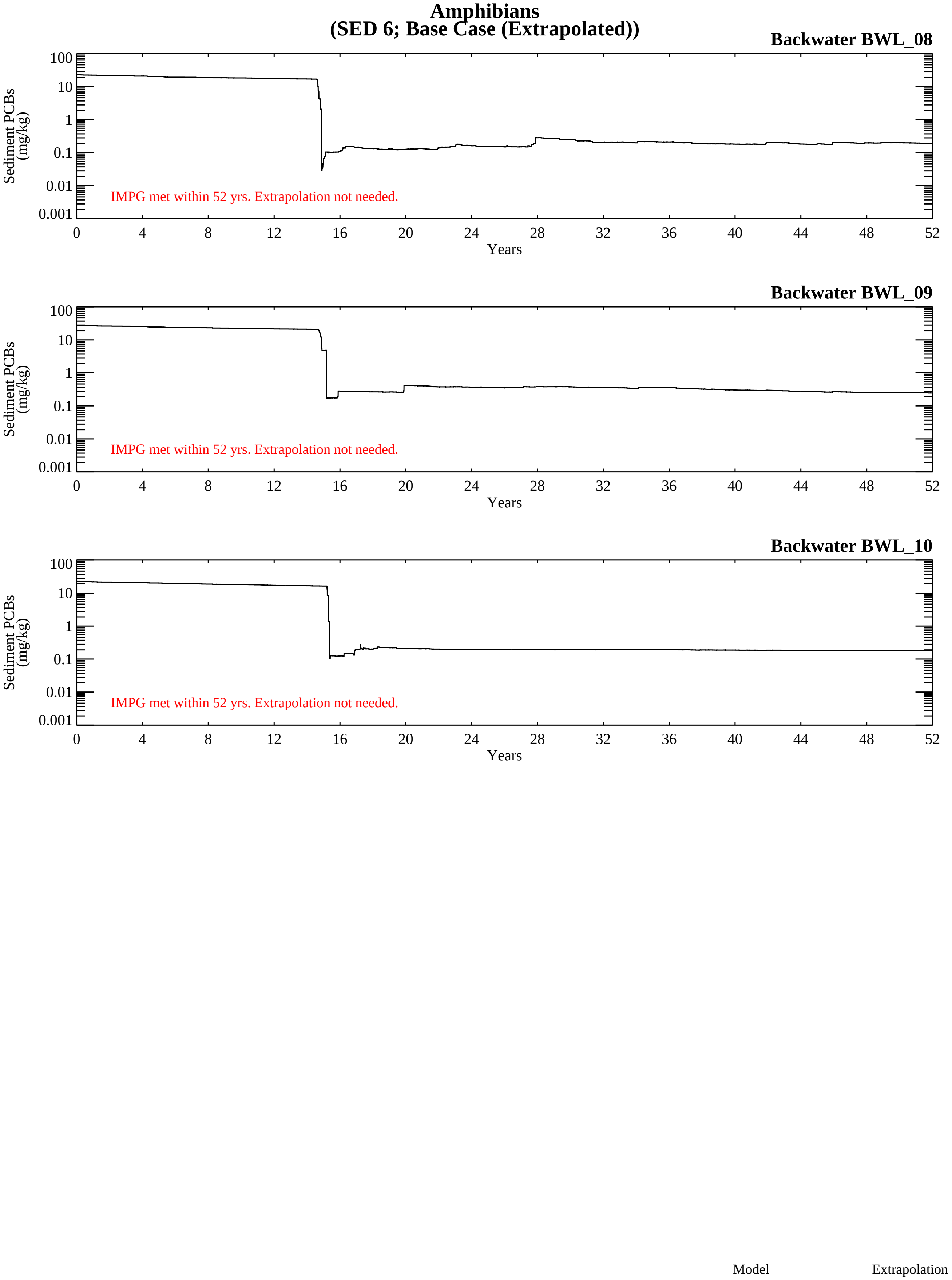

Figure G-5.3-5a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 6; Reach 5/6; Base Case).

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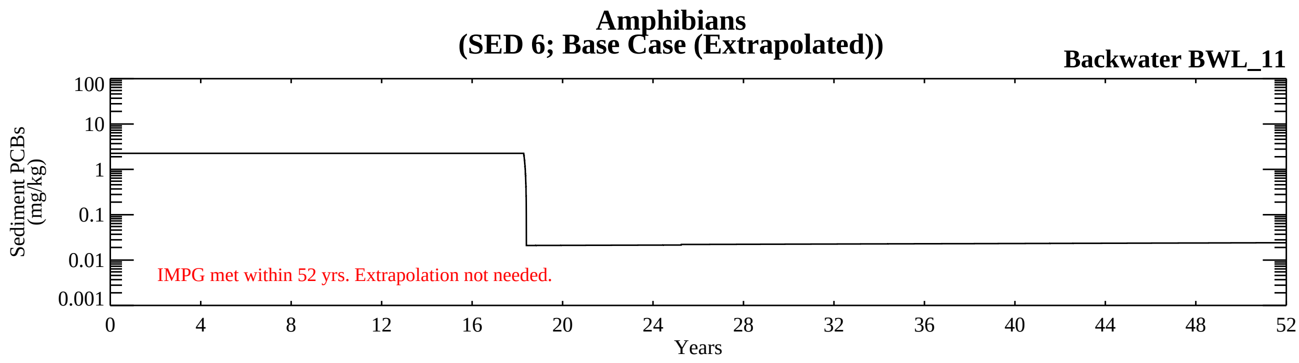

Figure G-5.3-5b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 6; Reach 7/8; Base Case).

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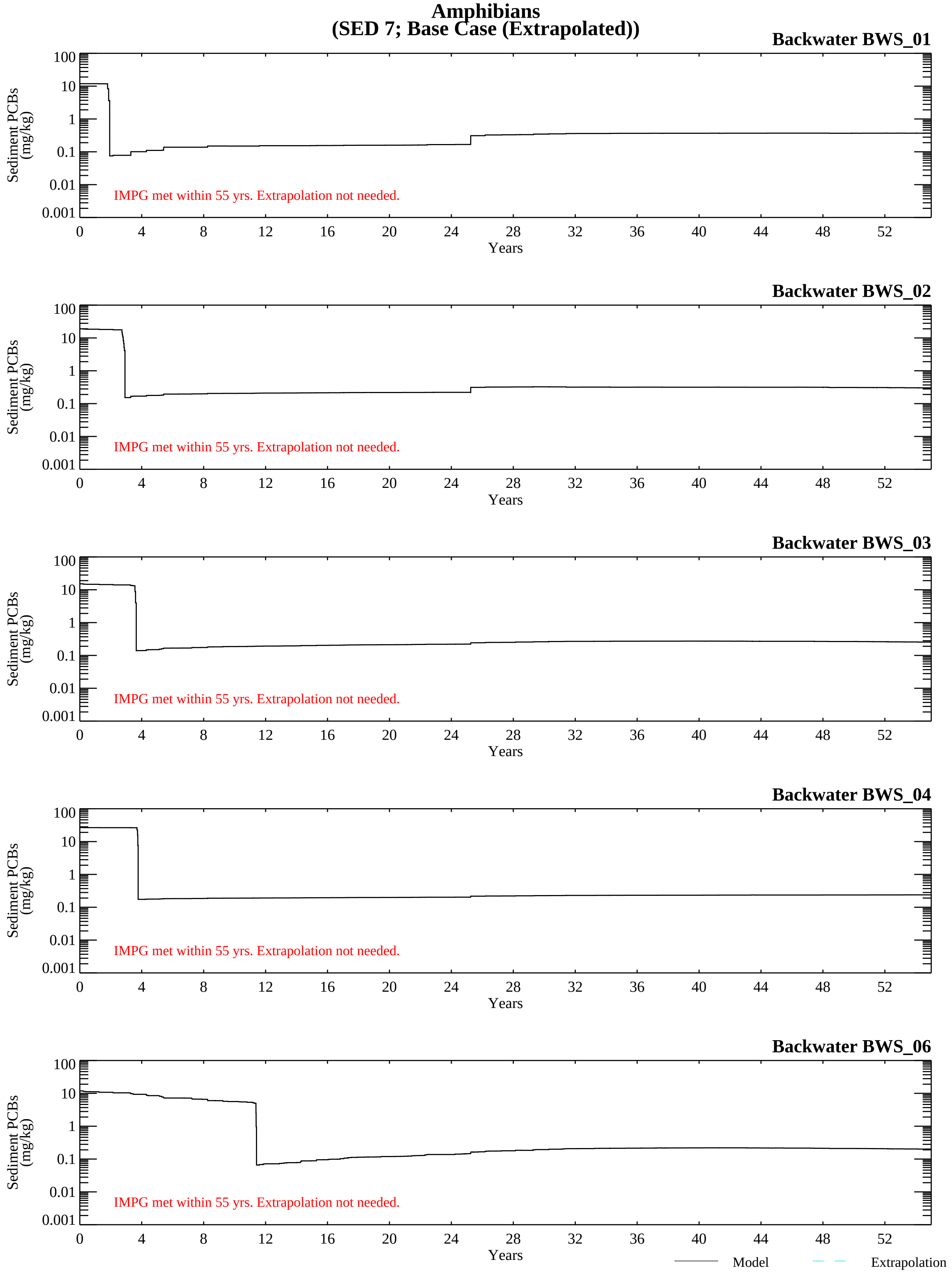

Figure G-5.3-6a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 7; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED7CMSBS_0712-03\bins

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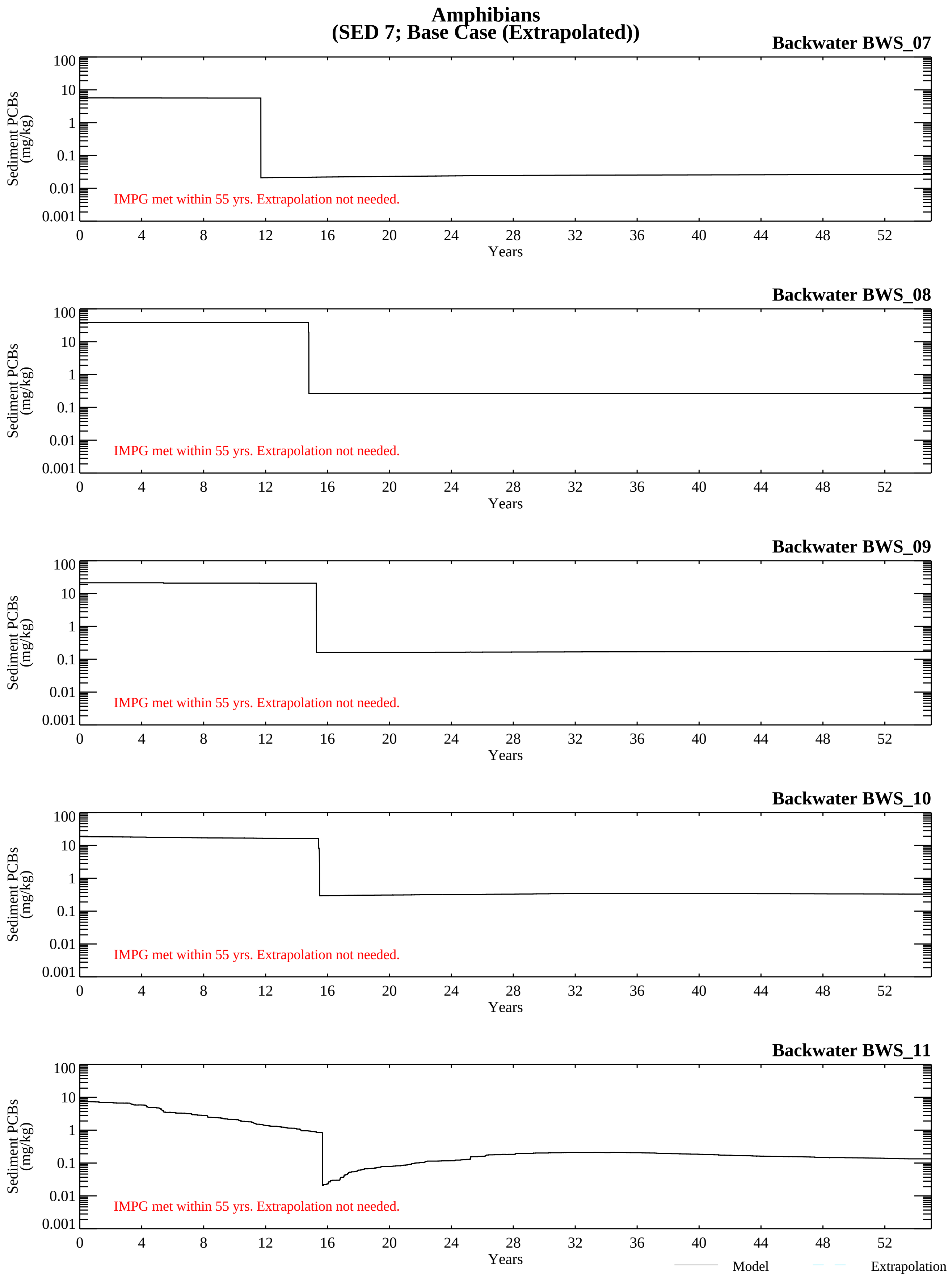

Figure G-5.3-6a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 7; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED7CMSBS_0712-03\bins

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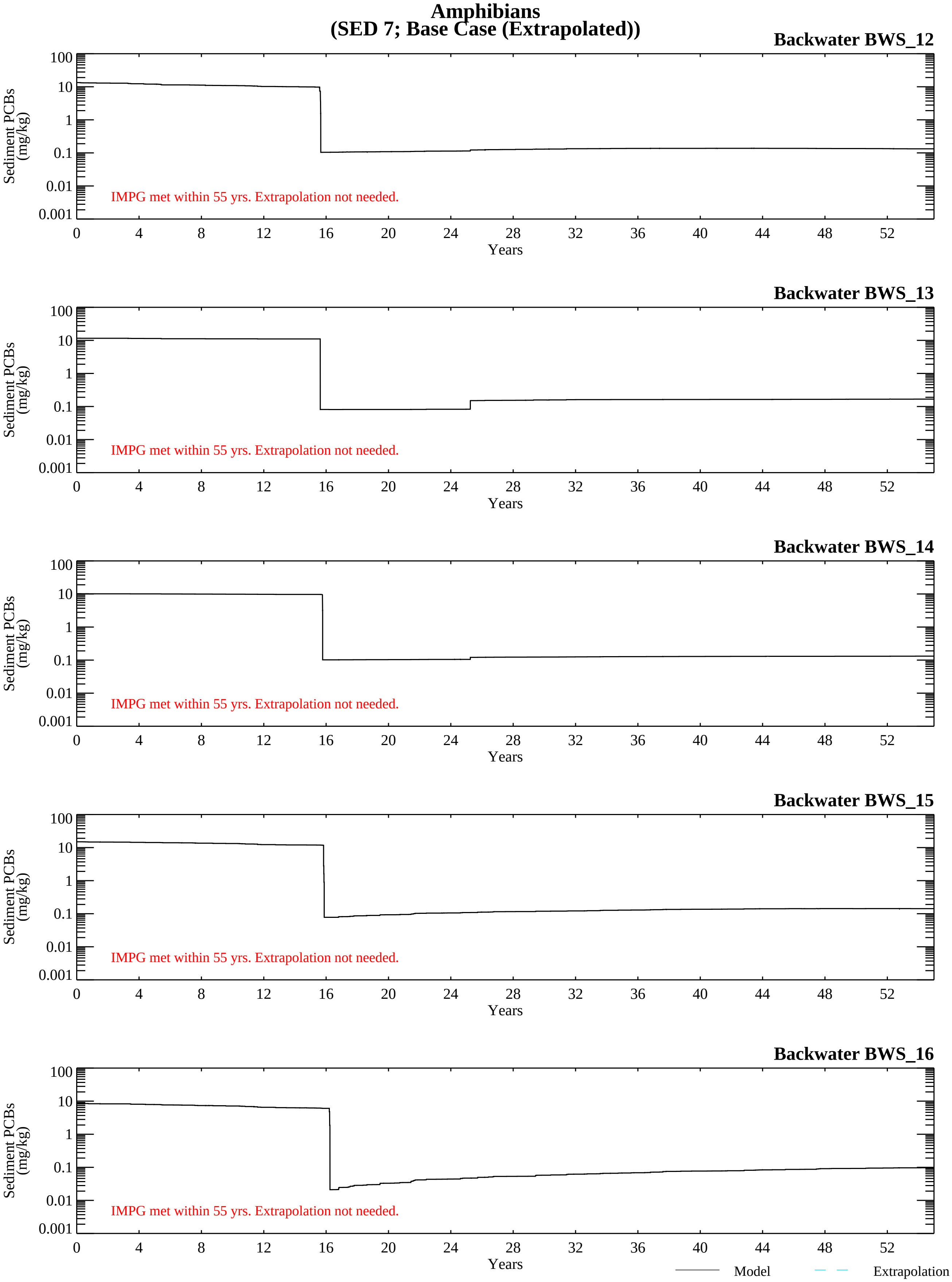

Figure G-5.3-6a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 7; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED7CMSBS_0712-03\bins

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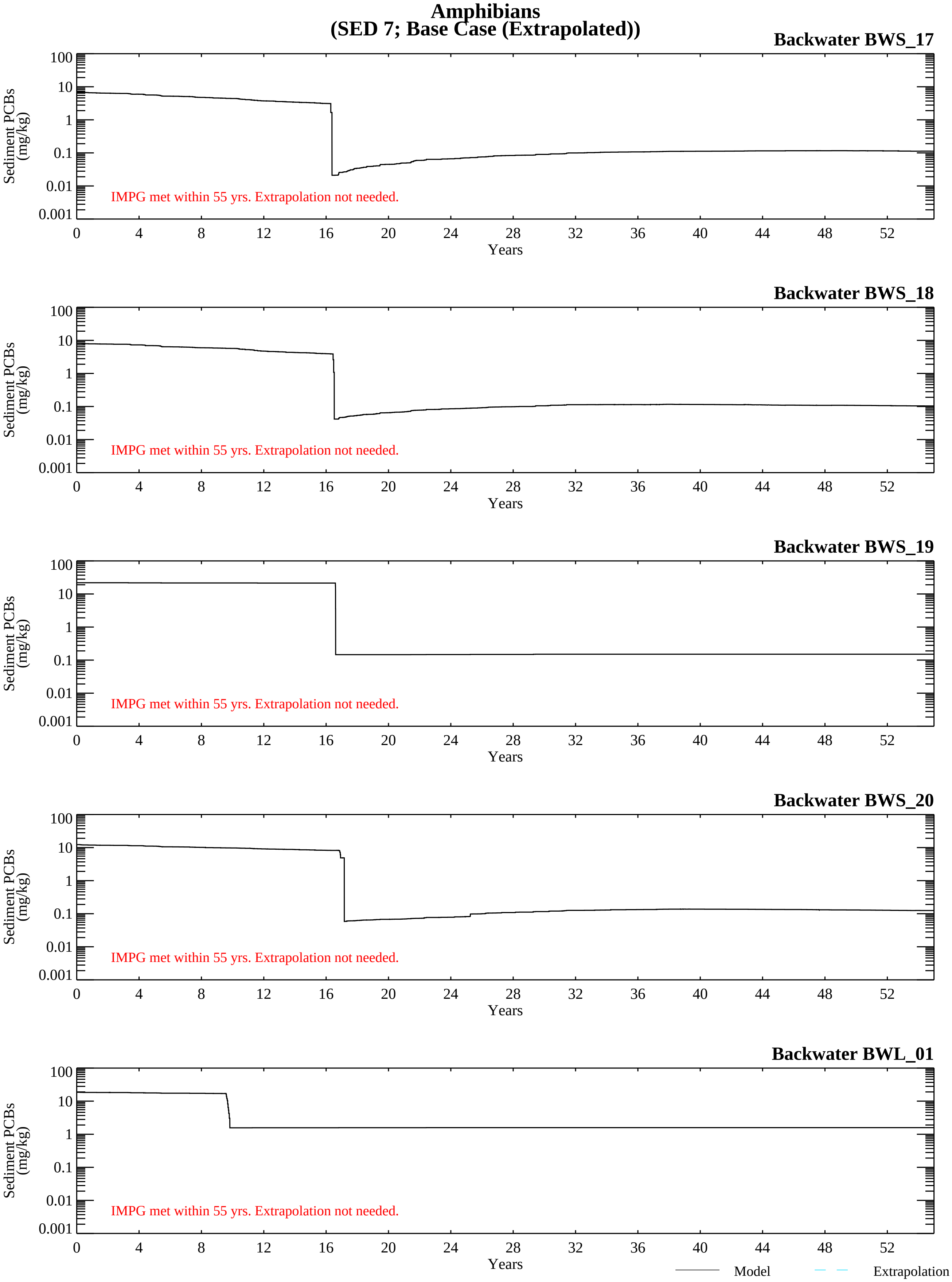

Figure G-5.3-6a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 7; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED7CMSBS_0712-03\bins

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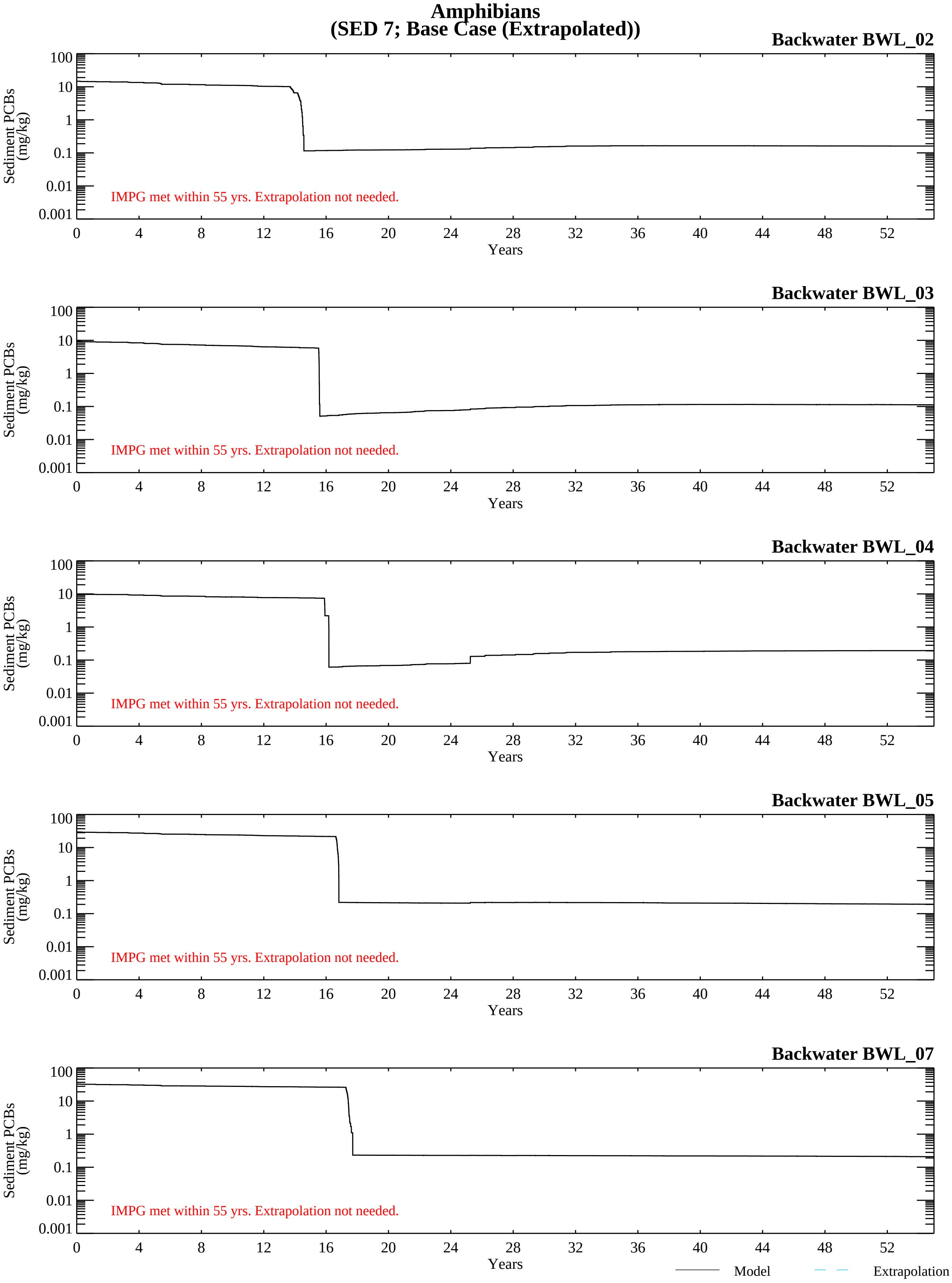

Figure G-5.3-6a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 7; Reach 5/6; Base Case).

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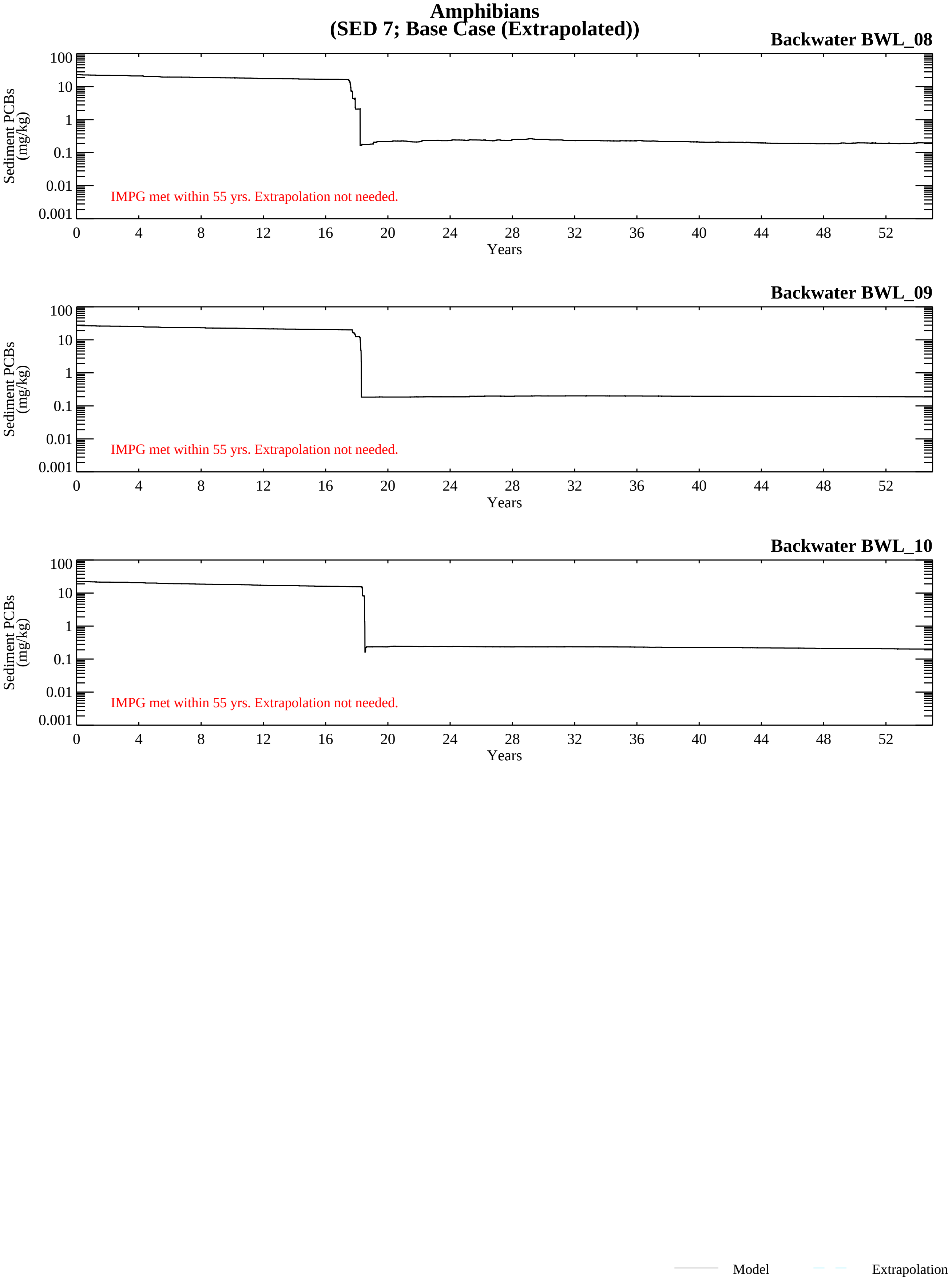

Figure G-5.3-6a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 7; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED7CMSBS_0712-03\bins

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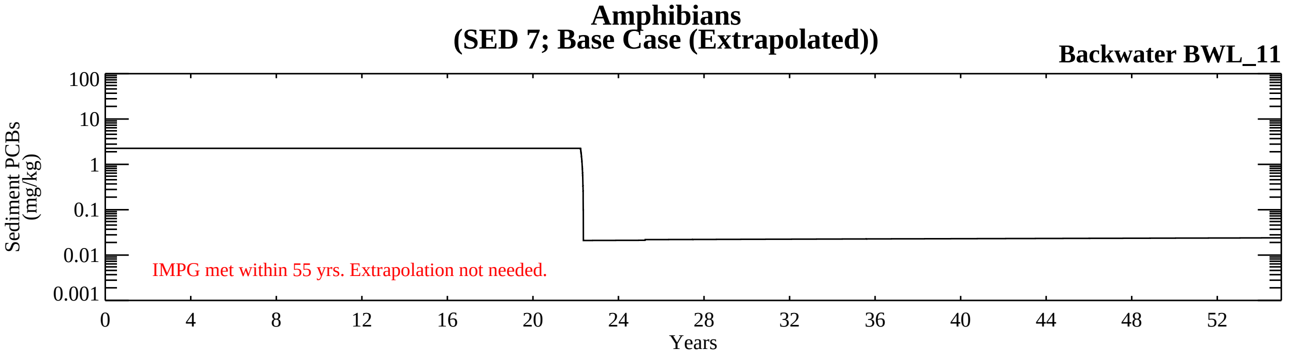

Figure G-5.3-6b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 7; Reach 7/8; Base Case).

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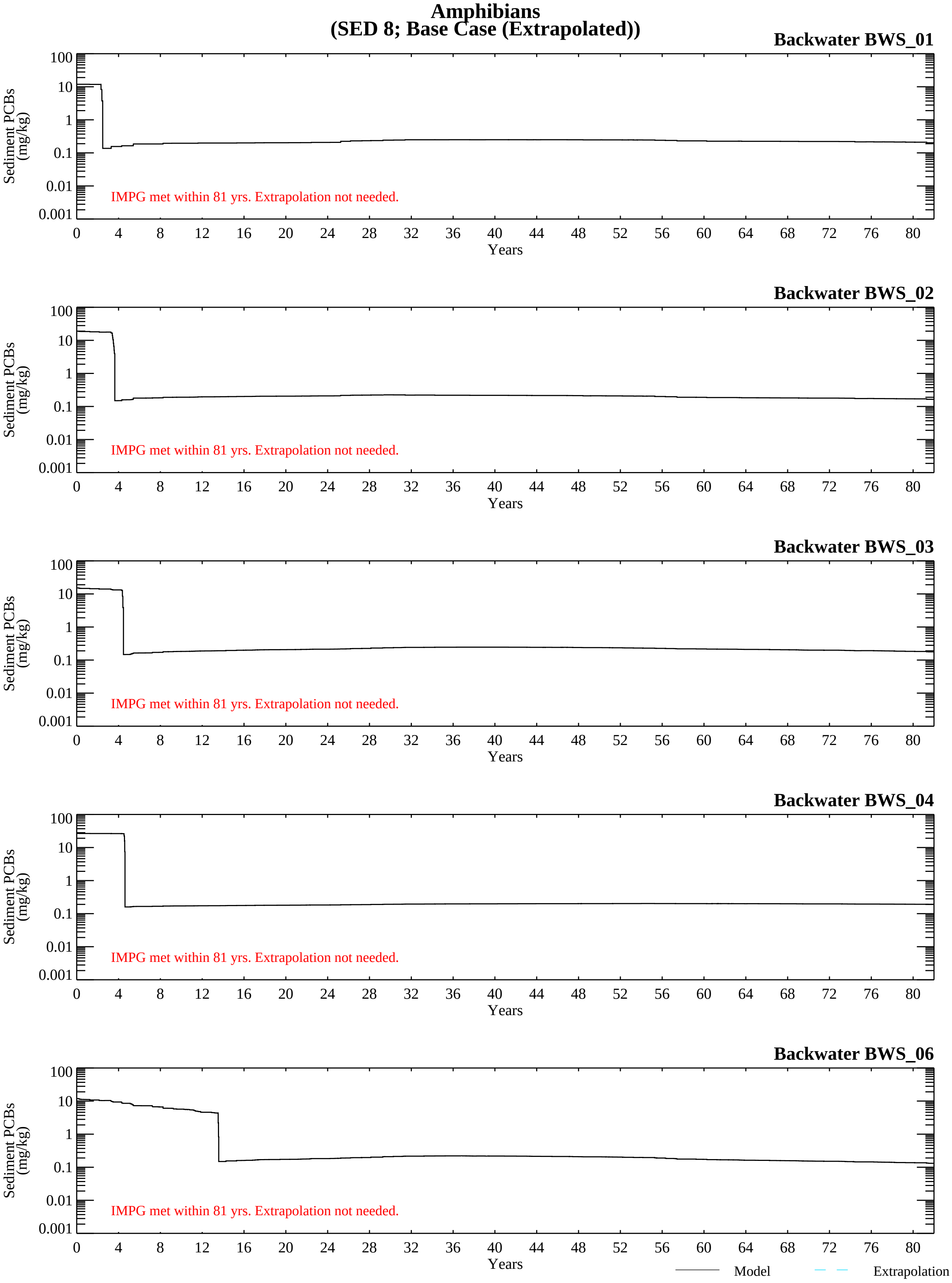

Figure G-5.3-7a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 8; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED8CMSBS_0712-18\bins

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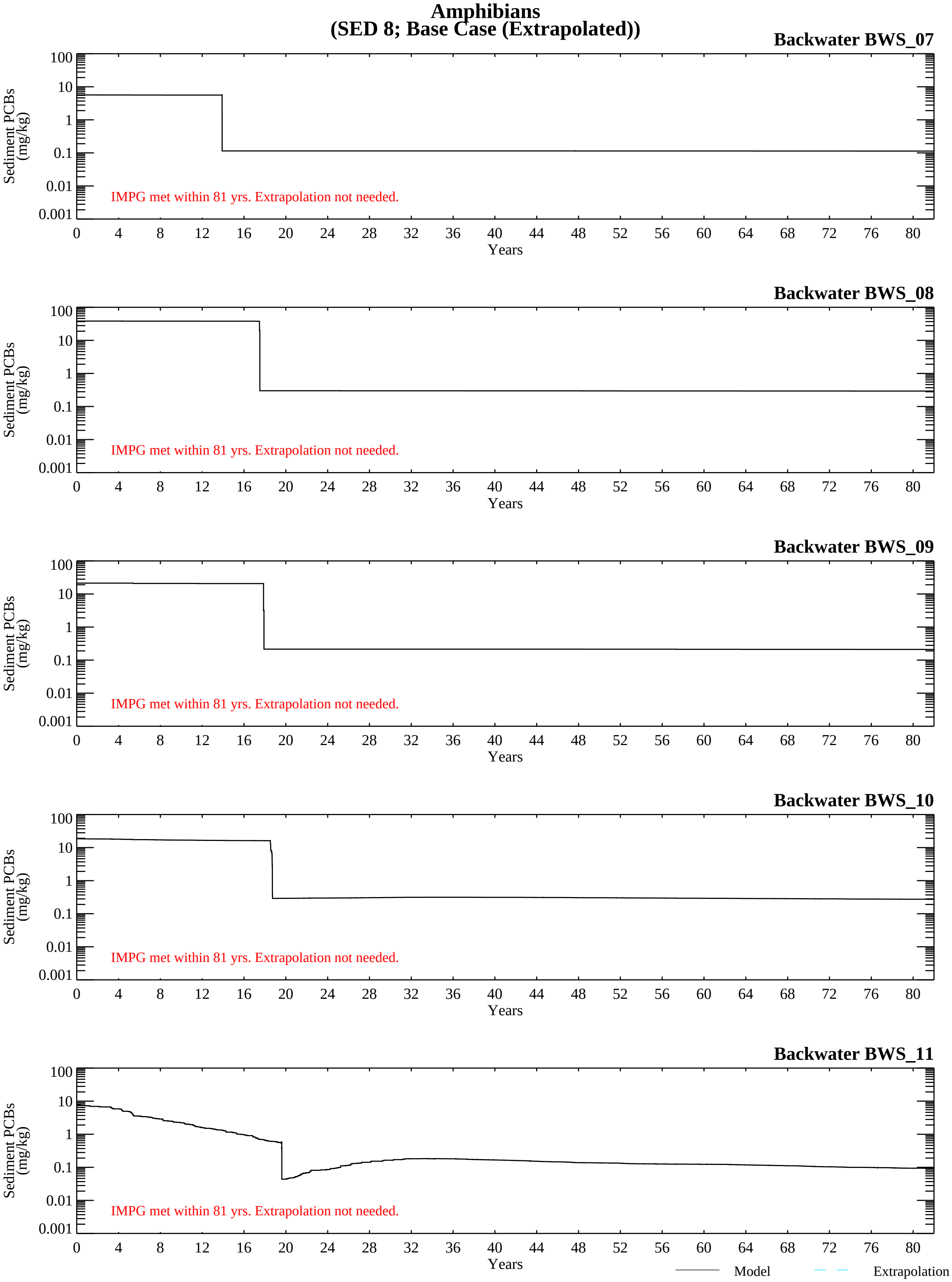

Figure G-5.3-7a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 8; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED8CMSBS_0712-18\bins

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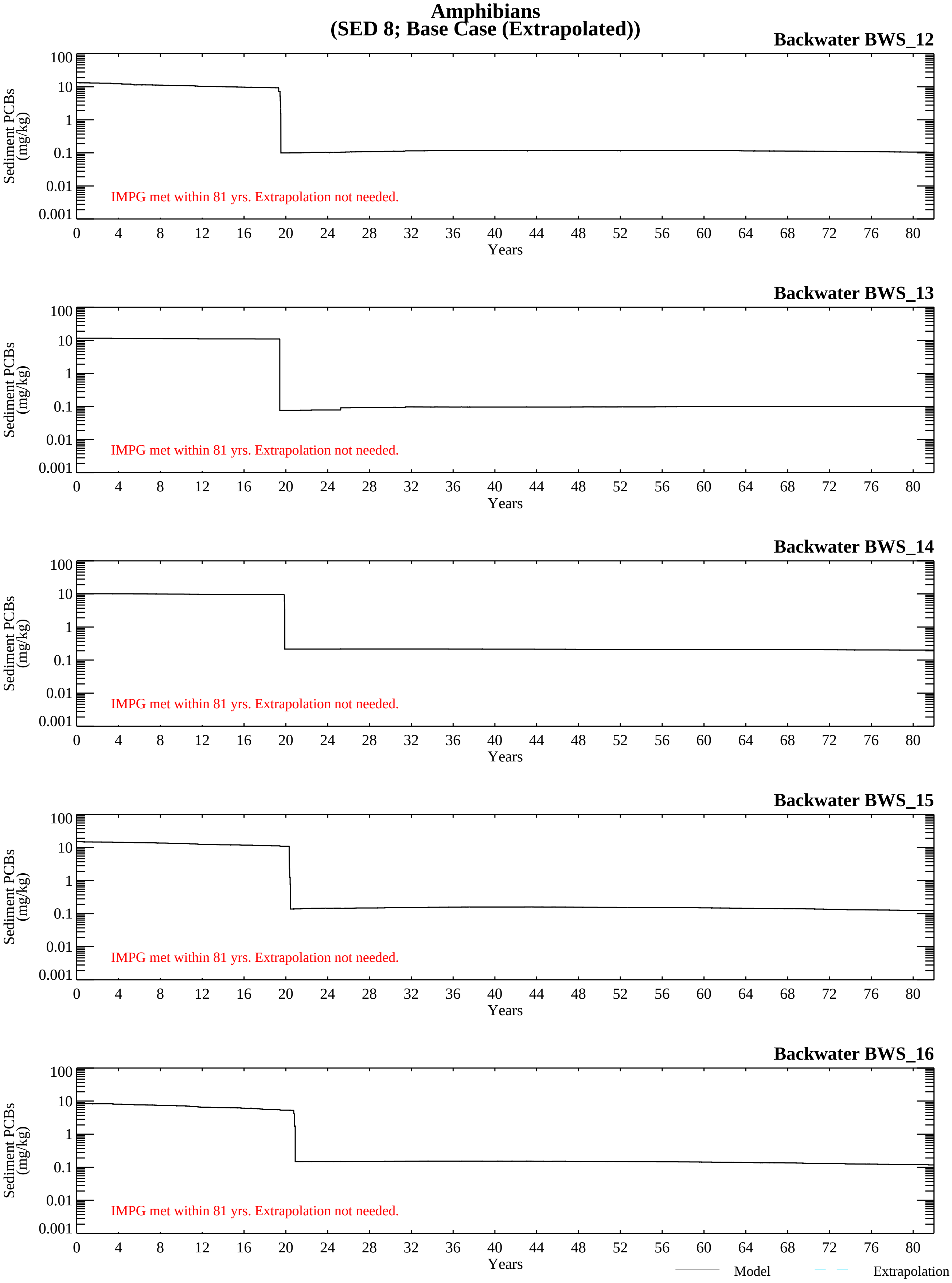

Figure G-5.3-7a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 8; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED8CMSBS_0712-18\bins

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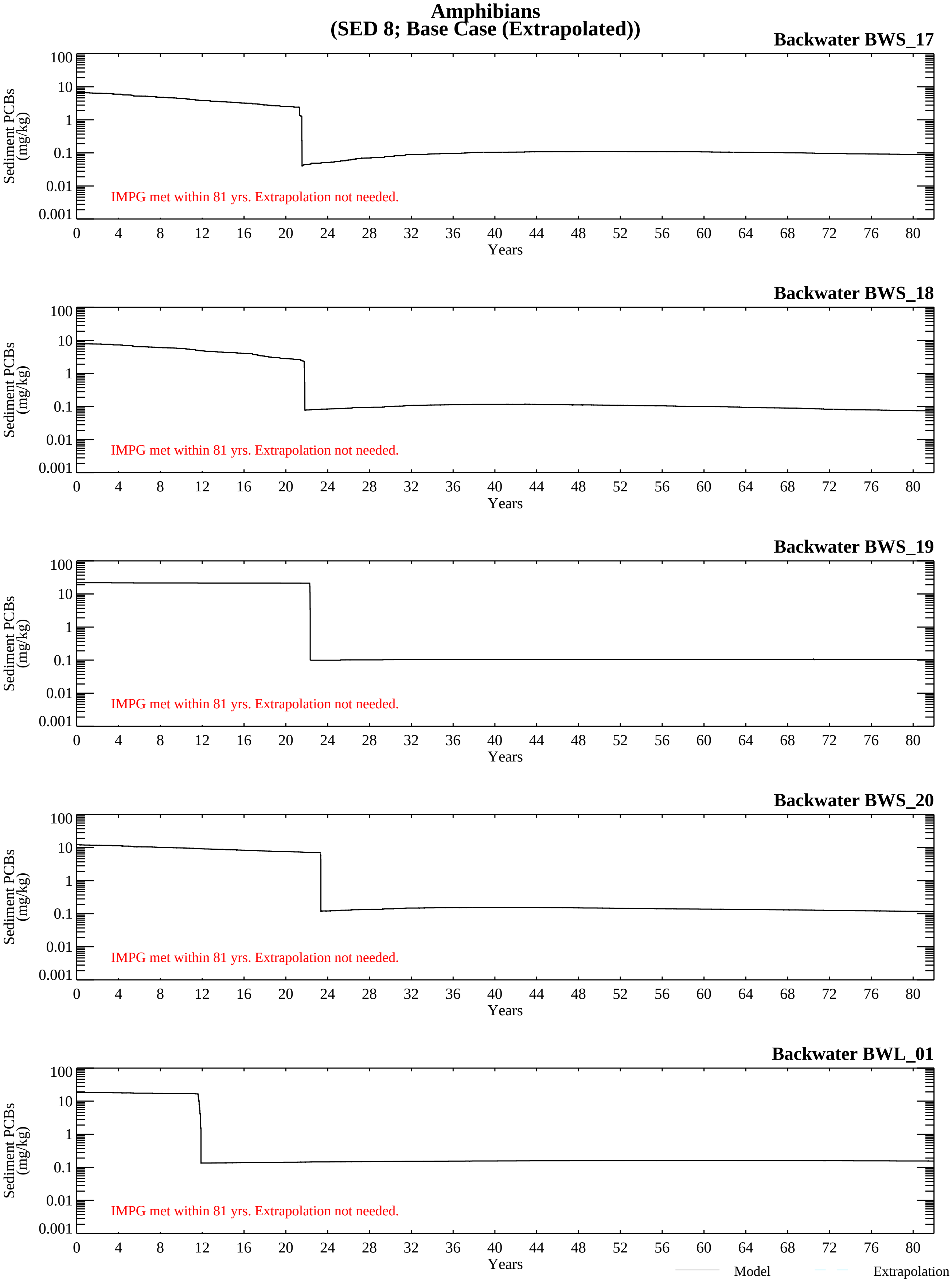

Figure G-5.3-7a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 8; Reach 5/6; Base Case).

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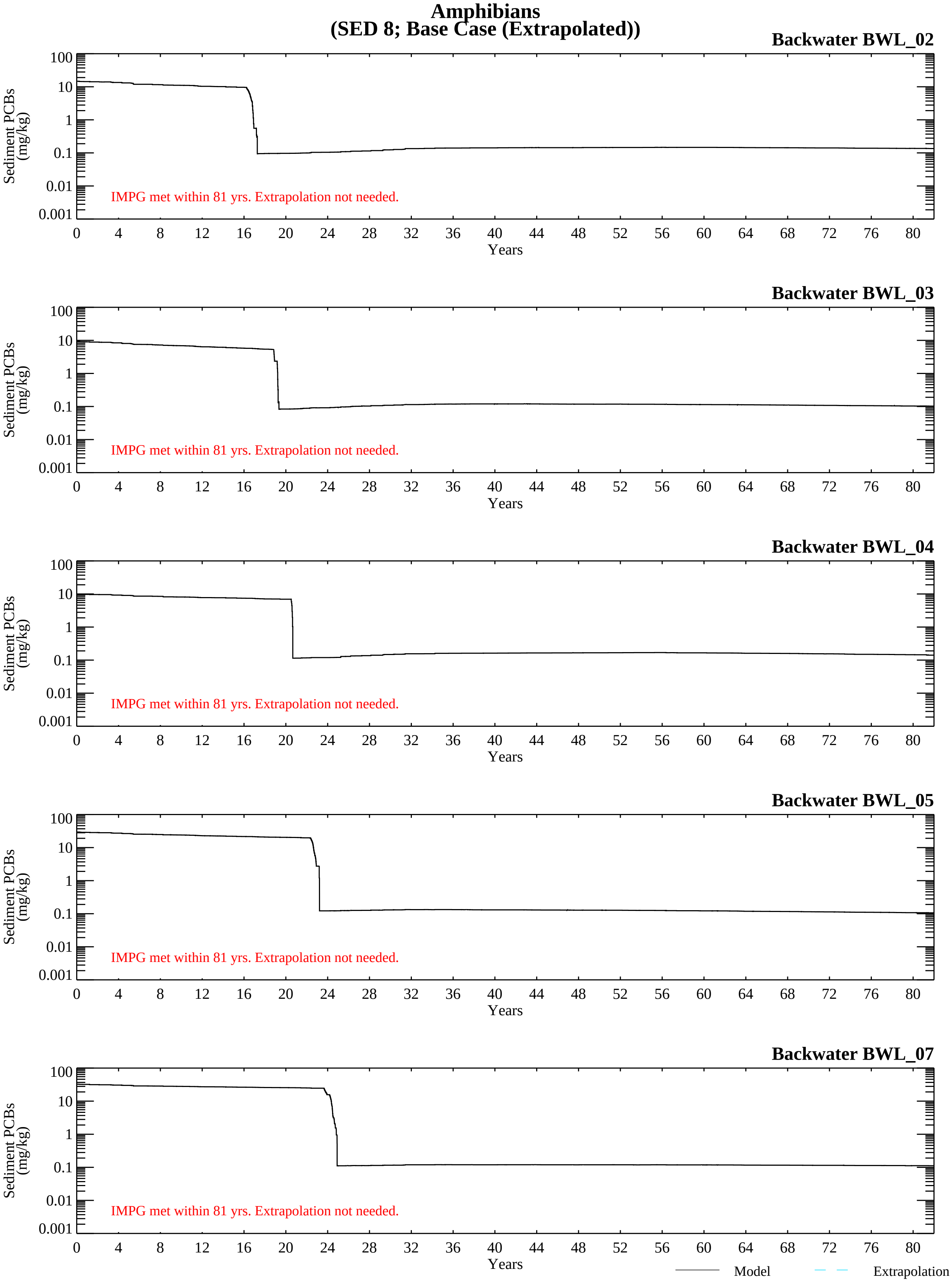

Figure G-5.3-7a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 8; Reach 5/6; Base Case).

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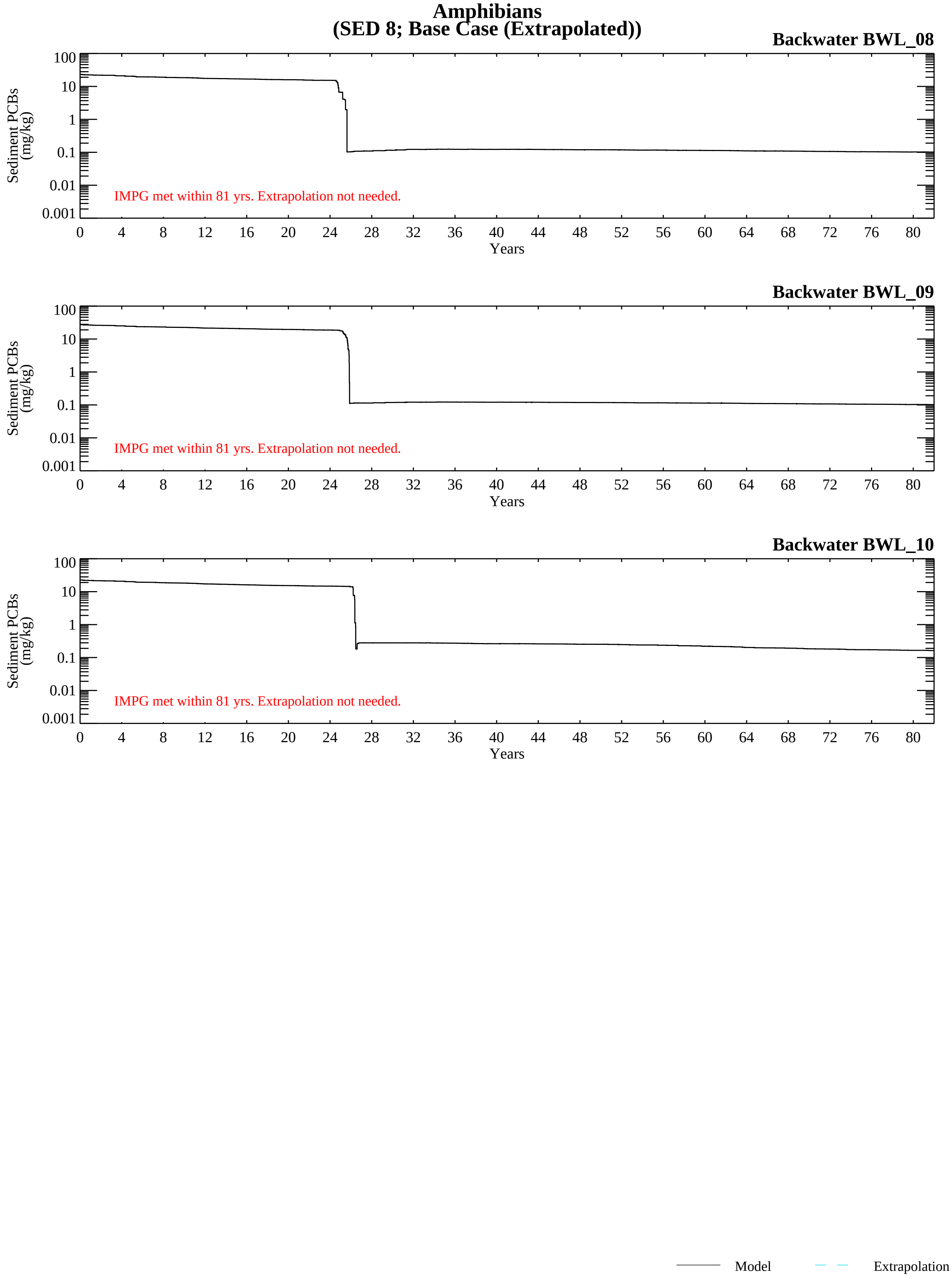

Figure G-5.3-7a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 8; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED8CMSBS_0712-18\bins

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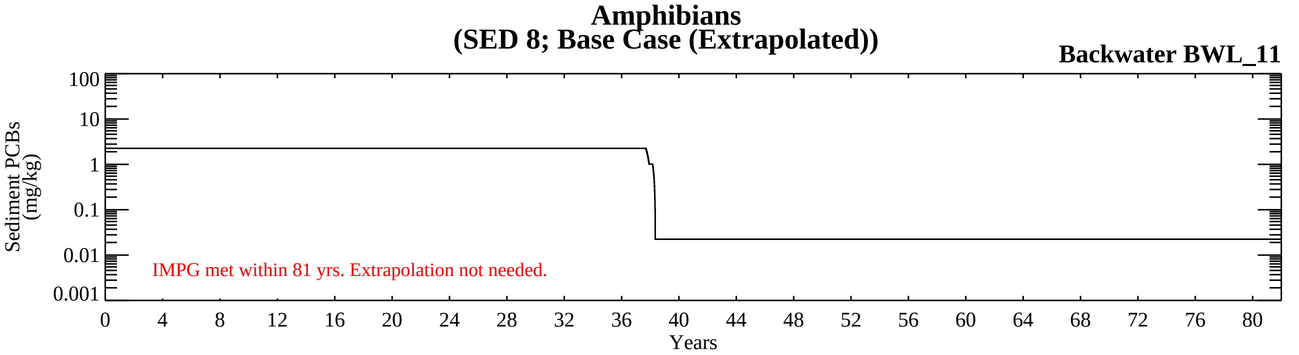

Figure G-5.3-7b. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to IMPGs for amphibians (SED 8; Reach 7/8; Base Case).

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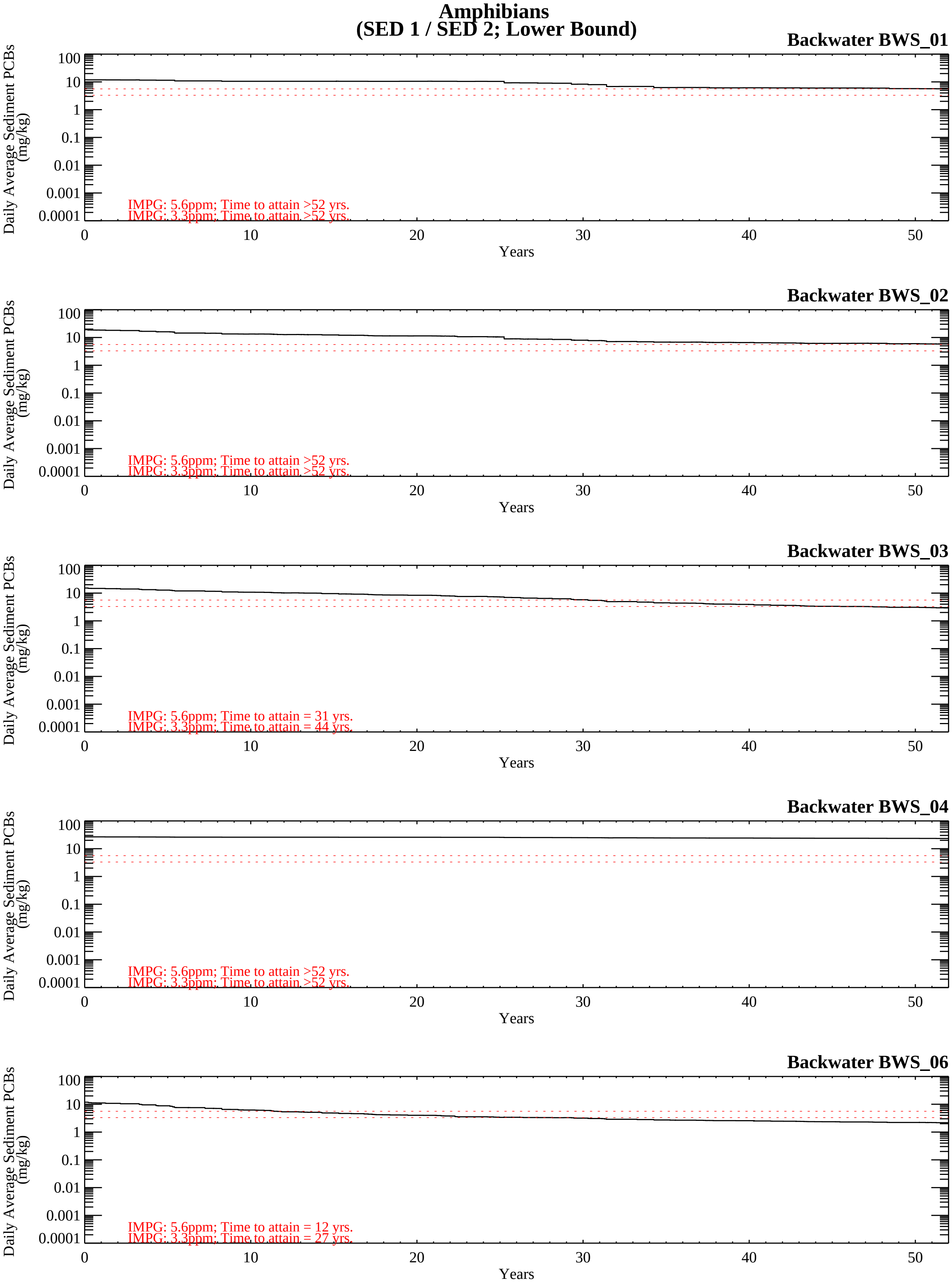

Figure G-5.4-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 1 / SED 2; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED1CMSLB_0712-19\\bins

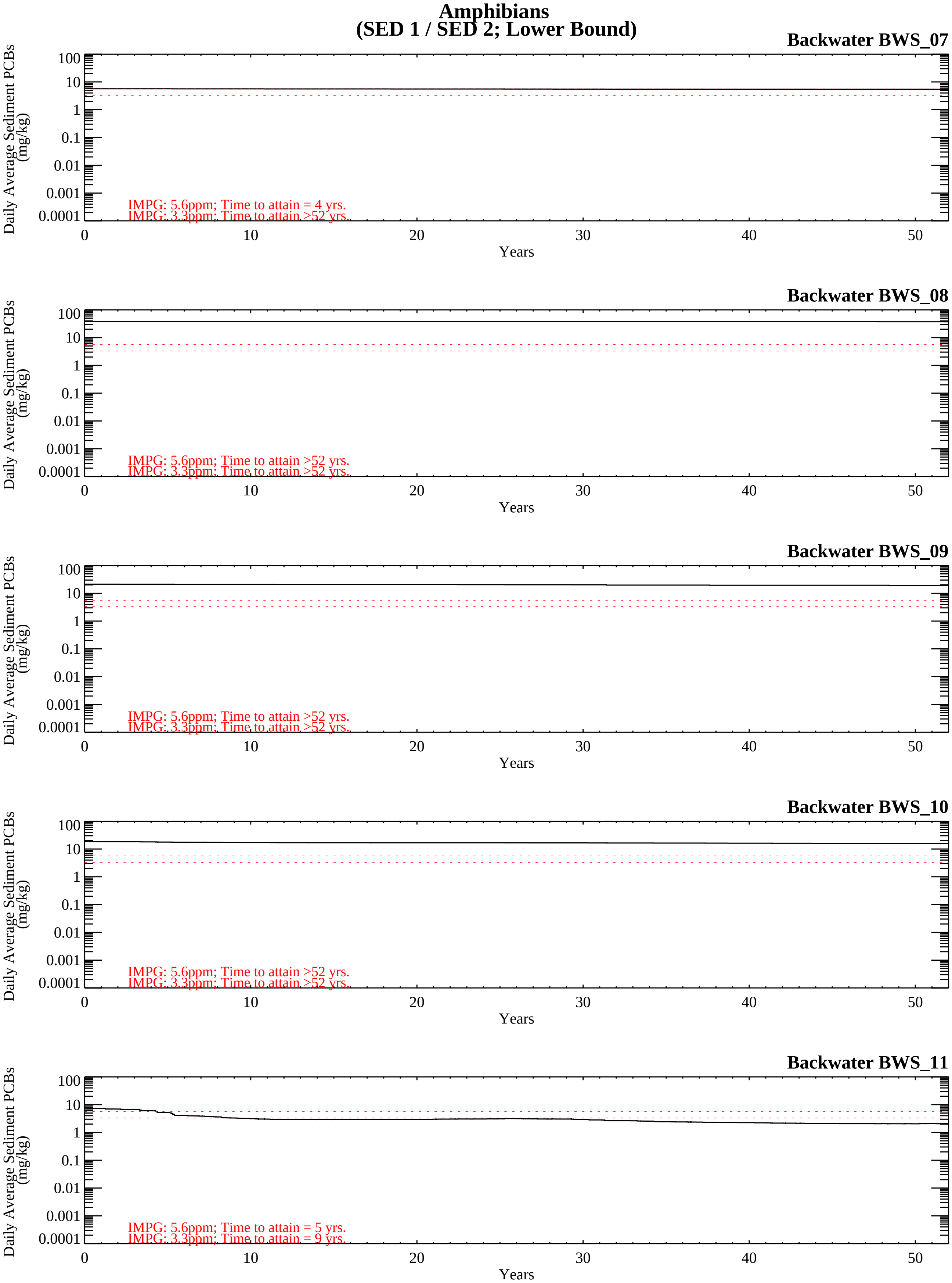

Figure G-5.4-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 1 / SED 2; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED1CMSLB_0712-19\\bins

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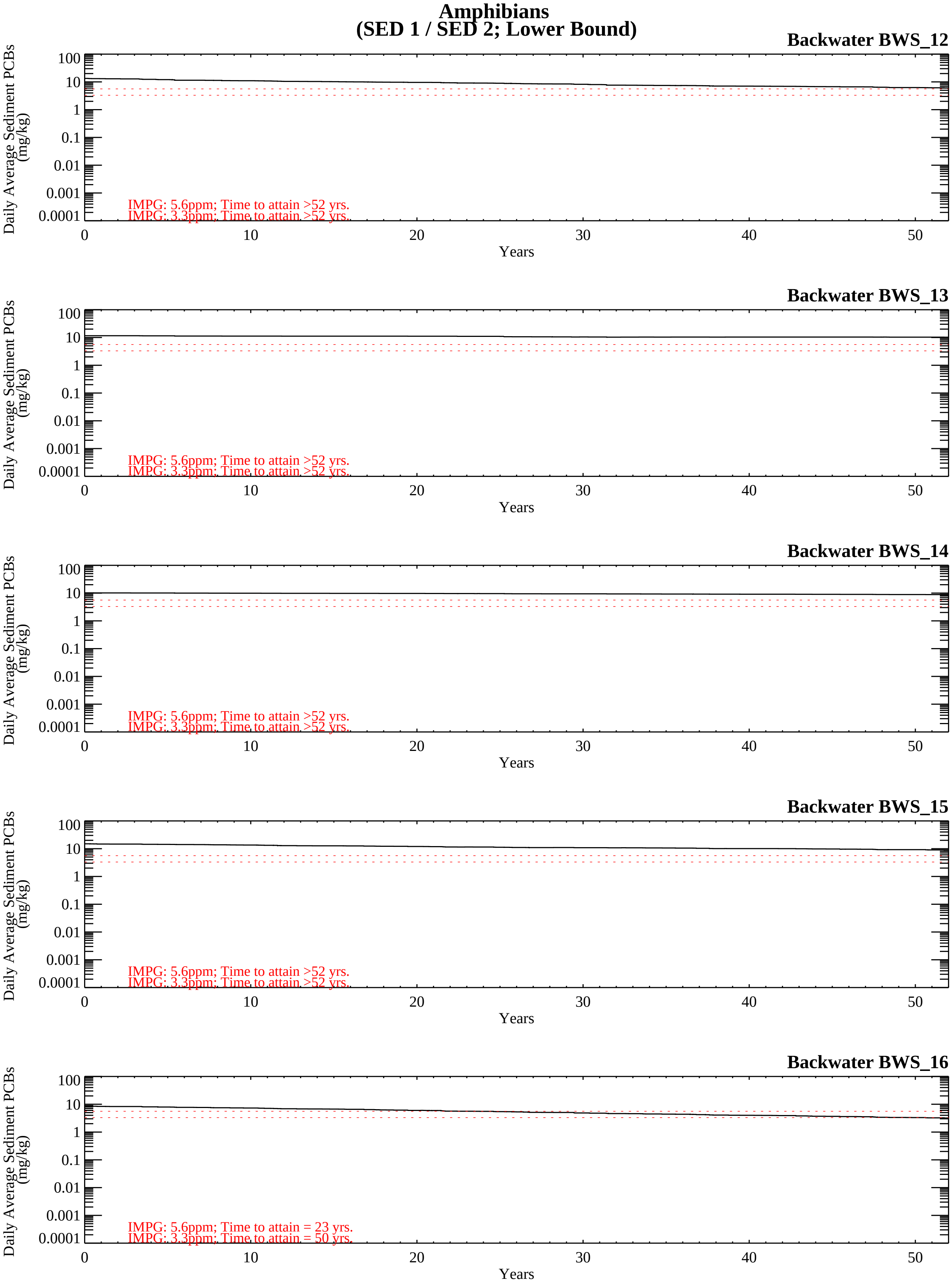

Figure G-5.4-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 1 / SED 2; Reach 5/6; Lower Bound).

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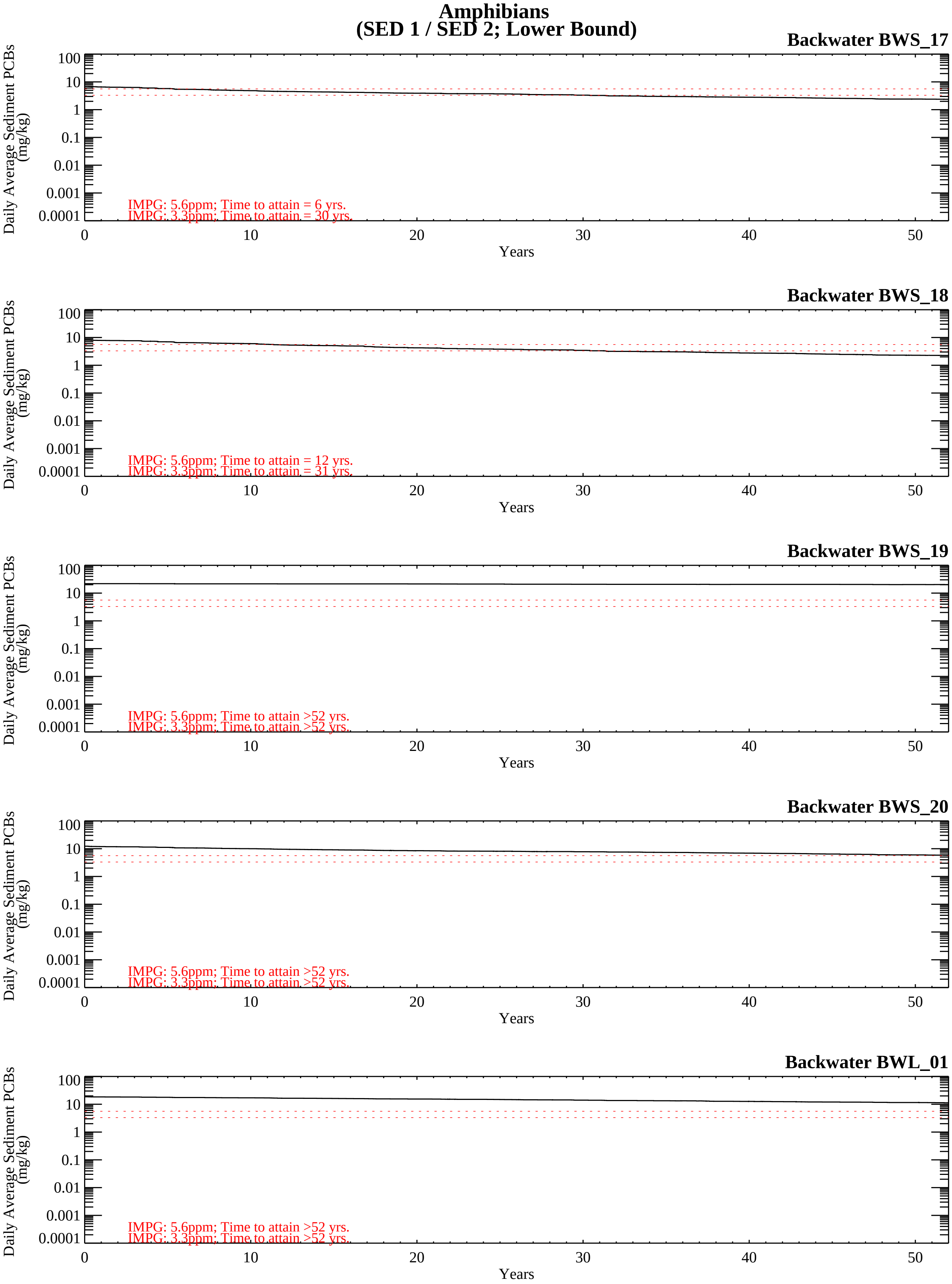

Figure G-5.4-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 1 / SED 2; Reach 5/6; Lower Bound).

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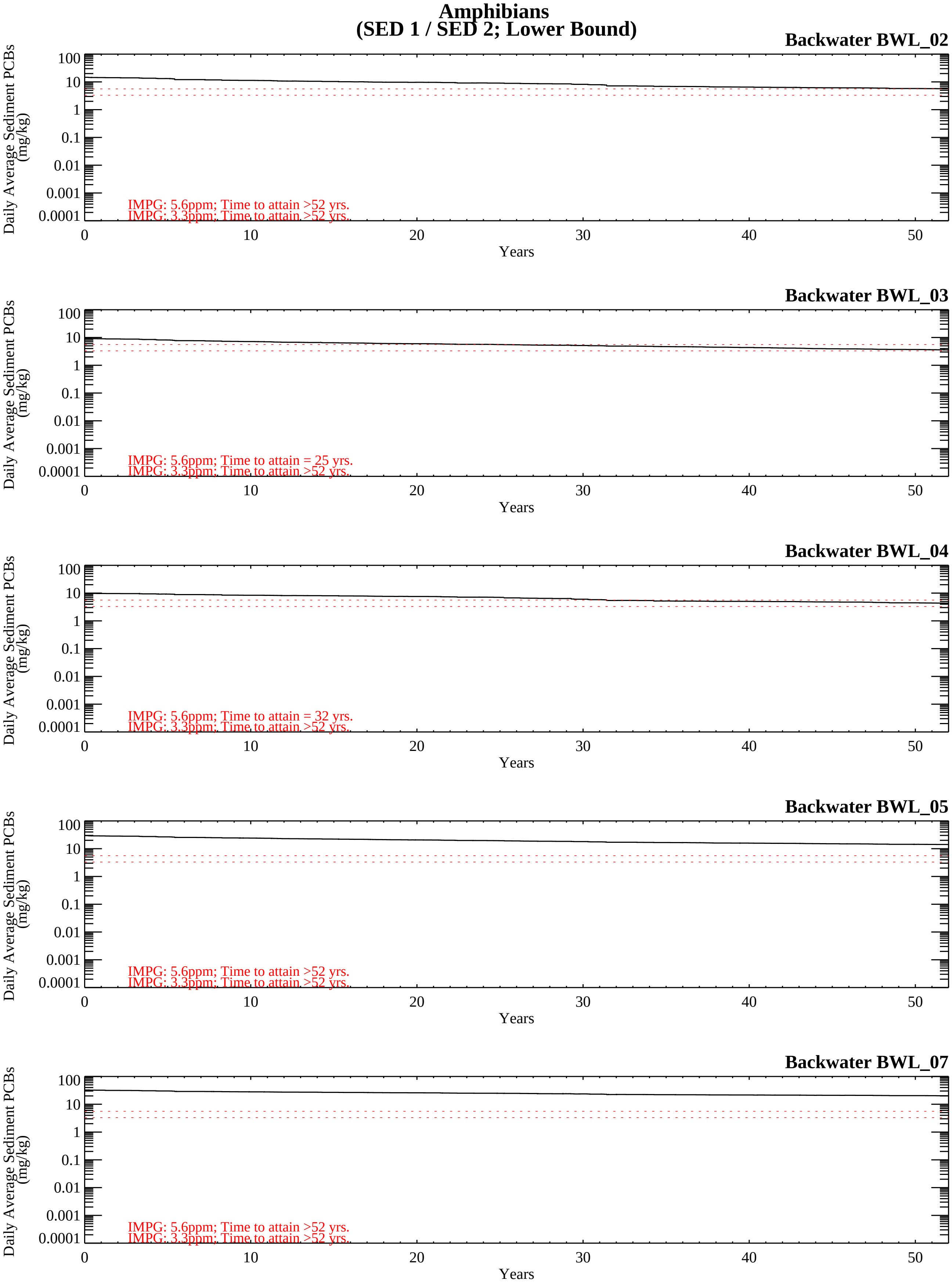

Figure G-5.4-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 1 / SED 2; Reach 5/6; Lower Bound).

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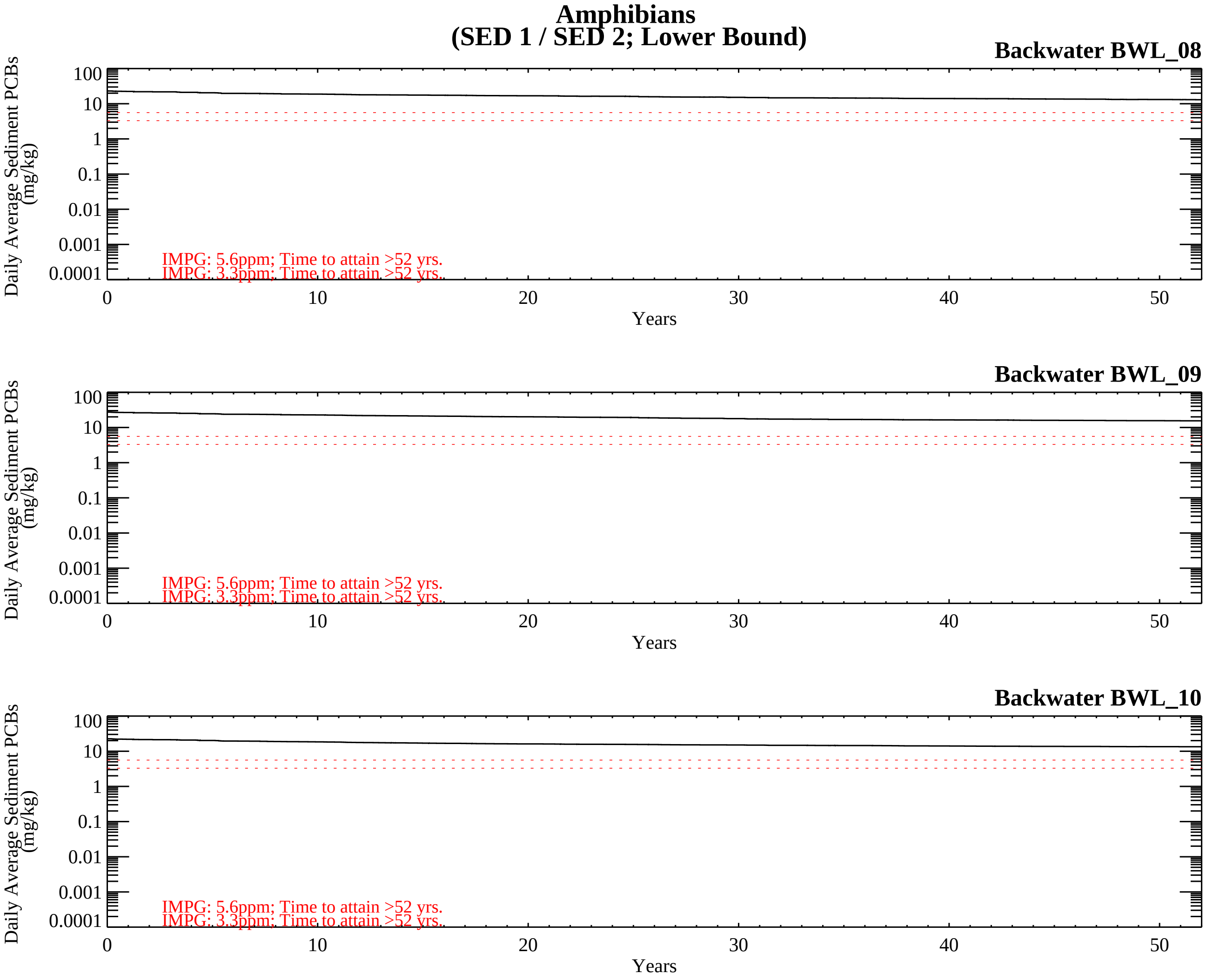

Figure G-5.4-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 1 / SED 2; Reach 5/6; Lower Bound).

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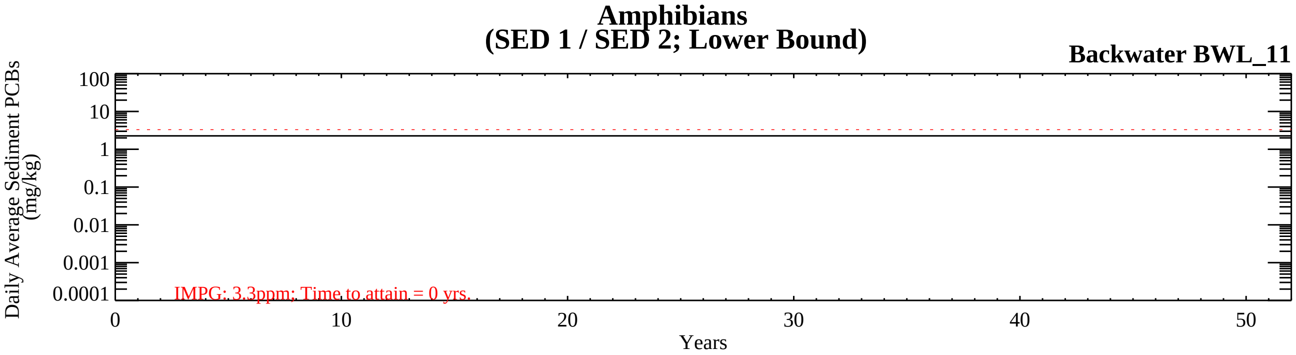

Figure G-5.4-1b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 1 / SED 2; Reach 7/8; Lower Bound).

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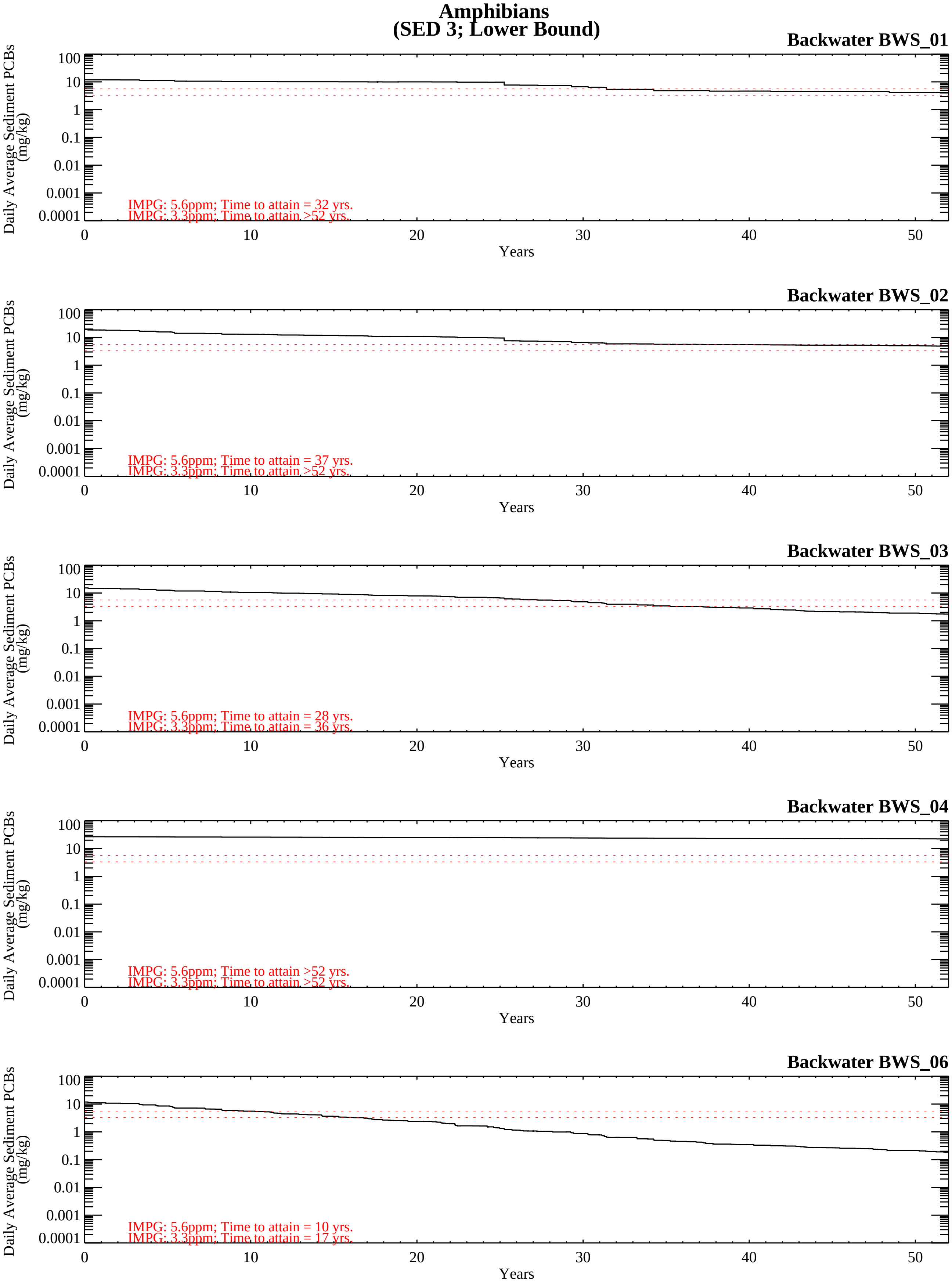
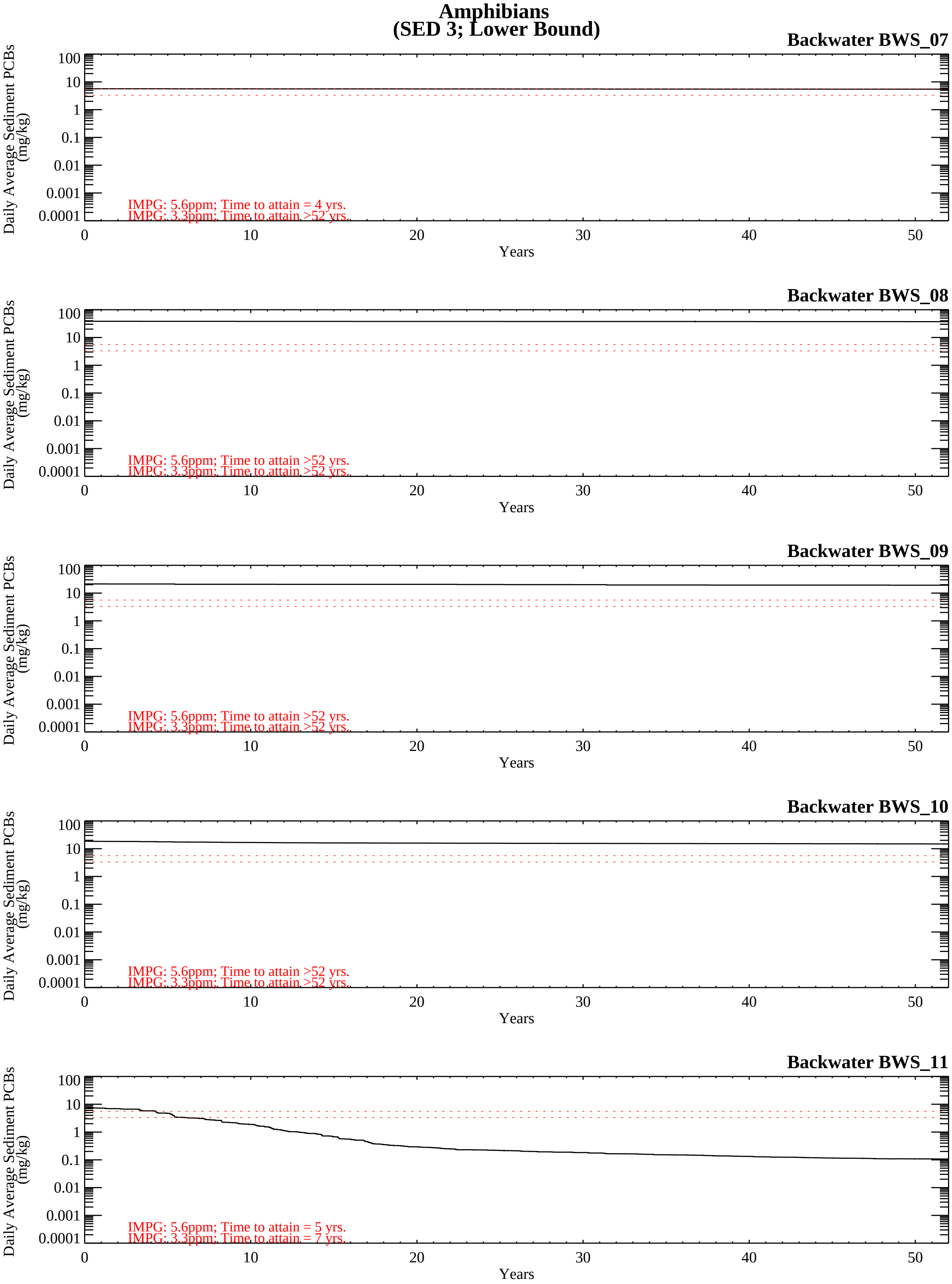


Figure G-5.4-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 3; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED3CMSLB_0712-20\\bins


Amphibians
(SED 3; Lower Bound)

Backwater BWS_07

IMPG: 5.6ppm; Time to attain = 4 yrs.
IMPG: 3.3ppm; Time to attain >52 yrs.

Backwater BWS_08

IMPG: 5.6ppm; Time to attain >52 yrs.
IMPG: 3.3ppm; Time to attain >52 yrs.

Backwater BWS_09

IMPG: 5.6ppm; Time to attain >52 yrs.
IMPG: 3.3ppm; Time to attain >52 yrs.

Backwater BWS_10

IMPG: 5.6ppm; Time to attain >52 yrs.
IMPG: 3.3ppm; Time to attain >52 yrs.

Backwater BWS_11

IMPG: 5.6ppm; Time to attain = 5 yrs.
IMPG: 3.3ppm; Time to attain = 7 yrs.

Figure G-5.4-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 3; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED3CMSLB_0712-20\\bins

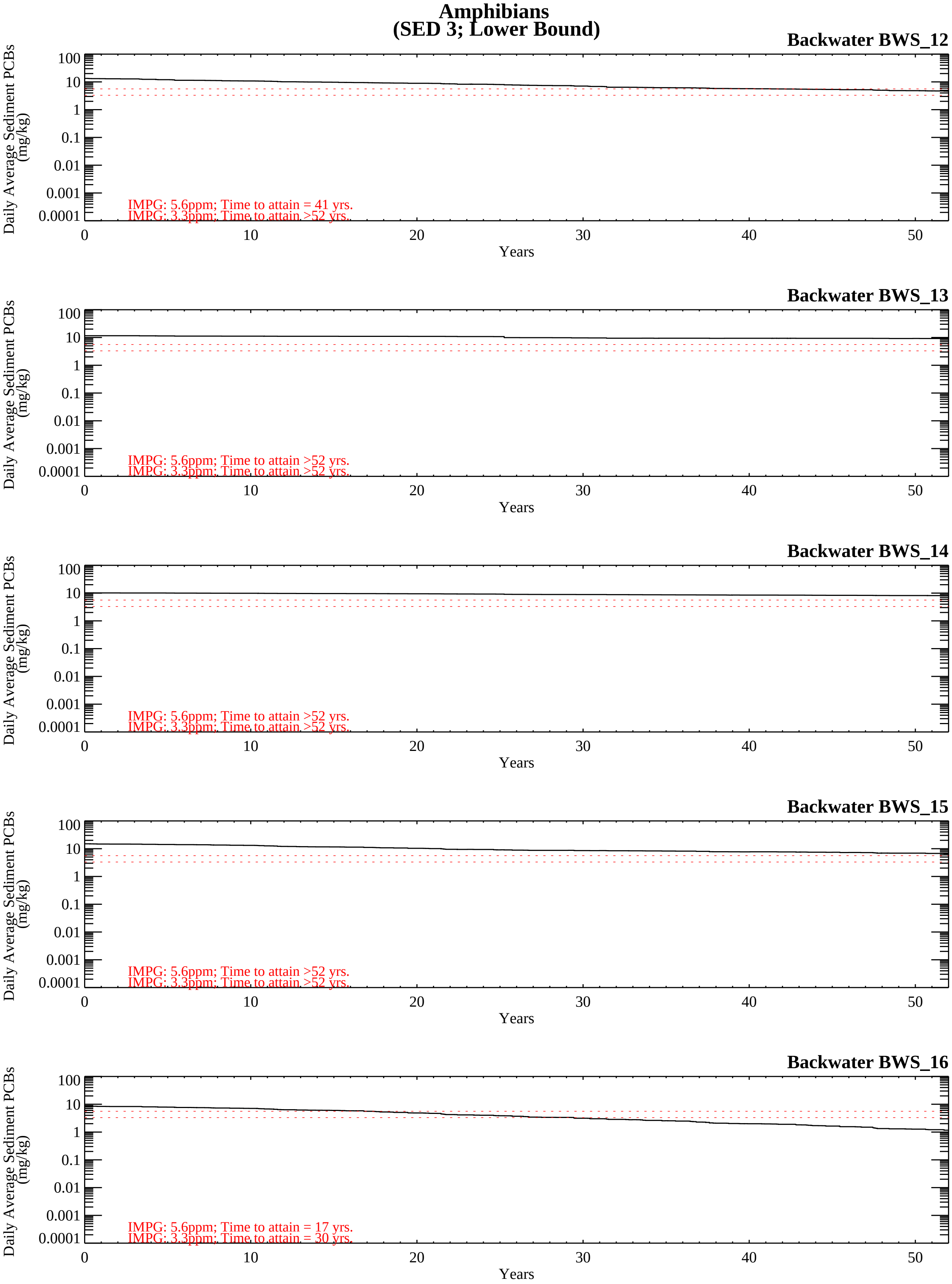


Figure G-5.4-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 3; Reach 5/6; Lower Bound).

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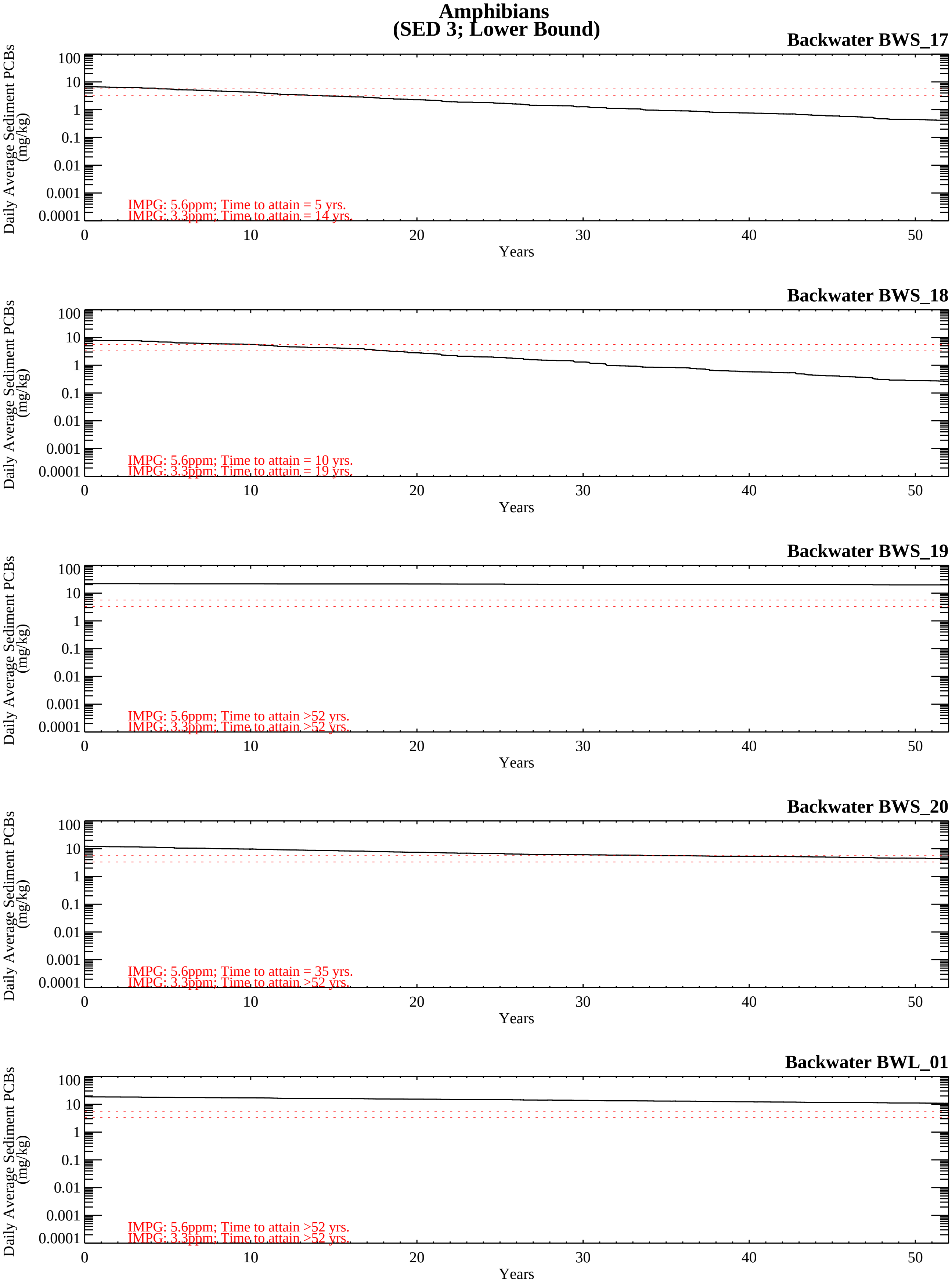

Figure G-5.4-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 3; Reach 5/6; Lower Bound).

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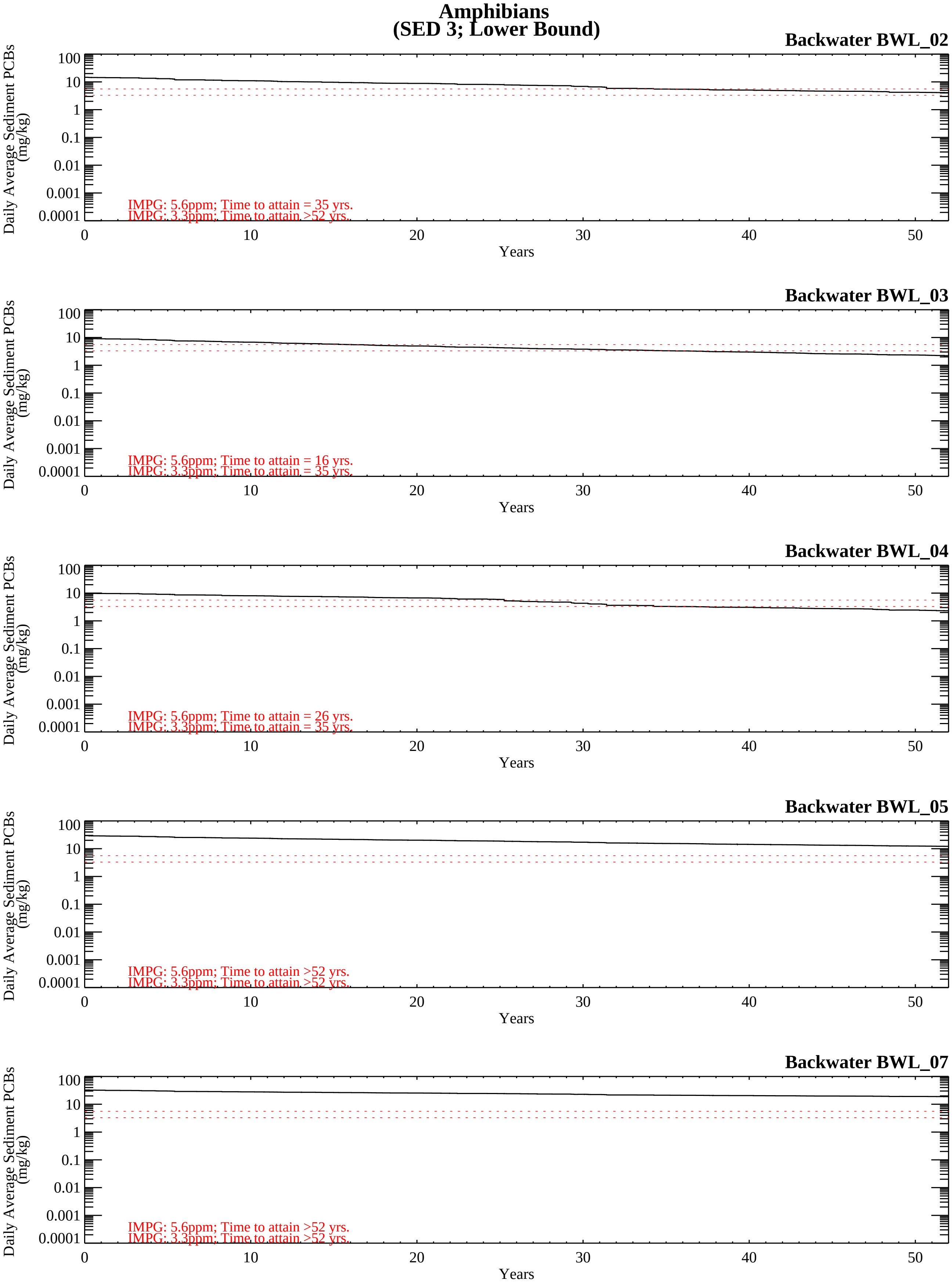

Figure G-5.4-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 3; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED3CMSLB_0712-20\\bins

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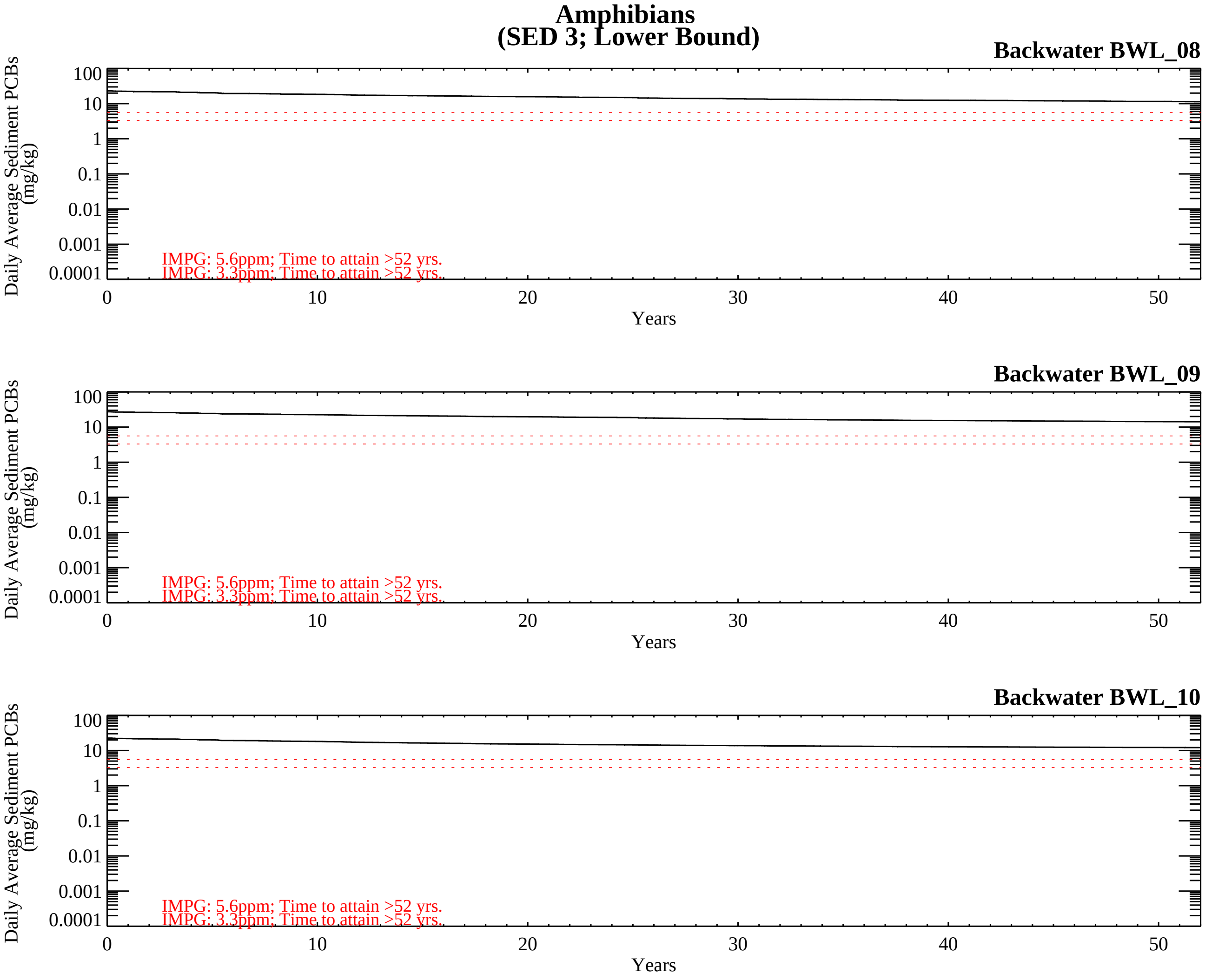

Figure G-5.4-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 3; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED3CMSLB_0712-20\\bins

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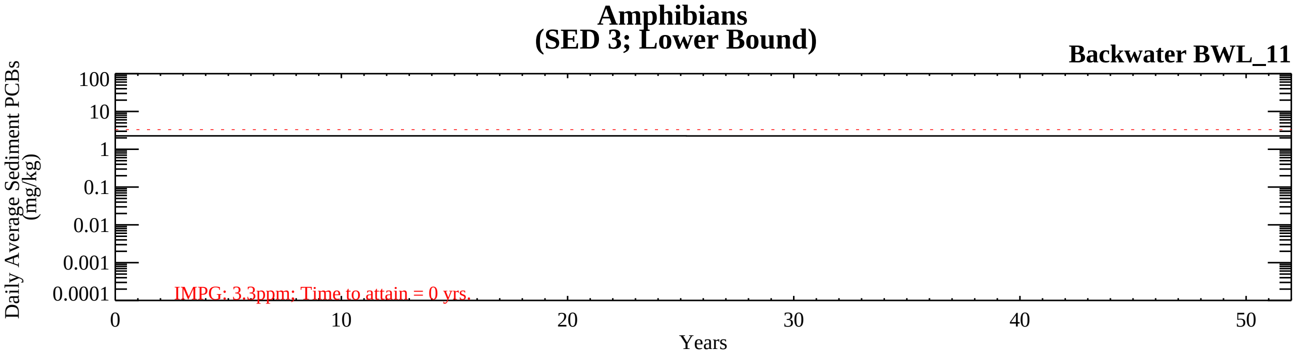

Figure G-5.4-2b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 3; Reach 7/8; Lower Bound).

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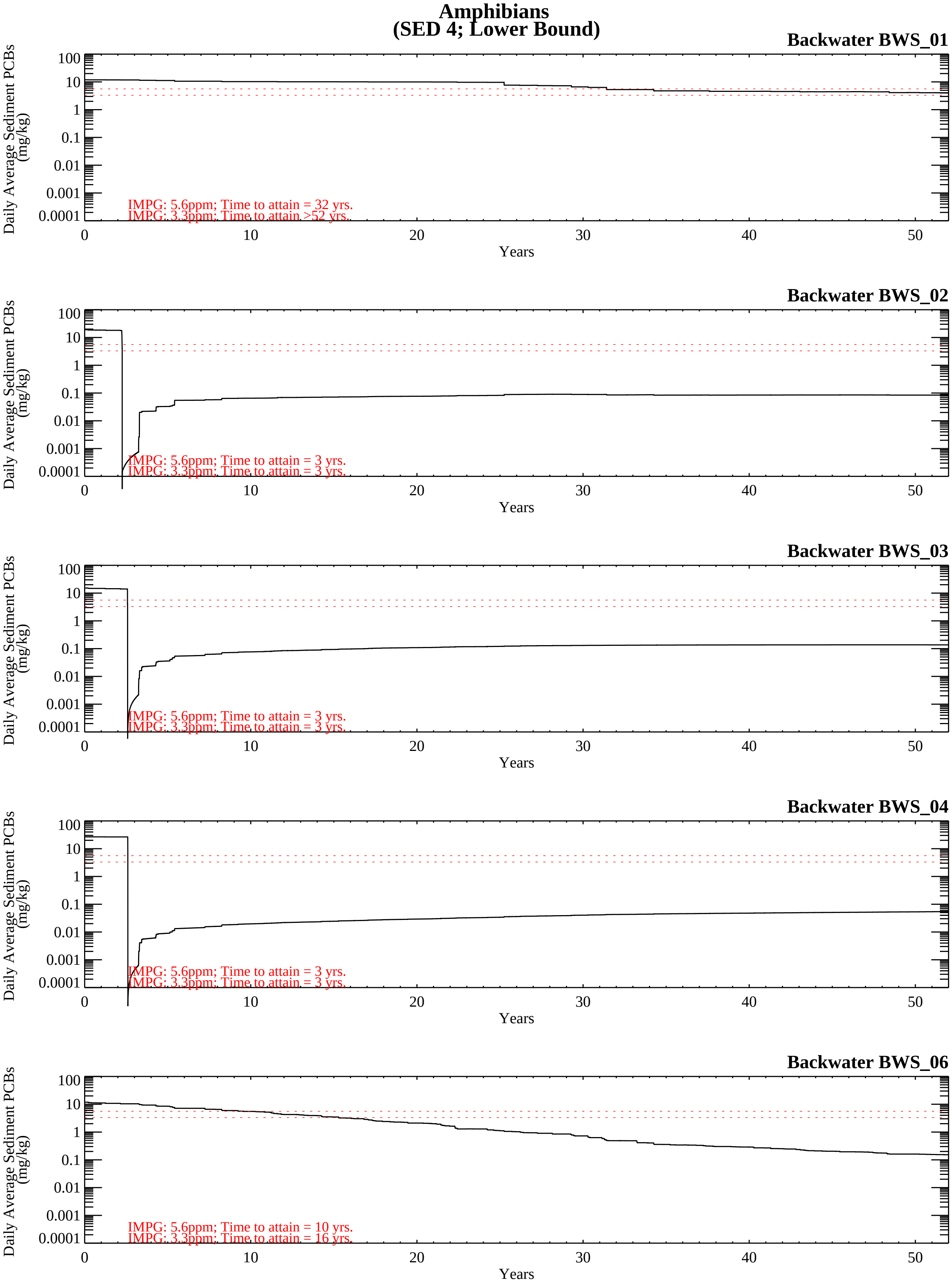
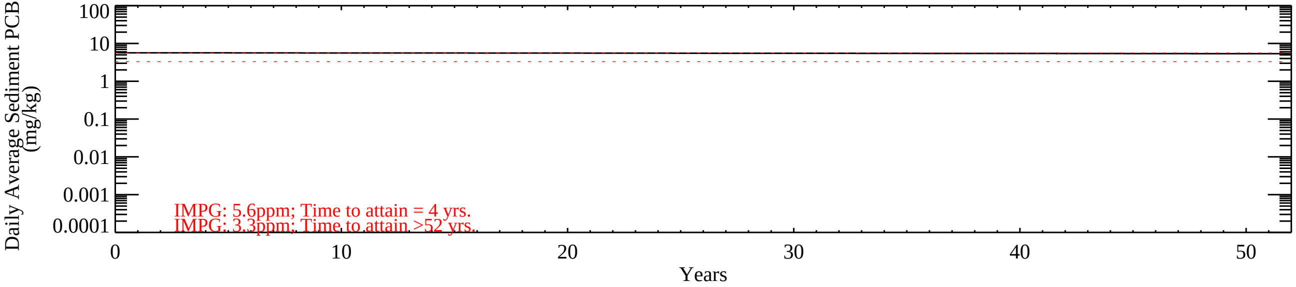
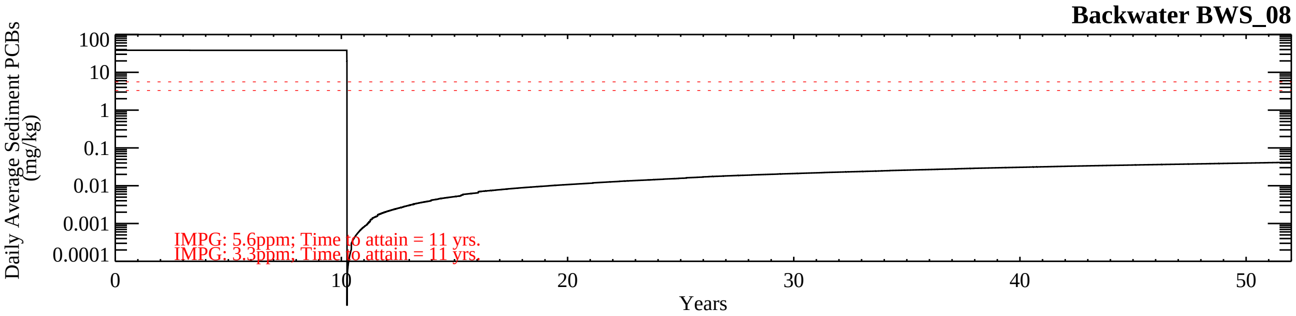


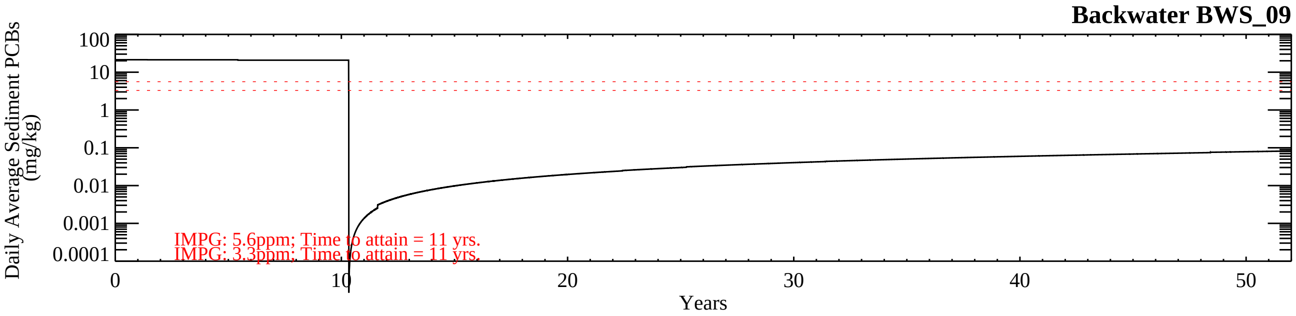
Figure G-5.4-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 4; Reach 5/6; Lower Bound).

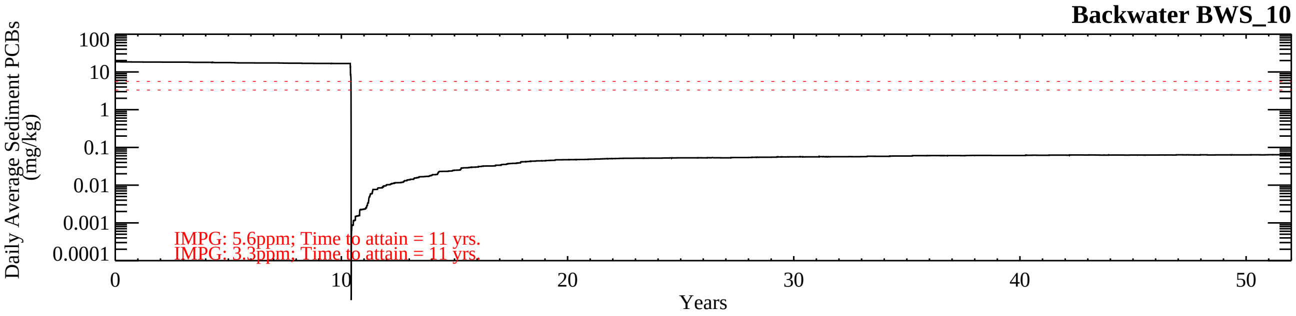
Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED4CMSLB_0801-03\\bins

Amphibians
(SED 4; Lower Bound)


Backwater BWS_07


Backwater BWS_08


Backwater BWS_09


Backwater BWS_10

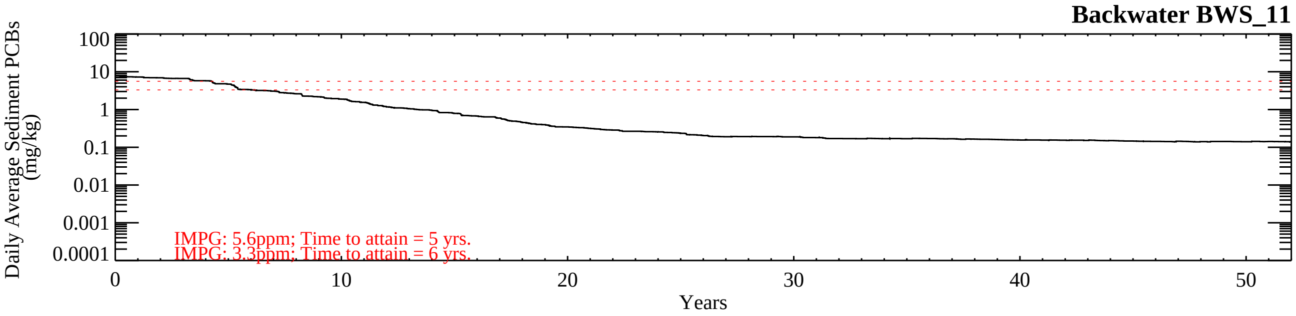

Backwater BWS_11

Figure G-5.4-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 4; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED4CMSLB_0801-03\\bins

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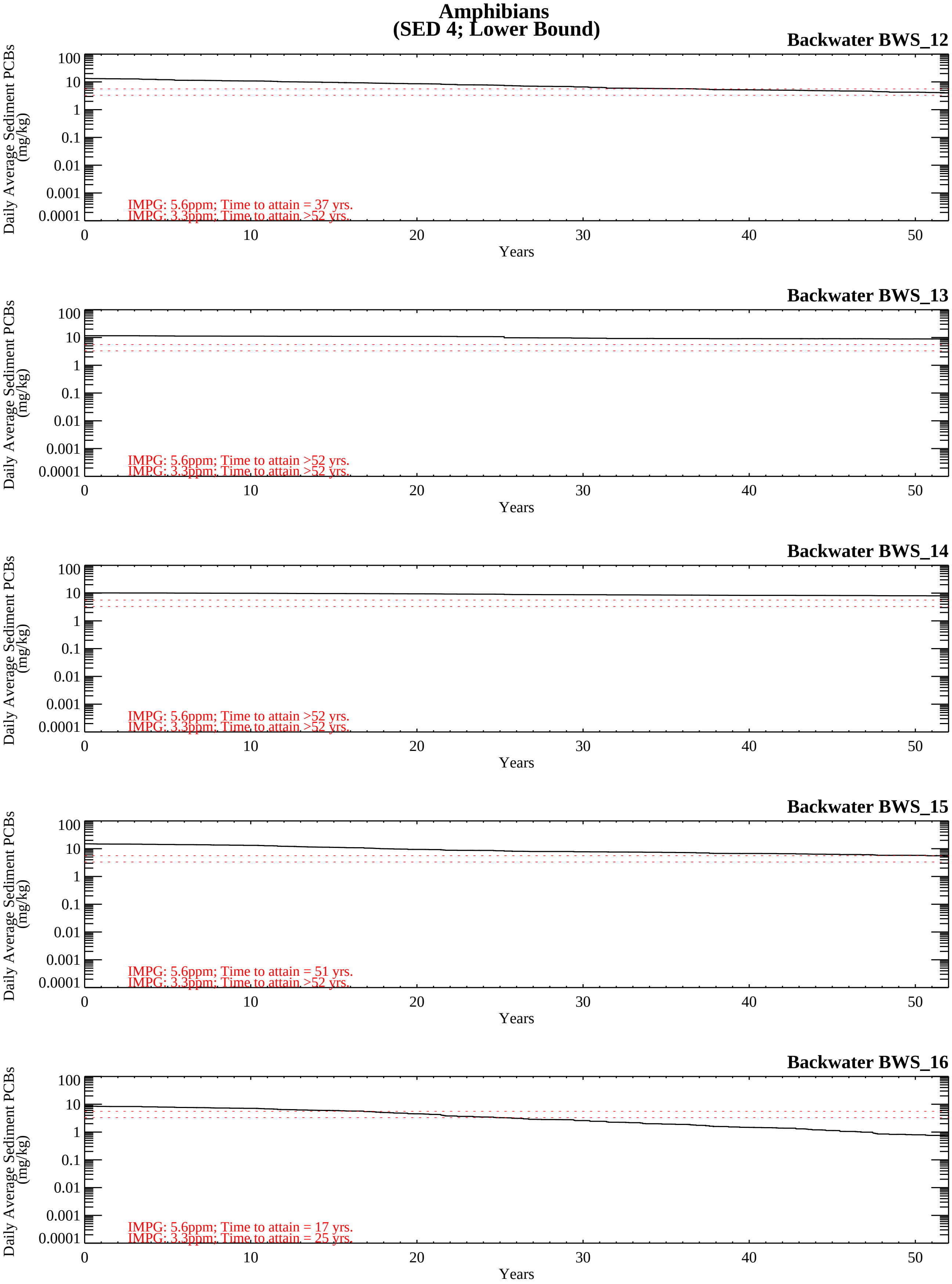

Figure G-5.4-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 4; Reach 5/6; Lower Bound).

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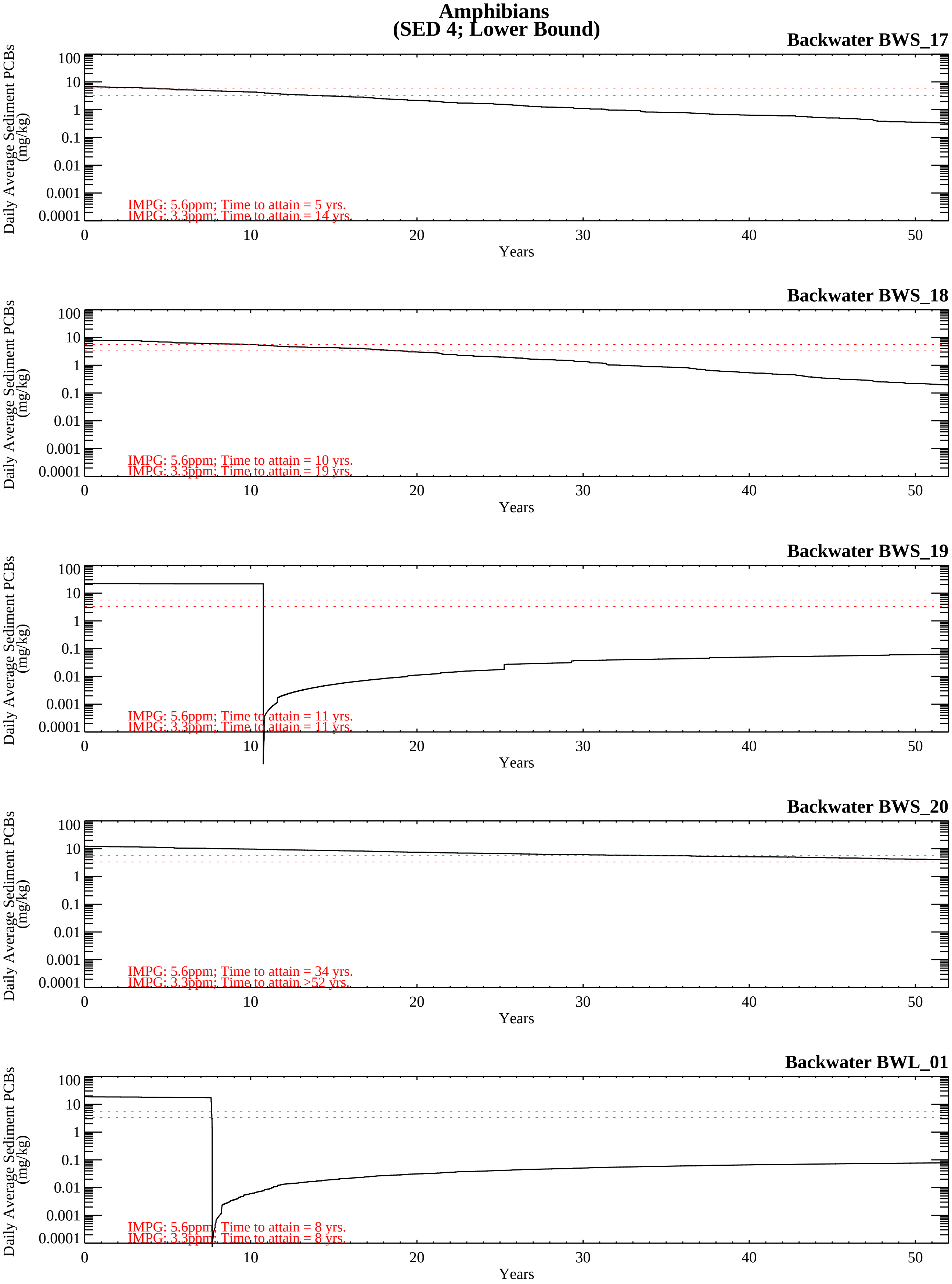

Figure G-5.4-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 4; Reach 5/6; Lower Bound).

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Amphibians
(SED 4; Lower Bound)

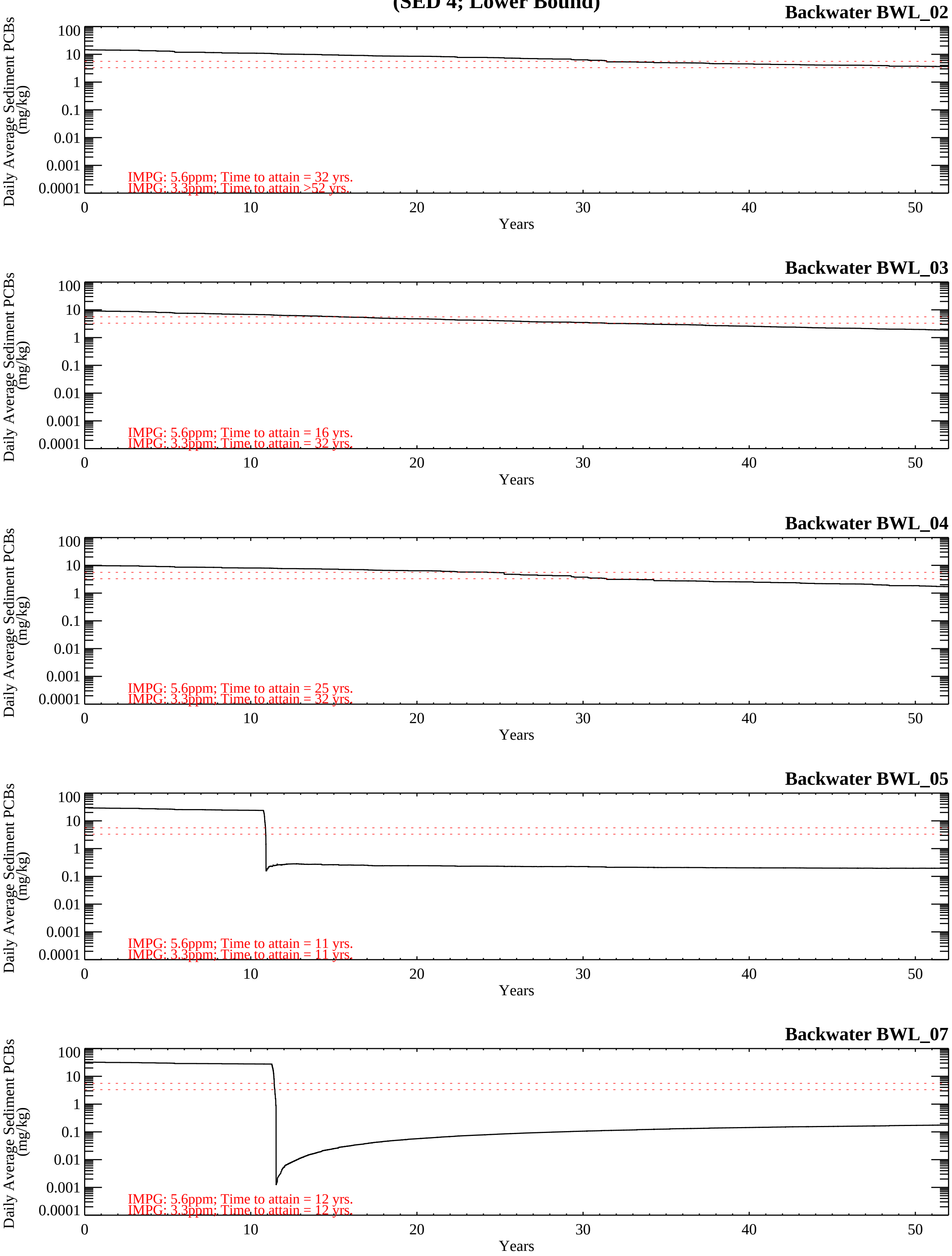

Figure G-5.4-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 4; Reach 5/6; Lower Bound).

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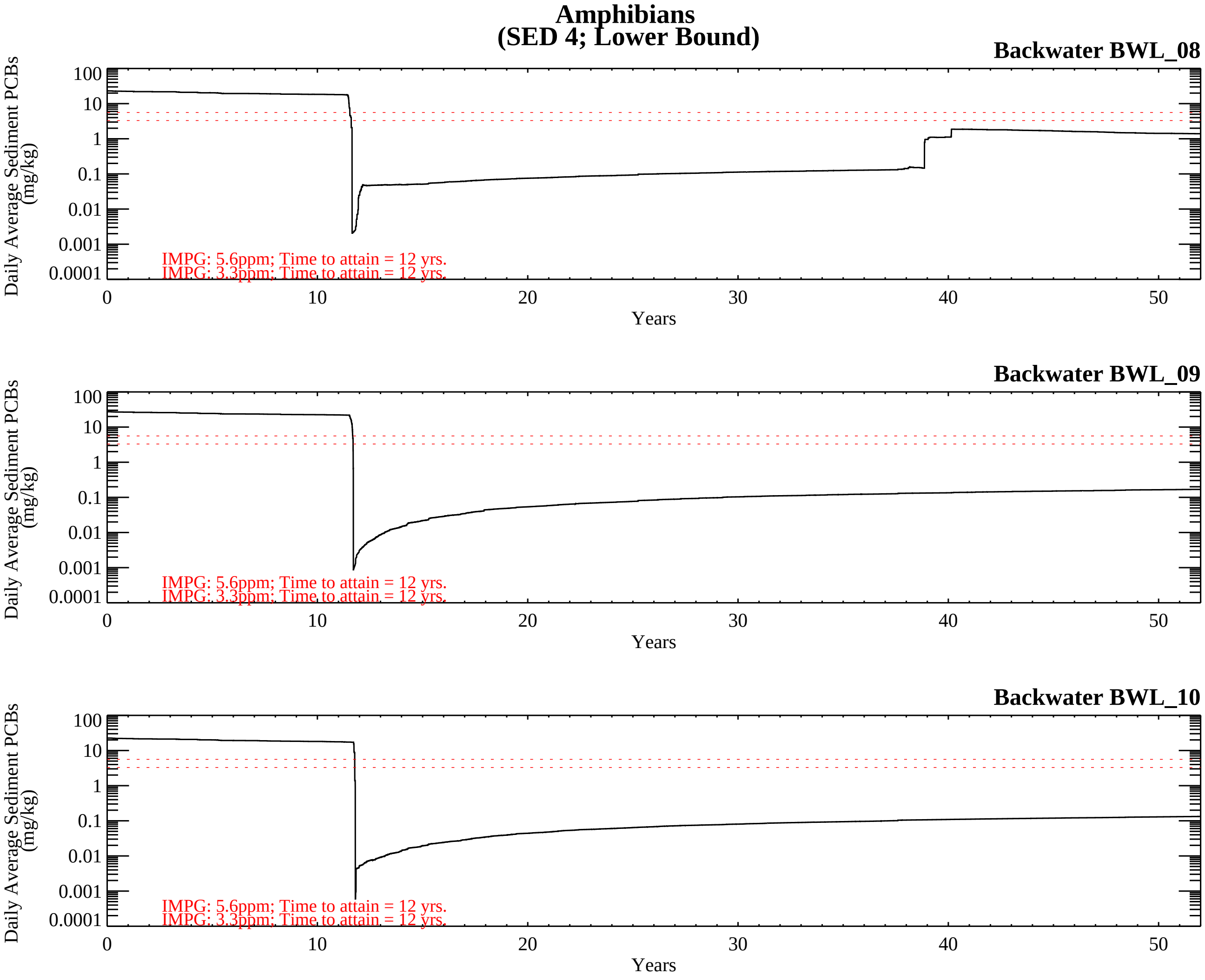

Figure G-5.4-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 4; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED4CMSLB_0801-03\\bins

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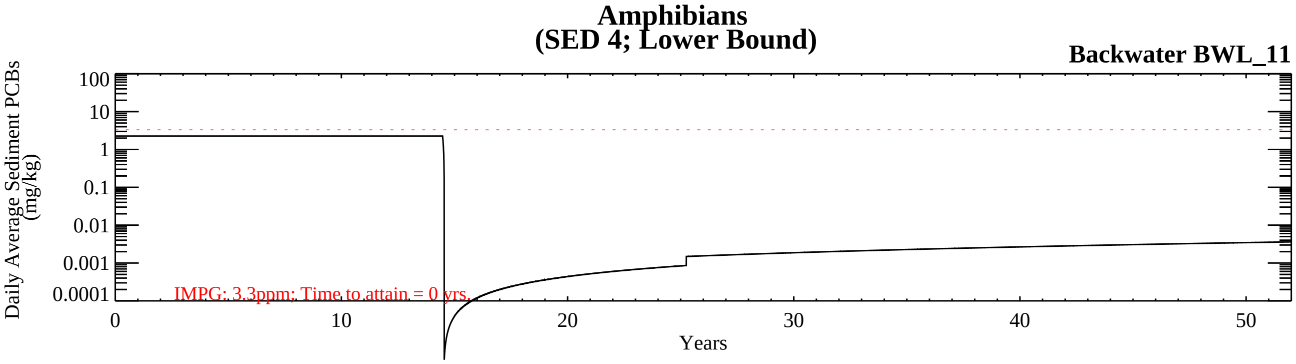

Figure G-5.4-3b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 4; Reach 7/8; Lower Bound).

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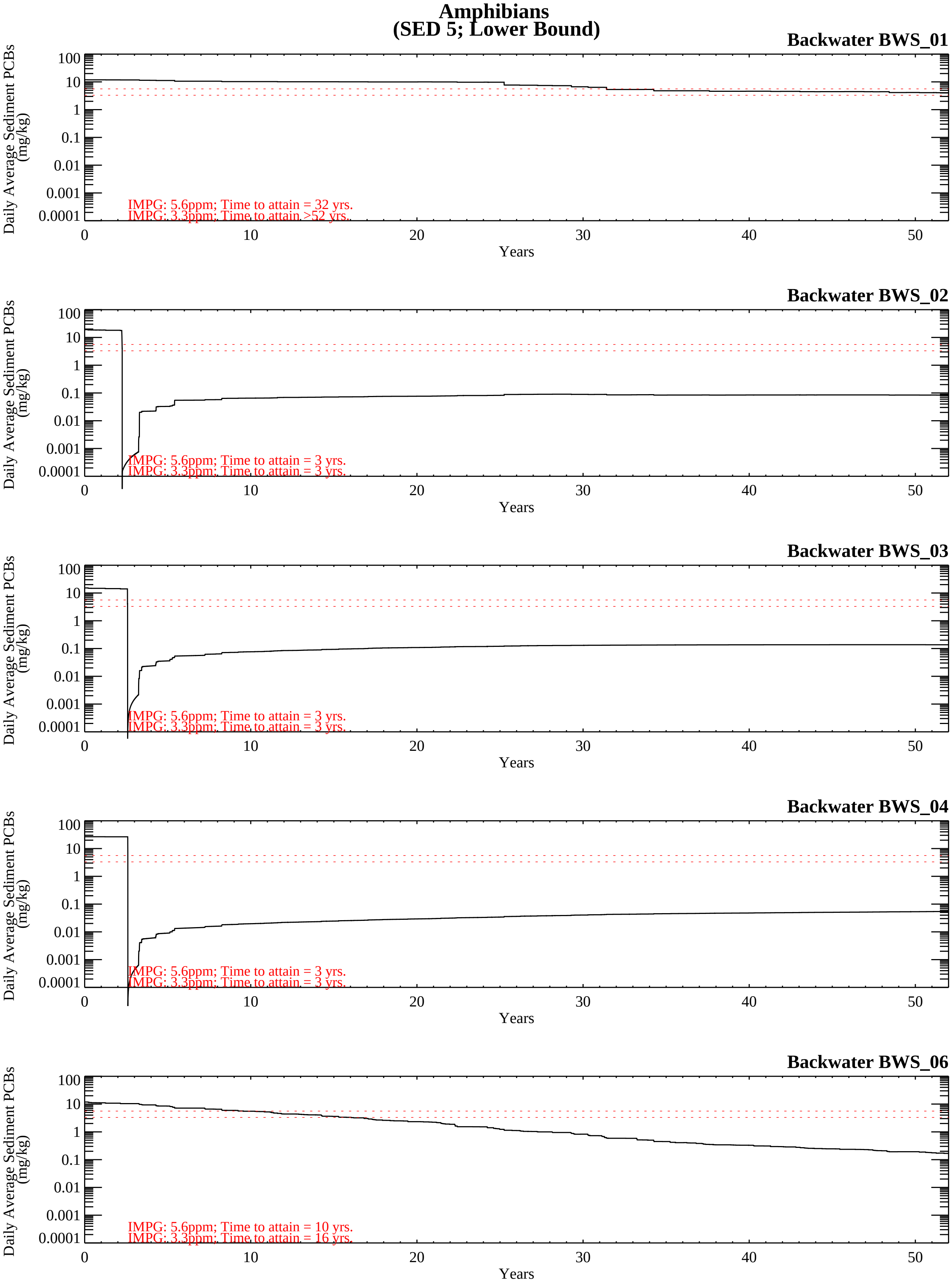

Figure G-5.4-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 5; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED5CMSLB_0801-04\\bins

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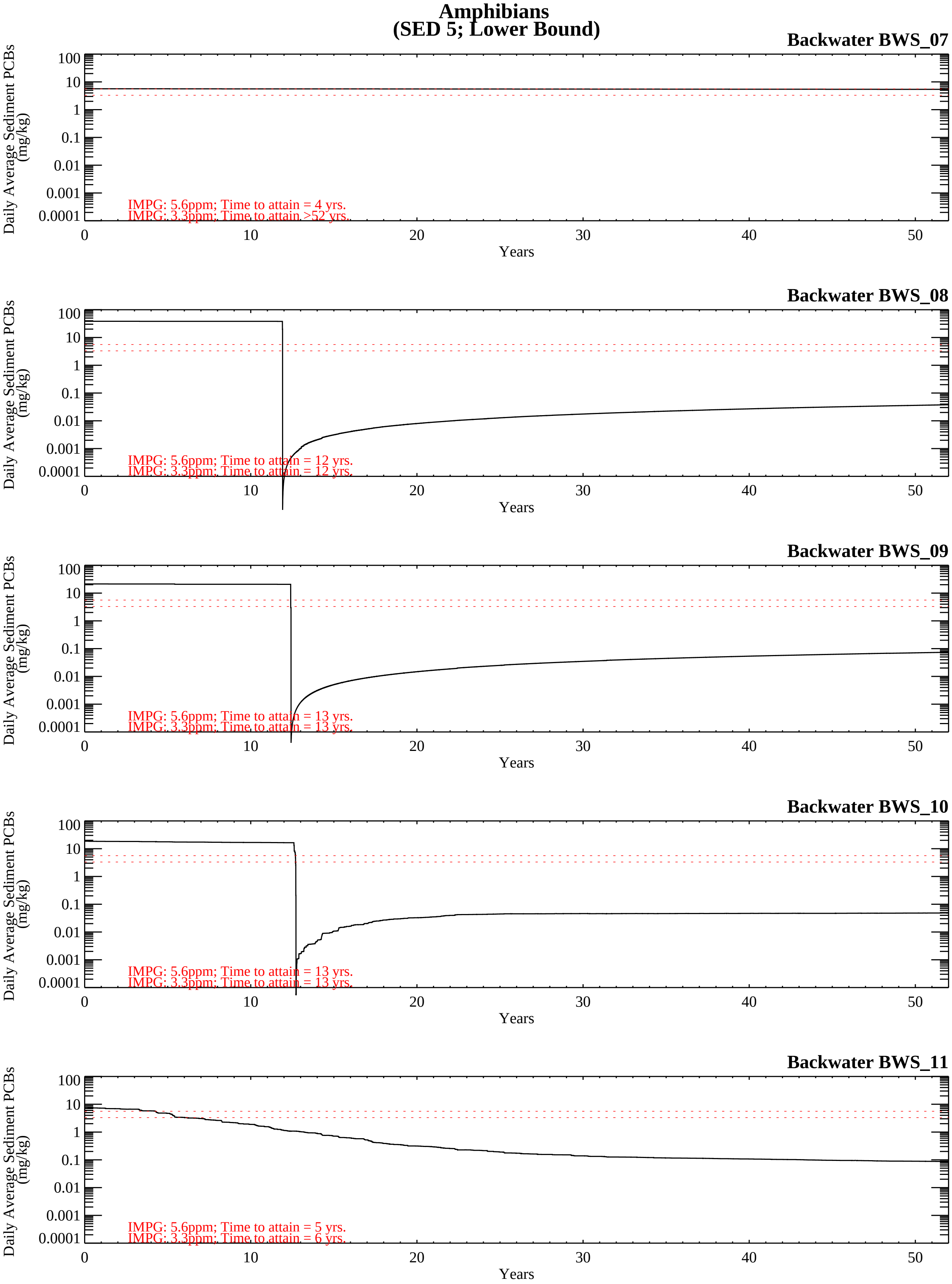

Figure G-5.4-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 5; Reach 5/6; Lower Bound).

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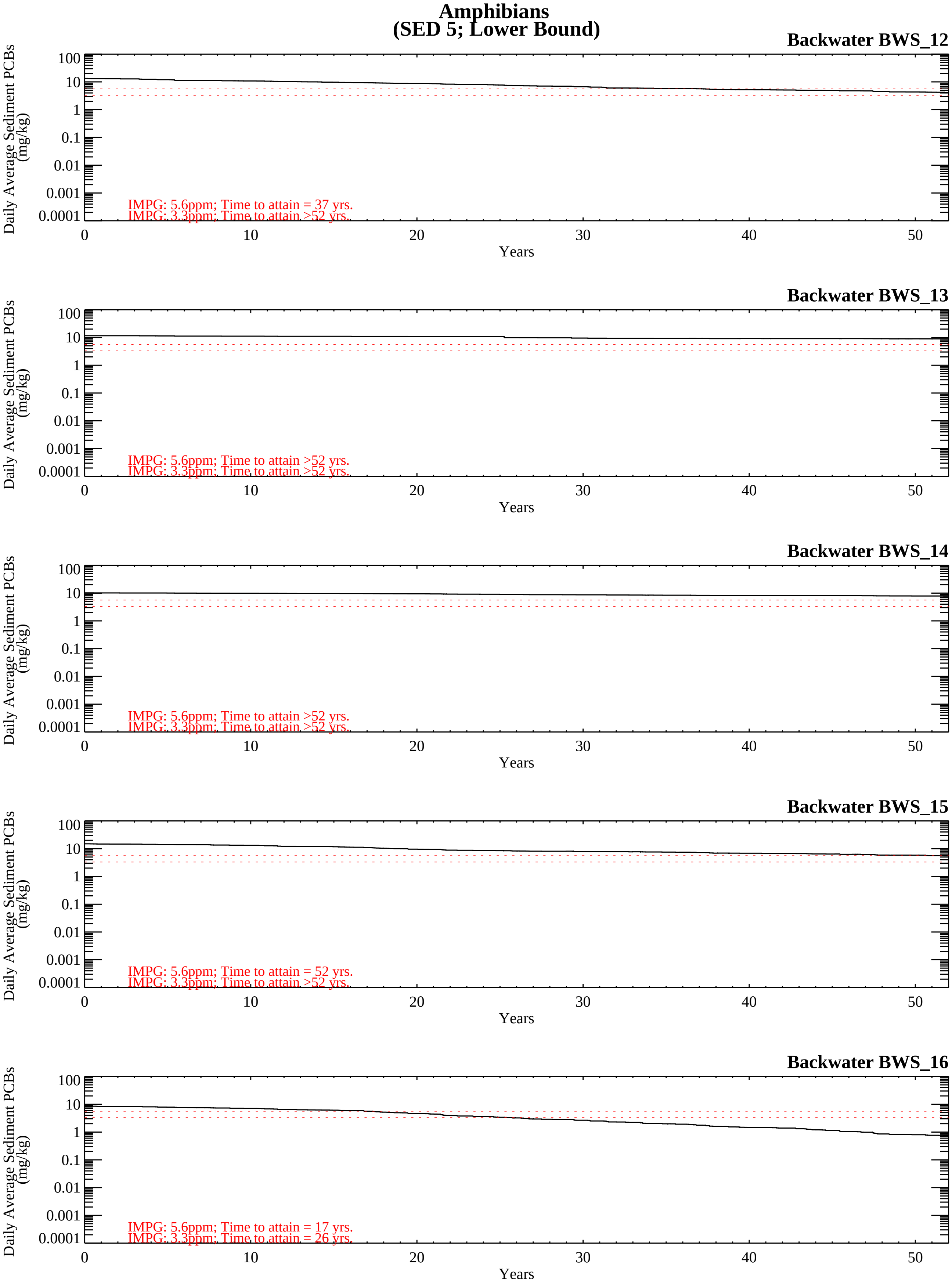

Figure G-5.4-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 5; Reach 5/6; Lower Bound).

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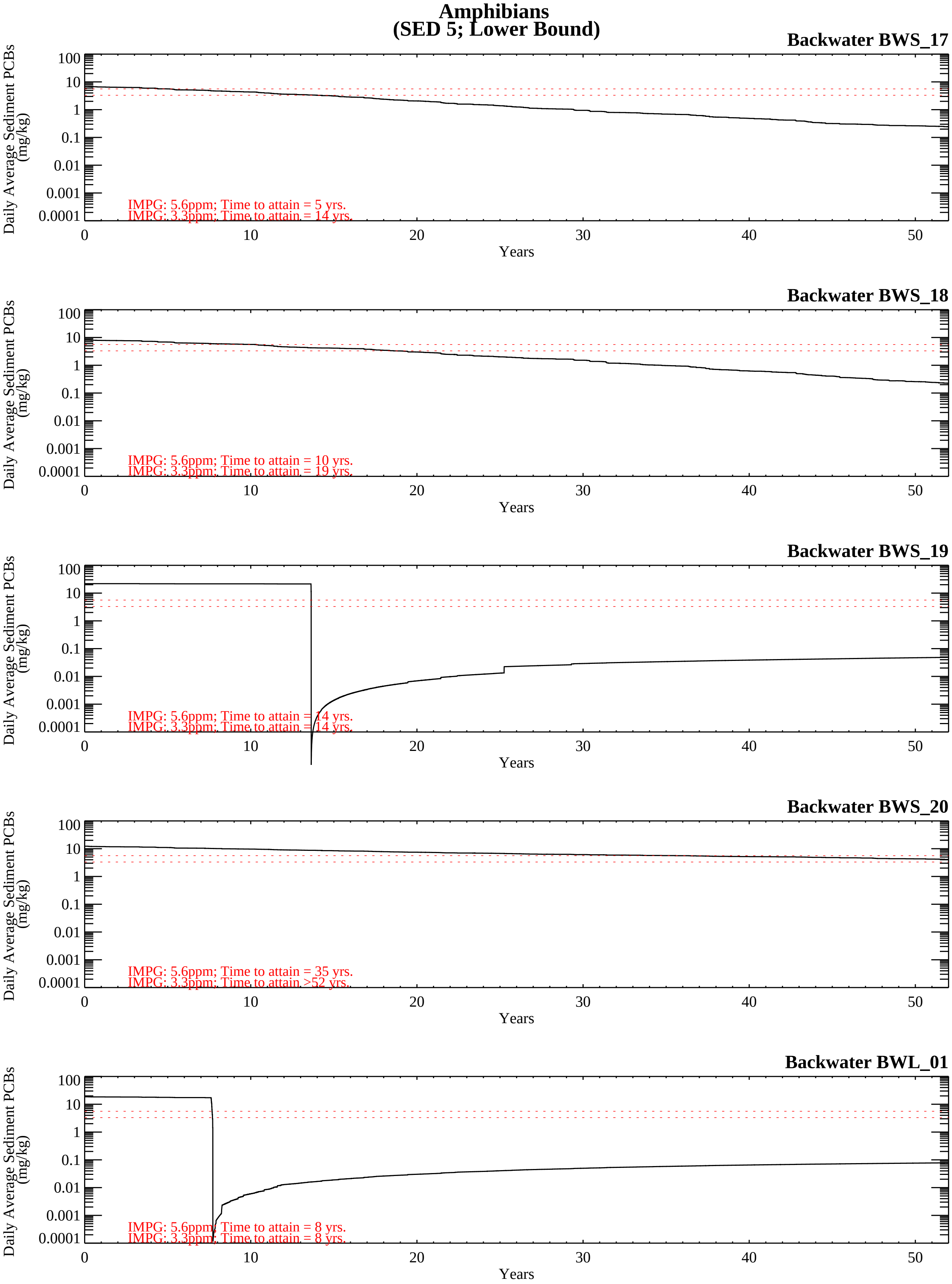
Amphibians
(SED 5; Lower Bound)

Backwater BWS_17

Backwater BWS_18

Backwater BWS_19

Backwater BWS_20

Backwater BWL_01

Figure G-5.4-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 5; Reach 5/6; Lower Bound).

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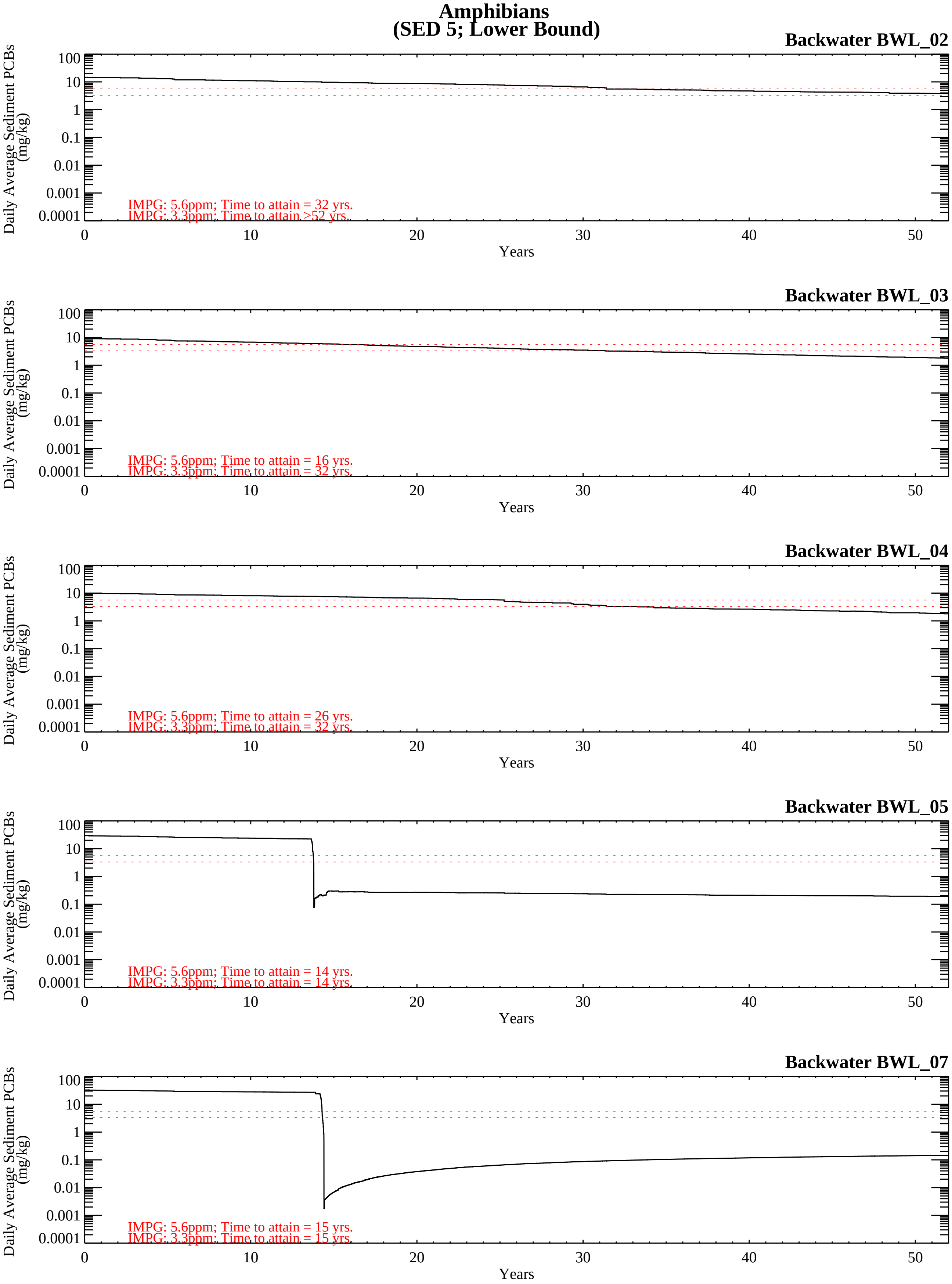

Figure G-5.4-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 5; Reach 5/6; Lower Bound).

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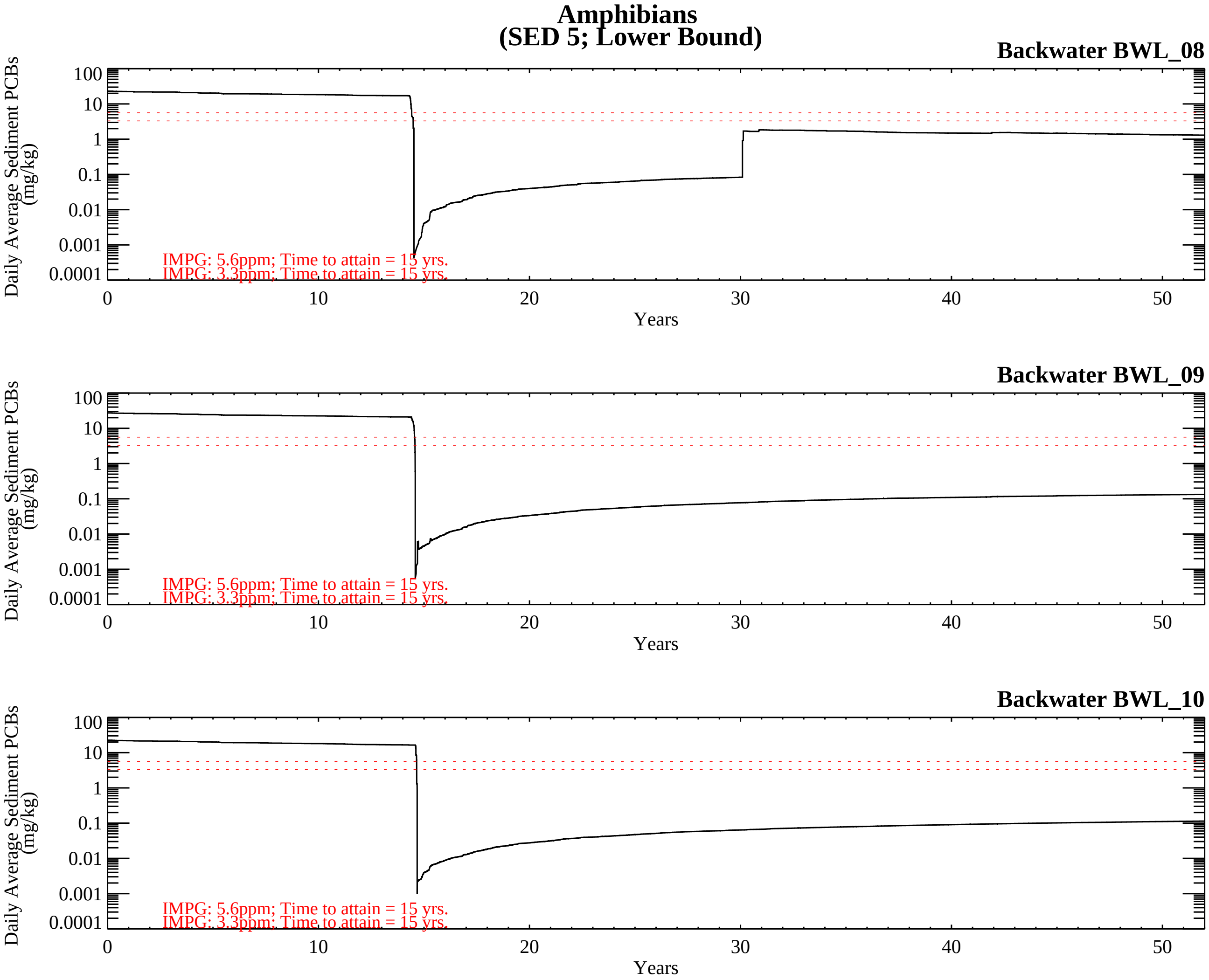

Figure G-5.4-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 5; Reach 5/6; Lower Bound).

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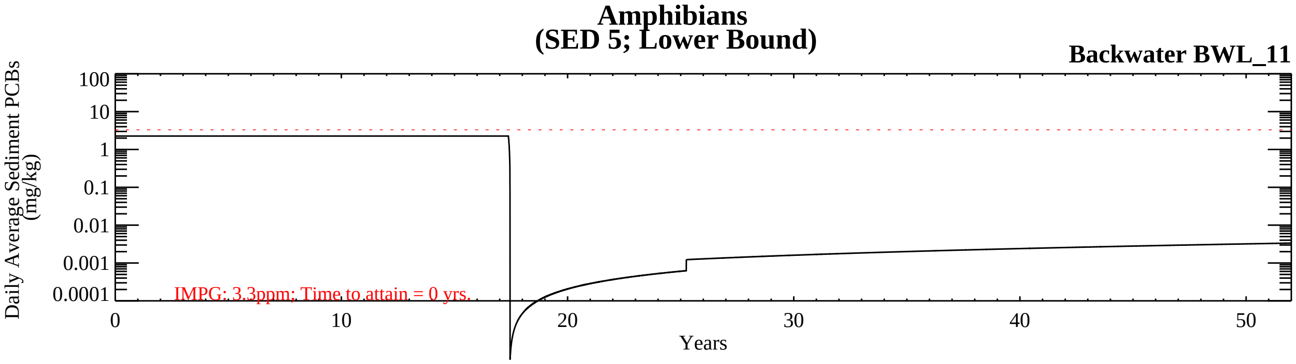

Figure G-5.4-4b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 5; Reach 7/8; Lower Bound).

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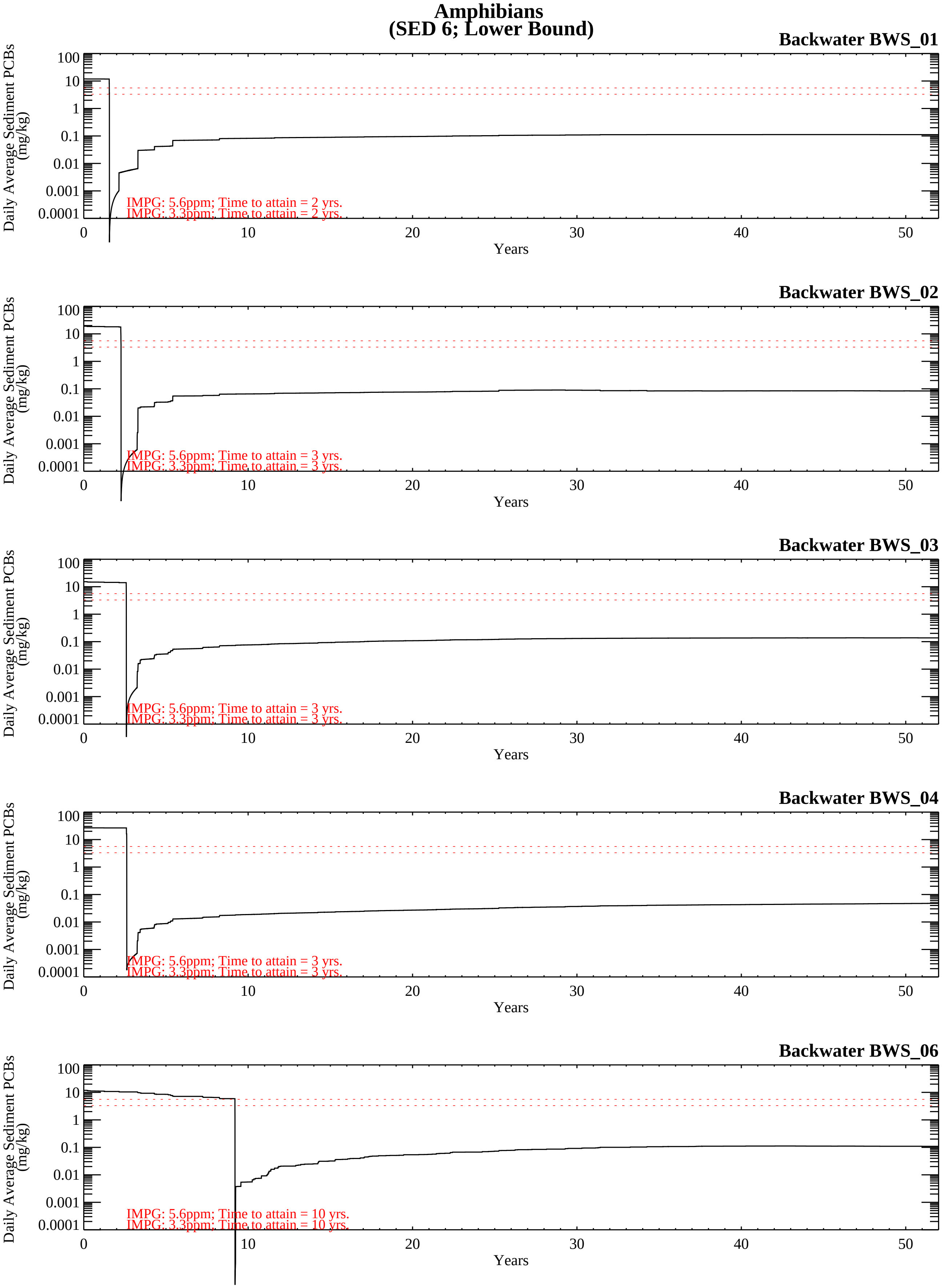

Figure G-5.4-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 6; Reach 5/6; Lower Bound).

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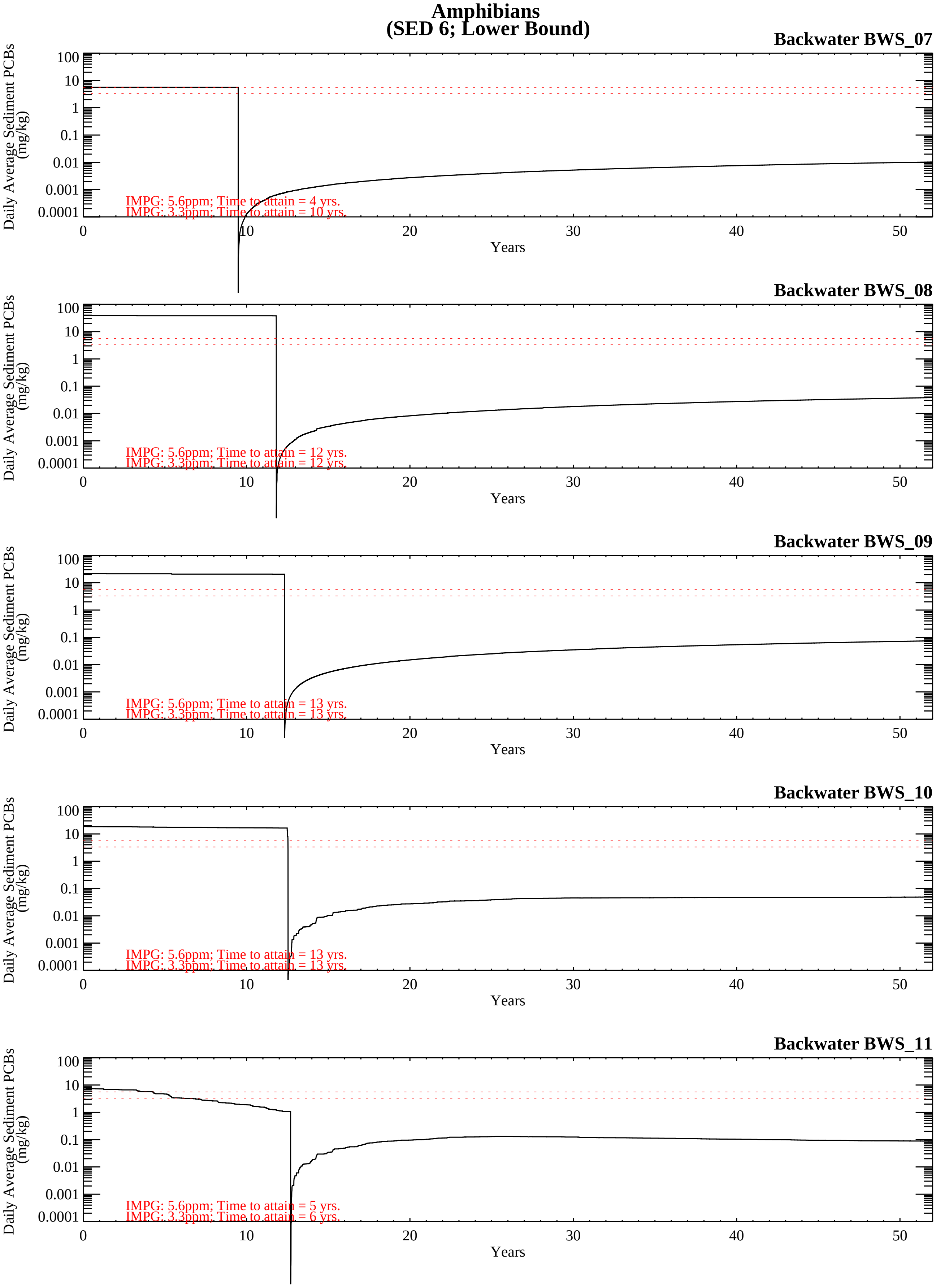

Figure G-5.4-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 6; Reach 5/6; Lower Bound).

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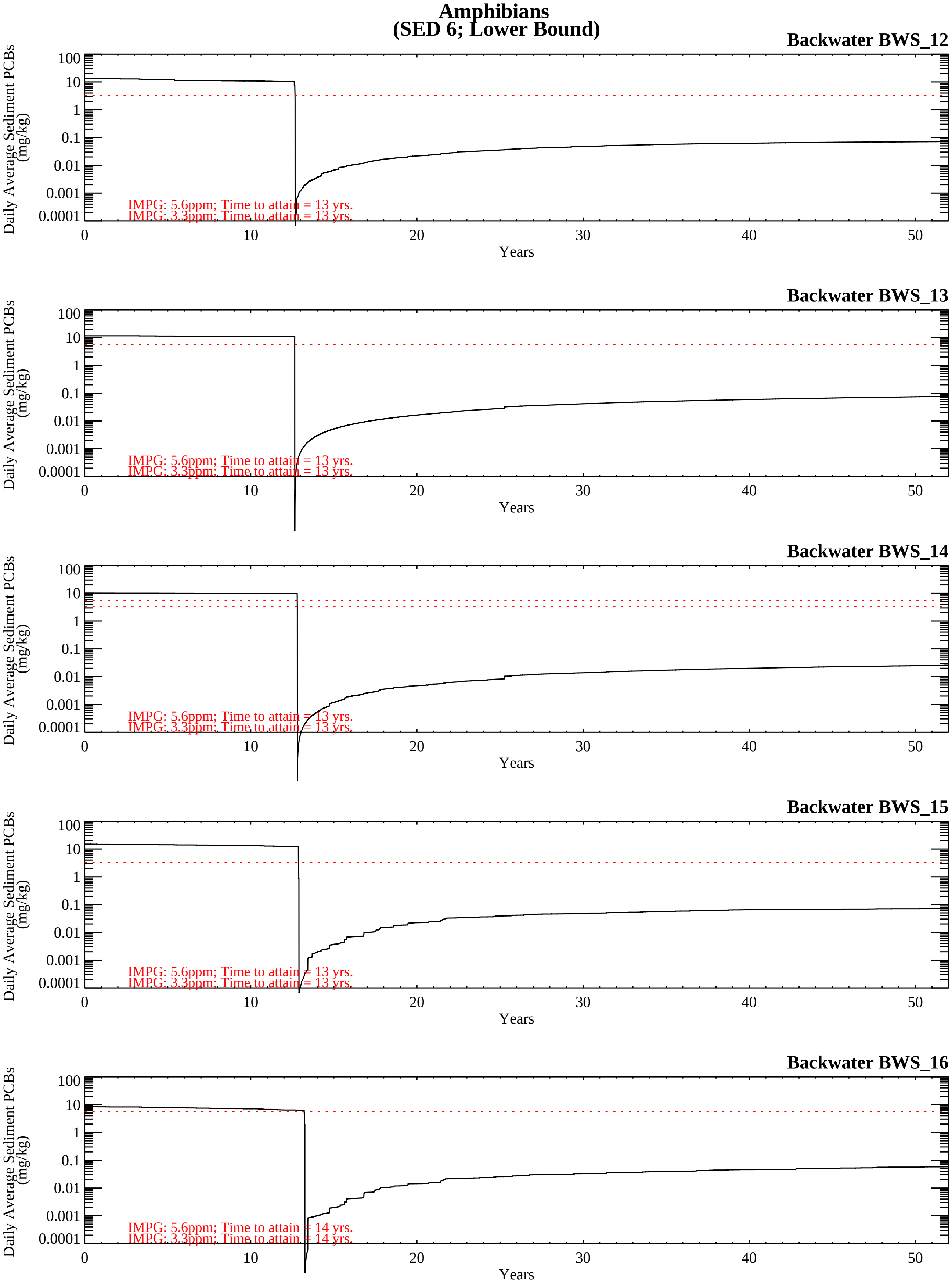

Figure G-5.4-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 6; Reach 5/6; Lower Bound).

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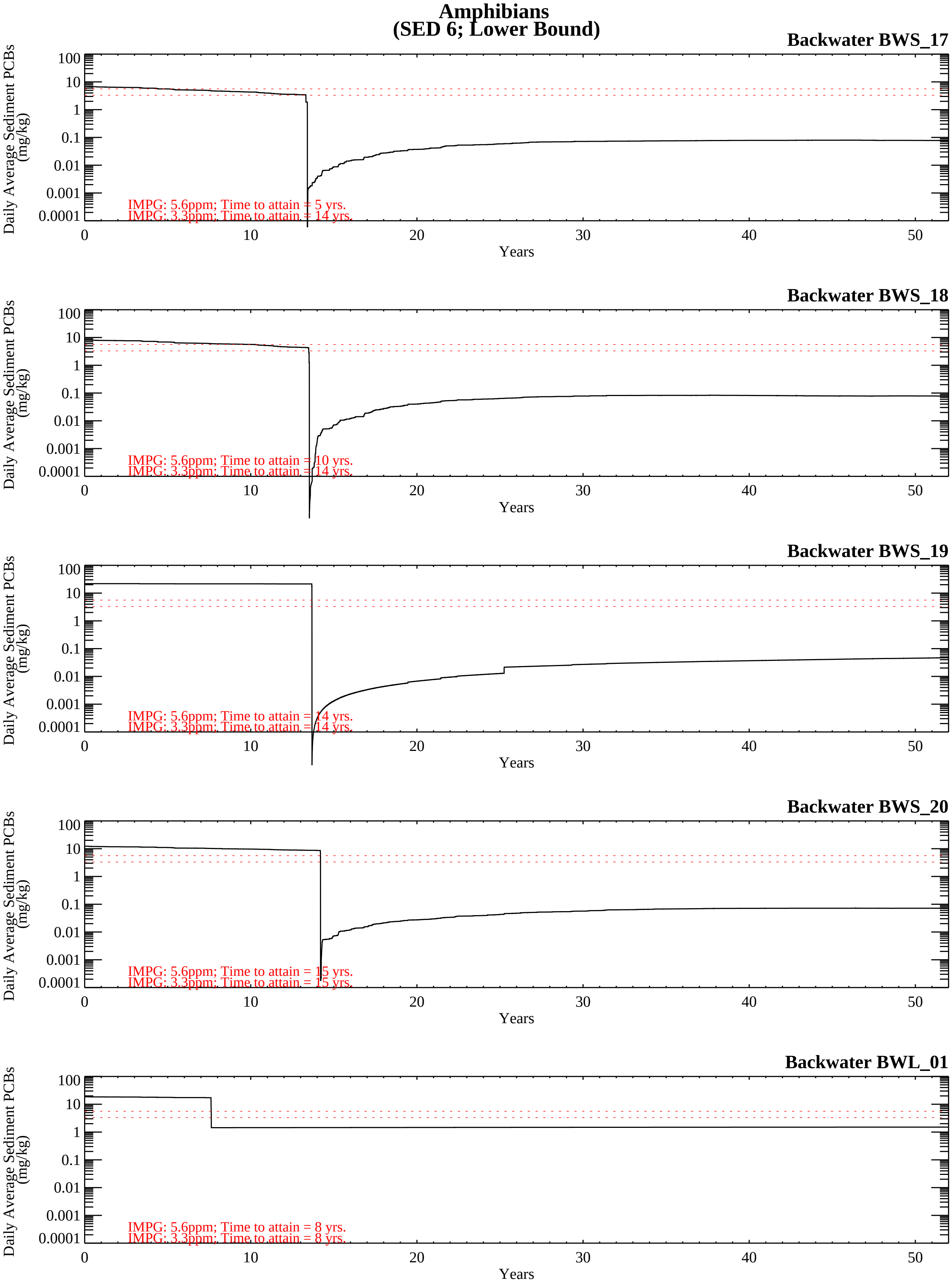

Figure G-5.4-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 6; Reach 5/6; Lower Bound).

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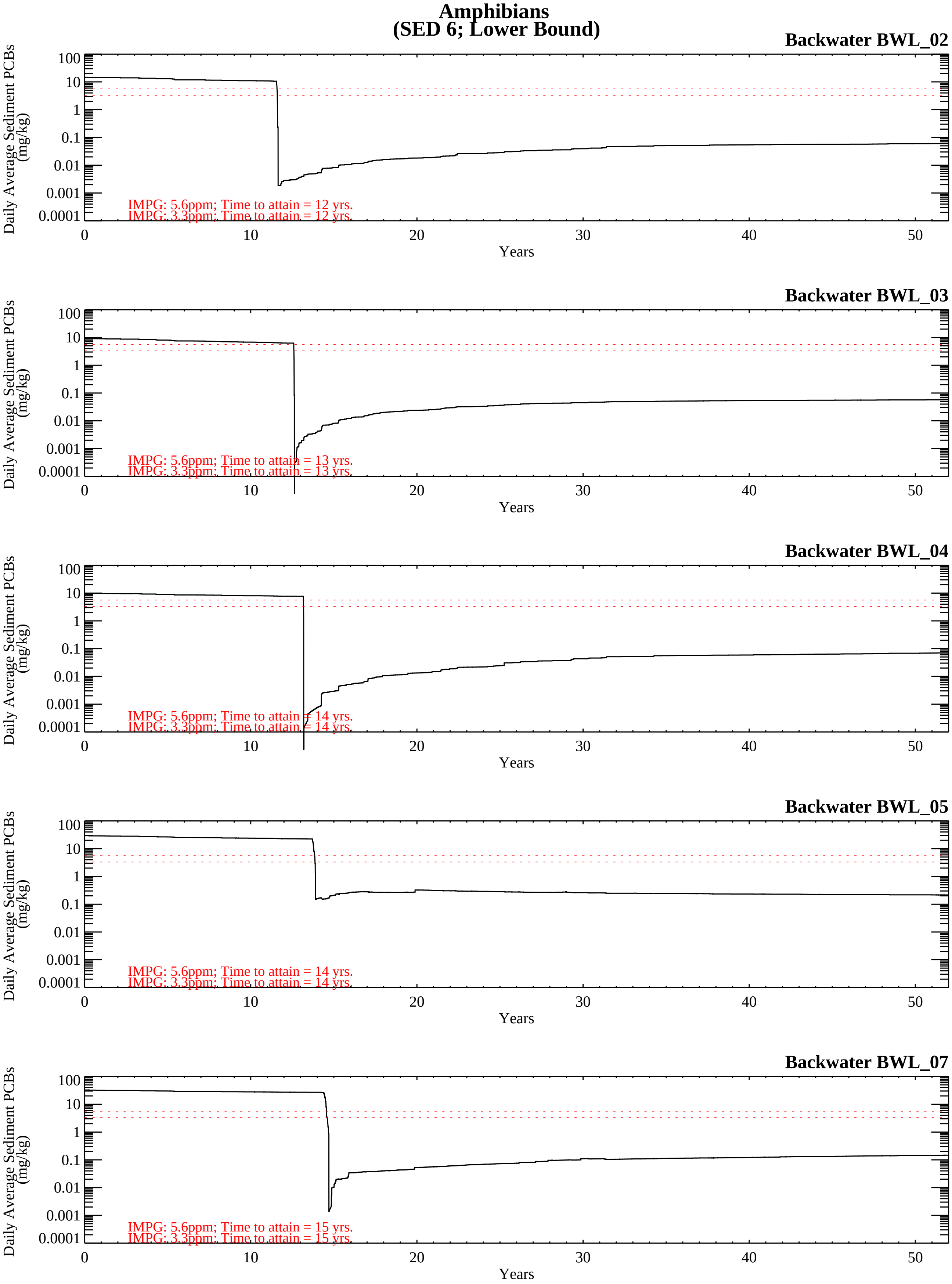

Figure G-5.4-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 6; Reach 5/6; Lower Bound).

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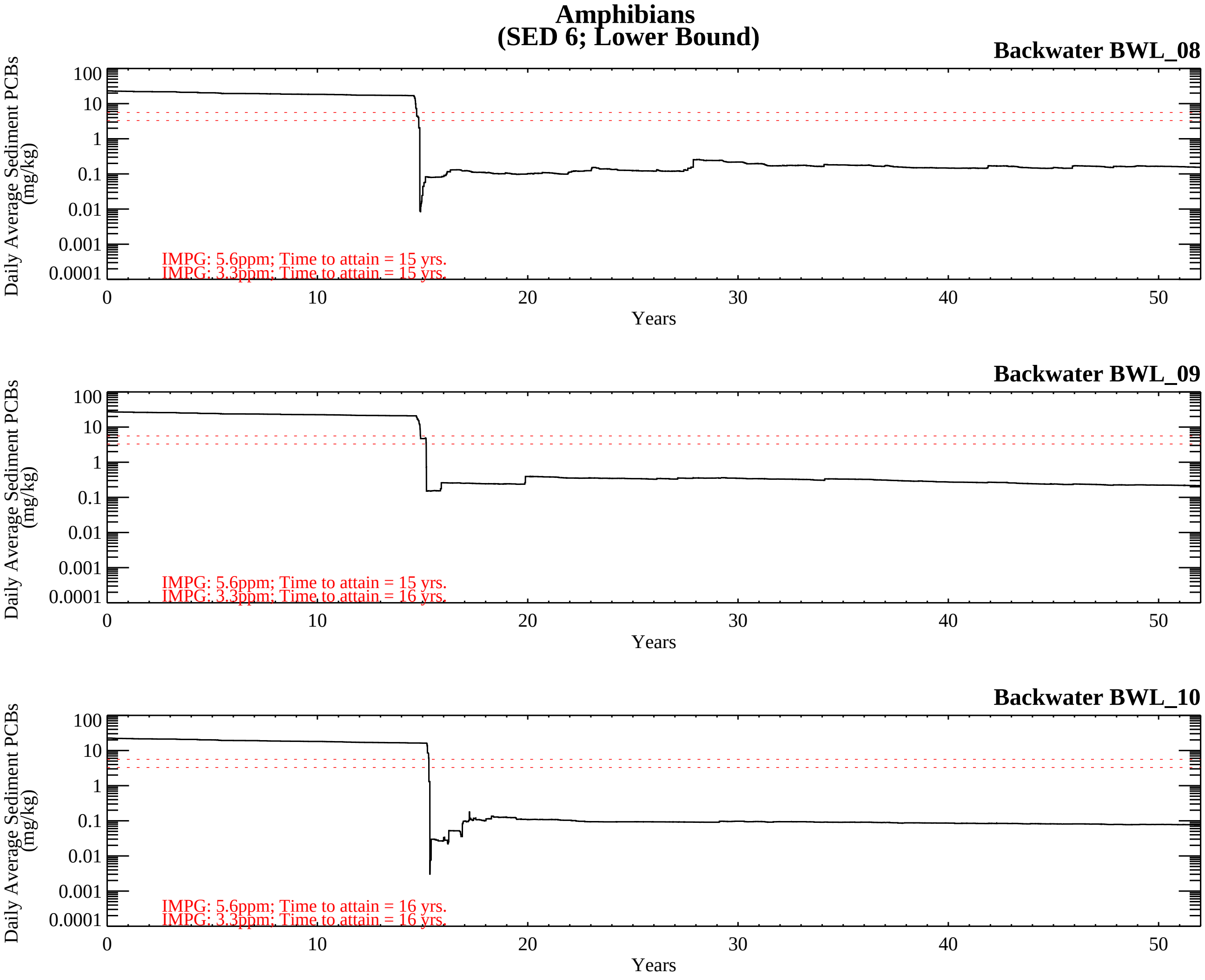

Figure G-5.4-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 6; Reach 5/6; Lower Bound).

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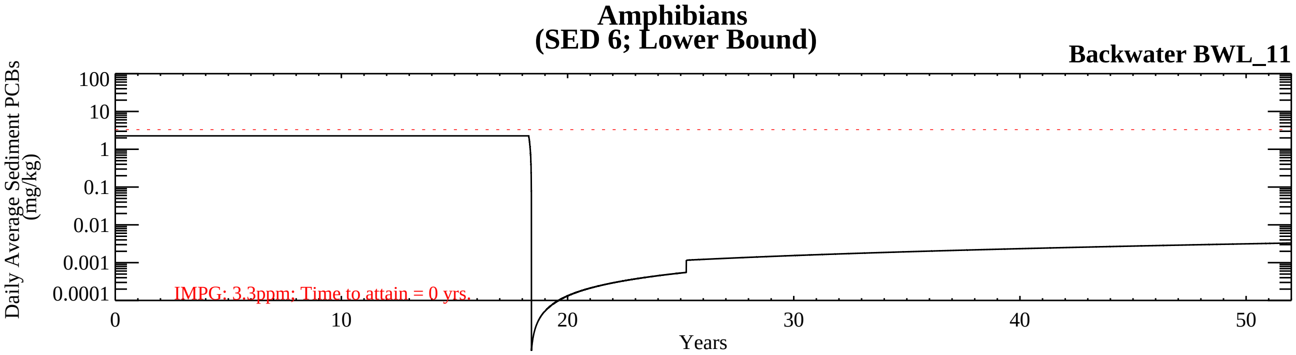

Figure G-5.4-5b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 6; Reach 7/8; Lower Bound).

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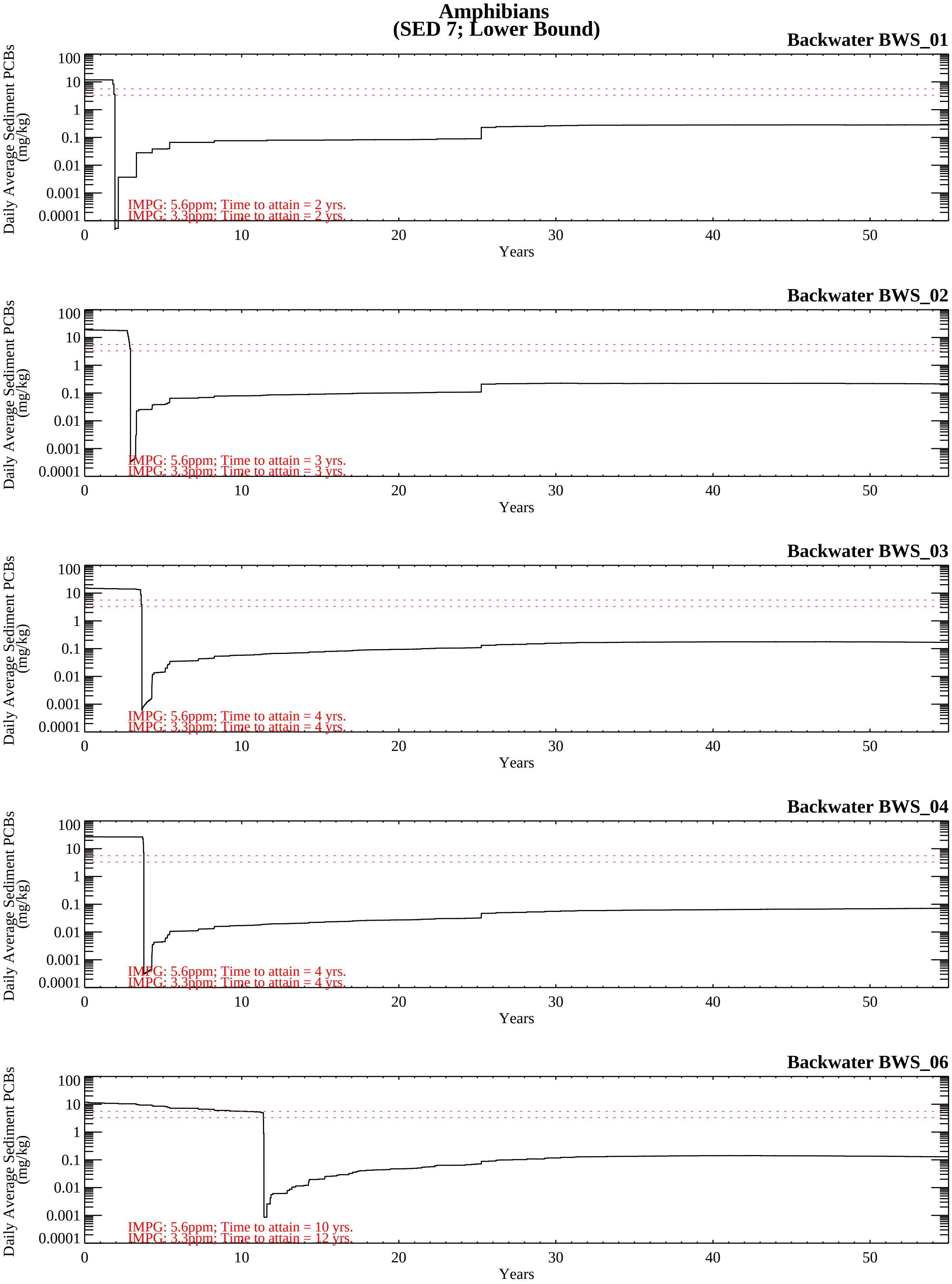

Figure G-5.4-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 7; Reach 5/6; Lower Bound).

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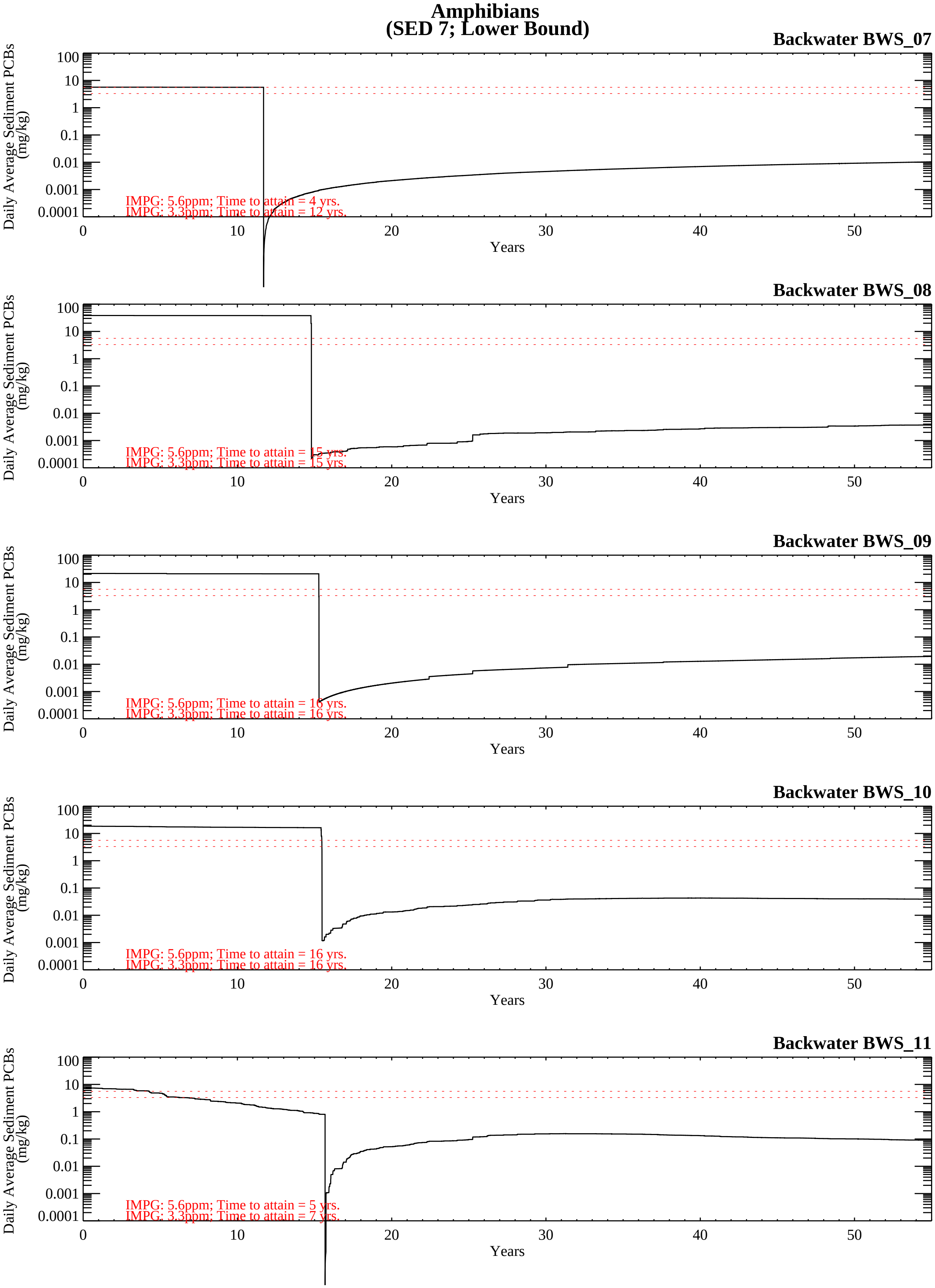

Figure G-5.4-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 7; Reach 5/6; Lower Bound).

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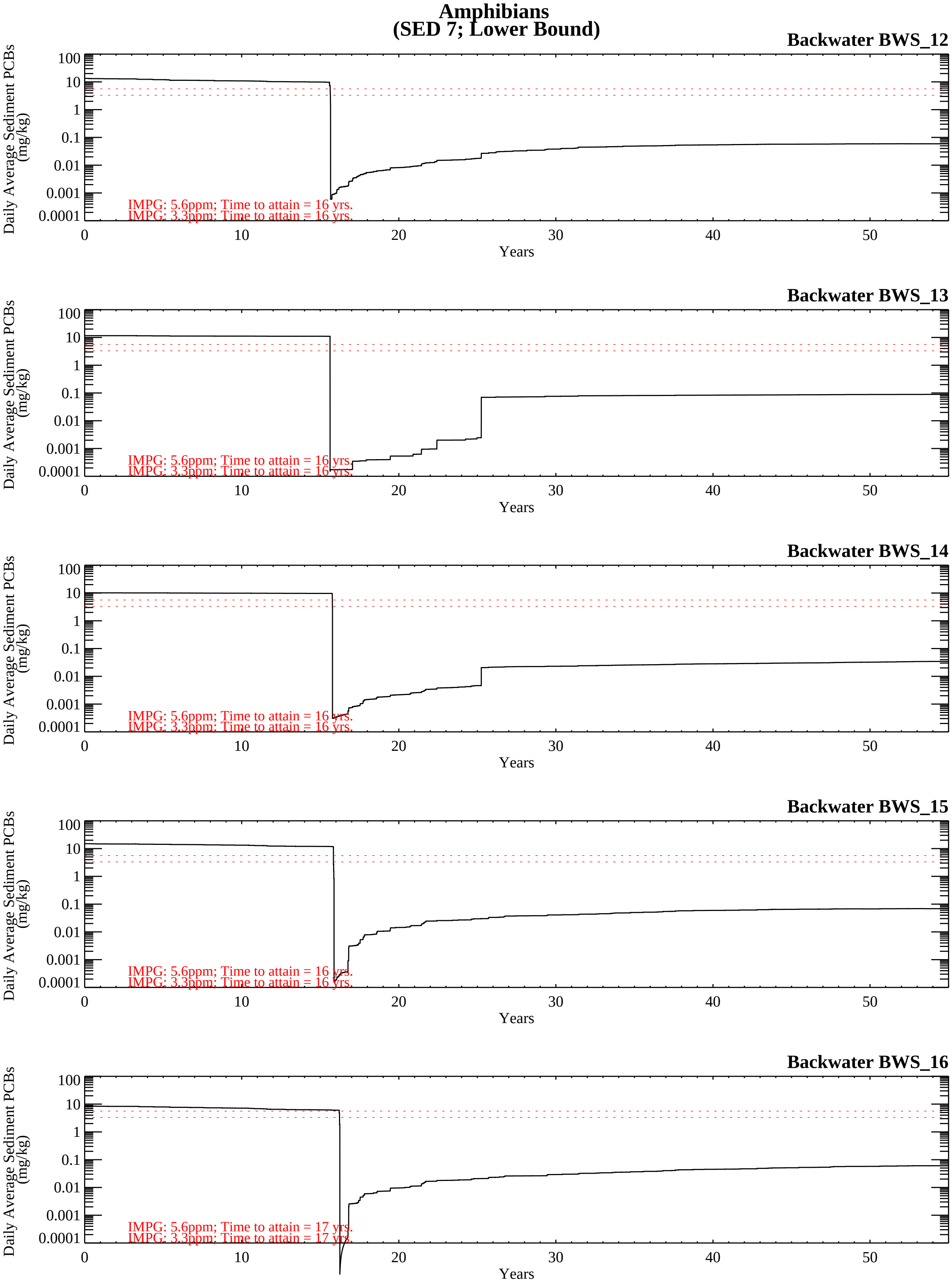

Figure G-5.4-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 7; Reach 5/6; Lower Bound).

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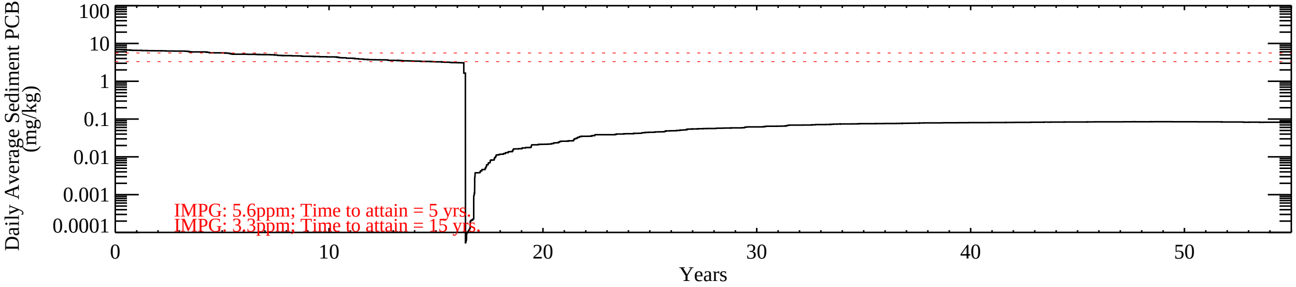
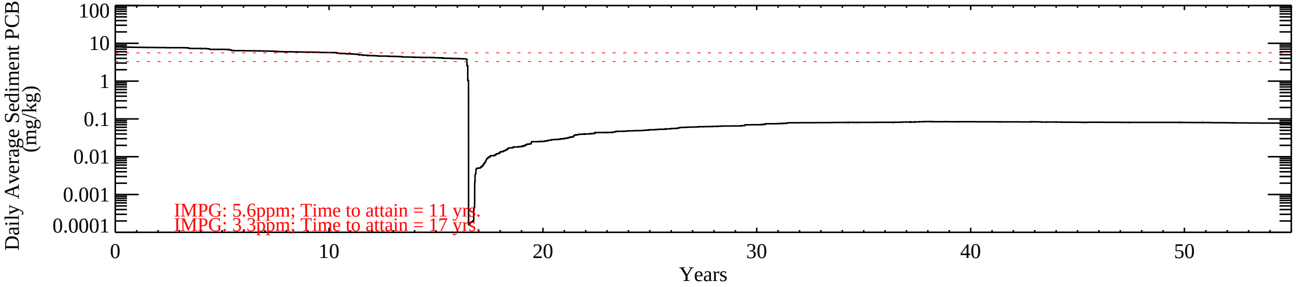
Amphibians
(SED 7; Lower Bound)

Backwater BWS_17



Backwater BWS_18



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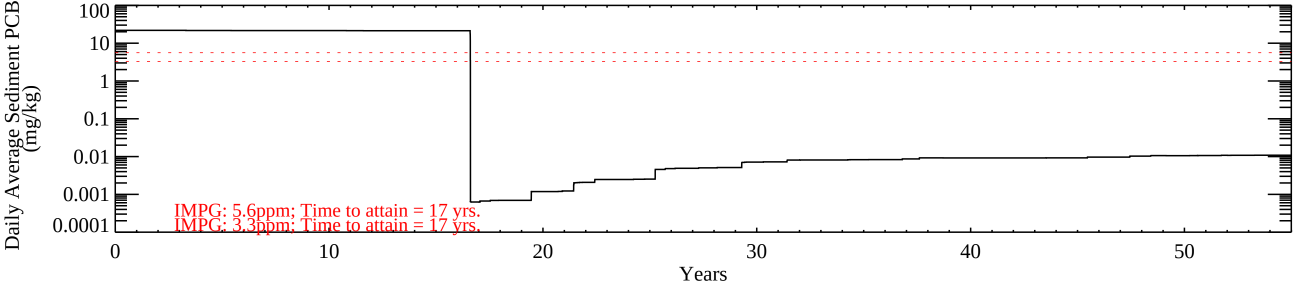
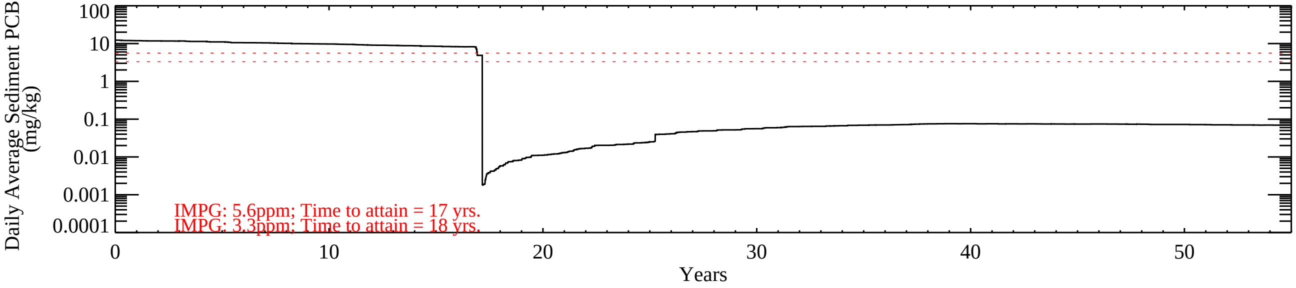


Backwater BWS_20



Backwater BWL_01

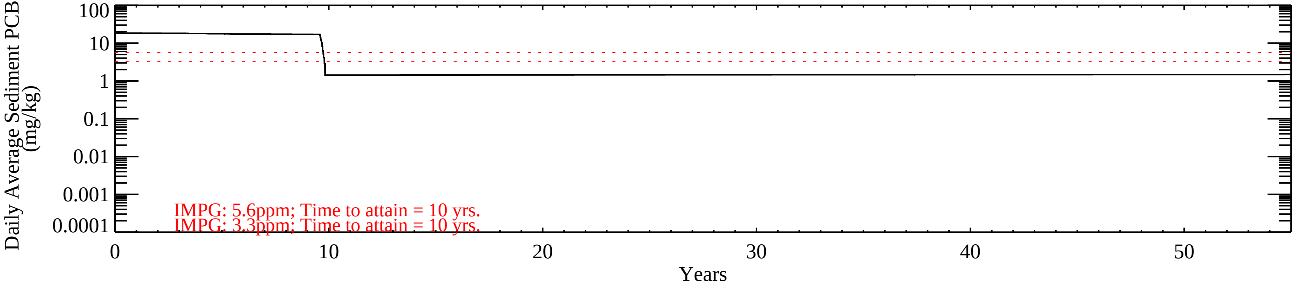


Figure G-5.4-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 7; Reach 5/6; Lower Bound).

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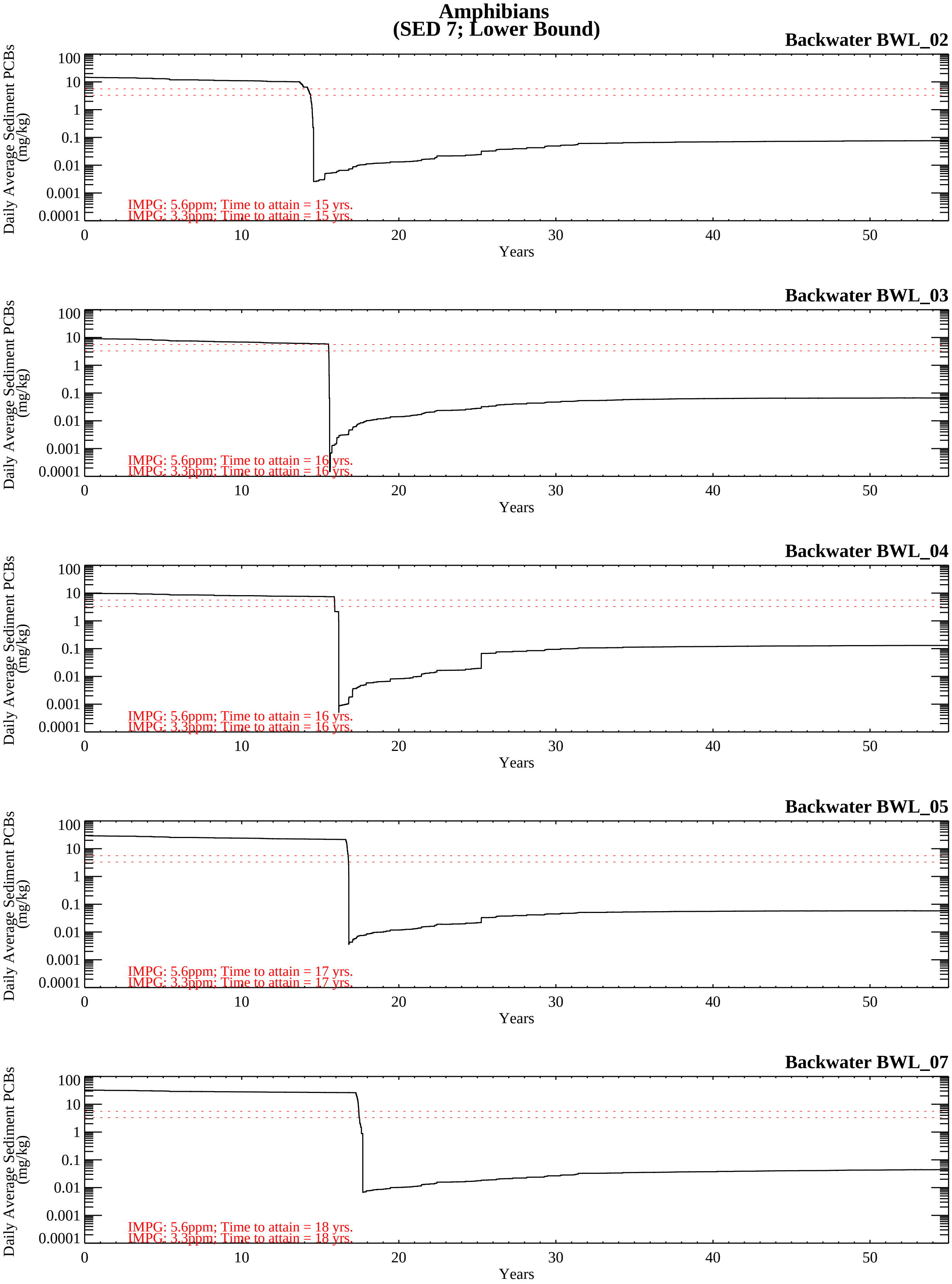

Figure G-5.4-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 7; Reach 5/6; Lower Bound).

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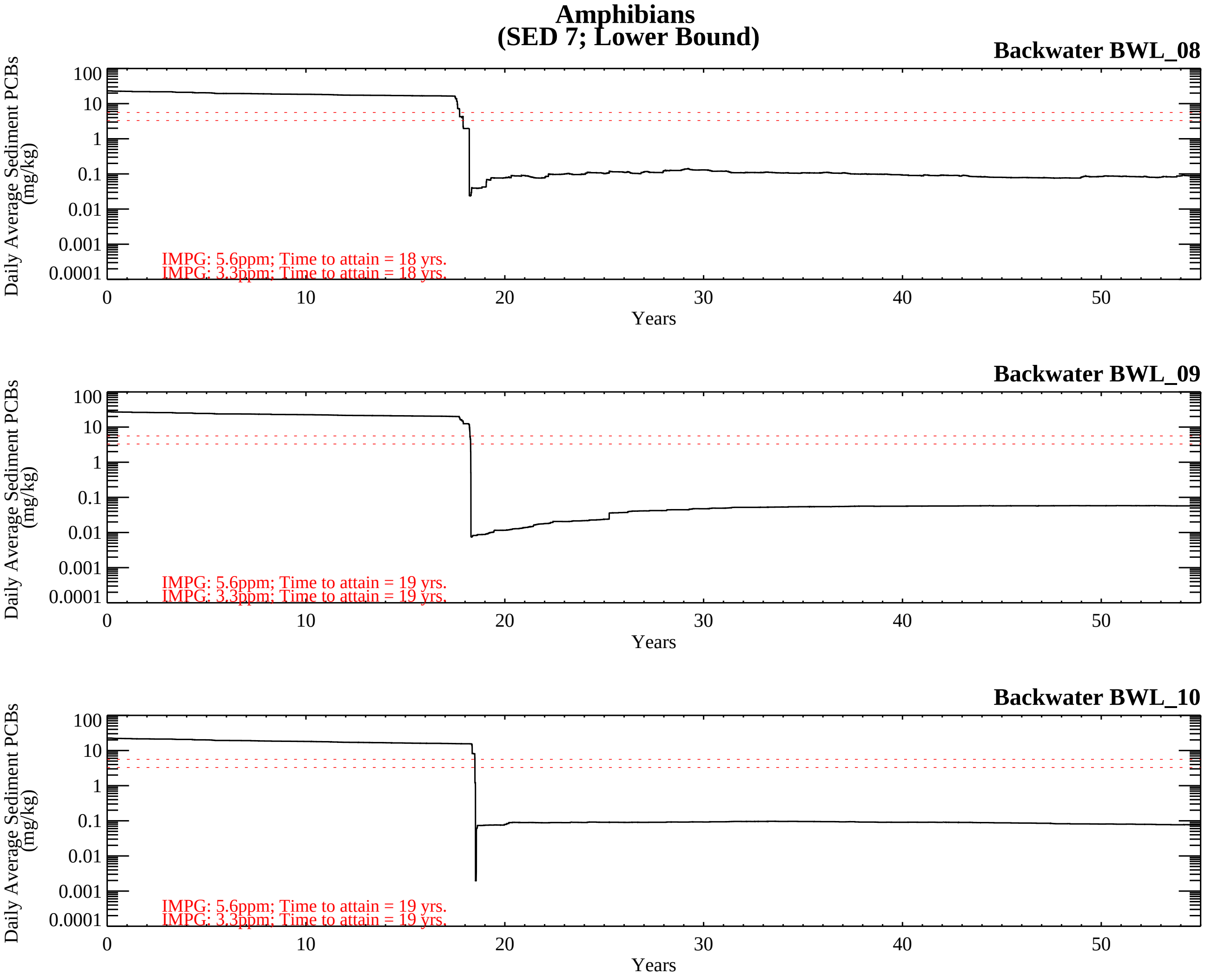

Figure G-5.4-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 7; Reach 5/6; Lower Bound).

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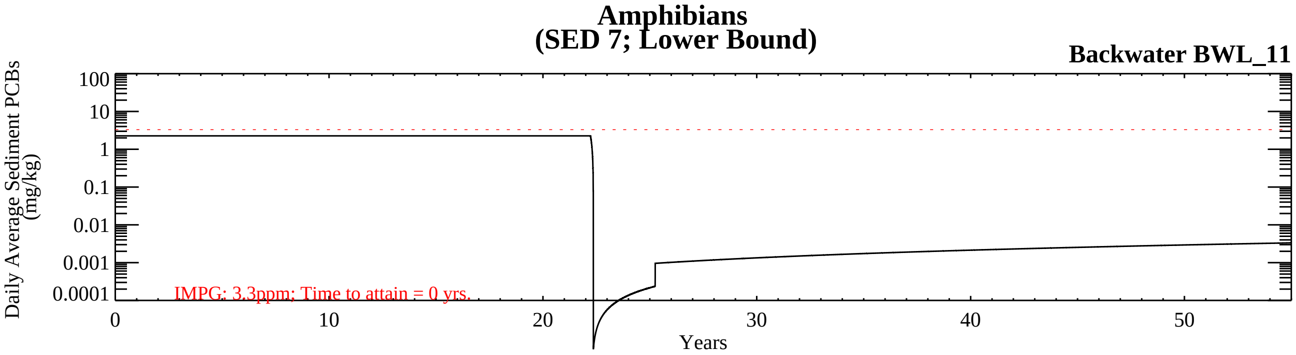

Figure G-5.4-6b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 7; Reach 7/8; Lower Bound).

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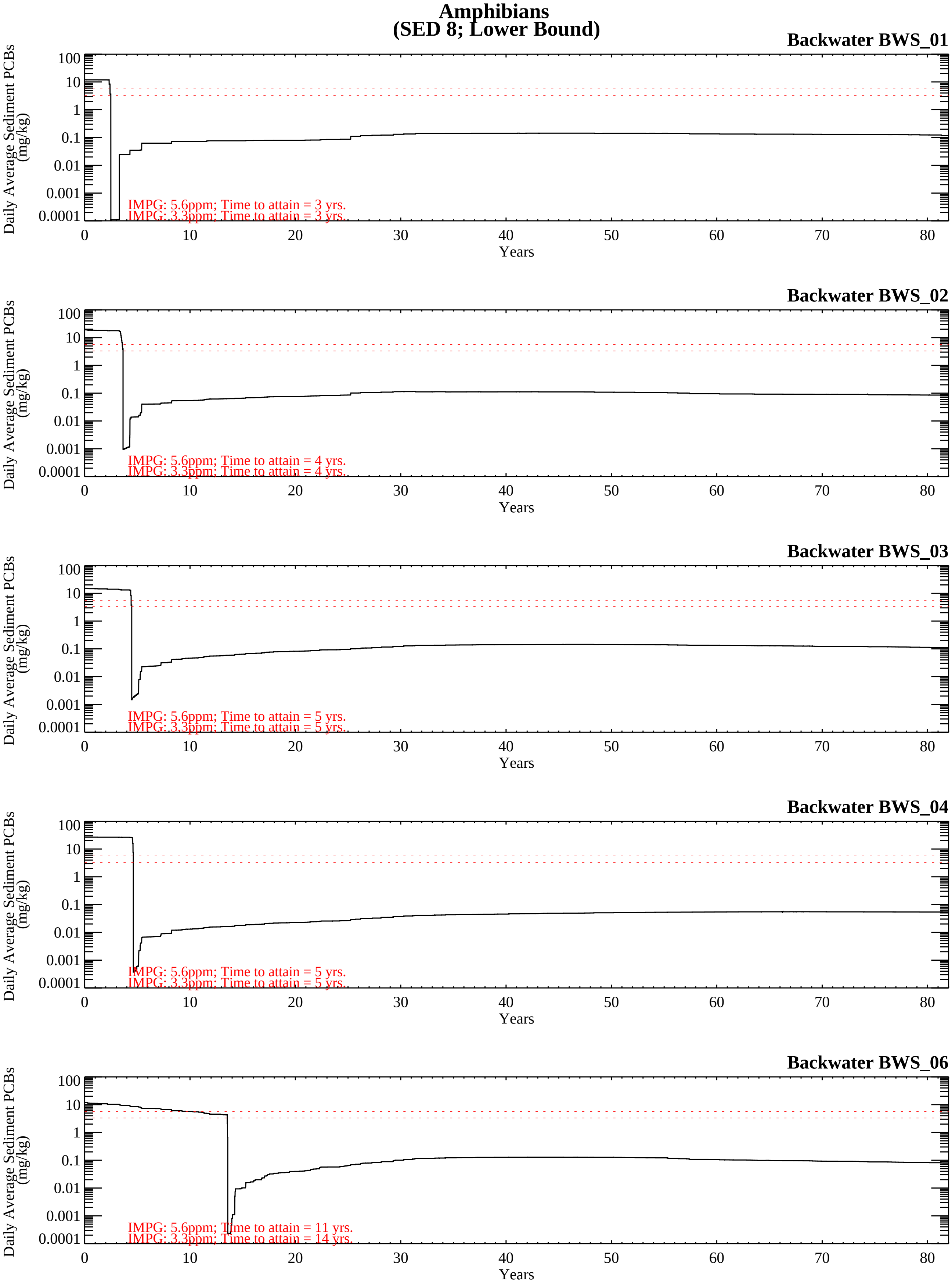

Figure G-5.4-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 8; Reach 5/6; Lower Bound).

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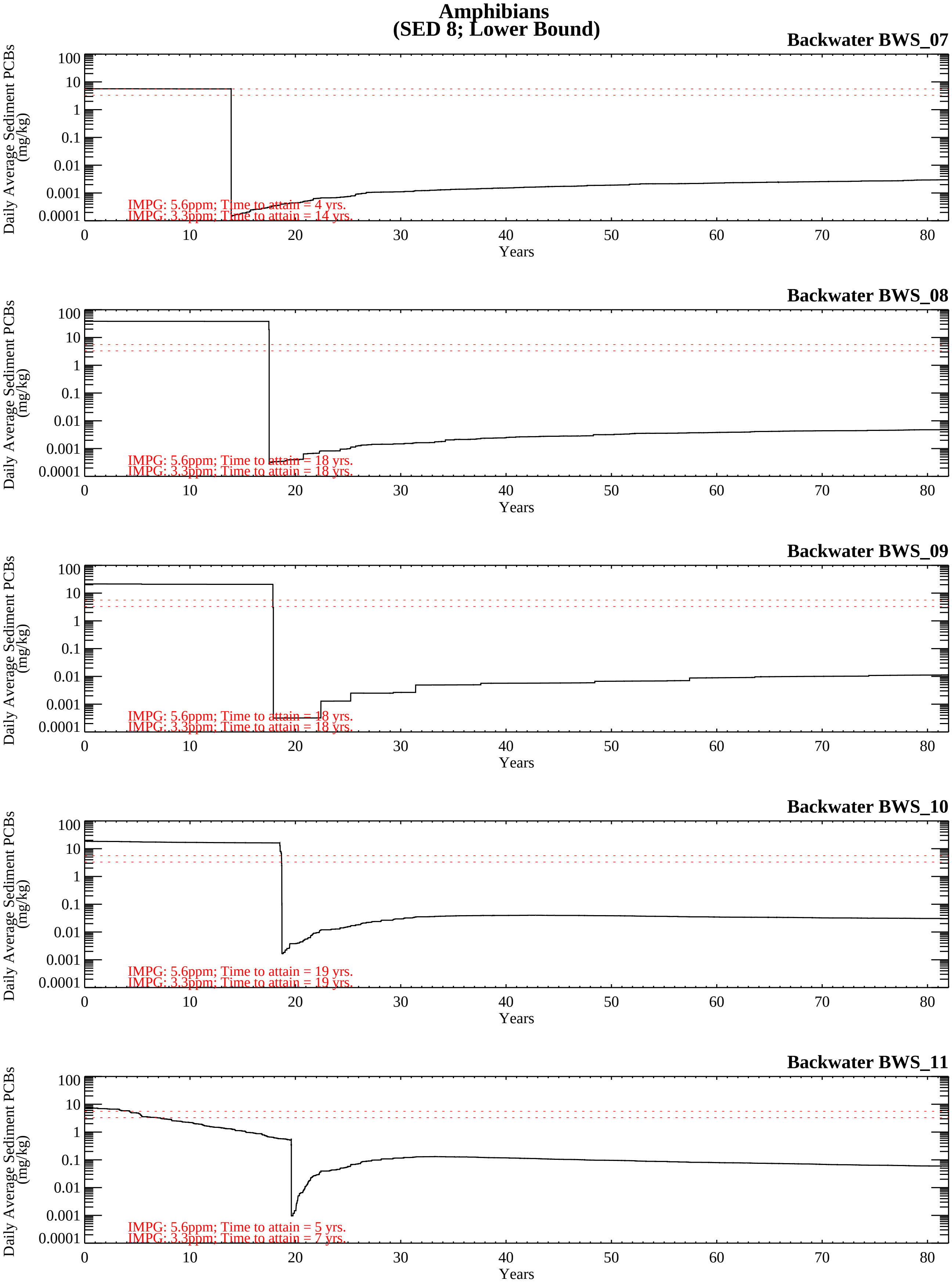

Figure G-5.4-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 8; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED8CMSLB_0712-25\\bins

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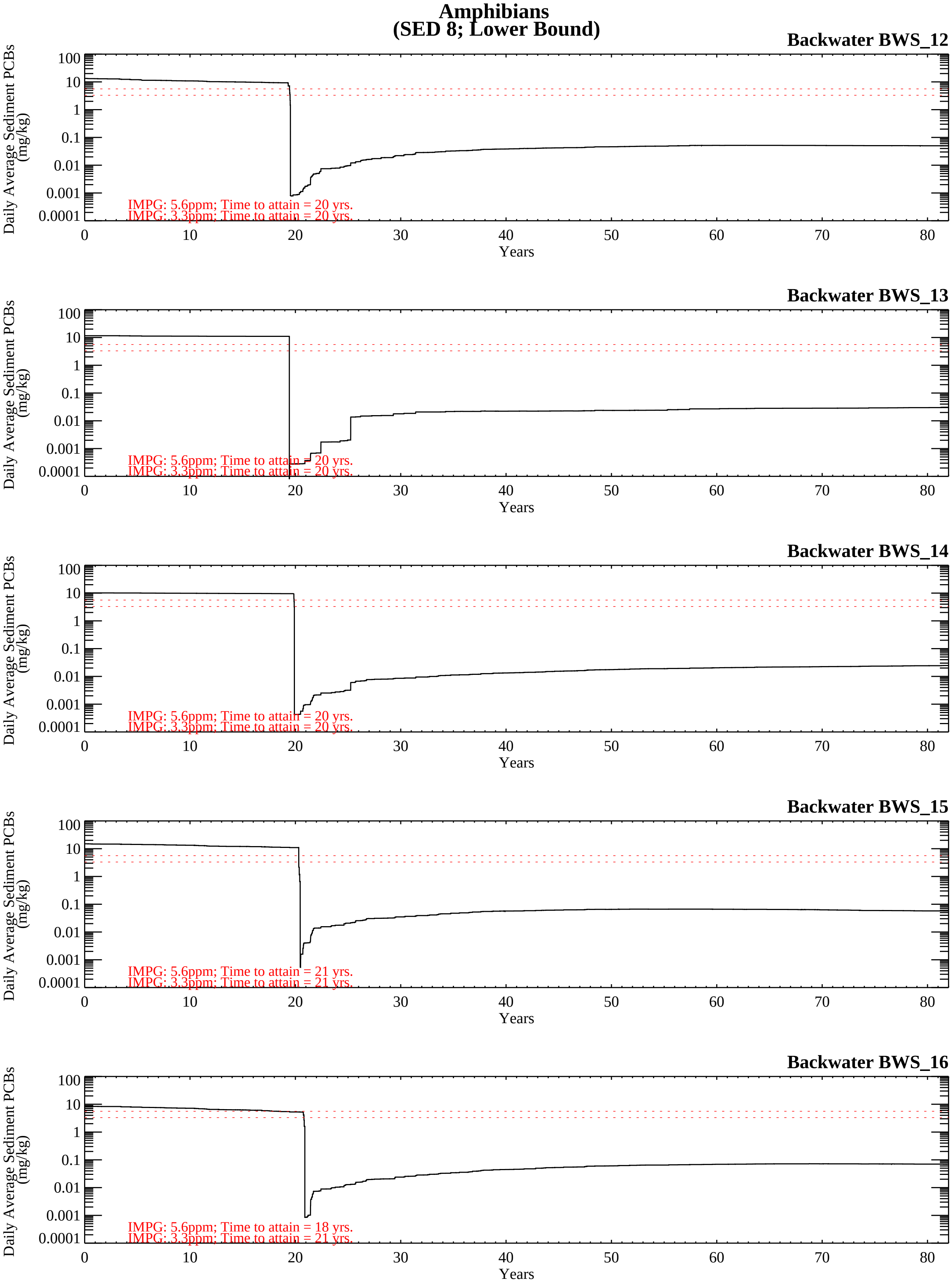

Figure G-5.4-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 8; Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED8CMSLB_0712-25\\bins

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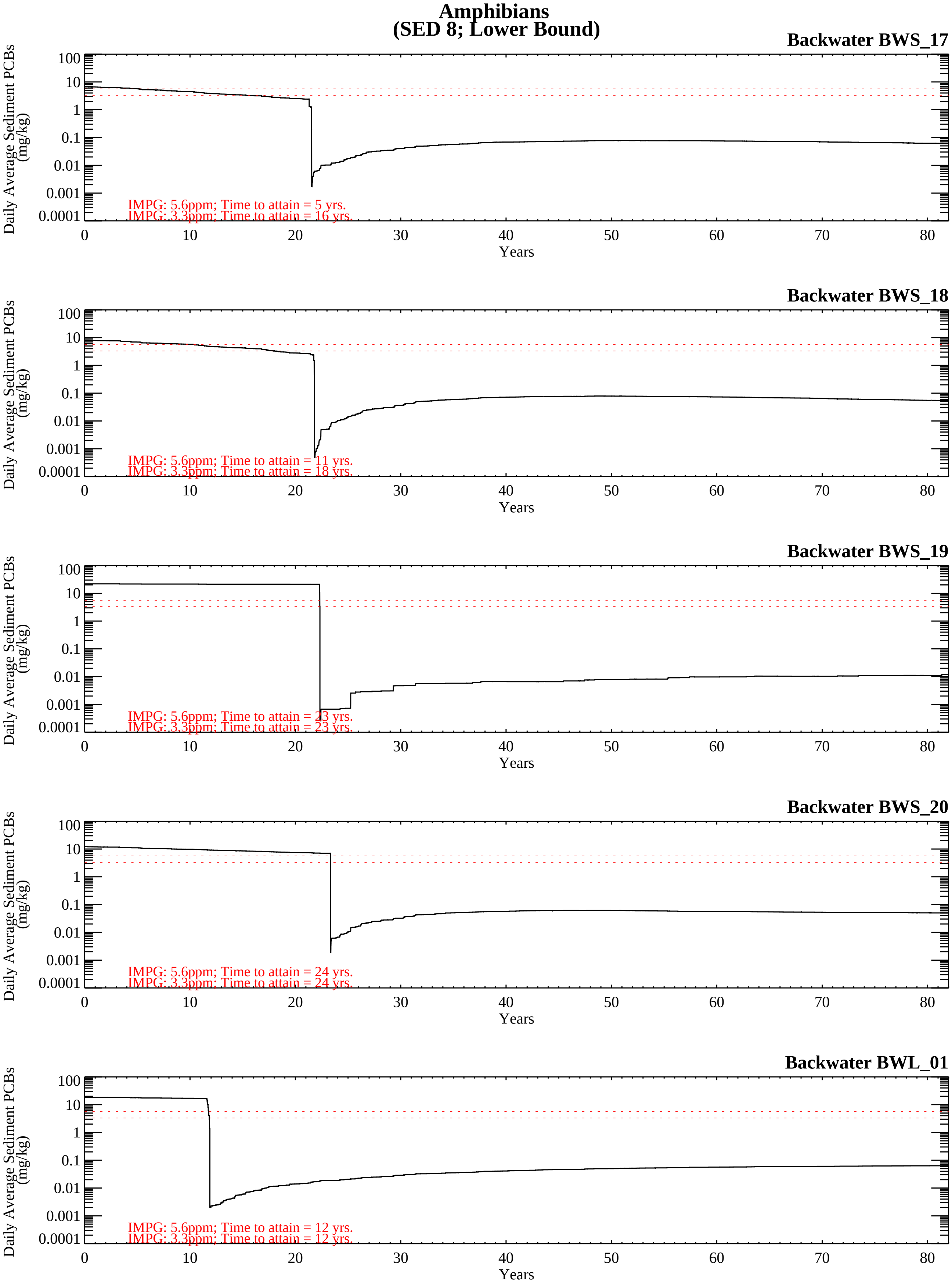

Figure G-5.4-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 8; Reach 5/6; Lower Bound).

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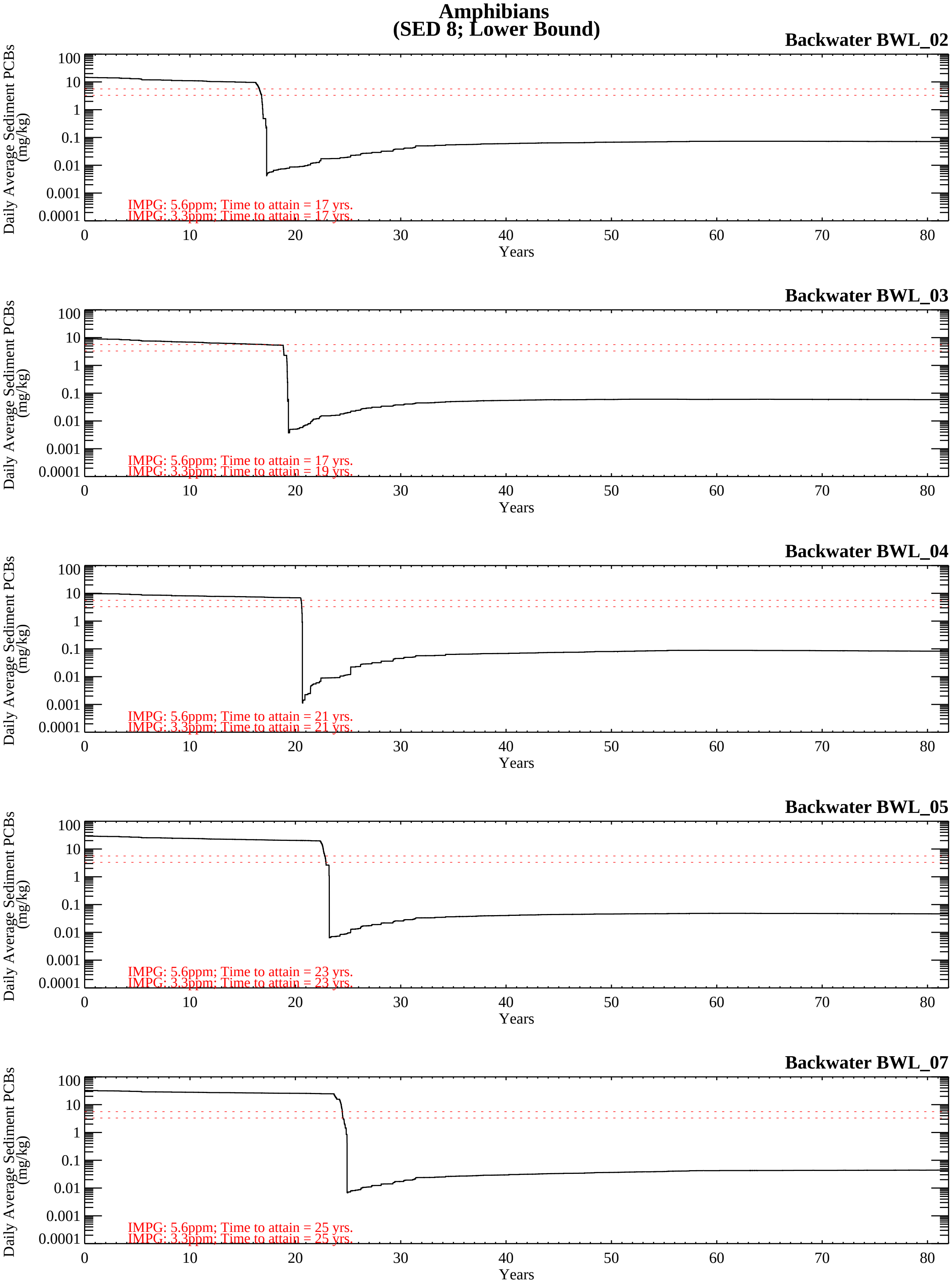

Figure G-5.4-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 8; Reach 5/6; Lower Bound).

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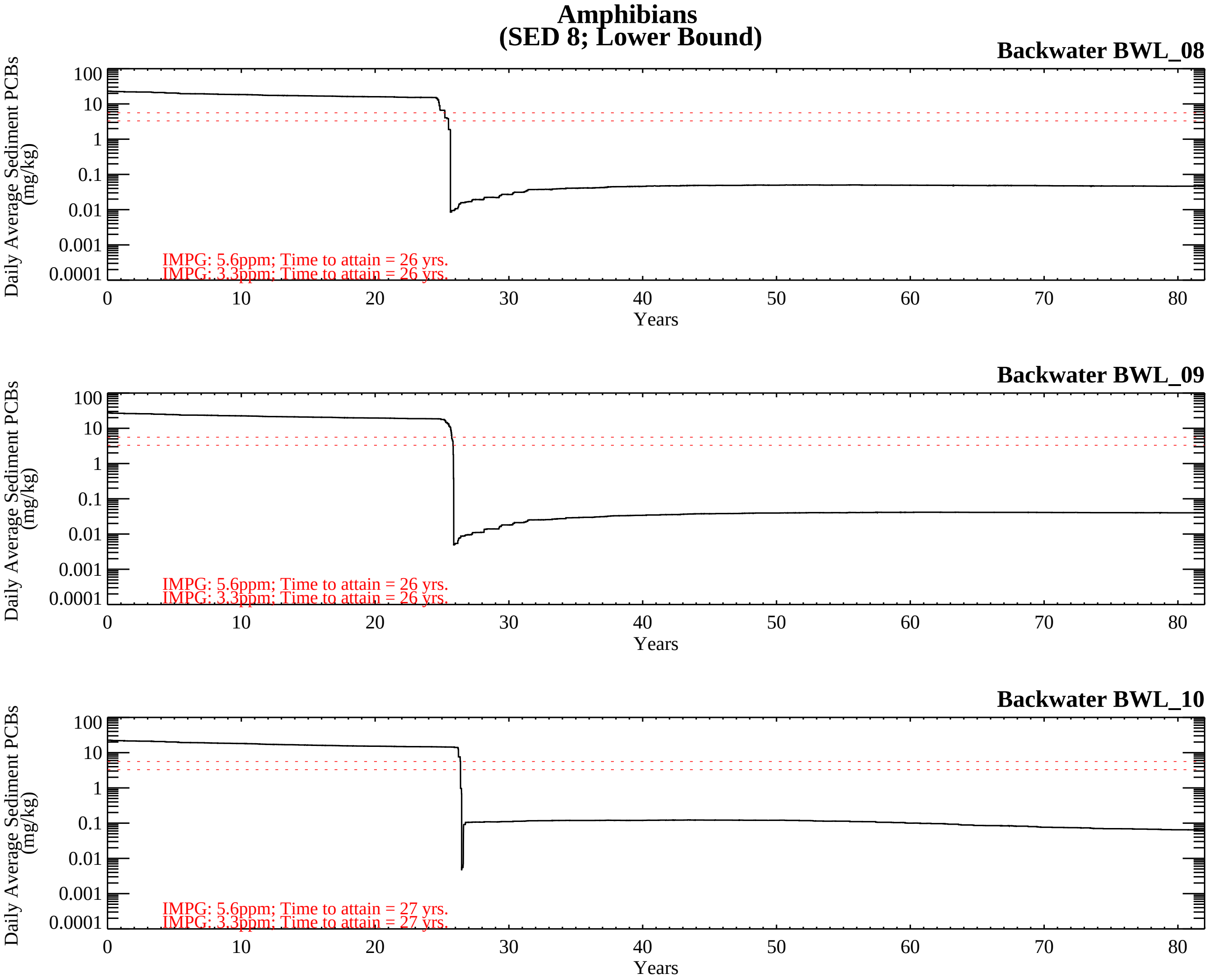

Figure G-5.4-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 8; Reach 5/6; Lower Bound).

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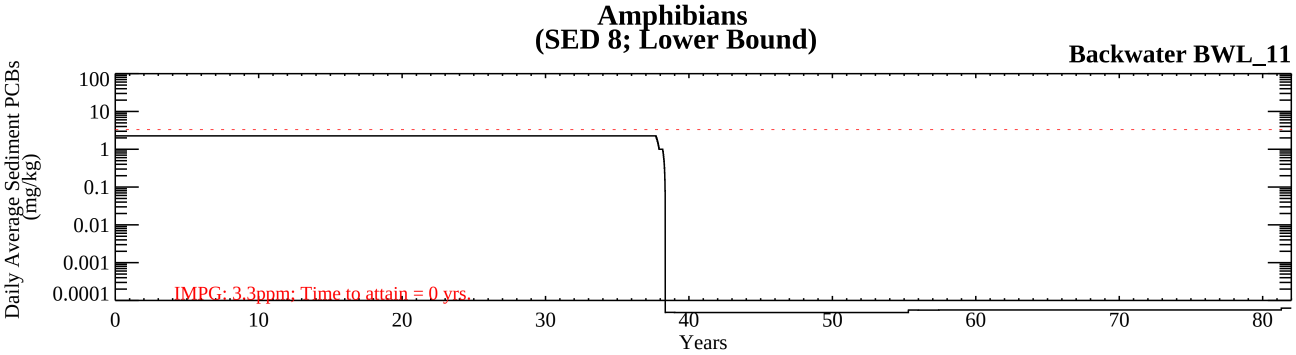

Figure G-5.4-7b. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for amphibians (SED 8; Reach 7/8; Lower Bound).

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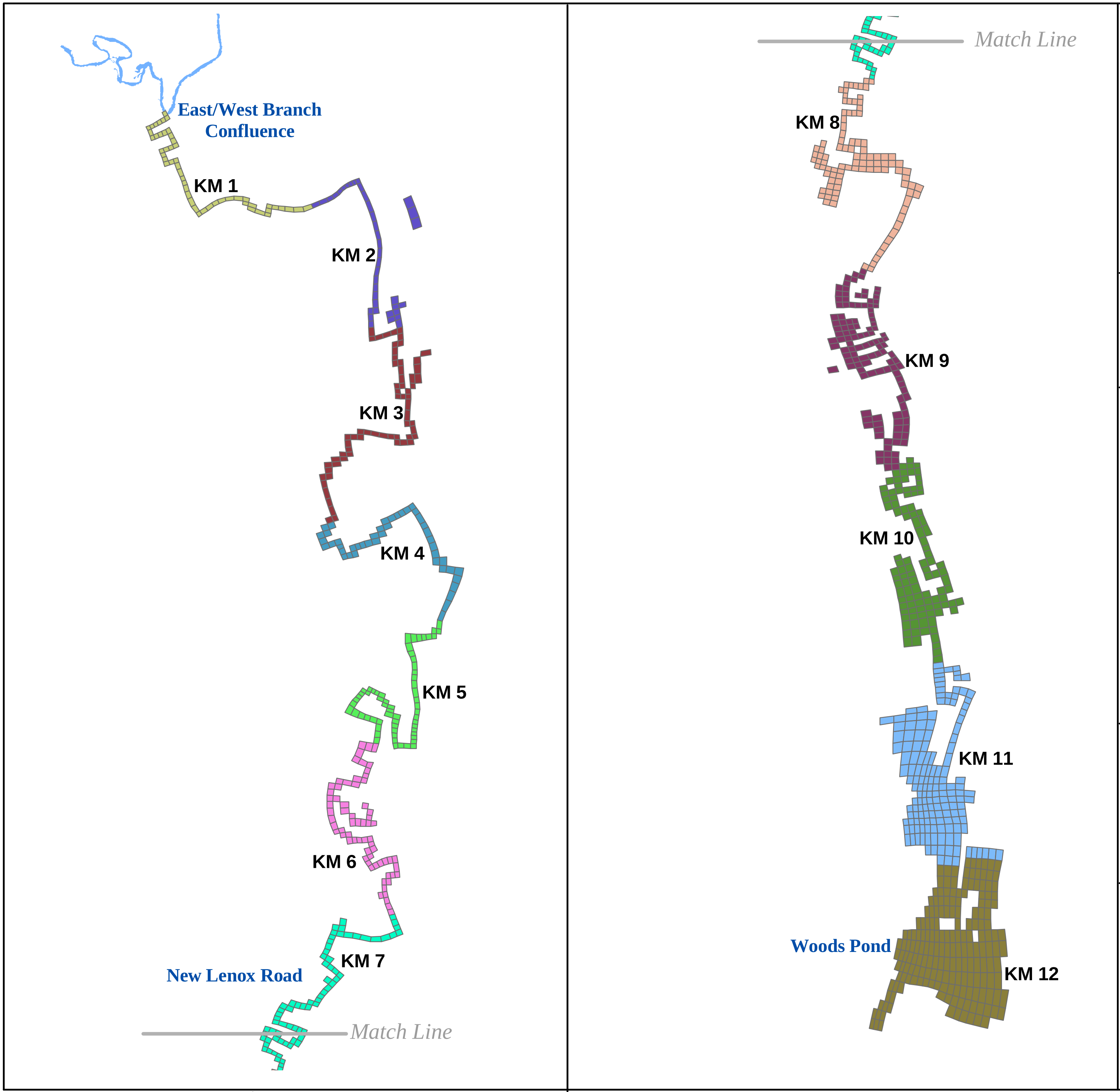
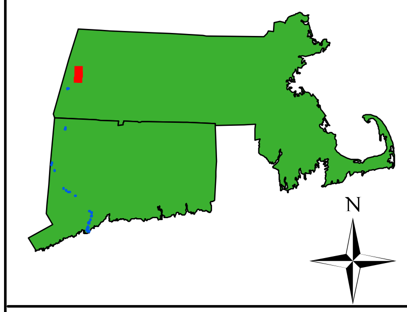


LOCATOR MAP



SCALE

0 0.25 0.5
Miles

LEGEND

☐ Wood Duck Averaging Areas

NOTE:
Separate averaging areas are shown as different colors, and labels (e.g., KM 11) represent averaging area IDs.

Figure G-6.1.
Model grid cells used to define the 1-km sediment averaging areas for insectivorous bird comparisons to sediment target levels.

ARCADIS

QEA
Quantitative Environmental Analysis, LLC
∂c/∂t

GENcms

March 2008

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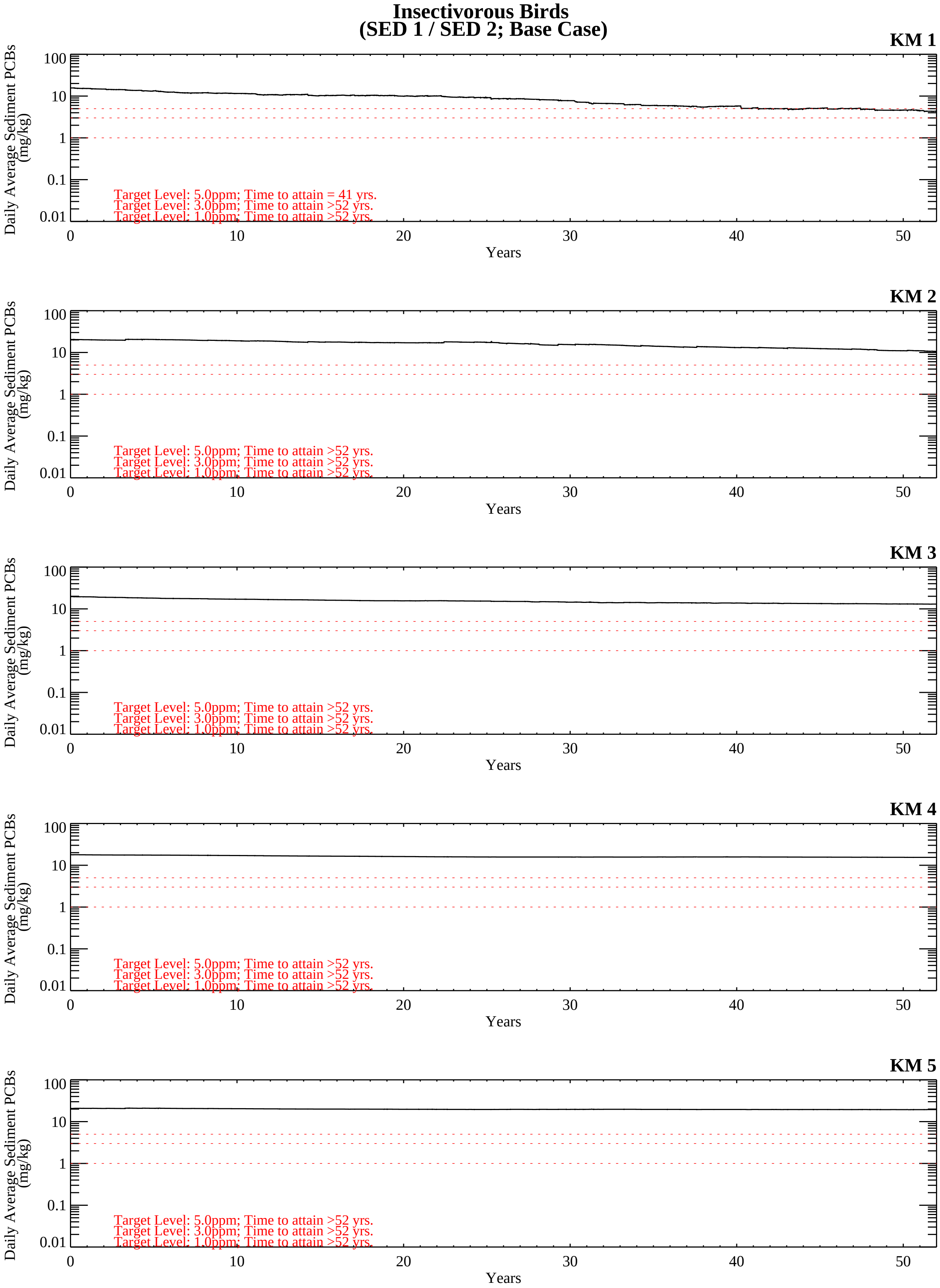

Figure G-6.2-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 1 / SED 2; Reach 5/6; Base Case).

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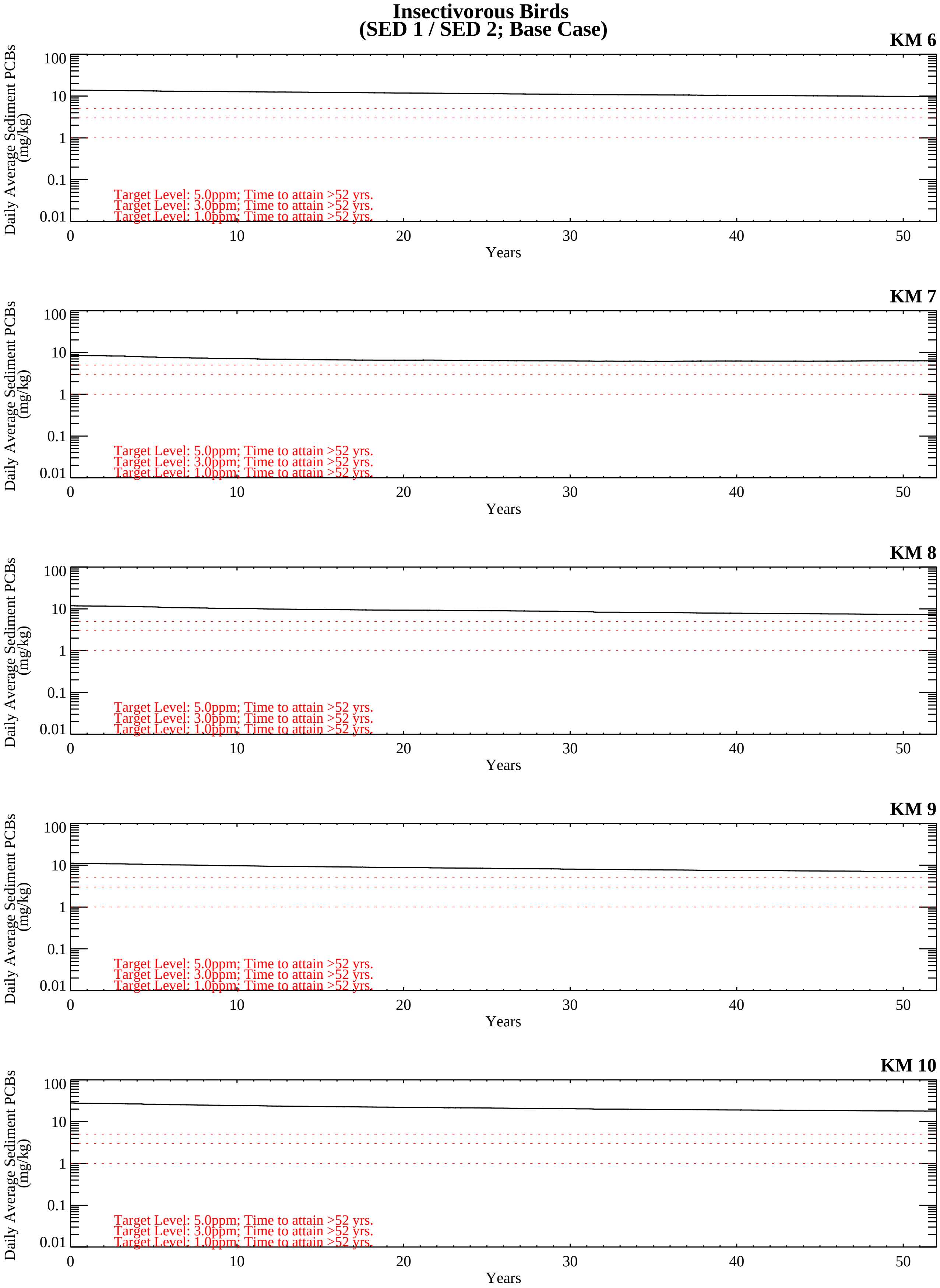

Figure G-6.2-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 1 / SED 2; Reach 5/6; Base Case).

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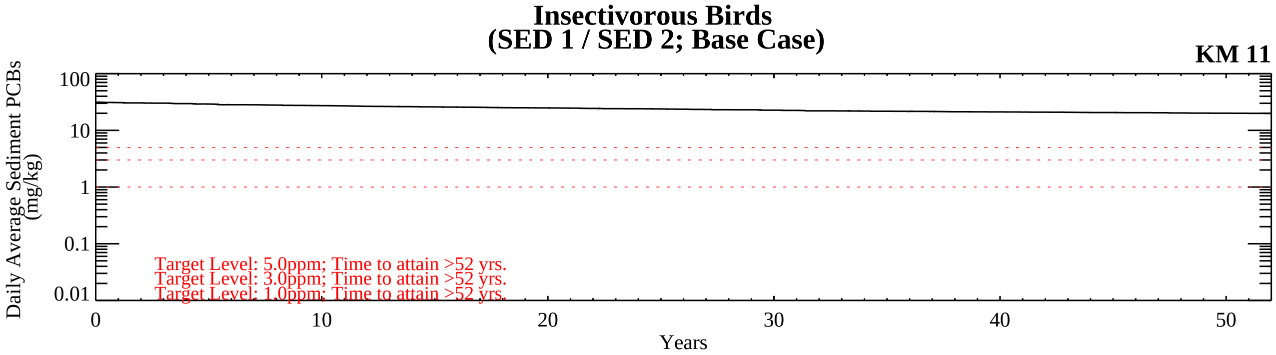

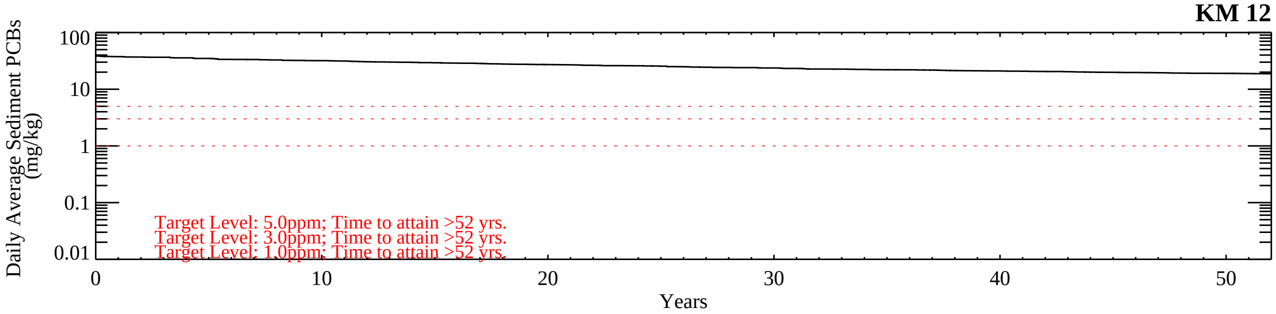

Figure G-6.2-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 1 / SED 2; Reach 5/6; Base Case).

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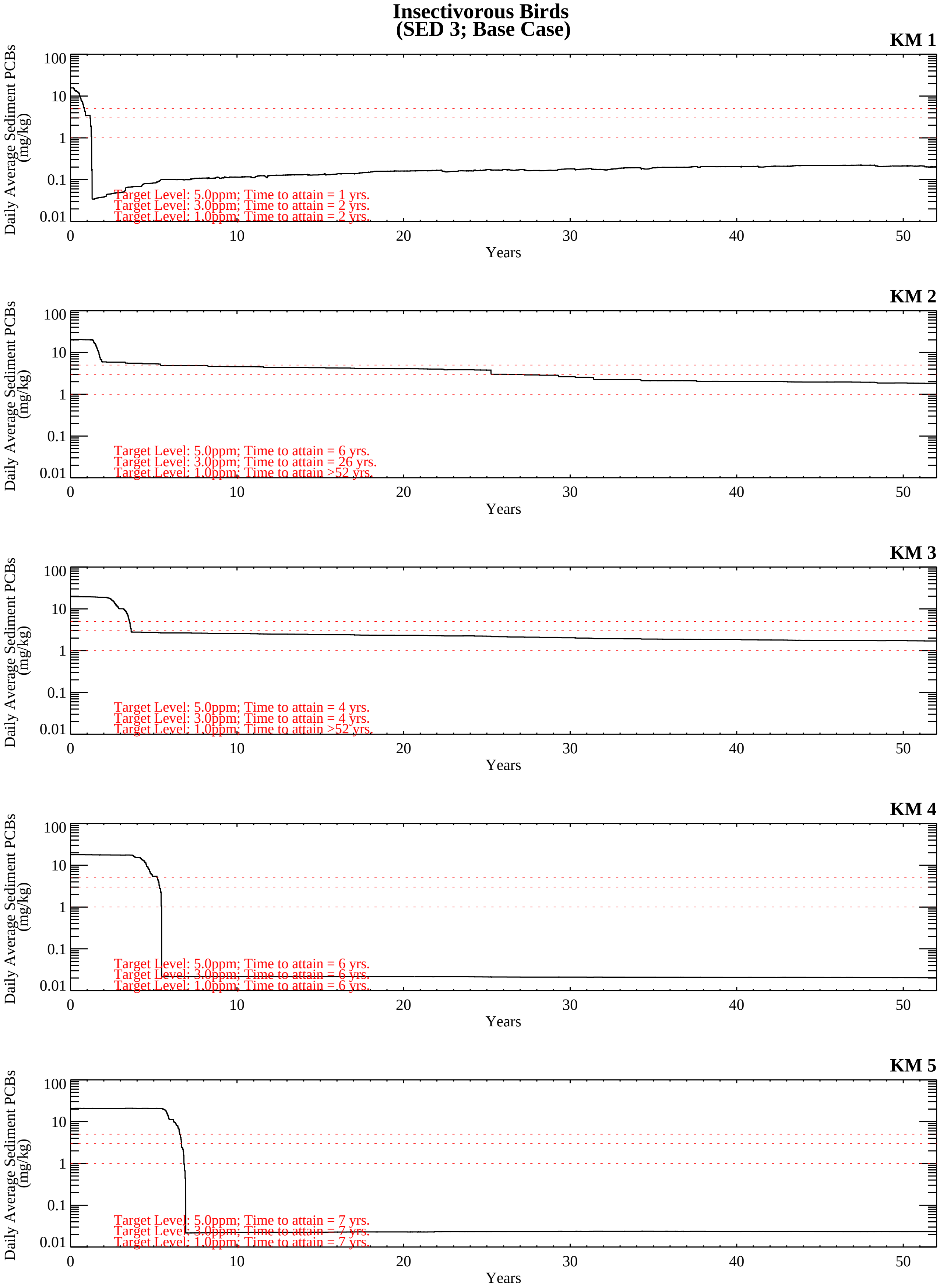

Figure G-6.2-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 3; Reach 5/6; Base Case).

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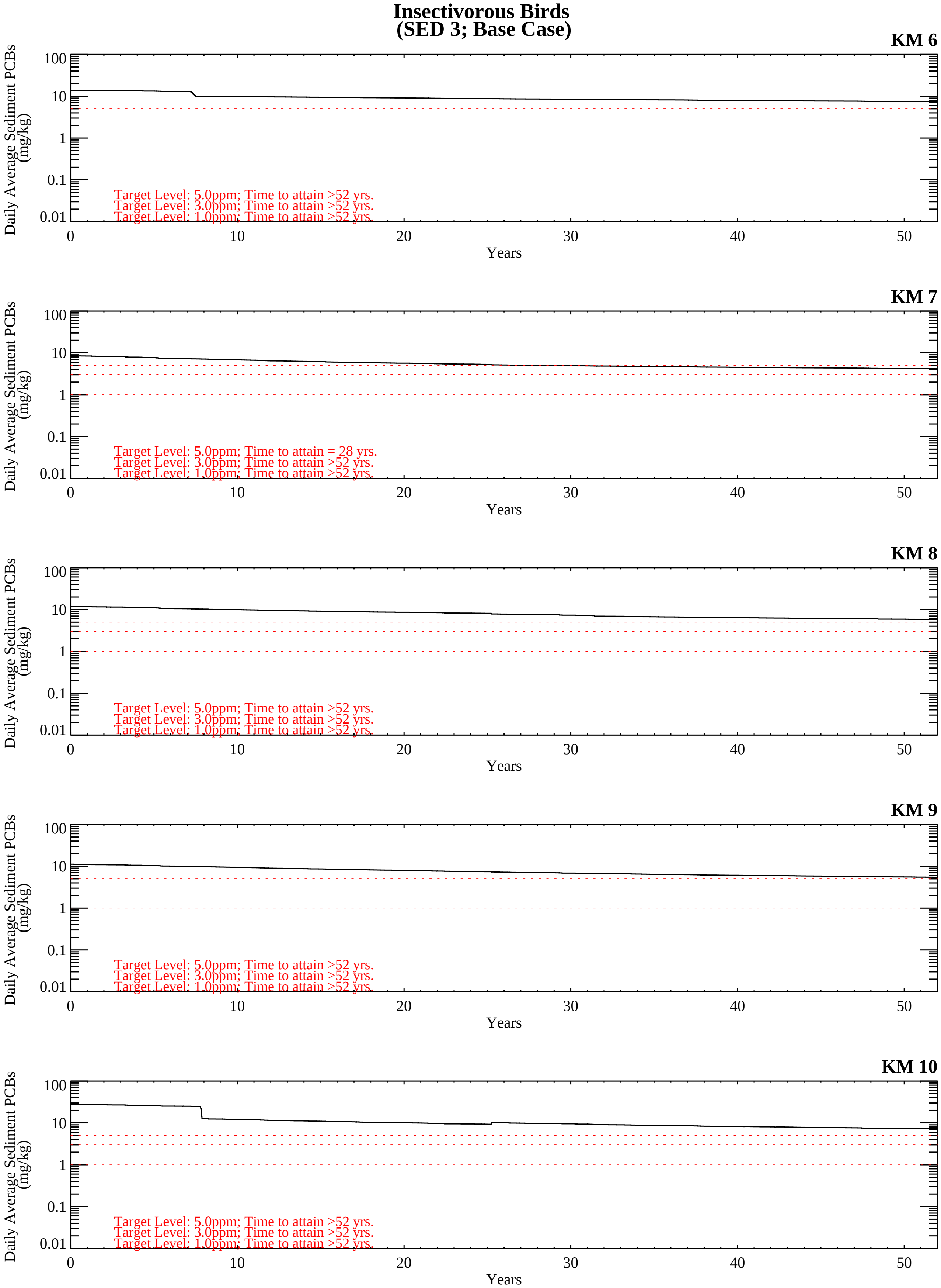

Figure G-6.2-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 3; Reach 5/6; Base Case).

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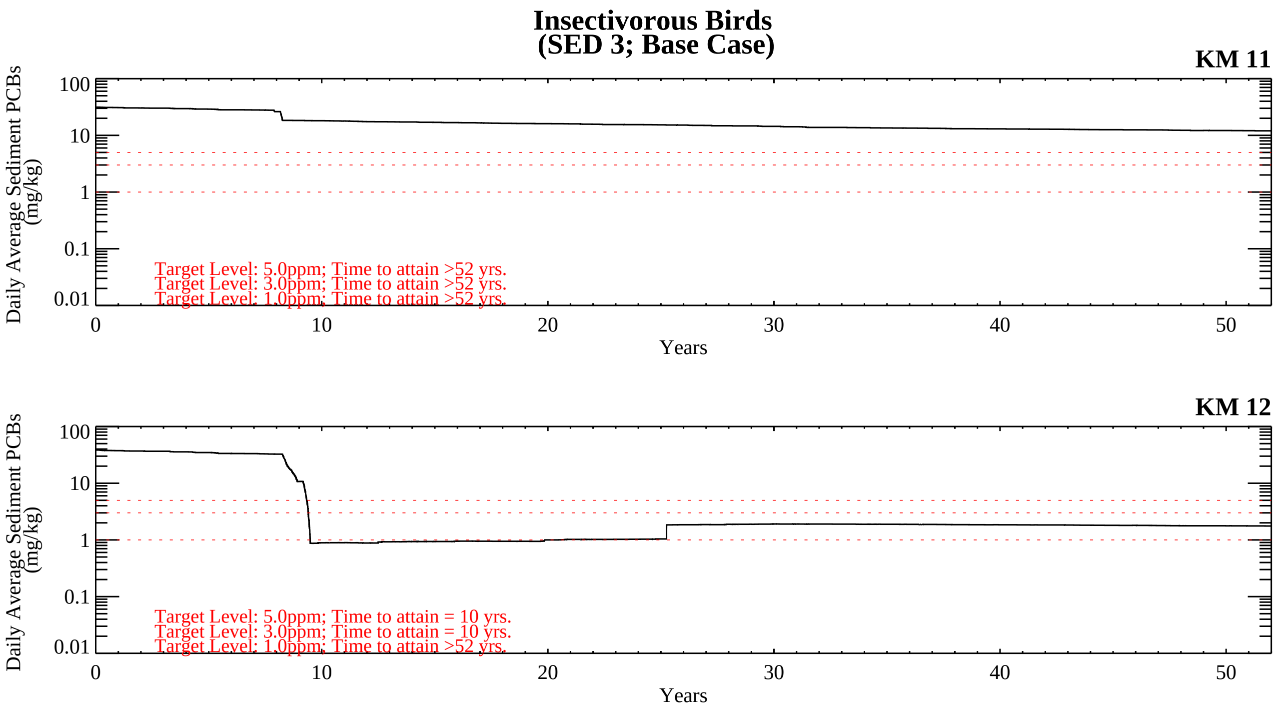

Insectivorous Birds
(SED 3; Base Case)

KM 11

Target Level: 5.0ppm; Time to attain >52 yrs.
Target Level: 3.0ppm; Time to attain >52 yrs.
Target Level: 1.0ppm; Time to attain >52 yrs.

KM 12

Target Level: 5.0ppm; Time to attain = 10 yrs.
Target Level: 3.0ppm; Time to attain = 10 yrs.
Target Level: 1.0ppm; Time to attain >52 yrs.

Figure G-6.2-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 3; Reach 5/6; Base Case).

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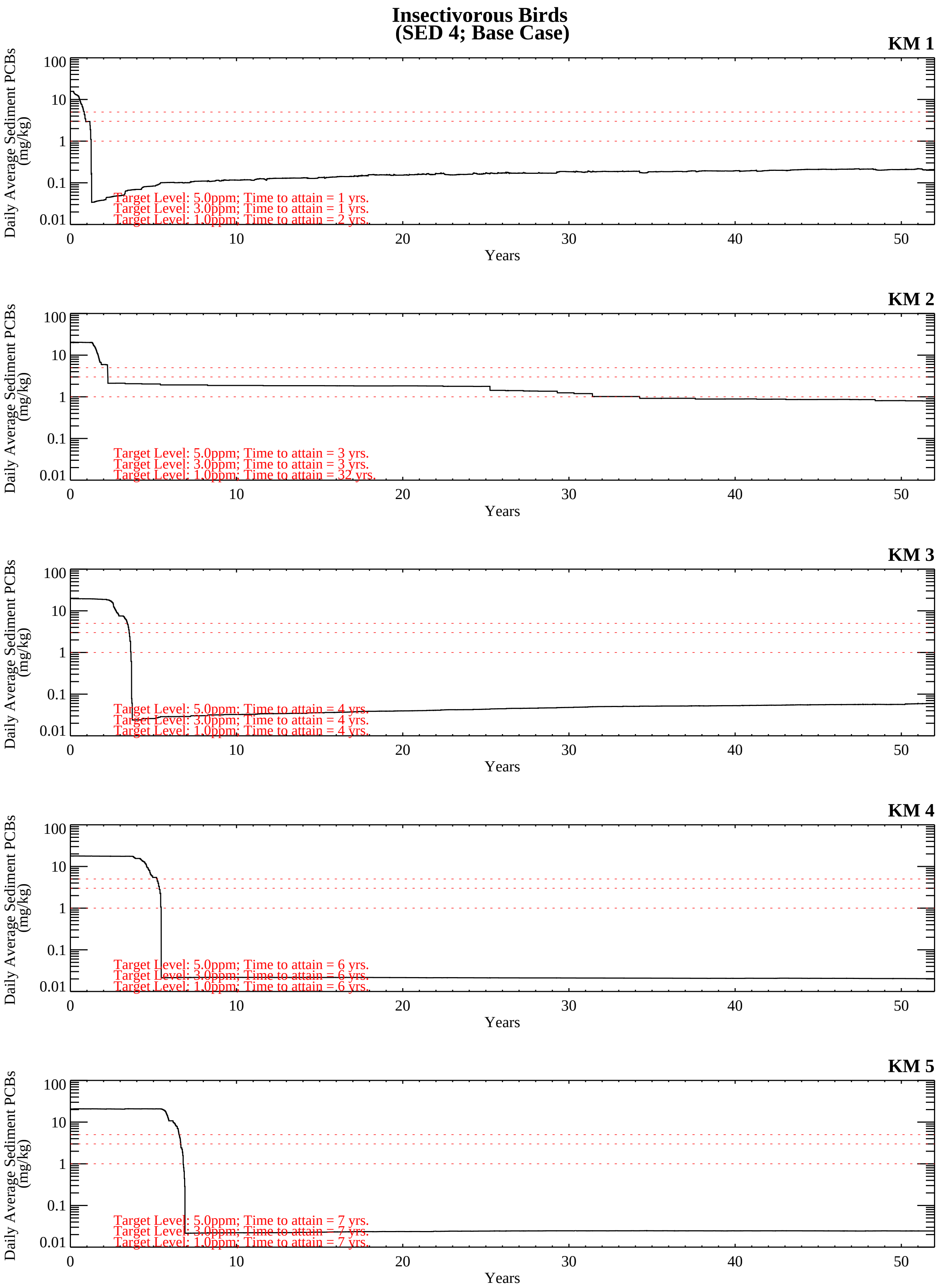

Figure G-6.2-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 4; Reach 5/6; Base Case).

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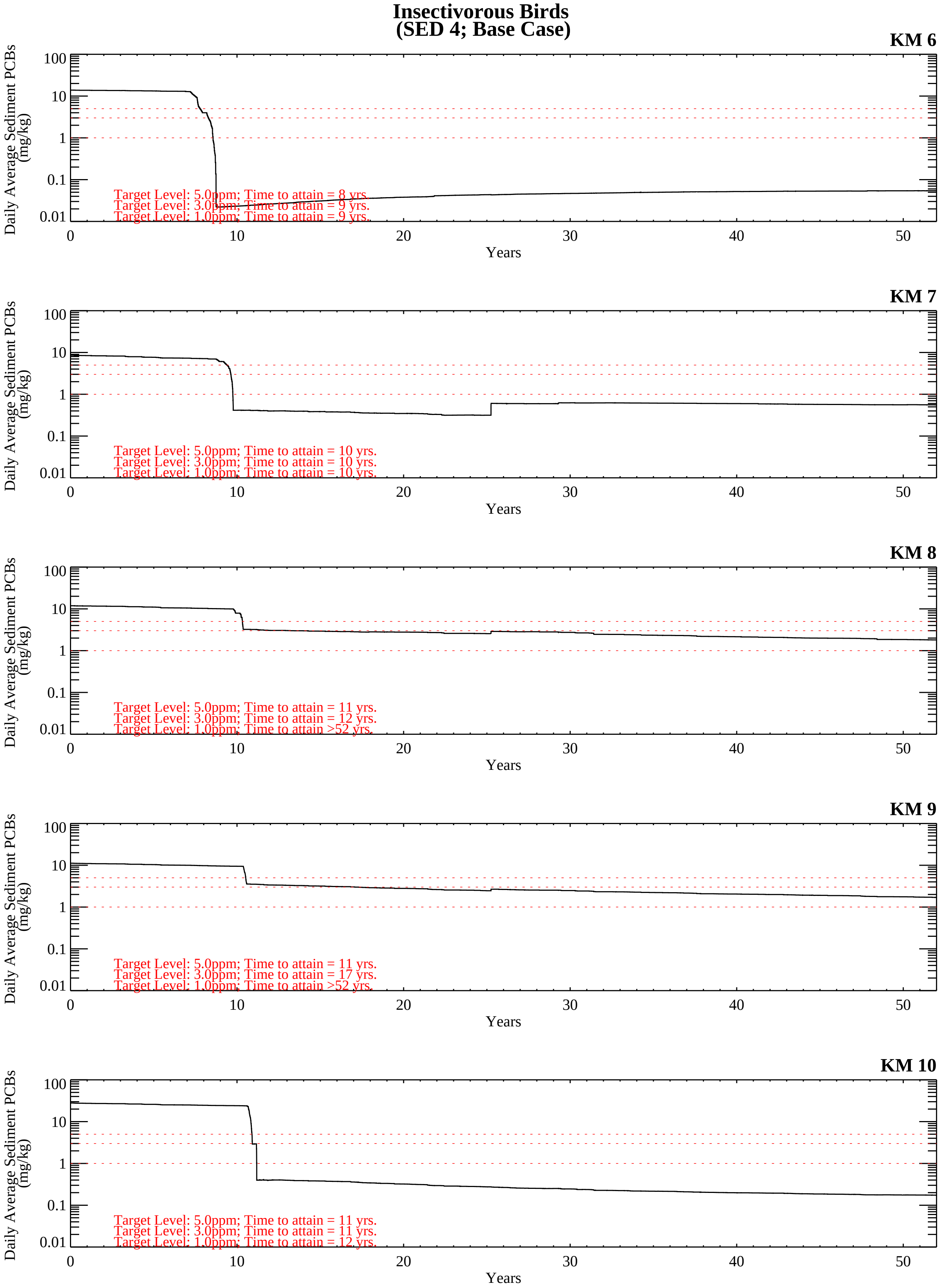

Figure G-6.2-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 4; Reach 5/6; Base Case).

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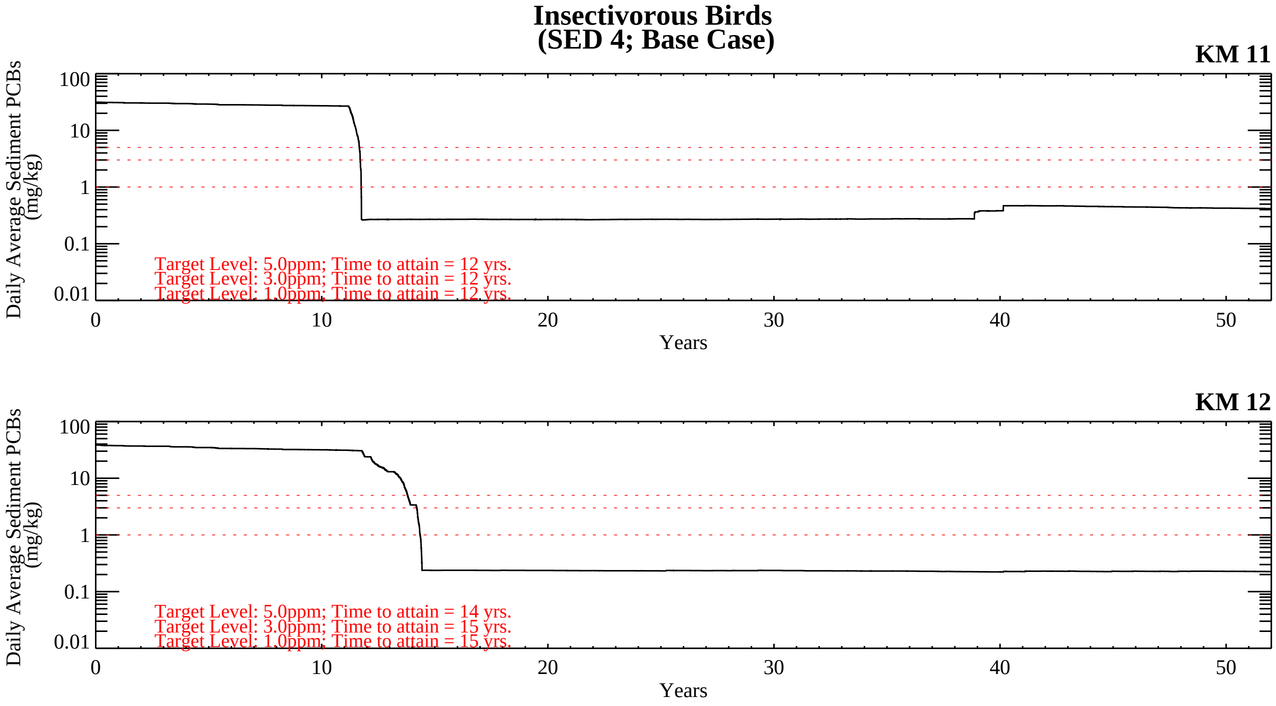

Figure G-6.2-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 4; Reach 5/6; Base Case).

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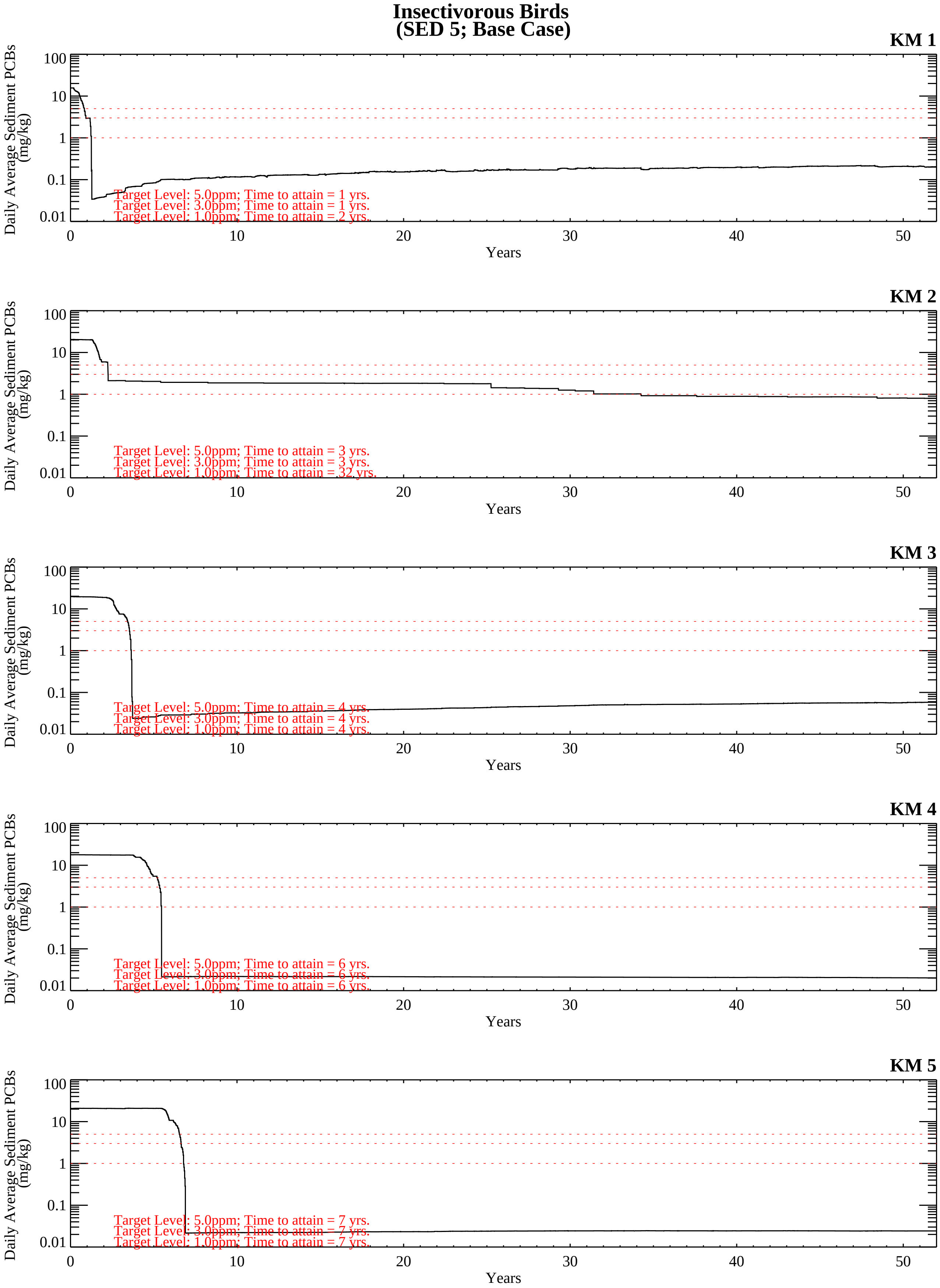

Figure G-6.2-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 5; Reach 5/6; Base Case).

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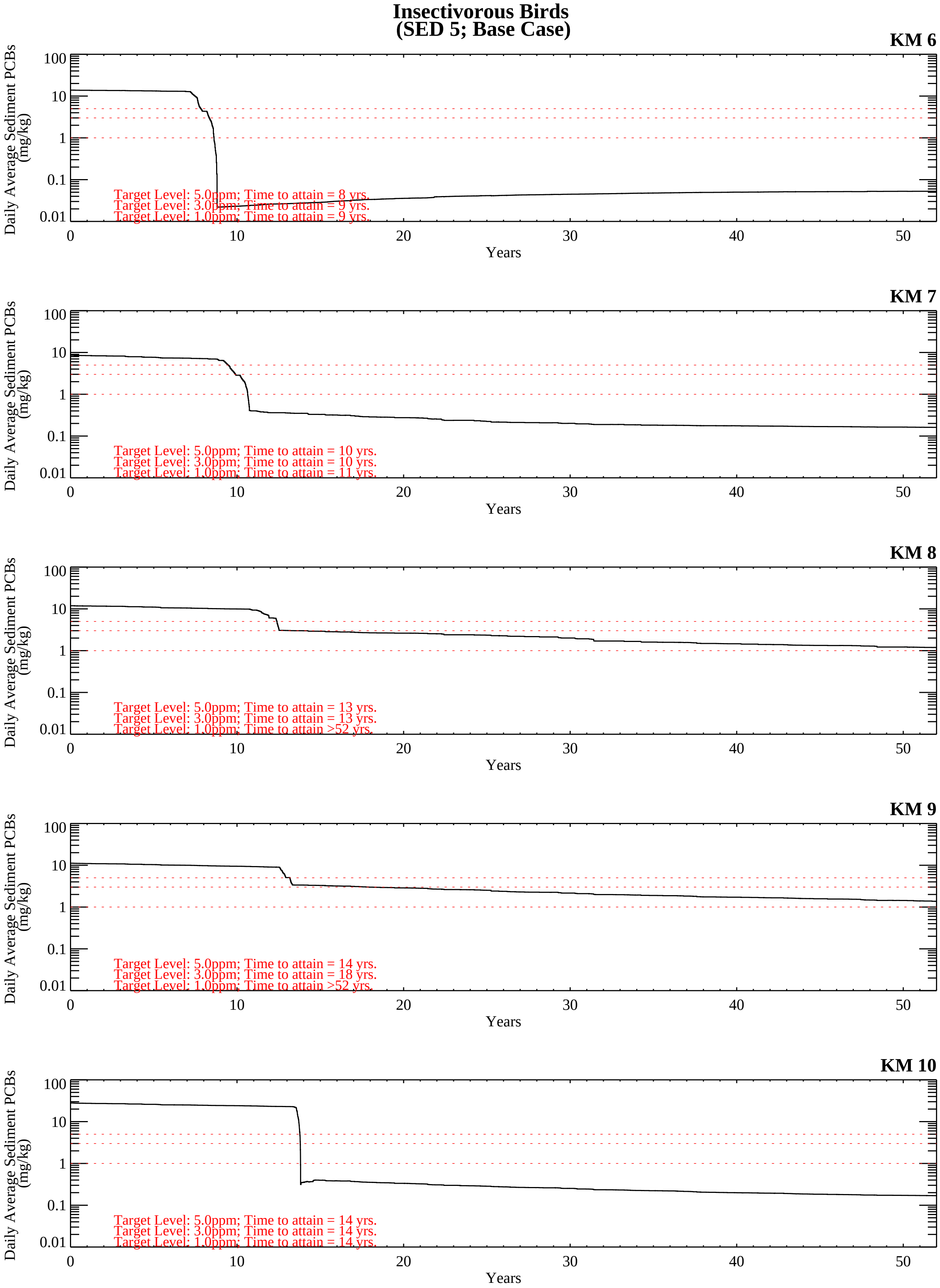

Figure G-6.2-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 5; Reach 5/6; Base Case).

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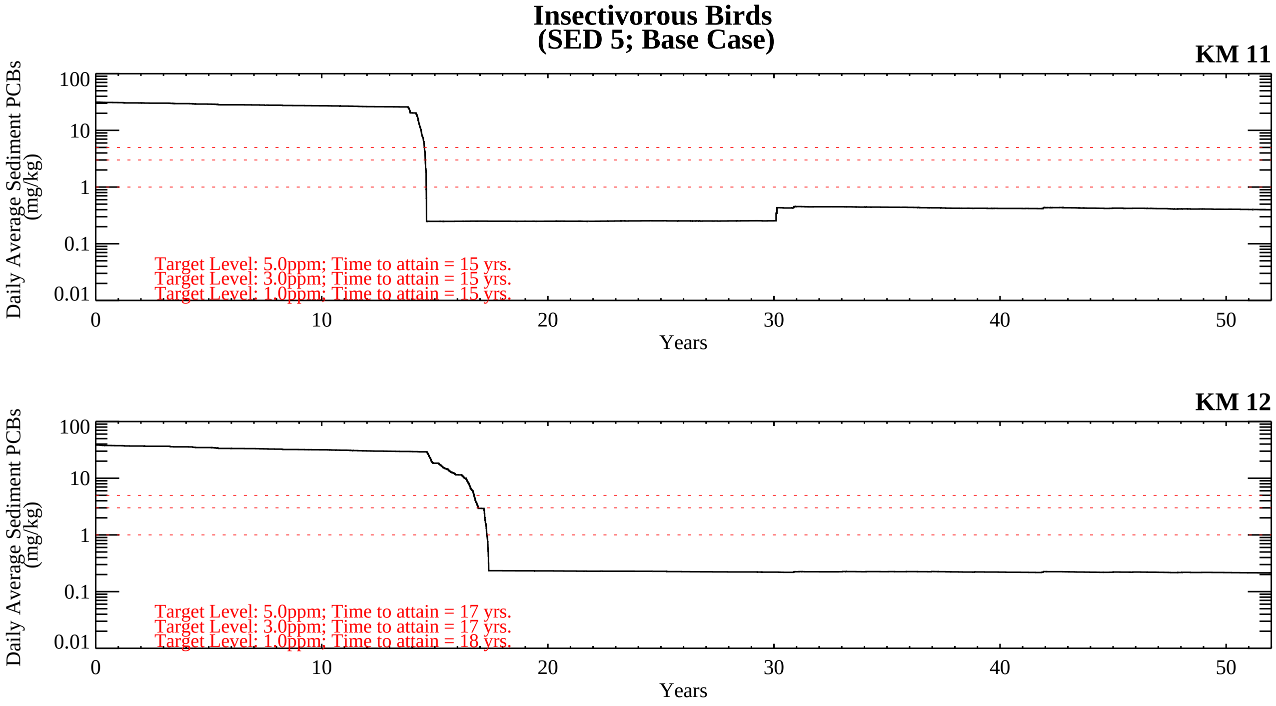

Figure G-6.2-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 5; Reach 5/6; Base Case).

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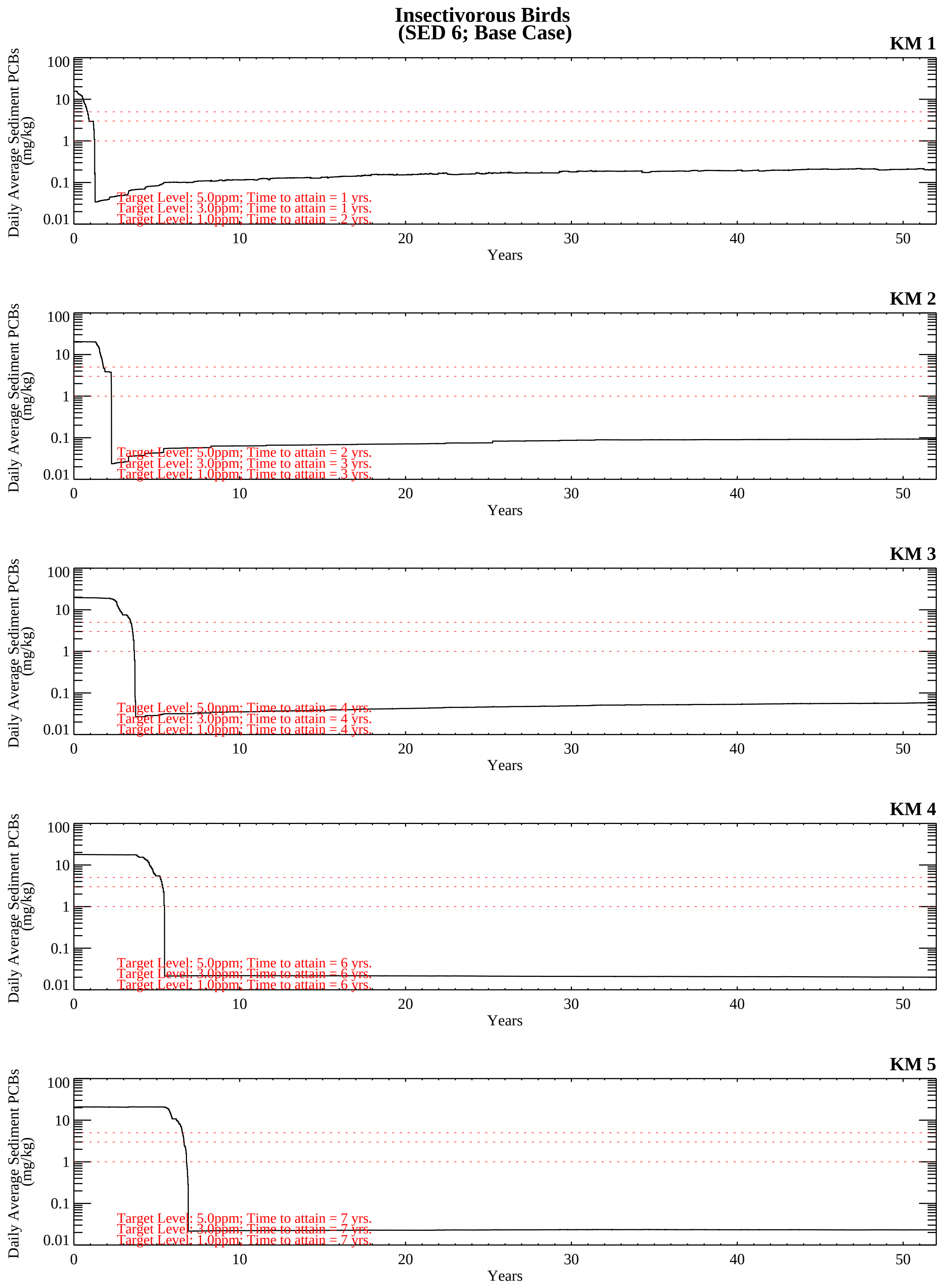

Figure G-6.2-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 6; Reach 5/6; Base Case).

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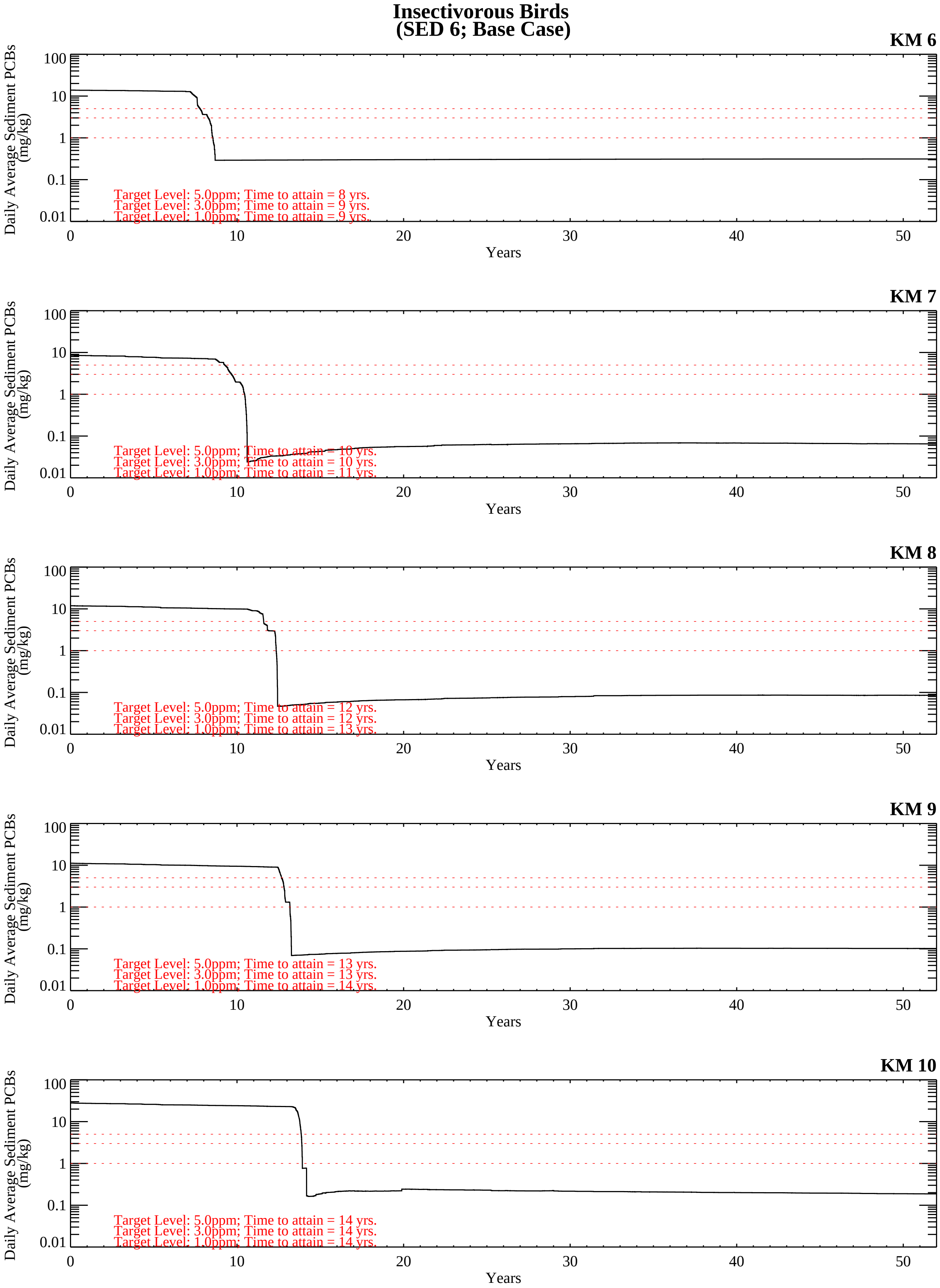

Figure G-6.2-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 6; Reach 5/6; Base Case).

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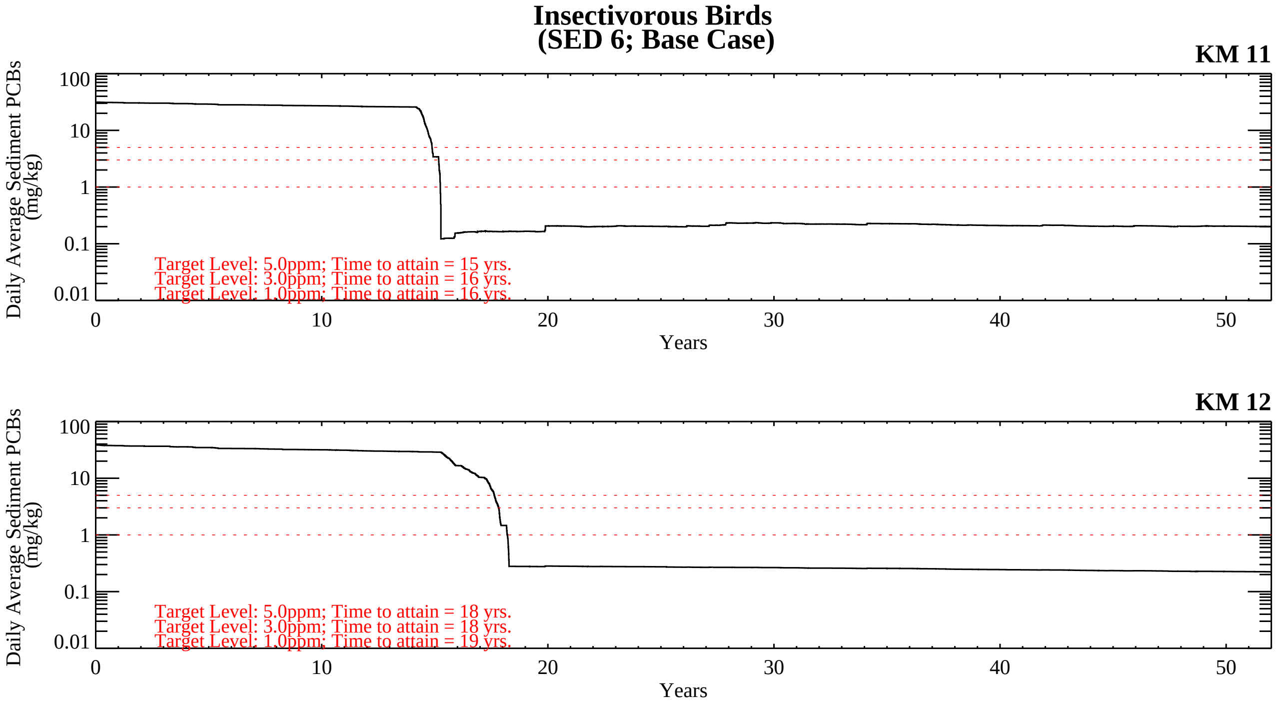

Figure G-6.2-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 6; Reach 5/6; Base Case).

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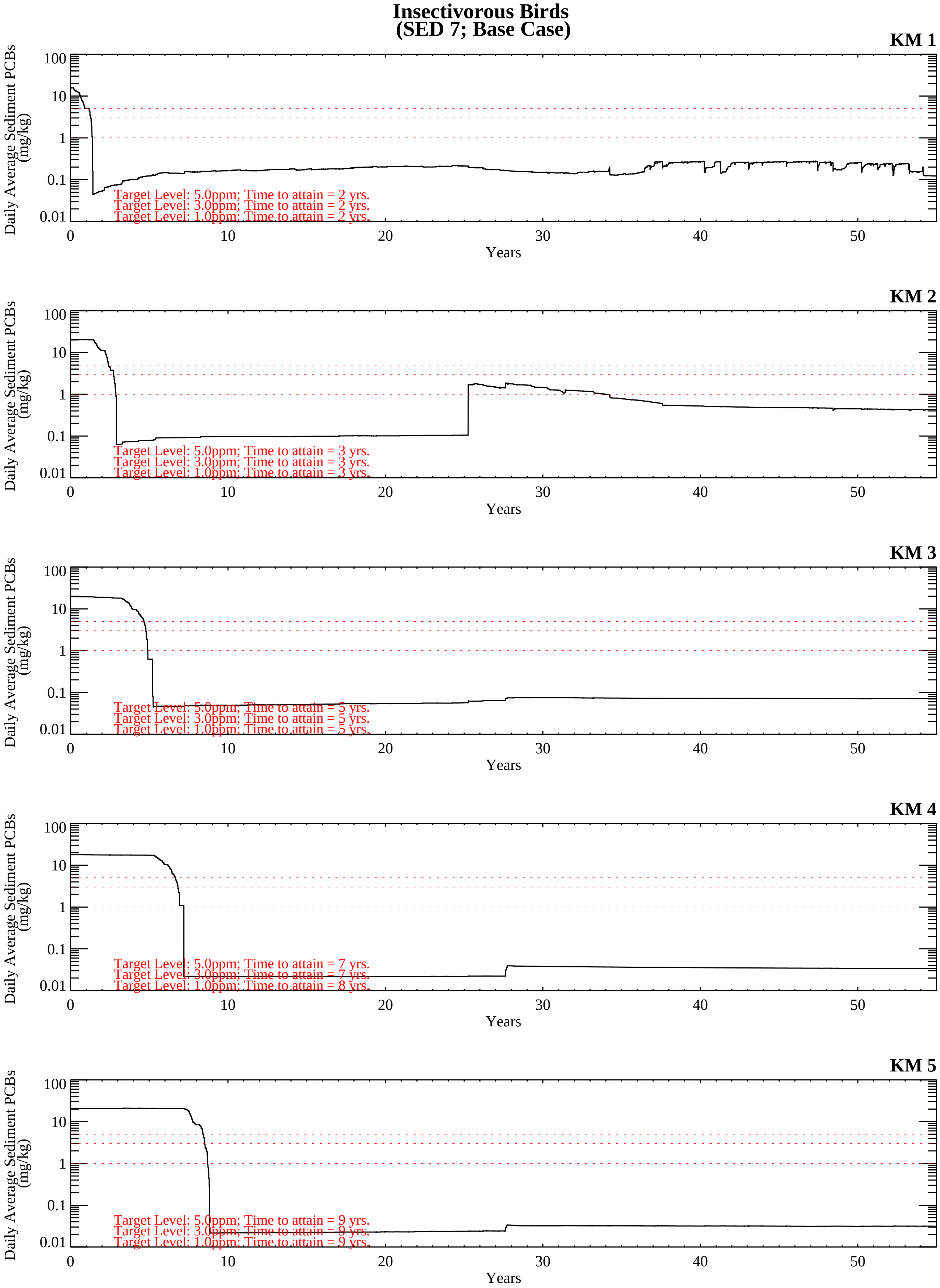

Figure G-6.2-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 7; Reach 5/6; Base Case).

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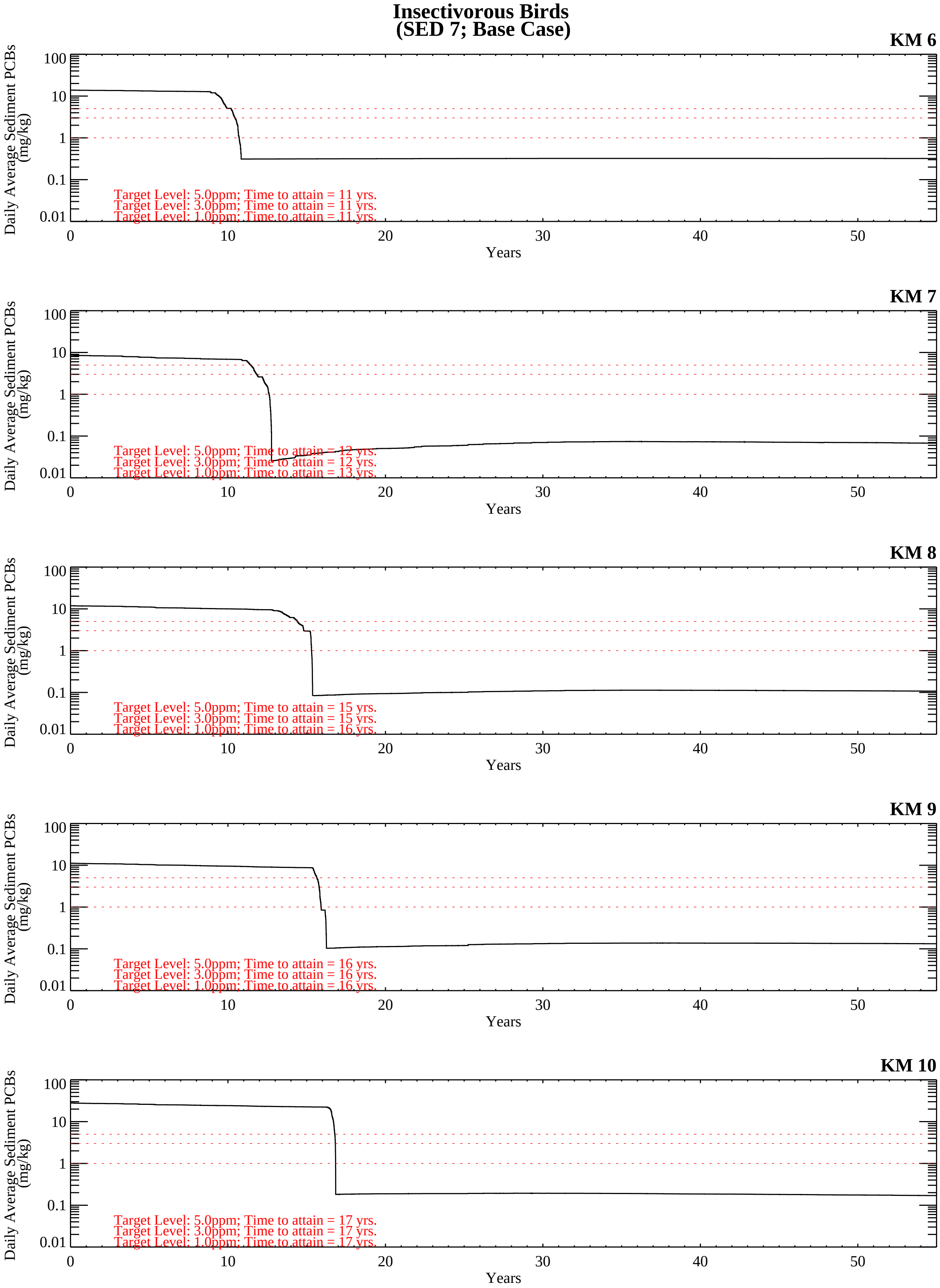

Figure G-6.2-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 7; Reach 5/6; Base Case).

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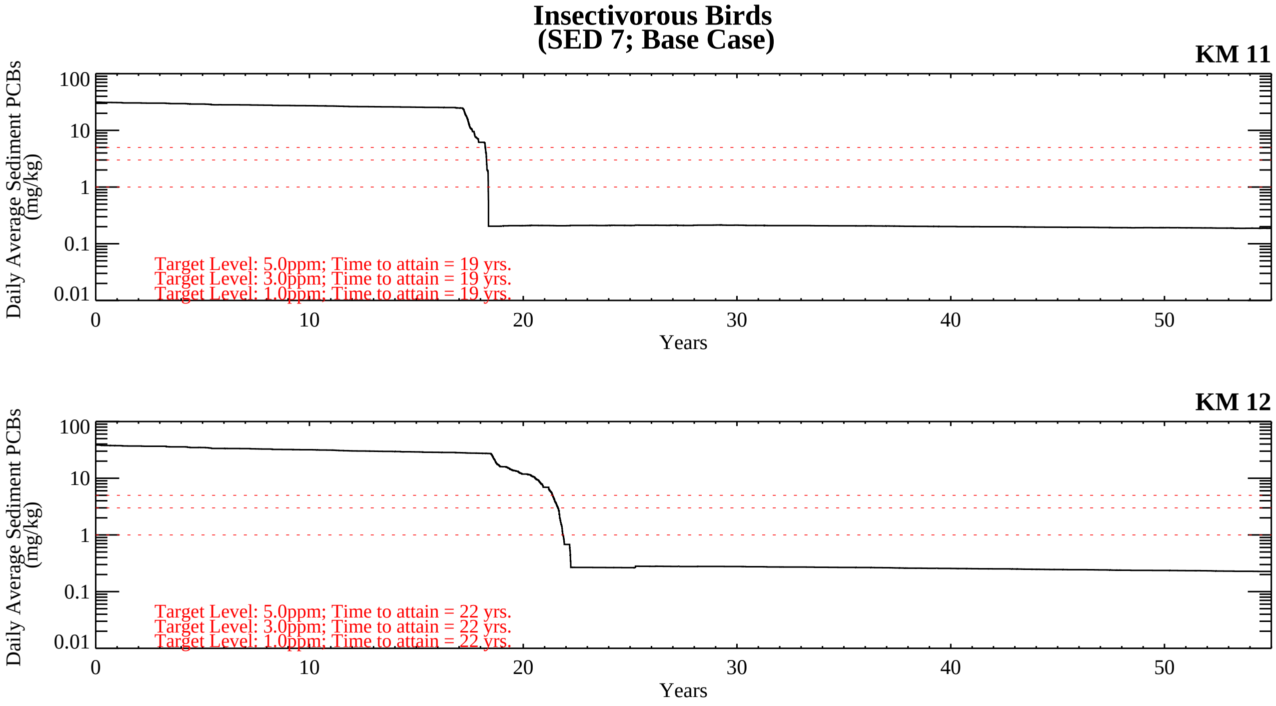

Figure G-6.2-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 7; Reach 5/6; Base Case).

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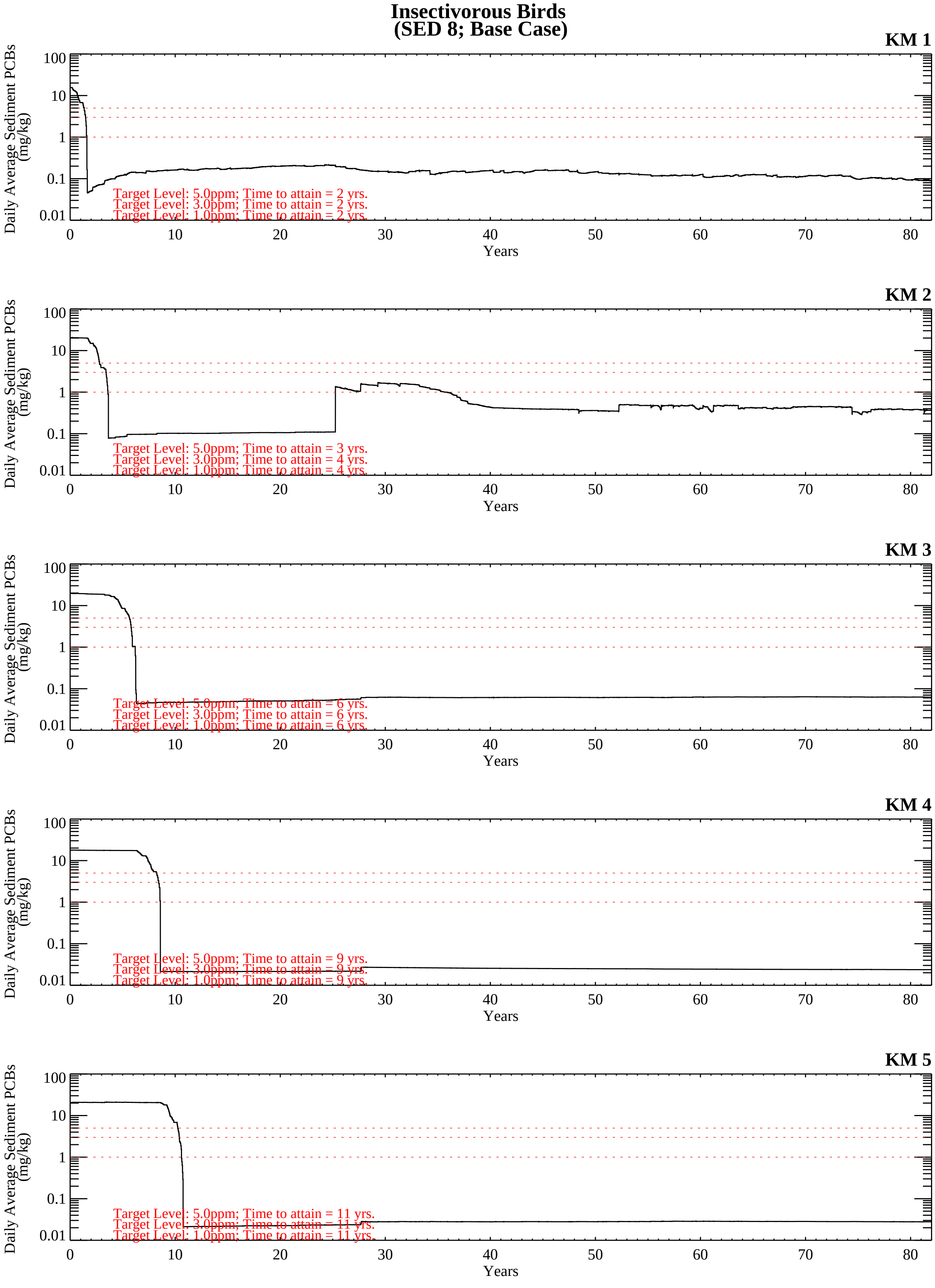

Figure G-6.2-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 8; Reach 5/6; Base Case).

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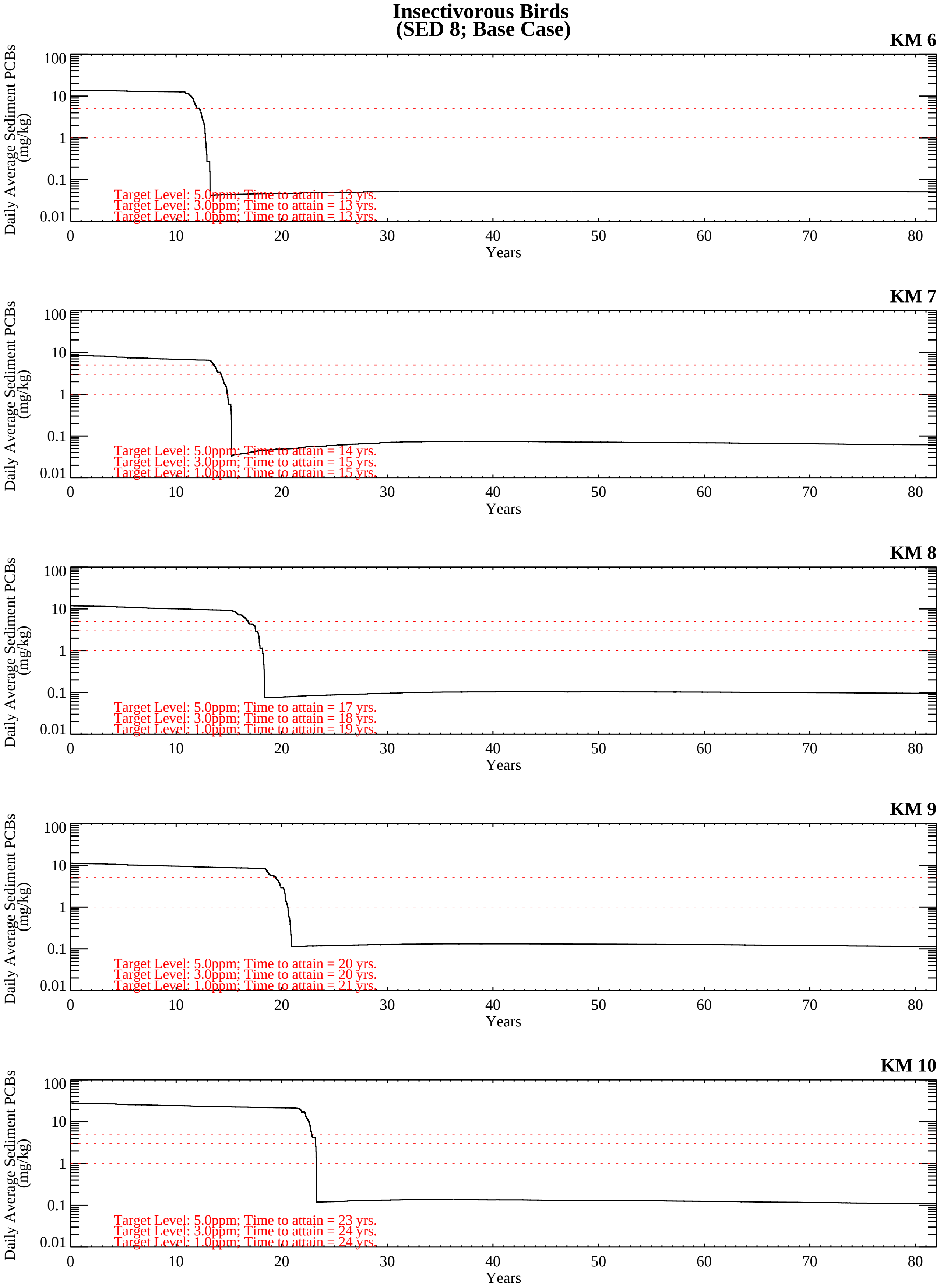

Figure G-6.2-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 8; Reach 5/6; Base Case).

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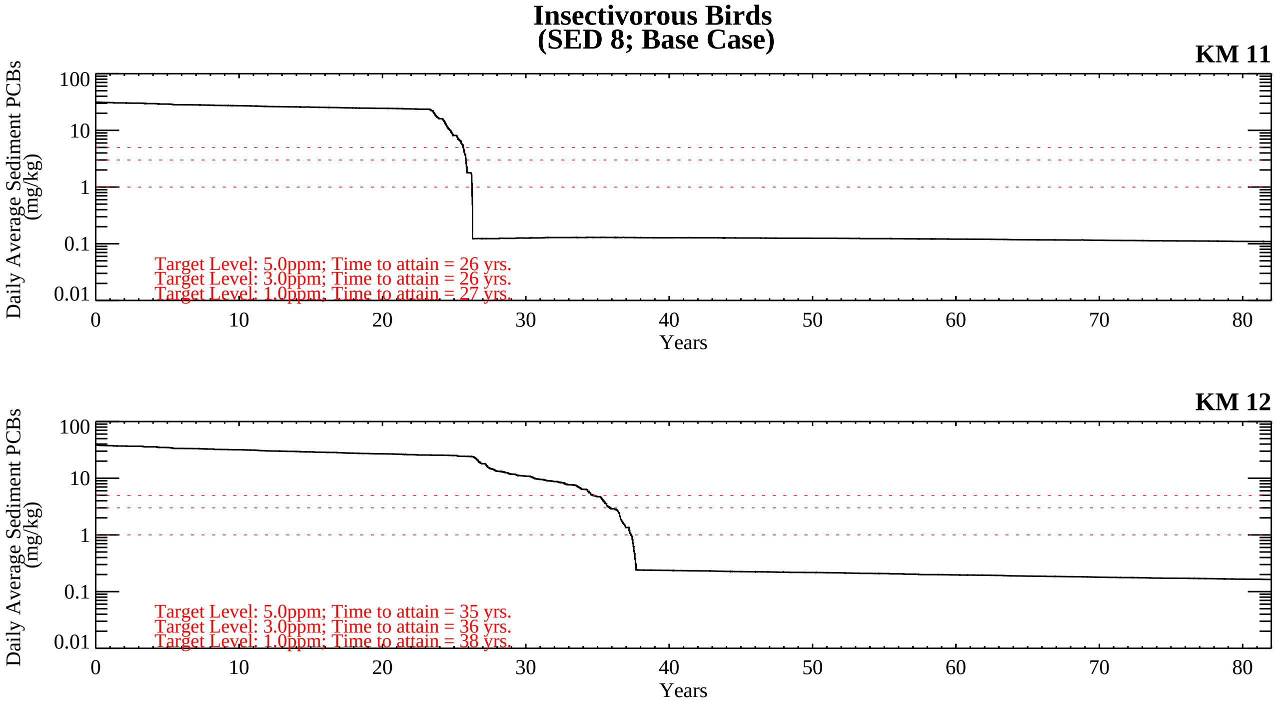

Figure G-6.2-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 8; Reach 5/6; Base Case).

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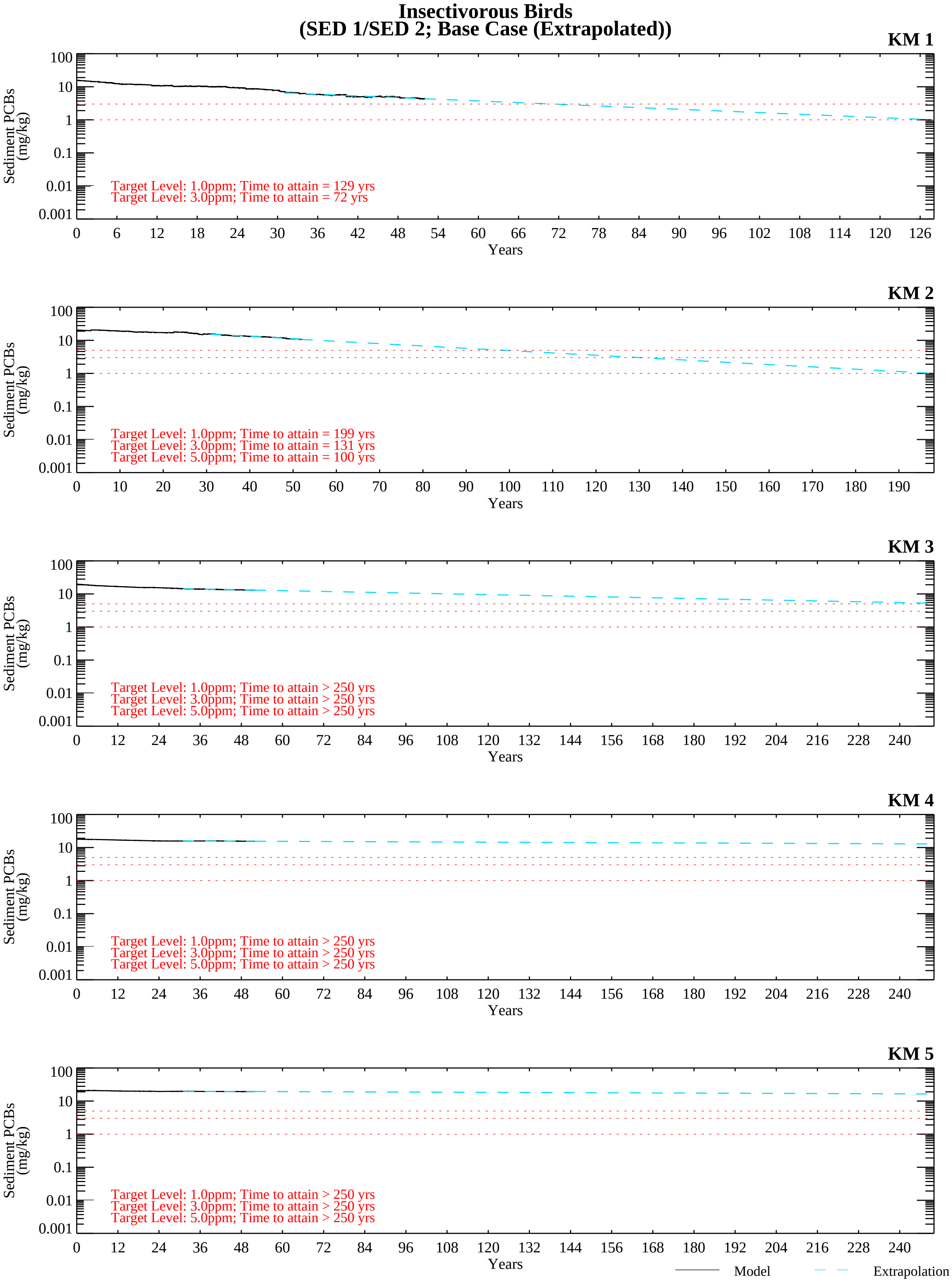

Figure G-6.3-1a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 1/SED 2; Reach 5/6; Base Case).

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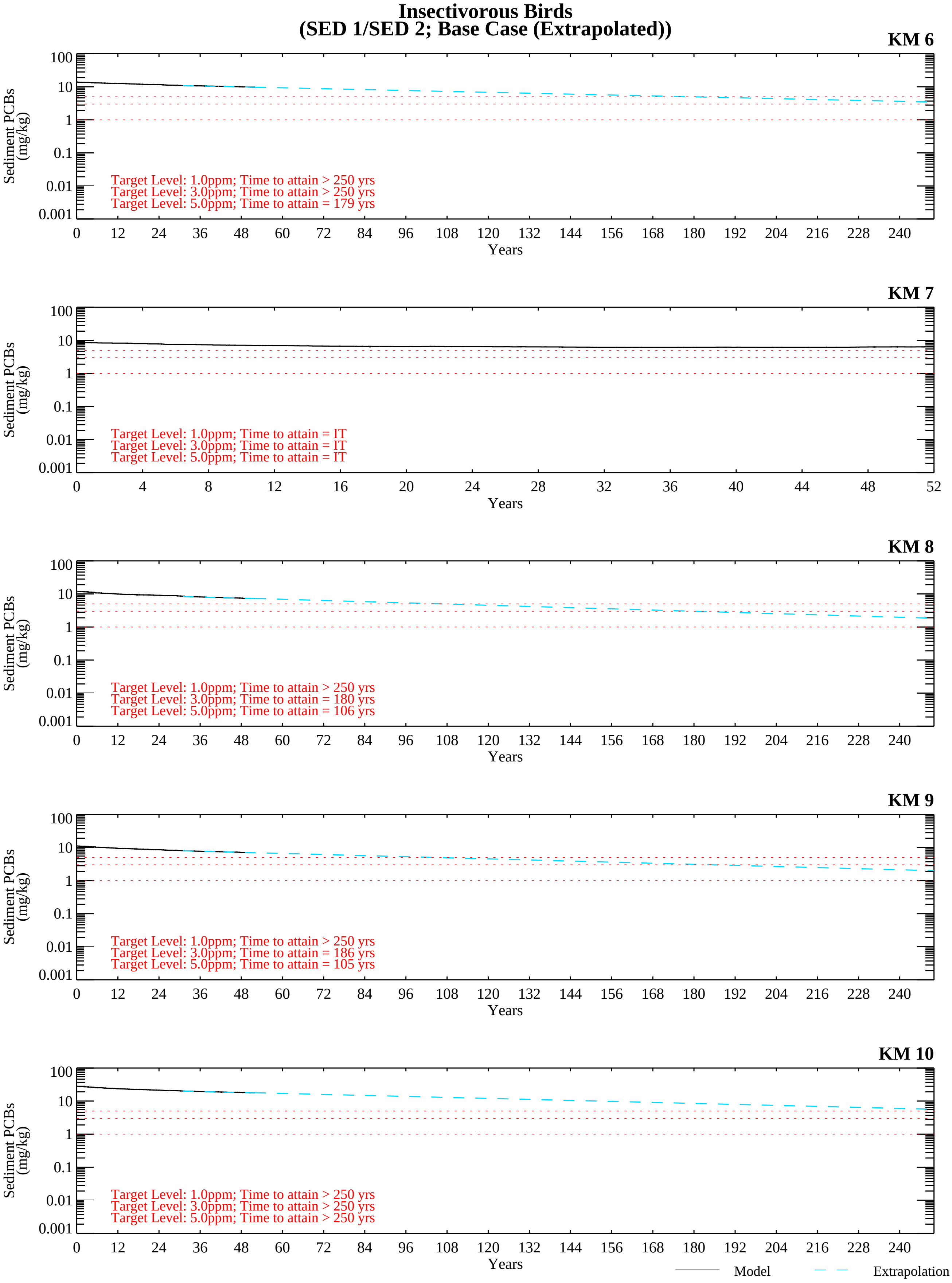

Figure G-6.3-1a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 1/SED 2; Reach 5/6; Base Case).

Run path:\\Tenmile\EFDC_Output\R56\CMS\Proj_R56_SED1CMSBS_0712-01\bins
Notes: IT = No extrapolation performed due to an increasing trend.

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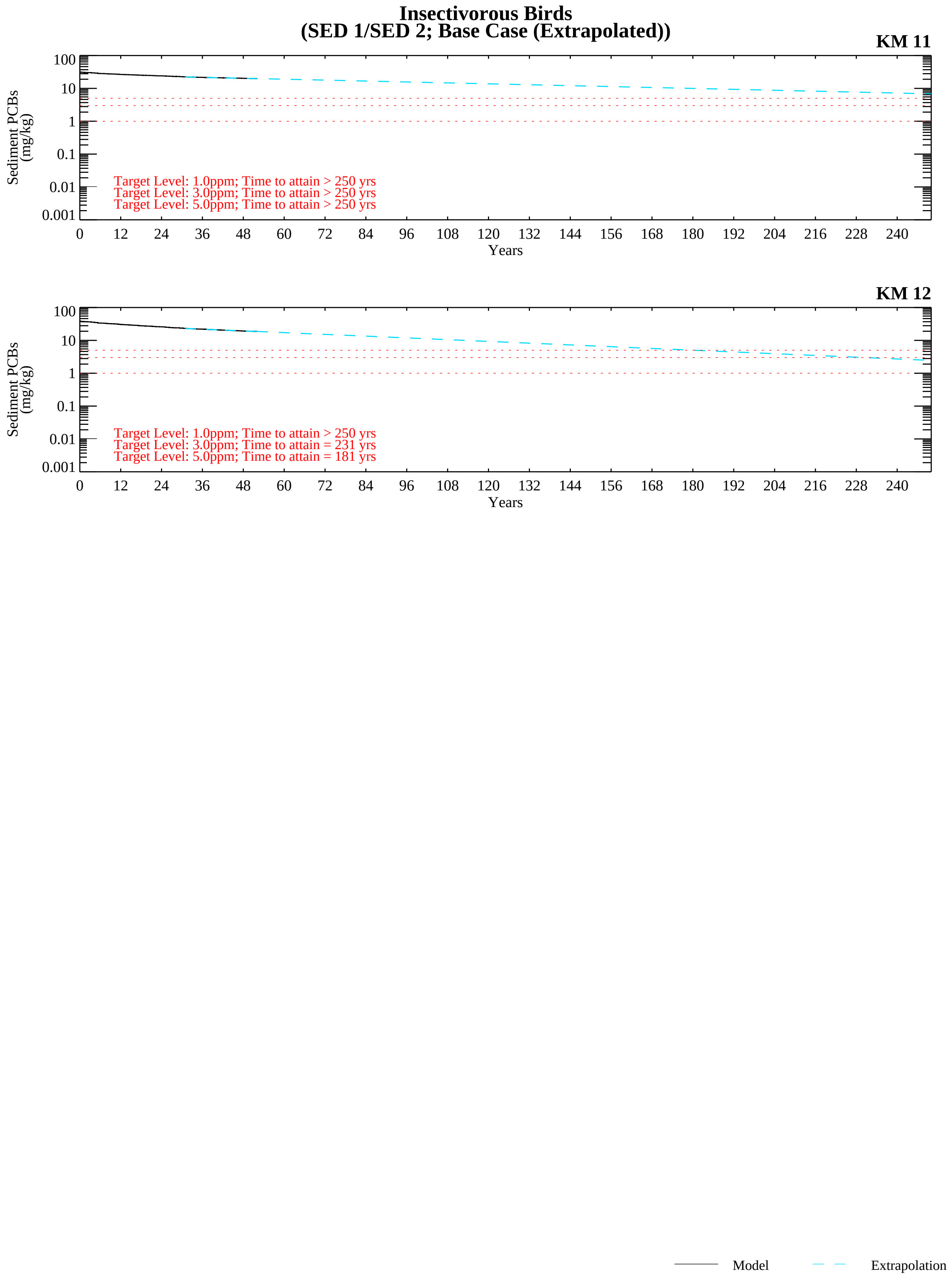

Figure G-6.3-1a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 1/SED 2; Reach 5/6; Base Case).

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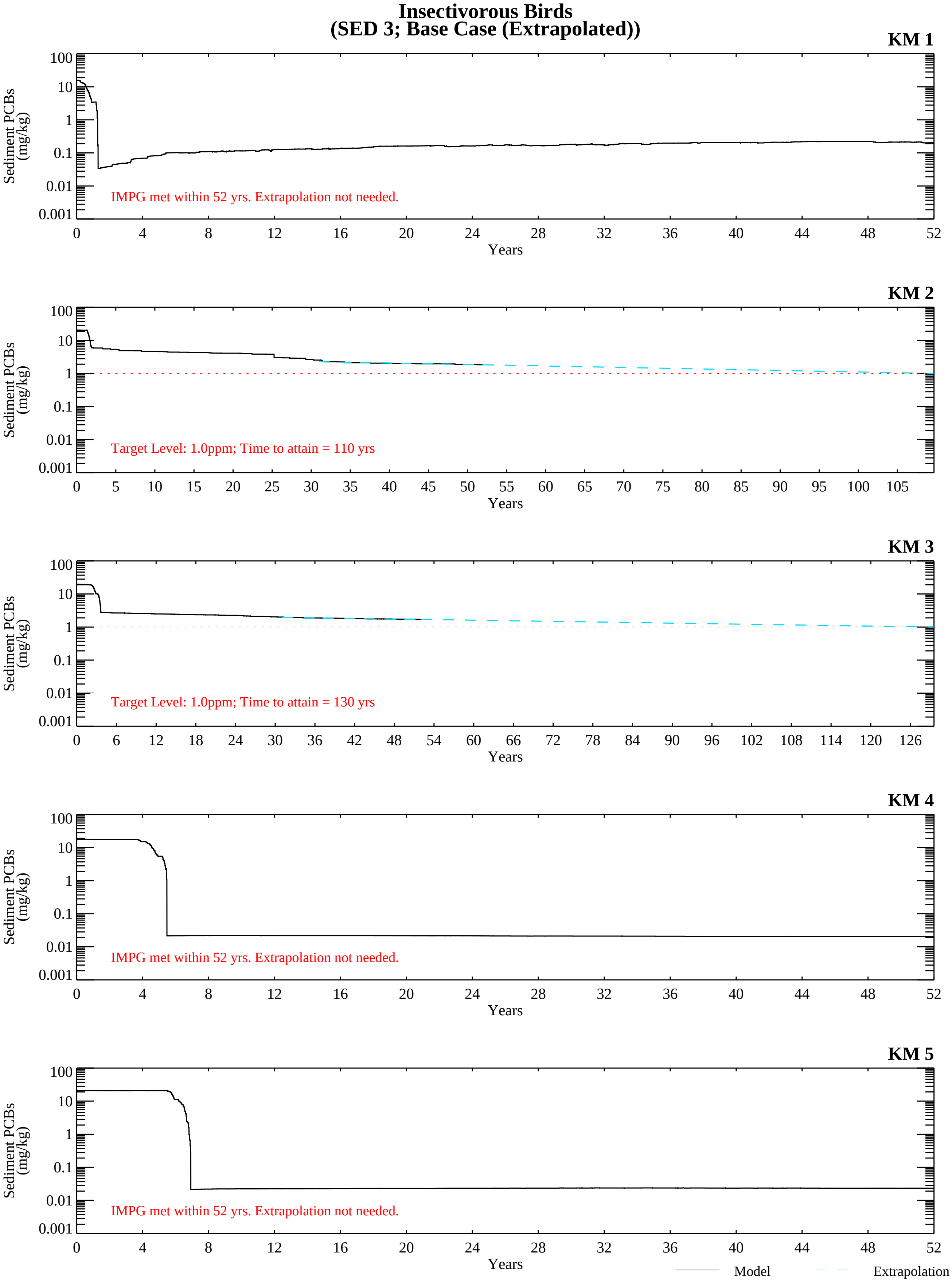

Figure G-6.3-2a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 3; Reach 5/6; Base Case).

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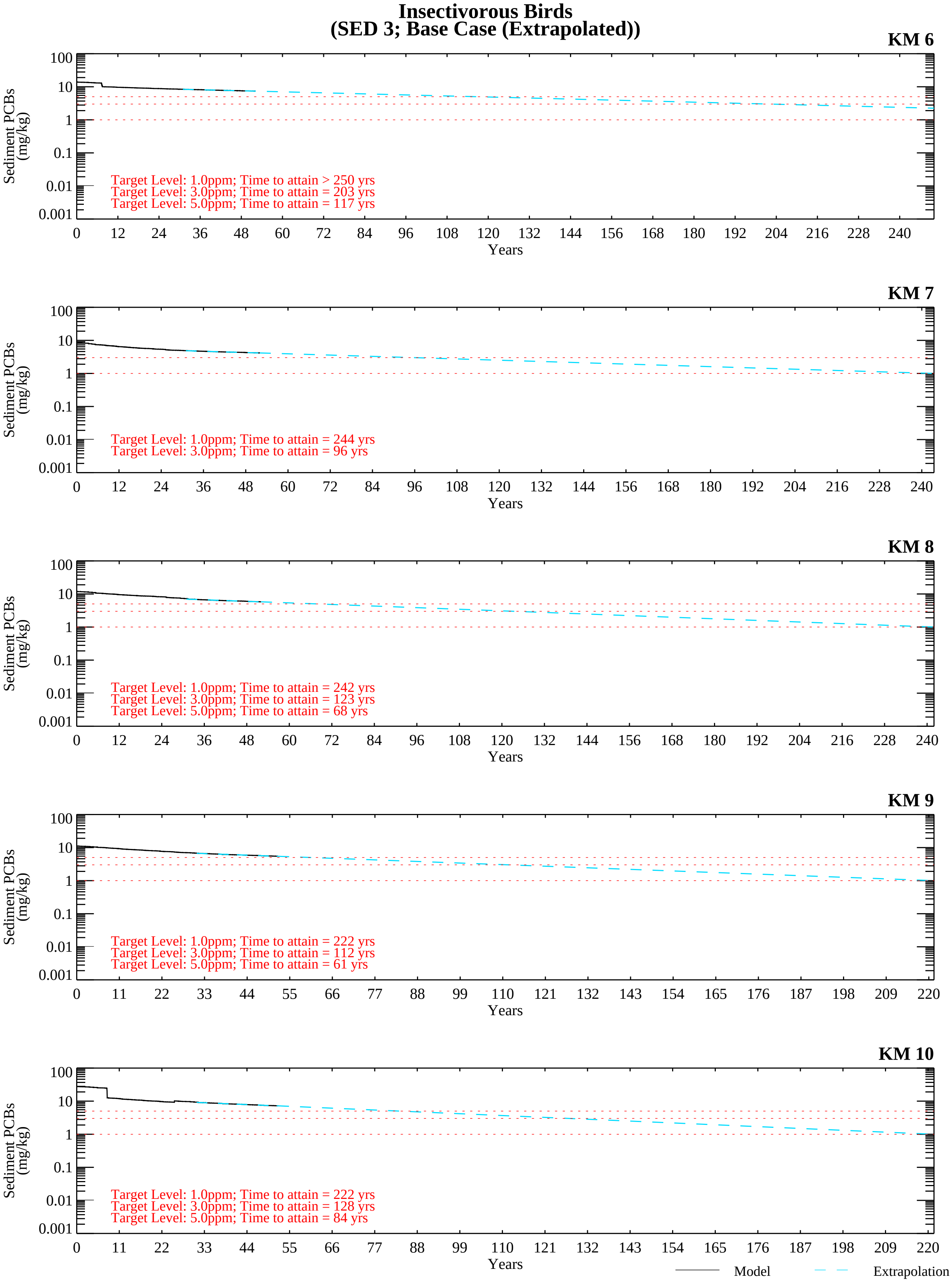

Figure G-6.3-2a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 3; Reach 5/6; Base Case).

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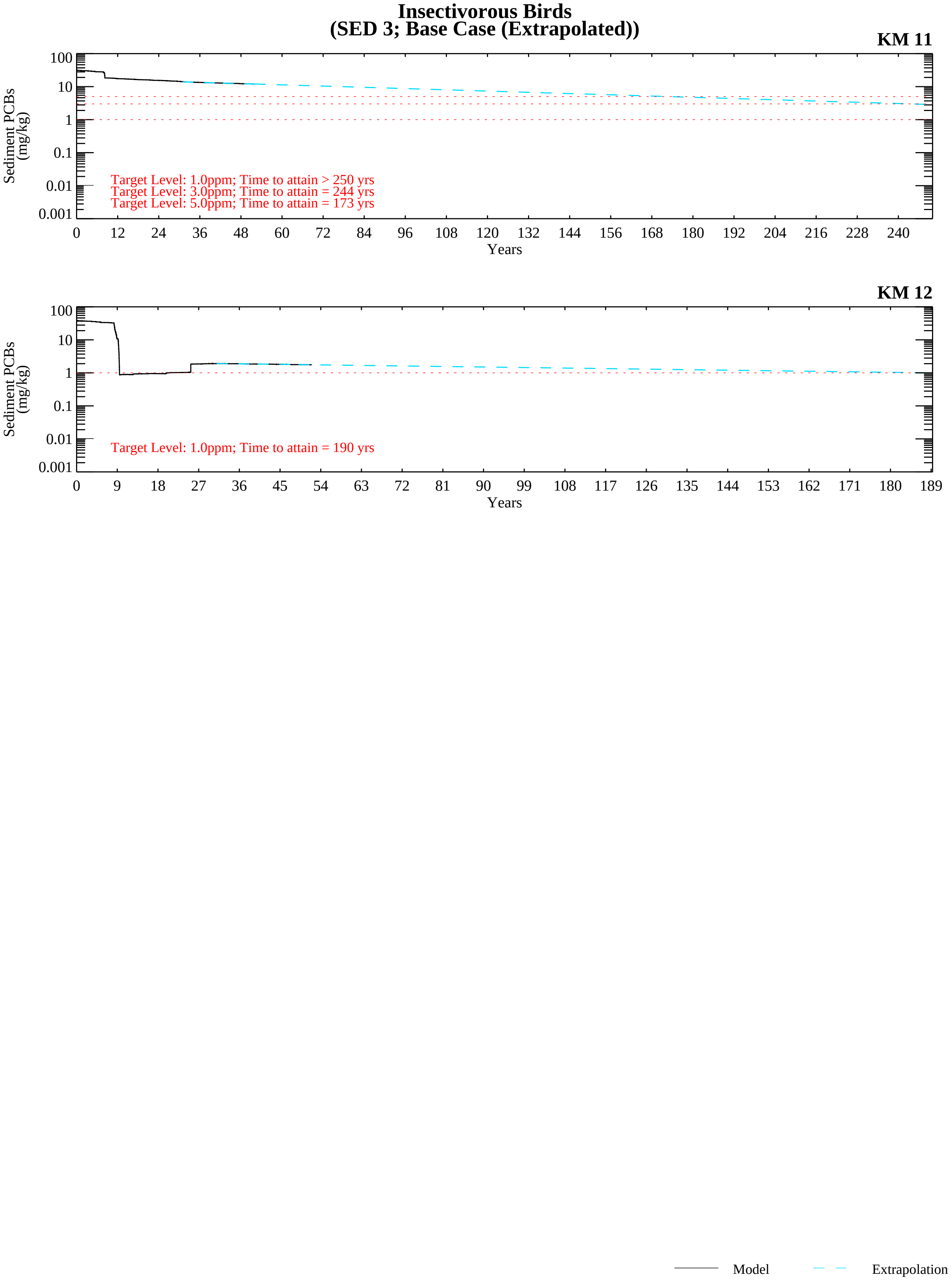

Figure G-6.3-2a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 3; Reach 5/6; Base Case).

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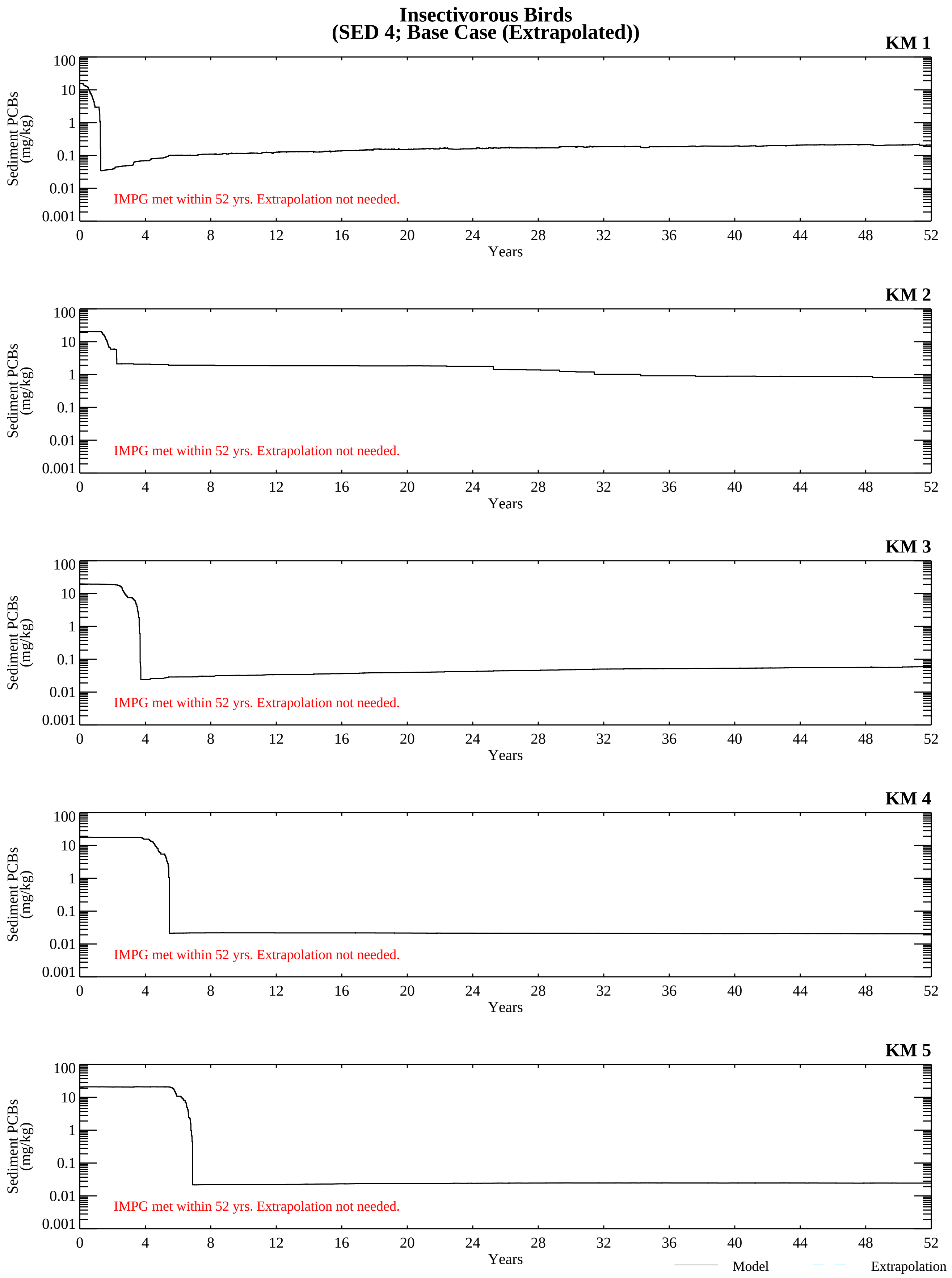

Figure G-6.3-3a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 4; Reach 5/6; Base Case).

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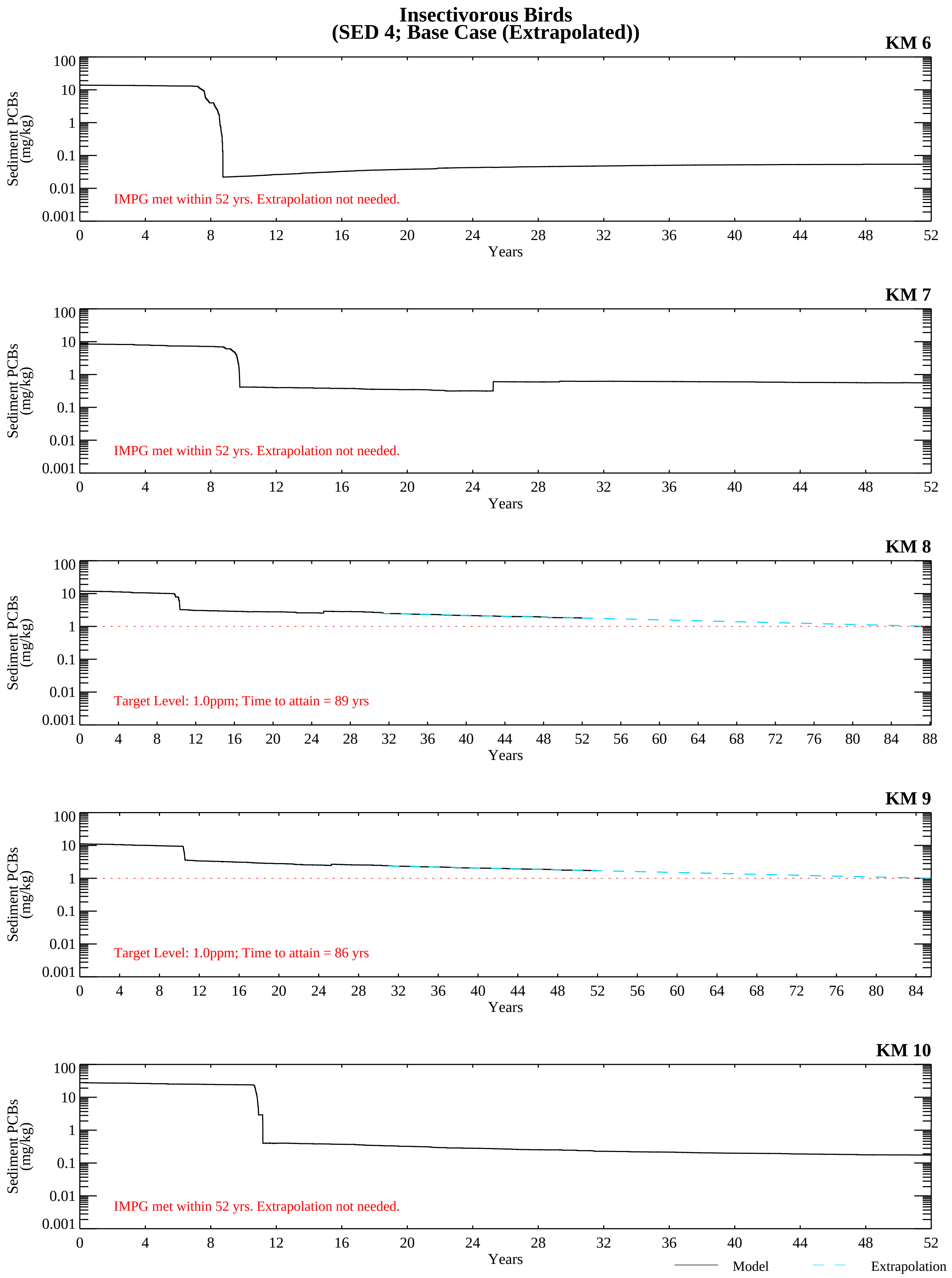

Figure G-6.3-3a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 4; Reach 5/6; Base Case).

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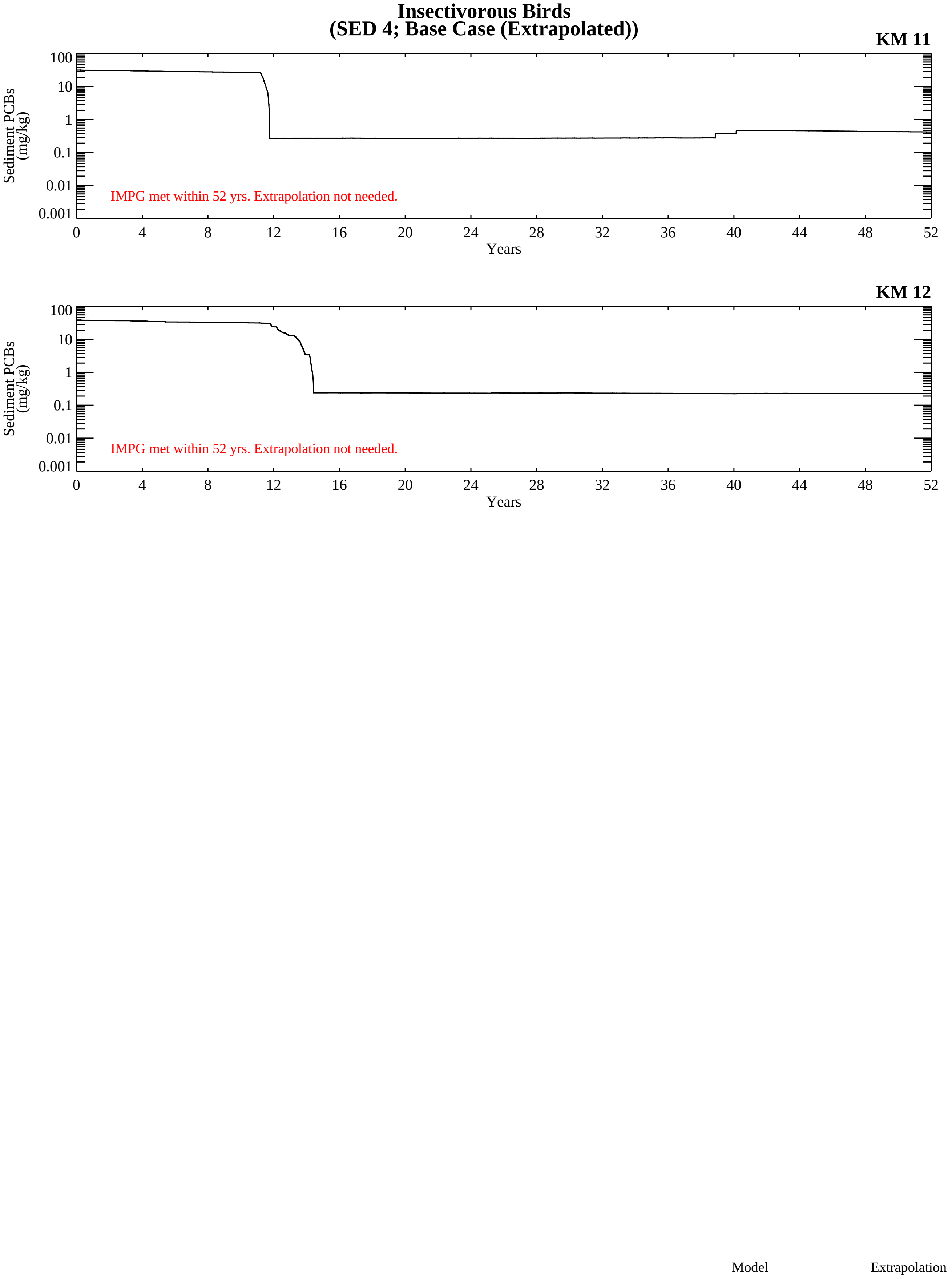

Figure G-6.3-3a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 4; Reach 5/6; Base Case).

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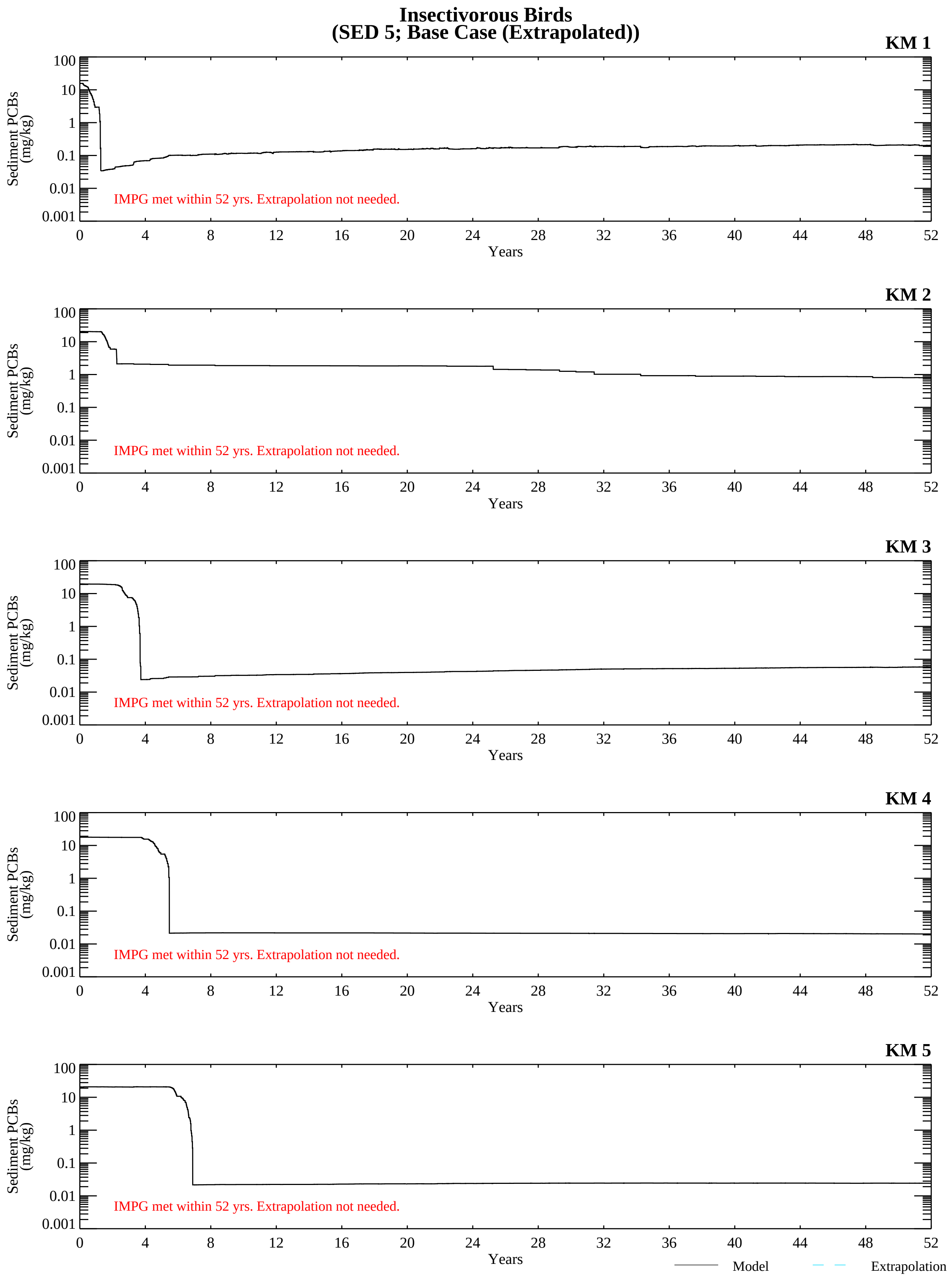

Figure G-6.3-4a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 5; Reach 5/6; Base Case).

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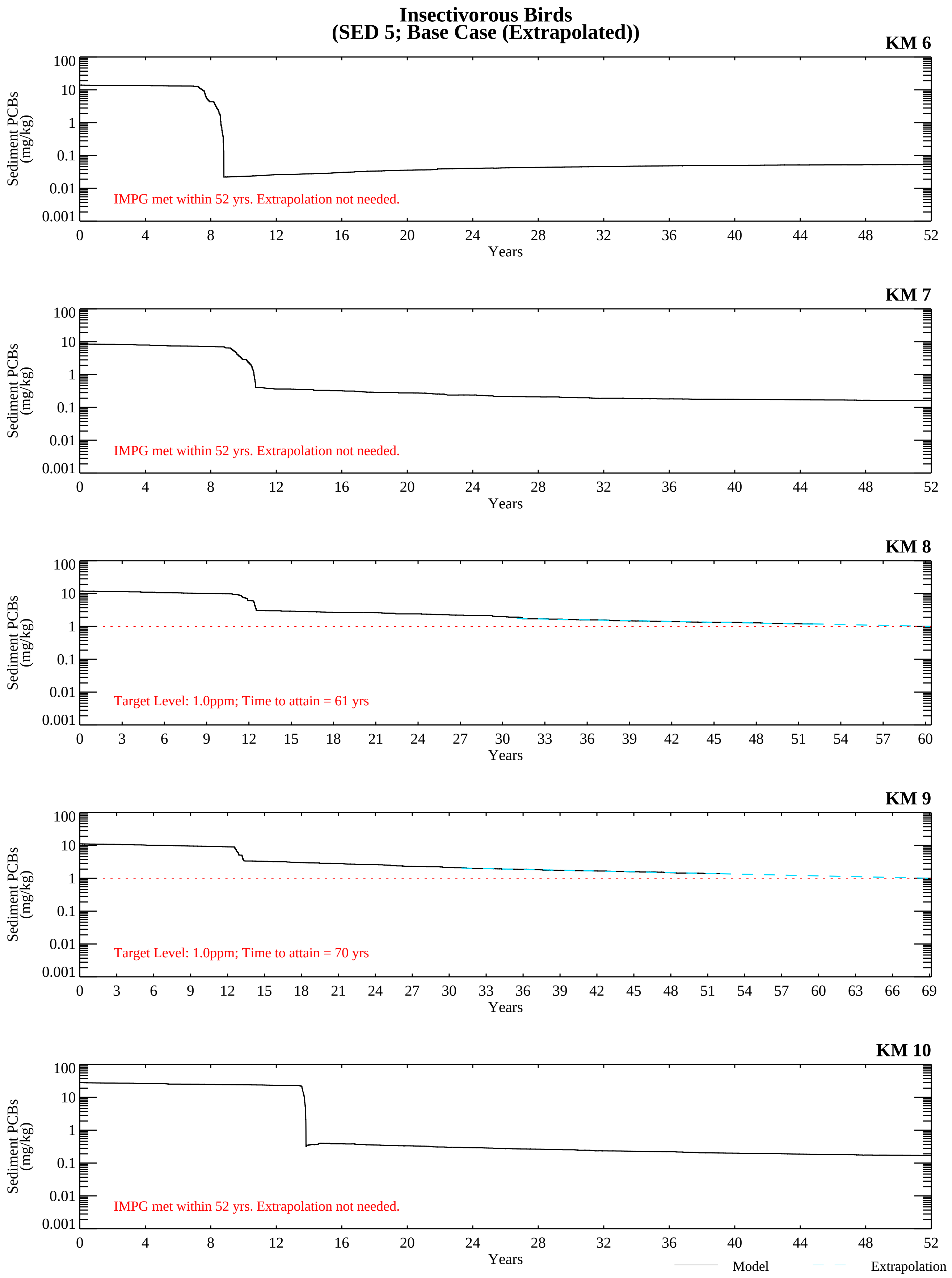

Figure G-6.3-4a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 5; Reach 5/6; Base Case).

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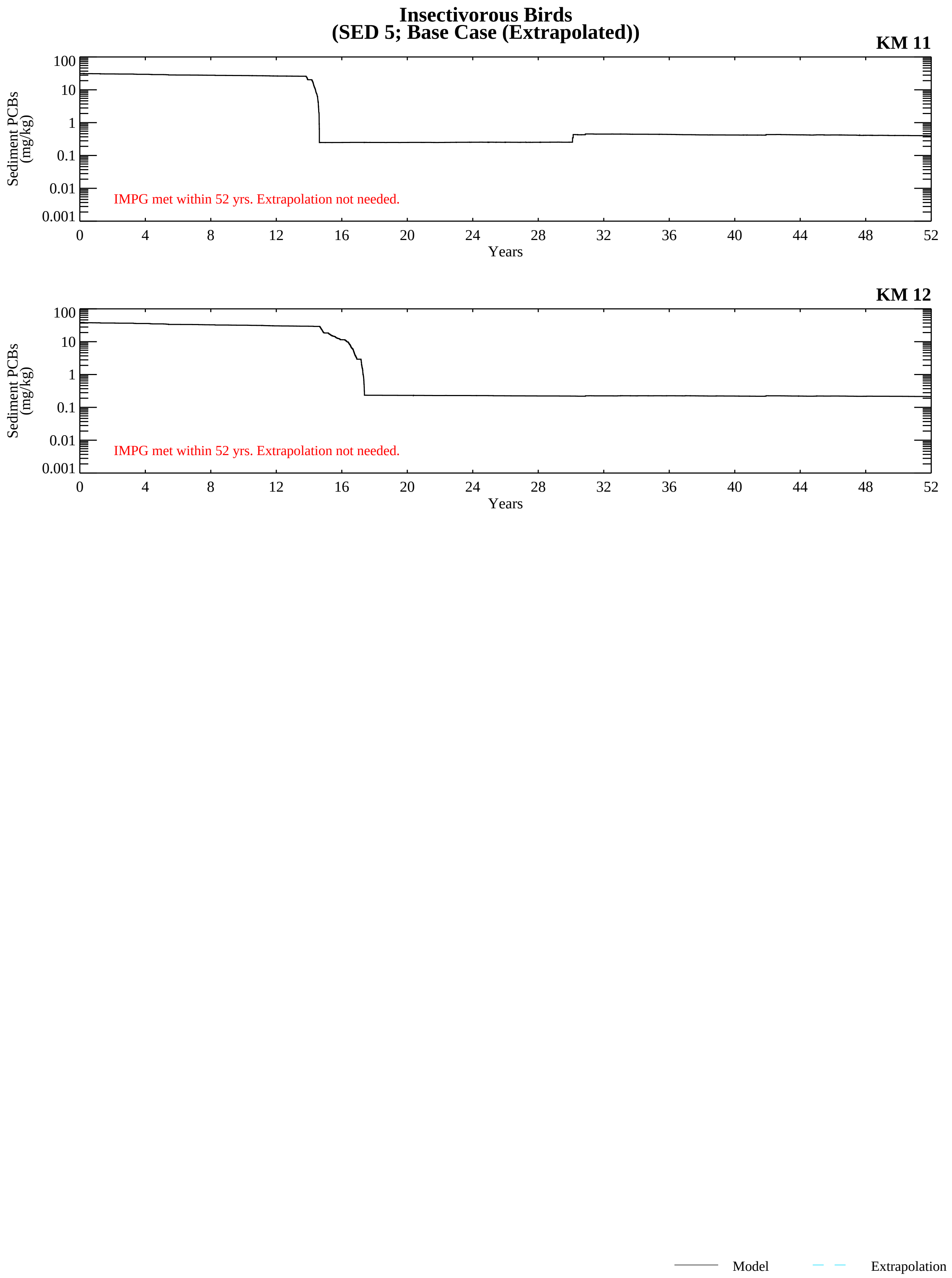
Insectivorous Birds
(SED 5; Base Case (Extrapolated))

Figure G-6.3-4a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 5; Reach 5/6; Base Case).

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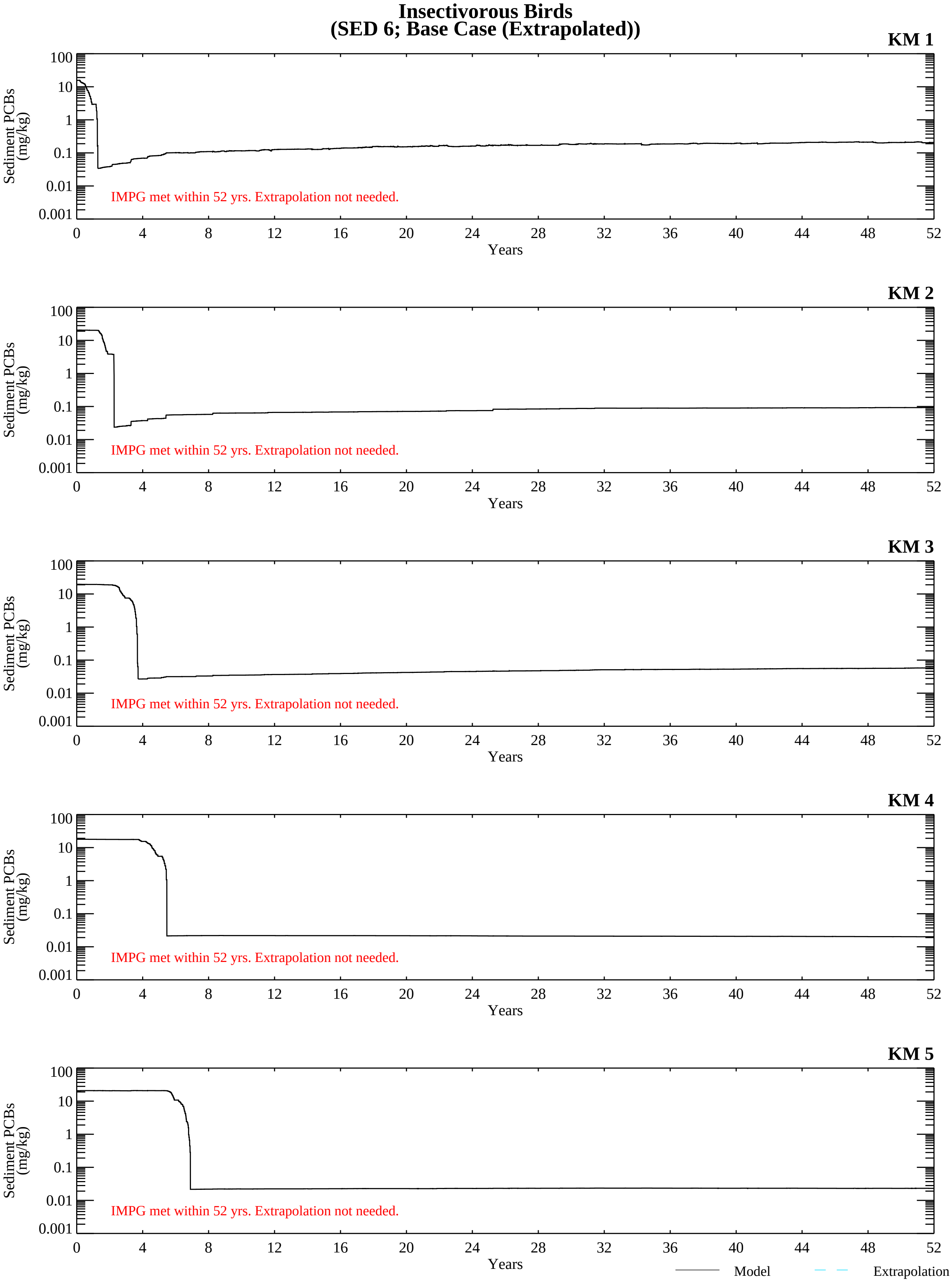

Figure G-6.3-5a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 6; Reach 5/6; Base Case).

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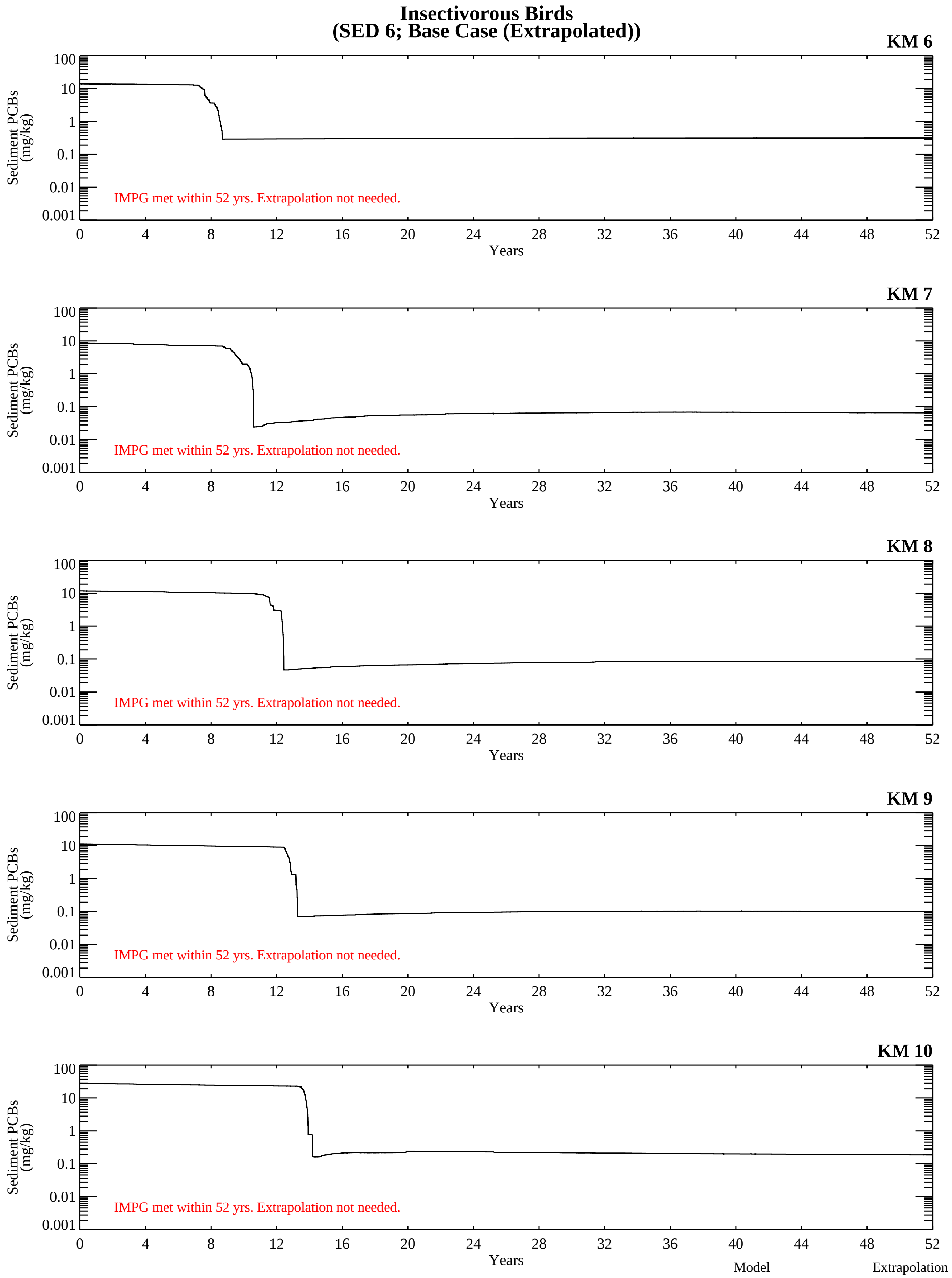

Figure G-6.3-5a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 6; Reach 5/6; Base Case).

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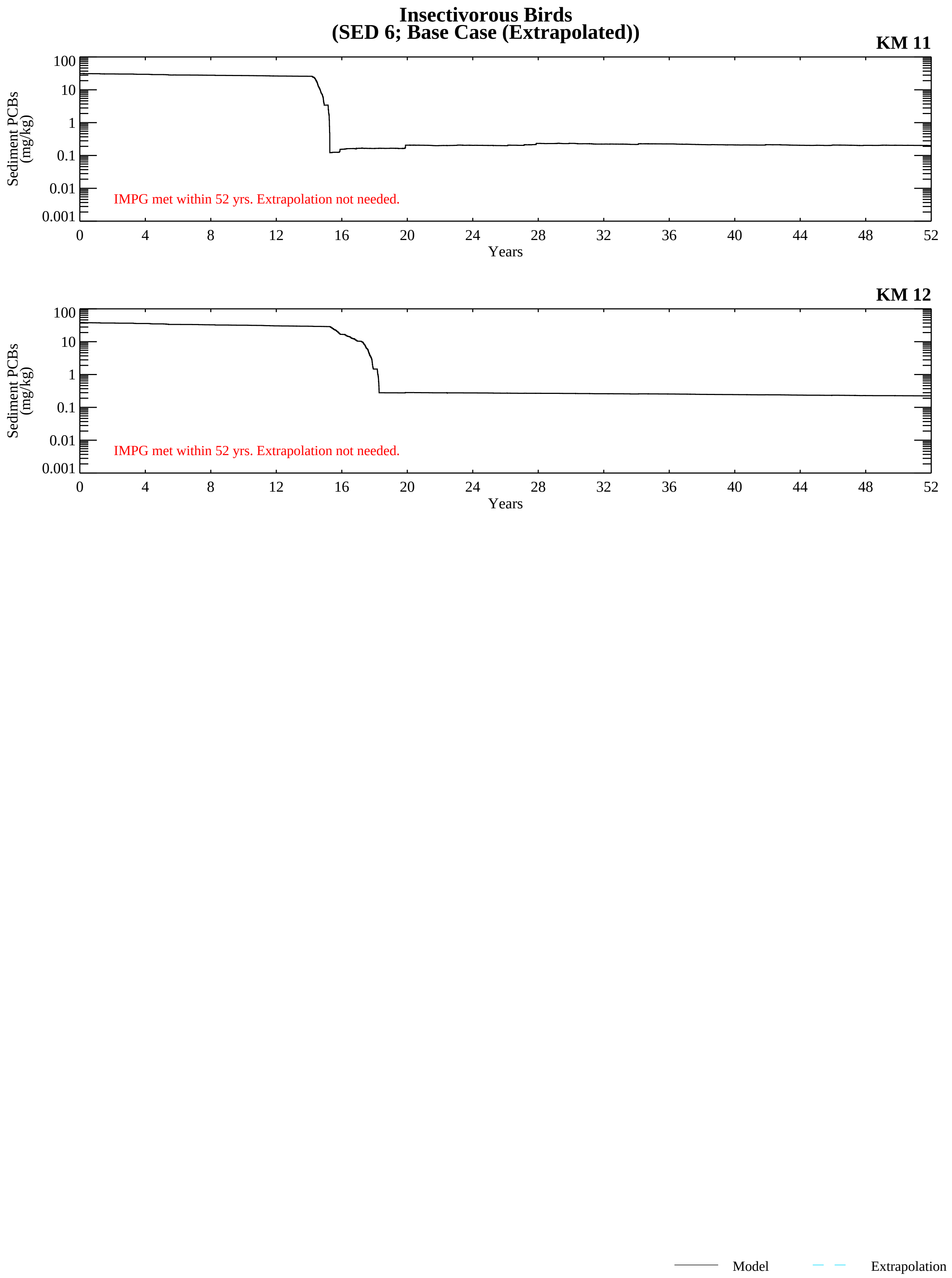

Figure G-6.3-5a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 6; Reach 5/6; Base Case).

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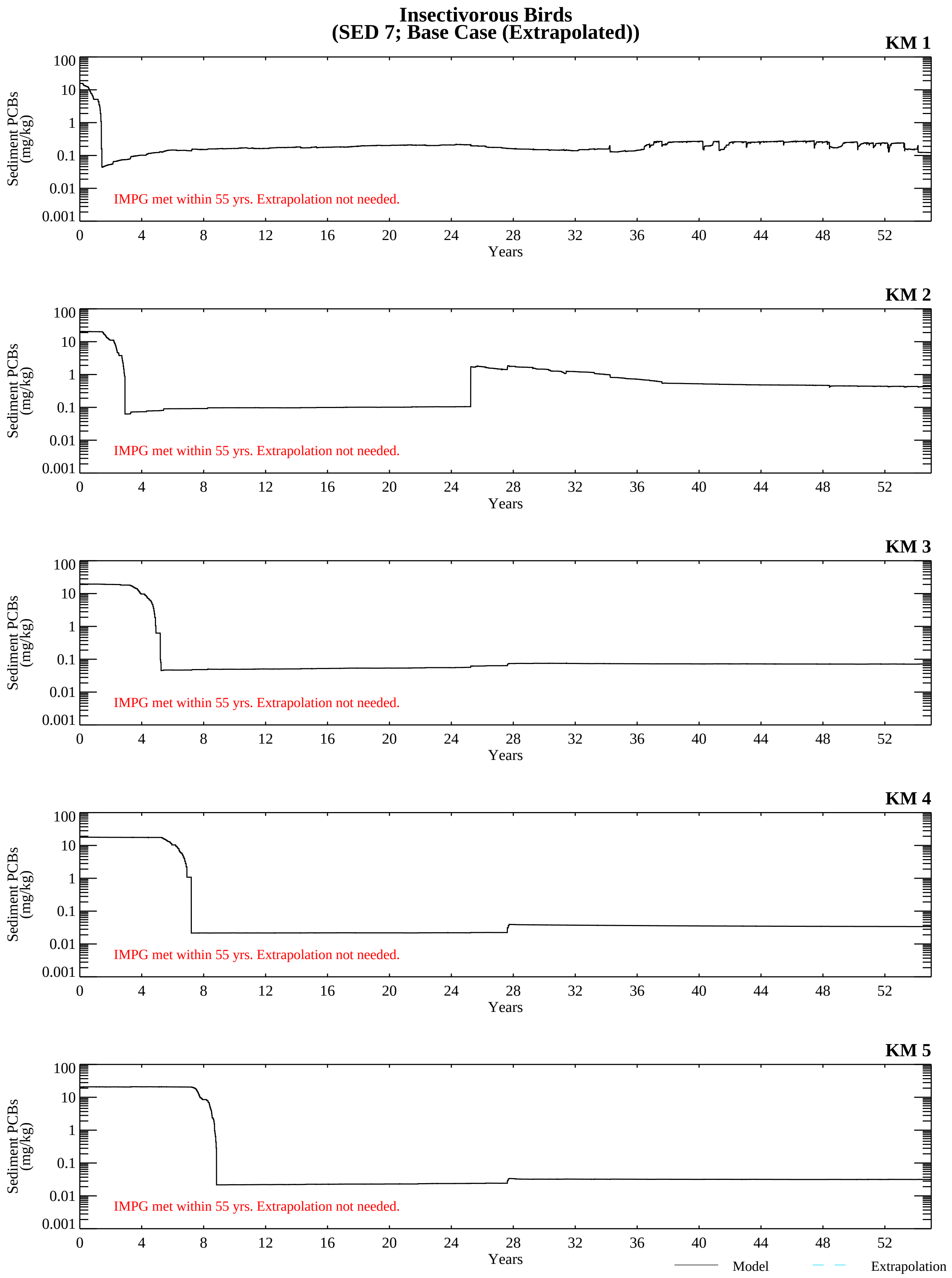

Figure G-6.3-6a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 7; Reach 5/6; Base Case).

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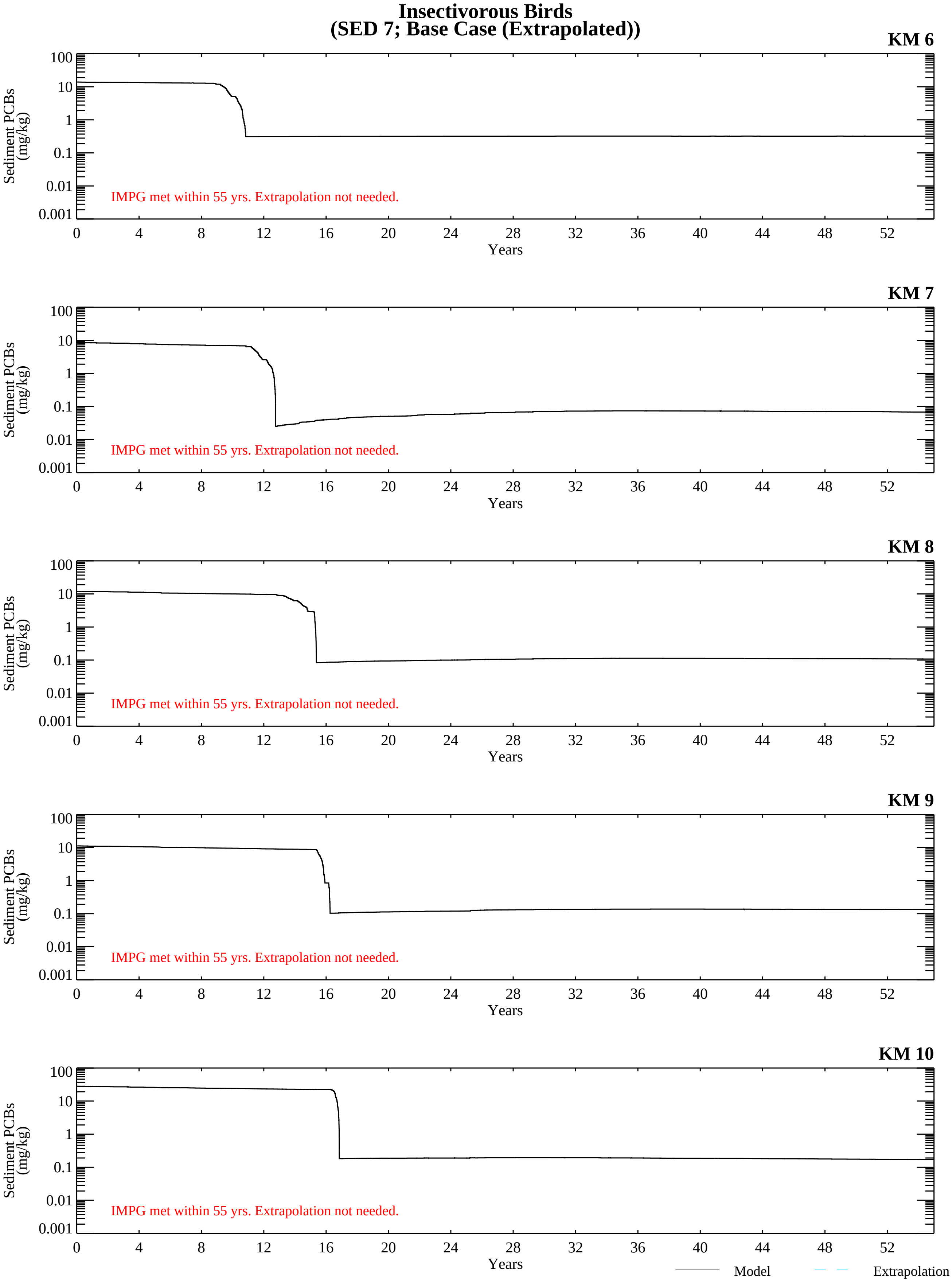

Figure G-6.3-6a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 7; Reach 5/6; Base Case).

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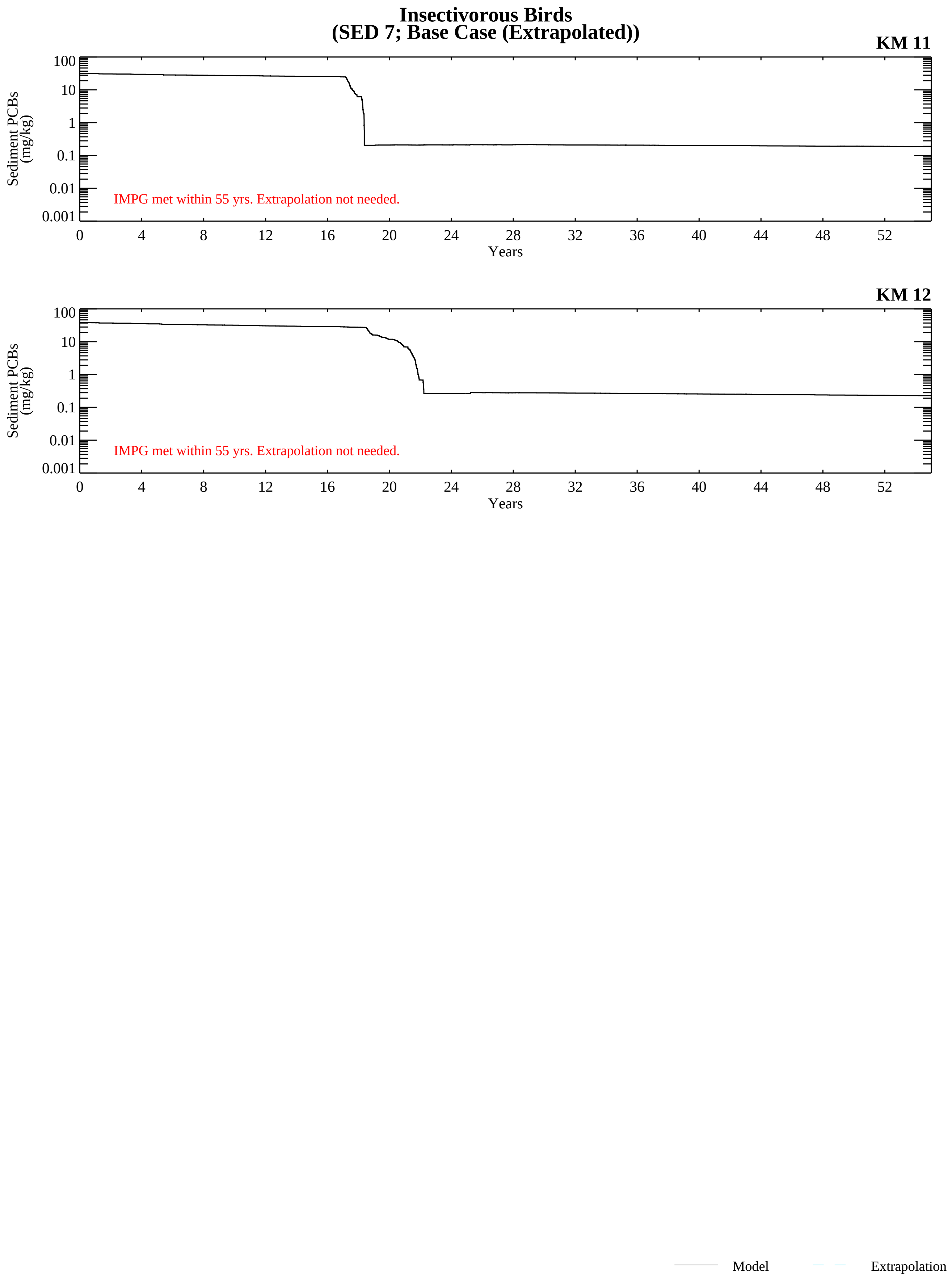

Figure G-6.3-6a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 7; Reach 5/6; Base Case).

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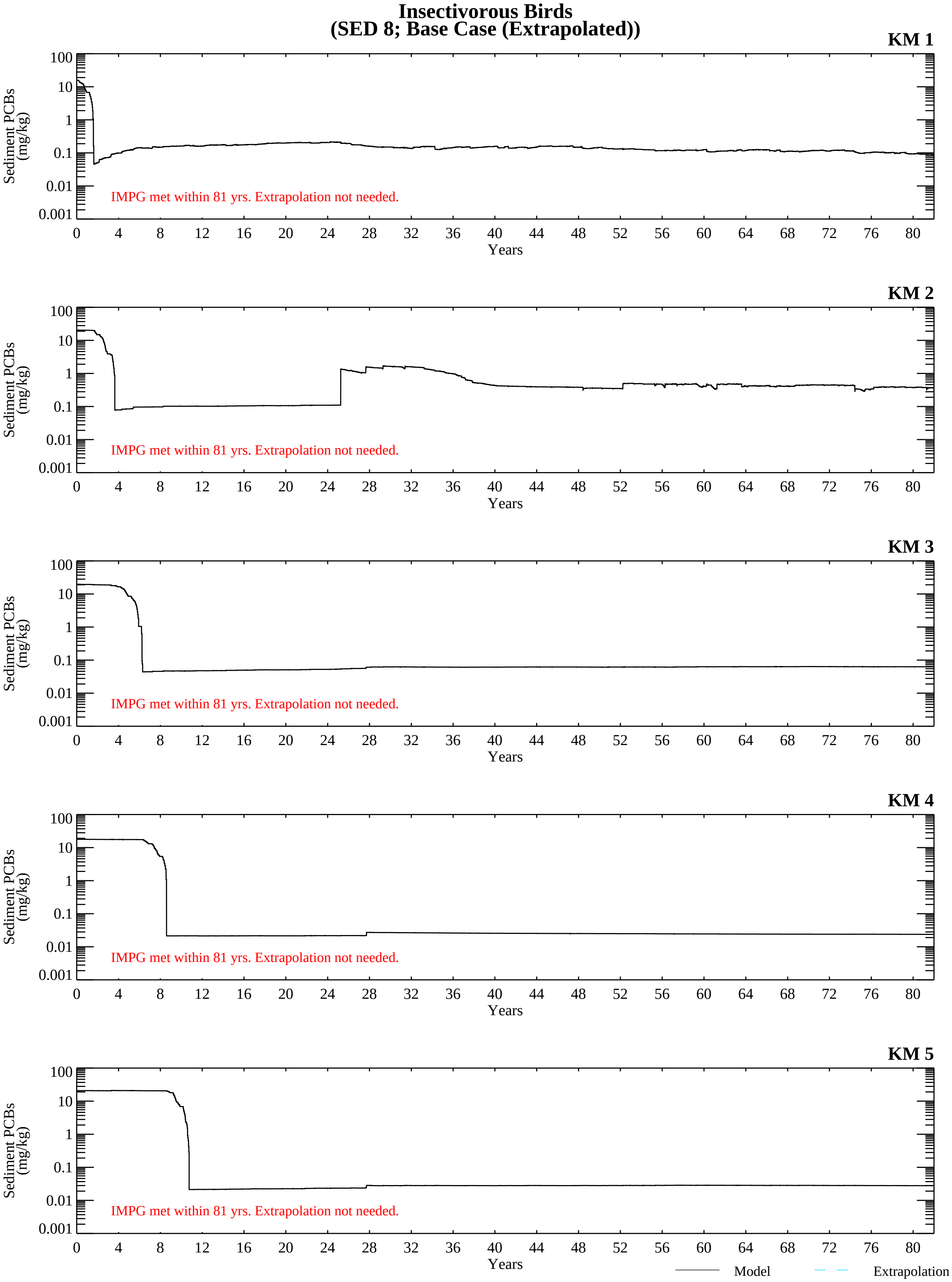

Figure G-6.3-7a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 8; Reach 5/6; Base Case).

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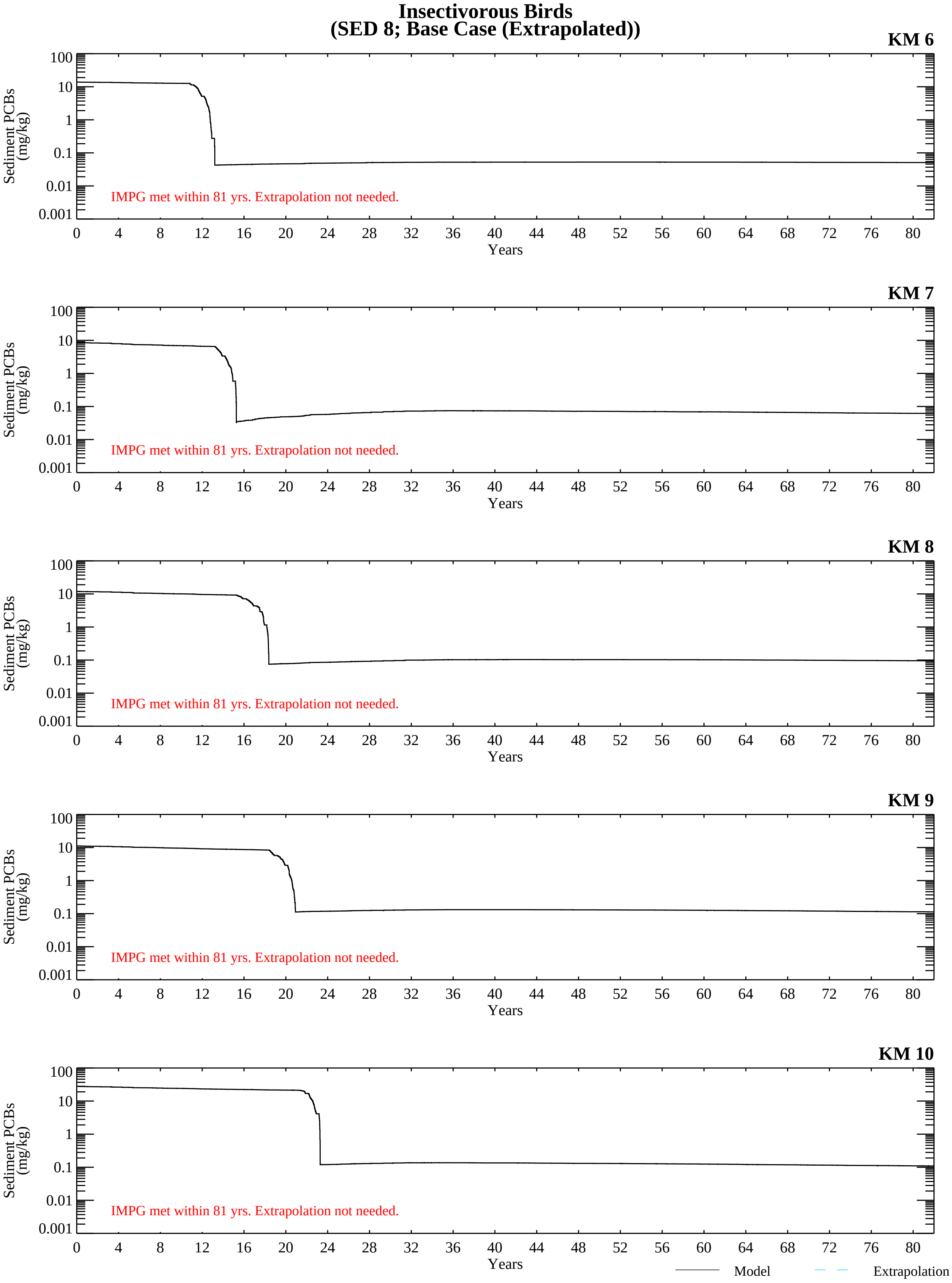

Figure G-6.3-7a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 8; Reach 5/6; Base Case).

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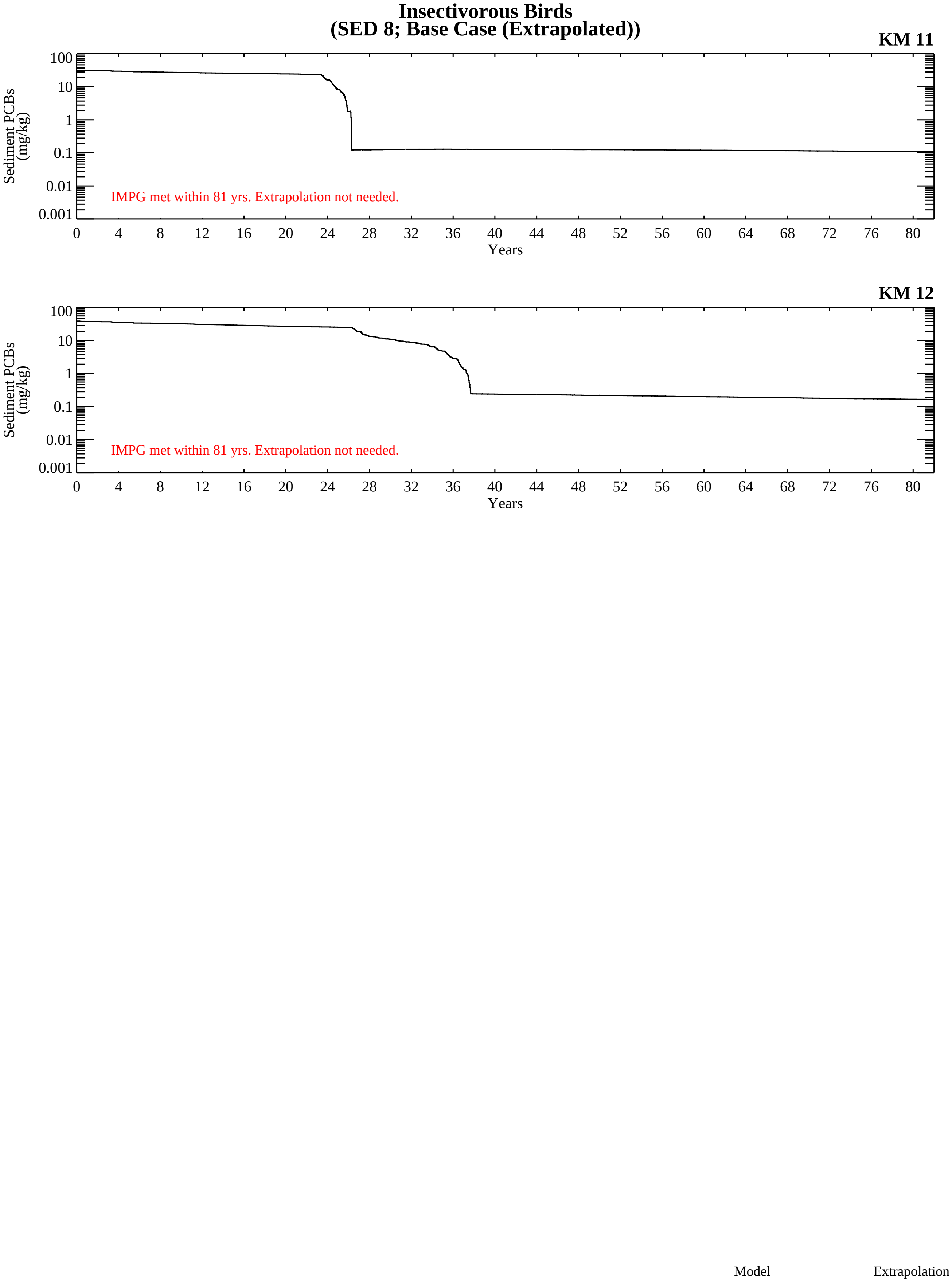

Figure G-6.3-7a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for insectivorous birds (wood duck) (SED 8; Reach 5/6; Base Case).

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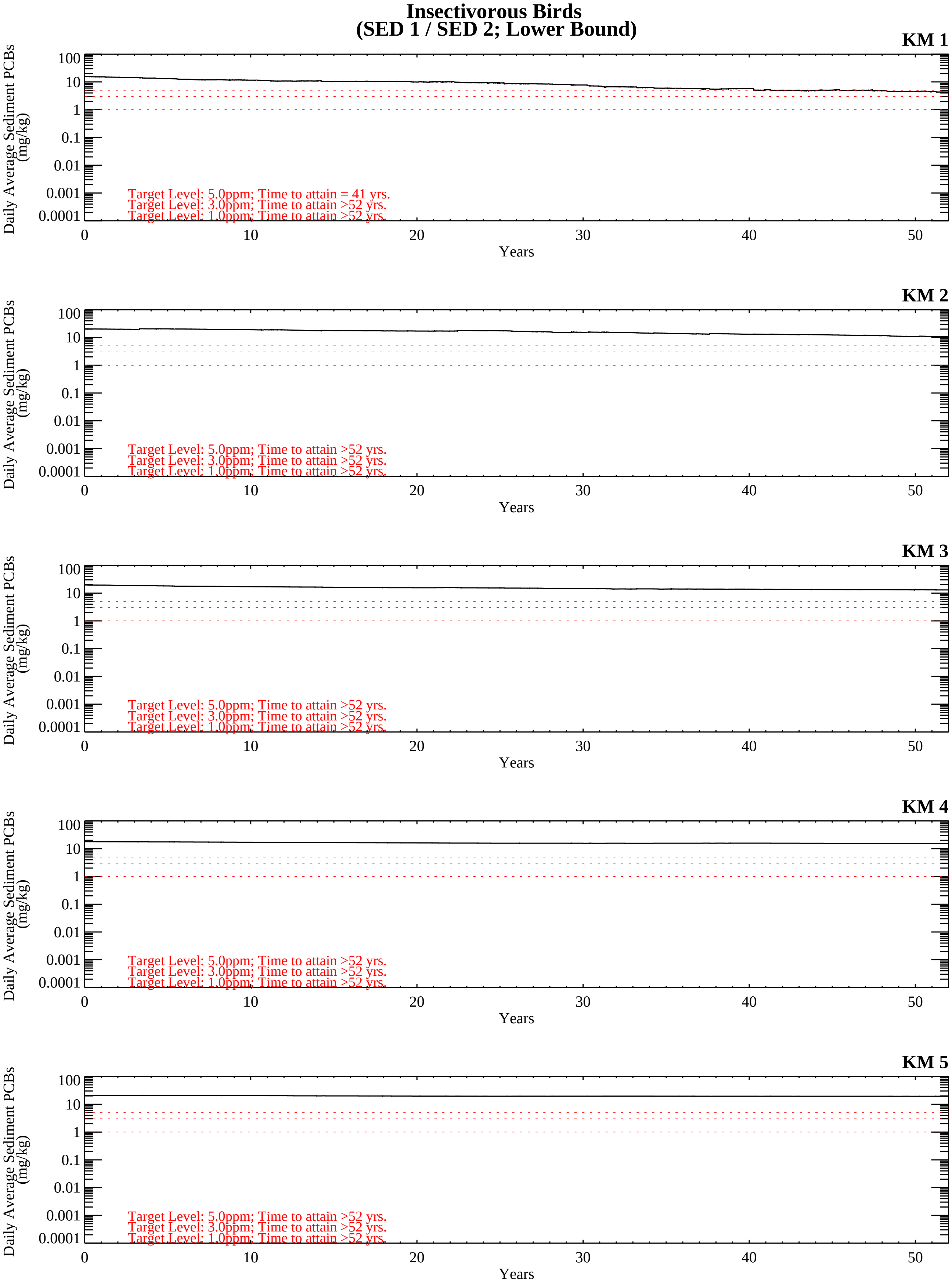

Figure G-6.4-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 1 / SED 2; Reach 5/6; Lower Bound).

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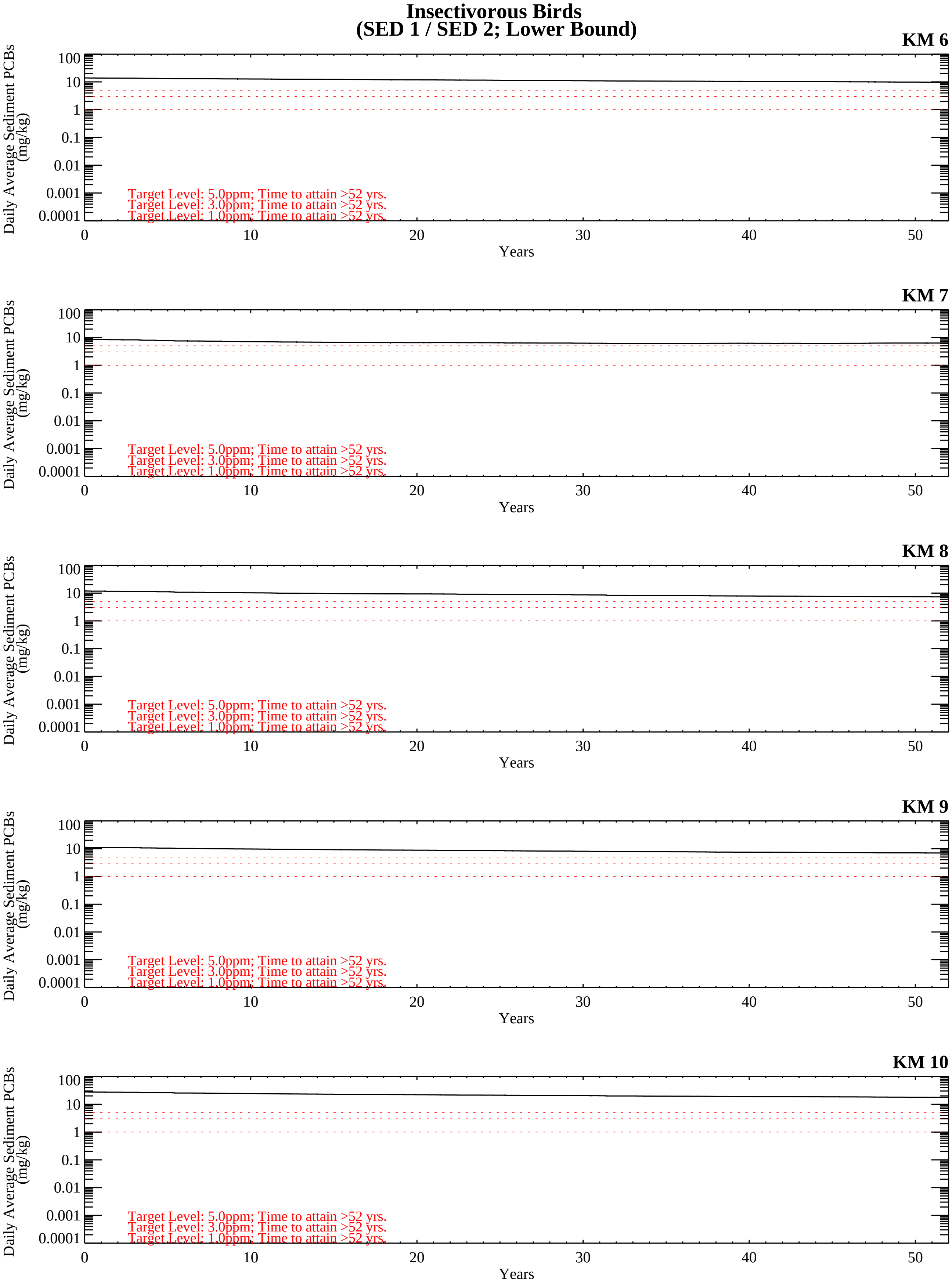

Figure G-6.4-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 1 / SED 2; Reach 5/6; Lower Bound).

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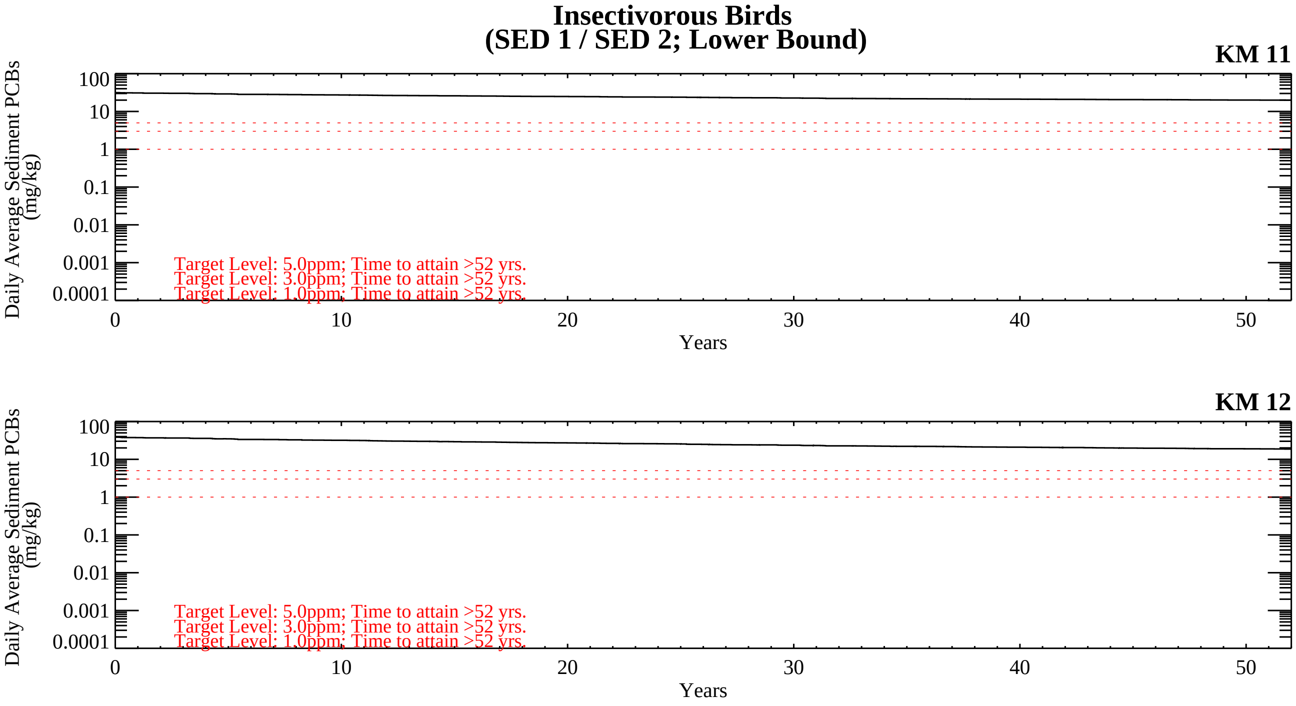

Figure G-6.4-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 1 / SED 2; Reach 5/6; Lower Bound).

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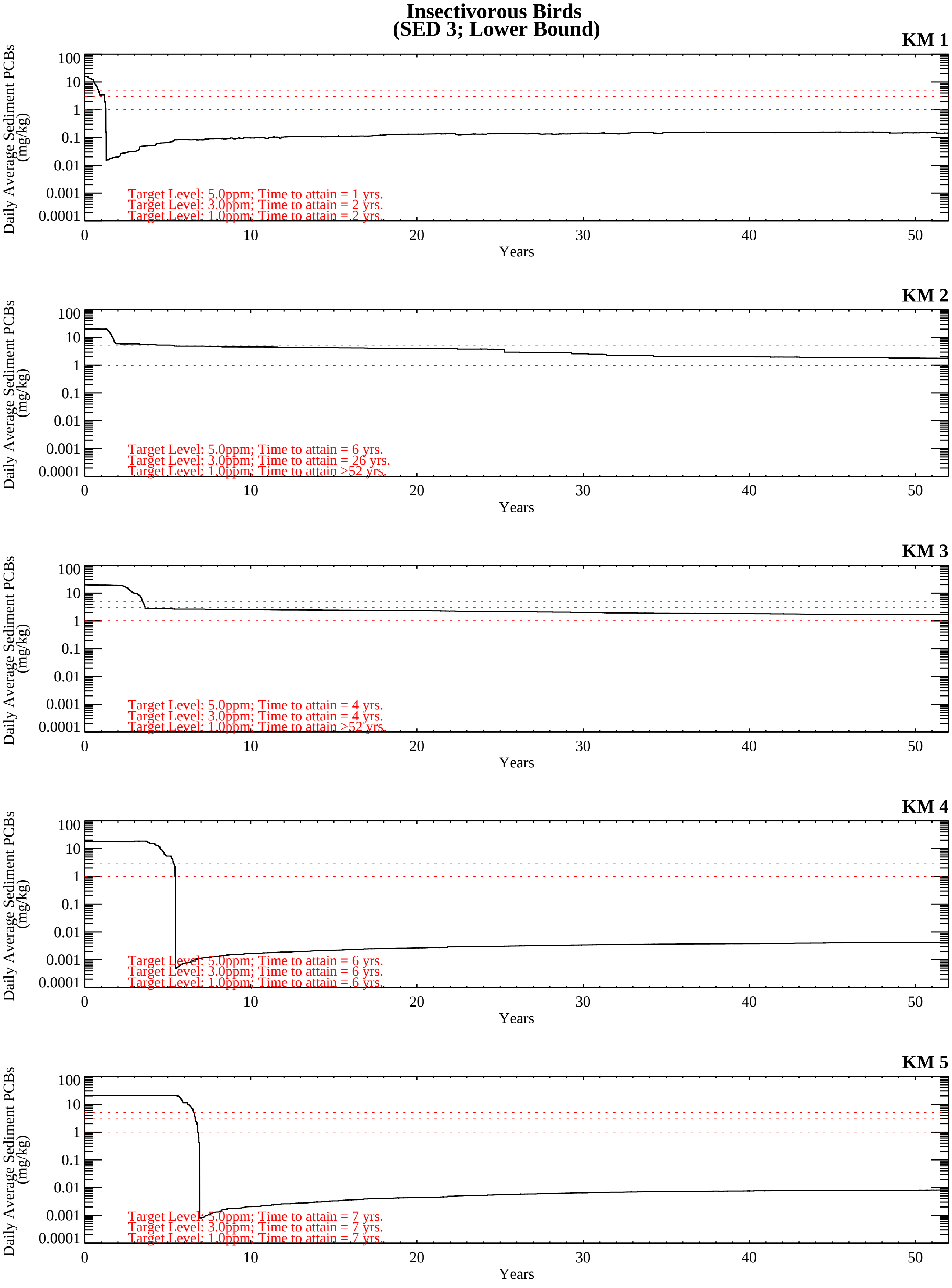

Figure G-6.4-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 3; Reach 5/6; Lower Bound).

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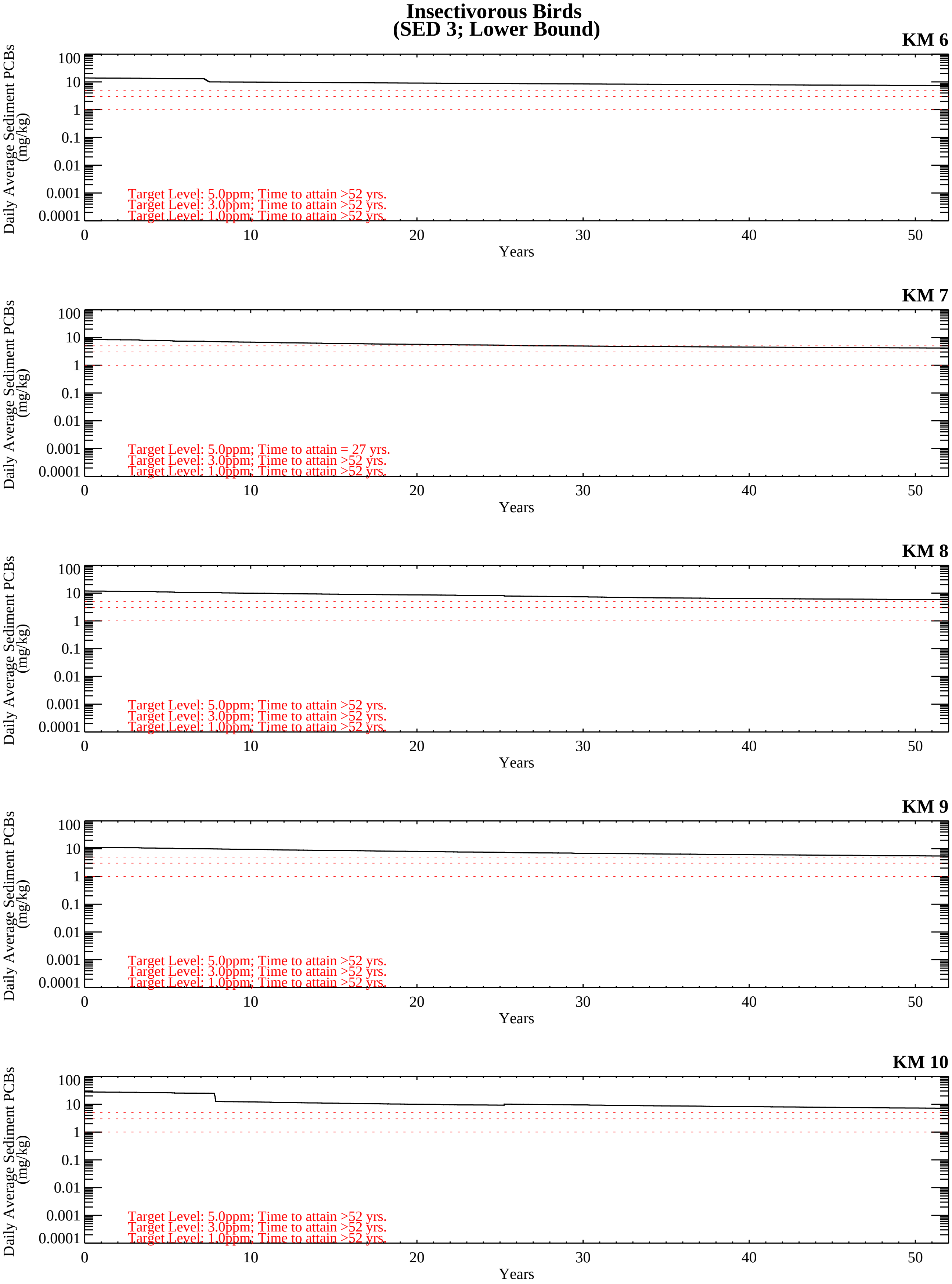

Figure G-6.4-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 3; Reach 5/6; Lower Bound).

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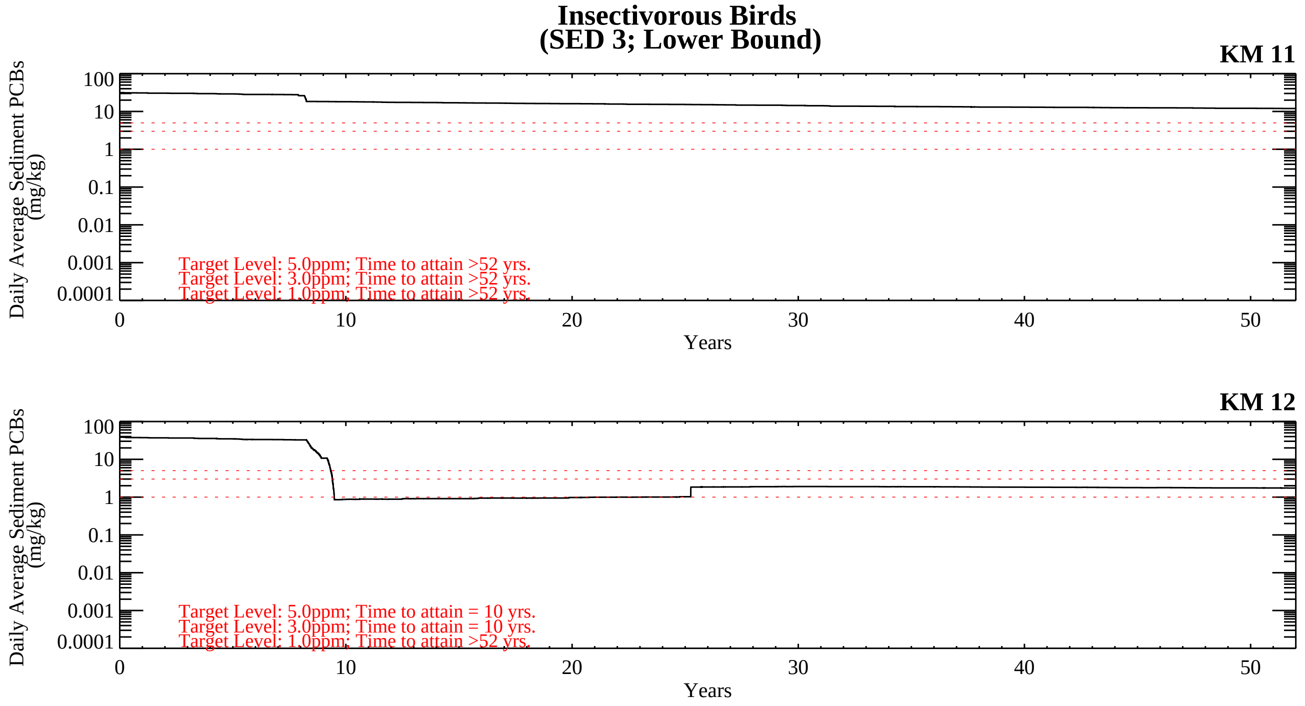

Figure G-6.4-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 3; Reach 5/6; Lower Bound).

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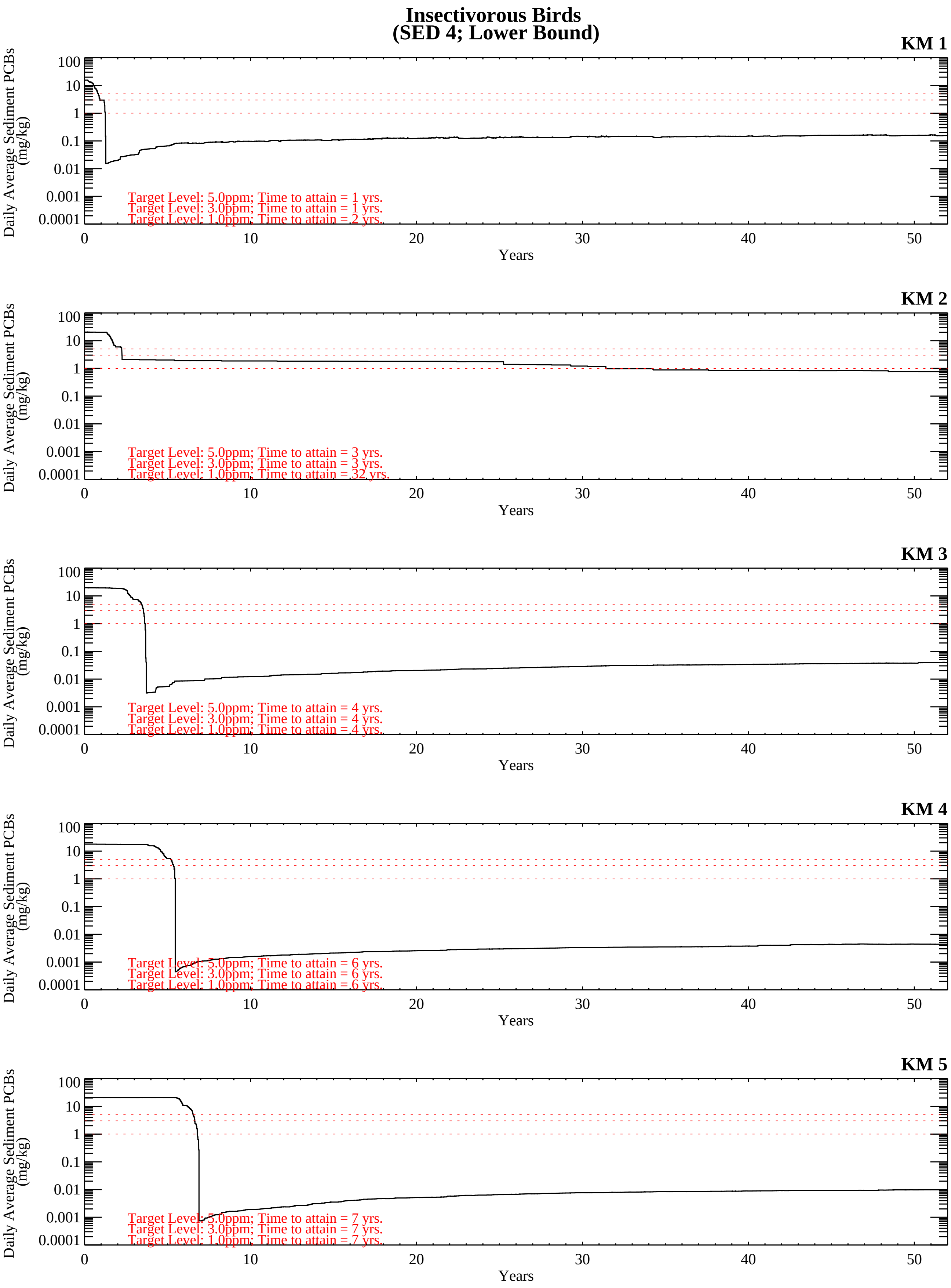

Figure G-6.4-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 4; Reach 5/6; Lower Bound).

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Insectivorous Birds
(SED 4; Lower Bound)

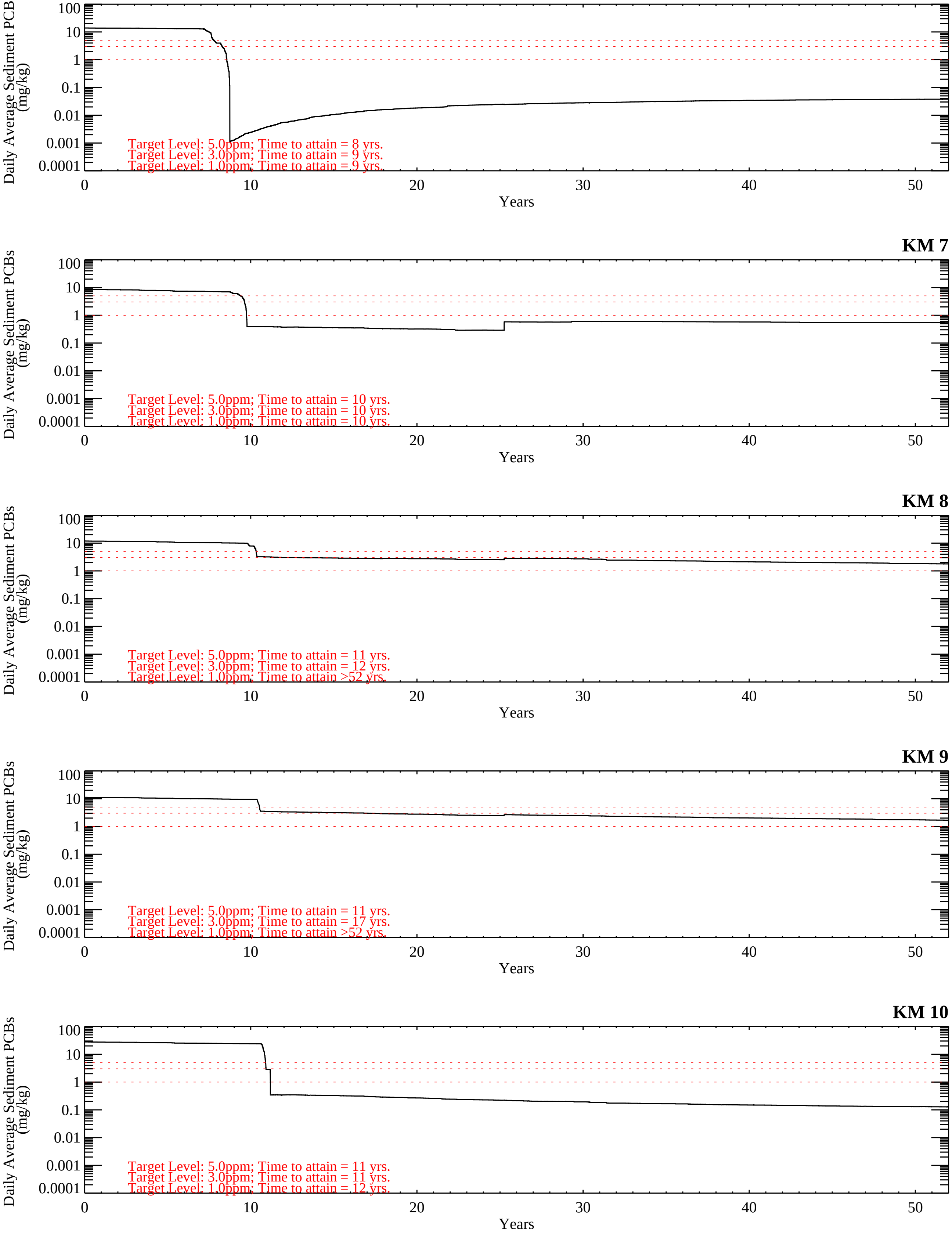

Figure G-6.4-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 4; Reach 5/6; Lower Bound).

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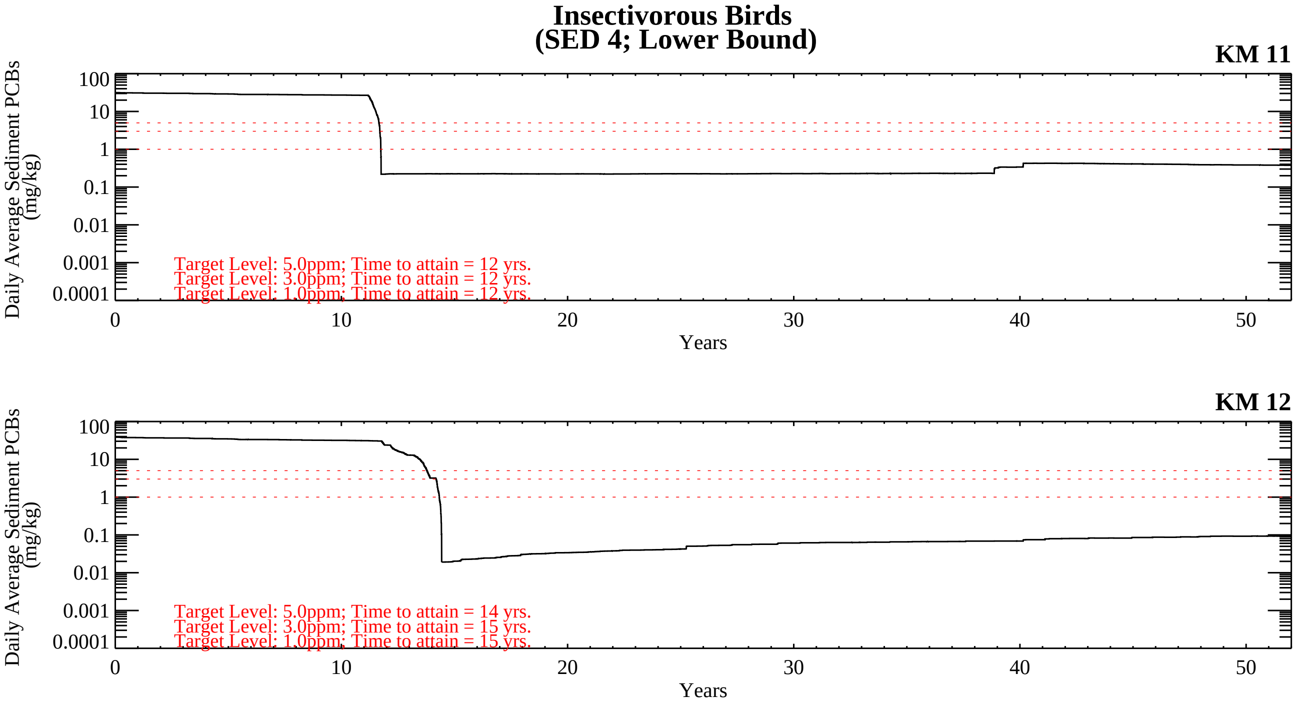

Figure G-6.4-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 4; Reach 5/6; Lower Bound).

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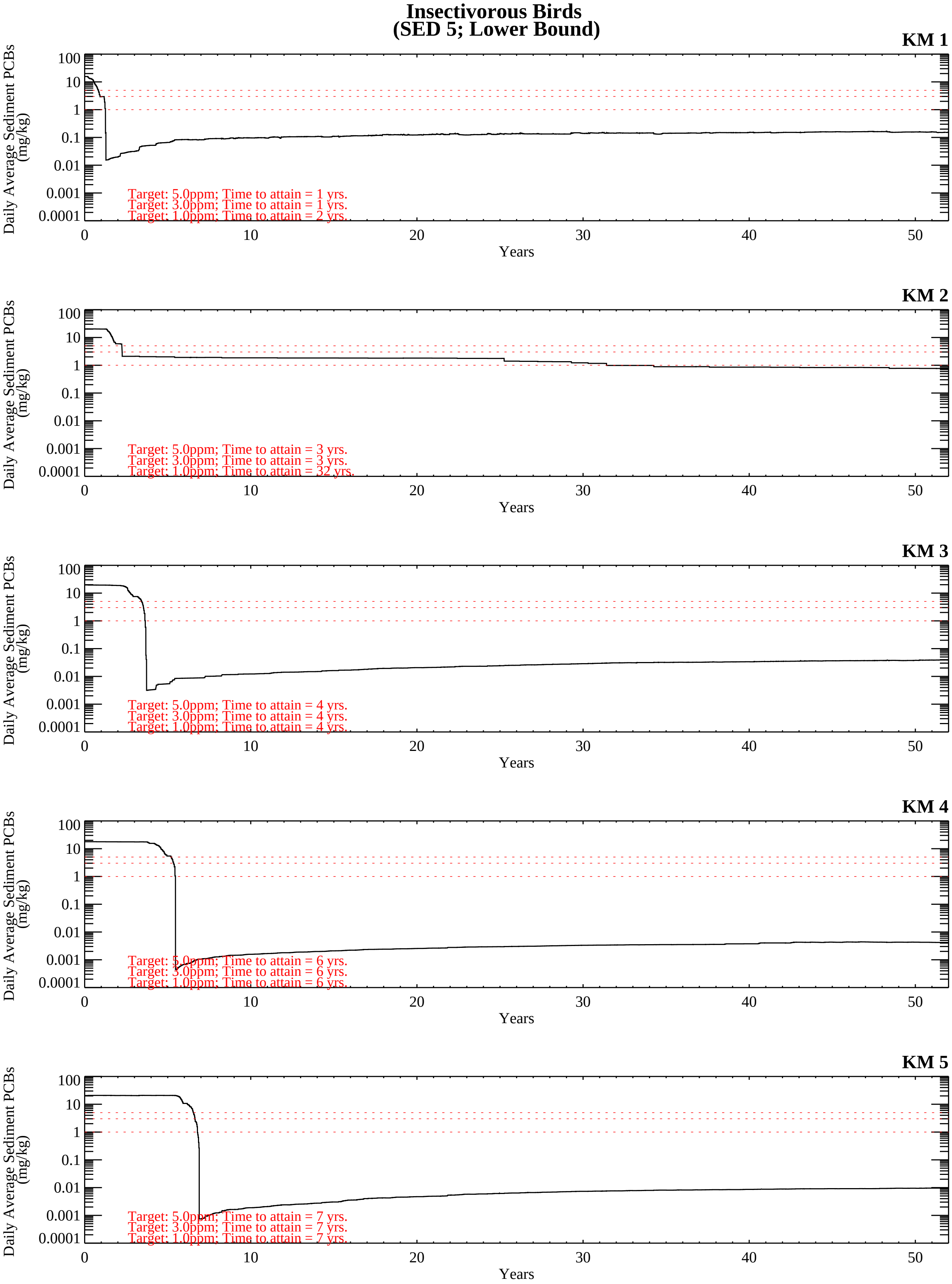

Figure G-6.4-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 5; Reach 5/6; Lower Bound).

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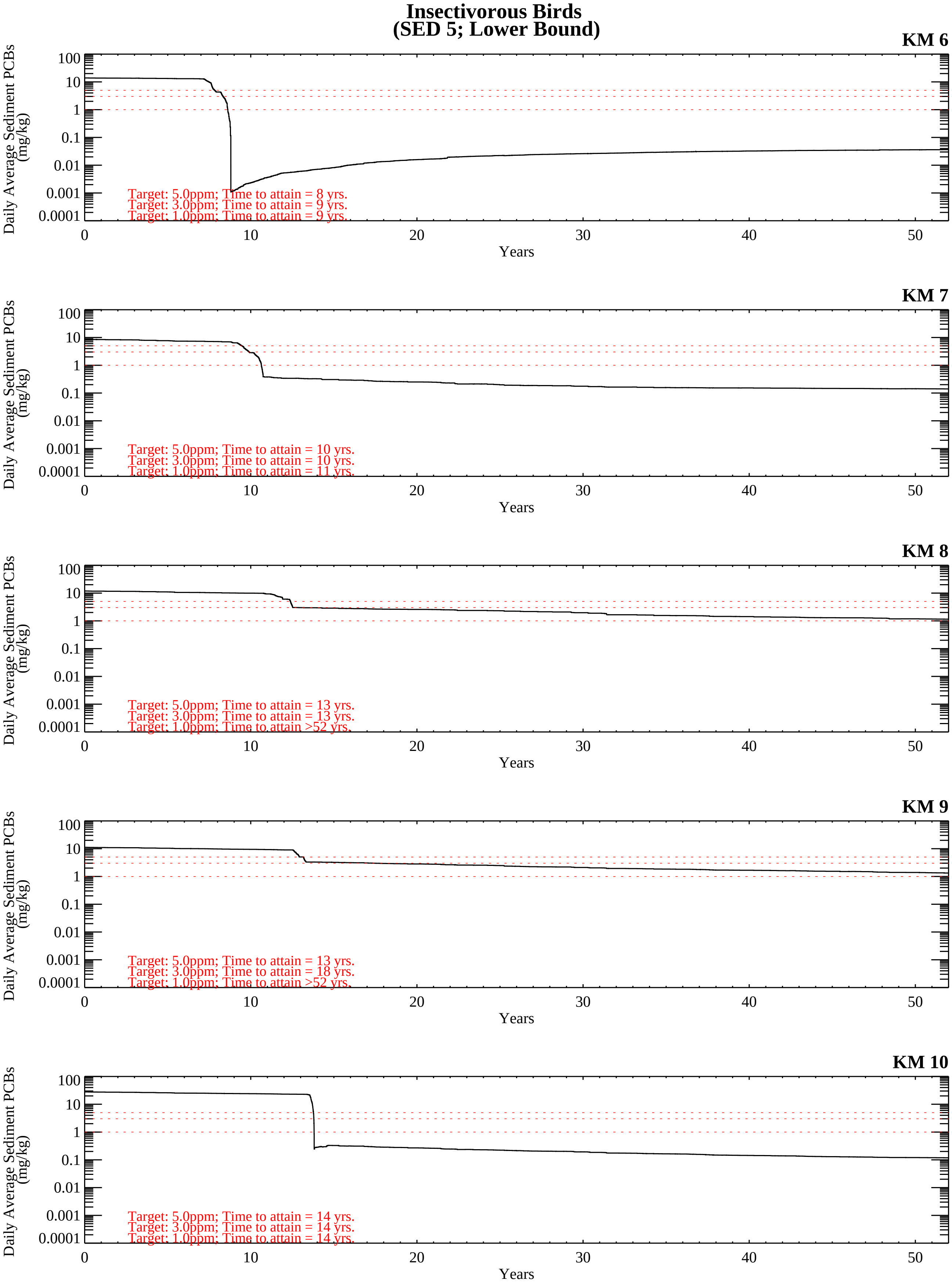

Figure G-6.4-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 5; Reach 5/6; Lower Bound).

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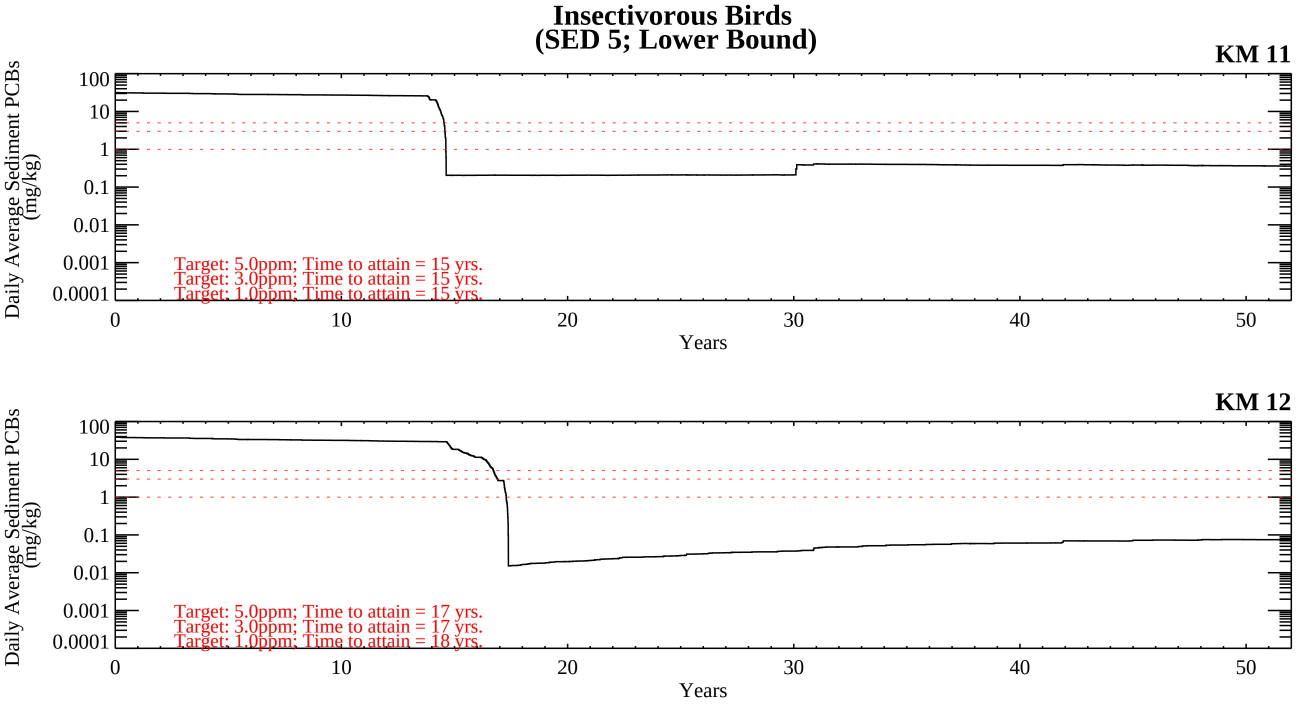

Figure G-6.4-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 5; Reach 5/6; Lower Bound).

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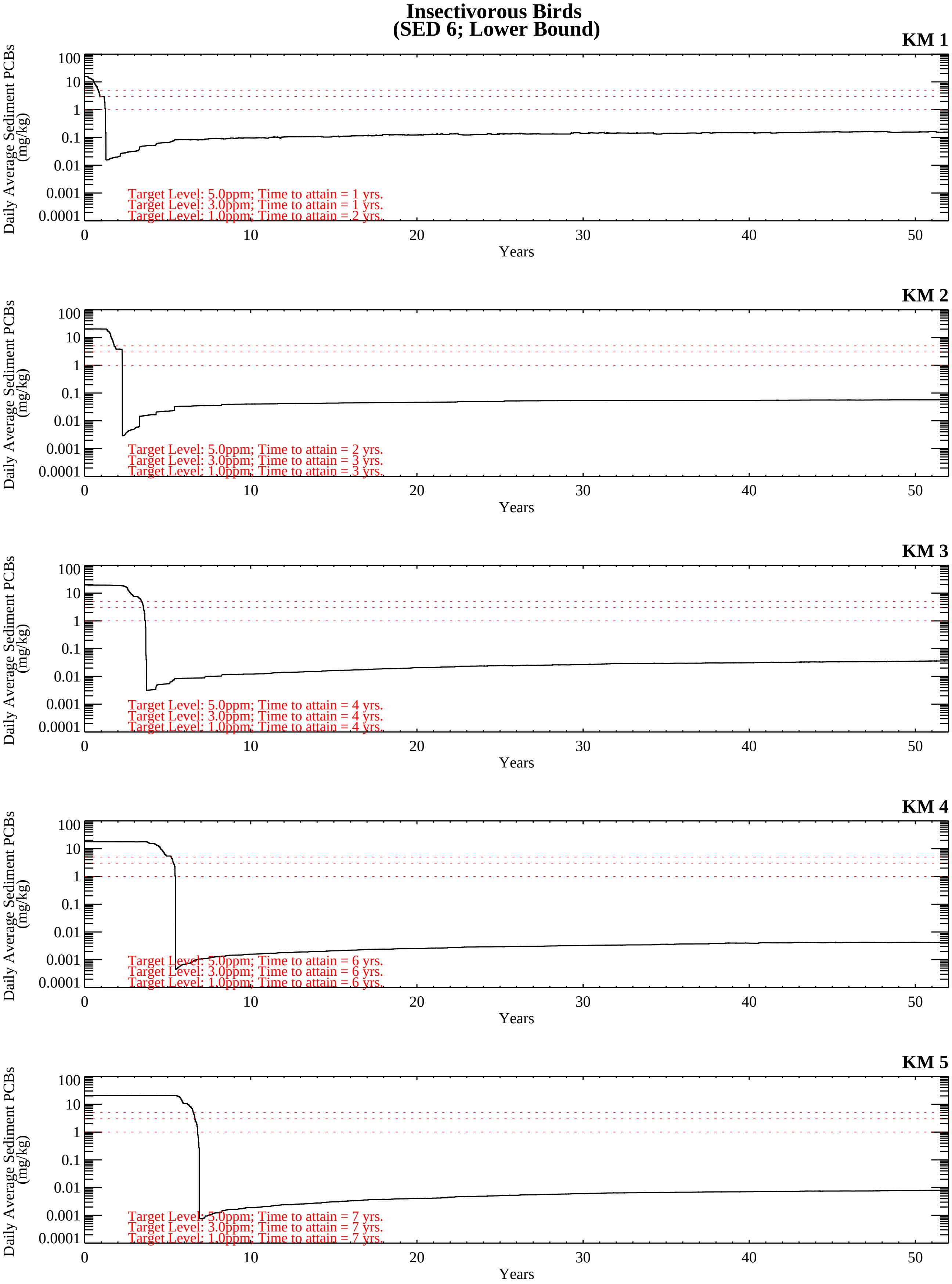

Figure G-6.4-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 6; Reach 5/6; Lower Bound).

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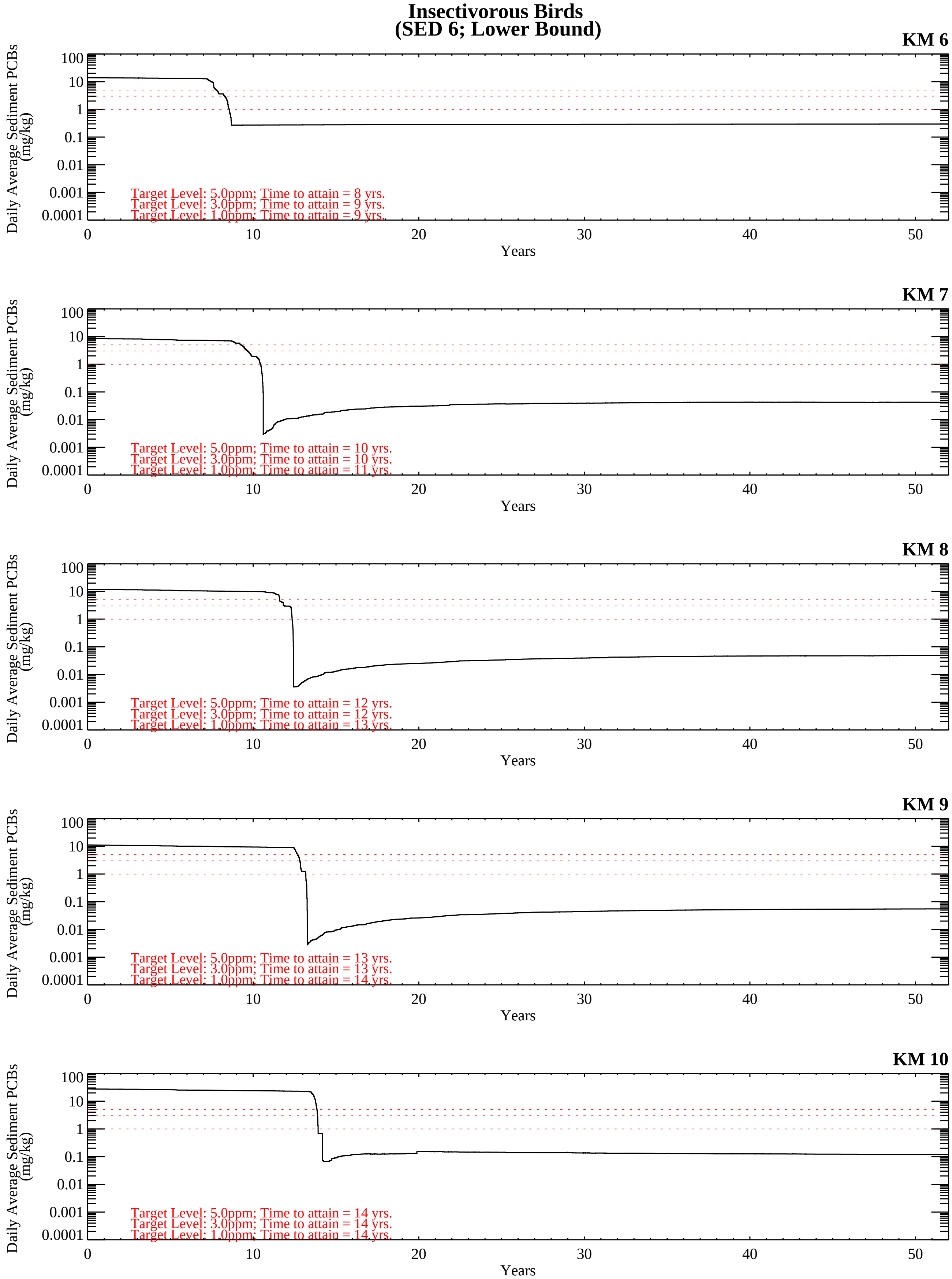

Figure G-6.4-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 6; Reach 5/6; Lower Bound).

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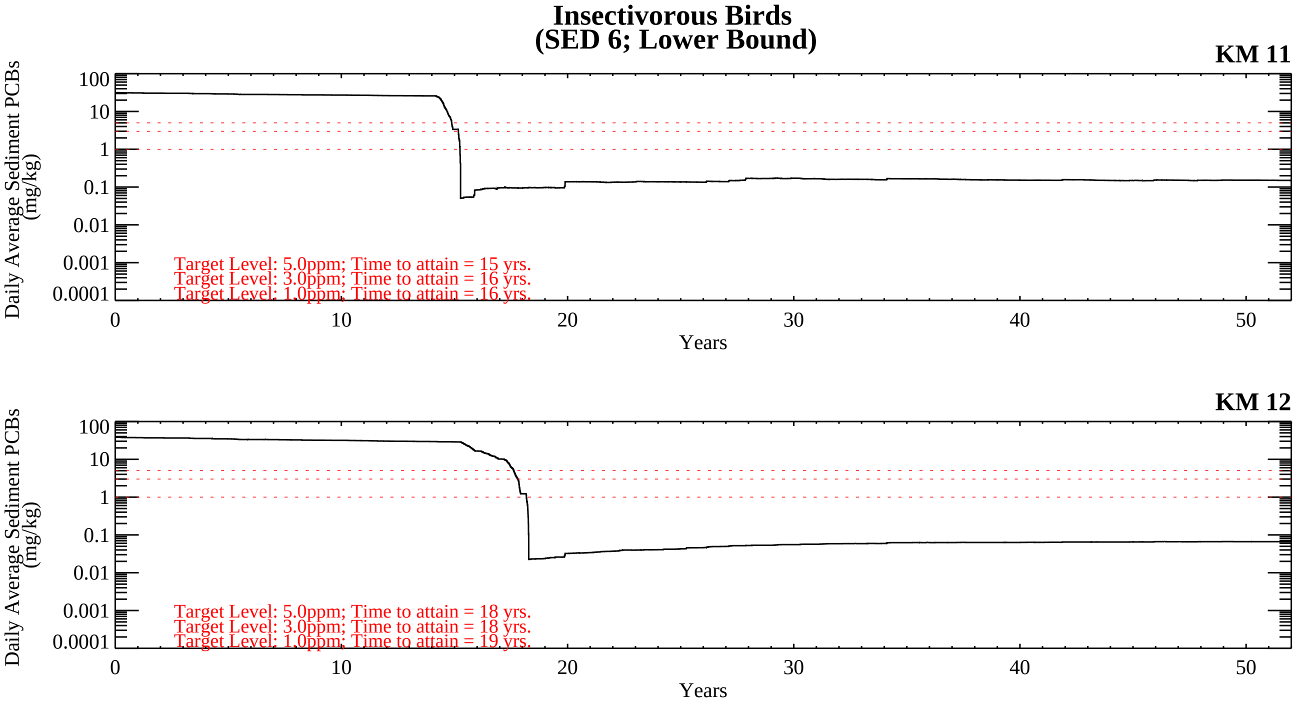

Figure G-6.4-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 6; Reach 5/6; Lower Bound).

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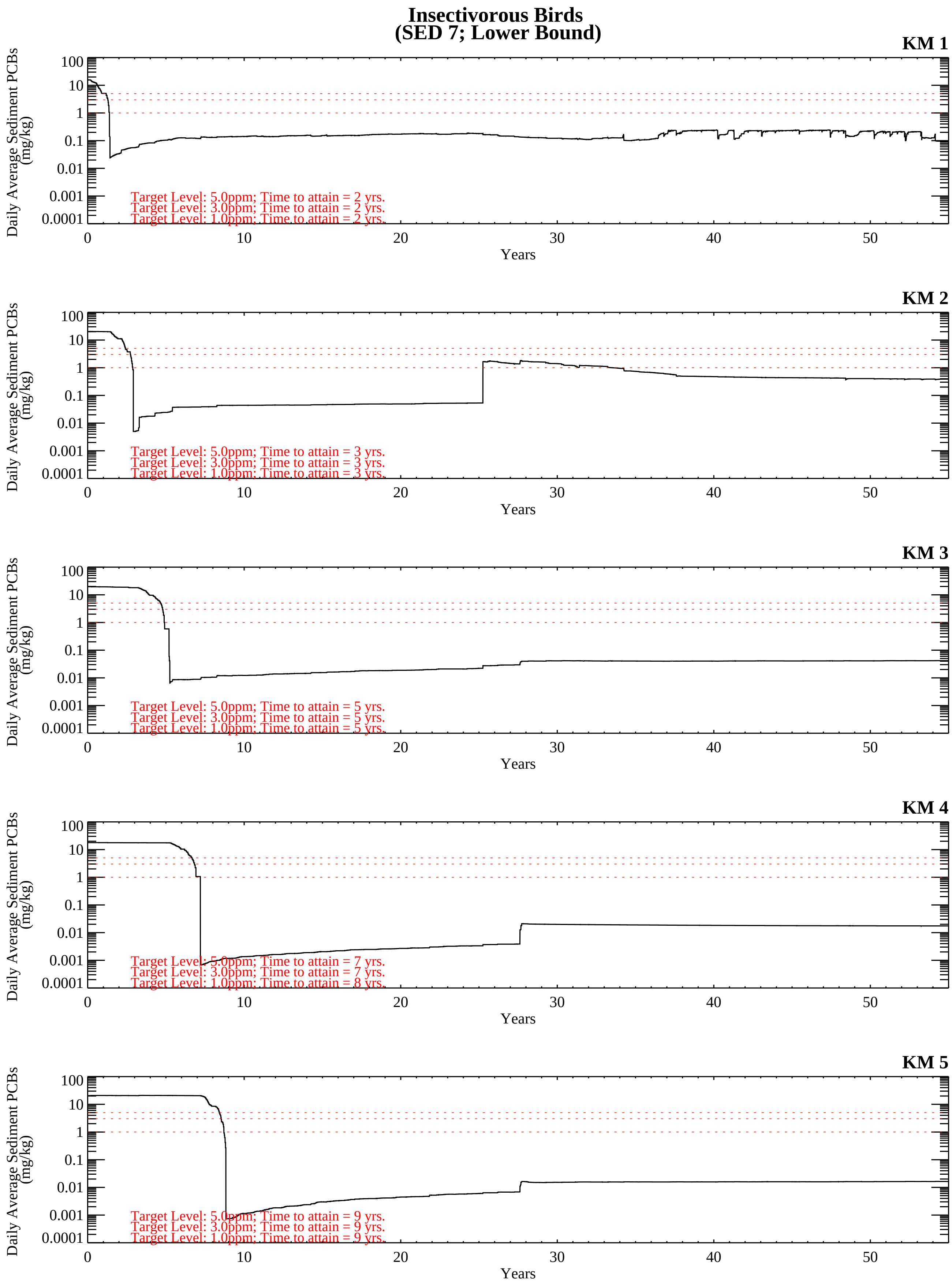

Figure G-6.4-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 7; Reach 5/6; Lower Bound).

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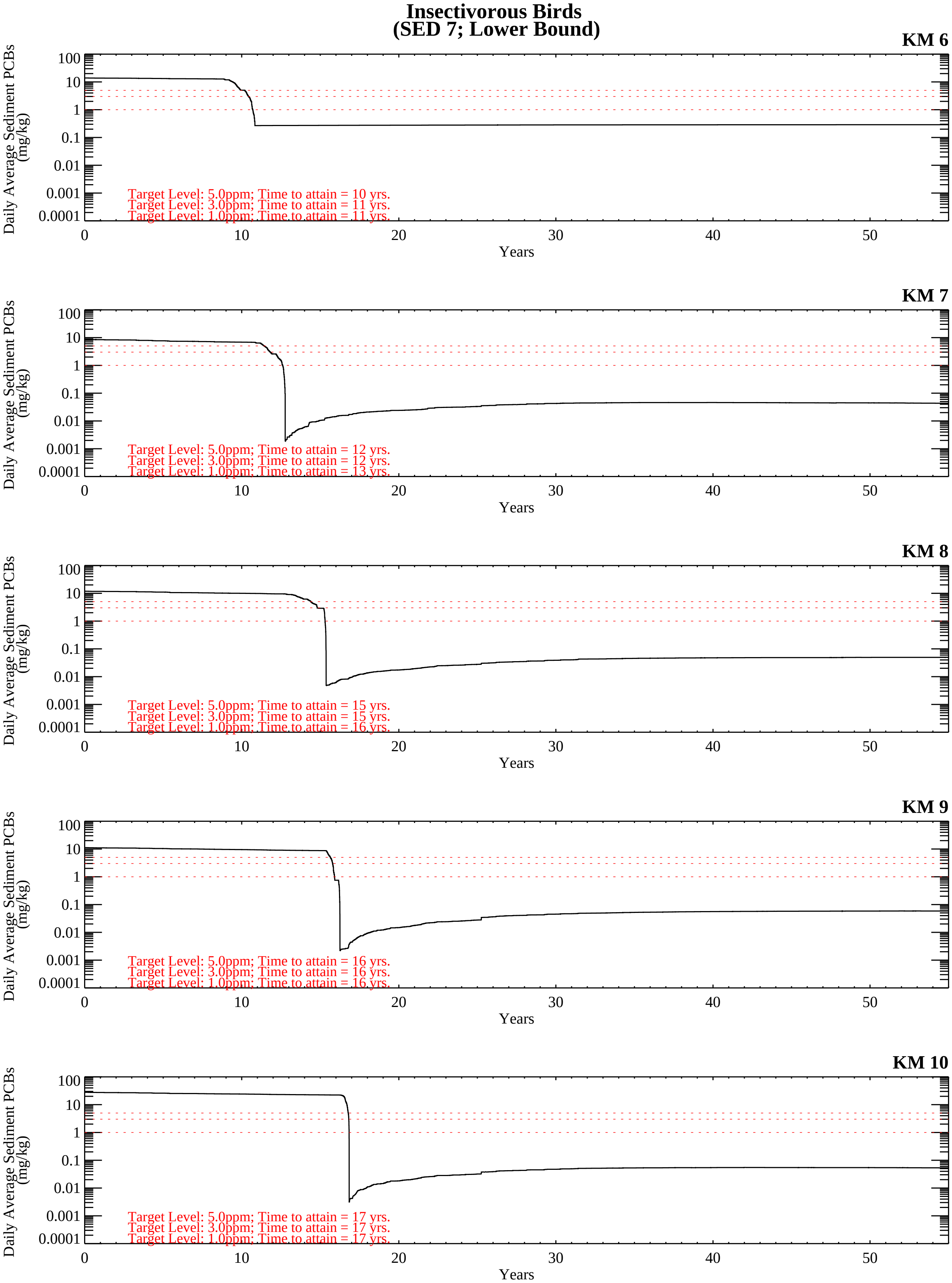

Figure G-6.4-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 7; Reach 5/6; Lower Bound).

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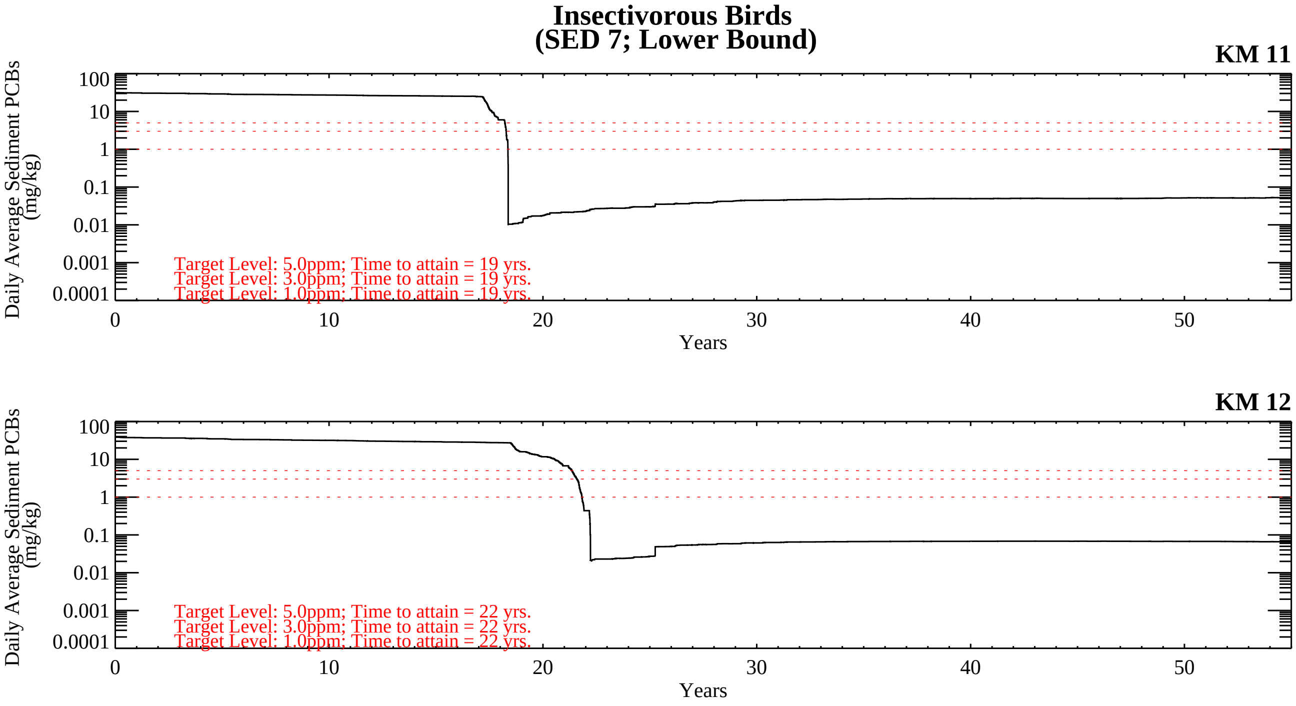

Figure G-6.4-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 7; Reach 5/6; Lower Bound).

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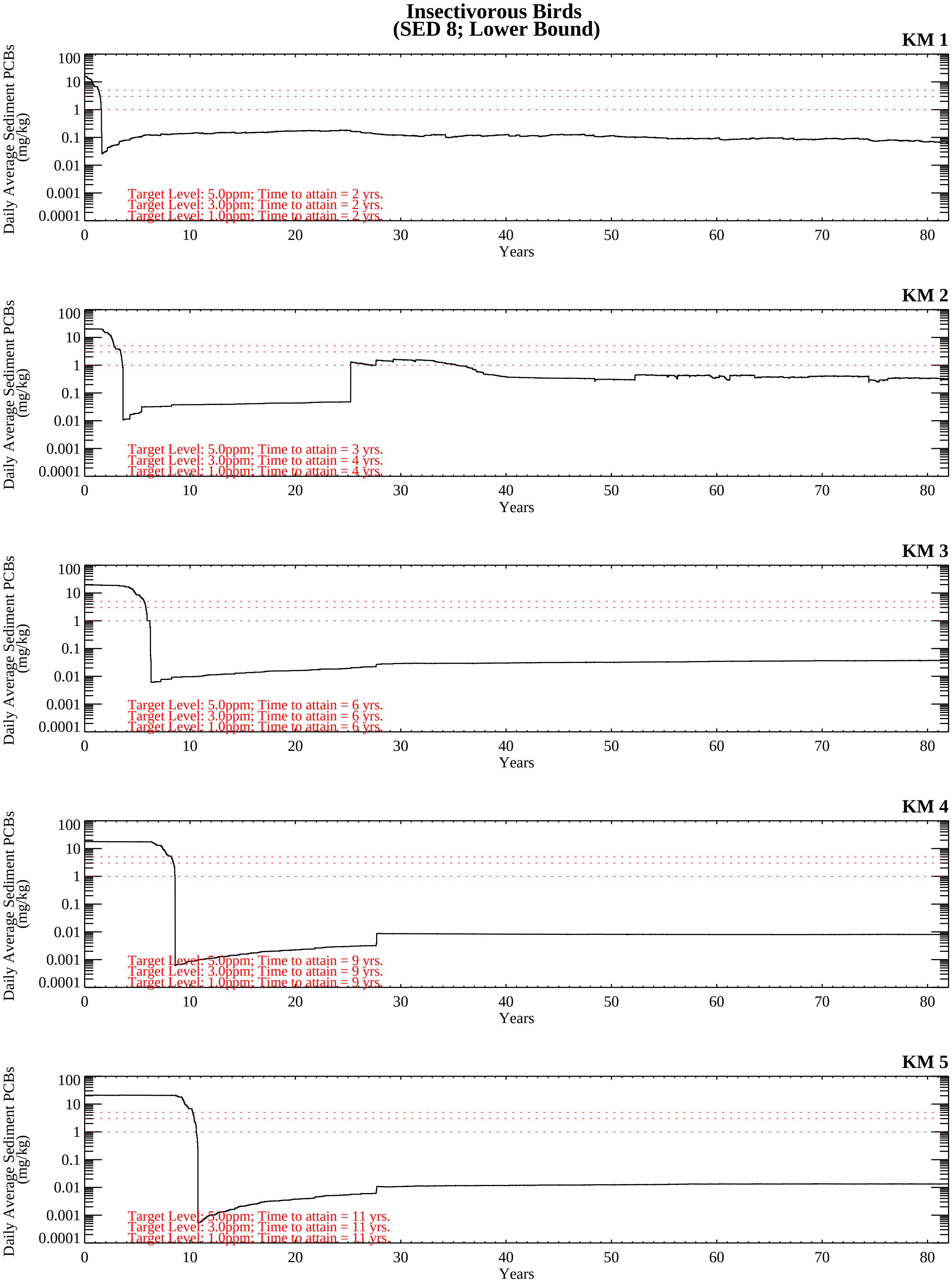

Figure G-6.4-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 8; Reach 5/6; Lower Bound).

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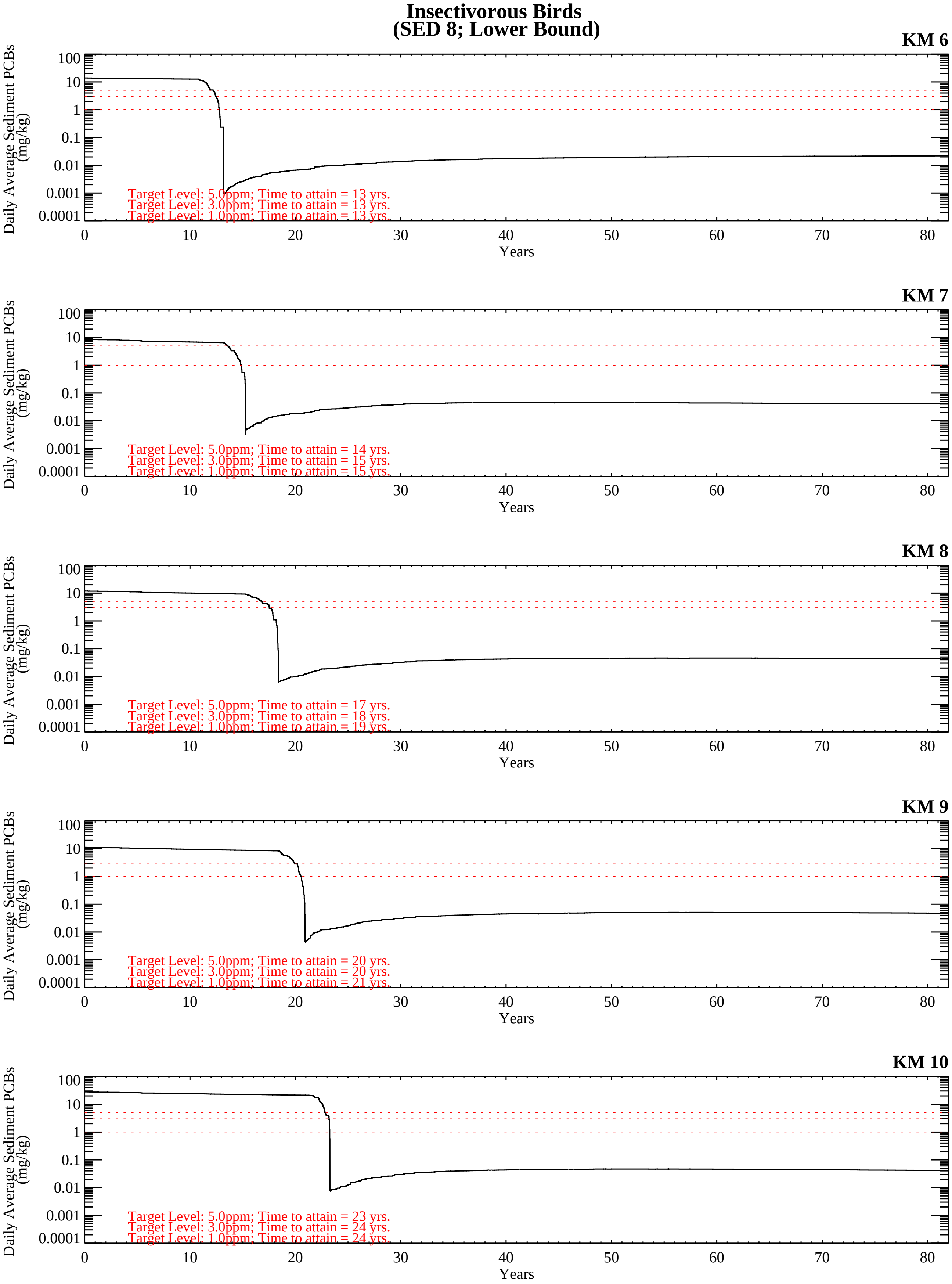

Figure G-6.4-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 8; Reach 5/6; Lower Bound).

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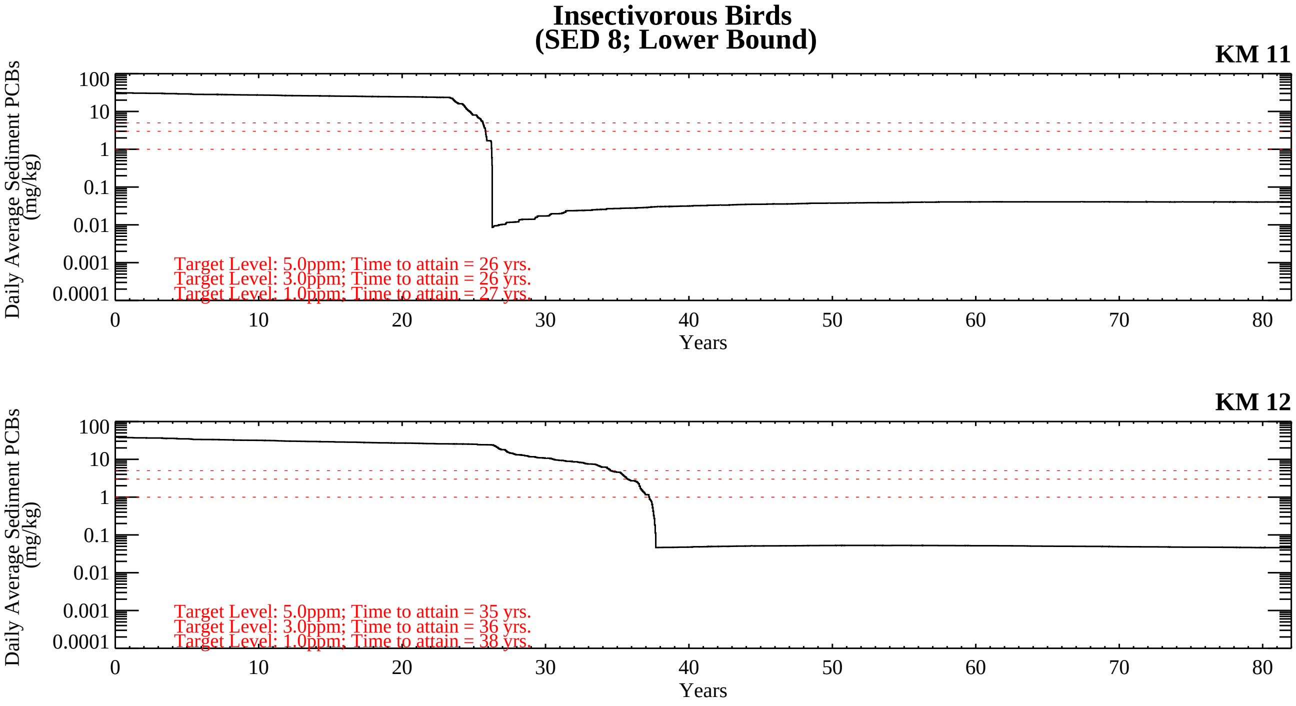

Figure G-6.4-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for insectivorous birds (wood duck) (SED 8; Reach 5/6; Lower Bound).

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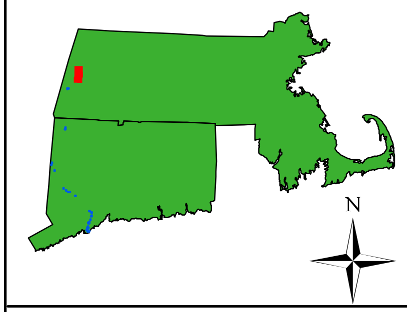
LOCATOR MAP



SCALE

LEGEND

Averaging Areas
for Mink

🟨 Reaches 5A/5B

🟦 Reaches 5C/5D/6

Figure G-7.1.
Model grid cells used to define the sediment averaging areas for piscivorous mammal comparisons to sediment target levels.

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March 2008

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Piscivorous Mammals
(SED 1 / SED 2; Base Case)

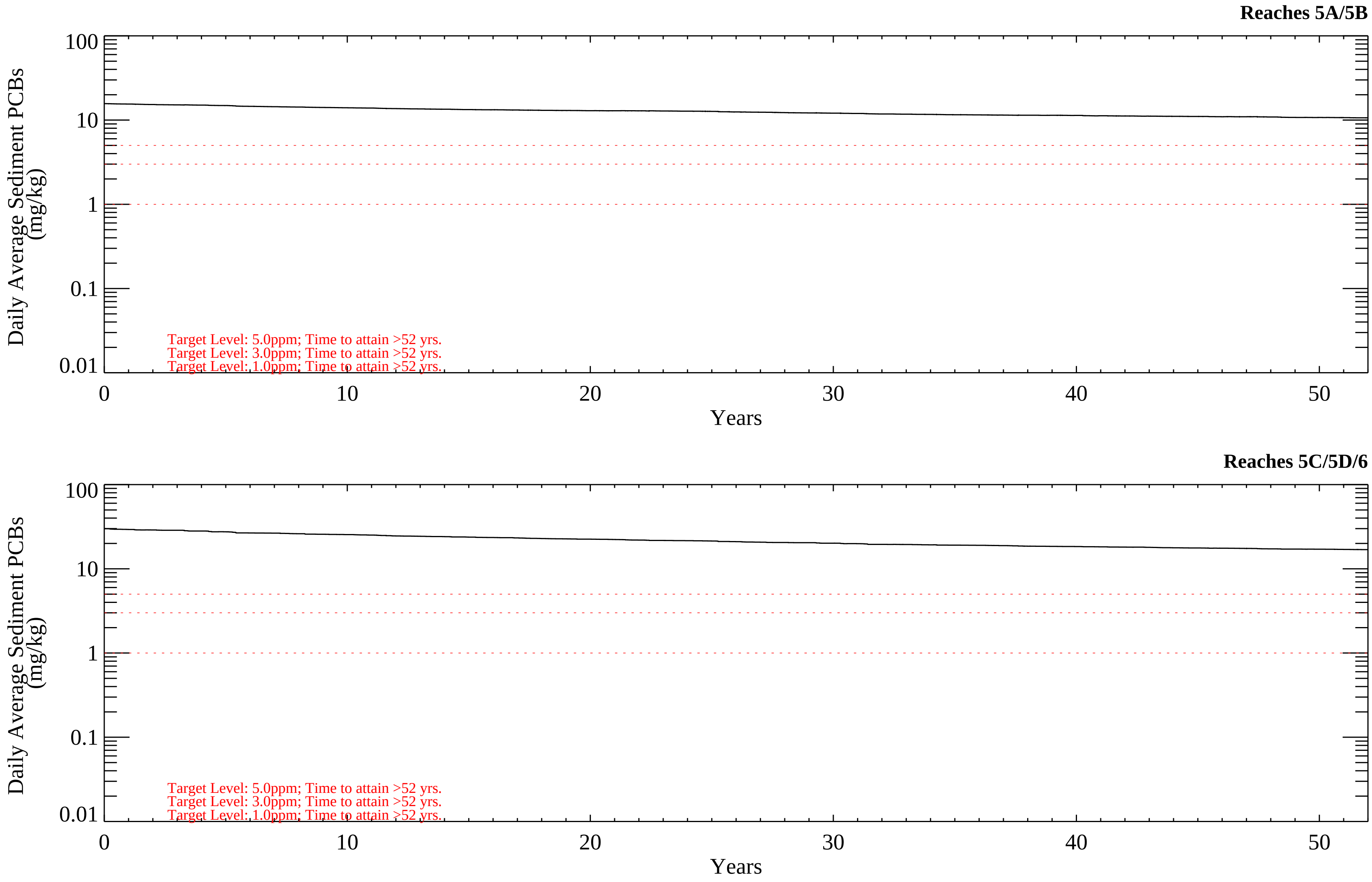

Figure G-7.2-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for piscivorous mammals (SED 1 / SED 2; Reach 5/6; Base Case).
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Piscivorous Mammals
(SED 3; Base Case)

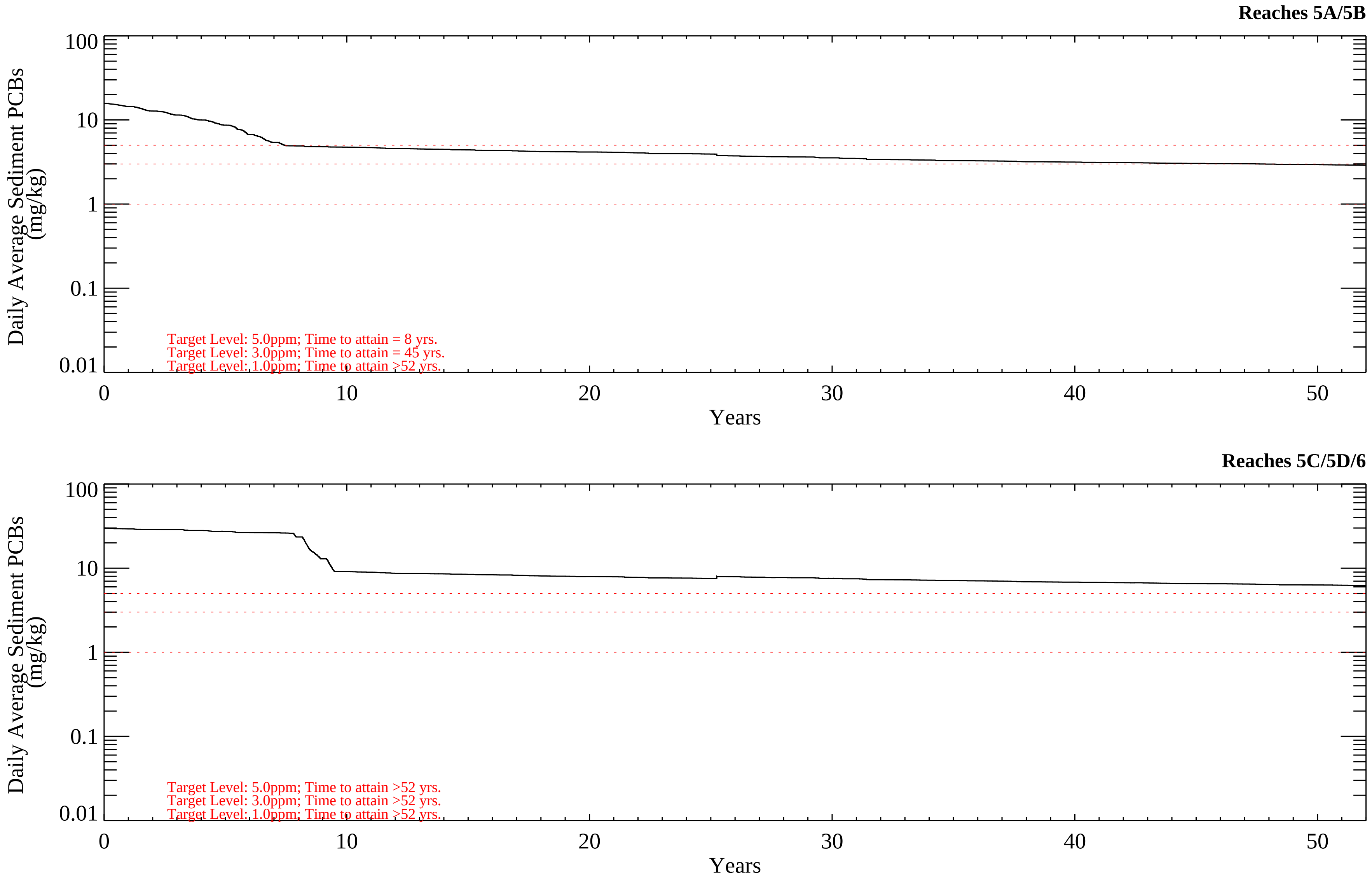

Figure G-7.2-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for piscivorous mammals (SED 3; Reach 5/6; Base Case).
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Piscivorous Mammals
(SED 4; Base Case)

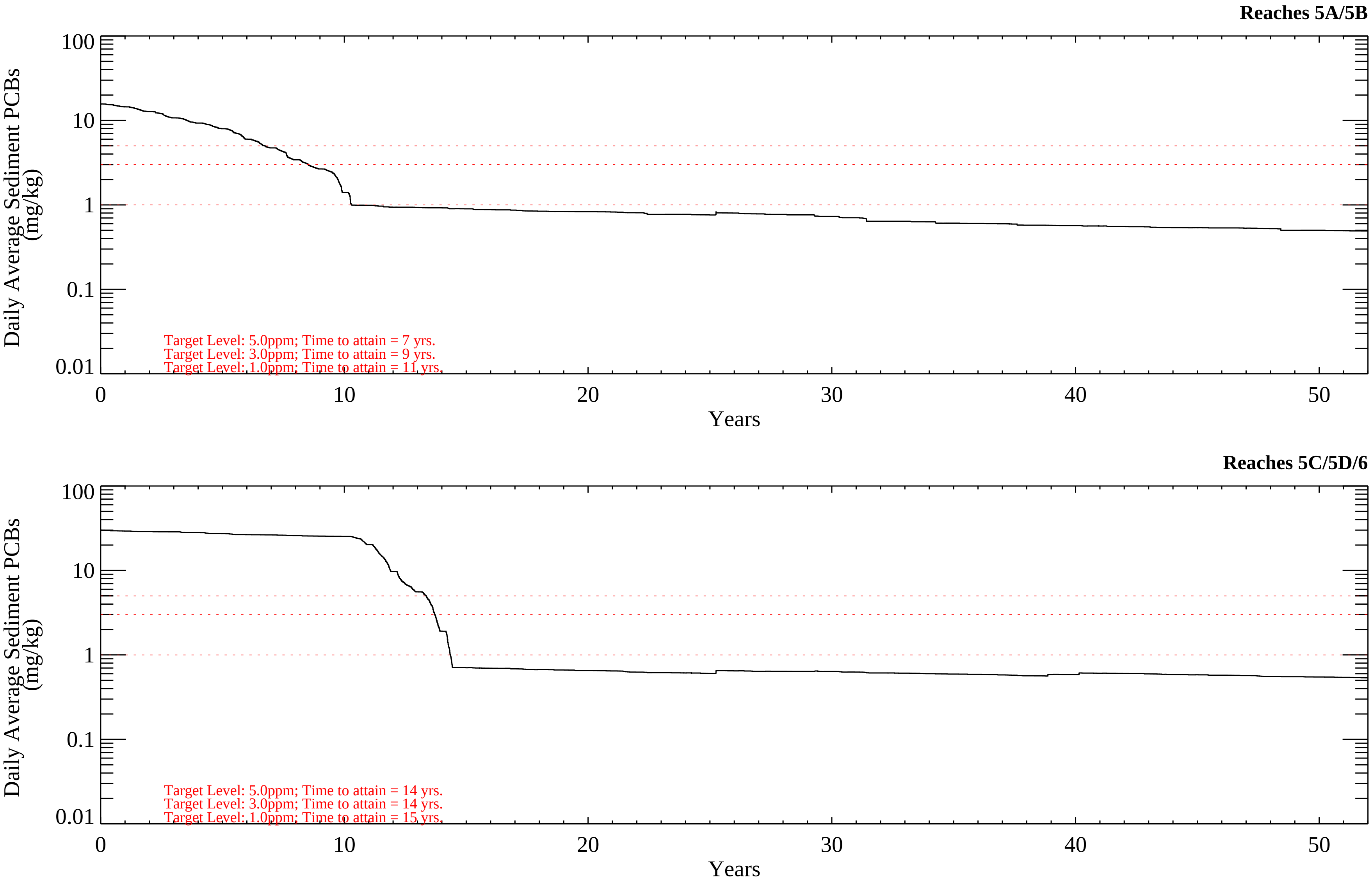

Figure G-7.2-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for piscivorous mammals (SED 4; Reach 5/6; Base Case).
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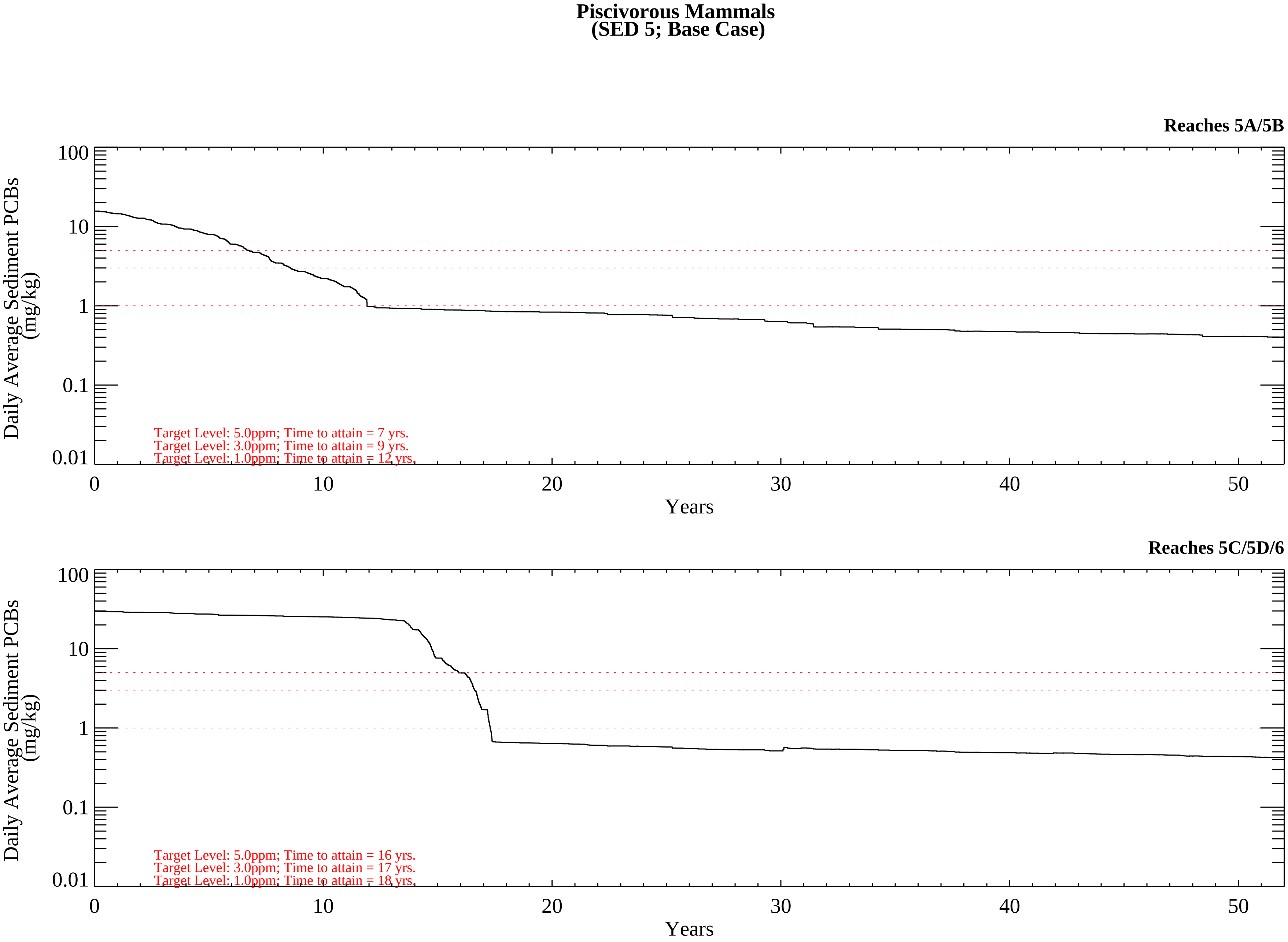

Figure G-7.2-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for piscivorous mammals (SED 5; Reach 5/6; Base Case).
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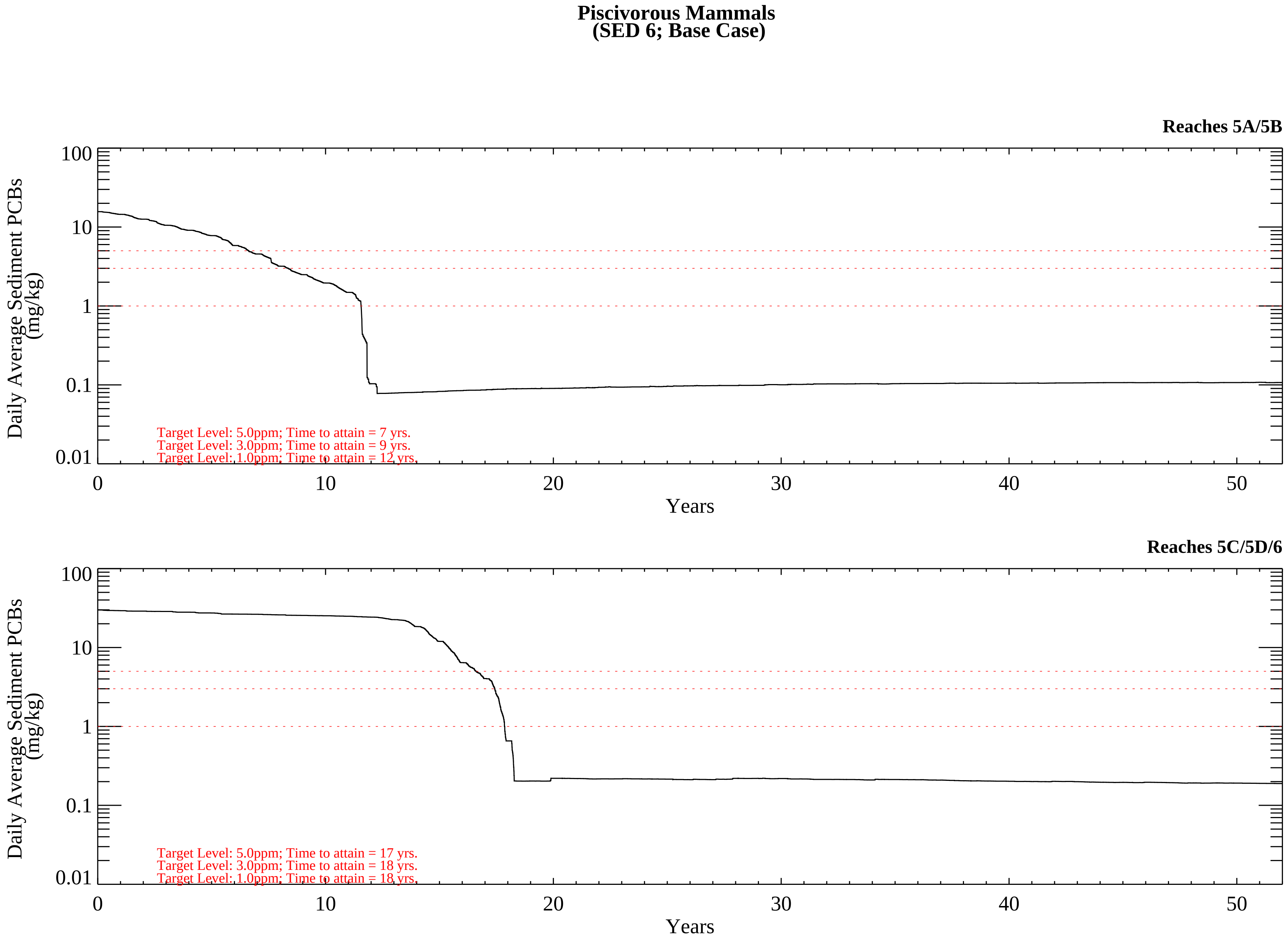
Piscivorous Mammals
(SED 6; Base Case)

Reaches 5A/5B

Target Level: 5.0ppm; Time to attain = 7 yrs.
Target Level: 3.0ppm; Time to attain = 9 yrs.
Target Level: 1.0ppm; Time to attain = 12 yrs.

Reaches 5C/5D/6

Target Level: 5.0ppm; Time to attain = 17 yrs.
Target Level: 3.0ppm; Time to attain = 18 yrs.
Target Level: 1.0ppm; Time to attain = 18 yrs.

Figure G-7.2-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for piscivorous mammals (SED 6; Reach 5/6; Base Case).
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Piscivorous Mammals
(SED 7; Base Case)

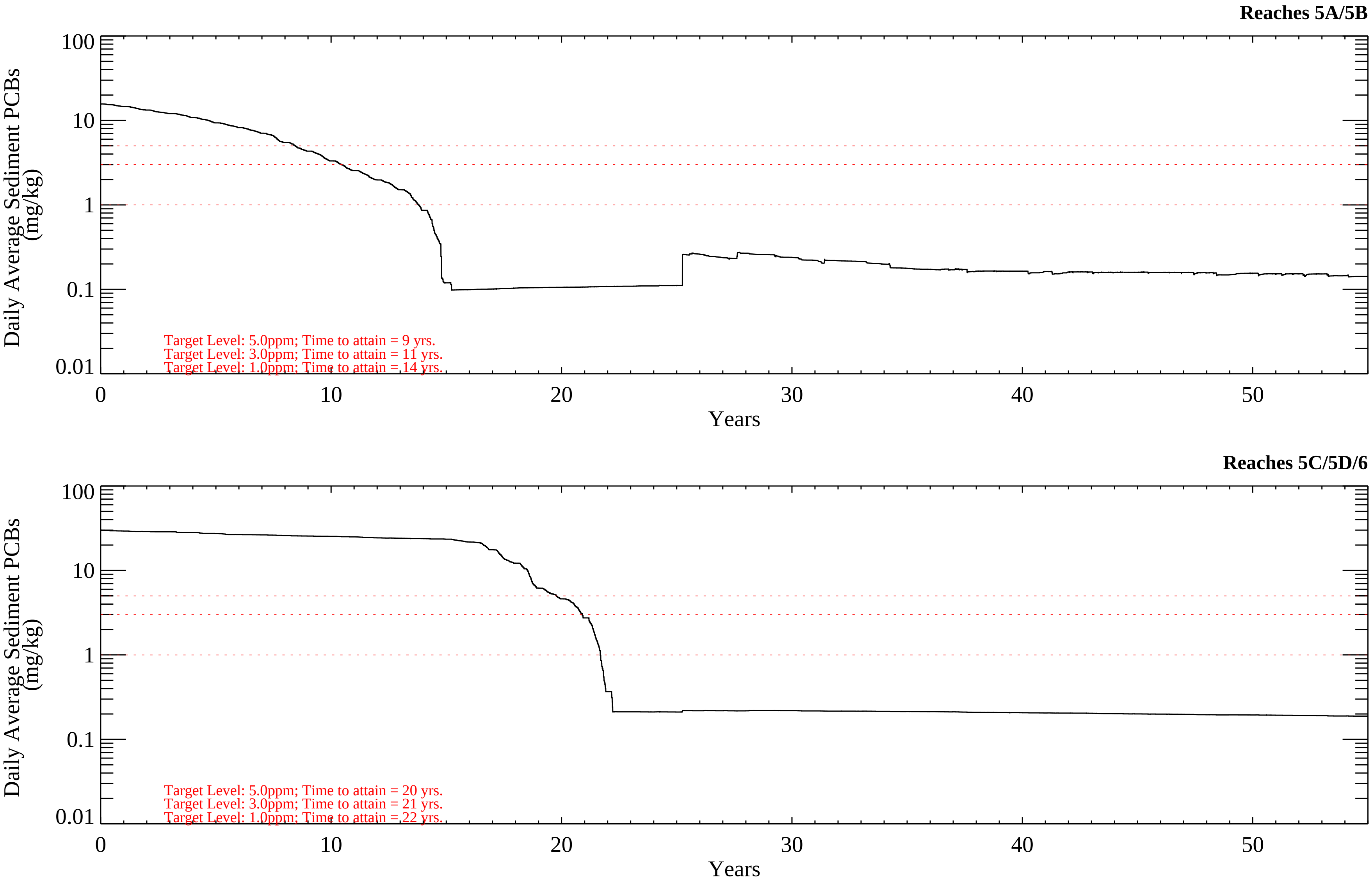

Figure G-7.2-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for piscivorous mammals (SED 7; Reach 5/6; Base Case).
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Piscivorous Mammals
(SED 8; Base Case)

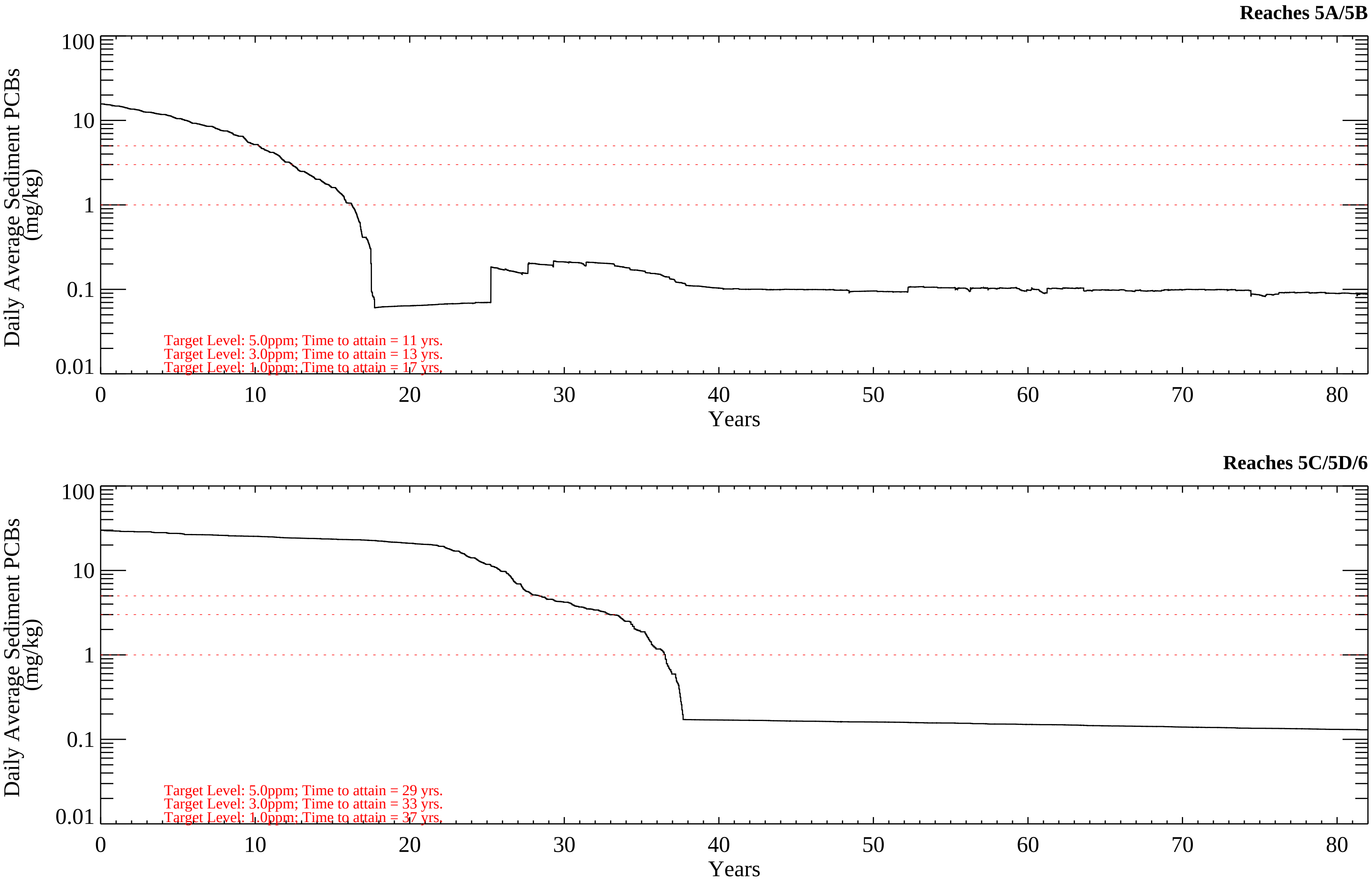

Figure G-7.2-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for piscivorous mammals (SED 8; Reach 5/6; Base Case).
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Piscivorous Mammals
(SED 1/SED 2; Base Case (Extrapolated))

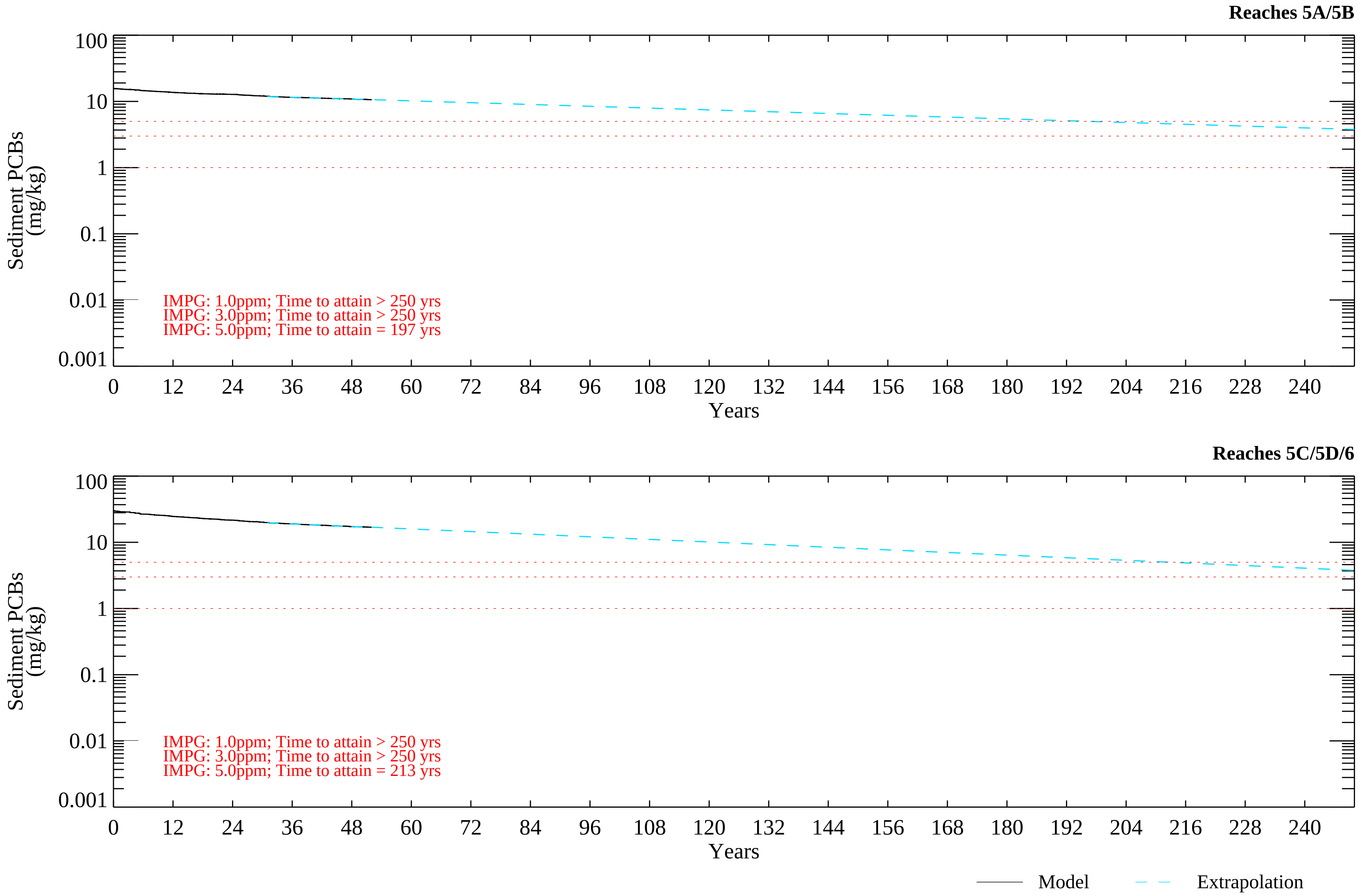

Figure G-7.3-1a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for piscivorous mammals (SED 1/SED 2; Reach 5/6; Base Case).

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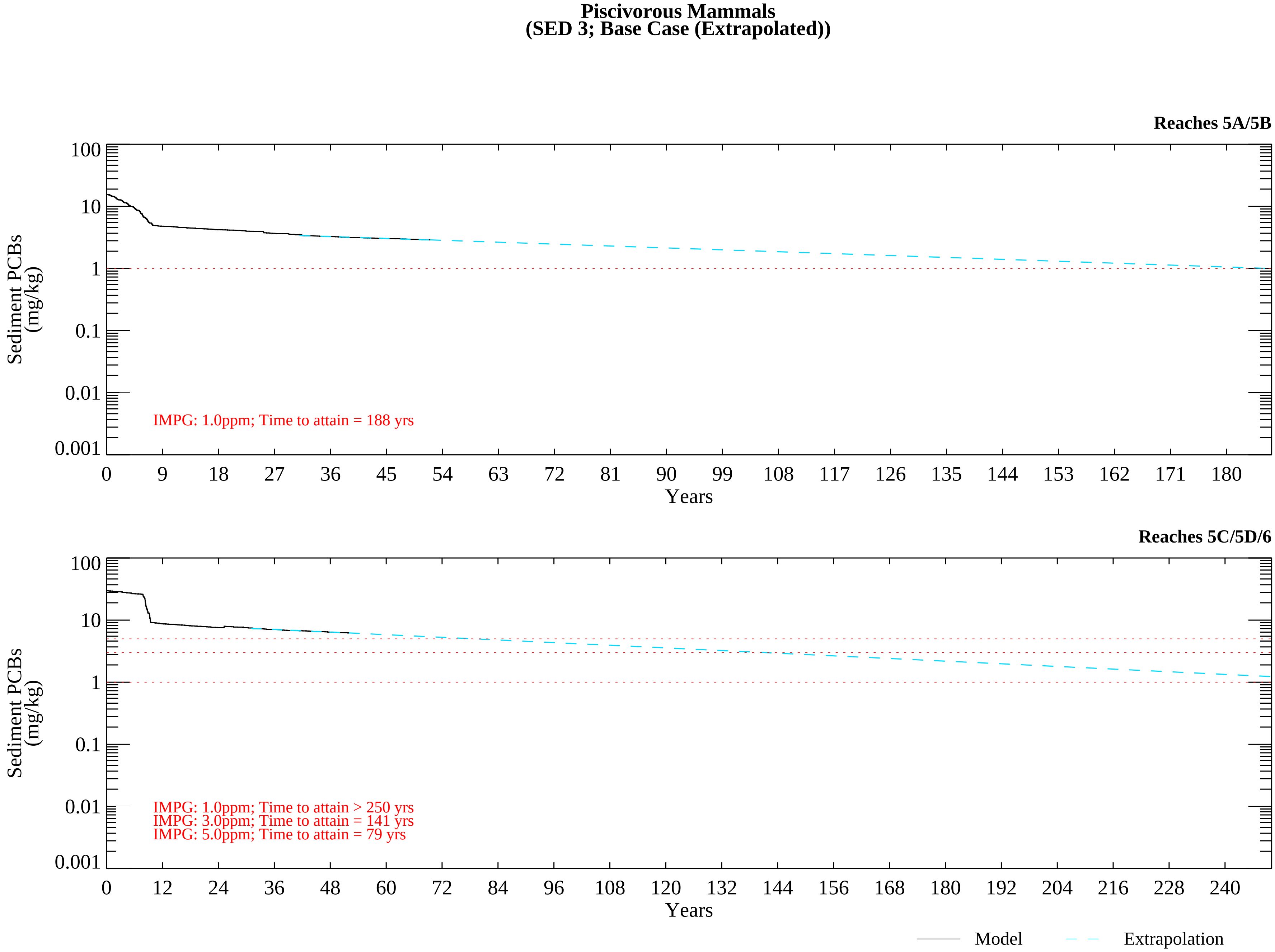

Figure G-7.3-2a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for piscivorous mammals (SED 3; Reach 5/6; Base Case).

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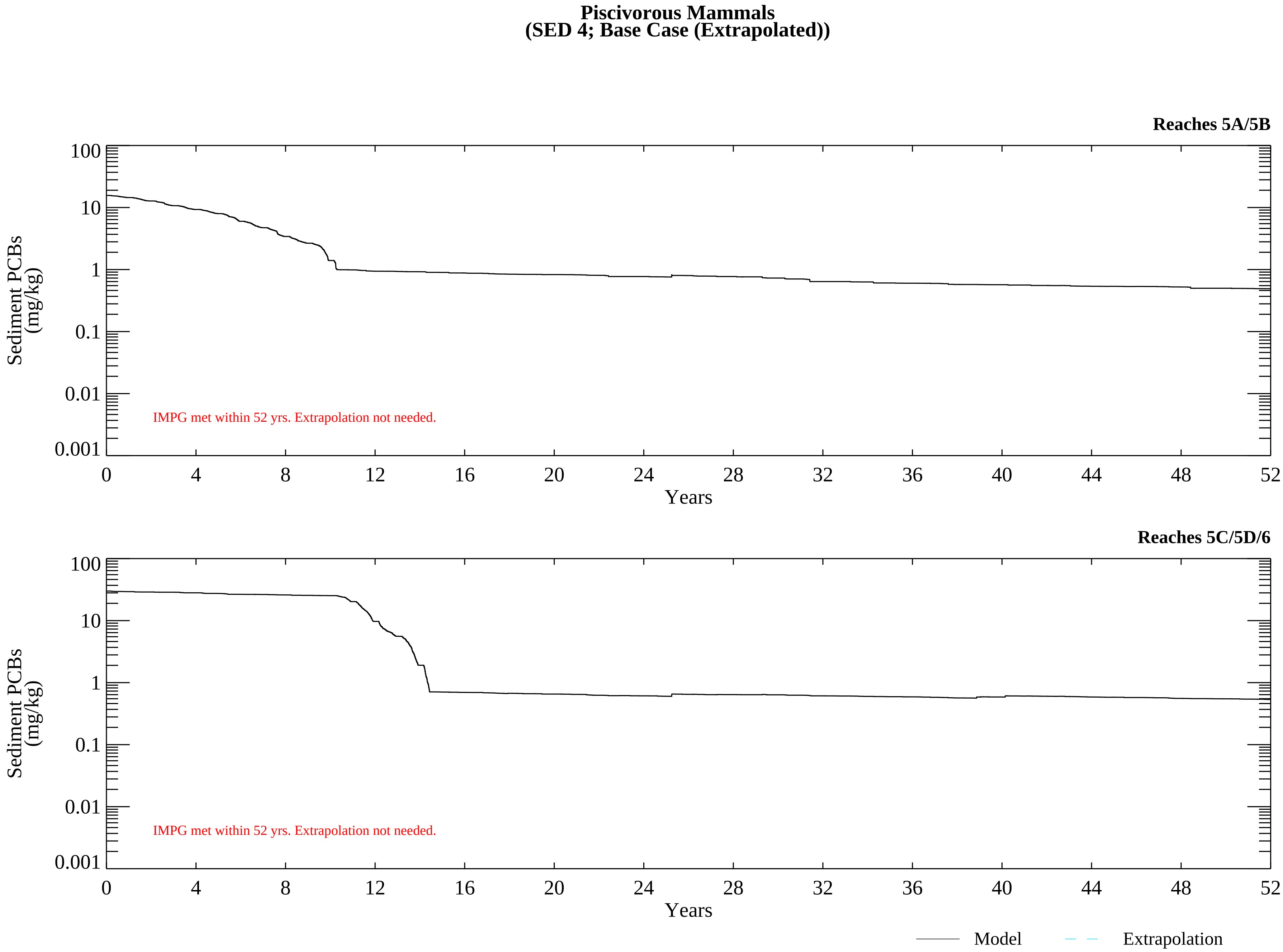

Figure G-7.3-3a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for piscivorous mammals (SED 4; Reach 5/6; Base Case).

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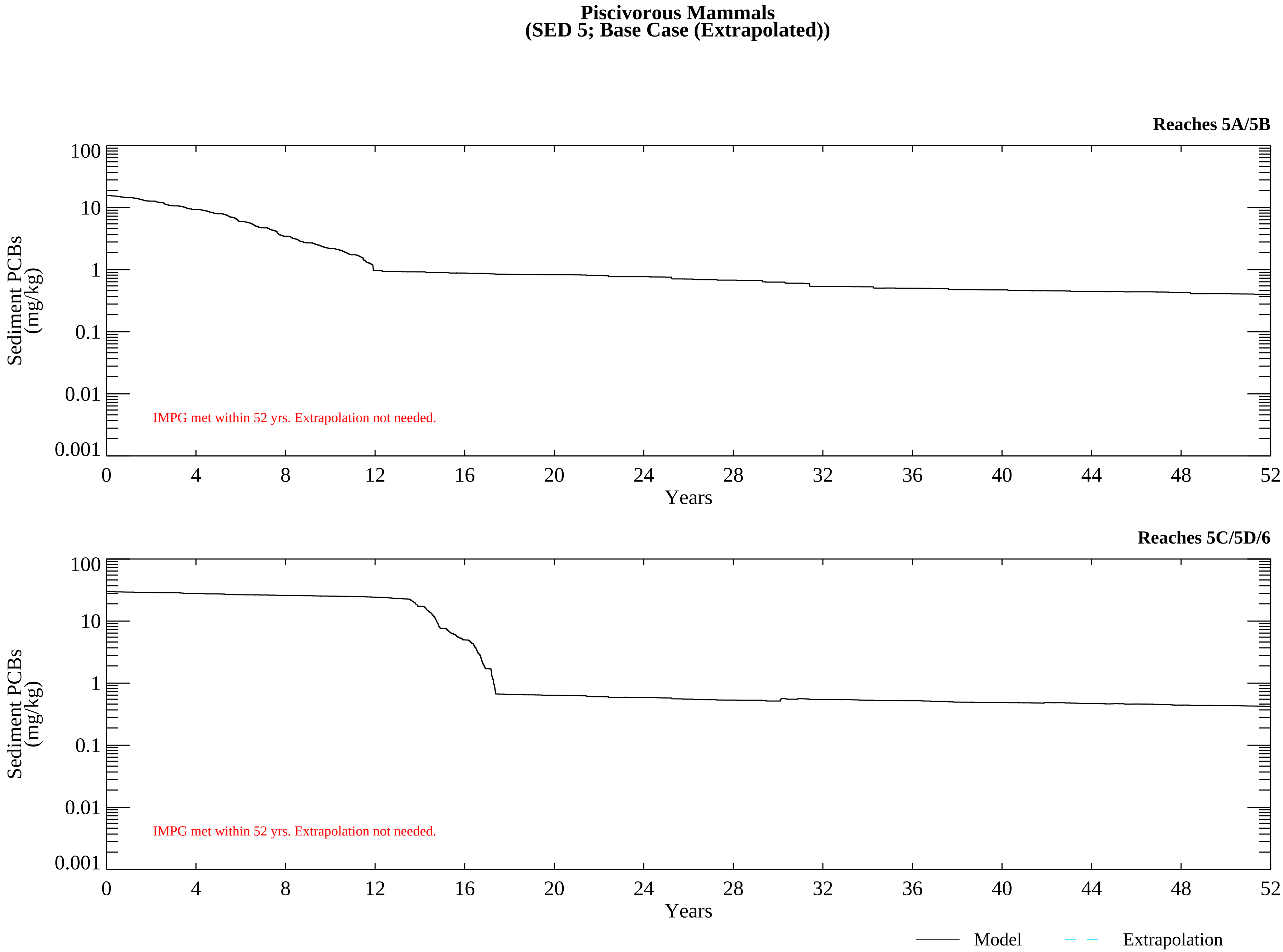

Figure G-7.3-4a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for piscivorous mammals (SED 5; Reach 5/6; Base Case).

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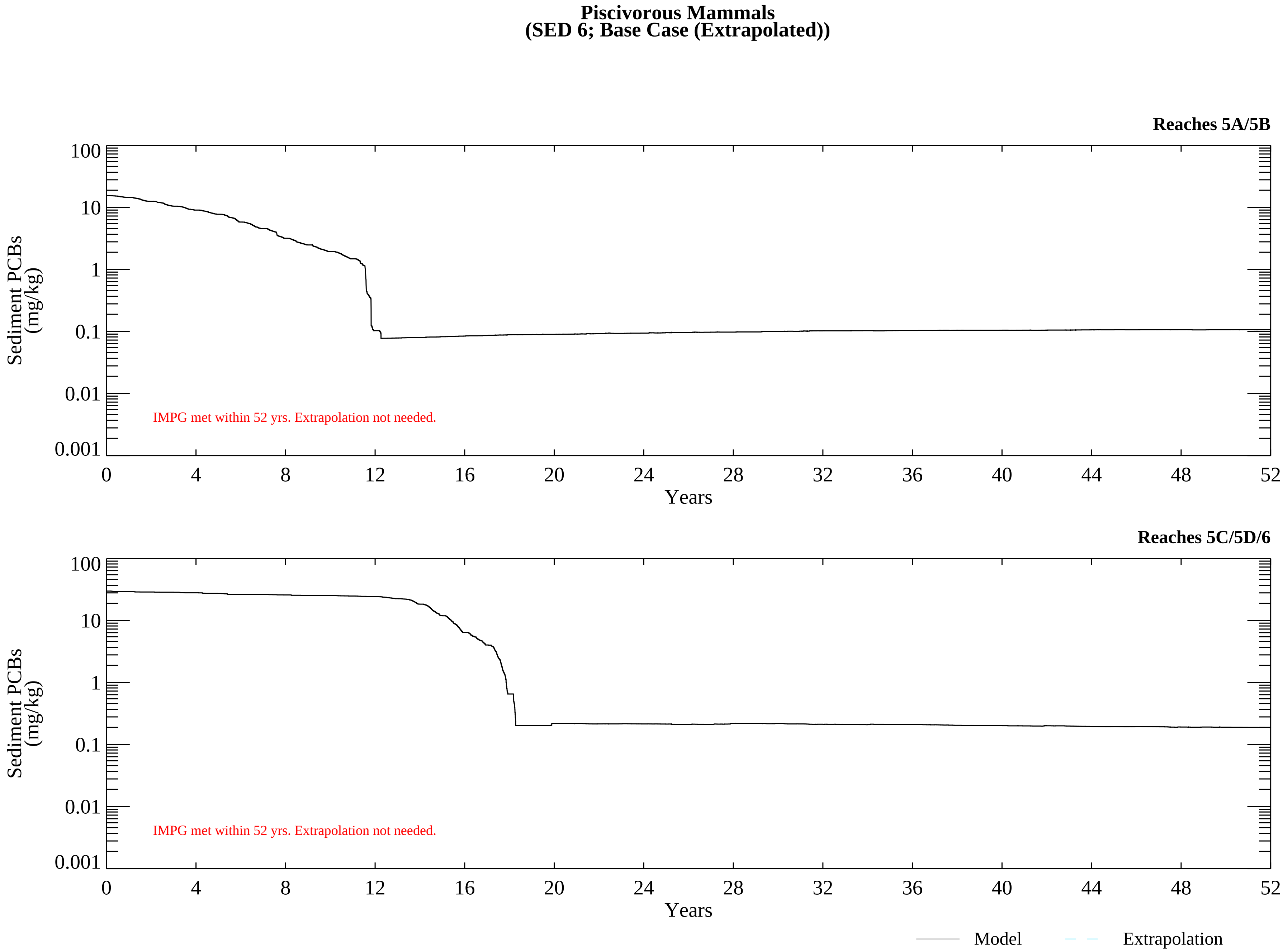

Figure G-7.3-5a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for piscivorous mammals (SED 6; Reach 5/6; Base Case).

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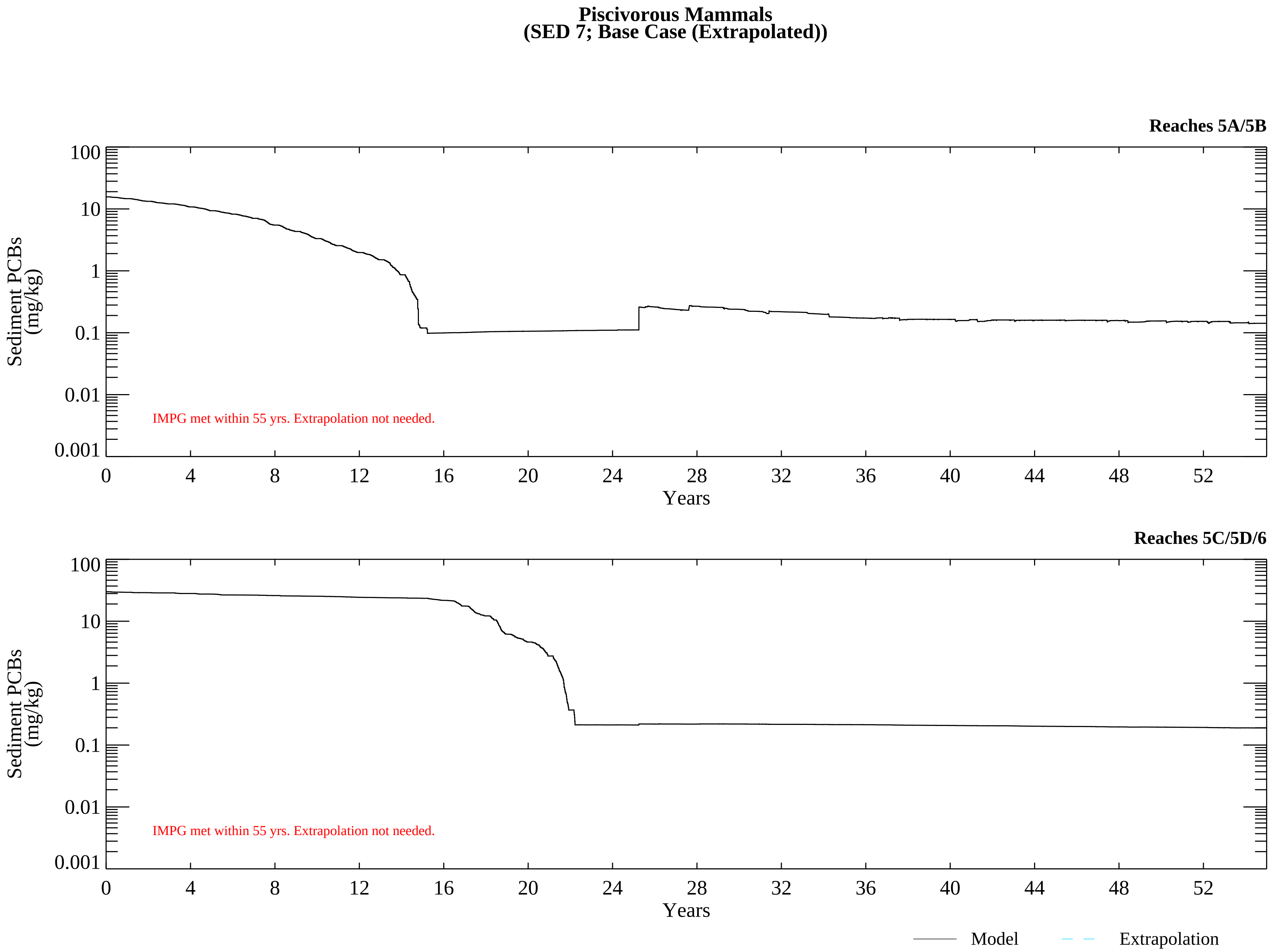

Figure G-7.3-6a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for piscivorous mammals (SED 7; Reach 5/6; Base Case).

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Piscivorous Mammals
(SED 8; Base Case (Extrapolated))

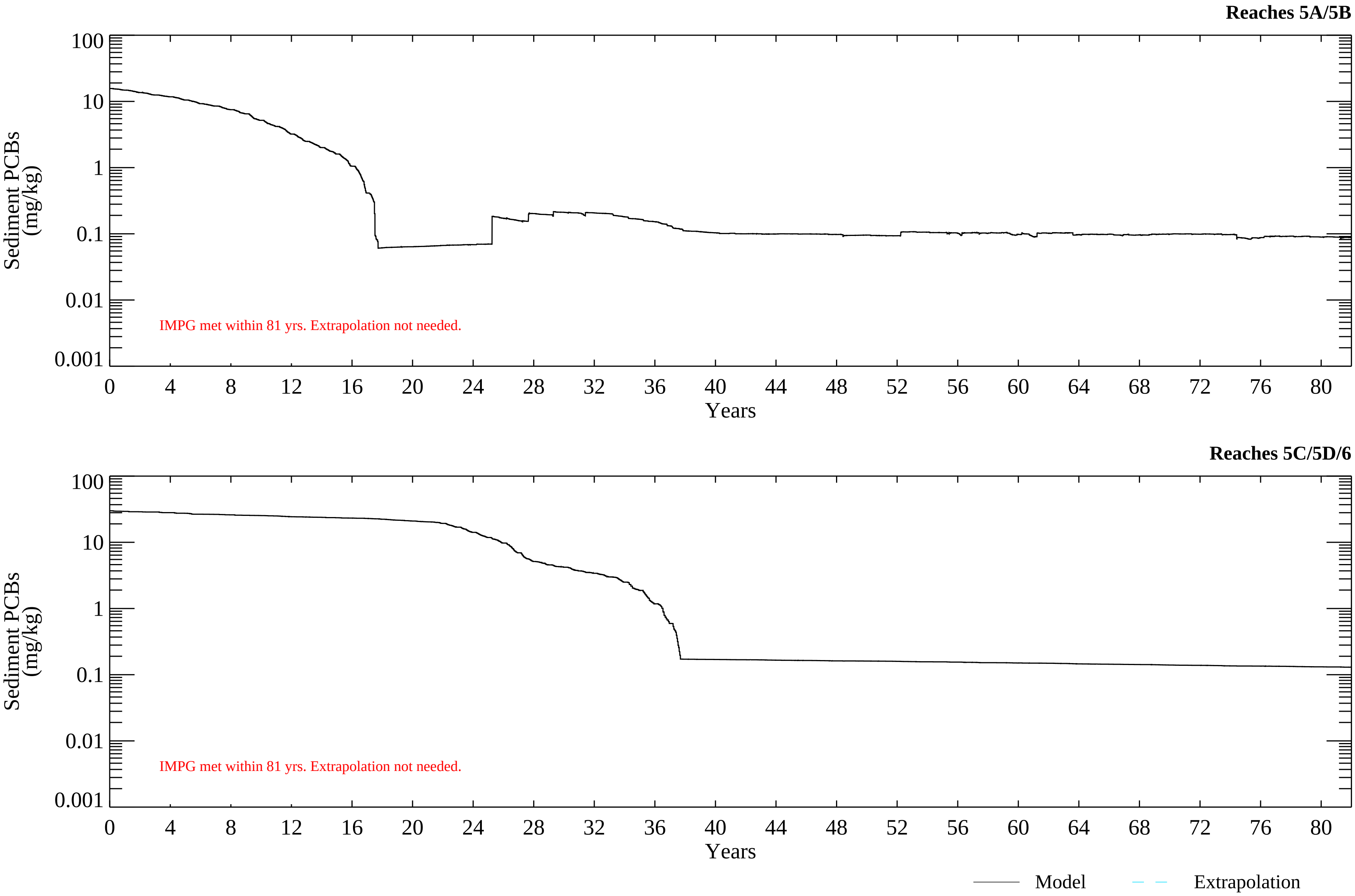

Figure G-7.3-7a. Extrapolated temporal trend of surface sediment (0-6") PCBs compared to sediment target levels for piscivorous mammals (SED 8; Reach 5/6; Base Case).

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Piscivorous Mammals
(SED 1 / SED 2; Lower Bound)

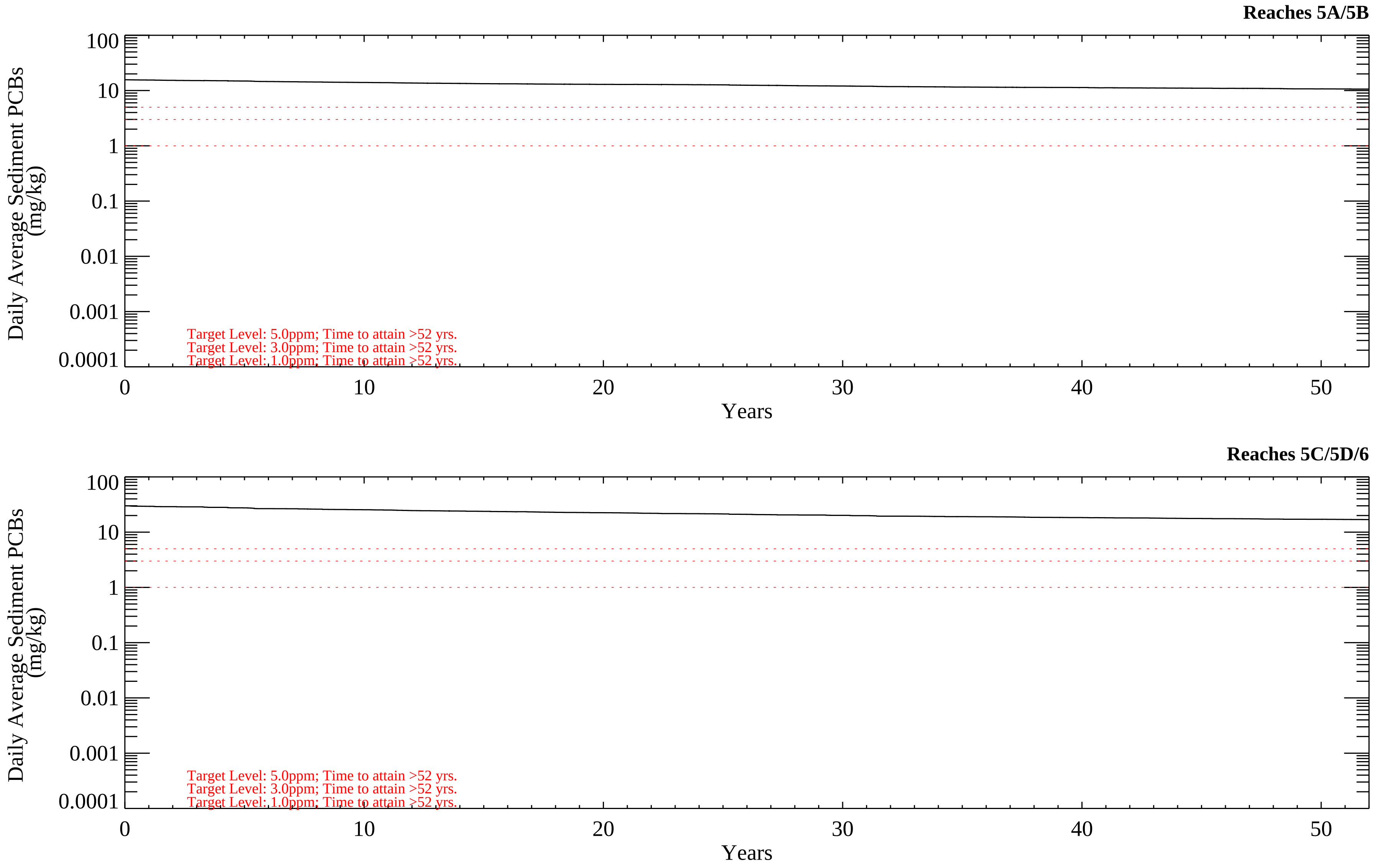

Figure G-7.4-1a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for piscivorous mammals (SED 1 / SED 2; Reach 5/6; Lower Bound).
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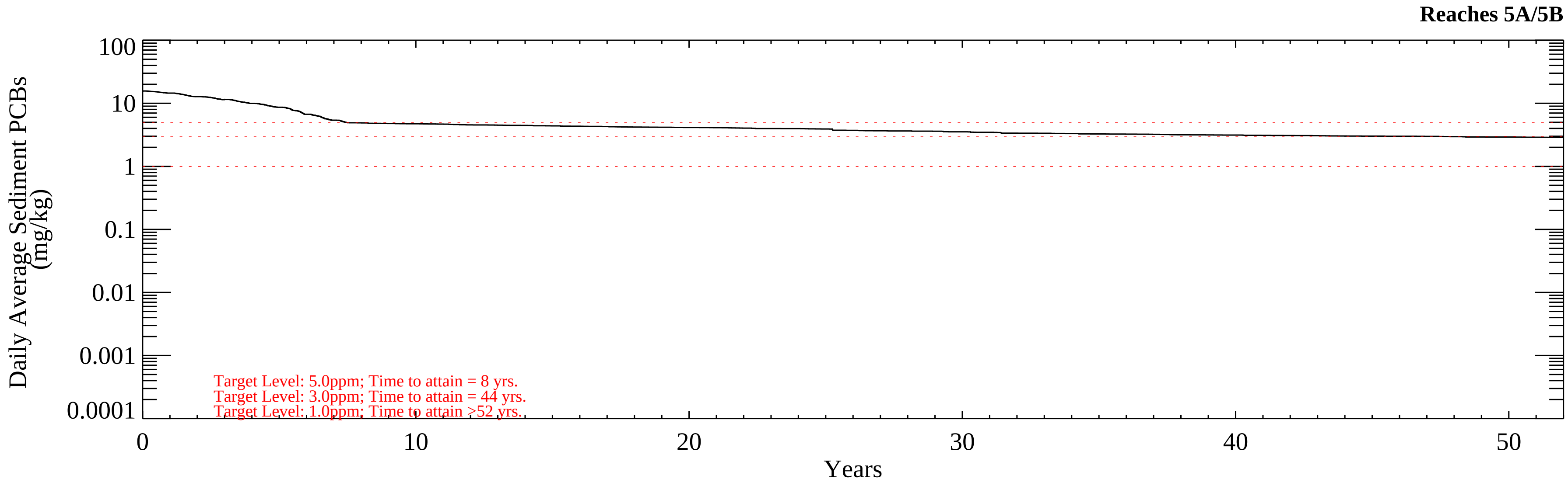
Piscivorous Mammals
(SED 3; Lower Bound)



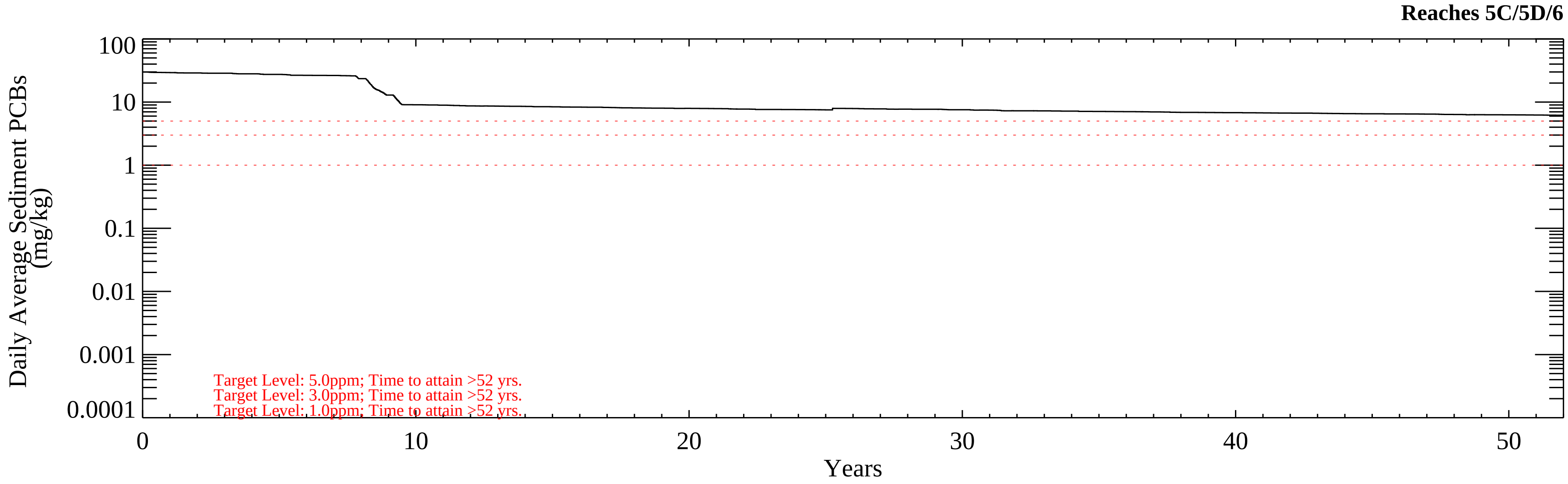


Figure G-7.4-2a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for piscivorous mammals (SED 3; Reach 5/6; Lower Bound).
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Piscivorous Mammals
(SED 4; Lower Bound)

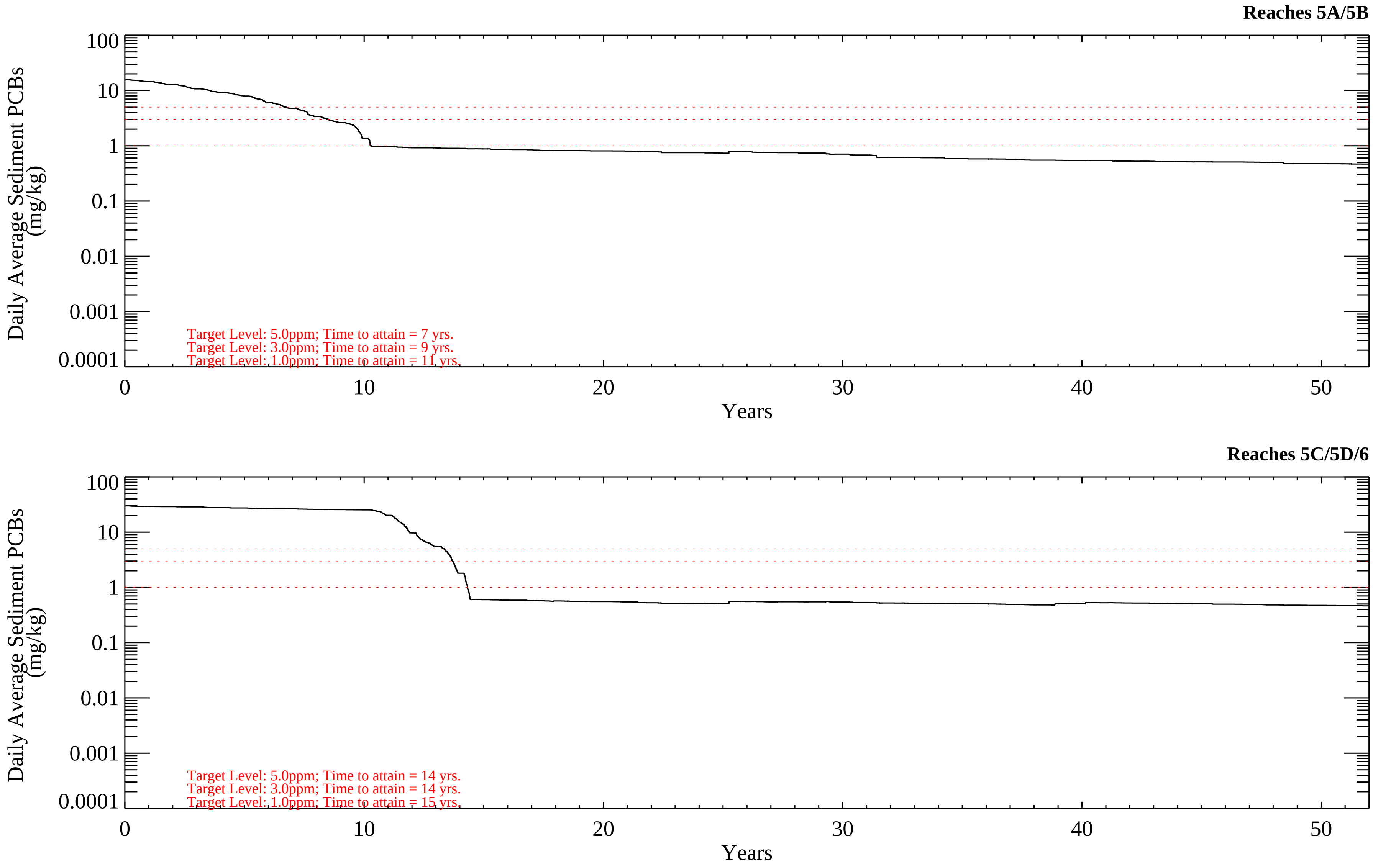

Figure G-7.4-3a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for piscivorous mammals (SED 4; Reach 5/6; Lower Bound).
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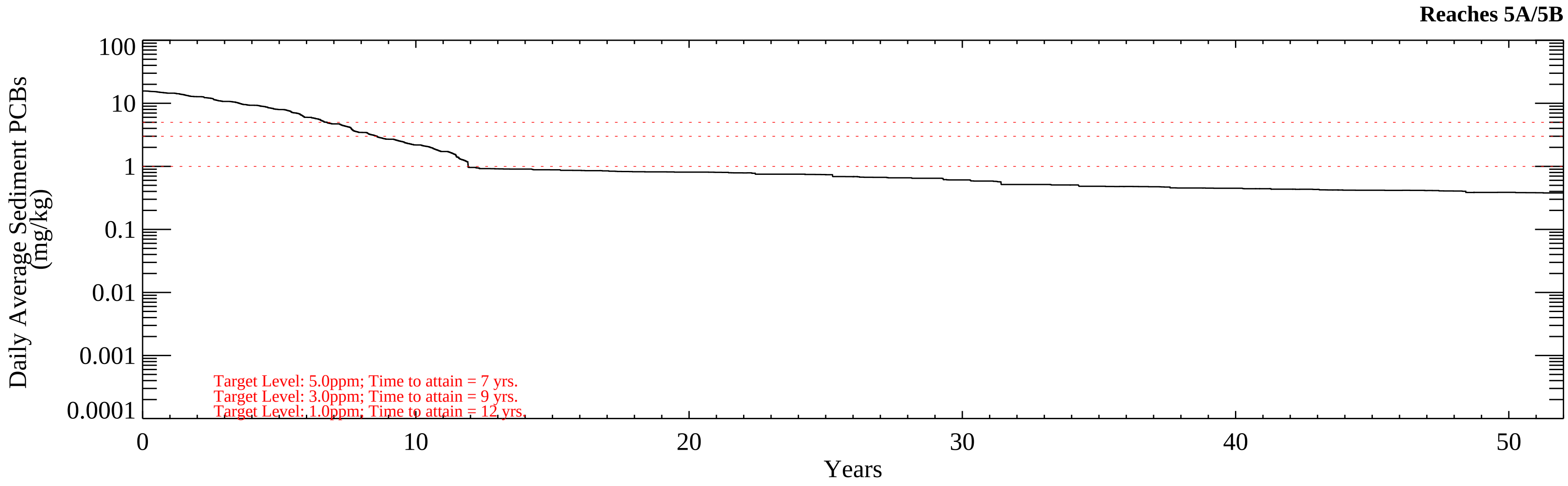
Piscivorous Mammals
(SED 5; Lower Bound)



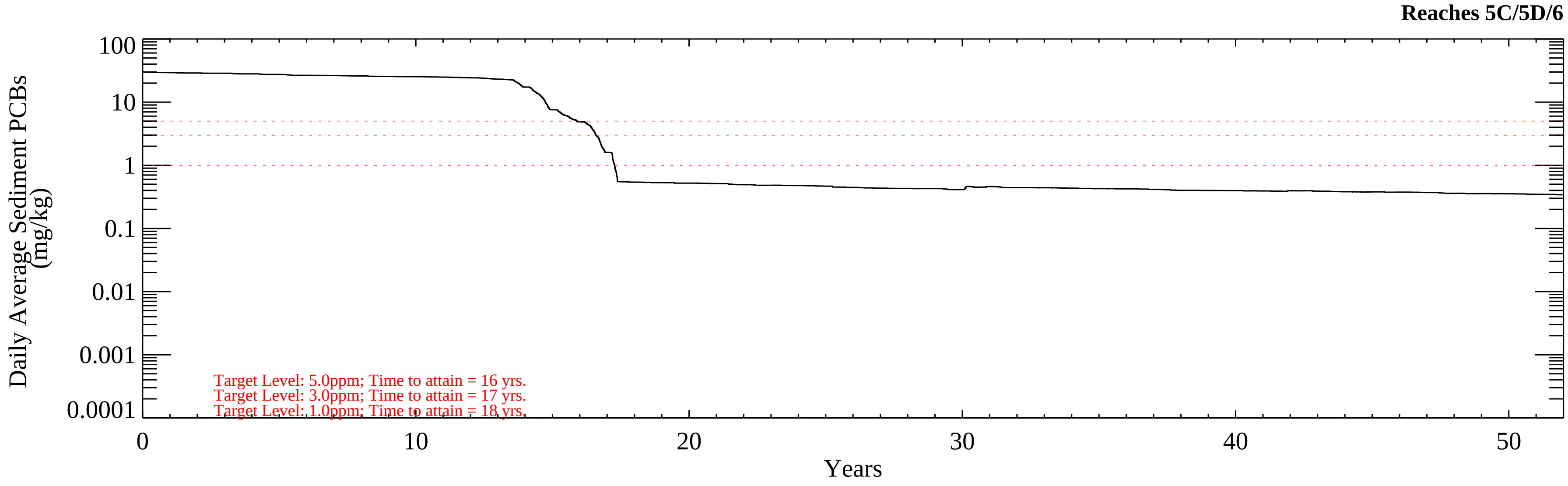


Figure G-7.4-4a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for piscivorous mammals (SED 5; Reach 5/6; Lower Bound).
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Piscivorous Mammals
(SED 6; Lower Bound)

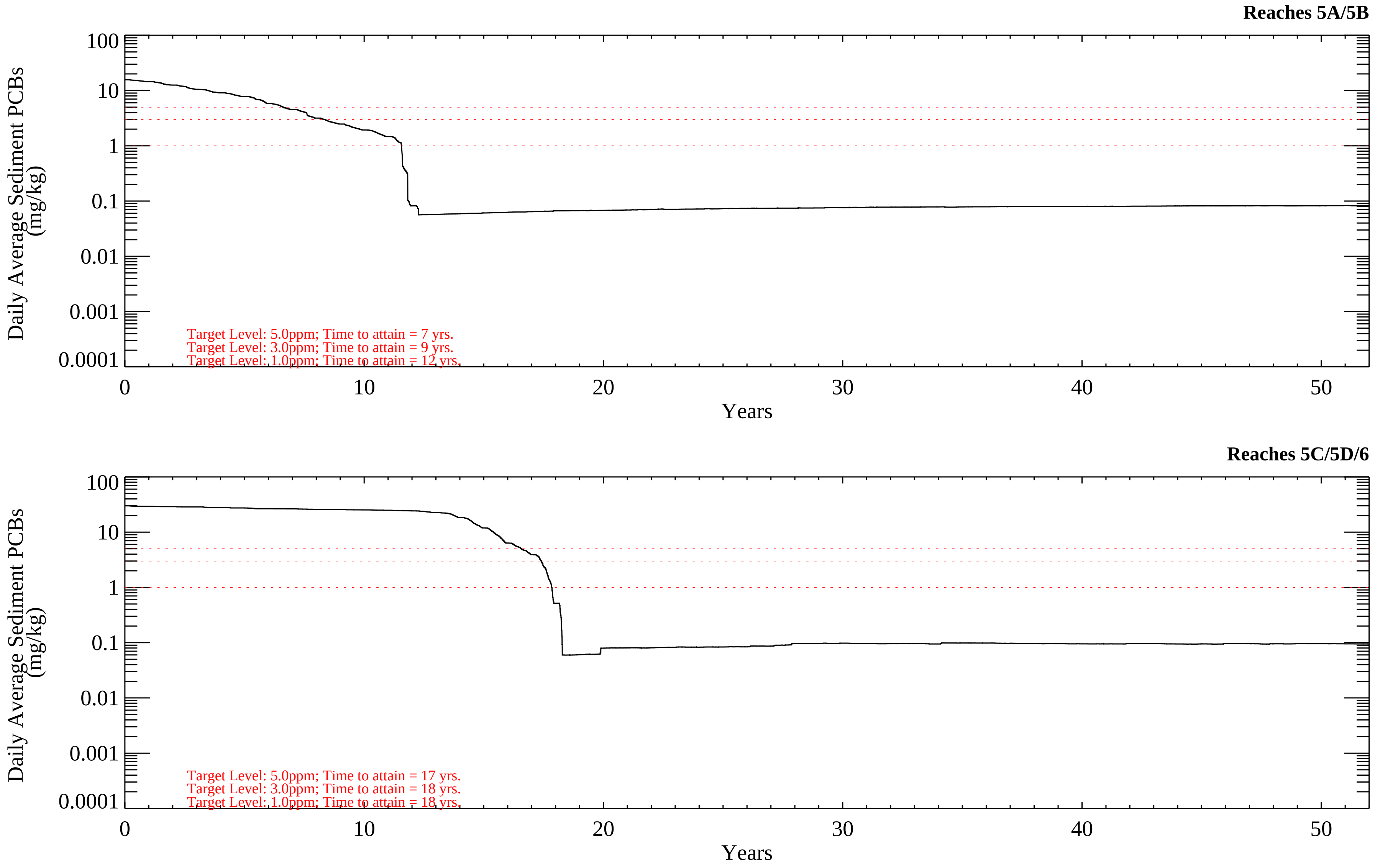

Figure G-7.4-5a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for piscivorous mammals (SED 6; Reach 5/6; Lower Bound).
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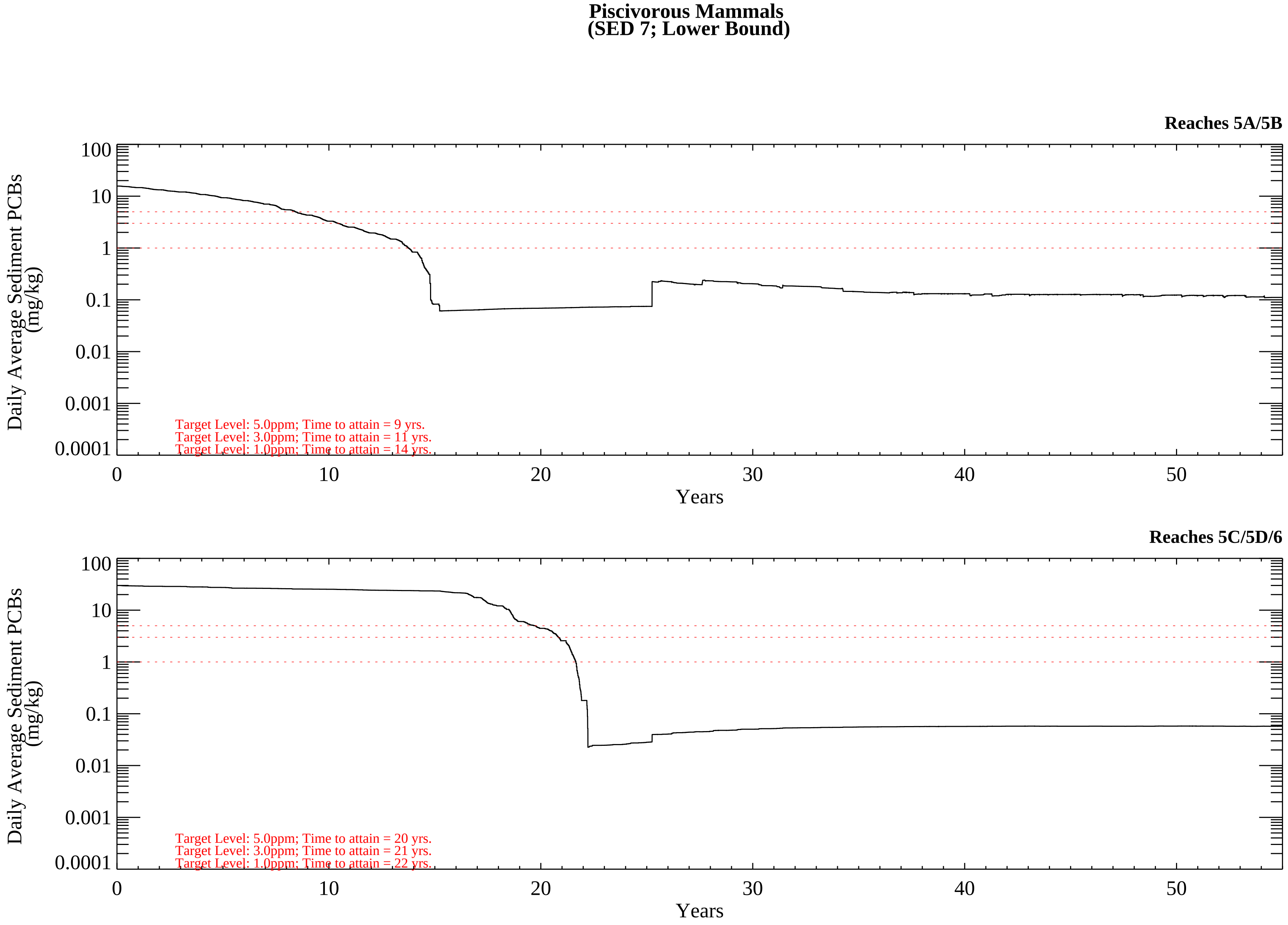

Figure G-7.4-6a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for piscivorous mammals (SED 7; Reach 5/6; Lower Bound).
Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED7CMSLB_0712-24\\bins

Piscivorous Mammals
(SED 8; Lower Bound)

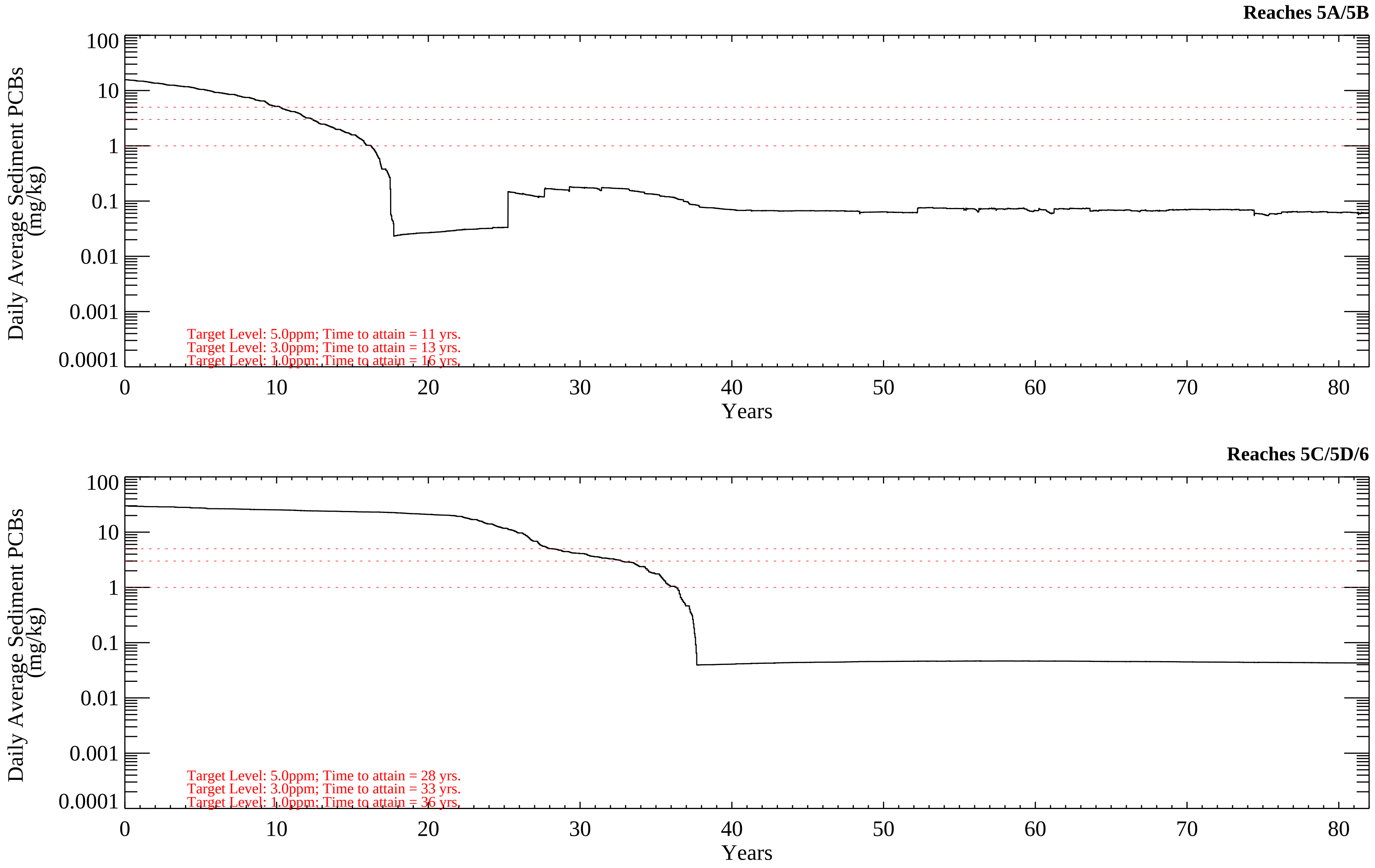

Figure G-7.4-7a. Temporal profiles of model-predicted surface (0-6") sediment PCB concentrations compared to IMPGs for piscivorous mammals (SED 8; Reach 5/6; Lower Bound).
Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED8CMSLB_0712-25\\bins

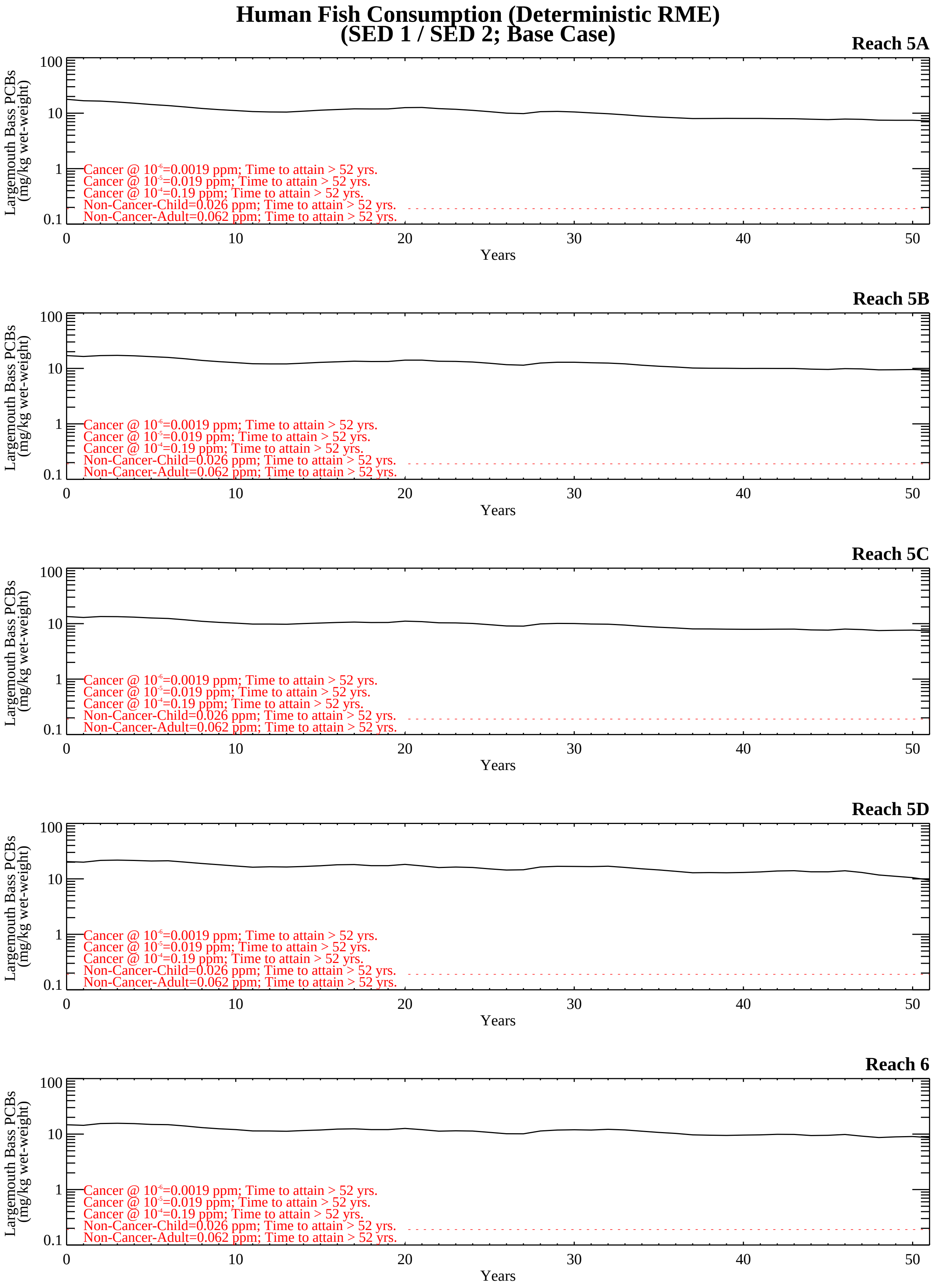

Figure G-8.1-1a. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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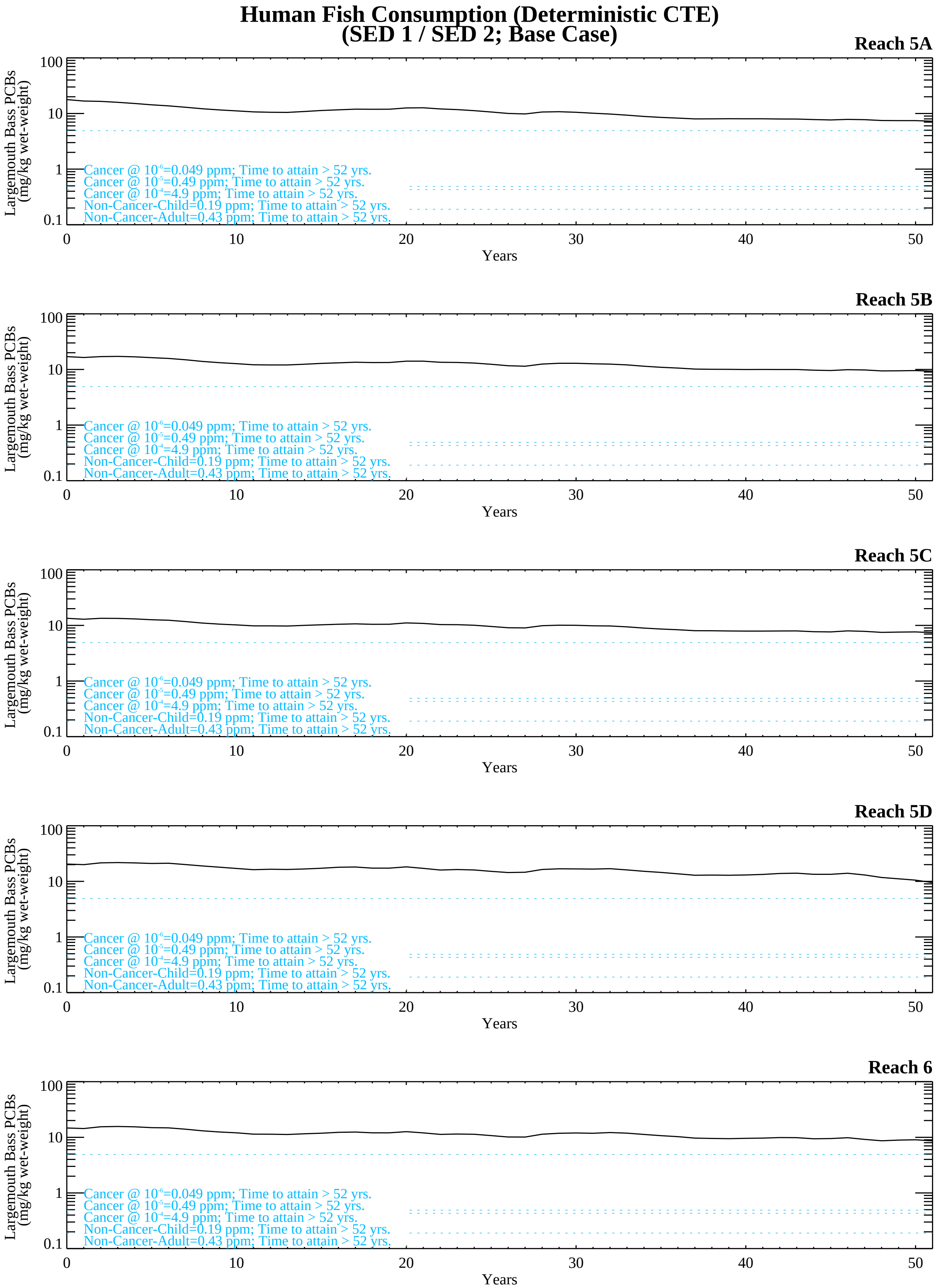

Figure G-8.1-1b. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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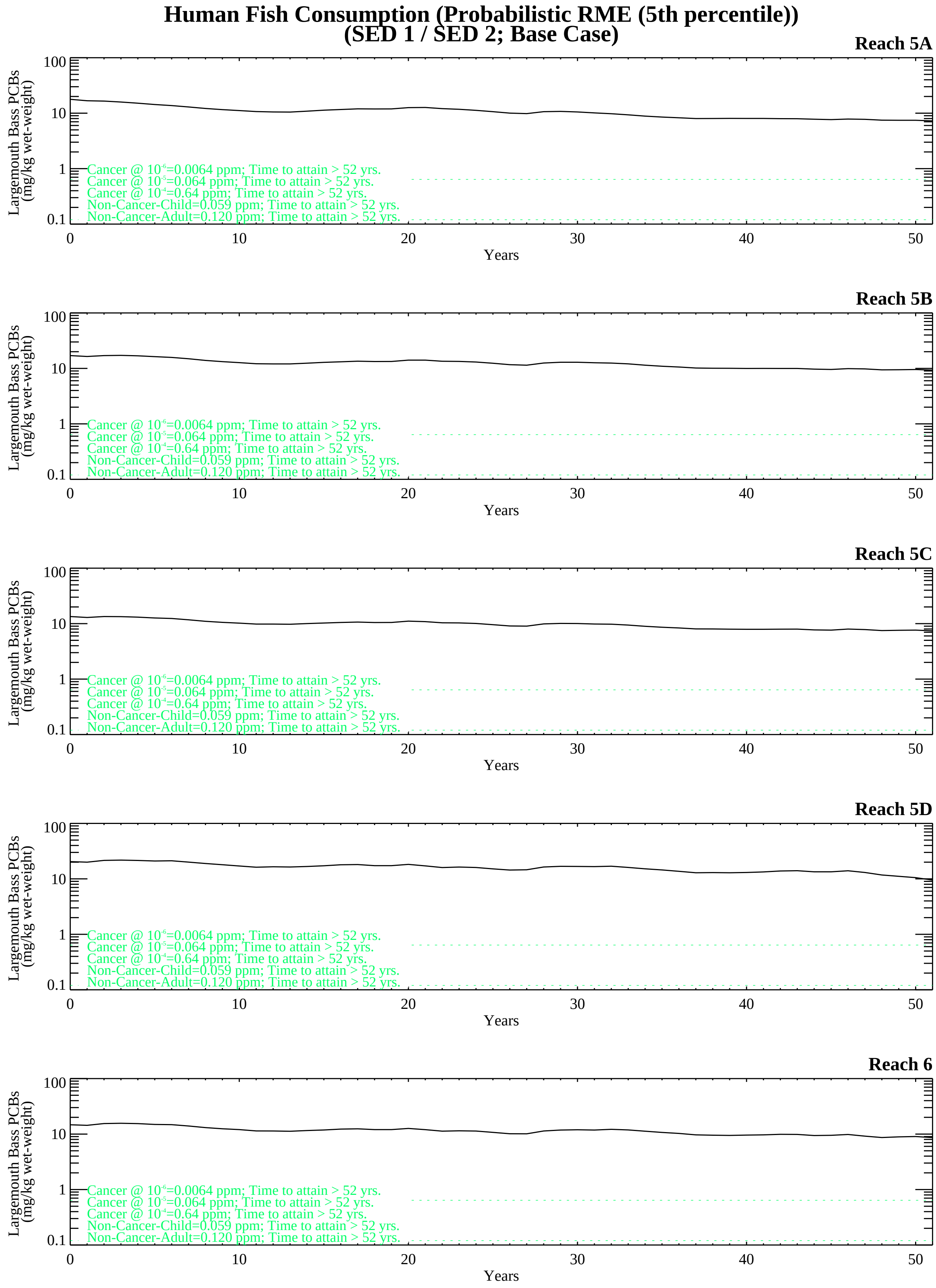

Figure G-8.1-1c. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

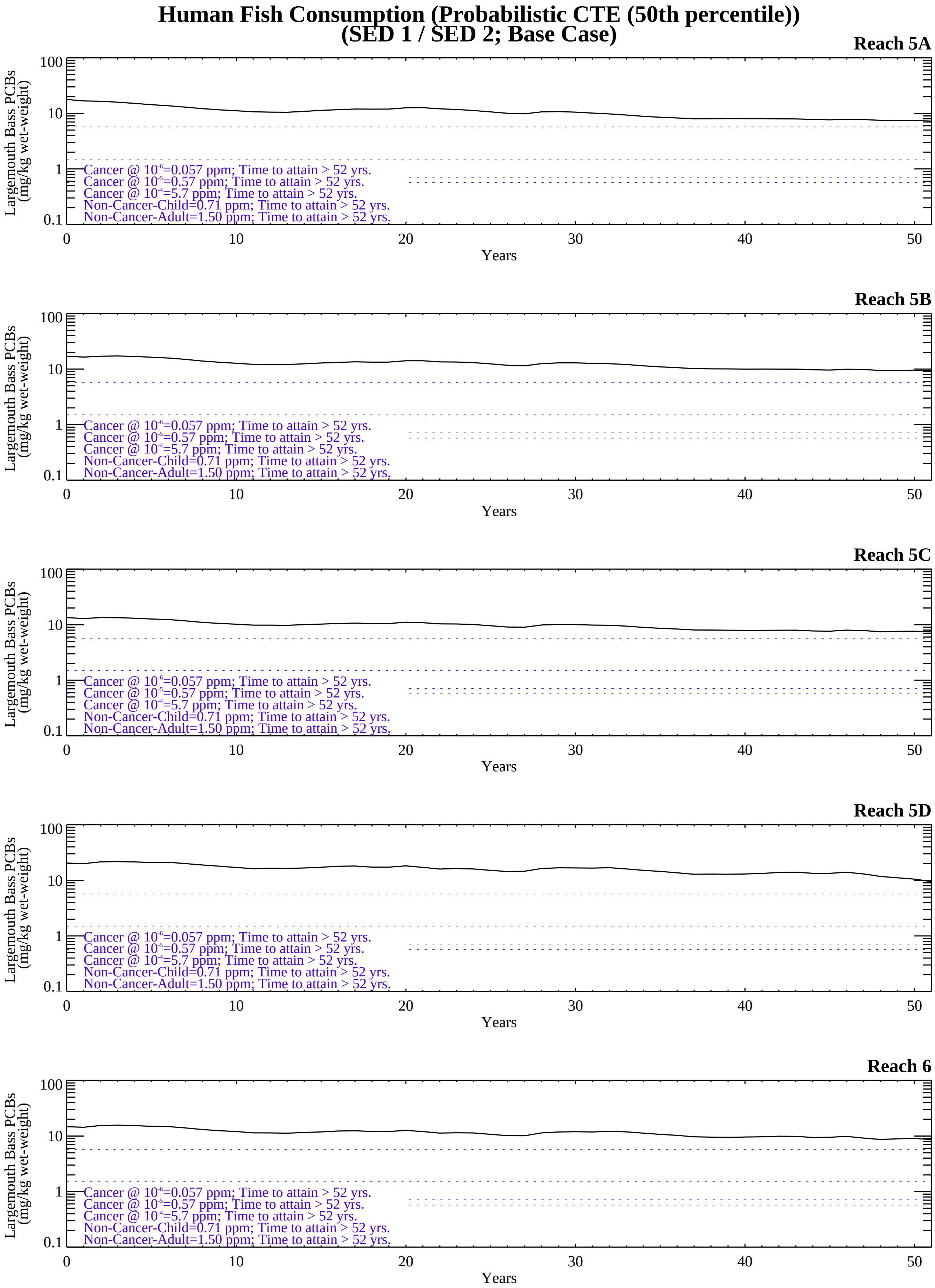

Figure G-8.1-1d. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

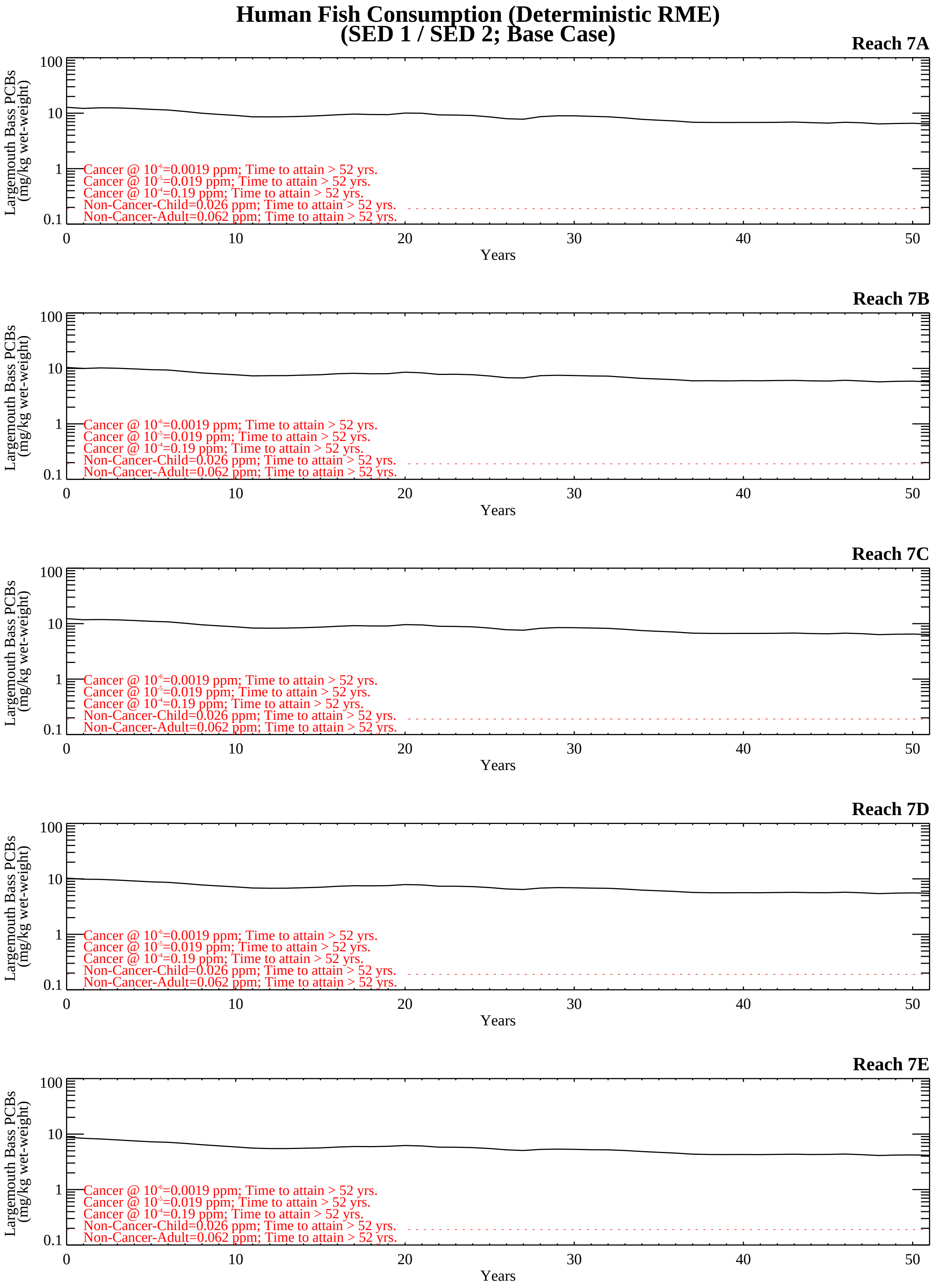

Figure G-8.1-1e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

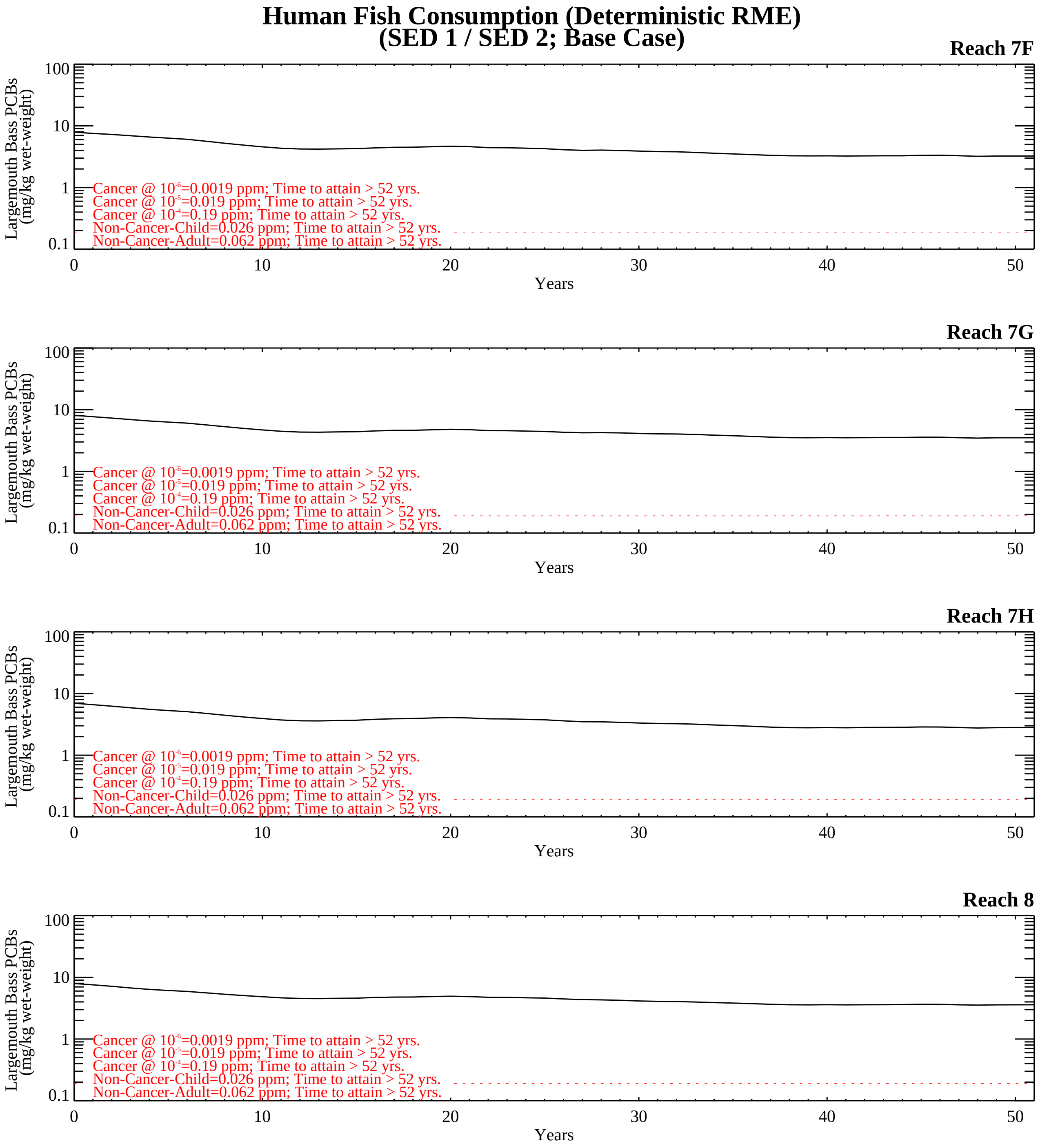

Figure G-8.1-1e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

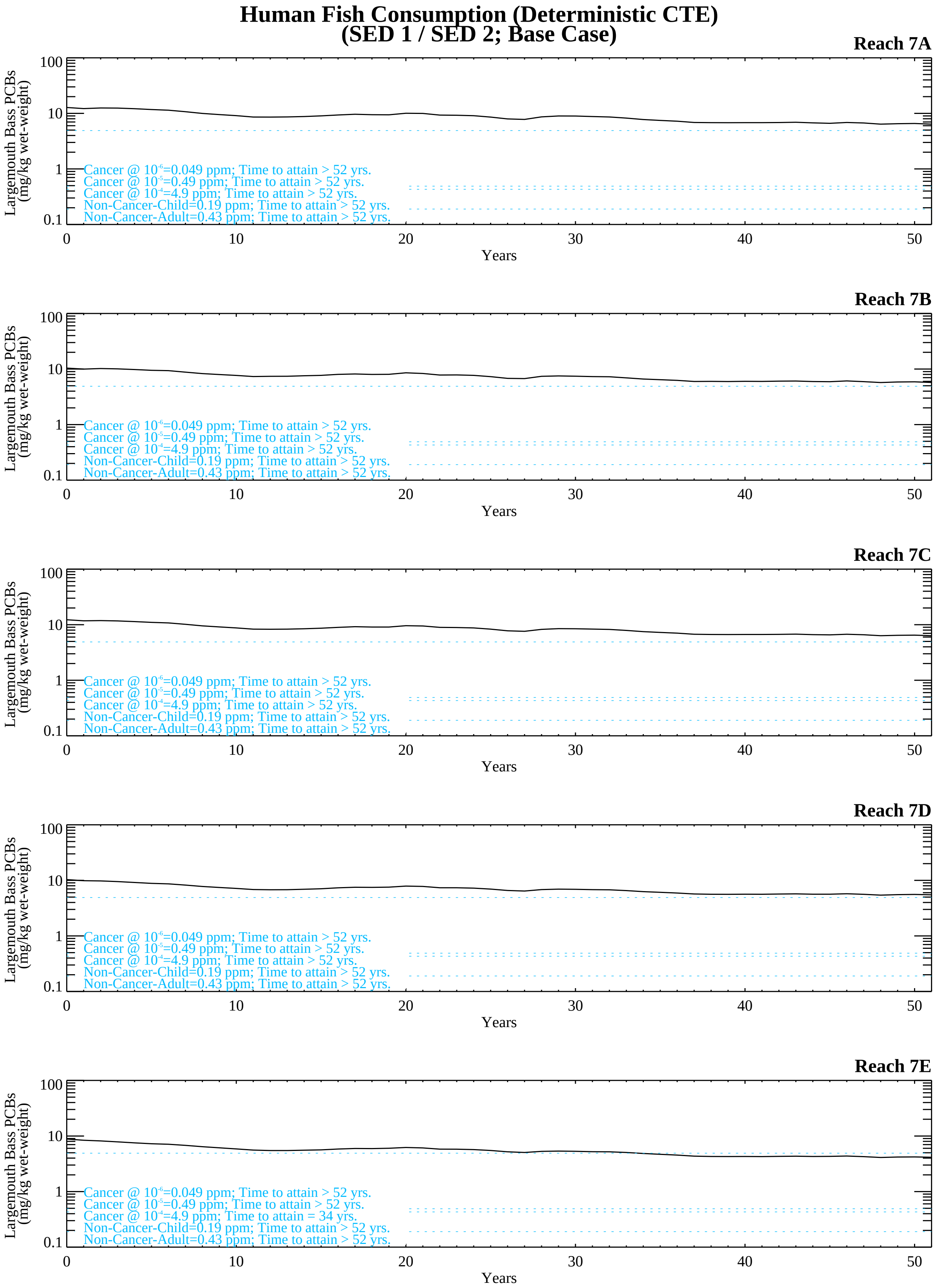

Figure G-8.1-1f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic CTE)
(SED 1 / SED 2; Base Case)

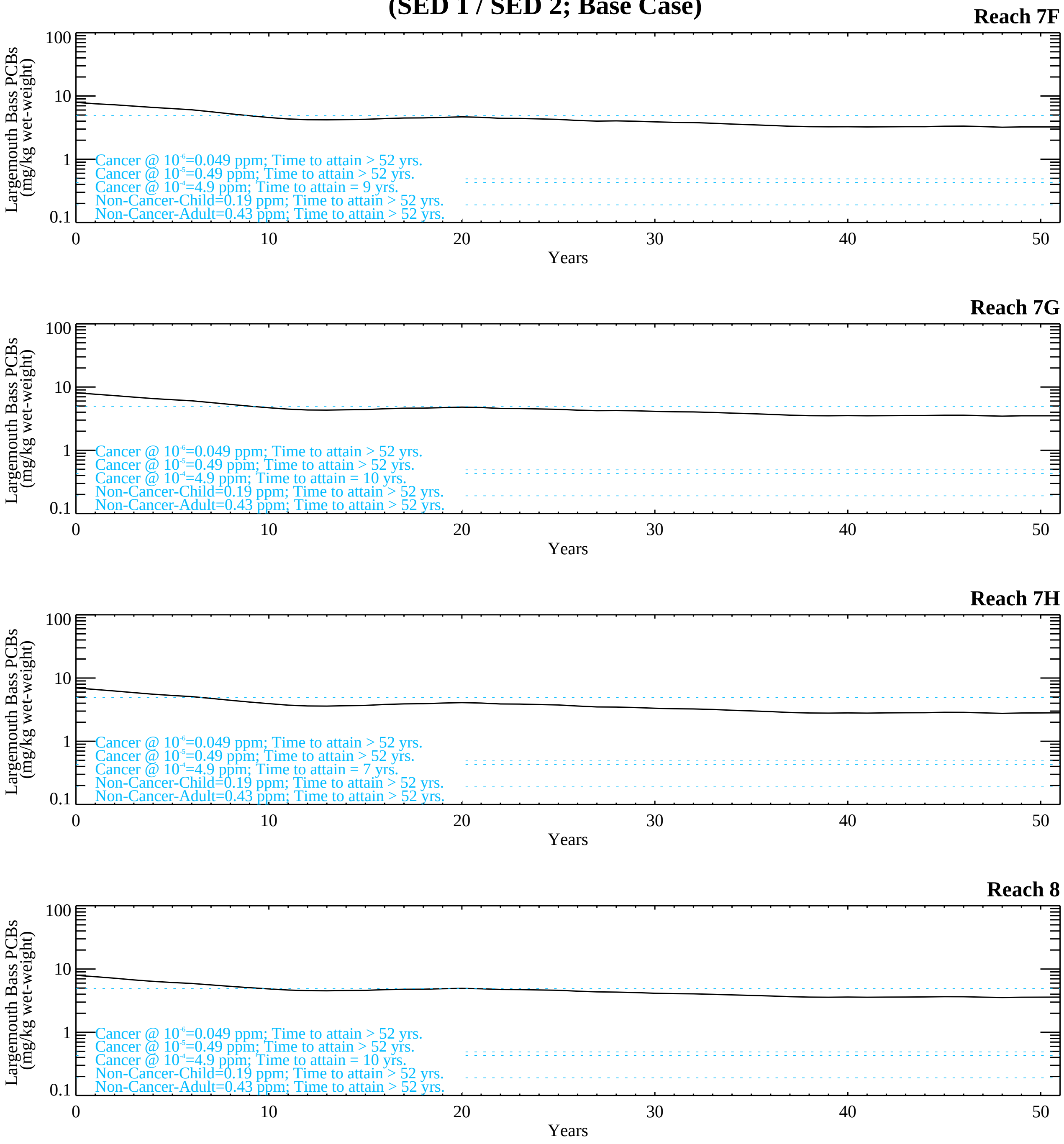

Figure G-8.1-1f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 1 / SED 2; Base Case)

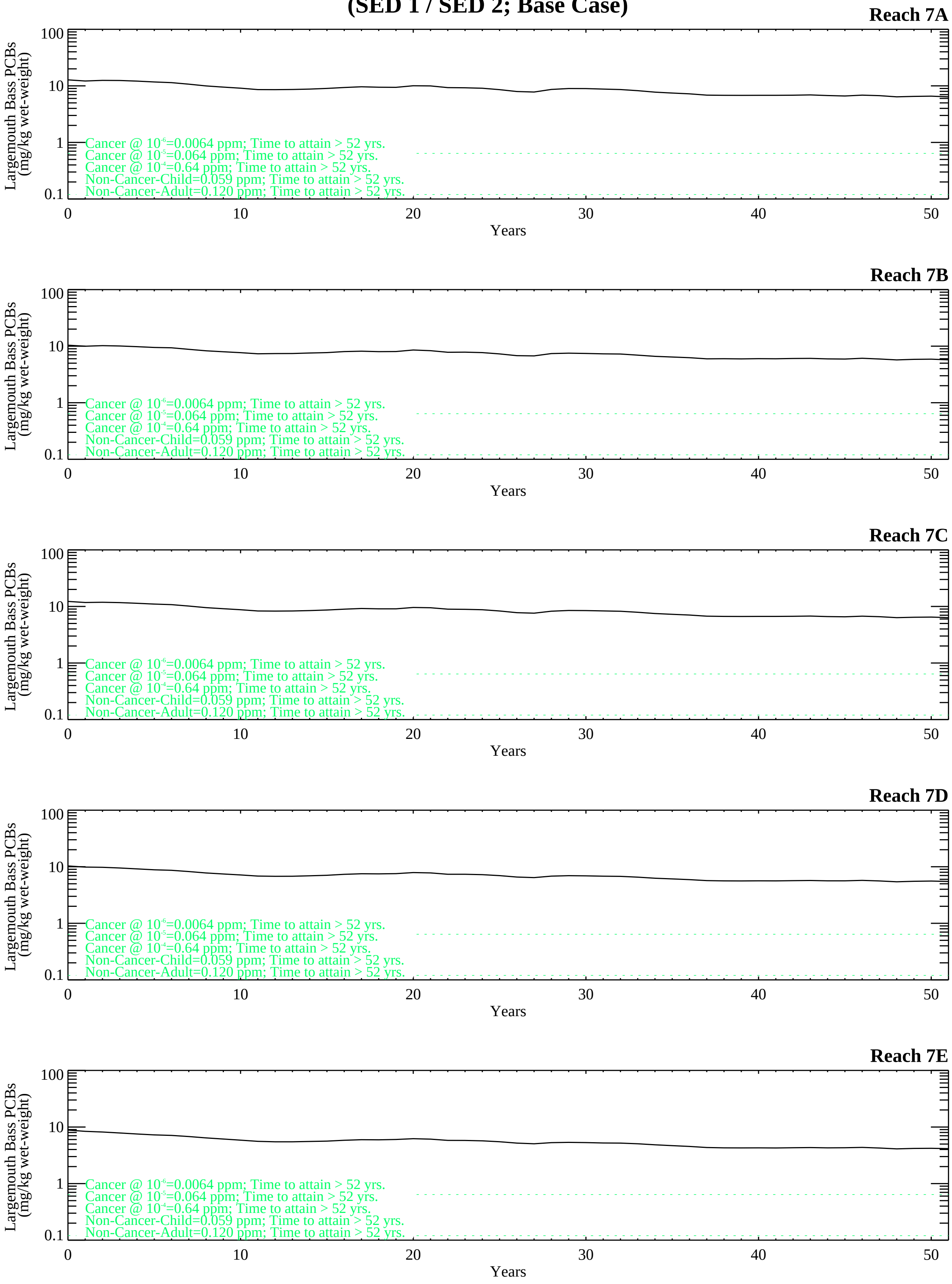

Figure G-8.1-1g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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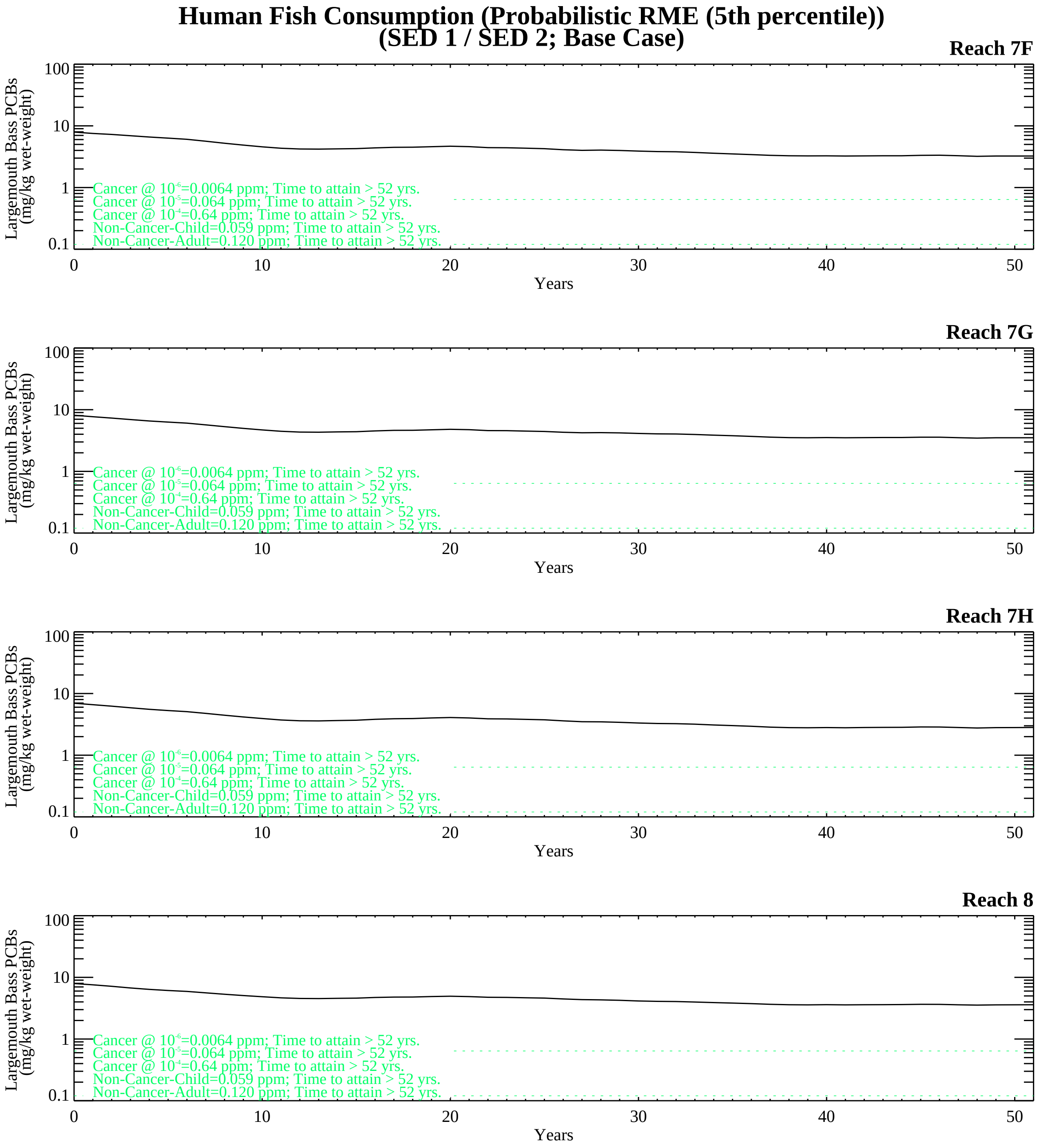

Figure G-8.1-1g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic CTE (50th percentile)) (SED 1 / SED 2; Base Case)

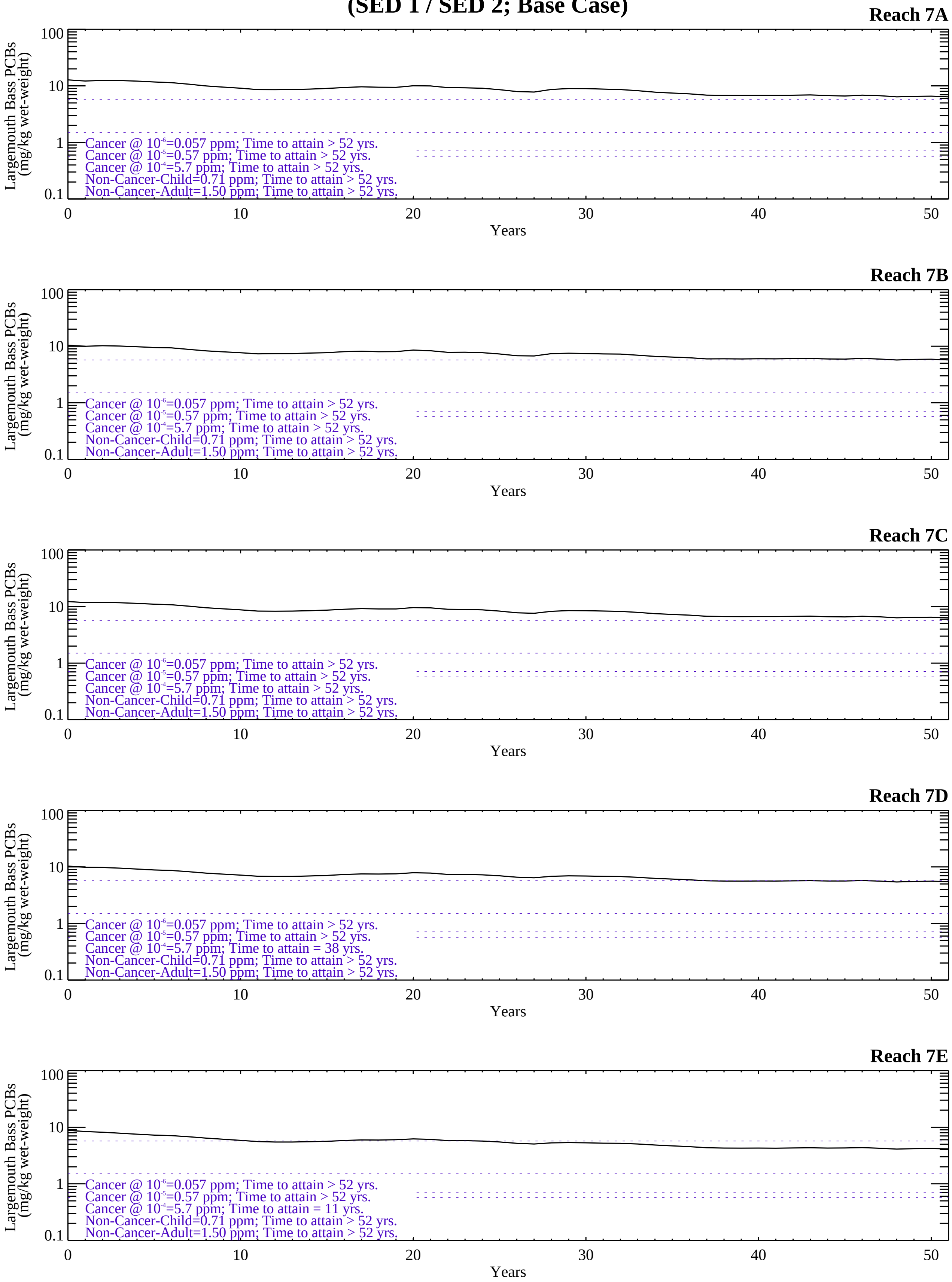

Figure G-8.1-1h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

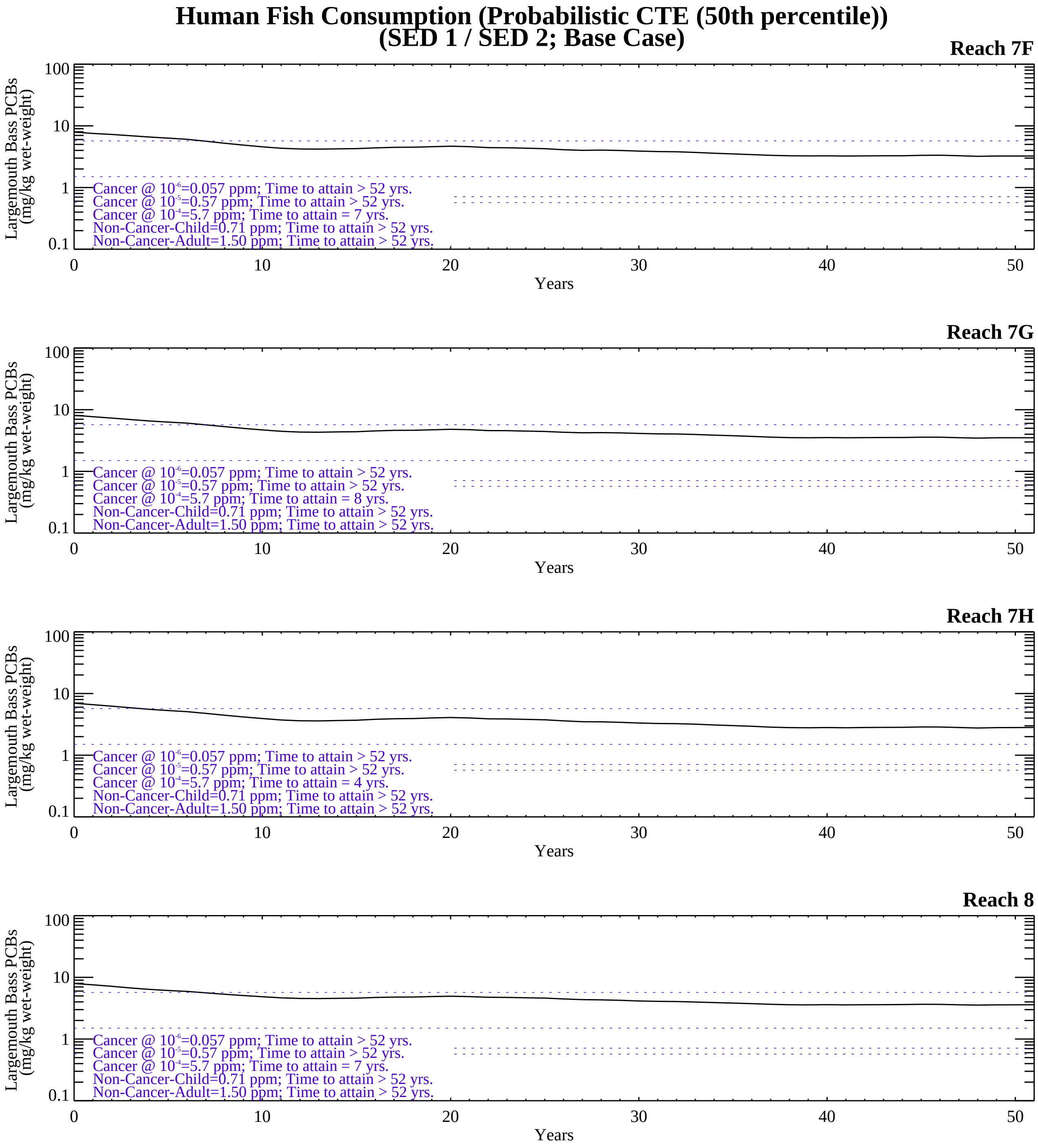

Figure G-8.1-1h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic RME)
(SED 1 / SED 2; Base Case)

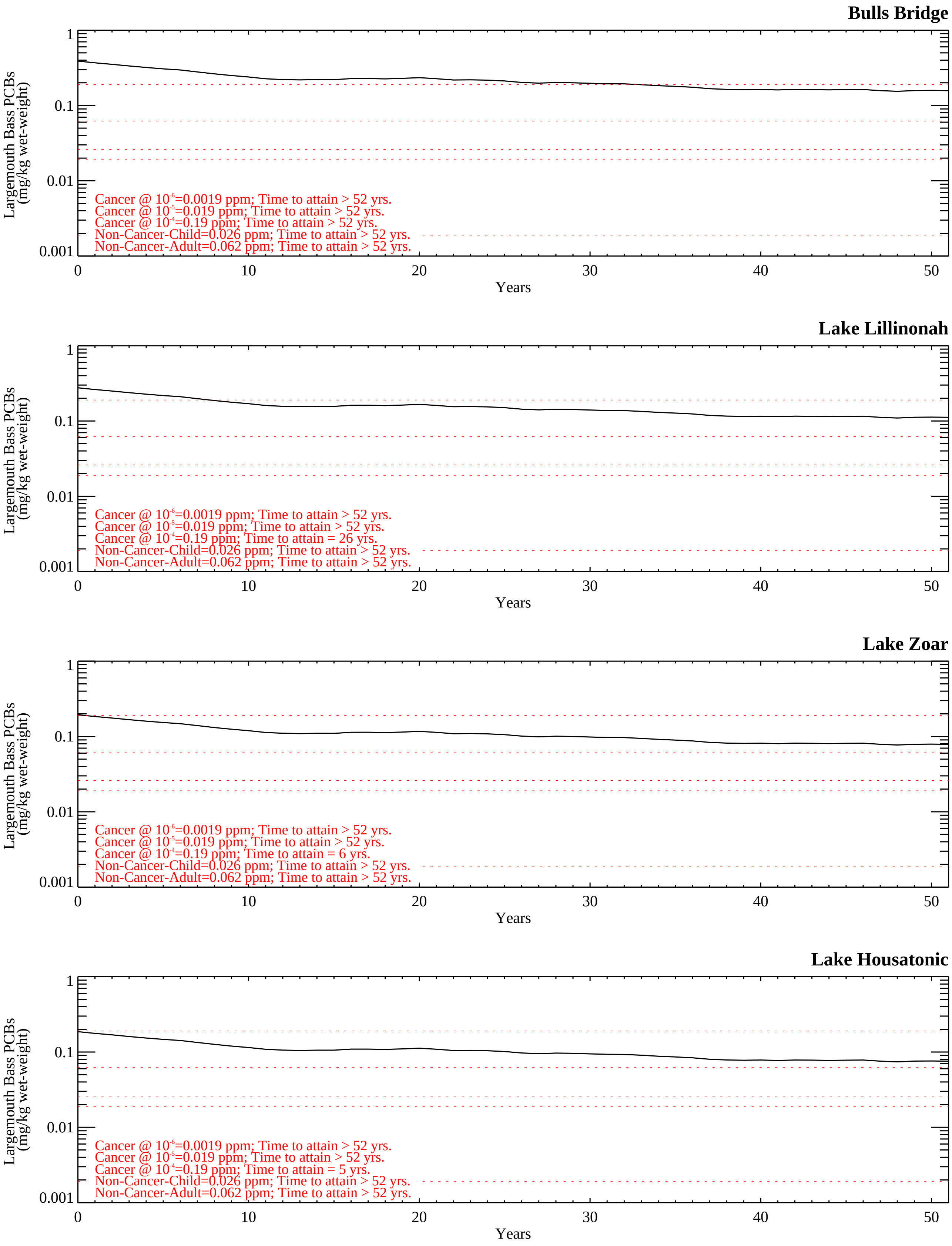

Figure G-8.1-1i. Temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D Analysis compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Deterministic CTE)
(SED 1 / SED 2; Base Case)

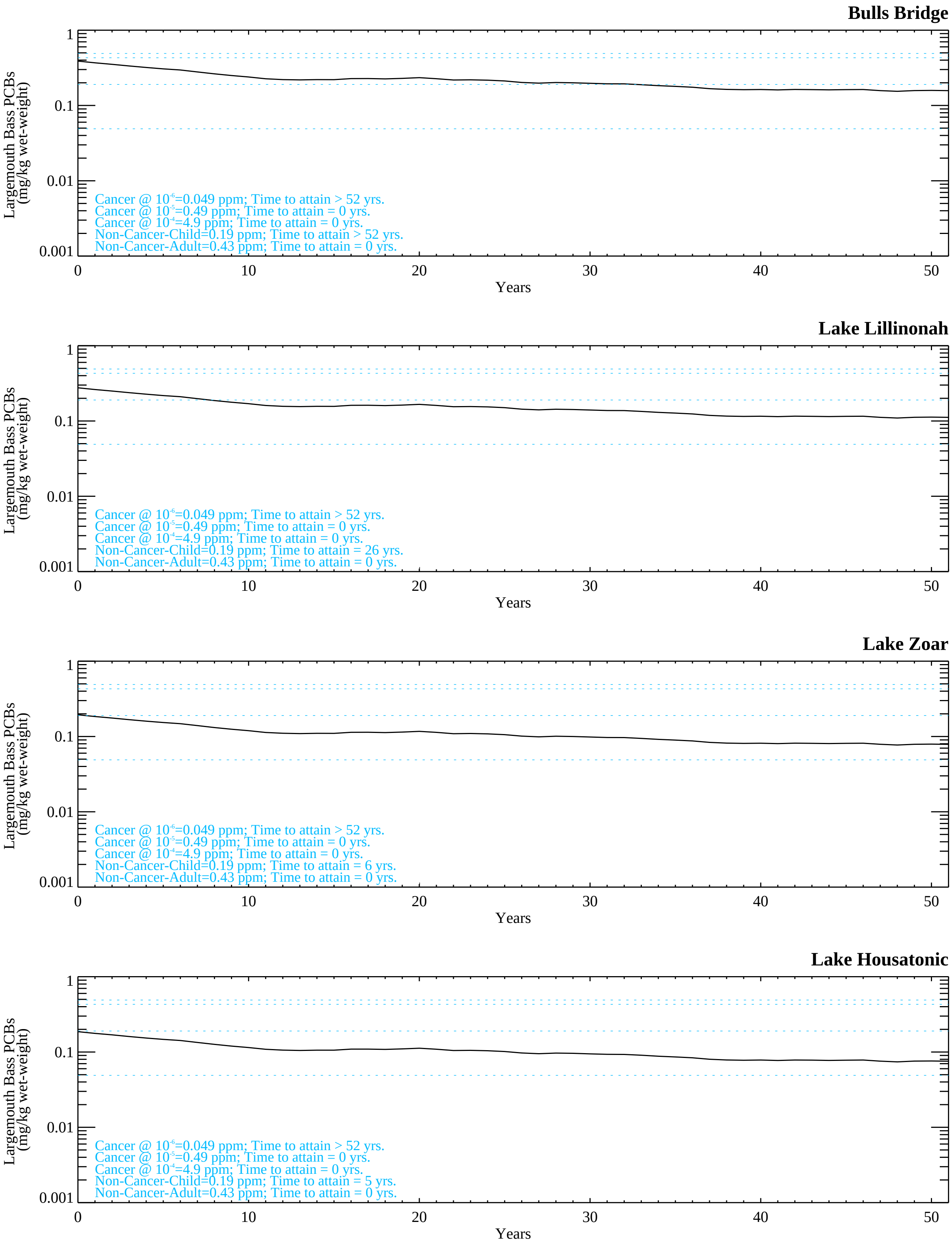

Figure G-8.1-1j. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 1 / SED 2; Base Case)

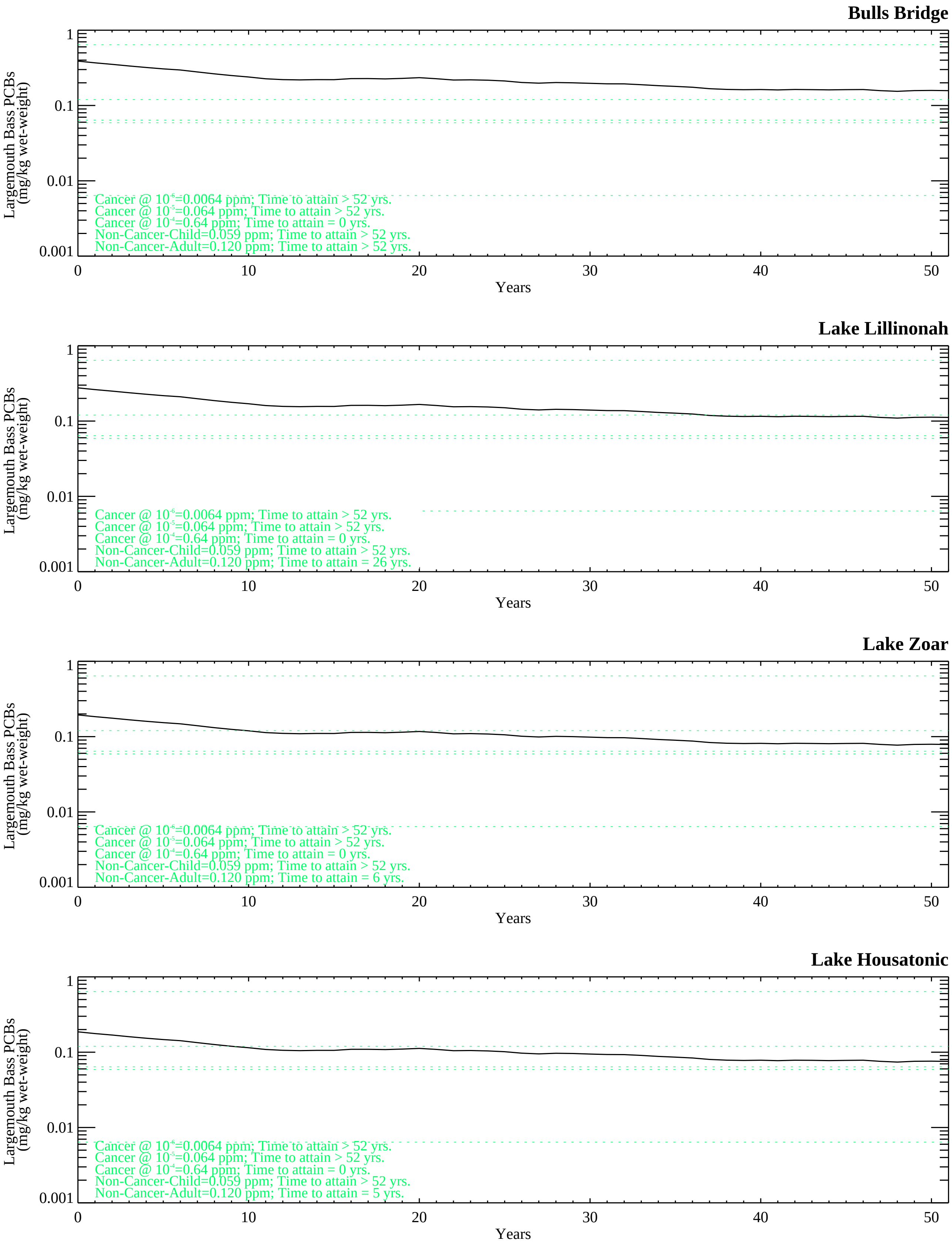

Figure G-8.1-1k. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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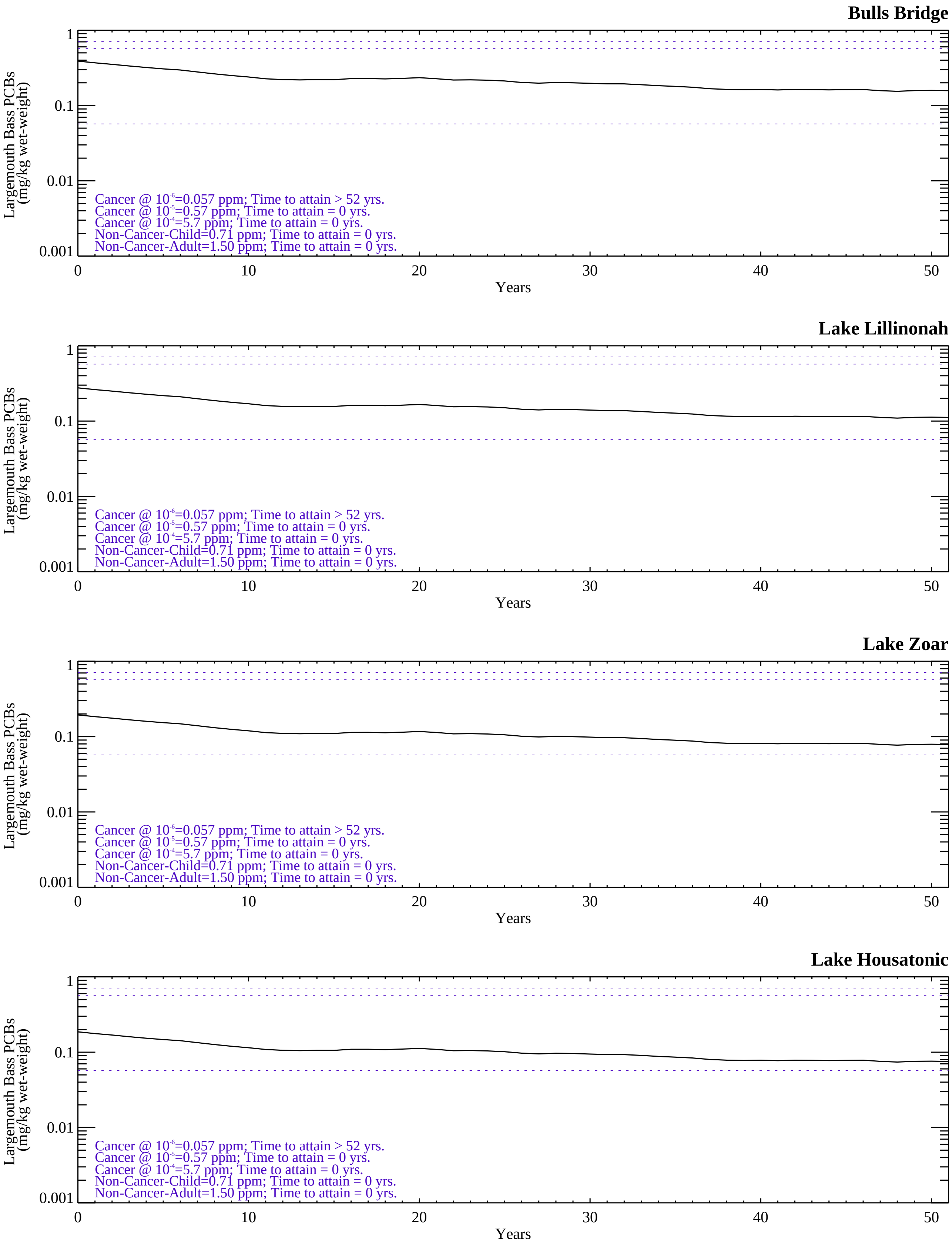

Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 1 / SED 2; Base Case)

Bulls Bridge

Lake Lillinonah

Lake Zoar

Lake Housatonic

Figure G-8.1-1l. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic RME)
(SED 3; Base Case)

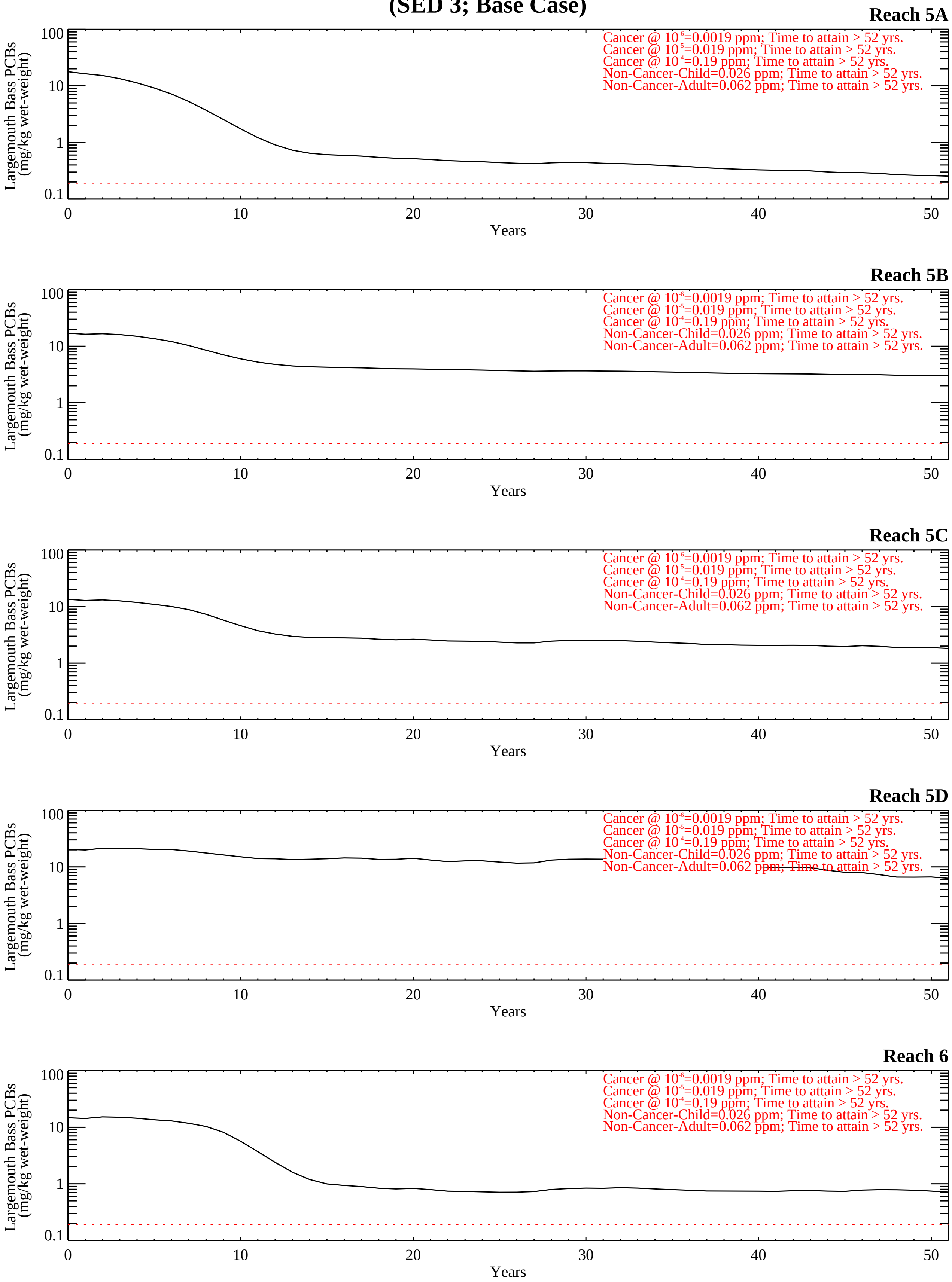

Figure G-8.1-2a. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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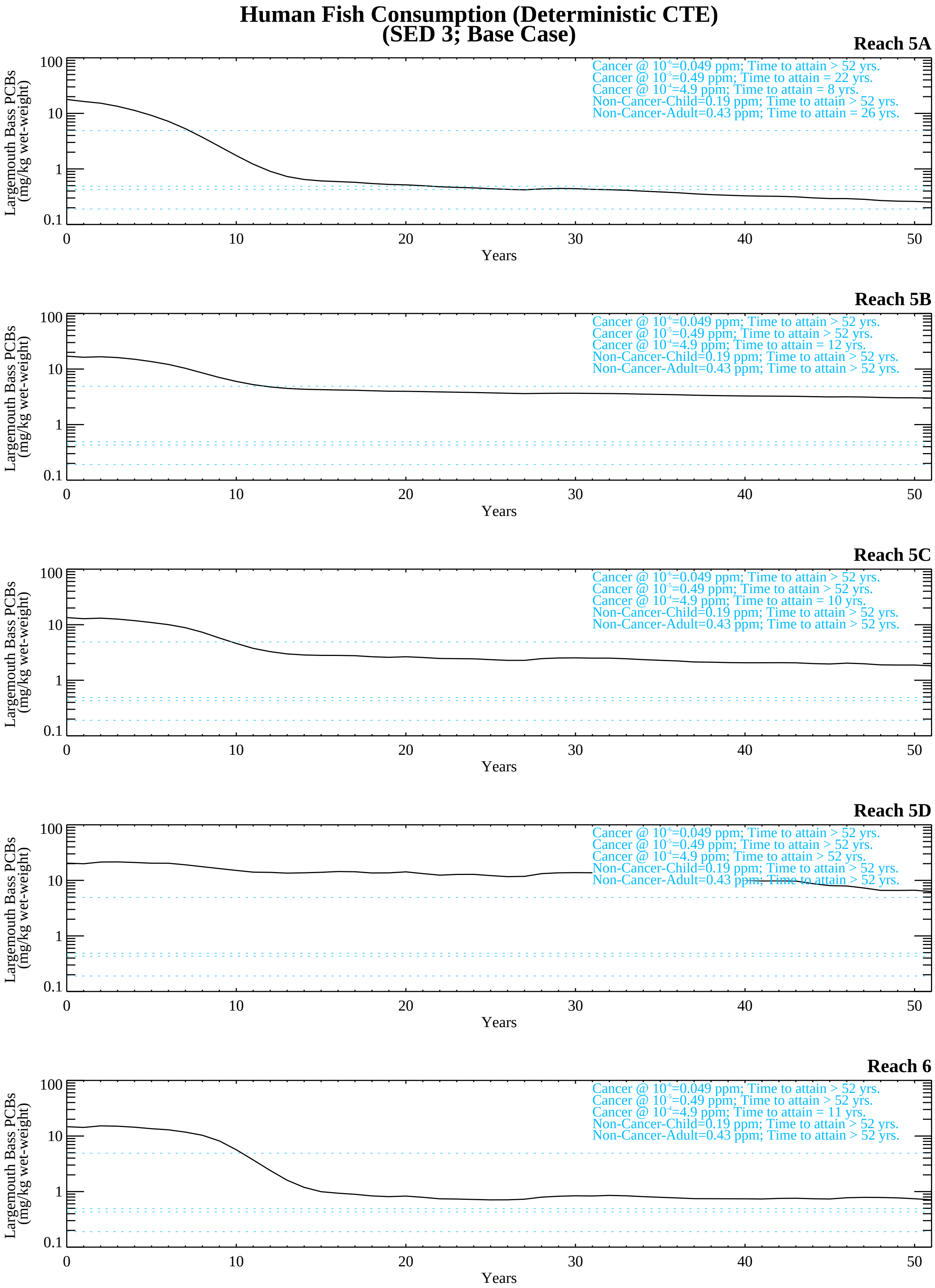


Human Fish Consumption (Deterministic CTE)
(SED 3; Base Case)

Reach 5A

Reach 5B

Reach 5C

Reach 5D

Reach 6

Figure G-8.1-2b. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

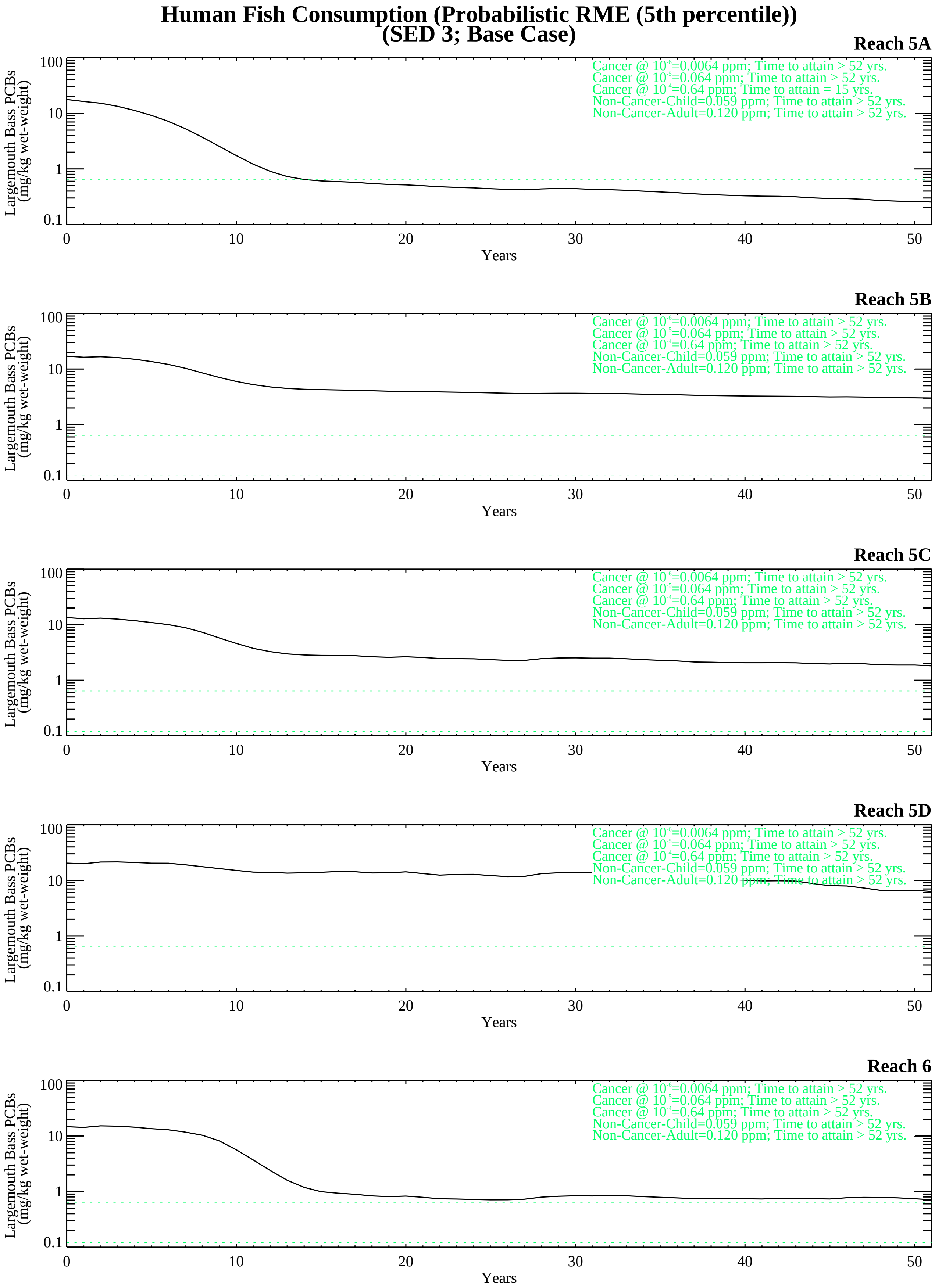


Figure G-8.1-2c. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

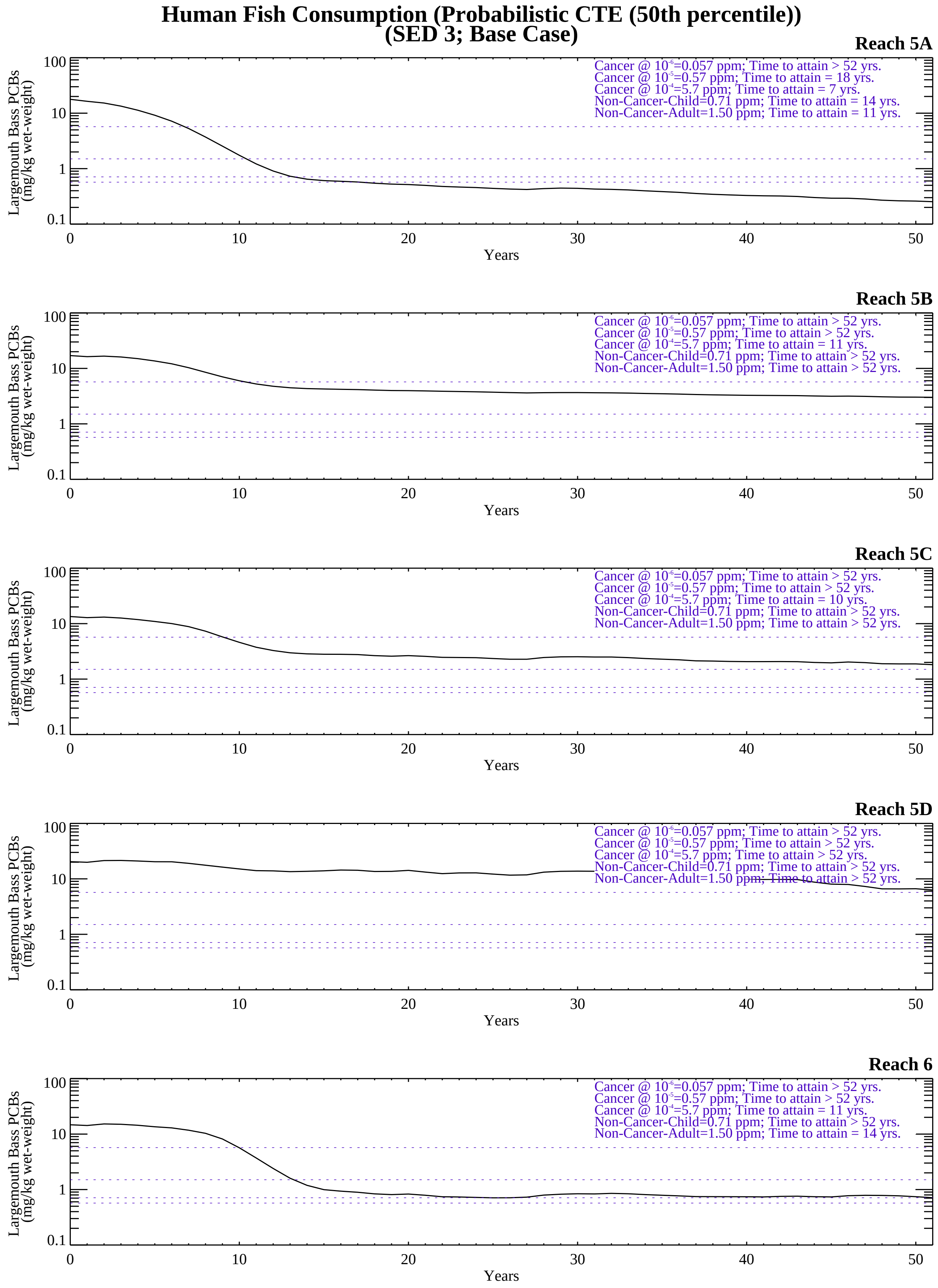


Figure G-8.1-2d. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

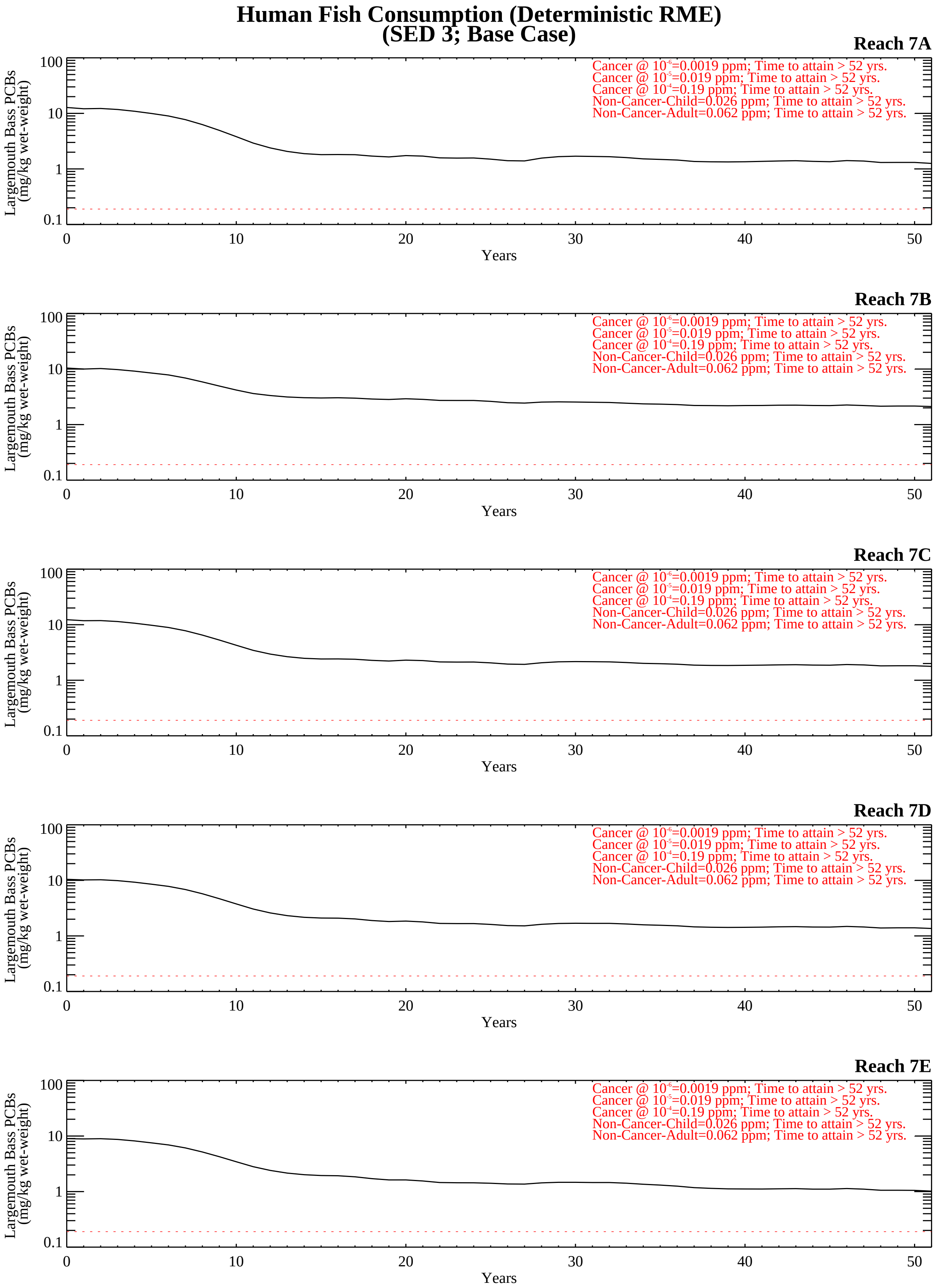


Figure G-8.1-2e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic RME)
(SED 3; Base Case)

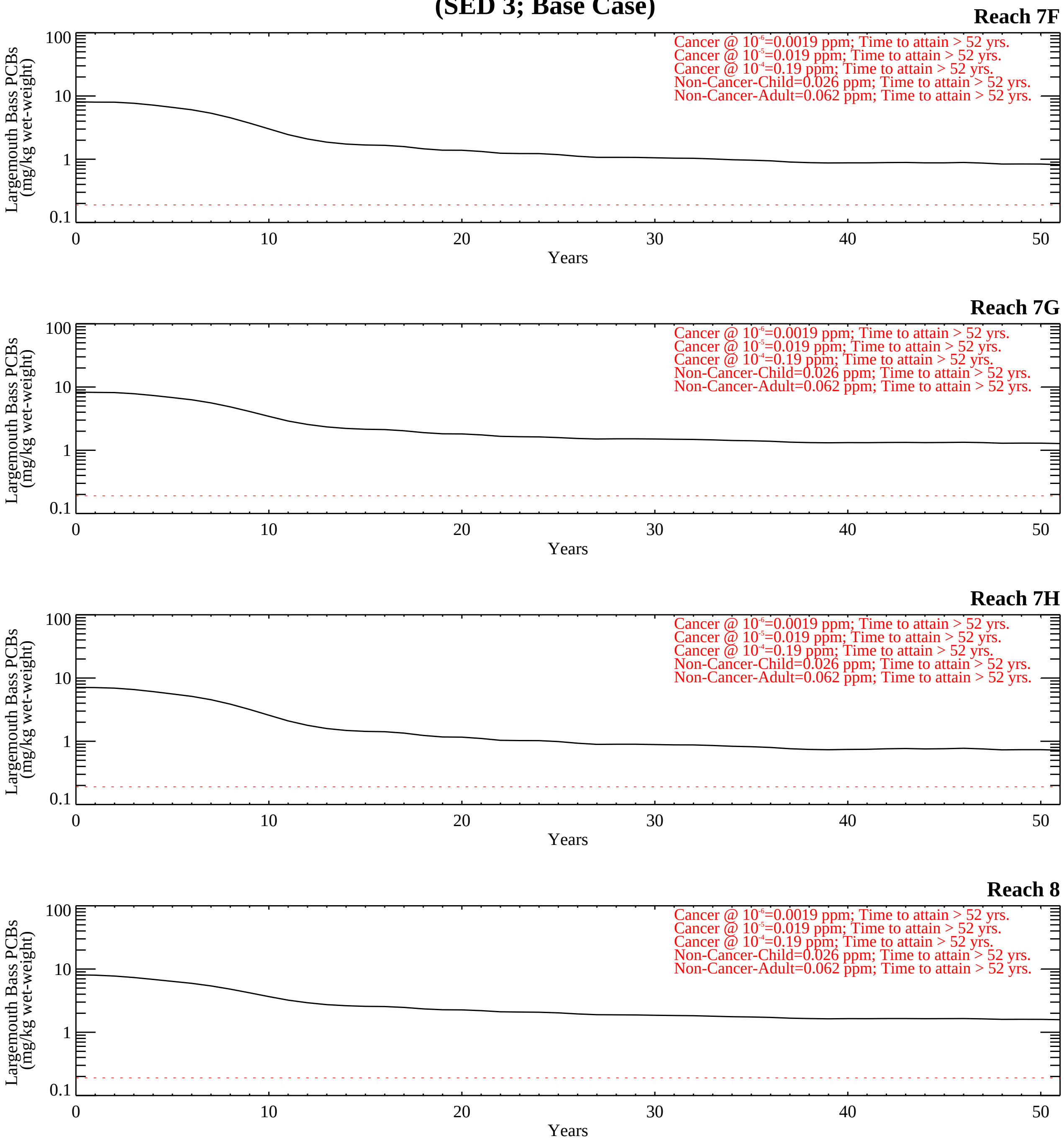


Figure G-8.1-2e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic CTE)
(SED 3; Base Case)

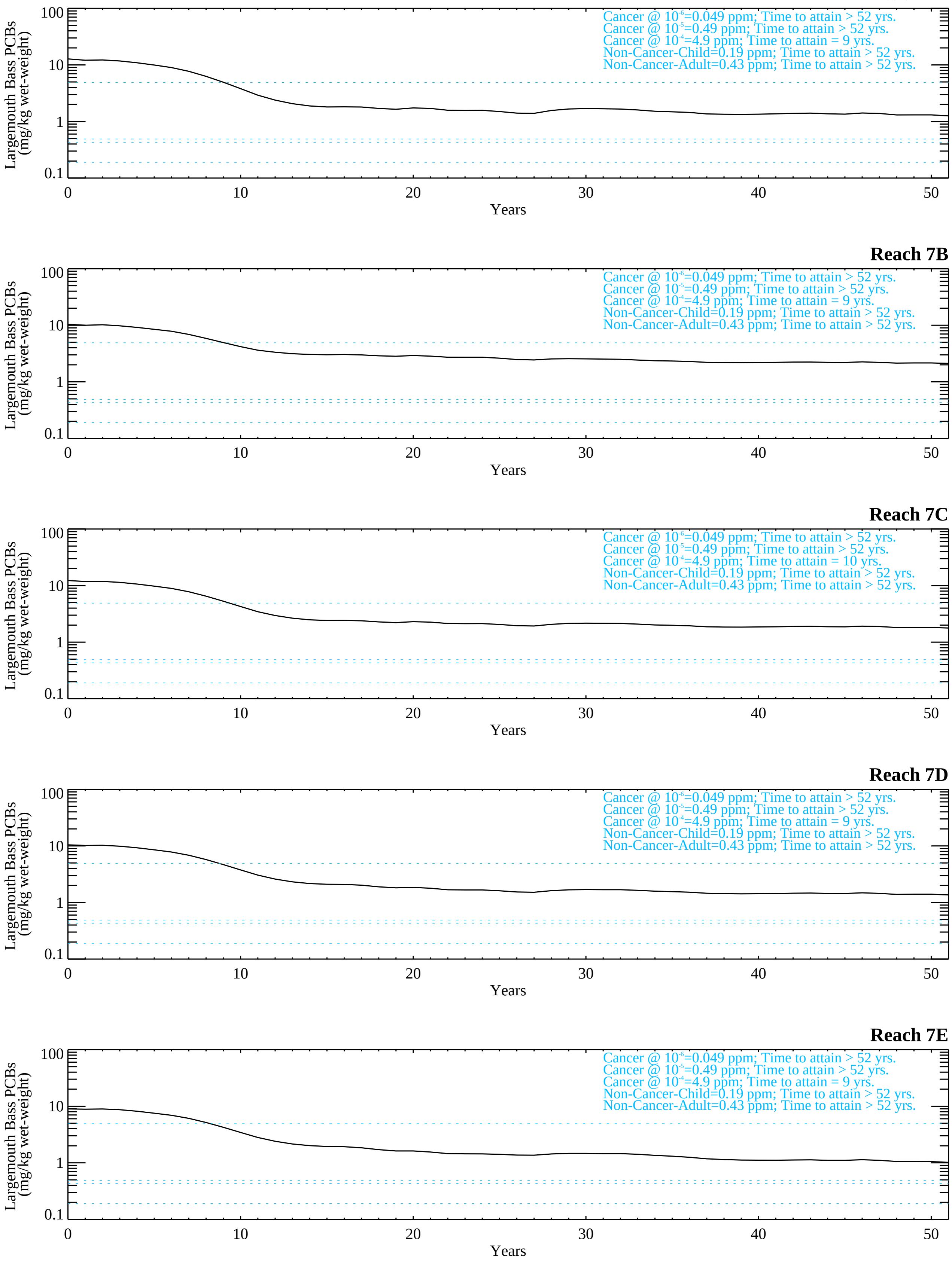


Figure G-8.1-2f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic CTE)
(SED 3; Base Case)

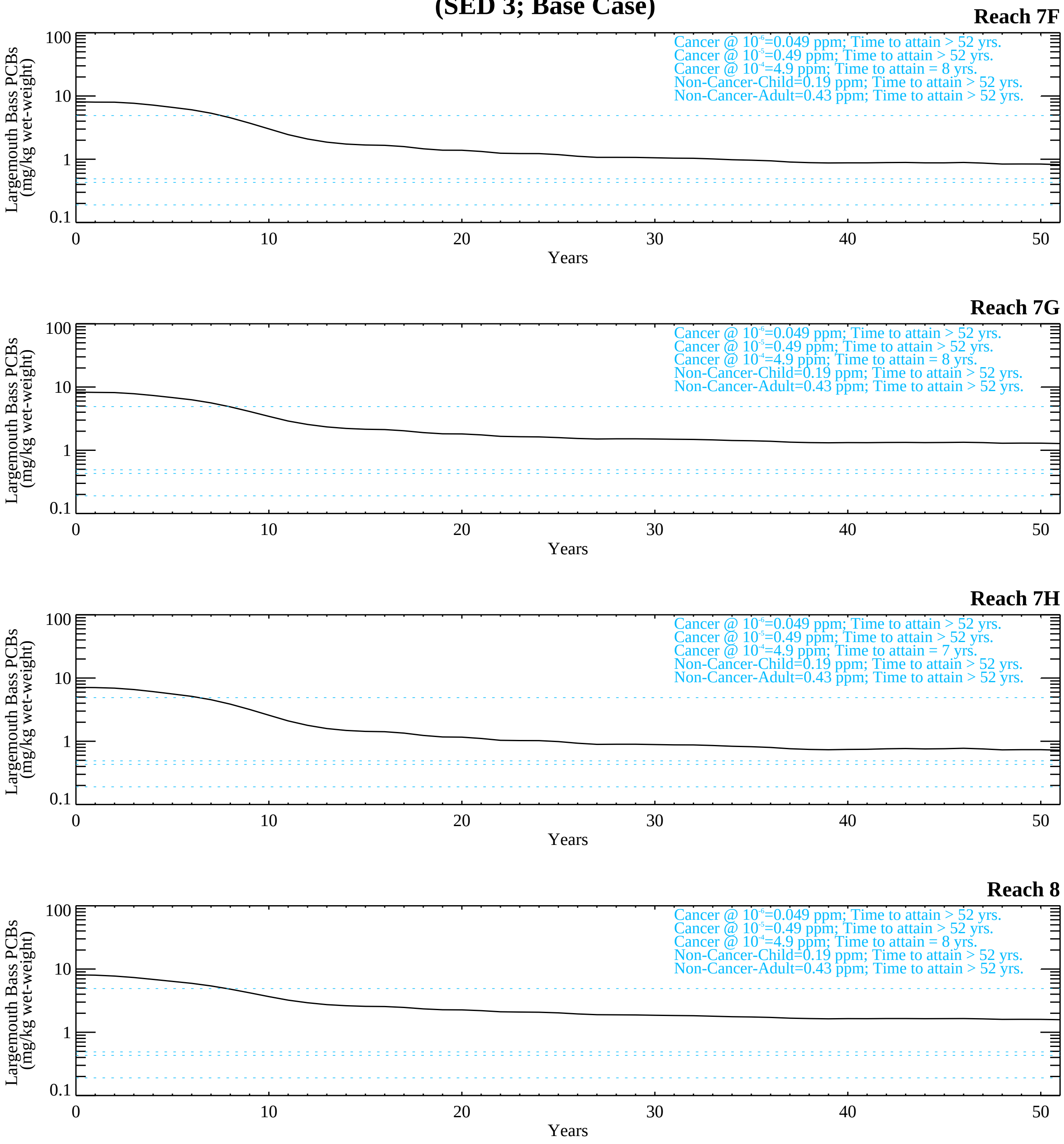
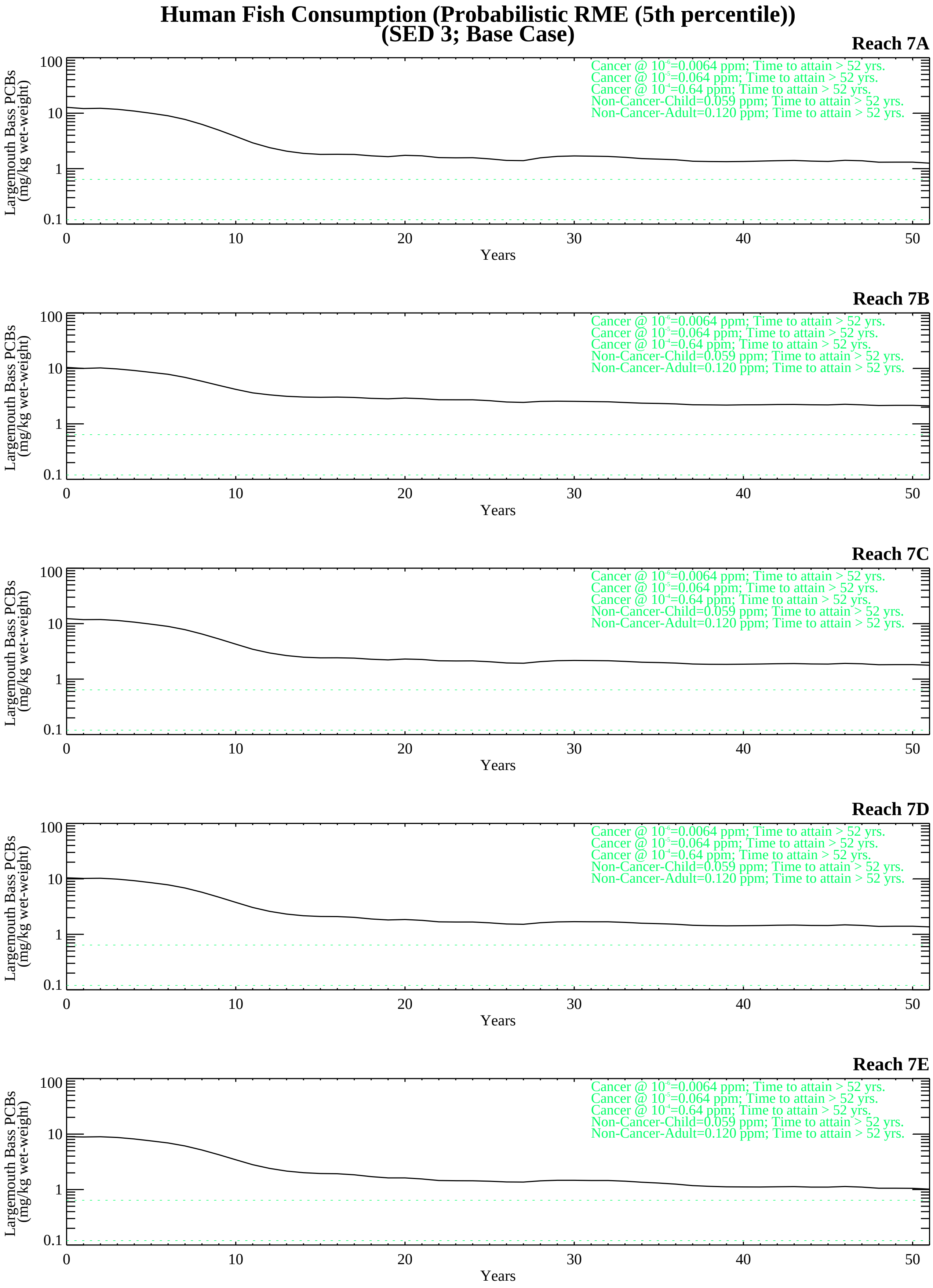


Figure G-8.1-2f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

# Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 3; Base Case)

Reach 7A

Reach 7B

Reach 7C

Reach 7D

Reach 7E

Figure G-8.1-2g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

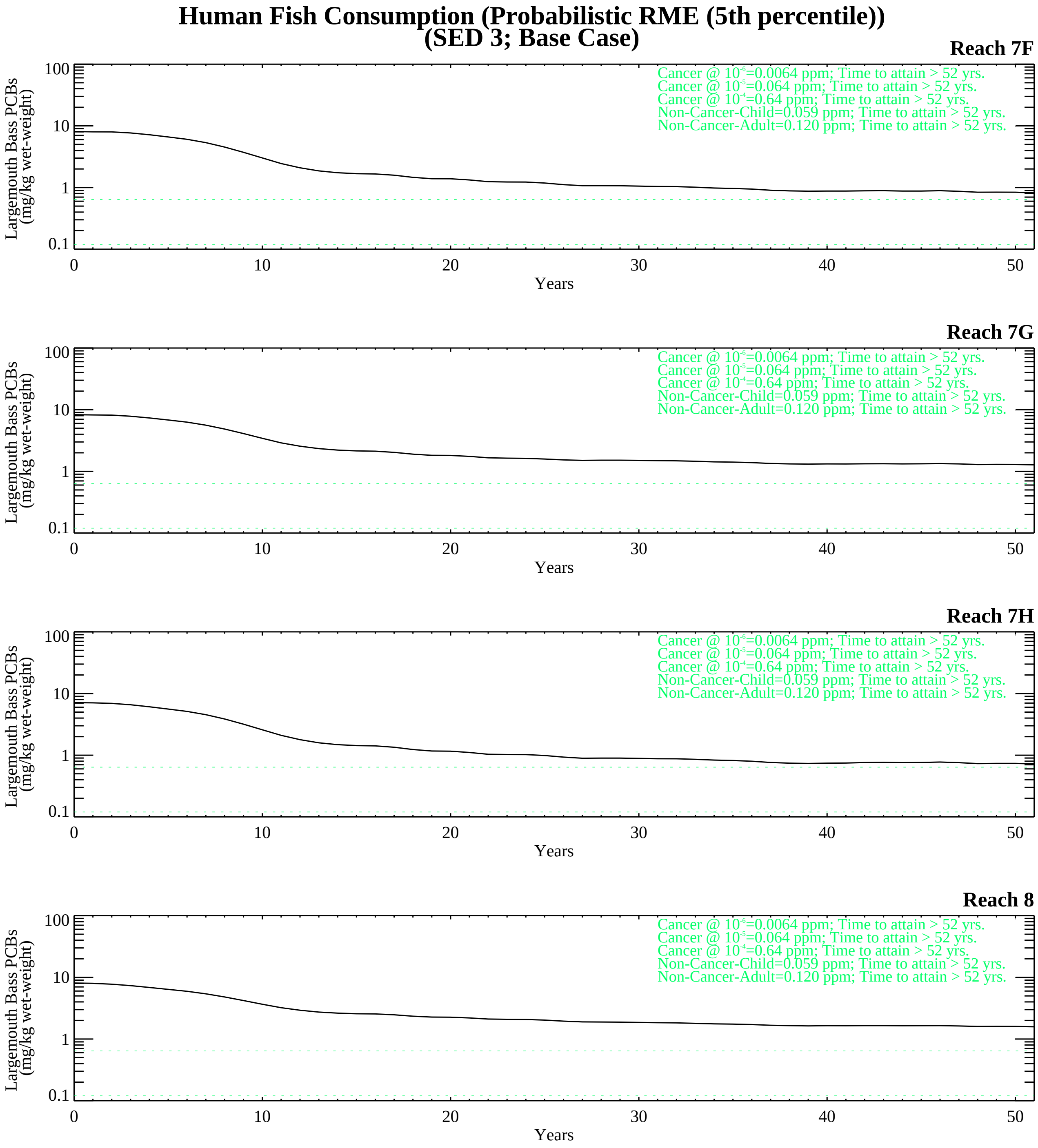


Figure G-8.1-2g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 3; Base Case)

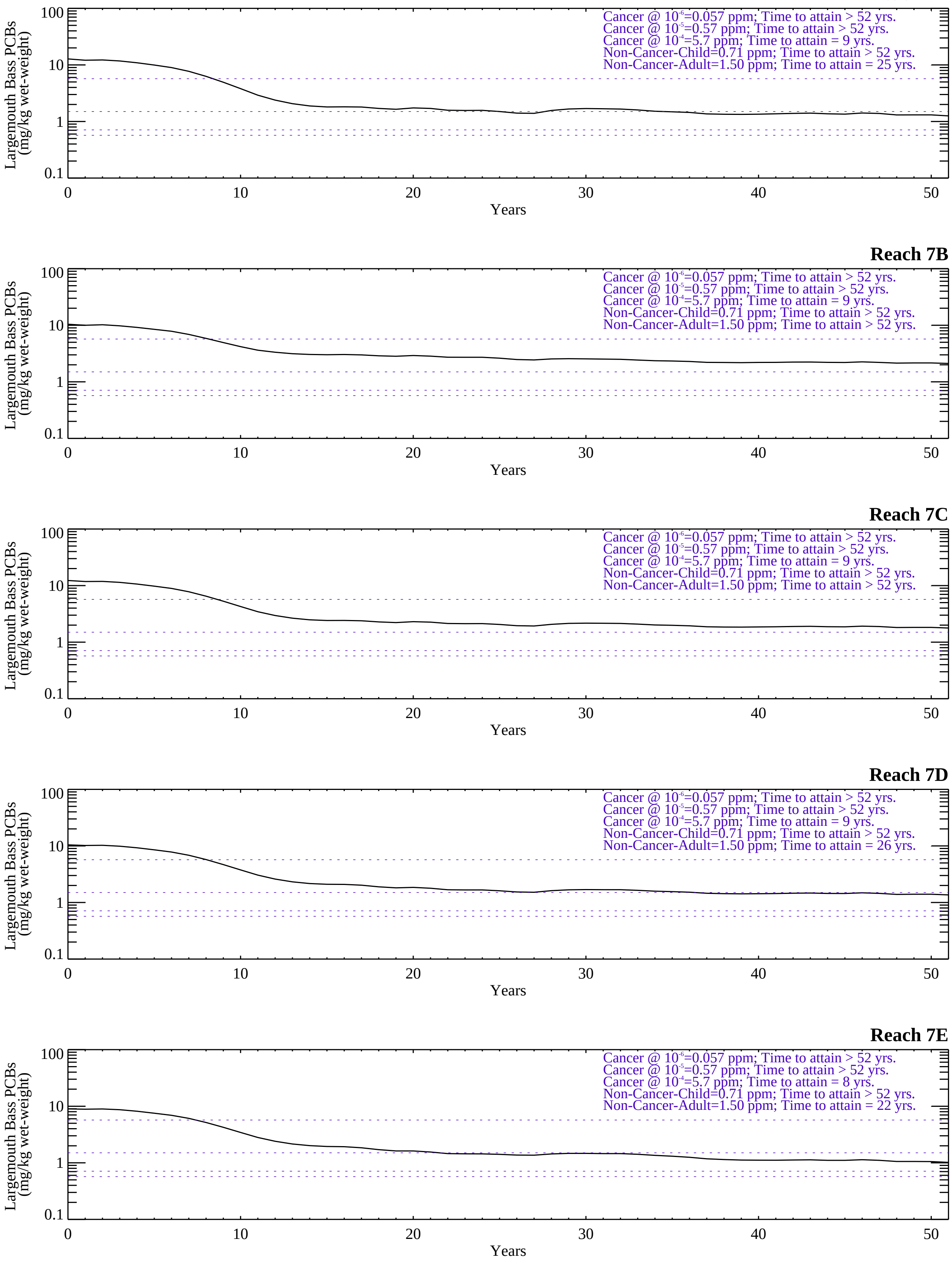


Figure G-8.1-2h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

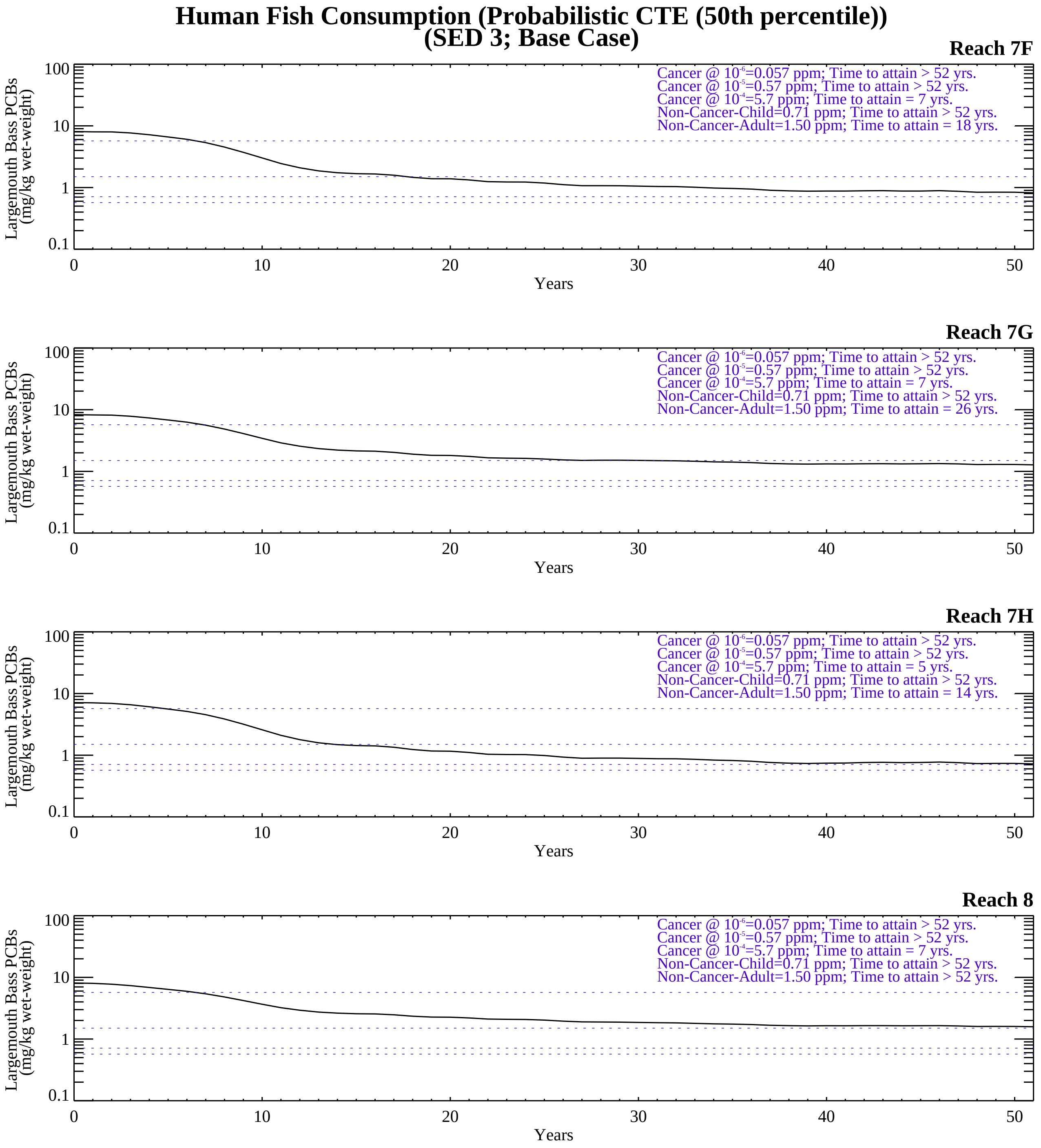


Figure G-8.1-2h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic RME)
(SED 3; Base Case)

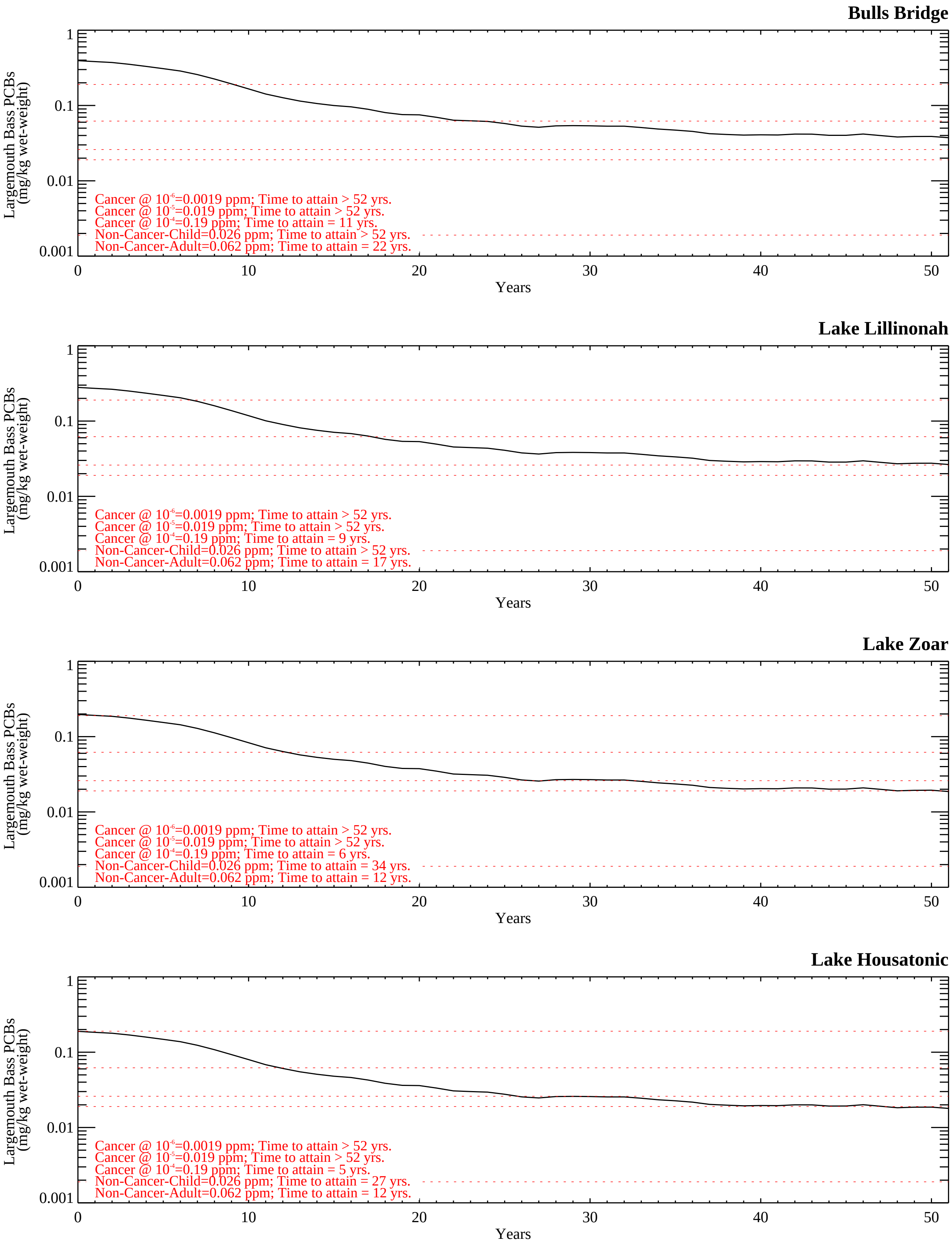


Figure G-8.1-2i. Temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D Analysis compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 3; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

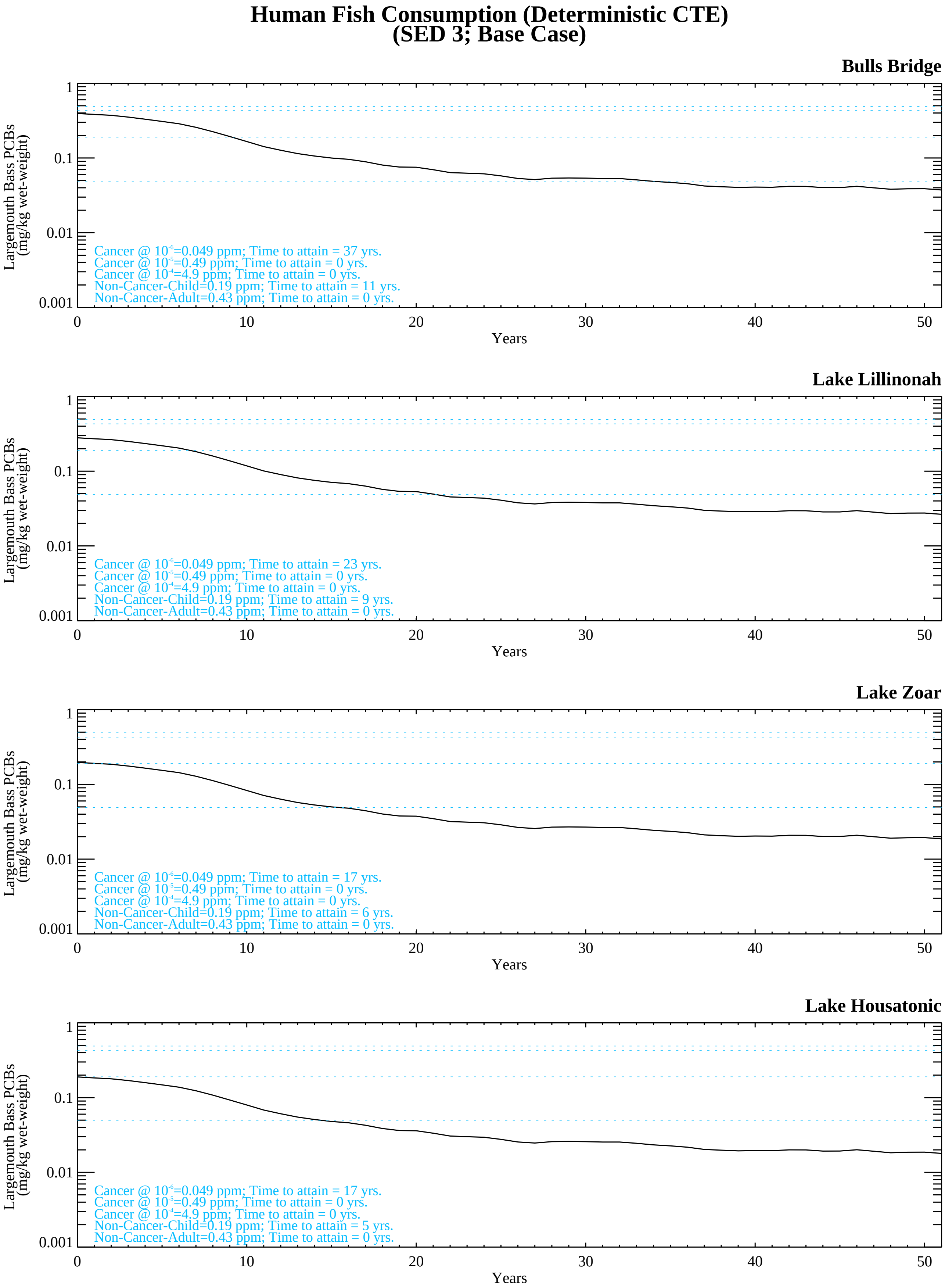


Figure G-8.1-2j. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 3; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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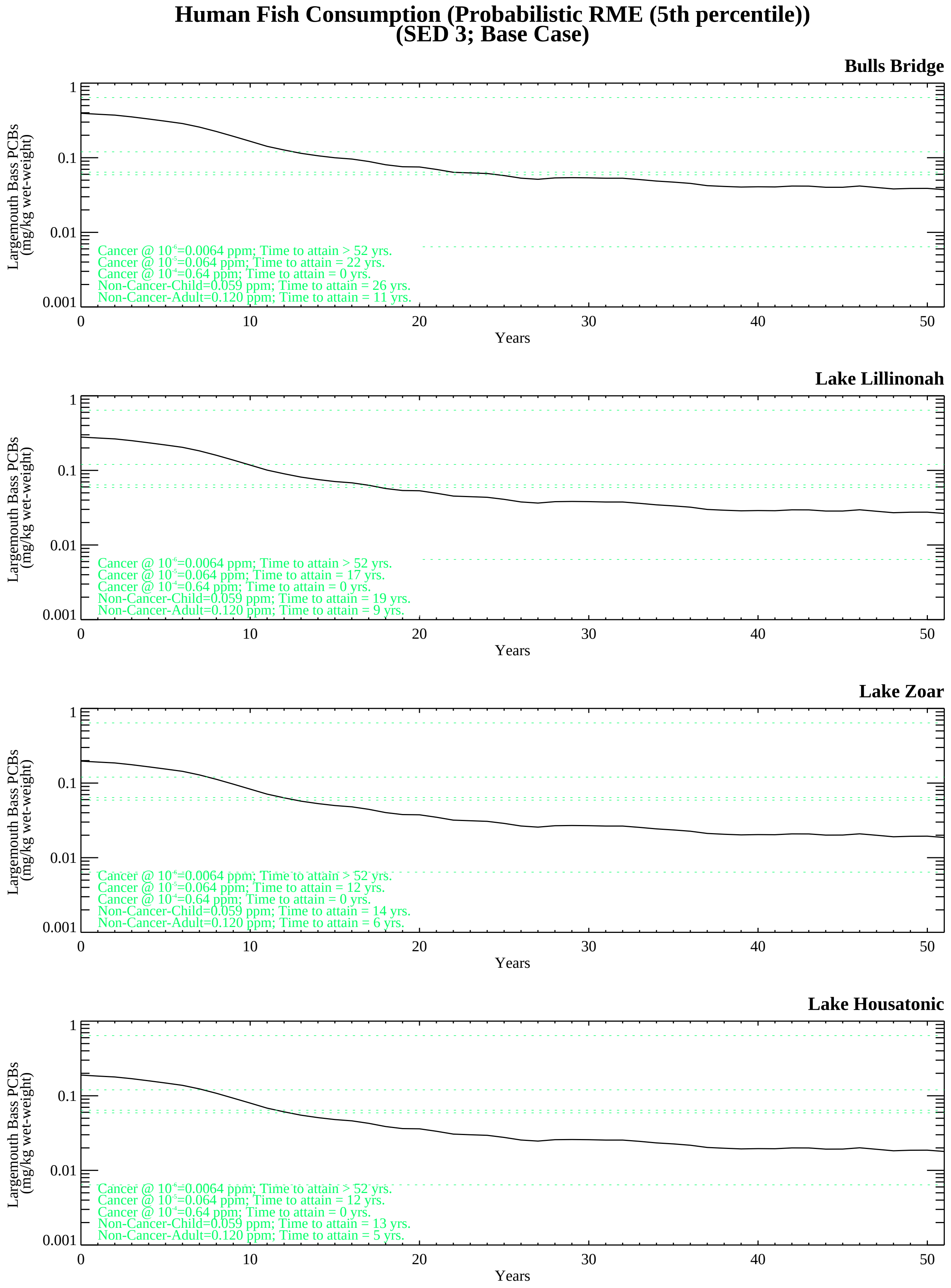

Figure G-8.1-2k. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 3; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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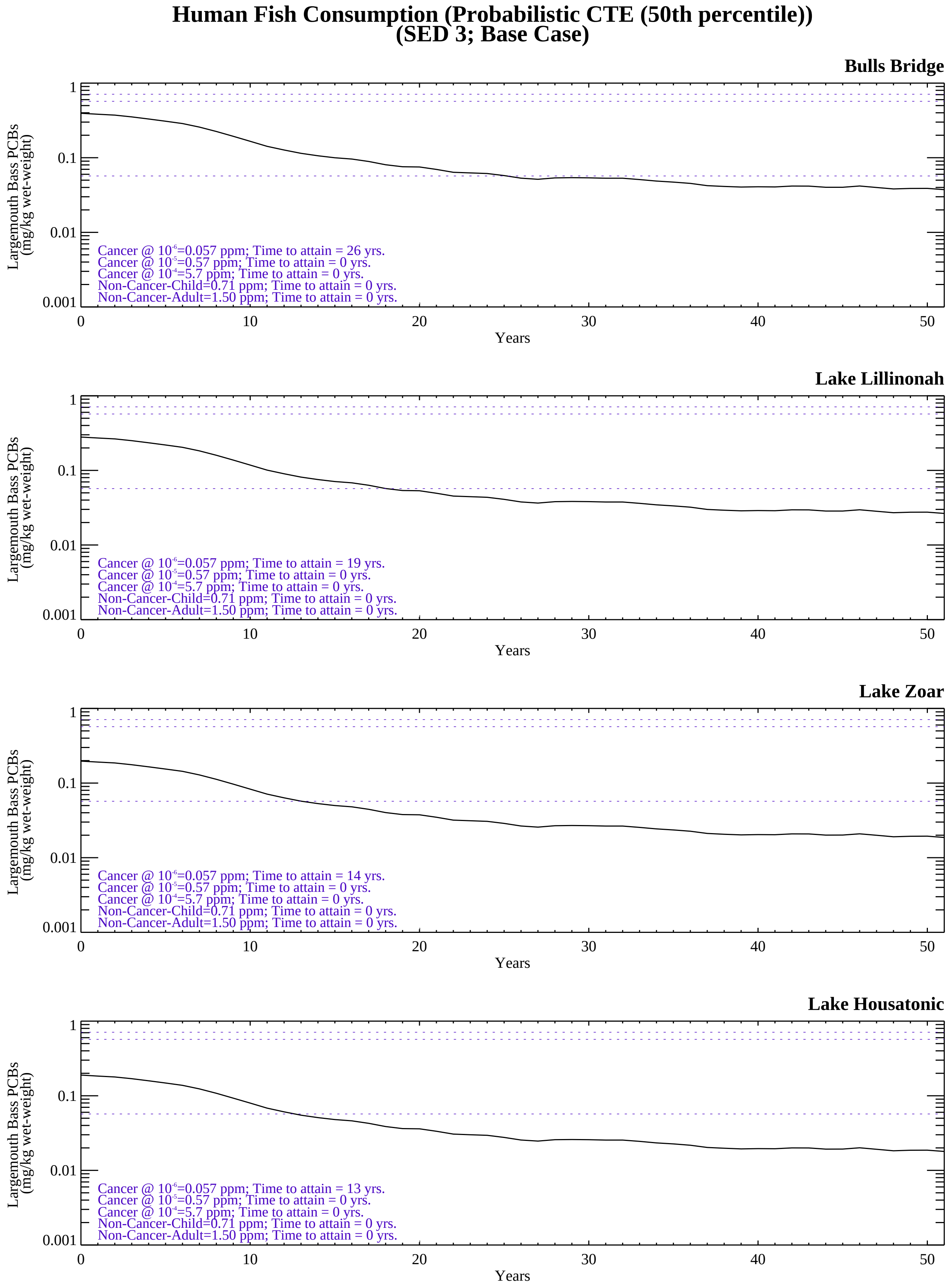

Figure G-8.1-2l. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 3; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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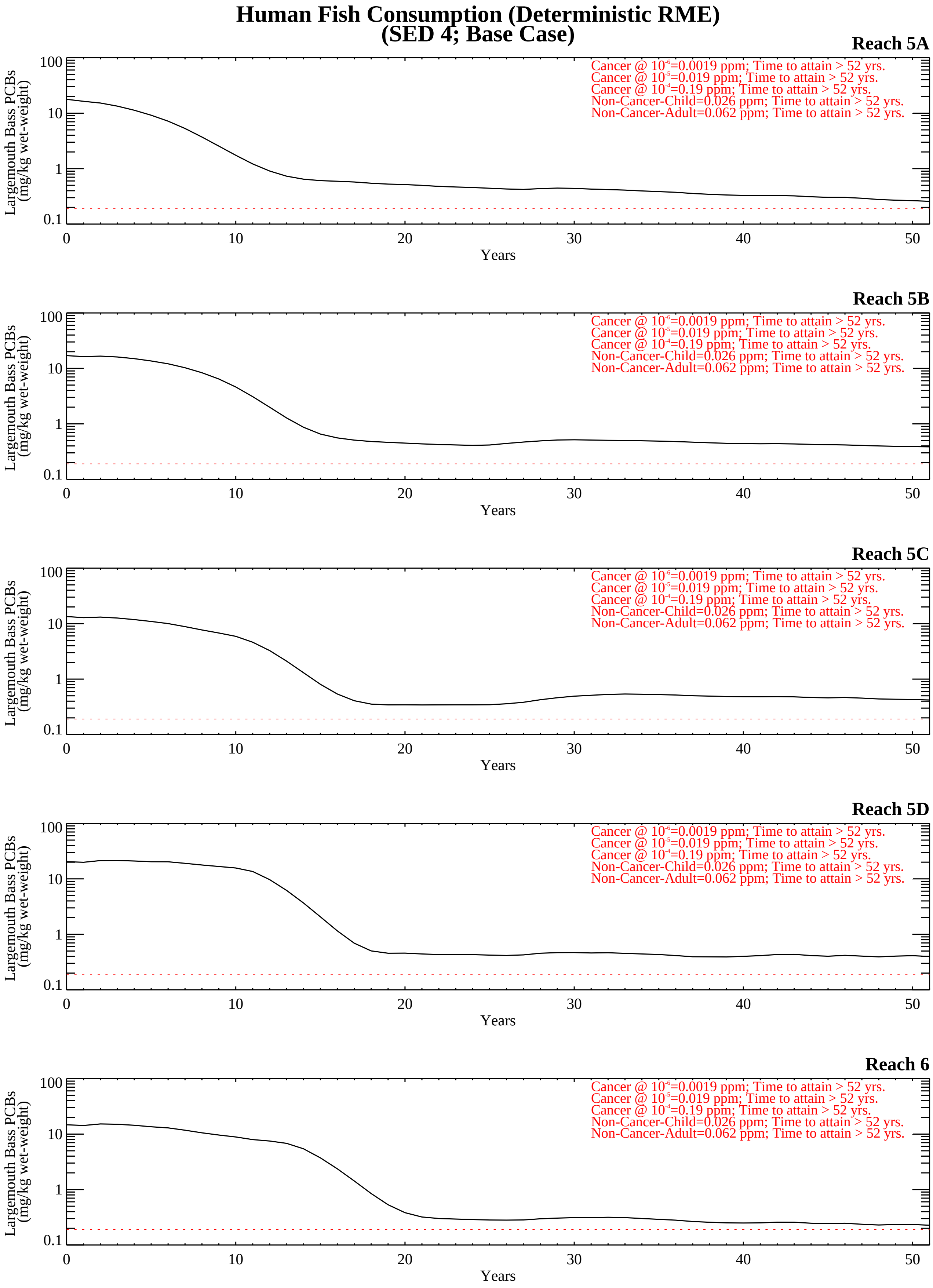

Figure G-8.1-3a. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic CTE)
(SED 4; Base Case)

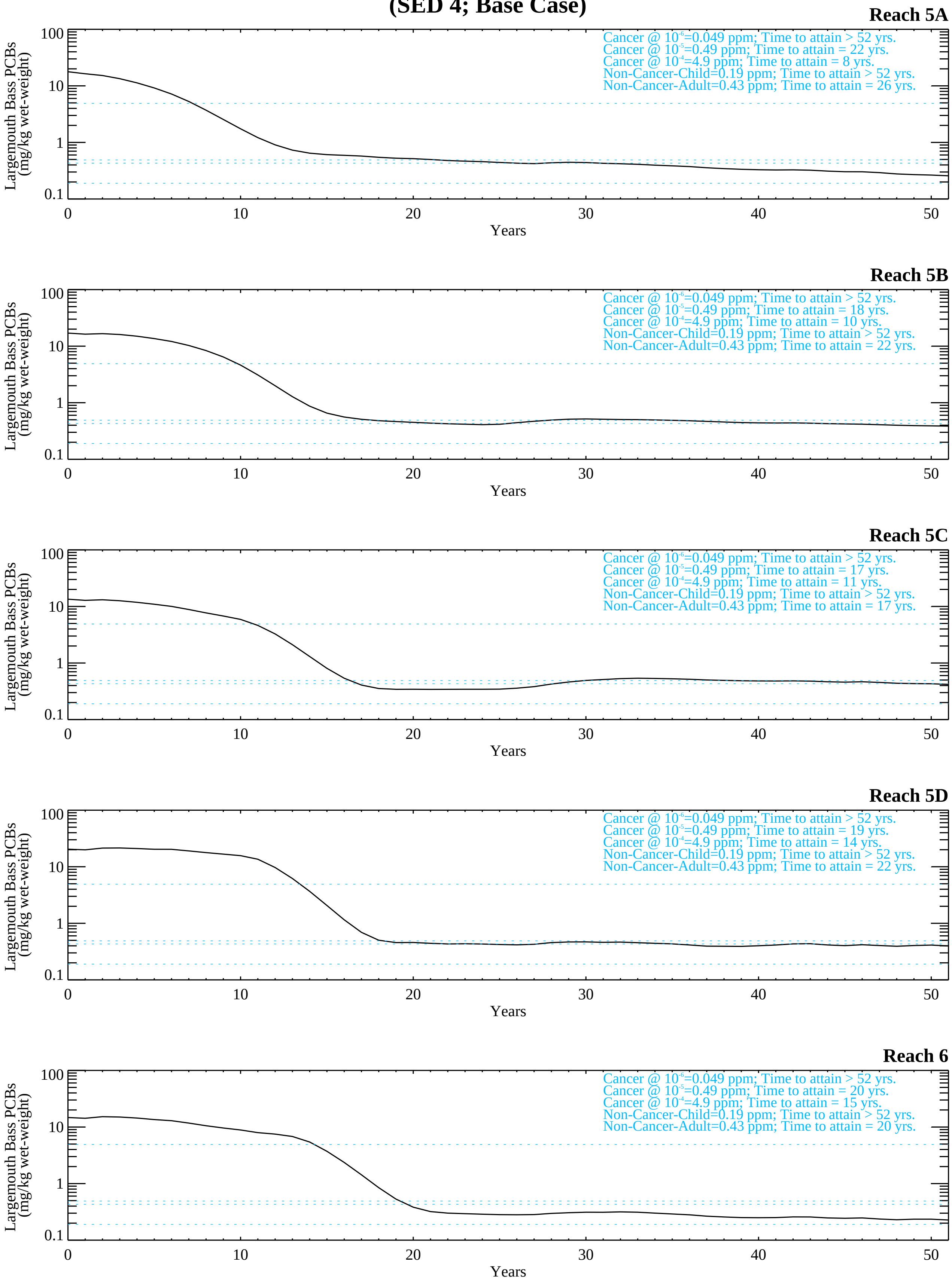

Figure G-8.1-3b. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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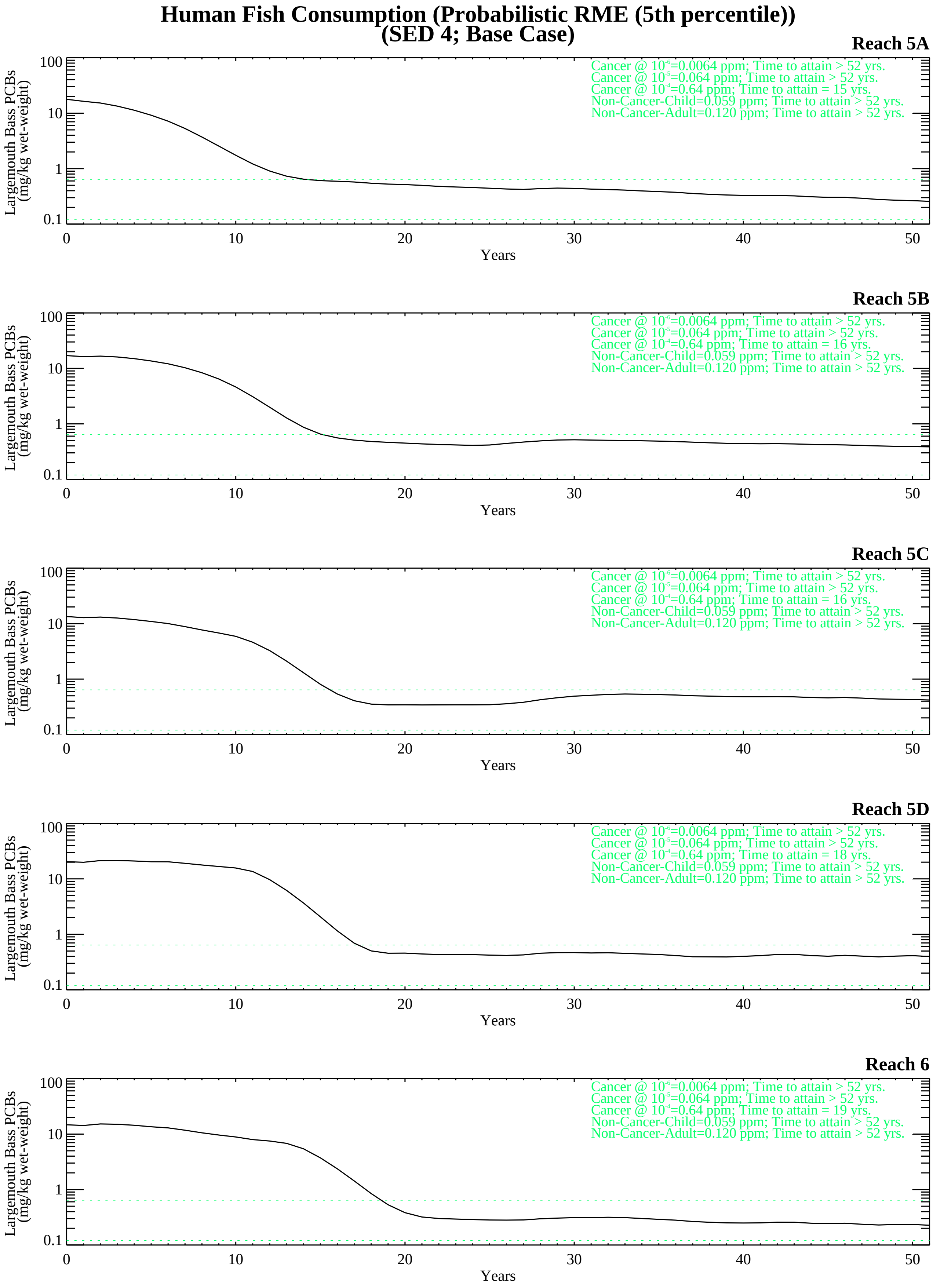

Figure G-8.1-3c. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 4; Base Case)

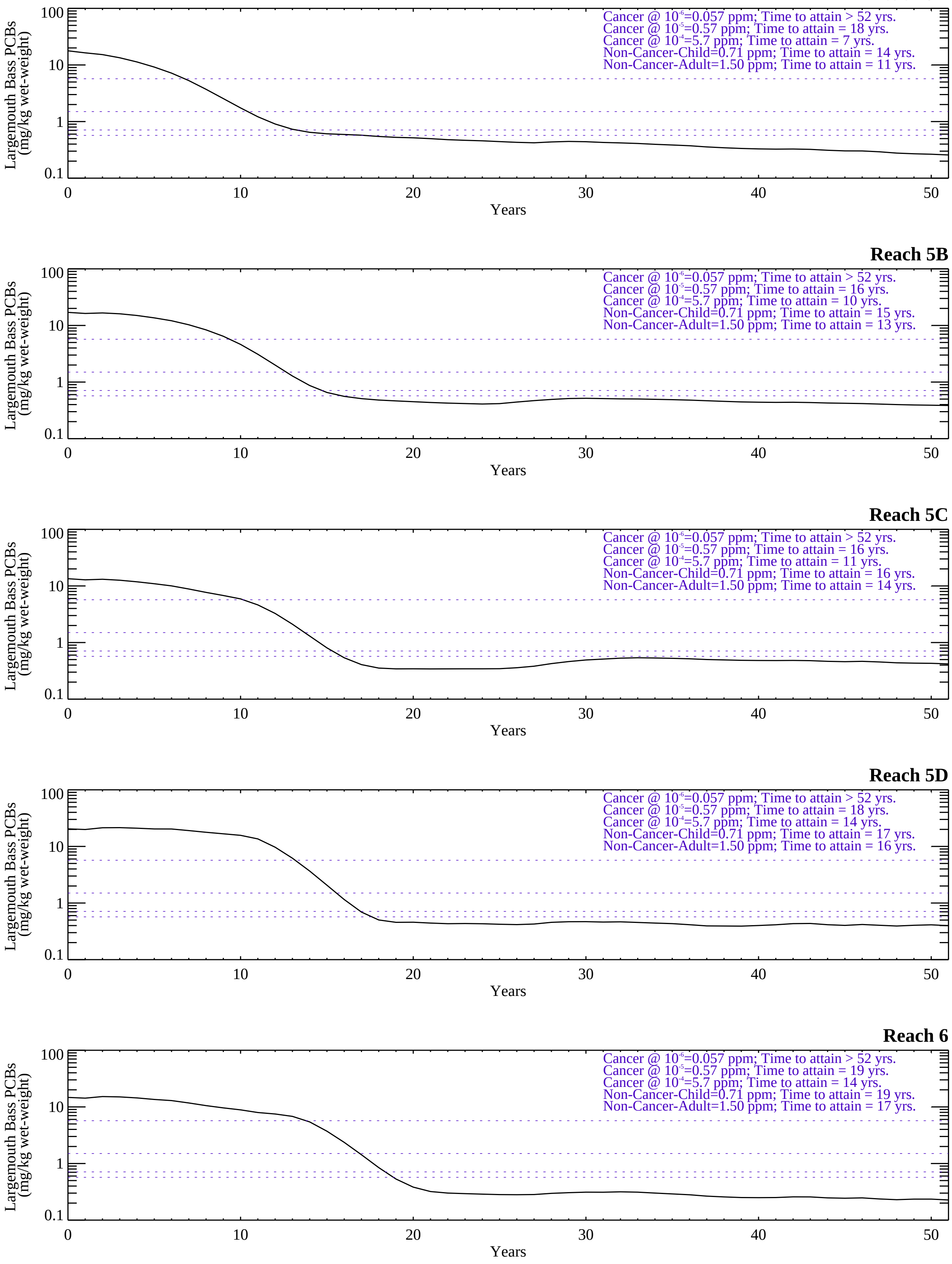

Figure G-8.1-3d. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

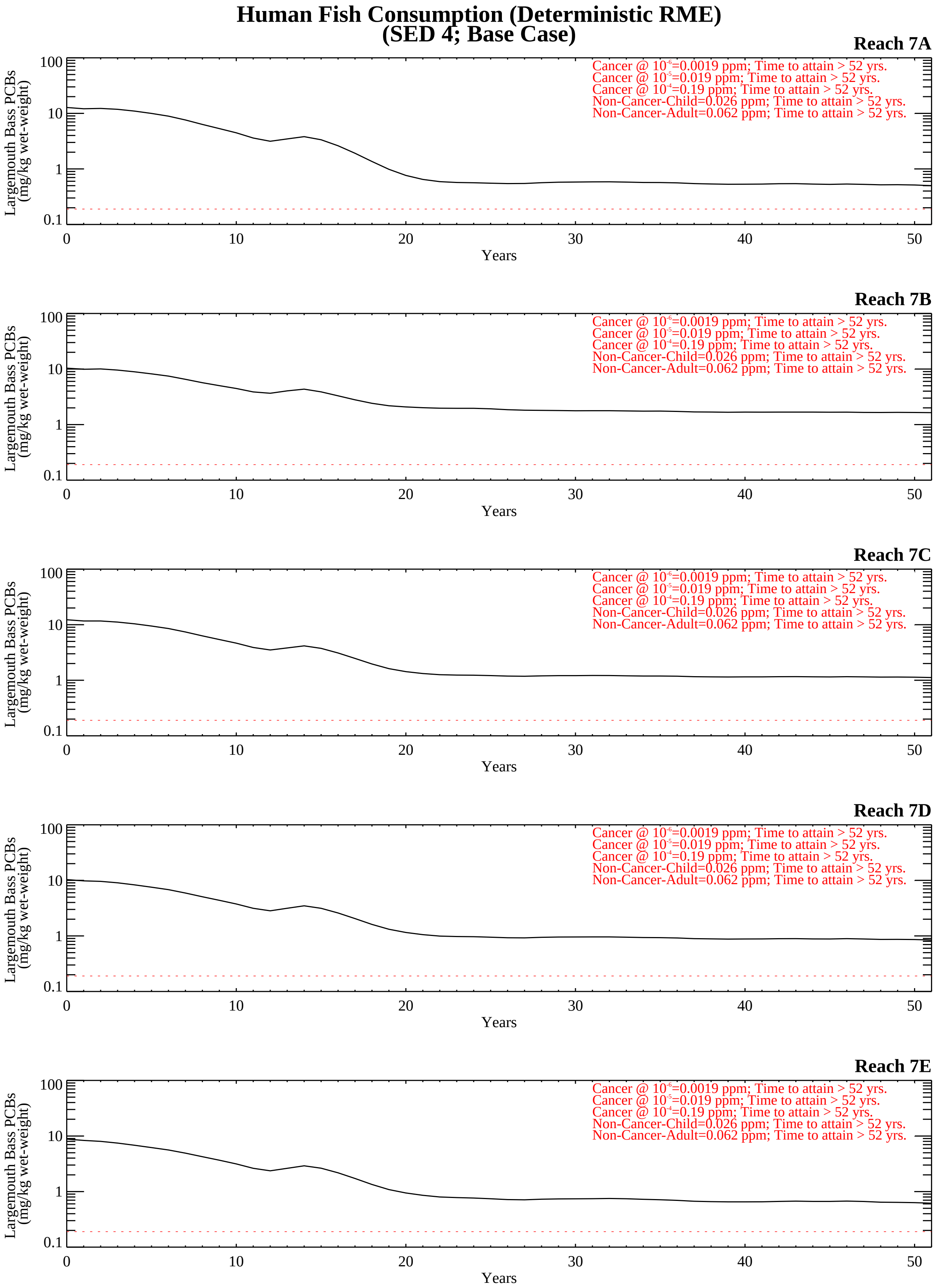

Figure G-8.1-3e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic RME)
(SED 4; Base Case)

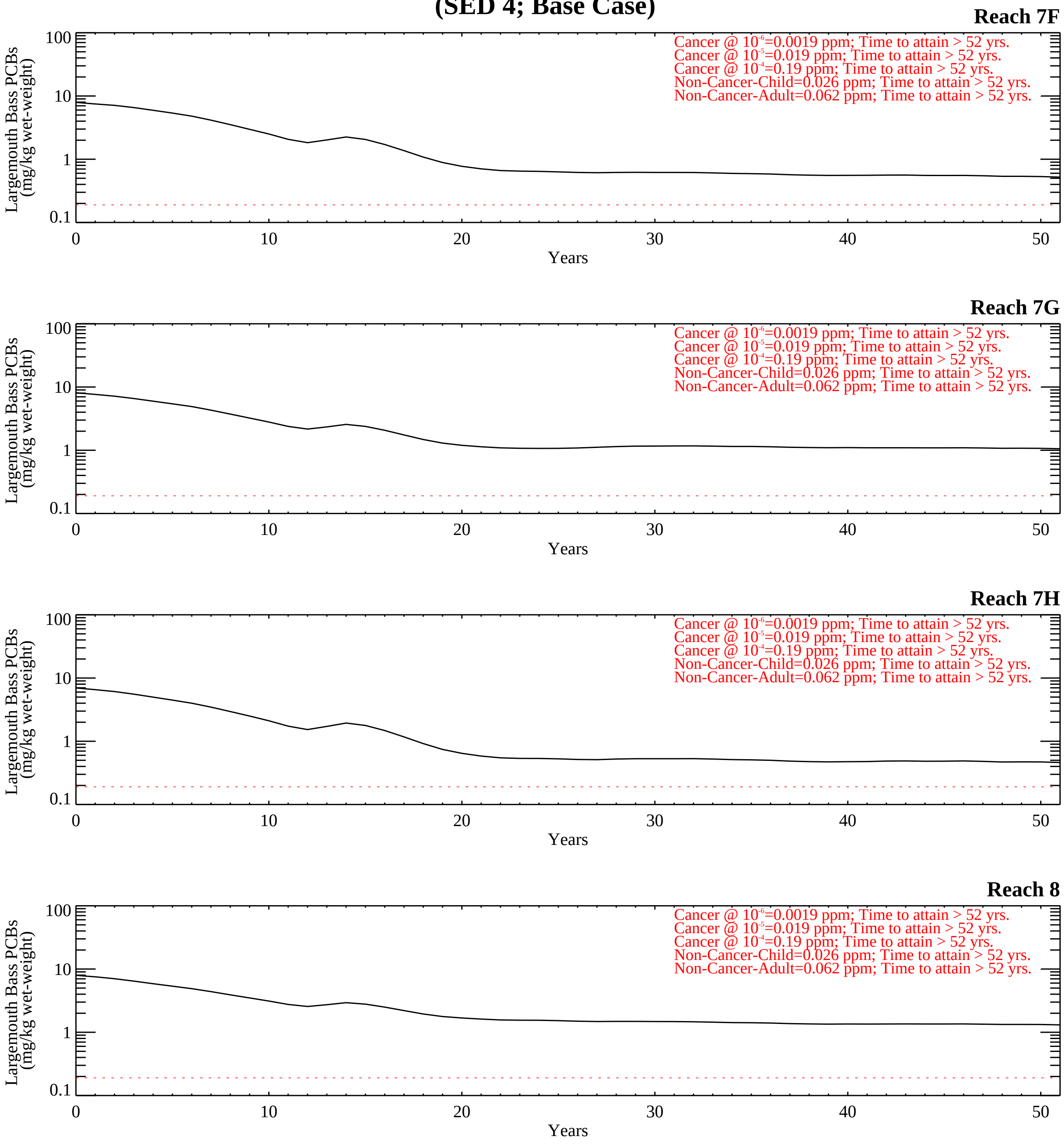

Figure G-8.1-3e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic CTE)
(SED 4; Base Case)

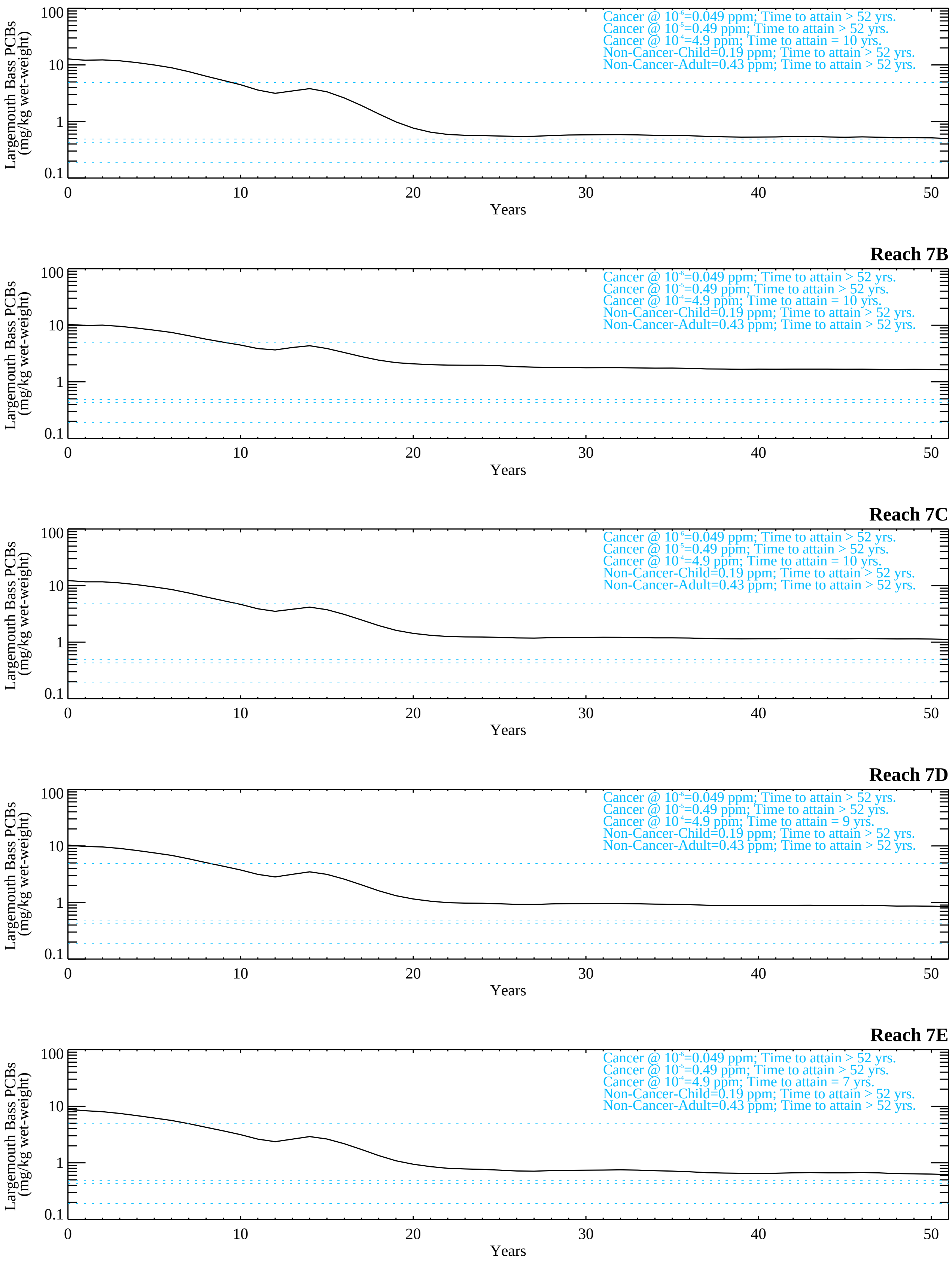

Figure G-8.1-3f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Deterministic CTE)
(SED 4; Base Case)

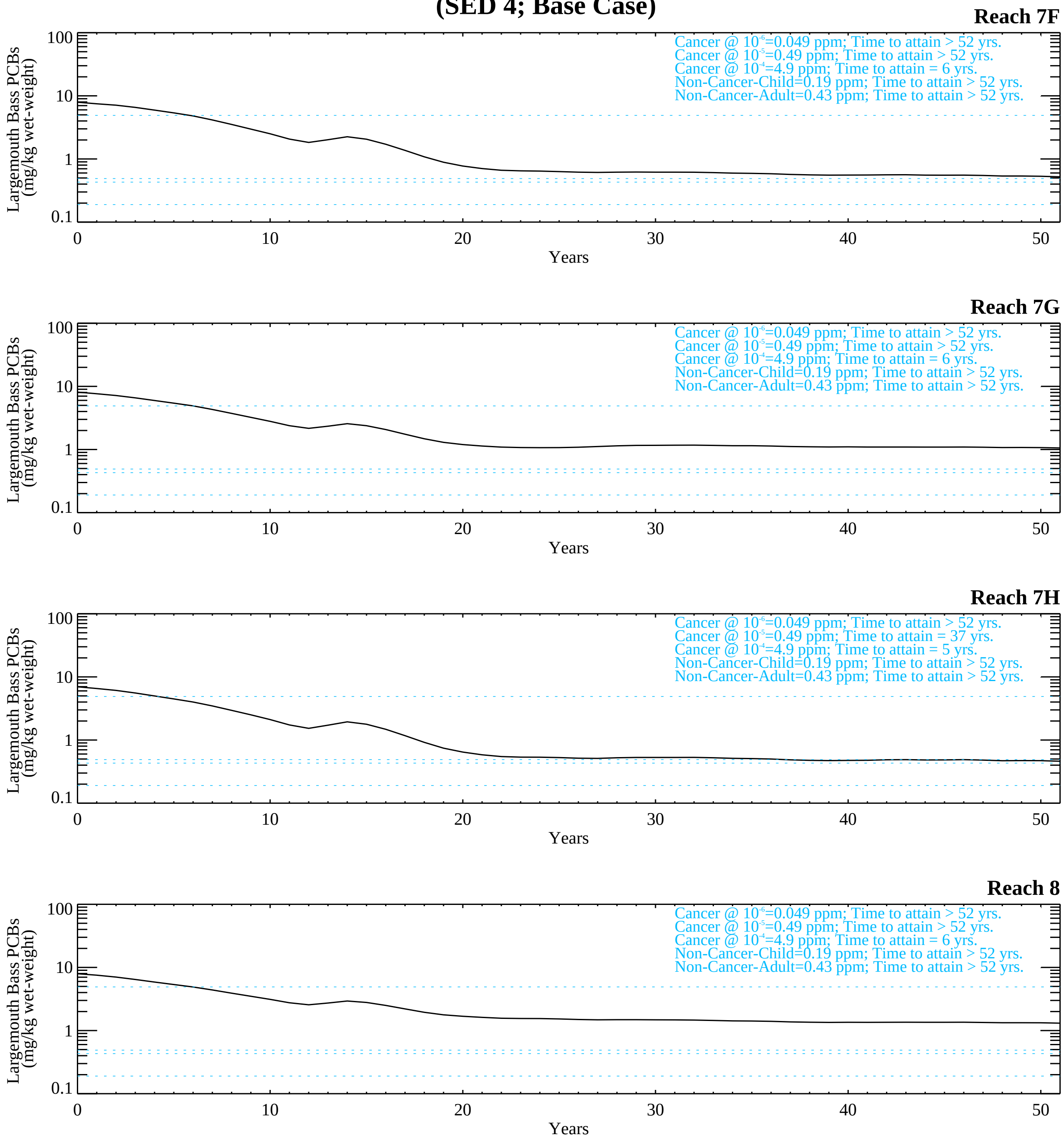


Figure G-8.1-3f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 4; Base Case)

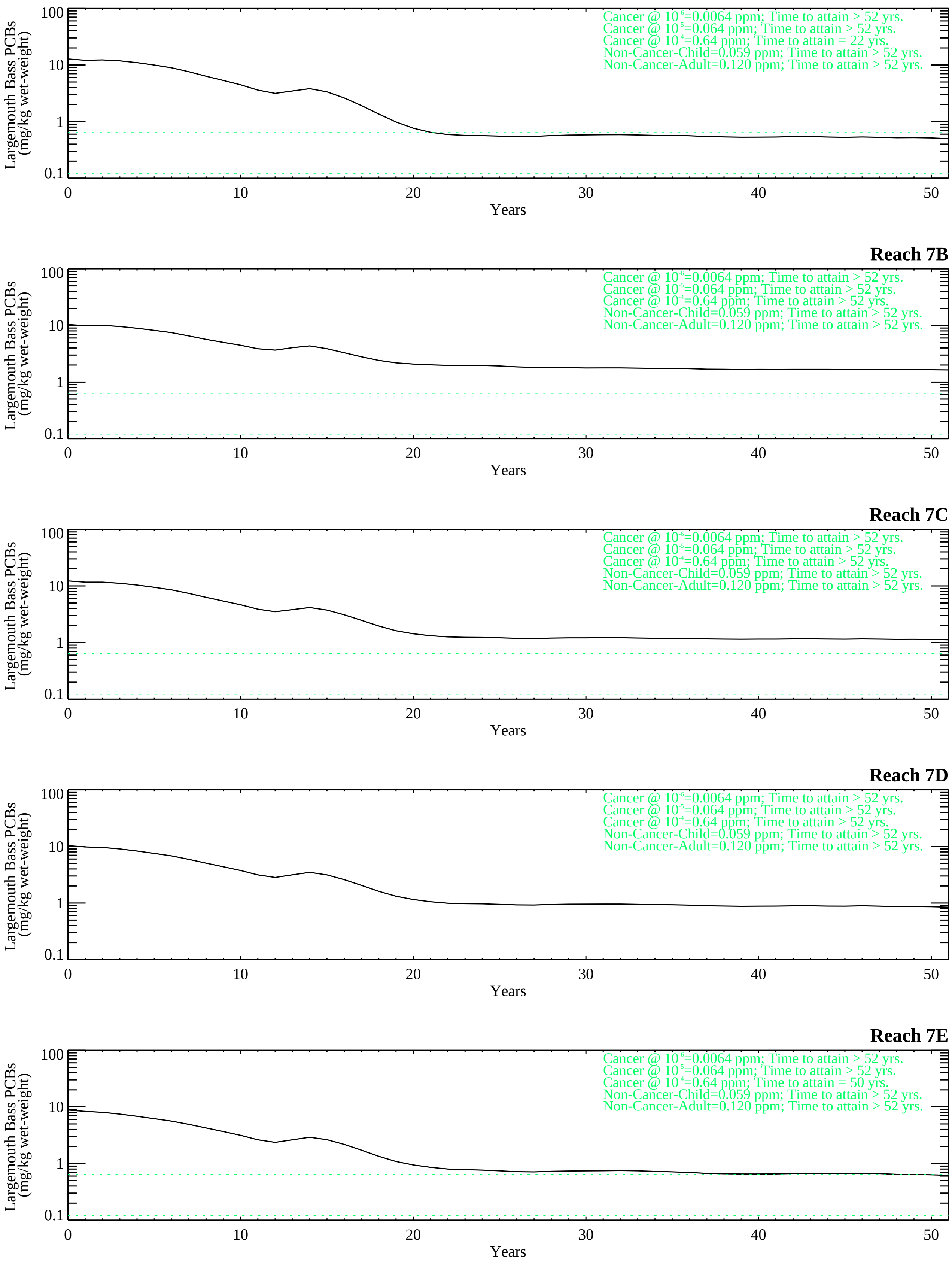


Figure G-8.1-3g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 4; Base Case)

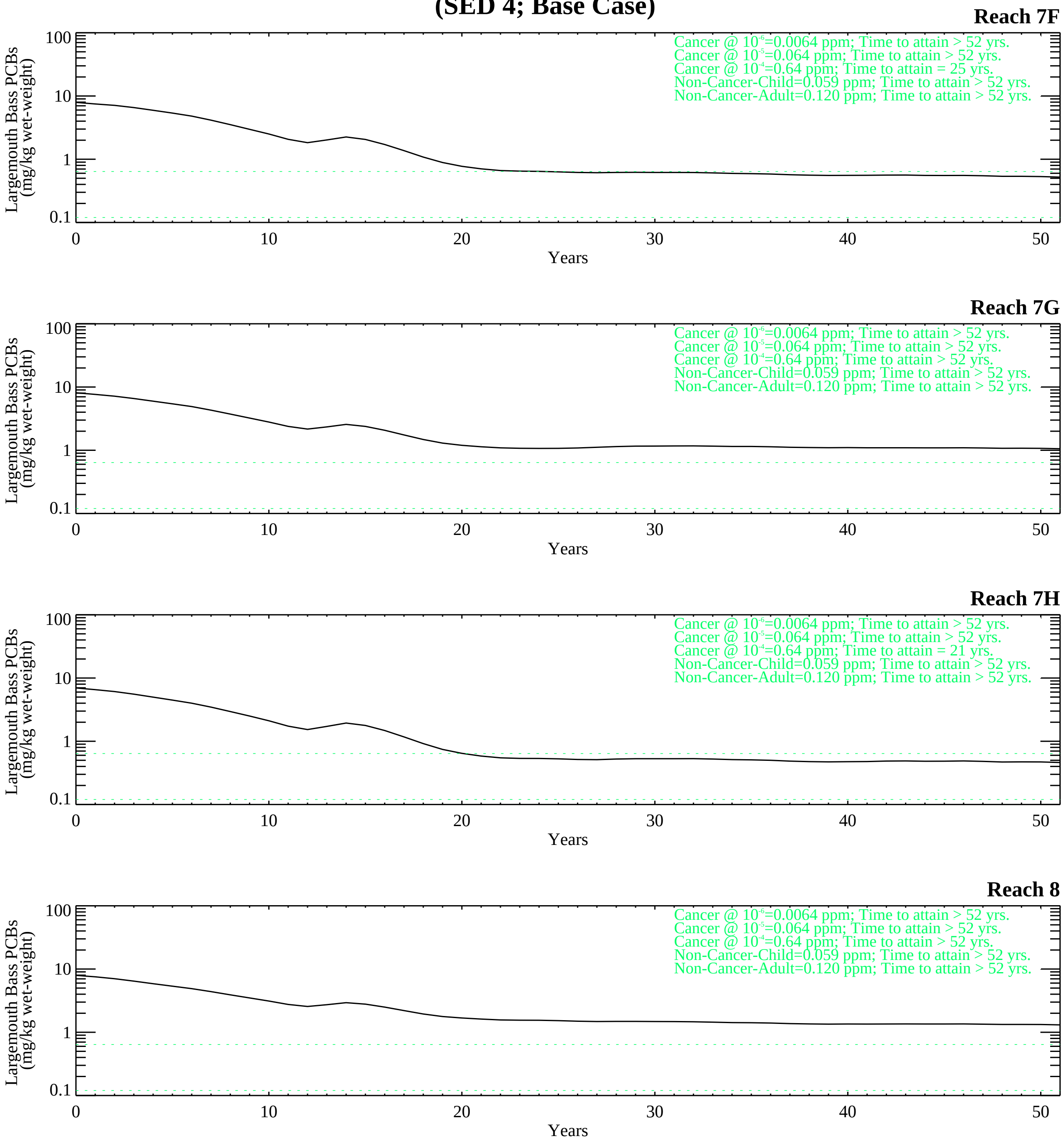


Figure G-8.1-3g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 4; Base Case)

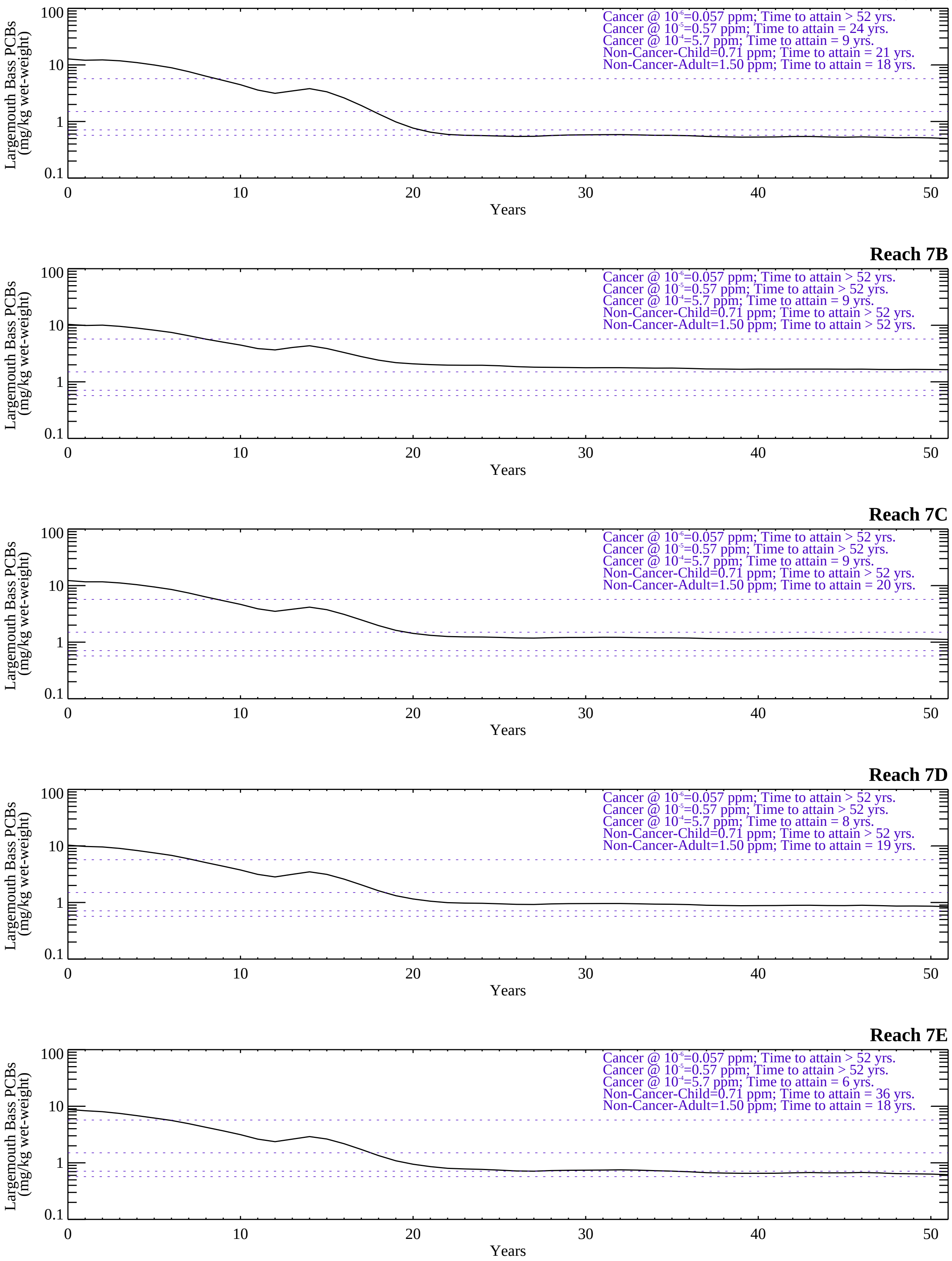
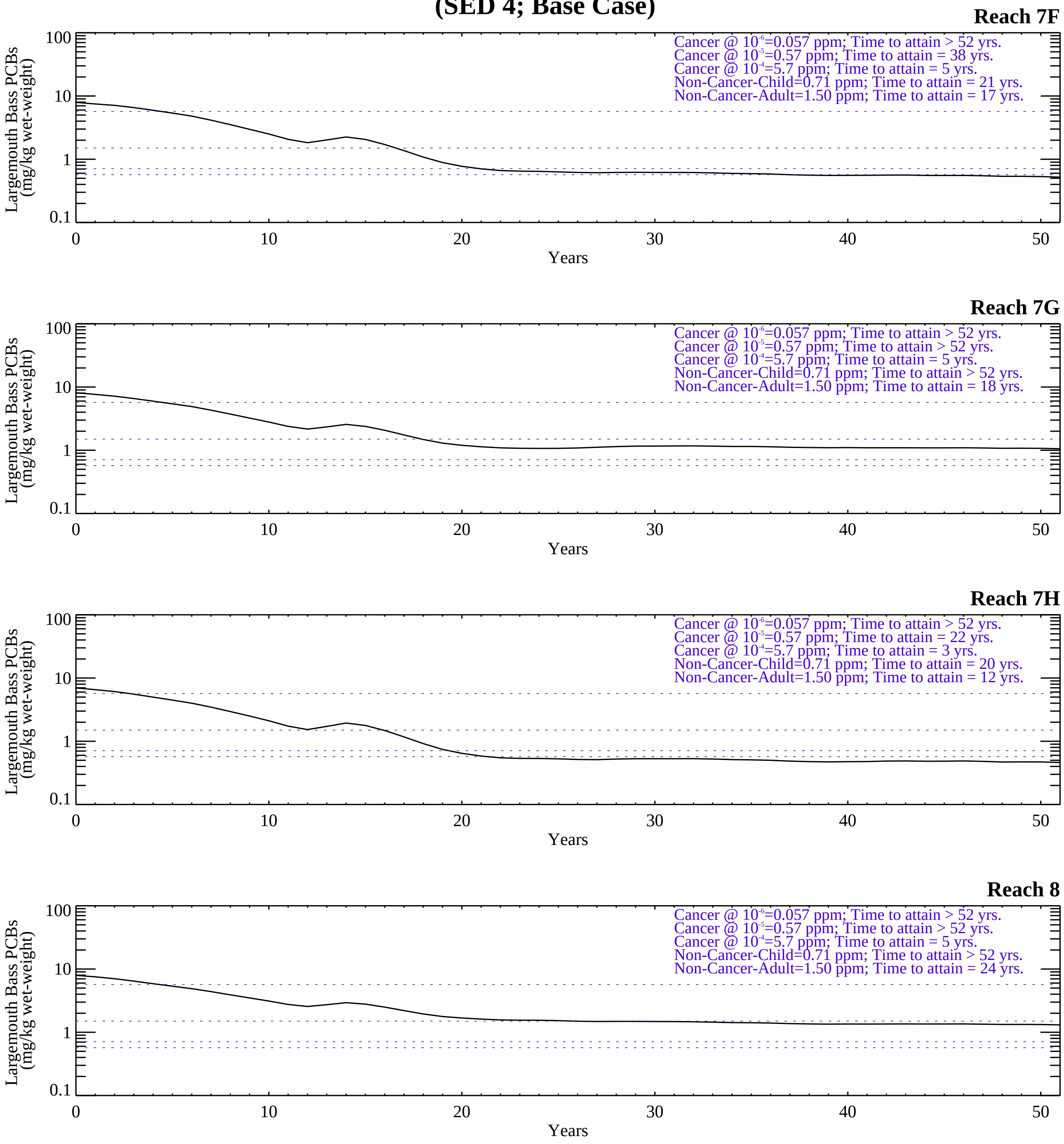


Figure G-8.1-3h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic CTE (50th percentile)) (SED 4; Base Case)



Reach 7F

Reach 7G

Reach 7H

Reach 8

Figure G-8.1-3h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic RME)
(SED 4; Base Case)

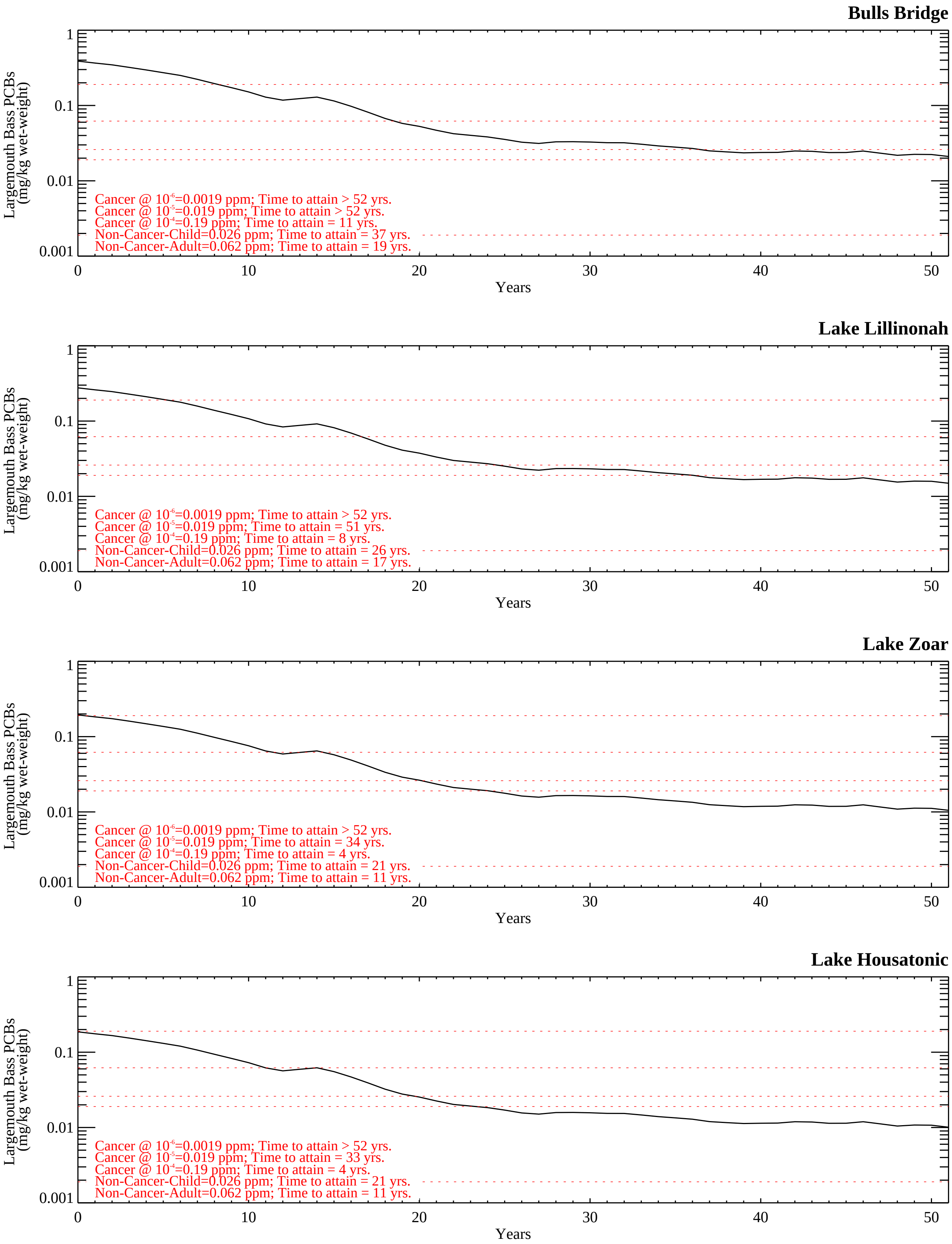


Figure G-8.1-3i. Temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D Analysis compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 4; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Deterministic CTE)
(SED 4; Base Case)

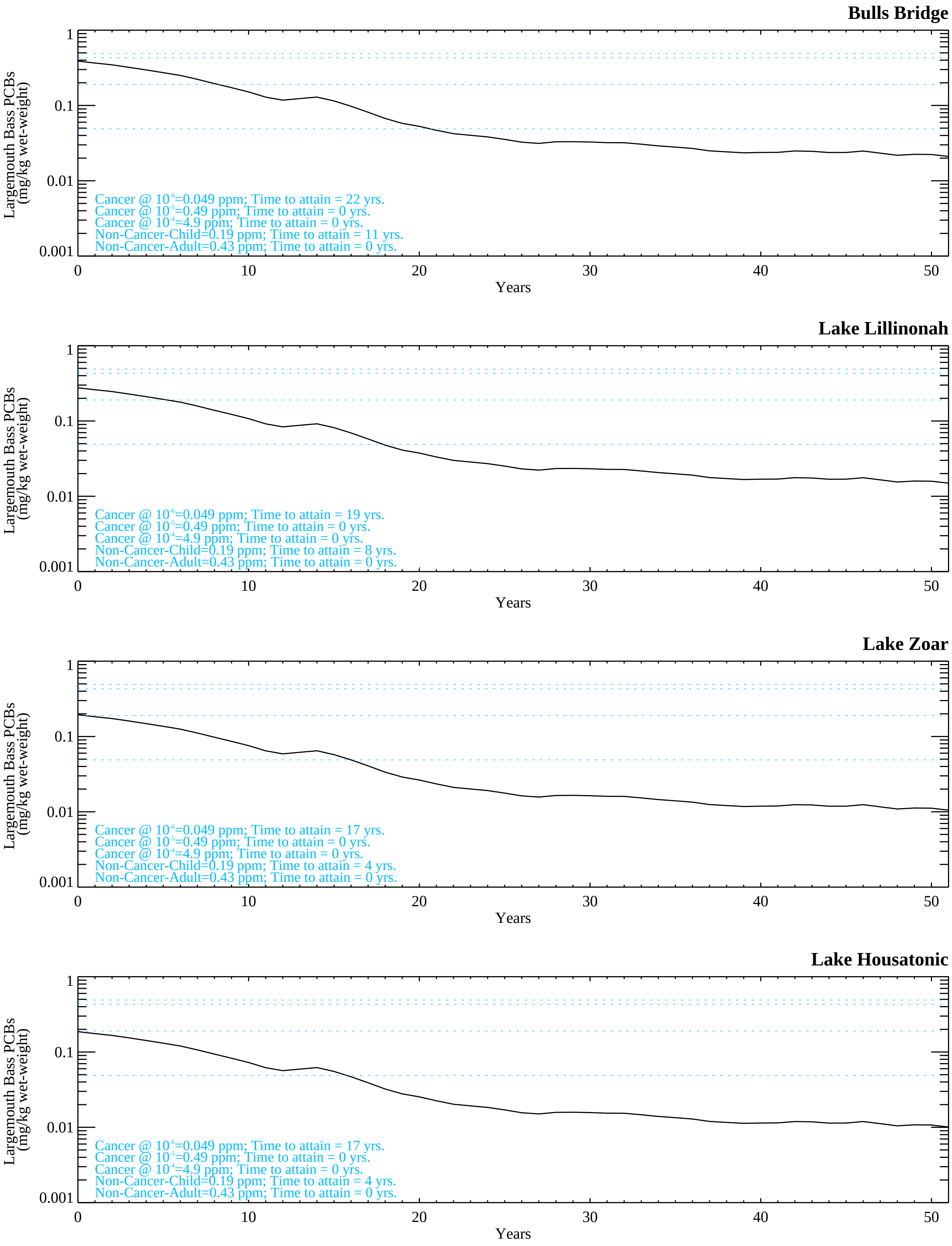

Figure G-8.1-3j. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 4; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

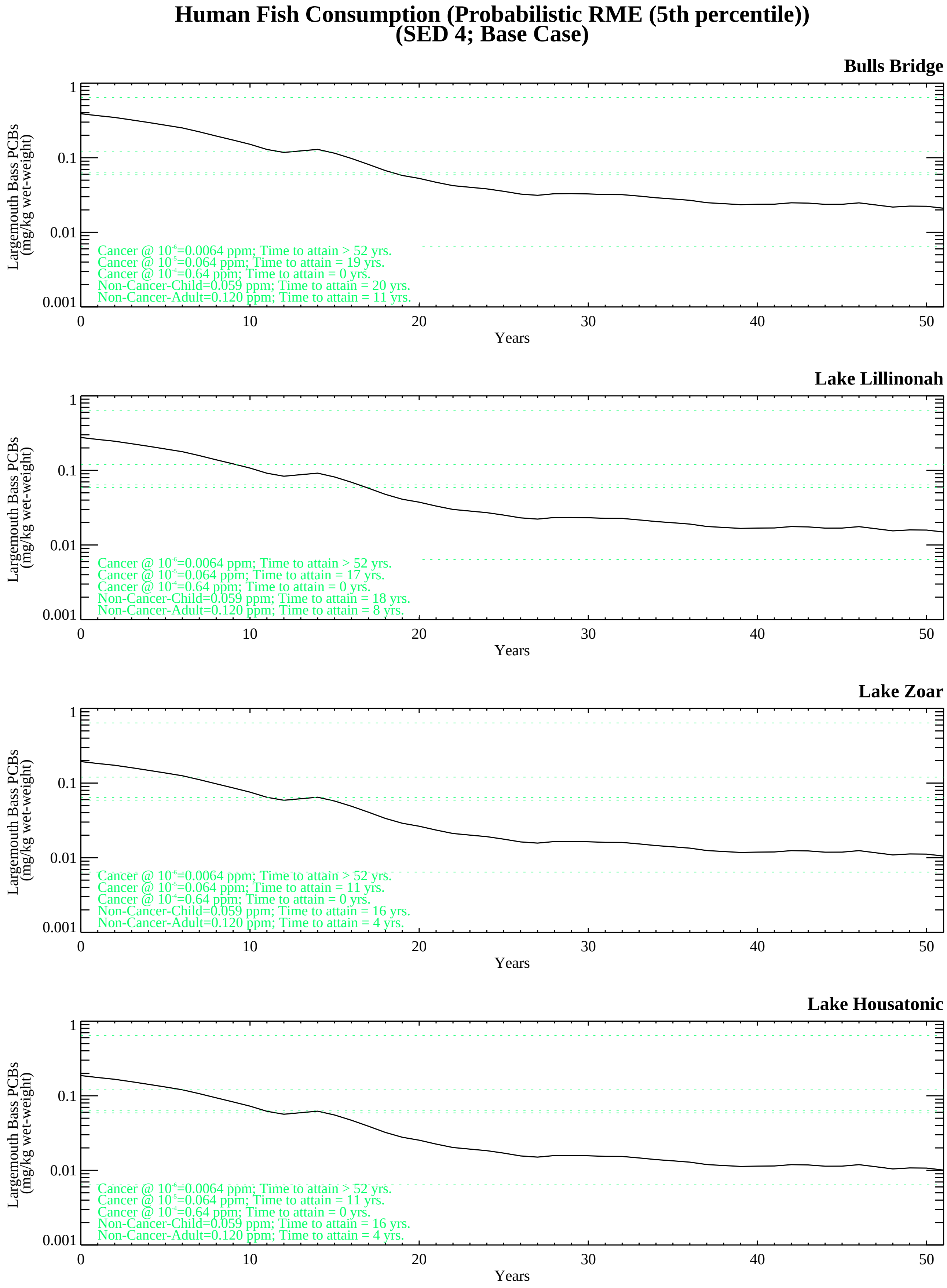

Figure G-8.1-3k. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 4; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 4; Base Case)

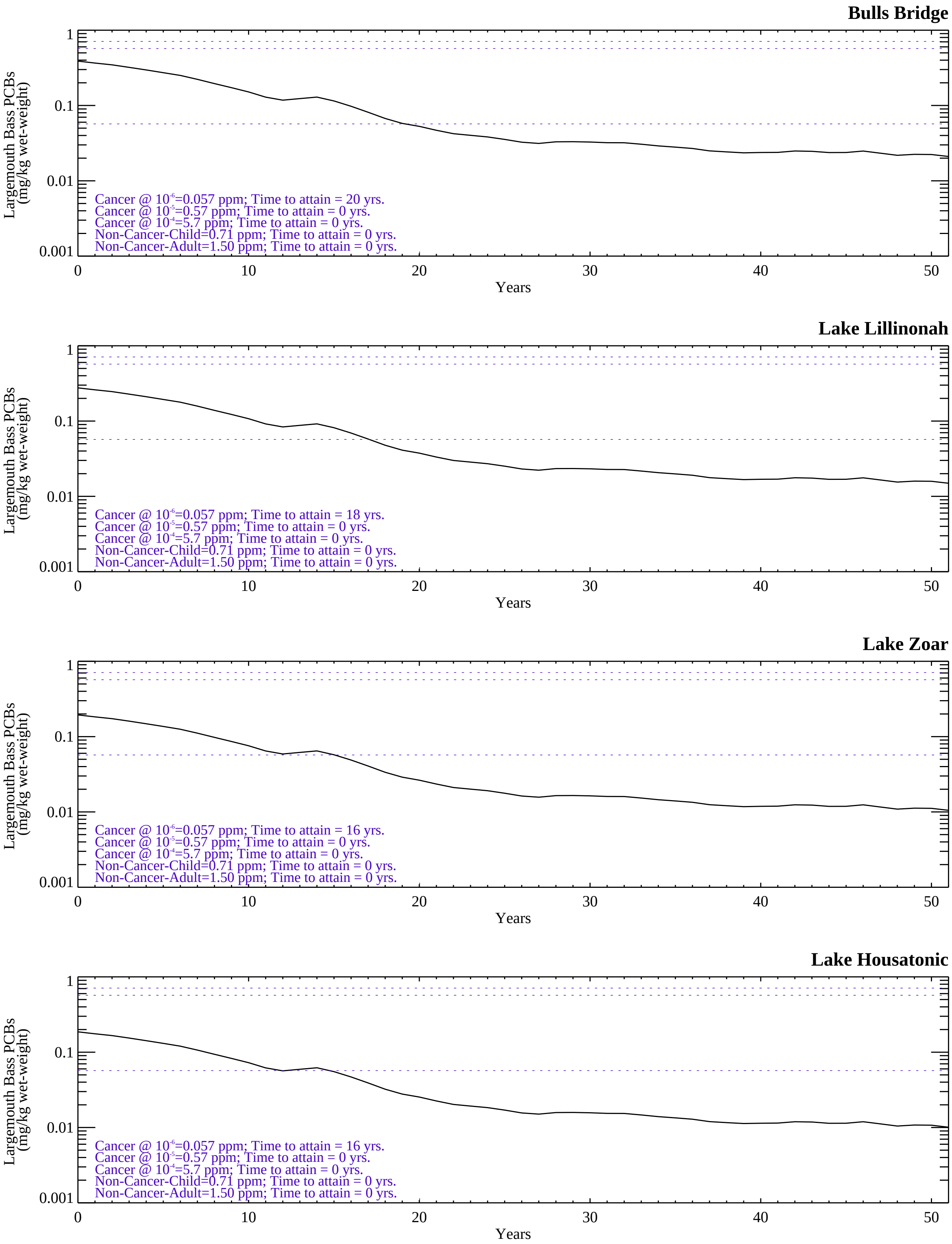

Figure G-8.1-3l. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 4; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

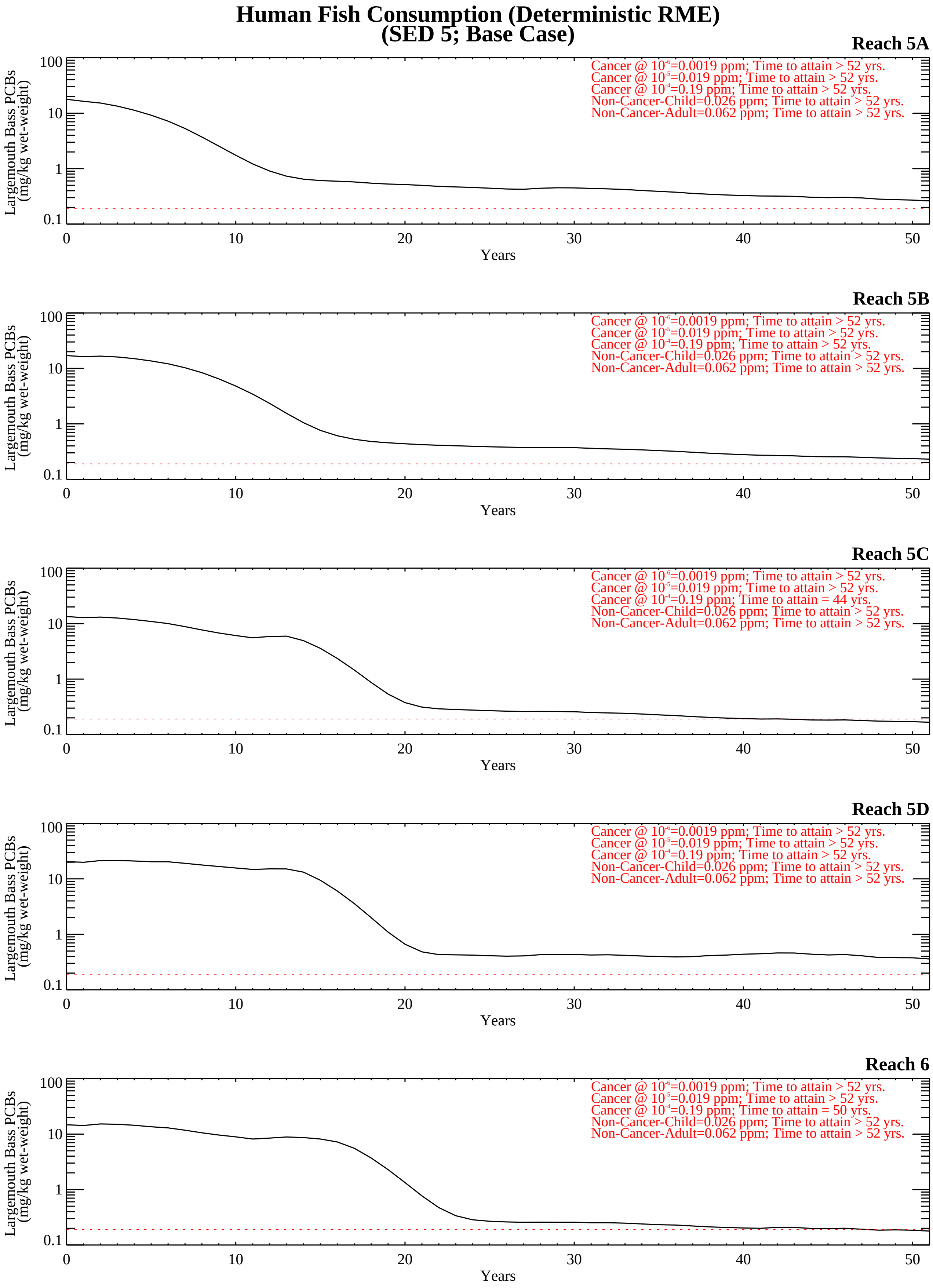

Figure G-8.1-4a. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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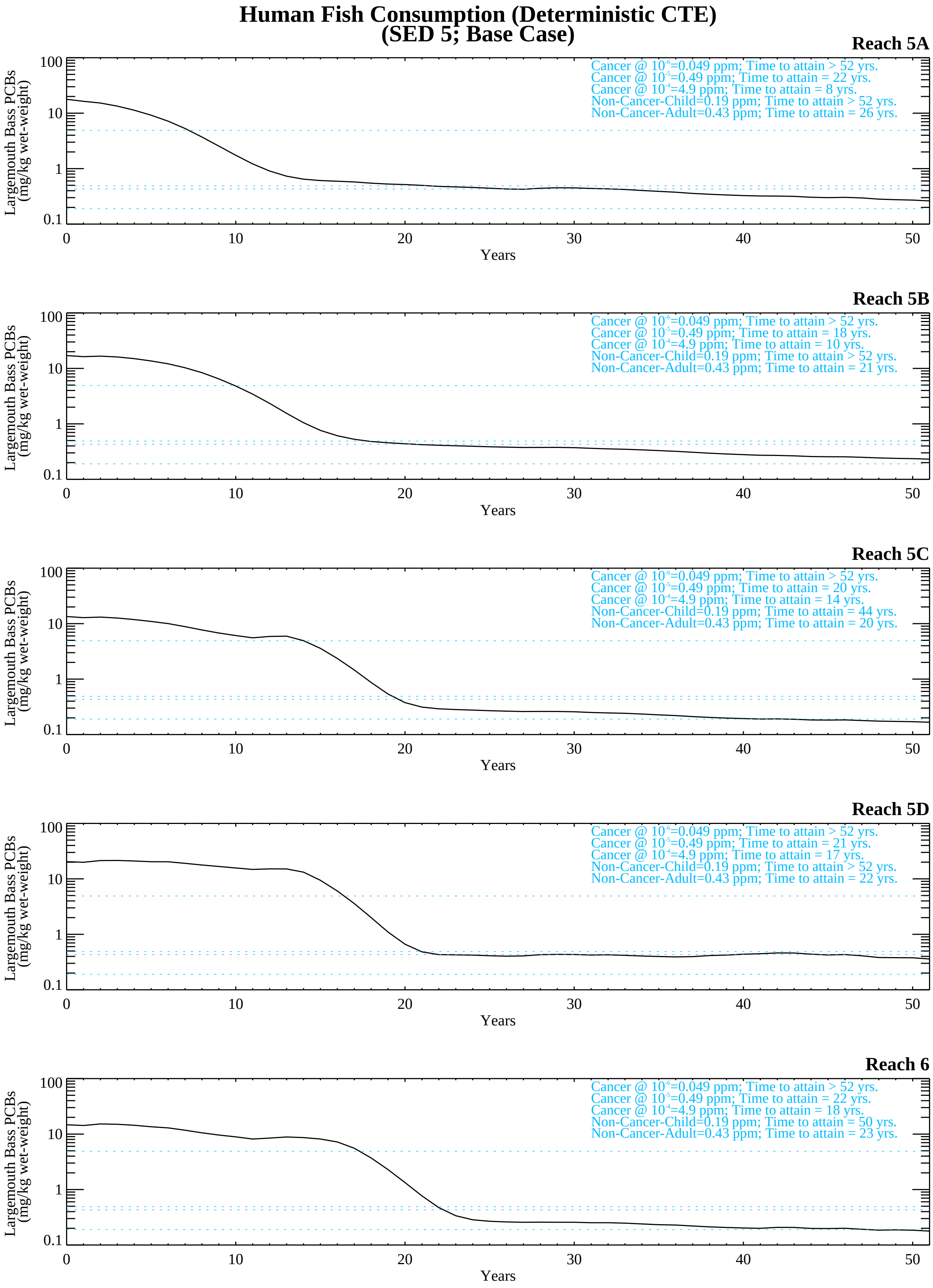

Figure G-8.1-4b. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

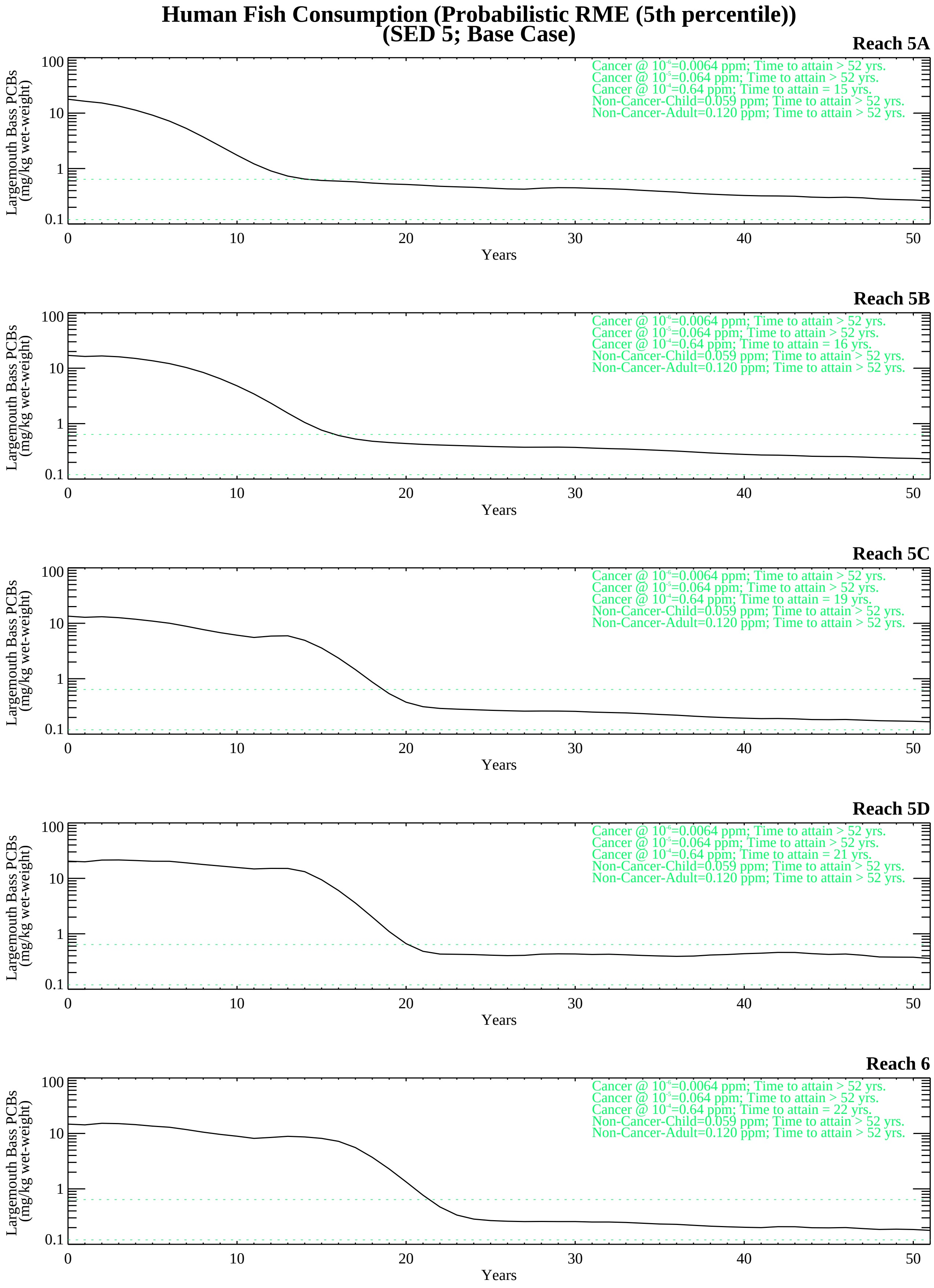

Figure G-8.1-4c. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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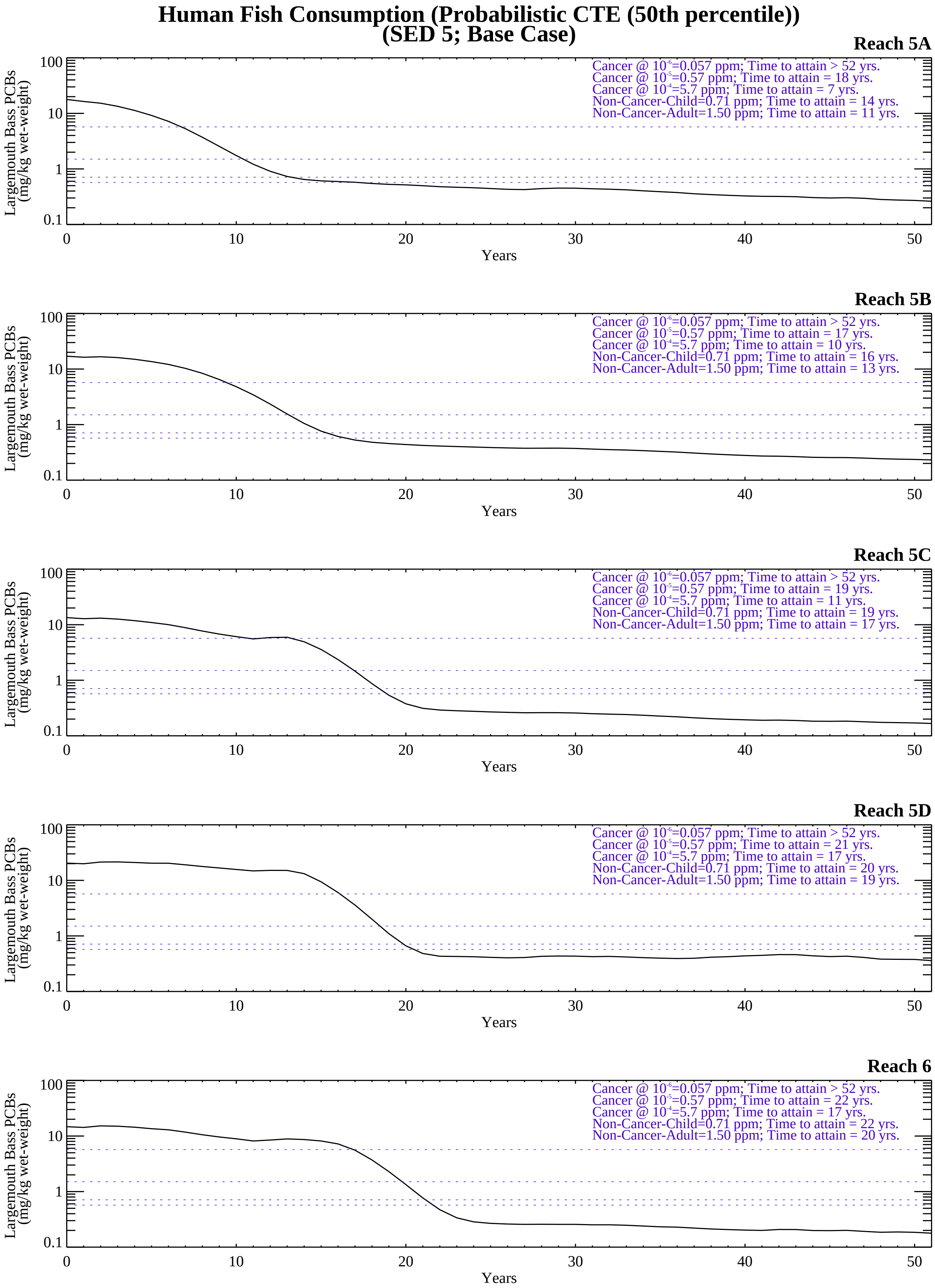

Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 5; Base Case)

Reach 5A

Reach 5B

Reach 5C

Reach 5D

Reach 6

Figure G-8.1-4d. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic RME)
(SED 5; Base Case)

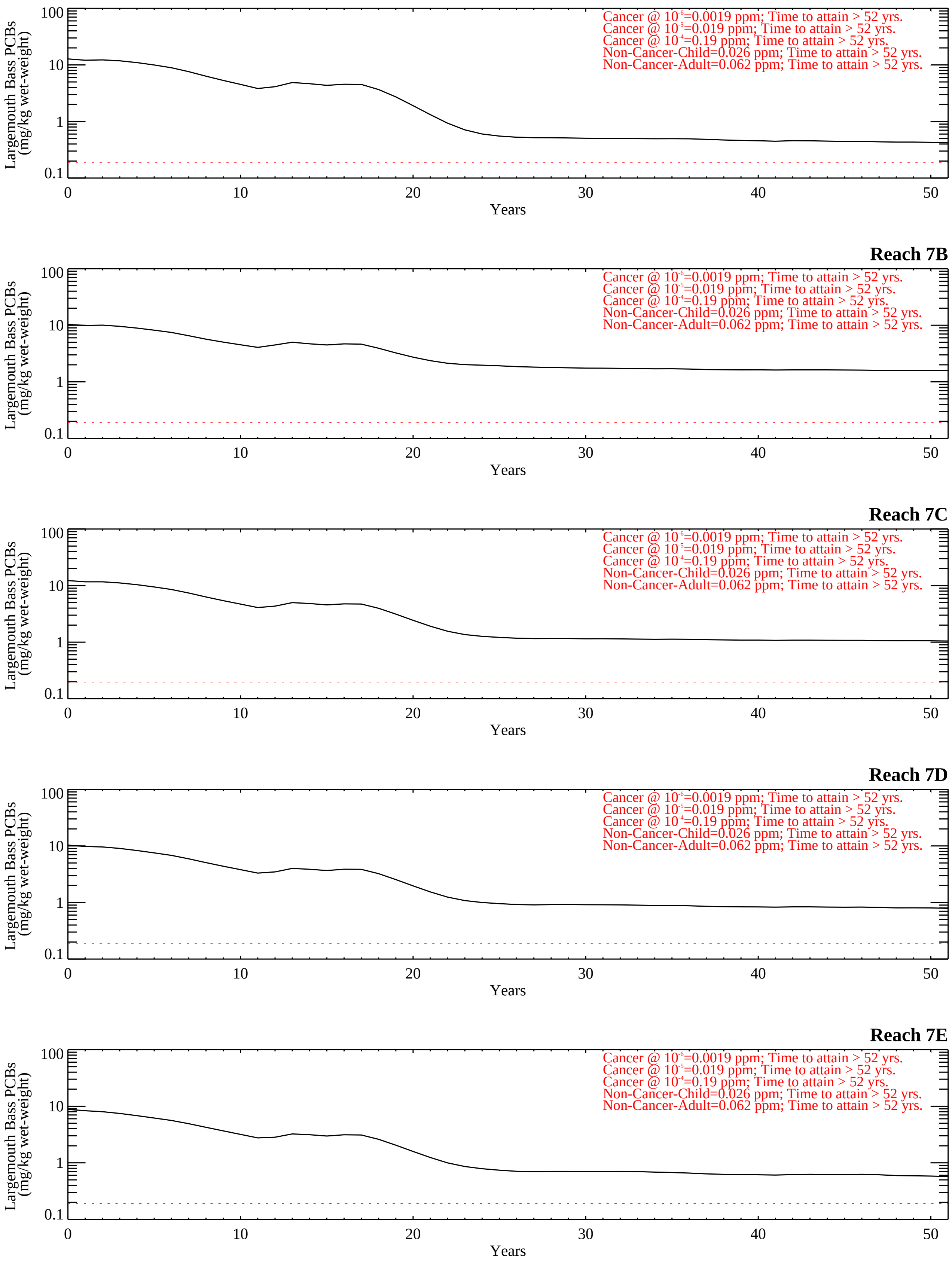

Figure G-8.1-4e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

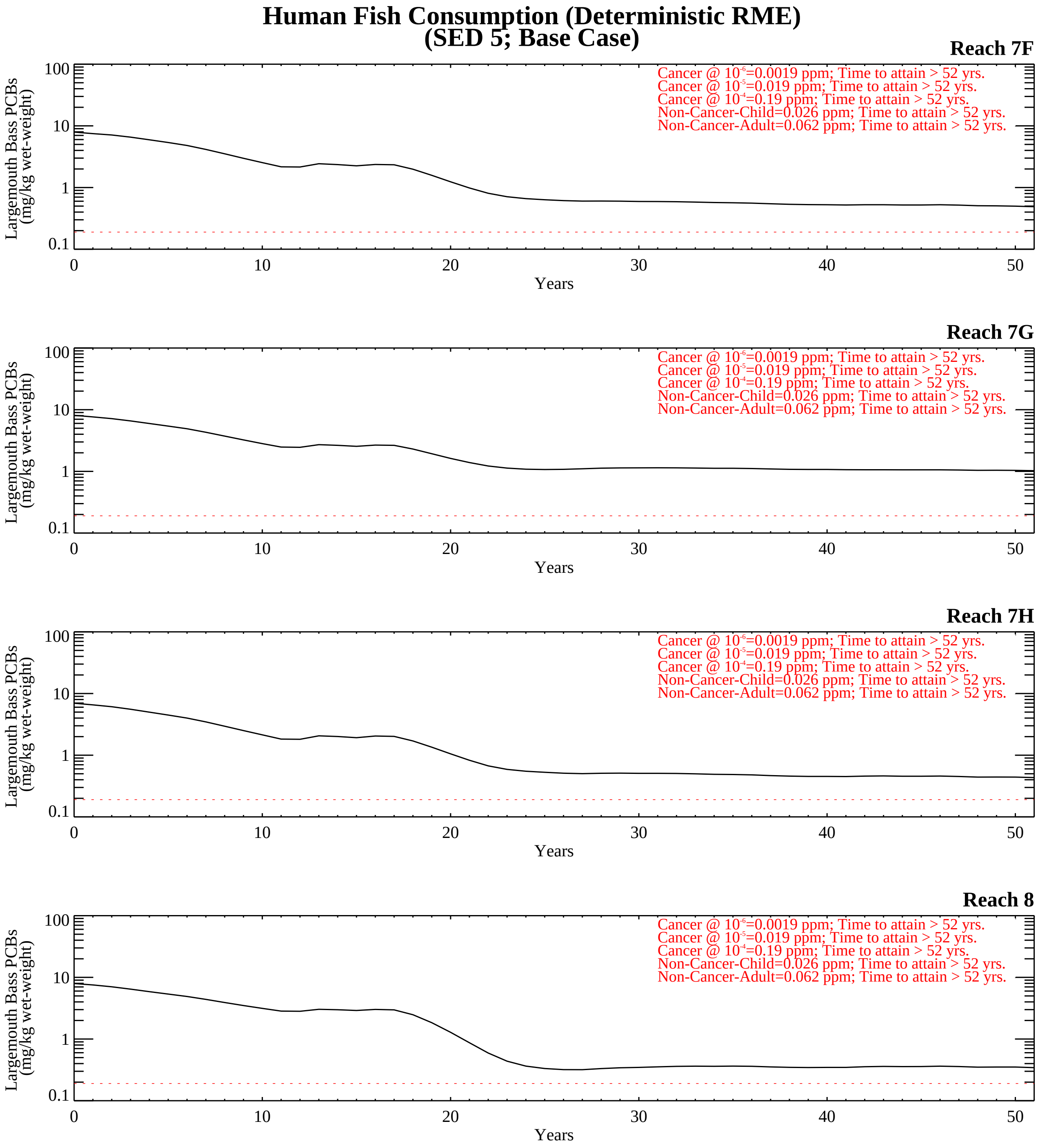

Figure G-8.1-4e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Deterministic CTE)
(SED 5; Base Case)

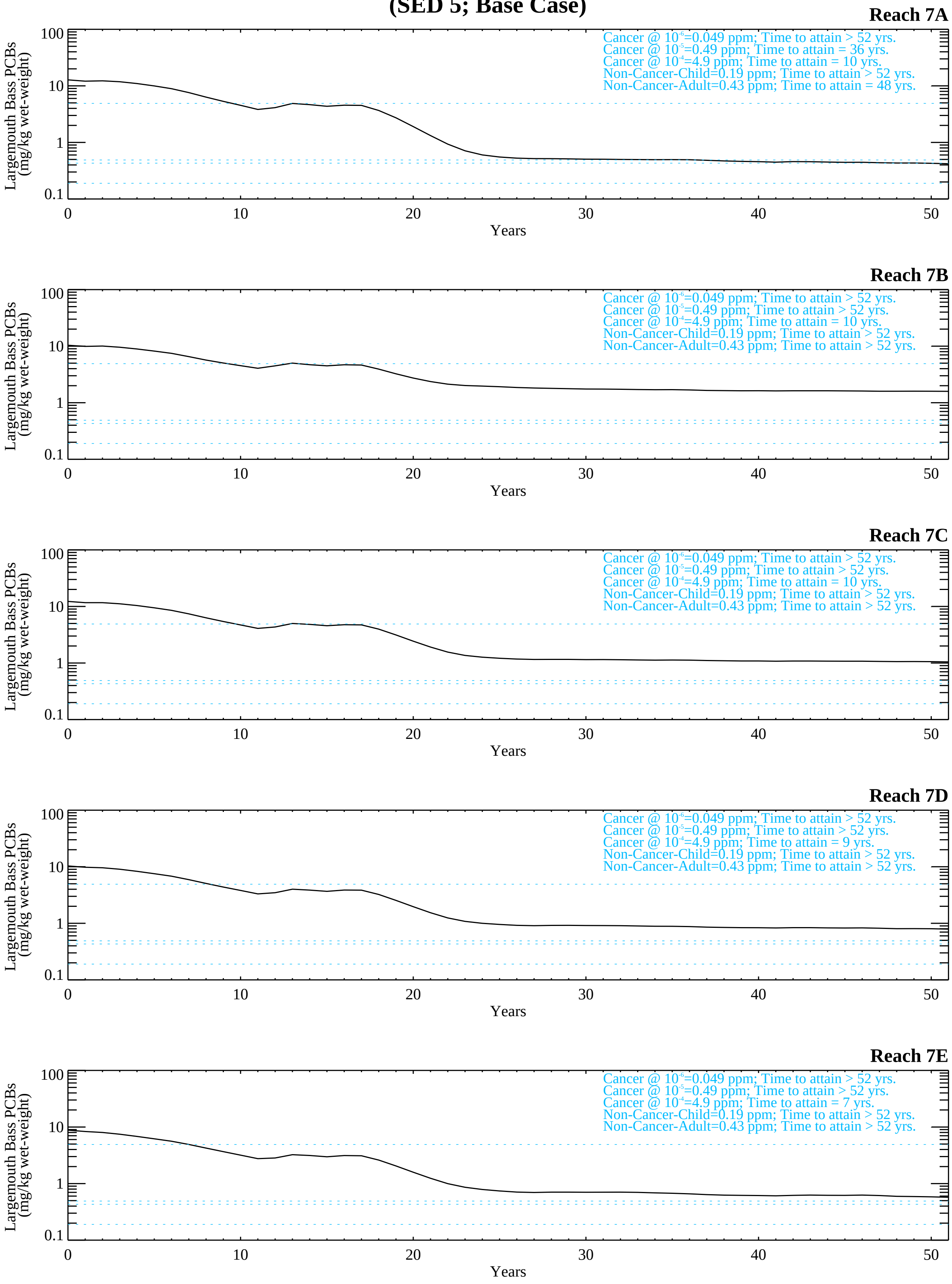

Figure G-8.1-4f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

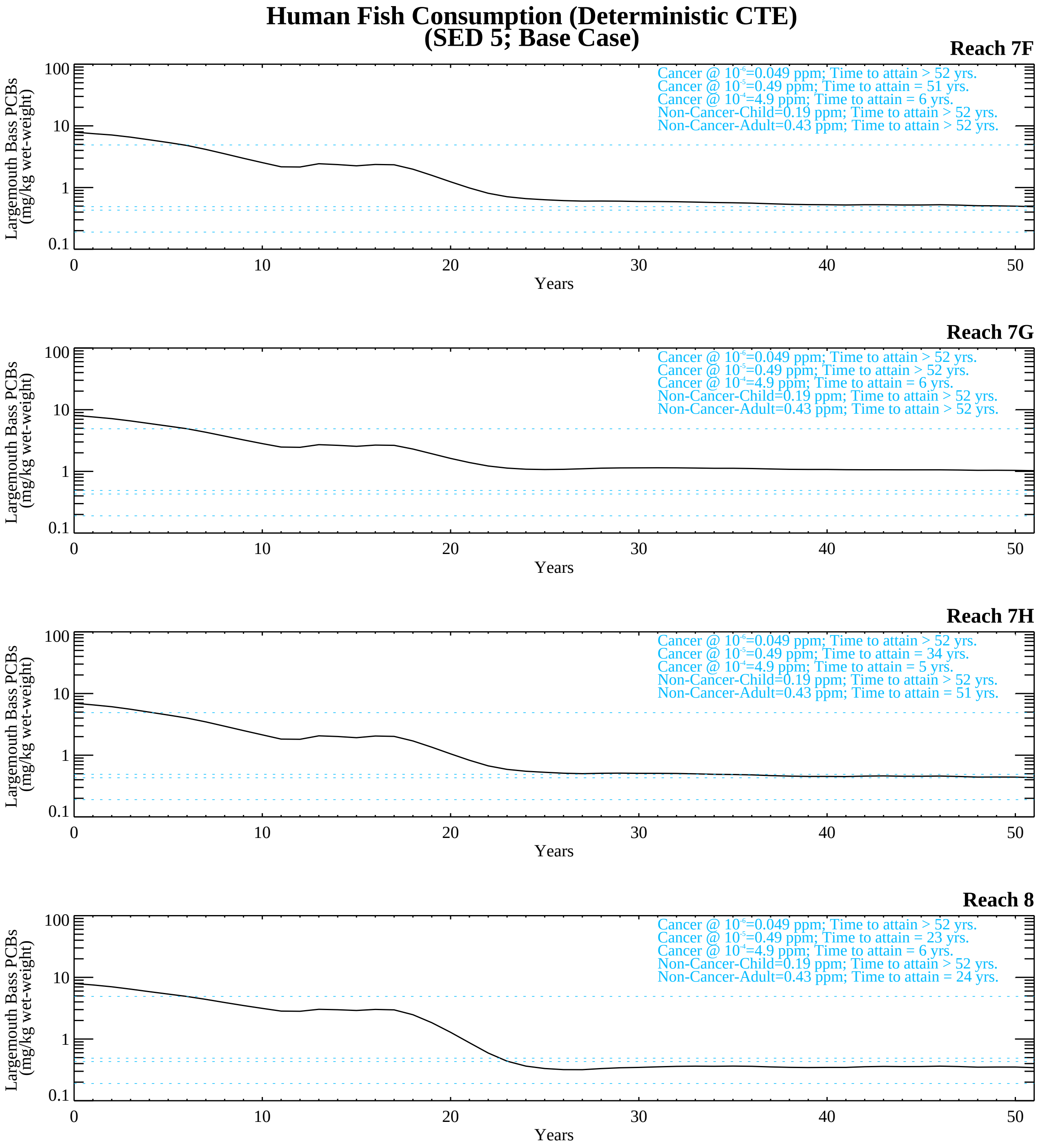

Figure G-8.1-4f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 5; Base Case)

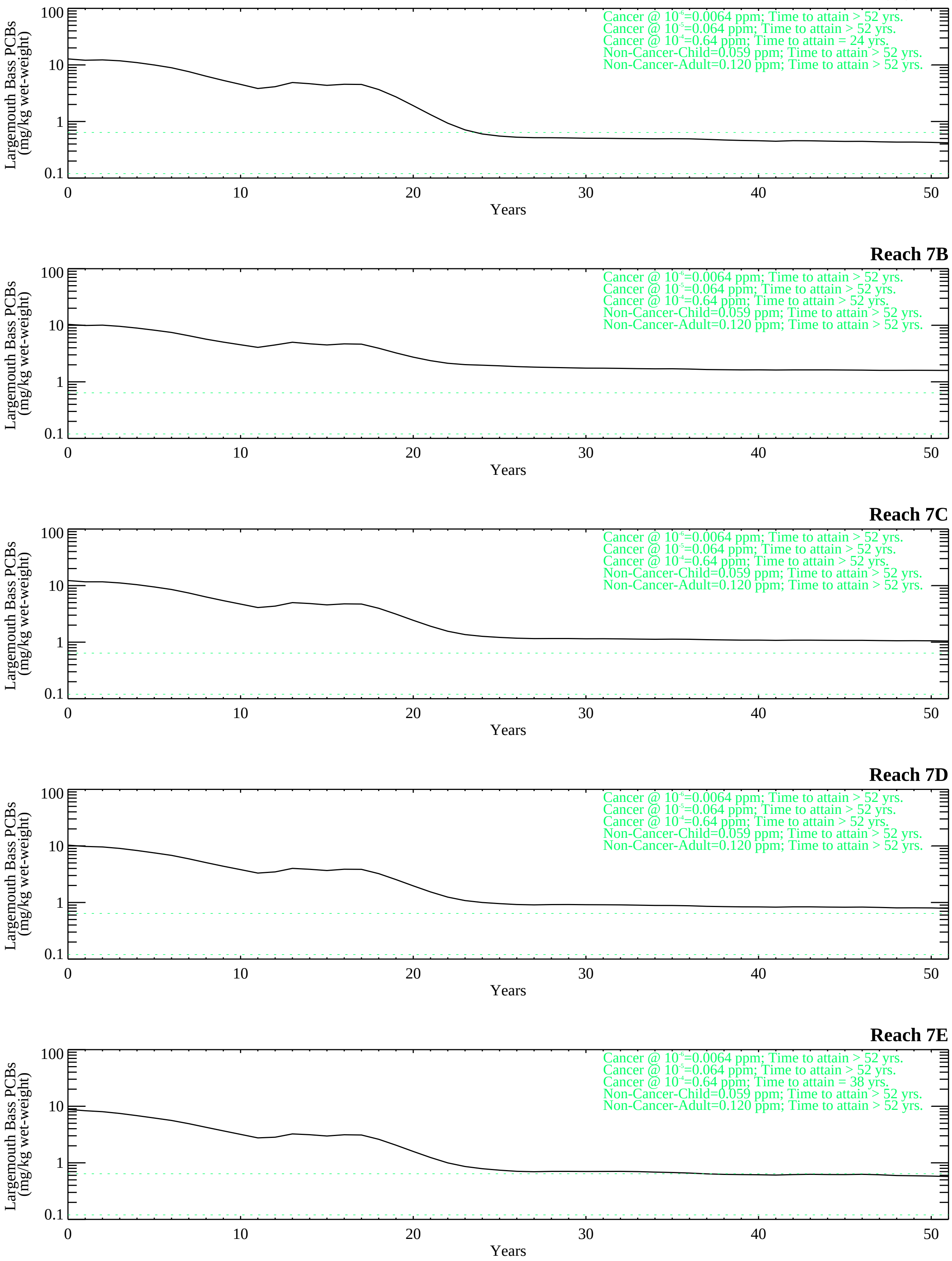

Figure G-8.1-4g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

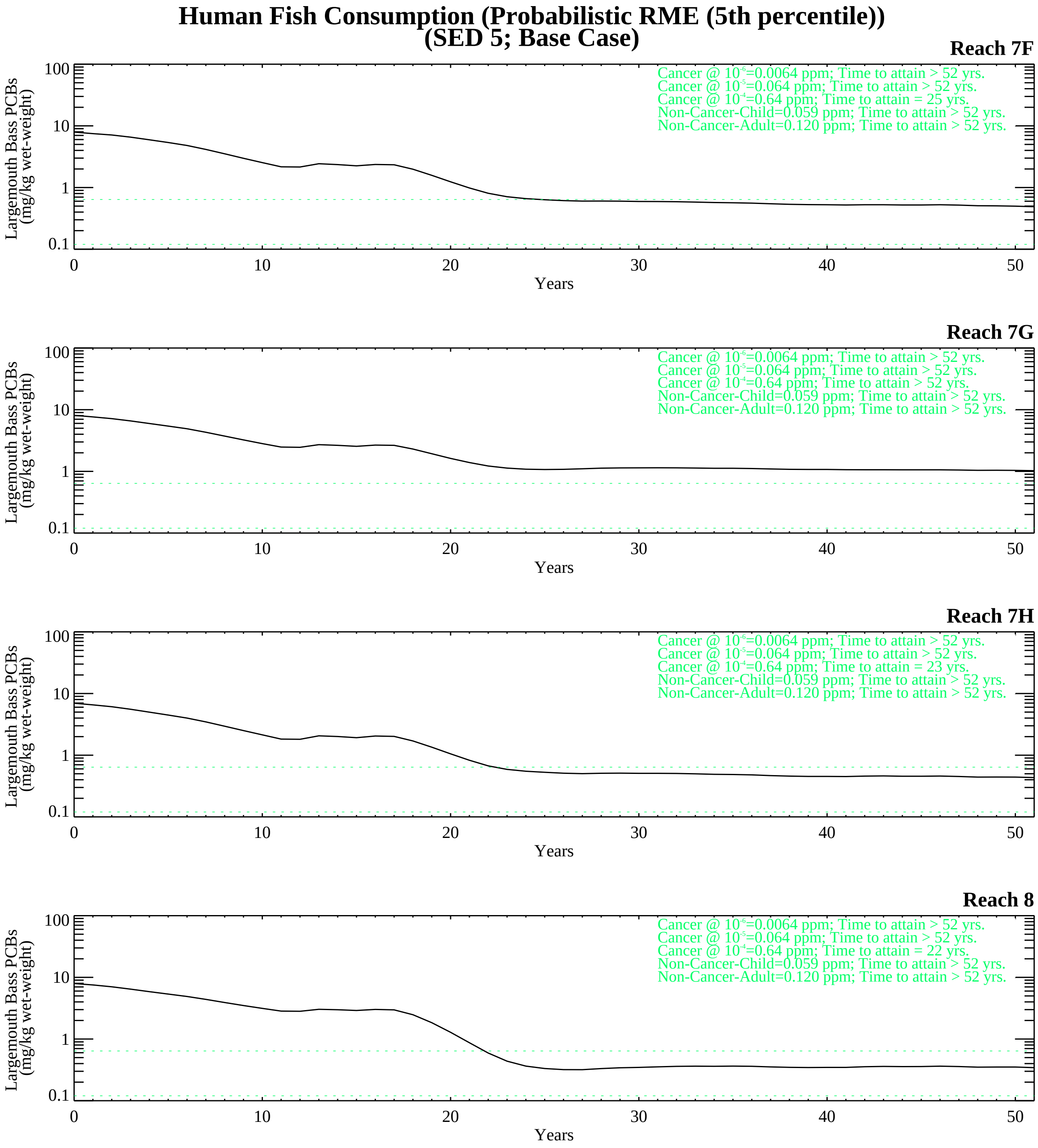

Figure G-8.1-4g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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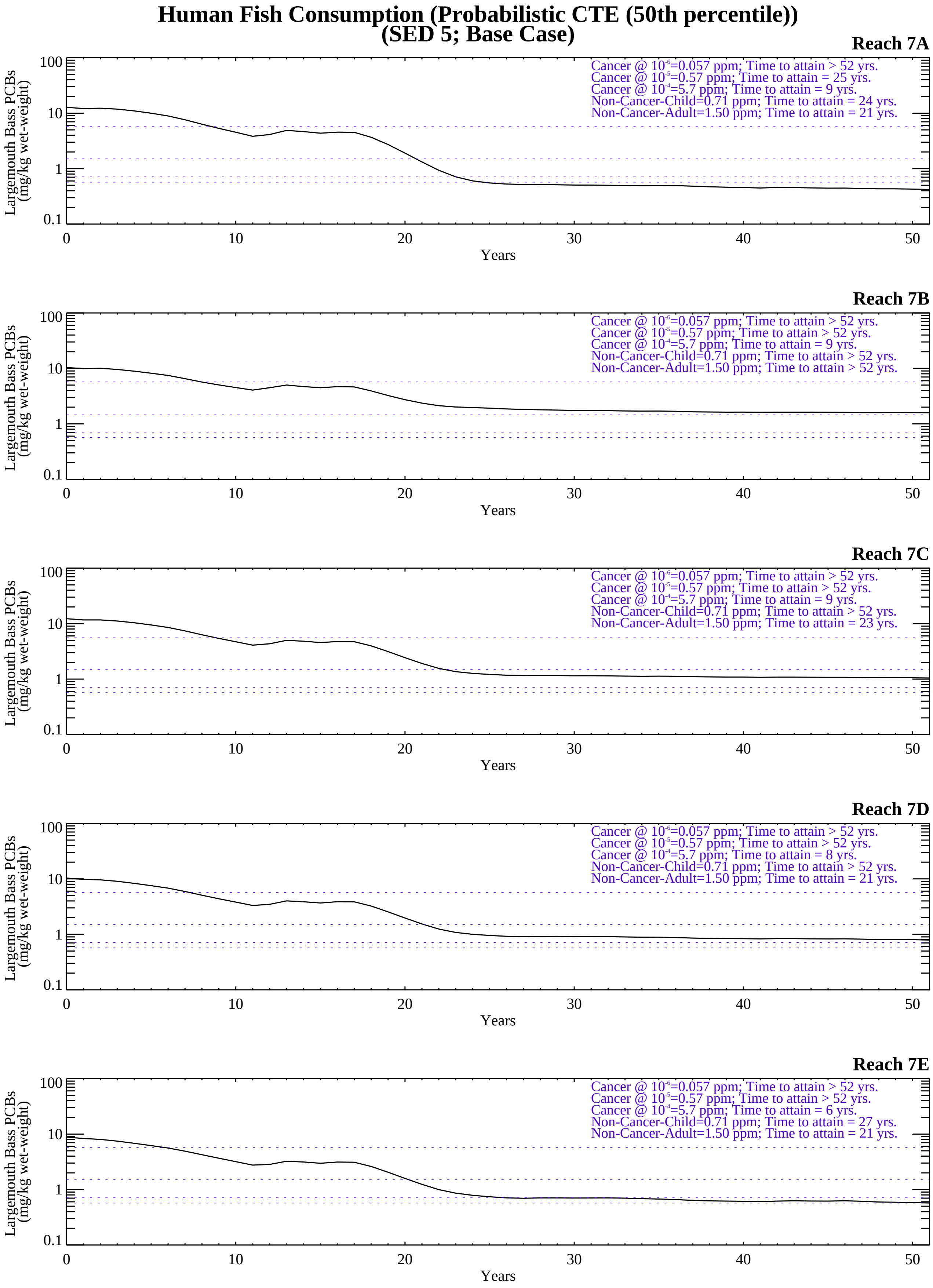
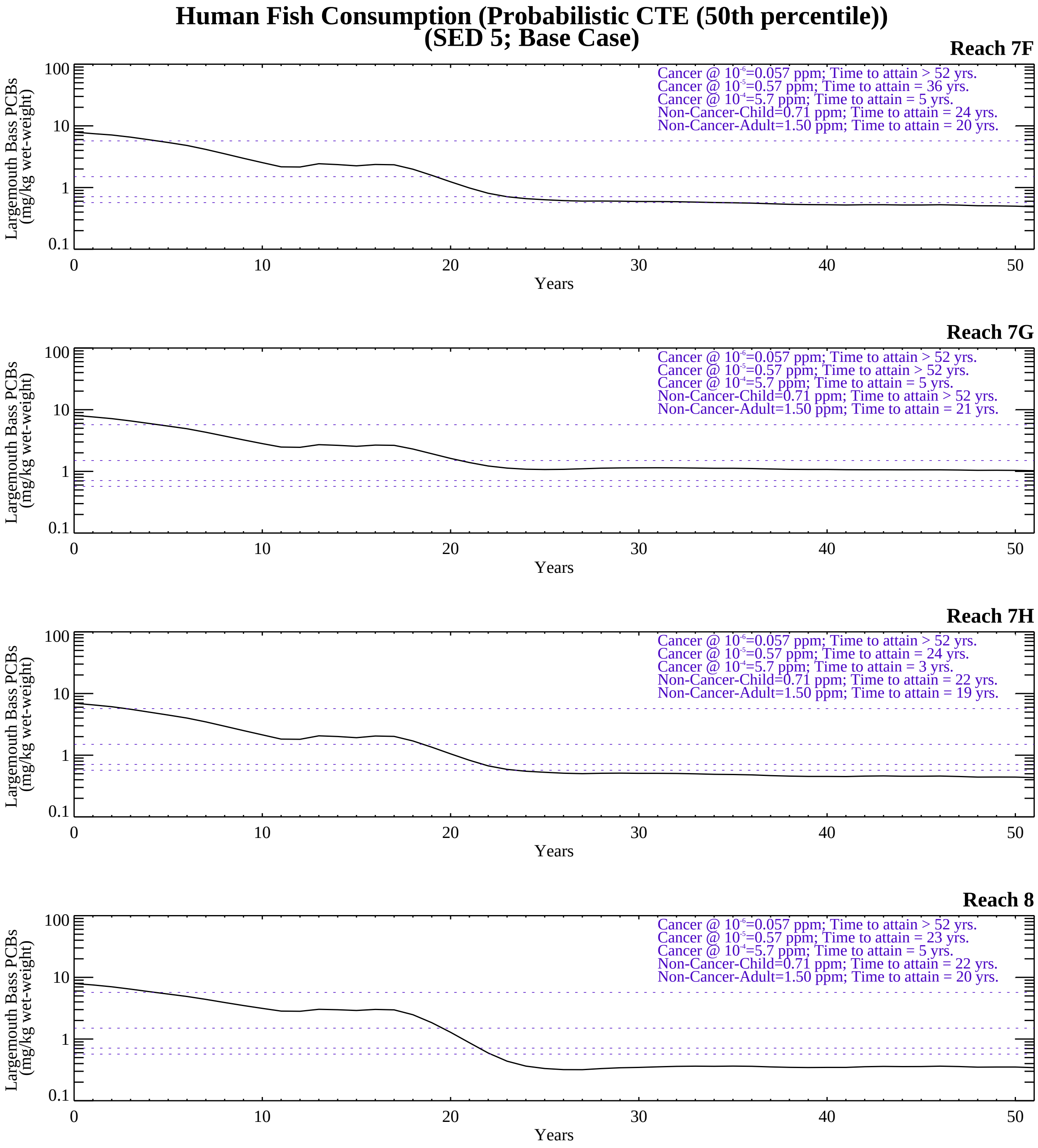


Figure G-8.1-4h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.



Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 5; Base Case)

Figure G-8.1-4h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

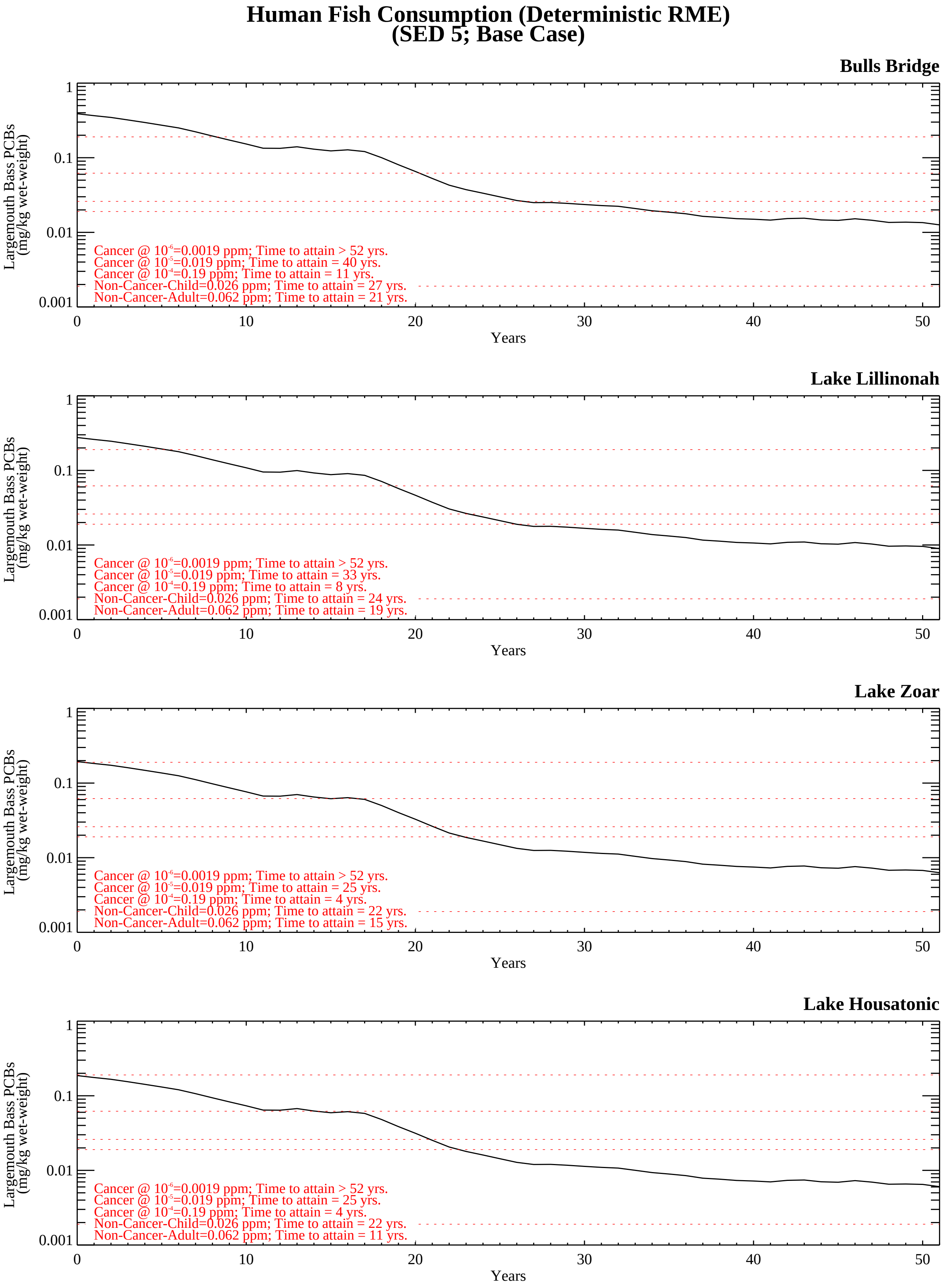


Figure G-8.1-4i. Temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D Analysis compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 5; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic CTE)
(SED 5; Base Case)

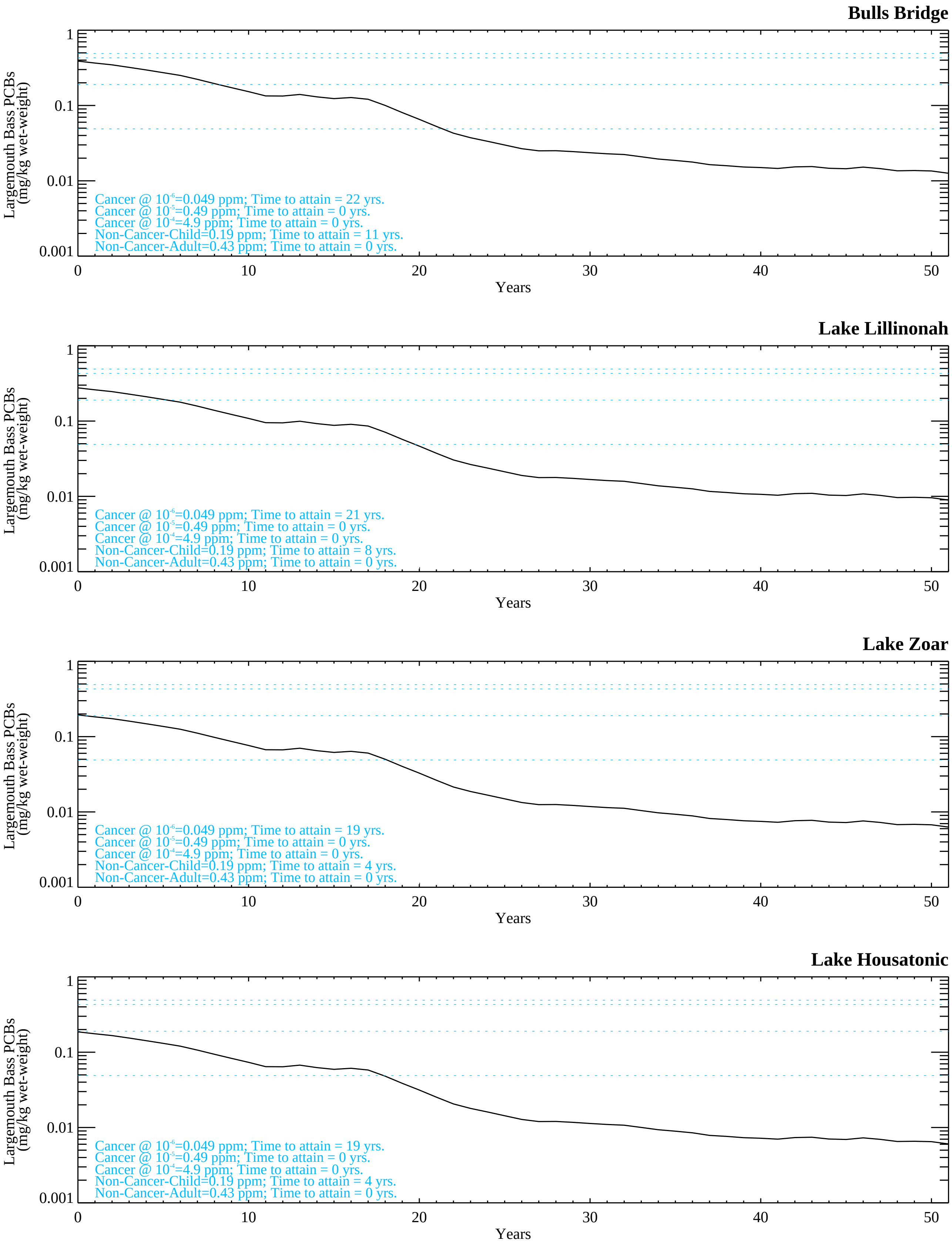


Figure G-8.1-4j. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 5; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Probabilistic RME (5th percentile)) (SED 5; Base Case)

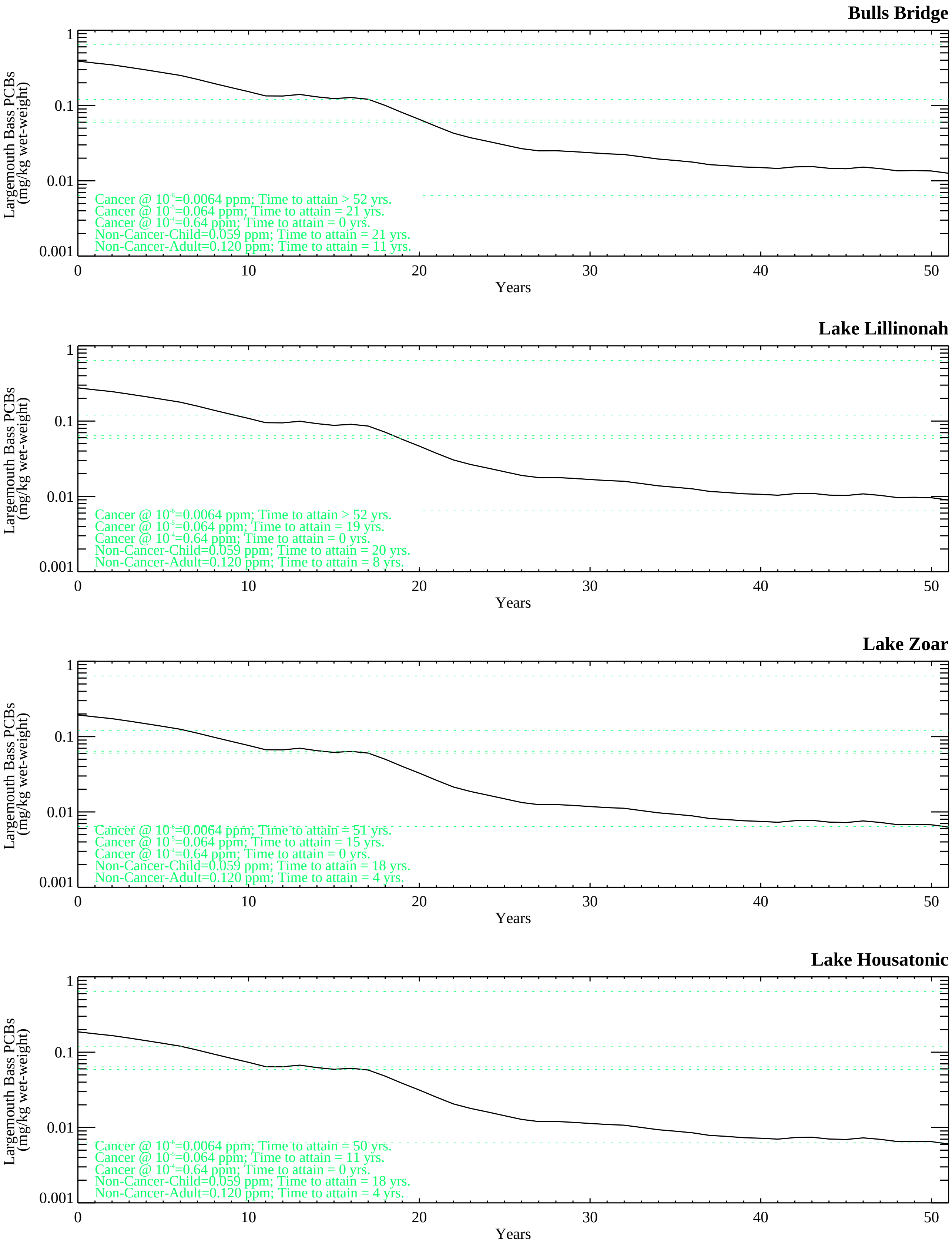
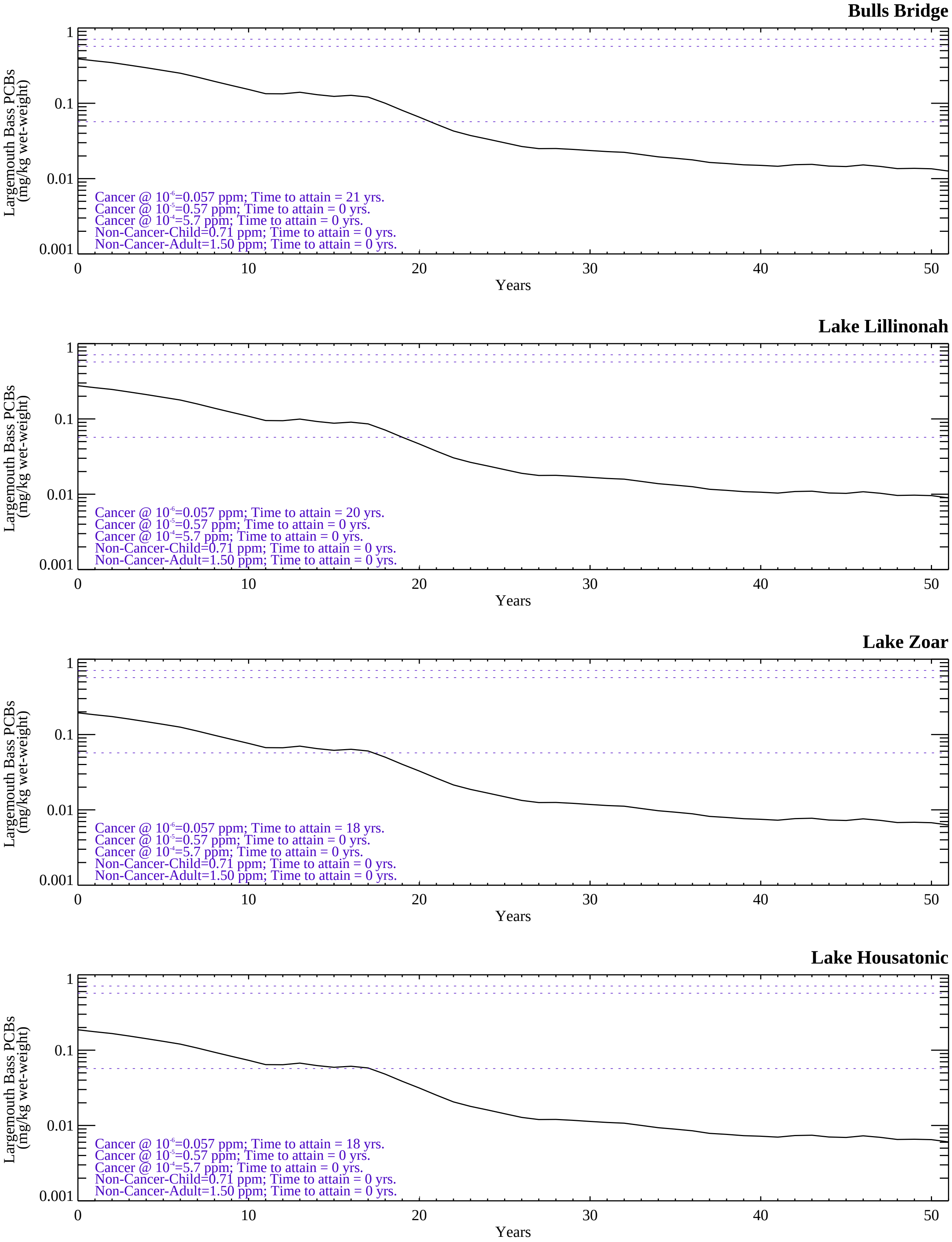


Figure G-8.1-4k. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 5; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 5; Base Case)


Bulls Bridge

Lake Lillinonah

Lake Zoar

Lake Housatonic

Figure G-8.1-4l. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 5; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic RME)
(SED 6; Base Case)

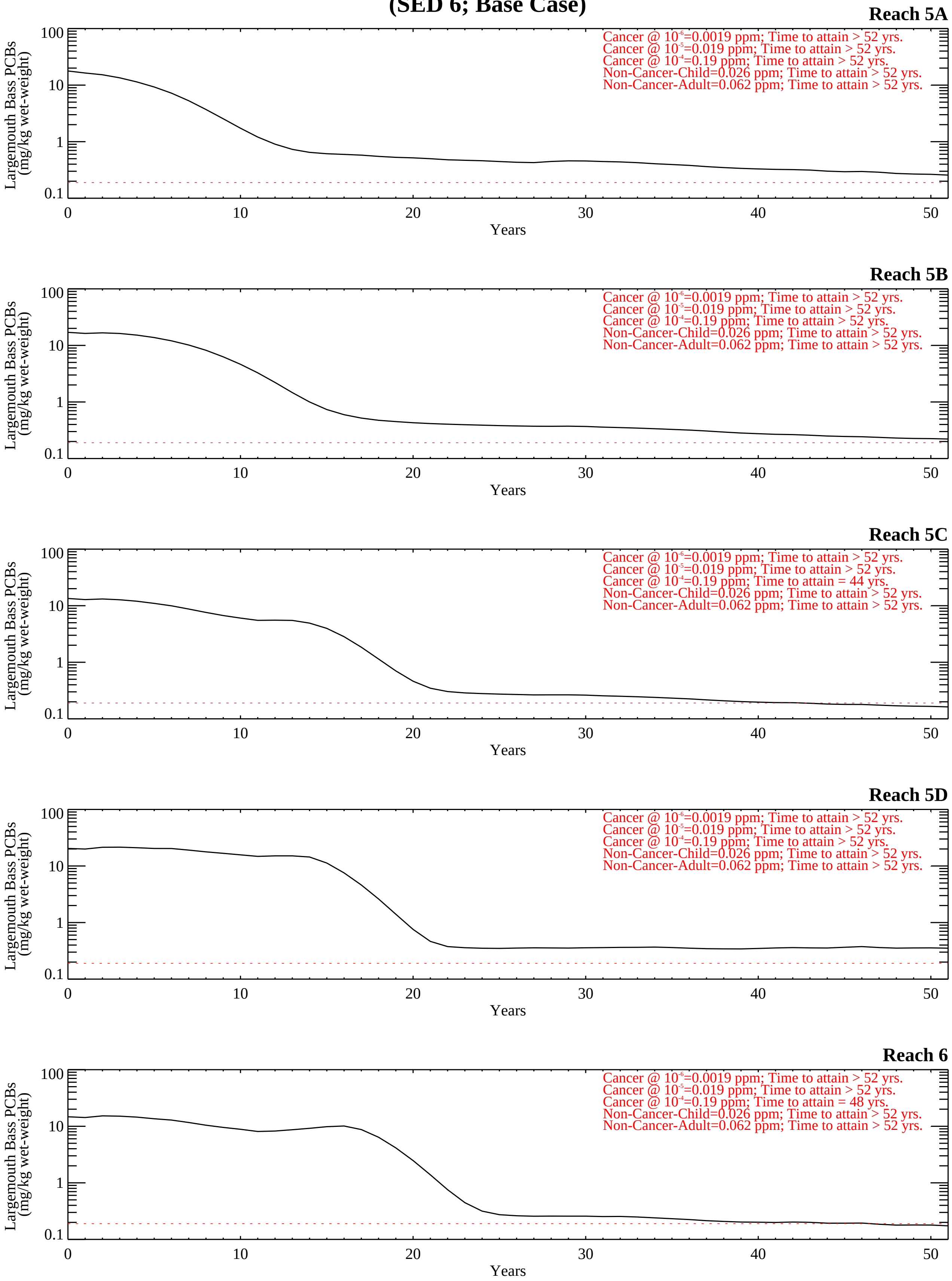


Figure G-8.1-5a. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic CTE)
(SED 6; Base Case)

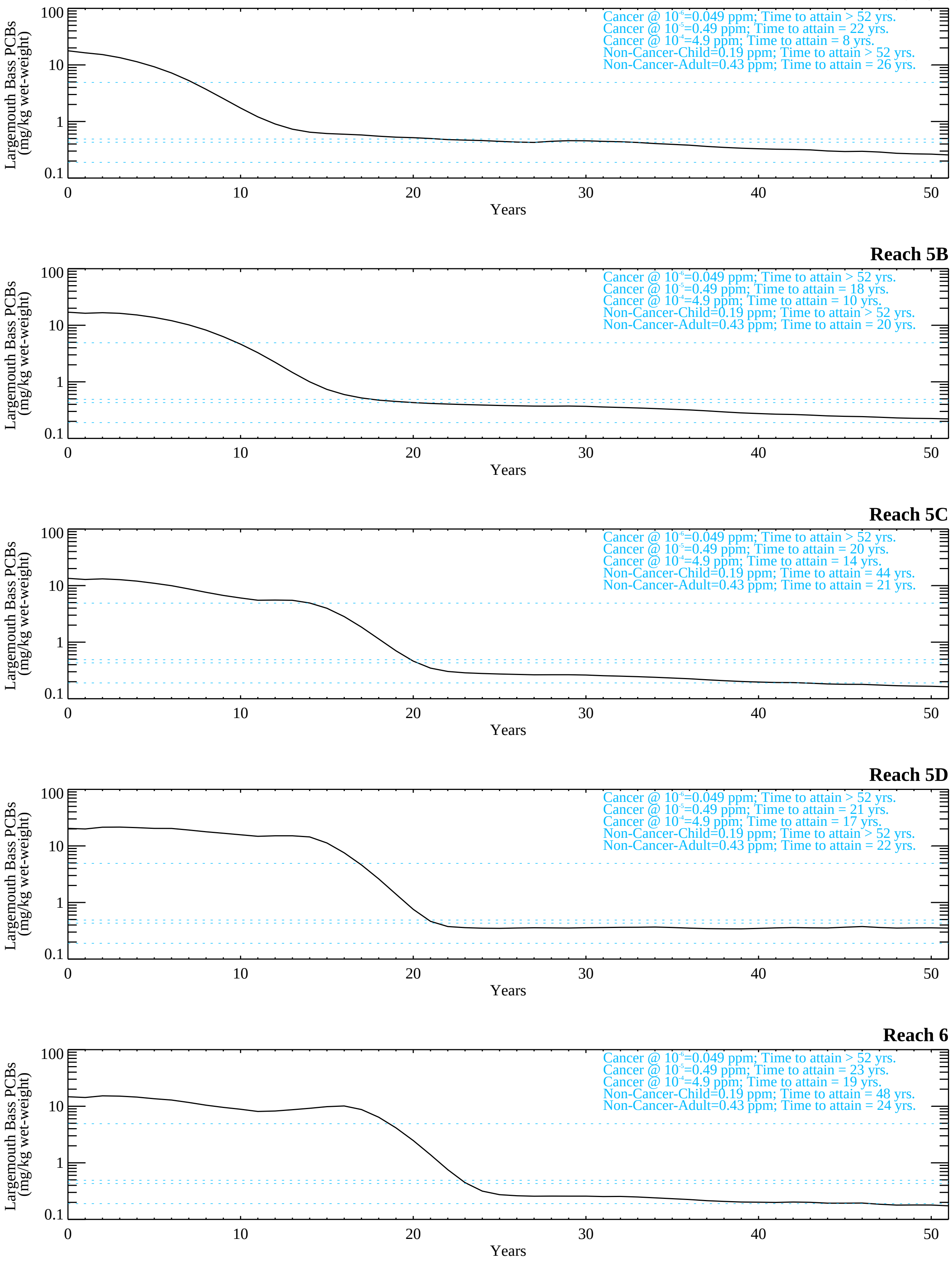


Figure G-8.1-5b. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

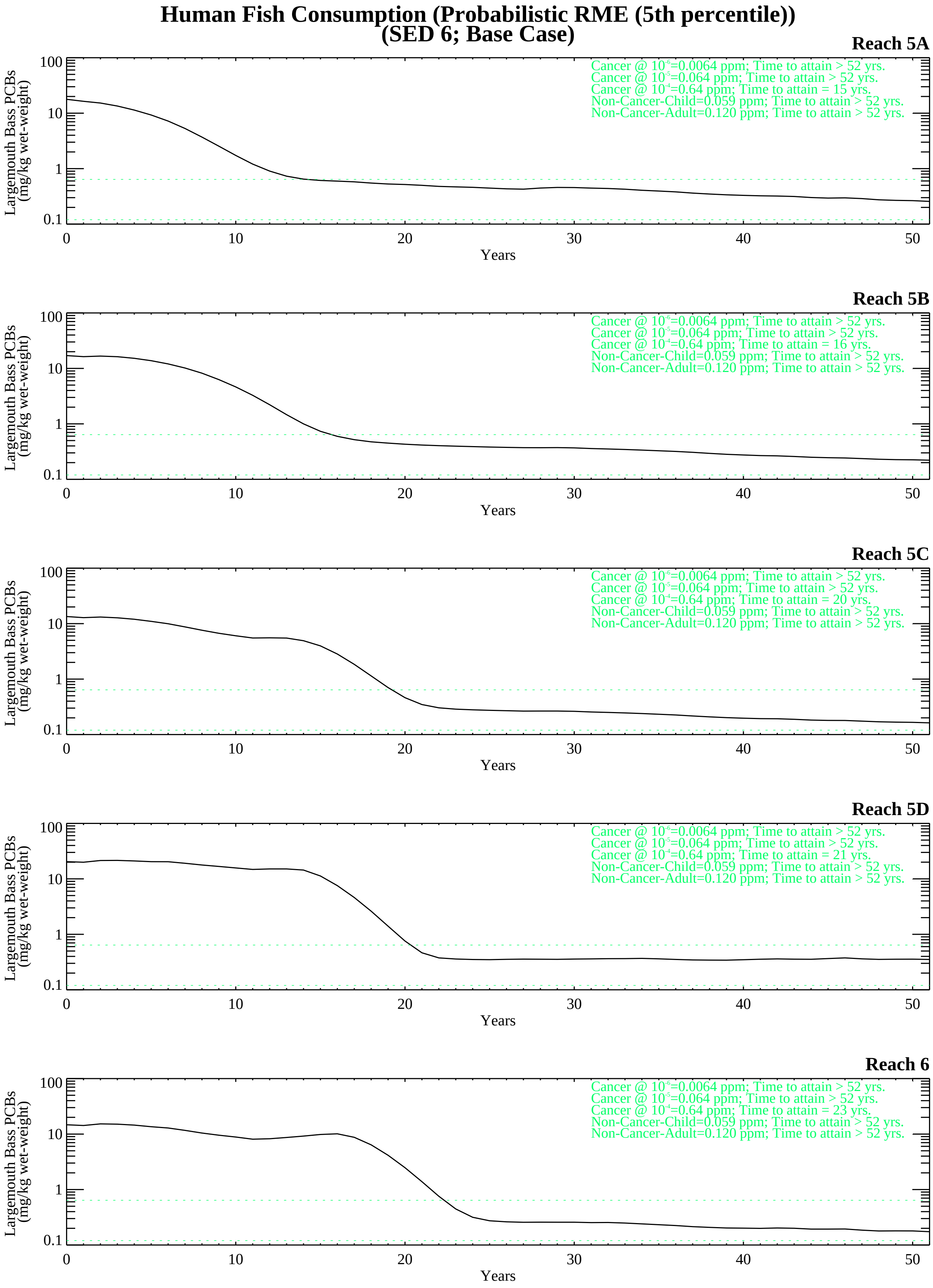


Figure G-8.1-5c. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

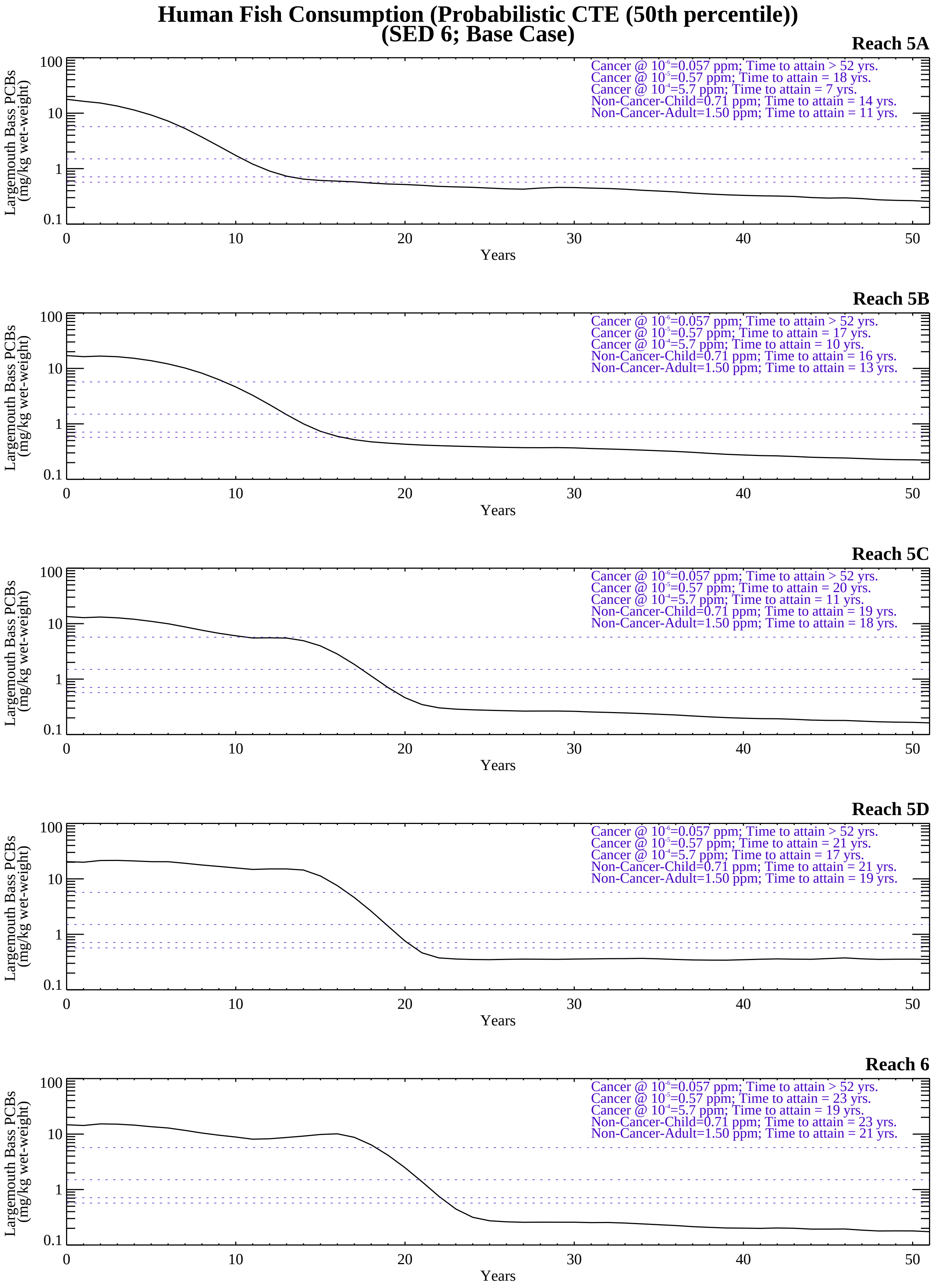


Figure G-8.1-5d. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic RME)
(SED 6; Base Case)

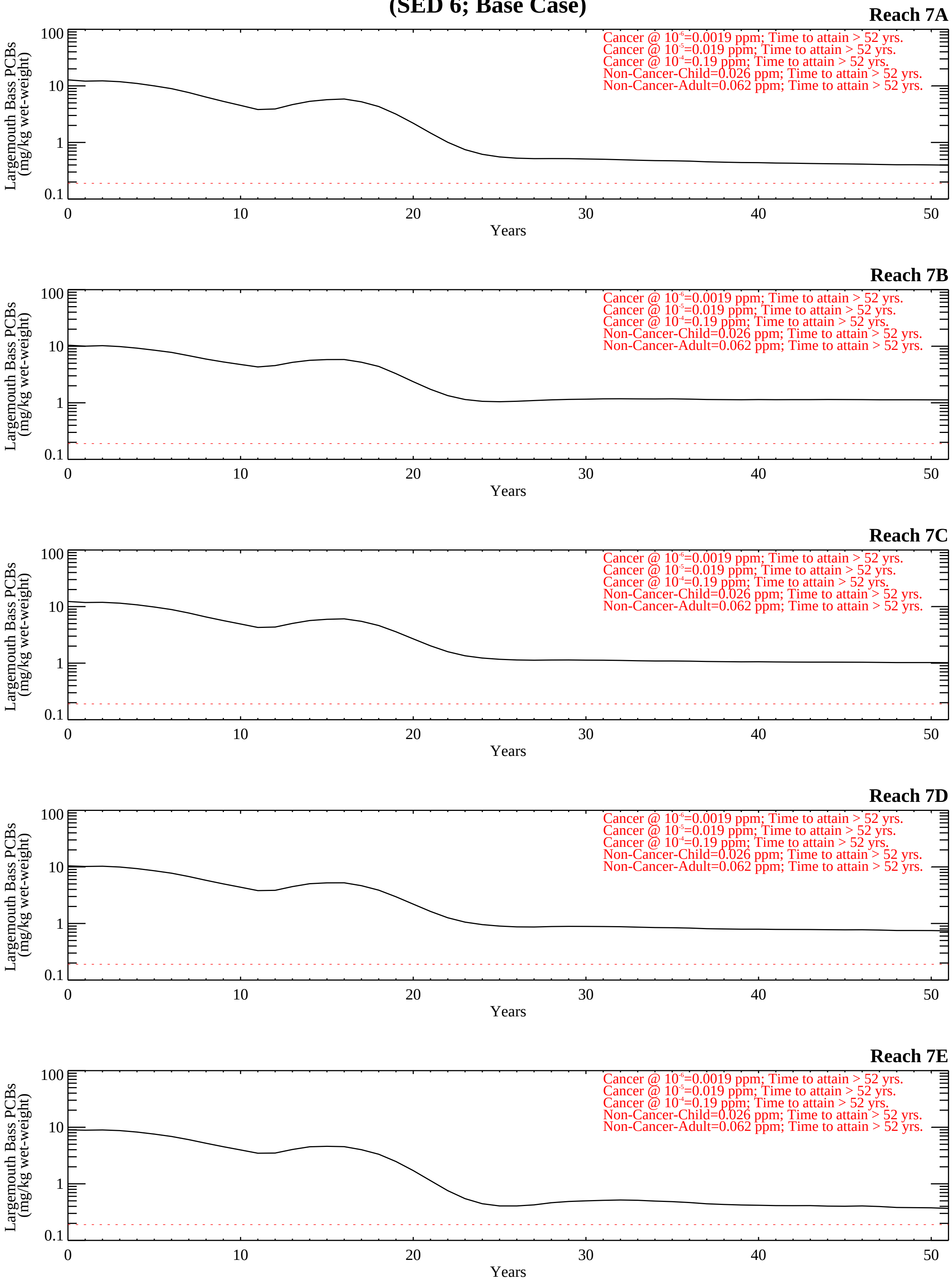


Figure G-8.1-5e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Deterministic RME)
(SED 6; Base Case)

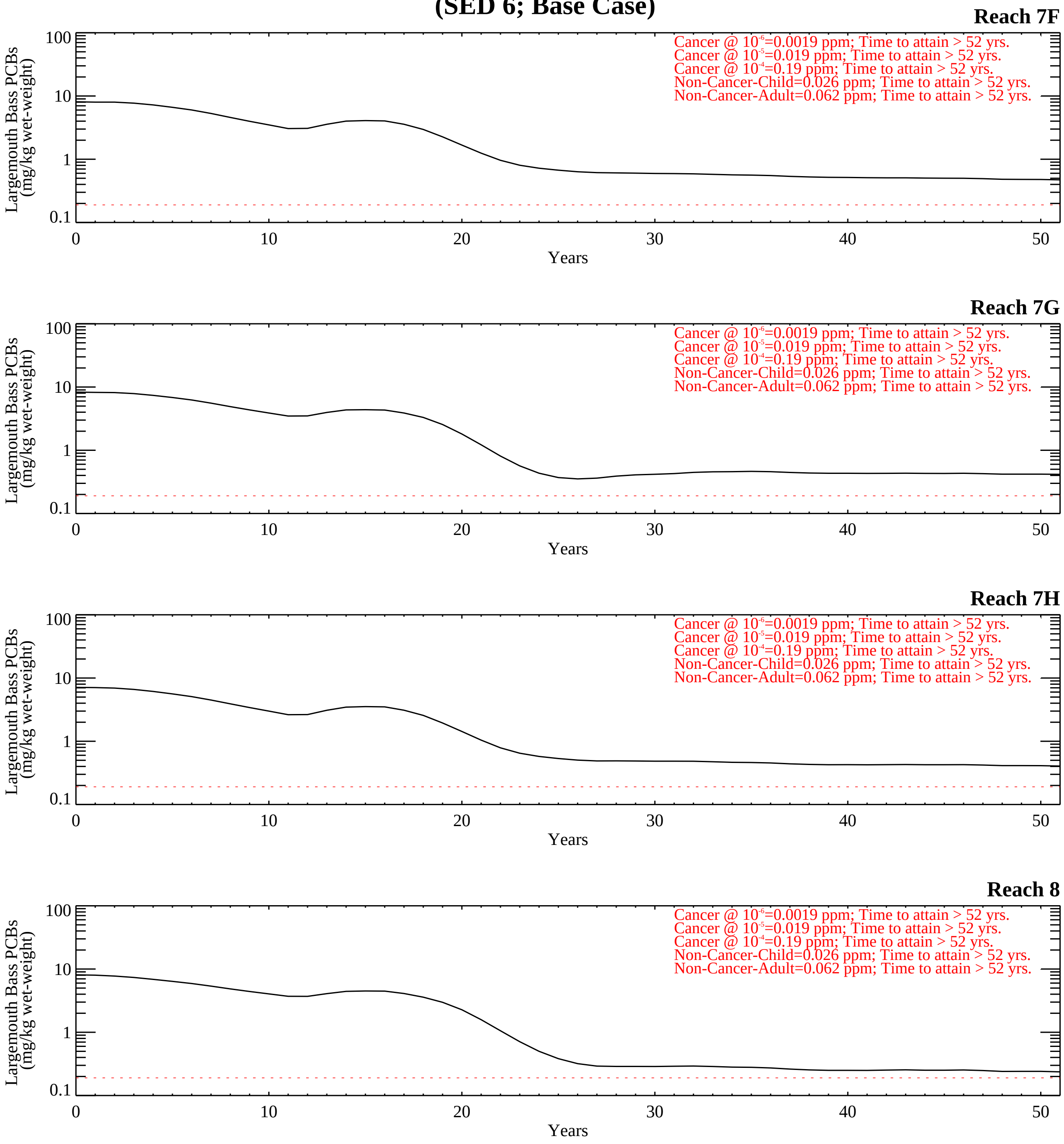

Figure G-8.1-5e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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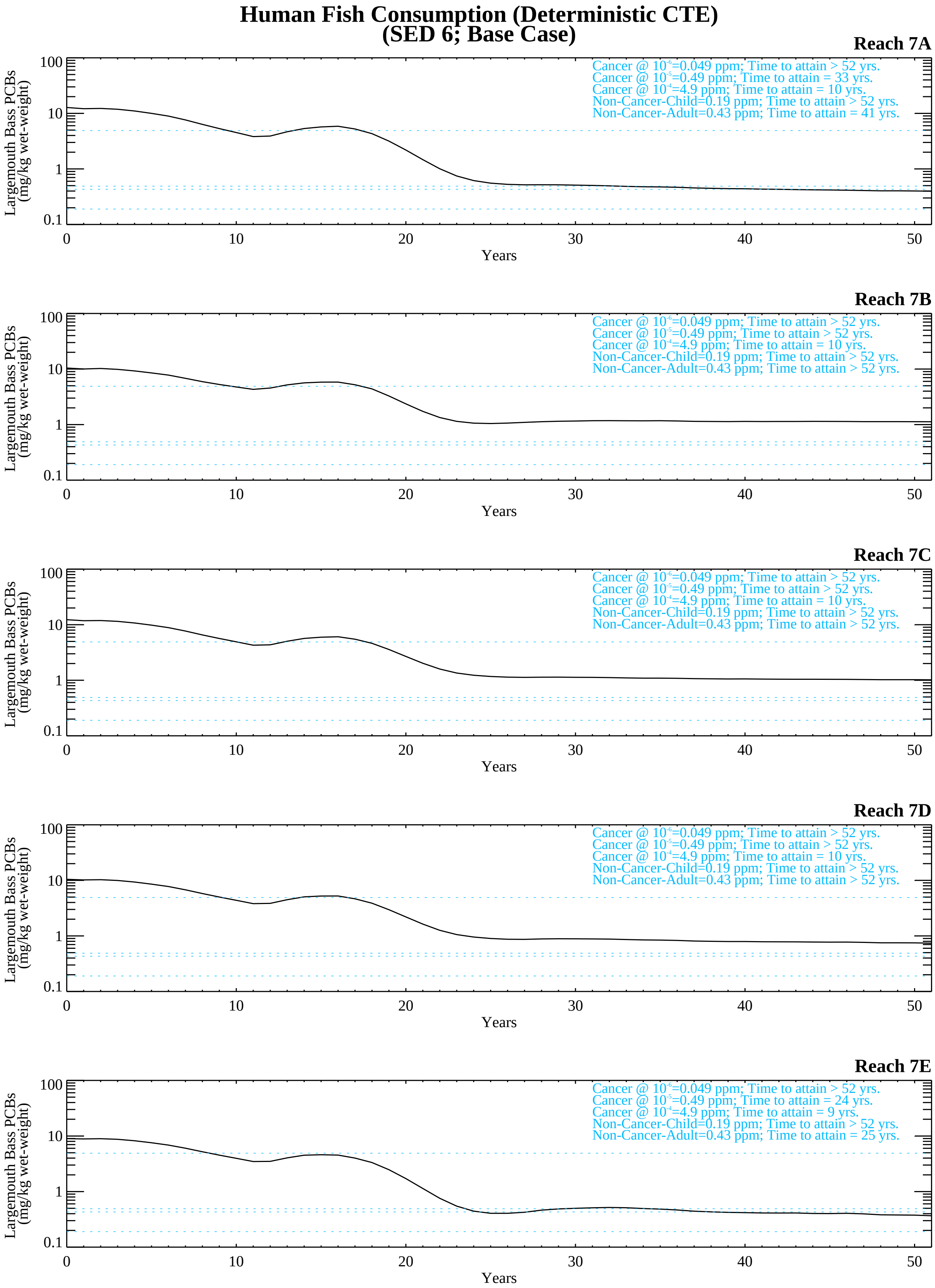

Figure G-8.1-5f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

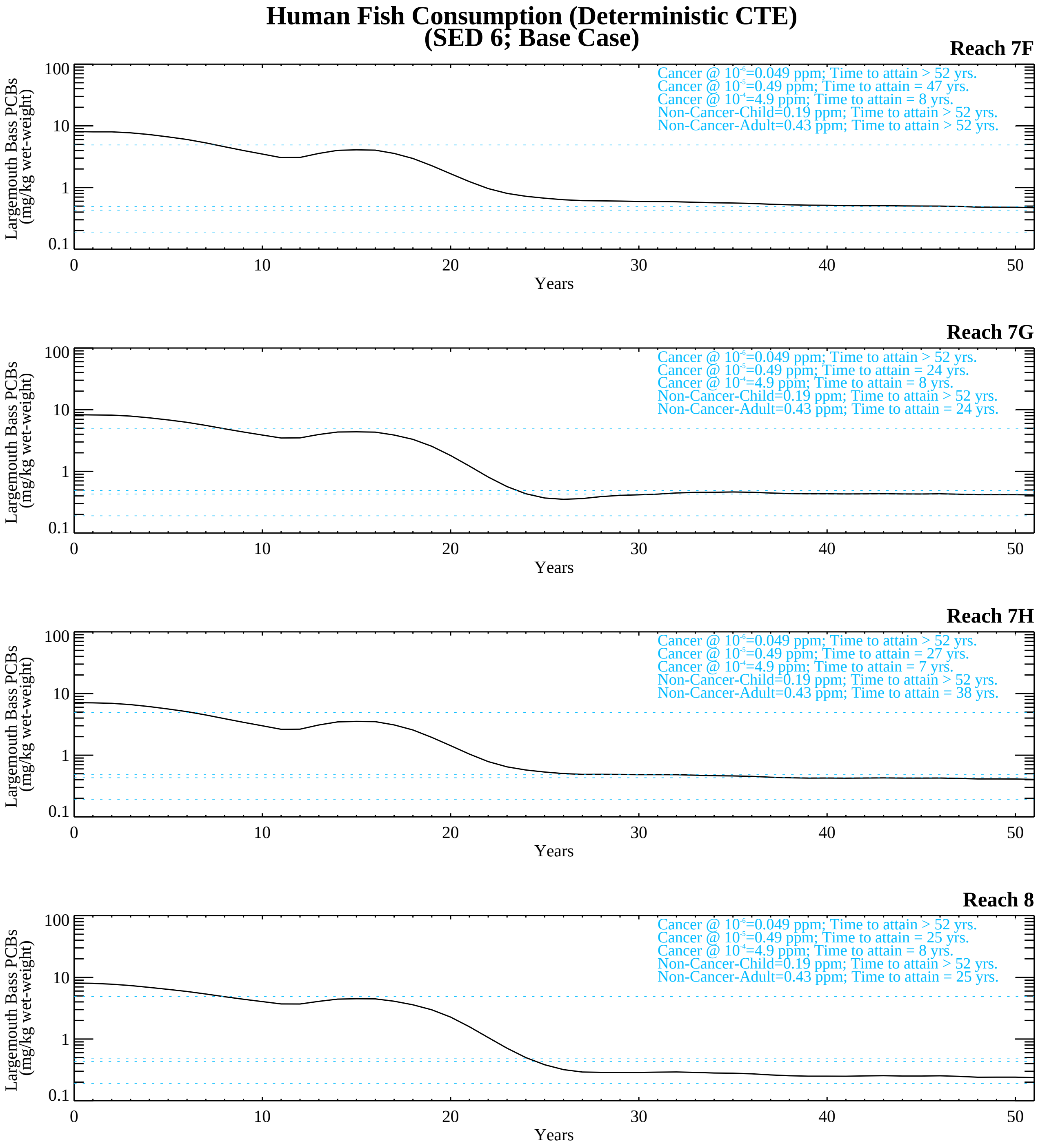

Figure G-8.1-5f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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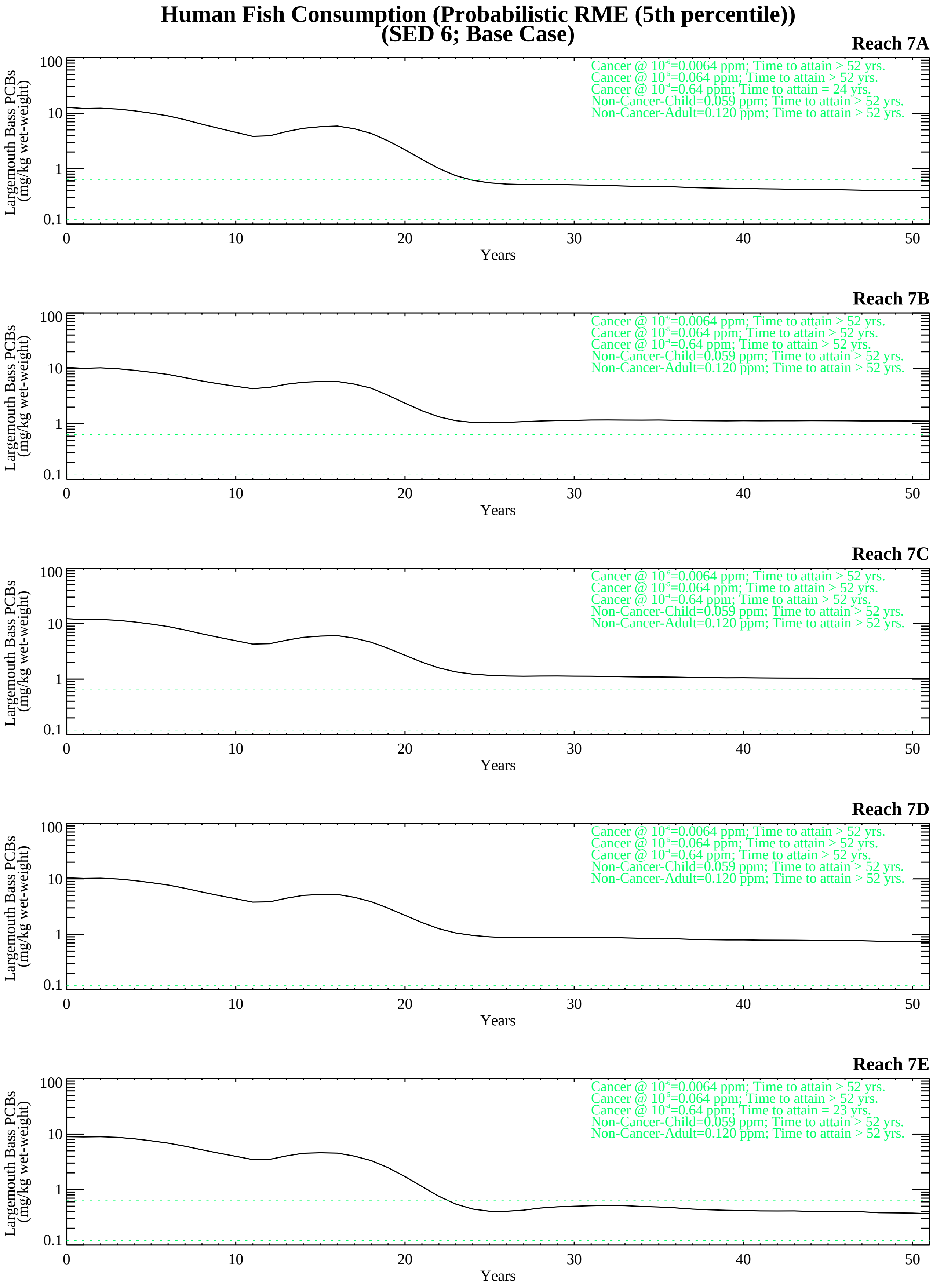

Figure G-8.1-5g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 6; Base Case)

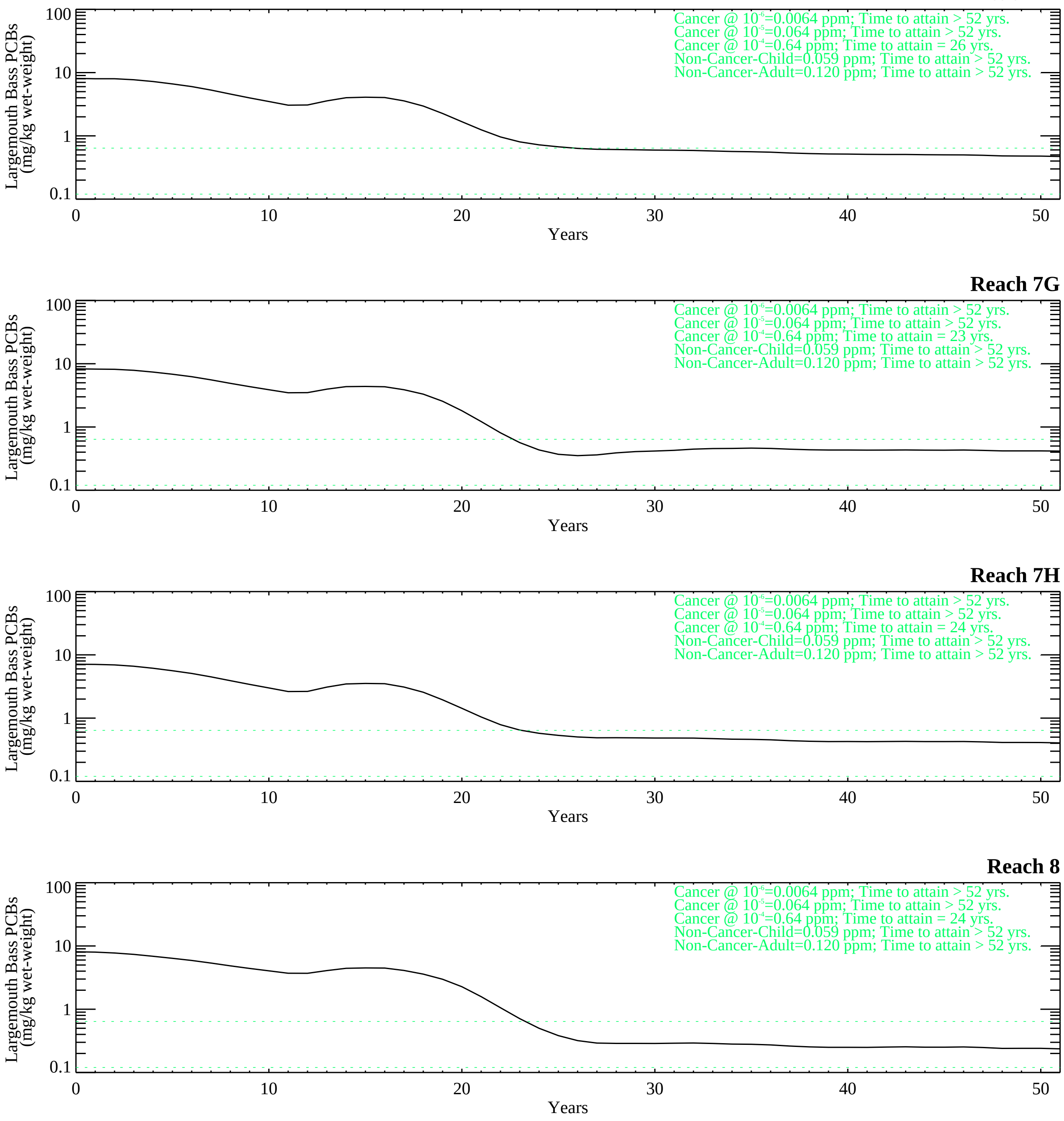

Figure G-8.1-5g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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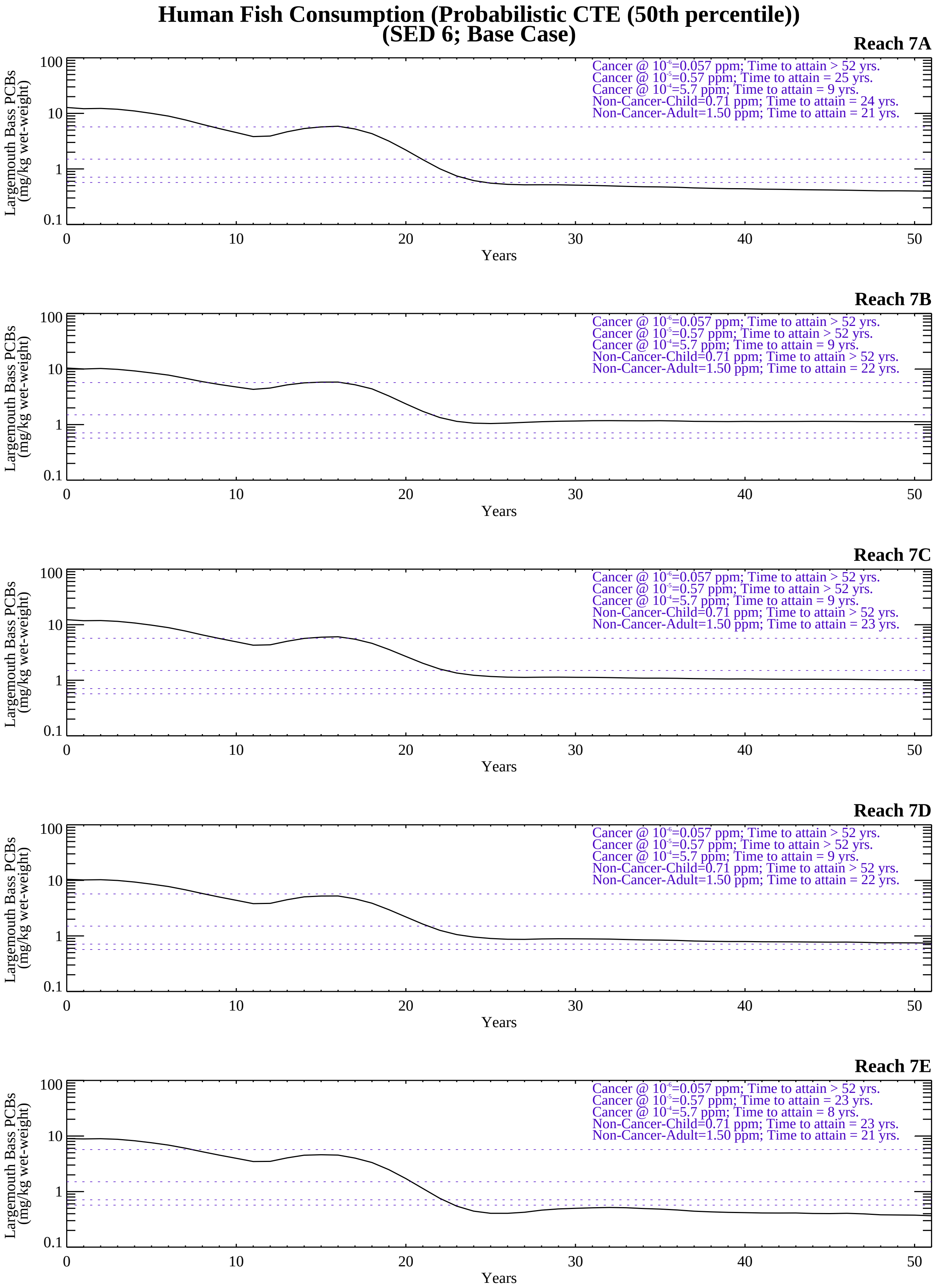

Figure G-8.1-5h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 6; Base Case)

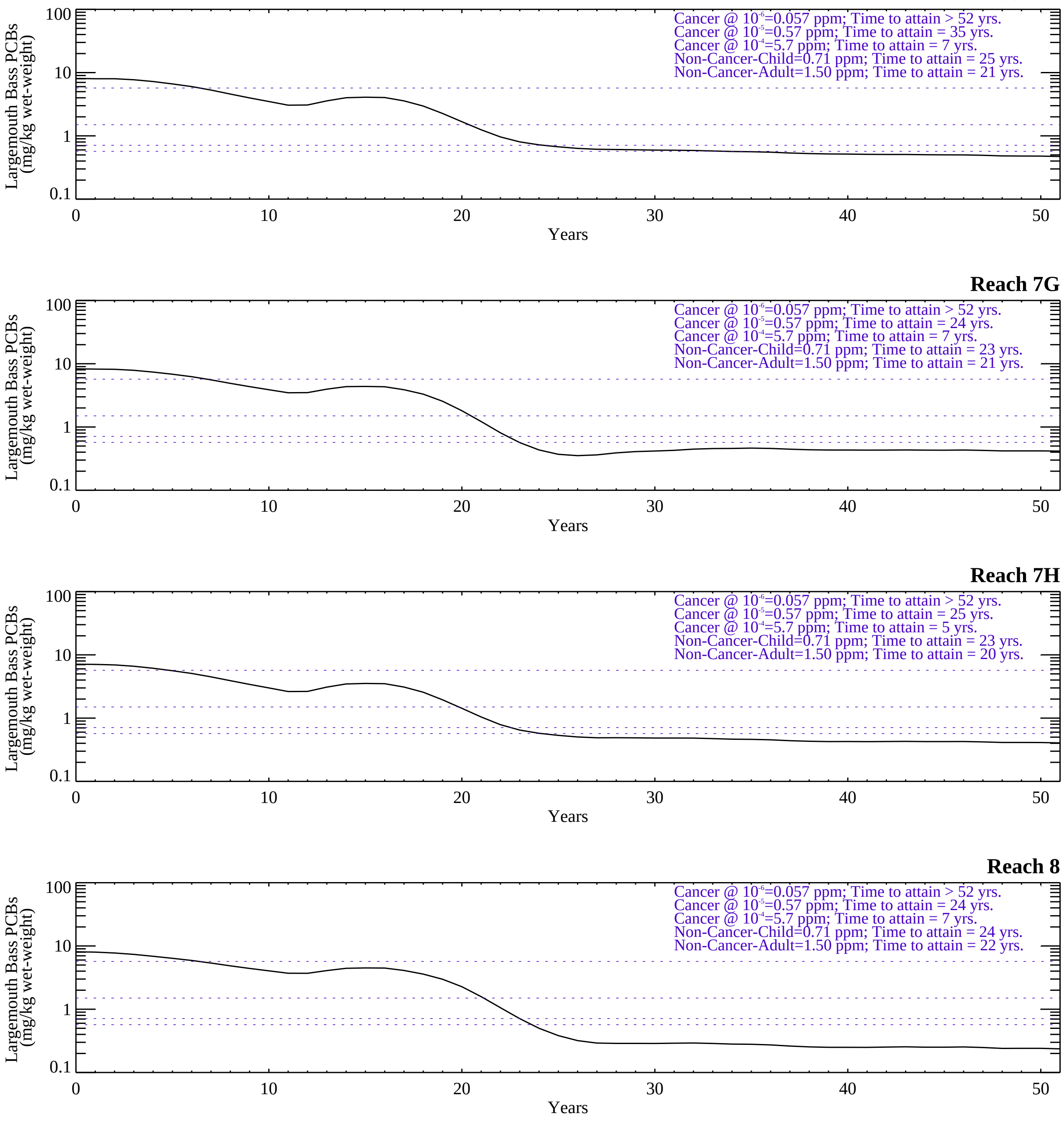

Figure G-8.1-5h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic RME)
(SED 6; Base Case)

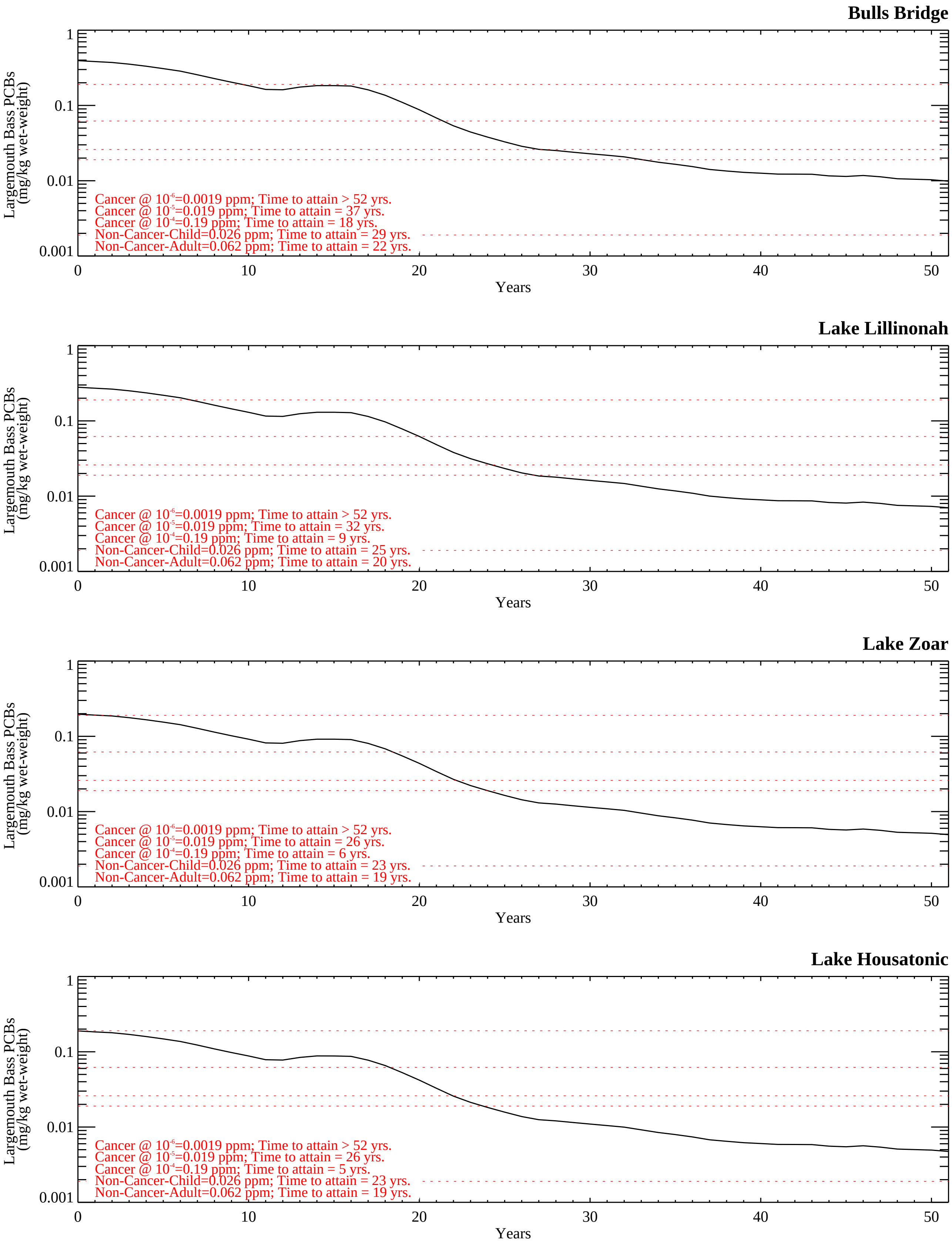

Figure G-8.1-5i. Temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D Analysis compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 6; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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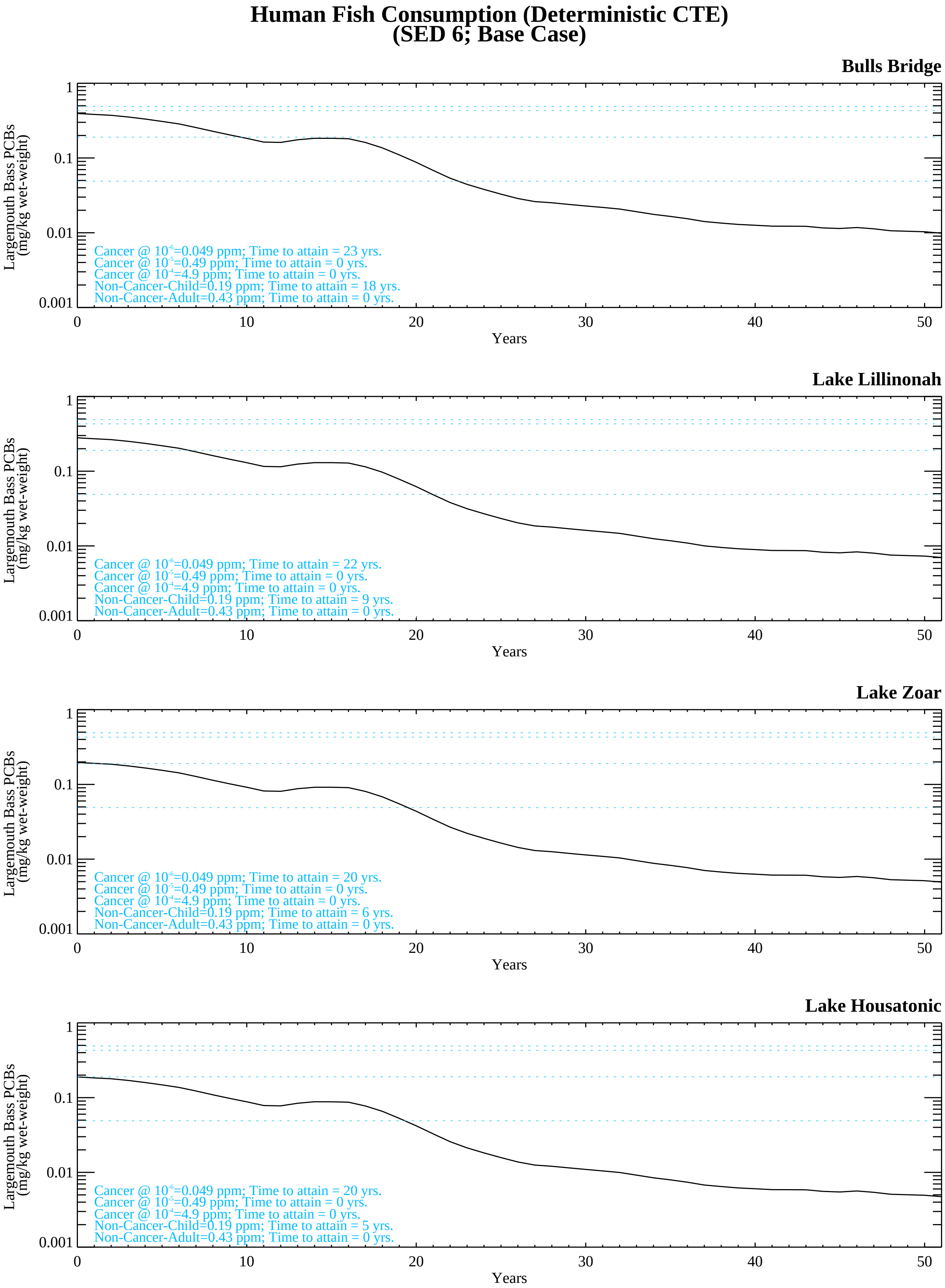

Figure G-8.1-5j. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 6; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 6; Base Case)

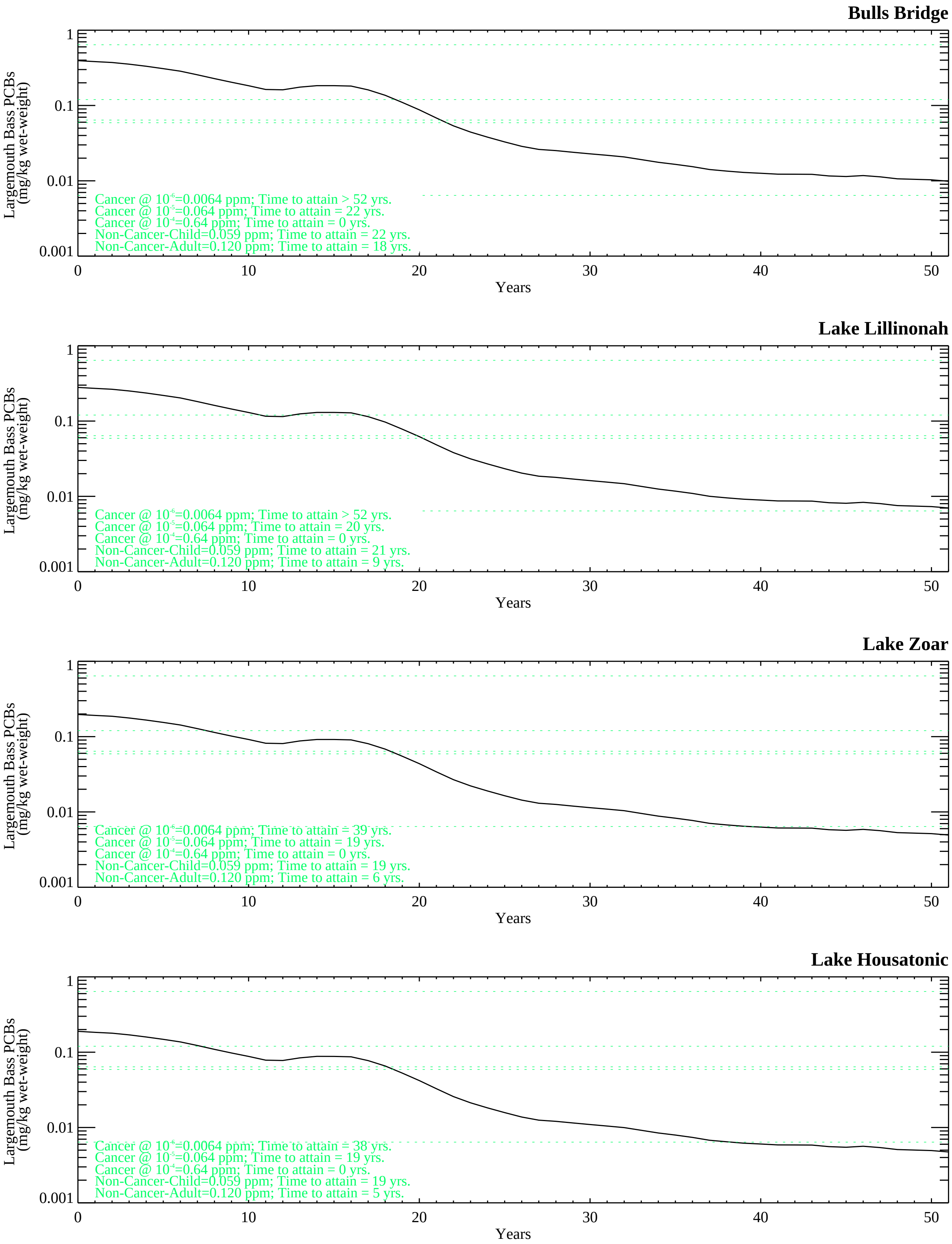

Figure G-8.1-5k. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 6; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 6; Base Case)

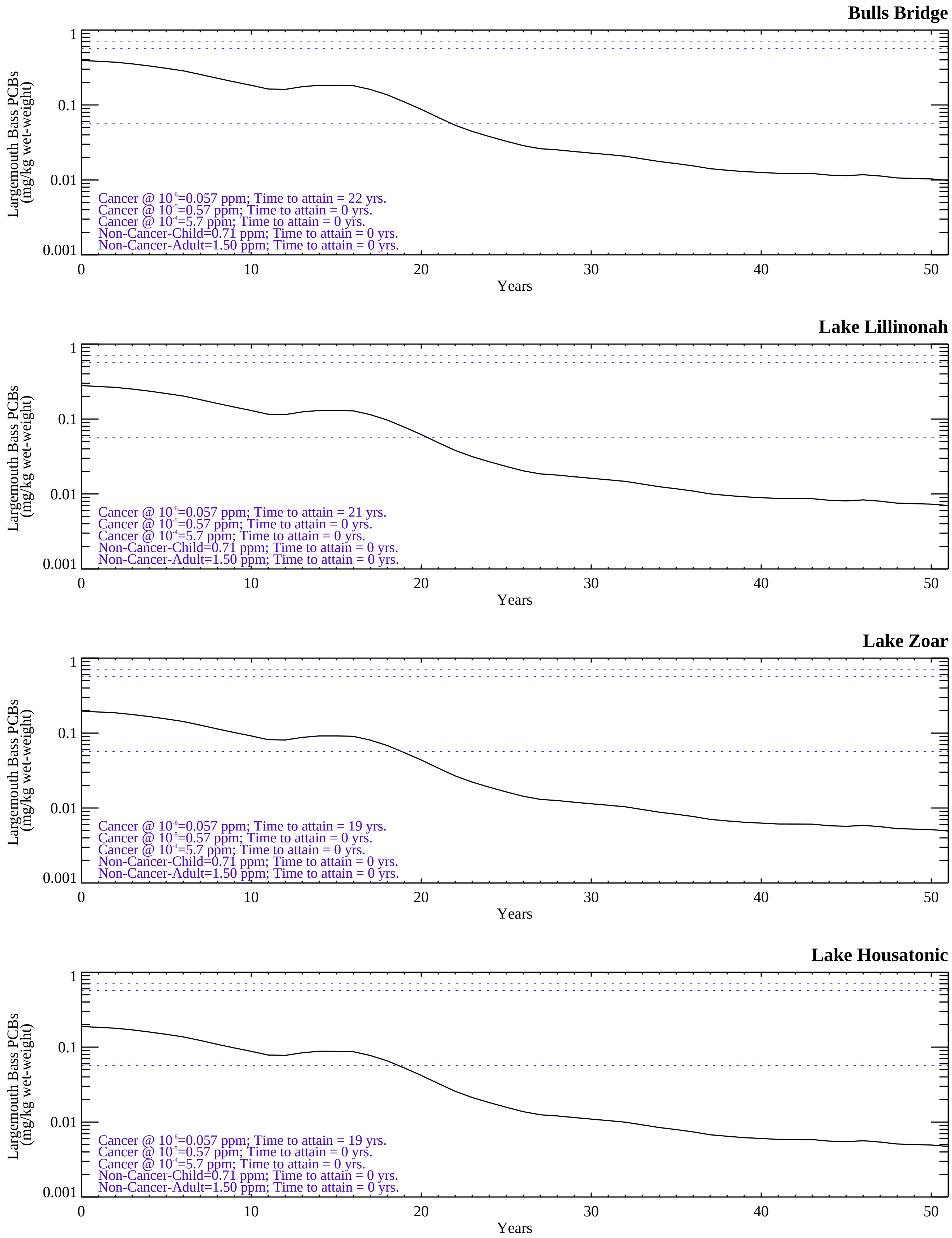

Figure G-8.1-5l. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 6; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Deterministic RME)
(SED 7; Base Case)

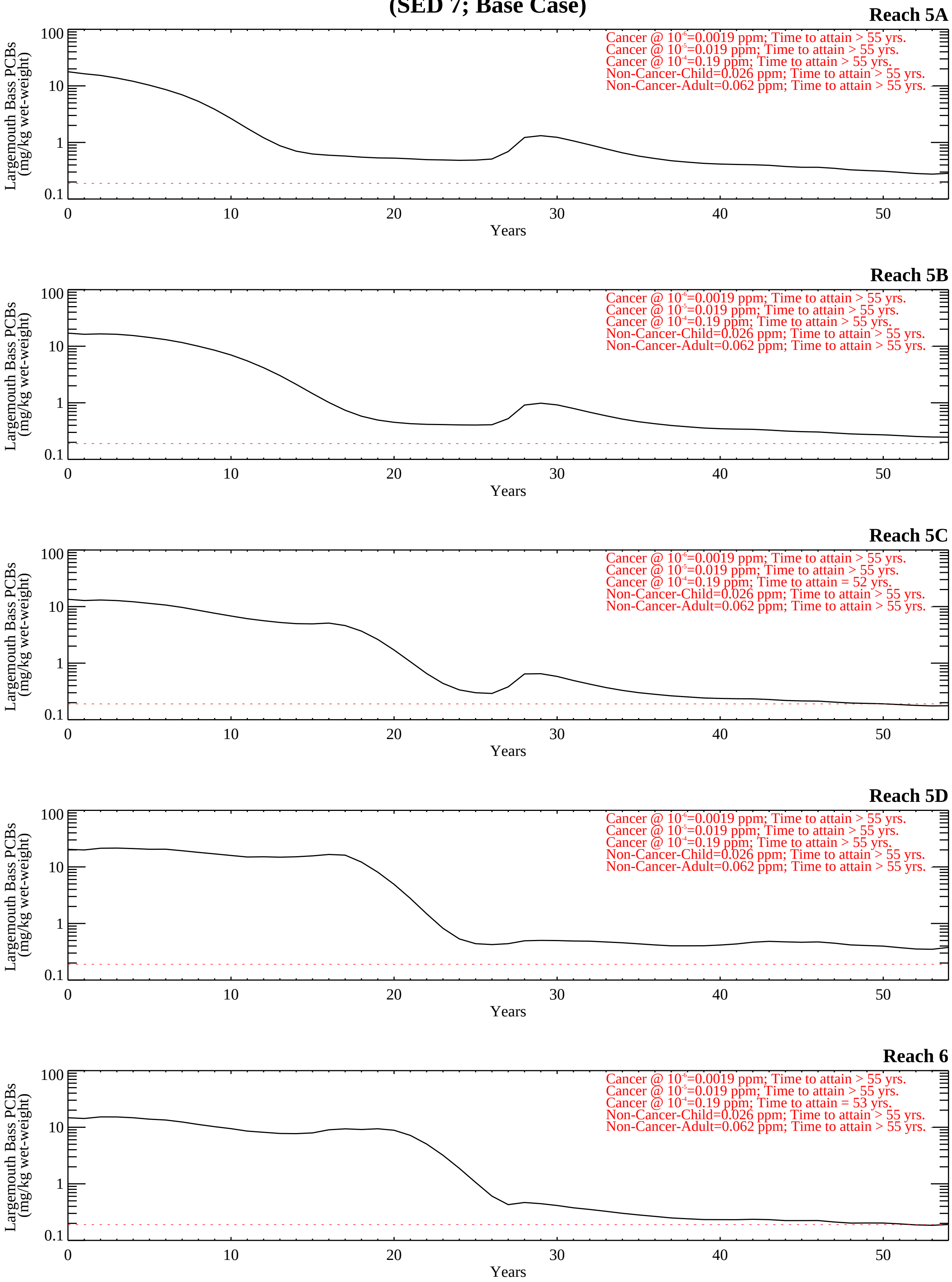

Figure G-8.1-6a. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic CTE)
(SED 7; Base Case)

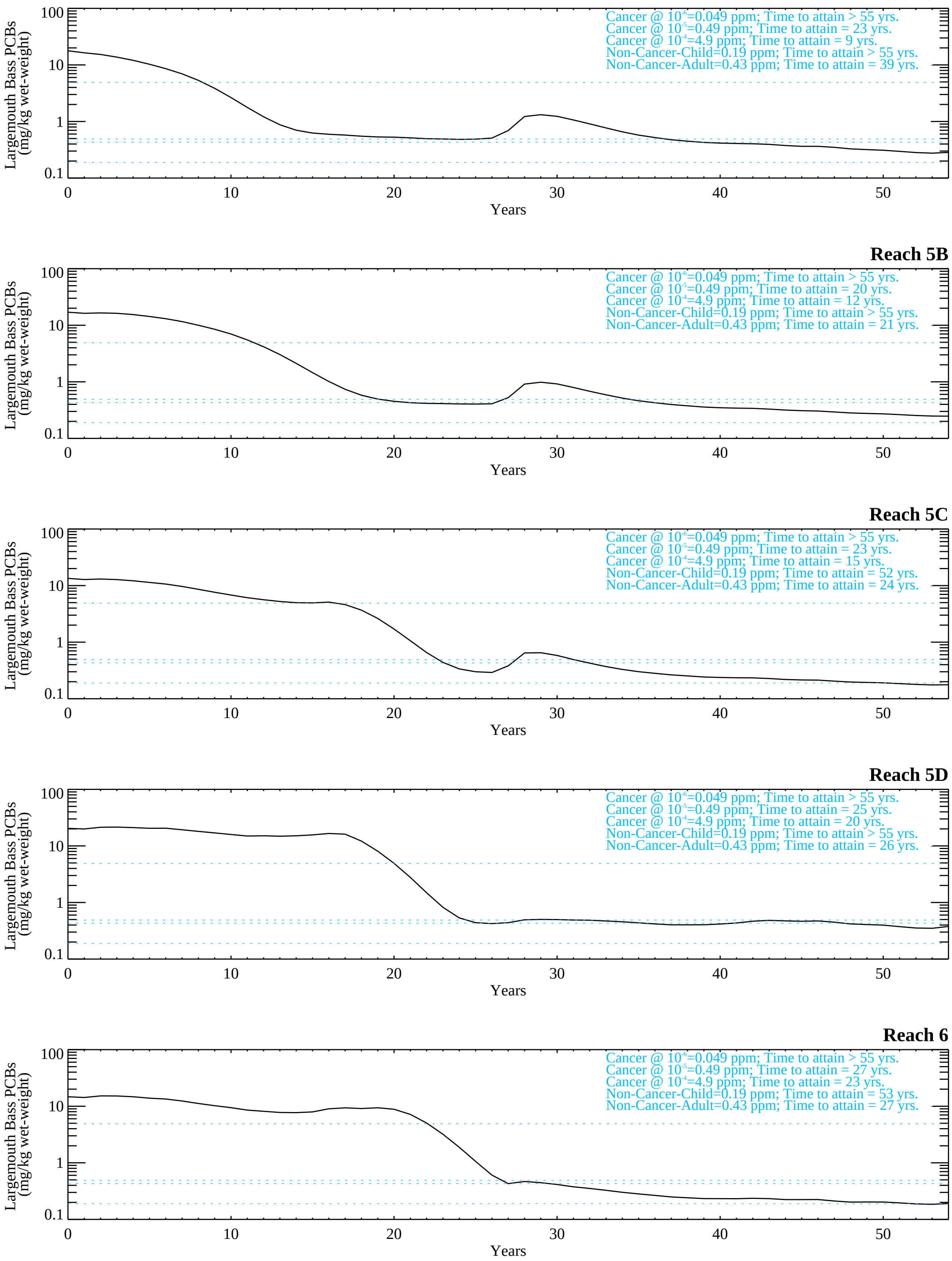

Figure G-8.1-6b. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 7; Base Case)

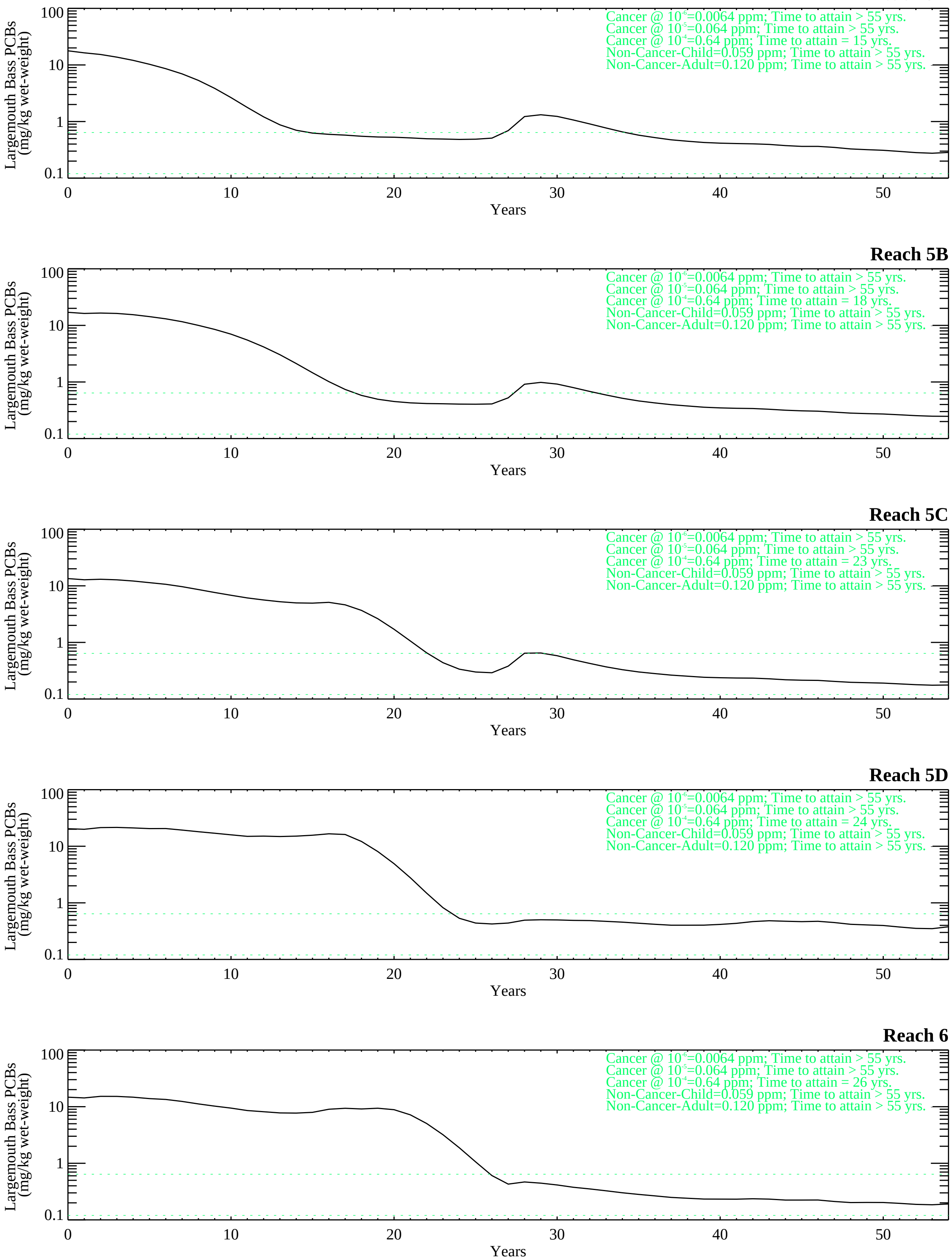

Figure G-8.1-6c. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

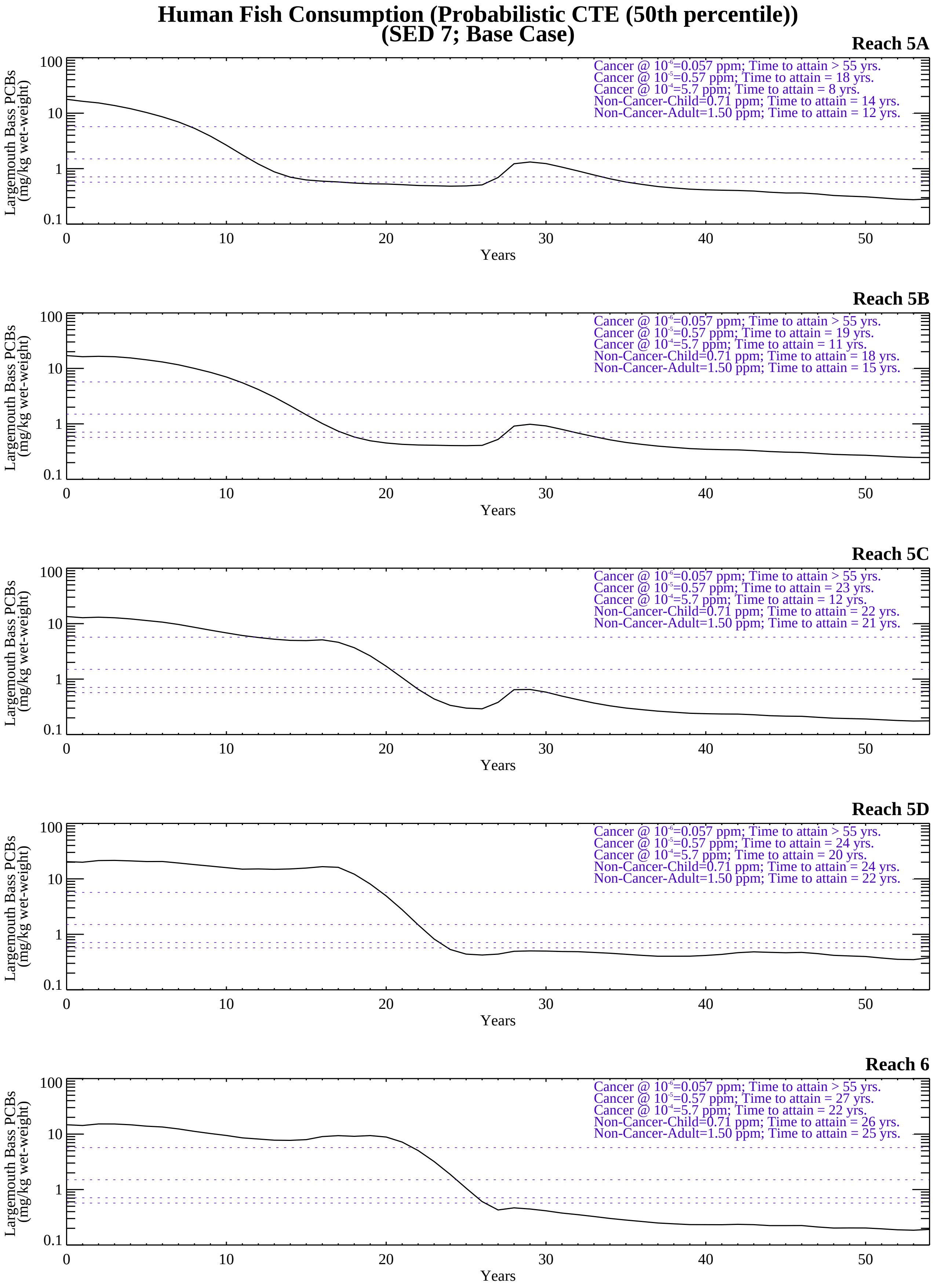

Figure G-8.1-6d. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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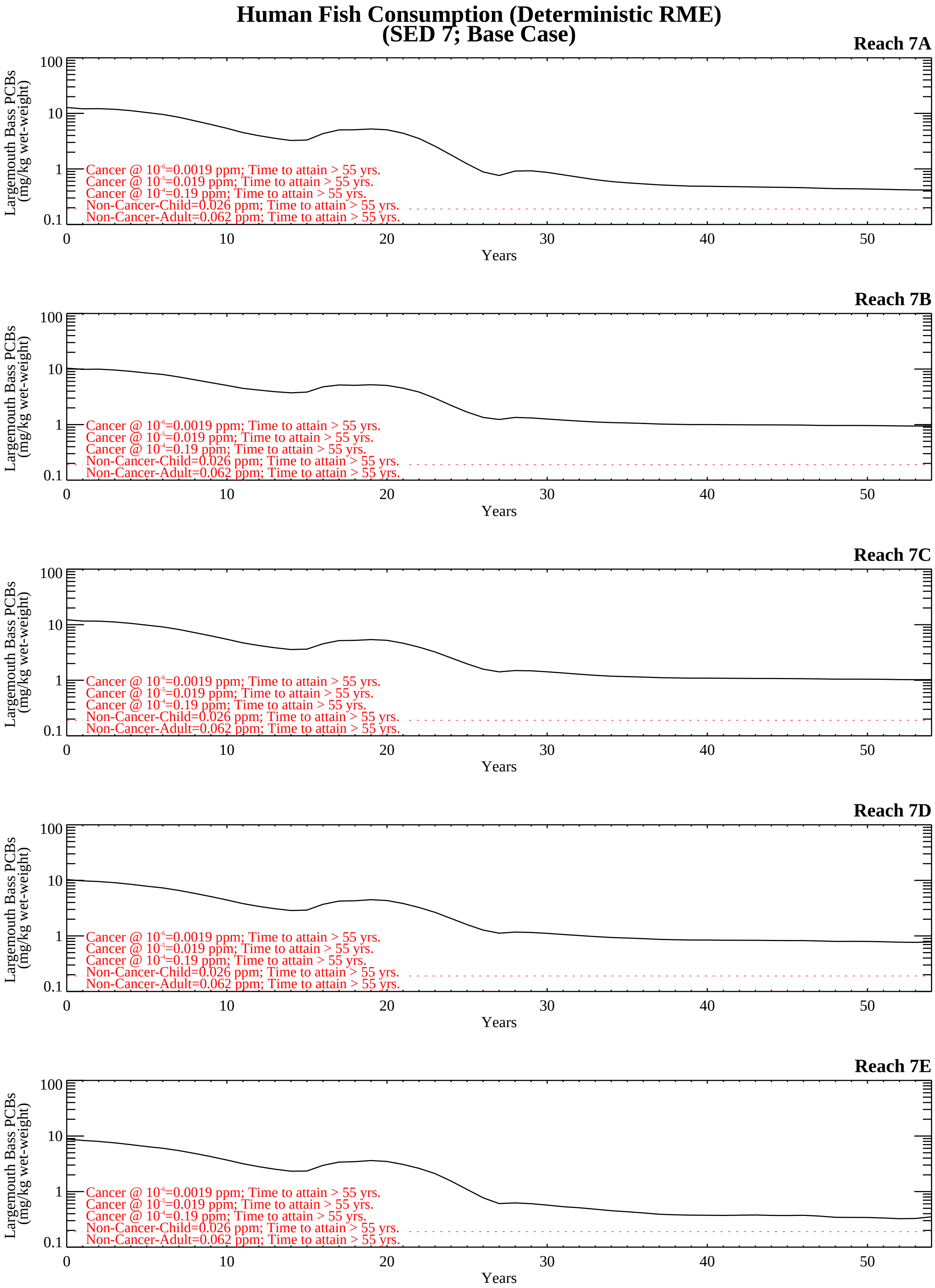

Figure G-8.1-6e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

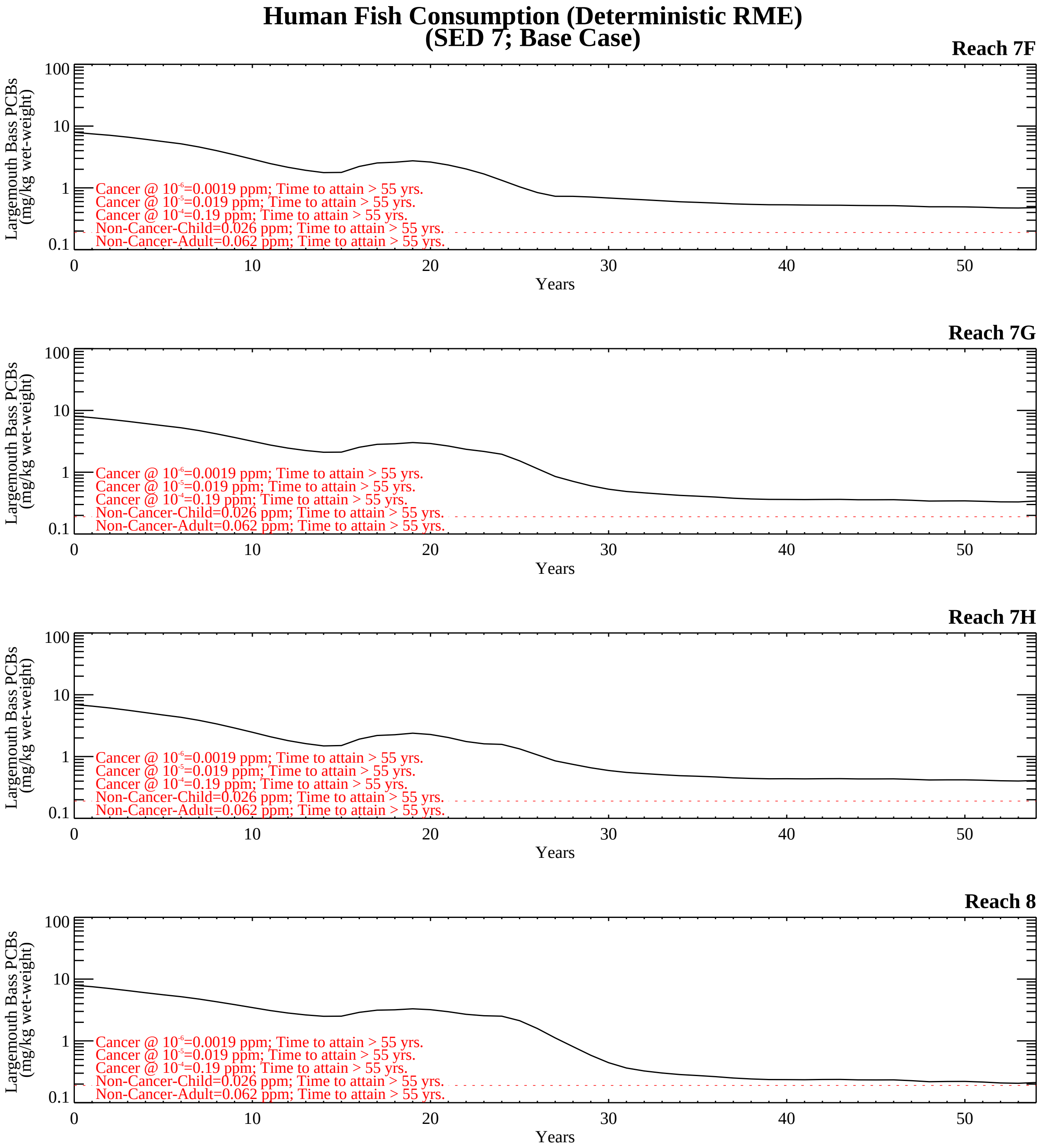

Figure G-8.1-6e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

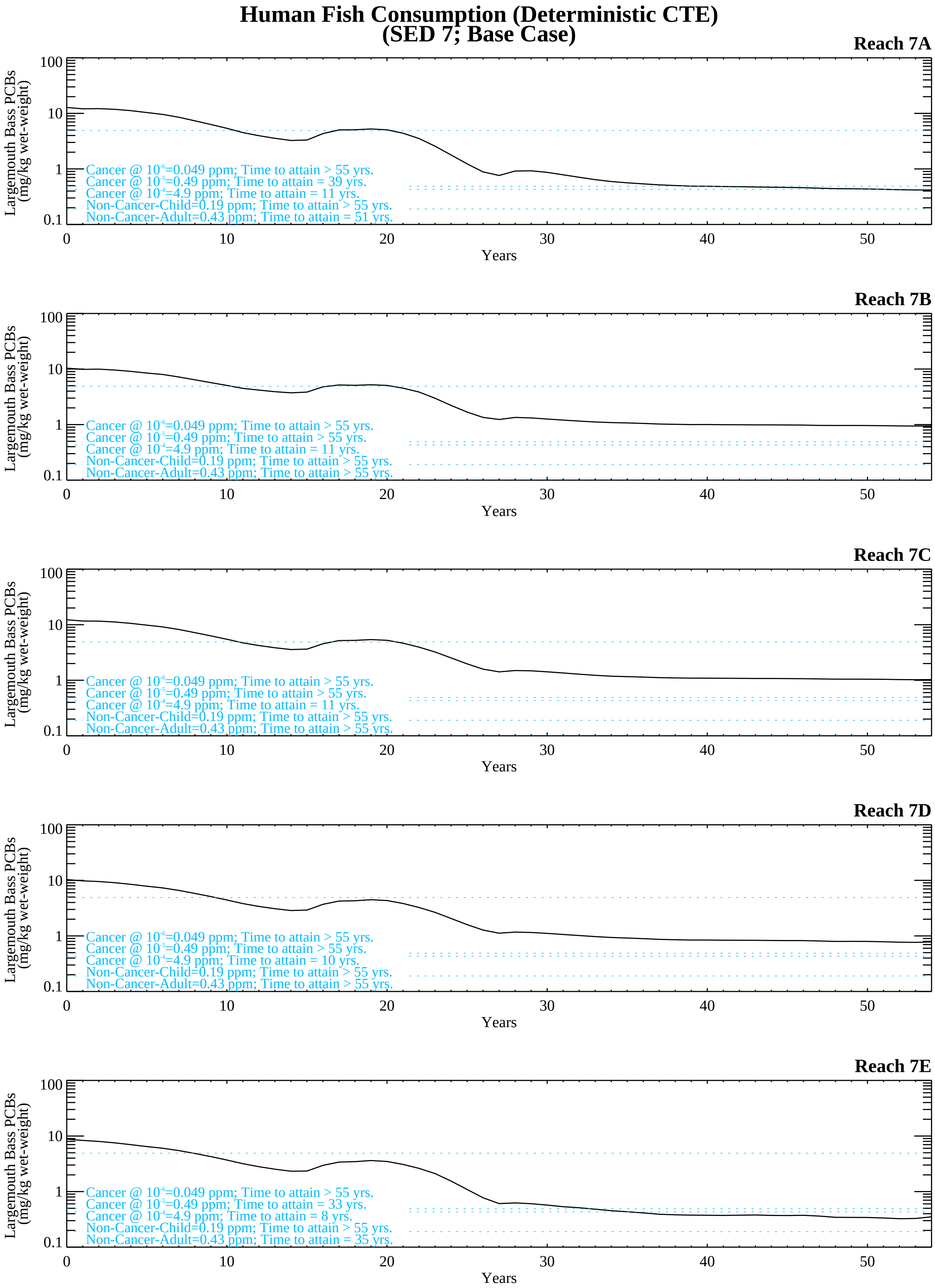

Figure G-8.1-6f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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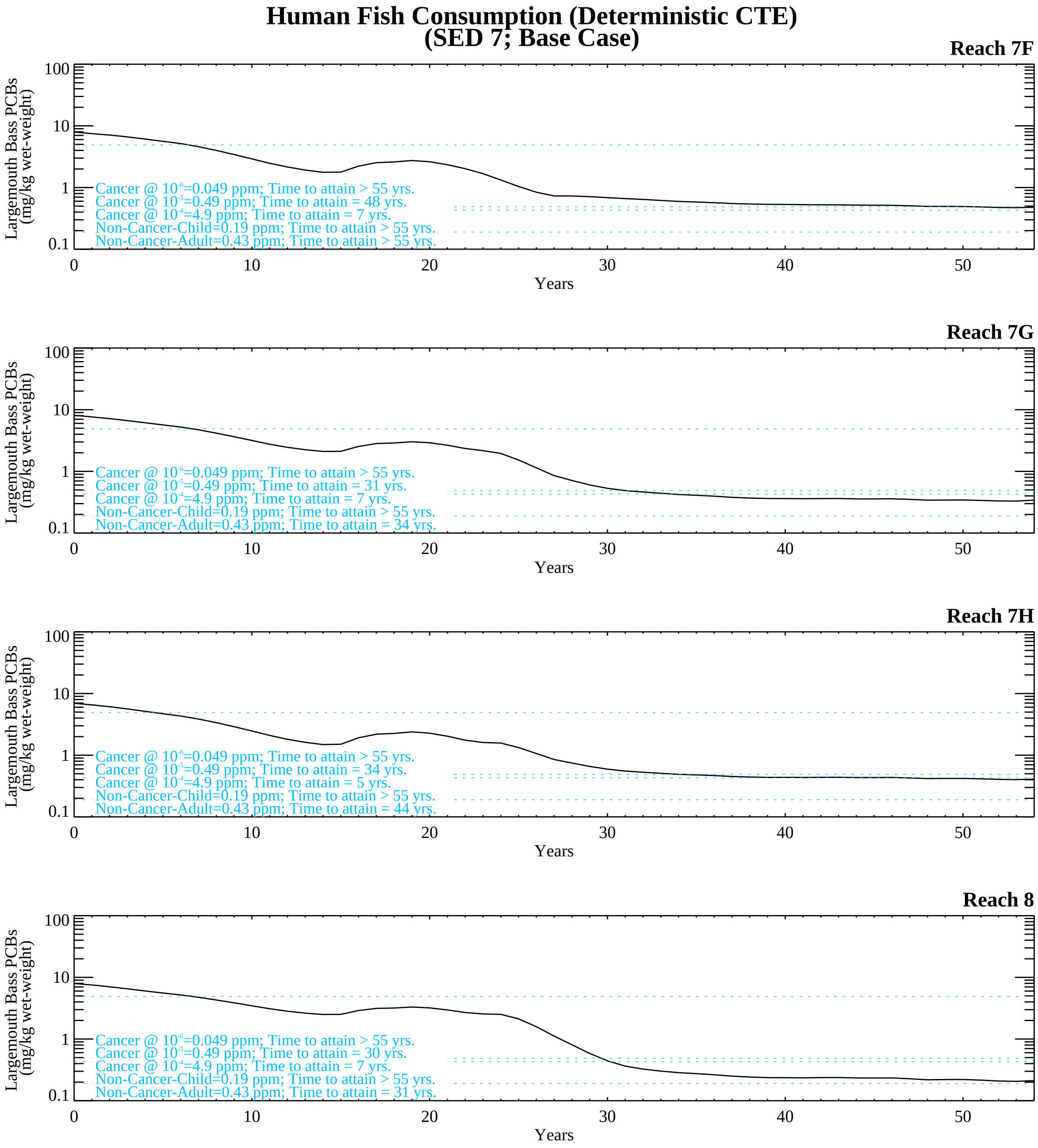

Figure G-8.1-6f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 7; Base Case)

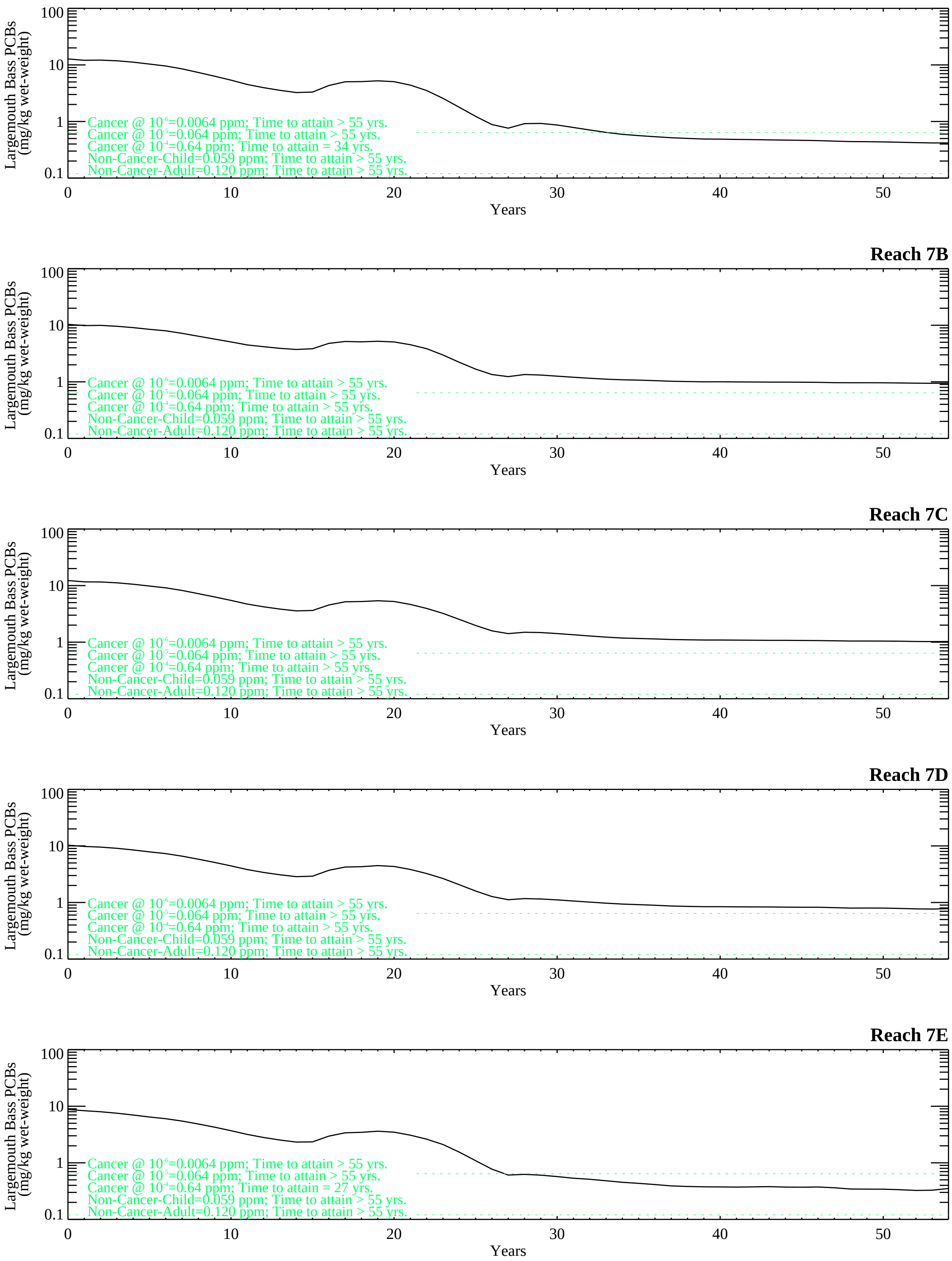

Figure G-8.1-6g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 7; Base Case)

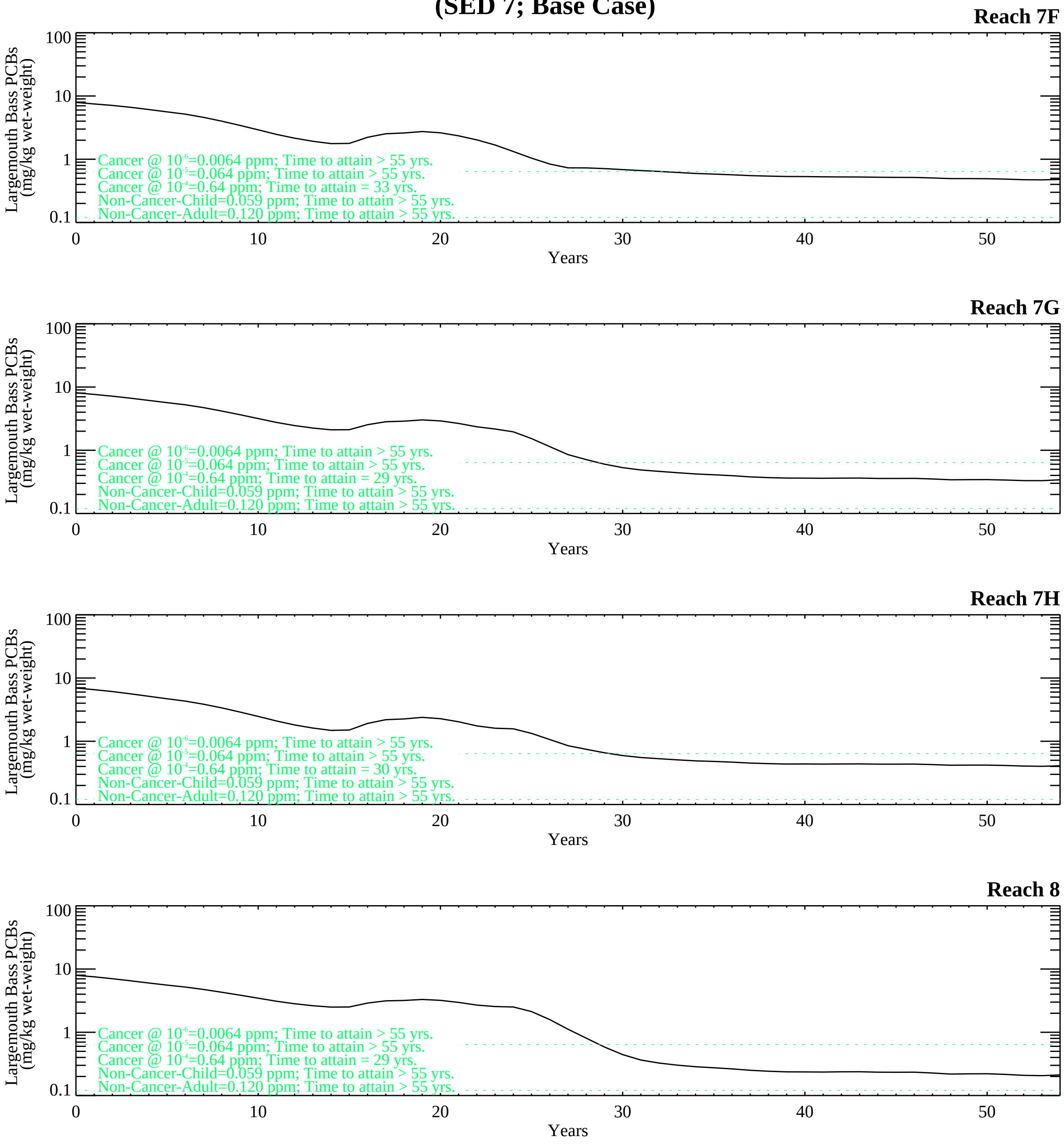

Figure G-8.1-6g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 7; Base Case)

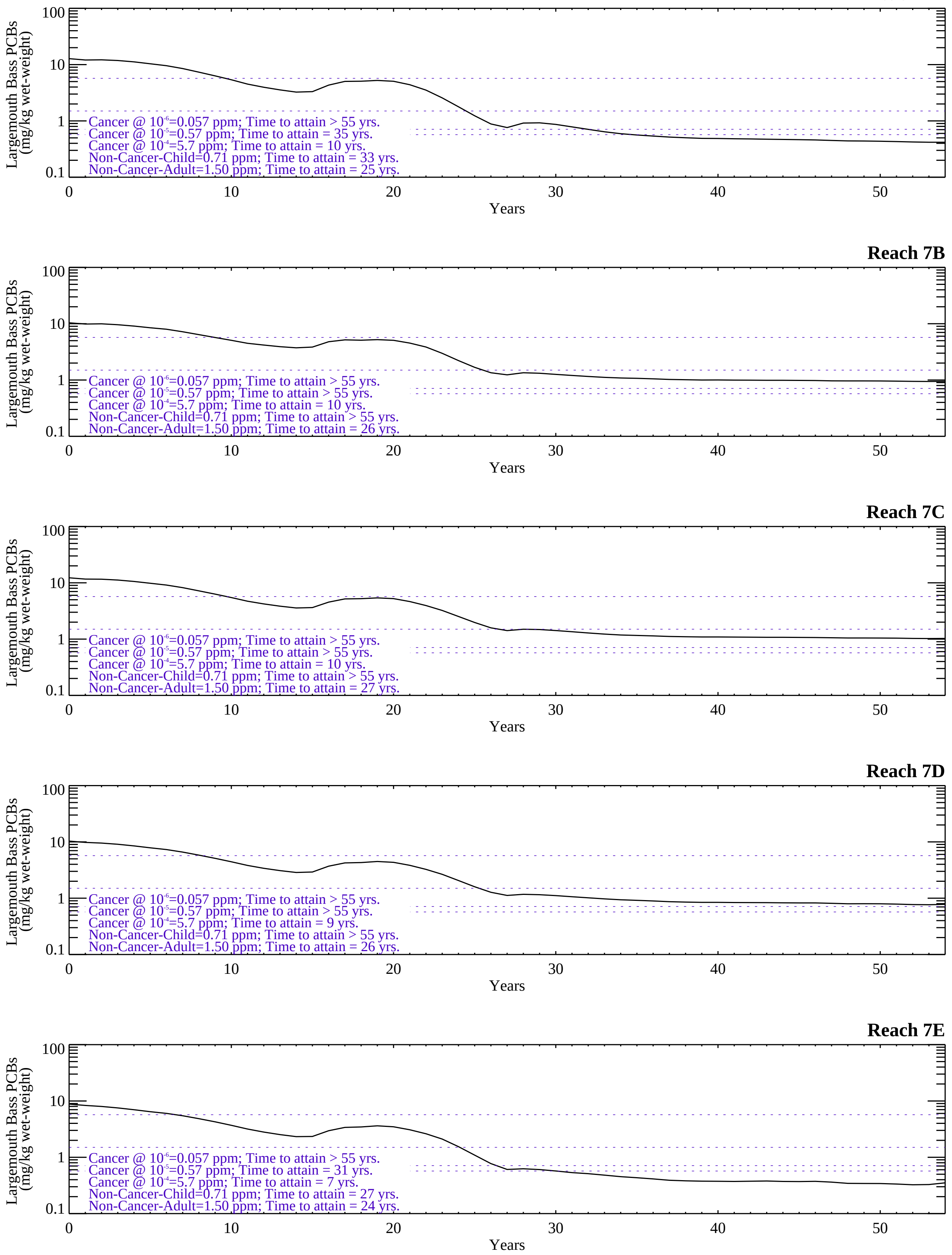

Figure G-8.1-6h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

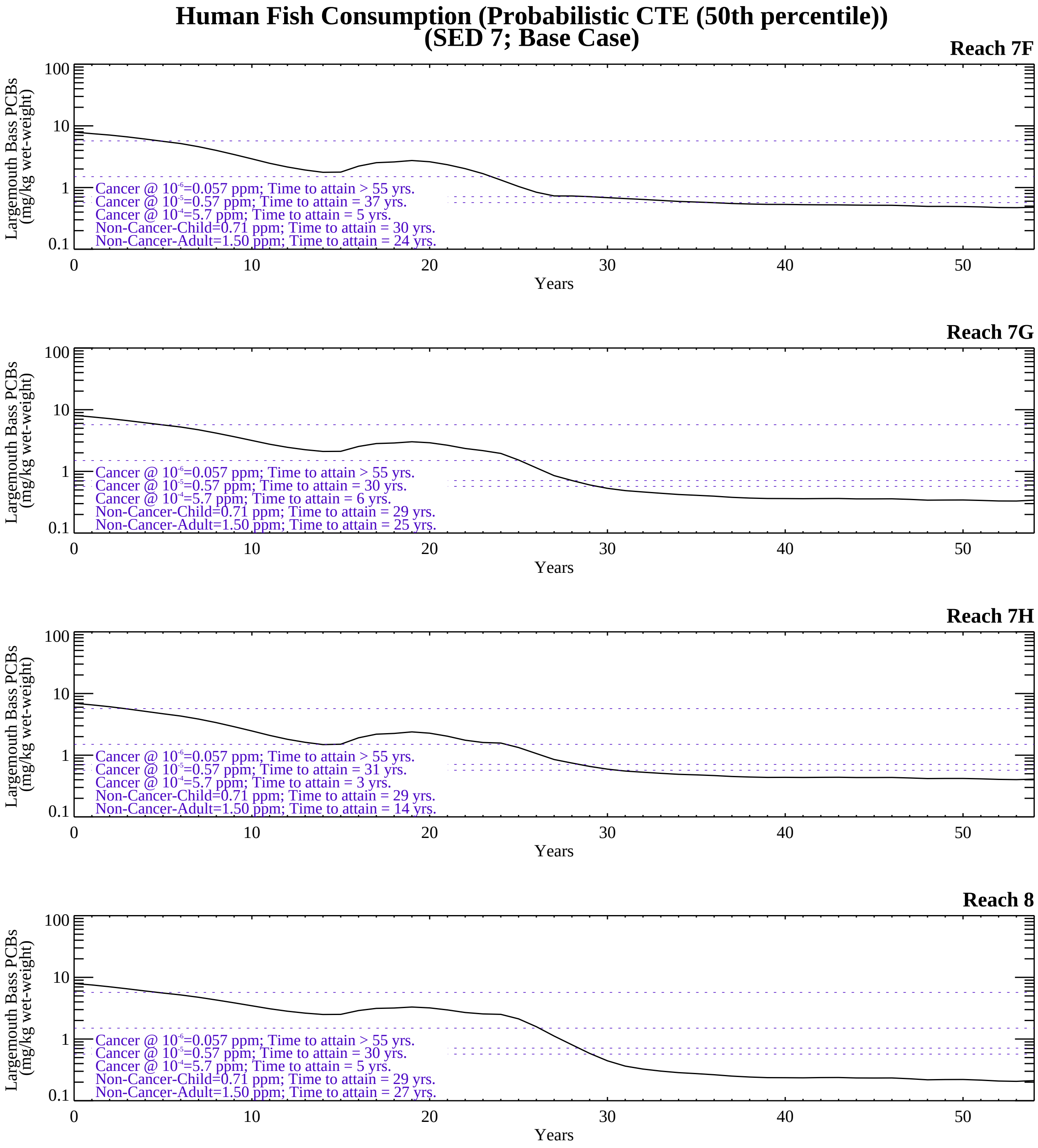

Figure G-8.1-6h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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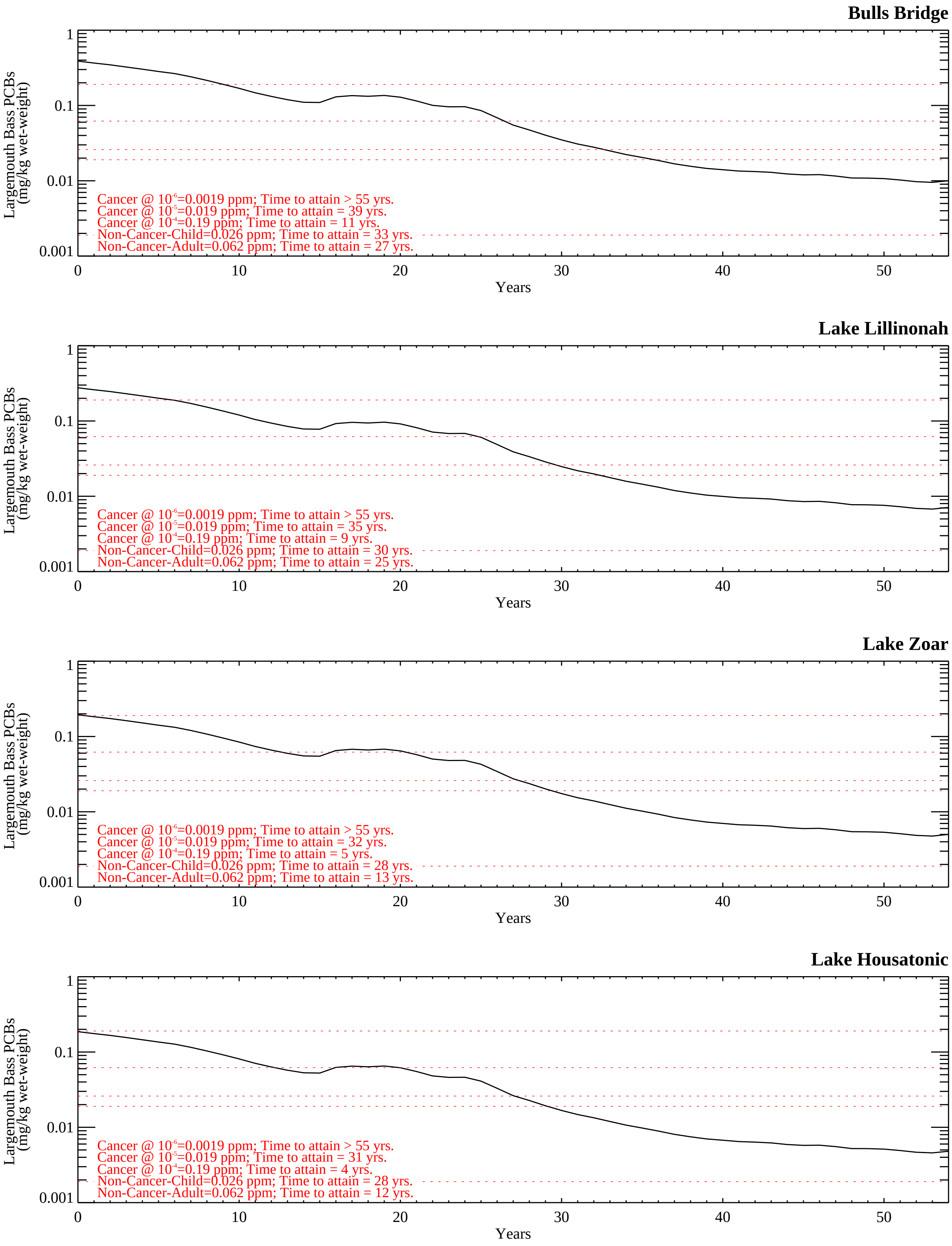
Human Fish Consumption (Deterministic RME)
(SED 7; Base Case)



Bulls Bridge

Lake Lillinonah

Lake Zoar

Lake Housatonic

Figure G-8.1-6i. Temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D Analysis compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 7; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic CTE)
(SED 7; Base Case)

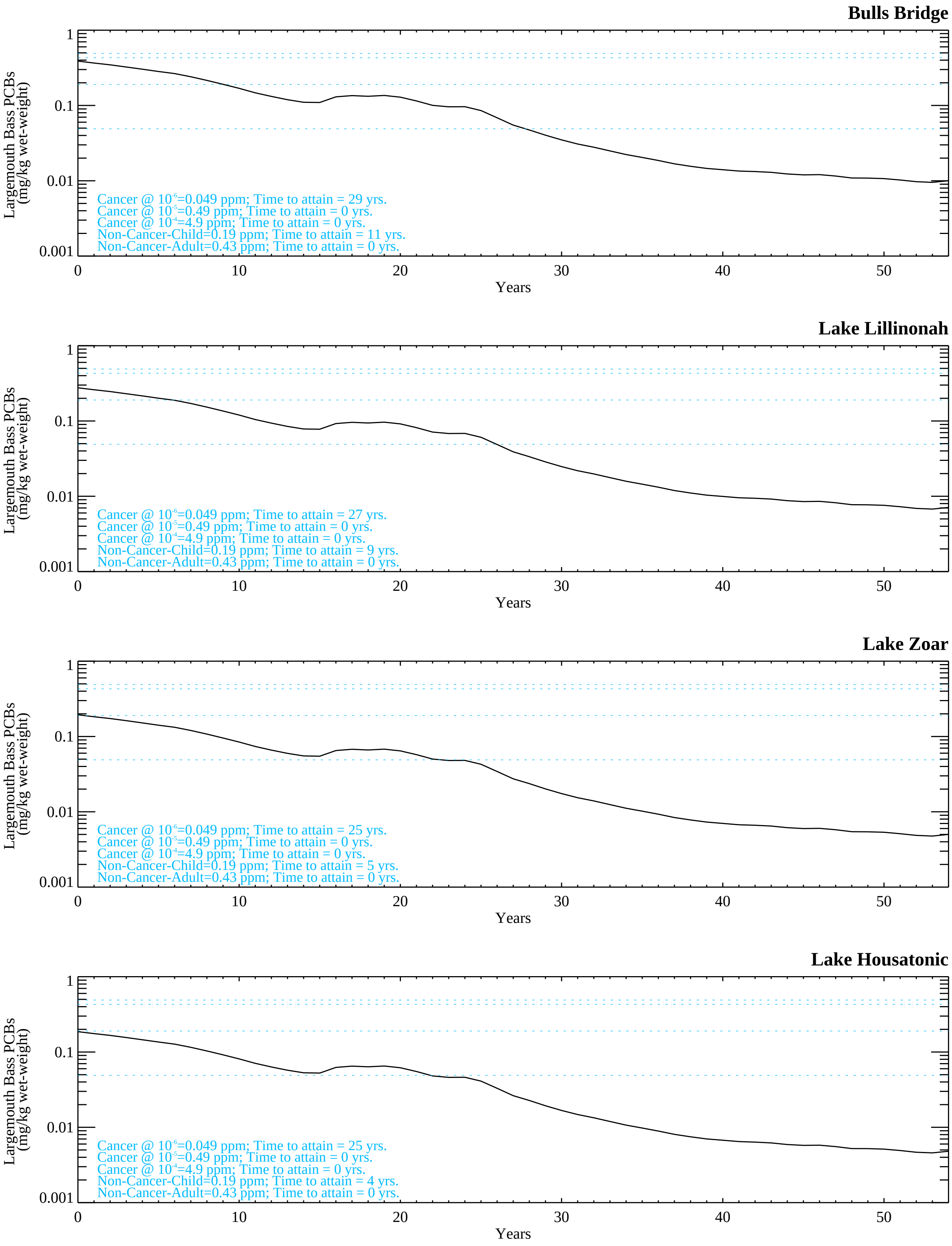


Figure G-8.1-6j. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 7; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 7; Base Case)

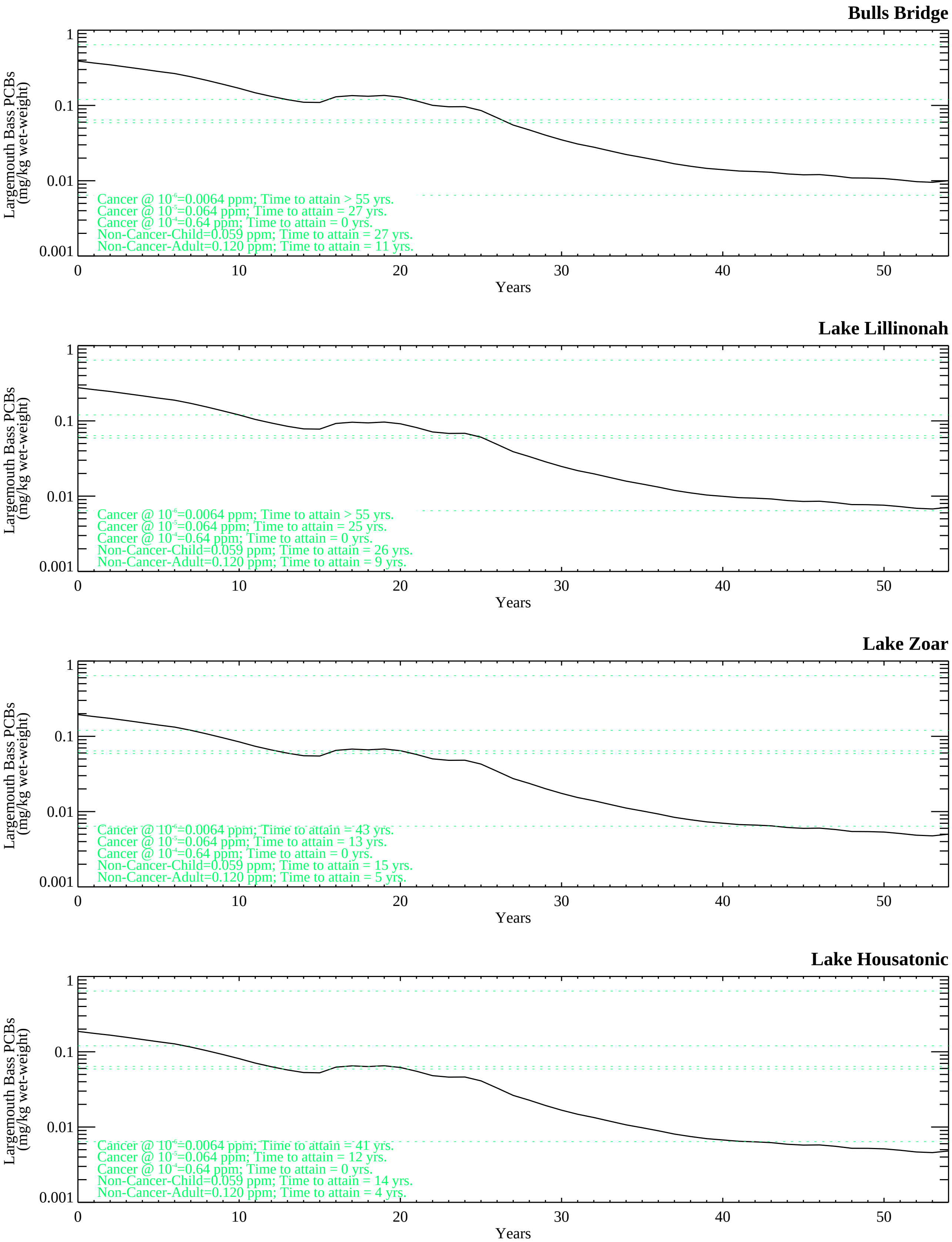

Figure G-8.1-6k. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 7; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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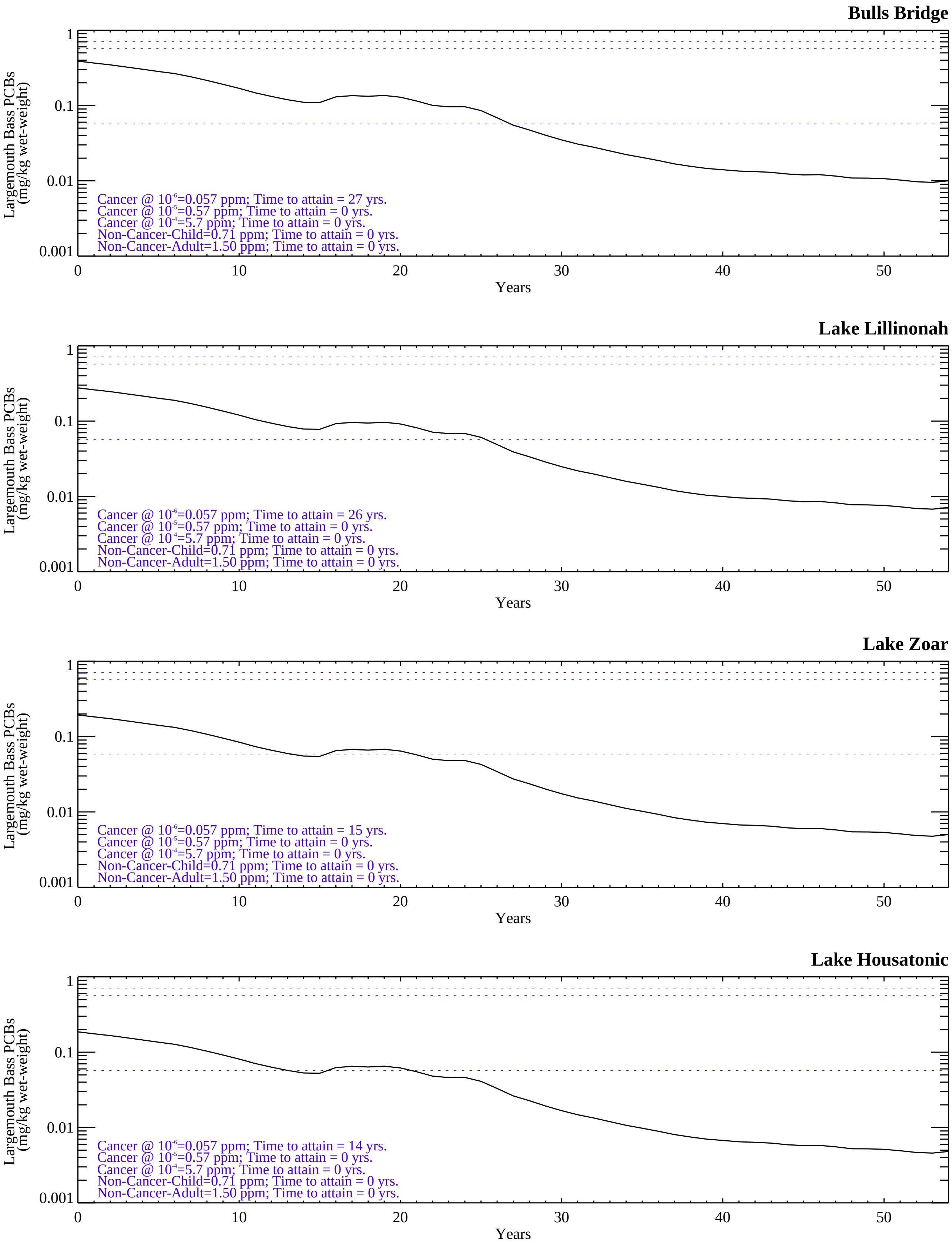
Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 7; Base Case)



Bulls Bridge

Lake Lillinonah

Lake Zoar

Lake Housatonic

Figure G-8.1-6l. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 7; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

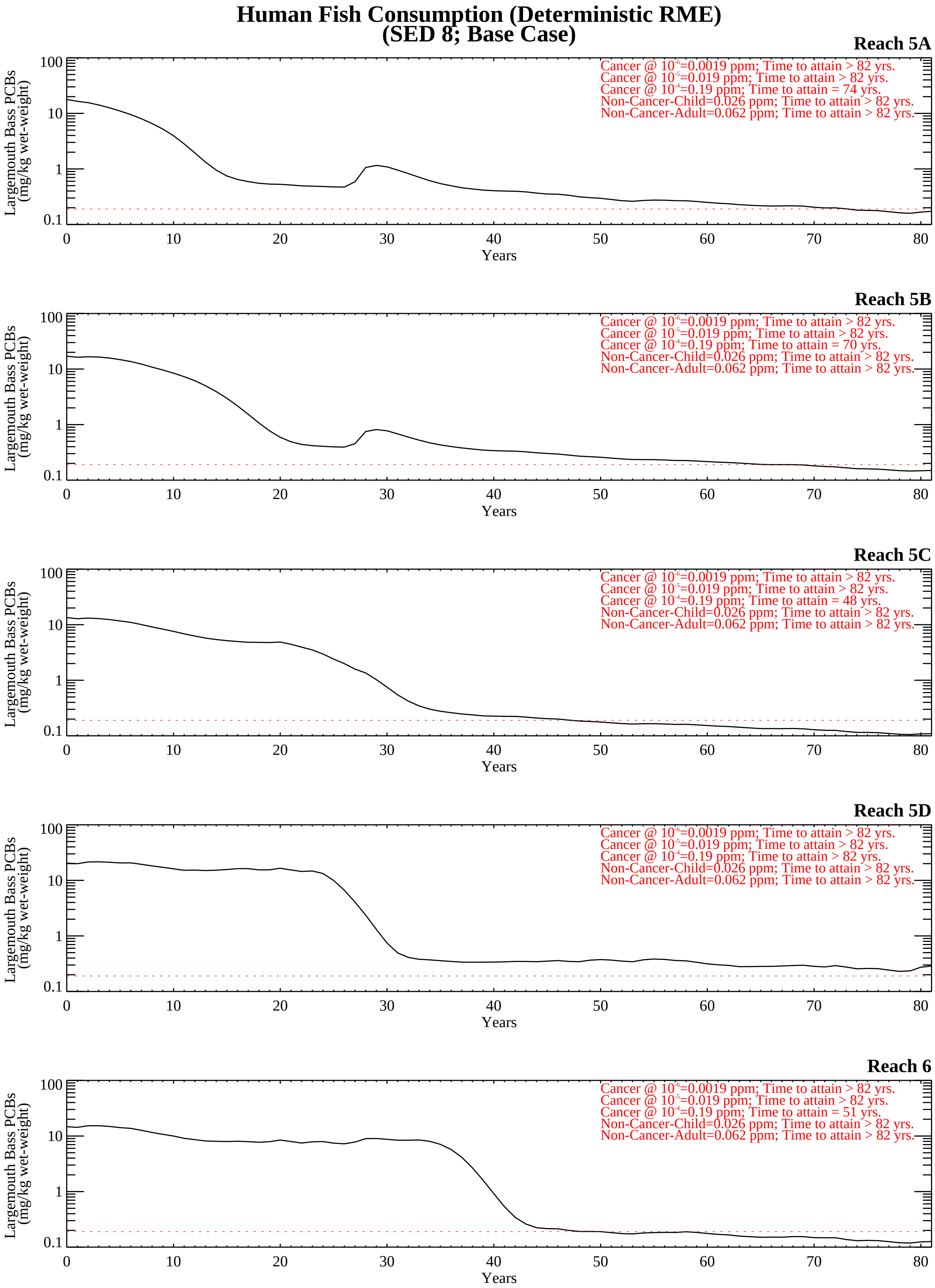


Figure G-8.1-7a. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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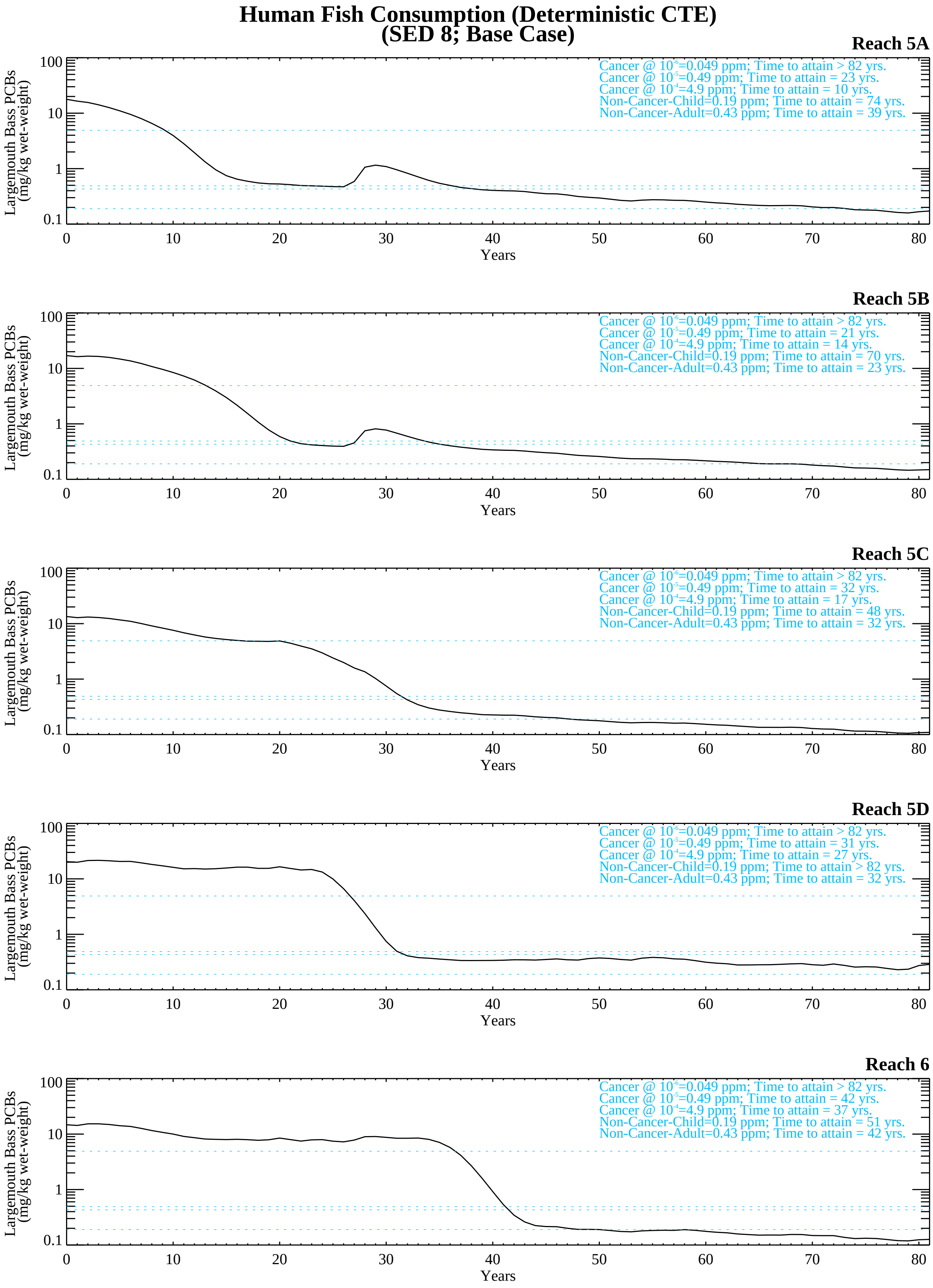

Figure G-8.1-7b. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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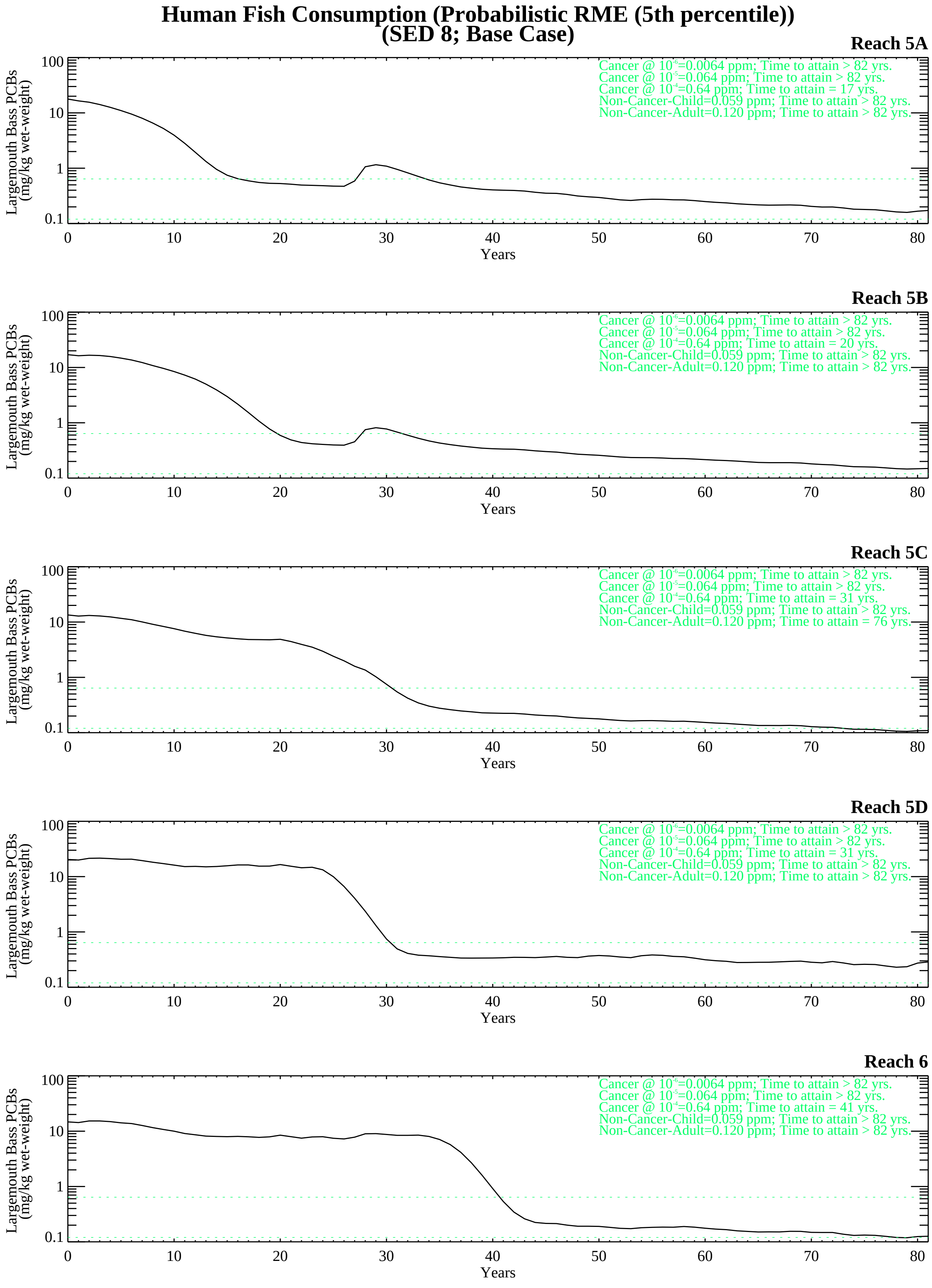

Figure G-8.1-7c. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

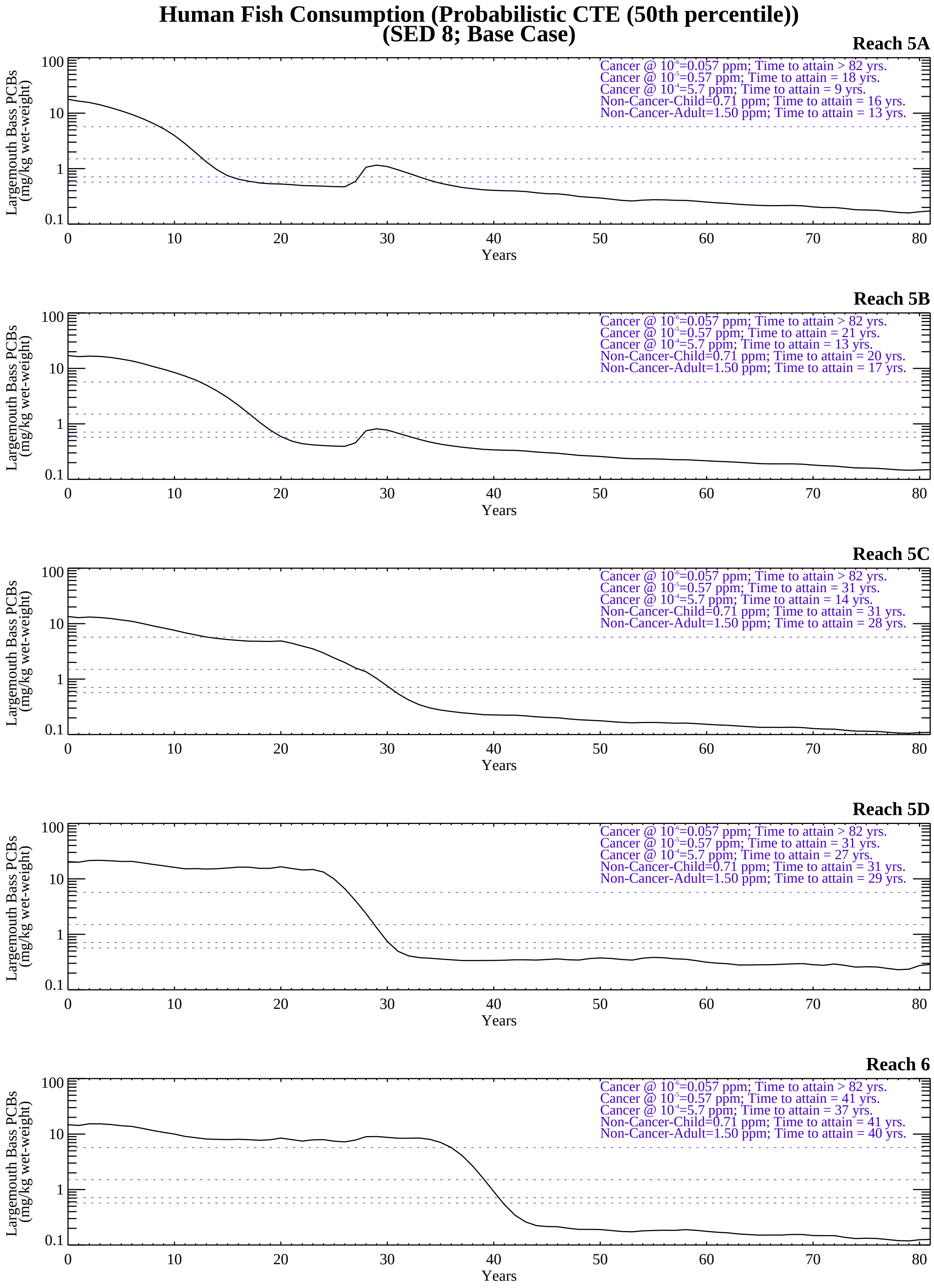

Figure G-8.1-7d. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

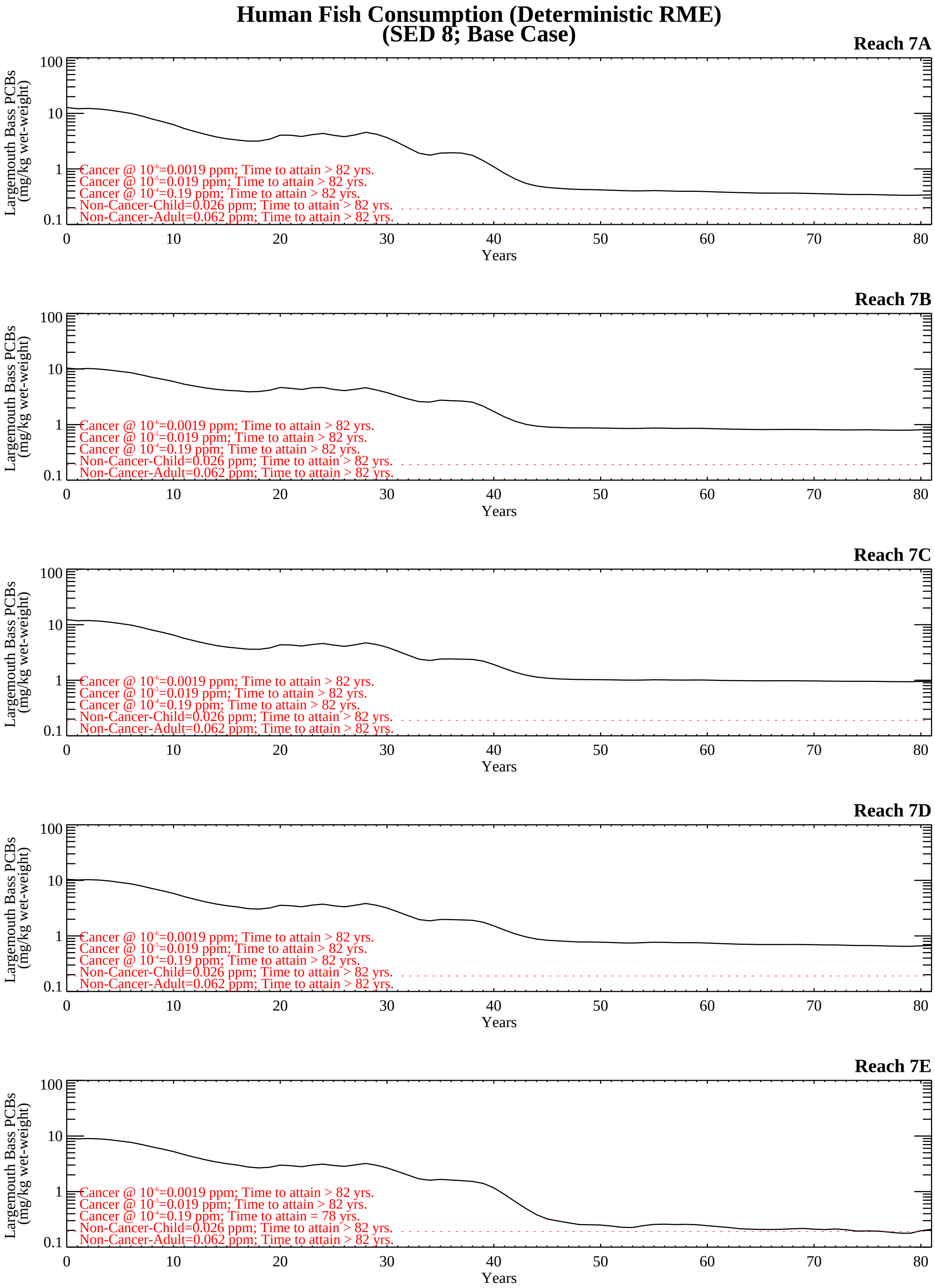

Figure G-8.1-7e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic RME)
(SED 8; Base Case)

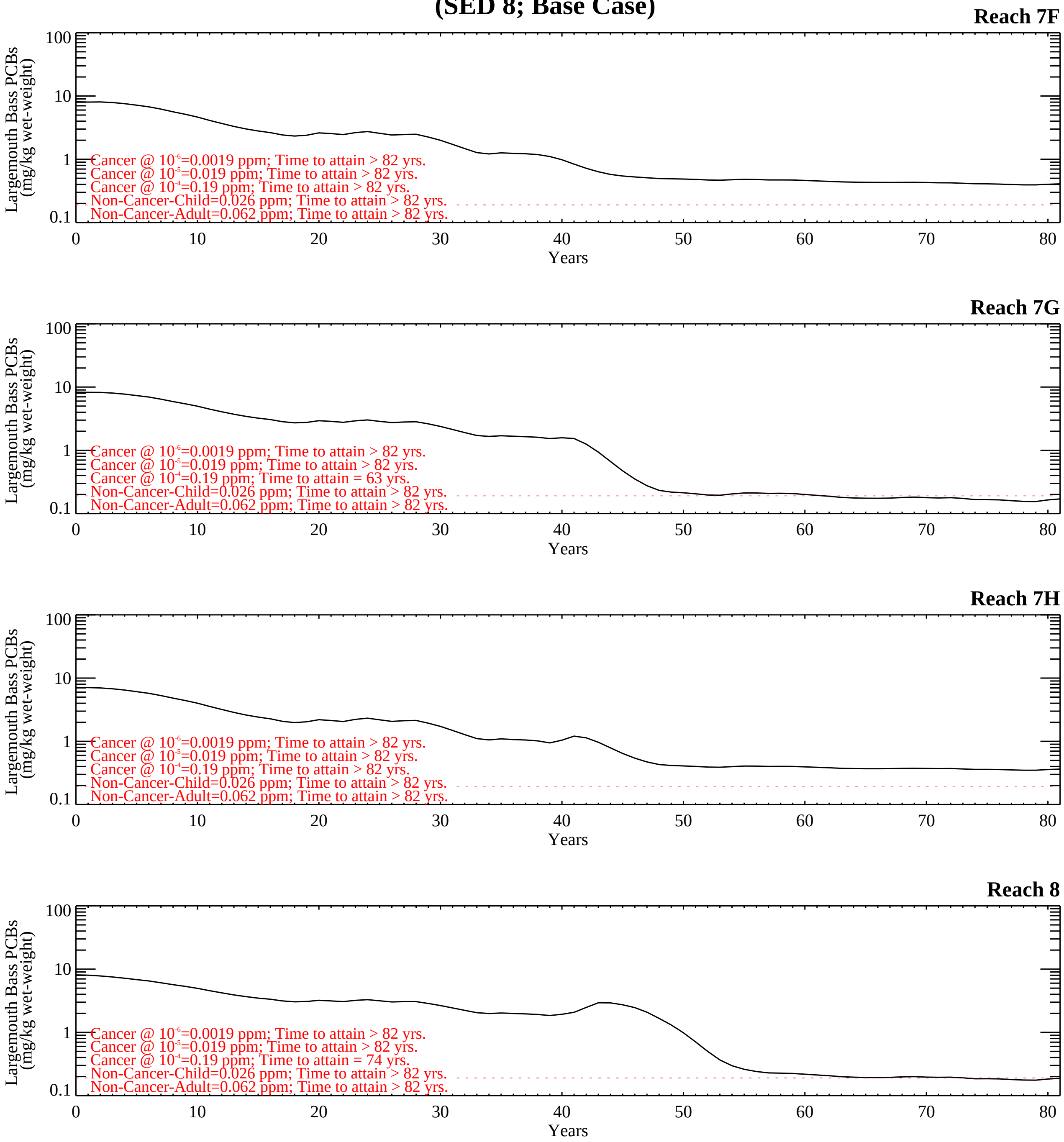

Figure G-8.1-7e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

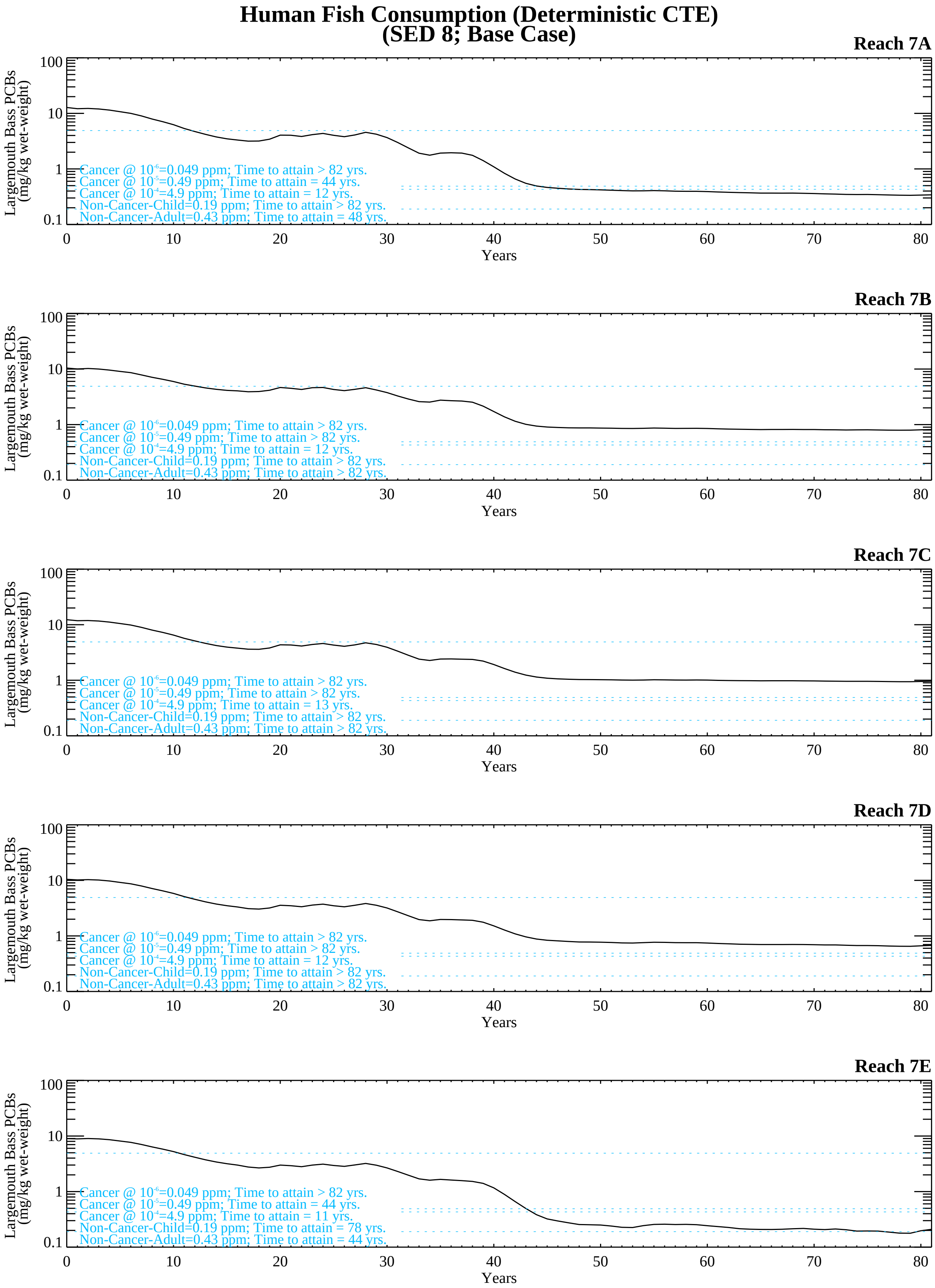

Figure G-8.1-7f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic CTE)
(SED 8; Base Case)

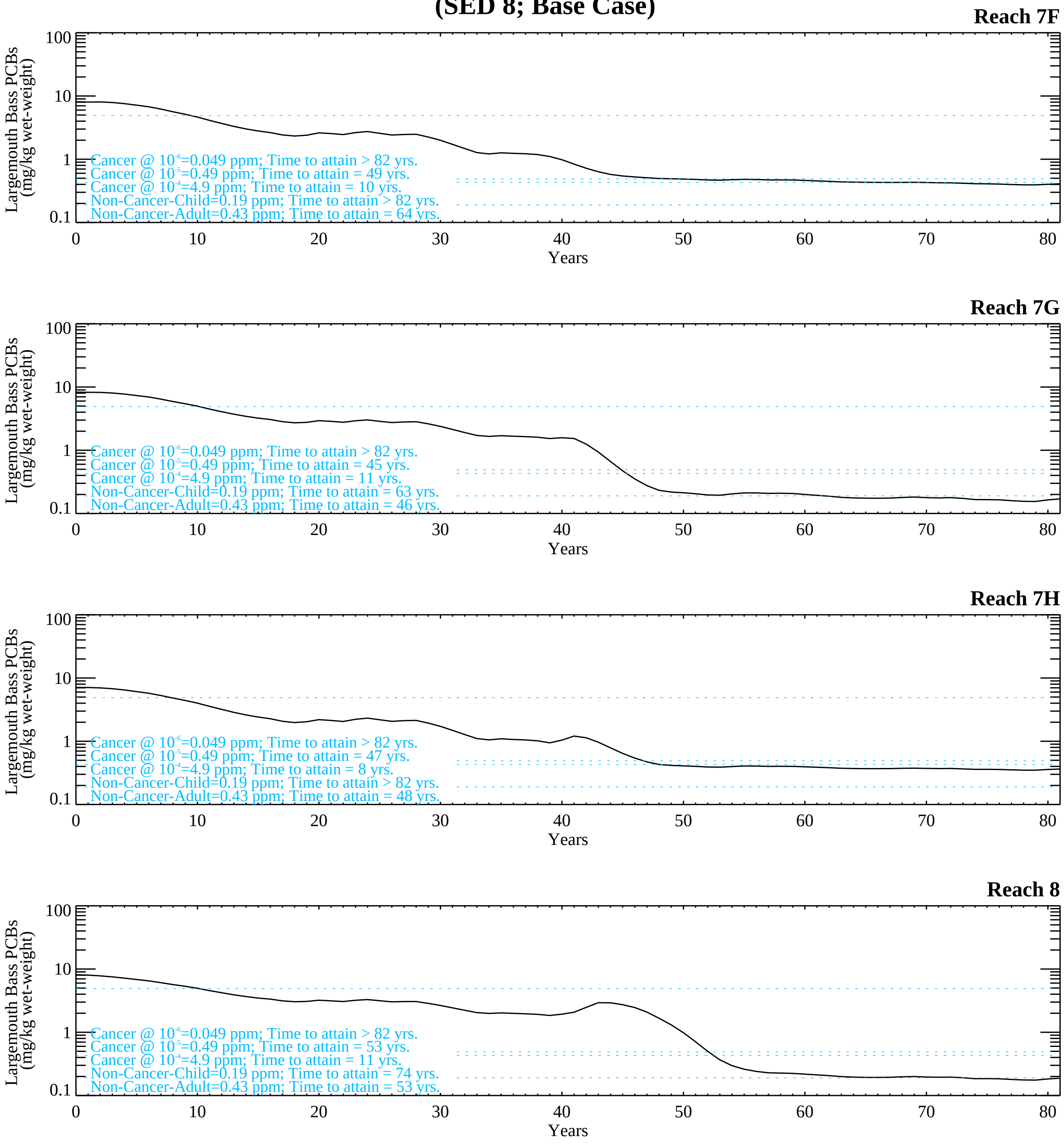

Figure G-8.1-7f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

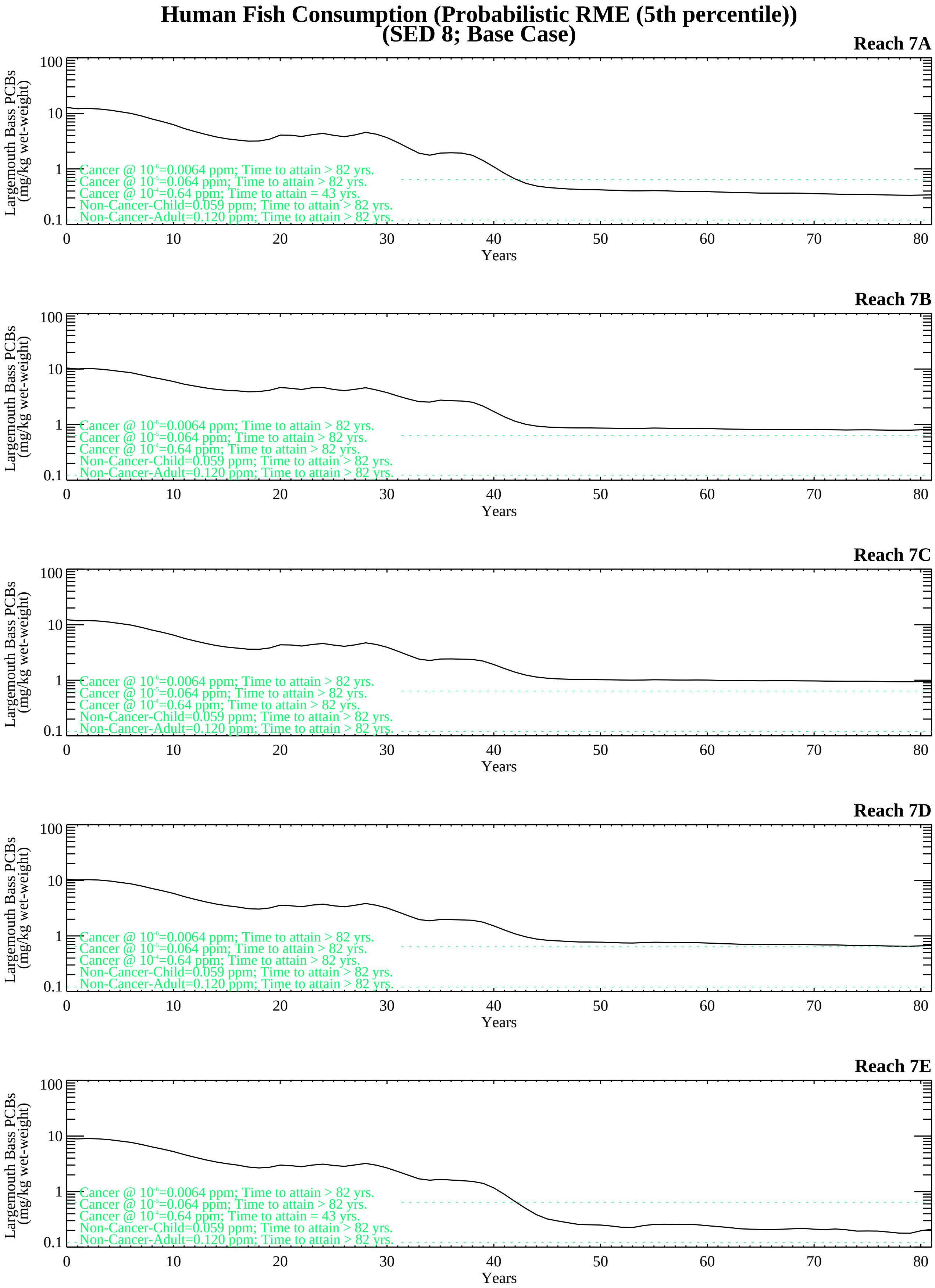

Figure G-8.1-7g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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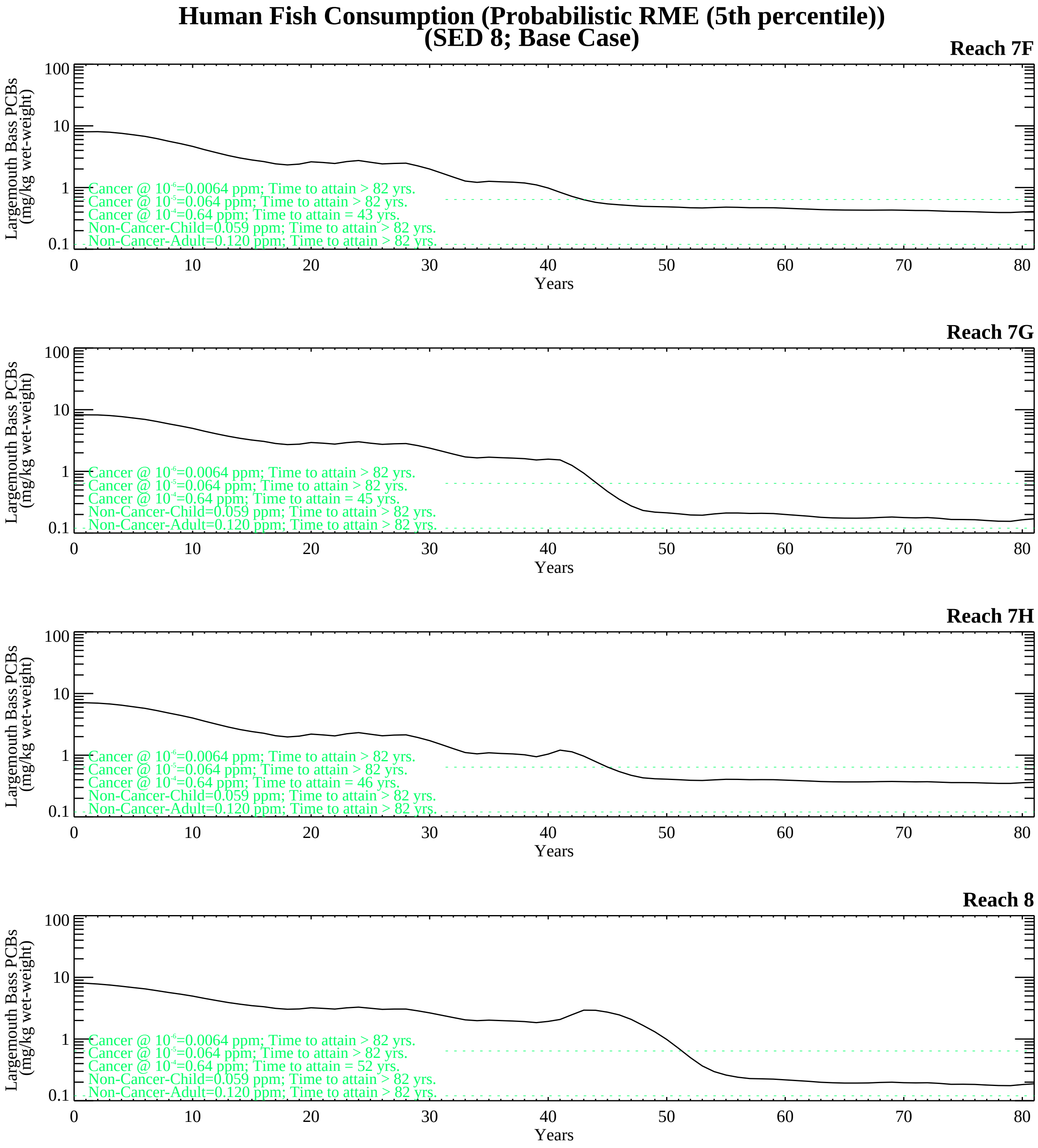

Figure G-8.1-7g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

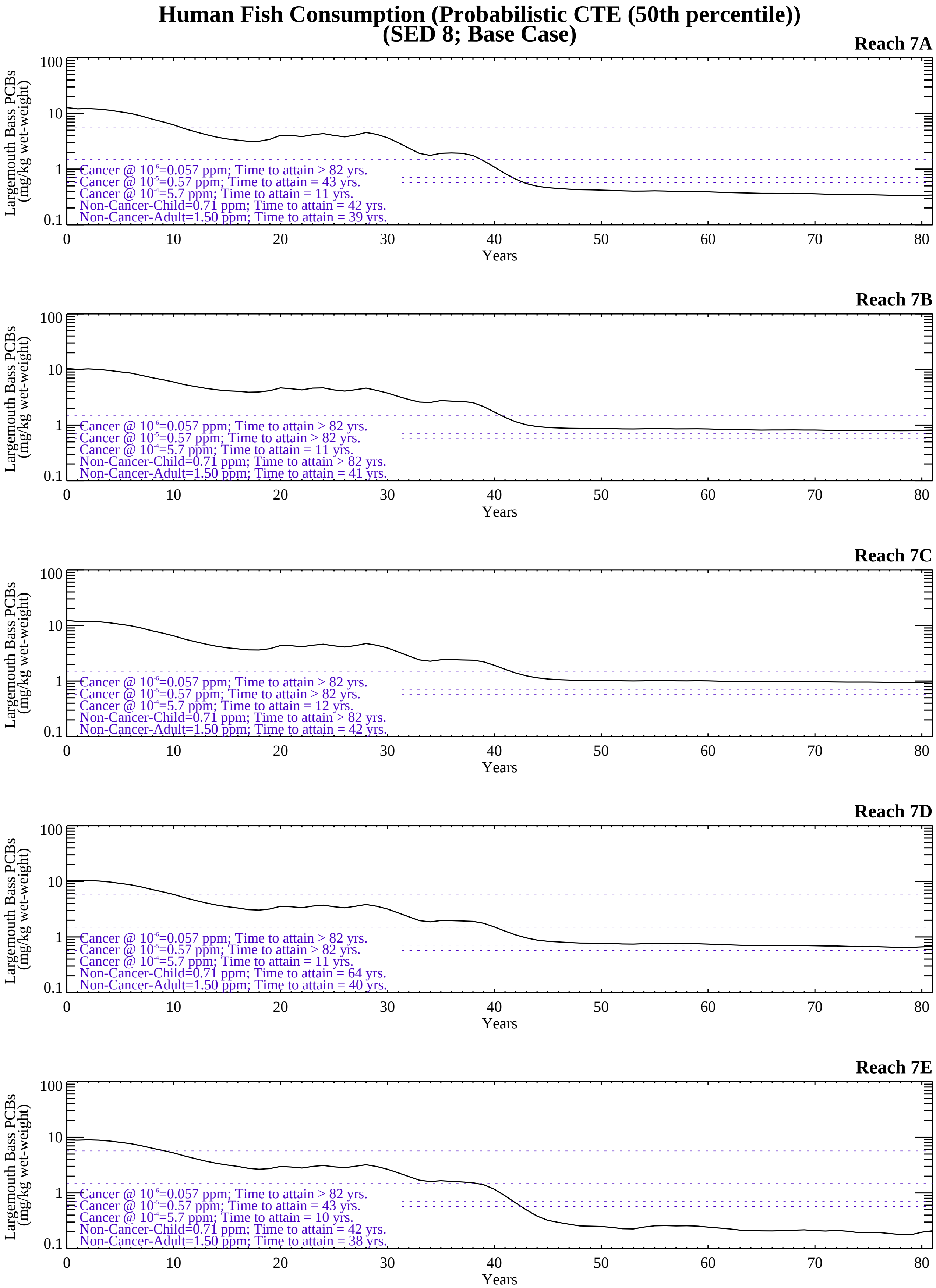

Figure G-8.1-7h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

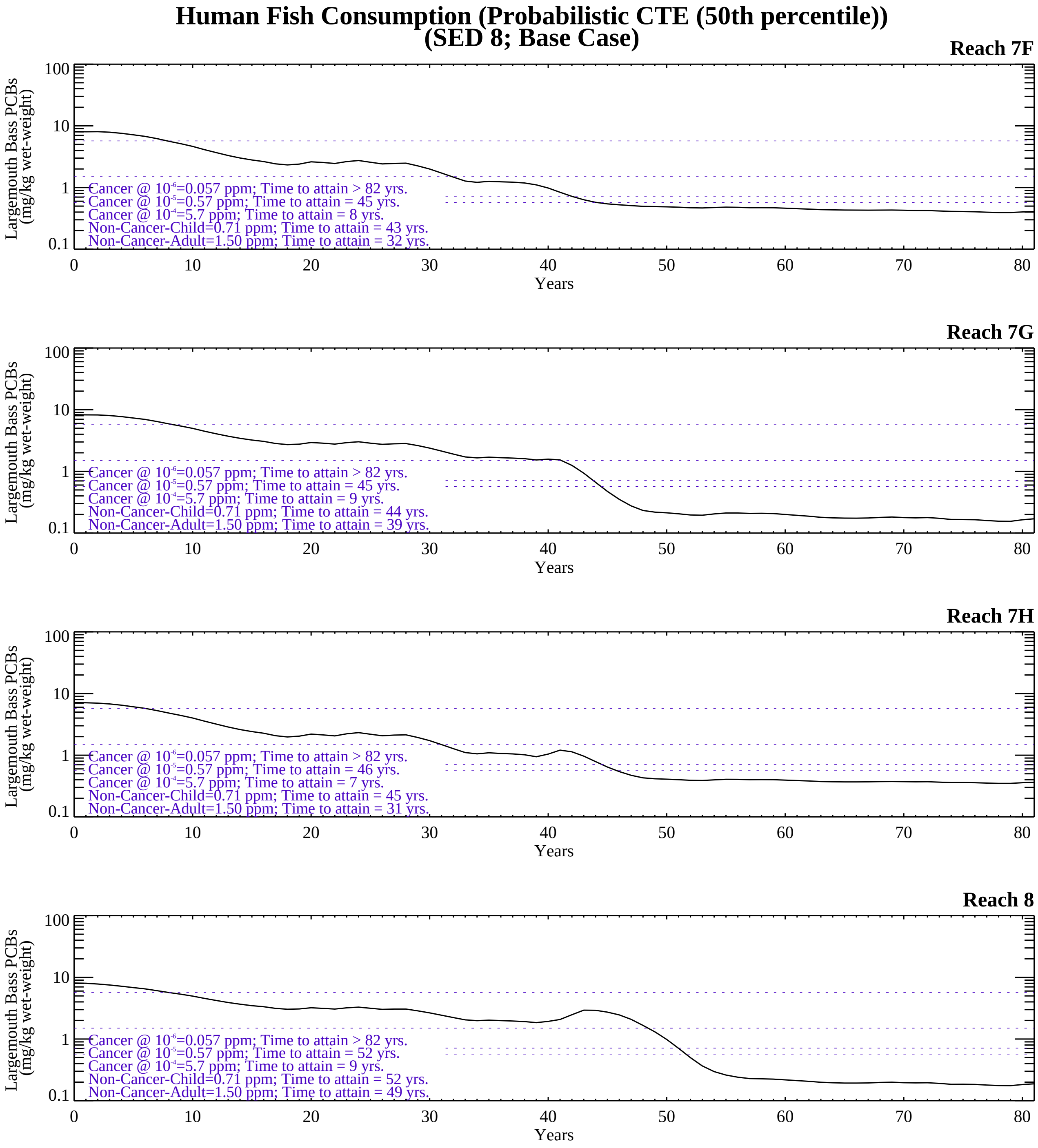

Figure G-8.1-7h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic RME)
(SED 8; Base Case)

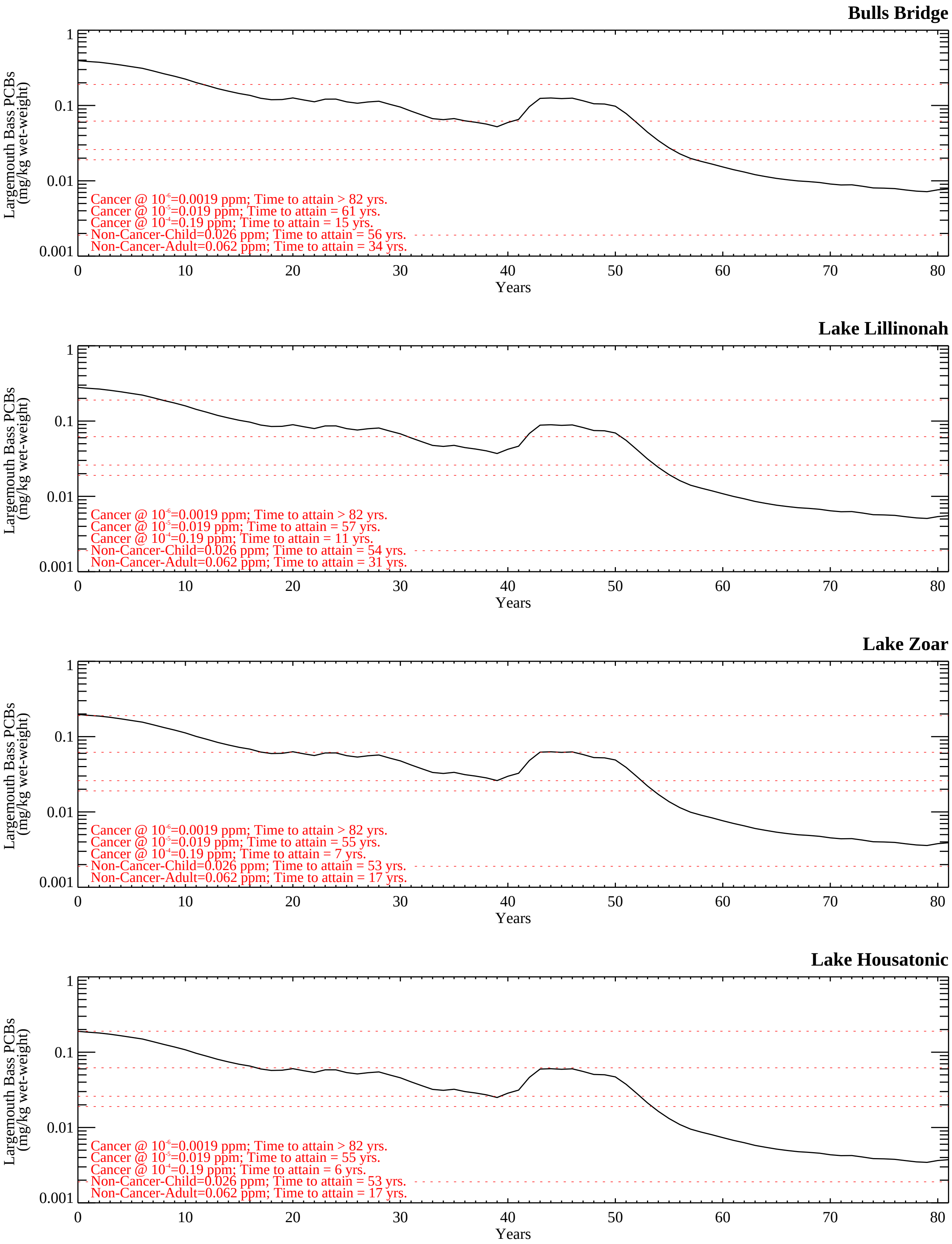

Figure G-8.1-7i. Temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D Analysis compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 8; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic CTE)
(SED 8; Base Case)

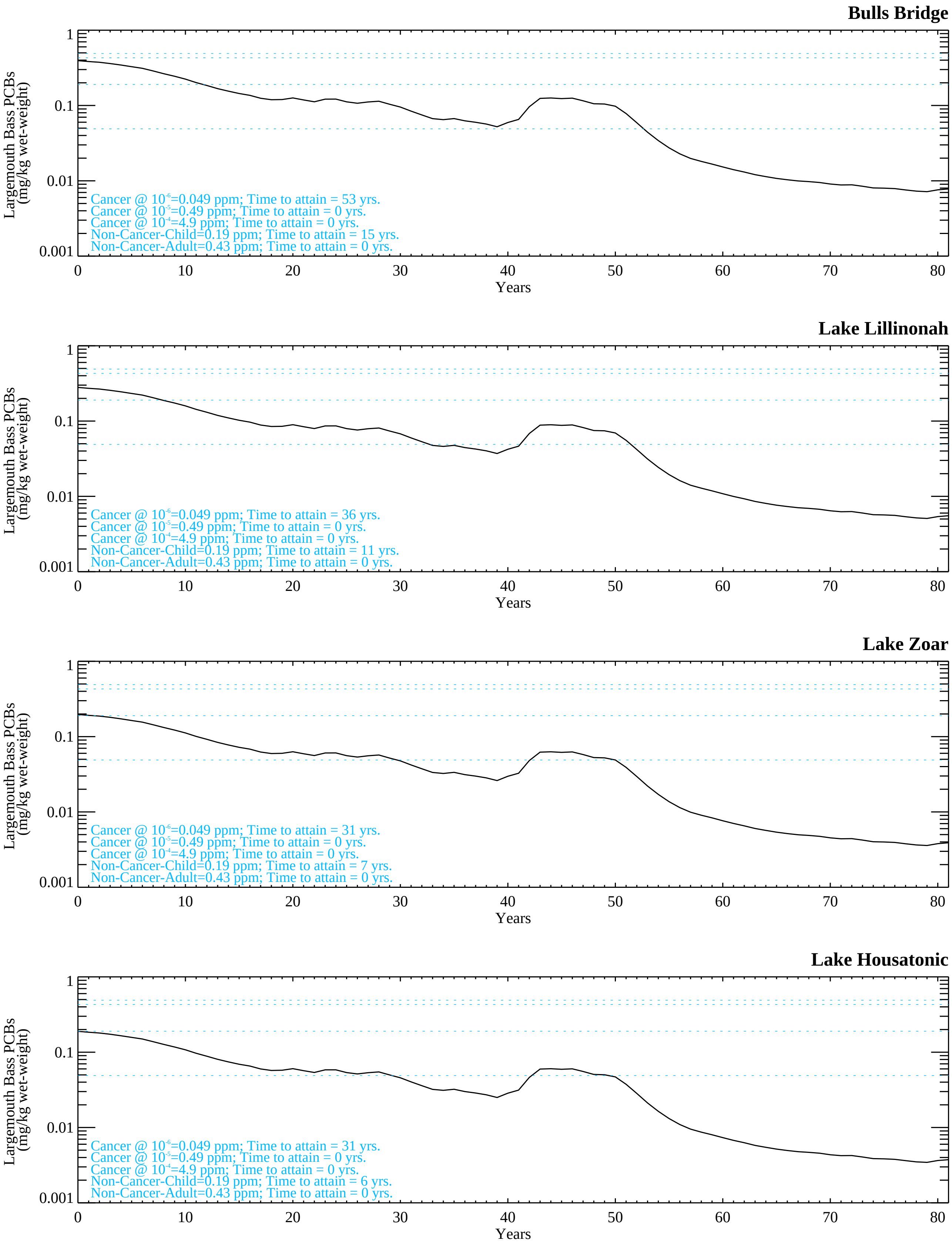

Figure G-8.1-7j. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 8; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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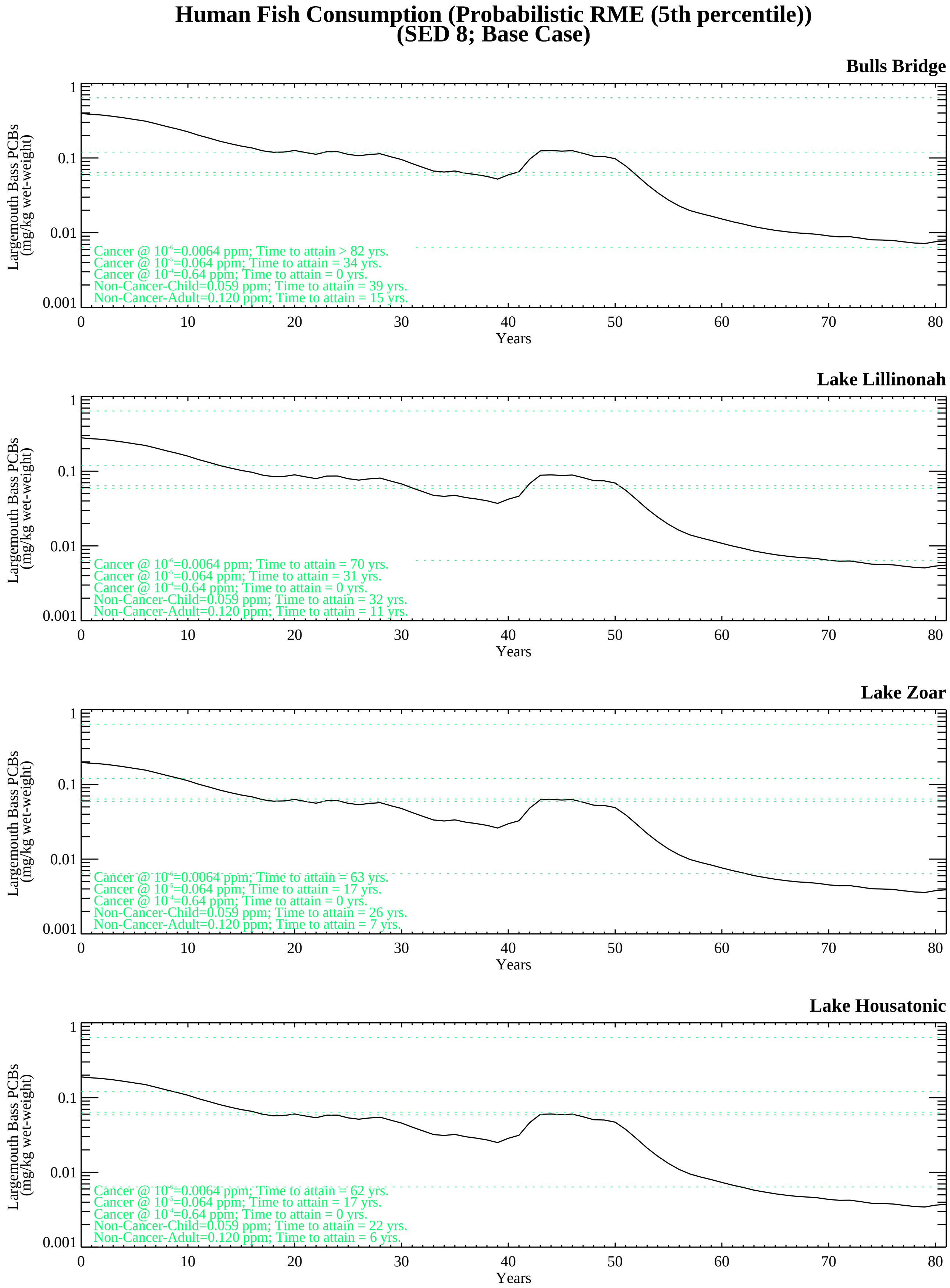

Figure G-8.1-7k. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 8; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

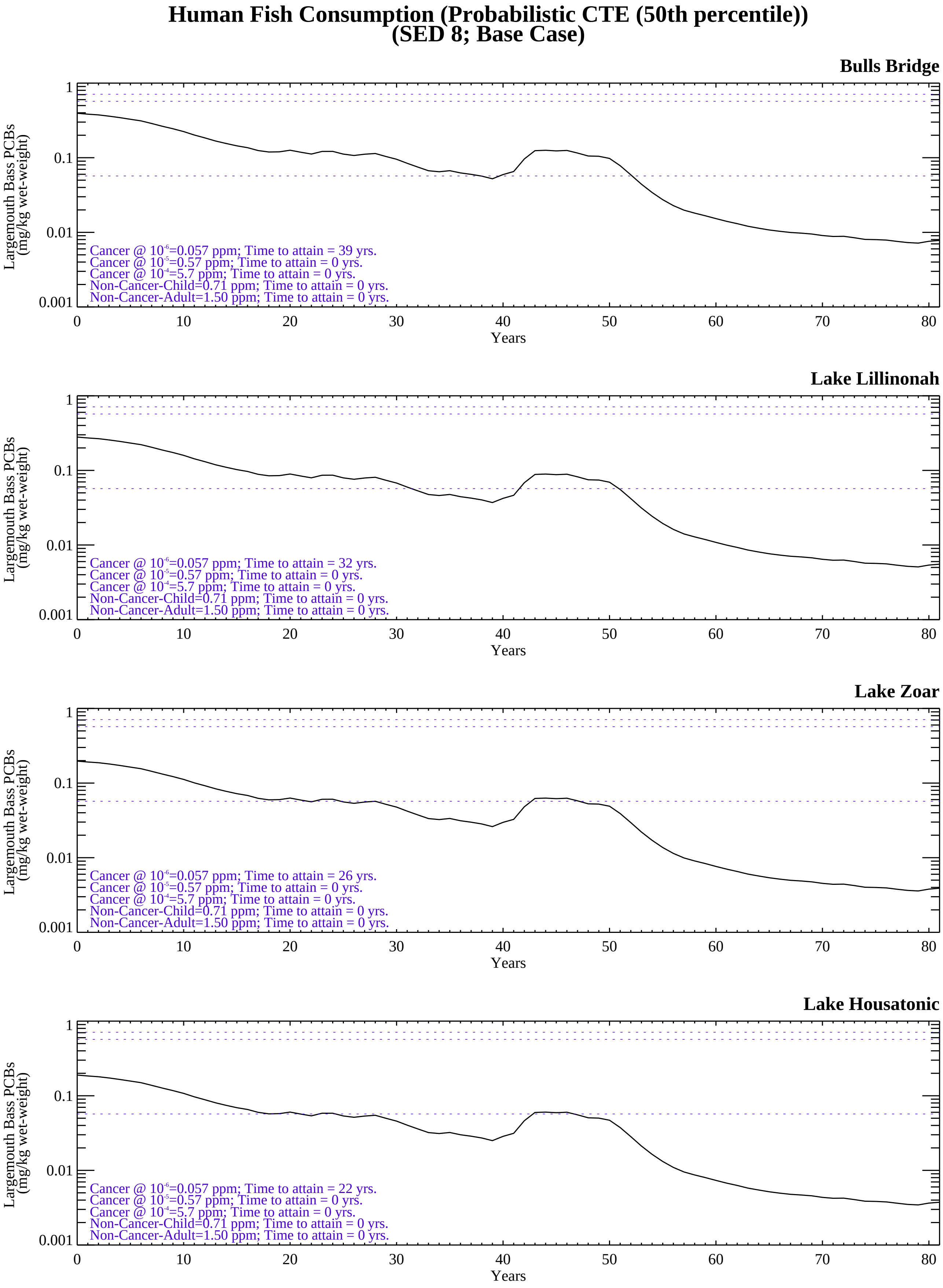

Figure G-8.1-7l. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 8; CT; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

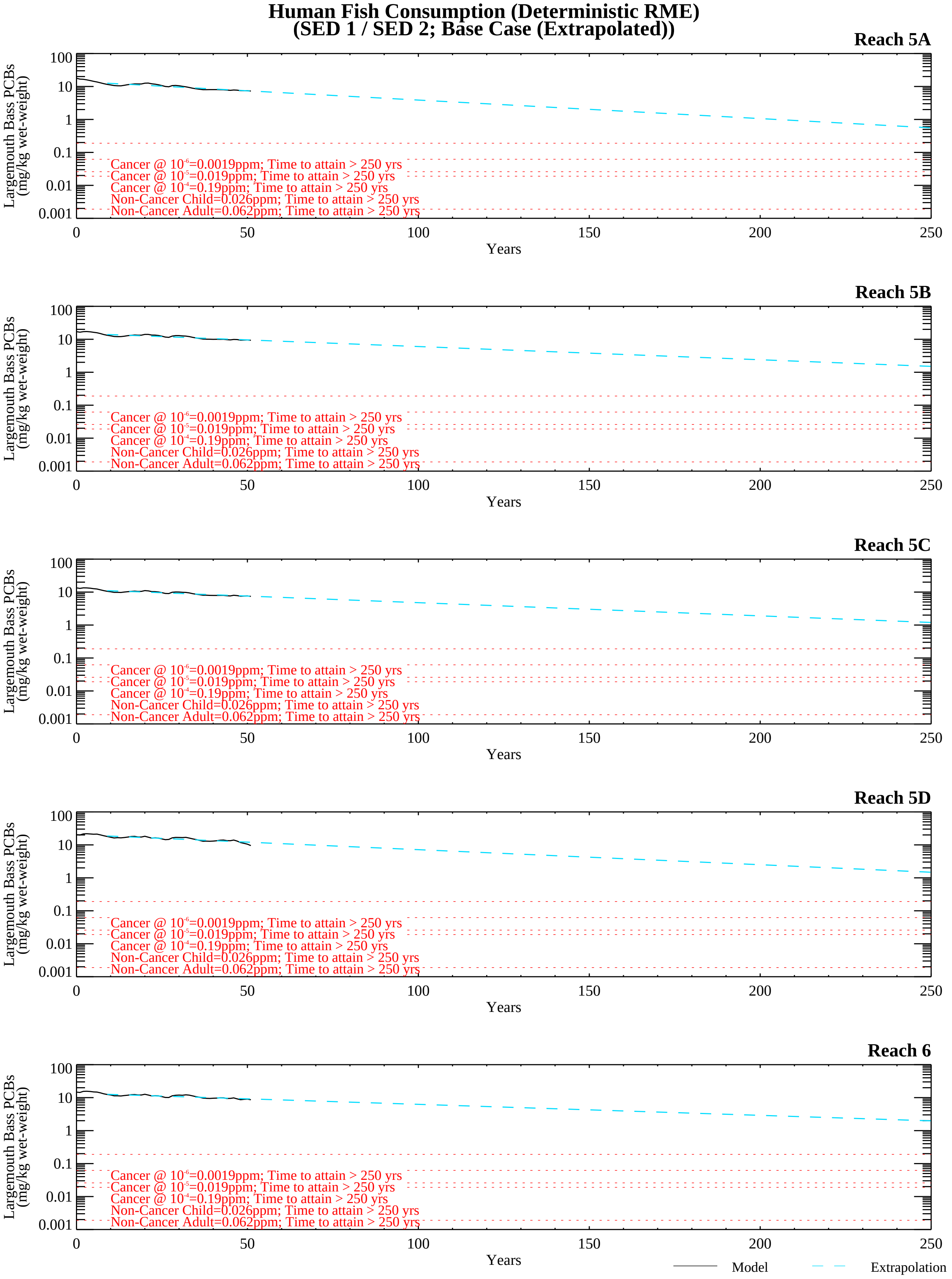

Figure G-8.2-1a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 1 / SED 2; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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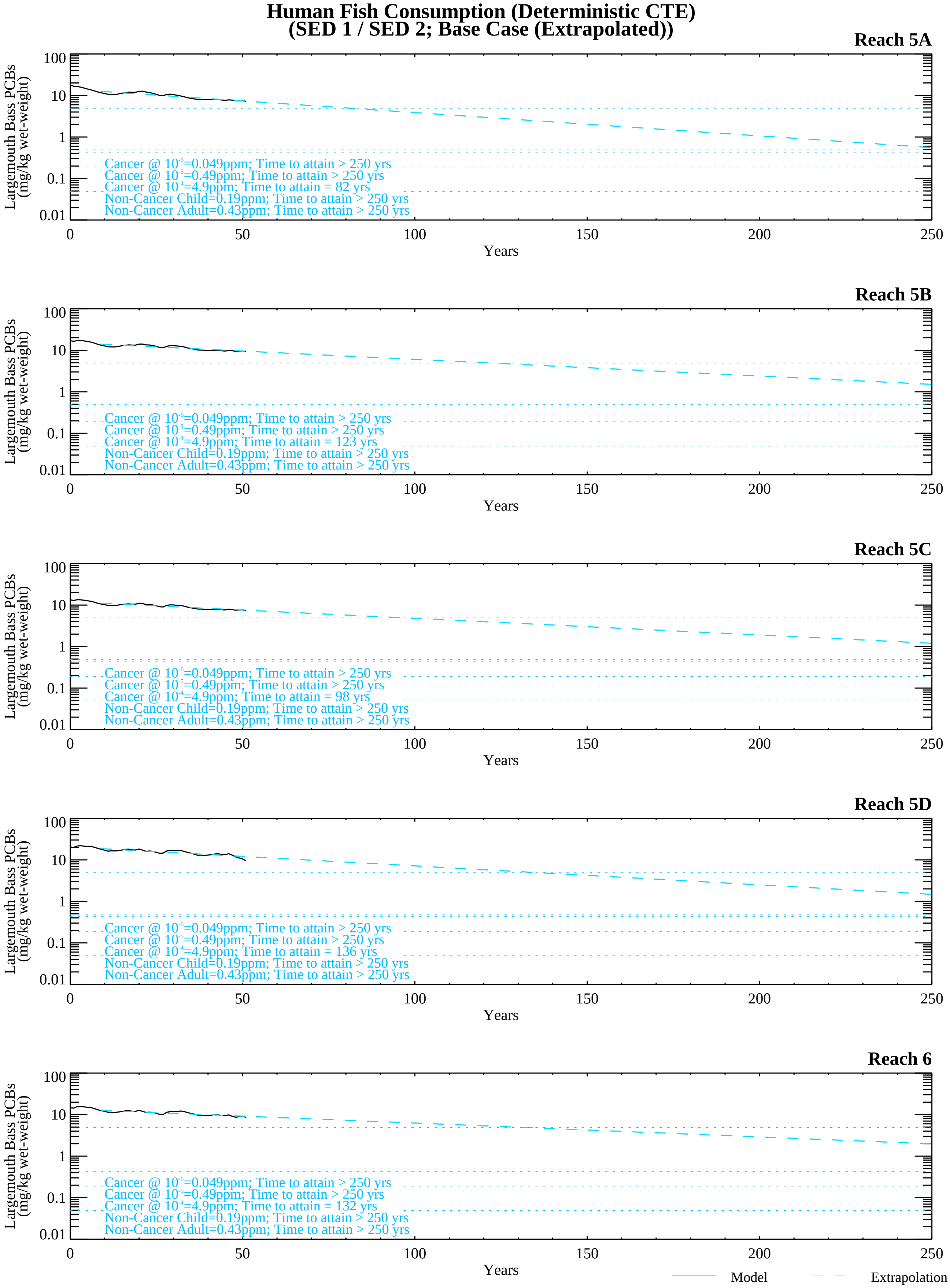

Figure G-8.2-1b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 1 / SED 2; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

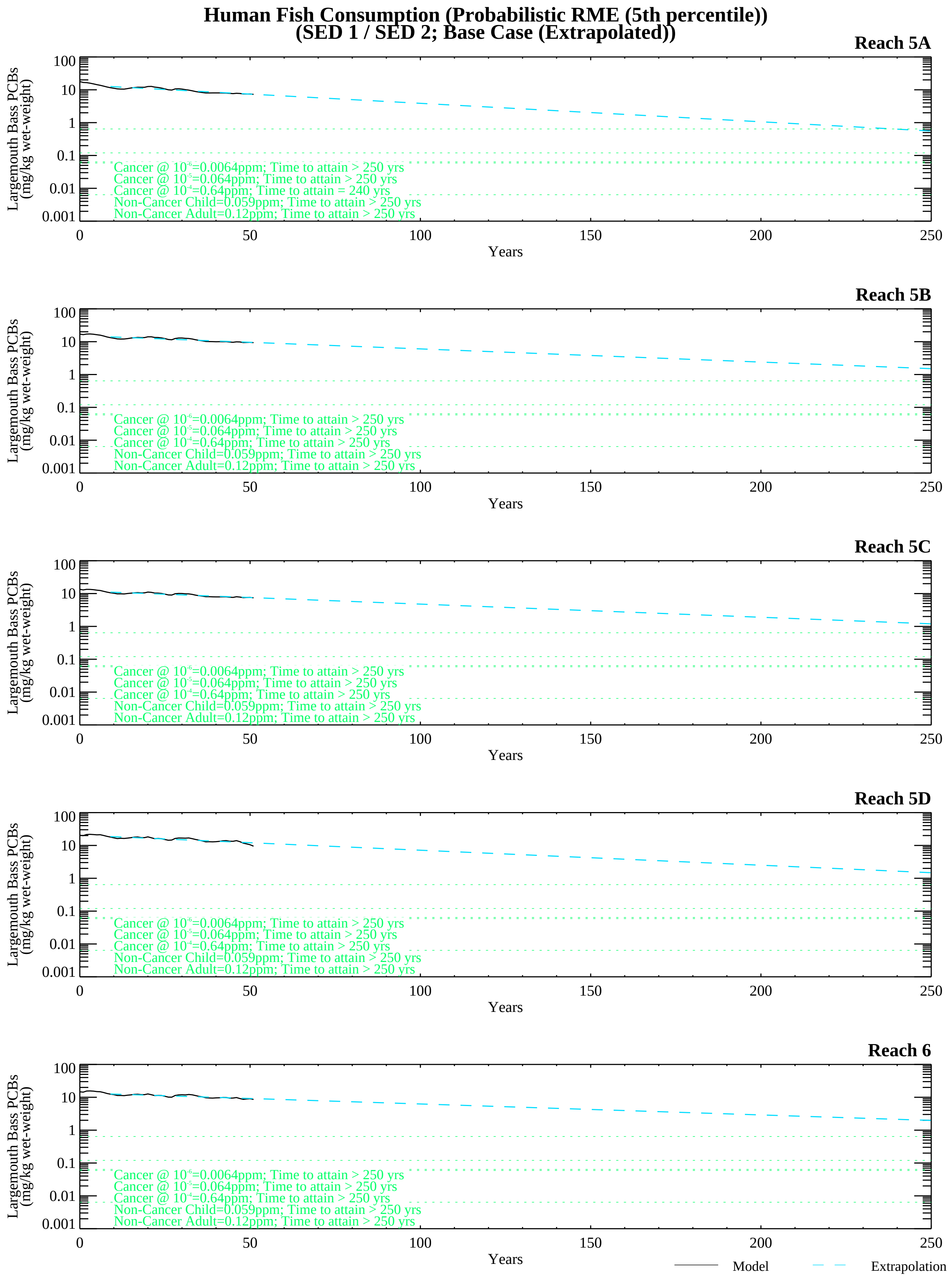

Figure G-8.2-1c. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 1 / SED 2; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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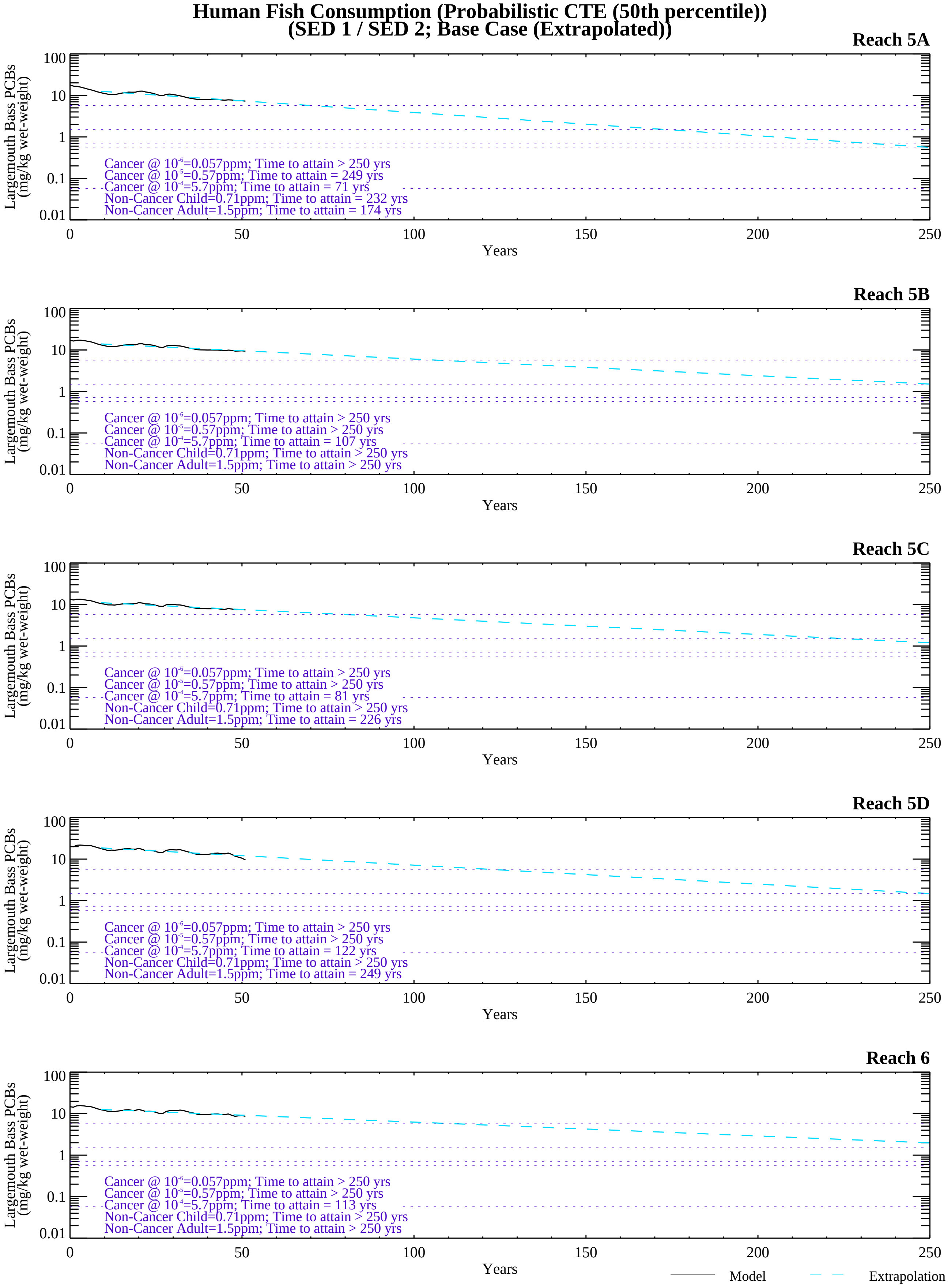

Figure G-8.2-1d. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 1 / SED 2; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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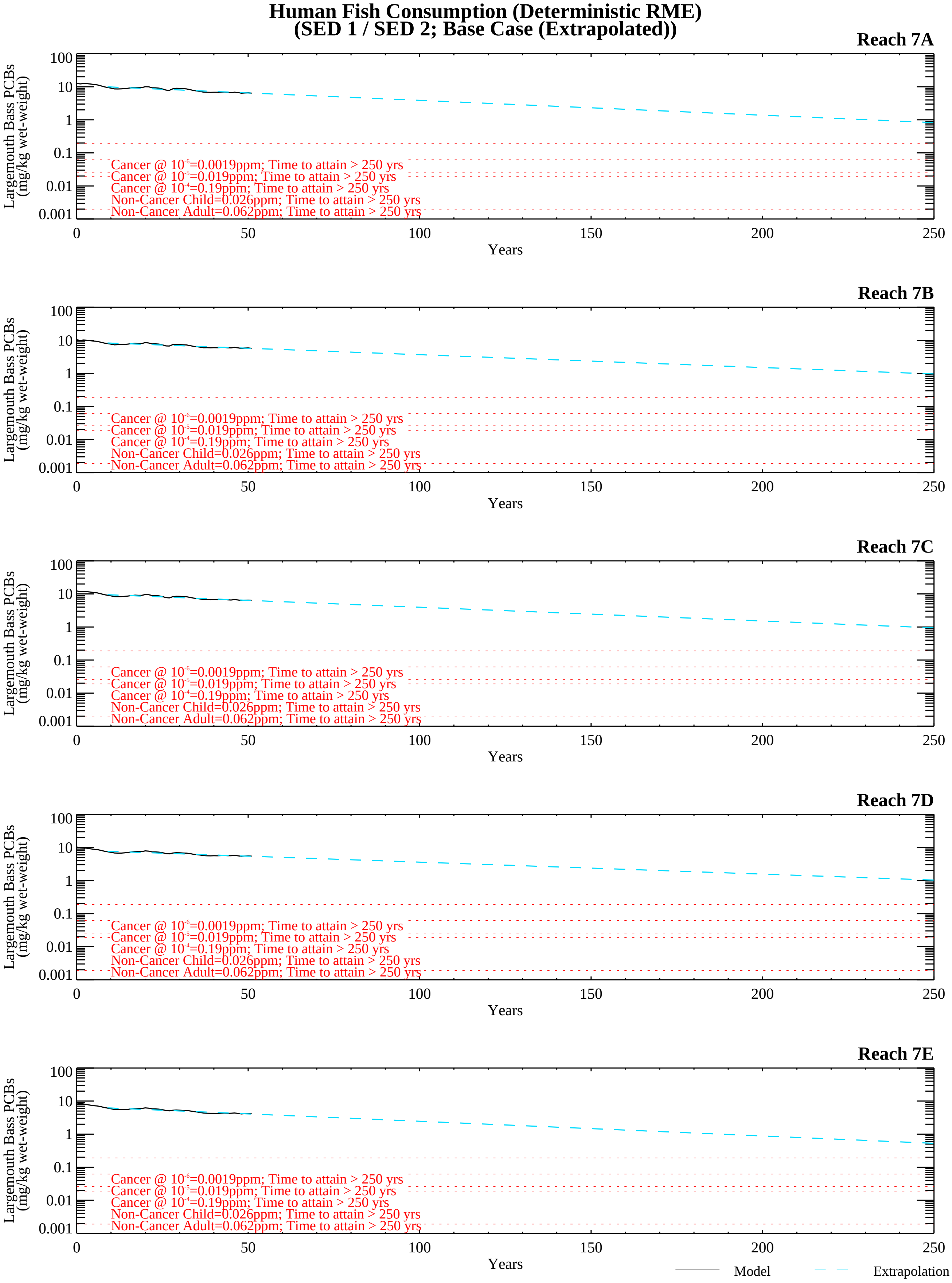

Figure G-8.2-1e. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 1 / SED 2; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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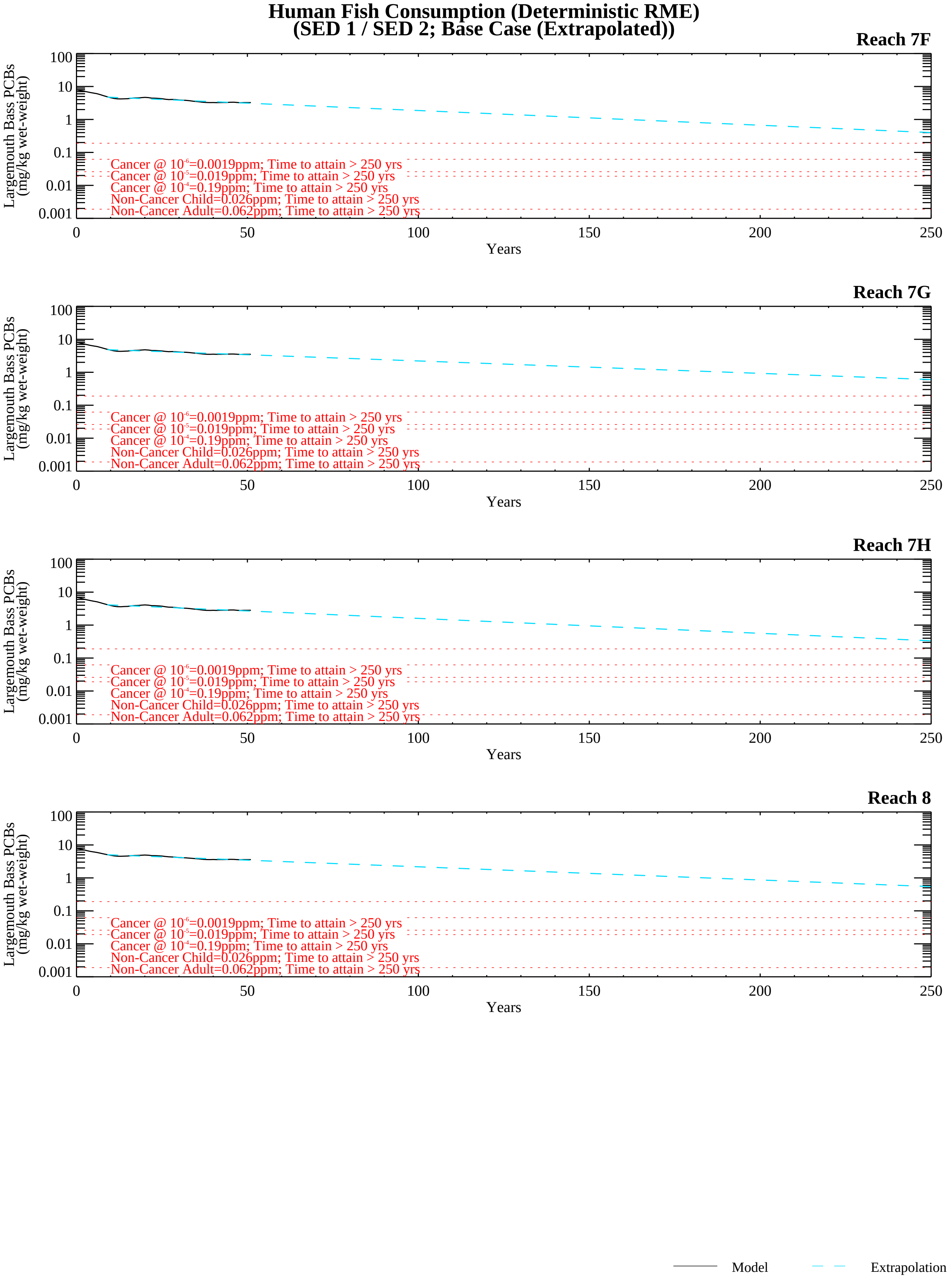

Figure G-8.2-1e. Extracted temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 1 / SED 2; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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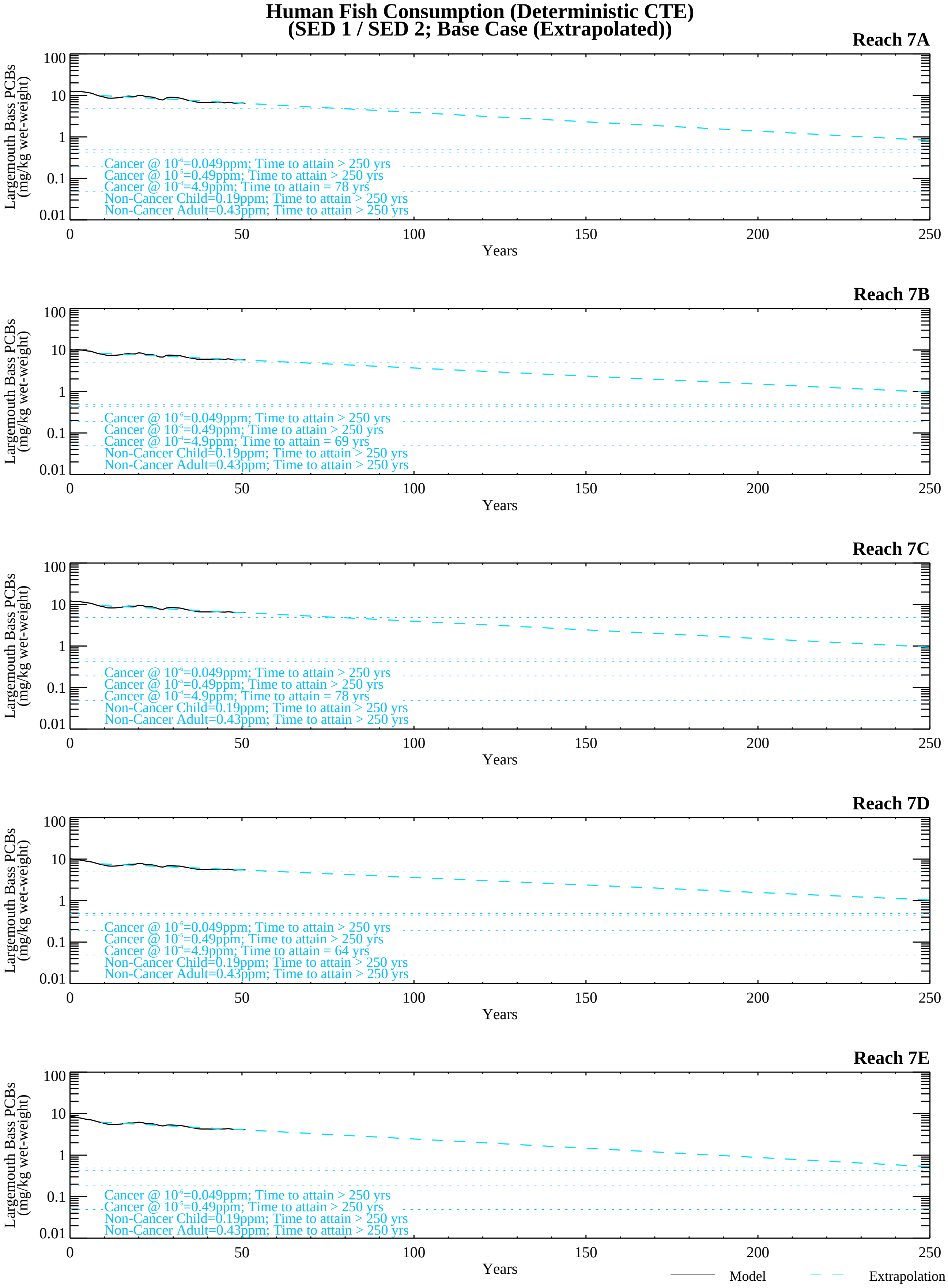

Figure G-8.2-1f. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 1 / SED 2; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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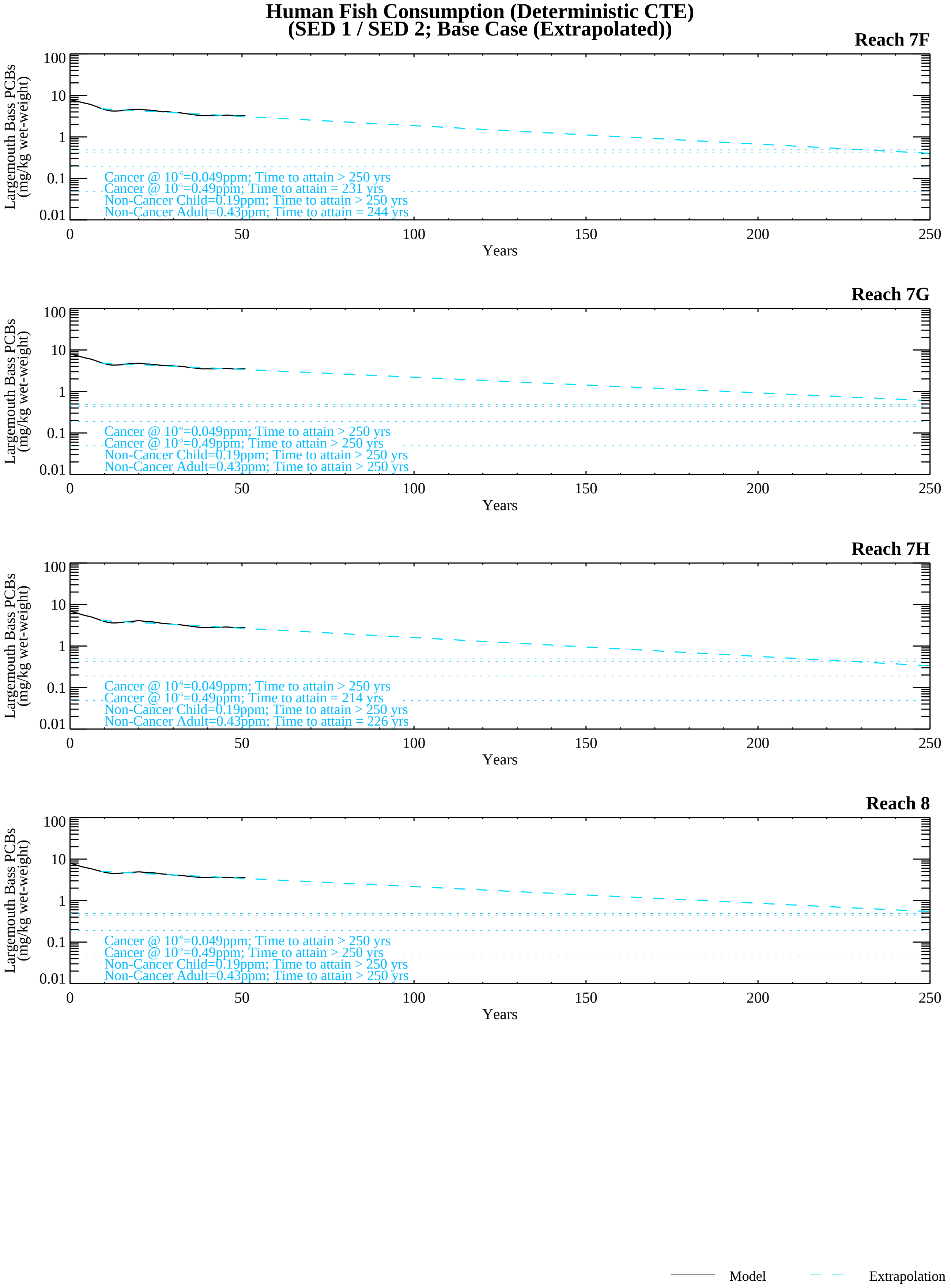

Figure G-8.2-1f. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 1 / SED 2; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

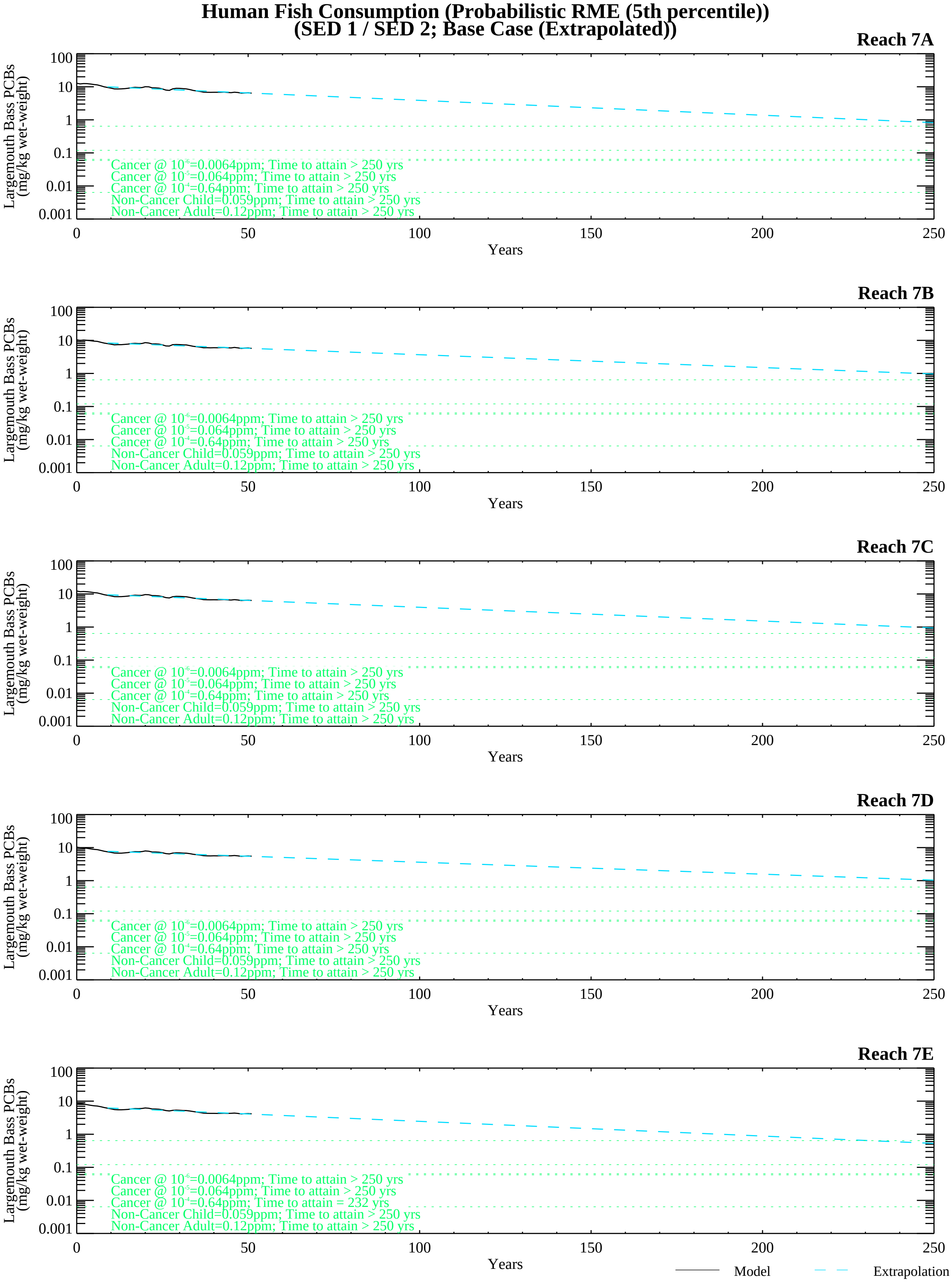

Figure G-8.2-1g. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 1 / SED 2; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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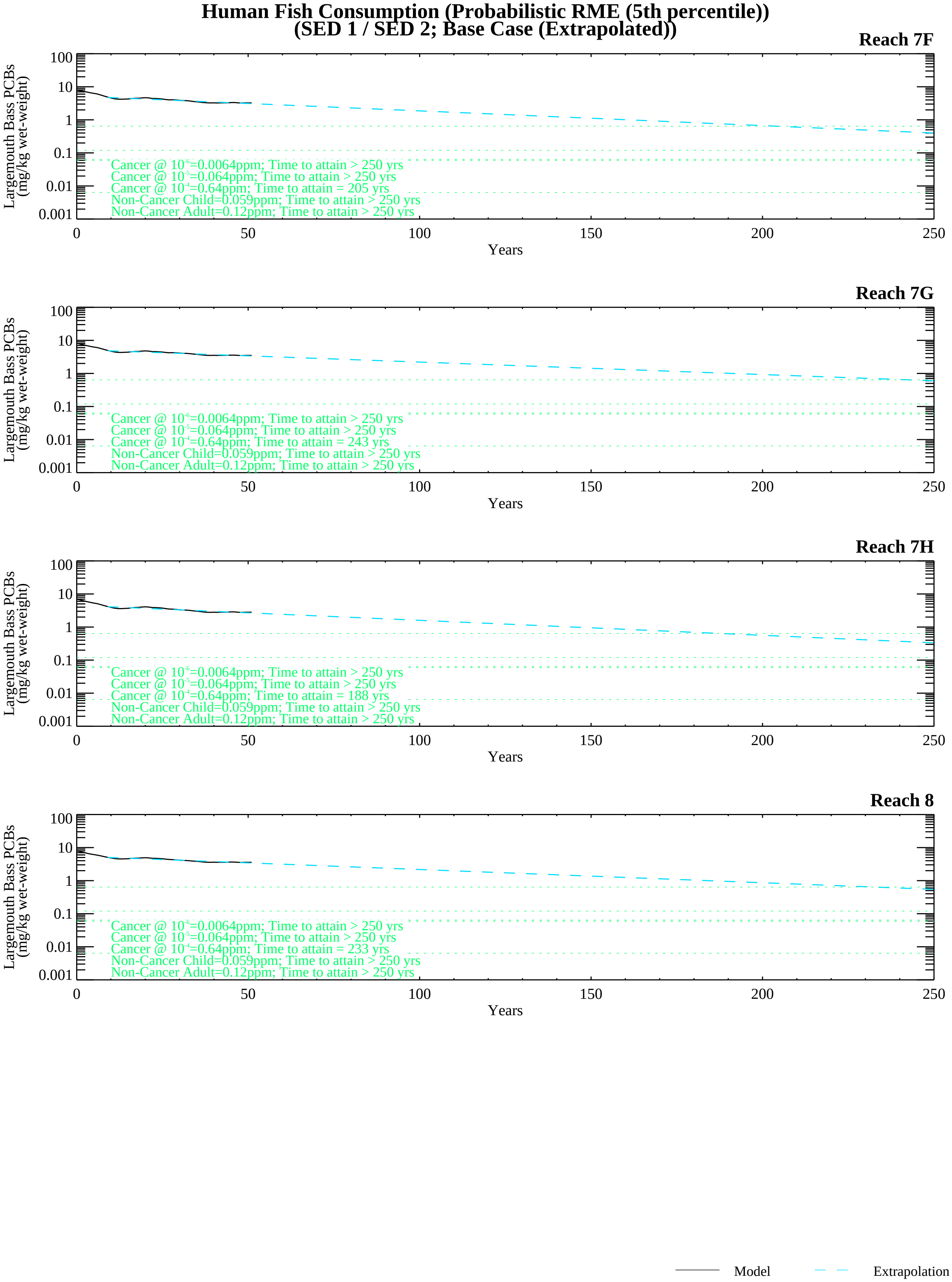

Figure G-8.2-1g. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 1 / SED 2; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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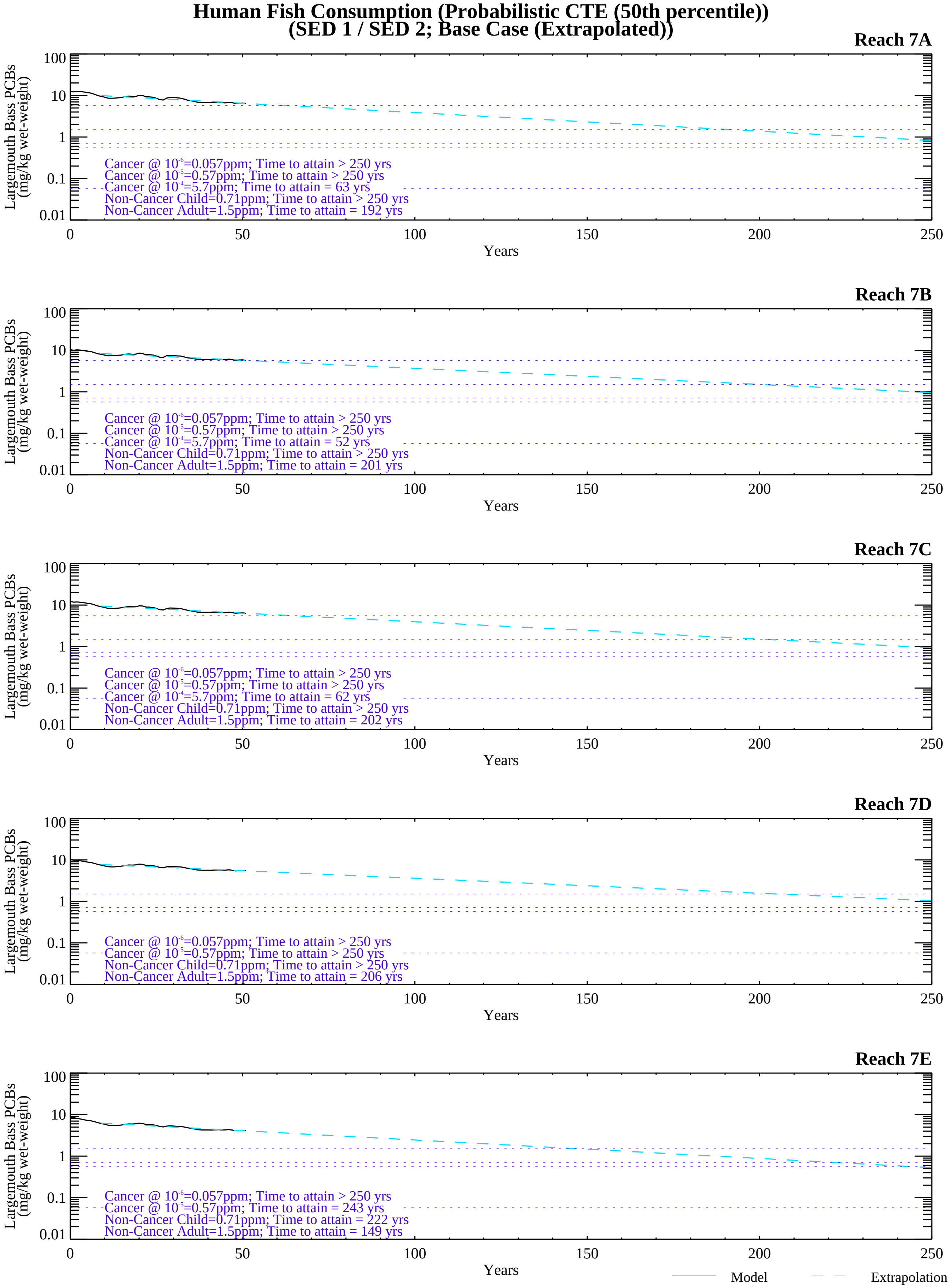

Figure G-8.2-1h. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 1 / SED 2; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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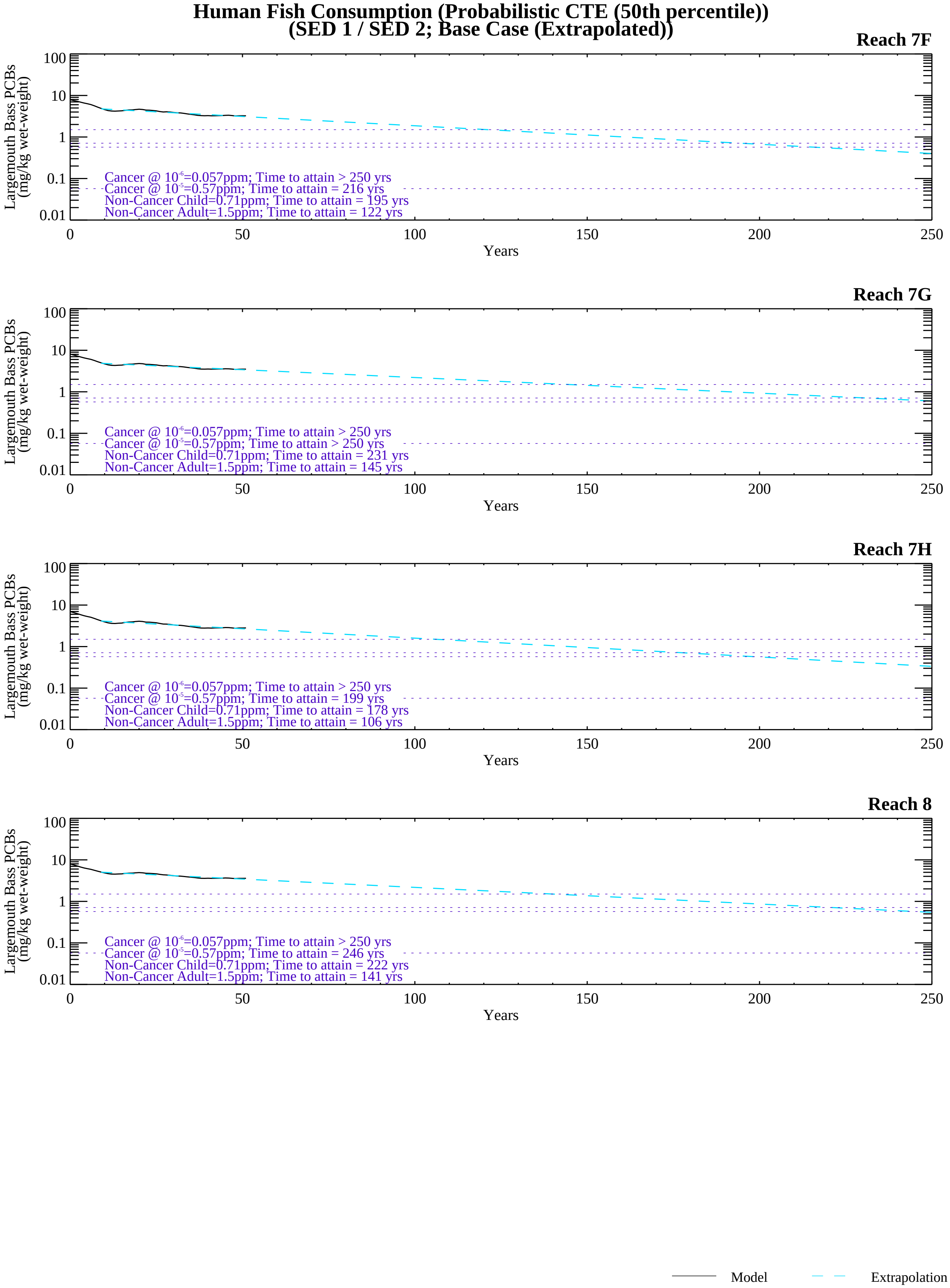

Figure G-8.2-1h. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 1 / SED 2; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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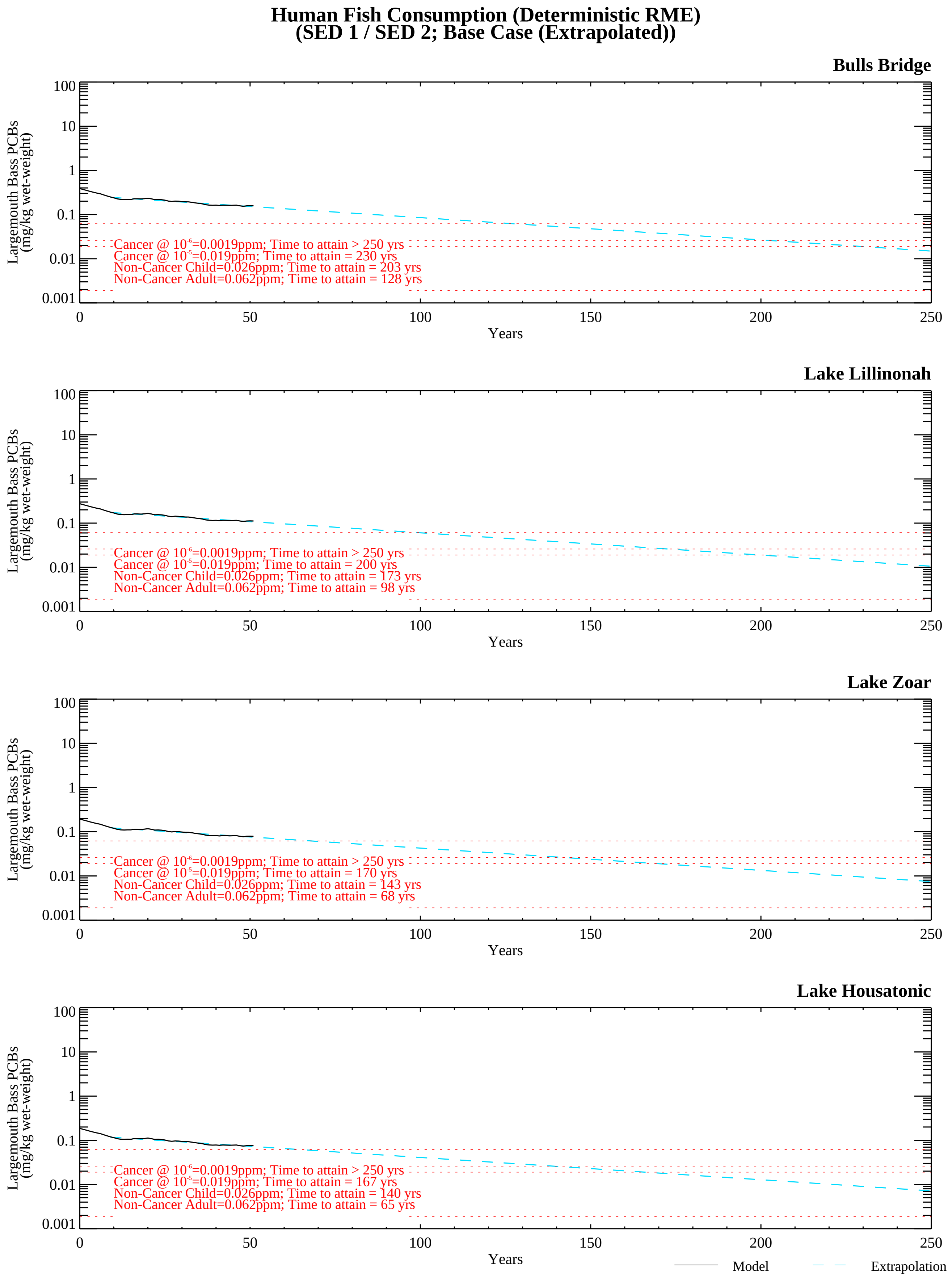

Figure G-8.2-1i. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to deterministic RME IMPGs for human consumption of fish (SED 1 / SED 2; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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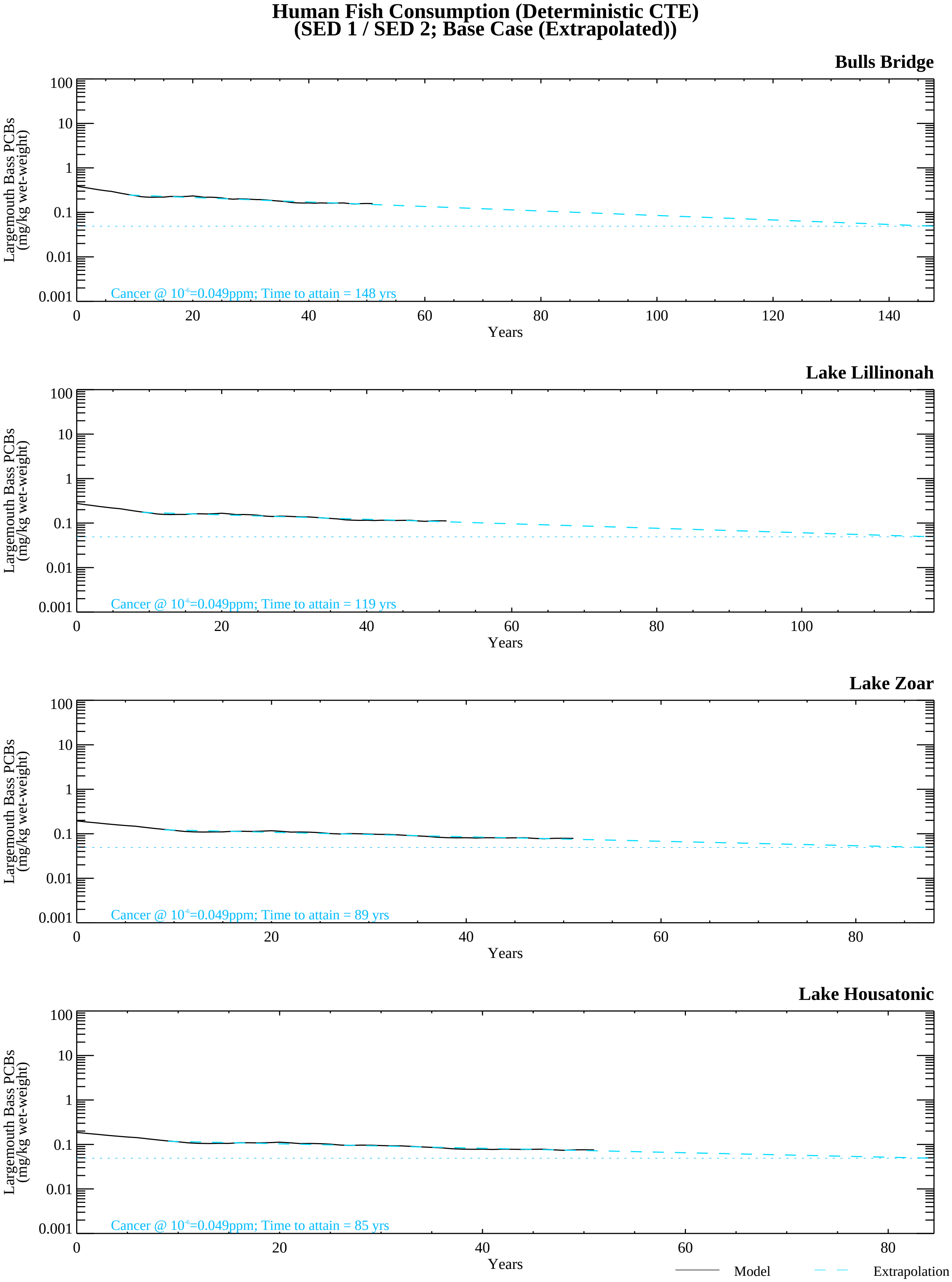

Figure G-8.2-1j. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to deterministic CTE IMPGs for human consumption of fish (SED 1 / SED 2; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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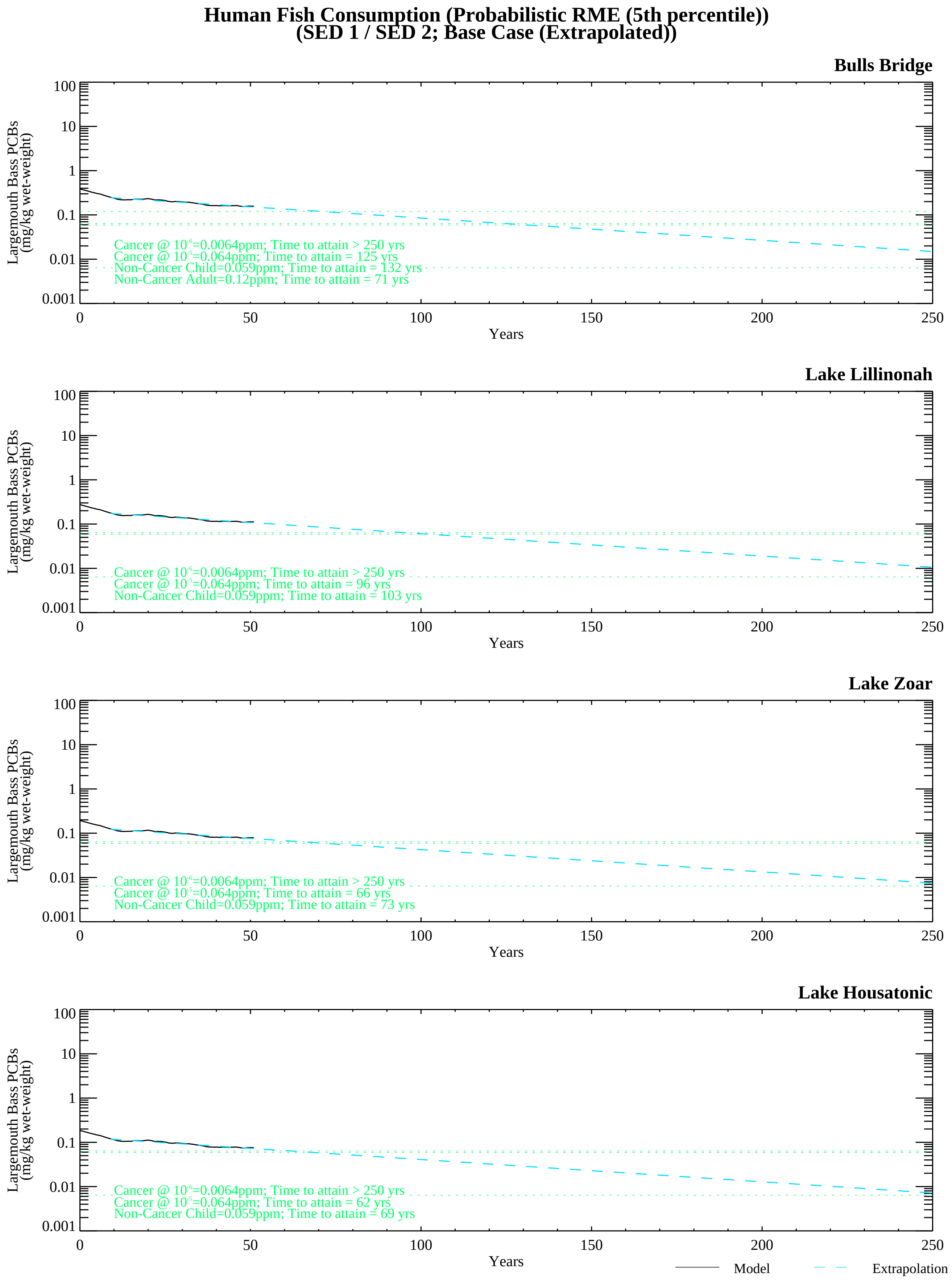

Figure G-8.2-1k. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to probabilistic RME IMPGs for human consumption of fish (SED 1 / SED 2; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 1 / SED 2; Base Case (Extrapolated))

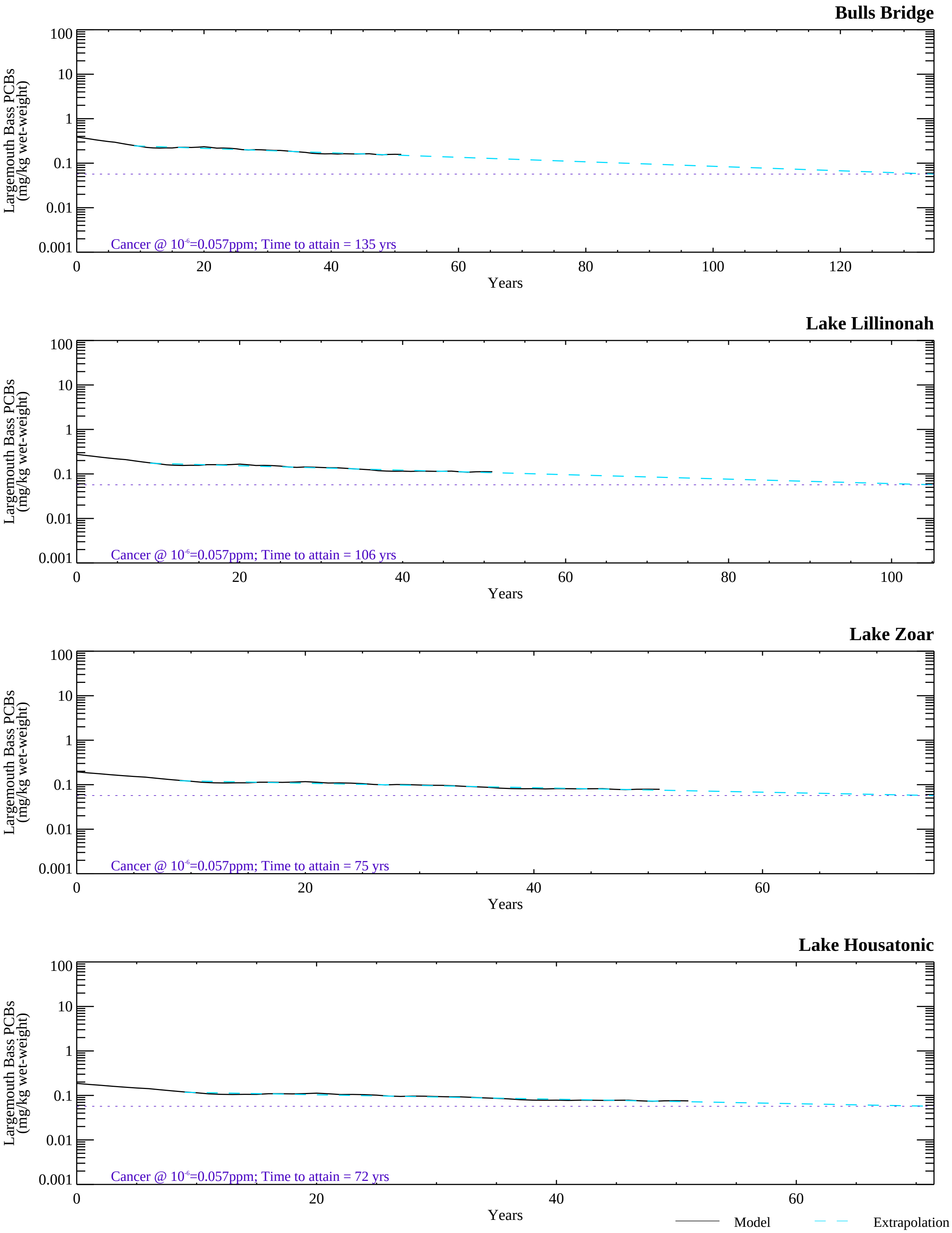

Figure G-8.2-1l. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to probabilistic CTE IMPGs for human consumption of fish (SED 1 / SED 2; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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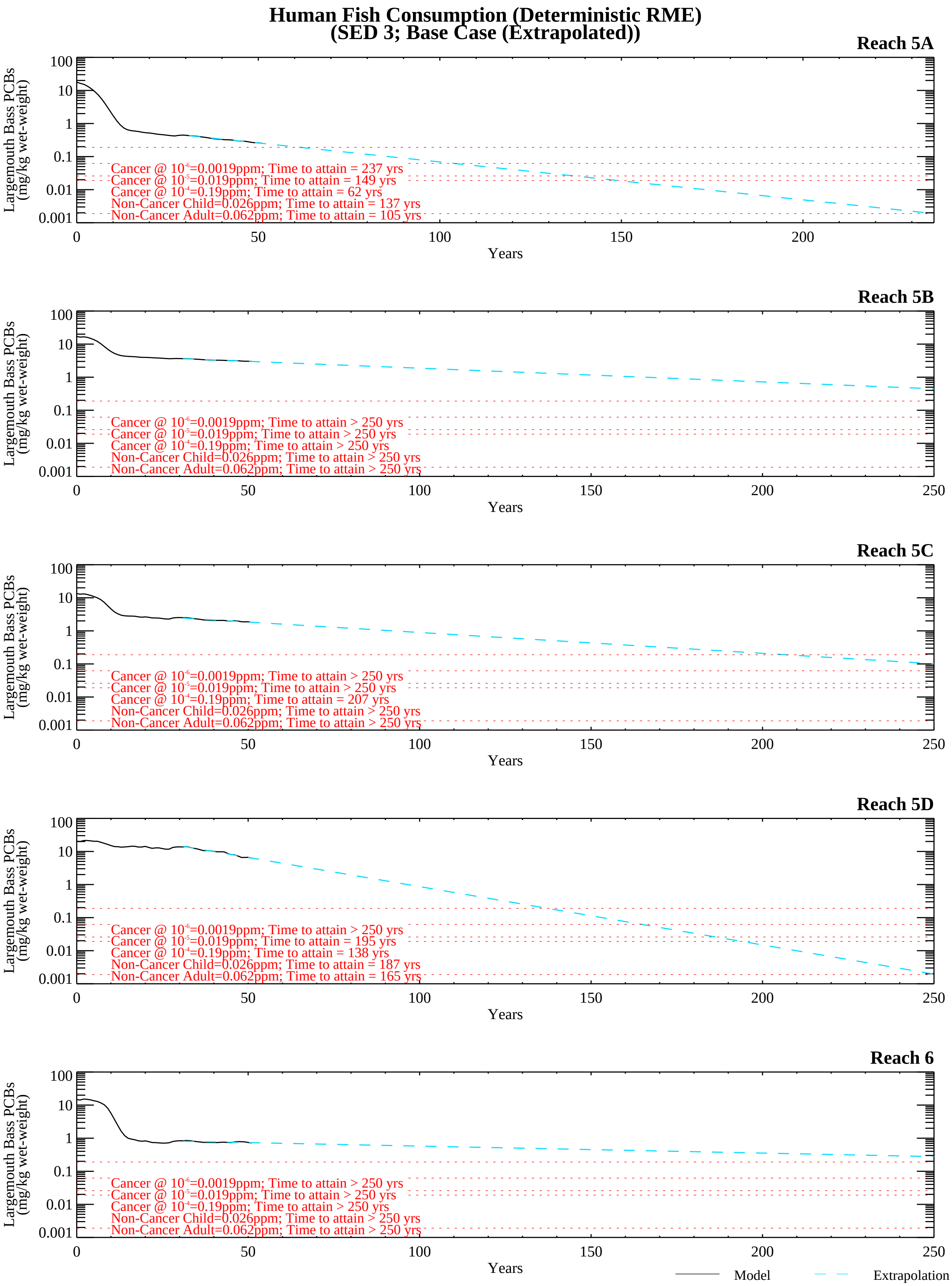

Figure G-8.2-2a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 3; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

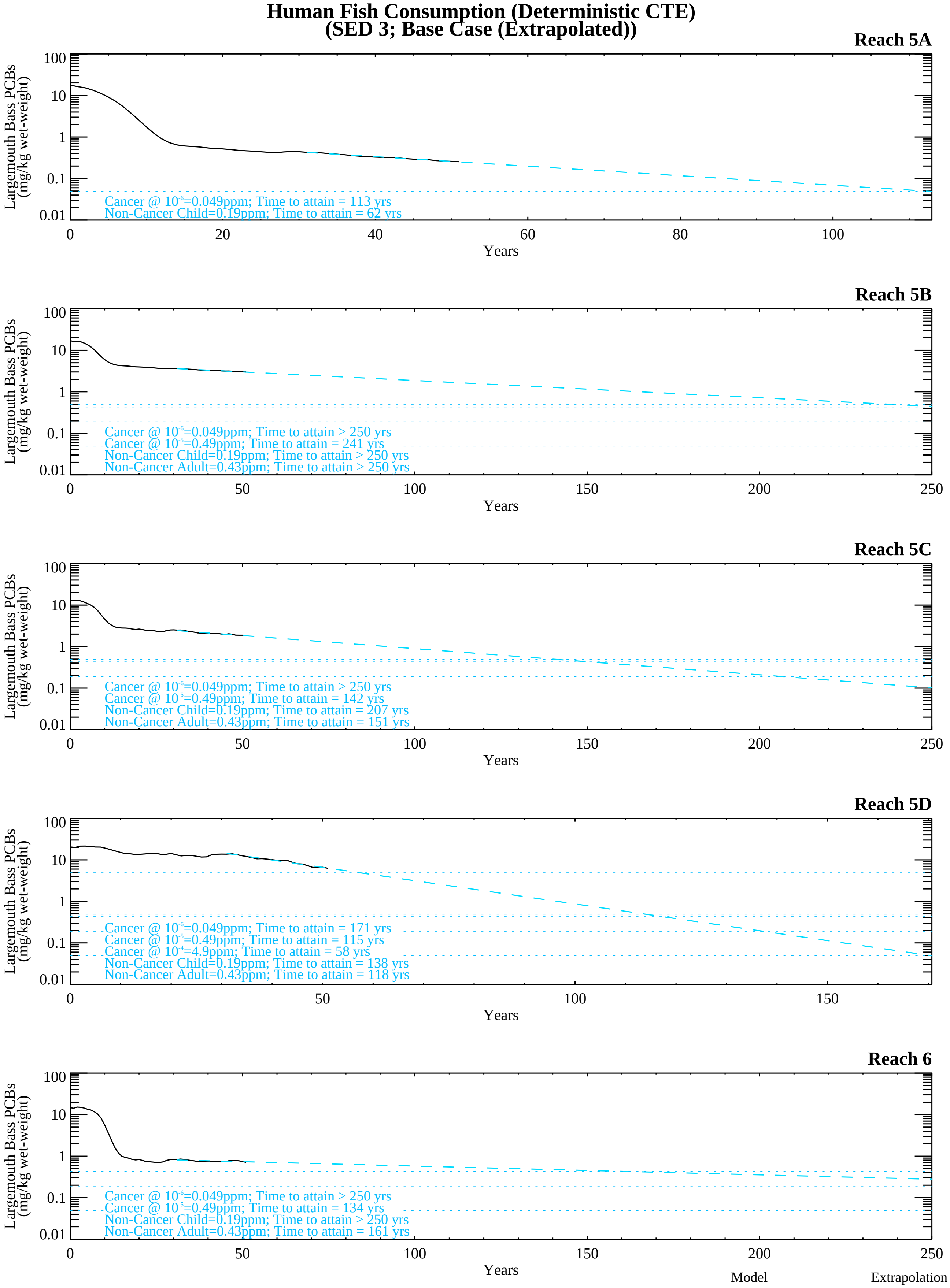

Figure G-8.2-2b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 3; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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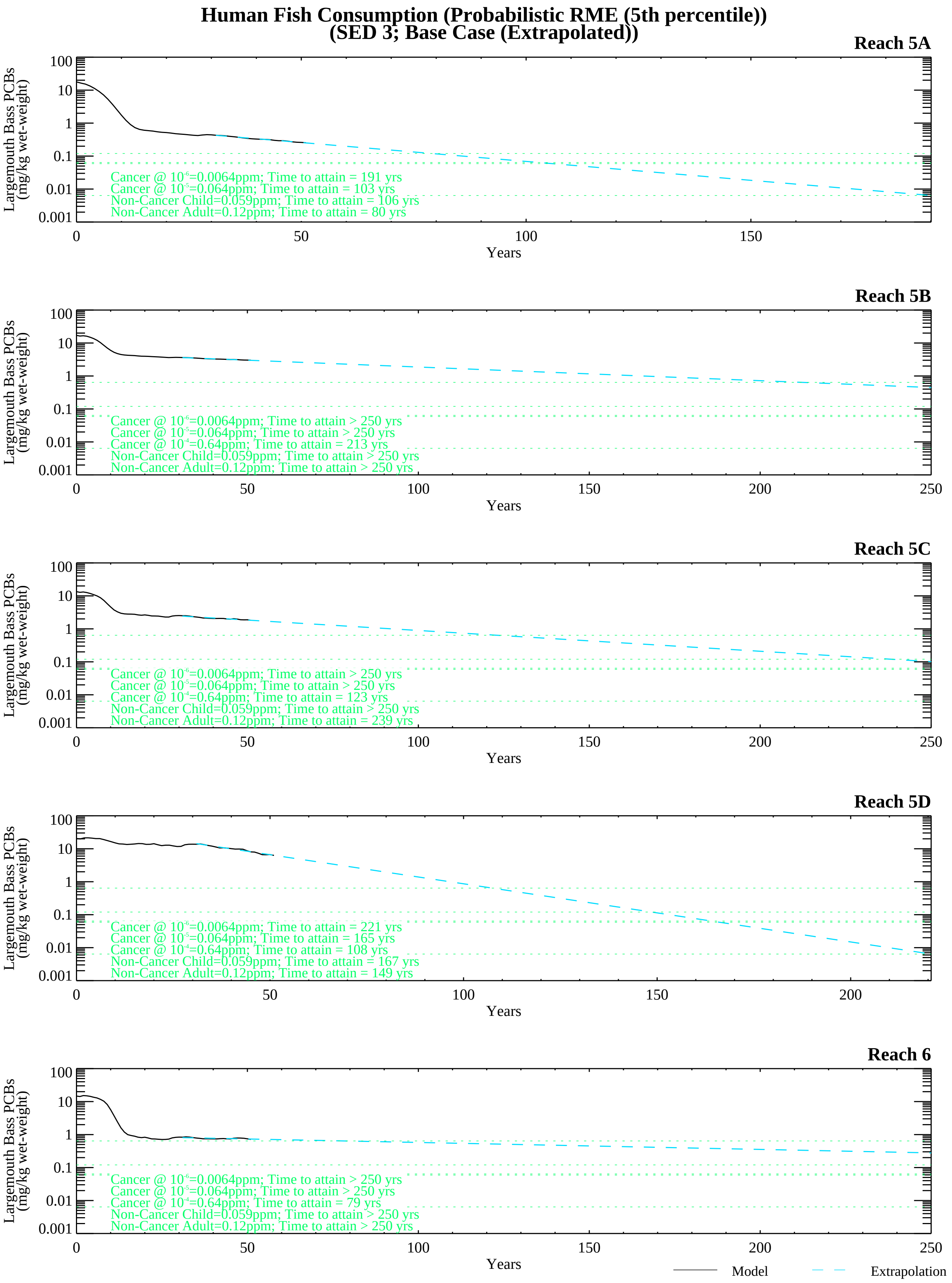

Figure G-8.2-2c. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 3; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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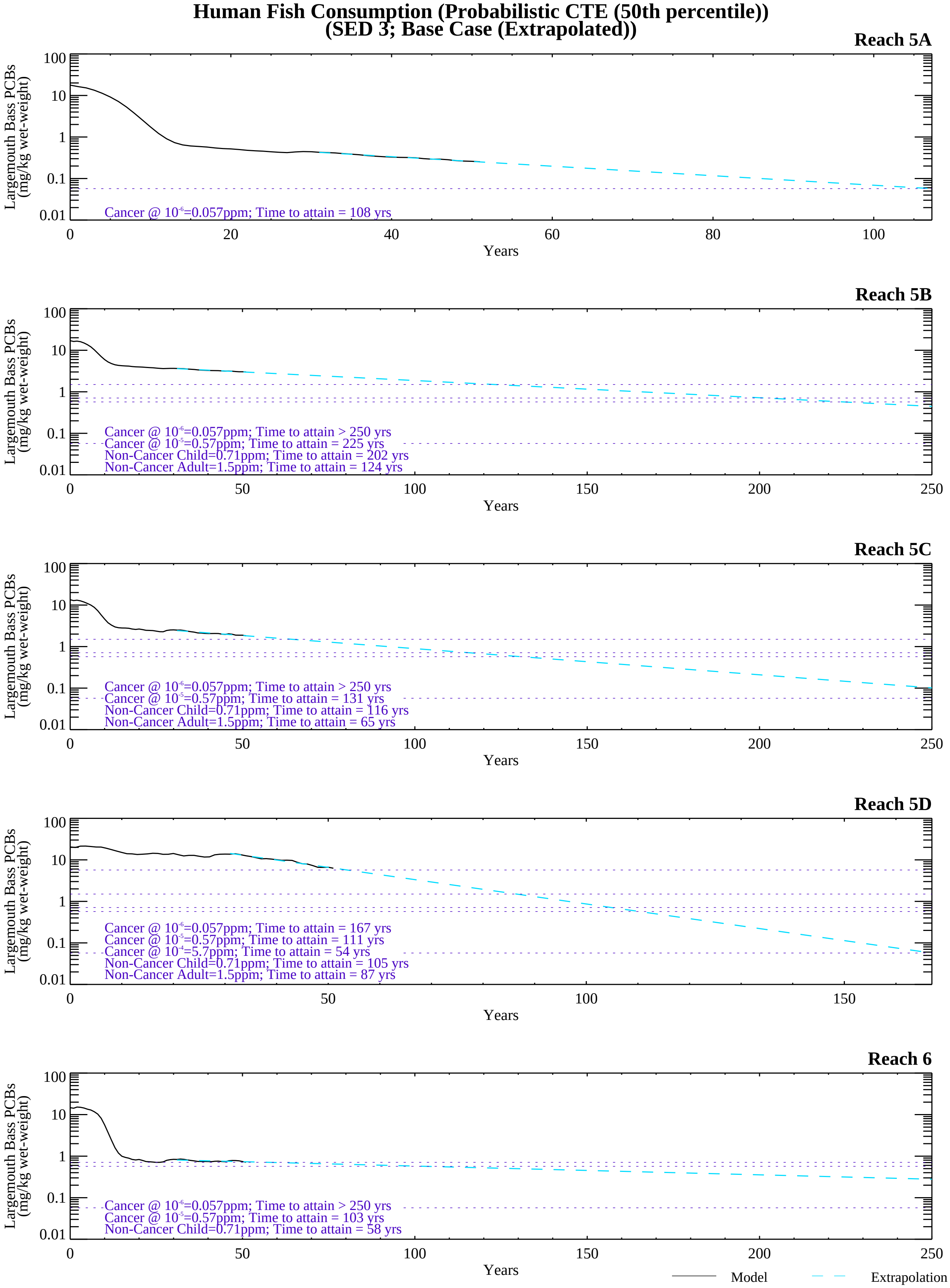

Figure G-8.2-2d. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 3; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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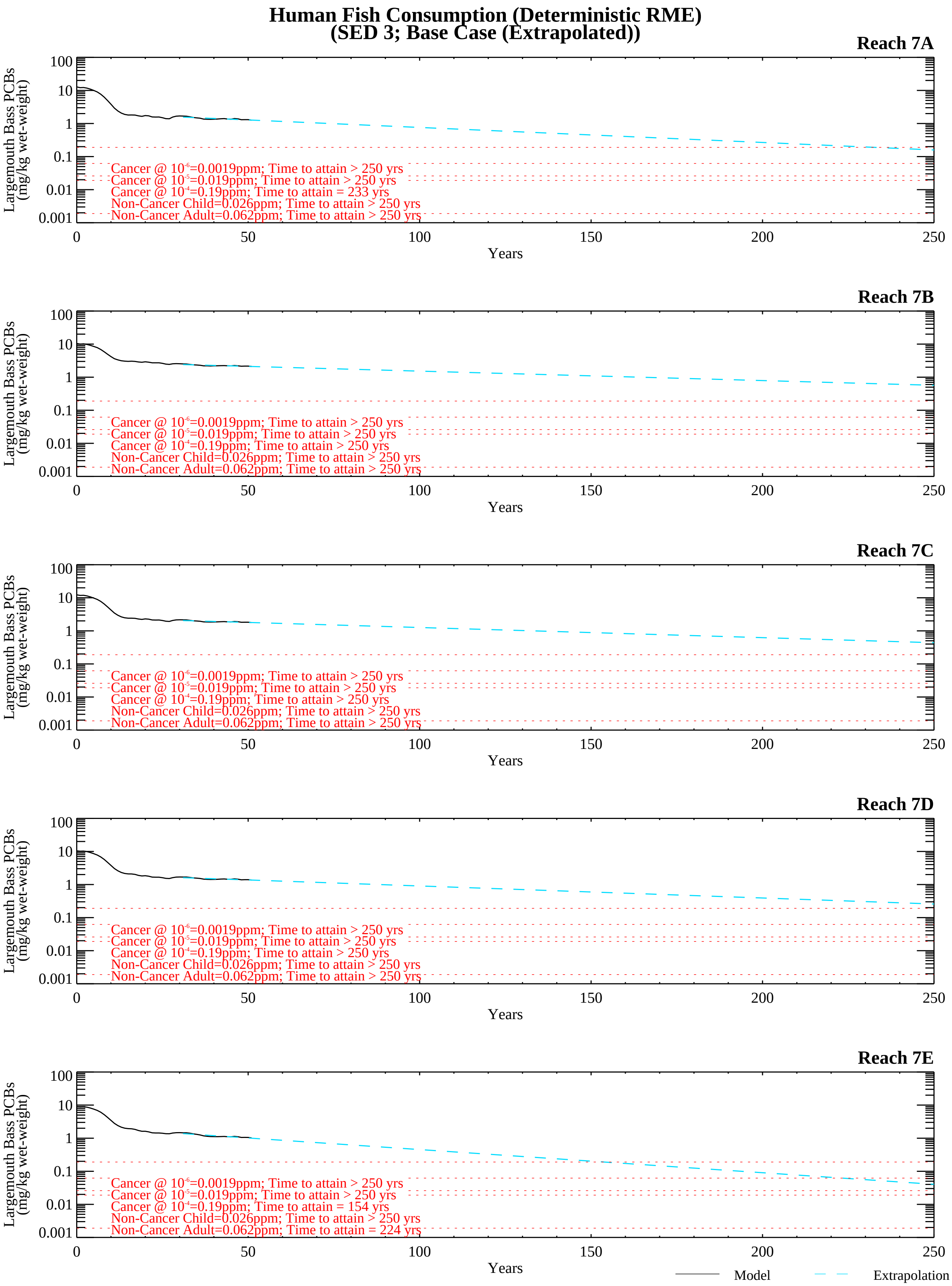

Figure G-8.2-2e. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 3; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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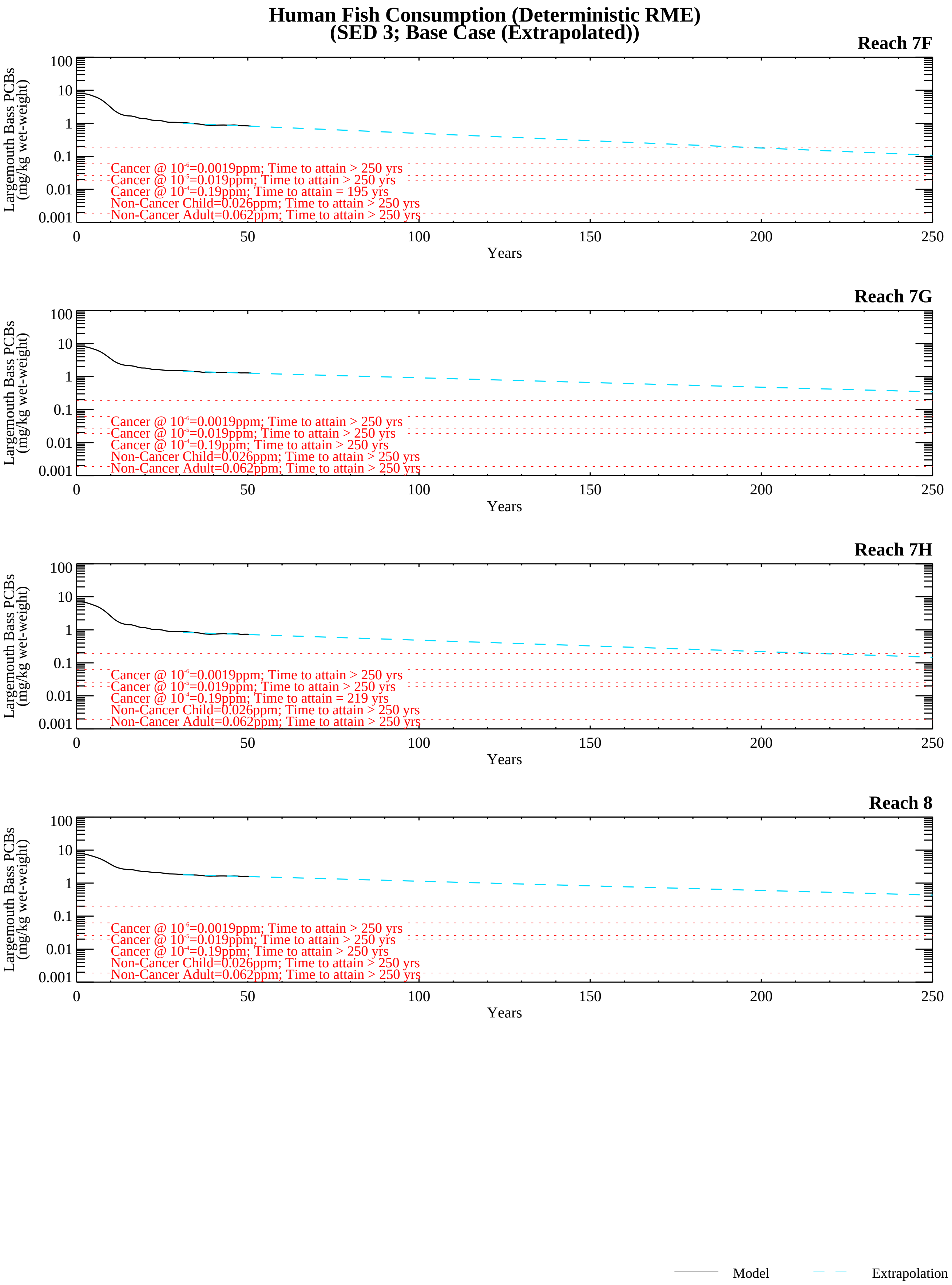

Figure G-8.2-2e. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 3; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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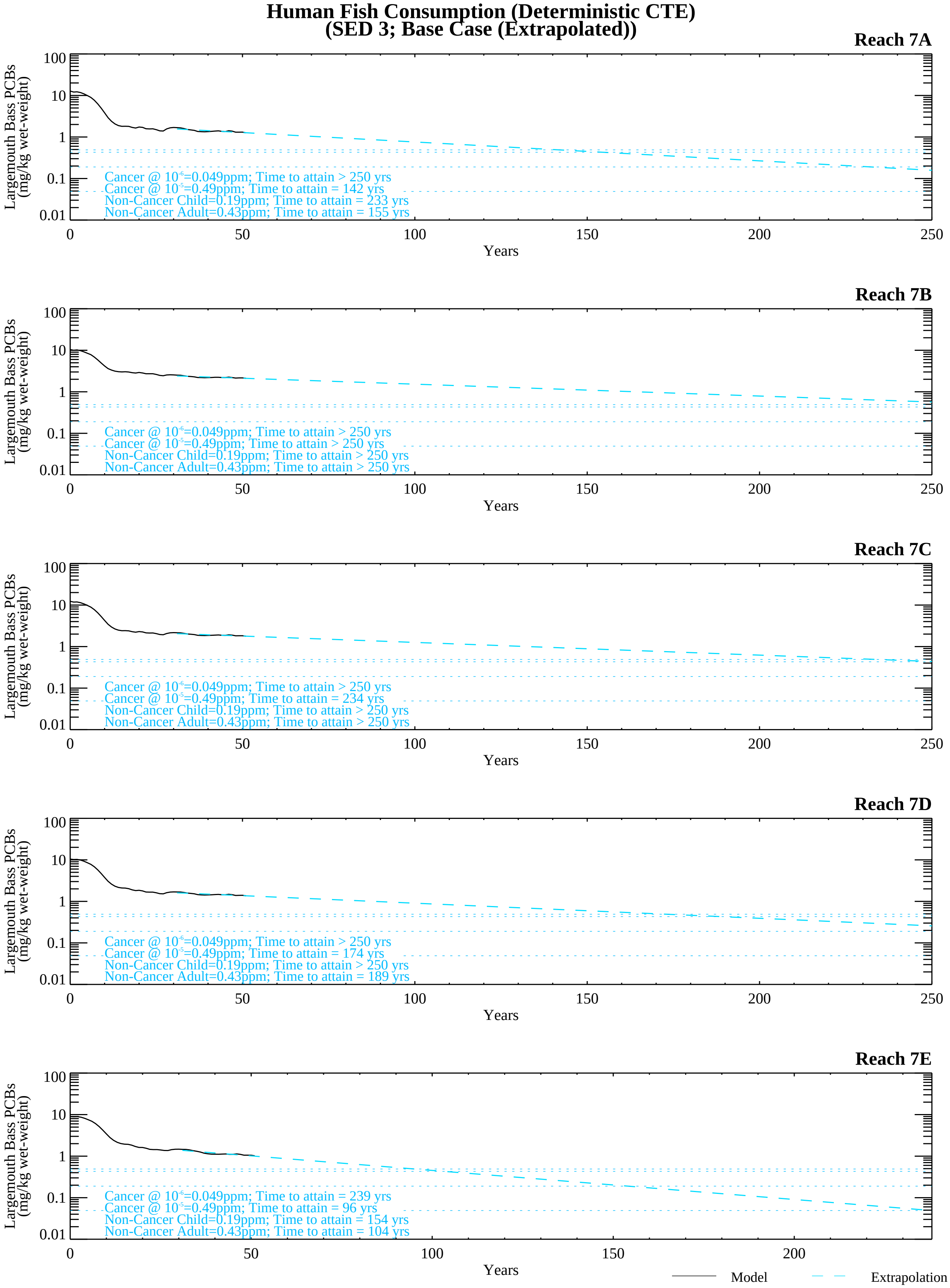

Figure G-8.2-2f. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 3; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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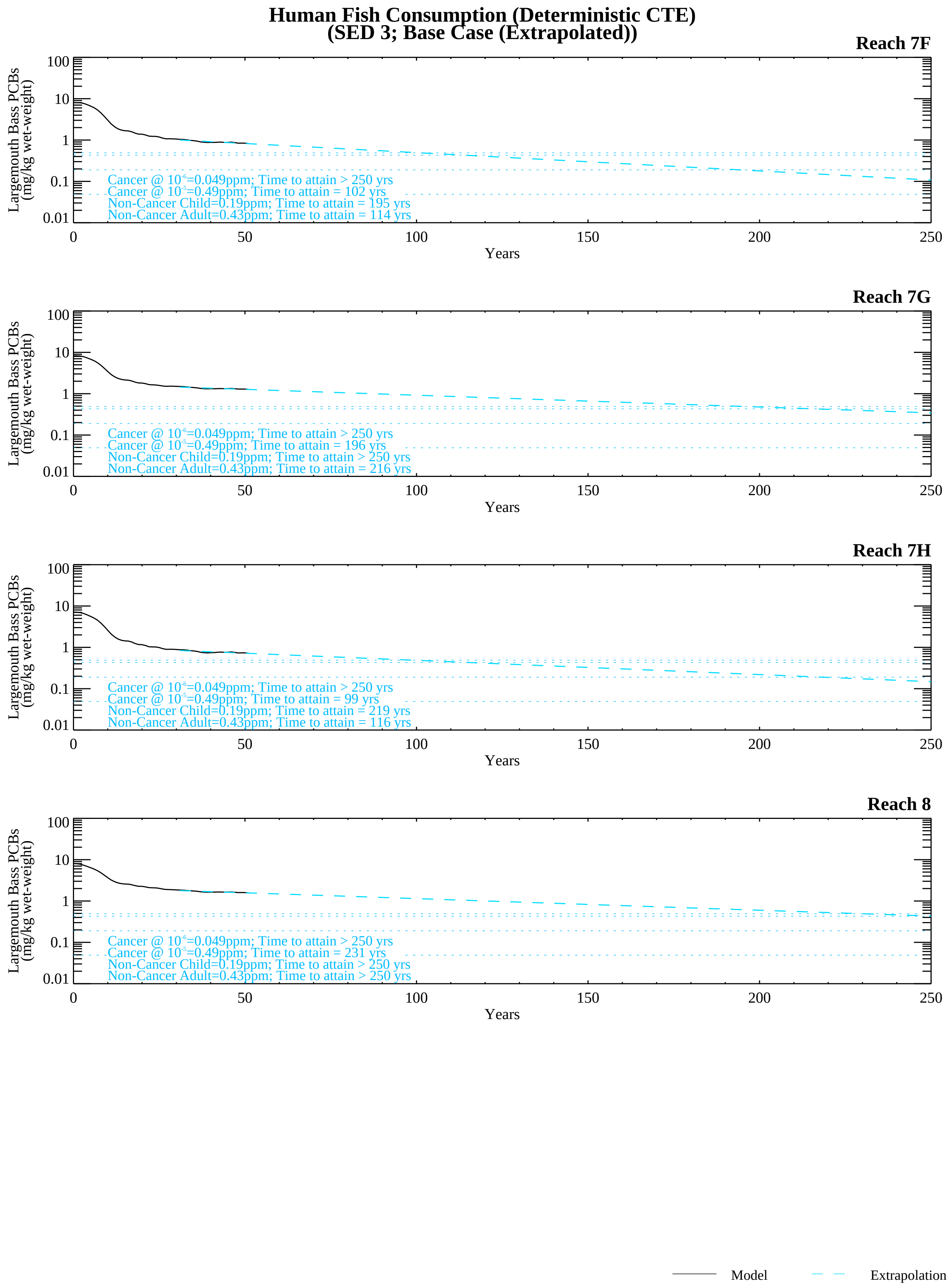

Figure G-8.2-2f. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 3; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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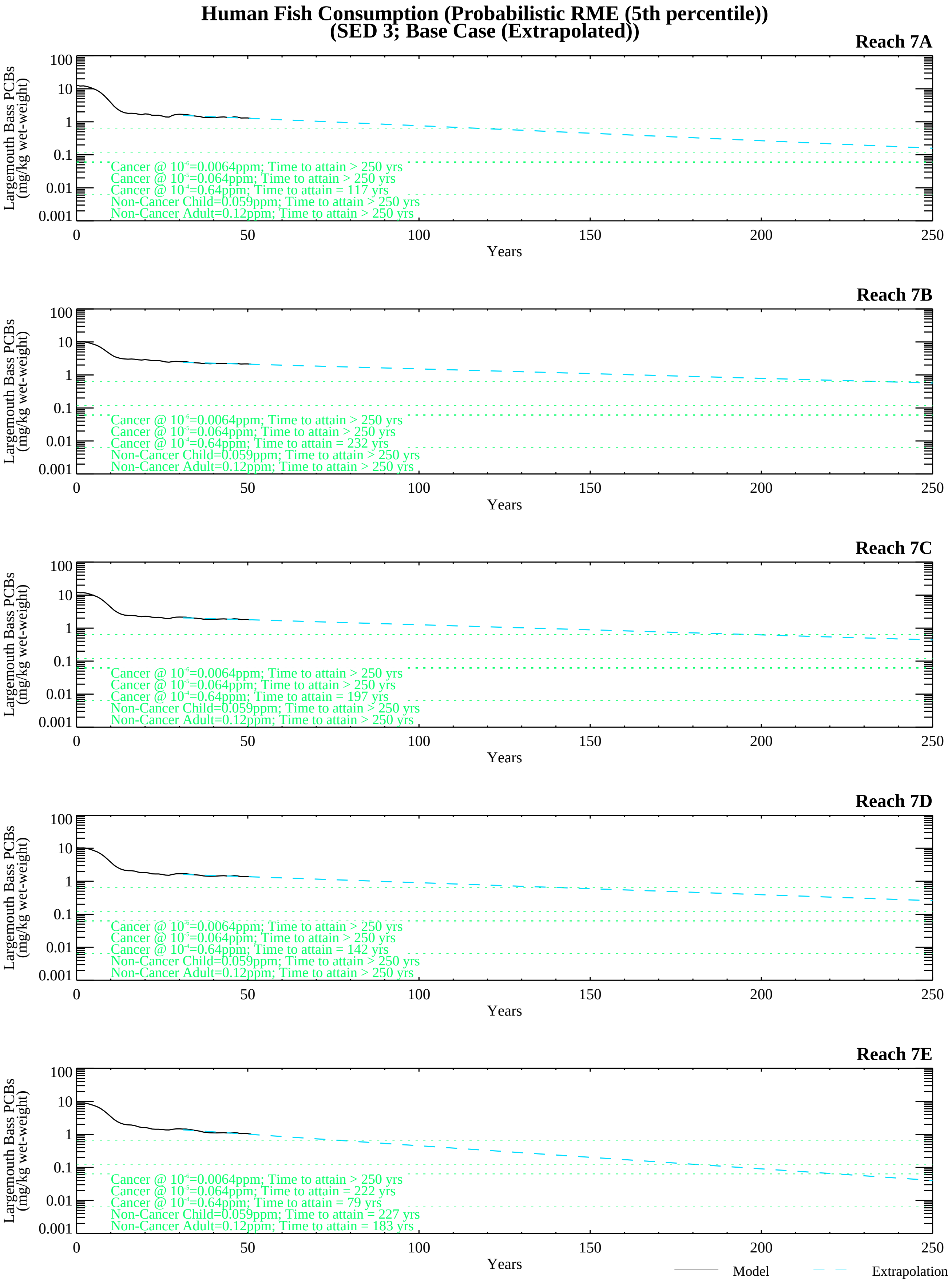

Figure G-8.2-2g. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 3; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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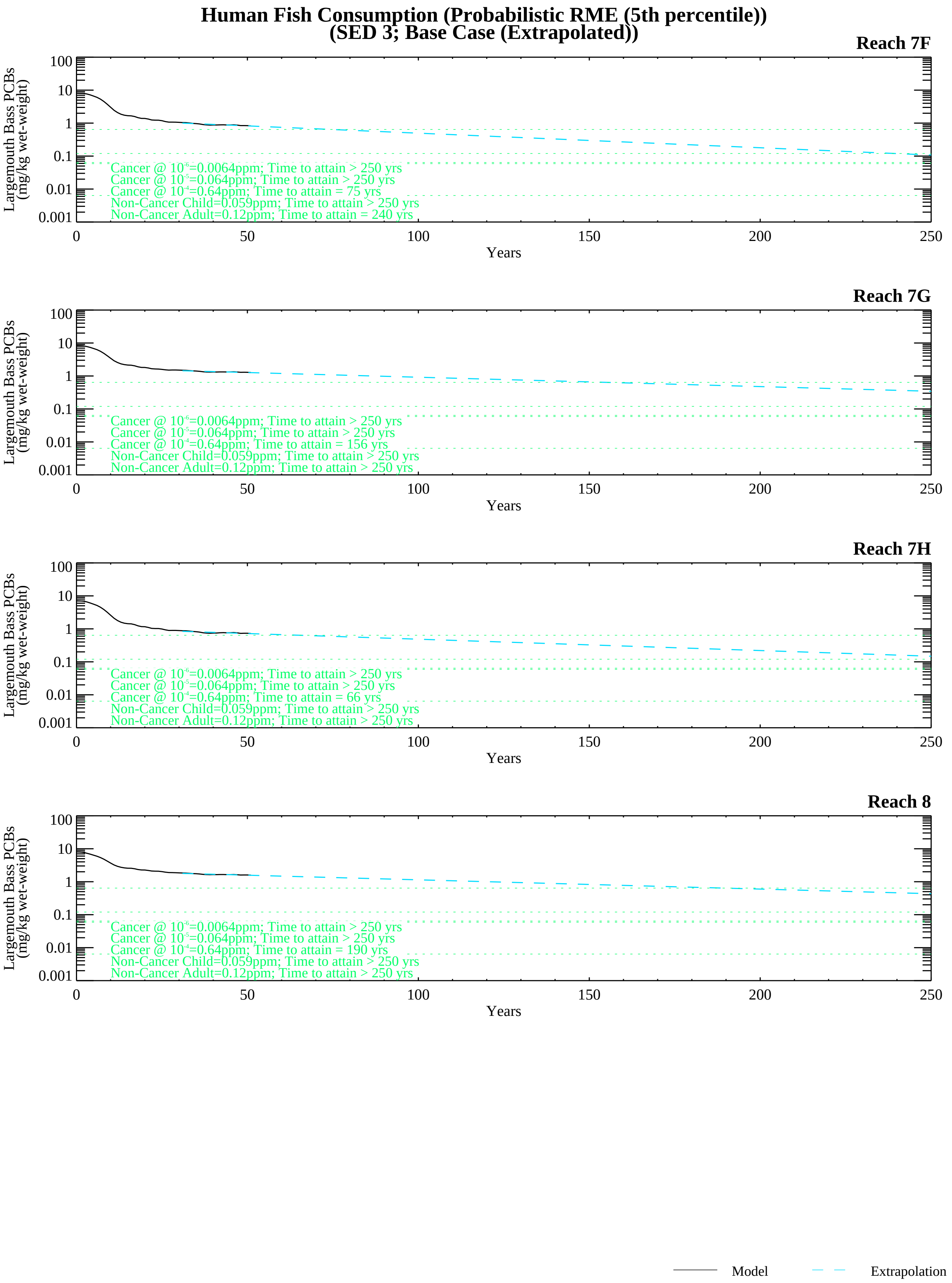


Figure G-8.2-2g. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 3; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

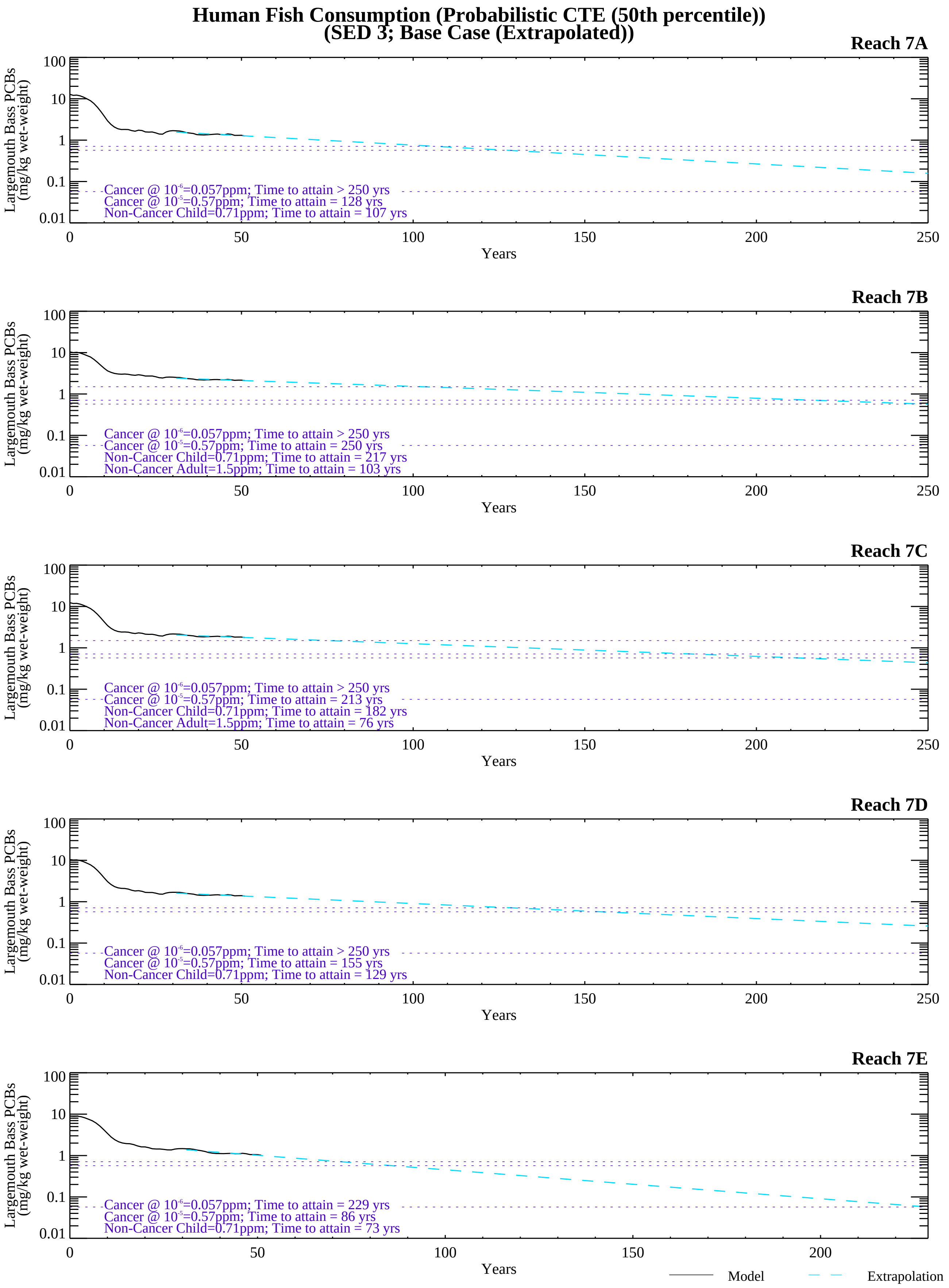


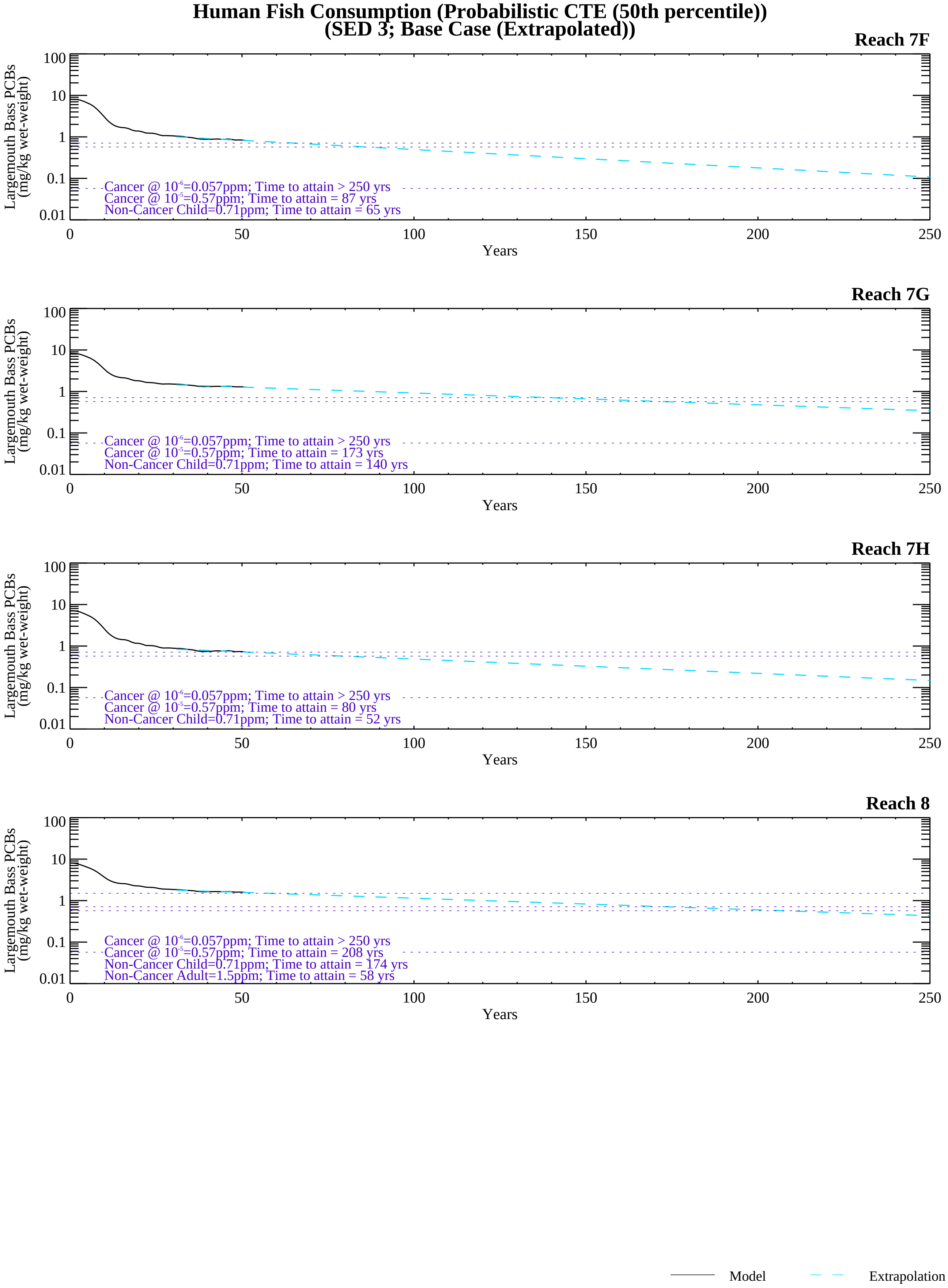
Figure G-8.2-2h. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 3; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

NDK - Z:\GENcms\MODEL\FDCHN\Analysis\IMPG\Fish\impg_tabulate_projections_fff_loop_run2.pro
Wed Mar 19 18:45:28 2008

Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 3; Base Case (Extrapolated))


Reach 7F

Reach 7G

Reach 7H

Reach 8

Figure G-8.2-2h. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 3; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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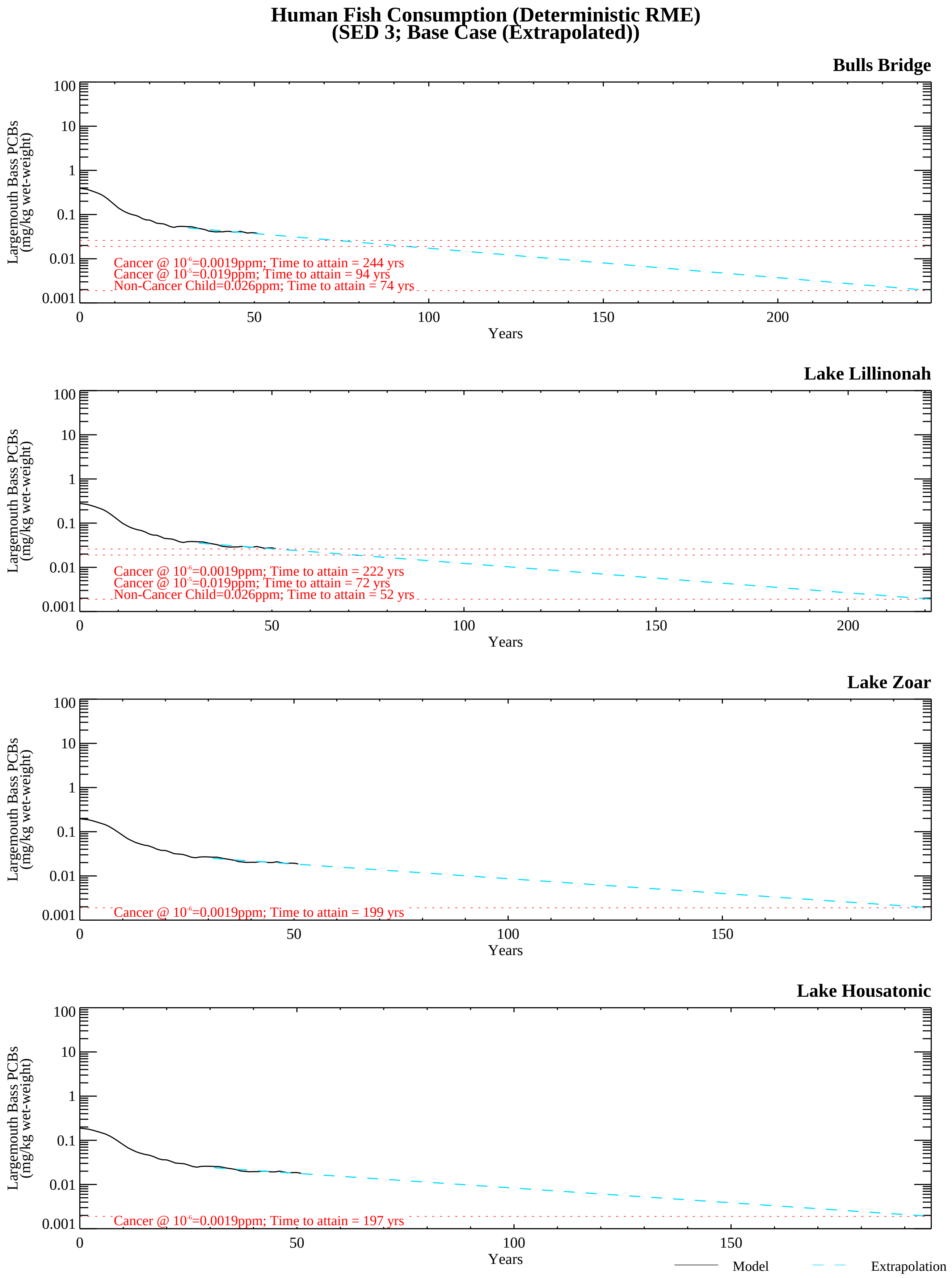

Figure G-8.2-2i. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to deterministic RME IMPGs for human consumption of fish (SED 3; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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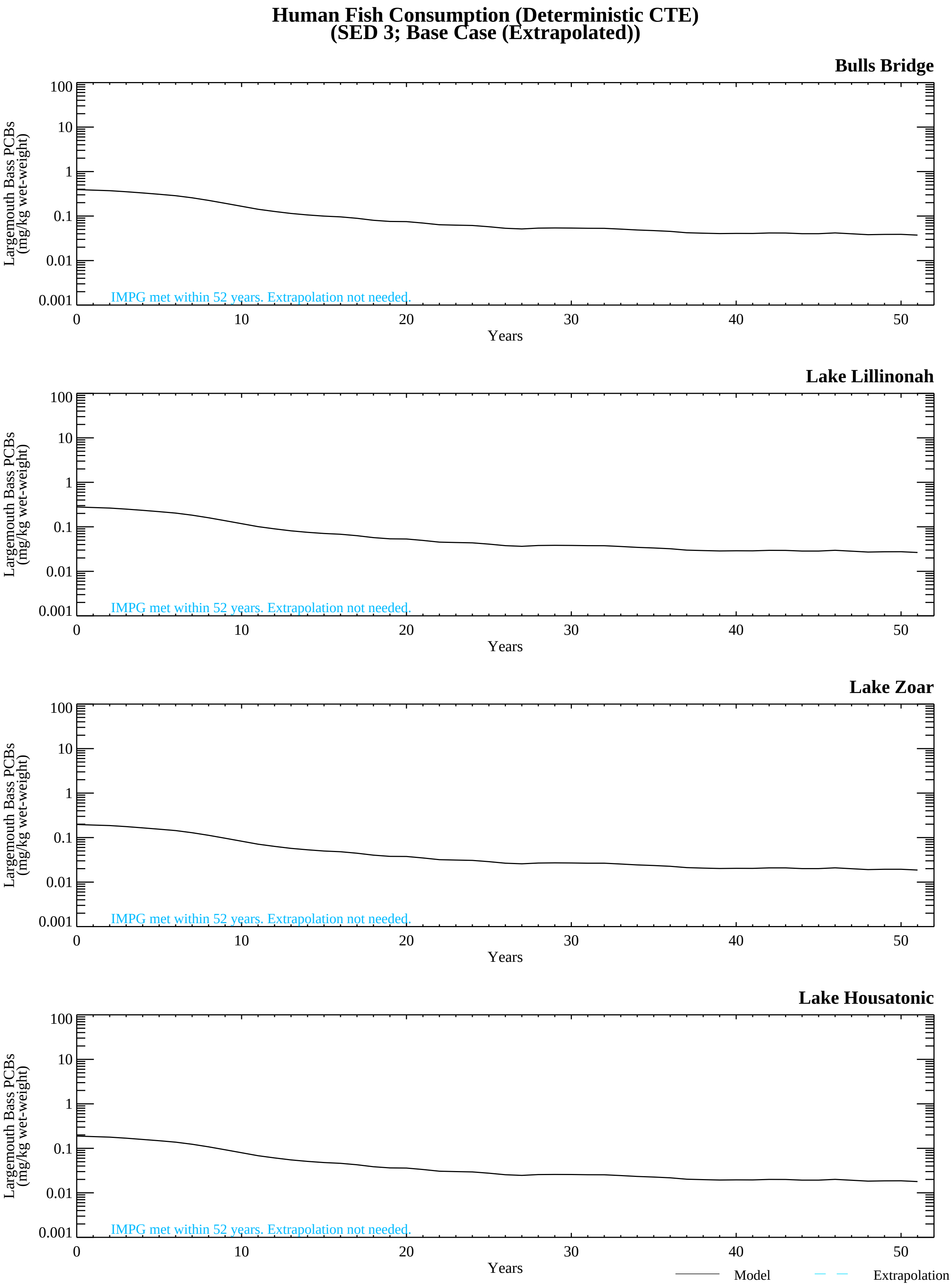

Figure G-8.2-2j. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to deterministic CTE IMPGs for human consumption of fish (SED 3; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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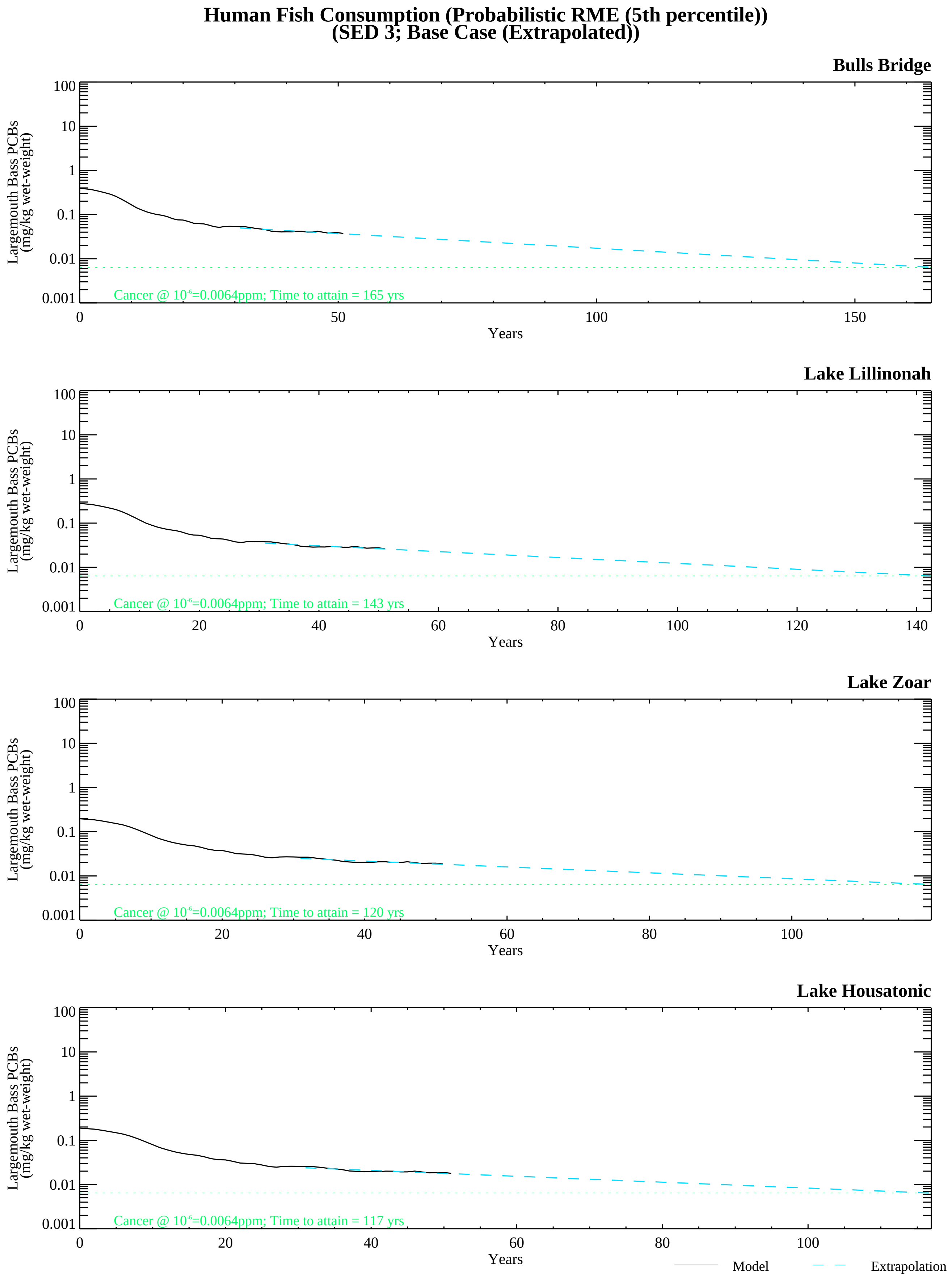

Figure G-8.2-2k. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to probabilistic RME IMPGs for human consumption of fish (SED 3; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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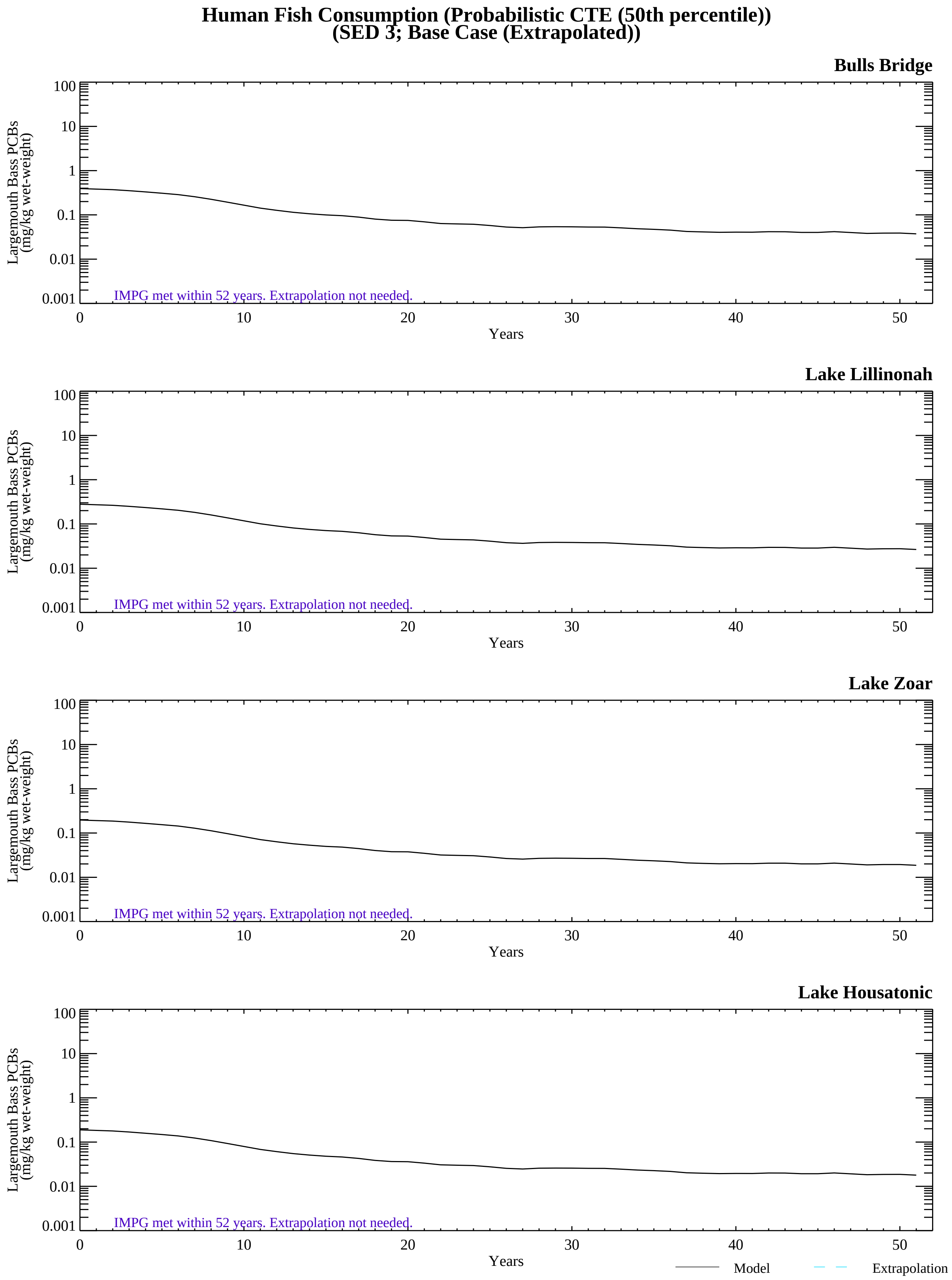

Figure G-8.2-2l. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to probabilistic CTE IMPGs for human consumption of fish (SED 3; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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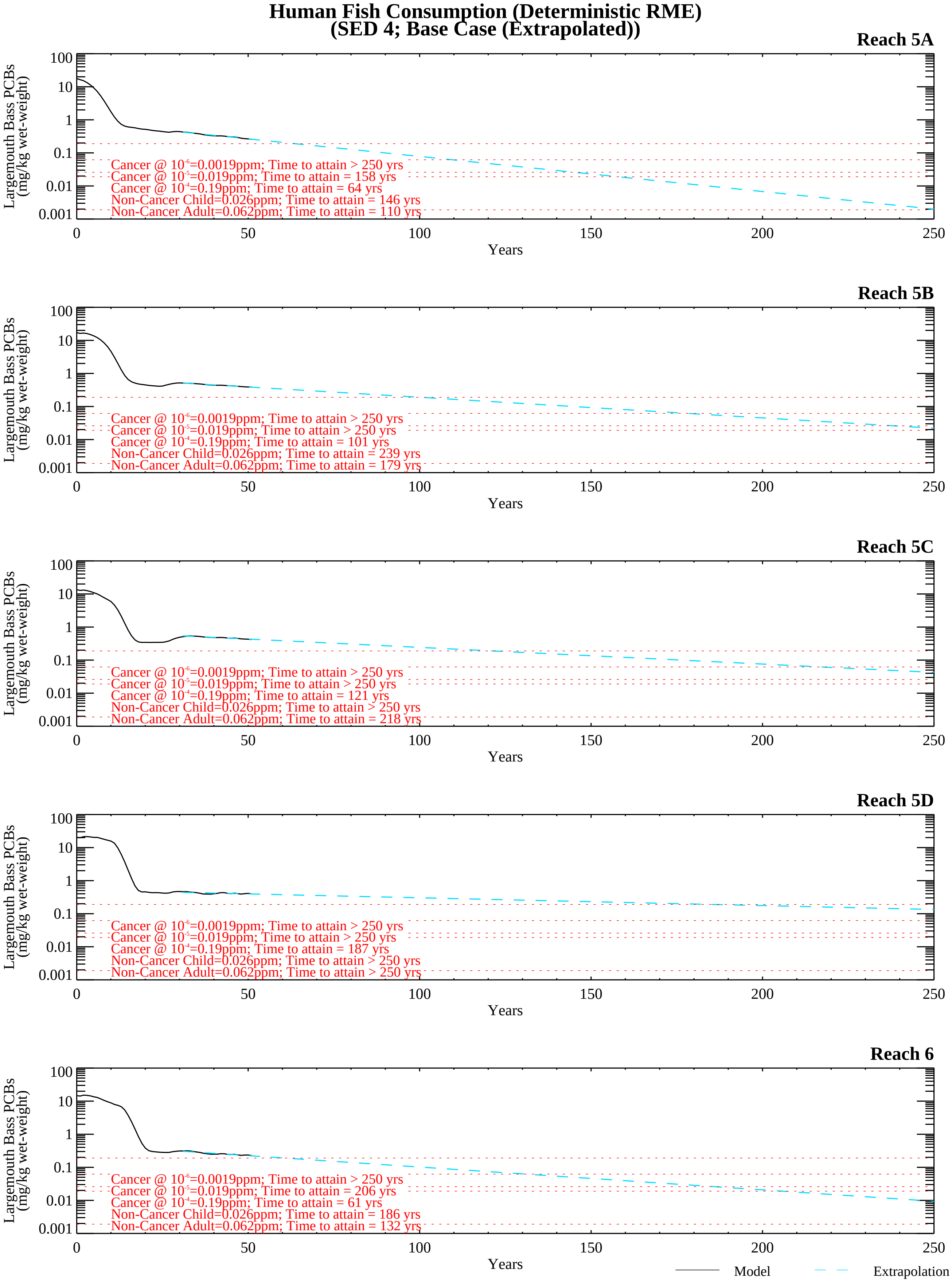

Figure G-8.2-3a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 4; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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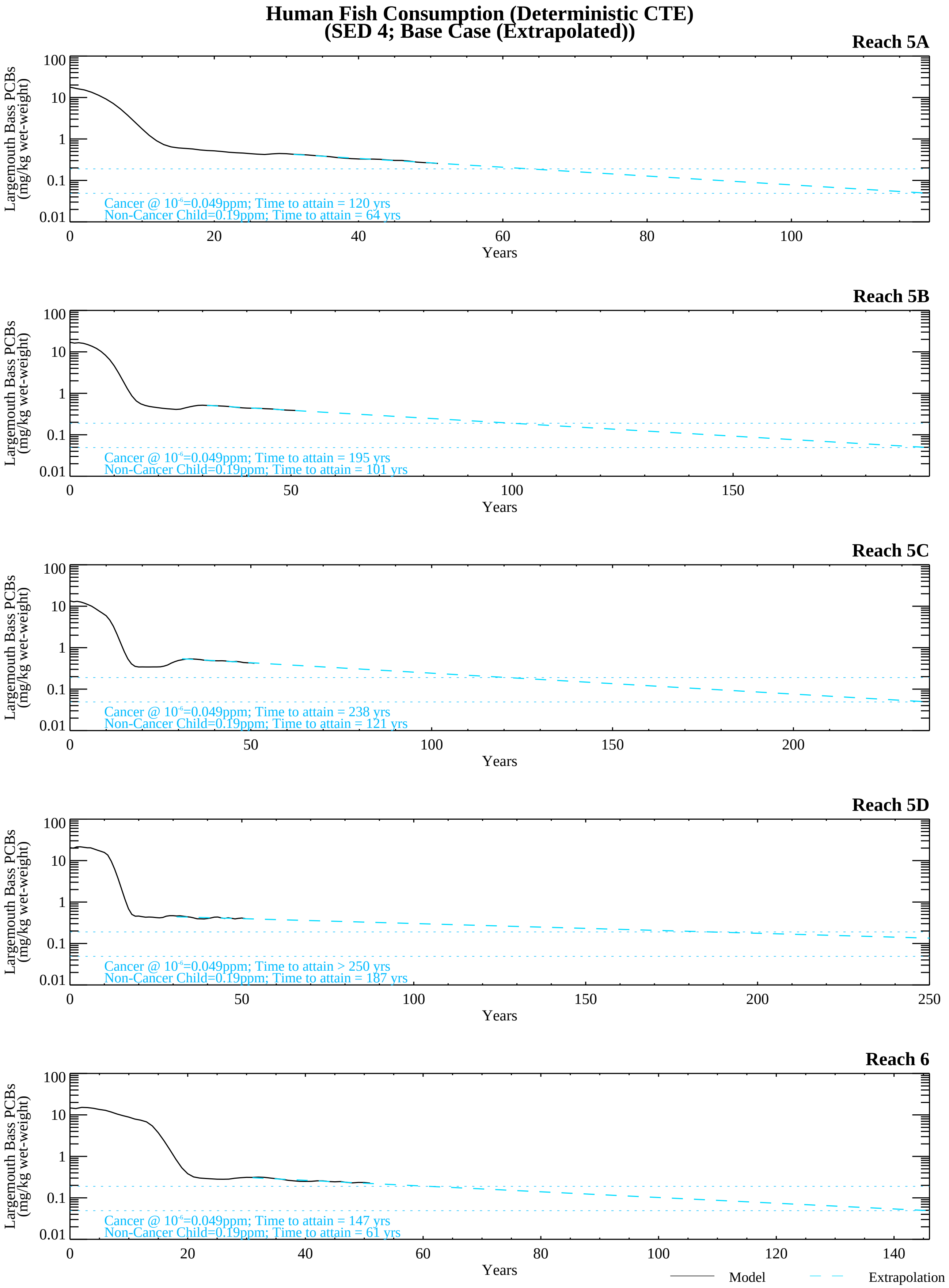

Figure G-8.2-3b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 4; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

NDK - Z:\GENcms\MODEL\FDCHN\Analysis\IMPG\Fish\impg_tabulate_projections_fff_LOOP.pro
Wed Mar 19 17:39:34 2008

Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 4; Base Case (Extrapolated))

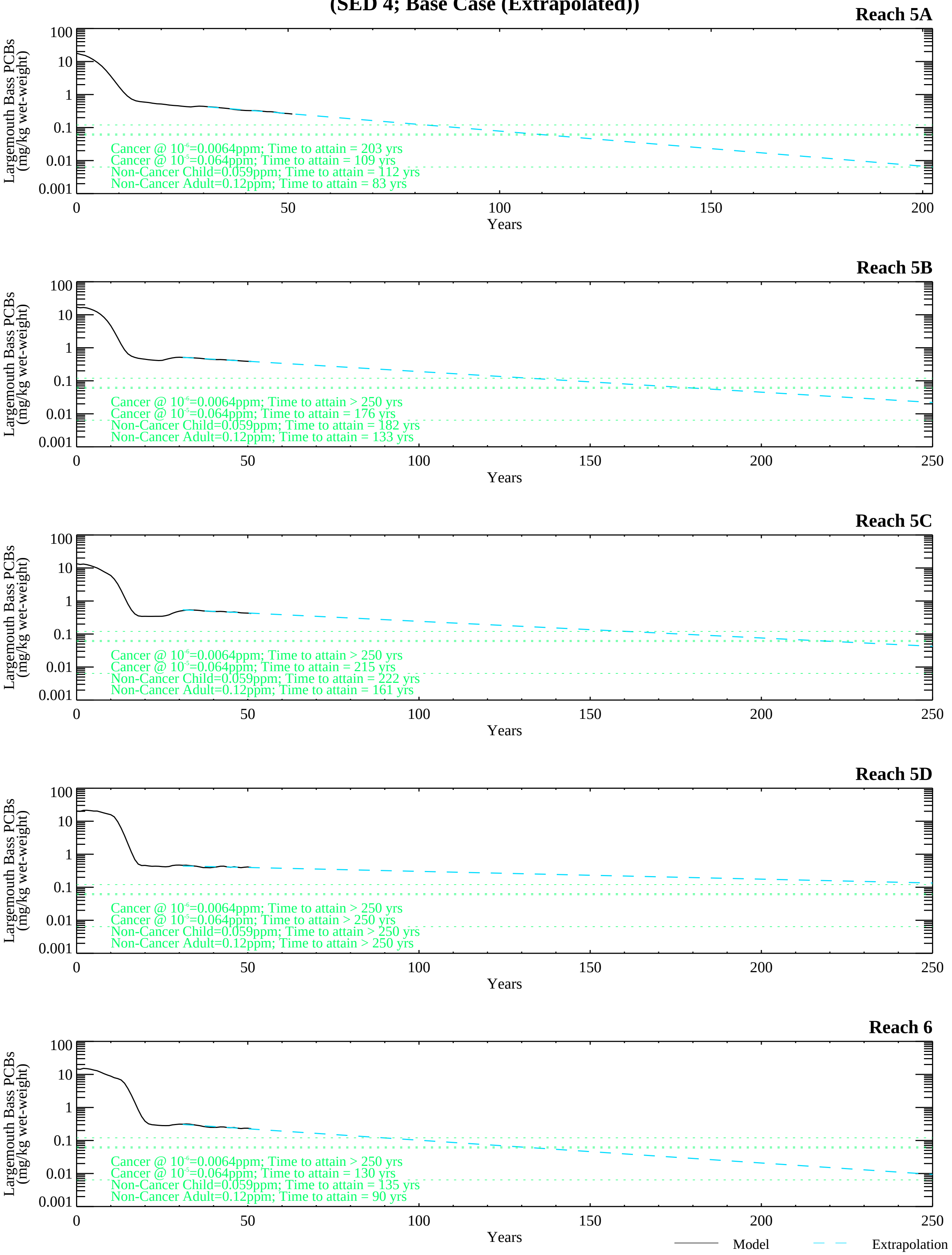

Figure G-8.2-3c. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 4; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

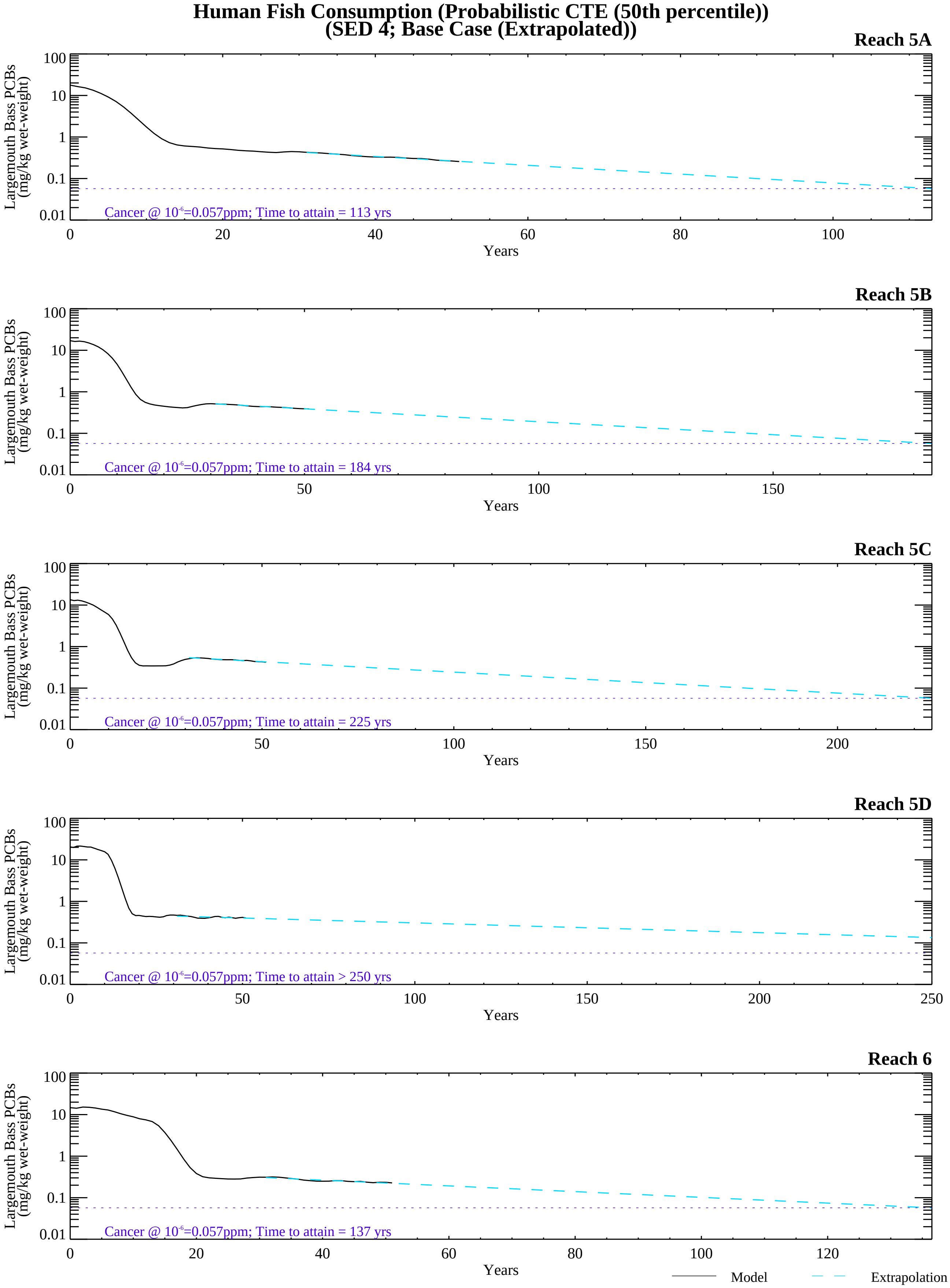

Figure G-8.2-3d. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 4; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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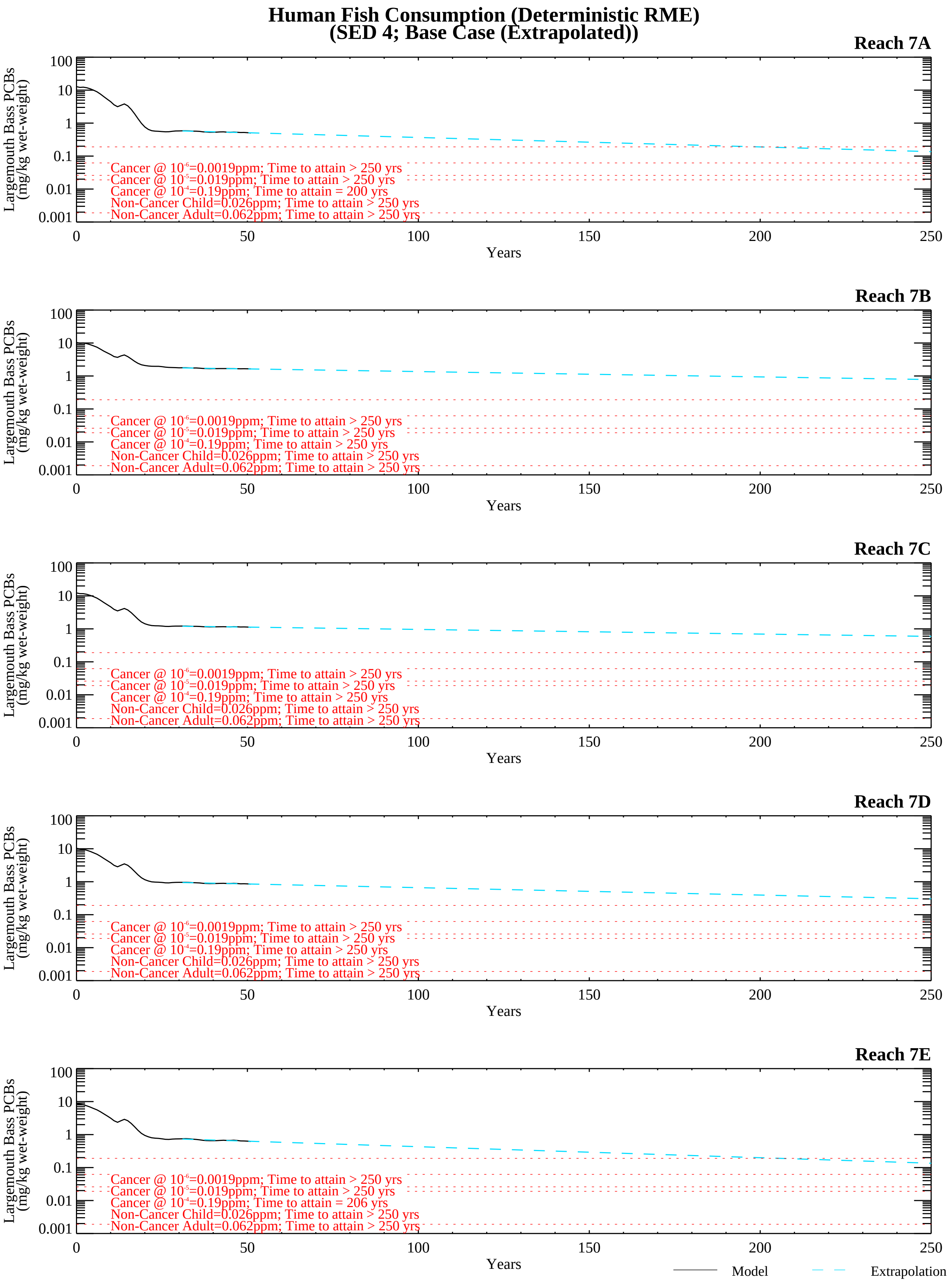

Figure G-8.2-3e. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 4; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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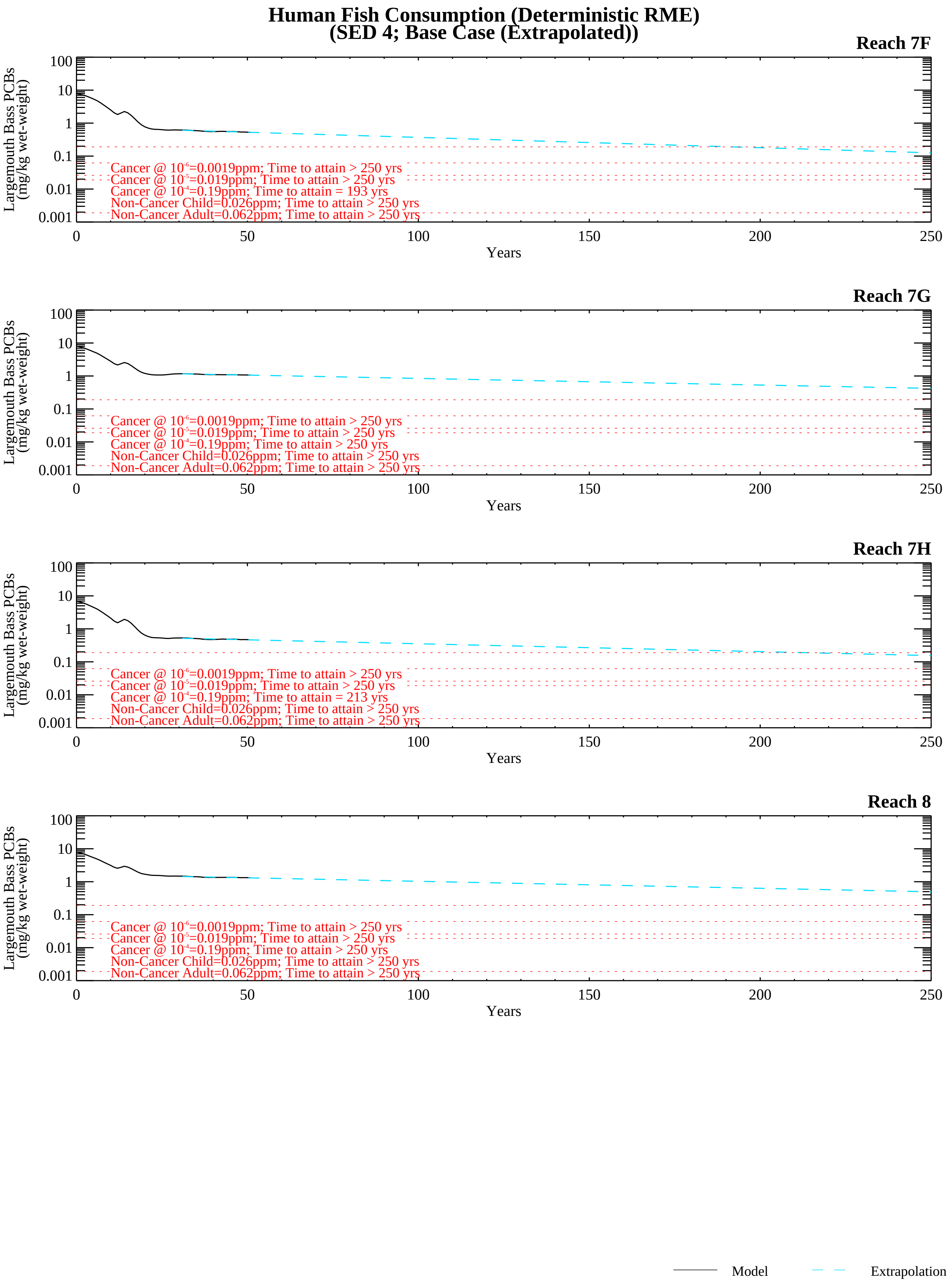

Figure G-8.2-3e. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 4; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

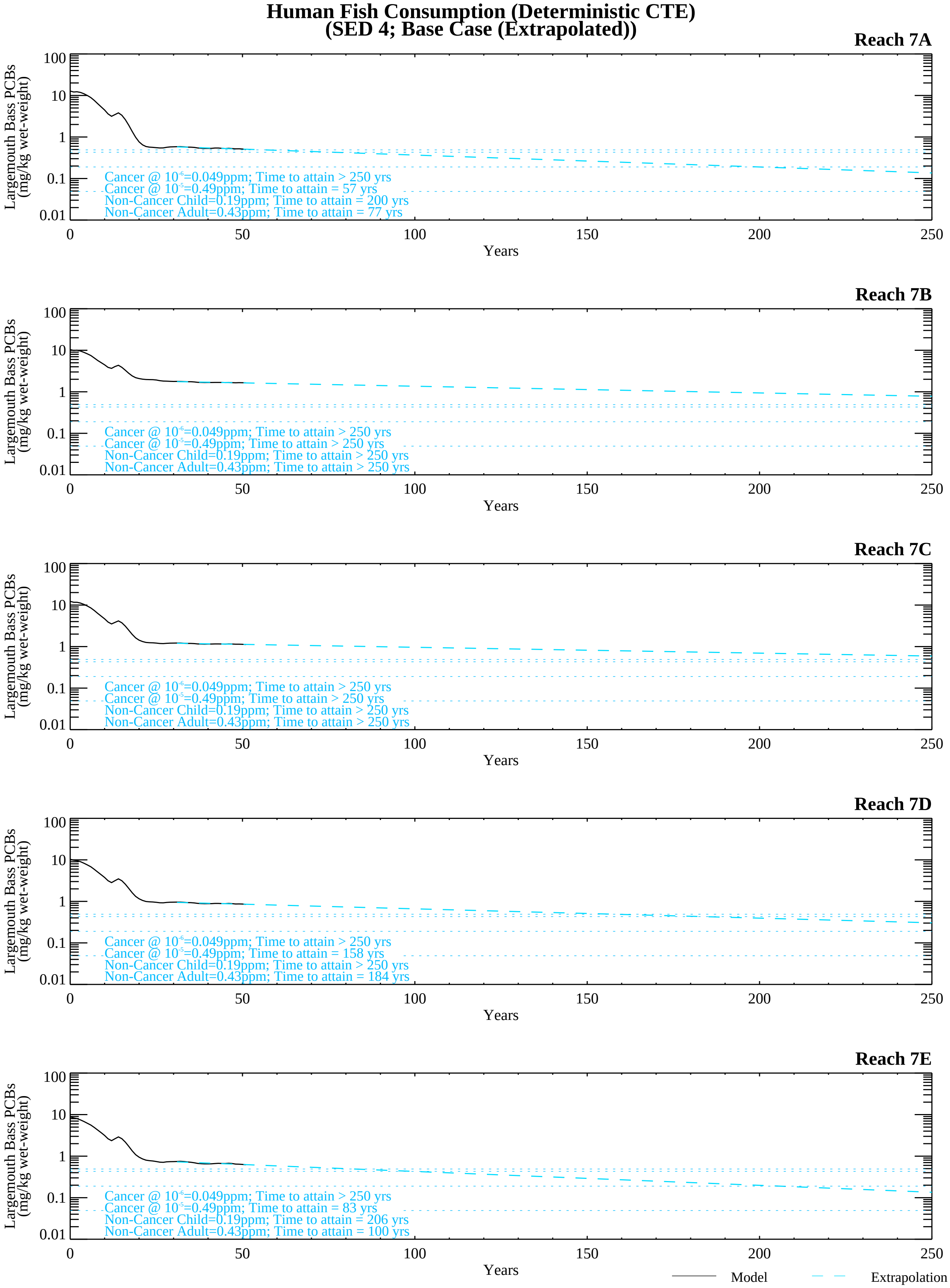

Figure G-8.2-3f. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 4; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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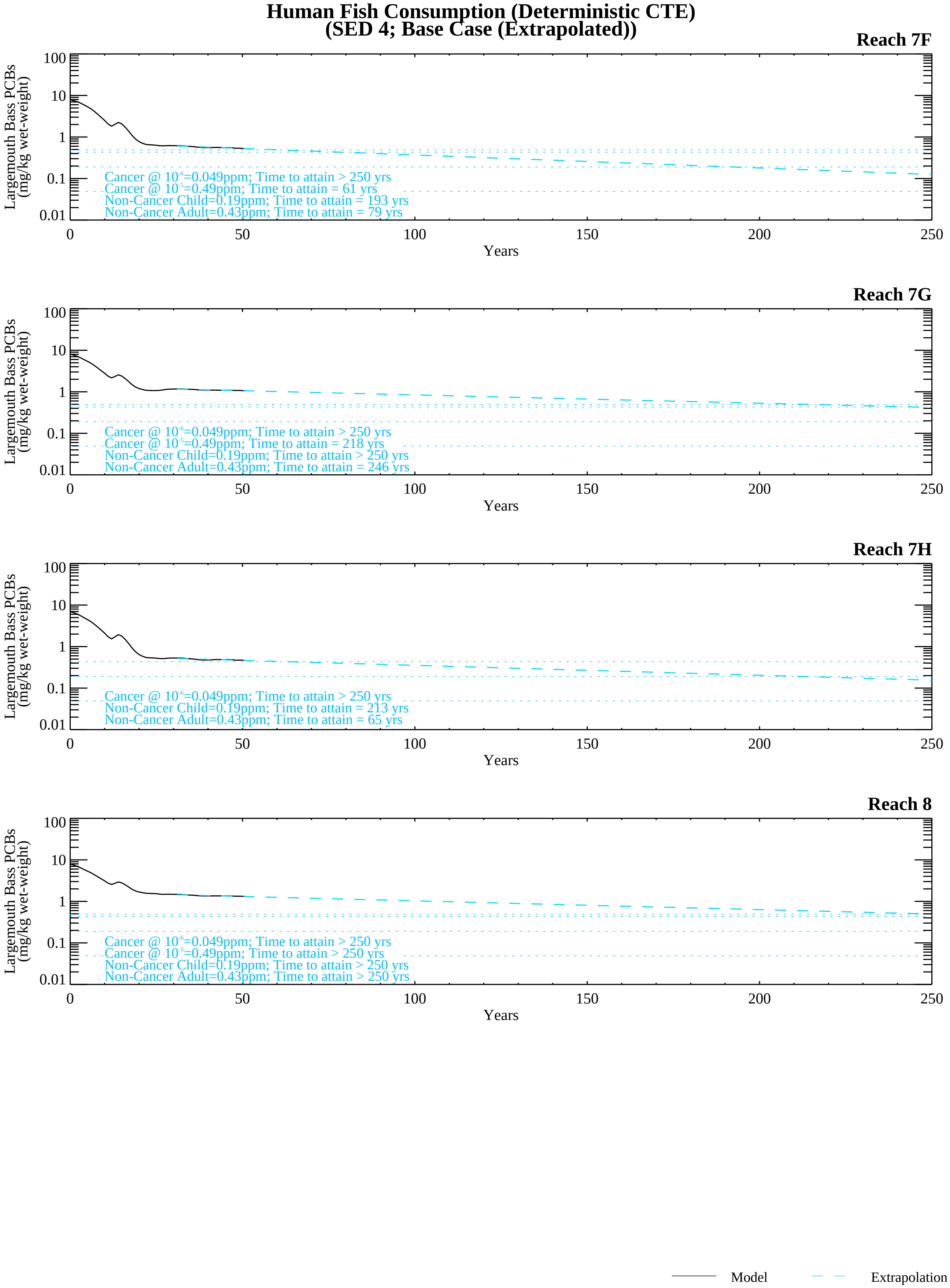

Figure G-8.2-3f. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 4; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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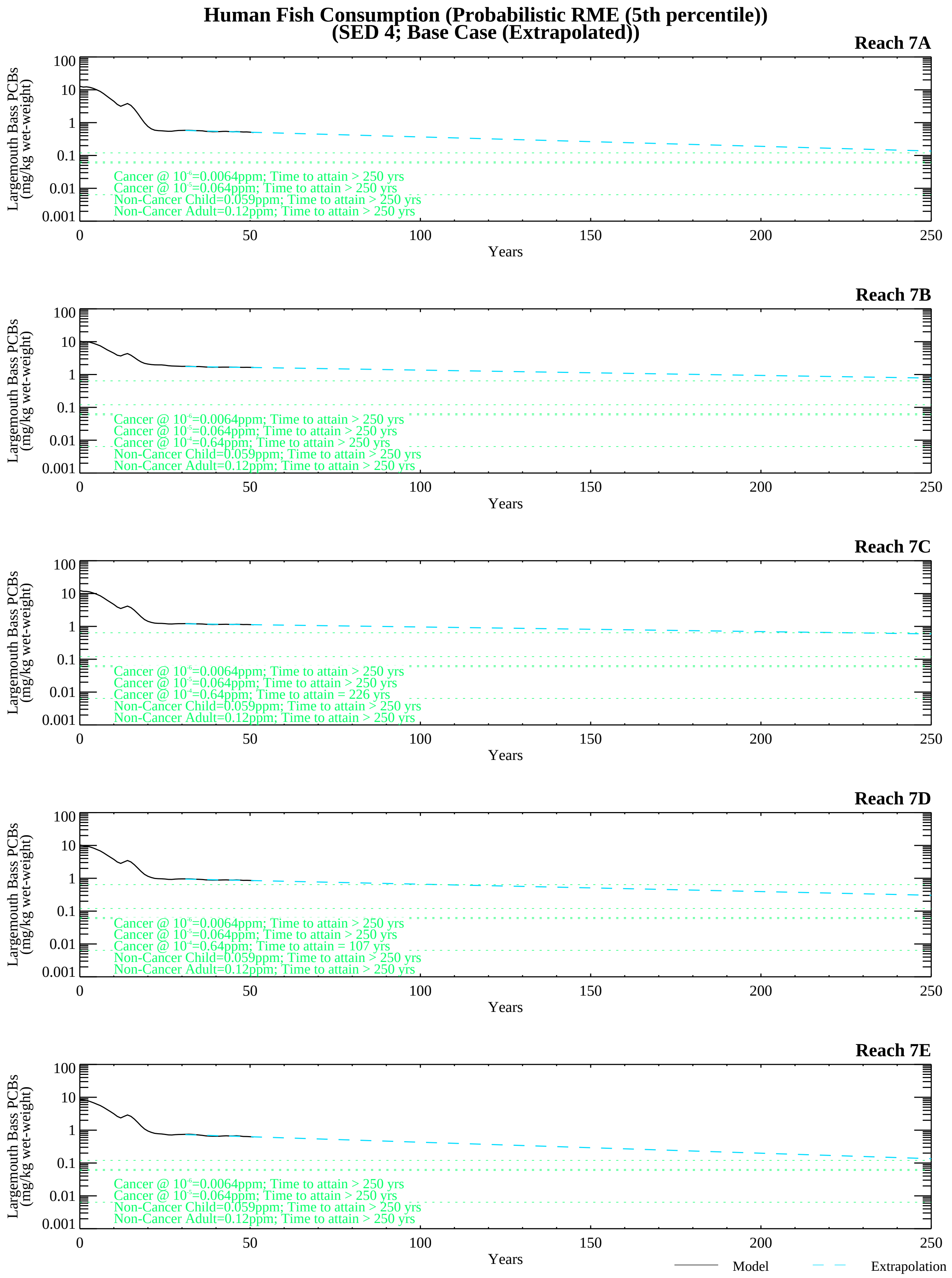

Figure G-8.2-3g. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 4; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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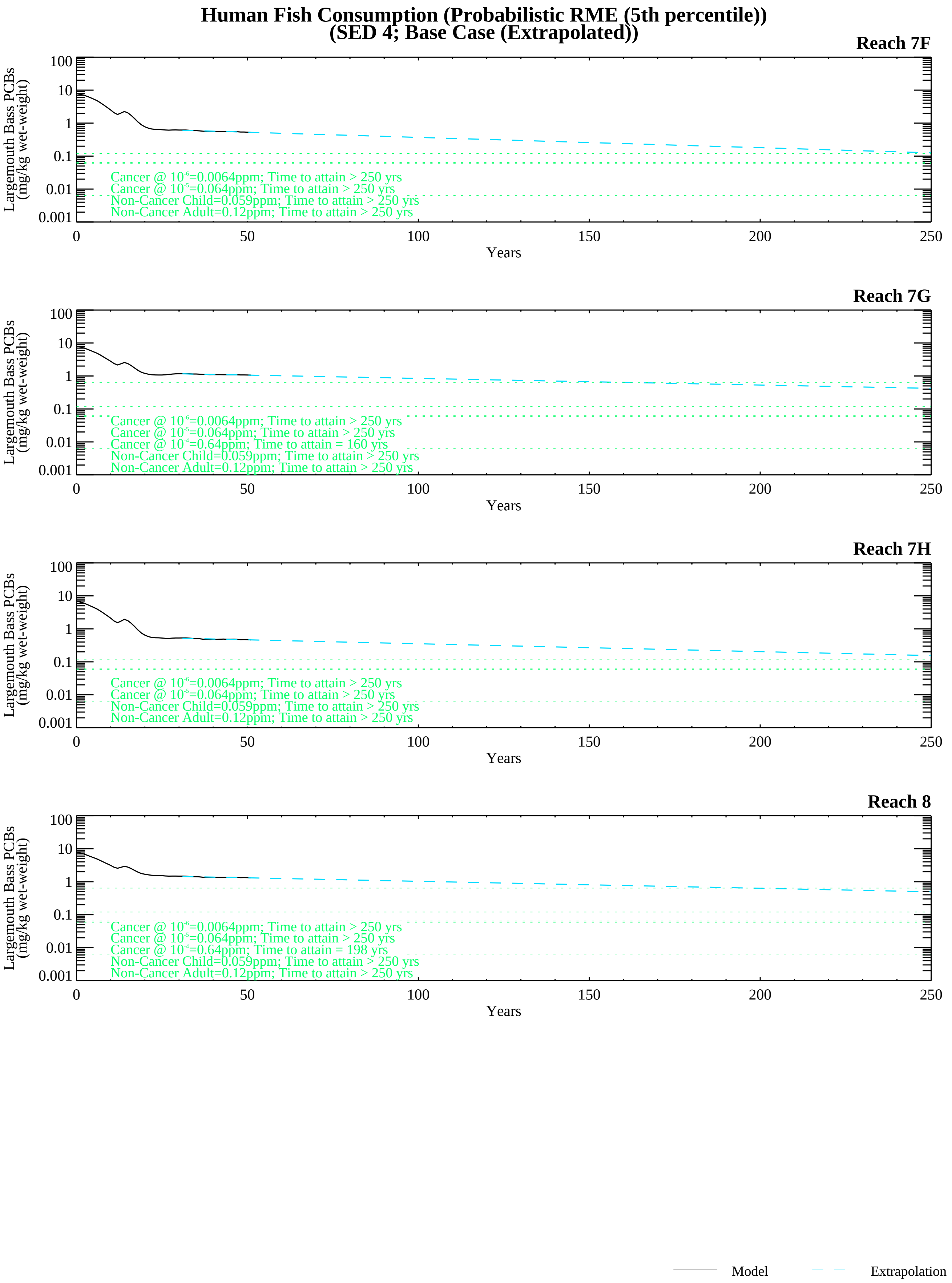

Figure G-8.2-3g. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 4; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

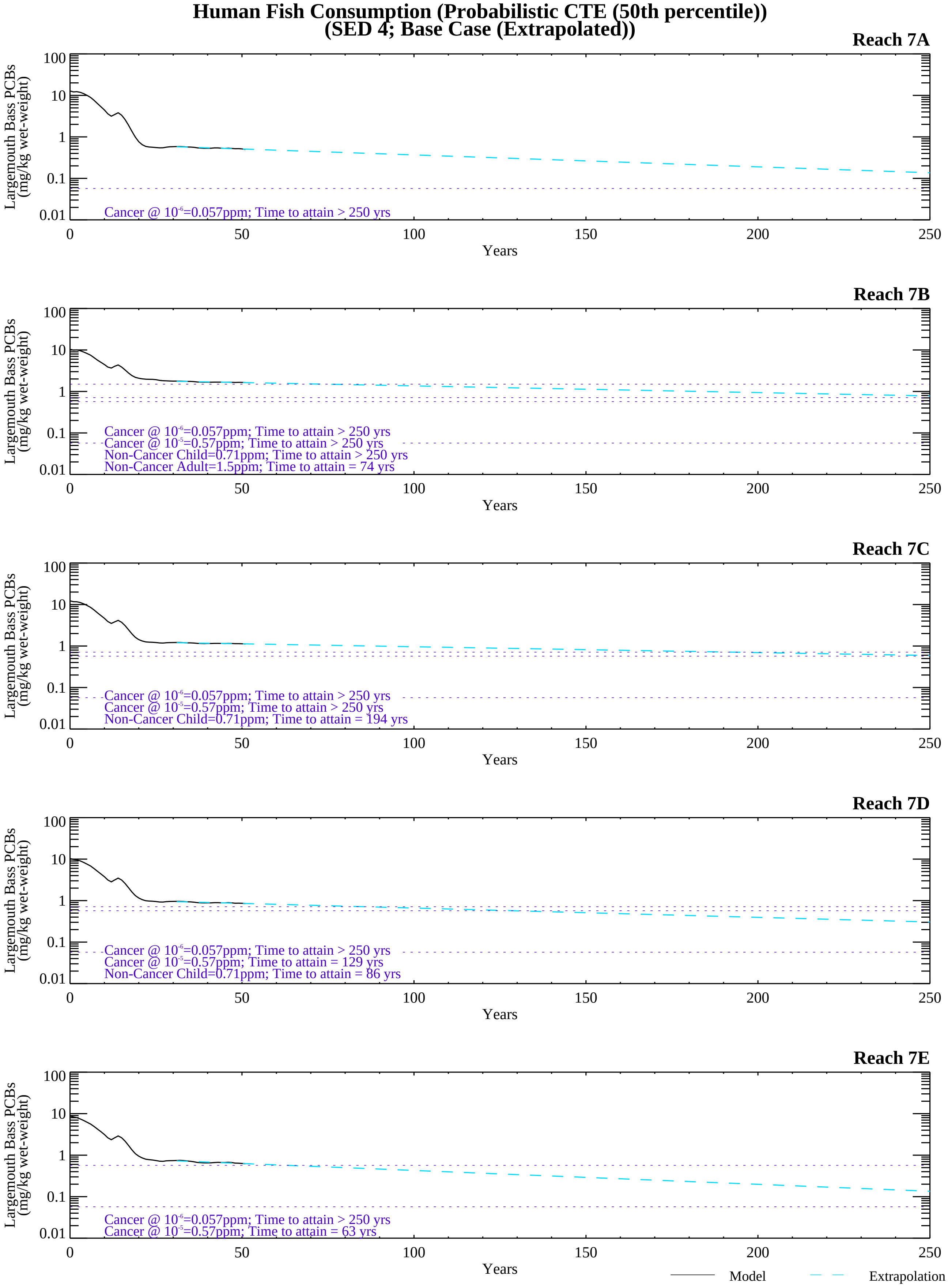

Figure G-8.2-3h. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 4; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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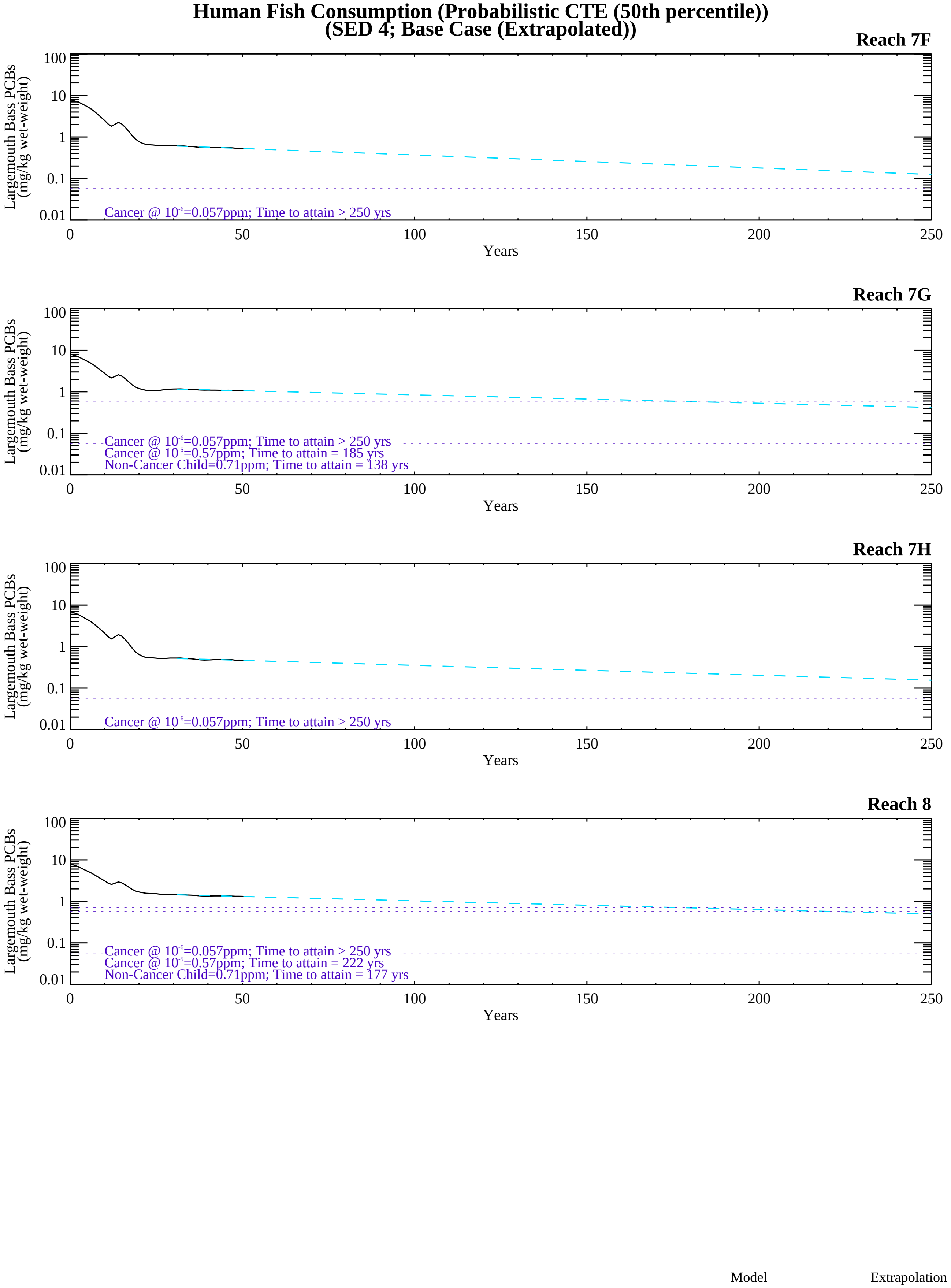

Figure G-8.2-3h. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 4; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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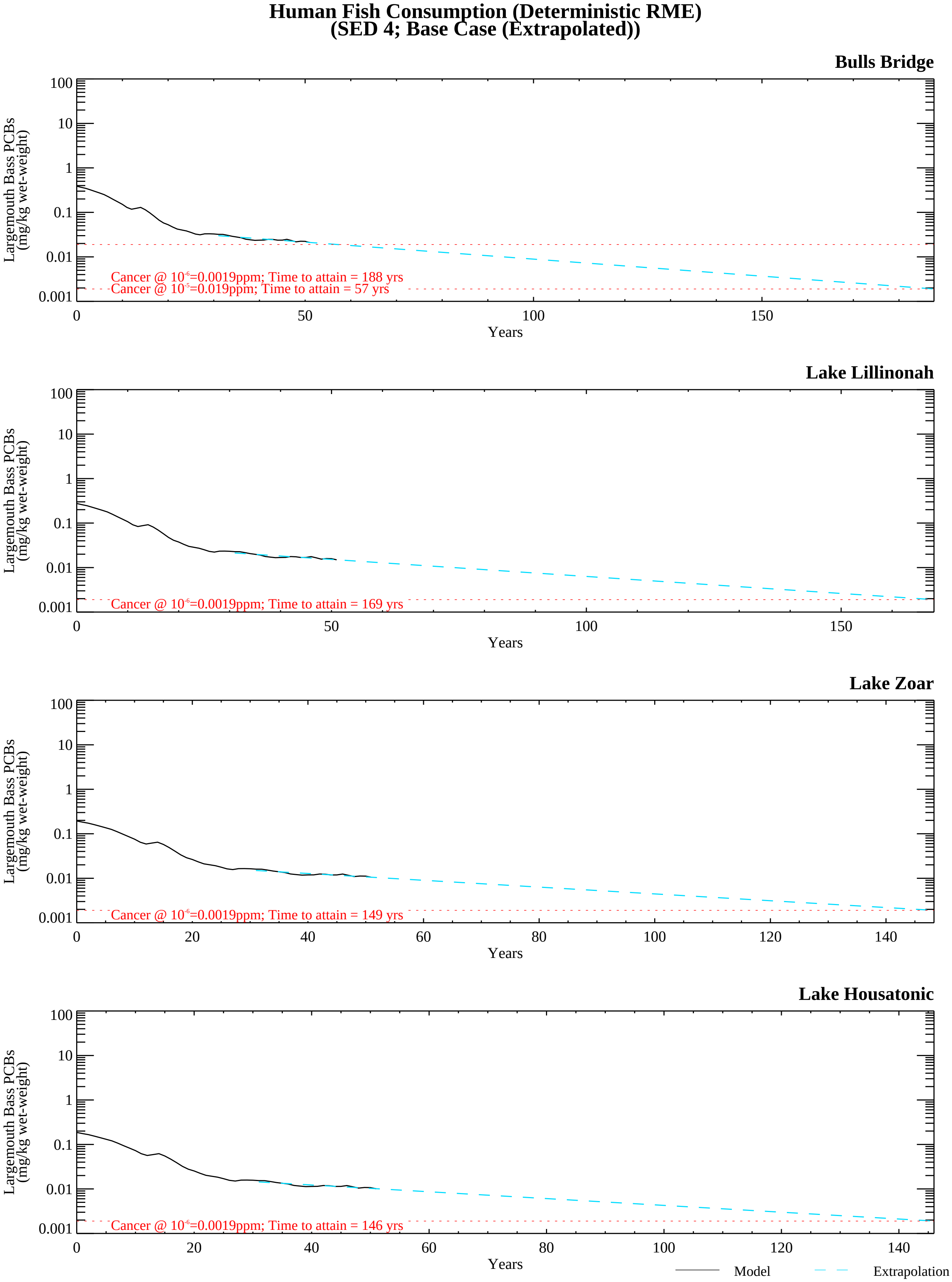

Figure G-8.2-3i. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to deterministic RME IMPGs for human consumption of fish (SED 4; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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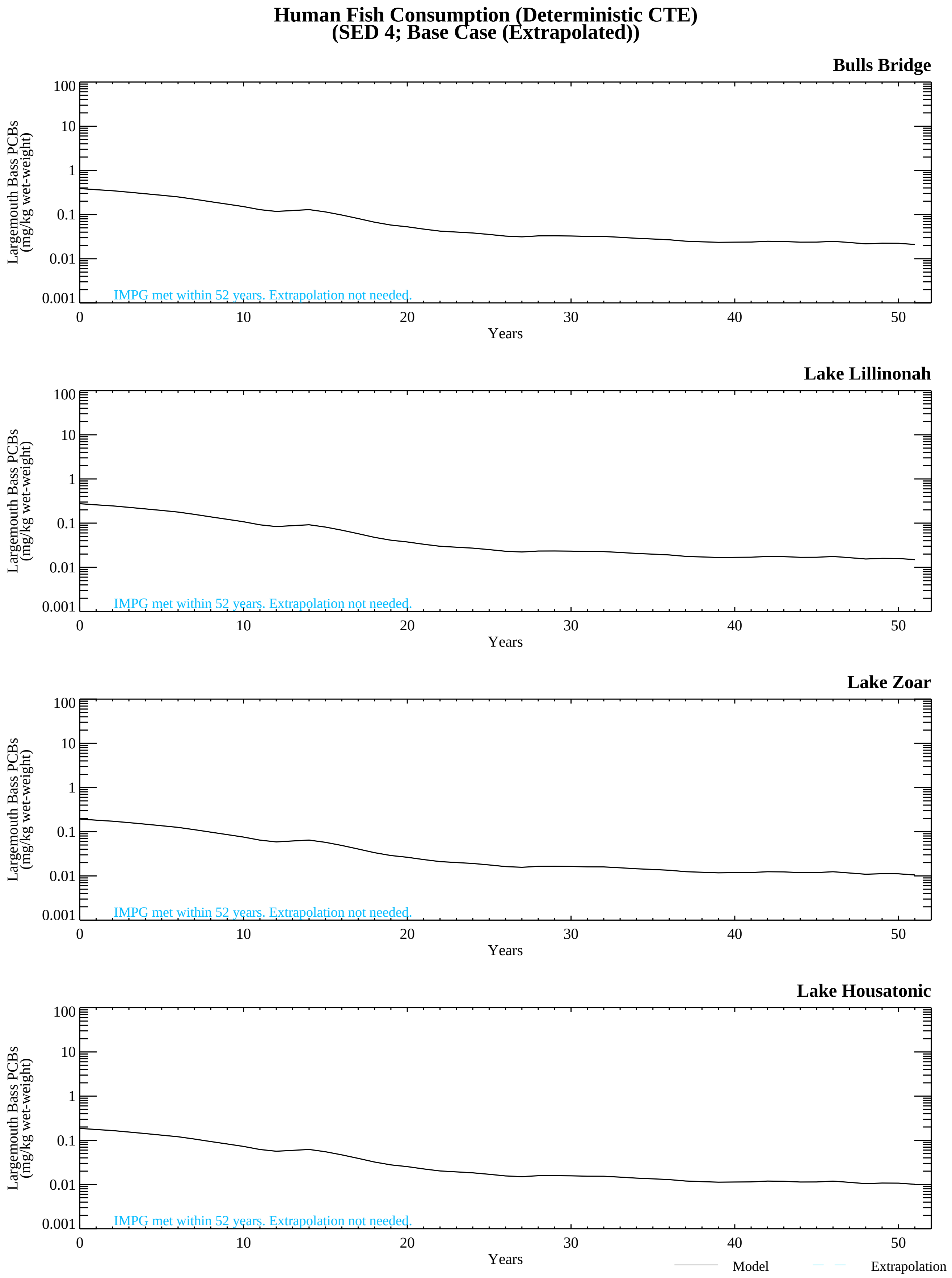

Figure G-8.2-3j. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to deterministic CTE IMPGs for human consumption of fish (SED 4; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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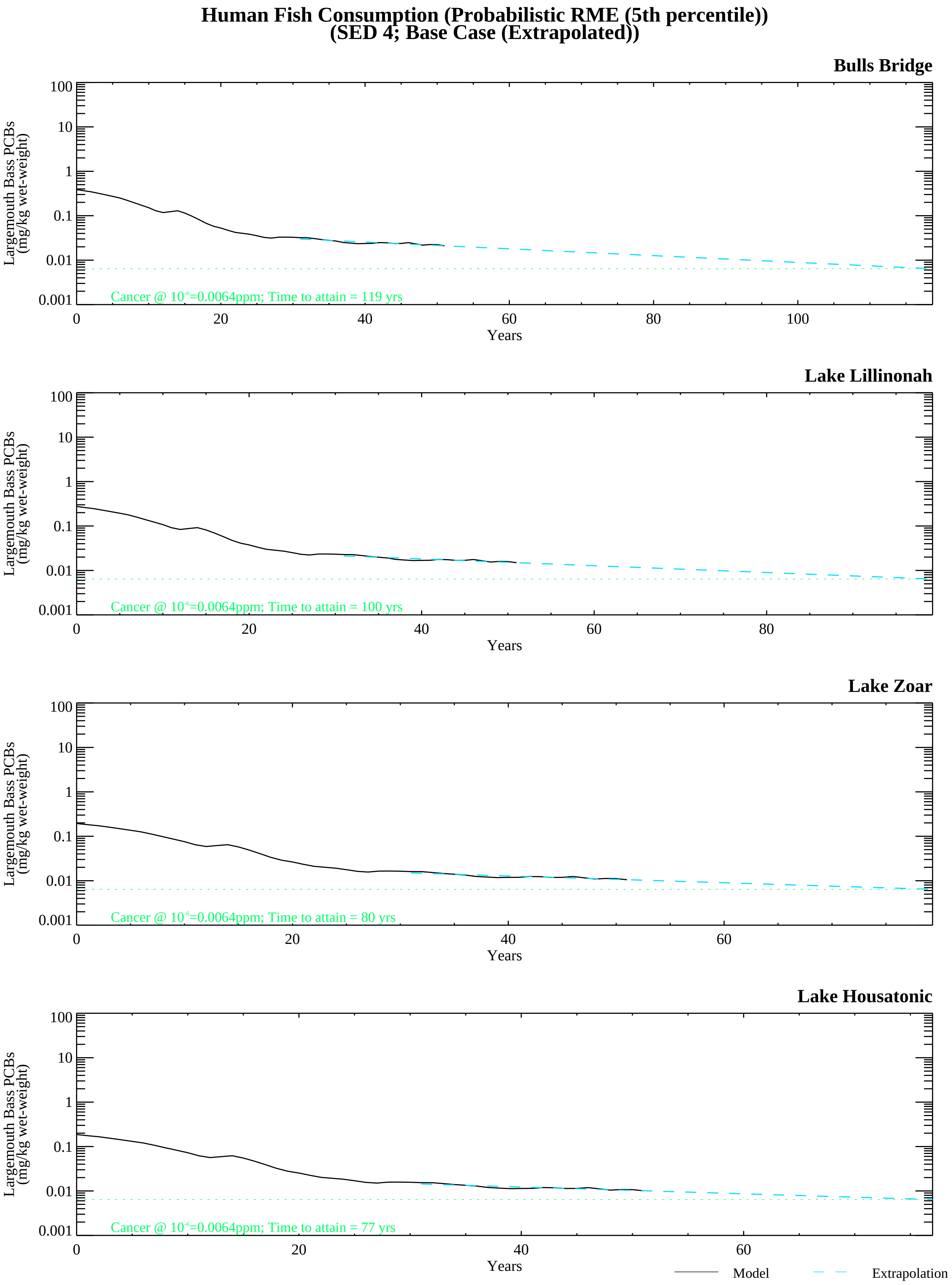

Figure G-8.2-3k. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to probabilistic RME IMPGs for human consumption of fish (SED 4; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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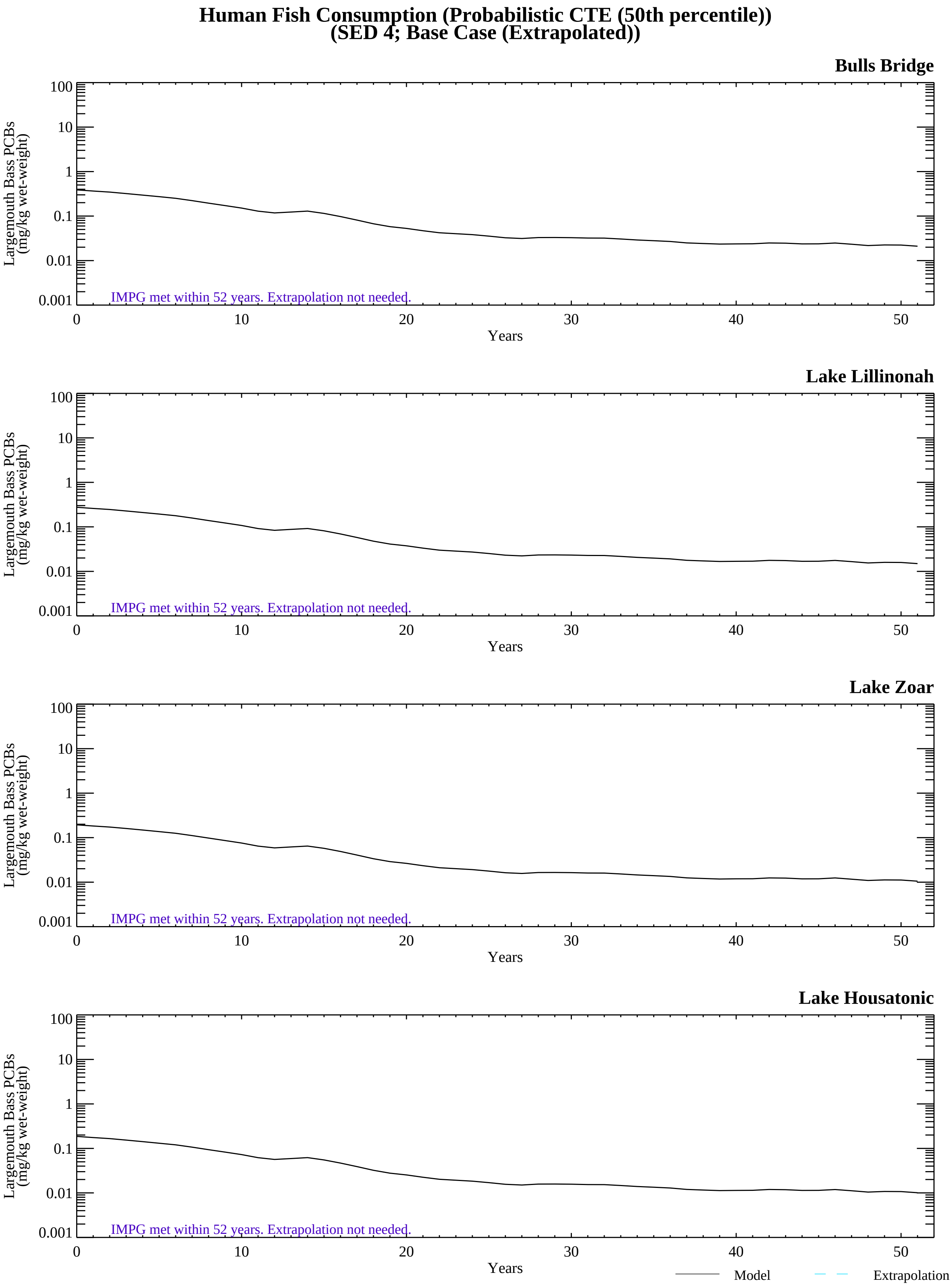

Figure G-8.2-3l. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to probabilistic CTE IMPGs for human consumption of fish (SED 4; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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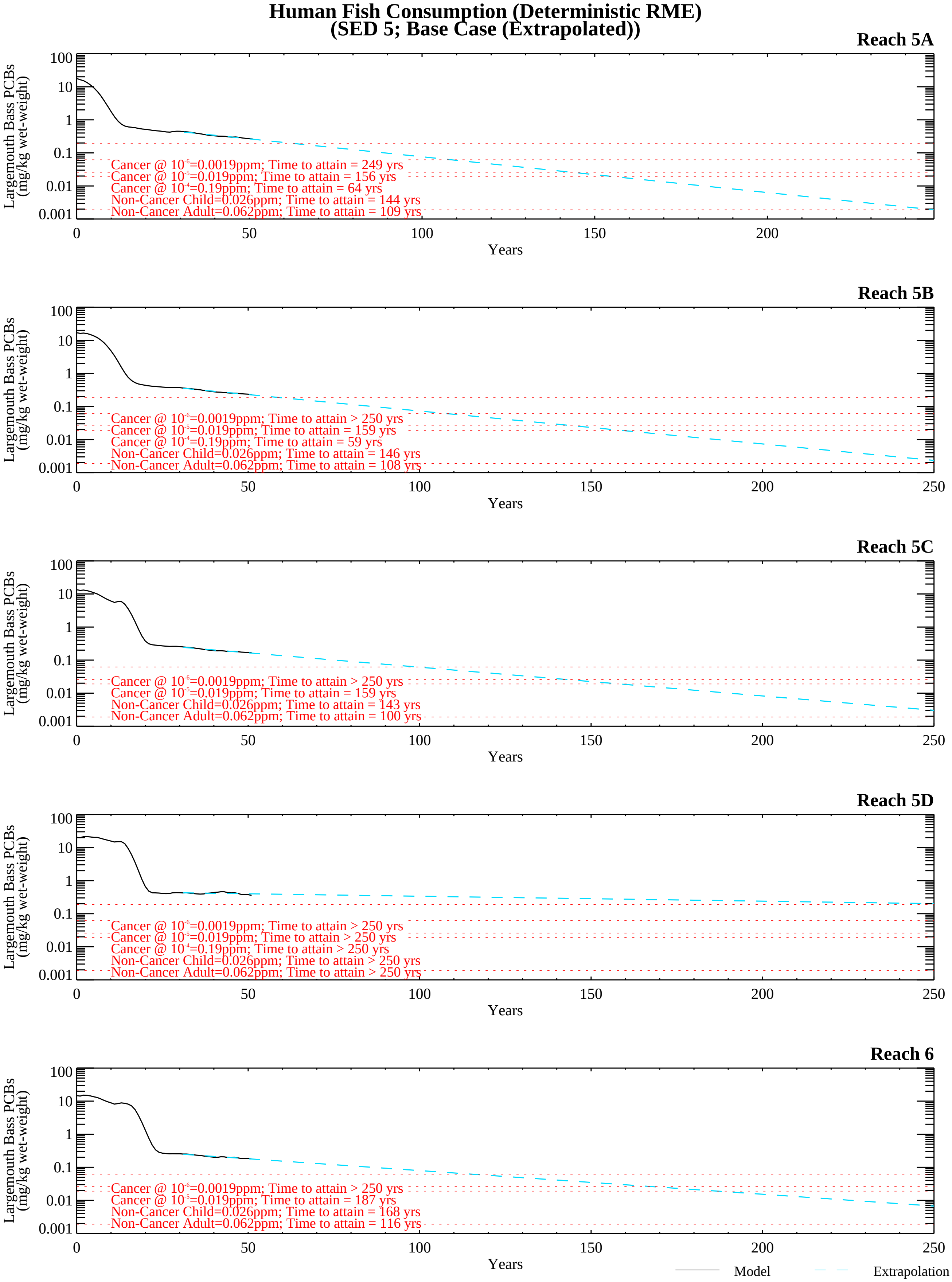

Figure G-8.2-4a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 5; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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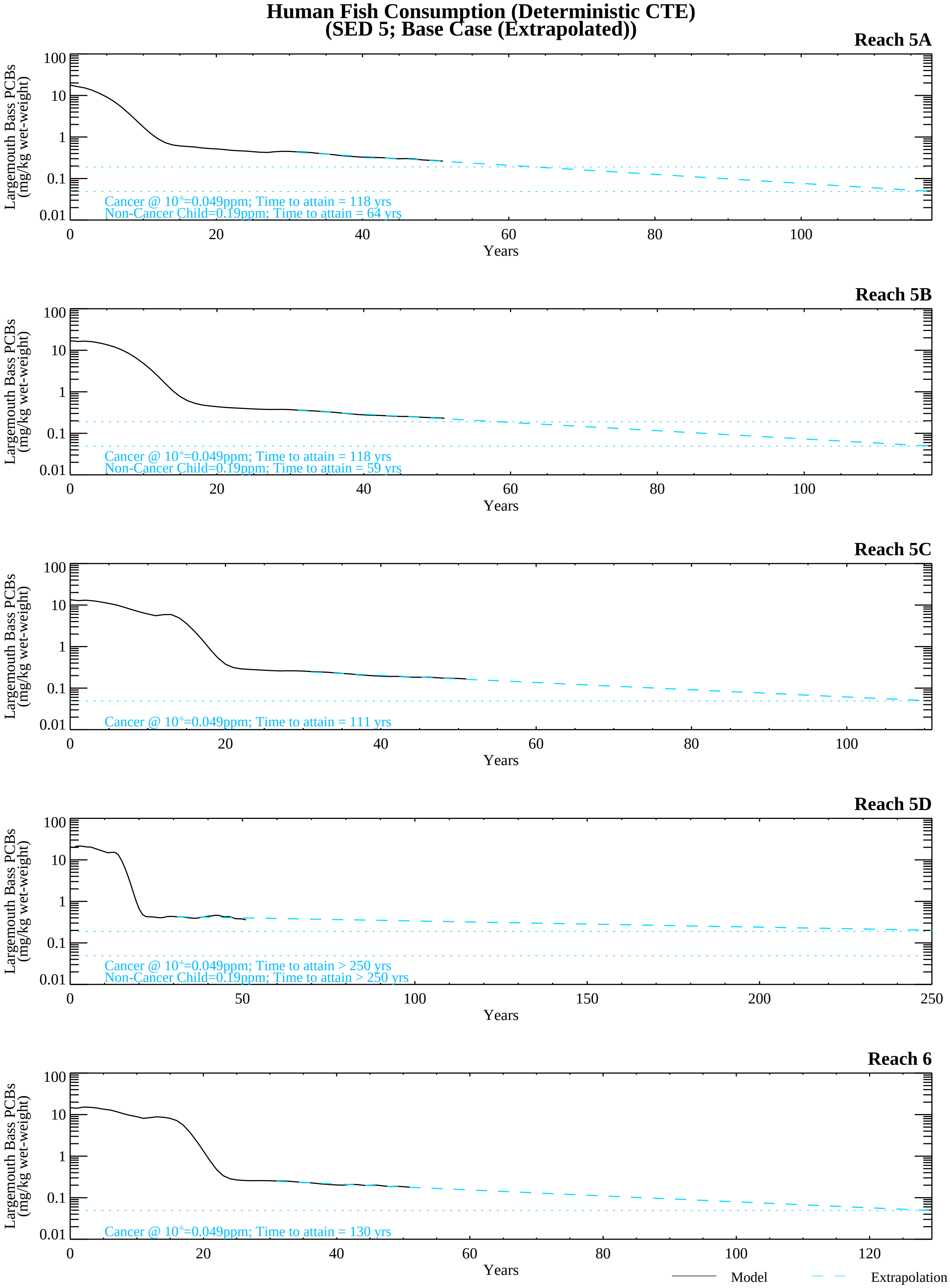

Figure G-8.2-4b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 5; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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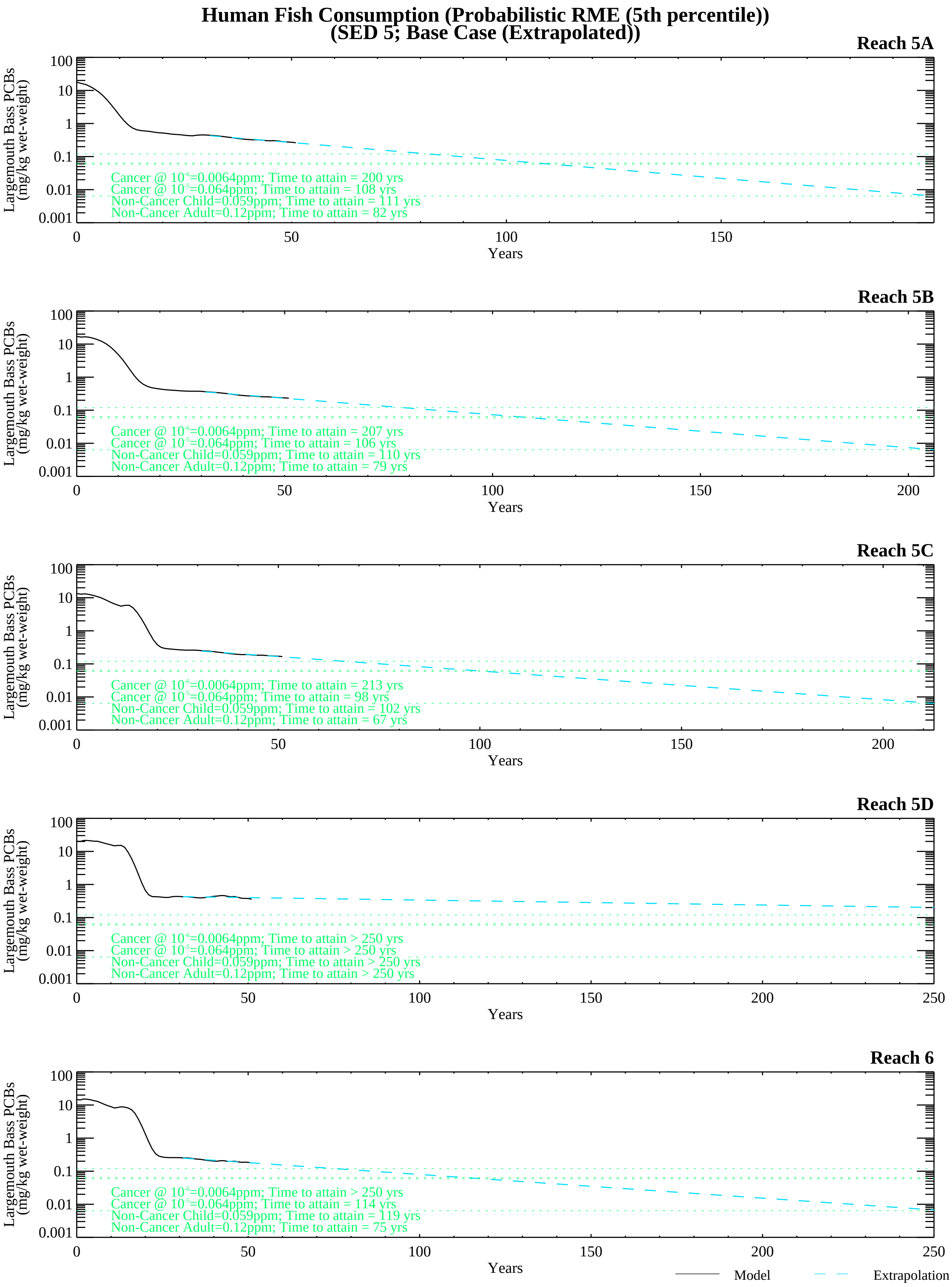

Figure G-8.2-4c. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 5; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

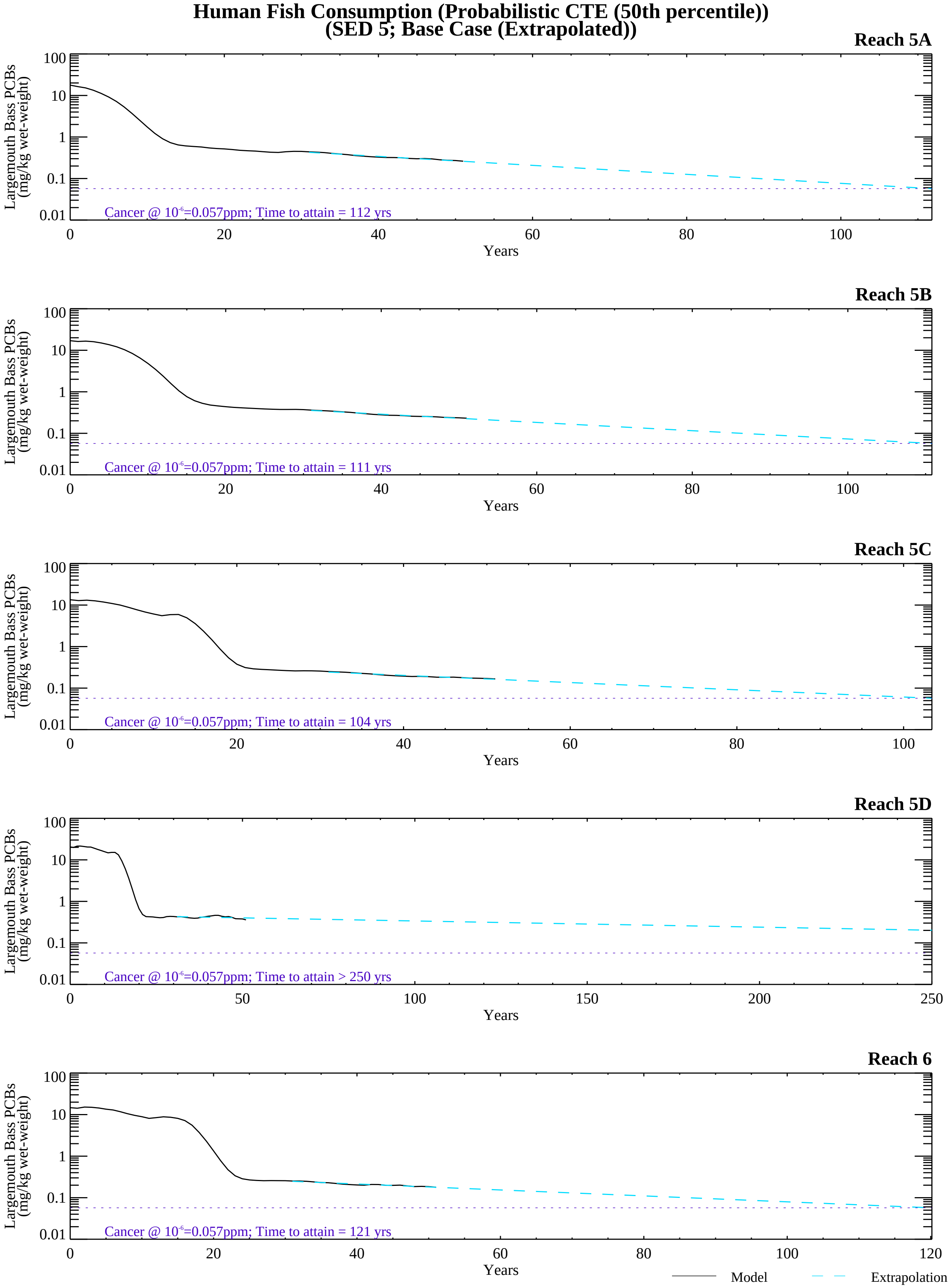

Figure G-8.2-4d. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 5; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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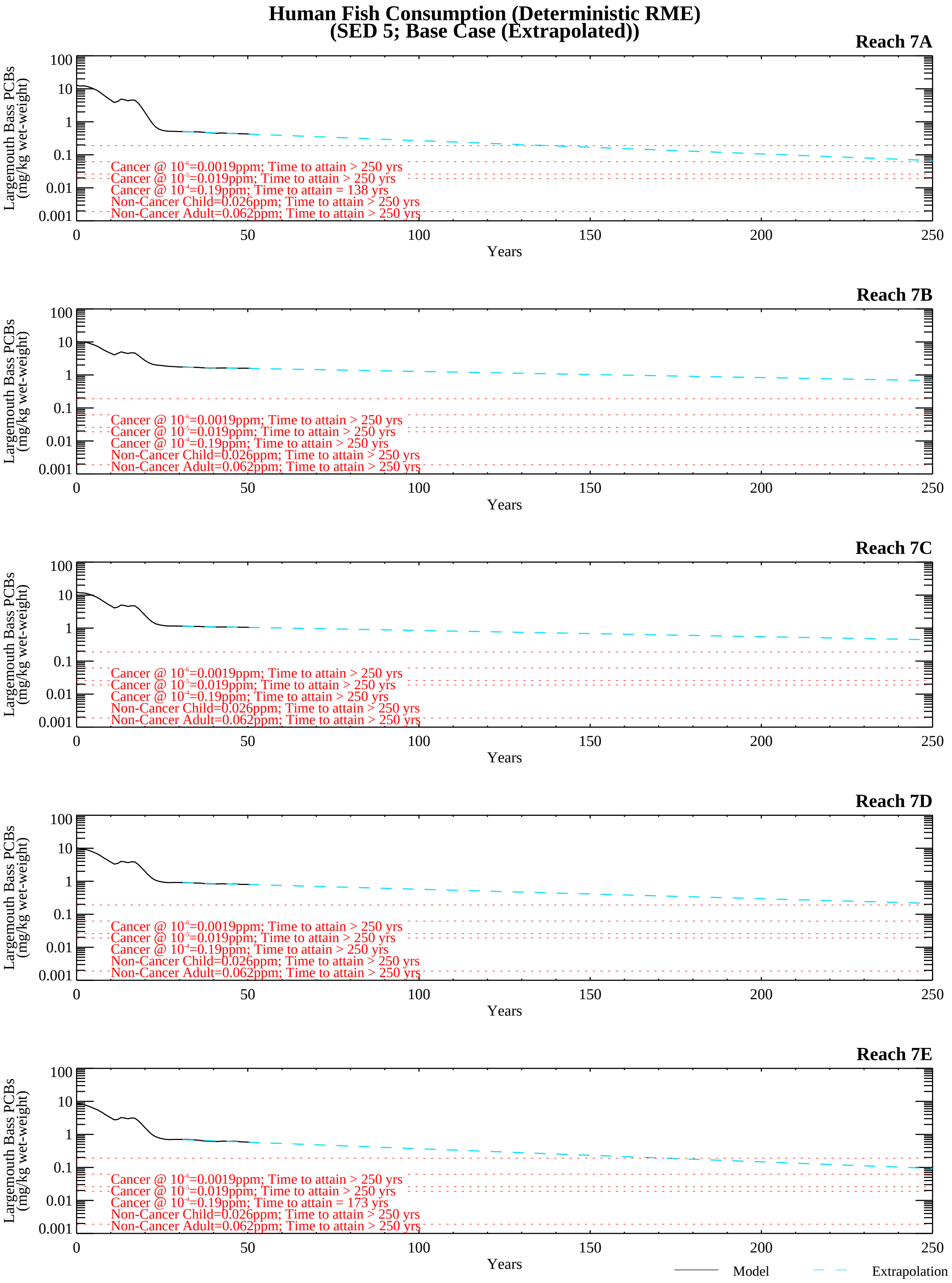

Figure G-8.2-4e. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 5; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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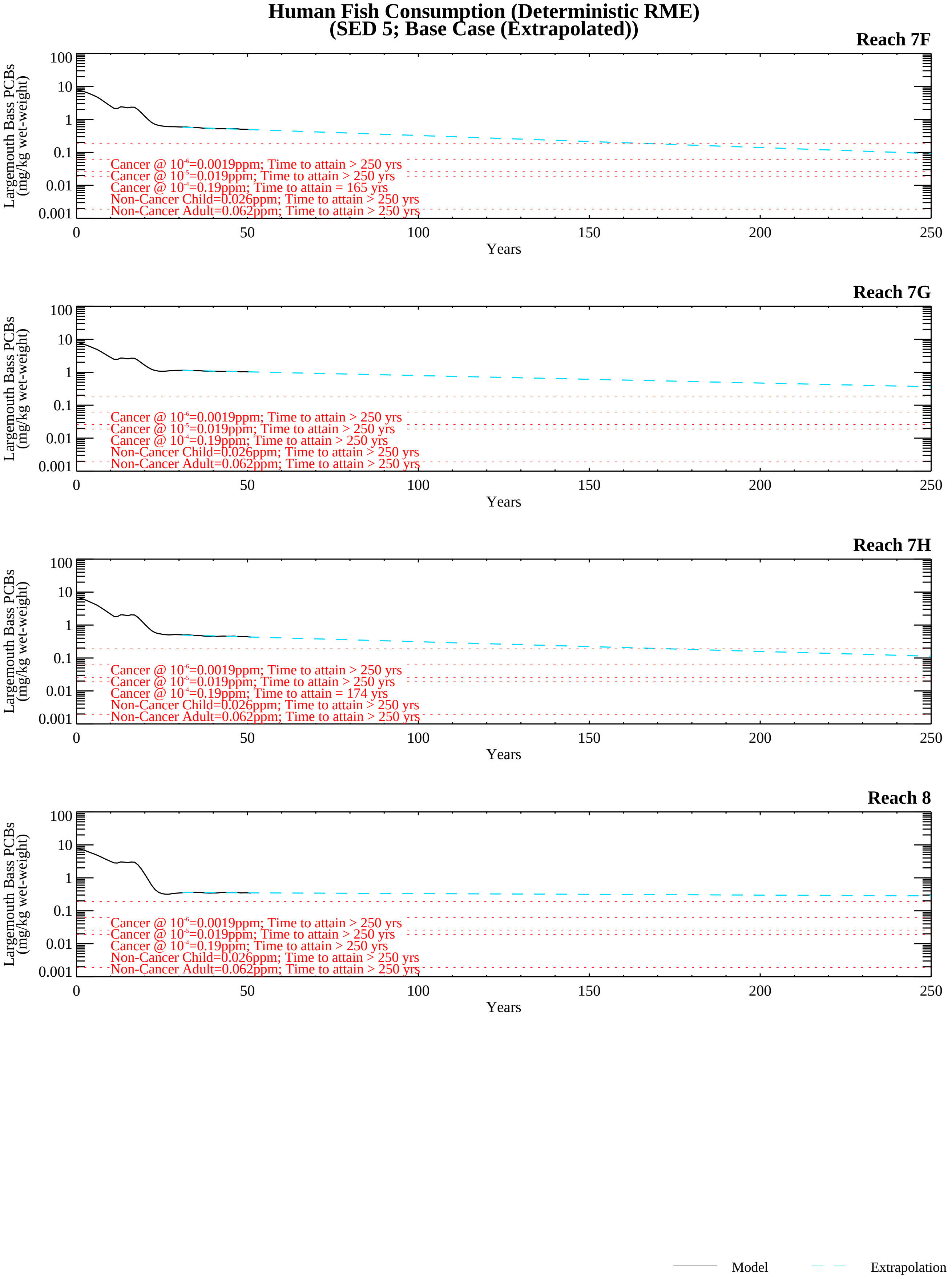

Figure G-8.2-4e. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 5; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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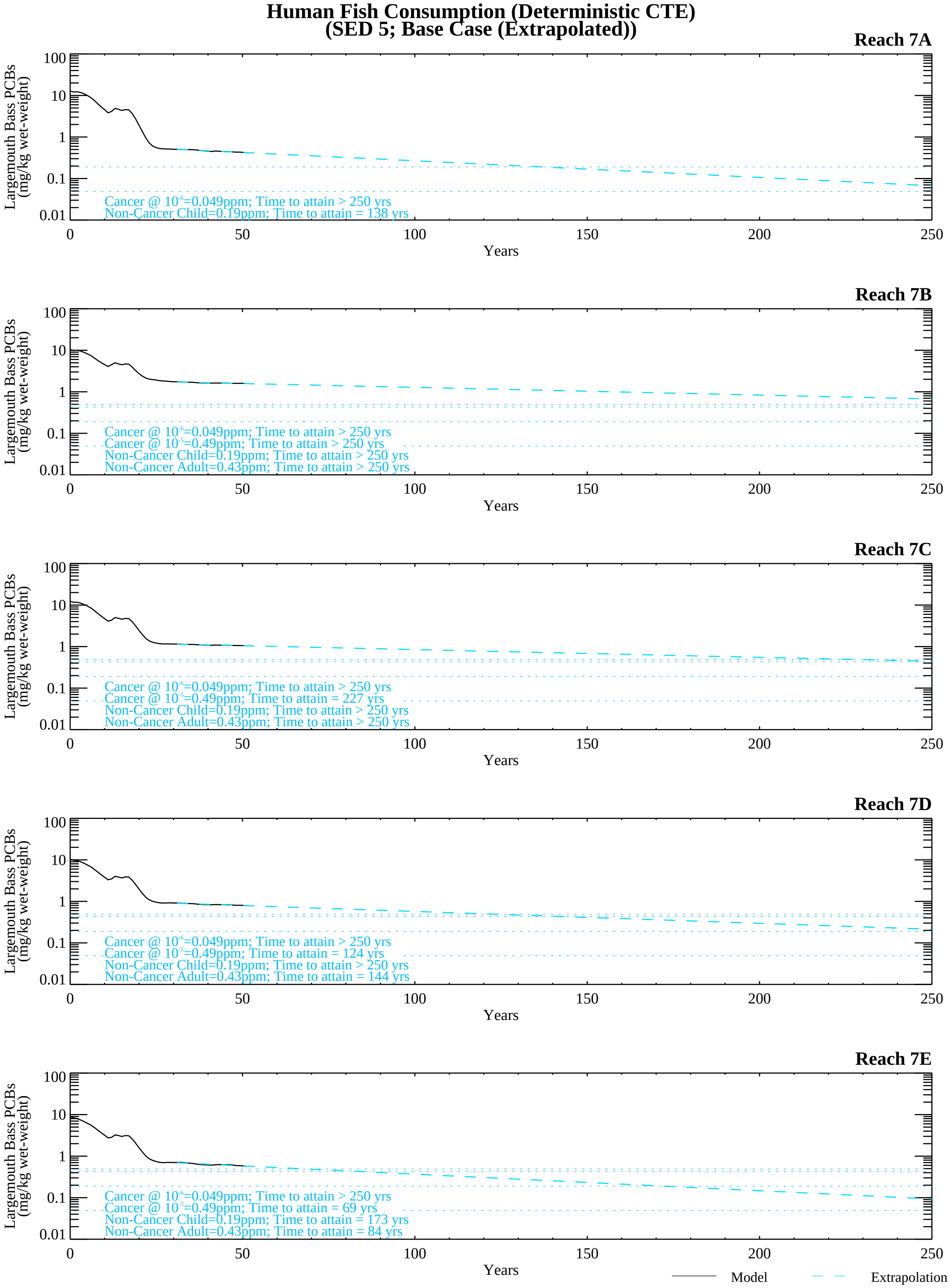

Figure G-8.2-4f. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 5; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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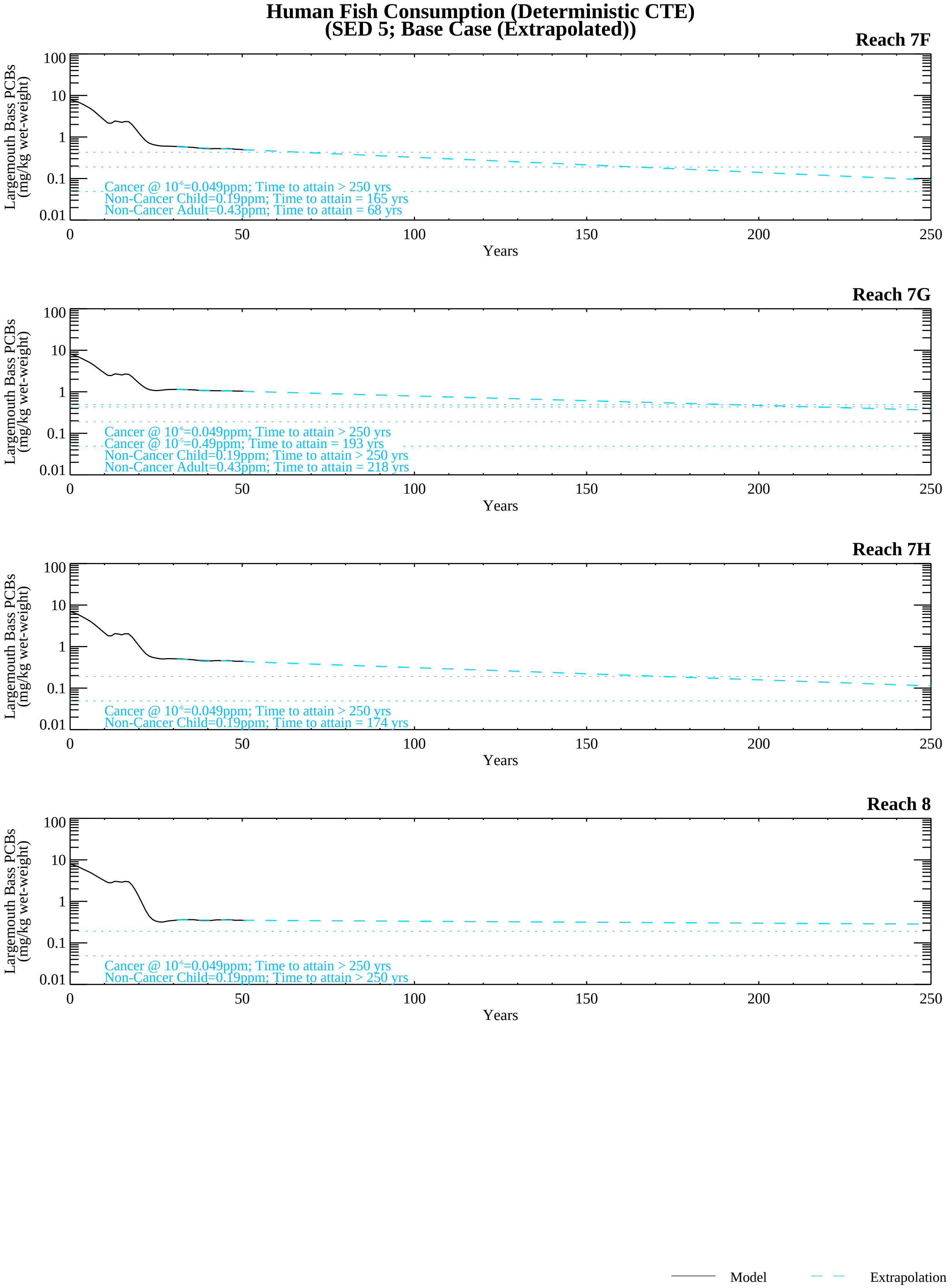

Figure G-8.2-4f. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 5; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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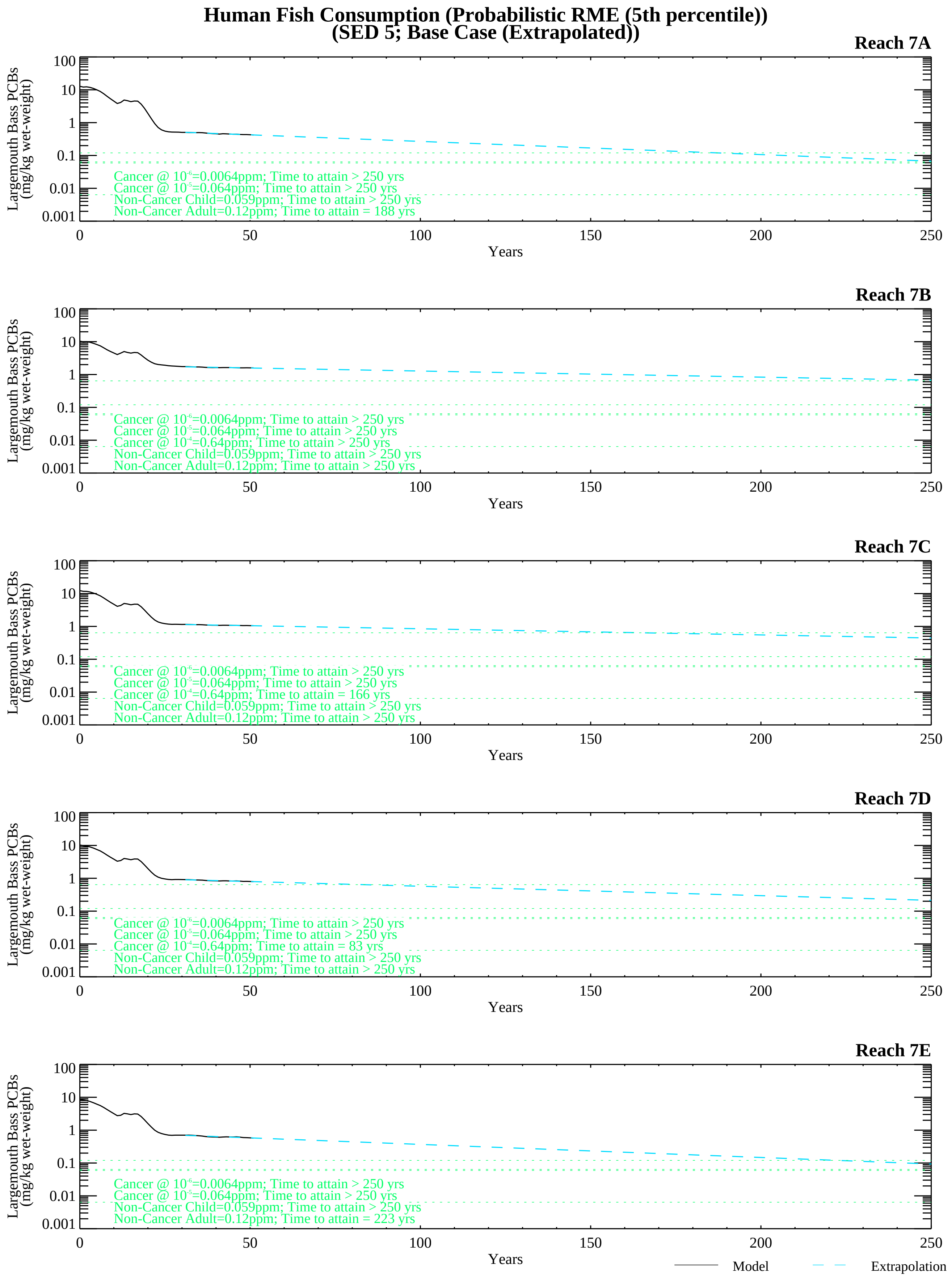

Figure G-8.2-4g. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 5; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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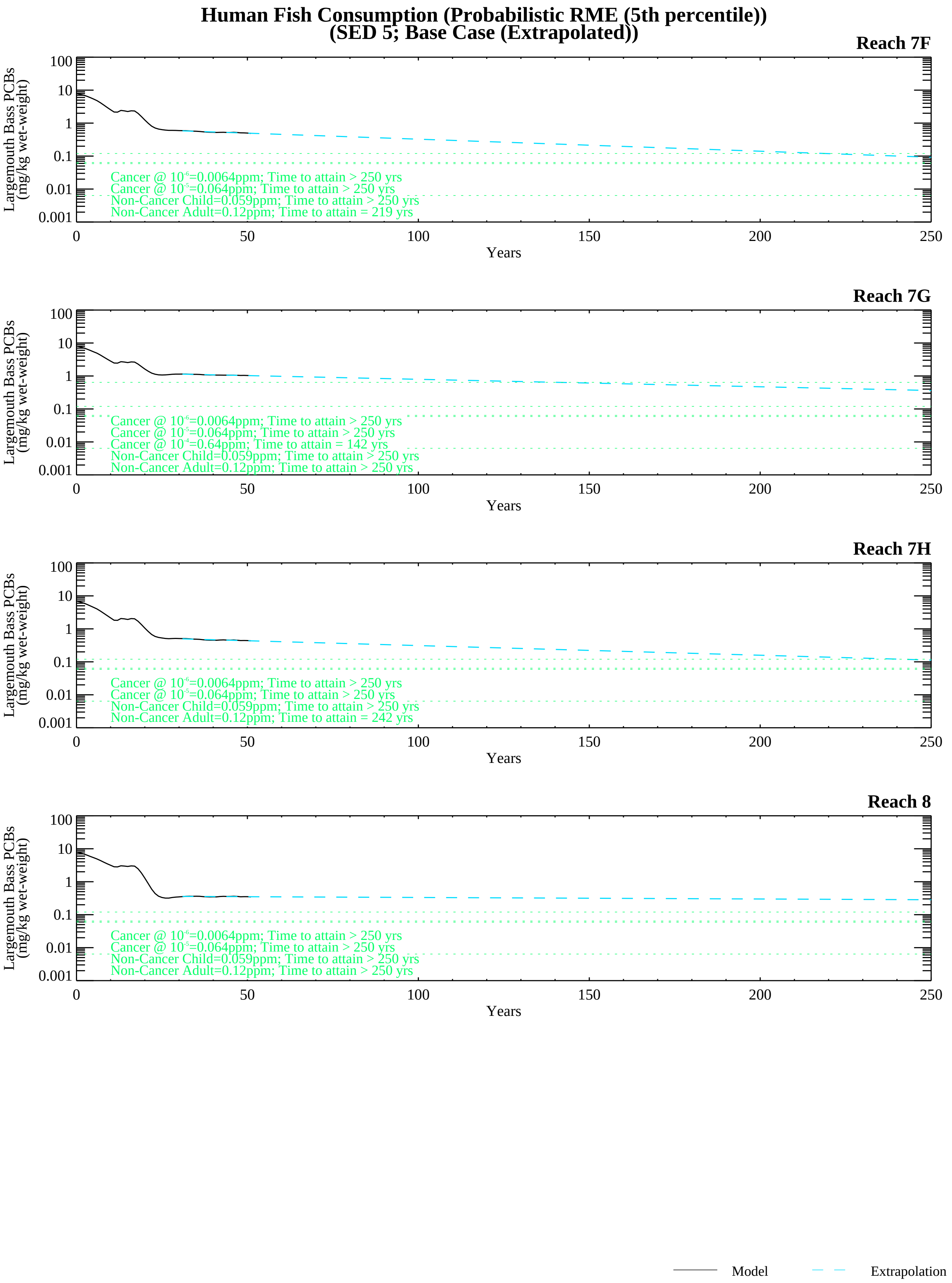

Figure G-8.2-4g. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 5; Reach 7/8; Base Case).

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Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

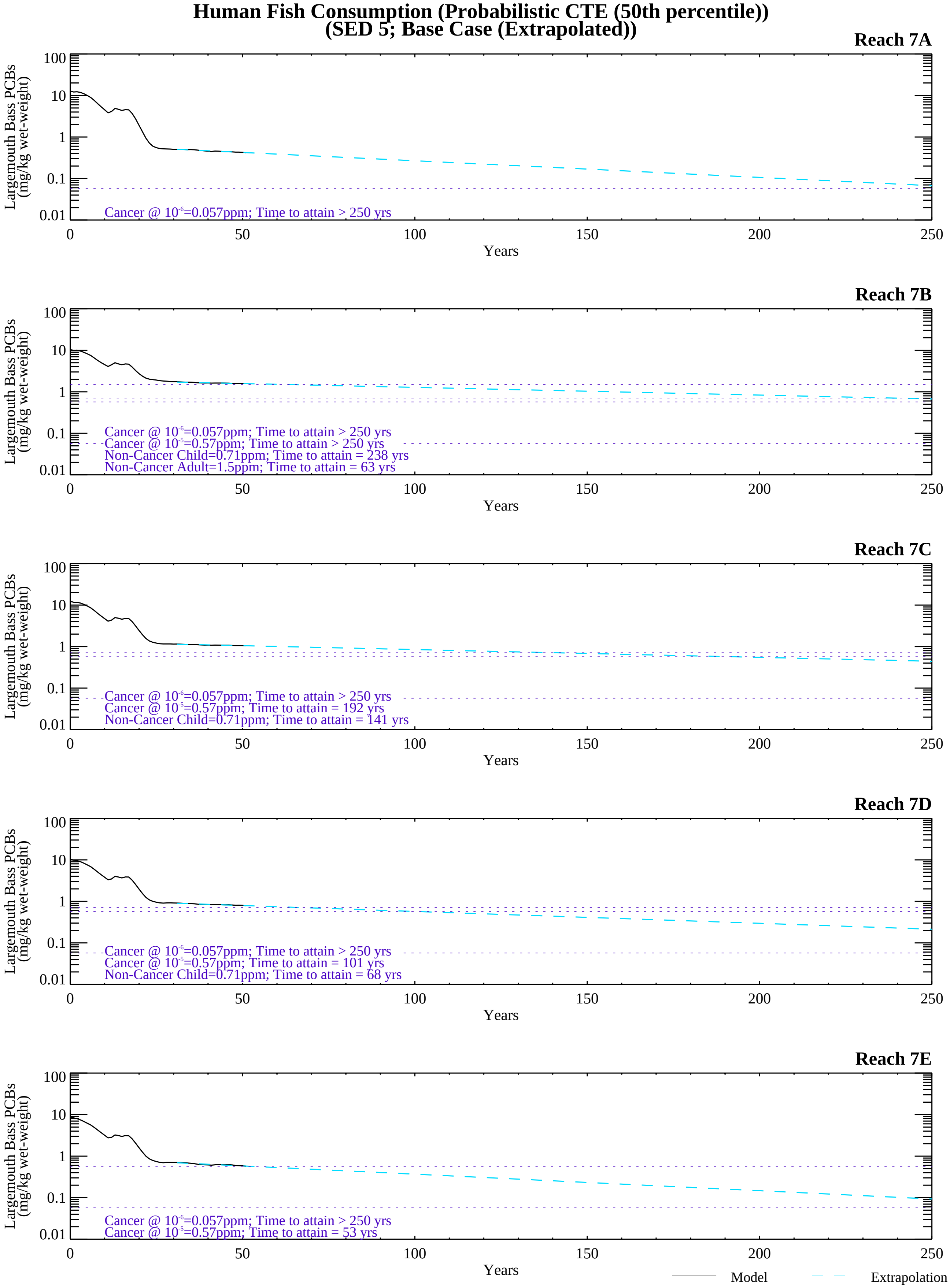

Figure G-8.2-4h. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 5; Reach 7/8; Base Case).

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Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

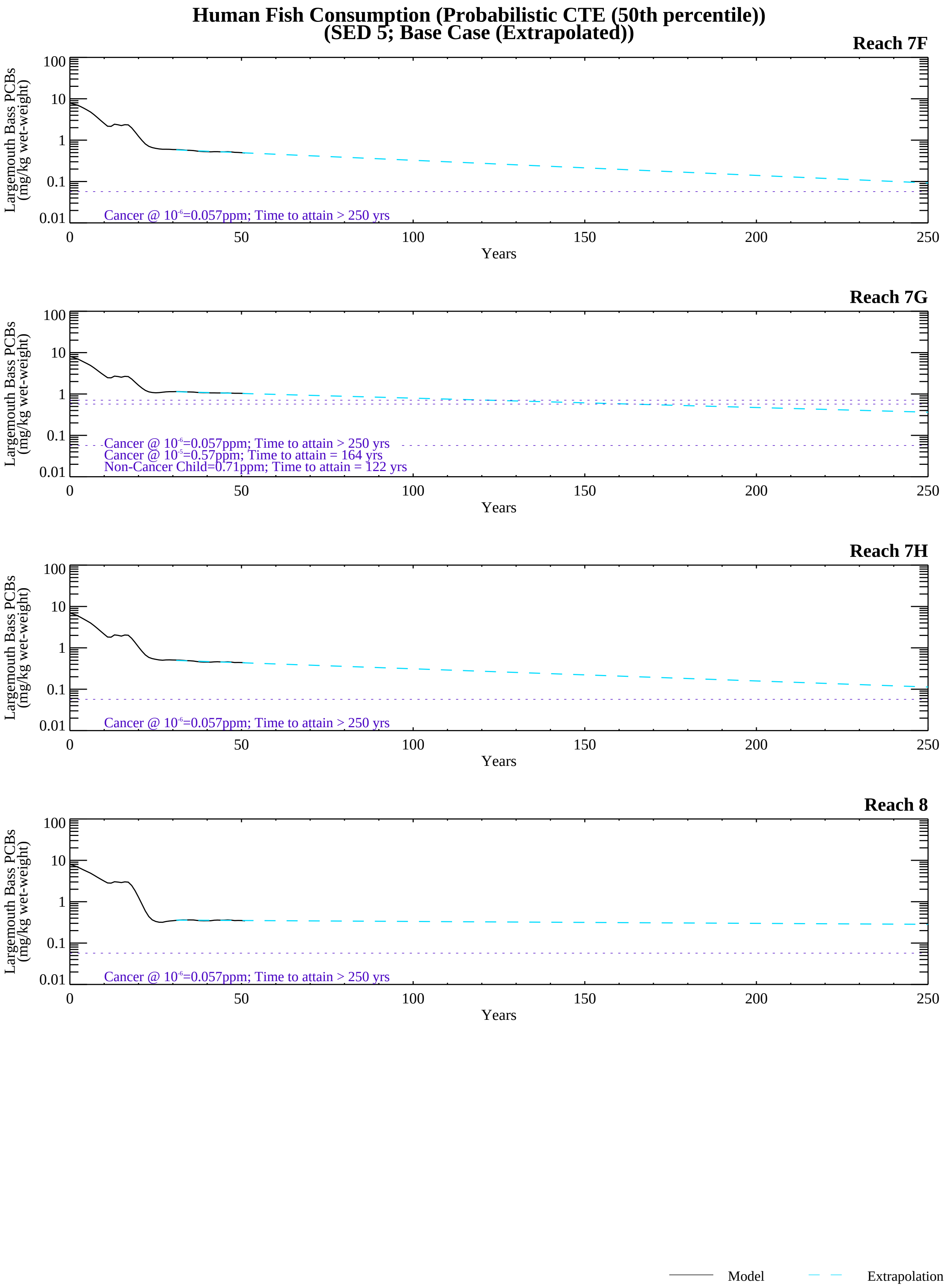

Figure G-8.2-4h. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 5; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

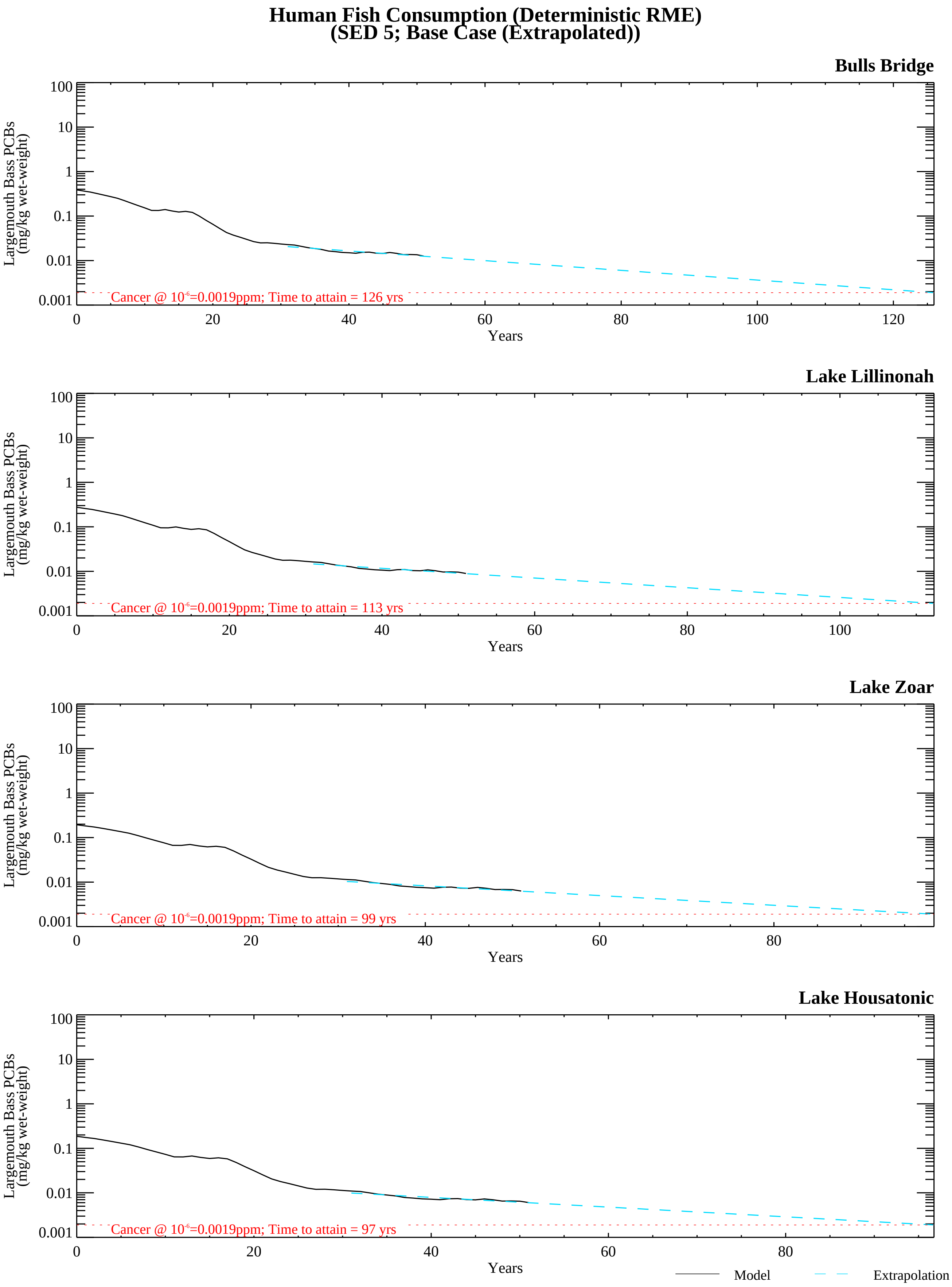

Figure G-8.2-4i. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to deterministic RME IMPGs for human consumption of fish (SED 5; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

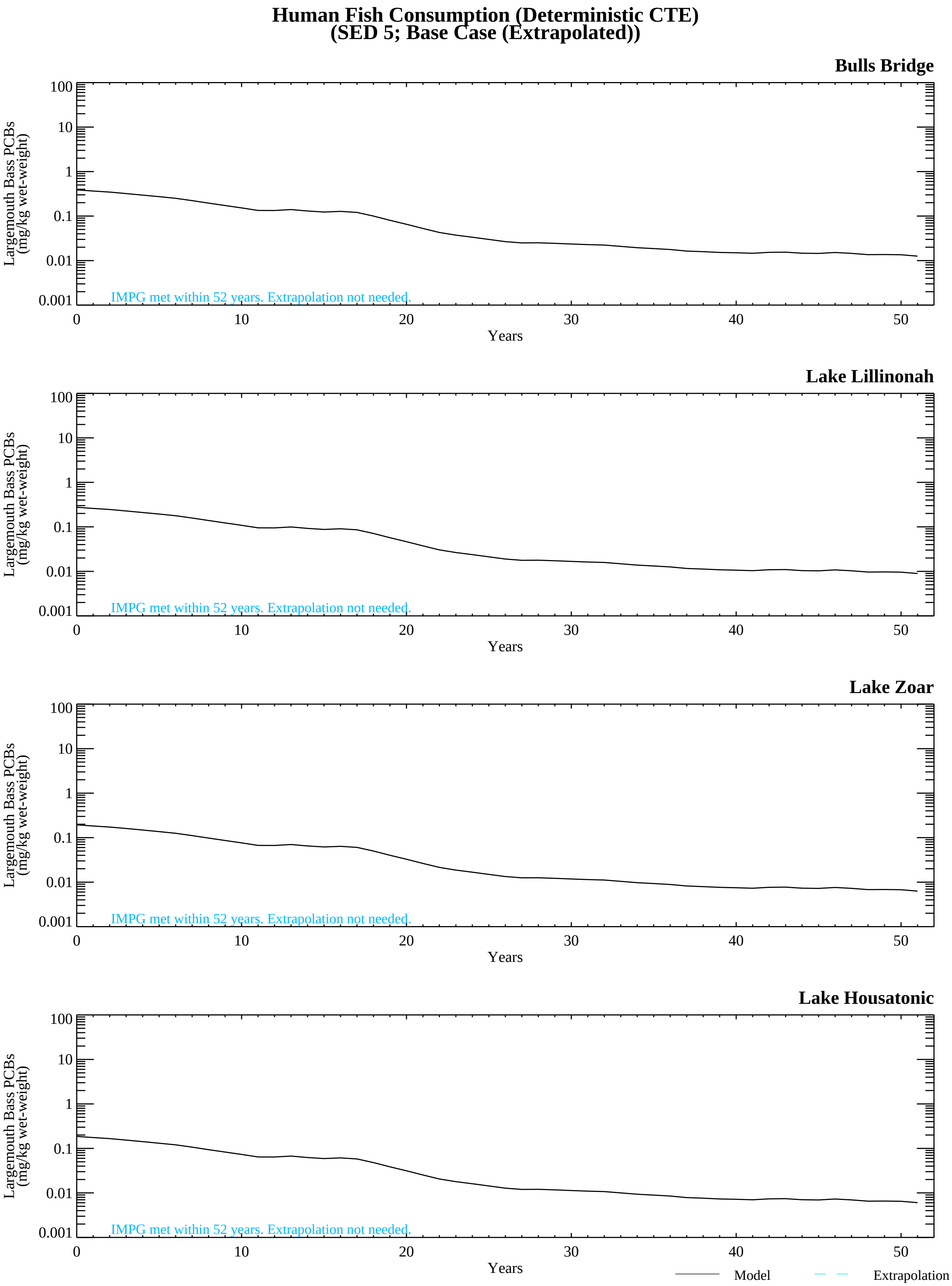

Figure G-8.2-4j. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to deterministic CTE IMPGs for human consumption of fish (SED 5; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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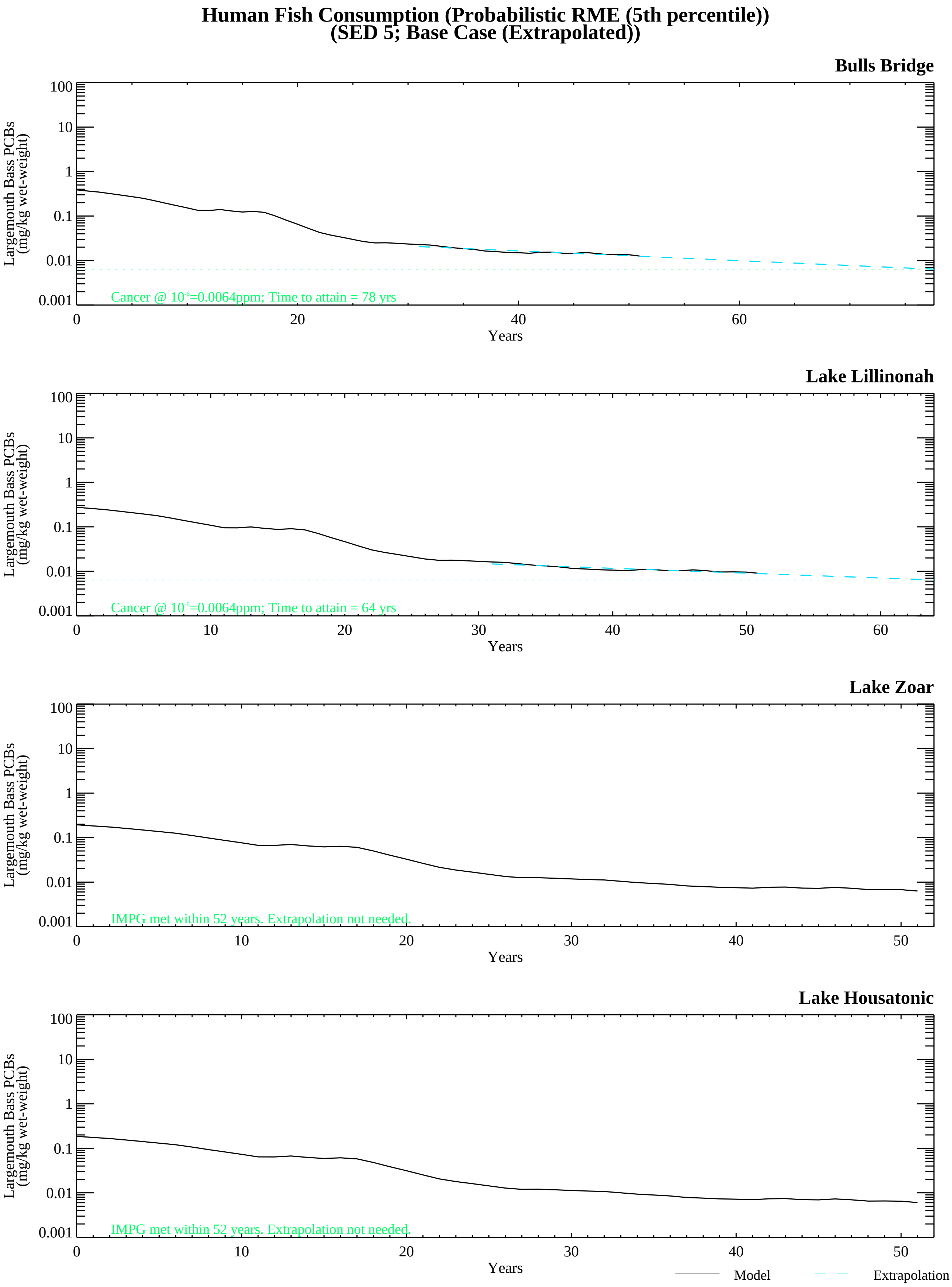

Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 5; Base Case (Extrapolated))

Bulls Bridge

Lake Lillinonah

Lake Zoar

Lake Housatonic

Figure G-8.2-4k. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to probabilistic RME IMPGs for human consumption of fish (SED 5; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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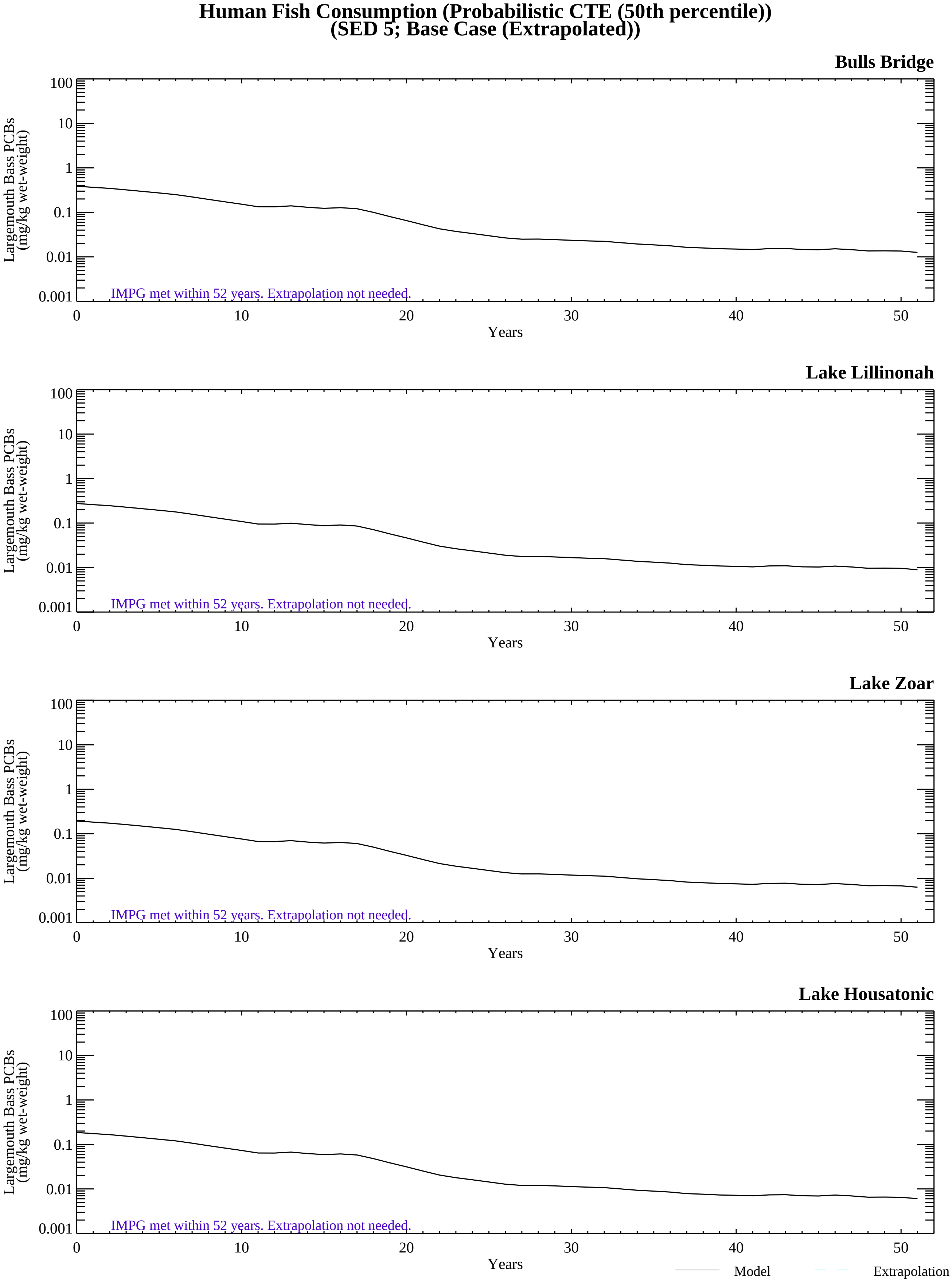
Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 5; Base Case (Extrapolated))

Bulls Bridge

Lake Lillinonah

Lake Zoar

Lake Housatonic

Figure G-8.2-4l. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to probabilistic CTE IMPGs for human consumption of fish (SED 5; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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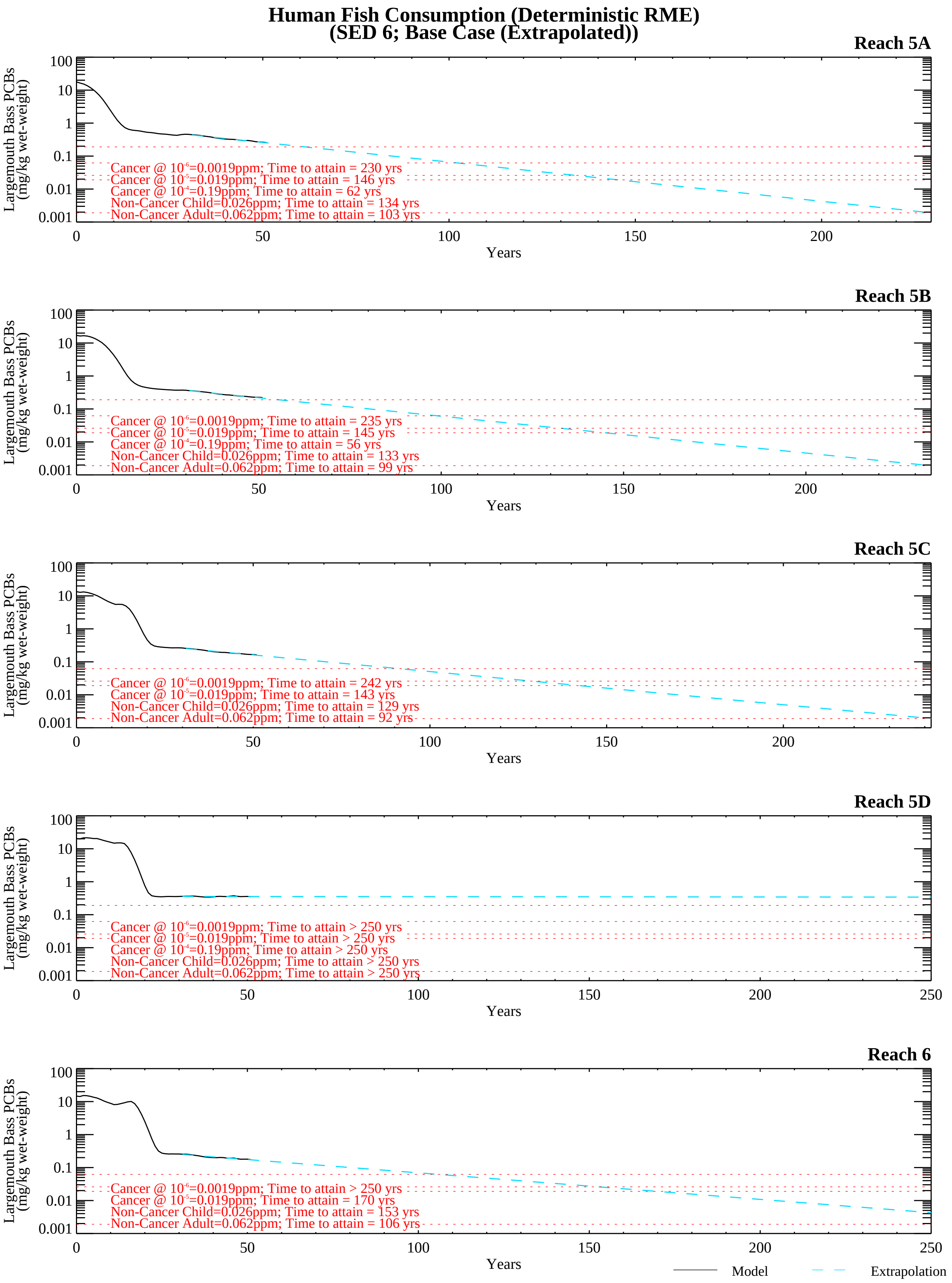

Figure G-8.2-5a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 6; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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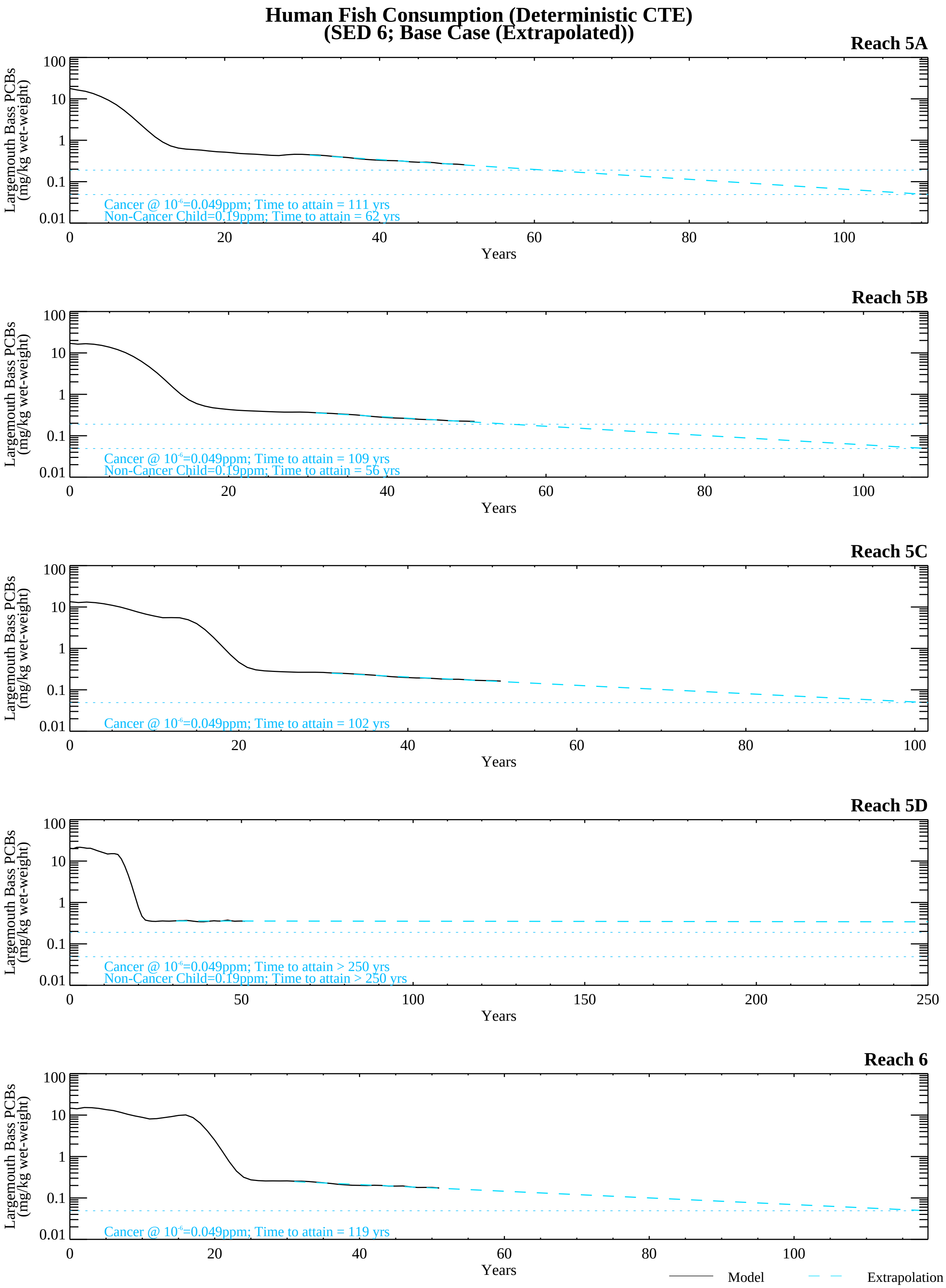

Figure G-8.2-5b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 6; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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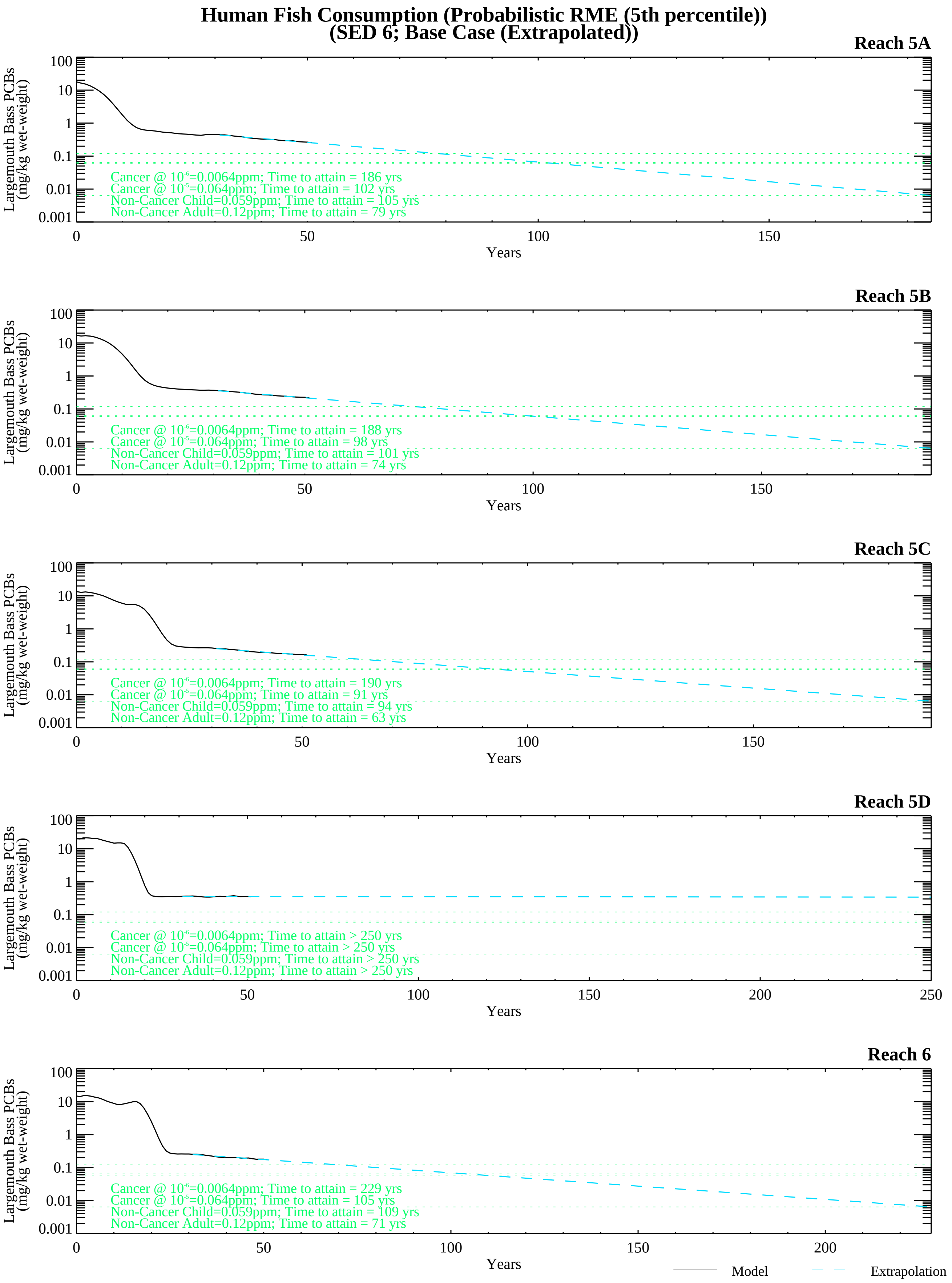

Figure G-8.2-5c. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 6; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

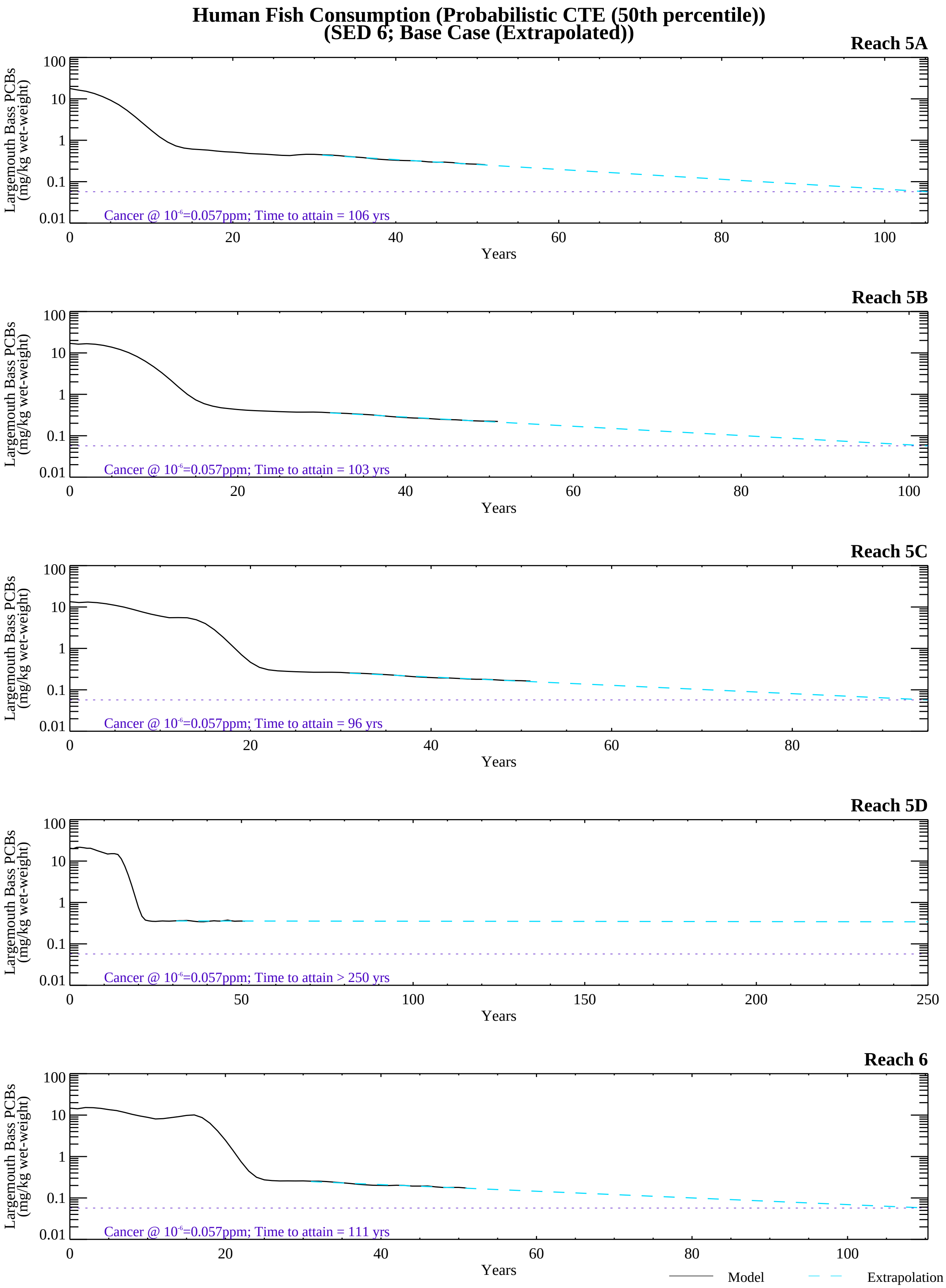

Figure G-8.2-5d. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 6; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

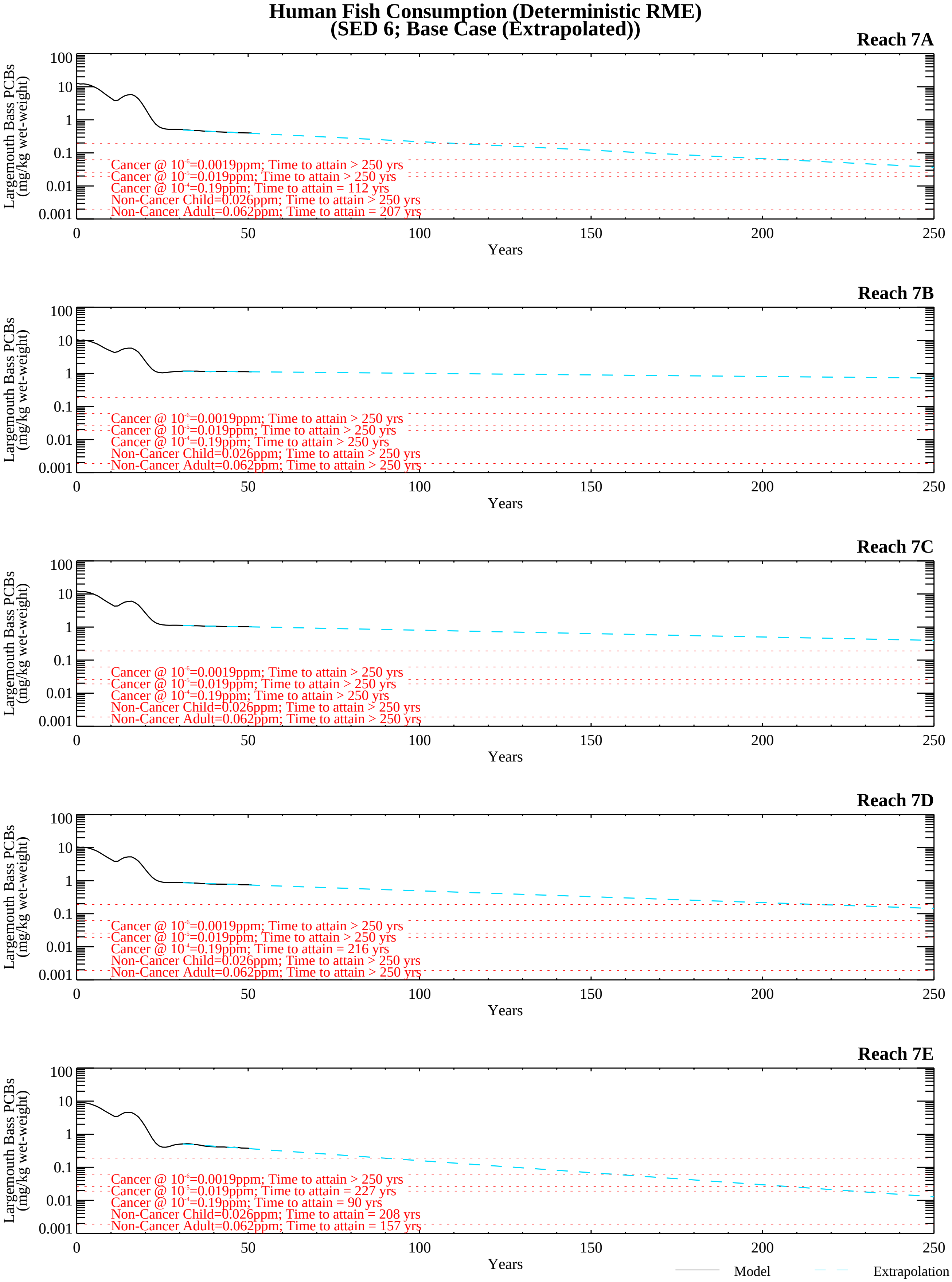

Figure G-8.2-5e. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 6; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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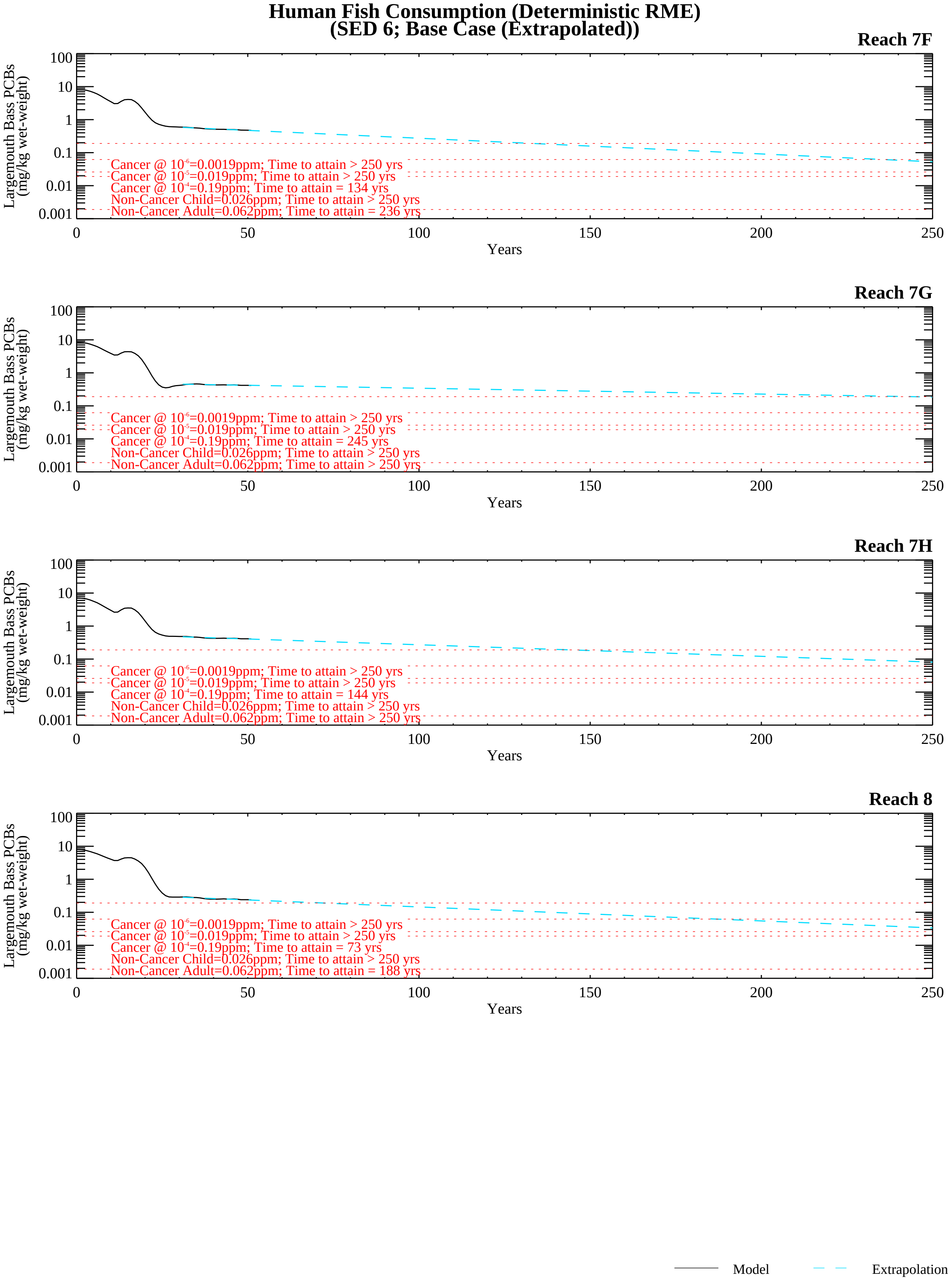

Figure G-8.2-5e. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 6; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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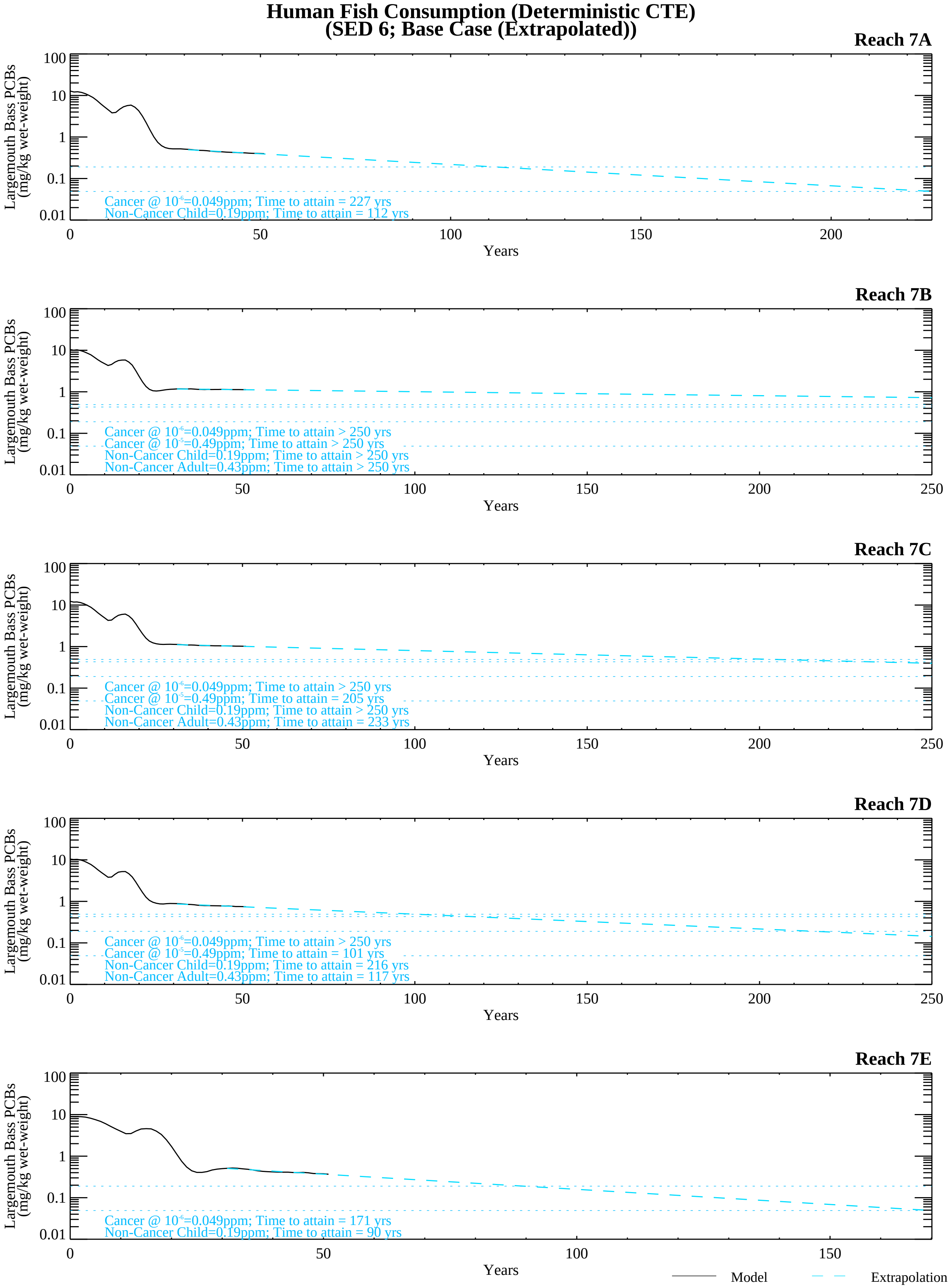

Figure G-8.2-5f. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 6; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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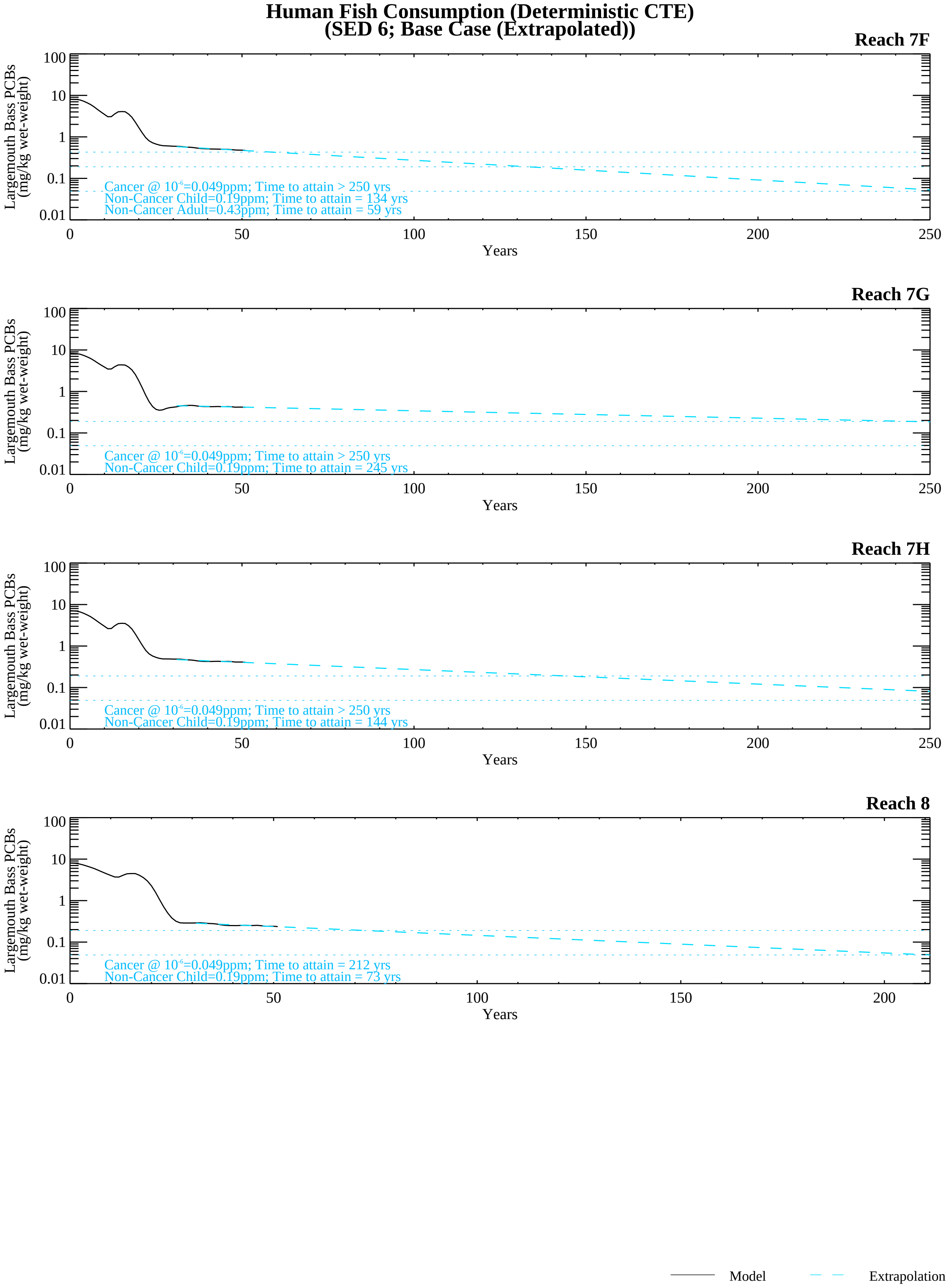

Figure G-8.2-5f. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 6; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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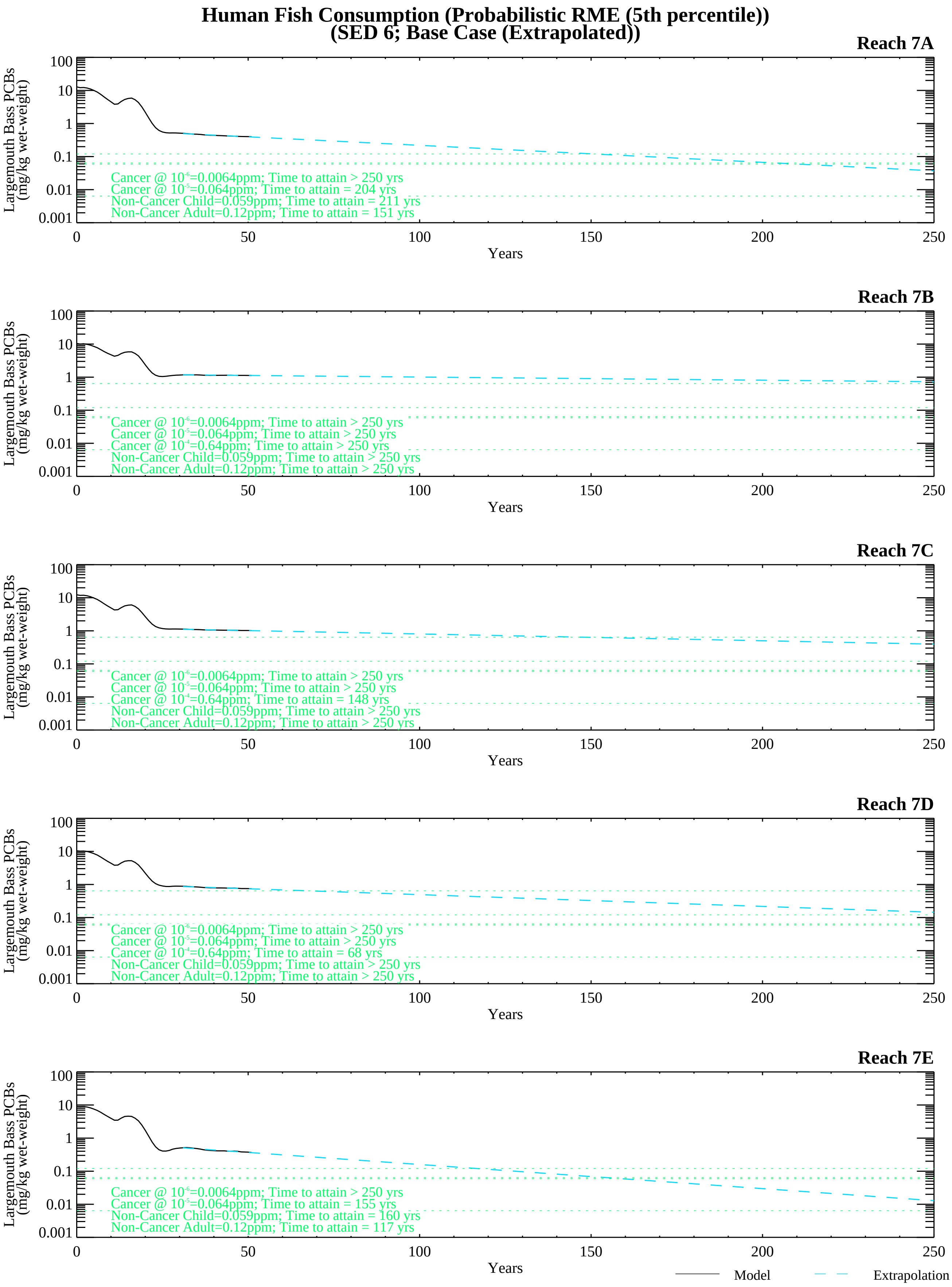

Figure G-8.2-5g. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 6; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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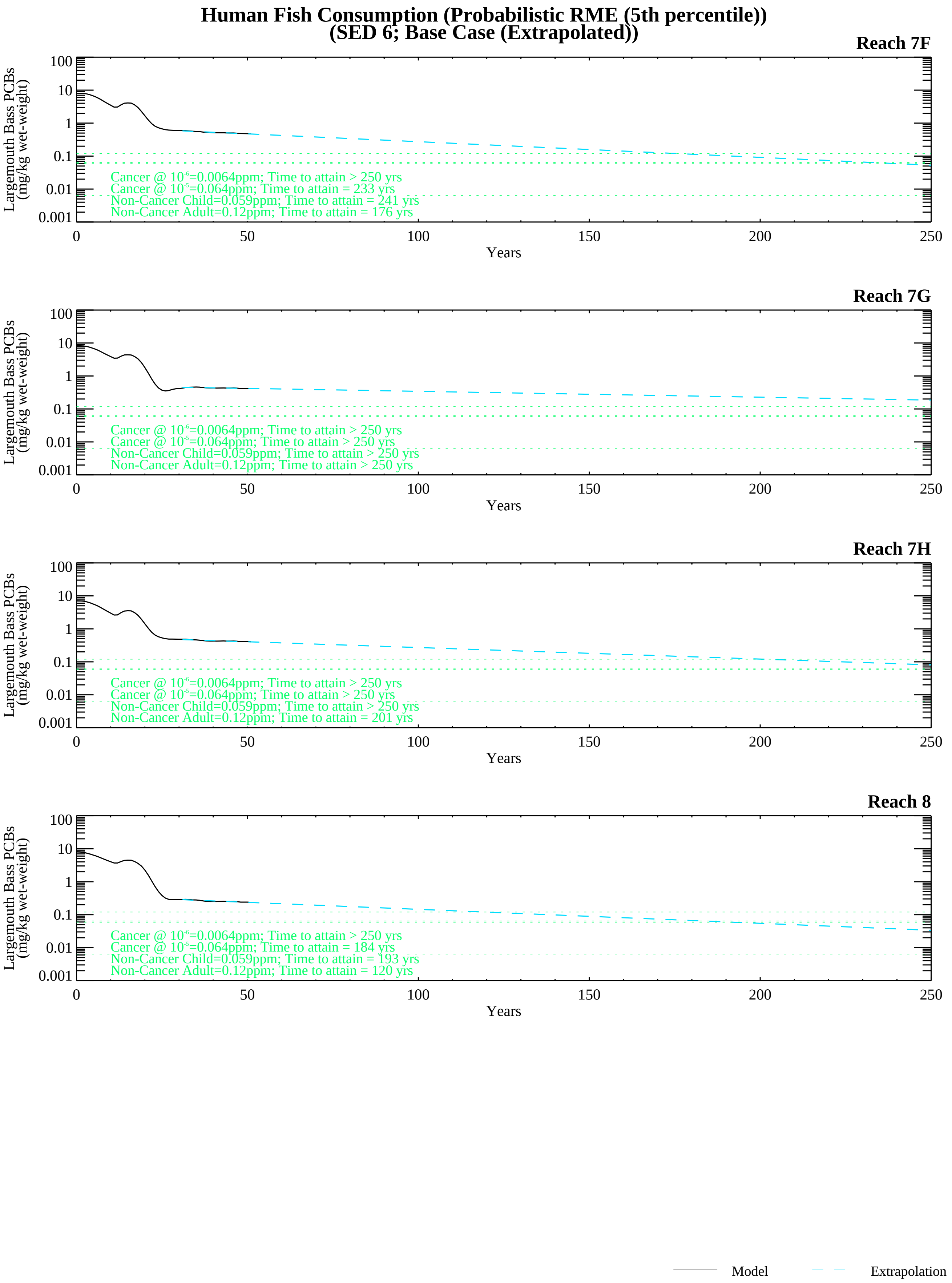

Figure G-8.2-5g. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 6; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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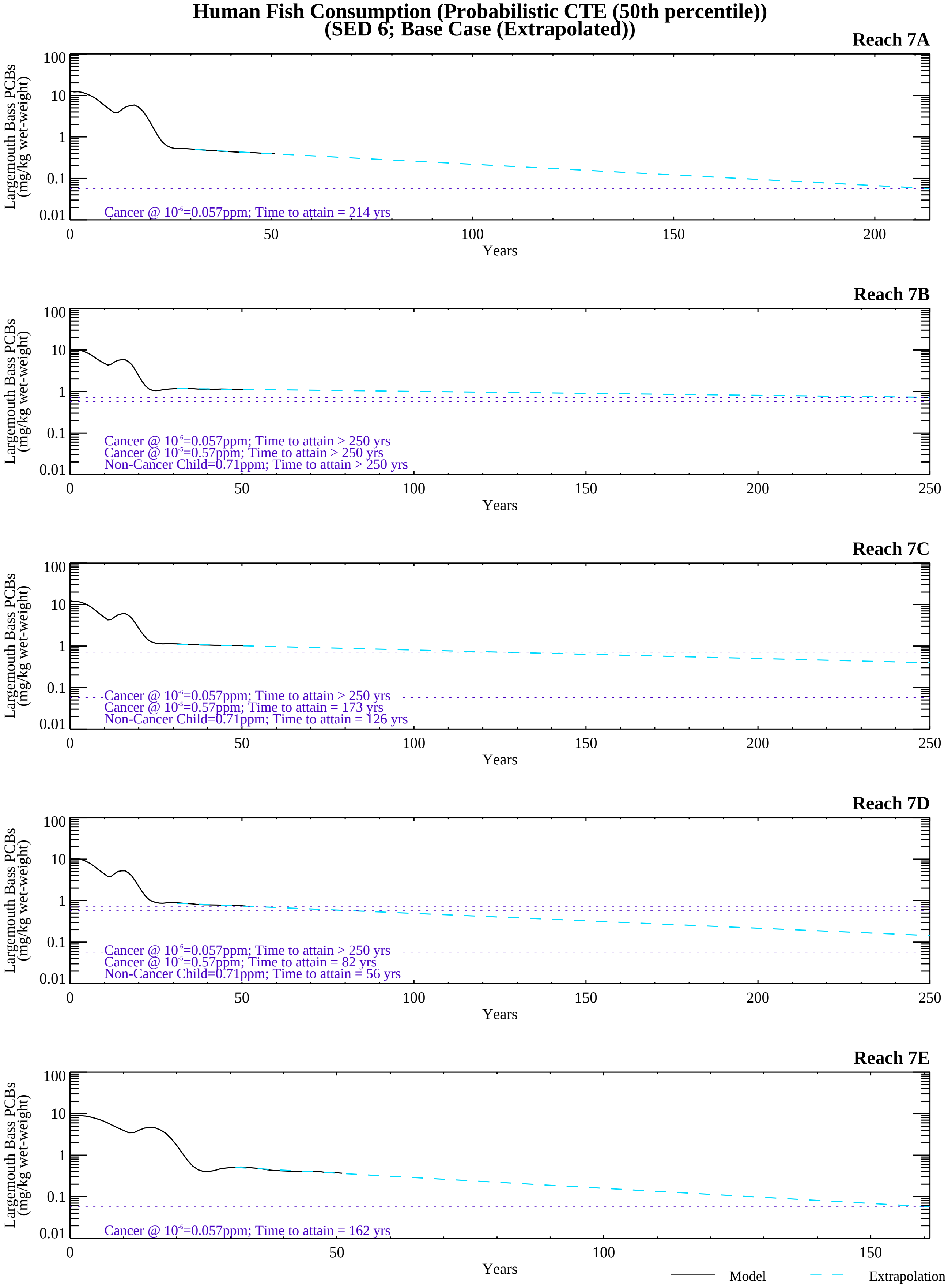

Figure G-8.2-5h. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 6; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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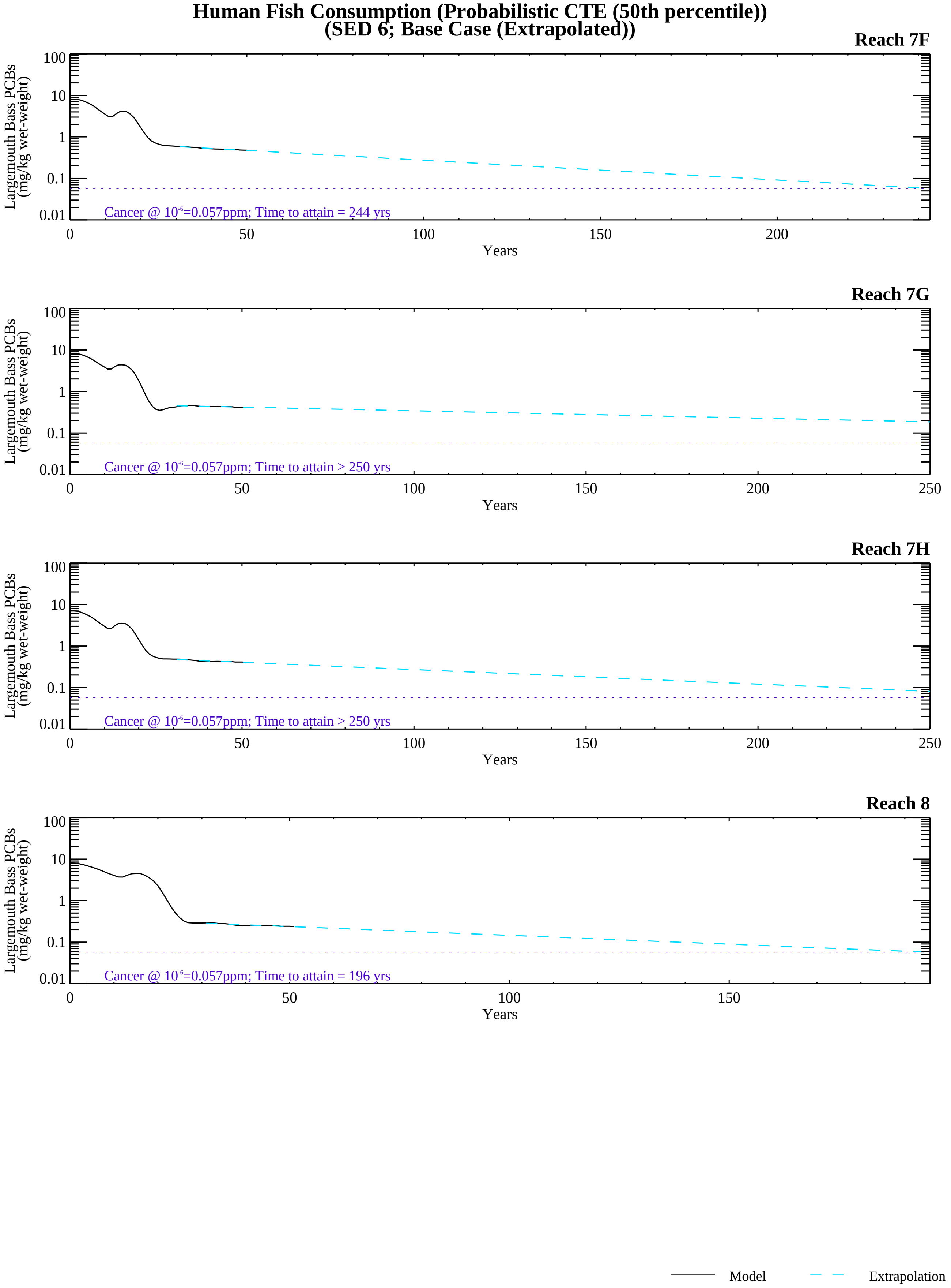

Figure G-8.2-5h. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 6; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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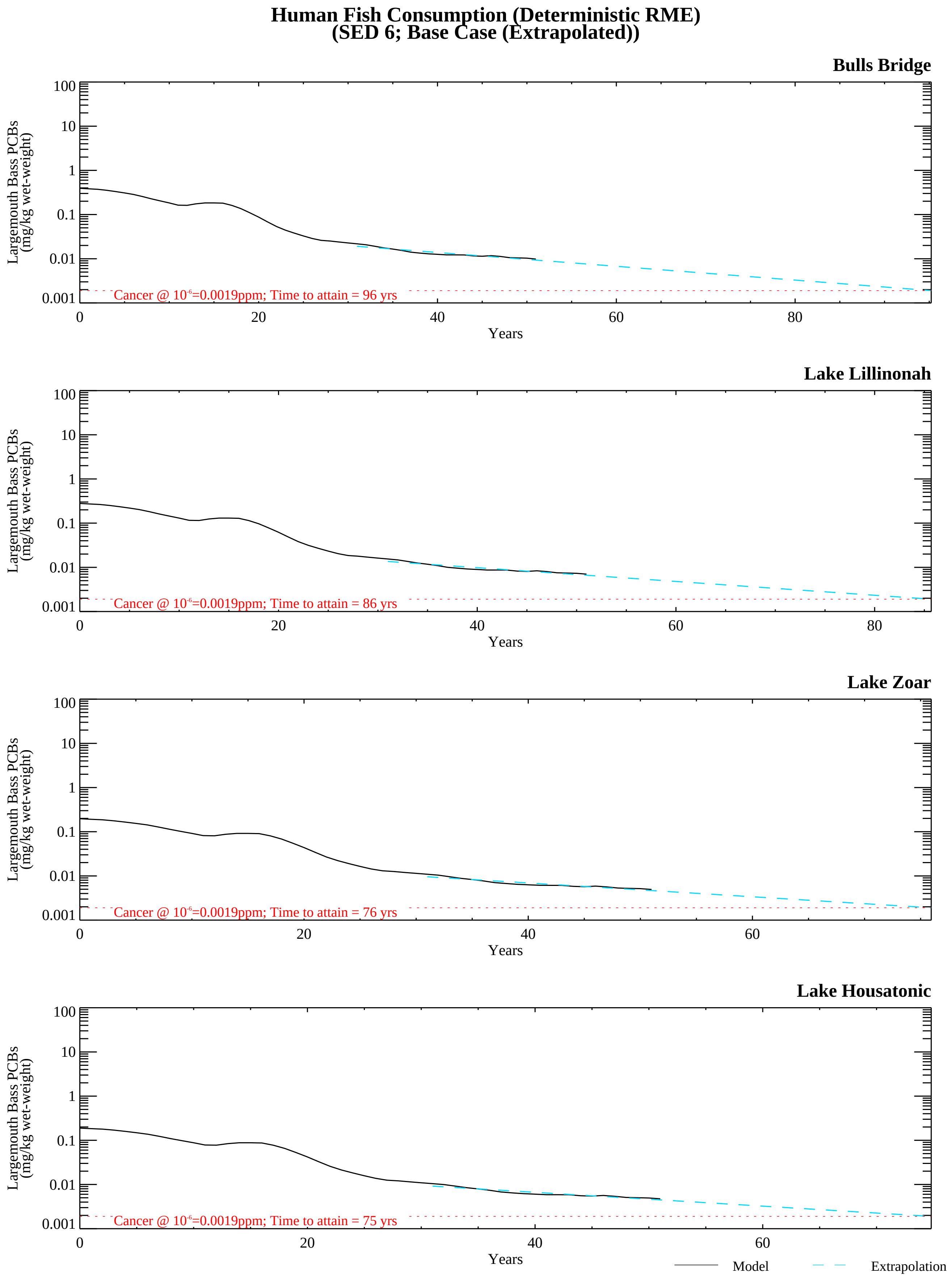

Figure G-8.2-5i. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to deterministic RME IMPGs for human consumption of fish (SED 6; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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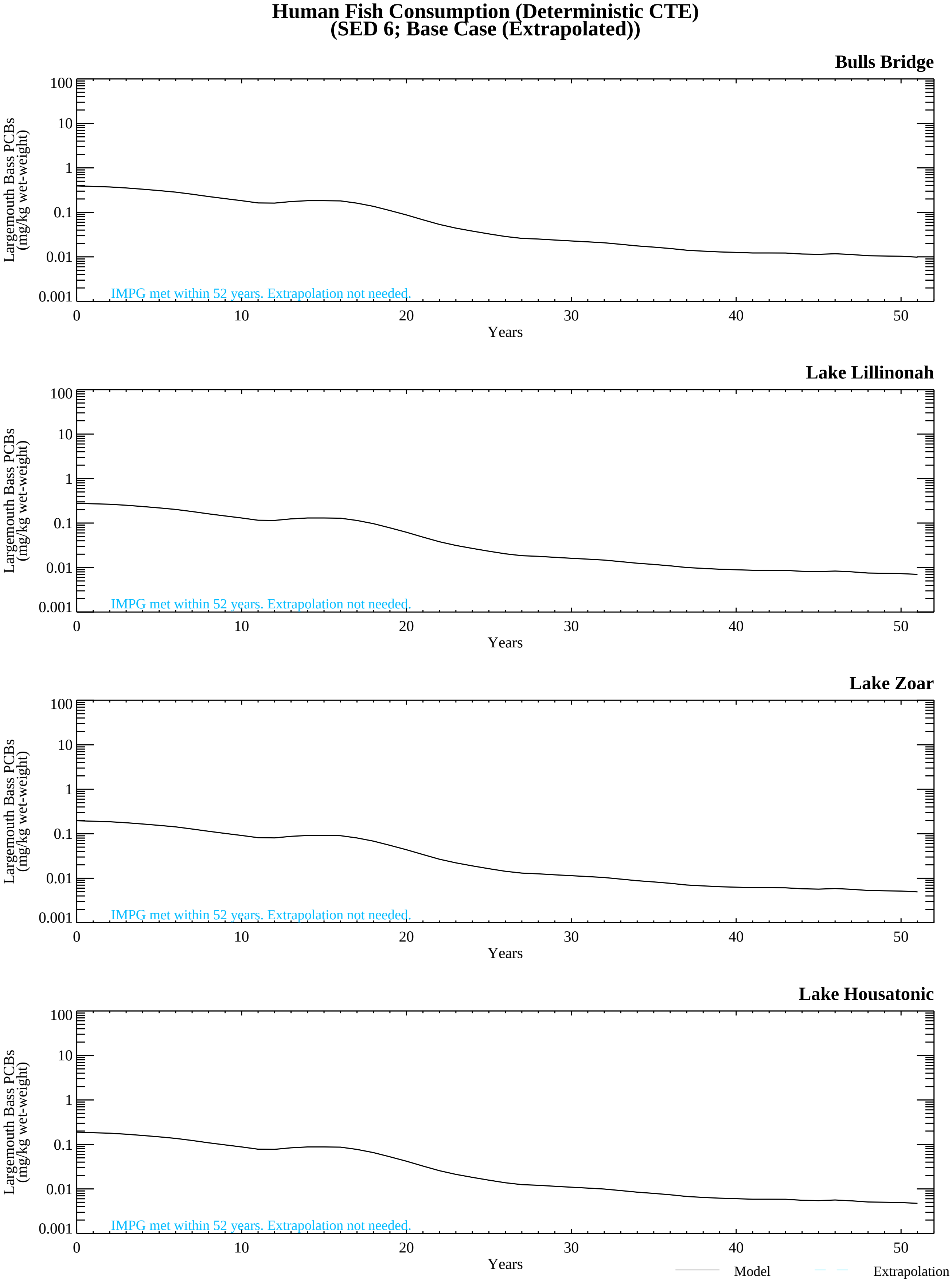

Figure G-8.2-5j. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to deterministic CTE IMPGs for human consumption of fish (SED 6; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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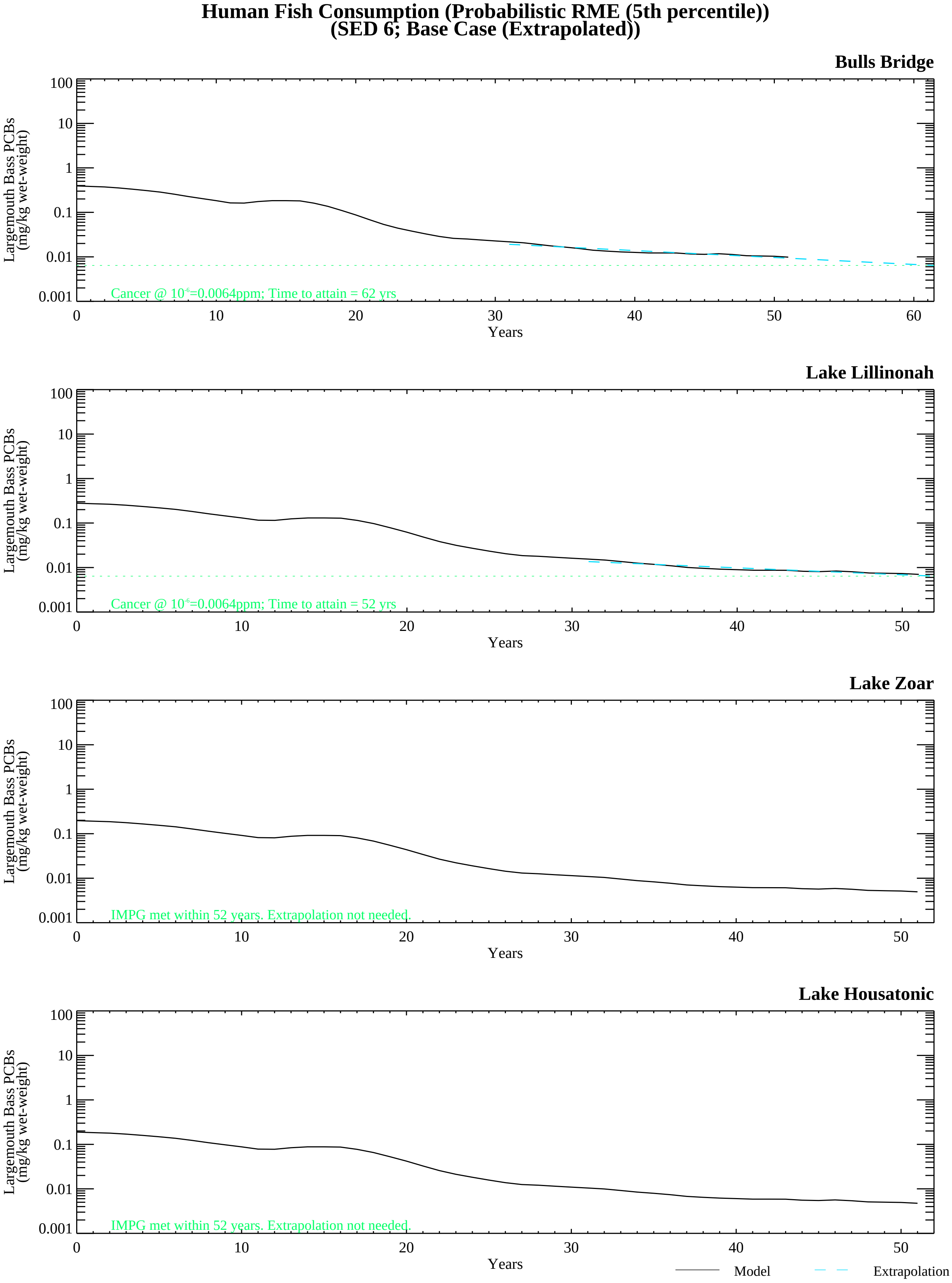

Figure G-8.2-5k. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to probabilistic RME IMPGs for human consumption of fish (SED 6; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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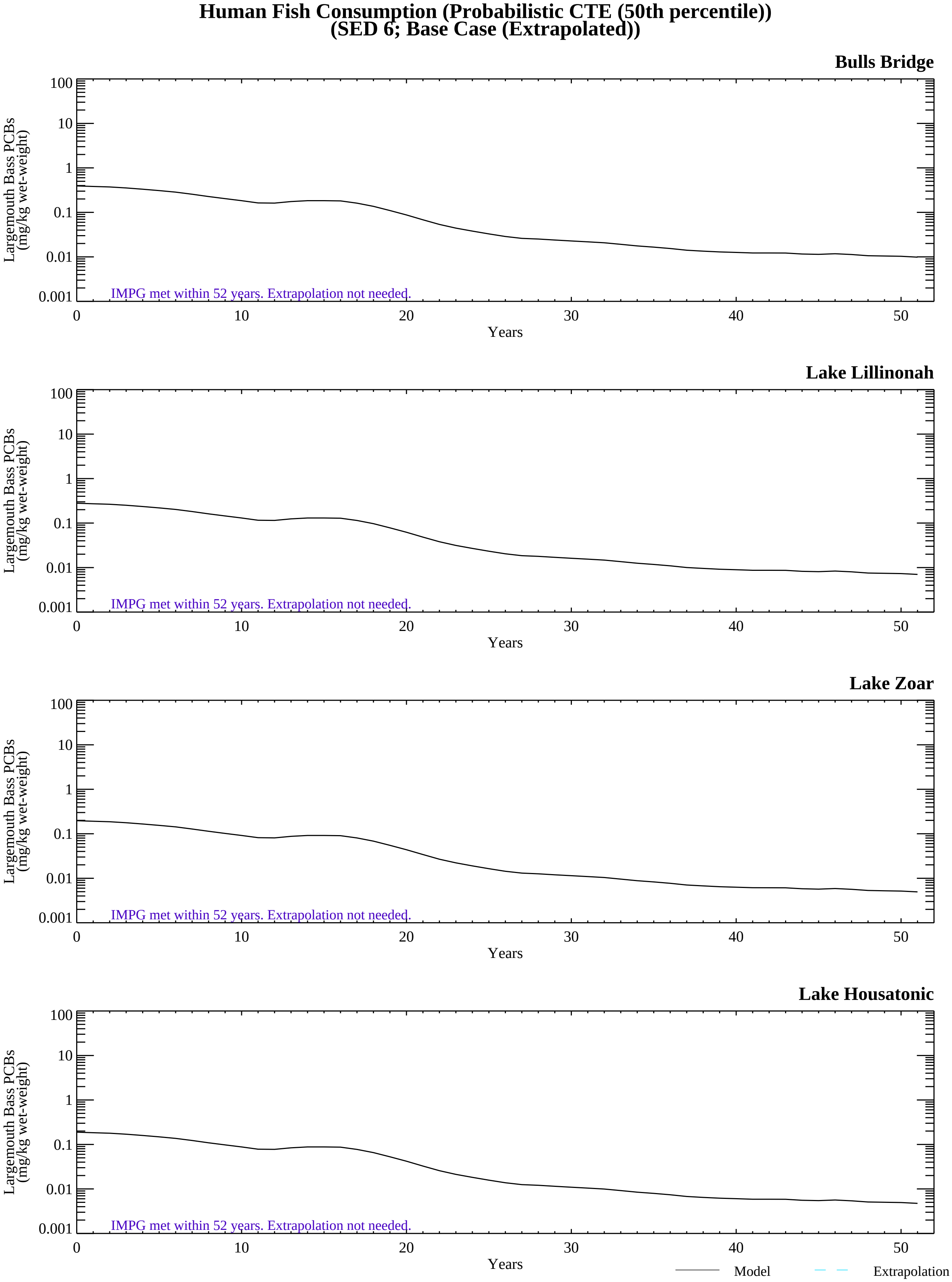

Figure G-8.2-5l. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to probabilistic CTE IMPGs for human consumption of fish (SED 6; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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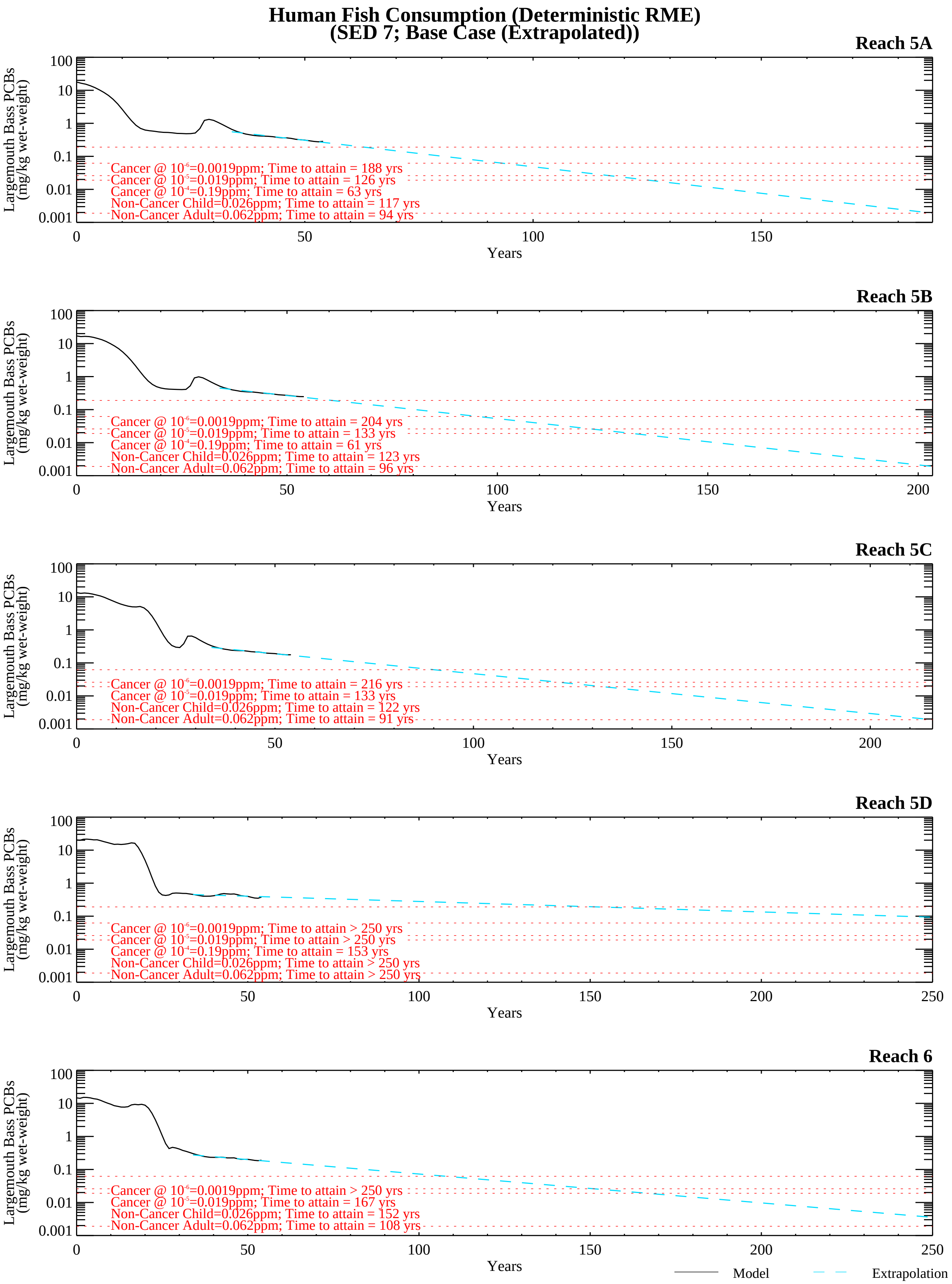

Figure G-8.2-6a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 7; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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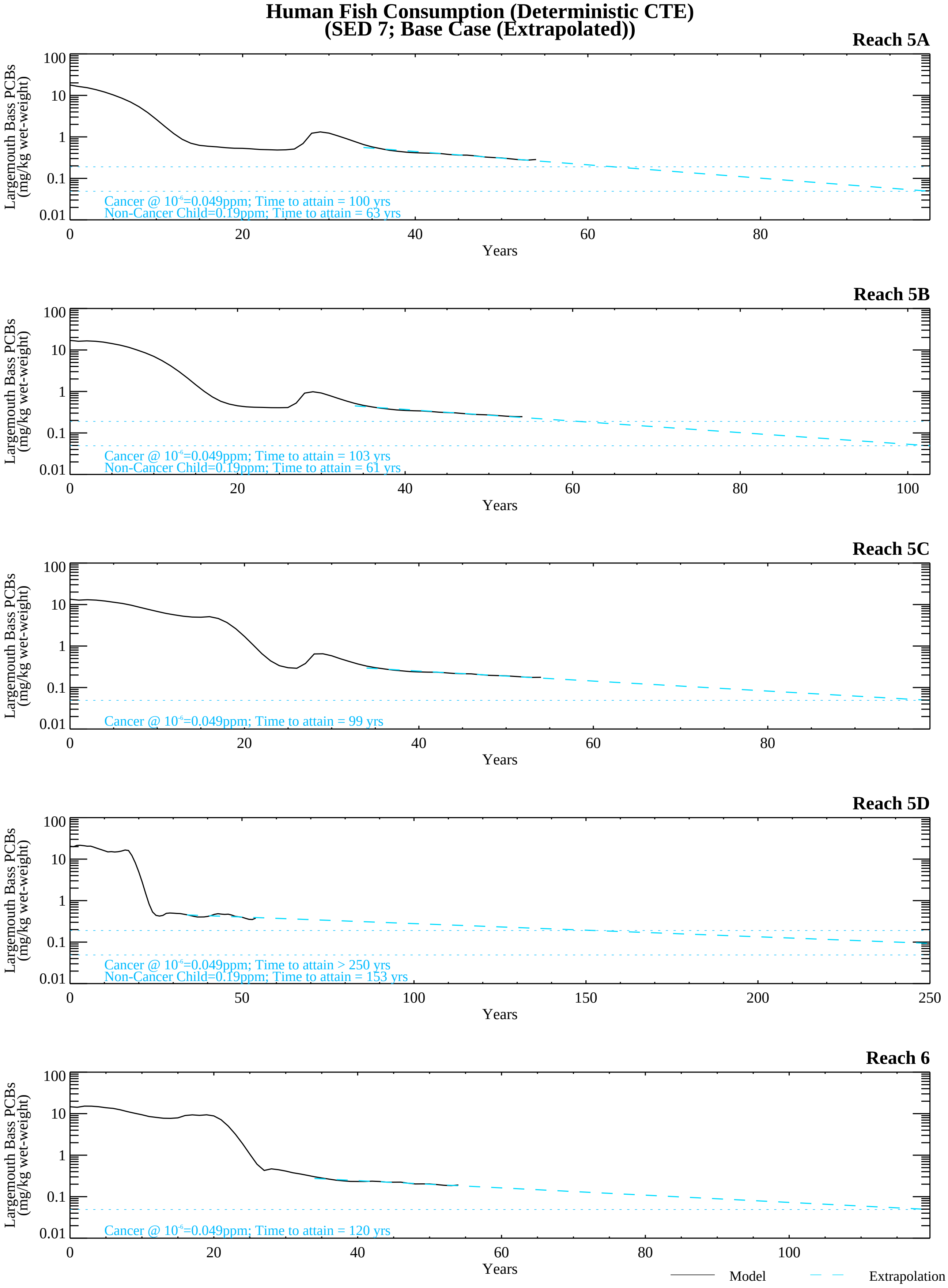

Figure G-8.2-6b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 7; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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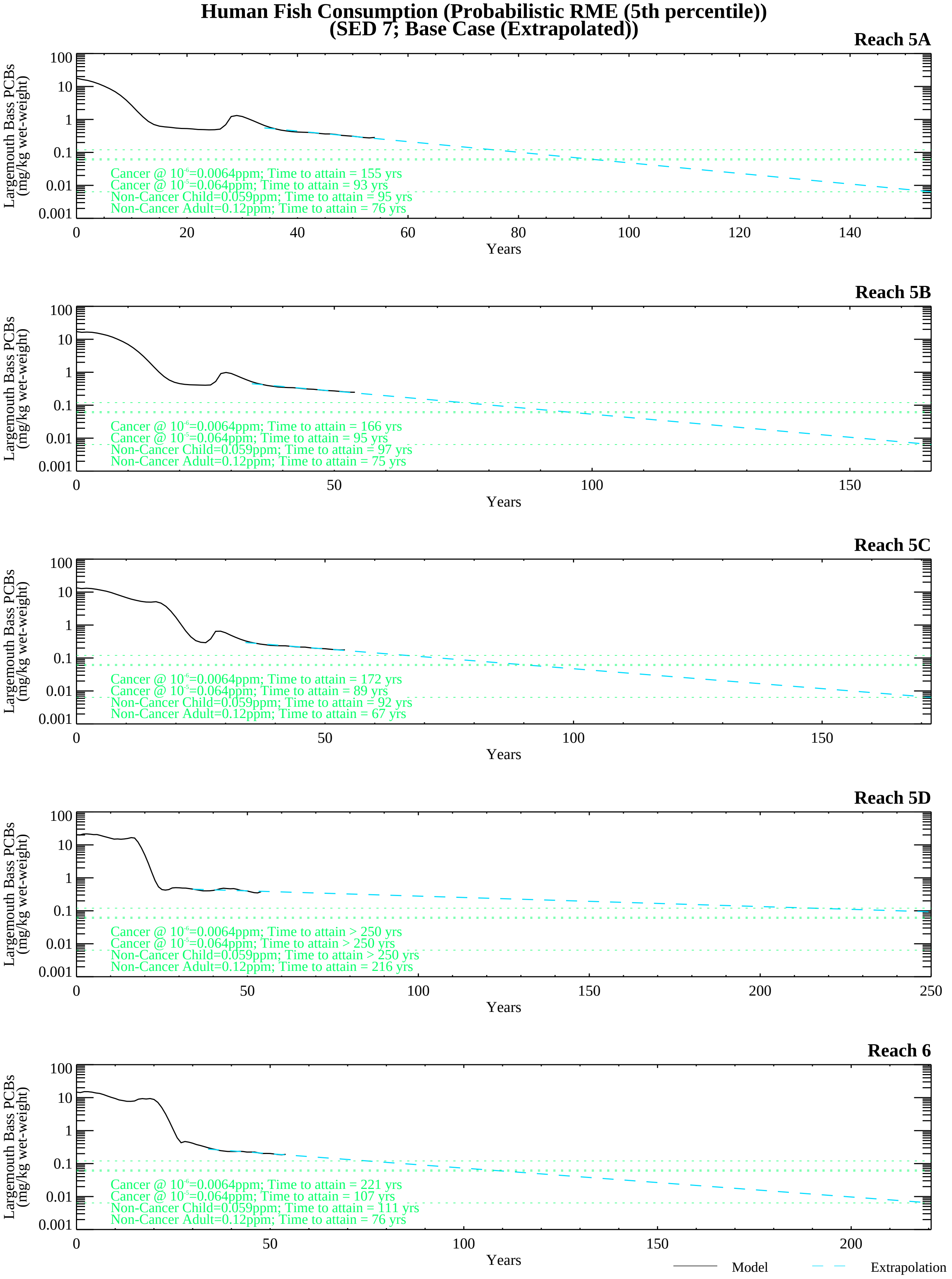

Figure G-8.2-6c. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 7; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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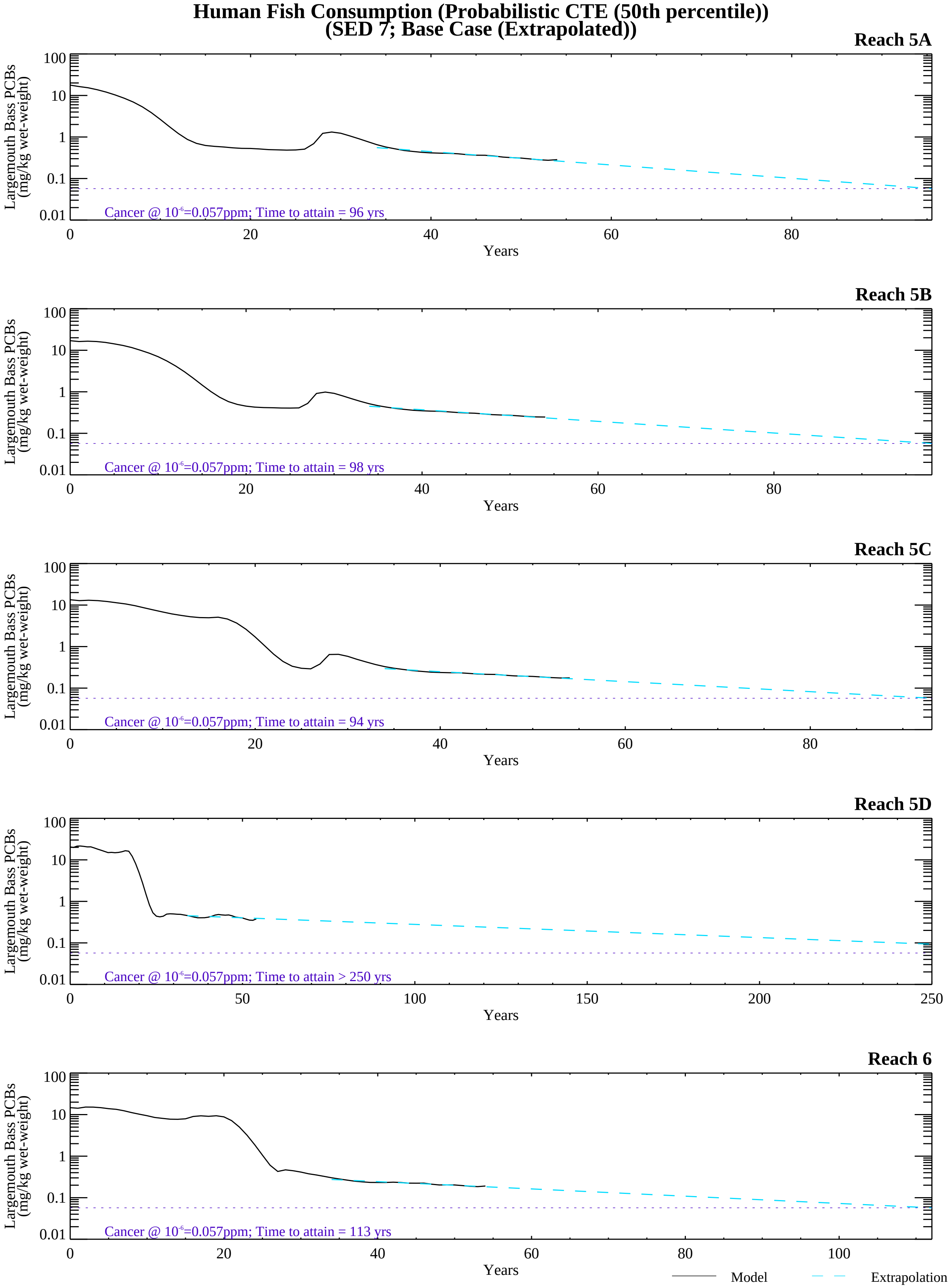

Figure G-8.2-6d. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 7; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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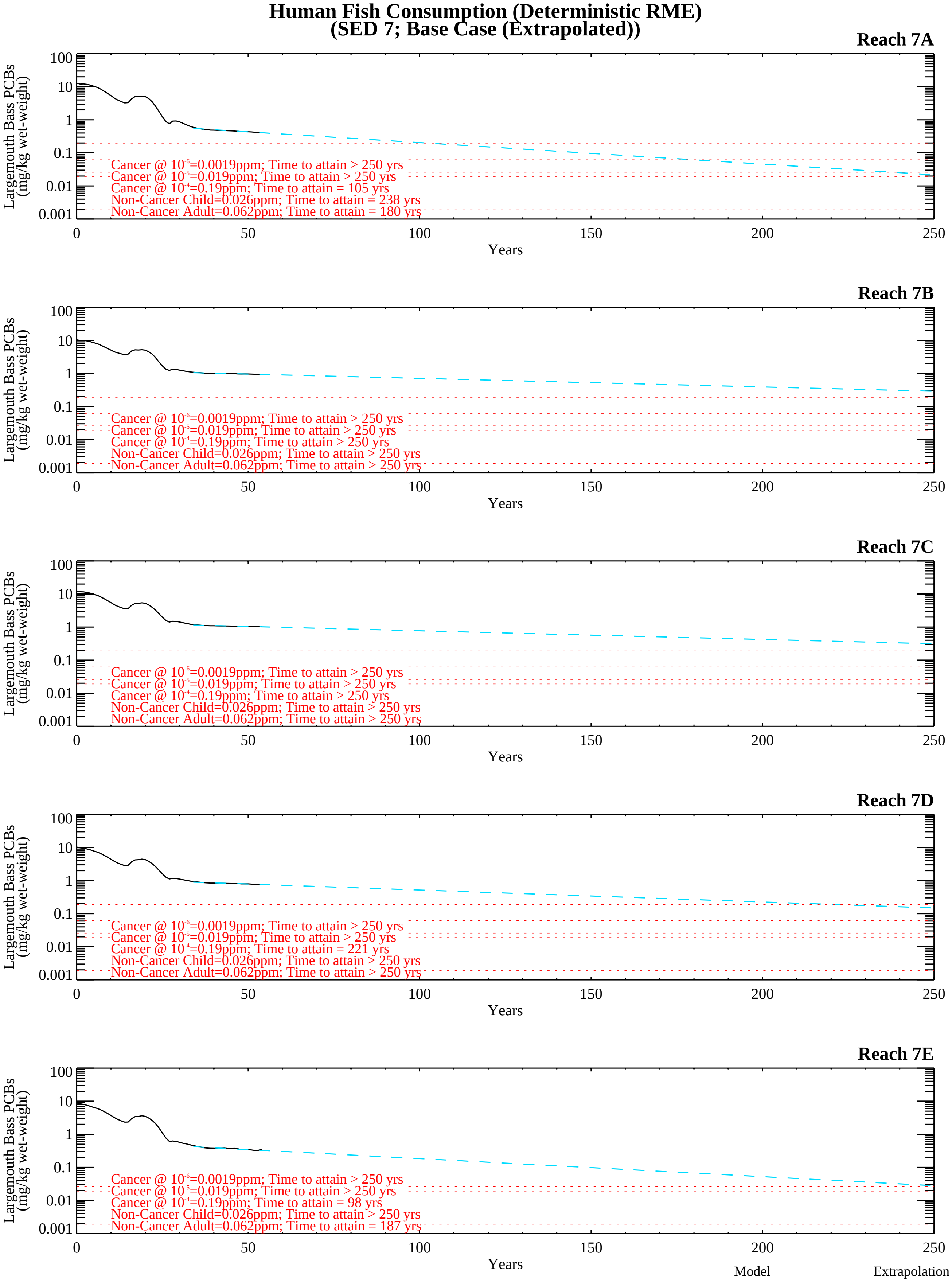

Figure G-8.2-6e. Extracted temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 7; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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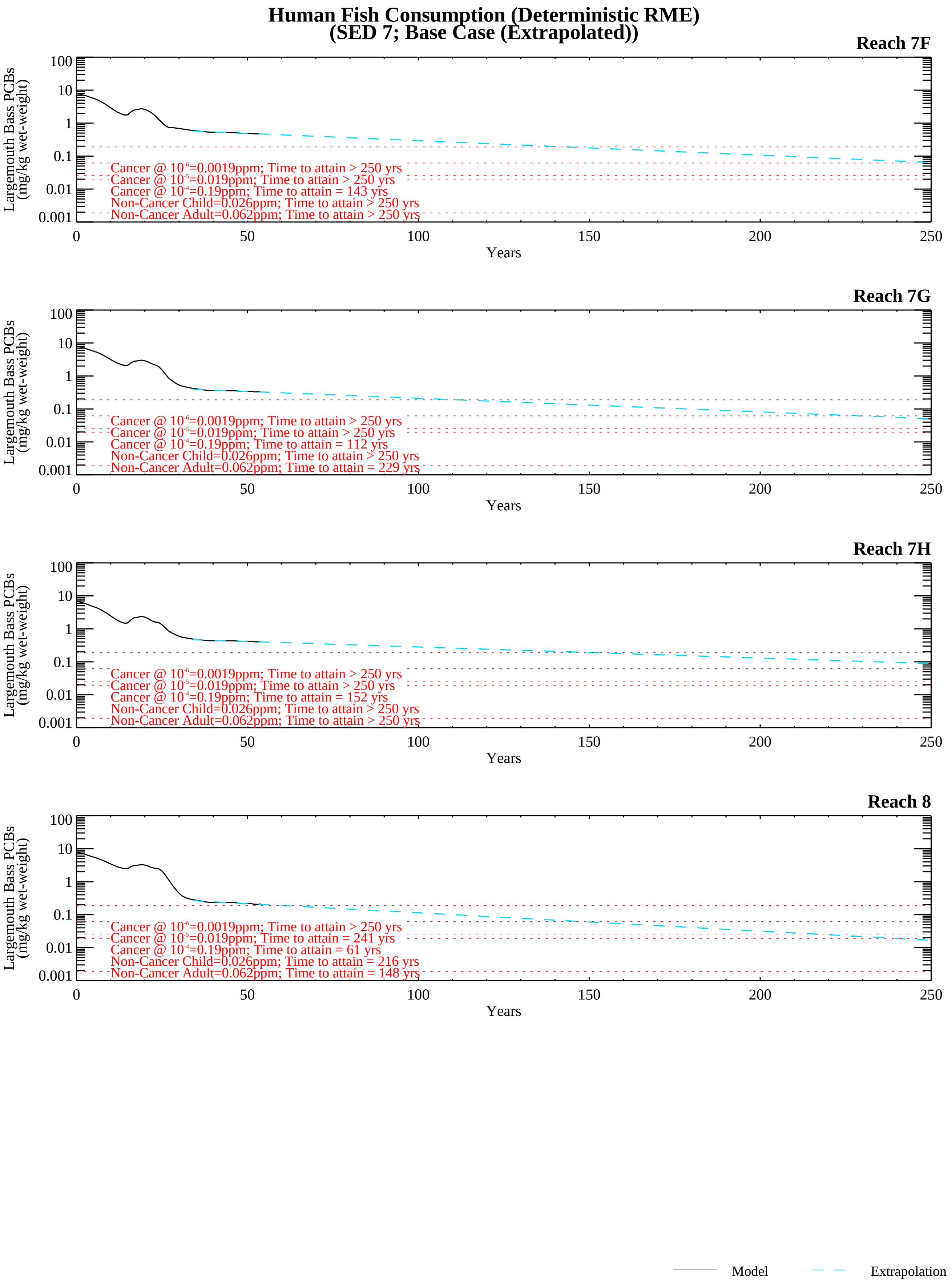

Figure G-8.2-6e. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 7; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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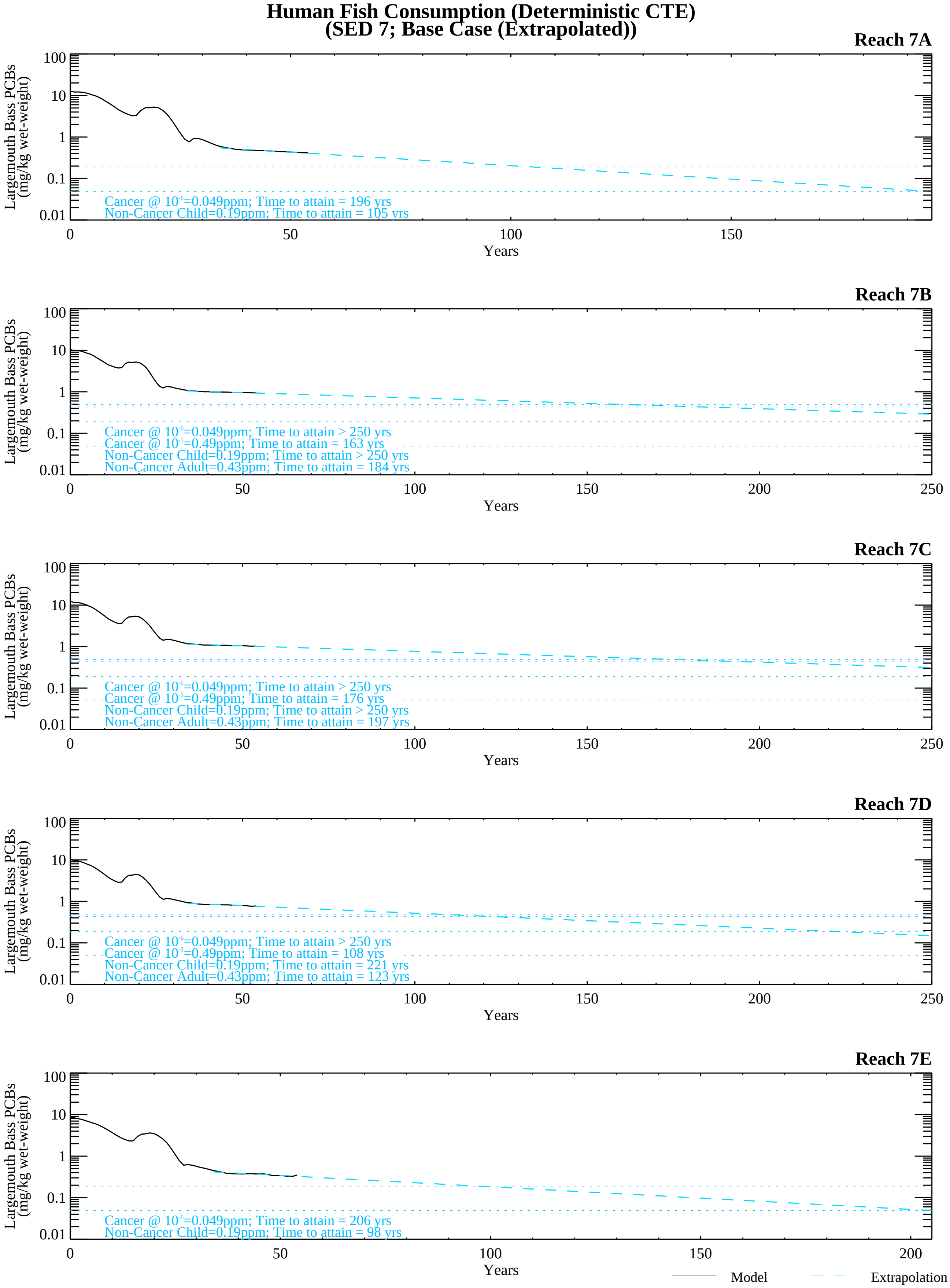

Figure G-8.2-6f. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 7; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

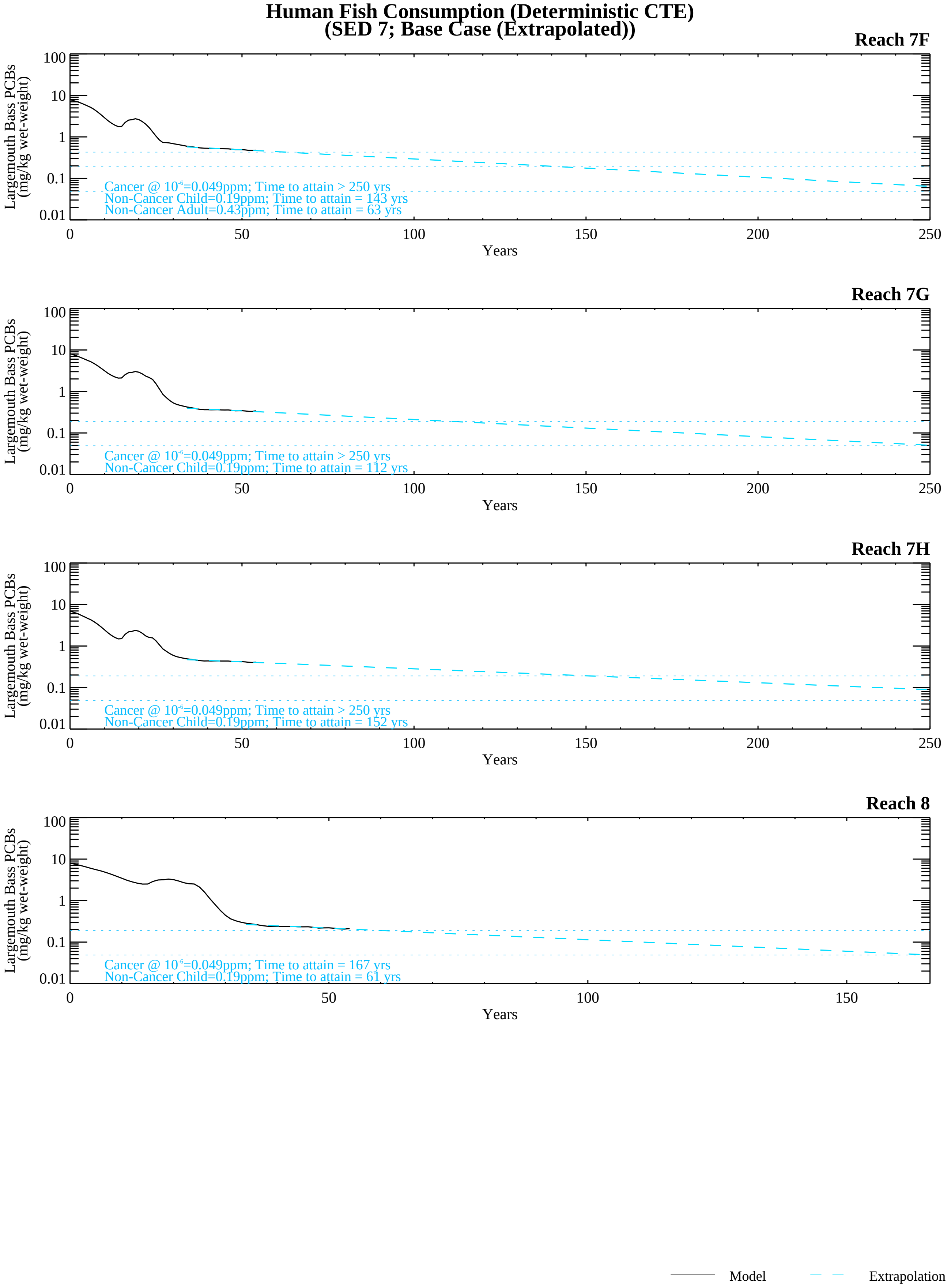

Figure G-8.2-6f. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 7; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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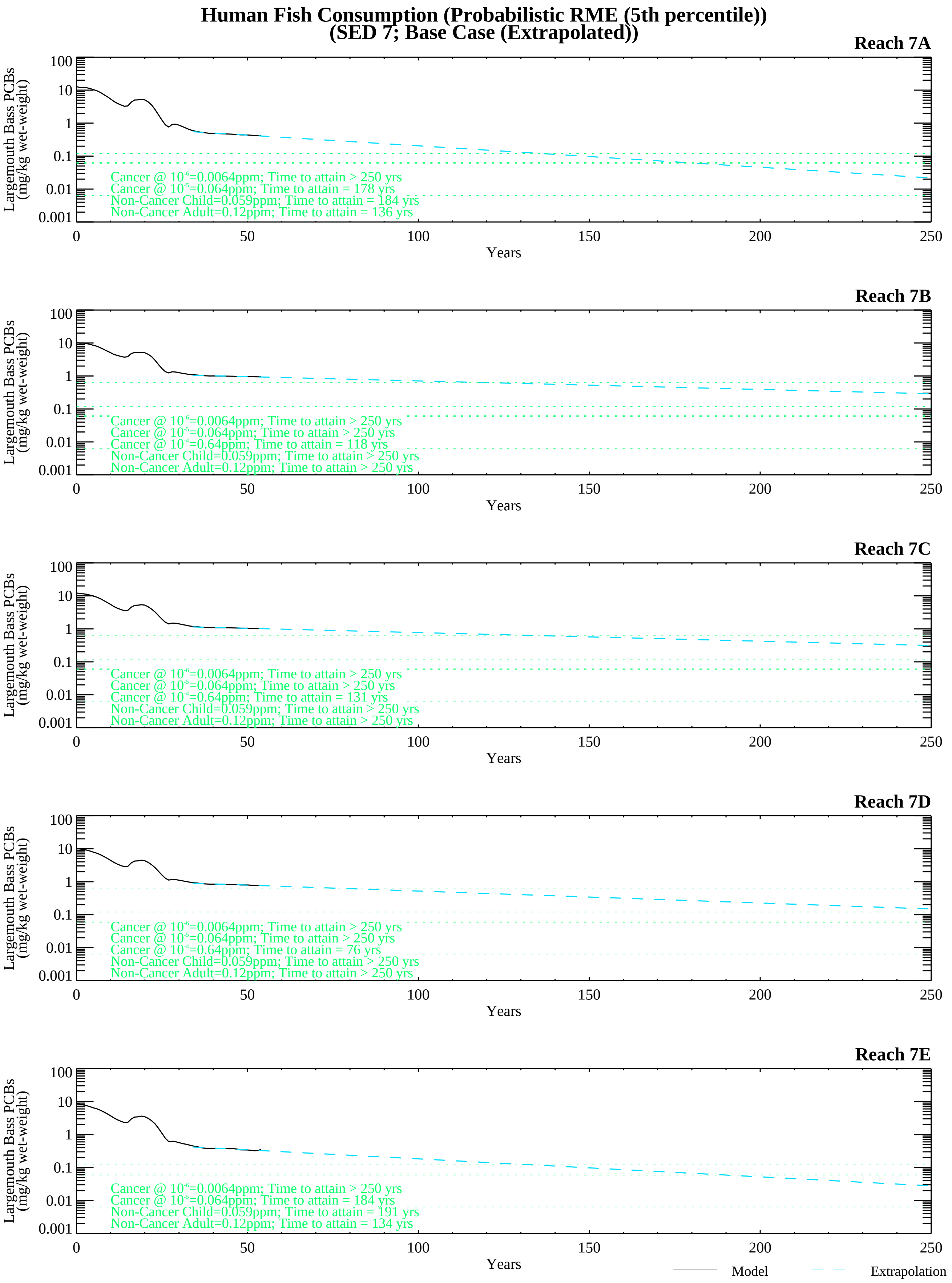

Figure G-8.2-6g. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 7; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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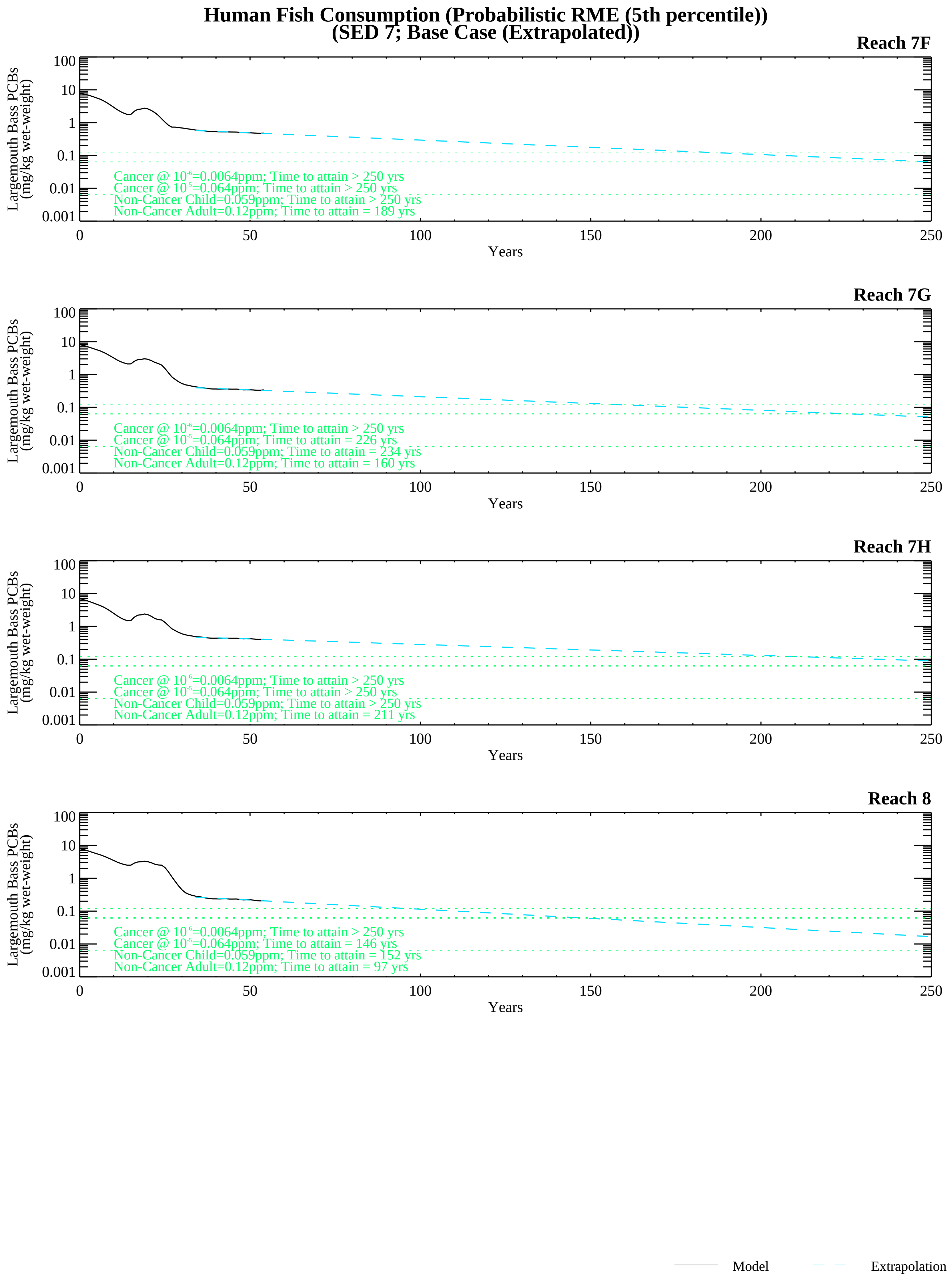

Figure G-8.2-6g. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 7; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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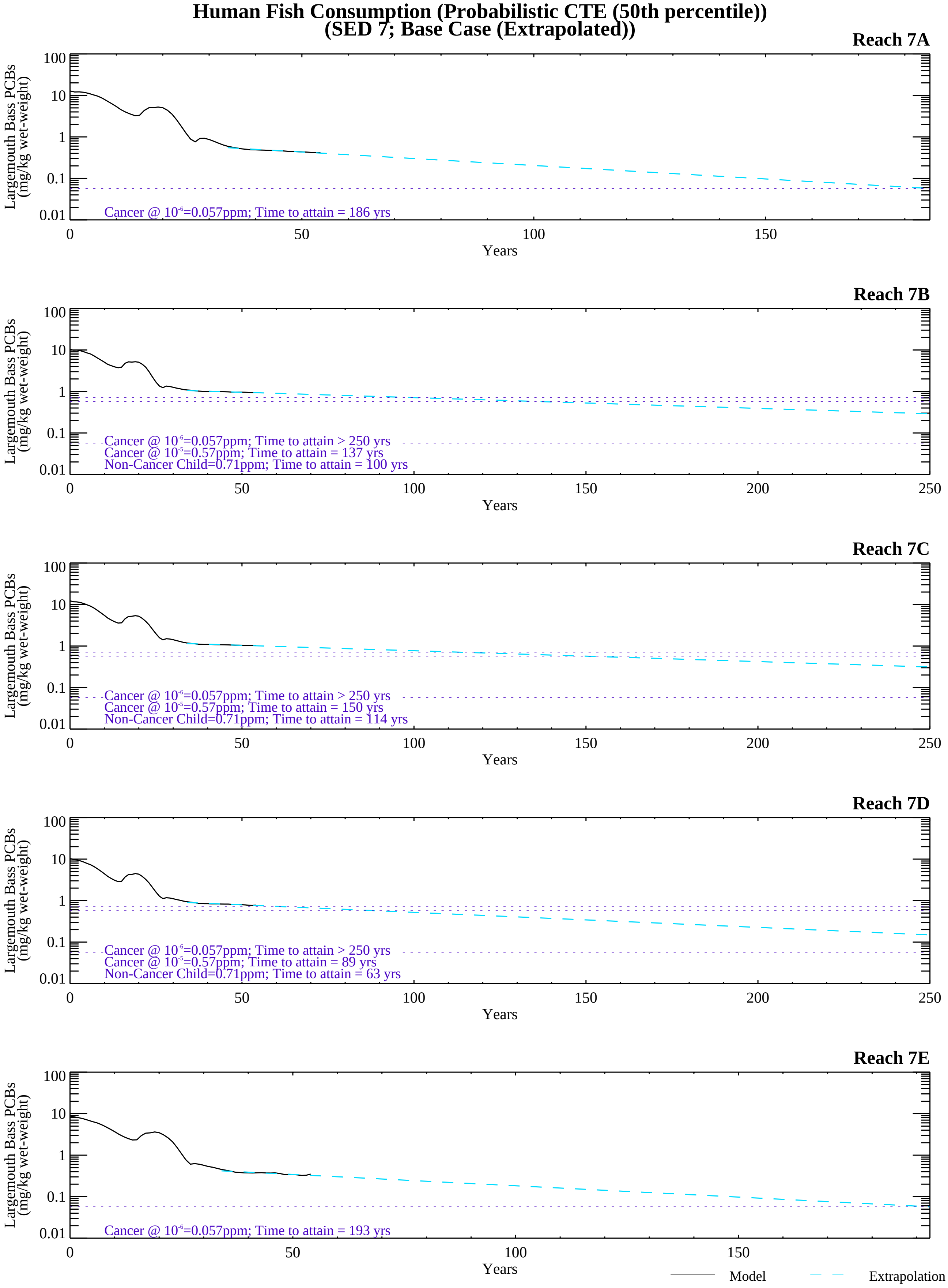

Figure G-8.2-6h. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 7; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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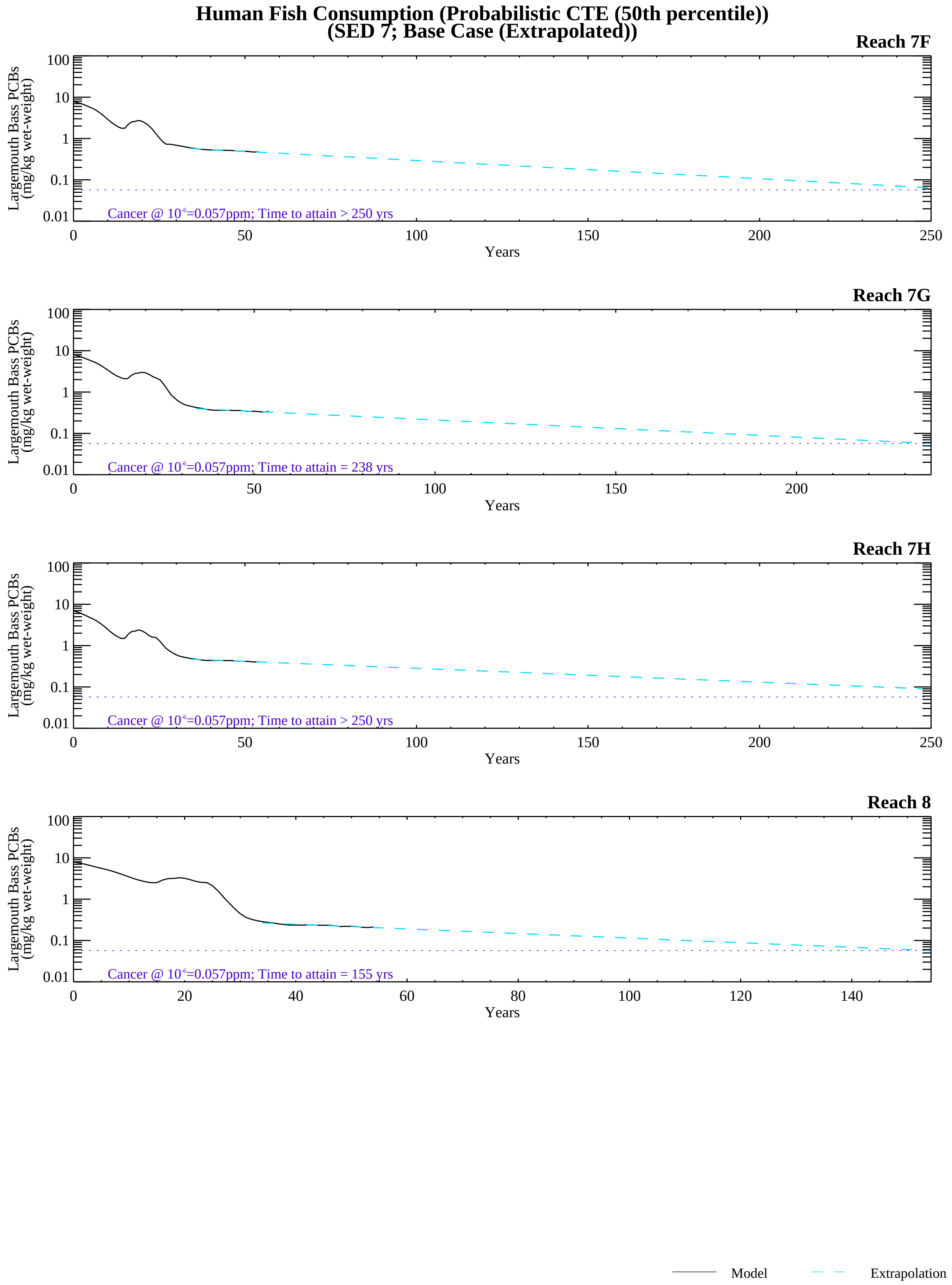

Figure G-8.2-6h. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 7; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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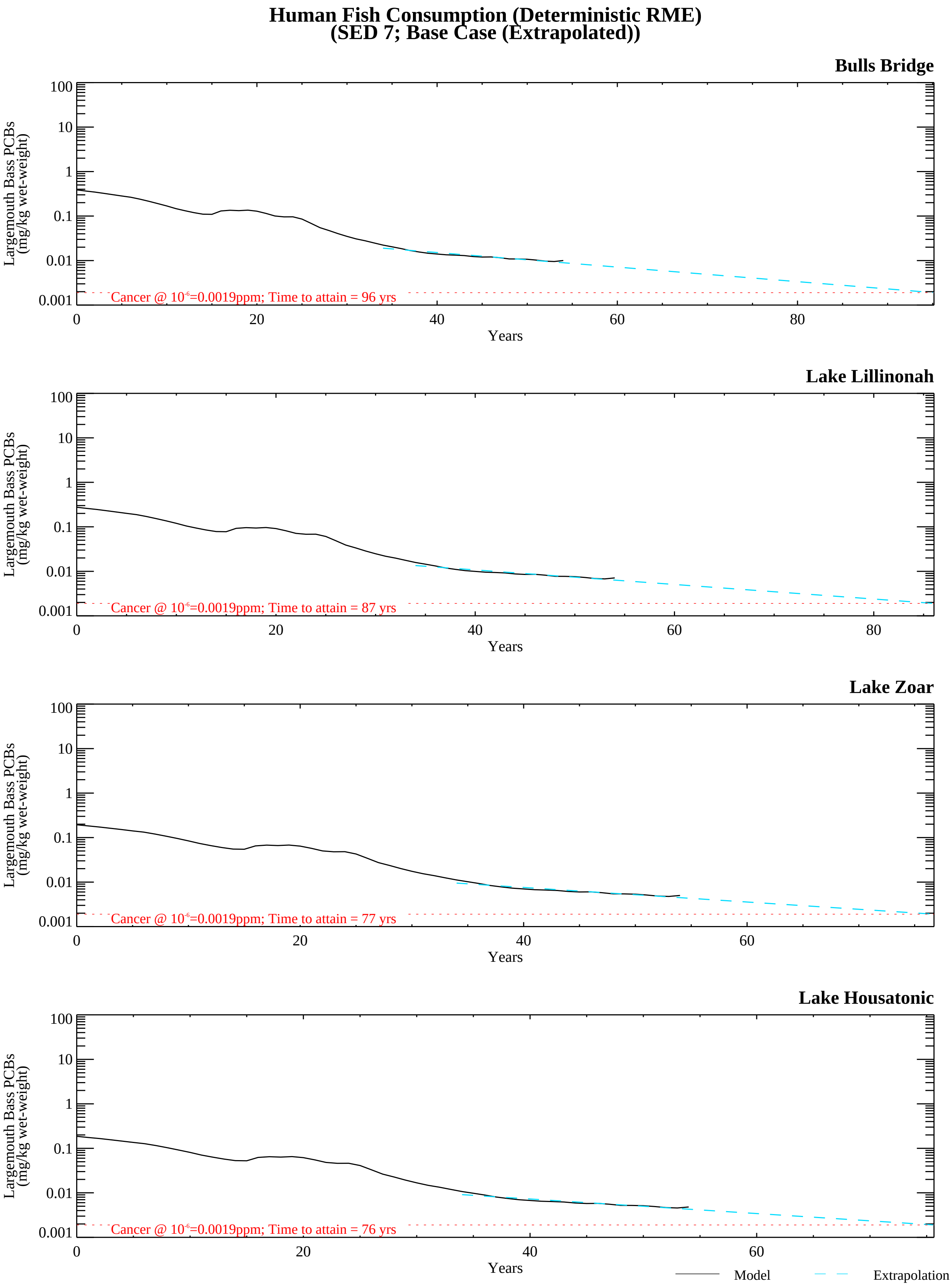

Figure G-8.2-6i. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to deterministic RME IMPGs for human consumption of fish (SED 7; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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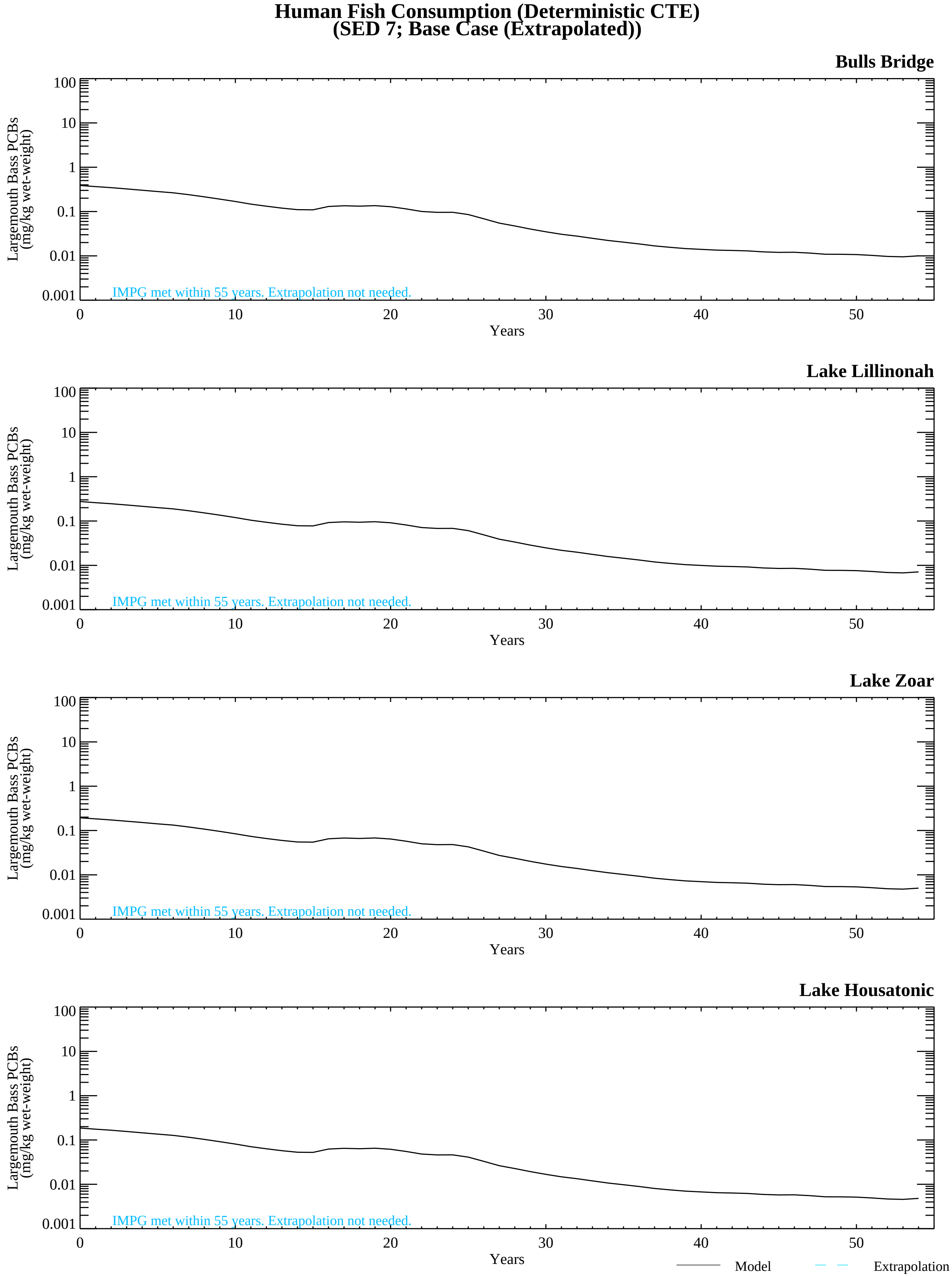

Figure G-8.2-6j. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to deterministic CTE IMPGs for human consumption of fish (SED 7; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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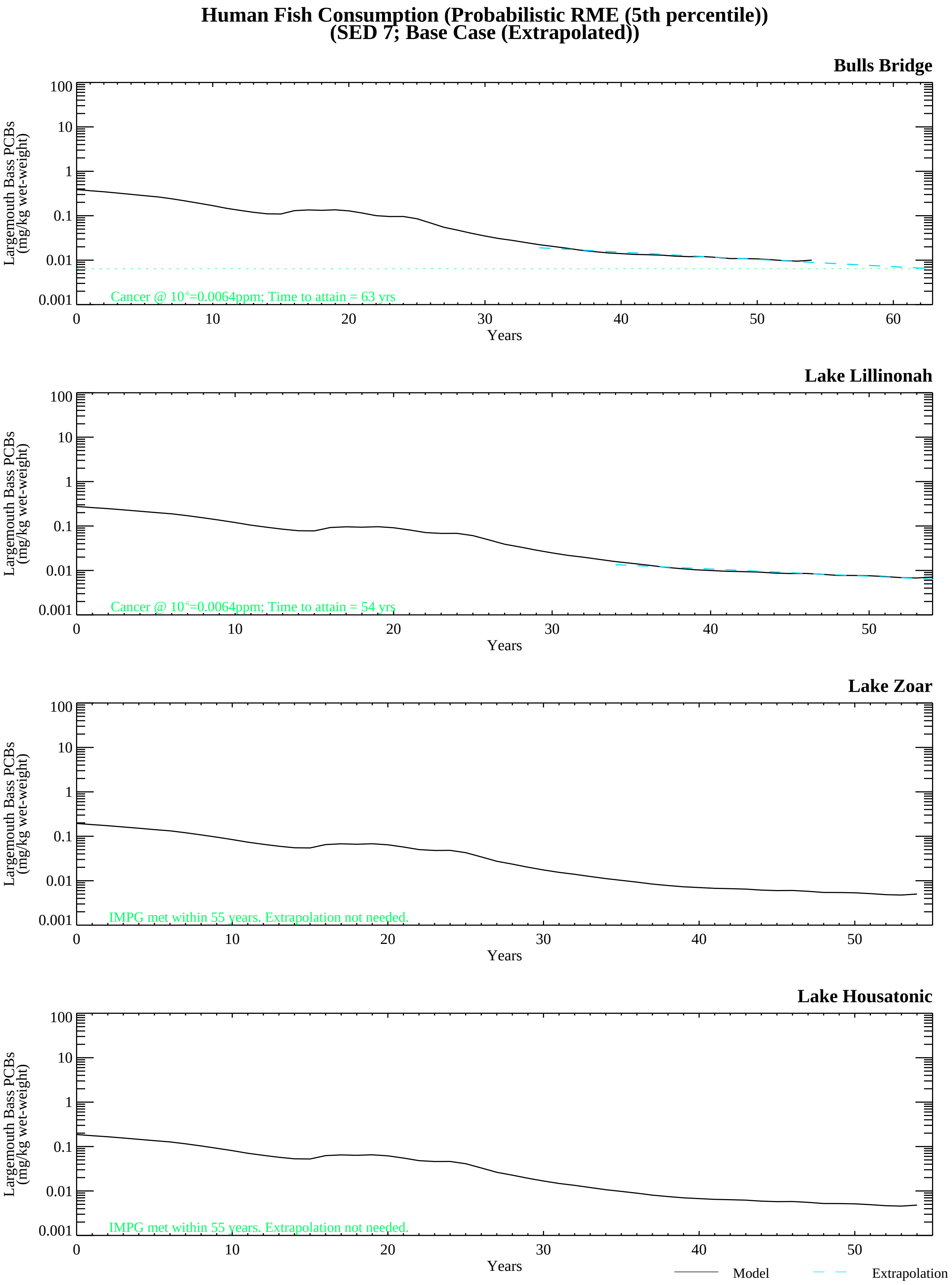

Figure G-8.2-6k. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to probabilistic RME IMPGs for human consumption of fish (SED 7; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

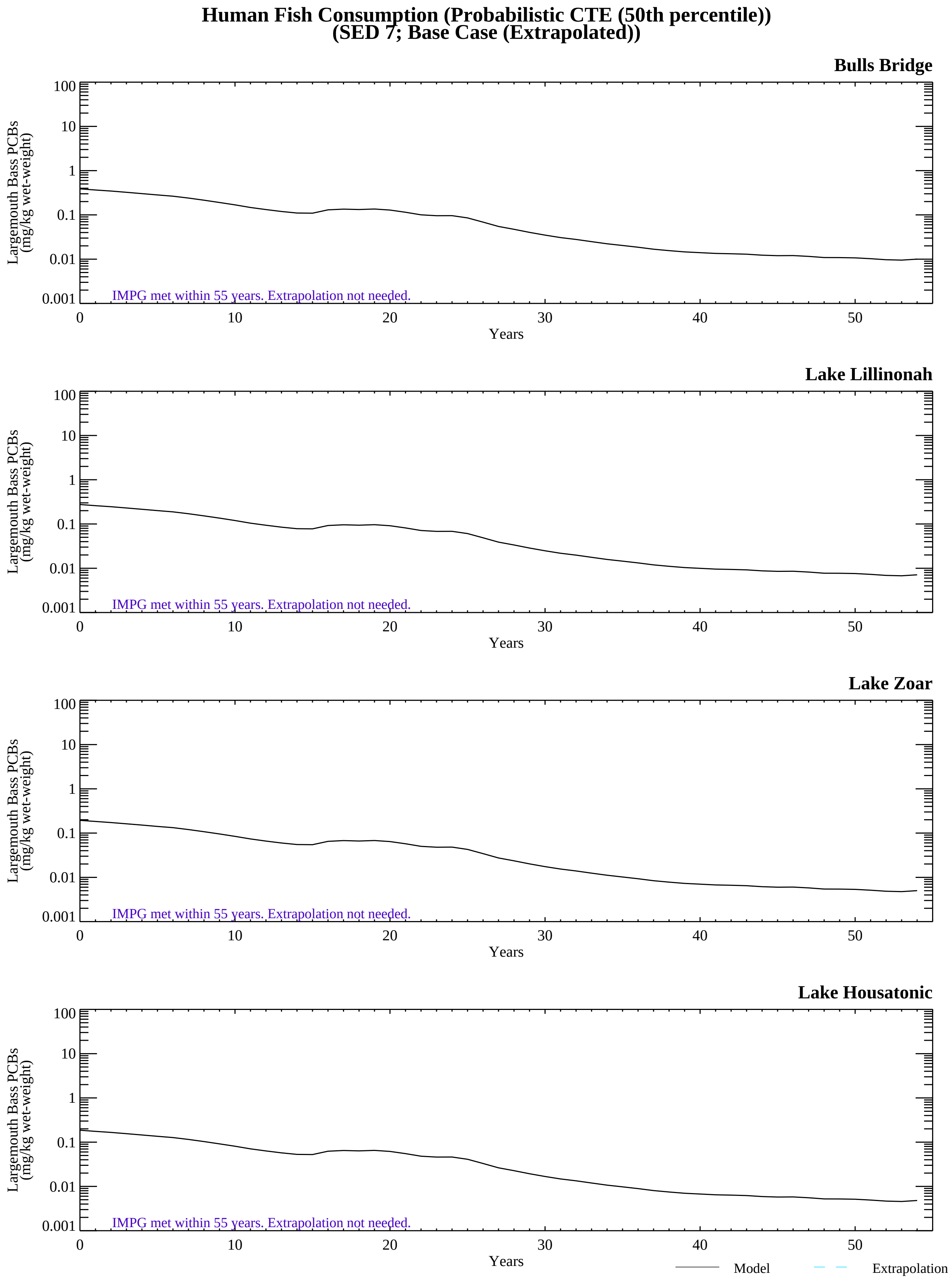

Figure G-8.2-6l. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to probabilistic CTE IMPGs for human consumption of fish (SED 7; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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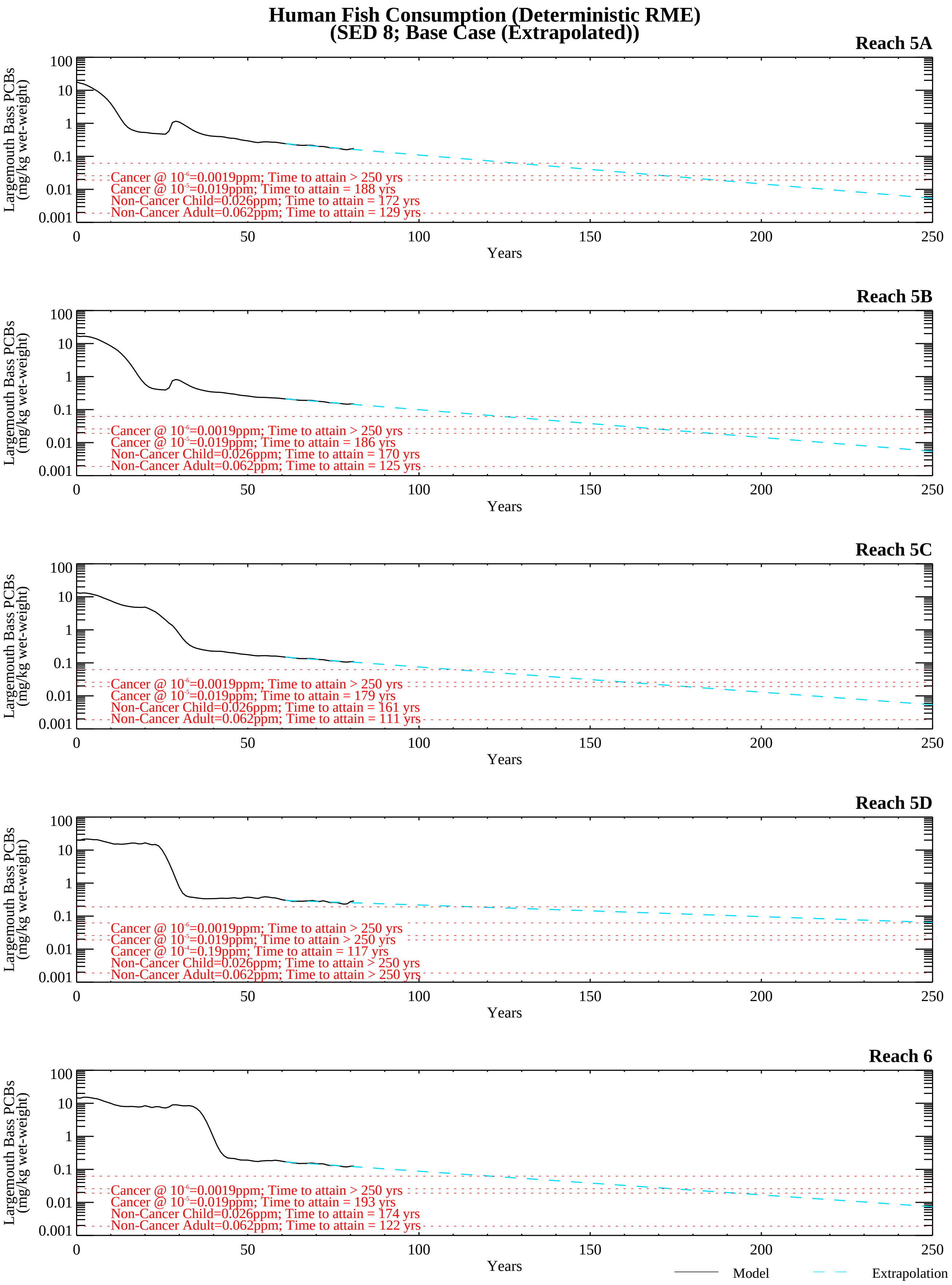

Figure G-8.2-7a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 8; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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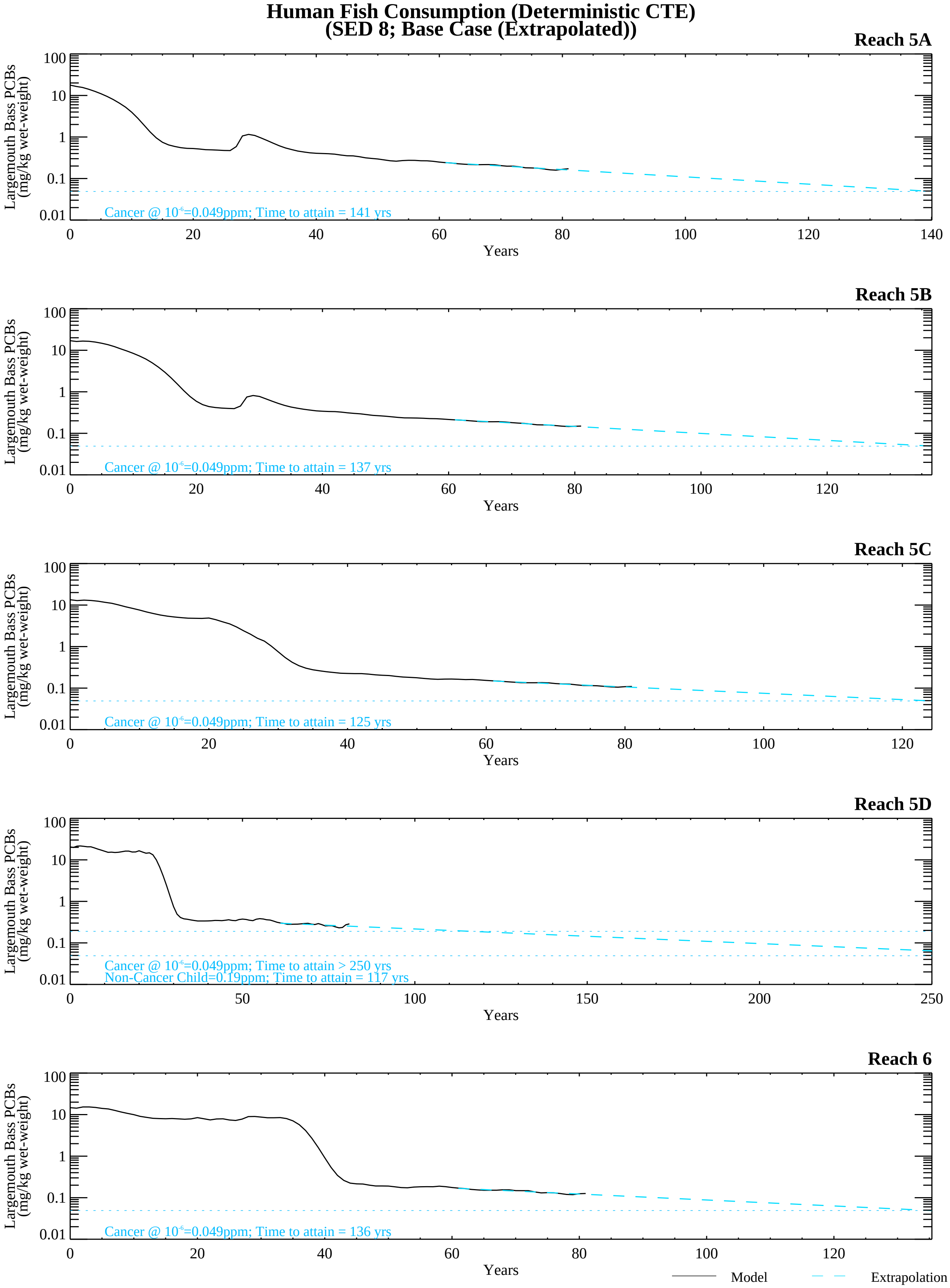

Figure G-8.2-7b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 8; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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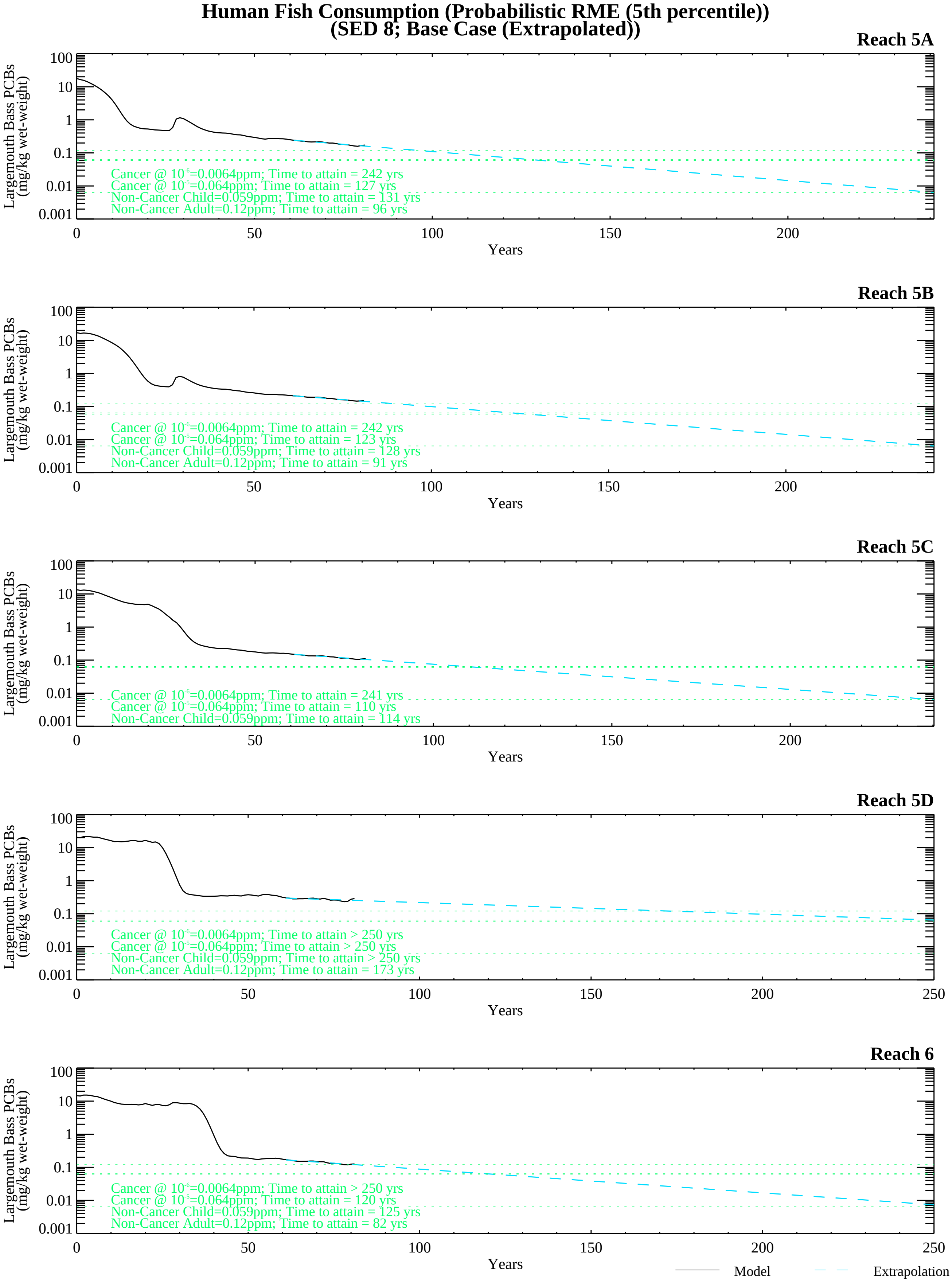

Figure G-8.2-7c. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 8; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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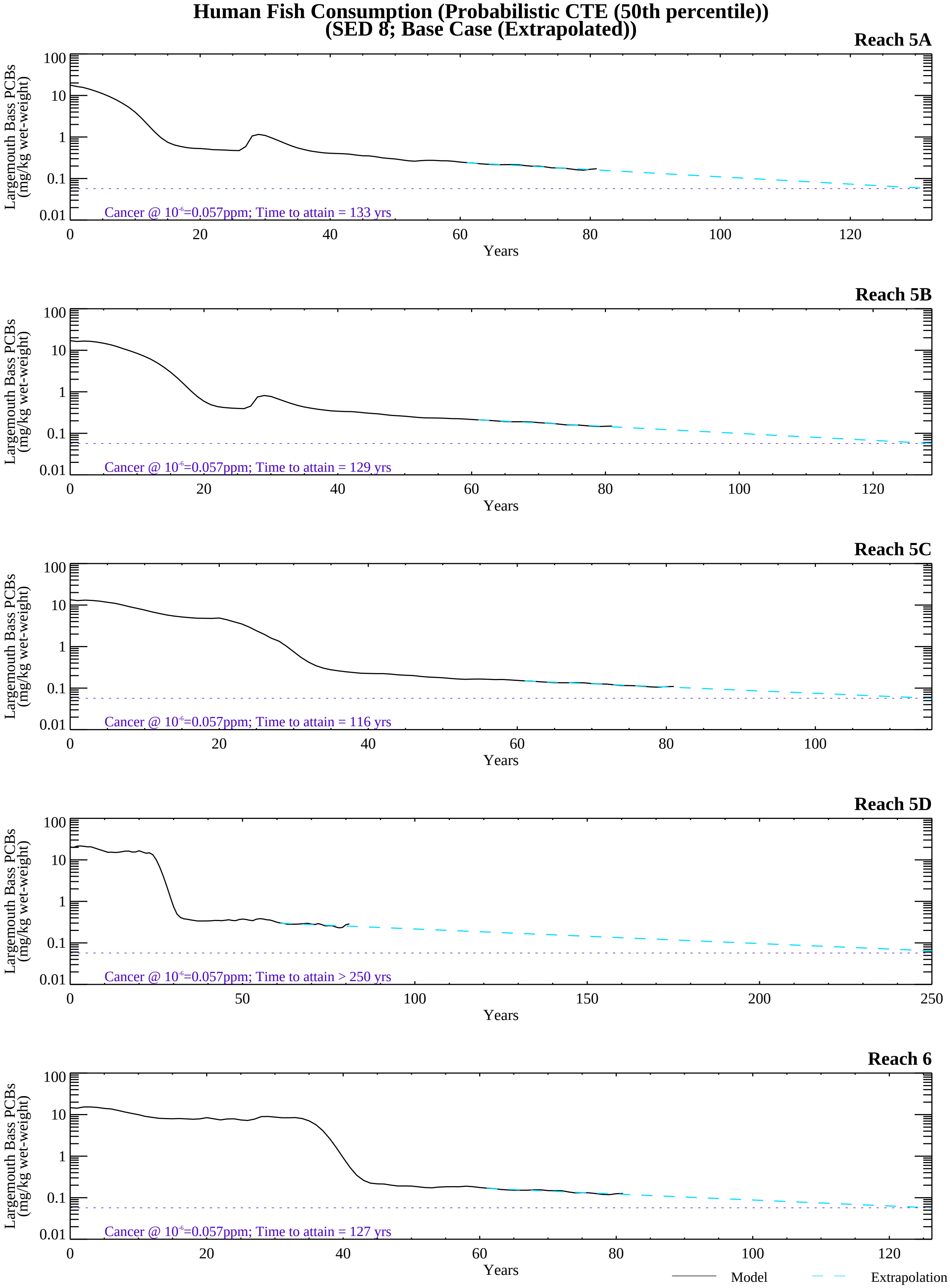

Figure G-8.2-7d. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 8; Reach 5/6; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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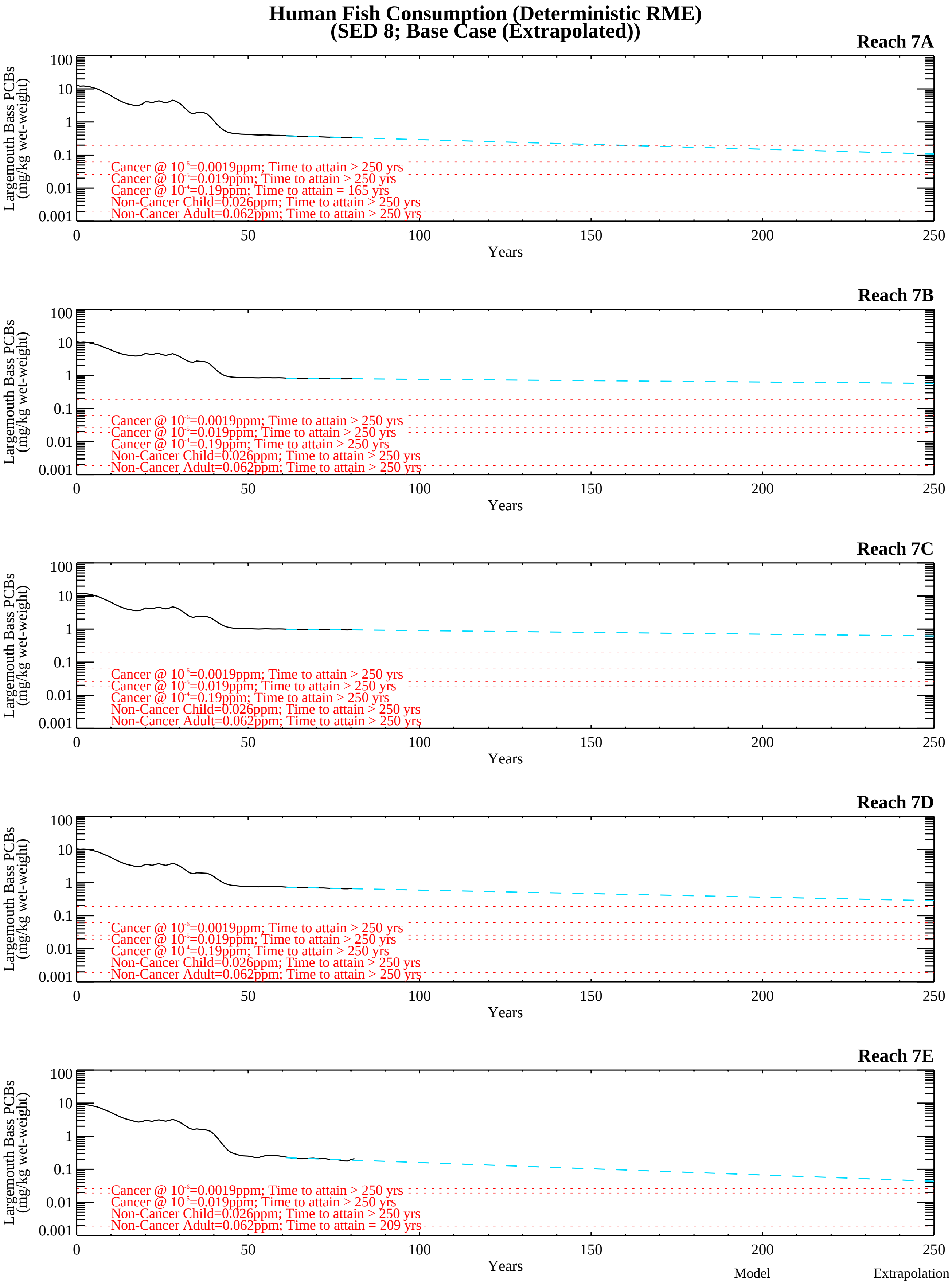

Figure G-8.2-7e. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 8; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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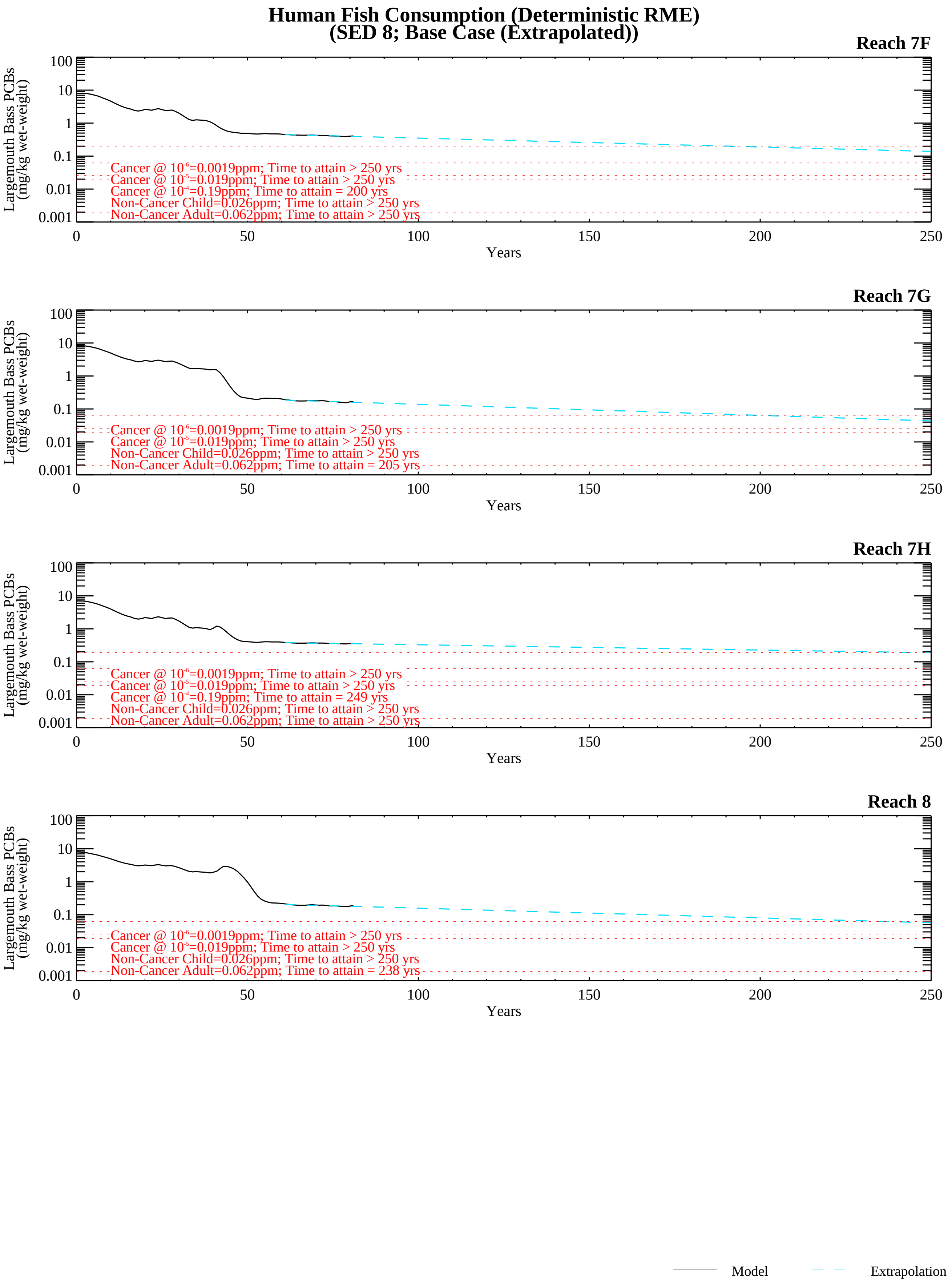

Figure G-8.2-7e. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic RME IMPGs for human consumption of fish (SED 8; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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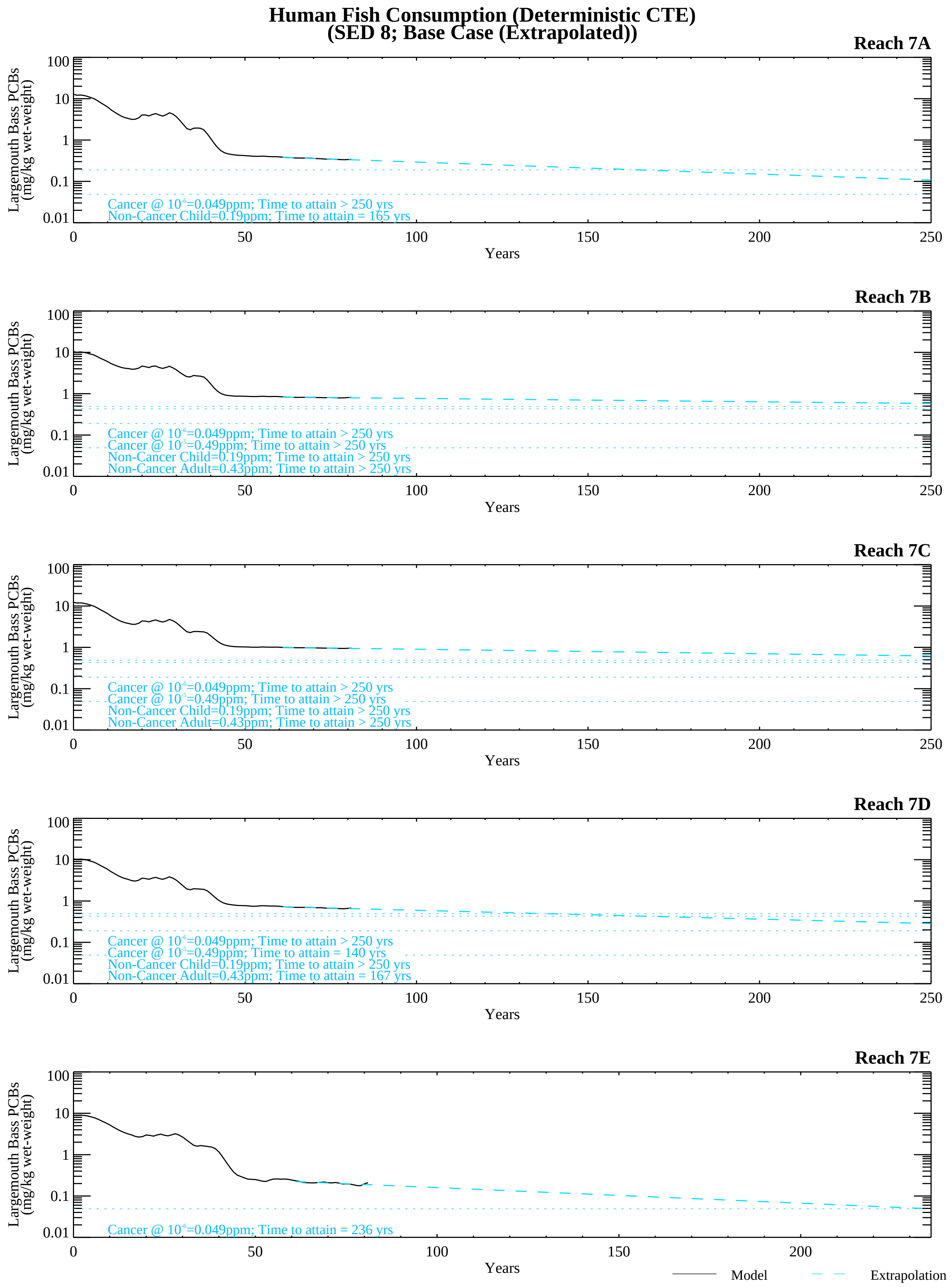

Figure G-8.2-7f. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 8; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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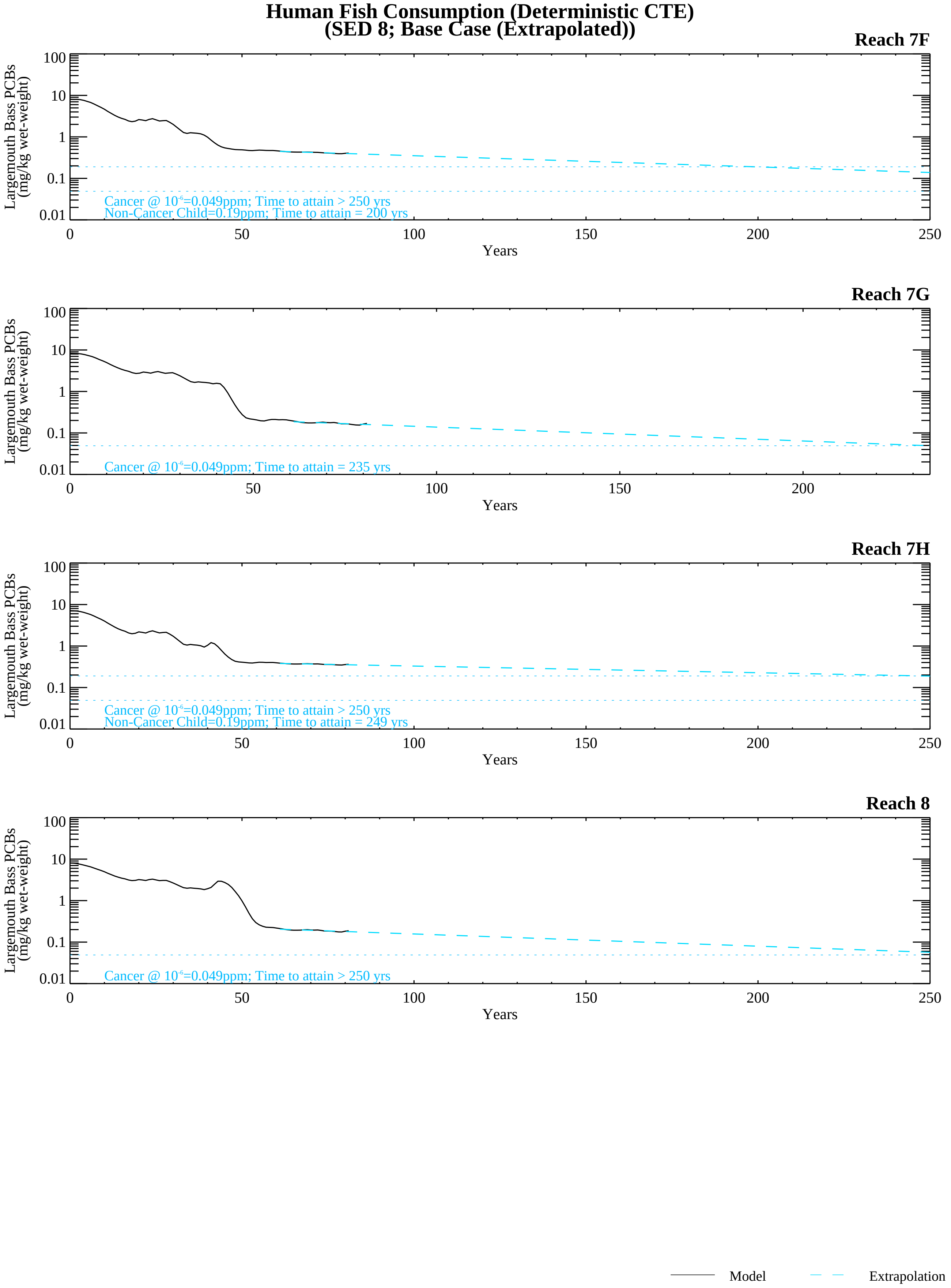

Figure G-8.2-7f. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to deterministic CTE IMPGs for human consumption of fish (SED 8; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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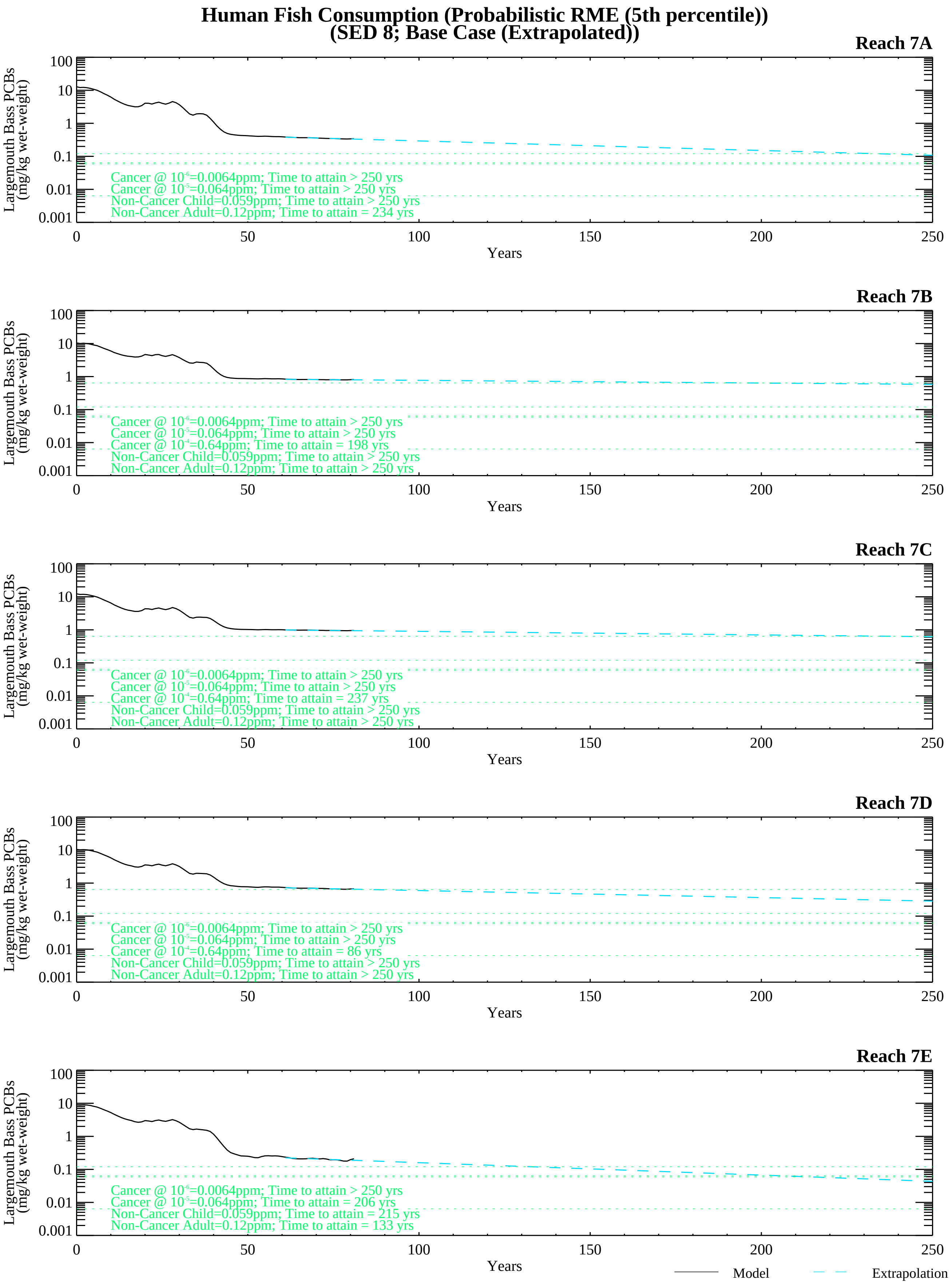

Figure G-8.2-7g. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 8; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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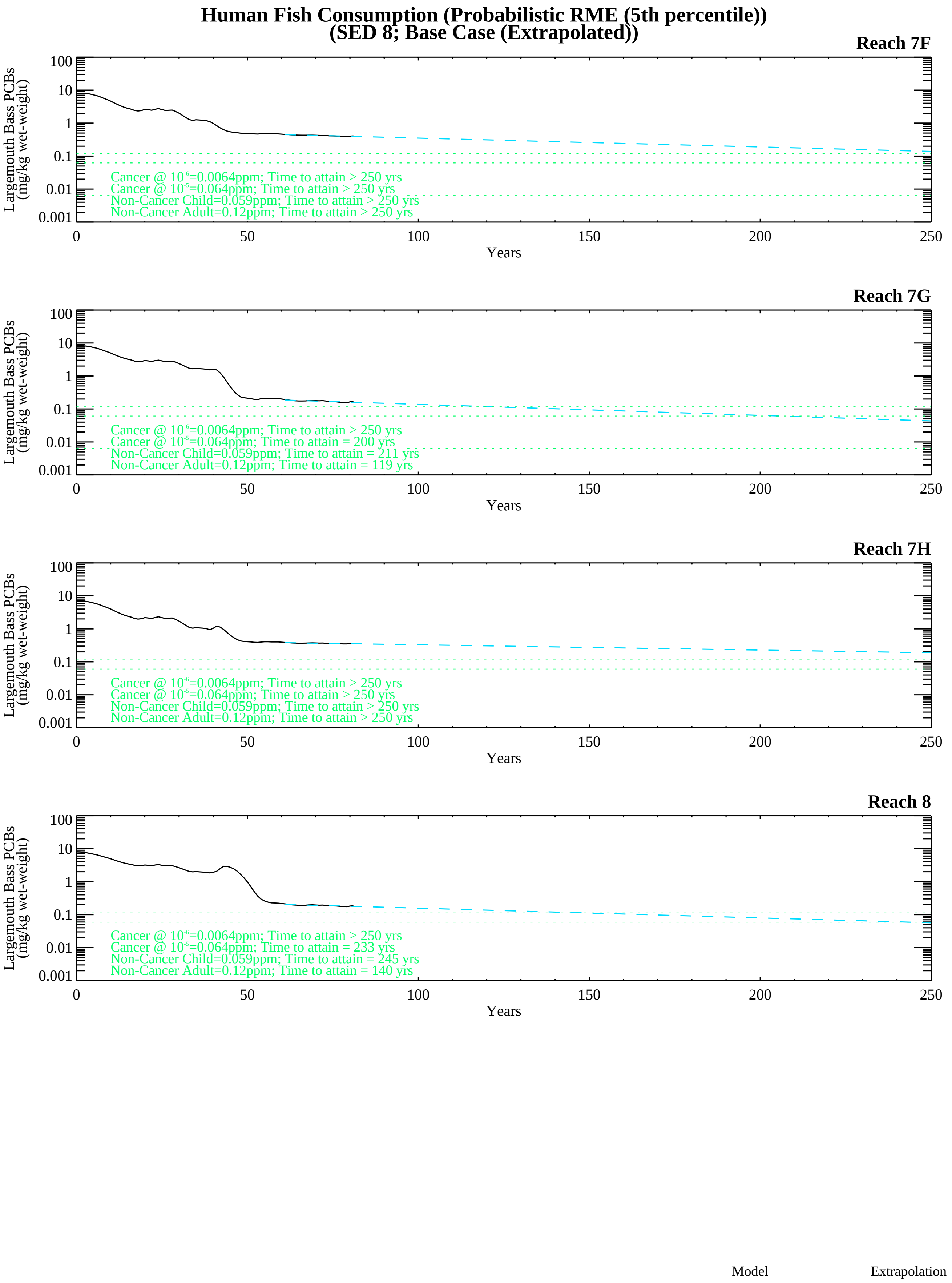

Figure G-8.2-7g. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic RME IMPGs for human consumption of fish (SED 8; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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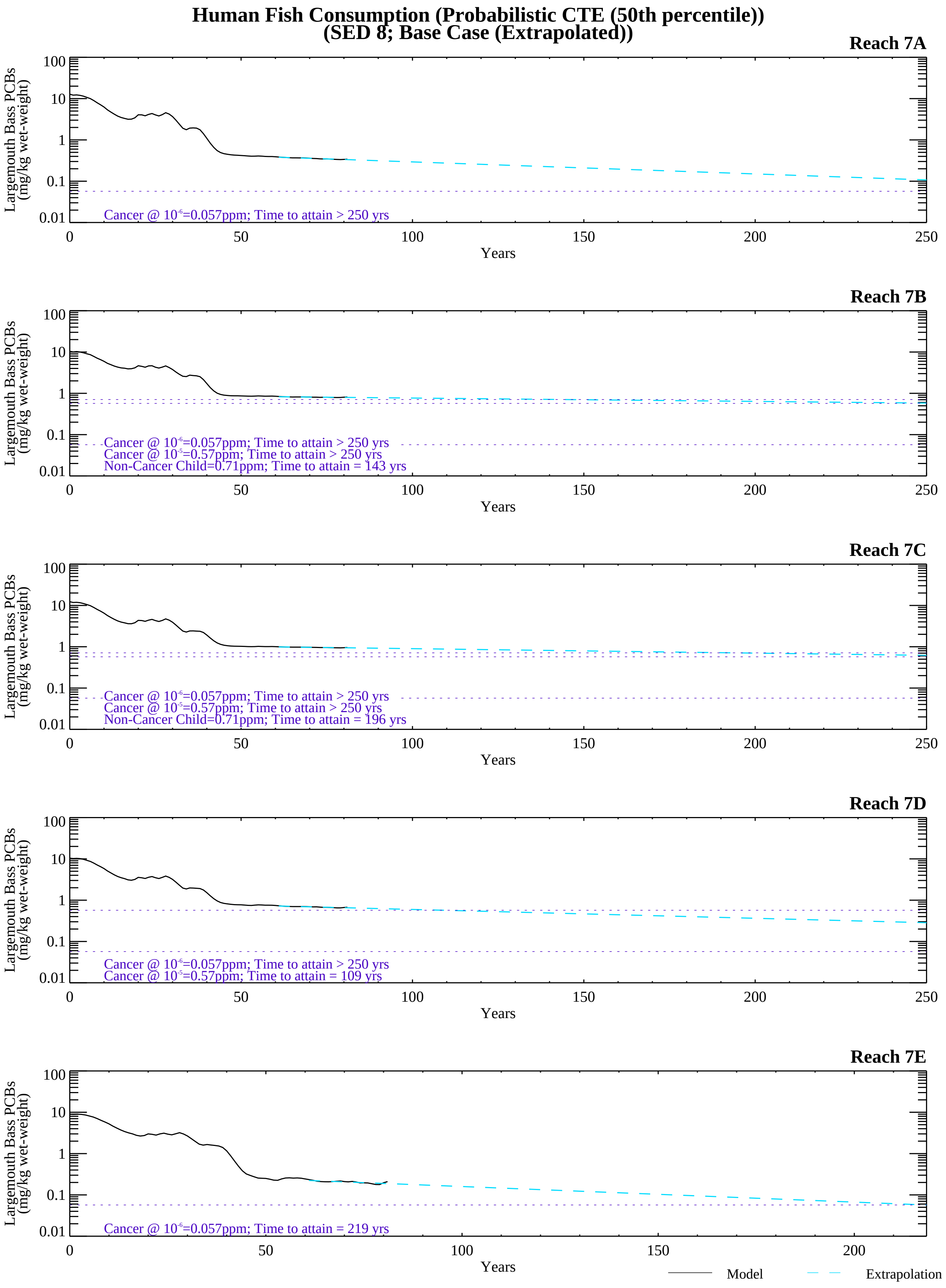

Figure G-8.2-7h. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 8; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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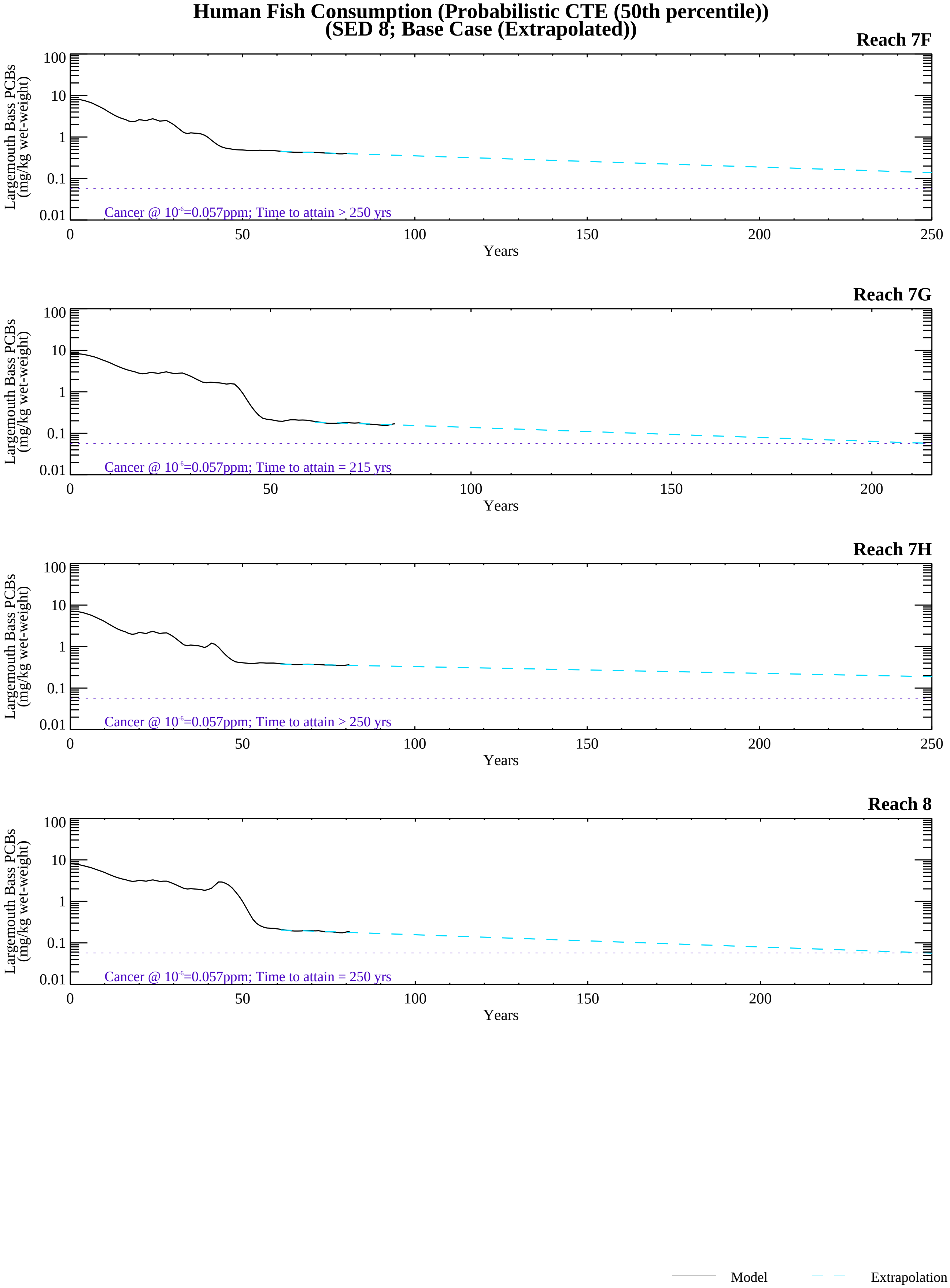

Figure G-8.2-7h. Extrapolated temporal profiles of model-predicted PCB concentrations in fish fillets compared to probabilistic CTE IMPGs for human consumption of fish (SED 8; Reach 7/8; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

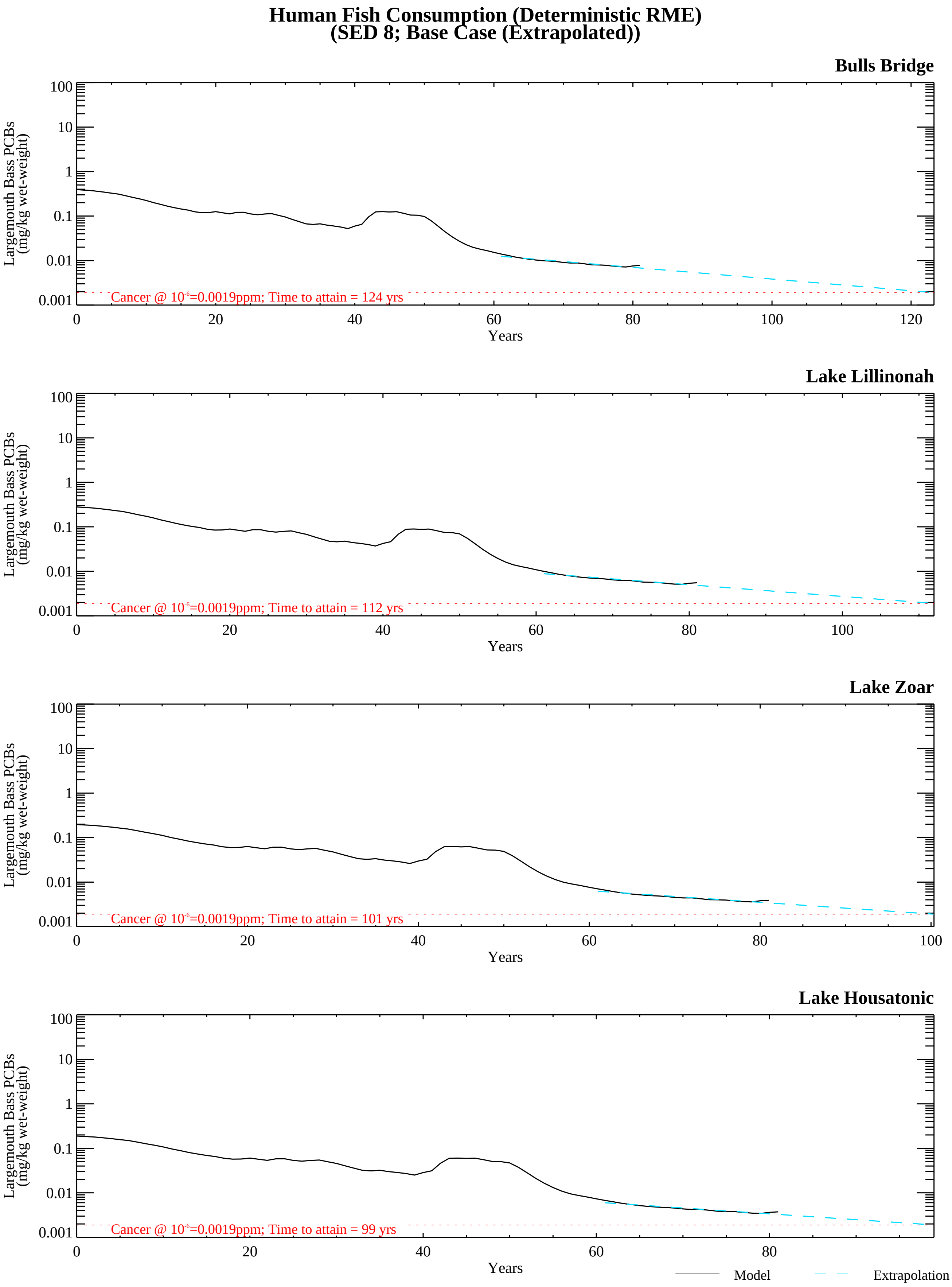

Figure G-8.2-7i. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to deterministic RME IMPGs for human consumption of fish (SED 8; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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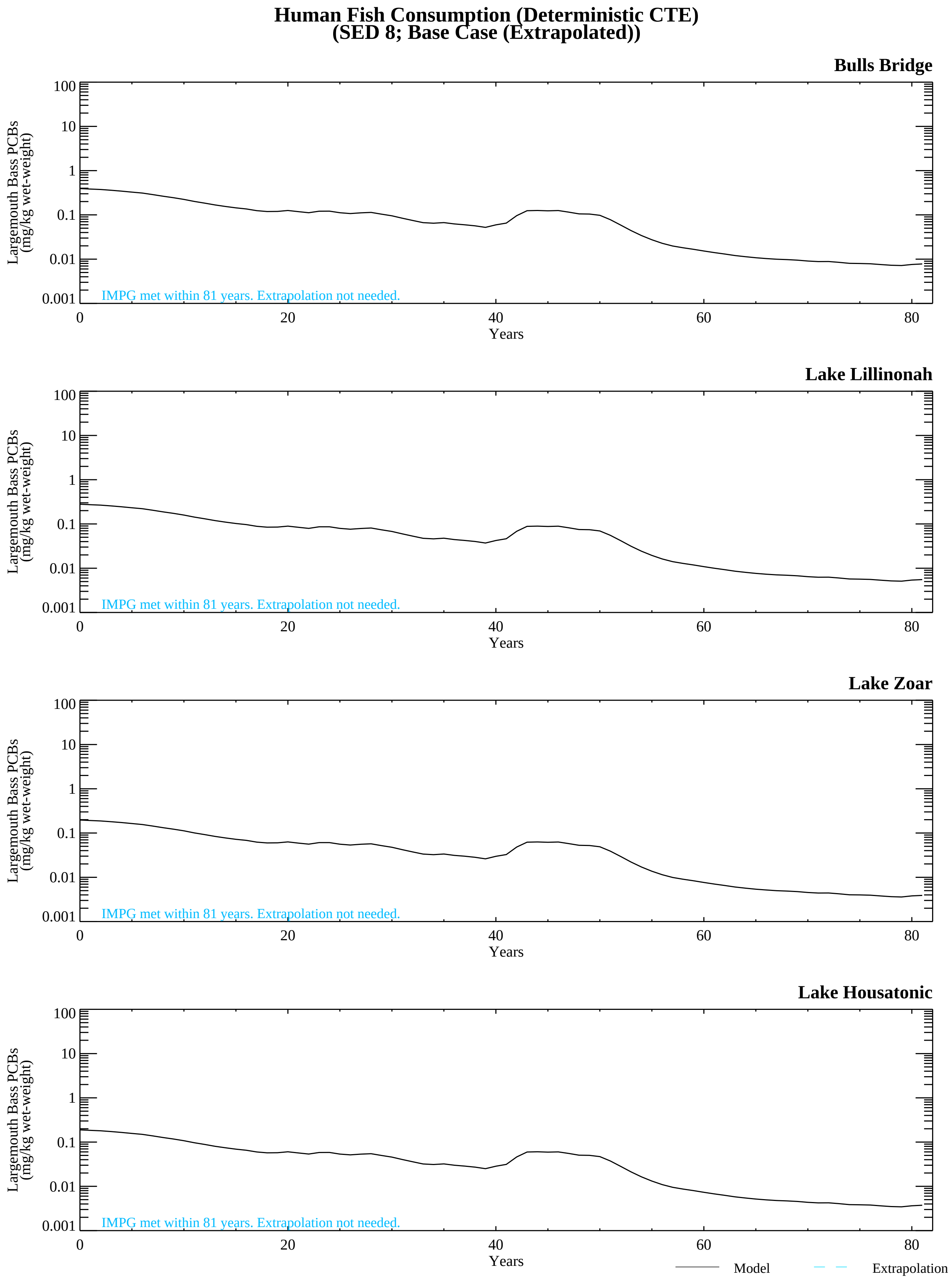

Figure G-8.2-7j. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to deterministic CTE IMPGs for human consumption of fish (SED 8; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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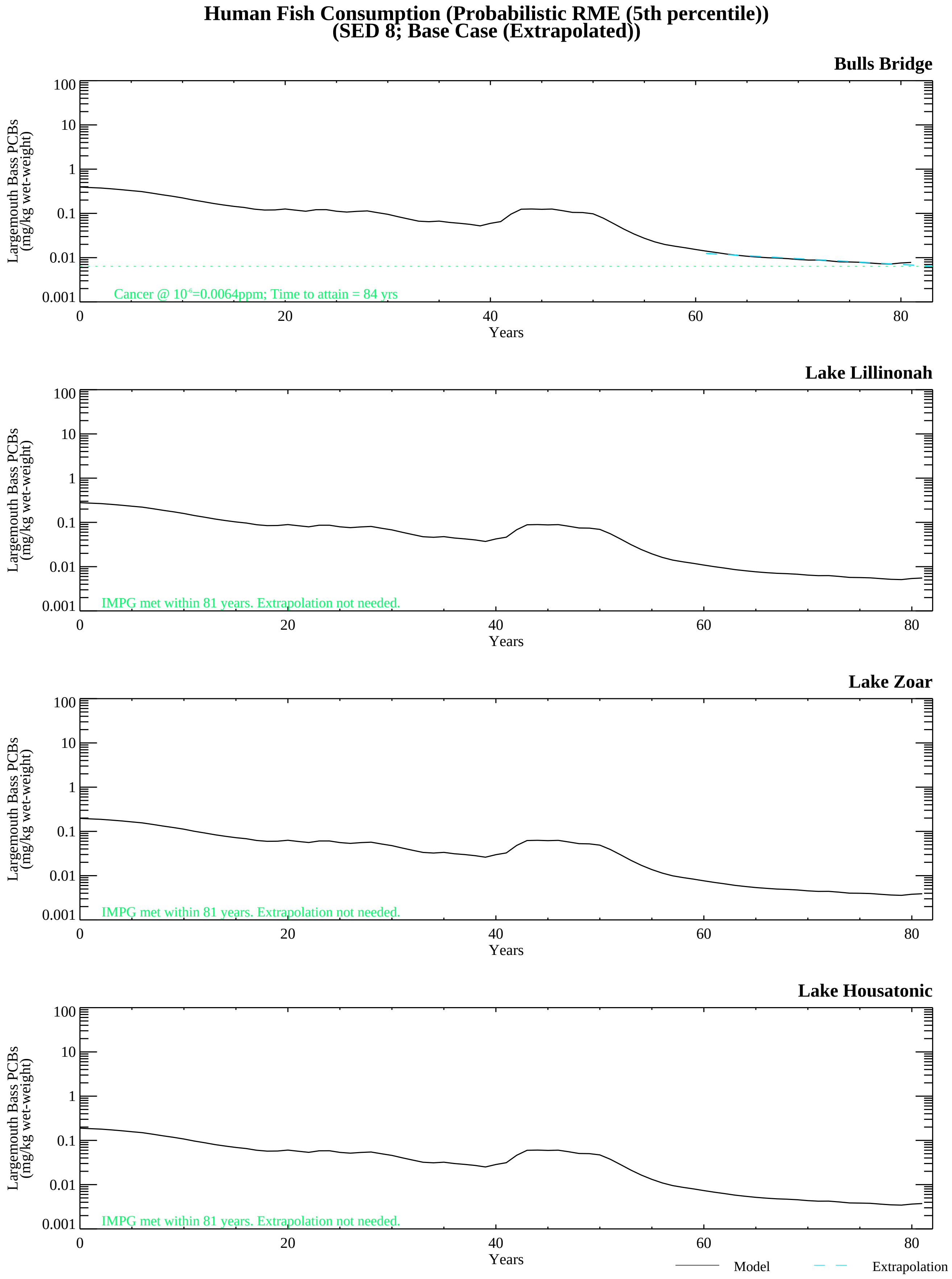

Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 8; Base Case (Extrapolated))

Figure G-8.2-7k. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to probabilistic RME IMPGs for human consumption of fish (SED 8; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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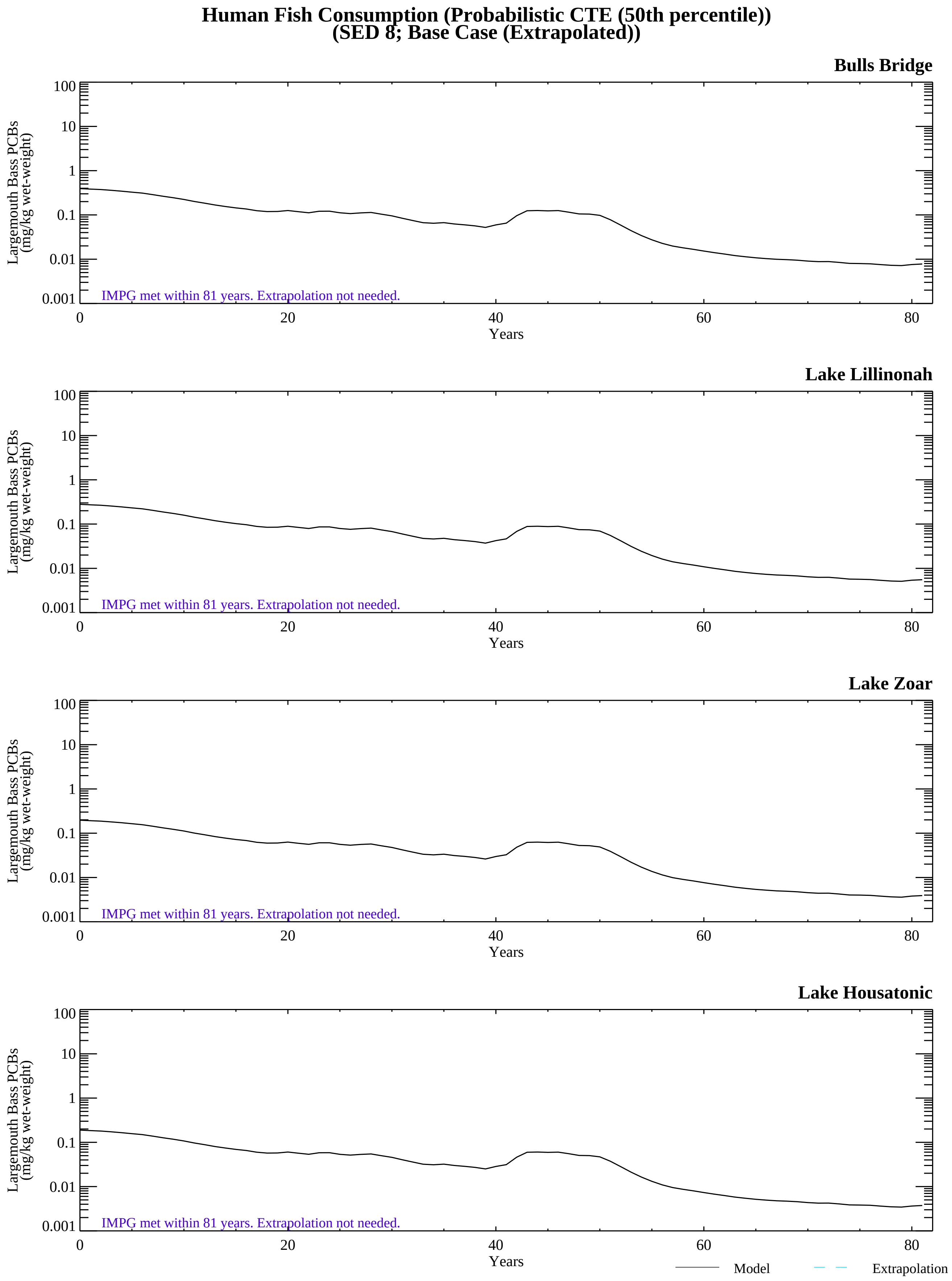

Figure G-8.2-7l. Extrapolated temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D analysis compared to probabilistic CTE IMPGs for human consumption of fish (SED 8; CT; Base Case).

Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 5 to 9.

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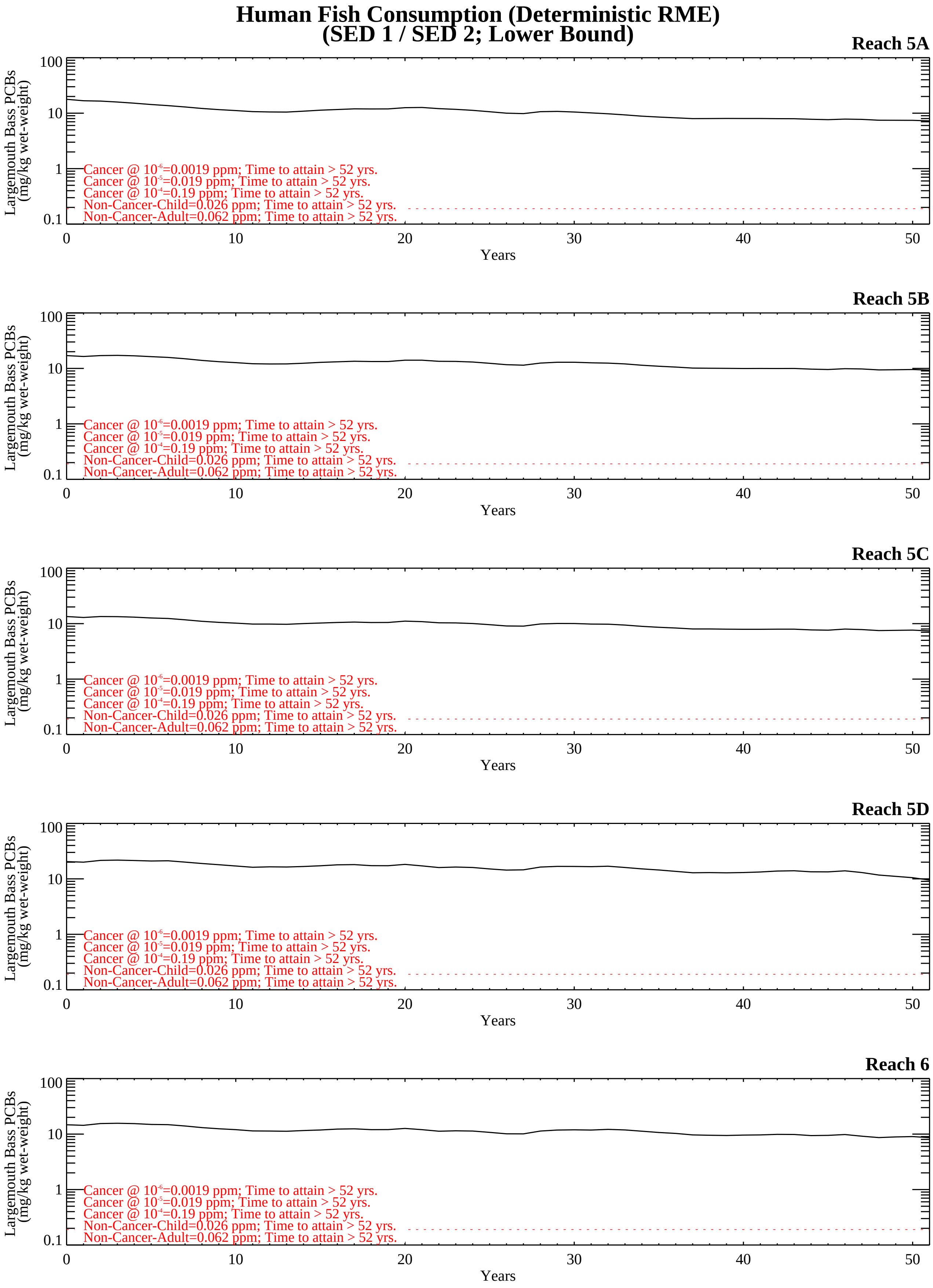

Figure G-8.3-1a. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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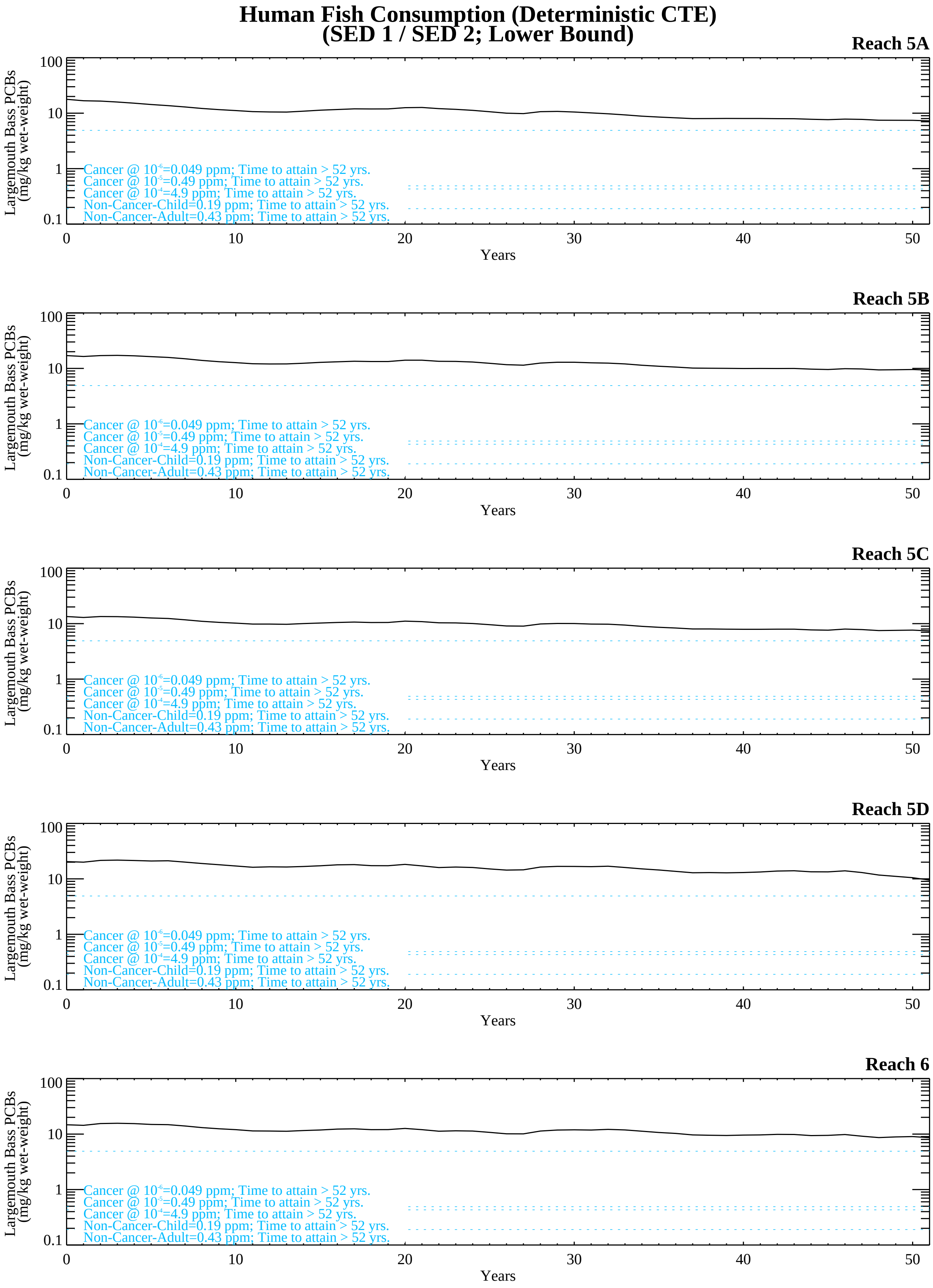

Figure G-8.3-1b. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 1 / SED 2; Lower Bound)

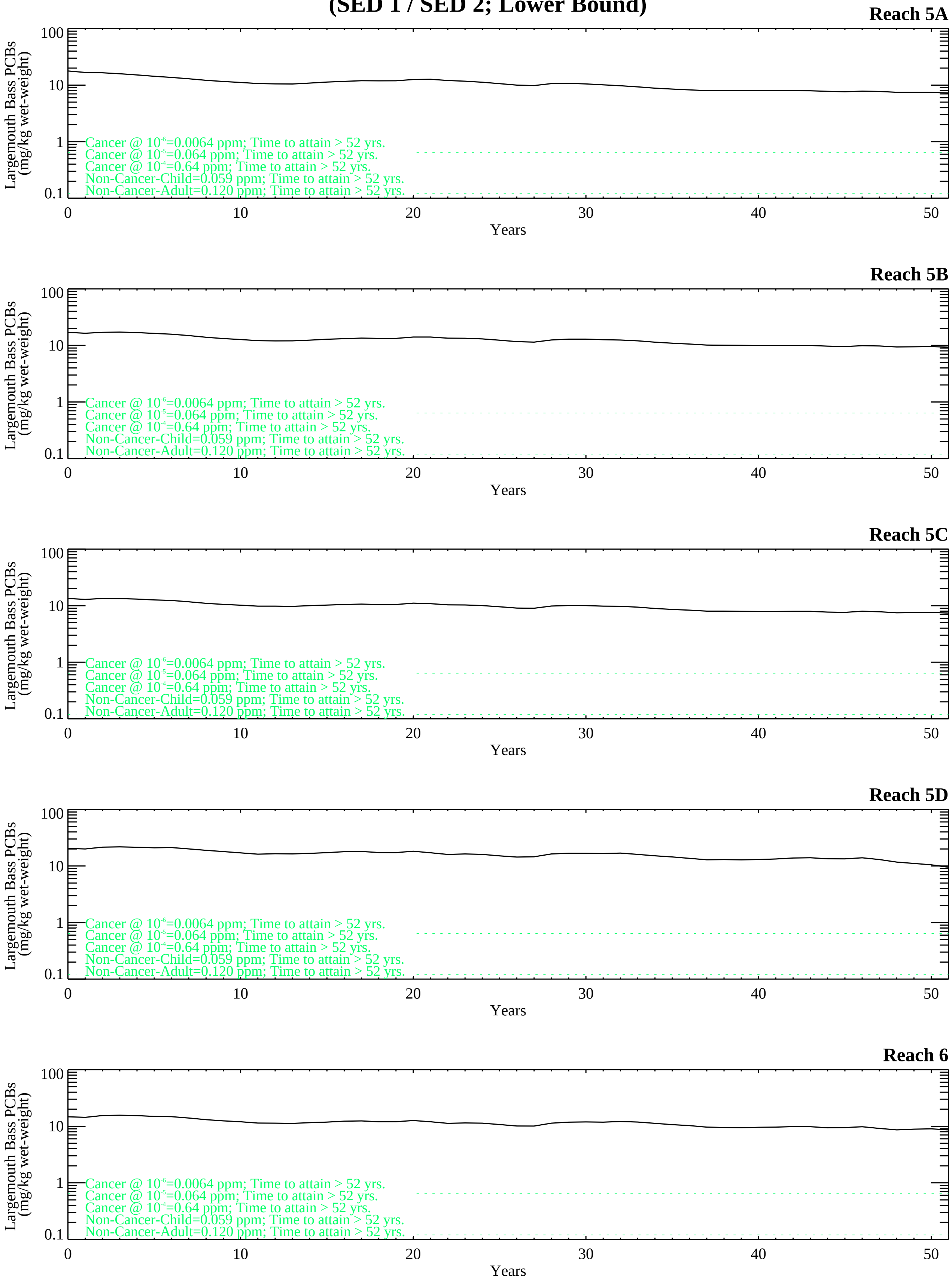

Figure G-8.3-1c. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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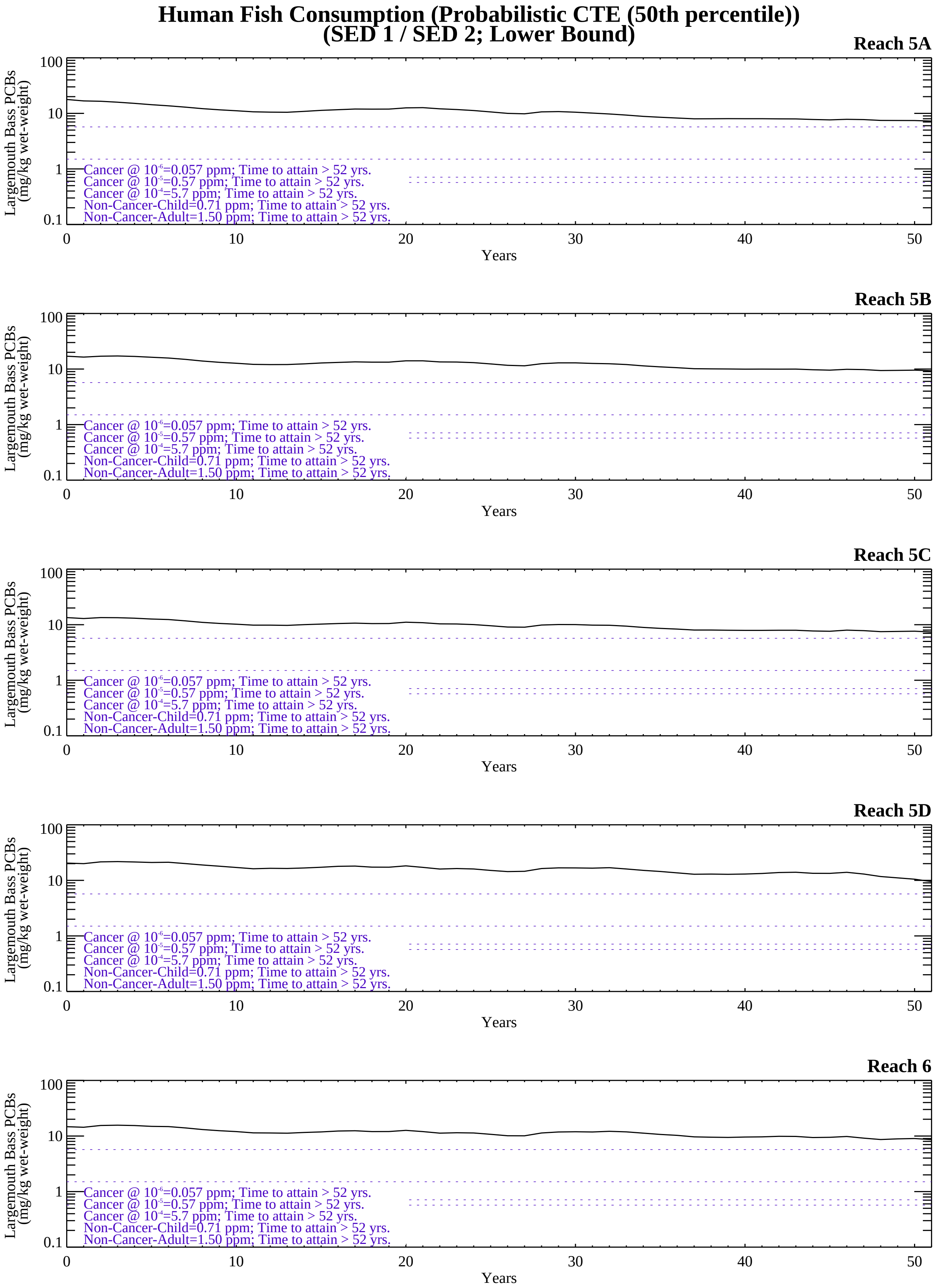
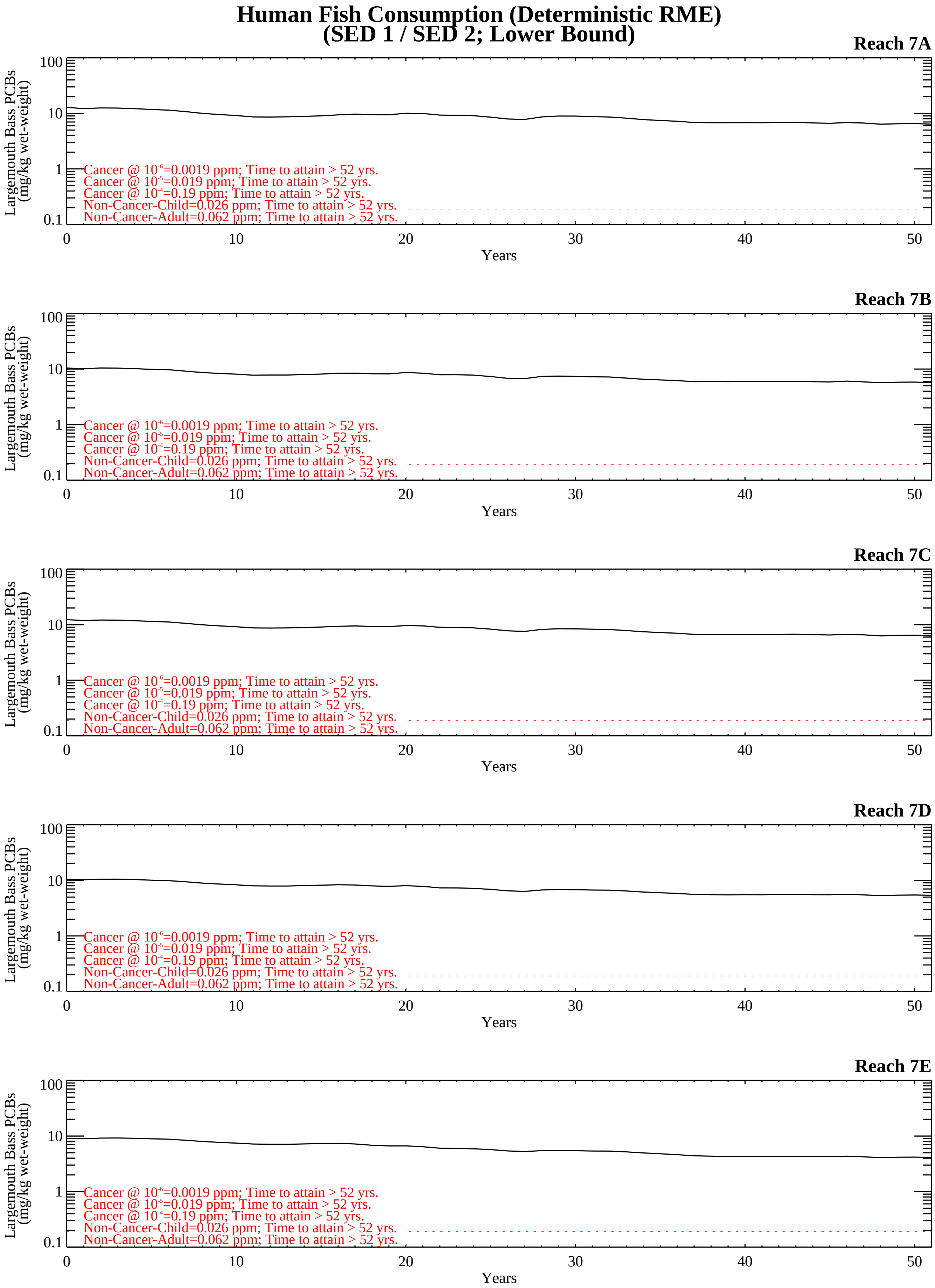


Figure G-8.3-1d. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.


Human Fish Consumption (Deterministic RME)
(SED 1 / SED 2; Lower Bound)

Reach 7A

Reach 7B

Reach 7C

Reach 7D

Reach 7E

Figure G-8.3-1e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

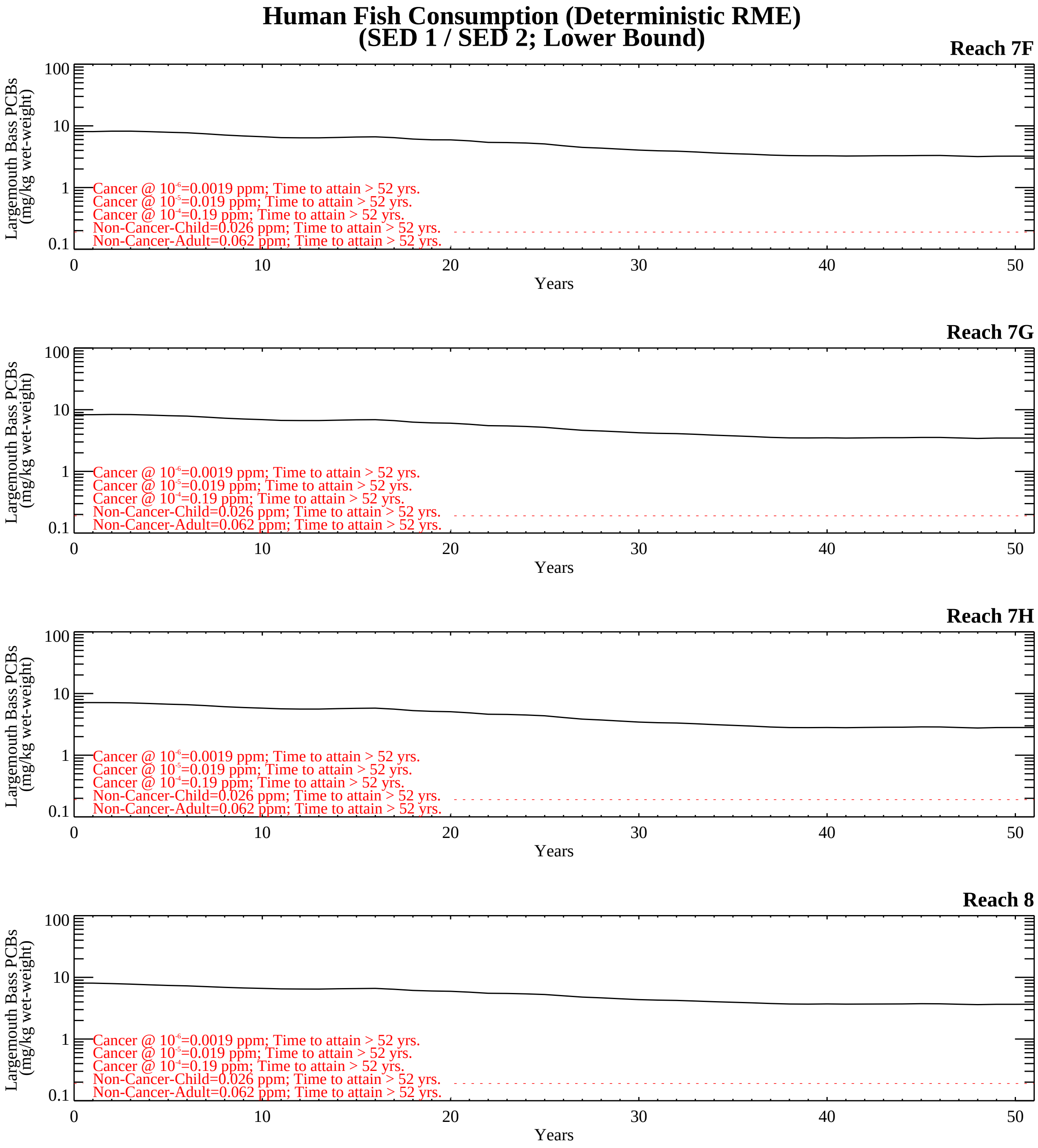


Figure G-8.3-1e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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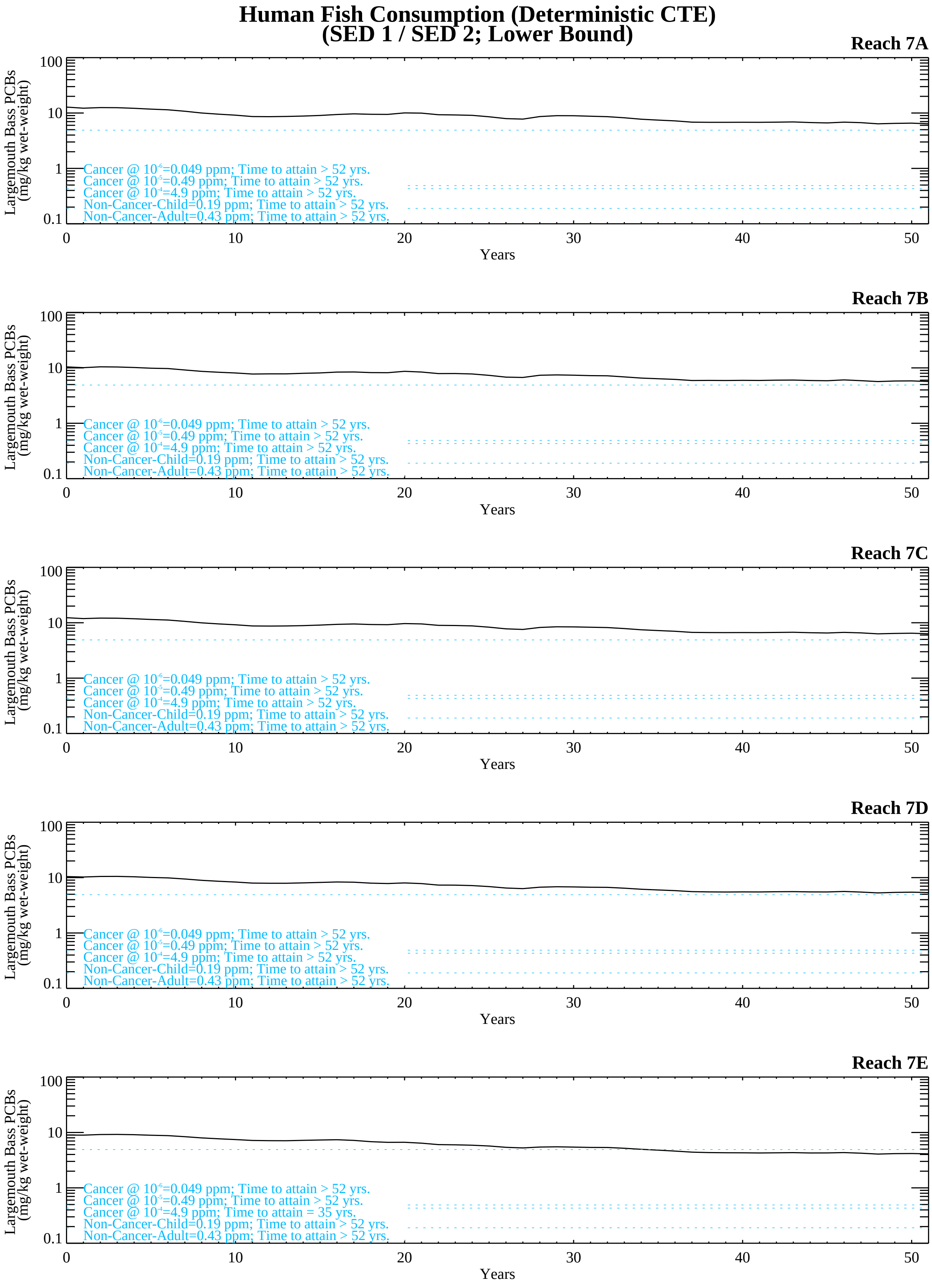

Figure G-8.3-1f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

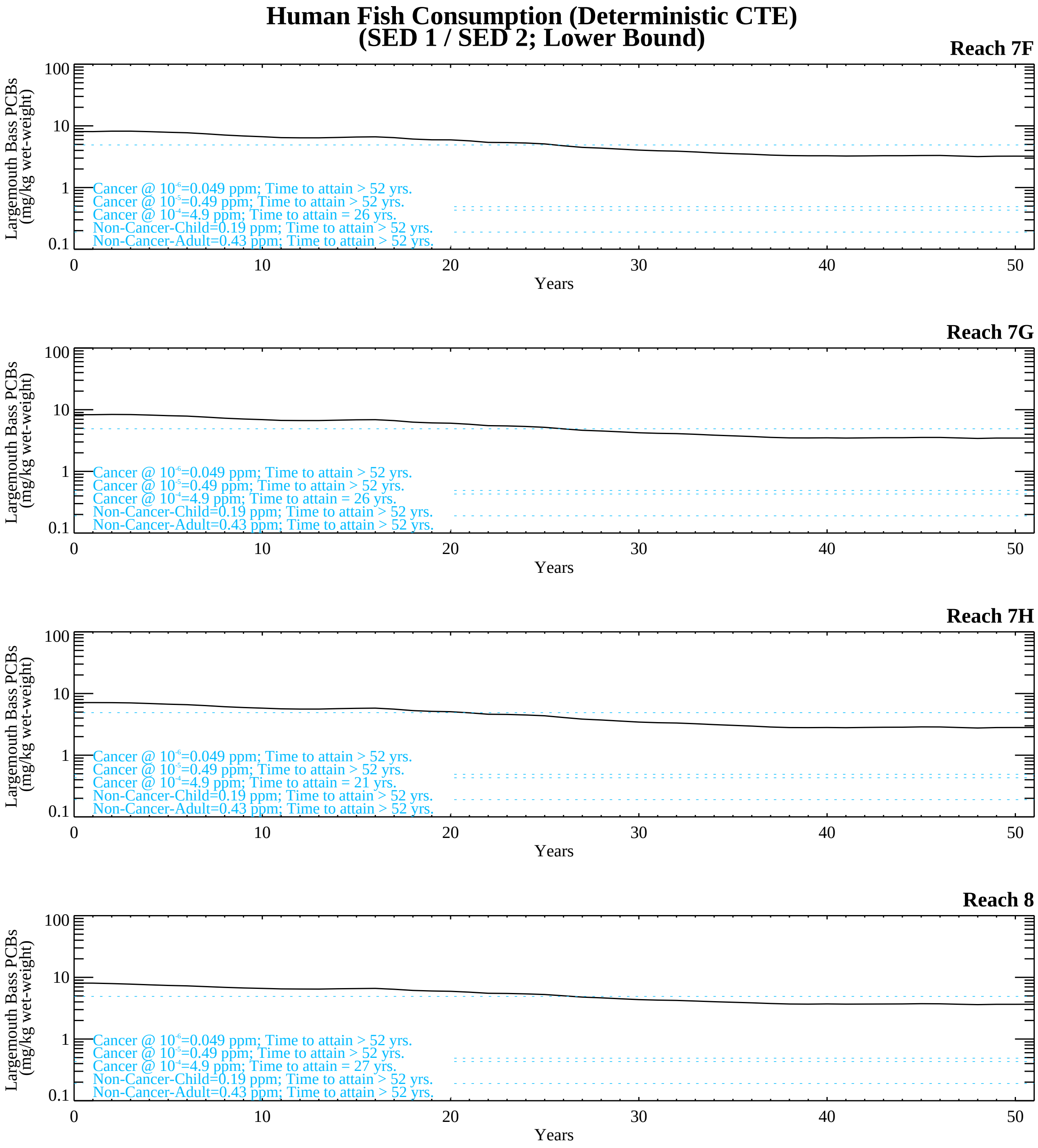

Figure G-8.3-1f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 1 / SED 2; Lower Bound)

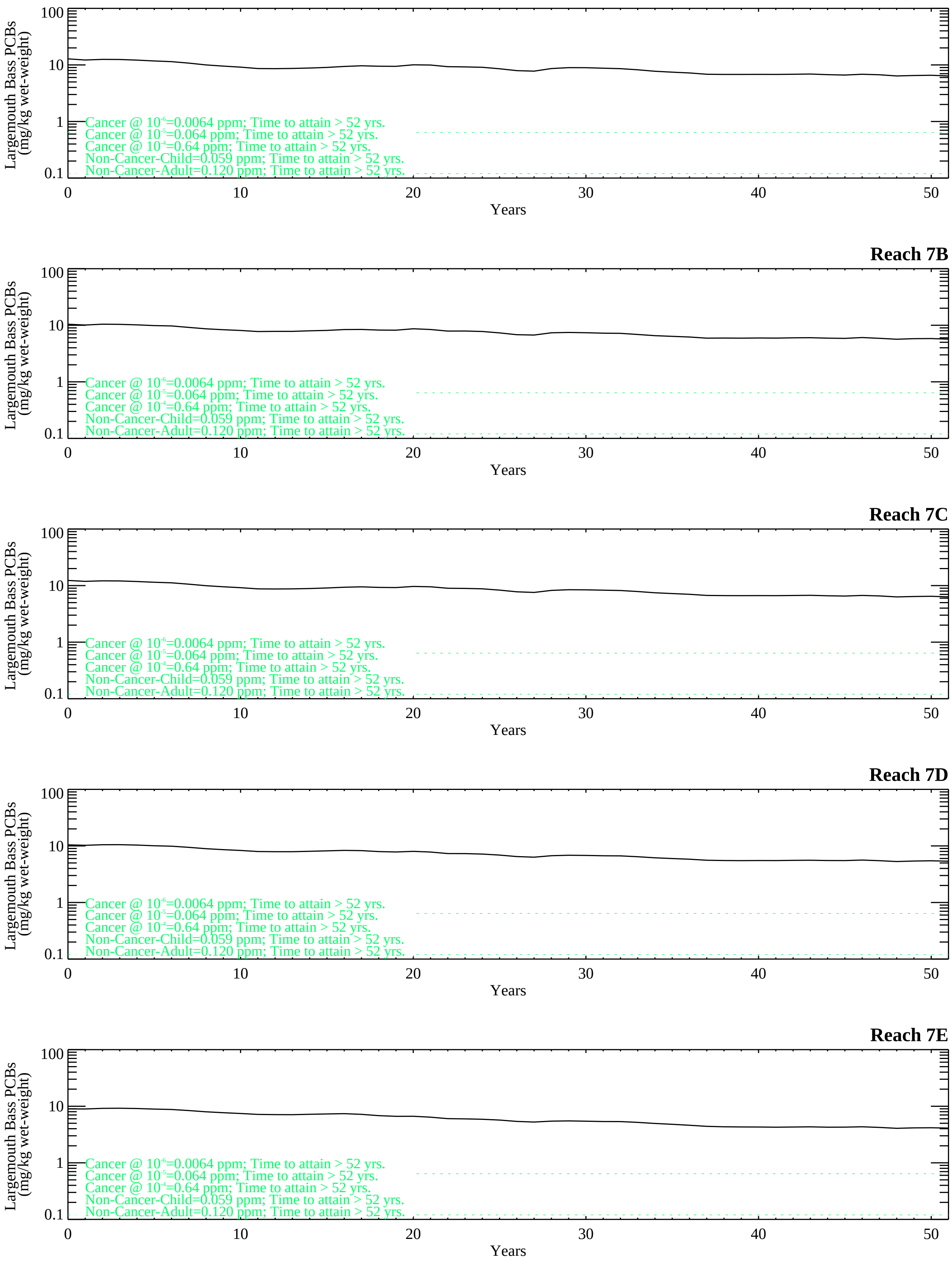

Figure G-8.3-1g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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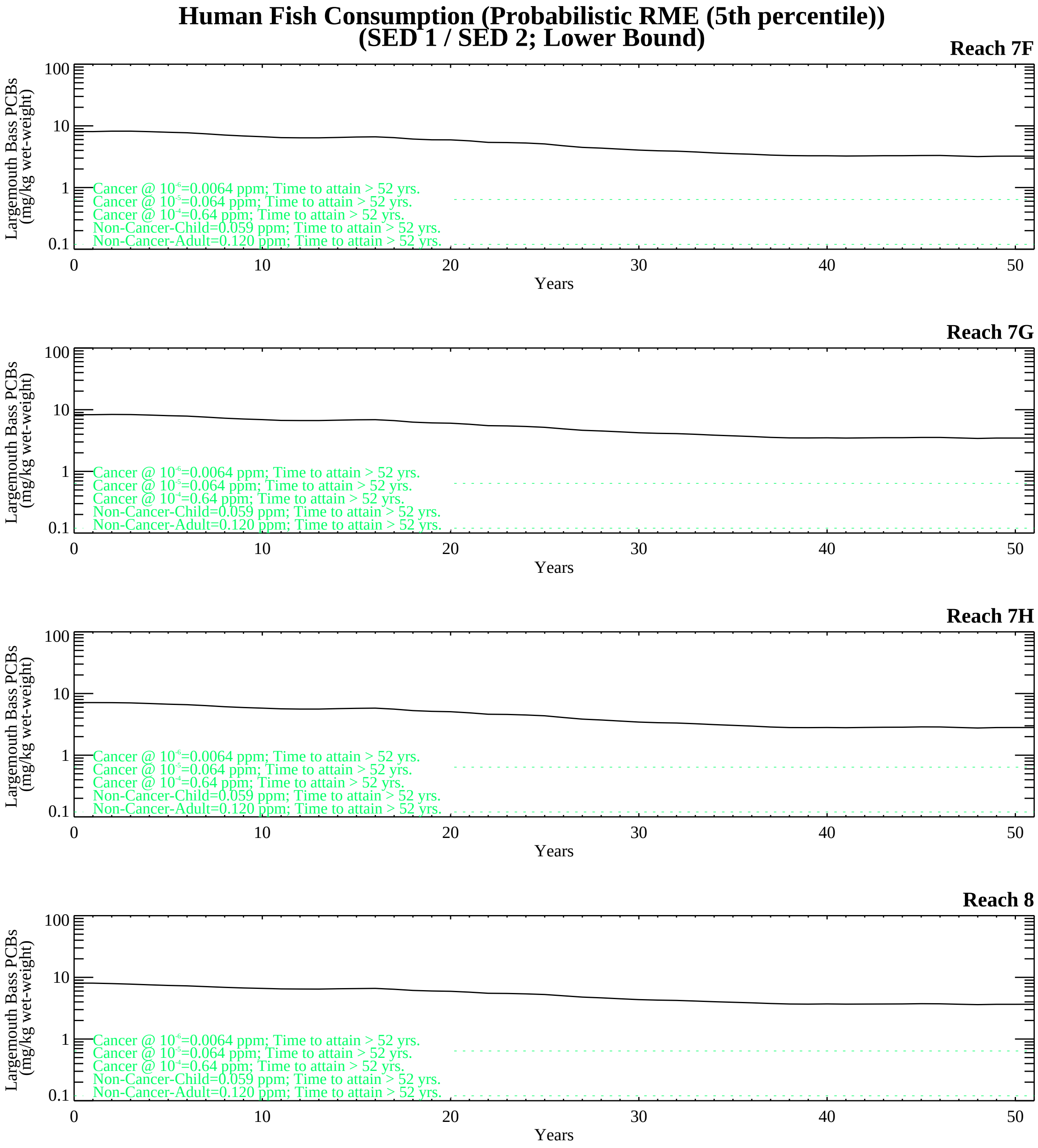

Figure G-8.3-1g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 7/8; Lower Bound).
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

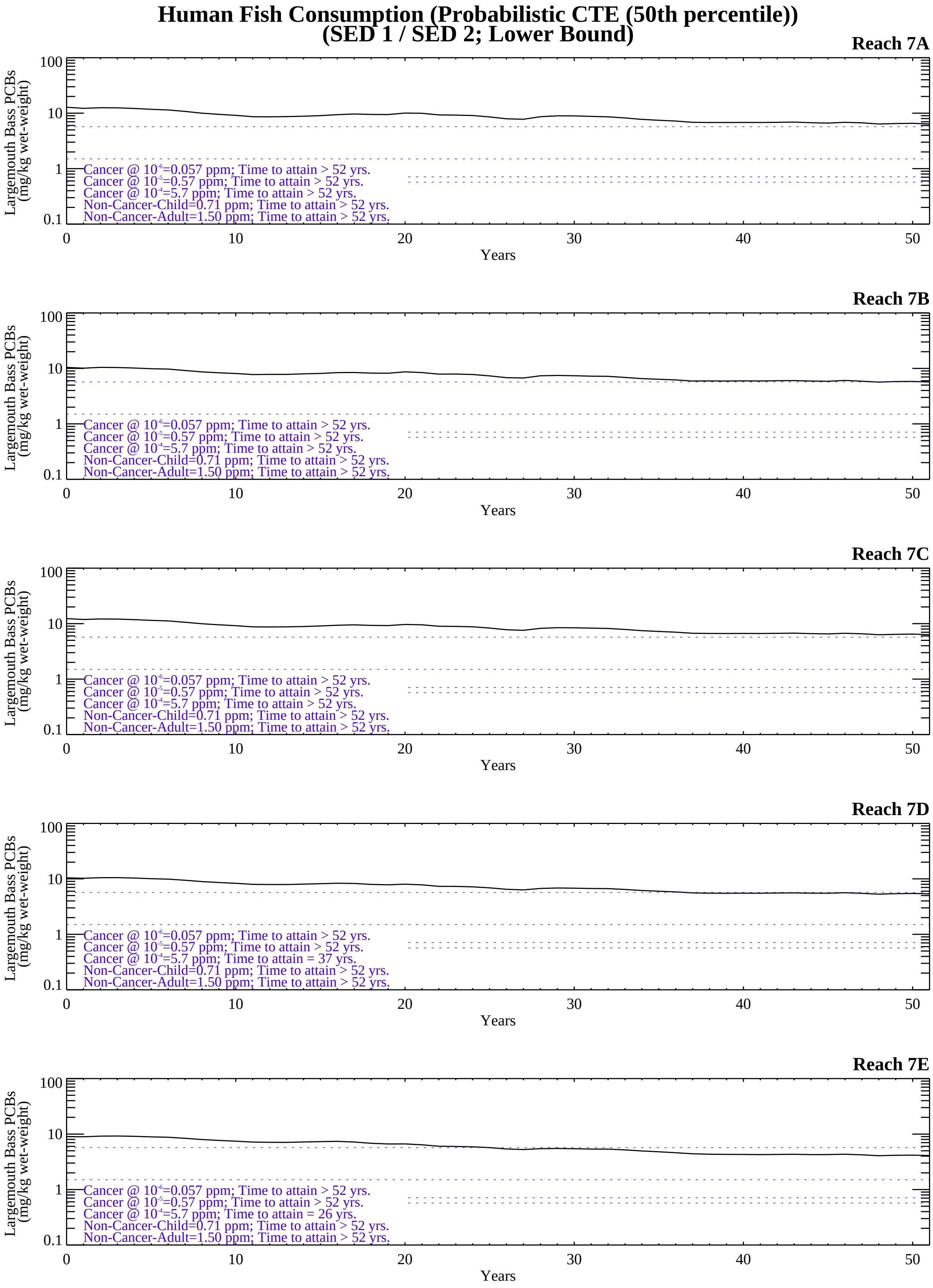

Figure G-8.3-1h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 1 / SED 2; Lower Bound)

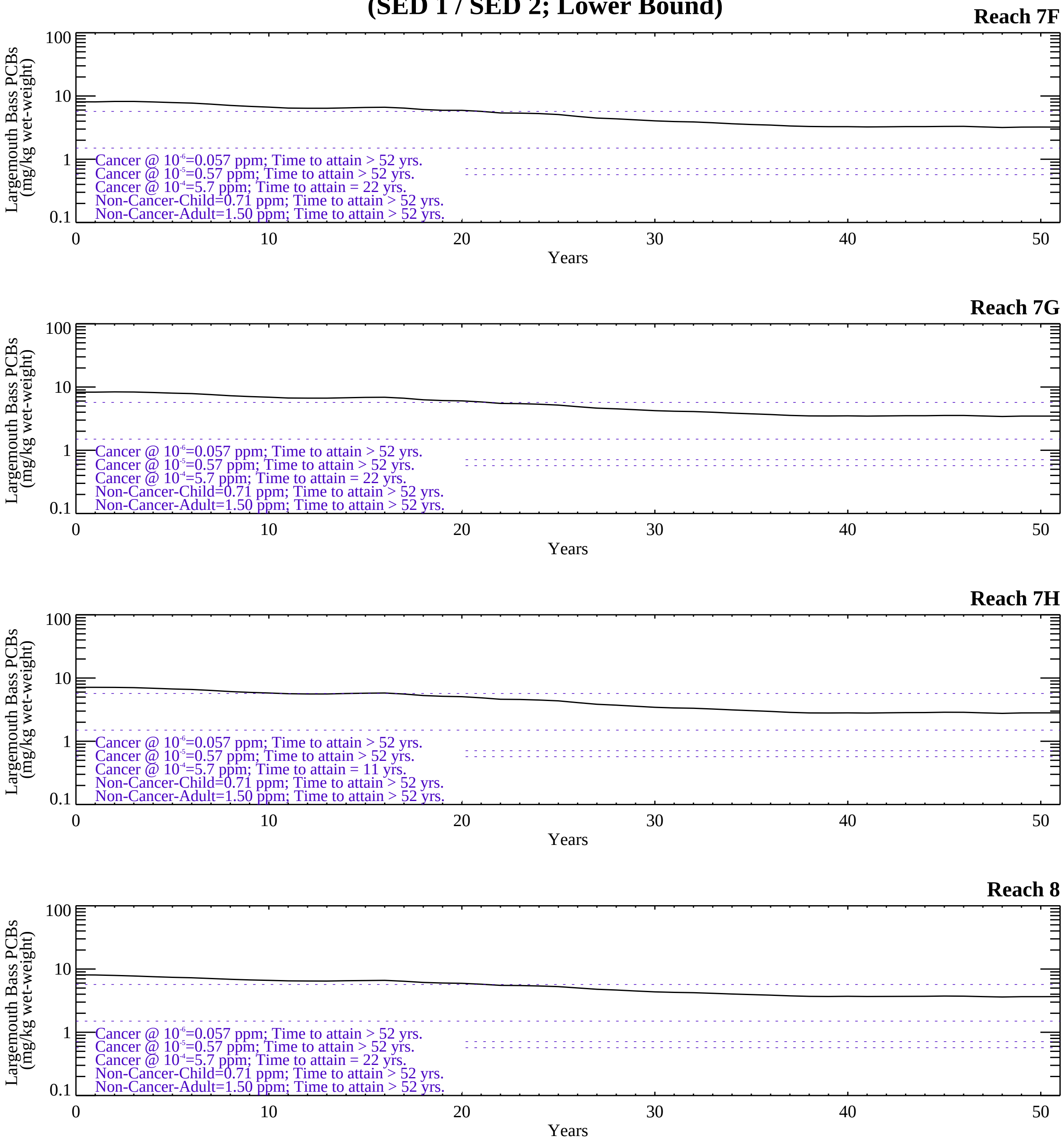

Figure G-8.3-1h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

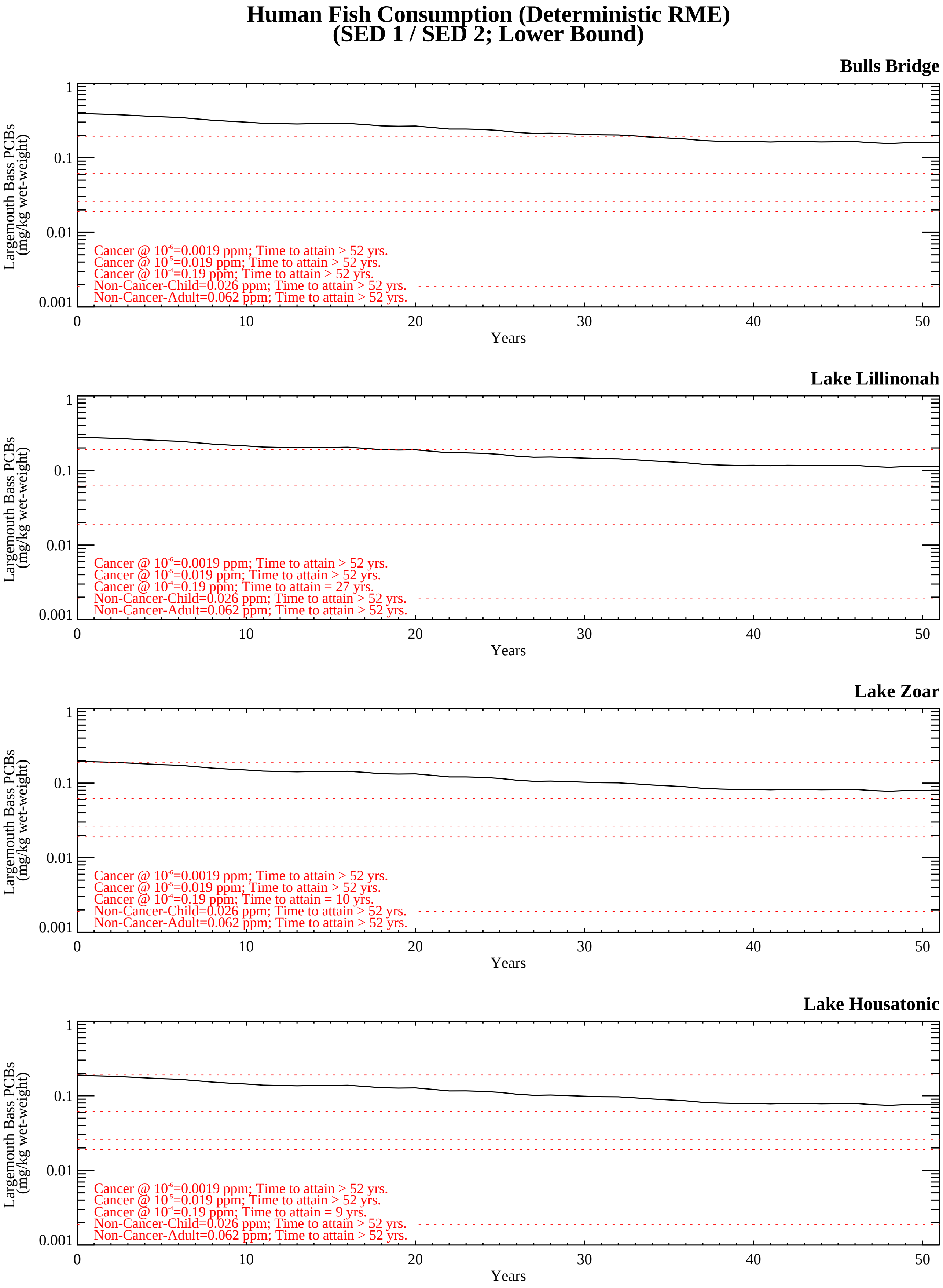

Figure G-8.3-1i. Temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D Analysis compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Deterministic CTE)
(SED 1 / SED 2; Lower Bound)

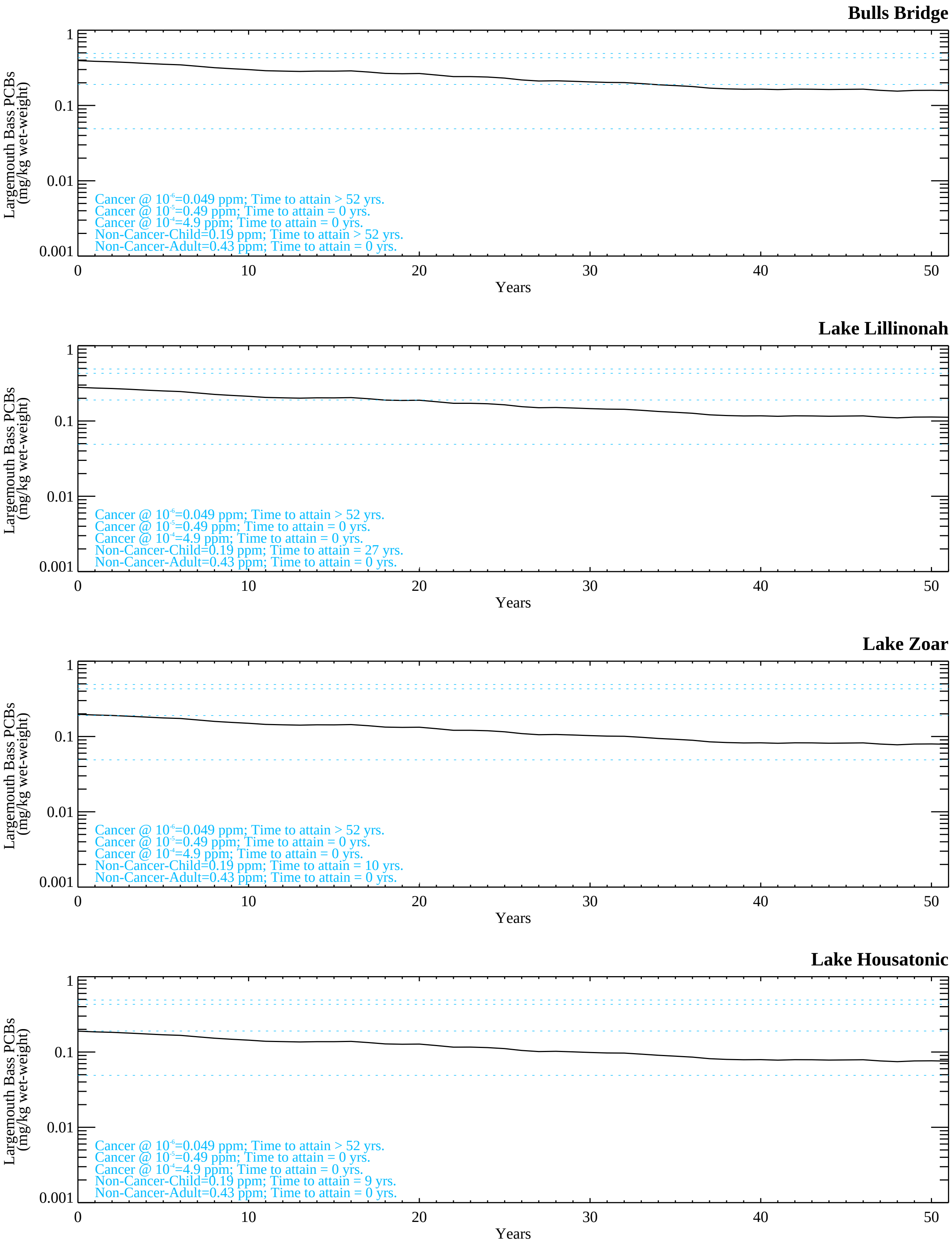


Figure G-8.3-1j. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 1 / SED 2; Lower Bound)

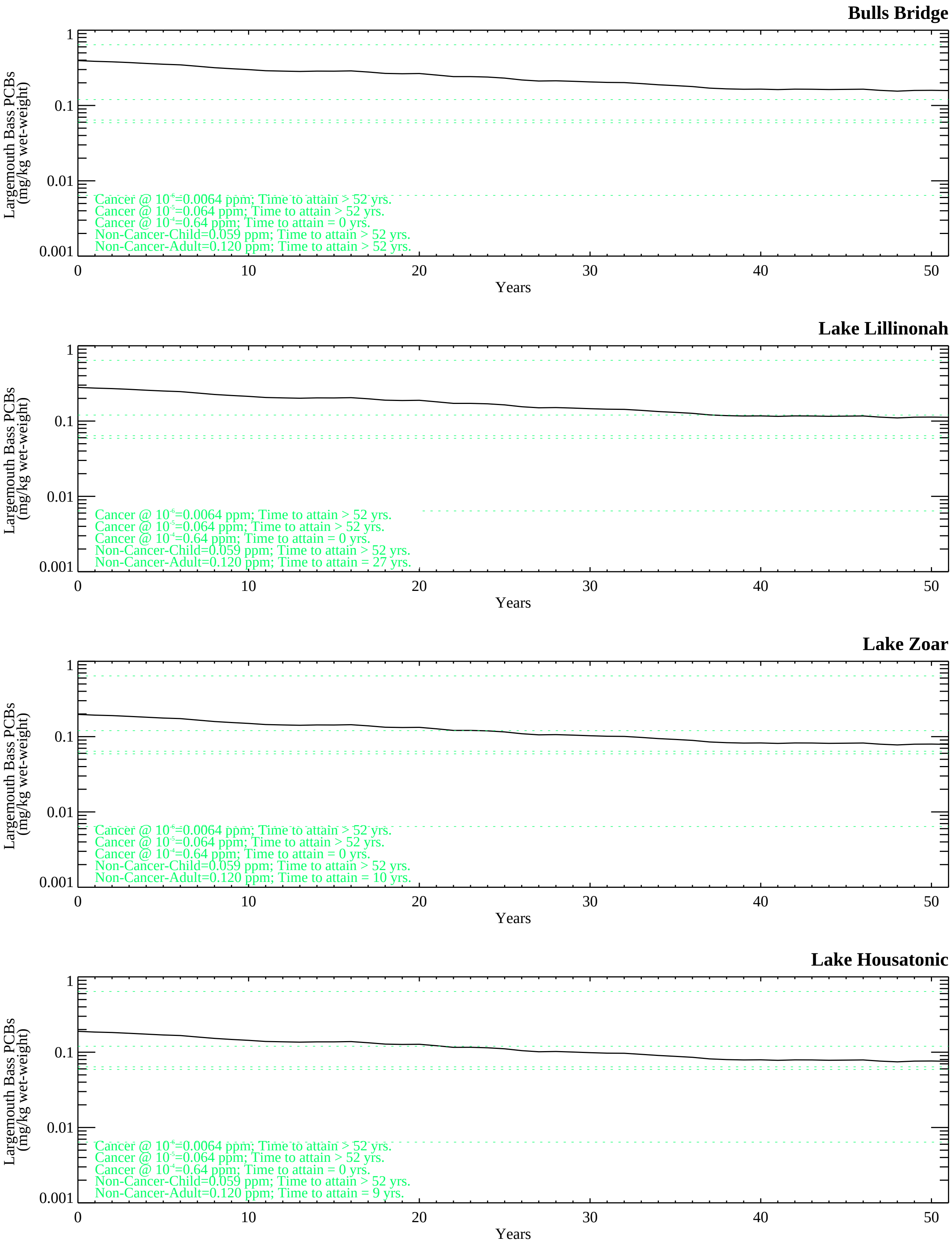
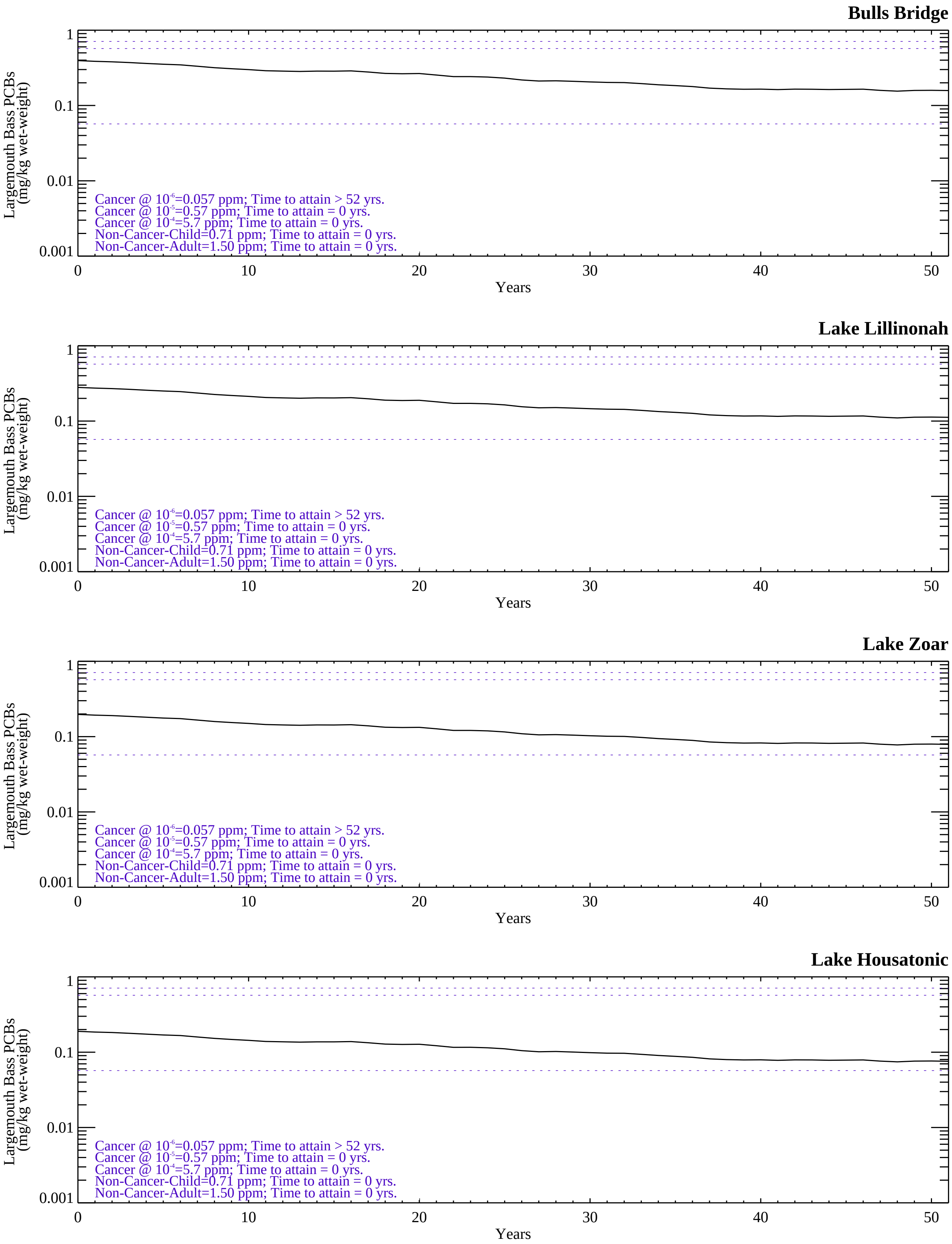


Figure G-8.3-1k. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 1 / SED 2; Lower Bound)


Bulls Bridge

Lake Lillinonah

Lake Zoar

Lake Housatonic

Figure G-8.3-1l. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 1 / SED 2; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Deterministic RME)
(SED 3; Lower Bound)

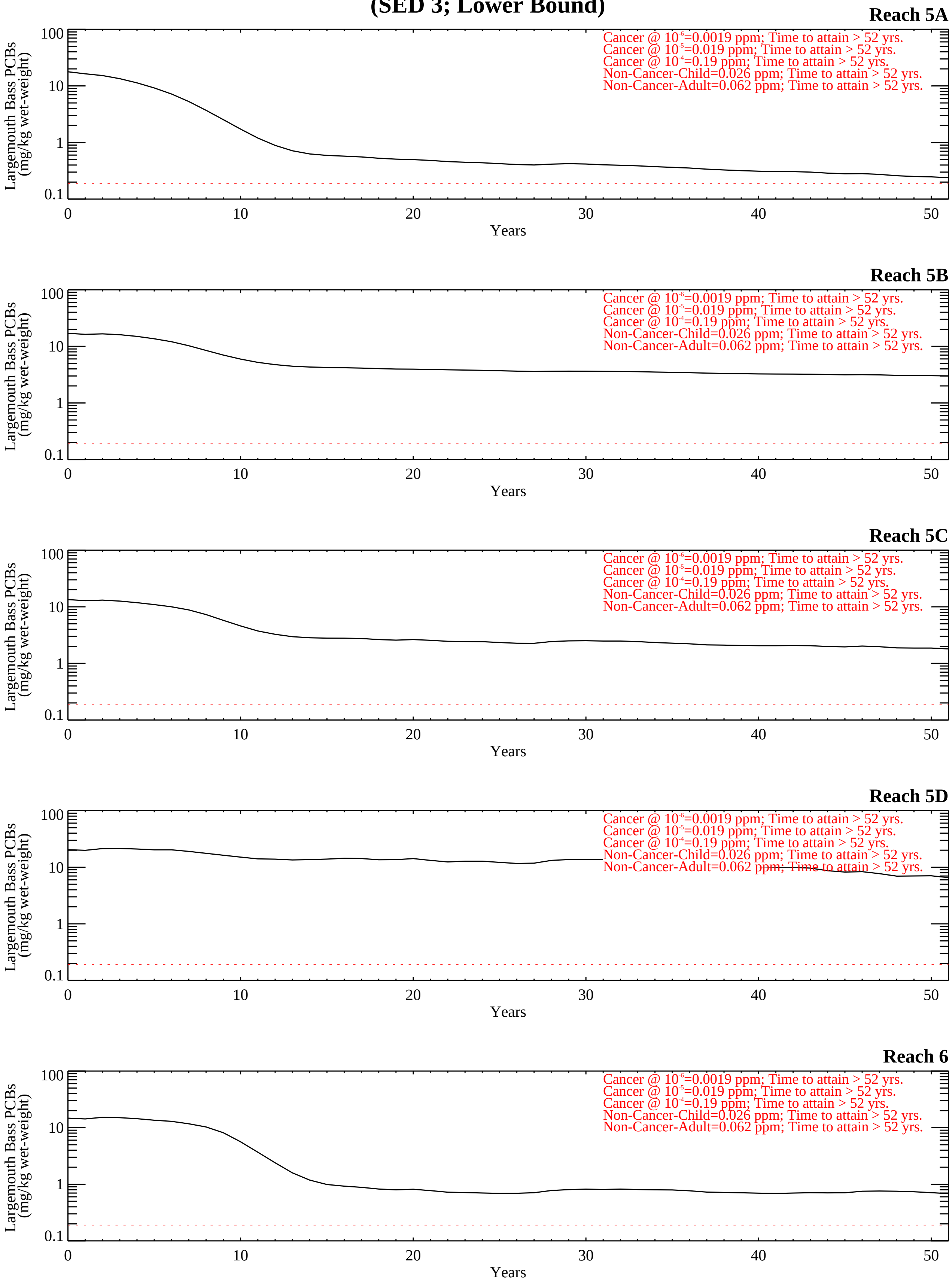


Figure G-8.3-2a. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

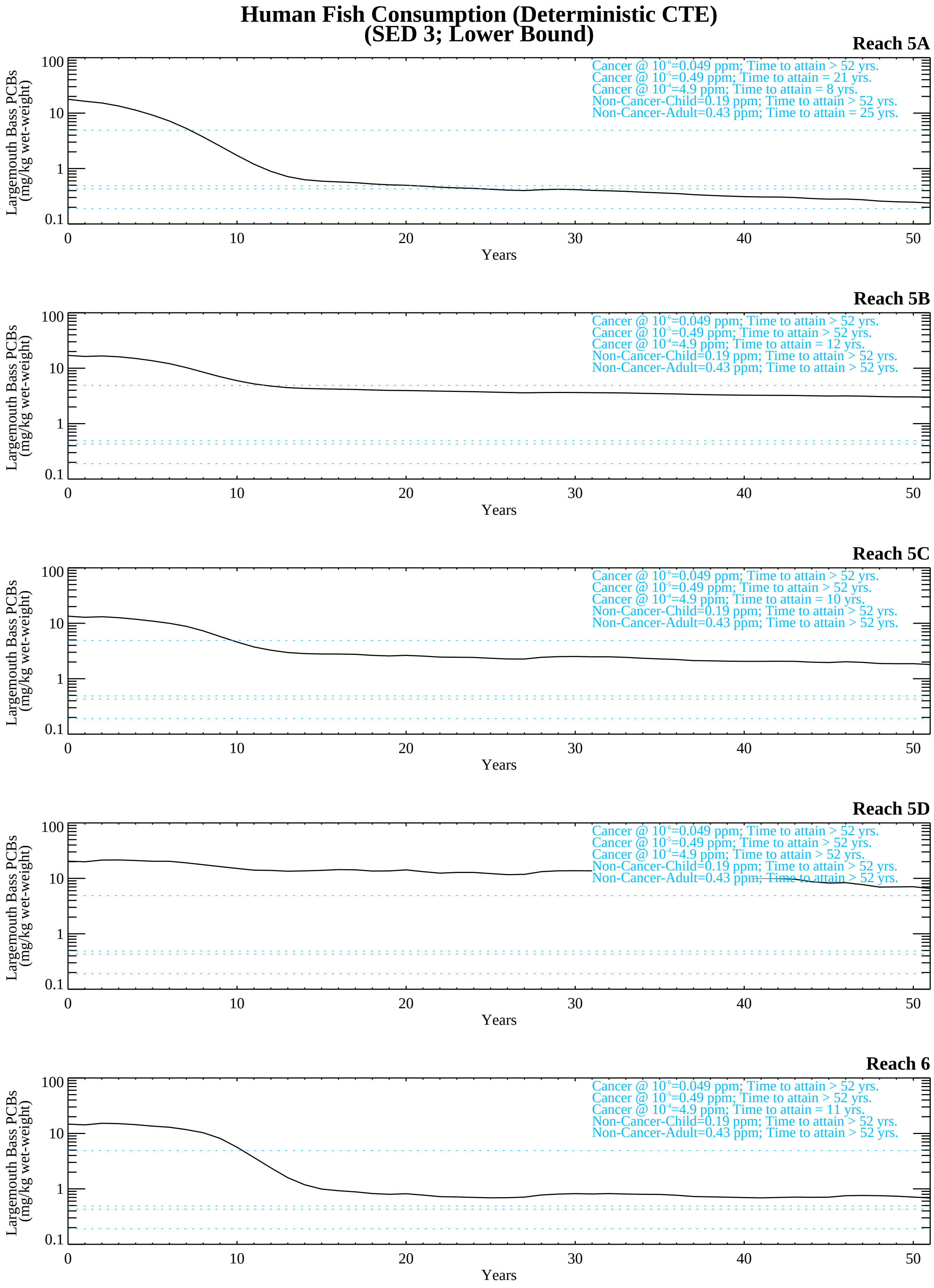


Figure G-8.3-2b. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

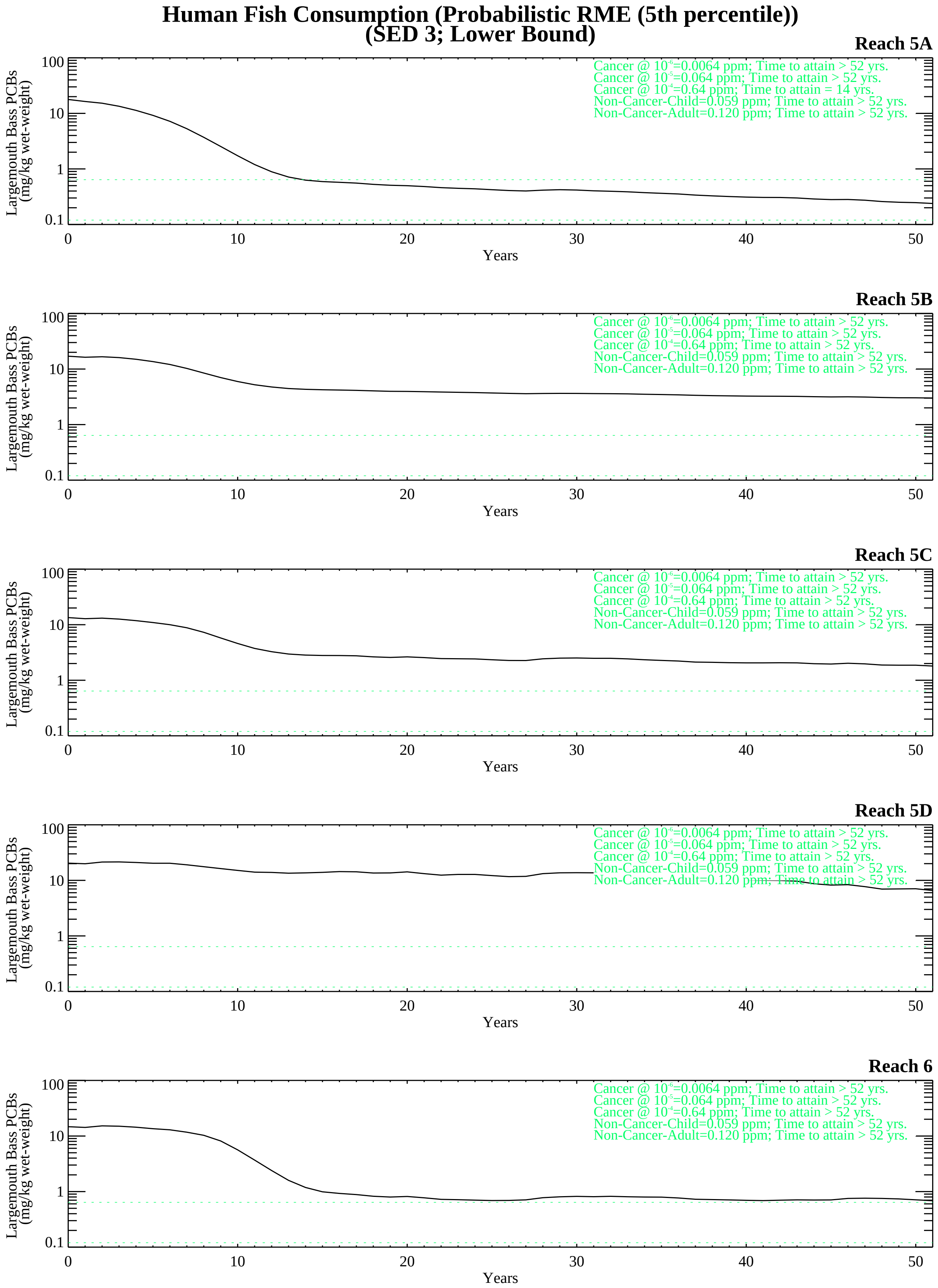


Figure G-8.3-2c. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

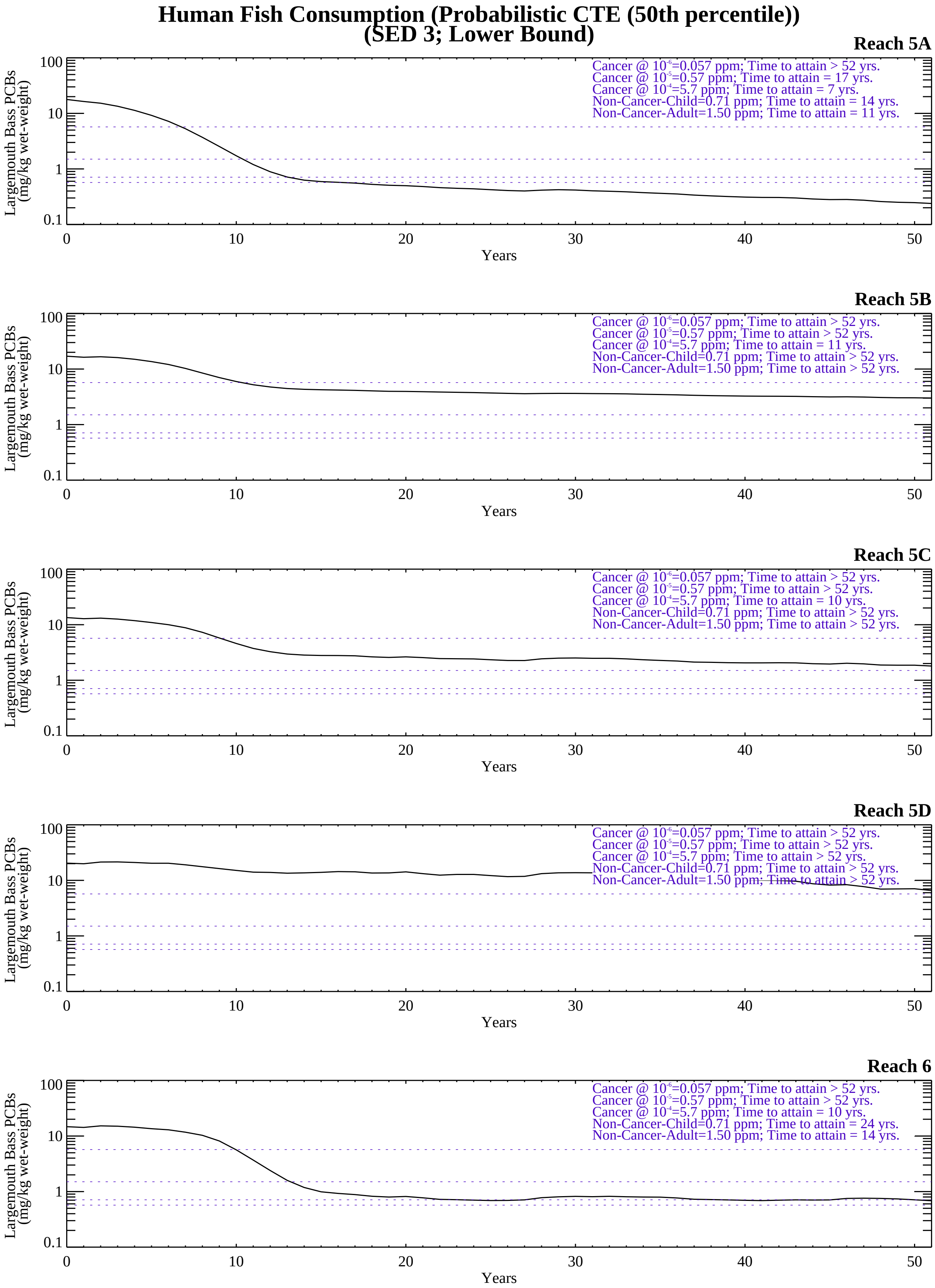


Figure G-8.3-2d. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

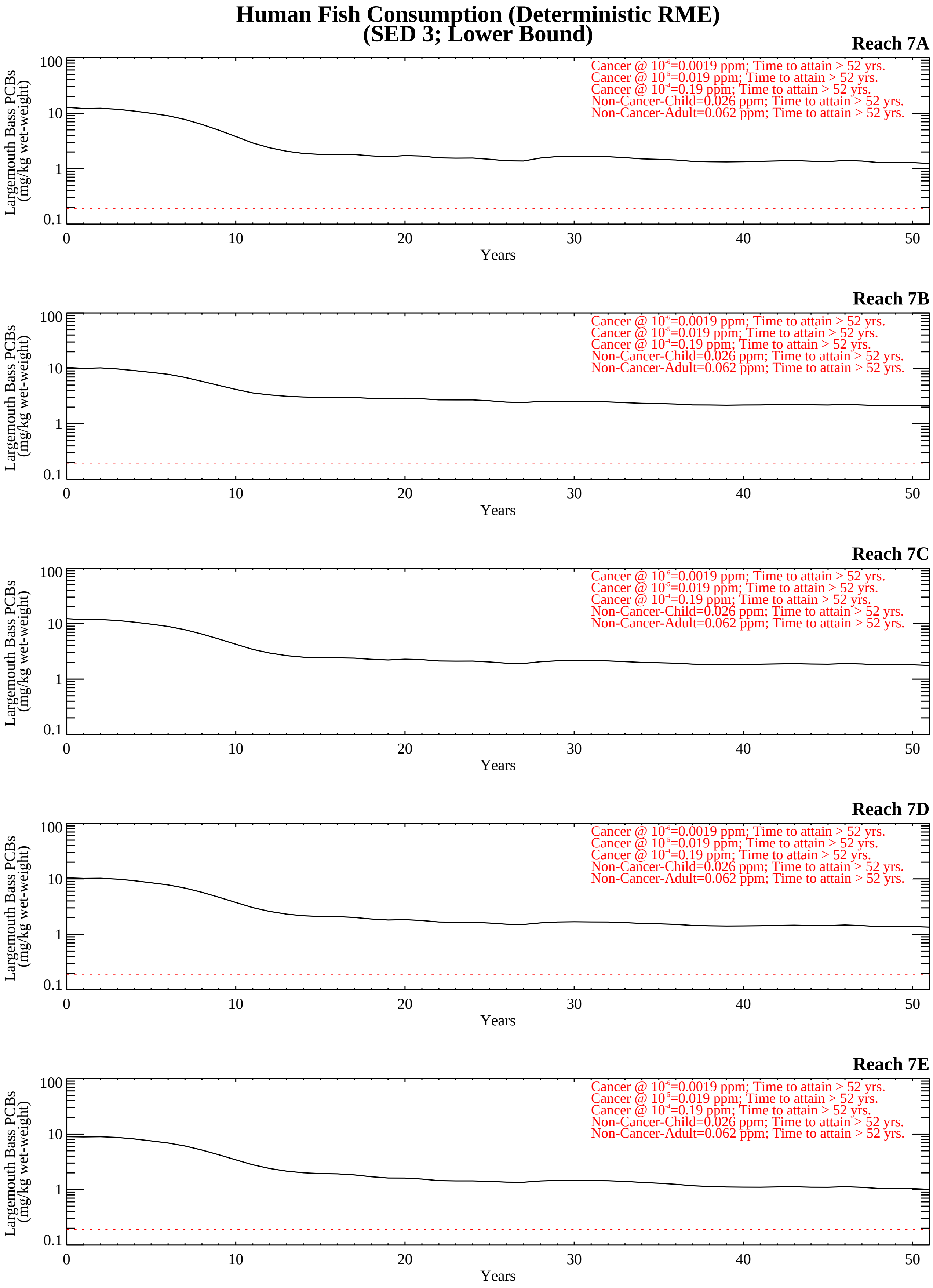
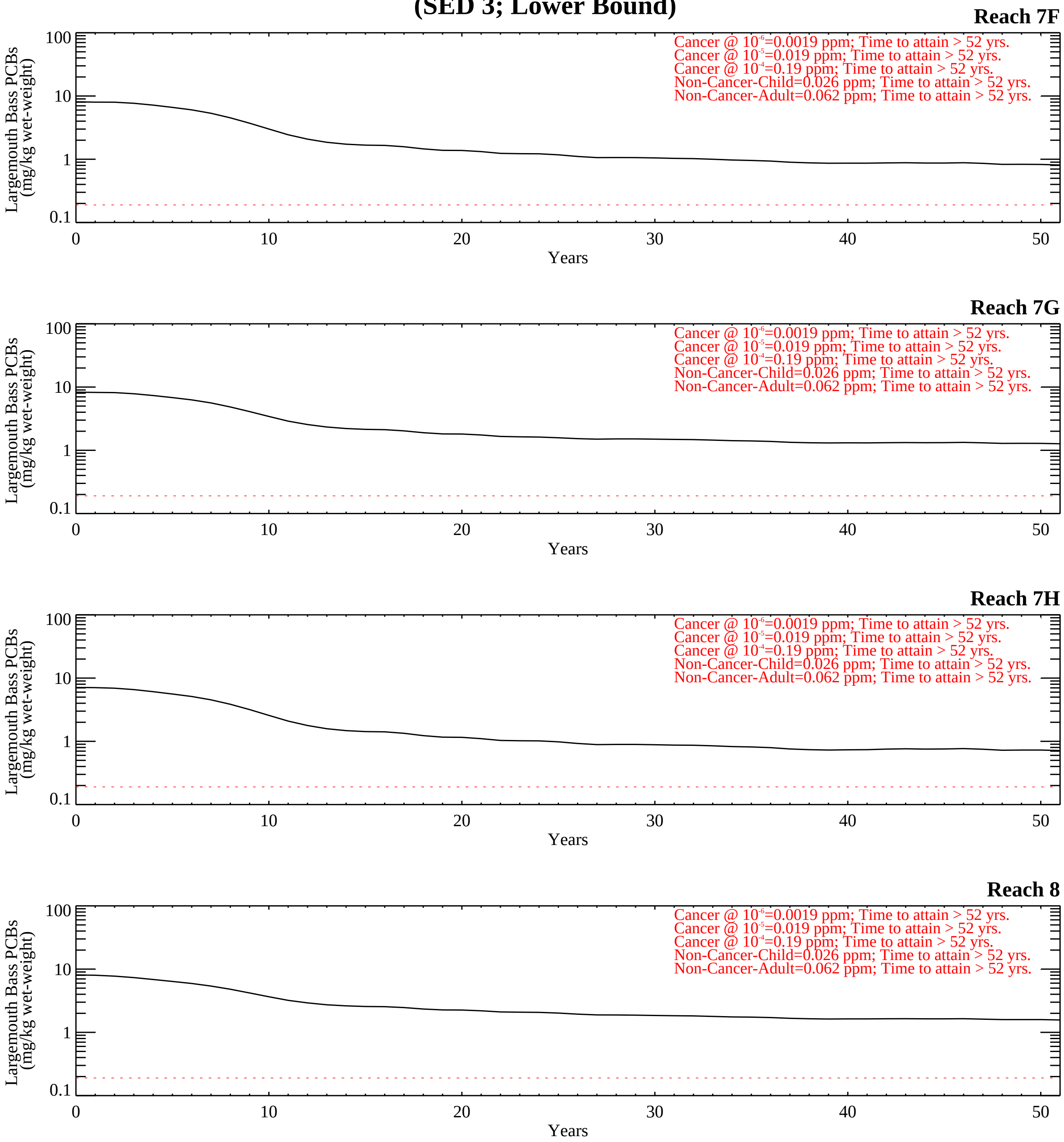


Figure G-8.3-2e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic RME)
(SED 3; Lower Bound)



Reach 7F

Reach 7G

Reach 7H

Reach 8

Figure G-8.3-2e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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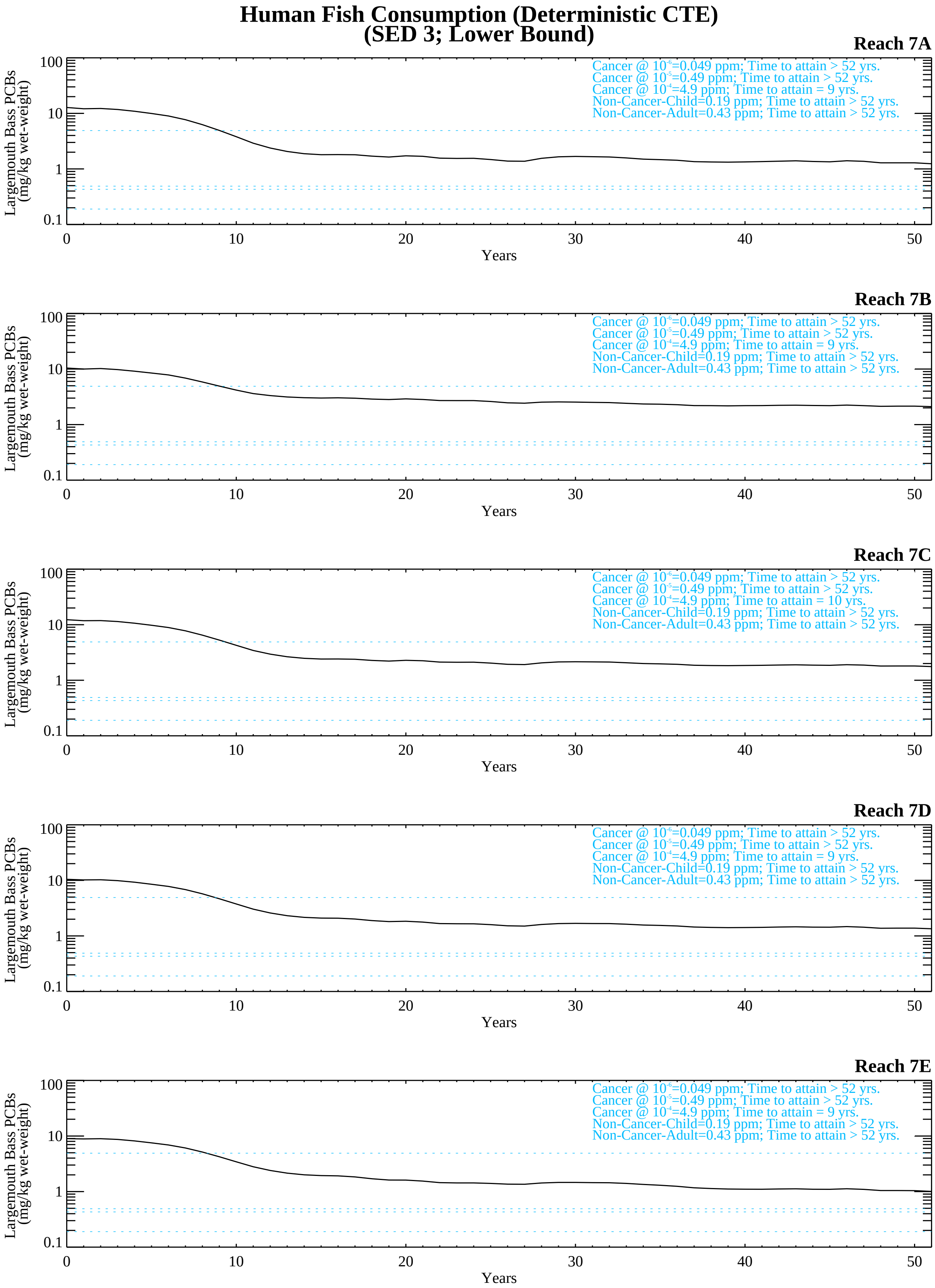

Figure G-8.3-2f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

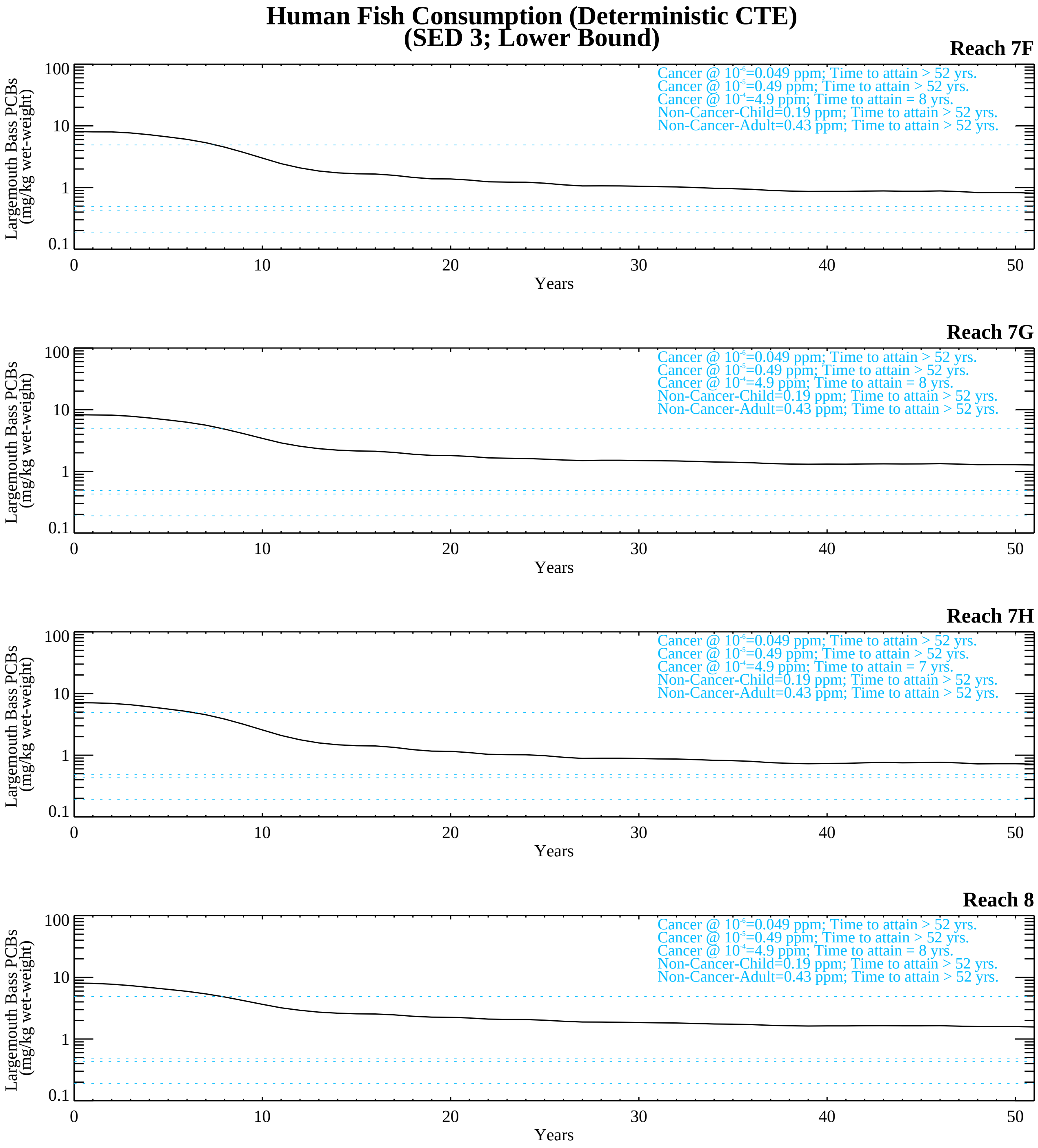

Figure G-8.3-2f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

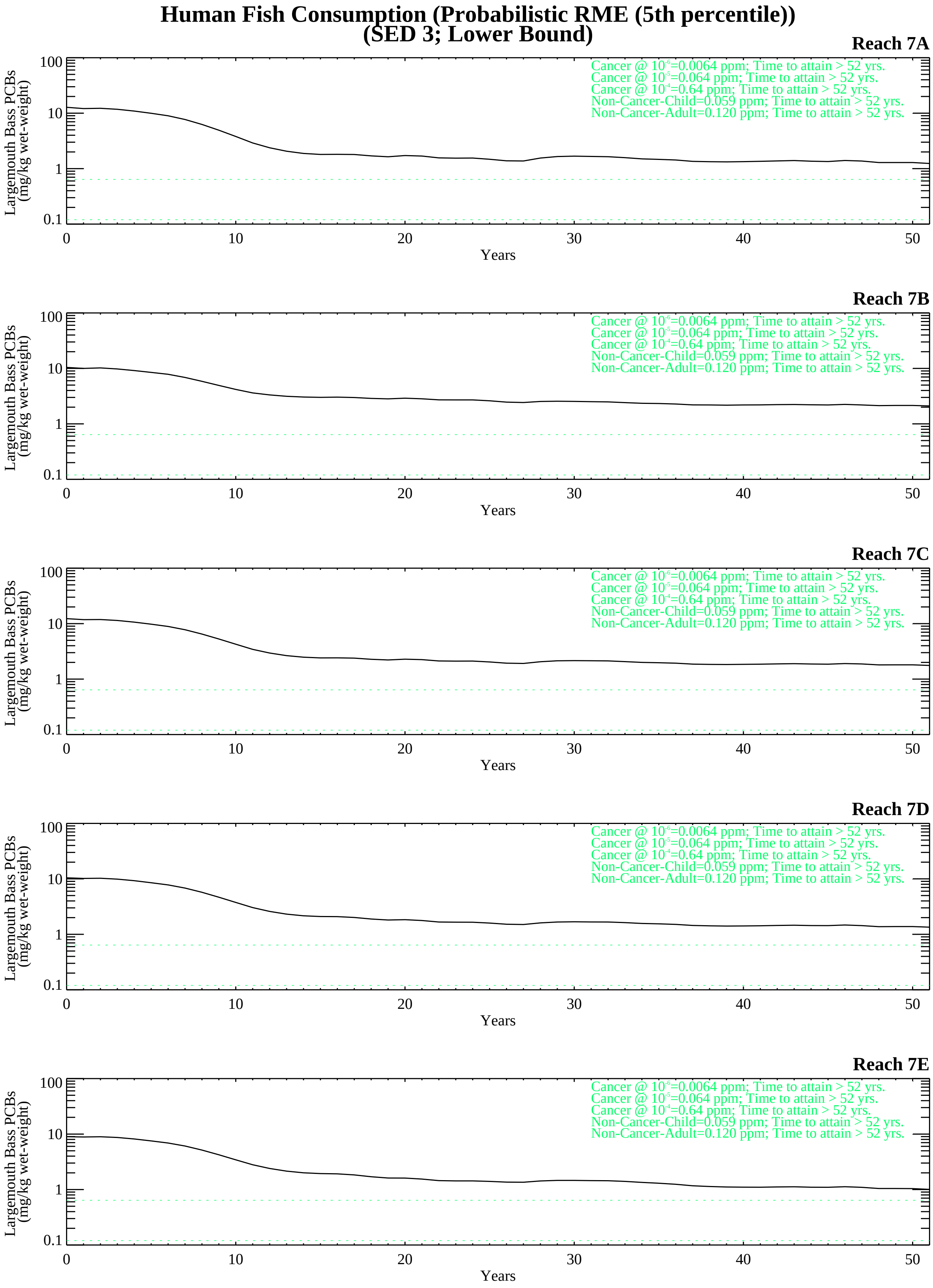

Figure G-8.3-2g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

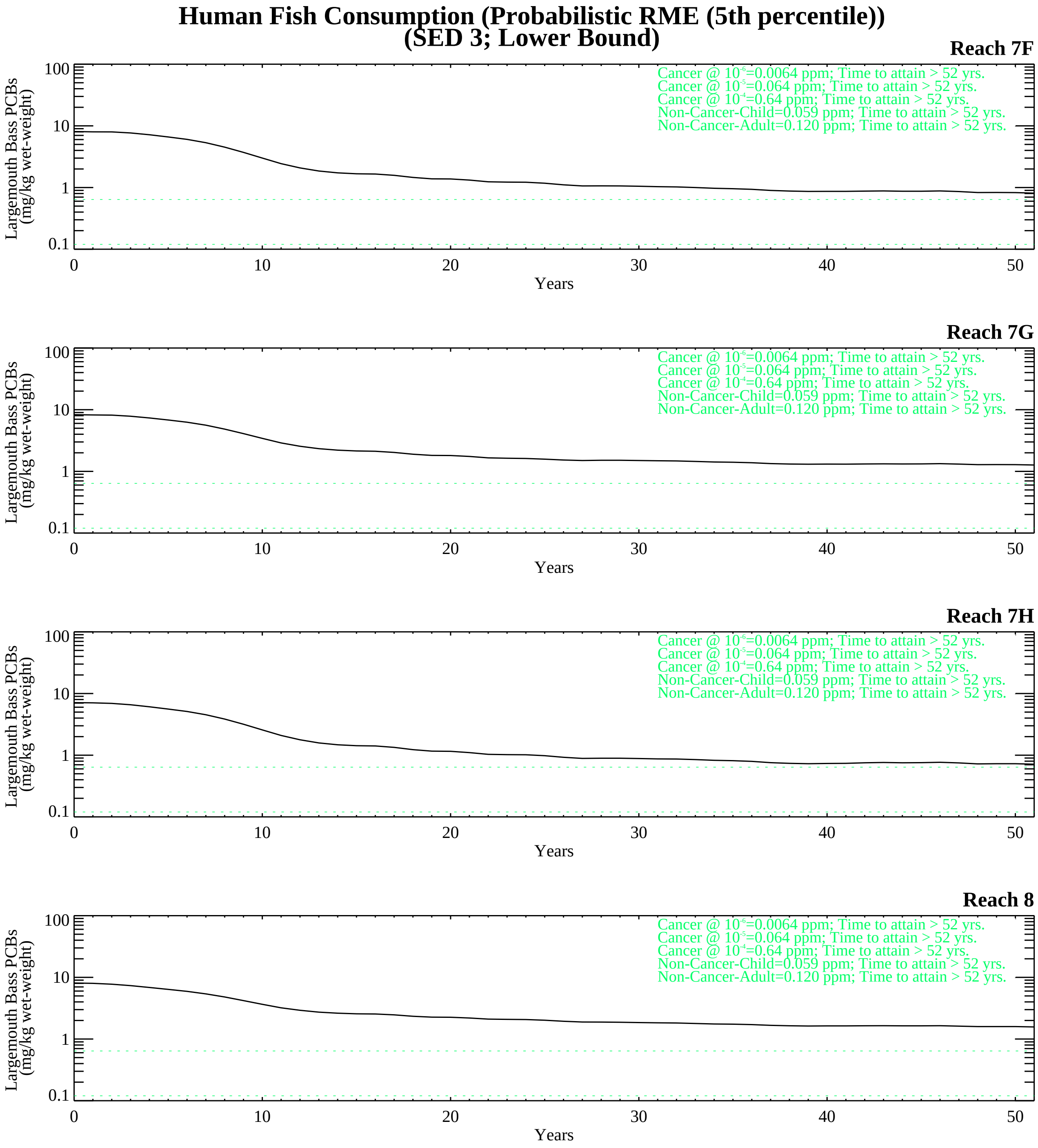

Figure G-8.3-2g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

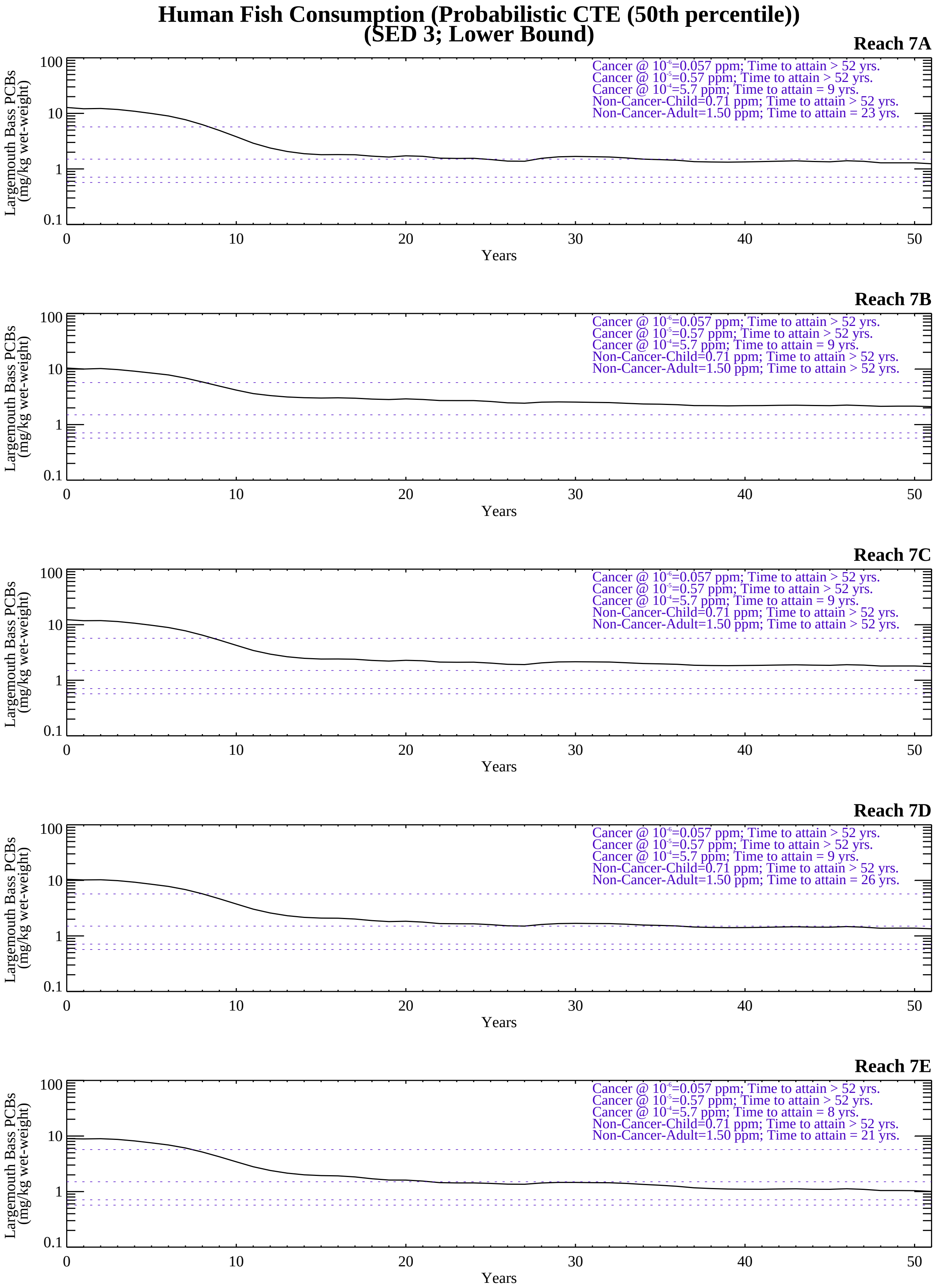

Figure G-8.3-2h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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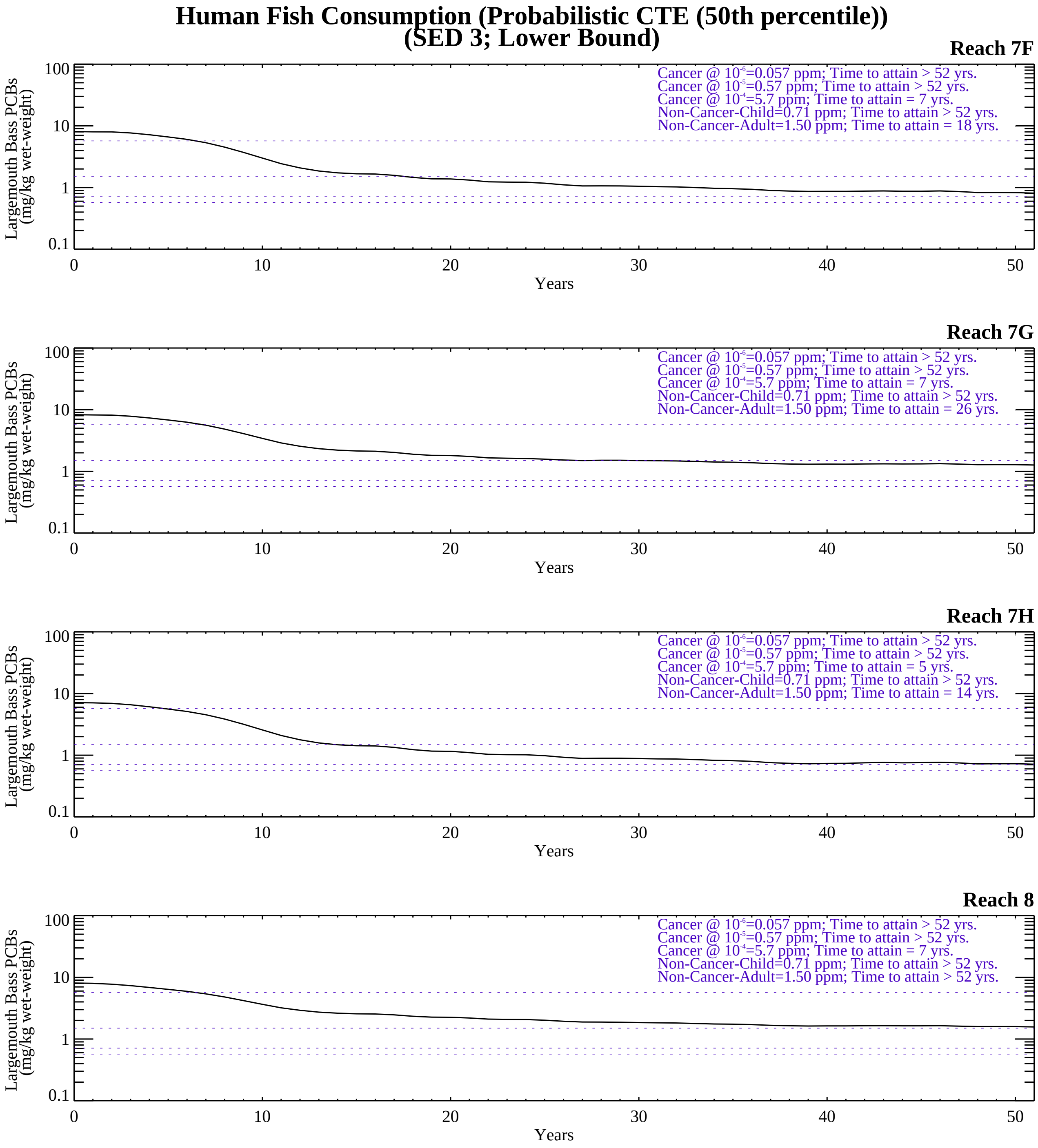

Figure G-8.3-2h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 3; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Deterministic RME)
(SED 3; Lower Bound)

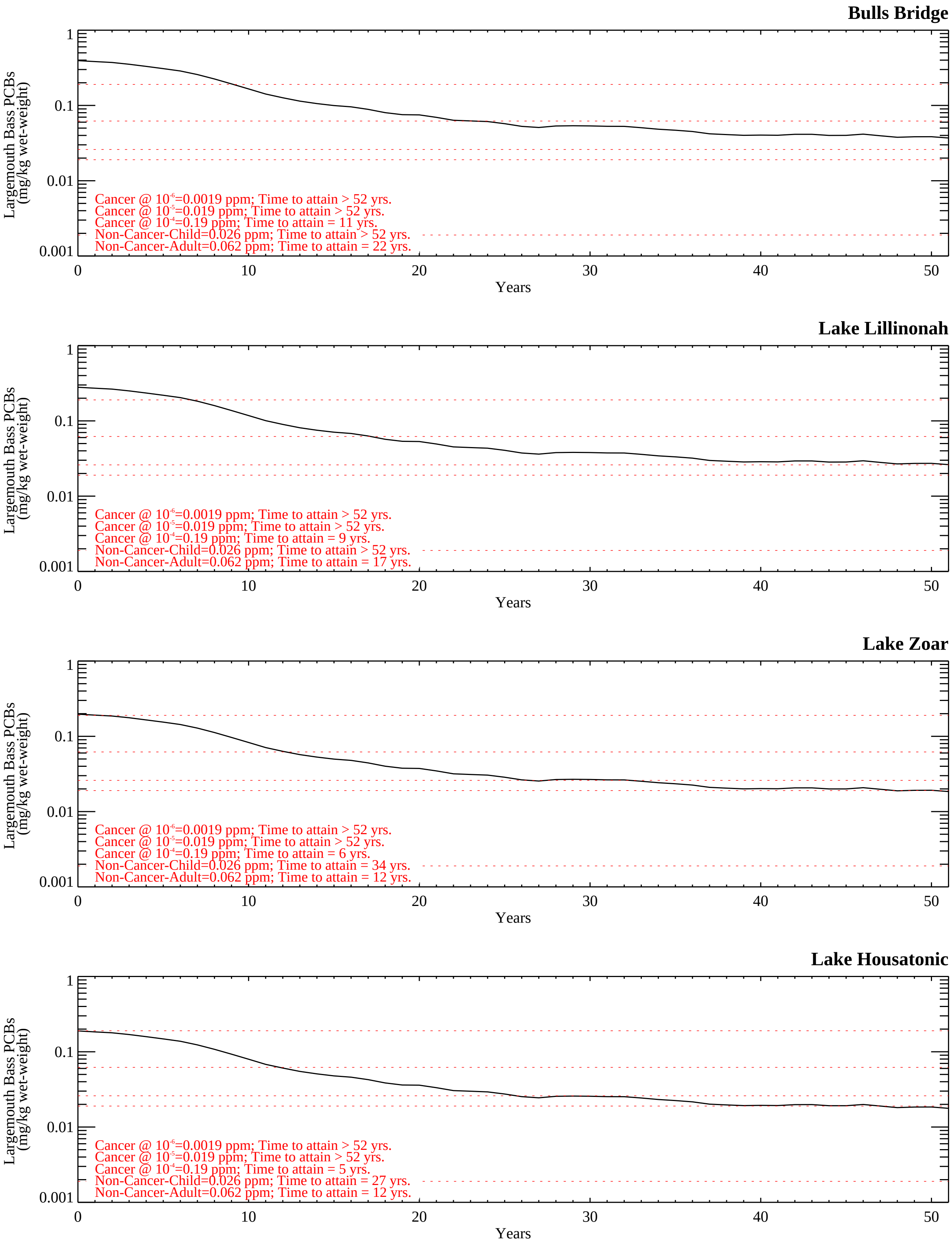

Figure G-8.3-2i. Temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D Analysis compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 3; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic CTE)
(SED 3; Lower Bound)

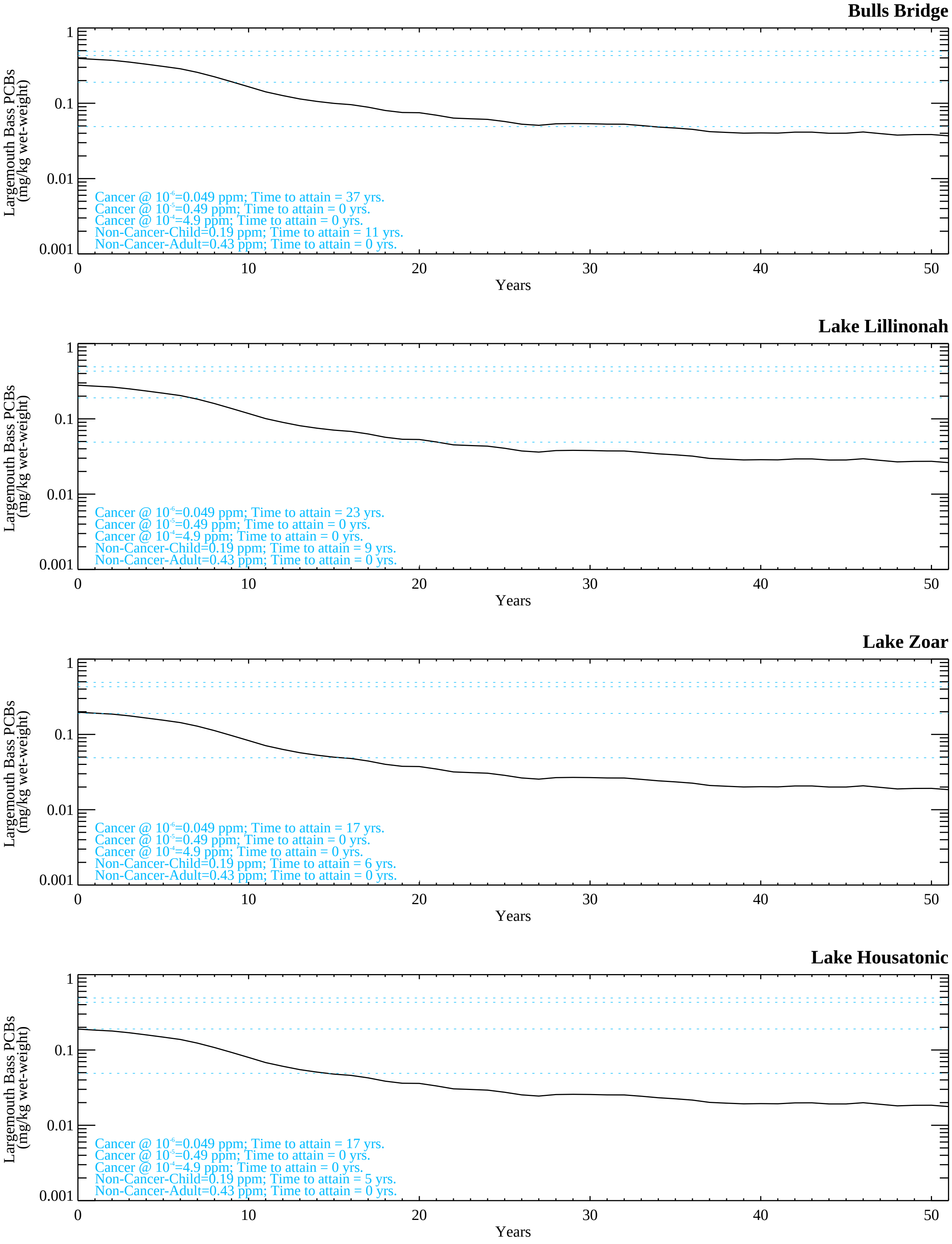

Figure G-8.3-2j. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 3; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 3; Lower Bound)

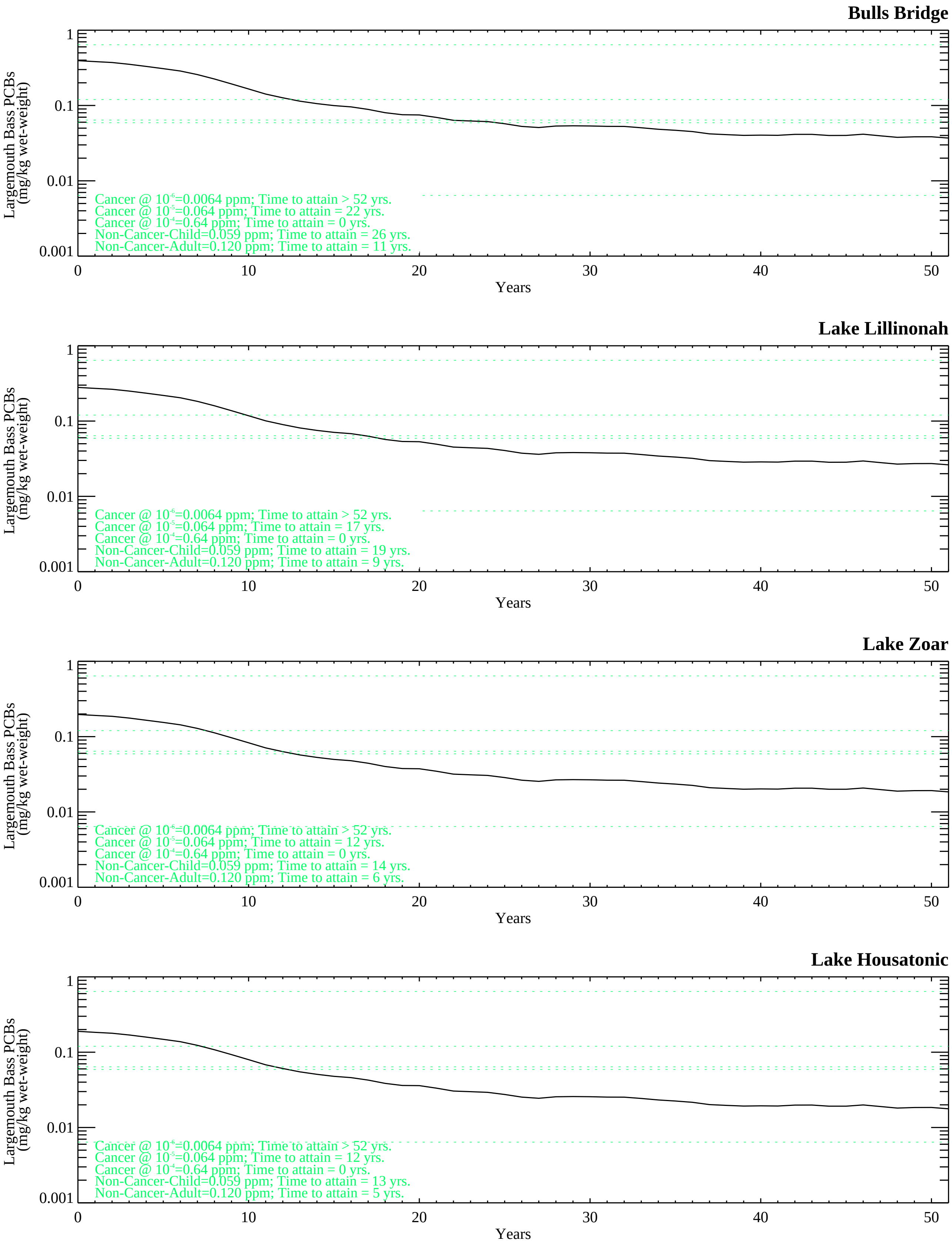

Figure G-8.3-2k. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 3; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 3; Lower Bound)

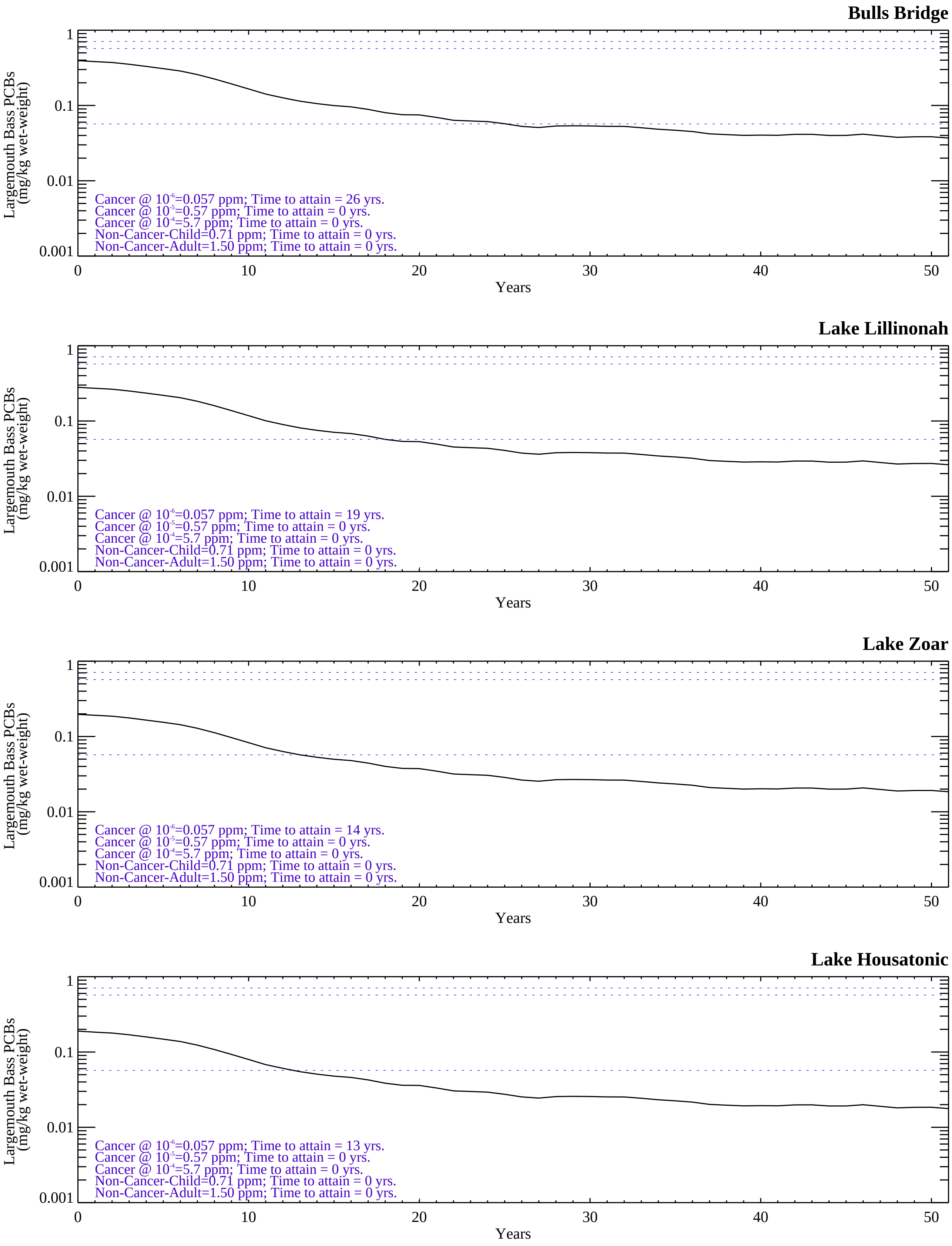

Figure G-8.3-2l. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 3; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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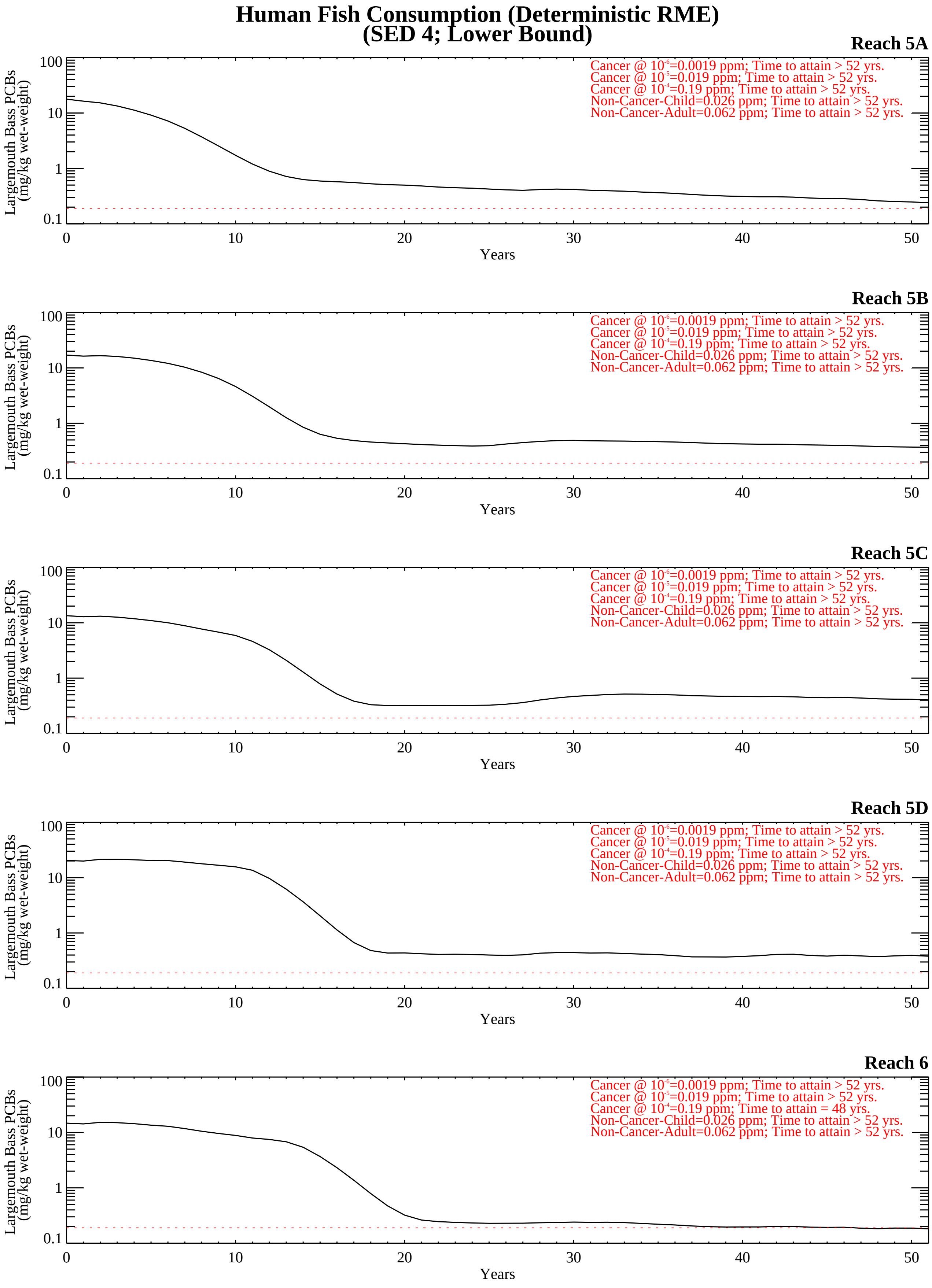


Figure G-8.3-3a. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

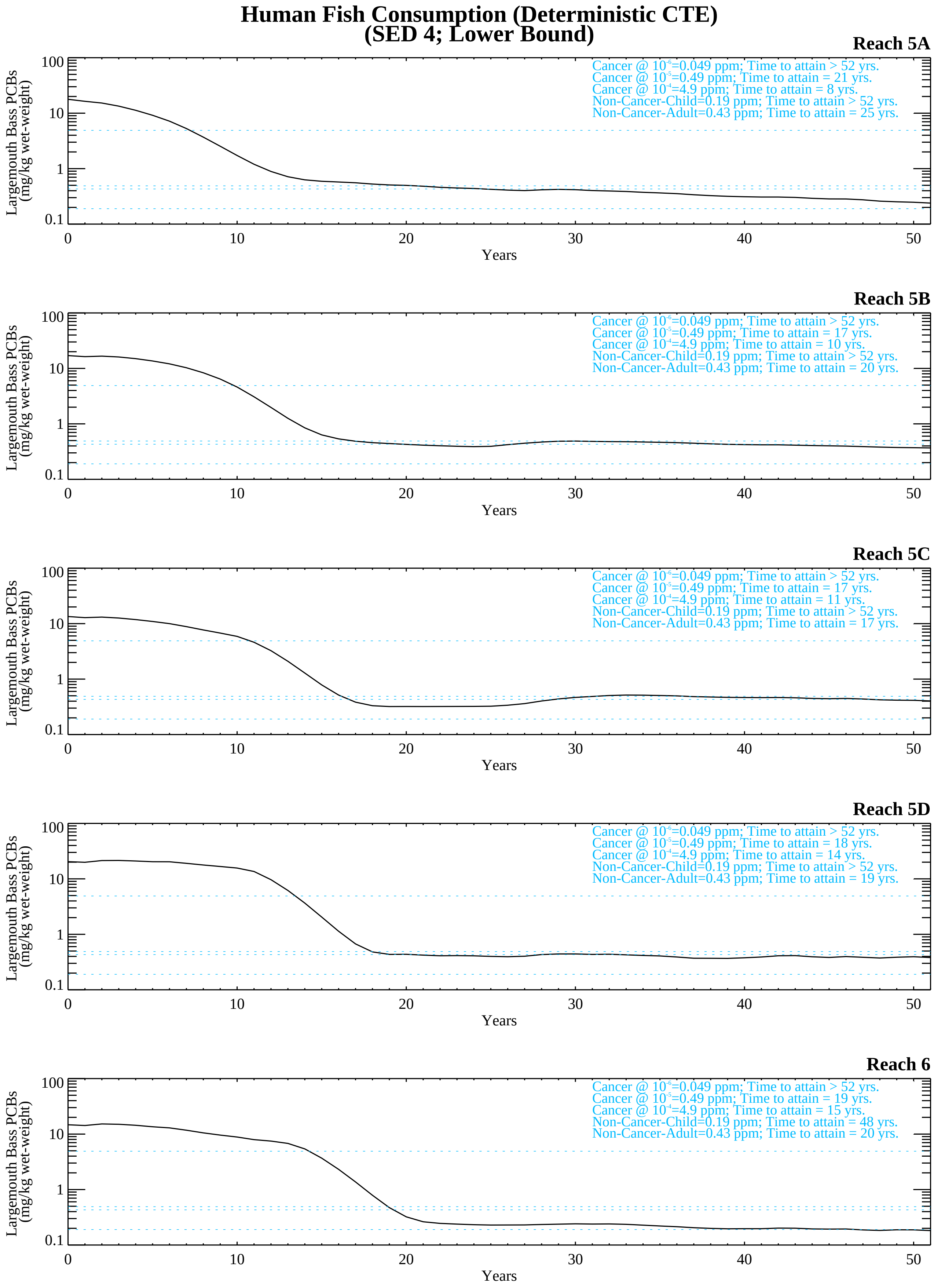


Figure G-8.3-3b. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

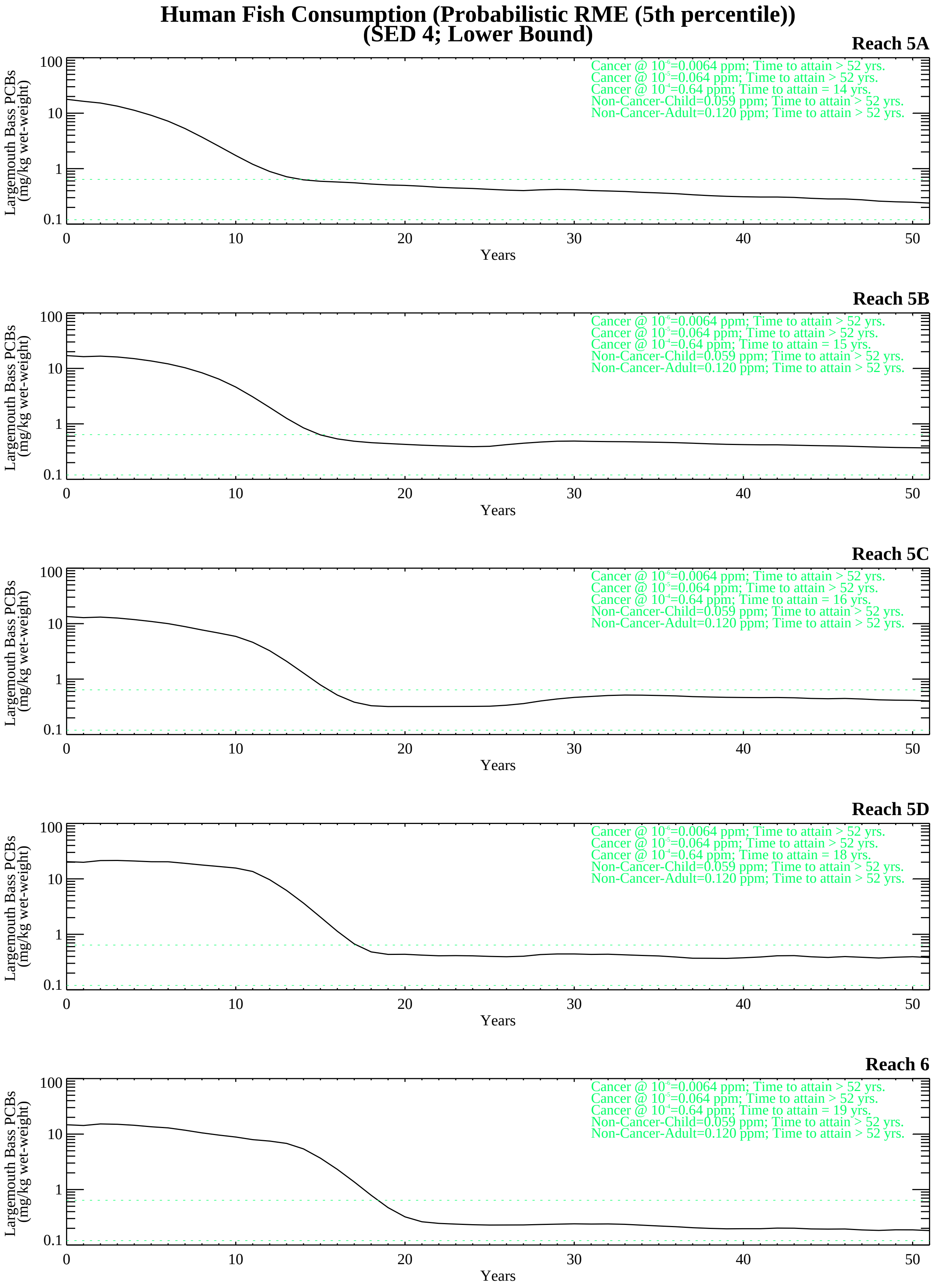


Figure G-8.3-3c. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

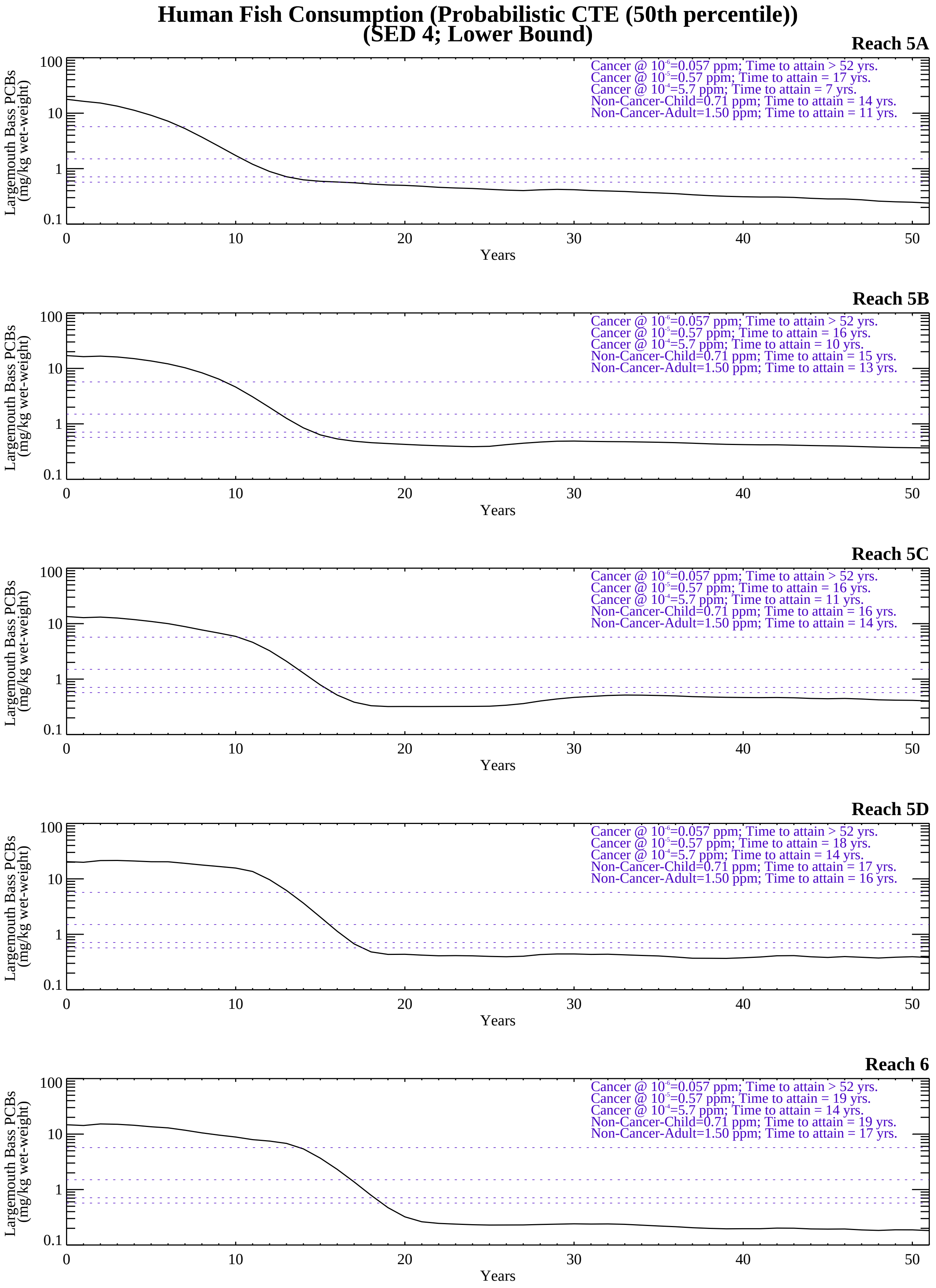


Figure G-8.3-3d. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

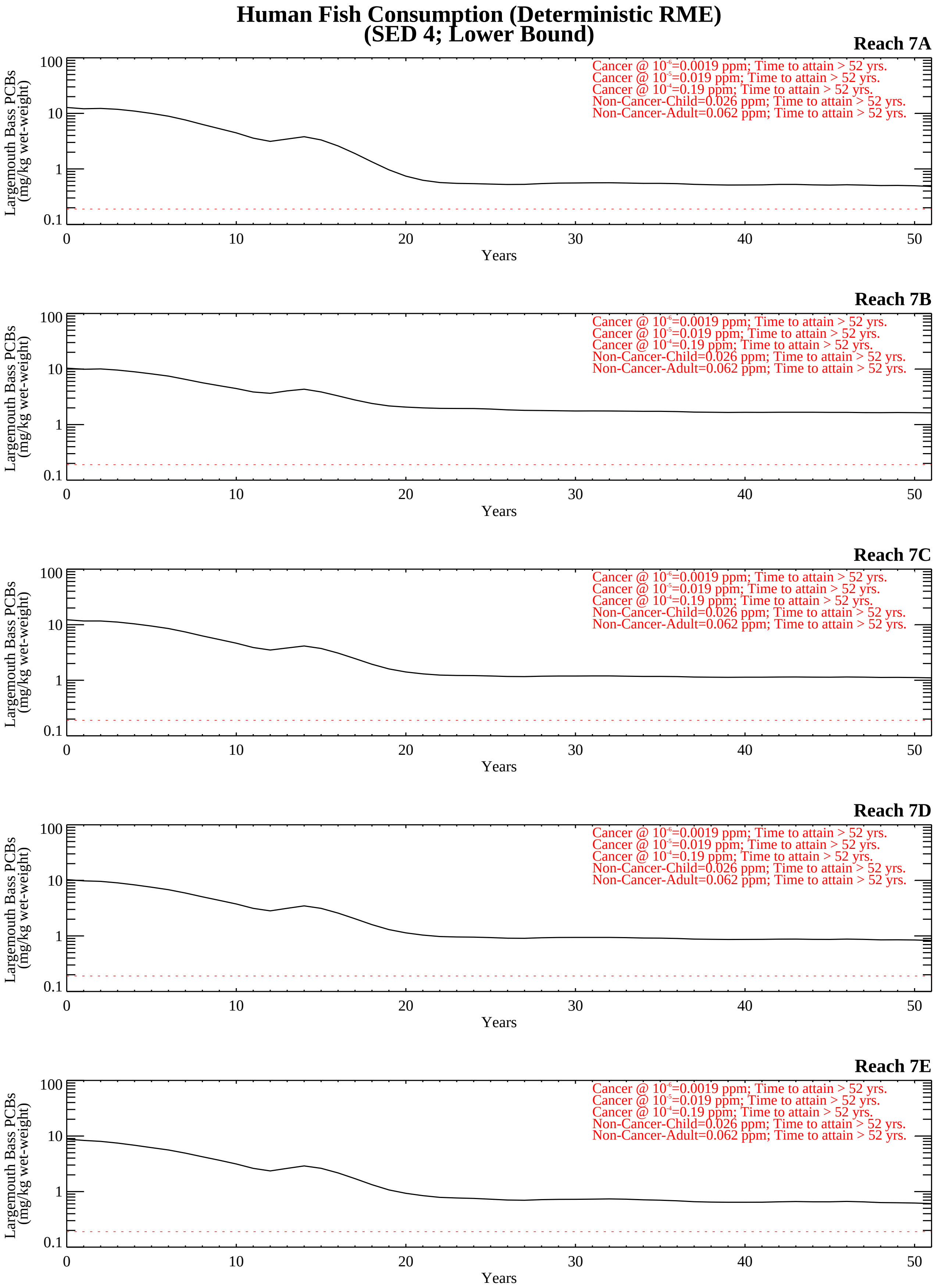
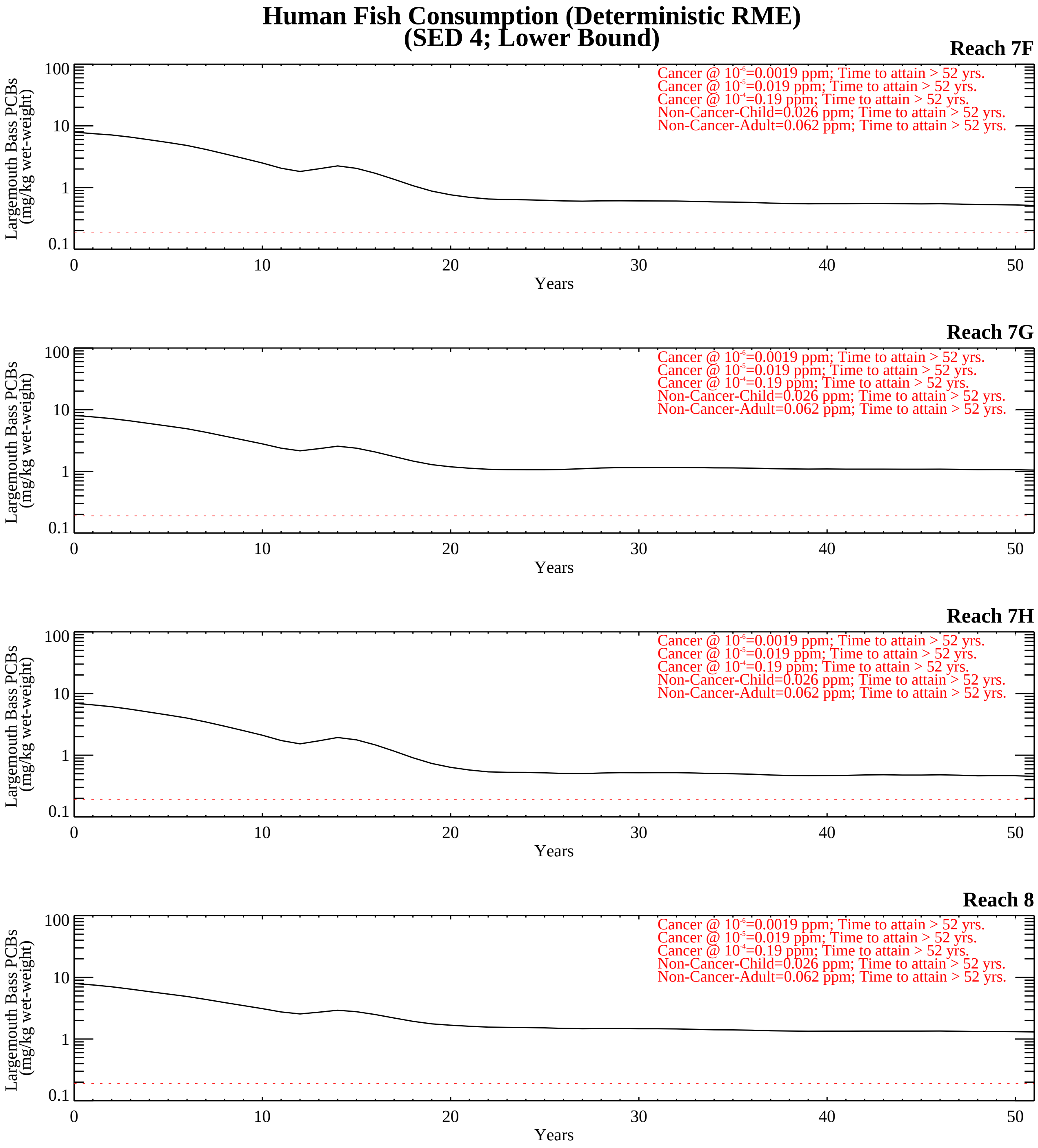


Figure G-8.3-3e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.



Human Fish Consumption (Deterministic RME)
(SED 4; Lower Bound)

Reach 7F

Reach 7G

Reach 7H

Reach 8

Figure G-8.3-3e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Deterministic CTE)
(SED 4; Lower Bound)

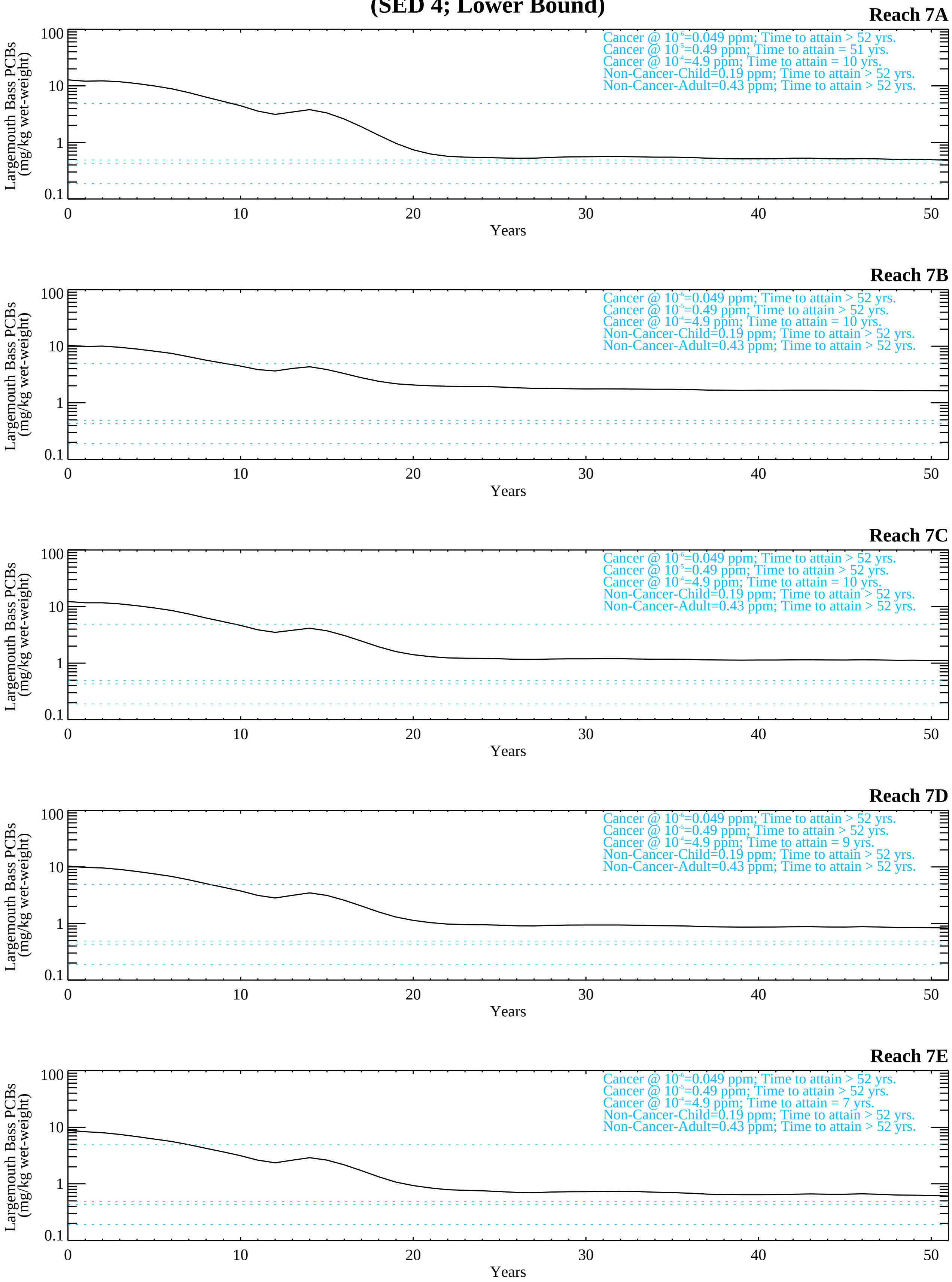

Figure G-8.3-3f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

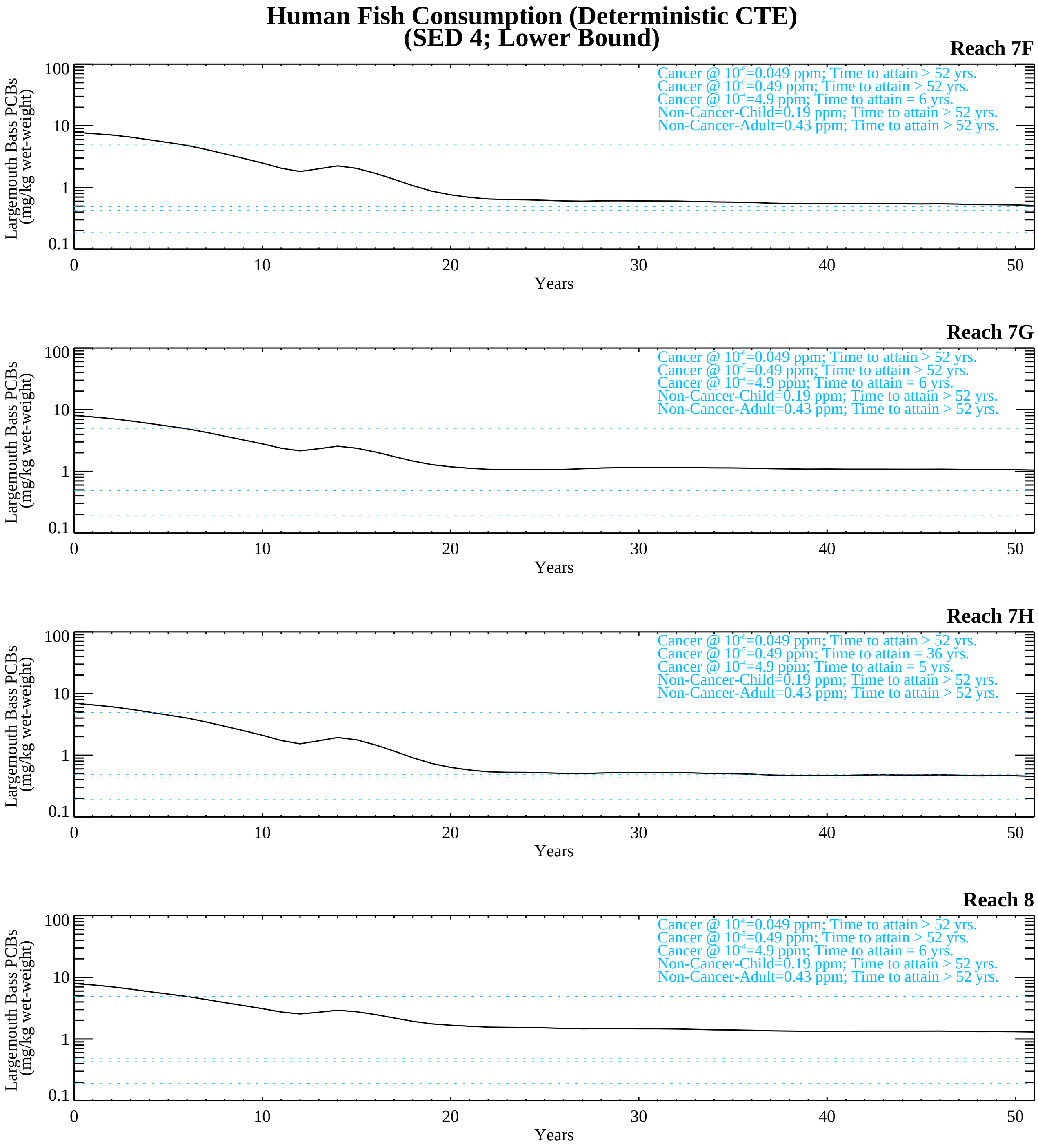

Figure G-8.3-3f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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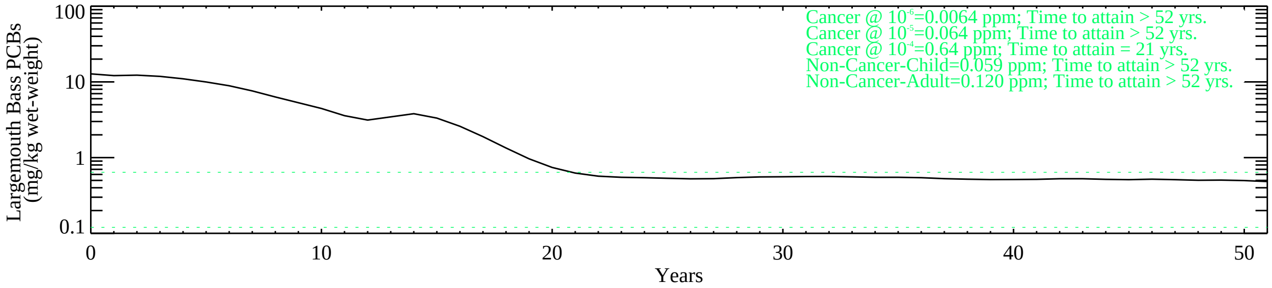
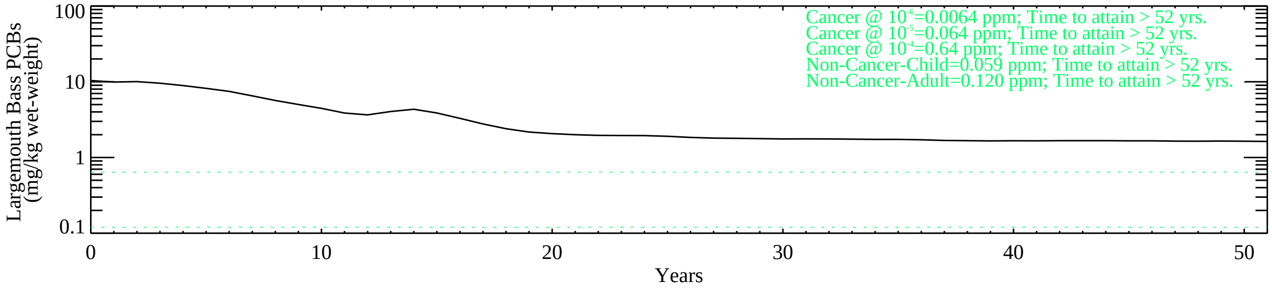
Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 4; Lower Bound)

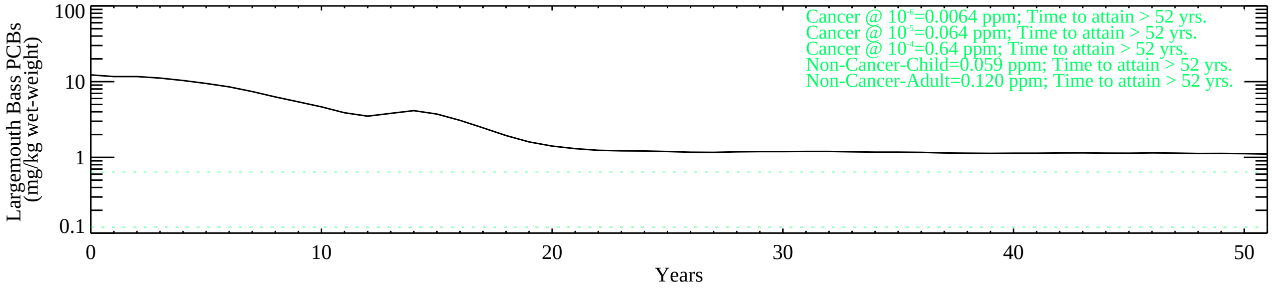
Reach 7A



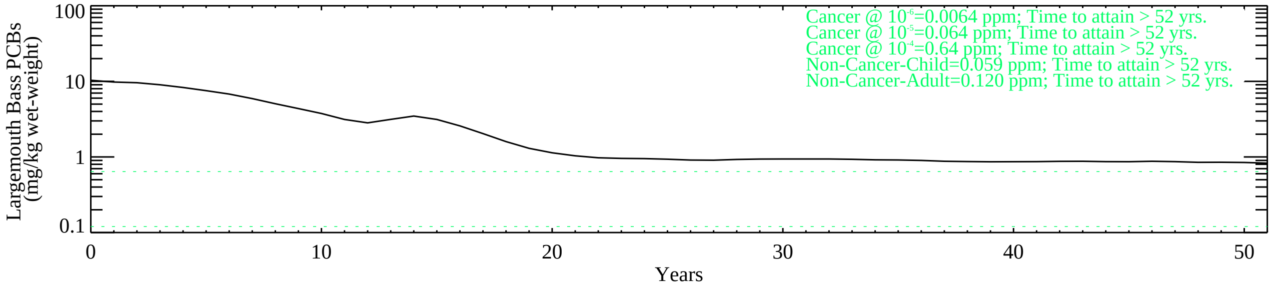
Reach 7B



Reach 7C



Reach 7D



Reach 7E

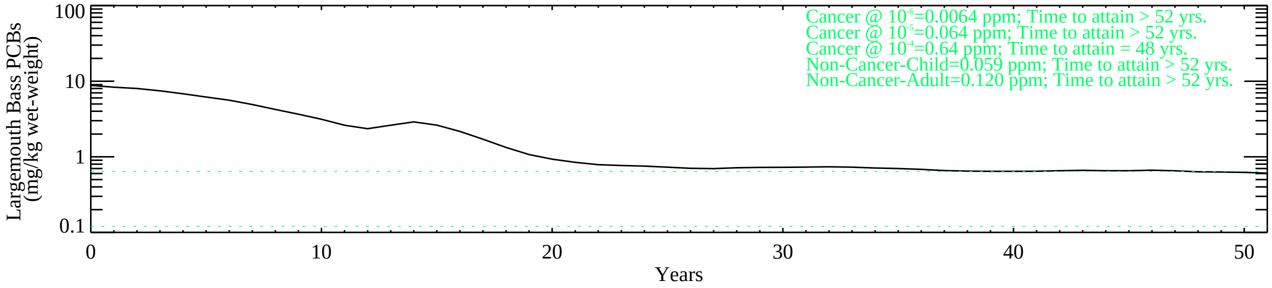


Figure G-8.3-3g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

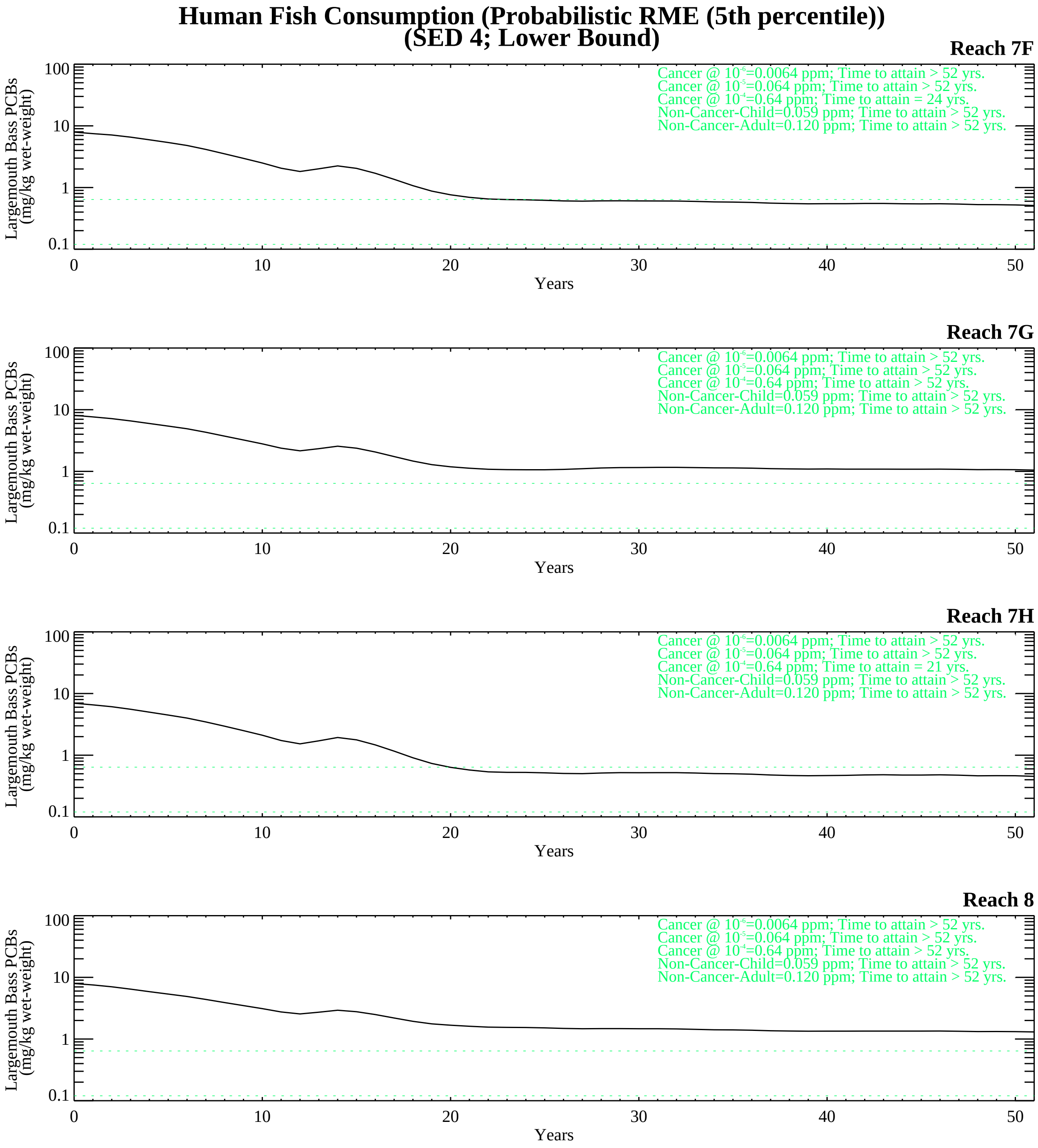


Figure G-8.3-3g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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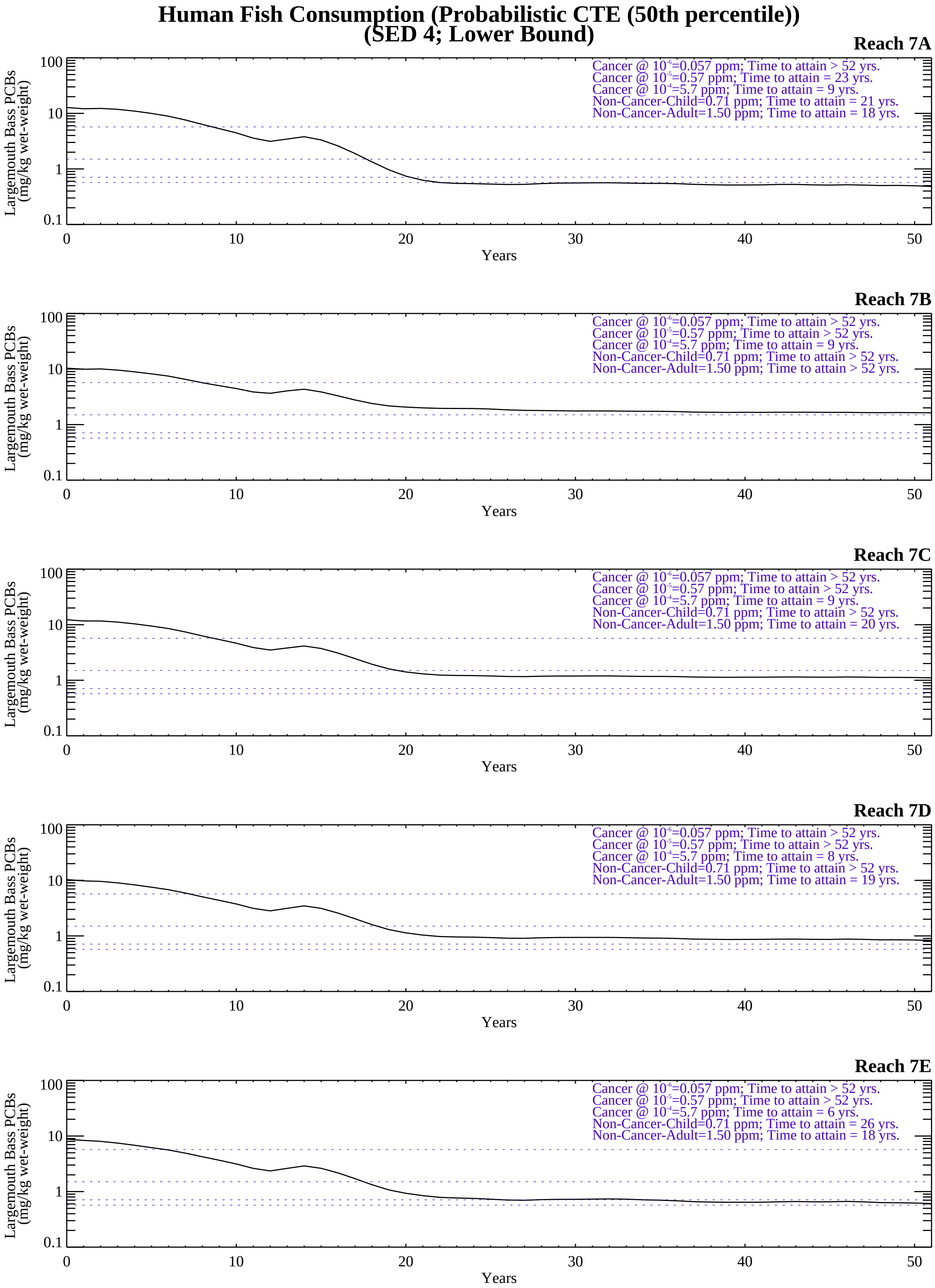

Figure G-8.3-3h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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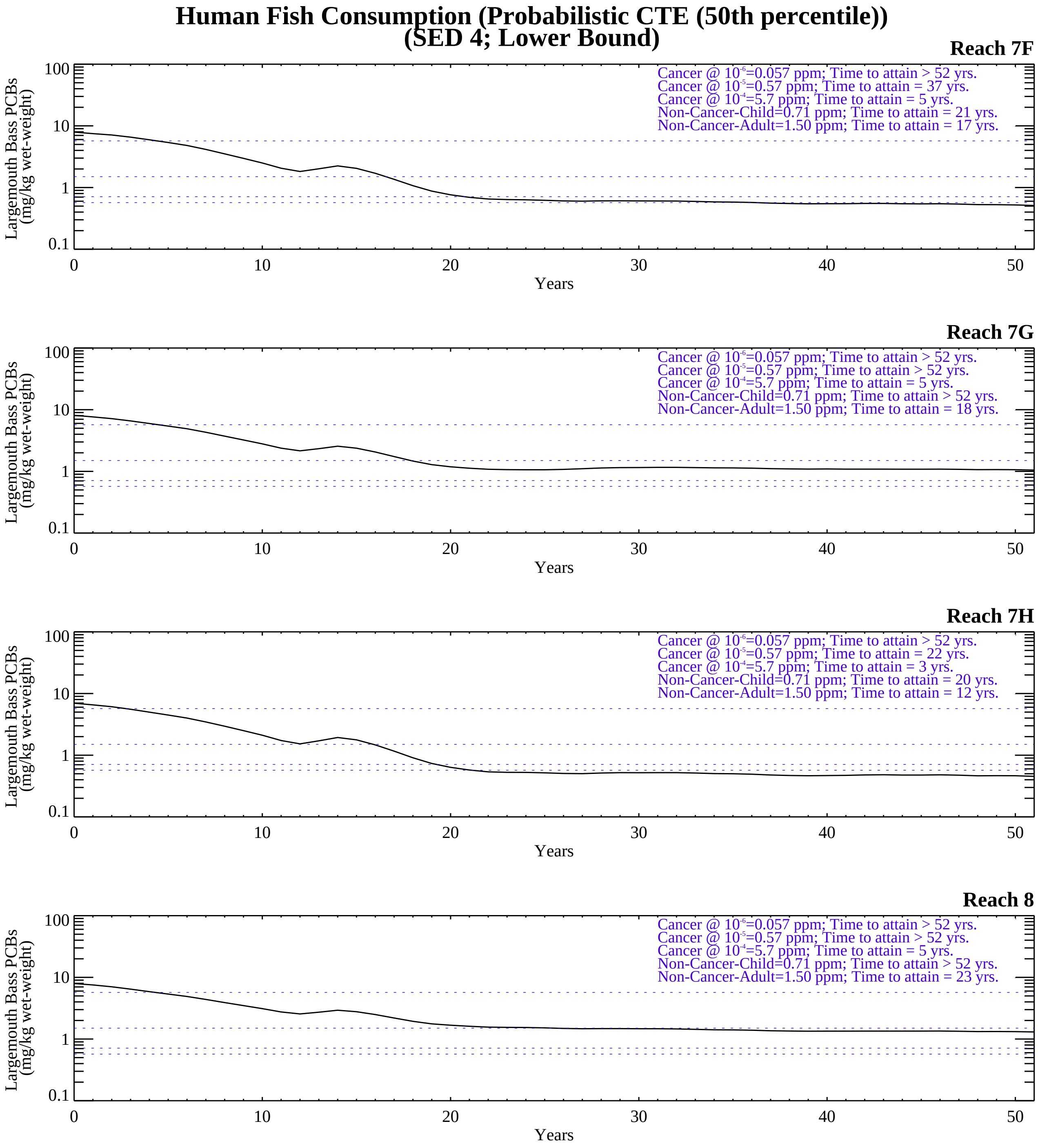

Figure G-8.3-3h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 4; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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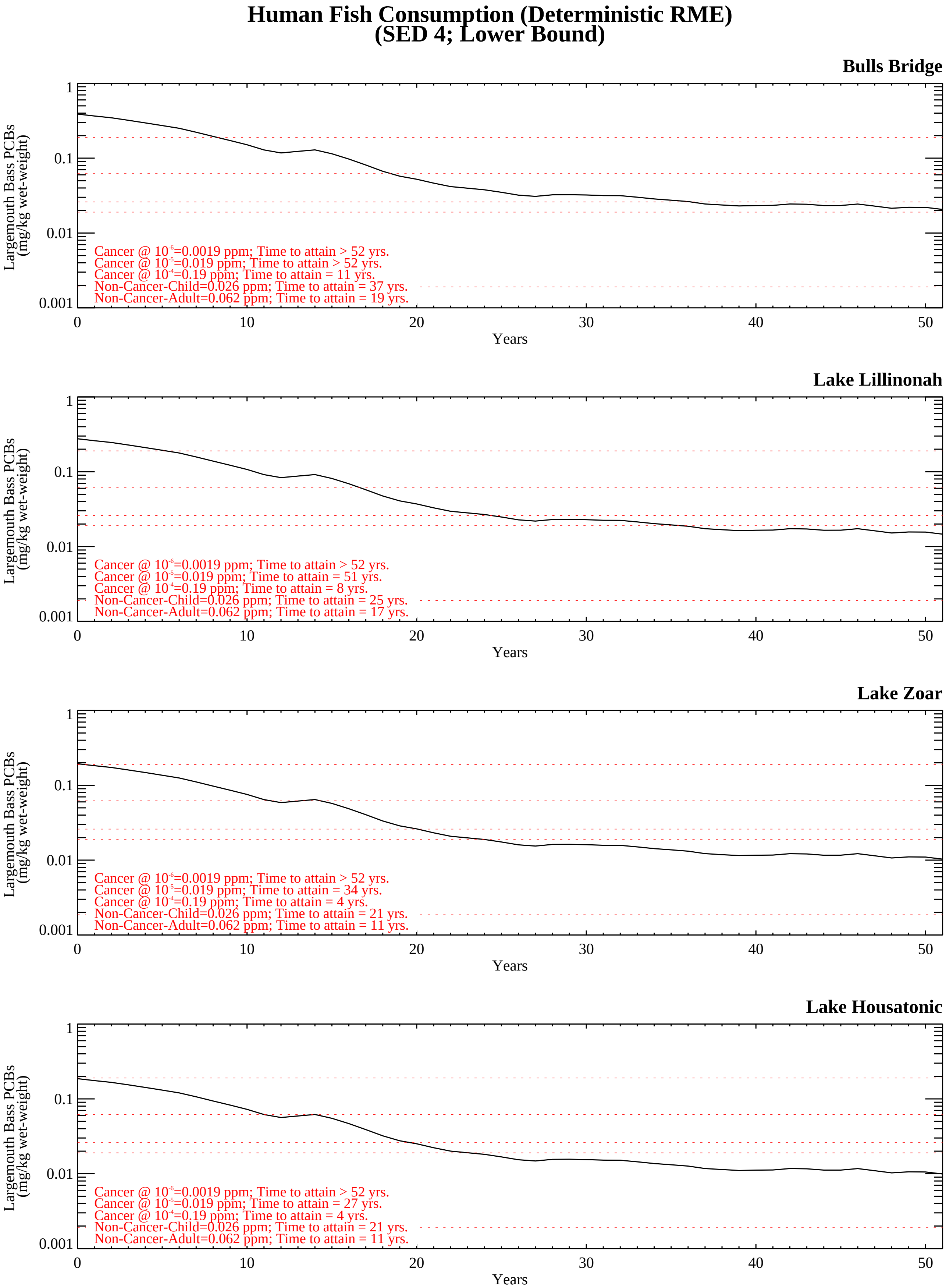


Figure G-8.3-3i. Temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D Analysis compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 4; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

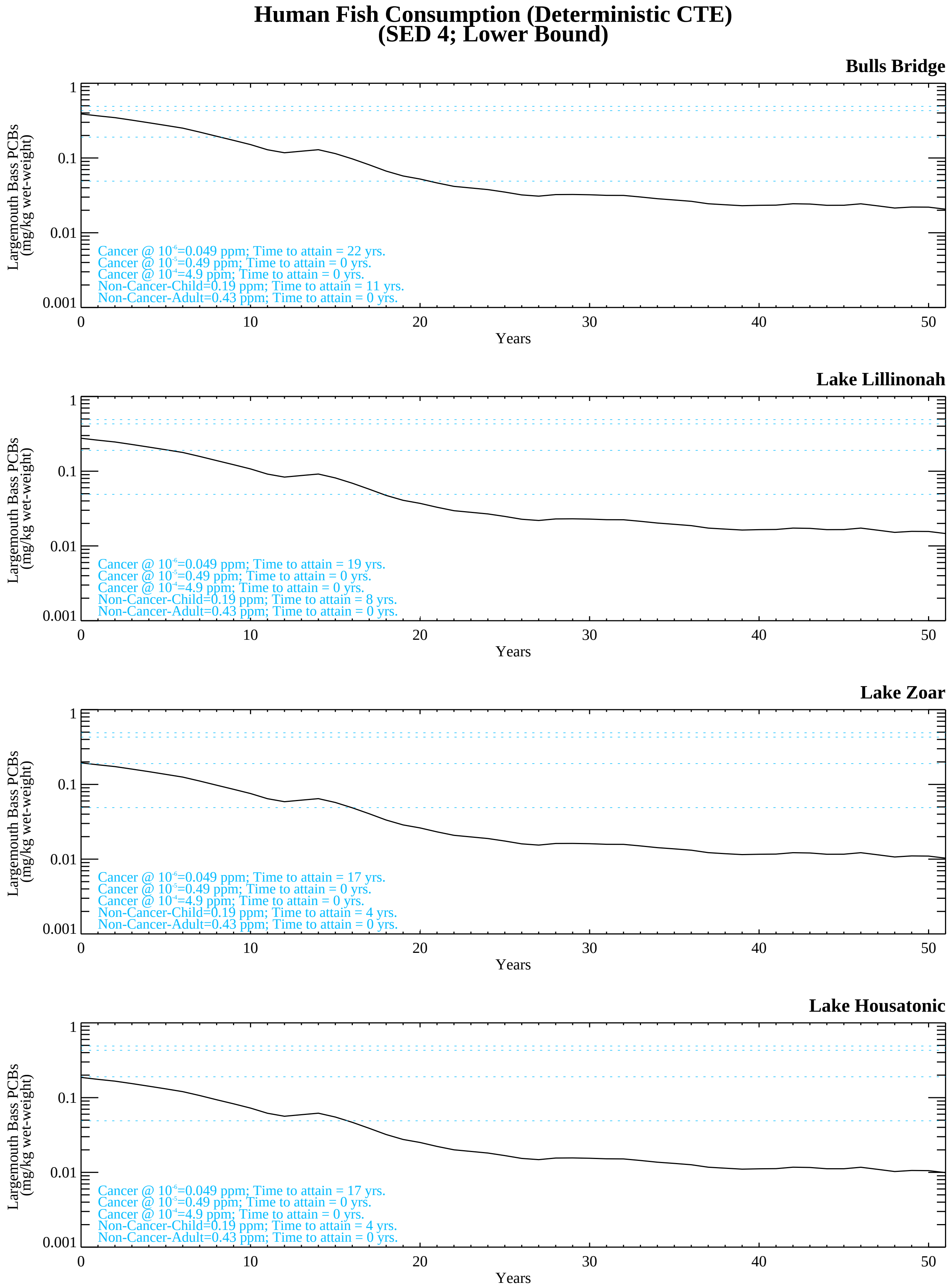
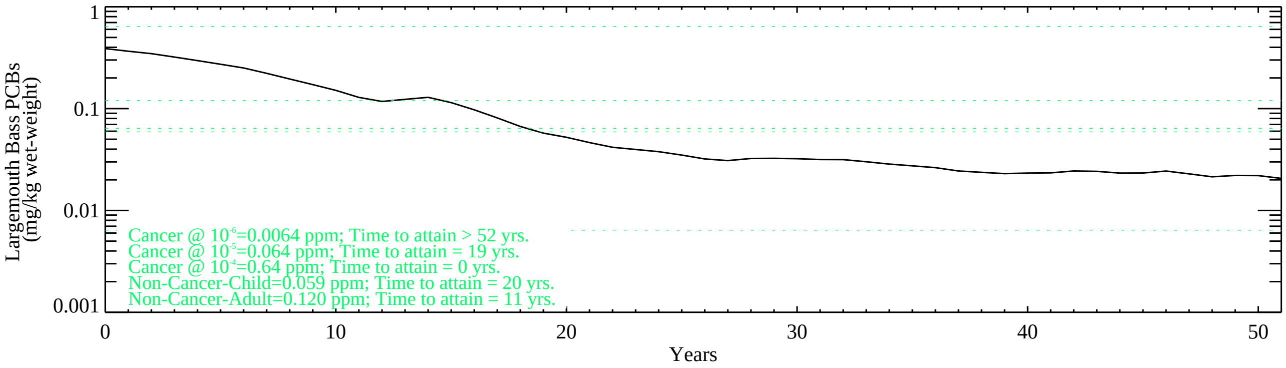


Figure G-8.3-3j. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 4; CT; Lower Bound).

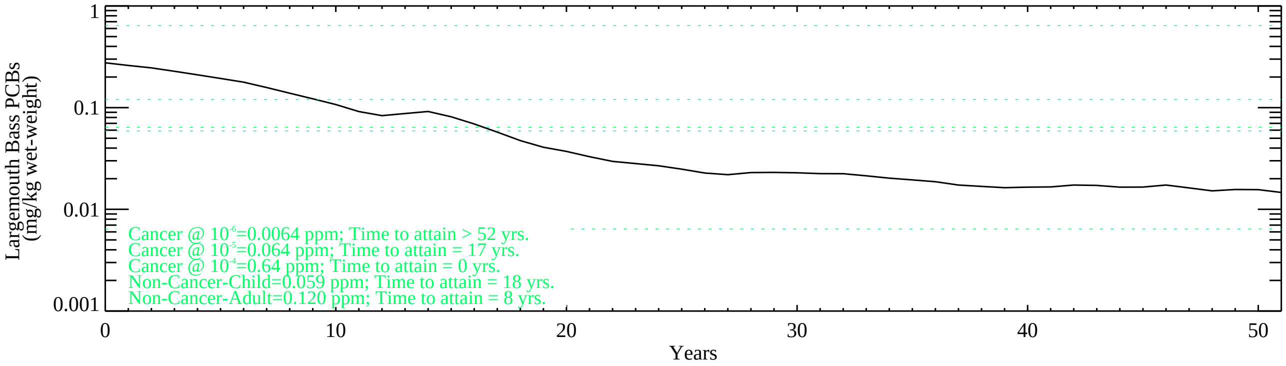
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 4; Lower Bound)

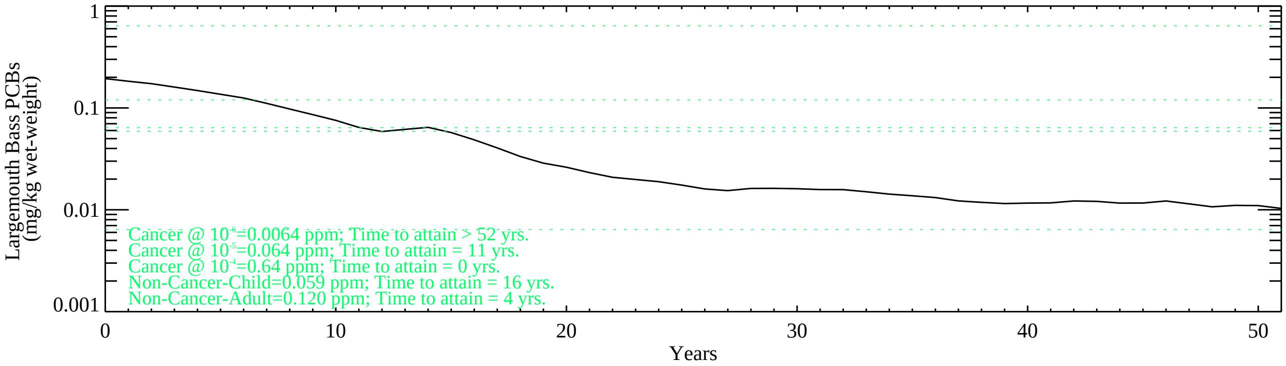
Bulls Bridge



Lake Lillinonah



Lake Zoar



Lake Housatonic

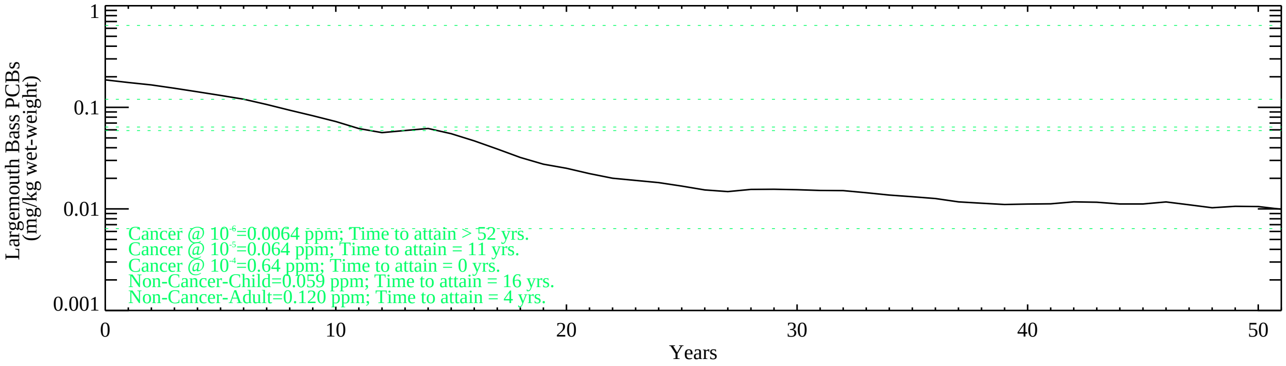


Figure G-8.3-3k. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 4; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 4; Lower Bound)

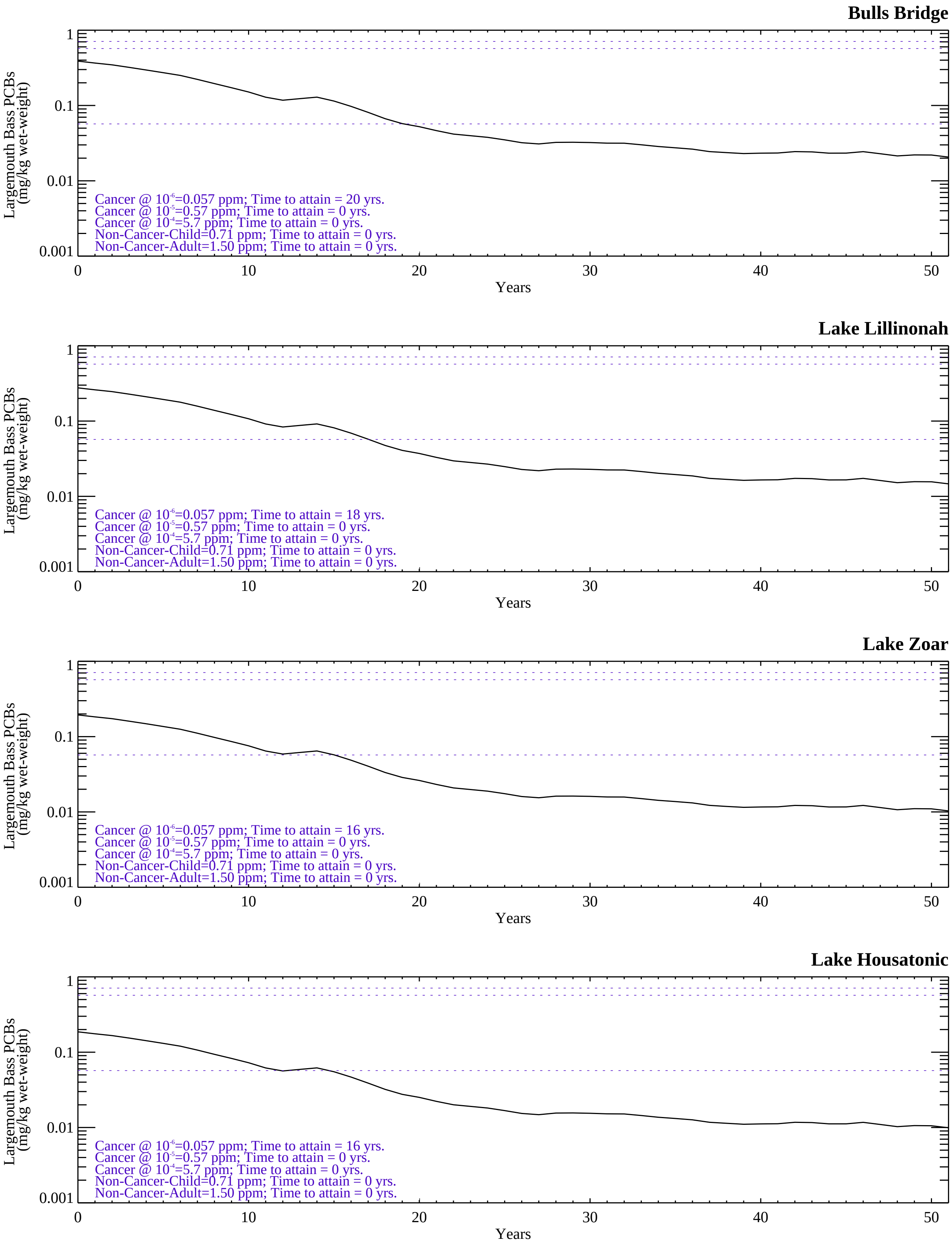

Figure G-8.3-3l. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 4; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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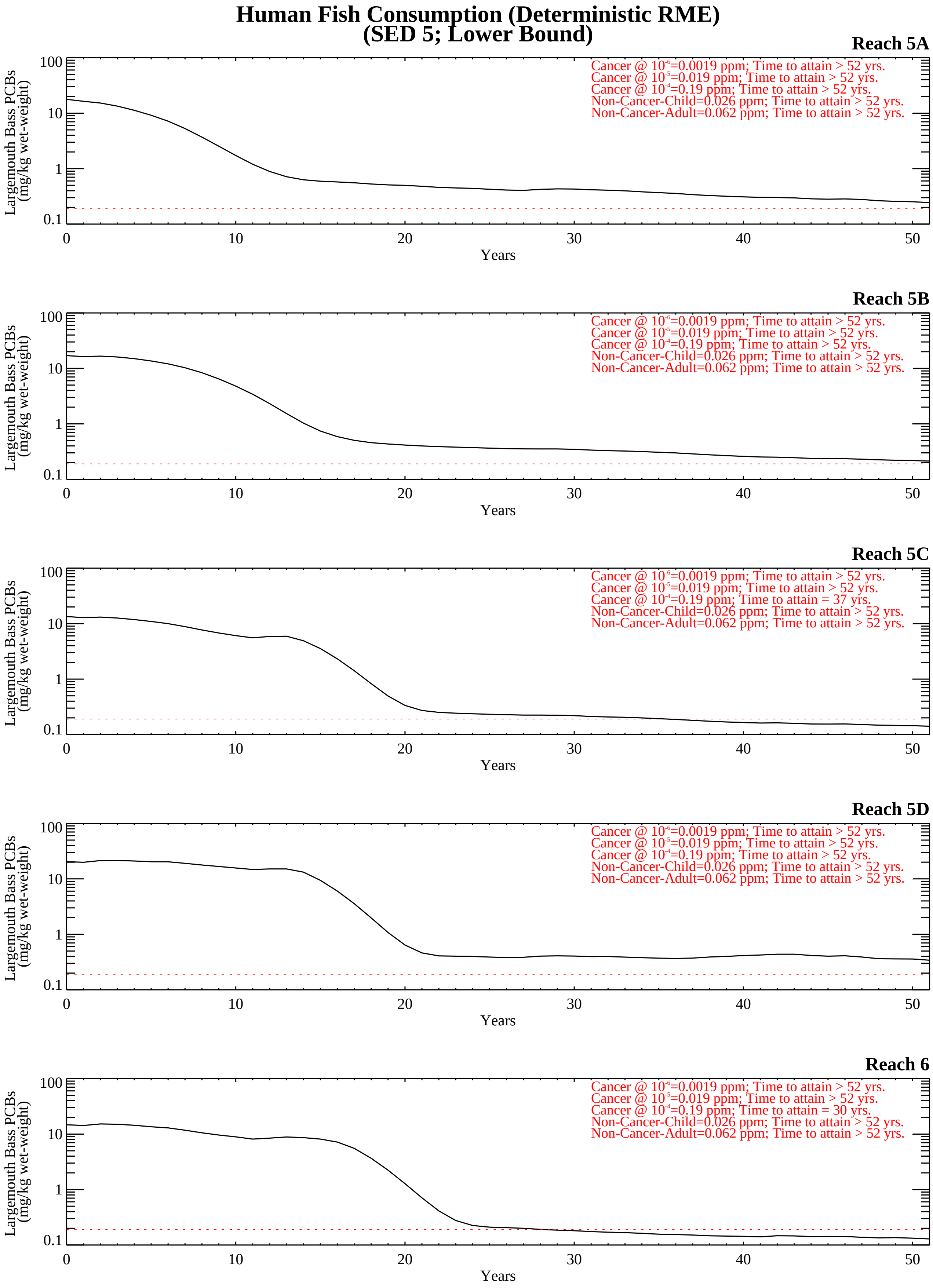

Figure G-8.3-4a. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

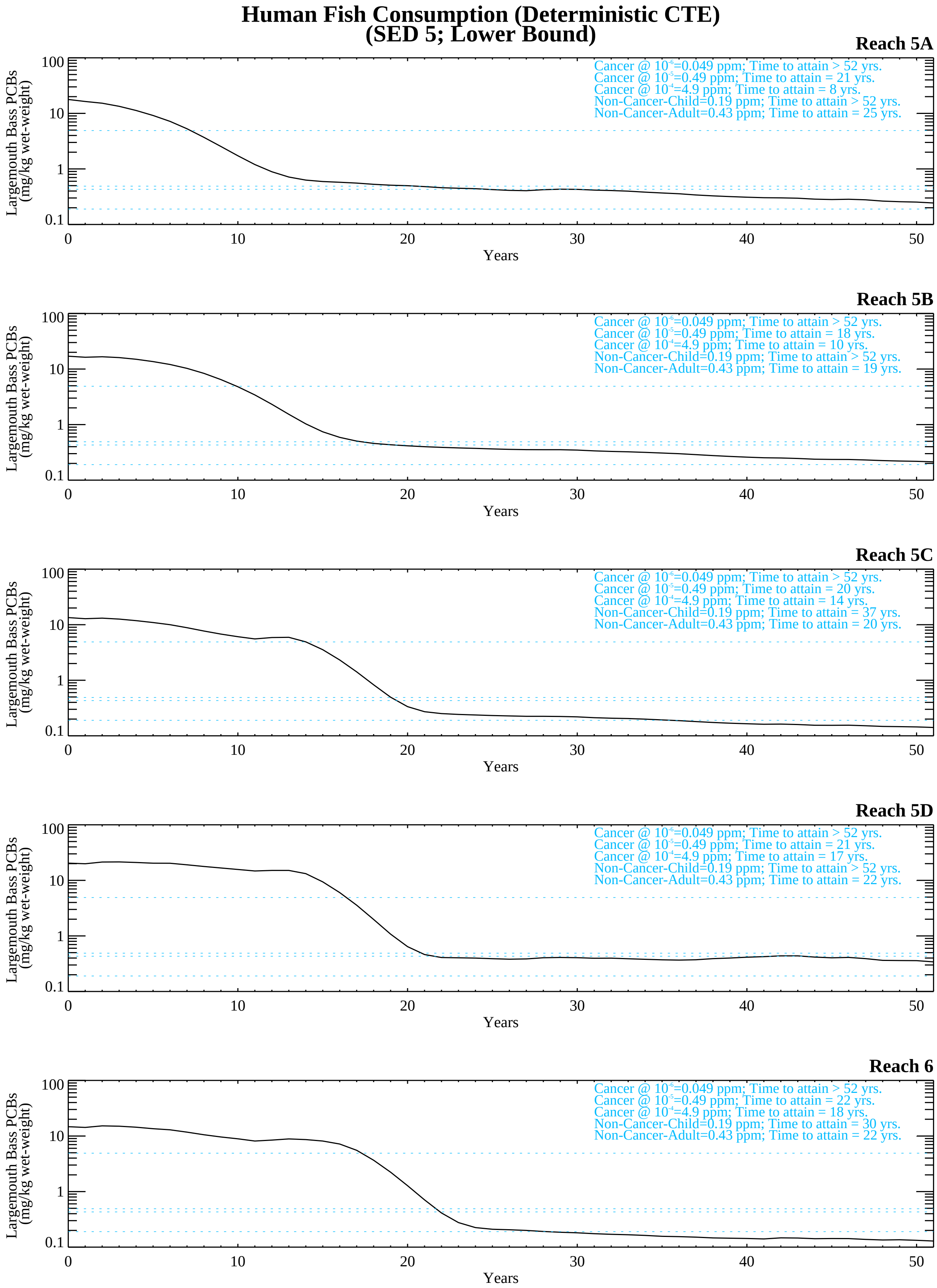

Figure G-8.3-4b. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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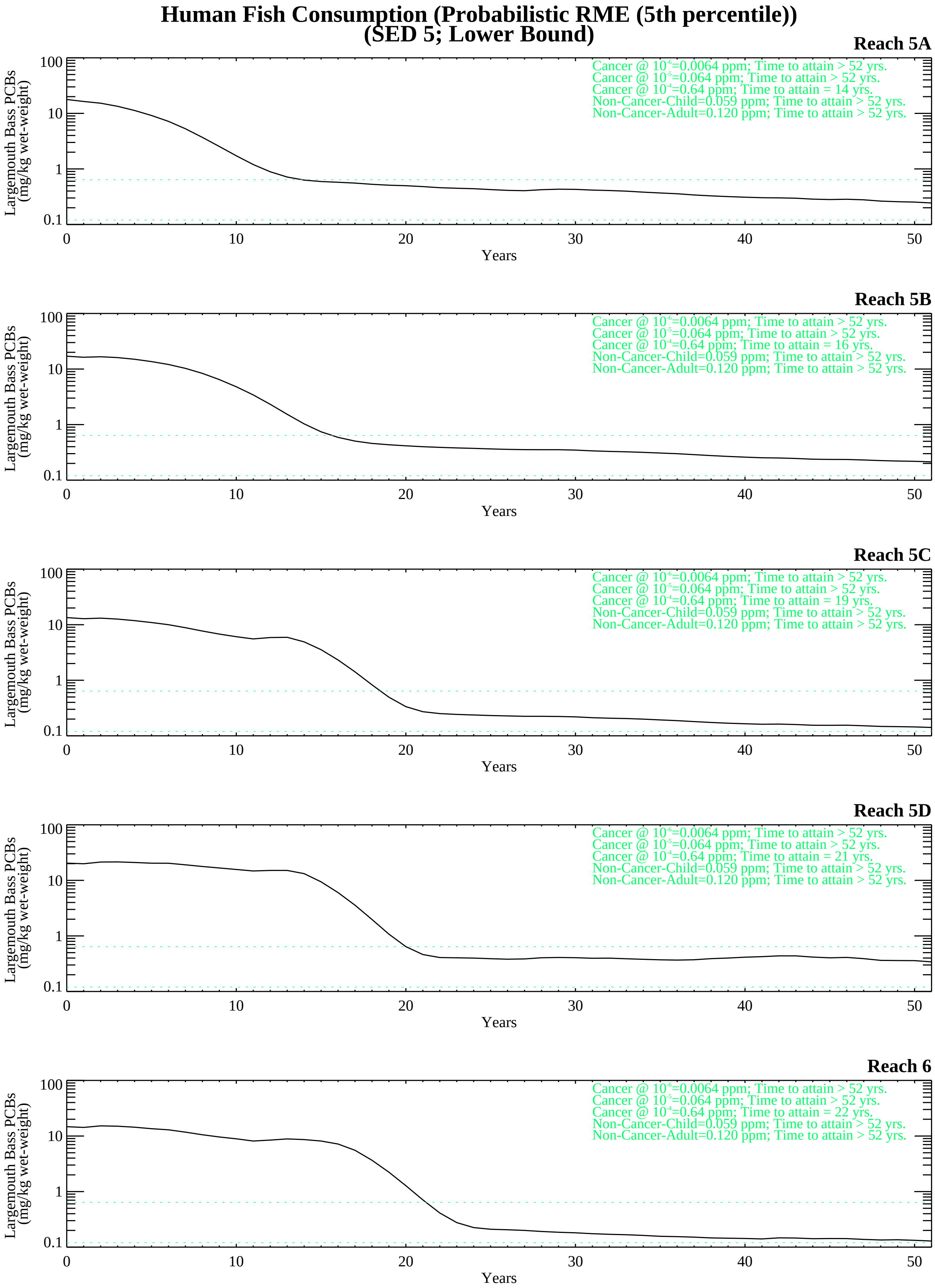

Figure G-8.3-4c. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 5; Lower Bound)

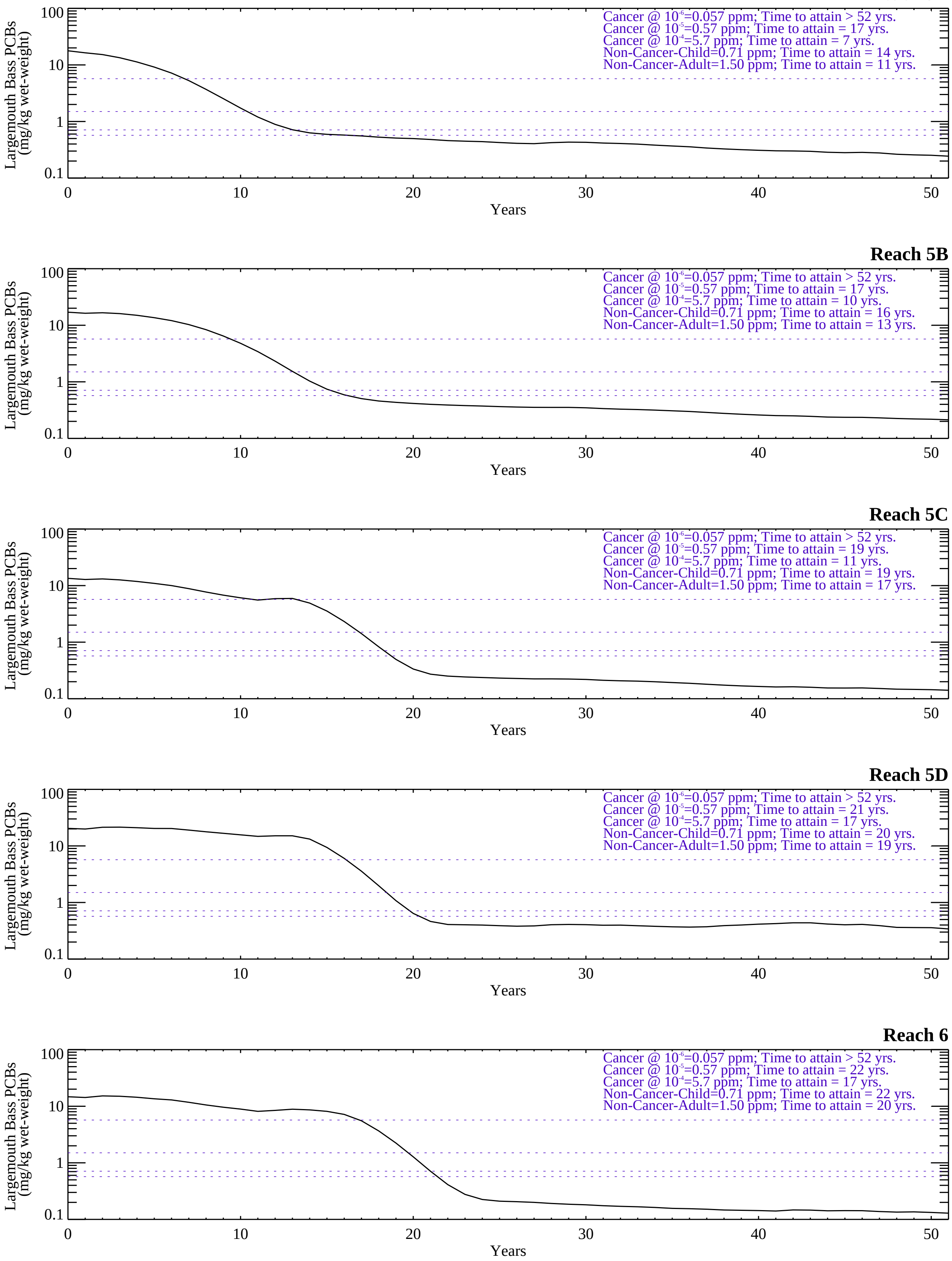

Figure G-8.3-4d. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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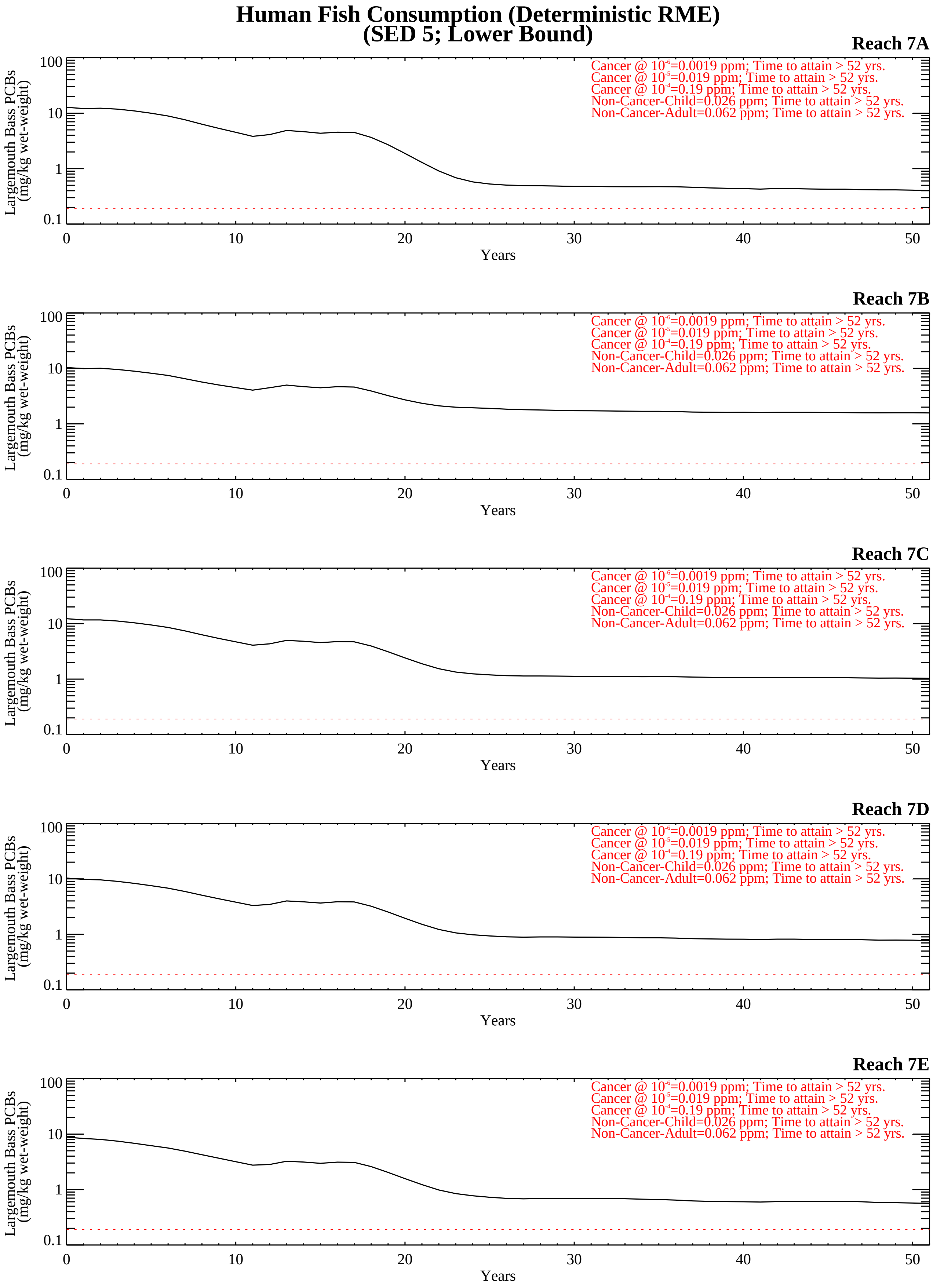

Figure G-8.3-4e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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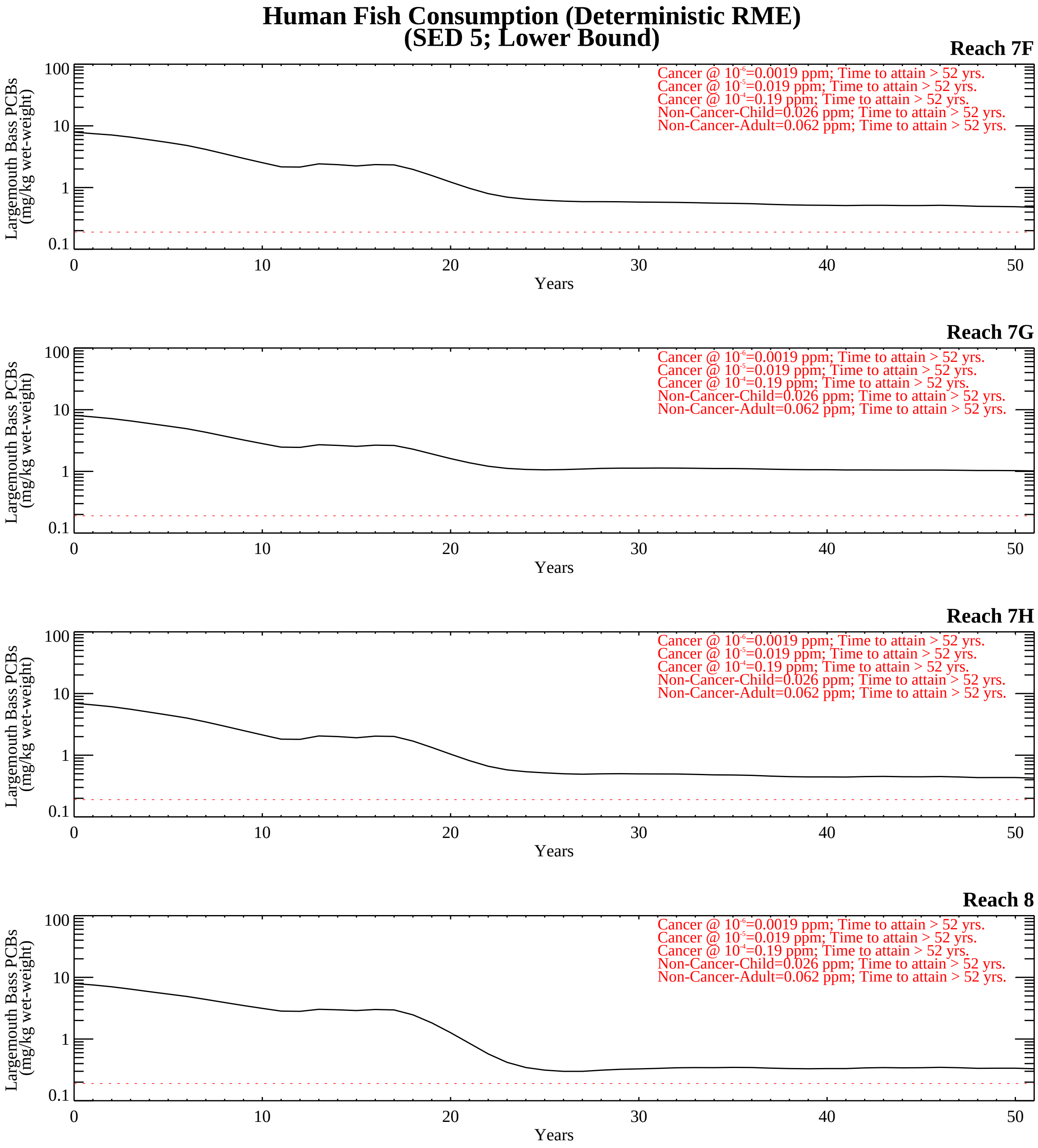

Figure G-8.3-4e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

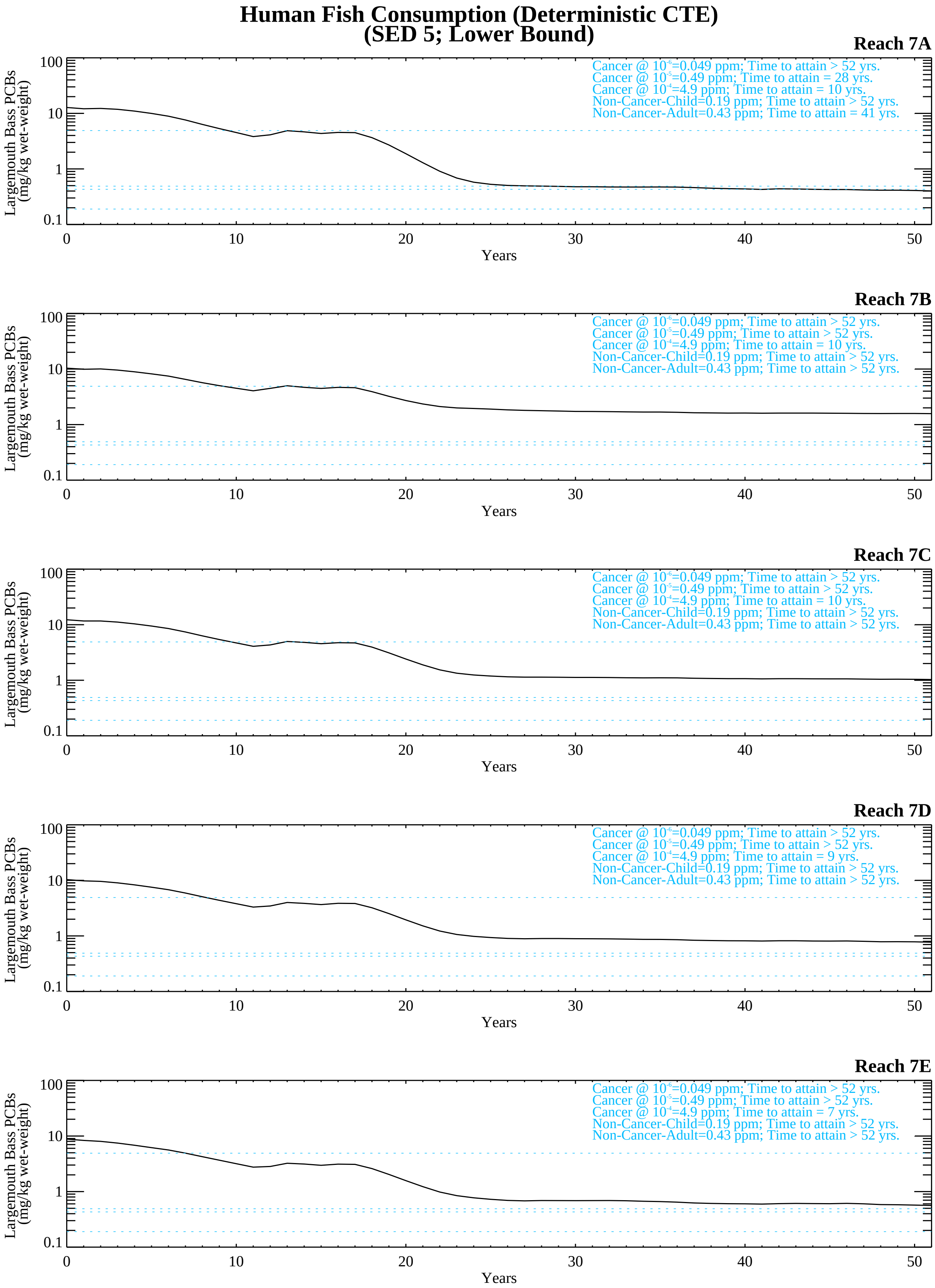

Figure G-8.3-4f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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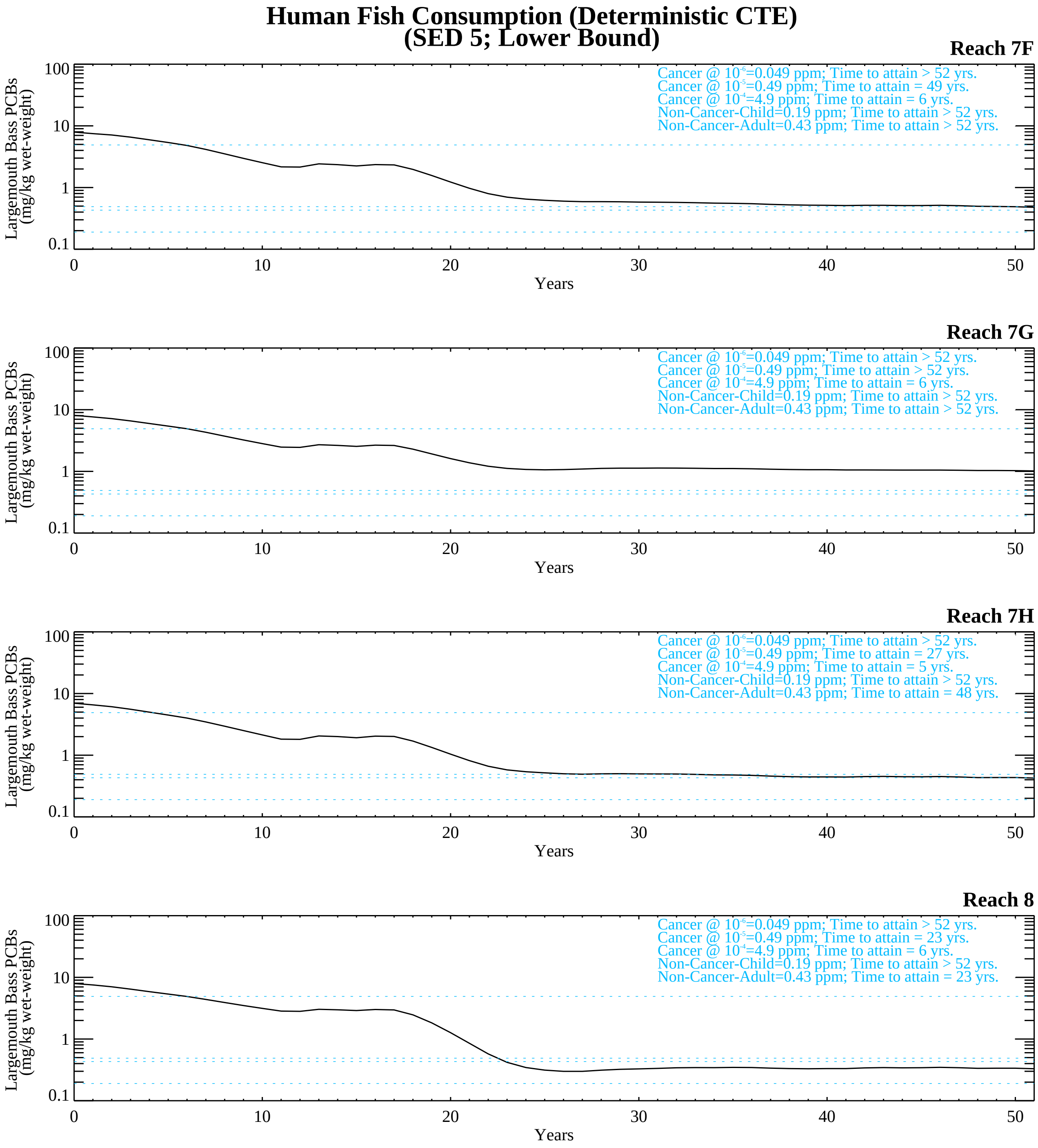

Figure G-8.3-4f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

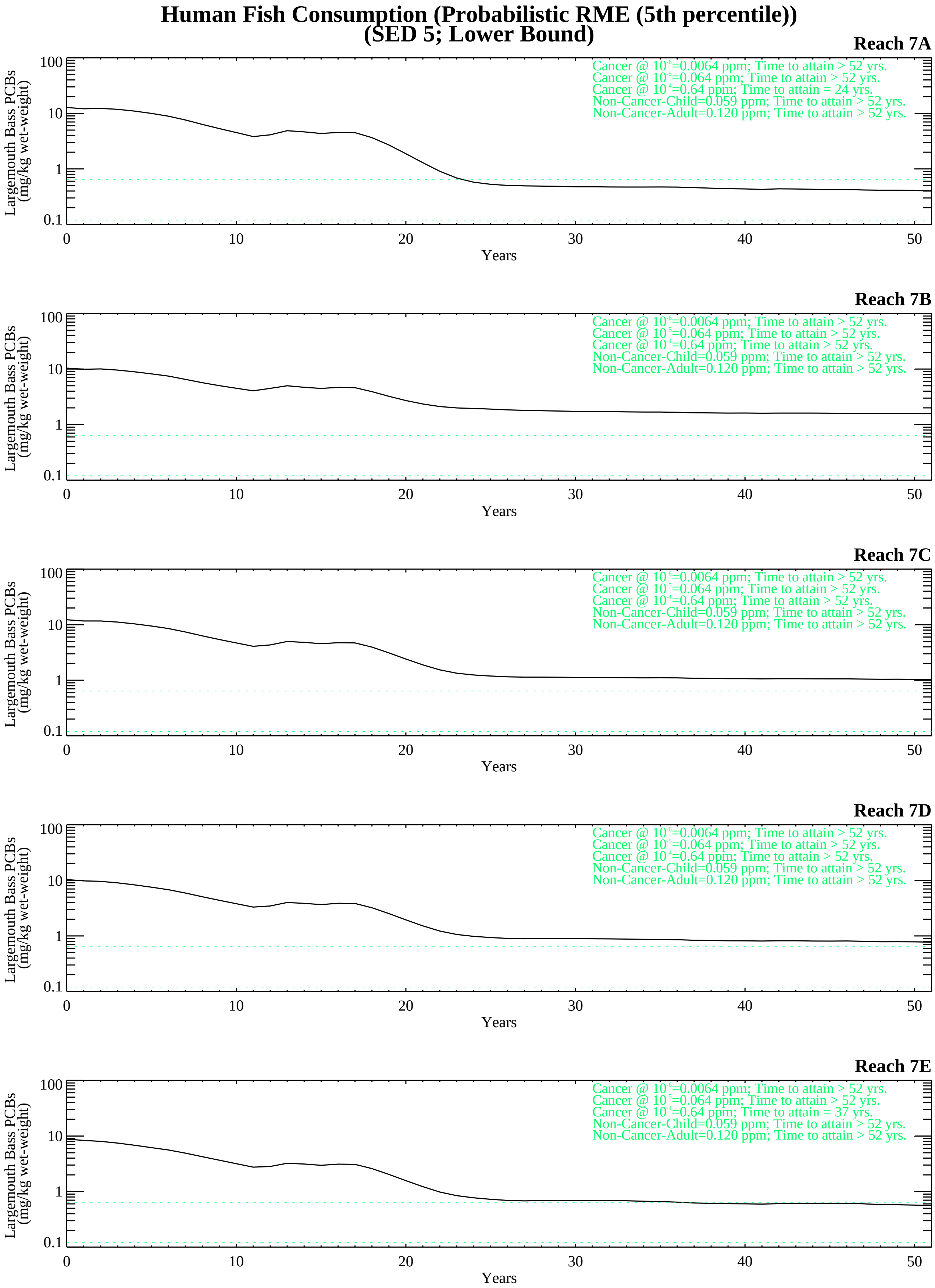

Figure G-8.3-4g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

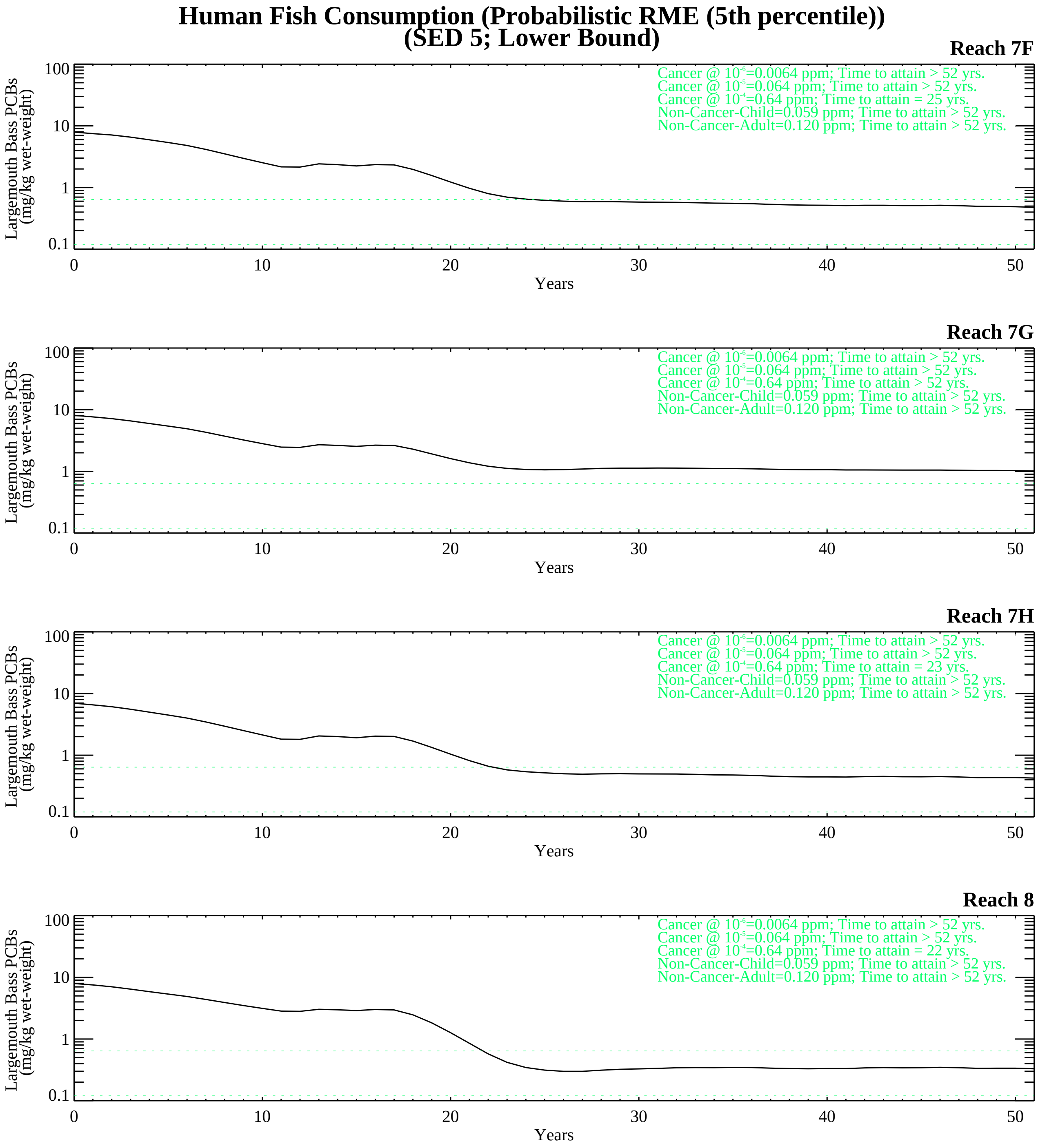

Figure G-8.3-4g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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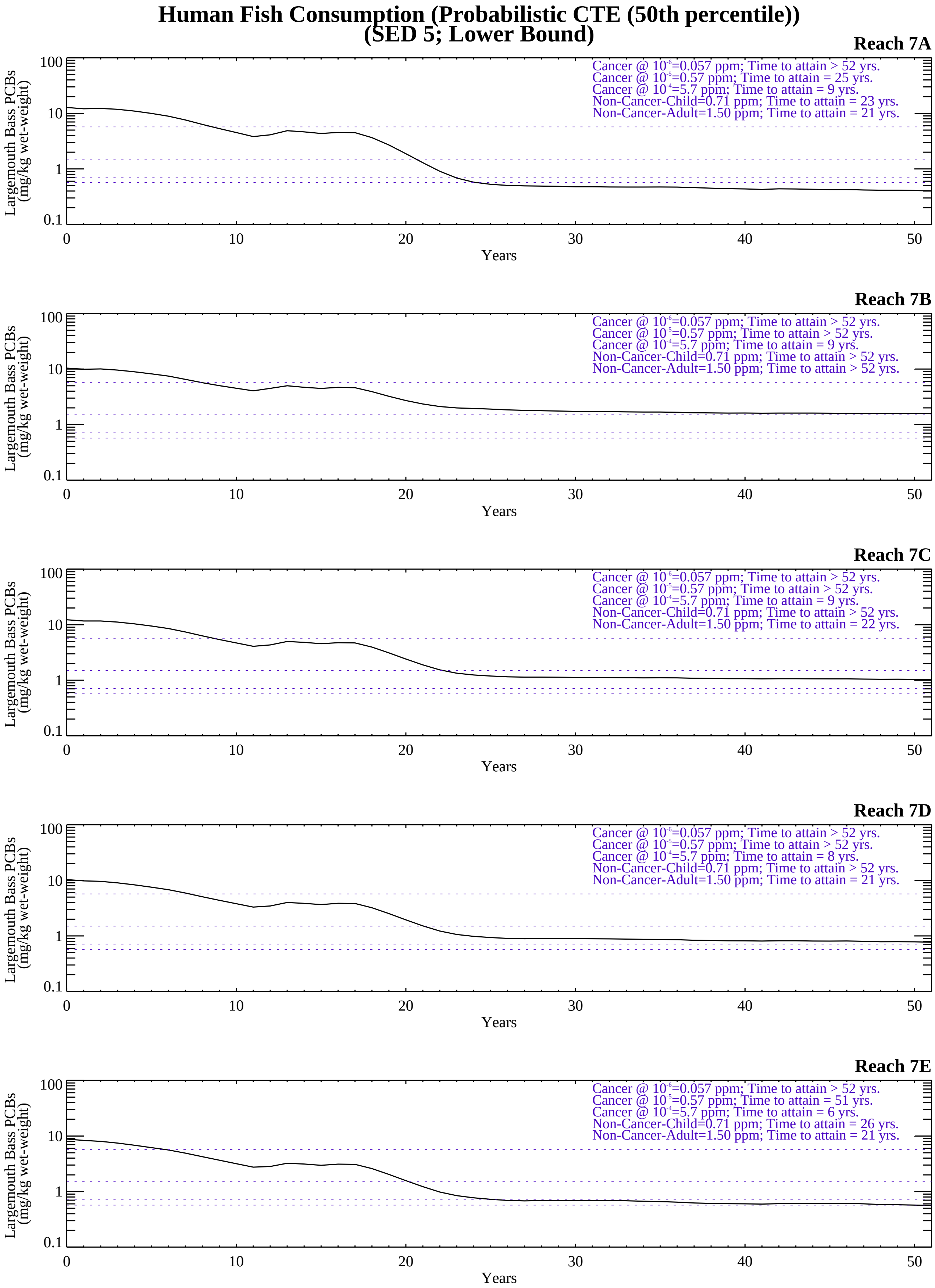


Figure G-8.3-4h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 5; Lower Bound)

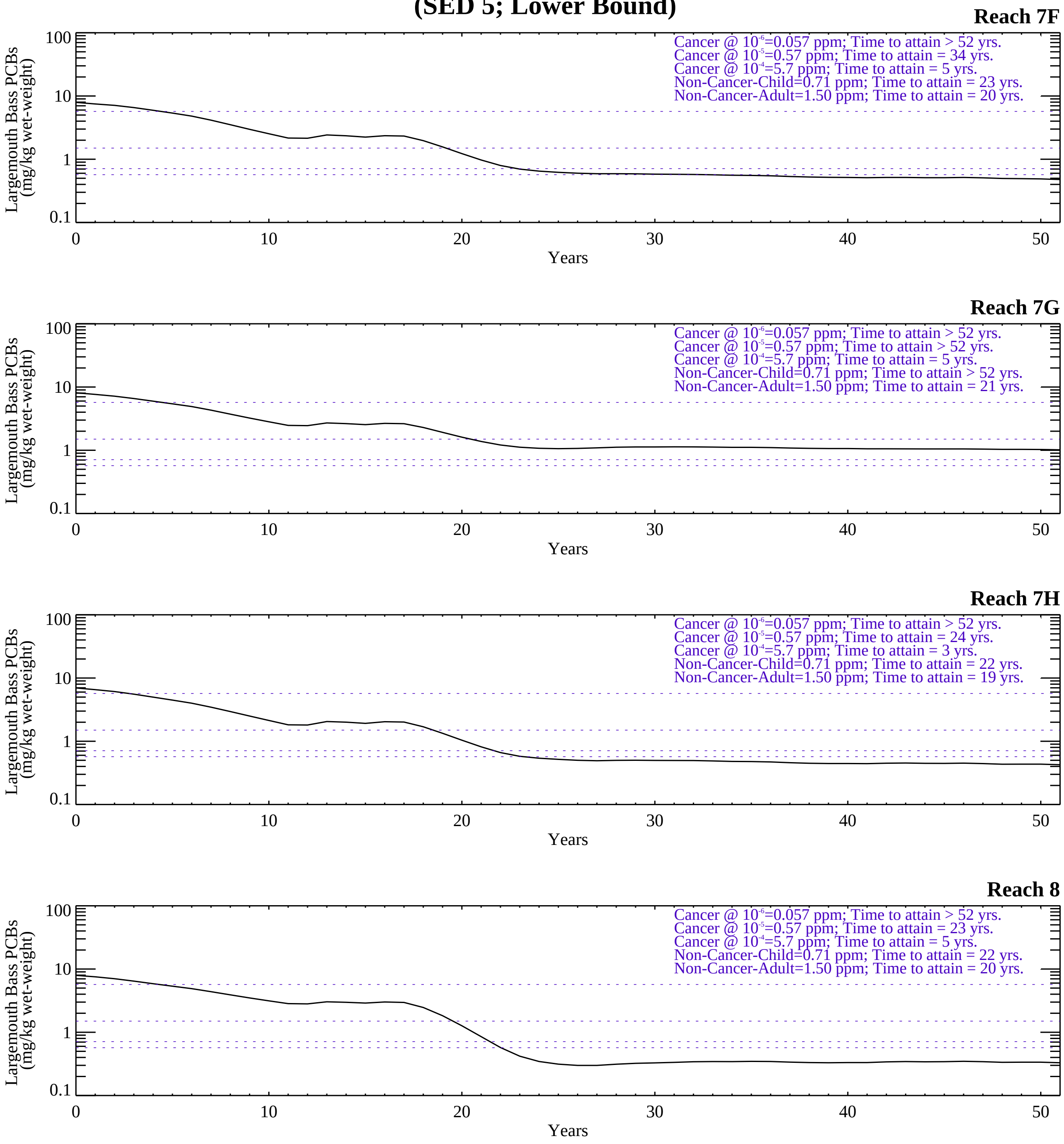


Figure G-8.3-4h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 5; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

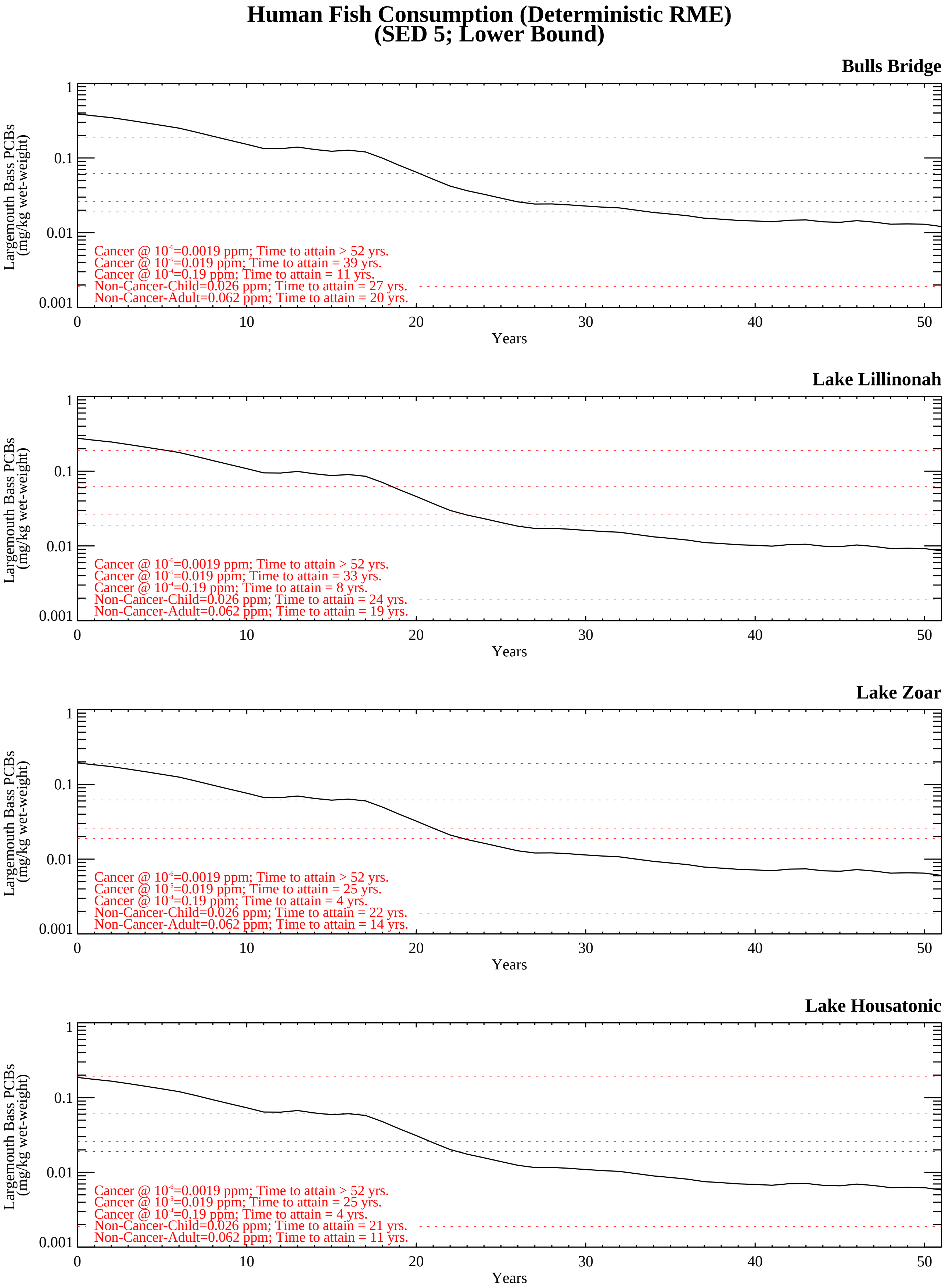
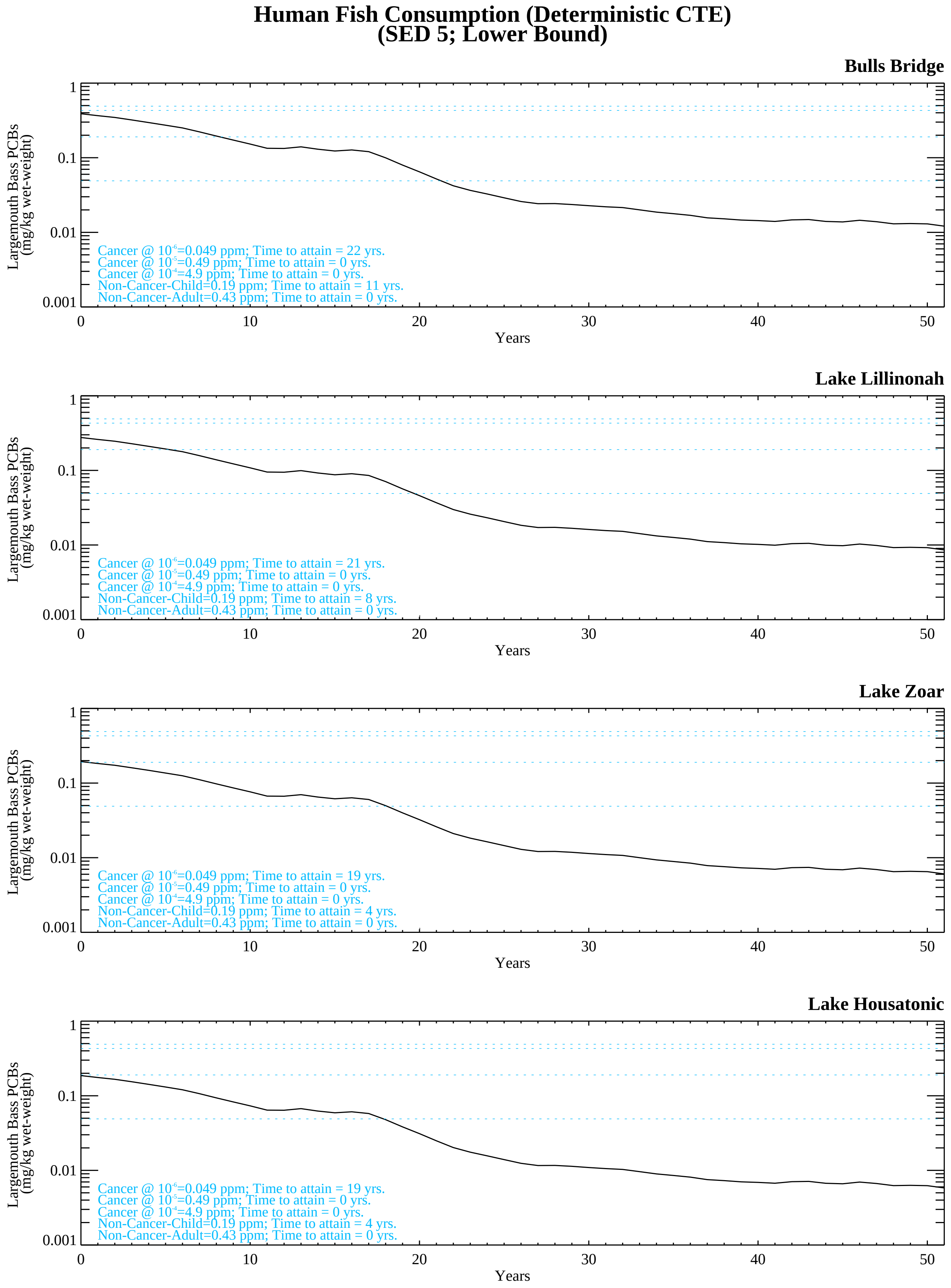


Figure G-8.3-4i. Temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D Analysis compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 5; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.



Human Fish Consumption (Deterministic CTE)
(SED 5; Lower Bound)

Bulls Bridge

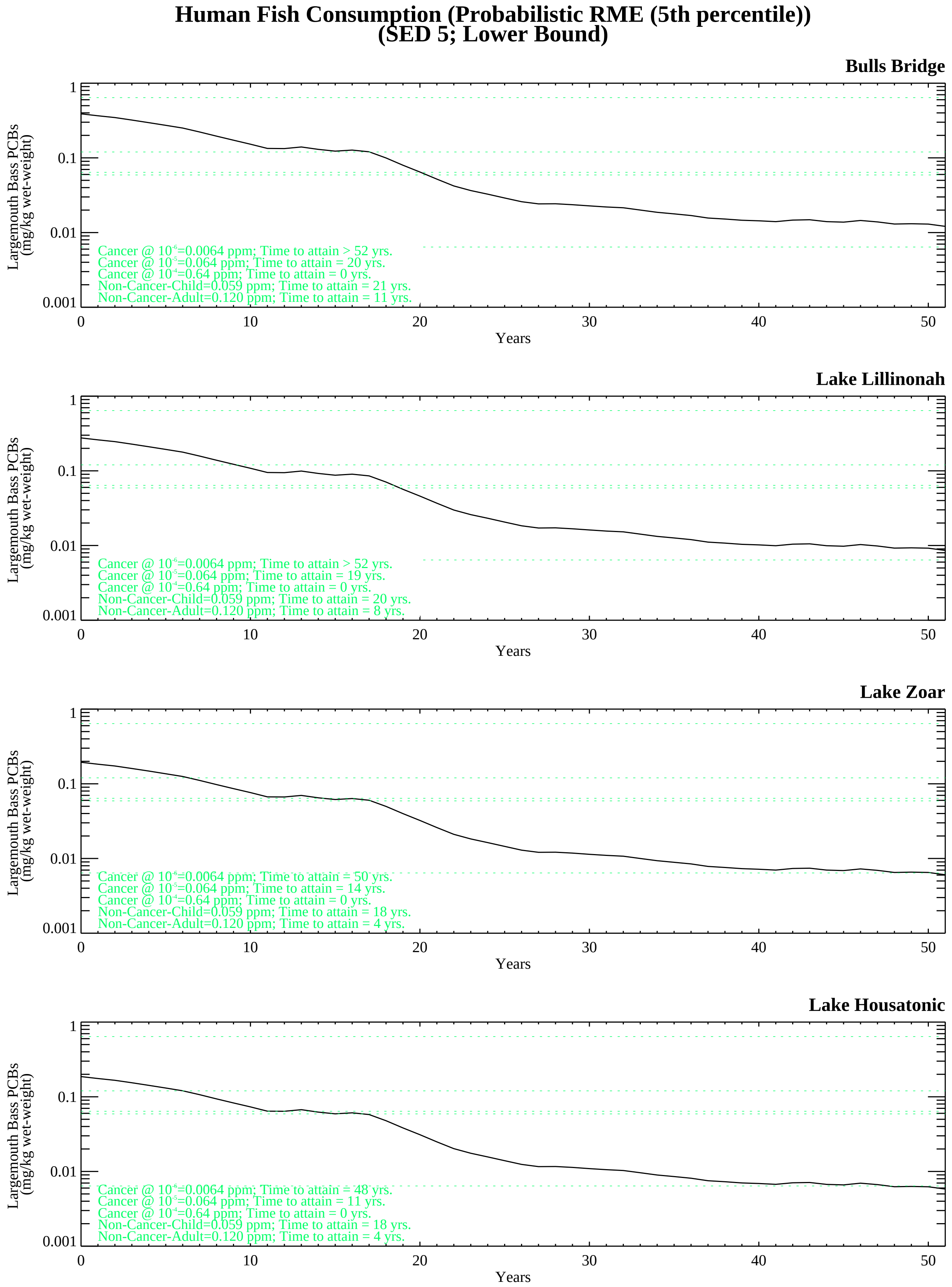
Lake Lillinonah

Lake Zoar

Lake Housatonic

Figure G-8.3-4j. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 5; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.



Bulls Bridge

Cancer @ 10^{-6}=0.0064 ppm; Time to attain > 52 yrs.
Cancer @ 10^{-5}=0.064 ppm; Time to attain = 20 yrs.
Cancer @ 10^{-4}=0.64 ppm; Time to attain = 0 yrs.
Non-Cancer-Child=0.059 ppm; Time to attain = 21 yrs.
Non-Cancer-Adult=0.120 ppm; Time to attain = 11 yrs.

Lake Lillinonah

Cancer @ 10^{-6}=0.0064 ppm; Time to attain > 52 yrs.
Cancer @ 10^{-5}=0.064 ppm; Time to attain = 19 yrs.
Cancer @ 10^{-4}=0.64 ppm; Time to attain = 0 yrs.
Non-Cancer-Child=0.059 ppm; Time to attain = 20 yrs.
Non-Cancer-Adult=0.120 ppm; Time to attain = 8 yrs.

Lake Zoar

Cancer @ 10^{-6}=0.0064 ppm; Time to attain = 50 yrs.
Cancer @ 10^{-5}=0.064 ppm; Time to attain = 14 yrs.
Cancer @ 10^{-4}=0.64 ppm; Time to attain = 0 yrs.
Non-Cancer-Child=0.059 ppm; Time to attain = 18 yrs.
Non-Cancer-Adult=0.120 ppm; Time to attain = 4 yrs.

Lake Housatonic

Cancer @ 10^{-6}=0.0064 ppm; Time to attain = 48 yrs.
Cancer @ 10^{-5}=0.064 ppm; Time to attain = 11 yrs.
Cancer @ 10^{-4}=0.64 ppm; Time to attain = 0 yrs.
Non-Cancer-Child=0.059 ppm; Time to attain = 18 yrs.
Non-Cancer-Adult=0.120 ppm; Time to attain = 4 yrs.

Figure G-8.3-4k. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 5; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 5; Lower Bound)

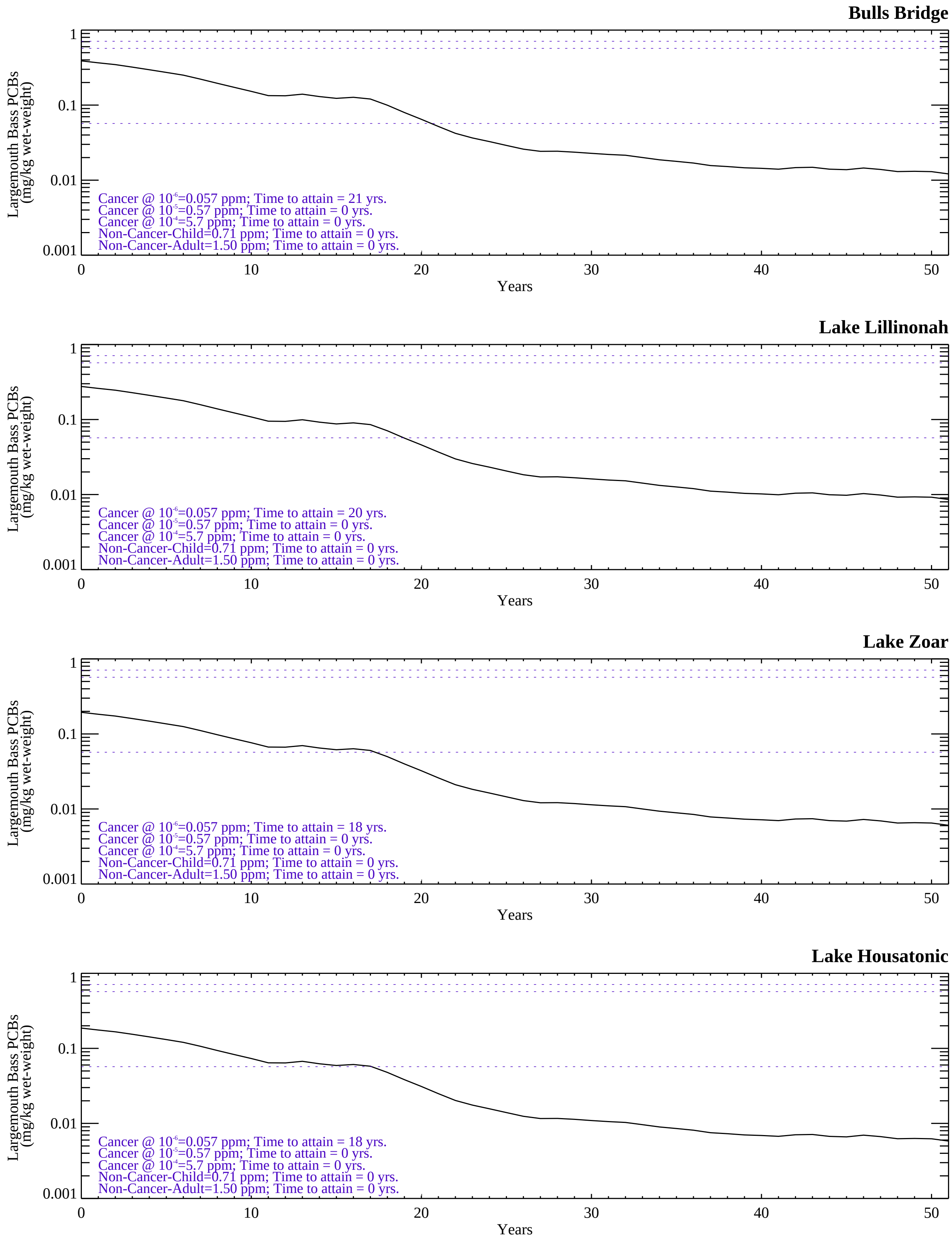

Figure G-8.3-4l. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 5; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

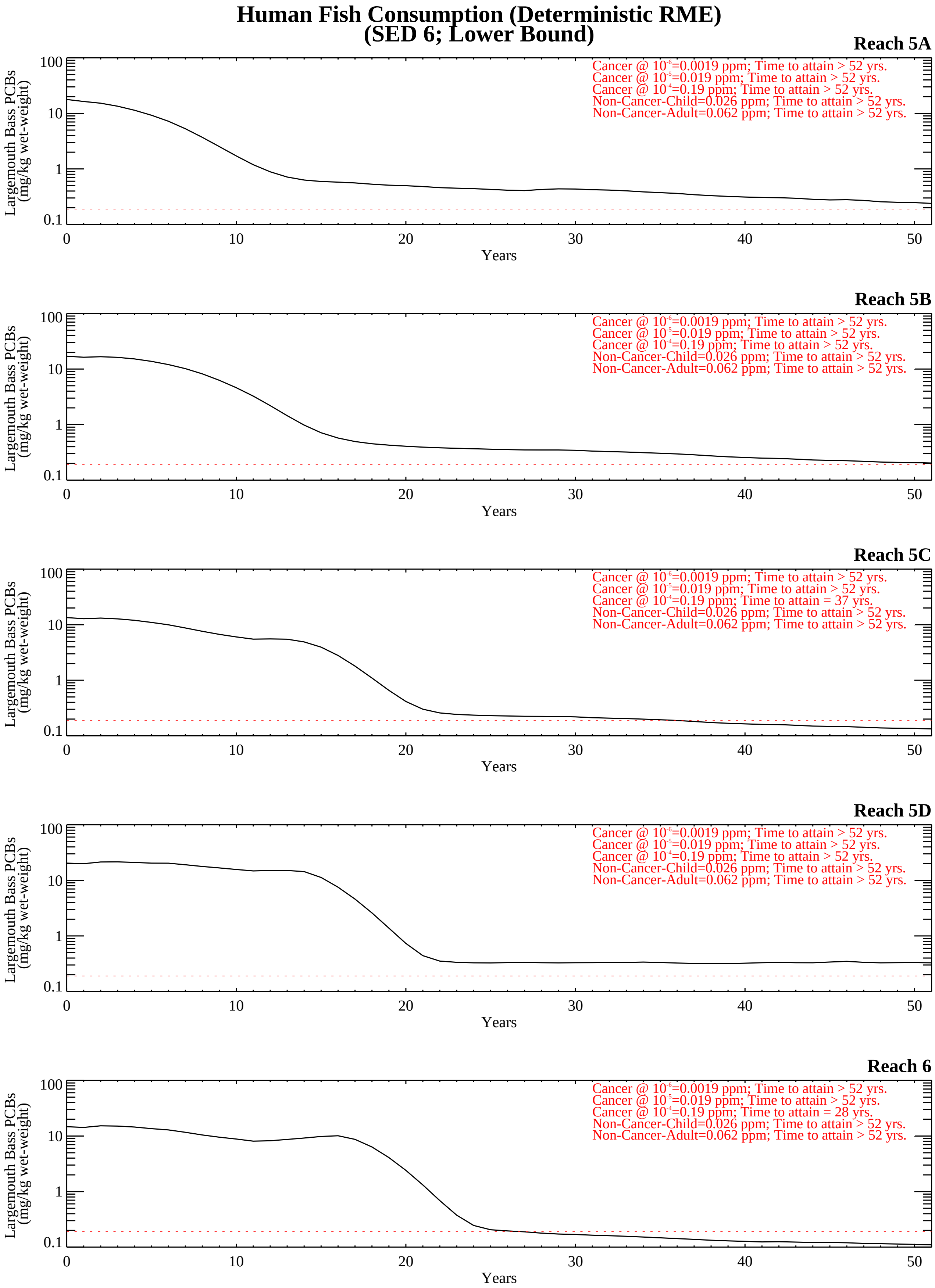

Figure G-8.3-5a. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic CTE)
(SED 6; Lower Bound)

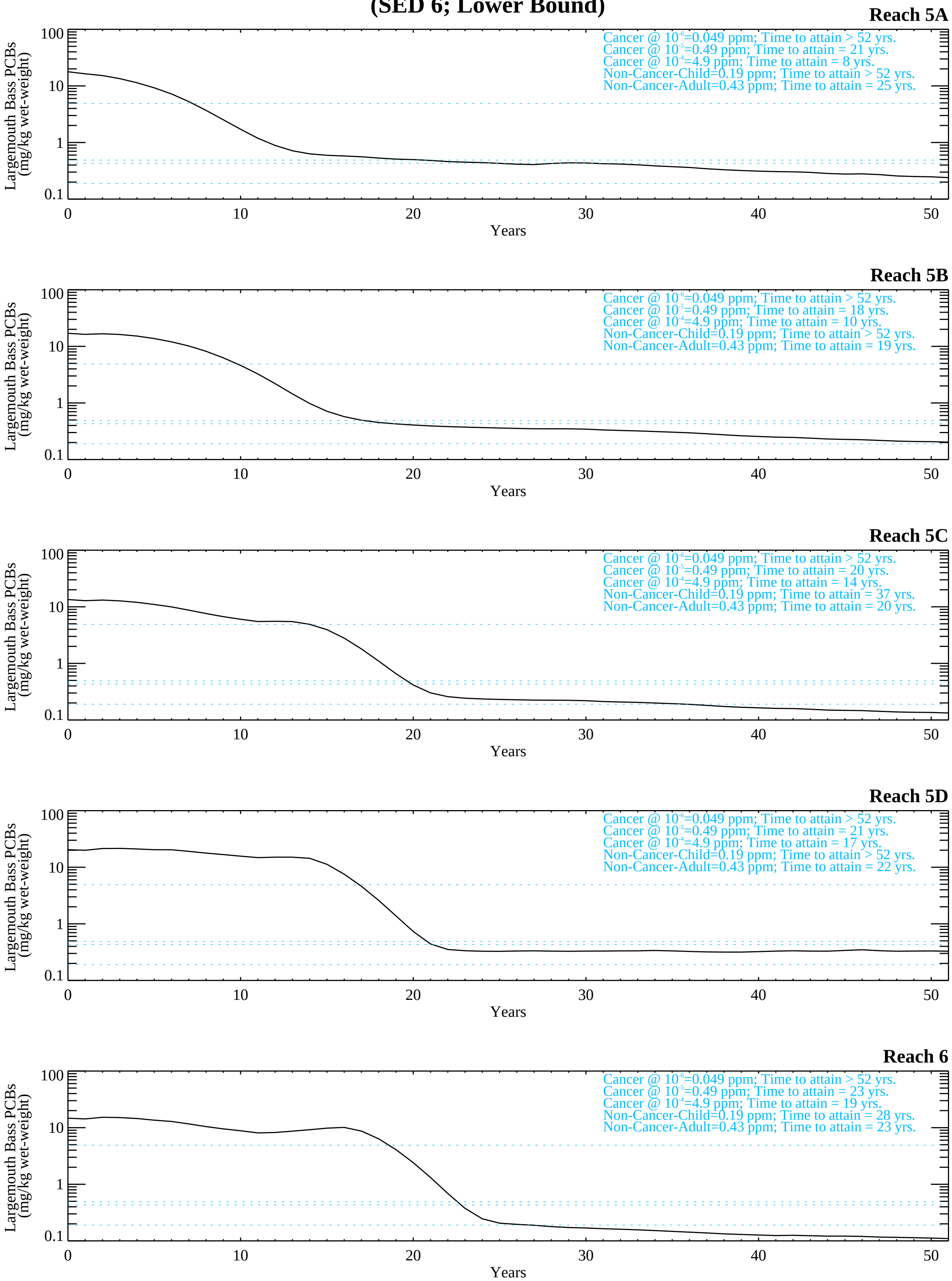

Figure G-8.3-5b. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

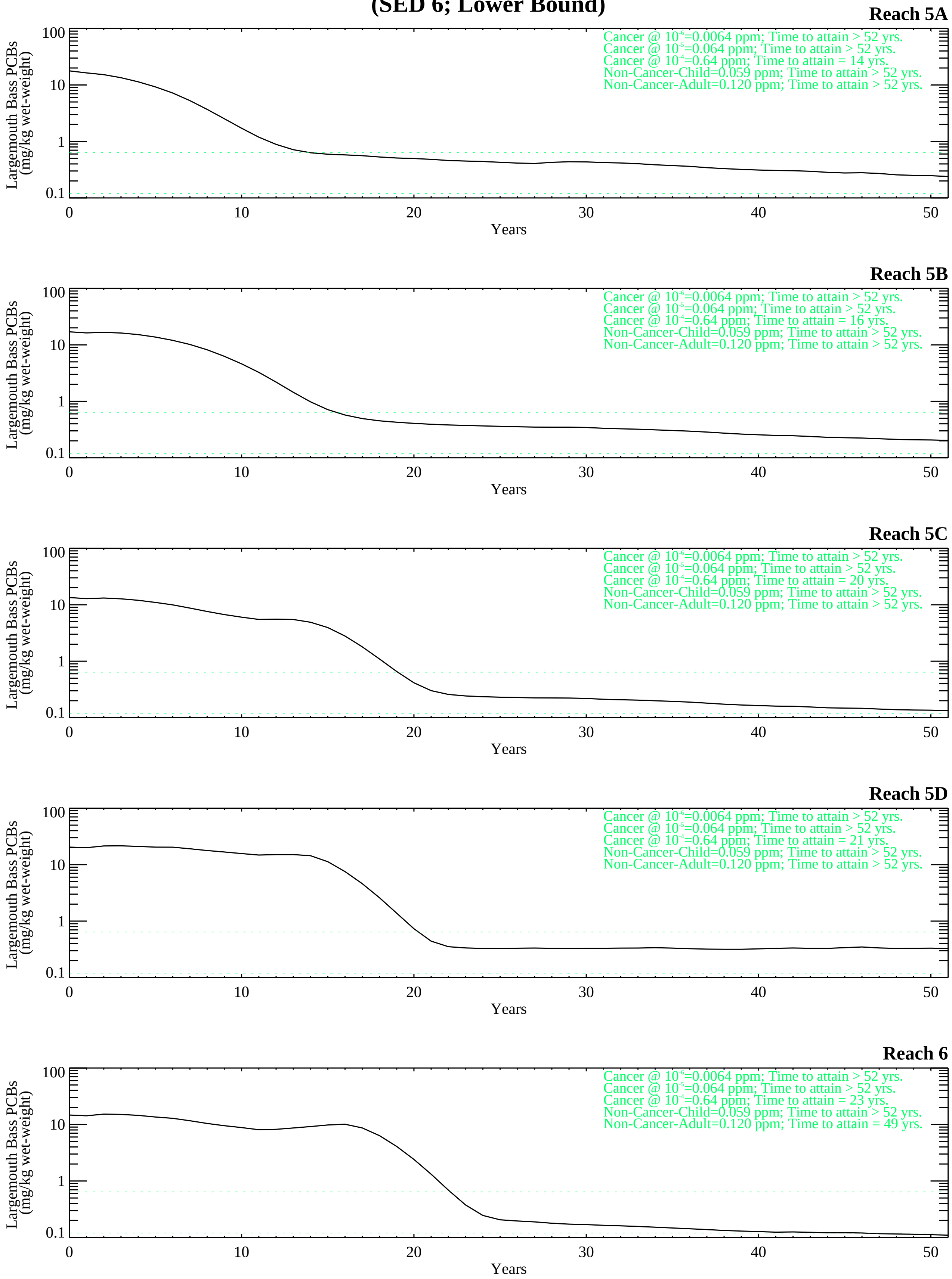

Figure G-8.3-5c. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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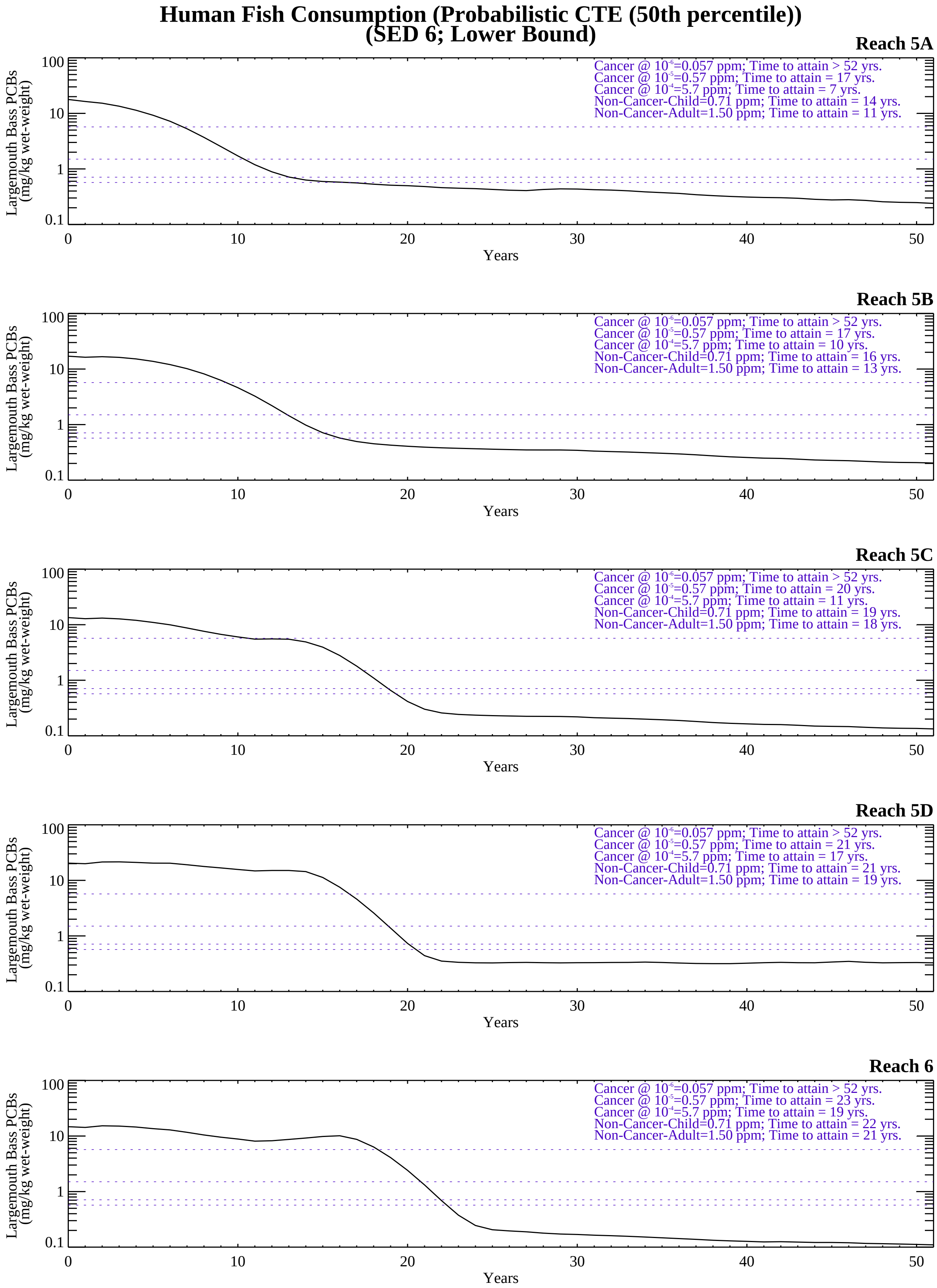

Figure G-8.3-5d. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

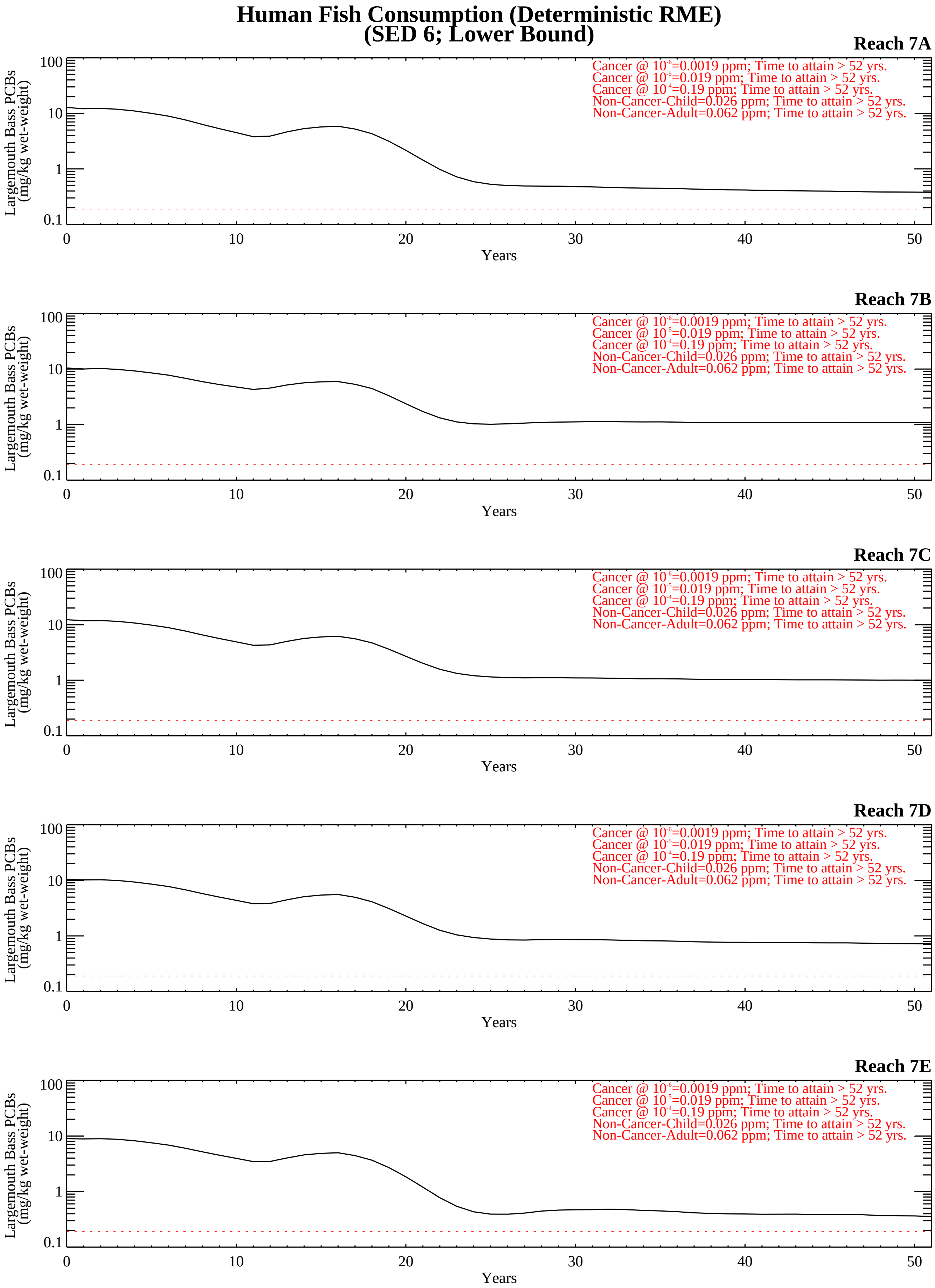

Figure G-8.3-5e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic RME)
(SED 6; Lower Bound)

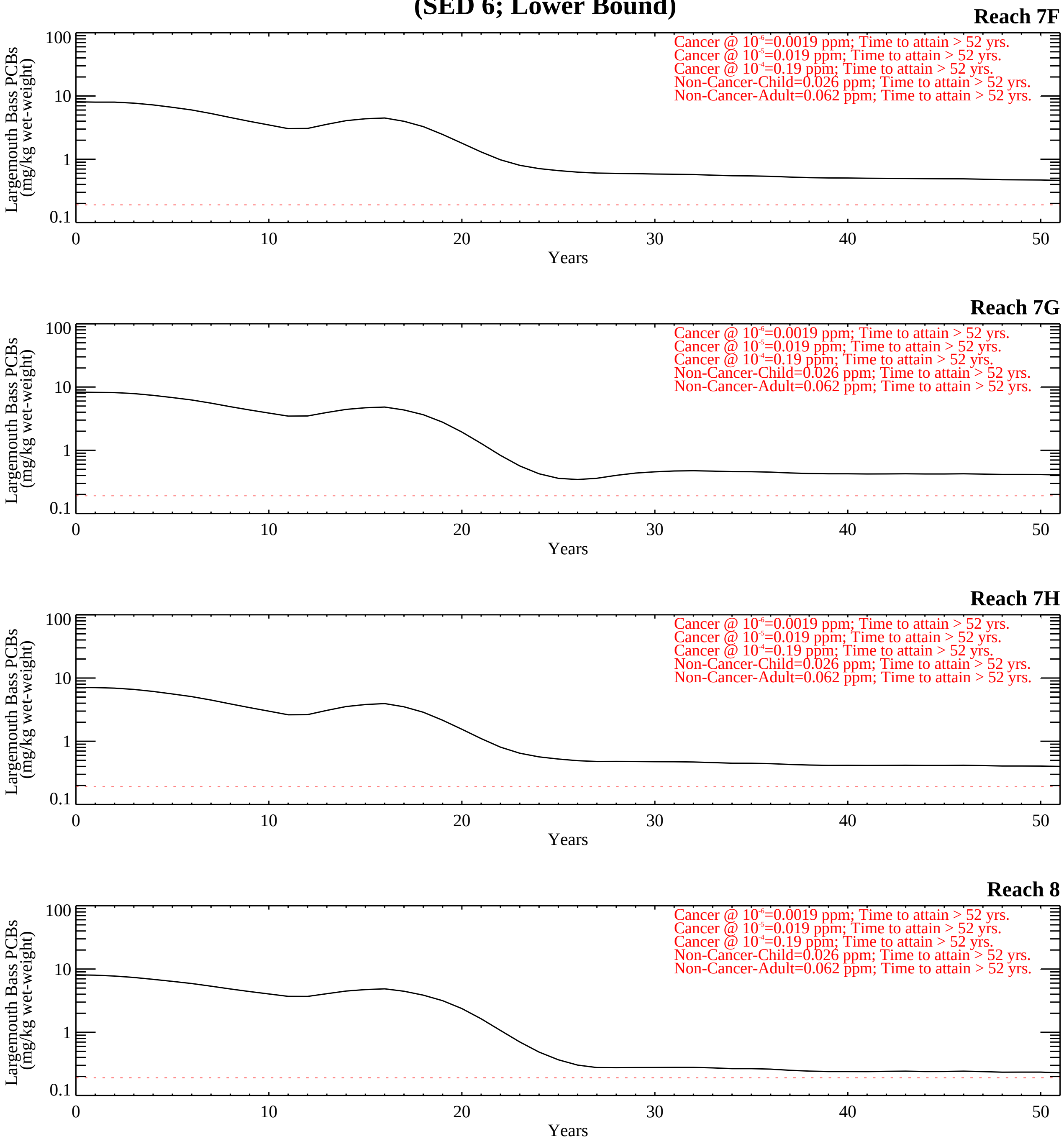

Figure G-8.3-5e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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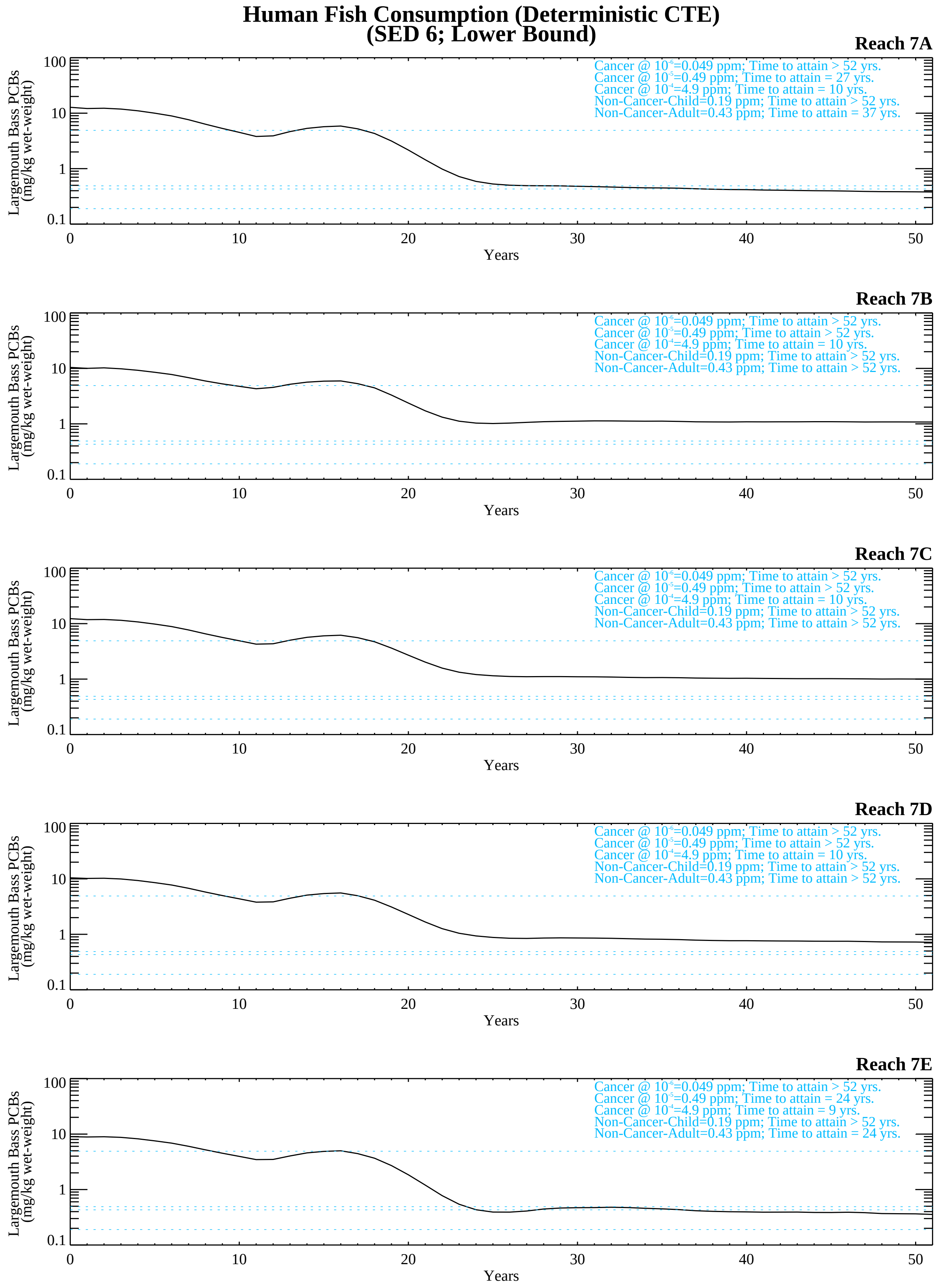

Figure G-8.3-5f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

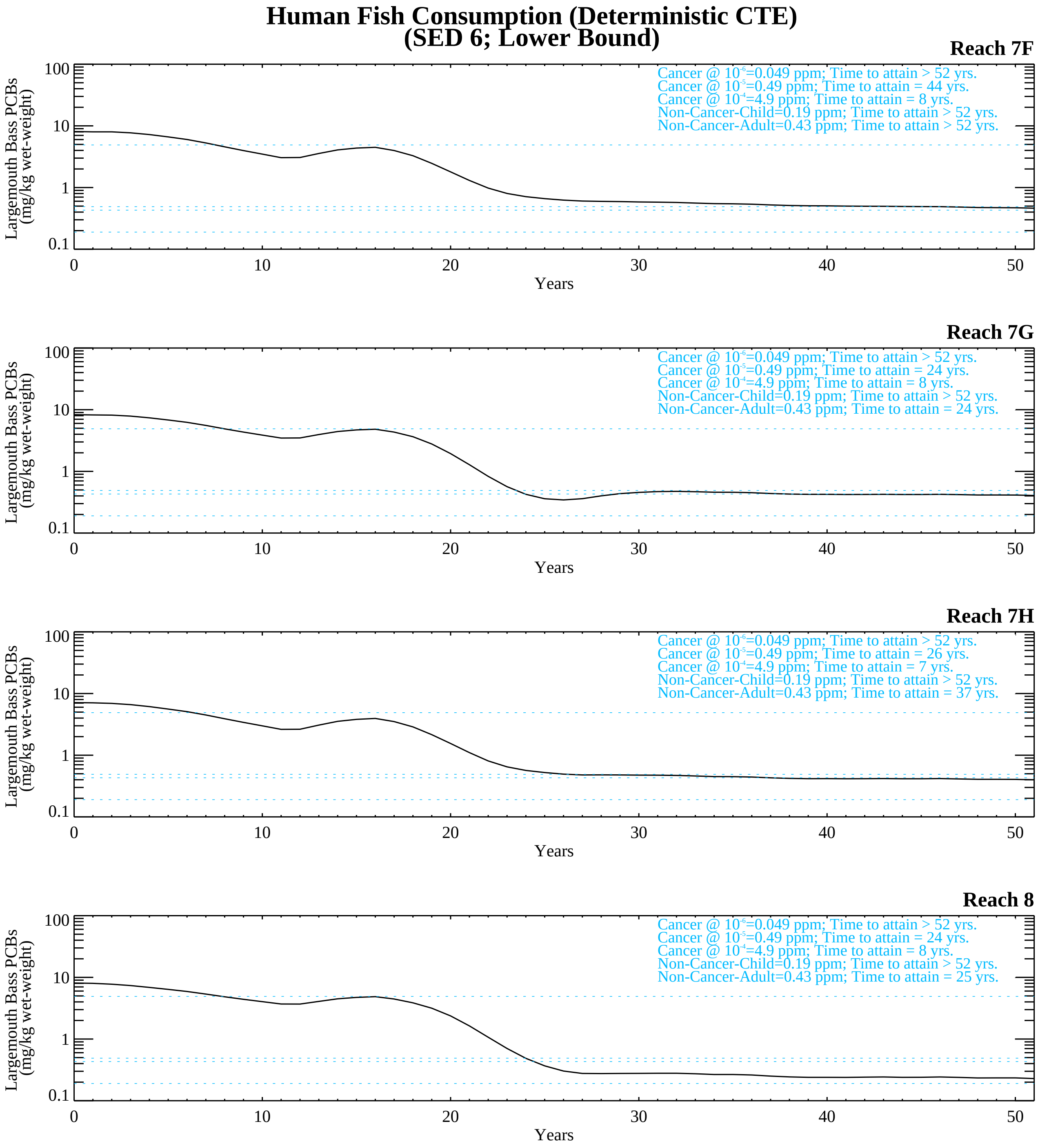

Figure G-8.3-5f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Probabilistic RME (5th percentile)) (SED 6; Lower Bound)

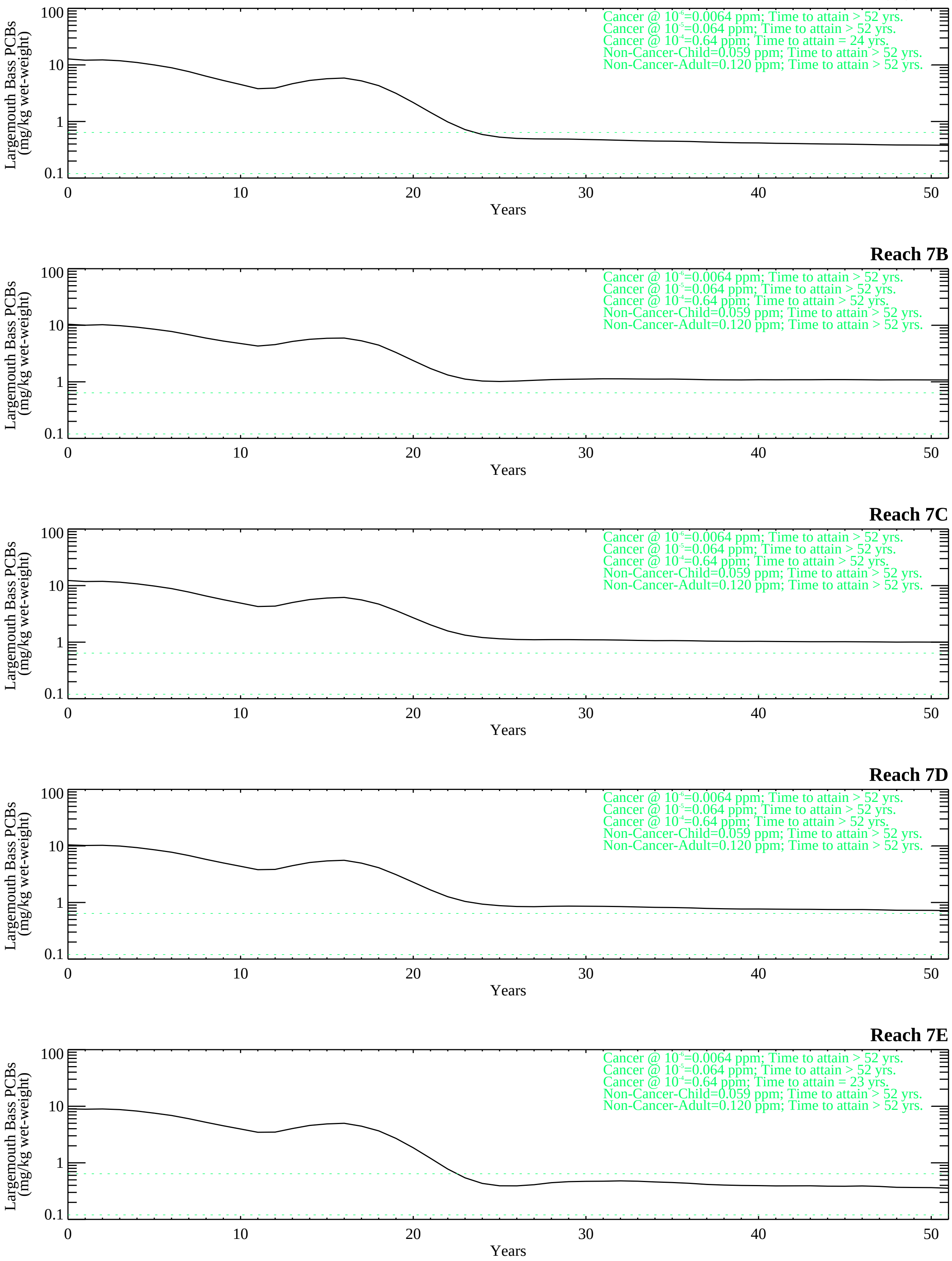

Figure G-8.3-5g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

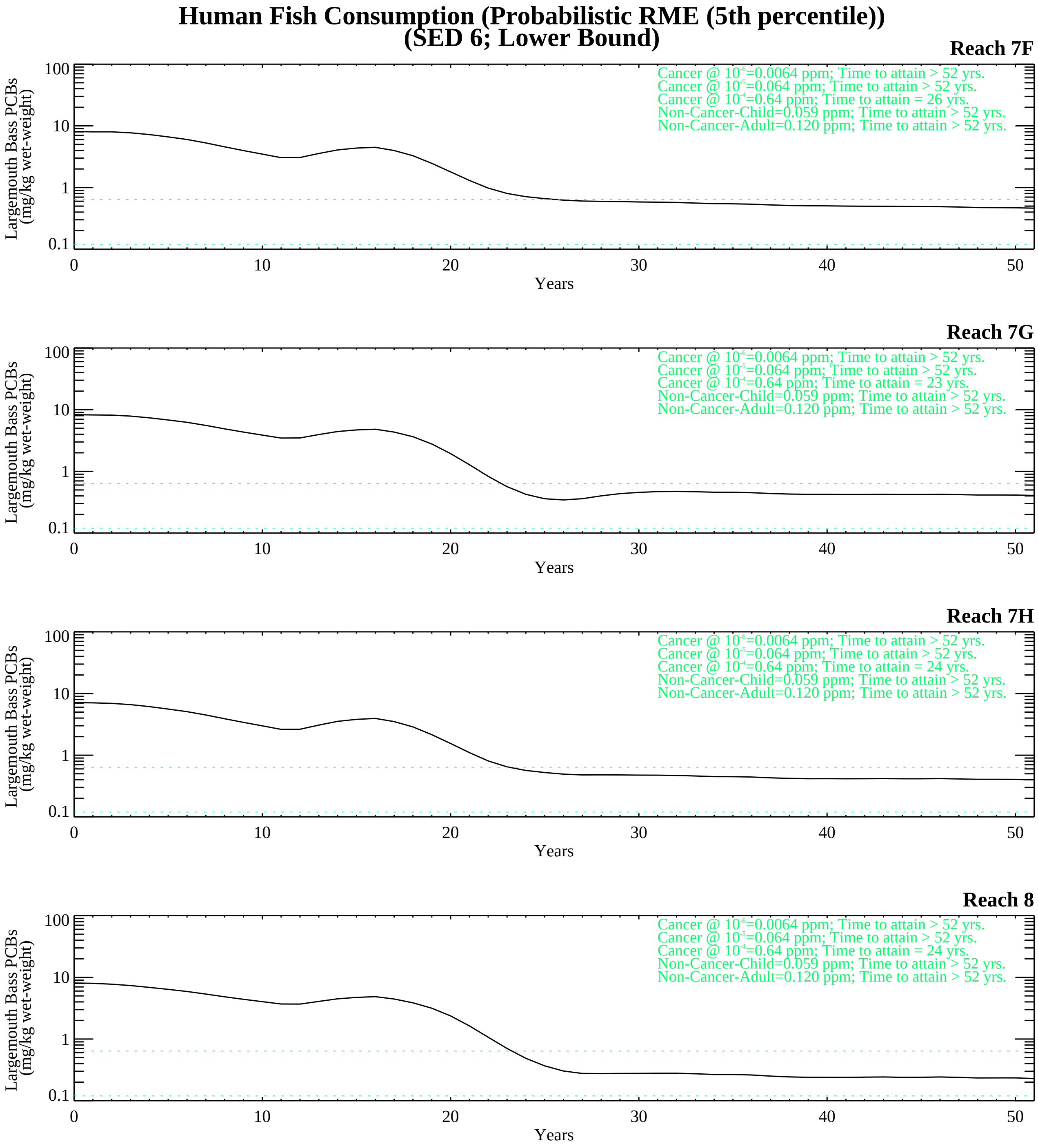

Figure G-8.3-5g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

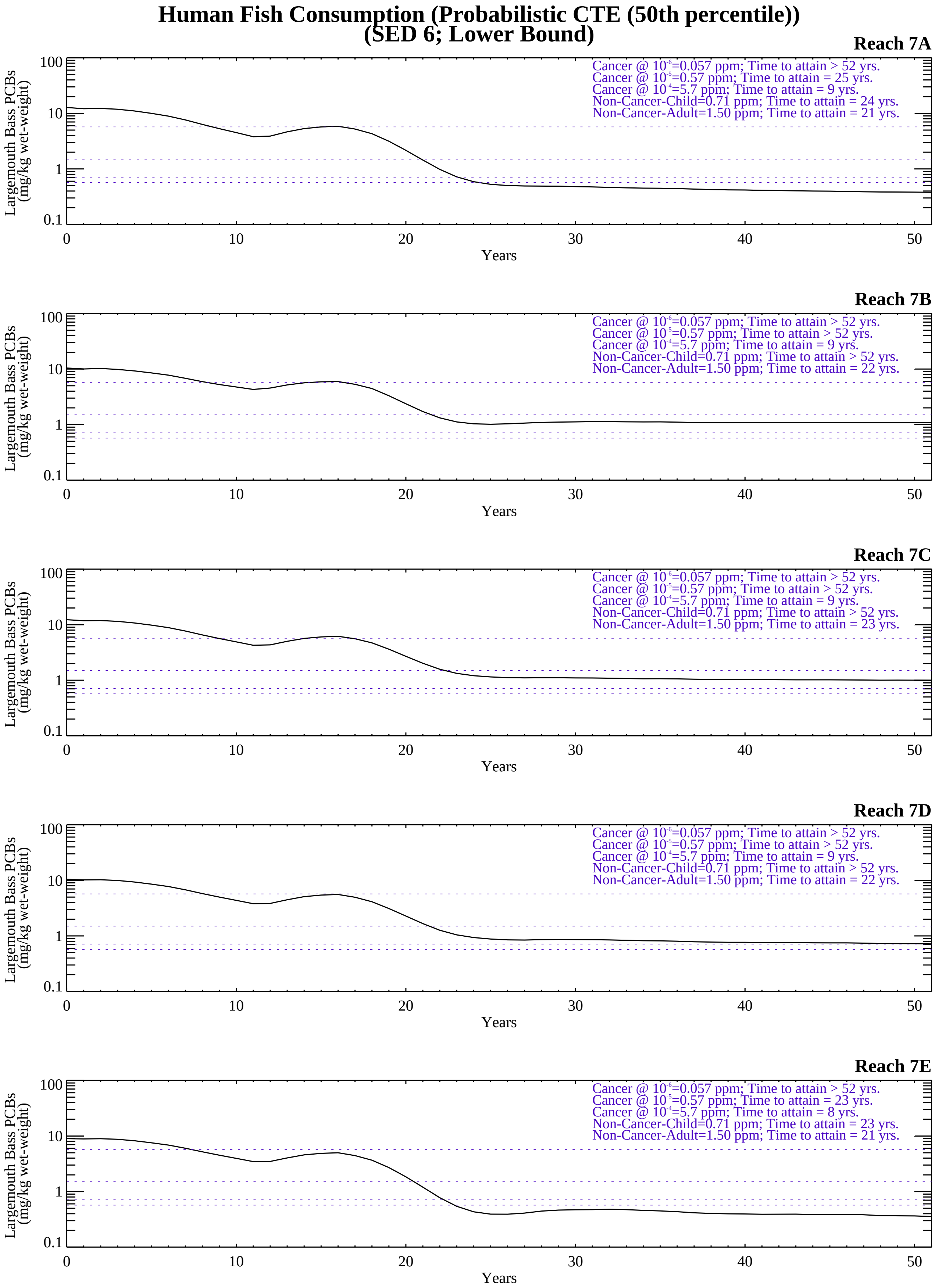

Figure G-8.3-5h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

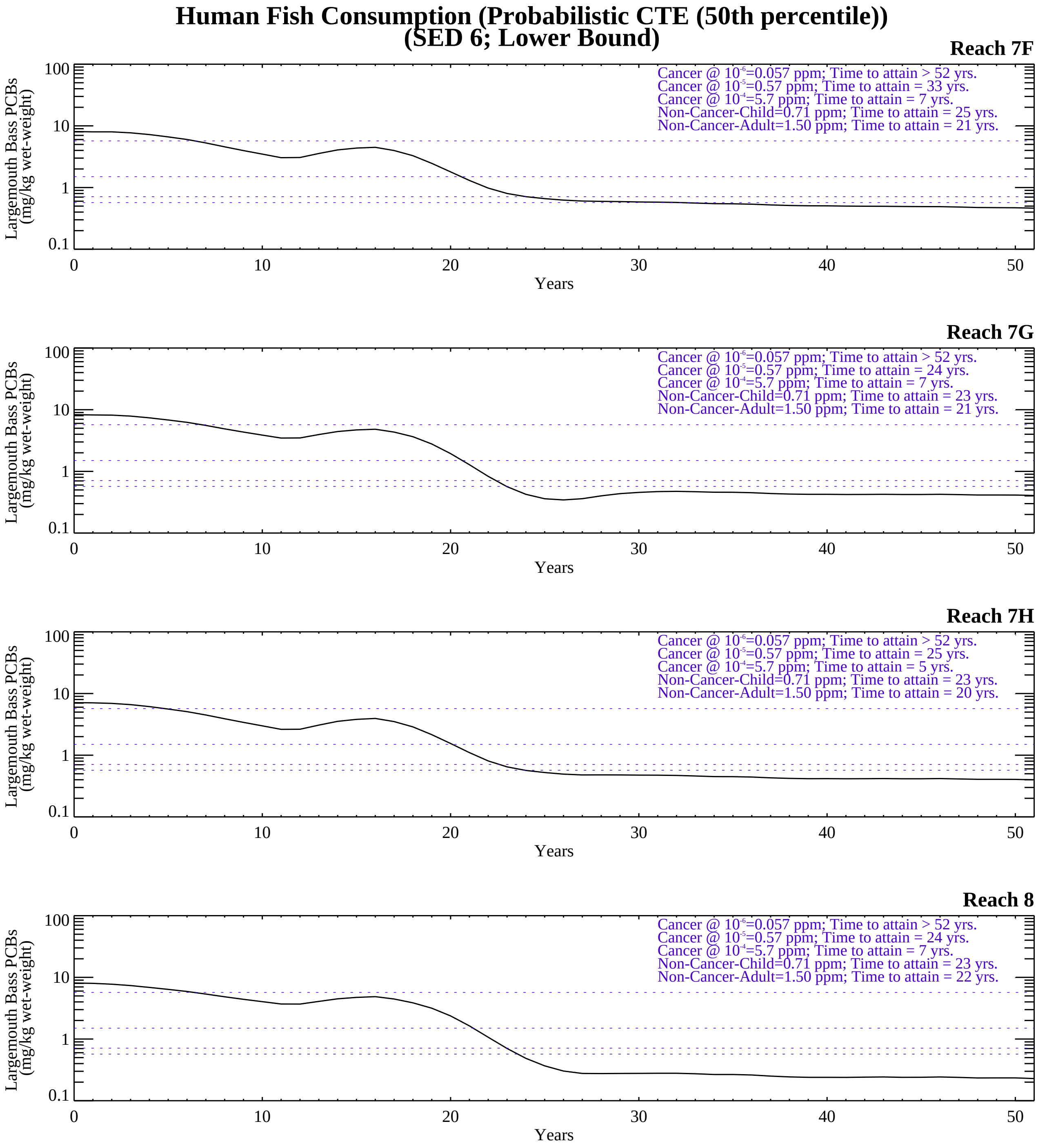

Figure G-8.3-5h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 6; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

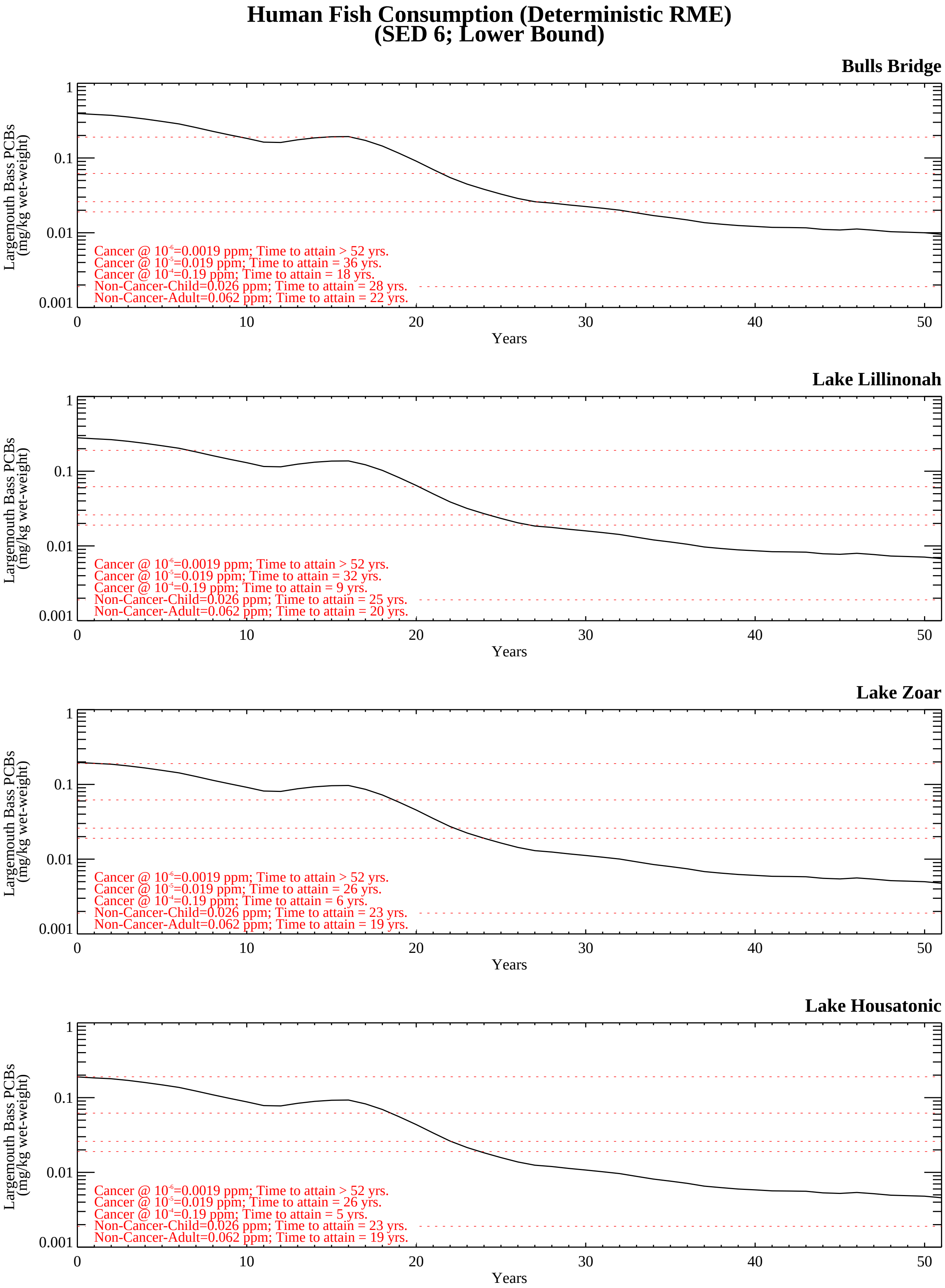

Figure G-8.3-5i. Temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D Analysis compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 6; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Deterministic CTE)
(SED 6; Lower Bound)

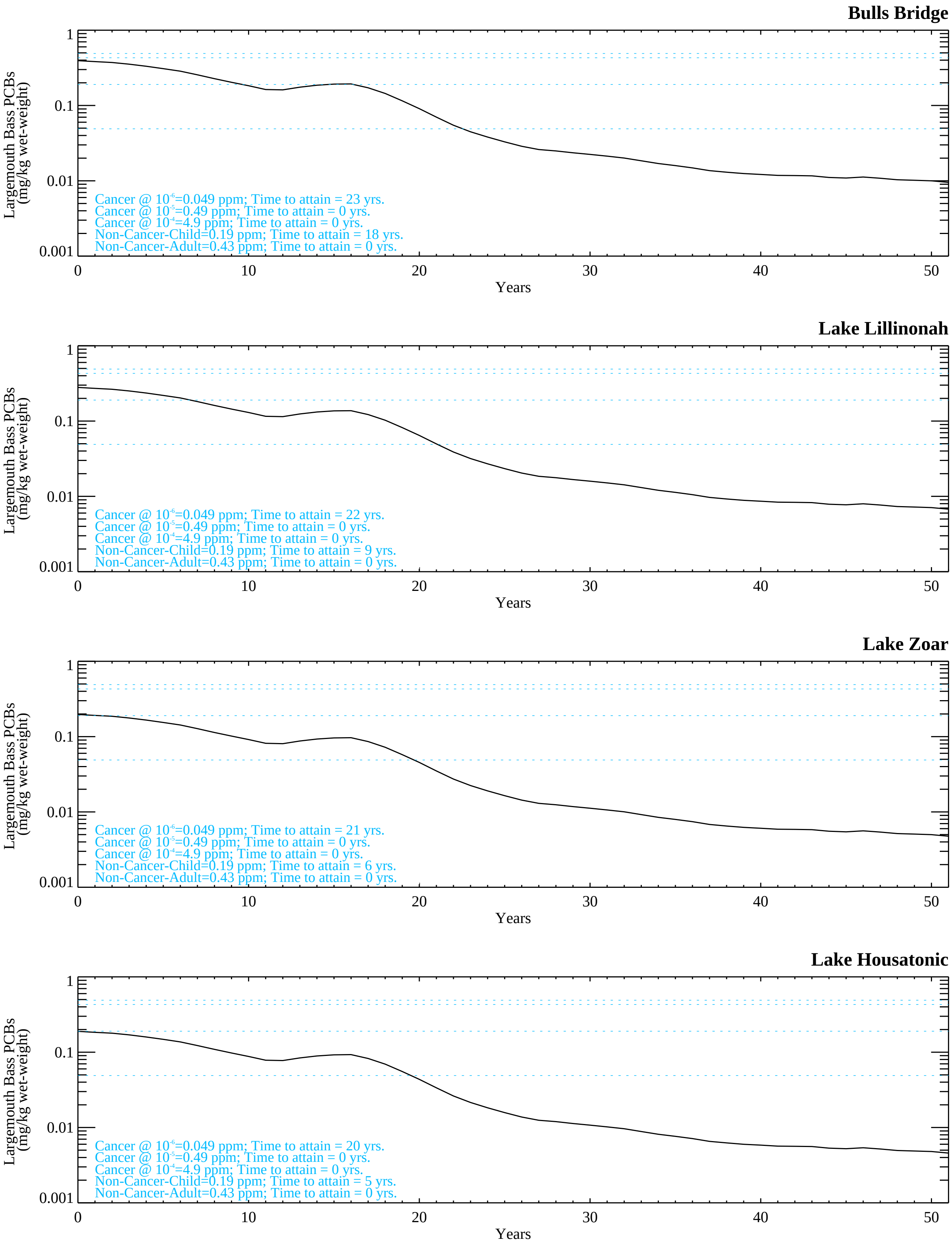

Figure G-8.3-5j. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 6; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Probabilistic RME (5th percentile)) (SED 6; Lower Bound)

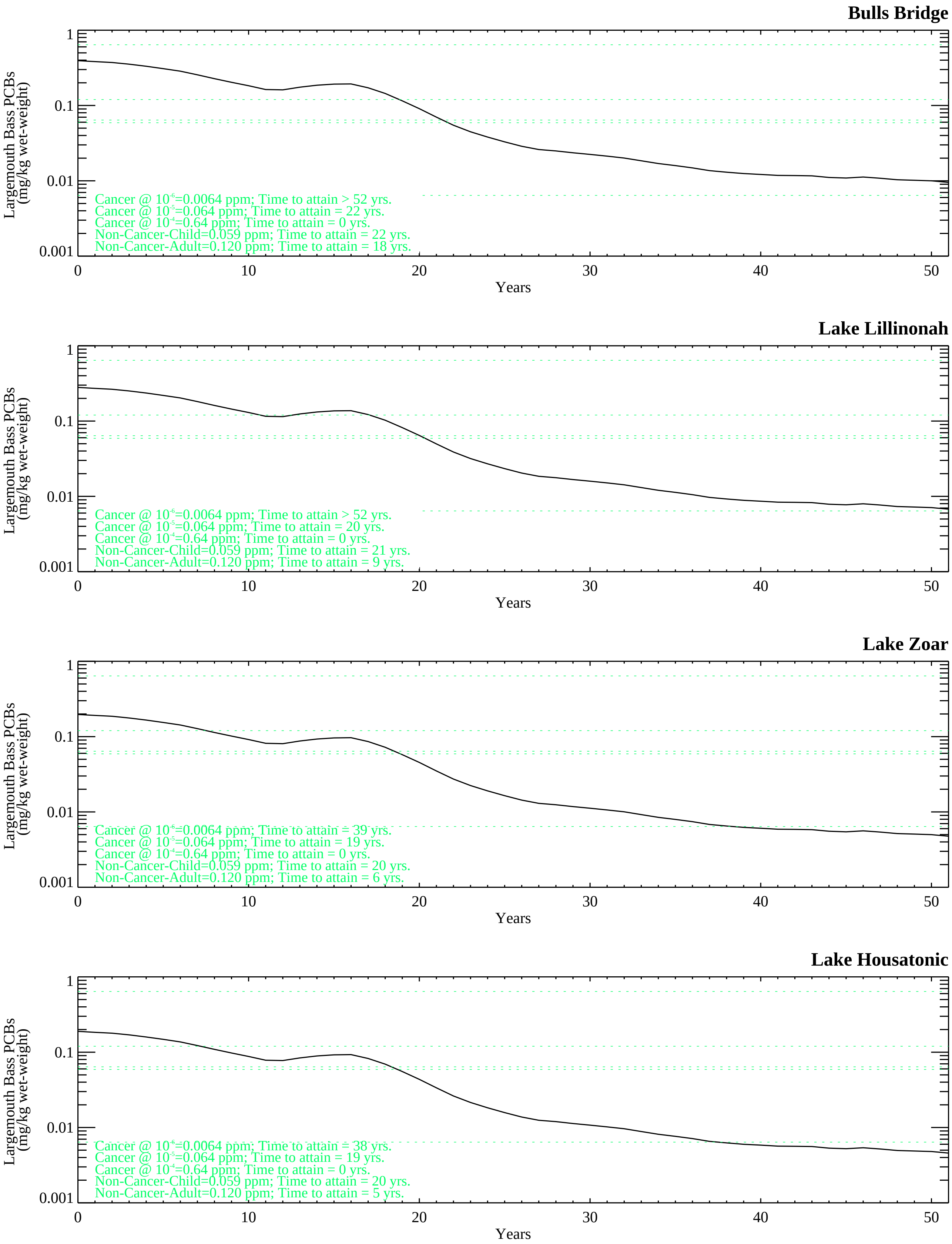

Figure G-8.3-5k. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 6; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 6; Lower Bound)

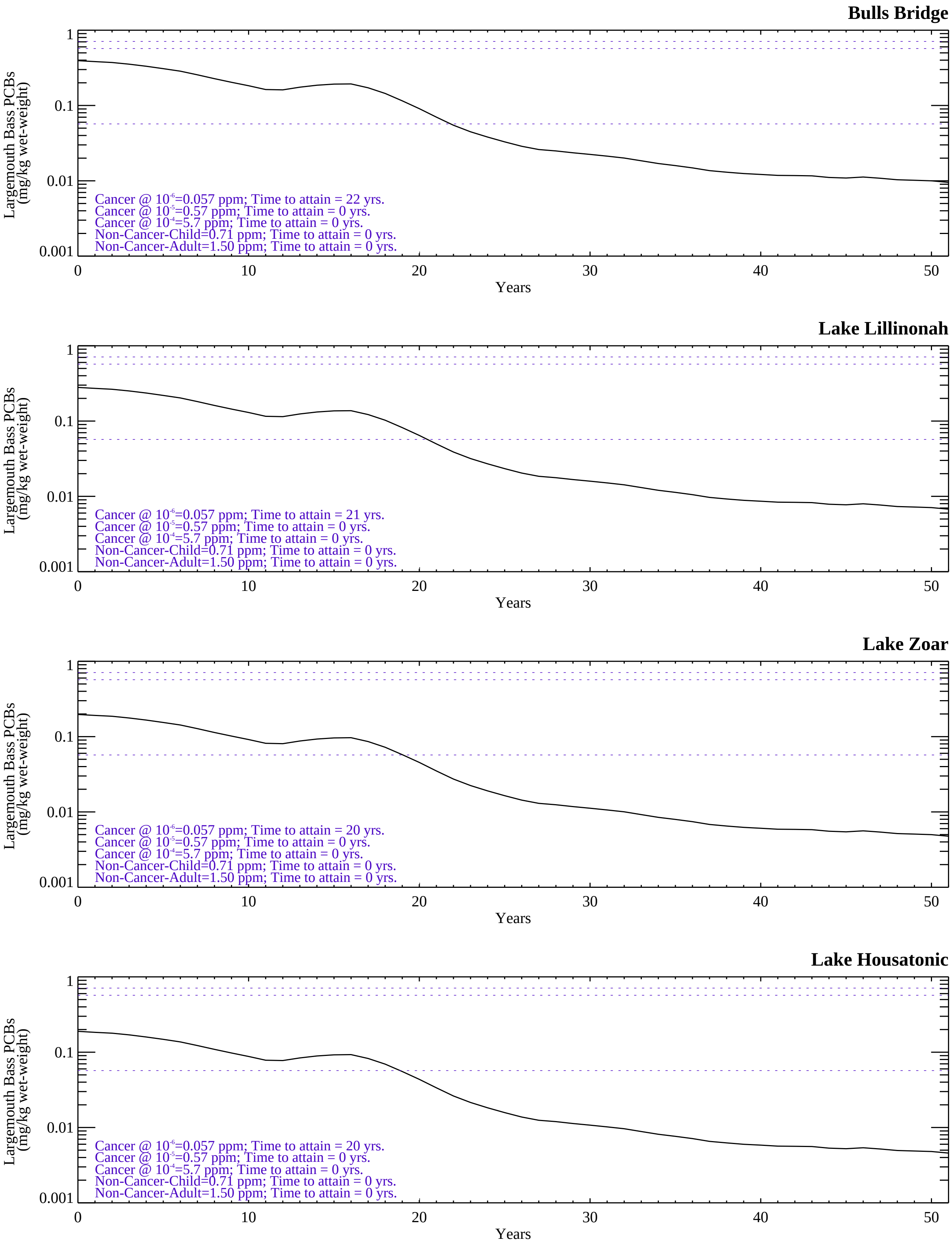

Figure G-8.3-5l. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 6; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic RME)
(SED 7; Lower Bound)

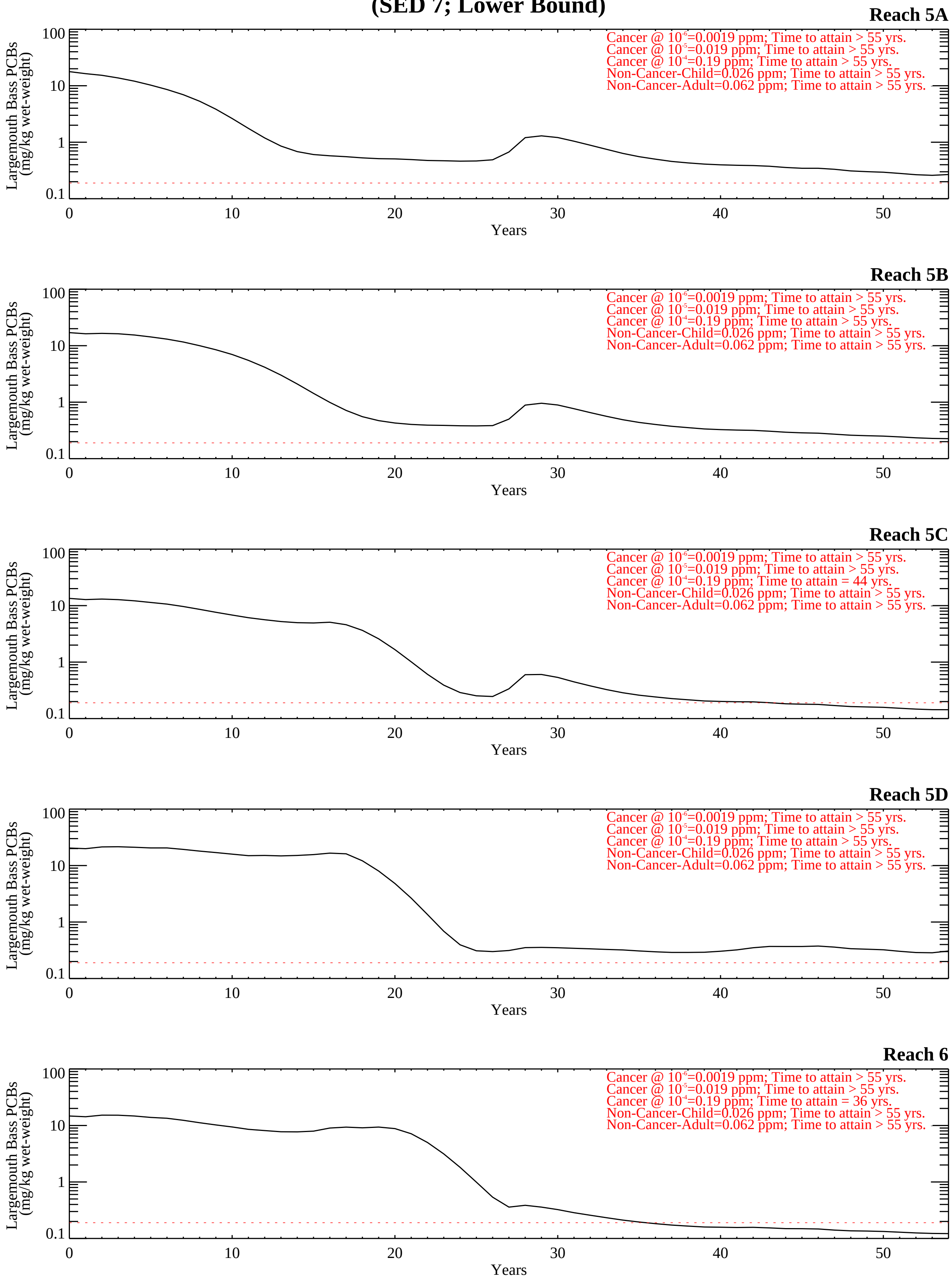

Figure G-8.3-6a. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic CTE)
(SED 7; Lower Bound)

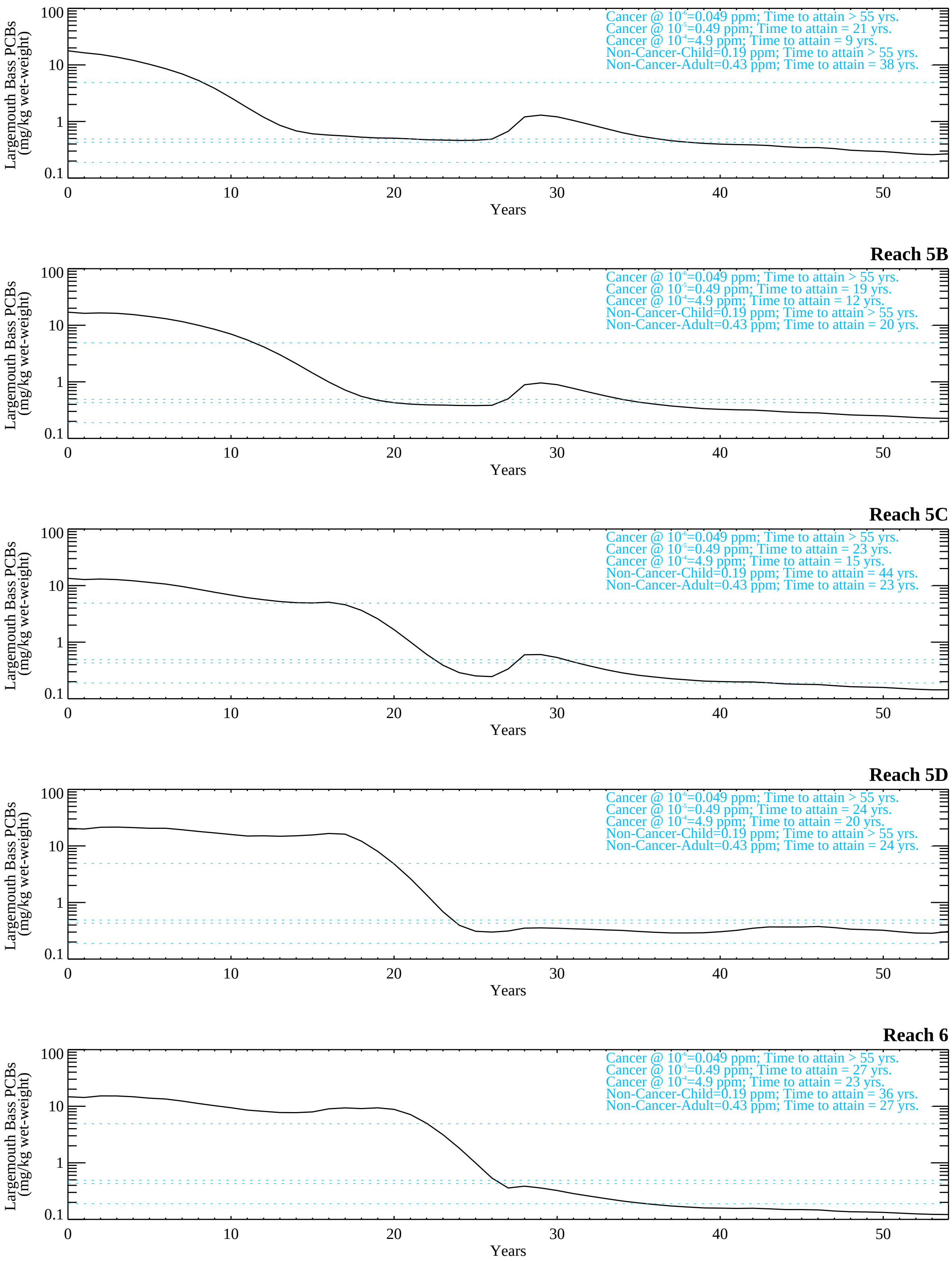

Figure G-8.3-6b. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

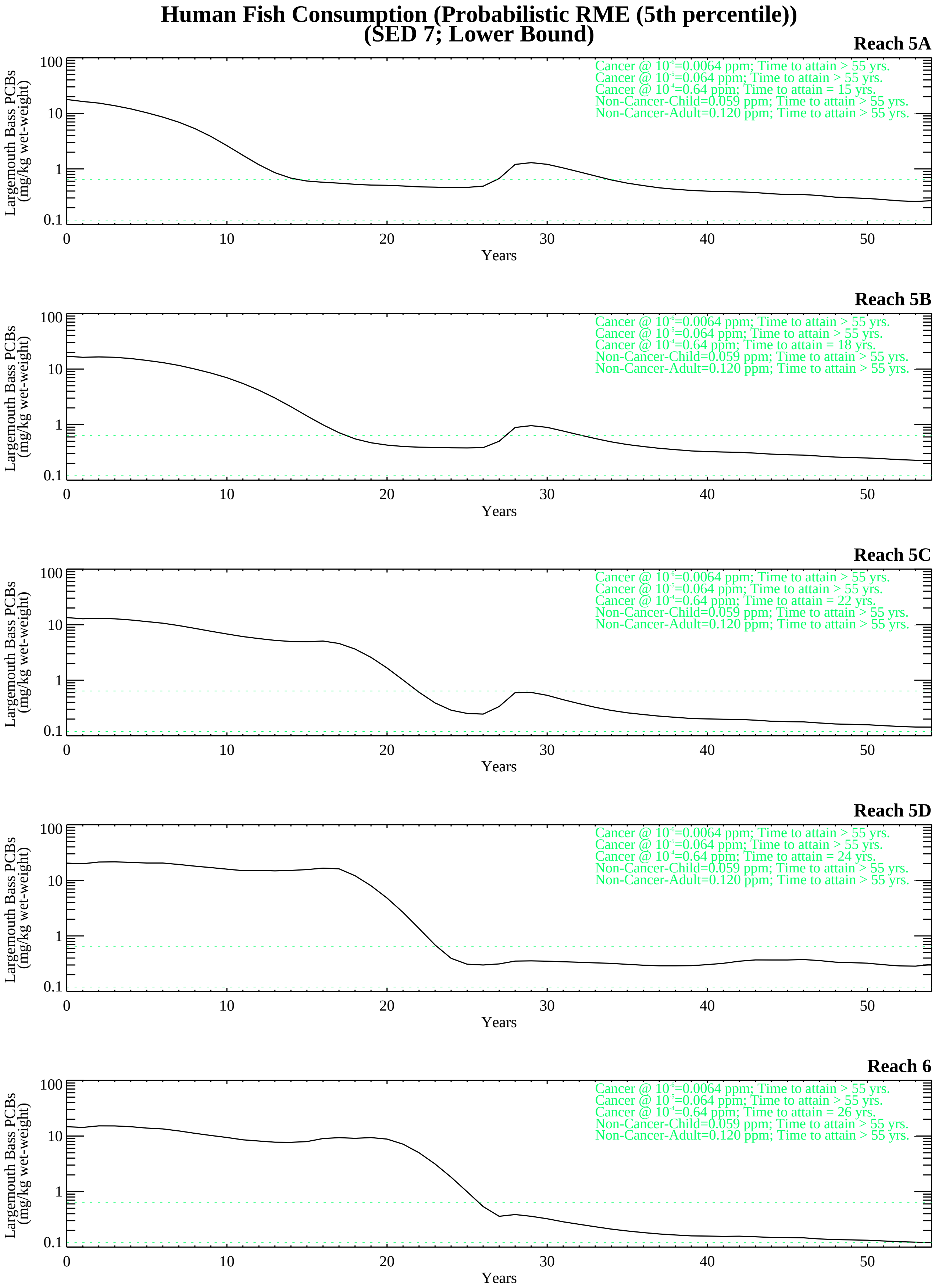

Figure G-8.3-6c. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 7; Lower Bound)

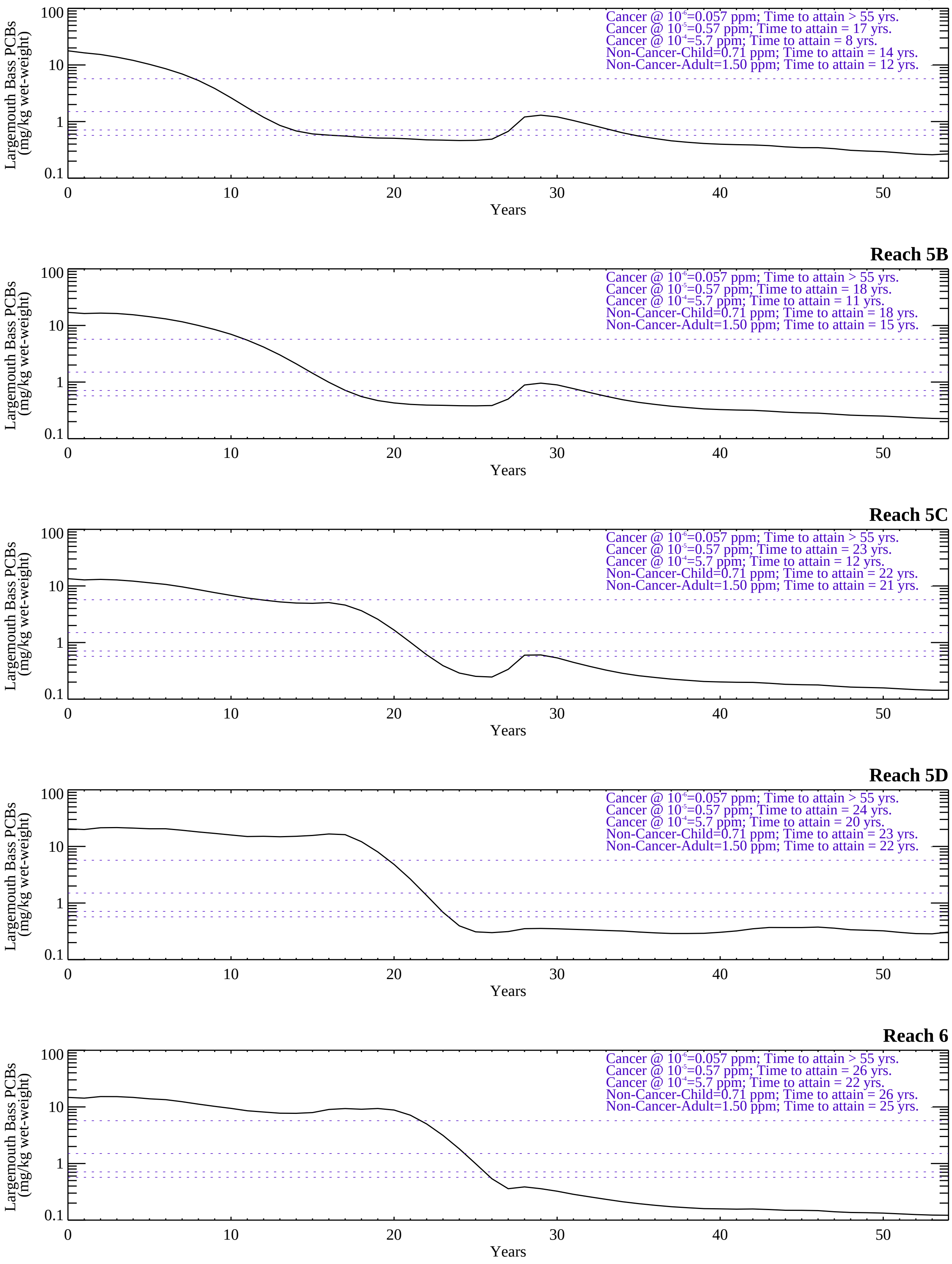

Figure G-8.3-6d. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

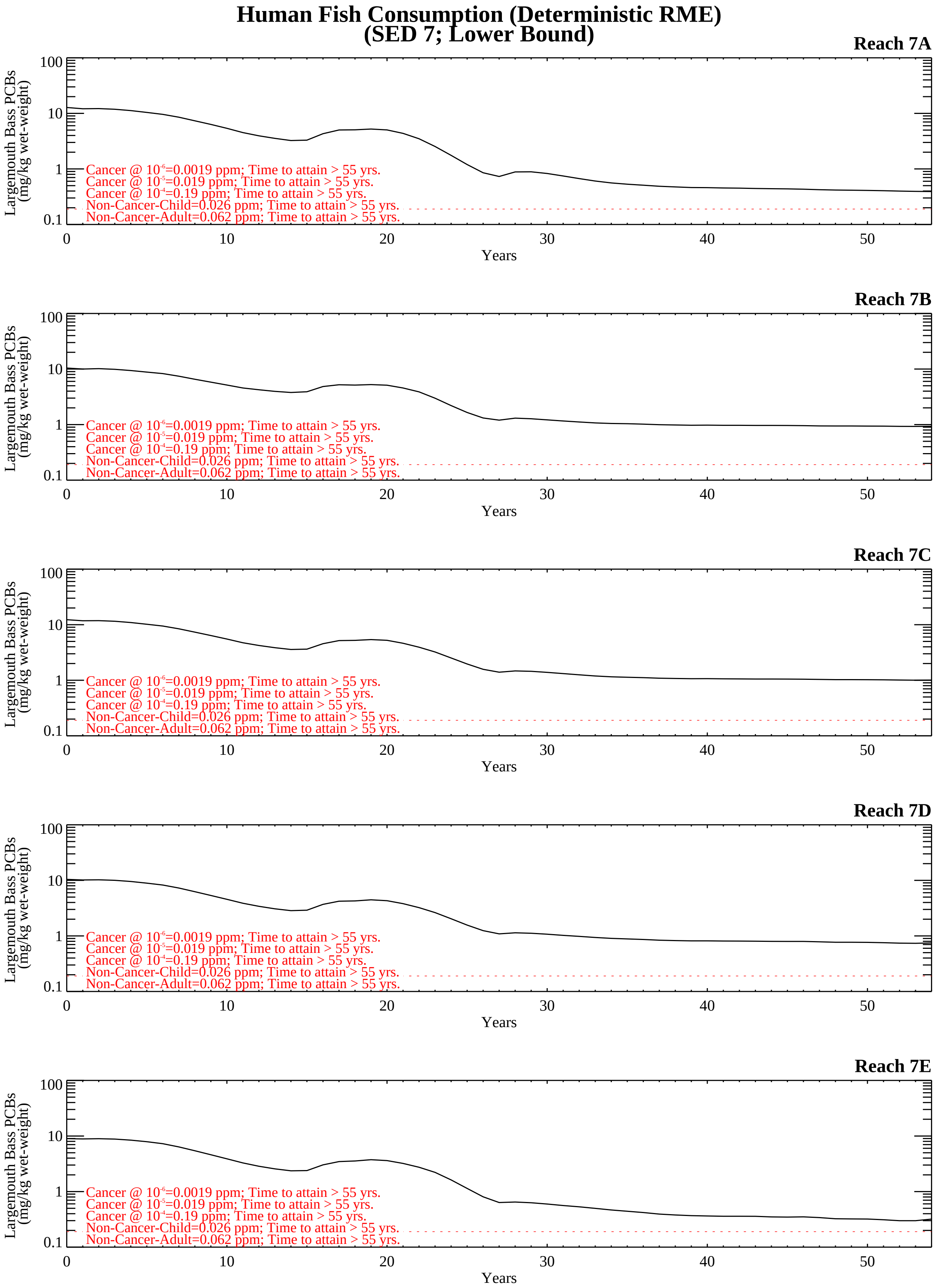

Figure G-8.3-6e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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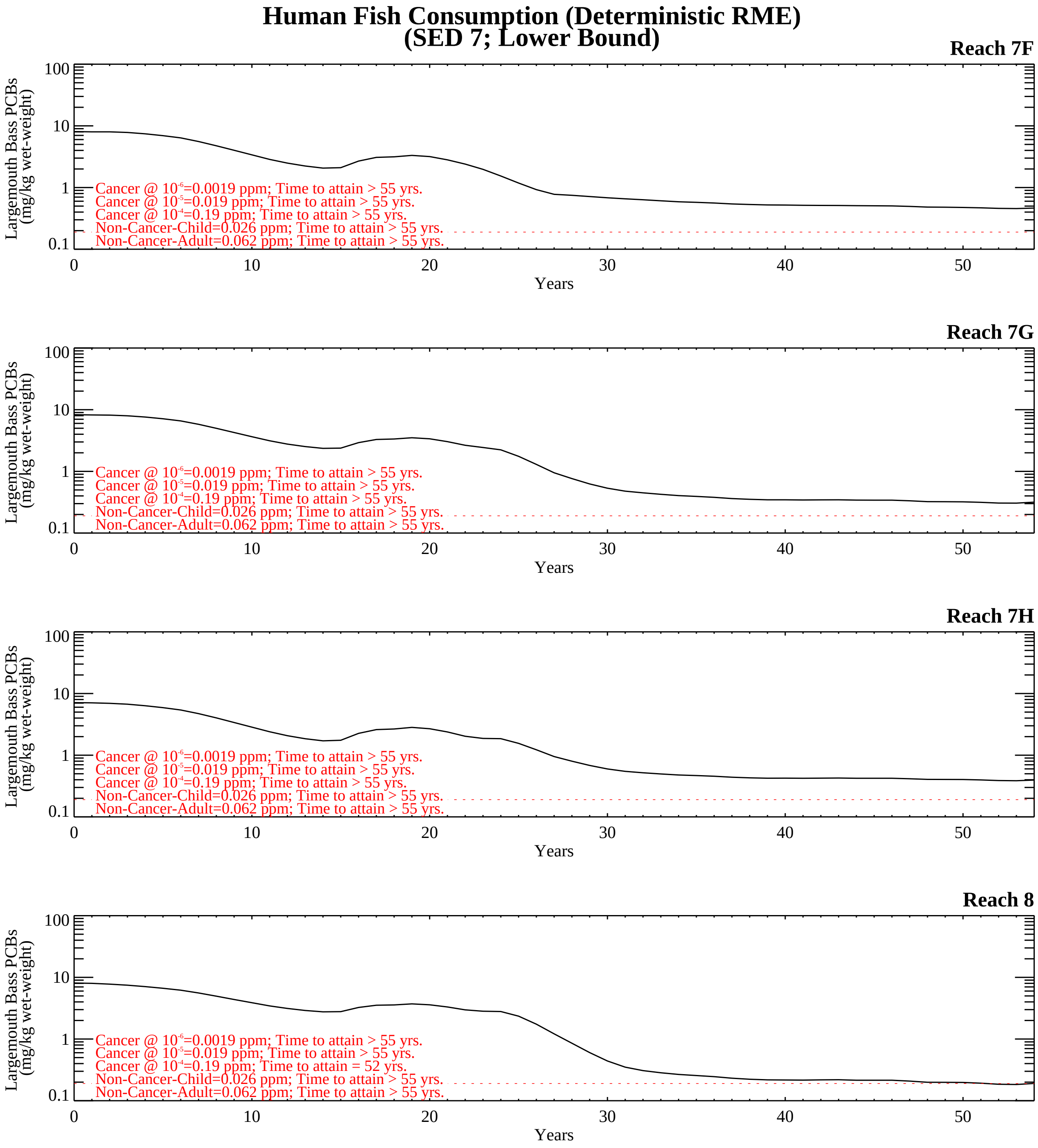

Figure G-8.3-6e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic CTE)
(SED 7; Lower Bound)

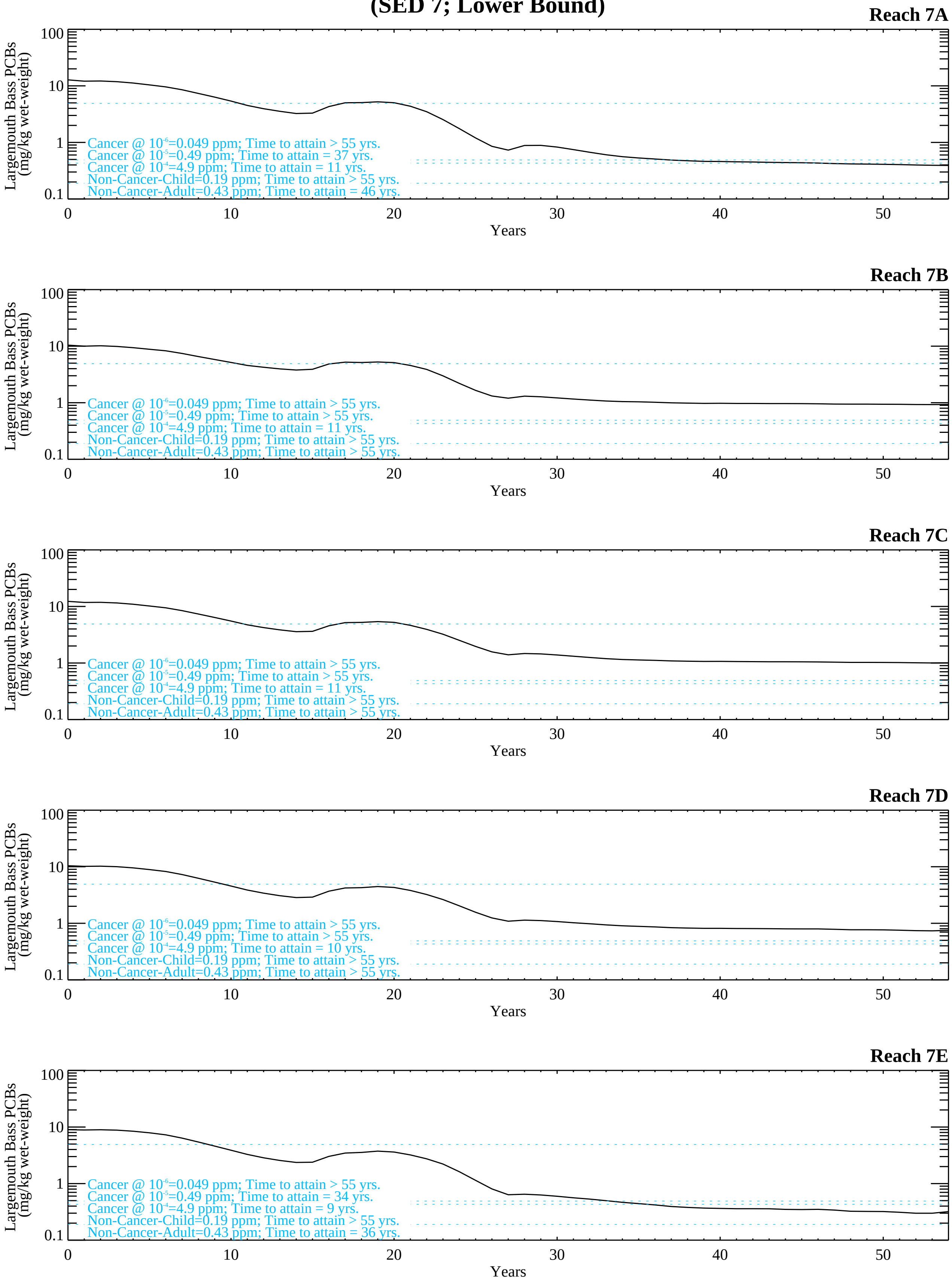

Figure G-8.3-6f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

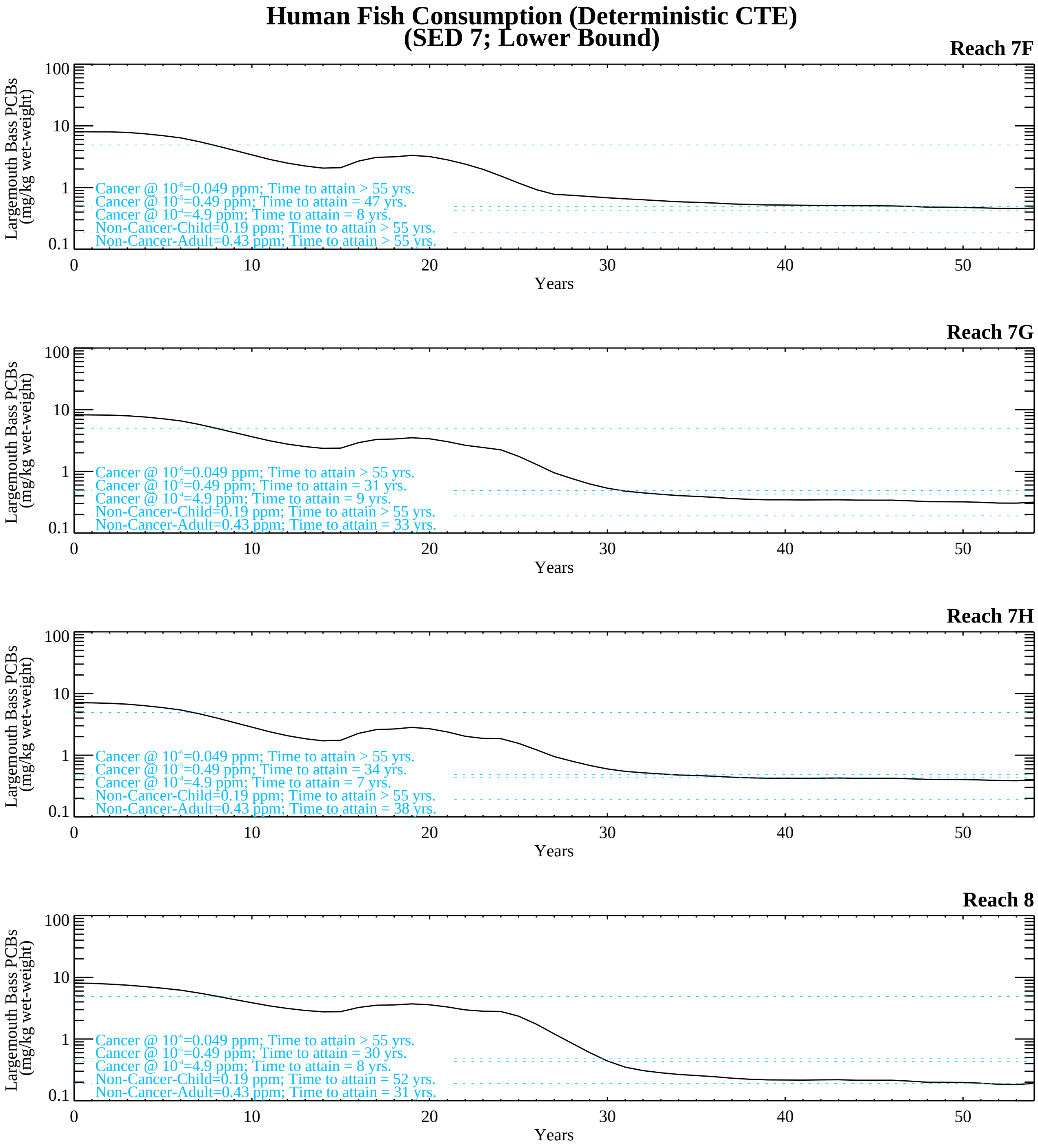

Figure G-8.3-6f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 7; Lower Bound)

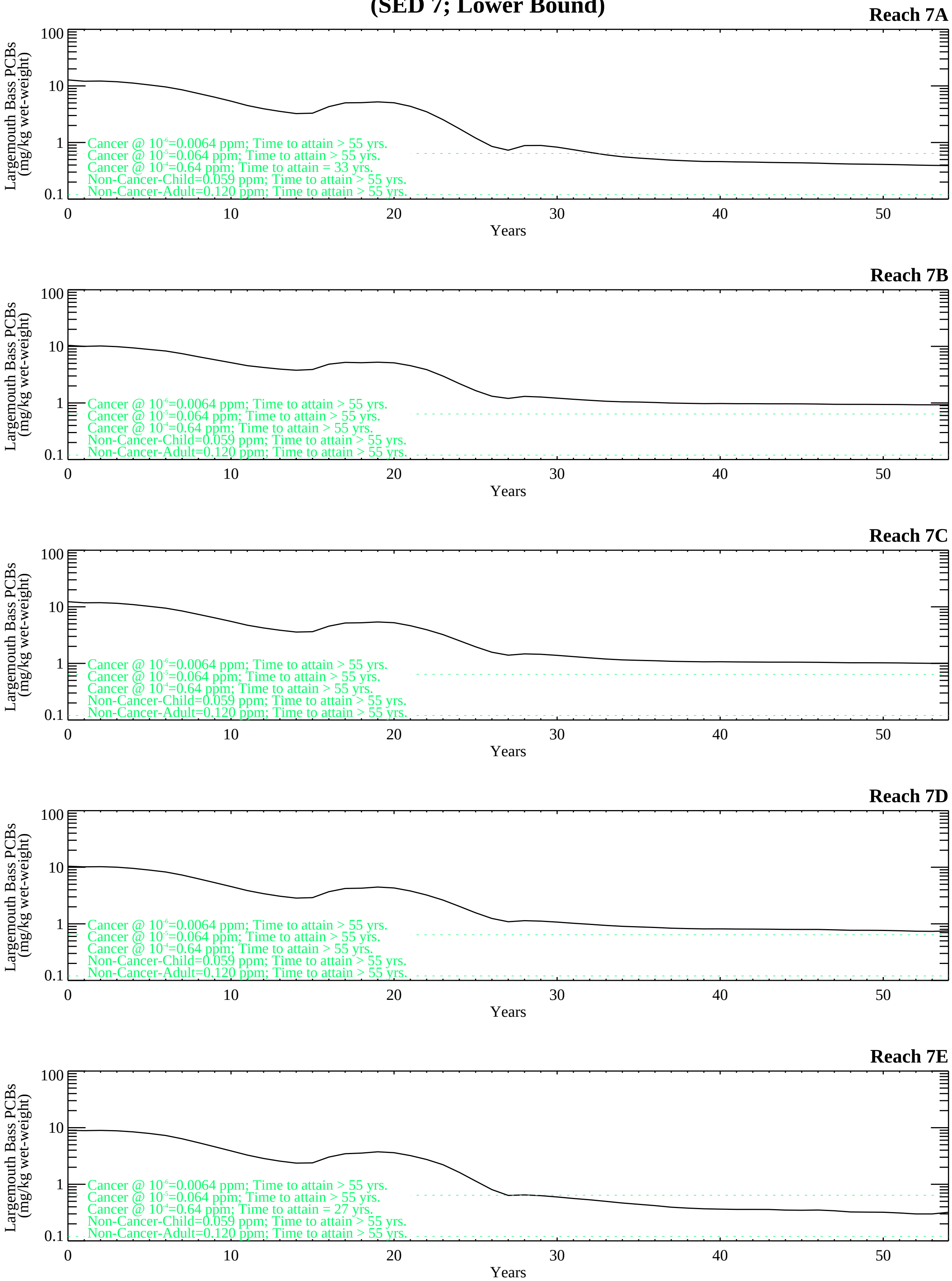

Figure G-8.3-6g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

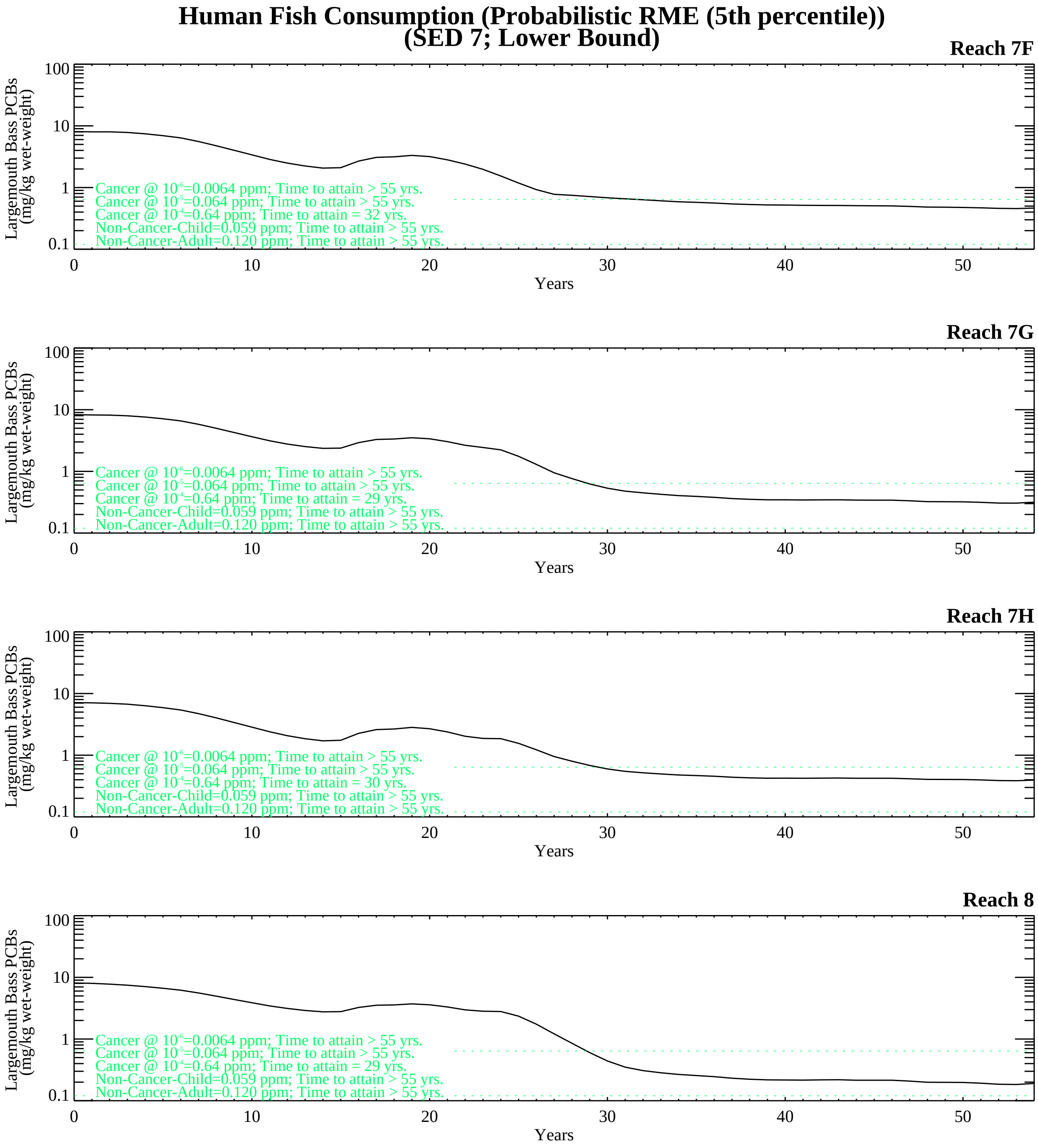

Figure G-8.3-6g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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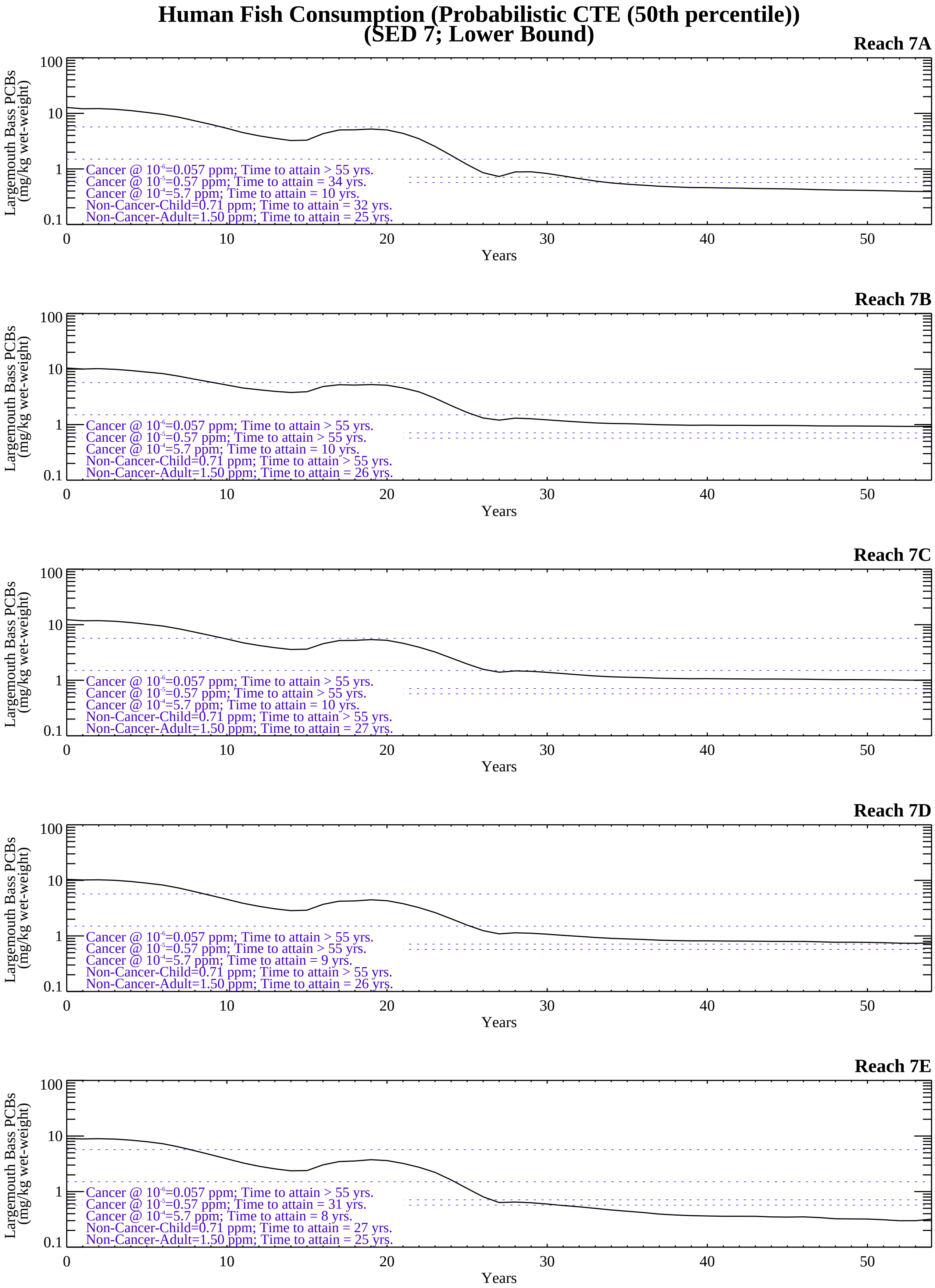

Figure G-8.3-6h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

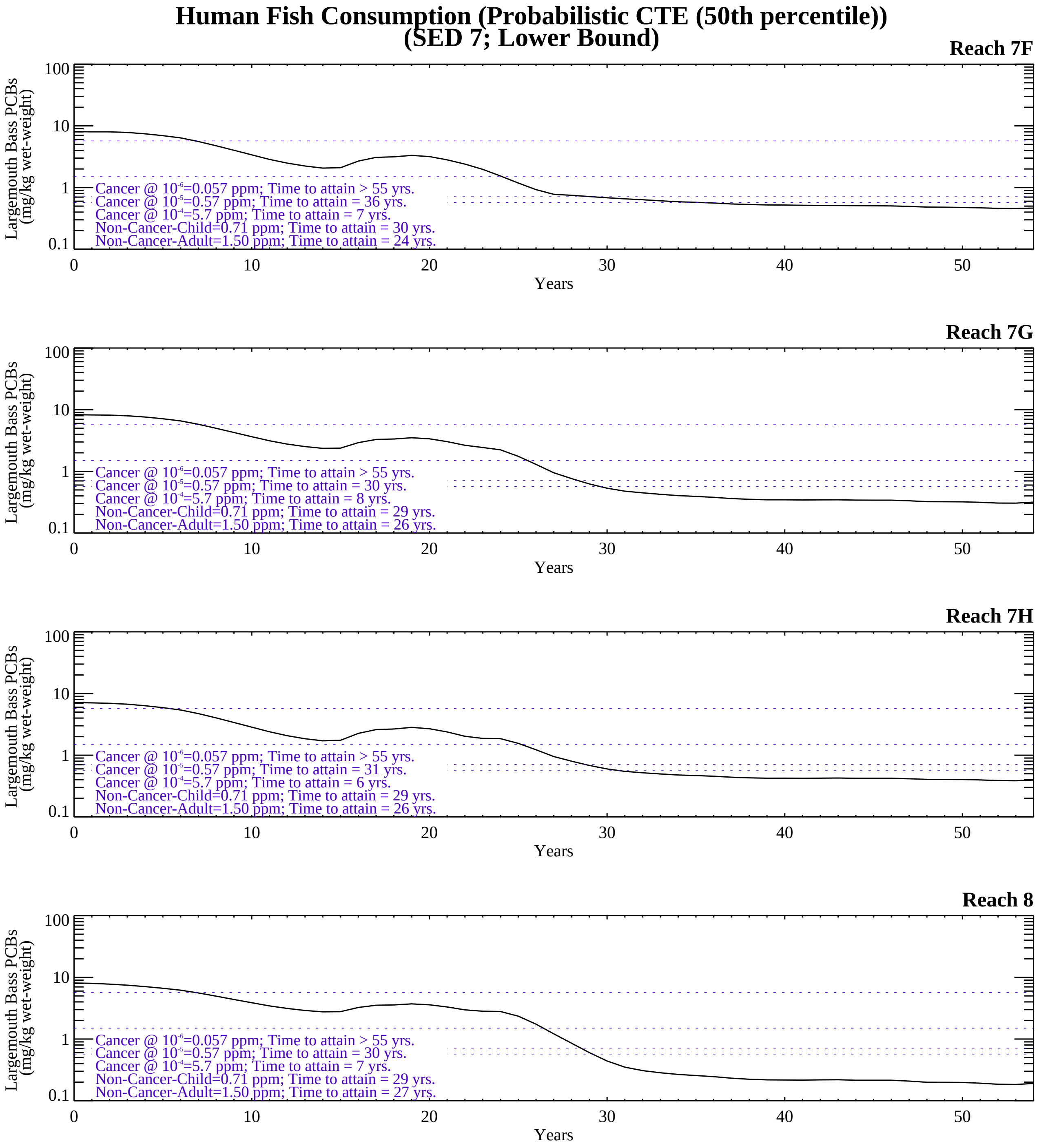

Figure G-8.3-6h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 7; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic RME)
(SED 7; Lower Bound)

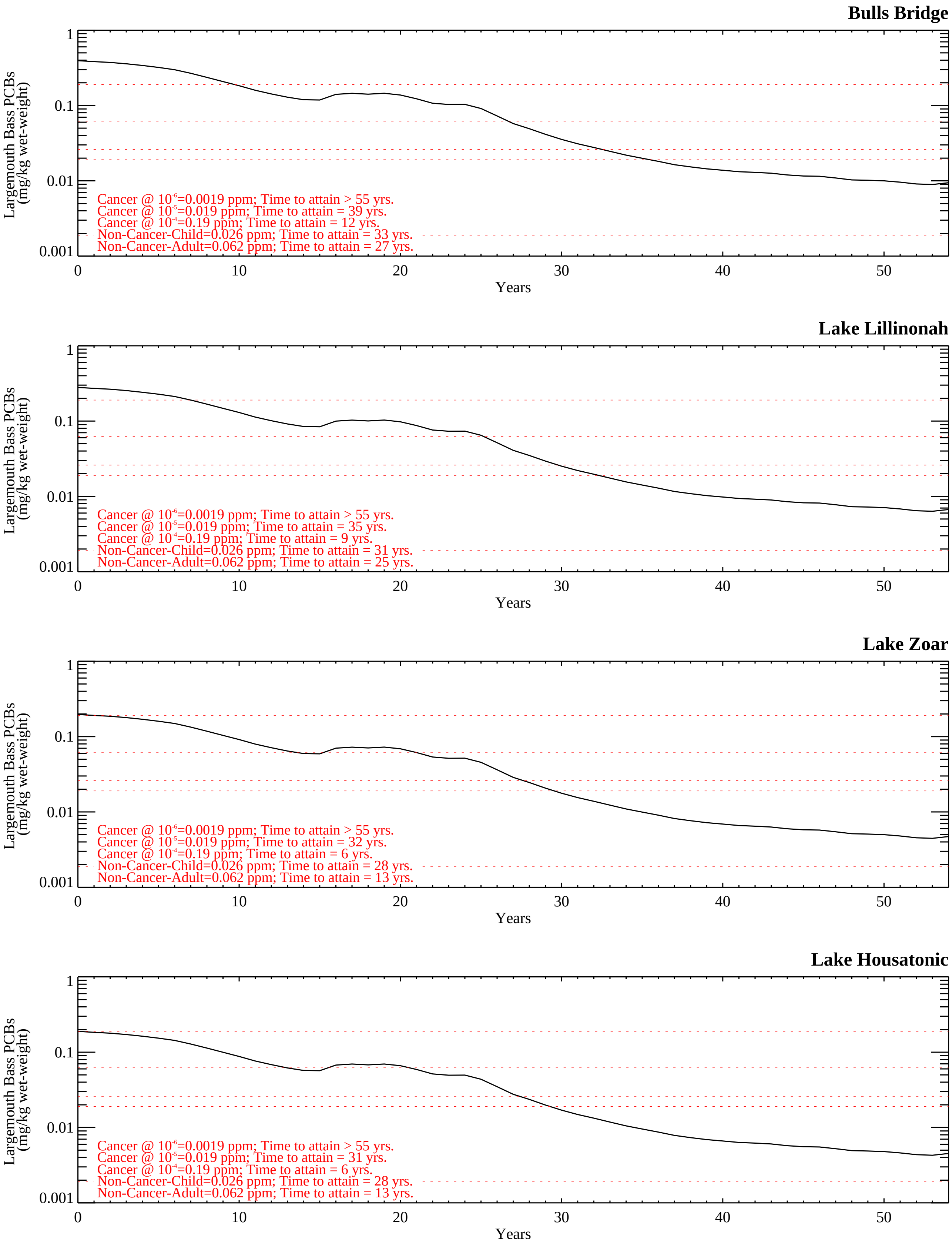

Figure G-8.3-6i. Temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D Analysis compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 7; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Deterministic CTE)
(SED 7; Lower Bound)

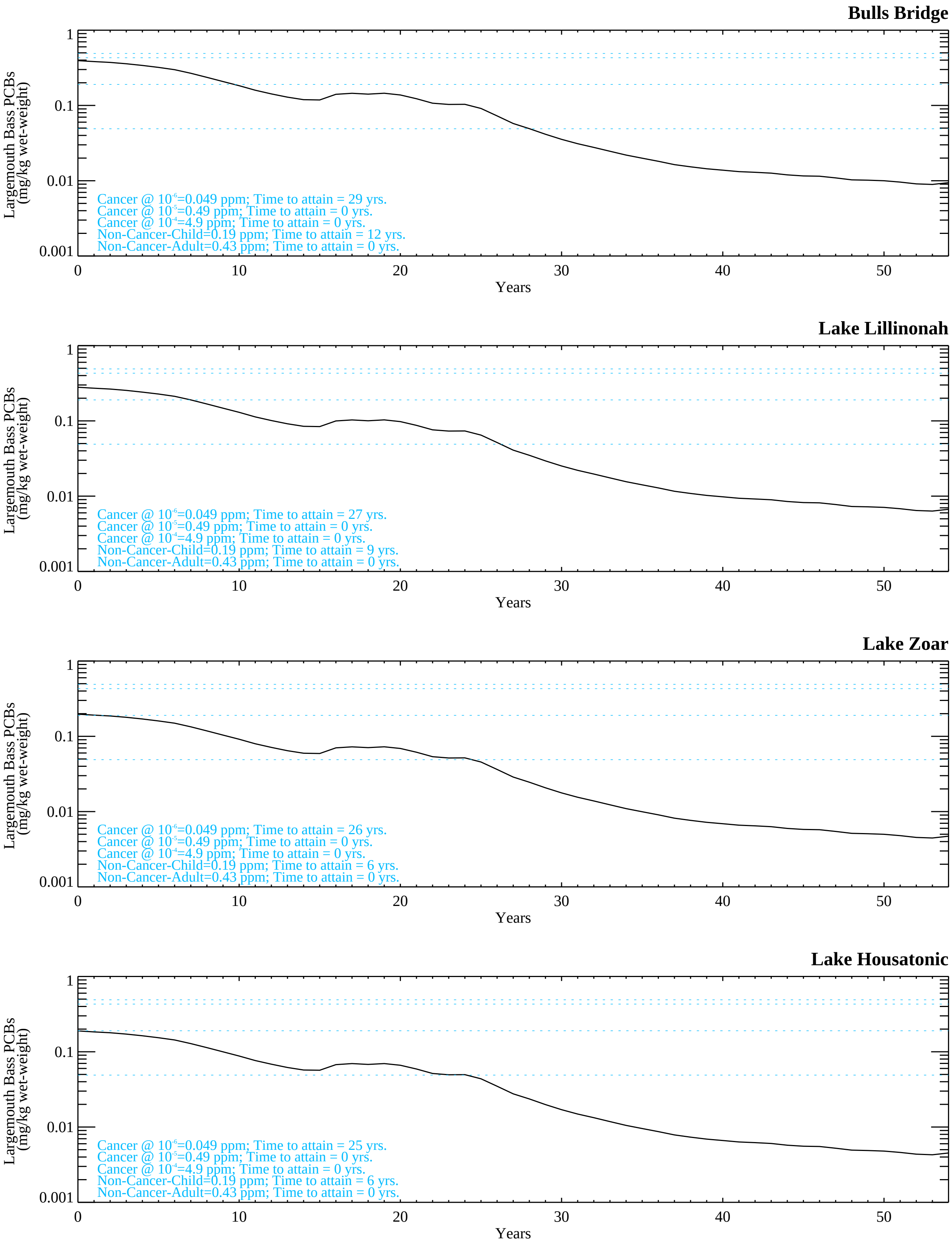

Figure G-8.3-6j. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 7; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 7; Lower Bound)

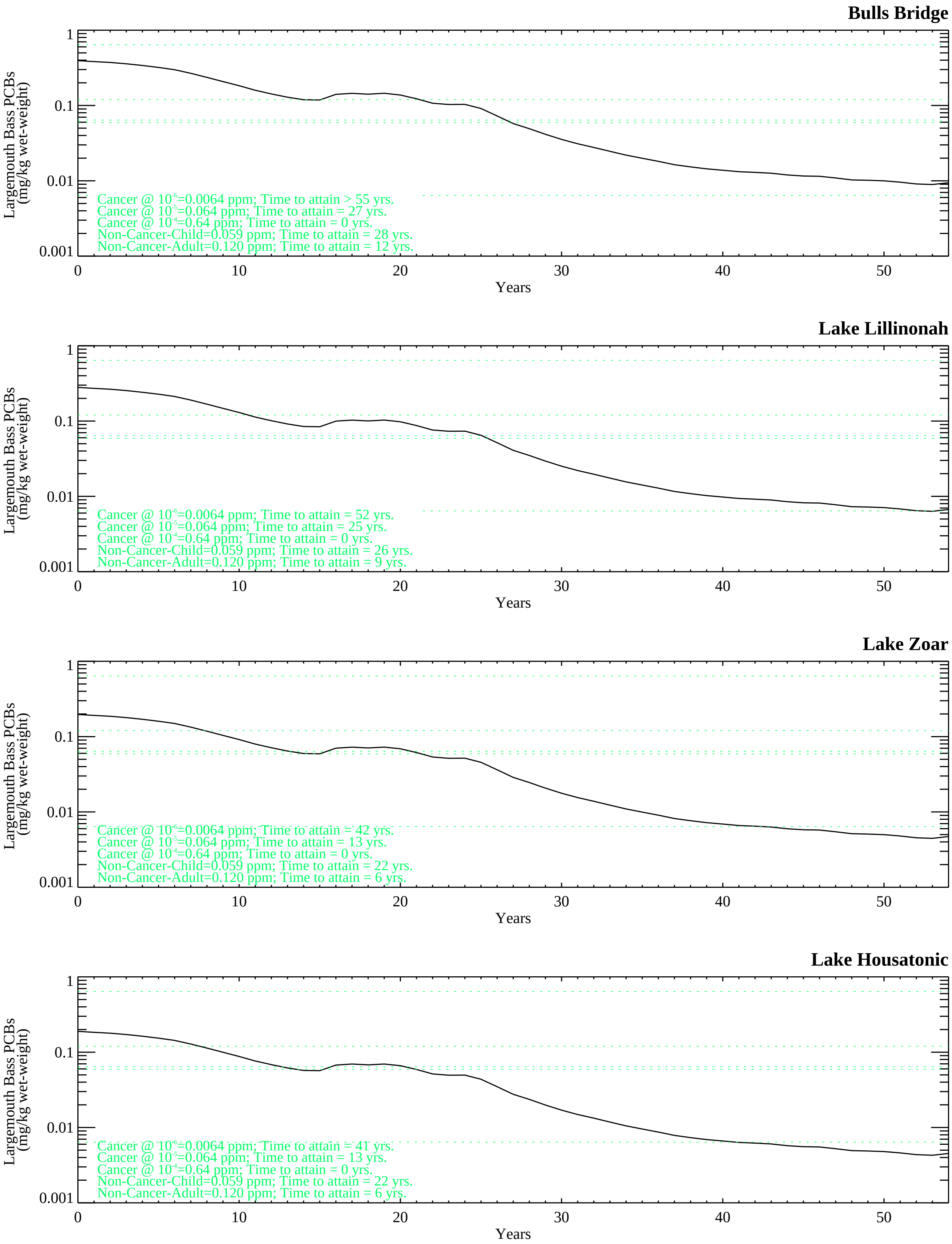

Figure G-8.3-6k. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 7; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 7; Lower Bound)

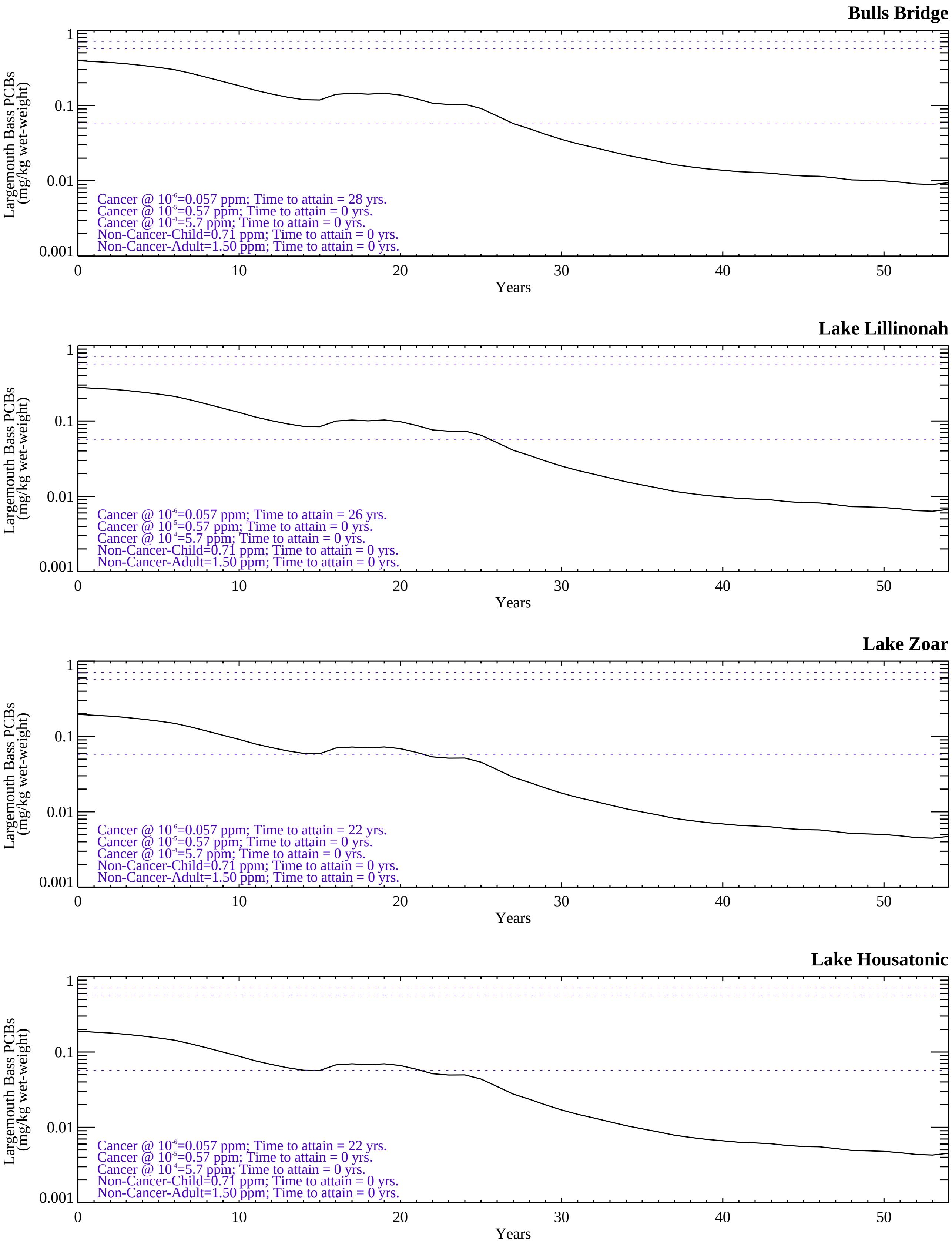

Figure G-8.3-6l. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 7; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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Human Fish Consumption (Deterministic RME)
(SED 8; Lower Bound)

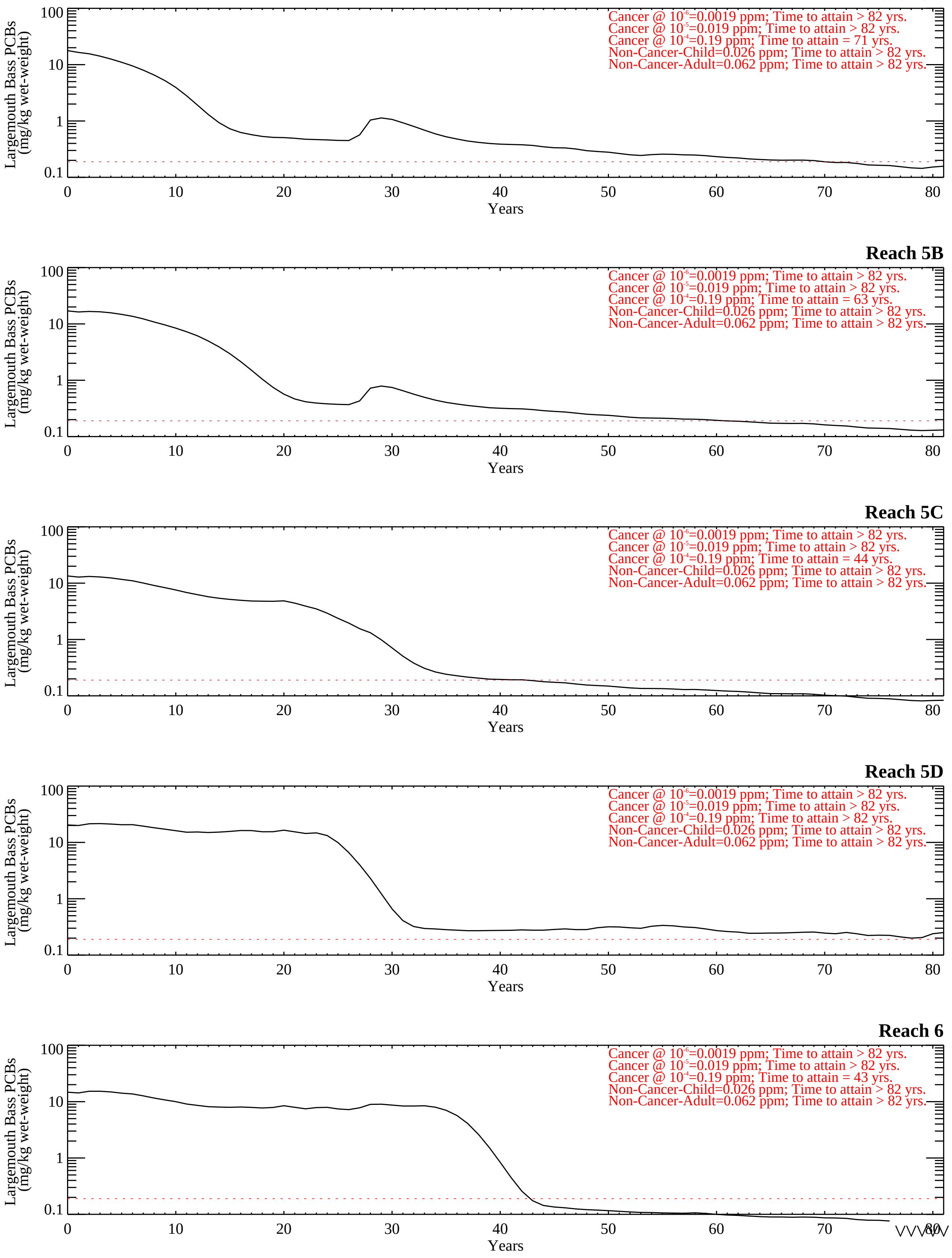

Figure G-8.3-7a. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

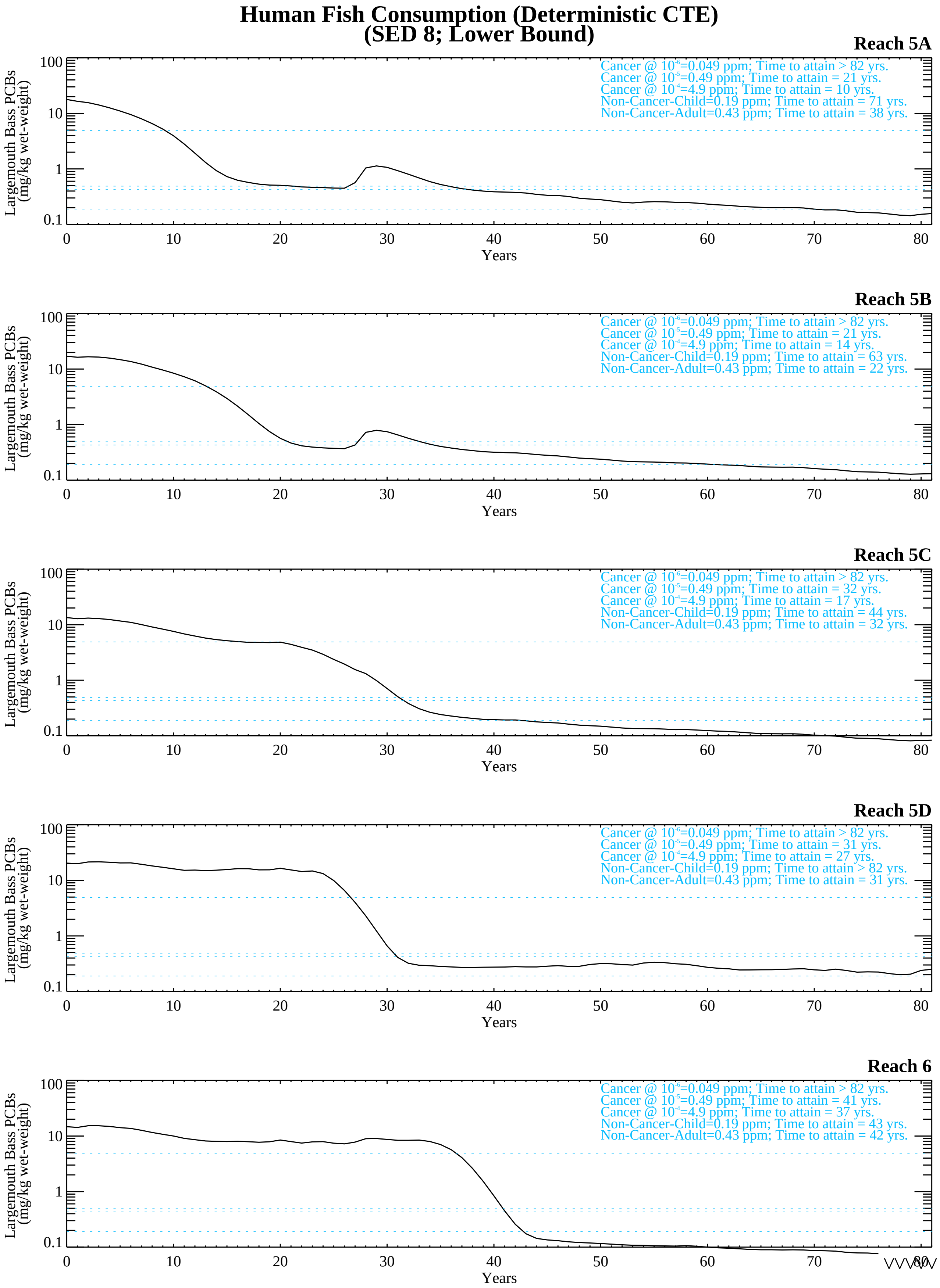

Figure G-8.3-7b. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

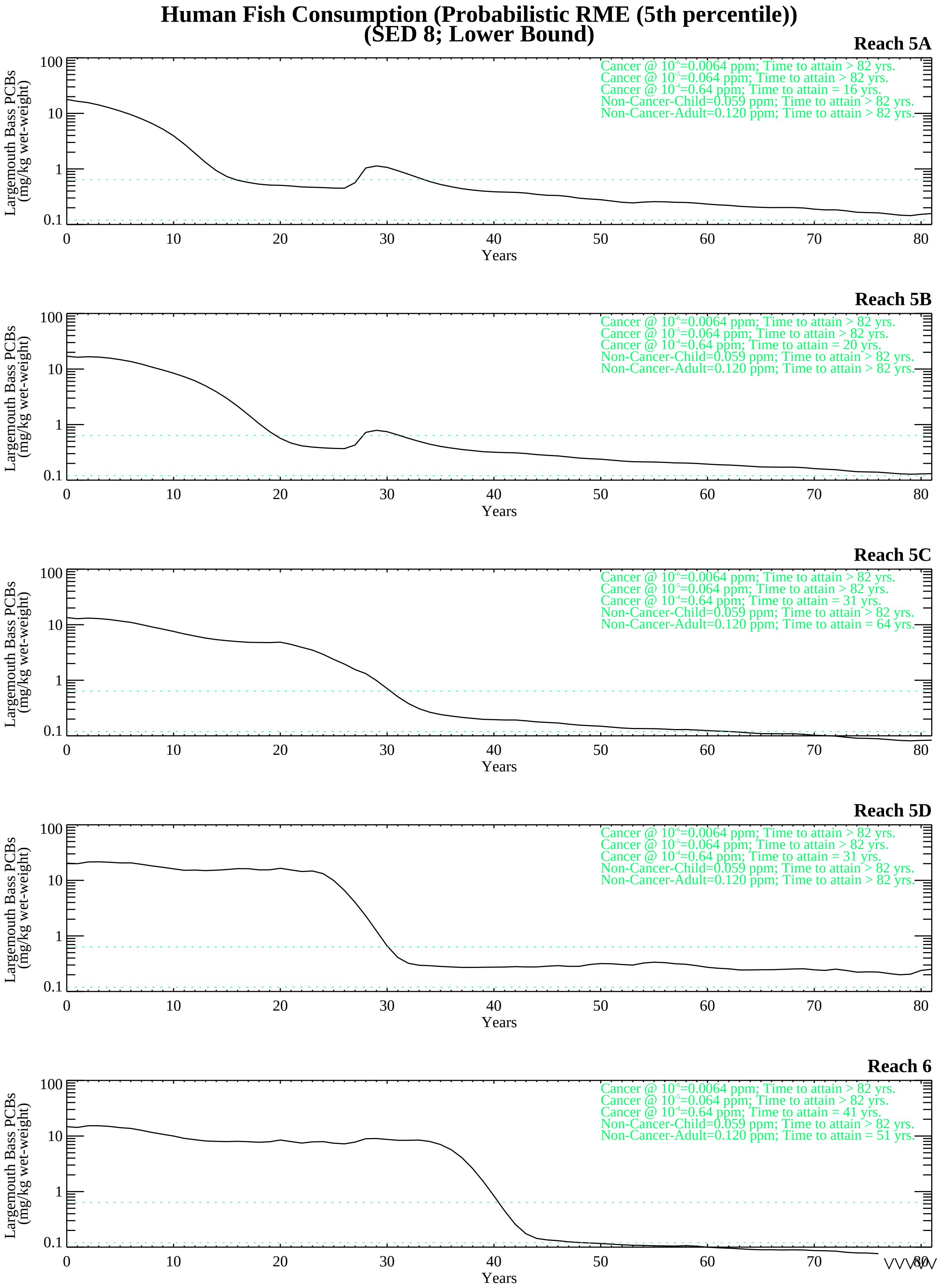

Figure G-8.3-7c. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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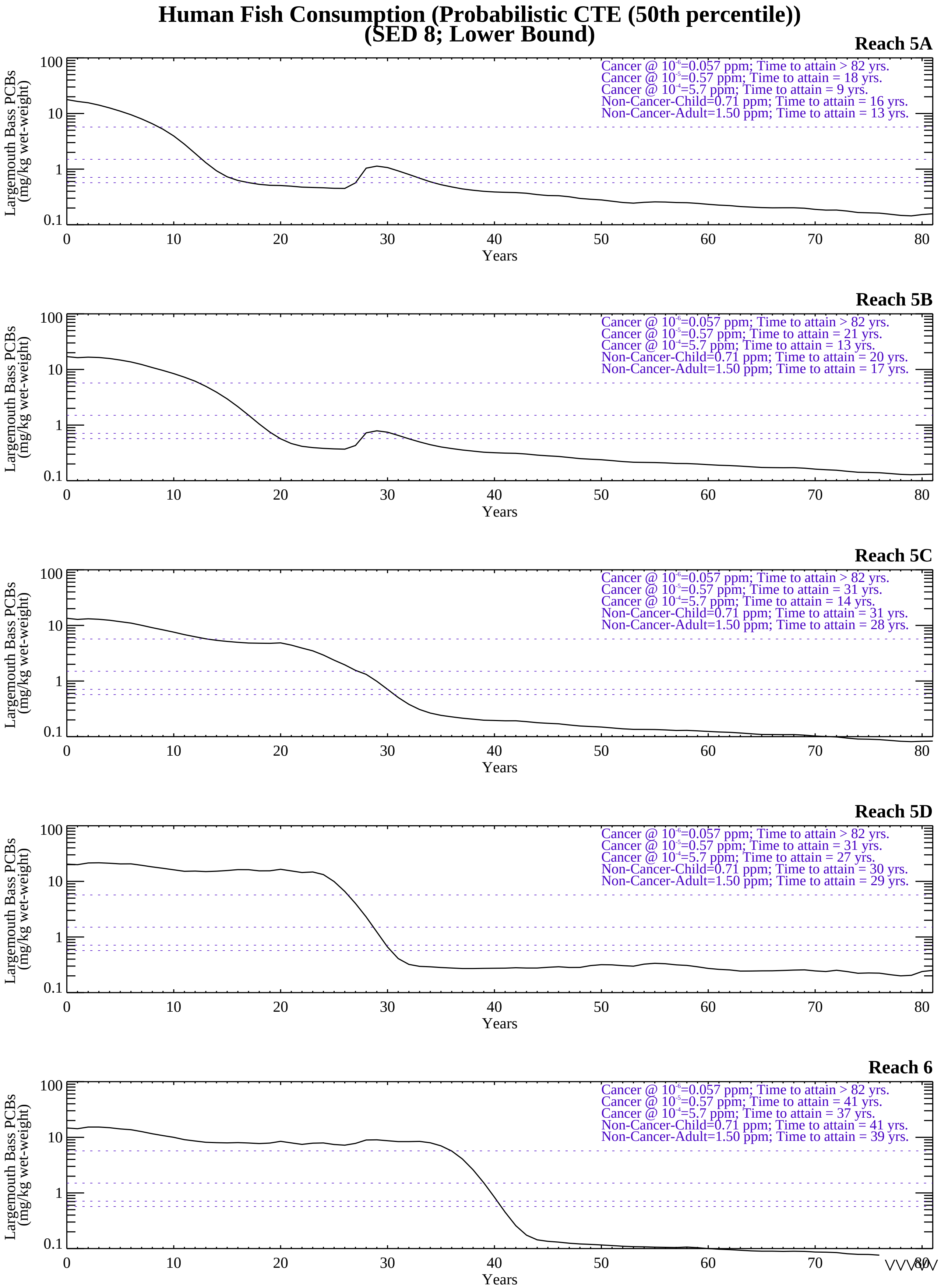

Figure G-8.3-7d. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

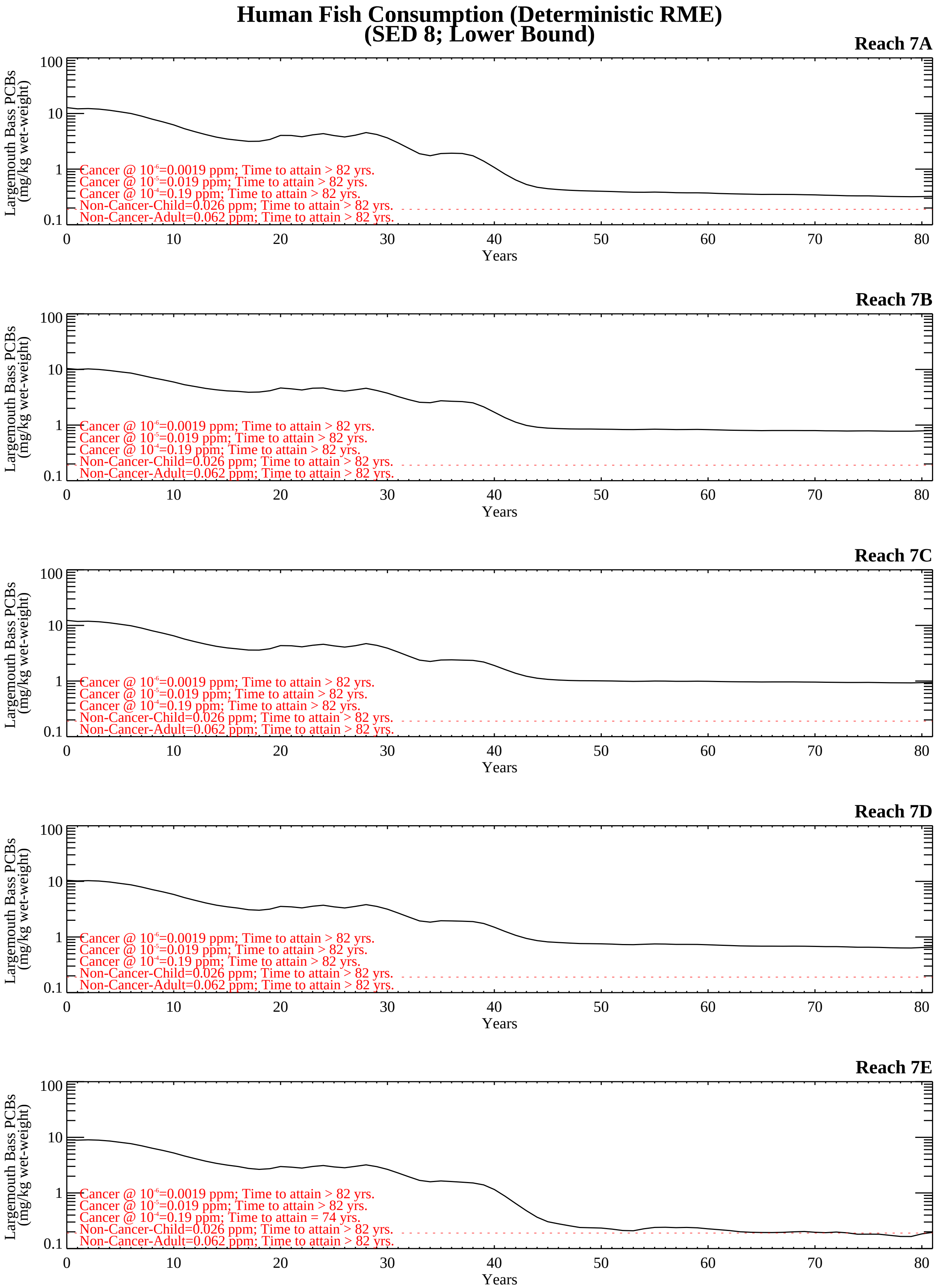

Figure G-8.3-7e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

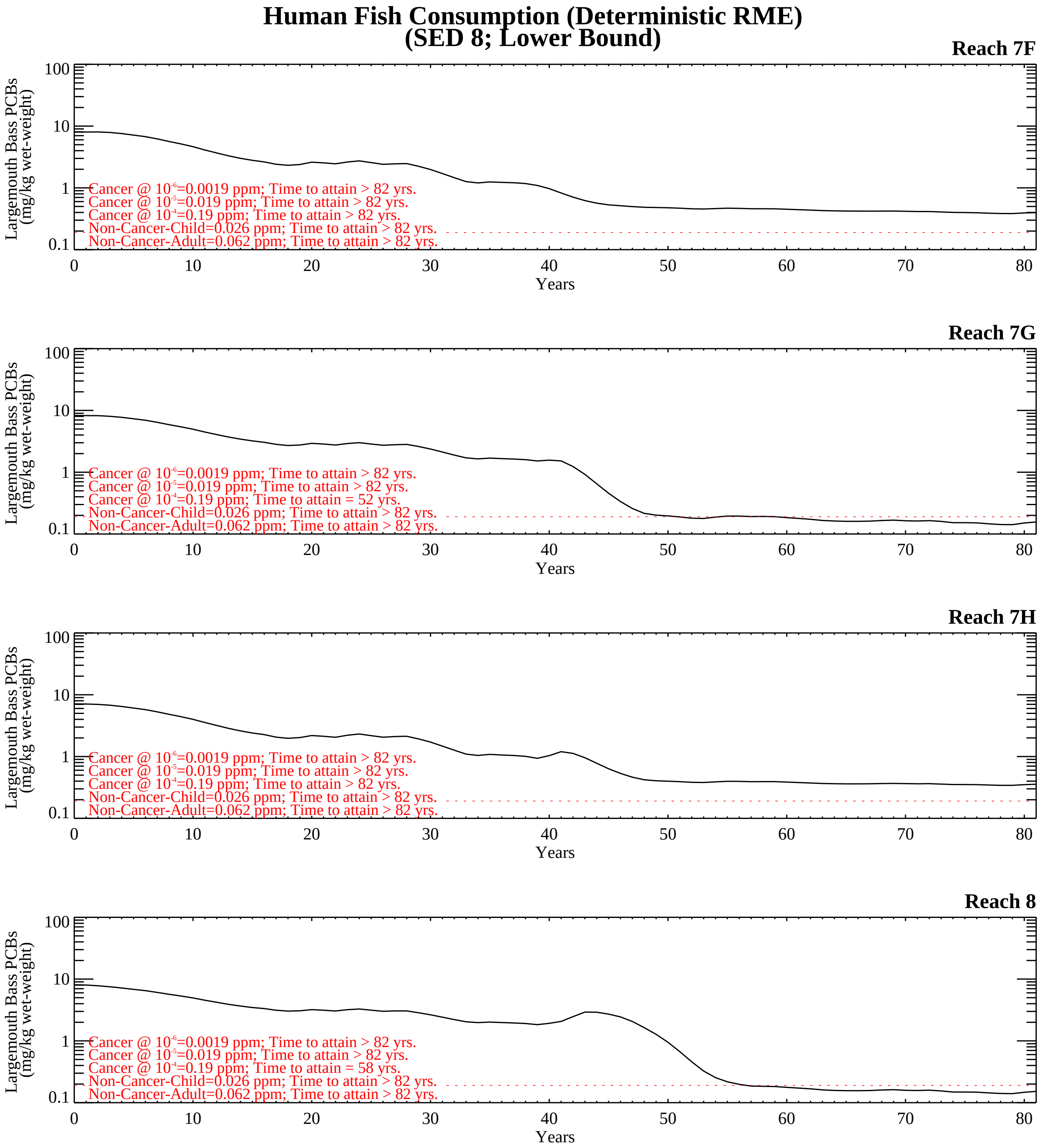

Figure G-8.3-7e. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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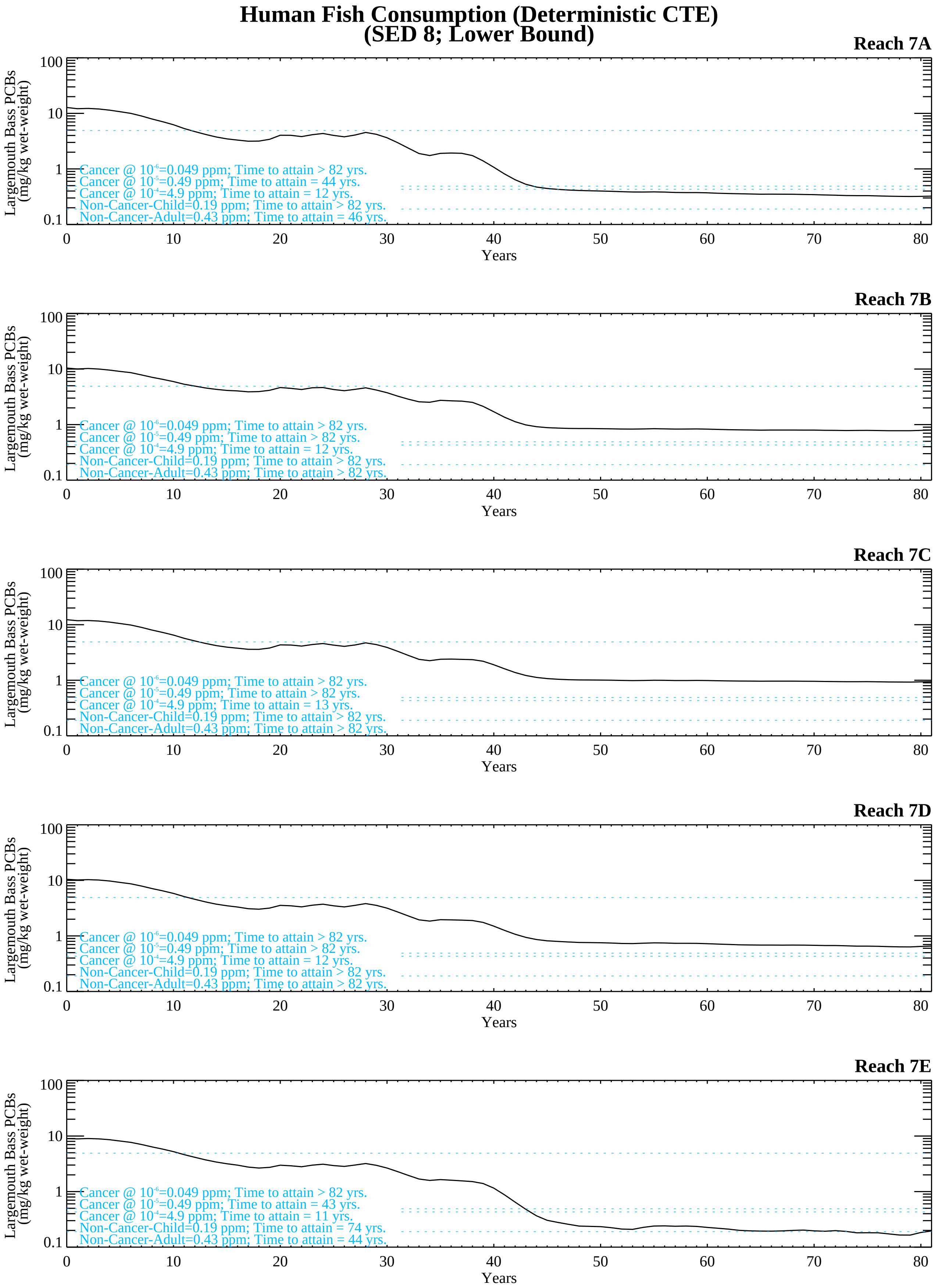

Figure G-8.3-7f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

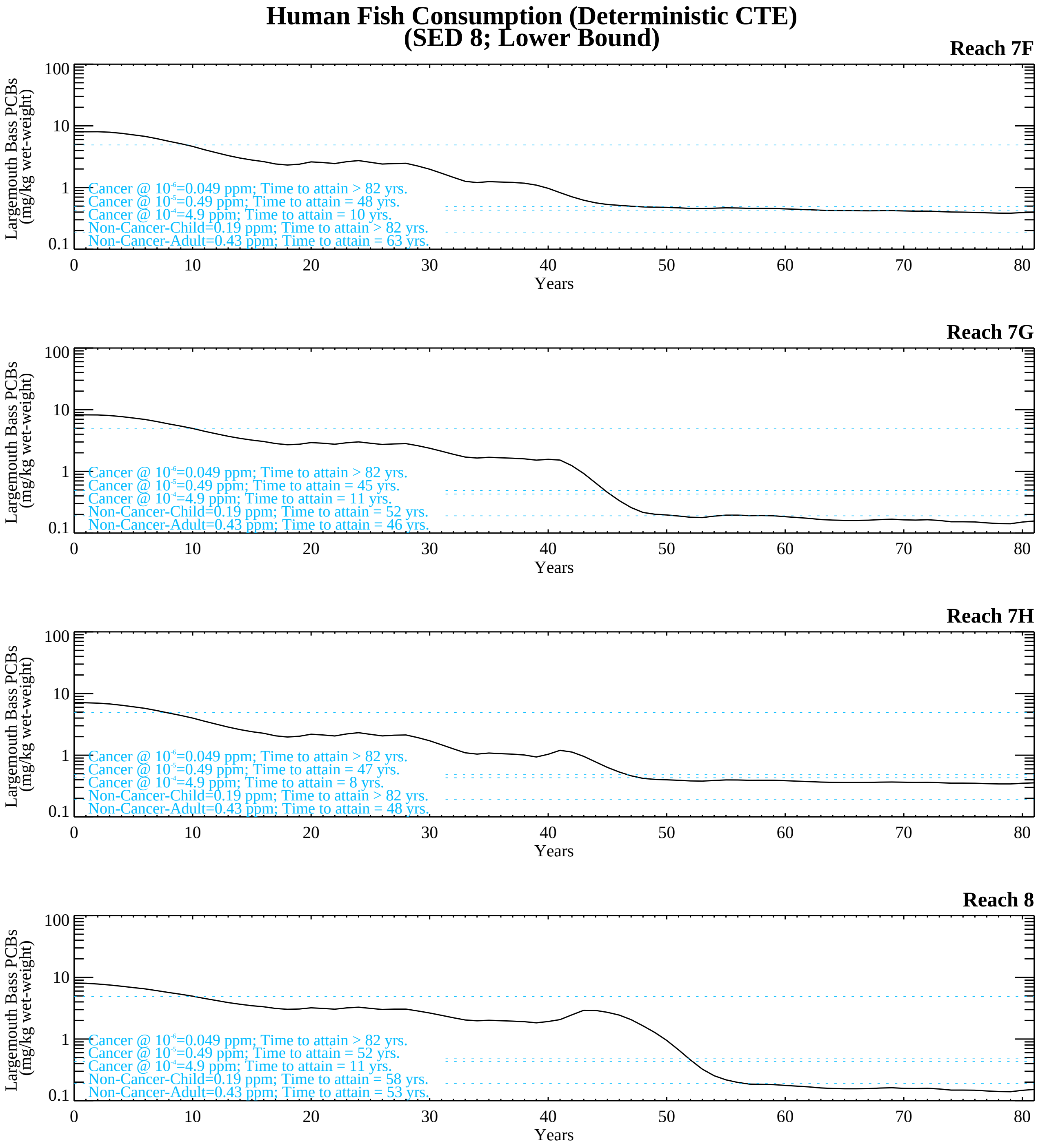

Figure G-8.3-7f. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

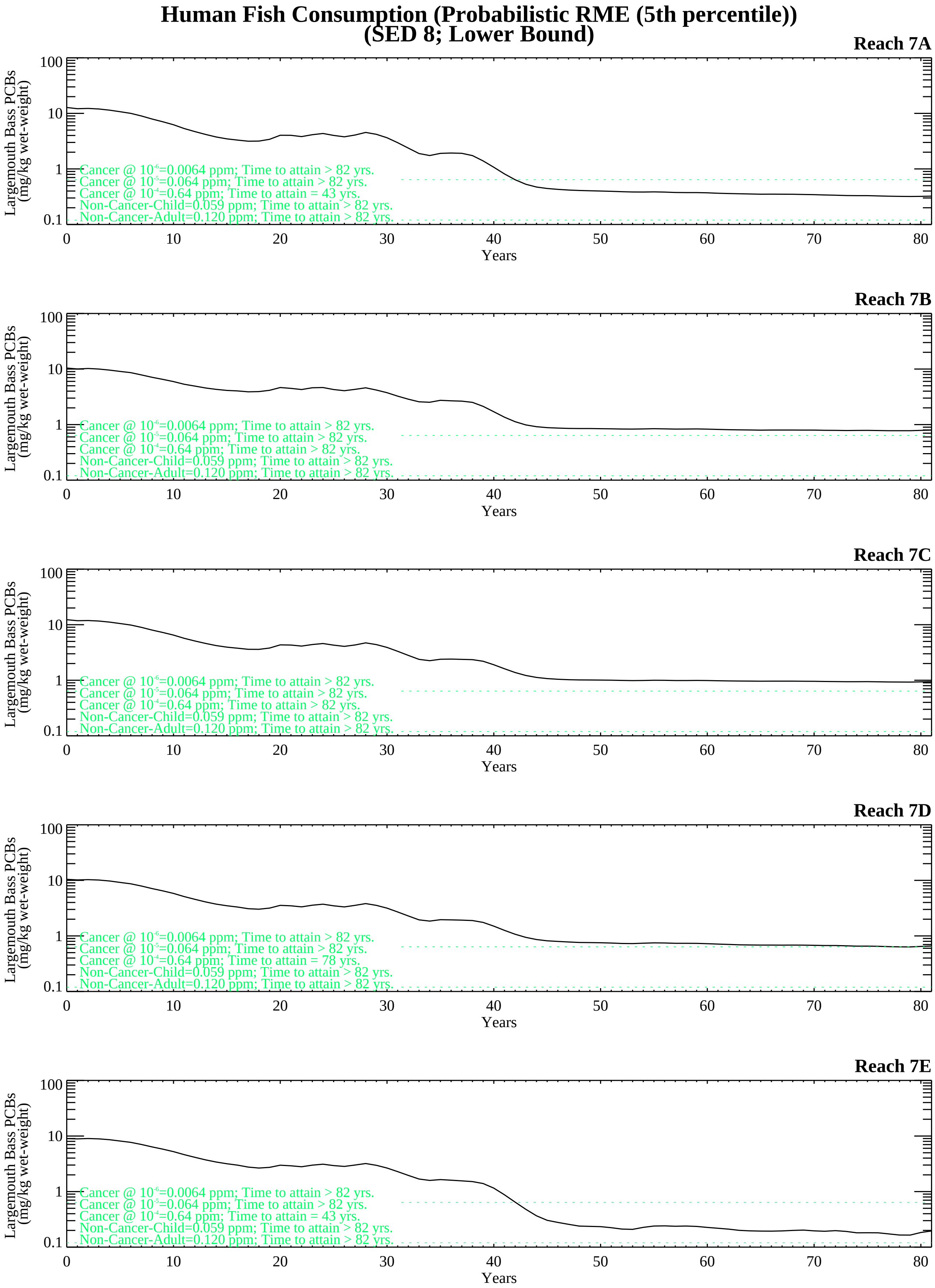

Figure G-8.3-7g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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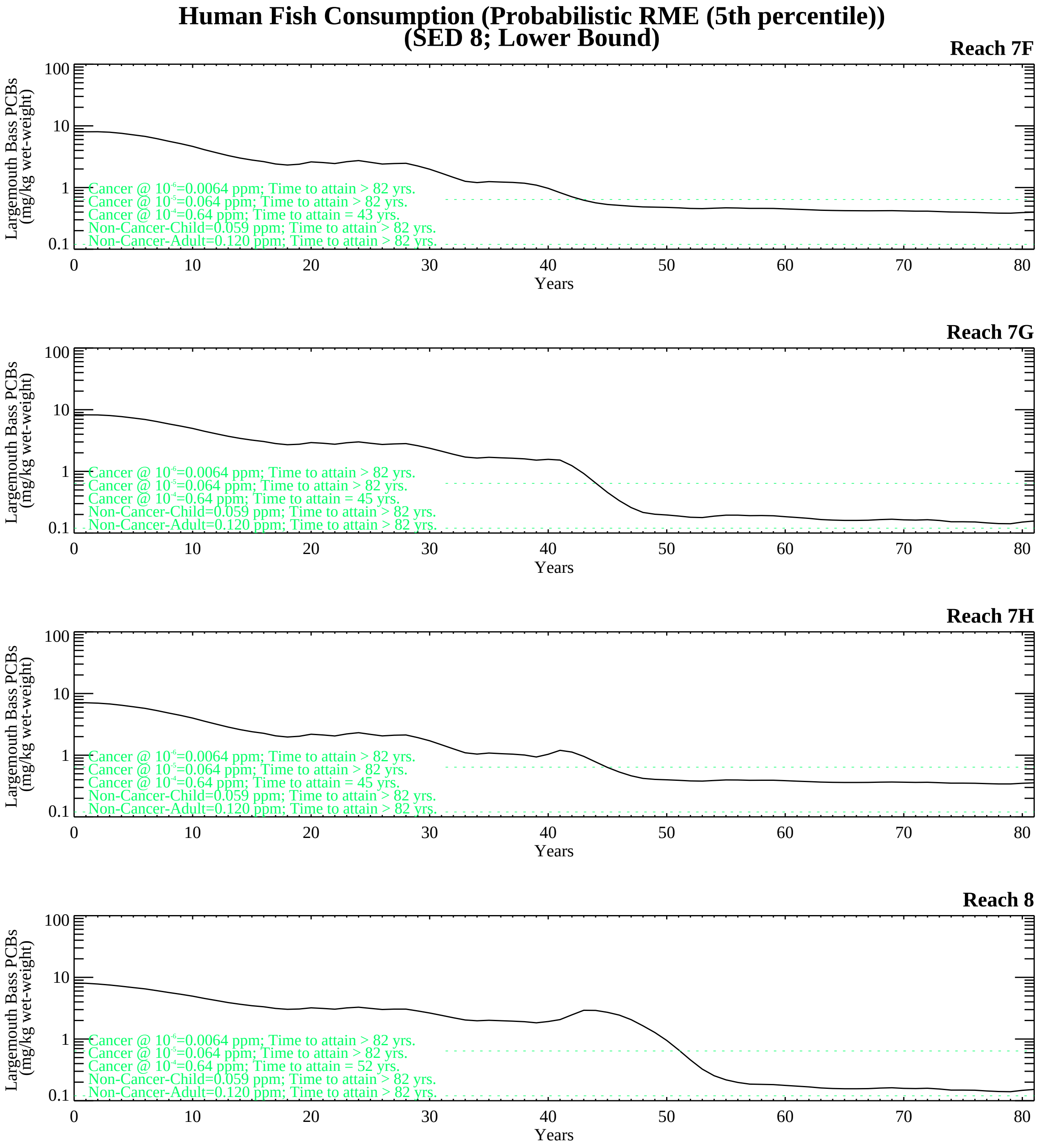

Figure G-8.3-7g. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

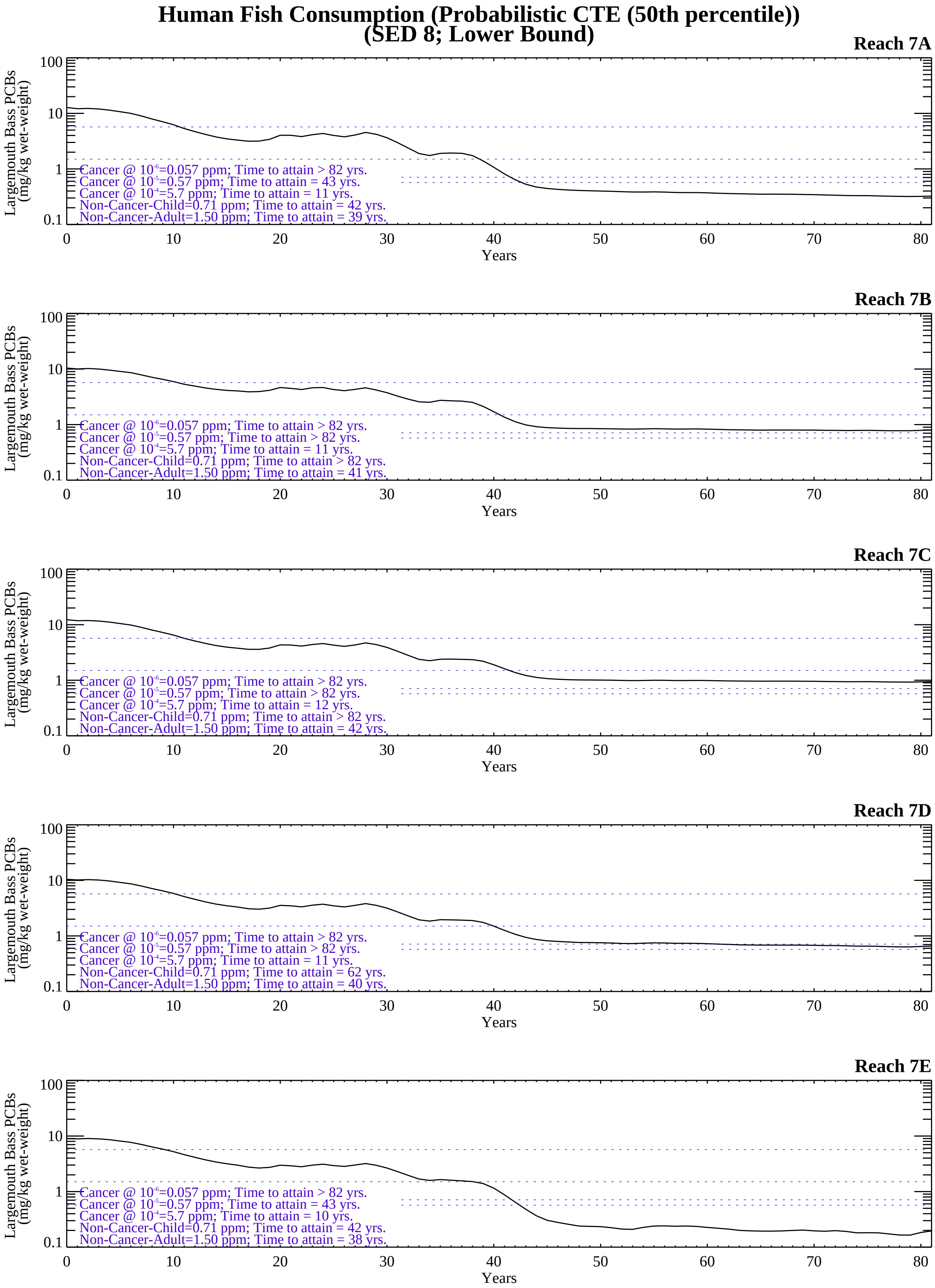

Figure G-8.3-7h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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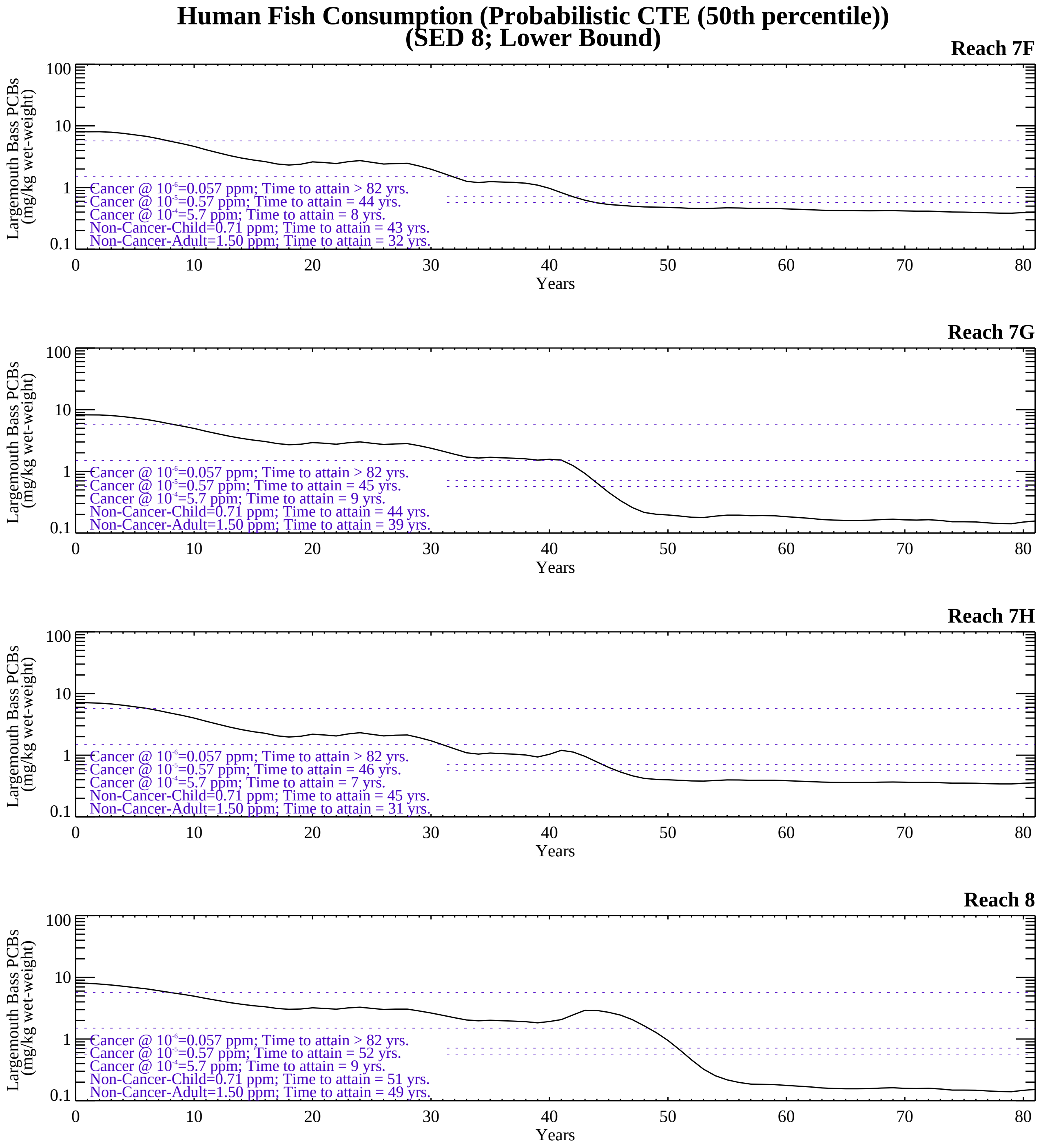

Figure G-8.3-7h. Temporal profiles of model-predicted PCB concentrations in fish fillets compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 8; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

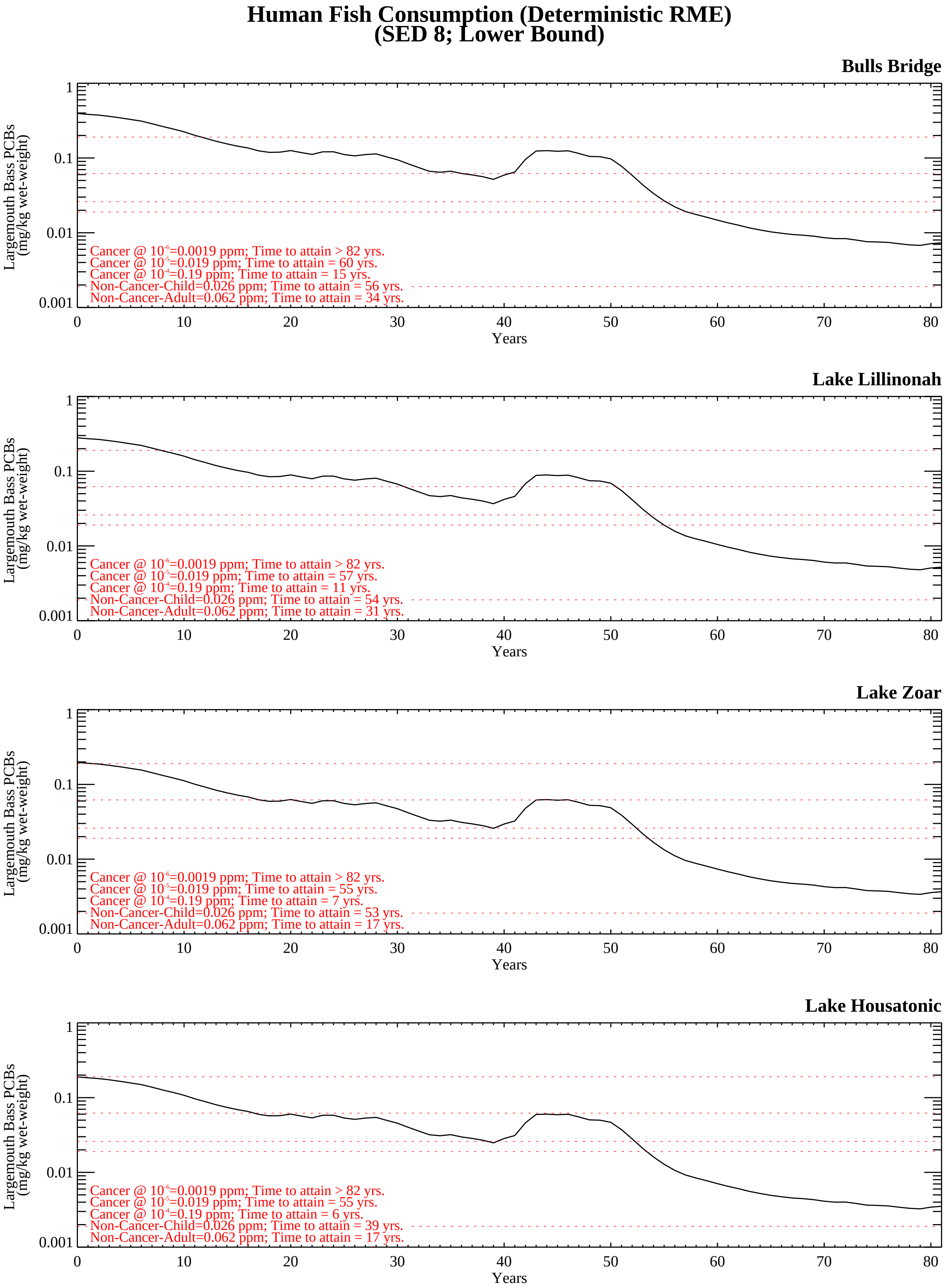

Figure G-8.3-7i. Temporal profiles of PCB concentrations in fish fillets estimated from the CT 1-D Analysis compared to the deterministic RME IMPGs (mg/kg) for human consumption of fish (SED 8; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Deterministic CTE)
(SED 8; Lower Bound)

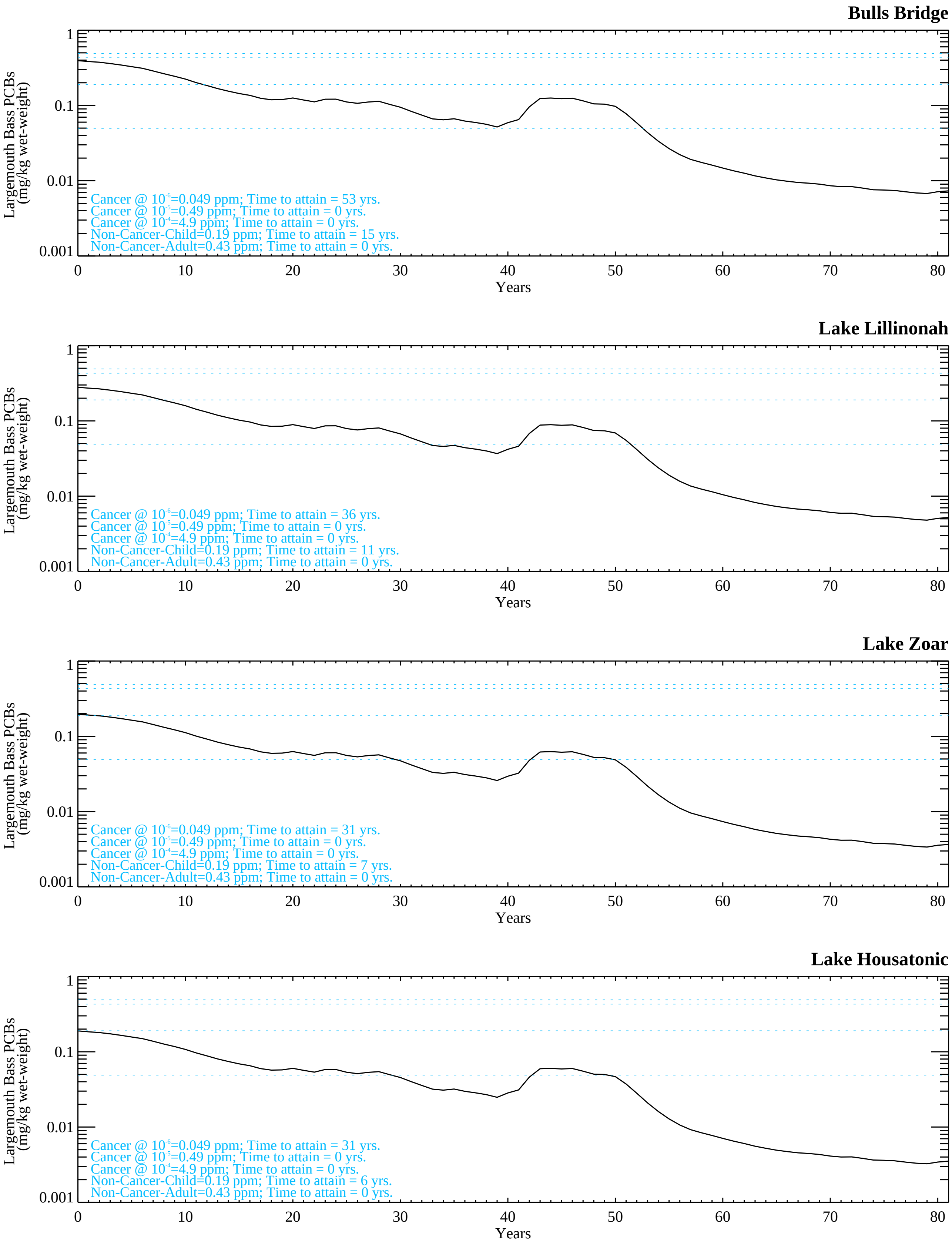

Figure G-8.3-7j. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the deterministic CTE IMPGs (mg/kg) for human consumption of fish (SED 8; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic RME (5th percentile))
(SED 8; Lower Bound)

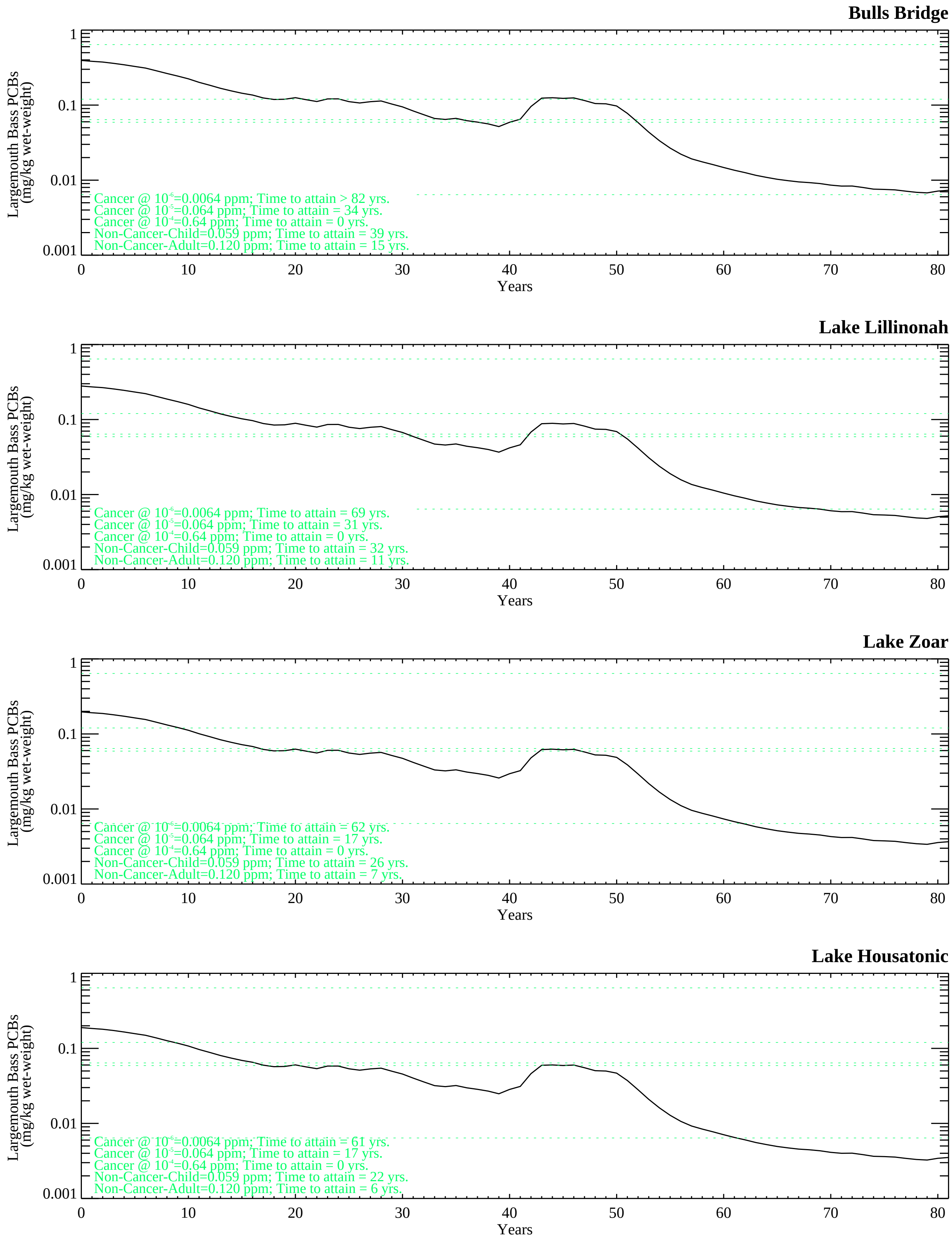

Figure G-8.3-7k. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic RME (5th percentile) IMPGs (mg/kg) for human consumption of fish (SED 8; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

Human Fish Consumption (Probabilistic CTE (50th percentile))
(SED 8; Lower Bound)

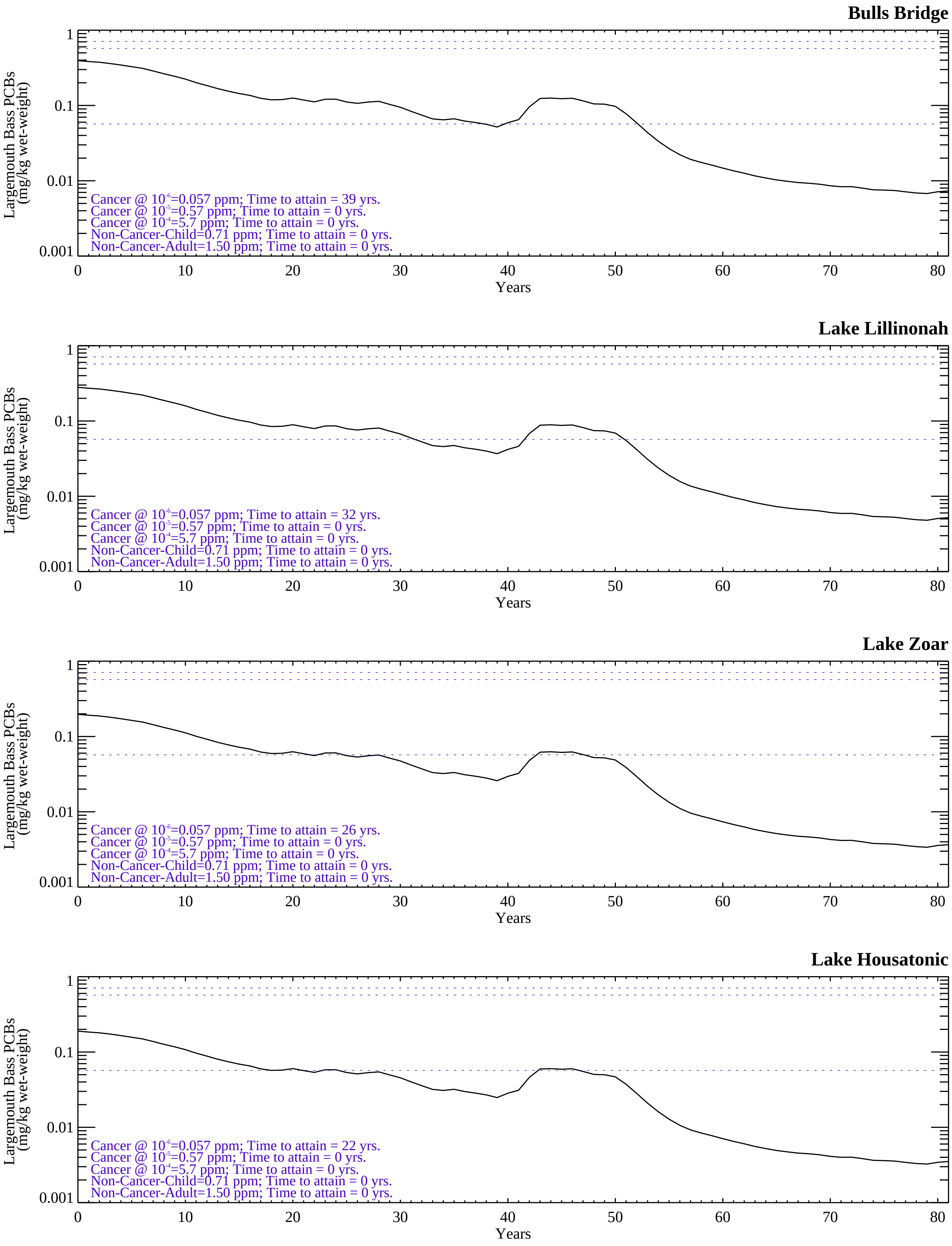

Figure G-8.3-7l. Temporal profiles of PCB concentrations in fish fillets from the CT 1-D Analysis compared to the probabilistic CTE (50th percentile) IMPGs (mg/kg) for human consumption of fish (SED 8; CT; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 5 to 9. Fillet-based concentrations were calculated as whole body concentrations divided by 5.0.

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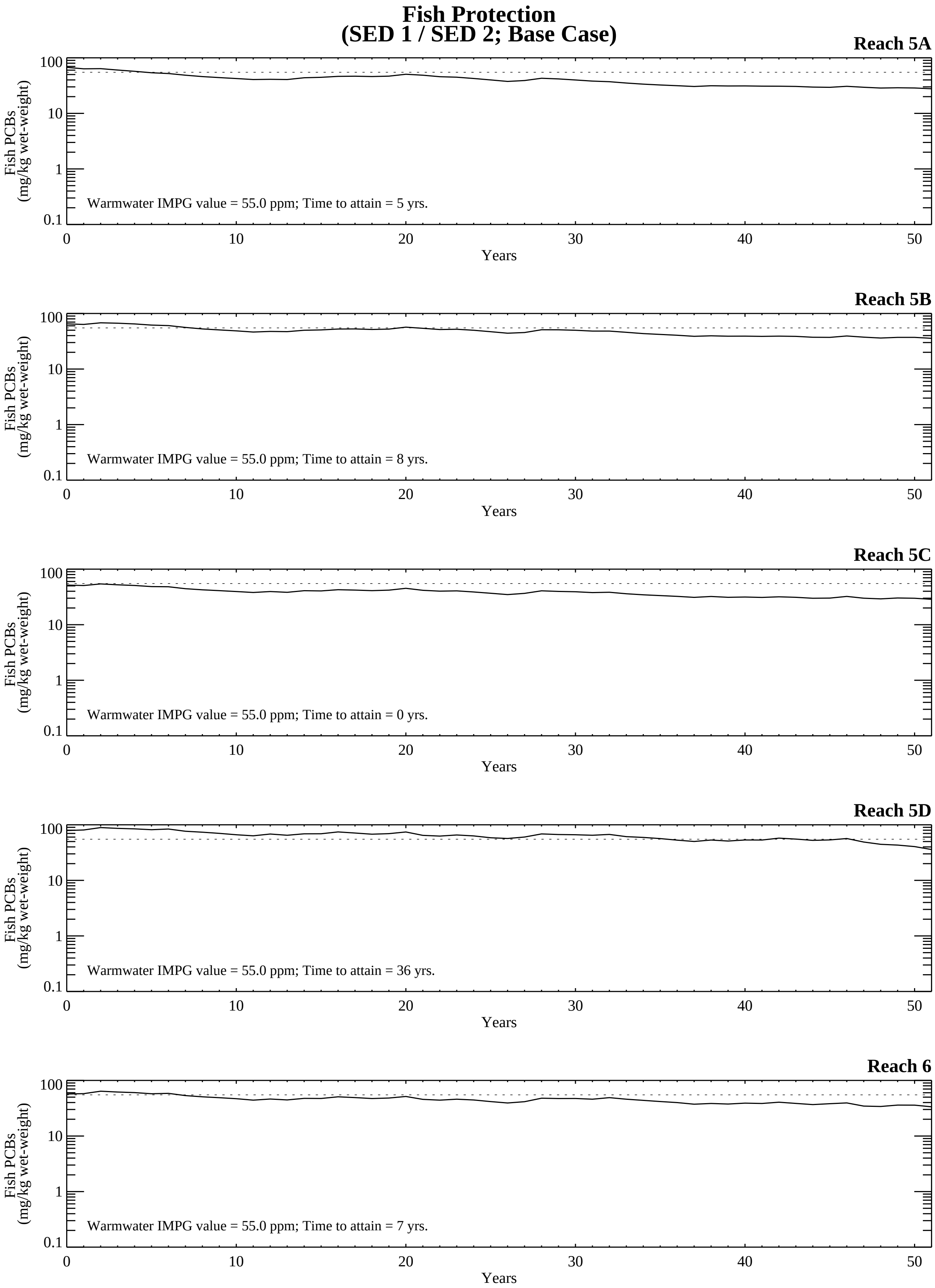

Figure G-9.1-1a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 1 / SED 2; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

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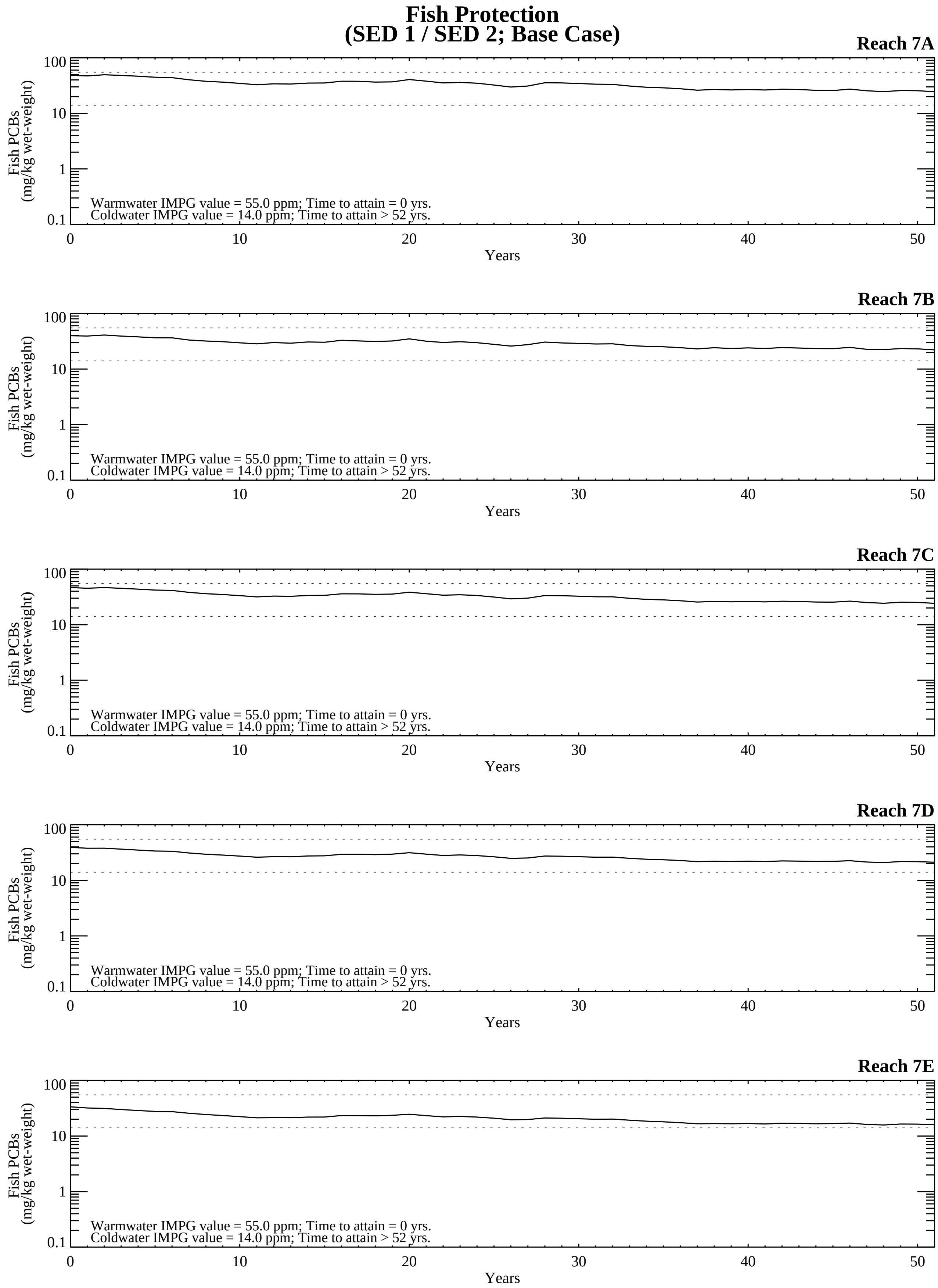

Figure G-9.1-1b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 1 / SED 2; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

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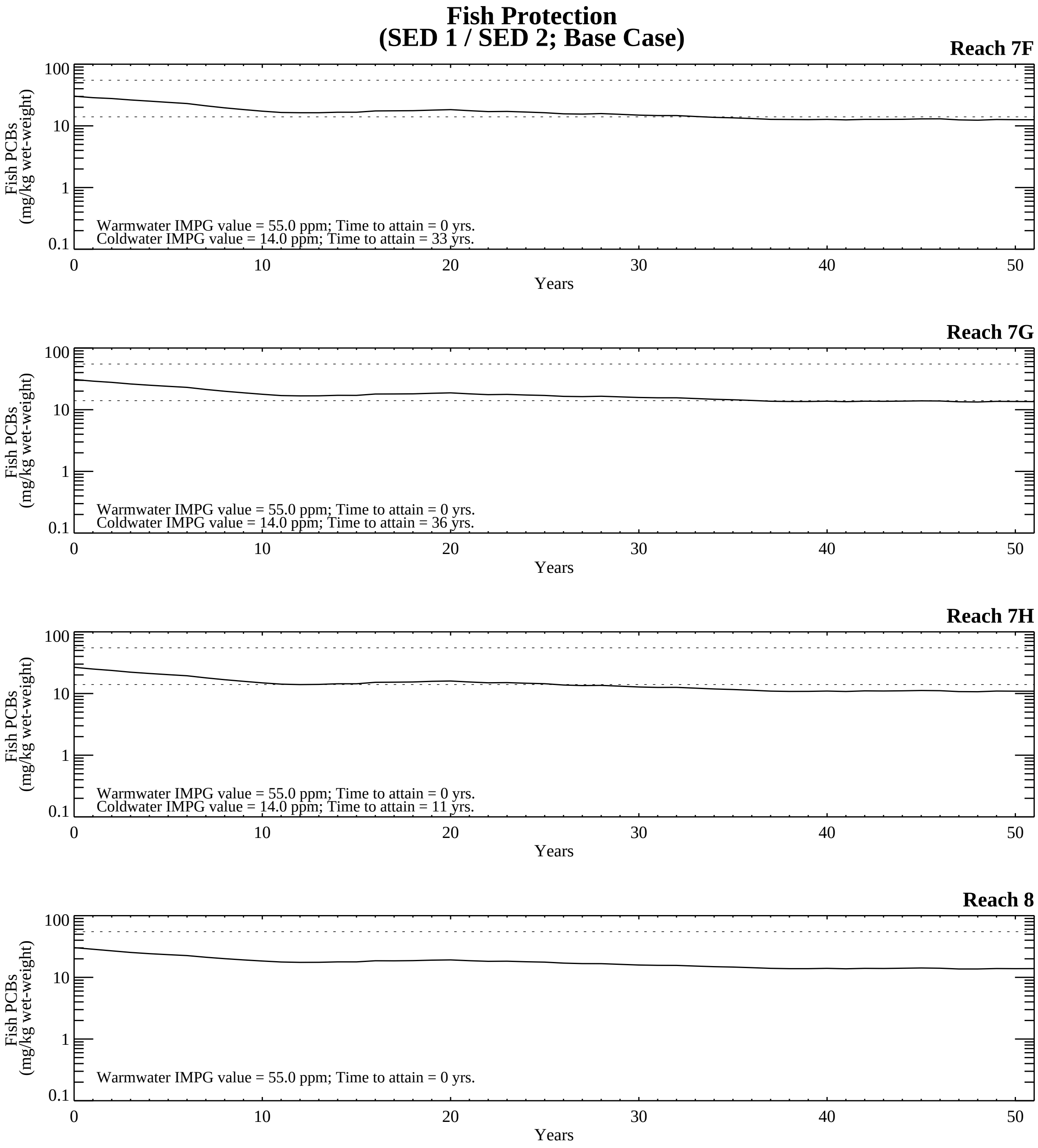

Figure G-9.1-1b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 1 / SED 2; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

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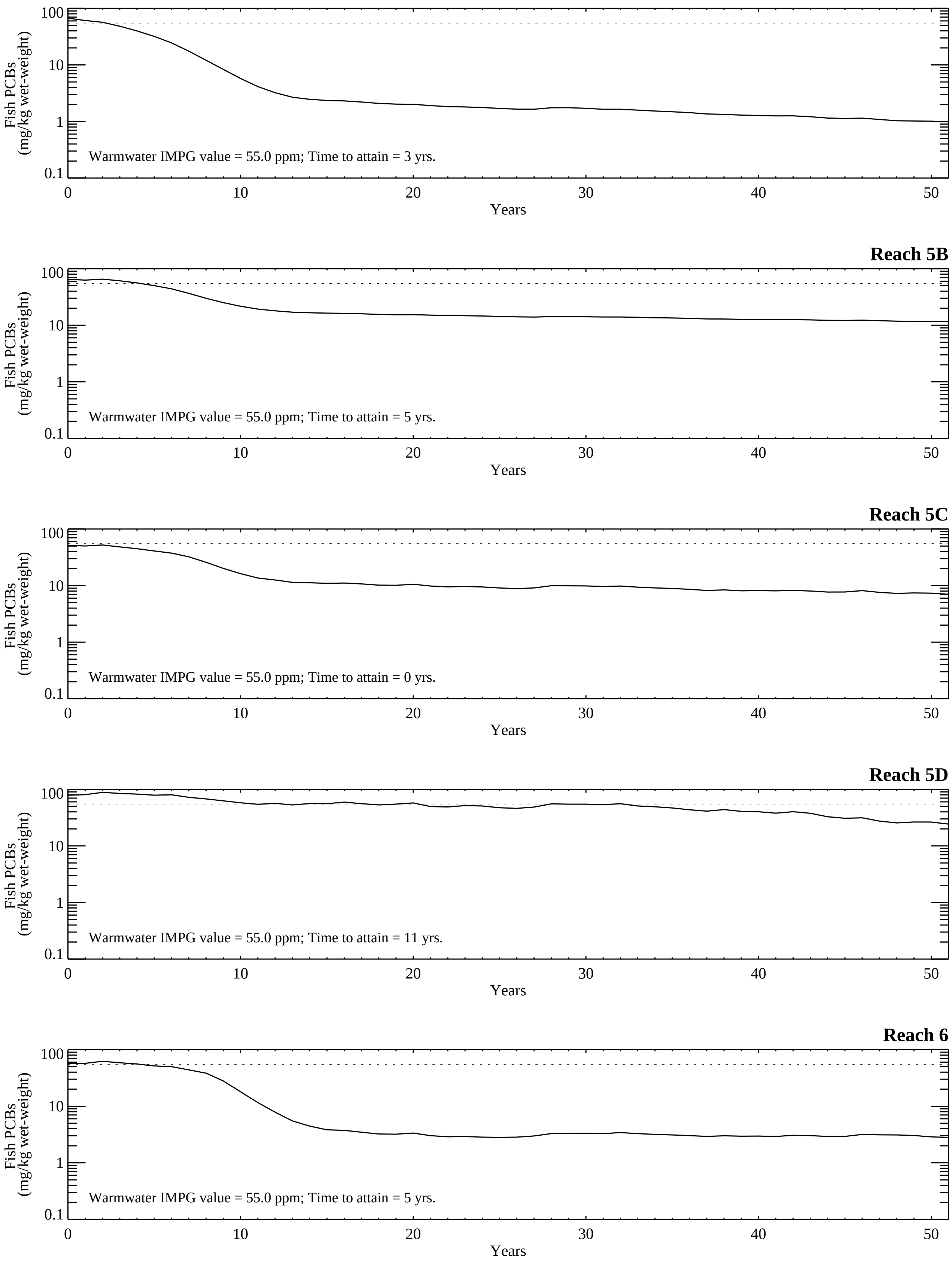
Fish Protection
(SED 3; Base Case)



Warmwater IMPG value = 55.0 ppm; Time to attain = 3 yrs.

Warmwater IMPG value = 55.0 ppm; Time to attain = 5 yrs.

Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.

Warmwater IMPG value = 55.0 ppm; Time to attain = 11 yrs.

Warmwater IMPG value = 55.0 ppm; Time to attain = 5 yrs.

Figure G-9.1-2a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 3; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

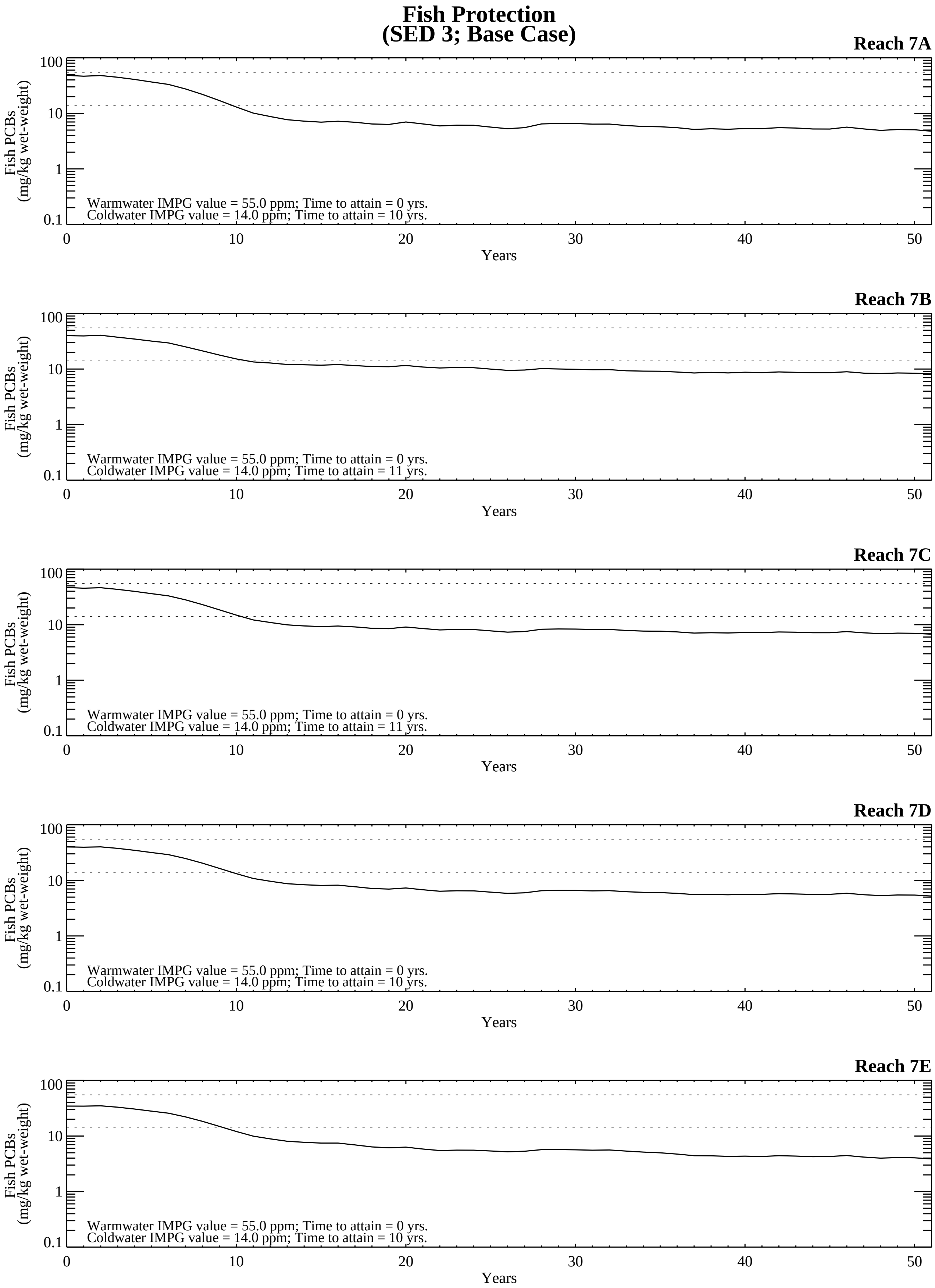


Figure G-9.1-2b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 3; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

Fish Protection
(SED 3; Base Case)

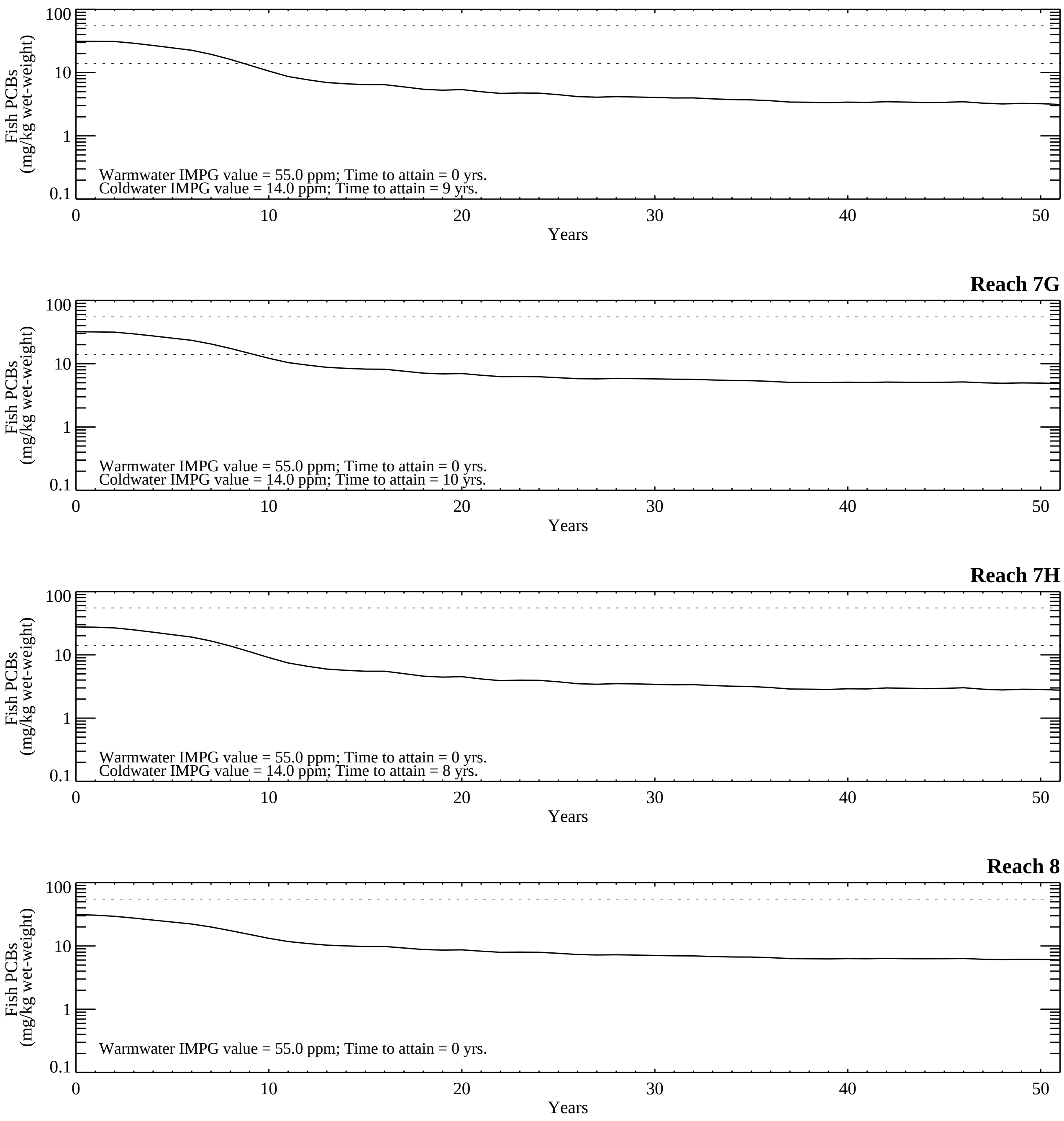


Figure G-9.1-2b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 3; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

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Fish Protection
(SED 4; Base Case)

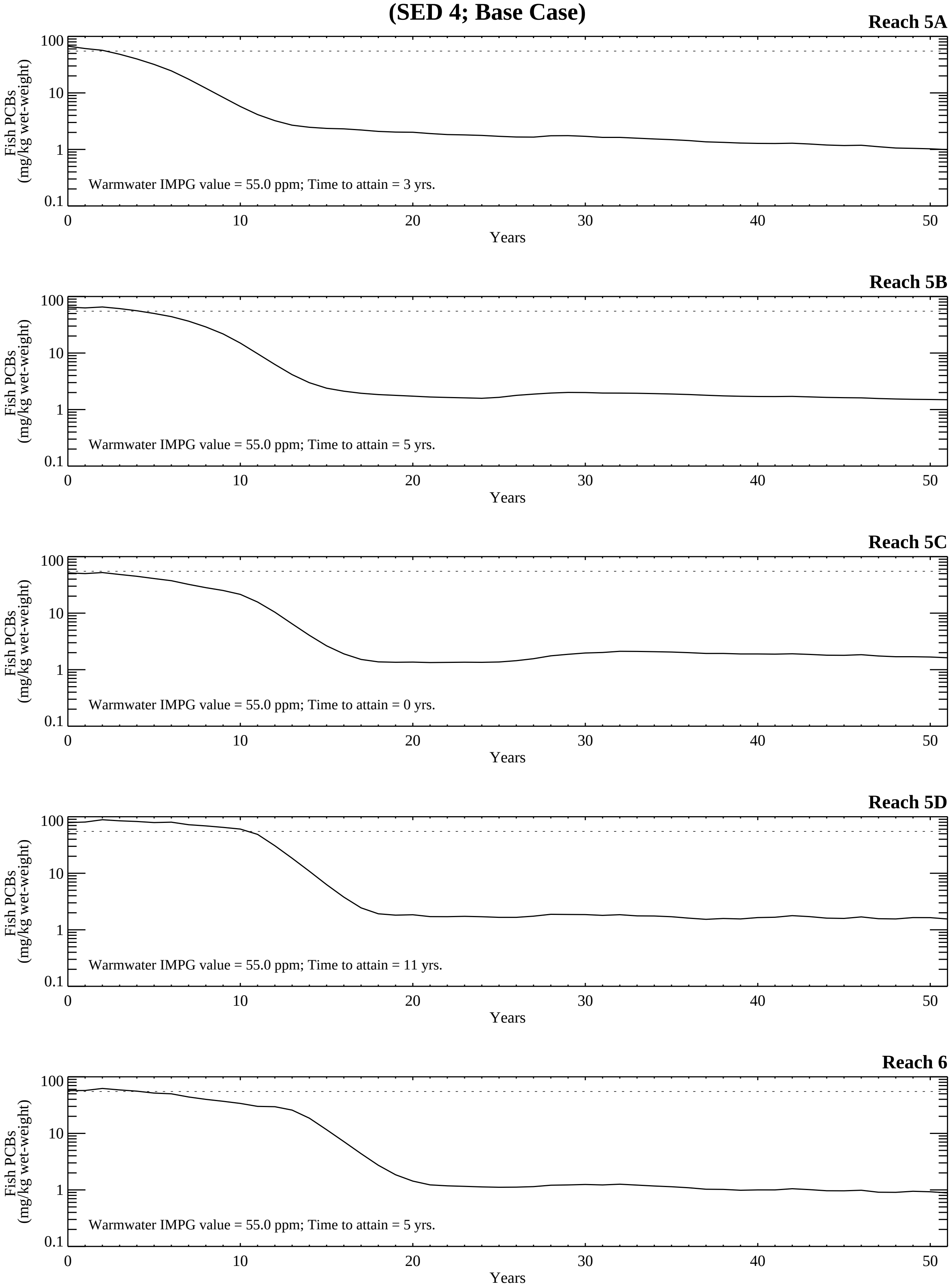

Figure G-9.1-3a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 4; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

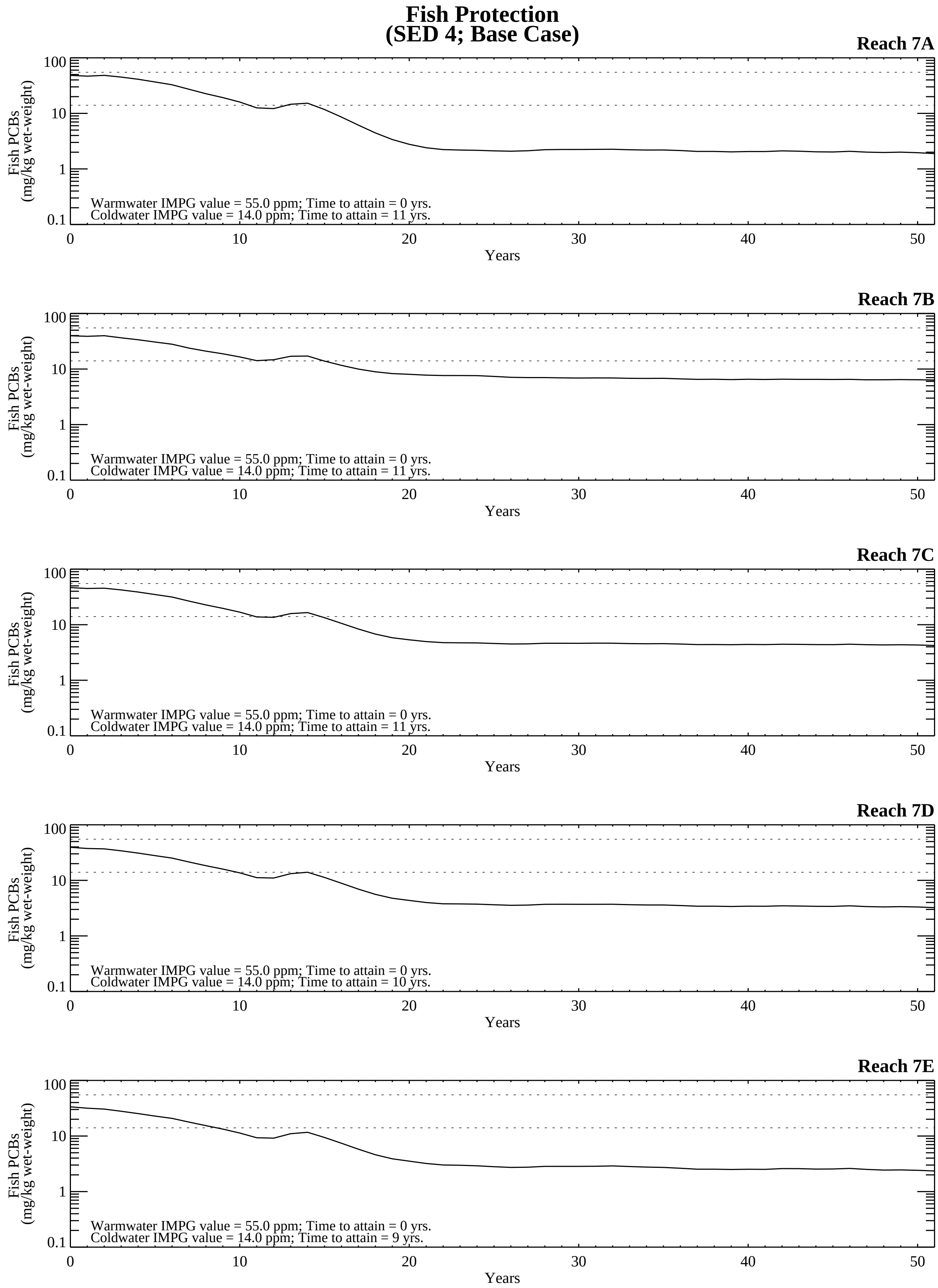

Figure G-9.1-3b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 4; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

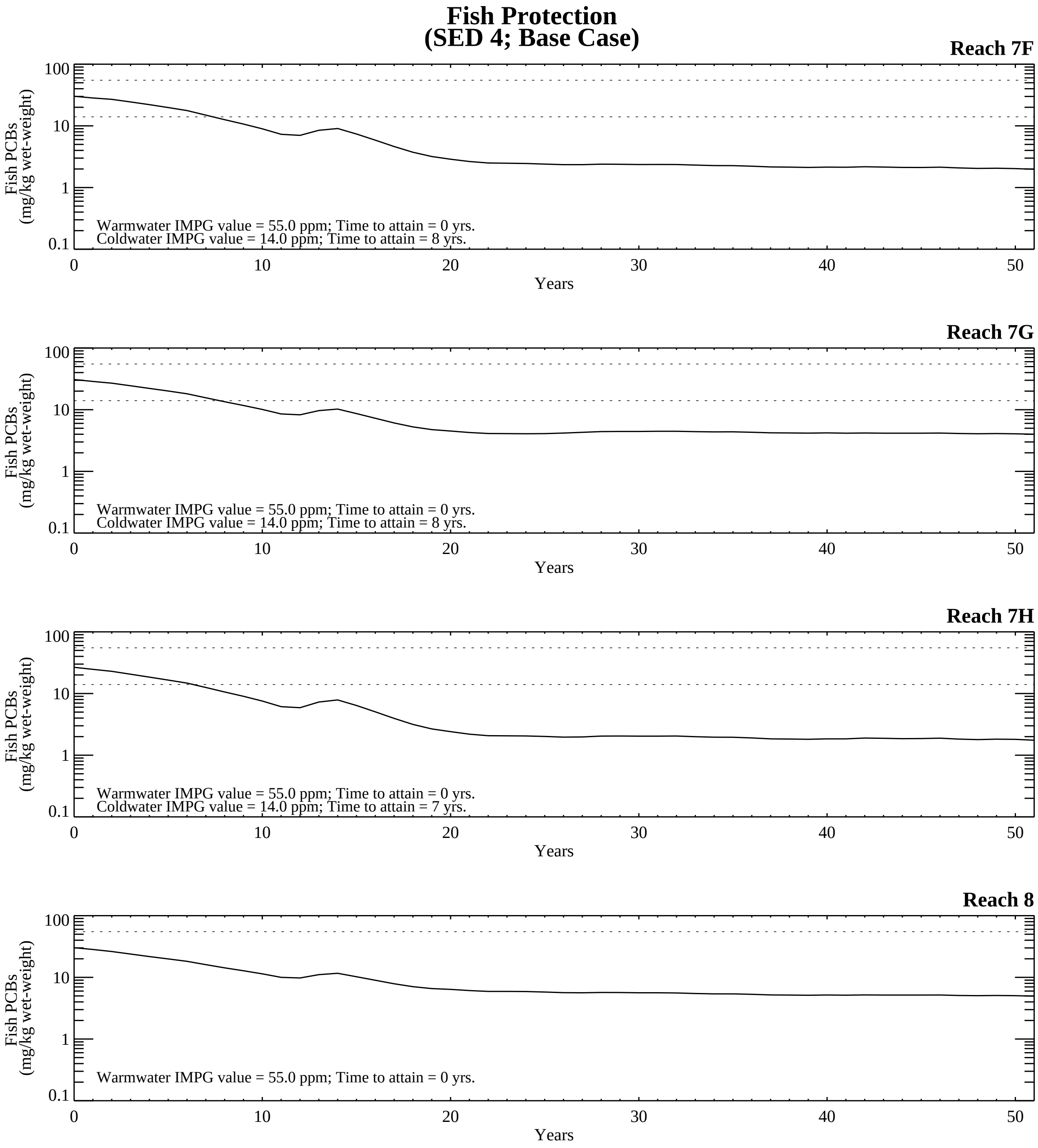

Figure G-9.1-3b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 4; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

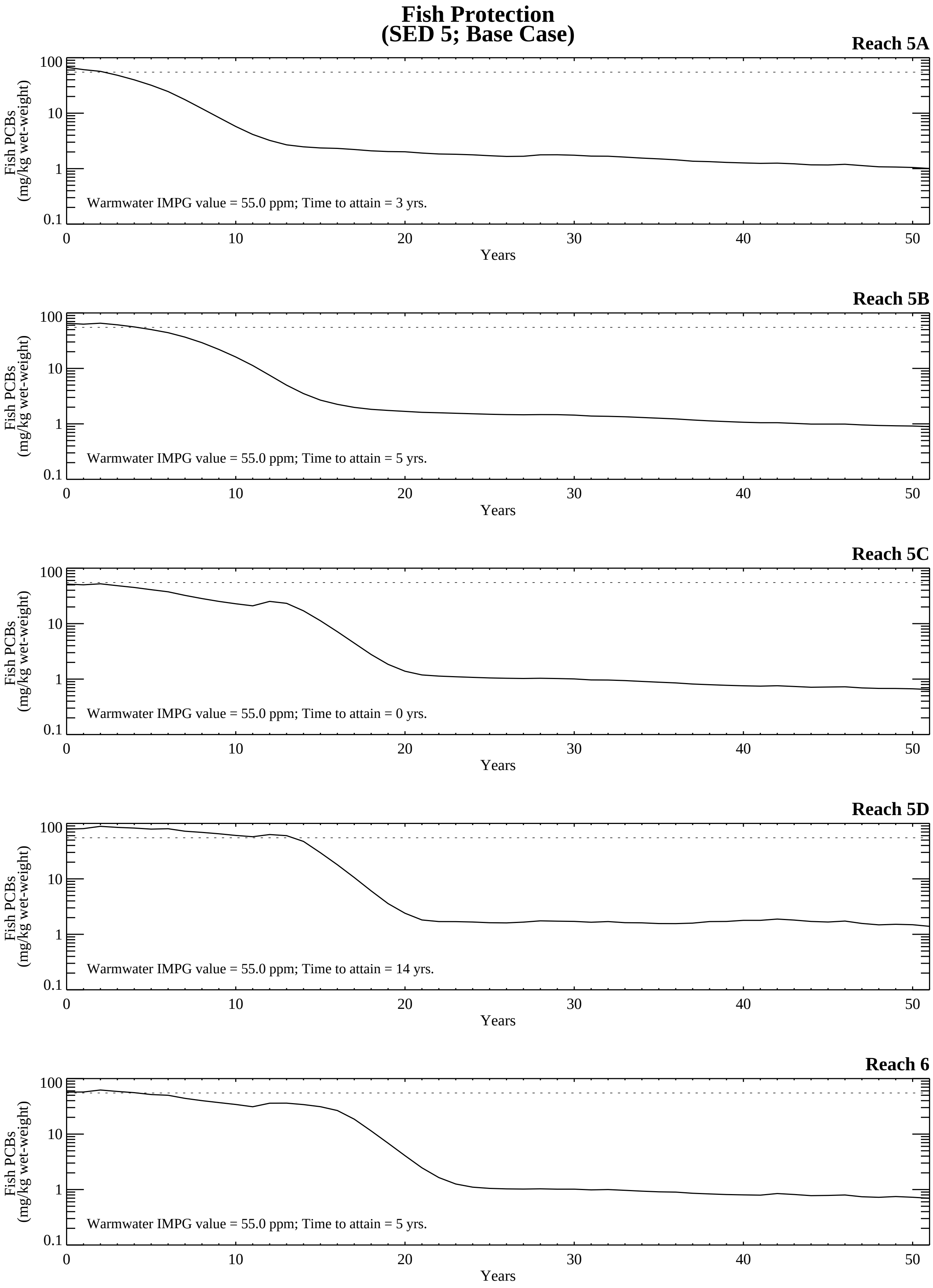

Figure G-9.1-4a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 5; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

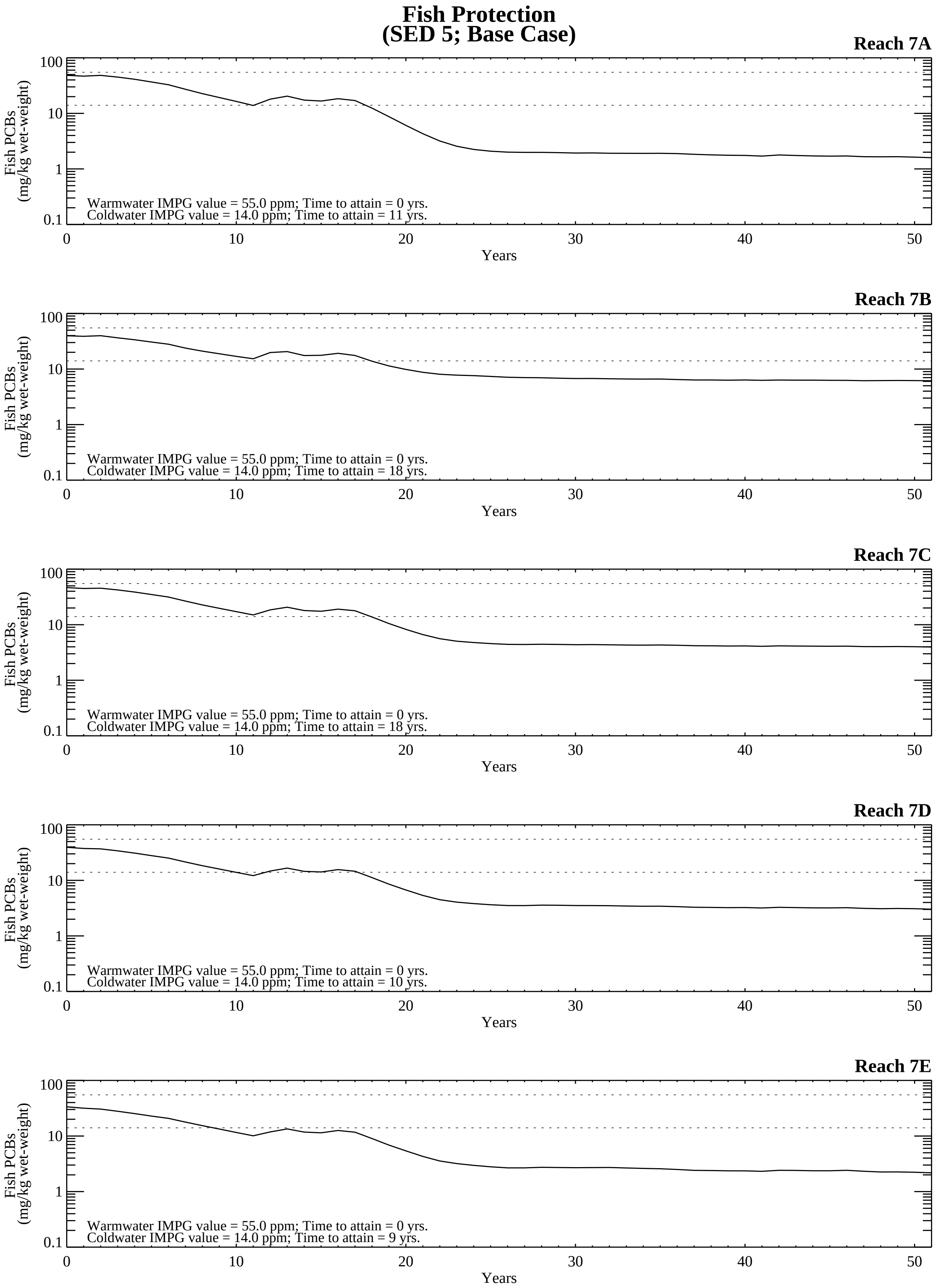

Figure G-9.1-4b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 5; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

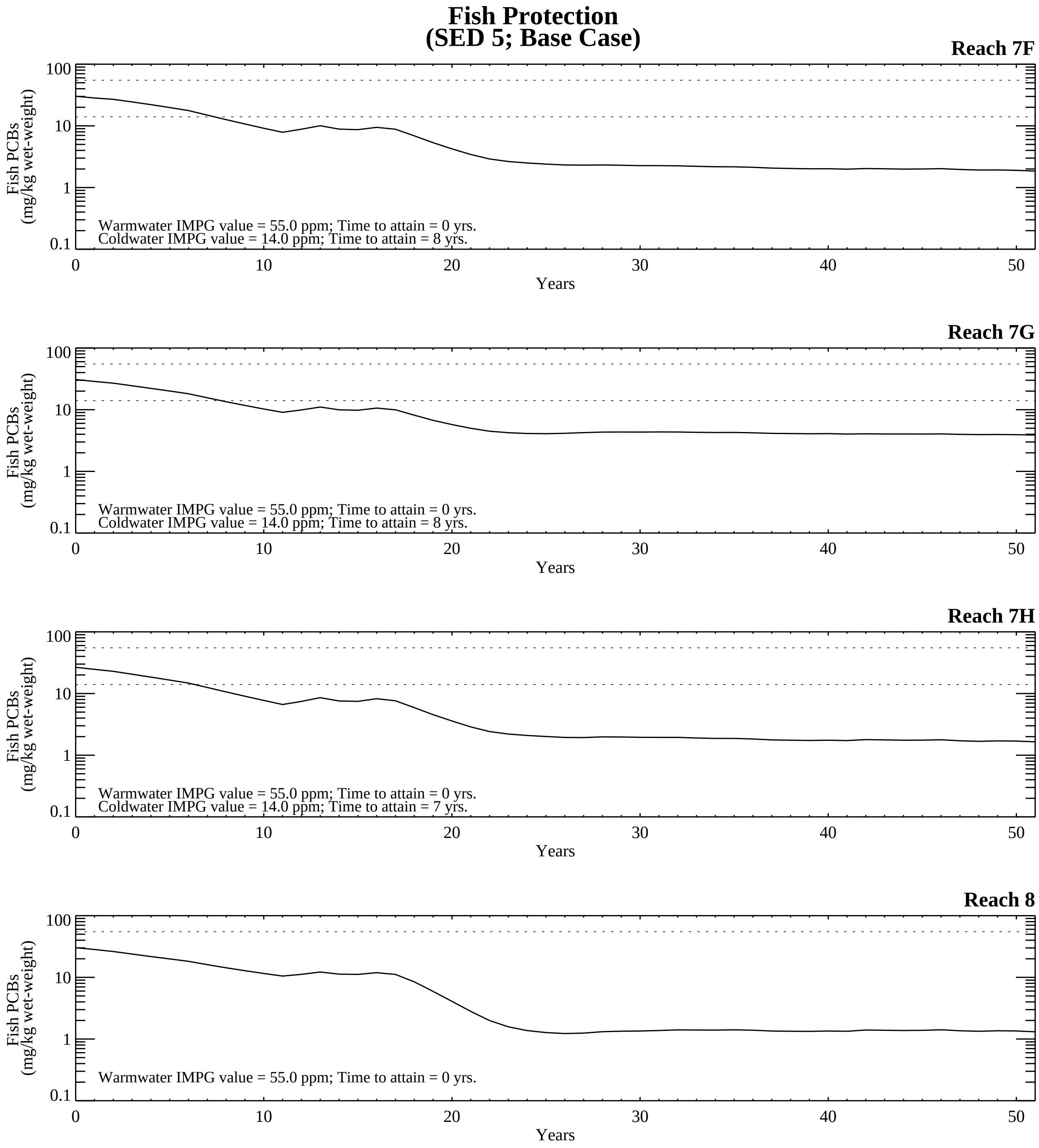

Figure G-9.1-4b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 5; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

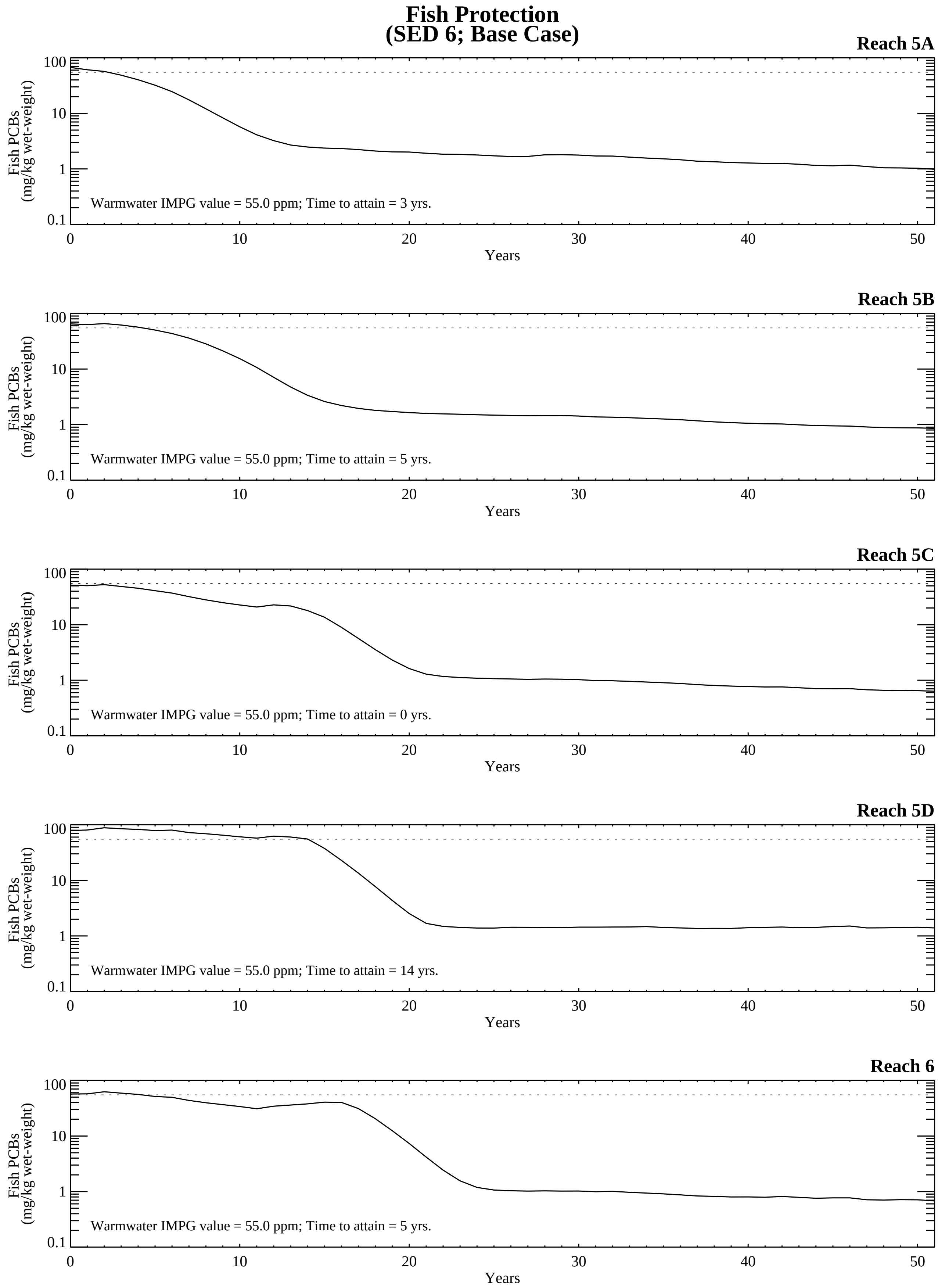

Figure G-9.1-5a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 6; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

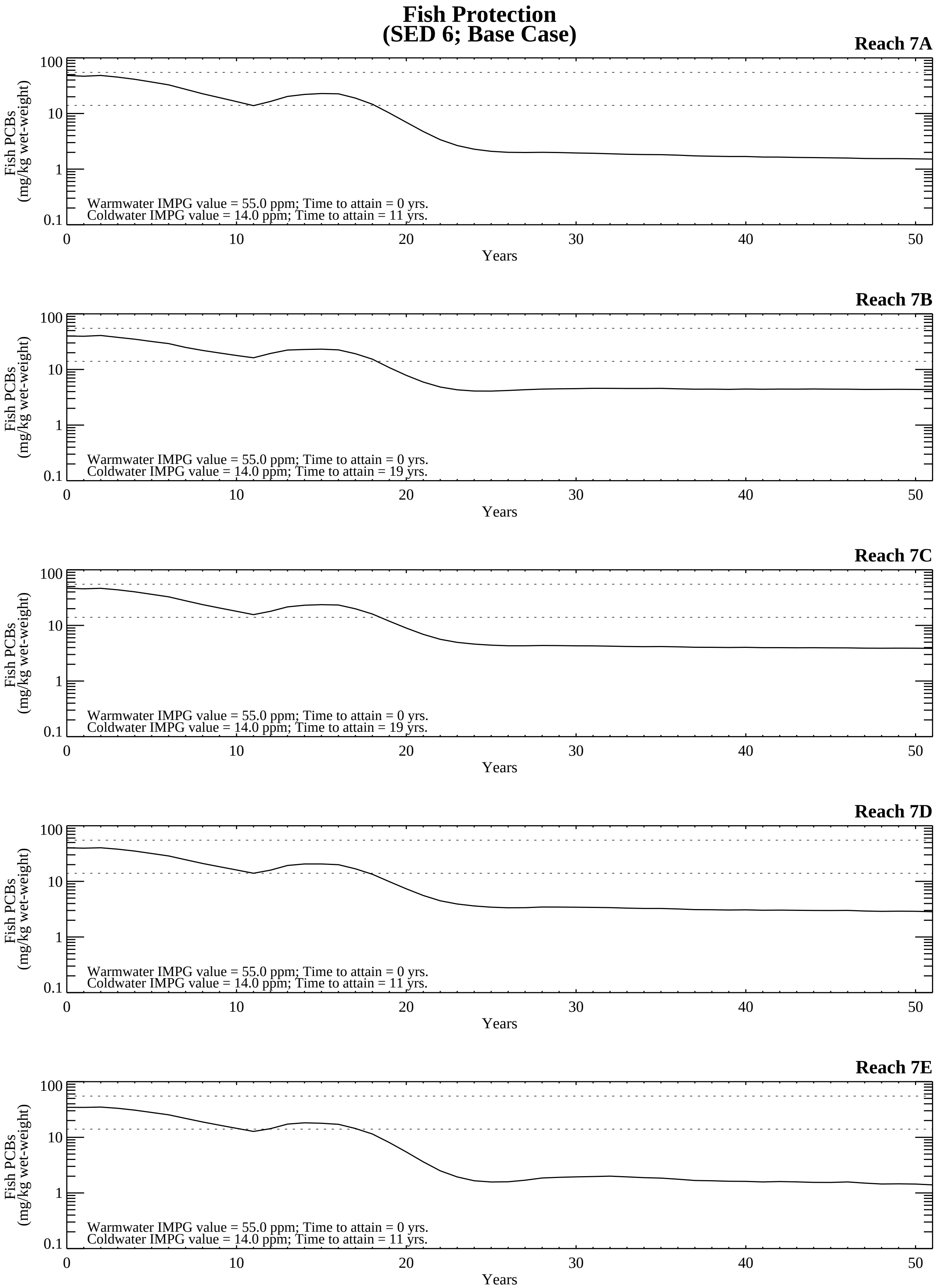

Figure G-9.1-5b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 6; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

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Fish Protection
(SED 6; Base Case)

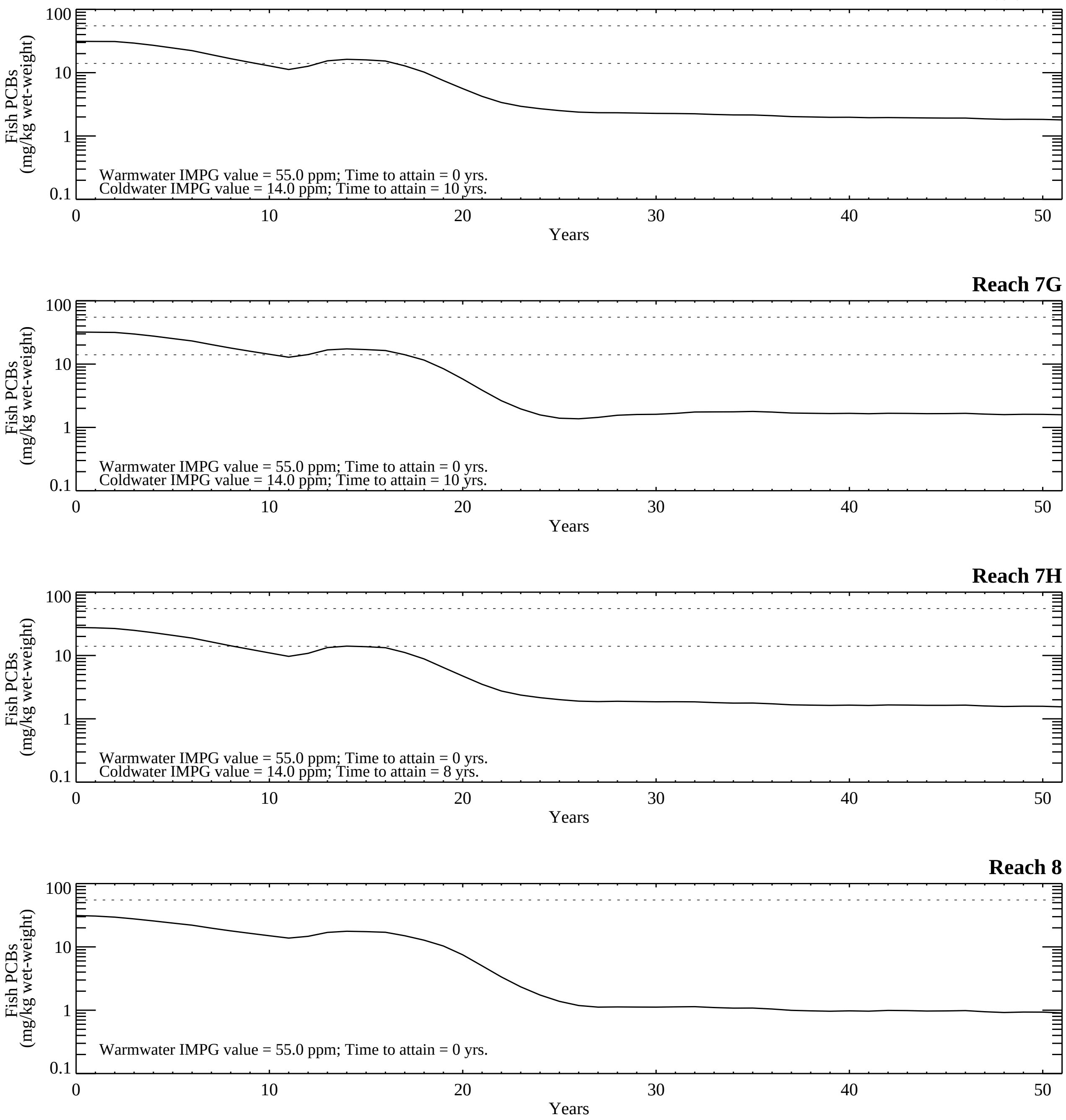

Figure G-9.1-5b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 6; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

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Fish Protection
(SED 7; Base Case)

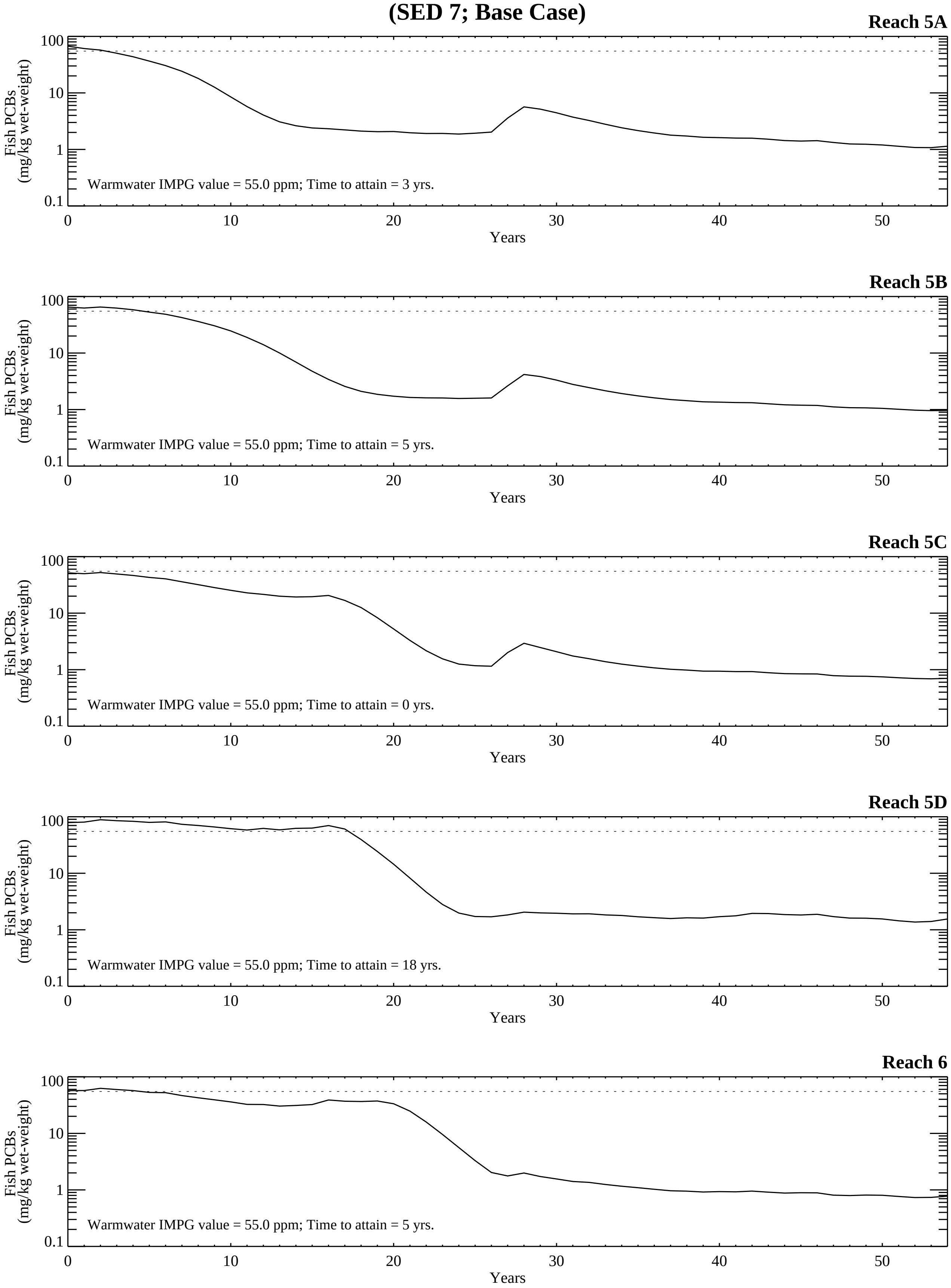
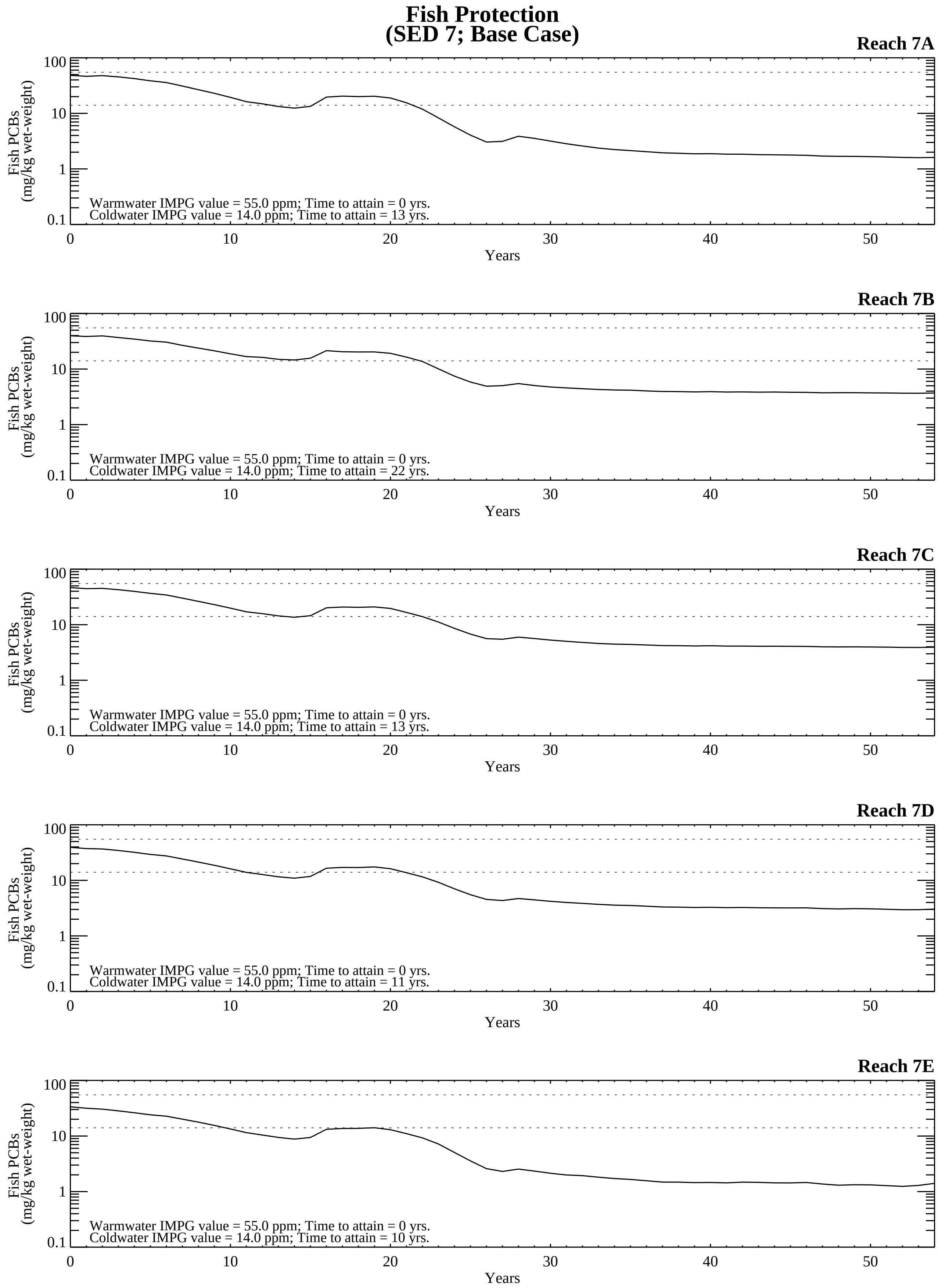


Figure G-9.1-6a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 7; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.



Reach 7A: Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.
Coldwater IMPG value = 14.0 ppm; Time to attain = 13 yrs.

Reach 7B: Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.
Coldwater IMPG value = 14.0 ppm; Time to attain = 22 yrs.

Reach 7C: Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.
Coldwater IMPG value = 14.0 ppm; Time to attain = 13 yrs.

Reach 7D: Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.
Coldwater IMPG value = 14.0 ppm; Time to attain = 11 yrs.

Reach 7E: Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.
Coldwater IMPG value = 14.0 ppm; Time to attain = 10 yrs.

Figure G-9.1-6b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 7; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

DR\LD - Z:\GENcms\MODEL\FDCHN\Analysis\IMPG\Fish\impg_tabulate_projections_loop.pro
Fri Mar 14 22:11:20 2008

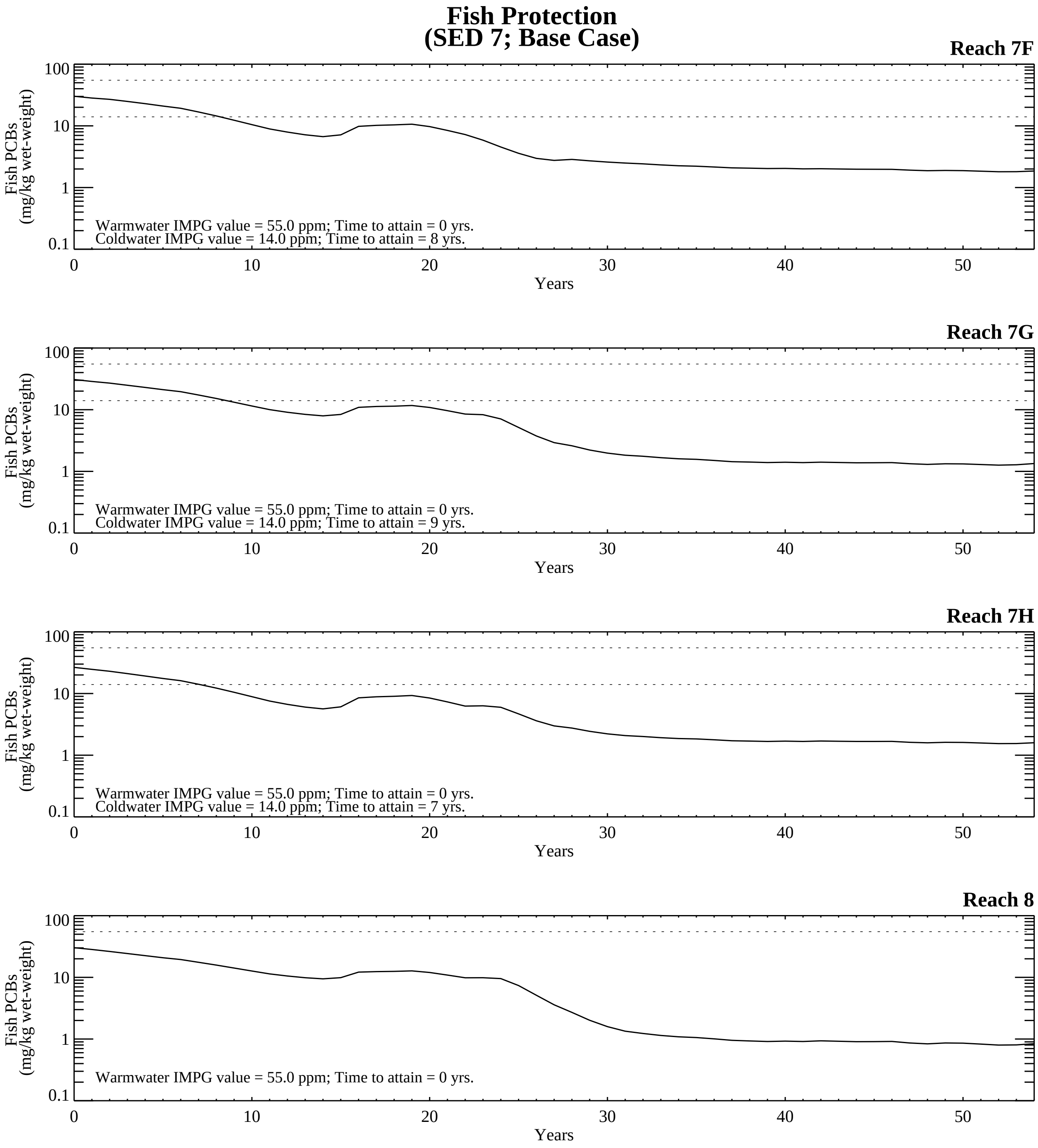


Figure G-9.1-6b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 7; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

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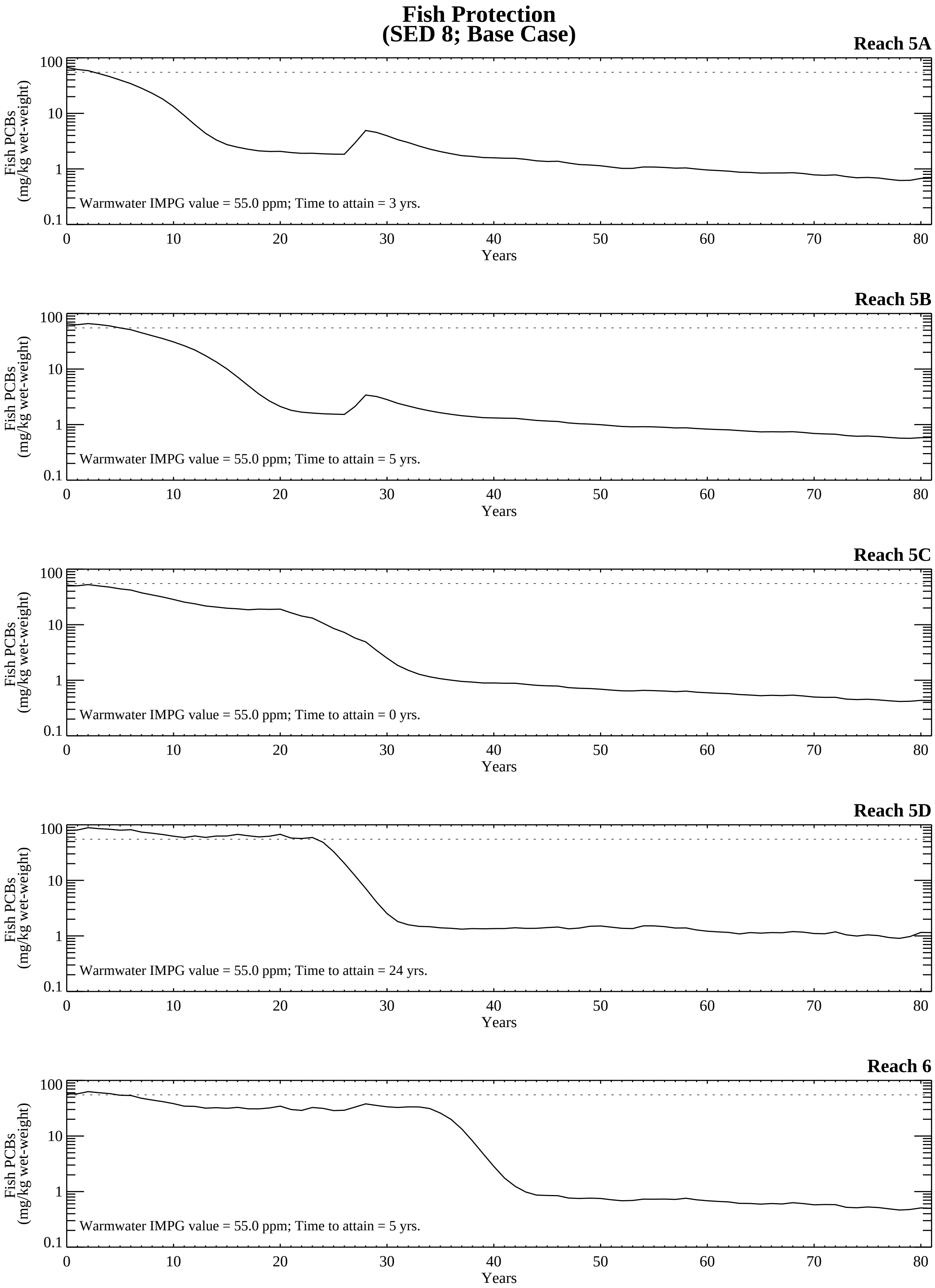

Figure G-9.1-7a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 8; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

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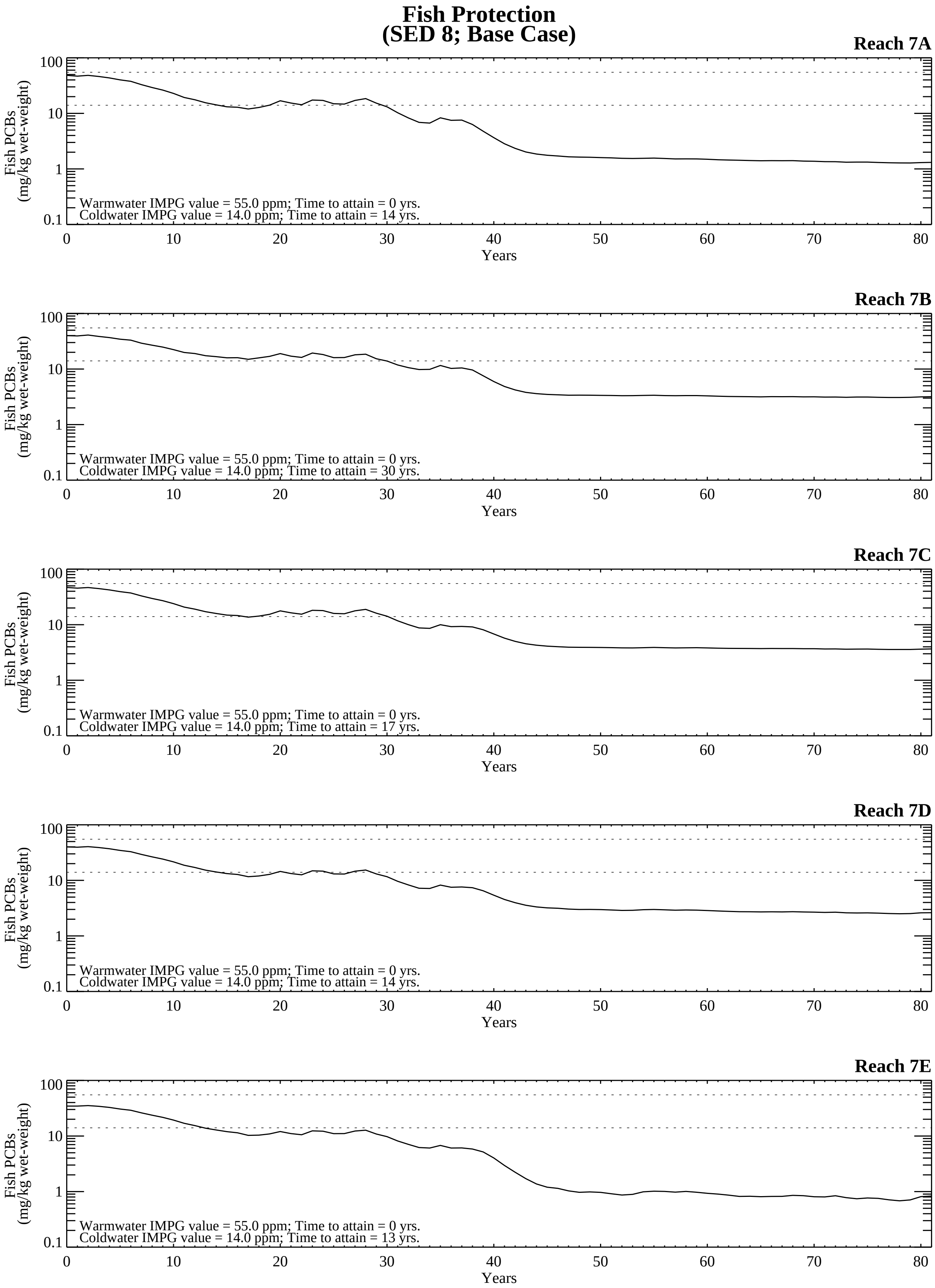

Figure G-9.1-7b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 8; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

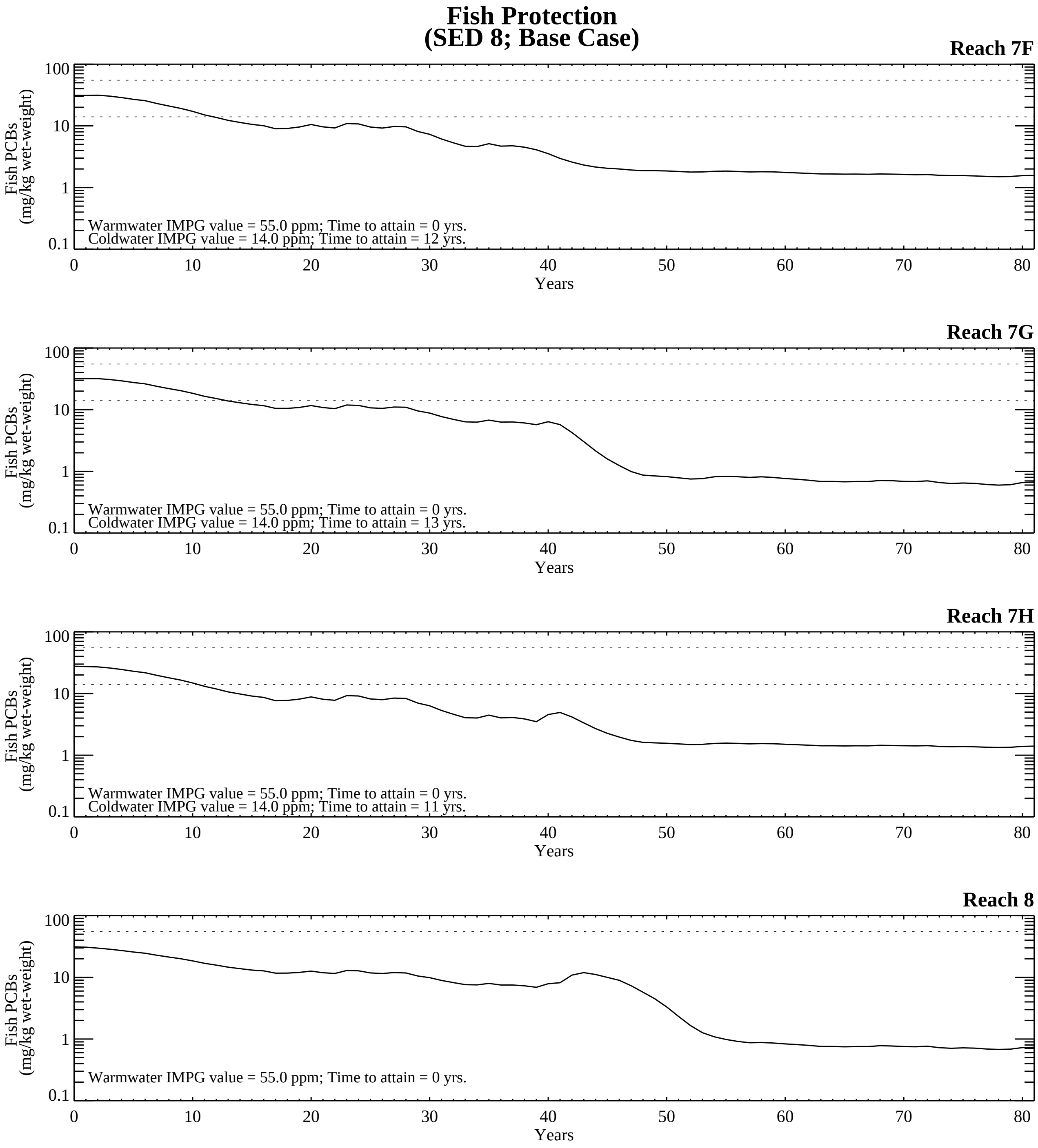

Figure G-9.1-7b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 8; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

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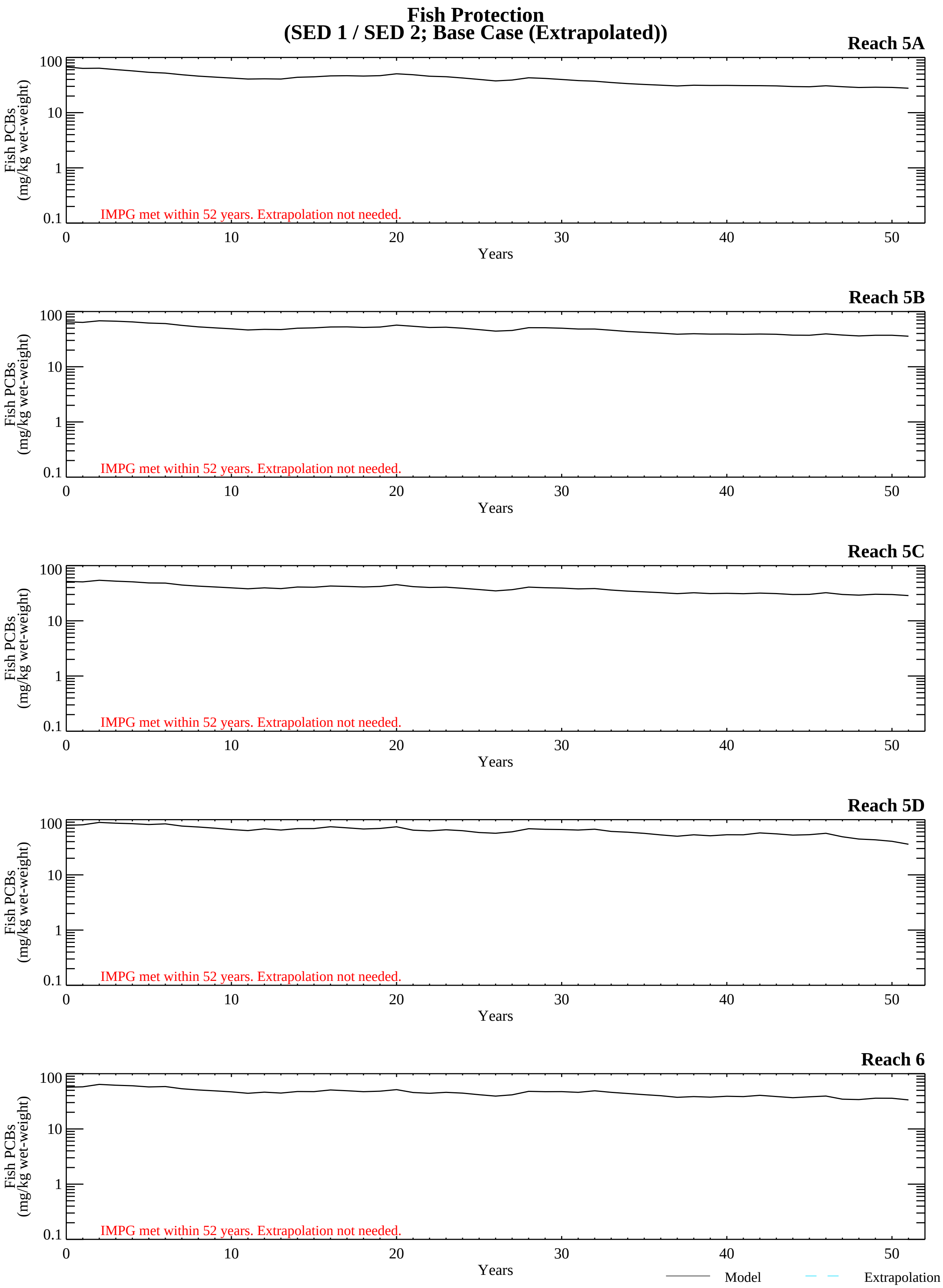

Figure G-9.2-1a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 1 / SED 2; Reach 5/6; Base Case).

IMPG value (mg/kg) = 55.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

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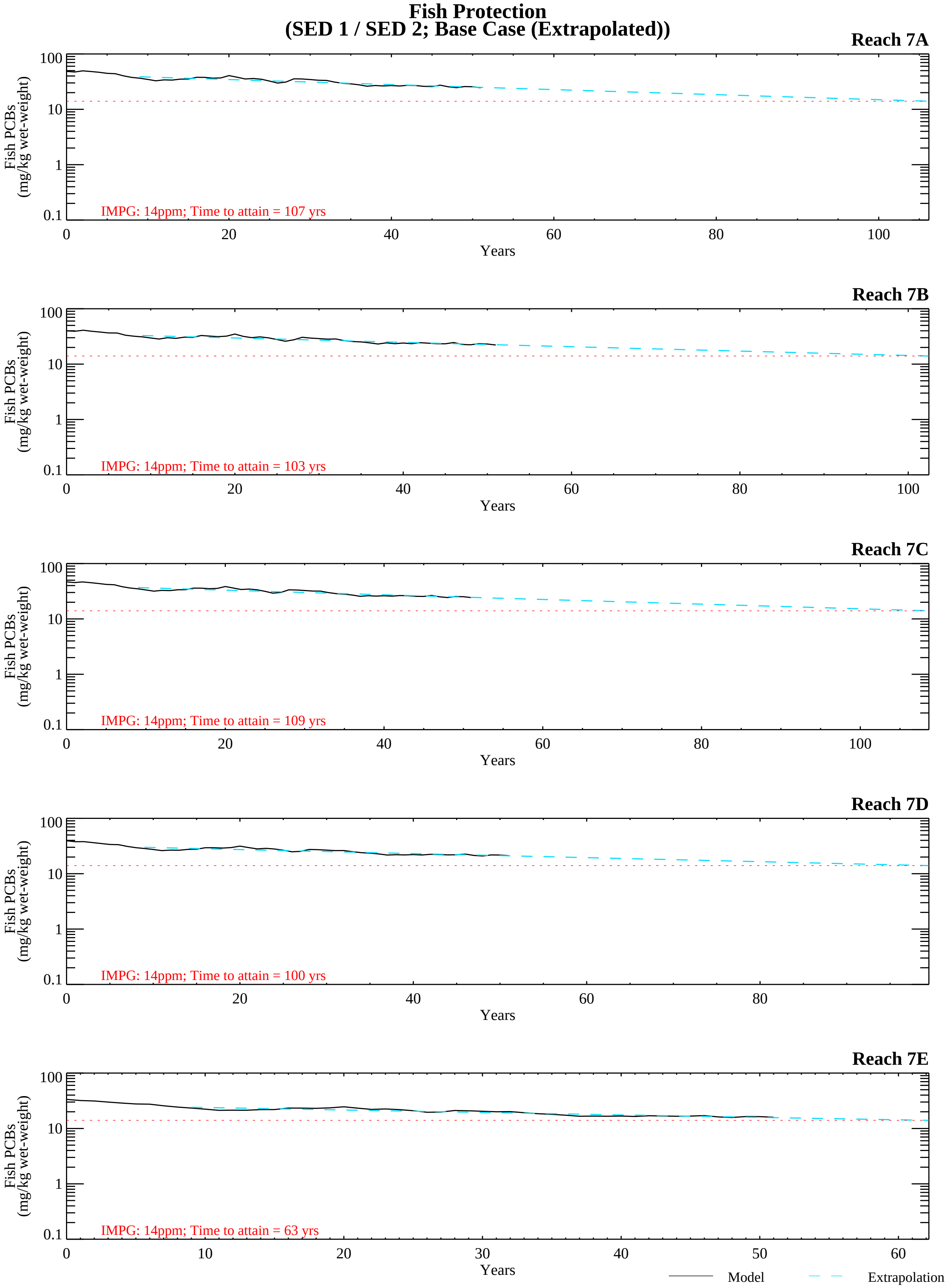

Figure G-9.2-1b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 1 / SED 2; Reach 7/8; Base Case).

Warmwater IMPG value (mg/kg) = 55.0
Coldwater IMPG value (mg/kg) = 14.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

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Thu Mar 20 08:44:49 2008

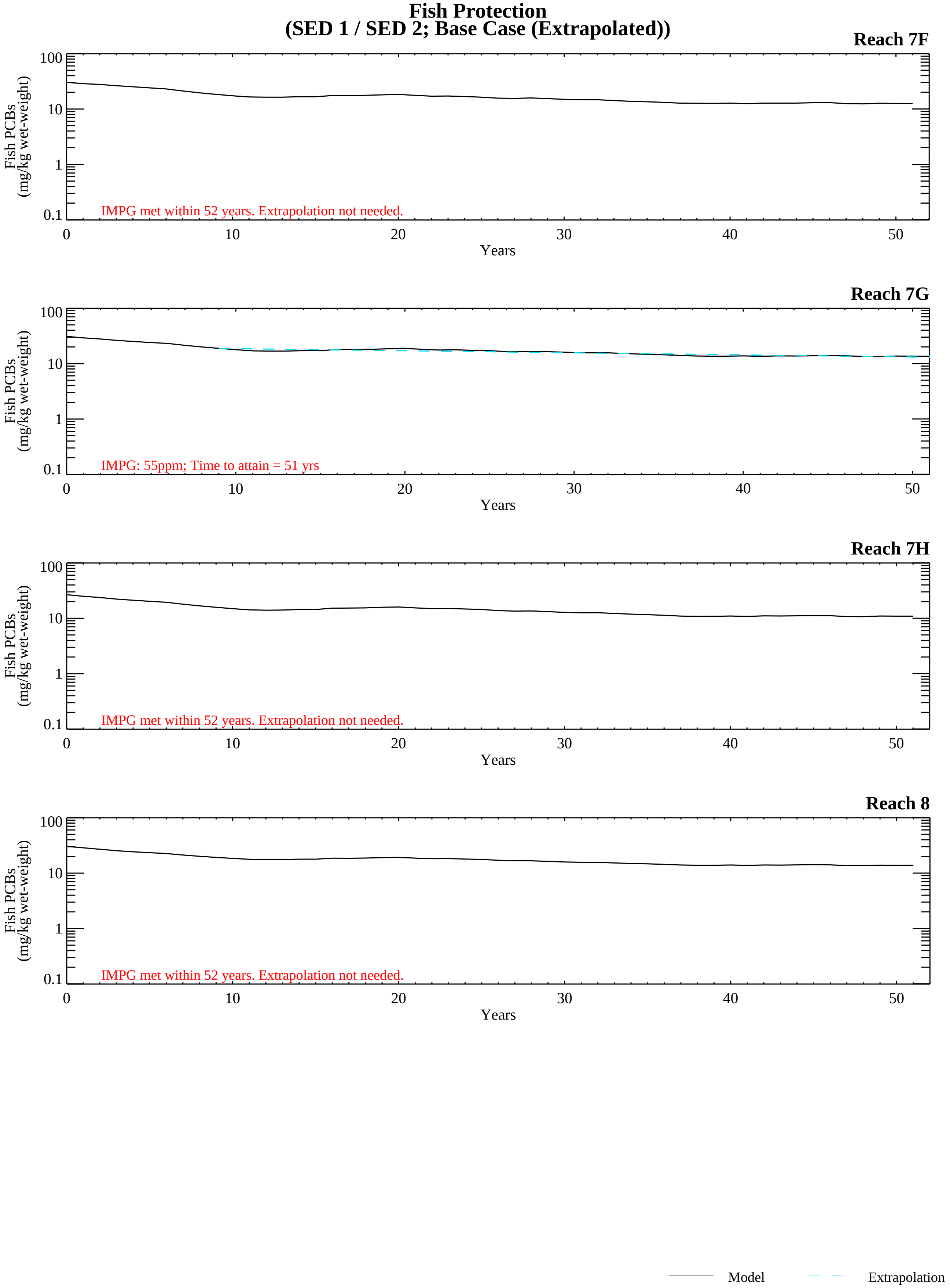

Figure G-9.2-1b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 1 / SED 2; Reach 7/8; Base Case).

Warmwater IMPG value (mg/kg) = 55.0
Coldwater IMPG value (mg/kg) = 14.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

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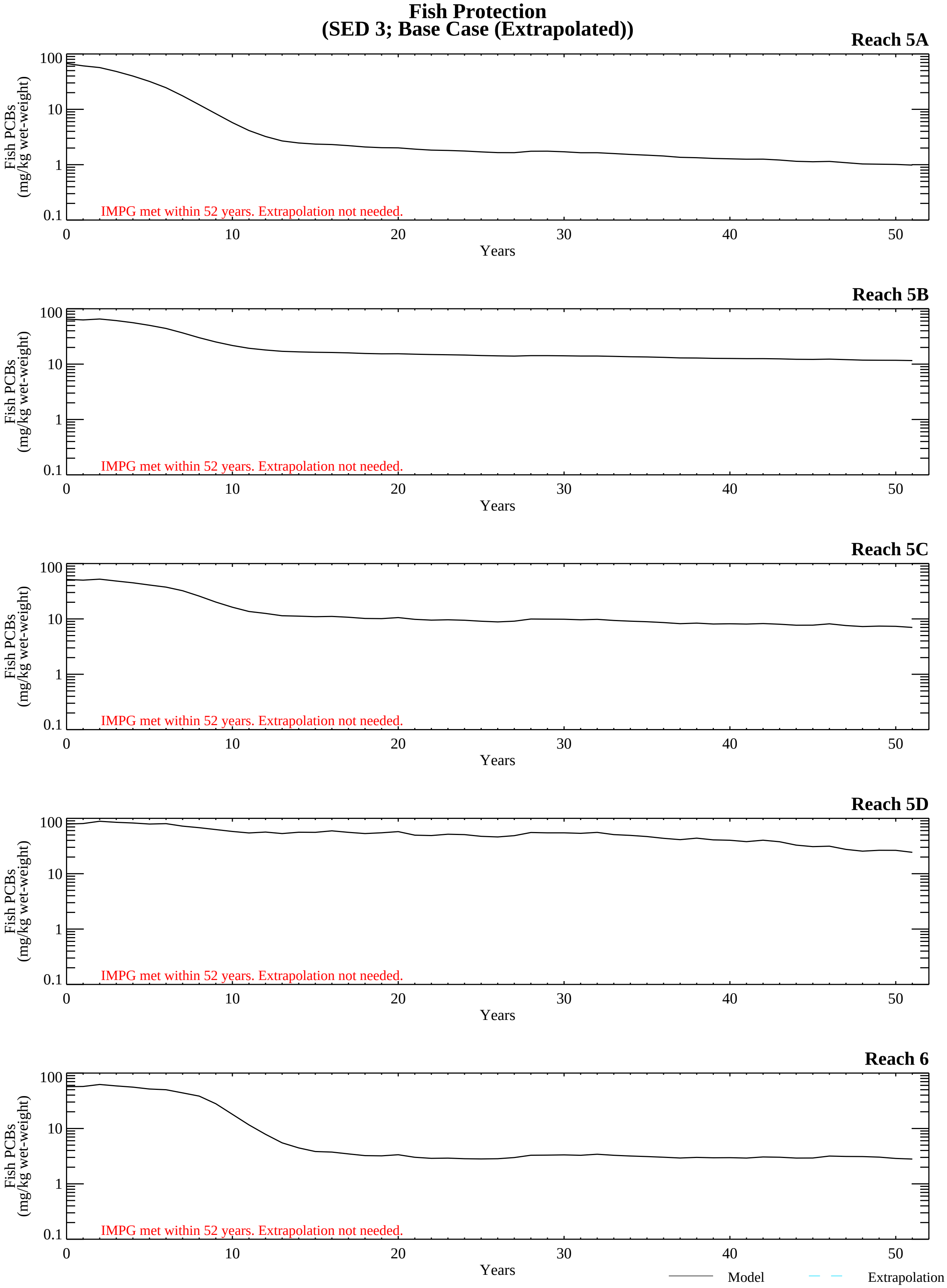

Figure G-9.2-2a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 3; Reach 5/6; Base Case).

IMPG value (mg/kg) = 55.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

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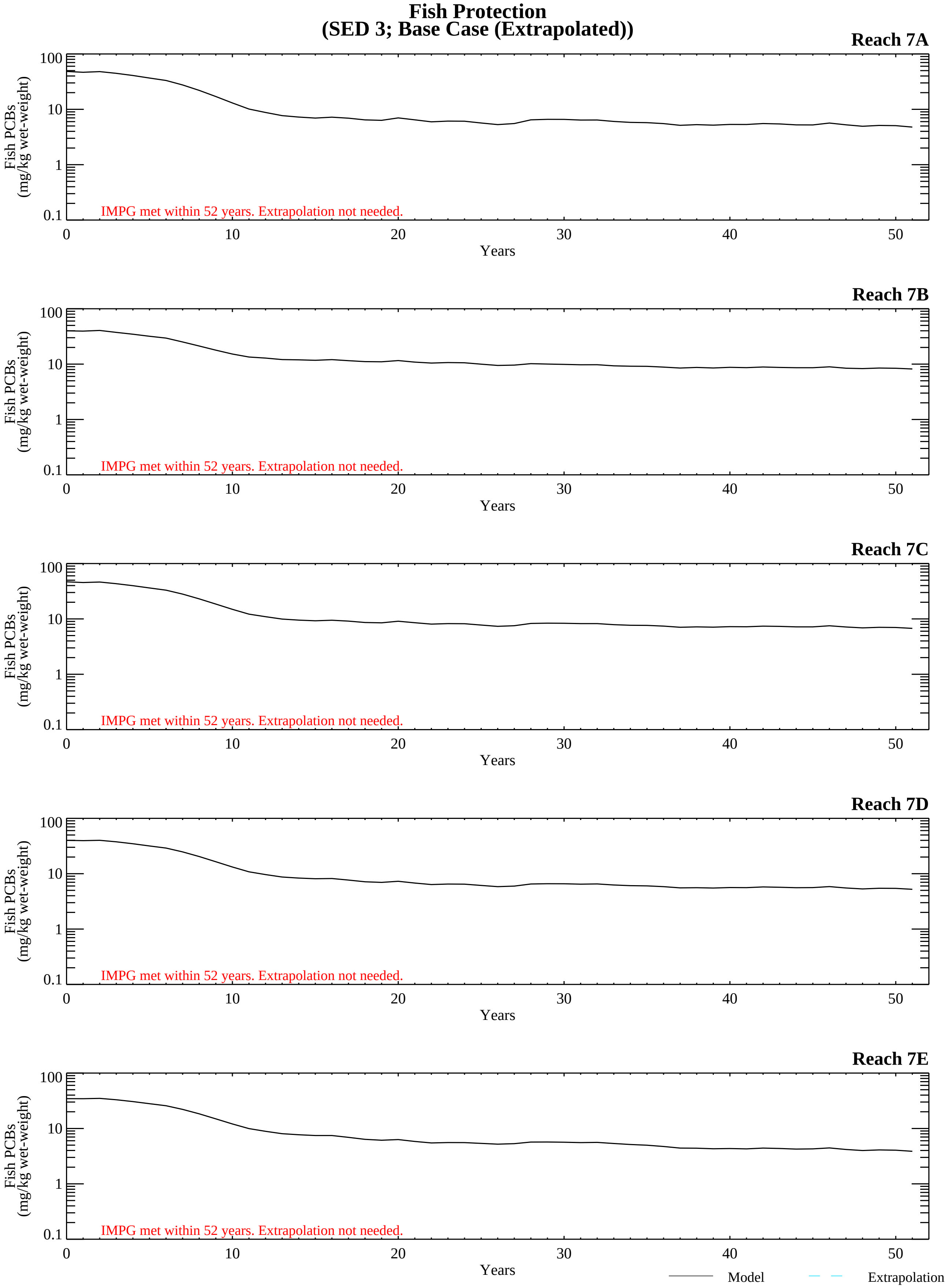

Figure G-9.2-2b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 3; Reach 7/8; Base Case).

Warmwater IMPG value (mg/kg) = 55.0
Coldwater IMPG value (mg/kg) = 14.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

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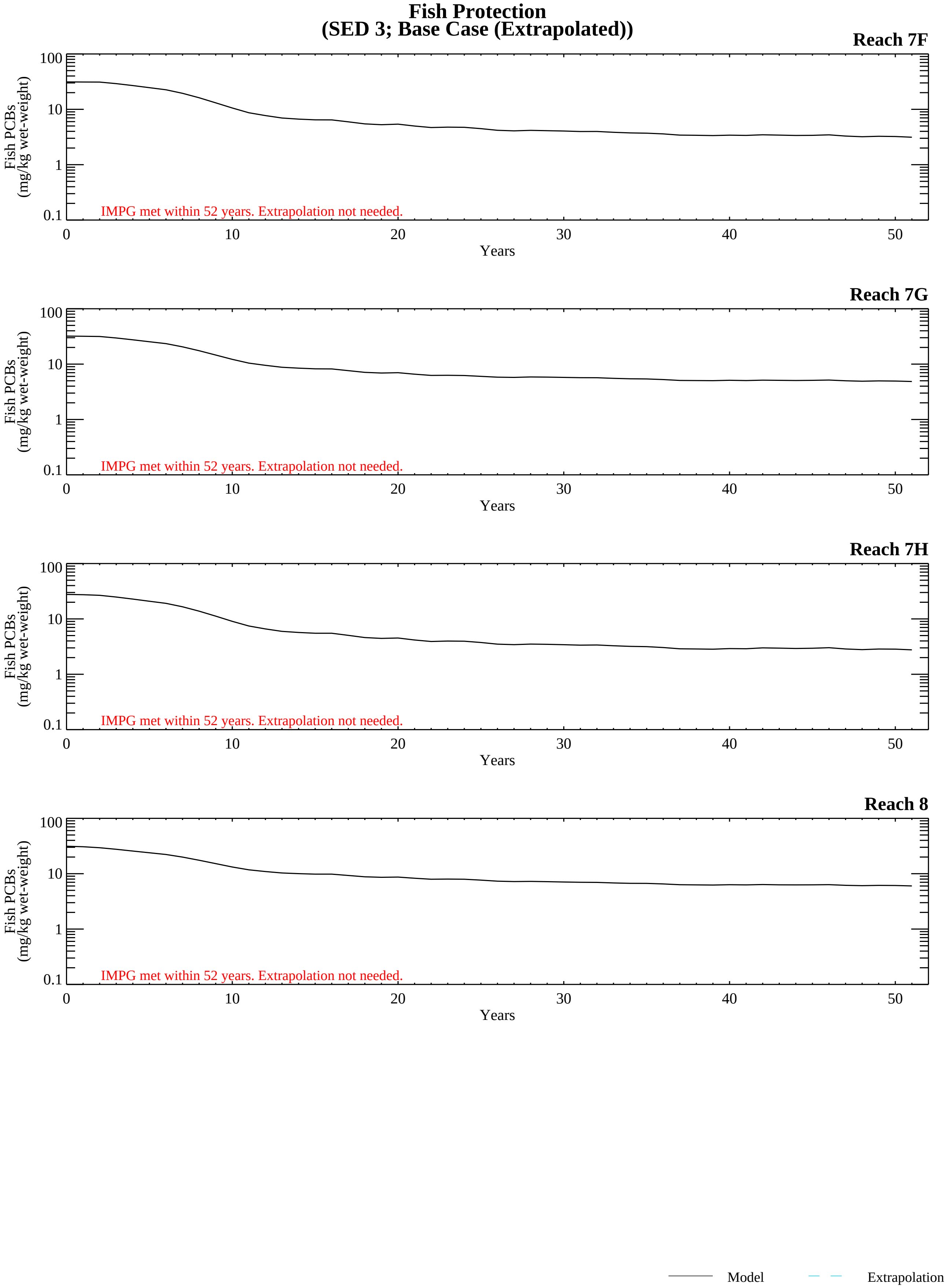

Figure G-9.2-2b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 3; Reach 7/8; Base Case).

Warmwater IMPG value (mg/kg) = 55.0
Coldwater IMPG value (mg/kg) = 14.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

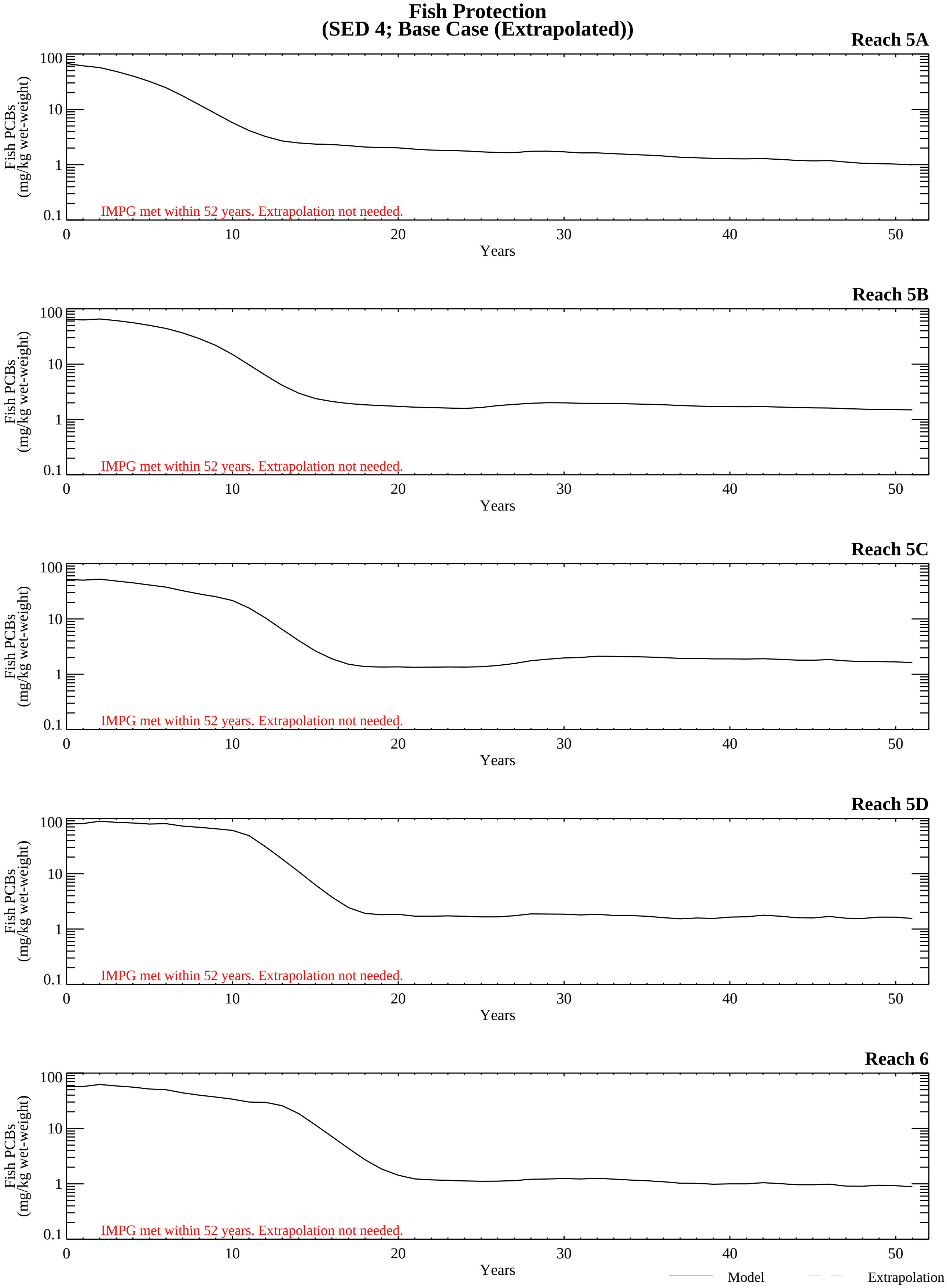

Figure G-9.2-3a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 4; Reach 5/6; Base Case).

IMPG value (mg/kg) = 55.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

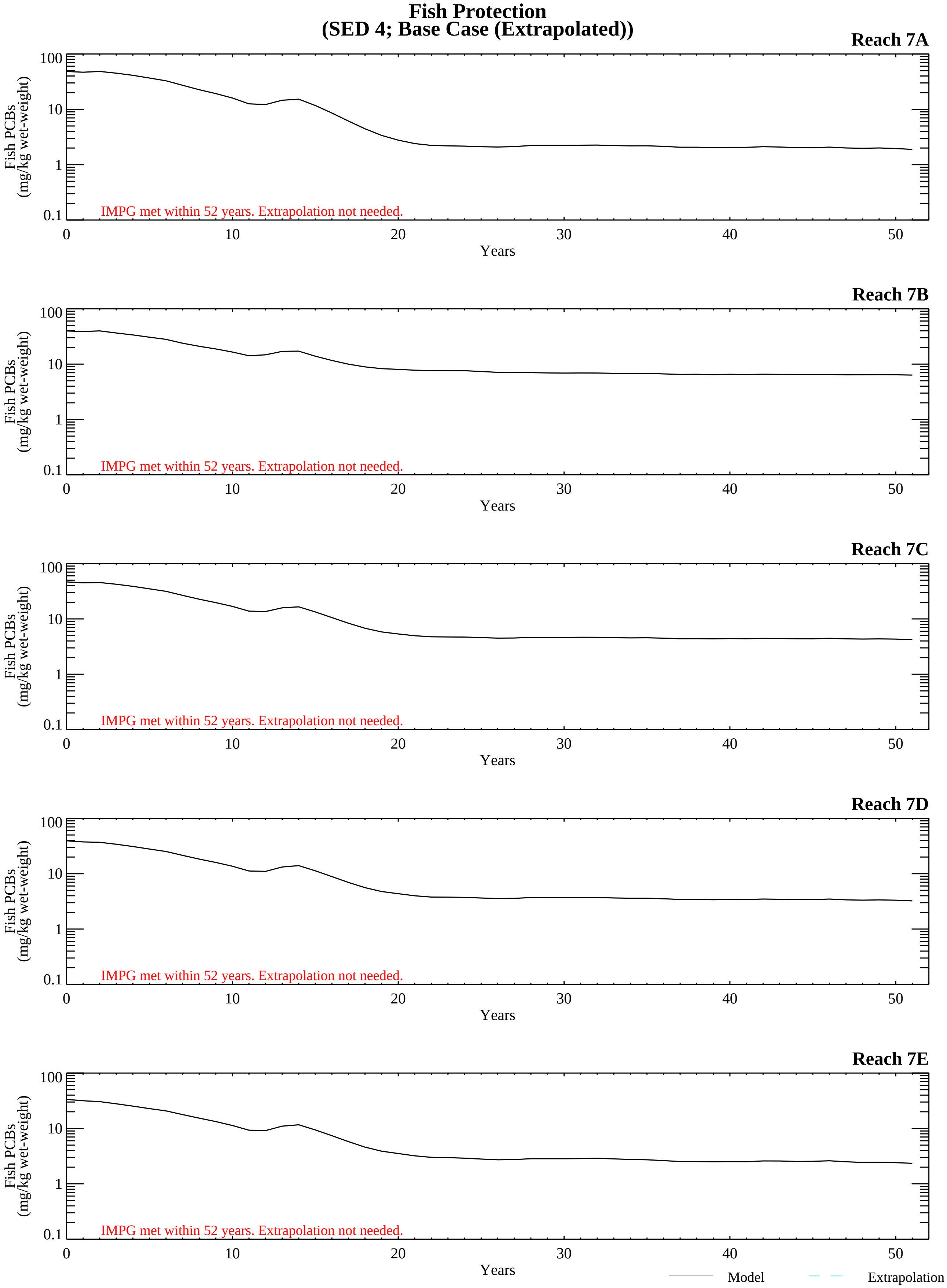

Figure G-9.2-3b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 4; Reach 7/8; Base Case).

Warmwater IMPG value (mg/kg) = 55.0
Coldwater IMPG value (mg/kg) = 14.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

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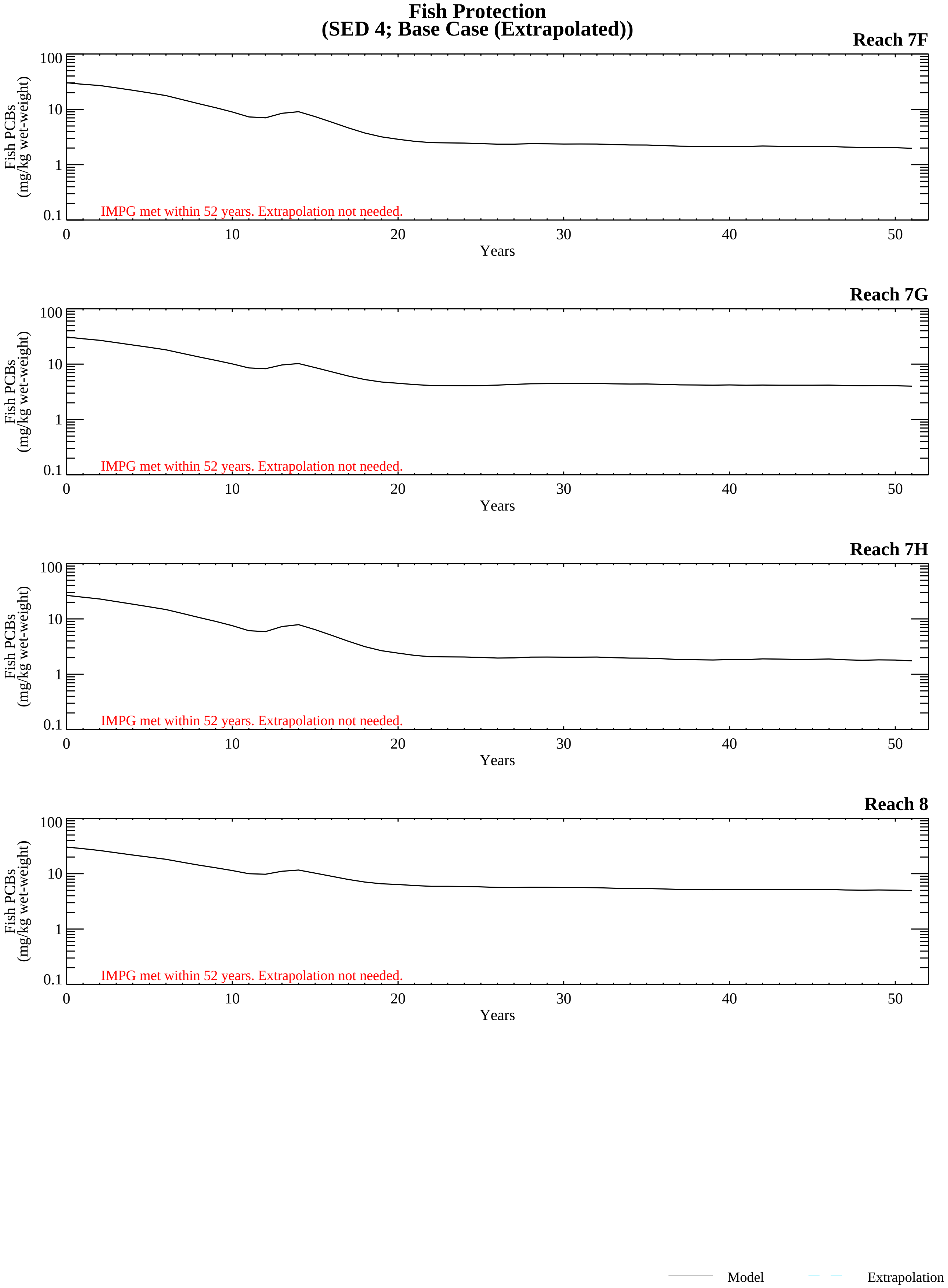


Figure G-9.2-3b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 4; Reach 7/8; Base Case).

Warmwater IMPG value (mg/kg) = 55.0
Coldwater IMPG value (mg/kg) = 14.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

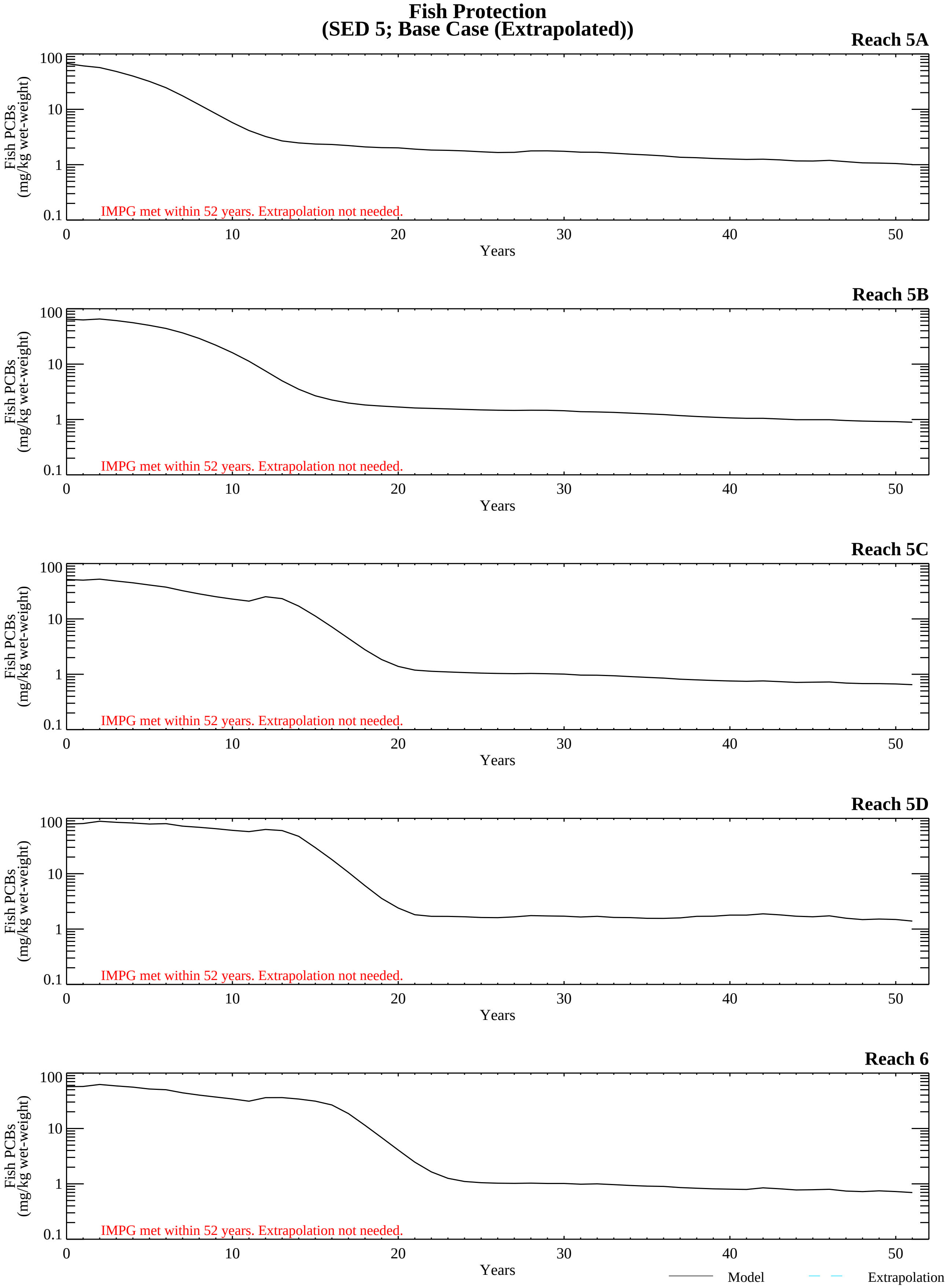
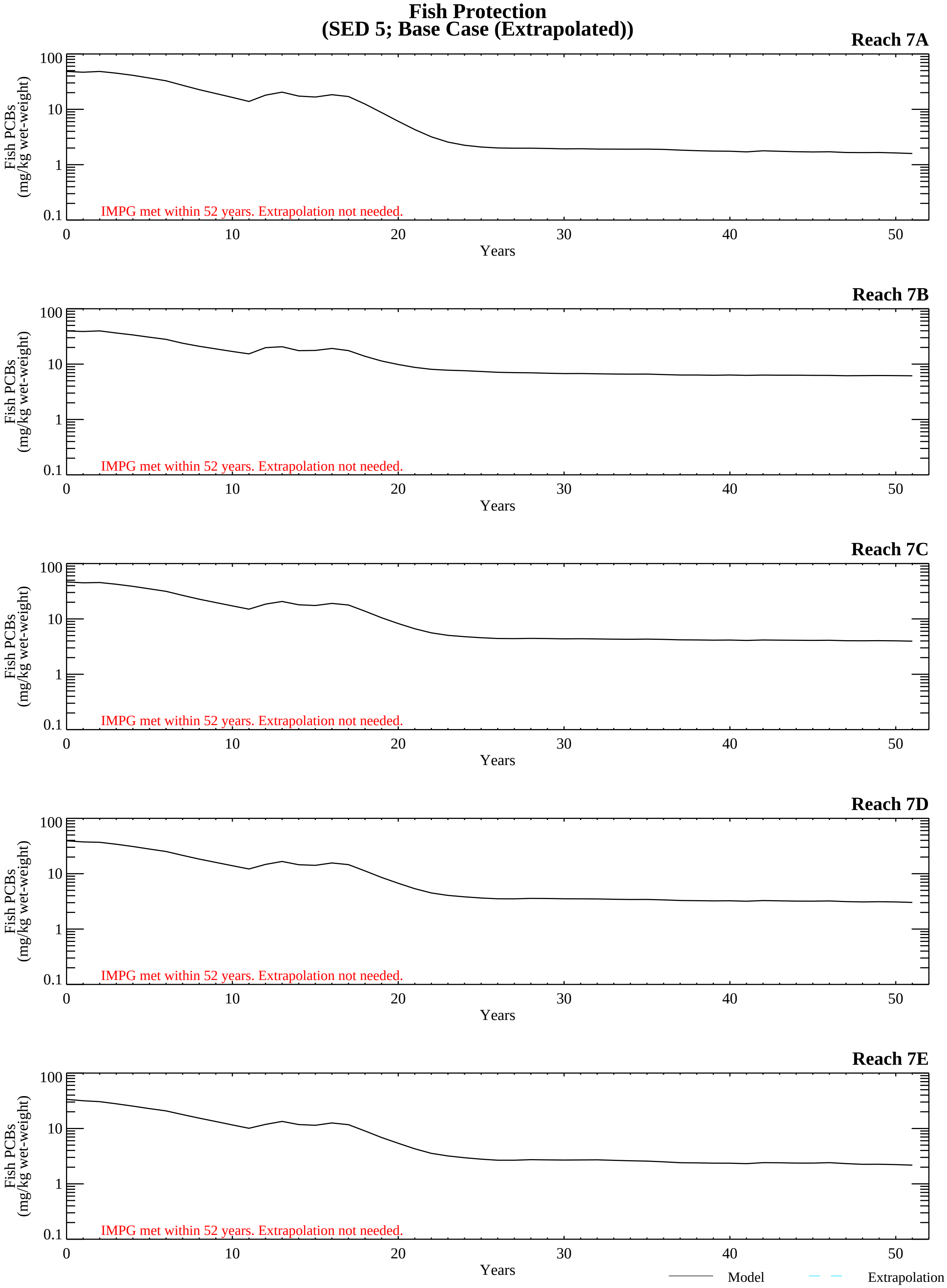


Figure G-9.2-4a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 5; Reach 5/6; Base Case).

IMPG value (mg/kg) = 55.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

NDK - Z:\GENcms\MODEL\FDCHN\Analysis\IMPG\Fish\impg_tabulate_projections_fff_LOOP.pro
Wed Mar 19 18:02:05 2008


Fish Protection
(SED 5; Base Case (Extrapolated))

Reach 7A

Reach 7B

Reach 7C

Reach 7D

Reach 7E

Figure G-9.2-4b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 5; Reach 7/8; Base Case).

Warmwater IMPG value (mg/kg) = 55.0
Coldwater IMPG value (mg/kg) = 14.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

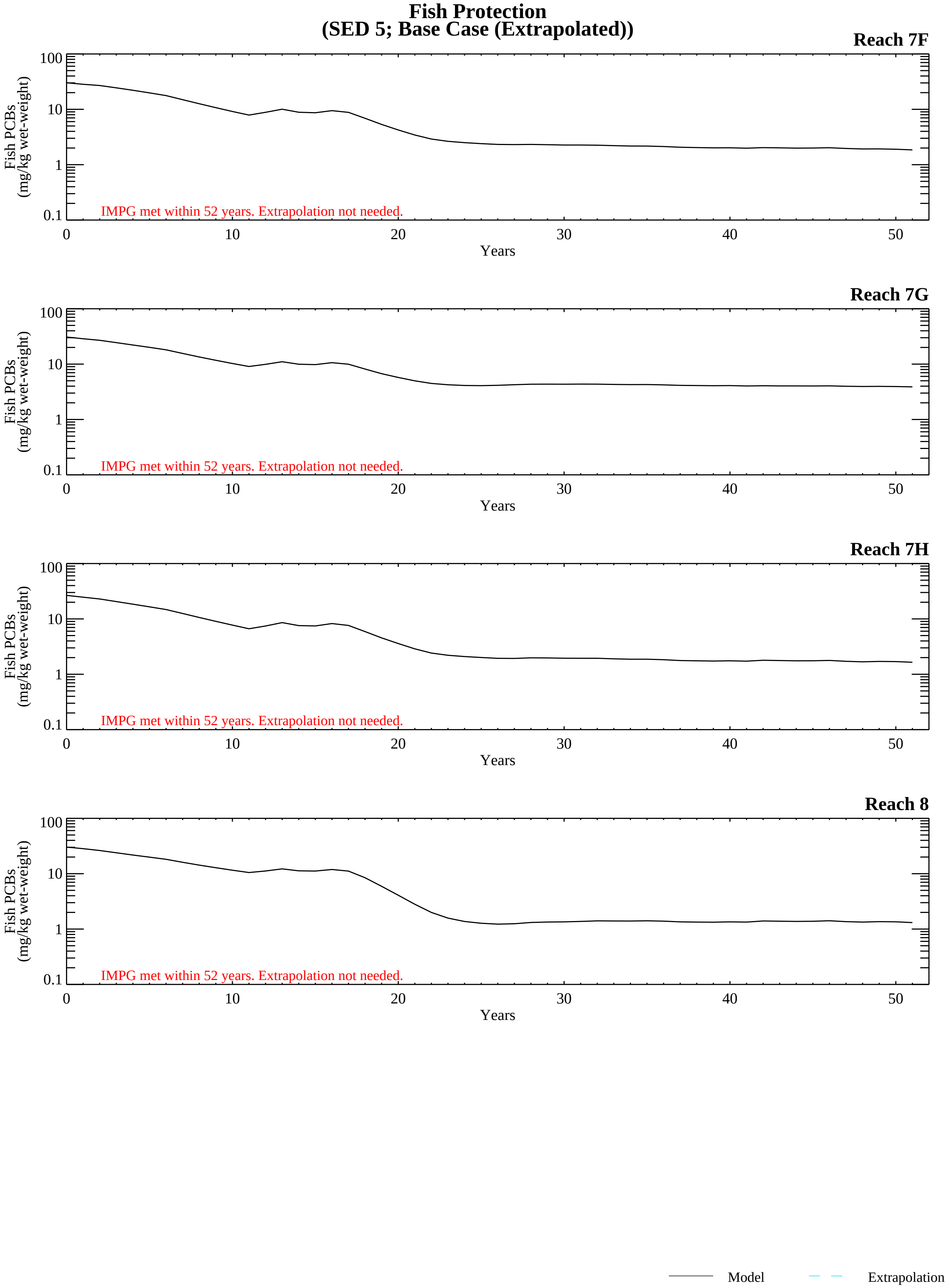


Figure G-9.2-4b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 5; Reach 7/8; Base Case).

Warmwater IMPG value (mg/kg) = 55.0
Coldwater IMPG value (mg/kg) = 14.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

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Wed Mar 19 19:47:56 2008

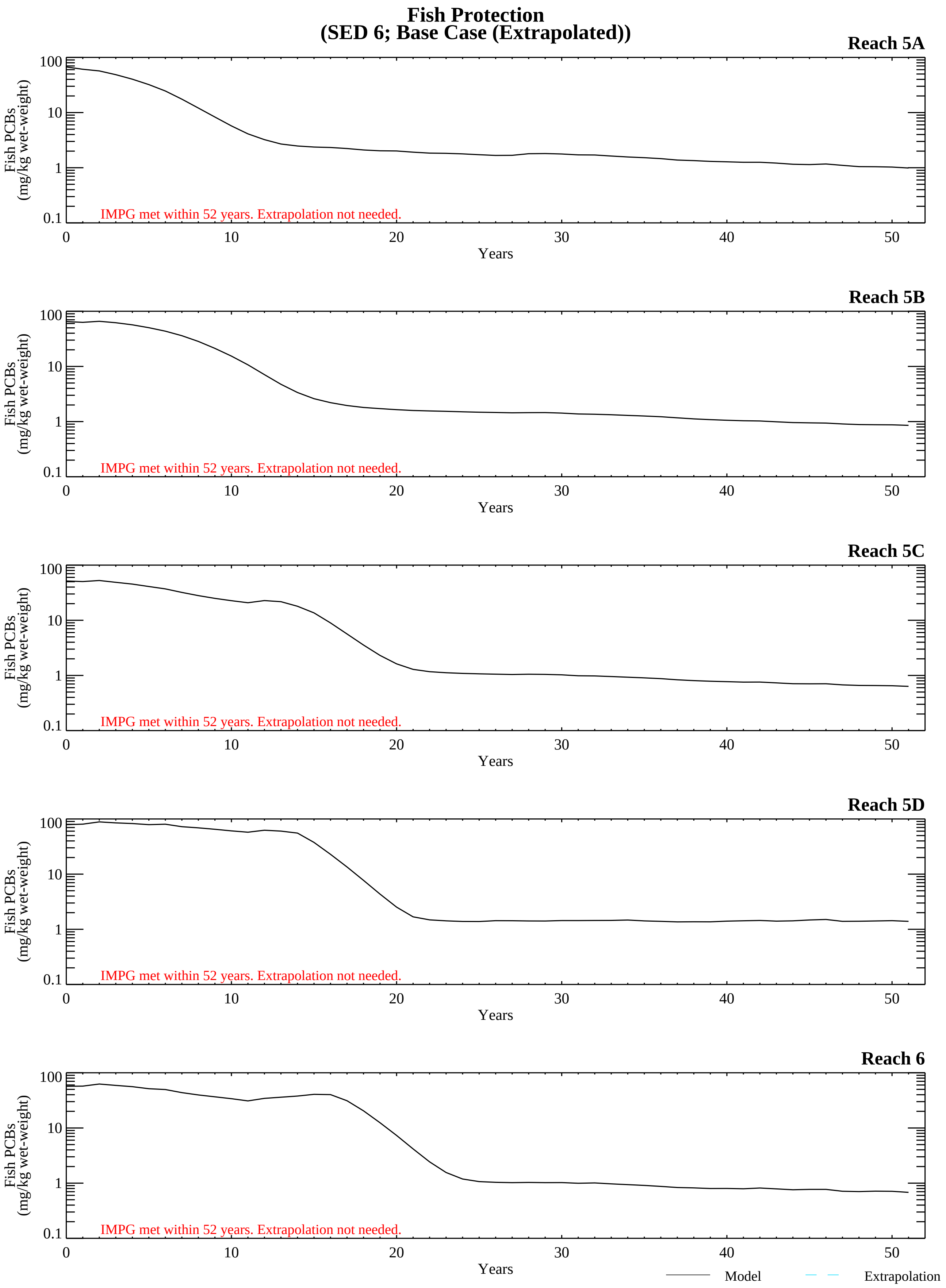

Figure G-9.2-5a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 6; Reach 5/6; Base Case).

IMPG value (mg/kg) = 55.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

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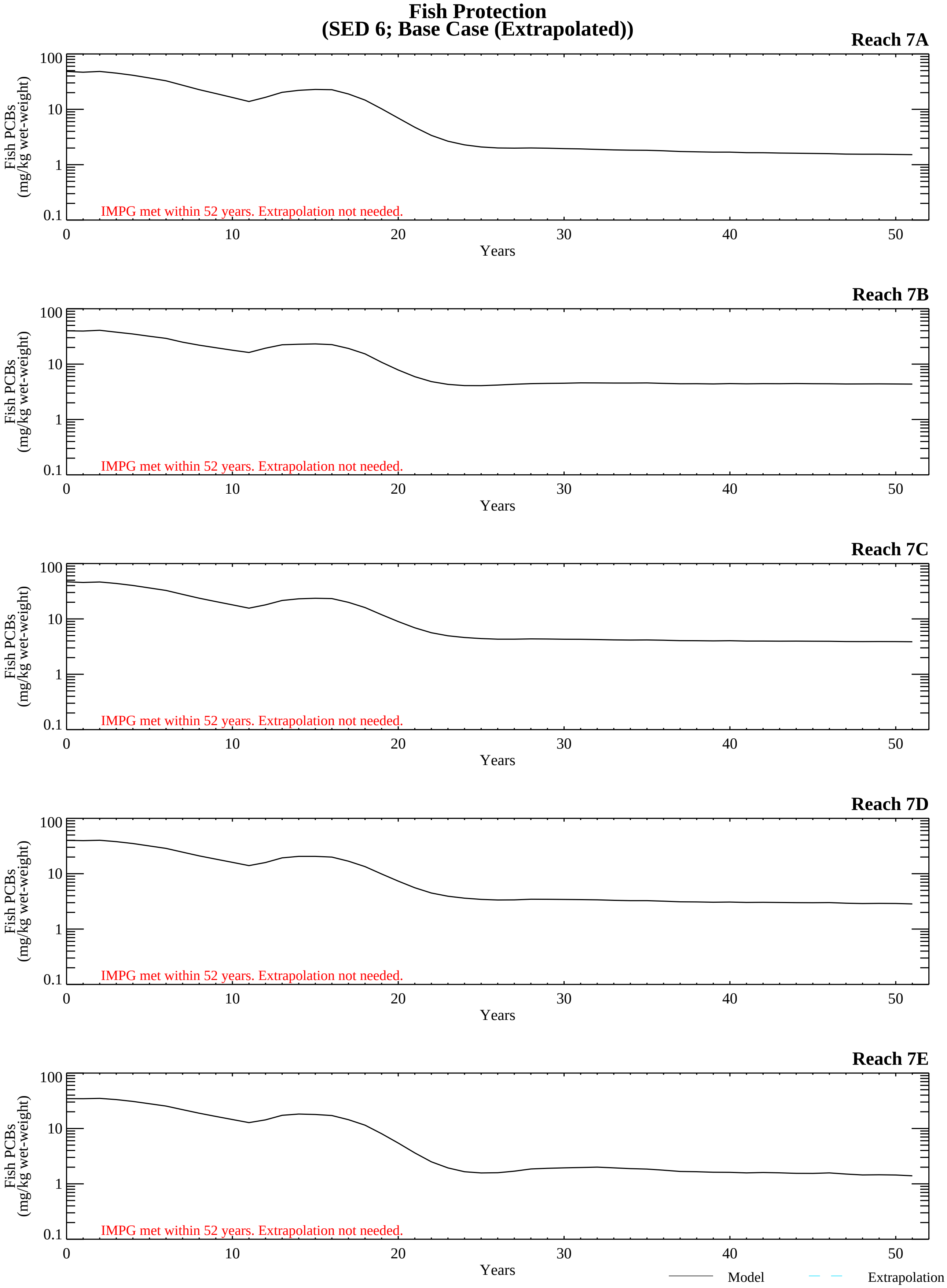
Fish Protection
(SED 6; Base Case (Extrapolated))

Reach 7A

Reach 7B

Reach 7C

Reach 7D

Reach 7E

Figure G-9.2-5b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 6; Reach 7/8; Base Case).

Warmwater IMPG value (mg/kg) = 55.0
Coldwater IMPG value (mg/kg) = 14.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

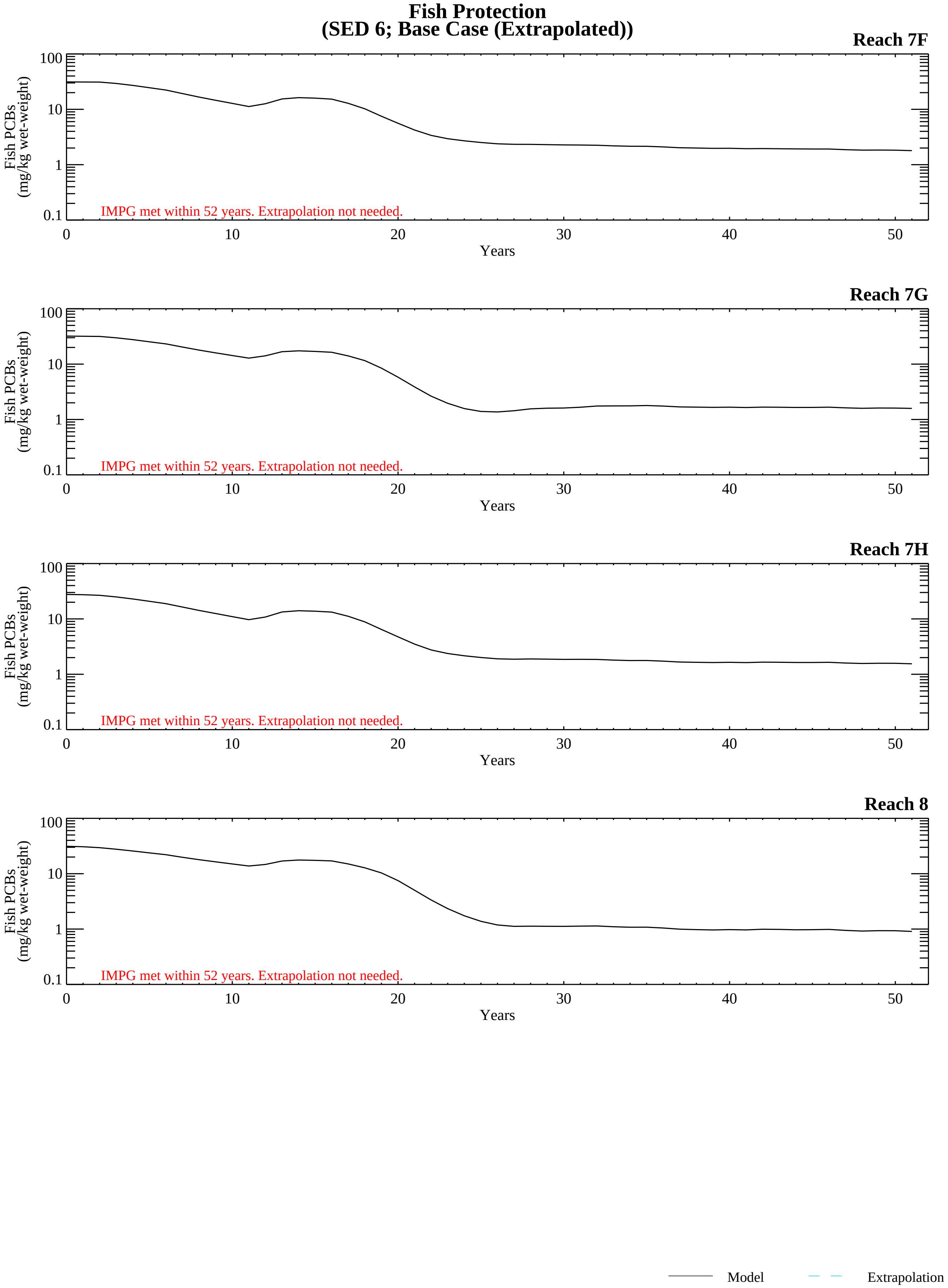

Figure G-9.2-5b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 6; Reach 7/8; Base Case).

Warmwater IMPG value (mg/kg) = 55.0
Coldwater IMPG value (mg/kg) = 14.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

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Wed Mar 19 20:15:46 2008

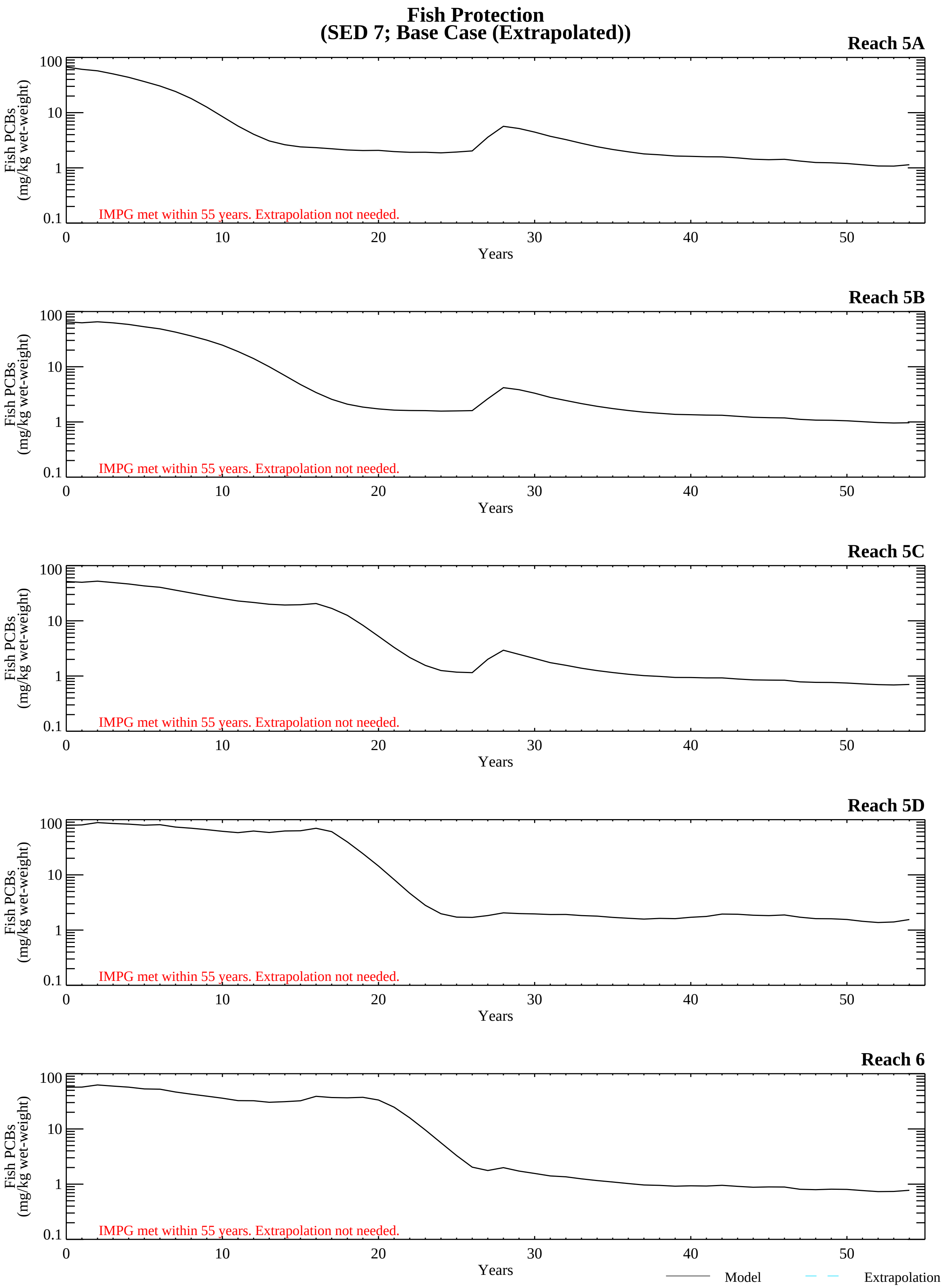

Figure G-9.2-6a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 7; Reach 5/6; Base Case).

IMPG value (mg/kg) = 55.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

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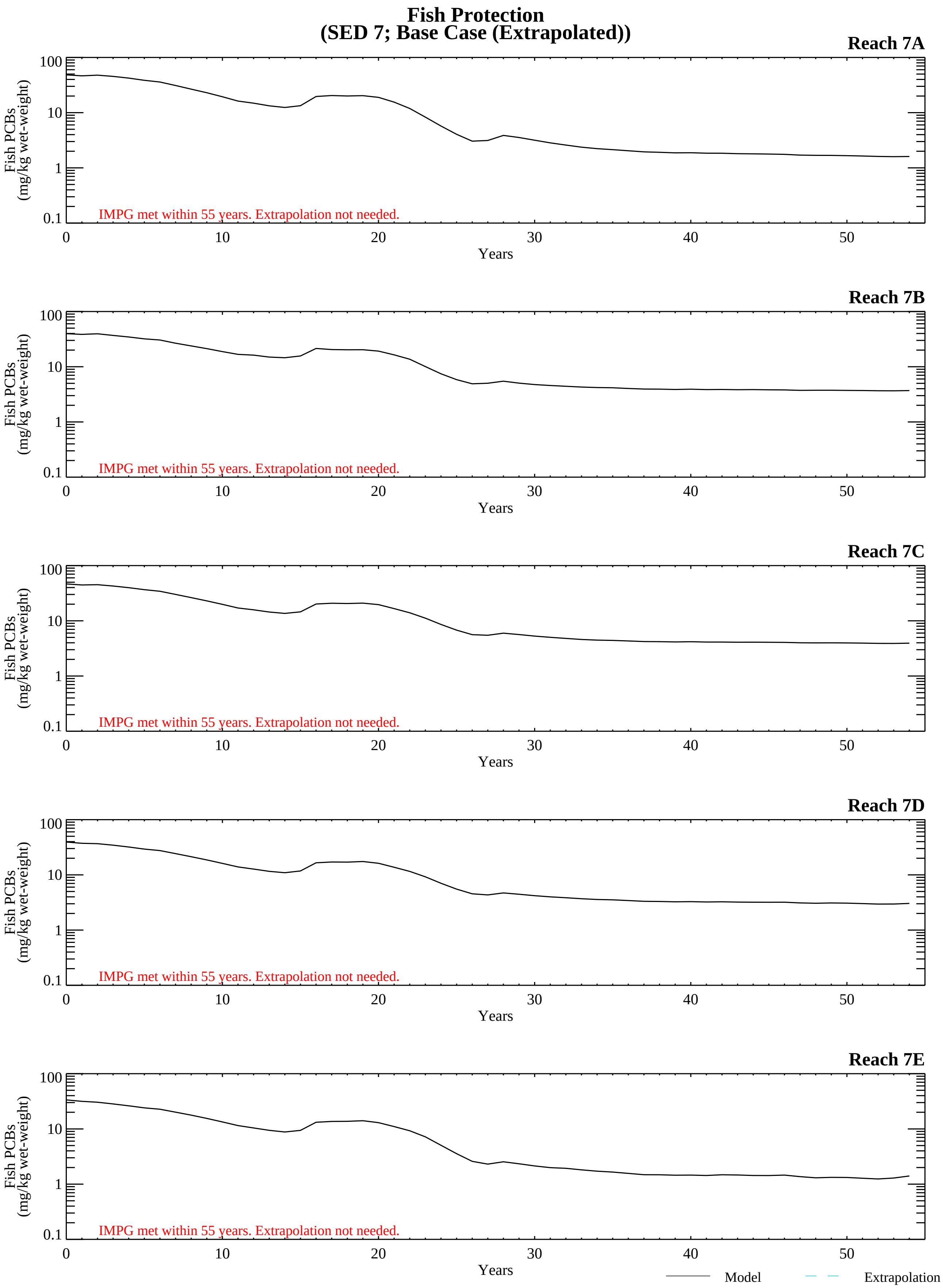

Figure G-9.2-6b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 7; Reach 7/8; Base Case).

Warmwater IMPG value (mg/kg) = 55.0
Coldwater IMPG value (mg/kg) = 14.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

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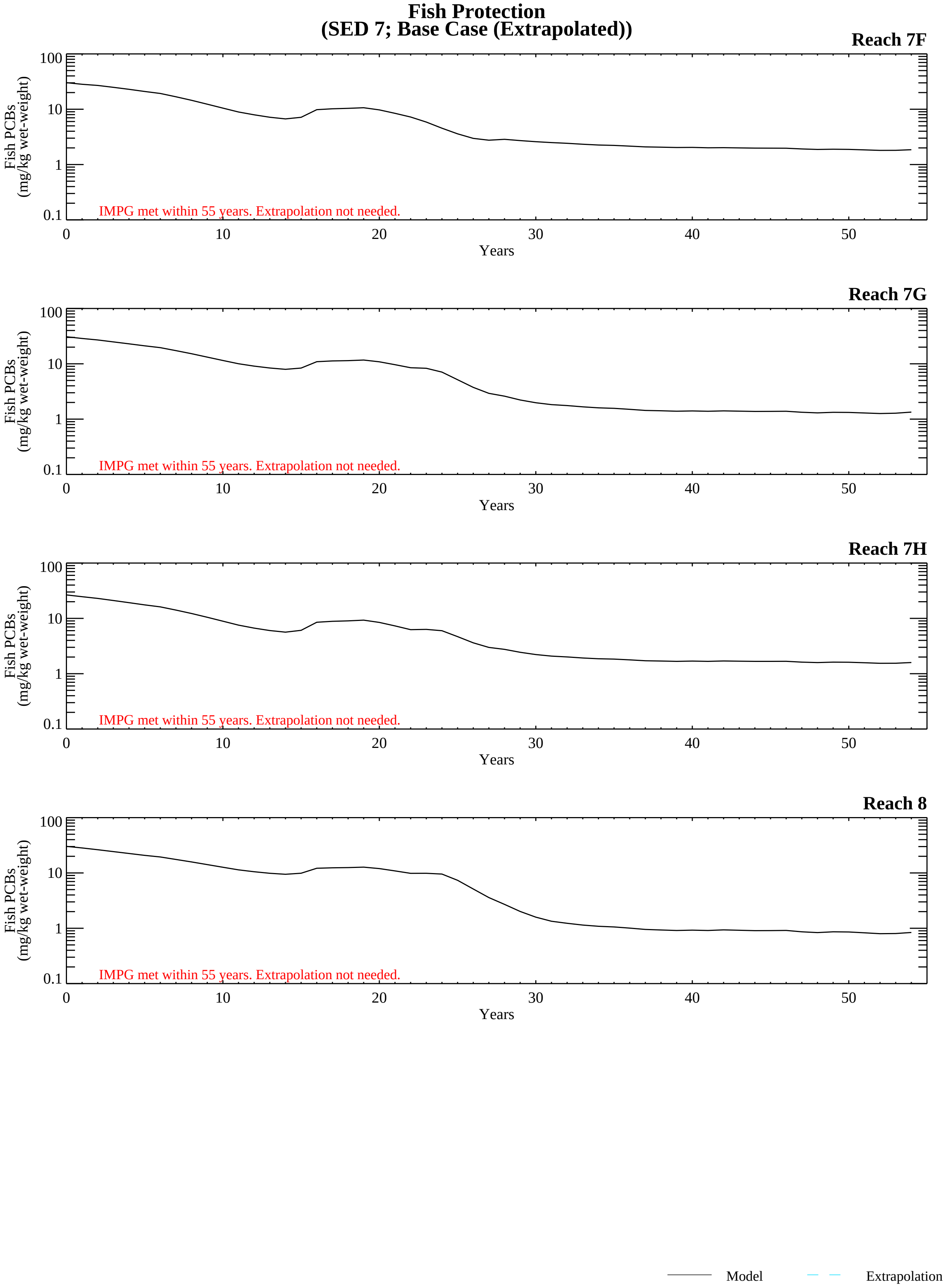

Figure G-9.2-6b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 7; Reach 7/8; Base Case).

Warmwater IMPG value (mg/kg) = 55.0
Coldwater IMPG value (mg/kg) = 14.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

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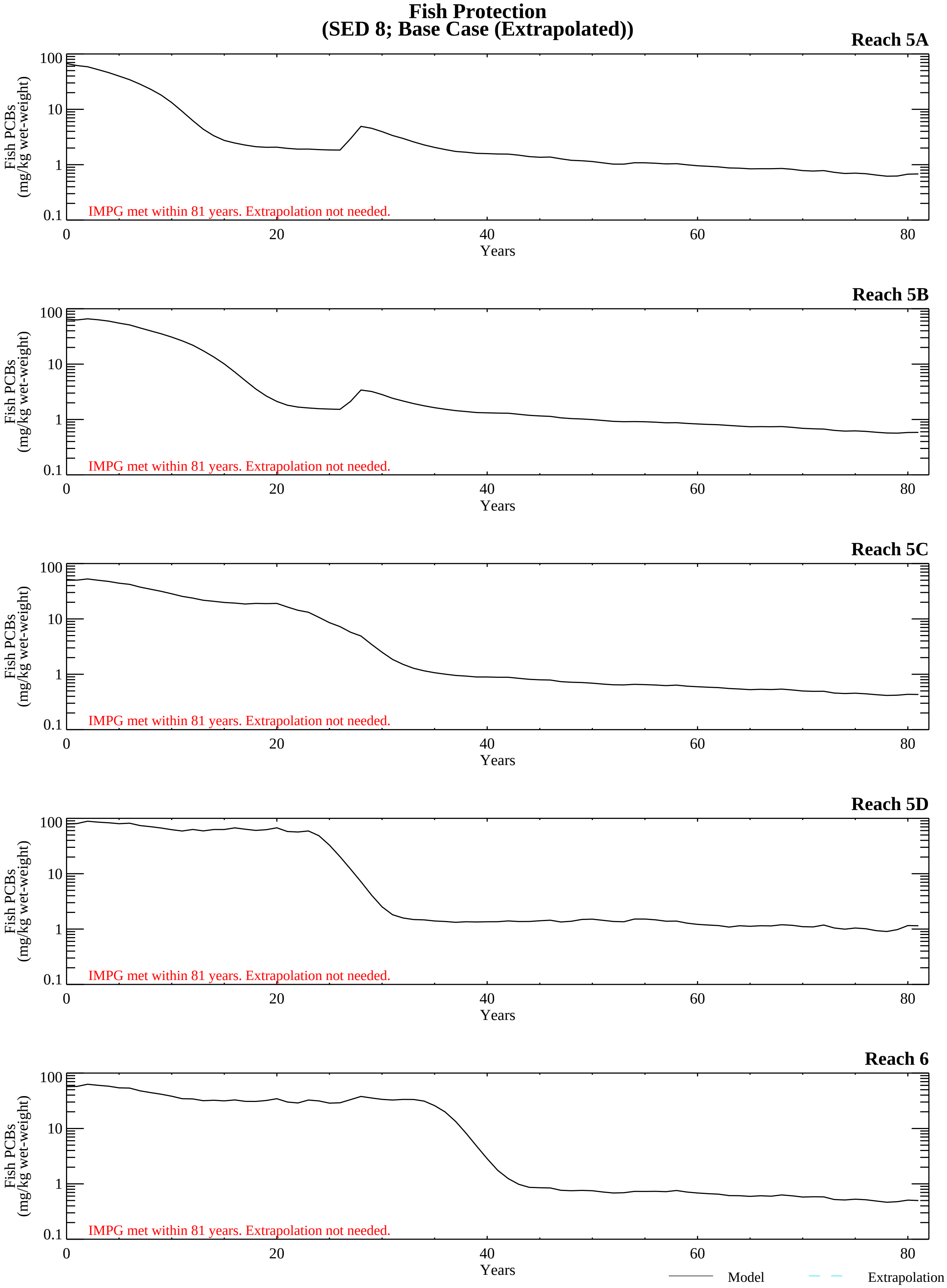

Figure G-9.2-7a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 8; Reach 5/6; Base Case).

IMPG value (mg/kg) = 55.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

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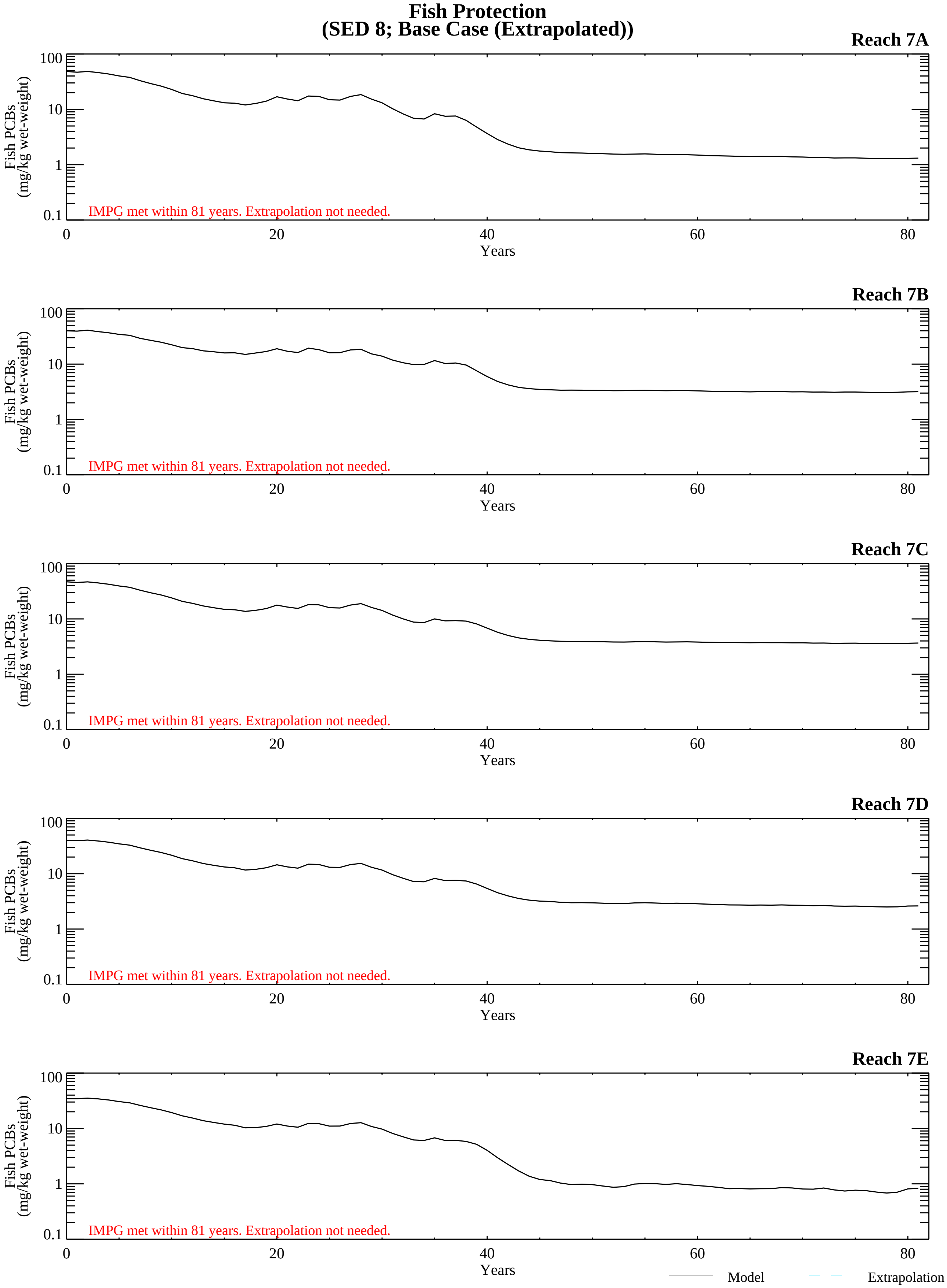


Figure G-9.2-7b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 8; Reach 7/8; Base Case).

Warmwater IMPG value (mg/kg) = 55.0
Coldwater IMPG value (mg/kg) = 14.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

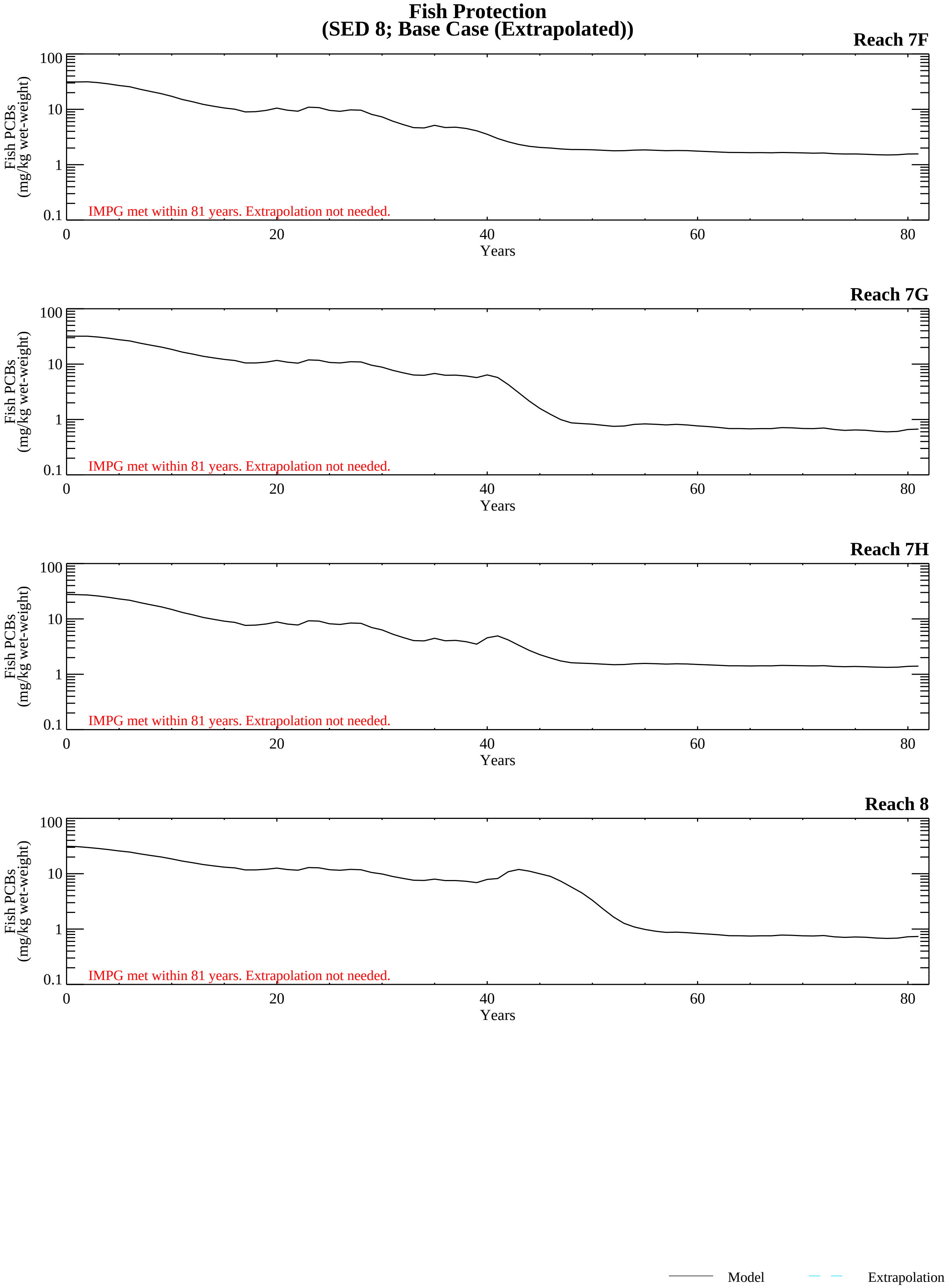


Figure G-9.2-7b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 8; Reach 7/8; Base Case).

Warmwater IMPG value (mg/kg) = 55.0
Coldwater IMPG value (mg/kg) = 14.0
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for fish ages 1 to 9.

Fish Protection
(SED 1 / SED 2; Lower Bound)

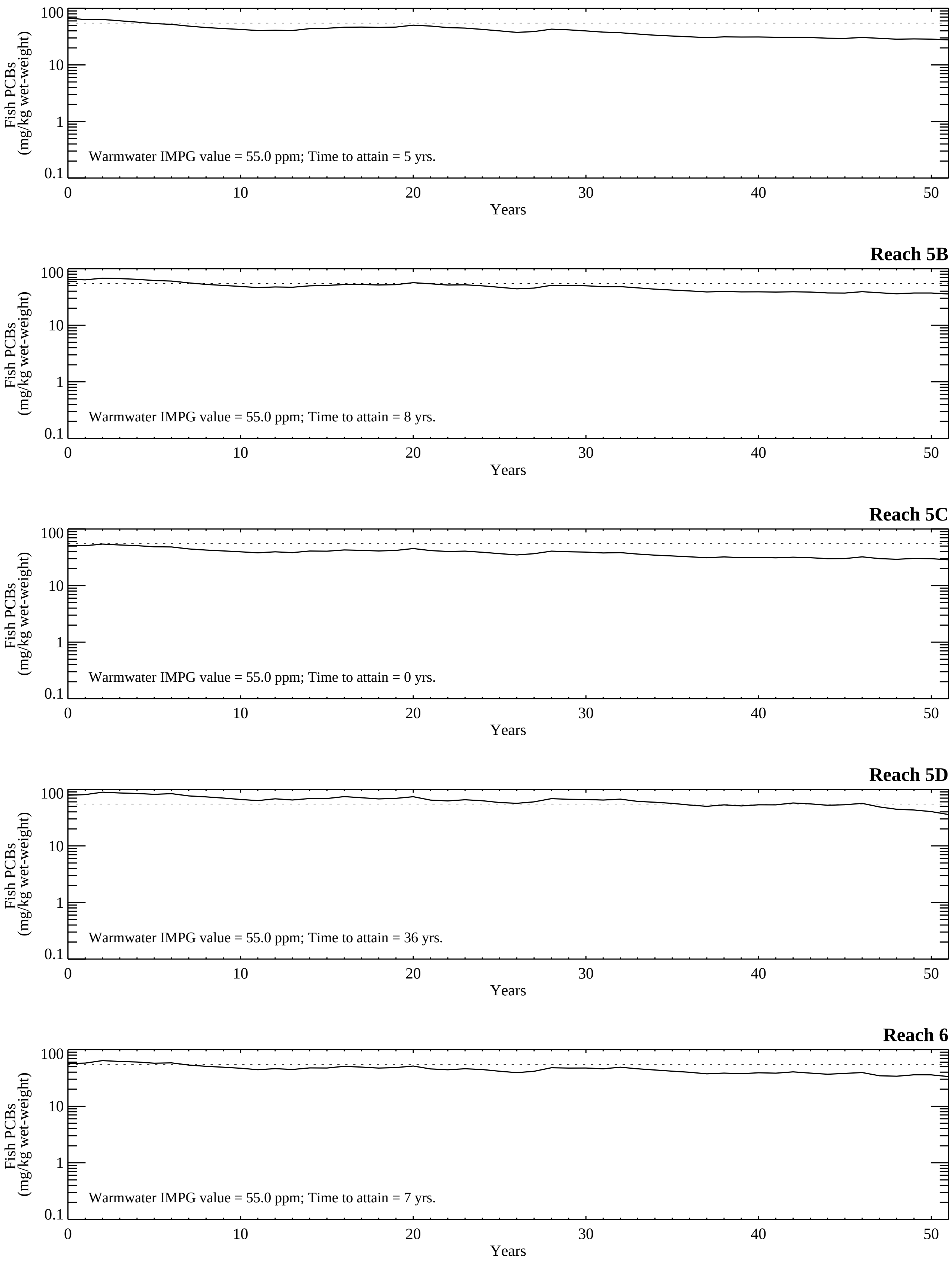
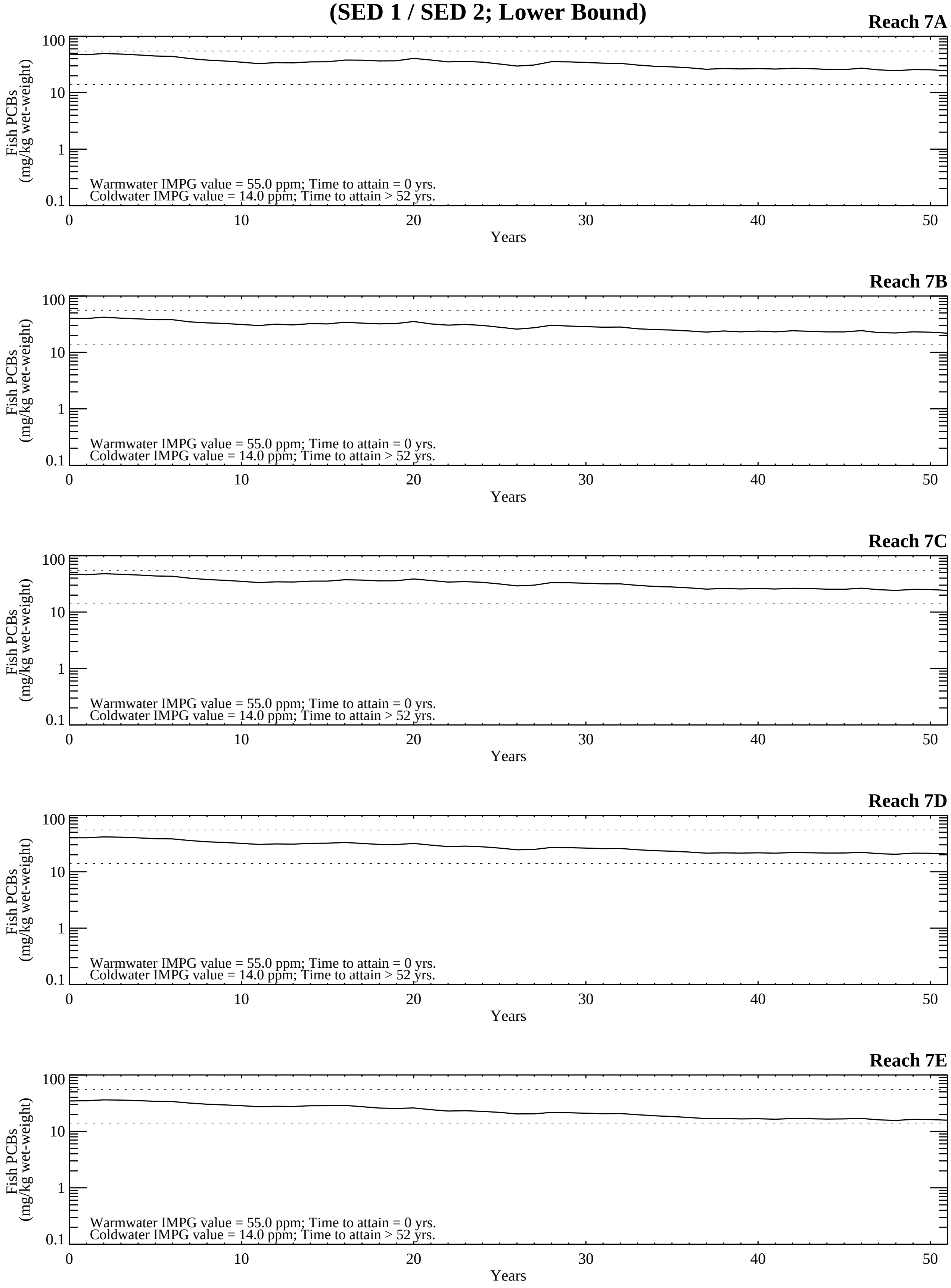


Figure G-9.3-1a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 1 / SED 2; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.



Fish Protection
(SED 1 / SED 2; Lower Bound)

Reach 7A

Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.
Coldwater IMPG value = 14.0 ppm; Time to attain > 52 yrs.

Reach 7B

Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.
Coldwater IMPG value = 14.0 ppm; Time to attain > 52 yrs.

Reach 7C

Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.
Coldwater IMPG value = 14.0 ppm; Time to attain > 52 yrs.

Reach 7D

Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.
Coldwater IMPG value = 14.0 ppm; Time to attain > 52 yrs.

Reach 7E

Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.
Coldwater IMPG value = 14.0 ppm; Time to attain > 52 yrs.

Figure G-9.3-1b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 1 / SED 2; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

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Fri Mar 14 22:48:43 2008

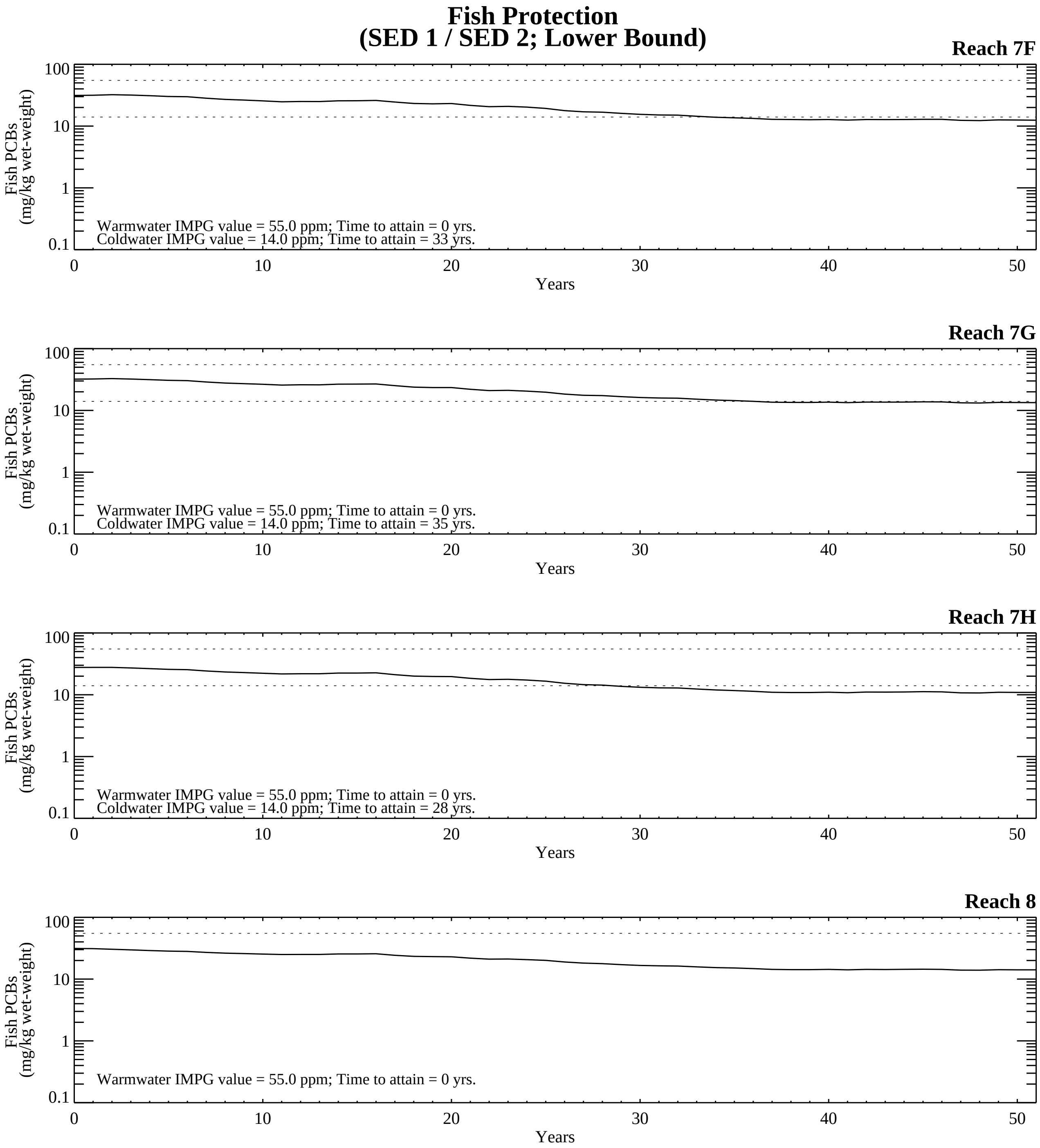


Figure G-9.3-1b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 1 / SED 2; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

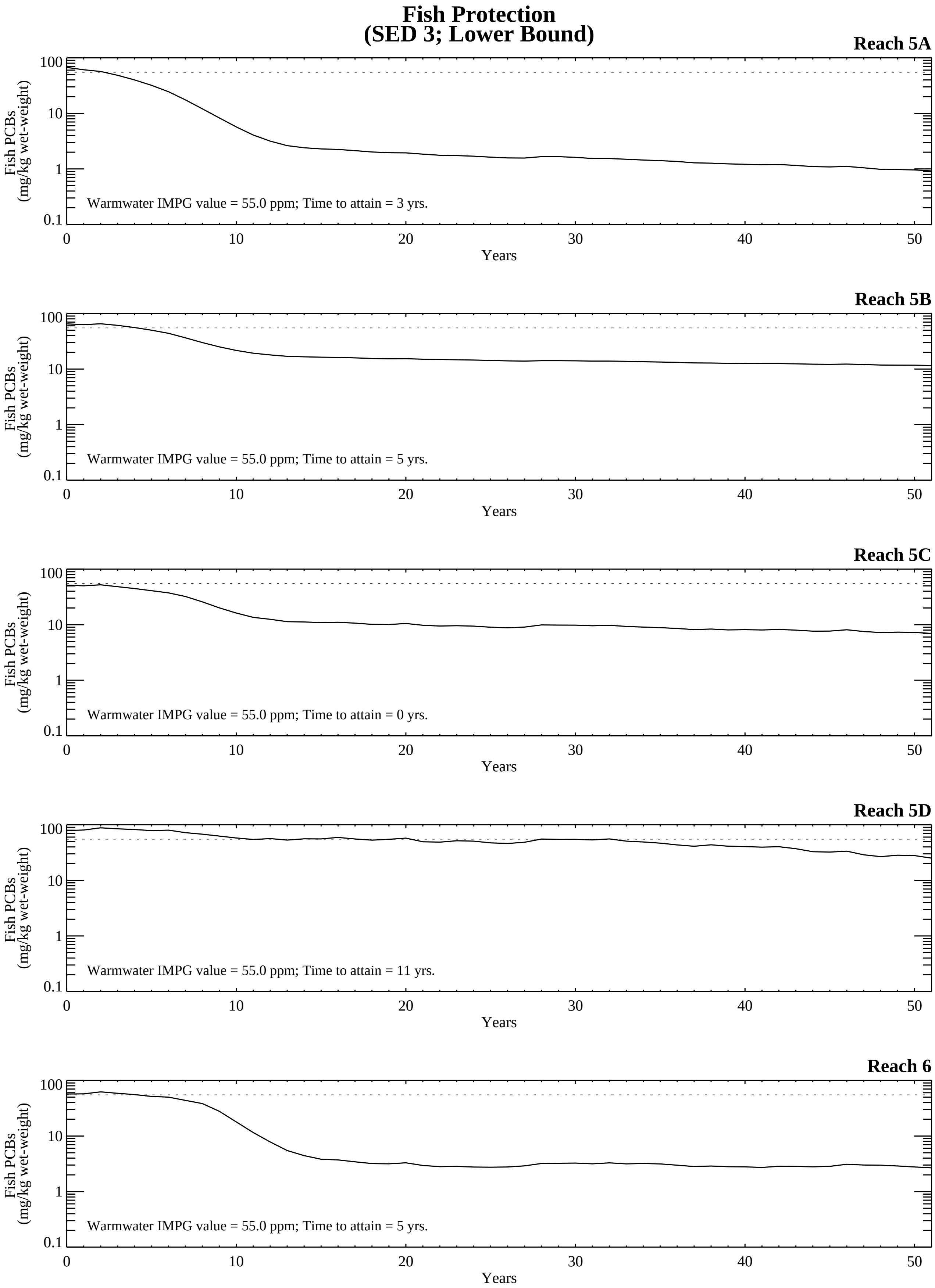


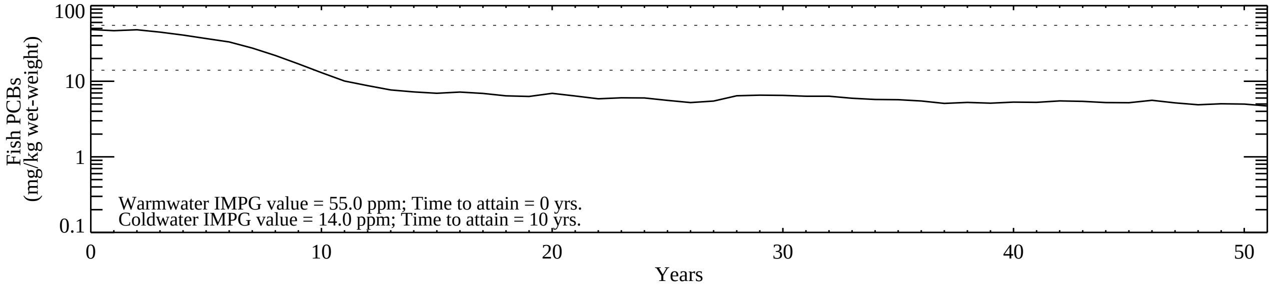
Figure G-9.3-2a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 3; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

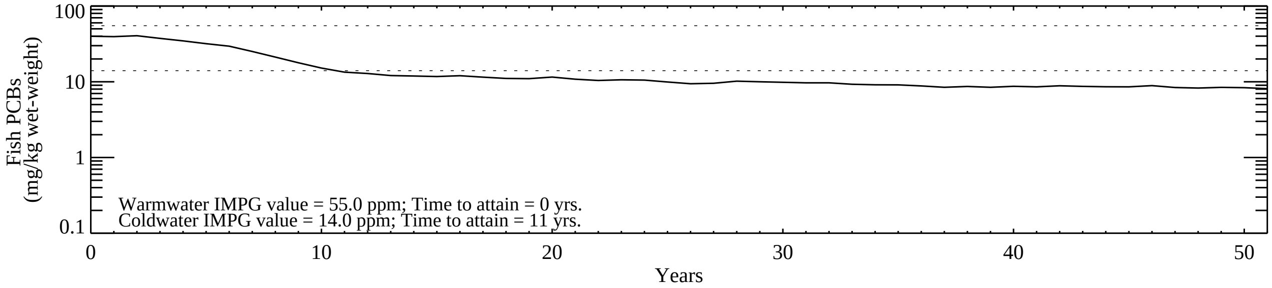
DR\LD - Z:\GENcms\MODEL\FDCHN\Analysis\IMPG\Fish\impg_tabulate_projections_loop.pro
Fri Mar 14 18:27:44 2008

Fish Protection
(SED 3; Lower Bound)

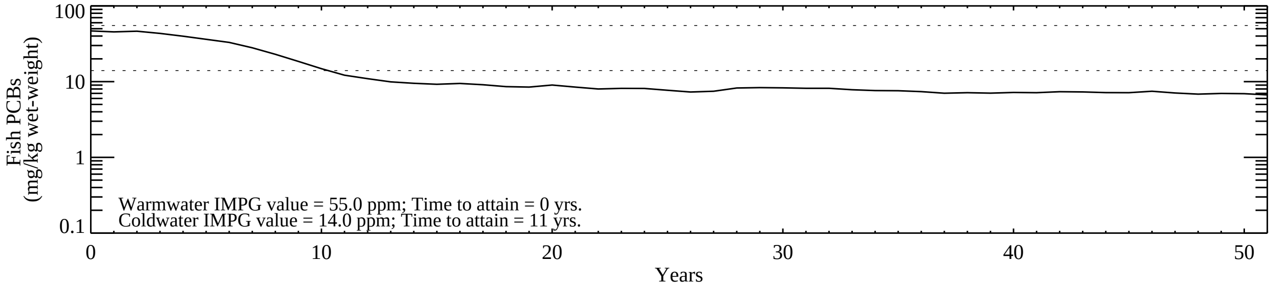
Reach 7A



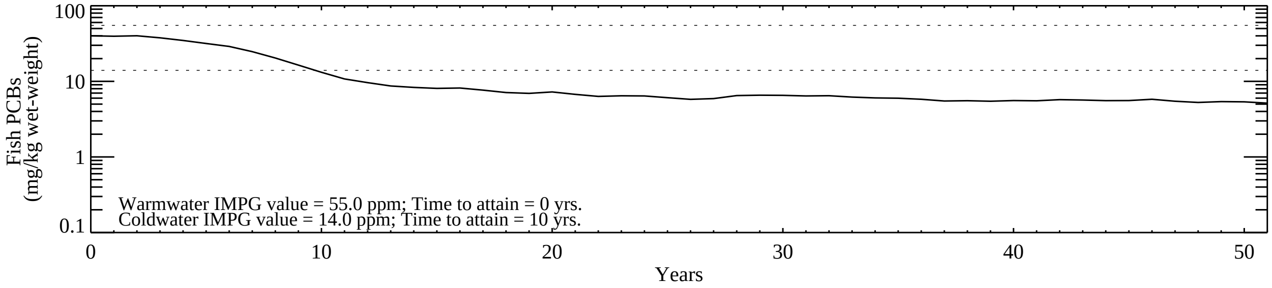
Reach 7B



Reach 7C



Reach 7D



Reach 7E

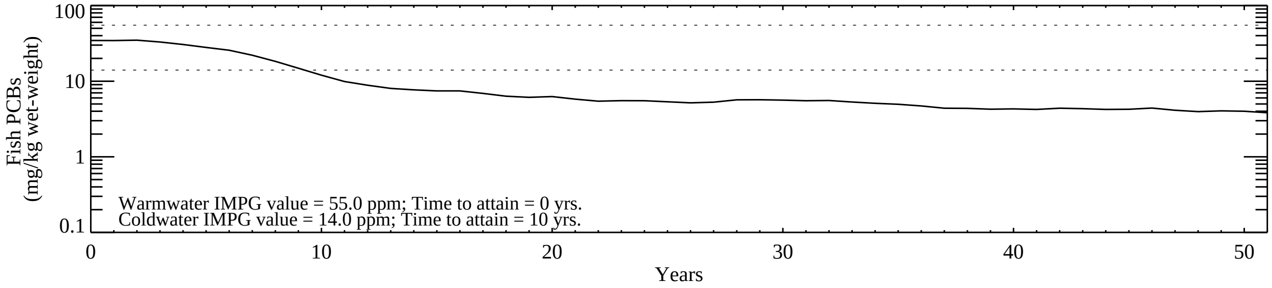


Figure G-9.3-2b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 3; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

Fish Protection
(SED 3; Lower Bound)

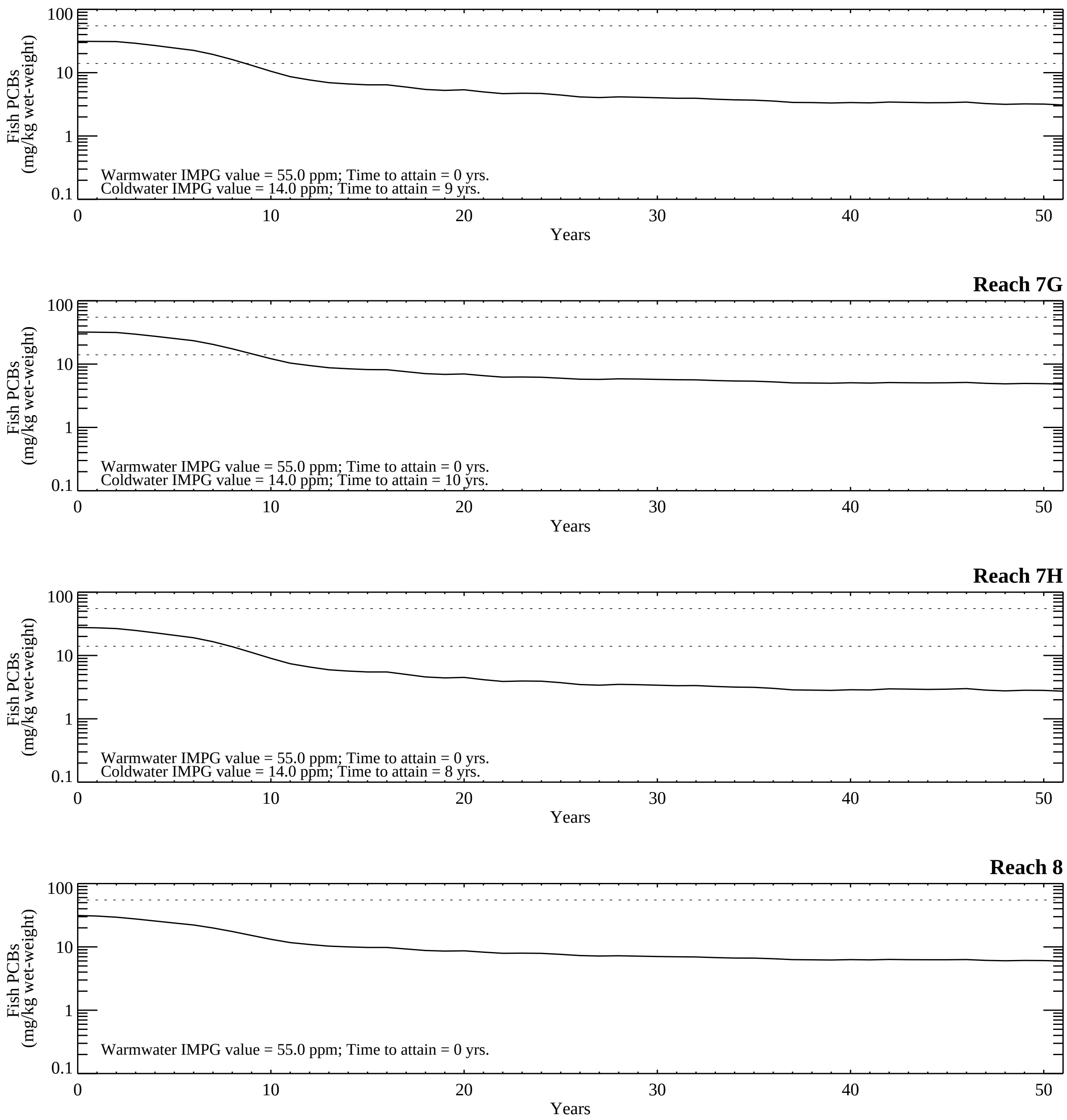


Figure G-9.3-2b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 3; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

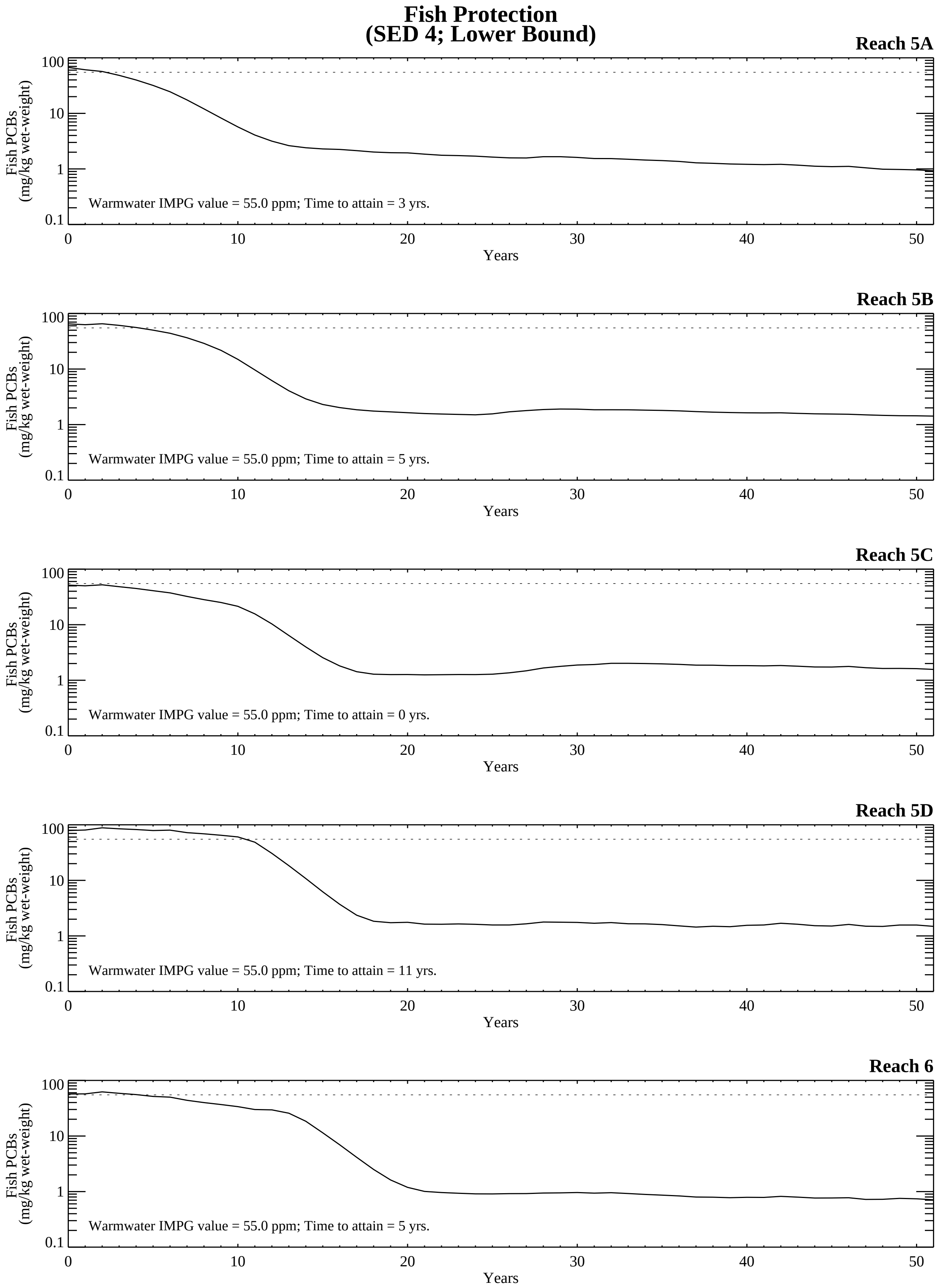


Figure G-9.3-3a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 4; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

DR\LD - Z:\GENcms\MODEL\FDCHN\Analysis\IMPG\Fish\impg_tabulate_projections_loop.pro
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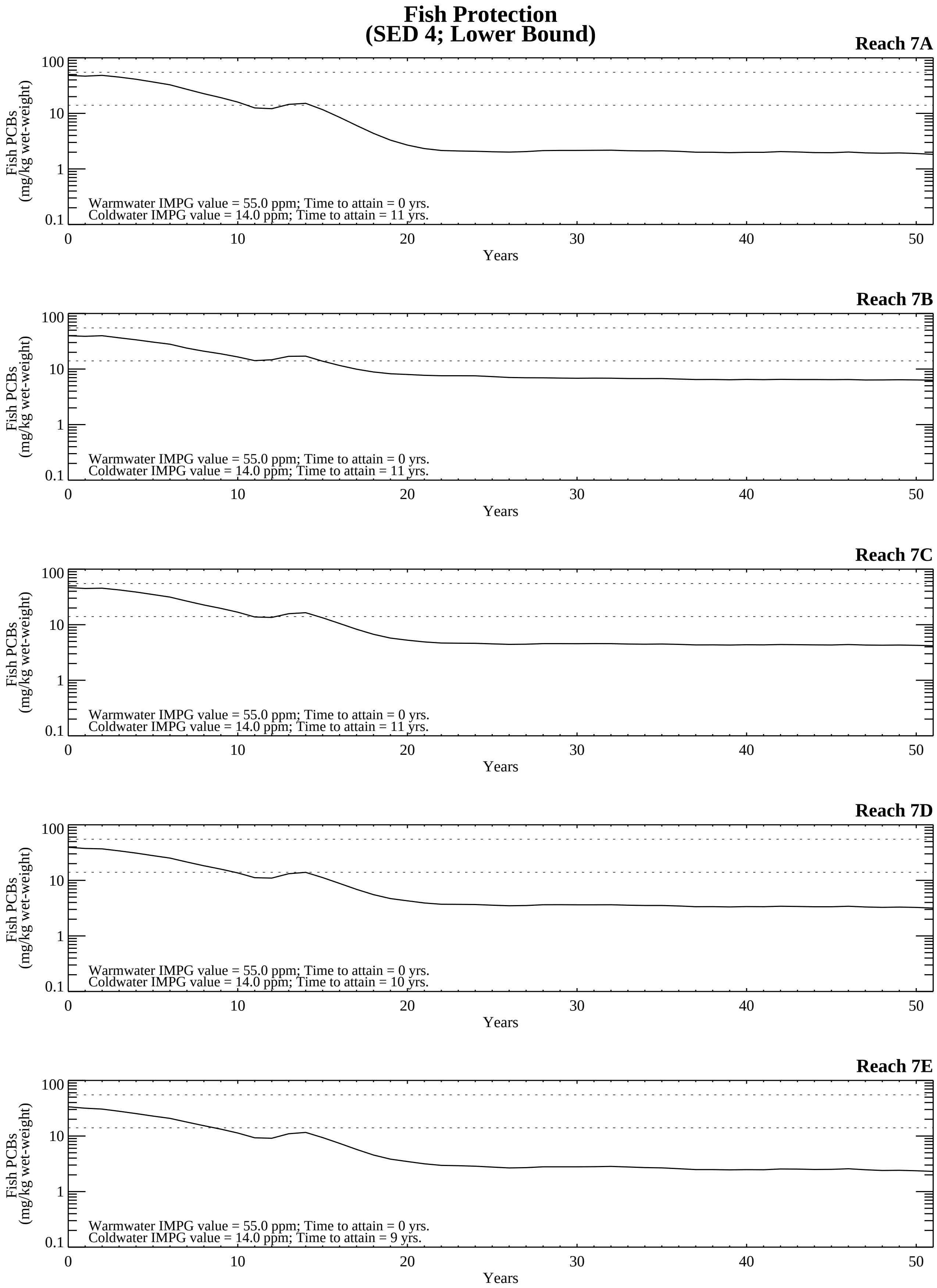

Figure G-9.3-3b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 4; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

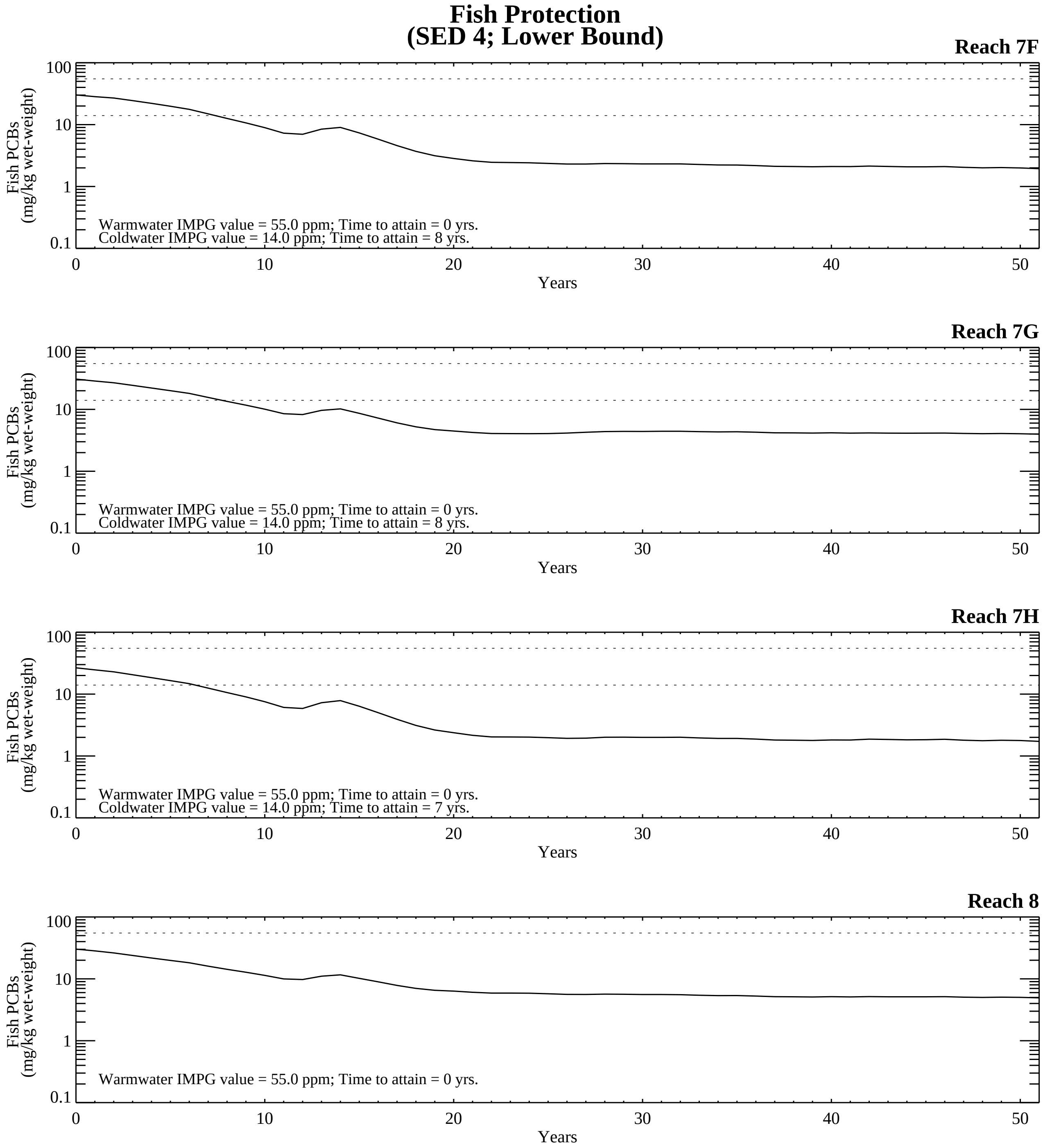

Figure G-9.3-3b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 4; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

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Fri Mar 14 23:18:41 2008

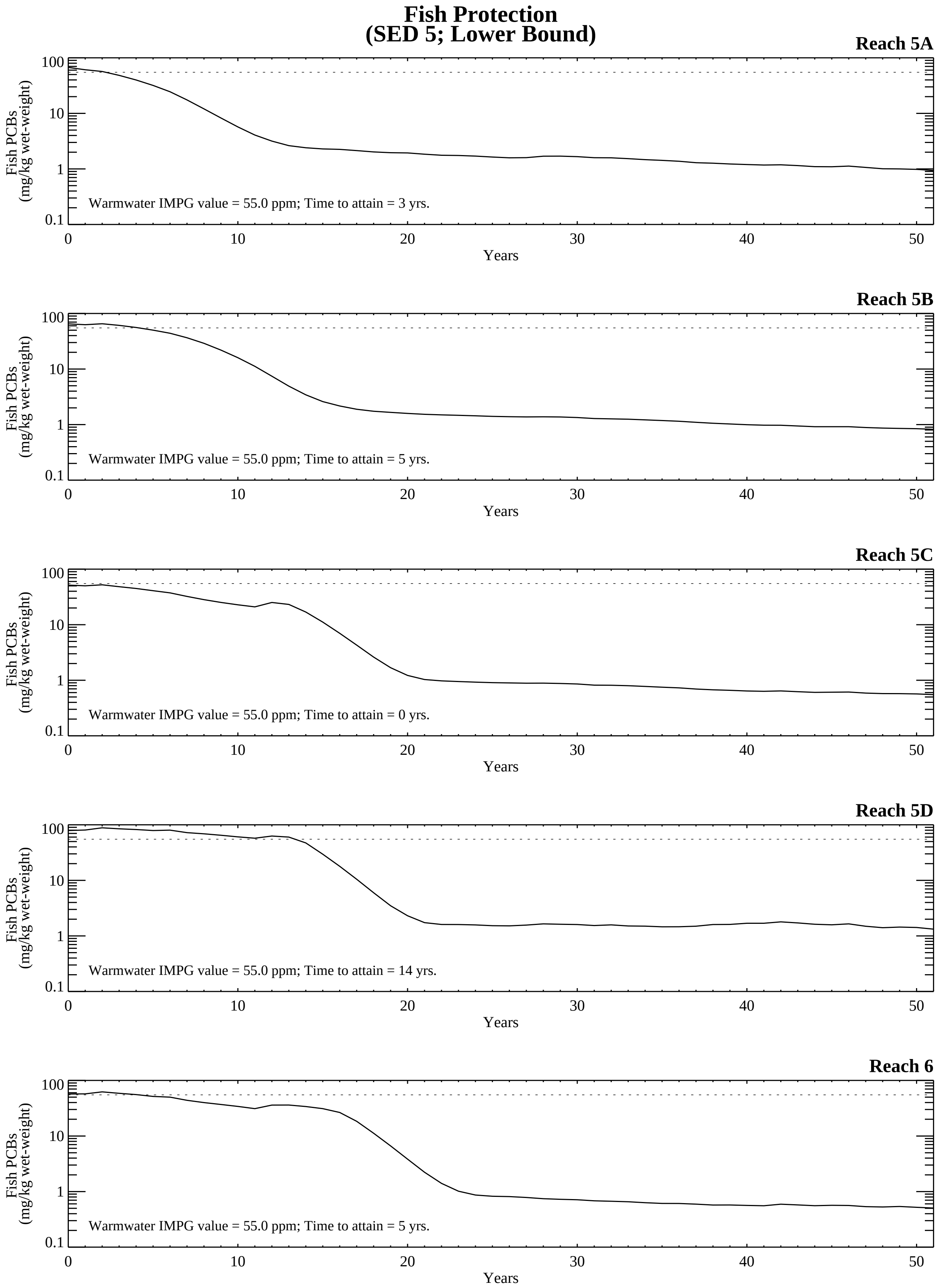

Figure G-9.3-4a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 5; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

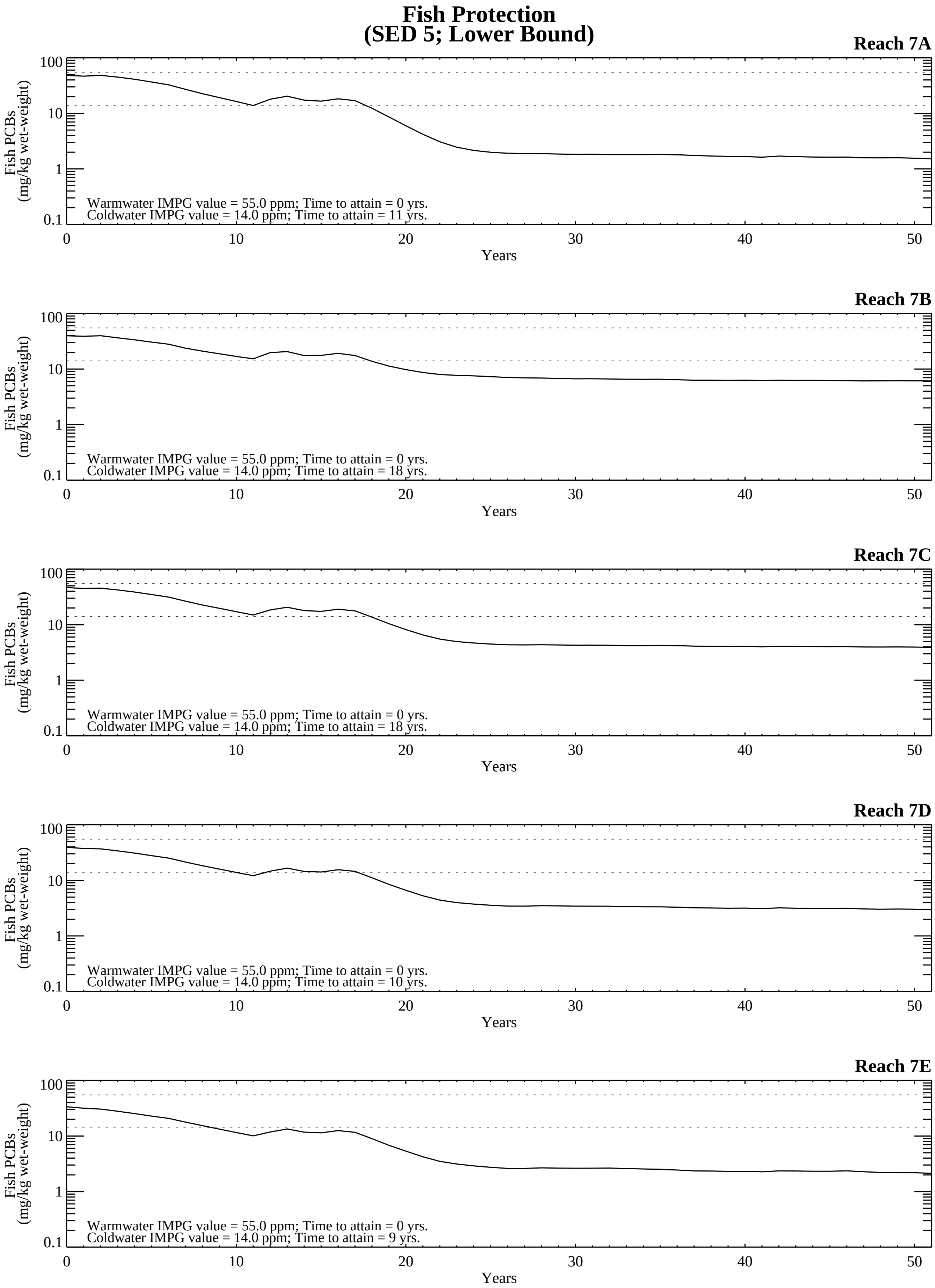

Figure G-9.3-4b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 5; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

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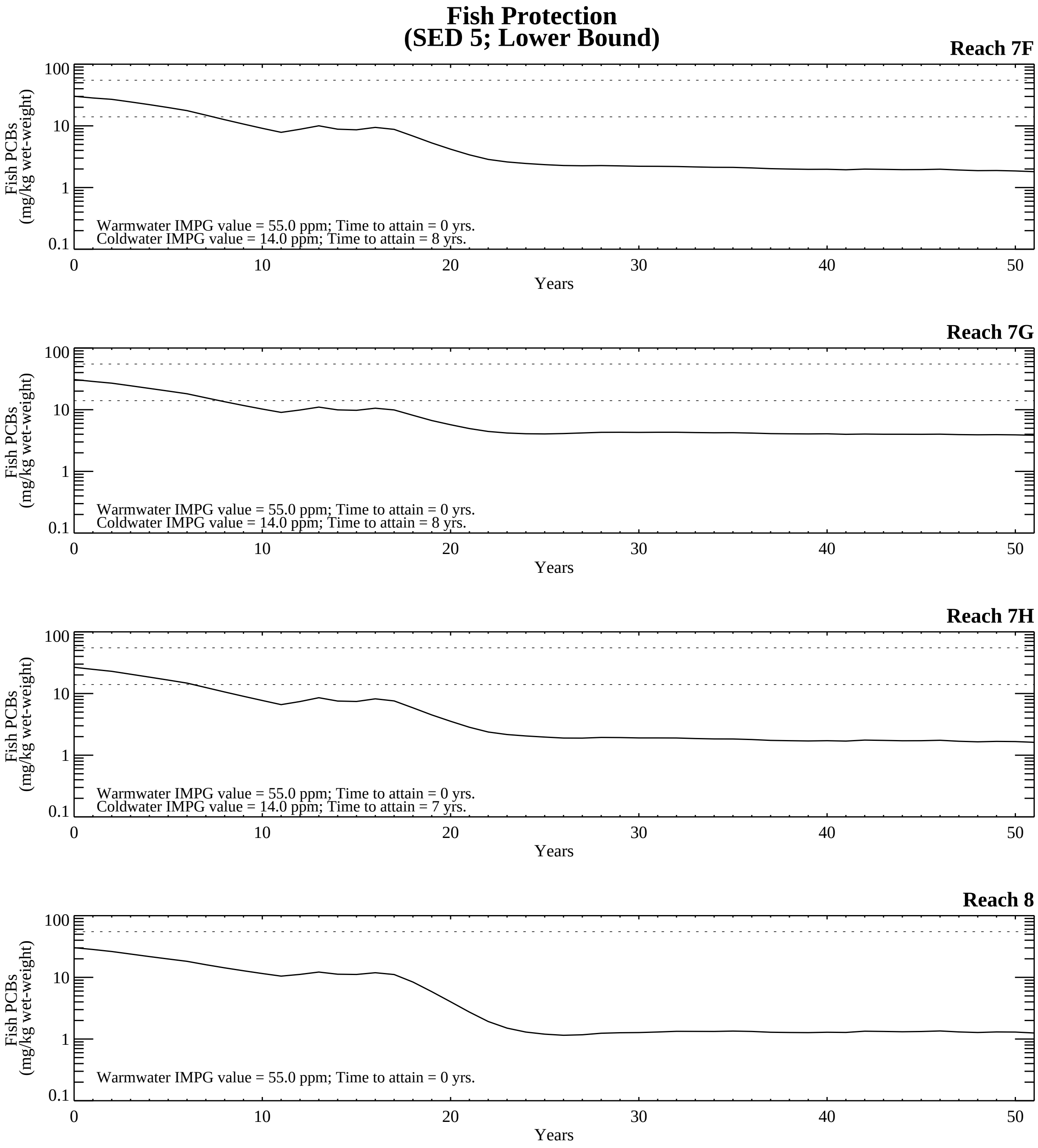

Figure G-9.3-4b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 5; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

Fish Protection
(SED 6; Lower Bound)

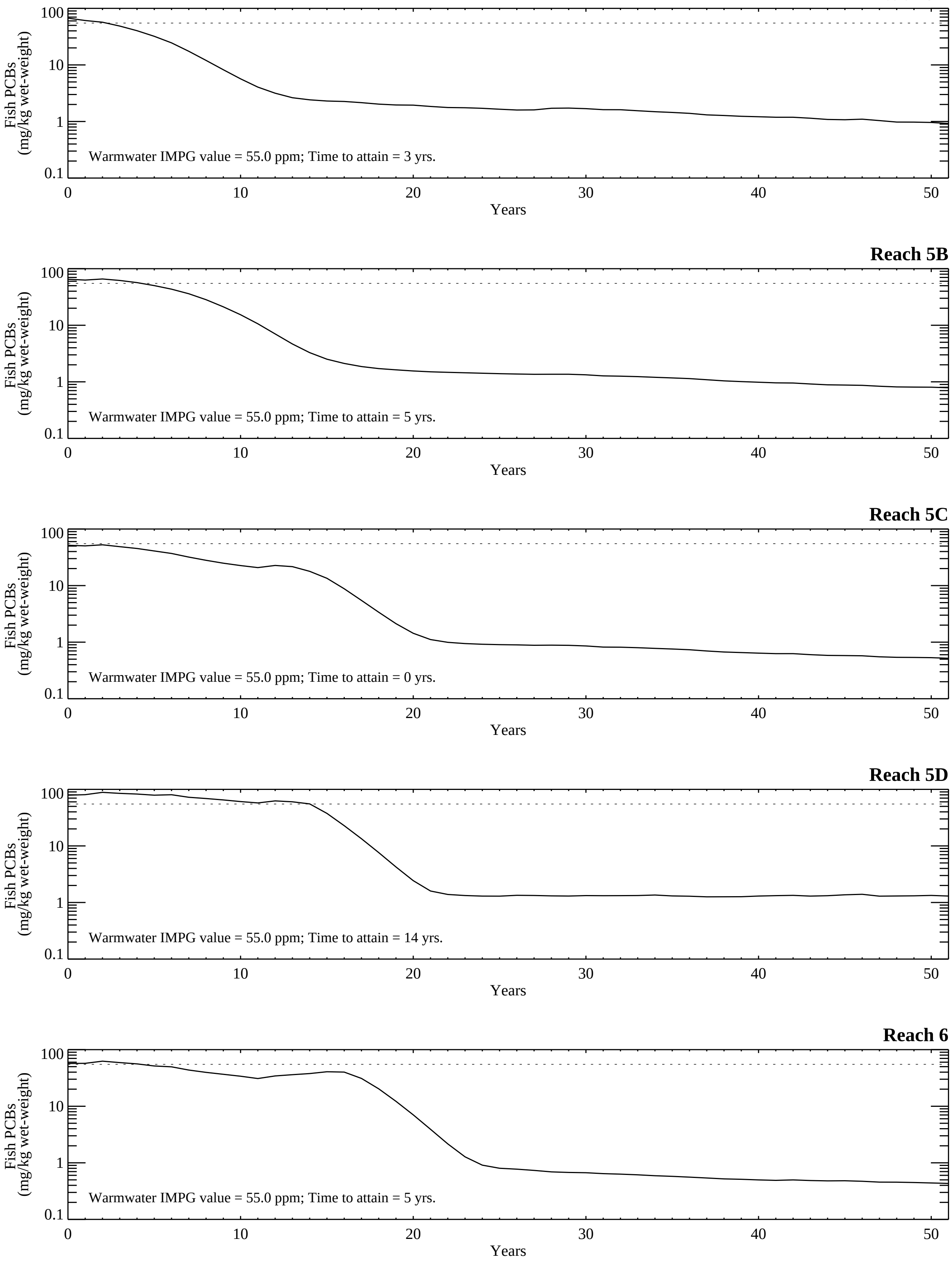

Figure G-9.3-5a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 6; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

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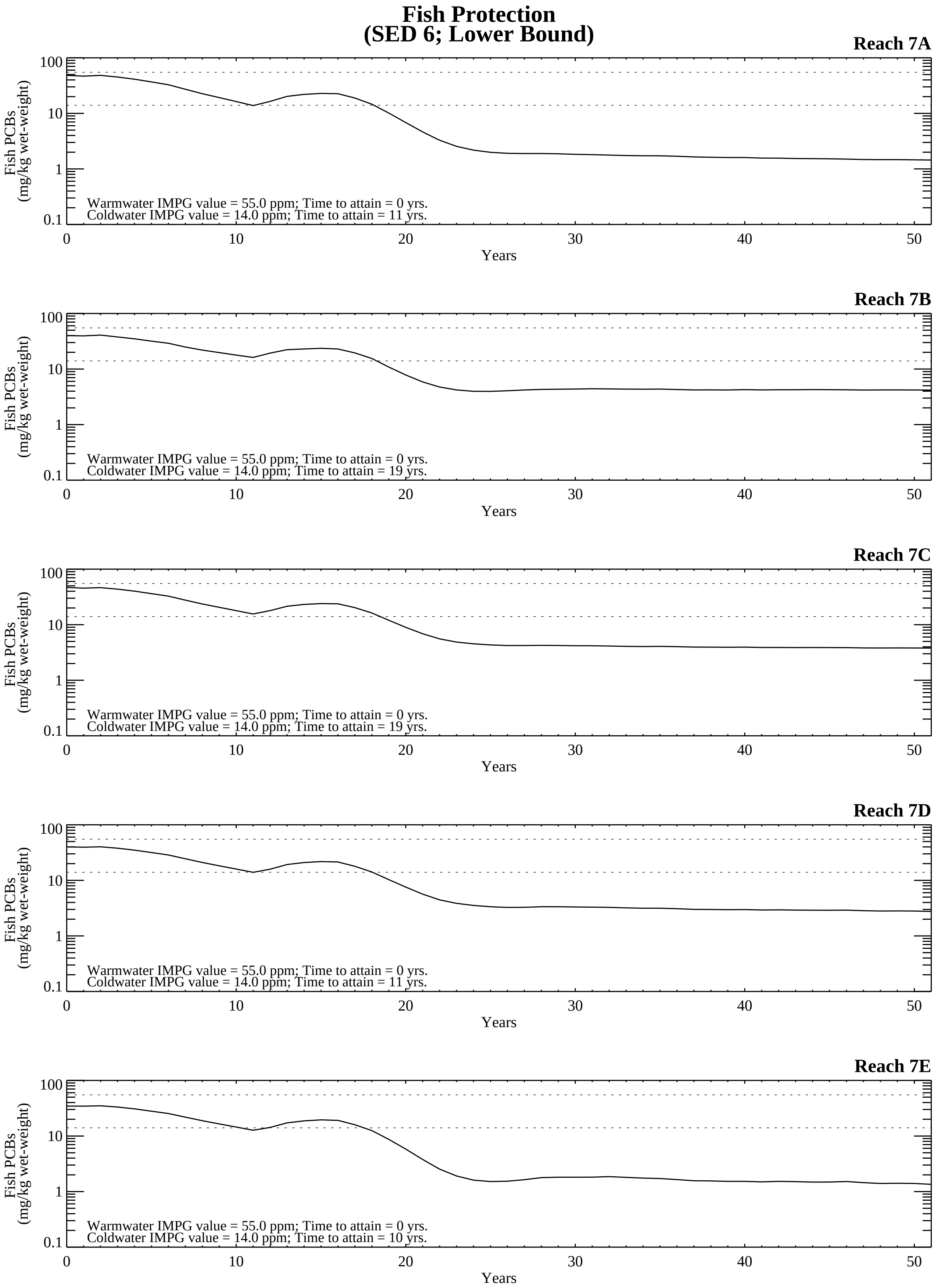

Figure G-9.3-5b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 6; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

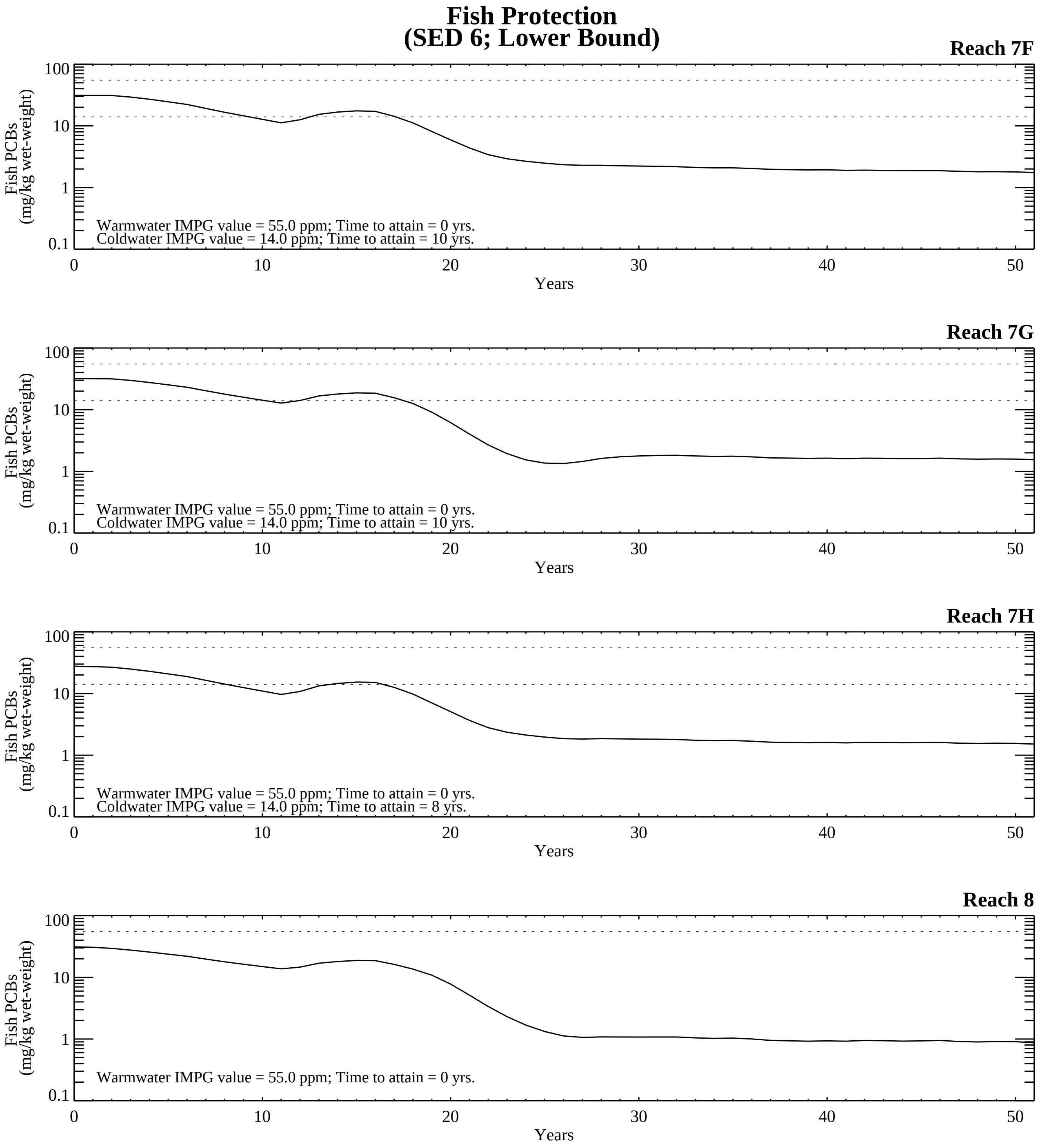

Figure G-9.3-5b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 6; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

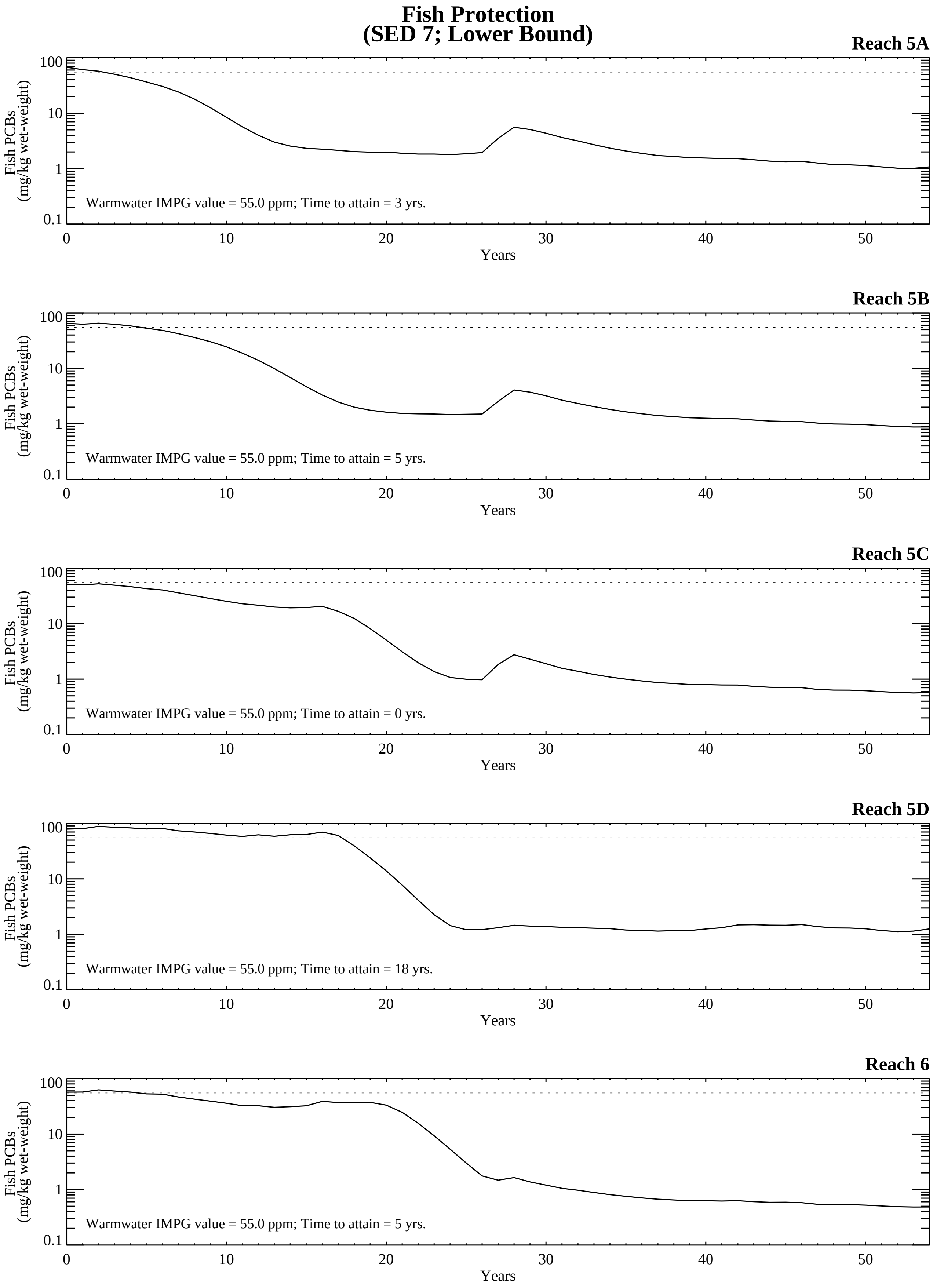

Figure G-9.3-6a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 7; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

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Fri Mar 14 20:12:39 2008

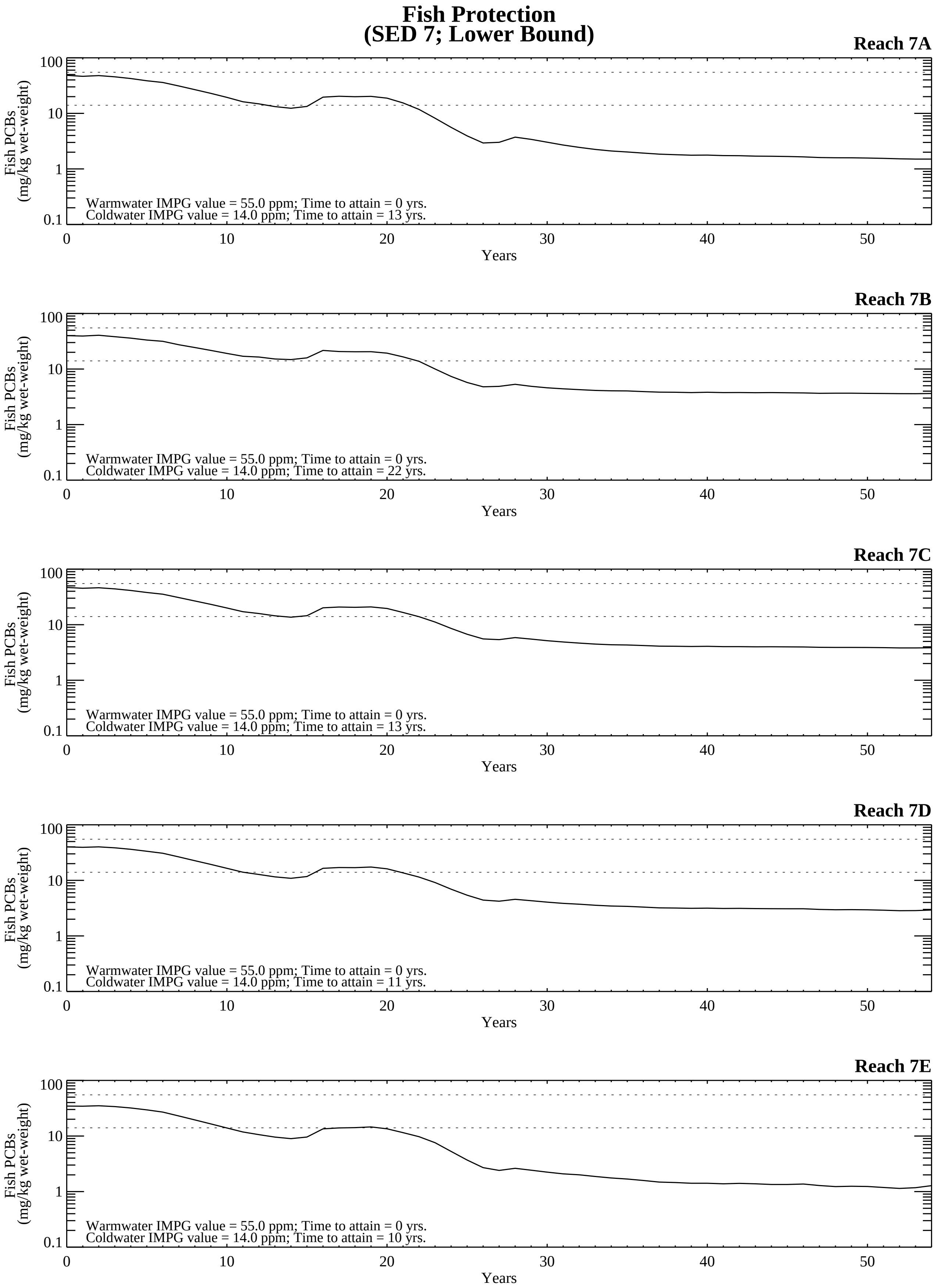
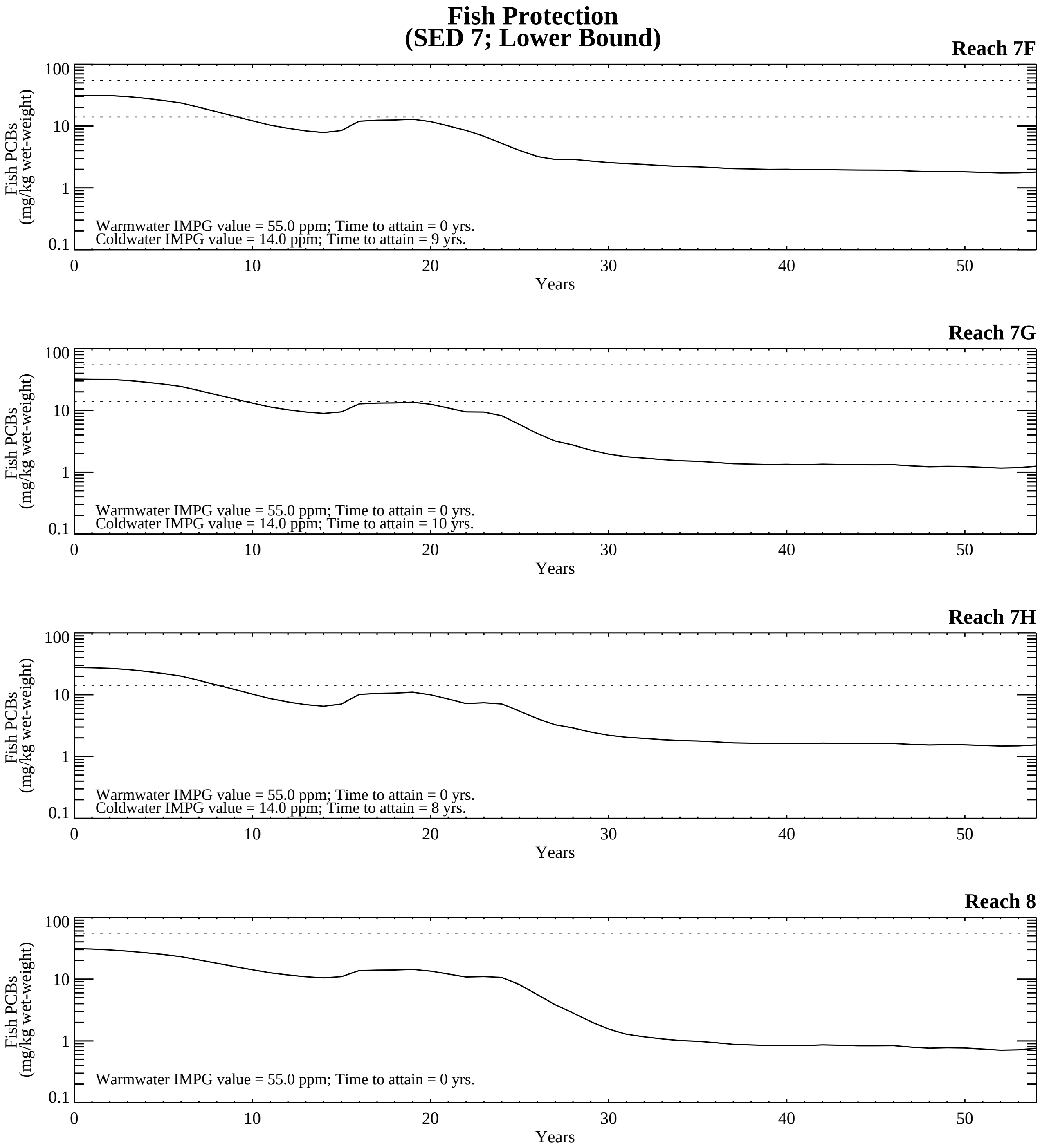


Figure G-9.3-6b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 7; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

DR\LD - Z:\GENcms\MODEL\FDCHN\Analysis\IMPG\Fish\impg_tabulate_projections_loop.pro
Sat Mar 15 00:04:19 2008



Reach 7F: Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.
Coldwater IMPG value = 14.0 ppm; Time to attain = 9 yrs.

Reach 7G: Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.
Coldwater IMPG value = 14.0 ppm; Time to attain = 10 yrs.

Reach 7H: Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.
Coldwater IMPG value = 14.0 ppm; Time to attain = 8 yrs.

Reach 8: Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.

Figure G-9.3-6b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 7; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

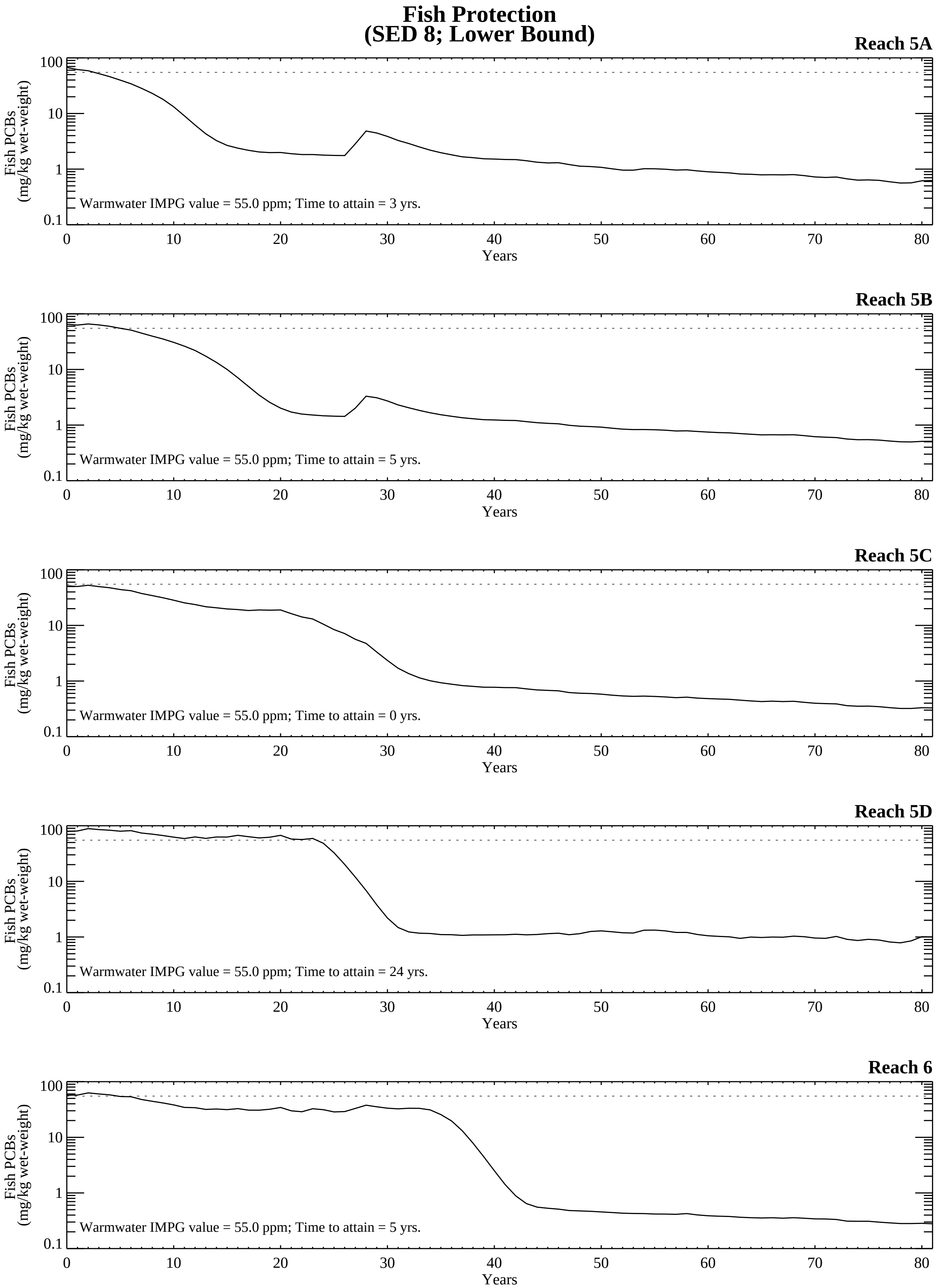
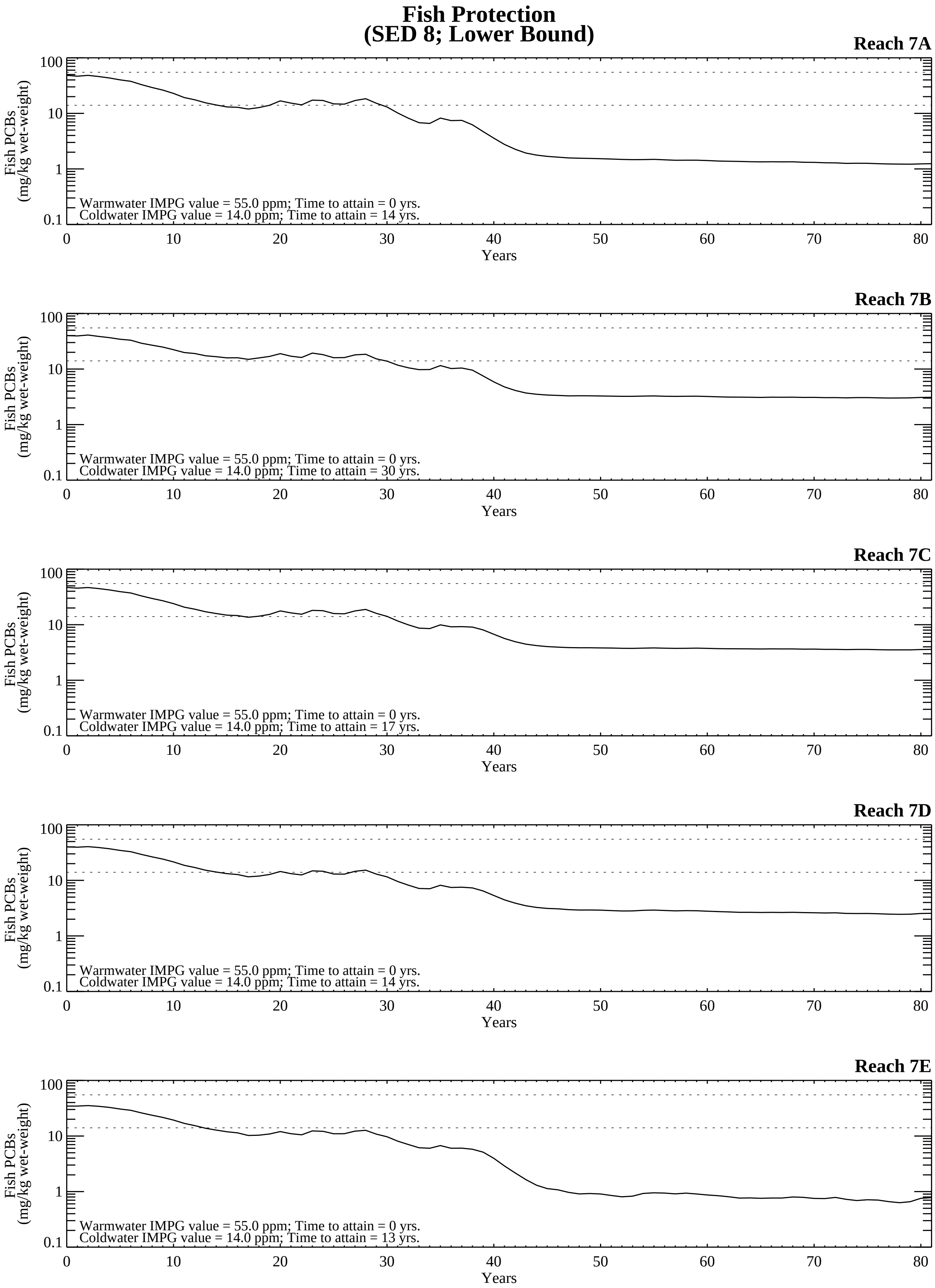


Figure G-9.3-7a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 8; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.



Reach 7A:
Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.
Coldwater IMPG value = 14.0 ppm; Time to attain = 14 yrs.

Reach 7B:
Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.
Coldwater IMPG value = 14.0 ppm; Time to attain = 30 yrs.

Reach 7C:
Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.
Coldwater IMPG value = 14.0 ppm; Time to attain = 17 yrs.

Reach 7D:
Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.
Coldwater IMPG value = 14.0 ppm; Time to attain = 14 yrs.

Reach 7E:
Warmwater IMPG value = 55.0 ppm; Time to attain = 0 yrs.
Coldwater IMPG value = 14.0 ppm; Time to attain = 13 yrs.

Figure G-9.3-7b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 8; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

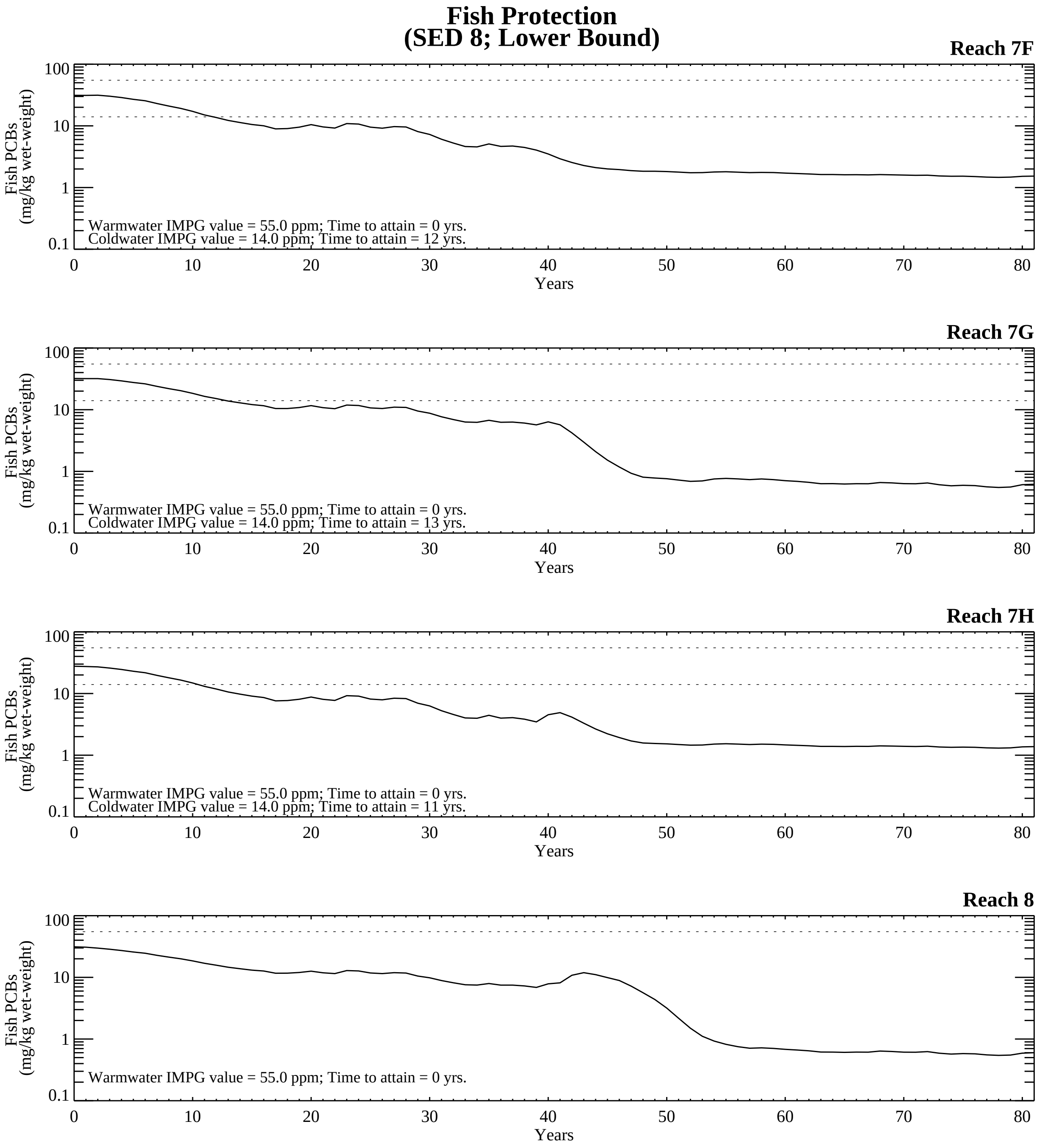


Figure G-9.3-7b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for fish protection (SED 8; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for ages 1 to 9.

DR\LD - Z:\GENcms\MODEL\FDCHN\Analysis\IMPG\Fish\impg_tabulate_projections_loop.pro
Sat Mar 15 00:26:50 2008

Threatened and Endangered Species
(SED 1 / SED 2; Base Case)

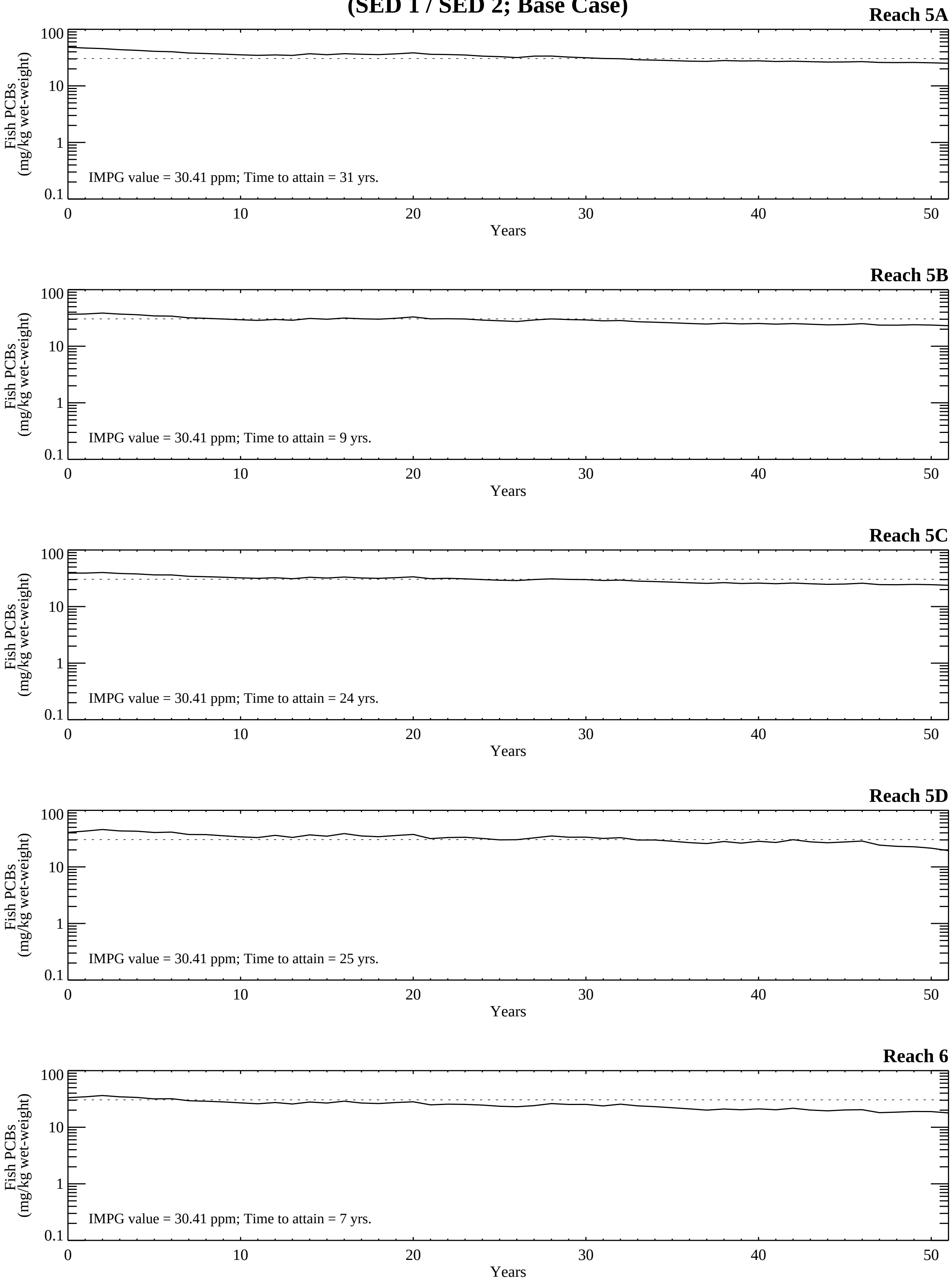


Figure G-10.1-1a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 1 / SED 2; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

DR\LD - Z:\GENcms\MODEL\FDCHN\Analysis\IMPG\Fish\impg_tabulate_projections_loop.pro
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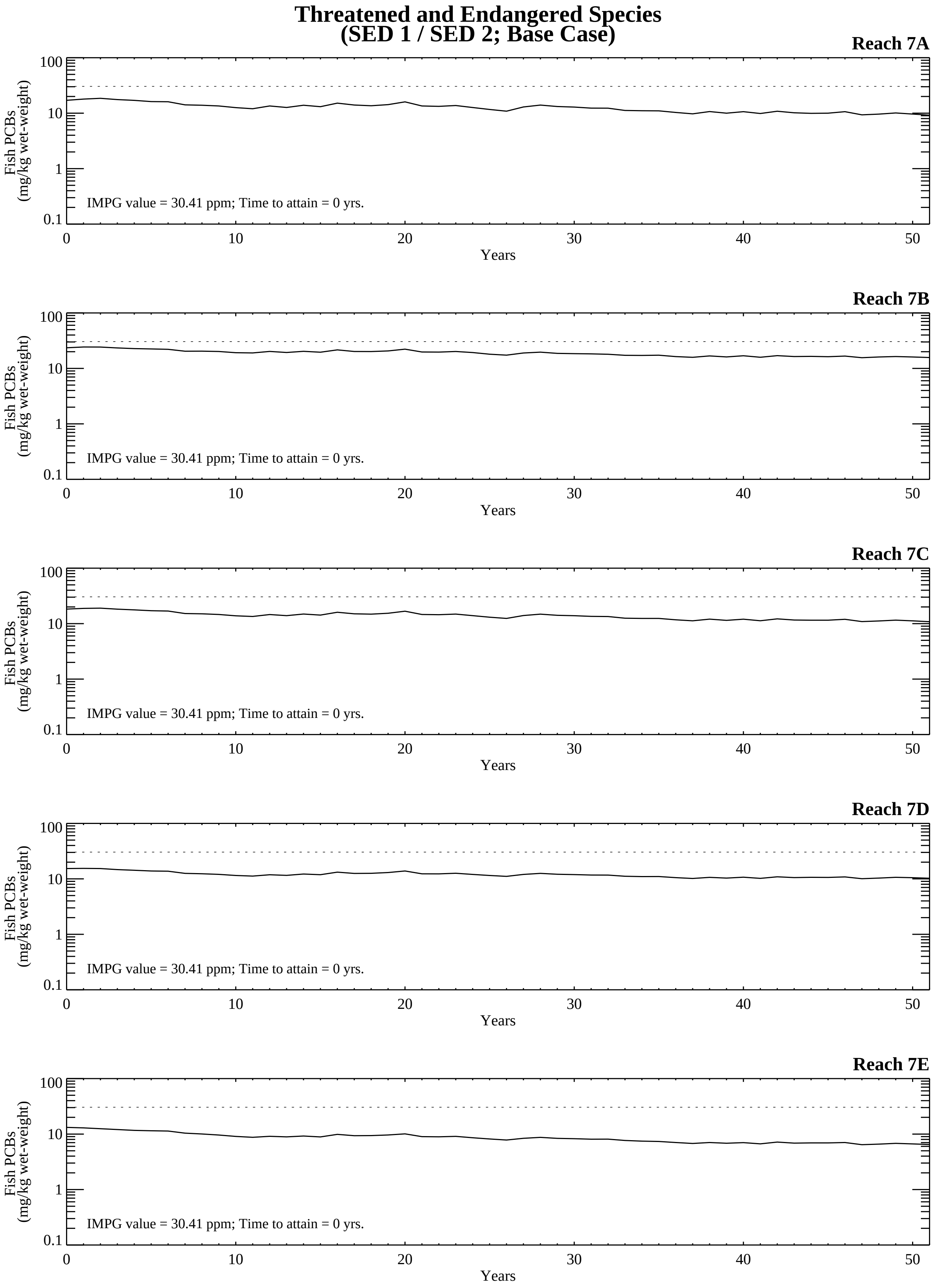


Figure G-10.1-1b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 1 / SED 2; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

DR\LD - Z:\GENcms\MODEL\FDCHN\Analysis\IMPG\Fish\impg_tabulate_projections_loop.pro
Fri Mar 14 20:54:46 2008

Threatened and Endangered Species
(SED 1 / SED 2; Base Case)

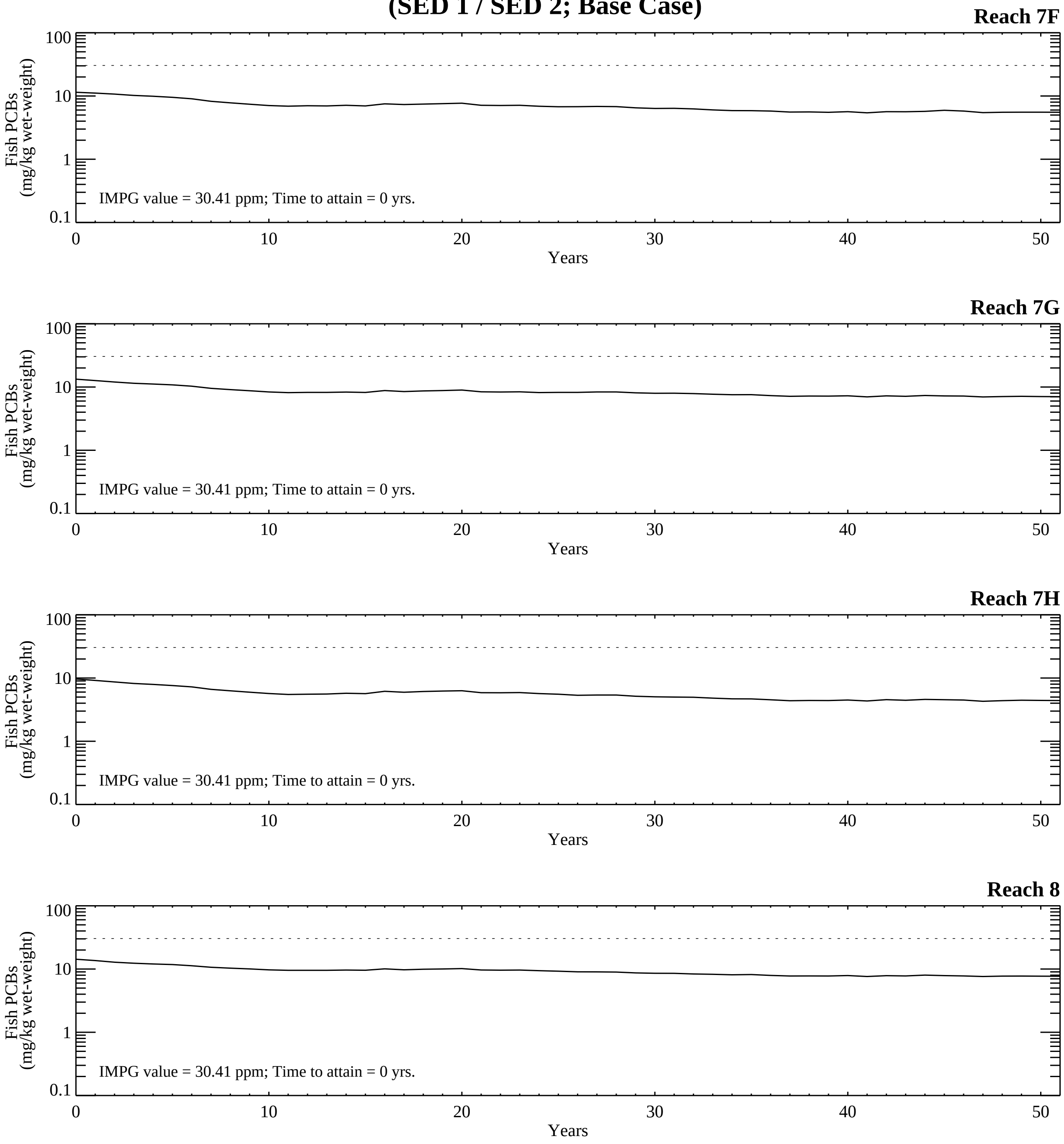
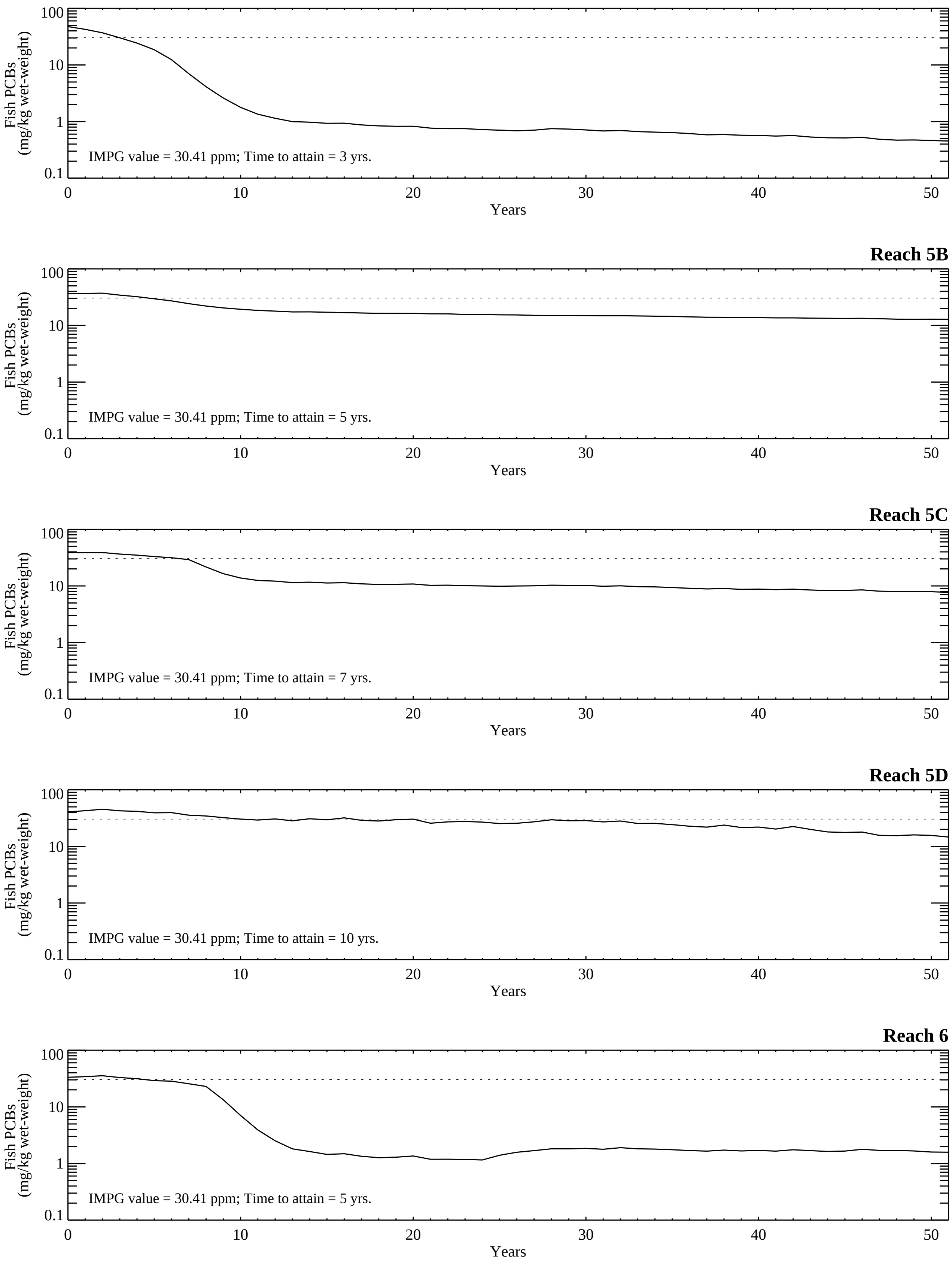


Figure G-10.1-1b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 1 / SED 2; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

Threatened and Endangered Species
(SED 3; Base Case)



IMPG value = 30.41 ppm; Time to attain = 3 yrs.

IMPG value = 30.41 ppm; Time to attain = 5 yrs.

IMPG value = 30.41 ppm; Time to attain = 7 yrs.

IMPG value = 30.41 ppm; Time to attain = 10 yrs.

IMPG value = 30.41 ppm; Time to attain = 5 yrs.

Figure G-10.1-2a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 3; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

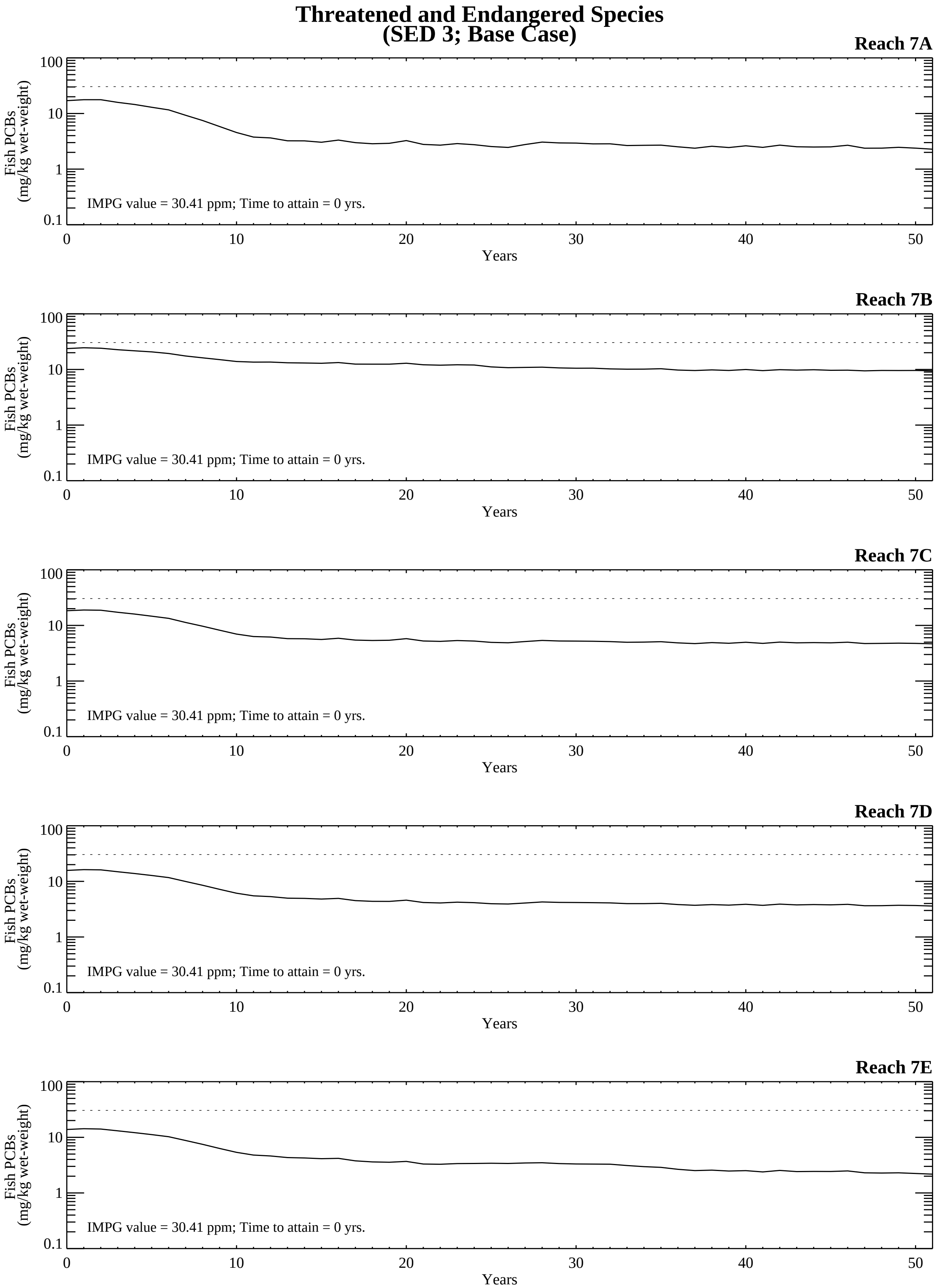


Figure G-10.1-2b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 3; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

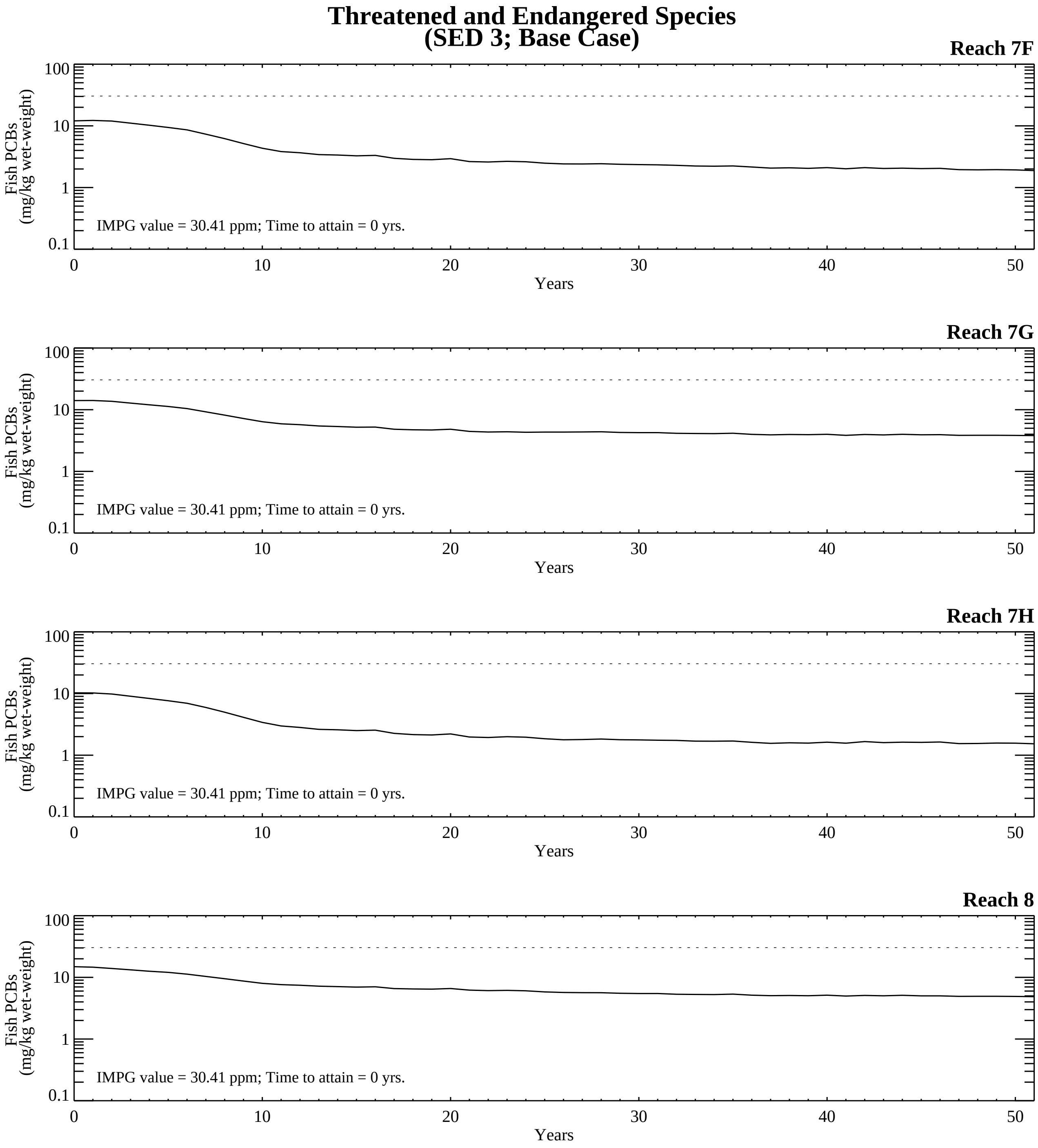


Figure G-10.1-2b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 3; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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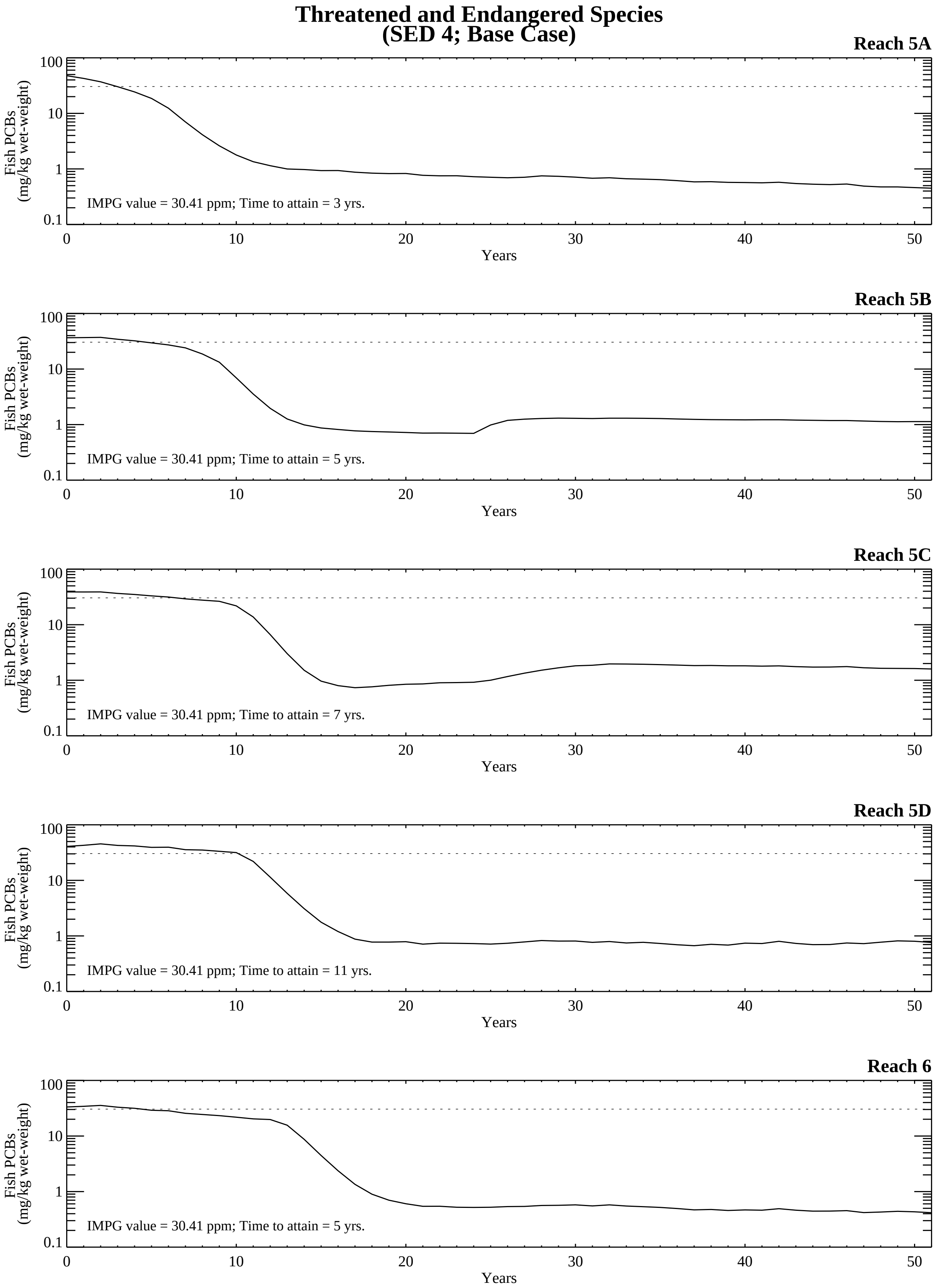

Threatened and Endangered Species
(SED 4; Base Case)

Reach 5A

IMPG value = 30.41 ppm; Time to attain = 3 yrs.

Reach 5B

IMPG value = 30.41 ppm; Time to attain = 5 yrs.

Reach 5C

IMPG value = 30.41 ppm; Time to attain = 7 yrs.

Reach 5D

IMPG value = 30.41 ppm; Time to attain = 11 yrs.

Reach 6

IMPG value = 30.41 ppm; Time to attain = 5 yrs.

Figure G-10.1-3a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 4; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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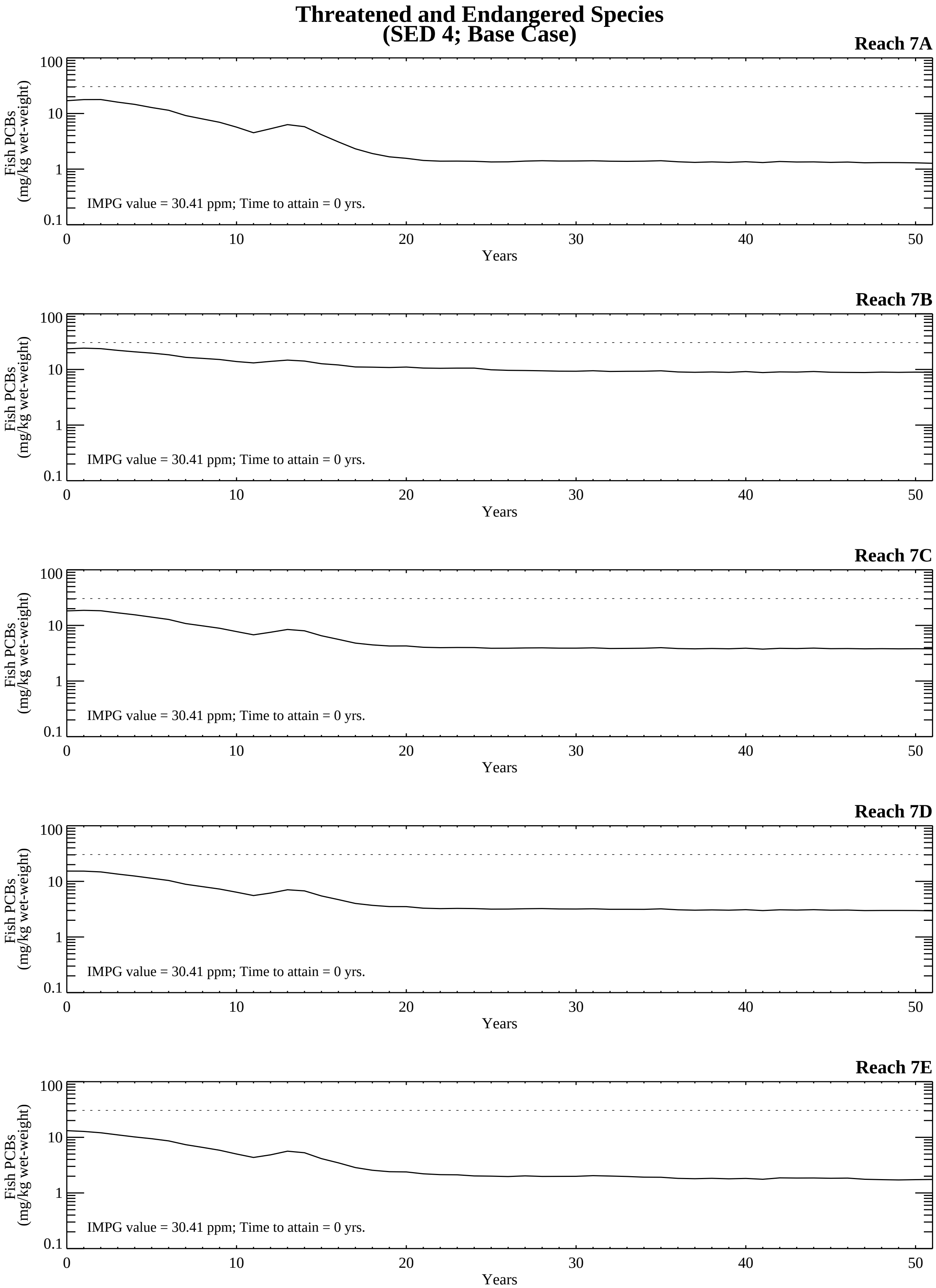

Figure G-10.1-3b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 4; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

Threatened and Endangered Species
(SED 4; Base Case)

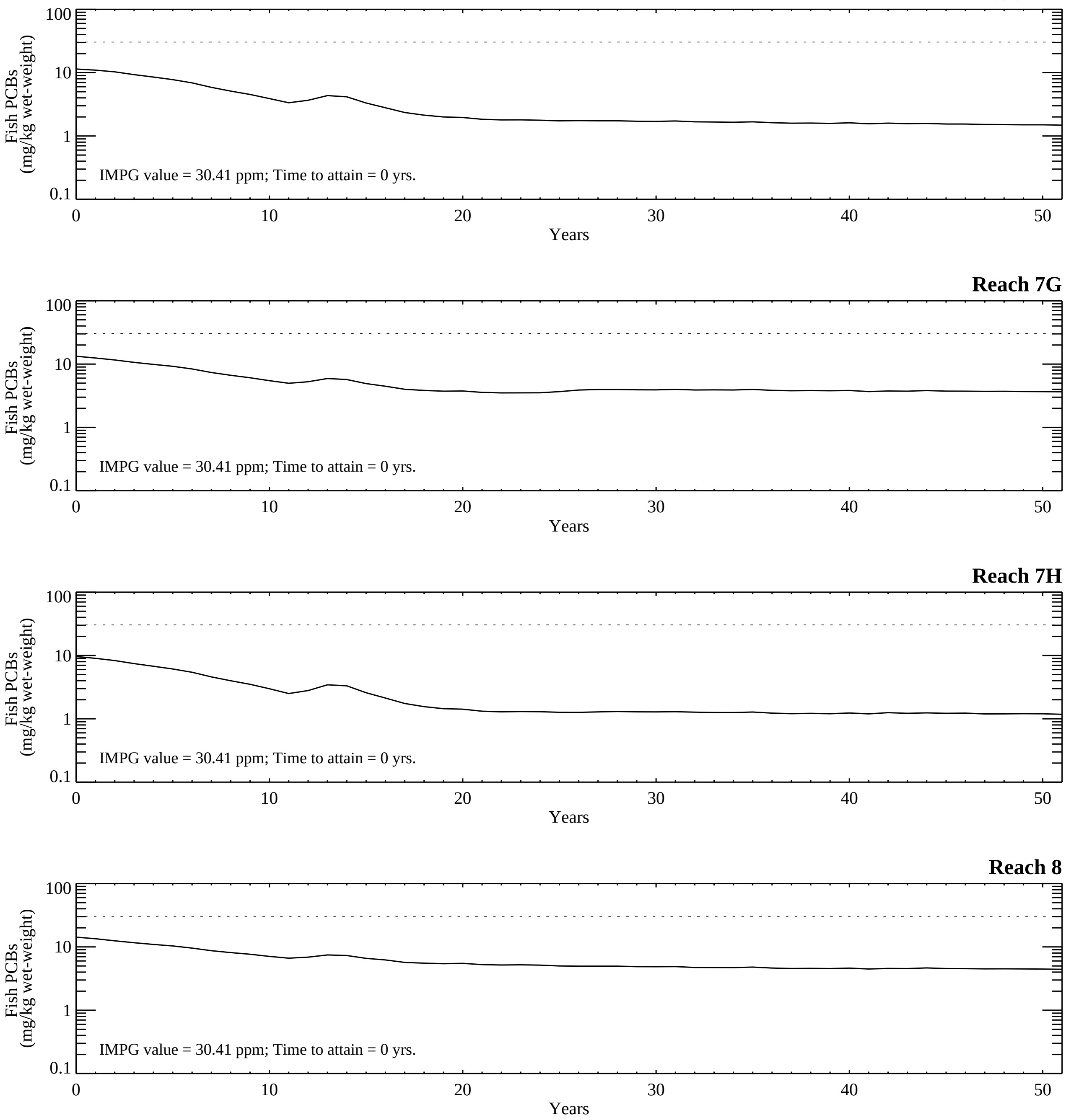

Figure G-10.1-3b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 4; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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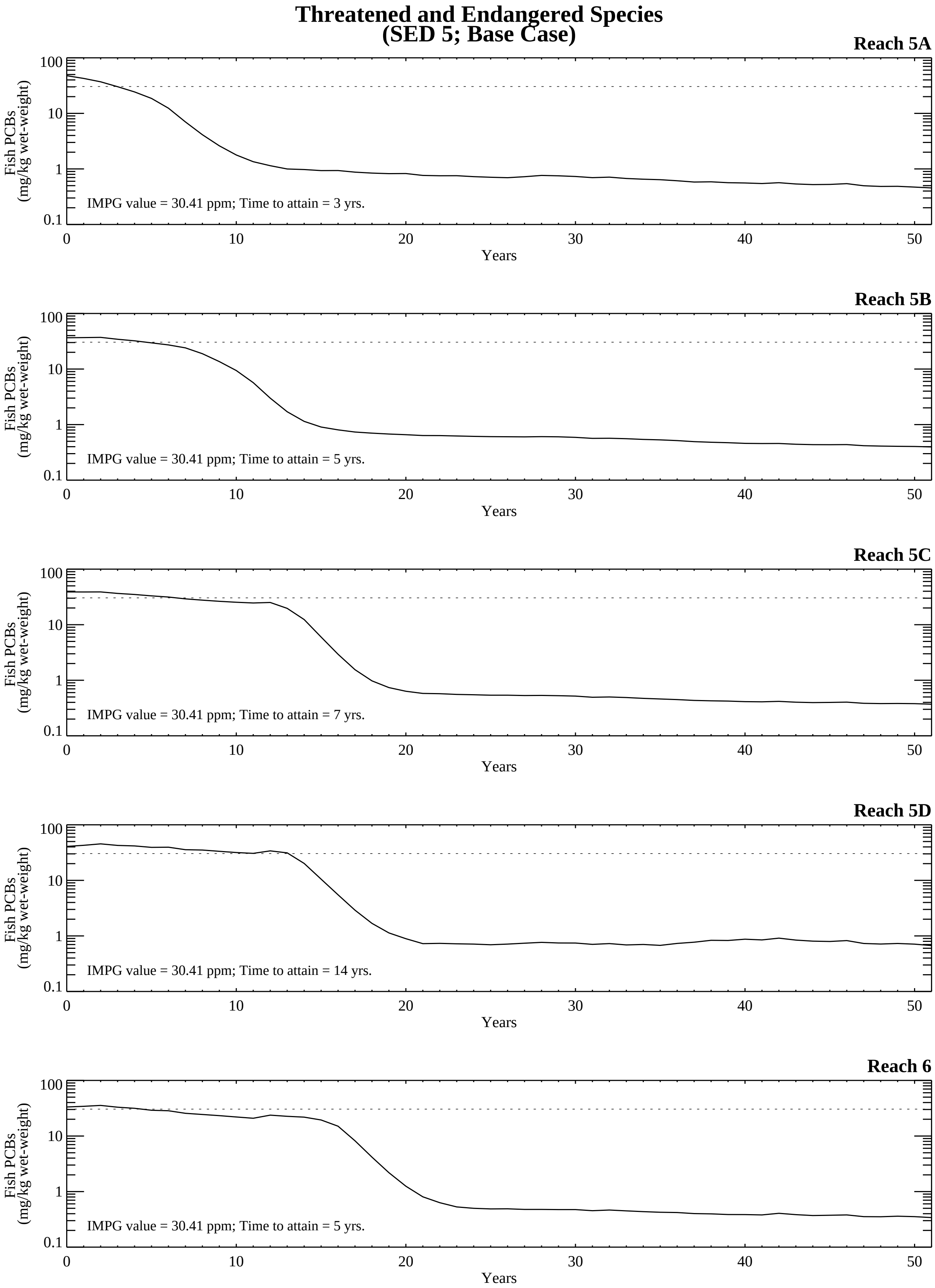


Threatened and Endangered Species
(SED 5; Base Case)

Reach 5A

IMPG value = 30.41 ppm; Time to attain = 3 yrs.

Reach 5B

IMPG value = 30.41 ppm; Time to attain = 5 yrs.

Reach 5C

IMPG value = 30.41 ppm; Time to attain = 7 yrs.

Reach 5D

IMPG value = 30.41 ppm; Time to attain = 14 yrs.

Reach 6

IMPG value = 30.41 ppm; Time to attain = 5 yrs.

Figure G-10.1-4a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 5; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

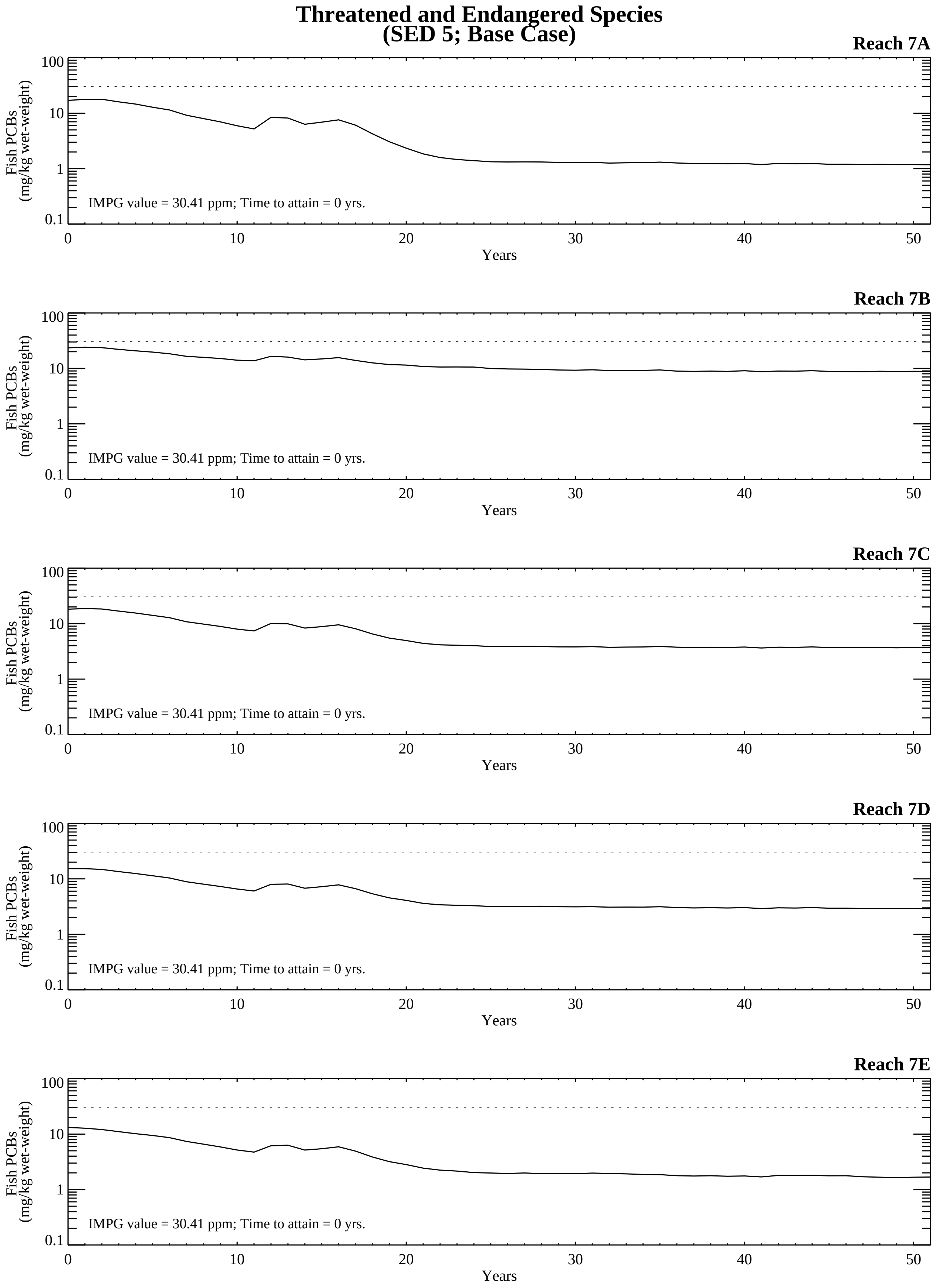


Figure G-10.1-4b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 5; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

Threatened and Endangered Species
(SED 5; Base Case)

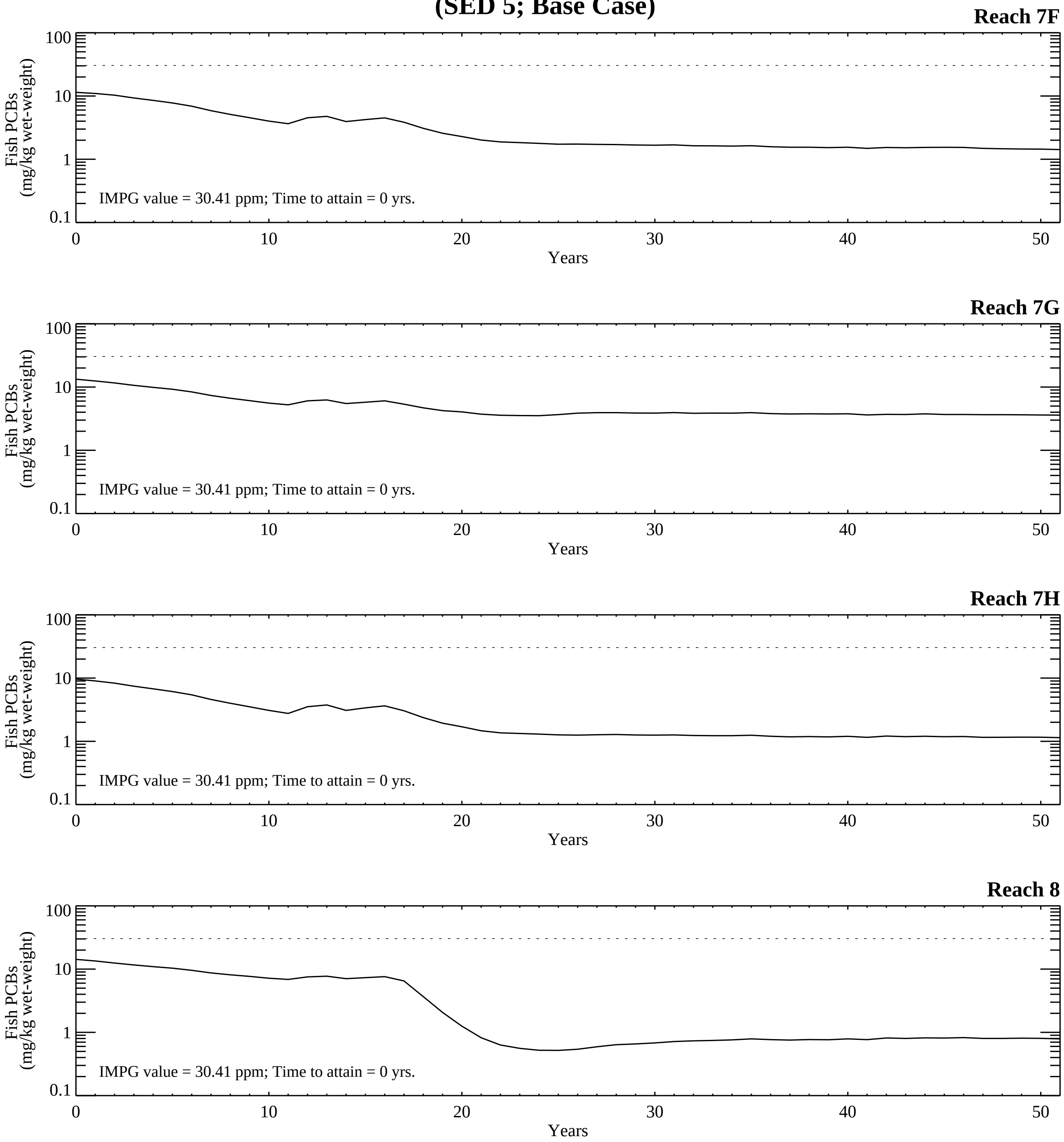


Figure G-10.1-4b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 5; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

Threatened and Endangered Species
(SED 6; Base Case)

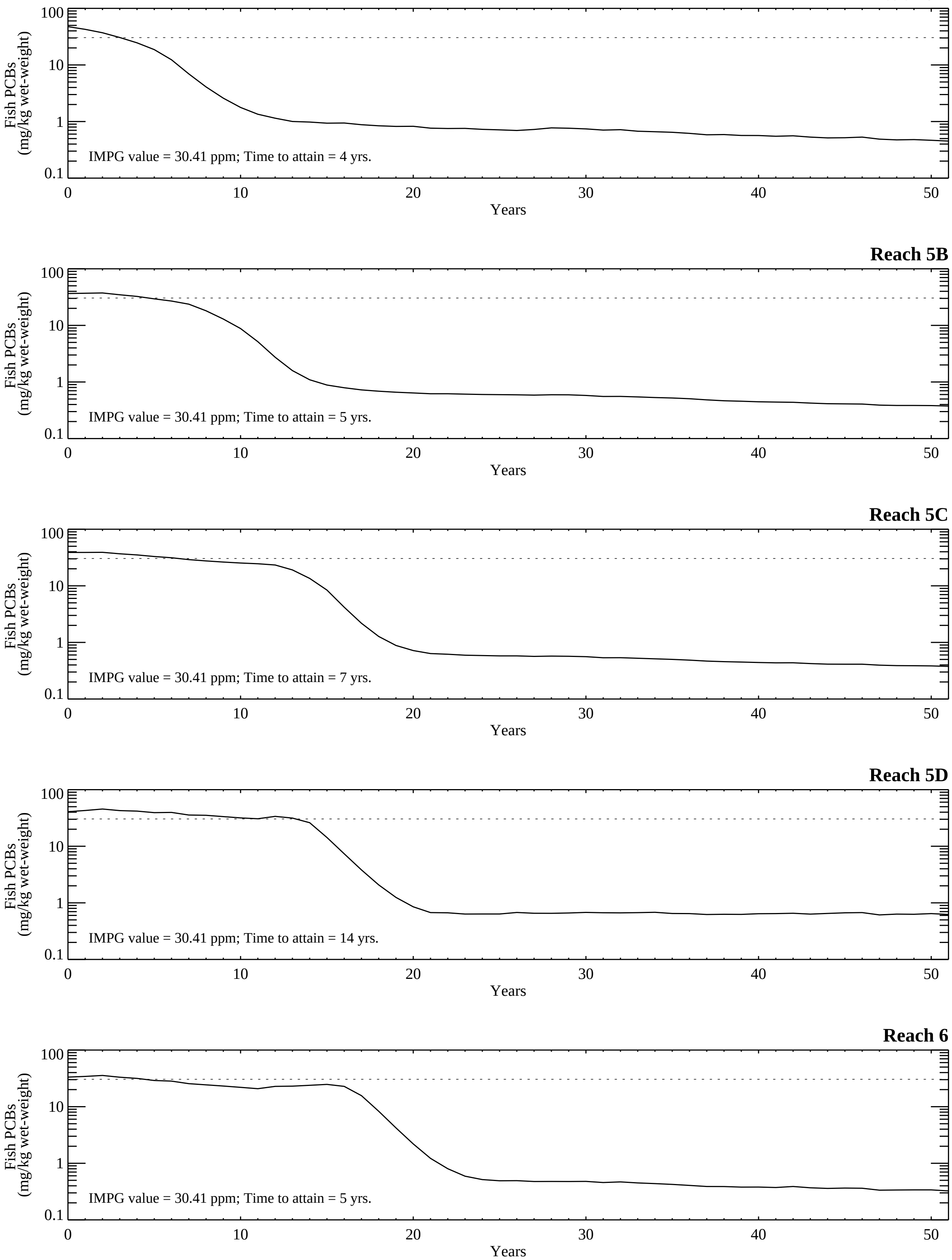
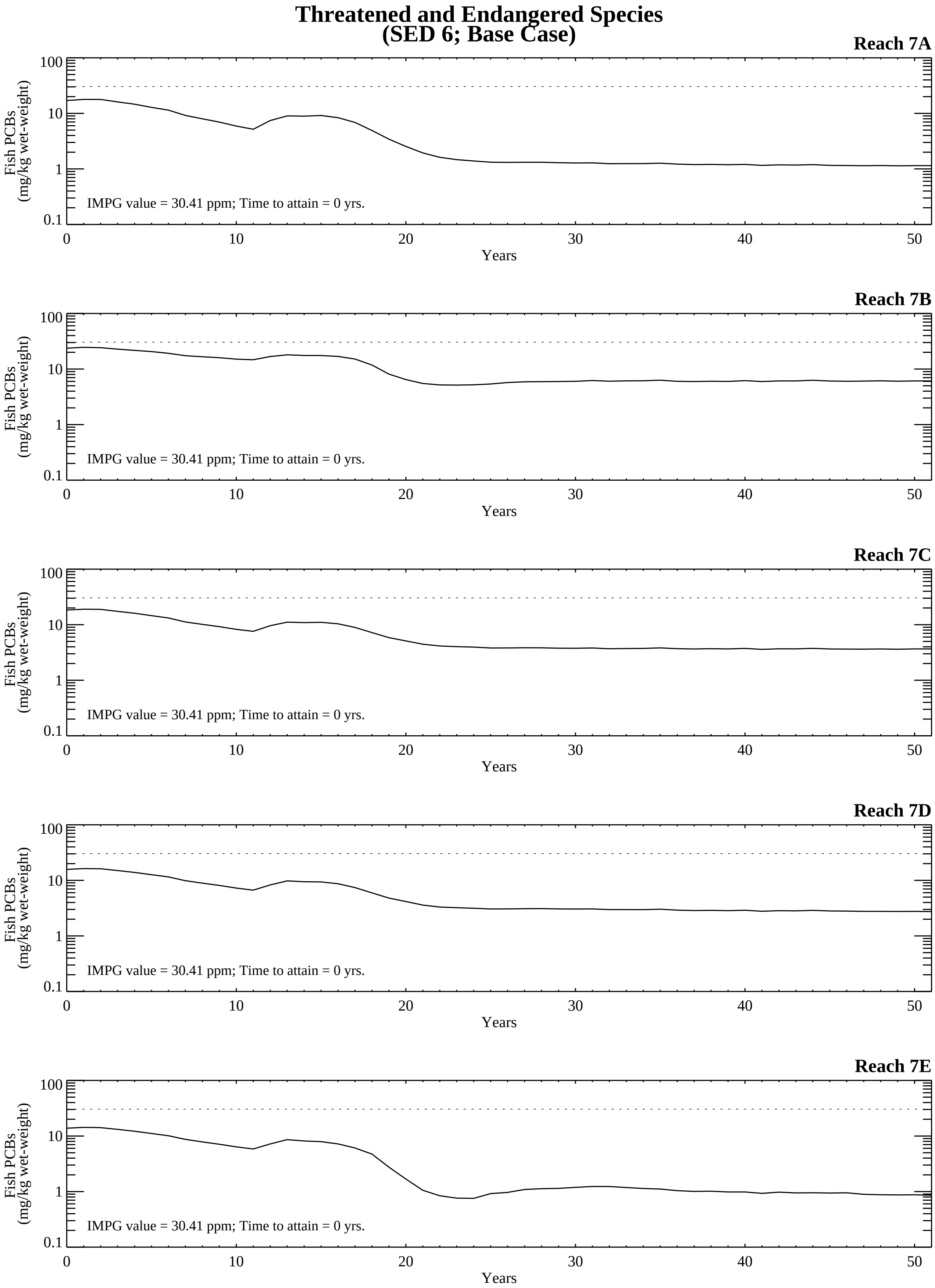


Figure G-10.1-5a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 6; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.



IMPG value = 30.41 ppm; Time to attain = 0 yrs.

Figure G-10.1-5b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 6; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

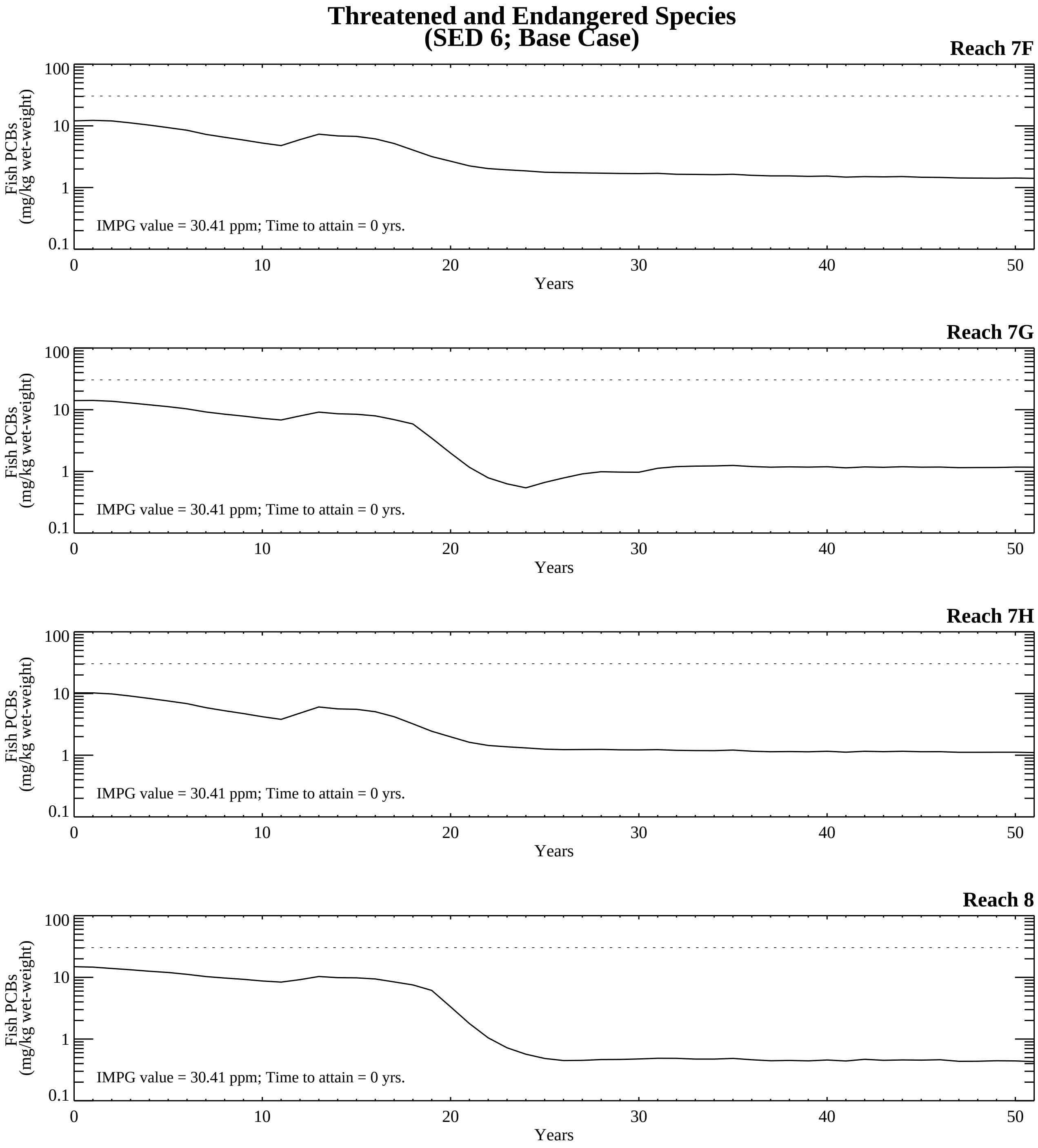


Figure G-10.1-5b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 6; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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Fri Mar 14 21:55:48 2008

Threatened and Endangered Species
(SED 7; Base Case)

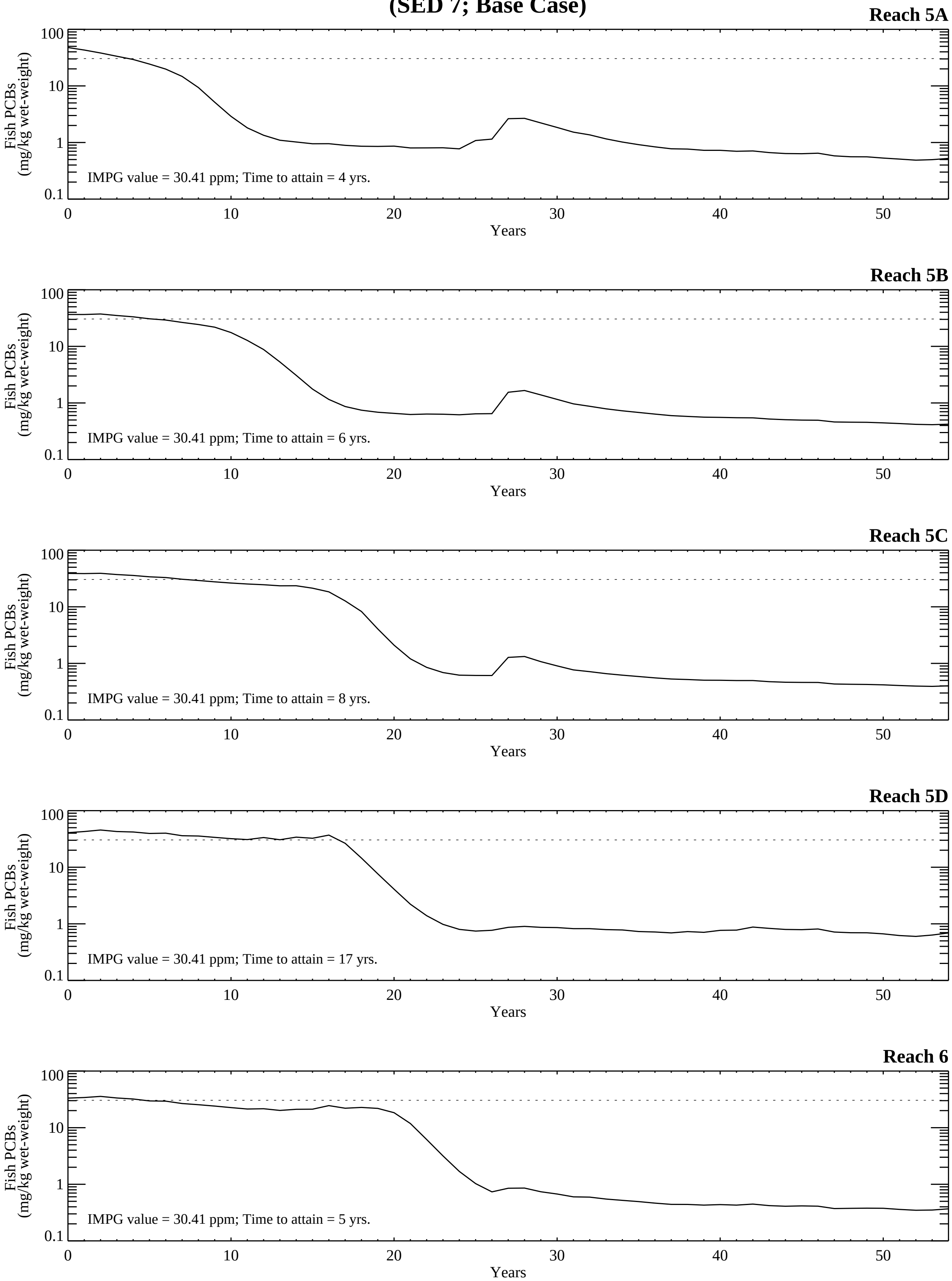

Figure G-10.1-6a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 7; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

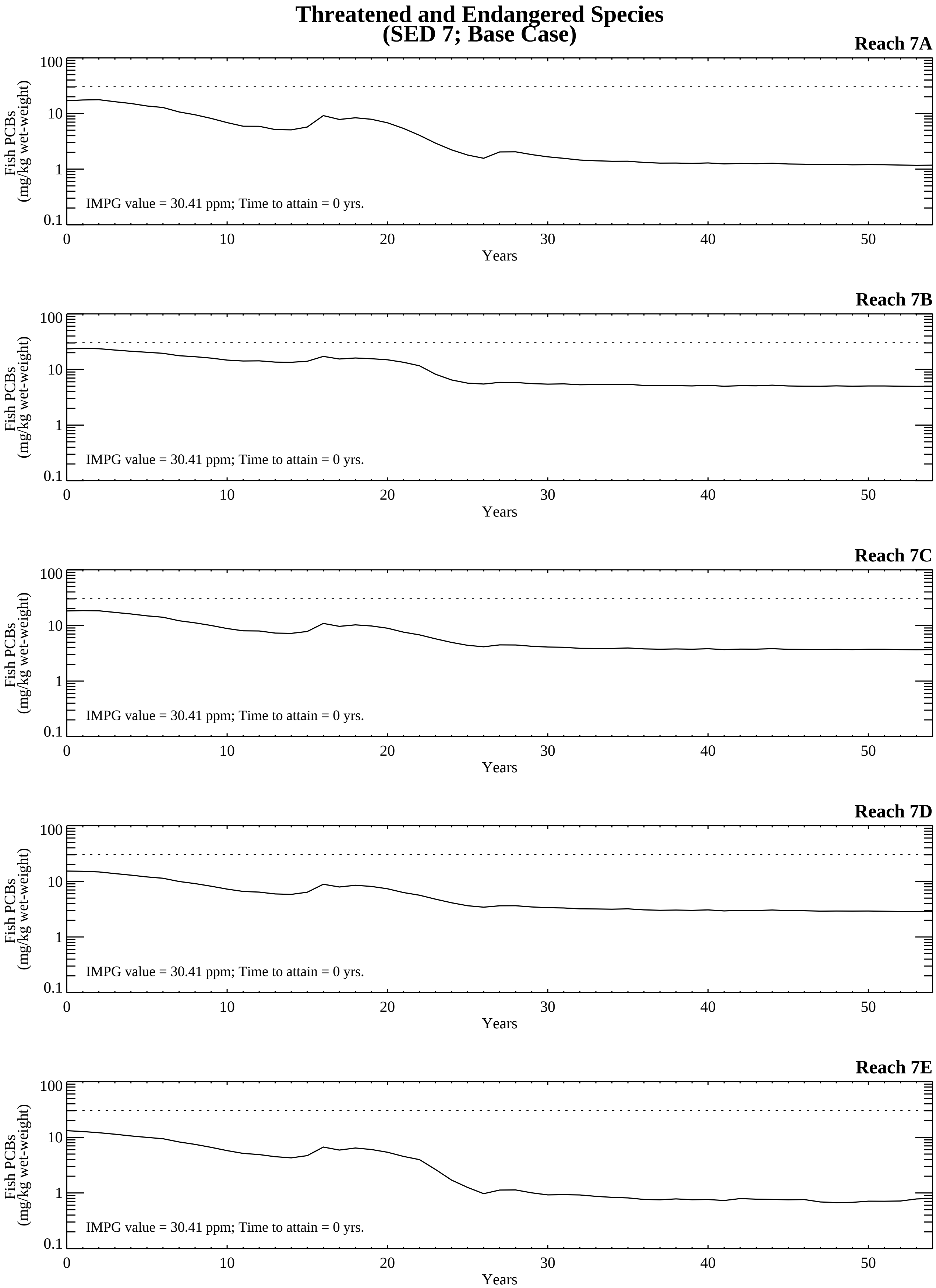

Figure G-10.1-6b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 7; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

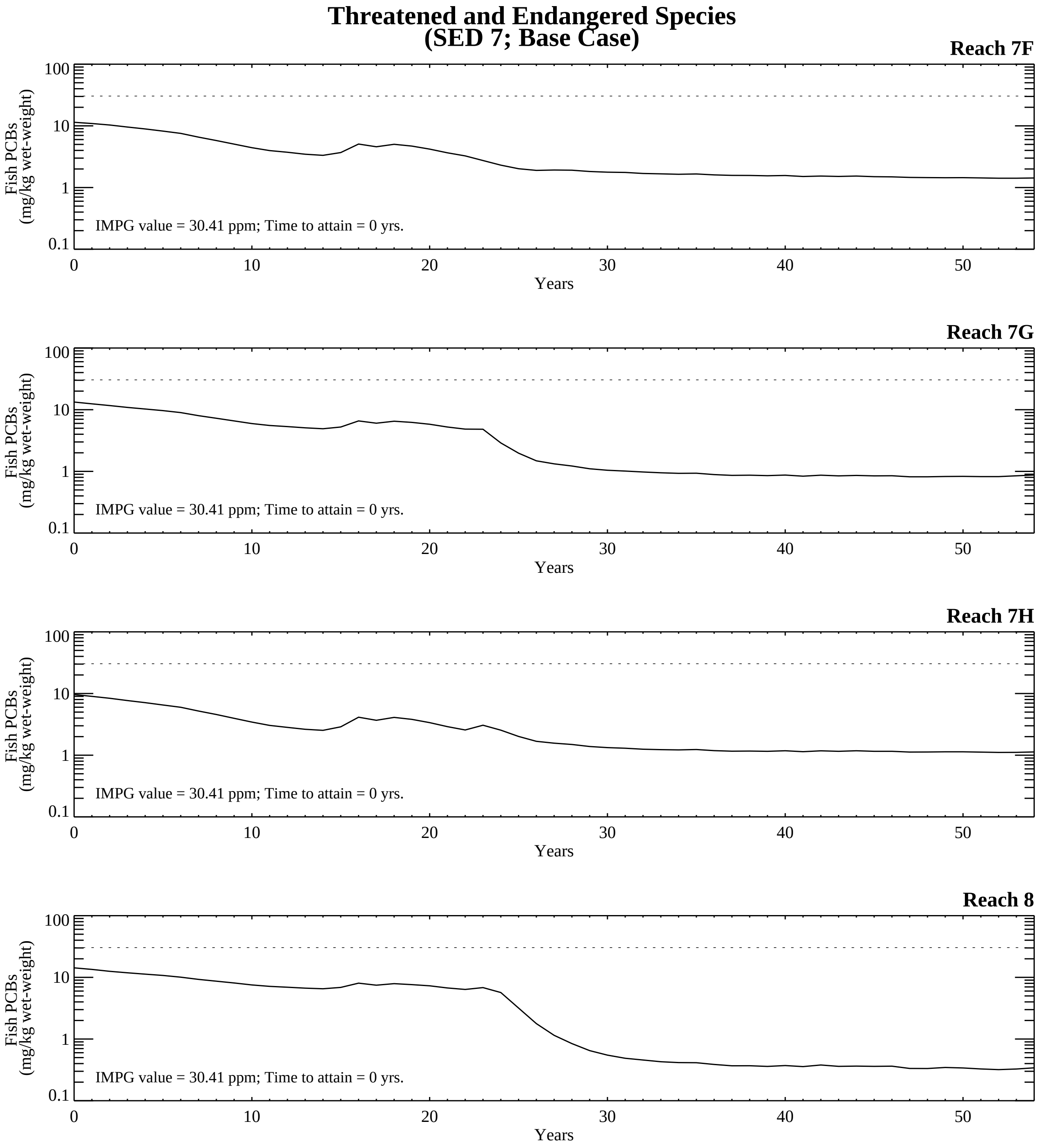

Figure G-10.1-6b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 7; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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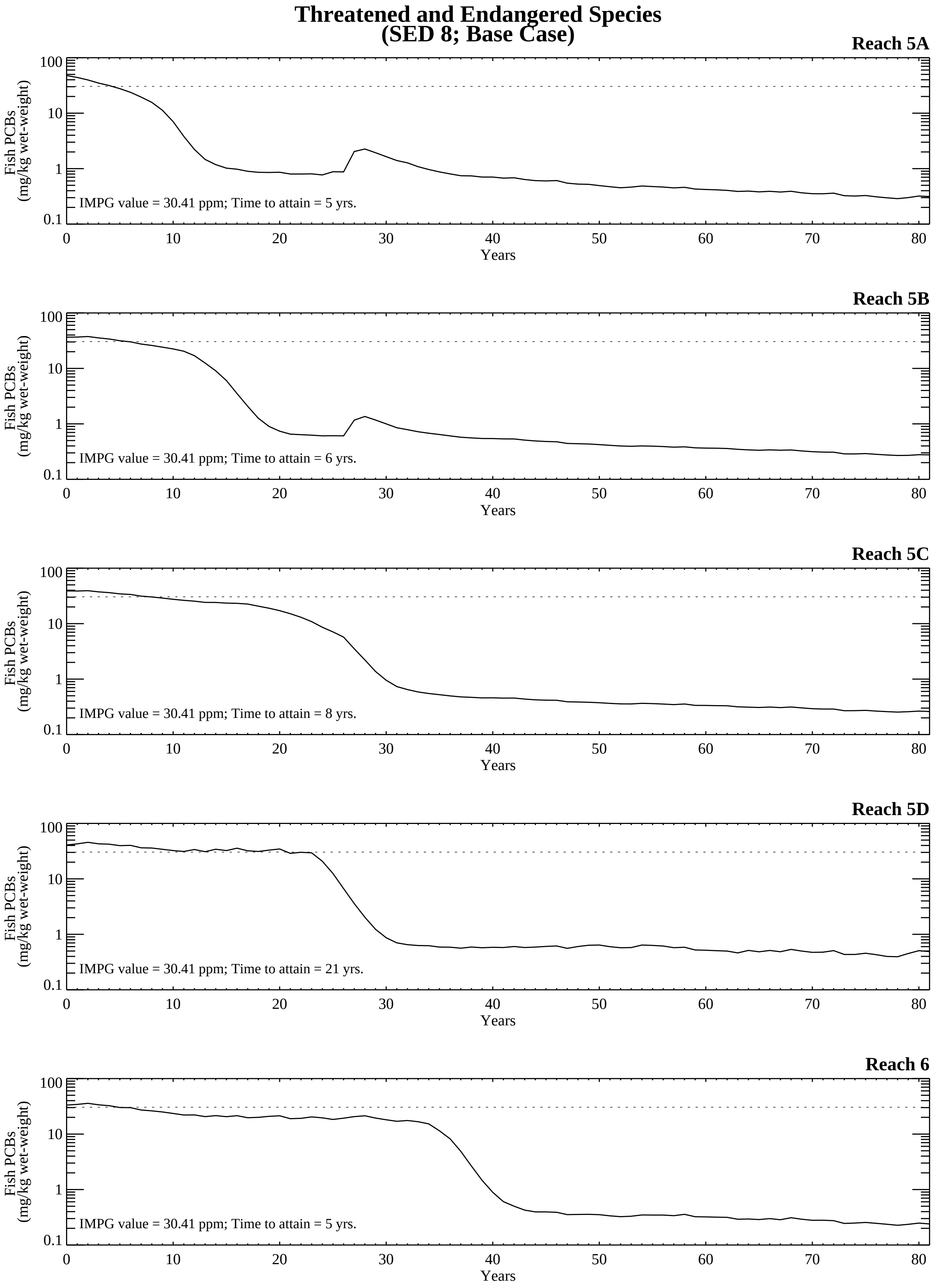

Figure G-10.1-7a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 8; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

DR\LD - Z:\GENcms\MODEL\FDCHN\Analysis\IMPG\Fish\impg_tabulate_projections_loop.pro
Fri Mar 14 17:25:50 2008

Threatened and Endangered Species
(SED 8; Base Case)

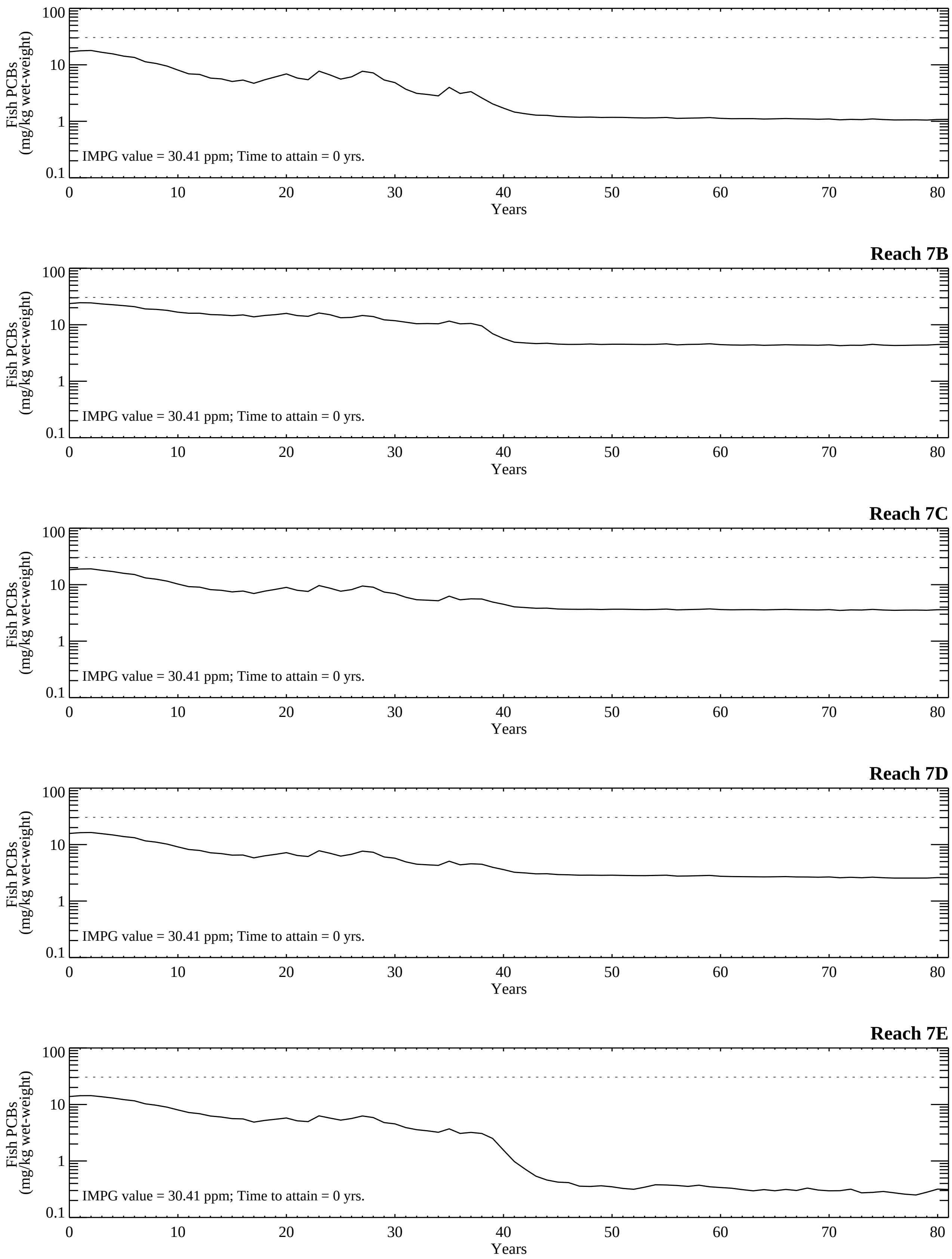

Figure G-10.1-7b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 8; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

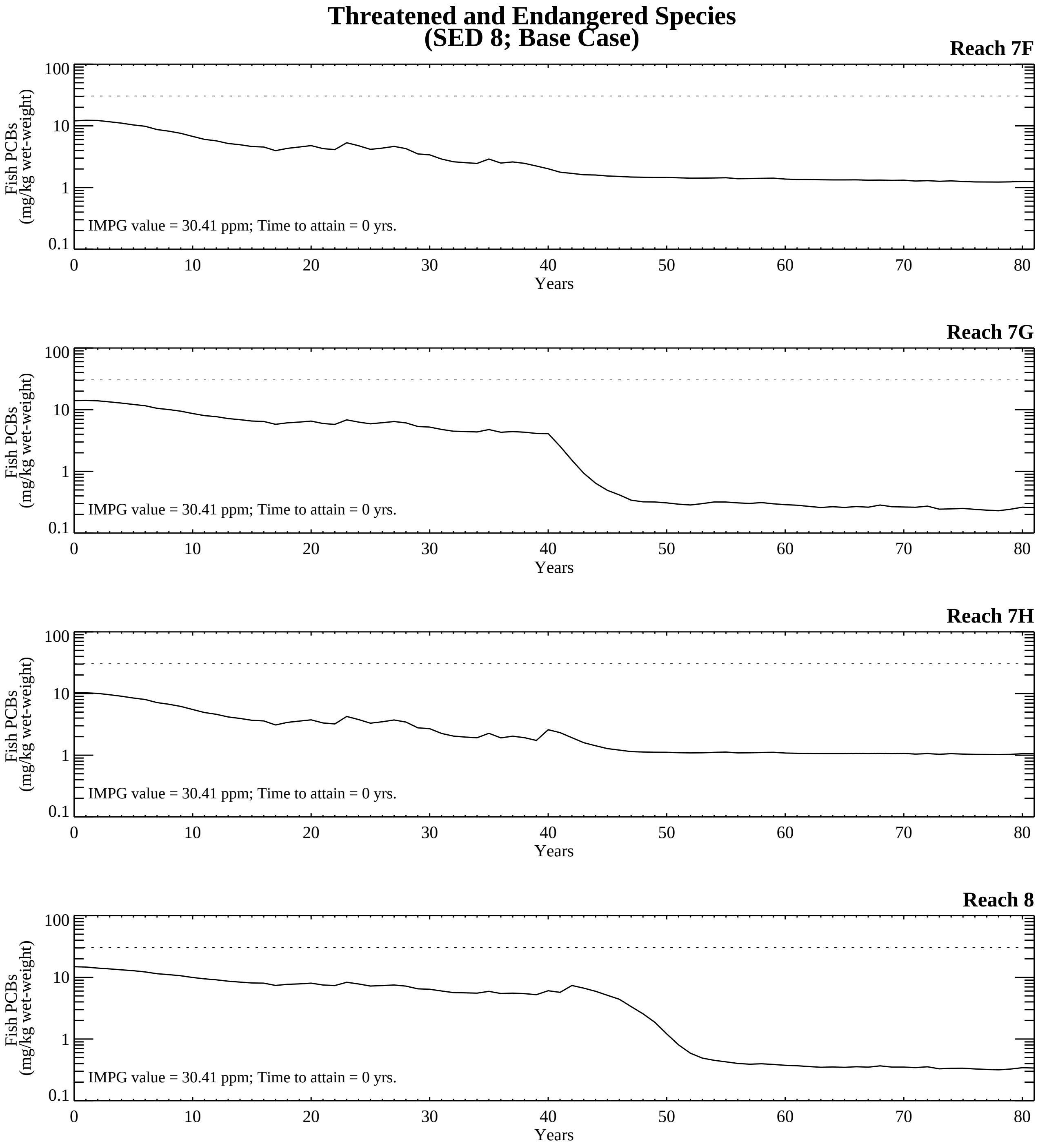

Figure G-10.1-7b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 8; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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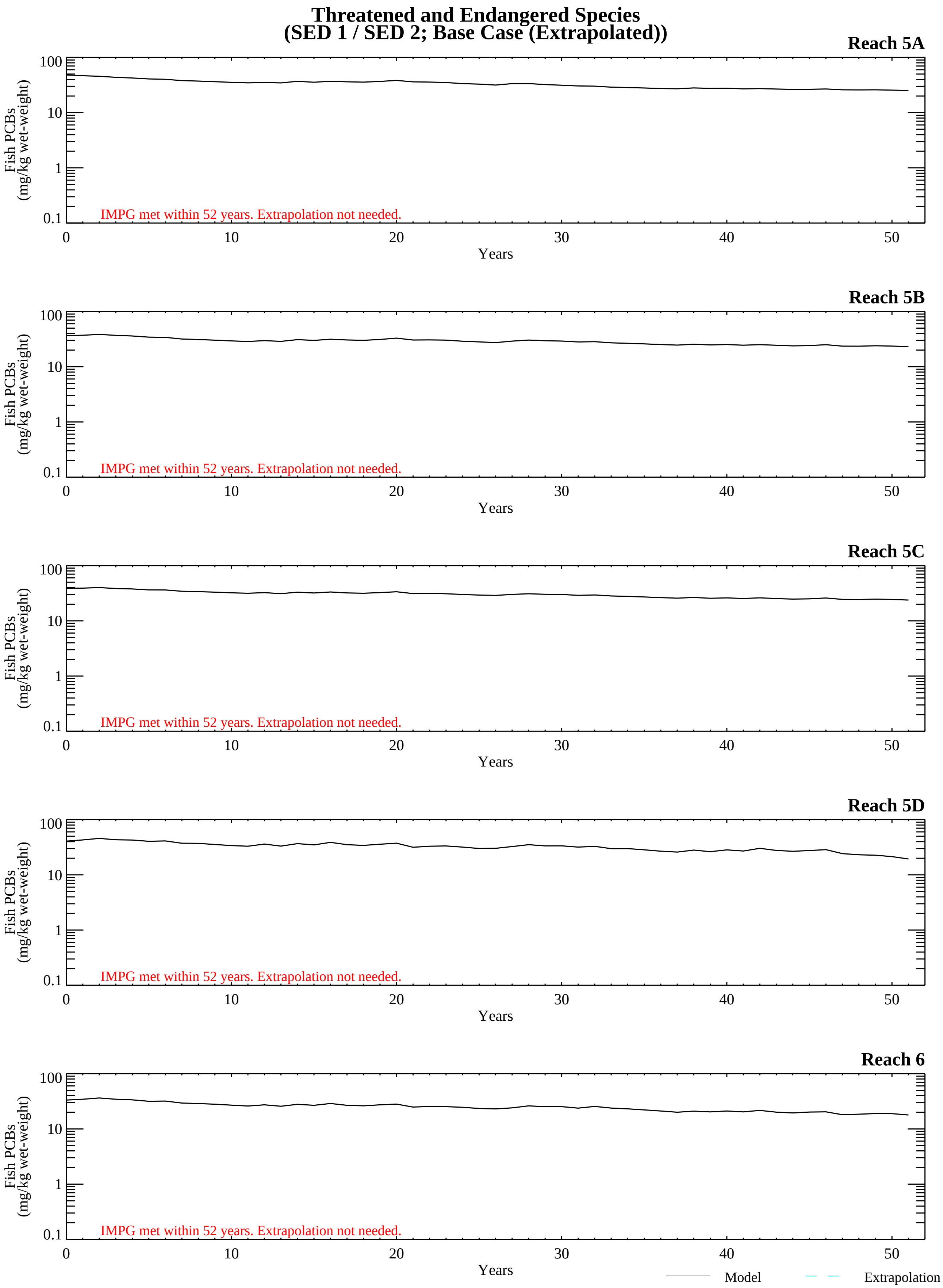

Figure G-10.2-1a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 1 / SED 2; Reach 5/6; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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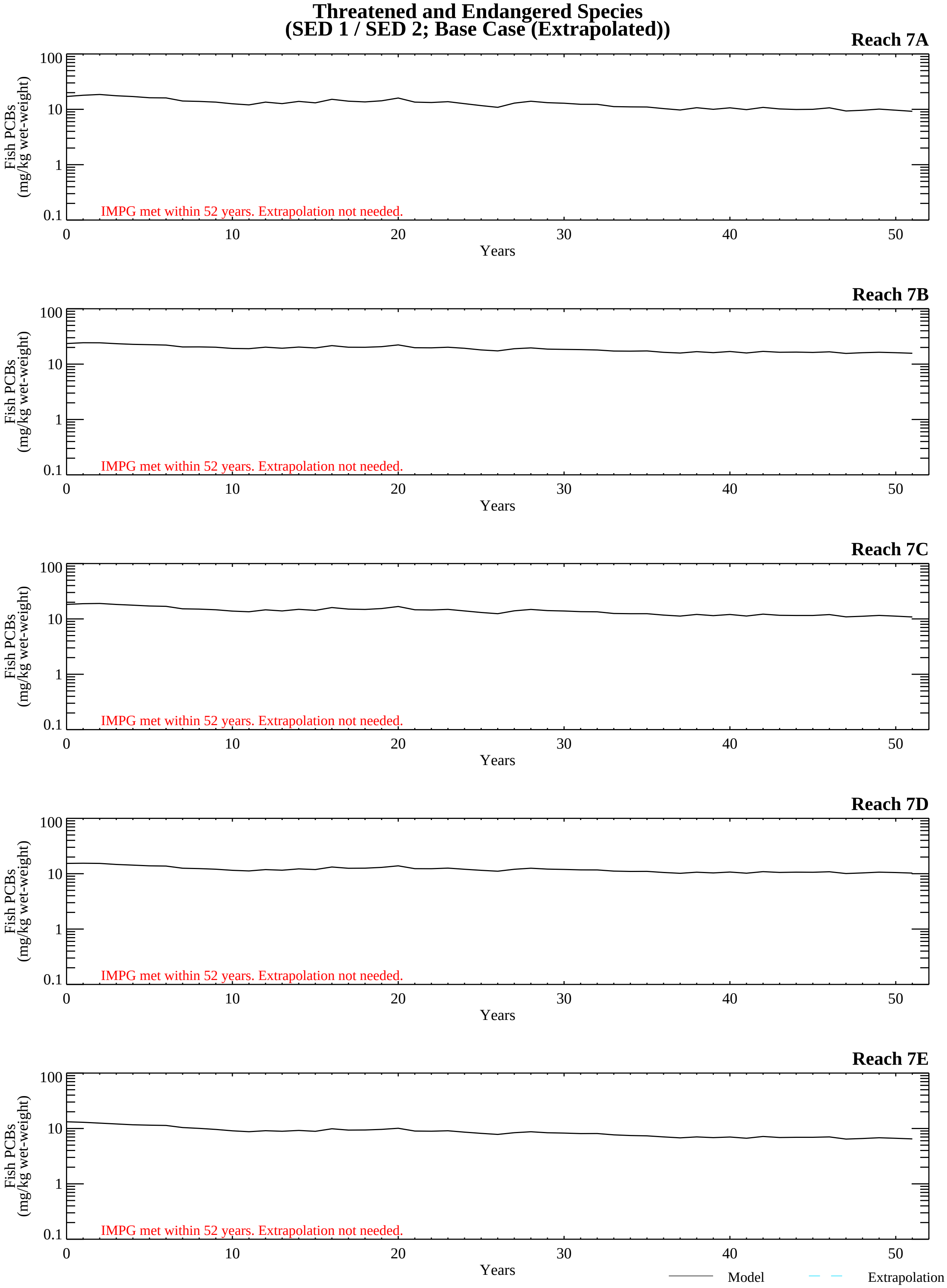

Figure G-10.2-1b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 1 / SED 2; Reach 7/8; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

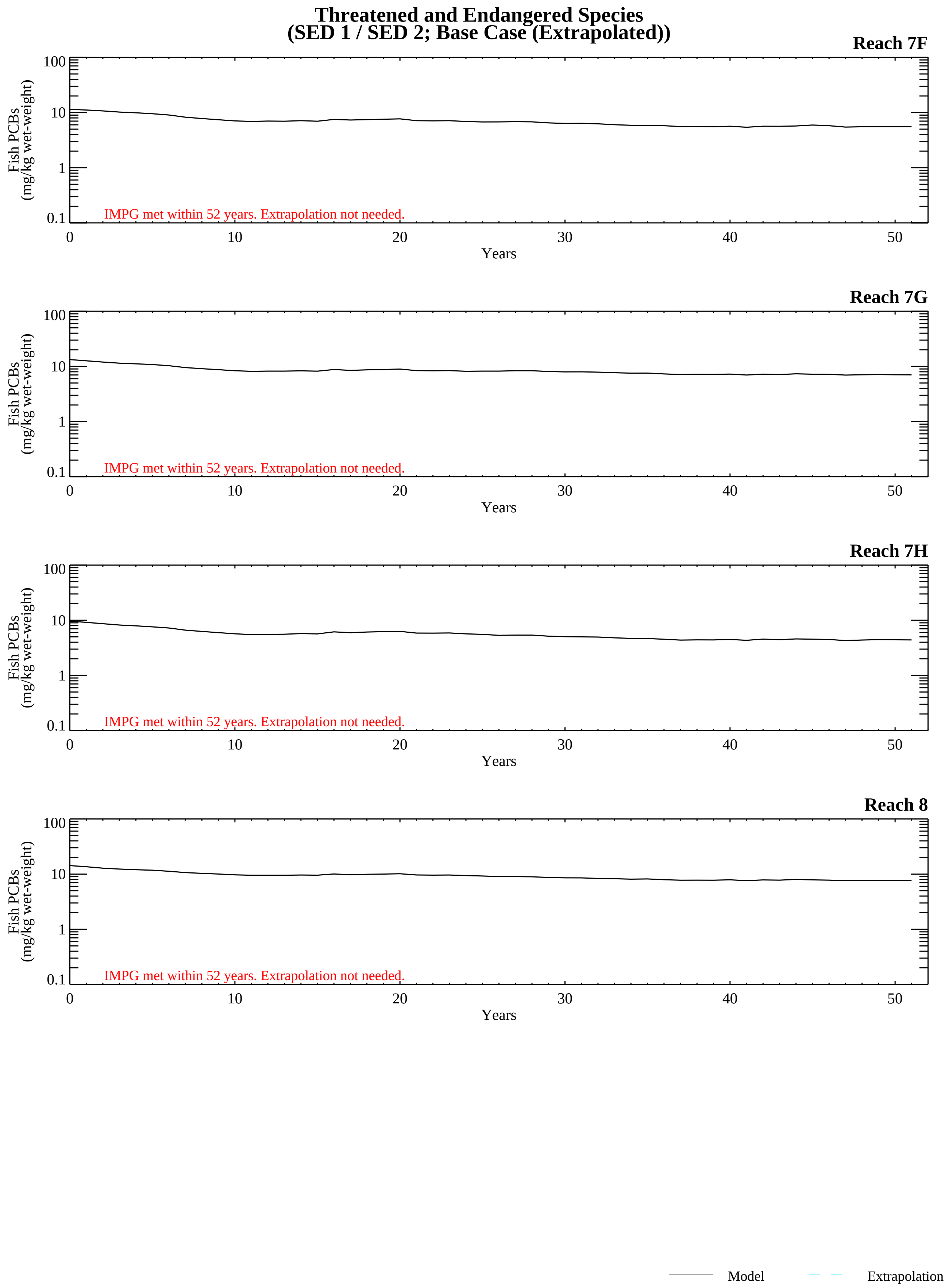

Figure G-10.2-1b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 1 / SED 2; Reach 7/8; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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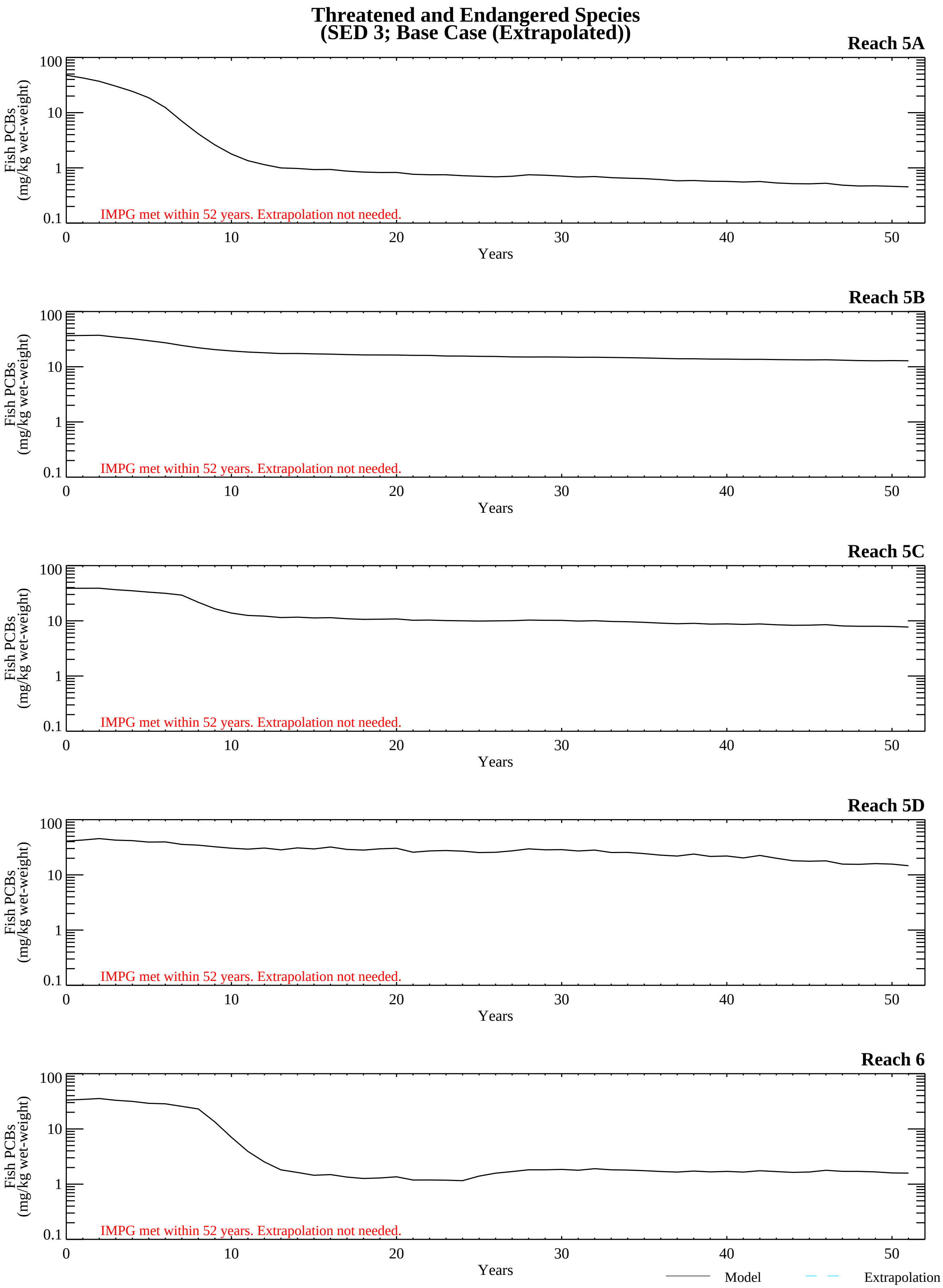

Figure G-10.2-2a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 3; Reach 5/6; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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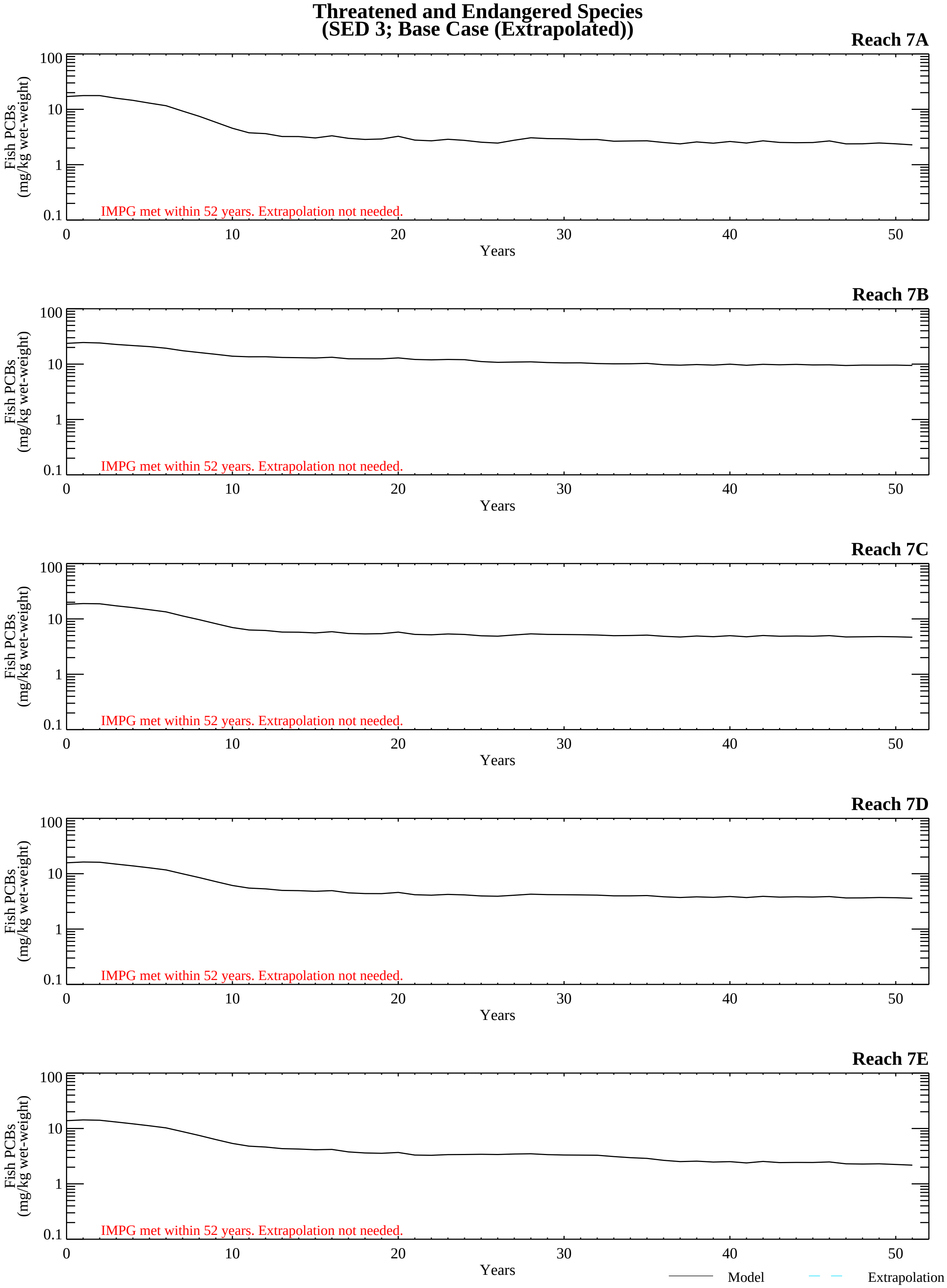

Figure G-10.2-2b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 3; Reach 7/8; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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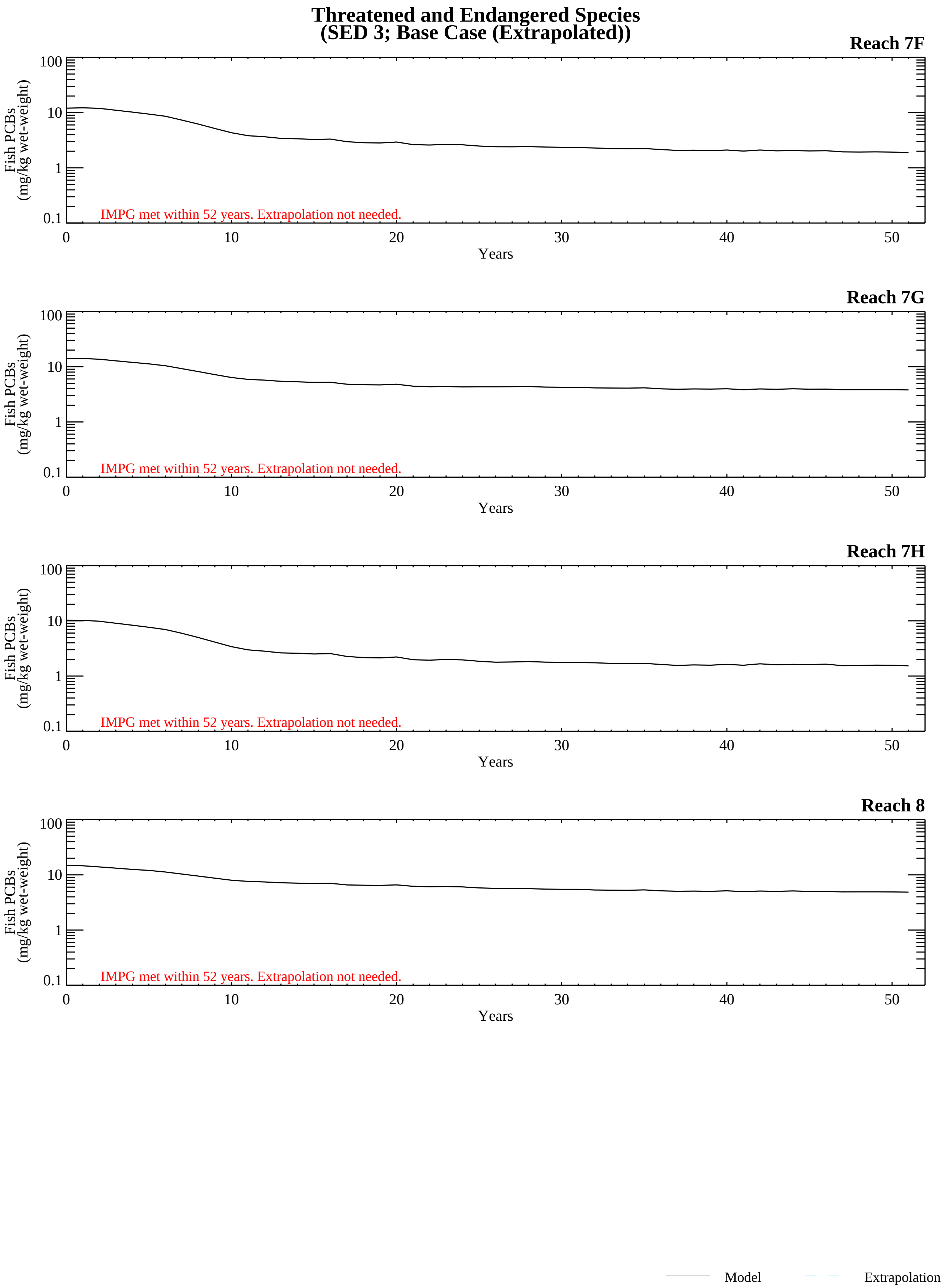

Figure G-10.2-2b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 3; Reach 7/8; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28^th^ through Oct. 26^th^ of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

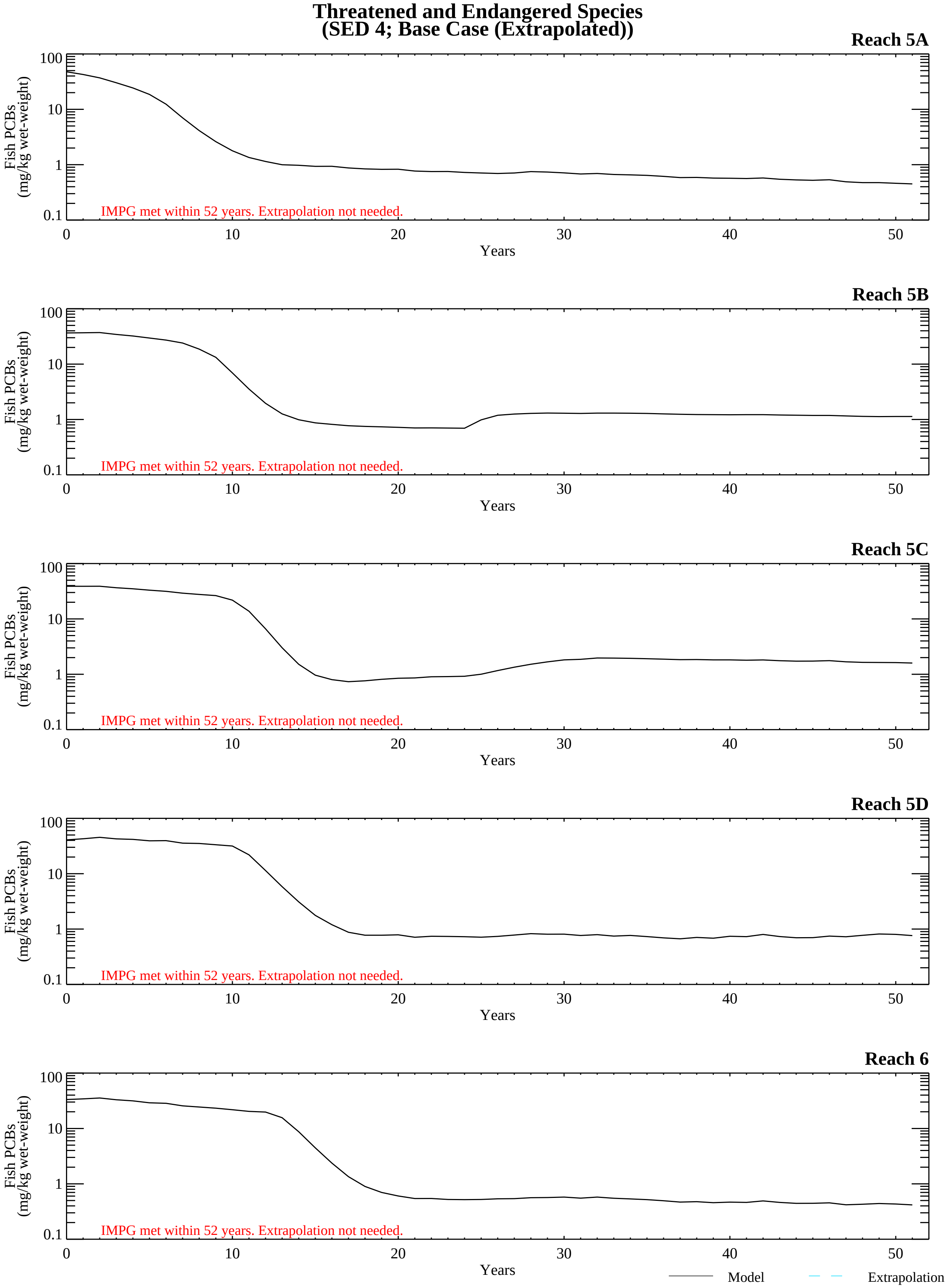

Figure G-10.2-3a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 4; Reach 5/6; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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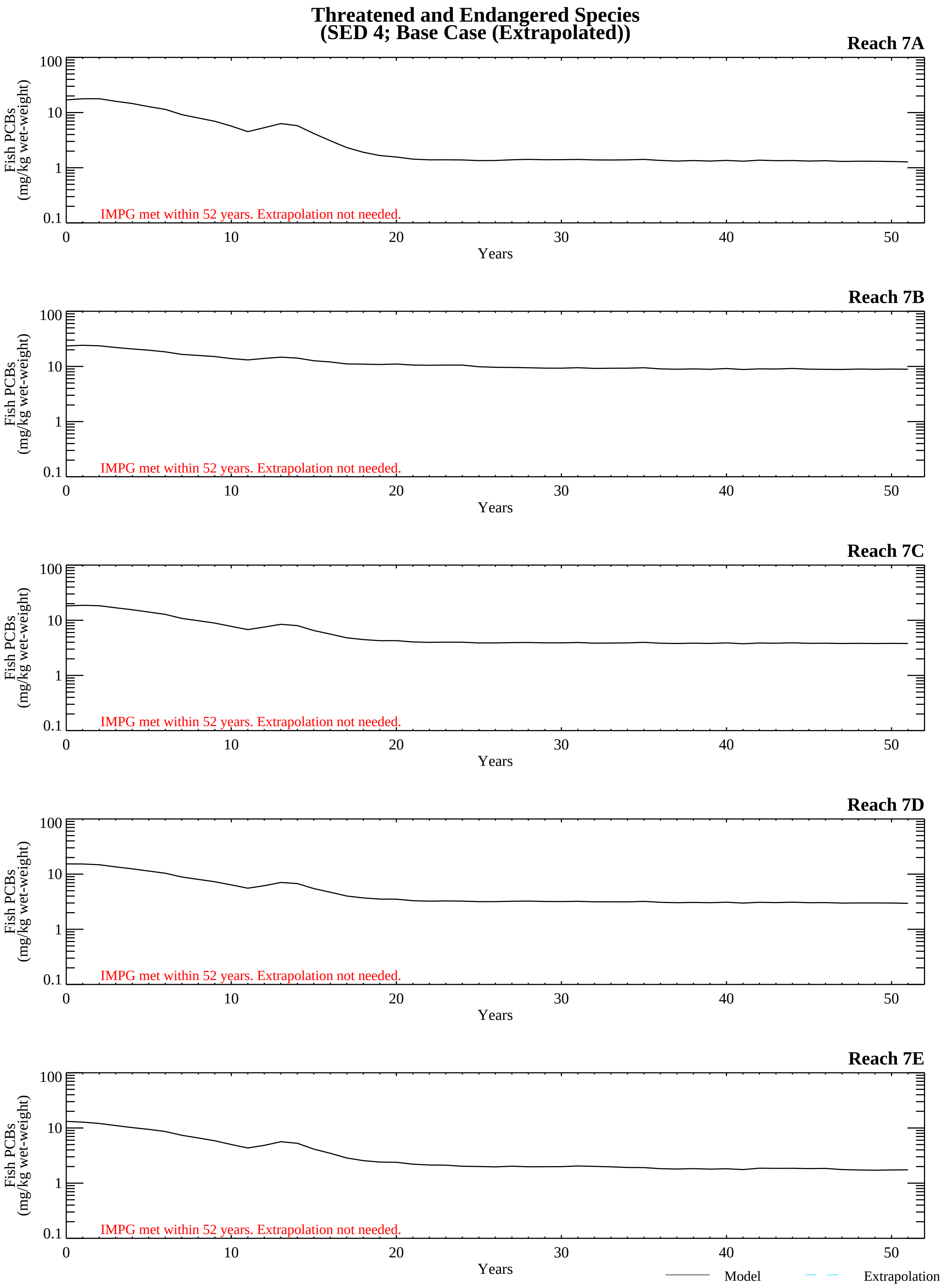

Figure G-10.2-3b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 4; Reach 7/8; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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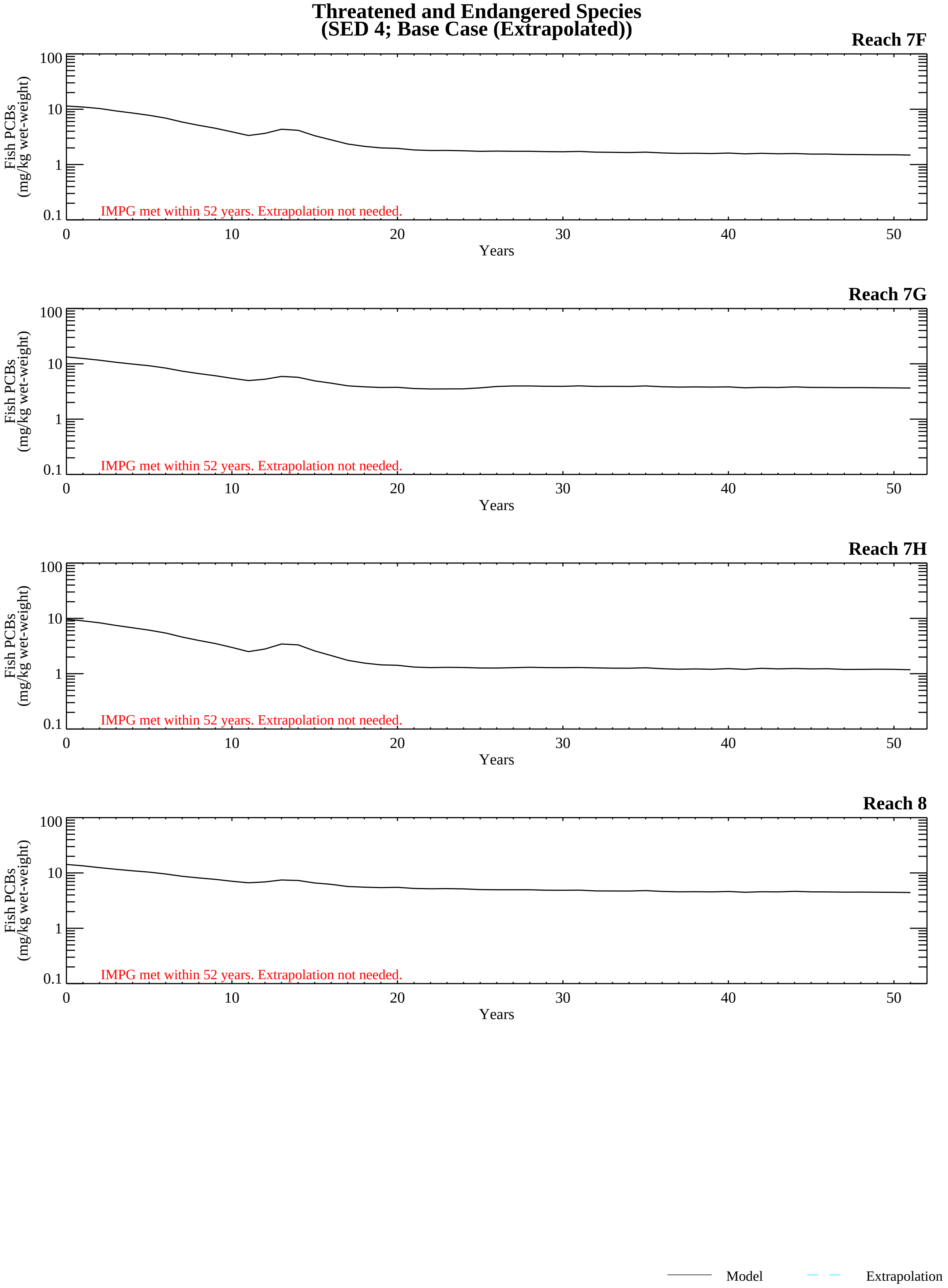

Figure G-10.2-3b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 4; Reach 7/8; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

Threatened and Endangered Species
(SED 5; Base Case (Extrapolated))

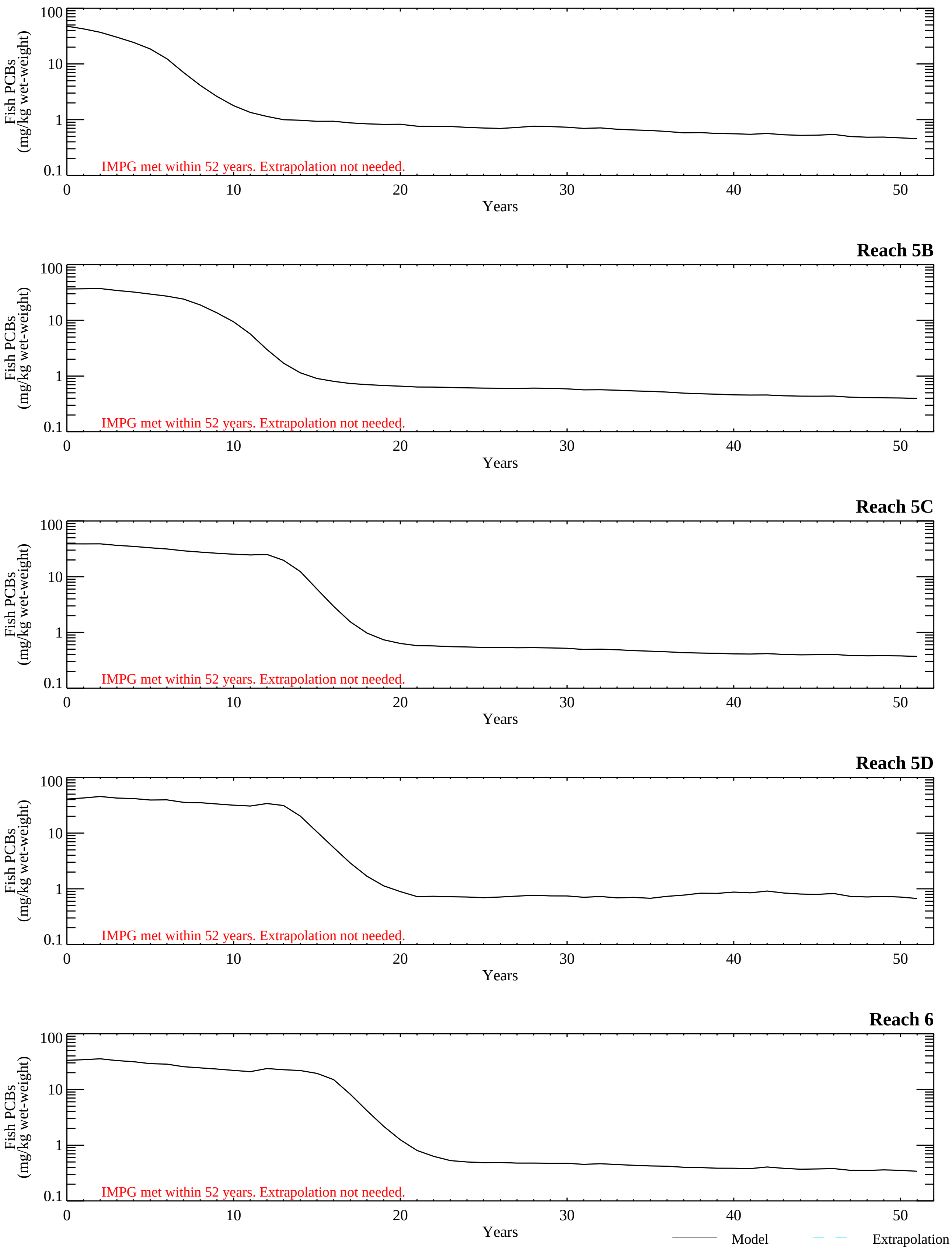

Figure G-10.2-4a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 5; Reach 5/6; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th *through Oct. 26*th *of each year.*
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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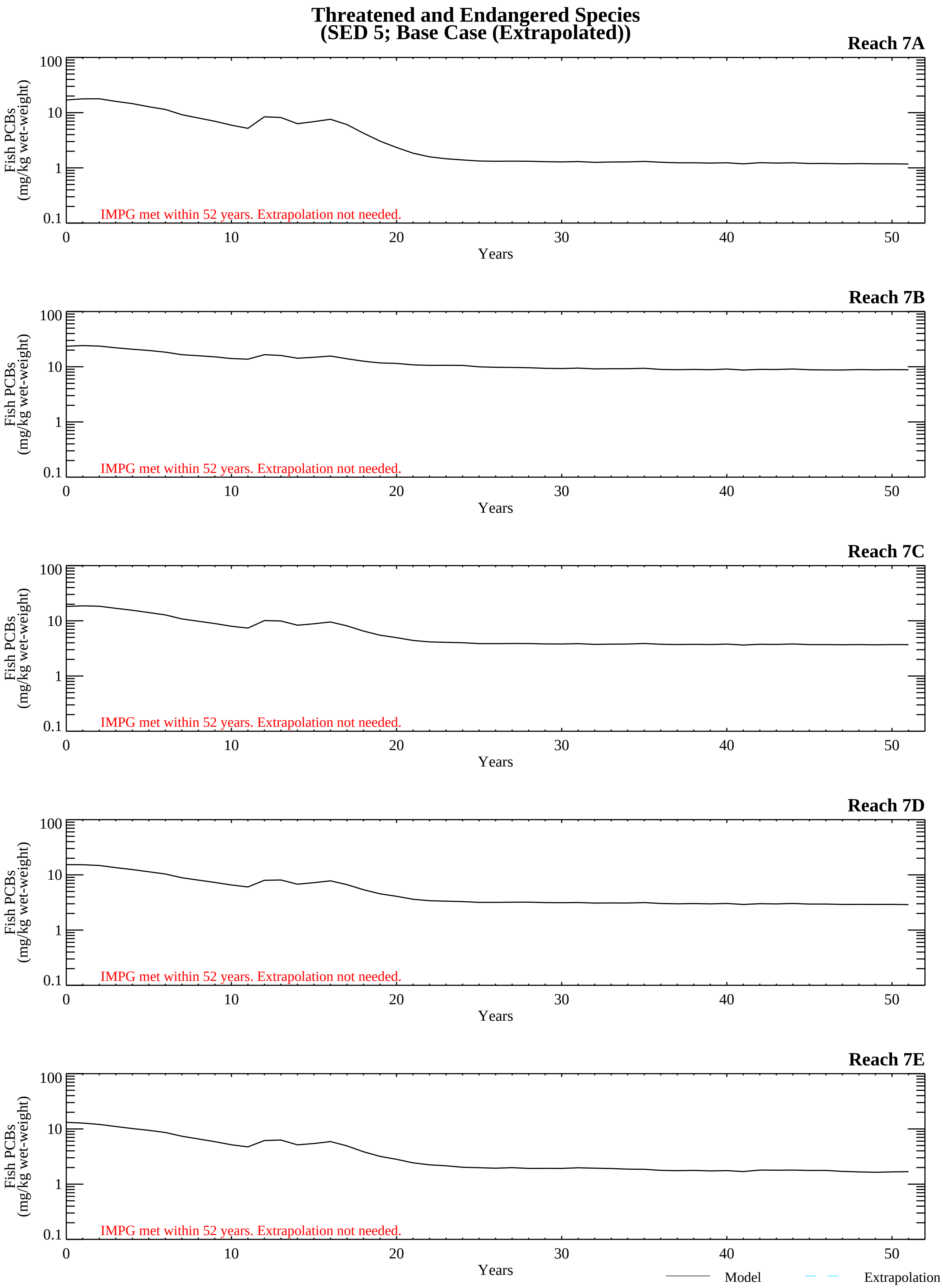

Figure G-10.2-4b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 5; Reach 7/8; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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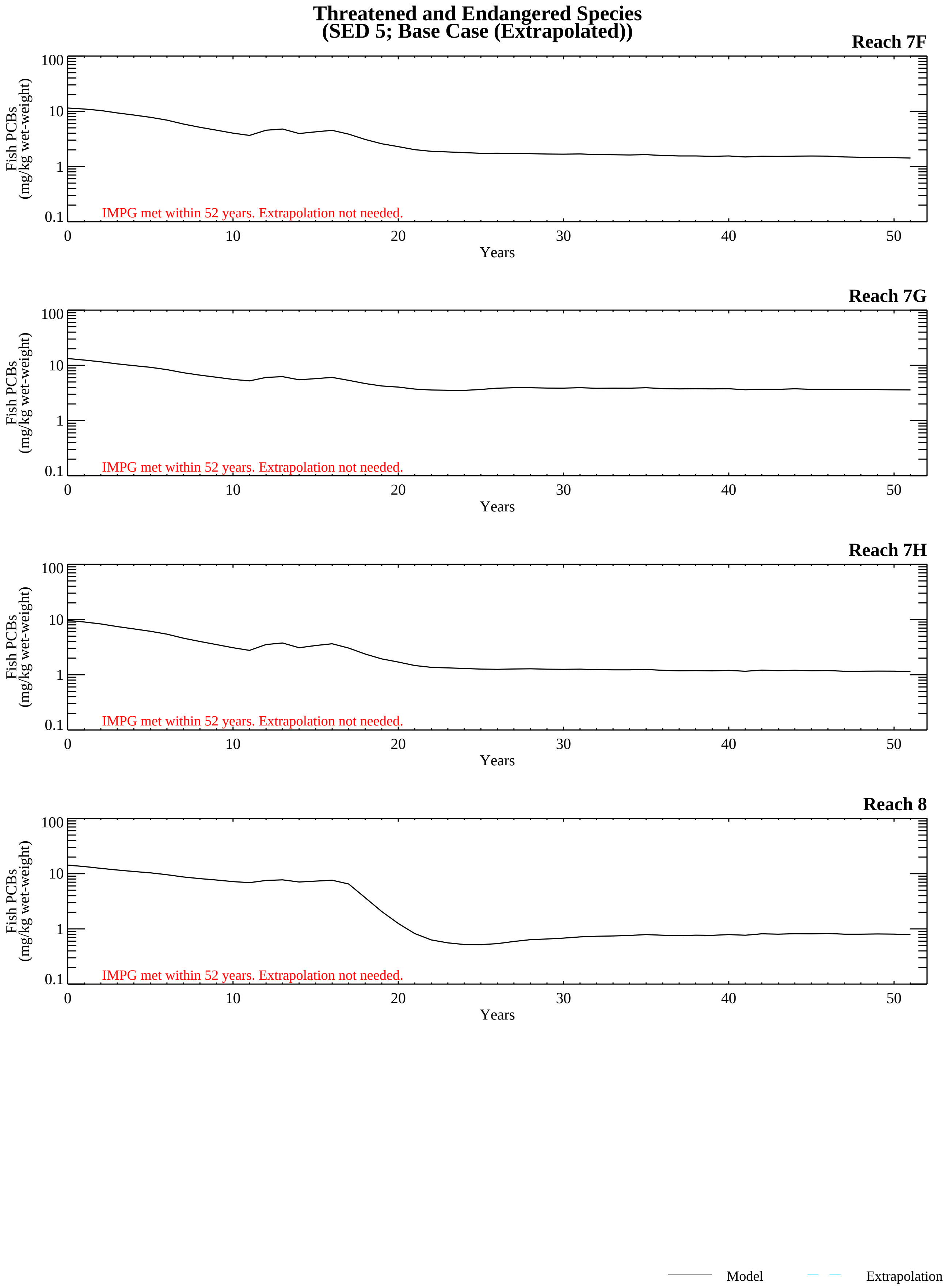

Figure G-10.2-4b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 5; Reach 7/8; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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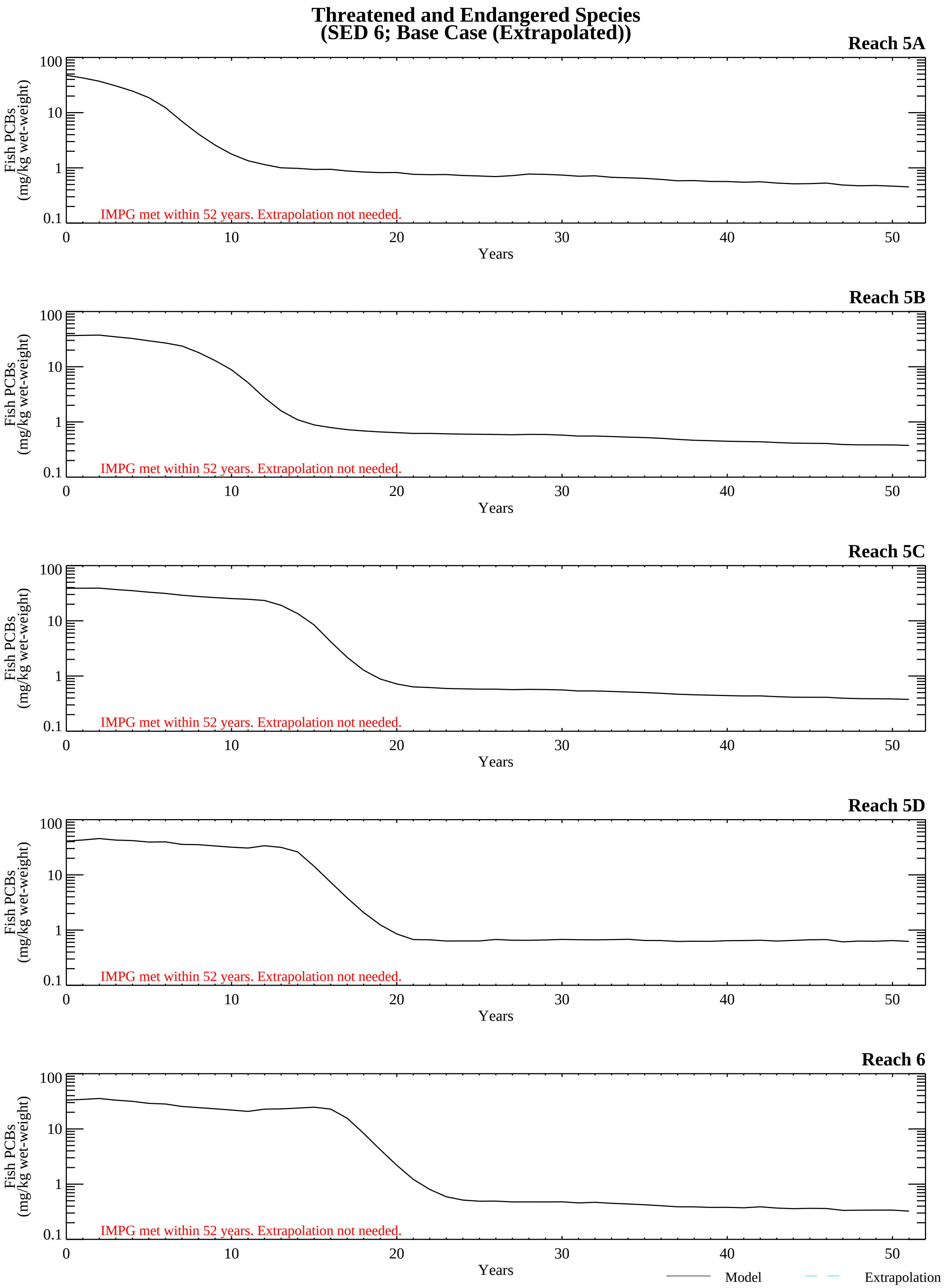

Figure G-10.2-5a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 6; Reach 5/6; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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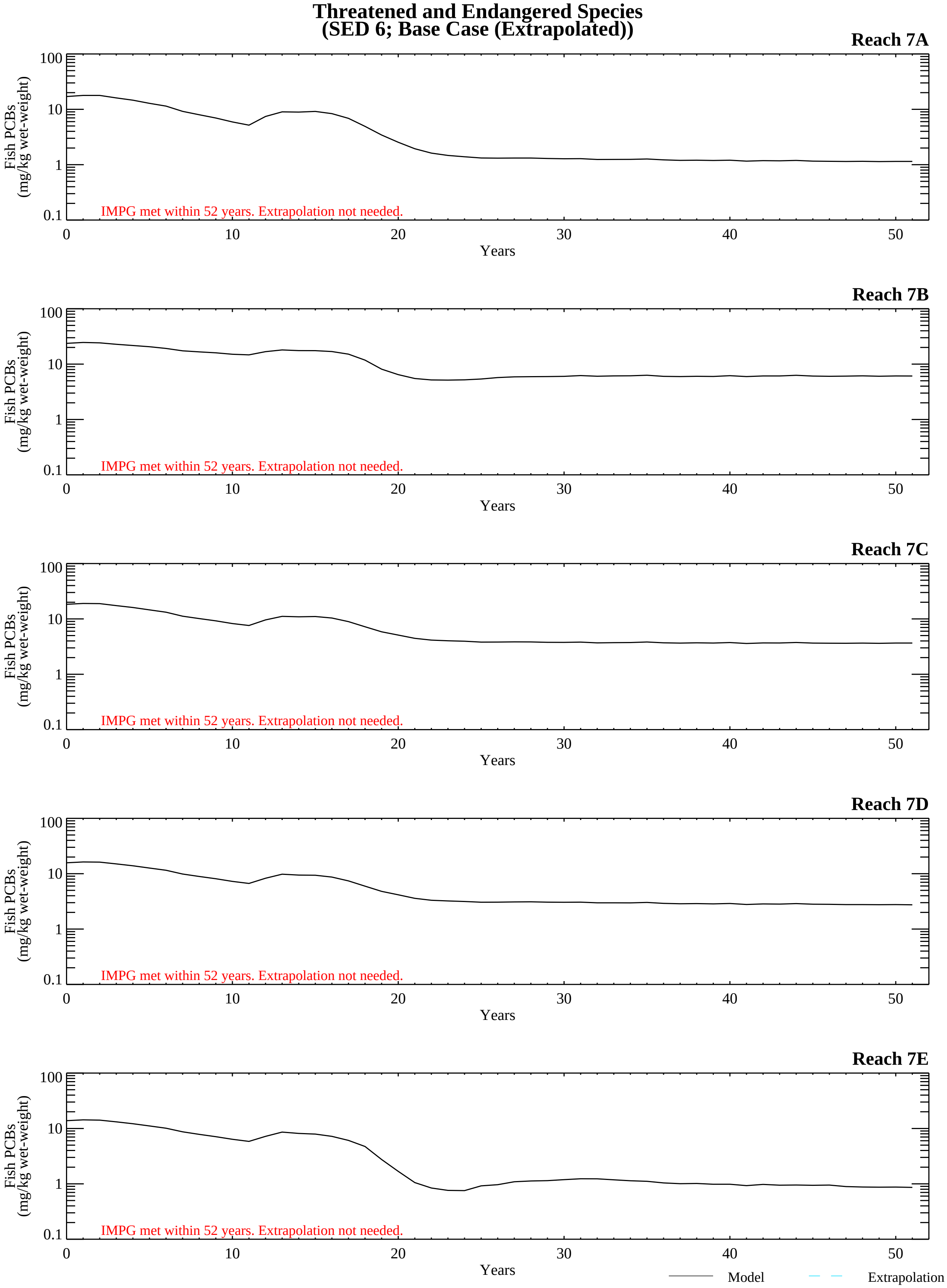

Figure G-10.2-5b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 6; Reach 7/8; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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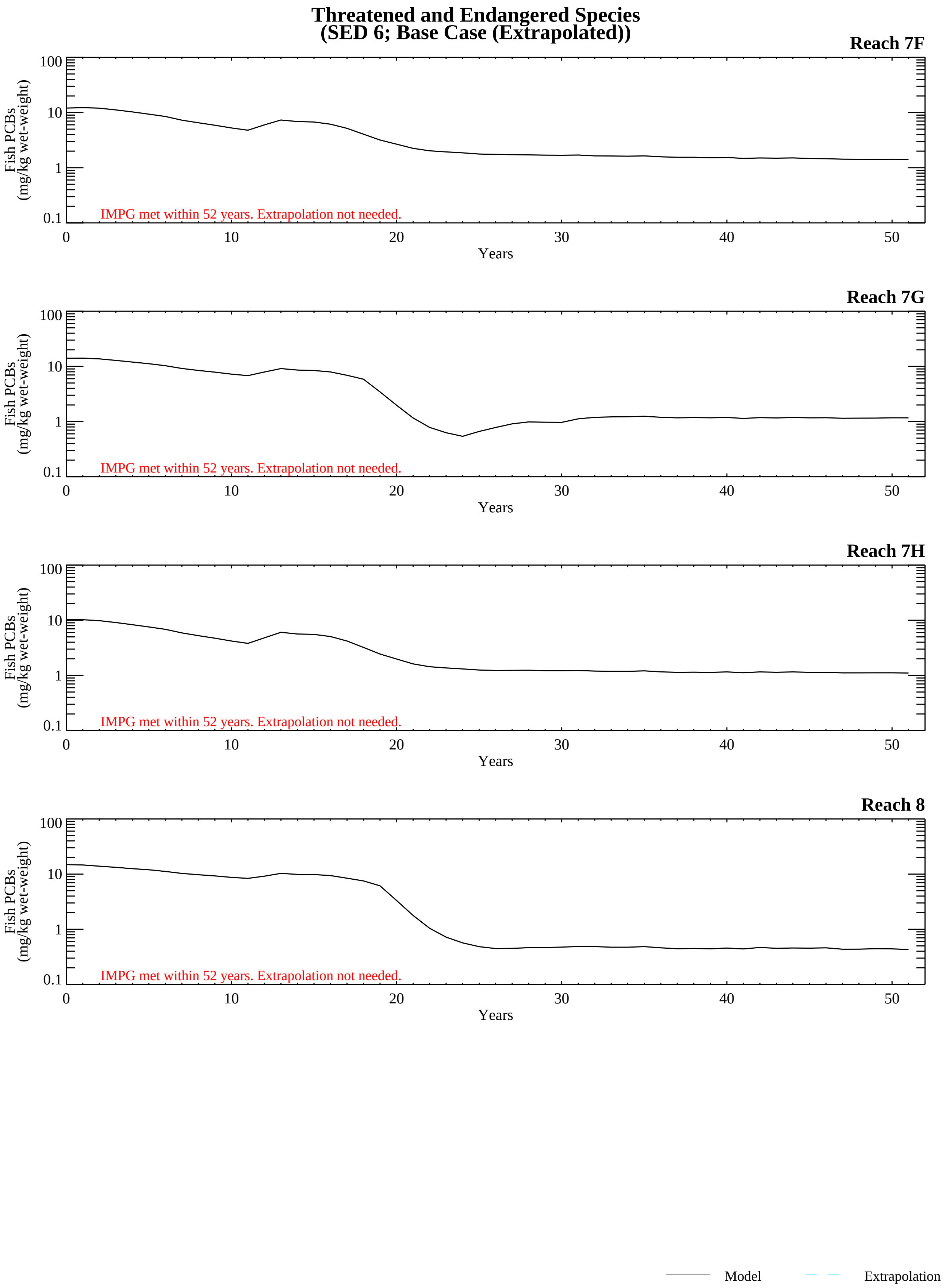

Figure G-10.2-5b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 6; Reach 7/8; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

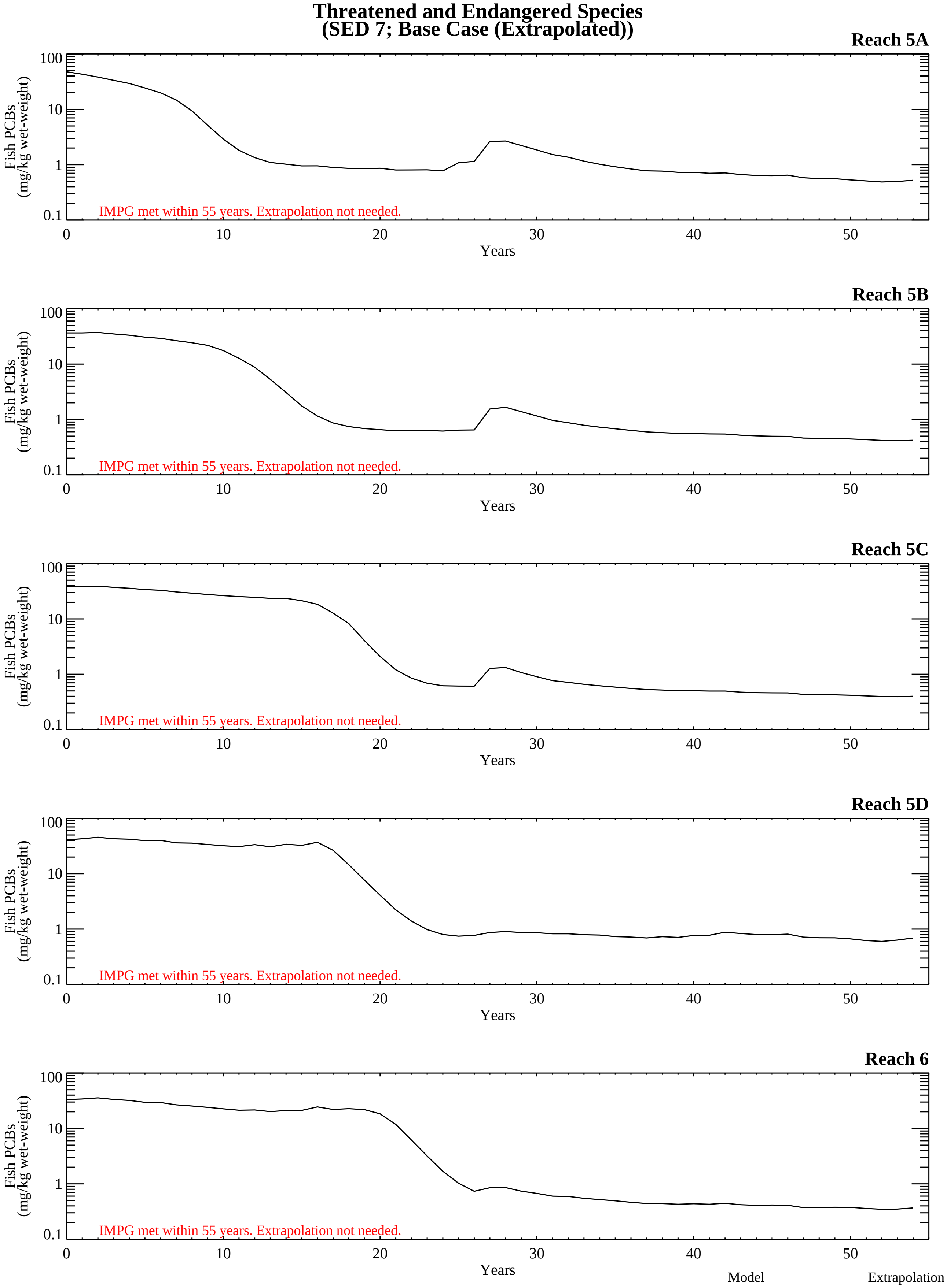

Figure G-10.2-6a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 7; Reach 5/6; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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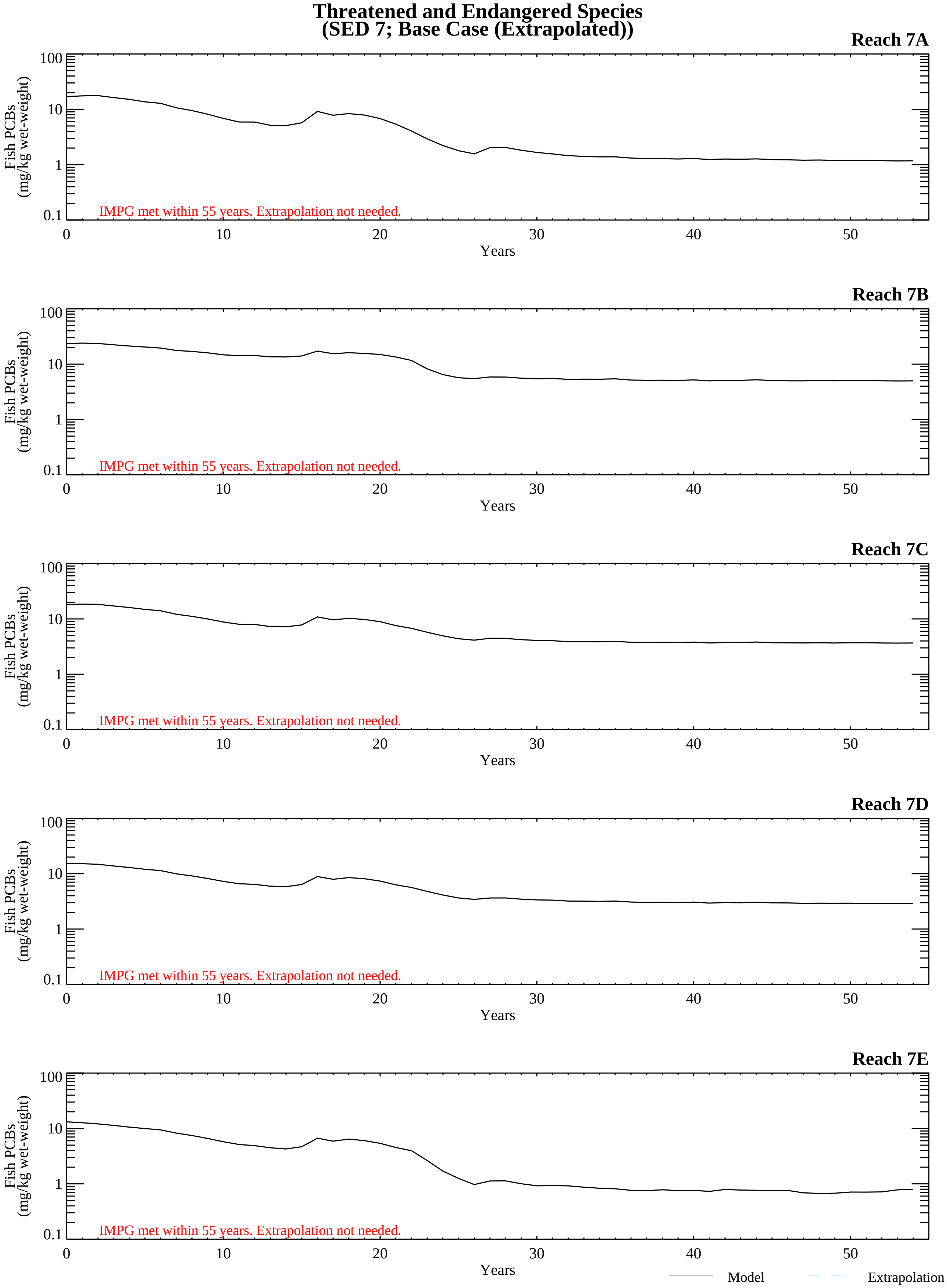

Figure G-10.2-6b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 7; Reach 7/8; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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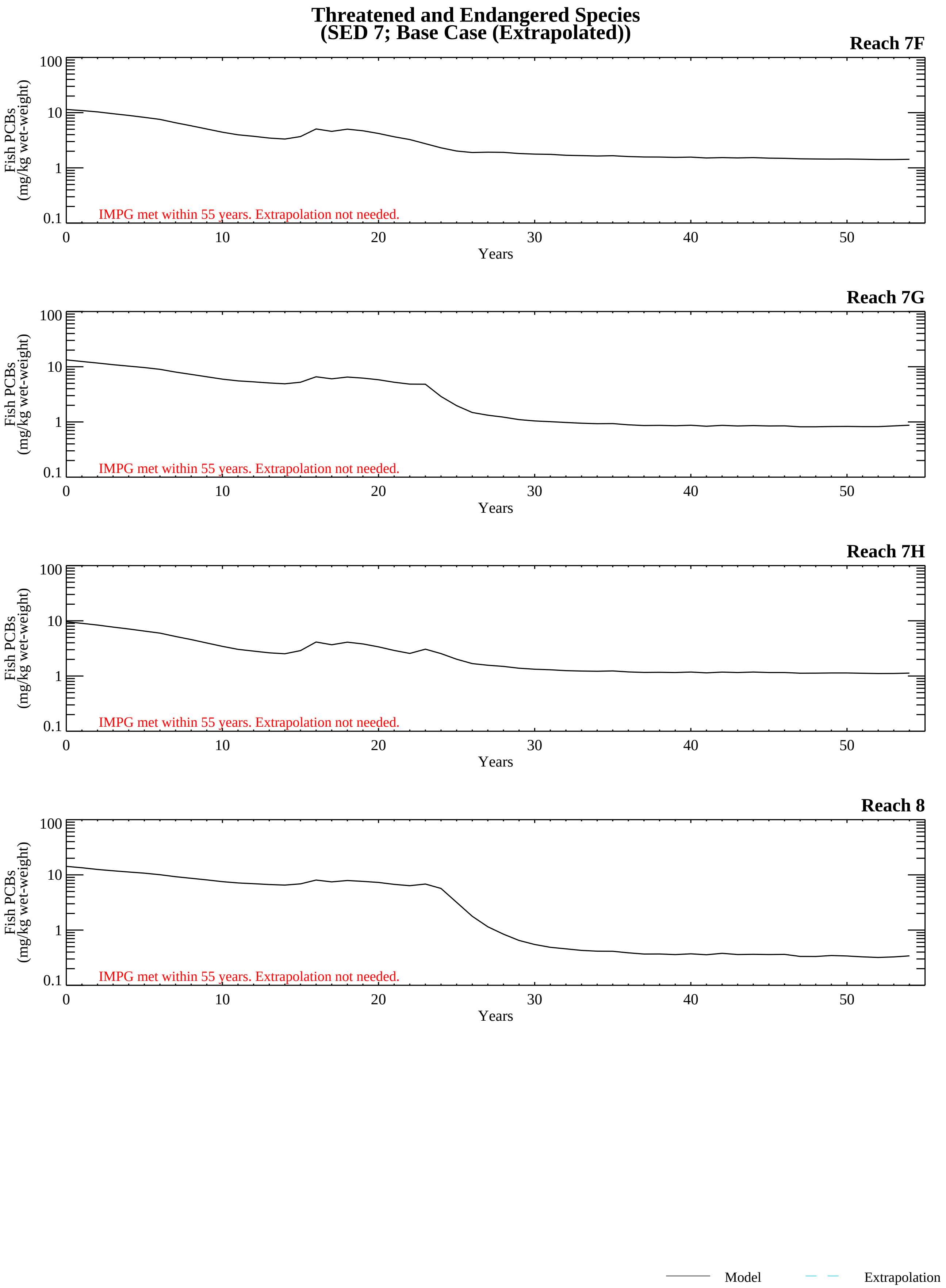

Figure G-10.2-6b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 7; Reach 7/8; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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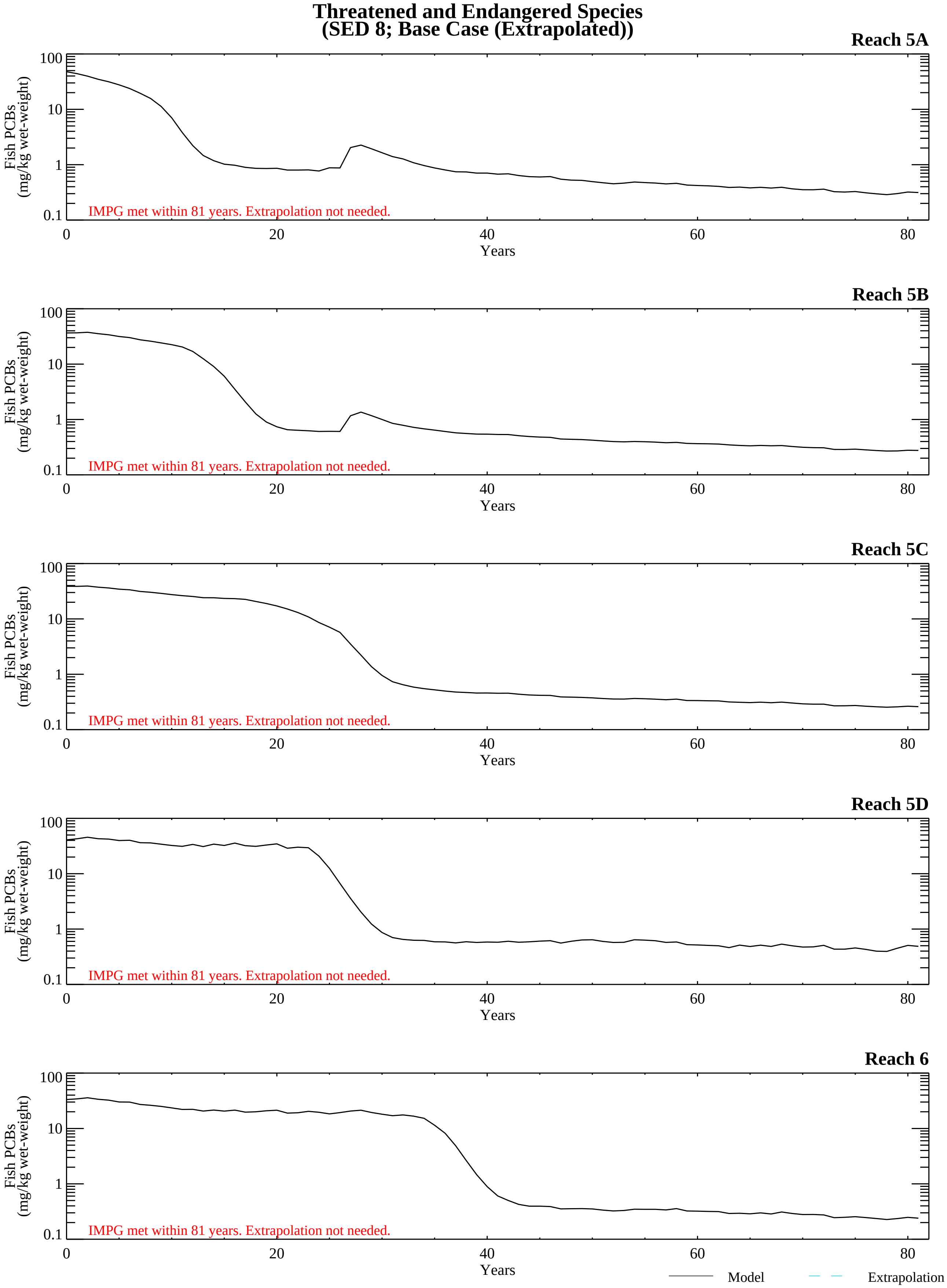

Figure G-10.2-7a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 8; Reach 5/6; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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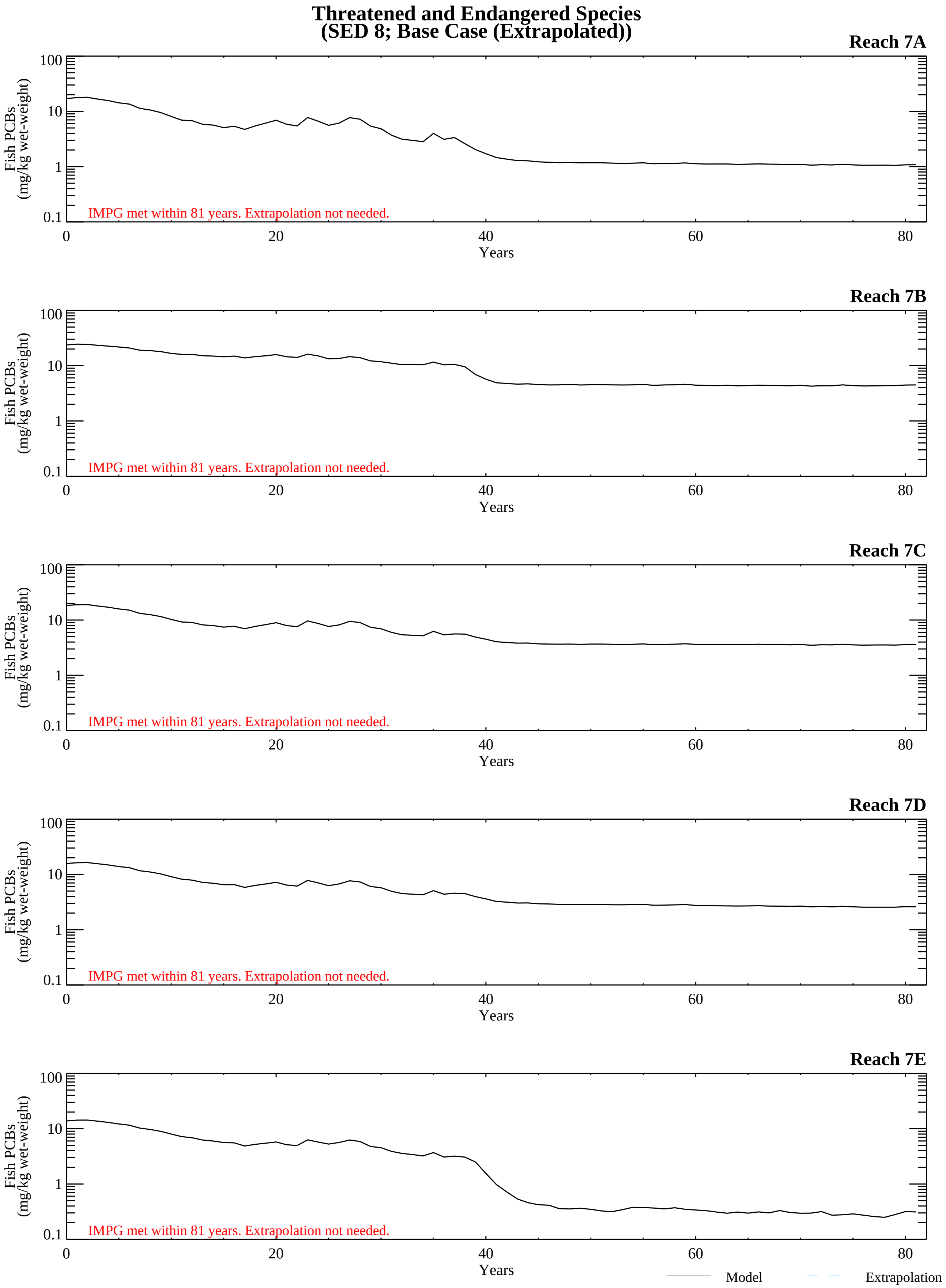

Figure G-10.2-7b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 8; Reach 7/8; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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Wed Mar 19 21:09:14 2008

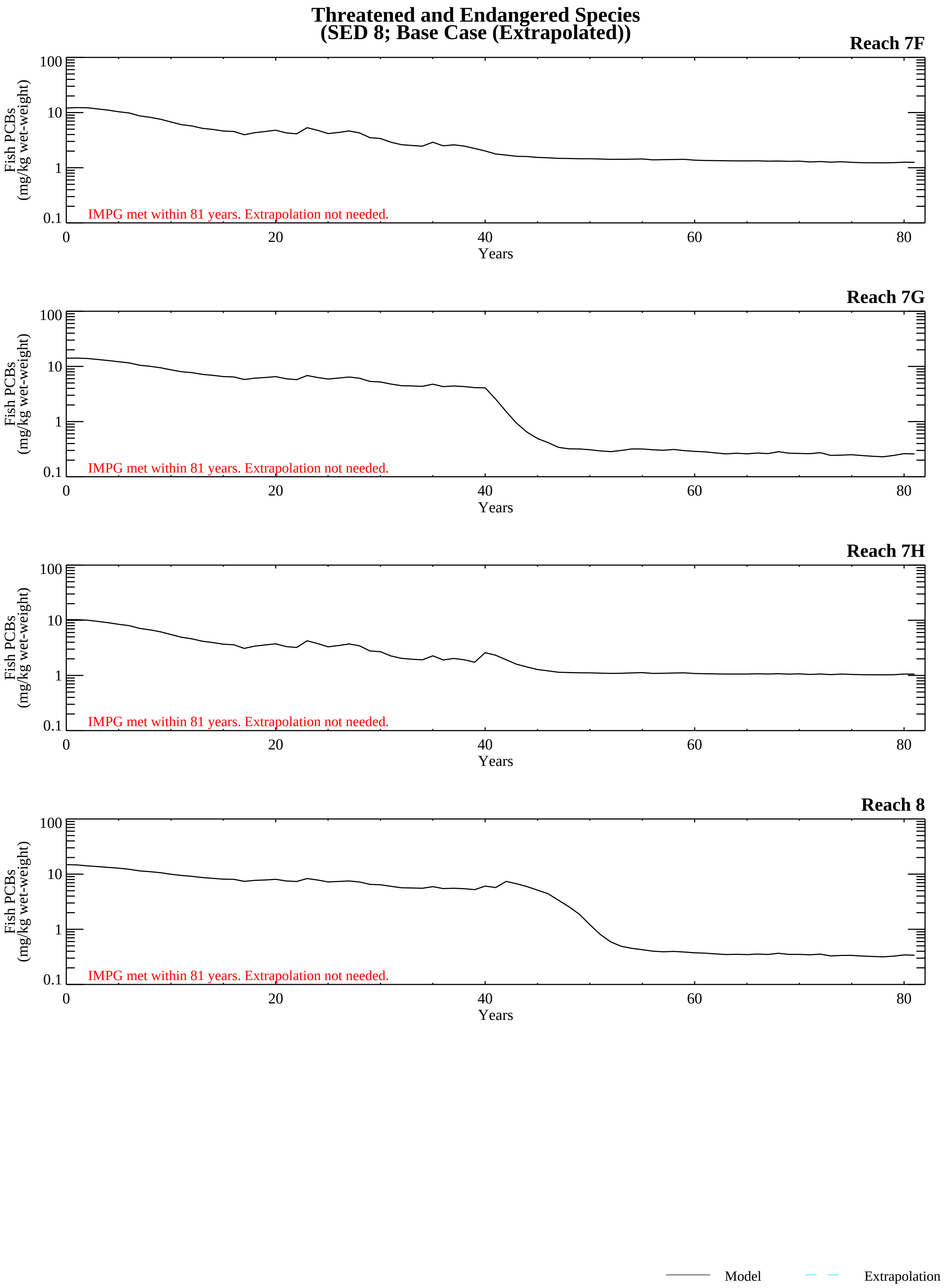

Figure G-10.2-7b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 8; Reach 7/8; Base Case).

IMPG value (mg/kg) = 30.41
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

NDK - Z:\GENcms\MODEL\FDCHN\Analysis\IMPG\Fish\impg_tabulate_projections_fff_loop_run2.pro
Wed Mar 19 21:09:14 2008

Threatened and Endangered Species
(SED 1 / SED 2; Lower Bound)

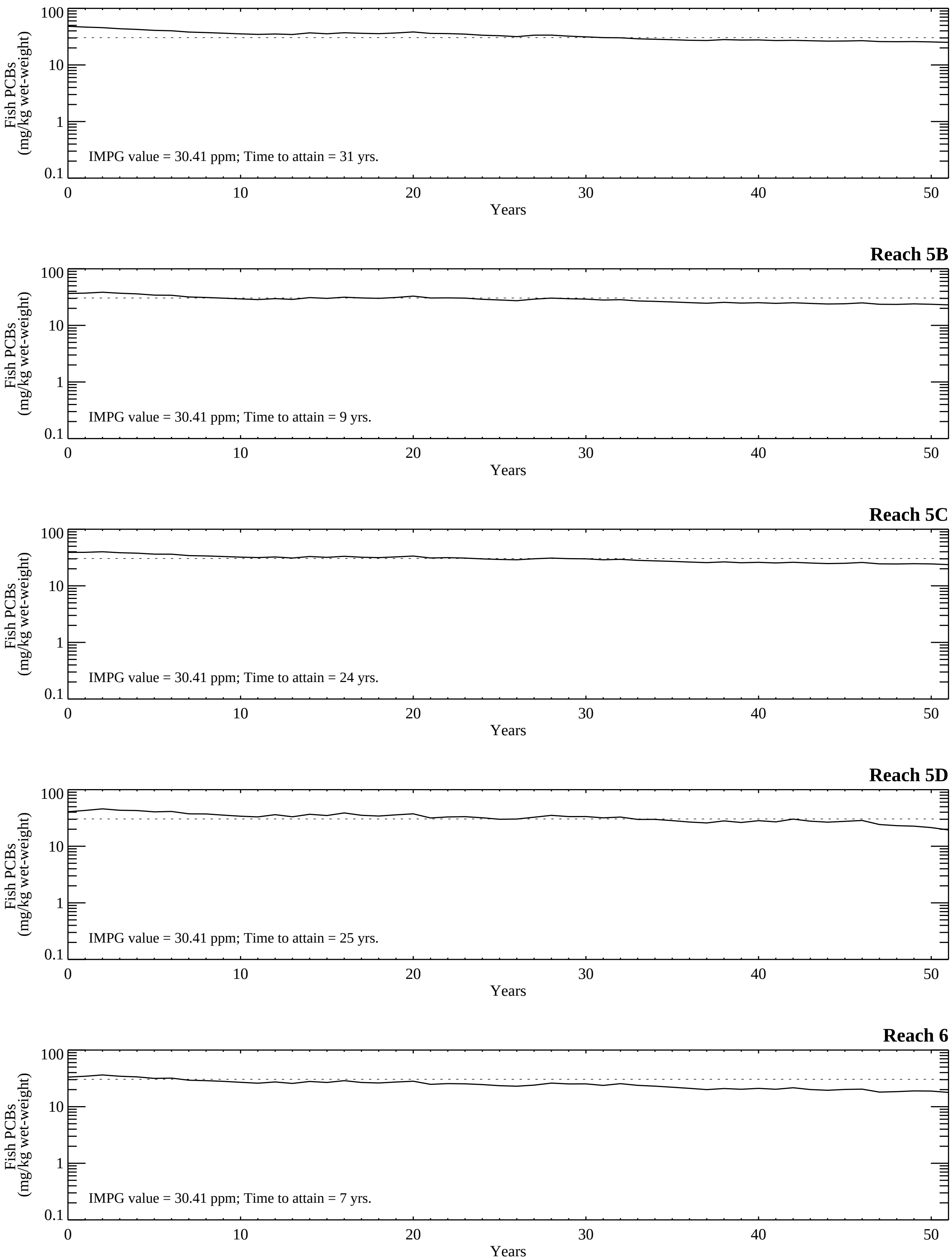

Figure G-10.3-1a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 1 / SED 2; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

DR\LD - Z:\GENcms\MODEL\FDCHN\Analysis\IMPG\Fish\impg_tabulate_projections_loop.pro
Fri Mar 14 17:56:46 2008

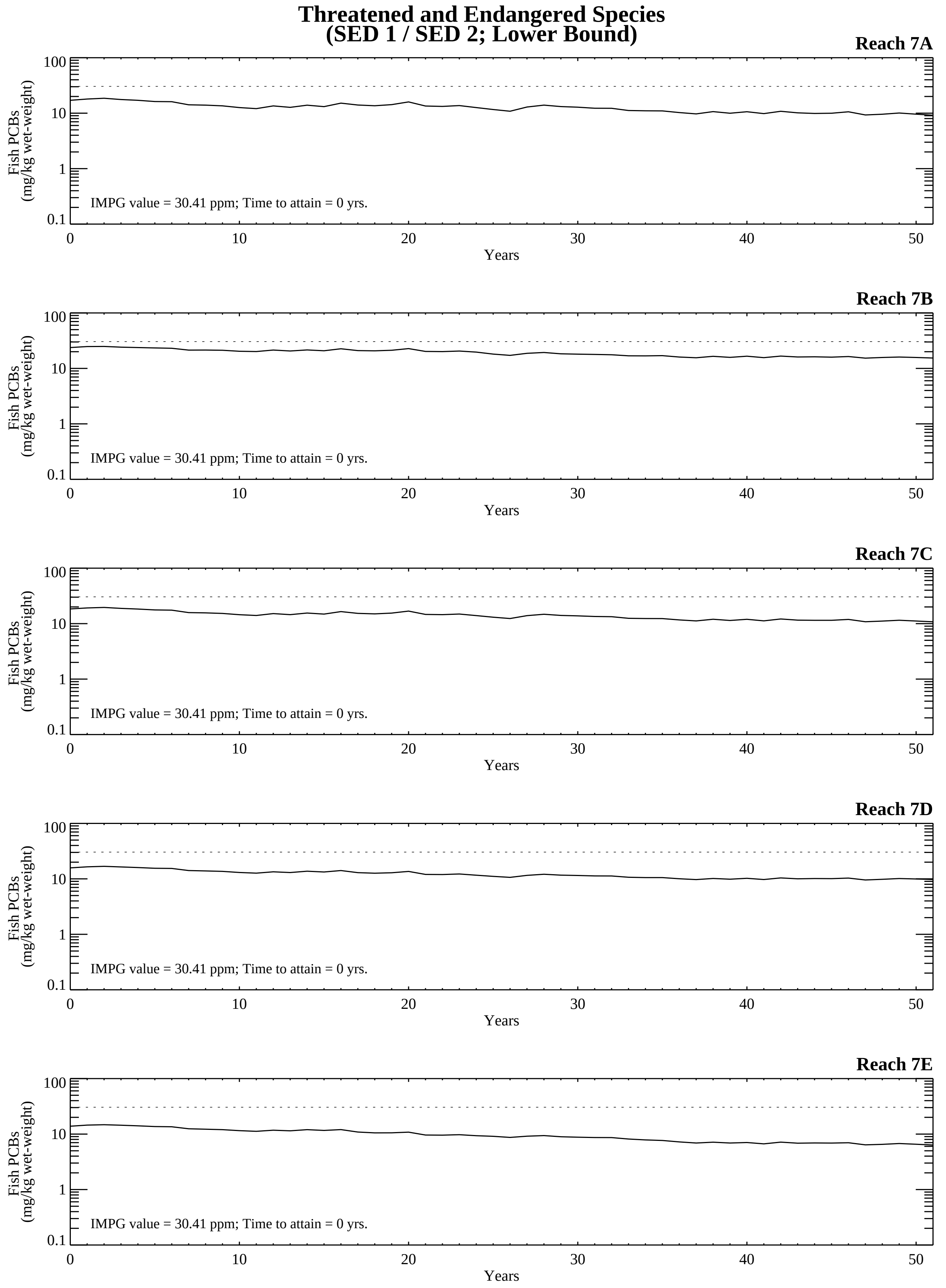

Figure G-10.3-1b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 1 / SED 2; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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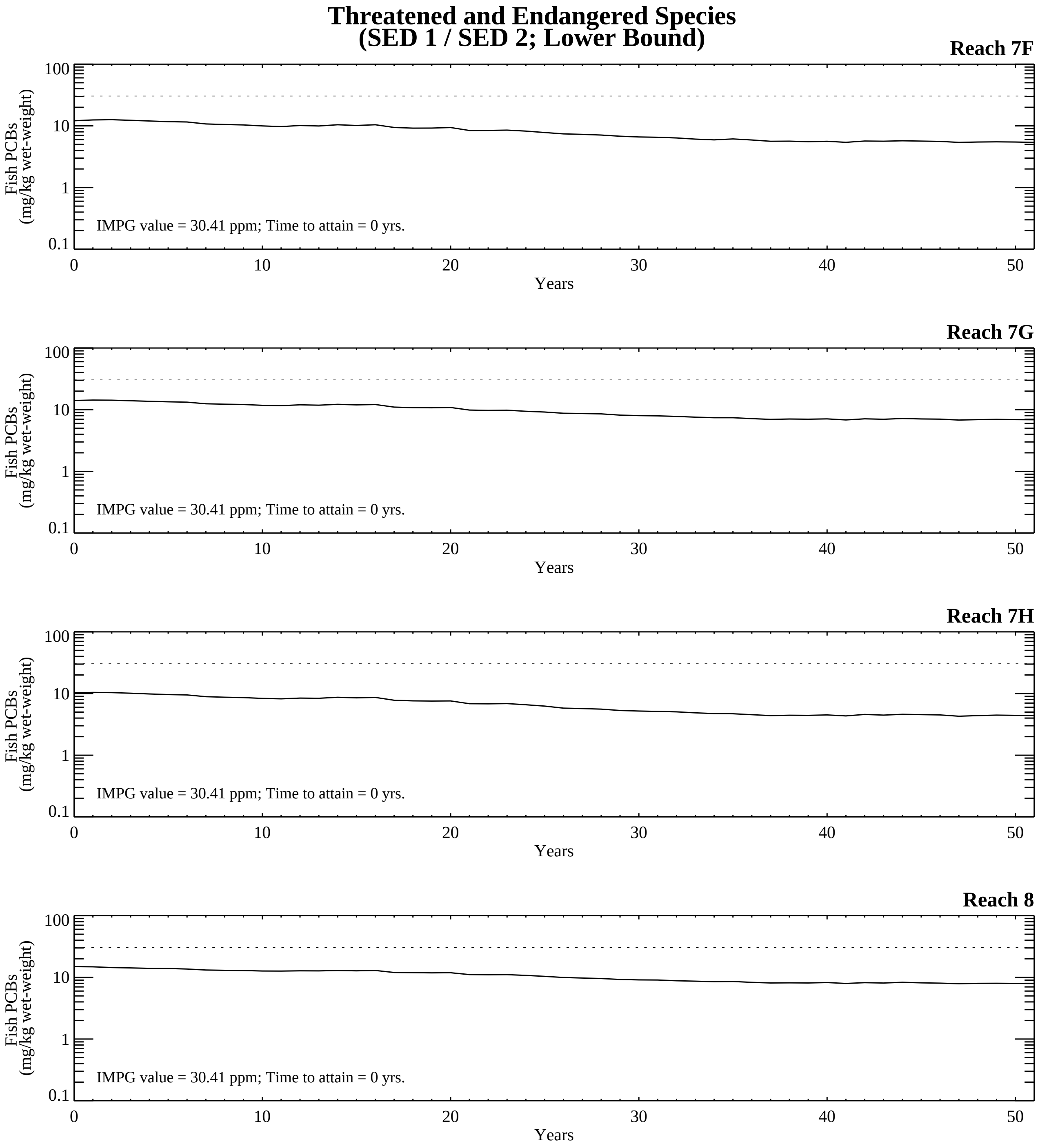

Figure G-10.3-1b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 1 / SED 2; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

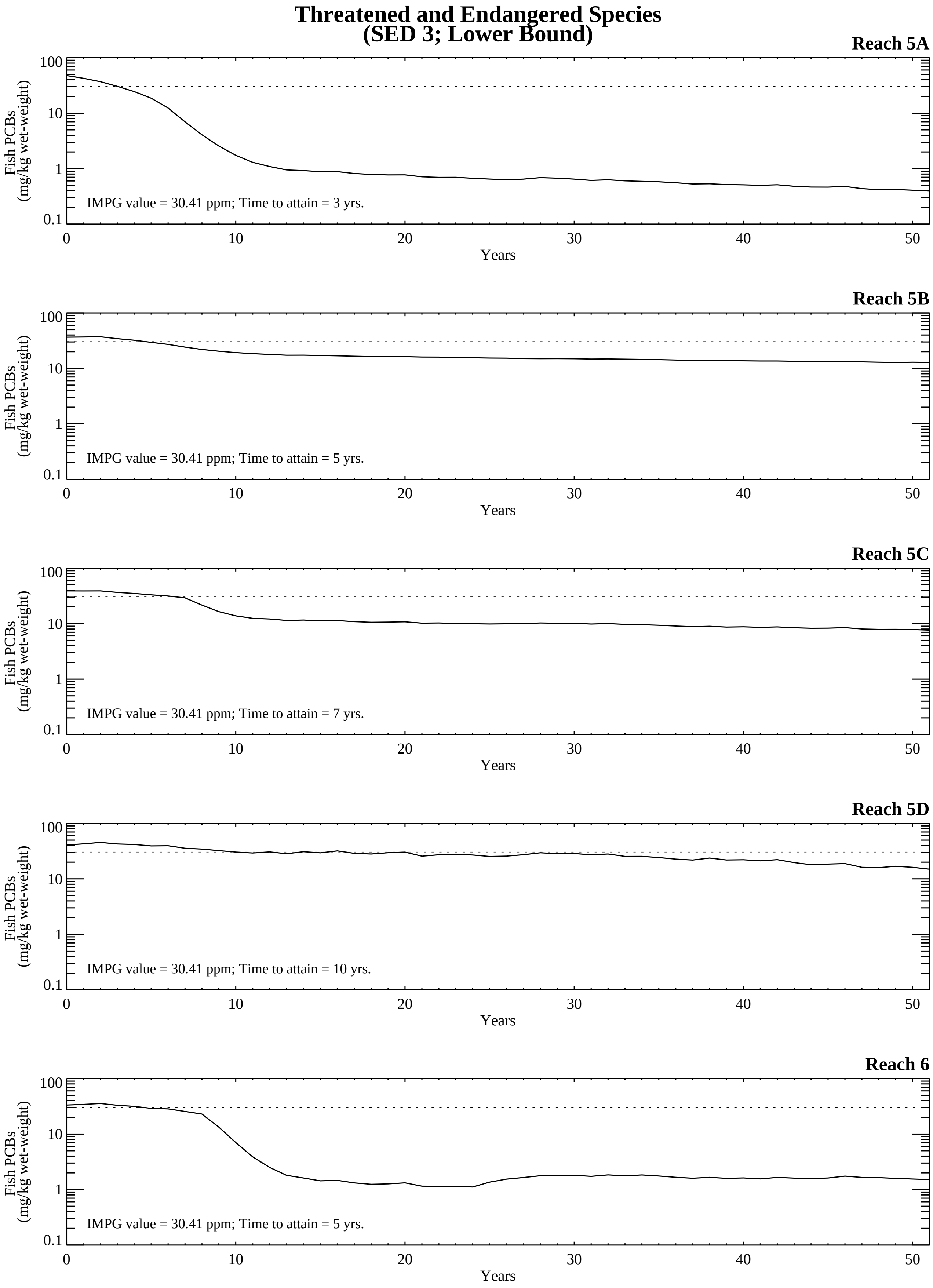

Figure G-10.3-2a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 3; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

Threatened and Endangered Species
(SED 3; Lower Bound)

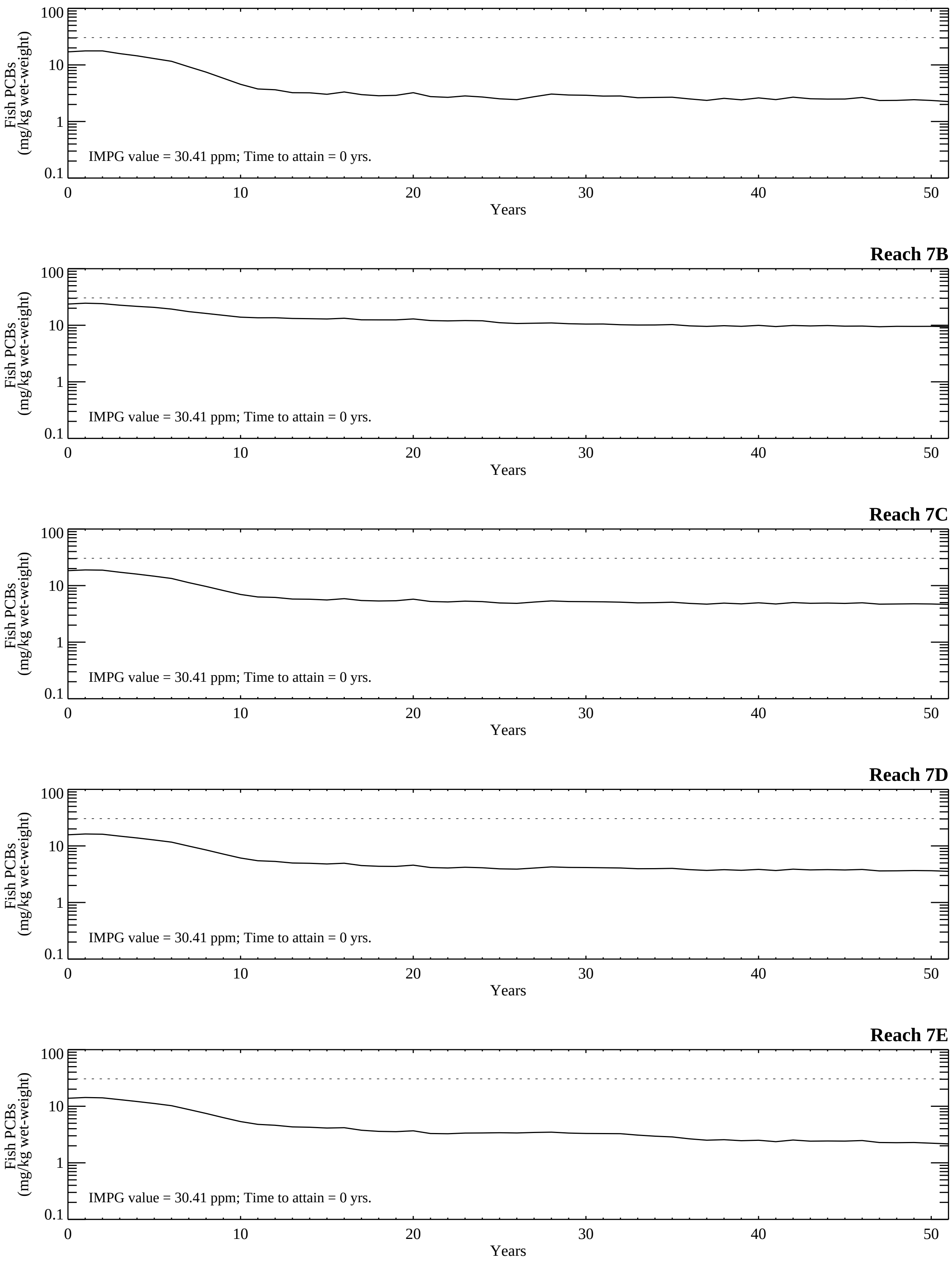

Figure G-10.3-2b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 3; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

Threatened and Endangered Species
(SED 3; Lower Bound)

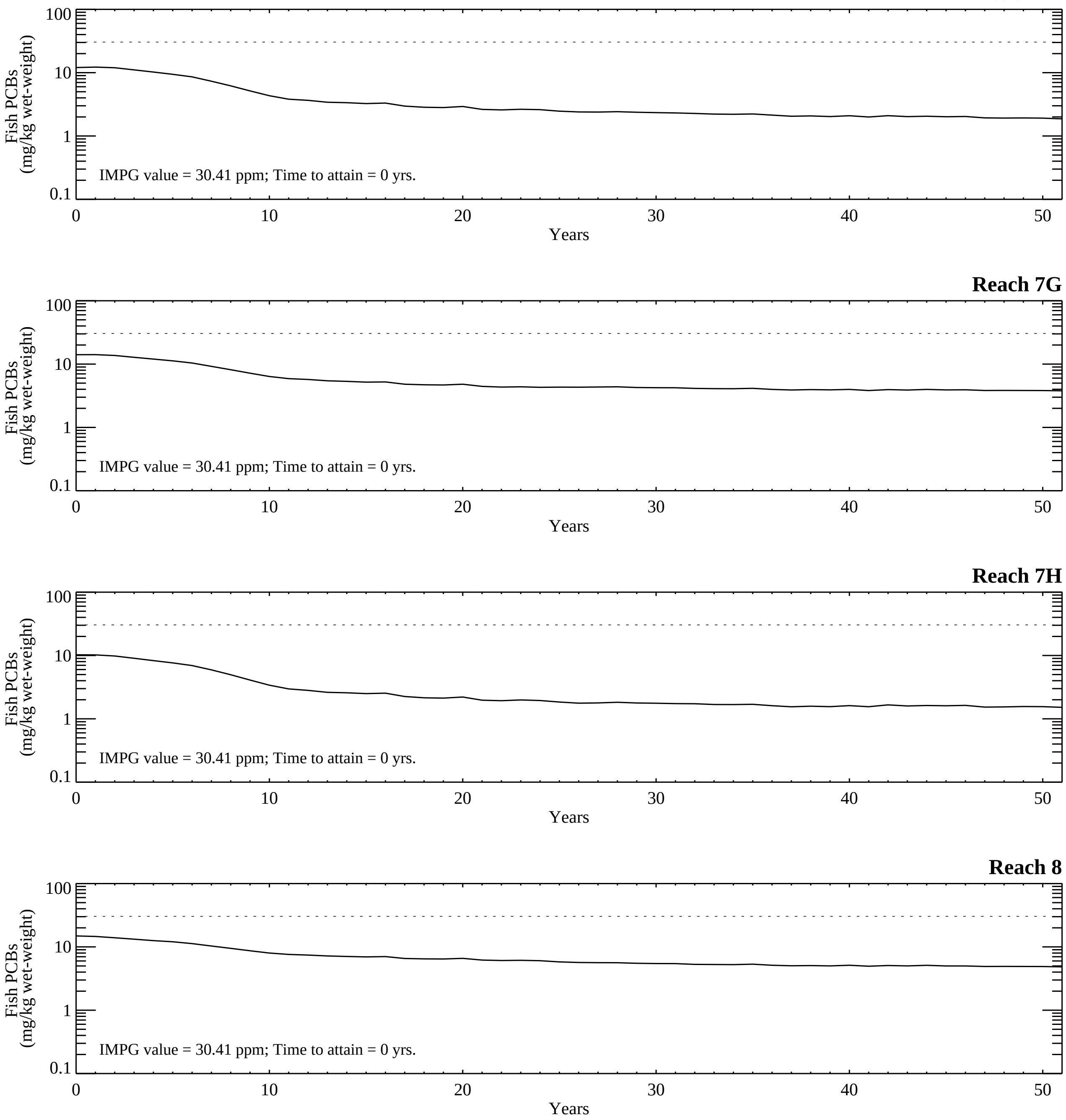

Figure G-10.3-2b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 3; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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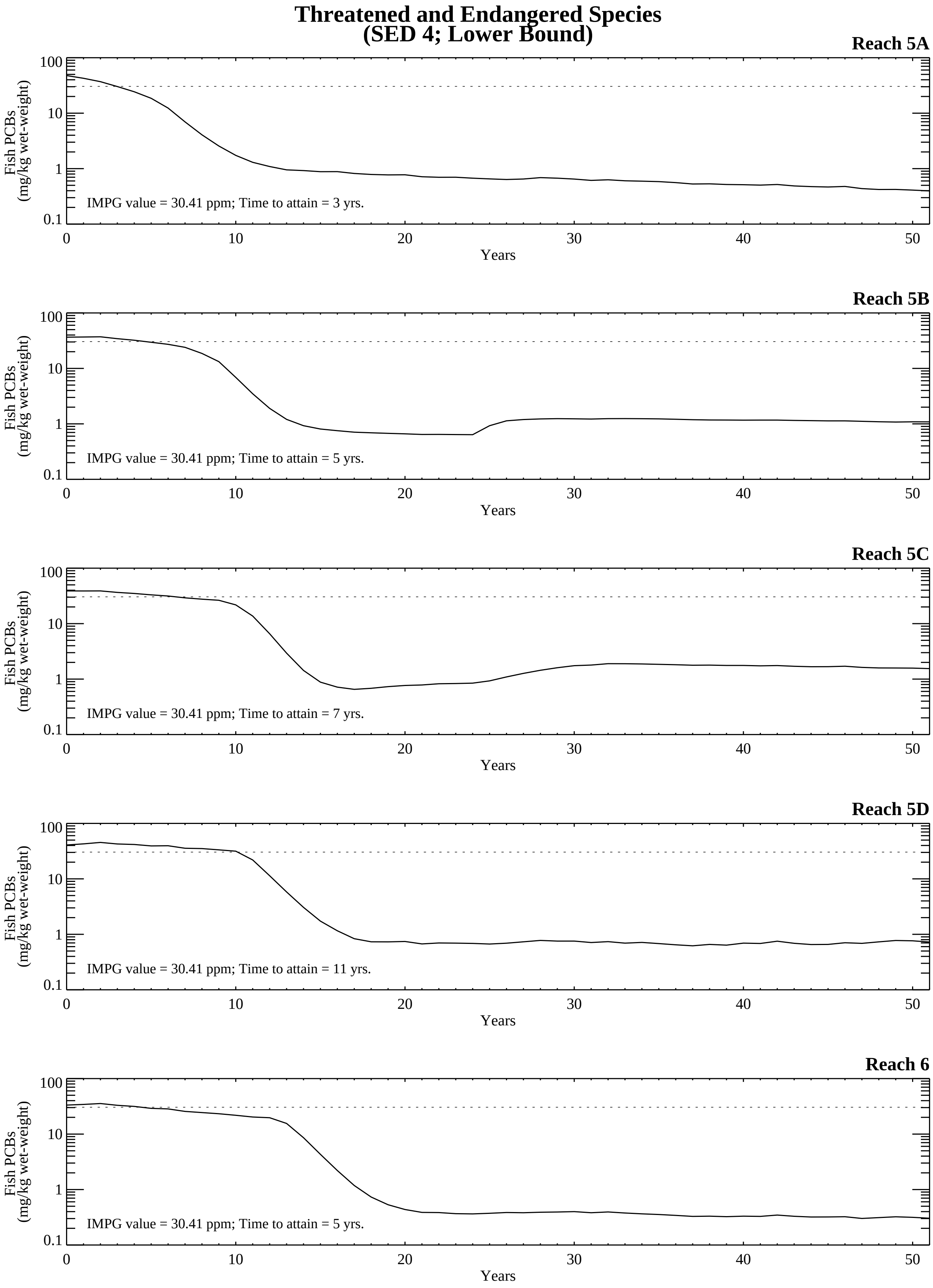

Figure G-10.3-3a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 4; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

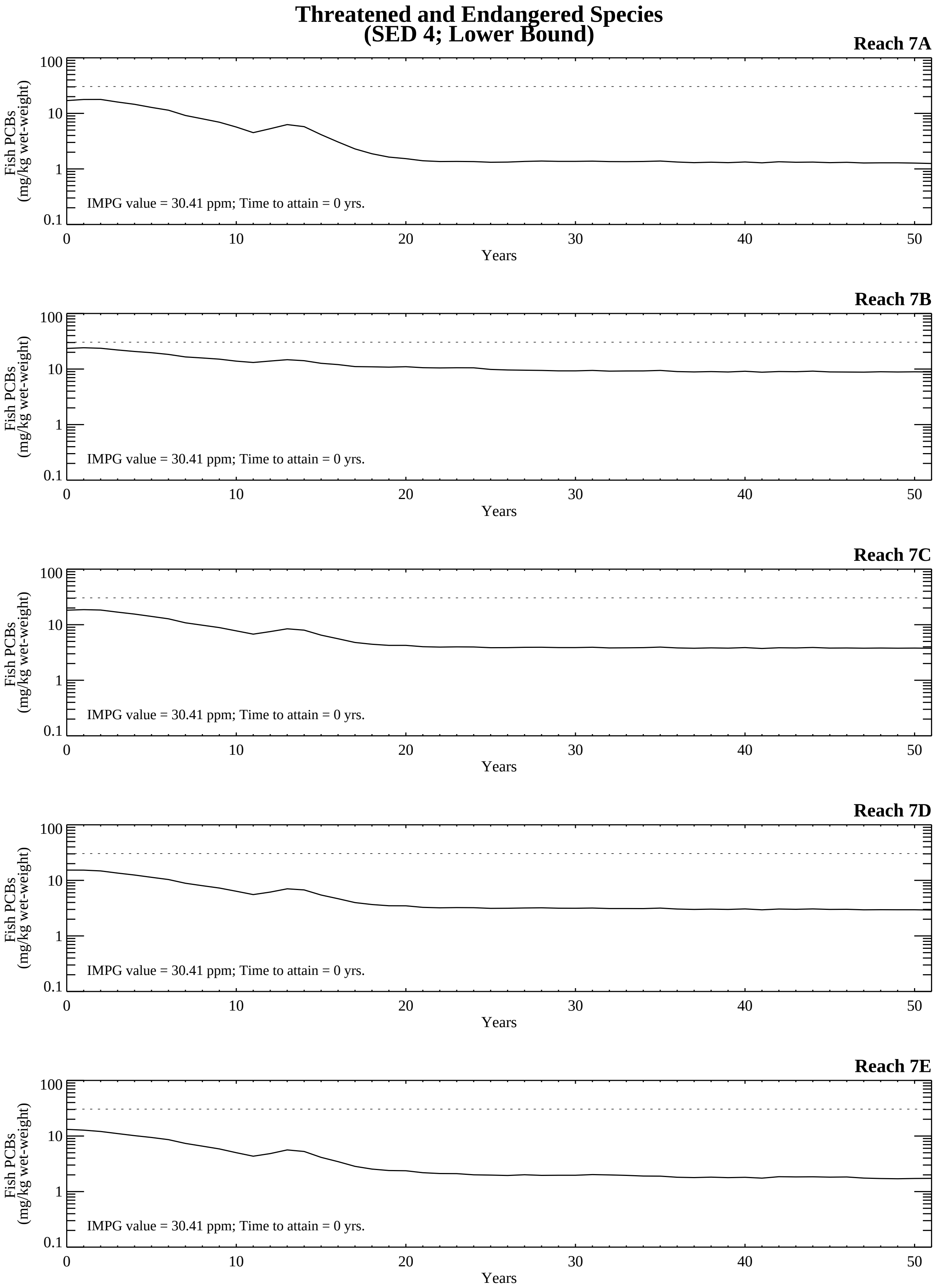

Figure G-10.3-3b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 4; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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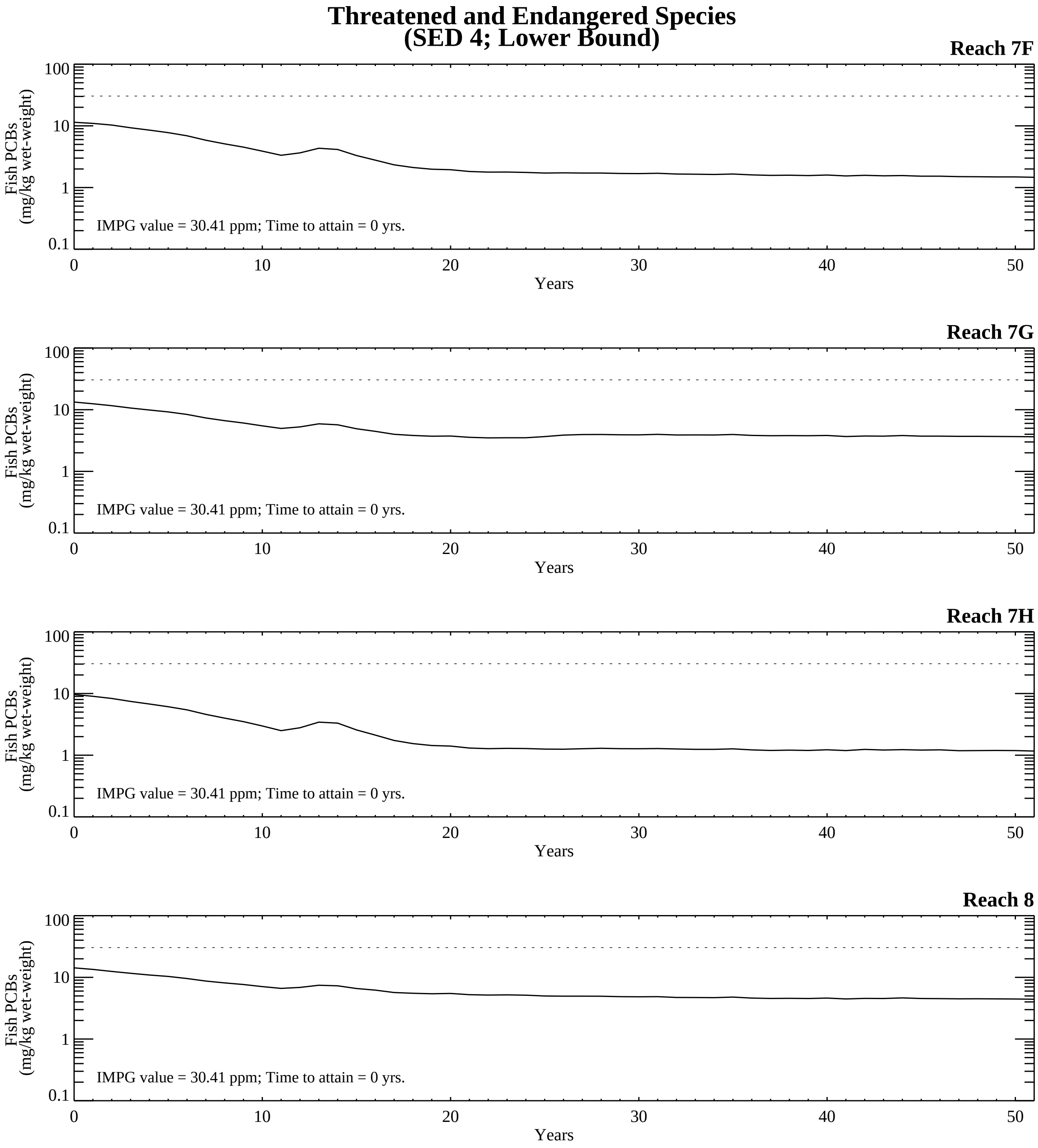

Figure G-10.3-3b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 4; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

Threatened and Endangered Species (SED 5; Lower Bound)

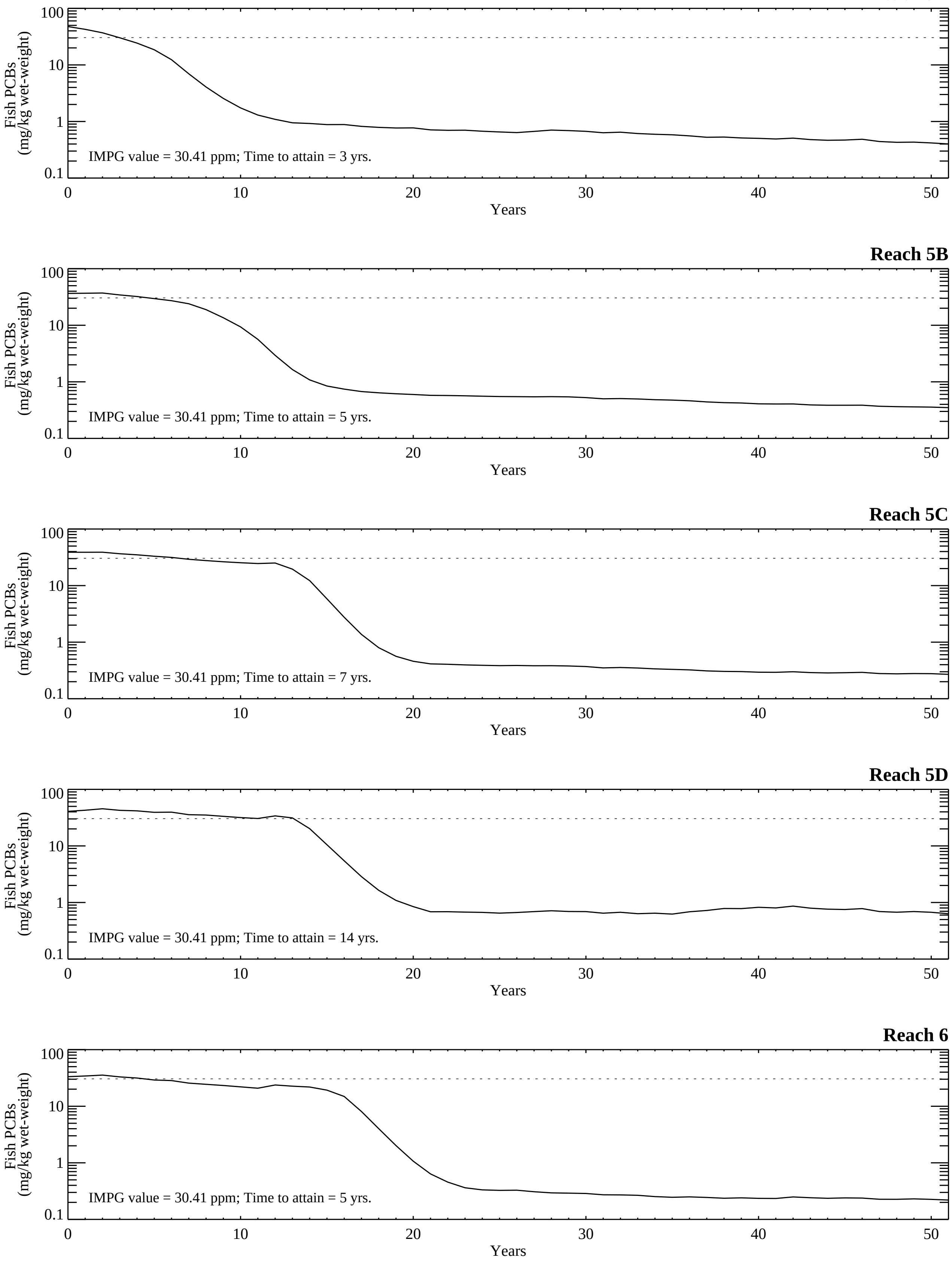

Figure G-10.3-4a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 5; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

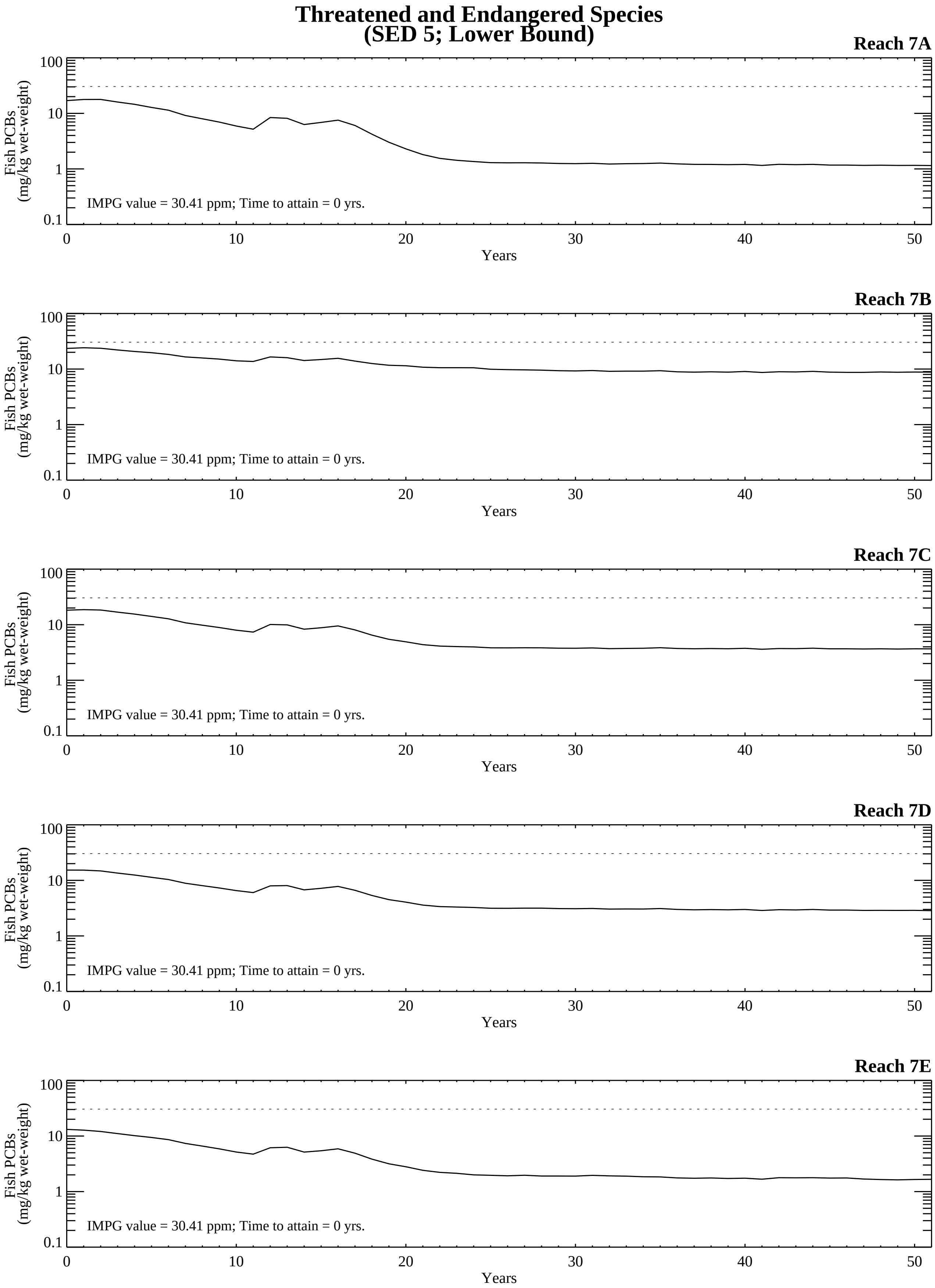

Figure G-10.3-4b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 5; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

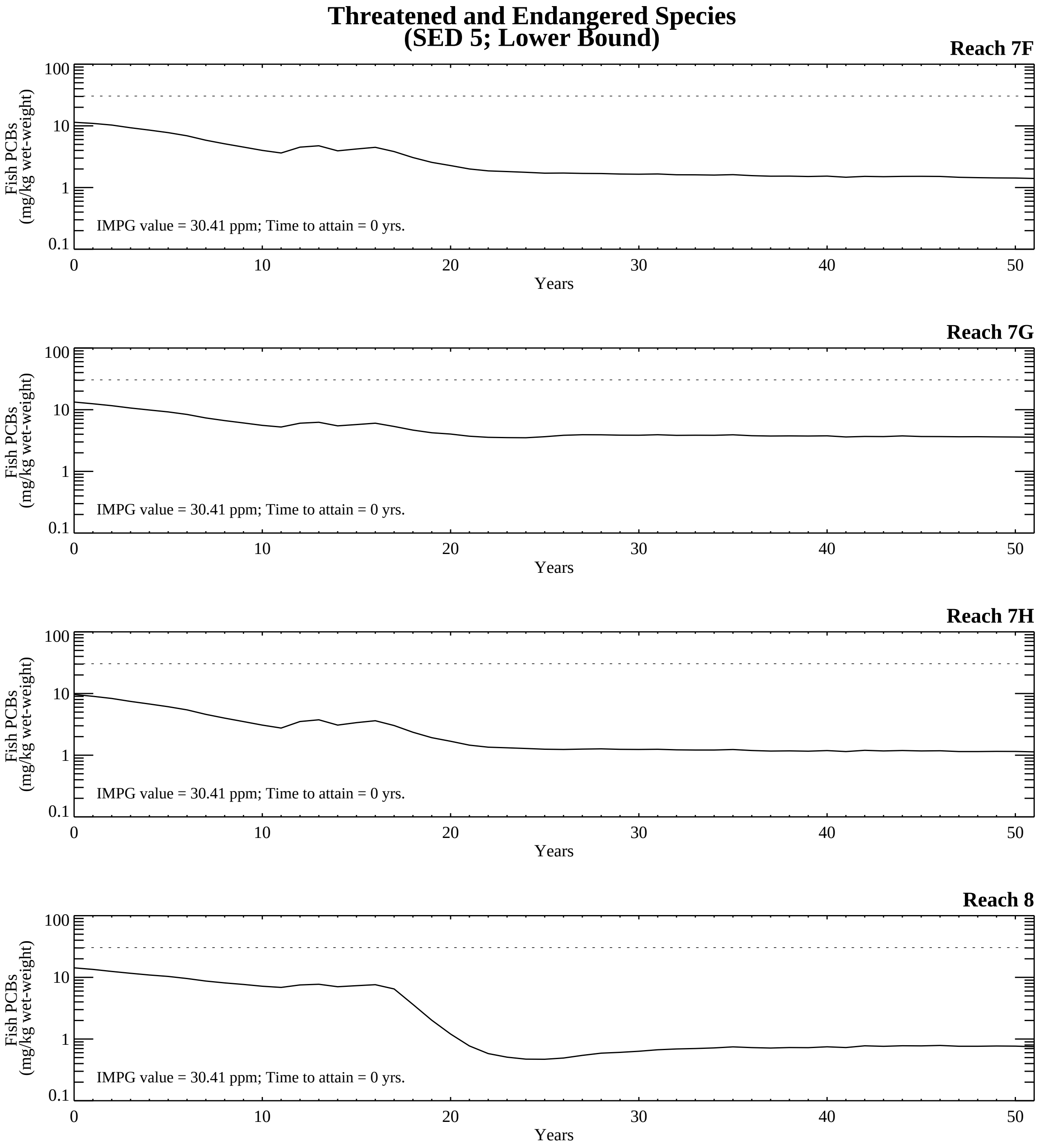

Figure G-10.3-4b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 5; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

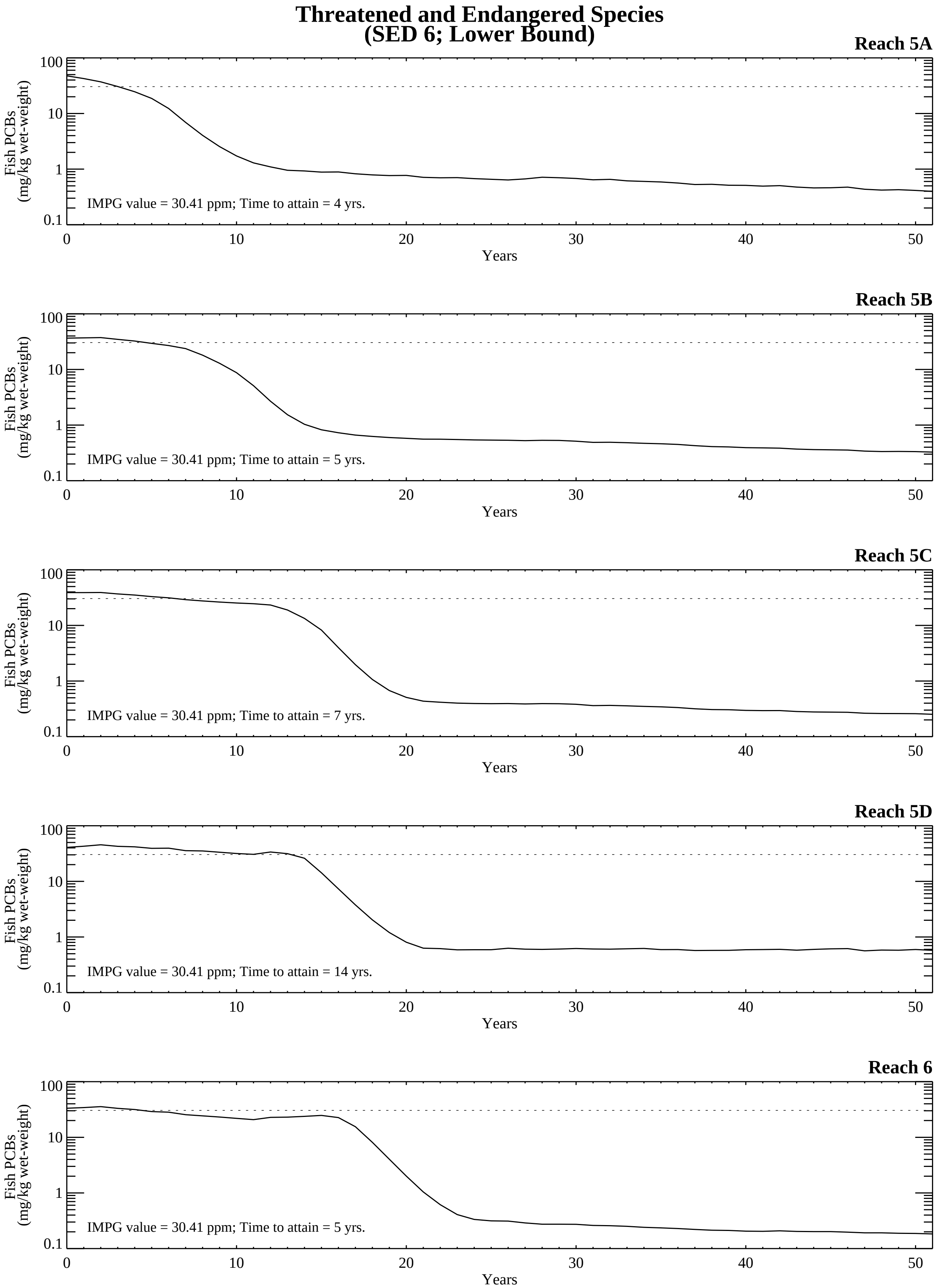

Figure G-10.3-5a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 6; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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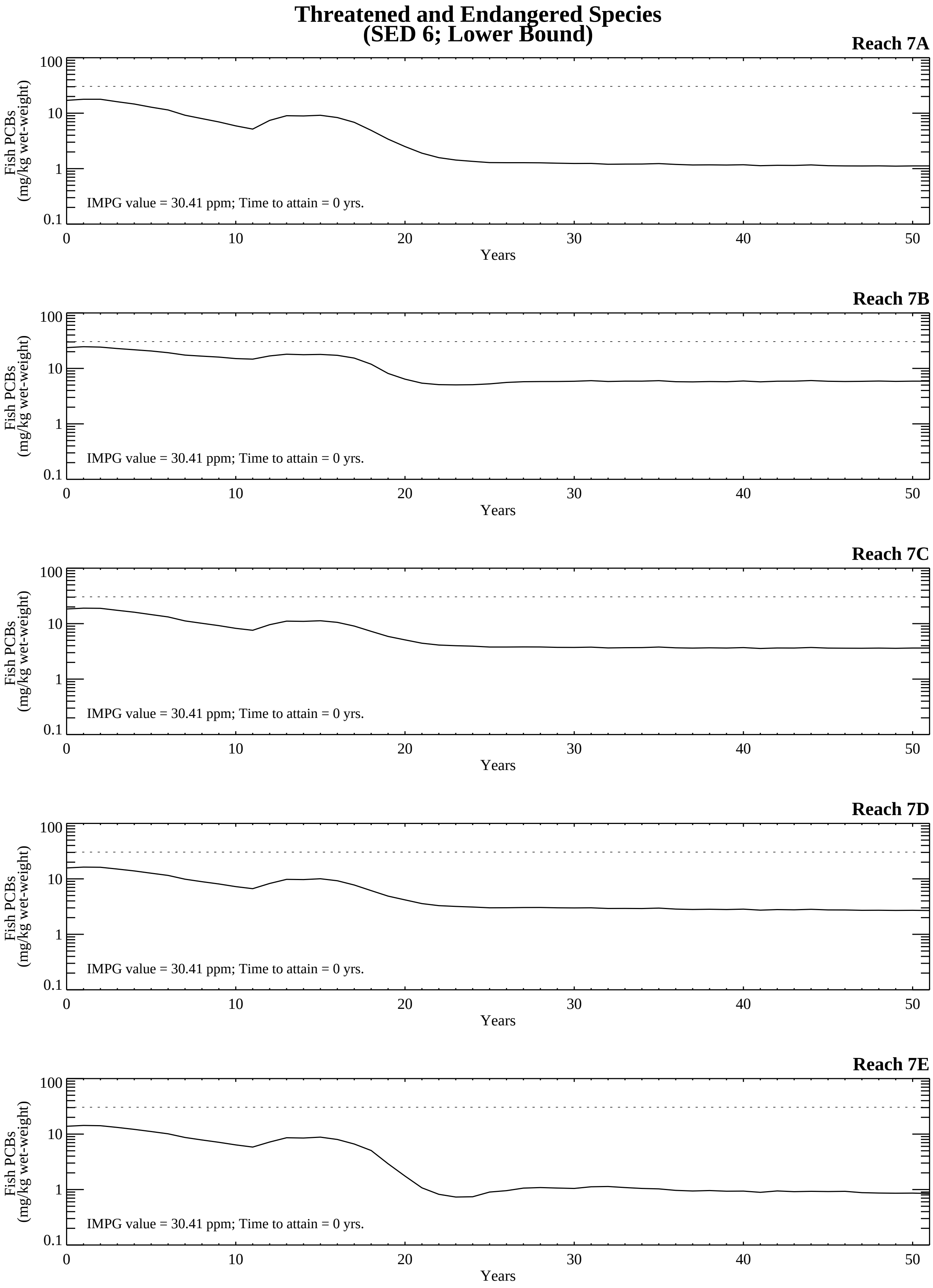

Figure G-10.3-5b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 6; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

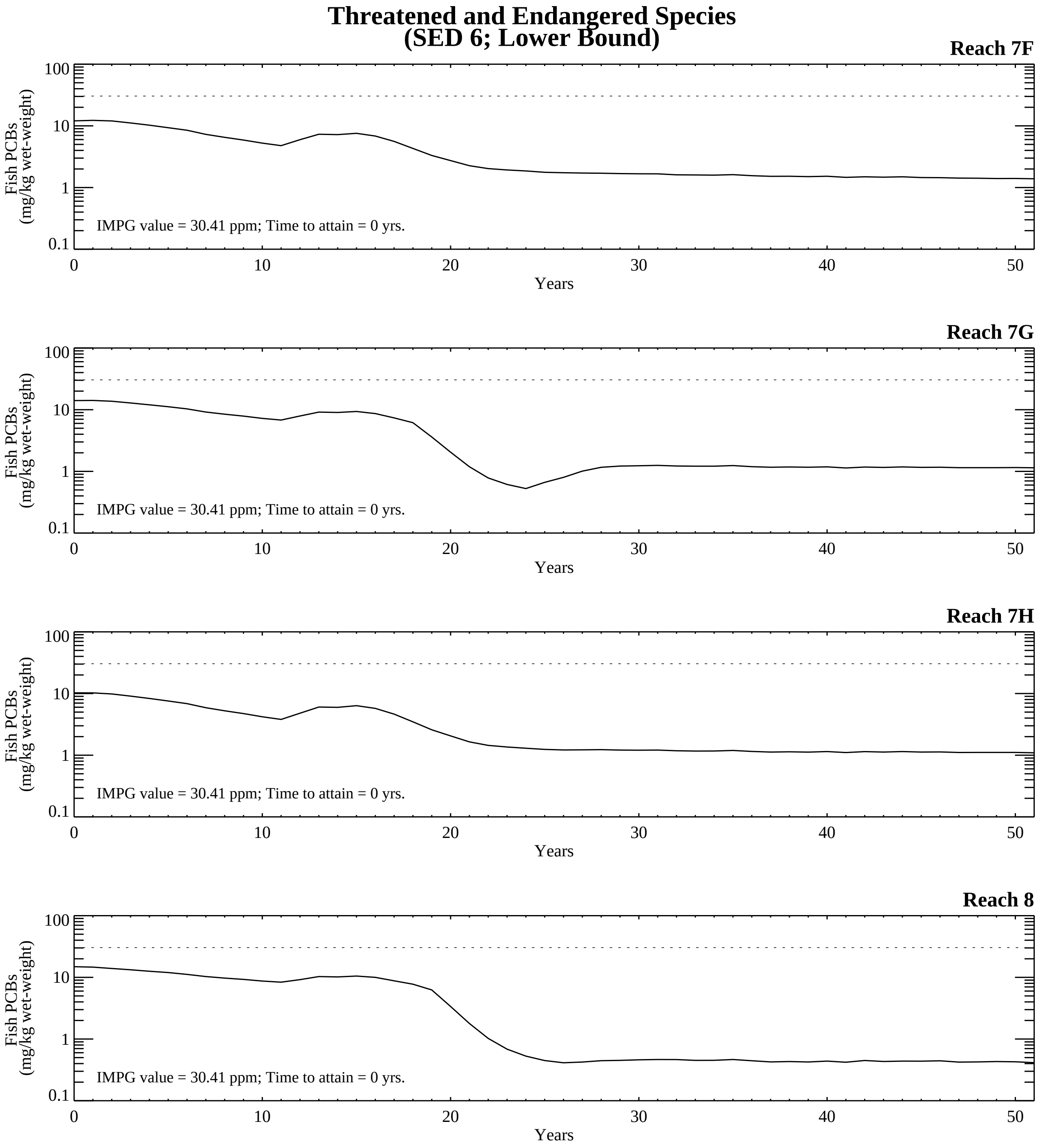

Figure G-10.3-5b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 6; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

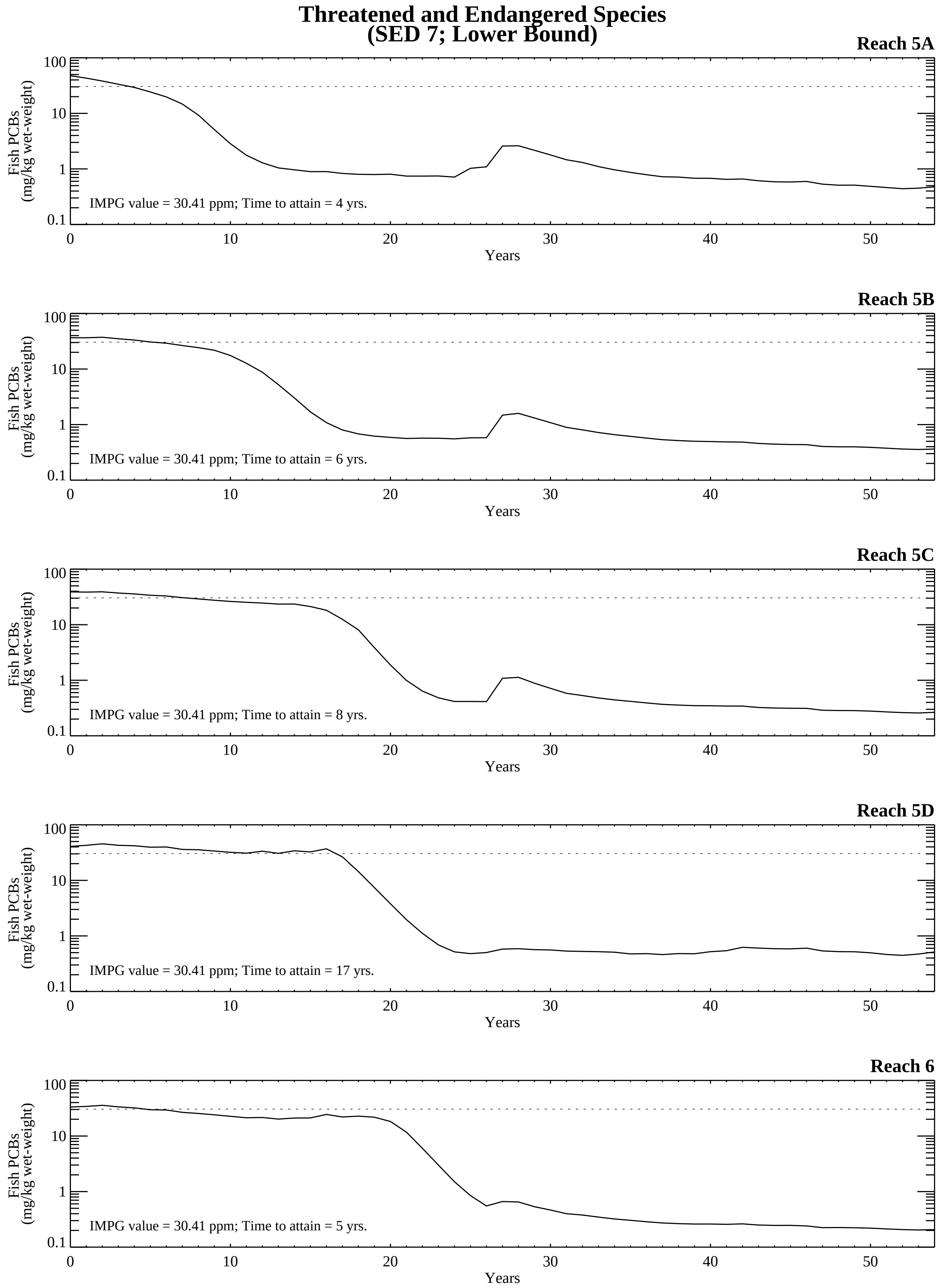

Figure G-10.3-6a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 7; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

Threatened and Endangered Species
(SED 7; Lower Bound)

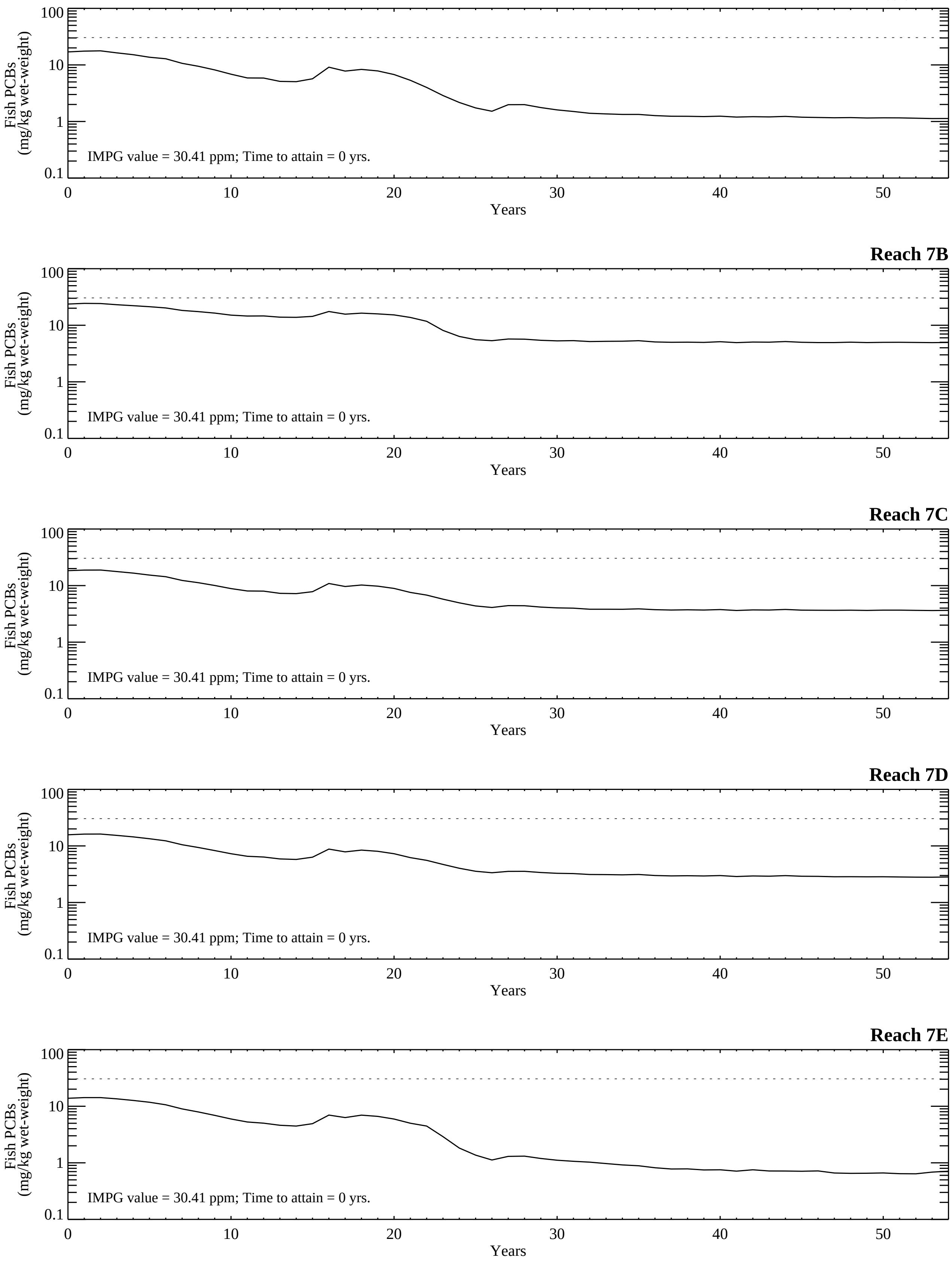

Figure G-10.3-6b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 7; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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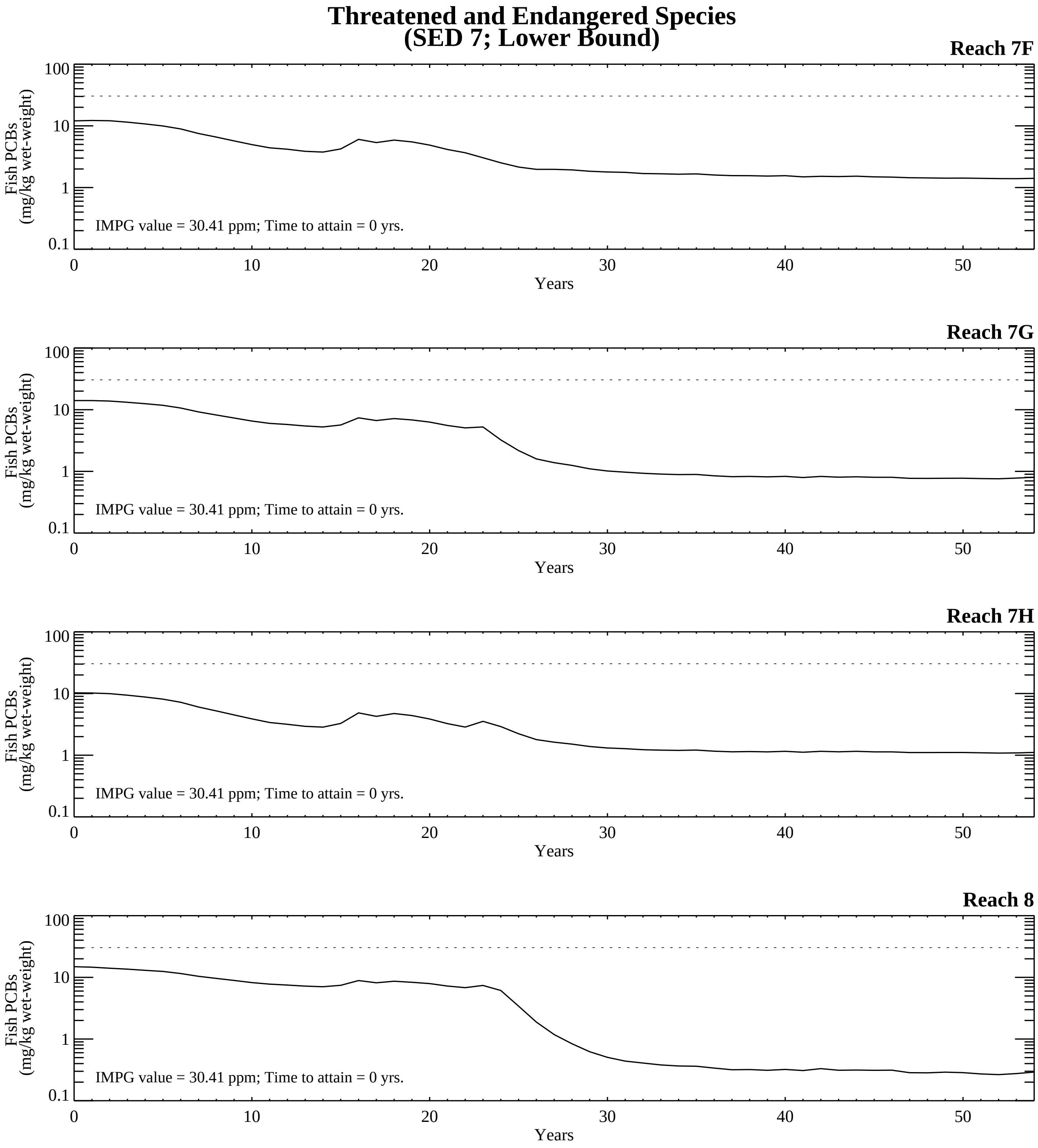

Figure G-10.3-6b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 7; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

Threatened and Endangered Species
(SED 8; Lower Bound)

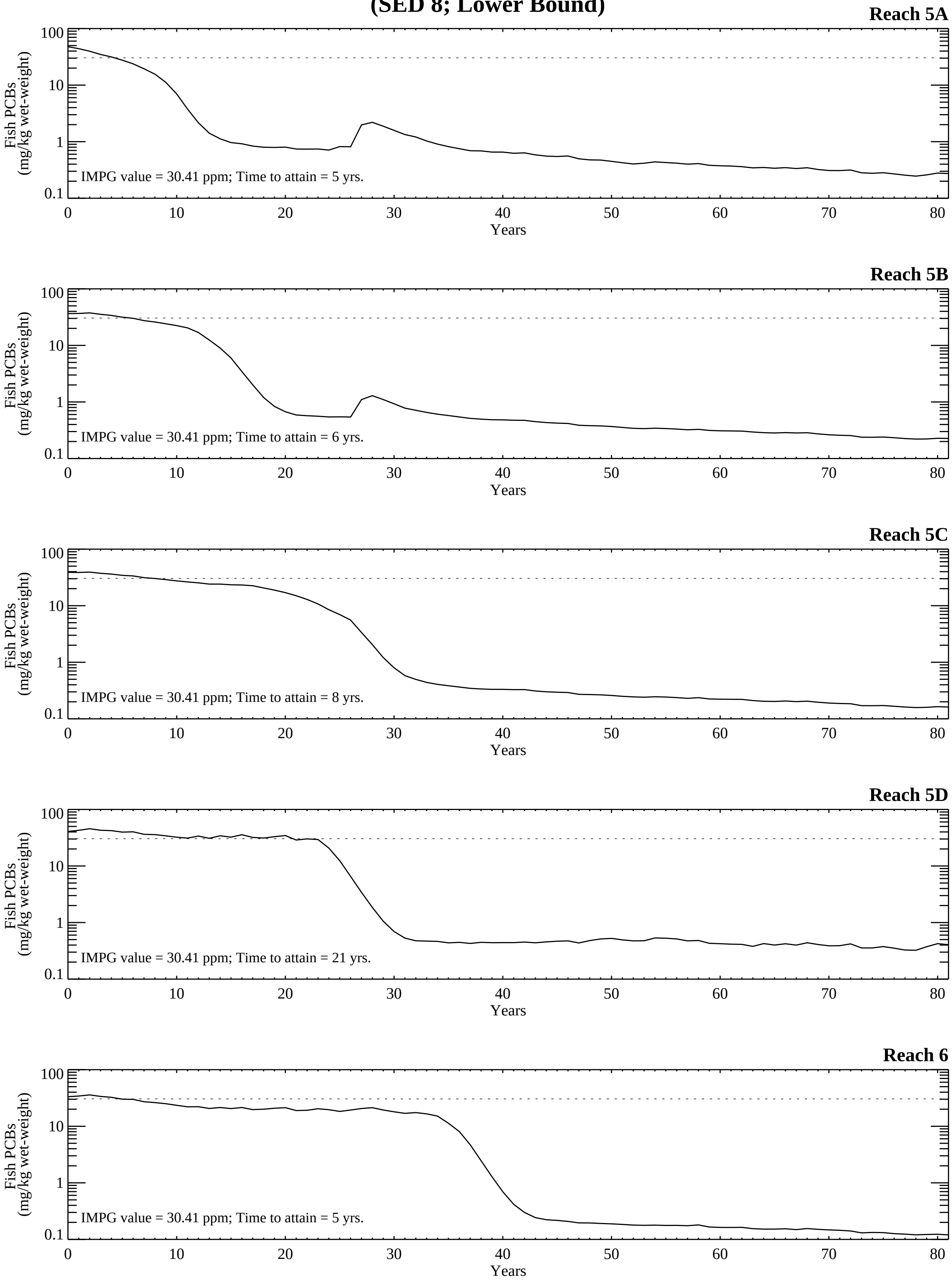

Figure G-10.3-7a. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 8; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

Threatened and Endangered Species
(SED 8; Lower Bound)

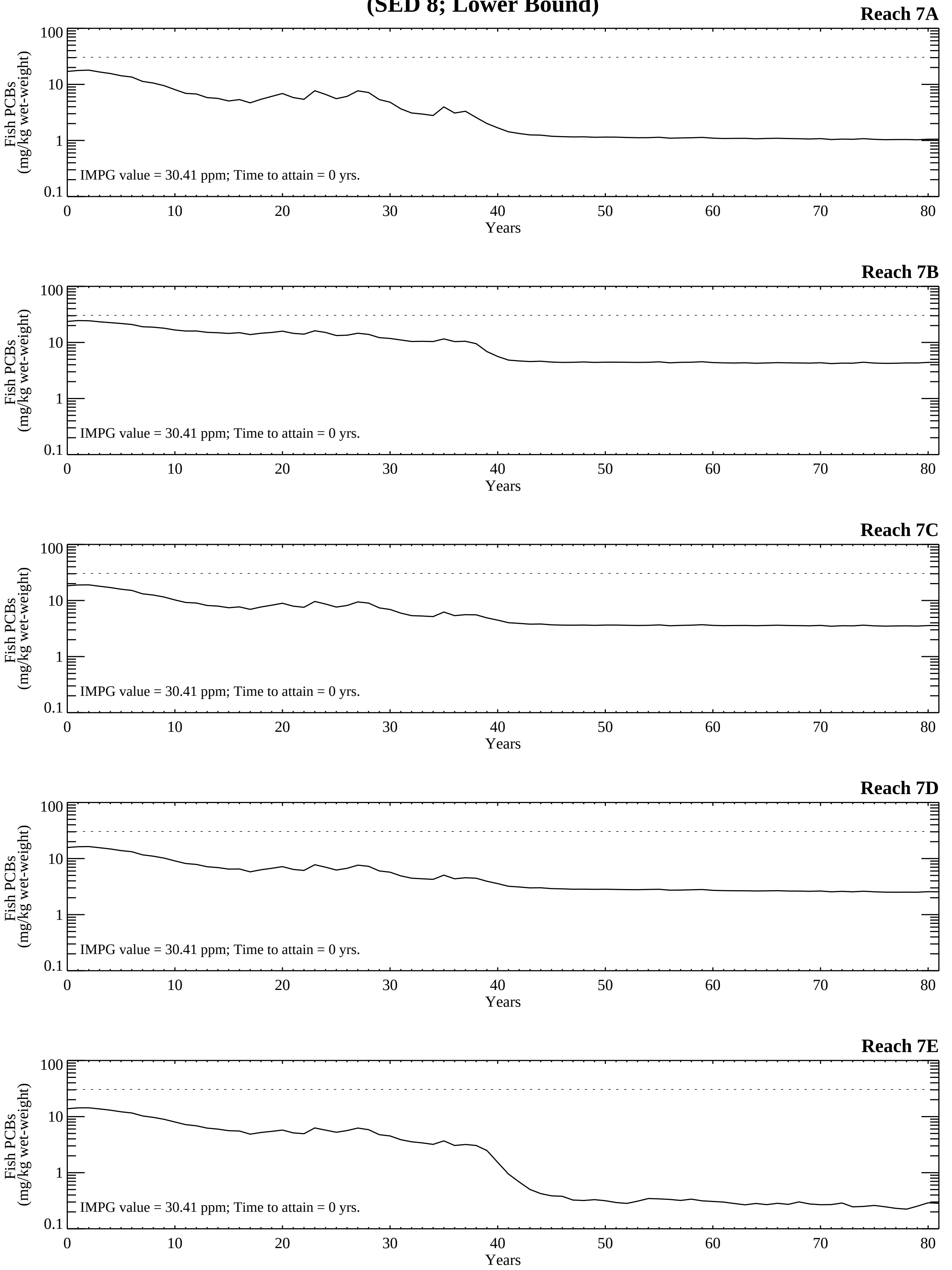

Figure G-10.3-7b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 8; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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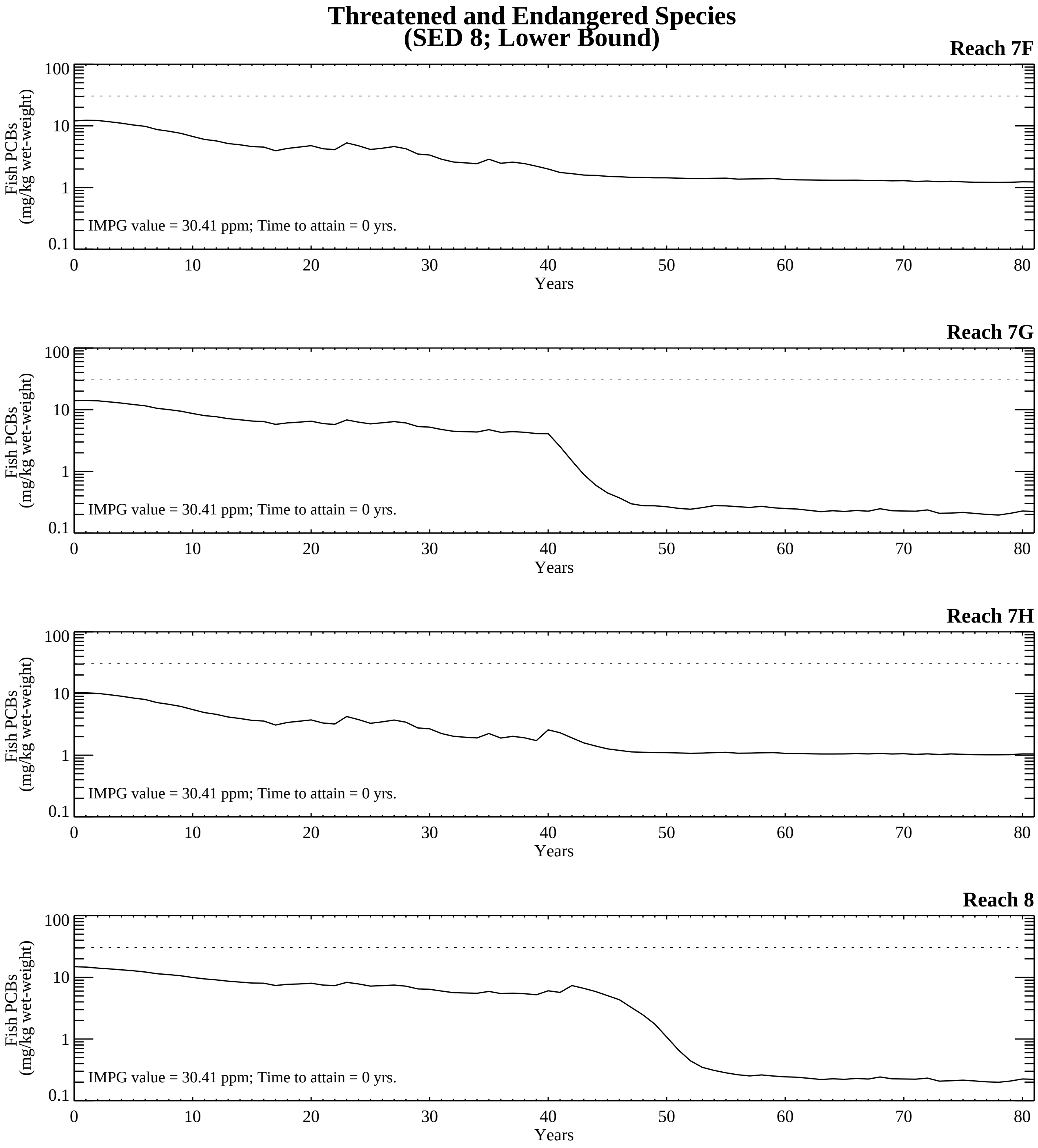

Figure G-10.3-7b. Temporal profiles of model-predicted PCB concentrations in fish compared to IMPGs for threatened and endangered species (SED 8; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20.6%), brown bullhead (32.2%), and white sucker (32.2%) ages 2+, pumpkinseed (7.5%) ages 3+, and cyprinids (7.5%) ages 5+.

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Piscivorous Birds
(SED 1 / SED 2; Base Case)

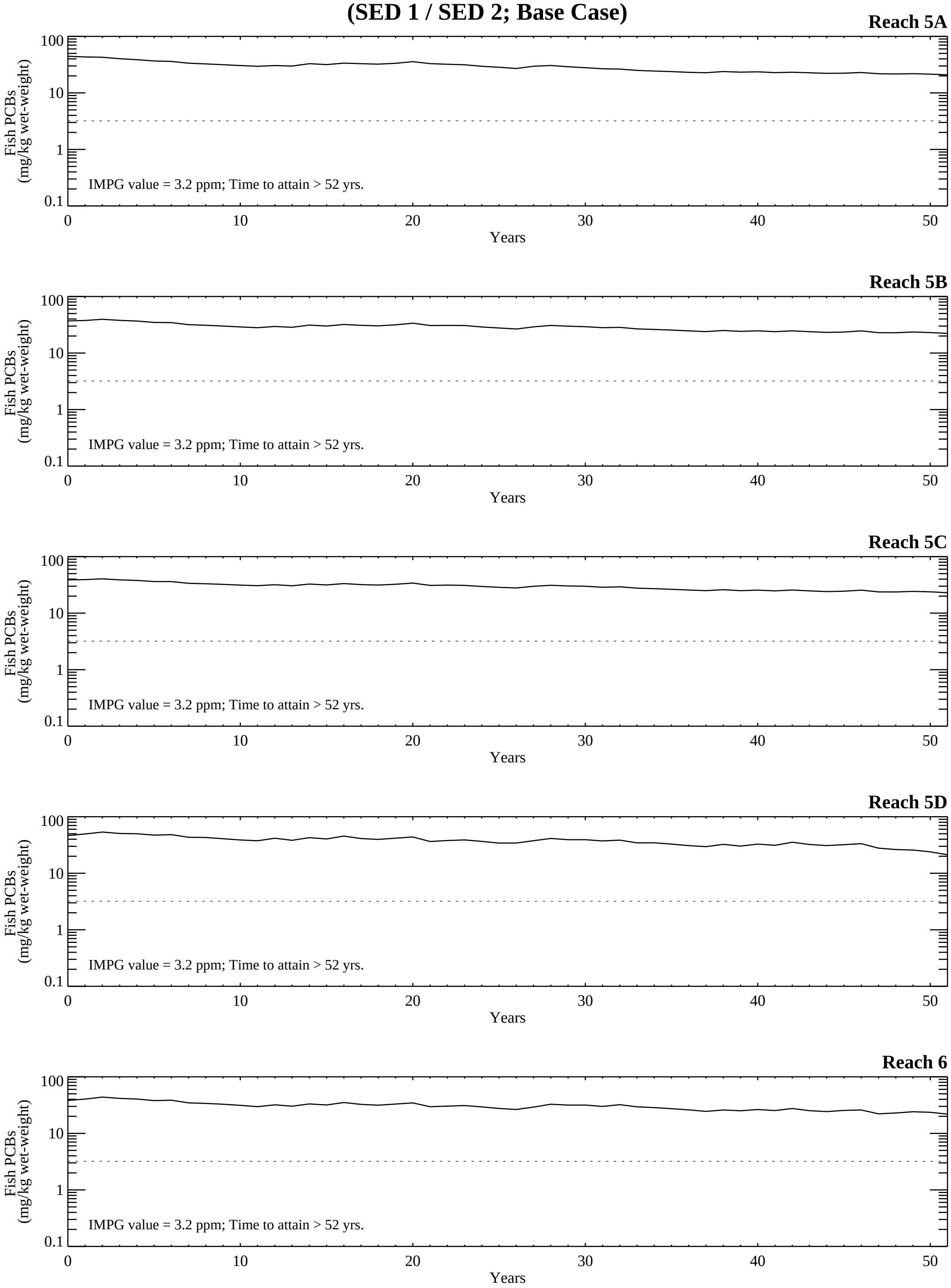

Figure G-11.1-1a. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 1 / SED 2; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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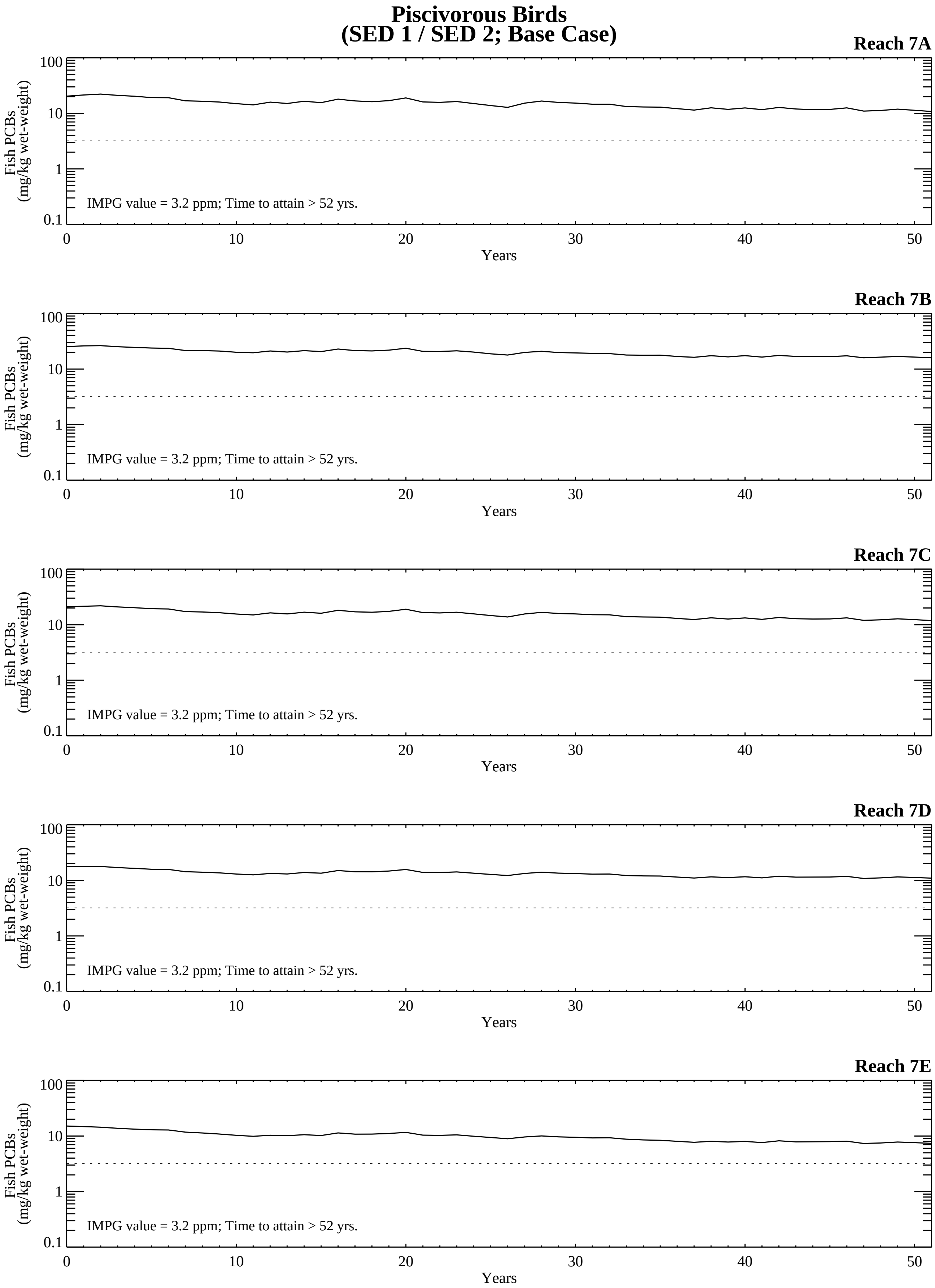

Figure G-11.1-1b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 1 / SED 2; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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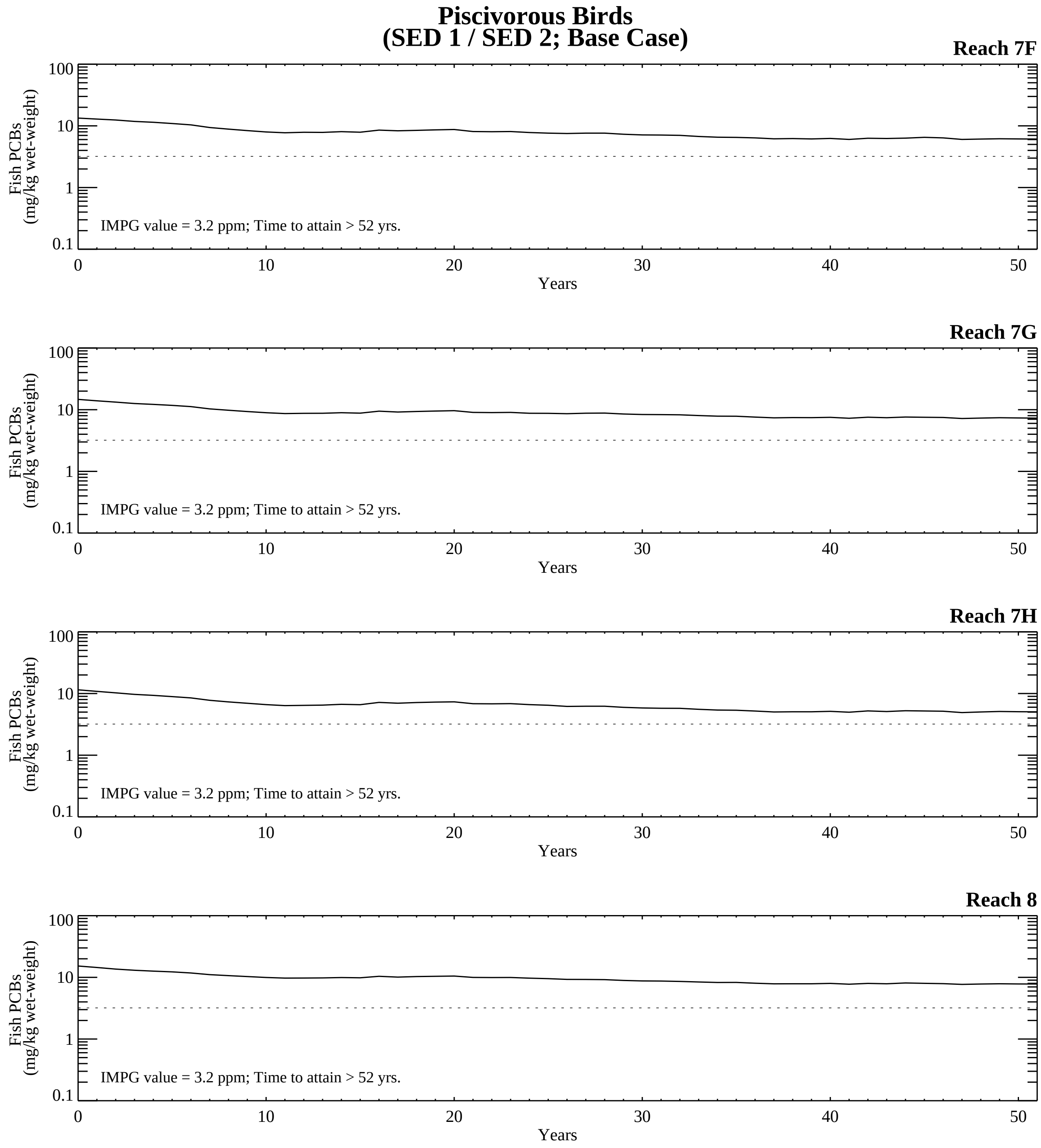

Piscivorous Birds
(SED 1 / SED 2; Base Case)

Reach 7F

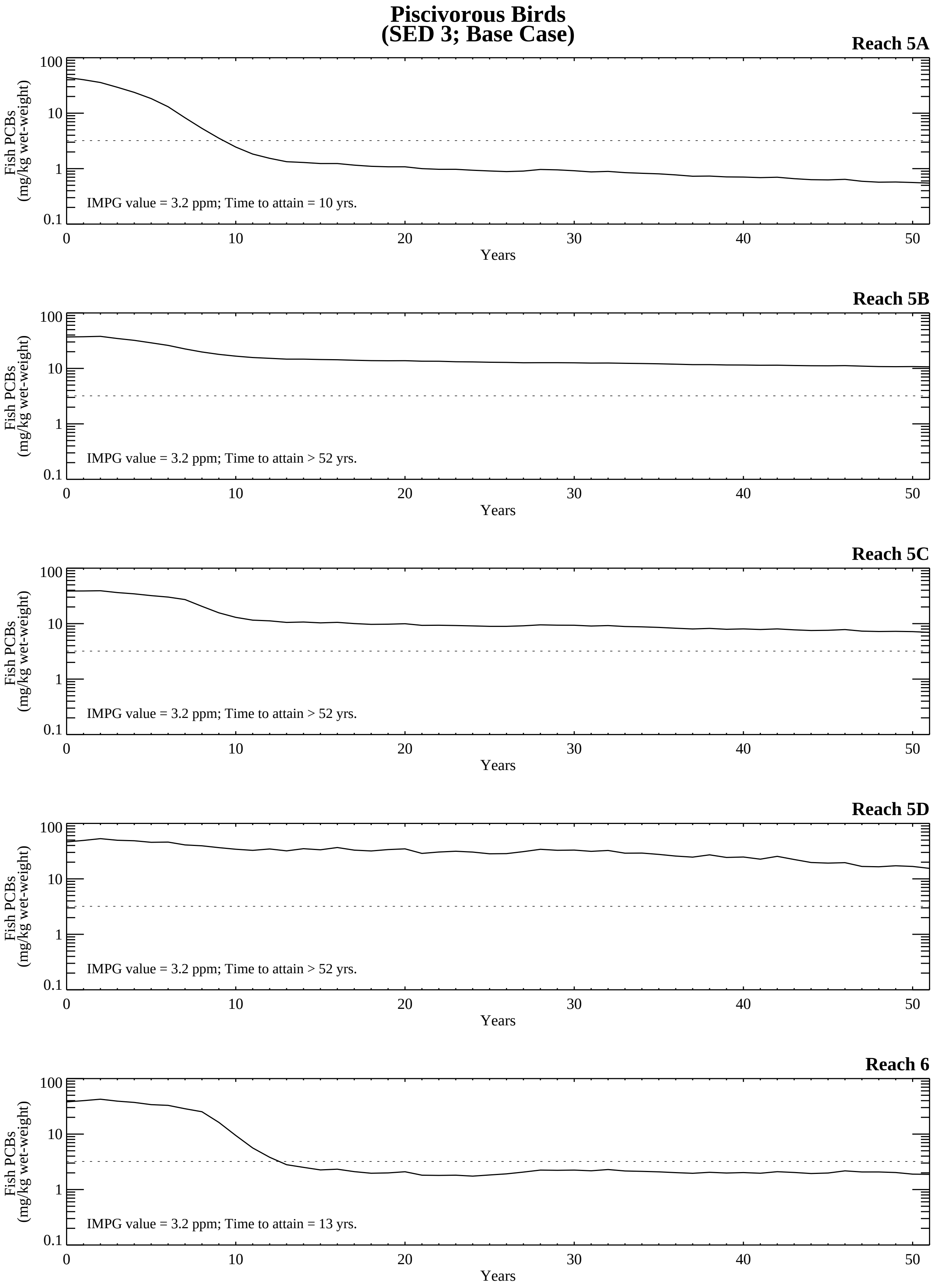
Reach 7G

Reach 7H

Reach 8

Figure G-11.1-1b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 1 / SED 2; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.



Piscivorous Birds
(SED 3; Base Case)

Reach 5A

IMPG value = 3.2 ppm; Time to attain = 10 yrs.

Reach 5B

IMPG value = 3.2 ppm; Time to attain > 52 yrs.

Reach 5C

IMPG value = 3.2 ppm; Time to attain > 52 yrs.

Reach 5D

IMPG value = 3.2 ppm; Time to attain > 52 yrs.

Reach 6

IMPG value = 3.2 ppm; Time to attain = 13 yrs.

Figure G-11.1-2a. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 3; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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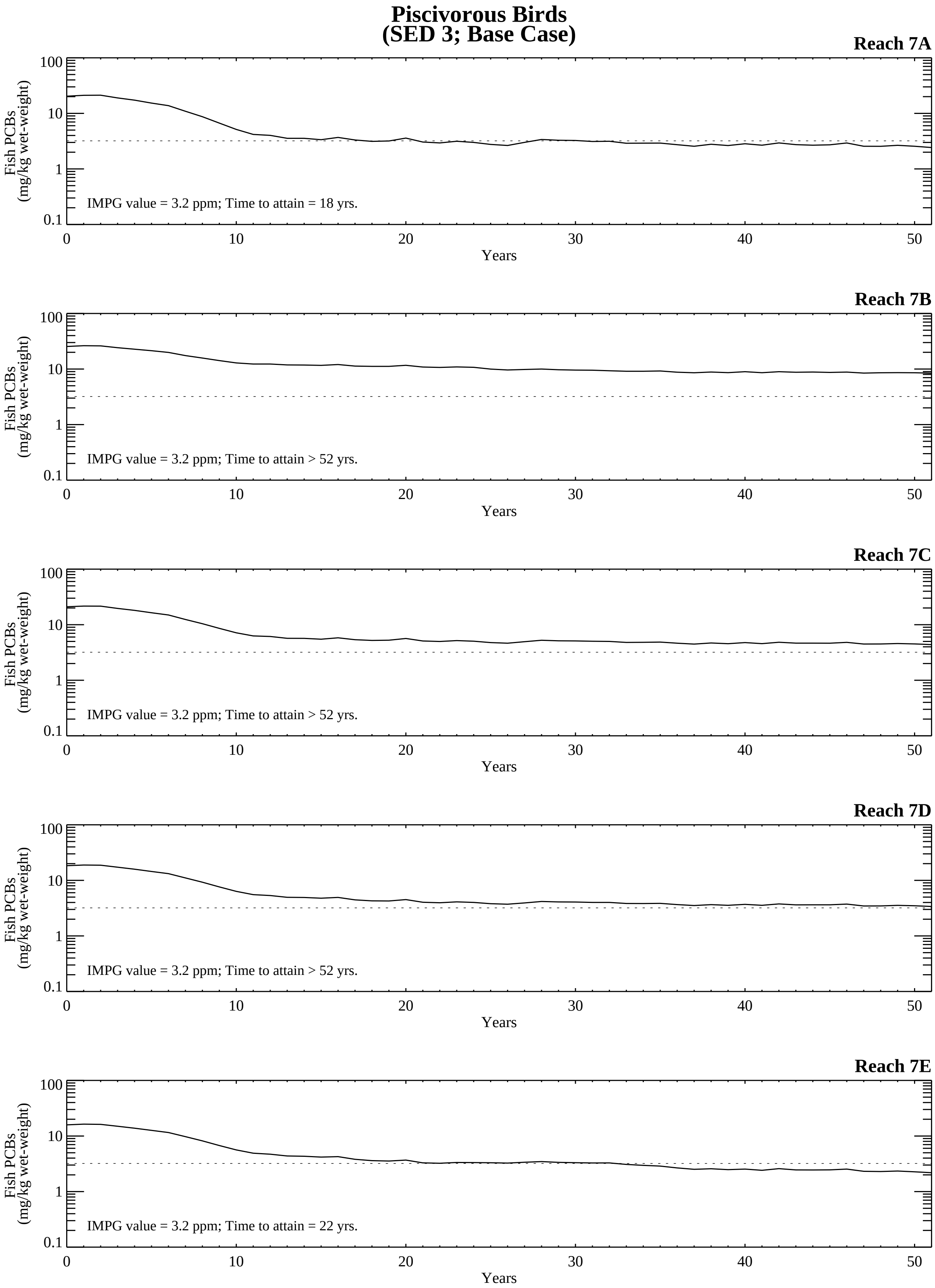

Figure G-11.1-2b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 3; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

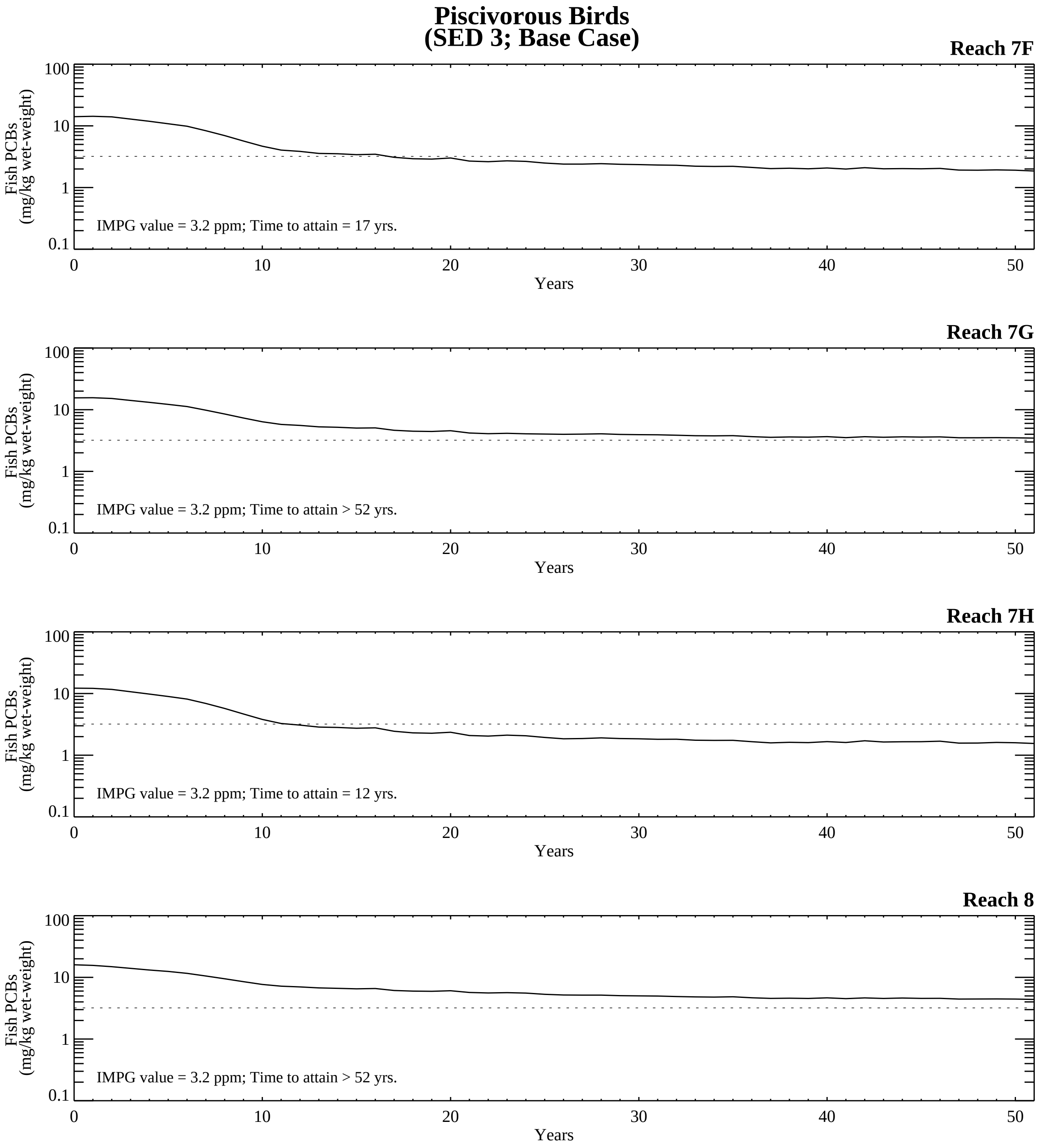

Figure G-11.1-2b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 3; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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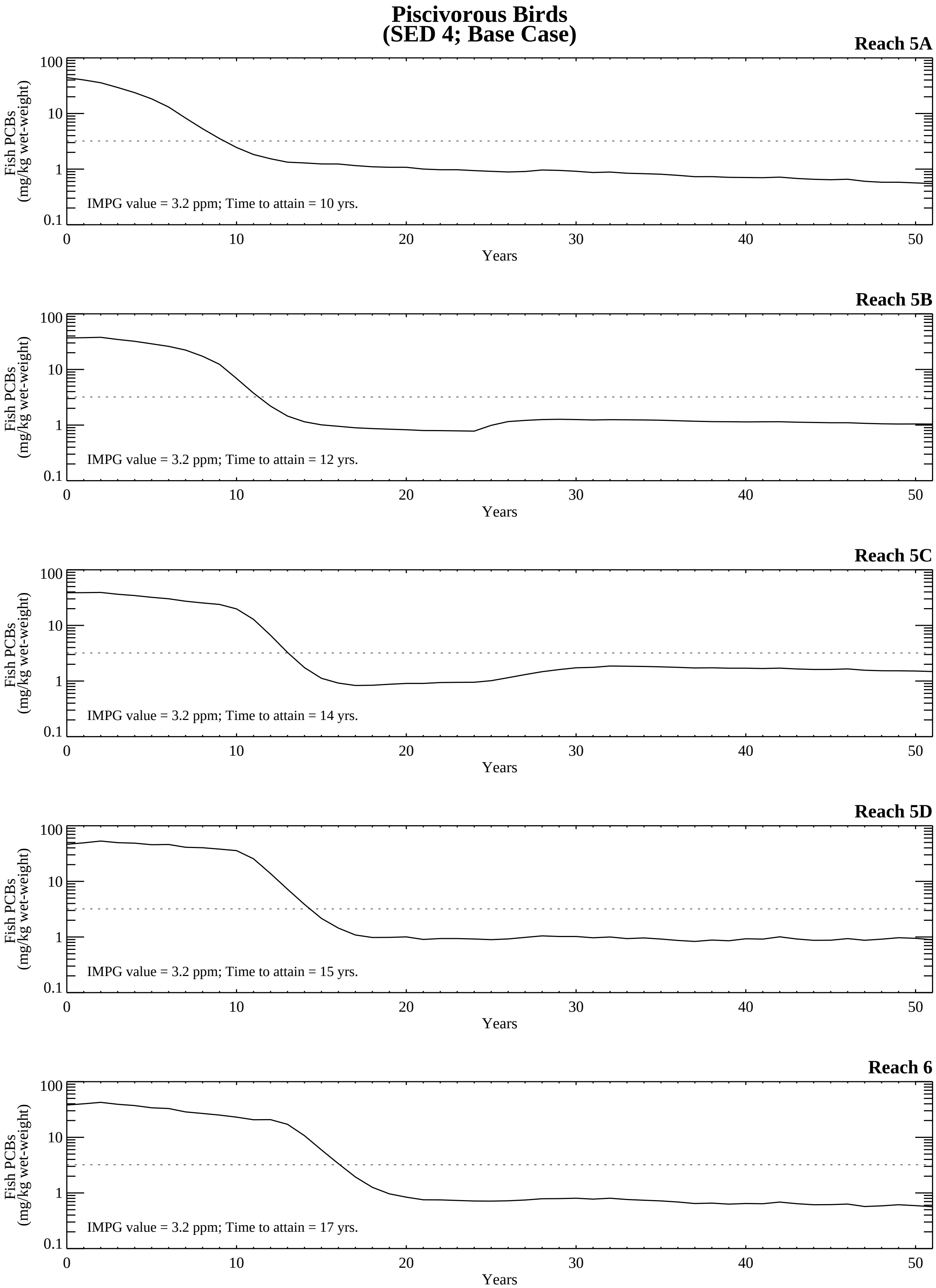

Figure G-11.1-3a. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 4; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

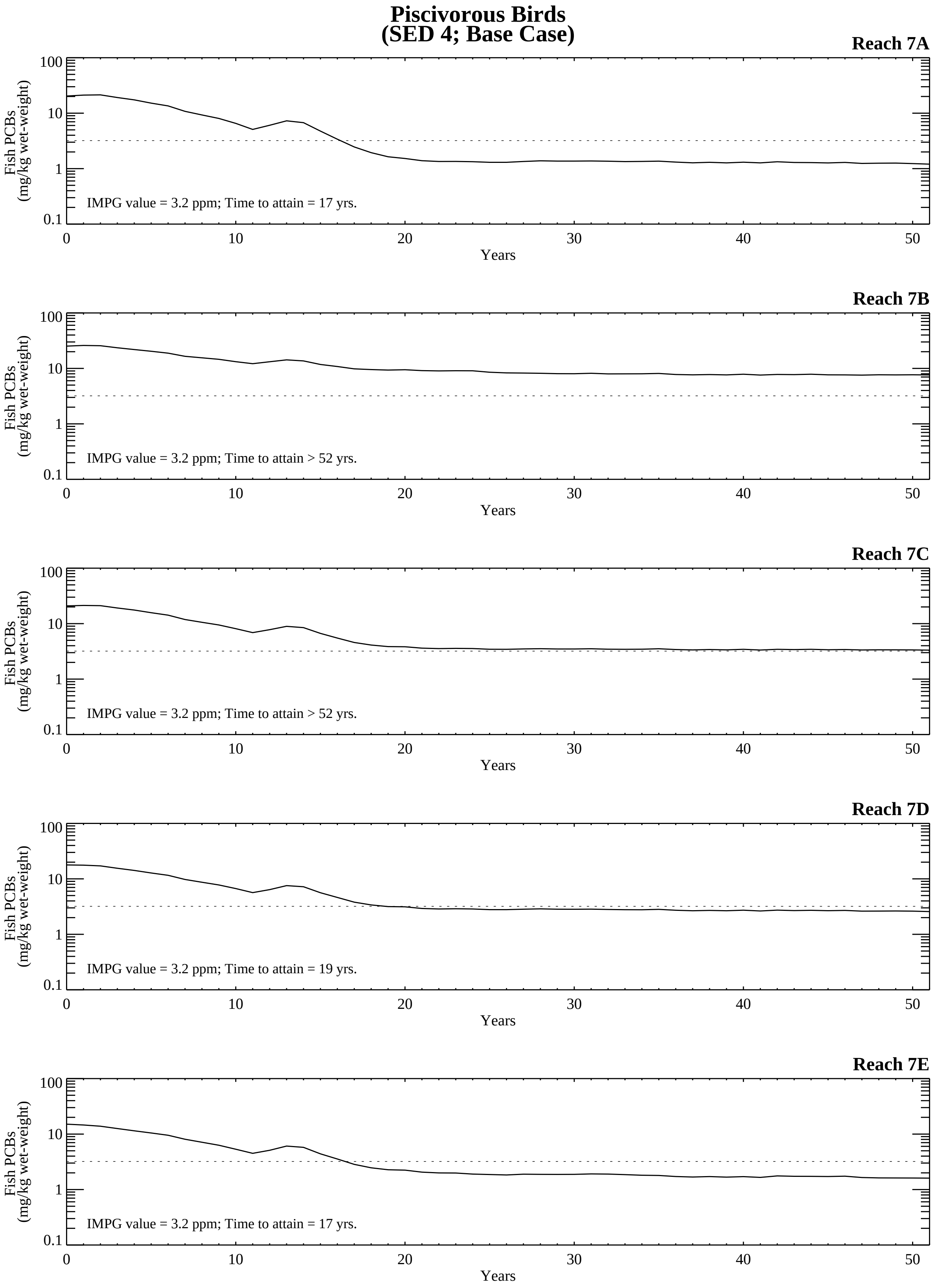

Figure G-11.1-3b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 4; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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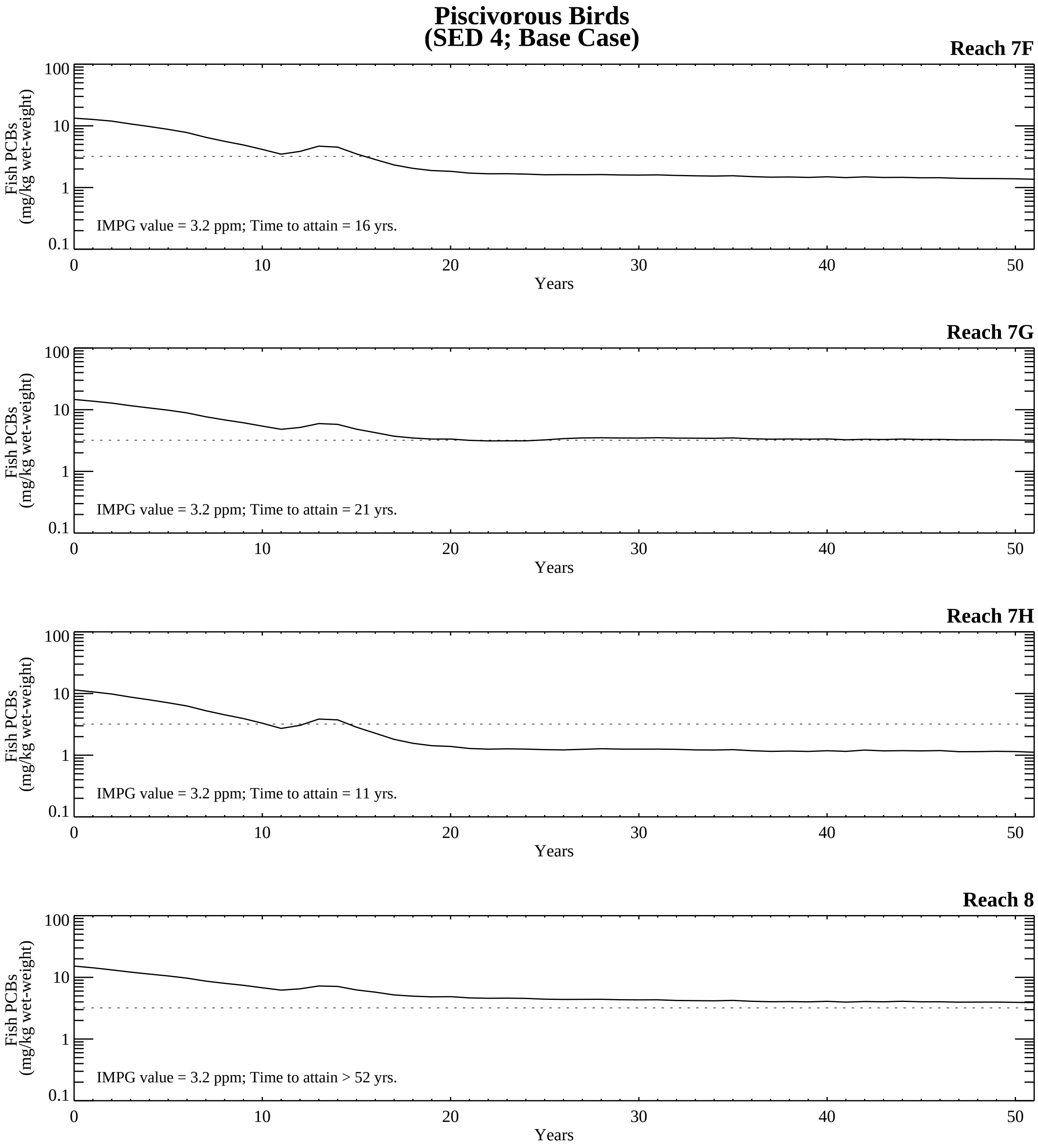

Figure G-11.1-3b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 4; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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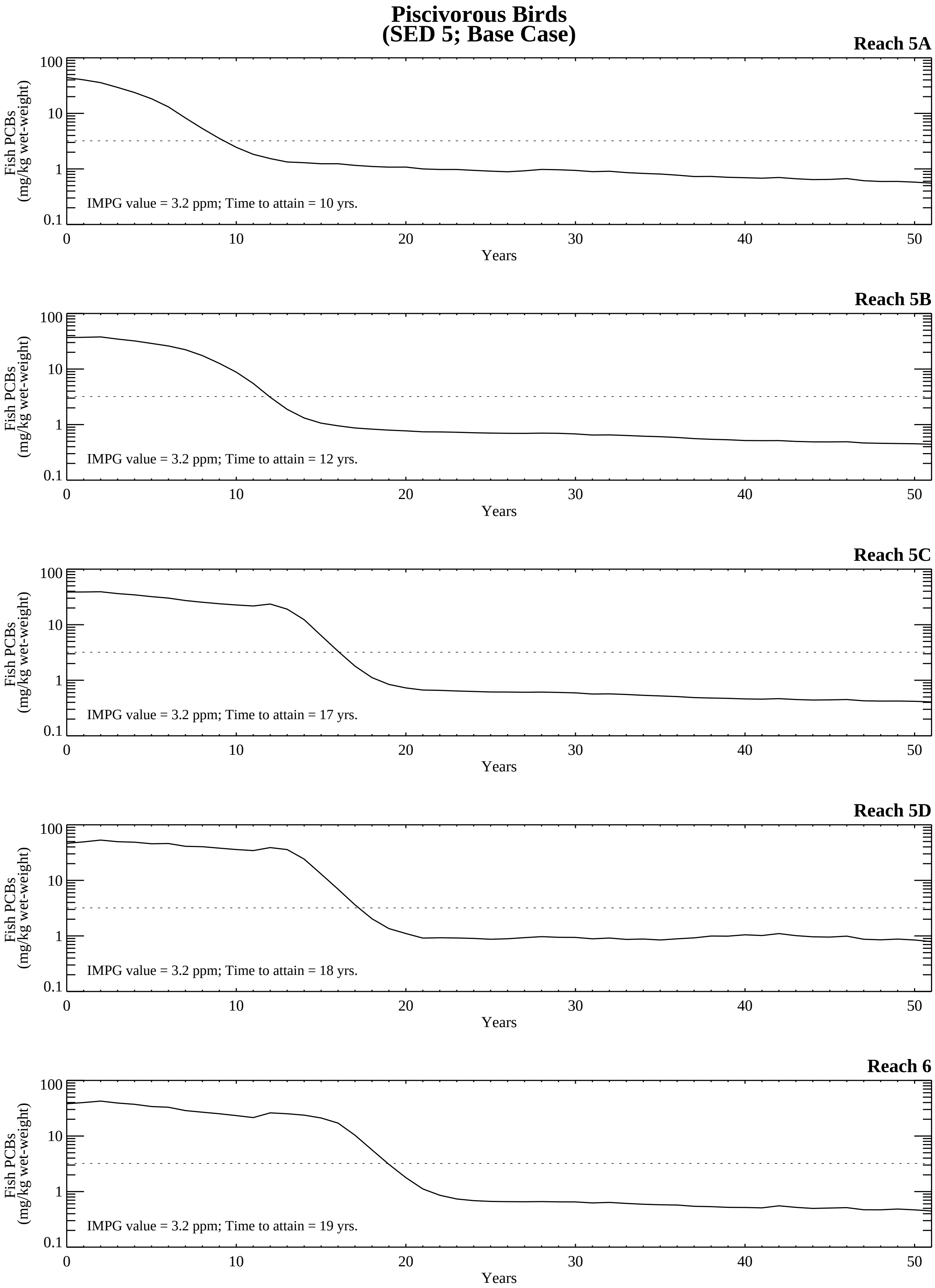

Figure G-11.1-4a. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 5; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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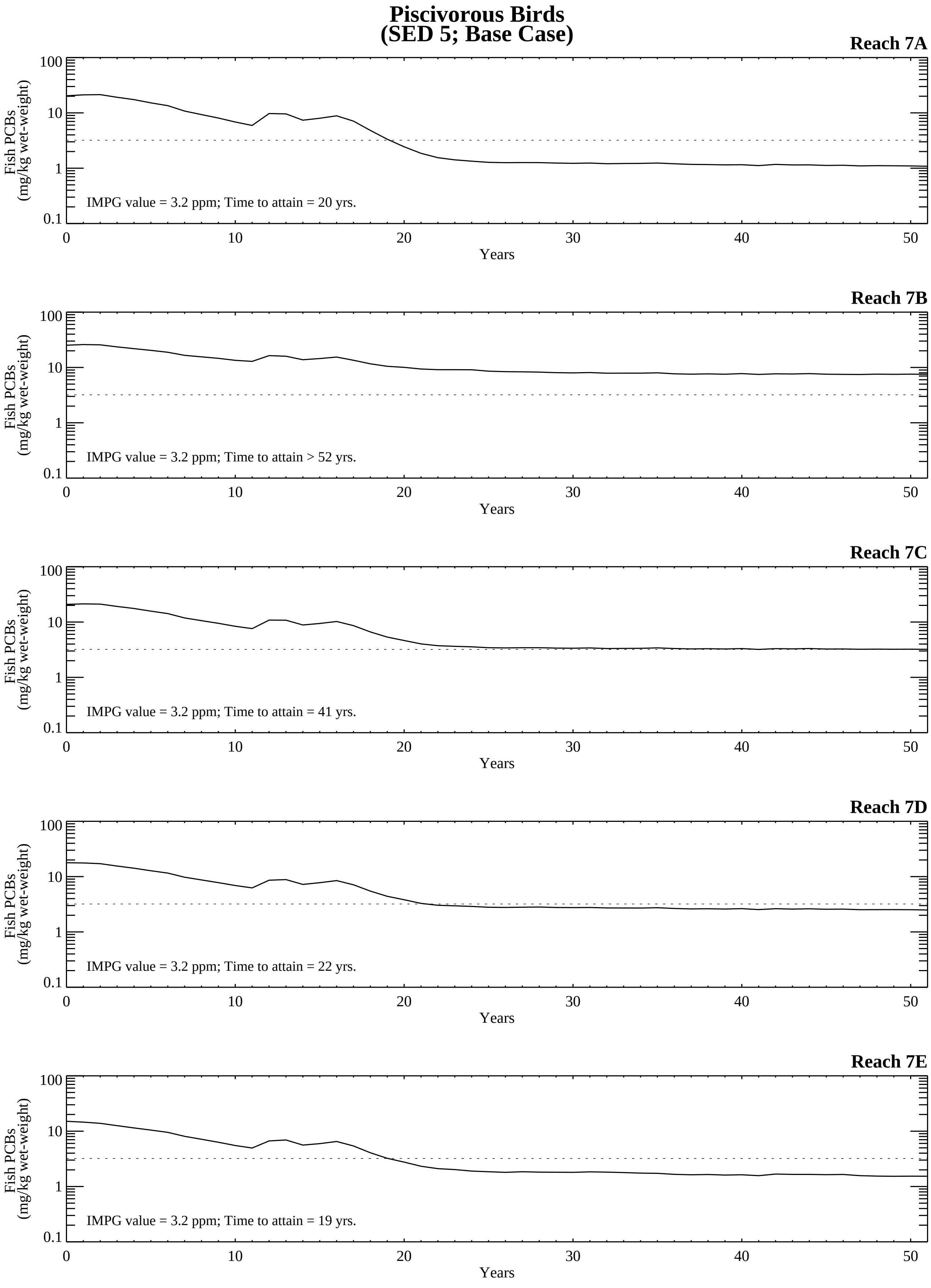

Figure G-11.1-4b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 5; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

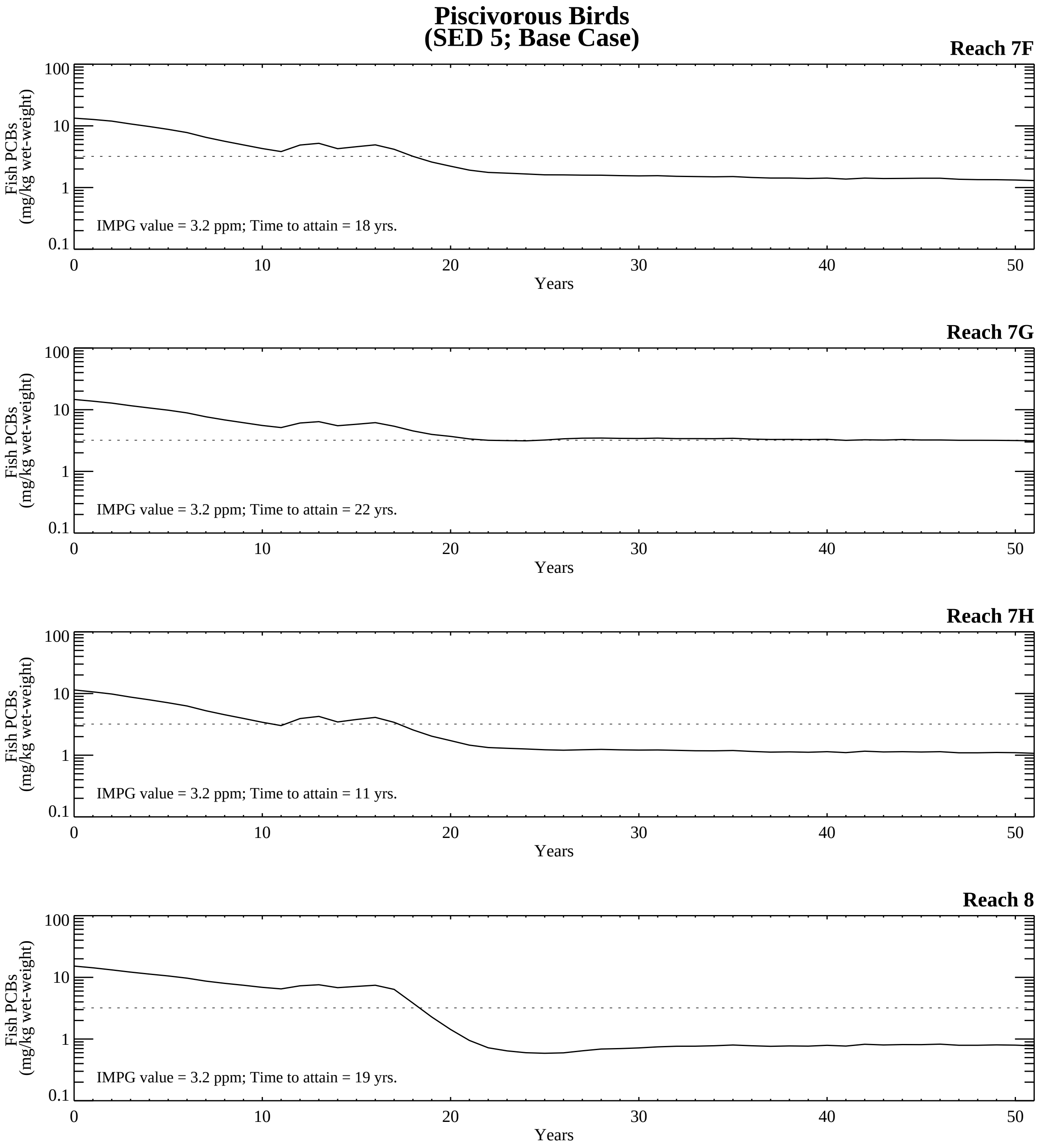

Figure G-11.1-4b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 5; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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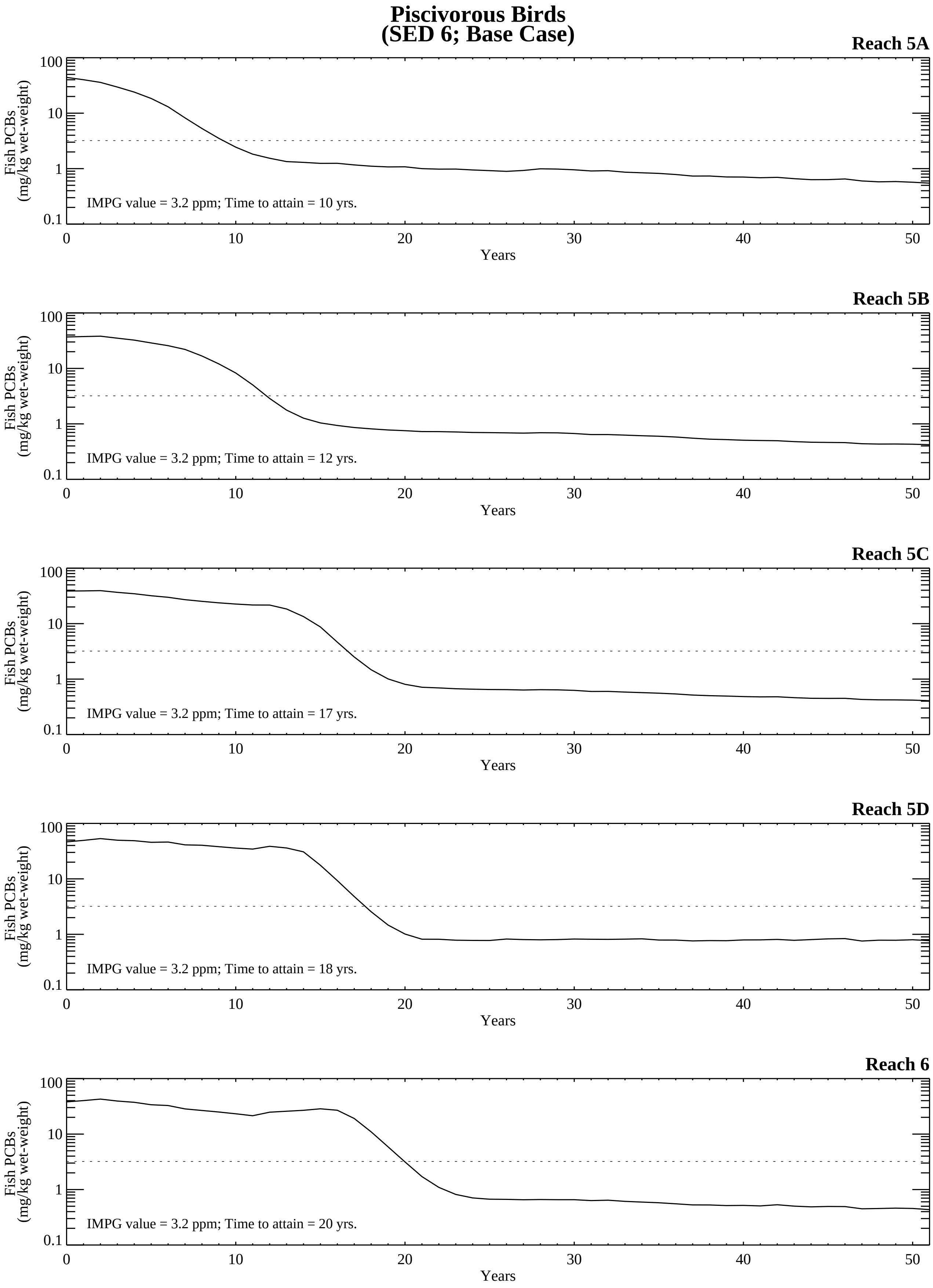

Figure G-11.1-5a. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 6; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

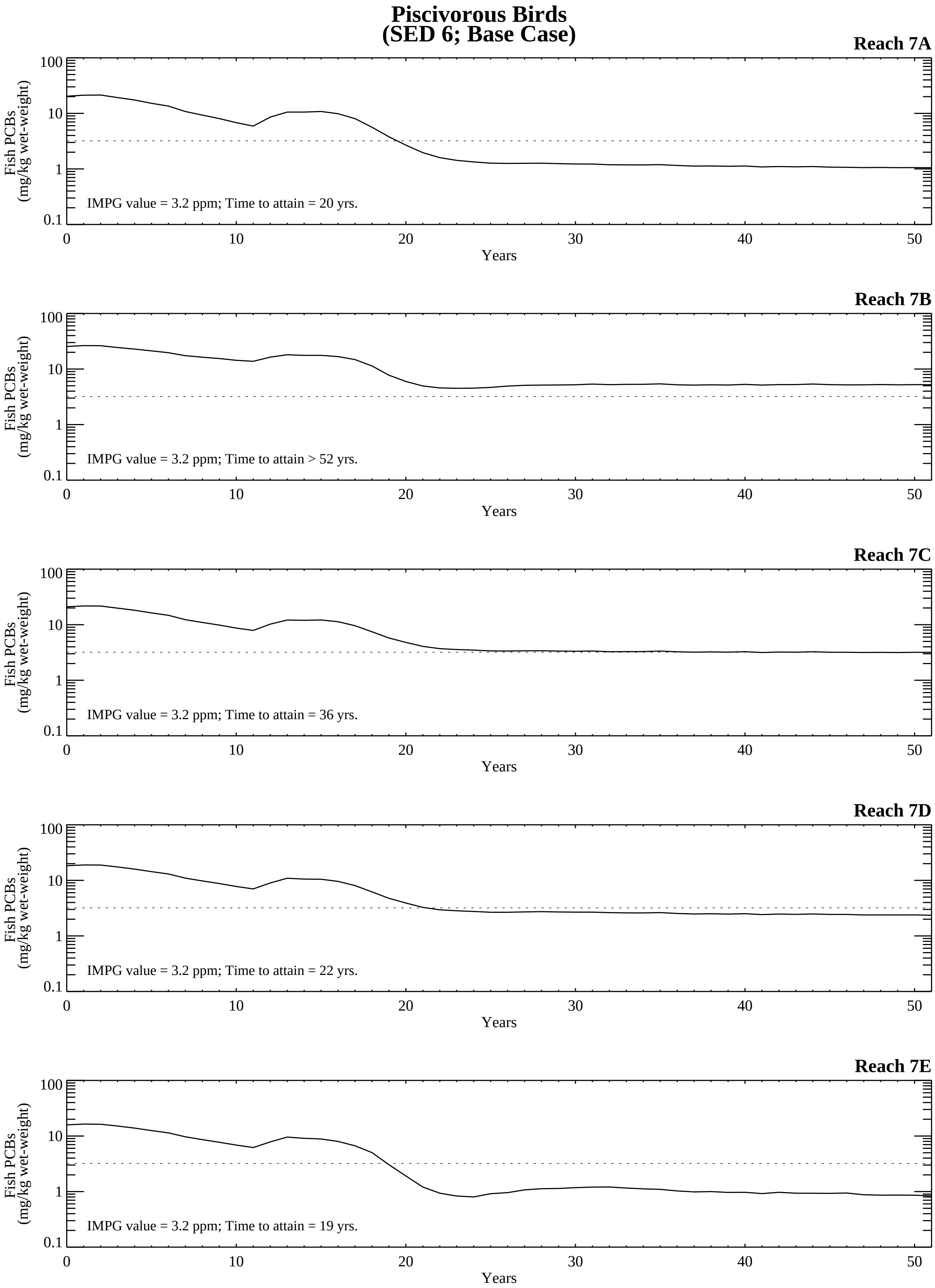

Figure G-11.1-5b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 6; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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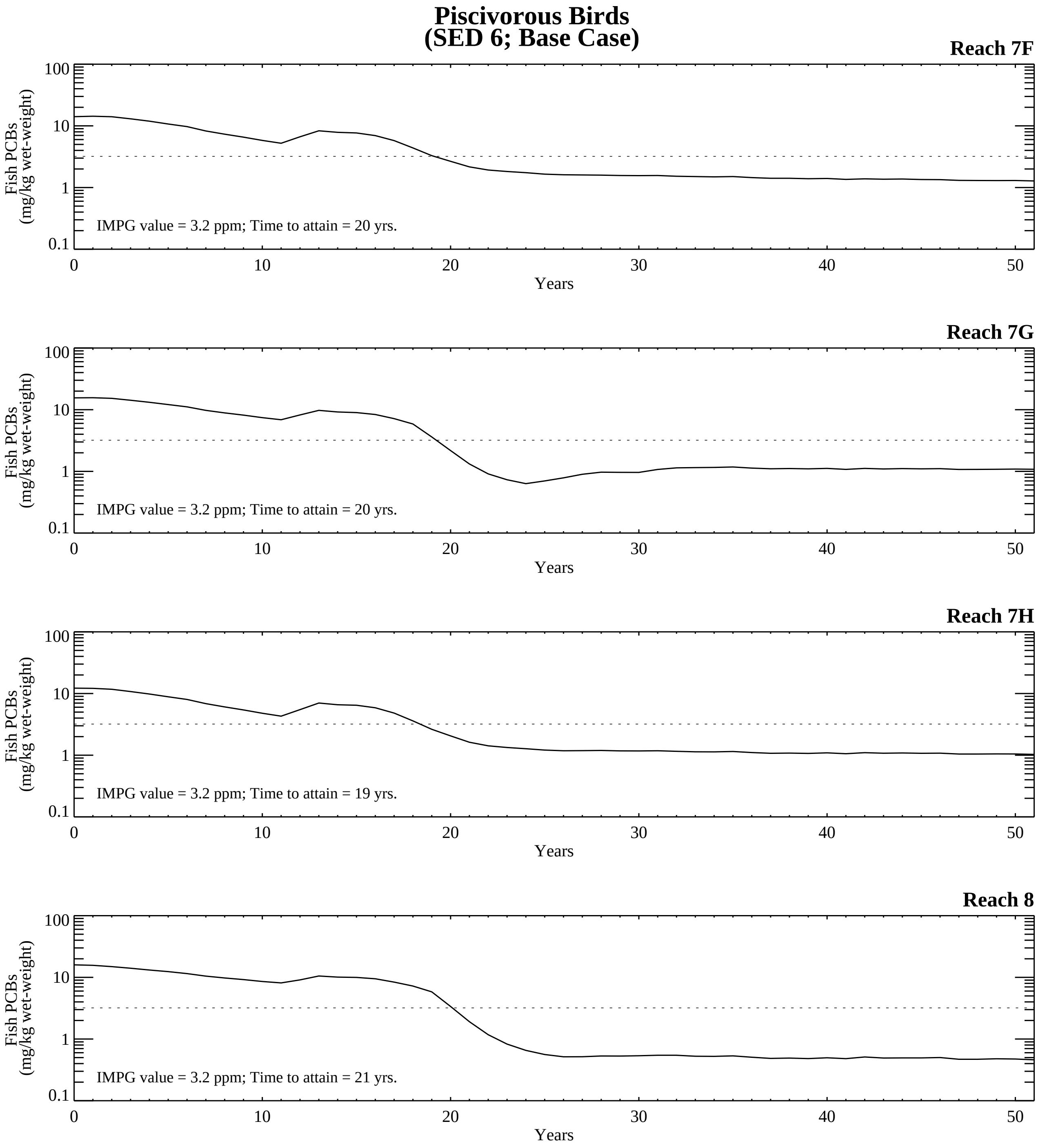

Figure G-11.1-5b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 6; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

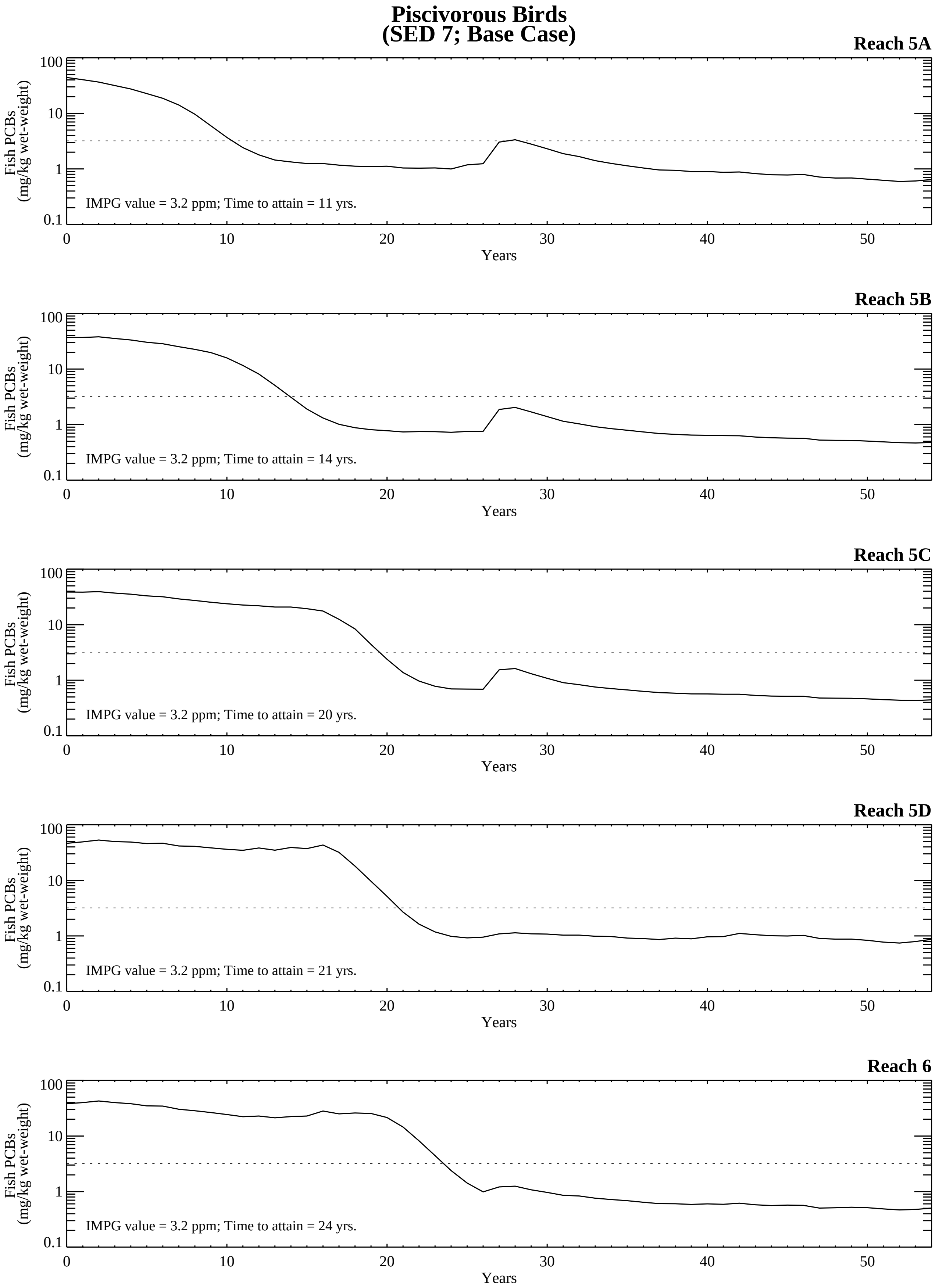

Figure G-11.1-6a. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 7; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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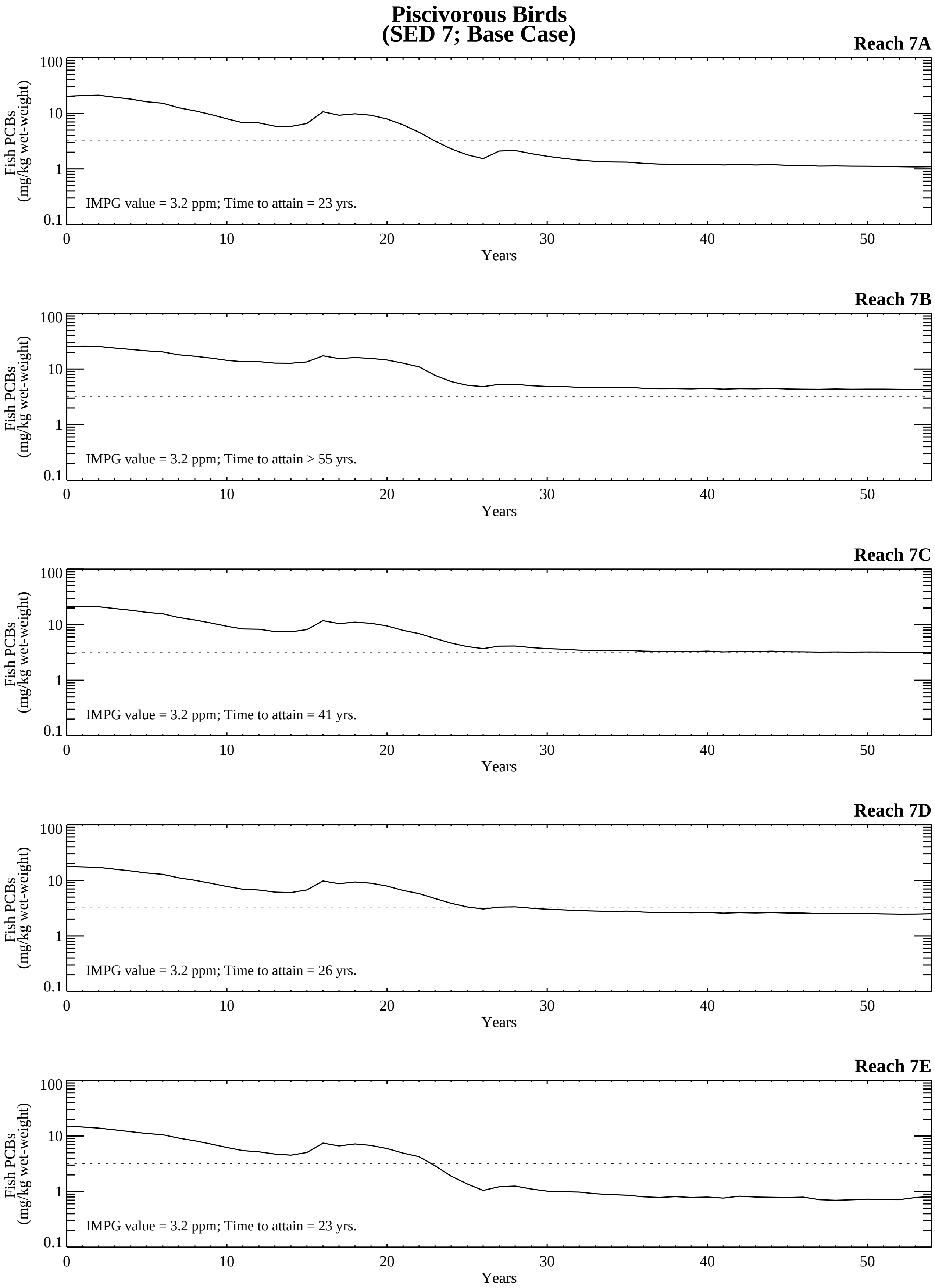

Figure G-11.1-6b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 7; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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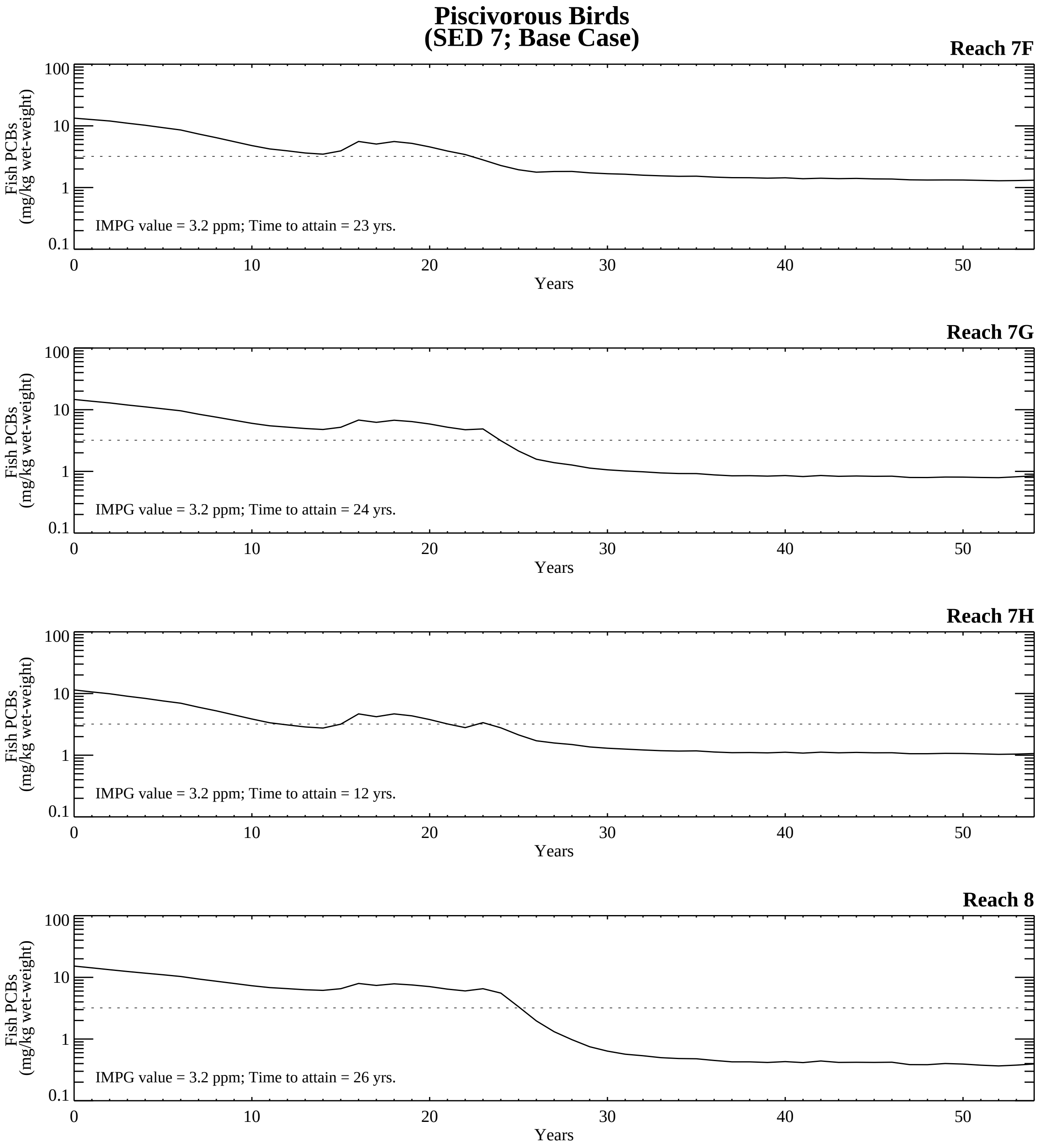

Figure G-11.1-6b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 7; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

DR\LD - Z:\GENcms\MODEL\FDCHN\Analysis\IMPG\Fish\impg_tabulate_projections_loop.pro
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Piscivorous Birds
(SED 8; Base Case)

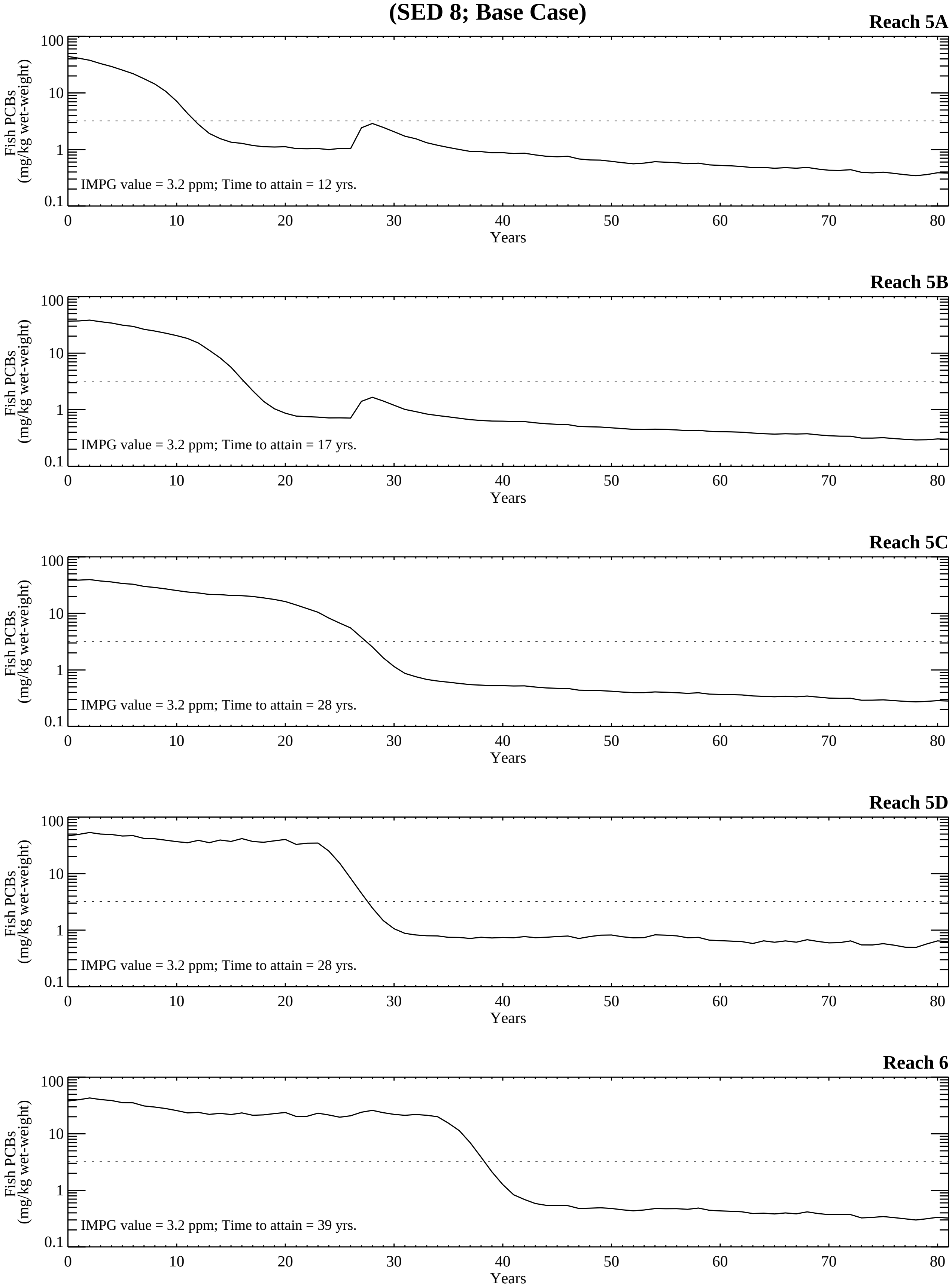

Figure G-11.1-7a. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 8; Reach 5/6; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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Fri Mar 14 17:25:50 2008

Piscivorous Birds
(SED 8; Base Case)

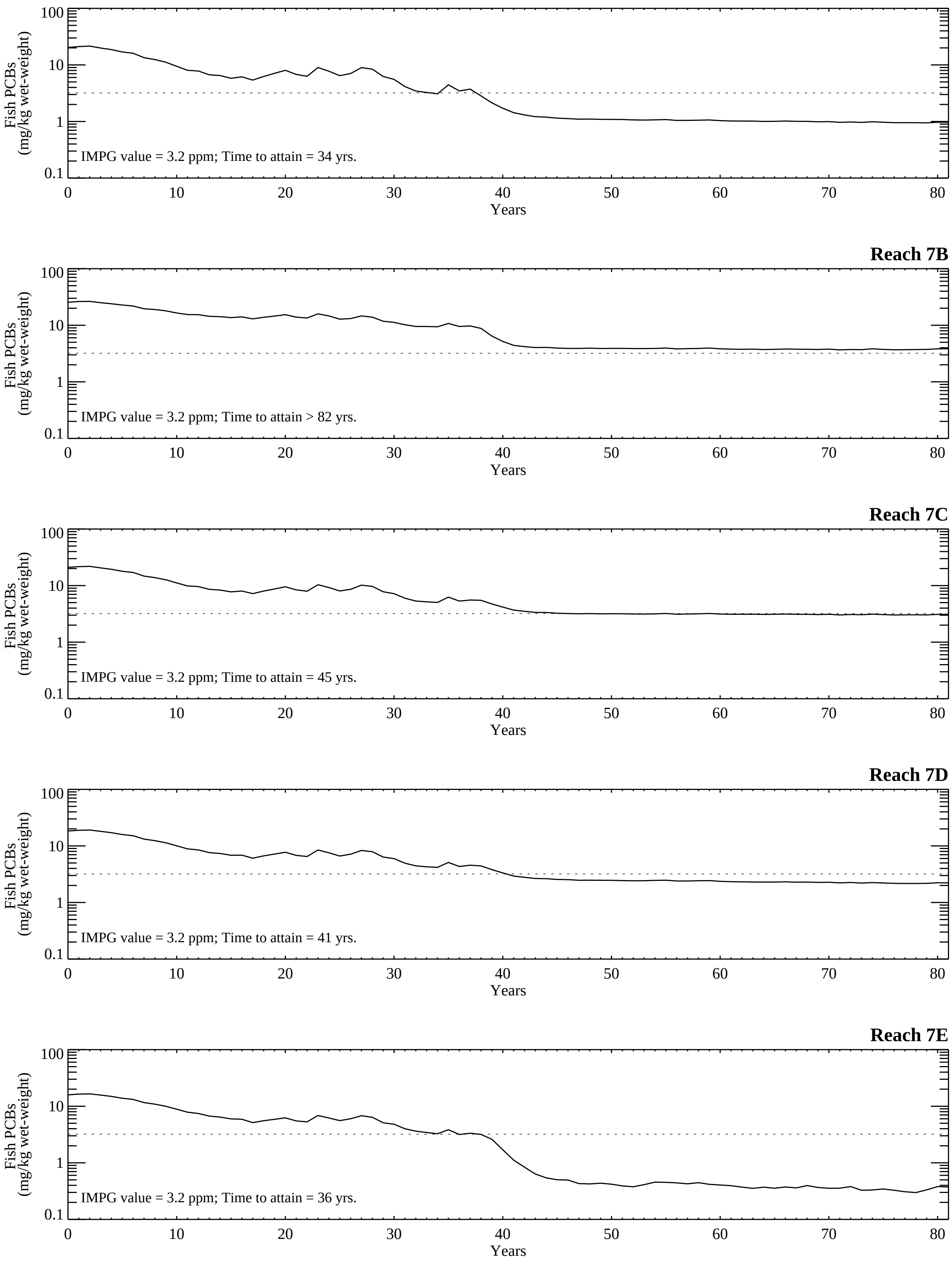

Figure G-11.1-7b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 8; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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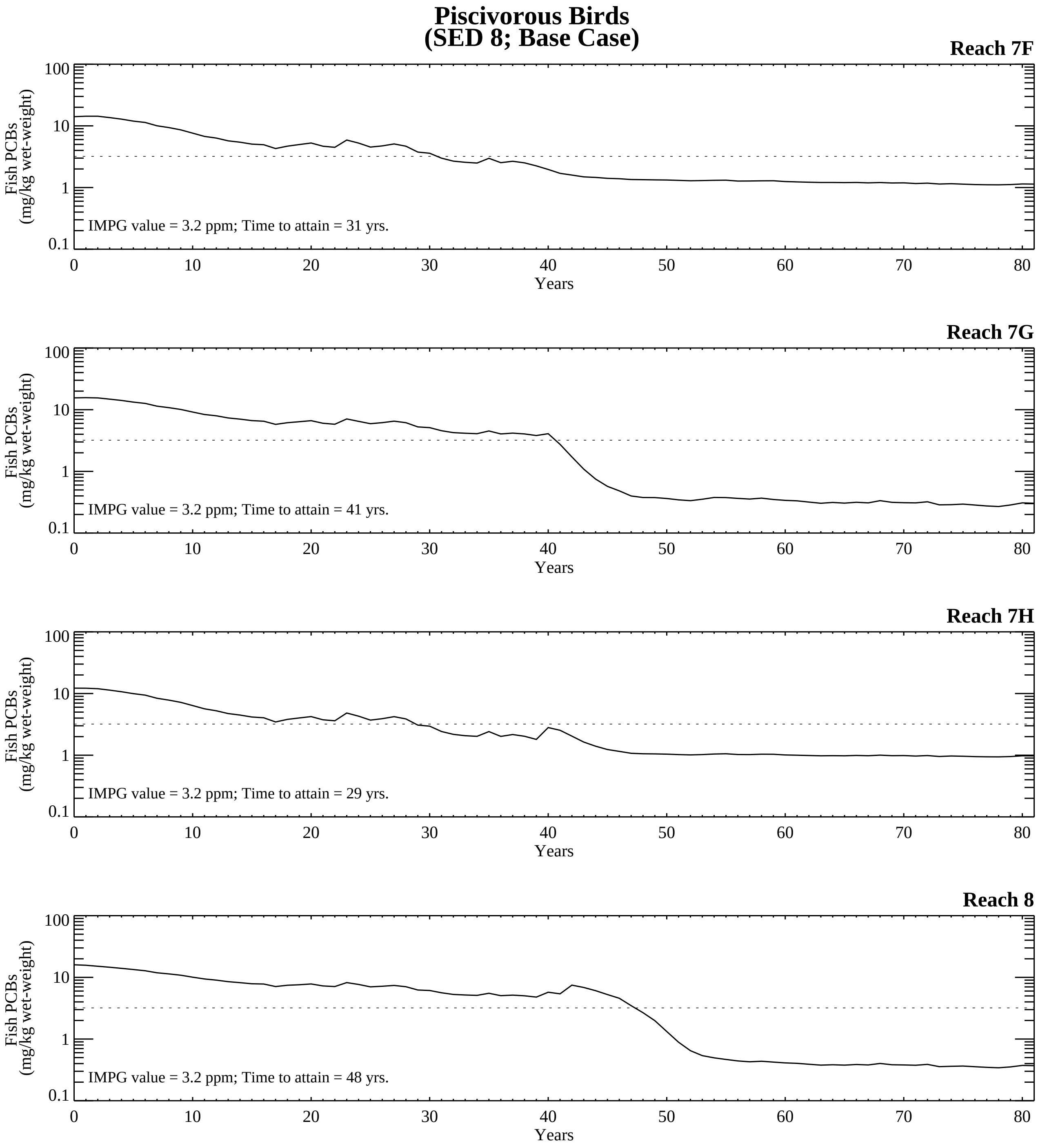

Figure G-11.1-7b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 8; Reach 7/8; Base Case).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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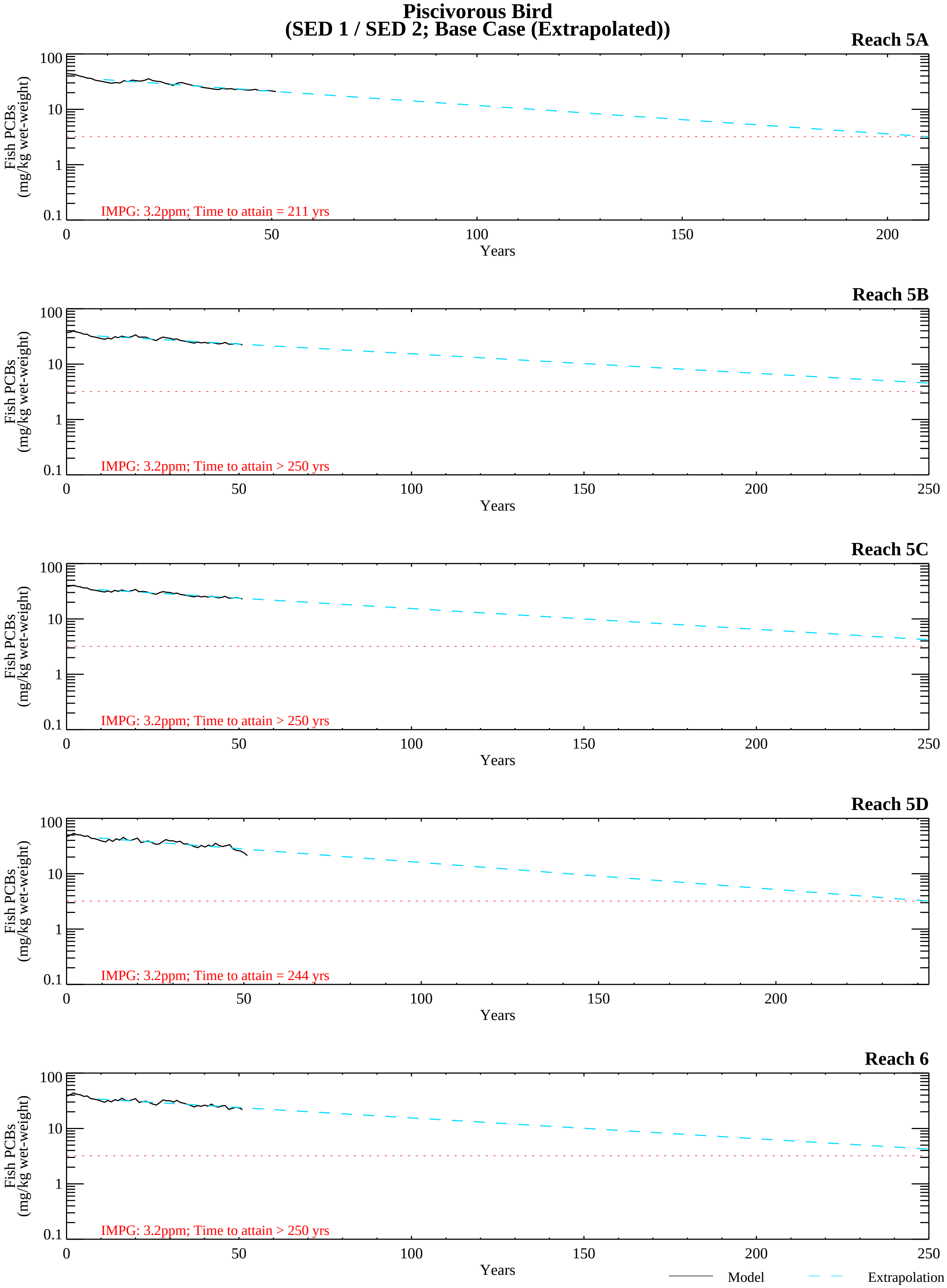

Figure G-11.2-1a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 1 / SED 2; Reach 5/6; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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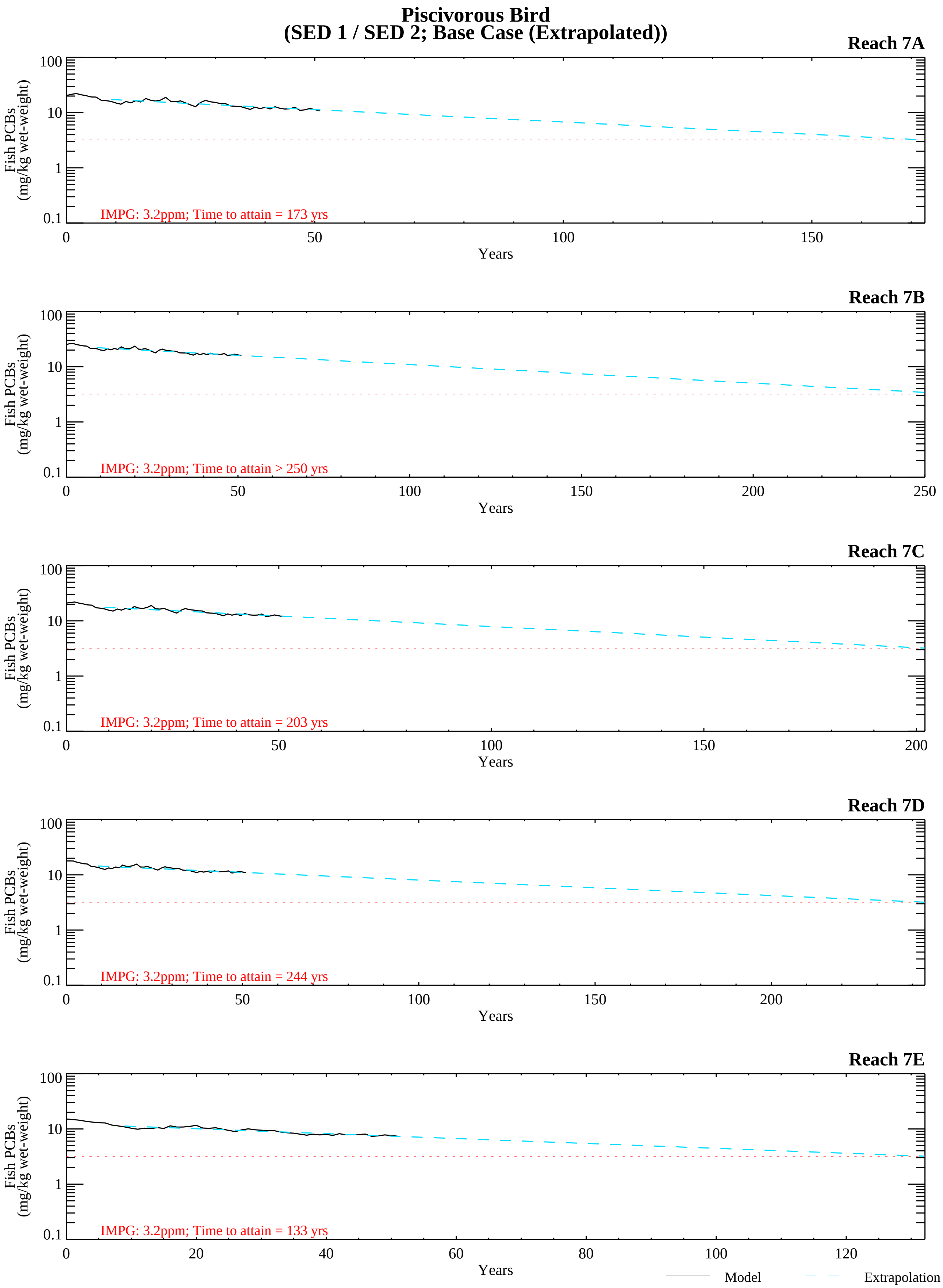

Figure G-11.2-1b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 1 / SED 2; Reach 7/8; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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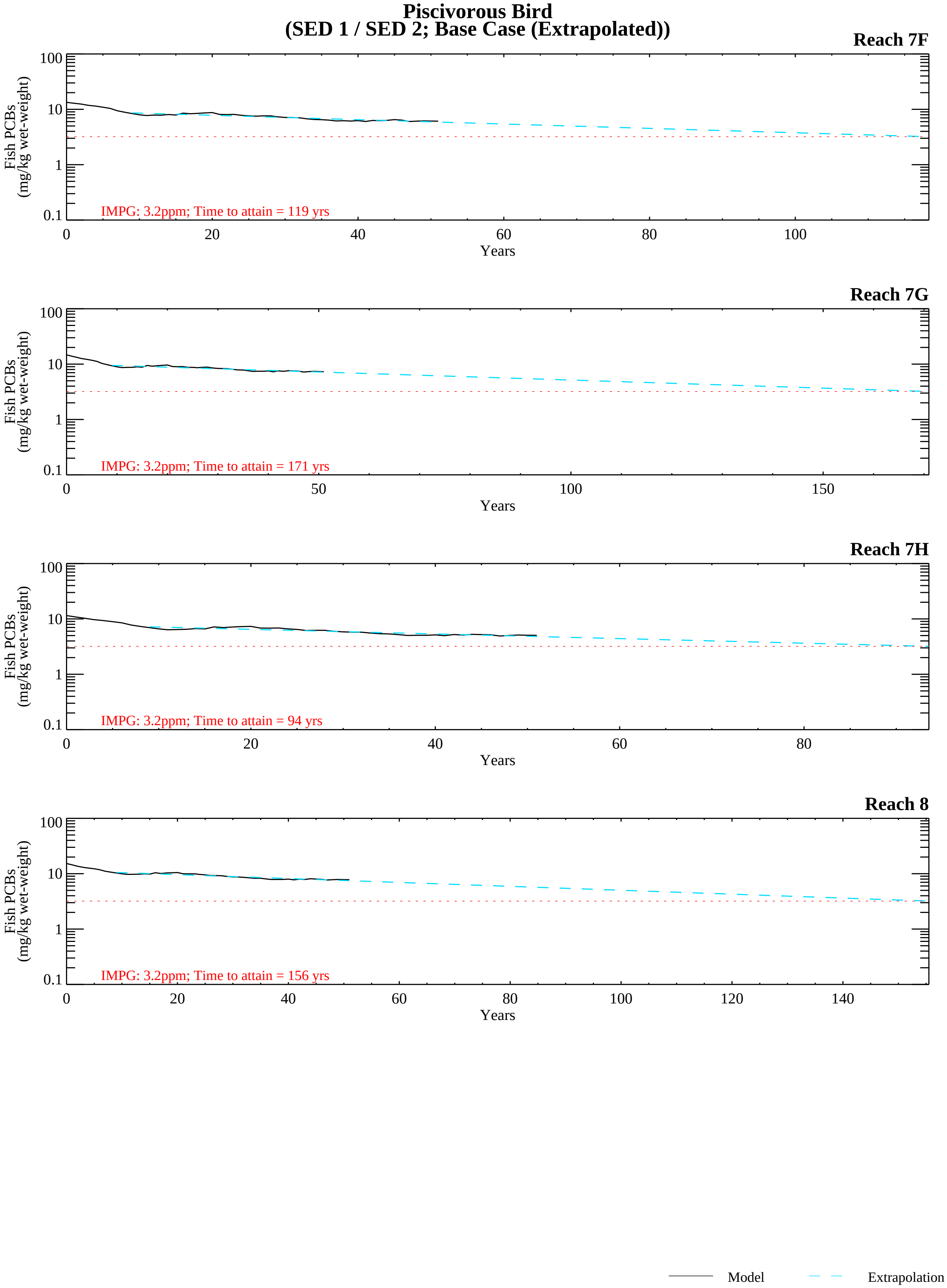

Figure G-11.2-1b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 1 / SED 2; Reach 7/8; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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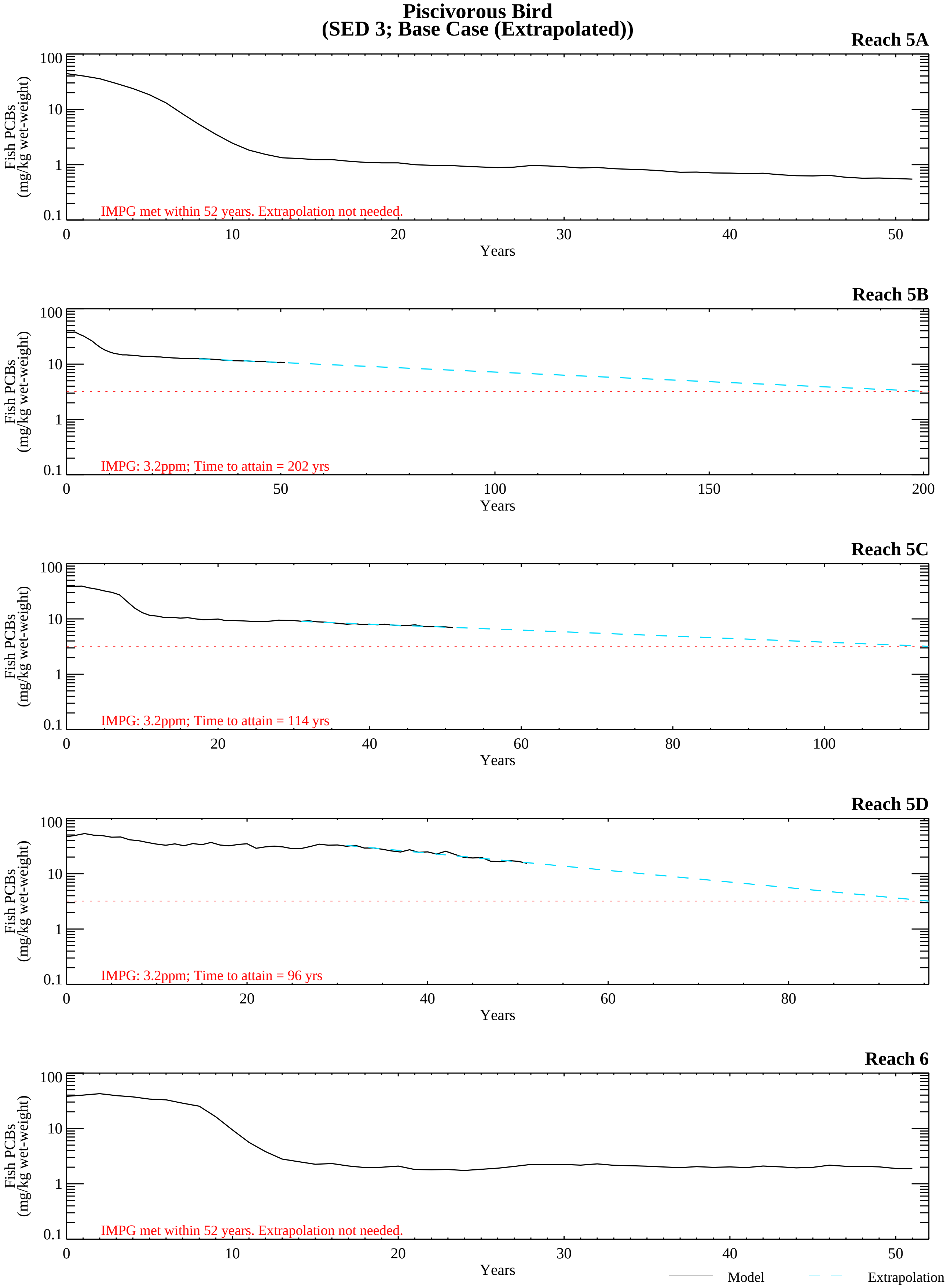

Figure G-11.2-2a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 3; Reach 5/6; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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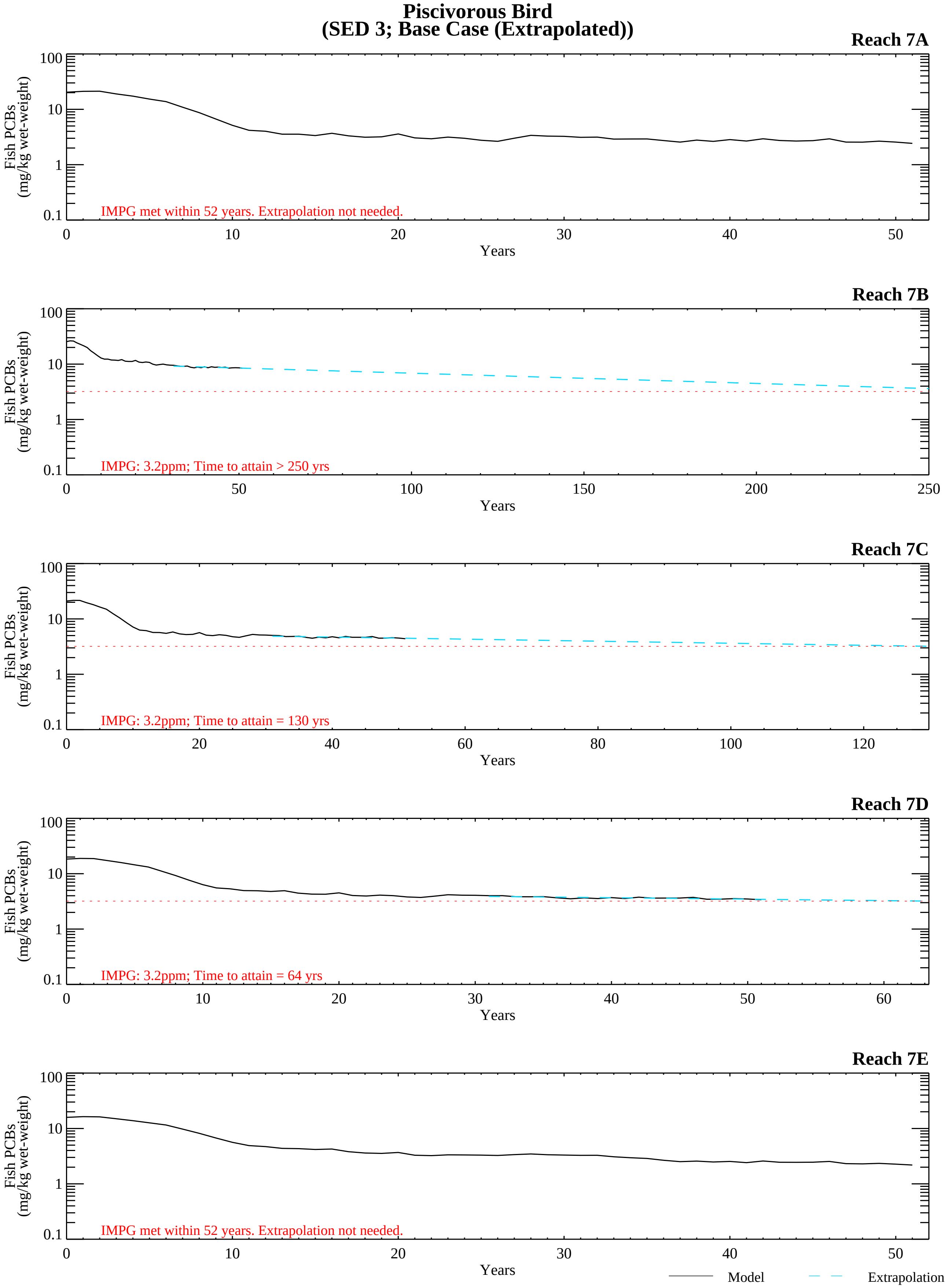

Figure G-11.2-2b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 3; Reach 7/8; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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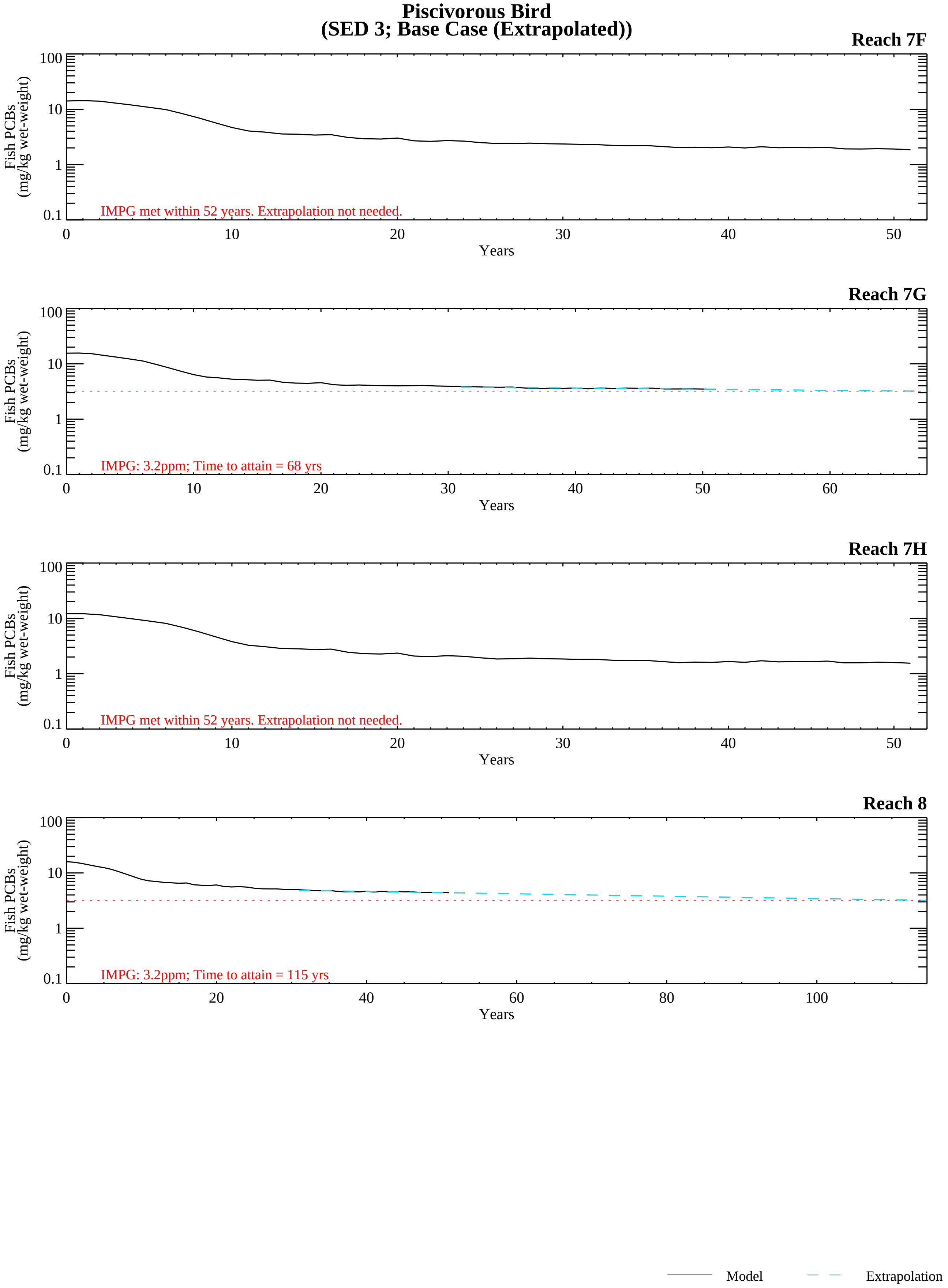

Figure G-11.2-2b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 3; Reach 7/8; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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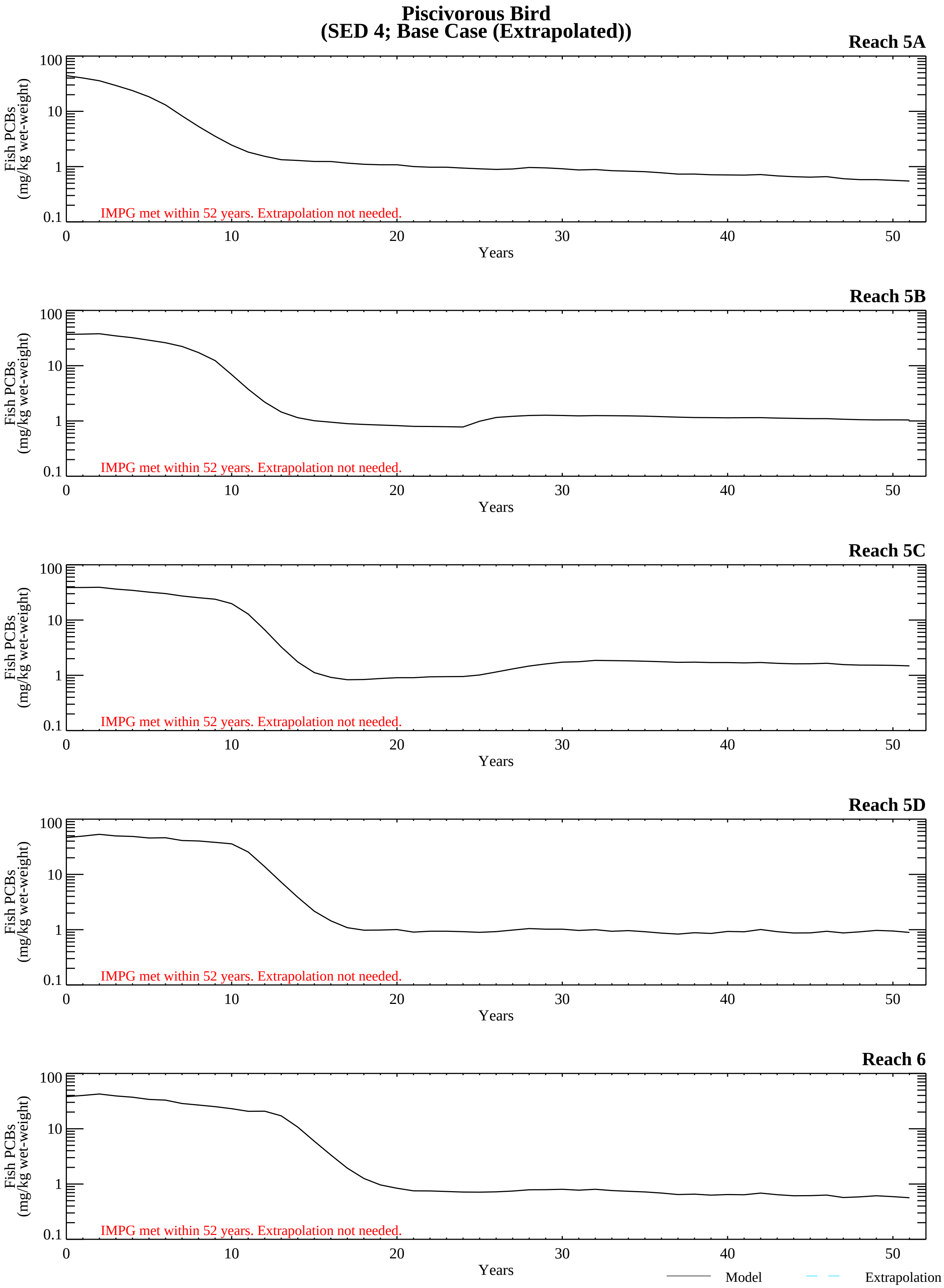

Figure G-11.2-3a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 4; Reach 5/6; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

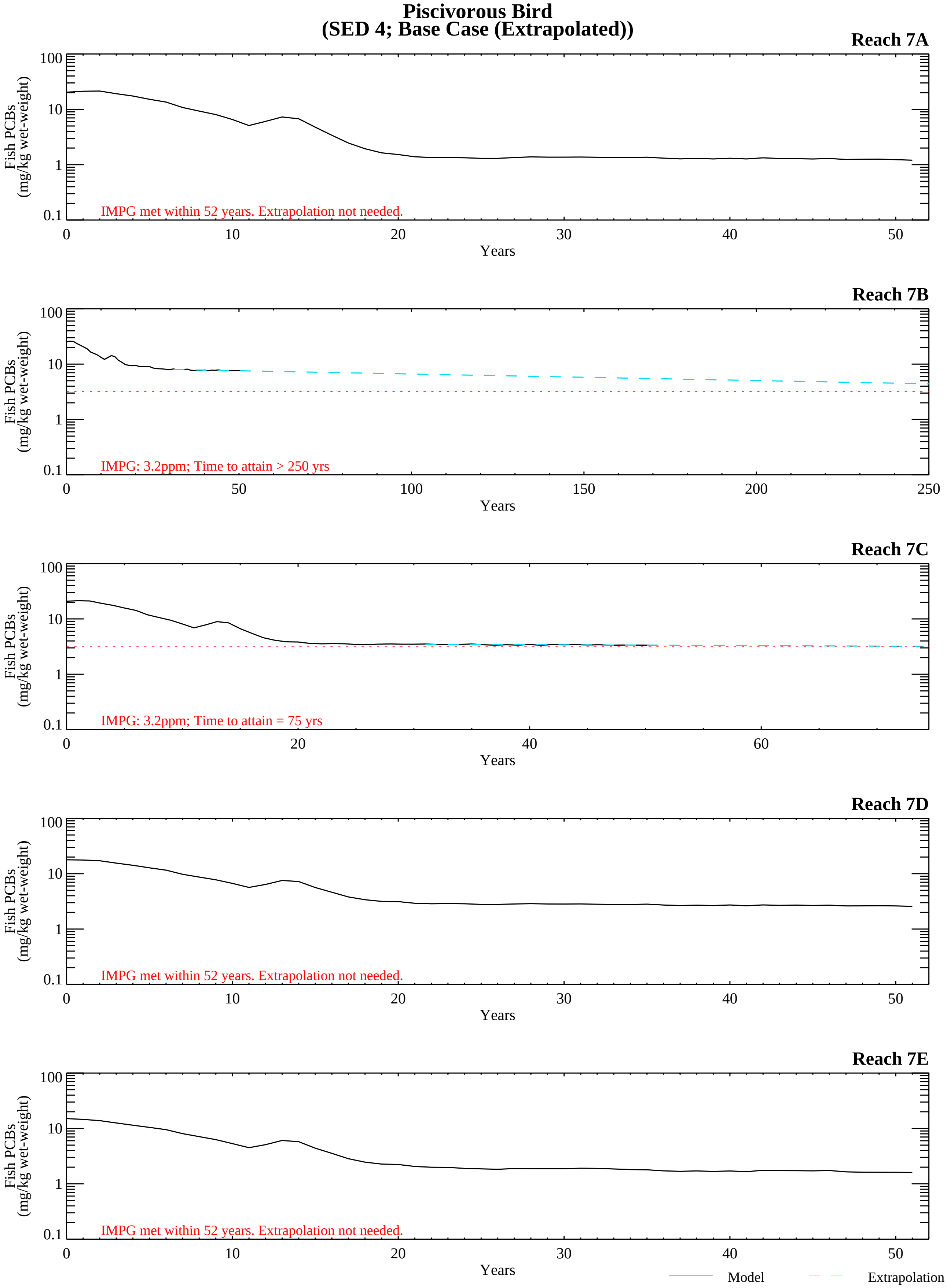

Figure G-11.2-3b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 4; Reach 7/8; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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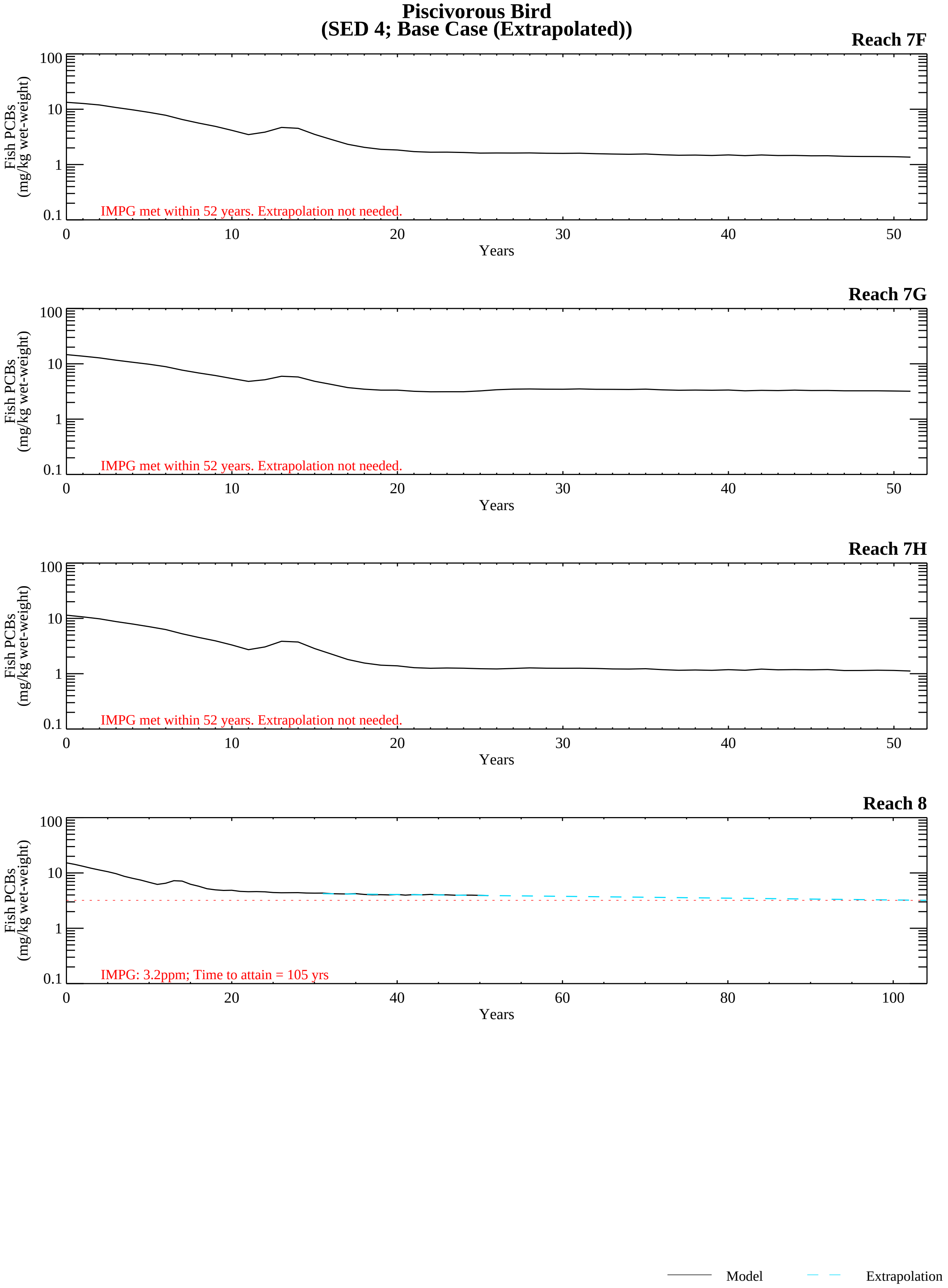

Figure G-11.2-3b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 4; Reach 7/8; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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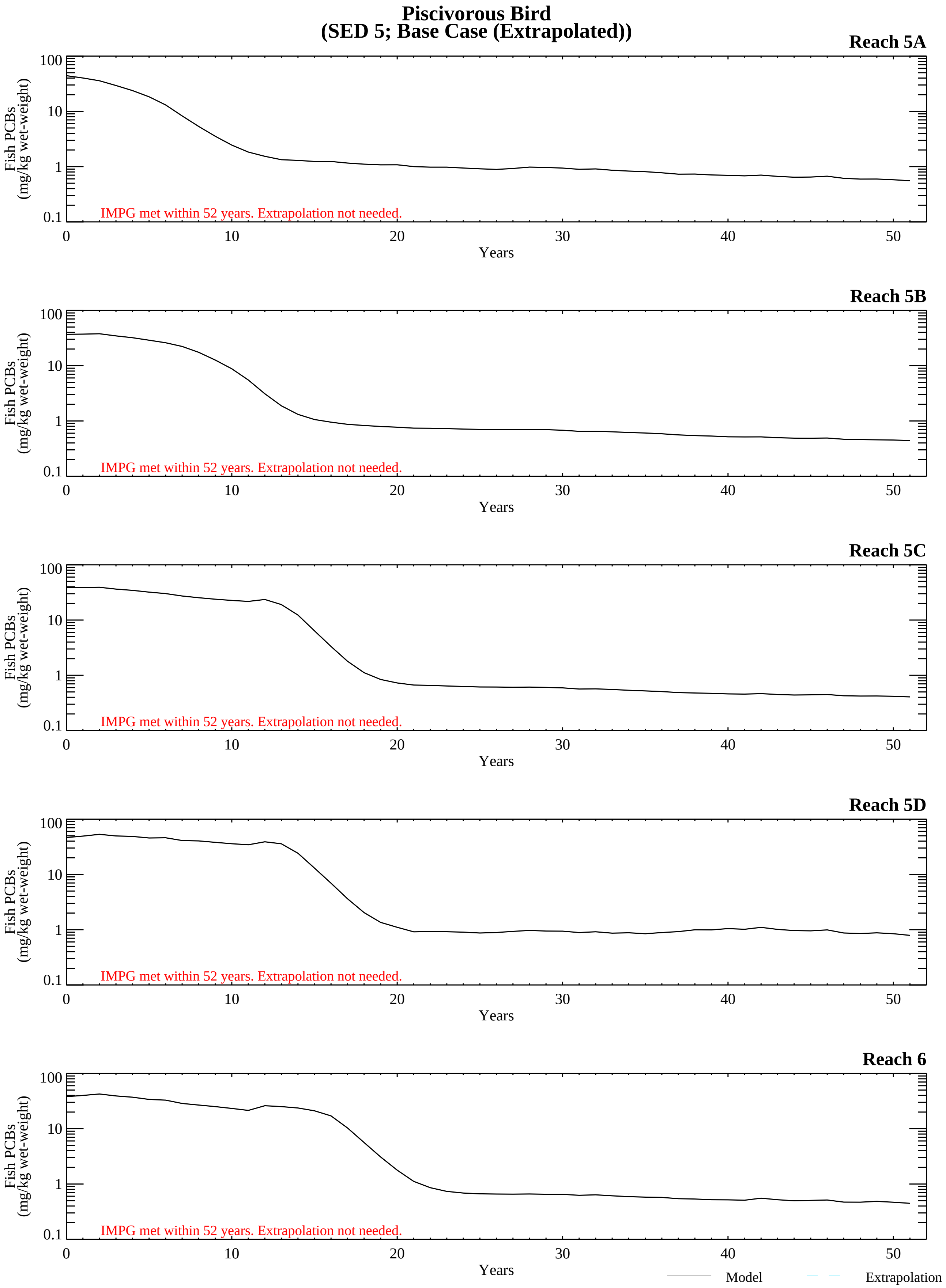

Figure G-11.2-4a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 5; Reach 5/6; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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Wed Mar 19 18:02:06 2008

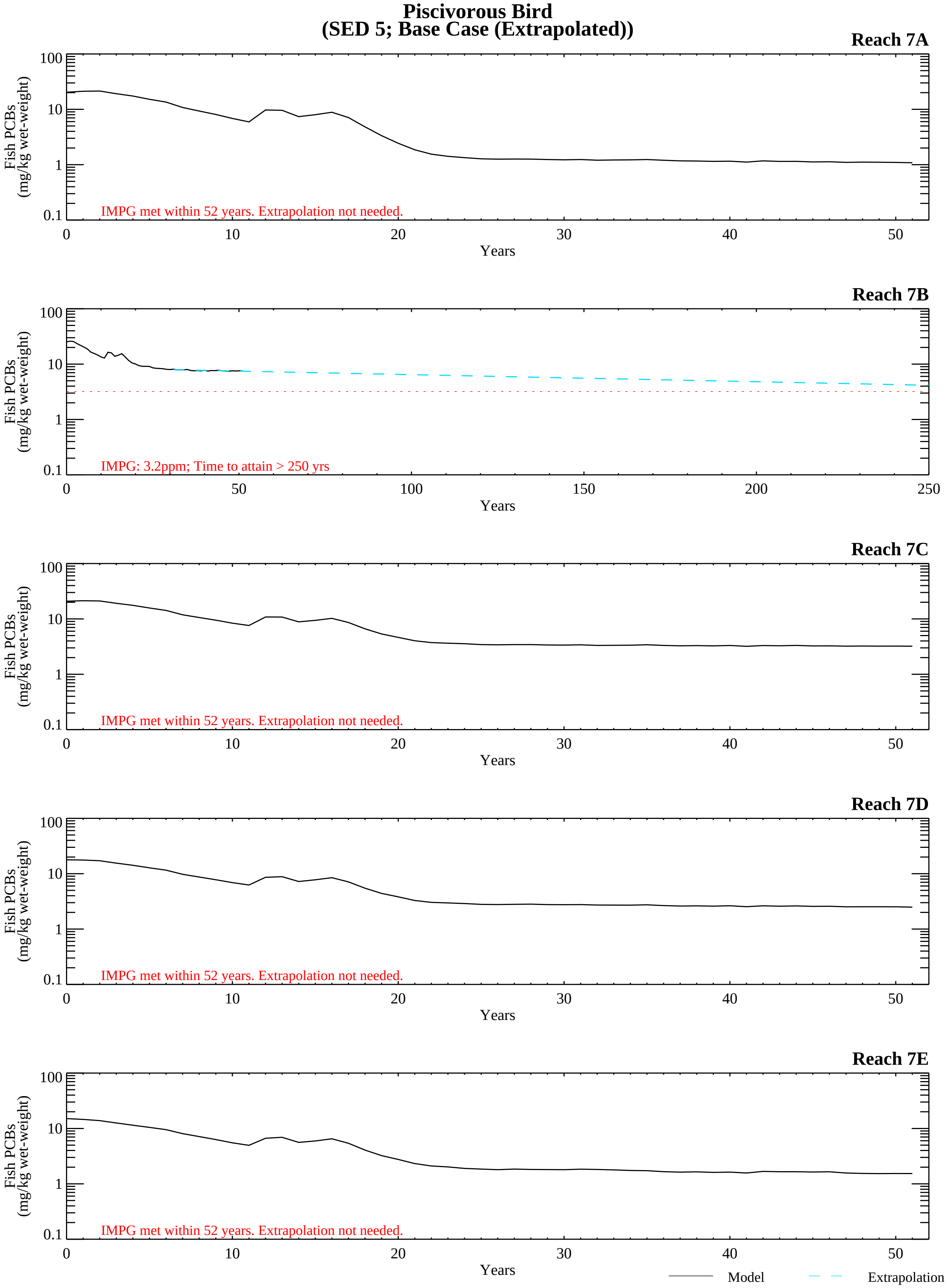

Figure G-11.2-4b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 5; Reach 7/8; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

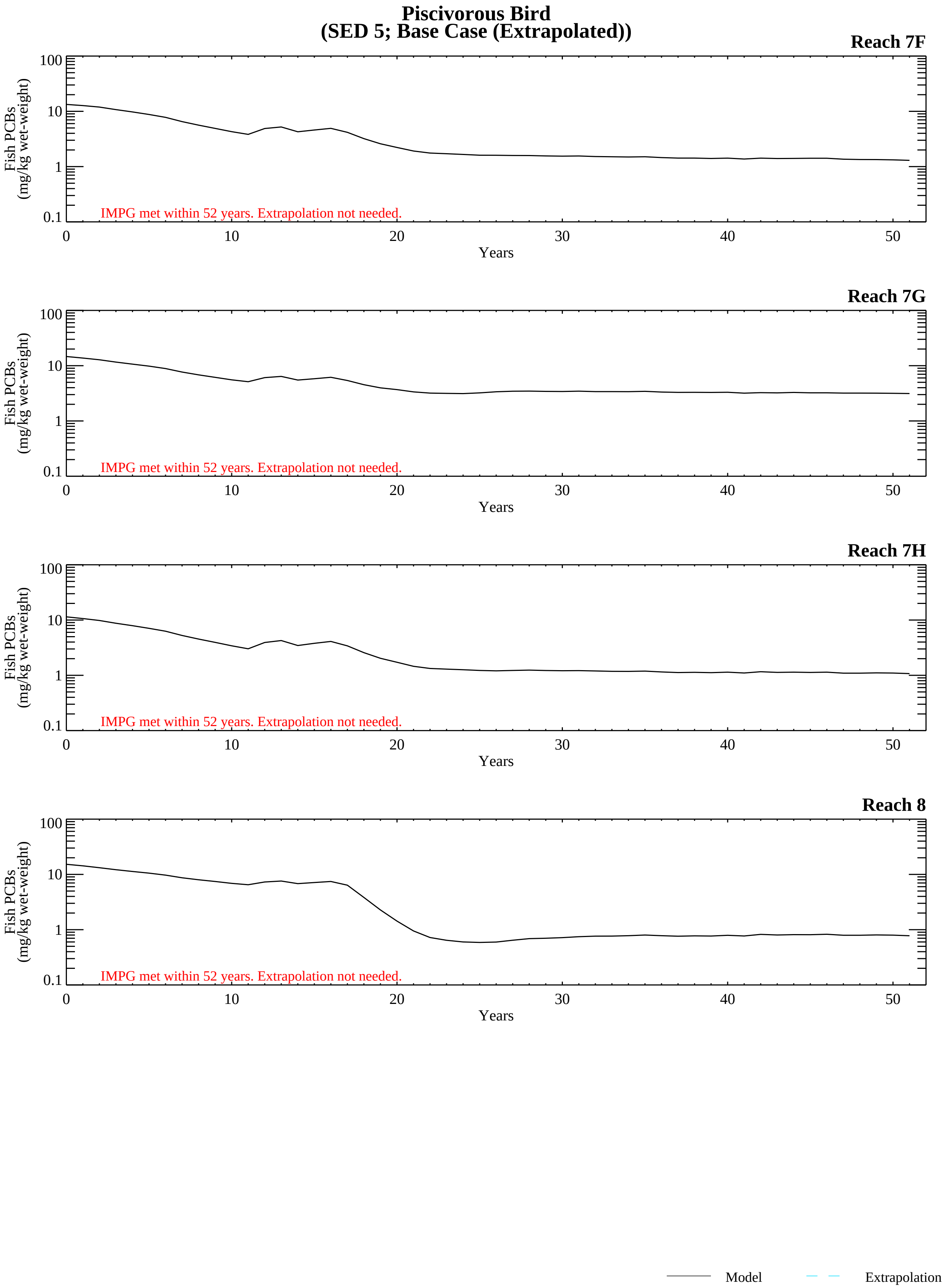

Figure G-11.2-4b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 5; Reach 7/8; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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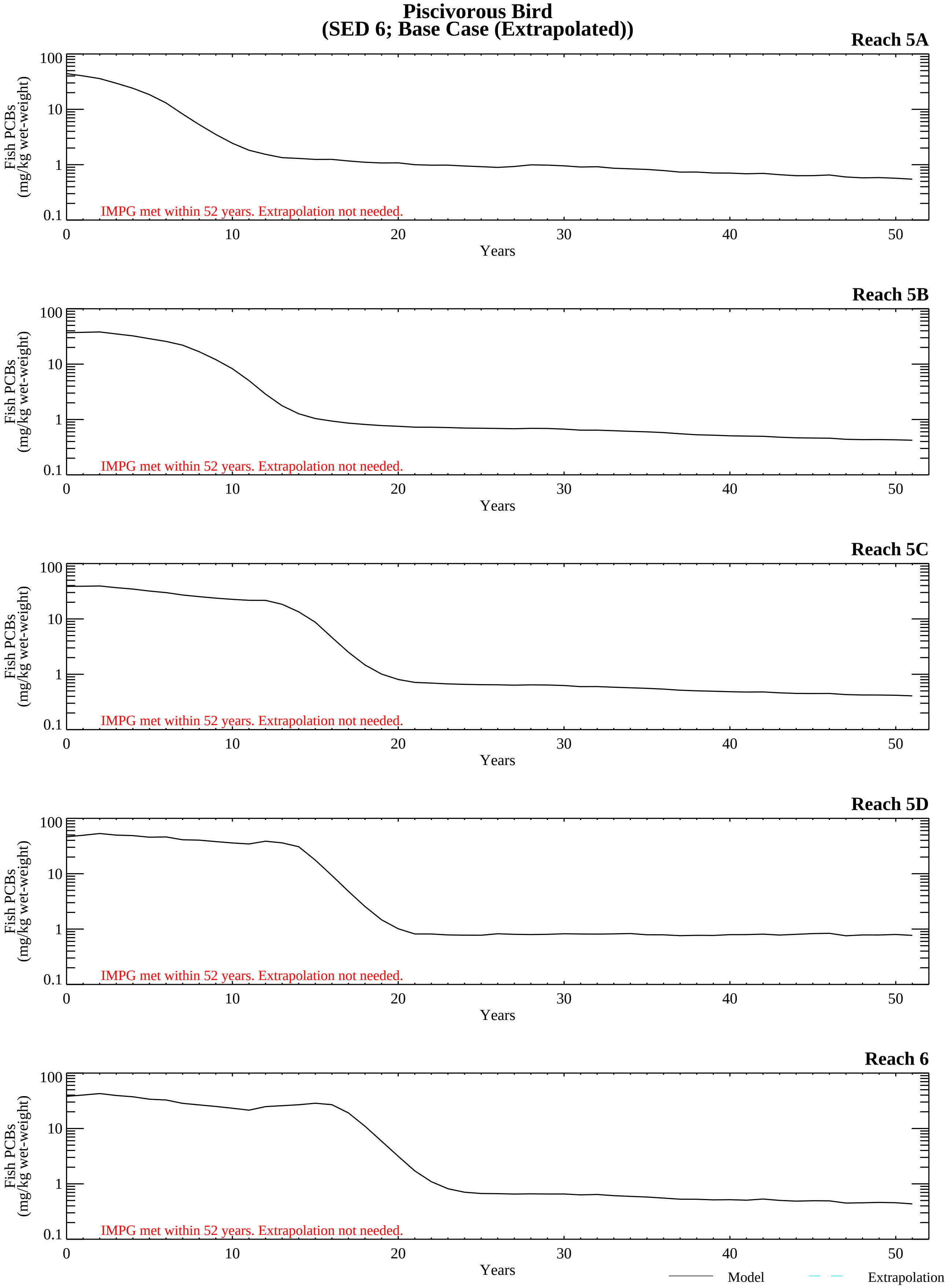

Figure G-11.2-5a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 6; Reach 5/6; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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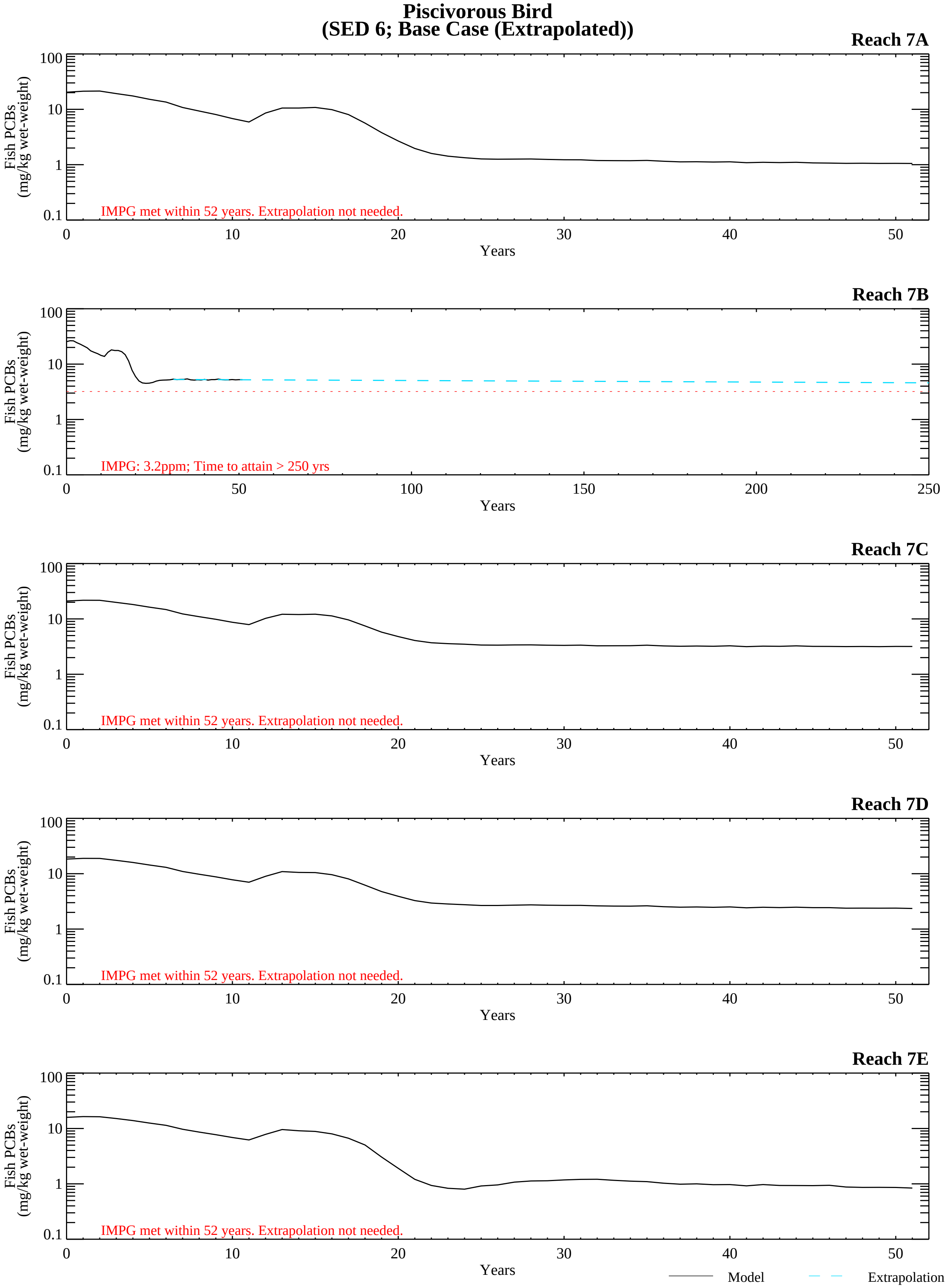

Figure G-11.2-5b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 6; Reach 7/8; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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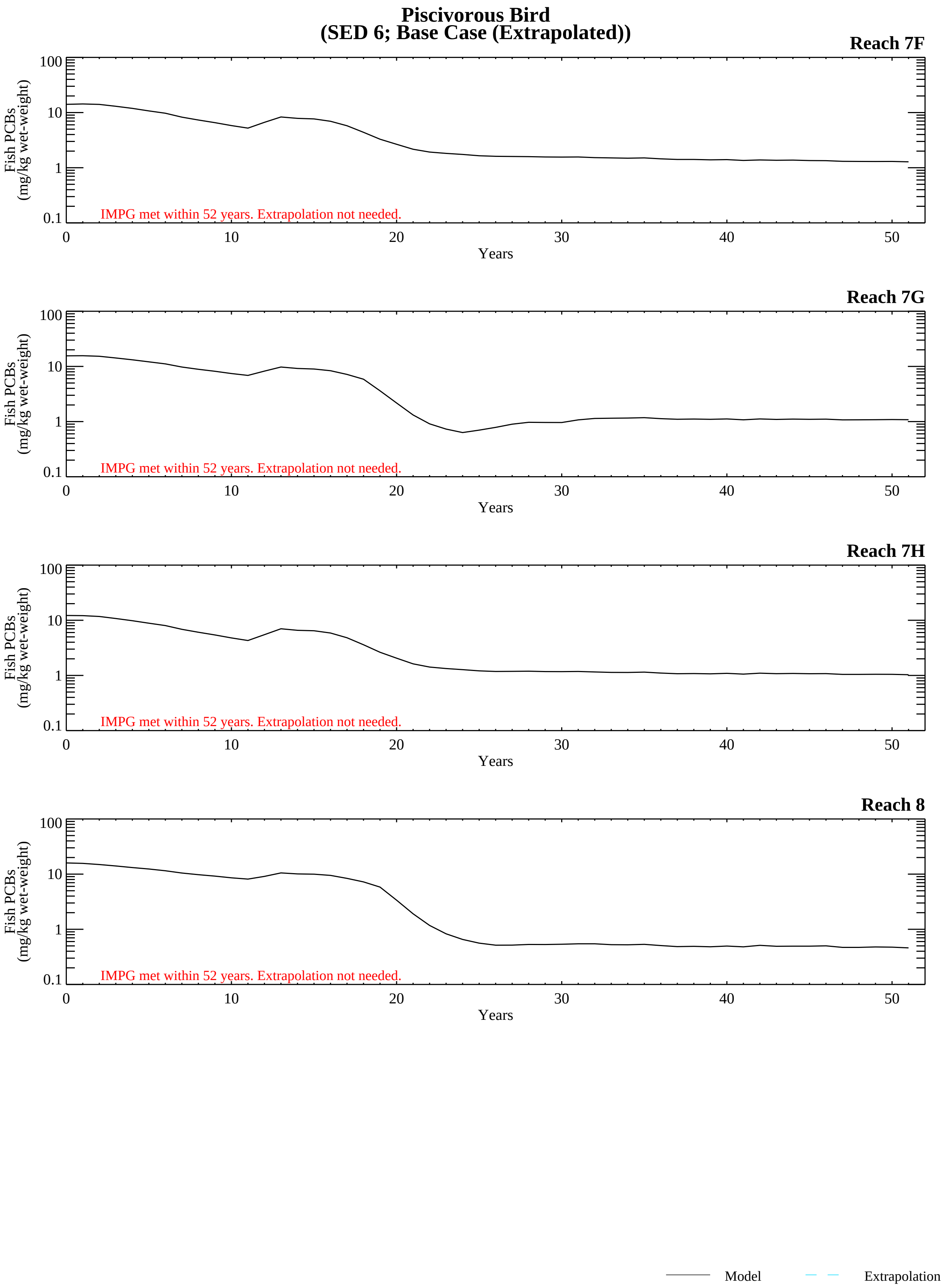

Figure G-11.2-5b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 6; Reach 7/8; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

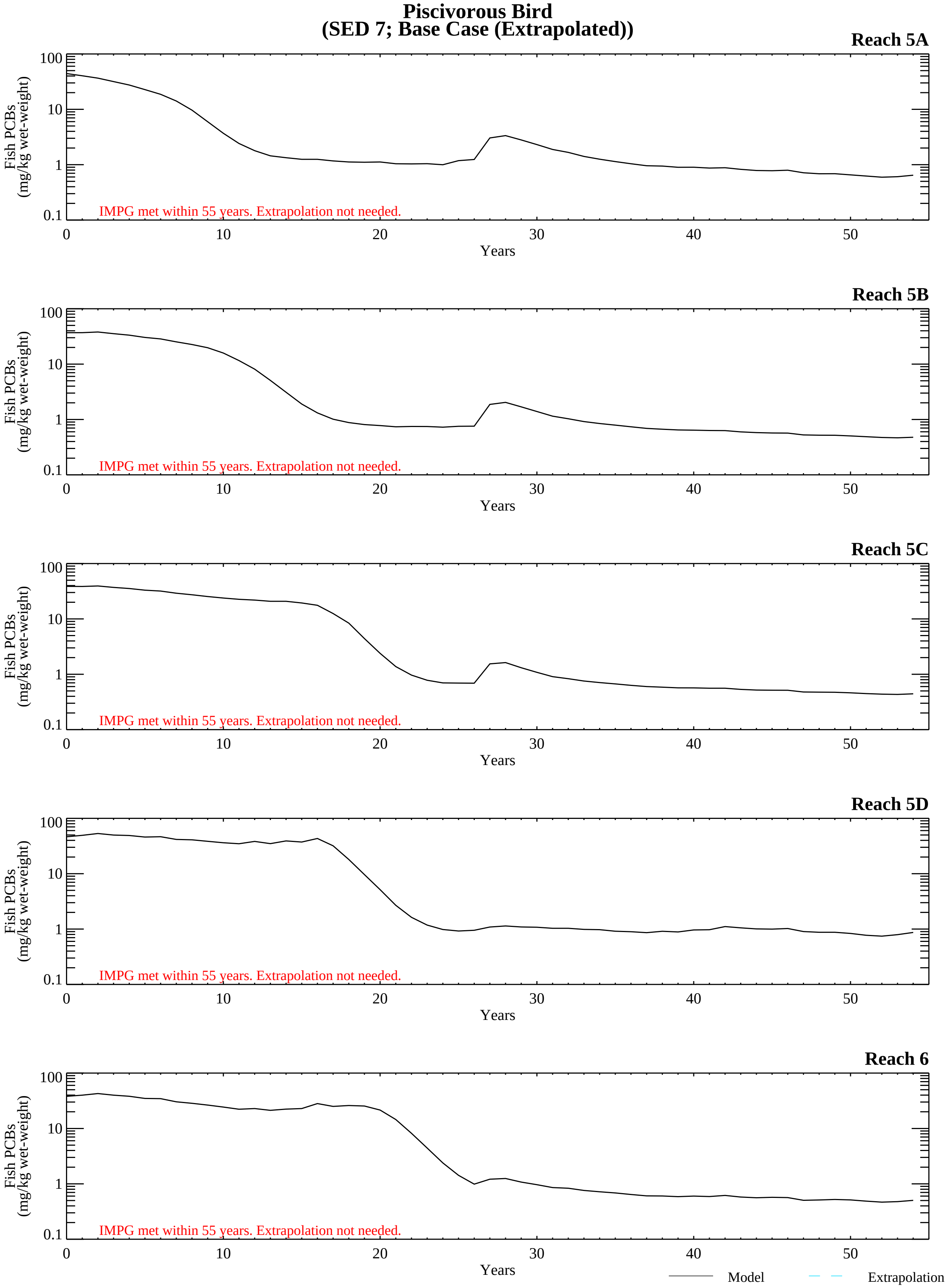

Figure G-11.2-6a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 7; Reach 5/6; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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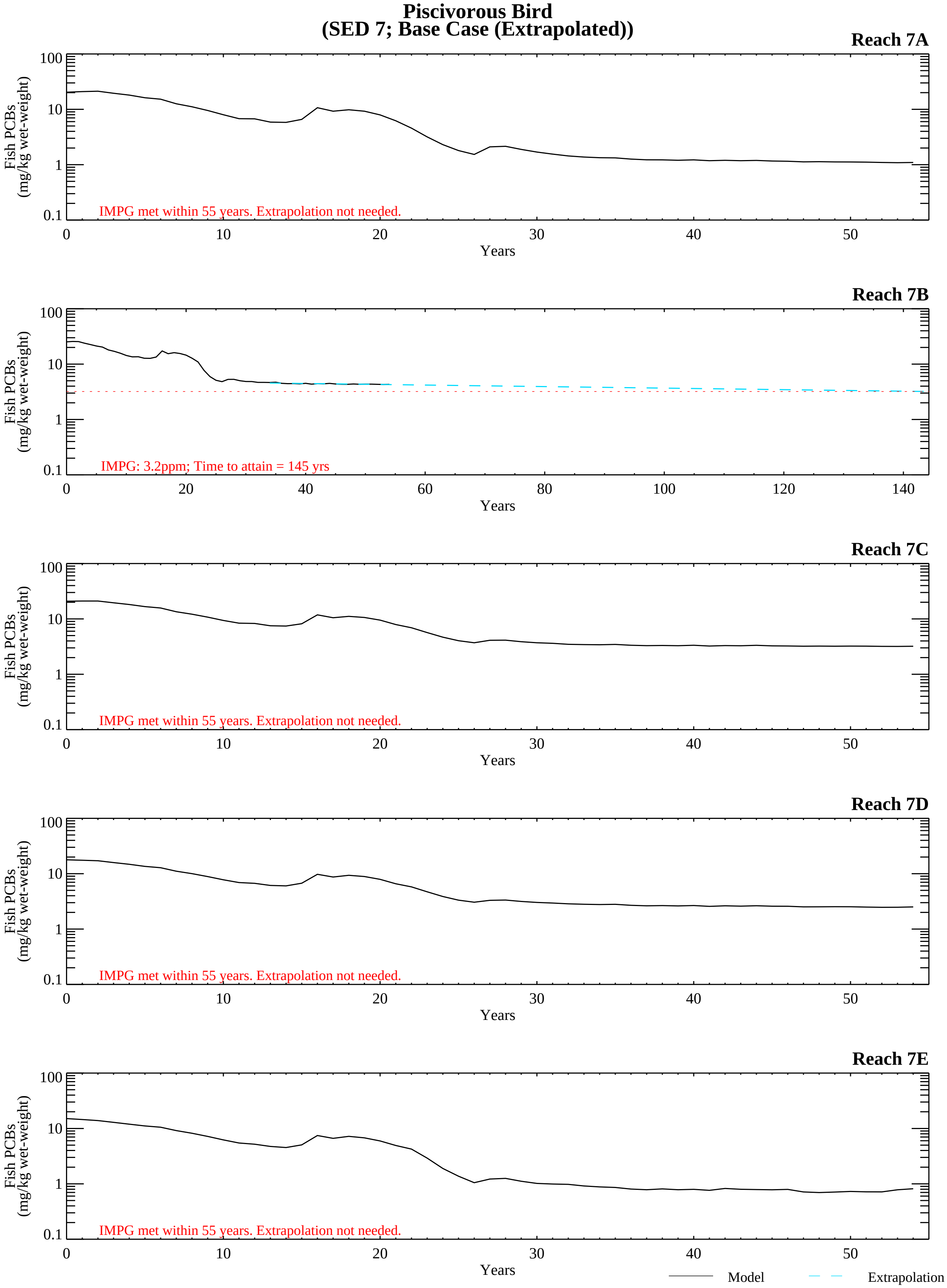

Figure G-11.2-6b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 7; Reach 7/8; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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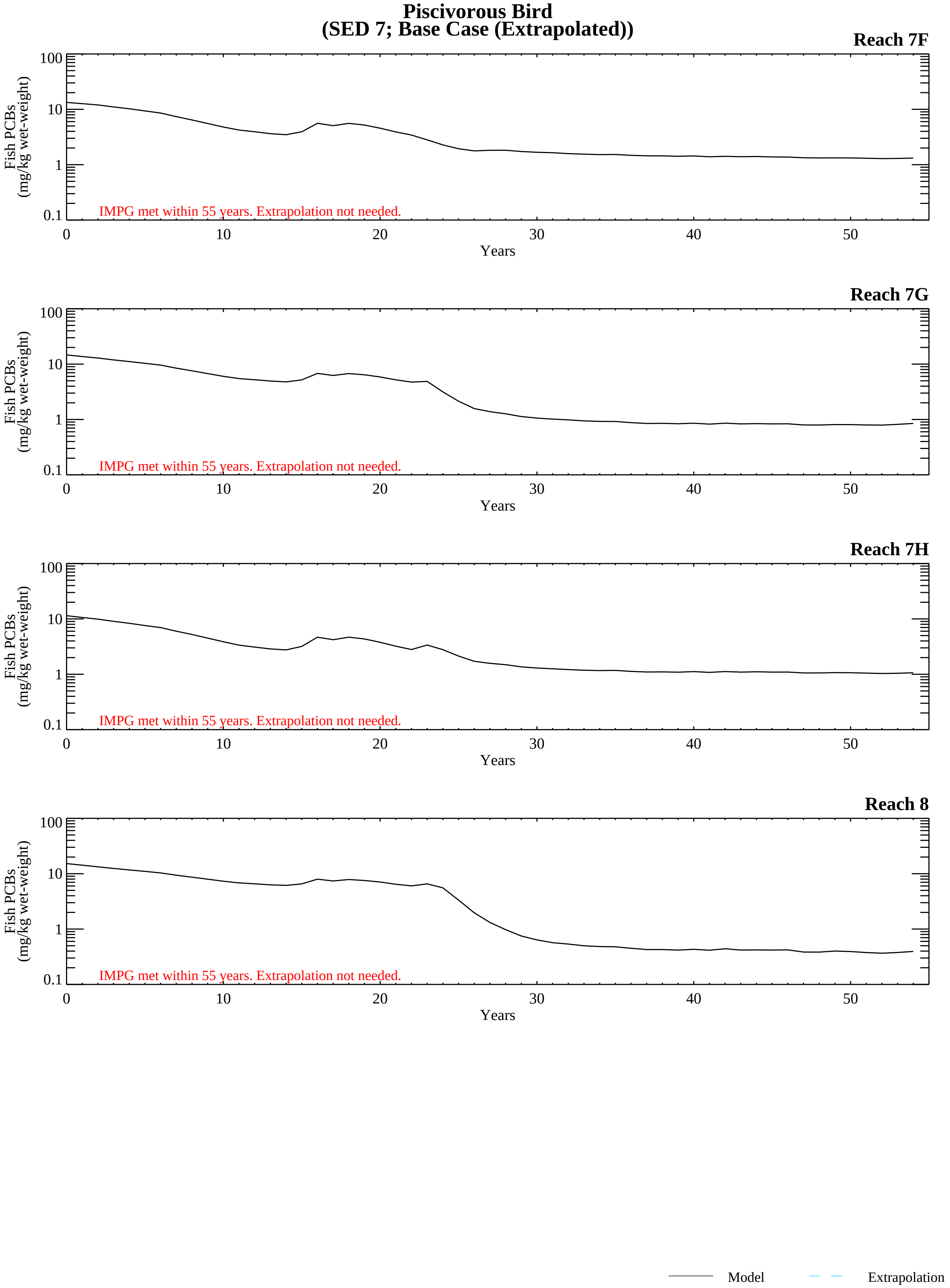

Figure G-11.2-6b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 7; Reach 7/8; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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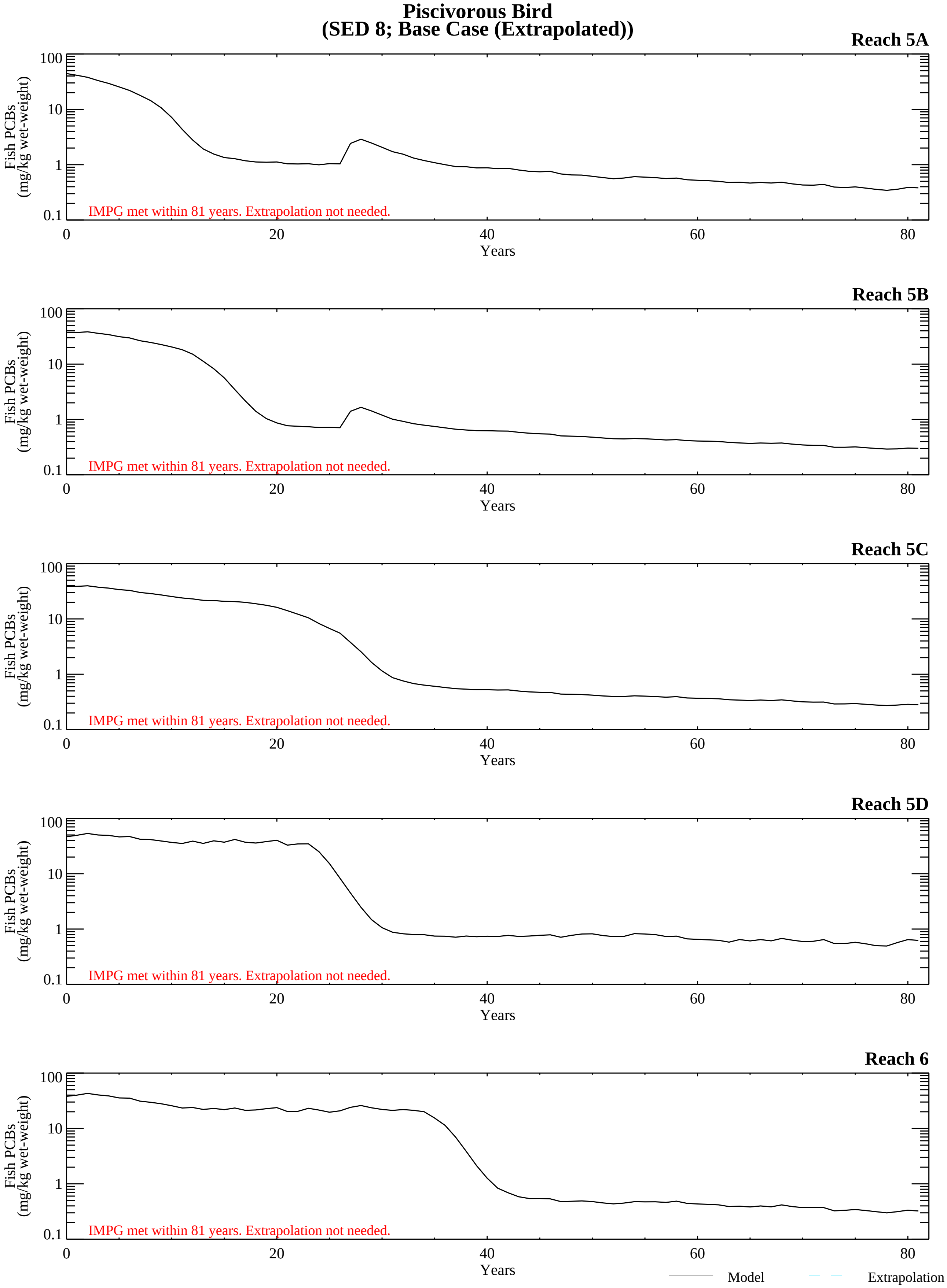

Figure G-11.2-7a. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 8; Reach 5/6; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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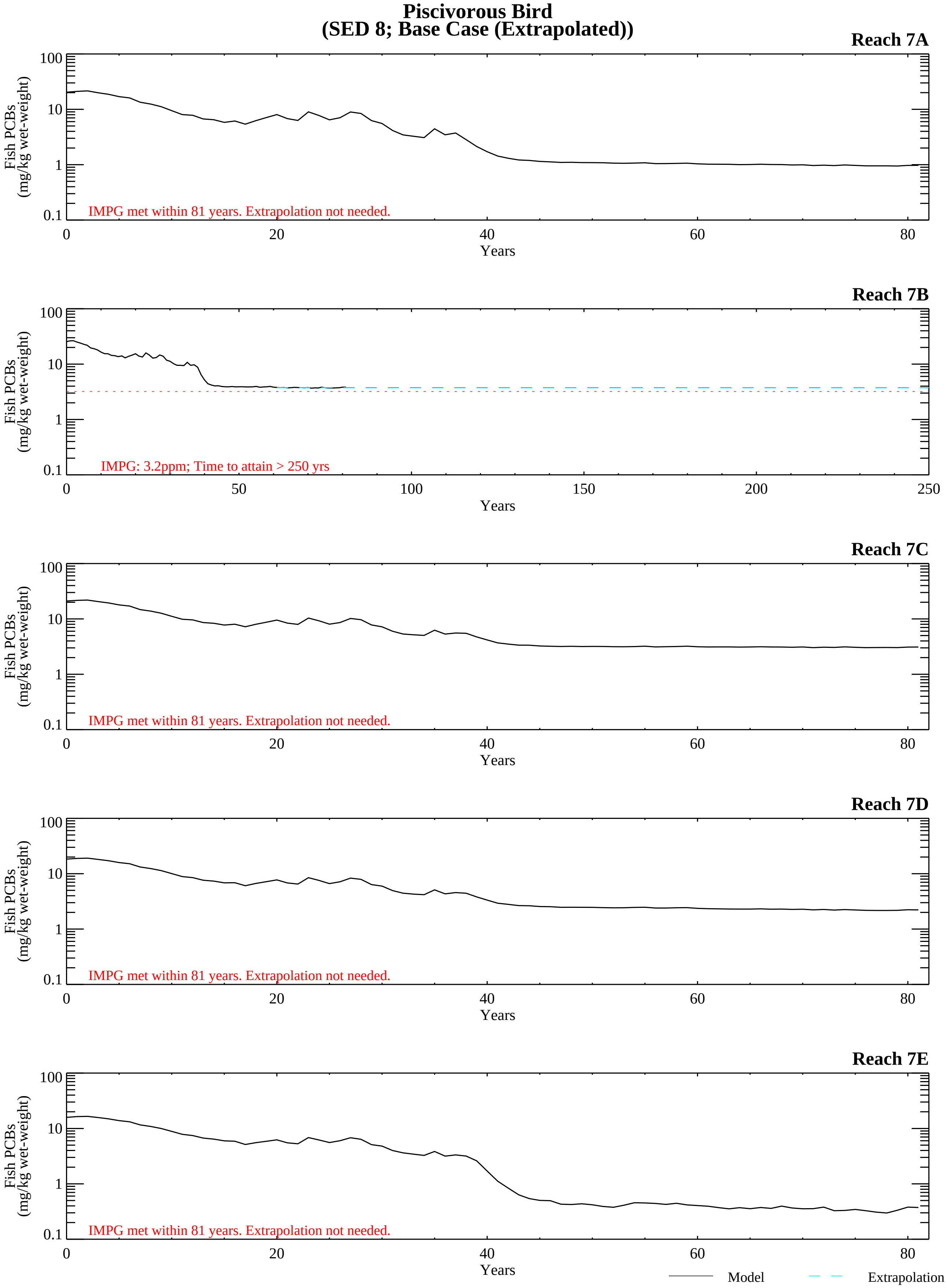

Figure G-11.2-7b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 8; Reach 7/8; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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Wed Mar 19 21:09:14 2008

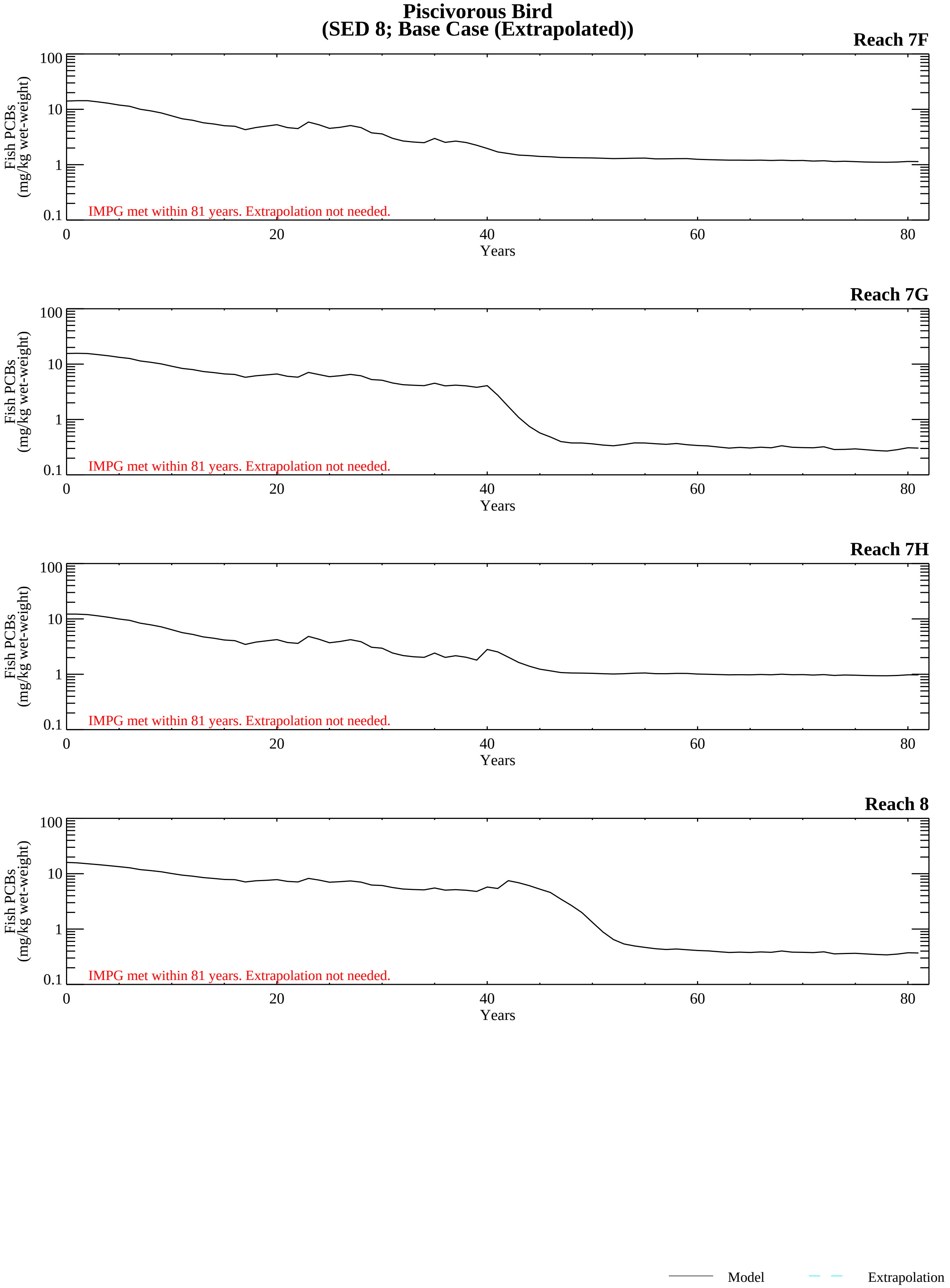

Figure G-11.2-7b. Extrapolated temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 8; Reach 7/8; Base Case).

IMPG value (mg/kg) = 3.2
Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year.
Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

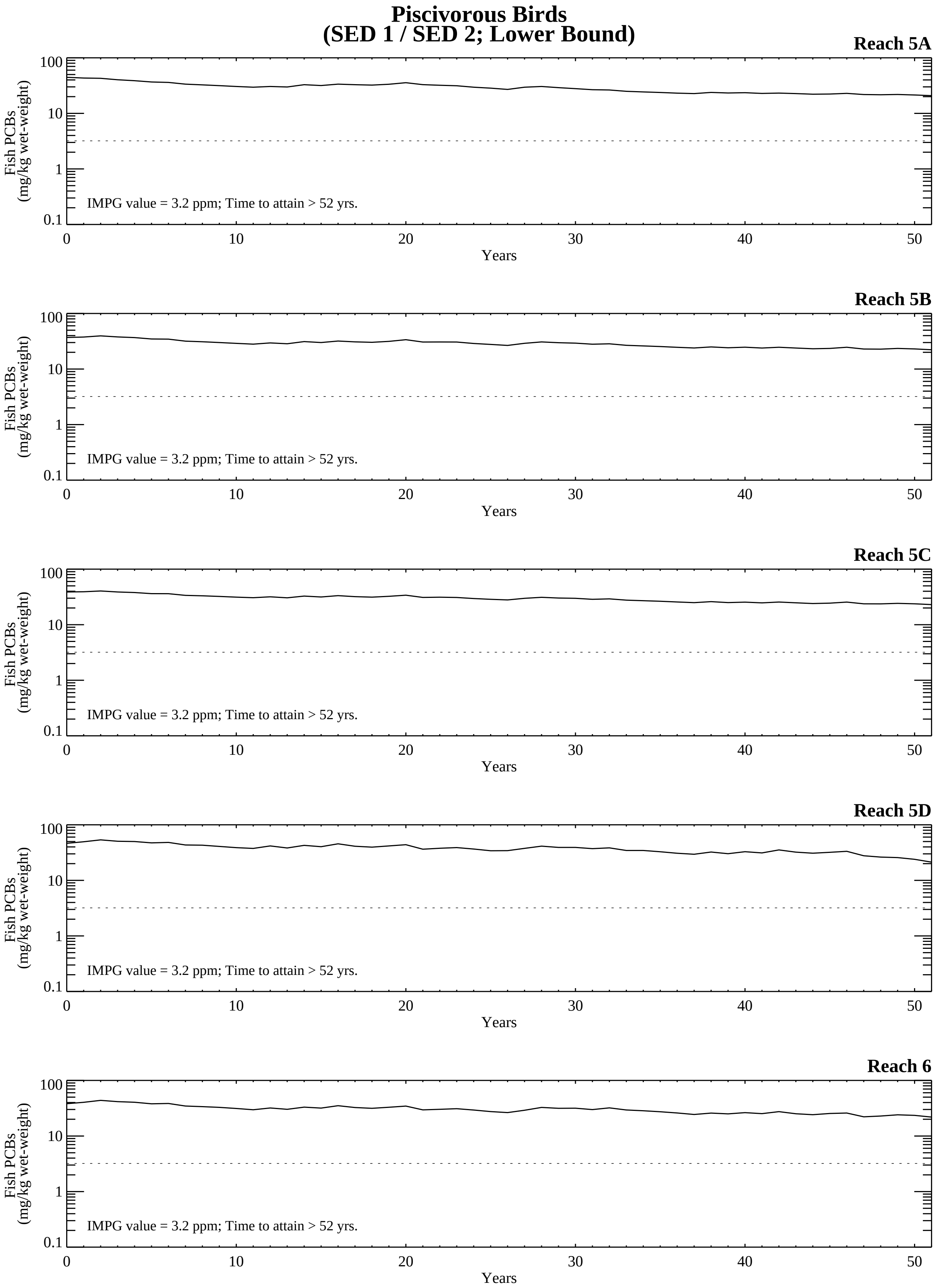

Figure G-11.3-1a. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 1 / SED 2; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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Fri Mar 14 17:56:46 2008

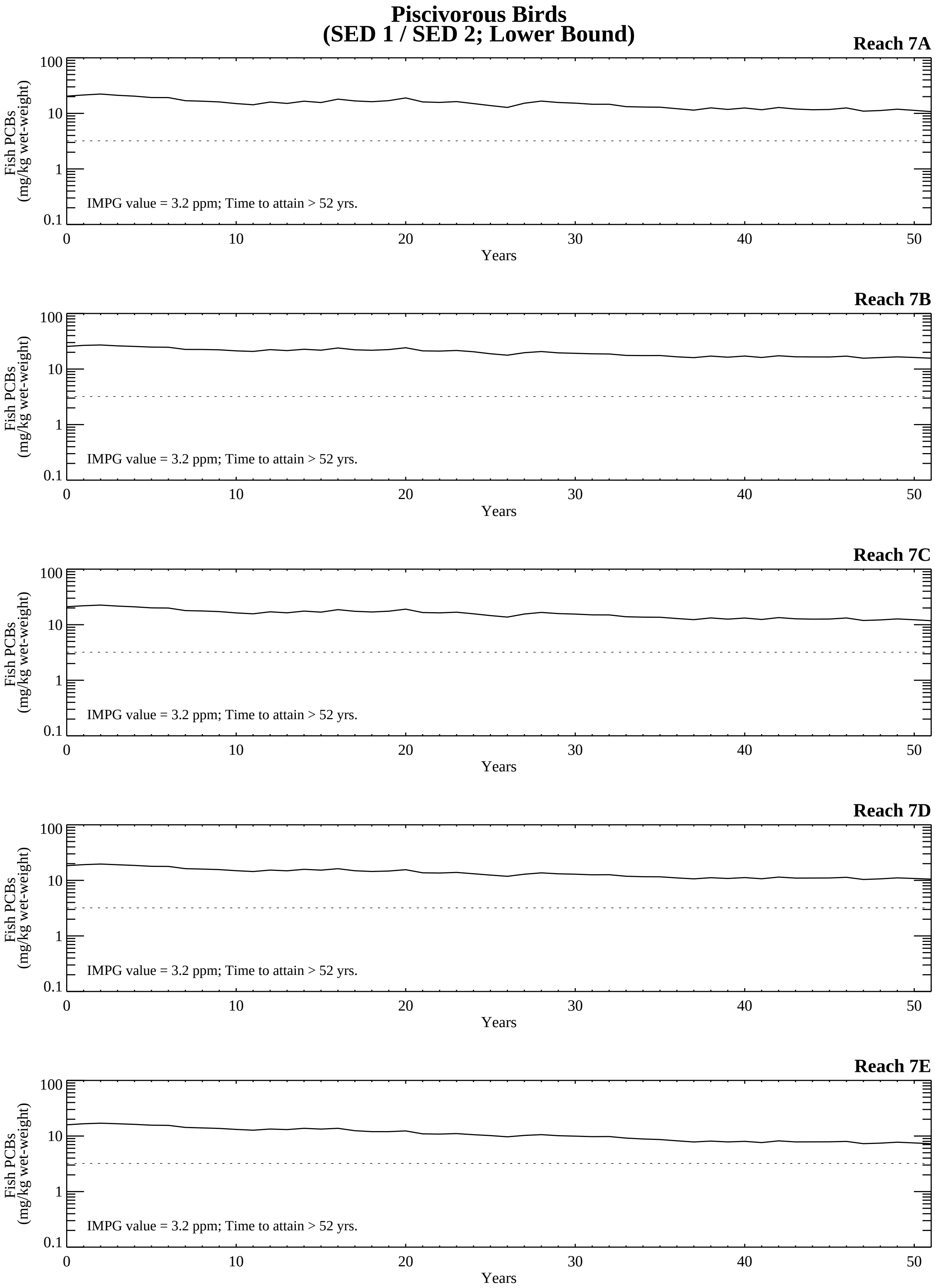

Figure G-11.3-1b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 1 / SED 2; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

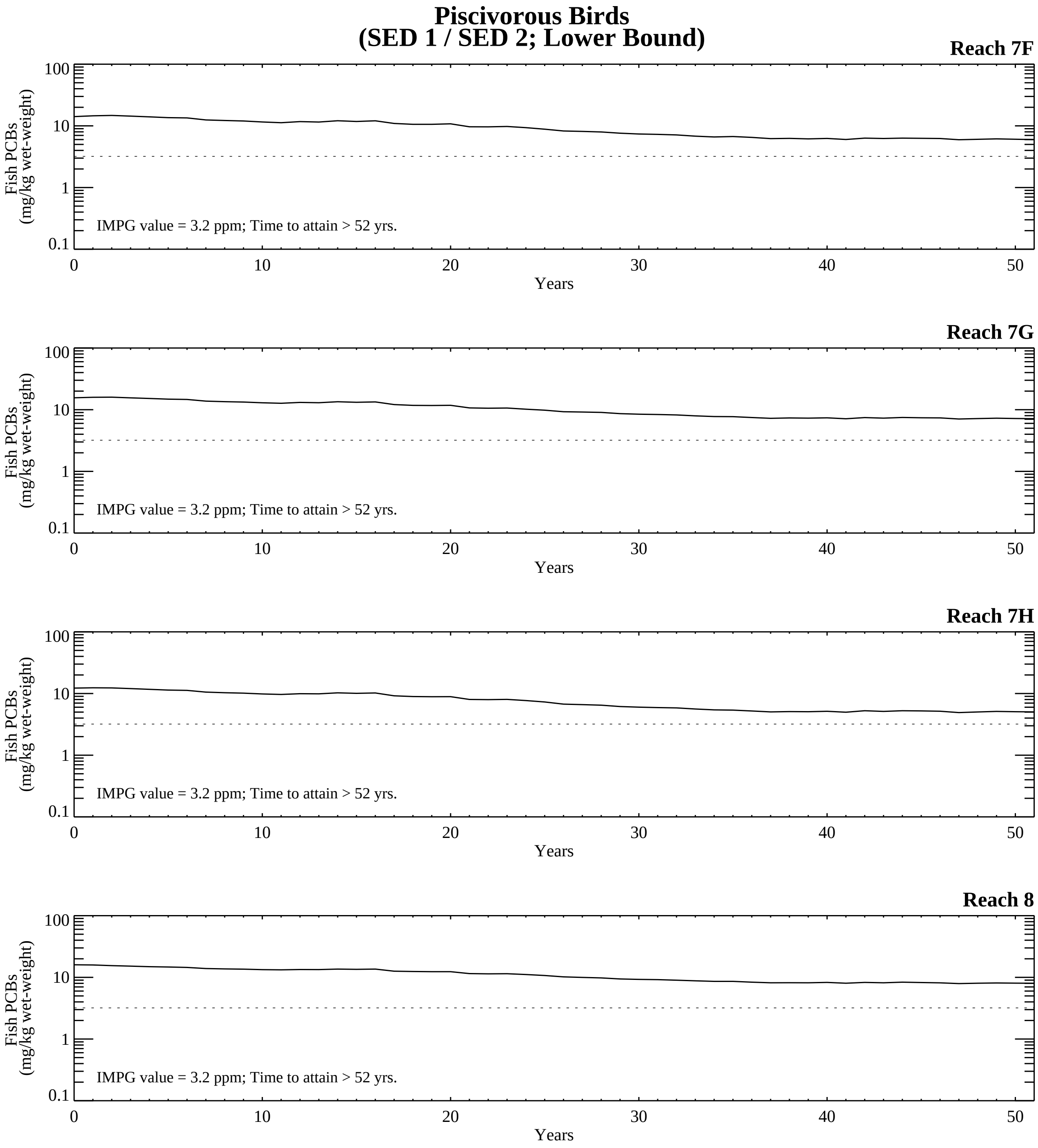

Figure G-11.3-1b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 1 / SED 2; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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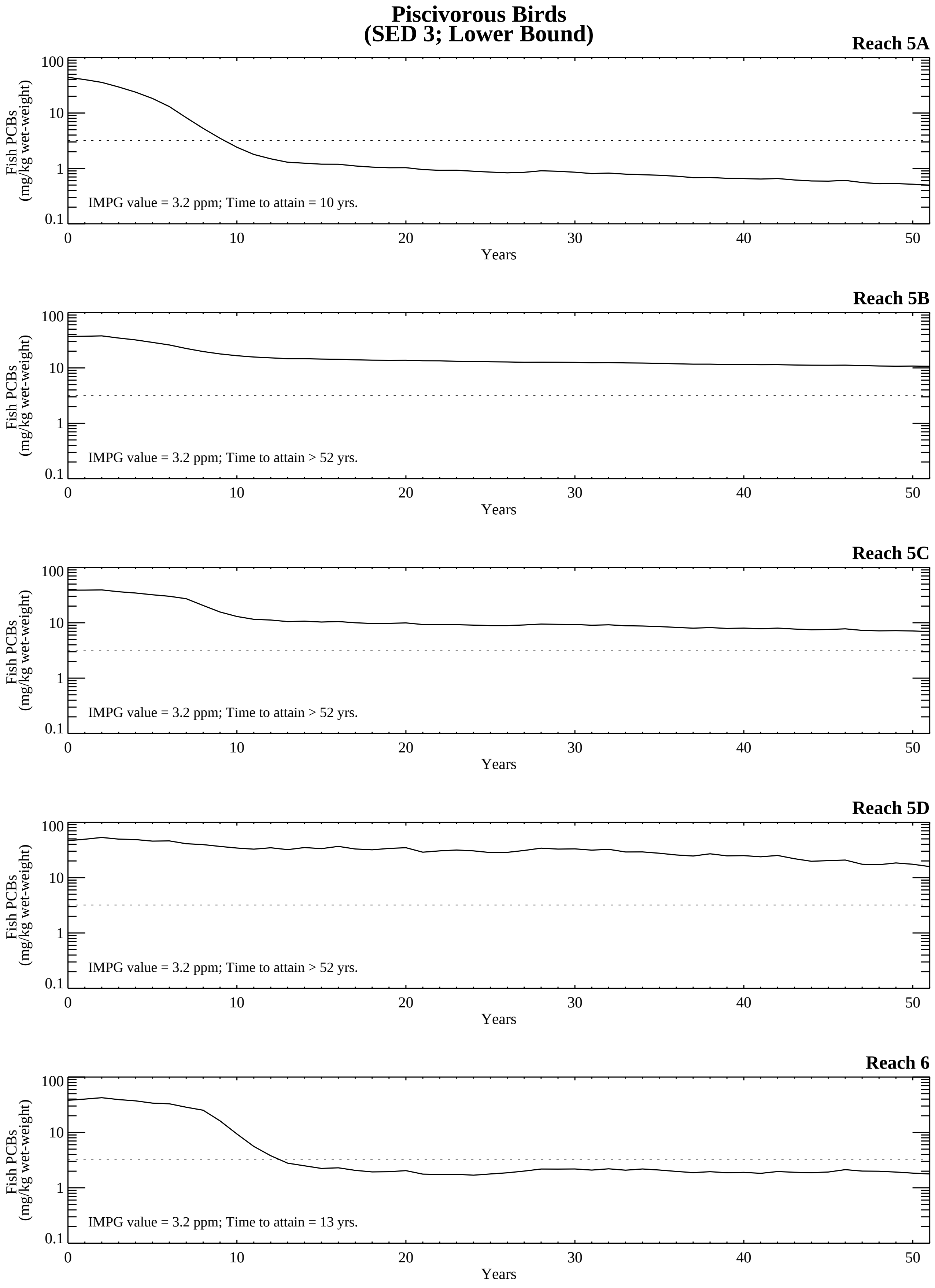

Figure G-11.3-2a. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 3; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

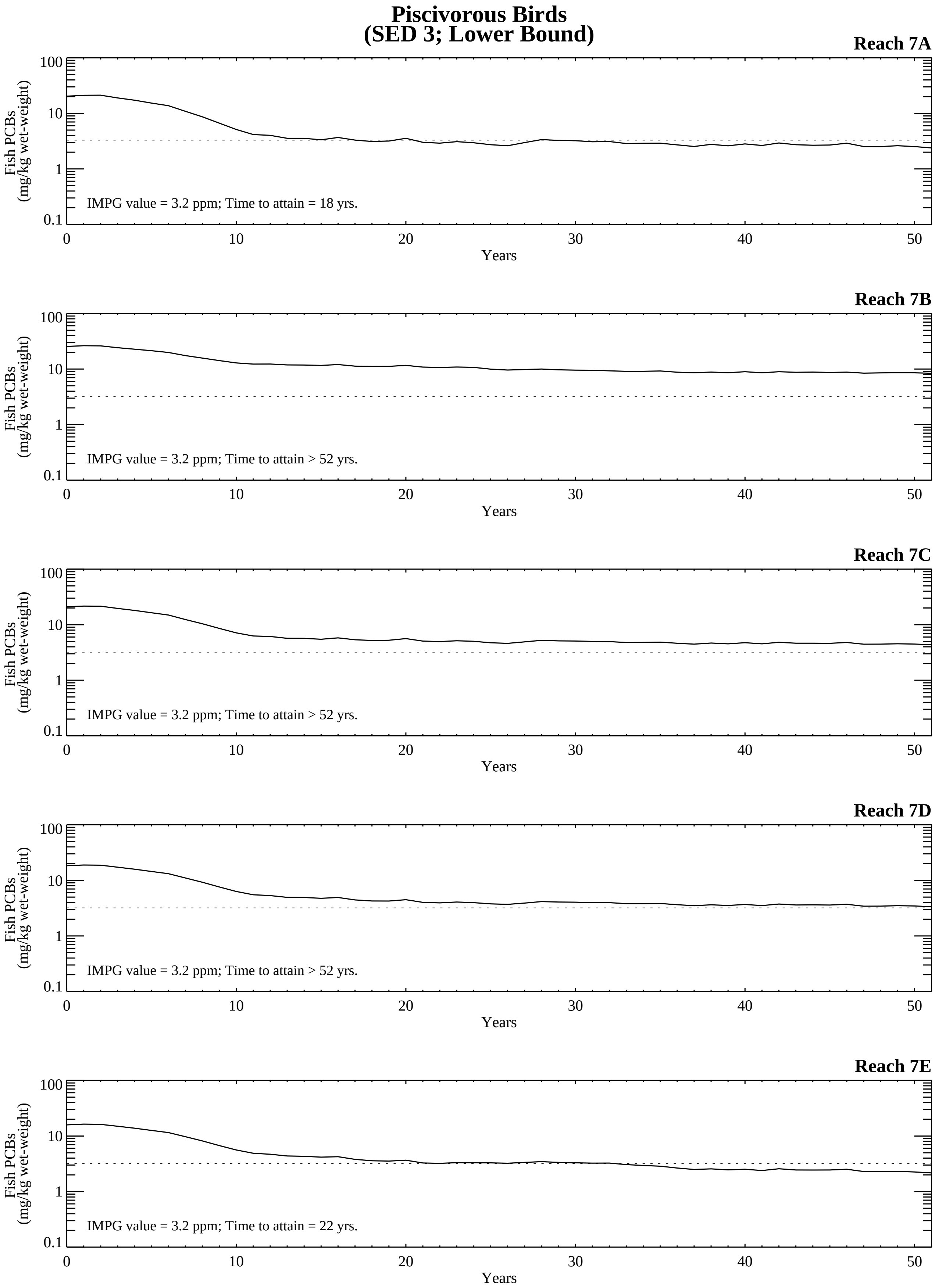

Figure G-11.3-2b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 3; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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Fri Mar 14 23:03:42 2008

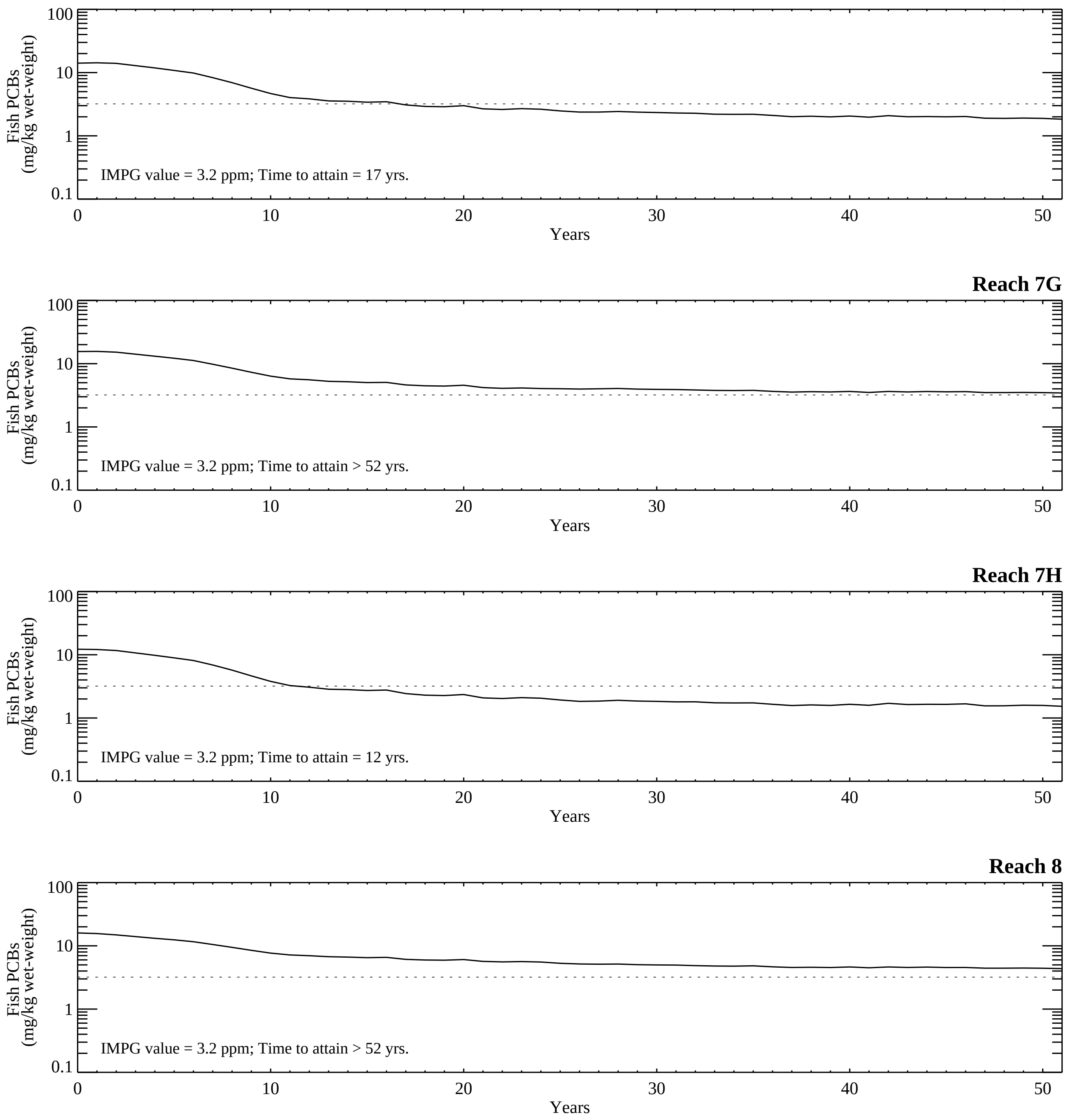
Piscivorous Birds
(SED 3; Lower Bound)

Figure G-11.3-2b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 3; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

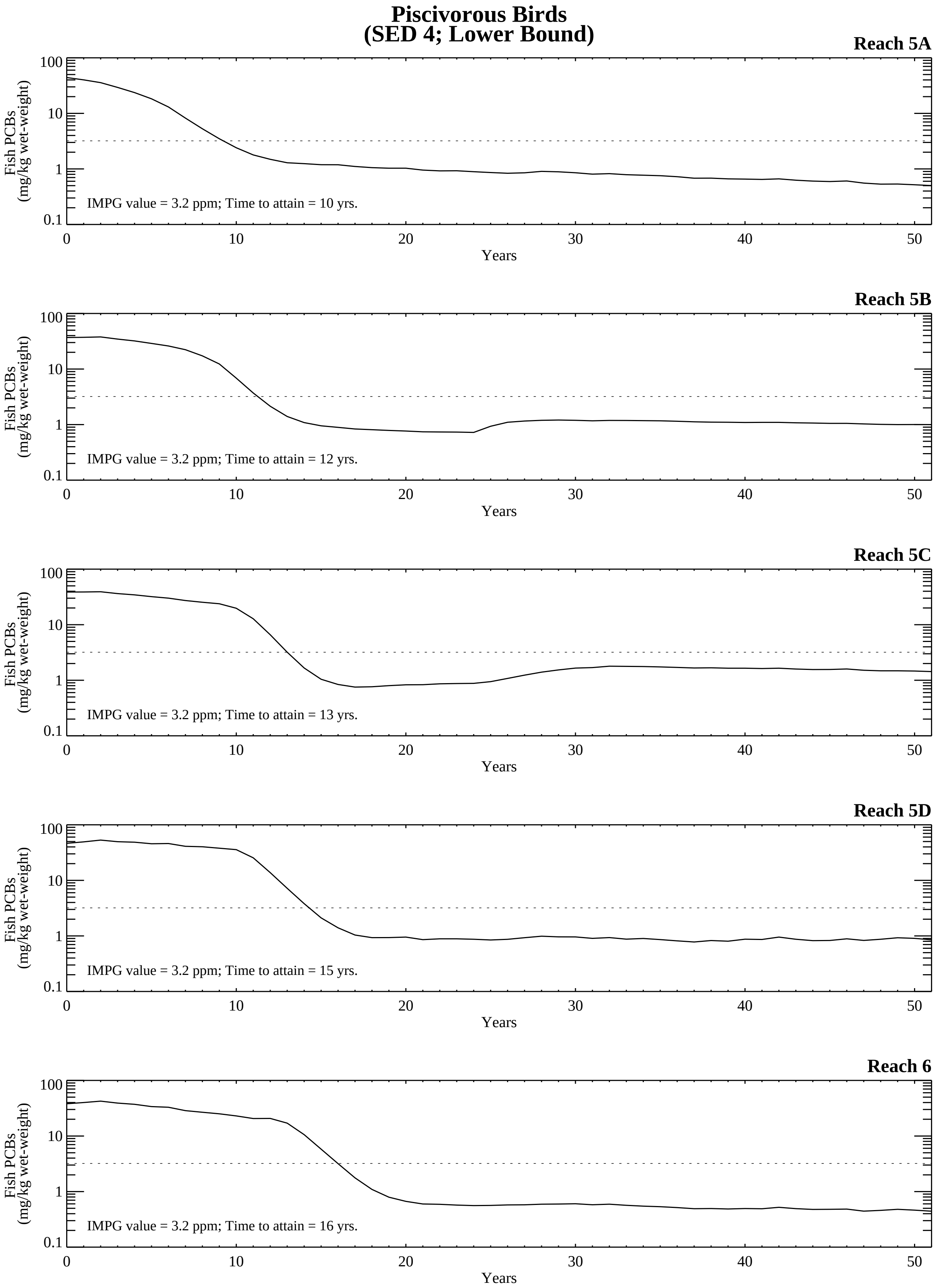

Figure G-11.3-3a. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 4; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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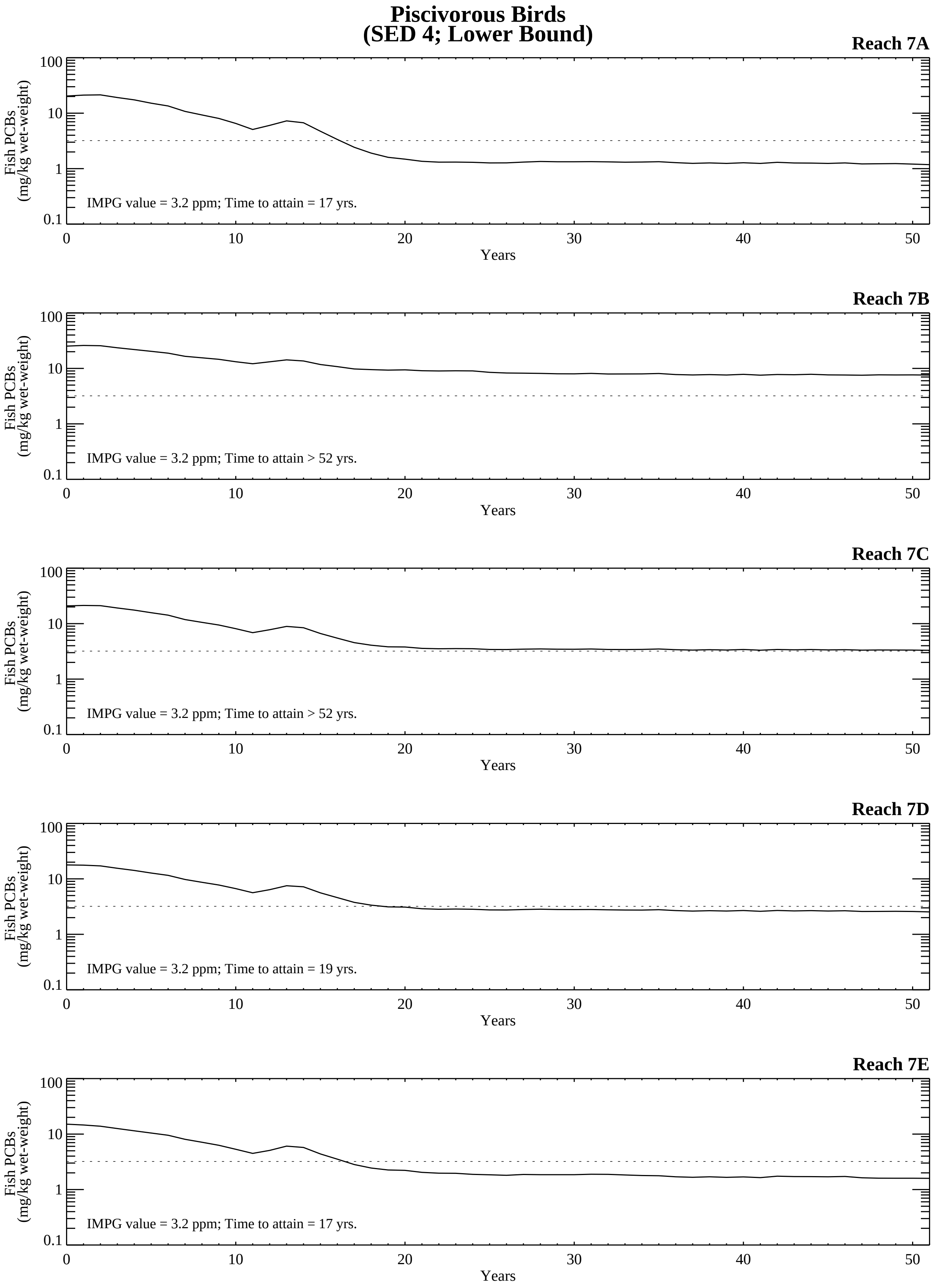

Figure G-11.3-3b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 4; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

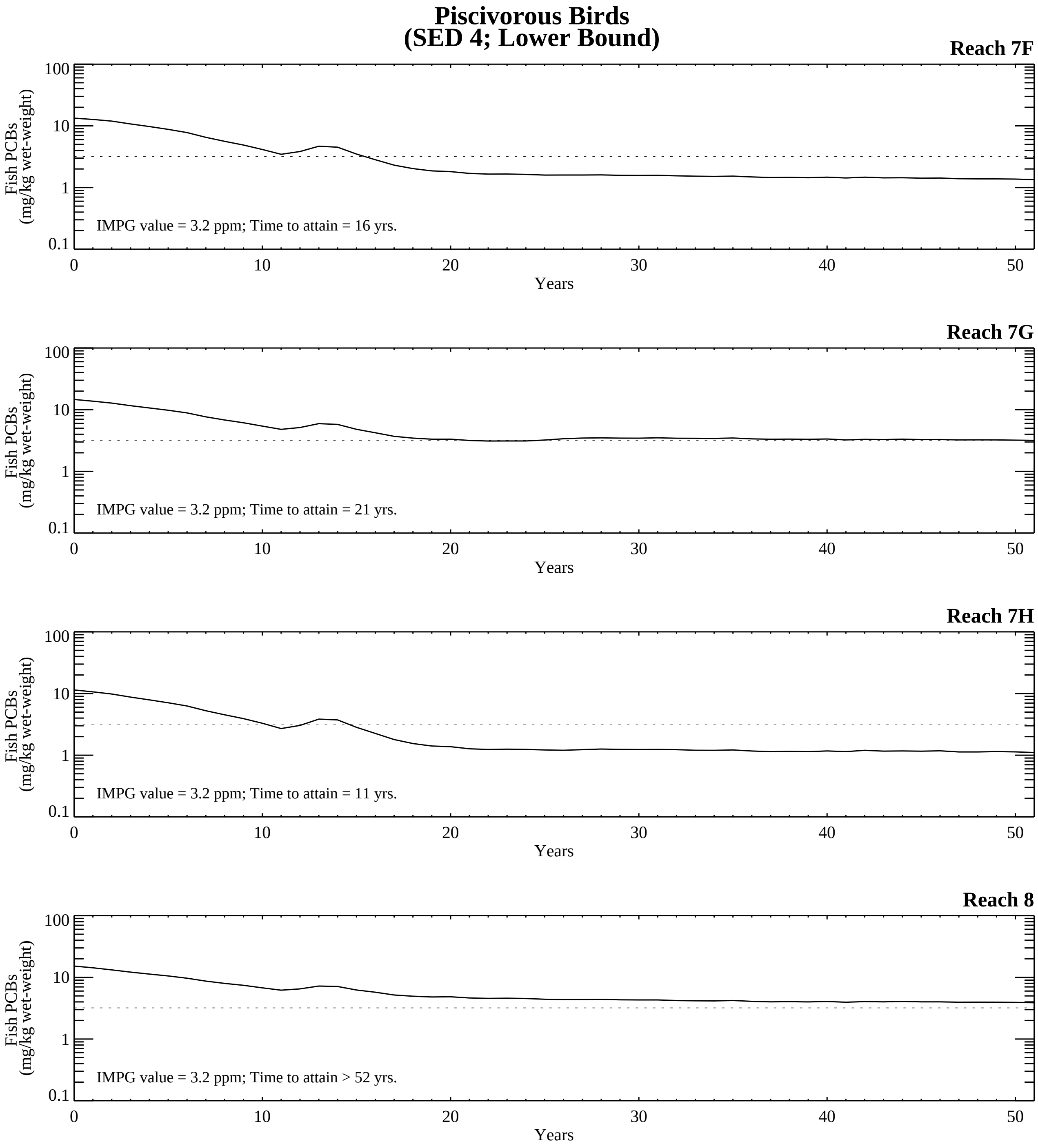

Figure G-11.3-3b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 4; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

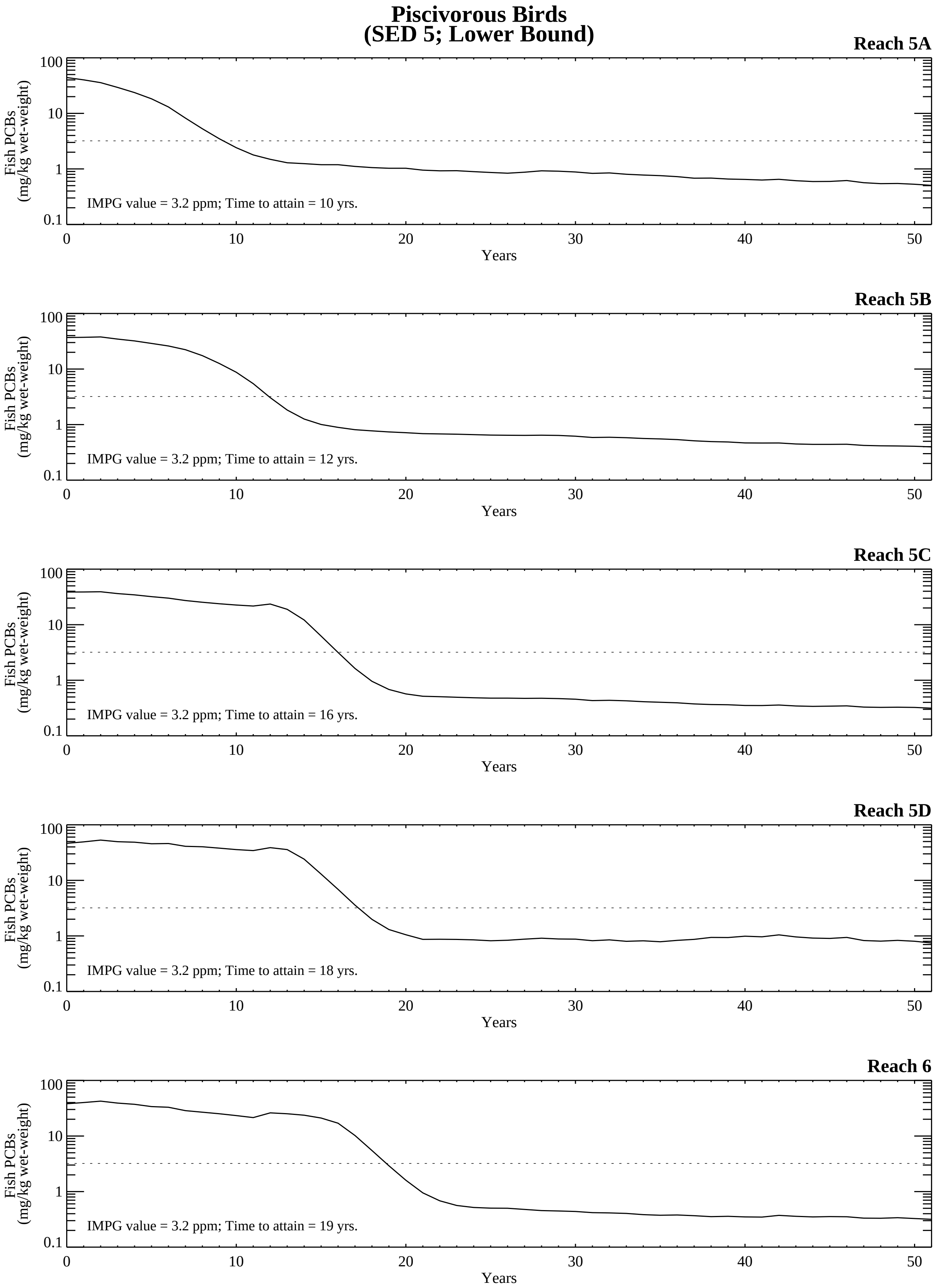

Figure G-11.3-4a. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 5; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

DR\LD - Z:\GENcms\MODEL\FDCHN\Analysis\IMPG\Fish\impg_tabulate_projections_loop.pro
Fri Mar 14 19:21:59 2008

Piscivorous Birds
(SED 5; Lower Bound)

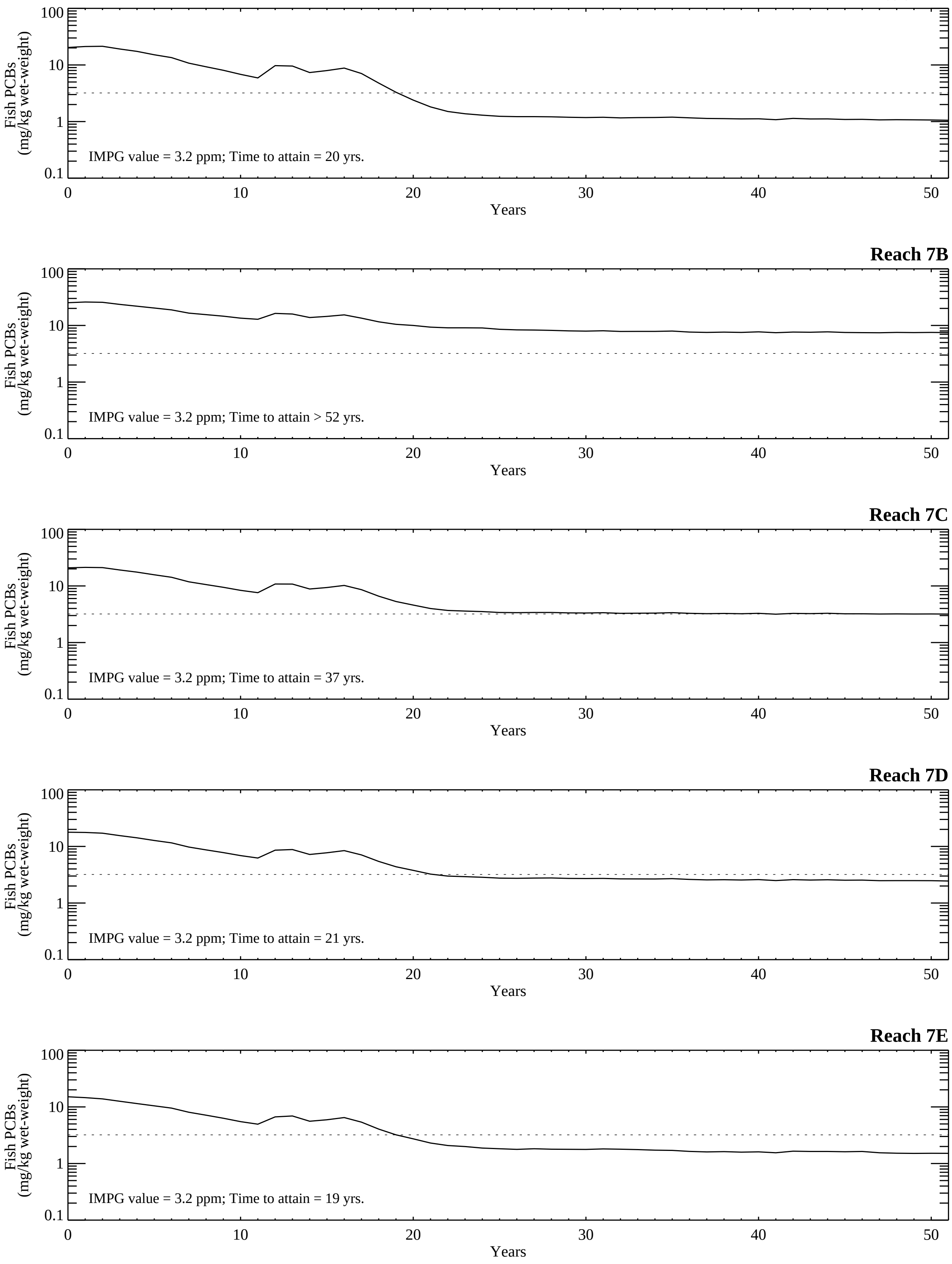

Figure G-11.3-4b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 5; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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Fri Mar 14 23:33:42 2008

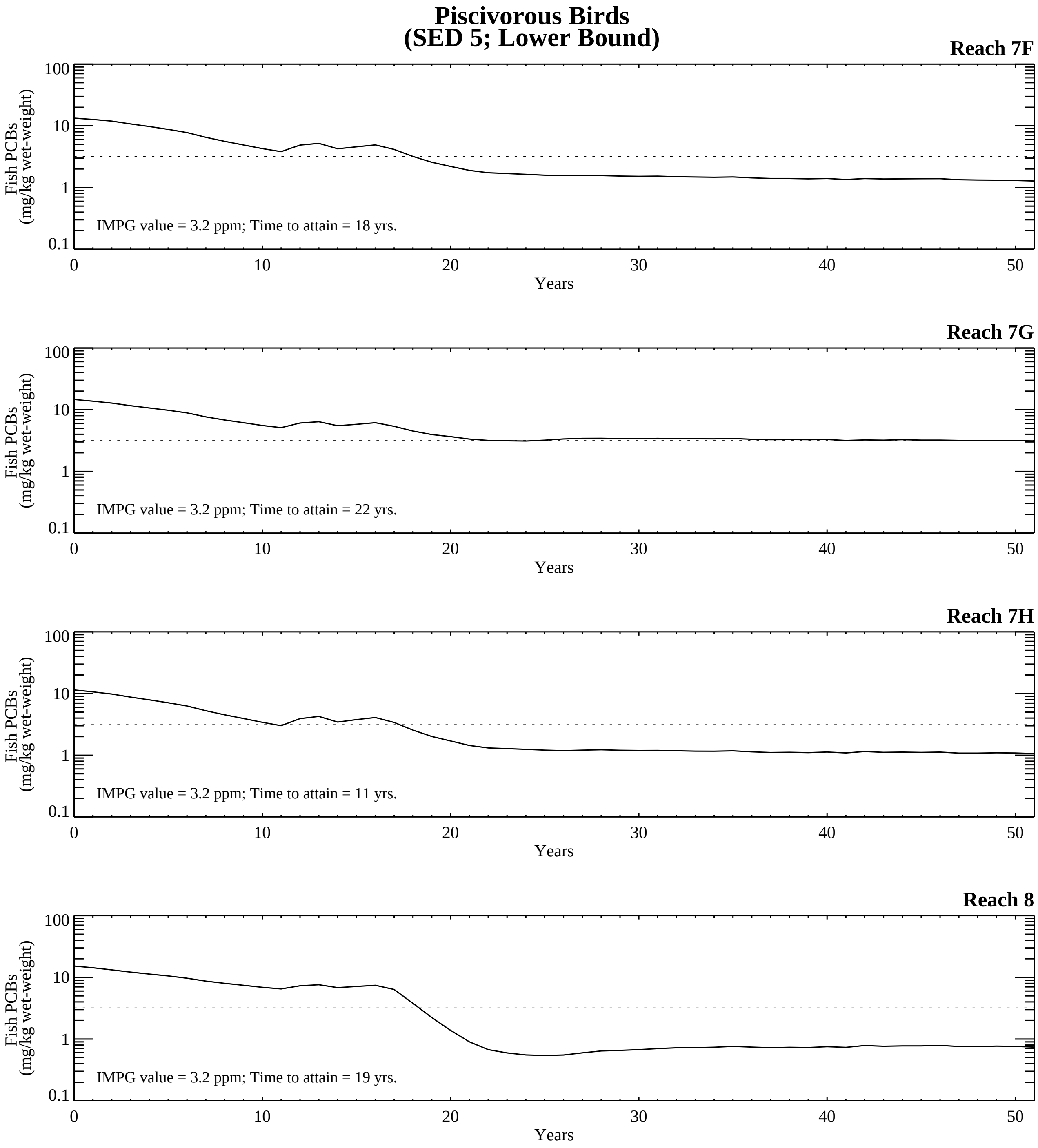

Figure G-11.3-4b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 5; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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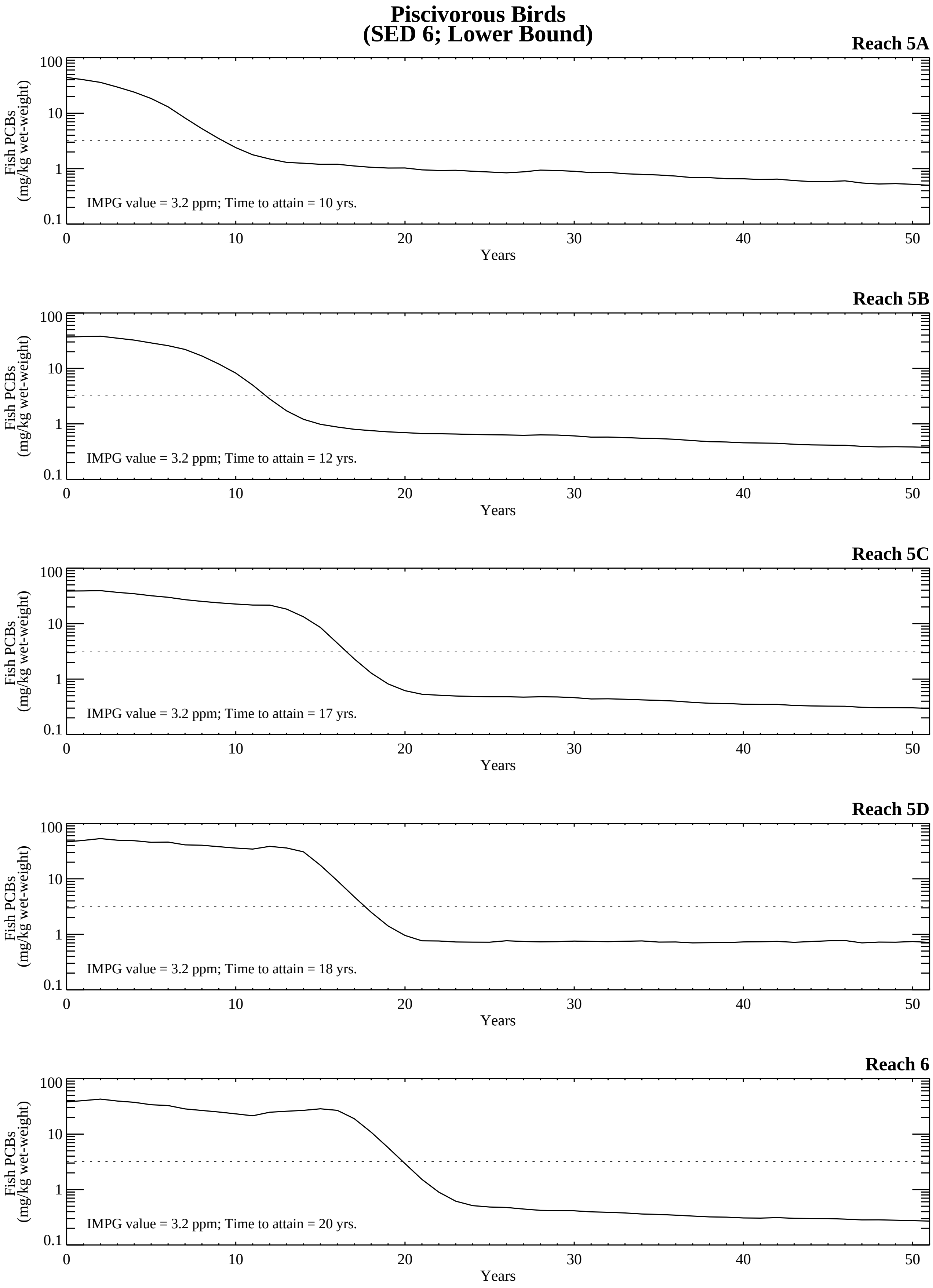

Figure G-11.3-5a. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 6; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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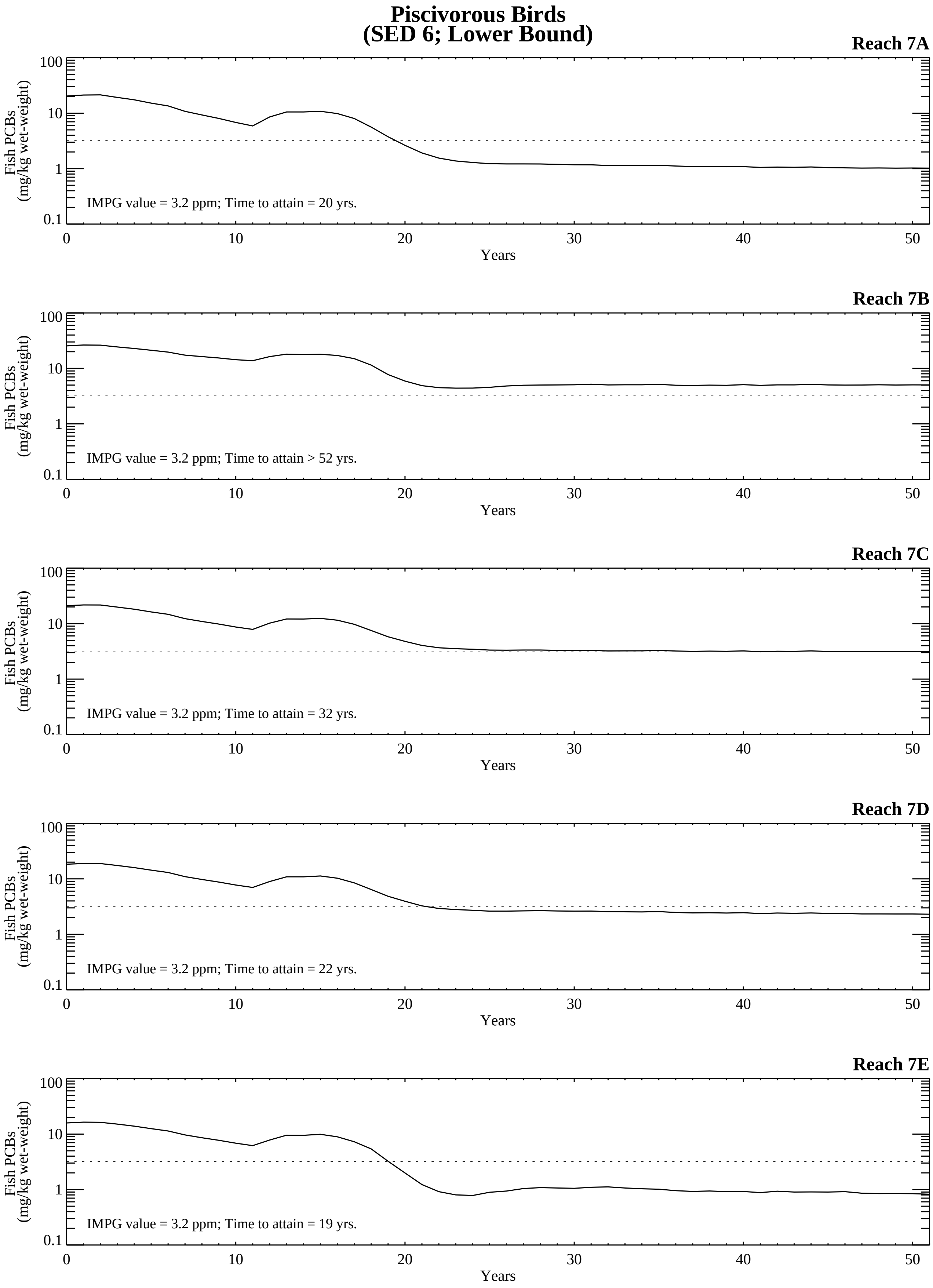
Piscivorous Birds
(SED 6; Lower Bound)

Reach 7A

IMPG value = 3.2 ppm; Time to attain = 20 yrs.

Reach 7B

IMPG value = 3.2 ppm; Time to attain > 52 yrs.

Reach 7C

IMPG value = 3.2 ppm; Time to attain = 32 yrs.

Reach 7D

IMPG value = 3.2 ppm; Time to attain = 22 yrs.

Reach 7E

IMPG value = 3.2 ppm; Time to attain = 19 yrs.

Figure G-11.3-5b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 6; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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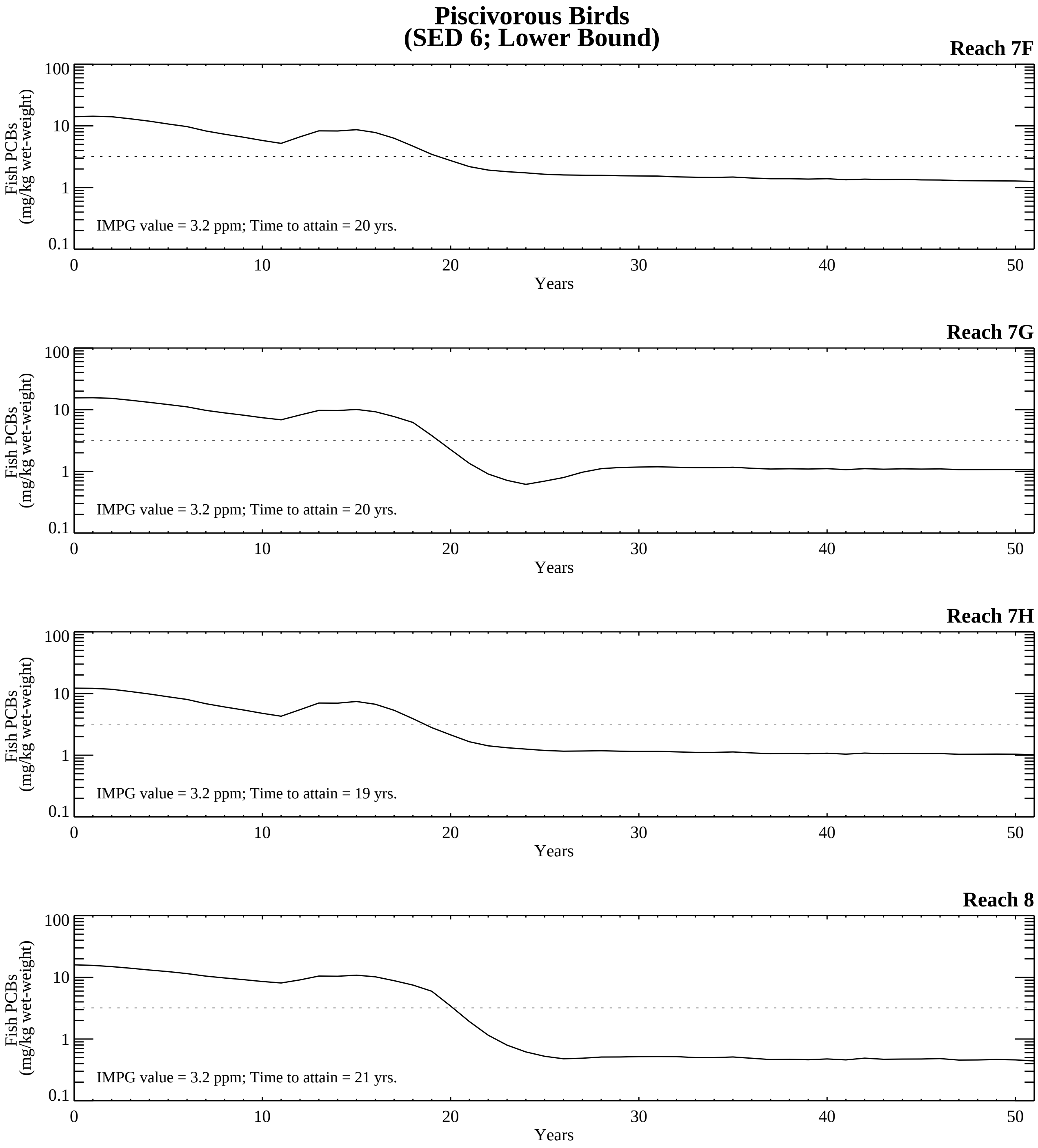

Figure G-11.3-5b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 6; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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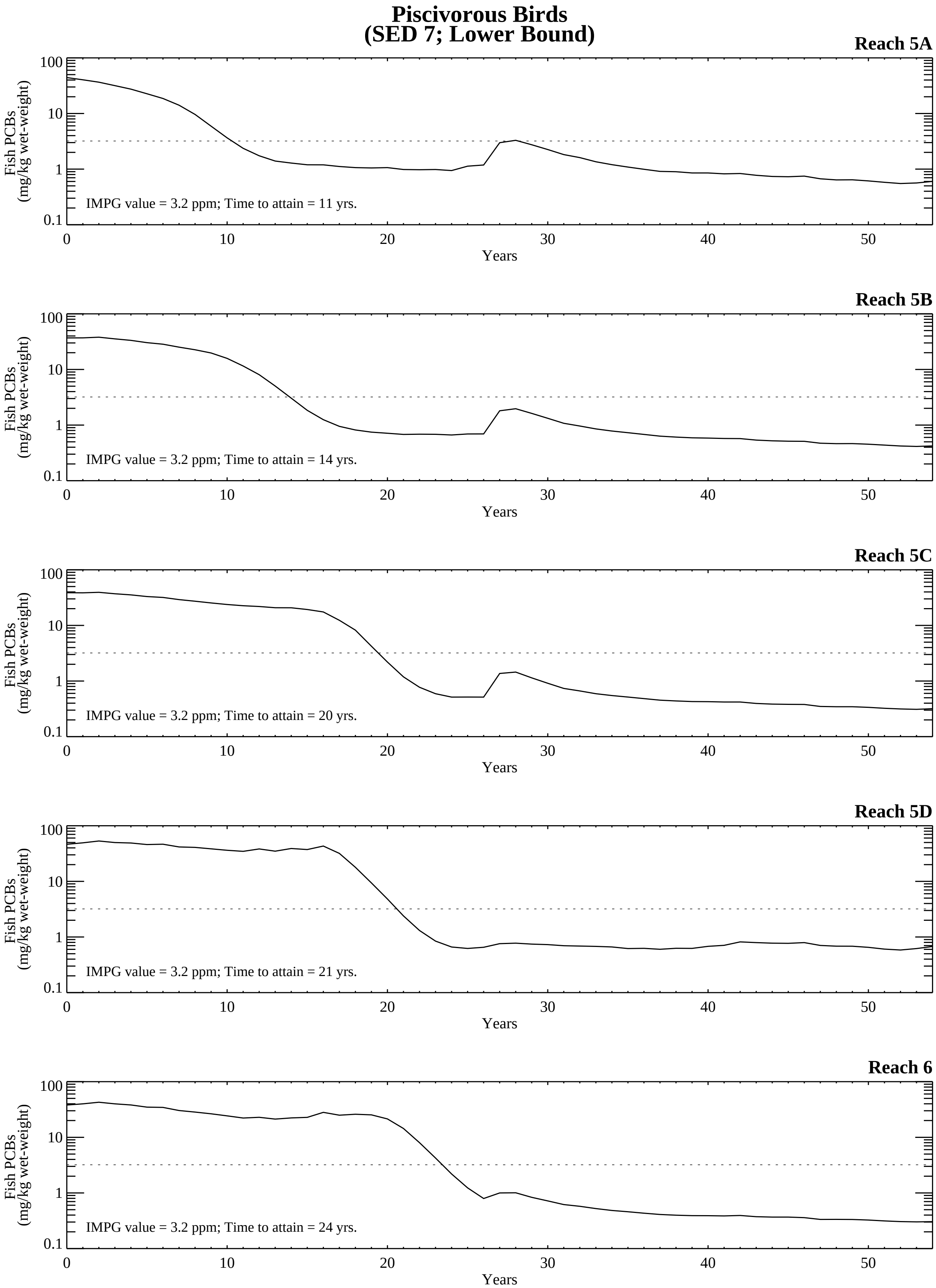

Figure G-11.3-6a. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 7; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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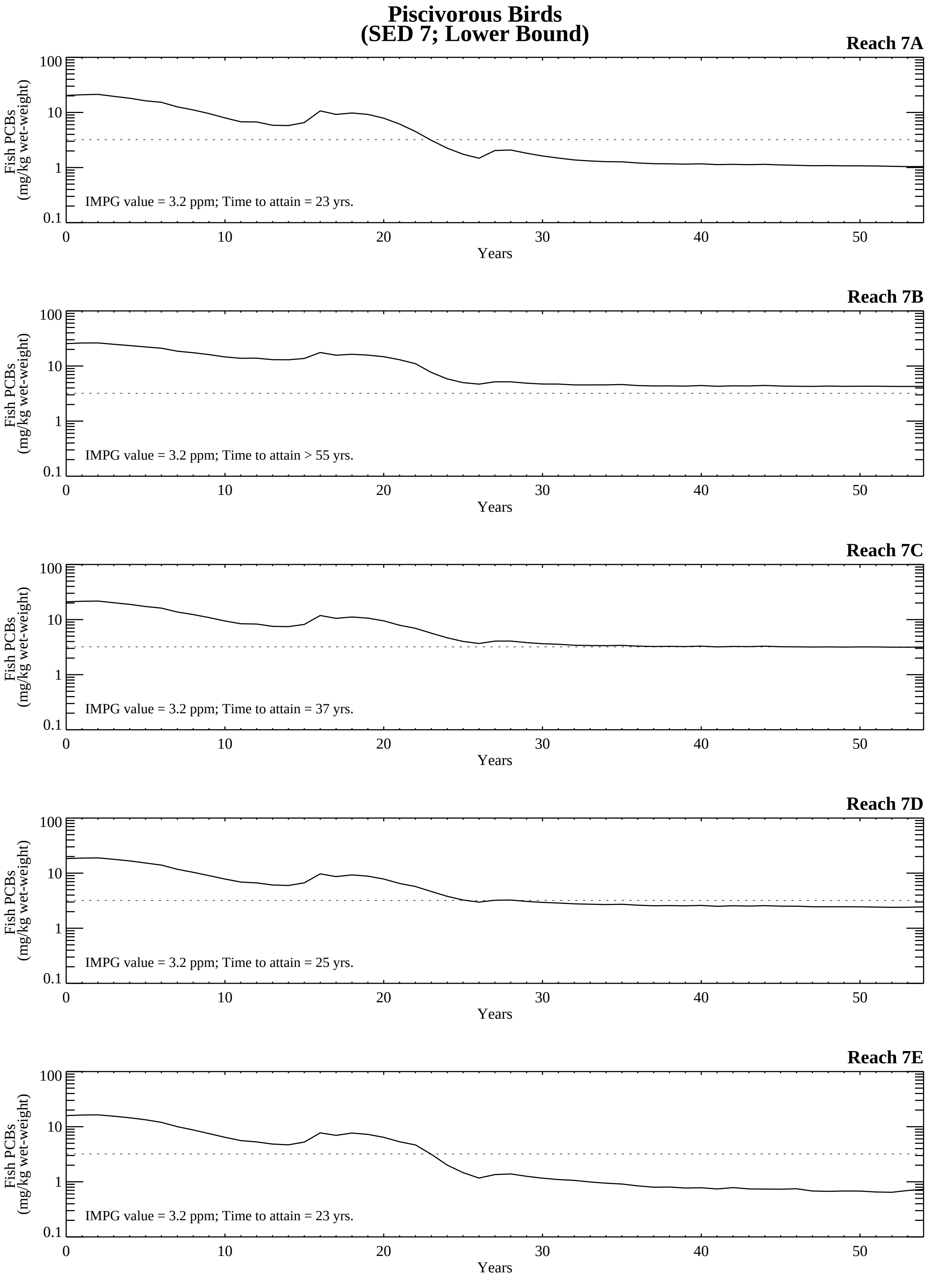

Figure G-11.3-6b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 7; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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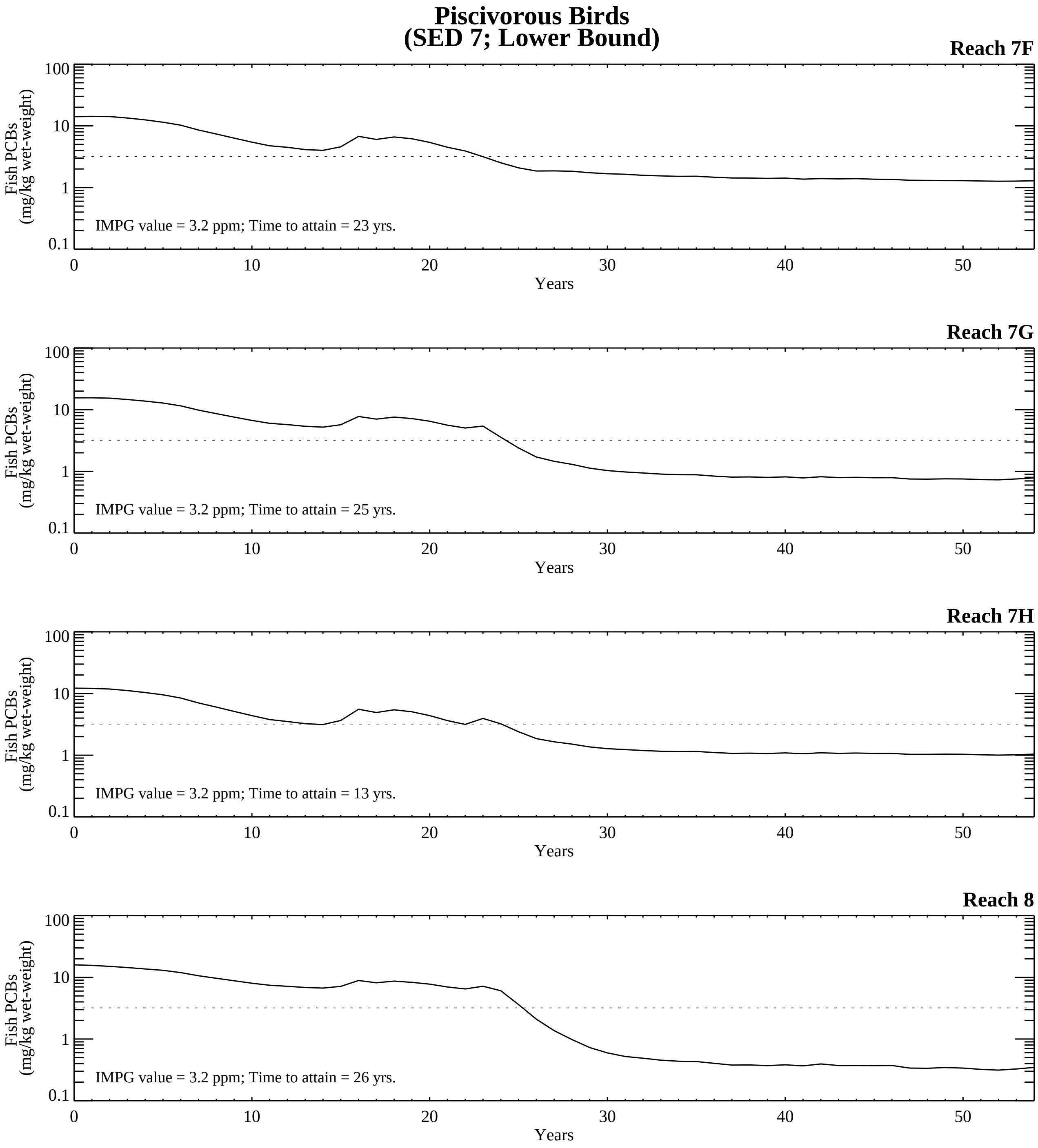

Figure G-11.3-6b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 7; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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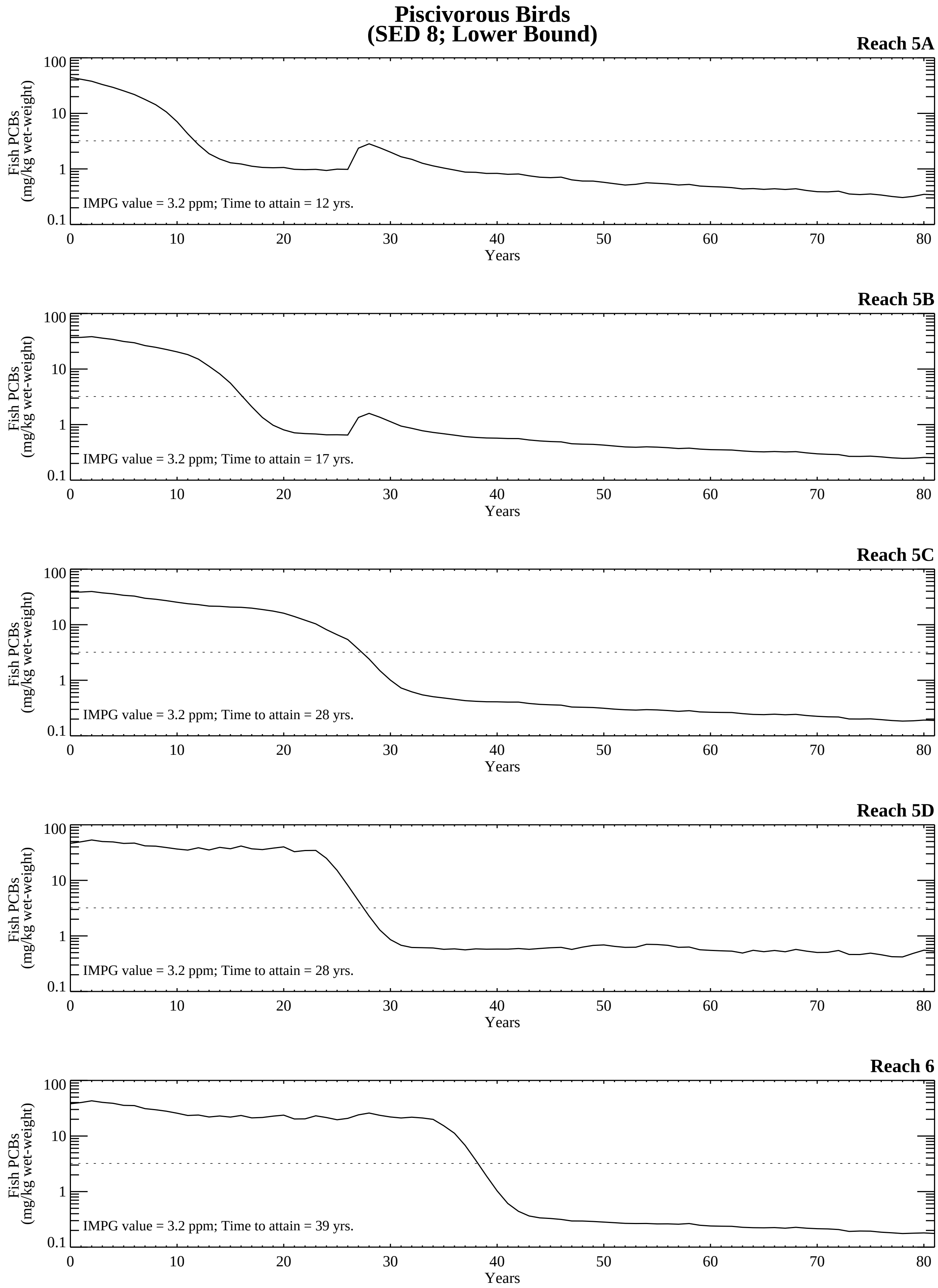

Figure G-11.3-7a. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 8; Reach 5/6; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

DR\LD - Z:\GENcms\MODEL\FDCHN\Analysis\IMPG\Fish\impg_tabulate_projections_loop.pro
Fri Mar 14 20:33:41 2008

Piscivorous Birds
(SED 8; Lower Bound)

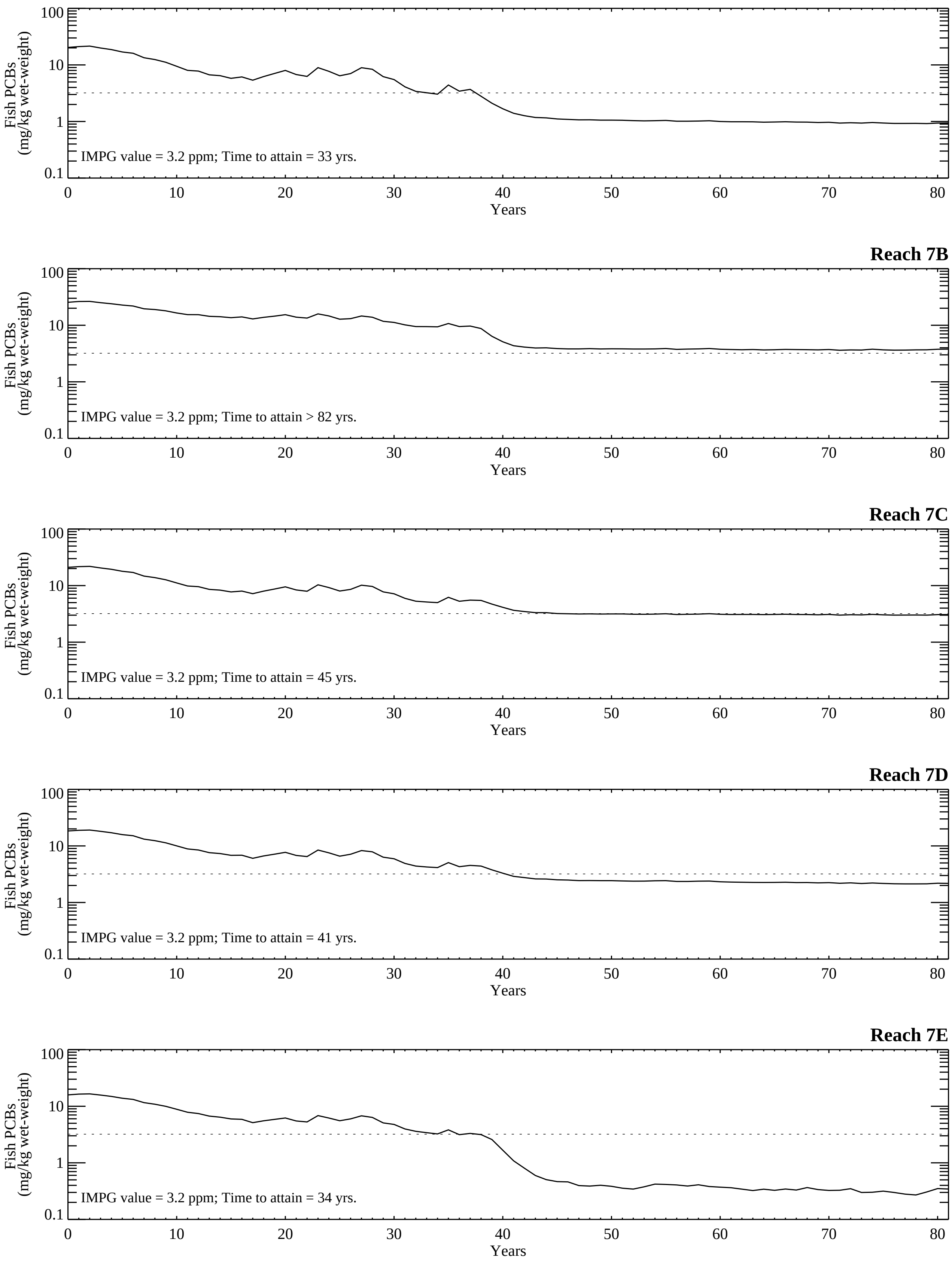

Figure G-11.3-7b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 8; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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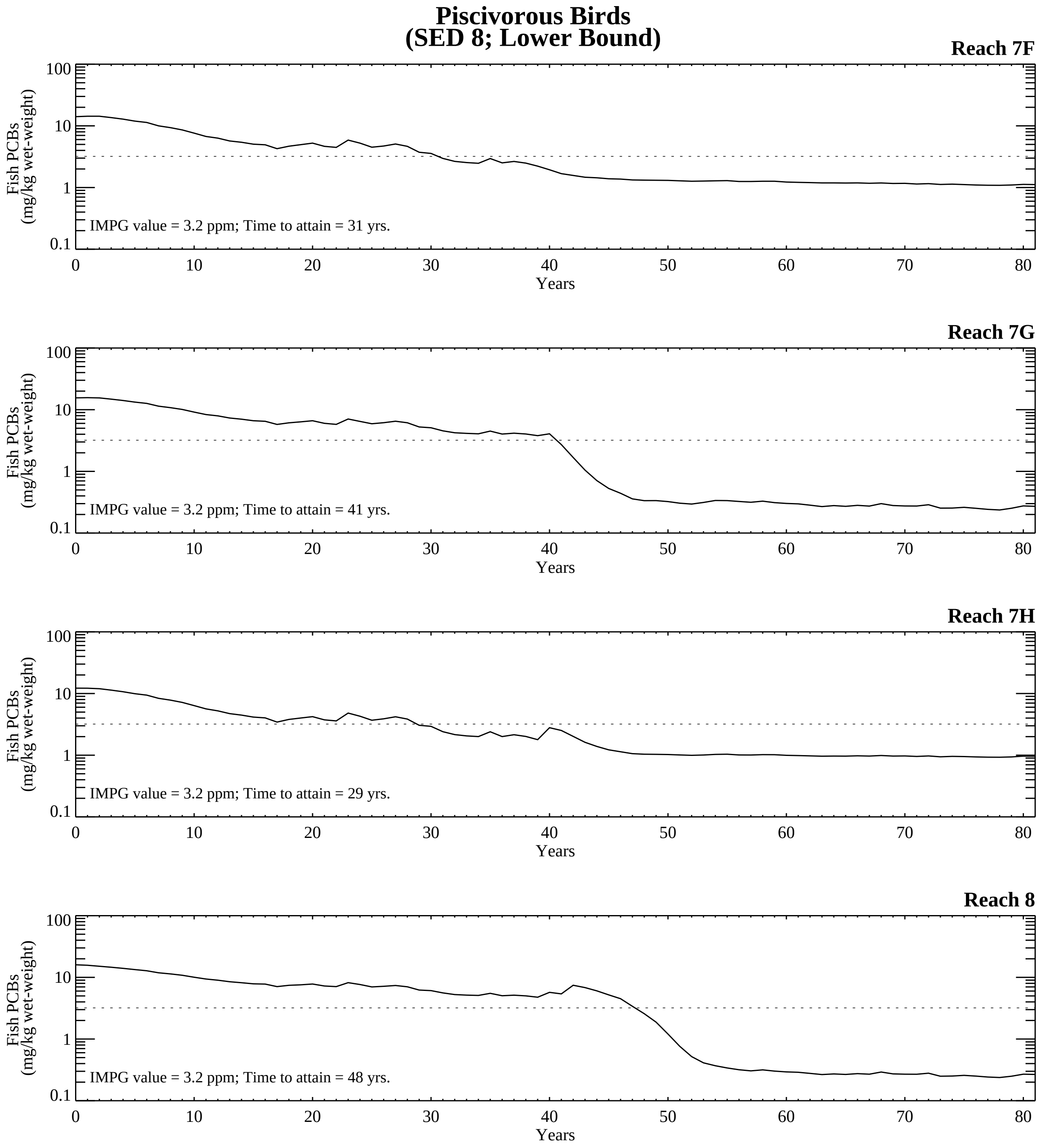

Figure G-11.3-7b. Temporal profiles of model-predicted PCB concentrations in fish compared to the IMPG for piscivorous birds (SED 8; Reach 7/8; Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year. Average calculated for largemouth bass (20%), brown bullhead (20%), and white sucker (20%) ages 2+, pumpkinseed (20%) ages 3+, and cyprinids (20%) ages 6+.

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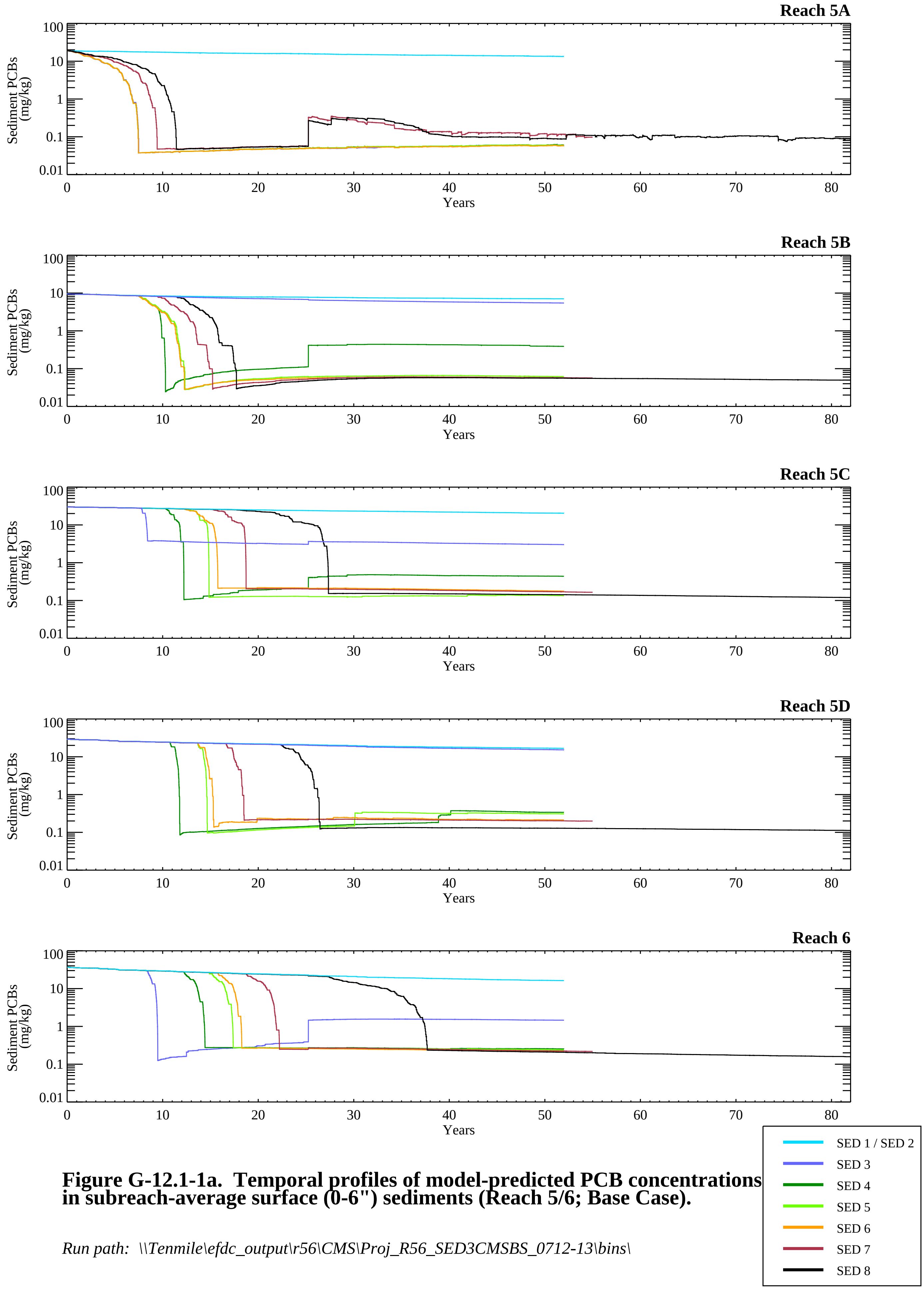

Figure G-12.1-1a. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (Reach 5/6; Base Case).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED3CMSBS_0712-13\bins

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Tue Mar 18 20:03:21 2008

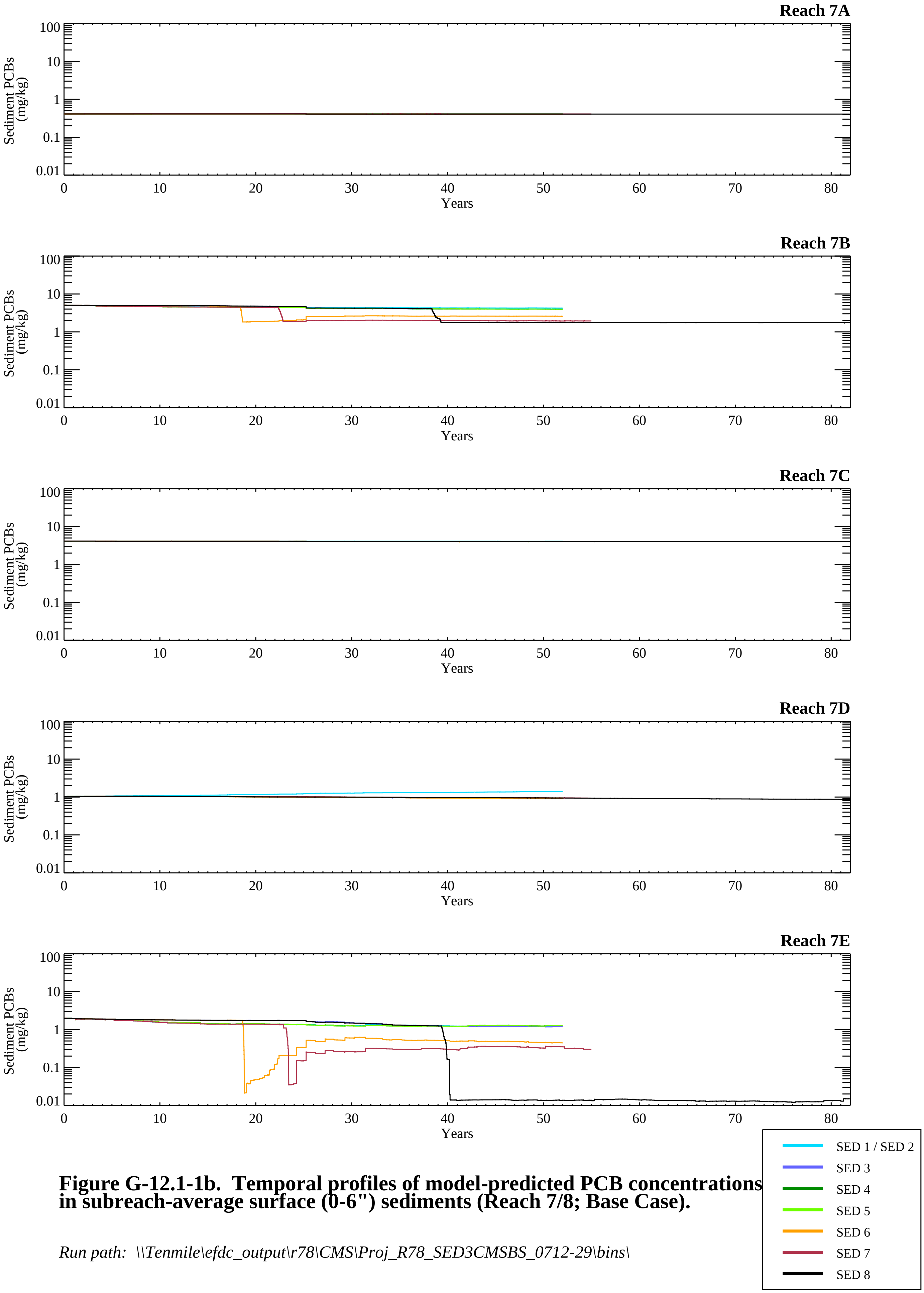

Figure G-12.1-1b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (Reach 7/8; Base Case).

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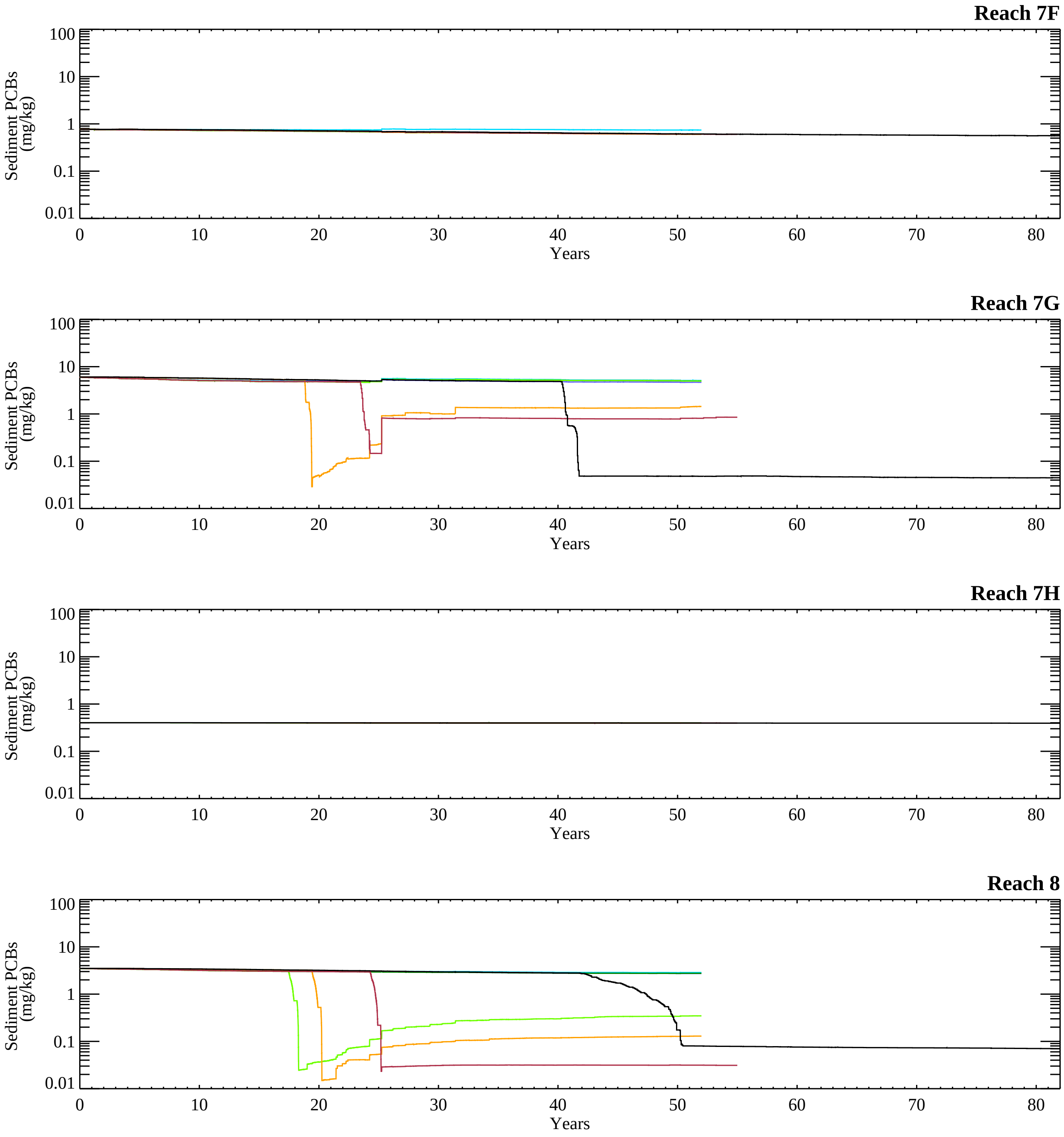

Figure G-12.1-1b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (Reach 7/8; Base Case).

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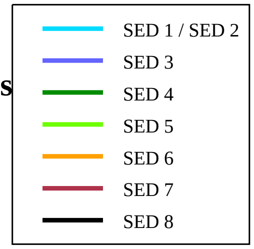

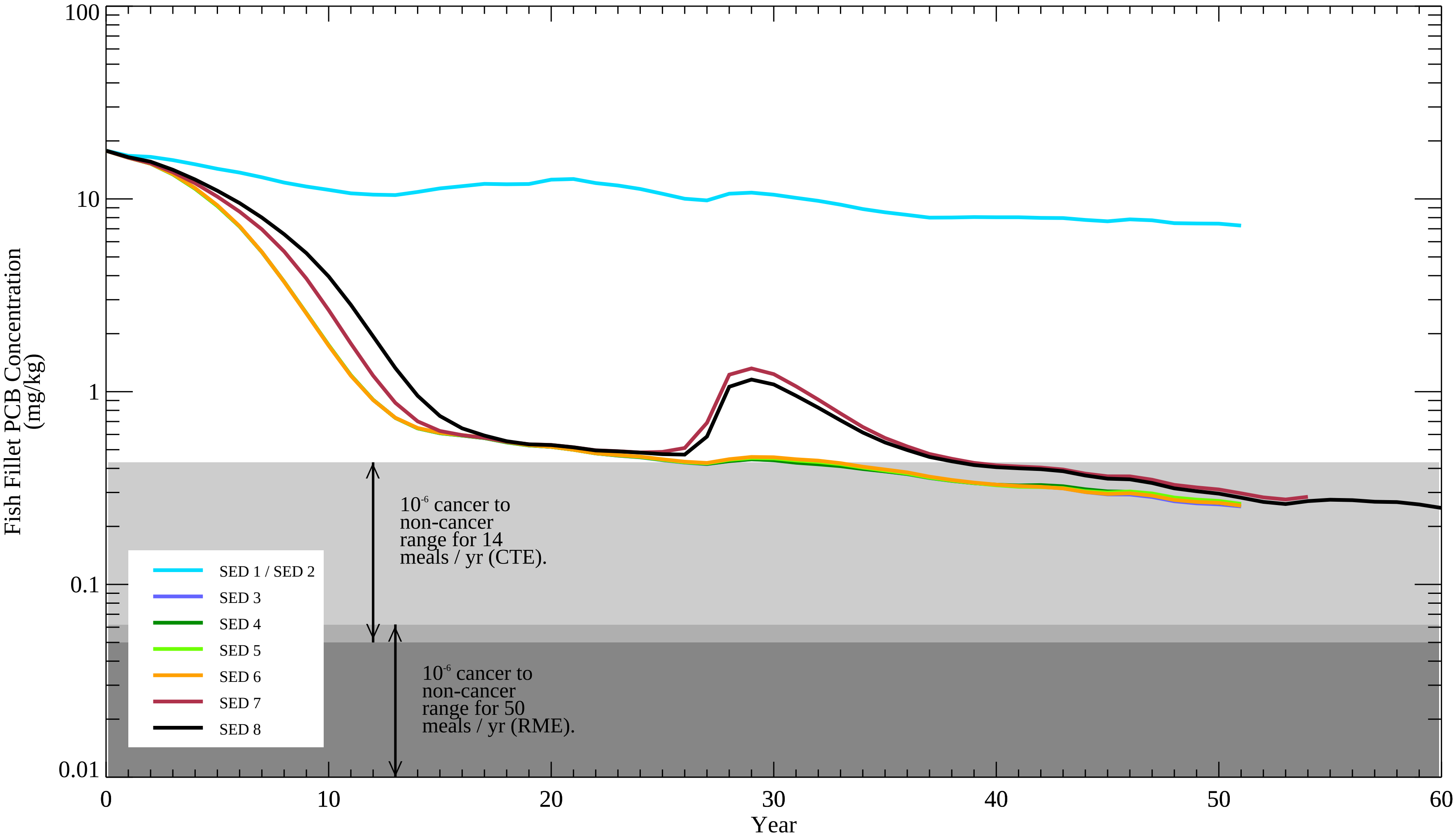

Figure G-12.2-1a. Average fillet PCB concentrations in largemouth bass from Reach 5A

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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Tue Mar 18 12:52:56 2008

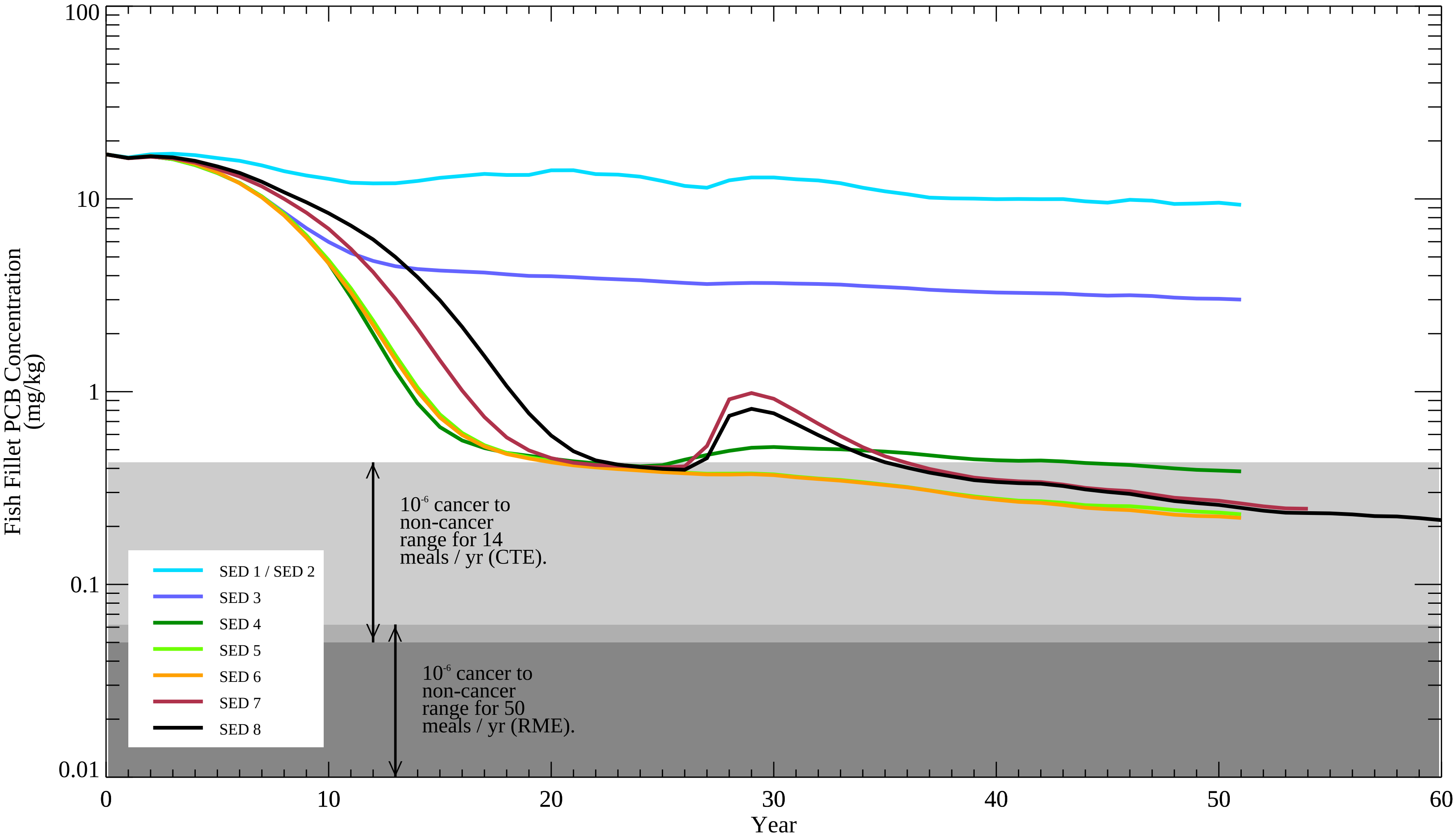

Figure G-12.2-1b. Average fillet PCB concentrations in largemouth bass from Reach 5B

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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Tue Mar 18 12:56:06 2008

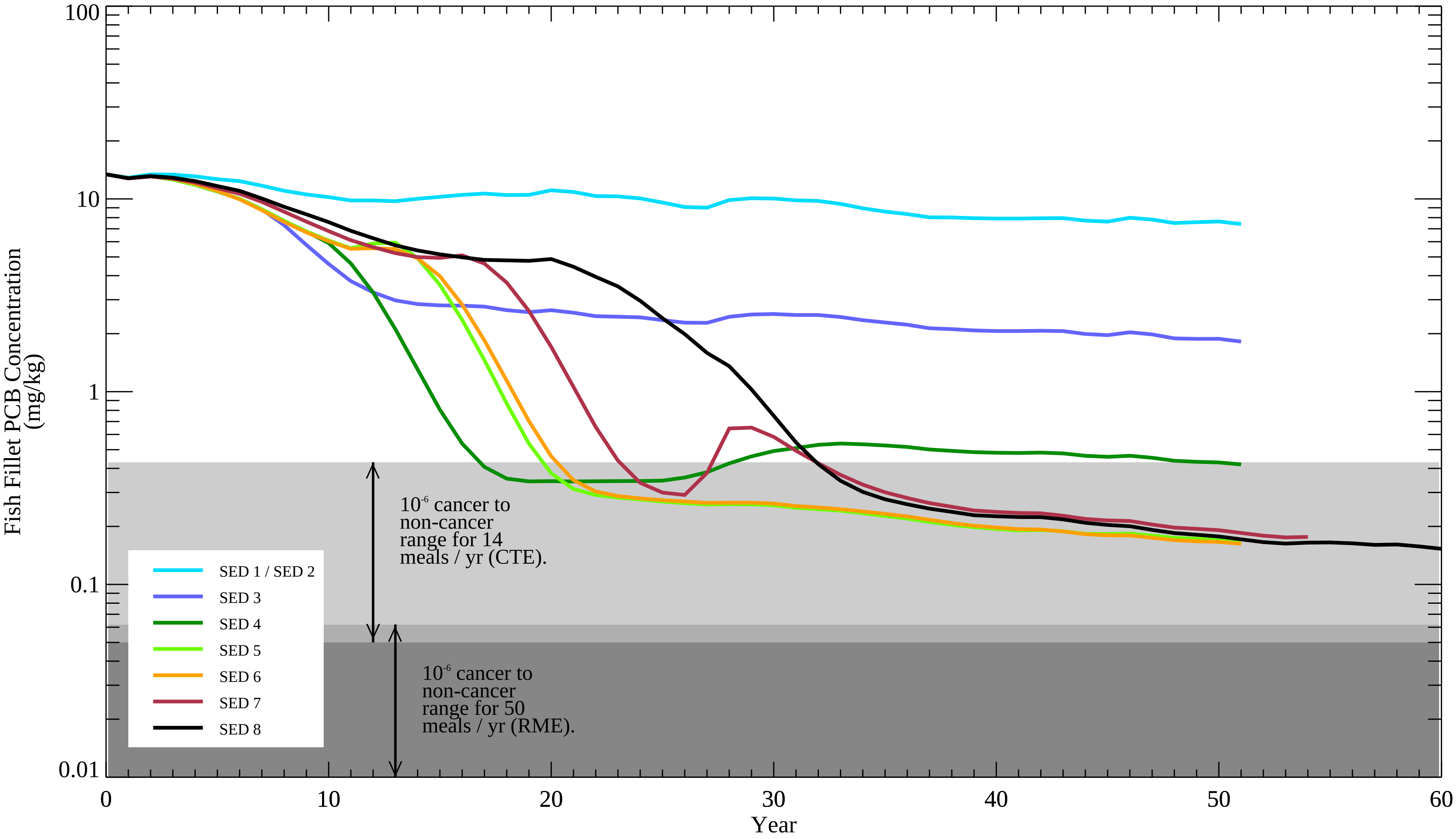

Figure G-12.2-1c. Average fillet PCB concentrations in largemouth bass from Reach 5C

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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Tue Mar 18 12:59:17 2008

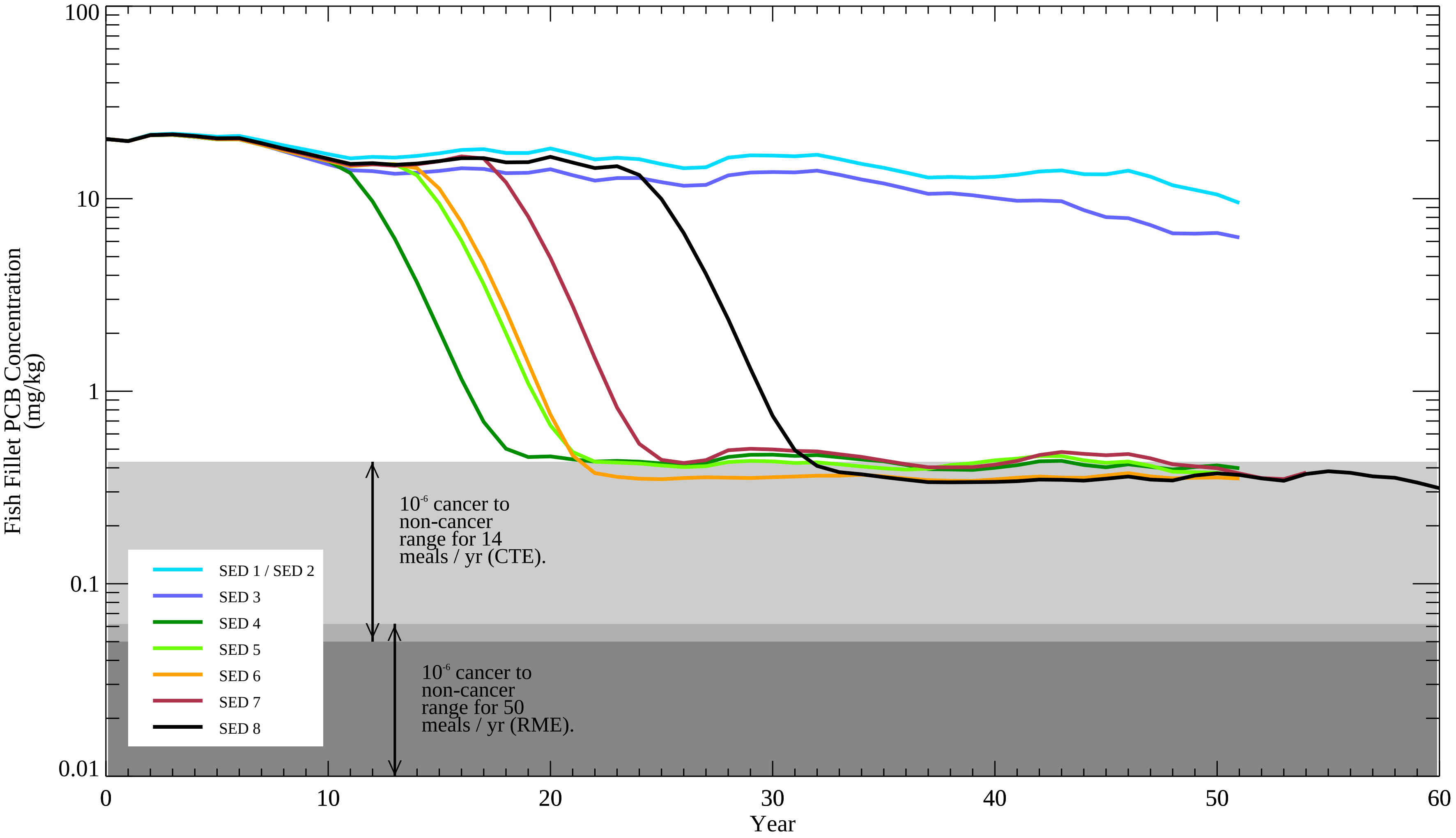

Figure G-12.2-1d. Average fillet PCB concentrations in largemouth bass from Reach 5D

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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Tue Mar 18 13:02:26 2008

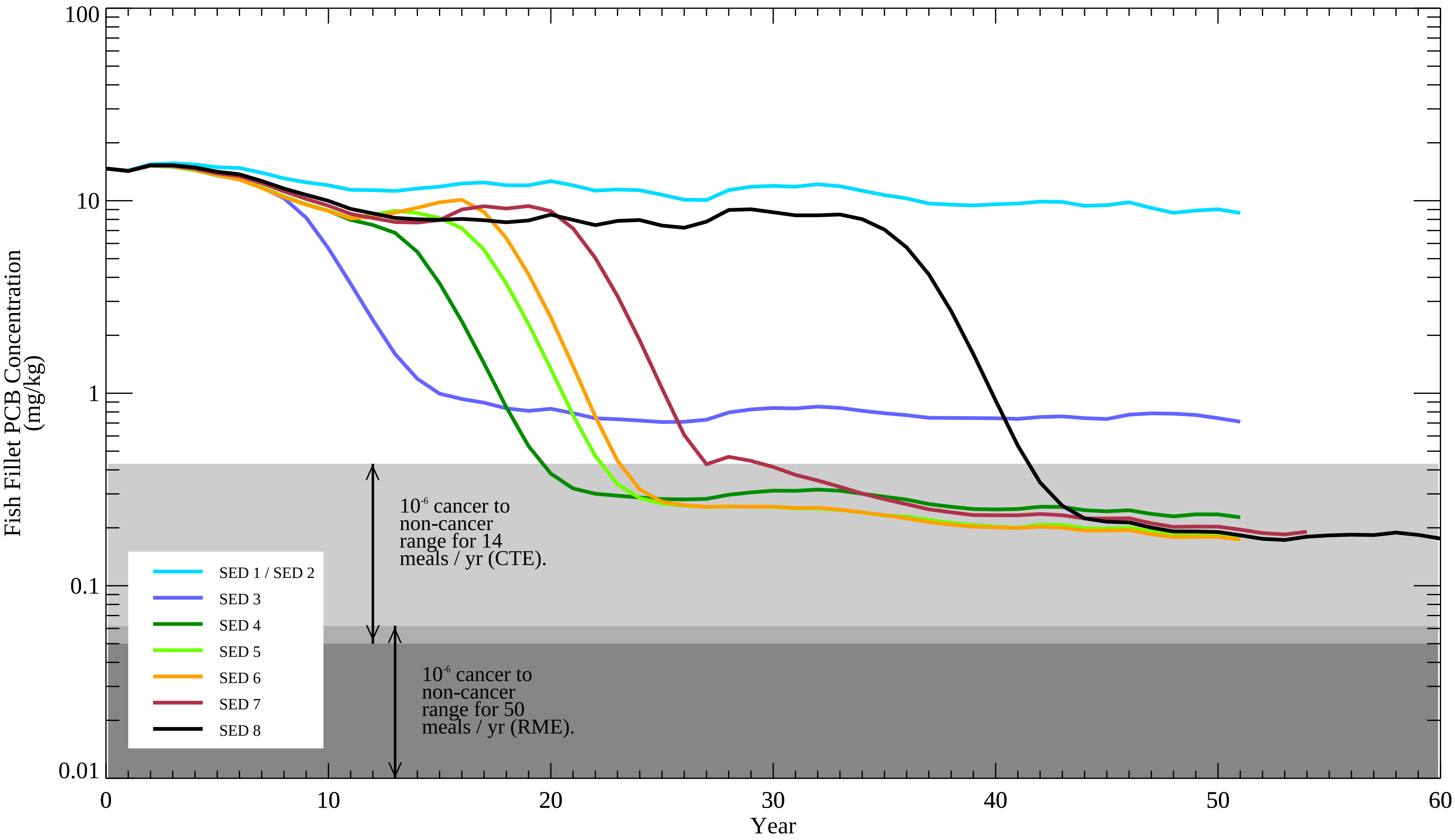

Figure G-12.2-1e. Average fillet PCB concentrations in largemouth bass from Reach 6

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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Tue Mar 18 13:05:35 2008

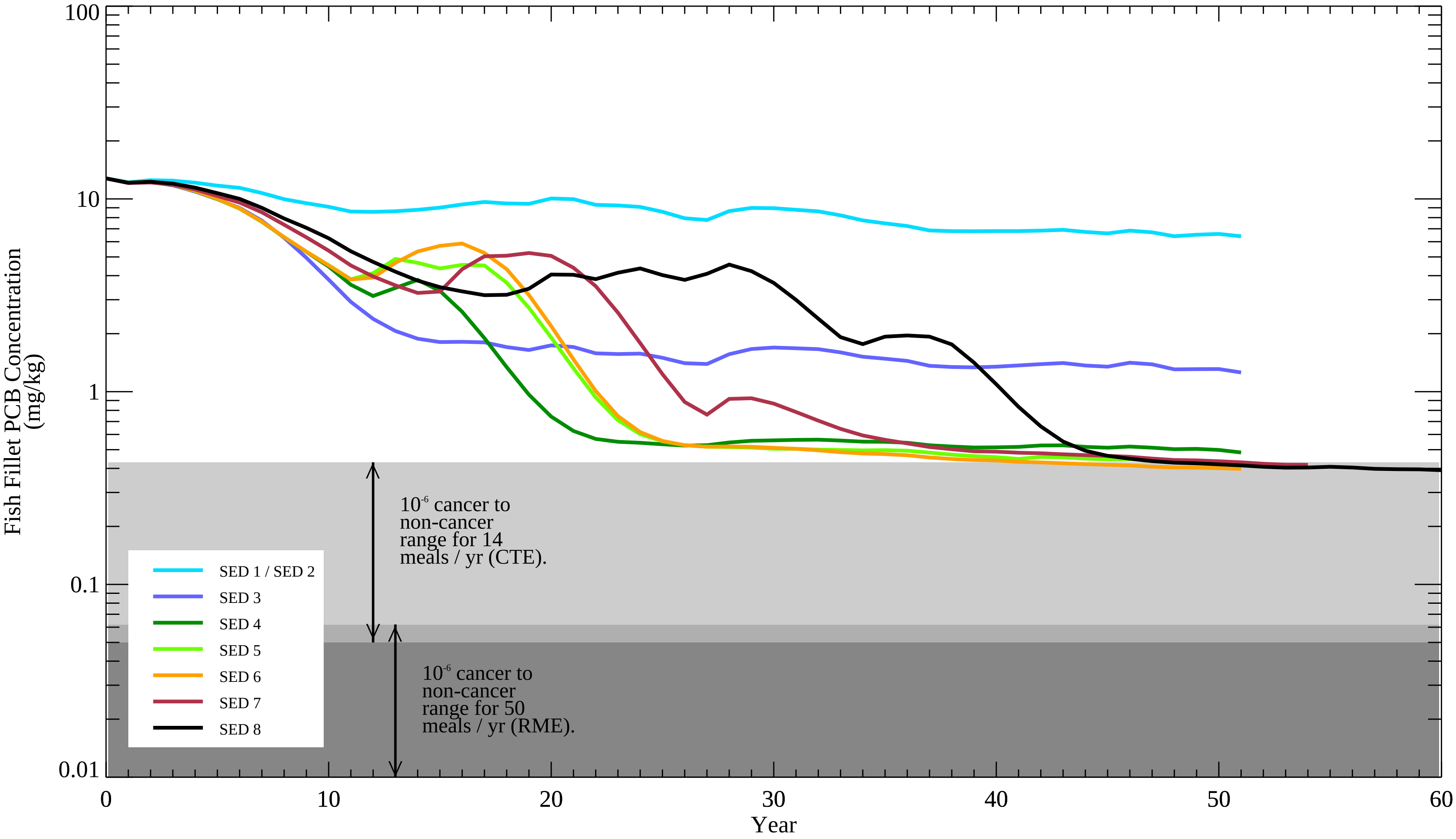

Figure G-12.2-1f. Average fillet PCB concentrations in largemouth bass from Reach 7A

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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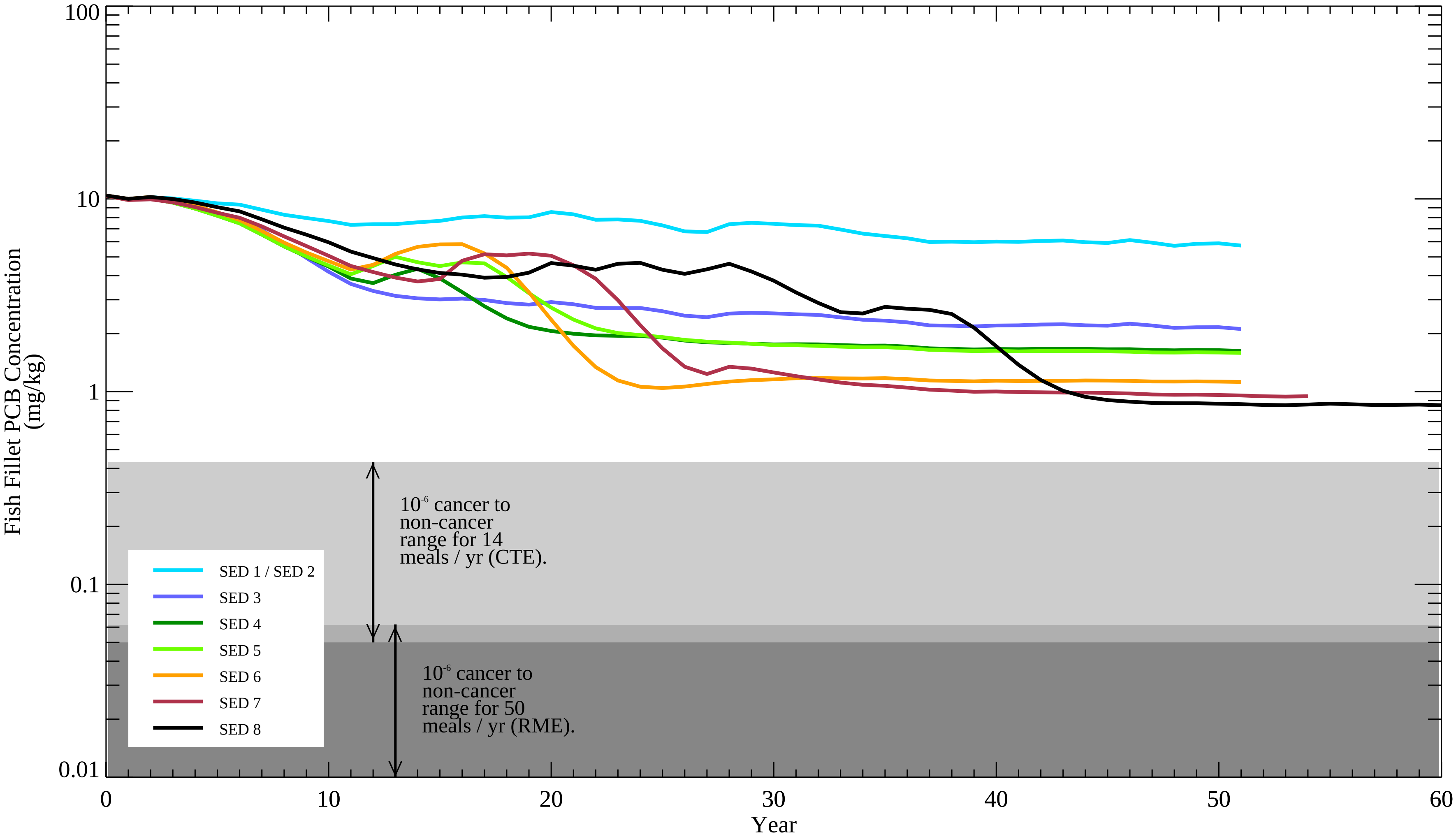

Figure G-12.2-1g. Average fillet PCB concentrations in largemouth bass from Reach 7B

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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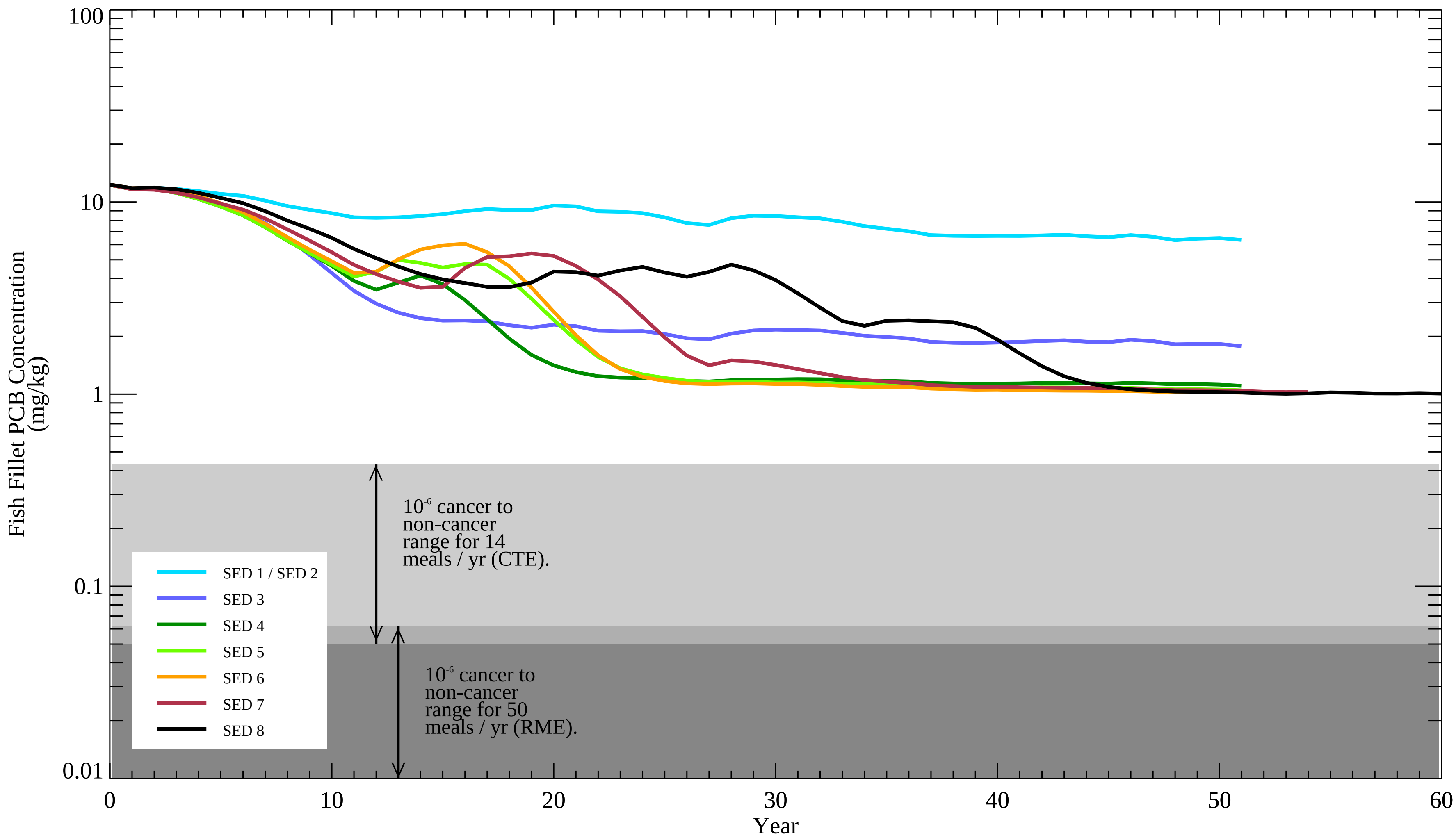

Figure G-12.2-1h. Average fillet PCB concentrations in largemouth bass from Reach 7C

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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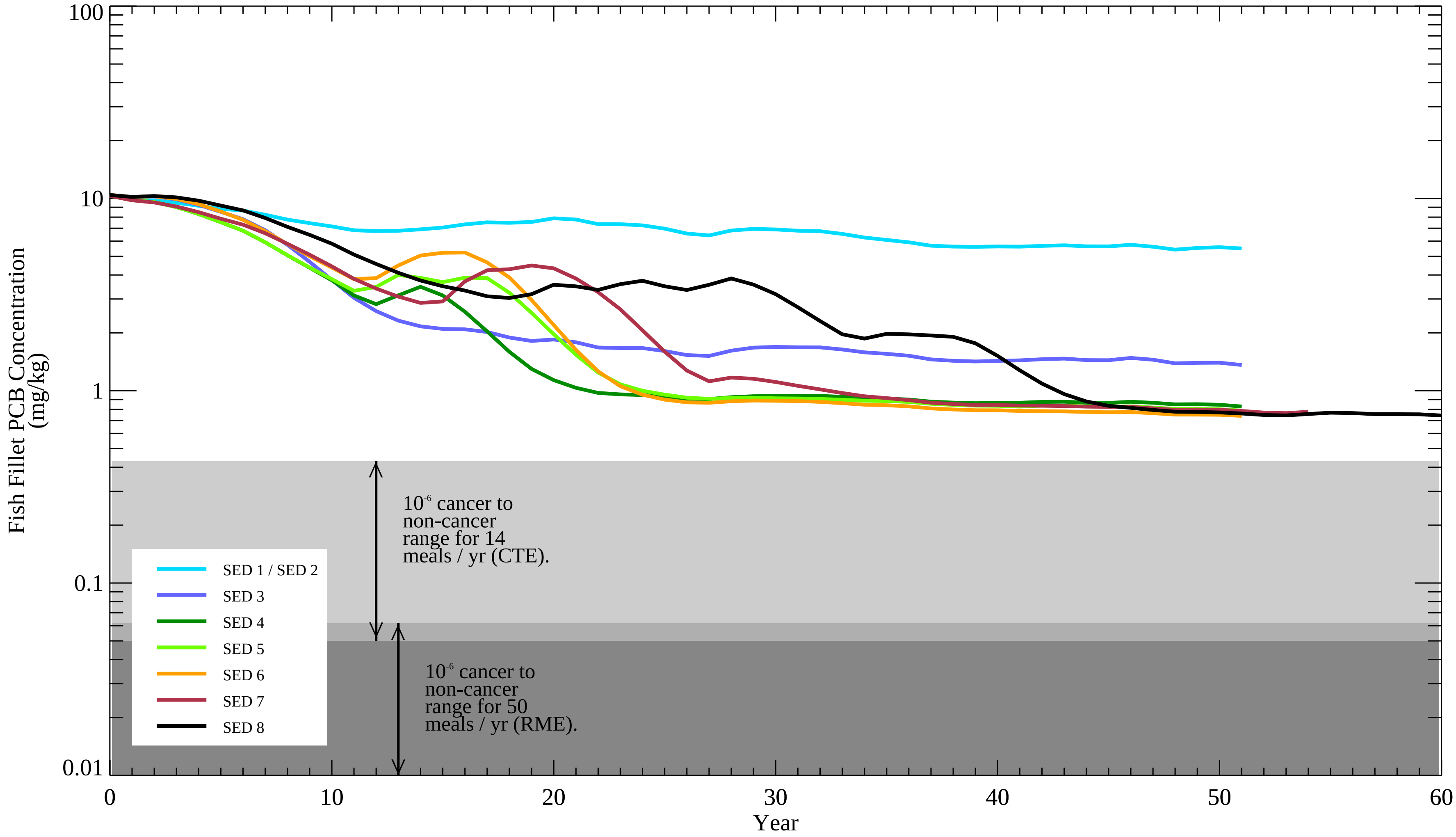

Figure G-12.2-1i. Average fillet PCB concentrations in largemouth bass from Reach 7D

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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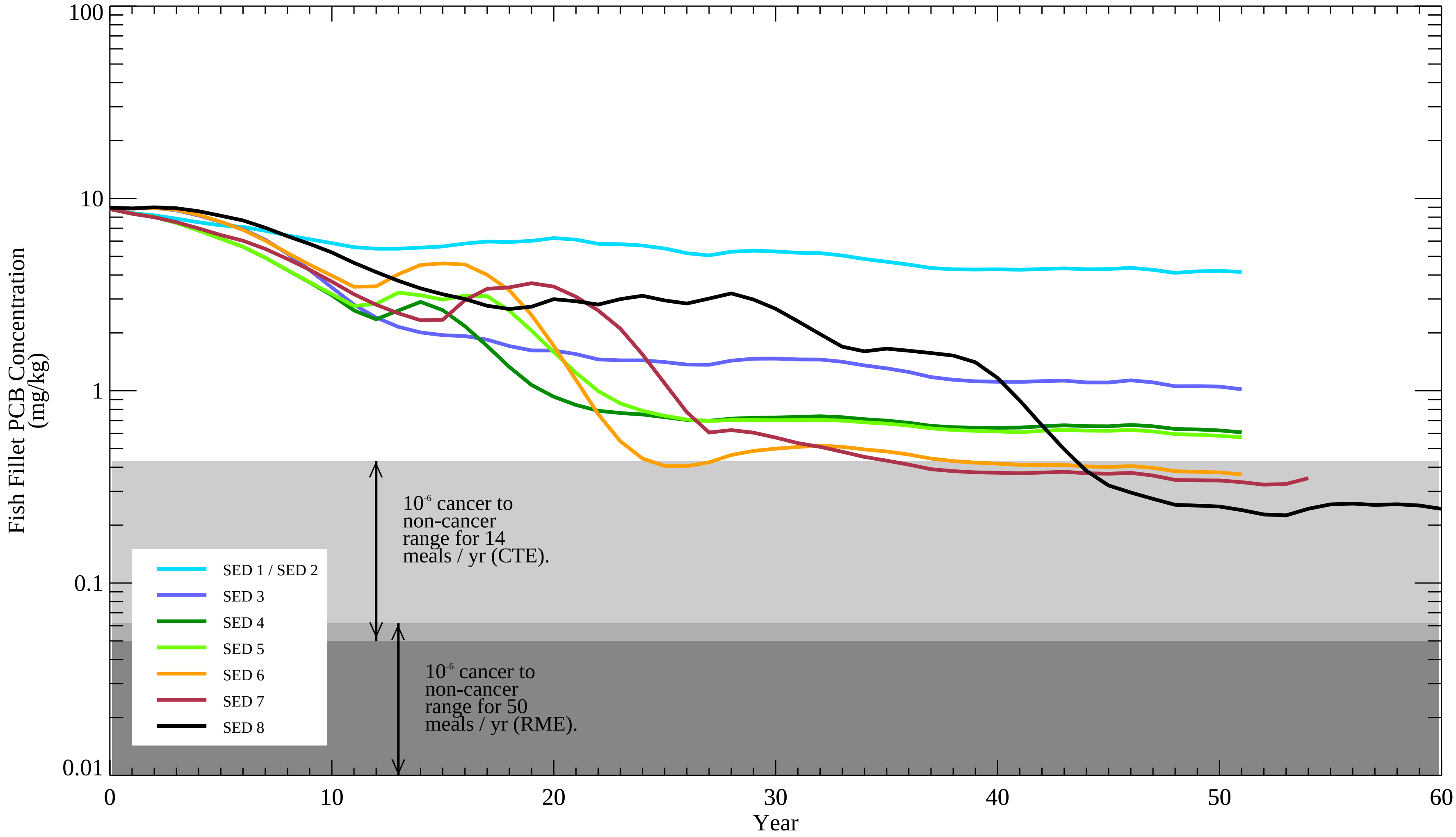

Figure G-12.2-1j. Average fillet PCB concentrations in largemouth bass from Reach 7E

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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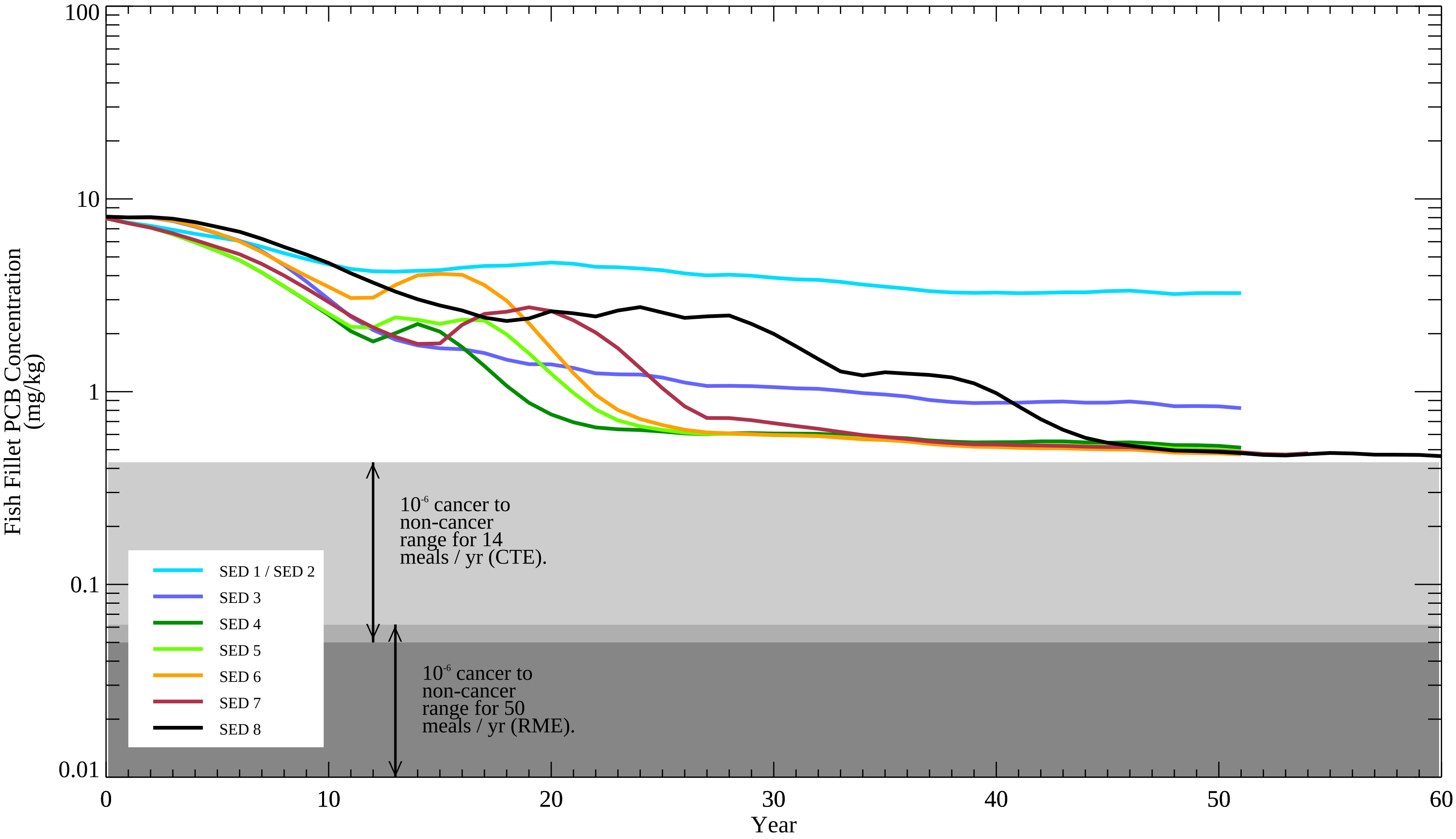

Figure G-12.2-1k. Average fillet PCB concentrations in largemouth bass from Reach 7F

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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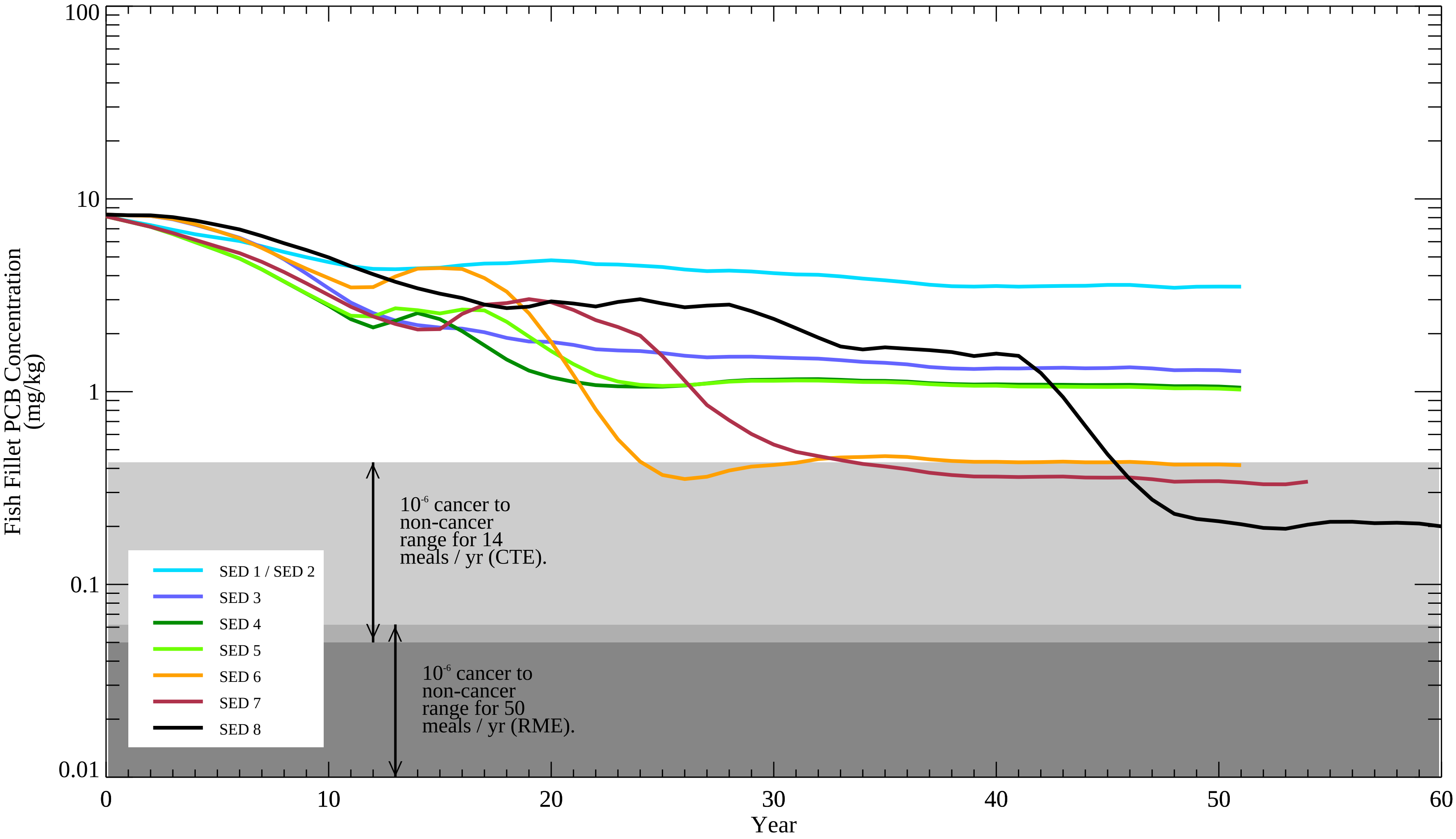

Figure G-12.2-1l. Average fillet PCB concentrations in largemouth bass from Reach 7G

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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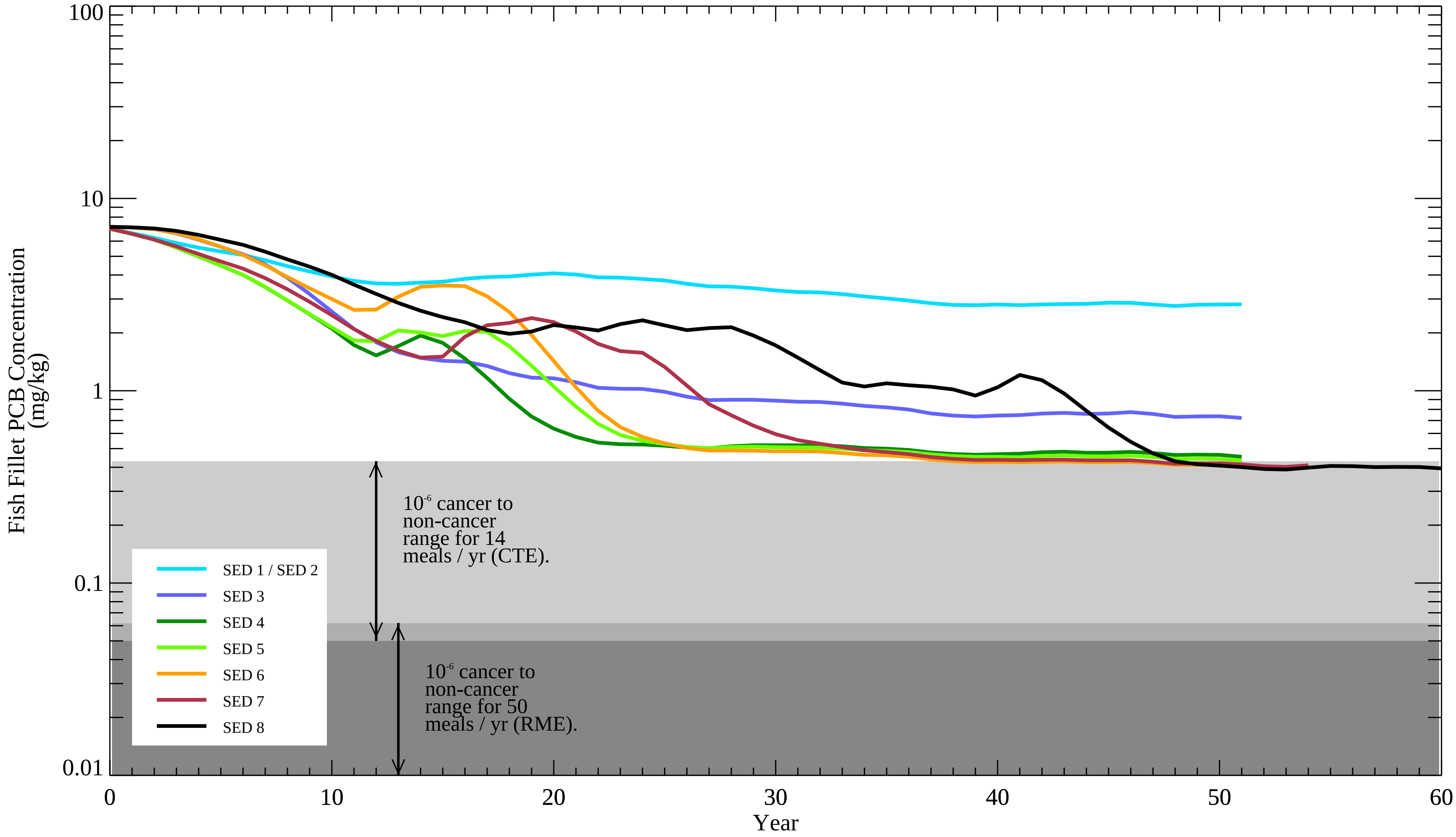

Figure G-12.2-1m. Average fillet PCB concentrations in largemouth bass from Reach 7H

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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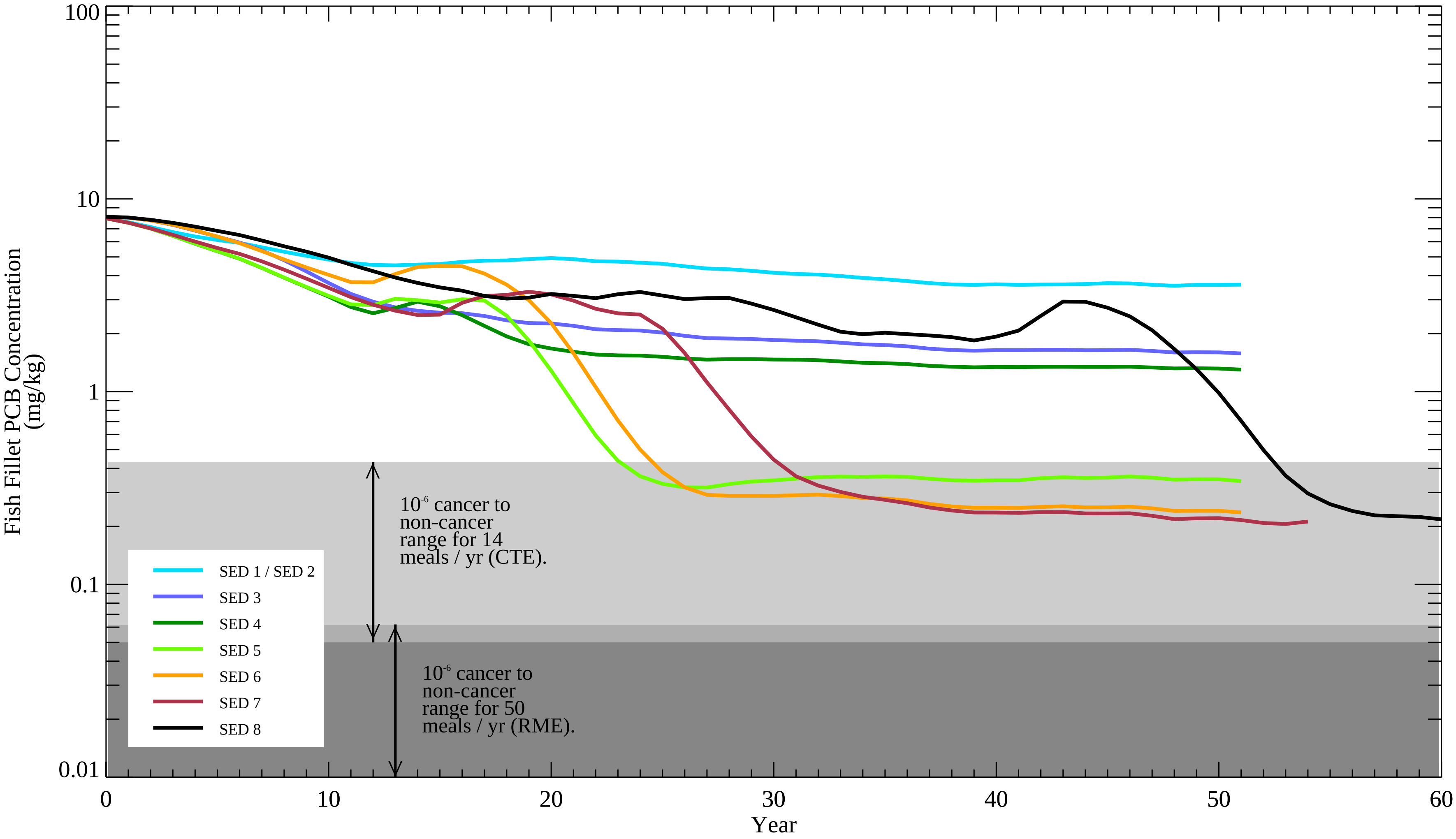

Figure G-12.2-1n. Average fillet PCB concentrations in largemouth bass from Reach 8

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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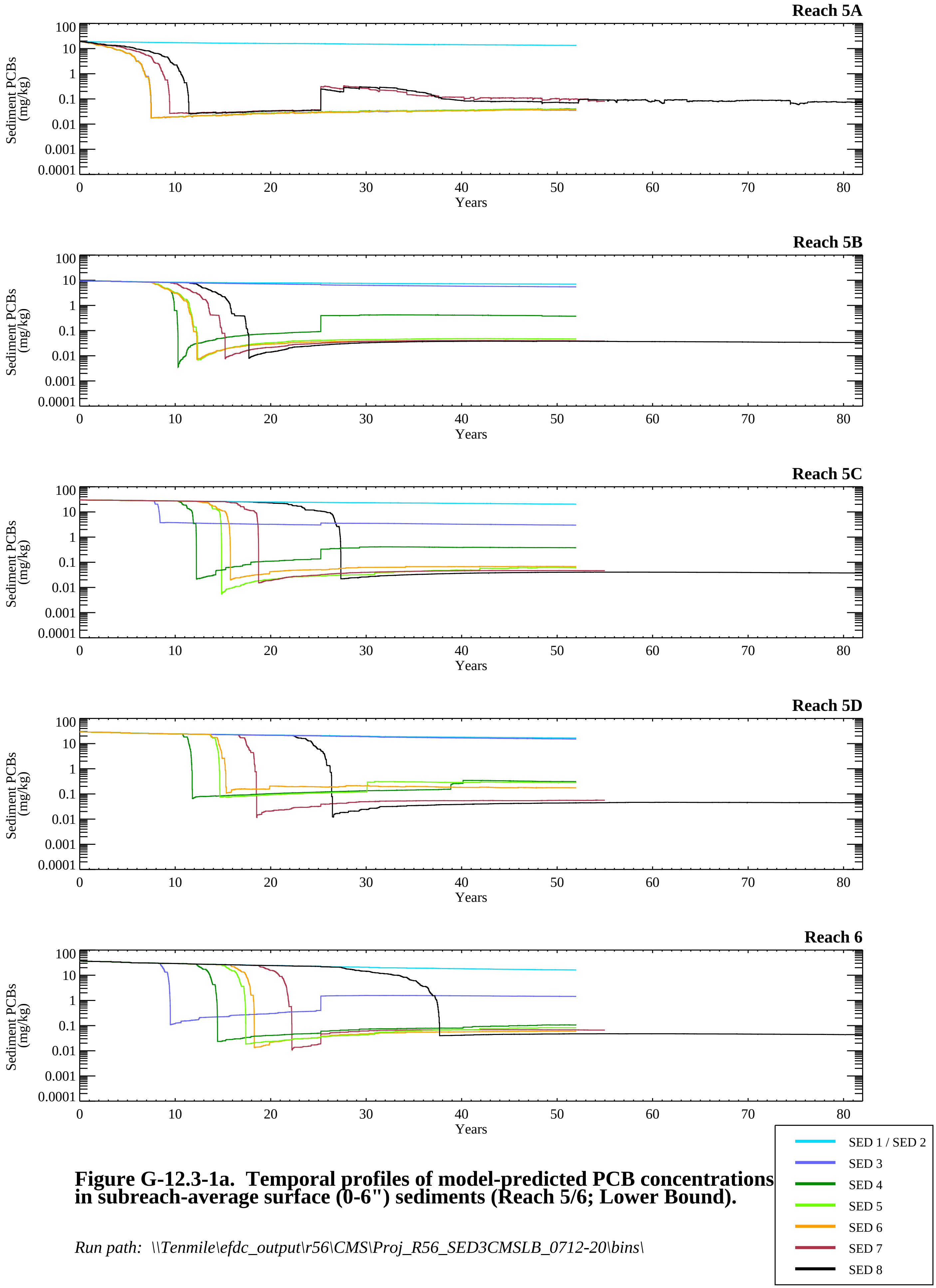

Figure G-12.3-1a. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (Reach 5/6; Lower Bound).

Run path: \\Tenmile\efdc_output\r56\CMS\Proj_R56_SED3CMSLB_0712-20\bins

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Tue Mar 18 19:55:27 2008

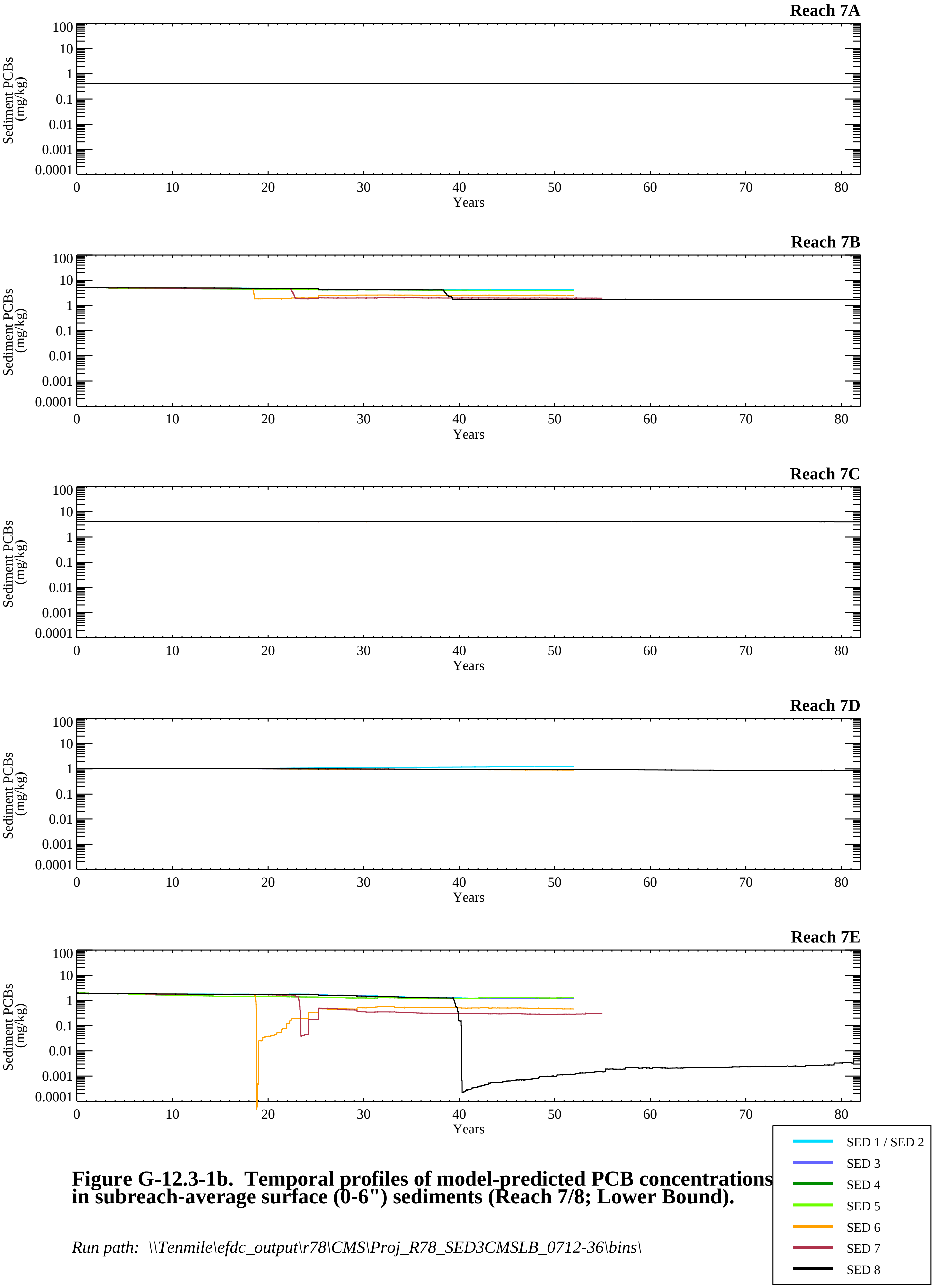

Figure G-12.3-1b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED3CMSLB_0712-36\bins

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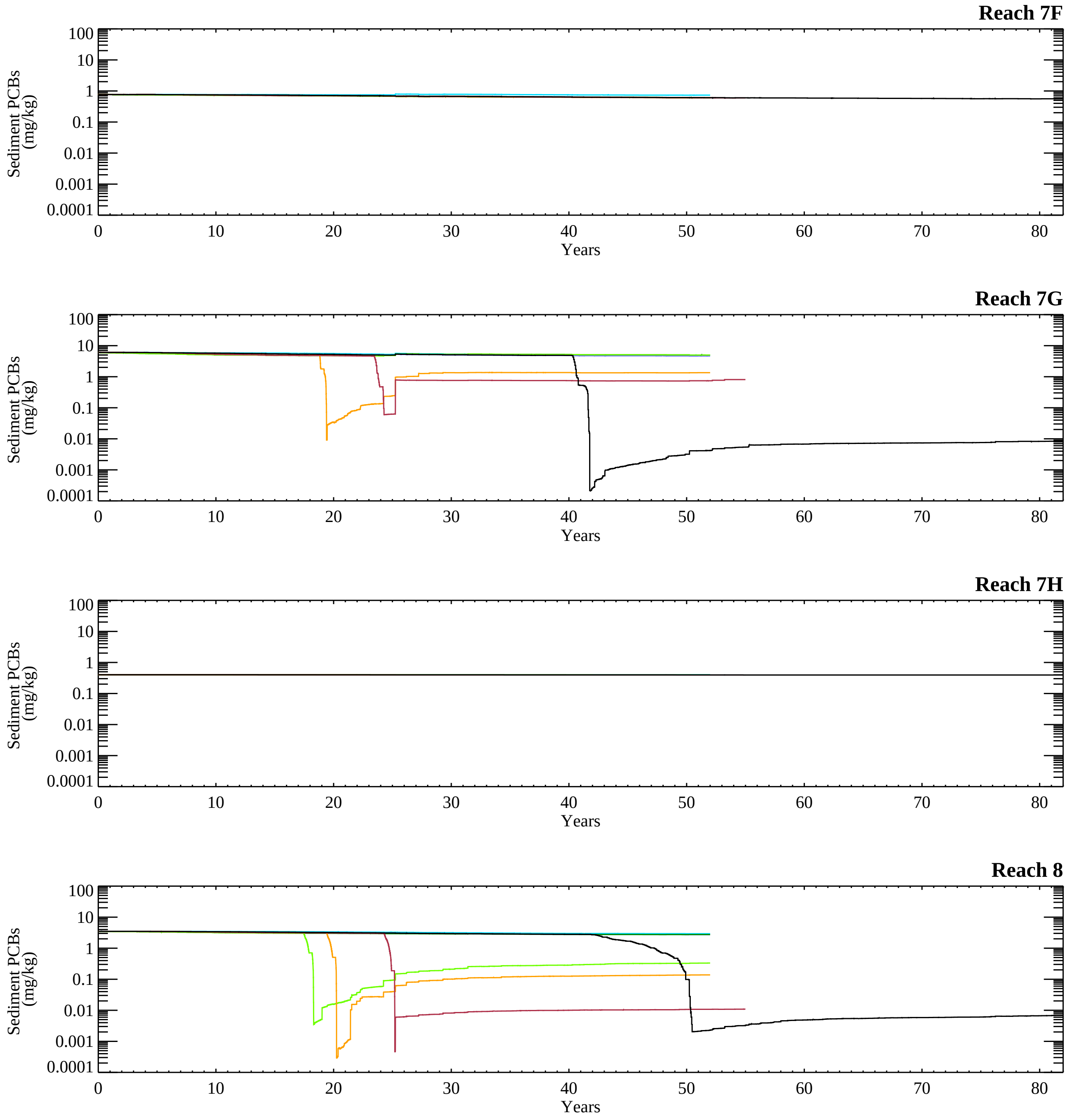

Figure G-12.3-1b. Temporal profiles of model-predicted PCB concentrations in subreach-average surface (0-6") sediments (Reach 7/8; Lower Bound).

Run path: \\Tenmile\efdc_output\r78\CMS\Proj_R78_SED3CMSLB_0712-36\bins

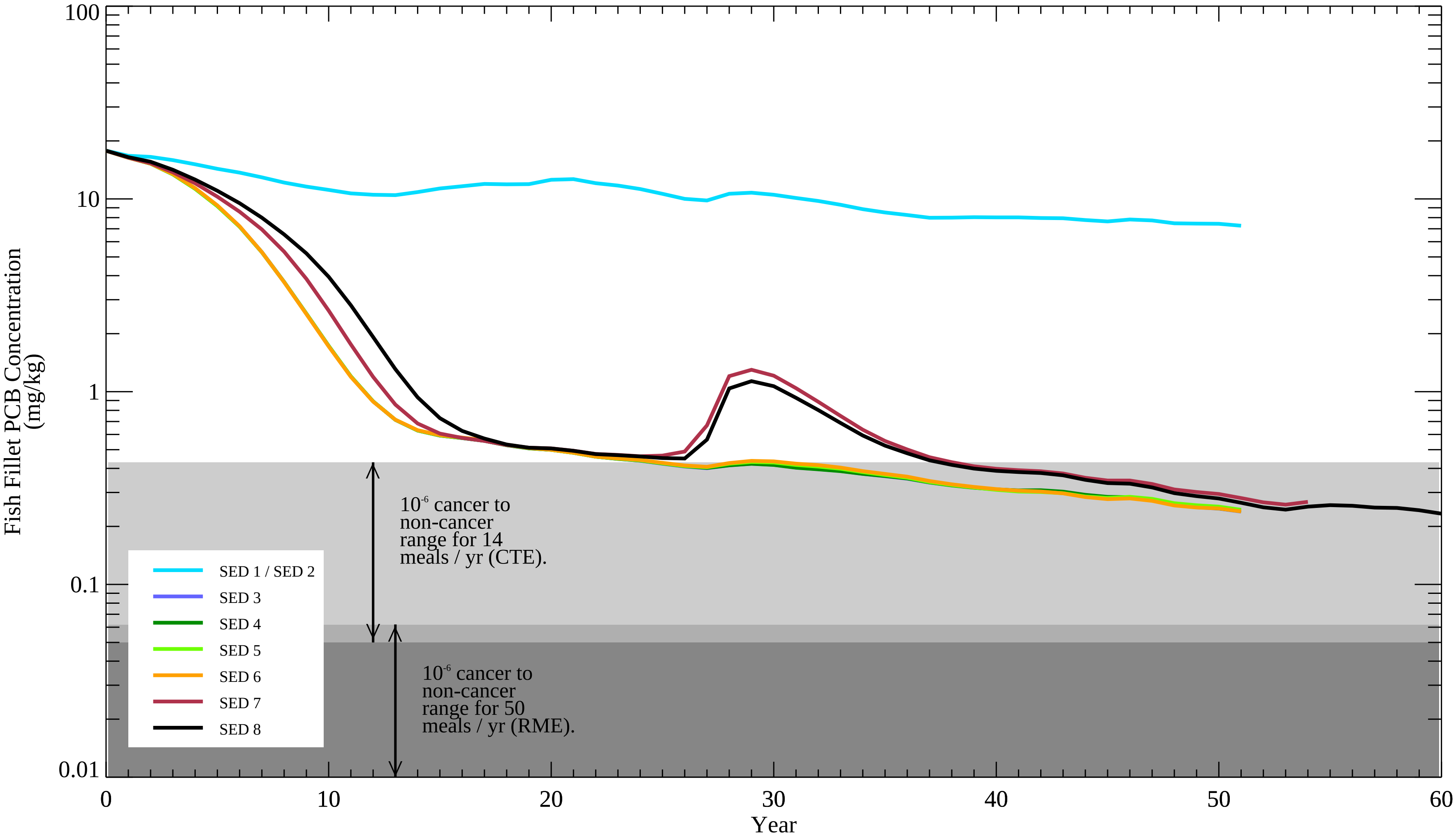

Figure G-12.4-1a. Average fillet PCB concentrations in largemouth bass from Reach 5A (Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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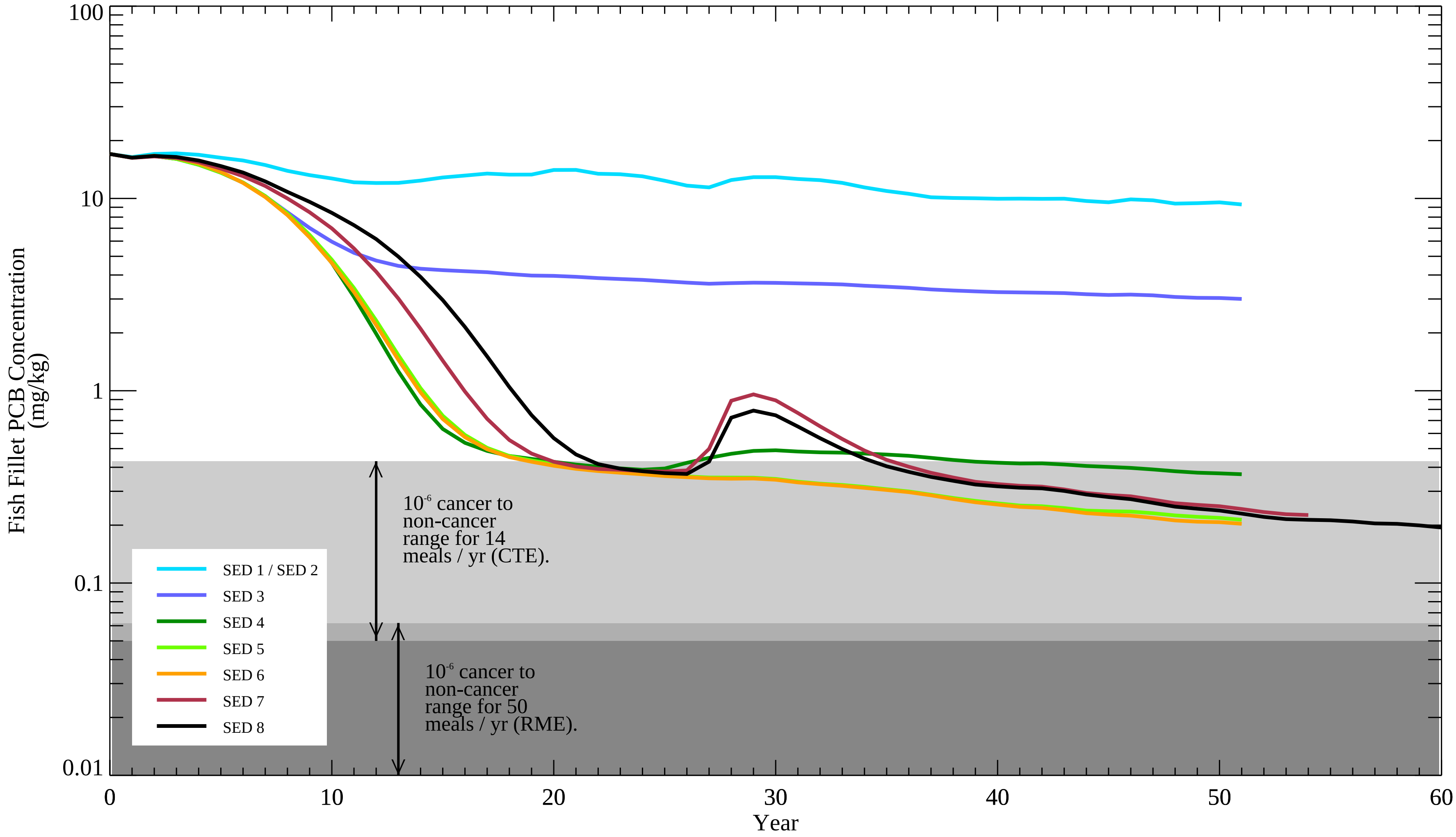

Figure G-12.4-1b. Average fillet PCB concentrations in largemouth bass from Reach 5B (Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

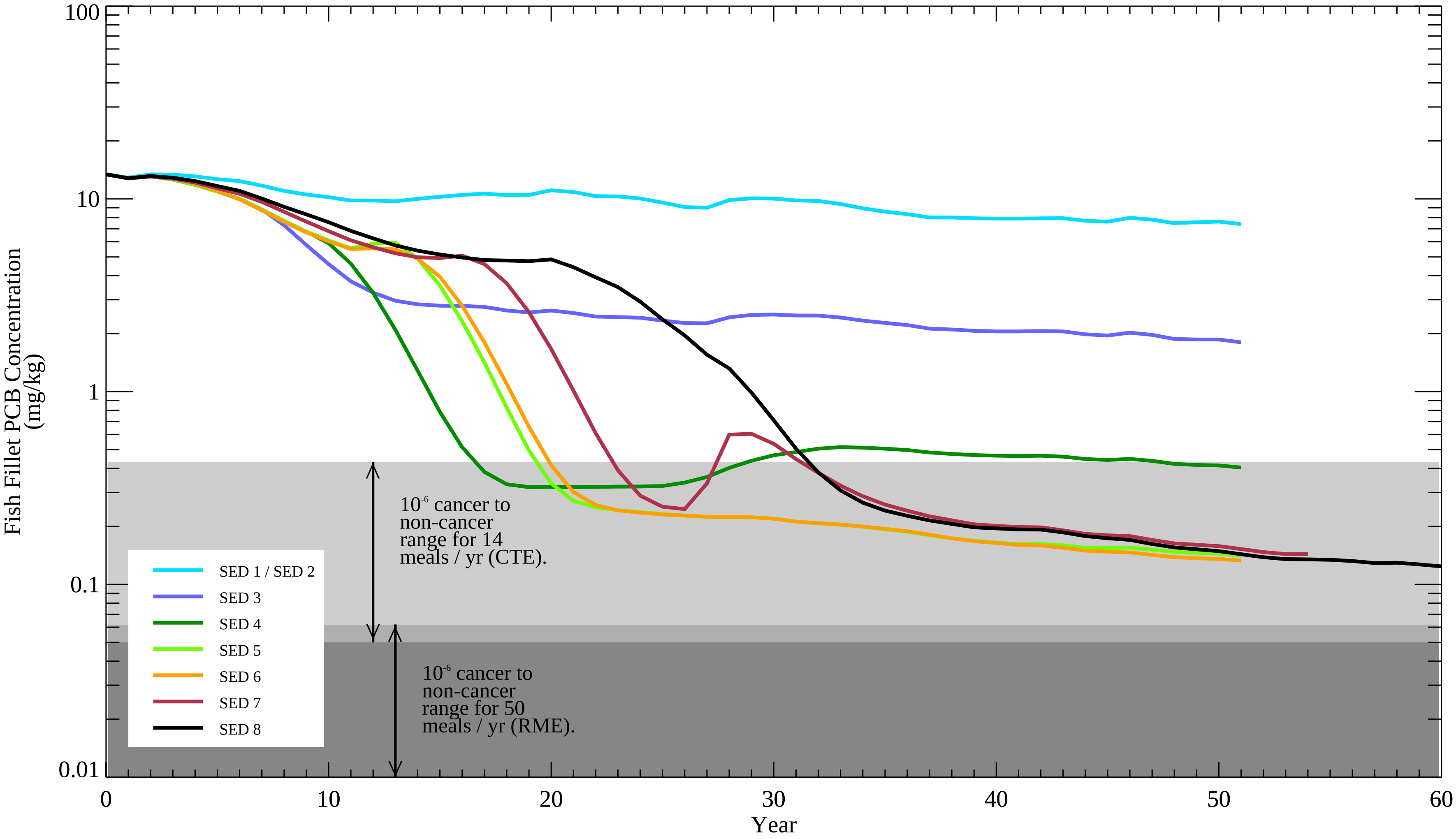

Figure G-12.4-1c. Average fillet PCB concentrations in largemouth bass from Reach 5C (Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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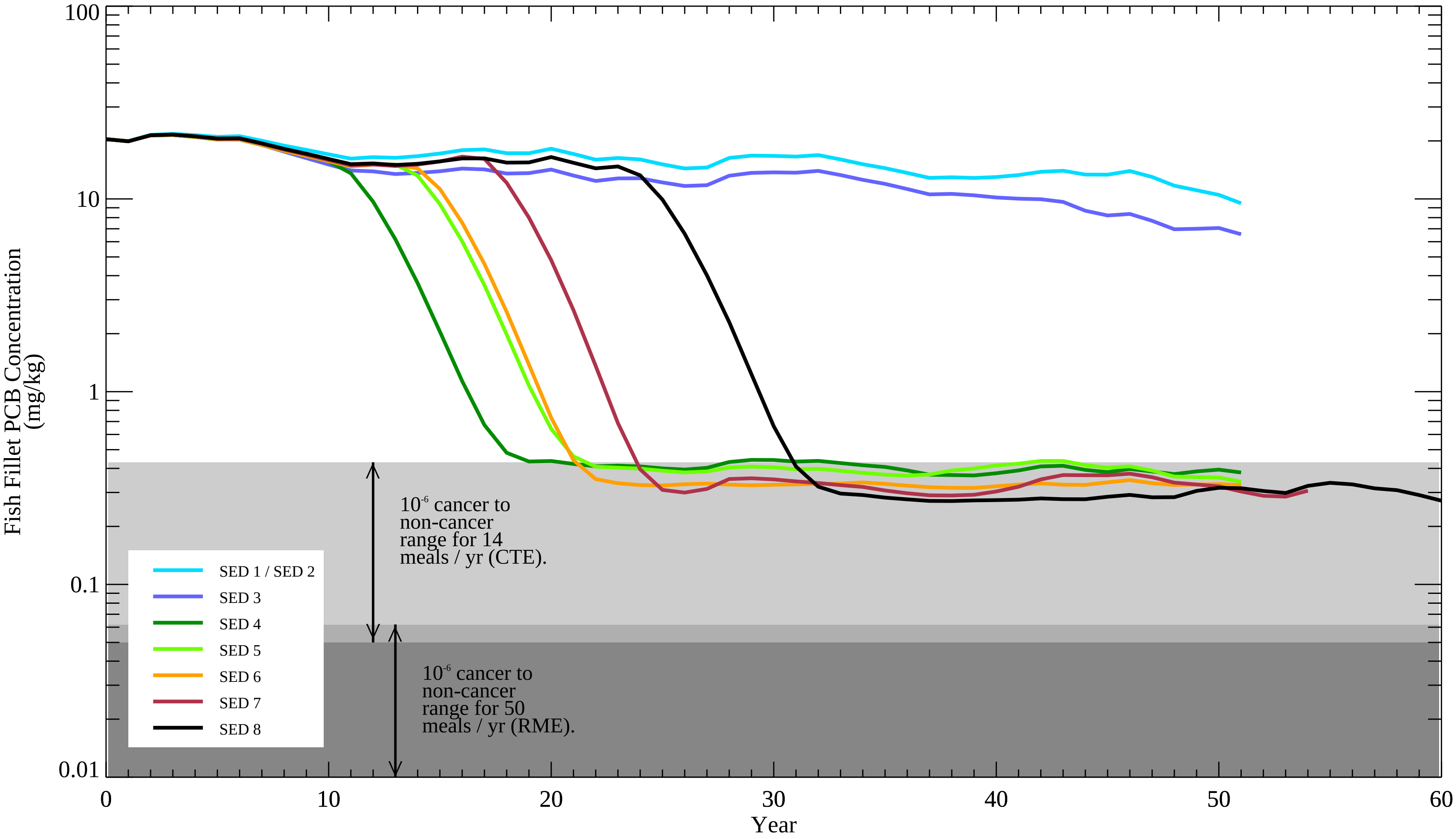

Figure G-12.4-1d. Average fillet PCB concentrations in largemouth bass from Reach 5D (Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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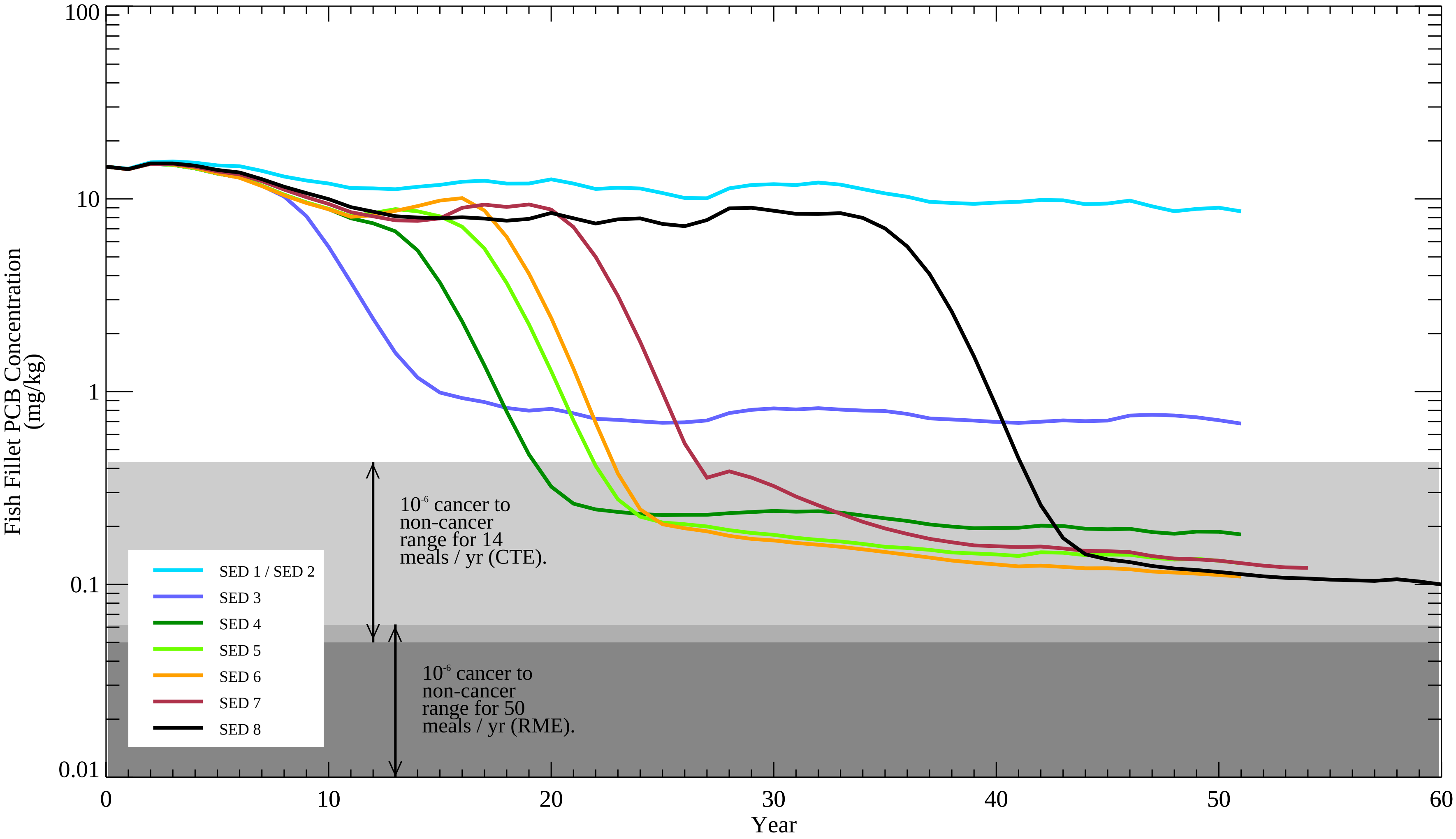

Figure G-12.4-1e. Average fillet PCB concentrations in largemouth bass from Reach 6 (Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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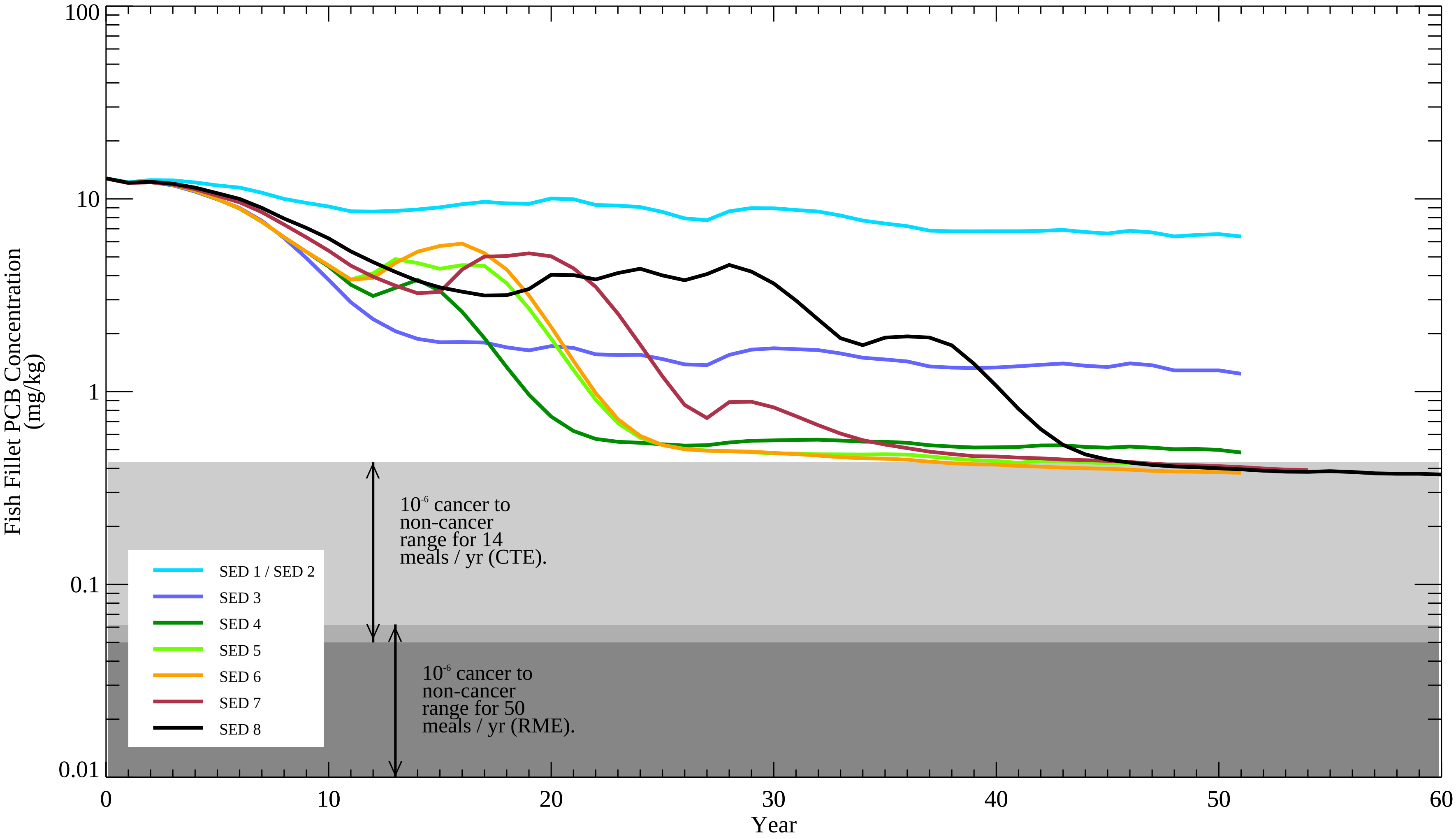

Figure G-12.4-1f. Average fillet PCB concentrations in largemouth bass from Reach 7A (Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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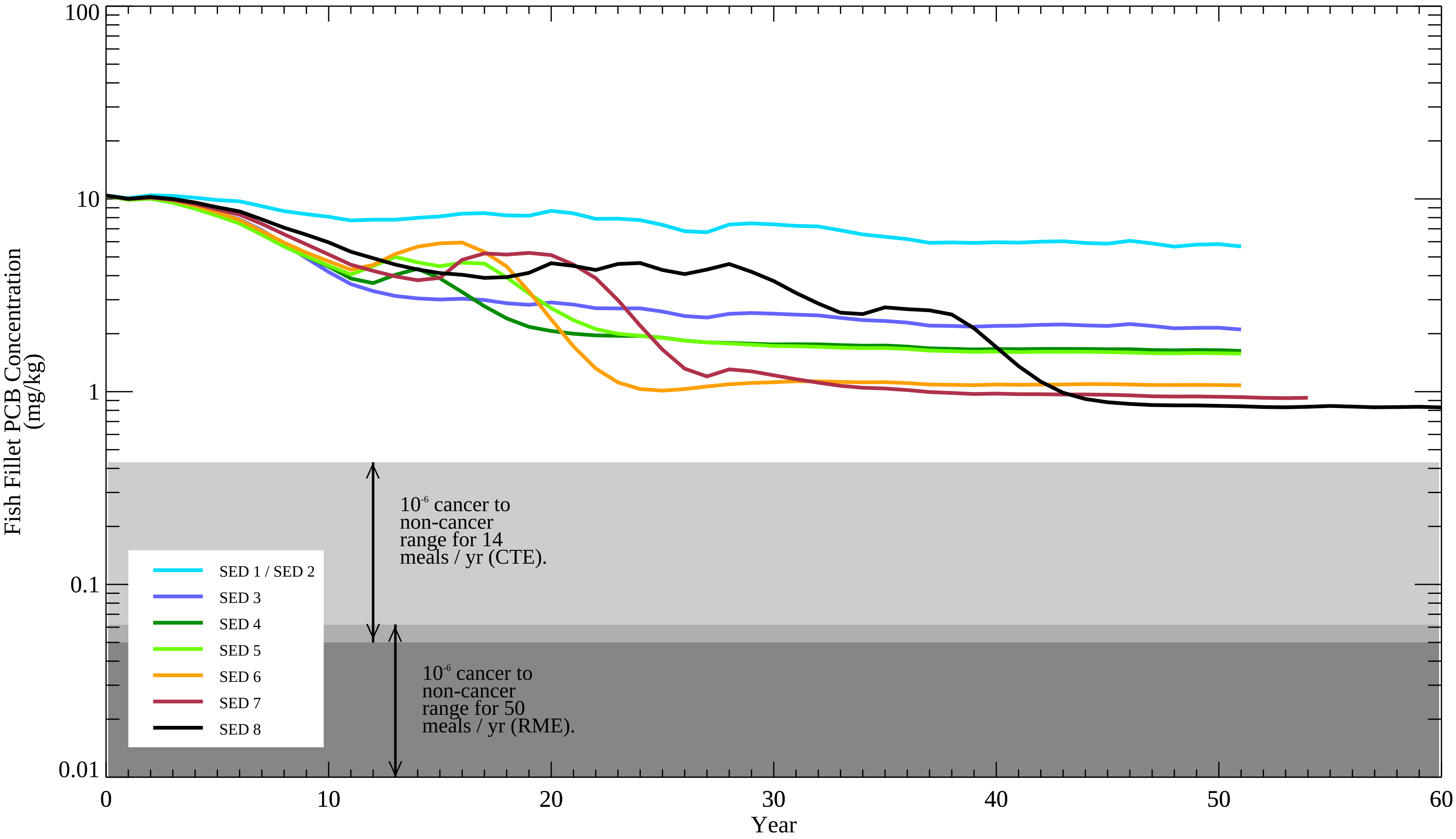

Figure G-12.4-1g. Average fillet PCB concentrations in largemouth bass from Reach 7B (Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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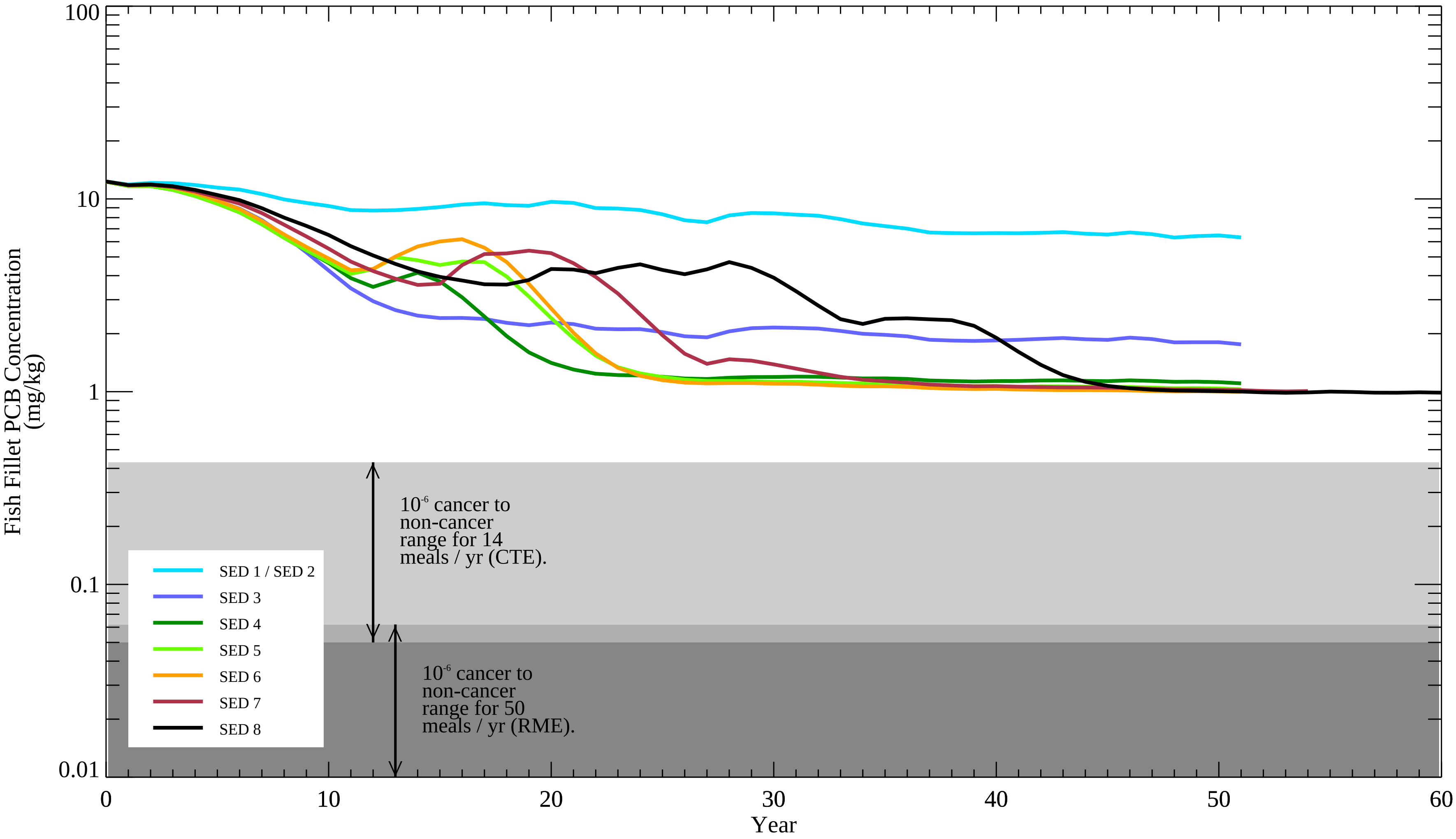

Figure G-12.4-1h. Average fillet PCB concentrations in largemouth bass from Reach 7C (Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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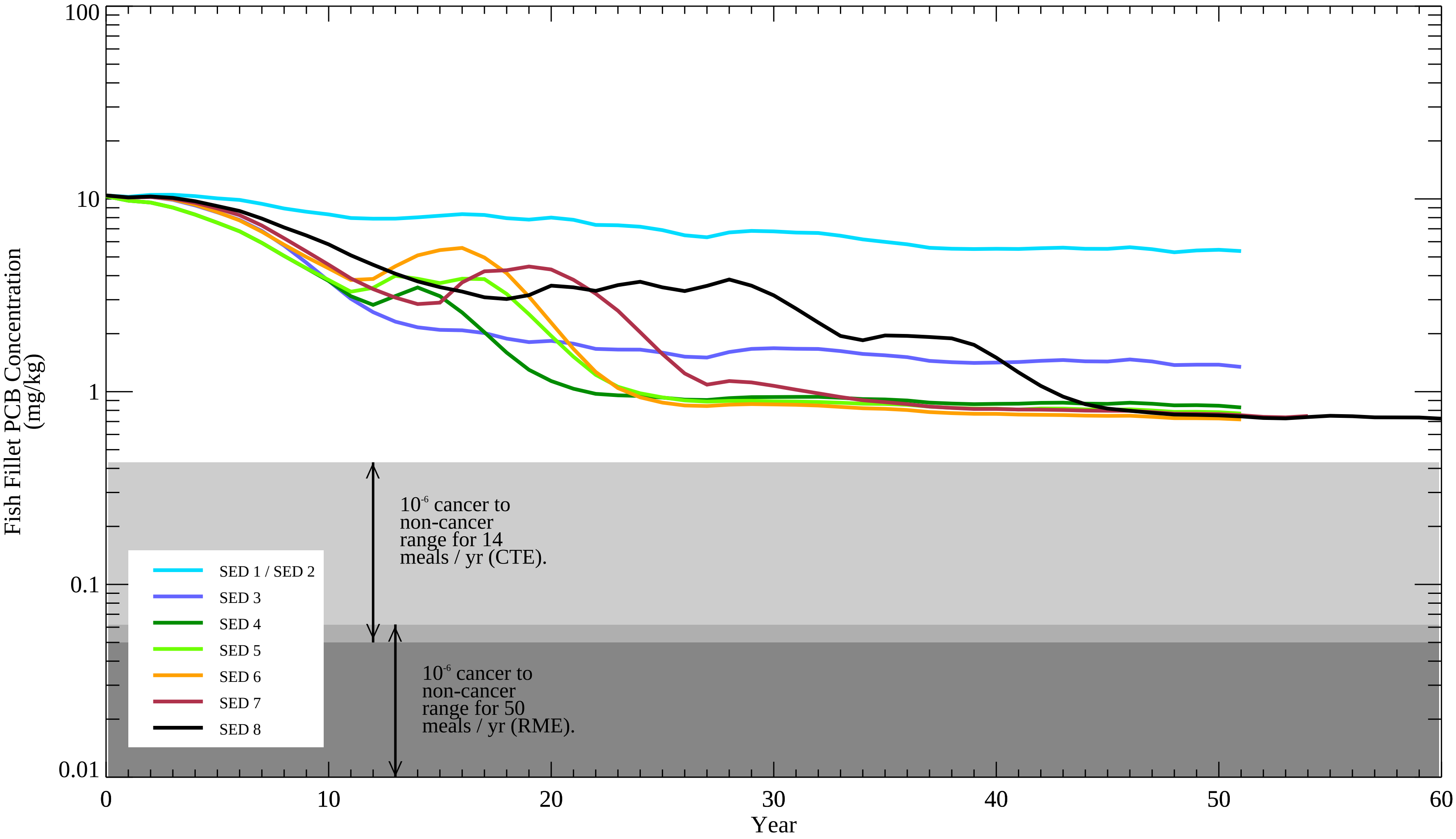

Figure G-12.4-1i. Average fillet PCB concentrations in largemouth bass from Reach 7D (Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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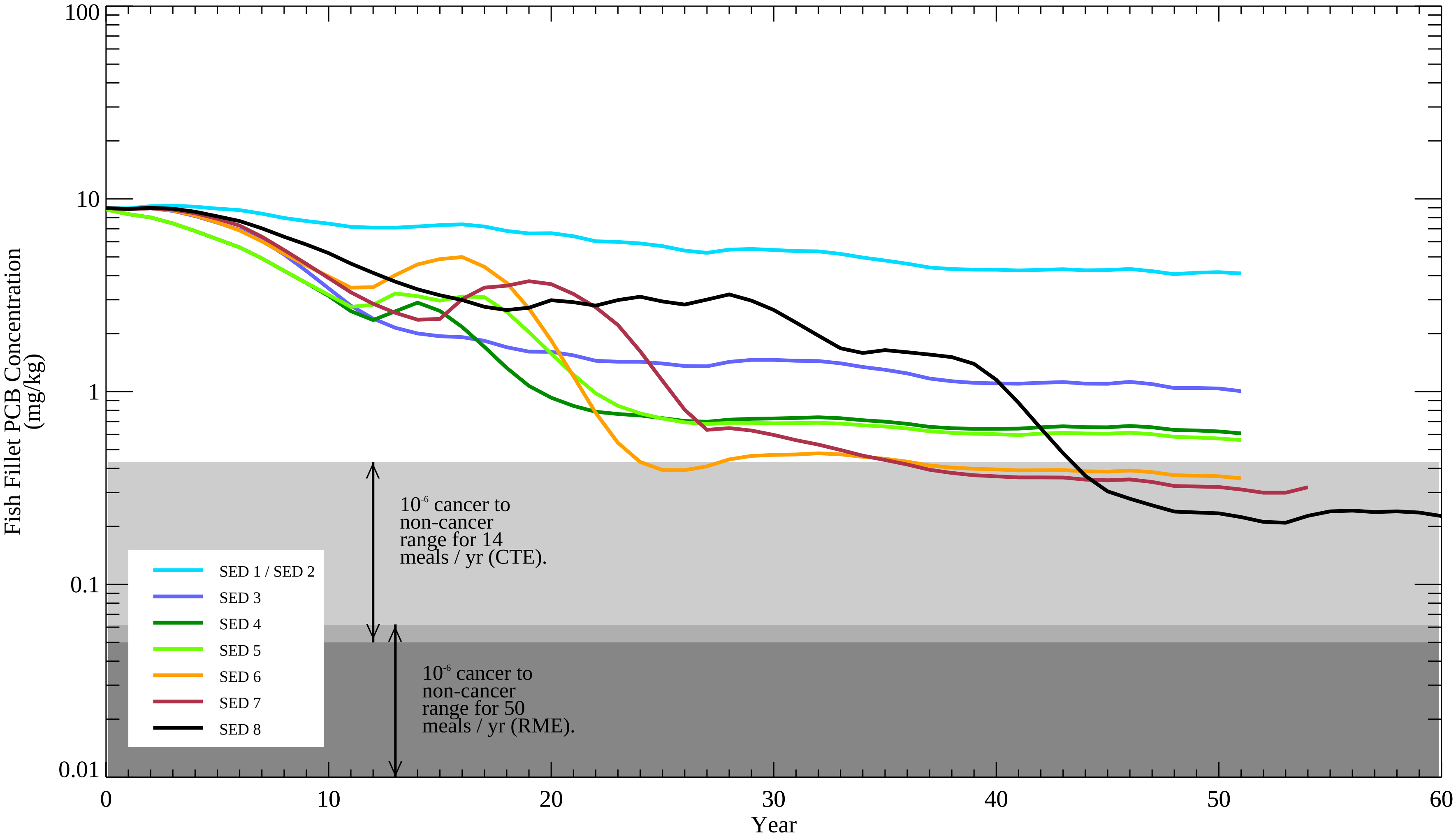

Figure G-12.4-1j. Average fillet PCB concentrations in largemouth bass from Reach 7E (Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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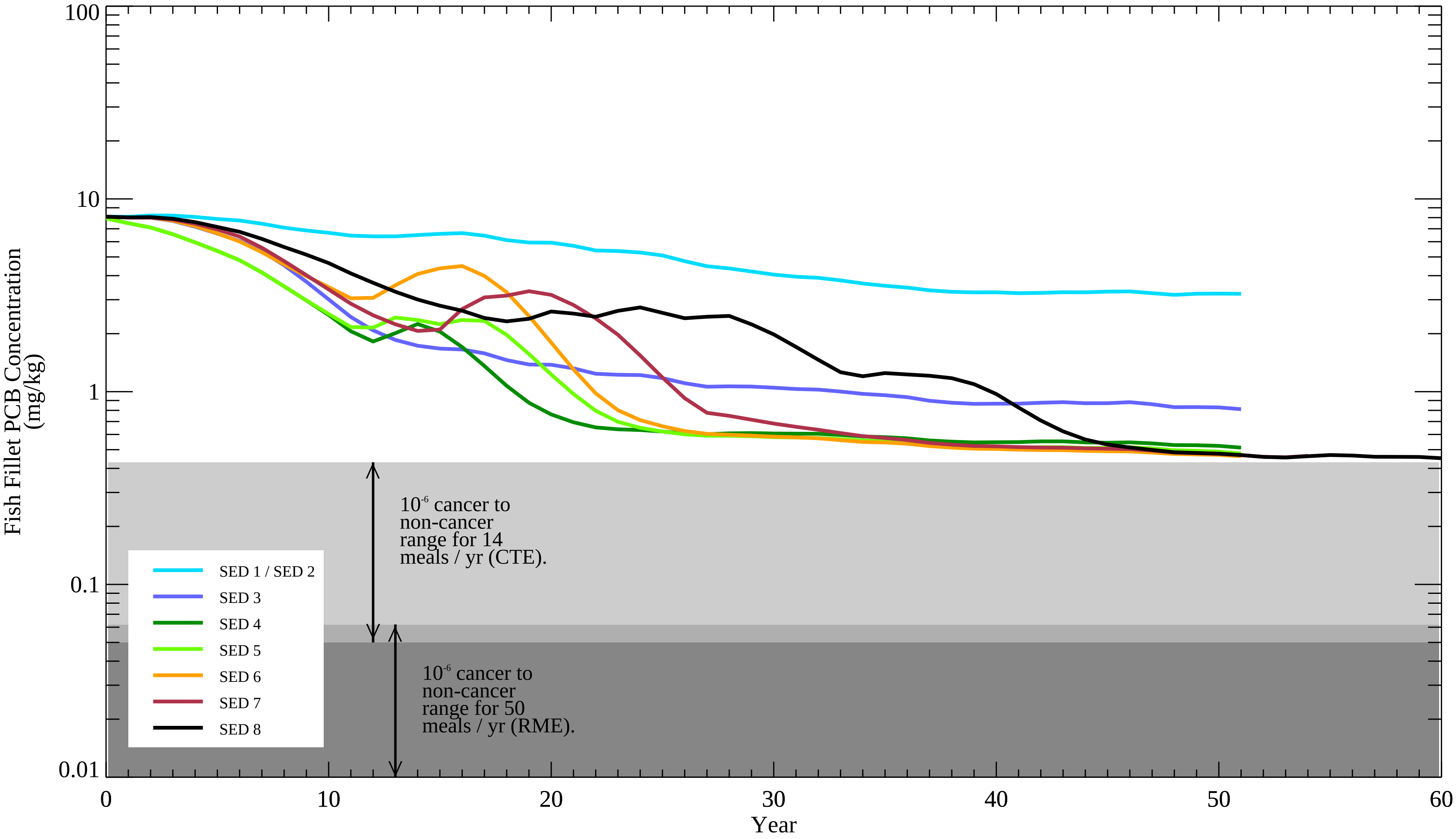

Figure G-12.4-1k. Average fillet PCB concentrations in largemouth bass from Reach 7F (Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

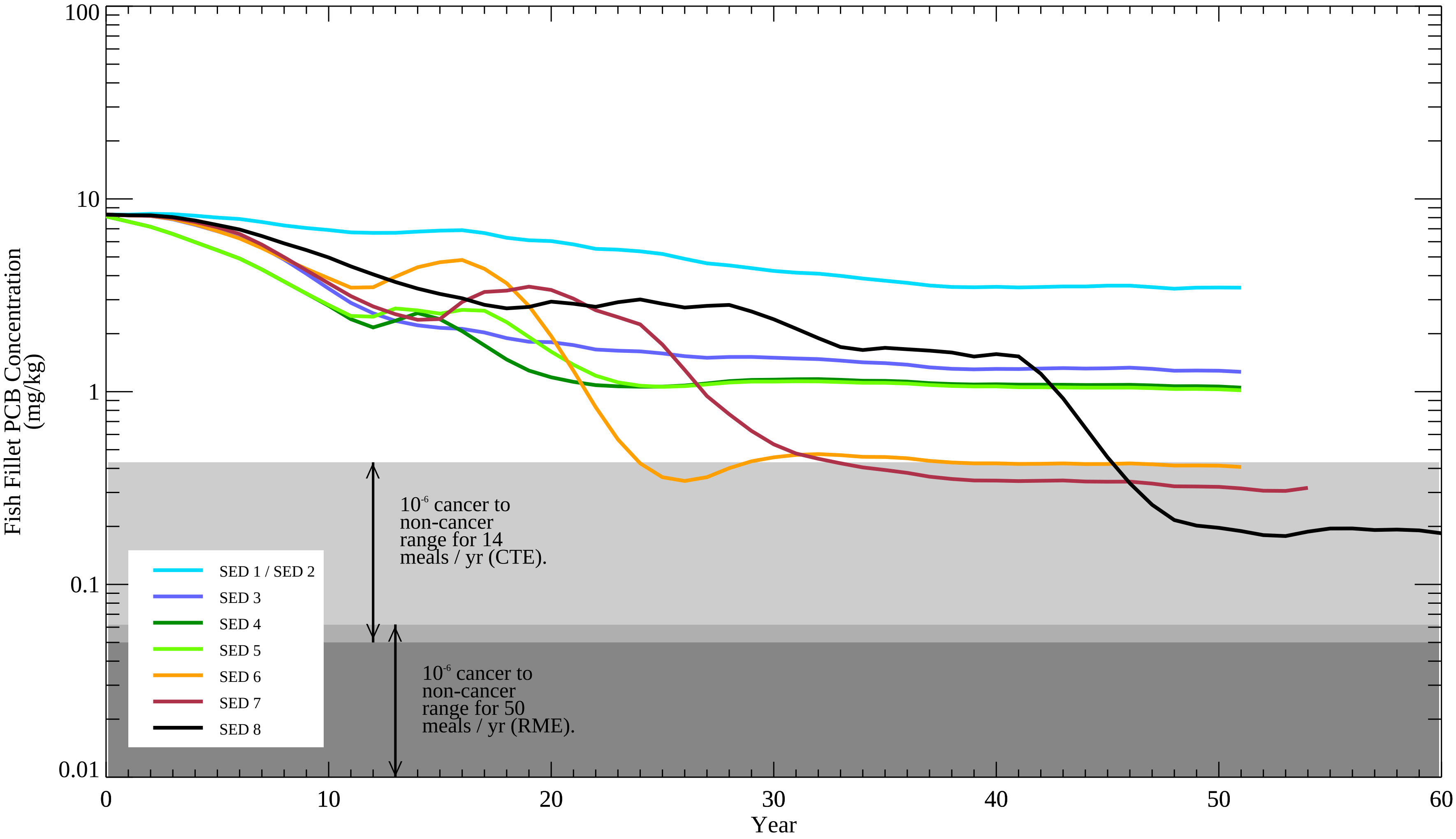

Figure G-12.4-1l. Average fillet PCB concentrations in largemouth bass from Reach 7G (Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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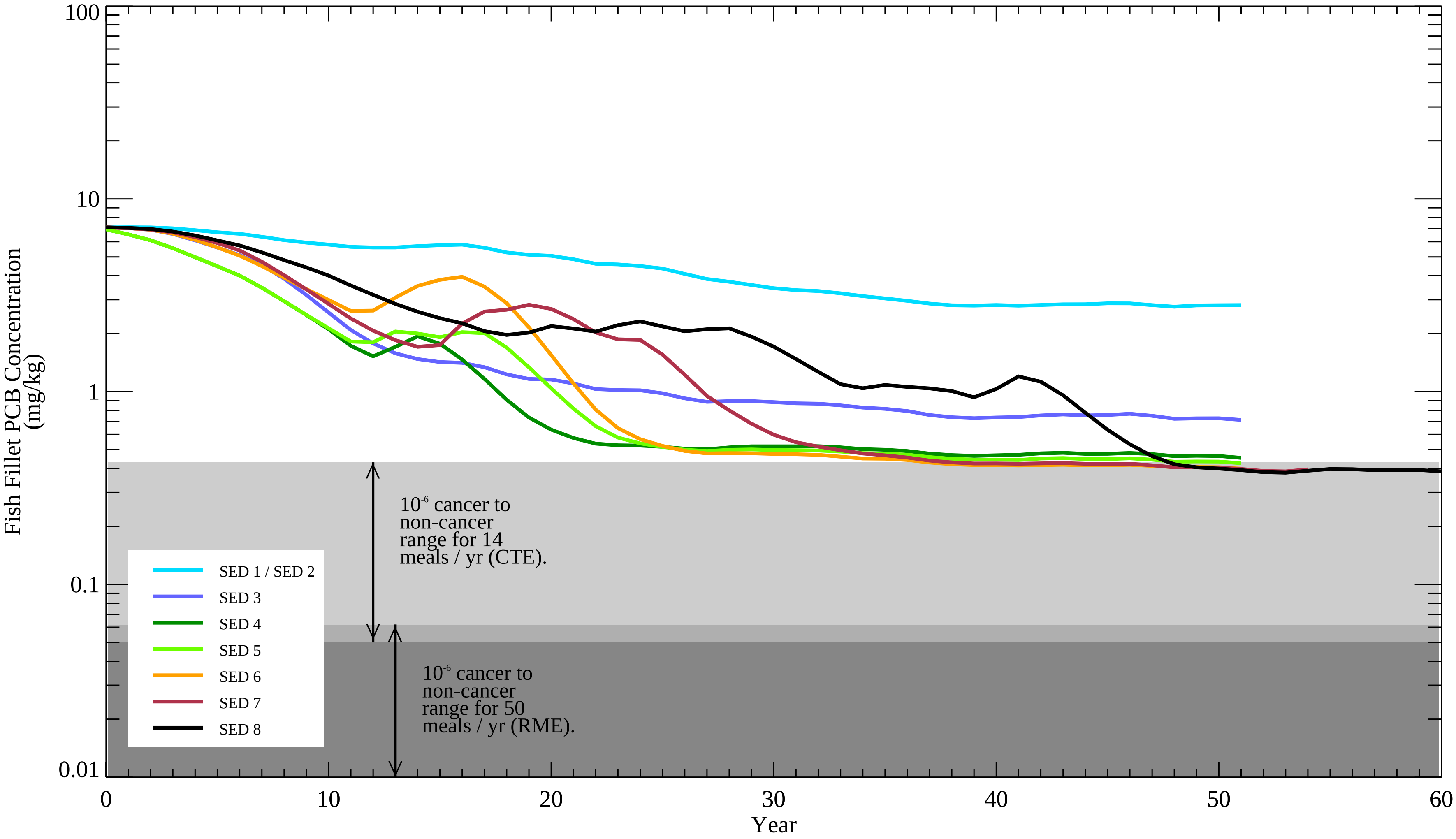

Figure G-12.4-1m. Average fillet PCB concentrations in largemouth bass from Reach 7H (Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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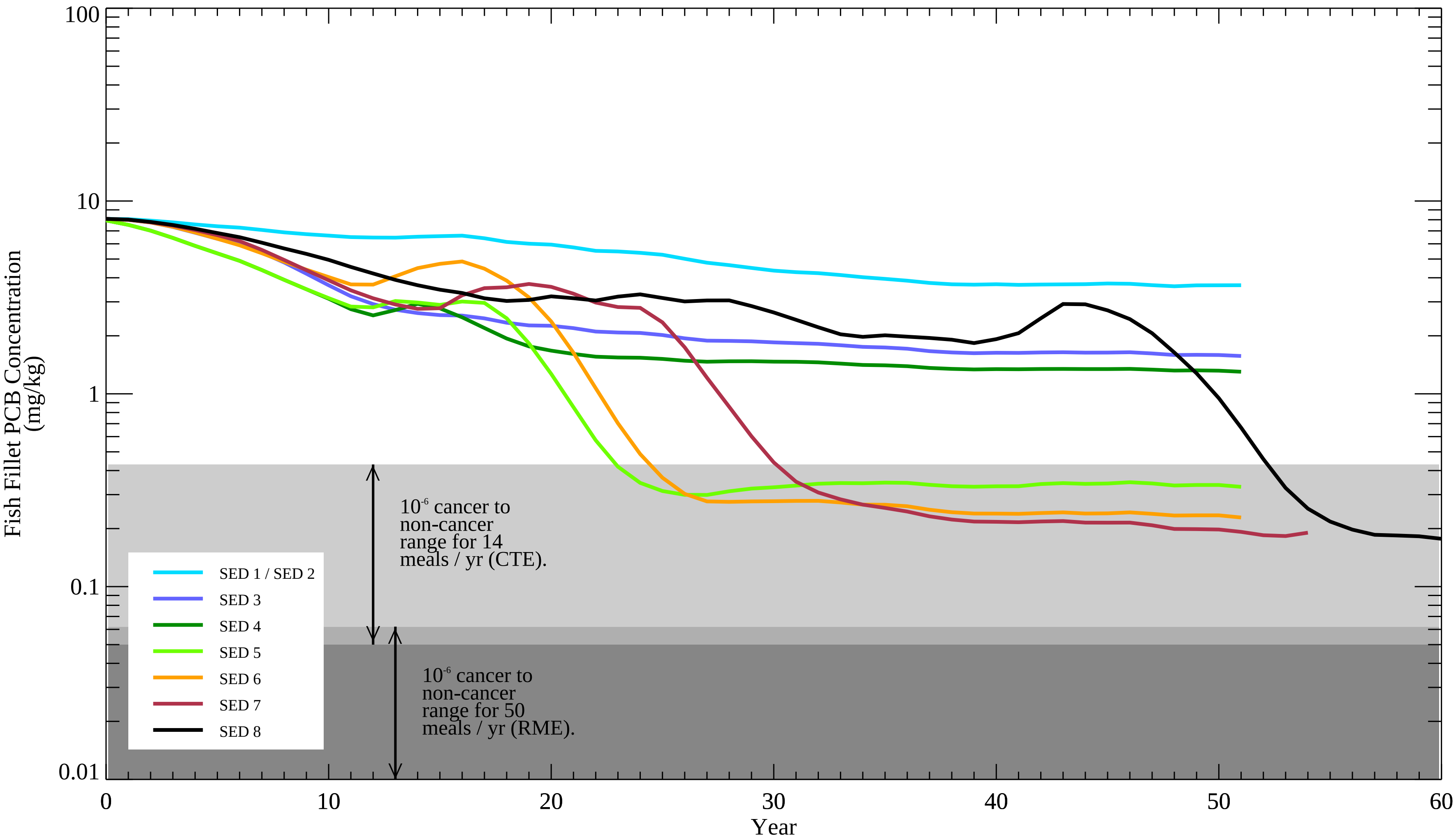

Figure G-12.4-1n. Average fillet PCB concentrations in largemouth bass from Reach 8 (Lower Bound).

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 5 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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