Attachment 7

Excerpts from GE's Comments on Draft Permit Modification and Statement of Basis (October 27, 2014)

COMMENTS OF THE GENERAL ELECTRIC COMPANY ON U.S. ENVIRONMENTAL PROTECTION AGENCY NEW ENGLAND REGION'S DRAFT RCRA PERMIT MODIFICATION AND STATEMENT OF BASIS FOR PROPOSED REMEDIAL ACTION FOR THE HOUSATONIC RIVER – REST OF RIVER

Volume I

Text, Tables, and Figures

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EXECUTIVE SUMMARY

I. Background and Introduction

At one time, the U.S. Environmental Protection Agency (EPA), the Commonwealth of Massachusetts, the State of Connecticut, and the General Electric Company (GE) decided that consensus, not confrontation, was the best path forward with respect to the polychlorinated biphenyls (PCBs) at the former GE facility in Pittsfield and in the Housatonic River and its floodplain. EPA, Massachusetts, Connecticut, and GE discussed their considerable differences, significant compromises were made, and a comprehensive agreement was reached. That agreement is memorialized in the judicially approved Consent Decree that specified the remedial actions that would be taken to address the PCBs everywhere but in the Rest of River.

Because the evaluations necessary to determine the best remedial course for the Rest of River would take several years to complete, EPA, Massachusetts, Connecticut, and GE agreed on a process for attempting to reach a consensus on the Rest of River as they had for all of the other areas that are addressed in the Consent Decree. That process included EPA's issuance to GE of a Rest of River Permit to conduct the evaluations necessary to select a Rest of River remedy with the understanding that the Permit would later be modified to select the Rest of River remedial action.

Since then, GE's Pittsfield-based project team has remediated the half mile of the Housatonic River beginning at the former GE facility, Silver Lake, and almost all of the other areas covered by the Consent Decree outside the Rest of River, having completed its work in 17 of 19 of those areas. The two remaining areas other than the Rest of River will be remediated as soon as the required remediation plans receive EPA's approval. At the same time, EPA's project team remediated another 1½ mile reach of the River (with a substantial contribution to the costs of that effort by GE).

GE also gave the Pittsfield Economic Development Authority 52 acres of remediated property and approximately $15 million to allow the creation of the William Stanley Industrial Park. GE gave Pittsfield another $10 million that has been used by the City to fund numerous projects, including the rehabilitation of the Colonial Theater, support of the Barrington Stage Company, and the creation of the Berkshire Innovation Center. GE also provided $15.7 million for environmental projects in Massachusetts and Connecticut.

In spite of all of this, there were those who opposed any effort by EPA, Massachusetts, and Connecticut to reach any consensus with GE. These critics have continued to criticize EPA, GE, and any suggestion of a consensus-driven approach to this day.

GE's evaluations necessary to select a Rest of River remedial action, as specified in the Consent Decree and the Permit, have now been completed. They include a massive Corrective Measures Study (CMS), and an even more comprehensive Revised Corrective Measures Study demanded by the Commonwealth of Massachusetts and others who concluded that the CMS did not sufficiently account for the inevitable negative impacts of further attempts to remove PCBs from the Housatonic River and its floodplain. The EPA New England Region (the "EPA

Region" or the "Region") has proposed a Rest of River remedial action in a draft Permit modification; and that draft Permit modification, and the Region's accompanying Statement of Basis and Comparative Analysis of Remedial Alternatives, contain (and purport to explain) the Region's proposed remedial action for the Rest of River.

However, the Region's proposal ignores the very evaluations that the Region itself demanded, and the Region has not conducted evaluations of its own proposal like those it demanded for every other remedial alternative in the CMS and the Revised Corrective Measures Study. The Region's proposed remedy is almost three times larger than the one proposed by the Commonwealth of Massachusetts in response to the Revised Corrective Measures Study, and larger than all but two of the alternatives evaluated in the Revised Corrective Measures Study. The Region's proposal would involve more removal, from more areas, with more negative impacts, and more cost. So it shouldn't be surprising that there is no consensus about the Rest of River remedy proposed by the Region, like the consensus that was reached with respect to all of the other areas addressed by the Consent Decree. Beginning when the Region first shared with the public and GE its intentions for the Rest of River in the summer of 2012, GE stretched as far as it could to try to achieve a consensus on a common-sense solution to the PCBs in the Rest of River that was consistent with the conclusions of the evaluations that the Region had required. GE was prepared to undertake one of the largest river cleanups in history, including elements important to stakeholders that can't be required under the Consent Decree or the Permit.

GE agrees that the Rest of River remedy must be fully protective of human health and the environment. However, as anyone who reads the Revised Corrective Measures Study can tell, the consideration of any effort to further reduce the concentrations of PCBs in the Rest of River requires a delicate balancing of the positive and negative impacts of such an effort. The Consent Decree and the Permit specify such a balancing by requiring EPA to select a Rest of River remedy on the basis of criteria that reflect particular kinds of positive impacts – like "overall protection of human health and the environment" and "control of sources of releases" – and negative impacts – like short-term and long-term negative impacts on the community and the ecosystem, as well as cost. The Consent Decree and the Permit do not allow EPA to propose a remedy that will do more overall harm than good, or to ask GE to spend unlimited amounts of money and effort to achieve speculative or minimal incremental benefits.

PCBs are undeniably present in the Rest of River, but PCBs have undeniably been present there for over 70 years, and the River, along with its unique forested banks and floodplains and associated wetlands, including dozens of irreplaceable vernal pools, all continue to support a rich variety of plant and animal life. Indeed, the Rest of River is home to many state-listed rare species that have not been able to maintain their footholds elsewhere.

At the same time, the Rest of River is a vulnerable and even a fragile place. Nearly any effort to remediate PCBs will disrupt it to some extent, and any aggressive cleanup effort will disrupt it beyond recognition and repair – clear cutting its forests, removing its delicate vernal pools, dredging the riverbed and wetlands, eliminating rare steep riverbanks carved by time and nature – destroying the habitats provided by these sensitive areas and destroying or displacing their many animal and plant inhabitants.

Given that removing PCBs from the Rest of River will also disturb its vibrant ecology, and that too many (or too aggressive) steps could result in "[d]estroying the river to clean it," as the Boston Globe entitled an editorial about an earlier proposal far smaller and less disruptive than what the Region is now proposing, it is essential that any Rest of River remedial decision carefully weigh all of the relevant impacts, positive and negative, of any particular remedy.

The Region's draft Permit modification does not employ such a balanced approach, and it does not achieve a balanced result. Time and again in the Region's Comparative Analysis of Remedial Alternatives and its Statement of Basis, the benefits of its unstudied approach are overstated (and benefits achievable by alternative remedial approaches that have been studied are downplayed), inevitable negative impacts are dismissed with a wave of the hand, and cost considerations are completely ignored. The remedy that the Region proposes would lay a heavy glove on the Rest of River even though it is exceedingly clear that a lighter touch will also protect human health and the environment, and be far less destructive. The draft Permit modification is therefore (i) procedurally defective, because the Region has not paid the necessary attention to the criteria specified in the Consent Decree and the Permit, and (ii) substantively wrong (even dangerous) because, in the name of protecting the environment, it would destroy substantial portions of the Rest of River.

II. <u>Off-Site Disposal</u>

Perhaps the most significant example of the Region's unbalanced approach is its selection of out-of-state disposal as the means of dealing with the nearly one million cubic yards of sediment and soil that would be removed if its proposal is implemented. Out-of-state disposal will be no more beneficial to the environment or the people of the Berkshires than on-site disposal in a secure upland facility on-site. In fact, out-of-state disposal could be more disruptive. Out-of-state disposal will certainly be far more expensive, costing GE about a quarter of a billion dollars more to implement than on-site disposal.

The Region knows this. It admits the vast disparity in cost, and it also admits that on-site disposal would be fully protective of human health and the environment. In fact, in the past, EPA has recognized on-site containment as the "presumptive remedy," approving on-site disposal of PCB-contaminated sediment and soil at other sites across the United States, including in Massachusetts, and in Pittsfield, after finding that on-site disposal was protective of human health and the environment.

Given EPA's long history of supporting on-site disposal in Pittsfield and elsewhere, it perhaps is not surprising that the Region's arguments for abandoning that position are not compelling. For example, an on-site disposal facility would not, as the Region claims, have a significant effect on existing habitat, especially in the context of the remedy that the Region is proposing. One of the locations proposed for such a facility is a sand and gravel quarry and the two others have no special ecological value.

The Region's other attempted justifications of out-of-state disposal highlight the impacts of on-site disposal while obscuring the essentially equivalent impacts of out-of-state disposal. For example, the Region focuses on the potential for improper operation and maintenance of an on-site disposal facility (despite its certain ongoing role in overseeing the operation and maintenance of such a facility), but ignores the comparable risks at any out-of-state facility. The Region claims that out-of-state disposal is more reliable in the long term because "it does not rely on operation, monitoring, and maintenance requirements (except at the receiving facility)." The parenthetical qualification at the end of this statement lays bare the Region's bias: Wherever the material in question goes, the facility that receives it will necessarily be subject to "operation, monitoring, and maintenance requirements." There is no reason to believe – and the Region certainly has given none – that it would be any more difficult to meet those requirements at an on-site disposal facility than at an out-of-state "receiving facility."

The fact is that even the EPA Region concedes that on-site disposal is equivalent to out-of-state disposal when it comes to their relative effectiveness. Further, the Region ignores certain impacts of out-of-state disposal that are not associated with on-site disposal. Out-of-state disposal will require construction of a rail loading facility that will, of necessity, have to be located near the River. Also, simply as a function of the total miles traveled, out-of-state disposal will result in many times higher emissions of greenhouse gases and a far higher risk of accidents, injuries, and even deaths.

Why then does the EPA Region insist on out-of-state disposal? The real reason is avoidance of local opposition. The Region claims that on-site disposal is not "implementable" because it would require "extensive coordination with state and local officials," as well as with "the public," and would encounter state and local opposition that could render the alternative infeasible. To be sure, implementability is one, albeit only one, of the many criteria EPA is required to consider in selecting a Rest of River remedy. However, as the Region knows, and even says elsewhere in its Comparative Analysis of Alternatives, the Rest of River remedial action is exempt from state and local permit requirements, and state and local opposition are not criteria that EPA is allowed to consider under the Consent Decree or the Permit. This was finally determined when the Court entered the Consent Decree. Thus, any state and local opposition to on-site disposal does not affect the implementability of that option.

On the other hand, cost is one of the criteria that EPA is specifically required to consider. GE estimates that out-of-state disposal will cost between $200 million and $300 million more than on-site disposal.

Given the functional equivalence between on-site and out-of-state disposal, EPA cannot require GE to pay for the much more expensive alternative. EPA's own guidance says that, when more than one potential remedy will meet all the threshold criteria (as is the case here), then "cost becomes an important consideration in choosing the remedy . . . ." Nothing in the Permit or Consent Decree authorizes EPA to abandon common sense and ignore its own guidelines. Requiring GE to spend hundreds of millions to achieve no incremental environmental benefit is the essence of arbitrariness.

III. <u>Lack of Health or Environmental Justification for EPA Proposal</u>

When it comes to the actual remediation of the Rest of River, the EPA Region has basically adopted the position that the more soil and sediment GE is required to remove, the better the outcome. This simplistic formula has caused the Region to propose a remedy that is not calculated to produce a greater benefit than less extensive alternatives, and will have far greater negative impacts.

In determining the appropriate "fix" for the Rest of River, an important initial question is this: Just how "broken" is the Rest of River ecosystem? The answer is: Not very. As the Commonwealth of Massachusetts has observed, despite what it calls a "legacy of contamination" in the River and floodplain resulting from PCB releases that began in the 1930s and did not end until the 1970s, the Housatonic River watershed continues to encompass "a rich and unique ecosystem supporting many rare plant and animal species and their associated habitats, including wetlands, floodplains, vernal pools, surface waters, and forested areas." Recent field surveys by the Commonwealth have documented the ongoing ecological vitality of the area, finding numerous plant and animal populations that continue to thrive, including several state-listed species found in few other places in the Commonwealth. The same is true with respect to the human population of the area. Studies have shown no elevated cancer rates or elevated blood PCB levels in the people who live in communities along the Housatonic River.

Real-world experience thus calls into question EPA's assumptions about the risks of PCBs in the Rest of River.

But even if one takes EPA's concerns at face value, the Region wants to do too much. Similar benefits can be achieved with less extensive, and less destructive, remedial action. For example, the Region's proposed remedy would require the removal of 890,000 cubic yards of river sediment. This drastic action, however, would still not allow for unrestricted fish consumption, and less radical alternatives would achieve essentially the same level of protection of human health relating to fish consumption.

Likewise, with respect to the risk of direct human contact with contaminated soils and sediment, EPA proposes far more removal – some 75,000-80,000 cubic yards of floodplain soil – than is necessary to protect human health. To justify this position, EPA adopts a set of unrealistic assumptions, this time about the extent of potential human exposure. It supposes that a given individual would visit a given "high use" recreational area three times per week, every week from April to October, every year for 47 years, spending all of his or her time in the most contaminated areas of the floodplain. This is not, of course, how the recreational areas in the Rest of River are actually used. More realistic – but still very conservative – assumptions about exposure indicate that a much less extensive remedy, involving the removal of about 10,000 cubic yards of floodplain soil, would fully achieve the goal of protecting human health. In any event, even accepting EPA's extreme exposure assumptions, a remedy that involved the removal of only about 26,000 cubic yards of soil would sufficiently address this risk.

In these ways, and others, the Region's draft Permit modification gets the "benefit" variable of the equation wrong, but that is only one variable in the equation that EPA is required by the Consent Decree and Permit to solve. Equally important are the negative impacts of the remedial actions necessary to achieve these "benefits." Like the Consent Decree and Permit, EPA's own internal guidance says that the agency must balance (i) residual risks posed by site contaminants before and after implementation of a selected remedy with (ii) the potential impacts of the selected remedy on the environment. The Agency has long recognized that "it may not be in the best interest of the overall environment" to actively remediate a site if the remediation would cause more long-term ecological harm than leaving the contamination in place.

When it comes to an assessment of those negative impacts here, more is clearly not better. The proposed remedy would cause substantial, extensive, and irreversible harm to the Rest of River ecosystem. While that ecosystem has thrived in the presence of PCBs, it is nonetheless vulnerable in many respects, a unique place with unique and sensitive riparian habitats and substantial biodiversity. The Region's proposed remedy would inevitably cause more harm to these habitats and their biodiversity than it could possibly relieve or prevent. For example, the proposed remedy would:

- Require the removal of sediment from over 200 acres of the river bed and the removal of riverbank soil from approximately 3.5 miles of river banks, "caus[ing] severe and long-lasting destruction of the Housatonic River ecosystem and state-listed rare species." Those are the words of the Commonwealth of Massachusetts, not GE. The process of sediment removal and the capping of the riverbed would kill all of the benthic invertebrates that occupy the base of the aquatic food chain in this stretch of the river, and would cause severe damage to native fish populations, creating a vacuum in which invasive plant and animal species could take hold. In addition, the stabilization of the riverbanks would cause an enduring loss of critical habitat for many species, which would not return to their current condition.

- Require the removal of all mature trees from floodplain wetland forests in the area, destroying a vital habitat across 36 acres.

- Damage or destroy as many as 43 vernal pools. While EPA hasn't even specified which pools would be affected, or how many of them would be "remediated," it is clear that the vernal pools that would be subject to PCB removal, and the species that rely on them, would suffer long-term damage from which they would not completely recover.

- Adversely affect 25 state-listed species, including significant portions of the local populations of at least 9 of those species.

The Region essentially shrugs off these impacts, and justifies its blindness to the damage that its proposed remedy would cause by waving the banner of what it calls "restoration." According to the Region, "restoration is expected to be fully effective and reliable in returning [the affected] habitats . . . to their pre-remediation state." Even more outrageous is the Region's claim that the likelihood of such complete restoration would be equal across all of the alternatives that have been presented, from the smallest to the largest.

How would this "restoration" be achieved, and what would it look like? The Region doesn't say. In fact, the Region's proposed remedy is so lacking in substance in this regard that one can barely make out what the Region really means when it refers to "restoration." This lapse is a violation of the terms of the Permit, which require EPA to evaluate every significant aspect of the proposed remedy in light of the Permit criteria. It also stands in stark contrast to, and opposition of, the exhaustive analysis that the Region required in the Revised Corrective Measures Study of the negative impacts of every other remedial alternative, what might be done to avoid or mitigate those impacts, and what the resulting condition of the affected areas would be.

From that Revised Corrective Measures Study and peer-reviewed research ignored by the Region, we know that restoration is not the panacea that the Region promises – not in general and not in the unique circumstances of the Rest of River. For example, there is absolutely no evidence that the complex infrastructure of a vernal pool network can be re-created once it, and its adjacent forest, is impacted in the way suggested by the proposed remedy. While it is narrowly true that forests can generally be "restored" by planting seedlings or saplings in the place of the mature trees that the proposed remedy will destroy, the prospect of "restoration" has to be tempered by the realization that it will, in the best case, be at least 50 to 100 years before the replanted forests could possibly return to their current, mature condition, with the ecological services they provide. That best case ignores the significant threats posed by invasive species, climate, and other forces working against such a possibility. In the meantime, the affected areas will be unable to sustain the species that currently rely on this unique habitat. The best case also ignores the steps that the Region would require to permanently prevent the reforestation of stabilized river banks.

In a critique that is attached to these comments, Professors Brooks, Calhoun, and Hunter, renowned experts on river ecosystems and vernal pools, demonstrate that the EPA Region has no basis for its optimism in the specific context of the Rest of River (because nothing like the "restoration" that the Region envisions has ever been attempted, much less achieved), and that the premise of the Region's reliance on "restoration" is incorrect. In truth, the affected ecosystems can never be returned to their pre-remediation state. As the Professors explain, what the Region calls "restoration" will actually produce a new ecosystem. The most that can be hoped for, then, is that "restoration" may be partly effective at returning some types of habitats to some semblance of their pre-remediation state after an extended period that cannot be predicted with any certainty. What the Region proposes, in other words, is a speculative technological and ecological gamble. Given the high stakes for this unique and sensitive ecosystem and the low need for the extent of remediation that the Region proposes, this is a very poor wager indeed for the Commonwealth of Massachusetts, and for the people of the affected communities.

IV. <u>Deficiencies in Specific Elements of Proposed Remedy</u>

The picture does not change if one tightens the focus to particular elements of the proposed remedy. In its details, as in its broader outlines, the Region's proposal is arbitrary and capricious because it fundamentally skews the necessary balance.

A. Proposed Remedies for Specific Parts of the Rest of River

The Region's plans for remediating PCBs at Woods Pond and Rising Pond, in the Reach 7 impoundments, in the backwaters, and at the precious vernal pools are all microcosms of the larger proposed remedy: Each suffers in some way from a defective calculation of positive and negative impacts. For each, the Region insists on more dredging, more capping, more removal of sediments and soils, but at every turn it fails to substantiate the assumption – more is better – that animates its insistence.

Thus, for example, at Woods Pond, the proposed remedy would require deep dredging and the placement of an engineered cap throughout the Pond, a remedy that will require the removal of at least 285,000 cubic yards of sediments and likely as much as 340,000 cubic yards, for the ostensible purposes of (i) reducing PCB concentrations in fish in the Pond and downstream, and (ii) reducing the transport of PCBs downstream from the Pond. But projections made using EPA's own model show no discernible difference in outcomes between the Region's proposal and alternatives involving far less removal. Likewise, in Rising Pond and in the Reach 7 impoundments and backwaters, the EPA model indicates that, at most, the Region's proposal would yield only tiny improvements in risk reduction over much more moderate remedies – or, in the case of Reach 7, even over Monitored Natural Recovery (MNR), in which the ecosystem is essentially allowed to recover without intrusion. Indeed, given the minuscule projected differences and the uncertainties inherent in the model, it cannot be said with statistical confidence that any real benefit would be achieved through the extra removal.

In each case, however, it is clear that performing the Region's proposed remedy will both (i) cost more, and (ii) have greater and more detrimental impacts. More dredging and more capping inevitably mean more traffic, and more traffic inevitably means more disruption and the emission of more greenhouse gases. The Region's proposal for Woods Pond would require an extra 30,000 truck trips over an equally effective plan involving much less removal; its plan to remove and replace up to 84,000 cubic yards of sediments in the Reach 7 impoundments would produce about 7,000 additional tonnes of greenhouse gases over "thin-layer capping" (and 10,000 more tonnes than MNR, which would be practically as effective); and its remedy for Rising Pond would necessitate approximately three times as many truck trips and generate nearly seven times as many tonnes of greenhouse gases as a more moderate approach. Remediating Woods Pond according to the proposed remedy would cost as much as $188 million; the expense of an equally effective alternative would be only $34-$39 million. The cost disparities are similarly dramatic for the other areas mentioned.

For the vernal pools in the floodplain, the draft Permit modification does not convey a proposed remedy at all, but only the vaguest outlines of a highly contingent plan. This plan, moreover, is not rooted in the Permit criteria, as any proposed remedy must be, but contemplates the performance of undefined pilot tests and experimental measures whose potential benefits and impacts cannot reliably be predicted. Thus, according to the draft Permit modification, EPA will select 8 to 10 vernal pools for remediation by excavation, an unspecified number of additional pools for treatment with activated carbon, and yet another unspecified number of pools for testing of an unspecified "third remediation method." After these pilot programs are completed, EPA will decide which method to use on the remaining vernal pools.

It is clear that excavation will have a devastating impact on the affected pools and their inhabitants, and that there is no basis for the Region's claim that the damaged pools could be "restored" to anything resembling their pre-excavation state. Where the activated carbon method would be used, the Region is proposing not a remedy but an experiment; there is no prior research on the effects of this approach, and no data on the harm that it might cause. With respect to the mysterious "third remediation method," of course, no assessment of impacts is possible and the proposed remedy could not possibly be anything but arbitrary and capricious.

B. Proposed Performance Standards

The draft Permit modification sets a number of "Performance Standards" for GE's performance of the proposed remedy. Several of these standards are inappropriate because – in line with the Region's philosophy that more is better – they set much more stringent benchmarks than needed to achieve the intended benefit. For example, engineered caps can be considerably thinner than the Region has estimated and still be effective.

Other proposed standards are arbitrary because the Region cannot tie them to actual reductions in risk or otherwise justify them under the Permit's selection criteria. For example, the numerical "flux values" set by the Region for downstream transport of PCBs are not related to any demonstrable benefit under the Permit. Moreover, that standard and a standard for PCB concentrations in fish tissue are not authorized under the Permit because they are essentially open-ended and contingent. Those standards suggest that, if GE someday does not meet them, then GE will have to undertake additional remedial actions; but the nature and extent of those actions are not specified in the draft Permit modification – they are instead left for future determination. This is contrary to the letter and spirit of the Consent Decree and the Permit, which are intended to provide everyone with certainty about the response actions that will be required, so that those interested can now take advantage of the review and appeal processes specified in the Consent Decree and the Permit.

V. Additional Requirements

The draft Permit modification contains a number of additional requirements that are inappropriate. For example, the habitat "restoration" requirements exceed EPA's authority under the Consent Decree, in addition to being too vague to evaluate and unachievable. Requiring GE to pay for the restoration of resources damaged by the implementation of a remedial action falls into the legal category of "natural resource damages." In the Consent Decree, however, GE entirely resolved its potential liability for natural resource damages by paying millions of dollars and agreeing to perform specified "Restoration Work." This matter is settled and EPA cannot now assert new claims for additional natural resource damages caused by its own proposed remedy.

Some of the other proposed requirements go beyond EPA's legal authority in other ways. For example, the draft Permit modification says that, if anyone implements any kind of a project along the river that would require sampling, handling, or disposition of sediment, then GE must pay all testing, handling, and disposal costs associated with PCBs in the sediment. This provision exceeds EPA's proper role in two ways. First, it does not address any identified risks to human health or the environment, and thus is not within EPA's purview. Second, EPA simply lacks the power to declare by administrative fiat that GE must pay costs incurred by third parties. If they suffer damages, and if the law makes GE liable for those damages, then they may seek relief from GE, and if necessary from the courts, which are empowered and obligated to take into account not just the claims of the injured parties but any defenses that GE may offer.

Finally, the draft Permit modification goes wrong in its listing of a litany of state and federal ARARs (Applicable or Relevant and Appropriate Requirements) that must be attained by the on-site remedial actions. Some of these ARARs are in fact unattainable and will have to be waived. Others do not qualify as ARARs at all – for example, because they are not applicable to the proposed remedy or are simply not measurable and attainable using current technology.

VI. <u>Conclusion</u>

The Permit requires EPA to select a remedy for the Rest of River on the basis of specific criteria agreed to by EPA, the Commonwealth of Massachusetts, the State of Connecticut, and GE and then approved by the Federal Court.

The EPA Region has not complied with this essential requirement.

In fact, the Region ignores the very evaluations that it has demanded and refuses to subject its proposed remedy to the same evaluation it required of every other remedial alternative. It has not quantified many of the impacts of its proposed remedy (for example, its impacts on several types of floodplain habitat, marking those impacts as "TBD"). In certain material respects, it has not even specified the remedial actions that might be required (for example, the to-be-determined and therefore not evaluable "third remediation method" for vernal pools or the further work that might be required in the event of a flux or fish tissue Performance Standard exceedance). It also relies on a general and unsupportable claim of the likelihood of success of "restoration" to ignore the negative impacts that it does identify.

For these reasons and others, the Region is proposing a Rest of River remedy that is far larger and more destructive than remedies that have already been rejected by the Commonwealth of Massachusetts as doing more harm than good. This is a much different direction than anticipated by the Consent Decree and the Permit and unlikely to result in a consensus like the one reflected in those documents. However, GE remains committed to implementing a responsible remedy that addresses the PCBs remaining in the Rest of River in a way that is consistent with the requirements of the Consent Decree, the Permit, and EPA precedent.

II. OFF-SITE DISPOSAL REQUIREMENT

The EPA Region's proposed remedy would require that GE dispose of all contaminated sediment and soil removed as part of the remedy at off-site disposal facilities located outside Massachusetts, and that GE "shall maximize the transport of such waste material to off-site facilities via rail" (Draft Permit, p. 31). The Region rejected the alternative approach, proposed by GE, of disposal in a secure on-site upland disposal facility to be constructed in close proximity to the river but outside the 500-year floodplain.[5] For purposes of the Region's analysis, off-site disposal (assumed to be via truck) has been designated alternative TD 1, off-site disposal by rail has been designated alternative TD 1 RR, and on-site disposition in a secure upland disposal has been designated alternative TD 3. In its Comparative Analysis of Remedial Alternatives, the Region notes that "[t]he Commonwealth of Massachusetts has expressed a strong preference for treatment/disposition alternatives that will permanently relocate contaminated materials in licensed out-of-state facilities, with a strong preference for the use of rail," and that "[o]f the evaluated alternatives, only TD 1 and TD 1 RR could satisfy this requirement" (Comp. Analysis, p. 75). The Region then concludes that, of all the treatment/disposition alternatives evaluation, "TD 1 RR is best suited to meet the General Standards of the RCRA permit in consideration of the Selection Decision Factors" (*id.*, p. 77).

A. Overview

The EPA Region's conclusion and consequent proposal twist the remedy selection criteria specified in the RCRA Permit in a heavy-handed effort to prevent on-site disposal, which is opposed by many in the local communities as well as the Commonwealth. The Region admits, as it must, that disposal of PCB-containing sediment and soil in a properly designed and maintained on-site upland disposal facility would be protective of human health and the environment (Stmt. Basis, p. 35; Comp. Analysis, p. 61). Indeed, EPA has long recognized that on-site disposal facilities are protective, particularly for wastes containing PCBs, which are relatively immobile. On-site disposal of removed PCB-containing sediment and/or soil has been a component of the remedy selected by EPA for numerous PCB sites throughout the country, including in Massachusetts. This is shown in Table 1. Unlike certain other types of waste, such sediment and soil basically consist of inert solid materials that have relatively low levels of contaminants and do not require treatment prior to disposal.

In fact, in the CD, EPA approved the use of such on-site disposal facilities for sediment and soil from other portions of this Site, including the upper two miles of the Housatonic River. In its response to comments on the proposed CD, EPA concluded that ***the use of on-site disposal facilities for PCB-containing material was appropriate*** and consistent with the use of such on-site containment as the "presumptive remedy" for similar situations and types of waste (United States' Response to Comments on proposed Consent Decree, pp. 69, 77). Further, in an attachment to the CD, EPA recognized that the material to be disposed of on-site "consist[s]

[5] As discussed in the Revised CMS Report (Section 9), GE has identified three potential locations for an upland disposal facility, referred to as the Woods Pond, Forest Street, and Rising Pond Sites. Any of these sites would have the capacity and thus could be used for disposition of the approximately 1 million cubic yards (cy) of sediments and soils that would be removed under EPA's proposed remedy.

of relatively low levels of PCB contaminated soils and/or sediments which are spread over a large area measuring hundreds of acres" and "PCBs are relatively immobile due to their low solubility in water" (CD Appendix D, p. 38). Thus, EPA approved the disposition of this material in on-site facilities, finding that such disposition "will not pose an unreasonable risk of injury to health or the environment" (*id.*, p. 41).

EPA's prior conclusions about contaminated sediment and soil from the Site apply with equal force to sediment and soil from the Rest of River. In fact, the prior conclusions are even more true at the Rest of River, where the PCB concentrations in the sediment and soil are generally lower on an overall basis than those in the areas above the Confluence, for which on-site disposition has already been authorized.

The EPA Region slants its discussion of many of the Permit criteria by suggesting new-found supposed problems with on-site disposal that are unsupportable or overblown and by ignoring similar problems with the off-site disposal alternatives. This is demonstrated by the detailed analysis of the Permit criteria in Section II.B, but a few examples are mentioned here.

- In discussing several of the Permit criteria, the Region claims that an on-site disposal facility would cause a permanent alteration of the habitat at that site of the disposal facility (e.g., Comp. Analysis, pp. 61, 66). Based on the assumed removal/disposal volume of approximately 1 million cubic yards (cy) of sediment and soil, potential configurations of the upland disposal facility at each of the three identified sites – the Woods Pond, Forest Street, and Rising Pond Sites – have been revised and are shown on Figures 2, 3, and 4, respectively. As shown on those figures and discussed further in Section II.B.1, the facility at the Woods Pond Site would be located predominantly (over 90%) within an already disturbed area that has been used for long-term sand and gravel quarry operations, where there would be no impact on any valuable habitat; and the facilities at the other two sites would be located within areas that are not subject to any special protections and are not part of the ACEC. Moreover, these facilities would not include any floodplain or wetland areas or rare species habitat of the sort that would be devastated by the Region's proposed sediment and floodplain remedy. By contrast, the Region does not even mention the habitat impacts of the on-site rail loading facility that would be necessary for TD 1 RR.

- In discussing several Permit criteria, the Region claims that TD 3 would have a risk of PCB leaks from trucks carrying leachate from the on-site disposal facility or from that facility itself if not operated properly (e.g., Comp. Analysis, pp. 61, 62, 64, 68, 69). In fact, however, as discussed further below, all aspects of the remediation, including the operation and maintenance of an on-site disposal facility, would be subject to EPA's day-to-day oversight to ensure proper operation. In any case, long-distance transportation of sediment and soil to an out-of-state disposal facility by truck or rail would involve a greater risk from leaks during transport than the much shorter-distance transportation required for on-site disposal; and the potential for leaks from the disposal facility itself is no greater for an on-site disposal facility than for an off-site disposal facility.

- In discussing ARARs, the Region attempts to support its out-of-state disposal requirement by asserting that off-site disposal would have fewer ARARs and would meet all of them, whereas on-site disposal would be subject to more ARARs and might not meet some of them, notably state ARARs relating to placement of a waste facility in an ACEC (e.g., Comp. Analysis, p. 63). As discussed further in Section II.B.3, that assertion is incorrect and simply another make-weight attempt to bolster the Region's position. Some of the regulations cited by the Region are not applicable at all. To the extent that the regulations prohibiting a waste facility in an ACEC are potentially applicable, they should not be applied to the Woods Pond Site (even though it is located within the ACEC boundaries) because on-site disposal in the quarry would not affect any of the resources of the ACEC. The other two potential disposal sites are well outside the ACEC. In any event, the Region has turned a blind eye to the fact that the very same ACEC prohibitions would also apply to the temporary sediment/soil staging areas necessary for any disposal alternative and to the rail loading facility necessary for TD 1 RR, as well as to the fact that other ACEC prohibitions would also apply to its proposed remedy for sediment (e.g., a state prohibition on dredging in an ACEC).

- Noting that there is "substantial local and state opposition" to on-site disposal, the Region claims that this opposition would make that alternative "very difficult, if not impossible, to implement" (Comp. Analysis, pp. 75, 76). That assertion is demonstrably wrong. As discussed in Section II.B.7, given the on-site permit exemption for remedial actions implemented under CERCLA, no state or local permits or approvals would be necessary for the on-site disposal facilities, and thus "local and state opposition" would pose no impediment to the implementability of this option.

Despite the Region's bias in favor of out-of-state disposal, an objective application of the Permit criteria clearly favors the selection of on-site disposal, as is demonstrated in Section II.B. This is because: (a) both off-site disposal and secure on-site upland disposal would meet the Permit's General Standards; (b) the Selection Decision Factors other than cost either favor on-site disposal or favor neither alternative; and (c) the cost factor strongly favors on-site disposal.

B. Detailed Analysis of Permit Criteria

This section discusses in detail each of the Permit criteria applicable to alternatives TD 1, TD 1 RR, and TD 3. The first three such criteria discussed are the General Standards in the Permit, and the next five are the Selection Decision Factors.[6]

1. Overall protection of human health and the environment

The EPA Region acknowledges that both TD 1 and TD 3 would provide "high levels of protection to human health and the environment" (Stmt. Basis, p. 35). It explains that TD 1 and TD 1 RR would provide such protection by "providing for permanent disposal of PCB-contaminated sediment and soil in permitted off-site landfills," and that TD 3 would provide such protection by "permanently isolating the PCB-contaminated sediment and soil in an upland disposal facility, which would be constructed with an appropriate double liner, cover, and double leachate collection system" (Comp. Analysis, pp. 60-61).

[6] The Region and GE agree that the Selection Decision Factor of attainment of IMPGs is not applicable to the analysis of disposition alternatives.

As discussed in the prior section and shown in Table 1, EPA has long recognized that on-site disposal facilities are protective, particularly for sediment and soil containing PCBs, in selecting on-site disposal of such materials as a component of the remedy for numerous PCB sites throughout the country, including in Massachusetts.[7] Indeed, the EPA Region has already approved the use of on-site disposal facilities (the On-Plant Consolidation Areas [OPCAs]) at this very Site, based on determinations that such facilities are appropriate for PCB-containing sediment and soil and would not pose an unreasonable risk of injury to health or the environment (see Section II.A). There is no justification for a different conclusion for the Rest of the River.

In an apparent attempt to distance itself from its own prior conclusions, the Region has inserted some qualifications into its discussion of the application of the overall protectiveness criterion in an effort to suggest that TD 3 would be less protective than TD 1 or TD 1 RR. Those qualifications do not withstand scrutiny and do not support the Region's conclusion.

Potential habitat impacts. The Region notes that TD 3 would cause a long-term or permanent habitat change in the footprint of the upland disposal facility, although it recognizes that the capped disposal area would be replanted with grass and that the support areas would be restored (Comp. Analysis, p. 61). The Region states that the significance of that change in habitat would depend on the location of the facility. As shown on Figures 2, 3, and 4, the upland disposal facility at each of the three identified sites could be configured so that it would not only be located outside the 500-year floodplain, but would also not include any wetlands (although a facility at the Forest Street Site would require building an access road across a small stream) and would be outside of any mapped Priority Habitat for state-listed rare species.

In fact, at the Woods Pond Site, as shown on Figure 2, the facility's operational area would be located predominantly (approximately 27 of 29.5 acres) within an already disturbed area that has been used for many years for sand and gravel quarry operations, with a small portion (total of approximately 2.5 acres) affecting two small currently wooded areas on the northern side of the disturbed area that are of no special ecological significance. Thus, at this site, the post-use planting of this disposal facility area with grass would result in a clear ***improvement*** of the habitat compared to its current condition. At the other two sites, as shown on Figures 3 and 4, the operational areas of the waste disposal facilities would be located predominantly within currently wooded areas that are not subject to any special protections (such as those relating to wetlands, floodplains, or rare species habitat) and where the trees could be cut without regulatory approval.

At all of these sites, the disposal facility area would be replanted after use with a grassland community, which would provide suitable habitat for a variety of field-dependent wildlife species, as discussed further in Attachment A to these comments. In any case, the impacts of the

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[7] As noted in Table 1, for example, the EPA New England Region has approved the use of an on-site Confined Aquatic Disposal (CAD) cell for disposition of PCB-contaminated sediment in New Bedford Harbor (EPA, 2011). It is inconsistent for the Region to conclude that disposition of such material within that waterbody is acceptable, but that disposition of similar materials in a secure on-site upland disposal facility outside the floodplain in Berkshire County is not.

upland disposal facilities would be minor compared with the much more severe adverse habitat impacts of the river and floodplain remediation, which would impact hundreds of acres of riparian habitat, including floodplain forests, wetlands, and rare species habitat (see Section III.C.1 below).

Moreover, the Region has failed to consider the potential habitat impacts that would be caused by the construction of a rail loading facility under TD 1 RR. While a specific location for such a facility has not been identified, any such facility would need to be located in proximity to the river and therefore would likely impact valuable habitat, including land within the designated ACEC.

In short, contrary to the Region's claim, any habitat impacts of TD 3 do not undermine the protectiveness of that alternative.

Truck traffic and risk of leaks. The EPA Region also asserts that TD 3 would have additional short-term impacts such as truck transport of leachate from the disposal facility over public roads to GE's Pittsfield facility for treatment (Comp. Analysis, p. 61). It states that, alternatively, GE would have to construct and operate a treatment facility at the upland disposal facility, and that if that facility was not operated properly, there could be releases of PCBs into the environment. This is another red herring. The Region admits that leaks during transport would occur only in the case of "malfunctioning equipment or an accident" (*id.*, p. 69) and that leaks from an on-site treatment plant would occur only if the plant "were not operated properly" (*id.*, p. 61). The Region has made no effort to quantify the risks of such unanticipated circumstances or to estimate the PCB content of the leachate. If fact, if trucks were used to transport leachate to the GE Pittsfield plant for treatment, they would be water-tight to prevent any release. Further, we have calculated that the total mass of PCBs that would be transported in the leachate by truck over the life of the project would be approximately 2 pounds, which is minuscule compared to the total mass of PCBs that would be transported off-site by truck under TD 1 or by rail under TD 1 RR – approximately 38,000 pounds. See Table 2. Alternatively, if a treatment plant for the leachate were constructed at the upland disposal facility, GE could and would install adequate controls, subject to EPA approval, to prevent any leachate from being released into the surrounding environment, let alone into the Housatonic River.

Moreover, the Region appears to ignore the fact that TD 1 RR would likewise involve truck transportation and a potential for releases. Although the Region claims that TD 1 RR "would provide additional protection" by "reduc[ing] the effects on neighborhoods from truck traffic" (*id.*), that alternative would in fact require the use of trucks to transport the excavated sediment and soil to the rail loading facility. There is a potential for releases of PCB-containing materials from those trucks or from the rail loading facility itself, although, for the same reasons mentioned above for TD 3, controls could be installed to prevent such releases. Further, the Region fails to mention the potential for releases from rail cars during long-distance rail transport to out-of-state disposal facilities (e.g., in the event of a derailment), which would involve many more miles of transport than would transfer to an upland disposal facility and thus would increase the risks from TD 1 RR.

The Region also does not discuss other short-term impacts of these alternatives that could affect their protectiveness, but would undercut its effort to prevent on-site disposal in

Massachusetts. For example, as discussed in Section II.B.6, both TD 1 and TD 1 RR would result in considerably more greenhouse gas (GHG) emissions than TD 3 and thus would have a larger carbon footprint. In addition, as also discussed in Section II.B.6, both TD 1 and TD 1 RR would result in a substantially higher estimated incidence (over 20 times higher) of accident-related injuries and fatalities due to off-site truck or rail traffic than would TD 3.

Overall, both off-site disposal (whether by truck or by rail) and on-site upland disposal would provide protection of human health and the environment and, for the reasons discussed above, in several respects, on-site disposal would be more protective.

2. Control of sources of releases

The EPA Region recognizes that both off-site disposal and on-site disposal would control the potential for releases of PCB-containing materials into the environment through placement of those materials into engineered disposal facilities, but it then asserts that TD 1 and TD 1 RR would better meet this criterion than TD 3 (Comp. Analysis, p. 62). To support this claim, the Region states that while TD 3 would "most likely" isolate the removed material from being released into the environment, "the potential remains for releases to occur to the Housatonic River watershed both during operations and in the long term if the facility, including potentially a water treatment plant, was not properly operated and maintained" (*id.*).

This is not a supportable distinction. Given that all aspects of this remedial action, including the construction and operation of any on-site disposal facility, would be subject to EPA approval and under close EPA oversight, EPA could and would ensure that an on-site disposal facility is properly designed, operated, maintained, and monitored. As such, the facility would provide the same control of releases as an off-site disposal facility. The Region has provided no data on releases from either on-site or off-site disposal facilities, even though it admits that on-site disposal of PCB-containing material "has been used as part of a final remedy at a number of sites and is an effective and reliable means for permanently isolating such materials" (*id.*, p. 64). The fact that any potential releases from an on-site disposal facility, in the unlikely event that they should occur, would be within the Housatonic River watershed, whereas any potential releases from an out-of-state disposal facility would take place within the area of that facility, does not affect the ability of the facility to meet the standard of control of sources of releases. The fact that the Region raises the potential for improper operation and maintenance as a shortcoming of an on-site but not off-site disposal facility reveals its bias against on-site disposal.

3. Compliance with federal and state ARARs (or waiver of ARARs)

With respect to the criterion of compliance with federal and state applicable or relevant and appropriate requirements (ARARs) (or the basis for a waiver of such ARARs), the Region asserts the following: (a) TD 1 and TD 1 RR have fewer ARARs and are the only TD alternatives that would attain all of them;[8] (b) TD 3 "has ARARs associated with being a

[8] The Region's Statement of Basis asserts in one place (p. 25) that the state requirements regarding disposal of removed sediment and soil would not constitute ARARs for TD 1 because ARARs apply only to on-site activities and,

hazardous waste and solid waste disposal site, and possibly impacts on wetland areas"; (c) two of the three identified sites for an on-site upland disposal facility "are in, or in close proximity to, a state-designated Area of Critical Environmental Concern (ACEC)" and thus would not meet the requirements of the Massachusetts site assignment regulations for solid waste facilities (310 CMR 16.40(3)&(4)) or the Massachusetts hazardous waste regulations (310 CMR 30.708), which (the Region says) prohibit a solid waste facility and a hazardous waste facility within or adjacent to or in close proximity to an ACEC; and (d) certain of those sites would not meet the Massachusetts hazardous waste facility site safety council regulations (990 CMR 5.04), which provide criteria for evaluating such a facility, including that it is not within an ACEC. See Comp. Analysis, p. 63; Stmt. Basis, p. 36. These erroneous assertions are insufficient to support the Region's position.

Massachusetts solid waste facility site assignment regulations. To begin with, these regulations would not apply at all if the disposal facility were subject to the Massachusetts hazardous waste regulations (as the Region claims), because the solid waste site assignment regulations do not apply to facilities that manage hazardous waste (310 CMR 16.01((4)(a)). Thus, the Region cannot rely on both the solid waste regulations and the hazardous waste regulations. If one set applies, the other does not.

In any event, to the extent that the Region nevertheless seeks to rely on the state solid waste site assignment regulations, those regulations should not be considered to be an ARAR here because EPA has not identified them as an ARAR at this and other sites in Massachusetts where an on-site disposal facility was part of the remedy, and the State has not consistently applied them to such on-site disposal facilities. Note that CERCLA and the National Contingency Plan (NCP) provide that a state ARAR should be waived where the State "has not consistently applied (or demonstrated the intention to consistently apply)" that requirement in similar circumstances at other sites (CERCLA § 121(d)(4)(E); 40 CFR § 300.430(f)(1)(ii)(C*)(5)*).

For example, at another portion of this same Site, the Massachusetts solid waste facility site assignment regulations were not identified as an ARAR for the Building 71 OPCA at the GE facility (a new on-site disposal facility). See ARARs tables in Annex 1 to Statement of Work for Removal Actions Outside the River (Appendix E to Consent Decree), Documentation Related to On-Plant Consolidation Area Activities. Similarly, these regulations were not listed as an ARAR in the EPA Records of Decision for other sites in Massachusetts that involved on-site disposal. These have included the Norwood PCBs Site (see EPA, 1996), the Sullivan's Ledge Site (see EPA, 1989, 1991a), and the Silresim Chemical Corp. Site (see EPA, 1991b), at all of which MassDEP concurred in the remedy. Given that EPA and the Commonwealth have not applied the solid waste facility site assignment regulations to other sites in Massachusetts, it would be arbitrary for EPA to apply them here to support its rejection of TD 3.

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under TD 1, those materials would be disposed of off-site. However, as the Region acknowledges elsewhere, TD 1 and TD 1 RR would involve on-site staging of the removal materials and, for TD 1 RR, transfer of the materials to an on-site rail loading station, dewatering them there, and loading them into rail cars. Thus, as discussed further below, those alternatives ***would*** be subject to some of the same state requirements regarding the handling of waste as on site-disposal.

In addition, the prohibition in those regulations on siting a solid waste management facility in an ACEC, even if applicable, would not bar the implementation of TD 3. Contrary to the Region's claim, the ACEC prohibition in those regulations would, on its face, be inapplicable to two of the three sites identified for an on-site upland disposal facility. Those regulations prohibit a solid waste management facility "within" an ACEC or one that is located outside "but adjacent to" the ACEC and "would fail to protect the outstanding resources of [the] ACEC" (310 CMR 16.40(4)(d)). Neither the Forest Street Site nor the Rising Pond Site is located within or adjacent to the ACEC and thus they would not be affected by this prohibition even if it was applicable.

Moreover, although the Woods Pond Site for an on-site disposal facility is located within the boundaries of the ACEC, the ACEC prohibition should not be applied to it because, as shown above, the disposal facility at that site would be located predominantly (over 90%) within previously disturbed land that has been used for long-term sand and gravel quarry operations and thus is of no environmental value (let alone a "critical" environmental concern). Indeed, in designating the ACEC, the Commonwealth's Secretary of Energy and Environmental Affairs stated that the Commonwealth would work with EPA to resolve any conflict between the ACEC designation and the remedy for the Rest of River (MA EOEEA, 2009, p. 17). In addition, in response a request from the owner of the quarry business at the Woods Pond Site that the ACEC should exclude that site, the Secretary declined to do so, but noted that the ACEC designation would not restrict that existing use of the site and was "not intended to impede development or redevelopment" (*id.*). The Secretary also rejected a request to exclude another project within the ACEC, finding that the ACEC designation was not intended to constitute a determination that that site has unique environmental resources or to place additional burdens on that project (*id.*, pp. 17-18).

Further, other state regulations contain ACEC prohibitions which the Region has ignored. Specifically, the Massachusetts Waterways Law regulations prohibit dredging in an ACEC (except for the sole purpose of fisheries or wildlife enhancement or as part of an Ecological Restoration Project, neither of which is the case here) (310 CMR 9.40(1)(b)); and regulations under the Massachusetts Wetlands Protection Act prohibit alteration of Bordering Vegetated Wetland in an ACEC (310 CMR 10.55(4)(e)). EPA knows this. In designating the Upper Housatonic River ACEC, the Commonwealth's Secretary of Energy and Environmental Affairs reported that EPA "request[ed] that in the ACEC designation, I either exempt the remediation activities [in the Rest of River] from any restrictions imposed by the ACEC designation, or clarify that certain types of activities are allowable under various regulations that are triggered by the ACEC designation." The Secretary declined to do this (MA EOEEA, 2009, page 17). Yet the Region has not cited any of these ACEC-based prohibitions as ARARs for the proposed remedy, let alone addressed whether they are properly waived. This selective memory about the Commonwealth's ACEC-based prohibitions is further evidence that the Region's reliance on such prohibitions to reject on-site disposal is arbitrary and capricious.

Additionally, to the extent that the solid waste assignment regulations, including the ACEC prohibition, are applicable, they would likewise apply under TD 1 to the sediment/soil staging areas and under TD 1 RR to those staging areas and the rail loading facility. Those regulations contain several general siting criteria for a "solid waste management facility" (310 CMR

16.40(4)), which includes any facility used for the "handling, storage, transfer, processing, treatment or disposal of solid waste" (310 CMR 16.02). That definition would encompass the temporary sediment/soil staging areas to be used under any alternative and the rail loading facility under TD 1 RR. Those general criteria include the ACEC prohibition (310 CMR 16.40(4)(d)). In addition, the regulations contain specific siting criteria for a "solid waste handling facility" (310 CMR 16.40(3)(d)), which includes any facility used for the "transfer" or "storage" of solid waste (310 CMR 16.02) and thus would also apply to the staging areas and rail loading facility. Among other requirements, these regulations prohibit any such facility within a "Riverfront Area" (i.e., the area within 200 feet of any flowing waterbody, 310 CMR 10.58(2)(a)3.) (310 CMR 16.40(3)(d)6.), which would apply to the staging areas and likely the rail loading facility. The Region does not mention these prohibitions, which further demonstrates its selective and arbitrary consideration of these regulations. See also Section IV.F.12 below.

Federal and state hazardous waste management regulations. Based on prior experience at other portions of this Site, it is not anticipated that the excavated sediment or soil would constitute hazardous waste under RCRA, and thus would not be subject to the federal hazardous waste regulations.[9] Further, in the unlikely event that future testing showed that some of those materials did constitute such hazardous waste, the upland disposal facility would be designed and operated to meet the substantive technical requirements for a RCRA hazardous waste landfill. In the further unlikely event that that facility were determined not to meet any requirements of the RCRA hazardous waste regulations, GE could arrange to transport those wastes off-site to a RCRA hazardous waste landfill for disposal.

These same considerations would apply to the Massachusetts hazardous waste regulations insofar as those regulations apply to materials that would constitute hazardous waste under the RCRA criteria. In addition to using the RCRA criteria, the Massachusetts hazardous waste regulations also identify wastes with PCB concentrations at or above 50 ppm as hazardous waste. However, those regulations provide that, with the exception of the prohibition discussed in the next paragraph (and one other exception not pertinent here), their requirements do not apply to facilities that manage such wastes in compliance with EPA's regulations under TSCA, which the on-site upland disposal facility would do. See 310 CMR 30.501(3)(a).

One recently adopted provision of the state hazardous waste regulations was specifically developed to apply to waste with PCB concentrations at or above 50 ppm. That provision provides that "[n]otwithstanding any other provision of" the state hazardous waste regulations, a hazardous waste management facility may not be located within an ACEC or "adjacent to or in close proximity to" an ACEC if it would "fail to protect the outstanding resources" of the ACEC (310 CMR 30.708). That prohibition applies even to facilities that meet EPA's TSCA regulations (see 310 CMR 30.501(3)(a)4). Again, this ACEC prohibition would clearly not apply to two of

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[9] A total of over 90 samples of sediment or soil collected by EPA or GE from the 1½-Mile Reach or adjacent floodplain were analyzed for hazardous waste characteristics by the Toxicity Characteristic Leaching Procedure (TCLP). None of these samples showed leachate levels in excess of the regulatory limits that would result in the material being classified as hazardous waste under RCRA. It is expected that the sediments and soils in the Rest of River would be similar to those in and adjacent to the 1½-Mile Reach and thus would likewise not constitute RCRA hazardous waste.

the three sites identified for an on-site disposal facility. Neither of them is within the ACEC. The Forest Street Site is over two miles from the boundary of the ACEC. As such, it is not in such "close proximity" that its use as a disposal facility would "fail to protect" the outstanding resources of the ACEC, and there is nothing in the record that indicates otherwise.[10] The Rising Pond Site is far – over 15 miles – downstream from the boundary of the ACEC.

With respect to the Woods Pond Site, this prohibition should not be identified as an ARAR or should be waived, because, as shown above, the facility footprint at that site would only affect previously disturbed quarry land and two small wooded areas that are not subject to any special protections (such as those relating to wetlands, floodplains, or rare species habitat) and where the trees could be cut without regulatory approval. Moreover, the timing of MassDEP's proposal and adoption of this provision in 2013, coupled with its vigorous opposition to on-site disposal for the Rest of River, indicate that MassDEP's adoption of this provision was calculated to bolster its opposition to an on-site disposal facility at this Site and to provide additional ammunition to assist EPA in rejecting that option. The Commonwealth stated plainly in its January 2011 comments on the RCMS that it strenuously opposed any on-site disposal within the State (MA EOEEA et al., 2011, pp. 14-15), and it reiterated that position in no uncertain terms in a public presentation on its proposed alternative on October 12, 2011 (see Attachment B). The Commonwealth consistently and vigorously continued that opposition through all subsequent discussions in 2012 and 2013. It was in this context that, in 2013, MassDEP proposed and adopted this provision of the hazardous waste regulations, which, unlike all other provisions in those regulations, applies specifically to facilities for the management of wastes containing PCBs at concentrations at or above 50 mg/kg, regardless of their compliance with the TSCA regulations. This context indicates plainly that this provision was directed at attempting to prevent on-site disposal for the Rest of River remedy. As such, waiver of this provision is warranted on the ground that the State has not "demonstrated the intention to consistently apply" this prohibition at other sites – which, as noted above, is a basis for waiver of a state ARAR under CERCLA and the NCP. Again, the fact that the Region has not mentioned the ACEC-based prohibitions in other state regulations (as discussed above) further demonstrates the one-sidedness of its reliance on the ACEC prohibition in the hazardous waste regulations.

Furthermore, the Region disregards and does not even mention the fact that this prohibition would also apply under TD 1 or TD 1 RR. As noted above, unlike the other provisions of the state hazardous waste regulations, the ACEC prohibition applies specifically to any "facility" for the treatment, storage, or disposal of waste containing PCBs at or above 50 ppm, regardless of its compliance with the TSCA regulations. A "facility" is defined under these regulations to include land used for "storing" hazardous waste, and "storage" means "the containment of hazardous waste for a temporary period . . . , at the end of which period the hazardous waste will be used, treated, disposed of, transported, or stored elsewhere" (310 CMR 30.010). Thus, the ACEC prohibition in the hazardous waste regulations would apply to staging areas or a rail loading facility located in or in close proximity to the ACEC. See also Section IV.F.11 below.

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[10] In fact, if the Forest Street Site were considered to be in "close proximity" to the ACEC such that it would "fail to protect" the outstanding resources of the ACEC, the same would be true of any hazardous waste management facility in Lee, and thus the ACEC prohibition could impact any businesses in Lee that generate hazardous waste.

Again, the Region's failure to mention this is clear evidence of its arbitrary and capricious bias in favor of out-of-state disposal and against on-site disposal, contrary to the CD and the Permit.

Massachusetts hazardous waste facility site safety council regulations. These regulations set forth criteria for the Hazardous Waste Facility Site Safety Council to consider in determining whether a proposed project is feasible and eligible for certain state assistance and special permitting procedures for hazardous waste siting and licensing (990 CMR 5.04). These regulations do not establish substantive requirements or restrictions on disposal facilities, and GE would not seek the Commonwealth's assistance and special permitting procedures under these regulations. As such, these regulations are totally irrelevant to this project and thus to the ARARs evaluation here.

"Possible" wetlands ARARs. As previously noted, the Region also asserts that TD 3 has ARARs "possibly" associated with wetland impacts. It provides no further details as to what it might have in mind. As discussed above, however, and shown on Figures 2 and 4, the operational footprints of the upland disposal facilities at the Woods Pond and Rising Pond Sites would not impact any wetlands, and thus would not be subject to ARARs associated with wetlands impacts.[11]

At the Forest Street Site, shown on Figure 3, the operational footprint of the disposal facility would require construction of an access road that would involve the crossing of a small stream in the southern portion of the site; and the facility would be located, in part, within the 100-foot buffer zone and the 200-foot Riverfront Area of that stream, which are subject to the Massachusetts Wetlands Protection Act regulations. However, given the limited nature of this work, the Region could readily find, as it did in the discussion of these regulations in the ARARs tables relating to the proposed sediment/floodplain remedy (Draft Permit, Attachment C), that the work would be conducted in accordance with the substantive requirements of these regulations.

4. Long-term reliability and effectiveness

The EPA Region states that both an off-site disposal facility and an on-site disposal facility would isolate the PCB-containing materials from direct contact with human and ecological receptors; but it asserts again, without giving any support or basis, that TD 3 would have "a greater potential" for exposure to such material and thus pose a greater "residual risk" than TD 1 and TD 1 RR (Comp. Analysis, pp. 63, 64). Presumably, that assertion is based on the same arguments that the Region presented for criteria 1 and 2 above. As such, it has the same flaws

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[11] As shown on Figure 2, the operational footprint of the disposal facility at the Woods Pond Site would be located near two isolated man-made ponds that were created as part of the quarry operations. These man-made quarry ponds should not be considered regulated wetlands; but even if they were, the facility would not extend into those ponds. Further, in the event that these ponds were considered resource areas under the Massachusetts Wetlands Protection Act regulations and the facility were deemed to affect the buffer zones of those ponds (as defined in those regulations [310 CMR 10.02(2)(b)]), GE would implement erosion and sedimentation controls and other best management practices as necessary to meet any applicable substantive requirements under those regulations.

discussed in Sections II.B.1 and II.B.2. TD 3 involves no greater potential for exposure to the PCB-containing material than TD 1 and TD 1 RR.

The Region also claims that off-site disposal is more reliable than on-site disposal because "it does not rely on operation, monitoring, and maintenance requirements (except at the receiving facility)" (Stmt. Basis, p. 36). This claim is disingenuous. Both an on-site disposal facility and an off-site disposal facility require long-term operation, maintenance, and monitoring. EPA has long recognized the reliability of on-site disposal facilities by including such facilities as the component of the remedies at numerous sites, as discussed above and shown in Table 1.

The Region also notes again that TD 3 would require local trucking of leachate from the disposal facility to the GE Pittsfield plant for treatment, or else the construction of a local treatment facility at the upland disposal facility, which could have releases if not operated properly (Comp. Analysis, p. 64). We have answered this claim in Section II.B.1. As shown there, if trucks were used to transport the leachate, they would be water-tight and would transport only a very small mass of PCBs, estimated at approximately 2 pounds, compared to the PCB mass of over 38,000 pounds that would be transported off-site by truck under TD 1 or by rail under TD 1 RR. Alternatively, if GE constructed a treatment facility at the on-site disposal facility, it would install controls, subject to EPA approval, to prevent leachate from being released into the environment, just as effectively as off-site facilities would do. Further, under TD 1 RR, there could be releases from the trucks transporting excavated materials to the rail loading facility or from the rail loading facility itself (if not operated properly), and there could be releases from the rail cars during the long-distance train transport (e.g., in the event of a derailment), which would cover many more miles of transport than the truck transport under TD 3 (see Tables 5 and 6, discussed in Section II.B.6 below). Again, the Region has provided no evidence that the risk of such releases would be greater with TD 3.

In addressing potential long-term adverse impacts on health or the environment, the Region states that TD 1 and TD 1 RR would not cause any adverse long-term environmental impacts in the Rest of River area, but that TD 3 would cause a permanent alteration of the existing habitat within the waste disposition area, "which, for the Woods Pond site, is located within an [ACEC]" (Comp. Analysis, pp. 65, 66). As discussed in Section II.B.1, although the Woods Pond Site identified for a disposal facility is located within the boundaries of the ACEC, the facility would be located predominantly (over 90%) within disturbed land used for quarry operations and would not affect any outstanding resources of the ACEC. In fact, the post-use planting of this disposal facility area with grass would result in a long-term improvement of the habitat (see Attachment A). At the other two sites, the disposal areas would be located within upland wooded areas, which are of no special ecological value and are not subject to any regulatory restrictions on cutting, and there would be no permanent impact on wetlands, rare species habitat, or other particularly valuable or protected types of habitat. Further, any impacts would be minor compared with the adverse habitat impacts of the river and floodplain remediation, which would impact those types of valuable habitat, as described in Section III.C.1 below.

5. Reduction of toxicity, mobility, or volume of waste

The Region does not draw a distinction between the off-site and on-site disposal alternatives in terms of this criterion, noting that neither of these alternatives would reduce the toxicity of the PCB concentrations in the removed material through treatment, that both would reduce the mobility of PCBs in that material through placement in a disposal facility, and that neither would reduce the volume of PCB-containing material (Comp. Analysis, pp. 66-67; Stmt. Basis, p. 37). However, the Region does state in the Statement of Basis (p. 37) that off-site disposal "would reduce the volume of material ***that remains at the Site***" (emphasis added). That statement is disingenuous and not pertinent to this criterion. Neither off-site nor on-site disposal would reduce the volume of waste material, but would just affect where it is placed.

6. Short-term effectiveness

The EPA Region notes that TD 1, TD 1 RR, and TD 3 would all have some short-term negative impacts, but it overemphasizes the adverse impacts of TD 3 and underplays the adverse impacts of TD 1 RR in a further effort to support its proposed alternative.

Habitat impacts. The Region states that TD 1 would have the fewest habitat impacts, requiring only access roads and staging areas; that TD 1 RR would also require construction of a rail loading facility; and that TD 3 would cause a short-term loss of habitat and loss or displacement of wildlife at the upland disposal facility and adjacent areas during construction and operation (Comp. Analysis, p. 68). In fact, both TD 1 RR and TD 3 would cause a loss of habitat and loss or displacement of the associated wildlife at the location of the facility involved – the rail loading facility for TD 1 RR and the disposal facility for TD 3. In both cases, the habitat impacts would be limited to the operational footprint of the facility.

Greenhouse gas emissions. The Region compares the range of GHG emissions (for the removal volumes of all sediment/floodplain remedial alternatives) resulting from TD 1 to those resulting from TD 3, correctly noting that TD 3 would result in much lower emissions. The Region does not estimate the GHG emissions resulting from TD 1 RR, although it notes that those emissions would be "significantly lower" than under TD 1 due to the use of rail instead of truck transport (Comp. Analysis, pp. 68-69). GE has estimated the total GHG emissions from each of these three TD alternatives for the removal volume represented by the proposed sediment/floodplain remedy (approximately 1 million cubic yards). Those estimates are summarized in Table 3. They confirm that TD 1 would result in the greatest amount of emissions (approximately 165,000 tonnes), but they also show that TD 1 RR would result in a considerably greater amount of emissions (approximately 70,000 tonnes) than TD 3 (6,600 to 36,000 tonnes, depending on the disposal facility site used). Thus, TD 3 is much more compliant than either TD 1 or TD 1 RR with EPA's general and the Region's specific "green remediation" policies to minimize GHG generation (EPA, 2009, 2012d).

Local community impacts. In terms of impacts on local communities, the Region focuses on the truck traffic that would be involved in the TD alternatives; and it erroneously concludes that "[d]epending on the location of the upland disposal facility under TD 3, TD 3 may have truck traffic comparable to TD 1," and that this truck traffic "may be greatly reduced by reliance on rail transportation" (Stmt. Basis, p. 37).

The Region correctly notes that TD 3 would involve far fewer off-site truck trips than TD 1; but it then states that TD 1 RR would greatly reduce the amount of off-site truck traffic associated with off-site disposal, erroneously claiming that that alternative would involve ***no*** off-site truck trips (Comp. Analysis, pp. 69-70). Similar to TD 3, TD 1 RR ***would*** involve off-site truck trips for importation of construction materials and equipment for construction and closure of the on-site facility (the rail loading facility for TD 1 RR and the upland disposal facility for TD 3). GE has estimated the number of off-site truck trips that would be required for TD 1, TD 1 RR, and TD 3 for the volume of materials required for disposal under the proposed remedy. Those estimates are summarized in Table 4. They show that TD 1 would require a total of approximately 83,000 off-site truck trips to transport excavated materials to the out-of-state disposal facilities, while TD 1 RR would require approximately 1,200 off-site truck trips to import materials and equipment for construction/closure of the rail loading facility and TD 3 would require approximately 2,400-2,600 off-site truck trips to import materials and equipment for construction/closure of the on-site disposal facility (except at the Forest Street Site, where, due to constructability issues, 68,000 trips would be necessary).[12]

In addition, TD 1 RR would require ***on-site*** truck trips to transport the removed materials from their excavation location to the rail loading facility, just as TD 3 would require on-site truck trips to transport such materials to the upland disposal facility. Estimates of these on-site truck trips are provided in Table 5. As shown in that table, assuming the use of trucks for such transport, the number of such truck trips under these alternatives would be the same – approximately 103,000 (~ 8,000 per year).

Moreover, if the Woods Pond Site were used for the on-site disposal facility, the number of such on-site truck trips could be reduced due to the capability for pumping of sediments from nearby areas (i.e.,, Reach 5C, Woods Pond, the nearby backwaters) to a disposal facility at that location, thus avoiding the need to truck those sediments. As shown in Table 5, the use of such a pumping approach would reduce the on-site truck trips for TD 3 by more than half – to approximately 40,000 trips (~ 3,000 per year).

Overall, considering both off-site and on-site truck trips, TD 1 would involve the most truck traffic, and TD 1 RR would involve comparable truck traffic to TD 3 (or much more truck traffic if the Woods Pond Site were used for TD 3 and sediments were pumped to the Site from nearby areas). Thus, the Region's assertions in the Statement of Basis that "TD 3 may have truck traffic comparable to TD 1" and that this truck traffic "may be greatly reduced by reliance on rail transportation" are without foundation and another example of its bias against TD 3.

In addition, GE has estimated the incidence of accident-related injuries and fatalities due to off-site truck traffic or, for TD 1 RR, off-site rail transport. These estimates are presented in Table

[12] For all of these alternatives, as noted in Table 4, these truck trips would be in addition to the truck trips necessary to import material for backfill, capping, and construction of staging areas and access roads (approximately 72,000 for all TD alternatives) and to dispose of the staging/access material (approximately 11,000 for all TD alternatives).

6. They indicate that TD 1 and TD 1 RR would, respectively, result in a total of approximately 39 and 34 non-fatal injuries and 1.8 and 6.5 fatalities associated with off-site transport, while TD 3 would result in approximately 0.06 to 1.6 non-fatal injuries and 0.003 to 0.075 fatalities associated with such transport (depending on the disposal facility site) – more than 20 times lower.[13]

The Region also again raises the specter that, under TD 3, there would be a risk that leachate being transported via truck from an upland disposal facility could be released en route, creating impacts to the environment and the local community (Comp. Analysis, pp. 68, 69). It asserts that, while "all alternatives would involve the potential for accidental releases of various PCB-contaminated materials during transportation to off-site or local disposal or treatment facilities," that potential would be greater with TD 3 (*id.*, p. 73). As shown in Sections II.B.1 and II.B.4, the Region has provided no evidence to justify that asserted difference, and in fact its claim is false.

Risks to remediation workers. The Region states that, for TD 1 and TD 1 RR, worker risks would consist of risks to truck drivers and (for TD 1 RR) railroad employees and to the employees of the off-site disposal facilities, rather than to on-site remediation workers, and thus were not quantified; and it provides an estimate of risks to on-site remediation workers for TD 3 (Comp. Analysis, p. 72). Even excluding risks to off-site workers, TD 1 RR would have risks to on-site remediation workers, just as TD 3 would, due to the need under TD 1 RR for local truck trips to the rail loading facility and for material processing and rail car loading operations at that facility.[14] Moreover, the risks to off-site truck, railroad, and disposal facility workers under TD 1 and TD 1 RR cannot be ignored just because they occur outside of this Site (or outside Massachusetts). As a result, worker risks do not provide a basis for selecting off-site disposal over on-site disposal.

Summary of short-term effectiveness. Overall, the short-term negative impacts from transport and disposal activities would be, depending on the types of impacts, either comparable among the TD alternatives or less for on-site disposal than for off-site disposal.

7. Implementability

The EPA Region concludes that TD 1 and TD 1 RR are more readily implementable than TD 3. This conclusion is based on several indefensible assertions.

First, the Region claims that on-site upland disposal would be "difficult, and potentially not feasible, to implement" (Stmt. Basis, p. 38; Comp. Analysis, p. 75) – or, in another place, "very difficult, if not impossible, to implement" (Comp. Analysis, p. 76). The basis for this claim is that TD 3 would require "extensive coordination with state and local officials," as well as with "the public," and would encounter substantial local and state opposition, which could render that

[13] Accident risks associated with on-site truck transport are considered under risks to remediation workers, discussed below.

[14] GE estimates that, for the volume of removal under the proposed remedy, the risks to workers from on-site truck transport would include approximately 3 non-fatal injuries and 0.02 fatality for TD 1 RR and approximately 4.8 non-fatal injuries and 0.04 fatality for TD 3, as shown in Table 7.

alternative infeasible (Stmt. Basis, p. 38; Comp. Analysis, p. 75). These claims are unsupportable. Given the CERCLA and CD exemption from state and local permit requirements for on-site remedial work (CERCLA § 121(e)(1); CD ¶ 9.a), construction and operation of such a facility would not require any state or local permits or other approvals, including those relating to siting of the facility. As a result, there would be no need to seek approvals from the state or local governments, and there would be no need to "coordinate" with "the public." Thus, despite the opposition of some state and local officials and members of the public, TD 3 is plainly administratively implementable.

The Region is clearly attempting to use implementability as a surrogate for state and community acceptance, which are "modifying criteria" in the remedy selection process under the NCP (40 CFR § 300.430(f)(1)(i)(C)), but are ***not*** remedy selection criteria under the Permit. Since the Region cannot rely on these factors directly, it has attempted to incorporate those factors into the implementability criterion in an attempt to find support in the Permit criteria for its bias against on-site disposal.[15]

The Region also asserts that, while TD 1 and TD 1 RR would comply with all ARARs, TD 3 could conflict with the ACEC designation, since "two of the three sites proposed for an upland disposal facility would likely be affected by ACEC and Massachusetts regulations restricting siting of such facilities within or in close proximity to an ACEC" (Comp. Analysis, p. 74). This is primarily an ARARs issue, not an implementability issue, and is discussed in detail in Section II.B.3. As shown there, the ACEC prohibition should not be applied or should be waived for the Woods Pond Site and, contrary to the Region's assertion, does not even arguably apply to the other two identified sites for an upland disposal facility. Further, as also discussed in that section, to the extent that the ACEC prohibition would present an implementability issue, it would present such an implementability issue for a rail loading facility under TD 1 RR and for staging areas under TD 1 and TD 1 RR – which the Region fails to mention.

The Region also suggests that if additional remediation beyond the currently proposed remedy should be required later, the capacity of the on-site disposal facility would represent a constraint (Comp. Analysis, p. 75). This hypothetical constraint does not affect the implementability of TD 3. Off-site landfill capacity is also an issue for TD 1 and TD 1 RR. In any case, under TD 3, if additional removal were required later, that additional material could be transported to an off-site disposal facility at that time (assuming there is sufficient capacity). This possibility provides no basis for not selecting an on-site disposal facility for the volume of the currently proposed remedy.

8. Costs

The Region correctly recognizes that TD 3 would be much less costly than TD 1 or TD 1 RR, although it has only estimated costs for these TD alternatives for the full range of potential

[15] Even under the NCP, the state and local community acceptance factors are only "modifying criteria" to be *considered*, not criteria that should drive the decision or justify EPA's deference to the state. By contrast, the other criteria are either "threshold criteria" or "primary balancing criteria" (which include costs) (40 CFR § 300.430(f)(1)(i)), and are to be given greater weight than state and community acceptance.

removal alternatives (Stmt. Basis, p. 38-39; Comp. Analysis, pp. 76, 78). GE has developed cost estimates for TD 1, TD 1 RR, and TD 3 (for each site) for the volume of materials that would require disposal under the Region's proposed sediment/floodplain remedy – approximately 1 million cubic yards – using cost estimating methodologies that were previously discussed with the EPA Region without its objection. Those estimates are limited to the transportation and disposal costs – i.e., they do not include the upfront costs of the sediment and floodplain remedial activities. Those estimates are presented in Table 8 and summarized below:[16]

- TD 1 (trucking): $368 million
- TD 1 RR: $314 million
- TD 3: $63 to $127 million (depending on the site used)

These estimates confirm that on-site upland disposal would be far less costly than off-site disposal – by up to approximately $305 million compared to TD 1 and up to approximately $250 million compared to TD 1 RR.

C. Conclusion

As shown in the preceding sections, TD 1, TD 1 RR, and TD 3 would all meet the General Standards of the Permit, and the Selection Decision Factors clearly favor TD 3 since that alternative is at least comparable to, if not better than, TD 1 and TD 1 RR in terms of the Permit criteria other than cost and is much less costly. Accordingly, TD 3 best meets the General Standards of the Permit in consideration of the Selection Decision Factors. This conclusion is supported by EPA guidance on RCRA corrective action, which states:

> "EPA believes that many potential remedies will meet all the threshold criteria. In that situation, ***cost becomes an important consideration in choosing the remedy which*** most appropriately addresses the circumstances at the facility and ***provides the most efficient use of Agency and facility owner/operator resources***" (emphases added).[17]

That is the situation here. Given the overall comparability of off-site disposal and on-site upland disposal in terms of the General Standards and the other Permit criteria, cost becomes a key factor; and given the substantially lower costs of on-site upland disposal, application of the Permit criteria compels selection of that alternative. The above quotation reflects a concept of cost-effectiveness similar to that in the NCP, which requires that a remedy be "cost-effective" and provides that a remedy "shall be cost-effective if its costs are proportional to its overall effectiveness" (40 CFR § 300.430(f)(1)(ii)(D)). The preamble to the NCP explained: "In comparing alternatives to one another, the decision-maker should examine incremental cost differences in relation to incremental differences in effectiveness. Thus, for example, ***if the***

[16] GE is submitting supporting information for these cost estimates in a 2014 Supplemental Cost Information Package under separate cover, since that package contains confidential business information subject to the protections in 40 CFR Part 2, Subpart B.

[17] Advance Notice of Proposed Rulemaking on Corrective Action, 61 Fed. Reg. 19432, 19449 (May 1, 1996), which EPA has stated is to be used as guidance for activities under RCRA corrective action permits (64 Fed. Reg., 54604, 54607, Oct, 7, 1999).

difference in effectiveness is small but the difference in cost is very large, a proportional relationship does not exist" (55 Fed. Reg. 8666, 8728 (1990), emphasis added). In such a situation, the more costly alternative would not be cost-effective. Since on-site upland disposal here satisfies the threshold criteria, is as effective as off-site disposal, and would cost much less, off-site disposal would not be cost-effective.

For the reasons given above, the Region's selection of out-of-state disposal over secure on-site upland disposal would be arbitrary and capricious and inconsistent with the Permit criteria.

III. LACK OF HEALTH OR ENVIRONMENTAL JUSTIFICATION FOR PROPOSED REMEDY

A. Incorrect Underlying Assumption

The EPA Region's proposed remedy is based on the underlying assumption that alternatives that result in the removal of the largest volume of sediment and floodplain soil provide the highest level of human health and environmental protection (e.g., Stmt. Basis, p, 28); see also *id.*, p. 30, noting that alternatives that remove the most soil and sediment are the most reliable and effective and provide the most reduction in risk. That assumption is incorrect, since it fails to consider other key factors that affect the overall protectiveness of a remedy, such as the long- and short-term impacts of remedy implementation on health and the environment, the effectiveness of other means of risk reduction including institutional controls, and the ability to achieve comparable health and environmental goals with smaller remedies (e.g., less removal).

B. The Proposed Remedy Goes Well Beyond What Is Necessary To Protect Human Health

To begin with, as noted in many of GE's prior submittals to EPA, the best scientific evidence demonstrates that the PCB toxicity values that the Agency used in its HHRA, which are based on studies of laboratory animals, substantially overstate both the carcinogenic potential and the non-cancer impacts of PCBs in humans. In fact, comprehensive reviews of human studies have concluded that: (a) there is no credible evidence that PCBs have caused cancer in humans, even in highly exposed PCB workers; and (b) there is no credible evidence that exposure to PCBs at environmental levels has caused adverse non-cancer effects.[18] Moreover, laboratory studies have demonstrated clearly that human cells are many times less sensitive to the effects of PCB than the cells of the laboratory test animals used in the studies on which EPA's toxicity values are based.[19] At this Site, the lack of adverse human health effects of PCBs is further borne out by empirical evidence showing no elevated cancer rates or elevated blood PCB levels among individuals in communities along the Housatonic River.[20]

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[18] For example, detailed reviews by Golden et al. (2003) and Golden and Kimbrough (2009) of the human epidemiological studies on cancer showed that there is no causal relationship between PCB exposure and any form of cancer. (Copies of these reviews are included in Attachment J.) Similarly, a comprehensive review of the non-cancer data by Bernier et al. (2001) demonstrated that, with the possible exception of dermal and ocular effects in highly exposed PCB workers, there is no reliable evidence of a causal relationship between PCB exposure and adverse non-cancer health effects in humans.

[19] See, e.g., Silkworth et al. (2005); Westerink et al. (2008); Carlson et al. (2009) (copies included in Attachment J).

[20] For example, a study conducted by the Massachusetts Department of Public Health (MassDPH), in coordination with the Agency for Toxic Substance and Disease Registry (ATSDR), of cancer incidence rates from 1982 through 1998 for communities along the Housatonic River showed that those cancer rates were not elevated and not associated with areas having high PCB concentrations (ATSDR, 2002). Similarly, the Berkshire Medical Center has reported, based on cancer incidence data from the National Cancer Institute of the National Institutes of Health from 2005 through 2009, that "Berkshire County lands squarely in the middle range of cancer incidence rates for all counties in Massachusetts, which itself has the lowest incidence of cancer in the Northeast U.S." (Berkshire Medical Center, 2012, p. 4; copy included in Attachment J). In addition, an exposure assessment conducted by MassDPH

Nevertheless, even accepting EPA's PCB toxicity values, the Region's proposed remedy clearly goes beyond what is necessary to protect human health. The specific health bases given by the Region for the proposed remediation are to prevent unacceptable risks from PCB exposure through human consumption of fish and waterfowl from the River and through human direct contact with river sediments and floodplain soils (Stmt. Basis, pp. 15, 17). Even accepting EPA's toxicity values, a less extensive remedy would provide human health protection from PCB exposure via both of these pathways, as shown below.

1. Fish consumption

The Region estimates that its proposed remedy would require removal of approximately 890,000 cubic yards of river sediment (Stmt. Basis, p. 21). The primary basis for this enormous sediment removal project is to reduce PCB concentrations in fish and thereby provide protection to individuals who consume fish from the Housatonic River.

The Region acknowledges that none of the remedial alternatives evaluated, including its proposed remedy, would achieve the fish consumption IMPGs based on EPA's Reasonable Maximum Exposure (RME) assumptions, which would allow unrestricted fish consumption, in the Massachusetts portion of the River within the model projection period (over 50 years) (Comp. Analysis, p. 13, Table 2). As a result, under all alternatives, fish consumption advisories would need to remain in place indefinitely to protect human health from the asserted risks due to fish consumption.

In these circumstances, to support its proposed remedy, the Region relies on the predicted attainment of a fish consumption IMPG based on its Central Tendency Exposure (CTE) assumptions (developed for "average" exposure) and derived from a probabilistic risk analysis method set forth in the HHRA. Specifically, the Region explains, its model predictions indicate that its proposed remedy would achieve the probabilistic CTE IMPG based on a non-cancer hazard index (HI) of 1 for adults (1.5 mg/kg in fish fillets) in all Massachusetts reaches except one (Reach 5B) within the 52-year model projection period (Comp. Analysis, p. 13 & Table 2). However, attainment of that CTE IMPG would not avoid the need for continued fish consumption advisories.[21]

In any event, a less extensive remedy would likewise achieve the same probabilistic CTE IMPG for fish consumption in Massachusetts. For example, Table 2 in EPA's Comparative Analysis shows that alternative SED 5 (which would involve 377,000 cubic yards of sediment removal) would achieve the same CTE IMPG in all Massachusetts reaches except one (in this case Reach 7B) within the model projection period – and in fact would achieve other CTE IMPG (i.e.,

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(1997) on PCB levels in blood from individuals in the Housatonic River valley having a high potential for PCB exposure indicated that the blood PCB levels in non-occupationally exposed individuals in that area did not exceed the background range in the general population.

[21] While the Region also refers to risks from consumption of waterfowl, it does not present any evaluation the extent to which its proposed remedy or any remedial alternatives would achieve the IMPGs based on waterfowl consumption. This is because its model cannot predict future PCB concentrations in waterfowl, and there is no other available mechanism to do so. Thus, the Region cannot rely on waterfowl consumption as a basis for selecting its proposed remedy.

those based on a 10^{-5} cancer risk and a non-cancer hazard index of 1 for children) in ***more*** reaches than the proposed alternative. Moreover, as discussed further below, use of alternatives involving less removal in Woods Pond, the Reach 7 impoundments, Rising Pond, and the backwaters would result in comparable reductions in fish tissue concentrations and comparable attainment of the probabilistic CTE IMPG as the proposed remedy. See Sections IV.A through IV.D below.

With respect to Connecticut, as noted above (Section I.A), since the Region decided not to extend its model to Connecticut, predictions of future PCB levels in fish in the Connecticut impoundments are based on extrapolations from the EPA model using a number of simplifying assumptions and factors without confirmatory data. Given their reliance on such simplifying assumptions and factors and the significant underlying data limitations, the results of those extrapolations are too uncertain and unreliable to support distinctions among alternatives regarding achievement of specific PCB concentrations at the low levels that exist in fish in Connecticut. In any event, those extrapolations do not show significant differences between the proposed remedy and smaller removal remedies in reducing fish PCB concentrations in Connecticut, as shown in Sections IV.A through IV.D below.

In fact, it appears that any of the active remediation alternatives, including those with much less extensive sediment removal than the Region's proposed alternative, would likely achieve PCB levels in fish that should allow removal or substantial reduction of the PCB fish consumption advisory in Connecticut within the foreseeable future. Under the guidance used by the Connecticut Department of Public Health (CT DPH) to establish and revise its fish consumption advisory (outlined by the EPA Region in note 1 on page 5 of its September 9, 2008 comments on the CMS), when PCB levels in fish fillets fall into the range of 0.1 to 0.2 mg/kg, fish consumption of one meal per week (approximately the same as EPA's assumed fish consumption rate for the RME scenario) would be allowed. While the model extrapolations to Connecticut are highly uncertain, the extrapolation results summarized in the Region's Comparative Analysis indicate that all of the active remediation alternatives evaluated in the RCMS, including the alternative recommended by GE in that report (SED 10/FP 9), would achieve PCB fish fillet levels within or below that range in 18 years or less in the most upstream Connecticut impoundment (Bulls Bridge) and in 11 years or less in the other Connecticut impoundments (see Comp. Analysis, Table 2, p. 14). The model extrapolation results show further that all of those alternatives would achieve or reach the boundary of the CT DPH's "unlimited" fish consumption level – less than 0.1 mg/kg – in all of the Connecticut impoundments within the model projection period (see *id.*, Table 4, p. 22).[22]

These comparisons make clear that the Region's proposed remedy requires more removal than is necessary to protect human health and thus cannot be justified on the ground that it is needed to provide such protection.

[22] It should also be noted that Connecticut has a state-wide fish consumption advisory, based on mercury, of no more than one meal per month for high-risk individuals (e.g., pregnant or nursing women, young children) and no more than one meal per week for others. Thus, regardless of the reduction in PCB levels, it is likely that a fish consumption advisory will remain on the Housatonic River in Connecticut due to mercury.

2. Direct contact with floodplain soils and river sediments

The EPA Region's proposed cleanup standards for the various identified exposure areas (EAs) in the floodplain are based on the EPA-approved IMPGs for direct human contact with floodplain soil, which, in turn, were based on EPA's assumptions in its HHRA. Specifically, the proposed Primary Cleanup Standards (applicable to all floodplain EAs except those in Core Area 1 and potentially in certain portions of Core Areas 2 or 3) are based on the RME assumptions in the HHRA and on a target cancer risk of $1x10^{-5}$ and a target non-cancer HI of 1 (Draft Permit, Tables 1 & 2). The proposed Secondary Cleanup Standards (applicable to Core Area 1 and potentially certain portions of Core Areas 2 or 3) are based on the RME assumptions in the HHRA and a target cancer risk of $1x10^{-4}$ and a target non-cancer HI of 1 (*id.*, Table 1). The Region estimates that application of these cleanup standards would require the excavation and disposal of approximately 75,000 cubic yards of floodplain soil (Comp. Analysis, p. 9 & Att. 6), but GE's estimate of the floodplain soil that would be required to meet these standards is 80,000 cubic yards. In addition, the Region cites the non-cancer-based IMPGs using RME assumptions for direct contact with river sediments as an additional basis for sediment remediation (Stmt. Basis, p. 15).

Many of the HHRA's RME exposure assumptions that underlie the EPA-approved IMPGs based on direct contract are unrealistic and unsupported and overstate exposures and risks. This was demonstrated in detail in GE's comments on the initial and revised drafts of the HHRA (AMEC and BBL Sciences, 2003, 2005; GE, 2003) and in GE's initial IMPG Proposal (GE, 2005), and some examples are provided below.

For many of the floodplain EAs that the Region determined fall into a general recreational scenario, the Region has assigned an assumed exposure frequency (i.e., assumed frequency of use) that is implausibly high and inconsistent with empirical data on actual frequency of use. Specifically, for 62 EAs, which the Region has designated as "high use" recreational areas, the Region assumes that an individual would use those areas 90 days per year (Draft Permit, Table 1), which translates to three days per week, every week, from April through October, and that the individual would spend all of that time within the floodplain (as opposed to other parts of the recreational areas) and be exposed to the upper-bound PCB concentrations in the floodplain, and would continue to do so for 47 years. For other EAs, designated as "medium use" or "low use" recreational areas, the Region has assumed an exposure frequency of 60 days per year or 30 days per year, respectively, for the same duration (*id.*). These exposure frequencies are unrealistic, particularly given that many of these areas are subject to physical constraints, such as wetlands, dense vegetation, and steep slopes.

The unrealistic nature of these assumed exposure frequencies was demonstrated by an empirical Floodplain User Survey conducted from April through October 2002 (TER, 2003, summarized in Attachment A to GE's comments on the initial draft HHRA [AMEC and BBL Sciences, 2003]). That survey included intensive observations of recreational use of most of the floodplain EAs identified by the EPA Region in Reaches 5 and 6. It revealed that most floodplain areas receive little or no recreational use, which shows that many of the exposure frequencies assigned by the Region, as set forth in the HHRA and specified in Table 1 of the Draft Permit, substantially overestimate use. Table 9 lists the floodplain EAs in Reaches 5 and

6, the Region's assumed exposure frequency for each, and the findings of the Floodplain User Survey for each of those EAs. As shown, for example, there are 24 EAs for which the Region has assigned a recreational exposure frequency of 90 days per year but at which the empirical survey showed either no recreational users or six or fewer total recreational visits over the season, despite the extensive coverage of the survey. Clearly, if the frequency of use assumed by the Region in those EAs were occurring, the survey would have observed more usage.[23]

Other unrealistic and overstated exposure assumptions in the HHRA, described in the prior GE submissions cited above, include: (a) overstated exposure frequencies for the dirt biking and sediment exposure scenarios; (b) assumed daily soil ingestion rates that are based on pre-1997 studies and are twice as high as those developed based on more recent studies with improved protocols; and (c) the HHRA's assumption that individuals would obtain 100% of their total daily soil ingestion from the floodplain (as opposed to other areas, such as home, work, school, other recreational areas) even for floodplain recreational activities that are relatively short in duration.

To illustrate the impact of using these overstated exposure assumptions, GE has determined what the cleanup standards would be if those assumptions were replaced with more reasonable (but still conservative) assumptions. For that purpose, GE has used the alternate RME IMPGs that GE identified in its initial IMPG Proposal (GE, 2005), which were based on more realistic assumptions for the exposure parameters discussed above; but it has adjusted them so that the toxicity inputs are based on EPA's PCB toxicity values. Those more supportable cleanup standards are listed in Tables 10a-10c. GE has applied these cleanup standards to the floodplain EAs using the same approach used by the Region – i.e., applying the more supportable Primary and Secondary Cleanup Standards to the same EAs to which the Region applied its Primary and Secondary Cleanup Standards. The results of this exercise shows that application of these more supportable cleanup standards to the floodplain EAs would require removal of approximately 10,000 cubic yards of soil, compared to the 75,000-80,000 cubic yards of removal required by the Region's proposed remedy.

Moreover, even accepting EPA's exposure assumptions, a less disruptive remedy than proposed by the Region would still achieve levels within EPA's acceptable cancer risk range and below an acceptable non-cancer hazard index for direct contact, and thus would adequately protect health. For example, as demonstrated by Tables 8-7a and 8-8 in the RCMS, alternative SED 10/FP 9, which would involve removal of approximately 26,000 cubic yards of floodplain soil and 235,000 cubic yards of sediment, would achieve the EPA-approved RME IMPGs based on a 10^{-4} cancer risk and a non-cancer HI of 1 in ***all*** of the floodplain and sediment EAs, and would achieve the EPA-approved RME IMPGs based on a 10^{-5} cancer risk and a non-cancer HI of 1 in the majority (over 65%) of the direct-contact floodplain EAs and in all but one of the sediment EAs. In this regard, it is significant that the Region accepts 10^{-4} cancer risks for fish consumption (as discussed above) and for direct contact exposure in Core Area 1, but not for

[23] GE recognizes that EPA needs to consider reasonably anticipated future use as well as current use, and that future use could be somewhat higher than current use in some areas. However, it is not reasonable to anticipate that future use in areas with such low current use would rise to the level assumed by the Region, particularly in EAs that are remote and/or have difficult access due to the presence of wetlands and/or dense vegetation (e.g., EAs 10, 13, 16, 17, 19, 20, 32, 33, 35).

direct contact in other EAs. The Region has provided no health basis for that distinction.[24] Since a smaller removal alternative such as SED 10/FP 9 would achieve cleanup levels based on a 10^{-4} cancer risk and a non-cancer HI of 1 in all EAs, it would provide protection of human health from potential risks due to direct contact.

As these comparisons demonstrate, the Region's proposed remedy would require far more removal than is necessary to prevent direct contact risks and thus cannot be justified on the basis that it is needed to protect against such risks.

C. The Proposed Remedy Would Cause Overall Harm to the Environment

EPA may not order a remedy that would cause harm greater that the benefit it purports to provide. The Permit requires, as a General Standard, an evaluation of whether a remedial alternative would provide "overall" protection of human health and the environment (Permit Special Condition II.G.1); and EPA guidance makes clear that "overall" protection of the environment requires a balancing of the short-term and long-term adverse environmental impacts of remediation with the residual risks. For example, EPA's *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* states: "[W]hile a project may be designed to minimize habitat 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, 2005d, p. 6-6). Similarly, 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, 1997a, p. 8-3). Further, EPA's *Ecological Risk Assessment and Risk Management Principles for Superfund* state that, "[e]ven though an ecological risk assessment may demonstrate that adverse ecological effects have occurred or are expected to occur, it may not be in the best interest of the overall environment to actively remediate the site" if the remediation would cause more long-term ecological harm than leaving the contamination in place (EPA, 1999, p. 6). In this case, the Region's proposed remedy as a whole would cause greater ecological damage to the environment than any ecological benefit and thus would not provide "overall" protection of the environment, as demonstrated below.

1. Ecological impacts of proposed remedy

Based on substantial evidence in the record, including evidence presented in the RCMS and in the comments submitted by the Commonwealth of Massachusetts, and with no serious effort by the Region to present any new contrary evidence, the proposed remedy would cause

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[24] In fact, EPA's acceptable cancer risk range is between 10^{-6} and 10^{-4}, not between $1x10^{-6}$ and $1x10^{-4}$ (40 CFR § 300.430(e)(2)(i)(A)(2)). EPA recently recognized this in its proposed cleanup plan for the Lower Passaic River, where it explained that "[t]he **upper boundary of EPA's acceptable risk range is not a discrete line at $1x10^{-4}$**," and thus found that risk estimates between $5x10^{-4}$ and $3x10^{-4}$ are "within the acceptable range". (EPA, 2014a, p. 27-28; emphasis added).

unavoidable, substantial, extensive, and irreparable harm to the Rest of River ecosystem, particularly in the PSA. As discussed in the RCMS and noted by the Commonwealth in its designation of the Upper Housatonic River as an ACEC (MA EOEEA, 2009) and its comments on the RCMS (MA EOEEA et al., 2011), this ecosystem is biologically unique, with substantial biodiversity and wildlife habitat and an exceptional number of state-listed rare species owing in part to its rare, unfragmented forested riparian corridor and network of numerous vernal pools. The proposed remedy would severely impact all of these aspects of this unique ecosystem.

Impacts on riverine and floodplain habitats. While the Region has quantified the impacts of its proposed remedy on aquatic and riverbank habitats, it has not quantified the impacts of its proposed remedy on the specific floodplain habitats, claiming that such impacts "are to be determined based on habitats and occurrences of state-listed species as defined by the Core Areas" (Comp. Analysis, p. 29). GE has quantified the impacts of the proposed remedy on the various affected habitat types based on the Region's descriptions of that proposed remedy, existing data, and a reasonable identification of the locations of access roads and staging areas necessary to implement that remedy.[25] Those impacts are listed, by habitat type, in Table 11 and depicted, for the PSA, on Figures 5a through 5f.[26] As shown in Table 11, the proposed remedy would impact over 400 acres of the Housatonic River ecosystem, including several types of sensitive habitats (e.g., riverbanks, floodplain wetland forests, and vernal pools).

In its discussions of the ecological impacts of the proposed remedy, the Region acknowledges impacts on the various types of habitat, but asserts that all of those impacts would be short-term, because the affected habitats can be successfully restored so as to re-establish their pre-remediation condition and functions (Comp. Analysis, pp. 16, 26, 27-32, 56). Specifically, the Region states that there is "a significant body of knowledge" that "documents the ability to reestablish the pre-remediation conditions and functions of the affected habitats" (*id.*, p. 26), citing a 2011 paper by an EPA consultant, which was included as Appendix D to the Region's 2012 Site Information Package to the NRRB and is reprinted as Attachment 12 to the Comparative Analysis. The Region thus concludes that "restoration is expected to be fully effective and reliable in returning [the affected] habitats, including vernal pool habitat, to their pre-remediation state," and that, "[a]s a result, the likelihood of effective restoration is equal under any of the alternatives" (*id.*).

The Region's claims regarding the severity and duration of the habitat impacts and the effectiveness and reliability of restoration are unsupportable and unjustified.[27] The impacts of

[25] The Region claims that the access road and staging area estimates presented by GE in the RCMS were not optimized (Comp. Analysis, p. 28 n.5, p. 53 n.9). The Region provides no support for that assertion. In fact, GE has attempted to optimize the locations of these facilities to minimize adverse impacts on forested and other sensitive areas and on residential neighborhoods and other densely populated areas to the extent practicable and to use existing infrastructure where possible.

[26] Specifically, the floodplain impacts listed in Table 11 and the "floodplain remediation" areas shown on Figures 5a through 5f, as well as on subsequent Figures 6a through 6c, 7a through 7f, and 9a and 9b, reflect the remediation that would be necessary, based on existing data, to attain the Region's proposed "Primary Standards" in all floodplain areas except in Core Area 1 and to attain the Region's proposed "Secondary Standards" in Core Area 1.

[27] Several other specific examples of the Region's unsupportable statements regarding the habitat impacts of the proposed remedy and the effectiveness of restoration are listed in Section VI.B.4 below.

remediation activities on the affected habitat types and the constraints on restoration techniques that would prevent re-establishment of pre-remediation conditions and functions for several of those habitat types were discussed in detail in the RCMS (e.g., section 5.3). Further, the negative impacts of the proposed remedy on these habitats are discussed specifically in comments by Professors Robert Brooks, Aram Calhoun, and Malcolm Hunter, a copy of which is provided in Attachment C hereto. Those comments also demonstrate that those impacts cannot be avoided through timing of the remedial construction work and that, due to the limitations of restoration techniques, the adverse impacts on some of the habitats would be long-lasting. Even the Region's consultant recognizes that the unavoidable impacts of the proposed remedy and any attempt to rectify those impacts will result in a "novel ecosystem" different than the "probable trajectory" of the "original ecosystem" but for the disturbance of the remedy (Comp. Analysis, Attachment 12). The Region's Statement of Basis and Comparative Analysis of Alternatives ignore this critical conclusion of its own consultant.

In addition, these Professors have prepared a separate critique of the Region's claims that restoration would effectively and reliably re-establish the pre-remediation conditions and functions of the affected habitats, including the consultant report on which EPA relies (contained in Attachment 12 to the Comparative Analysis). That critique, which references 30 sources not considered by the Region, most of which have been peer reviewed, is provided in Attachment D hereto. It includes a showing that none of the other sites referenced in that EPA consultant report as examples of "successful" restoration provides any precedent for restoration of an ecosystem remotely like that in the Rest of River. In fact, reviews of prior restoration efforts have shown low success rates in re-establishing ecological functions for rivers (e.g., Palmer et al., in press 2014, 2010), wetlands (e.g., Moreno-Mateos et al., 2012) and vernal pools (e.g., Calhoun et al., 2014). As the Professors conclude: "If EPA's proposed remedy is implemented, the Rest of River will be severely impaired for many decades, perhaps centuries, and restoration efforts will constitute just a small Band-Aid on a gaping wound" (Attachment D, section 3).

Some examples of the key adverse impacts of the proposed remedy and the limitations on efforts to ameliorate those impacts through restoration are as follows:

- The proposed remedy would impact the entire river channel in Reaches 5A and 5C and at least 3.5 miles of the riverbanks in Reach 5A (Table 11; Figures 5a through 5f). As the Commonwealth has noted, such work would "inevitably cause severe and long-lasting destruction of the Housatonic River ecosystem and state-listed rare species," and the Commonwealth therefore proposed no riverbed excavation (outside of Woods Pond) and no riverbank excavation or stabilization (MA EOEEA et al., 2011, p. 2). Although the proposed remedy specifies that this work should be conducted "considering the principles of Natural Channel Design" (Draft Permit, pp. 14, 15, 16), described in Chapter 11 of the *Part 654 Stream Restoration Design National Engineering Handbook* (U.S. Dep. of Agriculture, 2007), that would not avoid the severe and long-lasting destruction noted by the Commonwealth. For example, regardless of the technique used, the sediment removal/capping would kill all existing benthic invertebrates in the area, damage existing fish populations, and alter the current substrate type. These effects would last until natural deposition from upstream changes the substrate back to a condition approximating its pre-remediation condition and benthic invertebrates and fish recolonize these reaches – which could take many years, during which invasive aquatic plant and animal species would have an advantage (see RCMS sections 5.3.1.4 & 6.3.5.3; Attachment C hereto, section 2.2.1).

Even more significantly, the proposed riverbank stabilization/excavation work, even if Natural Channel Design or "bioengineering" techniques are used, would cause an enduring negative change in the character of those banks, because it would: (a) prevent significant bank erosion and lateral channel movement, thus eliminating the vertical and/or undercut banks that provide critical habitat for certain birds and other animals, and reducing adjacent wetland habitats; (b) require the removal and permanent elimination of mature trees overhanging the River, thus changing the character of the banks from their current wooded condition to a more open condition; (c) produce a long-term reduction in slides and burrows of certain mammals and reduce access routes for reptiles, amphibians, and smaller mammals between the River and the floodplain; and (d) increase the potential for colonization by invasive exotic species (see MA EOEEA et al., 2011, pp. 8-9; RCMS sections 5.3.2.4 & 6.3.5.3; Attachment C hereto, sec. 2.2.2).

A recent review by Palmer et al. (in press 2014) of ecological restoration projects in rivers and streams identifies the shortcomings with the Natural Channel Design approach – notably, its failure to address chemical and biological processes – and shows that river restoration is fraught with problems and has had disappointing outcomes to date. The authors concluded that "there remains a major emphasis on the use of dramatic structural interventions such as completely re-shaping a channel despite growing scientific evidence that such approaches do not enhance ecological recovery . . . ." This study of 644 river restoration projects found that only 16 percent showed any improvement in biodiversity and that was relative to the prior degraded state of the project sites, not a thriving ecosystem like that of the Upper Housatonic River system.

- The proposed remedy would impact 36 acres of floodplain wetland forested habitat (Table 11). It would require the removal of all mature trees in those areas, resulting in a long-term loss of mature wetland forested habitat, which is vital to the health of the riverine/floodplain ecosystem of high importance to the Commonwealth. Assuming these trees are replanted, it would take at least 50 to 100 years for a replanted forested community to reach a mature condition comparable to current conditions – or potentially longer due to cumulative stresses from floods, changes in microclimate, changes in hydrology, and colonization by invasive species (see RCMS sections 5.3.4.4 & 7.3.5.3; Attachment C hereto, section 3.2). During that period, there would be a loss of the coarse woody debris and leaf litter that provides habitat for numerous woodland species, a decrease in the floodplain's flow alteration function, changes in soil composition, a loss of the forest wildlife species that utilize the mature forested habitats, and a fragmentation of the largely undisturbed forested riparian corridor in the PSA that is critical to the dispersal and migration of various wildlife species (*id.*).

- The proposed remedy could impact up to 43 vernal pools (27 acres) in the PSA (Table 11).[28] Use of conventional remedial techniques in vernal pools would cause severe harm to those pools and loss of the sensitive amphibians that inhabit them due to changes in the hydrology, vegetative characteristics, and soil composition of the vernal pools (see RCMS sections 5.3.7.4 & 7.3.5.3; Attachment C hereto, section 6.2).[29] Moreover, those changes are likely to be irreversible since, contrary to the Region's assertion, there is no scientific support for the suggestion that vernal pool restoration will successfully return the affected pools to their pre-remediation condition. As shown by Professors Brooks, Calhoun, and Hunter in Attachments C (section 6.3) and D (section 2.6.4) and in the recent peer-reviewed publication by Calhoun et al. (2014) (attached to Attachment D), the evidence demonstrates that vernal pool creation or re-creation has a very low success rate and that, in most cases, vernal pool functions cannot be adequately replaced. The Commonwealth has likewise expressed its belief that "restoration of these vernal pools will not result in the actual replication of the vernal pools and associated amphibian communities that existed prior to removal of the pools" (MA EOEEA et al., 2011, p. 11).

  Further, in addition to the impacts on the vernal pools themselves, the proposed remedy would adversely affect varying portions of the critical 100-foot and 100- to 750-foot buffer zones around vernal pools in the PSA, which provide important non-breeding habitat functions (including cover, temperature and moisture regulation, foraging sites, and overwintering sites) for the vernal pool species. The proposed remedy would impact up to 52% of the 100-foot zone and up to 29% of the 100- to 750-foot zone for individual pools. In total, it would adversely affect approximately 10 acres within 100 feet and 60 acres within 100-750 feet of the vernal pools in the PSA. These impacts would disrupt those areas' important non-breeding functions for vernal pool amphibians, and thus further decrease the chances of successful restoration (see Attachment C, section 2.6.3).

- The impacts of the proposed remedy would extend beyond the footprints of the areas that are physically disturbed by remedial construction activities and for access roads and staging areas. As discussed in Attachment C (section 1.2), those activities would have significant "edge effects" or "spillover effects" outside of those footprints due to potential increases in erosion and sedimentation (even with controls), the spread of invasive plant and animal species to such areas, changes in microclimate, and the effects of noise from construction and traffic on sensitive bird and mammal species during the breeding and rearing seasons.

As a result of its direct and indirect impacts, the proposed remedy would cause fragmentation of and an overall loss of connectivity in the contiguous, largely undisturbed forested riparian

[28] The proposed remedy provides that, after identification of vernal pools with PCB concentrations exceeding 3.3 mg/kg, EPA will designate some of those pools outside Core Area 1 for excavation, some for amendment by activated carbon, and some for a third remediation method to be proposed by GE, and that after the first round of remediation, EPA will determine the preferred method for remediation of the remaining vernal pools with PCBs > 3.3 mg/kg outside Core Area 1. That specific proposal is discussed further in Section IV.F below. GE has determined that, of the 66 vernal pools identified by Woodlot (2002) in the PSA, 43 are located outside of Core Area 1 and have PCB concentrations exceeding 3.3 mg/kg. Thus, that appears to be the upper-bound number of vernal pools that would be remediated under the Region's proposal.

[29] The use of activated carbon in a portion of the vernal pools is discussed in Section IV.F.

corridor in the PSA, which is important to the viability and sustainability of populations of native species that depend on that near-continuous corridor for daily use, dispersal, and migratory movements (see *id.*). Given the constraints and limitations on restoration methods, the PSA ecosystem would not recover entirely from that loss.

Impacts on state-listed species. The Region's proposed remedy would also have severe adverse impacts on state-listed species. The impacts of the proposed remedy in the areas identified by the Natural Heritage and Endangered Species Program (NHESP) of the MassDFG as Core Areas 1, 2, and 3 (defined in Attachment B to the Draft Permit) are shown on Figures 6a, 6b, and 6c, respectively, and the impacts on areas in Reaches 5 and 6 with various densities of priority habitats of state-listed species are shown on Figures 7a through 7f. Although the Region's proposal would limit remediation in Core Area 1, that would not avoid substantial impacts on state-listed species. While the Region has not estimated the number of state-listed species that would be affected by its proposed remedy (Comp. Analysis, p. 33), GE has conducted such an assessment, building on the detailed assessment that was provided in Appendix L of the RCMS. This updated assessment for the proposed remedy is provided in Attachment E, which presents, for each potentially affected species, an evaluation of whether a "take" would occur, the estimated extent of the local population, and the estimated impact on a significant portion of the local population. This assessment is summarized in Table 12. It shows that the proposed remedy would involve a "take" of 25 state-listed species and would adversely impact a significant portion of the local populations of at least 9 of those species.

Despite the Region's proposal of limited remediation in Core Area 1, impacts on state-listed species would occur in other areas. For example, NHESP has defined Core Area 2 as areas having "the highest quality habitat for more mobile species that may be less vulnerable to remediation impacts, species where the habitat is likely to be somewhat more easily restored, and listed species that may be of somewhat lower conservation concern" (Draft Permit, Attachment B, p. 2), and has listed American bittern, mustard white, wood turtle, and common moorhen as Core Area 2 species. As shown in Attachment E, given the nature of the work in the proposed remedy, at least three of these species (American bittern, wood turtle, and common moorhen) would be adversely affected to a substantial degree, experiencing an impact to a significant portion of their local populations. Further, despite NHESP's use of American bittern as an example of a species with lower conservation concern (*id.*), Massachusetts Audubon's recent State of the Birds Report lists American bitterns as "locally and strongly declining; conservation action urgent" (Mass Audubon, 2013). NHESP's additional claim that the habitats of the Core 2 species are "more easily restored" is belied by the evidence, as discussed above. Additionally, since Core Area 3 refers to areas with dense concentrations of state-listed species (i.e., overlapping habitat for eight or more such species), implementation of remediation activities in those areas would contribute to the overall impacts on those species. Indeed, given that definition, Core Area 3 would seem to be at least as deserving of special protection as Core Area 1.

2. Minimal, if any, ecological risks to be addressed by proposed remedy

In contrast to the certain and severe adverse ecological impacts of the proposed remedy, the ecological risks identified by the Region are tenuous and uncertain at best. EPA's *Ecological*

Risk Assessment and Risk Management Principles for Superfund specify that the purpose of ecologically based remediation is to "result in the recovery and maintenance of healthy ***local populations and communities*** of biota," not to protect "organisms on an individual basis" (EPA, 1999, p. 3; emphasis added). However, many of the studies and conclusions in EPA's ERA on which the ecological IMPGs were based focused on effects on individual animals, rather than local populations and communities, and used highly conservative and, in some cases, unsupportable assumptions and inputs that overstate risks. This was demonstrated in GE's comments on the initial and revised drafts of the ERA (BBL Sciences et al., 2003, 2005; GE 2004), GE's initial IMPG Proposal (GE, 2005), GE's Statement of Position in dispute resolution on EPA's disapproval of that initial IMPG Proposal (GE, 2006b), and GE's submission entitled *Evaluation of Remedial Alternatives Using Sound Ecological Assumptions* (GE, 2010), which was submitted concurrently with the RCMS. A few examples follow:

- For amphibians, the ERA relied on a site-specific field wood frog study conducted for EPA. That study showed that PCBs had no effects on survival, hatching success, or metamorphosis of frogs. The only effects reported in the study were a calculated increase in malformations in wood frog metamorphs and a supposed skewing in sex ratio (more females than males), neither of which has a direct relationship to the sustainability of the local wood frog population. The lower-bound IMPG (3.3 mg/kg) was based on the calculated 20% effect level (EC20) for metamorph malformations (i.e., the sediment concentration associated with a 20% incidence of such malformations). However, use of an EC20 value for metamorph malformations from this study to set an effects threshold for amphibians is not appropriate because these frogs have a reproductive strategy in which they produce many more offspring than will ultimately survive and in which the loss of some individuals is compensated for by increased survival in other individuals (density dependence). Thus, these frogs can well tolerate a 20% or greater effect, even if the malformations led to mortality; and consequently a 20% incidence of malformations would not be expected to affect the local wood frog population. (EPA itself recognized that the EC20 for sex ratio was not biologically relevant.)

- For insectivorous and piscivorous birds, EPA required that the IMPGs be based on a calculated effect level (set forth in the ERA) of less than 20% from a 1974 literature study (at another site) of chickens, which have been consistently shown to be many times more sensitive to PCBs than wild bird species. In addition, for piscivorous birds, EPA required that the IMPG be based on a modeled food intake rate for a group of bird species that does not include piscivorous birds.

- For mink, the ERA relied on a study of ranch-bred mink that were fed fish from the Housatonic River at various PCB concentrations. Based on a statistical analysis of the data from this study, EPA derived a 20% effect level for kit survival at 6 weeks (0.984 mg/kg in fish), and required the lower-bound IMPG to be based on that level. However, that level is below a dose at which no effects were found in the study, and the study showed no consistent dose-response relationships. Additionally, the investigators did not necropsy the kits that died prior to 6 weeks but simply assumed that their death was caused by PCBs (even though necropsies on kits that died later showed that their deaths were due to infections, not PCBs).

In addition to requiring use of such overly conservative IMPGs, the EPA Region required GE to apply those IMPGs to designated "averaging areas" that are not consistent with the objective of protecting local populations of wildlife. For example, it is clear that, for most of the ecological receptor groups included in the ERA, the local populations extend over the entire PSA or, in some cases, beyond the PSA. However, for several groups of these receptors, including insectivorous birds (represented by wood ducks), piscivorous mammals (represented by mink), and omnivorous/carnivorous mammals (represented by short-tailed shrews), the Region directed GE to use smaller averaging areas, which ignore the extent of the local populations of these birds and mammals and overemphasize the potential effects of PCBs on individual animals in small areas. Similarly, for amphibians (represented by wood frogs), the Region directed GE to apply the IMPGs to every vernal pool and backwater area in the PSA as a separate averaging area, even though EPA's own ERA identified the wood frog population in the PSA as encompassing those frogs breeding within all of the PSA vernal pools identified as having suitable wood frog breeding habitat (EPA, 2004a, Vol. 5, App. E, Attachment E.4). These directives result in an overestimate of the potential impacts of PCBs on the local populations of these wildlife species.[30]

The absence of any discernible adverse impacts of PCB exposure on the local wildlife populations and communities in the Rest of River is evidenced by the fact that field surveys have documented the presence of numerous, diverse, and thriving plant and animal populations in the PSA, including numerous state-listed rare species, that continue to reproduce and inhabit the PSA despite the presence of PCBs in the area for over 70 years. As stated by the Commonwealth in its January 2011 comments on the RCMS, despite the "legacy of contamination" in the River and floodplain resulting from the PCB releases "from the 1930s through the 1970s," the "Housatonic River Watershed encompasses a rich and unique ecosystem supporting many rare plant and animal species and their associated habitats, including wetlands, floodplains, vernal pools, surface waters, and forested areas" (MA EOEEA et al., 2011, p. 2).

At a minimum, the current thriving Rest of River ecosystem demonstrates the uncertainty that there are any residual risks from PCBs to local populations and communities of wildlife in the Rest of River, and consequently the uncertain theoretical benefits of remediation to address those potential risks. As the Commonwealth noted, "any potential benefits associated with remediation to achieve ecological IMPGs would be far outweighed by the short and long-term damage to the meandering character of the Housatonic River ecosystem and to the associated state-listed species and their habitats" (*id.*, p. 8). Again, "in virtually all instances the actual and inevitable damage to this existing, unique ecological resource will far exceed the theoretical benefit of lower PCB concentrations" (*id.*, p. 1)

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[30] These points are discussed in more detail in GE's *Evaluation of Remedial Alternatives Using Sound Ecological Assumptions* (GE, 2010), as well as in GE's Statements of Position in dispute resolution on EPA's conditional approval letters for the CMS Proposal and CMS Proposal Supplement (GE, 2007a, 2007b).

3. Conclusion

The Region's proposed remedy does not include remediation that is directed specifically to attaining any ecological protection goals, except for amphibians in vernal pools (discussed further in Section IV.F). However, the Region asserts that the remedy developed on supposed health grounds will also reduce ecological risks (Stmt. Basis, pp. 11-12). As discussed elsewhere, alternative remedies involving much less extensive removal could achieve comparable reduction in human health risks (see Sections III.B and IV.A through IV.E) and would have fewer adverse ecological impacts. Further, as shown above and recognized by the Commonwealth, any uncertain theoretical ecological benefits of the remedy are far outweighed by the certain, substantial, and inevitable ecological damage. In these circumstances, the Region's proposed remedy would not provide "overall" protection of the environment, would cause more harm than necessary, and is therefore arbitrary and capricious.

IV. DEFICIENCIES IN SPECIFIC ELEMENTS OF PROPOSED REMEDY

This section demonstrates that several specific elements of the EPA Region's proposed remedy are arbitrary and capricious or otherwise unlawful. It includes a discussion of the proposed remedies for Woods Pond, the Reach 7 impoundments, Rising Pond, and the backwaters (as well as other proposed remedy components). It should be noted that the Region's removal volume estimates for these remedy components were based on those presented in the May 2012 Status Report (see Comp. Analysis, Attachment 6), whereas GE has developed updated removal volume estimates based on the Region's description of its actual proposed remedy. As a result, as discussed further in the following subsections, GE's volume estimates for some of these areas differ from those presented by the EPA Region (sometimes higher and sometimes lower). In addition, the following subsections discuss model projections for the proposed remedy and various alternatives. Those model runs are presented in Attachment F.

A. Deep Dredging in Woods Pond

The Region's proposed remedy for Woods Pond would require deep dredging and placement of an engineered cap throughout the Pond so as to achieve a minimum post-capping water depth of 6 feet (except in near-shore areas, where the slope from the shore to the 6-foot water depth must be as steep as possible) (Draft Permit, p. 18). The Region estimates that this remedy would require removal of 285,000 cubic yards of sediment from Woods Pond (Comp. Analysis, p. 8 & Att. 6). However, that estimated removal is based on achieving an ***average*** post-capping water depth of 6 feet; achieving a ***minimum*** post-capping water depth of 6 feet, as proposed, would require removal of approximately 340,000 cubic yards of sediment. This proposed remedy would be arbitrary and capricious because it would require extensive unnecessary removal and would not have the risk-based benefits claimed by the Region, compared to a smaller remedy such as shallower sediment removal in shallower portions of the Pond and placement of a cap over the entire Pond surface.

The Region claims that its proposed remedy would reduce human health risks from fish consumption (Comp. Analysis, p. 3). However, projections using EPA's model show no discernible difference between the proposed remedy and an alternative involving shallow dredging and full capping in reducing fish PCB concentrations or attaining fish consumption IMPGs in Woods Pond itself or in the downstream impoundments in Massachusetts and Connecticut. To illustrate this, we have compared the model results for the Region's proposed Woods Pond remedy with an alternative remedy that would involve sediment removal to a depth of 9 inches in the shallower portions of the Pond (estimated at 44,400 cubic yards) and placement of a cap over the entire Pond, holding all other aspects of these alternatives constant.[31] The results from these model runs showing the projected fish fillet PCB concentrations under these alternatives for Woods Pond, the four Reach 7 impoundments,

[31] This alternative was presented to EPA and the States during the 2012 discussions. See GE's presentation slides from December 7, 2012, a copy of which is provided as Attachment G. It is similar in concept to the Woods Pond component of RCMS alternative SED 5, which would involve removal to a depth of 1.5 feet in the shallow portion of the Pond (approximately 89,000 cubic yards) with capping of the entire Pond. The points in this section would also apply to a comparison of the proposed remedy with the Woods Pond component of SED 5.

Rising Pond, and the four Connecticut impoundments are presented on Figures 8-a through 8-j.[32] These results show no difference between these alternatives in fish fillet concentrations in Woods Pond or any of the downstream impoundments, because cap placement over the entire Pond would achieve the same reduction in fish PCB concentrations as deep removal over the entire Pond followed by capping. This demonstrates that the substantial additional sediment removal under the Region's proposed remedy (nearly 300,000 cubic yards) would have no benefit in terms of reducing fish PCB concentrations.

The Region also asserts that its proposed remedy would reduce direct contact risks and ecological risks (Comp. Analysis, p. 4). However, the less intrusive remedy described above, by installing a cap over the entire Pond, would result in a comparable reduction in any direct contact or ecological risks. For example, both of these alternatives are predicted to achieve a surface sediment PCB concentration of 0.4 mg/kg in Woods Pond, which is far below any threshold for direct contact or ecological risks.

The Region states further that its proposed deep dredging remedy would increase the solids and PCB trapping efficiency of Woods Pond and thereby reduce downstream transport of PCBs. To begin with, solids trapping efficiency does not equate to PCB trapping efficiency, since some portion of the PCBs are present and pass the dam in dissolved form. While the proposed remedy would appear to result in some increase in solids trapping efficiency compared to smaller alternatives (estimated by the Region to increase from about 15% to 30%, Comp. Analysis p. 17), the model runs indicate very little difference between the proposed remedy and the alternative of partial shallow dredging and capping of the entire Pond in terms of PCB transport past Woods Pond and Rising Pond Dams. The projected average annual PCB loads passing Woods Pond and Rising Pond Dams are 2.5 kg/year and 2.7 kg/year, respectively, under the proposed alternative and 2.6 kg/year and 2.9 kg/year under the smaller alternative. More importantly, the modest increase in solids trapping efficiency resulting from the proposed remedy would not translate to any reduction in risk due to fish consumption or anything else compared to the smaller alternative, as discussed above.[33] Thus, the difference in trapping efficiency would not result in an increase in the protectiveness of the remedy.

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[32] To ensure comparability in these comparisons, both of these alternatives assume the same remediation in other reaches – specifically, for Reach 5, removal and capping in Reaches 5A and 5C, remediation of eroding riverbanks in Reach 5A, and removal and capping of locations with PCBs > 50 mg/kg in Reach 5B (with application of activated carbon in the rest of the Reach 5B riverbed) (jointly referred to herein as the Reach 5 base case); removal and capping in the portions of the backwaters outside Core Area 1 to achieve a SWAC of 5 mg/kg; thin-layer capping in two Reach 7 impoundments and Rising Pond to achieve a SWAC of 1 mg/kg; and monitored natural recovery (MNR) elsewhere.

[33] The Region's estimates of solids trapping efficiency also show that other alternatives that involve some deepening of the Pond but less total sediment removal (i.e., SED 9 with 244,000 of removal and SED 10 with 169,000 cubic yards of removal) would achieve close to the same increase in solids trapping efficiency as the proposed remedy (Comp. Analysis, p. 17). The model shows that, so long as such alternatives involve capping of the entire Pond, they would also achieve the same risk reductions as EPA's proposed remedy. While such alternatives would not result in any appreciable risk reduction compared to the even smaller alternative described in the text (involving 44,400 cubic yards of removal), these comparisons further demonstrate the arbitrariness of the Region's proposed remedy for Woods Pond.

The Region also states that its proposed deep dredging remedy would reduce the potential for a release of PCBs from Woods Pond in the event of dam failure (Comp. Analysis, p. 4). However, dam failure is not a realistic risk, since GE owns Woods Pond Dam and conducts the necessary monitoring, maintenance, and repair of the dam to prevent dam failure, particularly in light of the fact that the CD's covenants from the federal and state governments for natural resource damage do not apply in the case of a failure of Woods Pond Dam (CD ¶ 176). Hence, that potential does not provide a justifiable basis for the proposed deep dredging.

In fact, it appears that the Region's actual purpose in proposing this Pond-deepening remedy is to improve Woods Pond as a recreational fishery, as desired by the State, not to reduce risks. Indeed, the Commonwealth proposed a deep dredging remedy for Woods Pond, citing the enhancement of recreational opportunities as one of the benefits (MA EOEEA et al., 2011, p. 13; see also Attachment B). The improvement of recreation, of course, is not within EPA's authority under either CERCLA or RCRA, which is limited to prescribing such actions as are necessary to protect human health and the environment from identified risks due to releases (see Section V.C.1 below). As shown above, any risks can be reduced to a comparable extent with a remedy that involves much less removal.

In contrast to this lack of difference in risk reduction and protectiveness, the Region's proposed remedy would involve greater adverse impacts due to the extra removal and much higher costs than the comparably protective smaller remedies. For example, due to the greater removal volume, the proposed remedy would require more truck trips (with their attendant community impacts) and produce greater GHG emissions than the smaller remedy. GE has estimated that the proposed Woods Pond remedy would require a total of approximately 39,000-46,000 truck trips to import the necessary remediation material (i.e., capping and staging/access material) and transport the dredged sediments from the Pond (with the range dependent on the size of trucks used to transport dredged sediments[34]), while the alternative described above involving shallow dredging (44,400 cy) and capping of the entire Pond would require a total of only approximately 10,000-11,000 such truck trips (see Table 13) – approximately 30,000 truck trips less. Further, GE has estimated that the proposed remedy for Woods Pond would produce 51,000 tonnes of GHG emissions, compared to 7,800 tonnes for the smaller alternative (see Table 14) – a difference of more than six-fold.

The proposed remedy for Woods Pond would also be much more costly. GE has estimated that, assuming off-site disposal, the proposed deep dredging remedy would cost $164-188 million (depending on whether rail or truck transport is used), whereas the shallow dredging/full capping alternative described above would cost $34-39 million (see Table 15). As discussed above, the latter alternative would be equally protective of human health and the environment and would effectively reduce residual risks to a similar extent as the proposed remedy. Further, the smaller alternative would meet ARARs to the same extent as the proposed remedy. In these circumstances, the incremental costs of the proposed remedy, which would be at least

[34] GE assumes that 20-ton trucks would be used for transport of excavated sediments to off-site disposal facilities and that 16-ton trucks would be used for transport of such sediments to an on-site rail loading facility or an on-site disposal facility.

$130 million, are not proportional to its incremental benefits (if any), and hence the proposed remedy would clearly not be cost-effective.[35]

For these reasons, adoption of the Region's proposed deep dredging remedy for Woods Pond would be arbitrary, capricious, and otherwise unlawful.

B. Remedy for Reach 7 Impoundments

The Region's proposed remedy for the Reach 7 impoundments would require that, if any entity is planning to use, maintain, or remove any Reach 7 dam or impoundment, GE must coordinate with that entity, including using "good-faith efforts to reach agreement with that entity(ies) on the scope and extent of costs attributable to the presence of PCBs in sediment and prompt payment by [GE] of these costs in advance of implementation of the necessary work" (Draft Permit, p. 19). It provides further that, if there are no plans for dam removal at the time of GE's work plan, GE must conduct the following remediation in each impoundment: (a) removal of surface sediments (including any such sediments with PCB concentrations > 50 mg/kg) and replacement of those sediments with an engineered cap so as to achieve a SWAC of 1 mg/kg in each of various identified averaging areas; and (b) for areas outside the footprint of the above cap, removal and capping of sediments as necessary to achieve a SWAC of 1 mg/kg in the subsurface sediments in each averaging area (*id.*). (For the subsurface sediments, this SWAC could be achieved by removal/capping of the overlying surface sediments.) The Region estimates that this proposed remedy would, as a "worst case" using prior estimates, require removal of 84,000 cy of sediments (Comp. Analysis, Att. 6), whereas GE has conservatively estimated the required removal volume as 53,000 cy.[36]

1. Requirement to coordinate with other entities

It is not clear whether the coordination prong of the Region's proposed remedy for the Reach 7 impoundments would require GE to agree to pay the PCB-related costs incurred by a project proponent in using, maintaining, or removing a Reach 7 dam or impoundment, or would just require GE to negotiate with that entity. To the extent that it would require GE to pay such costs of a third party, it would go beyond EPA's authority for the same reasons discussed below in Section V.C with respect to the proposed general requirement for GE to pay the PCB-related costs of any third party that conducts dam removal or another project on the River requiring handling or disposition of sediments containing PCB concentrations above 1 mg/kg. Such a requirement would not address risks to human health or the environment from such a project

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[35] The same conclusion would be true even if on-site upland disposal were allowed, which GE believes is required, as shown in Section II. In that event, the proposed remedy is estimated to cost $73-95 million (depending on the location of the on-site disposal facility) versus $21-24 million for the shallow dredging/full capping alternative (Table 15) – a difference of over $50 million. Those incremental costs are not proportional to or justified by any incremental benefits.

[36] To be conservative, this GE estimate and all other estimates in this section regarding the Region's proposed remedy for the Reach 7 impoundments assume removal of all sediments over 1 mg/kg in two of those impoundments (Reaches 7B and 7C) and removal to achieve a SWAC of 1 mg/kg in the other two impoundments (Reaches 7E and 7G).

remedy would produce adverse impacts on the aquatic habitat of these impoundments, while MNR would not produce such impacts and thin-layer capping would cause some, but not as severe, adverse impacts.

The estimated costs of the Region's proposed removal/capping remedy for the Reach 7 impoundments with off-site disposal are $36-37 million (depending on whether rail or truck transport is used) (Table 15).[42] By contrast, MNR in those impoundments would have minimal costs, and thin-layer capping in those impoundments is estimated to cost $14 million. As discussed above, the less intrusive alternatives would be protective of human health and the environment and would be as effective or nearly as effective as the proposed remedy. In addition, they would attain ARARs to a greater extent than the proposed remedy, since they would not involve any removal and thus would not implicate the ARARs relating to dredging or handling/disposition of excavated material.[43] In these circumstances, the substantial incremental costs of the Region's proposal are clearly not proportional to or justified by the small and uncertain incremental benefits.

For these reasons, adoption of the Region's proposed remedy for the Reach 7 impoundments would be arbitrary, capricious, and otherwise unlawful.

C. Rising Pond Remedy

The Region's proposed remedy for Rising Pond would require: (a) removal of surface sediments (including any such sediments with PCB concentrations > 50 mg/kg) and replacement of those sediments with an engineered cap so as to achieve a SWAC of 1 mg/kg in each of various averaging areas; and (b) for areas outside the footprint of the above cap, removal and capping of sediments as necessary to achieve a SWAC of 1 mg/kg in the subsurface sediments in each averaging area (Draft Permit, p. 21). (For the subsurface sediments, this SWAC could be achieved by removal/capping of the overlying surface sediments.) The Region's "worst-case" estimate is that this proposed remedy would require removal of 71,000 cy of sediments (Comp. Analysis, Att. 6), while GE's updated estimate of the required removal is 50,000 cy. The Region seeks to justify this proposed remedy on the grounds that it "will result in achieving cleanup levels in fish tissue, and reducing ecological risk and downstream transport of contaminants" (*id.*, p. 4).

As with the proposed impoundment remedies discussed above, this proposed remedy is arbitrary and capricious because it would not have significant risk-based benefits compared to a smaller remedy. In terms of reducing PCB concentrations in fish tissue, this is demonstrated by a comparison of the model results for the proposed remedy with those from smaller remedies. Specifically, we have compared the fish fillet PCB concentrations predicted (or extrapolated for Connecticut) to result at the end of the model period from the proposed Rising Pond remedy

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[42] If on-site upland disposal were used, the proposed remedy is estimated to cost $27-30 million, depending on the location of the disposal facility (Table 15).

[43] These alternatives would also achieve EPA's water quality criteria in all impoundments, except for the water quality criterion for human health protection from fish consumption (0.000064 μg/L), which would not be achieved In Reaches 7 or 8 (or any other Massachusetts reach) by the proposed remedy or any other alternative.

with those predicted (or extrapolated) to result from alternatives involving (a) MNR in Rising Pond, (b) implementation of thin-layer capping in Rising Pond, and (c) sediment removal to a depth of 6 inches in the shallow portions of that Pond (approximately 15,300 cy) and placement of a 6-inch engineered cap over the entire Pond, assuming the same remediation in the upstream reaches.[44] The results of this comparison are shown in the following table, which presents the predicted fish fillet concentrations under these alternatives for both Rising Pond itself and the Connecticut impoundments at the end of the 52-year projection period:

Scenario	Est. Fish Fillet Concentration (in mg/kg)				
	Rising Pond	**Bulls Bridge Dam**	**Lake Lillinonah**	**Lake Zoar**	**Lake Housatonic**
Current conditions (baseline)	6.3	0.39	0.28	0.20	0.19
MNR in Rising Pond	1.6	0.044	0.031	0.022	0.021
Thin-layer capping in Rising Pond	0.6	0.031	0.022	0.016	0.015
Partial shallow removal & full capping in Rising Pond	0.5	0.031	0.022	0.016	0.015
Region's removal/capping proposal for Rising Pond	0.9	0.033	0.024	0.017	0.016

As shown in the above table, the proposed Rising Pond remedy would result in small incremental reductions in fish PCB concentrations compared to MNR in Rising Pond and ***no*** incremental reductions in such concentrations (indeed, slightly higher concentrations) compared to thin-layer capping or implementation of a smaller removal alternative with an engineered cap over the entire Pond.[45] These comparisons demonstrate that neither reduction in fish PCB levels nor attainment of fish consumption standards provides a justifiable basis for the proposed dredging/removal remedy, since the same benefits could be achieved with much less removal.

The Region's claims that its proposed remedy is needed to reduce ecological risks and downstream transport likewise provide no risk-based justification for its proposal. The Region has made no showing that the smaller alternative remedies would result in any incremental increase in ecological risks in Rising Pond compared to the proposed removal/capping remedy. Further, since the smaller removal alternative would include capping the entire Pond, it would reduce exposure to ecological receptors to the same extent as the proposed remedy. With respect to downstream transport, the model runs do not show any incremental decrease in the

[44] The last of these alternatives was discussed with EPA and the States during discussions in 2013. Again, to ensure comparability in these comparisons, these alternatives all assume the same remediation in the upstream reaches – specifically, the Reach 5 base case, deep dredging and shallow capping over all of Woods Pond (which, as shown in Section IV.A, would have essentially the same results as shallow dredging in the shallow portion of the Pond and capping of the entire Pond), and MNR in the Reach 7 impoundments.

[45] Attachment H demonstrates that thin-layer capping can be appropriately used in Rising Pond as well as the Reach 7 impoundments. In any event, the smaller removal alternative would rely on engineered capping of the entire Pond and thus would avoid the asserted concerns raised by the Region regarding thin-layer capping.

PCB flux at Rising Pond Dam from the proposed remedy compared to the thin-layer capping or the partial removal/full capping alternatives. Assuming the same upstream remediation (as described above), the proposed remedy is predicted to result in an annual PCB flux past Rising Pond Dam of 2.7 kg/year, while both of the smaller alternatives are predicted to result in an annual PCB flux past that dam of 2.6 kg/year.

As at Woods Pond, dam failure is not a realistic risk at Rising Pond Dam, since GE owns that dam and conducts the necessary monitoring, maintenance, and repair to prevent dam failure, particularly in light of the fact that the CD's covenants from the federal and state governments for natural resource damage do not apply in the case of a failure of Rising Pond Dam (CD ¶ 176). Hence, the theoretical potential for dam failure does not provide a justifiable basis for the proposed remedy.

Again, in contrast to the absence of any appreciable incremental benefits, the Region's proposed remedy for Rising Pond would have greater adverse impacts and costs than the smaller alternatives discussed above. For example, GE has estimated that the proposed remedy would require a total of approximately 10,000-11,000 truck trips to import the necessary remediation material, transport the excavated sediments, and dispose of the staging/access material (with the range dependent on the size of trucks used to transport removed sediments) (see Table 13). However, thin-layer capping would require only about 3,100 truck trips and the shallow partial removal/full capping alternative would require only 5,000-5,500 truck trips (*id.*). Additionally, the proposed Rising Pond remedy is estimated to result in 9,600 tonnes of GHG emissions, compared to 1,400 tonnes and 8,800 tones for the thin-layer capping and smaller removal alternatives (see Table 14).

Moreover, as shown in Table 15, the Region's proposed Rising Pond remedy with off-site disposal is estimated to cost $30-31 million (depending on whether rail or truck transport is used), whereas thin-layer capping in that Pond is estimated to cost $10 million and the partial removal/full capping alternative is estimated to cost approximately $17 million with off-site disposal. As discussed above, the latter alternatives would be protective of human health and the environment and would be virtually as effective as the proposed remedy. In addition, they would also attain ARARs to at least a comparable extent as the proposed remedy.[46] Thus, as with the proposed remedies for Woods Pond and the Reach 7 impoundments, the substantial incremental costs of the proposed remedy for Rising Pond (at least $13 million higher than the alternatives) are not proportional to or justified by the incremental benefits (if any).[47]

For these reasons, adoption of the Region's proposed remedy for Rising Pond would be arbitrary, capricious, and otherwise unlawful.

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[46] In particular, these alternatives would achieve EPA's water quality criteria in Rising Pond, except for the water quality criterion of 0.000064 µg/L, which, as previously noted, would not be achieved in Rising Pond by the proposed remedy or any other alternative.

[47] Again, the same would be true even if on-site upland disposal were allowed, which GE believes is required, as shown in Section II. In that case, the proposed remedy is estimated to cost $22-26 million, compared to $10 million for thin-layer capping and $14-15 million for the partial dredging/full capping alternative (Table 15). Those incremental costs are not proportional to or justified by any incremental benefits.

differing results for different target species, types of AC, and application methods – which "underscore a need for well-designed pilot studies before widespread use of AC amendment at a particular site (*id.*, p. 4). Given the absence of data showing that AC application would not harm the natural local populations of vernal pool animals in the PSA, it is unwarranted to test that hypothesis where it could potentially cause such harm.

In contrast to the adverse impacts from vernal pool remediation, the risks to amphibians that the remediation is designed to address are, at best, theoretical. As discussed in Section III.C.2, the proposed vernal pool cleanup standard of 3.3 mg/kg was based on a calculated 20% effect value for metamorph malformations from an EPA wood frog study, when that study itself showed no effects of PCBs on the frogs' survival, hatching success, or metamorphosis and when the calculated 20% effect level for metamorph malformations would not be expected to have any impact on the local wood frog population.

Given these factors, the Region's conclusion that, in any vernal pools with PCB concentrations above 3.3 mg/kg, the amphibians that inhabit those pools are at risk is unjustified. In fact, such a conclusion is belied by the existence of a thriving healthy wood frog population in the PSA despite the long-term presence of PCBs in the pools. Thus, it is clear that the ecological damage from the proposed vernal pool remediation would outweigh any theoretical benefits to the amphibians from the PCB removal, with the extent of that damage dependent on the number of pools that are selected for remediation and the type of remediation required. The Commonwealth has recognized this fact. Its remediation proposal did not include ***any*** vernal pool remediation because "this would cause more ecological harm than benefit" (MA EOEEA et al., 2011, p. 11). For this reason, the Region's proposed vernal pool remedy is arbitrary and capricious.

G. PCB Downstream Transport Performance Standard

The Draft Permit contains, in Section II.B.1.a.(1), a Downstream Transport Performance Standard, which specifies particular annual average values for PCB flux over Woods Pond Dam and Rising Pond Dam (Draft Permit, p. 12). These flux values vary depending on flow rates. The Draft Permit provides that an exceedance of this standard would occur if the annual average PCB flux is greater than the standard (at either Woods Pond Dam or Rising Pond Dam) in three or more years within any five-year period after completion of the remedial construction activities. It provides further that, in the event of such an exceedance, GE "shall determine the cause of the exceedances, and EPA may consider modifications to the Rest of River remedy in accordance with its authority under the CD and CERCLA" (*id.*, p. 13).

As the Region notes (*id.*, p. 12), the annual average flux values specified by this proposed standard were simply derived from model predictions of the annual average PCB fluxes that would occur at these dams in the future under the proposed remedy (excluding the use of AC in Reach 5B and the backwaters), using the 95% prediction limits of a regression of annual average flux versus annual average flow rate. These flux values were not based on an analysis of risk, and the Region has made no showing that the specified PCB flux values are tied to reductions in risk or are otherwise justified under the Permit's remedy selection criteria. As such, they are arbitrary.

In addition, the standard is based on the assumption that the specified flux values can and will be achieved by the proposed remedy. That assumption, in turn, is based on the assumption that EPA's model accurately predicts future PCB fluxes. In fact, however, EPA's model was not designed and is not appropriately used for prediction of such absolute values. EPA has previously recognized this fact. In its Model Calibration Responsiveness Summary, EPA stated: "Because [the] projections [of future boundary conditions for flow, solids, and PCBs] will have an unknown degree of uncertainty associated with them that will impact model predictions, ***predictions of absolute concentrations are not anticipated to be accurate***. Therefore, EPA will focus primarily on comparisons of relative performance among remedial alternatives against baseline conditions." (EPA, 2006a, p. 3; emphasis added.) Further, in its Responsiveness Summary to the Peer Review of Model Validation, EPA "acknowledge[d] that given the uncertainty in the rate of decline [in PCBs in sediments] (due to the lack of ability to project this from the data), relative predictions by the model are likely more reliable than absolute predictions" (EPA, 2006b, p. 2-12) The National Research Council has also recognized that, since "[m]odels will always be constrained by computational limitations, assumptions and knowledge gaps," they "can best be viewed as tools to help inform decisions rather than as machines to generate truth or make decisions' (NRC, 2007, p. 2). In short, while the model results are useful for comparisons among remedial alternatives, they are not sufficiently accurate, and should not be used, to establish absolute numerical standards, as the Region has proposed here for the Downstream Transport Performance Standard. That further contributes to the arbitrariness of that proposed standard.[54] In fact, by using the 95% prediction limits, the proposed standard accounts for year-to-year variability in the PCB load (due to variability in flow), but does ***not*** account for model uncertainty in any way

We are not aware of any precedent at any of the major contaminated sediment sites in the country for a performance standard such as this, which establishes a numerical ***standard*** for future, post-remediation conditions – as opposed to a goal or remedial action objective (RAO) for such conditions – with specified consequences (other than continued monitoring) if that standard is not met. Indeed, the consequences specified by the Region for an exceedance of this standard are problematic.

To begin with, the proposed requirement that, in the event of an exceedance of the standard, GE must determine the cause is overbroad. Given the many factors that could potentially lead to an exceedance of the specified flux values at Woods Pond Dam and/or Rising Pond Dam, it may well not be possible to determine the cause. The most that could be done is to evaluate potential causes to determine whether a cause or causes can be identified.

Beyond that, the standard would provide that, in the event of an exceedance, EPA "may consider modifications to the Rest of River remedy in accordance with its authority under the CD

[54] The reported analytical results for the five most recent monthly water column samples collected at the sampling location immediately downstream of Rising Pond Dam (Division Street) indicate PCB concentrations higher than those predicted by EPA's model under current conditions. (These detections were a result of a recent lowering of the detection limit used for analysis of the Rest of River water column samples; prior analyses utilizing a higher detection limit showed mostly non-detect concentrations in recent years.) This illustrates the inability of EPA's model to accurately predict absolute PCB concentrations and thus the insufficiency of EPA's model for setting an absolute value for the Downstream Transport Performance Standard.

and CERCLA." EPA's authority under the CD to require GE to conduct additional response actions beyond the actions required by the initially selected remedy is limited to the situation in which the CD covenant reopeners are met – i.e., where EPA determines that the exceedance constitutes new information or conditions and that that new information or conditions, together with other relevant information, indicate that the selected remedy is no longer protective of human health or the environment (see CD ¶¶ 162, 163). There are several reasons for this.

First, a more open-ended standard would conflict with the CD and Permit requirements that the remedy decision must specify the particular remedial actions required, rather than giving the Region a blank check to determine such actions in the future. Paragraph 22.n of the CD provides that EPA will propose the draft permit modification pursuant to the RCRA Permit, and (as mentioned above) Special Condition II.J of the Permit states that "EPA will propose Performance Standards, and ***the appropriate corrective measures necessary to meet the Performance Standards***" (emphasis added). This requires that the Region's proposal specify not only the Performance Standards but also the specific corrective measures that it determines are necessary to meet the Performance Standards, rather than giving the Region the discretion to develop and mandate additional corrective measures later, which would not have been evaluated under the Permit's remedy selection criteria. Additionally, Paragraph 22.p provides that the final permit modification will obligate GE "to perform the selected Rest of River Remedial Action and O&M," thus indicating that that remedial action will be known and quantifiable at that time. Similarly, Special Condition II.J of the Permit states that the final permit modification "will set forth the selected Performance Standards and corrective measures for the Rest of River area" – again showing that the corrective measures are to be specified in that decision. These provisions demonstrate that, while the Rest of River Remedial Action was expected to include Performance Standards, the parties intended that those Performance Standards would be ones whose achievement would be ascertainable and attainable by doing certain specified work, rather than leaving the required work for a later EPA determination. This was intended to provide GE with certainty and finality at the time of the Rest of River remedy selection.

Second, an open-ended standard that allowed the EPA Region to require GE to conduct additional, unspecified response actions if the standard was exceeded would prevent the Region itself, as well as GE, other stakeholders, and the public, from conducting a meaningful evaluation of the proposed remedy under the applicable Permit criteria. Unless one knows the full extent of remediation actions necessary to meet the Performance Standards, one cannot apply the Permit criteria. For example, a requirement for significantly more removal to meet a Performance Standard could materially change the analysis of impacts (and thus overall protectiveness) and costs. Thus, such an approach is inconsistent with the Permit requirement to fully consider the above criteria in evaluating remedial alternatives and selecting a remedy.

In fact, this approach would constitute a "contingency remedy" under EPA guidance, because it would be contingent on a future event (i.e., an exceedance of the standard). As discussed in Section IV.F above, EPA guidance requires that a contingency remedy (as well as the selected remedy) be evaluated fully against the remedy selection criteria, and indicates that if that is not done at the time of initial remedy selection, it will need to be done to invoke the contingency at a later point in time. For any additional response actions that might be required in response to an exceedance of the Downstream Transport Standard, the Region's proposal has not evaluated the Permit's remedy selection criteria, and it does not propose that that be done in the future. As such, it would conflict with EPA guidance as well as the Permit.

This approach would also allow an impermissible end run around the covenants in the CD. Those covenants prohibit the United States from seeking to require GE to conduct additional response actions beyond those specified and required under the CD, unless the reopener conditions are met (i.e., that new information or conditions are discovered that indicate that the selected remedial action is not protective of human health or the environment) (CD ¶¶ 161, 162, 163). While the CD provides that EPA will conduct periodic reviews of the Rest of River remedial action and may select further response actions in the course of those reviews (CD ¶¶ 43.c, 44), it also provides that GE is obligated to perform such actions ***only*** if the covenant reopener conditions are satisfied (CD ¶ 46). An approach that would allow EPA to require GE to conduct additional response actions (not specified in the remedy decision) in the future without satisfying the reopener conditions would violate the covenants.

Paragraph 39.a of the CD is consistent with this conclusion. That provision states that, if EPA determines that modification to the Rest of River work "is necessary to achieve and maintain the Performance Standards . . . , EPA may require that such modification be incorporated in [the relevant work plans]; provided, however, that a modification may only be required pursuant to this Paragraph to the extent that it is ***consistent with the scope of the response action*** for which the modification is required and ***does not modify the Performance Standards***" (except with agreement of the parties and approval of the Court) (emphases added). Given the above-discussed requirement that the Rest of River remedy decision must specify not only the Performance Standards but the actions necessary to meet them, EPA's authority under Paragraph 39.a to require modifications of the Rest of River work does not extend to requiring additional remediation actions later to meet the Downstream Transport Standard, because that would not be "consistent with the scope of the [Rest of River] response action." Rather, any such requirement would be barred by the U.S. covenants in Paragraph 161. In addition, to the extent that such additional remediation actions would modify any other Performance Standard for the Rest of River Remedial Action or the Performance Standards for any of the upstream Removal Actions under the CD, that would be precluded by the provision of Paragraph 39.a that modifications thereunder cannot modify the Performance Standards.

Finally, an open-ended standard that allowed EPA to require GE to conduct additional, unspecified response actions if the standard was exceeded could deprive GE of its ability to obtain a timely Certification of Completion of the Rest of River Remedial Action, with the certainty it provides. Under Paragraph 88 of the CD, once GE concludes that it has completed the Rest of River Remedial Action, it is to submit a written report requesting EPA to certify that the Remedial Action is complete. EPA must respond, either by agreeing (and issuing the Certification) or by telling GE the specific activities that GE must undertake to complete the work and achieve the Performance Standards. The CD draws a bright line between completion of the Remedial Action and operation and maintenance (O&M). The Certification of Completion for the Remedial Action issues when the Remedial Action is done, ***excluding*** O&M. However, if the Downstream Transport Standard were interpreted to allow EPA to require GE to conduct additional response actions to address an exceedance (without meeting the reopener conditions), EPA could, at the completion of the prescribed remediation activities, decline to issue a Certification of Completion on the ground that further remediation might be required in the event of a future exceedance of the standard. The result would be an infinite do-loop in which GE is deprived of the certainty that it has undertaken the tasks necessary to complete the Remedial Action. This is not the deal that the parties struck in the CD.

H. Biota Performance Standard and Long-Term Benchmarks

The Draft Permit also includes, in Section II.B.1.a.(2)(a), a Biota Performance Standard consisting of an average PCB concentration of 1.5 mg/kg (wet weight) in fish fillets (skin off) in each reach of the river and the backwaters, to be achieved within 15 years of the completion of remedial construction activities in that reach (or, where the reach is subject to MNR, completion of such activities in the closest upstream reach subject to active remediation) (Draft Permit, p. 13).[55] The standard states that, "[i]n the event that this Biota Performance Standard is exceeded in two consecutive monitoring periods after the 15-year period specified above, [GE] shall determine the cause of the exceedance and EPA may consider modifications to the Rest of River remedy in accordance with its authority under the CD and CERCLA" (*id.*, p. 14).

As the Region notes, this standard is based on the fish consumption IMPG that was developed using a probabilistic risk analysis, CTE exposure assumptions, and potential non-cancer impacts to adults. (That value is between the probabilistic CTE cancer-based IMPGs for 10^{-5} and 10^{-4} cancer risks.) The Region assumes that the proposed remedy can achieve that standard based on model predictions. However, as discussed above in connection with the Downstream Transport Standard, the EPA model was not designed to be used, and cannot be reliably used, for the prediction of such absolute numerical values.

Moreover, the establishment of such a numerical performance standard with consequences raises similar issues to those discussed above with respect to the consequences of exceeding the Downstream Transport Standard. Again the requirement that, in the event of an exceedance of the Biota Standard, GE must determine the cause is overbroad, because many factors can affect fish tissue concentrations and thus it may well not be possible to determine the cause of an exceedance. Further, as with the Downstream Transport Standard, in the event of an exceedance, EPA's authority under the CD to require GE to conduct additional response actions beyond those prescribed by the selected remedy is limited to the situation in which EPA determines that the covenant reopener conditions are met. To the extent that the standard were interpreted to allow EPA to require GE to conduct such additional response actions without going through the covenant reopeners, it would be beyond EPA's authority for the same reasons discussed for the Downstream Transport Standard in Section IV.G.

In addition to proposing the Biota Performance Standard, the Draft Permit includes Long-Term Biota Benchmarks, consisting of reach-wide average PCB concentrations for fish fillets in

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[55] Although the parenthetical regarding reaches subject to MNR states that the standard is to be achieved "upon completion of the closest upstream reach subject to active remediation," we assume that it means to provide for achievement of the standard in those areas ***within 15 years of completion*** of remediation activities in the closest upstream reach.

Massachusetts (0.064 mg/kg), fish fillets in Connecticut (0.00018 mg/kg), and duck breasts in all areas along the river (0.075 mg/kg) (Draft Permit, p. 13). The Draft Permit states that GE "shall evaluate progress toward achieving these benchmarks" (*id.*) through a long-term monitoring program. There is no requirement – or provision that EPA may require – that GE implement any additional response actions (other than continued monitoring) based on these benchmarks or on a comparison of PCB concentrations in fish fillets or duck breasts to those benchmarks, including a determination that monitoring is not demonstrating continued progress toward achieving those benchmarks. To avoid any future question on this score, the Region should clarify that no such additional response actions will be required on the basis of these long-term benchmarks.[56]

[56] We also note that there is no justification for the Region's establishment of the long-term benchmark of 0.00018 mg/kg for fish fillets in Connecticut. That benchmark is not and cannot be an ARAR, since it was not promulgated after notice-and-comment rulemaking. It is based on an assumed cancer risk of 1 x 10^{-6} for an adult and the assumption that an adult eats a meal of Housatonic River fish ***7 days per week every day of the year for 64 years.*** This translates to a consumption rate of 227 grams of Housatonic fish per day. The assumption that people would eat a meal of Housatonic fish every day of their lives for 64 years is patently unreasonable. This is true even for subsistence anglers, although EPA found no evidence of such subsistence fishing populations in Connecticut (EPA's HHRA [EPA, 2005a], Vol. I, p. 8-28). In fact, in prior comments on the HHRA, CT DEP (now CT DEEP) argued that, for subsistence anglers, based on a 1999 study, the HHRA should use consumption rates of 43.1 grams/day for lower income populations and 59.2 grams/day for Southeast Asian populations; and EPA found even those rates unsupported (see EPA's Responsiveness Summary to Public Comments on New Information for HHRA [EPA, 2005c], pp. 9-11). Further, this benchmark is an order of magnitude more stringent than EPA's (and Connecticut's) water quality criterion of 0.000064 µg/L, which is based on human consumption of fish and would equate to a fish PCB concentration of approximately 0.002 mg/kg – and which the Region recognizes cannot be reliably measured (see Section V.F.1 below). The fact that CT DEEP has developed this benchmark and requested the EPA Region to include it in the Draft Permit is no justification for doing so in the absence of a determination by EPA that there is a health basis for this benchmark. The Region has not determined, and has no basis for determining, that a far stricter fish tissue benchmark is justified to protect health in Connecticut than in Massachusetts.

B. MESA Conservation Plan/Net Benefit Requirement

The Region states that, where the remedy would impact a state-listed species, GE will be required to submit and implement a Conservation and Management Plan under MESA providing a long-term Net Benefit to the conservation of state-listed species that would be taken (Draft Permit, Attachment C, p. 9; Comp. Analysis, p. 20). Such a requirement is both overstated and unauthorized.

While MESA prohibits a take of any state-listed species, the State's regulations under MESA allow the Director of the Massachusetts Division of Fisheries and Wildlife (MassDFW) within the MassDFG to permit a take, at his/her discretion, if three conditions are met: (a) the project proponent has "adequately addressed alternatives to both temporary and permanent impacts" to the species; (b) an "insignificant portion of the local population would be impacted"; and (c) the project proponent "agrees to carry out a conservation and management plan that provides a long-term Net Benefit to the conservation of the State-listed species" (321 CMR 10.23). Thus, under these regulations, the requirement to submit a Conservation and Management Plan providing for a Net Benefit to the species applies ***only*** when the take would impact an insignificant portion of the local population; if the take would impact a significant portion, it is prohibited altogether. The Region's ARARs table does not mention this. Its Comparative Analysis asserts that the impacts on state-listed species can be limited to an insignificant portion of the local populations (Comp. Analysis, p. 20), but it provides no support for that assertion. In fact, its conclusion is contrary to the evidence that, for at least nine state-listed species, the takes resulting from the proposed remedy would impact a significant portion of the local populations, as discussed in Section III.C.1 above.

In any event, as discussed in the RCMS (section 5.4), the requirement that GE must take actions that provide a Net Benefit to the conservation of affected species is unauthorized at this Site and thus cannot constitute an ARAR for the proposed remedy. Section 10.23 provides that, if the three above-listed conditions are met, the MassDFW Director may or may not permit a take, thereby giving him complete discretion as to whether to do so. Thus, if those conditions are met, the regulation does not provide any "standard, requirement, criteria, or limitation" with respect to whether the Director should allow a take – which would be required for a regulation to constitute an ARAR under the CERCLA definition (CERCLA § 121(d)(2)A)). In addition, application of the Net Benefit requirement here, requiring GE to conduct unspecified conservation and management measures in return for a take, would constitute an attempt to recover compensation for a take, which is a form of NRD. As noted above, GE has already provided compensation for NRD at this Site, and has a covenant from the federal and state governments not to seek additional NRD (except in the case of dam failure, not relevant here). Thus, any attempt to require additional conservation and management measures would undermine those covenants and conflict with the CD.

C. Requirements to Pay for Future PCB Costs Related to River Dams/Structures

The Draft Permit includes, in Section II.B.7.b (under the heading of "Institutional Controls and Related Requirements"), certain requirements relating to dams and other structures in the Housatonic River in both Massachusetts and Connecticut. Some of those requirements would mandate that GE pay PCB-related costs incurred by third parties. As shown below, those requirements do not constitute institutional controls, go beyond EPA's remedial authority, and conflict with the Permit requirement to apply the specified remedy selection criteria.

1. Requirement to pay PCB costs for river projects

Section II.B.7.b.(2) of the Draft Permit would require that, in the future, if anyone implements a project along the river (including dam maintenance or removal, a flood management project, road or bridge work or another infrastructure project, installation of a boat launch or dock, etc.) that would require sampling, handling, or disposition of sediments with PCB concentrations above 1 mg/kg, GE must pay all testing, handling, and disposal costs associated with PCBs (unless GE can show that the PCBs are not attributable to GE) (Draft Permit, p. 32). This requirement exceeds EPA's authority in issuing a cleanup remedy, as it is not based on addressing any identified risk to human health or the environment and would usurp the role of the courts.

It is clear under both CERCLA and RCRA that EPA's authority to select and require remedial actions or corrective measures pertains to prescribing such actions as are necessary to protect human health and the environment from identified risks due to releases. As noted above, CERCLA defines "remedial action" as actions to address releases of hazardous substances so "they do not migrate to cause substantial danger to present or future public health or welfare or the environment" (CERCLA § 101(24); and it provides that remedial actions must attain a degree of cleanup and release control that "assures protection of human health and the environment" and must require "a level or standard of control" that achieves ARARs (unless waived) (*id.* § 121(d)(1)). The RCRA corrective action provisions likewise provide for "corrective action to be taken beyond the facility boundary where necessary to protect human health and the environment" (RCRA § 3004(v)). The RCRA Permit recognizes this focus by specifying General Standards of protection of human health and the environment, control of sources of releases, and compliance with ARARs (unless waived), with balancing factors to be considered in determining the alternative that is best suited to meet the General Standards.

The Region's proposed requirement for GE to pay PCB-related costs ***incurred by others*** in conducting river projects is not directed to protecting human health or the environment from asserted risks due to PCB releases, and has nothing to do with the Permit's other remedy selection criteria. Any potential risks from handling and disposing of PCB-containing sediments during such a construction project would be addressed through the array of regulatory requirements and approvals that would apply to such projects (e.g., approval by FERC or the state dam authority for dam projects, a permit under § 404 of the Clean Water Act, water quality certification from the state, review under the state wetlands protection regulations, etc.), which the owner or project proponent would have to meet. The proposed requirement to pay costs does not address such risks; instead, it is a liability-shifting provision that unilaterally declares GE responsible for the economic losses of the owner or project proponent and then directs GE to provide compensation to that party without limitation. That is not EPA's role under CERCLA or RCRA and is not an appropriate part of a remedial action or corrective measures under those statutes.

Moreover, contrary to the heading in the Draft Permit, this proposed requirement does not constitute an institutional control. EPA defines institutional controls as administrative or legal instruments that "help to minimize the potential for exposure to contamination and/or protect the integrity of a response action" by "limiting land and/or resource use or by providing information that helps to modify or guide human behavior at a site." *Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites* (EPA, 2012c), p. 2. The requirement to compensate third parties for their costs does not meet any part of this definition.

If a third party incurs costs associated with PCBs in undertaking a project in the river, that party might seek recovery from GE (or others), and there are ample mechanisms available for resolving such claims. However, that is a matter for the parties to resolve or, if necessary, for the courts to decide. It is not within EPA's authority to make a unilateral administrative determination, by inserting a requirement into a cleanup remedy, that GE is liable to the third party and responsible for 100% of that party's PCB-related costs. That would dictate the outcome of the third party's claim, strip GE of potential defenses (e.g., statute of limitations, inconsistency with the NCP or Massachusetts Contingency Plan) by administrative fiat, and ultimately usurp the courts' role.

In addition, even if it were otherwise authorized, this proposed requirement would conflict with the requirement that EPA must apply the specified remedy selection criteria in selecting a remedy. Since this requirement would apply only in the event of a future contingency (i.e., the incurrence of PCB costs by a third party undertaking a river project), it would constitute a "contingency remedy" under EPA guidance. In such cases, as discussed in Section IV.F above and recognized in EPA guidance, the contingency remedy should be evaluated under the remedy selection criteria, and if that is not done at the time of remedy selection, it would need to be done later to invoke the contingency. Here, the Region has not evaluated its proposed requirement for GE to pay others' PCB costs under the remedy selection criteria and has not provided for any such evaluation in the future before the requirement would apply. As such, the proposed requirement would constitute an impermissible end run around the requirement to consider these criteria in selecting a remedy.[61]

For these reasons, Section II.B.7.b.(2) of the Draft Permit should be deleted from the final Permit.

2. Requirement to pay PCB costs resulting from dam failure or unpermitted release

Section II.B.7.b.(3) of the Draft Permit would require that, in the event of any dam failure or unpermitted release with respect to a dam on the river in Massachusetts or Connecticut, GE must "pay for the costs associated with PCBs" (Draft Permit, p. 32). As it relates to non-GE-owned dams, this requirement is unauthorized for similar reasons to those discussed in the prior subsection. GE is not responsible to prevent failure of any of those dams or unpermitted

[61] In fact, as discussed above, any such evaluation would demonstrate clearly that this proposed requirement would not meet those criteria since that payment requirement is not based on protecting human health or the environment and would not control sources of releases, and ARARs are not pertinent to such a requirement.

releases over those dams, nor is it responsible to pay for any costs resulting from such failure or unpermitted release. The dam owners are liable for such events. The proposed requirement that GE must pay the PCB-related costs resulting from such events does not address the impacts of those events and is not directed at protecting human health or the environment; it just relates to which party must pay the necessary costs of response. While the dam owners who are liable for such an event may have a claim against GE for any incremental costs they incur that are attributable to PCBs, that is a matter for the parties to resolve or, if necessary, for the courts to decide. The EPA Region cannot lawfully attempt to dictate the outcome of such a claim by including in its remedy a requirement that GE must pay these costs.

In addition, like the requirement discussed in the prior section, this requirement would constitute a contingency remedy that was selected without evaluating it under the Permit's remedy selection criteria or providing for such an evaluation before it would apply. It is thus unjustified for that reason as well.

Furthermore, the requirement to "pay for the costs associated with PCBs" could include a requirement to pay damages to the natural resource trustees for any asserted NRD resulting from the dam failure or unpermitted release. With respect to any dams other than the GE-owned Woods Pond and Rising Pond Dams, such a requirement would be flatly contrary to the federal and state governments' covenants in the CD that those governments will not seek to recover any additional NRD except in the case of a failure of Woods Pond or Rising Pond Dam (CD ¶¶ 161, 166, 170, 176).

For these reasons, Section II.B.7.b.(3) of the Draft Permit should also be deleted.

D. Requirements for EREs, Conditional Solutions, and Future Cleanup at Floodplain Properties

The Draft Permit includes, in Section II.B.7.c, a set of proposed requirements, which it also terms "institutional controls," that address future use of floodplain properties (Draft Permit, pp. 33-35, Tables 3-5). To be consistent with the CD, applicable legal principles, and EPA guidance, several changes are needed in these provisions.

Trigger level. All of these proposed requirements apply to floodplain properties with PCB concentrations exceeding the current Massachusetts Contingency Plan (MCP) Method 1 S-1 soil standard for PCBs and the current Connecticut Remediation Standard Regulations (RSR) residential direct exposure criterion for PCBs – both of which are 1 mg/kg. That trigger, however, should be changed to 2 mg/kg to be consistent with the CD Performance Standard for residential properties at this Site, including the Actual/Potential (A/P) Lawns of the Downstream Floodplain Residential Properties (see CD ¶ 28). The CD contains a specific risk analysis by EPA demonstrating that a cleanup level of 2 mg/kg is protective for current and future residential use at this Site (CD Appendix D, Attachment B); and it also includes a specific determination by EPA, MassDEP, and CT DEEP that Removal Actions that achieve that standard "are protective of human health and the environment" at residential properties (CD ¶ 8.b(i)). Further, in its April 3, 2006 approval letter for GE's revised IMPG Proposal, the EPA Region made clear that 2

In addition to the provision discussed above, subsection c.(3) of the Draft Permit would require that, for owners of these non-residential properties who elect to remove soil from their property for a legally permissible use, GE must pay the incremental costs associated with and attributable to the presence of PCBs (unless GE can show that they are not attributable to GE). That requirement goes beyond EPA's authority for the same reasons discussed in Section V.C.1 above relating to the requirement to pay future costs for sediment-related projects along the river – i.e., it is not based on addressing risks but simply provides for compensation to the owner for economic loss, it does not constitute an institutional control, it impermissibly attempts to dictate the outcome of the owner's potential claim against GE, and it constitutes a contingency remedy without evaluation of the remedy selection criteria.

4. Conditional Solutions for residential properties

Subsection c.(4) provides that for floodplain portions of residential properties downstream of the Confluence that are not part of the A/P Lawns, GE must implement a Conditional Solution that would obligate it to perform additional response actions to meet the cleanup standards in Tables 4 and 5 if the use should change to residential or agricultural. This provision should be changed in several respects.

First, this requirement would apply to all portions of residential properties other than A/P Lawns, even the absence of any reasonable potential for future changes in use of those portions (e.g., due to the topography, wet nature, or location of the area). This would include numerous residential properties for which EPA's own HHRA concluded that there is no reasonable potential for changes in use. Table 16 provides several examples of residential properties in the floodplain that are not part of the A/P Lawns of the Downstream Floodplain Residential Properties and for which the HHRA concluded that there is no reasonable potential for a change to a different use. To be consistent with that conclusion as well as the EPA guidance discussed above, this provision should be limited to non-A/P Lawn portions of residential properties for which a change to residential or agricultural use is "reasonably anticipated."

Moreover, this Conditional Solution requirement must be limited by the same conditions described in Section V.D.3. Specifically, the trigger for requiring additional response actions should be the same as specified in CD ¶ 34.d, the cleanup standards applicable to future response actions must be limited to those to which the parties already agreed in CD ¶ 34.d for application under Conditional Solutions (rather than establishing the entirely new standards in Tables 4 and 5), and the Region needs to estimate the potential implications of this requirement and evaluate it under the Permit criteria.

In addition, as in subsection c.(3), subsection c.(4) would require that, for the non-A/P Lawn portions of residential properties, if the owner elects to remove soil from the property for a legally permissible use, GE must pay the incremental costs associated with and attributable to the presence of PCBs (unless GE can show that they are not attributable to GE). For the same reasons discussed in Section V.C.1 and summarized in Section V.D.3 above, this requirement to pay the owner's future costs exceeds EPA's authority.

5. Requirement to pay future PCB costs at other non-residential properties

Subsection c.(5) requires that, for non-residential properties where there is not a reasonable potential for a change in future use, if the owner elects to remove soil from the property for a legally permissible use, GE must pay the incremental costs associated with and attributable to the presence of PCBs (unless GE can show that they are not attributable to GE). Again, for the same reasons discussed in Section V.C.1 and summarized in Section V.D.3 above, this requirement exceeds EPA's authority.

6. Five-year review requirement

Subsection c.(6) provides that GE must conduct inspections every five years to determine whether property owners have changed the use of a property "such that a re-evaluation of protectiveness is required," and if so, inform EPA; and EPA will determine if additional response actions are necessary. This provision states further that, if EPA or the State notifies GE of such conditions at any time and EPA determines that that additional response actions are required, GE must conduct such response actions.

This requirement is too broad and undermines the covenants that the United States granted to GE in the CD. It is EPA's obligation under CERCLA and the CD to conduct five-year reviews to assess whether any changes in land use have affected the protectiveness of the remedy (see CERCLA § 121(c); CD ¶ 43.c).[65] While EPA can select additional response actions as part of these reviews (or at any other time that it determines that an existing response action is not protective), EPA does not have authority as part of the present remedy to require GE to conduct any additional response actions that EPA determines are necessary. Under the CD, if EPA determines that there has been a change in land use and that that change has affected the protectiveness of the remedy, EPA could select further response actions (CD ¶ 44). However, in such a case, if the property is not covered by a Conditional Solution, the covenants in the CD preclude EPA from requiring GE to conduct such further response actions unless it finds that the change constitutes new information or conditions that render the selected remedy not protective of health or the environment (CD ¶¶ 46, 161-163). The remedy itself may not include a requirement that GE must necessarily carry out such further response actions in the absence of an EPA determination of non-protectiveness. Such a requirement would undermine and eviscerate the CD covenants.

7. Cleanup standards for future uses

Subsection c.(7) provides that, in the event of any future change in use of a floodplain property, GE must determine the appropriate exposure scenario, determine the exposure point concentration (EPC) for the exposure area, compare that EPC to the applicable cleanup standard from Table 4 (for agricultural use) or Table 5 (for other uses), and if the EPC exceeds that standard, conduct the necessary sampling and response actions to achieve that standard.

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[65] See also EPA's *Comprehensive Five-Year Review Guidance* (EPA, 2001a), pp. 4-5 & 4-7, and its 2010 future use guidance (EPA, 2010), p. 9.

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Table 1

Sites Where On-Site or Local Disposal of PCB-Containing Soils and/or Sediments Has Been Part of EPA-Selected Remedy

Site	Location	Program (Agency(ies))	Source/Basis	Primary Contaminant	Volume (cubic yards)	Type of Disposal
GE-Pittsfield/ Housatonic River, incl. Upper ½ Mile and 1½ Mile Reaches of Housatonic River	Pittsfield, MA	Superfund, RCRA (EPA and MassDEP)	Federal Consent Decree (2000)	PCBs	245,000	• Placement in two on-site consolidation areas at GE Plant – a new one for TSCA- and RCRA-regulated material and an existing one for other material
New Bedford Harbor	New Bedford, MA	Superfund (EPA)	ROD (1998); Fourth ESD for ROD 2 (2011)	PCBs	up to 550,000	• Disposal of sediments in on-site CAD in Lower Harbor
Norwood PCBs – OU 1	Norwood, MA	Superfund (EPA)	ROD Amendment (1996)	PCBs	20,000	• Consolidation of soils and sediments into portion of site to be covered with TSCA-compliant multi-layer cap
Sullivan's Ledge – OU 1 and OU 2	New Bedford, MA	Superfund (EPA)	ROD for OU 1 (1989); ROD for OU 2 (1991)	PCBs	26,100 (OU 1) + 5,200 (OU 2)	• Disposal of excavated soils and sediments (after solidification of OU 1 soils) in on-site disposal area to be capped
Silresim Chemical Corp.	Lowell, MA	Superfund (EPA)	ROD (1991)	VOCs, PCBs, metals, PAHs	18,000	• After in-situ treatment for VOCs, removal of soil with non-VOC contamination, solidification, and on-site disposal under RCRA cap
Alcoa Grasse River	Massena, NY	Superfund (EPA)	ROD (2013)	PCBs	109,000	• Disposal in on-site landfill
Onondaga Lake	Syracuse, NY	Superfund (EPA and NYSDEC)	ROD (2005)	Mercury, chlorobenzene, PAHs, VOCs (BTEX), PCBs	2,650,000	• Disposal of dredged sediments in on-site upland sediment consolidation areas (except for pure-phase chemicals, e.g., NAPL)
Lower Ley Creek Subsite of Onondaga Lake Site	Syracuse & Salina, NY	Superfund (EPA)	ROD (2014)	PCBs	160,000 total (~ 140,000 non-TSCA & non-RCRA)	• Disposal in on-site local landfill(s) (if available) for soils and sediments with PCBs < 50 ppm and not RCRA hazardous waste • Off-site disposal for TSCA/RCRA material
Grand Calumet River	Gary, IN	RCRA, CWA (EPA)	AOC under RCRA (1998); Consent Decree under CWA (1998)	PCBs	~800,000	• On-site disposal of sediments in a RCRA CAMU
Fox River – SMU 56/57	Green Bay, WI	Superfund (EPA and WDNR)	AOC (2000); see also Final Report on Project (2001)	PCBs	81,000	• Disposal at local industrial landfill owned by PRP located approximately 6 miles away

Site	Location	Program (Agency(ies))	Source/Basis	Primary Contaminant	Volume (cubic yards)	Type of Disposal
Ashtabula River	Ashtabula, OH	Great Lakes Legacy Act (EPA and Ohio EPA)	Ashtabula Legacy Act Cleanup (2005-07)	PCBs	500,000	• On-site disposal on PRP's property
Ottawa River	Toledo, OH	Great Lakes Legacy Act (EPA)	Ottawa River Legacy Act Cleanup (2010)	PCBs, PAHs, lead, oil, grease	250,000	• Disposal of sediments (except from limited "hot spots") in nearby landfill
River Raisin	Monroe, MI	Great Lakes Legacy Act (EPA and MDEQ)	River Raisin Legacy Project (2012)	PCBs	109,000	• On-site disposal of less contaminated sediment (106,000 cy) at CDF 2 miles north of river mouth • Off-site disposal of the most contaminated sediment (3,000 cy)
Outboard Marine Corporation Site, Waukegan Harbor – OU 2	Waukegan, IL	Superfund (EPA)	ROD Amendment (2009)	PCBs	124,000	• On-site disposal at Outboard Marine Corporation Plant 2 property at newly constructed sediment consolidation facility
Kinnickinnic River	Milwaukee, WI	Great Lakes Legacy Act (EPA and WDNR)	Kinnickinnic River Legacy Act Cleanup (2009); see also Remedial Action Report (2011)	PCBs, PAHs	167,000	• Disposal at newly constructed cell within the already existing on-site CDF
Allied Paper/Portage Creek/Kalamazoo River – OU 3	Kalamazoo, MI	Superfund (EPA)	ROD (1998)	PCBs	4,000+	• Consolidation of soil/sediment into existing on-site landfill to be capped
Bryant Mill Pond (portion of Portage Creek)	Kalamazoo, MI	Superfund (EPA)	Time Critical Removal Action (1999)	PCBs	~ 150,000	• Disposal in on-site former dewatering lagoons on PRP property
Willow Run Creek	Ypsilanti and Van Buren Townships, MI	Superfund and state law (EPA and MDEQ)	EE/CA (1994)	PCBs	450,000	• Disposal in newly constructed on-site dedicated TSCA landfill
Fields Brook – Sediment OU	Ashtabula, OH	Superfund (EPA)	ROD (1986); ESDs (1997, 1999, 2001)	PCBs, radionuclides	14,000	• Off-site thermal treatment of most contaminated sediments (3,000 cy) • Disposal of other excavated sediments (11,000 cy) at on-site TSCA-equivalent landfill
Ormet Corporation (backwater sediments)	Hannibal, OH	Superfund (EPA)	ROD (1994)	PCBs, PAHs	Not specified	• On-site consolidation of sediments with PCBs < 50 ppm under cap • Off-site disposal of sediments with PCBs > 50 ppm

Site	Location	Program (Agency(ies))	Source/Basis	Primary Contaminant	Volume (cubic yards)	Type of Disposal
Twelve Mile Creek – OU 2	Pickens, SC	Superfund (EPA)	ESD (2009)	PCBs	Not specified	• On-site disposal of sediments dredged from behind dams at upland SMU proximate to site
St. Lawrence River - Reynolds Metals Co.	Massena, NY	Superfund (EPA)	Decision Document Amendment (1998)	PCBs, PAHs, TDBFs	77,600	• On-site disposal of sediments with PCBs < 50 ppm at industrial landfill on PRP property with RCRA cap • Off-site disposal of sediments with PCBs > 50 ppm
Thea Foss/Wheeler Osgood Waterway – part of Commencement Bay	Tacoma, WA	Superfund (EPA)	ROD (1989); ESD (2000)	PAHs, PCBs, metals, phthalates, pesticides, phenols	620,000	• Disposal of contaminated sediments in on-site near-shore fill area (St. Paul near-shore fill area)
Hylebos Waterway – part of Commencement Bay	Tacoma, WA	Superfund (EPA)	ROD (1989); ESD (2000)	Metals, PCBs, PAHs	940,000	• Disposal of contaminated sediments at local near-shore man-made slip (Blair Slip 1) converted to CDF and at upland regional landfill

<u>Abbreviations</u>:

AOC = Administrative Order on Consent
BTEX = benzene, toluene, ethylbenzene, and xylenes
CAD = confined aquatic disposal
CAMU = corrective action management unit
CDF = confined disposal facility
CWA = Clean Water Act
cy = cubic yards
EE/CA = Engineering Evaluation/Cost Analysis
EPA = U.S. Environmental Protection Agency
ESD = Explanation of Significant Differences
MassDEP = Massachusetts Department of Environmental Protection
MDEQ = Michigan Department of Environmental Quality
NAPL = non-aqueous-phase liquid
NYSDEC = New York State Department of Environmental Conservation
Ohio EPA = Ohio Environmental Protection Agency
OU = operable unit
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
ppm = parts per million
PRP = potentially responsible party
RCRA = Resource Conservation and Recovery Act
ROD = Record of Decision
SMU = sediment management unit
TCSA = Toxic Substances Control Act
TDBFs = total dibenzofurans
VOCs = volatile organic compounds
WDNR = Wisconsin Department of Natural Resources

Table 2

Summary of PCB Mass Transported

<table>
<tr><th colspan="2" rowspan="3"></th><th colspan="4">Annually[1]</th><th colspan="2">For Duration of Project (During Operation and After Closure, where applicable)[1]</th><th rowspan="3">Pounds PCB per Truck or Rail Car</th></tr>
<tr><th colspan="2">PCBs Transported (lbs)</th><th colspan="2">Truck Trips</th><th rowspan="2">Total PCB Mass Transported (lbs)</th><th rowspan="2">Truck Trips/Rail Cars</th></tr>
<tr><th>During Operation</th><th>After Closure</th><th>During Operation</th><th>After Closure</th></tr>
<tr><td colspan="2">On-Site Leachate Transport from TD 3 Facility to Building 64G WTF[2]</td><td>0.091</td><td>0.005</td><td>1,357</td><td>82</td><td>1.7</td><td>25,800</td><td>0.000067</td></tr>
<tr><td rowspan="3">Off-Site Transport via Truck or Rail[3]</td><td>TD 1 Transport to Off-site Disposal Facility (Truck)</td><td colspan="2" rowspan="3">2,960</td><td colspan="2">6,360</td><td rowspan="3">38,450</td><td>82,700</td><td>0.465</td></tr>
<tr><td>TD 1 RR Transport On-site to Rail Loading Facility (Truck)</td><td colspan="2">7,960</td><td>103,400</td><td>0.372</td></tr>
<tr><td>TD 1 RR Transport from Rail Loading Facility to Off-site Disposal Facility (Rail)</td><td colspan="2">1,270</td><td>16,500</td><td>2.32</td></tr>
</table>

Notes:

1. "Annual" estimates assume total construction/operation duration of 13 years, consistent with EPA's estimated duration for its proposed remedy. Post-closure estimate assumes 100 years.
2. For a 1M cubic yard (cy) capacity TD 3 landfill, it is assumed that the footprint of the material consolidation area would be approximately 11 acres (based on assumed disposal at the Woods Pond Site). Leachate is assumed to be generated at 50,000 gal/acre/month during construction/operation (13 years) and at 3,000 gal/acre/month after closure (assumed to be 100 years for this estimate). It is assumed a 5,000 gallon capacity tanker would be used to transport leachate. It is assumed that the landfill would produce leachate with a PCB concentration of approximately 1.6 ppb or µg/L (i.e., lb/gallon).
3. It is assumed that 20-ton capacity trucks would be used to transport material off-site. It is assumed that 16-ton capacity trucks would be used for transport on-site to the TD 1 RR rail loading facility (assumed to be located near Woods Pond). It is assumed that each rail car can transport approximately 100 tons. Total PCB mass for the 998,000 cy removal volume is estimated at 38,450 lbs based on reach-specific numbers calculated for SED 9/FP 4 MOD.

Table 9

Comparison of EPA Region's Assumed Exposure Frequencies with Floodplain User Survey Observations

Exposure Area	EPA Region's Proposal		Observations from 2002 Floodplain User Survey			
	Exposure Scenario, Receptor	Exposure Frequency (day/yr)	Survey Days	Observed Visits	Age Groups	Breakdown of Observed Visits
1	General recreation (medium use), adult/older child	60	181	20	19 adults, 1 younger child	Walking/hiking/running (on trail): 11 (incl.1 younger child) Walking/hiking/running (off trail): 1 Fishing (on trail): 1 ATV/motorcycle use (off trail): 1 Biking (on trail): 6
2	General recreation (high use), adult/older child	90	181	3	Adults	Wild crop gathering (on trail): 2 Wild crop gathering (off trail): 1
2a	General recreation (low use), older child	30				
2b	General recreation (high use), older child	90				
3	General recreation (high use), adult	60	Not included in survey			
4	General recreation (high use), adult/older child	90	178	14	10 adults, 3 older children, 2 younger children	Walking/hiking/running (on trail): 6 (incl. 2 older children) ATV/motorcycle use (on trail): 3 (incl. 2 younger children & 1 older child) Wild crop gathering (on trail): 1 General recreation (on trail): 4 (incl. 1 younger child)
5	General recreation (high use), adult/older child	90	181	1	Older child	Walking/hiking/running
6	General recreation (low use), adult	30	60	0	None	None
7	General recreation (high use), adult/older child	90	181	2	Adults	General recreation (off trail): 2
8	Recreational canoeing, adult/older child	60/30	60	0	None	None
9	General recreation (low use), older child	30	60	0	None	None
10	General recreation (high use), young child	90	60*	0	None	None
10a	General recreation (high use), young child	90				

* Limited view of area from canoe survey.

Exposure Area	EPA Region's Proposal		Observations from 2002 Floodplain User Survey			
	Exposure Scenario, Receptor	Exposure Frequency (day/yr)	Survey Days	Observed Visits	Age Groups	Breakdown of Observed Visits
11	General recreation (high use), adult	90	181	0	None	None
12	General recreation (high use), adult/older child	90	181	49	24 adults, 3 older children, 2 younger children	Walking/hiking/running (on trail): 29 (incl. 2 younger children & 2 older children) ATV/motorcycle use (on trail): 9 Biking (on trail): 9 (incl. 1 older child) General recreation (on trail): 1 Farming (on trail): 1
13	General recreation (high use), adult	90	181	0	None	None
14	General recreation (high use), adult	90	Not included in survey			
15	General recreation (high use), adult	90	Not included in survey			
16	General recreation (high use), adult	90	181	0	None	None
17	General recreation (high use), adult	90	181	0	None	None
18	General recreation (medium use), adult	60	60	0	None	None
19	General recreation (high use), adult	90	181	0	None	None
20	General recreation (high use), adult	90	181	2	Adults	Walking/hiking/running (on trail): 2
21	General recreation (high use), adult/older child	90	60	0	None	None
22	General recreation (high use), adult/older child	90	181	0	None	None
22a	Dirt biking/ATVing, older child	90				
23	General recreation (medium use), older child	60	178	1	Adult	General recreation (off trail): 1
24	General recreation (high use), adult	90	181	1	Adult	General recreation (off trail): 1
25	General recreation (high use), older child	90	60	1	Adult	Walking/hiking/running: 1

Exposure Area	EPA Region's Proposal		Observations from 2002 Floodplain User Survey			
	Exposure Scenario, Receptor	Exposure Frequency (day/yr)	Survey Days	Observed Visits	Age Groups	Breakdown of Observed Visits
26a	General recreation (high use), adult/older child	90	182	45	43 adults, 2 older children	Walking/hiking/running (on trail): 8 (incl. 1 older child) Walking/hiking/running (off trail): 3 ATV/motorcycle use (on trail): 4 (incl. 1 older child) ATV/motorcycle use (off trail): 3 General recreation (on trail): 7 General recreation (off trail): 5 Hunting (off trail): 8 Paintball (on trail): 2 Horseback riding (off trail): 2 Farming (off trail): 3
26b	Agricultural use, adult farmer	40				
26F	General recreation (high use), adult/older child	90				
27	General recreation (high use), adult/older child	90	60	0	None	None
27a	Dirt biking/ATVing, older child	90				
28	General recreation (high use), adult/older child	90	60	1	Younger child	Walking/hiking/running: 1
28a	Dirt biking/ATVing, older child	90				
29	General recreation (low use), adult/older child	30	60	0	None	None
30	General recreation (high use), adult/older child	90	60	0	None	None
31	General recreation (high use), adult/older child	90	118	6	Adults	Walking/hiking/running: 1 General recreation: 5
31a	General recreation (high use), adult/older child	90				
32	General recreation (high use), adult	90	118	4	Adults	Walking/hiking/running: 3 General recreation: 1
33	General recreation (high use), adult	90	181	2	Adults	Hunting (off trail): 1 General recreation (off trail): 1
34	General recreation (medium use), adult	60	60	0	None	None
35	General recreation (high use), adult/older child	90	181	2	Adults	Walking/hiking/running (off trail): 1 Bird watching (on trail): 1
35a	General recreation (high use), adult/older child	90				

Exposure Area	EPA Region's Proposal		Observations from 2002 Floodplain User Survey			
	Exposure Scenario, Receptor	Exposure Frequency (day/yr)	Survey Days	Observed Visits	Age Groups	Breakdown of Observed Visits
36a	Commercial (low use), groundskeeper	30	181	0	None	None
36b	Agricultural use, adult farmer	40				
37	General recreation (high use), adult/older child	90	182	36	35 adults, 1 older child	Walking/hiking/running (on trail): 9 Walking/hiking/running (off trail): 1 Hunting (on trail): 2 Hunting (off trail): 17 (incl. 1 older child) Horseback riding (on trail): 2 General recreation (on trail): 5
37a	Bank fishing, adult/older child	30				
37b	General recreation (high use), adult/older child	90				
38	General recreation (high use), adult	90	118	6	Adults	Walking/hiking/running: 5 Bird watching: 1
38a	Bank fishing, adult/older child	30				
39	Marathon canoeing, adult	150	181	12	11 adults, 1 older child	Walking/hiking/running (on trail): 1 Fishing (on trail): 8 (incl. 1 older child) Bird watching (off trail): 1 Hunting (on trail): 2
40	General recreation (high use), adult/older child	90	181	70	62 adults, 6 older children, 2 younger children	Walking/hiking/running (on trail): 11 (incl. 2 older children) Walking/hiking/running (off trail): 4 Hunting (on trail): 6 Hunting (off trail): 11 Bow shooting tournament (on trail): 10 (incl. 2 older children) Bow shooting tournament (off trail): 12 (incl. 2 older children & 2 younger children) General recreation (on trail): 7 General recreation (off trail): 6 Fishing (on trail): 3
40a	Bank fishing, adult/older child	30				
40b	General recreation (high use), adult/older child	90				
41	General recreation (medium use), adult	60	181	0	None	None
41a	Bank fishing, adult/older child	30				

Exposure Area	EPA Region's Proposal		Observations from 2002 Floodplain User Survey			
	Exposure Scenario, Receptor	Exposure Frequency (day/yr)	Survey Days	Observed Visits	Age Groups	Breakdown of Observed Visits
42	General recreation (medium use), adult	60	118	6	Adults	Walking/hiking/running: 1 Bird watching: 1 General recreation: 4
42a	Bank fishing, adult/older child	30				
43	General recreation (medium use), adult	60	60	1	Adult	Walking/hiking/running: 1
43a	Bank fishing, adult/older child	30				
44	General recreation (high use), adult	90	60	1	Adult	Walking/hiking/running: 1
45	General recreation (high use), adult	90	118	11	Adults	Walking/hiking/running: 6 General recreation: 5
46	General recreation (high use), adult	90	118	6	Adults	Hunting: 2 General recreation: 3
47	Recreational canoeing, adult/older child	60/30	118	4	Adults	Walking/hiking/running: 3 General recreation: 1
47F	Recreational canoeing, adult/older child	60/30				
48	General recreation (high use), adult	90	118	9	Adults	Walking/hiking/running: 4 Hunting: 1 General recreation: 4
49	General recreation (low use), adult	30	60	0	None	None
50	General recreation (low use), adult	30	60	0	None	None
50a	Waterfowl hunting, adult/older child	14				
51	General recreation (low use), adult	30	60	0	None	None
51a	Waterfowl hunting, adult/older child	14				
52	Recreational canoeing, adult/older child	60/30	118	3	Adults	Walking/hiking/running: 2 Fishing: 1
53	Recreational canoeing, adult/older child	60/30	118	26	Adults	Walking/hiking/running: 4 Fishing: 2 Hunting: 12 General recreation: 6

Exposure Area	EPA Region's Proposal		Observations from 2002 Floodplain User Survey			
	Exposure Scenario, Receptor	Exposure Frequency (day/yr)	Survey Days	Observed Visits	Age Groups	Breakdown of Observed Visits
54	General recreation (high use), adult	90	118	9	Adults	Walking/hiking/running: 1 Fishing: 1 General recreation: 7
55	General recreation (high use), adult/older child	90	118	28	27 adults, 1 younger child	Walking/hiking/running: 12 Picnicking: 2 (incl. 1 younger child) General recreation: 13
55a	Waterfowl hunting, adult/older child	14				
56	General recreation (medium use), adult/older child	60	118	2	Older children	Biking: 2
56a	Waterfowl hunting, adult/older child	14				
57	General recreation (high use), adult/older child	90	118	31	30 adults, 1 younger child	Walking/hiking/running: 24 (incl. 1 younger child) Fishing: 2 Bird watching: 1 General recreation: 4
58	General recreation (high use), adult	90	118	25	Adults	Walking/hiking/running: 7 Fishing: 3 ATV/motorcycle use: 6 General recreation: 4
59	General recreation (high use), adult/older child	90	118	34	32 adults, 2 younger children	Walking/hiking/running: 15 (incl. 2 younger children) Fishing: 7 Hunting: 2 Bird watching: 1 General recreation: 9
59a	Bank fishing, adult/older child	30				
60	General recreation (high use), adult/older child	90	118	198	194 adults, 4 younger children	Walking/hiking/running: 102 (incl. 4 younger children) ATV/motorcycle use: 2 Biking: 2 Fishing: 10 Bird watching: 2 General recreation: 80
60a	Recreational canoeing, adult/older child	60/30				

Table 11

Summary of Impacts on Habitat Types Under SED 9/FP 4 MOD[1]

Habitat	Acres of Habitat	Impacted Area (acres)		
		Remediation	Access/Staging	Total
Aquatic Riverine Habitat	126	126	--	126
Riverbank (linear miles)	14[2]	3.5+[2]	--	3.5+[2]
Impoundment Habitat	139	116	--	116
Backwater	86	50	--	50
Floodplain Wetland Forest	485	30	6.1	36
Shrub and Shallow Emergent Wetlands	364	7.9	5.7	14
Deep Marshes	48	0.1	0.1	0.2
Vernal Pools Acres (number of pools)[3]	34	27 (43)	--	27 (43)
Disturbed Upland Habitats	78	3.9	5.2	9.1
Upland Forested Habitats	86	1.0	1.7	2.7
Sub-total[4]	**1,446**	**362**	**19**	**381**
Unmapped Habitats[5]		2.8	55	58
Total		**365**	**74**	**439**

Notes:

1. This table summarizes the impacts of remediation activities (including application of activated carbon) and construction of access roads and staging areas on various habitat types.

2. Riverbank habitat and impacts are presented in linear miles rather than acres. Total riverbank habitat (14 miles) includes Reaches 5A and 5B; riverbank impacts for SED 9/FP 4 MOD reflect EPA's estimate for Reach 5A only (assuming no remediation in Reach 5B).

3. Number of vernal pools impacted and associated acreage reflect upper-bound estimate involving the remediation of all identified vernal pools in the PSA with average PCB concentrations greater than 3.3 mg/kg and located outside of Core Area 1. If fewer pools are subject to remediation, the impacted acreage would decrease accordingly.

4. Sub-totals include in-river habitat impacts for Reaches 5-8; however, floodplain impacts are limited to the PSA (Reaches 5/6) within the boundaries of the Woodlot (2002) natural community mapping.

5. Unmapped habitats include impacts outside of Woodlot (2002) natural community mapping coverage.

Table 12

Summary of Impacts on State-Listed Species Under Proposed Remedy (SED 9/FP 4 MOD)[1]

Species with Priority Habitat Affected by Proposed Remedy[2]	Would a Take Occur?[3]	Impact on Significant Portion of Local Population?[3]
American bittern	Yes	Yes
Bald eagle	Yes	Unlikely
Bristly buttercup	Yes	No
Brook snaketail	Yes	Yes
Bur oak	Yes	No
Common moorhen	Yes	Yes
Creeper*	Yes	No
Crooked-stem aster	Yes	No
Foxtail sedge	Yes	Possibly
Gray's sedge	Yes	No
Hairy wild rye	Yes	No
Intermediate spike-sedge	Yes	Yes
Jefferson salamander	Yes	Unlikely
Longnose sucker*	Yes	No
Mustard white	Yes	Unlikely
Narrow-leaved spring beauty	Yes	Unlikely
Ostrich fern borer moth	Yes	No
Rapids clubtail	Yes	Possibly
Riffle snaketail	Yes	Yes
Skillet clubtail*	Yes	No
Spine-crowned clubtail	Yes	Yes
Stygian shadowdragon*	Yes	No
Wapato	Yes	Yes
Water shrew	Yes	Yes
Wood turtle	Yes	Yes

1. This table is based on the more detailed assessment in Attachment E to these comments.
2. This table does not include four species that were de-listed in February of 2012 (triangle floater, arrow clubtail, zebra clubtail, and black maple).
3. All of the Take and Significance assessments apply to impacts in Reaches 5/6, except for the four species marked with asterisks, which occur only in Reaches 7/8 and thus have been evaluated for those Reaches. In addition, the wood turtle has a second local population in Reaches 7/8 that would experience a take, but that take would not impact a significant portion of the local population.

Table 13
Estimated Truck Trips for SED 9/FP 4 MOD and Select Components

	All Reaches	Reach 6 (Woods Pond)		Reach 7 Impoundments		Reach 8 (Rising Pond)			Backwaters	
	SED 9/FP 4 MOD	SED 9/FP 4 MOD (340,000 cy)	Shallow dredging (44,400 cy)/ cap all	SED 9/FP 4 MOD (53,000 cy)	Thin-Layer Capping	SED 9/FP 4 MOD (50,000 cy)	Shallow dredging (15,300 cy)/ cap all	Thin-Layer Capping	SED 9/FP 4 MOD (95,000 cy)	3.3 mg/kg SWAC (excl CA 1) (40,000 cy)
Importation of Backfill, Cap Material, Staging/Access Material[1]										
Tons of Material	1,151,900	176,300	100,600	87,900	52,100	79,500	50,800	45,200	137,800	57,500
Number of Truck Trips[2]	**72,000**	**11,000**	**6,300**	**5,500**	**3,300**	**5,000**	**3,200**	**2,800**	**8,600**	**3,600**
Number of Vehicle Miles Traveled[3]	3,600,000	550,000	315,000	275,000	165,000	250,000	160,000	140,000	430,000	180,000
Disposition of Staging/Access Material[4]										
Tons of Material	222,200	0	0	13,400	11,700	14,200	13,400	6,400	0	0
Number of Truck Trips[5]	**11,110**	**0**	**0**	**670**	**585**	**710**	**670**	**320**	**0**	**0**
Number of Vehicle Miles Traveled[6]	9,248,000	0	0	557,700	487,000	591,000	557,700	266,400	0	0
Disposition of Excavated Sediments/Soils[7]										
Tons of TSCA Material	519,000	224,400	38,800	0	0	0	0	0	38,000	19,800
Tons of Non-TSCA Material	1,135,400	336,600	34,500	87,500	0	82,500	25,300	0	118,800	45,700
Number of Truck Trips for Off-site Transport to TD 1 Facilities[8]	**82,750**	**28,050**	**3,665**	**4,375**	**0**	**4,125**	**1,265**	**0**	**7,840**	**3,275**
Number of Truck Trips for On-Site Transport to TD 1 RR Rail Loading Facility or TD 3 Upland Disposal Facility[9]	**103,400**	**35,063**	**4,581**	**5,469**	**0**	**5,156**	**1,581**	**0**	**9,800**	**4,094**
Number of Vehicle Miles to TD 1 Facilities[10]	82,599,200	29,290,900	4,078,200	3,641,800	0	3,433,700	1,053,000	0	7,532,300	3,250,400
Number of Vehicle Miles to TD 1 RR Rail Loading Facility[11]	581,900	35,100	4,600	53,000	0	133,000	40,800	0	27,400	11,500
Number of Vehicle Miles to TD 3 Woods Pond Site Disposal Facility[11]	835,200	77,100	10,100	60,200	0	162,900	50,000	0	49,000	20,500
Number of Vehicle Miles to TD 3 Forest Street Site Disposal Facility[11]	1,584,800	413,700	54,100	55,000	0	116,500	35,700	0	137,200	57,300
Number of Vehicle Miles to TD 3 Rising Pond Site Disposal Facility[11]	3,100,100	1,037,900	135,600	101,200	0	1,000	300	0	317,500	132,600
Total Number of Truck Trips Assuming TD 1	**165,830**	**39,050**	**9,965**	**10,545**	**3,885**	**9,835**	**5,135**	**3,120**	**16,440**	**6,875**
Total Number of Truck Trips Assuming TD 1 RR or TD 3	**186,510**	**46,063**	**10,881**	**11,639**	**3,885**	**10,866**	**5,451**	**3,120**	**18,400**	**7,694**
Range of Average Truck Trips Per Year[12]	12,800 – 14,300	9,200 - 10,900	8,100 - 8,800	4,800 - 5,300	2,800	9,500 - 10,500	9,900 - 10,500	4,100	5,900 - 6,600	6,300 - 7,000
Total Number of Vehicle Miles Assuming TD 1	95,500,000	29,840,900	4,393,200	4,474,500	652,000	4,274,700	1,770,700	406,400	7,962,300	3,430,400
Total Number of Vehicle Miles Assuming TD 1 RR	13,400,000	585,100	319,600	885,700	652,000	974,000	758,500	406,400	457,400	191,500
Total Number of Vehicle Miles Assuming TD 3-Woods Pond Site	13,700,000	627,100	325,100	892,900	652,000	1,003,900	767,700	406,400	479,000	200,500
Total Number of Vehicle Miles Assuming TD 3-Forest Street Site	14,400,000	963,700	369,100	887,700	652,000	957,500	753,400	406,400	567,200	237,300
Total Number of Vehicle Miles Assuming TD 3-Rising Pond Site	16,000,000	1,587,900	450,600	933,900	652,000	842,000	718,000	406,400	747,500	312,600

Table 13 (cont'd)
Estimated Truck Trips for SED 9/FP 4 MOD and Select Components

Notes:

1. Tons of material "in" includes sand, stone, and rip rap used for backfill, capping, and staging areas/access roads, as well as material used for stabilization of excavated sediments.
2. Assumes 16-ton trucks for sand, stone, rip rap, and stabilization material. The number of truck trips also includes number of trips required for importation of material used for bank stabilization and site restoration.
3. Assumes a 50-mile round trip based on assumption that construction material would be available within 25 miles of the facility .
4. Volume of material "out" includes sand, stone, riprap, and other materials used for staging areas/access roads.
5. Assumes 20-ton trucks, where applicable.
6. Assumes a 832-mile round trip to landfill in Kersey, PA (non-TSCA trucking).
7. Volume of material "out" includes excavated material.
8. Assumes 20-ton truck for off-site transport.
9. Assumes 16-ton trucks for transport to on-site TD 1 RR rail loading facility or TD 3 upland disposal facility.
10. It is assumed that the distance to the TD 1 facility is a 832-mile round trip to landfill in Kersey, PA (for non-TSCA material) and a 1,362-mile round trip to EQ's Wayne disposal facility in Belleville, MI (for TSCA material).
11. It is assumed that the distance to the TD 1RR loading facility (assumed to be located near Woods Pond) as well as the three TD 3 facilities is measured from the approximate midpoint of each Reach. All vehicle miles assume a round trip.
12. Based on total estimated construction schedule for each alternative.

Table 14
Estimated Greenhouse Gas Emissions for SED 9/FP 4 MOD and Select Components

	Total SED 9/FP 4 MOD (includes Reach 5)	Woods Pond		Reach 7 Impoundments			Rising Pond			Backwaters	
		SED 9/ FP 4 MOD	Shallow dredging (44,400 cy)/cap all	SED 9/ FP 4 MOD[1]	MNR	Thin-layer capping	SED 9/ FP 4 MOD	Shallow dredging (15,300 cy)/ cap all	Thin-layer capping	SED 9/ FP 4 MOD	3.3 mg/kg SWAC (excl CA 1) (40,000 cy)
Emissions (tonnes CO_2 eq)											
Total	170,000	51,000	7,800	10,000	0	3,100	9,600	8,800	1,400	17,000	6,400
Direct[2]	61,400	9,100	2,100	3,100	0	2,500	3,000	5,500	1,100	4,500	1,300
Indirect[3]	3,300	1,400	180	190	0	0	210	520	0	520	220
Off-site[4]	105,000	41,000	5,600	6,700	0	600	6,400	2,700	320	12,000	4,800
Number of passenger vehicles with equivalent annual CO_2-eq emissions[7]											
Total	35,800	10,700	1,600	2,100	0	650	2,000	1,900	290	3,600	1,300
Direct	12,900	1,900	440	650	0	530	600	1,200	230	950	270
Indirect	700	290	38	40	0	0	44	110	0	100	46
Off-Site	22,100	8,600	1,200	1,400	0	130	1,300	600	70	2,500	1,000

Notes:

1. For Reach 7 impoundments, assumes removal of all sediments > 1 mg/kg in Reaches 7B and 7C and removal to achieve SWAC of 1 mg/kg in Reaches 7E and 7G.
2. Direct emissions include the following components:
   - Transportation - Emissions resulting from equipment and materials brought to/from the site.
   - Construction - Emissions resulting from hauling excavated materials to the stockpile areas.
   - Restoration - Emissions resulting from transportation and installation of new trees and other plantings.
   - Tree removal - Emissions resulting from tree removal and chipping of trees.
   - Changes in carbon stocks - Net emissions resulting from decomposition of mulched trees and differences in sequestration lost from removed mature trees and gained by replanted saplings, up through the anticipated time to fully implement each alternative.
3. Indirect emissions are due to the purchase of electricity for operating the water treatment system.
4. Refers to emissions resulting from off-site operations required to prepare materials used on-site.
5. Totals reflect rounding.
6. Assumptions and calculation methods are consistent with Appendix M from the 2010 Revised CMS Report.
7. Values presented were generated from EPA's Greenhouse Gas Equivalencies Calculator (http://www.epa.gov/cleanenergy/energy-resources/calculator.html), and have been rounded. Calculated based on 4.75 tonnes CO_2/vehicle/year; EPA provides details pertaining to this calculation here: http://www.epa.gov/cleanenergy/energy-resources/refs.html#vehicles.

Table 15
Cost Estimates for SED 9/FP 4 MOD and Select Components

Component	SED 9/FP 4 MOD (*alternative Reach options presented in italics*) (Costs in Million $, rounded)							
	Description	Removal Volume (cy)	Total Estimated Up-Front Cost	Total Estimated Cost				
				With off-site TD-1 (Trucking)	With off-site TD-1 RR (Rail)	With on-site TD 3		
						WP	FS	RP
Reach 5A	SED 9/FP 4 MOD (2.5 ft removal w/ cap to grade [~168,000 cy]; bank excavation/stabilization [~25,000 cy])	193,000	$78	$144	$136	$90	$103	$92
Reach 5B	SED 9/FP 4 MOD (remove/cap > 50 mg/kg; 27 acre AC)	1,000	$10	$10	$10	$10	$10	$10
Reach 5C	SED 9/FP 4 MOD (2 ft removal w/ cap to grade)	186,000	$100	$170	$159	$112	$123	$113
Reach 5 Backwaters	SED 9/FP 4 MOD (removal/cap to SWAC of 1 mg/kg, except remove/cap > 50 mg/kg & apply AC in Core Area 1)	95,000	$29	$61	$58	$35	$41	$36
	Remove/cap to SWAC of 3.3 mg/kg, except remove/cap > 50 mg/kg in Core Area 1 (40,000 cy of removal)	*40,000*	*$14*	*$28*	*$26*	*$16*	*$19*	*$17*
Reach 6 (Woods Pond)	SED 9/FP 4 MOD (6 ft removal, 1 ft cap over 60 acres)	340,000	$52	$188	$164	$73	$95	$75
	Shallow dredging in shallow areas (44,400 cy) + cap entire pond (60 acres)	*44,400*	*$18*	*$39*	*$34*	*$21*	*$24*	*$21*
Reach 7	SED 9/FP 4 MOD (assume removal/capping > 1 mg/kg in 7B and 7C and to achieve SWAC of 1 mg/kg in 7E and 7G)	53,000	$23	$36	$37	$27	$30	$27
	Thin-layer capping in all impoundments	*0*	*$14*	*$14*	*$14*	*$14*	*$14*	*$14*
Reach 8 (Rising Pond)	SED 9/FP 4 MOD (removal/cap to SWAC of 1 mg/kg)	50,000	$18	$30	$31	$22	$25	$22
	Shallow dredging in shallow areas (15,300 cy) + cap entire pond	*15,300*	*$13*	*$17*	*$17*	*$14*	*$15*	*$14*
	Thin-layer capping	*0*	*$10*	*$10*	*$10*	*$10*	*$10*	*$10*
Total Sediments		**918,000**	**$310**	**$640**	**$595**	**$368**	**$427**	**$374**
Floodplain	**SED 9/FP 4 MOD (direct contact)**	**80,000**	**$25**	**$63**	**$55**	**$30**	**$35**	**$31**
Long-Term Monitoring (10-year program)			$3.5	$3.5	$3.5	$3.5	$3.5	$3.5
TOTAL (w/o EPA oversight)		**998,000**	**$339**	**$707**	**$653**	**$402**	**$465**	**$409**
EPA Oversight			**$25**	**$25**	**$25**	**$25**	**$25**	**$25**
TOTAL		**998,000**	**$364**	**$732**	**$678**	**$427**	**$490**	**$434**

Notes:

1. Up-front costs (including transport and disposal of access road/staging area material) have been adjusted for 2014 dollars with a 2.5% assumed inflation factor.
2. TD 1 costs are based on assumed transport by truck of TSCA material to EQ's Wayne disposal facility in Belleville, MI, and non-TSCA material to ADS Greentree Landfill in Kersey, PA, along with per-ton unit costs provided by those facilities based on truck transport.
3. TD 1 RR costs are based on assumed transport by rail of TSCA and non-TSCA materials to EQ's Wayne disposal facility in Belleville, MI, along with per-ton unit costs provided by that facility (or estimated from facility's quote) based on rail transport.
4. TD 3 costs assume that leachate is trucked to GE's Building 64G treatment plant. If leachate is treated on-site at the disposal facility, the total estimated costs for each TD alternative would be reduced by approximately $2 million.

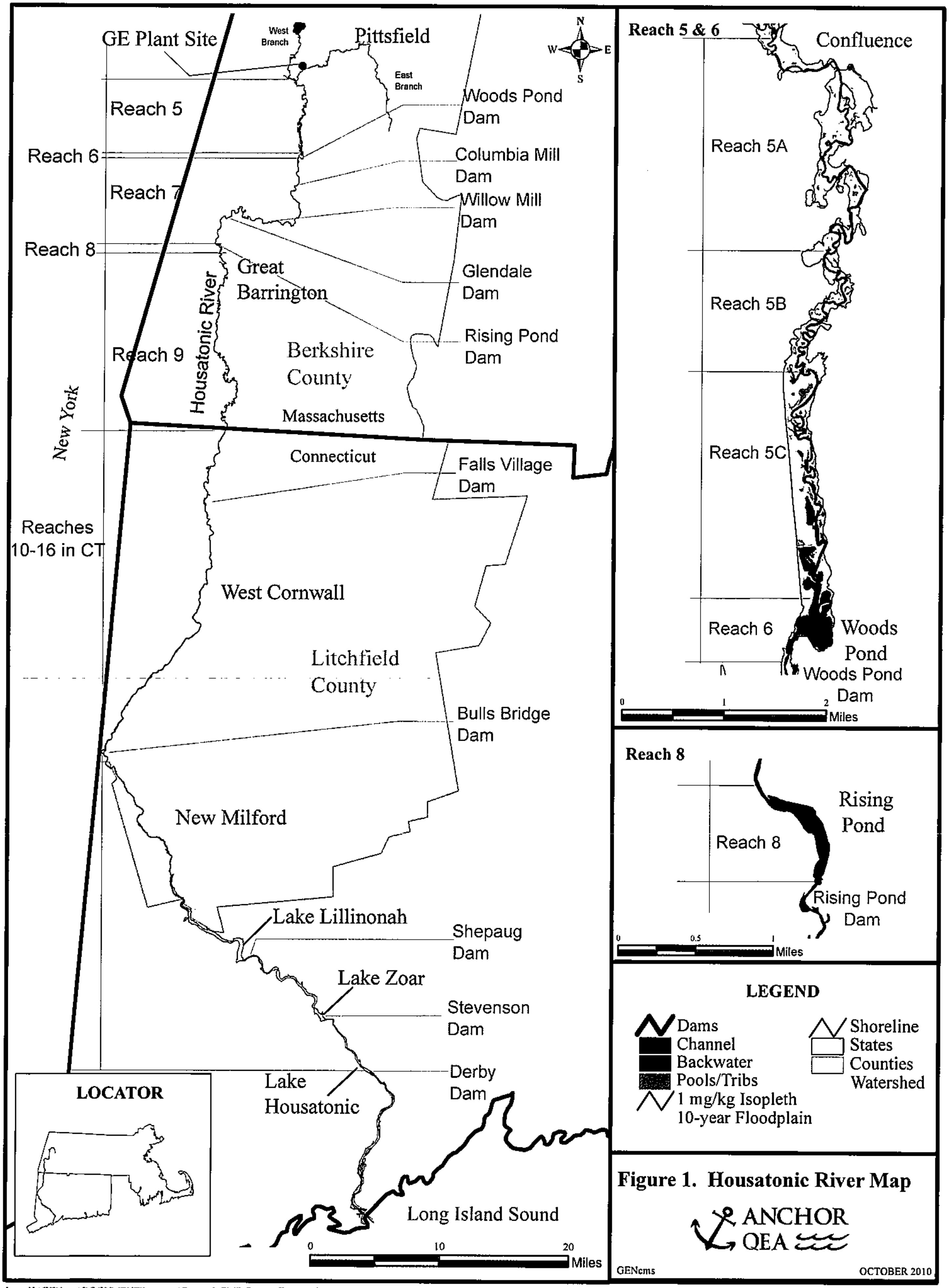

Figure 1. Housatonic River Map

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LEGEND:
-950- EXISTING INDEX ELEVATION CONTOUR
945 EXISTING INTERMEDIATE ELEVATION CONTOUR
500 YEAR FLOODPLAIN
APPROXIMATE PROPERTY LINE
APPROXIMATE LIMIT OF OPERATIONAL AREA
APPROXIMATE LIMIT OF LANDFILL CONSOLIDATION AREA
NHESP PRIORITY HABITATS OF RARE SPECIES (2010)
OPEN FIELD
HIGH GRADIENT STREAM
OPEN WATER
RED OAK-SUGAR MAPLE TRANSITION FOREST
SHRUB SWAMP
DISTURBED UPLAND
PALUSTRINE FOREST
UPLAND FOREST
WET MEADOW/EMERGENT MARSH
QUARRY PIT UNDER WATER
WOODLAND ROAD
WILLOW HILL ROAD
VALLEY STREET
CRYSTAL STREET
SAND AND GRAVEL QUARRY
GRAPHIC SCALE
NOTES:
1. EXISTING BASE MAP IS COMPOSED OF GIS DATA FROM MASS GIS AND INFORMATION FROM SK DESIGN, INC. DRAWING "SKETCH PLAN OF APPROXIMATE PROPERTY" DATED AUGUST 27, 2008 (REVISED ON OCTOBER 17, 2008).
2. BOUNDARIES OF AREAS IDENTIFIED AS QUARRY PIT UNDER WATER ARE BASED ON GOOGLE EARTH IMAGERY DATED MAY 10, 2014.
GENERAL ELECTRIC COMPANY
PITTSFIELD, MASSACHUSETTS
WOODS POND SITE FACILITY FOR 1M CY DISPOSAL VOLUME
ARCADIS
FIGURE
2
CITY: SYRACUSE, NY DIV/GROUP: ENVCAD DB: K. DAVIS, K.SARTORI LD: K. DAVIS PIC: P. KEANEY PM: D. KNUTSEN TM: G. GREAPENTROG LYR: ON=*;OFF=*REF* PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 10/17/2014 9:47 AM BY: POSENAUER, LISA
LAYOUT: 2 SAVED: 9/15/2014 10:43 AM ACADVER: 18.1S (LMS TECH)
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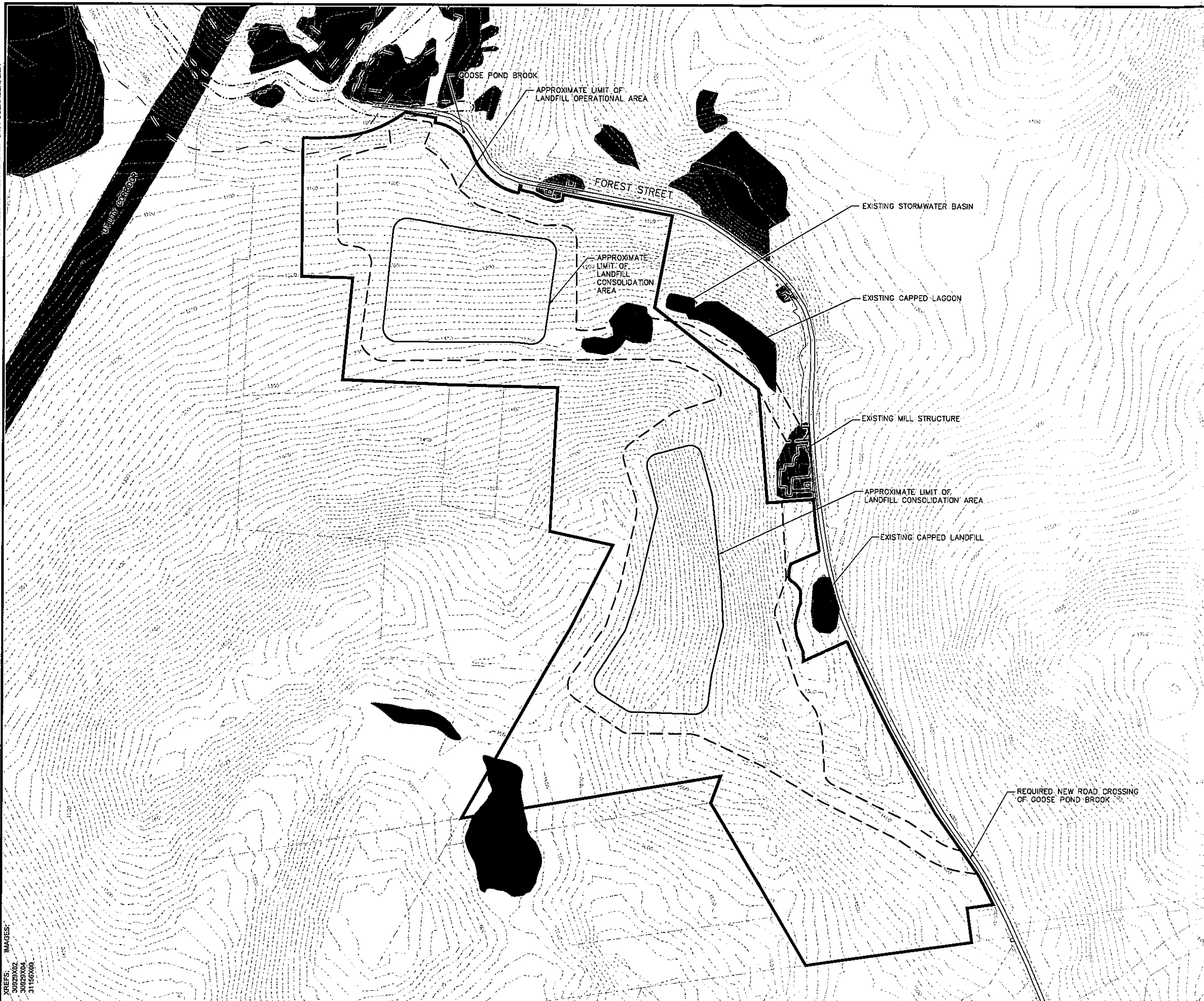


LEGEND:

- – – 950 – – – EXISTING INDEX ELEVATION CONTOUR
- - - - 945 - - - - EXISTING INTERMEDIATE ELEVATION CONTOUR
- 500 YEAR FLOODPLAIN
- APPROXIMATE PROPERTY LINE
- APPROXIMATE LIMIT OF OPERATIONAL AREA
- APPROXIMATE LIMIT OF LANDFILL CONSOLIDATION AREA
- NHESP PRIORITY HABITATS OF RARE SPECIES (2008) (SEE NOTE 2)
- OPEN FIELD
- OPEN WATER
- DISTURBED UPLAND
- PALUSTRINE FOREST
- UPLAND FOREST

NOTE:

1. EXISTING BASE MAP IS COMPOSED OF GIS DATA FROM MASS GIS AND FIELD SURVEY INFORMATION.
2. 2010 NHESP PRIORITY HABITATS OF RARE SPECIES MAPPING IS NOT AVAILABLE FOR THE AREA SHOWN ON THIS FIGURE.

0 300' 600'
GRAPHIC SCALE

GENERAL ELECTRIC COMPANY
PITTSFIELD, MASSACHUSETTS

FOREST STREET SITE FACILITY FOR 1M CY DISPOSAL VOLUME

ARCADIS

FIGURE 3

CITY: SYRACUSE, NY DIV/GROUP: ENVCAD DB: K. DAVIS, K.SARTORI LD: K. DAVIS PIC: P. KEANEY PM: D. KNUTSEN TM: G. GREAPENTROG PLOTTED: 10/17/2014 9:46 AM BY: POSENAUER, LISA

LEGEND:

- EXISTING INDEX ELEVATION CONTOUR (950)
- EXISTING INTERMEDIATE ELEVATION CONTOUR (945)
- 500 YEAR FLOODPLAIN
- APPROXIMATE PROPERTY LINE
- APPROXIMATE LIMIT OF LANDFILL OPERATIONAL AREA
- APPROXIMATE LIMIT OF LANDFILL CONSOLIDATION AREA
- NHESP PRIORITY HABITATS OF RARE SPECIES (2010)
- AGRICULTURAL FIELD
- OPEN FIELD
- OPEN WATER
- DISTURBED UPLAND
- PALUSTRINE FOREST
- UPLAND FOREST
- WET MEADOW/EMERGENT MARSH
- EXISTING ACCESS ROAD (APPROXIMATE)

NOTES:

1. EXISTING BASE MAP IS COMPOSED OF GIS DATA FROM MASS GIS, UPDATED BASED ON REVIEW OF 2014 AERIAL IMAGERY.
2. EXISTING ACCESS ROAD APPROXIMATED BASED ON REVIEW OF 2014 AERIAL IMAGERY.

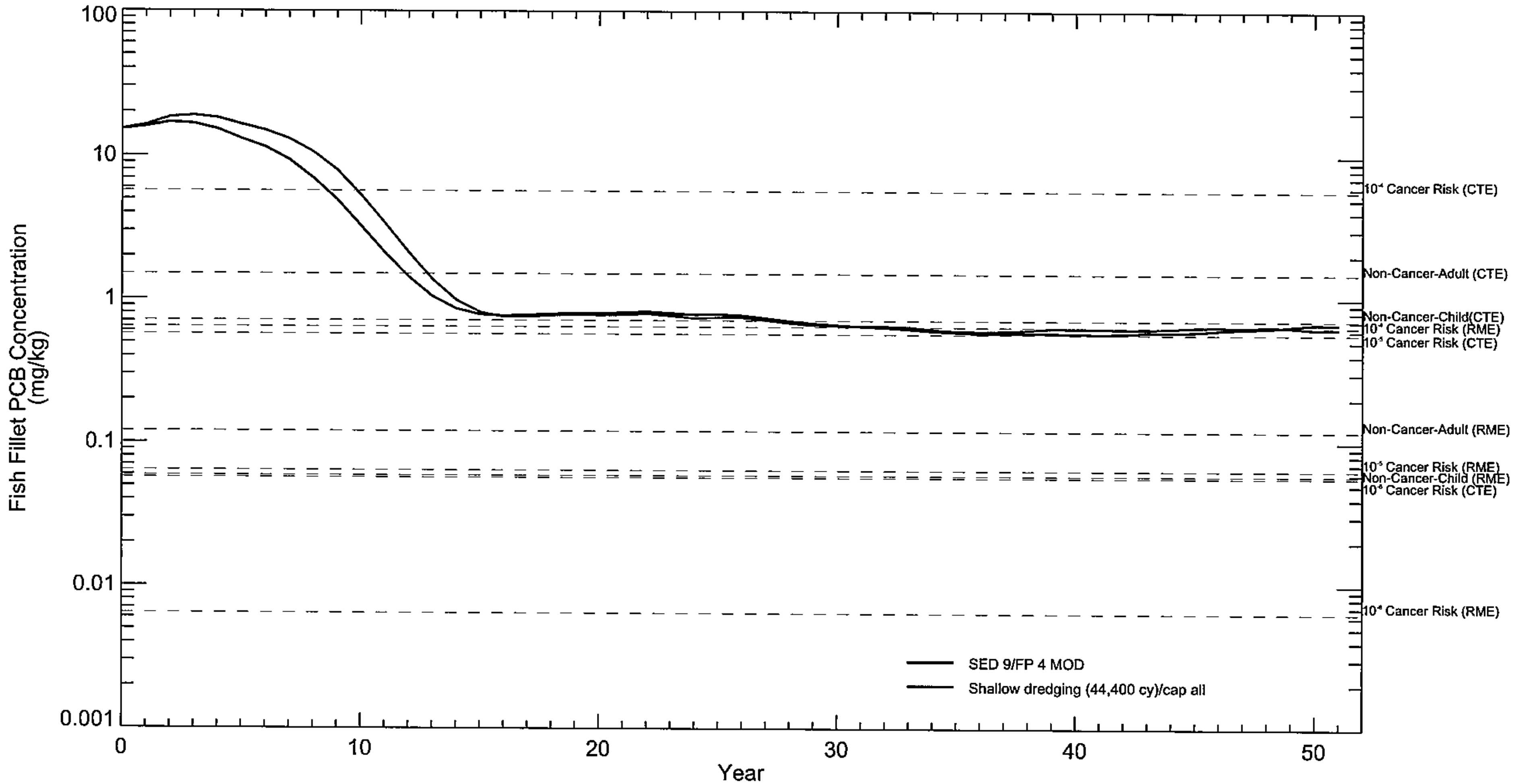
0 300' 600'
GRAPHIC SCALE

GENERAL ELECTRIC COMPANY
PITTSFIELD, MASSACHUSETTS

RISING POND SITE FACILITY FOR 1M CY DISPOSAL VOLUME

ARCADIS

FIGURE 4



Model runs:PR_EPA222, PR_EPA220

Figure 8a

Average Fillet PCB Concentrations in Largemouth Bass from Woods Pond

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.
Horizontal lines represent fish consumption (probabilistic) IMPGs.

ANCHOR QEA

DR - \\helios\aq\D_Drive\Projects\GE\Housatonic_CMS(GENcms)\MODEL\FDCHN\Analysis\Time_Series\Programs\Projection\CMS_Alternatives\EPA_SED9MOD\cms_alternatives_overlay_WP_alts_COMPARE.pro
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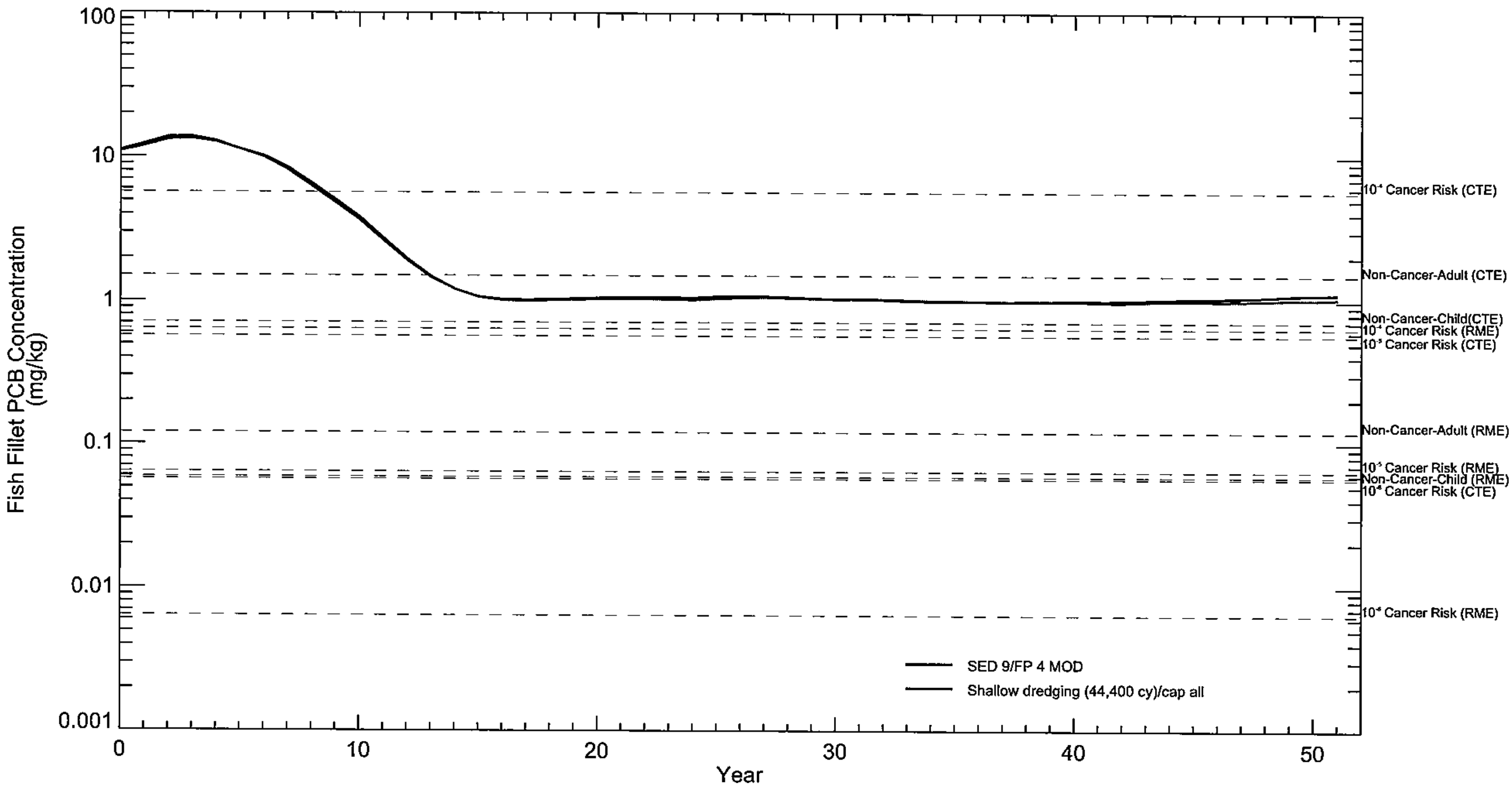

Model runs:PR_EPA230, PR_EPA228

Figure 8b

Average Fillet PCB Concentrations in Largemouth Bass from Reach 7B

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. Horizontal lines represent fish consumption (probabilistic) IMPGs.

ANCHOR QEA

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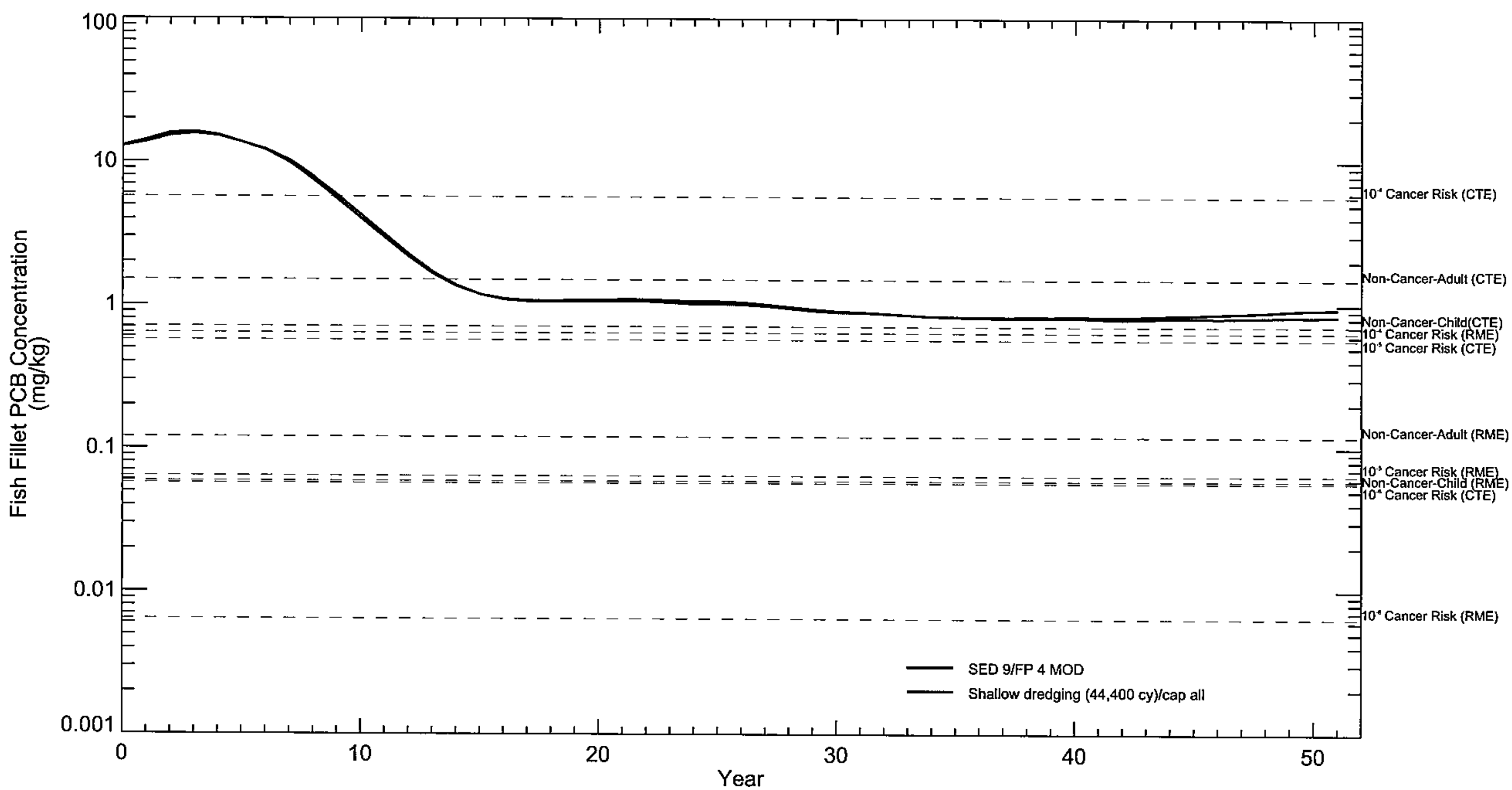

Model runs:PR_EPA230, PR_EPA228

Figure 8c

Average Fillet PCB Concentrations in Largemouth Bass from Reach 7C

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. Horizontal lines represent fish consumption (probabilistic) IMPGs.

ANCHOR QEA

DR - \\helios\aq\D_Drive\Projects\GE\Housatonic_CMS(GENcms)\MODEL\FDCHN\Analysis\Time_Series\Programs\Projection\CMS_Alternatives\EPA_SED9MOD\cms_alternatives_overlay_WP_alts_COMPARE.pro
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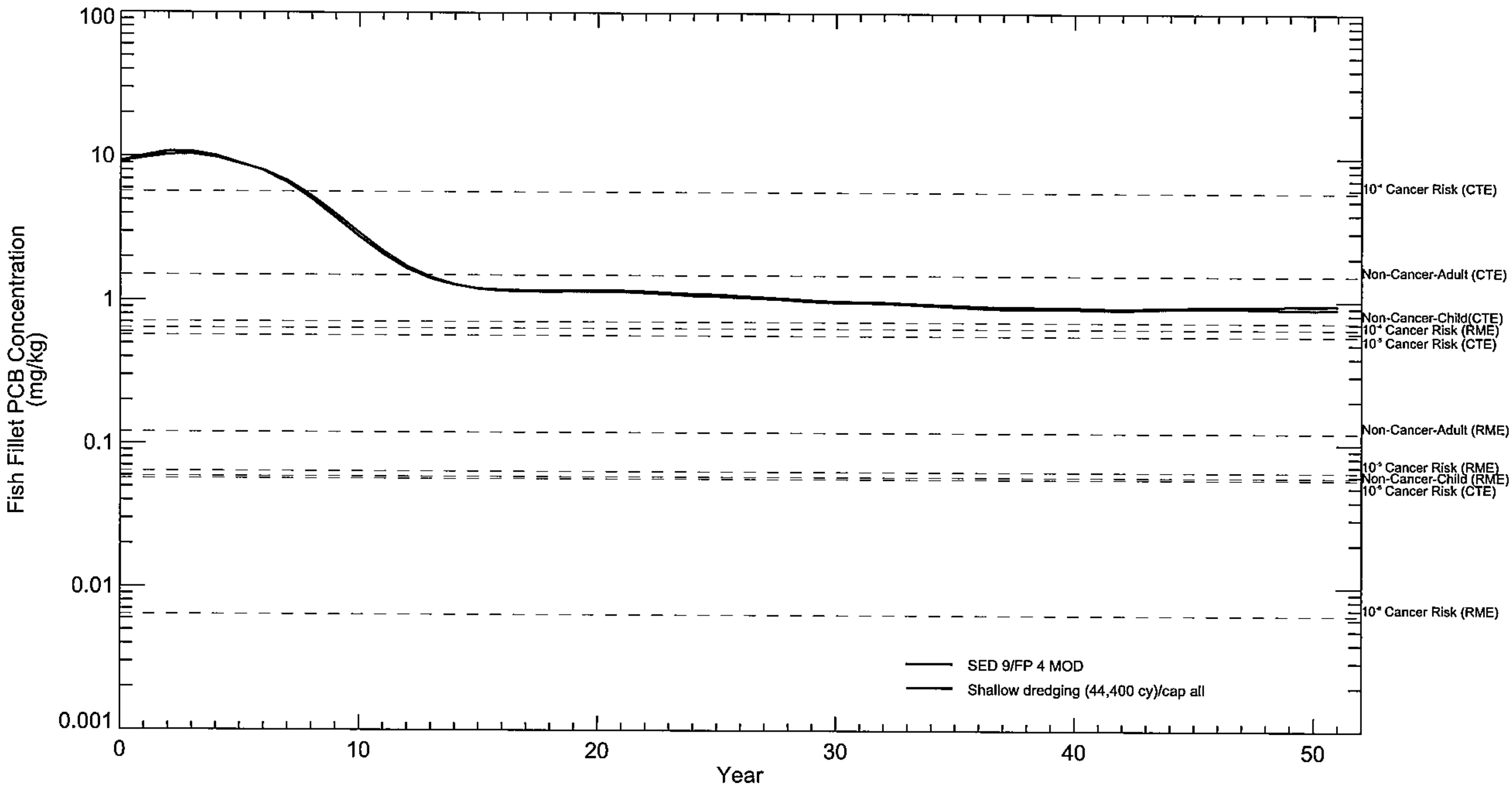

Model runs:PR_EPA230, PR_EPA228

Figure 8d

Average Fillet PCB Concentrations in Largemouth Bass from Reach 7E

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.
Horizontal lines represent fish consumption (probabilistic) IMPGs.

ANCHOR QEA

DR - \\helios\aq\D_Drive\Projects\GE\Housatonic_CMS(GENcms)\MODEL\FDCHN\Analysis\Time_Series\Programs\Projection\CMS_Alternatives\EPA_SED9MOD\cms_alternatives_overlay_WP_alts_COMPARE.pro
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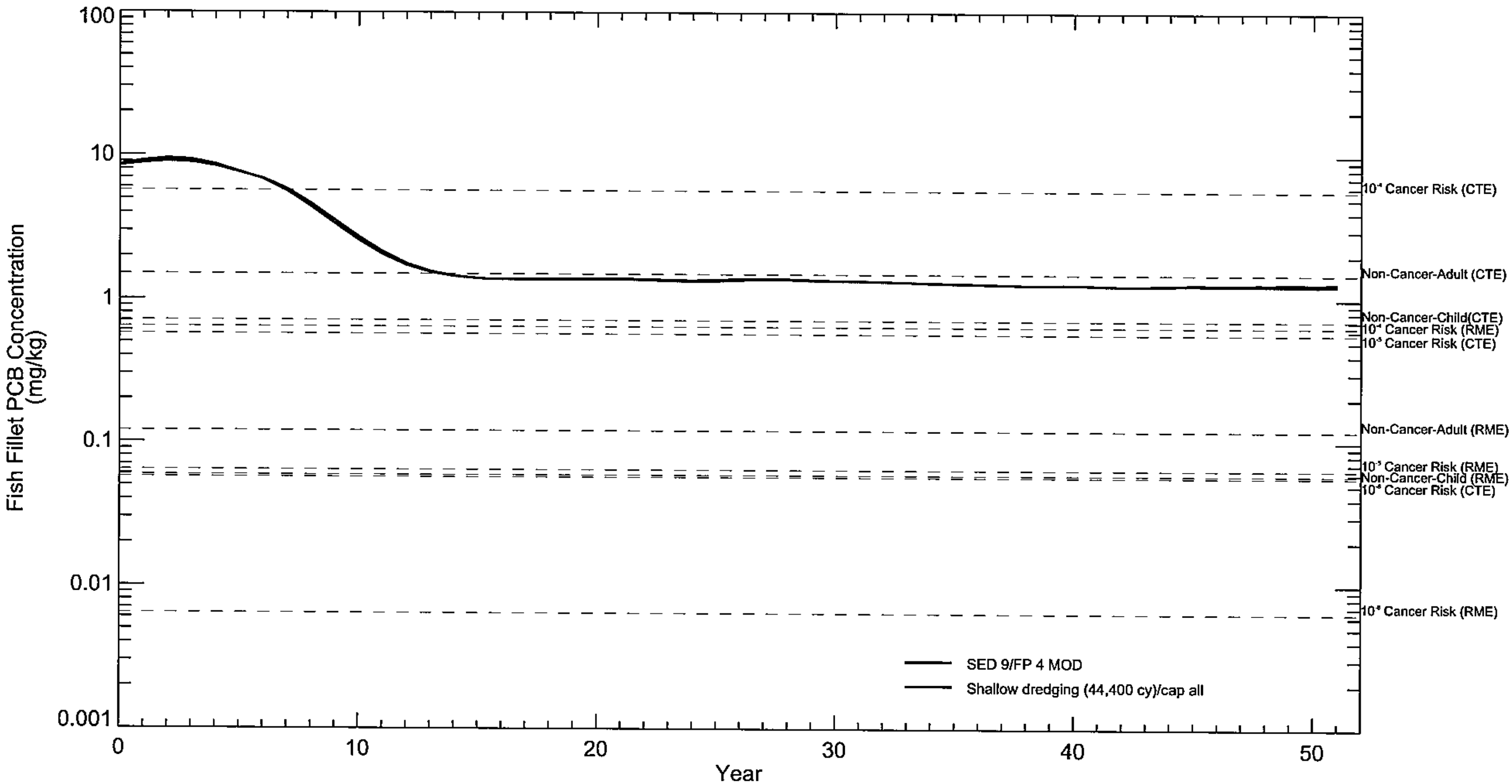

Model runs:PR_EPA230, PR_EPA228

Figure 8e

Average Fillet PCB Concentrations in Largemouth Bass from Reach 7G

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.
Horizontal lines represent fish consumption (probabilistic) IMPGs.

ANCHOR QEA

DR - \\helios\aq\D_Drive\Projects\GE\Housatonic_CMS(GENcms)\MODEL\FDCHN\Analysis\Time_Series\Programs\Projection\CMS_Alternatives\EPA_SED9MOD\cms_alternatives_overlay_WP_alts_COMPARE.pro
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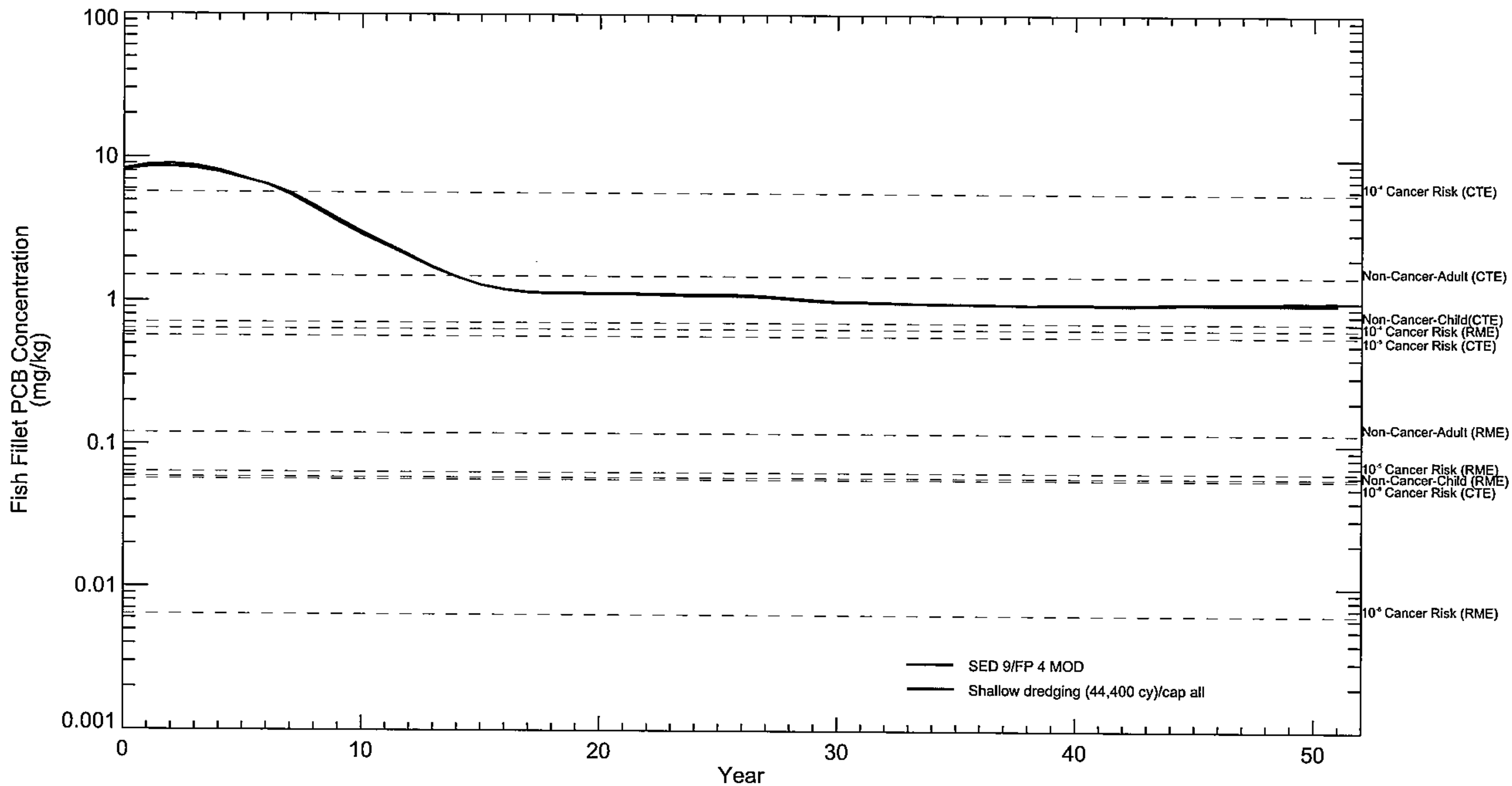

Model runs:PR_EPA230, PR_EPA228

Figure 8f

Average Fillet PCB Concentrations in Largemouth Bass from Rising Pond

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.
Horizontal lines represent fish consumption (probabilistic) IMPGs.

ANCHOR QEA

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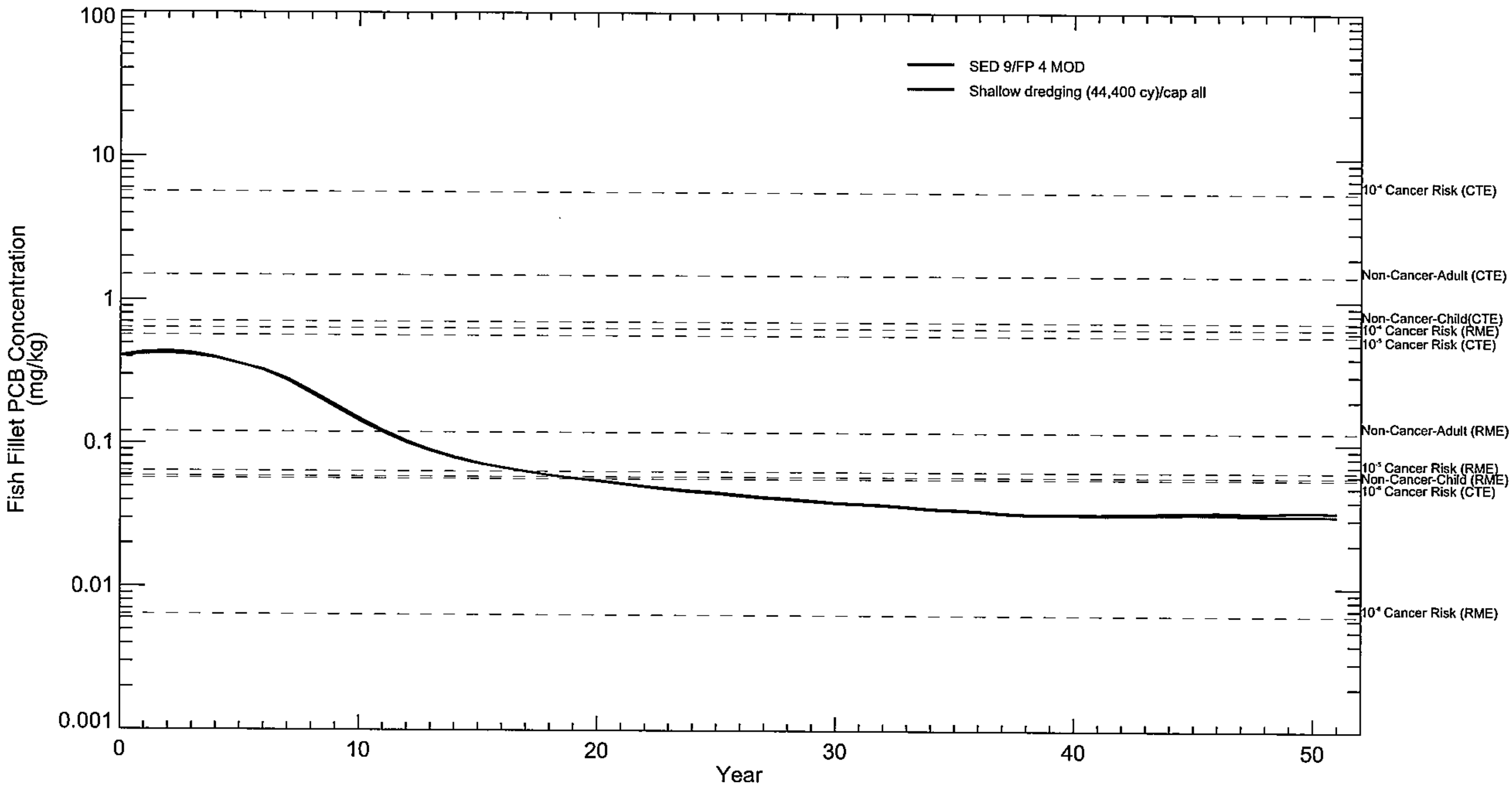

Model runs:PR_EPA238, PR_EPA236

Figure 8g

Average Fillet PCB Concentrations in Largemouth Bass from Bulls Bridge

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.
Horizontal lines represent fish consumption (probabilistic) IMPGs.

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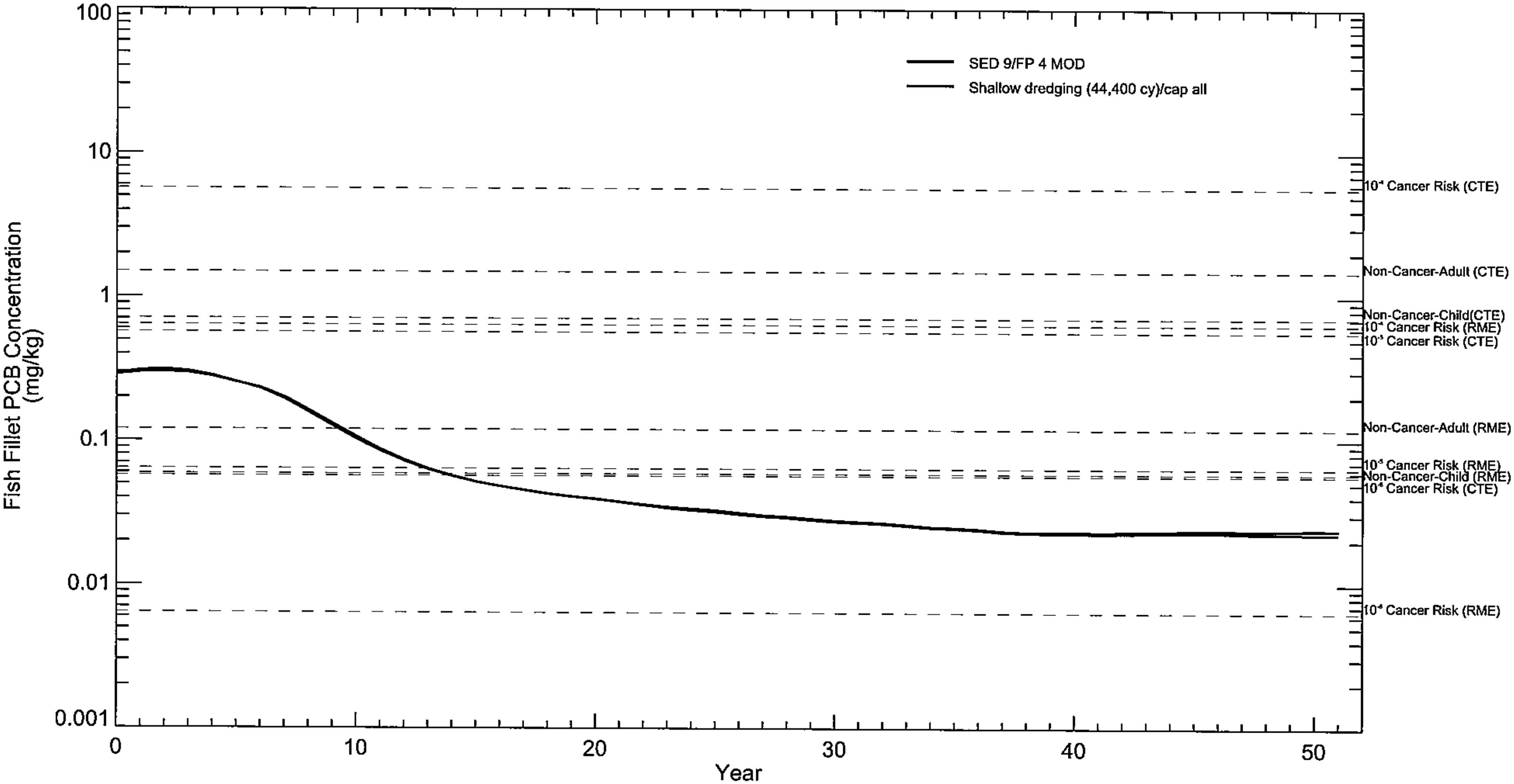

Model runs:PR_EPA238, PR_EPA236

Figure 8h

Average Fillet PCB Concentrations in Largemouth Bass from Lake Lillinonah

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.
Horizontal lines represent fish consumption (probabilistic) IMPGs.

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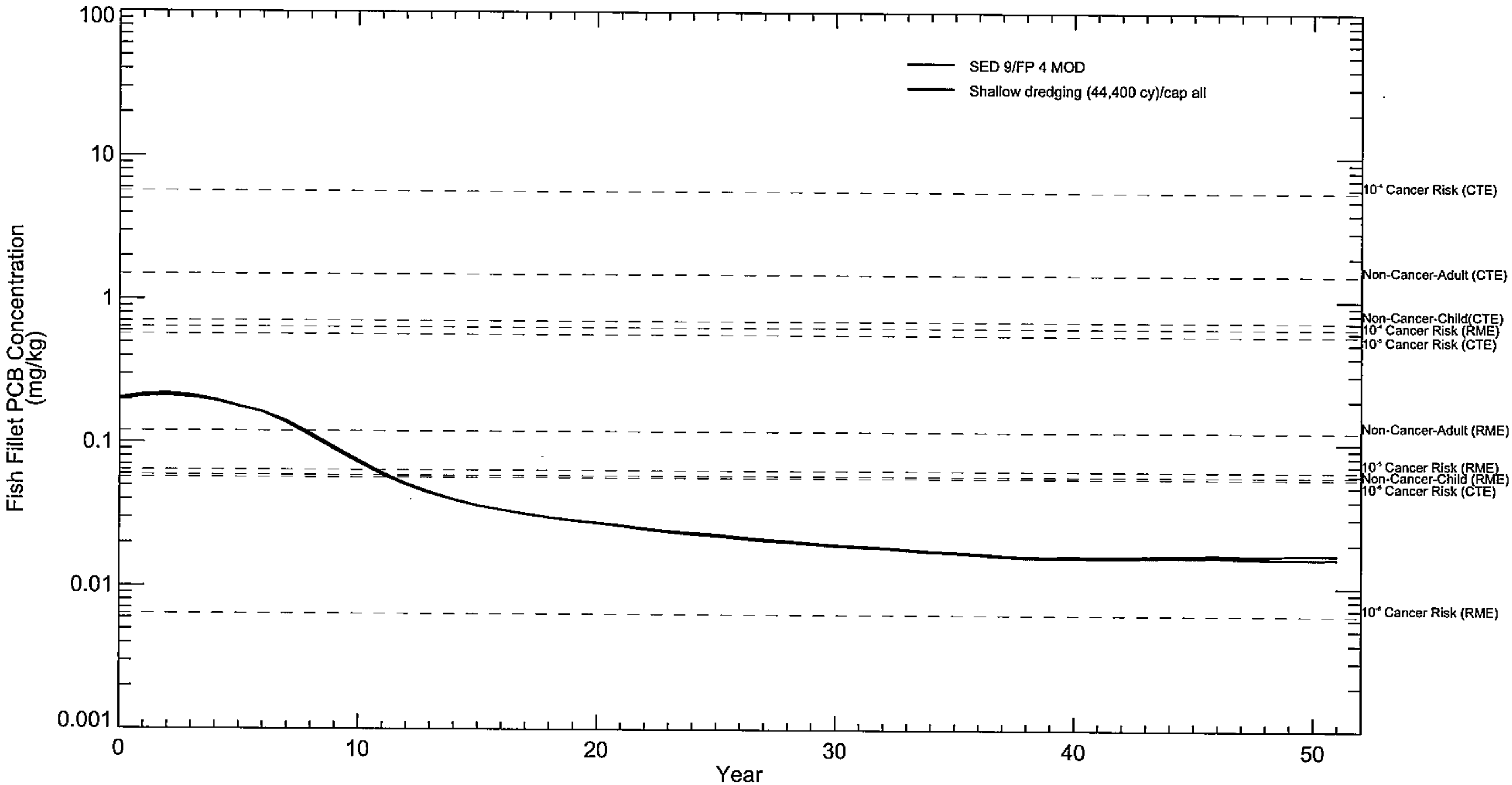

Model runs:PR_EPA238, PR_EPA236

Figure 8i

Average Fillet PCB Concentrations in Largemouth Bass from Lake Zoar

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. Horizontal lines represent fish consumption (probabilistic) IMPGs.

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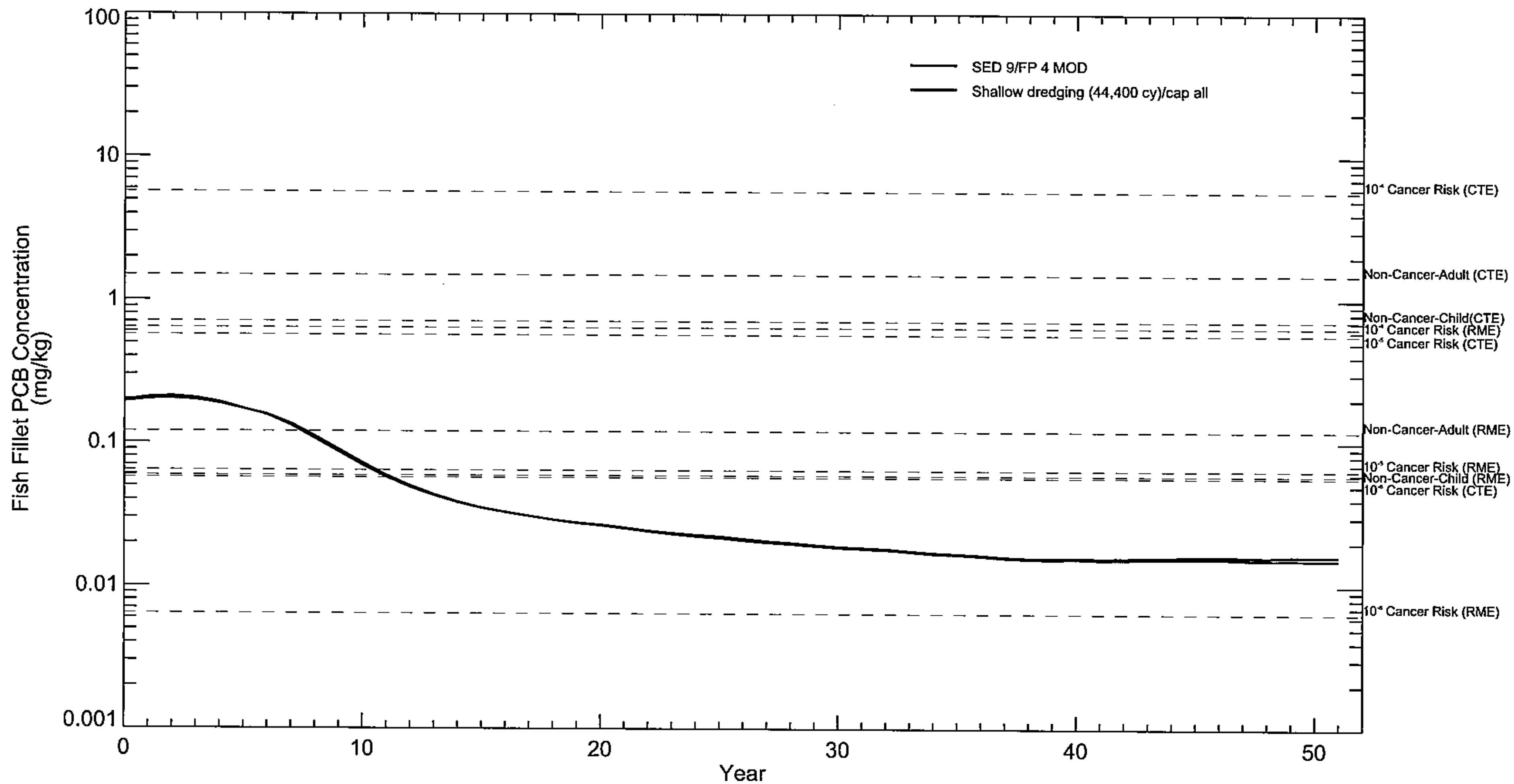

Model runs:PR_EPA238, PR_EPA236

Figure 8j

Average Fillet PCB Concentrations in Largemouth Bass from Lake Housatonic

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.
Horizontal lines represent fish consumption (probabilistic) IMPGs.

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ATTACHMENT C TO GE COMMENTS

ATTACHMENT C

ECOLOGICAL IMPACTS OF EPA'S PROPOSED REMEDY

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September 26, 2014

Table of Content

Executive Summary

EPA's proposed remedy for the Housatonic Rest of River, SED 9/FP 4 MOD, would involve the removal of close to one million cubic yards of sediment and soil, directly impacting over 400 acres of the Rest of River ecosystem, including approximately 370 acres of the stretch between the confluence of the East and West Branches of the River and Woods Pond Dam, known as the Primary Study Area (PSA). EPA concludes that this disruption will cause only short-term impacts because restoration will reliably reestablish the current ecosystem. In our paper entitled "A Scientific Response to EPA's Conclusion that Restoration of the Housatonic Rest of River Will Be Fully Effective and Reliable," we explain why this conclusion is not supported by the scientific literature. In this document, we describe the likely short-term and long-term impacts of SED 9/FP 4 MOD on each of the five key habitat types in the unique and diverse ecosystem of the PSA -- river and river banks, floodplains, impoundments, backwaters, and vernal pools. First, we address three overarching and unavoidable negative impacts of EPA's proposed remedy:

Ecological Impacts

The **integrity of the overall river-floodplain ecosystem** of the PSA will be compromised for two key reasons. First, remediation activities, including the construction of the access roads and staging areas necessary to support those activities, will cause extensive fragmentation of what is currently a fairly broad, nearly continuous ribbon of native vegetation, thus severing a forested "wildlife corridor" that extends along the Housatonic River, and also across the Housatonic River valley, between the intact forested hills that lie east and west. Second, there will be substantial "edge effects" that extend beyond the footprint of remediation, including sediment deposition, changes in microclimate, noise, and the invasion of exotic plants and animals. These effects will greatly increase the area negatively impacted by the remediation activities to the point that most of the PSA ecosystem will be degraded. These edge effects (other than noise) will continue long after SED 9/FP 4 MOD activities are completed.

Because of the profound soil disturbance that is unavoidable with SED 9/ FP 4 MOD, controlling the onslaught of invasive exotic plant species and restoring the current suite of native plant species in the PSA will be essentially impossible.

Two **temporal aspects** of SED 9/ FP 4 MOD are of significant concern. First, given the numerous animal and plant species that would be affected by SED 9/FP 4 MOD, each with its individual life cycle and growing season, there is no season in which construction work would not have a significant direct adverse impact on some species and the habitats to which they and other species would return in return in a different season. Second, the proposed duration of remediation in Reaches 5A through 5C – just 8 years – is far too short to allow any recovery of one area before an adjacent area is disrupted. In particular, within just 8 years, large silver maples will be replaced with saplings that will take at least 50 years to reach tree height, and probably well over 100 years for the development of full-size crowns and boles necessary to provide the full range of habitat values currently provided for wildlife.

Where **river channels** are targeted for remediation, aquatic macroinvertebrates and fish will be eliminated during the period of remediation. Impacts on the hyporheic zone (surface and groundwater interactions in the river substrate) will likely disrupt discharges of groundwater into the river in a way that cannot be repaired. Fish breeding sites will be eliminated. The time within which new breeding sites will be established, and for what species, is uncertain. Populations of stream and wetland insects and crustaceans, mussels, dragonflies and damselflies, and aquatic vascular plants, will be at least severely depleted for years to come, and perhaps eliminated for the foreseeable future. With important prey species like these depleted, the numbers of predators (e.g., pickerel, otter, kingfisher) – which are present now – will also decline precipitously. Regardless of the bank stabilization techniques selected (including bioengineering techniques), implementation of bank remediation and stabilization activities in Reaches 5A and 5B would permanently change the character of the **riverbanks** with major negative impacts on the river channel and current riverbank habitat in these subreaches.

Floodplains would be severely impacted by SED 9/FP 4 MOD, especially through the loss of mature floodplain forest. The infeasibility of locating a comparable source of soil to mimic current conditions in the floodplain make the re-establishment of the affected forested floodplain communities very unlikely. In general, restoration of shrub and shallow emergent wetland communities is expected to be more straightforward than restoring forested floodplain communities. However, at the scale of SED 9/FP 4 MOD there are numerous constraints that could adversely affect the recovery of even those wetland communities.

The restoration of **impoundments** and **backwaters** is more likely than that of all of the other habitats in the PSA ecosystem because excavation and capping procedures are more predictable. However the potential for colonization of invasive exotics is high (as evidenced by the current onslaught of these species in Woods Pond). Whether and how soon the current vegetation, invertebrate, and fish communities of the impoundments will recolonize them are uncertain.

Up to 43 of the 66 **vernal pools** in the PSA would be excavated with direct long-term impacts, including long-lasting changes in the hydrology of the vernal pools (which is extremely difficult to reproduce), in soil conditions in the pools (due to the inability of replacement soils to match the characteristics of the existing vernal pool soils), and in the vegetative characteristics of the pools (due to the loss of the complex and mature vegetative composition of the adjacent forest). There is also a high probability that invasive or other undesirable plant species and animal predators (such as green frogs, bullfrogs, and invertebrates) would invade pools where they did not previously exist. These alterations would, in all likelihood, result in the loss of obligate vernal pool species from most of these pools. The re-creation of the pre-remediation conditions in these vernal pools and their associated forested habitat is essentially impossible.

In **conclusion,** any remediation in the PSA should be weighed against the enduring loss of habitats and their associated animal and plant populations in the PSA. Where remediation activities occur, these animal and plant communities will be diminished for at least many years, in many instances 50 to 100 years or more, and in some instances even longer because there will be insufficient refugia for the native species that one would hope to return to the PSA after the remediation is completed. This will cause severe ecological consequences. Furthermore, the ecosystem integrity of the river and its associated floodplains will be seriously compromised by the fragmentation intrinsic to the proposed remediation activities, especially because their ecological impact will extend well beyond the footprint of remediation.

1.0 Introduction

SED 9/FP 4 MOD would involve the removal of close to one million cubic yards of sediment and soil, directly impacting approximately 370 acres of the PSA ecosystem. The impacts of disruption of this magnitude were specifically identified in the Revised Corrective Measures Study (hereafter referred to as "Revised CMS") on which we collaborated between 2008 and 2010. The Revised CMS also evaluated the extent to which these negative impacts could be mitigated and the inevitable long-term adverse impacts of work despite such mitigation. In the face of these detailed site-specific evaluations, EPA's Comparative Analysis for the Rest of River (May 2014) (hereafter, "Comparative

Analysis") concludes that any negative impacts of SED 9/FP 4 MOD, or any remedial alternative evaluated in the Revised CMS, can be quickly and effectively reversed. That conclusion ignores the Revised CMS, additional site-specific evaluations done by the Commonwealth of Massachusetts, and the "significant body of knowledge with respect to ecosystem restoration" to which EPA refers and which we discuss in detail in "A Scientific Response to EPA's Conclusion that Restoration of the Housatonic Rest of River Will Be Fully Effective and Reliable" (hereafter, "Restoration Response").

In fact, as discussed in Section 6.3.5.2 of the Revised CMS, there is no precedent for a remedial project of the ecological scope and spatial scale of SED 9/FP 4 MOD in an ecosystem like the PSA, a long and sinuous riparian corridor of diverse and ecologically sensitive habitats harboring numerous state-listed rare, threatened, endangered, and special concern species. SED 9/FP 4 MOD would involve substantial disturbances of that diverse and ecologically sensitive ecosystem.

Contrary to EPA's suggestion that "*restoration is expected to be fully effective and reliable in returning these habitats, including vernal pool habitat to their pre-remediation state*" (Comparative Analysis, page 26), there are significant constraints on the ability to re-establish the pre-remediation conditions and functions of the affected habitats. Any restoration attempted after a project of the nature and scope of SED 9/FP 4 MOD would not be fully effective or reliable in returning these habitats to their pre-remediation ecological condition. The best one could hope for is that these efforts would be partly effective at returning some types of habitat to a semblance of their pre-remediation state after an extended period. Larger combinations of sediment and soil removal like SED 9/FP 4 MOD would have a much greater negative impact on the PSA ecosystem than other combinations like SED 10/FP 9, the ecologically sensitive approach, or the alternative proposed by the Commonwealth of Massachusetts.

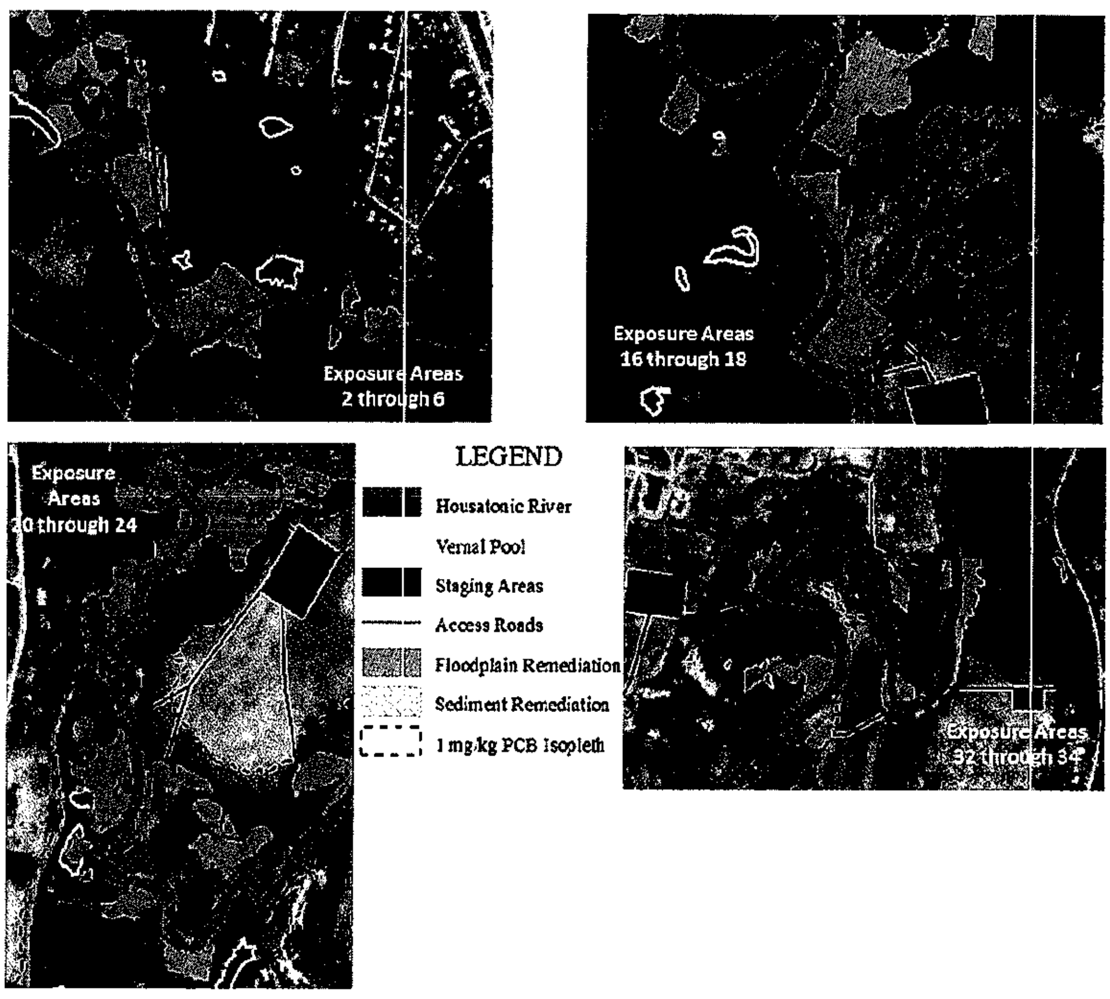
Most of this document is devoted to a habitat by habitat response to EPA's conclusions about SED 9/FP 4 MOD in the Comparative Analysis, but we begin by addressing three overarching issues that are pertinent to the overall PSA ecosystem.

1.1 Integrity of the Entire System

EPA's Comparative Analysis states: "*To fully restore the functions and values of a river and floodplain, the basis of a river restoration must embrace a whole systems approach. The goal of this whole systems approach is a fully functioning ecosystem that maintains the connection between the river and its unique, diverse and vital floodplain features.*" (Page 6 of Attachment 12 of the Comparative Analysis)

We could not agree more with the core concept embodied in this statement, the importance of thinking about the integrity of the whole ecosystem. However, SED 9/ FP 4 MOD ignores this critically important concept, and therefore will fragment the PSA as a whole ecosystem. The negative effects of ecosystem fragmentation are well documented, and the patterns of landscape-scale fragmentation are quite evident if you examine aerial photographs of the Housatonic Valley. Briefly, the surrounding hills are reasonably intact but most of the lowlands are in an advanced state of fragmentation. A key, critical exception exists along the PSA, a fairly broad ribbon of native vegetation through the lowlands, extending downstream from the confluence of the East and West Branches in Pittsfield . It has been narrowly dissected by roads in a few places but remains remarkably intact. However, this would not be the case after the remediation proposed by EPA. There will be extensive perforation of the vegetation in Reaches 5A and 5B (i.e., numerous patches cleared of what is currently unbroken vegetation), and in some places SED 9/FP 4 MOD will sever the linear forested riparian corridor of the PSA, such as in and near Exposure Areas (EAs) 2-6, 16-18, 20-24, and 32-34 (Fig. 1). Indeed, in three of these places (all but EA 16-18), the proposed remediation reaches laterally across almost the whole PSA. The estimated total of 45 acres of floodplain that would be disrupted by SED 9/FP 4 MOD (see page 34 of the Comparative Analysis) may seem modest, but the locations of these areas are critically important given the narrowness of the riparian corridor in those areas. More importantly, EPA's estimates do not include the extensive area of access roads and staging areas, and related clearing that will be required in connection with the excavation of soil in these areas.

Fig. 1. Areas where SED 9/FP 4 MOD would adversely impact the ecological connectivity of the PSA.



Furthermore, "edge effects" will cause significant negative impacts in areas extending beyond the footprint of the actual remediation work. These impacts will include potential increases in erosion and sedimentation, the spread of invasive exotic plant and animal species, changes in microclimate, and noise from construction and traffic that can disturb sensitive bird and mammal species. Exactly how far those edge effects reach could vary considerably. Some effects such as microclimate changes are usually measured in tens of meters but movement of invasive plants and animals may reach hundreds of meters (Laurance et al. 2002). If we look at the full impact of SED 9/FP 4 MOD, using 100 meters as a reasonable estimate of the lateral extent of edge effects, it is apparent that almost the entire PSA is likely to be affected (Fig. 2). These estimates likely understate the negative impacts of SED 9/FP 4 MOD because they do not include the substantial edge effects related to more than 3.5 miles of bank stabilization. Because banks are linear, they are particularly extensive sources of edge effects. Furthermore, despite EPA's stated goal of protecting what it has designated as Core Area 1 habitat (owing to its importance as habitat for immobile state-listed species), it is proposing the devegetation and excavation of areas within 100 meters around those areas. As depicted in Figure 3, the 100-meter wide area around Core Area 1 habitat should also be protected as a buffer because of the edge-effect phenomenon. Finally, it is noteworthy that all of these edge effects except for noise generated by remediation activities will persist long after the remediation work is complete, indefinitely in the case of invasive species that become established.

In short, the ecosystem integrity of the river and its associated floodplains will be seriously compromised by the fragmentation intrinsic to SED 9/FP 4 MOD, especially because the negative ecological impacts will extend well beyond the footprint of remediation.

Fig. 2. The cross-hatched area represents the extent of a 100-m wide edge effect zone around the areas in which EPA proposes remediation (and related access roads and staging areas) in Reaches 5A and 5B.

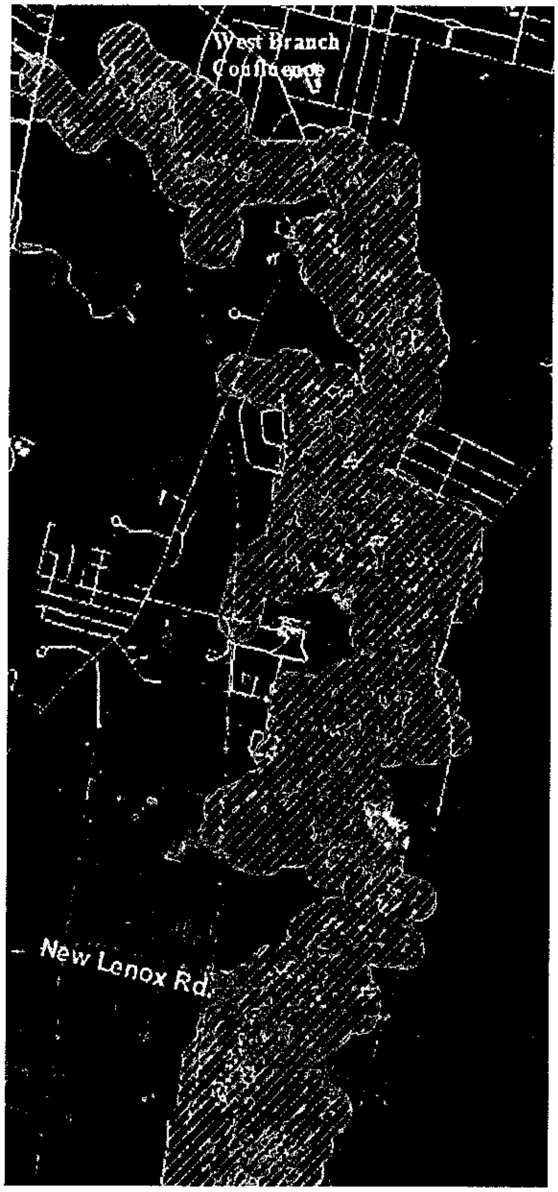
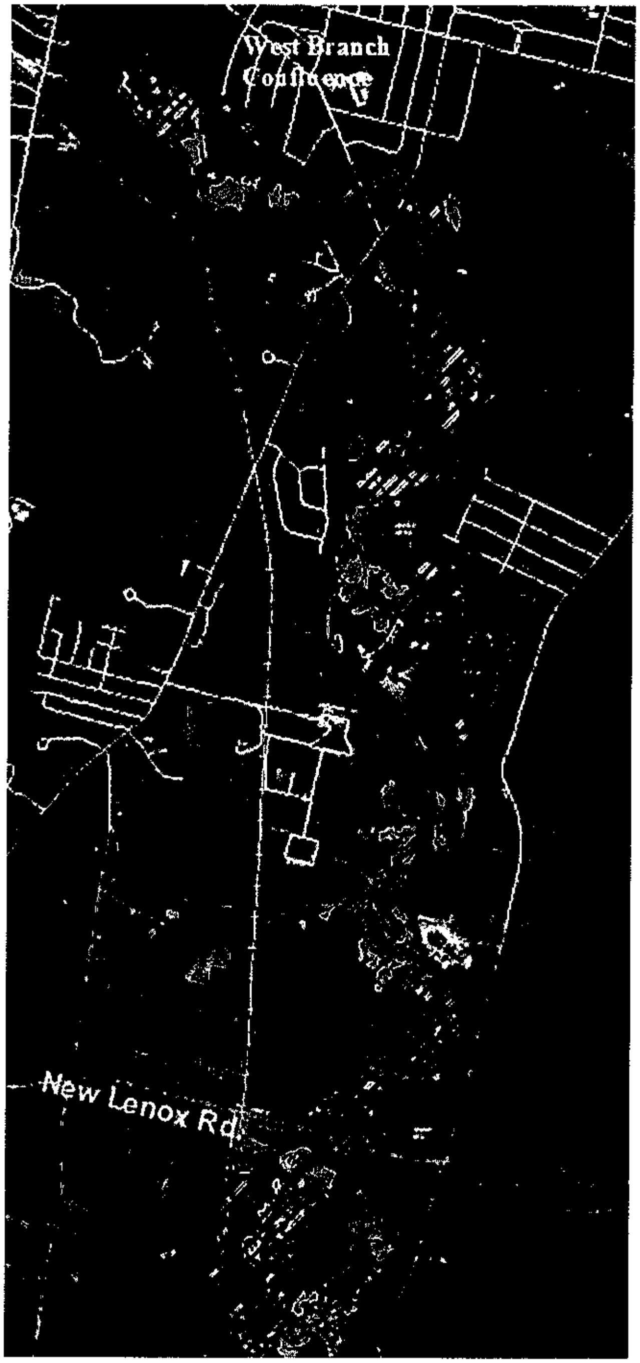


Fig. 3. The red-hatched area represents the area that falls within 100 m of a Core Area 1 and should be protected as a buffer zone because of edge effects.



1.2 Native Flora vs. Invasive Exotics

There is a world of difference between making a site green and restoring some semblance of the native flora, the suite of plant species indigenous to a particular environment, as is discussed in Section 2.6.6 of the Restoration Response document.

The low success rate for reintroducing native plants increases the risk that the PSA will be overrun by invasive exotic plant species. Invasive exotic plants are already present in the PSA, with 18 problematic species identified, and SED 9/FP 4 MOD will most likely increase the extent of their coverage. Invasive exotics will outcompete the native species currently present in the PSA because of the extensive areas of exposed soil (both backfill and new sediments), less competition from natives removed during remediation, and more sunlight following forest canopy removal (a factor relevant to both aquatic and terrestrial species). Furthermore, roads, staging areas, and the movement of vehicles and soil will all increase invasions of propagules of invasive exotics. EPA implies that controlling invasive exotics is straightforward, but this is not the case. One analysis (Kettenring and Adams 2011) examined 335 research papers covering control of 110 invasive exotic plant species and reported: "*Regardless of control method, our meta-analysis revealed that few studies produced gains in native plant cover, density or biomass*." They also warned about the negative ecosystem impacts of invasive control: "*Herbicide was the most commonly implemented and, according to our meta-analysis, the most effective control method for reducing invasives. However, native species response to herbicide was highly variable, probably because this broad-scale approach can hinder native species establishment through seed limitation*." In fact, there can be unintended consequences of using particular techniques to control invasive exotics (see Skurski et al. 2013).

In summary, devegetating an ecosystem makes it practically impossible to restore even a reasonable semblance of the previous flora because both reintroducing native species and controlling invasive exotic species are extremely difficult tasks.

1.3 Temporal Issues: Seasons and Duration

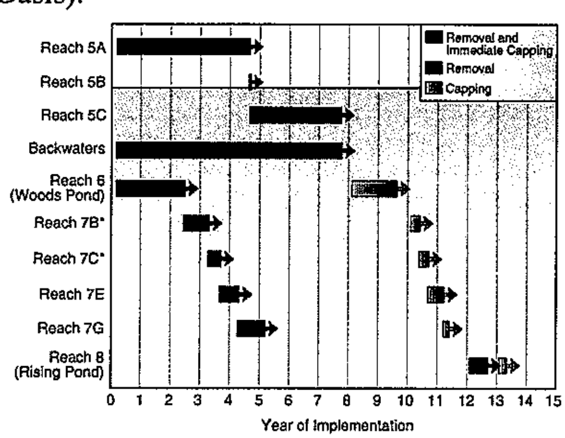
1.3.1 Work seasons: As is discussed in Section 5.2.3 of the Revised CMS, given the numerous animal and plant species that would be affected by SED 9/FP 4 MOD, with their individual life cycles and growing seasons, there is no way that the remedial construction work could be timed to prevent direct adverse impacts to all species. For example, sediment removal and/or capping could be scheduled to avoid working in the river during the breeding or emergence season for one generation of animals, such as dragonflies, mayflies, and possibly spawning fish (typically late spring and summer), but this approach would not avoid all adverse effects because the impacts would last well beyond the immediate construction season, affecting breeding and emergence in subsequent seasons. Similarly, for animals with high site fidelity, such as the American bittern, even if remediation work occurred only during periods when they are not present, only direct mortality would be avoided. The habitats would be negatively impacted for multiple years.

In most cases, loss of habitat equates to loss of populations, with subsequent negative impacts to food webs within the ecosystem.

With specific reference to plant species, there is no time of year that would avoid adverse impacts, since even winter removal activities would affect either the plants themselves (at least their underground roots and rhizomes) or their seed banks or both. Similarly, winter work would adversely affect the species that often spend the winter on the river bottom, such as the wood turtle or larvae of dragonflies. In short, there would be no time of the year in which remedial construction activities would not cause adverse impacts to many plant and animal species. Although a few temporal strategies could reduce the harm to some degree, the adverse impacts of SED 9/FP 4 MOD would still be significant.

1.3.2 Duration: Some remedial activities would have adverse effects that last many years, not just multiple seasons. For example, contrary to EPA's unsubstantiated suggestion, riverbank stabilization would result in the complete elimination of mature overhanging trees from the stabilized banks to prevent the destabilizing effect of large trees. Furthermore, the remediation proposed in Reaches 5A, 5B, 5C, and their associated backwaters is scheduled to be completed in just 8 years (Fig. 4). This means that extensive areas will be simultaneously denuded of their natural vegetation. This is of particular concern where the dominant vegetation is large silver maples. These trees are currently tall enough to support canopy-dwelling birds, have crowns wide enough to shade the river and backwaters, and have trunks old enough to provide dens for cavity-dwelling mammals and birds and to become large woody debris in the river. However, if SED 9/FP 4 MOD is implemented, these mature forests will, within just 8 years, be replaced with saplings that will take at least 50 years to reach tree height, and probably well over 100 years to develop full-size crowns and boles. Furthermore, where banks are stabilized, large trees will be removed and prevented from returning for the foreseeable future (see Section 2.2.2 below), which will affect the distance between the forest and the river in those areas for as long as the stabilized banks are maintained. EPA suggests that an Adaptive Management framework will be employed in the implementation of SED 9/FP 4 MOD but overlooks the fact that such a framework would require much more time than EPA proposes, especially when dealing with slow ecological processes like the growth and succession of vegetation.

Fig. 4. EPA's estimated timeline for cleanup activities (Fig. 5 from EPA's Statement of Basis).



2.0 River and Riverbanks

2.1 Context: River Channel and Riverbanks

SED 9/FP 4 MOD would directly impact 126 acres of aquatic riverine habitat and at least 3.5 miles of riverbank (in Reach 5A alone). This extensive disturbance to the PSA with its current high level of biodiversity and productivity will severely degrade this highly functioning ecosystem, resulting in the loss of valued riverine habitats and decreased plant and animal species diversity.

The riverbanks in Reaches 5A, 5B, and 5C are an integral part of the overall riverine ecosystem and provide a variety of habitat functions for a range of wildlife species. Exposed vertical banks and undercut banks are most prevalent in Reach 5A, less so in Reach 5B. These steep, primarily forested banks provide similar wildlife functions in both reaches. Mature overhanging trees are present in portions of these reaches, particularly in the upstream portions, where they offer shaded microhabitats within the river and foraging and perching sites for piscivorous and insectivorous birds. In the downstream portions of Reach 5B and in Reach 5C, where the banks are well vegetated with a shrub-dominated mix with some trees and herbaceous growth, the banks provide foraging habitat for a variety of amphibians, reptiles, birds, and mammals. The fate of the river channel and riverbanks are closely linked because they are structurally and functionally dependent upon each other. Impacts on both components will be considered together in this section.

2.2 Impact of Remediation on River Channel and Riverbanks

2.2.1 Impacts to the river channel. The dredging and/or capping of substrates and sediments in the river channel would cause a change in surface substrate type from present conditions (sand, sand and gravel, or silt) to an undetermined mix of textures, including armor stone. Because adjacent riverbanks will be disturbed simultaneously, the characteristics and stability of the river channel and associated riverbanks will be highly altered for extensive reaches of the PSA. When attempting to remove and replace the substrate of the entire river bottom for remediated reaches, the adjacent riverbanks will necessarily be affected, likely becoming unstable during construction, causing slumping and erosion of sediment into the river. If, as EPA proposes, riverbanks are remediated to remove contaminated sediments, and then structurally stabilized to reduce erosion and disallow meandering of the river, their ecological characteristics will be severely altered. In most reaches, the outcome will be lower slopes, use of stabilizing construction techniques at the base of the riverbank, such as riprap, and planting of herbaceous plants and shrubs. The resultant ecological character of the riverbanks will be quite different from the types of banks found in the current riverine system, to the detriment of plant and animal species that require them for habitat. For example, wood turtle, muskrat, beaver, river otter, belted kingfisher, bank swallows, and many dragonflies and damselflies will be negatively affected. Mature trees will be purposefully excluded, resulting in reduced shade, increased water temperature, and loss of woody habitat for cavity-nesting birds, cavity-denning mammals, and birds that hunt from perches, such as kingfishers and flycatchers. The dynamic movement of the river channel within the floodplain will be significantly curtailed causing unknown outcomes as the hydraulics of the river try to reach equilibrium.

The sediment removal and/or capping would remove or bury the existing aquatic vegetation and benthic invertebrates, and displace the fish. The substrate will be dependent on deposition from upstream to begin its recovery, but the timeframe for that process is uncertain. While some recolonization would occur, primarily by drift from upstream reaches of the river, it would be slow, taking years to decades. Of concern is that much of the Housatonic River upstream of the PSA is quite urbanized, meaning less diverse source populations will be available for recolonization downstream. It is likely that common and invasive species would arrive first, particularly those tolerant of changes in substrate materials. Less tolerant sensitive and rare species may never recolonize reaches where removal of the original substrate or riverbanks is extensive over long sections. SED 9/FP 4 MOD would destroy 126 acres of aquatic riverine habitat. Thus, aquatic communities are unlikely to match the pre-remediation communities in terms of composition, species richness, and relative abundance of species (e.g., Tullos et al. 2009, Sundermann et al. 2011).

Removal and replacement of substrate will adversely affect groundwater processes that are critical to both vertebrates and invertebrates. In particular, groundwater provides a base flow to a river during times of reduced surface flows. Groundwater flows also create a hyporheic zone in the riverbed where invertebrate and fish larvae can flourish. Disturbance of these discharge pathways by dredging, capping, and bank remediation will adversely affect groundwater-dependent habitats and flow patterns, and also destabilize the base of riverbanks, resulting in bank slumping and further erosion (e.g., Hester and Gooseff 2010). For small sections of riffles, there is evidence that if substrate is properly constructed, a functioning hyporheic zone can be restored (Kasahara and Hill 2006), but the restoration of this zone at a scale of miles of riverbed is highly uncertain. Under SEP 9/FP 4 MOD, much of Reach 5A will be directly destroyed by direct remediation of riverbed and riverbanks. Those reaches not remediated will be isolated from intact riverine habitats and/or become highly disturbed due to construction activities above and below their location. Where bank remediation is conducted in sections of Reach 5B, those sections will suffer similar fates. Figures 1 and 2 show the extensive fragmentation generated by the road and staging area system required to access the areas that would be remediated.

In areas in which bank stabilization will purportedly be avoided, riverbanks composed of silts and sands are likely to become unstable when the river channel is excavated and bank-stabilizing vegetation is removed. This will have a long-term (many decades, possibly centuries) effect on large trees along the destabilized riverbanks that provide significant shade and woody debris to the aquatic ecosystem. To be more specific, woody debris provides cover and substrate that is important to many aquatic and semi-aquatic species, and shading limits water temperature increases. In the absence of this shade, aquatic plant growth and water temperature would likely increase and change the suitability of the habitat for temperature-sensitive species. This loss of cover would also result in a loss of wind protection, as well as decreased amounts of large woody debris and overall organic material. When riparian trees are removed from a previously closed-canopy stream, the underlying energy regime may change from allochthonous resources to an autocthonous one driven by primary production, and this may shift the stream further away from the desired ecological state, often toward algae-dominated streambeds (Sudduth et al. 2011). When combined with excess sediments (likely during bed and bank remediation), desirable periphyton (forming the base level of aquatic food webs) and benthic invertebrate communities can be severely depressed. Figure 1 identifies examples of places where, under SED 9/FP 4 MOD, the riverine corridor will be fragmented by removal of native vegetation, especially mature trees in the floodplain and along riverbanks, which will have all of these adverse effects.

It is likely that the disturbed areas would be colonized by invasive exotic plants or algae, which are impractical to control in a flowing river and thus are likely to dominate over the native vascular plants. Exotic invasives are already present in small patches within the ecosystem, and thus, can colonize and spread rapidly into new reaches. Kettenring and Adams (2011), in their review of the literature on plantings for restoration projects, have shown that there are serious limitations on our ability to control and/or manage invasive plants, particularly for large projects. This will further reduce any chances of restoring the existing communities and habitats.

2.2.2 Impacts to riverbanks. Under SED 9/FP 4 MOD, more than 3.5 miles of the riverbanks in the PSA would be subject to bank stabilization, with removal of bank soil where necessary as part of the stabilization. The types of bank stabilization activities that would be implemented are described in Appendix G to the Revised CMS. These activities would cause numerous significant adverse impacts on the riverbank habitat.

The bank stabilization activities would require removal of riverbank vegetation and woody debris from the riverbanks, as well as the cutting back and reshaping of banks and removal of bank soil in many locations. Contrary to EPA's hopeful suggestion (Comparative Analysis, pages 29-30), this would result in the loss of large mature trees alongside, overhanging, and adjacent to the river in the areas subject to stabilization, leading to an open canopy, sparsely vegetated terrestrial community adjacent to the river. The nearest mature trees would be located roughly 30 feet from the river since such trees would be removed from the banks to facilitate implementation of the remediation/stabilization and to avoid subsequent destabilization of the banks. This would also remove key habitat elements for the birds that currently use these large trees as perching or cavity nesting sites (such as wood ducks, woodpeckers, kingfishers, and owls and other raptors), the dragonflies (including five species of state-listed clubtails and two other state-listed species of dragonflies) that use these trees for perching and resting during their adult stage, and the reptiles and mammals that use the living and dead woody vegetation for shelter, resting, and basking (e.g., the state-listed wood turtle, salamanders, frogs and toads, and various small mammals). The removal of native vegetation on the riverbanks will also increase the likelihood of the spread of invasive exotic plant species.

The stabilization of the riverbanks would also, by design, have a direct and material impact on two of the current geomorphic processes that have allowed for the existing heterogeneous mix of riverbank types, including vertical and cut banks. These processes are bank erosion and lateral channel migration. The proposed bank stabilization measures are intended to prevent significant bank erosion over the long term (e.g., Eubanks and Meadows 2002). To do so, the stabilization measures would be designed to basically lock the existing channel in a stable state or geometry. Thus, if successful, these measures would prevent the processes of significant bank erosion and lateral channel migration from continuing, leading to the loss of the vertical and undercut banks: an impact entirely ignored by EPA in the Comparative Analysis. This would result in the direct elimination of habitat for a number of riparian species that utilize the banks. Of particular concern is the loss of nesting sites for belted kingfishers and bank swallows, which build nest burrows in vertical banks. These species are known to return to these nest burrows over multiple years, demonstrating very strong site fidelity, but would find the stabilized banks no longer suitable for nesting. Similarly, the state-listed wood turtle uses overhanging banks for cover and overwintering, and also has strong site fidelity to specific riverbanks. This species would lose critical habitats for those activities.

The implementation of bank stabilization techniques would cause other adverse impacts on the local wildlife as well. For example, slides, burrows, and dens of mammals such as muskrat and beaver would be removed from the banks. Unavoidable changes in riverbank slope, composition, and vegetation would impede safe movement between terrestrial and aquatic habitats required by a number of amphibian, reptile, and mammal species (such as leopard frogs, wood turtles, snapping turtles, beaver, and mink), as well as large mammals (such as deer and black bear) trying to drink from or cross the river during low water periods.

These impacts would not be "temporary" as EPA suggests (Comparative Analysis, page 30), because the proposed remediation techniques are explicitly designed to stabilize banks and keep the river channel from meandering to and fro in the floodplain. Under SED 9/FP 4 MOD, the remediated banks would remain suboptimal habitat for decades, and possibly longer, for many of the current species that use them.

The bank stabilization would also curtail or eliminate wildlife corridors in Reaches 5A and 5B for resident and migratory species that move along the banks during migration or dispersal. With riparian banks altered (at least 3.5 miles of bank in Reach 5A alone), species moving either along the riverbank edge or through the riparian cover at the tops of banks would lose travel and migratory corridors. Stabilized banks would force species into suboptimal habitat (where they would be subject to increased predation) or eliminate these sections as dispersal and migratory corridors. Daily use, dispersal, and migratory movements by species that require relatively natural habitats are fostered by having vegetation connectivity among their required resource patches (e.g., breeding, foraging, resting, and wintering sites). Migratory and resident raptors, such as broad-winged hawk, red-shouldered hawk, sharp-shinned hawk, Cooper's hawk, will be forced to seek habitat elsewhere – when few suitable habitats exist. Wide-ranging species (coyote, gray and red foxes, bald eagle), some preferring interior forested habitats (fisher, bobcat, black bear), all detected within the PSA, would be required to seek alternate travel corridors where few exist, with a likely increase in mortality (roadkills). Carnivores that are dependent on natural riparian habitats (river otter, mink) would have no opportunity to go elsewhere.

As clearly shown in Figure 1, especially near EAs 16-18 and 20-24, connectivity between aquatic habitats, including backwaters, floodplain depressions, and vernal pools, and adjacent upland areas, would be disrupted. This would impact virtually every animal and plant species in the affected reaches of the river and adjacent areas.

2.3 Potential for Restoration of River Channels and Riverbanks

In project after project, the scientific evidence is clear that restoration of structural components of the riverine ecosystem (i.e., channel form, substrate, physical habitat) does not translate to restoration of biological diversity, especially in the benthos (Jahnig et al. 2010, Palmer et al. 2010, Louhi et al. 2011). Recent review papers of river restoration, summarized in our Restoration Response document (e.g., Bernhardt and Palmer 2011, Palmer et al. 2014, Palmer et al. in press), have cautioned that expectations of success in river restoration projects are not supported by the scientific evidence or available case studies. Contrary to EPA's suggestions, our reviews have found no precedent for a stream restoration project on this scale in which a highly functioning aquatic ecosystem is first dismantled and then an attempt to replace the same habitat types has been successful. Thus, it is highly unlikely that, following the implementation of EPA's proposal, the PSA could be restored to its current high level of biodiversity and productivity.

2.4 Summary for River Channels and Riverbanks

What is of great concern for the Housatonic Rest of River is the area of river channel and length of riverbanks designated for remediation. Given the magnitude of SED 9/FP 4 MOD, the negative impacts – change in substrate, loss of shade, increasing temperatures, loss of critical breeding, resting, and overwintering habitats – will cause significant changes to the PSA, damaging the ecological integrity of this valued system.

Regardless of the bank stabilization techniques selected (including bioengineering techniques), implementation of bank remediation and stabilization activities would change the character of the banks and have major negative impacts on the river channel and riverbank habitats in the upper portions of the PSA. As a result of these impacts, the stabilized river channel and riverbanks would not return to their current condition or level of function, despite restoration efforts.

3.0 Floodplains

3.1 Context: Floodplains

As discussed in the Revised CMS, a remedial alternative of the magnitude of SED 9/FP 4 MOD would cause severe ecological harm. The most significant and unavoidable impact on the floodplains of SED 9/FP 4 MOD would be the unavoidable loss of mature trees. Removing soils in the remediation work areas, and building the necessary access roads and staging areas to conduct the remediation, will devastate floodplain forests for decades to come. The proposed work in the floodplain is extensive (approximately 50 acres) and excavating floodplain soils creates severe ecological risk for both resident and migrant species that use the floodplain habitats. Floodplain soils develop from complex interactions between river flooding regimes and adjoining floodplains. The resultant soils provide substrate for soil organisms, burrowing vertebrates, and, of course, vegetation that forms the vertical structure of the forest. There is no way to acquire or create soils with equivalent parameters in the amounts that would be necessary to replace the soil that would be excavated in the course of SED 9/FP 4 MOD. With up to 21 species of state concern using all or portion of these habitats in the PSA, the potential for serious loss of biodiversity is very real. The area excavated will be severely altered, and there will also be significant negative edge effects in an even wider area (Fig. 2). The majority of the affected floodplain areas are forested (36 acres), which is the primary topic of concern discussed below. Floodplain areas with shrub and shallow emergent wetlands (14 acres) also will be impacted, and are considered in Section 3.2.4.

3.2 Impact of Remediation on Floodplains and Potential for Restoration

3.2.1 Soils: Excavating floodplain soils to a depth of one foot or three feet, as proposed by EPA, requires removal of all floodplain vegetation and at least one foot of soil. The upper layers of soil near the surface usually are those that have high organic matter, plant propagules, and soil biota. These soils also provide burrowing habitat for fossorial species of mammals, amphibians, reptiles, and invertebrates. Floodplain soils, particularly if saturated, serve as over-wintering habitat for those species of amphibian or reptiles that hibernate. The proposed remediation will kill individuals of animal and plant species during the excavation process as soils are removed and transported elsewhere, and eliminate their habitats for years to centuries.

3.2.2 Hydrology: There are multiple sources of water that feed these floodplain ecosystems (e.g., groundwater slope seepage, groundwater discharge from seasonally high water tables in the floodplain, and overbank flooding of the river). While efforts could be made to reconstruct the pre-existing swale systems to approximate current drainage patterns, the potential is high for larger overbank floods to cause erosion and destabilization in recently restored areas of the floodplain. The surface topography of the floodplain reflects the influence of floodwater dynamics. Thus, recently excavated soils will be highly exposed to erosion and transport by heavy precipitation and/or floodwaters because it is not possible to revegetate them quickly enough to risk exposure to a significant storm event. Exposing large areas of soil has the potential to subject other unaltered habitats in the floodplain and river to severely damaging sedimentation. Overbank flooding and subsequent floodplain deposition and erosion from surface flow patterns, along with remnant meander scars and levee formation, produce distinct surface topographic and soil variations that then affect biological conditions.

Soil removal and the related removal of trees and coarse woody material would affect the distinct floodwater-influenced microtopography of the floodplain forest, reducing the floodplain roughness that produces flow resistance and thus contributes to the important flood flow alteration function of the floodplain. Reduction in roughness cannot be countered because the vegetative cover would become less dense due to floodplain clearing activities, and no amount of planting can counter the reduction in roughness. These conditions would result in faster flows during flood events, more erosion, and less infiltration. Reduced infiltration will likely reduce sustaining base flow to the river.

3.2.3 Loss of biological structure and diversity in forested wetlands. Many of the trees found within the floodplain in Reaches 5A and 5B are about 50 to 75 years in age, and the mature forests bordering Reach 5C and around Woods Pond are most likely 75 to 100 years old or older. In EA 2, for example, cottonwood and silver maple occur as multi-stemmed clumps (about 8 trees/acre), 12-36 inches in diameter at breast height (dbh), with complex root masses. A multi-aged forest produced over time will have a portion of large-diameter stems (> 15-inch dbh) suitable for producing cavities. Cavity-nesting birds (e.g., screech owls, wood ducks, and pileated woodpeckers) and mammals (flying squirrels, bats) that use tree cavities and the bark of old trees return to these nesting, resting, and feeding sites over multiple years. Loss of the mature forest trees along the riparian corridor would remove these critical breeding habitats, and thus, many individuals of these species.

In the best case, it will take 50 to 100 years for the mature forest to be reestablished. However, reestablishment could take even longer due to the cumulative stresses of floods, changes in microclimate, changes in hydrology and colonization by invasive species. During the period of at least 50 to 100 years until the mature forest is re-established (if that occurs at all), the tree canopy would be more subject to sunlight and wind impacts and there would be a reduction in large woody material. The decrease in availability of mature trees and forested habitat would reduce the capacity of the floodplain forest to support species dependent on such habitat, such as pileated woodpeckers, thrushes, a variety of warblers and owls, and mammals such as the fisher and bobcat. 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. Thus, EPA's conclusion regarding a "temporary loss" is inapplicable to these floodplain forests.

In fact, replicating the structure and composition of the existing floodplain forest is unlikely. Although it is feasible to replace emergent and shrub species within a few years with direct planting, replacing forested habitat is much more complex, as the successional trajectory for a forest is much different than that for emergent, herbaceous, or shrub communities. Through competition, forests go through a reduction in numbers of stems from seedlings (up to 3 feet tall, 5,000-10,000+ stems/acre) to saplings (3-10 feet tall, < 5 inches in diameter, 1,000-3,000 stems/acre) to pole stage after about 20-30 years (5-11 inches in diameter, 500-1,000 stems/acre) to mature trees (>11 inches in diameter, 100-200 stems/acre), usually occurring at more than 50 years after planting (Stoddard 1978). Moreover, forests often have uneven size/age classes, as does the forested floodplain in the PSA. Planting replacement trees in a cleared area all at the same time could not reproduce these characteristics. Thus, even under optimum conditions (i.e., with invasive exotic species kept under control, which is highly unlikely over large areas), the developing forest would be an even-aged community for more than 25 years, with minimal structural profile diversity and associated significant reduction in overall wildlife diversity.

The removal of trees would also result in the loss of woody material that provides structural wildlife habitat – i.e., for perching, basking, denning, nesting, cover, or escape habitat. While it is assumed that some of the coarse material left over from cut tree trunks could be re-used in the remediated floodplain for that purpose, conditions would not be the same as before remediation. Similarly, while some of this material could also be chipped and left on site as an organic amendment to the imported topsoil, it would not be a soil amendment that could mimic the natural and beneficial carbon:nitrogen ratio afforded by leaf litter. In addition, the tree removal would cause the loss of yearly leaf litter that is generated by the mature deciduous trees that populate the floodplain. Leaf litter on the floor of the floodplain forest is important as part of the food chain by affecting soil permeability, providing cover habitat for amphibians, reptiles, small mammals and invertebrates, and regulating soil temperatures and relative humidity. The loss of woody debris and leaf litter when the trees are cut and soils removed would place a severe constraint on efforts to restore forested floodplains for at least decades after remediation.

3.2.4 Impacts to shrub and shallow emergent wetlands. The main direct negative impact to shrub and shallow emergent wetlands from floodplain soil remediation would be from vegetation and soil removal. Vegetation clearing would cause substantial direct effects, as these wetlands provide: (1) nesting, burrowing, and/or escape habitat and food for birds, amphibians, reptiles, mammals, and invertebrates, including important nesting habitat for migratory neo-tropical songbirds and, in the emergent areas, nesting habitat for two state-listed bird species (American bittern – Endangered, and common moorhen – Special Concern, as of 9-7-14); (2) a significant yearly infusion of biomass, consisting of fallen leaves, decaying herbaceous plants, and woody material, which make up a significant component of the underlying organic layer and are part of the foundation of the food web of these ecosystems; and (3) an effective system for cycling and transforming nutrients, evapotranspiring significant quantities of water, and helping to attenuate flood flows by increasing vegetation roughness.

Shrub and shallow emergent wetlands typically contain soils with high organic content (typically mucky silt or histosols [organic soils]) that have formed over many decades. It is unlikely that sufficient volumes of comparable organic soils could be found for use in any restoration effort, and attempts to manufacture such soils are not reliable, since the soil chemistry and seed bank of the on-site soils are specific to the existing Housatonic River floodplain system. The use of heavy machinery in these areas would likely cause soil compaction, which would affect the permeability of these soils, which influences plant colonization (e.g., slows the process of recolonization by native species and makes surface soils more susceptible to proliferation of invasive exotics), as well as adversely affecting the groundwater recharge/discharge and flood flow alteration functions of the floodplain. Replacement soils would be less conducive to the formation of the necessary subterranean burrows required by certain animals for overwintering, hinder the re-establishment of a native plant community, and facilitate proliferation of invasive plant species. Soil compaction is particularly problematic in shallow emergent marshes. These wetland types contain soft, organic soils that are extremely difficult to work in with heavy machinery when wet – which is most, if not all, of the time – and very difficult to keep dewatered during construction. The likely result would be creation of wetlands that are not the same as those of the current ecosystem. The plant communities would be different, and they would be conducive to colonization by invasive exotics. These new marshes would become less suitable for the current community of wetland-dependent wildlife.

Due to the changes in hydrological conditions (as described above for the entire floodplain system), the vegetation currently present in the shrub and shallow emergent wetlands is likely to change. Species that can tolerate a broader range of conditions are likely to be more abundant than those species which require specific habitat conditions within shrub and shallow emergent wetlands. For example, the exotic species purple loosestrife might replace native buttonbush. These changes in vegetation would last until such time as soil and hydrological conditions comparable to pre-remediation conditions return to these wetlands so as to support a vegetative community similar to the pre-remediation community. Given the unpredictable and likely slow rate of organic soil accumulation, it could take a decade or more to reach conditions that would support shrub or emergent plant communities comparable to current communities. It is uncertain whether certain sensitive species, such as the state-listed species, would return.

The return of wildlife communities comparable to the pre-remediation communities in these shrub and emergent wetlands would depend on the return of soil, hydrological, and vegetative conditions. In the meantime, many common game and non-game avian species, as well as state-listed species (e.g., American bittern, common moorhen, wood turtle), would be lost from these wetlands, and the return of the state-listed species is doubtful. Where shrub and shallow emergent wetlands are disturbed by floodplain soil removal or ancillary facilities (access roads and staging areas), it is expected that restoration efforts would result in re-establishment of most pre-remediation functions of these wetlands over time. However, given the constraints described above, this recovery time is uncertain and would likely be measured in decades. In addition, there is a serious risk of additional invasive exotic species expansion into these areas. Moreover, depending on the extent of the disturbances and the length of time over which they last, some of the pre-remediation functions of these wetlands, such as providing habitat for state-listed species, may not return for a much longer period, if ever, in some of the affected wetland areas.

3.2.5 Other floodplain impacts: The implementation of remediation activities will have a long-term impact on other floodplain functions as well. For example, the removal of surface soils in the floodplain would alter soil moisture levels, soil infiltration rates, and groundwater flow. These changes, together with the removal of sediments in the river (which controls the rate and level of groundwater flow in the valley), would alter the groundwater recharge/discharge function of the affected floodplain areas. This function should return as flood deposition restores soil conditions and the disturbed areas become vegetated and root systems stabilize the floodplain soils, but such a return could take decades and would be dependent upon unpredictable flood dynamics, which themselves would be affected by alterations to the river channel and/or banks.

These changes to the PSA floodplain could result in either wetter conditions, such as from the loss of evapotranspiration due to tree removal or from soil compaction resulting in greater perching of surface waters, or drier conditions, such as from the use of sandier topsoils or from changes in overbank flooding and grading that result in decreased flood flows onto the floodplain. Without knowing the source of replacement soils or the dynamics of the reconfigured river channel, the potential hydrologic conditions of the remediated floodplain remain unknown, thereby reducing the chances of correcting problems through adaptive management.

The plant communities in primary successional systems, as would be formed by these extensive remediation activities, are generally dynamic, and it is under these conditions that aggressive and exotic species readily take hold. This is a very real risk to the overall success of restoration activities, as the plant community is one of the foundations of the overall ecosystem. If non-native species out-compete native ones, the animals that depend on the native plants may be lost as well. Successful replacement of shrub and shallow emergent wetlands is more likely than for forested components of the floodplain (Moreno-Mateos et al. 2011, Gebo and Brooks 2012) – the latter being highly unlikely – but is still fraught with numerous issues related to how the overall configuration of river channel, bank structure, and floodplain topography are integrated to produce the essential hydrologic, soil, and vegetation elements required of these systems. Regarding the potential success for floodplain plant communities, the significant lag time for growth of mature trees will always be an issue. As Kettenring and Adams (2011) found in their review of invasive plant management, there are limitations to controlling the colonization and spread of invasive plants in aquatic and riparian ecosystems. As proposed, the remediation plans are not likely to replace the structure, function, or biodiversity of the floodplain components of the existing riverine ecosystem.

3.3 Summary for Floodplains

A river's course meanders cutting back and forth through the floodplain, and in that process creates the tremendous diversity of river, floodplain, and wetland habitats found in an ecologically healthy riverine ecosystem. This, in turn, supports the extraordinary biodiversity which can be observed and has been documented in the PSA floodplain. This floodplain would be adversely impacted by the remediation proposed by EPA and those impacts would be severe.

The effects of the significant loss of mature floodplain trees and the impracticability of locating a comparable source of soil to mimic current conditions make restoring this system extremely vulnerable to the constraints described above. Overall, despite the implementation of the most up-to-date restoration methods, the re-establishment of the affected forested floodplain communities in the PSA is very unlikely. In general, restoration of shrub and shallow emergent wetland communities is expected to be more straightforward than restoring forested floodplain communities. However, the restoration of these communities is subject to numerous constraints that will likely adversely affect or at least delay their recovery

4.0 Impoundments of the Housatonic Rest of River

4.1 Context: Impoundments

There are 116 acres of impounded areas expected to be disturbed under SED 9/FP 4 MOD, of which 60 acres are in the PSA. These open water and shallow aquatic beds are tied closely to river dynamics. Such impounded areas are more easily restored than other habitat types, but there is uncertainty as to what aquatic plant and animal communities will recolonize these habitats once they are excavated and capped.

4.2 Impact of Remediation for Impoundments

Removal of sediment in the impoundments would also remove any viable propagules (the organisms and their eggs, seeds, or regenerative tissue of any kind) in the sediment removed. Capping or backfilling would change the substrate from organic sediment over silt and fine sand to a substrate composed of the capping or backfill material. Over time, invertebrates and aquatic plants would recolonize the impoundments, although different species would be expected to dominate, at least initially, due to the changed substrates. For example, there is a high probability of invasion by non-native species – such as water chestnut (already prevalent in Woods Pond), as well as Eurasian water milfoil, curly-leaf pondweed, and potentially others not yet able to establish populations under current conditions – in areas within the photic zone. Such species are likely to immigrate and dominate, with few management strategies to avoid this occurrence.

Since impoundment remediation would kill most occupying organisms and displace the rest, at least temporarily, biological recovery would depend on colonization from outside the impoundments from upstream sources. Commonly occurring macroinvertebrates from upstream areas would be expected to recolonize the impoundments, as would aquatic plants, with such plants or their propagules arriving with flow into the impoundments. While fish would move back into the remediated impoundments readily, the composition and relative abundance of fish would vary, at least initially.

4.3 Potential for Restoration of Impoundments

As sand and organic sediments are deposited from upstream, a biological community in the impoundments that is consistent with those conditions would be expected to develop. However, the length of time for such a community to develop, the number of organisms that may be present, and the presence of any specialized species are all uncertain. The restoration of impoundments is most likely to follow lake restoration technology, which is relatively mature. Although most lake restoration projects have been focused on vegetation and pollutant management, there is a substantial body of knowledge concern dredging of sediments to deepen water bodies and/or remove pollutants. Also, undesirable plant species can be more easily removed with aquatic harvesters compared to emergent, shrub, or forested sites (see National Research Council 1992 for a review of methods).

4.4 Summary for Impoundments

The potential of restoration of impoundments has a higher likelihood than for most other aquatic habitat types. Excavation and capping procedures are more predictable. However, there are still concerns about the potential colonization of invasive exotics and how soon the existing vegetation, invertebrate, and fish communities will recolonize these areas during recovery.

5.0 Backwaters in the Housatonic Rest of River

5.1 Context: Backwaters

SED 9/FP 4 MOD would involve sediment removal and capping in 50 acres of backwaters. This would have the long-term impacts on the open water habitats and aquatic beds of these systems. Most backwaters in the PSA are in Reach 5C and influenced by the Woods Pond Dam.

5.2 Impact of Remediation on Backwaters

Sediment removal and capping in the backwaters would cause changes in surface substrate type from silts or mucky organic material to sand, which would last until enough silt and organic material have been deposited through flood events to approximate current conditions – which could take a decade or longer. There would be changes in vegetative characteristics corresponding to the change in substrate type and elevation. With these changes in substrate and hydrology, there would be a proliferation of invasive exotic plant species.

There would be a change in the wildlife communities using the backwaters until such time as the substrate, hydrologic, and vegetative conditions of the backwaters return to conditions comparable to pre-remediation conditions – which is uncertain. There is high potential for the loss of certain sensitive (e.g., state-listed) species, such as the American bittern and common moorhen.

5.3 Potential for Restoration of Backwaters

The potential for restoration of backwaters is better than for most other aquatic habitat types. Backwaters, having direct connections to the river, will readily receive propagules of plant species and mobile animals can move into these areas rapidly. The techniques for their restoration are most like those used for lakes and reservoirs, and thus there is abundant information available on how to proceed. Although comparable habitats can probably be constructed, there remains a major question about whether the desired plant and animal species can be attracted to and flourish within the restored backwaters. The specter of overwhelming colonization by invasive exotic plants remains present.

5.4 Summary for Backwaters

There are concerns for introduction of invasive exotic species into newly remediated backwaters, but overall the potential for restoration is greater in this habitat type than in other types such as forested areas and vernal pools.

6.0 Vernal Pools in the Housatonic Rest of River

6.1 Context: Vernal Pools

EPA, through Woodlot Alternatives (2002), identified 66 vernal pools in the floodplain of the PSA. About two-thirds of these pools are located north of New Lenox Road, where there are numerous depressions in the forested floodplain that are seasonally filled with water due to overbank flooding of the Housatonic River, groundwater discharge, and surface water inputs from snowmelt or subsurface flow from the forest. The remaining one-third of vernal pools in the PSA occur south of New Lenox Road, where the river has a lower gradient and the floodplain is broader and flatter.

Based on recent visual observations (2011-2014), some of the vernal pools identified by Woodlot (2002) now function as permanently inundated, deep marshes or backwaters, rather than classic vernal pools that would meet the Massachusetts Wetlands Protection Act definition. However, these pools may still perform some vernal pool functions in certain places and times. For example, portions of these pools may contain physical structure (e.g., leaf litter, woody debris, aquatic emergent vegetation, and woody shrubs) that could provide refugia for developing larvae and thus make it possible for some of the pool-obligate species to continue breeding in these pools despite current hydrologic conditions. Moreover, such longer hydroperiod wetlands may provide critical breeding habitat for sensitive vernal pool species during periods of drought when nearby seasonally flooded vernal pools dry too soon for emergence of metamorphs. In any case, since these pools were identified as vernal pools by Woodlot and have been considered vernal pools in developing the remedial alternatives requiring vernal pool remediation, they are considered vernal pools in the evaluations presented herein. Pocket breeding refugia in larger, permanent wetlands are often insufficient to maintain the full suite of pool-breeding populations as fairy shrimp and wood frogs may be less successful in recruiting young in these habitats (Cunningham et al. 2007; but see Karraker and Gibbs 2009).

Access roads and staging areas are also an important part of the context for understanding impacts on vernal pools. While an effort has been made to site access roads away from vernal pools, this was not possible in connection with SED 9/FP 4 MOD because of the access required adjacent to and in the vernal pools. Additionally, many of the access road alignments for the floodplain alternatives are constrained by severe topography, the river itself, and logical connection points to existing public roads that would be integral to the construction process. The adjustment of access road locations would not prevent the impacts that would unavoidably occur from soil removal and replacement within and near the vernal pools targeted for remediation.

SED 9/FP 4 MOD will adversely impact up to 43 vernal pools (the number of pools in the PSA with PCB concentrations above EPA's ecological standard that are outside Core Area 1) covering 27 acres. In addition, SED 9/FP 4 MOD would adversely impact approximately 10 acres within 100 feet of the vernal pools in the PSA and approximately 60 acres within 100 to 750 feet of those vernal pools. The adverse impacts will include the removal of the existing trees and other vegetation, change in water drainage patterns on the floodplain, and excavation of the native soil. These impacts are likely to result in significant losses to local amphibian subpopulations in the PSA and the species that rely on those amphibian populations for the reasons discussed below.

6.2 Impacts to Vernal Pools from Proposed Remediation

6.2.1 Hydrology: The most important and distinguishing feature of vernal pools is their hydroperiod, or the timing of flooding (when and how long before they dry down). The hydroperiod is what distinguishes these environments from permanent ponds and lakes by providing breeding habitat for obligate vernal pool species that excludes breeding populations of predatory organisms (e.g., bull frogs, green frogs, snapping turtles) (Calhoun and deMaynadier 2008). Hydroperiod is influenced by hydrogeomorphic setting (HGM), defined by where a pool occurs in the landscape (e.g., groundwater or surface water depression, floodplain or perched setting) (Leibowitz and Brooks 2008) and in-pool characteristics (e.g., sediment types and stratigraphy, microtopography, foliage cover). It is very unlikely that soils that will be used to replace the soil excavated from the vernal pools and the adjacent areas will have the same permeability as the current soils in the vernal pools, particularly given the complex inter-bedding of silt and mucky soil layers in the existing soils. Replacement soils with a different permeability would not retain comparable amounts of surface waters and may not allow for comparable flow of groundwater into or out of the pools. Pool replacement soils may subside, leading to longer hydroperiods. Attempts to reestablish hydroperiod are unlikely to be successful (see Calhoun et al. 2014).

Similarly, the reconstruction of the swales that convey water into and out of the vernal pools and re-establishment of riverbank conditions that would preserve the overbank flooding into the swales are unlikely to result in conditions that match current conditions. Minor changes in the surface elevations at control points where surface water is conveyed into and through the swales could significantly alter the quantity of flow to the vernal pools. In addition, loss of mature trees surrounding vernal pools would change rates of evapotranspiration, usually making the habitats wetter, and thus less suitable for obligate vernal pool species.

When existing pools are disturbed, as will be the case for as many as 43 vernal pools in the PSA, efforts to reproduce the full complement of soil and hydrologic characteristics are unlikely to re-establish existing or comparable hydroperiods within the vernal pools.

6.2.2 Soils: Vernal pool remediation would involve the removal of the surficial soil, together with the vegetative cover, tree stumps, roots, and woody debris, in all or a portion of the vernal pools and the adjacent areas. These soil disturbances would have a significant direct effect on vernal pool wildlife. They would result in the mortality of any amphibian and/or invertebrate eggs, larvae, or adults in the pools (or affected portion thereof) at the time of remediation. Moreover, the use of heavy equipment in the remediation and restoration would result in direct mortality of animals in their post-breeding habitat (typically up to 1 km from a breeding pool). This could have a particularly serious effect on the formation of subterranean burrows by shrews and other small mammals in areas around the pools, which are used by ambystomatid salamanders as both summer refugia and hibernation sites (Montieth and Paton, 2006). Juvenile and adult wood frogs resting in shallow depressions beneath the leaf litter in the pools and in the adjacent terrestrial habitat (Baldwin et al. 2006a) would be crushed or excavated during soil removal operations. The soil compaction associated with the remediation, as previously discussed in connection with shrub/emergent wetlands, would similarly result in long-term changes in hydrologic patterns. The remediation would also remove physical components of the vernal pools that are critical to vernal pool ecology – e.g., the organically enriched soils, which provide a medium that supports the food chain (microbial nutrient transformers), affect permeability so as to keep the pools from drying out too soon, and facilitate groundwater flow in groundwater-influenced vernal pools (Leibowitz and Brooks 2008). Further, the remediation would affect the surrounding landscape characteristics that affect the timing and quantity of surface water and groundwater inputs into the pool and conveyance of water out of the pool (e.g., their juxtaposition with fluvial swales that flood waters into the pools). As a result, important elements of the vernal pool animals' life cycles, including breeding for obligate vernal pool species, would be disrupted.

6.2.3 Vegetation removal: Tree clearing within and immediately adjacent to the vernal pools would also produce substantial direct adverse effects on the vernal pool ecosystem, as these mature trees provide shade that moderates surface water, soil, and air temperatures and evaporative losses, and additionally provide a significant yearly infusion of biomass (fallen leaves, twigs, and branches) that serves as the base of the detrital food web and as cover from predators (Baldwin et al. 2006b).

In addition, where the remediation would involve the removal of vegetation in the larger areas around the pools to facilitate remedial soil removal or to allow the construction of access roads, it would further exacerbate the adverse impacts on the vernal pool communities. The forested areas surrounding vernal pools provide important non-breeding habitat functions, including cover, temperature and moisture regulation, foraging sites, and overwintering sites, for the vernal pool species. Thus, as recognized by habitat management guidelines developed for forestry activities (Calhoun and deMaynadier 2004), any such disturbances to the non-breeding habitats surrounding a vernal pool – especially within 100 feet of the pool (Regosin et al. 2003), but also within the 100- to 750-foot critical life zone (see Calhoun et al. 2005; Regosin et al. 2005) – would negatively impact the local amphibian subpopulations and could result in significant losses of amphibians through degradation of the post-breeding life zone. SED 9/FP 4 MOD would adversely impact up to 52 percent of the 100-foot zone and up to 29 percent of the 100- to 750-foot critical life zone for the individual vernal pools in the PSA. In total, SED 9/FP 4 MOD would negatively impact approximately 10 acres within 100 feet of the vernal pools and 60 acres within 100 to 750 feet of the vernal pools. This is likely to result in significant losses to local amphibian subpopulations in the PSA.

6.2.4 Additional impacts on vernal pool species: In addition to the impacts on the breeding and non-breeding habitats described in the prior subsections, EPA's proposed remediation would have other adverse impacts on the populations of vernal pools species in the PSA. Vernal pools may function as discrete aquatic systems, but they often occur in clusters, allowing a metapopulation (a set of sub-populations) of amphibians to disperse among the pools (Gibbs and Read, 2008). It is the proximity of vernal pools with slightly differing, but generally suitable habitat characteristics, as currently present in the PSA, which provides the necessary network of breeding sites to keep the local population of a species intact. Vernal pool amphibians display a high degree of fidelity to breeding sites (Berven and Grudzien, 1990; Vasconcelos and Calhoun 2006), but opportunities for occasional exchange of genetic material among individuals by dispersing juveniles from different subpopulations are important to avoid reproductive isolation (Gibbs and Read, 2008). This exchange can occur when pools are present within an appropriate habitat matrix, such as the contiguous area of mature forest in the PSA. If the physical structures or hydrologic regimes of the pools are altered, or the habitat matrix shifts to a non-forest habitat type, as would occur if SED 9/FP 4 MOD is implemented, then amphibian populations are at risk. Adult and emigrating juvenile amphibians have been shown to avoid clearcut areas adjacent to vernal pools (Patrick et al. 2006). Disruption of connectivity that is essential for dispersing animals, along with loss of the critical features of the forest floor that provide cover, temperature and moisture regulation, foraging sites, and overwintering sites to vernal pool species (see deMaynadier and Hunter 1998; Calhoun and deMaynadier 2004), as would occur under SED 9/FP 4 MOD, would constrain subsequent colonization and recolonization of the impacted vernal pools by obligate vernal pool species. Additionally, conversion to more open pools (e.g., less shade and forest cover) will likely promote use of those pools by habitat generalists such as green frogs or bullfrogs, both voracious predators of pool obligates (Vasconcelos and Calhoun 2006).

Other species reliant upon vernal pools in an intact forest riparian corridor would also be negatively impacted by the proposed remediation. For example, the vegetation cutting would negatively impact the wide-ranging wood turtles that forage in vernal pools (Compton et al. 2002), star-nosed moles that burrow and forage along moist edges, and migratory songbirds like the northern and Louisiana waterthrush that forage along the pool edges under forest cover during both breeding and migratory seasons (Mitchell et al. 2008).

6.2.5 Timing issues: The impacts of SED 9/FP 4 MOD on vernal pools and associated habitat would be largely unavoidable as impacts would be significant regardless of the time of year of operations. Working in the pools when the amphibians have left the pools for the season would avoid one set of impacts (i.e., to the breeding and larval stages), but would simply displace impacts to the terrestrial life stage of the vernal pool amphibians, as vernal pool amphibians spend the majority of their annual life cycle in the surrounding forest. Even if the remediation work were to occur during the low-flow season and after the spring breeding and migration period, this would not avoid direct mortalities to vernal pool juveniles and adults living in the leaf litter or in shallow burrows. These are slow-moving organisms that are especially vulnerable to ground disturbance or soil compaction. Further, the impacts of remediation in a given pool would last multiple years beyond the season in which that remediation takes place, thereby adversely affecting the breeding potential of the local population. Because vernal pool amphibians have strong site fidelities, they may unsuccessfully attempt to return to disturbed vernal pools, even if the pools are no longer suitable for breeding as we expect would be the case here.

6.3 Potential for Restoration of Vernal Pools

A recent publication by Calhoun et al. (2014) summarized the current peer-reviewed published literature on vernal pool creation and the authors concluded (bolded text ours):

[The literature indicates] that vernal pool creation is an imperfect science and should be used as a ***last resort*** *after exhausting more reliable protective methods (Calhoun et al. 2005; Windmiller and Calhoun 2008; Denton and Richter 2013). The practice is perhaps appropriate in landscapes that have been subjected to severe wetland losses, such as former agricultural landscapes where forests have recovered but drained and destroyed wetlands have not.* ***Vernal pool ecosystems are difficult candidates for creation because the community structure is as tied to the surrounding forested ecosystems as to the actual pool depression and because pool function is so tightly tied to hydrology.*** *In addition, ideal breeding site characteristics may vary among pool-breeding species regionally (Snodgrass et al. 2000; Petranka et al. 2007) as do post-breeding habitat quality tolerances (Windmiller et al. 2008). For these reasons, mitigation efforts must, first and foremost,* ***consider conserving existing pools in a suitable landscape****, and, if that is impossible, seek to emulate pools in the region in terms of hydrogeomorphic setting, spatial distribution, and natural amphibian communities.*

For these reasons, it is not scientifically defensible to destroy high-functioning vernal pool landscapes like that present in the PSA that are intact, and that, by all available measures, are thriving.

There are significant constraints on the ability to restore vernal pools. Here we list key constraints in pool restoration; details on each of these topics and the relevant literature review for each constraint can be found in Calhoun et al. (2014).

1. Restoration of a vernal pool would require, first and foremost, the re-establishment of the requisite *hydrologic regime*, which, in turn, is dependent on specific surface flow patterns through the floodplain as well as micro-topographic and soil conditions that have developed within the floodplain depressions. Each of these factors would be very difficult to reproduce for a single created vernal pool, let alone a complex of such pools like the vernal pool network present in the PSA (as discussed earlier).

2. Restoration would require the reestablishment of the pre-existing *soil composition* of the vernal pool and the composition and structure of the native vegetation within and around the pool, each of which would also be very difficult to reproduce in even one vernal pool and would be impracticable in the event of the disruption of up to 43 vernal pools as is proposed for SED 9/ FP 4 MOD. These difficulties are reflected in literature describing vernal pool creation efforts that have not successfully produced the full range of vernal pool functions due to an inability to produce the correct hydrology or soil composition (Korfel et al., 2009; Gamble and Mitsch, 2009) and/or a situation in which sensitive vernal pool species, such as wood frogs, were driven out by more aggressive species such as green frogs (Vasconcelos and Calhoun, 2006; Gamble and Mitsch, 2009). For example, as discussed above, it is very unlikely that replacement soils will have the same permeability as the current soils in the vernal pools,

particularly given the complex interbedding of silt and mucky soil layers in the existing soils. Also, degraded water quality (e.g., from unstable soils), extended hydroperiods, and temperature increases due to loss of mature tree canopy can cause adverse effects on the developing amphibians (e.g., reduction in oxygen to developing embryos due to silty soils settling on egg masses; Ranavirus associated with warmer water temperatures) (Gahl and Calhoun 2010). Similarly, these factors can cause excessive growth of filamentous algae or aquatic plants such as duckweed, which may adversely affect the suitability of a pool for amphibian breeding. In addition, the surface structure of leaves and twigs on the pool bottoms would be extremely difficult, if not impossible, to sustain on a long-term basis, since this process occurs naturally under a forest canopy.

3. Restoration of *within-pool vegetation* and associated habitat functions is related to adequate re-establishment of microtopography, soils, and pool hydroperiod; if the resulting hydrologic conditions are too wet or too dry, as discussed above, they would result in completely different plant communities and succession. Establishing vegetative cover within the affected vernal pools, along with placement of other organic material such as leaf litter and coarse woody debris, would be part of the restoration effort for the vernal pools. However, the complex and mature organic vegetative composition (alive and dead) of these pools cannot be re-established in a predictable period, and numerous factors could derail the plant succession process and result in undesirable vegetative growth (e.g., invasive exotics or other aggressive species which are present in the PSA). Under optimum conditions, and assuming that invasive species could be effectively controlled without damaging newly planted and naturally colonizing native species (which is, in fact, unlikely), growth rates of the types of shrub species that would be used in these vernal pools typically range from 1 to 2 feet per year (Dirr, 1998) following development of an established root system (i.e., usually 1 to 2 growing seasons). Under such conditions, as herbaceous and shrub layers develop within the pools and around the pool edges, some of the physical aspects and habitat functions associated with the loss of these vegetation strata could recover within 5 to 15 years following restoration. However, flooding may impede the success or timing of this recovery process. Moreover, other vegetation strata would take longer to recover. As discussed for the forested floodplain, the return of mature trees would take at least 50 to 100 years if not impeded by floods or invasive species encroachment.

4. Another key constraint to successful vernal pool restoration is the impact of the remediation work on the *forested habitat surrounding the pools*. The restoration of vernal pools would be strongly influenced by the extent to which the connectivity among the various vernal pools in the floodplain and between the pools and important post-breeding forested habitat for amphibians is adversely affected. Most wetland-dependent amphibians do not have the capability to disperse or migrate if the matrix between habitat elements (breeding and non-breeding sites) is highly disturbed (deMaynadier and Hunter 1998; Patrick et al. 2006; Semlitsch et al. 2009); therefore, habitat connectivity is key to the viability and sustainability of amphibian populations. Under SED 9/FP 4 MOD, which would involve significant habitat alteration over widespread areas of the floodplain, it is likely that the connections among some number

of vernal pools, and between vernal pools and other related habitats, would be degraded or lost entirely. Even small impacts to the non-breeding habitats adjacent to vernal pools have the potential to reduce the value of this habitat for the vernal pool amphibians and thus to impact the functions required for a viable vernal pool ecosystem.

5. Further, even if the hydrology and soil structure and composition within the pools and the vegetation within and adjacent to these pools were eventually returned to their current condition, the interim loss or reduction of sensitive vernal pool species such as wood frogs, and/or their displacement by more aggressive species during that time, would create a high potential that those sensitive species would not be restored. For example, wood frogs breed only one or two times over their 3-5 year life span, and thus a few years of eliminated or severely lowered recruitment levels can negatively impact a local subpopulation. Hence, if there are not sufficient wood frogs in the area to migrate into the vernal pools to breed after the new vegetation is established, those pools may no longer support wood frogs. Moreover, the disturbance of the vernal pools would increase the likelihood of colonization by more opportunistic amphibian species such as green frogs and bullfrogs, whose larvae are aggressive predators of wood frog and salamander eggs and larvae (Calhoun et al. 2014). Thus, there would likely be a long-term loss of wood frogs and salamanders from these pools. Even if these more sensitive species did return to pools with more permanent hydrology, the pools could serve as an "ecological trap" for those species.

6.3.1 Restoration of a single pool—8-VP-1: EPA has previously pointed to the prior post-excavation restoration of a single vernal pool, 8-VP-1, located near the upper part of the PSA, as evidence of the ability to restore a remediated vernal pool. However EPA ignores the fact that this *one* vernal pool had the benefit of intact mature forest and nearby vernal pools to aid its recovery. This pool now provides appropriate breeding habitat for wood frogs in some but not all years (following a dry-down year) and serves as a potential sink in years when hydrologic conditions allow green frogs to successfully breed there (see memoranda from Weston Solutions to EPA dated January 11, 2012 and March 13, 2013 and memoranda from Stantec to Weston Solutions dated May 3, 2012, June 10, 2013, and April 29, 2014, reporting on inspections of this pool). Following the recovery of a single pool in a relatively undisturbed area tells us nothing about the effect of the remediation that EPA has proposed for the PSA. The relevant study here would require baseline research on amphibian breeding populations of an analogous section of river with multiple pools and associated terrestrial habitat followed by a recovery study. Since that has not been done, one needs to rely on broader scale studies that compare reference pools to mitigated pools with sample sizes large enough to be statistically significant (Calhoun et al. 2014). Findings from these studies are more relevant to guiding decision-making with respect to pool integrity in this system than are findings from a single, relatively undisturbed site where there is a strong local population of pool-breeders to recolonize a pool.

6.3.2 Activated carbon: There is no published research on the effect of the use of activated carbon on vernal pool breeding invertebrates and amphibians. The case studies referenced by EPA have no relevance to vernal pools as EPA's own consultant, the

Isosceles Group, recognized (see Attachment 3 to the Comparative Analysis). It would be reckless to research the potential impacts of this treatment technique in the sensitive ecology of the PSA. In any event, vernal pools in which activated carbon was used as an alternative to excavating the pools would still be adversely affected by the clearing and excavation of the 100-foot and the 100- to 750-foot zones around the pools.

6.4 Summary: SED 9/FP 4 MOD would include excavation and replacement of the surface soils and vegetation in up to 43 of the 66 vernal pools in the PSA, impacting up to 27 acres of vernal pools, approximately 10 acres within 100 feet of the vernal pools, and approximately 60 acres within 100 to 750 feet of the vernal pools. The direct long-term impacts of SED 9/FP 4 MOD would include long-lasting changes in the hydrology of the vernal pools and in soil conditions in the pools (due to the inability of replacement soils to match the characteristics of the existing vernal pool soils). There is also a high probability that invasive exotics or other undesirable plant species and animal predators (such as green frogs or bullfrogs) would invade pools where they did not previously exist. These alterations would, in all likelihood, result in the loss of obligate vernal pool species from many of the pools (Calhoun et al. 2014).

Moreover, the additional forest disturbance would cause great disruption to the critical non-breeding amphibian habitat around the vernal pools. These disturbances would result in direct mortality and disrupt important aspects of those areas' non-breeding functions for the vernal pool amphibians.

Given the extensive impacts of SED 9/FP 4 MOD on the vernal pools and the forested habitats around the vernal pools, it is highly likely that the full complement of characteristics that contribute to vernal pool functions would not be re-established for most of the affected pools. This is consistent with the body of broader scale studies comparing reference pools to restored pools with sample sizes large enough to be statistically significant, as summarized in our recently peer-reviewed and published paper in *Wetlands* (Calhoun et al. 2014). These unavoidable impacts to a high-functioning floodplain vernal pool landscape are why the Commonwealth of Massachusetts concluded that "any potential benefits associated with remediation to achieve ecological IMPGs [the sole reason for EPA's proposed vernal pool remediation] would be far outweighed by the short and long-term damage" and that "[w]e believe that restoration of these vernal pools will not result in the actual replication of the vernal pools and associated amphibian communities that existed prior to the removal of the pools." (Commonwealth letter to EPA, January 31, 2011, at pages 8 and 11). We agree.

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ATTACHMENT D TO GE COMMENTS

Attachment D

A Scientific Response to EPA's Conclusion that Restoration of the Housatonic Rest of River Will Be Fully Effective and Reliable

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1. INTRODUCTION

EPA's "Comparative Analysis of Remedial Alternatives" for the Housatonic Rest of River inaccurately portrays ecosystem restoration as a straightforward undertaking with predictable results, as summarized in these three sentences (p. 26, lines 31-36):

"There is a significant body of knowledge with respect to ecosystem restoration that documents the ability to reestablish the pre-remediation conditions and functions of the affected habitats (see Appendix D of the 2011 Site Information Package). Accordingly, restoration is expected to be fully effective and reliable in returning these habitats, including vernal pool habitat, to their pre-remediation state. As a result, the likelihood of effective restoration is equal under any of the alternatives."

This document explains why EPA's claims about the effectiveness and reliability of ecological restoration are inconsistent with what we know about the limitations of this endeavor, especially in a complex ecosystem like that of the Housatonic Rest of River. We provide a detailed critique of Attachment 12 to the Comparative Analysis (which was Appendix D to the EPA's Region's 2011 Site Information Package and is referred to herein as EPA's Appendix D), including a shorter critique of Attachment 11 to the Comparative Analysis. We also include as exhibits to this document a number of papers on ecosystem restoration.

First, we will provide a brief overview of our perspective on this topic by parsing the four elements of EPA's conclusion repeated above and responding to each.

1. *"There is a significant body of knowledge with respect to ecosystem restoration..."*

We generally agree. With over 10,000 scientific articles on the topic, and three specialty journals steadily publishing more research, this is a reasonably well-studied discipline. However, it is notable that it is also a fairly young discipline with virtually no published research before 1990, and over 90% of the articles published on the topic since 2000. This significantly constrains the ability to assess the long-term efficacy of restoration projects to date. It is notable that three major review articles regarding the attempted restoration of wetlands, rivers, and vernal pools have been produced recently (Moreno-Mateo et al. 2012, Palmer et al. in press, Calhoun et al. 2014, respectively) that provide a fairly comprehensive overview of relevant issues.

2. *"[This literature] documents the ability to reestablish the pre-remediation conditions and functions of the affected habitats."*

This statement implies that the ability to reestablish ecosystems is well-founded, but that is inconsistent with the body of knowledge referenced above. A better generalization would be that ecosystem restoration can improve the structure and function of degraded ecosystems and can occasionally, under the right circumstances, re-establish some approximation of the previous ecosystem. We will show that EPA's own statements contradict its claim that it is feasible to re-establish the pre-remediation conditions and functions of critically important elements of the Rest of River ecosystem, such as mature forests, vernal pools, and river dynamism.

3. *"Accordingly, restoration is expected to be fully effective and reliable in returning these habitats, including vernal pool habitat, to their pre-remediation state."*

We will also show that this statement is inaccurate and unsupported by the very body of knowledge to which EPA refers. At best it would be reasonable to say that restoration may be partly effective at returning some types of habitats to some semblance of their pre-remediation state after an extended period that cannot be predicted with any certainty.

4. *"As a result, the likelihood of effective restoration is equal under any of the alternatives."*

This statement is illogical unless you accept the premise that restoration is perfectly effective, and we will show that this is not the case. Because the impacts of the Rest of River remediation alternatives differ greatly and the required restoration will be far less than perfect, the ultimate result – that is, the extent and degree of ecosystem alteration – would differ markedly depending on the alternative selected and its impacts.

2. CRITIQUE OF EPA'S APPENDIX D (ATTACHMENT 12 TO COMPARATIVE ANALYSIS): RIVER AND FLOODPLAIN RESTORATION

2.1 RESTORATION TRAJECTORY – RESTORING THE FUTURE

Section 2.1 of EPA's Appendix D states (p.1 lines 31-35): *"Active ecological restoration 'sets the stage' for natural, passive restoration processes to take over, and can reduce the time needed for recovery from many decades to that of years."*

This generalization is misleading because the time frame for "recovery" depends very much on the type of ecosystem in question and can range into centuries for forests like those at the center of the Rest of River ecosystem in which large trees, snags, and logs are key components

(Lindenmayer et al 2012). Certainly ecosystem restoration can accelerate recovery, sometimes significantly, but there are important limitations. For example, one might subtract only 10 years from the 100-200 years it takes to grow a very large silver maple by planting a sapling rather than waiting for seed-based recruitment. In any event, as Fig. 1 (copied from EPA's own Appendix D) makes clear, the term "restoration" is a bit of a misnomer because the "ecological restoration" results in a "novel ecosystem," not the restoration of the "original" ecosystem as it would have naturally evolved.

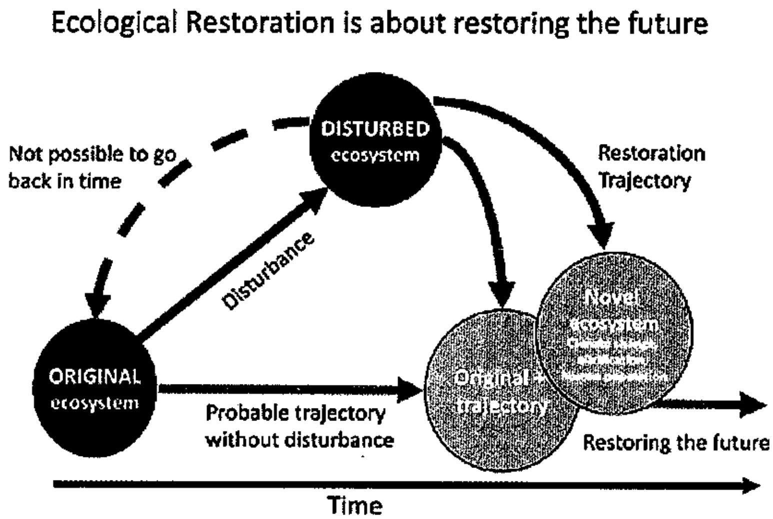

Fig. 1 Ecosystem restoration trajectories through time from EPA Comparative Analysis, Appendix D.

We agree with the ideas depicted in this figure. However, those ideas are inconsistent with EPA's statements about *"reestablish[ing] pre-remediation conditions and functions" or "returning these habitats...to their pre-remediation state"* because, as the figure makes clear, it is impossible to restore the original ecosystem. As EPA's figure recognizes, disturbance and attempted restoration will result in a "novel ecosystem" with a profoundly different species composition, including many non-native plant species. Further, EPA's figure underestimates the time necessary to generate a realistic novel ecosystem. Therefore, a revision of EPA's figure consistent with the "significant body of knowledge" to which EPA refers would look more like this:

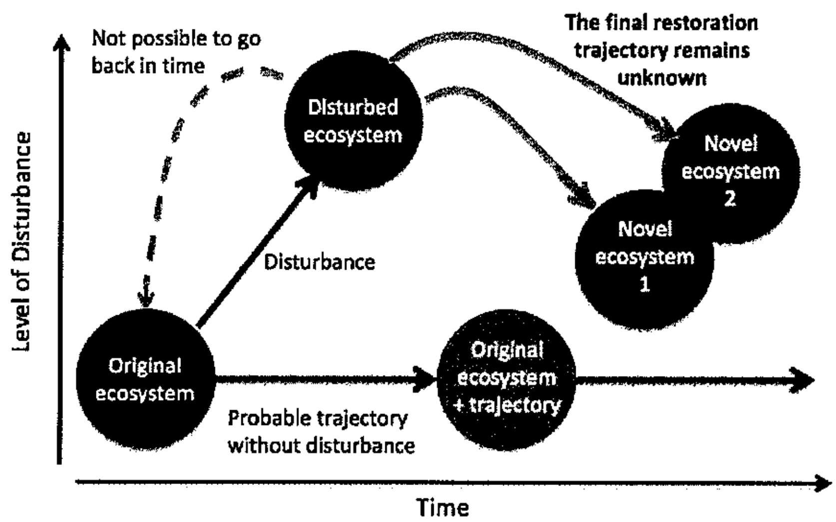

Fig. 2. A modification of Figure 1 displaying more realistic scenarios (Novel Ecosystems 1 & 2) for the likely trajectory for the Housatonic Rest of River if the proposed remediation plans are implemented. Note we have labeled the Y-axis Level of Disturbance, which was implicit in the original EPA figure. In the original EPA figure, the resultant Novel Ecosystem was unrealistically close to a likely natural trajectory for the original ecosystem following remediation of the kind and scope proposed. It is impossible to know just where the actual novel ecosystem will fall but it is likely to be higher on the Disturbance Axis and take longer to reach that state, so we have depicted some alternative, more realistic locations as Novel Ecosystems 1 & 2.

2.2 ELEMENTS OF A SUCCESSFUL RESTORATION PLAN

Among the eight items described in Section 2.2 of EPA's Appendix D, there are seven that merit comment.

-- *"A clear rationale as to why restoration is needed."*

It is noteworthy that, unlike most restoration projects in which historical ecological damage is being remedied (see again EPA's figure), in this case EPA is advocating the disturbance that would require the attempted restoration.

-- *"A statement of goals and objectives of the restoration project."*

The apparent goal of this project to "*reestablish the pre-remediation conditions and functions*" is not realistic for reasons that will be elaborated on below for each component of restoration.

-- *"A designation and description of the reference."*

The uniqueness of the Housatonic River and floodplain make this impossible. We note that EPA hasn't identified any system that is anything like a reasonable analog that might serve as a reference system.

-- *"An explanation of how the proposed restoration will integrate with the landscape and its flows of organisms and materials."*

The extent of the proposed remediation raises the specter of landscape fragmentation. Within the lowlands of the Housatonic Valley south of Pittsfield, the Housatonic River and its floodplain currently represent a remarkably intact corridor along which organisms can move up and down the valley. This corridor will be severed by the excavation and access roads and staging areas proposed by EPA and restoration cannot be relied upon to repair this fragmentation in any predictable time frame. (See more detailed analysis in our Ecological Impacts document.)

-- *"Explicit plans, schedules, and budgets for site preparation, installation, and post installation activities include a strategy for prompt mid-course corrections."*
-- *"Well-developed and explicitly stated performance standards, with monitoring protocols by which the project can be evaluated."*
-- *"Strategies for long-term protection and maintenance of the restored ecosystem."*

These three items cover details that are premature at this stage, but it is noteworthy how the banner of "we will restore the ecosystem" is waved with no recognition of the complexity of this process and the limitations that will constrain it. To quote a comprehensive review of 644 river restoration projects: *"Restoring the ecological integrity of degraded waterways is tough, complicated work"* and outcomes of river restoration tend to be *"disappointing"* (Palmer et al. in press).

2.3 RIVER RESTORATION PLANNING

Many important items are touched upon in Section 2.3 of EPA's Appendix D and we will comment on several here and below.

-- *"...re-establishing river and floodplain processes ..."*

Dynamic river processes are already established in the Rest of River. What is being proposed is to interrupt those processes, destroying the existing system with its varied habitats and communities, and then attempt to restore them with techniques designed to minimize sediment movements – from the substrates, banks, floodplains, and in the water column. Minimizing the movement of sediment is fundamentally antithetical to restoring river and floodplain dynamism. That objective will not allow natural, dynamic river and floodplain processes to occur, and hence, the existing, productive ecosystems currently present will be lost. See further discussion below.

-- *"...providing for landscape linkages ..."*

As indicated above, the proposal would sever existing linkages rather than providing for their enhancement.

--"*The composition and structure of vegetation provides the basis for riparian habitat.*"

This is true, and is a very worrisome aspect of the proposal given the profound difficulty of reestablishing many species of native plants and of controlling exotic invasive plant species, especially in an aquatic environment, as will be discussed below.

-- "*The morphology of the channel provides the basis for in-stream habitat.*"

This is a partially true statement. However, one also needs to be cognizant of the importance of other riverine ecosystem elements, such as bank condition, bank and floodplain vegetation, and inputs from the surrounding and upstream landscape. That said, the proposed remediation approach of attempting to stabilize the channel to minimize bank erosion will not restore in-stream habitats to their prior, productive condition as discussed in Section 2.6 below.

-- "*... ensures the future health and integrity of the river... without requiring external assistance.*"

EPA acknowledges the need for extensive control of invasive plant species, which contravenes this idea and will not be successful in this circumstance in any case. See further discussion of exotic plants below.

-- "*Include adaptive management*"

Adaptive management is explicitly mentioned by EPA, particularly in the context of vernal pool restoration (see pp. 6, 8, & 34 of EPA's Comparative Analysis), but the proposed time frame of eight years for Reaches 5A, 5B, and 5C and their associated backwaters is grossly inadequate for acting, monitoring, learning, revising, and acting again required of adaptive management. See further details below in Section 2.5.

2.4 HISTORY OF RIVER RESTORATION

The brief history presented in Section 2.4 of EPA's Appendix D omits some critically important recent attempts to assess the success of river restoration detailed below.

The section concludes with five criteria from Palmer et al. (2005) that are useful to consider:

1. A guiding image exists: a dynamic ecological endpoint is identified a priori and used to guide the restoration (within present regional context).

EPA's "guiding image" seems to be the riverine ecosystem in its current condition, or at least as close to that as feasible, but this overlooks the reality that it is the proposed excavation and dredging that would degrade the ecosystem and thus generate the need for restoration.

2. Ecosystems are improved: the ecological conditions of the river are measurably enhanced and move toward the guiding image.

This criterion will definitely not be met relative to the current state of the Rest of River ecosystem, as acknowledged by EPA: *"Remediation and restoration of the river and floodplain at this scale cannot be accomplished to any meaningful level without impacts to the present state of the river and floodplain"* (p. 6 of Appendix D, lines 23-24). As discussed below, it is far more likely that imperfect restoration will not rectify the degradation of the riverine ecosystem caused by the excavation and dredging inherent in EPA's proposal. A review of 644 river restoration projects found that only 16% showed any improvement in biodiversity following restoration activities (Palmer et al. in review) and these comparisons were relative to the degraded state of the ecosystems, not their condition prior to the degradation that required restoration. Certainly there will be no improvement in biodiversity relative to the Rest of River's current state.

3. Resiliency is increased: the river ecosystem is more self-sustaining than before.

Similar to Criterion 2, the Housatonic River ecosystem will be far less self-sustaining after proposed remediation and restoration, for decades at a minimum. Fundamentally, many species are likely to be extirpated or have severely reduced populations during this lengthy period. This is related to many driving factors discussed below.

4. No lasting harm is done: implementing the restoration does not inflict irreparable harm.

This criterion is particularly problematic if the project contributes to regional extinction of some listed species, as seems likely, given the difficulty of restoring endangered species populations and their habitats. In particular, implementation of the proposal would directly disturb approximately 374 acres of designated Priority Habitat of state-listed species, resulting in 25 takes, 9 of which would be of significant portions of the local populations of those species (see Table 12 and Attachment E of GE's comments on the proposed remedy).

5. Ecological assessment is completed: some level of pre- and post-project assessment is conducted and the information is shared.

This criterion will presumably be met, although it will be critically important to tie post-project monitoring and assessment both to measures taken prior to remediation and to "as-built" conditions immediately following construction. Some improvements compared to "as-built" conditions are likely but the negative changes compared to the pre-project conditions are certain to be profound. As discussed in the next section, the time frame for both completing the work, and presumably the assessment, is far too short.

2.5 CONSIDERATION OF TEMPORAL SCALE

In Section 2.5 of Appendix D, EPA emphasizes the dynamism of the Housatonic River and particularly its recovery from past disturbances. We concur that it is important to appreciate the role of river dynamics and below we highlight some of the potential conflicts between river dynamism and EPA's proposed bank restoration. Here we focus on two other temporal issues.

First, contrary to EPA's suggestion, any meaningful ecological recovery of certain elements of the Rest of River ecosystem will take, at best, decades beyond the timeframe of the remediation. This point is particularly salient where the dominant vegetation comprises large silver maples. These trees are currently tall enough to support canopy-dwelling birds, have crowns wide enough to shade the river and backwaters and have trunks robust enough to provide dens for cavity-dwelling mammals and birds and to become large woody debris in the river. These forests also provide critical post-breeding habitat for amphibians during summer, fall, and winter. However, if remediation proceeds in the manner proposed by EPA, these trees will be entirely replaced with saplings that will take at least 50 years to reach mature tree height, and probably over 100 years for full-size crowns and boles.

Second, despite EPA's claim that *"[r]emediation and restoration would progress incrementally from upstream to downstream, affecting small stretches of the river and floodplain at any given time."* (p. 26 of EPA's Comparative Analysis), all of the remediation in Reaches 5A, 5B, and 5C and their associated backwaters is scheduled to be completed in just 8 years (Fig. 3). This means that extensive areas will essentially be simultaneously denuded of their natural vegetation.

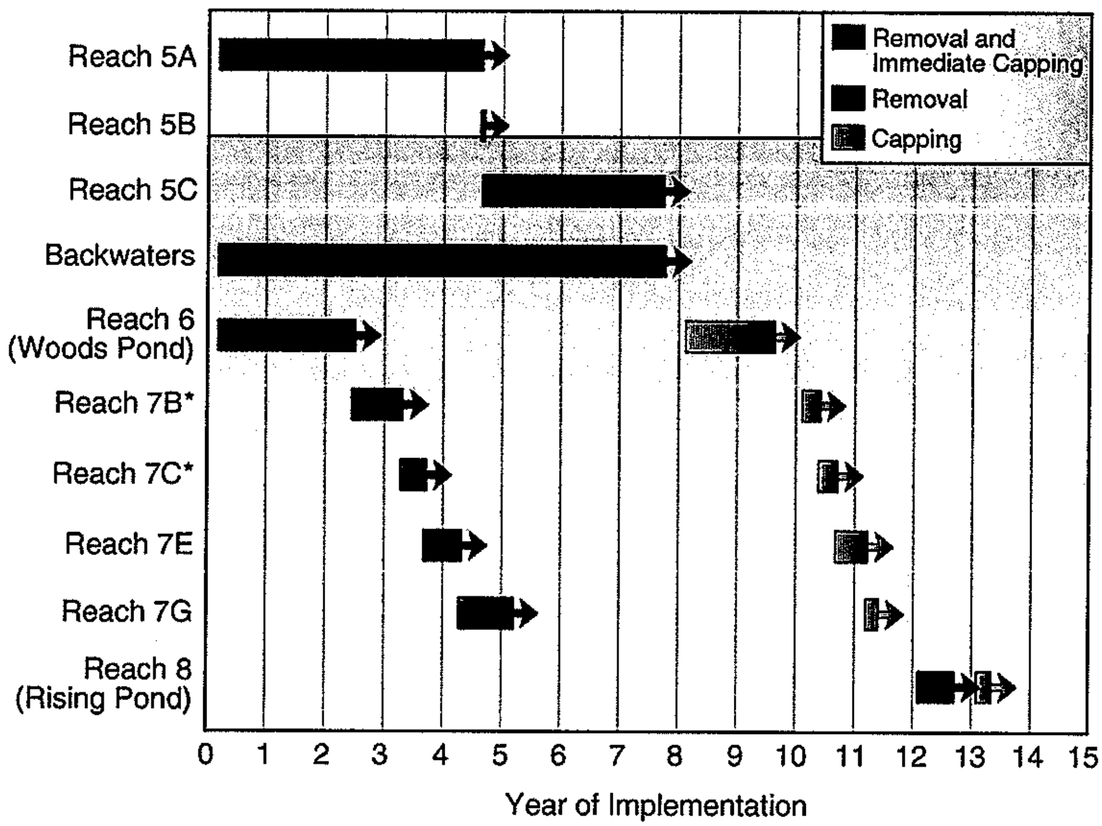

Fig. 3. EPA's estimated timeline for cleanup activities (taken from Figure 5 of EPA's Statement of Basis).

If the goal is to affect only *"small stretches ... at any given time,"* then one would remediate a small portion of the total area and wait until the vegetation has largely recovered before proceeding to the next portion. Translating "small portion" and "largely recovered" into two reasonable numbers (10% to constitute a "small portion" and the minimum of 50 years to achieve mature tree height to constitute "largely recovered") would generate a 500-year time frame for the entire undertaking (10 portions of 10% each x 50 years). This number highlights just how ill-advised it is to suggest that one can substantially mitigate the impact of the proposed remediation if it is conducted within an 8-year time frame. Even if you "pushed the envelope" very hard, the proposed 8 years is completely inadequate (for example, remediating 25% of the area per period and assuming trees were large enough after 20 years leads to an 80-year time frame, ten times longer than the proposal).

The fact is that adaptive management requires significant time, especially when dealing with slow ecological processes like the growth and succession of vegetation. The fundamental feature of adaptive management is learning from past experience, and that requires time to: monitor the results or outcomes of actions; assess if goals were met and unintended consequences incurred; and develop new approaches based on lessons learned. In the context of vegetation restoration it is likely to take at least 5-10 years just to be able to judge if the restoration effort is on track to be successful (e.g., planted trees are surviving and the site is not overrun with exotic species.) Thus, even at sites where the goal is to restore fast-growing plants, like annuals, rather than trees or shrubs, it is not reasonable to suggest that in just 8 years one can make multiple trips around the cycle of adaptive management (Fig. 4).

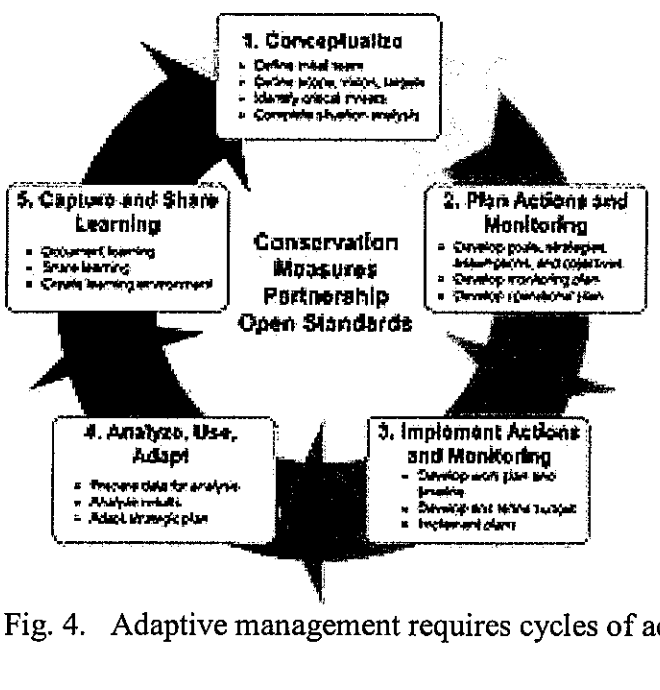

Fig. 4. Adaptive management requires cycles of action, monitoring, and learning.

2.6 RESTORATION TECHNIQUES SUPPORTING DIVERSE HABITAT

Section 2.6 of EPA's Appendix D discusses restoration techniques and presents EPA's view of successful restoration examples. A meta-analysis comparing 621 wetland restoration sites to 551 reference wetlands (Moreno-Mateos et al. 2012) speaks to the challenges of restoration ecology in general and is specifically relevant to floodplain restoration:

"Our results ... from throughout the world show that even a century after restoration efforts, biological structure (driven mostly by plant assemblages), and biogeochemical functioning (driven primarily by the storage of carbon in wetland soils), remained on average 26% and 23% lower, respectively, than in reference sites. Either recovery has been very slow, or post-disturbance systems have moved towards alternative states that differ from reference conditions."

Similarly, these lines appear in the conclusion of a review of 644 river restoration projects (Palmer et al. in press): *"While outcomes of river restoration based on our review of published studies may be disappointing, it is important to remember that stream restoration science is very young compared to, say, forest or prairie restoration. Researchers and practitioners are still developing methods, and the problematic ecological outcomes of many or most structurally based restoration projects are only now becoming more widely acknowledged. A unified perspective on how to succeed in restoring rivers has yet to take hold."*

In the following subsections we provide an overview of some key constraints on restoration ecology for each of four habitat types. A more detailed analysis appears in our Ecological Impacts document.

2.6.1 River

We refer back to the four statements from EPA's Comparative Analysis described above to evaluate their relevance to ease of restoring the river that is the heart of the Rest of River.

1. There is a significant body of knowledge with respect to ecosystem restoration.

Recent reviews have summarized what is known about the success, and lack thereof, for river restoration (e.g., Palmer et al. 2005, Bernhardt and Palmer 2011, Palmer et al. 2014, Palmer et al. in press). We summarize the findings from key papers in the next few sections.

2. *[The literature] documents the ability to reestablish the pre-remediation conditions and functions of the affected habitats.*

Recent review papers repeatedly call attention to the lack of river restoration success. Palmer et al. (in press) state: *"Yet, ecologists have pointed out that while restoration of hydro-geomorphology is a critical consideration in restoring many streams, it is typically not sufficient for degraded channels and it can even lead to worsening the ecological condition of the stream; i.e., may be viewed as a disturbance itself (Louhi et al. 2011, Tullos et al. 2009). For example, if in the process of restoring floodplain overflow potential, riparian trees are removed* *from a previously closed-canopy stream, the underlying energy regime may change from allochthonous resources to one driven by primary production, which may shift the stream further away from the desired ecological state often toward algae dominated streambeds and higher temperatures (Sudduth et al. 2011). Similarly, if the hydrologic regime is restored but there is no nearby source of invertebrate colonists, then the in-stream communities remain unrestored (Sundermann et al. 2011).*"

3. *Accordingly, restoration is expected to be fully effective and reliable in returning these habitats . . . to their pre-remediation state.*

For riverbeds, based on an extensive review of river restoration projects, this statement is simply not true. Palmer et al. (in press) found that: "*A strong focus on channel morphology has led to approaches that involve major earth-moving activities such as channel re-configuration with the unmet assumption that ecological recovery will follow.*" The same review "*showed there remains a major emphasis on the use of dramatic structural interventions such as completely re-shaping a channel despite growing scientific evidence that such approaches do not enhance ecological recovery and the data we assembled (Table 2) suggest they are generally ineffective in stabilizing channels when that is the primary goal.*" Thus, it is highly unlikely that, following the implementation of EPA's proposal (which would directly impact 126 acres of aquatic riverine habitat and at least 3.5 miles of riverbank in Reach 5A, as shown in Table 11 of GE's comments), the Rest of River could be restored to its current high level of biodiversity and productivity, and it is nearly certain this highly functioning set of reaches will become further degraded and lose valued riverine habitats, decreasing the diversity of species now present (see Table 12 and Attachment E of GE's comments).

4. [T]he likelihood of effective restoration is equal under any of the alternatives.

The remediation alternatives considered by the Comparative Analysis vary considerably in how they will alter the existing riverine ecosystem. Therefore, it is incorrect to suggest that the "*likelihood of effective restoration is equal*" unless, by being equal, it is assumed that any restoration outcomes will be suboptimal and ineffective in any alternative implemented, as a review of the literature suggests.

2.6.2 Riverbanks

We again refer back to the four statements from EPA's Comparative Analysis described above to evaluate their relevance to ease of restoring riverbanks in the Rest of River.

1. There is a significant body of knowledge with respect to ecosystem restoration.

As described in Attachment 11 (Bank Erosion/Restoration) to EPA's Comparative Analysis, there are accepted methods in the literature to stabilize and/or repair severely eroded riverbanks. What is not sufficiently acknowledged in EPA's analysis of alternatives are the system-wide, negative impacts that will result due to the extensive spatial extent of riverbank remediation – 3.5 miles of riverbank for Reach 5A alone. In addition, it is important to recognize that in most rivers of this type, a portion of the banks will be eroding as part of the natural process of forming meanders where the outer cut bank maintains a near-vertical face of exposed sediments and soil. Several species have adapted to or require this type of habitat (e.g., belted kingfisher, bank swallow, denning otter or mink, etc.). In the eastern U.S., when the dominant forest cover is intact, steep banks are stabilized by the root masses of trees living at the top of the bank. When steep, eroding riverbanks are not pervasive (and they are not pervasive in the Housatonic), then the negative impacts of erosion and sedimentation in the riverine ecosystem can be readily absorbed . Thus, the primary question that should be asked and answered is, what is the minimum length of eroding riverbank that should be, and can be, stabilized to reduce targeted riverbanks erosion problems without causing harm to the overall riverine ecosystem? We believe it is far less than 3.5 miles.

2. *[The literature] documents the ability to reestablish the pre-remediation conditions and functions of the affected habitats.*

We agree that "*[o]ver time, the Housatonic River will move toward a state of uniform energy dissipation that will result in reduced bank erosion, a reduction in bar formation, and fewer channel processes that form and maintain the oxbows*" (Attachment 11, page 2). We also agree that there are a series of standard techniques to stabilize severely eroding riverbanks (e.g., live staking, fascines, tree/log revetments, log or rock cross vanes, plant mats, geotextile applications, etc) (Eubanks and Meadows, no date). In degraded rivers, conducting selected stabilization or repair of highly eroded riverbanks is a common practice. What is of great concern for the Housatonic Rest of River is the excessive number and length of riverbanks designated for remediation. If a few sections were remediated, the consequences to the riverine ecosystem would be minor. If extensive sections are remediated, then negative impacts – loss of shade, increasing temperatures, loss of critical breeding, resting, and overwintering habitats – will cause significant changes to the Housatonic, damaging the ecological integrity of the system.

3. *Accordingly, restoration is expected to be fully effective and reliable in returning these habitats . . . to their pre-remediation state.*

This claim is incorrect for the riverbanks. As stated in the Section 2.6.1 on rivers, wholesale disturbance of the river channel along lengthy reaches can have undesirable impacts on the adjacent riverbanks and do not necessarily enhance the ecological recovery of the riverine ecosystem (Palmer et al. in press). Another factor of concern for the proposed remediation derives from EPA's statements that, because the objective is to permanently stabilize the remediated riverbanks, their angle of repose would be quite low, eliminating many of the vertical or steep banks. Also, there would be a sustained effort to keep the banks free from mature trees, the concern being that tree roots would dislodge some of the stabilizing structures. As a consequence, these remediated banks would not serve the same functions of the existing natural banks, that is, providing shade, habitat, and contributing coarse wood debris into the riverine ecosystem. Most of Reach 5 is designated as habitat for many state-listed species, and these impacts would be devastating to those valued populations.

4. *[T]he likelihood of effective restoration is equal under any of the alternatives.*

If only the most severely eroded riverbanks were stabilized – a much smaller proportion than proposed – then the natural recovery of the river could proceed unabated, since the few stabilized banks would likely not affect the overall recovery. If more than a small proportion of the riverbanks are disturbed during remediation, then this recovery would be set back for decades, since the stabilized banks themselves would be permanently altered and this would undermine or preclude the prospects of returning to overall pre-remediation conditions along the river.

2.6.3 Floodplain

We again refer back to the four statements from EPA's Comparative Analysis described above to evaluate their relevance to ease of restoring floodplain habitats in the Rest of River.

1. There is a significant body of knowledge with respect to ecosystem restoration.

The overwhelming majority of the literature on river restoration is focused on reclaiming the dimensions of the river channel and immediate banks. Few studies are directed specifically at floodplain restoration, and thus, there is not "*a significant body of knowledge*" concerning the potential restoration of this vital component of the riverine ecosystem.

2. *[The literature] documents the ability to reestablish the pre-remediation conditions and functions of the affected habitats.*

The literature on river restoration, and the relatively few successful examples, are most applicable to reaches where the channel and associated riverbanks and floodplains have been severely altered by channelization, filling and/or drainage of aquatic features of the floodplain, or encroachment of urban and industrial developments. These alterations, in turn, cause drying of the floodplain, loss of flood storage capacity, and elimination of suitable habitats for many floodplain species. Implementation of EPA's proposal would cause these types of destruction. Although the wholesale reconfiguration of channels, beds, and banks was appropriate for the Upper 2 Miles of the Housatonic River where severe alterations had previously occurred, they are highly inappropriate for the Rest of River where more natural hydrodynamics and the resultant productive habitats currently exist.

Palmer et al. (2014) describe the intentional shift in urban headwater streams toward highly engineered functions for stormwater management. These projects rarely achieve the intended functions (ecosystem services). In an earlier review paper, Palmer et al. (2010) stated: "*The findings indicate that physical heterogeneity should not be the driving force in selecting restoration approaches for most degraded waterways. Evidence suggests that much more must be done to restore streams impacted by multiple stressors than simply re-configuring channels and enhancing structural complexity with meanders, boulders, wood, or other structures.*" More recently, Palmer et al. (in press) state: "*A strong focus on channel morphology has led to approaches that involve major earth-moving activities such as channel re-configuration with the unmet assumption that ecological recovery will follow*"; and "*Our review showed there remains a major emphasis on the use of dramatic structural interventions such as completely re-shaping a channel despite growing scientific evidence that such approaches do not enhance ecological recovery and the data we assembled (Table 2) suggest they are generally ineffective in* *stabilizing channels when that is the primary goal.*" Therefore, it is clear that given its large spatial extent, limited period, and available techniques, EPA's proposal is unlikely to be successful in establishing pre-remediation ecological conditions or services. As stated previously, and shown in our revision of EPA's trajectory figure (Fig. 1), a novel ecosystem will develop over an extended time period of decades, but it will be one that is quite different from the current riverine ecosystem (Fig. 2).

3. *Accordingly, restoration is expected to be fully effective and reliable in returning these habitats . . . to their pre-remediation state.*

For floodplain habitats, this is not true for multiple reasons, many of which were covered in detail in Sections 5-8 of the Revised CMS. Here, we offer four examples from the literature of why restoration will not reliably return floodplain habitats – forested wetlands, emergent wetlands, riparian areas – to their pre-remediation states.

Jansson et al. (2007) found that animal and plant species affected before or during restoration of rivers do not necessarily return after restoration, and that an inability to manage invasive plants leads to novel ecosystems: "*Species that have been lost from a stream cannot be assumed to recolonize spontaneously, calling for strategies to ensure the return of target species to be integrated into projects. Possible effects of invasive exotic species also need to be incorporated into project plans, either to minimize the impact of exotics, or to modify the expected outcome of restoration in cases where extirpation of exotics is impractical.*"

Moreno-Mateos et al. (2012) and Gebo and Brooks (2012) compared multiple wetland mitigation projects to reference wetlands and found that neither the structure nor function of wetlands were being replaced with current restoration or mitigation practices. In a meta-analysis of 621 wetland restoration projects, Moreno-Mateos et al. (2012) found that: "*Ecological restoration to recover critical ecosystem services has been widely attempted, but the degree of actual recovery of ecosystem functioning and structure from these efforts remains uncertain.*" Gebo and Brooks (2012) showed that fringing wetlands along lakes had the highest probability of successful replacement, whereas vegetated depressions and forested wetlands were most vulnerable to failure. Under EPA's proposal, 14 acres of emergent wetland and 36 acres of forested wetland will be destroyed (see Table 11 of GE's comments on proposed remedy); and with a low likelihood of successful replacement of structural and functional features, the ecological value of these areas of the Rest of River floodplain will decline substantially.

Bernhardt and Palmer (2011), in summarizing river restoration practices, stated that "*given that a number of studies have now found no ecological improvement from channel reconfiguration projects and, in some cases, even found evidence of increased degradation (e.g., Tullos et al.2009), future restoration approaches should keep earthmoving activities to a minimum, particularly if they include the removal of trees.*"

Buchanan et al. (2012) offered extensive recommendations on how to critically model and monitor the complex hydrodynamics of river restoration projects, but they also realized how in-stream processes interact with restoration of floodplains: "*Problems with stream restoration projects involving floodplain creation, regrading, or clearing have been largely attributable to low hydraulic roughness over the floodplain.*" The authors expressed these concerns for relatively short reaches on a single river. What should be of significant concern for the Rest of River are the extensive areas of river channel, riverbank, and floodplain that will be disturbed simultaneously during the remediation process (see Section 2.5). Even if work is performed on short reaches or small areas, the cumulative floodplain and wetland revegetation efforts will not have sufficient time to produce "roughness" across the floodplain to counter the inevitable heavy rainfall and flooding events that will occur during the first few years of vegetation establishment. Newly planted areas, even after several years, will have reduced rooting masses, with less chance of resisting erosion and loss of soil during harsh weather events. Non-forested open areas will dominate any remediated floodplain areas, translating to loss of mature forest habitat and species, and fragmentation of the forested riverine corridor. Large trees in a forested floodplain are irreplaceable and without them, shade is reduced, water and land surface temperatures increase, species dependent on large trees are lost, and opportunistic invasive plants will proliferate, further degrading the ecological integrity of the system.

4. The likelihood of effective restoration is equal under any of the alternatives.

Under EPA's proposed remedy, the types and spatial extent of remediation activities will not be able to "*keep earth-moving activities to a minimum*" (Bernhardt and Palmer 2011) or produce sufficient native vegetation cover to protect land surfaces from erosion. The objective of reducing sedimentation will be negated by increased losses of sediment and soil from newly constructed riverbeds, riverbanks, and floodplains. These types of post-remediation problems will lead to even more damage to aquatic ecosystems in the Rest of River than the actual remediation process.

2.6.4 Vernal Pools

We again refer back to the four statements from EPA's Comparative Analysis described above to evaluate their relevance to ease of restoring vernal pools in the ROR.

1. There is a significant body of knowledge with respect to ecosystem restoration.

There is a fair amount of information about creating vernal pools and we recently reviewed the state-of-the-art of pool creation in a peer-reviewed paper (Calhoun et al. 2014) that is attached as Exhibit D-4 hereto. Our review of the literature indicates that vernal pool creation is an imperfect science (Calhoun et al. 2005, Windmiller and Calhoun 2008, Denton and Richter 2013). There is a lot of gray literature (not peer-reviewed) on pool creation methods (i.e., how-to guidance books for pool creation), but the peer-reviewed scientific studies that evaluate the success of pool creation raise serious doubts about the efficacy of these methods in conserving target pool-breeding species.

2. [The literature] documents the ability to reestablish the pre-remediation conditions and functions of the affected habitats.

Collectively, the peer-reviewed literature cautions against assuming pool creation will successfully create suitable habitat for obligate or target vernal pool species. It suggests that the key to effective vernal pool creation is attention to context: For example, what was the historical landscape distribution of wetlands and vernal pools and what is the current distribution? What are the target species of concern? Where will source populations come from if pools fail? What is the condition of the post-breeding habitat (e.g., the adjacent forest)? EPA's statement that the literature "*documents the ability to reestablish pre-remediation conditions and functions*" of vernal pools habitats is unfounded given: (a) the destruction of all or parts of numerous pools in the floodplain and clear cutting of mature forest and soil removal in adjacent post-breeding forested habitat; (b) the current pool context (a series of high functioning vernal pools that are connected through mature forested corridors and are habitat for target species that are sensitive to this type of destruction, such as wood frogs and fairy shrimp); and (c) the difficulty in re-establishing natural hydroregimes and soil substrates in artificially constructed pools.

3. *Accordingly, restoration is expected to be fully effective and reliable in returning these habitats, including vernal pool habitat, to their pre-remediation state.*

There are many reasons why this statement is invalid (e.g., difficulty in recreating appropriate hydroperiods, soil conditions and suitable post-breeding habitat) and these restoration liabilities have been discussed in depth in previous documents (e.g., in the response to vernal pool remediation in the Revised CMS, our vernal pool White Paper shared with EPA in 2012, and the pool creation literature review published by Calhoun et al. 2014). We focus on two key factors here: (1) EPA's use of the Massachusetts Natural Heritage and Endangered Species Program (NHESP) measure of success for vernal pool certification is inappropriate; and (2) the experience with the restoration of one vernal pool in the floodplain upstream of the Rest of River provides no basis for the conclusion that the vernal pool network of the Rest of River can be recreated in the highly degraded and/or deforested river floodplain that will exist following the implementation of EPA's proposal.

First, the evidence of breeding by any vernal pool amphibian sufficient for certification of a vernal pool under the Commonwealth's regulations is not appropriate to evaluate the potential population-wide effects on pool-breeding amphibians by destruction of both pool and terrestrial habitat at the scale proposed by EPA for the Rest of River. The MA NHESP's evidence-of-breeding criterion for certification is designed to protect vernal pools with this modest showing, not to maintain the population persistence of more diverse populations of pool-breeding amphibians or to maintain other vernal pool ecosystem services (e.g., resting and foraging sites for mammals, birds, and other herpetofauna (Mitchell et al. 2008), biogeochemical services including nutrient cycling and transformations (Capps et al. in press), or hydrologic functions (Mushet et al. in revision). These guidelines were NOT intended or crafted for determining whether a remediated pool meets the goal of sustaining current population levels of pool-breeding amphibians or other landscape-scale pool functions (see Lichko and Calhoun 2003, Calhoun et al. 2014).

Second, EPA's experience with the remediated and "restored" vernal pool known as 8-VP-1 is no evidence that the over 40 vernal pools that could be affected by EPA's proposal (as an upper-bound estimate) can be effectively restored. The single remediated vernal pool does now provide appropriate breeding habitat for wood frogs in some years (following a dry-down year) but also serves as a potential sink in years when hydrologic conditions allow green frogs to successfully breed there, which is devastating for sensitive vernal pool species. This mixed result tells us nothing about the effect of the remediation proposed by EPA for the Rest of River.

The relevant study would require baseline research on amphibian breeding populations of an analogous section of river with multiple pools and associated terrestrial habitat followed by a recovery study. Given that this is not possible, one needs to rely on broader scale studies that compare reference pools to mitigated pools with sample sizes large enough to be statistically significant (Calhoun et al. 2014). Findings from these studies are more relevant to guiding decision-making with respect to pool integrity in this system than are findings from a single, relatively undisturbed site where there is a strong local population of pool-breeders to recolonize a pool.

We have already summarized that body of literature in Calhoun et al. 2014. In short, vernal pool functions (within the pool footprint and as related to adjacent terrestrial habitats and ecosystem connections) cannot be adequately replaced in most cases and most certainly should not be used as a rationale for justifying destruction of intact breeding and post-breeding amphibian habitats, particularly at the scale currently proposed for the Rest of River.

4. The likelihood of effective restoration is equal under any of the alternatives.

Given that the degree of vernal pool remediation varies significantly among alternatives and that there is a high likelihood of vernal pool restoration failure, this is not true. Success of creation efforts hinges strongly on successful recreation of hydrology, soil conditions, adjacency of mature forest suitable for post-breeding habitat and connections to other wetlands, and healthy source populations from nearby pools, none of which will be available in the current proposed remediation for the Rest of River. The level and extent of habitat destruction vary greatly among remediation plans and are of supreme relevance to the level of restoration success.

2.6.5 EPA's Restoration Examples

We reviewed the case studies provided in EPA's Appendix D for relevance to potential success of the proposed remediation and restoration activities in the Housatonic. None of the case studies cited as examples of successful restoration is appropriate for comparing the potential outcomes of the proposed remediation and restoration efforts in the Rest of River (see Woolsey et al. 2007 on the importance of closely matching proposed restoration outcomes specifically with relevant reference metrics for each critical ecosystem function). The Rest of River is an ecologically vibrant reach of river as described below:

The Housatonic River watershed is critical to biological conservation in Massachusetts. The Western New England Marble Valleys ecoregion that spans the lowlands of the Housatonic watershed is characterized by calcium-rich conditions that support some of the rarest plants, animals, and natural communities in the state. The watershed currently contains 110 plant species and 51 animal species protected by the Massachusetts Endangered Species Act (MESA) (NHESP 2010).

The EPA proposal would cause extensive damage to a river and floodplain that winds for more than 10 miles through a diverse ecosystem that includes an extensive complex of riverbed, riverbank, wetland, floodplain, and backwater habitats. That complex system includes a largely unfragmented forested floodplain corridor and provides exceptional habitat for many wildlife and plant species, including over 50 rare species listed by the State. By contrast, the Provo

River, Kissimmee River, Big Spring Creek, Nine Mile Run, and Clark Fork River restoration projects identified by EPA were focused on rivers that were physically, chemically, and biologically degraded either in urban (Clark Fork, Nine Mile Run) or agricultural (Provo, Kissimmee) settings, and/or largely in semi-arid riparian settings in the western U.S. (Clark Fork, Provo, Big Spring Creek). In all of these cases, the river sections had been channelized, dammed, or otherwise physically and/or chemically compromised and restoration efforts consisted of removing point and non-point source pollutants and restoration or complete creation of the physical structure of the systems (restoring stream banks, meanders, hydrologic flows to floodplains, etc.). None had intact floodplain and bank ecosystems well connected to a diversity of other wetland resources, with the biodiversity and ecological integrity of the Rest of River. In addition, some of the restoration activities are still in progress and assessment of successes is premature.

2.6.5.1 Provo River Project, UT (URMCC 2011, cited in EPA's Appendix D)

Prior to restoration, the Provo River consisted of a highly altered river system that was created during the 1940s and 1950s when the river was dammed, channelized, and placed between dikes as part of federal water reclamation projects. It was a straight river channel running through agricultural land. The goal of the restoration project was to realign the river to a more natural, meandering pattern and provide a protected corridor along the river – or, in other words, to make it more like the current Rest of River. This is very different from attempting to re-establish the conditions of a highly productive natural ecosystem.

Relevance to Housatonic: The 12-mile Provo River section that was remediated was highly physically degraded in a landscape dominated by agriculture and semi-arid landscape riparian vegetation. **This project was a physical restoration to remediate past structural degradation of a river system.**

2.6.5.2 Kissimmee River, FL (Mossa 2009, cited in EPA's Appendix D)

Similar to the Provo River, the Kissimmee River prior to restoration consisted of a channelized canal that was created for flood protection in the 1960s by cutting and dredging a 30-foot deep straightaway through the river's former meanders. The restoration project included backfilling approximately 8 miles of the canal to reconnect and restore flow to the former river channel, and the removal of existing levees, water control structures, and various infrastructure improvements within the project area, including a number of headwater lakes. This project re-established flow to much of the former river channel and associated wetlands. This is much different from the promised restoration of the Rest of River because it involved a completely different setting and did not involve the reconstruction of riverbanks or adjacent wetland or other floodplain habitats. The continuation of the project is currently (as of August 2014) stalled in court.

Relevance to Housatonic: The Kissimmee River Basin is dominated by agriculture and marshes. A river that was dammed by flood control structures and drained has been restored to re-flood marsh land and re-establish the expansive wetland area associated with the Everglades. **This project involved a physical restoration to emulate past conditions.**

2.6.5.3 Big Spring Creek, MT (Inter-fluve 2011, cited in EPA's Appendix D)

This project addressed a small (2,600-foot-long) reach of Big Springs Creek that had been channelized and straightened in 1912, with the adjacent floodplain used for numerous industrial purposes until the mid-1980s. The work involved constructing a 4,000-foot-long meandering channel adjacent to the man-made channel while water continued to flow down the artificial channel.

Relevance to the Housatonic: This project provides no precedent for restoration of the 10+ miles of meandering river and densely wooded riparian floodplain corridor in the Rest of River. Further, the relevance of this project for riverbank reconstruction is undermined by the fact that it was performed in the dry, whereas EPA's proposal would involve riverbank restoration through flowing water, which would preclude use of several bioengineering restoration techniques. **The only commonality was an issue with PCBs** (see page 120 of the Inter-fluve report for PCB contaminant details), **but the banks, streambed, and floodplains of the river were *not* excavated. The stretch of river remediated was already highly degraded and physically and chemically and biologically compromised.**

2.6.5.4 Nine Mile Run Restoration Project, PA (see Powerpoint available at http://www.fws.gov/chesapeakebay/masrc/MASRC%20PDFs/A_session_web/9_A_Anderson.pdf)

This project addressed a two-mile reach of Nine Mile Run in Pittsburgh, which was a completely urbanized stream that had been subjected to 90 years of abuse from urban activity. According to one account, it was "polluted into lifelessness, buried in culverts, insulted with trash, gouged by flash floods, and stripped of its floodplain by vast piles of slag," and "was as close to biological death as a stream could get" ("Nine Mile Rerun," *Landscape Architecture*, Nov. 2007). The restoration project included removal of rocks, channel reconfiguration, creation of riffle and pool sequences, riverbank stabilization, and installation of native plantings.

Relevance to Housatonic: Restoration of biologically dead streams like this, where anything is better than its prior condition, is no precedent for efforts to restore the complex existing system of diverse environments and their wildlife that would be required if the EPA proposal is implemented in the Rest of River. Such efforts are much less likely to succeed than restoring a dead stream to life. Most of the work was to reduce source pollutants, re-introduce structure into the stream, and to stabilize the highly eroded and degraded banks. No river floodplain, banks, or streambeds were removed.

2.6.5.5 Loring Air Force Base, ME (see site visit summary report by Brooks et al. dated April 27, 2010 and Powerpoint presentation prepared for September 2012 meeting with EPA, attached as Exhibits D-30 and D-31)

This project in northern Maine involved restoration of 2.5 miles of a small streambed and 35 acres of riparian wetlands after remediation to remove PCB contaminated soils and sediments.

Relevance to Housatonic: The Loring "unnamed stream" drains just one square mile and has a minimal floodplain as is typical of 1st and 2nd order streams. In contrast, the Housatonic River is a large, dynamic river (draining approx. 180 sq miles above the Rest of River) with extensive floodplains and riparian wetlands characteristic of a 5th order river. Reaches 5A and 5B of the Housatonic River are characterized by high, undercut banks whereas the Loring AFB stream is characterized by low, primarily stony banks. Wetlands in much of the Rest of River are dominated by vegetation adapted to regular flooding, notably an understory of ferns and herbs under a tall forest canopy. Wetlands at the Loring site are dominated by species that do not tolerate flooding, notably tall shrubs such as alders and coniferous trees. The Rest of River has an array of at least 58 productive, naturally occurring vernal pools (or wetland depressions). The Loring restoration site had no documented vernal pools prior to restoration. Created pools visited in 2010 showed minimal pool-breeding amphibian activity. **In summary, Loring is an unsuitable comparison for the Housatonic due to differences in: watershed size and river hydraulics; number and type of banks and vernal pools; plant communities and soil types; and sensitive habitats of rare species.**

2.6.5.6 Clark Fork River, MT (MNRDP 2008; CERTAC 2009; EPA 2011 – cited in EPA's Appendix D; also see updates to this project at: http://www.cfrtac.org/061913.html).

This project has three components. The first component, and the only portion where restoration has been completed, was a headwater creek that was totally dead due to metals contamination from mining waste; it contained no living plants or aquatic life whatsoever. In that creek, the contaminants were removed, a new substrate was placed, and plantings were installed. The second component, involving the Clark Fork itself, is ongoing (see below), so cannot be a precedent for successful restoration. The third component is the Milltown Reservoir, where the dam was removed, the metals in sediments were cleaned up, and the State is restoring 2.5 miles of river upstream from the dam. An update (the project is still ongoing) and photos can be found at the Clark Fork River restoration website: http://www.cfrtac.org/061913.html.

Relevance to Housatonic: As noted above with respect to Nine Mile Run, restoration of the dead headwater stream is irrelevant to EPA's suggestion that the thriving ecosystem of the Rest of River could be restored after the widespread damage inherent in implementation of EPA's proposal. In addition, comparisons to remediation efforts for a static reservoir are irrelevant to remediation of a flowing river. Furthermore, the Clark Fork River is situated in a semi-arid region where the floodplain is dominated by willows and shallow river banks. The context and ecological function of this system and the Housatonic are not comparable. **This project involves the attempted restoration of a historic river channel and highly toxic reach of river through excavation and recreation. The clean-up is still ongoing and results of the efficacy of the project in restoring ecological functions, except for difficulty in revegetating the floodplains, remain to be seen.**

2.6.6 Attributes of a Restored Ecosystem

Section 2.6.4 of EPA's Appendix D presents nine attributes of a restored ecosystem based on the SER International Primer on Ecological Restoration (SER 2004). We respond to two of these in detail (Attributes 1 and 2), and for the other seven attributes we make summary observations based on our responses elsewhere in this document.

1. The restored ecosystem contains a characteristic assemblage of the species that occur in the reference ecosystem and that provide appropriate community structure.

As mentioned above, only 16% of the river restoration projects reviewed by Palmer et al. (in press) showed improvement. In the case of the Housatonic ecosystem, the most appropriate reference ecosystem is the current ecosystem, prior to the proposed remediation, that will necessitate restoration. Revegetating the bare substrate remaining after major earthworks is not too challenging, because "nature abhors a vacuum." However, there is world of difference between making a site green and restoring some semblance of the native flora, the suite of plant species indigenous to a particular environment. That difference is obvious from an analysis of 249 cases of restoring 172 plant species (Godefroid et al. 2011) in which only 29% of efforts were deemed successful by the people who undertook the restoration, despite using a low bar for success based simply on survival rather than reproduction. Also, germane to the "time required for adaptive management" issue discussed above, the authors found that metrics of success actually declined through time after a restoration. For example, percent of individuals flowering (one key to long term persistence) diminished steadily through time and averaged only 6% after 4 years. One study of restoring native plants is of particular interest because it was executed in Massachusetts and had a substantial sample size: almost 30,000 propagules in 596 plots. Fifteen years after a reintroduction project at two reserves outside Boston, Drayton and Primack (2011) revisited reintroduced populations of eight plants species and discovered that six species were entirely gone, one had limited success, and only one was well established. Ecosystem restoration proponents generally assume that animal species will recolonize a site on their own. This is unlikely in the case of many riverine animal species in the Rest of River, given the vast extent of the proposed intervention and the rather different environments upstream and downstream of the remediation areas, which are unlikely to harbor the same suite of species.

2. The restored ecosystem consists of indigenous species to the greatest practicable extent.

There is a high risk of greatly increasing the abundance of exotic invasives in the Rest of River. Exotic plants are already prevalent with 18 problematic species listed. Conditions will improve substantially for most exotic invasive species with extensive areas of exposed soil (both backfill and new sediments), less competition from native species removed during remediation, and more sunlight following forest canopy removal (a factor relevant to both aquatic and terrestrial species). Furthermore, access roads, staging areas, and the movement of vehicles and soil will all increase invasions of propagules. EPA documents imply that controlling exotics is straightforward, but this is not the case. One analysis (Kettenring and Adams 2011) examined 335 research papers covering control of 110 invasive plants species and reported: "*Regardless of control method, our meta-analysis revealed that few studies produced gains in native plant cover, density or biomass*." The authors also warned about the negative ecosystem impacts of invasive control: "*Herbicide was the most commonly implemented and, according to our meta-analysis, the most effective control method for reducing invasives. However, native species response to herbicide was highly variable, probably because this broad-scale approach can hinder native species establishment through seed limitation.*" In fact, there can be unintended consequences of using particular techniques to control invasive exotics (see Skurski et al. 2013).

3. All functional groups necessary for the continued development and/or stability of the restored ecosystem are represented, or, if they are not, the missing groups have the potential to colonize by natural means.

As detailed throughout this document and the Revised CMS, many functional groups will be impaired by the proposed work. To take but one example, sizable trees, notably silver maples, will take many decades to restore, especially the largest trees that have special functional significance (Lindenmayer et al. 2012).

4. The physical environment of the restored ecosystem is capable of sustaining reproducing populations of the species necessary for its continued stability or development along the desired trajectory.

As detailed throughout this document and the Revised CMS, profound changes to the physical environment will be widespread. Three of the most significant are diverse changes in the microclimate due to vegetation removal that affect all aspects of the ecosystem, changes in soil chemistry and hydrology due to the massive amount of earth moving proposed, and major changes to the structure and dynamism of the riverbanks.

5. The restored ecosystem apparently functions normally for its ecological stage of development, and signs of dysfunction are absent.

Because function is tied to the species composition of the ecosystem, this attribute will not be fully achieved because of issues raised above regarding loss of native species and increased populations of invasive species. Regardless of species composition, the restored ecosystem will not function normally because bank stabilization efforts will severely constrain the natural dynamism of the river, as described above.

6. The restored ecosystem is suitably integrated into a larger ecological matrix or landscape, with which it interacts through abiotic and biotic flows and exchanges.

This attribute will not be achieved because the proposed remediation and restoration efforts will lead to fragmentation in two ways. First, the river and its floodplain, which currently constitute a remarkably intact corridor, will be severed. Second, the Rest of River downstream of the more urbanized Upper 2-Mile Reach that was remediated previously will not have the benefit of colonization by plants and animals from upstream because the Upper 2-Mile Reach has only an impoverished biota.

7. Potential threats to the health and integrity of the restored ecosystem from the surrounding landscape have been eliminated or reduced as much as possible.

The key issues in this respect are tied to the access roads, staging areas, and footprint of remediation activities, all of which will result in significant, long-lasting changes in the landscape which will decrease the habitat suitability of the restored ecosystem for the species that currently rely on it and increase the success of invasive species, and other impacts.

8. The restored ecosystem is sufficiently resilient to endure the normal periodic stress events in the local environment that serve to maintain the integrity of the ecosystem.

The ecosystem's resiliency is likely to be significantly compromised by all the issues discussed above.

9. The restored ecosystem is self-sustaining to the same degree as its reference ecosystem, and has the potential to persist indefinitely under existing environmental conditions. Nevertheless, aspects of its biodiversity, structure, and functioning may change as part of normal ecosystem development, and may fluctuate in response to normal periodic stress and occasional disturbance events of greater consequence. As in any intact ecosystem, the species composition and other attributes of a restored ecosystem may evolve as environmental conditions change.

We acknowledge that ecosystems are not static as emphasized in the last two sentences above. Nevertheless, to be self-sustaining, an ecosystem must be resilient and cannot be challenged too severely. The proposed remediation will constitute an overly severe challenge that cannot be rectified by restoration attempts.

3. SUMMARY

As explained throughout this document, the science and practice of ecosystem restoration provide only a tenuous foundation for undertaking a vast, complex project such as the proposed remediation and restoration of the Housatonic Rest of River. To quote Palmer et al. in review again: "*...it is important to remember that stream restoration science is very young... [and that] a unified perspective on how to succeed in restoring rivers has yet to take hold.*" EPA has repeatedly minimized the difficulties involved, for example, by presenting an unrealistically short time-line, by minimizing the impacts of fragmentation, by implying that exotic invasive species will be readily managed, and much more. Perhaps EPA's most fundamental mistake is to assert boldly that "*restoration is expected to be fully effective and reliable in returning these habitats ... to their pre-remediation state.*" No student of restoration ecology would make such an assertion and indeed EPA contradicts itself on this basic issue. If EPA's proposed remedy is implemented, the Rest of River will be severely impaired for many decades, perhaps centuries, and restoration efforts will constitute just a small Band-Aid on a gaping wound.

4. REFERENCES

The literature review for EPA's Appendix D is very limited relative to what is available. Most notably only 6 out of 23 citations by EPA are from peer-reviewed scientific journals (noted by * in Section 4.1 below); 12 papers are from the so-called "gray literature," chiefly reports about particular projects written by the people who undertook them. This is potentially significant because, according to Bernhardt and Palmer (2011): "*Despite a lack of measurable ecological improvement..., most restoration practitioners consider their projects to be successful.*" (Also see Bernhardt et al. 2007.) It is also notable that the literature review is currently rather out-of-date, with no peer-reviewed articles since 2009, and only 5 project reports in 2010 and 2011. To provide some context for the "thinness" of Appendix D's literature, we performed a search of Web of Science using this keyword string – (River* or Stream* or Floodplain*) Restor* – and generated 9,874 references on July 17, 2014. Even if we eliminate citations after 2011, the total is 7,645. Clearly, most of these thousands of papers are only tangentially relevant to the Housatonic remediation and restoration proposal, but many of them are relevant, particularly those that provide an overview evaluation of earlier projects, but unfortunately they do not seem to have provided a foundation for EPA's Appendix D. In the next two subsections, we review the EPA's literature, then provide an annotated set of citations for 30 directly relevant papers that EPA did not cite.

4.1 REVIEW OF REFERENCES ON ECOSYSTEM RESTORATION CITED BY EPA

The papers cited in EPA's Appendix D represent a slim and dated reflection of the literature. Most are on methodologies and guidelines for restoration. The scientific papers cited there all suggest that river restoration is relatively young and a controversial and risky business that is very site-specific and, foremost, should be ecologically based. Thus, Appendix D does not reflect some of the key concepts set forth in the papers that it cites.

We have reviewed all of the papers cited in Appendix D and provide some brief annotations in italics. References about the case studies described in Appendix D are covered in Section 2.6.5 above.

*Bernhardt, E.S., M.A. Palmer, J.D. Allan, G. Alexander, K. Barnas, S. Brooks, J. Carr, S. Clayton, C. Dahm, J. Follstad-Shah, D. Galat, S. Gloss, P. Goodwin, D. Hart, B. Hassett, R. Jenkinson, S. Katz, G.M. Kondolf, P.S. Lake, R. Lave, J.L. Meyer, T.K. O'Donnell, L. Pagano, B. Powell, and E. Sudduth. 2005. Synthesizing U.S. River Restoration Efforts. Science 308:636-637. *(Paper concludes that river restoration is difficult, and more recent literature by Bernhardt and Palmer (2011) and Palmer et al. (in press) raises further concerns regarding river restoration.)*

Field, D.J. 2011. Housatonic River Historical Changes in River Morphology. Field Geology Services, Farmington, ME. March 2011. *(This publication on the straightened section of Rest of River states that there have been historical changes to the river, concluding that the river has already suffered major disturbances and "recovered." This is no justification for the drastic disturbances or destruction of habitat proposed by EPA and no evidence that repairing the resulting damage is likely.)*

Fischenich, J.C., and S. Dudley. 2000. Determining Drag Coefficients and Area for Vegetation. EMRRP-SR-08. (*A technical paper on method of determining drag coefficients.*)

*Kondolf, G.M., M.W. Smeltzer, and S.F. Railsback. 2001. Design and Performance of a Channel Reconstruction Project in a Coastal California Gravel-Bed Stream. *In*: Environmental Management, Vol. 28(6), pp. 761-776. (*This paper illustrates that implementing the concept of channel stability is often a failure and does not meet the goal of channel restoration as it is based on poor assumptions.*)

*Kondolf, G.M. 2006. River Restoration and Meanders. Ecology & Society, Vol. 11(2):42 *(Same conclusions as 2001 work.)*

Lave, R. 2008. The Rosgen Wars and the Shifting Construction of Scientific Expertise. Dissertation, Geography. University of California at Berkeley, Berkeley, CA. *(There is significant controversy over Rosgen Natural Channel Design and its emphasis on bank stability in restoration projects. This paper highlights that the science is still new and there are few new research initiatives. All studies should be very case specific; note the NRCS publications, listed below, are based on Rosgen river classifications.)*

*Lave, R. 2009. The Controversy Over Natural Channel Design: Substantive Explanations and Potential Avenues for Resolution. Journal of the American Water Resources Association (JAWRA), Vol. 45(6). pp. 1519-1532. *(See notes on Lave 2008.)*

Leopold, L.B., and T. Maddock, Jr. 1953. The Hydraulic Geometry of Stream Channels and Some Physiographic Implications. U.S. Geological Survey Professional Paper 252. U.S. Government Printing Office, Washington, DC. pp. 117-127. *(Luna Leopold did pioneering work on fluvial processes; this is a technical review of limited relevance to the Rest of River beyond foundational science.)*

Leopold, L.B., G.M. Wolman, and J.P. Miller. 1992. Fluvial Processes in Geomorphology. Dover Publications, Inc., Mineola, NY. *(An update to Leopold's earlier work.)*

NHESP (National Heritage and Endangered Species Program). 2010. Rare Species and Natural Community Surveys in the Housatonic River Watershed of Western Massachusetts. Massachusetts Division of Fisheries and Wildlife. July 2010. *(A key description of the Housatonic's special ecological status.)*

NRCS (Natural Resources Conservation Service). 2001. Stream Corridor Restoration Principles, Processes, and Practices. *(These are the guidelines discussed in Lave 2008 re: the Natural Channel Design controversy.)*

NRCS (Natural Resources Conservation Service). 2007. Stream 1 Restoration Design, National Engineering Handbook, Part 654, Des Moines, IA. *(Same as above.)*

*Palmer, M.A., E.S. Bernhardt, J.D. Allan, P.S. Lake, G. Alexander, S. Brooks, J. Carr, S. Clayton, C.N. Dahm, J.F. Shah, D.L. Galat, S.G. Loss, P. Goodwin, D.D. Hart, B. Hassett, R. Jenkinson, G.M. Kondolf, R. Lave, J.L. Meyer, T.K. O'Donnell, L. Pagano, and E. Sudduth. 2005. Standards for Ecologically Successful River Restoration. Journal of Applied Ecology, Vol. 42(2). pp. 208-217. *(This paper emphasizes that river restoration is very controversial; it highlights the importance of allowing for a dynamic system and "doing no harm.")*

SER (Society for Ecological Restoration International). 2004. *The SER International Primer on Ecological Restoration.* Science and Policy Working Group. *(This paper is cited because EPA's Appendix D uses their definition of "restoration.")*

*Shields, F.D., R.R. Copeland, P.C. Klingeman, M.W. Doyle, and A. Simon. 2003. Design for Stream Restoration. Journal of Hydraulic Engineering, Vol. 129(3). pp. 575-584. *(Paper concludes that research addressing problems associated with stream corridor ecosystem restoration is beset by numerous problems. First, terms referring to restoration are loosely* *defined. Secondly, stream ecosystems are not amenable to rigorous experimental design because they are governed by a host of independent variables that are heterogeneous in time and space, they are not scalable, and their response times are often too long for human attention spans. These problems lead to poorly controlled or uncontrolled experiments with outcomes that are not reproducible.)*

Smith, S.M. 1997. Changes in the Hydraulic and Morphological Characteristics of a Relocated Stream Channel" MS thesis, University of Maryland, College Park, MD. *(We found the publication that came from this work (Smith and Pestegaard 2005 cited below) and it describes the reasons for failure of one stream rehabilitation project.)*

USFWS (U.S. Fish and Wildlife Service). 2008. Natural Channel Design Review Checklist. *(This checklist is based on traditional river restoration stabilization literature; see Bernhardt 2005, 2006 for illumination of the controversy around stabilizing banks.)*

4.2 A COMPILATION OF 30 SCIENTIFIC PAPERS ON ECOSYSTEM RESTORATION NOT CITED BY EPA

New papers referred to below are attached as Exhibits D-1 through D-29 to this document (excluding the paper by Mushet et al., which has not yet been published). An * denotes peer-reviewed papers.

*Bernhardt, E.S., E.B. Sudduth, M.A. Palmer, J.D. Allan, and J.L. Meyer. 2007. Restoring rivers one reach at a time: Results from a survey of U.S. river restoration practitioners. Restoration Ecology 15(3):482–93. *(Results of a survey of 317 river restoration managers indicate two-thirds of them judge their projects to be successful even though less than half had measurable objectives.)*

*Bernhardt, E.S., and M.A. Palmer. 2011. River restoration: The fuzzy logic of repairing reaches to reverse catchment scale degradation. Ecological Applications 21:1926–1931. *(A brief summary of the river restoration literature and introduction to a collection of papers on the topic that explore the significant limitations on river restoration.)*

*Buchanan, B.P., M.T. Walter, G.N. Nagle, and R.L. Schneider. 2012. Monitoring and assessment of a river restoration project in central New York. River Research Applications 28:216–33. (*A case study that proposes a set of technical monitoring and assessment measures in an effort to assess success and discern failures in river restoration.*)

*Calhoun, A.J.K., J. Arrigoni, R.P. Brooks, M.L. Hunter, and S.C. Richter. 2014. Creating Successful Vernal Pools: A Literature Review and Advice for Practitioners. Wetlands DOI 10.1007/s13157-014-0556-8. (*Review of relevant scientific studies on the science of vernal pool creation concluding that vernal pool functions cannot be adequately replaced in most cases. The authors include two primary researchers in the field of pool creation and restoration, two scientists whose research focus is pool breeding amphibians, and one scientist who has expertise in wetland mitigation, floodplain ecology, and wetland hydrodynamics.)*

*Calhoun, A.J.K., N. Miller, and M.W. Klemens. 2005. Conserving pool-breeding amphibians in human-dominated landscapes through local implementation of Best Development Practices. Wetlands Ecology and Management 13:291-304. *(Recommendations for conserving vernal pools, including taking a landscape approach that incorporates issues of connectivity.)*

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ATTACHMENT E TO GE COMMENTS

Attachment E

Evaluation of Impacts to State-Listed Species from Proposed Remedy (SED 9/FP 4 MOD)

(Prepared by AECOM for General Electric Company)

This attachment presents an evaluation of whether EPA's proposed remedy for the Rest of River, designated SED 9/FP 4 MOD, would cause a "take," as defined in 321 CMR 10.02, of the state-listed endangered, threatened, or special concern species that have Priority Habitat, as mapped by the Massachusetts Natural Heritage and Endangered Species Program (NHESP), within areas that would be disturbed by EPA's proposed remedy. This evaluation includes an assessment of the extent of the local population(s) of each such species and an assessment of whether EPA's proposed remedy would adversely impact a significant portion of the local population(s) of each such species. This evaluation builds and relies upon the detailed assessment presented in Appendix L to the October 2010 Revised Corrective Measures Study Report (RCMS), entitled "Revised Assessment of MESA Issues for Rare Species Under Remedial Alternatives." References in this Attachment to RCMS Appendix L refer to that 2010 appendix.

The total acreage of the mapped Priority Habitats of these species and the acreage of those Priority Habitats that would be impacted by EPA's proposed remedy is provided in Table E-1 at the end of this Attachment. That table does not include impacts from vernal pool remediation, but such impacts are included in the impact estimates in the body of this Attachment. Higher impact values given in this Attachment reflect the upper-bound vernal pool remediation (remediation of all pools with average PCB concentrations greater than 3.3 mg/kg and located outside of Core Area 1). Lower impact values reflect the remediation of 16 vernal pools (based on assuming an initial remediation of 8 pools via excavation and 8 pools via activated carbon application).

Evaluation of Impacts to State-Listed Species from Proposed Remedy (SED 9/FP 4 MOD)

Species Acres in Priority Habitat	Would a Take Occur?	Local Population Assessment	Impact on Significant Portion of Local Population?
American bittern 501 acres in Reach 5 120 acres in Reach 7 Core Area 2 Species	Yes in Reach 5 due to impact on 57-62 acres of bittern Priority Habitat (see Table C-6 of RCMS Appendix L for specific impacts that would result in a take). The higher end of the impact range reflects the upper-bound vernal pool remediation, which would add over 5 acres of impact. No in Reach 7 due to no impacts on bittern Priority Habitat.	Priority Habitat for the American bittern occurs in and contiguous to the Primary Study Area (PSA) in Reaches 5A, 5B and 5C (see Figure C-1 of RCMS Appendix L), and also in Reaches 7D and 7F downstream of the PSA (see Figure C-2 of that appendix). Based on the Priority Habitat mapping and the life-cycle characteristics of the American bittern, two distinct local populations of American bitterns have been identified and evaluated in this assessment. One population of American bitterns was determined to be represented by the mapped Priority Habitat in Reach 5, while the mapped habitat in Reach 7 has been considered to represent a separate and distinct local population. The distance between the southernmost Priority Habitat area within Reach 5 and the northernmost mapped habitat area in Reach 7 is approximately seven miles, encompassing at least 1,500 acres of Housatonic River corridor and floodplain. There are both ecological (habitat) and cultural conditions (e.g., roadways/ bridges, developed areas) through this separation zone that likely function to separate these discrete Priority Habitat areas. Although this species is capable of flight, the home ranges reported in the literature are smaller than the distance between these discrete mapped Priority Habitat areas. Because of the distance between the two discrete areas of mapped Priority Habitats and the relatively high site fidelity of this species, two different local populations of American bittern have been identified for assessment in this section of the Housatonic River.	Yes in Reach 5. Proposed remedy would impact about 11-12% of the total mapped Priority Habitat of this species in Reach 5, much of it high quality bittern habitat. Approximately 6% of the core area for this species would be impacted. The impacts of the river and floodplain remediation would include direct loss of foraging habitat, along with indirect impacts from increased noise, truck traffic, and other construction activities, all resulting in disruption of the bittern's activities in Reach 5 over 10 years. Particularly given the sensitivity and high site fidelity of this species, this long-term disruption of bittern habitat would adversely impact a significant portion of the local bittern population. NA in Reach 7 due to no take. Even if both the Reach 5 and the Reach 7 Priority Habitats were considered to encompass a single local population of the American bittern in the Housatonic River corridor, approximately 9% of the Priority Habitat would be impacted, and 6% of the core area for this species would be impacted. Given the apparent value/size of the Reach 5 habitat, the widespread and long-term disruption to that Priority Habitat area would likely adversely affect the suitability of the overall combined area for that local population.

Species Acres in Priority Habitat	Would a Take Occur?	Local Population Assessment	Impact on Significant Portion of Local Population?
Bald eagle 187 acres in Reach 5	Yes in Reach 5 due to 45-48 acres of impact within the bald eagle Priority Habitat (see Table D-6 of RCMS Appendix L for specific impacts that would result in a take).	The total Priority Habitat of the bald eagle in Reach 5C comprises approximately 187 acres, with 136 acres of this Priority Habitat within the PSA (see Figure D-1 of RCMS Appendix L). Given this species' large home range and capacity for long-distance flight, it is likely that the individual bald eagles which utilize the habitat within the Reach 5C could interact with other bald eagles in the western and central portions of Massachusetts. The 187-acre mapped Priority Habitat in Reach 5C may provide a core habitat for the individual breeding eagles and foraging activities at this location, with the local population for this species extending to other areas of suitable habitat in western and central Massachusetts (i.e., those areas also having large water bodies with shallow waters and abundant fish and surrounded by mature forest).	Unlikely. Proposed remedy would impact approximately 24-26% of the mapped Priority Habitat, including work in multiple years. While these impacts could result in abandonment of breeding and foraging sites in Reach 5C, it is unlikely that this loss would affect a significant portion of the local bald eagle population because that population is expected to extend well beyond the Reach 5C Priority Habitat.
Bristly buttercup 30 acres in Reach 5 Core Area 1 Species	Yes, due to 1.5 acres of impact within the bristly buttercup Priority Habitat (see Table V-5 of RCMS Appendix L for specific impacts that would result in a take).	Priority Habitat of the bristly buttercup occurs in two locations in Reach 5 (see Figure V-1 of RCMS Appendix L), and these are considered to comprise the local population of this species. The first area is 29 acres in the central portion of Reach 5A to the west of the Housatonic River. The second location consists of two small areas (each less than 0.5 acre in size) outside of the river channel along the east and west banks of the Housatonic River in the lower portion of Reach 5C Although these two occurrences are at different ends of Reach 5, roughly seven miles apart, seed dispersal over this distance is possible via river water, given the lack of significant constrictions or disruptions in river flow over this stretch of the Housatonic. Therefore, these mapped Priority Habitat areas are considered to comprise the local population of this species. There is no bristly buttercup Priority Habitat mapped in Reaches 6, 7 or 8.	No. Proposed remedy would only impact approximately 5% of the total mapped Priority Habitat of this species, and only a portion of this (0.6 acre) would take place in the floodplain (preferred habitat for this species). Approximately 3% of the core area for this species would be impacted.

Species Acres in Priority Habitat	Would a Take Occur?	Local Population Assessment	Impact on Significant Portion of Local Population?
Brook snaketail 205 acres in Reach 5 173 acres in Reach 7	Yes in Reach 5 due to 53-55 acres of impact within the brook snaketail Priority Habitat (see Table I-5 of RCMS Appendix L for specific impacts that would cause a take). No in Reach 7 due to no impacts on Priority Habitat.	Priority Habitat of the brook snaketail comprises 205 acres within Reach 5A, with 158 acres located within the PSA. The habitat extends from the confluence of the East and West Branches downstream for approximately two miles (see Figure I-1 of RCMS Appendix L). Additional Priority Habitat for the brook snaketail occurs downstream of Woods Pond, in Reach 7 of the Housatonic River. The habitat area begins in the proximity of the Route 7 Bridge in Reach 7F and continues downstream for about 2 miles to approximately the Stockbridge Golf Course Bridge (see Figure I-2 of RCMS Appendix L). The total Priority Habitat mapped in Reach 7 covers 173 acres. The Priority Habitats in Reach 5 and Reach 7 are considered to encompass separate local populations due to the various extents of unsuitable habitat conditions between Reach 5 and the beginning of the Priority Habitat in Reach 7. While adults of the species can fly, they are considered a short-flight species and no habitat is mapped for approximately 19 river-miles downstream of the southernmost Priority Habitat in Reach 5.	Yes in Reach 5. Proposed remedy would impact approximately 26-27% of the total Priority Habitat in that reach, including the entire larval Priority Habitat within Reach 5 (~ 25 acres). The latter impacts would cause direct mortality of any larvae present and alteration of their feeding habitat. In addition, over 28 acres of the floodplain Priority Habitat in Reach 5A would be impacted through vegetative clearing, which would adversely affect adults using those areas. The cumulative impacts of the sediment and floodplain remediation would result in impacts to a significant portion of the local population. See also Table I-5 of RCMS Appendix L. NA in Reach 7 due to no take.
Bur oak 454 acres in Reaches 5/6 24 acres in Reach 7 Core Area 1 Species	Yes in Reaches 5 and 6 due to impacting 27-28 acres of bur oak Priority Habitat (see Table W-6 of RCMS Appendix L for specific impacts that would cause a take). No in Reach 7 due to no impacts on Priority Habitat.	Priority Habitat of the bur oak occurs throughout Reaches 5B, 5C, and 6. The habitat begins from the extreme downstream section of Reach 5B and runs throughout Reach 5C, and in Reach 6 near the north, south and east shores of Woods Pond (see Figure W-1 of RCMS Appendix L). Approximately 24 additional acres of mapped Priority Habitat occur in two locations within Reach 7 between the Willow Mill Dam and South Street in Stockbridge, Massachusetts (see Figure W-2 of RCMS Appendix L). The first area is located on the southern side of the Housatonic River within floodplain forest habitat and is approximately 23 acres in size. The second area is less than 1 acre in size and is located to the north of the river in forested habitat approximately 1,000 feet outside of the	No. Proposed remedy would impact approximately 6% of the total Priority Habitat in Reaches 5/6. Approximately 2% of the core area for this species would be impacted. No impacts would occur within the Reach 7 Priority Habitat.

Species Acres in Priority Habitat	Would a Take Occur?	Local Population Assessment	Impact on Significant Portion of Local Population?
		floodplain. Based on the Priority Habitat mapping, the characteristics of the bur oak, distances between mapped areas, and ecological factors in the intervening areas, three distinct local populations of bur oak have been identified and evaluated. In Reaches 5 and 6, the bur oaks (and any of its propagules) within the entire 454 acres of Priority Habitat in Reaches 5B, 5C and 6 constitute a single local population. Those within the 23-acre bur oak Priority Habitat to the south of the Housatonic River in Reach 7 constitute a distinct local population given that this area is over 8 miles downstream from the local population in Reaches 5 and 6, and there are several impoundments and other cultural features (e.g., developed areas, road crossings, etc.) that would limit the distribution of bur oak downstream over this 8-mile distance. The bur oaks within the Priority Habitat area in Reach 7 to the north of the river also constitute a separate local population given its location outside of the Housatonic River floodplain.	
Common moorhen 427 acres in Reaches 5/6 10 acres in Reach 7 Core Area 2 Species	Yes in Reaches 5 and 6 due to impacting 104-108 acres of the Priority Habitat (see Table E-6 of Appendix L in the RCMS for specific impacts that would cause a take). No in Reach 7 due to no impacts on Priority Habitat.	Priority Habitat of the common moorhen in the Housatonic River corridor upstream of Woods Pond Dam occurs in Reaches 5A, 5C, and 6 (see Figure E-1 of RCMS Appendix L). No mapped habitat occurs for the common moorhen in Reach 5B. Two small habitat areas exist in Reach 5A to the north of Utility Drive, on the east side of the Housatonic River. A third, larger habitat area begins in the upper portion of Reach 5C and continues downstream into Woods Pond. The area of Priority Habitat associated with the common moorhen in Reaches 5 and 6 is 427 acres, 297 acres of which are within the lateral boundaries of the PSA. An additional 10 acres of Priority Habitat for the common moorhen occurs downstream of Woods Pond within Reach 7 of the Housatonic River between South Street and Ice Glen Road in Reach 7F (see Figure E-2 of RCMS Appendix L). Based on the current Priority Habitat mapping and the life-cycle characteristics of the common moorhen, two	Yes in Reaches 5 and 6. Proposed remedy would impact approximately 24-25% of the total Priority Habitat in those reaches, with those impacts occurring primarily in the aquatic and backwater habitats used by this species in Reaches 5C and 6. Approximately 10% of the core area for this species would be impacted. Habitat impacts would include the loss of preferred habitat conditions that support foraging activity, along with breeding and nesting activity. Those impacts would be extensive enough to affect a significant portion of the local population. NA in Reach 7 due to no take.

Species Acres in Priority Habitat	Would a Take Occur?	Local Population Assessment	Impact on Significant Portion of Local Population?
		distinct local populations of this species have been identified in Reaches 5 and 6 and Reach 7, respectively. The local population in Reaches 5 and 6 consists of the birds present in the entire 427-acre Priority Habitat in those reaches, including 297 acres within the PSA. The distance along the river corridor between the southernmost Priority Habitat area within Reach 6 and the mapped habitat area in Reach 7 is approximately nine miles. There are both ecological (habitat) and cultural conditions (e.g., roadways/bridges, developed areas) through this separation zone that are likely to separate the local populations of common moorhen using these distinct habitat areas. The seven miles between the Reaches 5/6 and Reach 7 Priority Habitat areas include significant breaks in habitat such as downtown Lee and the Massachusetts Turnpike. Given the strong site fidelity of the common moorhen, its short, local flight pattern, the small home range sizes of this species, and this separation in habitat, it is not plausible that there would be any significant interaction of common moorhens between the Reach 5/6 area and the Reach 7 area. While winter migration patterns may result in some encounters between individuals of these areas, these would likely be short, random encounters and not material to the function of the local populations.	
Creeper 103 acres in Reach 7	Yes, due to 2.7 acres of riverine impacts within the Priority Habitat of the creeper in Reach 7E, causing a take through burial or removal of creepers within sediment removal or capping areas.	Priority Habitat of the creeper occurs in three segments of the Housatonic River in Reach 7 (Reaches 7D, 7E, and 7F), comprising a total of 103 acres (see Figure J-1 of RCMS Appendix L). Based on the current Priority Habitat mapping, the habitat conditions through the mapped stretches of the River, and the life-cycle characteristics of the creeper, the three mapped Priority Habitats in Reach 7 encompass one local population of this species. In their larval stage, creepers are reliant upon host fish species. The home ranges of some of the known host species are small, but the distances between mapped Priority Habitat areas are well within the home ranges of some fish host species.	No. Impacts would occur to less than 3% of the Priority Habitat of this species.

Species Acres in Priority Habitat	Would a Take Occur?	Local Population Assessment	Impact on Significant Portion of Local Population?
Crooked-stem aster 15 acres in Reach 5 Core Area 1 Species	Yes, due to impacting 0.3 acre of the Priority Habitat of this species (see Table X-5 of the RCMS Appendix L for specific impacts that would cause a take).	Two mapped areas of Priority Habitat for crooked-stem aster occur in the southern portion of Reach 5B, both just south of New Lenox Road (see Figure X-1 in RCMS Appendix L). The larger of the two occurs along the west side of the river; a small area occurs to the west of this location beyond the floodplain. Based on the Priority Habitat mapping and the characteristics of this species, the local population of the crooked stem aster consists of the plants (and seeds or other propagules) of this species present in all of the mapped Priority Habitat in the above-described locations identified within Reach 5. Although the smaller mapped area occurs outside of the Housatonic River 100-year floodplain, the two areas are in close enough proximity to each other (less than 1000 feet apart) that transport of seeds by air or wildlife between these two locations is likely.	No. Proposed remedy would impact 2% of the total Priority Habitat.
Foxtail sedge 137 acres in Reach 5	Yes, due to 12-13 acres of impact within the floodplain portion of the foxtail sedge Priority Habitat (see Table AA-6 of the RCMS Appendix L for specific impacts that would cause a take).	Priority Habitat of the foxtail sedge comprises 137 acres (66 acres within the PSA), extending contiguously from Reach 5B, 1,200 feet north of New Lenox Road, to the northern edge of Reach 5C (see Figure AA-1 of RCMS Appendix L). The local population of this species consists of the foxtail sedge plants and propagules within the entire 137 acres of mapped Priority Habitat	Possibly. The floodplain remediation and access/staging areas would impact approximately 12-13 acres of the floodplain portion of the mapped Priority Habitat of this species, which comprises 9% of the total Priority Habitat. Much of this affected floodplain habitat appears suitable for this species.
Gray's sedge 148 acres in Reach 5 Core Area 1 Species	Yes, due to 3.4 acres (0.2 acre in the floodplain) of impact within the Gray's sedge Priority Habitat (see Table CC-6 of the RCMS Appendix L for specific impacts that would cause a take).	Priority Habitat for Gray's sedge occurs within Reach 5C, consisting of two areas separated by the Housatonic River from approximately 1 mile south of New Lenox Road to the southern extent of Reach 5C near Woods Pond (see Figure CC-1 of RCMS Appendix L). The Priority Habitat for Gray's sedge comprises approximately 148 acres, of which 118 acres are located within the PSA. The local population of the Gray's sedge consists of the Gray's sedge plants (and seeds or other propagules) present on both sides of the river within the entire 148-acre area of Priority Habitat mapped within Reach 5C.	No. Only a small proportion (<3%) of the Gray's sedge Priority Habitat would be impacted under proposed remedy, and only 0.2 acre would be in the floodplain, where this species is most likely to occur.

Species Acres in Priority Habitat	Would a Take Occur?	Local Population Assessment	Impact on Significant Portion of Local Population?
Hairy wild rye 27 acres in Reach 5 Core Area 1 Species	Yes, due to 1.2 acres of impact with the Priority Habitat of this species (see Table DD-5 of RCMS Appendix L for specific impacts that would cause a take).	Priority Habitat of hairy wild rye comprises 27 acres (19 in the PSA) in the central portion of Reach 5A northeast of the Pittsfield Wastewater Treatment Facility on the west side of the Housatonic River (see Figure DD-1 of RCMS Appendix L). The local population of this species consists of the plants and seeds of this species in the 27 acres of mapped Priority Habitat in Reach 5A.	No. Proposed remedy would impact only approximately 4% of the total Priority Habitat of this species. There would be no impacts to the 15.2-acre core area for this species.
Intermediate spike-sedge 275 acres in Reach 5 33 acres in Reach 7 Core Area 1 Species	Yes in Reach 5, due to the impact on 119-128 acres of the Priority Habitat of this species in Reach 5 (see Table EE-5 of RCMS Appendix L for specific impacts that would cause a take). No in Reach 7 due to no impacts on Priority Habitat.	Priority Habitat of the intermediate spike-sedge comprises 275 acres (267 acres in the PSA) extending through all of Reaches 5A and 5B and into the central portion of Reach 5C (see Figure EE-1 of RCMS Appendix L). An additional 33 acres of mapped Priority Habitat are located within Reach 7, to the south of the Route 102 Bridge in Lee, Massachusetts (see Figure EE-2 of RCMS Appendix L). The two Priority Habitat areas are considered to comprise two distinct local populations of this species. Given the distance between the population in Reach 5 and that in Reach 7 (approximately 6 miles), as well as the ecological conditions in the intervening area (e.g., Woods Pond and its dam, other impoundments and roadway crossings), these are considered separate local populations.	Yes in Reach 5. Proposed remedy would impact approximately 43-46% of the Reach 5 Priority Habitat, and much of this impact area consists of riverine edge, backwater, and open floodplain habitats that are suitable habitats for this species. Although there would be no impacts to the core area for this species, the impacts to extensive lengths of river margins and open wetland habitats likely to support colonies of this species would result in an impact to a significant portion of the local population. NA in Reach 7 due to no take.

Species Acres in Priority Habitat	Would a Take Occur?	Local Population Assessment	Impact on Significant Portion of Local Population?
Jefferson salamander 105 acres in Reach 5 417 acres in Reach 7 Core Area 1 Species	Yes in Reach 5, due to impacts on 4-5 acres of the Priority Habitat in Reach 5 (see Table B-4 of the RCMS Appendix L for specific impacts that would cause a take). No in Reach 7 due to no impacts on Priority Habitat.	Priority Habitat of the Jefferson salamander comprises 105 acres in the southern section of Reach 5B and the northern portion of Reach 5C, just north of Yokun Brook (see Figure B-1 of RCMS Appendix L). This mapped habitat includes a cluster of five vernal pools referred to as 46-VP-1 through 46-VP-5. Priority Habitat for the Jefferson salamander also occurs in the downstream portion of Reach 7. There are four separate mapped Priority Habitat areas located on both sides of the River in this reach (see Figure B-2 of RCMS Appendix L), totaling approximately 417 acres, and these are associated with 11 NHESP-certified vernal pools. Based on the Priority Habitat mapping and the life-cycle characteristics of the Jefferson salamander, two local populations of Jefferson salamanders have been identified and evaluated in this assessment – one in Reach 5 and one in Reach 7. The Priority Habitat areas in Reach 7 were considered to encompass a separate population from that in Reach 5, because those areas are separated from the Reach 5 Priority Habitat by more than 15 river miles, which far exceeds the migration capability of this species, and this intervening area contains numerous roads and substantial development which would further restrict movements by this species.	Unlikely in Reach 5. Due to limitations on work in Core Area 1, proposed remedy would have no direct impacts on any vernal pools within the core area for this species or the associated 100-foot buffer zones. Proposed remedy would impact approximately 4-5% of the total Priority Habitat, including 2 vernal pools (1.4 acres) within the Priority Habitat but outside the core area, and about 10% of the 100-foot buffer zones around 5 vernal pools within the Priority Habitat but outside the core area. Assuming these vernal pools are not directly used by the Jefferson salamander, it is unlikely that the collective disturbance from river remediation, floodplain work, and access/staging areas would impact a significant portion of this local population of Jefferson salamanders. NA in Reach 7 due to no take.

Species Acres in Priority Habitat	Would a Take Occur?	Local Population Assessment	Impact on Significant Portion of Local Population?
Longnose sucker 109 acres in Reach 7	Yes in the upstream portion of Reach 7, due the impact on 6.4 acres of the Priority Habitat of this species in this area (see Table G-2 in RCMS Appendix L for specific impacts that would cause a take). No in downstream portion of Reach 7 due to no impacts on Priority Habitat.	Priority Habitat for the longnose sucker occurs along two distinct segments of Reach 7 (see Figure G-1 of RCMS Appendix L). One extends for approximately 5.5 miles from the Columbia Mill Dam to just downstream of the Hop Brook/Housatonic River confluence (Reaches 7C and 7D). A second segment extends approximately 2.5 miles from the Glendale Dam almost to the end of Reach 7 (i.e., just upstream of the Rising Pond Dam impoundment; Reach 7H). The overall mapped Priority Habitat within Reach 7 covers a total of 109 acres. Based on the Priority Habitat mapping and the life-cycle characteristics of the longnose sucker, two distinct populations of longnose suckers have been identified and evaluated in this assessment. The two local populations are separated by nearly eight miles of river and two dams (i.e., Willow Mill Dam and Glendale Dam). The upstream local population likely uses Goose Pond Brook as one of its primary spawning grounds. Goose Pond Brook is classified as a Class B coldwater fishery. The second, downstream local population in Reach 7 likely uses Mohawk Brook, another coldwater fishery, as its primary spawning grounds	No in upstream portion of Reach 7, given direct impacts to small percentage of the Priority Habitat in this portion of Reach 7, and none in likely spawning grounds. NA in downstream Priority Habitat.
Mustard white 1636 acres in Reaches 5/6 Core Area 2 Species 1400 acres consist of floodplain habitat	Yes, due to impacts occurring in 244-255 acres of the mustard white Priority Habitat (see Table L-6 of the RCMS Appendix L for specific impacts that would cause a take). Approximately 74-85 acres of floodplain habitat would be impacted within the mustard white Priority Habitat.	Priority Habitat of the mustard white butterfly extends south contiguously from Reach 5A below the Holmes Road bridge, through all of Reach 5B and Reach 5C, and into the northern and eastern portions of Reach 6 (see Figure L-1 of RCMS Appendix L). The total Priority Habitat area of the mustard white butterfly is 1,636 acres, of which 899 acres are within the PSA. Based on the Priority Habitat mapping and the life-cycle characteristics of this species, the entire 1,636 acres of mapped Priority Habitat encompass the local population of this species. Little information on documented home ranges or dispersal distances for this species is available. However, the flight distances of this species appear limited and the species does not migrate seasonally.	Unlikely. Although proposed remedy would impact approximately 15-16% of the total mapped Priority Habitat of this species, only approximately 5-6% of the floodplain habitat (74-85 of 1400 acres) would be impacted. Further, proposed remedy would impact only approximately 7% of the core area for this species (17 of 240 acres), which was designated by NHESP as the area where the "vast majority" of this population is located.

Species Acres in Priority Habitat	Would a Take Occur?	Local Population Assessment	Impact on Significant Portion of Local Population?
Narrow-leaved spring beauty 22 acres in Reach 5 Core Area 1 Species	Yes, due to the impact on 1.7 acres of the Priority Habitat for this species (see Table FF-5 of the RCMS Appendix L for specific impacts that would cause a take).	Priority Habitat of narrow-leaved spring beauty occurs at two locations within Reach 5; one just north of New Lenox Road comprises 20 acres on both the east and west sides of the Housatonic River, and a smaller (2-acre) area occurs in the central section of Reach 5C (see Figure FF-1 of RCMS Appendix L). The local population includes both Priority Habitat areas, which together total 22 acres, of which 18 acres are located within the PSA. These two areas are separated by only approximately 1.2 miles. Since there are no natural or man-made impoundments between the two mapped habitat areas, seed transport from the upstream to downstream sections of Priority Habitat is highly probable.	Unlikely. Proposed remedy would impact approximately 8% of the total Priority Habitat, and impacts would not occur in much of the preferred habitat for this species.

Species Acres in Priority Habitat	Would a Take Occur?	Local Population Assessment	Impact on Significant Portion of Local Population?
Ostrich fern borer moth 196 acres in Reach 5 169 acres in Reach 7 Core Area 1 Species	Yes in Reach 5, due to the impact on 30-31 acres of the Priority Habitat for this species (see Table M-5 of RCMS Appendix L for specific impacts that would cause a take of this species). No in Reach 7 due to no impacts in Priority Habitat.	Priority Habitat of the ostrich fern borer moth comprises 196 acres in the northern portion of Reach 5A (176 acres in the PSA), just downstream of the Holmes Road Bridge (see Figure M-1 of RCMS Appendix L). An additional ostrich fern borer moth Priority Habitat area of 169 acres occurs within Reach 7, at the confluence of Hop Brook and the Housatonic River (see Figure M-2 of RCMS Appendix L). The two distinct Priority Habitat areas of the ostrich fern borer moth comprise separate local populations based upon several factors. Information on documented home ranges or dispersal distances for this species is not available; however, the flight distances of moths are typically limited compared to those of birds or of certain other flying invertebrates known for longer flights (e.g., painted ladies, monarch butterflies), and this species is not documented to migrate seasonally. In addition, literature reviews for this species indicate that the larvae of this species are restricted to habitats with moderate to dense stands of ostrich fern, and the adults are usually in close proximity to these areas. Given these characteristics, the migration capability of this species is far exceeded by the nearly 10 miles of river corridor that separates the two mapped Priority Habitat areas and which is fragmented by agriculture, roads, and development. Accordingly, the moths in the Reach 7 Priority Habitat are considered to constitute a separate local population from those in the Reach 5A Priority Habitat.	No in Reach 5. Although proposed remedy would impact approximately 15-16% of the total Priority Habitat in Reach 5, only 14 acres of the floodplain Priority Habitat suitable for this species' host plants (approximately 7% of the total Priority Habitat) would be impacted. The remaining impacts would occur in more open and wetter wetland and deeper water habitats that would not support ostrich fern growth. NA in Reach 7 due to no take.

Species Acres in Priority Habitat	Would a Take Occur?	Local Population Assessment	Impact on Significant Portion of Local Population?
Rapids clubtail 208 acres in Reach 5	Yes, due to impacts on 51-54 acres of this species' Priority Habitat (see table N-6 of the RCMS Appendix L for specific impacts that would cause a take).	Priority Habitat of the rapids clubtail comprises 208 acres (166 acres in the PSA), extending from the southern portion of Reach 5A, through all of Reach 5B, and into the northern part of Reach 5C (see Figure N-1 of RCMS Appendix L). Based on the Priority Habitat mapping and the life-cycle characteristics of the rapids clubtail, the larvae and adults of this species within the Priority Habitat in Reach 5 constitute the local population.	Possibly. Proposed remedy would impact approximately 24-26% of the total Priority Habitat. In-river remedial activities would occur over 33 acres (16%) of the Priority Habitat, which is all of the riverine portion of the Priority Habitat. While most of this remediation would consist of activated carbon (AC) application, the cumulative impacts of that application along with sediment removal within riverine habitats may affect the larval forms; and impacts to adjacent floodplain habitats would occur over 19 acres of the Priority Habitat, affecting adults of the species.
Riffle snaketail 147 acres in Reach 5	Yes, due to 38-39 acres of impact within this species' Priority Habitat (see Table O-5 of the RCMS Appendix L for specific impacts that would cause a take).	Priority Habitat of the riffle snaketail comprises 147 acres in the upstream portion of Reach 5A, from the confluence of the East and West Branches to a point just upstream of the Joseph Road housing development off East New Lenox Road (see Figure O-1 of RCMS Appendix L). Based on the current Priority Habitat mapping and the life-cycle characteristics of the riffle snaketail, the larvae and adults of this species within the mapped Priority Habitat in Reach 5A constitute the local population	Yes. Proposed remedy would impact approximately 26-27% of the total mapped Priority Habitat, including sediment removal over the entire larval habitat. Approximately 18 acres of impact would occur within riverine habitats and affect the larval forms. This would cause direct mortality of all larvae in the Priority Habitat and alteration of their feeding habitat. In addition, approximately 20 acres of the floodplain Priority Habitat in Reach 5A would be impacted through vegetative clearing, which would adversely affect adults using those areas.
Skillet clubtail 265 acres in Reach 7	Yes, due to 10 acres of impact within this species' Priority Habitat (see Table P-5 of the RCMS Appendix L for specific impacts that would cause a take).	Priority Habitat for the skillet clubtail in the Housatonic River corridor occurs downstream of the PSA in Reach 7 (see Figure P-1 of RCMS Appendix L). This 265-acre area encompasses the local population of this species.	No. Proposed remedy would impact approximately 4% of the total mapped Priority Habitat.

Species Acres in Priority Habitat	Would a Take Occur?	Local Population Assessment	Impact on Significant Portion of Local Population?
Spine-crowned clubtail 351 acres in Reach 5	Yes, due to 85-87 acres of impact within this species' Priority Habitat (see Table Q-5 of RCMS Appendix L for specific impacts that would cause a take).	Priority Habitat for the spine-crowned clubtail comprises 351 acres from the confluence of the East and West Branches through Reach 5A to the upstream limit of Reach 5B (see Figure Q-1 of RCMS Appendix L). This area encompasses the local population of this species.	Yes. Proposed remedy would impact approximately 24-25% of the total mapped Priority Habitat, and involve removal of all larval habitats (~ 45 acres). The latter would cause direct mortality of any larvae present and alteration of their feeding habitat. In addition, over 40 acres of the floodplain Priority Habitat in Reach 5A would be impacted through vegetative clearing, which would adversely affect adults using those areas.
Stygian shadowdragon 650 acres in Reach 7	Yes, due to 17 acres of impact within this species' Priority Habitat (see Table R-5 of RCMS Appendix L for specific impacts that would cause a take).	The Priority Habitat for the stygian shadowdragon occurs in two areas within Reach 7 of the Housatonic River (see Figure R-1 of RCMS Appendix L). One mapped Priority Habitat extends from the former Eagle Mill Impoundment and extends downstream for about 4 miles to just north of the Hop Brook confluence in Lee. The second Priority Habitat area is about 5 miles downstream of Hop Brook, beginning to the east of the Stockbridge Golf Club in Stockbridge (below the Route 7 bridge) and continuing downstream for approximately 4 miles, ending to the north of the intersection of Dugway and Glendale Roads downstream of Glendale Dam. Based on the Priority Habitat mapping, the habitat conditions between the two mapped areas, and the life-cycle characteristics of the stygian shadowdragon, the two mapped Priority Habitat areas in Reach 7 encompass a single local population of this species. Although there are nearly 5 miles between the two mapped Priority Habitat areas, there are few cultural, hydrologic, or ecological barriers along this stretch to serve as a discontinuity for the stygian shadowdragon.	No. Proposed remedy would impact <3% of the total mapped Priority Habitat.

Species Acres in Priority Habitat	Would a Take Occur?	Local Population Assessment	Impact on Significant Portion of Local Population?
Wapato 390 acres in Reach 5 Core Area 1 Species	Yes, due to 186-196 acres of impact within the wapato Priority Habitat (see Table HH-6 of RCMS Appendix L for specific impacts that would cause a take).	Priority Habitat of wapato comprises 390 acres from the Confluence of the East and West Branches of the Housatonic River through Reach 5 to the northern section of Reach 6 (see Figure HH-1 of RCMS Appendix L). This Priority Habitat encompasses the entire local population of wapato.	Yes. Proposed remedy would impact approximately 48-50% of the total mapped Priority Habitat. This figure includes about 24 acres of riverine habitat impact in Reach 5B due to AC application. However, even if that work were not considered, the proposed remedy would still impact 42-44% of the Priority Habitat, causing direct and extensive alteration of suitable muddy substrates, riverbanks, and shallow water environments inhabited by wapato in various portions of the PSA. This is more than enough to impact a significant portion of the local population.
Water shrew 41 acres in Reach 5	Yes, due to 8.5-11 acres of impact within the water shrew Priority Habitat (see Table F-5 of RCMS Appendix L for specific impacts that would cause a take).	Priority Habitat of the water shrew occurs within a section of riverine and floodplain habitat in the middle of Reach 5C (see Figure F-1 of RCMS Appendix L). The total Priority Habitat for the water shrew covers approximately 41 acres, with nearly 39 acres located within the PSA. Based on the Priority Habitat mapping and the life-cycle characteristics of the water shrew, the local population is considered to encompass the 41 acres of mapped Priority Habitat within Reach 5.	Yes. Proposed remedy would impact approximately 21-27% of the total mapped Priority Habitat of the water shrew. The impacts would adversely affect the species in all aspects of its life, from foraging within the river and backwater areas to use of floodplain habitats near the river for overwintering, breeding, nesting, protective cover, and secondary foraging. These impacts would affect a significant portion of the local population using this Priority Habitat.

Species Acres in Priority Habitat	Would a Take Occur?	Local Population Assessment	Impact on Significant Portion of Local Population?
Wood turtle 1448 acres in and upstream of Reach 5 (including 1375 acres in Reach 5 and 73 acres upstream of confluence). 984 acres in Reaches 7/8 Core Area 2 Species	Yes in Reach 5, due to 203-215 acres of impact within the wood turtle Priority Habitat in that reach (see Table A-8 of RCMS Appendix L for specific impacts that would cause a take). Yes in Reaches 7 and 8, due to 36 acres of impact in that Priority Habitat (see Table A-8 of RCMS Appendix L for specific impacts that would cause a take).	Based on review of the Priority Habitat mapping, the distances between distinct mapped areas, ecological characteristics of the intervening landscape, and documented home ranges or dispersal distances for this species, two local populations of wood turtle have been identified and assessed in these sections of the Housatonic River corridor – one occurring in (and upstream of) Reach 5, and a separate local population in Reaches 7 and 8 (see Figures A-1 and A-2 of RCMS Appendix L) . These two areas of mapped habitats are separated by approximately 8 miles of riparian corridor, including Woods Pond Dam, Columbia Mill Dam, downtown Lee, and Interstate 90. In addition, significant portions of the landscapes directly adjacent to the river in Reaches 7 and 8 are well developed on both sides of the river north of Interstate 90, and along the northern/western side of the river south of Interstate 90. These features significantly reduce landscape connectivity and likely prevent movement or dispersal of wood turtles between the upper and lower mapped Priority Habitat areas. The local population of wood turtles in Reach 5 consists of those present within the 1375 acres of mapped Priority Habitat in Reaches 5A, 5B, and 5C, plus the 73 acres of contiguous wood turtle habitat above the Confluence (a total of 1448 acres). The local population of wood turtles in Reaches 7 and 8 consists of those present within the 984 acres of wood turtle Priority Habitat mapped in these reaches.	Yes in Reach 5. Proposed remedy would impact approximately 14-15% of the wood turtle Priority Habitat within (and upstream of) Reach 5. The excavation of river sediments, riverbank stabilization, and removal of adjacent floodplain habitat would substantially reduce wood turtle habitat suitability at various locations throughout the PSA. Approximately 10% of the core area for this species (46 of 458 acres) would be impacted. These habitat alterations would be extensive enough to impact a significant portion of the local population. Unlikely for Reaches 7 and 8. Proposed remedy would impact less than 4% of the wood turtle Priority Habitat in those reaches.

Table E-1. Impacts of EPA's Proposed Remedy on Priority Habitats of State-Listed Species

Species	Total Priority Habitat Area (acres)			Impacted Area (acres)											
				Sediment Remediation			Floodplain Remediation			Staging Areas/Access Roads			Total		
	R5/6	R7/8	Total	R5/6	R7/8	Total	R5/6	R7/8	Total	R5/6	R7/8	Total	R5/6	R7/8	Total
American Bittern	501	120	621	31.3	0	31.3	14.7	0	14.7	11.4	0	11.4	57.3	0	57.3
Bald Eagle	187	0	187	44.0	0	44.0	0.3	0	0.3	0.9	0	0.9	45.3	0	45.3
Bristly Buttercup	30	0	30	0.9	0	0.9	0.5	0	0.5	0.1	0	0.1	1.5	0	1.5
Brook Snaketail	205	173	378	24.6	0	24.6	19.0	0	19.0	9.4	0	9.4	53.0	0	53.0
Bur Oak	454	24	478	11.7	0	11.7	6.4	0	6.4	8.8	0	8.8	26.9	0	26.9
Common Moorhen	427	10	436	101.9	0	101.9	0.4	0	0.4	1.3	0	1.3	103.6	0	103.6
Creeper	0	103	103	0	2.7	2.7	0	0	0	0	0	0	0	2.7	2.7
Crooked-stem Aster	15	0	15	0.1	0	0.1	0	0	0	0.2	0	0.2	0.3	0	0.3
Foxtail Sedge	137	0	137	13.3	0	13.3	3.5	0	3.5	8.1	0	8.1	25.0	0	25.0
Gray's Sedge	148	0	148	3.2	0	3.2	0	0	0	0.2	0	0.2	3.4	0	3.4
Hairy Wild Rye	27	0	27	0.9	0	0.9	0	0	0	0.2	0	0.2	1.2	0	1.2
Intermediate Spike-sedge	275	33	308	103.9	0	103.9	11.6	0	11.6	3.1	0	3.1	118.6	0	118.6
Jefferson Salamander	105	417	523	0.4	0	0.4	0.9	0	0.9	2.6	0	2.6	3.9	0	3.9
Longnose Sucker	0	109	109	0	6.4	6.4	0	0.1	0.1	0	0	0	0	6.4	6.4
Mustard White	1636	0	1636	169.5	0	169.5	34.6	0	34.6	39.6	0	39.6	243.7	0	243.7
Narrow-leaved Spring Beauty	22	0	22	0.3	0	0.3	0.8	0	0.8	0.6	0	0.6	1.7	0	1.7
Ostrich Fern Borer Moth	196	169	364	15.8	0	15.8	10.2	0	10.2	3.8	0	3.8	29.9	0	29.9
Rapids Clubtail	208	0	208	32.7	0	32.7	8.6	0	8.6	10.0	0	10.0	51.3	0	51.3
Riffle Snaketail	147	0	147	17.7	0	17.7	12.2	0	12.2	8.0	0	8.0	37.8	0	37.8
Skillet Clubtail	0	265	265	0	7.1	7.1	0	2.3	2.3	0	0.8	0.8	0	10.2	10.2
Spine-crowned Clubtail	351	0	351	44.5	0	44.5	25.8	0	25.8	14.4	0	14.4	84.6	0	84.6
Stygian Shadowdragon	0	650	650	0	13.2	13.2	0.0	2.5	2.5	0	0.9	0.9	0	16.6	16.6
Wapato	390	0	390	169.2	0	169.2	11.5	0	11.5	5.1	0	5.1	185.9	0	185.9
Water Shrew	41	0	41	7.1	0	7.1	0.1	0	0.1	1.3	0	1.3	8.5	0	8.5
Wood Turtle	1375	984	2359	109.6	34.2	143.8	42.6	0	42.6	50.6	1.9	52.5	202.8	36.1	238.9

Note: Impacted areas do not include impacts from vernal pool remediation.

R5/6 = Reaches 5 and 6

R7/8 = Reaches 7 and 8

CERTIFICATE OF SERVICE

I hereby certify that on this 23rd day of November, 2016, I served one copy of the foregoing Attachments to Petition for Review of General Electric Company, Volume I, on each of the following by express commercial delivery service:

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