United States
Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, Washington 98101

TOTAL MAXIMUM DAILY LOADING (TMDL) TO LIMIT DISCHARGES OF 2,3,7,8-TCDD (DIOXIN) TO THE COLUMBIA RIVER BASIN

In compliance with the provisions of the Clean Water Act, 33 U.S.C. §1251 et seq.,as amended by the Water Quality Act of 1987, P.L. 100-4, the Environmental Protection Agency is hereby establishing a TMDL to limit discharges of dioxin to the Columbia River basin.

This TMDL shall become effective immediately, and is incorporated into the water quality management plans for the states of Washington, Oregon, and Idaho under Clean Water Act §303(e). Subsequent state actions must be consistent with this TMDL.

Signed this 25th day of February, 1991.

Dana A. Rasmussen
Regional Administrator, Region 10
U.S. Environmental Protection Agency

TOTAL MAXIMUM DAILY LOAD (TMDL)
FOR 2,3,7,8–TCDD
IN THE COLUMBIA RIVER BASIN

Decision Document
February 25, 1991

Developed pursuant to the provisions of the Clean Water Act, 33 U.S.C. §1251, *et seq*, as amended by the Water Quality Act of 1987, P.L. 100-4.

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TOTAL MAXIMUM DAILY LOAD FOR 2,3,7,8-TCDD IN THE COLUMBIA RIVER BASIN

Decision Document

1. SCOPE

This total maximum daily load (TMDL) addresses the following segments, pollutants, and source categories:

WATER QUALITY-LIMITED SEGMENTS:

RIVER SEGMENT		APPLICABLE WATER QUALITY RULES:[1]
Columbia River	(RM 0 - 745)	WAC 173-201-047 [2]
" "	(RM 0 - 309)	WAC 173-201-080(19) [3]
" "	(RM 309 - 596)	WAC 173-201-080(20) [3]
" "	(RM 596 - 745)	WAC 173-201-080(21) [3]
" "	(RM 0 - 86)	OAR 340-41-202 & 205(2)(p) [4,5]
" "	(RM 86 - 120)	OAR 340-41-442 & 445(2)(p) [4,5]
" "	(RM 120 - 147)	OAR 340-41-482 & 485(2)(p) [4,5]
" "	(RM 147 - 203)	OAR 340-41-522 & 525(2)(p) [4,5]
" "	(RM 203 - 218)	OAR 340-41-562 & 565(2)(p) [4,5]
" "	(RM 218 - 247)	OAR 340-41-602 & 605(2)(p) [4,5]
" "	(RM 247 - 309)	OAR 340-41-642 & 645(2)(p) [4,5]
Snake River	(RM 0 - 176)	WAC 173-201-047 [2]
" "	(RM 0 - 176)	WAC 173-201-080(97) [3]
" "		IDAPA 16.01.2120 & .2200 [6,7]
Willamette River	(RM 0 - 187)	OAR 340-41-442 & 445(2)(p) [4,5]

[1] In addition to the following, all waste load allocations and permit limits must ensure compliance with applicable water quality standards of downstream states [40 CFR §122.4(d)].
[2] WAC 173-201-047 describes Washington's applicable criteria for toxic substances.
[3] WAC 173-201-080 describes Washington's classification for specific waterbodies.
[4] OAR 340-41-xx2 describes beneficial uses designated by Oregon.
[5] OAR 340-41-xx5(2)(p) describes Oregon's applicable criteria for toxic substances.
[6] IDAPA 16.01.2120 describes the designated uses for the confluence of the Clearwater and Snake River in Idaho.
[7] IDAPA 16.01.2200 describes Idaho's criteria for hazardous and deleterious materials.

POLLUTANT CAUSING EXCEEDANCE OF WQ STANDARDS:

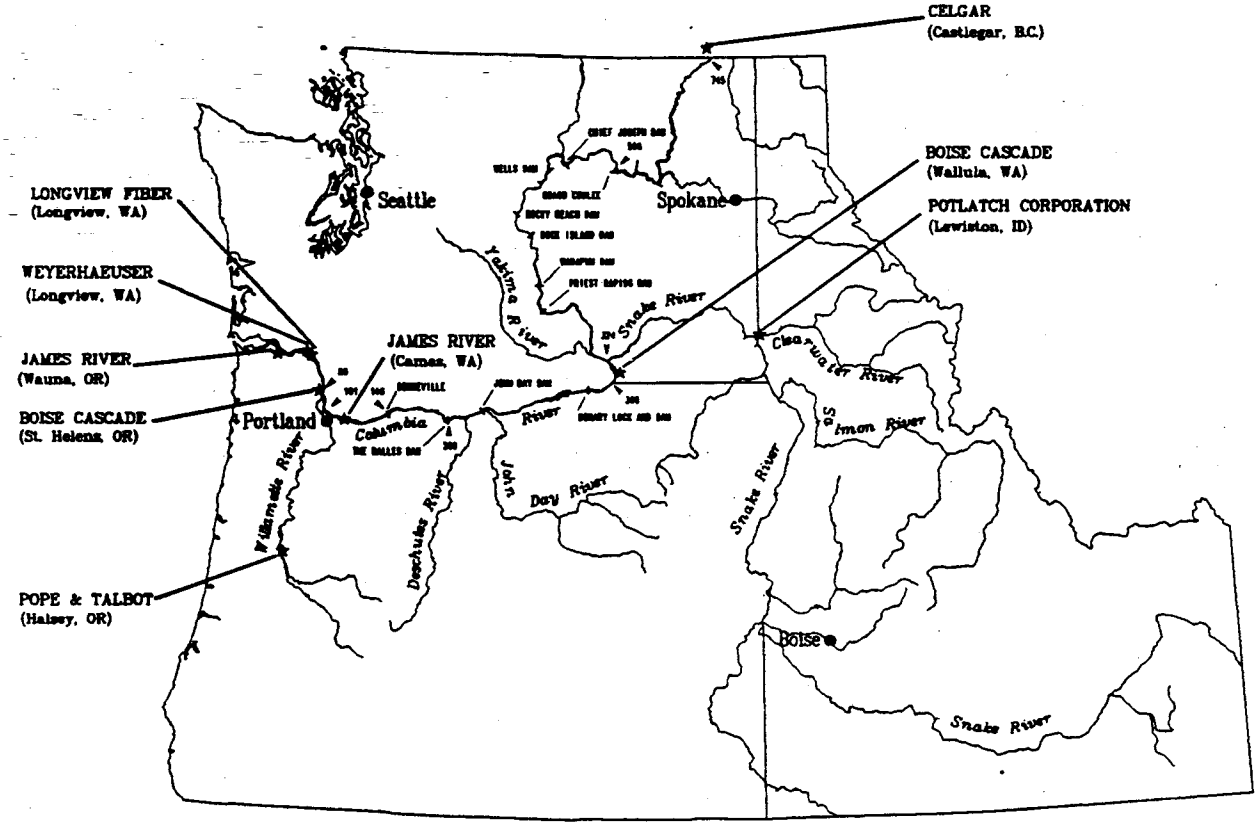
2,3,7,8 - tetrachlorodibenzo-para-dioxin (2,3,7,8-TCDD)

SOURCE CATEGORIES CONSIDERED:

Source Category	Allocation Type	Source Description
1	WLA [1]	Pulp & Paper Mills -- Chlorine Bleaching
2	Reserved	All Other Sources:

- Pulp & Paper Mills -- Non-Chlorine Bleaching
- Woodtreaters Using Pentachlorophenol
- Municipal Wastewater Treatment Facilities
- Canadian Sources
- Other Point Sources
- Port Activities
- Urban Areas
- Other Nonpoint Source
- Background

Figure 1-1. Columbia River Basin.



[1] WLA = waste load allocation

2. NEED FOR A TMDL

A. Overview

The Columbia River and segments of the Snake and Willamette Rivers are currently water quality-limited due to the presence of excessive levels of 2,3,7,8-TCDD. This pollutant is the most toxic of a group of compounds known as polychlorinated dibenzo-para-dioxins (dioxin). The concern over dioxin levels in the Columbia River is based on data describing concentrations of 2,3,7,8-TCDD in effluents and treatment plant sludges at chlorine-bleaching pulp mills as well as in fish tissue below these mills.

Section 303(d)(1)(C) of the Clean Water Act (CWA) and EPA's implementing regulations (40 CFR Part 130) require each state to identify waters for which existing required pollution controls are not stringent enough to attain applicable water quality standards. For these water quality-limited segments, each state is then to establish total maximum daily loads (TMDLs) for appropriate pollutants of concern. By definition (40 CFR, s130.2), a TMDL is the sum of the individual waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background. The CWA states that the TMDL:

> *"shall be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality."*

Thus, the TMDL is effectively an implementation plan for achieving water quality standards using an appropriate margin of safety. A margin of safety may be provided (1) by using conservative assumptions in the calculation of the loading capacity of the waterbody and (2) by establishing allocations that in total are lower than the defined loading capacity. The water quality standard being protected by this TMDL is 0.013 parts per quadrillion (ppq) 2,3,7,8-TCDD in the water (see Appendix A).

The national focus on toxics discharges as evidenced in the 1987 amendment to Section 304 of the CWA, 33 U.S.C. s1314(l), gives additional urgency to the establishment this TMDL. Congress intended s304(l) to focus state water quality protection programs on immediately addressing water quality problems due to point source discharges of toxic pollutants. States are required to develop lists of impaired waters, identify point sources and amounts of toxic pollutants they discharge,and to develop individual control strategies (ICSs) for each such point source. An ICS may be a draft or a final National Pollutant Discharge Elimination System (NPDES) permit. The s304(l) lists developed for Washington, Oregon, and Idaho have identified dioxin levels in the Columbia, Snake, and Willamette Rivers as exceeding applicable water quality standards. Limits included in ICS's, developed under s304(l), must be consistent with waste load allocations (WLAs) where a TMDL has been established.

B. The Concern

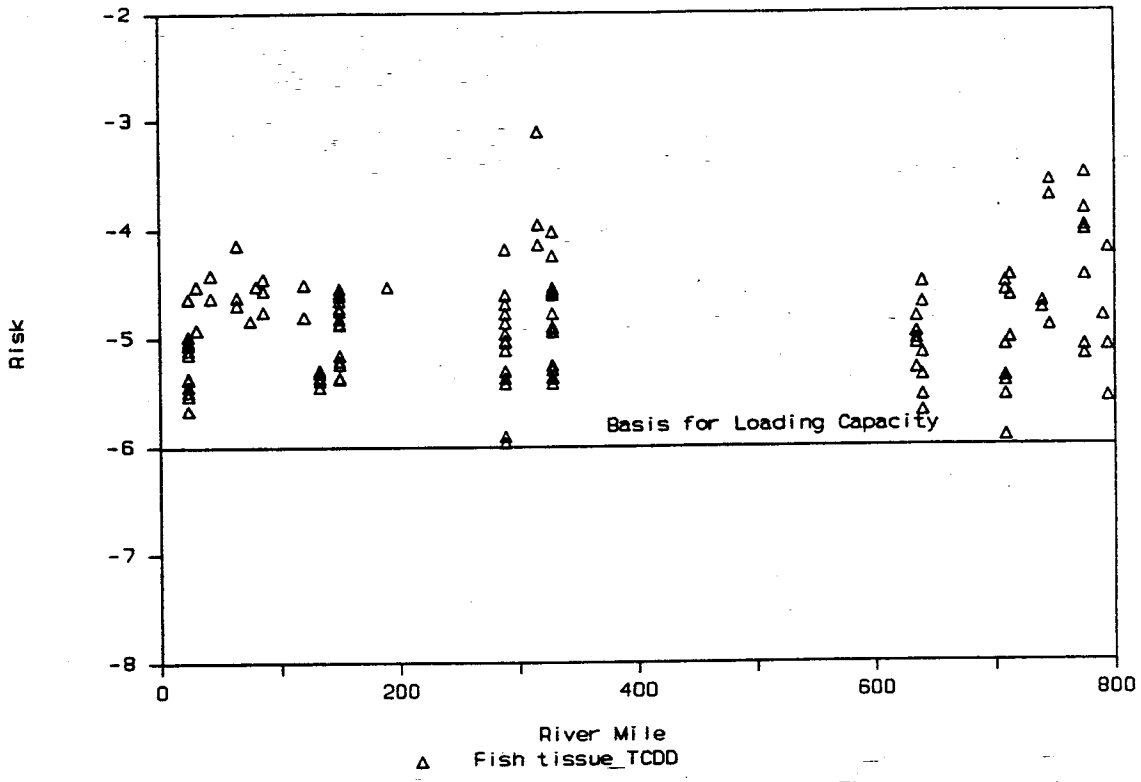
Dioxins are produced as a result of human activities, such as the manufacture of chlorinated herbicides, the combustion of domestic and industrial wastes, and the production of chlorine-bleached wood pulp. Both water column concentrations of dioxin in the Columbia River and the water quality standard for 2,3,7,8-TCDD are below levels which can be measured with current analytical technology. However, because some organisms, such as fish, accumulate dioxin in their bodies, 2,3,7,8-TCDD has been found at detectable levels in the tissue of fish taken from the Columbia River basin. As discussed below, these tissue levels are of concern and indicate that these waters exceed state water quality standards.

The state water quality standard applicable to 2,3,7,8-TCDD in the Columbia River basin has been determined to be 0.013 ppq (see Appendix A). The EPA criterion on which this standard is based was derived from human health concerns resulting primarily from consumption of contaminated fish. In establishing EPA's 1984 2,3,7,8-TCDD criterion values, the following factors were developed and used: a bioconcentration factor (this relates the concentration in fish tissue to the concentration in the water in which the fish lives), fish consumption rates, and a cancer potency factor. These factors relate water column concentrations to fish tissue concentration and cancer risk. A fish tissue concentration of 0.07 ppt and a water concentration of 0.013 ppq (the applicable water quality standard) are both estimated to result in a life-time cancer risk of 10^{-6} (one excess cancer per one million people).

In 1987, EPA initiated a National Bioaccumulation Study (NBS) designed to gather screening information on the prevalence and concentrations of selected toxic compounds in fish tissue and other aquatic organisms. This study was conducted on a broad scale across the United States and included testing for 2,3,7,8-TCDD. Sampling sites included relatively undisturbed background areas, streams below industrial, agricultural, and urban activities, and segments below mills using chlorine to bleach pulp. The NBS identified concerns related to chlorine-bleaching kraft pulp mills. Fish samples collected at several locations below chlorine-bleaching pulp mills on the Columbia River within EPA Region 10 (from the Canadian border to the mouth) have shown detectable concentrations of 2,3,7,8-TCDD. Another EPA study, the "104 Mill Study" (1988), subsequently confirmed, through testing of effluents and sludges, that chlorine-bleaching pulp mills are a significant source of 2,3,7,8-TCDD.

Figure 2-1 displays estimates of risk of excess cancer resulting from consumption of fish at various locations along the length of the river. The risk estimates were obtained by applying the fish consumption and cancer potency factors used in developing the EPA criterion for 2,3,7,8-TCDD to fish tissue concentrations actually measured. Fish tissue data used came from EPA's National Bioaccumulation Study (1987), the Northwest Pulp & Paper Associations's Columbia River Fish Study (Beak Consultants, 1989), the Washington Department of Ecology's work on Lake Roosevelt (1989-1990), and from efforts in Canada. The resulting risk estimates (Figure 2-1) are consistently higher than the 10^{-6} level, confirming that the water quality standard and, therefore, the loading capacity of the system, are being exceeded. This is consistent with, and supported by, predicted water column concentrations of 2,3,7,8-TCDD (based on in-stream dilution of pulp mill discharges as measured in the 104 Mill Study) which also exceed the water quality standard.

Figure 2-1. Columbia River Fish Tissue Data



C. Water Quality-limited Status

Oregon has identified the Columbia River (river miles 0 - 309) and the Willamette River (RM 0 - 187) as being water quality-limited for 2,3,7,8-TCDD. Washington has similarly identified the Columbia and Snake Rivers within that state as being water quality-limited for 2,3,7,8-TCDD. The state of Idaho has also identified the confluence of the Clearwater and Snake Rivers as being water quality-limited for 2,3,7,8-TCDD. On June 14, 1990, EPA approved these listings pursuant to CWA Section 303(d).

On March 21, 1990 the states of Oregon, Washington, and Idaho stated that they would not adopt a TMDL for dioxin in the Columbia River as state actions but rather requested that EPA establish this TMDL as a federal action. The states acknowledged that while the development of a TMDL has been a cooperative effort, the interstate nature of the Columbia River Basin and the desirability of consistency and equity in regulating dischargers in this basin necessitated that the TMDL be a federal action. Therefore, on June 14, 1990, pursuant to Section 303(d), EPA formally disapproved the expressed intent of Washington, Oregon, and Idaho to not submit TMDLs and, subsequently, developed this final TMDL for dioxin discharges to the Columbia River basin as a federal action.

This TMDL provides a framework to control 2,3,7,8-TCDD discharges to the Columbia River Basin and achieve compliance with water quality standards. The following sections of the decision document describe the established TMDL and the process used to develop it.

3. DEVELOPMENT OF THE TMDL

A. Overview

Development of a TMDL provides a process for weighing the needs of competing activities which affect water quality in a watershed and creating an integrated pollution control strategy for point and nonpoint sources. This process allows regulatory agencies to take a holistic view of water quality problems from the perspective of in-stream conditions.

The total load of a pollutant to a waterbody is attributable to point sources, nonpoint sources, and natural background. The TMDL process distributes portions of the stream's loading capacity to the various sources, including background conditions, in a way that will achieve water quality standards. The level of refinement reflected in actual allocations depends on the amount of available data. The Water Quality Management Regulations [40 CFR, s130.2] state, for example, that:

> *"Load allocations are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading."*

As previously pointed out, Section 303(d) states that a margin of safety should be used which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality. Thus, the law indicates that the TMDL process should move forward using available information. As new information becomes available in the future, the TMDL can be refined.

B. Process

The TMDL identifies the amount of a pollutant that may be discharged to a water quality-limited stream. TMDLs can be expressed in terms of either chemical mass per time, toxicity, or other appropriate measure. The TMDL for a particular waterbody is dependent on such factors as the location of sources, stream flow, water quality standards, background conditions, and in-stream pollutant reactions. The process of developing and implementing a TMDL for 2,3,7,8-TCDD in the Columbia River basin consists of several steps:

- **define the loading capacity** of the river at key points
- **identify sources** which potentially contribute loads of 2,3,7,8-TCDD
- **allocate loads** to point sources, nonpoint sources (NPS), and background
- **implement** the TMDL through Water Quality Management Plans and NPDES permits

C. Loading Capacity

WLAs and LAs represent the allocated portions of a receiving water's **loading capacity**. The loading capacity is the greatest amount of pollutant loading that the river can receive without violating water quality standards. A TMDL must not exceed the loading capacity of a waterbody.

Two fundamental issues must be determined at the outset when establishing a TMDL. These are (1) the definition of upstream and downstream boundaries of the waterbody for which the TMDL is being determined and (2) the flow conditions (design flow) appropriate for calculating the loading capacity or amount of pollutant which can be assimilated. Having defined the extent of the waterbody and the appropriate flow conditions, the loading capacity is calculated to achieve the applicable water quality standard (see Appendix A for discussion of applicable standards for dioxin and river flow rates occurring in the Columbia River Basin).

A loading capacity of approximately 6 mg of 2,3,7,8-TCDD per day has been calculated for the Columbia River at its mouth.

D. Sources

The Columbia River is over 1200 miles long and drains an area of about 259,000 square miles. Land use and terrain in the basin are diverse. General activities affecting water quality in the basin include areas of urban development, industry, agriculture, and forestry. In terms of 2,3,7,8-TCDD, chlorine bleaching pulp mills have been identified as a major source based on their effluent and sludge data.

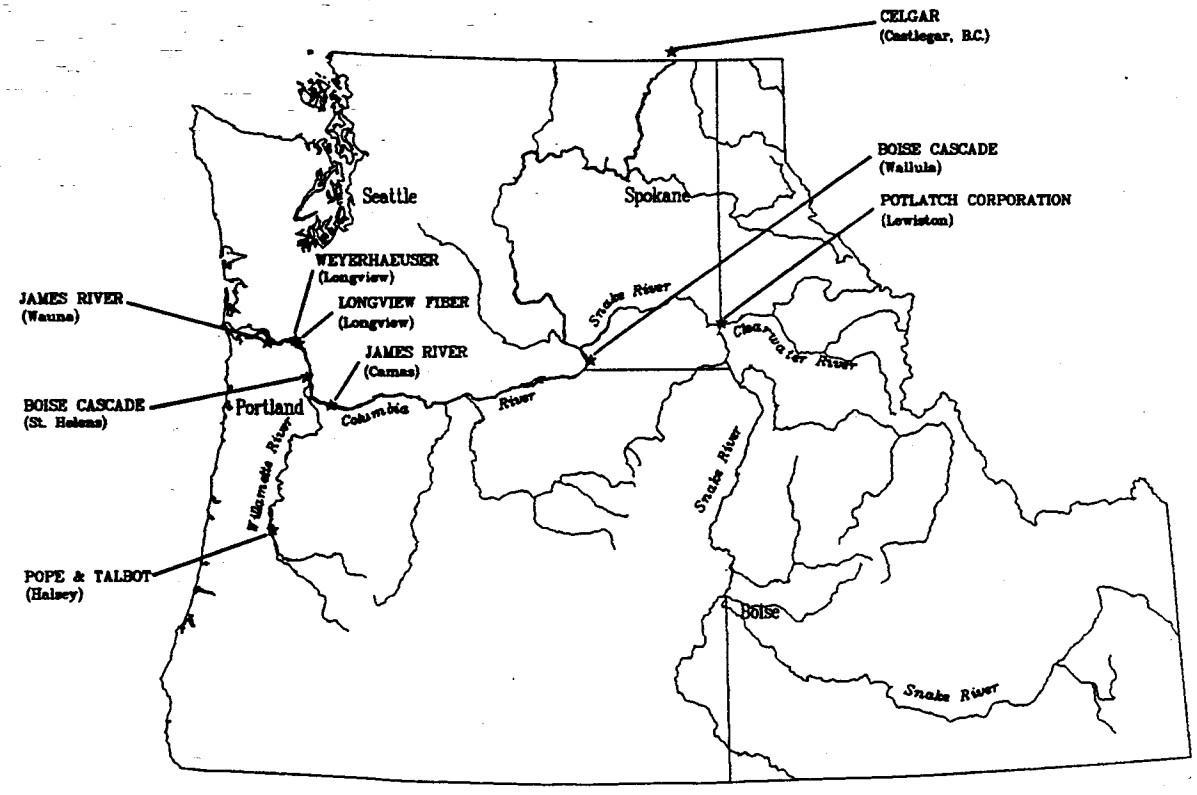
Within EPA Region 10, eight chlorine-bleaching pulp mills currently discharge to the Columbia River system. These mills, one in Idaho, four in Washington, and three in Oregon, are shown in Figure 3-1. The eight mills currently produce over 7,000 tons per day of bleached pulp. Another chlorine-bleaching pulp mill which discharges to the Columbia River is located near Castlegar, British Columbia, about 30 miles above the U.S. - Canadian border. Known sources of 2,3,7,8-TCDD are thus affecting the Columbia River within EPA Region 10, from the mouth near Astoria, Oregon to the Canadian border (river mile 745) and the Snake and Willamette Rivers, major drainages within the Columbia River system. Consequently, the entire Columbia River basin, including the Snake and Willamette Rivers, are included in the TMDL. Tributaries outside of EPA Region 10, such as the Clark Fork in Montana, have also been considered in developing the TMDL.

Besides chlorine bleaching pulp mills, other potential source categories include woodtreaters using pentachlorophenol, major municipal wastewater treatment plants, agricultural areas, industrial sites, urban areas, and release from bottom sediments. Data on dioxin discharges from these sources, however, are minimal or nonexistent for the following reasons:

- Concern over the extent of dioxin pollution is relatively recent.
- Many of the point sources have been considered minor dischargers in the past and had minimal monitoring requirements.
- It is difficult to characterize loadings from stormwater or nonpoint sources. These inputs are not continuous and are generally driven by weather related events such as rain storms or snow melt.
- There are analytical obstacles associated with measuring 2,3,7,8-TCDD. The water quality standard of 0.013 parts per quadrillion (ppq) is several orders of magnitude below a typical detection limit of 10 ppq for water column measurements.

The available data are not adequate to develop WLAs or LAs for these sources. However, current loadings for some of these other dioxin sources of concern in the Columbia basin are estimated in Appendix B and summarized later in the following section.

Figure 3-1. Location of Chlorine-Bleaching Pulp Mills in the Columbia River Basin



E. Allocation of Loads

Having identified major sources of 2,3,7,8-TCDD to the Columbia River basin, the TMDL must establish allocations sufficient to control discharges within the loading capacity. These allocations are made considering technical, socioeconomic, and institutional constraints. Historically, individual states have used various allocation schemes on a case-by-case basis or specified that a particular method be used. Technical guidance has been prepared which describes 19 potential approaches for allocation of loads ("Technical Guidance Manual for Performing Waste Load Allocations", U.S. Environmental Protection Agency, 1986). When evaluating various methods, conditions that favor one approach over another must be considered.

With respect to this TMDL there are some potential problems in using the more common methods described in the technical guidance:

- The geographic scale associated with the Columbia Basin and the number of potential sources is considerably larger than the scale typically encountered in most TMDL situations.
- Common methods focus on waste load allocations for point sources. Background sources (e.g. release from bottom sediments) and nonpoint source loads, however, may be significant considerations for 2,3,7,8-TCDD in the Columbia River basin.
- There are few data on 2,3,7,8-TCDD discharges from source categories other than chlorine bleaching pulp mills in the basin.
- There are complexities in addressing persistent and highly bioaccumulative pollutants such as 2,3,7,8-TCDD.

The last three of these points mean that data and methods of analysis (e.g. predictive models) are not available to adequately characterize all pollution sources at this time. However, the lack of information about some pollution sources or processes is not a reason to delay implementation of water quality-based controls for known sources contributing to violations of water quality standards. The key is to work within a logical framework that will lead to the attainment of water quality standards. After consideration of the above problems and the issues discussed in Appendix B, the following approach was developed for this TMDL:

- Identify watershed targets to be used as a framework to guide allocation decisions;
- Establish WLAs for the major source category for which there are currently sufficient data to do so;
- Estimate current loadings for other source categories;

- Reserve some of the unallocated loading capacity (beyond that necessary to cover the WLAs established and estimated current loadings for other sources) to provide an additional component of the margin of safety, some of which could be used for future growth.

This approach provides for further pollution reduction from known sources while additional data are collected to: (1) confirm that the reductions required by this TMDL are leading to water quality standards attainment; and (2) provide additional information necessary to refine estimates of assimilative capacities and TMDL allocations. This TMDL establishes WLAs that will form the basis of more stringent limits for dioxin discharges from confirmed point sources. It also estimates loadings from other sources and incorporates a margin of safety to account for existing uncertainties. Where new data show that modification of the TMDL is appropriate, the TMDL will be revised accordingly. By allowing future modification of the TMDL, regulatory agencies can avoid delays in controlling known sources while they continue to investigate other possible sources. Decisions on the use of the unallocated load will be made through a joint effort by the States and EPA.

Watershed Targets:

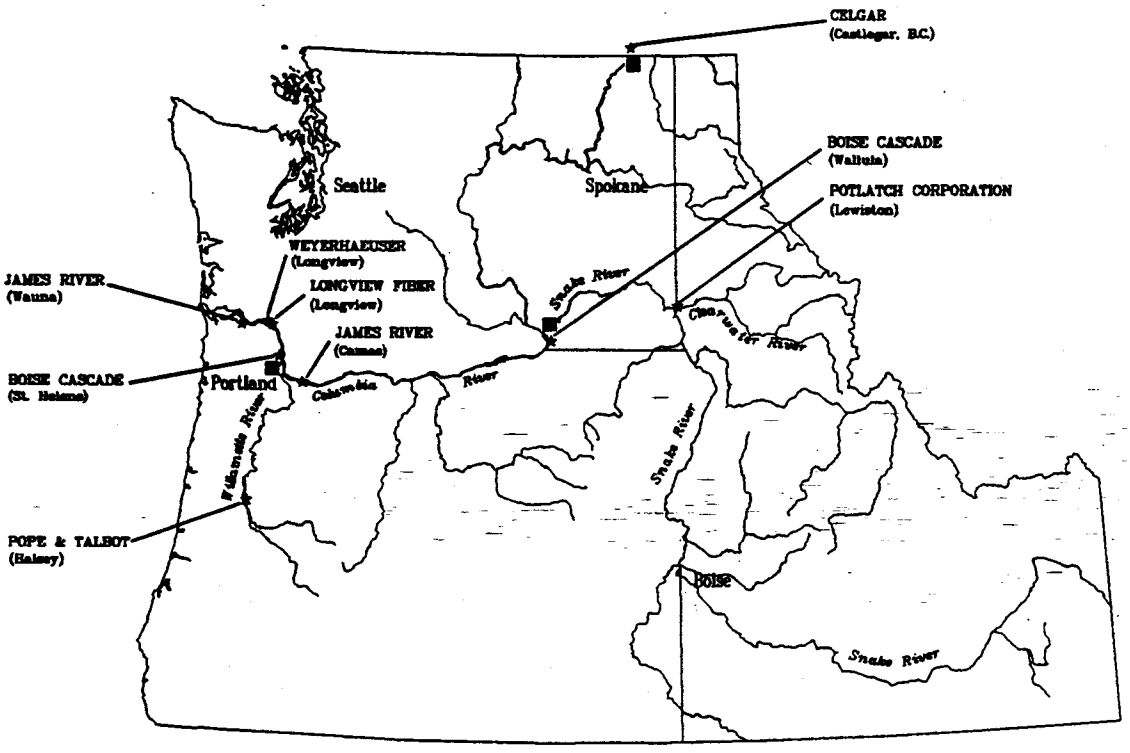
The Oregon Department of Environmental Quality (DEQ) has utilized the concept of watershed targets for developing TMDLs in Oregon. Watershed targets are particularly useful for TMDLs designed to achieve water quality standards in large waterbodies adversely affected by a pollutant coming from a variety of sources. Allocations for major sources are established after watershed targets are identified. The watershed targets serve as internal check points to determine that water quality standards will be met at key locations within the drainage. This same technique is also being used for the Columbia River in this TMDL.

Watershed targets can be set within the basin by simply identifying the loading capacity at key points in the drainage system. To determine these targets, the only data requirements are a water quality criterion and a design flow (in this case, the mean harmonic stream flow). The watershed targets focus on high priority tributaries. In the case of the Columbia, there are three logical points in addition to the lower Columbia near Bradwood (below Longview) for which loading capacities should be calculated. These locations are shown in Figure 3-2 and relevant data are summarized in Table 3-1.

The Willamette Basin is the most industrialized and populated area in the Columbia River system. There are high numbers of both industrial and municipal dischargers in the drainage compared to other sub-basins in the Columbia River system. The most logical approach is to establish the watershed target as equal to the loading capacity for the Willamette River at Portland (0.54 mg/day). The sum of all allocations to sources in the Willamette Basin must not exceed this watershed target. By the same token, loading capacity attributed to flow produced by the Willamette is not currently available for use in the mainstem Columbia.

Because the Willamette Basin is entirely within Oregon, the Oregon Department of Environmental Quality (ODEQ) has the option, within the context of a TMDL, to adjust allocations for specific sources which would still meet this watershed target. In fact, Oregon has already initiated dioxin controls in the Willamette through issuance of an NPDES permit to Pope & Talbot at Halsey with effluent limits for 2,3,7,8-TCDD (0.19 mg/day). Furthermore, DEQ has committed to developing a TMDL for dioxin in the Willamette which will meet the watershed target.[1] A Willamette Basin TMDL could include different limits for Pope & Talbot, based on needs determined by ODEQ.

Figure 3–2. Location of Watershed Targets (▪) Relative to Pulp Mills



Watershed targets were also evaluated at two other locations in the Columbia system: 1) at the mouth of the Snake River and 2) at the U.S. – Canadian border. Far fewer sources exist upstream of these locations than is the case with the Willamette River basin. However, significant levels of 2,3,7,8-TCDD have been measured in tissue of fish taken from sites associated with each of these watersheds. The fish tissue concentrations indicate that the water quality standard and, therefore, the loading capacity for 2,3,7,8-TCDD is currently exceeded.

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[1] This TMDL will be reviewed by EPA in accordance with §303(d) of the Clean Water Act.

Based on currently available data, reductions in 2,3,7,8-TCDD loads are needed to meet all three of these watershed targets. These watershed targets must be achieved in order to ensure attainment of water quality standards where those watersheds enter the Columbia River. To the extent that the TMDL results in loading reductions beyond that necessary to meet the watershed targets, the difference is available for other downstream uses, future growth, or margin of safety.

Table 3-1. Loading Targets for 2,3,7,8-TCDD to Selected Watersheds in the Columbia River System

Watershed	Harmonic Mean Flow (cfs)	Loading Capacity (mg/day)
TOTAL COLUMBIA RIVER BASIN	188,000 [1]	5.97
SELECTED SUB-BASINS		
Watershed N. of WA/Canada Border	72,700 [2]	2.31
Snake River Watershed	37,000 [3]	1.18
Willamette River Watershed	17,100 [4]	0.54
TOTAL FOR SUB-BASINS		4.03

[1] Flow at Columbia River near Bradwood
[2] Flow at Columbia River at WA/Canada border
[3] Flow at Snake River below Ice Harbor Dam
[4] Flow of Willamette River at Portland

Establish WLAs

This TMDL focuses on developing waste load allocations for the chlorine bleaching pulp mills in the basin. These mills constitute the only source category in the Columbia River basin where site specific quantitative information exists describing effluent quality and waste loads for 2,3,7,8-TCDD. Nationally, the median 2,3,7,8-TCDD concentration in tissue of fish collected below pulp mills using chlorine bleaching was higher than for fish collected below any other source category studied in the National Bioaccumulation Study (1987). In addition, the §304(l) listings under the Clean Water Act specifically identified these mills in the Columbia River Basin as point sources requiring individual control strategies (ICS's). The basis of this listing was not only data describing concentrations of 2,3,7,8-TCDD in fish tissue below the mills but also measured concentrations of 2,3,7,8-TCDD in effluents and treatment plant sludges at these mills. The analysis undertaken in developing this TMDL indicates that this source category would lead to exceedance of water quality standards even if no other sources existed.

The proposed TMDL (public notice issued on June 15, 1990) discussed several alternative methods to establish waste load allocations for chlorine bleaching pulp mills. The waste load allocation methods evaluated are summarized in Appendix C. The proposed TMDL allocated approximately 2 mg/day (not including the Canadian Celgar mill or the planned expansion at Pope & Talbot) to the chlorine bleaching pulp mills. A major criterion for evaluating alternative methods for establishing WLAs for chlorine bleaching pulp mills was the need to verify compliance with resulting NPDES permits. Allocations for each mill were derived based on the lowest verifiable concentration (long term average of 4.7 ppq 2,3,7,8-TCDD in the bleached wastestream) in an assumed average wastewater flow per quantity bleached pulp produced (14,470 gallons/ton). Such an approach yields WLAs which are equal in terms of mass discharge per unit production of bleached pulp product (0.257 μg 2,3,7,8-TCDD/ton).

Table 3-2 displays WLAs based on updated production figures including planned production increases for Celgar [based on comments from R.W. Sweeney, Celgar Pulp Co.] and Pope & Talbot [based on comments from CH2M-Hill for James River and Pope & Talbot; July 20, 1990]. WLAs resulting from allowing 4 different quantities of 2,3,7,8-TCDD per ton of bleached pulp produced are given in the table. Three of the options reflect some of the comments received during the public comment period for the proposed TMDL.

Option 1. This option reflects the belief by the pulp and paper industry that they should be given the entire loading capacity of the river system. An allowed discharge rate of 0.68 μg 2,3,7,8-TCDD per ton of bleached product results in 100% of the calculated loading capacity being allocated to the existing pulp and paper mills in the basin.

Option 2. This option is generally equivalent to the WLAs proposed in the draft TMDL submitted for public comment. Two differences are noted: (1) the WLA for Pope & Talbot at Halsey is increased based on planned production increases and the NPDES permit recently issued by DEQ; and (2) a WLA has been calculated for the Celgar mill based on planned production increases and the discharge rate (0.257 μg 2,3,7,8-TCDD per ton of bleached product) allowed for the other mills. The calculated WLA for Celgar has no regulatory authority, but is used for comparison purposes and as an estimated loading which should be achievable by Celgar.

Option 3. This option reflects the concern by the local pulp mills that the proposed TMDL did not provide equity with the Celgar mill at Castlegar, British Columbia. Based on information submitted by both the Celgar mill and the British Columbia Ministry of Environment (see Appendix B), the proposed modernization project at Celgar will result in 2,3,7,8-TCDD discharges which are less than 0.05 mg/day (or 0.042 μg/day per ton bleached pulp). The technology planned for use at Celgar is being or has been installed at several bleached kraft mills in other parts of the world. Option 3 applies this discharge rate to all the affected mills and results in 7% of the calculated loading capacity being allocated to the existing pulp and paper mills in the basin.

Option 4. This is the zero discharge option requested by many commenters. The environmental community believes that zero discharge is the only viable option, because of dioxin's persistence and cumulative build-up in the sediments and biota.

Table 3-2. Waste Load Allocation Options for Chorine-Bleaching Pulp Mills

Pulp Mill -- Location	Production of Bleached Product		Waste Load Allocations (mg 2,3,7,8-TCDD/day, long term average)			
	(tons/day)	(%)	Option 1 (0.68)	Option 2 (0.257)	Option 3 (0.042)	Option 4 (0.00)
Potlatch -- Lewiston, ID	1,509	15.1	1.03	0.39	0.06	0.00
Boise Cascade -- Wallula, WA	957	9.6	0.65	0.25	0.04	0.00
James River -- Camas, WA	1,650	16.5	1.12	0.42	0.07	0.00
Longview Fibre -- Longview, WA	310	3.1	0.21	0.08	0.01	0.00
Weyerhaeuser -- Longview, WA	1,026	10.3	0.70	0.26	0.04	0.00
Pope & Talbot -- Halsey, OR	1,500	15.0	0.19	0.19	0.06	0.00
Boise Cascade -- St. Helens, OR	1,035	10.4	0.70	0.27	0.04	0.00
James River -- Wauna, OR	800	8.0	0.54	0.21	0.03	0.00
Celgar -- Castlegar, B.C.	1,200	12.0	0.82	0.31	0.05	0.00
TOTAL Source Category Allotment	9,987	100.0	5.96	2.38	0.40	0.00
% of Basin Loading Capacity			100%	40%	7%	0%

Note: a) The value shown parenthetically under each option represents the equivalent quantity of 2,3,7,8-TCDD discharged in µg per ton of bleached pulp produced.

b) The WLA listed for Pope & Talbot under Options 1 and 2 has been adjusted to the long term average of 0.19 mg/day identified in the NPDES permit issued by the Oregon Department of Environmental Quality (November 7, 1990). See discussion in "Watershed Targets" section.

c) The WLAs listed for Celgar are included for comparison purposes only. EPA has no authority to establish enforceable WLAs for a Canadian source.

All available information has been carefully considered. Based on that information the "zero discharge" option is not necessary to achieve water quality standards and would not be enforceable due to the fact that the analytical detection limit is significantly higher than zero. Option 3 has similar difficulties, especially with respect to measuring compliance. This leaves Options 1 and 2 as still reasonable. The existence of other sources (see below), the lack of information on processes affecting the distribution of 2,3,7,8-TCDD, and the concern over the potential release from 2,3,7,8-TCDD stored in sediments and aquatic biota make Option 1 inappropriate. Consequently, Option 2 is the most reasonable approach at this time and **the WLAs listed under that option are being established as final in this TMDL**. EPA has concluded that these WLAs are the lowest levels consonant with analytical practicalities at this time and, as discussed below, can be accommodated within the available loading capacity taking into account other existing sources. NPDES permits issued subsequent to this TMDL must be consistent with these waste load allocations.

EPA recognizes that, as NPDES permits are developed, some adjustment of the above WLAs to reflect differences in particular mill capabilities may be appropriate. Such adjustments, if needed, will be determined on a case-by-case basis in consultation with the affected states.

Estimated Loadings From Other Sources

There is insufficient information, at this time, to establish WLAs for other point sources or LAs for nonpoint sources. However, in order to be reasonably certain that total loadings under this TMDL will not exceed the loading capacity of the system, loadings from some of the most significant other source categories are evaluated in Appendix B and summarized below.

Canada:

The Celgar pulp mill is the only Canadian source of dioxin to the Columbia River for which 2,3,7,8-TCDD has been measured in the effluent. As pointed out in the previous section, however, EPA has no authority to establish an enforceable WLA for the Celgar pulp mill in Canada. In this TMDL, EPA estimates that 2,3,7,8-TCDD loadings from sources upstream of the U.S.-Canada border will be no more than the 0.31 mg/day which we would allocate to Celgar if it were a Region 10 mill (Table 3-2, Option 2). Since Celgar is expected to reduce its 2,3,7,8-TCDD loadings to 0.05 mg/day by 1994, the higher 0.31 mg/day estimate provides some room to cover other unidentified sources upstream of the U.S.-Canada border and/or a margin of safety for the possibility that Celgar may not fully achieve anticipated reductions in its 2,3,7,8-TCDD loading to the Columbia River.

Other U.S. Point Sources:

As detailed in Appendix B, woodtreating facilities and municipal wastewater treatment plants are estimated, in total, to contribute current loadings of less than 2.3 mg/day 2,3,7,8-TCDD. Establishing WLAs for these facilities is not feasible at this time due to the shortage of data. Recent Resource Conservation and Recovery Act (RCRA) regulations for woodtreaters and NPDES regulations and guidance for stormwater discharges will lead to better information and control of discharges from these sources in the future. WLAs will be established, if appropriate, for those point source discharges with existing NPDES permits when information becomes available.

Other Sources and Background:

The remaining 22% of the loading capacity (1.29 mg/day) will be held in reserve as part of the needed margin of safety. This will cover contributions from (1) nonpoint sources such as agricultural or atmospheric inputs, (2) other industrial sources such as non-chlorine bleaching pulp mills, (3) background levels of 2,3,7,8-TCDD stored in the sediments and aquatic biota, and (4) possible future growth.

Data Collection

The establishment of this TMDL is not the conclusion of EPA's efforts with respect to controlling dioxin in the Columbia River basin. A more comprehensive data collection program is planned to confirm assumptions made in the development of this TMDL. Monitoring efforts will be designed to obtain better baseline information and to fill recognized data gaps, particularly with respect to other potential sources of 2,3,7,8-TCDD and the role of sediments. If necessary, the TMDL will be revised based on new information.

EPA will work cooperatively with the states to take the following actions: [1]

- Develop a strategy to address water quality concerns related to 2,3,7,8-TCDD inputs from woodtreating facilities. The proposed strategy should identify individual sources in each state to be considered for allocations, a sampling plan for determining reductions needed, and a schedule for implementation of the strategy. This should be done in conjunction with activities required by NPDES regulations as implemented under recent guidance for controlling stormwater discharges.
- Address other point source concerns, such as other major industrial NPDES dischargers and major municipal NPDES facilities with formal pretreatment programs, by States forwarding to EPA existing state data on concentrations of dioxin in sludge.
- Develop a strategy that addresses the other source categories such as urban runoff and agriculture.

F. Judicial Review

Parties seeking to challenge this TMDL are advised that exclusive review of this TMDL might be in the United States Court of Appeals because arguments could be made that this TMDL includes "effluent limitations" or is part of a determination as to a State permit program, or is inextricably bound to the issuance or denial of NPDES permits. If that is the case, any petition for such review would have to be filed within 120 days of EPA's action in establishing the TMDL, as described in 40 CFR Section 23.2.

[1] This information collection is exempt from the Paperwork Reduction Act because it is being sought from fewer than 10 sources.

4. SUMMARY

Although certain types of data are currently lacking, available information highlights several concerns. Concentrations of 2,3,7,8-TCDD in fish tissue in several areas of the Columbia River basin exceed levels protective of human health at the 10^{-6} risk level and indicate that the state water quality standards are currently being exceeded. Regional and national data strongly suggest that pulp mills which use chlorine to bleach are the most significant sources of 2,3,7,8-TCDD to surface waters. Direct measurements of effluent samples taken from chlorine-bleaching pulp mills in the Columbia River basin confirms 2,3,7,8-TCDD levels requiring control.

There is a remaining need to refine information on contributions from other potential sources such as woodtreaters, as well as to describe the effect of attenuation and the role of sediments. This TMDL reserves a portion of the calculated loading capacity as unallocated because of this need for information. The TMDL established herein for 2,3,7,8-TCDD discharges to the Columbia River Basin completes the following actions:

- Establishes waste load allocations to individual pulp mills which use chlorine bleaching, at this time. Use equal mass discharge per unit production (Table 3-2, Option 2) to allocate waste loads to individual pulp mills in that source category. NPDES permit limits for these pulp mills must be consistent with this TMDL.

- Estimates loading from Columbia River sources upstream from the U.S.-Canada border. The total loading reserved for this source category is 0.31 mg/day. By 1994 the Celgar pulp mill, is expected to reduce its contribution to approximately 0.05 mg/day. The remainder of the 0.31 mg/day is reserved as a margin of safety to cover other unidentified sources upstream of the U.S.-Canada border and/or a shortfall by Celgar in achieving anticipated reductions.

- Estimates loading from some Region 10 point sources other than the pulp mills for which WLAs were established. Appendix B describes the evidence suggesting a total 2,3,7,8-TCDD loading from these sources of less than 2.3 mg/day.

- Reserves the remaining loading capacity (1.29 mg/day, after subtracting the WLAs and estimated loadings for the sources identified above) for (1) other undesignated sources, (2) an additional margin of safety to account for uncertainties in the assumptions used in developing this TMDL, and (3) future growth. This reserved portion is equal to approximately 22% of the total loading capacity. As uncertainties are reduced, more of the reserved capacity could be allocated to new or existing sources.

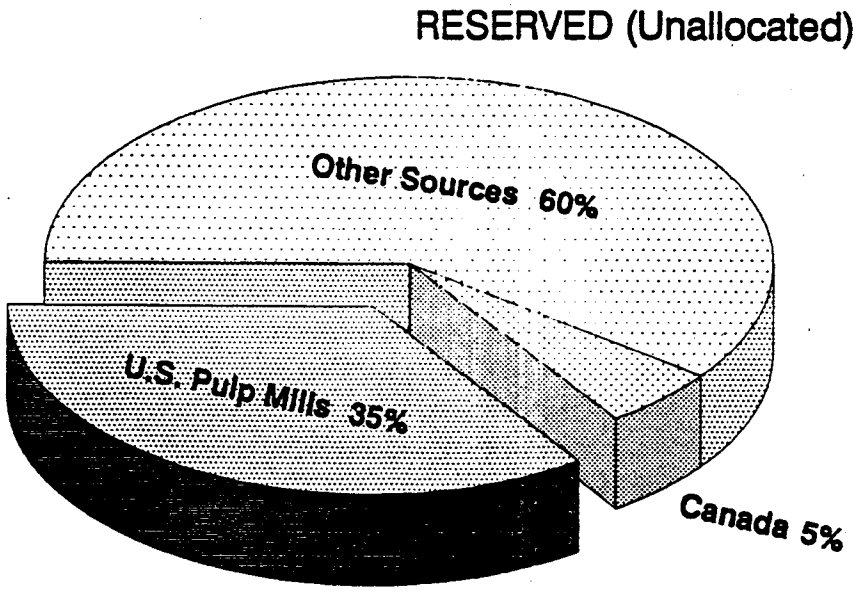
Table 4-1 and Figure 4-1 summarize the overall structure of the Final TMDL with the allocations based on currently available information.

Table 4–1. Waste Load Allocations for Chlorine-Bleaching Pulp Mills in Context of Watershed Targets

		2,3,7,8-TCDD (mg/d) WLA	Loading Capacity
LOADING CAPACITY FOR ENTIRE COLUMBIA RIVER BASIN			5.97
Columbia River Basin above Washington/Canada border			
Watershed target			2.31
Estimated Canadian Loading including Celgar mill		[0.31] [1]	
Snake River Basin above Ice Harbor Dam			
Watershed target			1.18
Pulp Mill WLAs:	Potlatch (Lewiston, ID)	0.39	
Willamette River Basin above confluence with Columbia R.			
Watershed target			0.54
Pulp Mill WLAs:	Pope & Talbot (Halsey, OR)	0.19 [2]	
Remainder of Columbia R. Basin			
Pulp Mill WLAs:	Boise Cascade (Wallula, WA)	0.25	
	James River (Camas, WA)	0.42	
	Longview Fibre (Longview, WA)	0.08	
	Weyerhaeuser (Longview, WA)	0.26	
	Boise Cascade (St. Helens, OR)	0.27	
	James River (Wauna, OR)	0.21	
	TOTAL	1.49	
SUM OF WLAs FOR REGION X PULP MILLS IN BASIN		2.07	

[1] This is not a WLA, but is included for purposes of comparison with the WLAs for U.S. mills.
[2] This is the same WLA identified in ODEQ's NPDES permit (issued 11/7/90) for this facility.

Figure 4–1. Overall Division of Columbia River Basin Loading Capacity



APPENDIX A. LOADING CAPACITY

Waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources represent the allocated portions of a receiving water's **loading capacity**. The loading capacity is the greatest amount of loading that the river can receive without violating water quality standards. A TMDL must not exceed the loading capacity of a waterbody. To determine the appropriate loading capacity available for allocation requires:

- the **water quality standard** applicable to 2,3,7,8-TCDD and the Columbia River basin.
- the **river flows** used to calculate the loading capacity of the Columbia River basin at key locations.

1. Applicable Water Quality Standards

The pollutant of concern for this TMDL, 2,3,7,8-TCDD, is the most toxic of a group of compounds known as polychlorinated dibenzo-para-dioxins. These compounds are produced as a result of human activities such as the manufacture of chlorinated herbicides, the combustion of domestic and industrial wastes, and the production of chlorine-bleached pulp.

Oregon, Washington, and Idaho have adopted water quality standards for toxic substances which apply to parts of the Columbia River basin including the Snake and Willamette Rivers. Because the purpose of this TMDL is to provide a framework for attaining all applicable water quality standards for dioxin, this multi-state TMDL must be protective of the waters with the most stringent of those standards. A brief description of individual state standards follows.

Oregon has adopted a numeric criterion for 2,3,7,8-TCDD. Oregon Administrative Rules (OAR) Chapter 340, Division 41 summarizes water quality criteria for toxic substances applicable to all basins. This includes the Columbia River from its mouth to river mile 309 and the Willamette River from its mouth to river mile 187. OAR 340-41-205(p)(B), for example, states:

> *"Levels of toxic substances shall not exceed the most recent criteria values for organic and inorganic pollutants established by EPA and published in Quality Criteria for Water (1986). A list of the criteria is presented in Table 20."*

The ambient water concentration listed in Table 20 for protection of human health from carcinogenic effects caused by 2,3,7,8-TCDD is 0.000013 ng/L, or 0.013 parts per quadrillion (ppq). This value represents the 10^{-6} risk level, the concentration at which a lifetime exposure results in a probability of one excess cancer case per one million people. It considers the consumption of contaminated water as well as fish or other aquatic organisms.

Washington has identified the Columbia River from the mouth to river mile (RM) 596.6 as a Class A waterbody and from RM 596.6 to the Canadian border (RM 745) as a Class AA waterbody. Washington has also identified the Snake River from the mouth to RM 176.1 as a Class A waterbody. Washington's rules which apply to toxic substances are found in WAC 173-201-047. The narrative part of the rule indicates that:

> *"Toxic substances shall not be introduced above natural background levels in waters of the state which may adversely affect characteristic water uses, cause acute or chronic conditions to the aquatic biota, or adversely affect public health"*

WAC 173-201-047 also states that appropriate concentrations for toxic substances in Washington are to be determined in consideration with EPA's **Quality Criteria for Water** (1986). In the process of developing its lists of degraded waters as required by §304(l) of the Clean Water Act, Washington interpreted its standard for 2,3,7,8-TCDD in a manner consistent with Oregon's numeric standard, i.e. 0.013 ppq of 2,3,7,8-TCDD as an ambient water concentration needed to protect human health.

Idaho has narrative standards which are intended to protect the beneficial uses of its waters including the Snake River. The standard, found in IDAPA 16.01.2200, states:

> *"As a result of man-caused point or nonpoint source discharge, waters of the State must not contain: 01. Hazardous materials ... in concentrations found to be of public health significance or to adversely affect designated or protected beneficial uses. 02. Deleterious materials ... in concentrations that impair designated or protected beneficial uses without being hazardous."*

In the process of developing Idaho's §304(l) short list, EPA interpreted this standard also in a manner consistent with Oregon's numeric standard.

As stated above, this TMDL has been developed to achieve attainment of the water quality standards of all affected states. Although the wording of the applicable state standards for Idaho, Oregon, and Washington differs, EPA has interpreted these standards as being equally stringent. Even if this is not the case, however, 2,3,7,8-TCDD loading to upstream segments still must be restricted to levels ensuring the attainment of water quality standards applying to downstream segments.[1] Where this document refers to "the standard" or "the criterion" for 2,3,7,8-TCDD, this means the 0.013 ppq criterion at the 10^{-6} risk level and, by implication, the assumptions which form the basis of that criterion as established by EPA. That criterion, adopted by the State of Oregon, is the controlling water quality standard which this TMDL protects.

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[1] The Superior Court of Washington for Thurston County recently found that the manner in which the State applied their water quality standards to the listing under §304(l) of three pulp and paper mills was invalid. EPA believes that this decision does not affect the use of 0.013 ppq as the water quality standard for dioxin in developing this TMDL because all waste load allocations and permit limits must ensure compliance with applicable water quality standards of downstream states [40 CFR §122.4(d)]. Oregon's water quality standard is clearly stated as being 0.013 ppq for 2,3,7,8,-TCDD.

2. River Flow:

The loading capacity of a stream is determined using the water quality criteria value and a design flow for the receiving water. Typically, loads are expressed as chemical mass per time such as pounds per day. In the case of 2,3,7,8-TCDD, loads have been expressed as milligrams (mg) per day and are calculated as follows:

$$\text{Load (mg/day)} = 0.00245 * \text{Concentration (ppq)} * \text{Flow (cfs)}$$

The 0.00245 is the factor needed to convert the units of parts per quadrillion (ppq) and cubic feet per second (cfs) to milligrams per day (mg/day)

The design flow significantly affects the determination of the loading capacity. The choice of design flow used to calculate the loading capacity for the Columbia River basin was based on the characteristics of the 2,3,7,8-TCDD water quality criterion. That criterion, 0.013 ppq 2,3,7,8-TCDD, is based on human health concerns over a lifetime. In order to address human health concerns, the harmonic mean flow is recommended as the appropriate stream design flow (**Draft Technical Support Document for Water Quality-based Toxics Control**, U.S. Environmental Protection Agency, 1990).

The harmonic mean flow was used to develop this TMDL because it provides a more reasonable estimate than the arithmetic mean to represent long-term average river flow. Flood periods in naturally flowing rivers bias the arithmetic mean above flows typically measured. This overstates available dilution. The calculation of the harmonic mean, however, dampens the effect of peak flows. As a result, the bias is reduced. The harmonic mean is also an appropriate conservative estimate of long-term average flow in highly regulated river basins, such as the Columbia. In a regulated river basin, the harmonic mean and the arithmetic average are often much closer numerically.

Table A-1 summarizes the loading capacity for 2,3,7,8-TCDD in the Columbia River system at several key locations. A long-term flow record must be used in order to minimize the effect of either droughts or wet years. It is also important to recognize the effect that reservoirs have had on flows in the Columbia basin. Many of the major dams were constructed before 1950. Thus, flow records used to determine the loading capacity in the Columbia River were those reported by the U.S. Geological Survey from 1950 to present.

Table A-1. Loading Capacity for 2,3,7,8-TCDD in the Columbia River

Gage	Location	Drainage Area (sq.mi.)	Harmonic Mean Flow (cfs)	Loading Capacity (mg/day)
12399500	Columbia River at International Boundary	59,700	72,700	2.31
12472800	Columbia River below Priest Rapids	96,000	95,100	3.03
14019200	Columbia River at McNary Dam	214,000	143,000	4.54
14105700	Columbia River at The Dalles	237,000	152,000	4.83
14144700	Columbia River at Vancouver	241,000	159,000	5.04
14222880	Columbia River at Columbia City	254,000	180,000	5.73
14246900	Columbia River below Longview	256,900	188,000	5.97

Flows at three locations on the Columbia River were estimated because of inadequate long-term records. These locations are at Vancouver (gage #14144700), at Columbia City (gage #14222880), and below Longview (gage #14246900). The estimates were based on gaged flows from tributary rivers for the corresponding segments. Average flow yield from the tributaries for a particular segment was used to estimate flow from the ungaged portion of that segment. These gaged tributaries are listed in Table A-2.

Table A-2. Loading Capacity for 2,3,7,8-TCDD in the Columbia River Tributaries

Gage	Location	Drainage Area (sq.mi.)	Harmonic Mean Flow (cfs)	Loading Capacity (mg/day)
13343500	Snake River near Clarkston	103,200	35,700	1.14
13353000	Snake River below Ice Harbor Dam	108,500	37,000	1.18
14113000	Klickitat River near Pitt	1,297	1,207	0.04
14120000	Hood River near Hood River	279	612	0.02
14123500	White Salmon River near Underwood	386	951	0.03
14125500	Little White Salmon River near Cook	134	317	0.01
14128500	Wind River near Carson	225	514	0.02
14142500	Sandy River below Bull Run River	436	1,009	0.03
14143500	Washougal River near Washougal	108	234	0.01
14166000	Willamette River at Harrisburg	3,420	7,600	0.24
14211720	Willamette River at Portland	11,100	17,100	0.54
14220500	Lewis River near Ariel	731	2,396	0.08
14222500	East Fork Lewis River near Heisson	125	196	0.01
14223500	Kalama River near Kalama	198	618	0.02
14243000	Cowlitz River at Castle Rock	2,238	5,721	0.18

APPENDIX B. ALLOCATION ISSUES

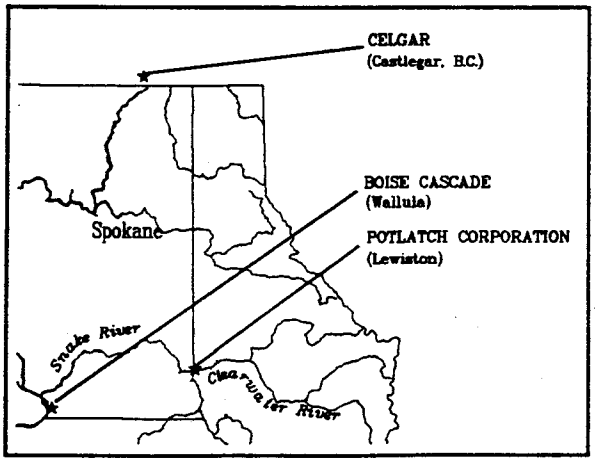
In determining appropriate allocation methods for the Columbia, several concerns have been identified that affect decisions on the TMDL. Issues identified which were considered in developing allocations for 2,3,7,8-TCDD to the Columbia River include:

- Loading from the **British Columbia pulp mill**
- Loading from **other potential sources** such as woodtreaters
- Fate, transport, and **attenuation**
- **Role of bottom sediments** (cumulative effects and resuspension)
- Framework for addressing **future allocations** (both growth within the pulp industry and allocations to other source categories)

1. British Columbia Pulp Mill

Celgar Pulp Company operates a bleached kraft pulp mill located in Castlegar, British Columbia. Wastewater from this mill is discharged to the Columbia River approximately 30 miles upstream from the United States - Canada border (Figure B-1). Studies conducted by Canadians have shown elevated concentrations of 2,3,7,8-TCDD in lake whitefish collected below the Celgar mill (Mah *et al.*, 1989; EVS, 1990). In addition, follow-up analyses by the Washington Department of Ecology of fish from Lake Roosevelt found elevated levels of TCDD and TCDF (Johnson, 1990). Lake Roosevelt is the impoundment formed by Grand Coulee Dam on the Columbia River downstream from the Celgar mill. Because of concern over the amounts of TCDD and TCDF detected in fish tissue, the Washington Department of Health took action in August 1990. A health advisory was issued that children under age four and under 40 pounds should not eat whitefish from Lake Roosevelt. Subsequent sampling by the Washington Department of Ecology suggests that concentrations of 2,3,7,8-TCDD may also be elevated in sturgeon as well.

Figure B-1. Location of Celgar Pulp Co. (Castlegar, B.C.)



The discovery of elevated levels of dioxins and furans below Celgar and other British Columbia pulp mills resulted in action by the Canadian government. New regulations under the Canadian Environmental Protection Act (CEPA) have been proposed to regulate the discharge of chlorinated organics. The Canadian federal government is proposing limits of non-detectable amounts of dioxins and furans by January 1994. In addition, the Province of British Columbia (B.C. Environment) has adopted regulations to control adsorbable organic halides (AOX) discharged from bleached kraft pulp mills. The control of AOX requires reductions in the use of chlorine which, in turn, decreases the formation of dioxins and furans. The new regulations require that, by 1993, AOX be limited to 2.5 kg per metric tonne of pulp produced.

Over the past decade, the B.C. Ministry of Environment has been trying to get various owners of the Celgar pulp mill to resolve water pollution problems caused by their failure to meet waste permit requirements. The identification of chlorinated organics as a health issue has resulted in increased urgency on the part of the Canadians to install pulping technology and effluent treatment works to resolve problems. To meet these government requirements, Celgar has proposed a mill modernization effort.

The most recent measurements of effluent quality discharged by the Celgar mill were obtained during the Canadian Pulp and Paper Association survey (CPPA, 1990). Information on present and projected levels of 2,3,7,8-TCDD and -TCDF have been provided by Celgar. These are summarized in Table B-1. The load measured in early 1990 from the Celgar pulp mill is less than 1.37 mg/day. Since this survey, the mill has made several improvements that were designed to further reduce dioxin and furan levels in the effluent. Results of the follow-up sampling will be available later this year. The amount of 2,3,7,8-TCDD measured from the Celgar mill in the 1990 survey is significantly less than the loading capacity of 2.3 mg/day for the Columbia River at the International Boundary. This does not consider other potential sources upstream of the border. However, no other sources have been identified where 2,3,7,8-TCDD has been detected.

Table B-1. Concentrations of TCDD and TCDF from Celgar Pulp

	2,3,7,8-TCDD		2,3,7,8-TCDF	
	Concentration (ppq)	Load (mg/day)	Concentration (ppq)	Load (mg/day)
CPPA 1990 Survey	ND (14)	< 1.37	310	30.4
Projected after modernization (from bleach plant)		< 0.0485		< 0.0485

Celgar is also seeking government approval to increase the mill's production from 560 to 1200 air dried metric tonnes of pulp per day. B.C. Environment recently completed public hearings regarding the proposed Celgar pulp mill expansion project. Modifications to the mill's production process are being proposed which include oxygen delignification, 70% substitution of chlorine dioxide for chlorine, and hydrogen peroxide bleaching followed by primary and secondary effluent treatment. The improvements to the Celgar mill are expected to be in place by 1994. Concentrations of TCDD and TCDF in the bleach plant effluent are expected to be below detection limits of 10 ppq. Maximum daily discharges after modernization are expected to be <0.05 mg/day for TCDD and <0.05 mg/day for TCDF (Celgar, 1990). Recognizing problems in the past, B.C. Ministry of the Environment has stated that: "Either Celgar will have to significantly upgrade pollution control technology in their existing mill to achieve compliance or they will face heavy penalties for breaking the law."

Several of the U.S. mills criticized the proposed TMDL (June 15, 1990) for a perceived lack of equity with Canada. The final TMDL estimates a loading of 0.31 mg/day from Celgar. This is equal to the loading which would be allocated to Celgar if it were a mill in Region 10. This accounts for Celgar's planned production after modernization (see Table 3-2) and applies a factor of 0.257 μg/day of 2,3,7,8-TCDD discharged per ton of bleached pulp. This is the same factor used to calculate the WLAs for the Region 10 mills. This is not a WLA but rather an estimated loading. This estimate provides a margin of safety to cover other unidentified sources in Canada and/or a possible shortfall in Celgar's attainment of the projected 0.05 mg/day loading. As additional information is assembled, this preliminary estimate may be refined.

2. Other Potential Sources

The development of the TMDL needs to consider all potential sources of 2,3,7,8-TCDD in the Columbia drainage. Besides chlorine bleaching pulp mills, other potential source categories include woodtreaters, major municipal wastewater treatment plants, agricultural areas, industrial sites, and urban areas. Table B-2 summarizes potential sources of TCDD in the Columbia, the type of available information on loading rates, and median fish tissue concentrations from the National Bioaccumulation Study (NBS) associated with the source category. The NBS was conducted as a screening investigation to determine the prevalence of selected bioaccumulative pollutants in fish. One of the study objectives was also to identify general correlations between fish tissue concentrations and sources of these pollutants.

The NBS results, listed in Table B-2, clearly indicate that the highest levels of TCDD contamination in fish were found in areas below chlorine bleaching pulp mills. However, two other site categories from the NBS in the Columbia basin which were not immediately below pulp mills had elevated levels of TCDD in fish. Both sites are located in the north Portland area. One of the sites, Columbia Slough, is affected by nonpoint sources, predominantly urban runoff and a landfill. The other site is located below a major woodtreating operation (McCormick & Baxter) which uses pentachlorophenol (PCP). TCDD contamination has been associated with PCP.

Table B-2. Potential Sources of 2,3,7,8-TCDD in the Columbia Basin

Source Category	Availability of Data for Region 10	National Bioaccumulation Study Comparative Results (from draft report)
		Median Conc. (ppt)
Chlorine Bleaching Pulp & Paper	104 mill study	4.73
Non-Chlorine Bleaching Pulp & Paper	N/A	1.30
Superfund Sites	Remedial Investigations	1.47
Woodtreaters, Incinerators, etc.	TRI , DMR	1.39
Other Industrial Sites	N/A	1.27
Urban Areas	N/A	1.27
Municipal Wastewater Treatment Plants	Sewage Sludge Survey	0.64
Agricultural Areas	N/A	0.56
Other Sites	N/A	0.63

Note: N/A - Not Available
TRI - Toxics Release Inventory (PCP)
DMR - NPDES Discharge Monitoring Reports (PCP)

Woodtreaters:

A number of current and former wood treatment facilities exist in the Columbia River basin where pentachlorophenol (PCP) has been used as a preservative. A potential source of 2,3,7,8-TCDD from woodtreating facilities is contaminated PCP. Thirteen sites near former or existing woodpreserving facilities were sampled during the National Bioaccumulation Study. The median 2,3,7,8-TCDD concentration in fish tissue at these sites was 1.39 ppt (compared to 4.73 for the chlorine bleaching pulp mills). Of the thirteen sites sampled nationally near woodtreaters, only one was in the Columbia River basin: the Willamette River at Portland (below McCormick & Baxter). Three species of aquatic organisms were sampled at that site with the following results:

Species	2,3,7,8-TCDD
Largemouth Bass	0.74 ppt
Sucker	2.22 ppt
Crayfish	2.61 ppt

The values for this site are higher than the median for the NBS. However, organisms collected from this location are also influenced by other potential sources of 2,3,7,8-TCDD, such as urban runoff.

These measured values reflect the need to evaluate information on the potential discharge of 2,3,7,8-TCDD from woodtreating facilities. EPA has recently developed a data system which contains information from the Toxics Release Inventory (TRI). A retrieval of reported releases of PCP for 1987 identifies seven facilities (woodtreaters) in the Columbia Basin (Table B-3). Five of these facilities are located in the Willamette drainage. Although the TRI information does not contain data on TCDD, the indicated releases of PCP lead to concern over woodtreaters, particularly in the Willamette basin. DMR data and inspection reports describing PCP discharges are also available for

several woodpreserving facilities with NPDES permits in the Columbia basin.

Table B-3. PCP Discharges from Columbia Basin Woodtreating Facilities

Cataloging Unit	Facility Name	Location	NPDES DMR Data	TRI Data (lbs. PCP released) 1987 (Water)	1987 (Total)	1988 (Water)	1988 (Total)
17010214	B.J. Carney	Sandpoint, ID					
17010214	L.D. McFarland	Sandpoint, ID		C	1,850	C	500
17010216	Poles, Inc.	Oldtown, ID					
17010305	B.J. Carney Industries, Inc.	Spokane, WA					
17020003	Chewelah Log and Post	Chewelah, WA					
17020003	Colville Post and Pole	Colville, WA					
17040201	Garland Pole Co.	Idaho Falls, ID					
17040219	Penta Post	Gooding, ID					
17050114	Pressure Treated Timber	Boise, ID				C	7
17050114	Roundy Pole Fence Co.	Eagle, ID					
17070105	J.H. Baxter & Co.	The Dalles, OR					
17080001	Allweather Wood Treaters	Washougal, WA					
17080001	Exterior Wood, Inc.	Washougal, WA					
17080001	Pacific Wood Treating	Ridgefield, WA	I/R	250	2,300	B	1,500
17080003	International Paper Co.	Longview, WA					
17090001	Jasper Wood Treating	Jasper, OR					
17090003	J.H. Baxter & Co.	Eugene, OR	X	250	1,250	200	202
17090003	L.D. McFarland	Eugene, OR	X	250	1,500	B	750
17090008	Taylor Lumber & Treating	Sheridan, OR	o	250	13,488	B	2,150
17090010	Dant & Russell	North Plains, OR					
17090010	Permapost	Hillsboro, OR		0	250		
17090012	McCormick & Baxter	Portland, OR	X	31	6,999	150	154

Notes TRI data for releases of PCP to: Water (discharge)
Total (includes water, air and land disposal)

B : 1 - 499 lbs.
C : No discharge to water identified
I/R : Inspection Report
X : Loads calculated for PCP
o : Only PCP concentration reported

The preamble to a proposed RCRA rule relating to the wood preserving industry (53 FR 53292, December 30, 1988) describes ranges of chlorinated dibenzodioxin and chlorinated dibenzofuran as well as PCP concentrations in wastewaters from woodtreating facilities. Thus, an estimate of potential 2,3,7,8-TCDD releases from woodtreating facilities can be made based on data on PCP discharges. The TRI data were considered in estimating TCDD wastewater releases from woodtreaters. However, there are some apparent problems. Several facilities, for instance, reported zero discharge to water while others reported the same value of 250 pounds. DMR data, on the other hand, appear to provide better information on PCP discharges. Applying assumed ratios of 2,3,7,8-TCDD per unit PCP (derived from Table 7, 53 FR 53292) to the DMR data, EPA estimates that 1 - 2 mg/day 2,3,7,8-TCDD could be originating from woodtreating operations in the Columbia basin. This estimate includes the potential release from facilities where no DMR or TRI data exists.

Levels of 2,3,7,8-TCDD observed in fish and sediments below one major woodtreating operation plus estimates of potential loads point to the need for additional data. Any allocation scheme used to develop the TMDL must leave room for these facilities. Using available information, a range of 1 - 2 mg/day appears to be a reasonable estimate. However, this estimate is preliminary and data are still being generated. As additional information is assembled, this estimate may be refined. Most of the released 2,3,7,8-TCDD is associated with site run-off during rainfall. Thus, the loading from woodtreaters could be reduced by implementing stormwater controls.

Municipal Wastewater Treatment Facilities:

National data demonstrate that the sludges removed from some municipal wastewater treatment plants contain dioxins and furans. Generally, octa-chlorinated forms predominate the dioxins found in these sludges, although 2,3,7,8-TCDD has also been detected. Where sludges are contaminated, the wastewater discharges could also contain 2,3,7,8-TCDD. Testing performed for 2,3,7,8-TCDD in sludge nationally included five municipal wastewater treatment plants in the Columbia basin ("National Sewage-Sludge Survey Facility Analytical Results", U.S. Environmental Protection Agency, 1989). Results for these five facilities are listed in Table B-4.

Table B-4. Columbia Basin Sludge Testing for 2,3,7,8-TCDD

Cataloging Unit	Facility Name	Location	2,3,7,8-TCDD (ng/kg)	Detection Limit
	Municipal WWTP's			
17050114	West Boise STP	Boise, ID	ND	(4.7)
	" " "	" "	ND	(6.1)
17080001	Columbia Blvd. STP	Portland, OR	ND	(16.0)
	" " "	" "	ND	(8.9)
17090005	Stayton STP	Stayton, OR	ND	(23.0)
17090006	Lebanon STP	Lebanon, OR	3.3	---
	" "	" "	2.2	---
17090012	Tryon Creek STP	Lake Oswego, OR	ND	(57.0)
	" " "	" " "	ND	(43.0)
	Chlorine Bl. Mills			
17060306	Potlatch Corp.	Lewiston, ID	78.0	---
17070101	Boise Cascade	Wallula, WA	70.0	---
17080001	James River	Camas, WA	12.0	---
17080003	Boise Cascade	St. Helens, OR	4.2	---
17080003	Longview Fibre	Longview, WA	69.0	---
17080003	Weyerhaeuser	Longview, WA	25.0	---
	" "	" "	35.0	---
17080003	James River	Wauna, OR	19.0 (pri.)	---
	" "	" "	89.0 (sec.)	---
17090003	Pope & Talbot	Halsey, OR	31.0	---

Of the five municipal facilities whose sludges were examined in the Columbia basin, only one had detectable levels of 2,3,7,8-TCDD. This indicates that the TMDL should leave some room for potential allocations to municipal sewage treatment plants. Analytical results for this treatment plant, however, show that the detected concentration was at levels much lower than sludge tested at chlorine bleaching pulp mills (Table B-4). Thus, it can be expected that load estimates for municipal facilities will be much lower than the loads allocated to the pulp mills based on the sludge data.

Initial estimates of 2,3,7,8-TCDD discharged from municipal wastewater treatment facilities can be made using available data. Permitted total suspended solids for each facility and an assumed average 2,3,7,8-TCDD concentration in municipal sludge form the basis of these calculations. The analysis also assumes that chlorinated dioxins / furans found in municipal sludge are associated with effluent solids at the same concentrations. The average 2,3,7,8-TCDD concentration detected was 2.8 ng/kg. The permitted total suspended solids load from Region 10 municipal wastewater treatment plants in the Columbia Basin is over 170,000 pounds per day. Based on this information, these municipal wastewater treatment facilities could, as a group, contribute an average of 0.2 mg/day 2,3,7,8-TCDD. As additional information is assembled, this preliminary estimate may be refined.

Other Industrial Sources:

Non-chlorine bleaching pulp mills (Table B-5) and other potential industrial sources also need to be considered in the allocation process. No data has been presented on 2,3,7,8-TCDD concentrations in either wastewater or sludges for Columbia basin non-chlorine bleaching pulp mills. Another potential industrial source of 2,3,7,8-TCDD is Rhone-Poulenc, located in north Portland. This plant has produced chlorophenolic herbicides since 1956. The facility discharges boiler blowdown, cooling water, site runoff, and treated groundwater to the Willamette River (across from McCormick & Baxter). The effluent is known to contain chlorinated phenols, although 2,3,7,8-TCDD was not detected during a National Dioxin Study.

Table B-5. Non Chlorine Bleaching Pulp Mills in the Columbia Basin

Cataloging Unit	Facility	Location
17010305	Inland Empire Paper Co.	Spokane, WA
17080001	Boise Cascade Corp.	Vancouver, WA
17090003	Willamette Industries	Albany, OR
17090004	Weyerhaeuser	Springfield, OR
17090007	Smurfit Newsprint	Newberg, OR
17090012	James River II	West Linn, OR
17090012	Smurfit Newsprint	Oregon City, OR

An estimate of loadings from these sources cannot be determined at this time. With respect to non-chlorine bleaching pulp mills, an analysis cannot be conducted because no data has been identified which describes 2,3,7,8-TCDD in either effluents

or sludges. As to Rhone-Poulenc, available data from the National Dioxin Study showed non-detect for 2,3,7,8-TCDD. However, the detection limits were higher than present day limits. As additional information is gathered, it will be possible to estimate loadings from these sources.

3. Fate, Transport, and Attenuation

Losses of 2,3,7,8-TCDD in the water column can occur through sedimentation (see discussion in next section), photolysis, and volatilization, as well as through uptake by aquatic organisms. 2,3,7,8-TCDD's structural properties, laboratory bioconcentration experiments, and field observations also indicate a strong potential for bioaccumulation. Thus, the role of these processes needs to be expressed in terms of potential bioavailability. Limited information exists which can be used to provide initial estimates on the effects of fate, transport and attenuation in the Columbia River system. Readily available, quality data have been considered. This includes information from the Northwest Pulp & Paper Association's Columbia River Fish Study (1989), from EPA's National Bioaccumulation Study (1987), from the Washington Department of Ecology's work on Lake Roosevelt (1989-90), and from efforts in Canada.

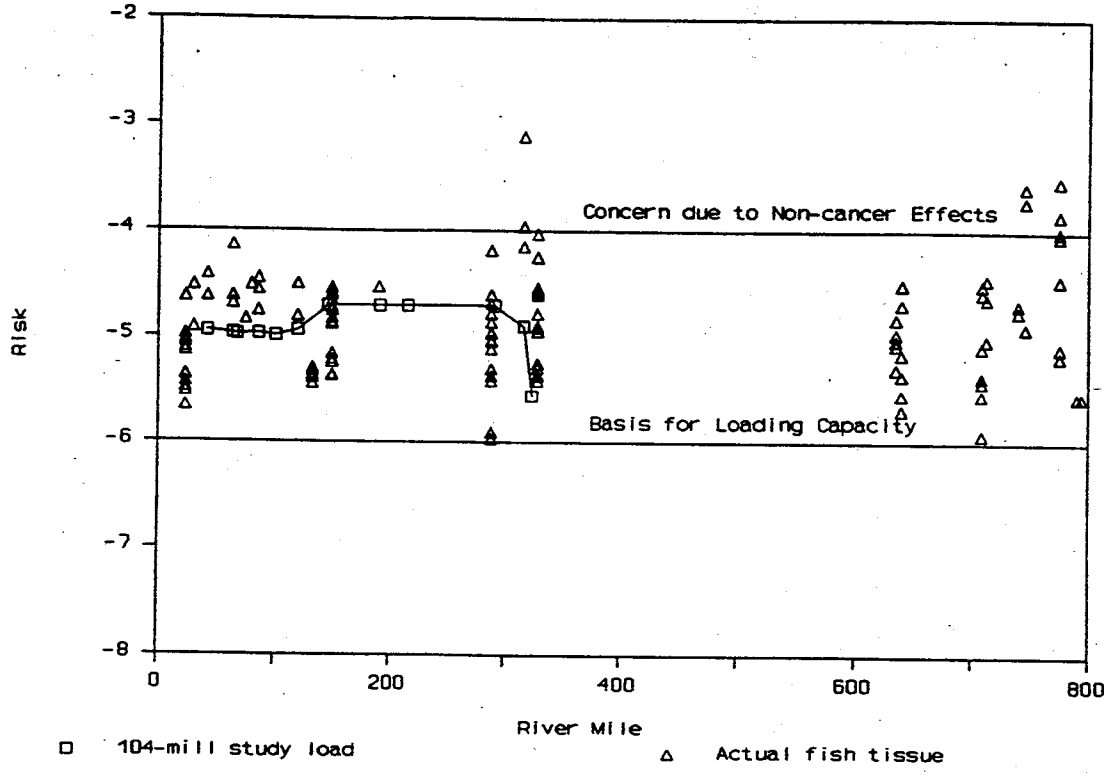
Several approaches exist to evaluate the effects of fate, transport, and attenuation. Water quality models, using a variety of assumptions, can be used to assess ambient data and to evaluate the need for additional controls. Available analytical tools range from simple estimates to complex data-intensive dynamic models. Analyses can include a loss rate which considers potential adsorption of TCDD on particulate matter within the water column. The potential release of TCDD from the sediment to the overlying water or the potential effect of sediment bound TCDD on the benthic and aquatic life food chain must also be considered. However, quantitative predications of bioaccumulation for specific cases and regulatory actions are complicated by many uncertainties. These uncertainties include the degree of partitioning between dissolved and bound phases, definition of the food chain structure plus bioenergetic parameters, and the relative importance of other fate and transport phenomena.

The Clean Water Act specifically states that TMDL's shall be established with a margin of safety which takes into account any lack of knowledge. Based on the lack of knowledge concerning attenuation of TCDD in the Columbia River basin, assumptions must be made with respect to attenuation in determining the loading capacity of the system and allocations of that capacity. A review of comments received on the proposed TMDL did not provide conclusive evidence that **net** attenuation occurs. Although TCDD may be lost to the sediments, that loss may only be temporary because of resuspension, desorption, or biological uptake directly from the sediments.

Figure B-2 superimposes predicted fish tissue concentration data on a graph of the actual (measured) fish tissue data plotted in Figure 2-1 in Section 2 of this document. Water column concentrations of 2,3,7,8-TCDD were modeled based on (1) the results of TCDD sampling in source effluents (the "104-Mill Study), (2) receiving

water dilution calculated from the harmonic mean flows at the discharge points, and (3) an assumption of no net attenuation. Predicted fish tissue concentrations were then calculated using a bioccncentration factor of 5,000 (the factor used in developing the water quality criterion). As in Figure 2-1, all fish tissue concentrations (both measured and predicted) are displayed in terms of estimated cancer risk based on the factors used to calculate EPA's water quality criterion for 2,3,7,8-TCDD. Both the 10^{-6} and 10^{-4} risk levels are identified. The 10^{-6} risk level corresponds to the 0.013 ppq ambient 2,3,7,8-TCDD concentration which is the basis of the TMDL, while 10^{-4} represents a level of possible concern due to non-cancer effects. Note that the line plotted between data predicted based on an assumption of no net attenuation closely follows the data points based on directly measured fish tissue concentrations.

Figure B-2. Columbia River Fish Tissue: TCDD



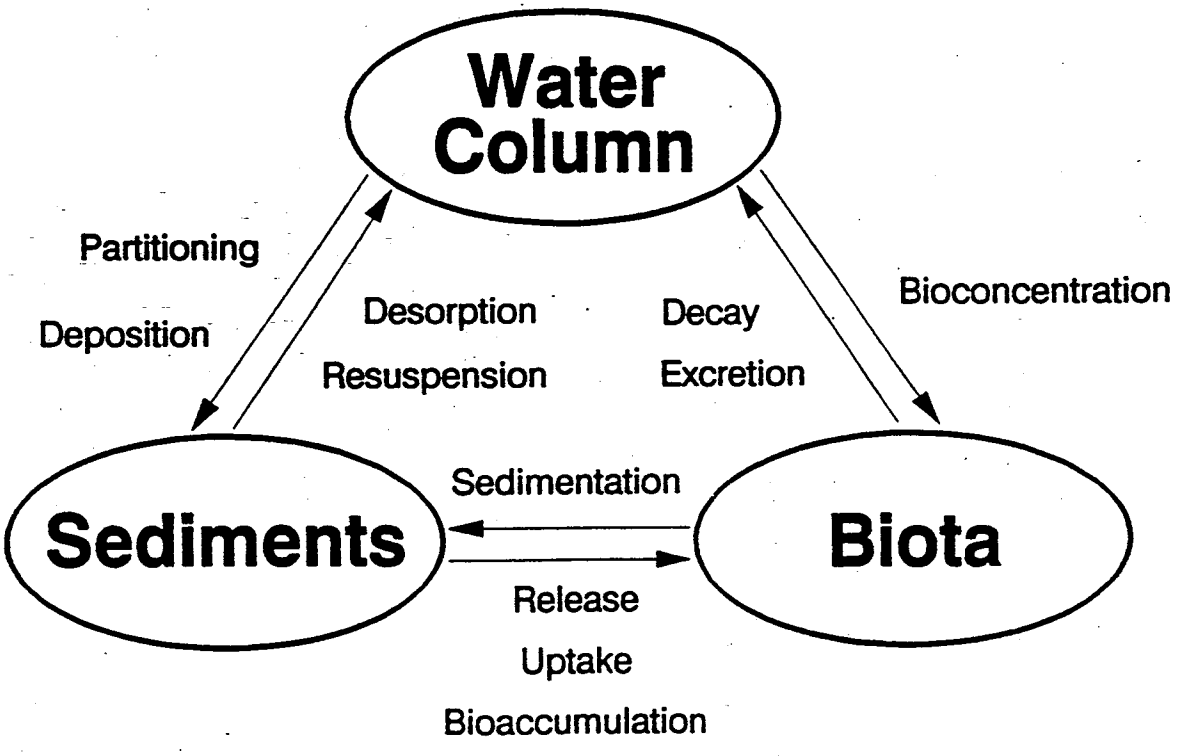
Based on the comparison in Figure B-2 of predicted tissue concentrations with observed values, an assumption of no net attenuation appears to be reasonable. Thus, for purposes of developing this TMDL, all 2,3,7,8-TCDD discharged is assumed to remain in the water column and remain biologically available. Because this is a conservative assumption, this TMDL should lead to the attainment of water quality standards regardless of the actual level of attenuation. If future studies quantify a net attenuation rate, allocations can be modified to reflect this. This capacity could be used to provide an increased margin of safety to account for unknown sources, increase allocations for existing sources, or accommodate future growth needs. By the same token, if studies indicate that TCDD releases from historical accumulations in

the sediments constitute a problem, tighter controls may be needed (see discussion in following section).

4. Role of Bottom Sediments

Sediment concentrations are the result of a complex series of interactions between TCDD, the overlying water column, solids, aquatic organisms, and the external loading of TCDD. Because of the hydrophobic nature of dioxin, there is a tendency for TCDD to move from the water column to the sediments and aquatic biota. Although attenuation may result in a net loss of TCDD from the water column, the potential also exists for the sediments to act as a source of dioxin through the release of TCDD which has accumulated (Figure B-3).

Figure B-3. Exchange of TCDD Between Water Column, Sediments, and Biota



Some fraction of the TCDD which enters a river is quickly associated with solids. The adsorption of TCDD to particulate matter may ultimately determine levels in fish tissue. There are a number of different theories about the role of equilibrium partitioning and bioaccumulation from contaminated sediments. The fate of TCDD in the aquatic environment is increasingly being discussed in terms of food chain mechanisms. Dioxins are believed to be adsorbed to bacteria, fungi, and organic sediment particles. These particles are eaten by filter-feeding benthic invertebrates which in turn are consumed by fish.

In addition, solids tend to settle to the bottom of the receiving water. In areas where the river is not filling in, these particles (and the TCDD associated with them) will continue to be carried downstream as either bedload or resuspended sediments. In areas of sediment accretion, typically where river velocities are diminished, TCDD will tend to accumulate in the bottom sediments where it may be available to aquatic organisms. Resuspension of sediments either through high streamflows, boat traffic, or dredging activities must also be considered.

Current knowledge of the Columbia system is not adequate to determine the availability of TCDD associated with particulate matter to benthic organisms or fish on a basin-wide basis. Existing sediment concentrations probably reflect a combination of both current and historical discharges of TCDD. Because the Region's pulp mills have implemented some process changes recently, such as the use of different defoamers, it is unlikely that existing sediment contamination levels are in equilibrium with current loadings to the basin. Also, if desorption of dioxin occurs slowly, it may take several years to observe the effect of reduced discharges in sediments and in biota.

Limited sediment sampling for dioxin has been done in the Columbia system. Data collected in the mainstem Columbia River below Bonneville Dam have not detected 2,3,7,8-TCDD. However, current detection limits may be above the level of concern considering the low organic content of the sediments analyzed. TCDD has been detected in Willamette River sediments below a woodtreating operation. These spatial differences reflect both physical characteristics and the influence of specific sources. Thus, future studies on the effect of sediments should address site-specific concerns.

Given these conditions it would not be appropriate to assume a permanent loss of 2,3,7,8-TCDD through sedimentation. Indeed, a portion of the loading capacity should remain unallocated to account for potential release from the sediments and from TCDD currently stored in the food chain. As indicated in the discussion on attenuation, tighter controls will be needed if data show that the cumulative effects of historical discharges significantly delay attainment of TCDD standards under the reduced loadings required by this TMDL.

5. Future Allocations

TMDLs may provide a framework for dealing with future allocations. Examples include the assignment of any unallocated portion of the loading capacity to specific point or nonpoint sources. Future growth of the pulp industry in the Columbia River basin, either expansion of existing mills or new mills, is a possibility which should be considered in this TMDL.

Developing an equitable framework for future allocations is not an easy task. This TMDL reserves a portion of the loading capacity as unallocated for 2,3,7,8-TCDD to account for uncertainties and to provide for future growth. As uncertainties are reduced, the amount held back can be made available to other sources or for additional future growth. Decisions on the use of the unallocated load will be made on

a case-by-case basis by EPA in consultation with the affected States. If proposed projects are not consistent with this TMDL, a revised TMDL would need to be established before the proposed increased loadings could be allowed.

APPENDIX C. WASTE LOAD ALLOCATION METHODS CONSIDERED

In developing the proposed TMDL, several alternative waste load allocation methods were considered for allocating portions of the loading capacity to chlorine bleaching pulp mills. These alternatives were presented in the Decision Document for the proposed TMDL to illustrate the effect of assumptions made on resulting WLAs and to stimulate public consideration of the pros and cons of alternative allocation scenarios. Included in the presentation of options was one preferred alternative.

There was no information received during the public comment period which has caused EPA to change its decision about the preferred allocation method (Option 4, Table C-2). Two additional options were suggested, however. These were: (1) allocate the entire loading capacity to the bleaching pulp mills, and (2) require zero discharge of dioxin from the pulp mills. The first suggestion is clearly inappropriate since other sources, which are presently difficult to control, would cause the loading capacity of the system to be exceeded. Appendix B includes additional discussion and estimates of sources other than chlorine bleaching pulp mills which supports the likelihood of this exceedence. The zero discharge option is also further discussed in this document and in the response to comments. Zero discharge is not necessary in order to meet water quality standards for dioxin in the Columbia River basin.

For the convenience of the public, the discussion of options contained in the Decision Document for the proposed TMDL is repeated here. The alternative approaches considered fall into several different categories which include:

- Equal Effluent Concentrations
- Equal Mass Discharge per Unit Production
- Equal Percent Reduction

Equal Effluent Concentrations:

One allocation option is to set an equal effluent concentration for each pulp mill which uses chlorine bleaching. The resultant cumulative load is the portion of the loading capacity allocated to chlorine bleaching pulp mills located in EPA Region 10. Some margin of safety is then provided by the difference between the loading capacity and the WLAs to the chlorine bleaching pulp mills in the Columbia basin of Region 10. The unallocated amount depends directly on the effluent concentration selected.

A starting point is to look at a long term average effluent limit of 10 ppq (the current general method detection limit) at each mill. This limit is initially applied at the

point of discharge. Total plant effluent flows are used as a basis to calculate loads. Discharge monitoring report (DMR) data have been summarized and includes average effluent discharge rates.

Using a long term average effluent limit of 10 ppq applied at the point of discharge and current estimates of monthly average flow at each mill, the cumulative load from all the mills equals 11.7 mg/day (Table B-1). This is greater than the loading capacity of 5.97 mg/day. Consequently, this option must be rejected because water quality standards would not be met under conservative assumptions, such as no attenuation. In addition, this would not account for any 2,3,7,8-TCDD from other sources. Thus, more restrictive controls are needed.

A permit condition set at a level below the general analytical detection limit creates a situation where it is difficult, if not impossible, to determine compliance. Because dioxins and other chlorinated organic compounds are produced in the bleach plant, concentrations of 2,3,7,8-TCDD are higher in the combined bleach plant flow than in the total plant effluent. This means that waste load allocations which result in total plant effluent concentration limits that are below the general analytical detection limit could be monitored for compliance by measuring concentrations in the combined bleach plant waste stream. Using **estimates** of bleach plant flows and a long term average limit of 10 ppq in the combined bleach plant flow, the cumulative load is 3.7 mg/day or approximately 62 percent of the total loading capacity (Table B-1). Although this option yields a cumulative load from chlorine bleaching pulp mills which is less than the loading capacity, several concerns exist:

- there is very little room for allocations to other potential sources, such as woodtreaters or the mill in British Columbia (estimates described in Appendix B indicate current loadings from other sources would exceed the unallocated portion of the loading capacity)
- there would be no margin of safety
- future growth in the pulp & paper industry is not addressed

For these reasons, the possibility of yet lower effluent limits was evaluated. This was accomplished by setting a "maximum" concentration of 10 ppq, rather than using a long term average of 10 ppq. To understand how this results in a lower allocation, the relationship between the waste load allocation (WLA) and the actual permit limits must be examined. In certain cases, permit limits will be different than WLA values. Because the criteria for 2,3,7,8-TCDD is set to protect human health, the loading capacity (and WLAs) reflect a long term average. It is important to consider how the WLAs address variability in effluent quality. Permit limits are set at the upper bounds of acceptable performance and are values not to be exceeded. Requirements are usually expressed using two types of permit limits, either daily maximum or monthly average. Procedures have been developed for computing monthly average permit limits from long term average WLAs in EPA's TSD ("Technical Support Document for Water Quality-based Toxics Control", U.S. Environmental Protection Agency, 1985).

Assuming a coefficient of variation (C.V.) of 0.6 describes the effluent variability for 2,3,7,8-TCDD from pulp mills[1] and one sample required to be taken per month, a monthly average permit limit of 10 ppq converts to a long term average WLA value of 4.7 ppq. Using estimates of bleach plant flows and 4.7 ppq as the long term average concentration limit for the combined bleach plant flow, the cumulative load is 1.8 mg/day or just over 30 percent of the total loading capacity. This leaves nearly 70 percent of the loading capacity available to cover loadings from other potential sources. This approach also results in more than a 95 percent reduction in 2,3,7,8-TCDD discharged from these pulp mills when compared to estimates of current loading based on results of the 104 mill study.

Table C-1. Waste Load Allocations for Chlorine-Bleaching Pulp Mills

Production (tons/day)	Percent	Option 1 TCDD WLA (mg/day)	Option 2 TCDD WLA (mg/day)	Option 3 TCDD WLA (mg/day)	Mill
1,509	17.2	1.42	0.71	0.33	Potlatch -- Lewiston, ID
957	10.9	0.76	0.14	0.06	Boise Cascade -- Wallula, WA
1,650	18.8	2.20	0.87	0.41	James River -- Camas, WA
310	3.5	2.37	0.23	0.11	Longview Fibre -- Longview, WA
1026	11.7	2.01	0.57	0.27	Weyerhaeuser -- Longview, WA
1500	17.1	0.19	0.19	0.19	Pope & Talbot -- Halsey, OR [2]
1,035	11.8	1.29	0.64	0.30	Boise Cascade -- St. Helens, OR
800	9.1	1.44	0.36	0.17	James River -- Wauna, OR
7,837	100.0	11.67	3.72	1.84	TOTAL Source Category Allotment

Option 1: Set Equal Long Term Average Effluent Concentration of 10 ppq at Point of Discharge

Option 2: Set Equal Long Term Average Effluent Concentration of 10 ppq at Bleach Plant

Option 3: Set Equal Long Term Average Effluent Concentration of 4.7 ppq at Bleach Plant

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[1] A C.V. of 0.6 is recommended in EPA's TSD ("Technical Support Document for Water Quality-based Toxics Control", U.S. Environmental Protection Agency, 1985) for situations where there is insufficient data to estimate a C.V. for a specific pollutant from a specific industrial process. In the fact sheet accompanying the public notice for the draft TMDL, EPA solicited information of use in developing a more appropriate C.V., if available, from the public. No such information was provided.

[2] The WLAs listed for Pope & Talbot under all options have been adjusted to the long term average of 0.19 mg/day identified in the NPDES permit issued by the Oregon Department of Environmental Quality (November 7, 1990).

Equal Mass Discharge per Unit Production:

A disadvantage of equal effluent concentrations based on current flow rates is that it may not be equitable for all mills. A common approach for industrial permits is to consider production levels in establishing effluent limits. To provide for more equity, each mill could be allocated an equal amount of 2,3,7,8-TCDD for discharge per quantity of bleached pulp produced. One way to accomplish this is to associate bleach plant flow rates with production quantity of bleach pulp. In estimating bleach plant flows, the Washington Department of Ecology used 14,470 gallons of wastewater generated per ton of bleached pulp produced. Applying this figure to calculate bleach plant flows and 4.7 ppq as the long term average concentration limit for the combined bleach plant flow, the cumulative load is 2.07 mg/day (Table B-2) or approximately 35% of the total loading capacity.

Table C-2. Waste Load Allocations for Chorine-Bleaching Pulp Mills

(**Option 4:** Set Equal Long Term Average Effluent Concentration of 4.7 ppq at Bleach Plant and Set Flows at 14,470 gallons / ton bleached pulp)

Production (tons/day)	Percent	TCDD WLA (mg/day)	Mill
1,509	17.2	0.39	Potlatch -- Lewiston, ID
957	10.9	0.25	Boise Cascade -- Wallula, WA
1,650	18.8	0.42	James River -- Camas, WA
310	3.5	0.08	Longview Fibre -- Longview, WA
1026	11.7	0.26	Weyerhaeuser -- Longview, WA
1500	17.1	0.19	Pope & Talbot -- Halsey, OR [1]
1,035	11.8	0.27	Boise Cascade -- St. Helens, OR
800	9.1	0.21	James River -- Wauna, OR
7,837	100.0	2.07	TOTAL Source Category Allotment

Although this is an increase of 0.13 mg/day over that shown in Table 5-5, the approach does address one major problem with using current bleach plant flows. Mills have been encouraged to recycle internal waste streams to the maximum extent possible. One example, Boise Cascade at Wallula, practices extensive recycling. Under the equal effluent concentration method, a mill that does a high level of recycling receives a lower allocation. However, a mill that does not make efficient use of water in the bleach plant benefits from a high allocation. This is a major reason for relating bleach plant flows to pulp production when determining allowable loads. This

[1] The WLA listed for Pope & Talbot has been adjusted to the long term average of 0.19 mg/day identified in the NPDES permit issued by the Oregon Department of Environmental Quality (November 7, 1990).

approach still results in more than a 95 percent reduction in 2,3,7,8-TCDD discharged from these mills when compared to results of the 104 mill study. Based on the evaluation in Appendix B, this reduction, although less than obtained by Option 3, is still sufficient to achieve total 2,3,7,8-TCDD loadings to the basin which are less than the loading capacity.

Equal Percent Reduction:

Another option considered is **equal percent reduction for all source categories**. Because there is an absence of specific data for loadings of TCDD to the Columbia, this approach can be viewed in several different ways. The first could use information on the relative magnitude of 2,3,7,8-TCDD in fish collected below potential sources of dioxin. Using median tissue concentrations summarized in Table A-1 as a general indicator of these relative contributions, thirty-six percent (36%) of the loading capacity could be attributed to chlorine bleaching pulp production. The remaining sixty-four percent (64%) could be attributed to other sources, such as municipal wastewater treatment plants or agricultural areas. This analysis excludes refineries because this industry is not known to be a significant source in the Columbia drainage. Although this approach does offer some advantages by accounting for other source categories, there are some major drawbacks. These include:

- NBS was intended as a screening study and not to describe source category loadings
- fish sampled nationally were collected from streams of varying sizes and did not account for dilution
- results of NBS associated with certain source categories may also include other sources (i.e. a site directly below a municipal wastewater treatment plant may also be 30 miles below a bleached kraft pulp mill)

Another option suggested is to use values of 2,3,7,8-TCDD measured in Columbia River fish and the bioconcentration factor used to develop the water quality criterion (0.013 ppq) to "back calculate" current TCDD loads. Although it may be possible to estimate the relative magnitude of present plus historic TCDD loading by looking at tissue concentrations, other factors besides a weighted average bioconcentration factor of 5000 must be considered. For instance, bioconcentration factors specific to the species should be evaluated. The age of the fish and lipid content of the samples must also be taken into account. The 5000 bioconcentration factor used to develop the criterion is intended to represent the weighted average factor for the species mix and lipid content in the "average" American fish / shellfish diet. The lack of species-specific bioconcentration data, as well as the difficulty in distinguishing the effects of historic versus current loading, makes using this approach inappropriate for this TMDL at the present time.