

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, § 130.2] 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.

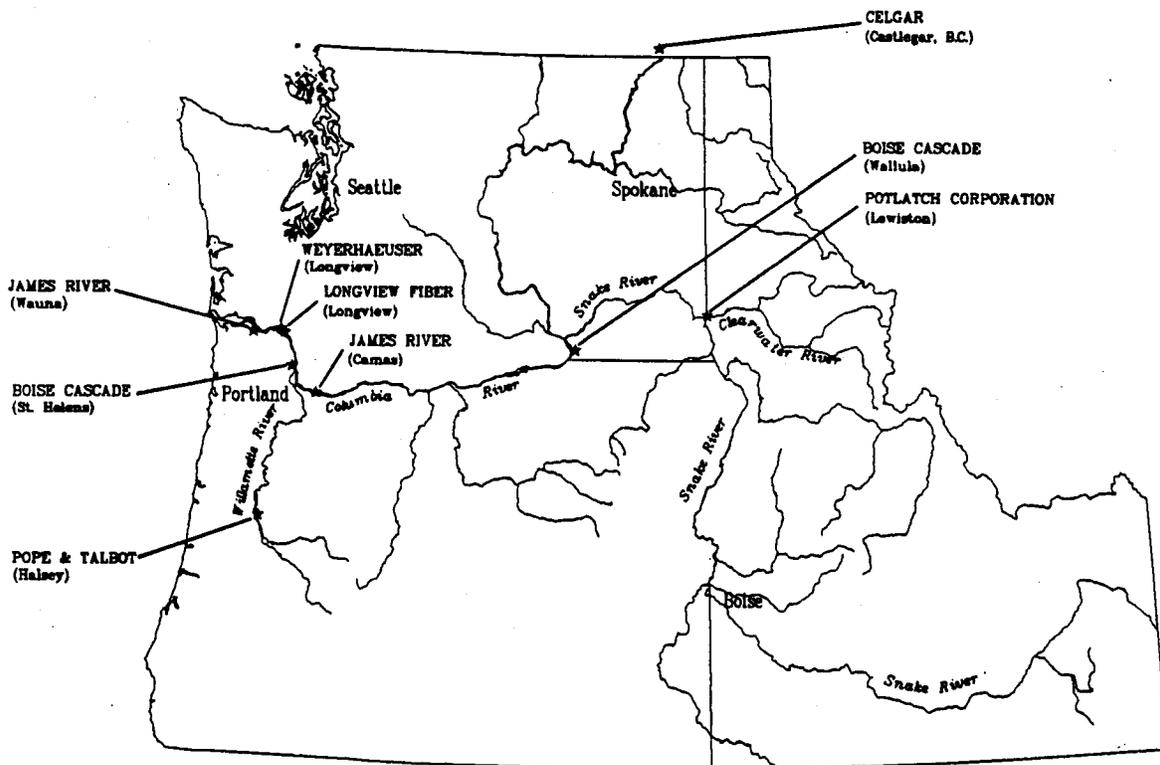
Within EPA Region 10, eight chlorine-bleaching pulp mills currently discharge to the Columbia River system. These mills, one in Idaho, four in Washington, and three in Oregon, are shown in Figure 3-1. The eight mills currently produce over 7,000 tons per day of bleached pulp. Another chlorine-bleaching 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:

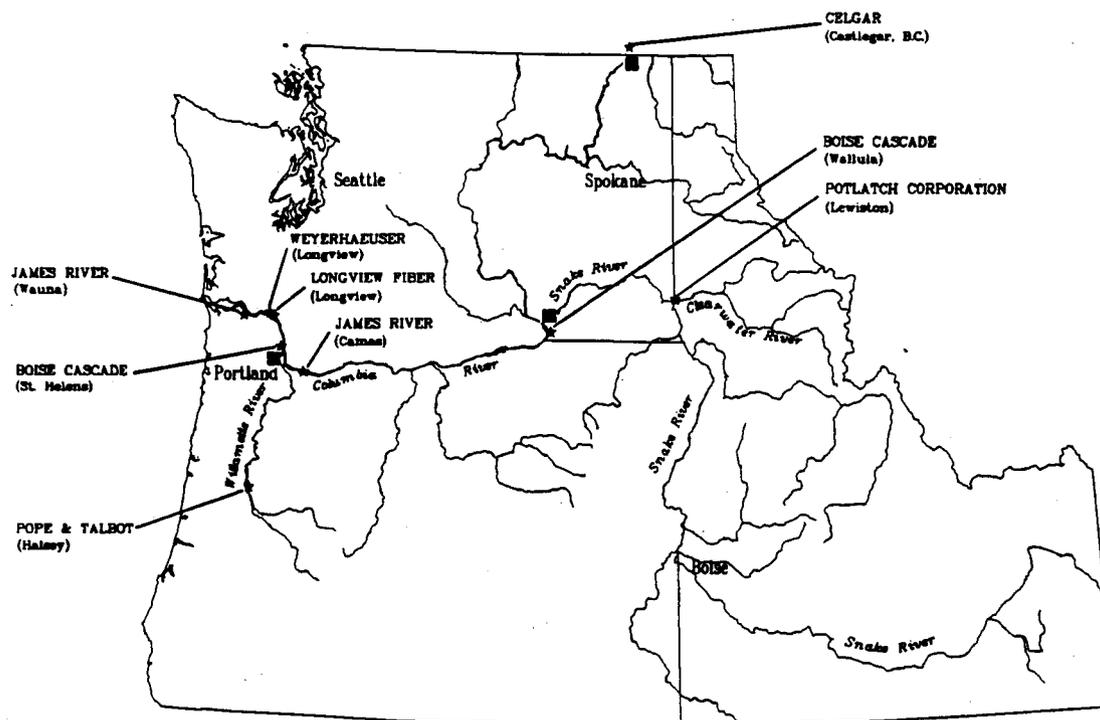
The Oregon Department of Environmental Quality (DEQ) has utilized the concept of watershed targets for developing TMDLs in Oregon. Watershed targets are particularly useful for TMDLs designed to achieve water quality standards in large waterbodies adversely affected by a pollutant coming from a variety 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.

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	<u>0.54</u>
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 s304(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 Chlorine-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.