Lake Chelan DDT and PCB TMDL

Water Quality Implementation Plan

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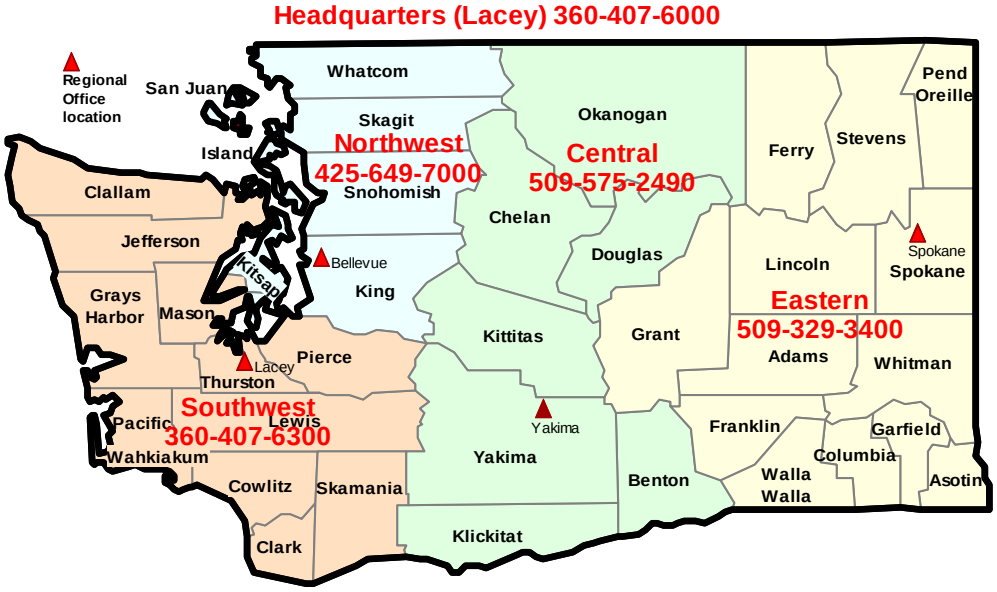

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Lake Chelan DDT and PCB TMDL

Water Quality Implementation Plan

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Executive Summary

Persistent, manmade chemicals, a legacy of past agricultural and industrial activities, contaminate the sediment, water, and fishes in Lake Chelan and Roses Lake. These toxins are the pesticide DDT and its associated breakdown products as well as polychlorinated biphenyls (PCBs). Federal and state governments banned the use of these toxins more than 25 years ago, but they still persist in water, land, and fish in the Lake Chelan watershed today. The improvement of Lake Chelan's sediment, water quality, and fish will depend on minimizing the movement of these contaminants from the surrounding lands to the lake and its tributaries. This Water Quality Implementation Plan (WQIP) addresses 303(d) listings for DDT and PCBs in fish tissue in Lake Chelan and Roses Lake.

Lake Chelan is located in north-central Washington State (Figure 1). It is the longest and deepest natural lake in the state. Lake Chelan collects water from a watershed that is 924 square miles. Ninety percent of the watershed is forested or open lands, with the majority managed by the United States Department of Agriculture's Forest Service (USFS) and the National Park Service. The lake itself occupies two distinct basins: the northwestern Lucerne Basin and the southeastern Wapato Basin. Lands used for agriculture and orchards comprise three percent of the watershed's land area. Almost all of them are located in the more developed area surrounding the Wapato Basin. A cluster of three small lakes: Roses Lake, Wapato Lake, and Dry Lake, are located about a mile north of the town of Manson and drain to Lake Chelan.

DDT and PCB compounds enter Lake Chelan and Roses Lake and accumulate in the tissues of the fish living in these waters. The levels of these chemicals in the tissue of burbot, kokanee, and lake trout exceed federal and state water quality standards set to protect human health. Washington State completed a Water Quality Improvement Report (WQIR), also known as a Total Maximum Daily Load (TMDL), to address these contaminants in the fish of Lake Chelan and Roses Lake.

Much contamination is already in the lake sediment and is likely being transported to fish through the food web (from sediment and water to plants, insects and other small animals to fish). Food web exposure to contaminants already in the lake should slowly decrease through chemical breakdown, dilution, and the sequestering of these contaminants under accumulating sediments. As the contaminants decrease in the environment, they will be less available to the fish. Because the rate of chemical breakdown of these contaminants in the lakes is slow, it is necessary to minimize the amount of contaminants entering water bodies in the watershed in order to assure continued improvements in fish tissue concentrations.

Residues of DDT persist in soils where it was applied, most often on agricultural lands. These residues move with soils when erosion occurs. DDT can also move through the soil profile to ground water during irrigation, snowmelt, and rain events. The most practical means to minimize the additions of DDT to the lake are taking steps to minimize (1) soil erosion to surface water, and (2) DDT transport through the soil profile to ground water from the agricultural lands.

Sources of PCBs are more difficult to determine than DDT. The U.S. Environmental Protection Agency (EPA) phased out the use and manufacture of PCBs in 1979. Some locations of PCB

sources have already been identified and remediated (see *Lake Chelan Watershed DDT and PCB TMDL Water Quality Improvement Report, June 2006*). Although atmospheric deposition is likely the main contributor to PCBs in the lake, the main implementation action associated with PCBs is the careful disposal of potential sources of PCBs if they are found in the watershed.

Many actions have been taken to reduce the input of DDT and PCB contamination in the environment. DDT and PCBs were both banned in the 1970s, which established the beginning of environmental recovery. Reduced soil erosion and improved management of riparian lands also contributed to the reduction of DDT in the Lake Chelan watershed. Regulatory restrictions, as well as collection and disposal of old PCB electrical equipment, have reduced the quantity of PCBs entering the environment.

Additionally, the *Lake Chelan Watershed DDT and PCB TMDL Water Quality Improvement Report* identified several actions to reduce inputs of these legacy pollutants to Lake Chelan and Roses Lake. Water quality standards for DDT and PCBs in fish tissue are expected to be met by 2055. Milestones will be established and evaluated along the way.

The Washington State Department of Ecology (Ecology) will track implementation of this plan. As implementation occurs, the amount of DDT and PCBs entering the streams and ground water will diminish. As a result, the contaminants in the lake and fish will diminish, until water quality standards are met in 2055.

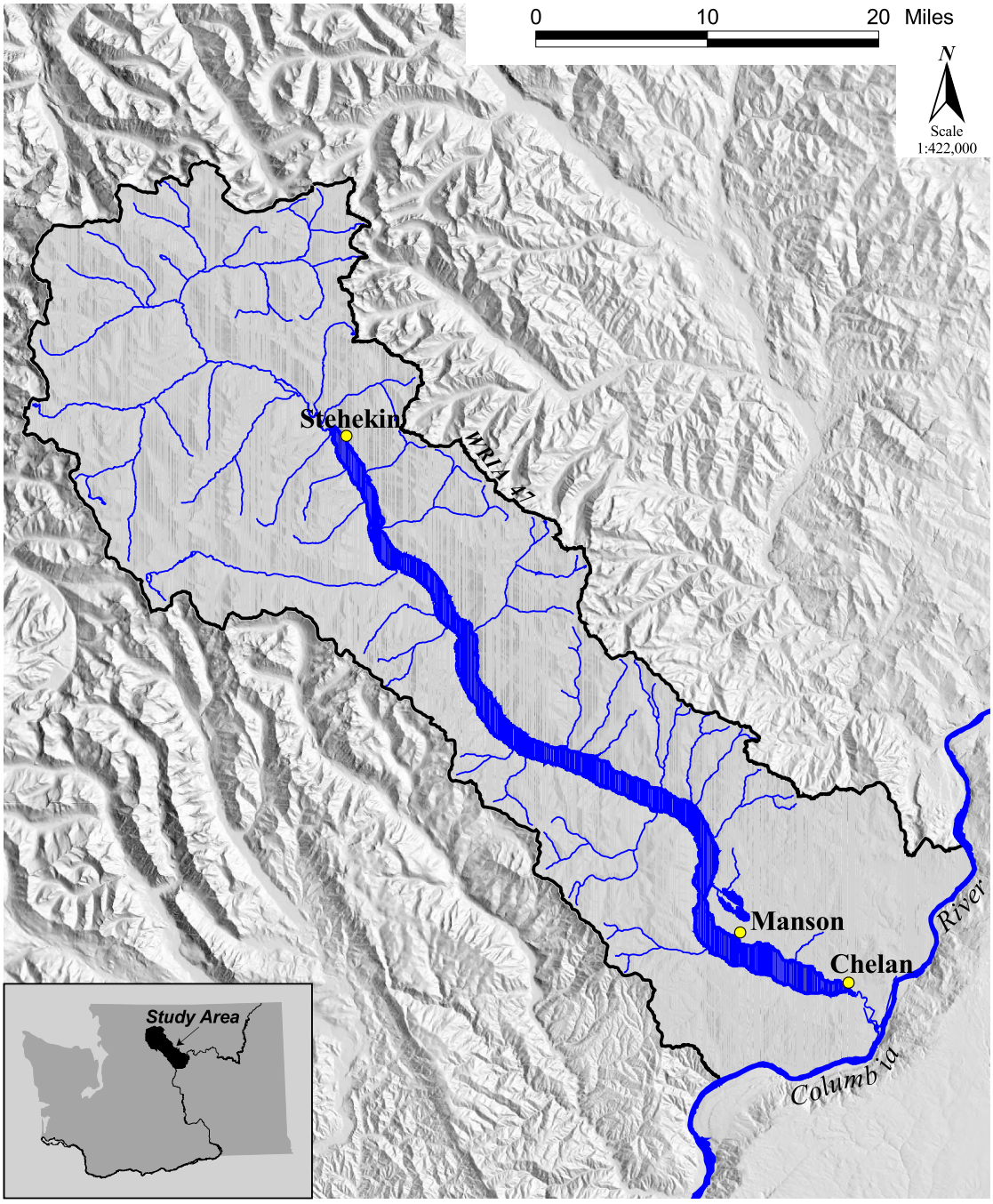

Figure 1: Lake Chelan Watershed

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Introduction

Federal Clean Water Act requirements

The Clean Water Act established a process to identify and clean up polluted waters. Under the Clean Water Act, each state is required to have its own water quality standards designed to protect, restore, and preserve water quality. Water quality standards consist of designated uses for protection, such as cold water biota and drinking water supply, as well as criteria, usually numeric criteria, to achieve those uses.

Every two years, states are required to prepare a list of water bodies – lakes, rivers, streams, or marine waters – that do not meet water quality standards. This list is called the 303(d) list. To develop the list, Ecology compiles its own water quality data along with data submitted by local state and federal governments, tribes, industries, and citizen monitoring groups. All data are reviewed to ensure that they were collected using appropriate scientific methods before the data are used to develop the 303(d) list. The 303(d) list is part of the larger Water Quality Assessment.

The Water Quality Assessment is a list that tells a more complete story about the condition of Washington's water. This list divides water bodies into one of five categories:

Category 1 – Meets standards for parameter(s) for which it has been tested.

Category 2 – Waters of concern.

Category 3 – Waters with no data available.

Category 4 – Polluted waters that do not require a TMDL because:

- 4a. – Has a TMDL approved and its being implemented.
- 4b. – Has a pollution control program in place that should solve the problem.
- 4c. – Impaired by a non-pollutant such as low water flow, dams, culverts.

Category 5 – Polluted waters that require a TMDL – the 303d list.

TMDL process overview

The Clean Water Act requires that a Total Maximum Daily Load (TMDL) be developed for each of the water bodies on the 303(d) list. The TMDL identifies pollution problems in the watershed and then specifies how much pollution needs to be reduced or eliminated to achieve clean water. Then Ecology works with the local community to develop an overall approach to control the pollution, called the Implementation Strategy, and a monitoring plan to assess effectiveness of the water quality improvement activities. Once the TMDL has been approved by the U.S. Environmental Protection Agency (EPA), a *Water Quality Implementation Plan* must be developed within one year. This plan identifies specific tasks, responsible parties and timelines for achieving clean water.

Elements required in a TMDL

The goal of a TMDL is to ensure the impaired water will attain water quality standards. A TMDL includes a written, quantitative assessment of water quality problems and of the pollutant sources that cause the problem. The TMDL determines the amount of a given pollutant that can be discharged to the water body and still meet standards (the loading capacity) and allocates that load among the various sources.

If the pollutant comes from a discrete source (referred to as a point source) such as a municipal or industrial facility's discharge pipe, that facility's share of the loading capacity is called a wasteload allocation. If it comes from a set of diffuse sources (referred to as a nonpoint source) such as general urban, residential, or farm runoff, the cumulative share is called a load allocation.

The TMDL must also consider seasonal variations and include a margin of safety that takes into account any lack of knowledge about the causes of the water quality problem or its loading capacity. A reserve capacity for future loads from growth pressures is sometimes included as well. The sum of the wasteload and load allocations, the margin of safety and any reserve capacity must be equal to or less than the loading capacity.

Identification of the contaminant loading capacity for a water body is an important step in developing a TMDL. EPA defines the loading capacity as "the greatest amount of loading that a water body can receive without violating water quality standards" (EPA, 1999). The loading capacity provides a reference for calculating the amount of pollution reduction needed to bring a water body into compliance with standards. The portion of the receiving water's loading capacity assigned to a particular source is a load or wasteload allocation. By definition, a TMDL is the sum of the allocations, which must not exceed the loading capacity.

TMDL = Loading Capacity = sum of all Wasteload Allocations + sum of all Load Allocations + Margin of Safety

In June 2006, Ecology submitted the *Lake Chelan Watershed DDT and PCB TMDL* (Schneider and Coots, 2006) to EPA. The TMDL was approved in October of 2006. This Water Quality Implementation Plan (WQIP) is a detailed implementation plan for achieving water quality standards in fish tissue for DDT and its breakdown products and PCBs in Lake Chelan and Roses Lake.

Overview

The Lake Chelan Watershed is located in Chelan County and Water Resource Inventory Area (WRIA) 47. The watershed includes the city of Chelan, town of Manson, and the surrounding area that drains into Lake Chelan.

Land uses in the watershed vary but are dominated by forested lands. More than ninety percent of the watershed is surrounded by forests, with moderately dense Douglas fir forest along the

upper end of the lake, and sparse mixed ponderosa pine and shrub-steppe (sage/bitter brush) vegetation along its lower end. Agriculture comprises approximately 3.5 percent of the land area, almost all of which drains to the Wapato Basin. Urban areas comprise less than one percent and include the cities of Chelan and Manson in the Wapato Basin and the small towns of Stehekin, Lucerne, and Holden in the Lucerne Basin (Patmont et al., 1989, Cross, 1998). See Table 1. Land surrounding the Wapato Basin is currently experiencing a rapid and significant increase in urban development.

Table 1: Land Use within the Lake Chelan Watershed

LAND USE	AREA (KM^2)	PERCENT OF TOTAL
Lake Chelan	135	5.6
Other Water bodies	4	0.2
Forested Public Lands	2,000	83.6
Forested Private Lands	163	6.8
Agriculture – Orchard	47	2.3
Agriculture – Non-Orchard	31	1.3
Urban	7	0.2
Roadways	6	0.2
Total	**2,393**	**100.0**

Washington State's 303(d) list of impaired water bodies has included Lake Chelan and Roses Lake for DDT-related compounds and PCBs in fish tissue since they were initially listed in 1996. These listings resulted from analysis of fish tissue samples taken between 1982 and 2003, where the levels of DDT and PCBs exceeded the standards in the National Toxics Rule (see Table 2).

Table 2. 2004 303(d) Listings for Lake Chelan and Roses Lake Addressed by this WQIP

Water Body	Parameter	Medium	Listing ID	Township	Range	Section
Lake Chelan	4,4'-DDE	Fish tissue	8963	27N	22E	13
Lake Chelan	4, 4'-DDD	Fish tissue	14325	27N	22E	13
Lake Chelan	4,4'-DDE	Fish tissue	14326	27N	22E	13
Lake Chelan	4,4'-DDT	Fish tissue	14324	27N	22E	13
Lake Chelan	4,4'-DDT	Fish tissue	36426	27N	22E	13
Lake Chelan	Total PCBs	Fish tissue	14328	27N	22E	13
Lake Chelan	Total PCBs	Fish tissue	8964	27N	22E	13
Roses (Alkali Lake	4,4'-DDE	Fish tissue	8966	28N	21E	26

As a result of the 303(d) listings, the Washington State Department of Ecology developed a TMDL for fish tissue in Lake Chelan and Roses Lake (see Appendix A, *Lake Chelan DDT and PCBs in Fish Total Maximum Daily Load Study*, [Coots, 2005] and Appendix B, *Lake Chelan*

Watershed DDT and PCB TMDL [Schneider and Coots, 2006].) The TMDL established targets for reduction of DDT and PCBs in surface water tributaries to Roses Lake and Lake Chelan. (See Table 4.) The percent reduction of total DDT needed from each tributary to the Wapato Basin is presented in Table 3.

Table 3. DDT Loads and Reductions Needed in Tributaries and Irrigation Drains

Lake Chelan Tributary or Irrigation Drain	Current Total DDT Load (mg/day)	Allowable Total DDT Load (mg/day)	Load Reduction Needed (mg/day)	Percent Reduction Needed
First Creek	2.2	12	0	0
Knapp Coulee	2.4	0.39	2.0	84
Culvert at Crystal View	0.14	0.04	0.10	71
Purtteman Creek	5.8	2.3	3.5	60
Culvert at Veroske's	3.00	0.21	2.8	93
Cooper drainage	1.5	0.10	1.4	93
Bennet Road	0.29	0.13	0.16	55
Keupkin Street	43	1.5	42	97
Buck Orchards	6.1	0.46	5.6	92
Wapato Lake/Joe Creek	0.04	0.22	0	0
Stink Creek	1.9	1.1	0.80	42
Mill Bay boat ramp	0.02	0.05	0	0
Totals	66.4	18.5	58.4	
Roses Lake Orchard Drain				
ST11	3.2	0.15	3.1	95

Purpose

The purpose of this water quality implementation plan (WQIP) is to provide a strategy to reduce levels of DDT and PCBs entering Lake Chelan and Roses Lake from tributaries to the Wapato Basin of Lake Chelan and to Roses Lake. This is the fundamental strategy for achieving reductions of DDT and PCBs in fish tissue in the Lake Chelan watershed. As implementation of this WQIP progresses, DDT and PCB levels in fish tissue should decline. Monitoring will track progress and provide information regarding future implementation needs.

Approach

This WQIP is meant to be a reasonable approach to achieving improved water quality within a realistic timeframe. Actions taken pursuant to this WQIP are divided into three general categories:

1. Voluntary stewardship actions.
2. Actions that are taken in accordance with a law or legal agreement.
3. Monitoring activities.

Additionally, Ecology recognizes the importance of supporting communities in the watershed as they implement projects to clean up Lake Chelan. Ecology will coordinate implementation with individual project sponsors and with the Lake Chelan Water Quality Committee (LCWQC).

The above general approach will be applied to the following four specific implementation goals:

1. Prevent soils contaminated with DDT, its breakdown products, and PCBs from entering surface waters by preventing erosion of potentially contaminated soils.
2. Prevent release to the environment of concentrated forms of contaminants by participating in the Washington State Department of Agriculture's (WSDA) Pesticide Pick up Program.
3. Allow time-related reduction of exposure pathways to DDT, its break down products and PCBs from Lake Chelan and Roses Lake bottom sediments.
4. Monitor trends in fish tissue concentration and contaminant loading from tributaries to Lake Chelan and Roses Lake.

DDT, its breakdown products and PCBs most likely enter fish tissue via two pathways:

- *Bioconcentration* of DDT, its breakdown products, and PCBs occur as a result of fish taking the chemicals into their systems through gills and bodily exposure to contaminated surface waters.
- *Bioaccumulation* of DDT and PCBs occurs as a result of bioconcentration and the uptake of DDT and PCBs from food sources that are also contaminated.

To limit bioconcentration pathways of DDT to fish, the source of the DDT entering surface waters needs to be reduced. To limit bioaccumulation pathways of DDT and PCBs to fish, reductions of DDT and PCBs need to be made in all parts of the environment that load the chemicals into the food web. To reduce bioaccumulation in lake biota (things that live in the lakes), the chemicals need to be reduced in the sediments, water column, and surface water tributaries of Lake Chelan and Roses Lake.

DDT residues are often found in the soils of lands used for agriculture between 1945 and 1972. DDT is also found in locations where soils have eroded and been transported from agricultural lands where the product was applied. The success of this TMDL primarily relies on preventing DDT and PCBs from entering Lake Chelan and its tributaries through the erosion and transport of contaminated soils to surface water or ground water in the Lake Chelan watershed.

This TMDL also relies on the removal of concentrated forms of DDT and PCBs that have not been released to the environment, but represent a risk of contamination to the environment until they are removed from the watershed and disposed of properly. Concentrated forms of these contaminants include unapplied pesticides that were put away in storage, and PCBs in old electrical equipment that has yet to be identified or disposed of properly.

This WQIP recognizes that many actions were taken prior to the initiation of this TMDL process. These actions contributed to reducing the amount and impact of DDT and PCB contamination in the Lake Chelan Watershed. The actions were taken on national, regional, and local scales. Examples of these actions include banning DDT, pesticide pick-up and disposal programs, PCB transformer removal, and improving irrigation efficiency to reduce agricultural run off. The goal of this WQIP is to assure the continuation and possible expansion of these actions and to provide further support for the actions identified in the TMDL.

Pollution Transport Mechanisms and Sources

Transport Mechanisms

The primary transport mechanism for DDT into Lake Chelan is soil erosion from agricultural lands that received pesticide application between the mid 1940s and the early 1970s. Current loading of PCB to the lakes may be from soil erosion, storm water transport, and air deposition. These chemicals can be transported in water runoff over land, roads, and through storm drains and agricultural drains. Changing land uses, whether as crop changes or a change from agriculture to another land use can create loose soils that are transported to the lake by stormwater runoff and winds. Water leaching from soils and old dump sites may carry contaminants to the lake. After these transport mechanisms deliver contaminants to the lake they tend to settle into the sediments on the lake bottom. The contaminants in the lake sediments may eventually be buried by sediments accumulating on top of them, or they may enter into the lake food web through bottom-dwelling organisms.

Organisms in the lake can concentrate these contaminants in their bodies as they move through the water and sediments. These contaminants tend to move through the food web from algae and plants to aquatic invertebrates (insects and other animals without backbones) through small fish to the largest fishes in the lake. Bioaccumulation increases contaminant concentrations as they move from one part of the food web to another. The contaminated sediments on the lake bottoms may be a reservoir that will keep the contaminants moving through the food chain until time has allowed them to chemically degrade or become buried under accumulating new sediments. For this reason it is extremely important to prevent additional contaminated sediments from reaching the lakes and tributaries.

The loading analysis from the TMDL showed that most of the DDT impacting the aquatic environment is already in the lake sediments. This load already in the lake is a result of transport of contaminated soils over many years. However, since DDT and PCBs do not degrade easily, they continue to exist in soils and are still being transported to the lake. This WQIP identifies actions to reduce ongoing transport mechanisms and inputs until standards for fish tissue are met.

Sources

The *Lake Chelan Watershed DDT and PCBs in Fish TMDL Study* identified agricultural lands and lands where industrial practices occurred as the primary sources of additional contamination to surface waters in the watershed. Inputs to Lake Chelan may also occur from other locations, including yards; gardens; pastures; roads; storm drains; development areas; and old dump sites. The TMDL technical study stated that DDT continues to enter Lake Chelan primarily through tributaries and possibly through ground water and stormwater in the Wapato Basin. The Wapato Basin contains most of the agricultural lands (past and present) as well as the majority of population and development in the watershed. Water quality improvement efforts will focus primarily on these contaminant sources in the Wapato Basin.

Another potential nonpoint source of DDT in the Lake Chelan watershed may be from unused DDT products still located in the watershed. These products may be stored or may have been buried as a means of disposal after their use was banned more than 30 years ago. Erosion from flood events caused by snow melt or rain storms could carry these concentrated contaminants into the lakes. Redevelopment of agricultural lands may reveal stored or buried pesticides in the property conversions. Activities to identify and collect old pesticides will continue to be supported and implemented.

The TMDL study also identified a seasonal pattern of DDT and its breakdown products' concentrations to Lake Chelan. The highest concentrations occur during the irrigation season when water is being applied to agricultural lands.

PCBs were widely used in industrial applications such as insulating fluids, electric transformers, plasticizers, carbonless paper ink, heat transfer and hydraulic fluids, as well as a variety of other uses (e.g. marine paints).

Most of the DDT and PCB contamination in the Lake Chelan watershed is diffuse, and so it can be difficult to pinpoint sources. One exception is in certain locations where the contaminants might concentrate. The TMDL identifies several locations where snow melt, irrigation water, and stormwater are collected and directed that carry high concentrations of DDT. These areas should be addressed to insure that contaminants stay out of Lake Chelan and Roses Lake.

Sediments of Lake Chelan and Roses Lake

The sediments of Lake Chelan and Roses Lake hold a large amount of contaminants such as DDT and PCB. The TMDL recommends two primary implementation steps to control sediment as a source of contaminants to fish tissue: (1) allow chemical breakdown of the contaminants already in the sediments, and (2) allow impoundment of the contamination below clean sediments. Additionally, reducing the DDT and PCB loading to the lakes will ensure that the chemical break down will occur at a faster rate than pollutant loading, and ensure that the upper layer of sediments is composed of cleaner material.

A study performed for Chelan County showed that sediments in near shore areas are coarser than sediments in a deeper transect studied by the TMDL evaluation for this project. The study indicated that near shore sediments with coarser composition had lower concentrations of DDT and its breakdown products than fine sediments deposited in the deeper parts of the Wapato Basin of Lake Chelan.

Organizational Responsibilities, Roles, and Activities

Organizational Responsibilities

Agriculture: The conservation and agricultural agencies (Washington State Department of Agriculture, Cascadia Conservation District, Natural Resources Conservation Service, and Lake Chelan Reclamation District) are responsible for providing technical assistance, educational outreach, and financial support to promote implementation of agricultural best management practices (BMPs). The Washington State Department of Agriculture will continue to provide assistance through its pesticide pick-up program. Individual irrigators are responsible for implementation of irrigation BMPs.

Property Owners: Chelan County; the city of Chelan; town of Manson; Chelan-Douglas Health District; state and federal agencies; and other entities may implement public education and awareness programs for watershed property owners to prevent DDT and PCB inputs to Lake Chelan. All landowners and developers are responsible for meeting water quality standards by preventing pollutant inputs from their property to streams and lakes.

Stormwater: Chelan County; the city of Chelan; the town of Manson; irrigation districts; developers; landowners with stormwater systems; land developers; and other appropriate entities are responsible for implementing actions to prevent sediment inputs that may carry DDT and PCBs to streams and waters of Lake Chelan from their stormwater systems.

Monitoring: Ecology is responsible for conducting monitoring associated with TMDLs. Ecology will evaluate monitoring data and/or coordinate TMDL-related monitoring associated with Ecology grants and TMDL effectiveness. Monitoring associated with this TMDL should be conducted in compliance with the *2004 Water Quality Data Act* (90.48 570-590 RCW).

Organizational Roles and Activities

Table 4 lists key groups and contributions each entity will provide toward implementation of the WQIP. Actions are grouped related to voluntary actions, actions taken in accordance with a law or legal agreement, and monitoring activities.

Table 4. Key Groups and Their Contributions

Entity	Contributions	Milestones - Years in Implementation										
		1	2	3	4	5	6	7	8	9	10	Beyond 10 Years
Voluntary Actions												
Cascadia Conservation District, Chelan County, city of Chelan, Lake Chelan Reclamation District, Washington Department of Ecology, other appropriate entities	Develop recommendations for BMPs to prevent sediment migration to Lake Chelan and tributaries.	X	X	X	X	X	X	X	X	X	X	X
Washington Department of Agriculture	Continue to bring pesticide pick-up collection events to the Lake Chelan Watershed.	X	X	X	X	X	X	X	X	X	X	X
Washington Department of Agriculture, watershed landowners	Irrigation BMPs.	X	X	X	X	X	X	X	X	X	X	X
Washington Department of Agriculture, watershed landowners	Riparian vegetation buffers.	X	X	X	X	X	X	X	X	X	X	X
City of Chelan, Chelan County, Manson, developers, landowners	Stormwater BMPs.	X	X	X	X	X	X	X	X	X	X	X
Chelan County, city of Chelan, Lake Chelan Reclamation District, Washington Department of Ecology	Develop recommendations for constructed wetlands and maintenance of the constructed wetlands to reduce DDT loading to Lake Chelan from tributaries.	X	X	X	X	X	X	X	X	X	X	X

Entity	Contributions	Milestones - Years in Implementation										
		1	2	3	4	5	6	7	8	9	10	Beyond 10 Years
Washington Department of Ecology, WRIA 47 Watershed Planning Unit, Upper Columbia Salmon Recovery Board, Chelan PUD, Bonneville Power Administration, others	Funding projects that keep contamination out of Lake Chelan and Roses Lake.	X	X	X	X	X	X	X	X	X	X	X
Actions Taken in Accordance with a Law or Legal Agreement												
Chelan-Douglas Health District	Continue fish consumption advisory for mackinaw.	X	X	X	X	X	X	X	X	X	X	?
Chelan County, city of Chelan	Institute BMPs in land use conversions.	X	X	X	X	X	X	X	X	X	X	X
Washington Department of Ecology, city of Chelan, Chelan County, developers, landowners	Stormwater regulation compliance, development regulation compliance, and land use regulations compliance.	X	X	X	X	X	X	X	X	X	X	X
Chelan County, city of Chelan	In-lieu mitigation fee program.	X	X	X	X	X	X	X	X	X	X	X
Washington Department of Agriculture, growers, residents, Chelan County, city of Chelan, city of Manson, utilities and industry	Compliance with restrictions on DDT and PCBs.	X	X	X	X	X	X	X	X	X	X	X
Monitoring Activities												
Washington Department of Ecology, members of Lake Chelan Water Quality Committee	(1) Track projects implemented to reduce DDT and PCB loading to Lake Chelan.	X	X	X	X	X	X	X	X	X	X	X

Entity	Contributions	Milestones - Years in Implementation										
		1	2	3	4	5	6	7	8	9	10	Beyond 10 Years
Washington Department of Ecology, other contributing entities	Stormwater.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Washington Department of Ecology	TMDL effectiveness monitoring.					**X**					**X**	**X**

Measuring Progress toward Goals

The Lake Chelan DDT/PCB TMDL was initiated to address the DDT and PCB contamination contained in the tissues of fish in the Lake Chelan Watershed. The TMDL identified potential actions designed to prevent DDT and PCB inputs to Lake Chelan and Roses Lake. Monitoring fish tissue concentrations will be the primary strategy to track progress of the TMDL implementation approach. TMDL targets will be achieved only when fish tissue targets are met. Ecology will evaluate the need for fish tissue data collection and evaluation every five years to assess progress toward meeting TMDL targets.

All monitoring for this TMDL should be conducted using methodology and analytical techniques consistent with the original methodology used by Ecology in the original technical analysis. In addition, monitoring conducted related to this TMDL should comply with the Water Quality Data Act of 2004 codified in RCW 90.48.570 through 90.48.590 and Ecology's Water Quality Program Policy 1-11. Also, monitoring related to this TMDL should be conducted after the completion of a quality assurance project plan (QAPP) that meets Ecology requirements for the collection of high quality data. Any divergence from Ecology's original methodology should be clearly explained in QAPPs and final monitoring reports.

Chelan County used money from a Centennial Clean Water Act grant to conduct some additional monitoring on water column concentrations of DDT and its breakdown products. They also completed a study on the suspended sediment concentration of DDT and its breakdown products in near-shore sediments. The water column study was conducted using methodology inconsistent with Ecology's methodology, so the results are not comparable. However, the study did provide some conclusions about the concentration of DDT and its breakdown products in Lake Chelan:

- The water column concentration of DDT and its breakdown products can vary spatially in Lake Chelan. Concentrations of DDT can be detected at different concentrations at varying depths and locations in the lake.
- Methodology for estimating the concentration of DDT in Lake Chelan can make a very large difference in results.
- Semipermeable Membrane Devices (SPMDs) can estimate water column concentration at values lower than Large-Volume Solid-Phase Extraction Devices.

Monitoring projects can be conducted at various scales based primarily on the objective of the project. Sometimes an organization's jurisdictional area determines the spatial scale and objectives of a monitoring project. Post-TMDL monitoring usually can be categorized as TMDL effectiveness monitoring and implementation project monitoring. Monitoring can include the tracking of locations and numbers of particular types of implementation projects, and it can include measurement of changing environmental conditions such as fish tissue concentrations.

Effectiveness Monitoring

Effectiveness monitoring evaluates whether implementation of the TMDL achieves the TMDL's target(s) for lowering pollutant loading. Primarily, the success of this TMDL will be determined by directly measuring fish tissue concentrations and comparing them to historical data and the fish tissue standards for protection of human health. The fish tissue standards for protection of human health are presented in Table 5. Success of this TMDL may also be measured by measuring the daily loading of DDT, its breakdown products, and PCBs from the tributaries where load allocations were set by the TMDL.

Table 5: Fish Tissue Criteria for Protection of Human Health

	Fish Tissue Criteria
Chemical	**(**ug/Kg)
4,4'-DDT	32
4,4'-DDE	32
4,4-DDD	45
DDT and metabolites	
PCBs	5.3 ug/Kg

Ecology recommends that fish tissue sampling plans be reviewed by the Washington State Department of Health so they can assure that the proposed sample size is adequate to evaluate results in respect to continuing or discontinuing the Lake Chelan fish consumption advisory.

The fish tissue, sediment, and water data from the TMDL technical study will serve as the baseline data to judge progress of environmental improvement. BMP actions and monitoring data compiled through other sources will be evaluated over time. Fish tissue and tributary water sampling needs will be evaluated at least every five years by Ecology for tracking the effectiveness of actions toward meeting TMDL targets. Other monitoring plans may be developed to provide information about the effectiveness of implementing this TMDL.

Ecology maintains the responsibility for the monitoring activities under this TMDL. Other entities are encouraged to monitor the effectiveness of their water quality projects at scales that relate to their implementation responsibilities.

Additional Monitoring Recommendations

Storm event sampling should be conducted for discharges to the Wapato basin of Lake Chelan and to Roses Lake. In addition to the sites sampled for this study, other discharges should be evaluated that may flow only during storm events. Stream flow (discharge) should be measured when water samples are collected, which will allow calculation of pollutant loads. This is the most important data gap to fill for implementation of this TMDL. Stormwater analysis should also be conducted for suspended sediment in water leaving construction sites.

Low level analytical techniques, consistent with Ecology's original TMDL study, should be used for water samples to assure that reporting limits are low enough to satisfy study objectives and to compare with previous data.

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Adaptive Management

This implementation plan provides a framework to reduce the amount of contamination in fish in the Lake Chelan watershed. Adaptive management will be utilized to adjust and improve WQIP actions and progress toward reducing input of DDT and PCBs to Lake Chelan and fish tissue contamination. If anticipated progress is made toward the reduction of DDT and PCB inputs to Lake Chelan and concentrations in fish tissue, sediments, and water, the schedule for implementation actions identified in this WQIP will be continued.

If effectiveness monitoring shows that adequate progress is not being made toward reducing DDT inputs and DDT and PCB concentrations in fish tissue, additional recommendations for actions to achieve water quality standards may result. Additional investigation of potential sources of contamination may be conducted. New implementation actions and associated monitoring may also be recommended. Re-evaluation of this TMDL by Ecology and participating entities is anticipated to occur at five-year intervals.

Reasonable Assurances

When establishing a TMDL, reductions of a particular pollutant are allocated among the pollutant sources (both point and nonpoint sources) in the water body. For the Lake Chelan Watershed DDT and PCB TMDL only nonpoint sources exist. TMDLs (and related action plans) must show "reasonable assurance" that these sources will be reduced to their allocated amount. Education, outreach, technical and financial assistance, and enforcement will all be used to ensure that the goals of this WQIP are met.

Many of the activities noted in Table 5 already support this TMDL and add to the assurance that DDT and PCBs in the fish tissue in Lake Chelan and Roses Lake will meet conditions provided by state water quality standards. This assumes that the activities described in Table 5 continue.

There is reasonable assurance that the goals of this TMDL will be met by 2055.

While Ecology is authorized under Chapter 90.48 RCW to impose strict requirements or issue enforcement actions to achieve compliance with state water quality standards, it is the goal of all participants in the TMDL process to achieve clean water through voluntary control actions.

Ecology will consider and issue notices of noncompliance, in accordance with the Regulatory Reform Act, in situations where the cause or contribution to the cause of noncompliance with load allocations can be established.

- During the development of the Lake Chelan Watershed DDT and PCB TMDL, historical water quality data from the watershed were compared to TMDL sampling data. Data analysis conducted as part of the TMDL indicated a downward trend in DDT and PCB contaminant concentrations over time in various parts of the Lake

Chelan watershed's environment. Due to the known persistence of DDT and PCBs in the environment, the decline in concentrations will be slow.

- During the development of the TMDL, several old PCB-filled transformers were discovered and properly disposed of in the Manson and Stehekin areas. Efforts such as this will continue, if necessary, to properly dispose of concentrated contaminant sources remaining in the watershed.

The decrease in concentrations of DDT and PCBs in the deep sediments will be monitored over time. Additionally, ongoing monitoring of BMPs, fish tissue, water, and aquatic biota may be conducted. The conservative assumptions used in setting the regulatory criteria, documentation of BMPs, associated monitoring, and adaptive management will provide reasonable assurance that, with time, water quality will improve and standards will be met. Each of the conservative measures identified in this WQIP will assure that the Lake Chelan watershed will be protected from land use activities that may threaten water quality while the legacy load concentrations are reduced through time and nature.

This WQIP document builds on the TMDL technical assessment and submittal documents, which provide clear direction by Ecology and the Lake Chelan Water Quality Committee (LCWQC) for actions and associated monitoring to meet water quality targets in Lake Chelan. Full compliance with the water quality targets outlined in the *Lake Chelan Watershed DDT and PCB TMDL* (Schneider and Coots, 2006) is expected to be achieved before the end of 2055.

Public Involvement

A citizen's workgroup, the LCWQC, has served since 2001 as the Technical Advisory Committee (TAC) for the *Lake Chelan Watershed DDT and PCB TMDL* (Schneider and Coots, 1996*)*. Participants represent a broad range of local government and interested parties that have a strong historyof caring for the water quality of Lake Chelan. This workgroup met numerous times during the development of the TMDL. There is a high level of cooperation and communication between project participants, and they continue active pursuit of the goals of the TMDL.

- Chelan County was awarded a Centennial Clean Water Fund Grant to be used to collect additional information in order to support this TMDL's development and implementation.

Chelan County completed one water column study comparing Semi Permeable Membrane SPMD sampling techniques with the use of a large volume solid phase filtration sampler, the Infiltrex 300. The name of the study is "DDT Concentrations in Lake Chelan Waters Measured Using Semipermeable Membrane Devices (SPMDs) and a Large-Volume Solid-Phase Extraction Device." The study concluded that SPMDs and the formulae used to estimate water column concentration estimated water column concentration lower than the Infiltrex 300. Also, the county was able to complete one study on sediment concentrations in the Wapato Basin lake bottom. The study concluded that DDT and its breakdown products are more likely to be found in the fine sediments in the deeper portions of the lake than in shallow, near-shore areas with less fine sediment.

The following education/outreach has been provided to the community:

June, 2003 - "DDT and Lake Trout" brochure distributed by Chelan-Douglas Health District. Brochures were distributed at health clinics and other locations.

Various dates - Other media coverage related to the Lake Chelan TMDL. Brochures developed and distributed on environmental landscaping.

September, 2005 - News release and coverage on results of monitoring study, TMDL allocations, and continuation of public health notice on mackinaw consumption.

January, 2006 - News release and media coverage on continuation of Lake Chelan fish consumption advisory for mackinaw by the Department of Health.

February, 2006 - Department of Ecology Environmental Excellence awards issued to Paul Cross and Jean Peterson for PCB transformer removal efforts.

May 4, 2006 - Public workshop on *Draft Lake Chelan Watershed DDT and PCB TMDL Water Quality Improvement Report.*

April 21 – May 21, 2006 - Public comment period on *Draft Lake Chelan Watershed DDT and PCB TMDL Water Quality Improvement Report*.

June, 2006 – Ecology issued a response to comments on *Draft Lake Chelan Watershed DDT and PCB TMDL Water Quality Improvement Report*.

September, 2006 - News release and associated coverage on *Lake Chelan Watershed DDT and PCB TMDL Water Quality Improvement Report* approval by EPA.

April 2007 - Ecology and Chelan County issued a joint editorial in local newspapers affirming their shared commitment to keep Lake Chelan clean.

Funding Implementation

There are numerous existing potential sources that may provide funding for water quality improvement in the Lake Chelan watershed. Ecology funds water quality facilities and nonpoint activities through its statewide water quality grants and loans programs. There are also sources of funding available for watershed planning and shoreline impact mitigation that can support actions to improve water quality conditions in the watershed.

The Natural Resources Conservation Service often provides cost-share funding to agricultural producers for on-farm conservation improvements via the Environmental Quality Incentives Program (EQIP) and the Conservation Reserve Enhancement Program (CREP).

The Washington State Department of Agriculture's waste pesticide program is funded through the State Model Toxics Control Account. This funding is derived from the Model Toxics Control Act administered by the Department of Ecology and should continue to receive Ecology's support.

Potentially, the above-listed funding resources could be utilized by members of the LCWQC to implement activities leading to water quality improvements.

References

90.48 570-590 Revised Code of Washington *The 2004 Water Quality Data Act*

Coots, R.. (2005) Lake Chelan DDT and PCBs in Fish Total Maximum Daily Load Study. Washington State Department of Ecology Publication Number 05-03-014

Cross P., Lake Chelan Reclamation District. (1998) Water Quality Trends and Characteristics of Agricultural Drains. Washington State Department of Ecology, Central Regional Office Publication Number WQ 3.6250-02 CR983156

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Patmont, C., G. Pelletier, E. Welch, D. Banton, and C. Ebbesmeyer. (1989) Lake Chelan Water Quality Assessment. Prepared by Harper-Owes for the Washington State Department of Ecology, Olympia, Washington. Publication Number 89-e37.

Schneider, D., R. Coots. (2006) Lake Chelan Watershed DDT and PCB Total Maximum Daily Load Water Quality Improvement Report. Washington State Department of Ecology Publication Number 06-10-022

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Appendix A

Lake Chelan DDT and PCBs in Fish
Total Maximum Daily Load Study

June 2005
Ecology Publication Number 05-03-014

This publication may be downloaded at the following website:
www.ecy.wa.gov/biblio/0503014.html

Appendix B

Lake Chelan Watershed DDT and PCB
Total Maximum Daily Load
Water Quality Improvement Report

June 2006
Ecology Publication Number 06-06-022

This publication may be downloaded at the following website:
www.ecy.wa.gov/biblio/0610022.html

Appendix C Implementation Tracking Table

Table C1. Tracking Implementation Activities

Year(s) Planned	Activity , Entities	Brief Description	Date Completed
Voluntary Actions			
Annually or every other year.	Participate in WSDA Pesticide Pick-up Program collections. Growers, other appropriate entities.	The Washington State Department of Agriculture runs the pesticide pick-up program. This program should visit the Lake Chelan watershed area periodically to remove unregistered and unusable pesticides, including those containing DDT products	
Ongoing - begin in 2007	Implement ongoing BMPs to prevent wind or water erosion. Lake Chelan Reclamation District (LCRD), Lake Chelan Public Utilities District (PUD), Washington State Department of Agriculture (WSDA), Washington State Department of Transportation (DOT), growers, developers, landowners, other appropriate entities.	Implement BMPs on agricultural lands, riparian lands, drains, land conversions, roads, and other areas, working with appropriate entities.	
Ongoing - begin in 2007	Implement water efficiency BMPs to reduce soil erosion from agricultural lands and limit irrigation ground water return flow. National Resource Conservation Service (NRCS), Chelan County Conservation District, LCRD, WSDA, growers, other appropriate entities.	Work with growers on irrigation BMPs including irrigation system evaluations, scheduling models, soil moisture monitoring, weather stations, monitoring microclimates, and new technologies.	
Ongoing - begin in 2007	Restore riparian buffers along streams and lake. LCRD, Washington State Department of Fish and Wildlife (DFW), Washington State Department of Natural Resources (DNR), PUD, DOT, Chelan County, city of Chelan, land owners, other appropriate entities.	Restore riparian vegetation along streams and Lake Chelan.	
2007- 2009	Stormwater management. Chelan County, city of Chelan, town of Manson, developers, landowners, other appropriate entities.	Research stormwater systems (plans, designs, capacities, discharge points, etc.). Develop and implement BMPs to prevent inputs to Lake Chelan.	

Year(s) Planned	Activity , Entities	Brief Description	Date Completed
Ongoing - begin in 2007	Identify funding sources. LCWQC and participating entities.	Funding sources include Ecology Centennial and 319 grants and loans, Lake Chelan shoreline development in-lieu mitigation funding, Watershed Planning, Salmon Recovery, Chelan PUD, Bonneville Power Administration, Bureau of Reclamation, Department of Fish and Wildlife, and other sources.	
Ongoing - begin in 2007	Conduct education and outreach activities. LCWQC and participating entities.	Improve awareness, knowledge, and actions. Develop a newsletter and web page. Use radio, newspaper, public forums, and other awareness activities.	
Actions Taken in Accordance with a Law or Legal Agreement			
Ongoing since 2004 – until fish tissue standards are met	Fish consumption advisory. Chelan-Douglas Health District, Washington State Department of Health (WDOH).	Continue fish consumption advisory for mackinaw (lake trout). Distribute advisory brochures to Health District outlets, National Park Service sites, city of Chelan and Chelan County outlets.	
Ongoing - begin in 2007	Land use/Construction Stormwater BMPs. Chelan County and city of Chelan.	Land use conversion BMPs will be implemented by Chelan County and the city of Chelan through their comprehensive plans, ordinances, and construction permits. The Eastern Washington Stormwater Manual or equivalent will be used.	
Ongoing - begin in 2007	Stormwater, development, and land use controls. City of Chelan and Chelan County	Controls identified in the Ecology's Stormwater Program will be incorporated into regulations and policies for the city of Chelan and Chelan County in the Lake Chelan watershed. The Eastern Washington Stormwater Manual or equivalent will be used to direct stormwater practices.	
2007-2009	Comprehensive Water Quality Assessment and Implementation Plan. LCWQC and other appropriate entities.	Develop a long-term strategic Comprehensive Water Quality Assessment and Implementation Plan to direct actions to protect water quality in the Lake Chelan watershed. Hold six facilitated sessions and 3 community workshops.	
Ongoing since 2001	Compliance with restrictions on DDT and PCBs. Agriculture, WSDA.	Participate in the WSDA pesticide pick-up program to encourage removal of waste DDT and PCBs.	
Monitoring Activities			
2008, 2013, 2018, 2023,…..	TMDL effectiveness monitoring.	Implement sample plan to assess DDT, DDD, DDE, and PCB concentrations in fish tissue comparable to original data set. Sample tributaries to assess improvements (reductions) in pollutant loading to Lake Chelan from upland sources.	