



**Lake Sawyer**  
**Total Phosphorus**  
**Total Maximum Daily Load**

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**Water Quality Implementation Plan**



DEPARTMENT OF  
**ECOLOGY**  
State of Washington

June 2009  
Publication No. 09-10-053

## Publication Information

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This report is available on the Department of Ecology's website at <http://www.ecy.wa.gov/biblio/0910053.html>

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\* Cover Photo of Lake Sawyer by Mark Davis.

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**Water Quality Implementation Plan**

*by*  
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# Executive Summary

Lake Sawyer has exceeded state standards for total phosphorus since the late 1980s. The Department of Ecology (Ecology) developed a total maximum daily load (TMDL) for phosphorus in Lake Sawyer in 1991, which set a target total phosphorus concentration for the lake at 16  $\mu\text{g/L}$ . Lake Sawyer's water quality has generally improved since the TMDL was approved in 1993. Significant urban growth is scheduled to occur in the watershed over the next few years, which could have a negative impact on water quality. Ecology produced a technical memo titled *Effectiveness Monitoring for Total Phosphorus Total Maximum Daily Loads for Fenwick and Sawyer Lakes* in 2002 (Onwumere 2002). Ecology's Lake Sawyer Effectiveness Monitoring report concluded that the lake is meeting its long-term goal of reducing phosphorus, but further actions are still needed to control nutrient input from the watershed in order for the lake to maintain water quality standards into the future.

This *Lake Sawyer Total Phosphorus Total Maximum Daily Load Water Quality Implementation Plan* is the follow-up document to the *Lake Sawyer Total Phosphorus TMDL*. It provides a framework for corrective actions to address ongoing and future sources of phosphorus pollution in Lake Sawyer and the surrounding watershed. This implementation plan also incorporates recommendations from King County's Lake Sawyer Management Plan and other documents developed for Lake Sawyer.

Organizations involved in water quality improvement and TMDL implementation at Lake Sawyer include Lake Sawyer Community Club, King Conservation District, Lake Sawyer Steering Committee, King County Stormwater Division, King County Lake Stewardship Program (KCLSP), city of Black Diamond, Black Diamond City Council, city of Maple Valley, and Ecology. The Lake Sawyer Community Club will meet at least annually to discuss projects and may post implementation projects and updates on their webpage. King Conservation District will continue to advise and assist in situations involving small farms and livestock. The Lake Sawyer Steering Committee will serve as sounding board for implementation projects, monitoring updates, and adaptive management.

Municipal stormwater permit holders Black Diamond, Maple Valley, and King County will develop stormwater management programs and implement requirements of their respective permits. Permit holders will include actions to reduce phosphorus in stormwater to meet Lake Sawyer TMDL requirements. The phosphorus stormwater treatment menu will be applied to stormwater conveyed to Lake Sawyer by surface flow, as well as to stormwater infiltrated to unsuitable soils within one-quarter mile of the lake in accordance with the lake's *sensitive lake* designation.

The city of Black Diamond has been proactive in preparing for expected growth in the city, and updated several key components within the city's infrastructure. The city recently hired a Watershed Steward Director whose primary focus will be to coordinate with the residents in the Lake Sawyer Watershed and continue to actively seek out and implement new best management practices. Black Diamond contracts with King County's Lake Stewardship Program to continue monitoring phosphorus in Lake Sawyer to track trends and enable adaptive management.

Ecology will administer permits and manage TMDL implementation activities in the Lake Sawyer watershed with special attention to phosphorus. The Ecology Northwest Region Water Quality Lake Specialist will continue to coordinate TMDL-related activities and provide technical assistance for the Lake Sawyer Phosphorus TMDL. Ecology will conduct a minimum of three sampling surveys, at approximately six or more sampling sites in Lake Sawyer watershed, to help further define pollution sources and promote source correction. Ecology Northwest Region Municipal Stormwater Specialists will assist with municipal stormwater permit compliance. Ecology Northwest Region Grant Project Managers will assist grant applicants in developing stream restoration, lake restoration, and other water quality improvement projects.

All these watershed groups and agencies will have an active role in helping manage activities in the watershed in order to protect Lake Sawyer water quality. The Lake Sawyer Total Phosphorus Total Maximum Daily Load Water Quality Implementation Plan serves as an evolving document that will help guide the Lake Sawyer Steering Committee, as well as other interested parties, to track water quality trends and update best management practices suitable for implementation in the watershed. This implementation plan provides a timeline for when recommended projects will be completed, lists local government agencies and other entities that plan to implement projects, describes various funding opportunities, and promotes public involvement. Phosphorus TMDL reductions are expected to be achieved by 2014, and adaptive management measures are in place to help ensure this schedule will be met.



# Introduction

Lake Sawyer is located in the city of Black Diamond, and is a significant regional recreational resource for the area. Lake Sawyer is 280 acres in size and its watershed encompasses approximately 8,300 acres. The watershed is divided into three sub-basins: Rock Creek, Ravensdale Creek, and the nearshore area of Lake Sawyer. Lake Sawyer serves as a pathway for late winter Coho salmon, which travel through the lake on their way to spawning grounds in Ravensdale and Rock Creek systems. Resident Rainbow Trout, Cutthroat Trout, Kokanee, and various warm water fish species are also present in Lake Sawyer (King County 2000).

In the 1970s, evidence of failing onsite septic systems in the Lake Sawyer watershed resulted in the decline of water quality of Rock Creek, Ginder Creek, and Lake Sawyer. To address this concern, the city of Black Diamond acquired funding from the Environmental Protection Agency's (EPA) Innovative and Alternative Grants Program to build a wastewater treatment plant. The treatment plant began operating in 1981 and was designed to discharge to a natural wetland next to Rock Creek, ultimately draining to Lake Sawyer. The innovative project soon failed, resulting in excessive nutrient loading to Lake Sawyer, prompting Ecology to set stricter effluent limits for the city of Black Diamond. In 1992, all wastewater from the treatment plant was diverted to Renton via King County's (Metro) sewer line.

In 1991, Ecology developed a total maximum daily load (TMDL), more commonly referred to as a water cleanup plan, for Lake Sawyer. A water cleanup plan is a numerical description of the amount of pollutant that a water body can accept and still meet state Water Quality Standards (Washington Administrative Code 173-201A). The *Lake Sawyer Total Phosphorus TMDL* set the total phosphorus concentration for Lake Sawyer at 16  $\mu\text{g/L}$ . EPA approved the TMDL in 1993. Supporting documents for the *Lake Sawyer Total Phosphorus TMDL* include the *Lake Sawyer-Black Diamond Waste Load Allocation* (1989), *Diagnostic Study of Lake Sawyer* (1991), and the *Lake Sawyer Management Plan* (2000). These documents identify pollution sources to Lake Sawyer as well as in the surrounding watershed.

An Ecology technical memo titled *Effectiveness Monitoring for Total Phosphorus Total Maximum Daily Loads for Fenwick and Sawyer Lakes* (Onwumere 2002) determined that Lake Sawyer was not consistently meeting its TMDL goal of 16  $\mu\text{g/L}$ , but may be meeting its long-term water quality goal. The report states that diverting Black Diamond's wastewater discharge from the natural wetland above Lake Sawyer to a sewer line reduced the majority of nutrient input to the lake and significantly helped the lake to recover. All aforementioned studies conclude that further actions still need to be taken to control nutrient input from the watershed in order for Lake Sawyer to meet and maintain water quality standards.

The Lake Sawyer management plan (LSMP) thoroughly examined both internal and external sources of phosphorus loading and identified the primary external sources of phosphorus in the watershed. Primary sources of total phosphorus include the sub-basins that drain to Lake Sawyer, (which include Rock Creek sub-basin, Ravensdale Creek sub basin, and the nearshore of Lake Sawyer sub-basin), nearshore septic systems, and rainfall contributions to the lake (King County 2000).

Internal sources of phosphorus were identified as aquatic plant decay, with the majority occurring in the fall, and through phosphorus-rich sediments being re-suspended into the water column during annual lake turnover, making the phosphorus-rich nutrients available to blue-green algae.

The LSMP describes best management practices (BMPs) for Lake Sawyer and its watershed that address sources of total phosphorus. The majority of the BMPs listed in the plan however, have not been implemented due to lack of funding. The LSMP made recommendations and set management goals to control excessive phosphorus loading to Lake Sawyer and its watershed.

This report, the *Lake Sawyer Total Phosphorus Total Maximum Daily Load Water Quality Implementation Plan* is the follow-up document to the *Lake Sawyer Total Phosphorus TMDL*. It provides a framework for corrective actions to address ongoing and future sources of phosphorus pollution in Lake Sawyer and the surrounding watershed. This implementation plan also incorporates recommendations from the LSMP and other documents developed for Lake Sawyer.

To effectively develop this water quality implementation plan, a committee of interested parties contributed to the development of the plan. The Lake Sawyer Steering Committee consists of representatives from Ecology; city of Black Diamond; King County; King Conservation District; Washington Department of Fish and Wildlife; the Muckleshoot Indian Tribe; and local watershed residents. The committee developed a plan of action that is in concert with meeting water quality goals for Lake Sawyer and maintaining a healthy ecosystem in preparation of expansive growth within the watershed in the near future.

The *Lake Sawyer Total Phosphorus Total Maximum Daily Load Water Quality Implementation Plan* provides a timeline for when recommended projects will be completed, lists local government agencies and other entities that plan to implement projects, provides various funding opportunities, and promotes public involvement.

In the following pages, we will discuss:

- The water cleanup process and why Lake Sawyer needs help.
- The Lake Sawyer Watershed and phosphorus pollution sources.
- Addressing the sources of phosphorus pollution in Lake Sawyer and its surrounding watershed.
- The participating parties involved in helping Lake Sawyer achieve clean water.
- Funding opportunities that may be available for implementation activities.

# What is a Total Maximum Daily Load (TMDL)

## Federal Clean Water Act requirements

The Clean Water Act (CWA) established a process to identify and clean up polluted waters. It requires each state 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.

To learn more about Washington State's Water Quality Standards, please visit Ecology's website link at <http://www.ecy.wa.gov/programs/wq/swqs/index.html>.

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 of impaired water bodies. 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 state's larger Water Quality Assessment.

The Water Quality Assessment is a list that tells a complete story about the condition of Washington's water. This list divides water bodies into 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 it is being implemented.

4b. – Has a pollution control program in place that should solve the problem.

4c. – Is 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 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 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 EPA approves the TMDL, a *Water Quality Implementation Plan* must be developed. This plan identifies specific tasks, responsible parties, and timelines for achieving clean water in Lake Sawyer.

## Elements required in a TMDL

The goal of a TMDL is to ensure that 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 loading from a given pollutant that can be discharged to the water body and still meet water quality standards (the loading capacity) and allocates that capacity 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 nonpoint sources), 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 in the TMDL. 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 of the receiving water body.

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, 2001). The loading capacity provides a reference for calculating the amount of pollution reduction needed to bring a water body into compliance with water quality 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 and other factors, which must not exceed the loading capacity.

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

## What part of the process are we in?

Lake Sawyer's TMDL study was approved in 1993 by the Environmental Protection Agency (EPA). This *Lake Sawyer Total Phosphorus Total Maximum Daily Load Water Quality Implementation Plan* is the follow-up document to the *Lake Sawyer Total Phosphorus TMDL* (Ecology, 1993). It provides a framework for corrective and preventative actions to address ongoing and future sources of phosphorus pollution in Lake Sawyer and the surrounding watershed.

# Why Ecology is Conducting an Implementation Plan in this Watershed

In the 1970s, evidence of failing septic systems in the watershed resulted in the decline of water quality for Rock Creek, Ginder Creek, and Lake Sawyer. To address this concern, the city of Black Diamond acquired funding from EPA's Innovative and Alternative Grants Program to build a wastewater treatment plant. The wastewater treatment plant began operating in 1981 and was designed to discharge to a natural wetland that discharged to Rock Creek, which in turn flows into Lake Sawyer. The wetland portion of the treatment plant soon failed, resulting in increased loading of phosphorus to Lake Sawyer.

In 1989, Ecology developed a TMDL wasteload allocation (WLA) for the Black Diamond wastewater treatment plant and concluded that a complete diversion of the wastewater treatment plant discharge from the Rock Creek drainage was necessary to protect the water quality of Lake Sawyer. It was also predicted that the lake would be eutrophic by the year 2010 if the diversion were not implemented. In 1991, all wastewater from the treatment plant was diverted to Renton via King County's (Metro) sewer line. The phosphorus WLA from the Black Diamond treatment plant to Lake Sawyer was set at zero. Furthermore, Ecology set an in-lake total phosphorus criterion of 16  $\mu\text{g/L}$  to protect the lake's water quality. In 1993, EPA approved the Lake Sawyer TMDL study. In 2000, King County developed a lake management plan for Lake Sawyer that recommended best management practices to address sources of total phosphorus.

Since the diversion of the Black Diamond wastewater discharge, very little in the way of implementation has been performed in the Lake Sawyer watershed. Ecology produced a technical memo titled *Effectiveness Monitoring for Total Phosphorus Total Maximum Daily Loads for Fenwick and Sawyer Lakes*, which determined that Lake Sawyer was not consistently meeting its TMDL goal of 16  $\mu\text{g/L}$  (Onwumere 2002). The report concluded that diversion of the city's wastewater to a Metro sewer line reduced the majority of nutrient input to the lake and significantly helped the lake to recover. However, the report further states that cumulative loading from internal phosphorus and increased fall and winter stormwater runoff will continue to elevate total phosphorus concentrations, even though some external sources of phosphorus to the lake have been eliminated. In addition, significant urban growth is planned in the Lake Sawyer watershed in coming years, which is expected to have a negative impact on water quality. The report concludes that the total phosphorus target concentration of 16  $\mu\text{g/L}$  cannot be met or maintained without targeting further reductions of internal and external sources of total phosphorus.

This report, the *Lake Sawyer Total Phosphorus Total Maximum Daily Load Water Quality Implementation Plan* is the follow up document to the *Lake Sawyer Total Phosphorus TMDL* and provides a framework for corrective actions to address sources of phosphorus pollution in Lake Sawyer and the surrounding watershed. This implementation plan also incorporates recommendations from the LSMP and other documents developed for Lake Sawyer.

A committee of interested parties contributed significant recommendations to the development of this water quality implementation plan. The Lake Sawyer TMDL Steering Committee consists

of representatives from Ecology, city of Black Diamond, King County, King Conservation District, Washington Department of Fish and Wildlife, the Muckleshoot Indian Tribe and local watershed residents. Washington Department of Fish and Wildlife and the Muckleshoot Indian Tribe also provided technical assistance to the TMDL steering committee. The committee developed a plan of action that is in concert with meeting water quality goals for Lake Sawyer and maintaining a healthy ecosystem in anticipation of extensive future development within the watershed.

## Why is phosphorus a problem?

Phosphorus is a basic element found in nature, and is also a primary nutrient that all living organisms need to survive. Lakes typically build up phosphorus levels as they age, and ultimately fill in with vegetation and sediment, a process that usually takes thousands of years. This process is called **eutrophication**. Increased amounts of phosphorus due to human activity can accelerate eutrophication and be detrimental to a lake's water quality and its beneficial uses (Figure 1). Higher levels of phosphorus from sediment, fertilizers, waste, and other sources can cause excessive plant and algae growth, which in turn may have unfavorable impacts to water clarity, aquatic habitat, fish survival, swimming, boating, and aesthetic enjoyment (Murphy et al. 2002). Human activities, such as home building, road construction, and deforestation, can drastically speed up a lake's aging process and adversely affect lake uses.

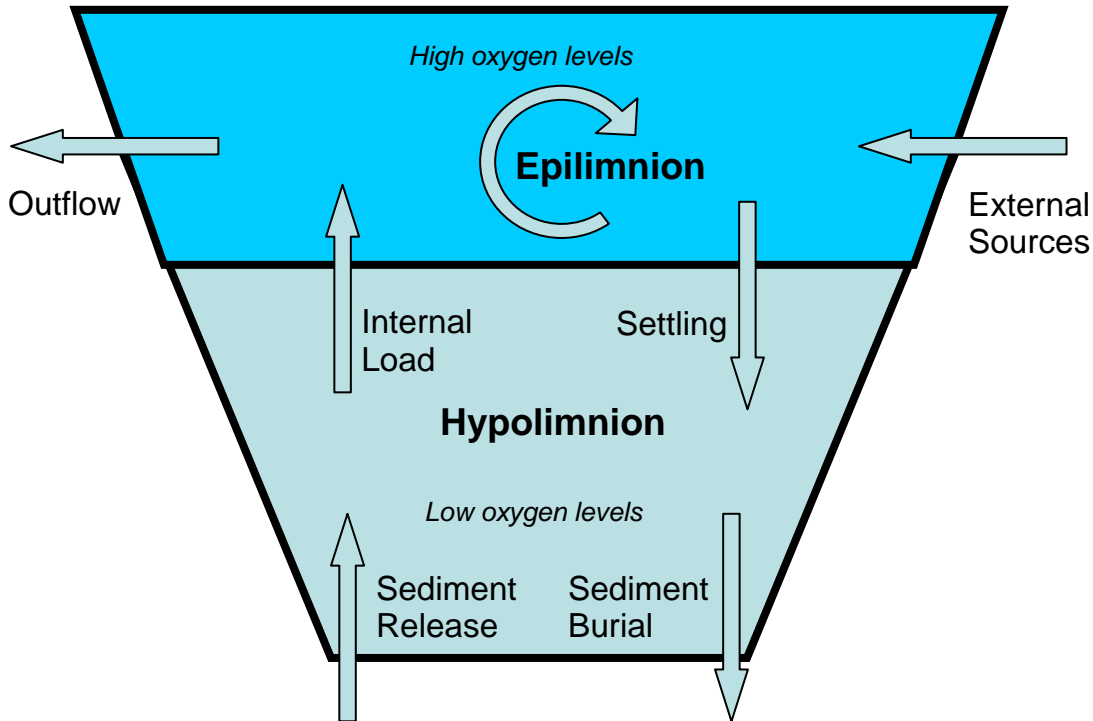
In lakes of the Puget Sound Lowlands, phosphorus is often the nutrient in least supply, meaning that biological productivity is often limited by the amount of available phosphorus (Abella, 2009). Thus, for lakes such as Lake Sawyer, phosphorus is usually the main nutrient that drives the eutrophication process. Though other nutrients, such as potassium and nitrogen, can affect surface water quality, the amount of phosphorus being transported through various sources and pathways, such as human and animal waste, fertilizers, and stormwater in the watershed, often limits the amount of algal growth and aquatic plants (Minnesota Department of Agriculture, 2004). Nutrient levels generally determine a lake's level of biological activity or *trophic state*.



**Figure 1. Blue-green algae bloom.** Blue-green algae, as seen in this picture, thrive on excessive nutrients in water. When conditions are favorable, an algae bloom can cover the entire surface of a lake. Some species of blue-green algae can produce toxins, which can be harmful to humans and kill pets and wildlife. Photo by Eric Scollard.

Lakes with low levels of biological activity are classified as *oligotrophic*. Those with moderate biological activity are *mesotrophic*. When lakes get older, or when they are polluted with excessive levels of nutrients and have high biological activity, they are considered *eutrophic*. Lakes with lower levels of biological activity have better water clarity and are more desirable for swimming and boating activities.

Lake Sawyer, like many lakes, experiences *thermal stratification*. This process generally occurs from June to mid-November and separates the lake into several distinct layers according to water temperature. The upper level of the lake, where water is relatively warm and continues to circulate is called the *epilimnion*. The deeper portion of the lake, that is much colder and denser, is called the *hypolimnion*. As phosphorus enters Lake Sawyer via tributaries, the nearshore area of the lake, and from the release of phosphorus from lake-bottom sediments, it can mix across the lake layers and effect the amount and timing of plant growth and algae blooms (Dion 1978) (Figure 2).



**Figure 2. Phosphorus dynamics in Lake Sawyer.** *Phosphorus is constantly cycling through the water column in Lake Sawyer. The amount of phosphorus available to algae in the epilimnion is dependent on phosphorus levels in external sources, the amount leaving the lake, and mixing with the hypolimnion.*

## Washington State water quality criteria for phosphorus

In Washington State, a water body is considered polluted when it exceeds the thresholds set forth in the Washington State Water Quality Standards (WAC 173-201A). Unlike most pollutant parameters, the water quality standards do not have specific numeric criteria for total phosphorus, thus lake phosphorus capacity needs to be determined for each individual lake. A *loading capacity*, or maximum amount of total phosphorus that can be introduced to Lake Sawyer, must be established (Figure 3) in order to protect the beneficial uses of the lake. A *target concentration* is developed to achieve the necessary reductions of total phosphorus loading to the lake epilimnion. Target concentration relates to the specific numeric concentration of phosphorus derived from modeling calculations.

Ecology's total phosphorus target concentrations vary by eco-region. Eco-regions are divided into Pacific Coast range, Puget Sound Lowlands, and Northern Rockies. Lake Sawyer lies within the Puget Sound Lowlands eco-region. More information about Washington State water quality criteria for lakes can be found in Appendix B of this document.



## Lake Sawyer’s inclusion on the state 303(d) list

Although the state of Washington does not have specific numeric criteria for phosphorus, the amount of total phosphorus entering a water body is used to determine a lake’s trophic state. Lake Sawyer was not listed on Ecology’s 1996, 1998, and 2002/2004 303(d) for total phosphorus, even though water quality data submitted to Ecology showed that the lake was still occasionally exceeding its total phosphorus limit of 16 µg/L (Figure 5). However, more recent data shows the lake is currently achieving its target limit, but short-term violations persist. The lake was placed in Category 4a on Ecology’s 2008 water quality assessment, which means that the water is impaired but has an approved TMDL.

**Components of a TMDL**

1) **Wasteload allocations (WLA):** Represents the contribution of discrete “point” sources of pollutants (e.g., municipal, industrial, and construction stormwater discharges);

2) **Load allocations (LA):** Represent “nonpoint” sources of a pollutant, (natural sources, most agricultural activities, and other sources that are not regulated by an Ecology permit); and

3) **Margin of safety (MOS):** Allows for uncertainty in the estimation of, and ability to achieve, the previous two allocations.

Thus, the TMDL equation is as follows:

**TMDL = WLA + LA + MOS**

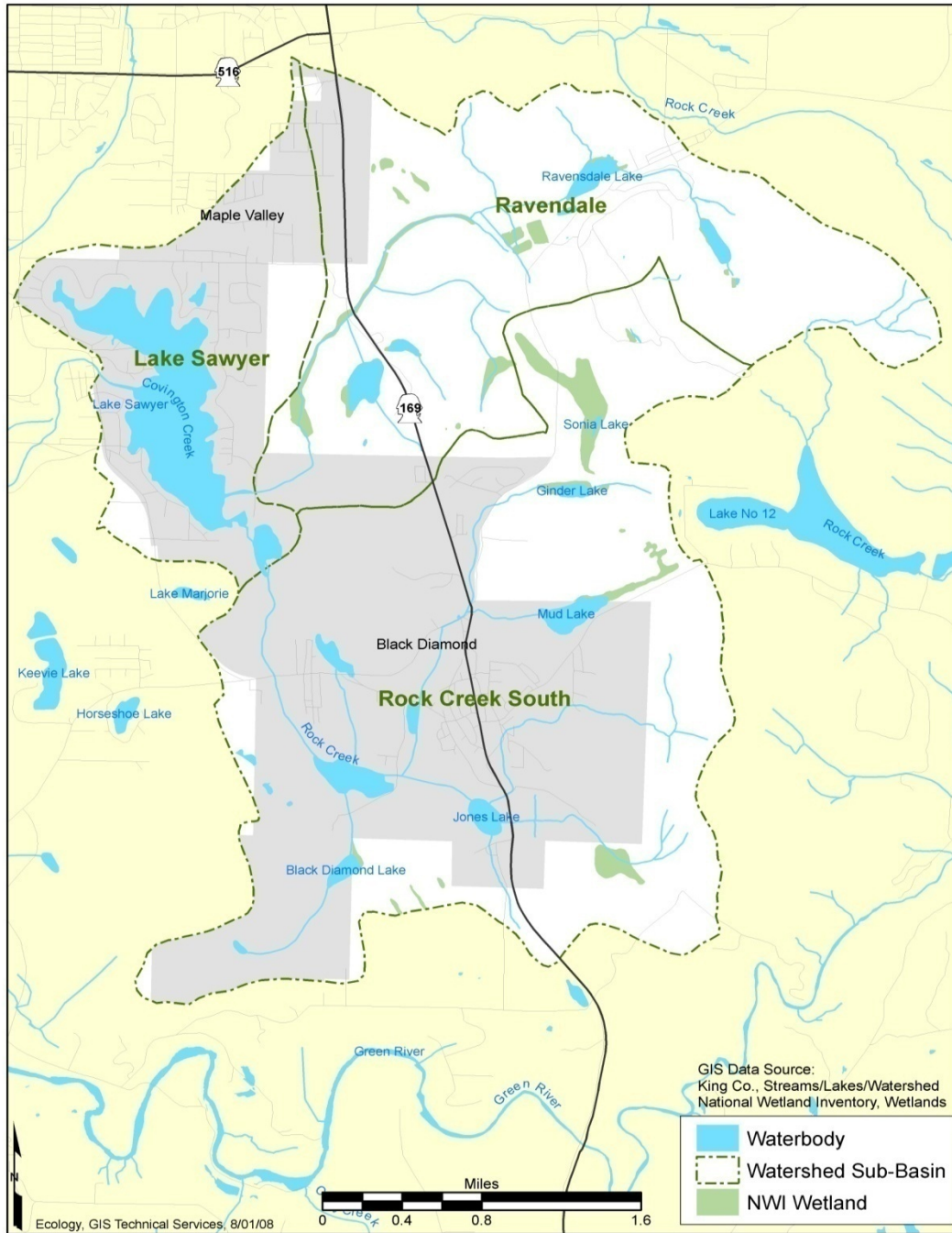
The sum of these three components may not exceed the **Loading Capacity**.

**Figure 3. Components of a TMDL.** *These three parts of a TMDL may not exceed the maximum amount of a pollutant that a water body can receive before it is considered polluted.*

**Table 1. Loading Capacity Distribution.** *Lake Sawyer’s total phosphorus load capacity distribution from the 1993 TMDL study.*

<b>Total Phosphorus (P) target in-lake average = 16 µg/L</b>	
<b>Total Phosphorus Source</b>	<b>Loading capacity distribution (kg/June-August)</b>
Lake Sawyer	1.9 kg per day or (715 kg/yr)
Wasteload Allocation	0 kg per day for Black Diamond wastewater treatment plant
Tributaries Ravensdale Creek and Rock Creek	1.4 kg per day includes a 0.08 kg per day allocation for uncertainty
Internal Recycling	0.54 kg per day includes a 0.34 kg per day for uncertainty

## Lake Sawyer Watershed



**Figure 4. Map of Lake Sawyer Watershed.** The watershed includes the city of Black Diamond and a portion of the city of Maple Valley. Map provided by King County Lake Stewardship Program.

# Watershed Description

Lake Sawyer is located in the city of Black Diamond, and is a significant recreational resource for the area. Lake Sawyer is 280 acres in size and its watershed encompasses approximately 8,300 acres. The watershed is divided into three sub-basins: Rock Creek sub-basin is 4,454 acres (54%); Ravensdale Creek sub-basin is 2,532 acres (30%); and Nearshore area of Lake Sawyer is 1324 acres (16%) (Figure 4). As the fourth largest lake in King County, Lake Sawyer is a primary recreation area for swimming, boating, fishing, and aesthetic enjoyment (King County, 2000). As part of the Big Soos Creek Basin of the Green River Watershed, Lake Sawyer serves as a pathway for late winter Coho salmon that travel through Lake Sawyer on their way to spawning grounds in Ravensdale and Rock Creek systems. Resident Rainbow Trout, Cutthroat Trout, Kokanee, along with various warm water fish species are also present in the lake (King County, 2000).

## Water quality in the Lake Sawyer watershed

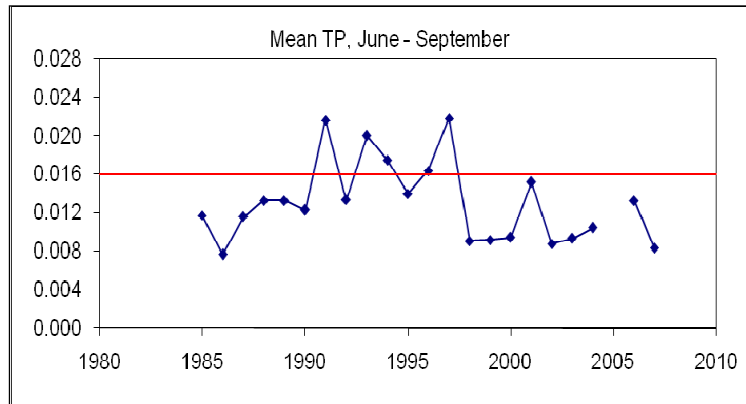
Water quality in Lake Sawyer was relatively stable over the last decade, based on monitoring by King County Lake Stewardship Program (KCLSP) (Abella, 2009). Lake water temperature followed a pattern similar to other lakes in the region, with cool temperatures in winter and spring, and summer maximum temperatures occurring in July and August. Lake Sawyer temperatures ranged from 14 to 23 degrees Celsius during the May through October 2008 sampling season, with an average of 19 degrees. Compared to other lakes monitored in 2008 through the KCLSP, Lake Sawyer is generally in the lower range of summer temperatures.

Secchi transparency is a common method used to assess and compare water clarity. It is a measure of the water depth at which a black and white disk disappears from view when lowered from the water surface. Lake Sawyer Secchi transparency ranged from 3.0 m to 4.5 meters from May through October 2008, averaging 3.7 meters.

The ratio of nitrogen (N) to phosphorus (P) can be used to determine if conditions are favorable for the growth of cyanobacteria (bluegreen algae) that can impact beneficial uses of the lake. Total phosphorus and total nitrogen remained in relatively constant proportion to each other in Lake Sawyer through the 2008 sampling period, ranging from 21.5 to 61.2 with an average of 36.7. Since N:P ratios below 20 favor growth of cyanobacteria, conditions in Lake Sawyer were generally unfavorable for nuisance bluegreen algae growth in 2008 (Abella, 2009).

Long-term water quality sampling performed by King County's Lake Stewardship volunteer monitoring program led to Lake Sawyer's inclusion on the state's water quality assessment lists for 1996, 1998, and 2002/2004. Lake Sawyer has been monitored by King County Lake Stewardship Program and local volunteers since the early 1980s (King County 2000). Fecal coliform levels in Lake Sawyer and its tributaries are also noted as a public health concern, but the most recent monitoring data provided by King County shows that the lake is within water quality standards for bacteria.

Data from King County's Lake Stewardship Program show Lake Sawyer generally meeting its TMDL target of 16  $\mu\text{g/L}$  phosphorus in recent years (Figure 5). The 16  $\mu\text{g/L}$  phosphorus target has been met in the Lake Sawyer epilimnion since 1998, according to KCLSP measurements. However, more long-term monitoring of Lake Sawyer and its tributaries is needed before it can be determined that the lake is consistently meeting its phosphorus TMDL target.



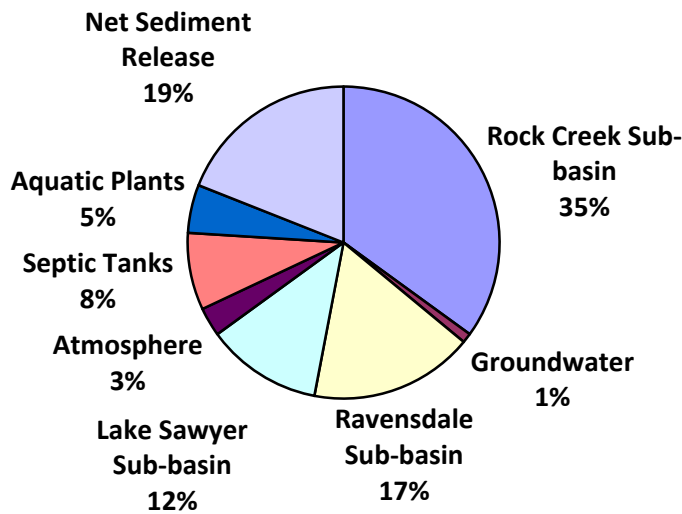
**Figure 5. Average summer phosphorus in Lake Sawyer 1985-2007.** King County data shows Lake Sawyer meeting and exceeding its TMDL phosphorus target concentration of 16  $\mu\text{g/L}$ .

In 1996, King County Surface Water Management developed the draft Lake Sawyer Management Plan with assistance from an Ecology Centennial Clean Water Fund grant (King County, 2000). The plan identified sources of phosphorus in the Lake Sawyer Watershed and made recommendations to reduce total phosphorus input to the lake (Figure 6). Specifically, the plan outlines 14 recommendations to address specific internal and external sources of pollution that contribute to phosphorus loading to Lake Sawyer. To date, the majority of the recommendations have not been implemented due to lack of funding. Management measures from the plan include stormwater controls, watershed measures, regional stormwater and phosphorus control, aquatic plant management and water quality monitoring activities.

## Sources of phosphorus

Sources of phosphorus to Lake Sawyer can be categorized in various ways. In the Lake Sawyer Management Plan, phosphorus sources were classified by sub-basin and several general source pathways as shown in Figure 6 (King County, 2000). The majority of annual phosphorus loading to Lake Sawyer from external sources occurs in winter, during the period of highest stormwater runoff. Internal phosphorus loading from lake bottom sediments increases during late summer, often contributing to lake algal blooms in fall and early winter.

### Lake Sawyer Pollution Sources



**Figure 6. Pollution Loading Sources.** *The Lake Sawyer Management Plan (2000) identifies eight pathways of phosphorus loading. The Pie graph shows relative loading from each source to Lake Sawyer.*

For the purposes of this implementation plan, sources of phosphorus are generally examined by type of land use activity, so that corrective actions can be more easily identified for them. These general sources of phosphorus include stormwater; construction activity; sediments; agriculture and hobby farms; home and automotive maintenance activities; onsite septic systems; loss of riparian habitat; wildlife; and aquatic plants. Most (approximately 76%) of the phosphorus loading comes from external sources to the lake (King County, 2000) (Figure 6). The majority of this phosphorus will not leave the lake, but rather will bind with lake sediments and recycle internally for years after being introduced. Therefore, it is important to address external pollution sources and control them to the greatest extent possible.

**Table 2. Potential Phosphorus Pollution Sources.** *The sources listed below are some of the most common activities associated with contributing pollutants to local water bodies (i.e., Lake Sawyer, Ravensdale and Rock Creeks) particularly excessive amounts of phosphorus.*

Potential Sources	Explanation
Stormwater <ul style="list-style-type: none"> <li>• Municipal Stormwater</li> <li>• Construction Stormwater</li> <li>• Industrial Stormwater</li> </ul>	Stormwater can transport: Small farm and residential pet waste, illegal sewer connections to storm drainage systems, nutrient runoff from excessive lawn and garden fertilization, sewage from failing onsite septic systems, car wash wastewater, and runoff from composting facilities.
Sediment	Often carries high levels of phosphorus because the rock material consists of phosphorus-containing minerals and phosphorus adsorbs to sediments.
Agriculture and Hobby Farms	Bacteria, nutrients, and surface runoff from improper grazing or manure management practices. Excessive use of fertilizers. Removal of riparian vegetation. Certain ditch maintenance practices.
Home and Automotive Maintenance	Improper use and disposal of soaps, fertilizers, pesticides, vehicle fluids, and other home-generated waste products.
Onsite Septic Systems	Malfunctioning septic systems could be caused by: Improper soil, lack of maintenance, construction, or improper use.
Loss of Riparian Habitat	Lack of shoreline vegetation to filter contaminants. Lack of buffer affects temperature, dissolved oxygen levels, and nutrients entering the Lake. Removal of shoreline vegetation can also contribute to the amount of untreated stormwater that can enter a water body.
Wildlife	Usually considered part of natural background levels. Exceptions are when a pollution source is created by man-made alterations of the environment, or when wildlife is being fed by humans rather than acquiring food on their own.
Aquatic Plants	Use phosphorus and other nutrients during growth period, but release phosphorus back into the water body during plant die-off.

## Stormwater

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In a watershed that is covered with natural vegetation and trees, water from rainfall or snowmelt is easily absorbed into the ground. Where natural vegetation has been altered, more water flows off the land to local streams. This water is commonly referred to as *stormwater* (Table 2). In lakeside and rural areas, lawns and animal pastures are good examples of where stormwater may carry phosphorus and other pollutants to Lake Sawyer. In more developed areas, stormwater is generated primarily by road surfaces, rooftops, driveways and other impervious surfaces, or by building activities (Ecology, 2005).

As stormwater moves through the watershed, it picks up all types of pollutants, including sediment; fertilizers; pet and wildlife waste; pesticides; vehicle fluids; and household product waste (Figure 7). As suburban areas grow, the amount of impervious surface increases and stormwater impacts become more prevalent. The loss in naturally vegetated area due to development is directly correlated with the amount of stormwater present in a watershed (Ecology, 2007a).



**Figure 7. Stormwater Pollution.** Stormwater can carry a variety of pollutants including sediment, household products, metals, fertilizers, bacteria, and phosphorus. Some of these pollutants enter Rock and Ravensdale Creeks and eventually enter Lake Sawyer.

Stormwater is the most significant source of pollution affecting Washington State waterways. It can carry bacteria from pet waste, runoff from failing onsite septic systems; sediment runoff; excess nutrients from lawns and gardens; and pollutants associated with activities such as construction and road building. The transport of pollutants via stormwater increases lake eutrophication, sedimentation, reduces water clarity; causes swim beach and shellfish closures and contaminate water wells (Ecology, 2007a).

As urban growth increases in the Lake Sawyer watershed, stormwater becomes more of a concern. To control stormwater and prevent it from further impacting Lake Sawyer, *best*

*management practices* (BMPs) must be implemented throughout the watershed. BMPs are tools and techniques that help to prevent environmental damage and are developed specifically to address a particular source of pollution. BMPs consist of physical structures such as stormwater treatment devices, activities like education and outreach to local residents, or practices such as chemical containment and street sweeping to prevent pollution.

**Municipal Stormwater:** Municipal stormwater refers to stormwater runoff from cities or other municipalities that enters their conveyance or system of conveyances (including roads with drainage systems; municipal streets; catch basins; curbs; gutters; ditches; manmade channels; or storm drains). Municipal stormwater conveyance systems are known as municipal separate stormwater sewer systems (or MS4s). Federal and state regulations address municipal stormwater through Ecology's Phase I and Phase II Municipal Stormwater Permit programs. The municipal stormwater permit allows permit holders to discharge stormwater to waters of state of Washington through municipal storm sewers. The Municipal Stormwater Permits require municipal permit holders to establish ordinances that prohibit non-stormwater discharges from entering stormwater systems, and apply controls to reduce the discharge of pollutants to maximum extent practicable (Ecology, 2007a).

In 1995, Ecology issued the first Phase I Municipal Stormwater Permit. The permit regulates discharges from MS4s owned or operated by King, Pierce, Clark, Snohomish Counties, as well as the cities of Seattle and Tacoma. The Phase I Municipal Stormwater Permit was re-issued in January 2007. Ecology also developed a Phase II Municipal Stormwater Permit for Western Washington that incorporates 80 cities and 5 counties, including Black Diamond and Maple Valley. The Phase II Municipal Stormwater Permit went into effect February 2007.

Both permits require the development of a *Stormwater Management Program* (SWMP) to reduce pollutant discharges and protect water quality in areas served by the MS4. All SWMPs must include public education; public participation; illicit discharge detection and elimination; construction runoff control; post construction runoff control; and pollution prevention and good housekeeping for municipal operations. The majority of the Lake Sawyer Watershed is located within the city of Black Diamond's jurisdiction; however a small portion of the watershed is in the city of Maple Valley, and the remainder is in the jurisdiction of King County. Therefore, the Lake Sawyer watershed is covered by both Phase I and Phase II Municipal Stormwater Permits.

**Construction Stormwater:** Construction activity can pollute water when phosphorus-rich disturbed soil is washed off a site and easily transported to water bodies. Ecology requires that a permit be obtained for all soil-disturbing activities (including grading, stump removal, demolition) where one (1) or more acres will be disturbed and stormwater will be discharged to a receiving water directly (e.g., wetlands, creeks, unnamed creeks, rivers, marine waters, ditches, estuaries), or to storm drains that discharge to a receiving water. If all stormwater is retained on site and cannot enter surface waters of the state under any condition, permit coverage is not required. Construction site operators must apply for a permit 60 days prior to discharging stormwater.



**Industrial Stormwater:** There is one Individual Industrial Stormwater permit in the Lake Sawyer Watershed, issued to Pacific Coast Coal Company (PCCC). Their coal mine site is located west of Lake Sawyer, and is also known as John Henry Coal Mine. PCCC is currently not actively mining, but accepting fill materials from various places, including filter cake from sand and gravel operations. PCCC expects to resume mining in the near future. PCCC discharges from four outfalls to three different receiving waters. The applicable receiving water quality standards are those adopted Ecology in WAC chapters 173-201A, 173-200. Outfall 001 discharges to Ginder Lake that flows along the western perimeter of the mine site prior to joining Mud Lake Creek just above the culvert underneath State Highway 169.

Ecology issued a Notice of Penalty (NOP No. 4162) to PCCC for violations of effluent limits for phosphate/total phosphorus between January 2005 and November 2006. PCCC has received both formal and informal enforcement actions since the company began operating in 1986. PCCC's individual permit (WA-003083-0) was re-issued by Ecology in early 2008 and the company has been in compliance with permit conditions since that time. Ecology set phosphorous limits for the mine as low as can be achieved using reasonable treatment methods.

In addition to the John Henry mine, there is a ~220-acre sand and gravel mine located near the south end of Lake Sawyer operated by the Palmer Coking Coal Company. Stormwater and process water discharges from the Palmer sand and gravel mine are covered under the Sand and Gravel General Permit (No. WAG 503007). Turbidity from the Palmer pit is limited by the permit to 50 nephelometric turbidity units (NTUs), which should help minimize phosphorus contributions from the mine site to Lake Sawyer. There are also wetlands located between Lake Sawyer and the mine site, which should help further treat runoff from the mine.

## Sediment

Since phosphorus tends to adhere to sediment particles, sediment is a primary source of phosphorus. As sediment is transported through the Lake Sawyer Watershed, it will eventually make its way into Lake Sawyer. The amount of sedimentation received by Lake Sawyer has a direct effect on its trophic status. Although lakes naturally fill in over time, the process can be dramatically increased by human activities such as construction, agricultural practices, land development, and the removal of natural vegetation.

For smaller projects by homeowners near streams or ditches flowing to Lake Sawyer either directly or through one of its tributaries, preventing soil from running off site is perhaps the most economical and time-saving step. This plan recommends the following BMPs, which are proven to be effective in controlling sediment erosion:

1. Protect existing vegetation.
2. Install filter fences.
3. Lay down matting.
4. Re-seed exposed areas prior to performing any project, (i.e., construction, landscaping, or other disturbance) and consider possible effects to water quality.

## Agriculture and hobby farms

The majority of land dedicated to caring for horses and other livestock is associated with homeowners and their personal stables (Figure 8). The range of land types used for residential livestock facilities is very diverse. For budgetary and other reasons, residential livestock owners frequently have limited area for grazing and exercise. Thus, many times horses and other livestock live in wooded conditions or are confined to small outdoor paddocks where grass and vegetation is quickly consumed or destroyed. Phosphorus-rich manure deposited by animals frequently finds its way into natural drainage corridors and becomes a source of water pollution.



**Figure 8. Horse Facilities.** *The average horse generates 50 pounds of manure per day (that's 8 tons per year not counting soiled bedding). This owner uses gravel, rubber mats, wood pellet bedding, interceptor drains, and frequent use of the dumping fork to prevent water pollution and improve compost quality. Composting manure is covered to prevent rain from carrying waste to surface water.*

**Corrective/preventative actions:** Like commercial facilities, horse and other livestock owners need to carefully manage their pastures and the manure produced by their animals. All small farms in proximity of a drainage conveyance should contact the King Conservation District to develop a farm plan and should implement the plan.

## Home and automotive maintenance activities

Many of our everyday activities in and around our homes can have dramatic consequences for local water bodies. For example, storm sewer drains that remove excess water from our streets do not take the water to our local sewage treatment plant as one might believe. More likely, it is ultimately discharged to a local stream or lake. Car wash wastewater going to the nearest water body is a common problem (Figure 9). Whether we use biodegradable soap or some other type of soap, sudsy wash water from driveways and streets often ends up in a lake or

stream. Most people wouldn't dream of emptying dirty soapy water into the stream but that is often what happens.

Similarly, if water runs off a fertilized lawn, the same thing can happen. Although there are no suds to indicate the pollution, the phosphorus in the fertilizer can be washed away to the storm sewer. Pesticides and herbicides we put on our lawns are also found in urban creeks. These compounds act the same way in the water as they do on your lawn, and may kill off beneficial aquatic life. Common garden chemicals are now widespread throughout Puget Sound, and are damaging local waters.



**Figure 9. What's wrong with this picture?** Although you can't drive your car onto a lake as shown in this picture, the ultimate destination of car wash wastewater can be Lake Sawyer if owners are not careful.

**Corrective/preventative actions:** Consider alternatives to concrete or asphalt surfaces. Gravel, wood chips, and various types of porous pavers allow water to infiltrate through the ground much faster. These types of surfaces also allow pollutants such as oil, fertilizers and sediment to be contained while water is allowed to seep back into the ground. Ecology encourages a balanced approach between the natural landscape and individual property needs. Here are some other simple steps that homeowners can take to avoid polluting nearby water bodies.

- Reduce or use no chemical fertilizers on your lawn. Excessive use of fertilizers will only “feed” Lake Sawyer’s nutrient problem, resulting in other problems such as frequent algal blooms and excessive plant growth.
- Use household products sparingly. Items such as cleansers, detergents, and auto fluids used around houses that are improperly disposed of can also be transported to the lake.
- Clean up hazardous material spills according to label directions.

- Maintain native plant vegetation to help stabilize the shoreline and filter pollutants.
- Avoid feeding wildlife.
- Wipe up spills with an absorbent material. Store all household and automotive products in tightly sealed, leak-proof containers. Using water to rinse away material can transport chemicals and contaminants to streams and lakes.
- Mulch grass clippings and leaves to naturally fertilize your lawn. Mulch/plant exposed soil as soon as possible after disturbing soil and use sediment barriers when necessary.
- Wash your car on your lawn or take it to a salmon-friendly car wash. Car washing water, excess fertilizer, pet waste, and anything else that can dissolve in water will travel in stormwater runoff and eventually pollute local water bodies.

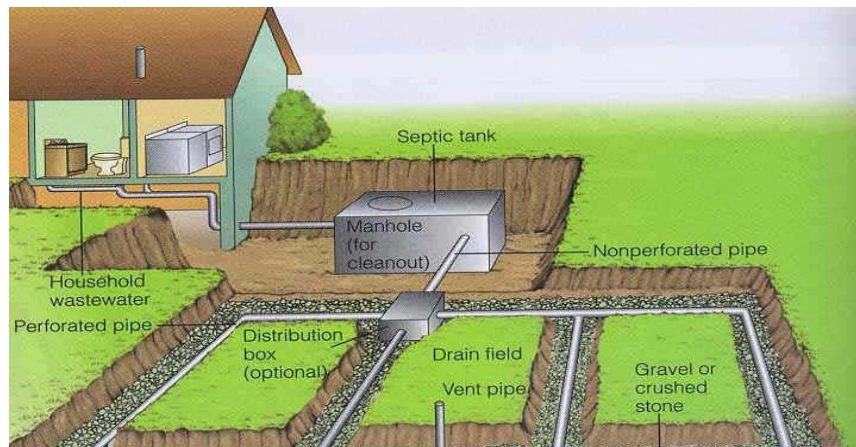
For more information on household product disposal and alternatives to using such products, contact:

**King County** at 206-296-4692 or 1-888-TOXIC-ED or  
<http://www.govlink.org/hazwaste/house/index.cfm>

King County's Water and Land Resources Division provides several different alternatives to car washing. To get a car wash kit from King County log on to: [http://dnr.metrokc.gov/wlr/pi/carwash\\_res.htm](http://dnr.metrokc.gov/wlr/pi/carwash_res.htm).

### Onsite septic systems

Onsite septic systems (OSS), both community-based and individual systems, are not a problem when designed, sited, and operated properly (Figure 10). A properly functioning OSS uses the soil surrounding the drainfield to remove bacteria and some nutrients from the wastewater. However, soil compaction, clogging of the soil with solids, and hydraulic overload can all cause a failure of the system to adequately treat wastewater to meet quality standards for bacteria.



**Figure 10. Onsite Septic Systems.** *Onsite Septic Systems require servicing. If you have a septic system, and the ground is wet and smells bad, you should have your system inspected.*

Signs of OSS failure include:

- Odors, surfacing sewage, wet spots, or lush vegetation in the drainfield area.
- Plumbing or septic tank backups.
- Slow draining fixtures, and gurgling sounds in the plumbing system.

If wastewater surfaces as described, it is possible that wastewater could go directly to a nearby stream or ditch and contribute phosphorus to Lake Sawyer. Connecting septic systems to stormwater sewers or piping them directly to surface waters is occasionally discovered and is illegal. Another problem observed in some older septic systems is the subsurface movement of wastewater through extremely porous soils.

**Corrective/preventative actions:** To assist the 100,000 King County households with septic onsite sewage systems, Public Health's new Operation and Maintenance Program offers tips to improve the longevity of onsite systems and protect the community's health. For more information about the King County Wastewater Program go to: <http://www.metrokc.gov/health/wastewater/> or call 206-296-4932. This program also applies to Black Diamond residents.

House Bill 2322 was recently passed into law, which restricts the amount of phosphorus in dishwashing detergent. The new law complements a 1993 law banning phosphates in laundry detergent, and prohibits distribution of any dishwashing detergent that contains more than 0.5 percent of phosphorus by weight. Washington State is the first state in the Union to restrict the amount of phosphorus for dishwashing detergent. The law will be effective statewide by 2010. For more information see Ecology's Reducing Phosphorus website: <http://www.ecy.wa.gov/programs/wq/nonpoint/phosphorus/PhosphorusBan.html>

### Loss of riparian habitat

Riparian zones are defined as the transition zone between land and water environments. This particular area of the lake plays a valuable role in improving and protecting water quality. Riparian zones can be made up of grasses, shrubs, trees, roots, and submersed aquatic plants. Adequately sized and healthy riparian buffers help filter out a variety of pollutants, stabilize shorelines, reduce flooding, and provide food and shelter for wildlife.

Healthy riparian habitat benefits local waters in many ways such as:

**Filtering runoff:** Excess water runoff from yards and driveways, which carry sediment and other pollutants are filtered and removed by riparian plants.

**Bank stabilization:** Native plant buffers extending from down the water's edge can be the most efficient way to stabilize a bank and prevent erosion.

**Preservation of aquatic habitat:** Riparian areas can provide habitat for fish, protection from predators, and provide nesting areas for sensitive species of birds or amphibians.

**Aesthetics:** Though land owners may have varying ideas of what is aesthetically-pleasing, most agree that viewing wildlife in a somewhat natural setting is important. Leaving a natural riparian buffer in place provides natural habitat, noise reduction, and privacy to homeowners as well (Pennsylvania Association of Conservation Districts).

**Corrective/preventative actions:** Vegetated buffers should be placed (or left in place) between the lake and shoreline. This plan encourages all affected landowners and developers to maximize buffer widths consistent with reasonable land use expectations and meeting the goal of providing shade and maintaining natural stream and lake landscapes. Lake-side homes should explore natural landscape practices rather than having green, fertilized lawns up to the water's edge. Buffer sizes and plant communities should be designed to filter runoff, stabilize stream banks, and preserve aquatic habitat.

## Wildlife

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Wildlife is a natural and healthy part of our environment. Problems can arise when in certain situations animals are being fed by humans by way of improper storing of garbage or by intentionally leaving food out. This can lead to prolific reproduction or an interruption in animal behavior such as the seasonal migration of certain bird species. In order to avoid drastic measures, such as euthanizing animals that have been deemed as nuisances, it best to not feed wildlife and allow them to forage for food and to maintain their natural instincts and behaviors.

## Aquatic plants

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Excessive aquatic plant growth can be an indication of too much phosphorus loading in a lake. A comprehensive list of aquatic plant species in Lake Sawyer is listed in Table 3. Most of these plants are both native and beneficial to the lake and provide habitat and food for local wildlife. However, *White waterlily*, *Yellow flag iris*, and *Eurasian watermilfoil* are examples of invasive, noxious aquatic weeds found in abundance in Lake Sawyer (Figure 11). Their excessive growth leads eventually to plant die-off and decay in lake sediments, adding an additional source of internal phosphorus loading. Excessive amounts of aquatic noxious weeds can interfere with native fish populations, out-compete native aquatic plants, and restrict recreational opportunities.

**White waterlily**



**Yellow flag iris**



**Eurasian watermilfoil**



**Figure 11. Noxious aquatic weed species found in Lake Sawyer.**  
*Eurasian Watermilfoil photo by Margaret Hill. Other photo sources unknown.*

Every effort should be made to eradicate or control noxious and invasive weeds. There are a variety of mechanical, manual, or chemical options available. To learn more about aquatic plant control visit Ecology's website:

<http://www.ecy.wa.gov/programs/wq/links/plants.html>

A complete list of aquatic plant species found in Lake Sawyer is shown in Table 3.

**Table 3. Lake Sawyer Aquatic Plant List.**

<b>Scientific Name</b>	<b>common name</b>
<i>Ceratophyllum demersum</i>	Coontail; hornwort
<i>Chara sp.</i>	muskwort
<i>Elodea canadensis</i>	common elodea
<i>Hydrocotyle ranunculoides</i>	water-pennywort
<i>Iris pseudacorus</i>	yellow flag iris
<i>Juncus sp. or Eleocharis sp.</i>	small grass-like plants
<i>Lemna minor</i>	duckweed
<i>Ludwigia palustris</i>	water-purslane
<i>Lysimachia nummularia</i> <i>Megalodonta beckii</i>	creeping loosestrife
<i>Megalodonta beckii</i>	water marigold
<i>Myosotis sp.</i>	forget-me-not
<i>Myriophyllum sibiricum</i>	northern watermilfoil
<i>Myriophyllum spicatum</i>	Eurasian watermilfoil
<i>Najas flexilis</i>	common naiad
<i>Nitella sp.</i>	stonewort
<i>Nuphar polysepala</i>	spatter-dock, yellow waterlily
<i>Nymphaea odorata</i>	fragrant white waterlily
<i>Polygonum amphibium</i>	water smartweed
<i>Potamogeton gramineus</i>	grass-leaved pondweed
<i>Potamogeton illinoensis</i>	Illinois pondweed
<i>Potamogeton praelongus</i>	whitestem pondweed
<i>Potamogeton pusillus</i>	slender pondweed
<i>Potamogeton robbinsii</i>	fern leaf pondweed
<i>Potamogeton sp (thin leaved)</i>	thin leaved pondweed
<i>Potamogeton sp.</i>	pondweed
<i>Potamogeton zosteriformis</i>	eel-grass pondweed
<i>Scirpus sp.</i>	bulrush
<i>Sparganium sp.</i>	bur-reed
<i>Stuckenia pectinata</i>	sago pondweed
<i>Typha angustifolia</i>	lesser cat-tail
<i>Typha latifolia</i>	common cat-tail
<i>unknown plant</i>	unknown
<i>Utricularia sp.</i>	bladderwort
<i>Utricularia vulgaris</i>	common bladderwort
<i>Wolffia sp.</i>	water-meal

 Washington State Department of Ecology



# What Will be Done

## Implementation strategy

This water quality implementation plan outlines specific projects that are either planned or recommended for the Lake Sawyer watershed in order for the lake to continue to attain its water quality goal of 16  $\mu\text{g/L}$  total phosphorus. Ecology recognizes the many projects that have already occurred in the watershed due to the efforts of the watershed community and local government, and acknowledges current progress toward improved water quality in Lake Sawyer. The maintenance of acceptable total phosphorus levels in Lake Sawyer will continue to take effort on the part of all stakeholders. Improving Lake Sawyer phosphorus levels is expected to be a slow process, especially because of internal loading, and may take several years to see measurable results.

Ecology is the primary agency charged with developing an implementation plan addressing both current and future impacts to water quality. But this plan cannot be accomplished without the combined effort and support of local agencies and watershed residents. Below is a brief summary of implementation actions that have occurred to date as well as current actions that have been developed by the Lake Sawyer Water Quality Implementation Steering Committee.

1. From 1983 to 1992, Black Diamond operated an innovative wastewater treatment plant that discharged all of the city's wastewater to a natural wetland, part of the Rock Creek drainage.
2. In 1989, Ecology conducted a Phase I lake study concluding that the wetland portion of the wastewater treatment system had failed and was significantly increasing nutrient loading to lake. Excessive blue-green algae blooms were also present.
3. In 1992, the wastewater treatment plant was shut down, and all wastewater from the plant was re-routed to King County's Metro sewer line in Renton.
4. In 1998, Lake Sawyer was designated as a phosphorus-sensitive lake under King County's Surface Water Design Manual. This is the first year a sensitive lake treatment menu is included in the manual.
5. The Lake Sawyer Management Plan was finalized in 2000, in cooperation with EPA and Ecology. Many of the activities in the plan were not executed due to lack of funding.

Ecology's 2002 effectiveness monitoring report reviewed available water quality data collected by King County. The report concluded that Lake Sawyer is meeting its long-term goal of reducing phosphorus, but further actions are still needed to control nutrient input from the watershed in order for the lake to meet and maintain water quality standards into the future.

## Organizations involved in cleanup efforts

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- 1) Lake Sawyer Community Club
- 2) King Conservation District
- 3) Lake Sawyer Steering Committee
- 4) King County Stormwater Division
- 5) King County Lake Stewardship Program (KCLSP)
- 6) City of Black Diamond

- 7) Black Diamond City Council
- 8) City of Maple Valley
- 9) Washington Department of Ecology

### **Lake Sawyer Community Club (LSCC)**

The Lake Sawyer Community Club is a non-profit organization. *“The purpose of the LSCC is to bring together all Members in good standing to inform and discuss mutual problems, concerns and interests affecting our community, the Lake, and our surrounding environment.”* LSCC Bylaws (Article II). For more information about current events and updates, see LSCC website: <http://www.lakesawyer.org/>.

TMDL expectations: LSCC should continue to meet at least annually to discuss implementation projects that are occurring and propose new projects that will help address water quality problems in the watershed. The LSCC should post all current implementation projects and updates on their webpage, which can serve as an excellent information tool to educate citizens about best management practices for the Lake Sawyer watershed and provide current general information about lake water quality. LSCC is an important entity and should make every effort to stay informed on water quality issues. As noted in the Lake Sawyer Management Plan, LSCC should continue to build partnerships with shoreline residents, local government, and other stakeholders in the watershed.

### **King Conservation District**

King Conservation District is a natural resource agency that provides education and technical assistance to landowners, schools, and consultants. All landowners within the district boundaries are entitled to free information and technical assistance for water quality protection, wildlife habitat enhancement, farm management plans, soil, and slope stability information. The district also provides native plant products, manure exchange information, volunteer opportunities, stream restoration/enhancement assistance, and information on many other natural resource topics. <http://www.kingcd.org/aboutkcd.htm>.

TMDL expectations: KCD should continue to provide guidance and technical assistance to residents within the watershed. KCD should continue to work with small farms, equestrian facilities, and any landowners that seek support in developing strategies for water quality protection, manure management, farm plan development, and stream rehabilitation. Ecology is interested in working with KCD on projects that help reduce phosphorus loading to Lake Sawyer.

### **Lake Sawyer Steering Committee**

The Lake Sawyer Steering Committee (LSSC) consists of representatives from Ecology, King County Lake Stewardship Program, Lake Sawyer Community Club, King Conservation District, Washington Department of Fish and Wildlife; the Muckleshoot Indian Tribe and the city of Black Diamond.

TMDL expectations: LSSC should continue to meet at least annually to discuss

implementation projects that are occurring, assess the effectiveness of those projects, and propose new projects that advance TMDL goals within the watershed. The committee is an important entity for watershed improvement and should continue to make every effort to stay informed on water quality issues.

### **King County Stormwater Division**

A portion of the Lake Sawyer Watershed is under the jurisdiction of King County. King County is responsible for implementing its Phase I Municipal Stormwater Permit in all areas under its jurisdiction. Under the permit, King County is required to develop a stormwater management program (SWMP) which applies to their municipal separate storm sewers (MS4s), and areas served by their MS4s. To the extent allowable under state and federal law, all SWMP components are mandatory and are discussed below.

**1. Legal authority**

No later than the effective date of the permit, each permit holder must demonstrate that they can operate pursuant to legal authority which authorizes or enables the permit holder to control discharges to and from their MS4s.

**2. Municipal separate storm sewer system mapping and documentation**

The SWMP includes an ongoing program for mapping and documenting the MS4.

**3. Coordination**

The SWMP includes coordination mechanisms among departments within each jurisdiction to eliminate barriers to compliance with the terms of the permit. The SWMP also includes coordination mechanisms among entities covered under a municipal stormwater NPDES permit to encourage coordinated stormwater-related policies, programs, and projects within a watershed.

**4. Public involvement and participation**

The SWMP provides ongoing opportunities for public involvement in the permit holder's stormwater management program and implementation priorities.

**5. Controlling runoff from new development, redevelopment, and construction sites**

The SWMP includes a program to prevent and control the impacts of runoff from new development, redevelopment, and construction activities. The program applies to private and public development, including roads.

**6. Structural stormwater controls**

SWMPs include a program to construct structural stormwater controls to prevent or reduce impacts to waters of the state caused by discharges from the MS4. Impacts addressed include disturbances to watershed hydrology and stormwater pollutant discharges. The program considers impacts caused by stormwater discharges from areas of existing development, including runoff from highways, streets, and roads, and areas of new development, where impacts are anticipated as development proceeds. The program addresses impacts that are not adequately controlled by other required actions of the SWMP, and provides proposed projects and an implementation schedule.

**7. Source control program for existing development**

The SWMP includes a program to reduce pollutants in runoff from areas that discharge to the Permit holder's MS4.

**8. Illicit connections and illicit discharges detection and elimination**

The SWMP includes an ongoing program to detect, remove and prevent illicit connections and illicit discharges, including spills, into the Permit holder's MS4.

**9. Operation and maintenance program**

The SWMP includes a program to regulate and conduct maintenance activities by the Permit holder that prevent or reduce stormwater impacts.

**10. Education and outreach program**

SWMPs include an education program aimed at residents, businesses, industries, elected officials, policy makers, planning staff, and other employees of the Permit holder. The goal of the education program is to reduce or eliminate behaviors and practices that cause or contribute to adverse stormwater impacts. An education program may be developed locally or regionally.

Lake Sawyer was designated as a sensitive lake by King County in 1998, when the county adopted their Surface Water Design Manual. The county's sensitive lake designation means that King County's manual will be applied to all areas within the Lake Sawyer Watershed under jurisdiction of the county. King County's manual is consistent with Ecology's 2005 Stormwater Management Manual for Western Washington and contains standards and requirements for surface and stormwater management systems in King County. The Manual includes a Sensitive Lake Protection Menu which applies to all stormwater conveyed to the lake by surface flow as well as stormwater infiltrated within one-quarter mile of Lake Sawyer in soils with high infiltration rates. The Sensitive Lake Protection Menu section of the manual is designed to achieve a goal of 50 percent total phosphorus (TP) removal.

TMDL expectations: King County is expected to fully implement all requirements of their Phase I Stormwater Permit, which includes public education and outreach, public involvement, illicit discharge detection and elimination, construction site stormwater, post-construction stormwater, and pollution prevention for municipal operations. King County must continue to require removal of phosphorus as provided in Section 6.1.3 of the King County Surface Water Design Manual. With the additional TMDL expectations noted in this paragraph, compliance with the permit constitutes compliance with the TMDL. To learn more about King County's Phase I Municipal Stormwater Permit, log onto the following website:

<http://www.ecy.wa.gov/programs/wq/stormwater/municipal/phaseIpermit/phipermit.html>

**King County Lake stewardship program**

The King County Lakes Stewardship Program (KCSLP) is a division of King County Department of Natural Resources and Parks, Water and Land Resources Division. KCSLP "empowers citizens to act as stewards of their lakes and watersheds through education and technical assistance." KCSLP documents trends in water quality, encourages citizen lake stewardship, and provides educational outreach and technical support to lake residents. You can learn more about the KCSLP by visiting their website at:

[http://dnr.metrokc.gov/wlr/waterres/smlakes/.](http://dnr.metrokc.gov/wlr/waterres/smlakes/)

TMDL expectations: This plan recommends that KCLSP continue to work with residents of Black Diamond and Maple Valley to document lake water quality trends and encourage lake stewardship. Ecology also recommends that KCLSP participate actively in the adaptive management of this TMDL and continue to provide leadership in the development of a water quality sampling program for Lake Sawyer and its tributaries in order identify and control phosphorus inputs to Lake Sawyer.

### **City of Black Diamond**

The city has a critical role in protecting the water quality of Lake Sawyer and its watershed. The city is responsible for implementing its Western Washington Phase II Municipal Stormwater Permit, providing technical assistance, education and outreach opportunities to residents, and seeking out funding opportunities for implementation.

The city of Black Diamond is covered under Ecology’s Western Washington Phase II Municipal Stormwater Permit, which authorizes discharge of stormwater to their MS4. The Phase II Municipal Stormwater Permit prohibits non-stormwater discharges into storm sewers that discharge to surface water, and applies controls to reduce the discharge of pollutants to the maximum extent practicable. Permit holders are required to develop a stormwater management program (SWMP), including a set of actions and/or activities to meet the requirements of applicable TMDLs. The city of Black Diamond’s SWMP shall be designed to reduce the discharge of pollutants, including phosphorus from MS4s to the maximum extent practicable, meet the state’s all known, available, and reasonable methods of treatment (AKART) requirements, and protect water quality. The SWMP shall contain the following components:

**1. Public education and outreach**

SWMPs include an education program aimed at residents, businesses, industries, elected officials, policy makers, planning staff and other employees of the permit holder. The goal of the education program is to reduce or eliminate behaviors and practices that cause or contribute to adverse stormwater impacts.

**2. Public involvement and participation**

SWMPs include ongoing opportunities for public involvement through advisory councils, watershed committees, participation in developing rate-structures, stewardship programs, environmental activities or other similar activities.

**3. Illicit discharge detection and elimination**

The SWMP includes an ongoing program to detect and remove illicit connections, discharges as defined in 40 CFR 122.26(b)(2), and improper disposal, including any spills not under the purview of another responding authority, into the MS4. Permit holders must fully implement an ongoing illicit discharge detection and elimination program no later than 180 days prior to the expiration date of the permit.

**4. Controlling runoff from new development, redevelopment and construction sites**

Permit holders must develop, implement, and enforce a program to reduce pollutants in stormwater runoff to a regulated MS4 from new development, redevelopment, and construction sites. This program is applied to all sites that disturb a land area one acre or greater, including projects less than one acre that are part of a larger common plan of

the development or sale. The program applies to private and public development, including roads.

**5. Pollution prevention and operation and maintenance for municipal operations**

Within three years of the effective date of the permit, each permit holder must develop and implement an operations and maintenance (O&M) program that includes a training component and has the ultimate goal of preventing or reducing pollutant runoff from municipal operations.

The majority of the Lake Sawyer Watershed is located within the city of Black Diamond's jurisdiction; however, a small portion of the watershed is in the jurisdictions of Maple Valley and unincorporated King County. Therefore, both the Phase I Municipal Stormwater NPDES Permit and Western Washington Phase II Municipal Stormwater Permit will be implemented within the watershed.

Black Diamond will adopt Ecology's 2005 Stormwater Management Manual for Western Washington by August 2009, which requires the following phosphorus treatment menu be implemented for water bodies with TMDLs.

**Phosphorus treatment menu:** This menu applies to stormwater conveyed to Lake Sawyer by surface flow, as well as to stormwater infiltrated within one-quarter mile of the lake in soils that do not meet the soil suitability criteria in Chapter 3 of Volume III of the manual. The menu applies to projects within watersheds that have been determined by local governments, Ecology, or the USEPA to be *sensitive* to phosphorus, such as Lake Sawyer, and that are being managed to control phosphorus inputs from stormwater.

**Performance goal:** The phosphorus treatment menu facility choices are intended to achieve a goal of 50% phosphorus removal for a range of influent concentrations of 0.1 – 0.5 mg/l total phosphorus. In addition, the choices are intended to achieve the basic treatment performance goal which applies to the water quality design storm volume or flow rate, whichever is applicable, on an annual average basis. The incremental portion of runoff in excess of the water quality design flow rate or volume can be routed around the facility (off-line treatment facilities), or can be passed through the facility (on-line treatment facilities) provided a net pollutant reduction is maintained. Ecology encourages design and operation of treatment facilities that engage a bypass at flow rates higher than the water quality design flow rate. This is acceptable, provided that the overall reduction in phosphorus loading (treated plus bypassed) is at least equal to that achieved with initiating bypass at the water quality design flow rate.

**Water quality monitoring:** Black Diamond currently contracts with the King County Lake Stewardship Program to coordinate a volunteer water quality monitoring program for Lake Sawyer. King County staff trained several lake residents to collect accurate water quality data.

### **Community development**

Black Diamond is strongly encouraged to aggressively implement low impact development (LID) on a construction sites. Projects that maintain, restore or improve natural hydrologic processes should be given significant consideration in the prioritization of capital improvement and public land acquisition projects.

### **Critical areas ordinance**

Black Diamond is currently updating its critical areas ordinance. The ordinance will require a 225 foot setback from core wetlands as identified by the city. Black Diamond purchased a GIS system and plotter to help identify and map the city's stormwater system and outfalls.

### **Onsite septic system maintenance**

The city is strongly encouraged to develop a city-wide septic system maintenance program, similar to King County's on-site maintenance program. The city should also institute an inspection component to its program in order to identify and correct malfunctioning systems.

### **Pet waste stations**

The city should identify public common areas where pets are frequently present. These identified areas should be installed with pet waste dispensers and educational stations. Public areas include, but are not limited to parks, trails, walkways, and any other places the city deems appropriate.

### **Local partnerships**

The city of Black Diamond recently hired a Watershed Steward Director whose primary duties will be to provide technical assistance to watershed residents, coordinate with state and local governments, develop watershed implementation projects, and provide education and outreach opportunities to local watershed residents.

Citizens of Lake Sawyer developed a collaborative partnership (a sub-committee of the Lake Sawyer Water Quality Implementation Steering Committee) with Black Diamond's Watershed Steward Director. The newly-formed committee will initially begin focusing on the following education and outreach projects:

- Develop a newsletter about information on upcoming events and general environmental education and good steward practices.
- Network with other lake groups and cities in neighboring watersheds to exchange ideas and experiences in watershed management.
- Develop a natural yard care series for local residents.
- Explore the possibility of forming a lake management district.

TMDL expectations: Black Diamond must continue to require removal of phosphorus as provided in Volume V, Section 3.3 of the 2005 Ecology Western Washington Stormwater Manual. The city is strongly encouraged to continue implementing a water quality monitoring program in coordination with implementation projects within the watershed so that improvement or decline in water quality can accurately be determined. *Source detection*

*monitoring* is also an invaluable tool that can help identify and address sources of pollution quickly. With the additional TMDL expectations noted in this paragraph, compliance with the permit constitutes compliance with the TMDL.

### **Black Diamond City Council**

The city operates “under a strong mayor form of government with five elected members serving four year terms. The council acts as the legislative body for Black Diamond and when the city’s population reaches 5,000 residents, the council will expand to seven-members.” The council regulates expenditures, incurs debt, and approves the final operating cost and budget for the city.

**TMDL expectations:** The council should continue to support water quality protection standards, implementation projects as they are developed by staff, and carry out permit requirements as detailed under the city’s Phase II Stormwater Permit.

### **City of Maple Valley**

A small portion of the city of Maple Valley is located in the upper northwest corner of the Lake Sawyer Watershed. Maple Valley is a permit holder under Ecology’s Western Washington Phase II Municipal Stormwater Permit. The permit authorizes discharge of stormwater to Maple Valley’s MS4. The Phase II Municipal Stormwater Permit prohibits non-stormwater discharges to storm sewers that discharge to surface water, and applies controls to reduce the discharge of pollutants to the maximum extent practicable. Permit holders are required to develop a stormwater management program (SWMP) including actions and/or activities to meet the requirements of applicable TMDLs. The Maple Valley SWMP shall be designed to reduce the discharge of pollutants including phosphorus from MS4s to the maximum extent practicable, meet state AKART (all known, available, and reasonable methods of treatment) requirements, and protect water quality. The SWMP shall contain the following components:

#### **1. Public education and outreach**

The SWMP includes an education program aimed at residents, businesses, industries, elected officials, policy makers, planning staff, and other employees of the city. The goal of the education program is to reduce or eliminate behaviors and practices that cause or contribute to adverse stormwater impacts.

#### **2. Public involvement and participation**

The SWMP includes ongoing opportunities for public involvement through advisory councils, watershed committees, participation in developing rate-structures, stewardship programs, environmental activities, or other similar activities.

#### **3. Illicit discharge detection and elimination**

SWMPs include an ongoing program to detect and remove illicit connections, discharges as defined in 40 CFR 122.26(b)(2), and improper disposal, including any spills not under the purview of another responding authority, into the MS4. Permit holders must fully implement an ongoing illicit discharge detection and elimination program no later than 180 days prior to the expiration date of the permit.



- 4. Controlling runoff from new development, redevelopment, and construction sites**  
The permit holder must develop, implement, and enforce a program to reduce pollutants in stormwater runoff to the MS4 from new development, redevelopment, and construction sites. This program applies to all sites that disturb one acre or more of land area, including projects less than one acre that are part of a larger common plan of the development or sale. The program applies to private and public development, including roads.
- 5. Pollution prevention and operation and maintenance for municipal operations**  
Within three years of the effective date of the permit, each permit holder shall develop and implement an operations and maintenance (O&M) program that includes a training component and has the ultimate goal of preventing or reducing pollutant runoff from municipal operations.

Maple Valley has also officially adopted the 2005 Stormwater Management Manual for Western Washington. The following requirements from the 2005 Stormwater Manual are particularly relevant for the Lake Sawyer TMDL.

**Phosphorus Treatment Menu:** This menu applies to stormwater conveyed to Lake Sawyer by surface flow as well as to stormwater infiltrated within one-quarter mile of the lake in soils that do not meet the soil suitability criteria in Chapter 3 of Volume III of manual. The menu applies to projects within watersheds that have been determined by local governments, Ecology, or the USEPA to be *sensitive* to phosphorus, such as Lake Sawyer, and that are being managed to control phosphorus inputs from stormwater. The phosphorus menu facility choices are intended to achieve a goal of 50% phosphorus removal for a range of influent concentrations of 0.1 – 0.5 mg/l total phosphorus.

Some of Maple Valley’s current education and outreach activities for citizens include:

- Natural yard care workshops.
- Articles on water quality issues aimed at the general public published in a quarterly newsletter.
- Storm drain stenciling program.
- Adopt a road litter pickup.
- Signage on proper pet waste disposal posted.

**Water quality monitoring:** City of Maple Valley is familiar with lake protection and lake monitoring as they are currently contracting with King County Lake Stewardship Program to coordinate a volunteer water quality monitoring program for Lake Wilderness. King County staff trained several lake residents to collect accurate water quality data. The city agreed to apply their knowledge and experience to the portion of their jurisdiction which is in the Lake Sawyer watershed.

TMDL expectations: Maple Valley must continue to require removal of phosphorus as provided in Volume V, Section 3.3 of the 2005 Ecology Western Washington Stormwater Manual. The city should also continue to investigate and require new technologies for phosphorus removal as they become available and are both reasonable and achievable to implement. Maple Valley is strongly encouraged to continue implementing a water quality

monitoring program and to include drainages within the Lake Sawyer watershed if available. Monitoring should be in coordination with implementation projects within the watershed so that improvement or decline in water quality can accurately be determined. *Source detection monitoring* is also a useful tool that can help identify and address sources of pollution quickly. To learn more about the city's stormwater management plan, log onto the following website:

<http://www.ci.maple-valley.wa.us/pw/pw.asp>

With the additional TMDL expectations noted in this paragraph, compliance with the permit constitutes compliance with the TMDL.

### **Washington State Department of Ecology**

Ecology has been delegated authority by the EPA to implement many aspects of the federal Clean Water Act. This includes National Pollution Discharge Elimination System (NPDES) permitting and the total maximum daily load (TMDL) program. The Lake Sawyer watershed is under the jurisdiction of Ecology's Northwest Regional Office (NWRO). To address the municipal permitting needs of this TMDL, the NWRO has municipal stormwater specialists who provide technical assistance and auditing activities for the Phase I and Phase II municipal stormwater permits across the region.

Ecology's NWRO also has a team of inspectors that oversee compliance with stormwater permits issued to the Washington State Department of Transportation (WSDOT) and nonpublic entities. When technical assistance is not effective or is inappropriate, the NWRO also has two staff responsible for preparing enforcement actions for this team to ensure compliance with NPDES permits.

Ecology's lake specialist is assigned to develop and help implement the Lake Sawyer Total Phosphorus TMDL, and will assist all parties in coordinating TMDL-related activities. Ecology's Northwest Regional Office also has environmental specialists who are available to provide assistance with ambient monitoring and source identification monitoring projects. Ecology's Environmental Assessment Program may assist in conducting additional effectiveness monitoring in approximately five years to determine if Lake Sawyer is meeting water quality goals.

Ecology also helps local governments with funding for water quality facilities and activities through the Centennial Clean Water Fund, 319 Fund, and State Revolving Loan Fund. The full range of Ecology funding opportunities is listed under the section "Funding Opportunities." Ecology's Grant Managers assist local government to develop stream restoration and water quality improvement projects. Ecology is responsible for organizing meetings of the Lake Sawyer Steering Committee, no less than annually, and will lead or be present at additional meetings as requested by the committee.

**TMDL expectations:** Ecology should continue providing the current level of support for implementing this plan and assisting with compliance with the municipal stormwater permits. It is essential to the success of this TMDL that Ecology continue to coordinate TMDL activities within the Lake Sawyer Watershed and continue to provide grant funding opportunities to assist in funding TMDL-related activities.

## **Adaptive management**

Adaptive management is the process by which strategies can be changed if it is determined that the implementation approach currently in place is not being implemented or Lake Sawyer water quality goals set forth in the Lake Sawyer TMDL are not being met. The Lake Sawyer Implementation Plan's first three years will focus on the successful implementation of BMPs, monitoring, and stormwater management actions associated with the municipal and construction stormwater permits. As the permitting programs are put into place and BMPs and other implementation activities are completed, evaluation of their success will be assessed through effectiveness monitoring.

Historical flow data for Ravensdale and Rock Creeks is not sufficient to determine if the creeks are exceeding the loading capacity of 1.4 kg/L. Currently, Lake Sawyer data demonstrate the lake is meeting its target of 16  $\mu\text{g/L}$ . However, if lake water quality does not continue to meet water quality goals, it will be necessary to reassess the pathways and further identify the sources of phosphorus. If new sources of phosphorus loading are identified, they will be corrected through the proper entity. TMDL reductions should be achieved by 2013. Partners will work together to monitor progress towards these goals, evaluate successes, obstacles, and changing needs, and make adjustments to the cleanup strategy as needed.

It is ultimately Ecology's responsibility to assure that cleanup is being actively pursued and water standards are achieved.

**Table 4. Implementation Summary Table**

Organization	Recommended Action	Schedule				
		2009	2010	2011	2012	2013
Lake Sawyer Community Club	Education and outreach activities accomplished through its website and newsletter.					
	Continue to work with Black Diamond’s Watershed Steward and the Lake Sawyer Steering Committee.					
	Recruit volunteers to perform rehabilitation projects around the lake and its tributaries, perform water quality monitoring, and encourage local residents to implement best management practices on their own properties.					
King Conservation District	Provide guidance and technical assistance to residents within the watershed.					
	Continue to assist local farms in developing and implementing farm plans that minimize polluted runoff.					
Lake Sawyer Steering Committee	Meet at least annually to discuss implementation projects occurring in the watershed.					
	Assess water quality improvement and identify trends.					
City of Black Diamond	Implement the Phase II Stormwater Permit and additional actions in this plan.					
City of Maple Valley	Implement the Phase II Stormwater Permit and additional actions in this plan.					
King County Stormwater Division	Implement the Phase I Stormwater Permit and additional actions in this plan.					
King County Lake Stewardship Program	Provide technical assistance to the city and local residents.					
	Continue to implement a water quality monitoring program for Lake Sawyer along with volunteers from the watershed.					
City of Black Diamond Watershed Steward Director	Coordinate with Lake Sawyer Watershed residents and actively seek out new best management practices. Continue to work closely with Ecology’s municipal stormwater and construction permit managers to develop a Stormwater Management Plan (SWMP) and to ensure compliance with the city’s permit. Participate as an active member of the Lake Sawyer steering committee. Seek funding for implementation projects.					

Organization	Recommended Action	Schedule				
		2009	2010	2011	2012	2013
Black Diamond City Council	Continue to support implementation efforts in the Lake Sawyer Watershed. Provide necessary funding to help support efforts. Continue to support water quality protection efforts and finalize the updated Black Diamond Critical Areas Ordinance.					
Black Diamond Parks	Develop park plans that help protect and enhance water quality and natural areas. Install pet waste stations in all applicable areas in order to control phosphorus and bacterial pollution from reaching any waterbody or stormwater conveyance system.					
Washington Department of Ecology	Provide the current level of support for implementing this lake phosphorus improvement plan and the municipal stormwater permits.					
	Continue to coordinate TMDL activities within the Lake Sawyer Watershed and provide grant funding opportunities to assist lake phosphorus improvement activities.					

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## Measuring Progress toward Goals

Progress of the Lake Sawyer Phosphorus Implementation Plan will be measured by 1) assessing the implementation projects completed and 2) direct measurement of water quality. The primary goal in accomplishing these strategies will be to meet and maintain the state's water quality criteria for the lake characteristic use. Implementation projects (Table 4) currently identified in the plan are education and outreach, restoration, monitoring, and assessment. Ecology will track implementation projects annually, and review construction and municipal stormwater permit coverage with the aid of Ecology inspectors and permit managers.

Measurement of water quality will be performed by volunteer monitors trained by King County Lake Stewardship Program (KCLSP). Twice a month from May to September, volunteers sample Lake Sawyer to measure total phosphorus, chlorophyll *a*, total nitrogen, and phytoplankton. Temperature, Secchi depth, precipitation, and lake level are also collected by volunteers weekly throughout the year. This direct measurement of lake water quality will help document whether implementation efforts have been successful and may indicate what other actions are needed in the watershed.

### Monitoring

Successful identification of phosphorus sources, source control, adaptive management, and evaluation of TMDL implementation will continue to rely on current and future sampling for phosphorus in the Lake Sawyer watershed. The city of Black Diamond and King County have conducted periodic water quality monitoring in Lake Sawyer since 1976, and propose to continue water quality monitoring into the foreseeable future (Table 5).

**Table 5. Summary of Water Quality Monitoring in Lake Sawyer Watershed.**

Monitoring Program	Responsible Parties	Schedule
Stormwater phosphorus	City of Black Diamond City of Maple Valley King County	As needed for IDDE
Average in-lake phosphorus	King County Lake Stewardship Program	~12 sites ~8 times per year; 2009 - 2014
Phosphorus sampling surveys	Ecology Water Quality	~6 sites ~2 times per year; 2009 - 2014
Construction site phosphorus monitoring	City of Black Diamond Public Works Engineering	As required under construction stormwater permit

EPA (1991) guidance calls for a monitoring plan for TMDLs where implementation will be phased in over time. Monitoring is conducted to provide assurance that pollution control measures achieve the expected phosphorus reductions and water bodies will reach water quality standards. Over the next three years, Black Diamond, Maple Valley, King County, and Ecology will periodically monitor water quality in the Lake Sawyer watershed. Compliance monitoring will be needed when water quality standards are believed to be achieved.

### **Stormwater phosphorus monitoring**

In the first year following issuance of the water quality implementation plan, city of Black Diamond, city of Maple Valley, and King County will develop and implement their respective monitoring programs designed to further identify the principal sources of phosphorus loads to their MS4s. This monitoring will be done as part of municipal stormwater management Illicit Discharge Detection and Elimination (IDDE) programs. Stormwater permittees will be responsible for meeting the requirements of their permits.

### **King County Lake stewardship monitoring**

King County Department of Natural Resources and Parks, Water and Land Resources Division coordinates the King County Lake Stewardship Program. The program organizes citizen lake stewardship groups which participate in volunteer sampling to help document and track trends in lake quality. The county Lake Sawyer Stewardship Program coordinates with volunteers from Lake Sawyer to perform what is titled Level II Data Collection. Sampling occurs twice a month, from April to October, on a pre-determined schedule. Samples are taken at one meter depth for every sampling date. Deeper samples are taken twice during the season, usually at mid-depth and at one meter from the bottom. Samples are generally taken at the deepest point in the lake. Both Secchi and temperature are taken at one meter depth. Total phosphorus, total nitrogen, chlorophyll *a* and phytoplankton are measured depending on the depth of the sample (King County, 2004).

### **Ecology monitoring**

Ecology will conduct a minimum of two sampling surveys annually at approximately six or more sampling sites in the Lake Sawyer watershed to help further define pollution sources and promote source correction. Additional monitoring will be considered, if necessary, for source identification and to evaluate TMDL effectiveness. Monitoring results will be used to evaluate whether the TMDL goals are being met. Monitoring to identify phosphorus sources in the basin will continue to focus on sources of high phosphorus loading in Rock Creek, Ravensdale Creek, and the Lake Sawyer shoreline area. Investigations of sources in all areas will include the potential for on-site septic system failures.

Ecology will initiate water quality monitoring for compliance where ambient monitoring shows that adequate progress toward phosphorus targets is not occurring. Ecology will coordinate compliance monitoring to identify the specific source(s) of phosphorus pollution, and will refer identified sources to the appropriate agency that has technical assistance resources or enforcement authority. Sampling will be adjusted to help locate sources by bracketing geographic areas where contamination is occurring and thereby focus on the specific source of



phosphorus pollution. This strategy allows implementation of appropriate BMPs in the specific areas of concern, and maximizes use of the limited resources available for source control and TMDL implementation.

### **Effectiveness monitoring**

Effectiveness monitoring determines if the interim targets and water quality standards have been met after the water quality implementation plan is implemented (i.e. the in-stream water quality monitoring). Effectiveness monitoring of TMDLs is usually conducted by Ecology's Environmental Assessment Program. After implementation has had time to take effect, an effectiveness monitoring plan may be developed in order to accurately assess the needs of Lake Sawyer and its tributaries at that time.

### **Enforcement**

The Water Pollution Control Act (chapter 90.48 RCW) provides broad authority to issue permits and regulations, and to prohibit illegal discharges to surface water. It designates Ecology as the state water pollution control agency for all the purposes of the federal Clean Water Act. The act openly declares that it is the policy of the state to maintain the highest possible standards to ensure the purity of all waters of the state and to require the use of all known, available, and reasonable means to prevent and control water pollution. The act defines waters of the state and pollution and authorizes Ecology to control and prevent pollution, and to make and enforce rules, including water quality standards. Under this statute, Ecology is authorized to administer wastewater disposal permits and to require prior approval of plans and methods of operation of sewage or other disposal systems.

Local governments are expected to continue exercising their authority to enforce their ordinances. Ecology will also encourage local government to enforce local ordinances pertaining to stormwater discharge or water quality where in effect and applicable. Those conducting restoration projects or installing BMPs will be responsible for monitoring plant survival rates and maintenance of improvements, structures and fencing.

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# Funding Opportunities

Multiple sources of financial assistance for water cleanup activities are available through Ecology's grant and loan programs, local conservation districts, and other sources. Refer to the website (<http://www.ecy.wa.gov/programs/wq/tmdl/TMDLFunding.html>) to find out more about funding sources and opportunities.

## **Centennial Clean Water Fund (CCWF)**

A 1986 state statute created the Water Quality Account, which includes the Centennial Clean Water Fund (CCWF). Ecology offers CCWF grants and loans to local governments, tribes, and other public entities for water pollution control projects. During the FY 2004 funding cycle, Ecology is proposing to award \$12.5 million from the CCWF. The application process is the same for CCWF, 319 Nonpoint Source Fund, and the state Water Pollution Control Revolving Fund.

## **Section 319 Nonpoint Source Fund**

The 319 Fund provides grants to local governments, tribes, state agencies, and nonprofit organizations to address nonpoint source pollution and to improve and protect water quality. Nonpoint source pollution includes many diffuse sources of pollution, such as stormwater runoff from urban development, agricultural and timber practices, failing septic systems, pet waste, gardening, and other activities. Non-governmental organizations can apply to Ecology for funding through a 319 grant to provide additional implementation assistance.

## **State Water Pollution Control Revolving Fund**

Ecology administers the Washington State Water Pollution Control Revolving Fund. This program uses federal funding from U.S. Environmental Protection Agency and monies appropriated from the state's Water Quality Account to provide low-interest loans to local governments, tribes, and other public entities. The loans are primarily for upgrading or expanding water pollution control facilities such as public sewage and stormwater plants, and for activities to address estuary management and nonpoint source water quality problems.

## **Coastal Protection Fund**

Since July 1998, water quality penalties issued under Chapter 90.48 RCW have been deposited into a sub-account of the Coastal Protection Fund. A portion of this fund is made available to regional Ecology offices to support on-the-ground projects to perform environmental restoration and enhancement. Local governments, tribes, and state agencies must propose projects through Ecology staff. Stakeholders with projects that will reduce bacterial or nutrient pollution are encouraged to contact their local TMDL lead to determine if their project proposal is a good candidate for Coastal Protection funding.

## **Salmon Recovery Funding Board (SRFB)**

The Salmon Recovery Funding Board (SRFB) provides grants to local governments, tribes, nonprofit organizations, and state agencies for salmon habitat restoration, land acquisition and habitat assessments. Funded projects and programs must produce sustainable and measurable benefits for fish and fish habitat. Most projects designed to improve salmon habitat also provide water quality benefits. As of October 2002, the SRFB has provided grants for 517 projects statewide with an accumulated value of \$96.4 million.

## **Aquatic Weeds Management Fund**

The Aquatic Weeds Management Fund (AWMF) provides financial and technical assistance to local and state governments, tribes, and special purpose districts to reduce the propagation of freshwater aquatic weeds and to manage the problems these weeds cause. An annual three-dollar license fee assessed to the owners of boat trailers provides funding.

<http://www.ecy.wa.gov/programs/wq/plants/grants/>

## Reasonable Assurance

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 Sawyer Total Phosphorus TMDL, both point and nonpoint sources exist. TMDLs (and related action plans) must show “reasonable assurance” that these sources will be reduced to their allocated amounts. Education, outreach, technical and financial assistance, permit administration, and enforcement will all be used to ensure that the goals of this water cleanup plan are met.

Ecology believes that the following activities already support this TMDL and add to the assurance that total phosphorus in Lake Sawyer will meet conditions provided by state water quality standards. This assumes that the activities described below are continued and maintained. In addition, compliance by Black Diamond, Maple Valley, and King County with their municipal stormwater permits will help reduce phosphorus loading to Lake Sawyer via stormwater.

The goal of the Lake Sawyer Water Quality Implementation Plan for total phosphorus is for the waters of the basin to meet the state’s water quality standards. Since Lake Sawyer’s water quality data indicates that the lake is generally meeting its long-term TMDL goal of 16  $\mu\text{g/L}$ , the continued collaboration of local governments and active community interests helps provide reasonable assurance that the short and long-term Lake Sawyer TMDL goals will be met by 2014.

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 Lake Sawyer TMDL process to achieve clean water through partnerships and 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 of cause of noncompliance with wasteload allocations, load allocations, or permit limits can be established.

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# Summary of Public Involvement Methods

Ecology solicited members to join the Lake Sawyer Steering Committee in preparation for the development of the Lake Sawyer water quality implementation plan. Members include representatives from the city of Black Diamond, King Conservation District, King County Lake Stewardship Program, Muckleshoot Indian Tribe, residents and members from the Lake Sawyer Community Club, and Ecology.

Future public involvement will include but will not be limited to informational websites from the city of Black Diamond and the Lake Sawyer Community Club. Information contained on these sites will cover education and outreach, upcoming events happening within the watershed, and general lake water quality information. The city's Watershed Steward Director has taken steps to organize a sub-committee that will remain active in developing small implementation projects and seeking out funding opportunities to implement projects within the watershed.

King County Lake Stewardship Program has also been diligent in training and seeking out volunteers for the volunteer monitoring program which help to monitor the water quality of the lake. Provided that the city continues its contract with King County and funding the volunteer monitoring program, this program will continue to help provide a great opportunity for public involvement and sampling data that can help determine if Lake Sawyer and its tributaries are meeting water quality goals.

Meetings of the Lake Sawyer Steering Committee occurred on the following dates:

- May 20, 2008
- July 14, 2008
- September 8, 2008

The Lake Sawyer draft implementation plan was introduced at a public meeting on January, 21, 2009. The public comment period was from February 1 through February 16, 2009.

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# Conclusions

Lake Sawyer's water quality has generally improved since the lake's phosphorus TMDL was approved in 1993. Significant urban growth is planned in the Lake Sawyer watershed in coming years, which could have a negative impact on water quality. Ecology's 2002 Lake Sawyer Effectiveness Monitoring Report concluded that the lake is meeting its long-term goal of reducing phosphorus, but further actions are still needed to control nutrient input from the watershed in order for the lake to meet and maintain water quality standards into the future.

Organizations involved in water quality improvement at Lake Sawyer include Lake Sawyer Community Club; King Conservation District; Lake Sawyer Steering Committee; King County Stormwater Division; King County Lake Stewardship Program; city of Black Diamond; Black Diamond City Council; city of Maple Valley; and Ecology. Lake Sawyer Community Club will meet at least annually to discuss implementation projects and may post projects and updates on their webpage. King Conservation District will continue to advise and assist in situations involving small farms and livestock. The Lake Sawyer Steering Committee will serve as sounding board for implementation projects, monitoring updates, and adaptive management.

Municipal stormwater permit holders Black Diamond, Maple Valley, and King County will develop stormwater management programs and implement requirements of their respective permits. Permit holders will include actions to reduce phosphorus in stormwater to meet Lake Sawyer TMDL requirements. The phosphorus stormwater treatment menu will be applied to stormwater conveyed to the lake in accordance with the Lake Sawyer's *sensitive lake* status. Ecology Northwest Region municipal stormwater specialists will assist with municipal stormwater permit compliance.

The city of Black Diamond updated several key components within the city's infrastructure and recently hired a Watershed Steward Director whose primary focus will be to coordinate with the residents in the Lake Sawyer Watershed and continue to actively seek out and implement new best management practices. Black Diamond will continue to contract with King County's Lake Stewardship Program to monitor phosphorus in Lake Sawyer to track trends in lake quality and enable adaptive management.

Ecology will administer permits and manage TMDL implementation activities in Lake Sawyer watershed with special attention to phosphorus. Ecology's Northwest Region water quality lake specialist will continue to coordinate TMDL-related activities and provide technical assistance for the TMDL. Ecology will also conduct at least three sampling surveys in Lake Sawyer watershed to help further define pollution sources and promote source correction. Ecology grant programs will provide project funding opportunities and Northwest Region grant project managers will assist grant applicants to develop water quality improvement projects.

This implementation plan serves as an evolving document that will help guide the Lake Sawyer Steering Committee as well as other interested parties to track water quality trends and update best management practices suitable for implementation in the watershed. Phosphorus TMDL

reductions are expected to be achieved by 2014 and adaptive management measures are in place to help ensure this schedule will be met.

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# Appendices

## Appendix A. Glossary and acronyms

**303(d) List:** Section 303(d) of the federal Clean Water Act requires Washington State periodically to prepare a list of all surface waters in the state for which designated uses of the water – such as for drinking, recreation, aquatic habitat, and industrial use – are impaired by pollutants. These are water quality limited estuaries, lakes, and streams that fall short of state surface water quality standards, and are not expected to improve within the next two years.

**Best management practices (BMPs):** Physical, structural, and/or operational practices that, when used singularly or in combination, prevent or reduce pollutant discharges.

**Char:** Char (genus *Salvelinus*) are distinguished from trout and salmon by the absence of teeth in the roof of the mouth, presence of light colored spots on a dark background, absence of spots on the dorsal fin, small scales, and differences in the structure of their skeleton. (Trout and salmon have dark spots on a lighter background).

**Chlorophyll-a:** Specific green fat-soluble photosynthetic pigment used to indicate biological productivity.

**Clean Water Act (CWA):** Federal Act passed in 1972 that contains provisions to restore and maintain the quality of the nation's waters. Section 303(d) of the CWA establishes the TMDL program.

**Designated uses:** Those uses specified in Chapter 173-201A WAC (Water Quality Standards for Surface Waters of the State of Washington) for each water body or segment, regardless of whether or not the uses are currently attained.

**Effective shade:** The fraction of incoming solar shortwave radiation that is blocked from reaching the surface of a stream or other defined area.

**Enterococci:** A subgroup of the fecal streptococci that includes *S. faecalis*, *S. faecium*, *S. gallinarum*, and *S. avium*. The enterococci are differentiated from other streptococci by their ability to grow in 6.5% sodium chloride, at pH 9.6, and at 10 degrees C and 45 degrees C.

**Epilimnion:** The top most layer of thermally stratified lake.

**Existing uses:** Those uses actually attained in fresh and marine waters on or after November 28, 1975, whether or not they are designated uses. Introduced species that are not native to Washington, and put-and-take fisheries comprised of non self-replicating introduced native species, do not need to receive full support as an existing use.

**Extraordinary primary contact:** Waters providing extraordinary protection against waterborne disease or that serve as tributaries to extraordinary quality shellfish harvesting areas.

**Fecal coliform (FC):** That portion of the coliform group of bacteria which is present in intestinal tracts and feces of warm-blooded animals as detected by the product of acid or gas from lactose in a suitable culture medium within 24 hours at 44.5 plus or minus 0.2 degrees Celsius. Fecal coliform are “indicator” organisms that indicate presence of disease-causing organisms. Concentrations are measured in colony forming units per 100 milliliters of water (cfu/100mL).

**Geometric mean:** A mathematical expression of the central tendency (an average) of multiple sample values. A geometric mean, unlike an arithmetic mean, tends to dampen the effect of very high or low values, which might bias the mean if a straight average (arithmetic mean) were calculated. This is helpful when analyzing bacteria concentrations, because levels may vary anywhere from ten to 10,000 fold over a given period. The calculation is performed by either: (1) taking the  $n$ th root of a product of  $n$  factors, or (2) taking the antilogarithm of the arithmetic mean of the logarithms of the individual values.

**Hypolimnion:** The dense bottom layer of a thermally stratified lake.

**Load allocation (LA):** The portion of a receiving waters’ loading capacity attributed to one or more of its existing or future sources of nonpoint pollution or to natural background sources.

**Loading capacity:** The greatest amount of a substance that a water body can receive and still meet water quality standards.

**Margin of safety (MOS):** Required component of TMDLs that accounts for uncertainty about the relationship between pollutant loads and quality of the receiving water body.

**Metalimnion:** The middle layer of a thermally stratified lake sometimes referred to as the thermocline.

**Municipal separate storm sewer systems (MS4):** A conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains): (1) owned or operated by a state, city, town, borough, county, parish, district, association, or other public body having jurisdiction over disposal of wastes, storm water, or other wastes; and (2) designed or used for collecting or conveying stormwater; (3) which is not a combined sewer; and (4) which is not part of a Publicly Owned Treatment Works (POTW) as defined in the Code of Federal Regulations at 40 CFR 122.2.

**National Pollutant Discharge Elimination System (NPDES):** National program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements under the Clean Water Act. The NPDES program regulates discharges from wastewater treatment plants, large factories, and other facilities that use, process, and discharge water back into lakes, streams, rivers, bays, and oceans.

**Nonpoint source:** Pollution that enters any waters of the state from any dispersed land-based or water-based activities, including but not limited to atmospheric deposition, surface water runoff from agricultural lands, urban areas, or forest lands, subsurface or underground sources, or discharges from boats or marine vessels not otherwise regulated under the NPDES program. Generally, any unconfined and diffuse source of contamination. Legally, any source of water

pollution that does not meet the legal definition of “point source” in section 502(14) of the Clean Water Act.

**Pathogen:** Disease-causing microorganisms such as bacteria, protozoa, viruses.

**Phase I Stormwater Permit:** The first phase of stormwater regulation required under the federal Clean Water Act. The permit is issued to medium and large municipal separate storm sewer systems (MS4s) and construction sites of five or more acres.

**Phase II Stormwater Permit:** The second phase of stormwater regulation required under the federal Clean Water Act. The permit is issued to smaller municipal separate storm sewer systems (MS4s) and construction sites over one acre.

**Point source:** Sources of pollution that discharge at a specific location from pipes, outfalls, and conveyance channels to a surface water. Examples of point source discharges include municipal wastewater treatment plants, municipal stormwater systems, industrial waste treatment facilities, and construction sites that clear more than 5 acres of land.

**Pollution:** Such contamination, or other alteration of the physical, chemical, or biological properties, of any waters of the state. This includes change in temperature, taste, color, turbidity, or odor of the waters. It also includes discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state. This definition assumes that these changes will, or is likely to, create a nuisance or render such waters harmful, detrimental, or injurious to (1) public health, safety, or welfare, or (2) domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or (3) livestock, wild animals, birds, fish, or other aquatic life.

**Primary contact recreation:** Activities where a person would have direct contact with water to the point of complete submergence including, but not limited to, skin diving, swimming, and water skiing.

**Salmonid:** Any fish that belong to the family *Salmonidae*. Basically, any species of salmon, trout, or char. [www.fws.gov/le/ImpExp/FactSheetSalmonids.htm](http://www.fws.gov/le/ImpExp/FactSheetSalmonids.htm)

**Secchi transparency:** A common method used to assess and compare water clarity measuring the water depth at which a black and white disk disappears from view when lowered from the water surface.

**Stormwater:** The portion of precipitation that does not naturally percolate into the ground or evaporate but instead runs off roads, pavement, and roofs during rainfall or snow melt. Stormwater can also come from hard or saturated grass surfaces such as lawns, pastures, playfields, and from gravel roads and parking lots.

**Surface waters of the state:** Lakes, rivers, ponds, streams, inland waters, saltwaters, wetlands and all other surface waters and water courses within the jurisdiction of the state of Washington.

**Thermal stratification:** A change in temperature at different depths in a water body.

**Total Maximum Daily Load (TMDL):** A distribution of a substance in a water body designed to protect it from exceeding water quality standards. A TMDL is equal to the sum of all of the following: 1) individual wasteload allocations (WLAs) for point sources, 2) the load allocations (LAs) for nonpoint sources, 3) the contribution of natural sources, and 4) a Margin of Safety to allow for uncertainty in the wasteload determination. A reserve for future growth is also generally provided.

**Trophic state:** The measurement of lake biological productivity based on water clarity (Secchi) and concentrations of TP and chlorophyll-*a*.

**Wasteload allocation (WLA):** The portion of a receiving water's loading capacity allocated to existing or future point sources of pollution. WLAs constitute one type of water quality-based effluent limitation.

**Watershed:** A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.



## Appendix B. Criteria for lakes

The Department of Ecology, by process of adoption of state water quality standards, has re-defined criteria for fresh waters and lake class. Prior to development, Ecology classified water bodies in A, AA, B, and C classes. Classification is now defined by actual use (i.e., swimming, water supply, and fish habitat). The new classifications only apply to fresh water.

Protection of Characteristic uses [WAC 173-201A-030(5)] Lake Class Characteristic uses shall include, but not be limited to, the following:

- 1) Water supply (domestic, industrial, agricultural).
- 2) Stock watering.
- 3) \*Fish and shellfish:  
Salmonid migration, rearing, spawning, and harvesting.  
Other fish migration, rearing, spawning, and harvesting.  
Clam and mussel rearing, spawning, and harvesting.  
Crayfish rearing, spawning, and harvesting.
- 4) \*Wildlife habitat.
- 5) \*Recreation (primary contact recreation, sport fishing, boating, and esthetic enjoyment).
- 6) Commerce and navigation.

### Washington State's recommended total phosphorus lake criteria for the Pacific Coast range, Puget Sound lowlands and Northern Rockies eco-regions.

Trophic State	Ambient TP Range ( $\mu\text{g/L}$ )	TP Criteria
Ultra-Oligotrophic	0 – 4	4 or less
Oligotrophic	>4 – 10	10 or less
Lower Mesotrophic	>10 – 20	20 or less
Mesotrophic – Eutrophic	>20	Lake Specific Study

\*Lake Sawyer lies within the Puget Sound Lowlands Region

The Tropic State Index (Carlson 1977) is used to determine the trophic status of a lake, and its lake overall health. Total phosphorus, secchi depth, and chlorophyll *a* are the three parameters measured.

### The range in TSI parameters as they relate to lake trophic status.

Trophic State	Secchi Depth (m)	Chloro( <i>a</i> ) ( $\mu\text{g/L}$ )	TP ( $\mu\text{g/L}$ )	TSI
Oligotrophic	> 4	< 3	< 14	< 40
Mesotrophic	2 – 4	3 – 9	14 – 25	40 – 50
Eutrophic	< 2	> 9	> 25	> 50

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## Appendix C. Tables of listings, wasteload and load allocations, and water bodies

Total Phosphorus (P) target in-lake average = 16 µg/L	
Total Phosphorus Source	Loading capacity distribution (kg/June-August)
Lake Sawyer	1.9 kg per day or (715 kg/yr)
Wasteload Allocation	0 kg per day for Black Diamond wastewater treatment plant
Tributaries Ravensdale Creek and Rock Creek	1.4 kg per day includes a 0.08 kg per day allocation for uncertainty
Internal Recycling	0.54 kg/ per day includes a 0.34 kg per day for uncertainty

### Components of a TMDL

1) **Wasteload allocations (WLA)**: Represents the contribution of discrete “point” sources of pollutants (e.g., municipal, industrial, and construction stormwater discharges);

2) **Load allocations (LA)**: Represent “nonpoint” sources of a pollutant, (natural sources, most agricultural activities, and other sources that are not regulated by an Ecology permit); and

3) **Margin of safety (MOS)**: Allows for uncertainty in the estimation of, and ability to achieve, the previous two allocations.

Thus, the TMDL equation is as follows:

$$\text{TMDL} = \text{WLA} + \text{LA} + \text{MOS}$$

The sum of these three components may not exceed the **Loading Capacity**.

Components of a TMDL. These three parts of a TMDL may not exceed the maximum amount of a pollutant that a water body can receive before it is considered polluted.

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## Appendix D. 303 (d) Listings in the Lake Sawyer Watershed.

Study area water bodies on the 2008 303(d) list for parameter(s).

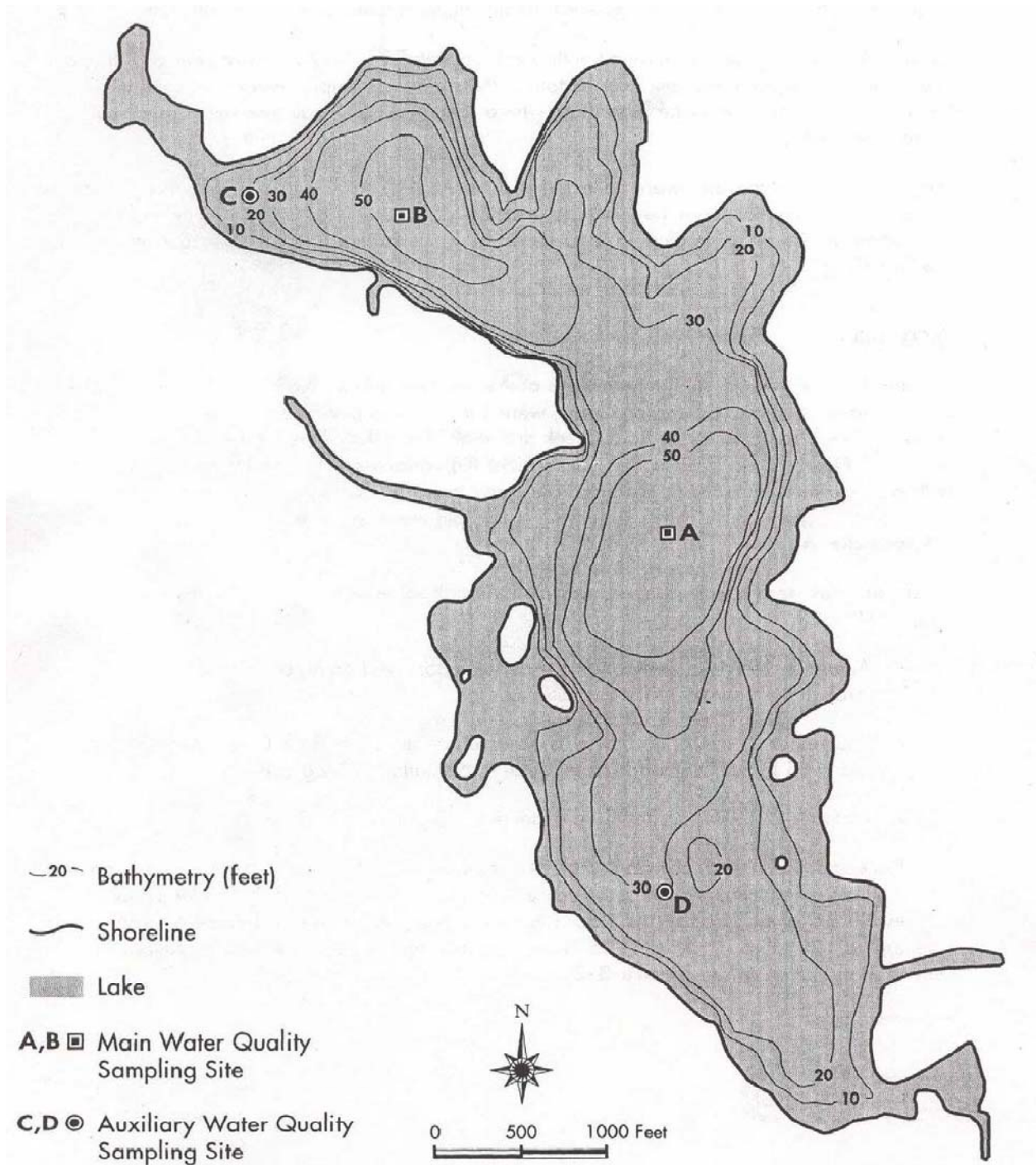
Water body	Parameter	Medium	Listing ID	Township	Range	Section
Lake Sawyer	2,3,7,8-TCDD	Tissue	51577	21.0N	06.0E	04
Lake Sawyer	PCB	Tissue	52691	21.0N	06.0E	04

Additional 303(d) listings not addressed by this report.

Water body	Parameter	Medium	Listing ID	Township	Range	Section
Ravensdale Creek	Water	Temperature	15883	22.0N	06.0E	36
Covington Creek	Water	Dissolved Oxygen	13162	21.0	05.0E	12
Covington Creek	Water	Fecal Coliform	47477	21.0	06.0E	18

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## Appendix E. Bathymetric map of Lake Sawyer



Main and Auxiliary Water Quality Sampling Stations in Lake Sawyer from 1994 to 1995 (Map from Lake Sawyer Management Plan, King County 2000).

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# Appendix F. Lake Sawyer Focus Sheet

## Focus on Lake Sawyer



Water Quality Program

February 2009

### Too Much Phosphorus for Lake Sawyer

Phosphorus is a basic element found in nature and a primary nutrient that all living organisms need to survive. Lakes typically build up phosphorus levels as they age, and ultimately fill in with vegetation and sediment. This process, called eutrophication, usually takes thousands of years.

High lake phosphorus can cause excessive plant and algae growth and drastically speed up its aging process. Human activities such as home building, road construction, failing septic tanks, lawn fertilizers, soaps, and deforestation are some of the primary sources of phosphorus that can increase amounts of phosphorus in a lake and may cause algae blooms.

Many of these pollution sources are transported to nearby water bodies by stormwater and have negative affects by degrading water clarity, aquatic habitat, fish survival, swimming, boating and aesthetic enjoyment.

#### Lake Sawyer

Lake Sawyer, along with Rock Creek and Ginder Creek, have had poor water quality since the 1970s. In 1981, City of Black Diamond obtained funding to develop their wastewater treatment plant and designed it to discharge into a natural wetland that ultimately drains to Lake Sawyer.

The wetland portion of the treatment plant system soon failed resulting in increased amounts of phosphorus polluting Lake Sawyer. This led to moving Black Diamond's wastewater discharges to the King County Metro wastewater treatment plant at Renton.

In 1993, the Department of Ecology's (Ecology) Lake Sawyer Total Maximum Daily Load (TMDL) assessment was approved. Then in 2000, King County developed a Lake Management Plan for Lake Sawyer that provides recommendations to help reduce the amount of phosphorus to the lake. Lack of funding has prevented many of these recommendations from being implemented.

#### MORE INFORMATION

The Department of Ecology's Freshwater Algae Program provides identification and toxicity testing of algae for Washington State water bodies.



To learn more about the program, visit our website at:

<http://www.ecy.wa.gov/programs/wq/plants/algae/index.html>

#### Contact information:

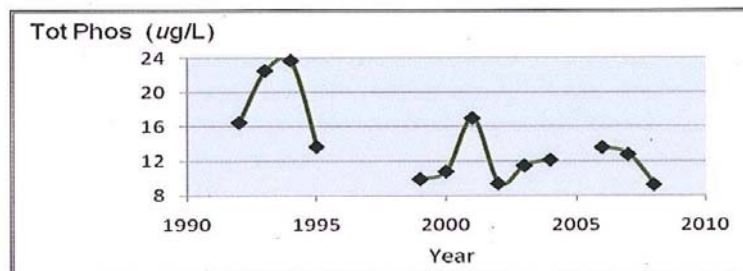
Tricia Shoblom  
425-649-7288  
[tsho461@ecy.wa.gov](mailto:tsho461@ecy.wa.gov)

#### Special accommodations:

If you need this publication in an alternate format, call the Water Quality Program at 360-407-6404. Persons with hearing loss, call 711 for Washington Relay Service. Persons with a speech disability, call 877-833-6341.

### What's being done?

Since re-directing Black Diamond waste water away from Lake Sawyer there has been a general decline in phosphorus but the lake still has too much. In 2008, Ecology and the Lake Sawyer community did follow-up work to the 1993 TMDL and produced the *Lake Sawyer Total Phosphorus Total Maximum Daily Load Water Quality Implementation Plan*. It incorporates recommendations from the Lake Sawyer Management Plan and other documents developed for the lake, and provides a framework for corrective actions to address sources of phosphorus pollution.



Upper Lake Sawyer Annual Total Phosphorus (micrograms per liter)

Data provided by King County

### What you can do

We all live in a watershed and can take actions to reduce polluted runoff and nutrients from our property that reach our lakes and streams. Here are some things you can do:

- Cover and store manure, yard waste, fertilizers, and other chemicals away from the water. Contact **King County** at 206-296-4692 or 1-888-TOXIC-ED or <http://www.govlink.org/hazwaste/house/index.cfm>
- Maintain or enhance vegetation alongside water bodies, to filter pollutants from run-off water. Never remove the natural riparian (stream or lakeside) vegetation.
- If you have large animals, keep them away from the lake or stream. Animals trample shorelines, destroy riparian vegetation, and directly add nutrients to the stream.
- If you must clear or grade the land or build a road, be careful to prevent erosion and keep sediments (dirt with contaminants) out of the waterways.
- If you use a septic system, inspect it regularly to make sure its functioning properly. For more information about the King County Wastewater Program, call 206-296-4932 or go to: <http://www.kingcounty.gov/healthservices/health/ehs/wastewater>
- Carefully use only phosphate-free soaps, detergents and cleaners in your home or business.
- Reduce or eliminate the use of fertilizers and chemicals on your lawn and garden. Rain carries these nutrients into our nearby water bodies. For more information, visit: <http://your.kingcounty.gov/solidwaste/naturalyardcare/index.asp>

\*See 'Washington Waters - Ours to Protect' website: [http://www.ecy.wa.gov/washington\\_waters](http://www.ecy.wa.gov/washington_waters)

## Appendix G. Response to comments

### Commenter 1. The City of Black Diamond

1. Executive Summary, second paragraph – We understand that salmonids also utilize Rock Creek within this system for spawning.

*Comment Noted. The report was revised according to this comment.*

2. Under sediment – Particularly in Black Diamond’s history, mining has seemed to have been a contributor to Phosphorous loading in the past.

*Comment Noted. The discussion of Black Diamond’s mining history has been expanded accordingly.*

3. Do not feed wildlife – You might include some information on how feeding wildlife contributes to the problems this watershed is facing.

*Wildlife can contribute to pollution problems and in some situations become nuisances due to concentration and overpopulation. The Lake Sawyer Water Quality Implementation Plan supports efforts to keep wildlife species as natural as possible and promotes the message of Do Not Feed Wildlife.*

4. Under Corrective/preventative actions – does this program apply to residents of unincorporated King County as well?

*All of the potential sources of pollution listed in the Lake Sawyer Water Quality Implementation Plan have corrective/preventative actions that can be taken to address those sources, and therefore can be applied to the entire watershed regardless of jurisdiction.*