Stillaguamish River Fecal Coliform, Dissolved Oxygen pH, Mercury, and Temperature Total Maximum Daily Load

Water Quality Implementation Plan

June 2007
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Fecal Coliform, Dissolved Oxygen pH, Mercury, and Temperature
Total Maximum Daily Load

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by

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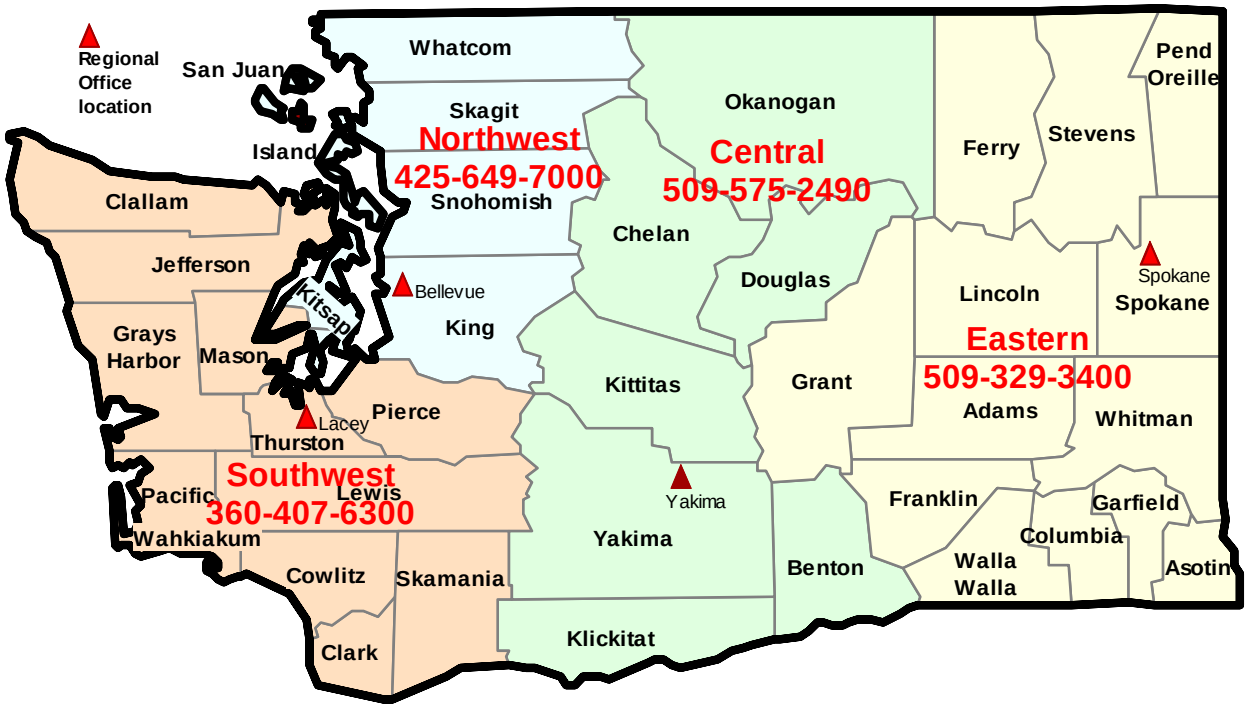

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Acknowledgements

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Jenny Baker, Habitat Restoration Specialist, Snohomish Conservation District

Stacie Watne, Natural Resource Specialist, Washington State Department of Natural Resources

Many Ecology staff contributed to this plan as well. The technical work by Greg Pelletier and Joe Joy continue to be the foundation of this plan's efforts to improve water quality in the Stillaguamish Watershed. Marcus Von Prause and Mike Woodall helped provide considerable GIS support for this plan. While mentioning help with GIS information, Laura Audette of Snohomish County Surface Water also provided significant help.

Finally, Ecology would like to thank the residents of the Stillaguamish watershed who love the river and its creeks and are working diligently to protect and restore this beautiful watershed. We appreciate all of your interest and support of our work and look forward to our ongoing collaborations and conversations.

Figure 1. First Channel in Port Susan. Among the many recreational opportunities available in Port Susan and the Stillaguamish River is canoeing. All waters of the Stillaguamish River should be safe for swimming, boating, fishing, and the harvest of shellfish.

Executive Summary

A number of chemical and physical pollutants impair the Stillaguamish Watershed. We must take action to reduce them so that the river will be a healthy place for people and fish. This document, the *Stillaguamish River Water Quality Implementation Plan* (*Action Plan*), addresses the problems of high temperature, bacteria, and mercury levels, as well as low dissolved oxygen and widely fluctuating pH levels. The goal of the plan is for the Stillaguamish River to meet Washington State Water Quality Standards.

This *Action Plan* identifies many pollution sources contributing to the river's problems. Solutions to bacteria and nutrient pollution include illicit discharge detection, pet waste management, farm management, and investigations of areas with poorly functioning onsite septic systems. Near-stream (riparian) areas that do not provide adequate shading are a priority for lowering stream temperatures and controlling sediment discharges. Because algal growth can provide control of widely fluctuating pH levels, this plan addresses pH problems through the control of plant nutrients. The Action Plan relies heavily on local tribes, government agencies, and environmental organizations to help reduce these pollution sources.

Four entities discharging wastewater to the Stillaguamish Watershed and Port Susan are affected through their National Pollution Discharge Elimination System (NPDES) permits. Effluent limits for municipal wastewater from Arlington, Snohomish County (Indian Ridge Corrections Center), will incorporate wasteload allocations (WLAs) set for bacteria and temperature. Warm Beach Christian Camp and Conference Center will address WLAs for bacteria and nutrients by removing its discharge to surface water during summer months and relocating its winter discharge away from First Channel. Additional study of dissolved oxygen dynamics in the mainstem Stillaguamish downstream of Arlington will be conducted. Installing best management practices, providing public education and involvement, and performing water quality monitoring will help to control bacteria and nutrients discharged in municipal stormwater from Snohomish County, Arlington, and the Washington State Department of Transportation.

Water quality monitoring is important for locating pollution sources and tracking the return of these waters to good health. Good resources are in place now to track water quality. This *Action Plan* requires monitoring for NPDES permittees. However, additional monitoring currently performed by the Stillaguamish Tribe is critical to meeting the needs of this plan.

Arsenic and mercury levels in the Stillaguamish are higher than the levels set in state standards (Lawrence and Joy 2005*)*. However, the elevated arsenic levels are a natural condition in the watershed. For that reason, this *Action Plan* does not recommend activities to reduce arsenic levels. This *Action Plan* does not detail specific actions to reduce mercury levels. Ecology believes that the key to controlling mercury is to control suspended solids levels. Therefore mercury reductions will occur through control of sediment discharges.

Ecology anticipates that if state and local coordination proceed as expected, fecal coliform, dissolved oxygen, pH, and mercury levels will be in compliance with state standards by 2013. River and stream temperatures are expected to return to compliance by 2065 after trees have been planted and have become well established in riparian areas.

Where funding is not currently available, Ecology will assist in finding appropriate funding sources. To gauge the progress of this *Action Plan*, Ecology will meet with stakeholders no less than annually to share water quality data, trends (where applicable), and to evaluate the status of implementation activities. Stormwater and municipal wastewater permit requirements will be reevaluated every five years as part of this plan's process to evaluate progress in reaching our goal for clean water.

Figure 2. Whitehorse Mountain near Darrington and the North Fork of the Stillaguamish Watershed.

Why is Ecology Concerned about the Stillaguamish River?

The Washington State Department of Ecology (Ecology) is concerned about the quality of water in the Stillaguamish watershed. The Stillaguamish River is polluted with high levels of **fecal coliform bacteria**[1] and plant nutrients. Water temperatures are too high in many locations and **dissolved oxygen** (DO) levels are too low. These problems indicate that the water is frequently unhealthy for either people or for fish.

To make the Stillaguamish River safer for people and fish, Ecology prepared this report, the *Stillaguamish River Water Quality Implementation Plan* (referred to hereafter as *the Action Plan*). It details our current understanding of the pollution problems in the Stillaguamish River and the actions we should be taking to solve them. However, this report is only a plan. Unless it is put into action, the Stillaguamish River will not get cleaner.

Section **303(d)** of the Federal **Clean Water Act** (CWA) requires a scientific explanation when local waters are found to be polluted. This scientific explanation is called a Total Maximum Daily Load or "**TMDL**." In Washington State, the Department of Ecology prepares a *Water Quality Improvement Report* that contains the TMDL.

In the *Action Plan*, you will learn more about where pollution is coming from and how we can get it under control. We all need to work together to get the river consistently clean. You will learn where the Stillaguamish River is located and how your everyday activities might be affecting the it. Finally, the *Action Plan* will tell you about the activities of your local city or county government, environmental organizations, and what you can do on your property to be part of the solution.

In the following pages, we will discuss the following:

- How does Ecology's Water Cleanup Process work?
- Where is the Stillaguamish Watershed and where is the pollution coming from?
- What are the solutions to this problem and what can you do?

Special Note On Arsenic, Mercury, and pH: Arsenic, mercury, and pH levels in the Stillaguamish exceed the levels set in state standards (Lawrence and Joy 2005*)*. However, the elevated arsenic levels are a natural condition. For that reason, this *Action Plan* does not recommend activities to reduce arsenic levels. This *Action Plan* also does not detail specific actions to reduce mercury levels. Mercury reductions will occur as part of efforts to improve temperatures through control of sediment, to which mercury is bound. Because algal growth is believed to cause the widely fluctuating pH levels, this plan addresses pH problems through the control of plant nutrients.

[1] Definitions for bold text can be found in Appendix A of this document.

The Water Cleanup Process

Washington State typically follows a three-step process for documenting the problems and solutions for polluted waterbodies (see Figure 3). Ecology prepares separate reports for each step of the process. Those steps are discussed below. We are currently in step 3 of the process.

Step 1: The Water Quality Study: Ecology reviews available water quality data and shares this information with local governments, environmental organizations, and others. This scientific review shows how dirty the water is now, and how clean it needs to be. The report details the amount of pollution that is in the water now and how much it needs to be reduced. Two studies have already been prepared and are available on Ecology's internet website (Joy 2004, Pelletier and Bilhimer 2004).

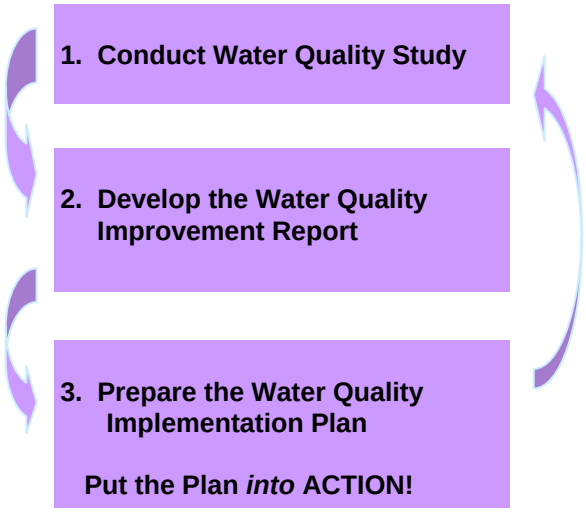

Figure 3. Ecology's Water Cleanup Process

Step 2: Ecology prepares a *Water Quality Improvement Report*: This report outlines the findings of the Water Quality Study and sets the numeric goals for cleaning up the Stillaguamish River. Ecology sends this plan to the United States Environmental Protection Agency (EPA) for review and approval. To learn more about the federal TMDL program visit the EPA website at http://www.epa.gov/owow/tmdl/intro.html. Two reports (Lawrence and Joy 2005, Lawrence 2006) on Stillaguamish River Water Quality have been prepared and are available for viewing on Ecology's website at http://www.ecy.wa.gov/programs/wq/tmdl/watershed/index.html.

Step 3: Ecology prepares the *Water Quality Implementation Plan* (*Action Plan*): Ecology collaborates with local government, businesses, and the public to identify the actions needed to make the Stillaguamish River a safe place for people and fish.

As noted earlier, a *Water Quality Improvement Report* contains a **Total Maximum Daily Load** or "TMDL." Simply put, the TMDL is the maximum amount of a pollutant that a water body can accept before the risk of injury to human or aquatic life becomes too high. In common usage, the term TMDL is frequently used to describe the entire process for cleaning up an impaired water body. For our purposes in this *Action Plan*, it refers to a discrete amount of pollution, or load that is divided into three components; the **wasteload allocation (WLA)**, the **load allocation (LA)**, and the **margin of safety**. Some TMDLs establish only load allocations or only wasteload allocations. This TMDL has all three components. Details of the TMDL development process is discussed in more detail in Joy 2004 and Pelletier and Bilhimer 2004.

Why is Ecology preparing an *Action Plan* for the Stillaguamish River?

Ecology's previous studies and reports document the pollution problems in the Stillaguamish River. The types of pollution observed in the river pose a risk to fish and other aquatic organisms that live in the river. More information on the effect of these pollutants is provided below.

Health risks for people

Bacteria levels in Washington waters should be low to protect people who work and play in and on the water from waterborne illnesses. **Fecal coliform** is used as an "indicator bacteria" for the state's freshwaters (e.g., lakes and streams). Fecal coliform in water "indicates" the presence of waste from humans and other warm-blooded animals. Waste from warm-blooded animals is more likely to contain **pathogens** that will cause illness in humans than waste from cold blooded animals. Pathogens known to be present in fecal matter include E. coli 0157, Salmonella, Cryptosporidium, Giardia, and viruses such as Hepatitis A. Keeping local waters at or below state bacteria standards should result in low rates of serious intestinal illness (gastroenteritis) in people.

The majority of the Stillaguamish River has a "**Primary Contact**" designation in the Washington State Water Quality Standards (Washington Administrative Code (WAC) 173-201A). Primary contact use waters should support swimming and other recreational activities. Waters should be suitable for activities that involve direct contact with water to the point of complete submergence. To meet this standard, fecal coliform levels must not exceed a **geometric mean** value of 100 colonies/100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) exceeding 200 colonies/100mL" (WAC 173-201A-200(2)(b), 2003 edition).[2] The "not-more-than-10 percent" criterion is referred to in this report as the 90th percentile criterion[3]. Parts of the upper watershed have an even higher standard of "**Extraordinary Primary Contact**."

The criteria for fecal coliform bacteria limit the risk of illness to humans that work or recreate in a water body. Our state standards are designed to allow 7 or fewer illnesses out of every 1,000 people engaged in primary contact activities. Once the concentration of fecal coliform in the water exceeds one of the criteria, the chance of becoming ill increases above acceptable levels. Ecology studies have shown we have reached that point and bacteria levels must now be reduced.

[2] The term "colony forming units" refers to the number of bacteria colonies that grow in a Petri dish after 100 milliliters (mL) of stream water is filtered and tested on the dish. To give you an idea of how much water that is, 100 mL is almost half a cup (0.42 cups to be more exact).

[3] For compliance with not-more-than 10 percent criterion, 90th percentile levels determined using the log values of sample results (as done by the National Shellfish Sanitation Program (2003)) will be used as a screening tool. Where this conflicts with the Water Quality Standards, Ecology will use the state standard.

Health risks for animals

Clean water is just as important for keeping livestock and other animals healthy. When local waters are polluted with bacteria, livestock may be exposed to more bacteria.
Water constitutes 60 to 70 % of the body of livestock. Animals that do not drink enough water may suffer stress or even dehydration. This in turn makes them more susceptible to disease. Waters polluted with suspended solids, objectionable tastes, or unusual odors can cause animals to drink less than they should (Pfost et al. 2006).

Water needs change depending on weather and the type of food consumed. While dry cows generally need 8 to 10 gallons of water daily, a cow in her last 3 months of pregnancy may drink up to 15 gallons/day. Those producing milk need about five times as much water as the volume of milk produced (Faries et al. 1998).

Sick animals do not gain weight quickly which can result in lower profits at sale time. Among the many water-transmitted diseases that can affect livestock are Leptospriosis (foot-rot), Fusobacterium, Cryptosporidium, and Giardia (Fleming and Eng 2004, Atwill 2006). Fusobacterium is carried on the feet of animals, which contaminates any body of water they enter (Pfost et al 2006). Cryptosporidium affects mainly younger animals—approximately 25 percent of calves with diarrhea between 5 days to 1 month old are infected with *C. parva* (Fleming and Eng 2004). In some cases, Giardia infections can reduce livestock weight gains by 20 percent (Yurchak and Buchanan 2006).

Effect on aquatic life

Washington State Water Quality Standards are also meant to help protect all natural biota living in our local waters. It is a well known fact that the Stillaguamish watershed supports many species of salmon, trout, whitefish, suckers, and other important fish species (discussed in more detail in the *Description of the Stillaguamish Watershed* section). The watershed is home to the threatened Chinook and other salmon species that use the waters throughout the year. When nutrient levels and temperatures increase and dissolved oxygen levels decrease, many organisms are affected. All of these problems are occurring in the Stillaguamish watershed.

Other organisms that live in the watershed are no less important to salmon survival although they receive less attention. The wide range of plants, insects, and other living organisms that live in the watershed provide the underlying support for those fishery resources. Starting at the plant level with algae, then moving up to zooplankton and macroinvertebrates, each of these organisms are needed to feed fish from their development from fry to fingerlings to smolts. Good oxygen levels, low water temperatures, proper nutrient levels, and adequate stream flows are all important to the good health of the small creatures that live in the river and its tributary streams.

When a stream or river experiences pollution, native plants and bugs fail to flourish and are replaced by nonnative plants and bugs. Fish that have come to expect native species for survival over their thousands of years in the stream do not adjust to the new food sources and suffer from a lack of nutrition. Poorly nourished fish do not compete as well and become more susceptible

to predation. In extreme cases young fish could die due to malnutrition. Inappropriate oxygen levels, nutrient levels, or temperatures can cause this problem. In addition, young fish that experience excessively high temperatures during rearing are more susceptible to disease and can suffer developmental problems that can reduce their ability to spawn successfully in the future.

Restoring and maintaining good water quality is smart *and* required by law—Washington's Antidegradation Policy

The state of Washington's goal of restoring waters to good health and keeping them that way is part of the state's Water Quality Antidegradation regulation (WAC 173-201A-070). This *Action Plan* supports the purposes of the antidegradation regulation which are to:

- Restore and maintain the highest possible quality in state surface waters;
- Describe situations where water quality may be lowered from its current condition;
- Apply three levels of protection for surface waters of the state:
    - Tier I is used to ensure existing and **designated uses** are maintained and protected and applies to all waters and all sources of pollution.
    - Tier II is used to ensure that waters of a higher quality than the criteria assigned in this chapter are not degraded unless such lowering of water quality is necessary and in the overriding public interest.
    - Tier III is used to prevent the degradation of waters formally listed as "outstanding resource waters," and applies to all sources of pollution.

Relationship of this *Action Plan* with Ecology's new Water Quality Standards

Ecology finished revisions to the Washington State Water Quality Standards (Chapter 173-201A WAC) in December of 2006. The revisions completed the transition from a "class-based" to a "use-based" system. In the older, class-based system, water bodies were listed as being either Class AA, A, B, or Lake Class. Each class had a specific set of expectations for water quality.

In the new use-based system, Ecology now sets water quality expectations based on the type of designated use expected for a particular water body. Although the criteria for most water quality parameters stayed the same, there were significant changes to temperature criteria based on the needs of fish species during their life stages. The new standards establish six different categories for aquatic life uses. Three of the uses are found in the Stillaguamish Watershed: 1) Char spawning and rearing, 2) Core summer salmonids habitat, and 3) Salmon spawning and rearing. In addition, Ecology has established additional standards for salmonid spawning and incubation protection (Ecology 2006).

The original TMDL studies on Stillaguamish temperature problems relied on the old water quality criteria for temperature while anticipating adoption of the new standards. The goal of

this *Action Plan* is to achieve compliance with the new standards, which are shown in Table B-1 in Appendix B.

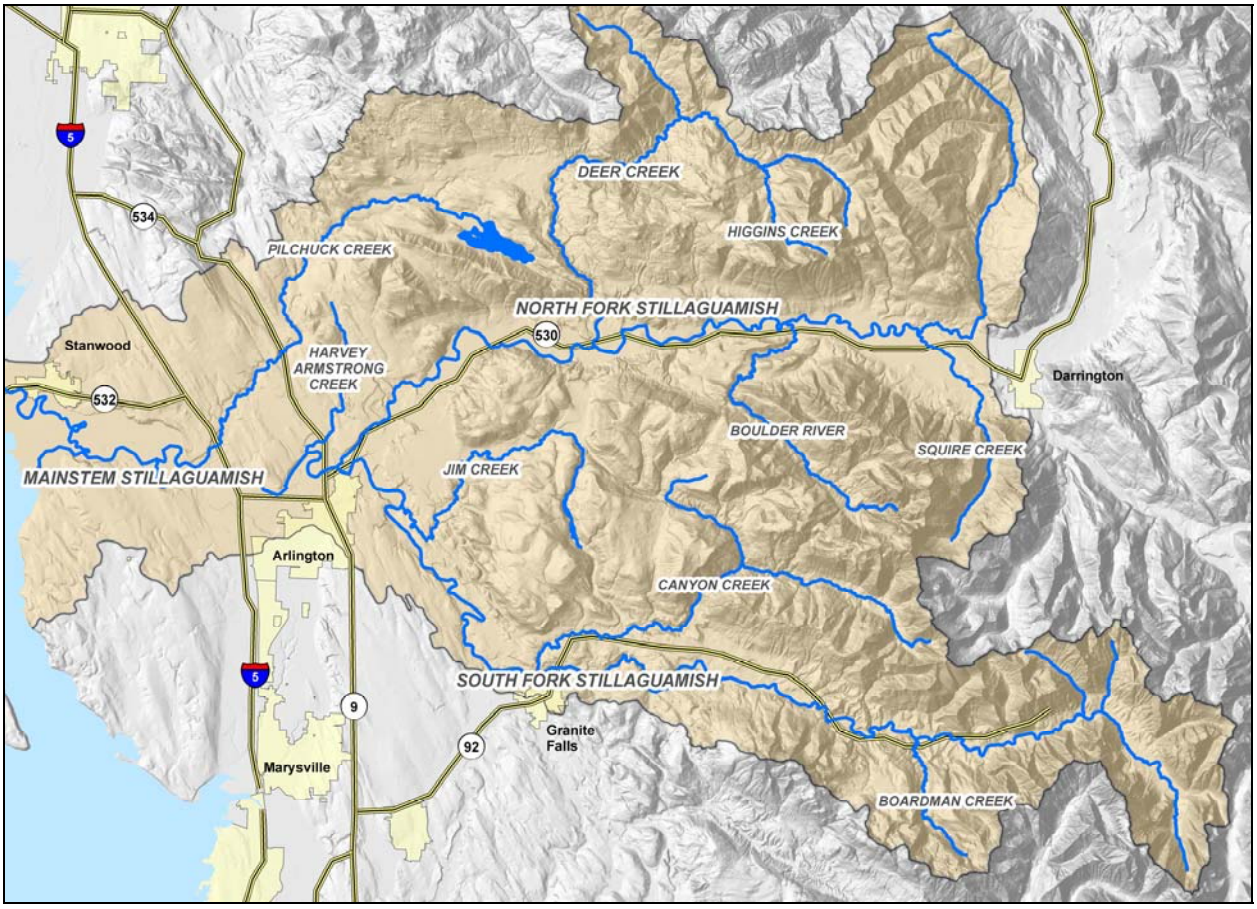

Figure 4. Stillaguamish watershed and its major rivers.

Description of the Stillaguamish Watershed

The Stillaguamish River watershed is located in western Washington State. Its headwaters originate in the Cascade Mountains and flow westerly to a broad floodplain that starts near the city of Arlington (Figure 4). The river divides and rejoins as it meanders through the floodplain and travels to Puget Sound. From the floodplain, most of the river's flow travels through Hat Slough into Port Susan, a large embayment of the Puget Sound. A smaller portion of the flow travels to Skagit Bay through the Old Stillaguamish Channel. Located in northern Snohomish and southeastern Skagit Counties, the Stillaguamish is the fifth largest watershed draining to Puget Sound (SWM 2000). The watershed covers 683 square miles and provides numerous recreational opportunities including fishing, swimming, and boating.

Land use

The mountainous upper watershed is comprised primarily of public forest lands. Historically, it has supported significant timber harvesting activities--about 40 percent of the watershed is managed by the US Forest Service and about 12 percent is managed by the Washington State Department of Natural Resources. As of the late 1990's, 85 percent of the watershed was in forest land use, 6.5 percent was used for agriculture or other human development, with 11.5 percent remaining as wetlands and other barren or nonforested vegetative conditions.

The Stillaguamish floodplain, west of Arlington, is characterized by traditional agriculture with increasing pressures for higher density rural development (SWM 2000). Commercial agriculture, mainly dairy farms and croplands, occurs along the mainstem Stillaguamish and Portage Creek. Small, noncommercial farms with horses or cattle are common along the tributaries.

Snohomish County used Landsat imagery from 2001 to assess riparian forest cover and determined that there has been a loss of forest coverage in the watershed area within 300 feet of flowing waters over the period 1991 to 2001 (Purser et al., 2003). These "near-stream" areas are important for providing shade and for filtering out stormwater pollution. Because of their potential to restore water quality in the Stillaguamish, areas where near-stream vegetation has been lost are described in more detail in the section "Improving Water Temperatures" later in this plan.

The Stillaguamish Floodplain is expected to face increasing pressure for urbanization and rural development from population growth. For more detailed and recent analysis on population growth, land use, and development trends within the Snohomish County's portion of the watershed, the reader is referred to the "State of the Stilly" report that was just published (SWM 2007).

Water quantity

Because of its size and geography, flows in the Stillaguamish River change with the seasons. Winter rainfall refills groundwater aquifers. In some cases prolonged rainfall runs off into the

river's many tributary streams causing flows to increase. The lower flows seen during the summer months are fed by melting from small glaciers and snowfields and stored ground water supplies. Some subbasins with urban, industrial, and residential uses respond very quickly to rainfall creating a "flashy" change in flow rates. These same areas are likely to experience lower than normal summer flows due to a loss in ground water storage.

On August 29, 2005, Ecology established minimum instream flows for 32 rivers and streams in the basin (Instream Flow Rule for the Stillaguamish River, Chapter 173-505 WAC). The rule reserves a limited amount of groundwater for future domestic use and a limited amount of water for stock watering. Maximum limits for withdrawals from nine water sources are now established, and certain lakes and ponds are closed to new diversions, except for domestic use. Numerous rivers and streams are administratively closed to new uses unless the use qualifies under identified exemptions.

Armstrong, Deer, Fortson, Segelsen, Jim, Moose, Squire, Grant, and French creeks are administratively closed to new water rights that would withdraw or affect usage from June to November. In addition, the rule reaffirms prior closures for Canyon, Pilchuck, Portage, and Church creeks. The rule does not affect existing water rights, including those who have small wells already in place that are exempt from state permitting requirements. People who receive their supplies from municipal or community water systems are also not affected. General information about the state's process for establishing instream flows can be found on the web at www.ecy.wa.gov/programs/wr/instream-flows/isfhm.html**.**

With the exception of residential wells, a water right is needed to withdraw water from state surface or ground waters. Recorded water rights from surface water total 81 cfs4 with 56 cfs withdrawn from ground water. As a point of reference, this is about 25 percent of the lowest combined flows of the North and South Forks projected to occur for 7 consecutive days during a typical 10-year period (7Q10 flow). Although this provides some perspective of the volume of surface water withdrawals that are possible, the actual withdrawal of water at any one time can not be determined and is likely to be below this value.

Fishery Resources

Salmon, trout, and other fish that depend on clean water in the Stillaguamish watershed are valuable cultural and economic resources to our state, even more so to local Native American Indians. The Stillaguamish Tribe has traditional fishing grounds in the Stillaguamish watershed. Other tribes with fishing rights in Port Susan include the Tulalip Tribes, Swinomish Tribe, and Lummi Tribe. The Stillaguamish watershed is home to nearly all salmon and trout species found in the Puget Sound area (Table 1). Nontribal fisherman

Table 1. Salmon Usage in the Stillaguamish Watershed.

Species	Fish Usage	
	Spawning	Rearing
Fall Chinook	X	X
Summer Chinook	X	X
Coho	X	X
Fall Chum	X	
Pink	X	X
Sockeye	X	X
Bull Trout	X	X
Summer Steelhead	X	X
Winter Steelhead	X	X
Cutthroat Trout	X	X
Rainbow Trout	X	X

[4] One cfs (cubic foot per second) is about 7.5 gallons of water passing by you every second.

from Washington State to Alaska harvest salmon from the Stillaguamish.

Depending on the species, a young salmon may spend one to two years in the watershed before it travels to salt water where it will fully mature.

Salmon are more susceptible to chemical and thermal pollution during their youth. Young salmon exposed to sufficiently high temperatures can experience developmental problems that reduce their ability to spawn when they return years later. High temperatures can also make them more sluggish, more susceptible to predation by larger fish and more prone to becoming stressed and diseased.

Although the return of salmon to spawn is a remarkable and inspiring feat, it is important to remember that most salmon species will spend more time in the watershed in their early developmental periods rather than their spawning periods.

Recreational Uses

The Stillaguamish watershed supports many recreational uses. The fishery resources provide opportunities for both fresh water fishing as well as salmon fishing in Puget Sound. Cool, well oxygenated water and an abundance of suitable spawning and rearing areas are needed to sustain and support these important fisheries.

The river and its tributaries are also cherished for the boating, swimming, and snorkeling for underwater sight-seeing. Whether you are snorkeling, rafting, kayaking, or boating, it is important to control bacteria levels so that recreating in the water does not pose an unacceptable risk for becoming ill.

Figure 5. Bacteria and Nutrient Pollution. Common sources of bacteria and nutrients include livestock (horses, cattle, dairy cows, sheep, goats, pigs, llamas, and others), failing septic systems, and pet waste.

Reducing Bacterial and Nutrient Pollution

Many areas within the watershed have been shown to have high fecal coliform levels or low dissolved oxygen levels (Table 2, from Lawrence and Joy 2005). Bacterial reductions needed to reach state standards ranged from 7 percent at the mouth of the South Fork Stillaguamish to 99 percent at the outfall called Twin City Foods Drain #4. Dissolved oxygen levels fell below standards at 12 locations. Seven locations received load and wasteload allocations.

Table 2. BOD5 loading and fecal coliform reductions necessary to meet Washington State water quality Standards. Distribution of wasteload allocations for point sources provided in Appendix B.

Waterbody Name	Allowable BOD_5 Loading (lbs/day)			Fecal Coliform Reductions
	Load Capacity	Load Allocation	Wasteload Allocation	
Fish Creek				81%
Harvey Creek				76%
Jim Creek at Mouth				38%
Jorgenson Slough (Church Creek)				87%
Lake Martha Creek				92%
Port Susan				61%
Portage Creek at 212th NE	300	280	20	83%
Portage Creek at 43rd	250	108	142	69%
Stillaguamish River at I-5				52%
Stillaguamish River at Marine Drive				36%
N.F. Stillaguamish River (at mouth)				14%
S.F. Stillaguamish River (at mouth)				7%
Unnamed Creek #0456				97%
Glade Bekken				92%
Pilchuck Creek	890	680	206	26%
March Creek	30	30	0.8	98%
Armstrong Creek at Mouth				29%
Armstrong Creek below Hatchery				66%
Kackman Creek (BOD_5 @ 252nd)	10	9	0.6	68%
West Pass of Old Stillaguamish				97%
South Pass of Old Stillaguamish				75%
Douglas Slough				68%
Irvine Slough				99%
Church Creek at Park				74%
Miller Creek at Miller Road				91%
Twin City Foods Drain #1				94%
Twin City Foods Drain #2				99%
Twin City Foods Drain #3				98%
Twin City Foods Drain #4				88%
Twin City Foods Drain #5				96%
Warm Beach Creek above WWTP	20	18.6	1.4	81%
Agricultural Drain to Warm Beach	30	28	1.4	89%
Warm Beach Dike Pond				92%
Warm Beach Slough				64%

As part of our effort to develop this *Action Plan*, Ecology examined the sources of bacteria and nutrient pollution in the Stillaguamish watershed. We looked at monitoring data and available literature, spoke with people that live and work in the watershed, and observed the watershed from public roadways (windshield surveys). Bacterial pollution continues to be widespread throughout areas where most human activity takes place (Figure 7). Areas with the highest density of human activity tend to exceed state standards year round (consistent problem areas). In less populated areas, bacterial pollution is only a problem during either the dry or the wet weather months, but not both (occasional problem area).

Snohomish County recently contracted a study of Stillaguamish watershed water quality using long term data from all Ecology, Snohomish County, and Stillaguamish Tribe sites (Read 2006). The study analyzed data collected as early as 1959 at some locations. The majority of the data was collected between 1994 to the present. The data was classified by wet or dry season for the analysis, with April through September as the dry season, and October through March as the wet season. The partial summary of the results are shown in Table 3.

Many of the long term monitoring locations showed statistically significant (probability <0.5) changes. Overall, bacteria levels at many sites have been decreasing over time. A recent review of bacteria data showed most areas outside of the North and upper South Forks still exceed state standards. An improving trend in oxygen levels are noted in a number of areas in Read 2006; however, it is unclear how much of the data collected by all organizations evaluated diurnal fluctuation. Ecology for instance will typically only evaluate diurnal oxygen levels as a part of special studies.

Table 3. Trend analysis of water quality data in the Stillaguamish Watershed. Recent analysis of water quality data collected by Snohomish County and Ecology show a number of areas where water quality is improving. Shading indicates the data are statistically significant (p<0.5)(Read 2006). An asterisk indicates continuing bacterial pollution problems based on a recent Ecology analysis.

Stream Name	Bacteria	Temperature	Oxygen	Sediment
Mainstem – Arlington	None*	Improving	Improving	Improving
Mainstem – Silvana	Improving*	None	Improving	None
Mainstem – Hatt Slough	None*	Improving	Improving	Improving
North Fork – Cicero	Improving	None	None	None
North Fork – Darrington	None	*Worsening*	None	None
South Fork – Arlington	Improving*	*Worsening*	None	*Worsening*
South Fork – Granite Falls	Improving	None	None	*Worsening*
Pilchuck Creek	None*	Improving	Improving	Improving
Church Creek	Improving*	Improving	Improving	Improving
Portage Creek	Improving*	Improving	None	Improving
Fish Creek	None*	Improving	Improving	Improving
Glade Bekken	Improving*	Improving	Improving	Improving

The trend analysis results are very encouraging. Water quality is progressing in the right direction in many areas. But bacteria levels are too high and dissolved oxygen too low in many

places in the Stillaguamish watershed. The most likely pollution sources affecting the Stillaguamish River and the actions needed to reduce them are discussed below.

Residential and Commercial Livestock and Other Animals

The Stillaguamish watershed is home to a number of commercial farms, small farms, and livestock-related businesses (Figure 7). Dairies, cattle ranches, equestrian facilities, and personal stables are most common although sheep, llama and other animals are raised as well. These facilities have the potential to discharge bacterial pollutants and nutrients to the Stillaguamish River if proper management practices are not followed. Manure management, watering practices, stormwater management, and pasture management are key areas for the control of bacterial pollution.

A typical dairy cow produces about 2.0 cubic feet of manure per day. Combined with water used for cleaning, dairy farmers manage a considerable amount of manure and wastewater every day. However, to the dairy farmer, manure is a valuable resource that they manage carefully and use during the growing season as a nutrient for feed crops. The Washington State Department of Agriculture (WSDA) inspects each dairy once every 18-24 months so they receive oversight and technical assistance.

Beef cattle ranches and heifer raising facilities are not regulated. Animals typically graze much of the year and farms do not receive regular inspections. The greatest challenges to cattle ranchers include protection of riparian areas from bank trampling and direct access of animals to streams.

Snohomish County is home to a particularly large number of horses. It is estimated that one horse produces 50 pounds of manure a day, which adds up to over eight tons of manure per year per animal. Additional waste is produced from their bedding, which can become soiled with 8-10 gallons of urine from each horse per day. Manure management can create a challenge for any property owner and can quickly get out of hand unless a good management plan is in place.

Because wetlands and low areas near drainage conveyances are frequently unsuitable for grazing and grass production throughout the year, manure and used bedding are commonly found there. Wetlands and low areas are typically right next to surface waters and can become a pathway for bacterial pollution.

Where are the Potential Problem Areas?

Approximately 27 dairy facilities are located in the Stillaguamish Watershed (Figure 7). All of these facilities have farm plans and should not be causing water quality violations as a result of normal operations.

Livestock operations recently observed by car from public roads are shown in Figure 8 (SCD 2007). Although the survey did not examine the upper watershed, it is believed that most farms are located in the lower floodplain, mainstem North and South Fork, and foothills areas. The Snohomish Conservation District estimates that the survey accounted for about half of the farms in the areas examined. Previous literature suggests that commercial agriculture is generally found along the lower floodplains of both forks from Oso to Arlington on the North Fork (18 river miles, RM) and from Jim Creek to Arlington on the South Fork (3 river miles)(SWM 2000).

No specific businesses have been identified as problem sources; however, a detailed inspection of the **best management practices** (BMPs) at these facilities has not been performed. Because dairies are the only type of livestock-related business that is tracked, the number of other types of livestock facilities is unknown. An internet search revealed approximately 10 equestrian facilities and two animal kennels in the watershed. There are no required BMPs for small farms or kennels.

Figure 6. Residential Horse Care. This owner keeps her horse in a sacrifice area when pastures are wet or grasses are dormant. The sacrifice area is designed to drain well and is an easy place to pick up manure while pastures rest and help protect water quality.

What Should be Done to Reduce Pollution from Livestock and Commercial Animal Wastes?

It is especially important for businesses and home owners to recognize the importance of implementing best management practices (BMPs) on the farm to protect water quality. Good BMPs include careful manure management, livestock exclusion from streams and wetlands, pasture management, and gutters and downspouts.

Recommended actions for livestock owners: This *Action Plan* recommends that all farms and commercial stables in the proximity of a stream or drainage conveyance should have a farm plan developed by the Snohomish Conservation District (SCD). Livestock owners should fully implement all elements of their farm plans that relate to water quality protection. You can reach the SCD at www.snohomishcd.org or by calling 425-335-5634. The following are some key BMPs that are typically part of a farm plan:

- *Livestock manure should be collected, when possible, and covered*. Livestock manure storage piles should not be located by any water drainage system, including wetlands that connect to local streams. Manure applied as fertilizer should be used at agronomic rates during the growing season and should not be allowed to drain or run off to surface waters as a result of rainfall or during application to the land. Avoid spreading on wet, saturated, or frozen soils and prior to rainfall. Bacteria from manure is a pollutant when it is introduced to surface waters. The addition of pollution to surface waters is a violation of state law (RCW 90.48.080).

- *Livestock should be fenced away from streams and wetlands.* Fencing prevents animals from depositing manure in these critical areas and ensures that their hooves are not contributing to erosion. This also provides a filter strip where nutrients and bacteria are captured by vegetation before they reach the local stream.

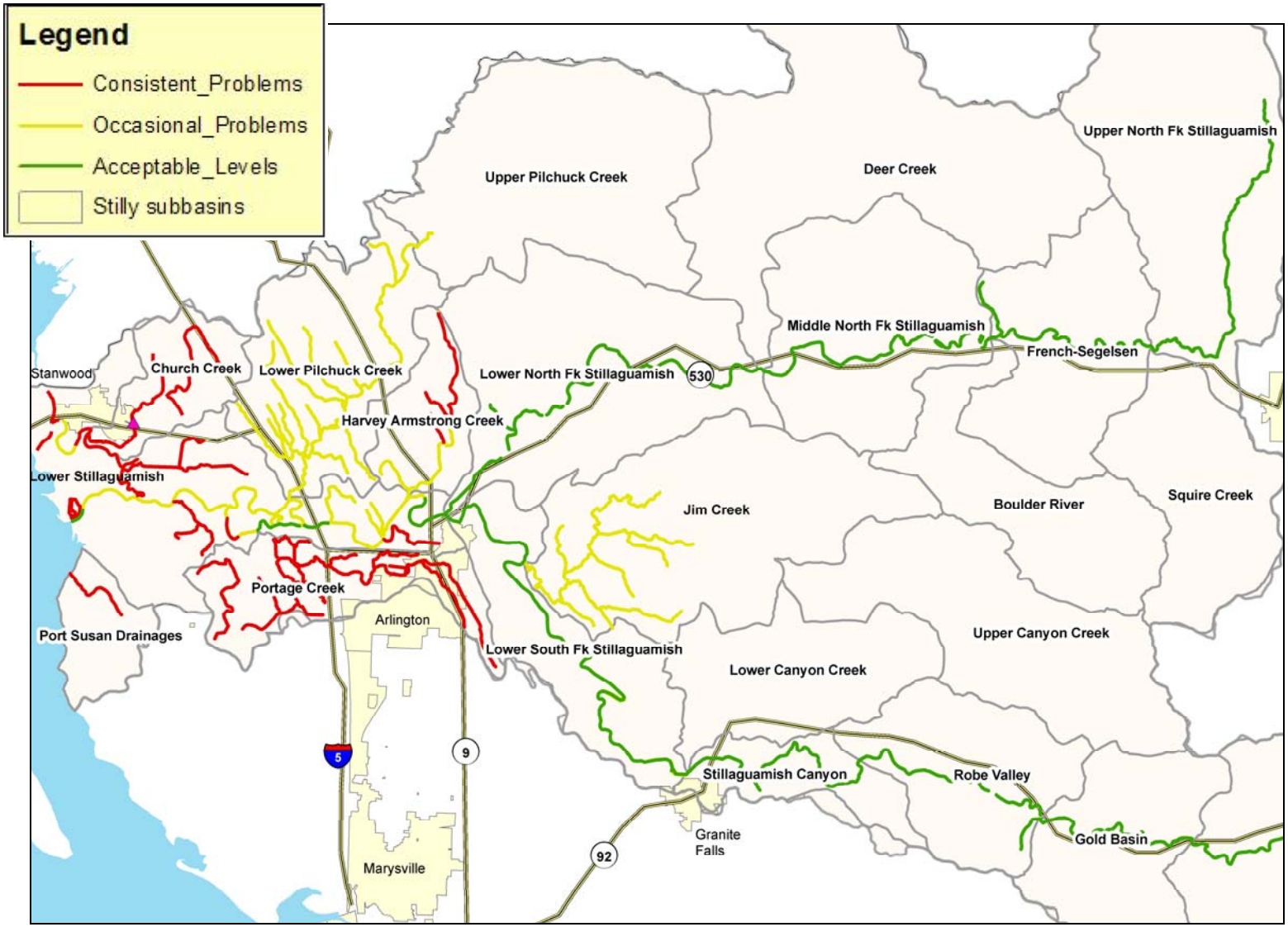

Figure 7. Bacteria concentrations in the Stillaguamish Watershed. Areas shown in red exceed state standards throughout the year. Yellow indicates problems during either dry (June-October) or wet (November-May) weather, but not both. Green areas meet standards year round. Data were collected after 2000 through monthly or quarterly monitoring. Compliance/noncompliance areas are based on sampling performed at, or close to, the most downstream point of each colored water segment.

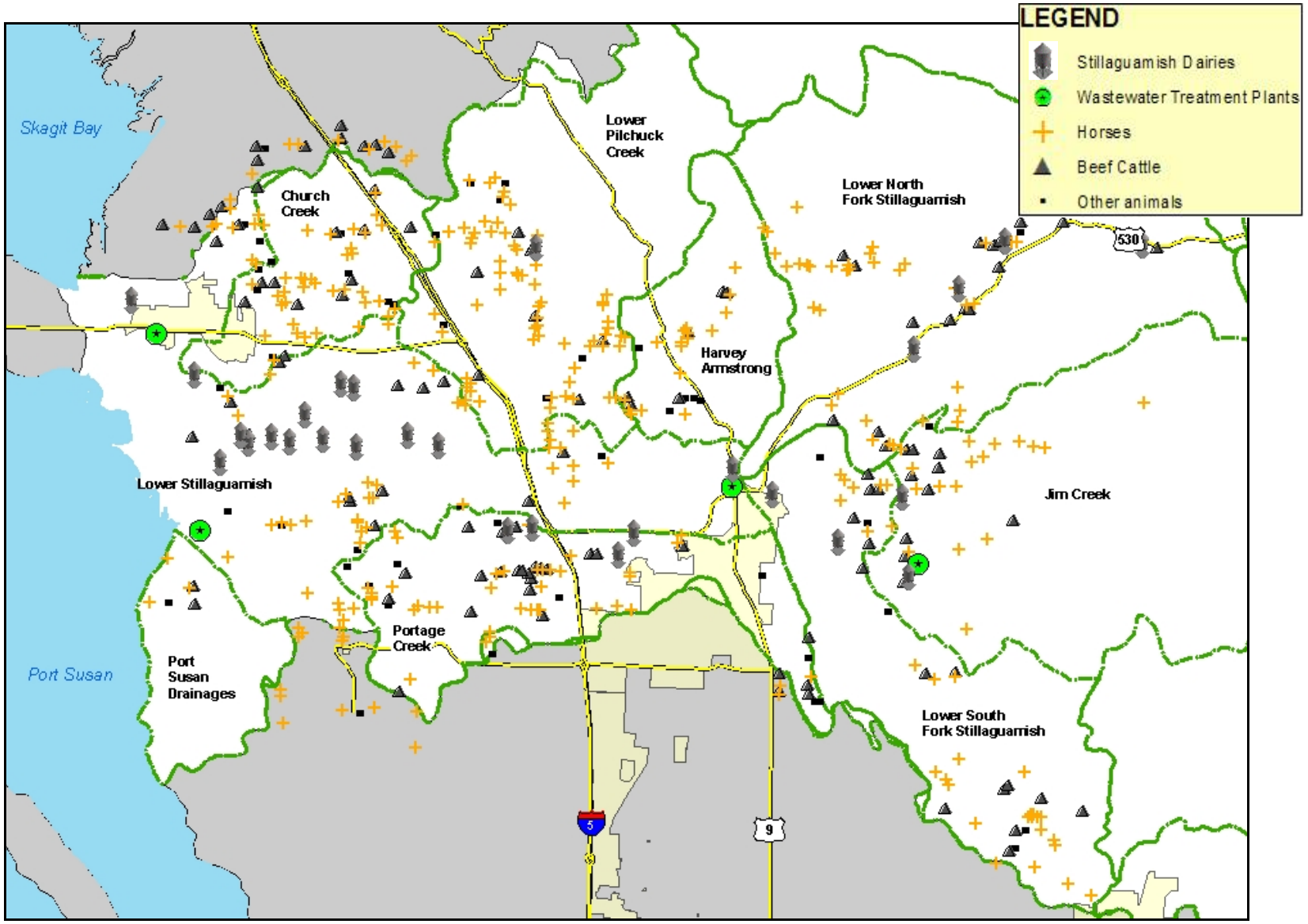

Figure 8. Potential pollution sources in the Stillaguamish Watershed. Where animals live near streams or ditches, there is a potential for bacterial waste to cause pollution problems. Also shown above are wastewater treatment plant locations.

- *Pastures should be managed so that grasses remain healthy and are able to absorb pollutants.* Continuous grazing weakens plants and offers an opportunity for invaders (weeds) to become established and pollutants to drain into a wetland or stream. Healthy grass is also better for livestock. Grass forage has its best nutrient value between 3" and 8" of height. Grazing below 3" depletes the plants' energy reserves, which it needs throughout its dormant period. Remove animals when grass height reaches 3" and return them when the height reaches 6".

- *Install gutters and downspouts on buildings to keep water clean.* This keeps clean water that falls as rain or snow from becoming contaminated with pollutants on the farm, as well as minimizes mud. The roof on a 20'x40' barn can generate 22,500 gallons of water in a typical Snohomish County winter. In addition, manure can hold twice its weight in water and can significantly contribute to muddy conditions.

The WSDA should continue to respond to requests for inspections of dairies and other facilities needing technical assistance or enforcement. This *Action Plan* recommends that commercial dairies be inspected at least once every 18-24 months. Small farms should receive periodic technical assistance visits from the Snohomish Conservation District to ensure BMPs are being followed, especially as properties change ownership.

Recommendations for animal kennels: Animal kennels should manage fecal waste products to prevent their entry into surface or stormwater systems by implementing the BMPs listed below:

- Regularly sweep and clean animal keeping areas to collect and properly dispose of droppings to prevent their entry into surface waters or stormwater systems.
- Do not hose down areas of potential fecal contamination to storm drains or to receiving waters. Always verify that drains used for this purpose go to the sanitary sewer.
- Do not allow any wash waters to be discharged to storm drains or to receiving waters.
- If animals are kept in unpaved and uncovered areas, the ground should have vegetative cover or some other type of ground cover such as mulch.
- If animals are not leashed or in cages, the area where animals are kept should be surrounded by a fence or other means that prevents animals from moving away from the controlled area where BMPs are used.
- Consult with your local health district and waste disposal company for the proper procedures to dispose of fecal waste.

Snohomish County and the cities of Arlington, Marysille, Stanwood, and Granite Falls should inspect any businesses that are discharging stormwater to their storm sewer system. In cases where businesses discharge stormwater directly to surface waters, this TMDL strongly recommends that local government or other entities provide technical assistance or other actions as needed to prevent pollution runoff from these potential sources.

Recommendations for Ecology grant funded projects addressing bacteria and nutrient problems: This *Action Plan* recommends that a strategic approach be taken when developing projects to address bacteria and nutrient pollution problems. Priority projects shall consider focusing work areas of high livestock concentration identified in Figure 8 and will use the most current outreach strategies to affect behavioral changes on the largest percentage of homeowners and land owners. The geographic scope of projects should be limited to help ensure that there is a high likelihood of success and that progress effectiveness is measurable. This *Action Plan* recommends that proponents for Ecology grant funding strongly consider the following project elements: 1) direct door-to-door canvassing, 2) implementation of BMPs in addition to education, 3) water quality monitoring, and 4) documentation of all outreach activities and techniques to aid in process refinement over time.

Onsite Septic Systems

Onsite septic systems (OSSs), both community-based and individual systems, are not a problem when designed, sited, and operated properly. A properly functioning OSS uses the soil surrounding the drainfield to remove bacteria and some nutrients from the wastewater. However, siting OSSs on incompatible soils, soil compaction, clogging of the soil with solids, and hydraulic overload can all cause a failure of the system to adequately treat wastewater. There are approximately 75,000 onsite septic systems in Snohomish County (SHD 2007).

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
- Gurgling sounds in the plumbing system

If a septic system failure results in discharges that come to the ground surface or move too rapidly through soils, it is possible that this wastewater could go directly to a nearby stream, or it could be carried there when it rains and water travels over the land surface.

Figure 9. Onsite septic system care. If the ground above your septic system is wet, squishy, or smells bad, you should have it inspected and pumped as shown here.

Recent changes in state regulations require state and local authorities to revise the operations and maintenance schedule for onsite septic systems (WAC 246-272A-0270). No later than July 1, 2007, owners of residential systems will be

required to have their septic systems inspected once every three years for conventional, gravity flow systems; and once per year for all mechanical systems. Snohomish Health District is currently developing the local rules to address the new state regulations.

Where are the Problem Areas?

Although failing onsite septic systems can pose a threat to local residents, this *Action Plan* focuses only on those failures with the potential to pollute surface waters. Detailed information on potential problem areas that could be affecting surface waters is not well developed at this time. General problem areas are discussed below.

Anywhere that a septic system is located near surface water or a drainage conveyance there is an increased risk for water pollution. Most systems pose no problem when operated as originally designed and sited. However, circumventing the original design of a septic system can cause problems and is illegal. Septic systems are sometimes connected to storm sewers by mistake or to save on costly repairs. They have also been found to be piped directly to surface waters. Installation of curtain drains around a drain field to dry out a wet yard is also occasionally discovered and is also illegal.

Another problem observed in some older septic systems is the subsurface movement of wastewater through extremely porous soils. This latter problem can be difficult to detect.

What Should be Done to Reduce Pollution from Onsite Septic Systems?

Snohomish County and the Snohomish Health District (SHD) are now developing a process to identify potential problem areas. By combining the experience of registered sanitarians with GIS analysis, the project will examine factors such as system age, known failure rates, soil type, proximity to surface water and drainage features, and other factors to help focus public resources where they are needed most. The city of Arlington is also preparing its *Comprehensive Wastewater System Plan* that will address assimilating all onsite septic systems within its boundaries into its central wastewater collection and treatment system in the future.

Although the collaborative project between the County and the SHD is expected to be a valuable tool for identifying problem septic systems, proper system operation is ultimately the responsibility of the system owner. A number of organizations can play a valuable role in finding and resolving failing or illegal systems as recommended below.

Snohomish Health District: The SHD should continue its prompt responses to reported failures and bypassing of approved septic systems. This *Action Plan* also recommends that the District lead efforts to identify problem onsite septic systems and prevent the discharge of untreated wastewaters in the future. Based upon the success of its collaborative project with Snohomish County (see *What will be done, who will do it?* section of this plan) the SHD should develop adequate base funding to investigate and manage onsite septic performance across the county starting with the high priority areas identified by the current project.

Homeowners: Homeowners should follow the new operation and maintenance requirements that will become effective in July 2007 (Chapter 246-272A WAC). Performing maintenance can help to prevent costly repairs and protect local surface waters. Repair costs for failing septic systems can

vary greatly and can only be determined on a case by case basis. Homeowners should contact the SHD for assistance if they suspect a problem with their septic system (Figure 9). You can get information on the location of your septic system on their website at www.snohd.org by clicking on "septic as builts" in their A-Z Index, or by calling 425-339-5250. Residents with septic systems located within 50 to 100' of the high water/high tide of a stream or ditch should be especially diligent to inspect and maintain their systems.

Snohomish Housing Authority (SHA): The SHA has a low interest loan program to help moderately-low income residents (family of two less than $46,000 income) to finance septic system repairs. You can contact the Snohomish Housing Authority by calling 425-290-8499 or at http://hasco.org. (See Funding Sources Section for more information).

Snohomish County, city of Arlington: Local governments should work to help find illicit septic system connections to their municipal separate storm sewer systems (MS4s), which is required in their **National Pollutant Discharge Elimination System (NPDES)** permits, as well as to surface waters. Areas within Arlington and its Urban Growth Area (UGA) are not served by sewer. As part of its *Stormwater Management Plan*, or its *Wellhead Protection Program*, the city should systematically evaluate these areas as sources of bacterial pollution and work with Snohomish County and the Snohomish Health District as needed.

Local organizations: Field staff at the Stillaguamish/Snohomish Fisheries Enhancement Task Force, Snohomish Conservation District, and other groups should get basic training on visually identifying potentially failing septic systems and illicit connections and work with homeowners and the Snohomish Health District to facilitate investigation and correction activities.

Priorities for Ecology grant funded projects: This *Action Plan* strongly supports additional work by the Snohomish Health District to develop a model program for identifying and resolving problems associated with failing onsite septic systems in freshwater and marine areas. Projects should be geographically focused to help ensure that the progress made is measurable and should seek to reach the highest percentage of the targeted population as is feasible. Ecology also encourages all other organizations performing door-to-door canvassing to obtain training in identifying potential septic system failure from the District or other organization and to work with the District and homeowners to make repairs where they are needed. Projects that integrate water quality characterization, education, technical assistance, and correction as combined elements should receive the highest priority for Ecology funding.

Wastewater Treatment Plants

Three wastewater treatment plants (WWTPs) were examined in the bacteria and dissolved oxygen TMDL for the Stillaguamish River: Warm Beach Conference Center WWTP, Indian Ridge WWTP, and the city of Arlington WWTP. The discharges from these plants are not allowed to exceed state water quality criteria at the outer edge of a chronic mixing zone established as part of their NPDES permit.

Bacteria limits were set for all the WWTPs (Table 4). However, nutrient/biological oxygen demand (BOD) loadings were not established for all facilities. More specific information on how

these limits were derived can be found in the TMDL submittal report (Ecology 2005). A brief discussion on the current status of these facilities and their permits is provided below.

Table 4. Fecal Coliform Bacteria Wasteload Allocations for Wastewater Treatment Plants.

Facility Name	Current FC Permit cfu/100 mL	Proposed Permit cfu/100 mL	WLA cfu/day
Indian Ridge Corrections Center WWTP	100	100	8.0×10^8
Arlington WWTP	200 / 400	39 / 128	3.0×10^9
Warm Beach Conference Center WWTP*	200 / 400	47 / 100	1.3×10^8
Warm Beach Conference Center WWTP**	-	11 / 26	3.1×10^7

* Assuming discharge to Warm Beach Creek at current maximum monthly flow of 0.075 MGD, and the discharge is allowed under special considerations.

** Assuming discharge to Hat Slough near the South Branch with maximum monthly flow of 0.075 MGD.

Arlington WWTP

The city of Arlington currently operates a sequencing-batch-reactor type treatment plant followed by ultraviolet disinfection. Limitations on fecal coliform discharges are required as part of this *Action Plan*. However, due to the complexity of nutrient inputs and interactions in the area below the Arlington WWTP, Ecology was not able to establish a wasteload allocation.

Arlington is upgrading its WWTP to accommodate future growth within its urban growth boundary. The city has chosen secondary treatment followed by membrane filtration and ultraviolet disinfection. Membrane filtration is the highest available level of secondary treatment and it will greatly reduce the concentration of biological oxygen demand (BOD), fecal coliform, and phosphorus in the plant's final effluent.

Ecology is still reviewing the city's engineering report at the time this *Action Plan* is being developed. Although the concentration of phosphorus will be decreased over current levels, additional study of the dissolved oxygen below the Arlington WWTP is needed. Ecology will develop a study and work with the city to gather data on nutrient inputs and natural processes affecting the downstream area. It is possible that the study will result additional restrictions on the discharge of nutrients from the Arlington WWTP during the critical summer months. The new plant is expected to be in operation by the end of 2008.

Warm Beach Christian Camp and Conference Center WWTP

The Warm Beach Christian Camp and Conference Center is located on a bluff adjacent to Port Susan. The Center accommodates groups throughout the year, but peak attendance is in summer. The center is developing a residential facility for seniors so it is increasing its wastewater treatment capacity.

The existing WWTP at the Center consists of biological treatment in two aerated lagoon cells followed by wetlands treatment and disinfection with calcium hypochlorite solution. Ecology is currently (April 2007) reviewing an engineering report and the plans and specifications for an upgrade to the Center's WWTP to a membrane filtration plant.

Ecology has required the Center to remove its discharge from Warm Beach Creek during the dry weather months by September 30, 2007, through an agreed upon order. The engineering report proposes that Center apply its treated wastewater to land during the dry summer months. The proposed dry weather application site is a horse pasture located on the Center's grounds. As additional effluent is generated, it is expected to be applied subsurface in the vicinity of the Conference Center.

During the wet weather months, the proposed discharge would go to Port Susan at a location about 1,500 ft northwest of the dike pond that discharges to First Channel. Thus, the discharge of wastewater through the dike pond into First Channel will be eliminated.

Indian Ridge Corrections Center WWTP

Indian Ridge Corrections Center is a small facility formerly operated by the Washington State Department of Social and Health Services, but now operated by Snohomish County. The facility discharges effluent to Jim Creek approximately 4.8 kilometers (3 miles) above the confluence with the South Fork Stillaguamish River. The treatment process at the facility has operated since 1997, and it includes preliminary treatment through a mechanical fine screen, biological treatment in sequencing batch reactors followed by an ultraviolet disinfection system.

The Stillaguamish TMDL determined that Indian Ridge can continue to discharge fecal coliform bacteria using the same limitations as found in their last NPDES permit. The TMDL did not find it necessary to set load and wasteload allocation for this part of the watershed and nutrient and BOD limitations were not needed.

Wastewater Conveyance Systems

Wastewater treatment plants are generally located in topographic low points in the communities they serve. Wastewater from individual homes and businesses is conveyed through individually-owned side sewers to larger pipes operated by the wastewater treatment plant. Where hills and other obstructions prevent gravity flow, "lift stations" are constructed to pump wastewater under pressure to an elevation where it can continue to flow by gravity to the WWTP. The only major wastewater conveyance system in the Stillaguamish is operated by the city of Arlington. Although the Warm Beach Conference Center and Indian Ridge Corrections Center operate treatment plants, their systems are small by conventional standards.

Centrally conveyed sewage can enter surface waters under several scenarios: 1) leaky sewer lines, 2) preferential flowpaths provided by trenches, and 3) overflows at lift stations. Each of these potential problem areas is discussed below.

Leaky Sewer Lines

Relatively little is known about the potential of leaky sewer lines to contaminate local surface and ground waters (called exfiltration). Some sewer mainlines are located near streams because of the favorable natural grade or the need to cross a stream. If a leak were caused by shifting earth, line deterioration, or improper installation, raw sewage could make its way to surface water. Mains in the older part of Arlington (Old Town, Island Crossing) are more subject to

leaks from deterioration and ground shifting. There are 17 locations in Arlington where the sewer system crosses a stream, all of them in the Portage Creek subbasin—in all cases these lines are located underground below the stream bottom. Roots can also grow right through some pipe joints causing leaks; however, sewer mainlines are usually laid too deep for this to be a problem.

The infiltration of groundwater into a sewer system is not necessarily an indicator of sewage exfiltration because the force of groundwater pressure on the outside of the sewer pipe is generally greater than the force of sewage trying to get out. Depending on the location and size of leakage areas, the solids in sewer pipes could, in some cases, seal themselves before substantial leakage to groundwater could occur.

Preferential Flowpaths

It is also possible for leaking sewage to be transported through the trenches where sewer pipes are laid. Compounding the problem is the possibility of groundwater entering these trenches thus improving the conveyance ability of the man-made trench. If porous backfill materials are used, pollutants and groundwater can travel more freely. Newer methods of installing sewer lines use periodic dams within the trenches to help prevent the conveyance of groundwater or pipe leakage. The city of Arlington has required the use of these dams for at least a decade.

Overflows at Lift Stations

Overflows can occur when a system is overloaded or there is a collection system malfunction. System redundancy and telemetry are employed to help ensure that overflows do not occur if and when mechanical or physical problems occur. Overflows are also more likely to occur during high use periods, during wet weather if infiltration is significant, or as a result of a line blockage. They can occur at pump stations or manholes.

Blockages are usually short-lived and unlikely to account for consistent high bacterial levels. Depending on where it occurs, a blockage can result in an overflow to surface water, or a sewer backup into a home. Because these events pose such an immediate threat to human health and are a great inconvenience, they are usually resolved quickly.

Ecology does not generally allow sewer overflow pipes at pump stations. Where allowed, overflow points are usually capped and locked and can only be opened in the event of an emergency. Ecology reviews all overflow incidents when they are reported and is not aware of any open overflow points into the Stillaguamish watershed. When overflows occur they are short-lived and cannot account for the consistent high bacterial counts observed in Portage Creek. None of Arlington's lift stations have overflow pipes. There have been no recorded overflows from manholes since at least 1973.

What Should be Done to Investigate Pollution from Regional Conveyance Systems?

This *Action Plan* recommends the following actions for the city of Arlington and its citizens regarding the investigation and maintenance of the sewer collection system.

- *Evaluate and monitor the potential for exfiltration near stream crossings*: Detailed inspections of stream segments where sewer lines are located near, or cross, a creek are recommended. Evaluations should be prioritized based on flow type (with a preference for force mains), history of line integrity, age of the line, type of materials, and any other relevant factors. Staff should look for the sudden appearance of unusually high periphyton levels or slime growths in areas where streams and conveyance systems intersect or travel together. Suspicious areas should be tested for high bacteria levels and presence of optical brighteners or methyl blue active substances. Other reasonable methods to inspect pipe integrity such as TV inspection and pressure testing should be considered also as they are appropriate. Both surface water and ground water testing may be necessary in some cases. Sewer lines known or suspected not to conform to Ecology's Criteria for Sewage Works Design (Louthain 1998) should be a priority for inspection.
- *Maintain sewage collection system*: The city of Arlington should ensure that system growth is matched with adequate staffing to provide proper operation and maintenance, which should include:
    - Daily inspection of lift stations (or telemetry with periodic checks)
    - Twice annual jetting and vactoring of lift station wet wells
    - Jetting and vactoring of sewer mains
    - Video inspections of sewer mains
    - Construction inspections, including pressure testing of all new lines
    - Scheduled replacement of aging sewer mains as part of the city's capital improvement program.

Urban and Roadway Stormwater

Stormwater can be a significant source of bacterial and nutrient inputs to local water bodies. In this document, stormwater is defined very broadly and includes 1) rainwater that hits the ground and does not infiltrate at that location and 2) other discharges that are collected in stormwater collection systems (pipes or ditches) and is conveyed to local surface waters. (See http://www.ecy.wa.gov/programs/wq/stormwater for more information.) Sources of stormwater pollution that are not conveyed in a regulated stormwater system are discussed individually elsewhere in this chapter.

Figure 10. Managing Urban Stormwater. The best way to prevent stormwater from becoming a problem is to treat and infiltrate it right away. This new facility in Arlington treats and infiltrates most of its stormwater underneath the parking lot.

Where are the Problem Areas?

Urban stormwater exists anywhere we have roads and parking lots. Pollution collects on these surfaces and is washed into local streams through ditches and storm sewers. Common pollution sources include pet wastes, surfacing wastewater from failing septic tanks, excess nutrients from lawns and gardens, and oxygen-depleting pollutants that come from car washing and sidewalk cleaning. Even a latte or soft drink that is emptied on a parking lot can make its way to where fish live. Bacterial and nutrient sources of stormwater pollution are discussed below.

Bacterial pollution: In urban areas around Puget Sound and elsewhere across the country, bacteria concentrations in stormwater range from approximately 10 to over 1,000 times our state's geometric mean standard (100 organisms/100 mL) (Chang 1999, Doran et al. 1981, Pitt 1998, Varner 1995). In a study conducted by the Center for Watershed Protection, mean fecal coliform concentrations in urban stormwater were reported to be 15,000 cfu/100 mL (CWP 1999). That same study showed that nearly every individual stormwater runoff sample exceeded bacterial standards, usually by a factor of 75 to 100.

DNA ribotyping studies of bacteria found in streams and creeks in urban Puget Sound streams consistently show the presence of bacteria from dogs and cats (Svrjcek 2006, Table 5). In a watershed containing 100,000 people, it is estimated that dogs alone generate over two and one half tons of feces each day—that is almost 2 million pounds per year. Although current methods do not allow for quantification of sources, the consistent presence of pet waste in regional studies indicates that BMPs to control these particular sources should begin as soon as possible.

Snohomish County is nearing completion of its pilot Pet Waste Management Campaign project, which researched the habits of area dog owners. Survey respondents reported that 89 percent of owners allow their dogs to drop some or all of their waste in their yard versus 19 percent that allow some waste to be dropped on walks (Ward and Thornburgh 2005). Thus, pet waste management is strongly needed on private properties near streams and stormwater conveyances. Public locations where animals are taken for exercise may have a particularly high potential for stormwater contamination due to the presence of storm sewer systems adjacent to sidewalks, roadways, and other public areas. Veterinary offices, animal kennels, and other commercial animal handling facilities can also generate significant amounts of animal wastes as a byproduct of boarding and other services. Animal kennels and horse boarding facilities are not regulated by the Snohomish Health District or the Department of Ecology.

Roadways throughout the watershed can also contribute bacterial pollution. Recent data collected from the Washington State Department of Transportation (WSDOT 2005, 2006) showed that untreated stormwater from selected roadways had bacteria concentrations of 307 and 2,179 cfu/100 mL, geometric mean and 90^{th} percentile, respectively. The source of the bacteria from roadways is most likely a combination of discharges from highway users (spillage from livestock conveyance, baby diaper disposal), wildlife, and regrowth of bacteria in conveyance systems. Ecology litter crews regularly encounter used baby diapers in their work to clean up our state roadside areas (Williams 2007, personal communication).

Table 5. Summary of bacteria sources identified in urban streams in Puget Sound. Numbers shown are a percentage of the total isolates identified (except bottom "unknown" row). Values shown do not accurately reflect relative concentrations from each source category. Bold numbers show the three most common isolates for each study.

Source	Edgewater Creek (2000)	Glennwood Creek	Swamp Creek (2000)	Woodland Creek (2002)	North Creek Bothell (2004)
Cat/Feline	6.8	14	1.6	1.5	3
Dog/Canine	**7.4**	**21**	**14.3**	**24.3**	**15**
Opossum/Rabbit	2.7	2.5	2.4	1.5	1
Raccoon	**10.8**	2	**7.1**	5.1	5
Beaver/Rodent	2	9	0.8	8.8	**18**
Squirrel	1.4		0.8		
Deer				6.6	<1
Storm Drain		0.5			
Human/Sewage	1.4		2.4	**14.7**	12
Horse				3.7	
Bovine				3.7	
Chicken				0.7	
Avian	**8**	**28**	**13.5**	**11**	**38**
Goose		1.3	4.8	2.2	
Sea gull		0.7	1.6	1.5	
Duck					<1
Multi species				6.6	
Unknown	*60.1*	*21*	*50.8*	*8.1*	*6*
Total percentage	100	100	100	100	100
# of isolates	147	196	126	182	349

Nutrient pollution: Many of the everyday pleasures (or chores, depending on how you look at it) that we take for granted as a normal, acceptable, modern activities can have a dramatic effect on local waters. That is because the storm sewer systems that remove excess water from our streets do not take the water to our local sewage treatment plant as one might believe.

Car wash wastewater going to urban streams is a common problem. Whether or not we use biodegradable soap, the suds that go off our driveway and down the street often end up in the local stream. Most folks wouldn't dream of emptying dirty soapy water into the stream but actually, that is just what happens. Fertilizers and soaps can lower the oxygen content of the water far away from where they first enter a stream and cause problems for fish.

Similarly, if water runs off a fertilized lawn, the same thing can happen although you don't have the suds to let you know the pollution is there. Pesticides and herbicides we put on our lawns are also being found in urban creeks. These compounds act the same way in the water as they do on your lawn. Common garden chemicals are now widespread throughout Puget Sound and damaging local waters. Businesses that sell fertilizer, or use it as a regular part of their business activities can add to nutrient pollution if spills are not managed properly or if fertilizers are overapplied or misapplied.

What Should be Done to Reduce Urban Stormwater Pollution?

Snohomish County and the city of Arlington were issued municipal stormwater permits on January 17, 2007. Ecology anticipates that the WSDOT will also be issued a new permit in late 2007. These permits require action to reduce the impact of stormwater pollution in local waters. This *Action Plan* adds additional requirements to the Snohomish County and Arlington permits (see Appendix C) as they are reissued in the future. Additional TMDL-related conditions for the WSDOT permit will be developed as part of the standard permit development process.

Figure 11. Animal waste on roadways. Roads themselves do not generate bacterial pollution; however, spillage from trucks, discarded baby diapers, and rodents attracted to stormwater pipes are all possible sources. Shown above is a truck transporting dairy cows that has manure leaking out onto the roadway,

The municipal stormwater permits will control pollution from these sources of stormwater, although their full effect will take time. Because stormwater pollution also occurs outside of the area covered by these permits, this plan must also makes recommendations for action in those areas. Both required and recommended actions are discussed below.

Required actions for municipal governments: The municipal stormwater permits require many activities including the identification and correction of illicit discharges, control of commercial bacteria discharges to the storm sewer, public education, and public involvement. The basic activities required for counties and cities include:

- Establish adequate legal authority to control stormwater discharges
- Mapping of the stormwater system
- Coordination with other stormwater permittees
- Public Involvement and Participation
- Control of stormwater from new development, redevelopment, and construction sites
- Illicit connections and illicit discharges detection and elimination
- Proper operation and maintenance of municipal facilities
- Education and Outreach to the public and business community
- Compliance with additional TMDL conditions
- Construction of structural stormwater controls for new/ existing development *(Phase 1 only)*
- Source control program for existing development *(Phase 1 only)*
- Water quality monitoring *(Phase 1 only)*

For more information on the municipal stormwater permits, visit Ecology's website at http://www.ecy.wa.gov/programs/wq/stormwater/index.html.

This *Action Plan* also requires water quality monitoring, targeting of illicit discharge activities, and additional public involvement, outreach and education to help reach TMDL goals. The additional actions are discussed in more detail in Appendix C. Ecology does not anticipate that the activities listed in Appendix C will be required until the municipal stormwater permits are reissued in approximately five years. For that reason, this *Action Plan* strongly encourages permittees to begin the implementation of these additional activities as soon as possible.

Figure 12. Pet Waste Management. Studies show that pet wastes are getting into our local streams. This is a pet waste management station located in Arlington along the Centennial Trail near multifamily housing where pets frequent public areas. Pet waste stations help citizens pick up after their pet.

Recommended actions for municipal governments: This plan also encourages additional action by local governments to control stormwater pollution. Ecology strongly recommends the following actions to control bacterial pollution from urban stormwater:

- *Develop and implement an aggressive plan to control pet wastes.* Actions should target this specific pollution source on both private property and in public places. Local municipalities should refer to recent study results and education/outreach materials developed by Snohomish County that target residential homeowners. Pet waste control programs should also assess the need for pet waste collection/education stations (Figure 12), installation and maintenance of these stations in public areas and private areas where necessary, and development and enforcement of animal waste control ordinances.
- *Control nutrient inputs at the source.* Fertilizer runoff, food and grease wastes, and waste wash waters all provide nutrients that could support the growth of bacteria in storm sewers and algae or periphyton in local streams.
- *Employ aggressive street sweeping and catch basin maintenance.* Local efforts in Kitsap County suggest that catch basins can be a source of bacteria. To help control this, aggressive street sweeping and catch basin maintenance could be explored to reduce the buildup of pollutants in storm sewers.
- *Manage private storm sewer systems closely.* Where the responsibility for storm sewer management is given to homeowners associations or individuals, local government should regularly inspect to see these systems are maintained and work with owners as needed. Where private ownership is posing a barrier to proper maintenance and causing

pollution problems, local government should work to assume those maintenance responsibilities.

Recommended actions for citizens, businesses, and owners of private stormwater systems: Private stormwater systems are subject to the same pollution sources as publicly owned systems discussed above. Within the Stillaguamish watershed there are numerous private storm sewer systems. Business owners and neighborhood associations should examine their land use and maintenance strategies to improve local water quality. Educational outreach to private stormwater system owners is recommended to prevent car washing, pet waste, and other discharges. Grant funding sources are encouraged to support these collaborative efforts.

If possible, wash your car on lawns and other grassy areas—otherwise go to a salmon-friendly charity car wash (Snohomish County and the city of Arlington can help them set the car wash up in an environmentally safe manner), or to a local car wash. If you are interested in having Snohomish County's basin steward talk to you about other ways to reduce your potential to create stormwater pollution through better landscaping, contact the County's "Watershed Stewardship Program" at 425-388-3464 or email www.stewards.surfacewater.info.

Home supply stores should store fertilizers under cover and quickly clean up any spilled materials that could contribute to storm or surface water pollution. Educational materials on the proper use of fertilizers should be provided at the point of sale and organic/slow release alternatives (which break down slowly) should be made available to consumers. Plant nurseries should take particular care not to allow any fertilizers to be discharged into storm or surface waters.

Figure 13. Car washing can hurt water quality. Car wash water, excess fertilizer, pet wastes, and anything else that can dissolve in water will travel in stormwater runoff and may eventually pollute your local stream. Instead, wash your car on your lawn or take it to a salmon-friendly car wash. Use as little fertilizer and pesticides as you can to prevent these chemicals from reaching your local stream.

Wildlife

This *Action Plan* assumes that wildlife generally contribute bacteria to surface waters in natural levels and thus are not considered pollution. The Stillaguamish TMDL (Lawrence and Joy 2005) noted that bacteria loading from wildlife can be significant during periods of the spring, fall, and winter. During those periods, the concentrations of snow geese, ducks, and shorebirds can vary greatly. However, only a fraction of that loading is available because wildlife are not in the water all the time. Wildlife are considered pollution where human-caused alterations of the environment have increased their numbers well beyond natural levels and a potential to pollute exists.

Where are the Problem Areas?

No problem areas have been identified in the preparation of this *Action Plan*. Examples of human-caused alterations may include certain agricultural areas (birds congregating on warm farm roofs for example), docks near swimming and clamming areas, or recreational areas offering year-round refuge for large numbers of Canadian geese.

What Should be Done to Reduce Pollution from Wildlife?

This plan recommends that the appropriate local government officials (county or city surface water management staff) be contacted to coordinate the investigation of wildlife congregation areas that may present a potential pollution problem. When excessive waterfowl are present in public recreation areas, exclusionary vegetation, "Do Not Feed the Waterfowl" signage, or other measures should be considered to reduce bacteria inputs.

Figure 14. Waste from Wildlife. Snow geese (shown above), and other wildlife in their natural settings do contribute bacteria to local waters. However, where they occur in natural numbers, this plan assumes that they do not usually cause water quality problems.

Photo by Steve Mlodinow.

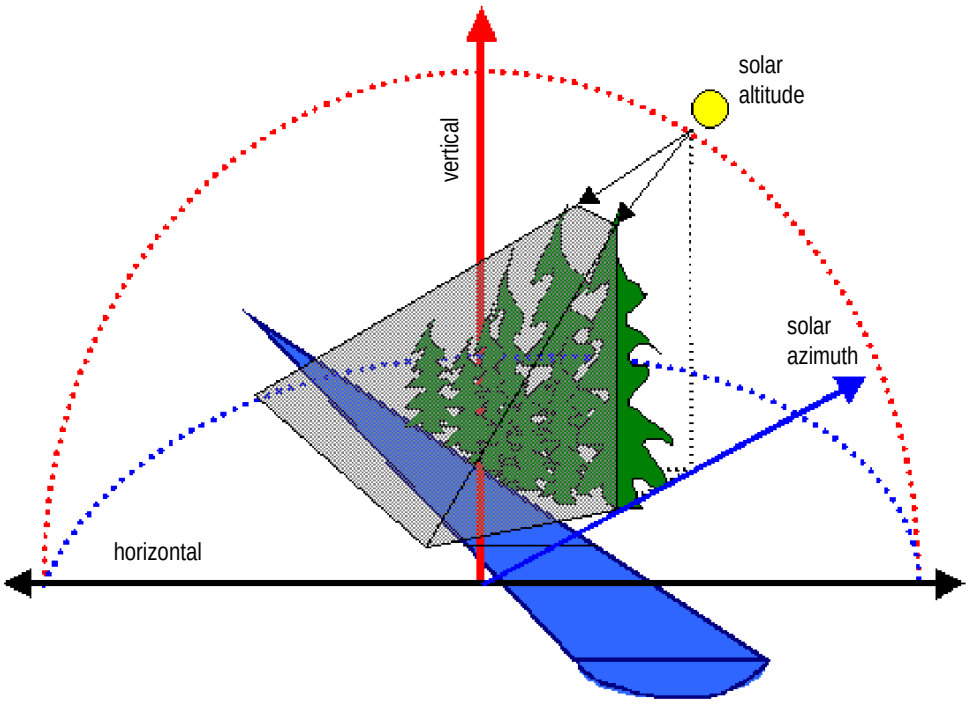

Figure 15. Tree height and sun position affect stream temperature. During summer months, the sun is high in the sky and closer to the red vertical arrow (high solar azimuth and high solar altitude). This means that tree heights need to be higher to protect streams from solar radiation.

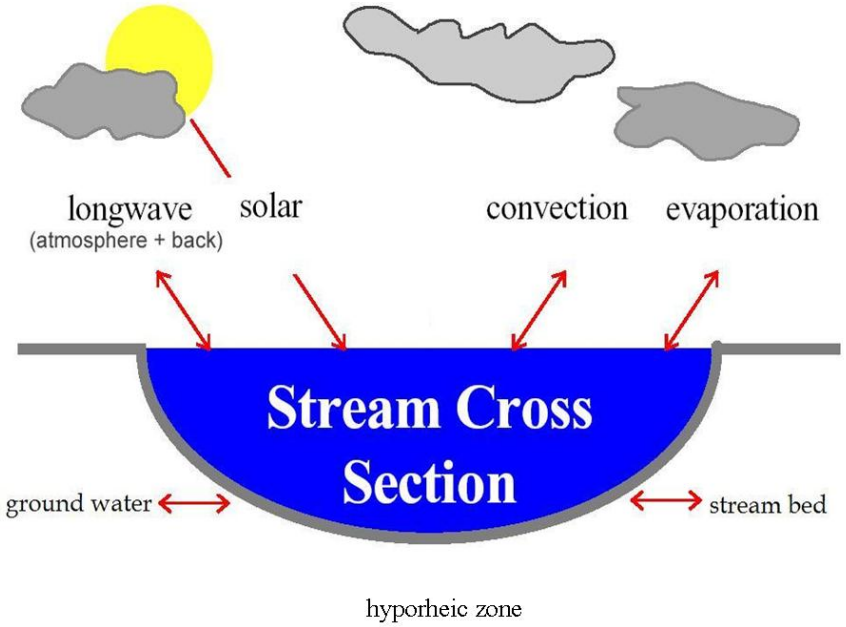

Figure 16. Surface heat exchange processes in streams. As a stream interacts with the ground, air, and the sun, many forces are at work to affect water temperatures. The net heat flux is the sum of energy from solar inputs, longwave radiation from the atmosphere, convection, evaporation, and interactions with groundwater and the stream bed.

Improving Water Temperatures

In the Pacific Northwest, a cool stream is a healthy stream. Many natural processes work together to create habitat for the cold-water salmon and trout species that call the Stillaguamish River home. Most obvious is shade, which keeps sun off the water like a big umbrella protects you at the beach (Figure 15). The contribution of springs and subsurface groundwaters is a second process that feeds the river with cool groundwater throughout the year, especially during our dry summer months (Figure 16). The shape of rivers and their feeder streams is a third factor that plays a key role in regulating stream temperature--narrower, deeper stream reaches absorb less heat than wide and shallow streams. Finally, facilities such as wastewater treatment plants can have significant local effects on stream temperatures. Each of these four processes is discussed below in more detail.

Riparian Vegetation and Shading

Riparian areas (streamside buffers) play many valuable roles in protecting water quality. The TMDL model results demonstrated that under critical conditions mature riparian vegetation is the most important factor for protecting stream temperatures. In addition to its direct role in blocking incoming solar radiation, riparian vegetation creates an area of moderating microclimate, prevents erosion, and provides **large woody debris** (LWD). It can also filter out unwanted substances before they are carried by surface runoff into streams. Cooler water also holds more oxygen to support fish and other stream life.

The upper portions of the Stillaguamish watershed have a higher percentage of forested riparian zone than the floodplain (Table 6). Maturing of existing riparian forest cover in Stillaguamish subbasins, and planting of additional forest cover are expected to provide substantial stream temperature reductions. This Action Plan supports protection of existing riparian forest cover shown in Table 6, as well as planting of additional riparian areas, especially in the shade-deficit areas on the basin map shown in Figure 18.

Table 6. Percent of riparian zone under forest cover in Stillaguamish sub-basins (based on Snohomish County data in Purser et al., 2003). Some of these forested riparian zones are less than 30 years of age and do not provide maximum shade.

Sub-basin	%	Sub-basin	%
Gold Basin	79	Pilchuck Creek (upper)	55
South Fork (upper)	79	French-Segelsen	50
North Fork (upper)	77	North Fork (middle)	48
Canyon Creek (upper)	77	Harvey Armstrong Creek	39
Stillaguamish Canyon	72	North Fork (lower)	38
Boulder River	70	Pilchuck Creek (lower)	36
Deer Creek	67	South Fork (lower)	34
Robe Valley	64	Port Susan drainages	34
Jim Creek	57	Church Creek	20
Canyon Creek (lower)	56	Portage Creek	19
Squire Creek	55	Stillaguamish River (lower)	16

What does a healthy riparian area look like?

In the Stillaguamish Watershed, a healthy riparian area will look different depending on where it is located (Pollock 1997). In foothill and lower mountain areas, tributary streams will be surrounded by conifers like Douglas fir and Western Red cedar. Traveling to lower elevations in the valleys of the lower and middle North Fork and lower South Fork below Granite Falls, streams should be surrounded by a mix of conifers and deciduous trees such as cottonwood, alder, and bigleaf maple. In the mainstem valley below Arlington, it is normal to see riparian areas composed primarily of deciduous trees. In areas disturbed by natural causes such as channel meandering, fire, or landslides, shrub and small trees might been seen. Disturbed areas should not comprise more than 5-20 percent of the area adjacent to streams in the watershed (SIRC 2005).

Streams that are tributary to the mainstem, North Fork, and South Fork would normally be almost entirely covered by tree shade. Much of the precipitation from rain and mountain snowpack would be stored as groundwater and slowly released to the stream throughout the year. Forests that are about 27 years old are considered "hydraulically mature", meaning that precipitation is captured and stored normally (Purser et al. 2003). Smaller streams would have less water in the summer but the stored groundwater that feeds them would stay cool due to direct shading and cooler air temperatures created by the surrounding riparian forest (microclimate).

Studies have shown that wooded areas have slightly narrower channels than average, which allows riparian shading to cover a greater percentage of stream surface (Dunne and Leopold, 1978). Bank vegetation exerts a stabilizing effect on the channel, maintaining narrower bankfull dimensions wherever a deep root structure is intact (Booth, 1997). Thus, healthy riparian areas will contribute to improving stream temperatures, nutrient and bacteria levels and decreasing erosion.

Where are the Problem Areas?

Many reaches of the mainstem Stillaguamish and its feeder streams need riparian planting and restoration. Ecology's earlier TMDL reports recommended improving shade along major river segments based on riparian conditions in 1991 (Lawrence 2006), the most recent stream temperatures throughout the watershed, and other factors (Pelletier and Bilhimer 2004) (Figure 18). As part of this *Action Plan*, Ecology reviewed the information above, more recent riparian vegetation data from 2001 (Simmonds et al. 2004), and 2006 USGS orthophotos. This data was discussed with the TMDL advisory group. Thus, the following analysis provides the most current data on riparian vegetation and temperature levels in the lower mainstem, North Fork, and South Fork subareas (Figure 17). Selected subbasins within those subareas are discussed. Tables showing near-stream vegetation composition can be found in Appendix E.

The discussion of riparian vegetation focuses on the near-stream area (approximately 270' of each side of flowing surface water) in 2001 (Simmonds et al 2004). This *Action Plan* acknowledges that a more discrete analysis of the riparian buffer closer to 150' on each side might be more helpful in targeting the majority of riparian shade restoration needs. However, the available data were prepared to examine processes beyond conventional vegetative shading including shading provided by large woody debris from the long-term recruitment of fallen trees from mature forest buffers. These data reflect the most current riparian vegetation analysis

available at this time and are a very valuable aid to help target riparian areas that should be examined for rehabilitation.

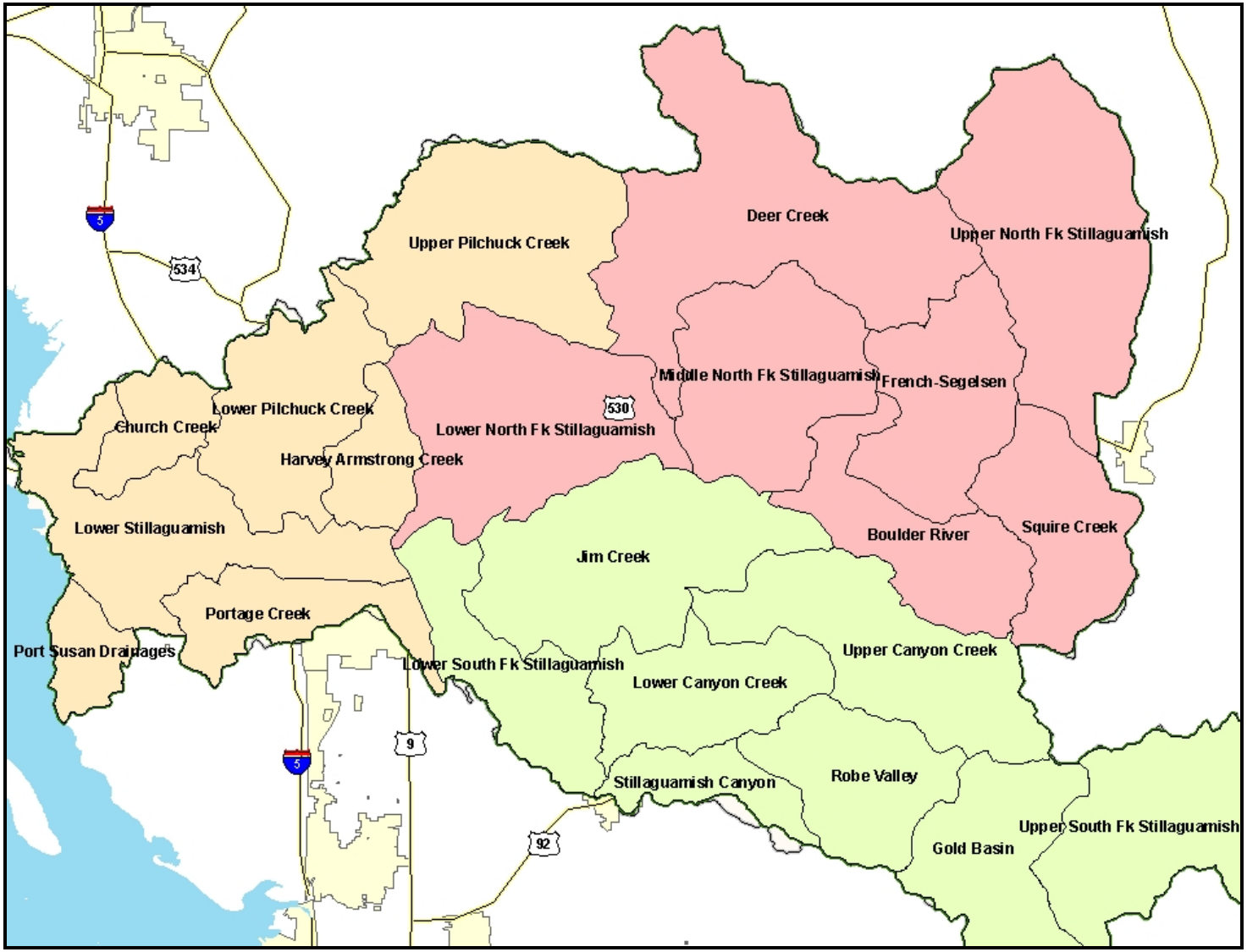

Figure 17. Stillaguamish Watershed. The Action Plan groups the discussion of temperature impairment by dividing the watershed into three major subareas as shown above. The beige color denotes the lower floodplain area, the pink color denotes the North Fork and tributaries, and the green color shows the South Fork and its tributaries

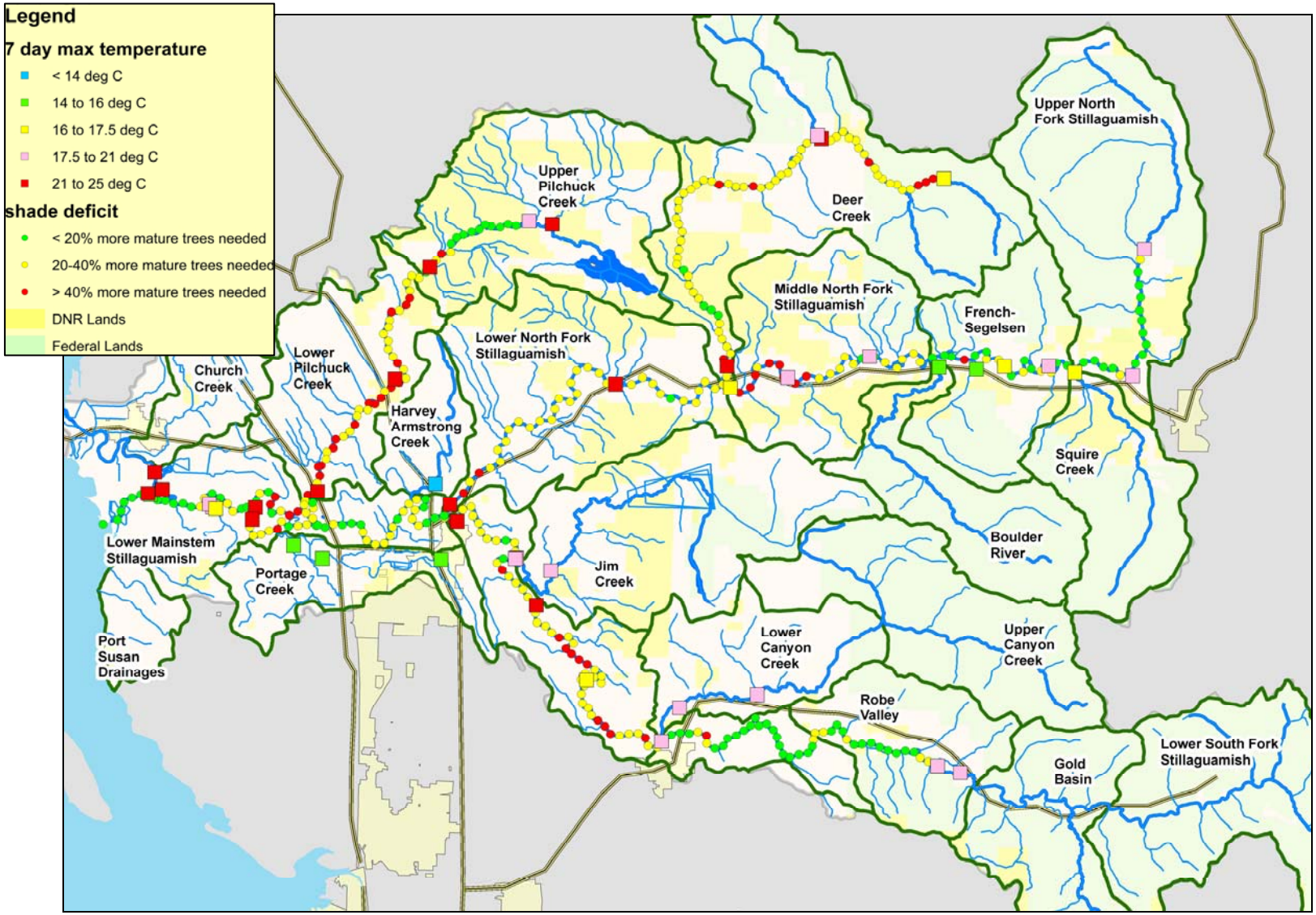

Figure 18. Comparison of shade needs for major river segments in the Stillaguamish Watershed.

In the following discussion, the Stillaguamish Watershed has been divided into three major subareas: Lower Floodplain, North Fork, and South Fork (Figure 17). Selected subbasins within these three major subareas are examined. Due to limitations on the amount of data, not all subbasins are discussed with the same level of detail. In the discussion of the near stream vegetation data, total forest is the combination of mature and medium evergreen forests and deciduous stands.

Lower floodplain sub area: The Lower Floodplain subarea receives most of its flow from the North and South Fork subareas. The river meanders through a flat and exposed floodplain, where it experiences extensive exposure to solar radiation and receives additional inputs of water from Pilchuck, Portage, Harvey Armstrong, Glade Bekken, and several other creeks. These tributaries that discharge into the mainstem, along with the Church Creek and the Port Susan drainages which do not, are discussed in more detail below.

During the warmest part of the summer (**critical conditions**), nearly all the water entering the mainstem is above state standards (Figure 18). The maximum **7-day average daily mean (7-DADM)** temperatures in the lower mainstem were shown to exceed state standards at several stations during July and August in the original TMDL (Figure 18).

From 1991 to 2001, there was about a 10 percent loss in forest cover and a 10 percent increase in grass cover in riparian areas. The amount of bare ground also increased by ~ 9 percent during that period. Overall forest cover in the lower floodplain near-stream area was ~ 31 percent, about half the amount in near-stream areas of the other upper basin subareas. Along the lower half of the mainstem riparian area, over 80 percent of potential shade was in place in the early 1990's. The upper half of the lower mainstem is still believed to have many areas where significant additional shade could be provided (Figure 18).

Portage Creek: Three locations in Portage Creek were monitored by the Stillaguamish Tribe during the TMDL study and none exceeded state standards (Figure 18). Although temperatures were below state standards, Portage Creek has relatively little high quality riparian habitat with only 19 percent in forest coverage. The amount of deciduous forest increased to 7 percent between 1991 and 2001. There was considerable change in grass coverage (decreased by 20 percent) and bare ground coverage (increased by 14 percent) with increases in medium and high density development of 8 percent.

In recent years, four wetland restoration projects were completed to help maintain stream flows during dry weather periods (base flows) and 8.4 miles of riparian area was replanted to improve stream cover. Given the low level of forested riparian areas, Portage Creek continues to be an important area for restoration activities that can aid in the reduction of high mainstem temperatures.

Harvey Armstrong Creek: Water temperatures stayed below state standards during critical conditions in 2001 in Armstrong Creek (14 ^{o}C.). Although the current 1:1 ratio of deciduous to coniferous vegetation appears acceptable, the amount of total forest cover of 39 percent is relatively low. With 32 percent of the riparian area in the shrub/small tree category, the potential for improving forest cover could however be high. Regardless, with

27 percent of land with grass and bare ground coverage, there appear to be many opportunities for improvement in riparian areas.

Pilchuck Creek: Seven-day average daily maximum (7-DADM) temperatures at five different stations spread throughout the Pilchuck watershed ranged from 22 to 24 ^{o}C. during the critical summer period. The new state standards for temperature in the Pilchuck are a 7-DADM of 17.5 ^{o}C up to 268th St, where it changes to 16 ^{o}C. Ecology modeling shows that riparian areas on all private land up to DNR forests provide far less shade than is needed (Figure 18). The problem persists for several miles into DNR land where potential shade levels increase to 80 percent. Water temperatures were also high in stream segments below Lake Cavanaugh where stream inputs from both public and private lands converged.

Riparian forest levels in the upper Pilchuck watershed dropped 17 percent to a total of 54 percent. There was a 12 percent net loss of mature forest cover in the lower Pilchuck subbasin, which has a relatively small amount of total mature cover of only 36 percent. There are a large number of private land holdings in the lower portion of this subbasin that could be investigated for improving riparian vegetation.

Church Creek: The Church Creek subbasin had an exceptionally low level of 20 percent forested cover, nearly all of it as deciduous forest. Deciduous forest in the near-stream area dropped from a low 26 percent to a lower 16 percent between 1991 and 2001. There was a 6 percent loss in grass coverage and a 6 percent increase in medium/high density development. Bare ground coverage increased by 16 percent. Thus, there appears to be considerable potential for improving riparian areas in the Church Creek area.

Port Susan drainages: Because of changes in land use analysis methods used for this area, the available data were clouded by an unusual increase in open water and unknown areas. Riparian forest cover in Port Susan drainages was low at 31 percent. There appears to be a lot of opportunity for providing additional shade. Port Susan drainages may have lost as much as 42 percent of their forest coverage between 1991 and 2001. Although portions of the data for the Port Susan drainages made the comparison of 1991 and 2001 land uses more challenging, it is clear that there was an excessive loss of mature forest cover and there may be many opportunities for riparian restoration.

Glade Bekken Creek: Glade Bekken Creek is a small tributary discharging to the lower floodplain subarea (not shown in Figures 17 or 18). Located just below the confluence of the North and South Stillaguamish Sloughs in the middle of the Lower Floodplain subarea, maximum 7-DADM water temperatures recorded at three stations near the mouth of Glade Bekken approached or exceeded state standards. Assuming that Glade Bekken is representative of small tributaries in the lower floodplain, these small streams should be analyzed closely for riparian restoration potential.

North Fork Stillaguamish sub area: The North Fork winds through a gently sloping mountain valley along Hwy 530 flowing from the town of Darrington down to Arlington at RM 17.8. It includes the Upper North Fork, French Segelsen, Middle North Fork, Lower North Fork, Squire Creek, Boulder River, and Deer Creek subbasins (Figure 17). The latter three are major tributaries.

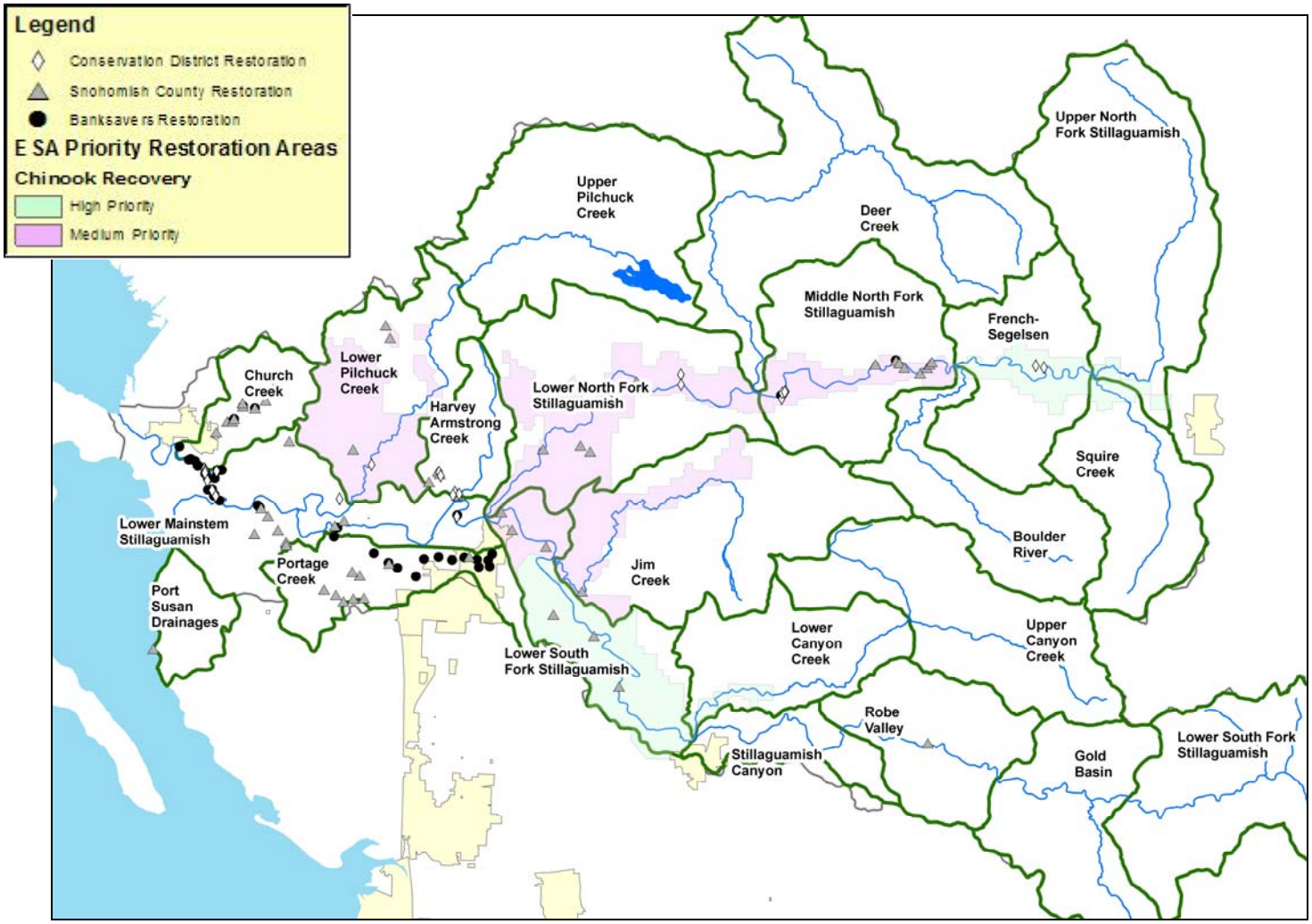

Figure 19. Riparian Restoration in the Stillaguamish Watershed. Many riparian restoration projects have been undertaken in recent years. The priority restoration areas identified in the *Stillaguamish River Chinook Recovery Plan* show where restoration efforts can help meet salmon recovery goals as well as the water quality objectives targeted by this *Action Plan*.

Riparian areas along the valley floor are privately owned and do not provide optimal shade along most of the river's length until reaching the Boulder River just east of Hazel (Figure 18). During most summer months, the recently revised state standards for the North Fork call for 7-DADM temperatures of 16 ^{o}C. from the confluence of the North Fork with the mainstem Stillaguamish up to the Boulder River. Above the Boulder River, summer standards are set for the needs of char at 12 ^{o}C. From the period September 1-July 1, much of the mainstem must now meet the 13 ^{o}C. supplemental spawning and incubation standards (see Appendix B, Table B-2 for more details on where the new standards apply).

Critical period 7-DADM temperatures in the mainstem North Fork ranged from 17 to 22 ^{o}C. up to the Hazel area, dropped a few degrees above Hazel, then increased to about 20 ^{o}C. at the USFS boundary.

Overall mature forest cover in the near-stream area was about 58 percent in 2001. Shrub and small tree coverage increased to about 28 percent from 1991 levels suggesting that the long term potential for returning to a forested condition with existing vegetation would be 86 percent if the latter figure was fully represented as small trees. Between 1991 and 2001, there was a loss of about 4 percent riparian forest cover. Deciduous forest dropped about 6 percent as medium evergreen forest increased by 3 percent. The loss in forest cover may have been balanced by the 5 percent increase in shrub/small tree coverage; however, our present analysis tools do not allow us to determine whether this new coverage is new trees or blackberries. There appear to be numerous opportunities for improving mainstem riparian areas all along the North Fork, especially up to the Hazel area (Figure 18).

Deer Creek: Just over 14 miles from the confluence of the North Fork with the mainstem Stillaguamish is the major tributary Deer Creek. Deer Creek is almost exclusively contained within forest production areas held by a combination of private interests and state and federal government. During critical periods the water entering the North Fork had a 7-DAMD temperature of 21.5 ^{o}C. Water temperatures as high in the watershed as Little Deer Creek (about 14 miles upstream) ranged from about 21 to 23 ^{o}C., with temperatures dropping to 16 ^{o}C. in USFS lands. Mature forest cover in riparian areas reflected those found overall in the North Fork subbasin and dropped only 2 percent over the period 1991 to 2001. Federal, state, and private forest lands, full shade potentials along the mainstem had not been reached as of 1993 (Figure 18).

Boulder River and other upper forest production subbasins: The Boulder River is typical of the upper North Fork subbasins where a combination of DNR and USFS lands make up the majority of the landscape. Entering the North Fork about 24.5 miles above its confluence with the mainstem Stillaguamish, Boulder Creek contributed relatively cool water of about 14 ^{o}C. during the summer critical period (7-DAMD). The Boulder River, like most of the upper North Fork watershed is in USFS lands, where the most conservative buffer widths for forest management activities are found (150' each side of perennial streams). State forest lands account for nearly all of the remaining land. This area may eventually contribute even cooler water as riparian vegetation ages and the beneficial effect of federal and state forest management plans grow. Figure 18 shows that there may be many opportunities for improving shade in the upper forest production subbasins.

South Fork Stillaguamish sub area: The South Fork stretches about 70 miles into the Cascade Mountains past Granite Falls and into the Mount Baker-Snoqualmie Forest. Its major tributaries are Jim Creek and Canyon Creek. Recently revised state standards for temperature call for a 7-DADM of 16 ^{o}C. during summer months for the mainstem South Fork up to Cranberry Creek in the Robe area. Above that point the char standard of 12 ^{o}C 7-DADM applies. Jim Creek above Little Jim Creek (about 15 miles from the confluence with the South Fork) and Canyon Creek about 1 mile above the crossing at Jeep Trail (about 6.2 miles from confluence with South Fork) have the char standard of 12 ^{o}C. during most summer months.

Critical period temperatures in the mainstem South Fork ranged from about 17.5 to 23 ^{o}C. 7-DADM during the TMDL study period. Water temperatures were measured at 19.5 ^{o}C. shortly after leaving USFS lands and generally did not improve until traveling below Granite Falls where it dropped to 17.5 ^{o}C. Water temperature increased again shortly downstream to 22 ^{o}C. Large stretches of broad stream meander zones exist throughout the South Fork. This condition extends into USFS land as well. The upper temperature station near the USFS boundary is very likely influenced by the high level of solar radiation in the wide stream beds caused by excess sediment from the Gold basin landslide and unstable forest roads in the upper watershed.

Overall, there was about a 5 percent loss in riparian forest between 1991 and 2001 to a total of 64 percent riparian cover. The largest decreases occurred in Lower and Upper Canyon Creek watersheds, which had 11 and 13 percent losses in mature evergreen forest, respectively. Shade potentials fell short throughout the mainstem riparian area from the confluence with the mainstem up until the Granite Falls area where there was a marked improvement beyond Canyon Creek.

Jim Creek: Jim Creek is predominantly in private ownership. A portion of the headwaters, approximately 1,600 acres, are USFS lands. Approximately 4,000 acres near the headwaters are under the management of the US Navy, where a 5,000' reach of unvegetated tributary stream allows the ground network portion of the long wave radio antenna to function. The remainder is a mix of private and DNR lands. Riparian areas in public ownership were primarily conifer forests while private lands were generally mixed conifer and deciduous vegetation in 1993 (Pess et al. 1999). Water temperatures in lower Jim Creek during the 2001 critical period were about 19 ^{o}C. 7-DADM, which is well above the state standard of 16. ^{o}C. No data are available on temperatures in the upper watershed.

Changes in forest cover were small in the Jim Creek watershed. The total forest coverage is 57 percent in the riparian zone with small shrubs and trees accounting for nearly 30 percent of vegetation in the near-stream area. Bare ground levels increased 4 percent. Because temperatures are well above state standards in the basin, areas of the Jim Creek watershed with shrub/small tree, grass, or bare ground should be evaluated to ensure that proper riparian vegetation is in place for growth and protection of the stream in the future.

Canyon Creek: Canyon Creek meets the South Fork about 16 river miles above its confluence with the North Fork at Arlington. Each of the 3 monitoring stations in the lower 10 miles of the Canyon Creek watershed had critical period temperatures of 20 ^{o}C. or higher during the TMDL study period. The headwaters of Canyon Creek are in USFS lands,

whereas most of the lower Canyon Creek basin is in private ownership. Upper Canyon Creek had a relatively high amount of total forest cover (76 percent) compared to other watersheds in 2001.

Total forest cover dropped 14 percent to a total of 55 percent in the lower part of the Canyon Creek watershed. Shrub/small trees accounted for 17 percent of Upper Canyon Creek suggesting good long term potential for restoring riparian cover over the long term if that vegetation is comprised of small trees. Gains of 13 percent were seen in the combined category of shrubs/small trees, grass, bare ground, and developed areas in the lower watershed. Like other river and stream segments in the Stillaguamish, there appears to be a number of areas in the mainstem of Lower Canyon Creek that have wide channel meander zones. It is not clear from orthophotos whether these are natural conditions or a result of sediment inputs and altered hydrology from past logging practices.

Because most of the Canyon Creek Watershed is managed under state and federal forestry management practices, work performed in this basin is generally confined to those implementing agencies, or their partners.

What Should be Done to Provide More Shade and Improve Riparian Areas?

This *Action Plan* recognizes that 130 years of development and resource extraction in the watershed resulted in the current impaired condition in the Stillaguamish Watershed. It will require patience and persistence to mitigate or repair the effects of those earlier actions. In the case of some landowners along small tributaries, simply removing animals from streams and establishing a small buffer will be an important step. Over time, each project helps move the local community towards the long-term goal of allowing native vegetation and channel forming processes to become reestablished. However, all projects should strive to establish conditions that will return local waters to good health in the shortest reasonable timeframe. The locations of many projects completed over the last 10 years are shown in Figure 19.

This *Action Plan* encourages all affected landowners (and developers in urban/rural residential areas) to maximize buffer widths consistent with reasonable land use expectations to help filter out pollutants, provide stream shading during summer months, and protect or improve stream hydrology. Because much of the watershed is regulated under other plans or agreements such as the on USFS lands and the Forests and Fish rules on large private forest and DNR lands, this plan emphasizes the work that is needed on privately held lands.

Private lands that are not managed by state and federal forestry regulations are generally concentrated along the mainstem Stillaguamish and tributaries and include much of the entire length of the North Fork and all of the South Fork downstream of Granite Falls. Figure 18 and related text in this *Action Plan* should be used as an initial guide to help prioritize where additional effort is needed. Where there is inadequate information on site shade potential, information should be collected. Where it is determined that shade potential will not be maximized through the growth of existing vegetation, this *Action Plan* recommends well planned and executed riparian protection and habitat enhancement projects.

Although projects should be designed to meet site-specific conditions and landowner expectations, they should generally be judged or prioritized by their ability to address the following critical elements for success:

Promote high design standards: Projects should strive to establish buffers of at least 100' on each side of a fish bearing stream and 35' on non fish-bearing streams. Planting sites should be properly prepared based on local soil, topography, and location within the channel migration zone. The need for annual plant maintenance for a period of 5 years following plantings should be evaluated and always be included where the previous dominant vegetation was composed of blackberries, reed canary grass, Japanese knotweed, and other invasive or noxious weeds. Restoration specialists should regularly review the success of techniques to ensure that planting, watering, weed management, and outreach techniques are the most effective ones available.

Focus work where it is needed: Although project managers should take advantage of all good opportunities for improving riparian vegetation, a systematic approach to developing successful projects is encouraged by this *Action Plan*. Subbasin-scale projects should start with a clear understanding of where planting needs exist and focus outreach efforts on those properties—GIS based tools are available to facilitate this. All organizations completing riparian restoration projects should share information on the location, type, and amount of restoration performed through the Stillaguamish Implementation Review Committee and its related activities.

Monitoring project effectiveness is critical to long-term success: Monitoring the effectiveness of projects helps ensure that the time and effort of public, private, and citizen resources are put to the best use. Most project managers have some level of effectiveness they are required to meet as part of their riparian planning projects. Forestry management, city and county mitigation plantings, and even voluntary riparian plantings are examples of different projects subject to different rules. Federal (EPA Clean Water Act 319 fund program), state (Joint Legislative Audit and Review Committee), and local authorities are demanding additional data regarding accountability. All project managers should consider including an effectiveness monitoring component that is representative of the work they are doing.

Monitoring of project effectiveness can be done in many ways and should help improve the quality of restoration projects over time. All relevant aspects of a project should be considered for effectiveness assessment. Initially, the efficiency of outreach efforts (changes in stakeholder behavior, number and percentage of watershed residents participating, etc.) can be evaluated. After plants are in the ground, it is important to establish good baseline monitoring and plan for additional monitoring at approximately 5 year intervals up to 15 years. Plant type and survival rates should be calculated for representative projects. Water temperatures should be measured, along with reductions in bacteria or nutrients where appropriate.

The SIRC is establishing a Monitoring and Adaptive Management Plan as part of its work on the Puget Sound Chinook ESU. All monitoring efforts should be coordinated to reduce duplication of effort.

The evolving condition of riparian areas throughout the watershed should also be evaluated periodically. Factors that should be analyzed through GIS analysis and associated field verification include trends in riparian vegetation composition and stream width.

Use innovation to overcome obstacles: Where there are impediments to progress in meeting TMDL goals, this *Action Plan* encourages innovation to solve difficult problems. For example, if economic issues stand in the way of increasing buffer sizes after all available tools have been used, then new policies and strategies should be investigated to resolve this problem such as secondary crop harvests (fiddleheads, mushrooms), the use of carbon credits, additional private or public support, or changes in current regulations.

If research is needed to investigate new watershed tools, this *Action Plan* supports targeted pilot projects to test new techniques and hypotheses to improve progress toward reaching water quality goals on a long term, sustainable basis.

This *Action Plan* recognizes that the state-of-the-art for restoration projects can be site-specific and is constantly evolving and improving. All restoration projects should strive to follow the latest standards for their development, execution, and maintenance.

Relationship of this TMDL to land use decisions: Ecology's water cleanup process does not in itself bring any authority to control local land uses that improve and protect local water quality. However, federal, tribal, state, and local governments and non-governmental organizations should incorporate the recommendations of this TMDL in the revision or development of their Critical Areas Ordinances, Shoreline Management Plans, and other land use regulations during the public process to allow for effective outreach and involvement by the public. The public should be provided information explaining how those authorities will optimize stream shading to restore and protect critical habitat.

Special note on private, state and federal forest lands: Although Figure 18 indicates some riparian shade needs on private, state, and federal forest lands, this plan places most emphasis on areas where no other existing federal or state plans are in place. However, all land managers within the basin are expected to refer to this *Action Plan* for guidance and to consider the implementation of this plan in the ongoing management of forestlands and revision of existing regulations and agreements.

In accordance with the Forest and Fish agreement, Ecology is relying on the adaptive management component of the Forest and Fish process to bring private and state forestlands into compliance with the state water quality standards and the goals of this *Action Plan*. This formal adaptive management process is designed to test the effectiveness of the forest practices rules in protecting water quality and meeting the state standards. Forest harvest prescriptions in the rules that are found inadequate will be subject to revision based on the results of the research being carried out by interdisciplinary teams of forest science specialists. The next key date for reviewing the effectiveness of the current forest practices rules is 2009. If the research available at that time cannot show the rules meet, or are on a clear path to meet, the water quality

standards at that time, Ecology will consider setting separate load allocations for the forested portions of the watershed subject to this TMDL.

The regulations for private, State Trust, and national forestlands are discussed below.

Private Forests: Private forests must follow the Forest Practices Rules (FPRs, Chapter 76.09 RCW) and the *Final Forest Practices Habitat Conservation Plan* (FPHCP). The FPRs are regulations adopted by the Forest Practices Board that establish minimum guidelines for timber harvesting and riparian forest management. Riparian vegetation must remain intact along all perennial streams, except where silvicultural activities will accelerate the development of healthy, functioning riparian forests[5]. The FPHCP is designed satisfy National Marine Fisheries Service and U.S. Fish and Wildlife Service concerns that all forest practice activities set out in the Forest Practices Rules will fully satisfy federal requirements for protection of aquatic species.

State Trust Lands: State Trust Lands are subject to the FPRs as well as the *State Lands Habitat Conservation Plan* (HCP). The HCP is a multi-species agreement that ensures management activities on State Trust lands will not result in degradation of habitats that are important for federally listed species.

Buffer widths depend on the stream type[6]. Fish bearing streams have a site index buffer applied. The width of a site index buffer depends on the productivity of the soil, and is equal to the height the site dominant tree species is expected to get in 100 years. Streams that have an average bank full width of two (2) feet or wider have a 100' riparian buffer applied. Streams that do not meet either of these requirements have no buffer, but are treated as operational limitation zones.

Currently, under the HCP, some silvicultural activities are allowed within the riparian management zones if the stand does not meet the desired future condition. Where riparian zones will be entered, a core zone of 25 feet on each side of the stream is considered a no touch area, and is not subject to any management practices. Within the remaining buffer area, thinning can occur, as well as creation of downed woody debris and snags. It is expected that these activities will have a positive influence on the stream itself, as well as on the riparian ecosystem and the species which rely on it.

National Forest Lands: The US Forest Service (USFS) is the designated management agency for meeting federal Clean Water Act requirements on national forest system (NFS) lands within the state of Washington. This authority is set forth in the Memorandum of Agreement between the USDA Forest Service (Region 6) and Ecology for meeting responsibilities under federal and state water quality regulations (USDA and WDOE 2000). Under this agreement, the Forest Service ensures that all waters on NFS lands meet or

[5] Detailed descriptions of different riparian scenarios for private forest lands are available in the Forest Practice Rules (Timber Harvesting section, 222-30); stream type descriptions are also in the forest practice rules (Definitions section, 222-16) available online at http://www.dnr.wa.gov/forestpractices/rules.

[6] For a description of what occurs on State Lands, refer to the HCP Riparian Forest Restoration Strategy, found at http://www.dnr.wa.gov/hcp/rfrs/

exceed water quality standards, laws and regulations, and that activities on NFS lands are consistent with the level of protection of the Washington Administrative Code relevant to state and federal water quality requirements.

The Darrington Ranger District of the Mt. Baker-Snoqualmie National Forest (MBS) manages lands under its jurisdiction within the Stillaguamish River according to direction in pertinent management documents. The *MBS Land and Resource Management Plan* was signed in 1990 (MBS 1990) and amended in 1994 by the Record of Decision for Amendments to the Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl (USDA and USDI 1994), also known as the *Northwest Forest Plan* (NWFP). These two documents establish goals and objectives, standards and guidelines, and a system of management areas and land allocations for management of the MBS.

The purpose of the *Northwest Forest Plan* is to move National Forest management, in the range of the Northern Spotted Owl, into a more ecosystem and science-based approach. The objectives of the NWFP are as follows:

- Meet requirements of existing laws and regulations,
- Maintain a healthy forest ecosystem, including riparian areas and waters, with habitat that will support populations of native species (particularly those associated with late-successional and old-growth forests), and
- Maintain a sustainable supply of timber and other forest products that will help maintain the stability of local and regional economies on a predictable long-term basis.

Restoration of stream temperatures and sediment regimes on National Forest System lands in the Stillaguamish River rests heavily on implementation of the NWFP standards and guidelines, and specifically, on the *Aquatic Conservation Strategy*. As part of the Aquatic Conservation Strategy, the USFS has completed a number of Watershed Analyses (a detailed assessment of geomorphic and ecological processes in the Upper North Fork Stillaguamish River, Canyon Creek and Lower Stillaguamish River, Upper South Fork Stillaguamish River, and Deer Creek) and has designated NFS lands in the Stillaguamish River (both the North and south Forks) as a Key Watershed.

Key Watersheds are considered crucial to at-risk fish species and stocks and for maintaining high water quality. Activities to protect and restore aquatic habitat in Key Watersheds are higher priority than similar activities in other watersheds. Riparian Reserves (areas around streams, wetlands, ponds, lakes, and unstable or potentially unstable areas) have been established and are managed to maximize shade and large wood recruitment. As a Key Watershed, restoration activities in the Stillaguamish River will be of higher priority than in non-Key Watersheds across the forest.

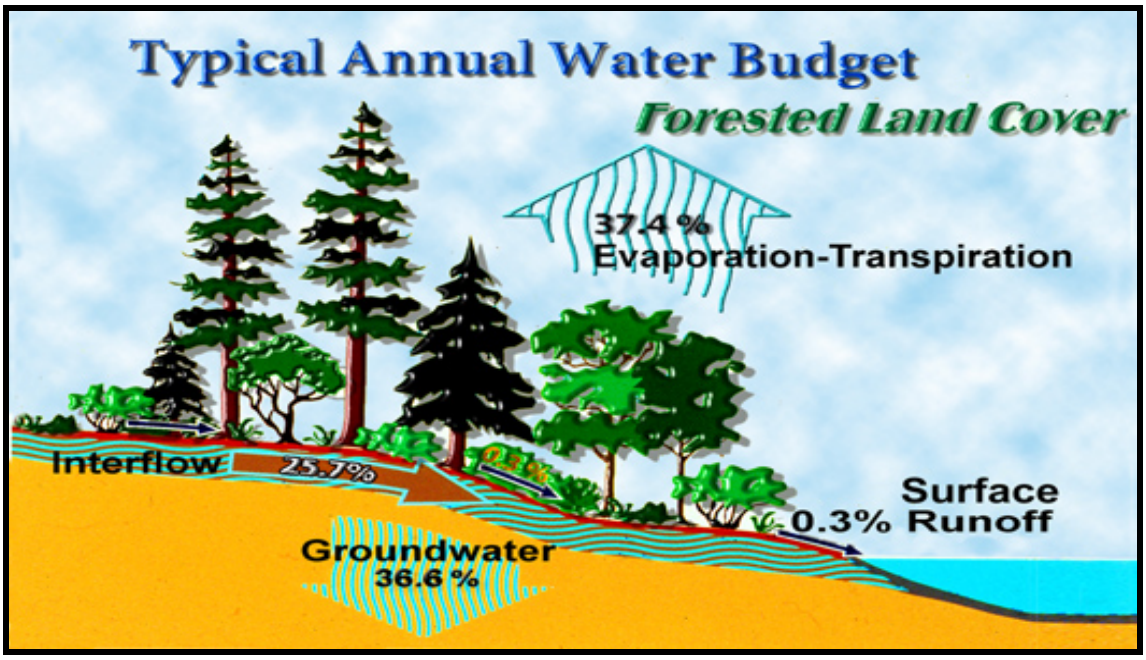

Figure 20. Forested Land Cover helps protect streams and aquifers. Forests capture rainwater and return much of it to groundwater or back into the atmosphere. Streams and rivers receive water slowly over a longer period. Streams need groundwater during the summer to support fish and provide recreational opportunities. Groundwater also provides drinking water throughout the year.

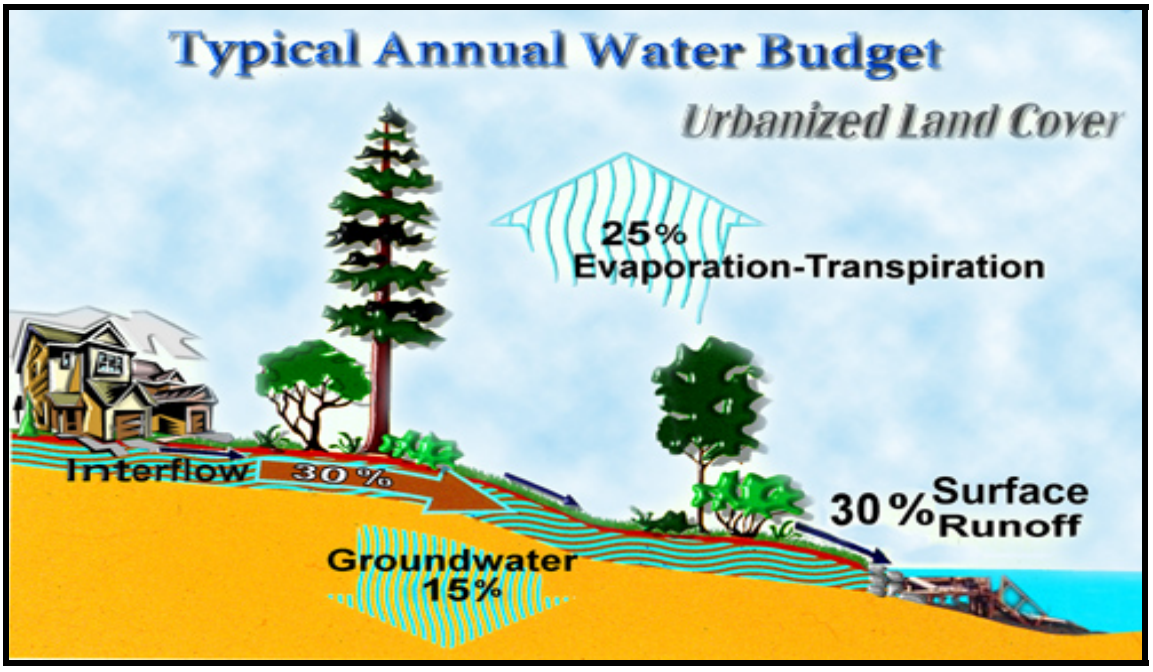

Figure 21. Impervious surfaces increase runoff and reduce groundwater storage. Hard surfaces like roofs, roads, and parking lots do not soak up water like a forest. Urban streams are likely to have less water during the summer because there is less groundwater recharge. Because surface runoff is higher, stream erosion and flooding are a problem.

Most of the NFS lands in the Stillaguamish River are designated wilderness or Late-Successional Reserve. This means that the majority of the watershed will be managed to protect and enhance conditions of late-successional forest ecosystems, which serve as habitat for late-successional and old-growth species.

Ecology and the USFS are currently developing a joint plan to manage federal forests to ensure compliance with state and federal water temperature standards and goals. This plan is expected to be completed in 2008.

Protecting Cool Groundwater and Restoring Natural Hydrologic Processes

Hydrology is the study of the water cycle. Water from rivers, lakes, and oceans evaporates and is returned to the earth as rain and snow. Under natural conditions much of that rain and snow is captured by plants, infiltrates into the ground, or is stored in wetlands. Stored water feeds local creeks during our long dry summer months. Natural water storage processes also help to filter out pollutants. Existing inflows of cool groundwater and tributaries benefit the Stillaguamish River system throughout the year, especially during the warmer, drier, summer months. In addition to keeping overall water temperatures low, groundwater surface seeps and inputs through the **hyporheic zone** (Figure 16) can also provide important areas of refuge for fish where surrounding water temperatures are high.

Human activities can alter river and stream hydrology. Changes in land use generally affect streams and rivers by 1) increasing the size and number of peak flow events, and 2) reducing groundwater recharge and summer base flows. A third activity is excessive withdrawal of groundwater, which can also reduce summer base flows. Each of these processes is discussed below.

Peak Flows

Land development practices typically result in an increase in roofs, roads, and parking lots and a decrease in natural storage facilities such as wetlands and beaver ponds. These new land uses are called impervious surfaces because they do not absorb water. Water that lands on our roads and parking lots runs quickly to local streams, frequently with no treatment and no chance to be absorbed into the ground. Development practices that quickly send this unabsorbed water (**stormwater**) to the nearest creek or stream can deposit pollutants, create turbid water, widen streams, and contribute to the loss of fish habitat (CWP 2002).

Stormwater that makes its way quickly to local streams causes water levels and speeds to increase quickly. As water levels and speeds increase, stream sediment begins to move and erosion of stream banks can occur. Although a certain amount of sediment movement and erosion is normal, stormwater from developed areas causes this to happen much more frequently than normal. Besides the destruction of stream habitat where the erosion occurs, downstream areas suffer too when the water slows down and deposits that sediment. Downstream areas become wider, shallower, and warmer during summer months. For people and animals downstream this can mean inconvenience or even destruction of property as the amount of flooding increases.

Reduced Base Flows

Puget Sound lowland streams depend on groundwater and water stored in wetlands to keep them flowing during the dry summer months when rain and snow are not present. This relatively unseen process occurs in the form of groundwater seeps and through **hyporheic exchange**. When water runs off as stormwater and is no longer absorbed into the ground, it is no longer available to recharge groundwater and support this process.

Where a stream is open to sunlight, or where pollutants are being added through human activities, a reduction in stream flows makes the pollution problem worse. The temperature of water can get higher and the concentration of pollutants in the water can become greater. Decreasing summer baseflows increases the challenge that we face as a society to return streams to good health.

Where has Natural Hydrology been Altered?

Due to the complexity of scientifically documenting the specific causes of altered hydrology in a watershed as large as the Stillaguamish, this *Action Plan* has not attempted to identify specific problem areas. In general, there are four areas of human activities most likely to alter natural hydrology: 1) areas of increasing urbanization, 2) areas of excessive water withdrawal, 3) areas where forestry practices have dramatically altered land use, and 4) climate change.

Urbanizing areas: Although it is just common sense that reducing that absorption of water will result in lower streamflows, there is relatively little research on this difficult to measure process in urban areas. Current research on the reduction of summer base flows by increasing amounts of impervious cover is still inconclusive (Konrad and Booth 2002, CWP 2002). Some studies suggest that summer base flows in urban creeks are likely augmented by water imported from other basins (Konrad and Booth 2002, Kerwin 2001), which could be discharged as excess lawn irrigation water, water system leakage, or septic tank discharge. We do not want to depend on these sources of water to maintain healthy stream flows. More conclusive research is expected to be completed in the future.

Where people live there will be an increase in roofs, roads, and parking lots so the potential for adverse impacts from impervious surfaces will occur in those areas (Figures 20, 21). This plan generally considers the urban areas in Arlington, Marysville, Granite Falls, and unincorporated Snohomish County to pose the greatest threats to natural hydrologic processes.

Water withdrawals: Growing populations need clean drinking water and places to live. Outside of urban areas, groundwater is the key source of water for new development. Ecology has set minimum instream flows and allowable groundwater withdrawal rates to protect those instream flows.

The city of Arlington may have a seasonal effect on base flows in the Stillaguamish in the area near the confluence and downstream (Figure 22). On an annual basis, Arlington obtains about one third of its potable water from an interbasin transfer from the Sultan River. Most of this water, in addition to the city's withdrawals within the basin from the Haller Well Field, discharges to the river through the Arlington WWTP.

During 2004-2006, the amount of water withdrawn from the local aquifer exceeds the WWTP discharge on 55 to 73 days each year. The largest difference between withdrawals and discharges was about 1.7 cfs, or about 0.6 percent of the 7Q20 flow in the mainstem Stillaguamish. Although this analysis suggests the potential for a slight loss in mainstem base flows, additional work on locating the well field impacts, aquifer characteristics, and other factors are needed to quantify the net effect on mainstem flows. Ecology considered the impact of Arlington water use when it set minimum instream flows.

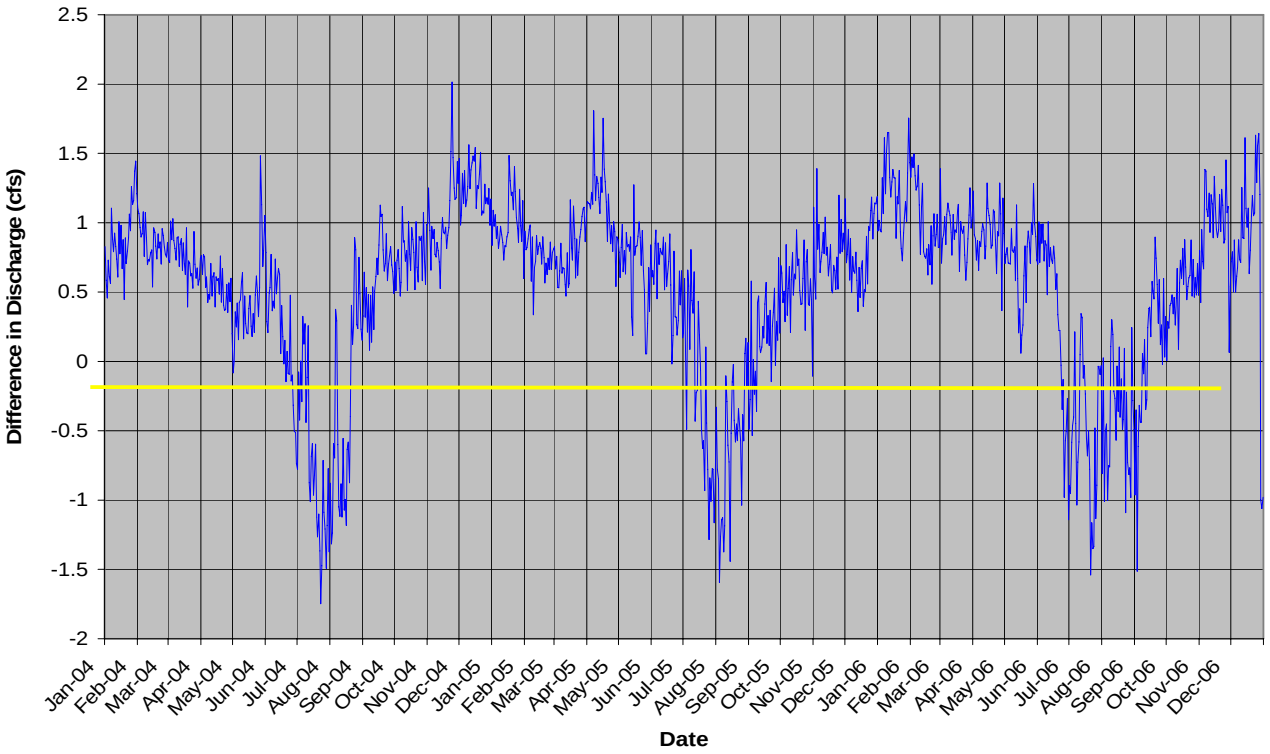

Figure 22. Balance of water withdrawal and water discharges by the city of Arlington. Arlington withdraws more water than they discharge during part of the dry summer season.

Changes in land use from forestry activities: This *Action Plan* recognizes that large scale land use changes from forestry activities affect watershed hydrology. Changes in interflow, groundwater storage, and surface runoff can occur from the construction of roads and clearing of land that results from forestry activities. However, it was not possible to perform a review of current literature to provide more information on this topic for this report. It is expected that existing forestry management rules and plans will consider this impact on water quality as they are revised. Ecology is currently working with the U.S. Forest Service on a regional plan to manage forests in a way that will protect water temperatures.

Climate change: Although this *Action Plan* recognizes the potential effect of climate change on stream flows in the future, it is beyond the scope of this document to examine any current effects or to predict future challenges. As more information on the potential effects of climate change in the Pacific Northwest become available, they should be considered during the adaptive

management of the Stillaguamish River TMDL *Action Plan*. More information on climate change can be found at www.ecy.wa.gov/climatechange/.

What Should be Done to Improve and Protect Hydrologic Processes?

The key activities recommended by this Action Plan to improve and protect hydrologic processes are to reduce the effect of impervious surfaces and protect and enhance groundwater flows that provide water during dry weather periods. Each of these activities is discussed in more detail below.

Reduce the effect of impervious surfaces in urban areas: To help reduce the effect of new and existing stormwater discharges, this plan recommends that state and local government work together to advance the use of **Low Impact Development (LID)** practices in new development and redevelopment. Low impact development is a stormwater management and land development strategy applied at the parcel and subdivision scale that emphasizes conservation and use of on-site natural features integrated with engineered, small-scale hydrologic controls to more closely mimic pre-development hydrologic functions (PSAT, 2005). Ideally, as a basin is developed, site planning and stormwater management are integrated at the initial design phases of a project to maintain a more hydrologically functional landscape.

Snohomish County has adopted an ordinance that helps facilitate the use of LID practices. The county also helps coordinate the activities of the Sustainable Development Task Force, a group of public officials, private businesses, environmental interests, and citizens to promote and utilize sustainable planning, design, and construction in Snohomish County. The city of Arlington is examining the incorporation of LID into its building codes as well.

It is important to remember that much of our pollution problems are a result of past practices that will not be solved even if we do everything right in new building projects in the future. For that reason, local government should also examine areas of existing development for LID retrofits as funding allows.

This *Action Plan* encourages the Puget Sound Action Team (PSAT), cities within the watershed, and Snohomish County to coordinate activities that will speed the transition of builders from the use of high impact development practices to LID practices where practical. Training should be provided for city and county staff as needed.

Individual land owners should examine stormwater pathways on their properties and assess the feasibility of infiltrating stormwater onsite to maintain groundwater levels and reduce the potential for creating contaminated stormwater. On all properties, protecting existing trees and planting new ones, especially evergreen species, should help maximize evaporation and reduce stormwater volumes. In urban areas, the installation of rain gardens, and addition of soil amendments to yards are key tools for small landowners. Rural landowners with livestock should manage pastures to prevent soil compaction by decreasing or eliminating winter grazing (see the Snohomish Conservation District for details).

Protect and restore cool goundwater inflows throughout the watershed: Land use and water withdrawal are the key human actions that can be controlled to help protect and restore

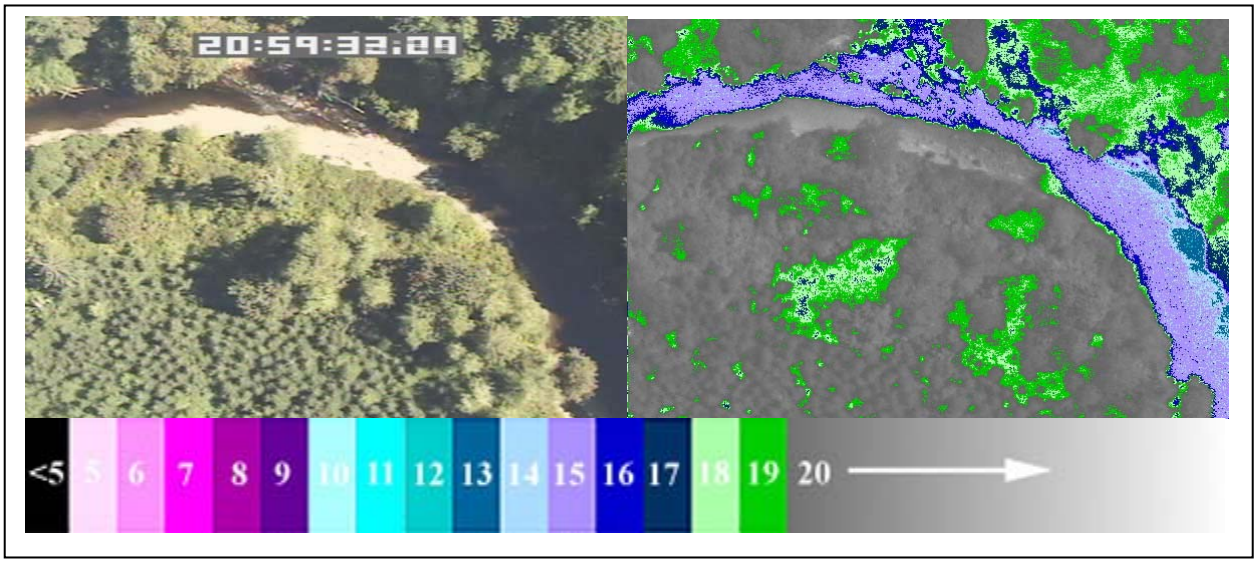

Figure 23. Thermal Infrared Imaging. Ecology Stillaguamish Thermal Infrared Imaging (TIR) study shows a cool pocket in Pilchuck Creek at mile 4.8, left bank (left side of the river going left to right).

groundwater inputs to the Stillaguamish Watershed. County and city planning departments should protect streamside lands with springs and side channels that provide habitat, refuge, and cooler water to salmon species.

In September 2001, Ecology conducted an aerial Thermal Infrared (TIR) photographic study of the Stillaguamish. The data (for an example see Figure 23) include aerial photographs paired with corresponding infrared images showing surface temperatures indicated by a color key (for more information visit Ecology's web site at: http://www.ecy.wa.gov/apps/watersheds/temperature).

The Stillaguamish TIR data may be useful for identifying cool-water-contributing reaches that should be protected and for finding locations for future riparian and streambed restoration projects. The Stillaguamish Tribe, for example, consults these data as it researches good locations for large wood debris placement.

Ecology tracks the number of well logs received that are located in the Stillaguamish Watershed using a geographic information system (GIS). Ecology publishes a notice of water used in the fall of each year. Ecology anticipates that is will be able to count the multiple residences using a single new well, so that water used under the reservation may be more than a straight number of wells time multiplied by a water duty. Ecology will attempt to account for water use within a sewer area differently than those on septic (350 or 175 gpd respectively) as well.

This *Action Plan* encourages the following activities to help protect and restore surface water flows in the Stillaguamish Watershed:

- *Additional research into the identification, protection, and creation of areas making important groundwater contributions to the Stillaguamish Watershed.* Projects that take a landscape approach to understanding groundwater processes on a watershed or

subwatershed basis are highly encouraged and should consult Ecology's TIR study as applicable. The strategic placement of large woody debris to improve the amount of cool water inputs and localized fish refuges is highly encouraged as a means of implementing this TMDL. Because little is known about the location of critical hyporheic zones and impaired areas that no longer provide cool groundwater, this Plan recommends additional study in these areas as they apply to improving stream temperatures.

- *Ecology should continue to track water withdrawals* to ensure that instream flow protections are maintained. Local governments should stay aware of instream flow restrictions and plan for future development with those restrictions in mind.
- *Reduce water demand through conservation.* Reducing water demand will ultimately conserve and perhaps increase groundwater supplies.
- *Examine the feasibility of purchasing and transferring existing water rights.* This *Action Plan* encourages projects that seek to work with local communities or individuals to voluntarily retire water rights to help ensure that instream flow levels are maintained.

Controlling Sediment Inputs and Improving Channel Morphology

Excessive sediment loading can affect local waters and aquatic life by covering salmon eggs and filling streams so that they become wider and more shallow. Mercury loads were strongly associated with suspended solids in the Stillaguamish River (Lawrence and Joy 2005). The problem of covering salmon eggs with sediment is called "cementing" a redd. A redd is where salmon deposit their eggs. Cemented redds get clogged with fine sediment causing poor water flow through the gravel. Without good water flow, oxygen levels needed by developing eggs are too low causing them to die.

Making a stream wider and shallower can also affect water temperatures and dissolved oxygen levels. This problem happens in parts of the stream where water velocities decrease and sediment falls to the bottom of the stream. The new sediment sources cause the stream to spread out and become wider. When the stream is wider, more water comes into contact with air and sunlight making the water warmer. The warmer water holds less oxygen to support fish and other aquatic life.

Bank erosion in streams and rivers is part of a waterbody's evolution. When it occurs a natural levels, the process of erosion brings in fresh gravel to support healthy aquatic invertebrate communities as well as provide good salmon spawning substrates. However, when human activities change stream hydrology and increase water flows, the force of the higher flows accelerate this process. When trees and native vegetation are cleared from riparian areas, the loss of roots make banks more susceptible to erosion as well. Unvegetated banks located at the outer edge of a river or stream bend are especially vulnerable and can cause both a destruction of fish habitat and significant property loss.

Controlling sediment input from the upper watershed is the primary mechanism utilized by this *Action Plan* to control mercury levels. Where sediment containing metals is disturbed, drinking water uses at downstream locations could be impaired. Elevated mercury levels observed in the

basin are from natural sources and can only be controlled by managing inputs from erosion and landslides.

Where are the Problem Areas?

The most common sources of sediment in the Stillaguamish watershed include 1) landslides, 2) erosion resulting from poor forestry management practices, and 3) construction site runoff and hydraulic scouring following urban and rural development.

Landslide problems: The watershed includes some very large natural landslides as well as landslides caused by human activity. Land use practices during the period 1870 to 1900 included the clearing of forests from the floodplain of most of the mainstem as well as significant portions of the North and South forks (Collins 1997). Those clearing activities removed stabilizing vegetation, eliminated a source of woody debris to the channels, increased streambank erosion, and altered the hydrology of the river system. As timber harvest and road building continued at higher elevations in the watershed during the mid-twentieth century, the resulting physical and hydrological modification of the watershed led to landslides with their heavy load of sediment to the Stillaguamish.

According to a study of landslides in the watershed by Collins (1997), "Nearly all landslides in the Stillaguamish basin (97 percent) are in the North and South fork basins. Three quarters are associated with land uses, mostly clearcuts (52 percent) or roads (22 percent). Shallow-rapid failures are the most common (59 percent), with debris torrents accounting for 18 percent and deep-seated landslides for 21 percent. Most deep-seated landslides were in glacial deposits. These are predominantly in Deer Creek (North Fork), Higgins Ridge, Gold Basin, Canyon Creek, and Hell-Hazel basins." Two major landslide areas are shown in Figure 24.

Forestry practices (land clearing and logging road Treatments): The active channels in many of portions of the Stillaguamish Watershed have widened as a result of logging of riparian forest after the late 1800s (Pess et al. 1999). Changes in stream hydrology reduced tree root strengths allowing bank erosion to widen the channels. Sediment input from the resulting erosion and from unstable logging roads made the problem worse. A number of forest roads located on steep slopes on susceptible soils that are especially susceptible to erosion and creation of landslides are shown in Figure 24 (SIRC 2005). Placement of roads too close to riparian areas increases the chance of land slides and erosion.

The Tulalip Tribes concluded that the North Fork delivered over nine times the sediment load on average than the South Fork. The Tribes estimated that 1,400 tons per day of suspended sediment was produced by the North Fork and 130 tons in the South Fork (SWM 2000). The highest sediment levels were found in tributaries where forest practices and fragile soils occurred together, such as in Deer and Boulder Creeks. The major sources of fine sediment on the North Fork came from Deer Creek, Boulder River, the Hazel Slide on the North Fork above Oso, and the agricultural reach between Oso and Arlington. High sediment levels were also measured in Montague Creek. Sources of sediment in the South Fork are above Redbridge, and include the Gold Basin Slide, and Mallardy and Boardman Creeks. The Stillaguamish and Tulalip Tribes found low levels of suspended sediment in Jim and Canyon Creeks.

Rural and urban development: Many traditional land development and agricultural practices can lead to increased sediment loading. Removing tree cover alone will tend to cause increased amounts of stormwater. This *Action Plan* has not attempted to identify specific problem areas but generally recognizes certain land uses as potential problems as discussed below. All urban and suburban areas where municipal stormwater systems collect the majority of storm flows are potential problem areas. Where stormwater retention/detention facilities do not conform to the standards set forth in Ecology's Western Washington Stormwater Manual, there is a higher likelihood that storm events are contributing to stream erosion by increasing the number and intensity of peak flow events. Where low development densities and soils with good infiltration coexist, the risk of downstream erosion problems is greatly reduced.

Pastures or other husbandry areas that provide direct livestock access to surface waters are problem areas. Large animals should not have direct access to streams because they will cause bank erosion and the direct deposition of sediment and manure.

What Should be done to Reduce Sediment Loading and Improve Channel Morphology?

In order to gain efficiencies with Chinook salmon recovery goals, a high priority should be given projects that perform TMDL activities in the sediment correction priority areas identified in the Stillaguamish Chinook Recovery Plan (Figure 24). This *Action Plan* supports the following projects aimed at reducing sediment buildup in the channels of this river system.

Protect and restore riparian areas: Projects that protect or restore riparian areas can help to stabilize streambanks and eventually reduce stream widths. Natural stream channel meander patterns can enhance hyporheic flow and help lower stream temperatures.

Increase the amount of large wood debris (LWD): The placement of large woody debris in stream channels creates channel complexity and forms scour pools; improving fish habitat as well as enhancing streambed groundwater inflow to the stream (Booth 1997, Drury 1999). Properly located arge woody debris placement can also help to control erosion, increase groundwater inputs, increase amount of fish refuge available.

The placement of LWD in a stream may have an important role in keeping stream temperatures cool. In addition to providing structural cover for fish, LWD itself can provide shade. LWD in stream channels produces hydrologic conditions conducive to pool formation, which may tap additional sources of cold groundwater. This groundwater can be especially valuable for creating localized fish refuges where surrounding water temperatures are above state standards, or less than optimal. Projects to install LWD should give a priority to areas where there is a high likelihood of creating new or increased groundwater inputs. Potential risk of injury to the recreating public when LWD is installed should be taken into account during project design.

Provide livestock exclusion fencing and off-channel watering facilities: Animal exclusion measures reduce the loss of riparian vegetation and direct trampling of streambanks. Voluntary measures to assist landowners are the primary tool recommended to ensure livestock exclusion is achieved. Options to provide off stream watering are available and should be employed. Incentive programs to assist the agriculture community in the conversion to off stream watering are encouraged to promote the rapid and widespread adoption of this best management practice.

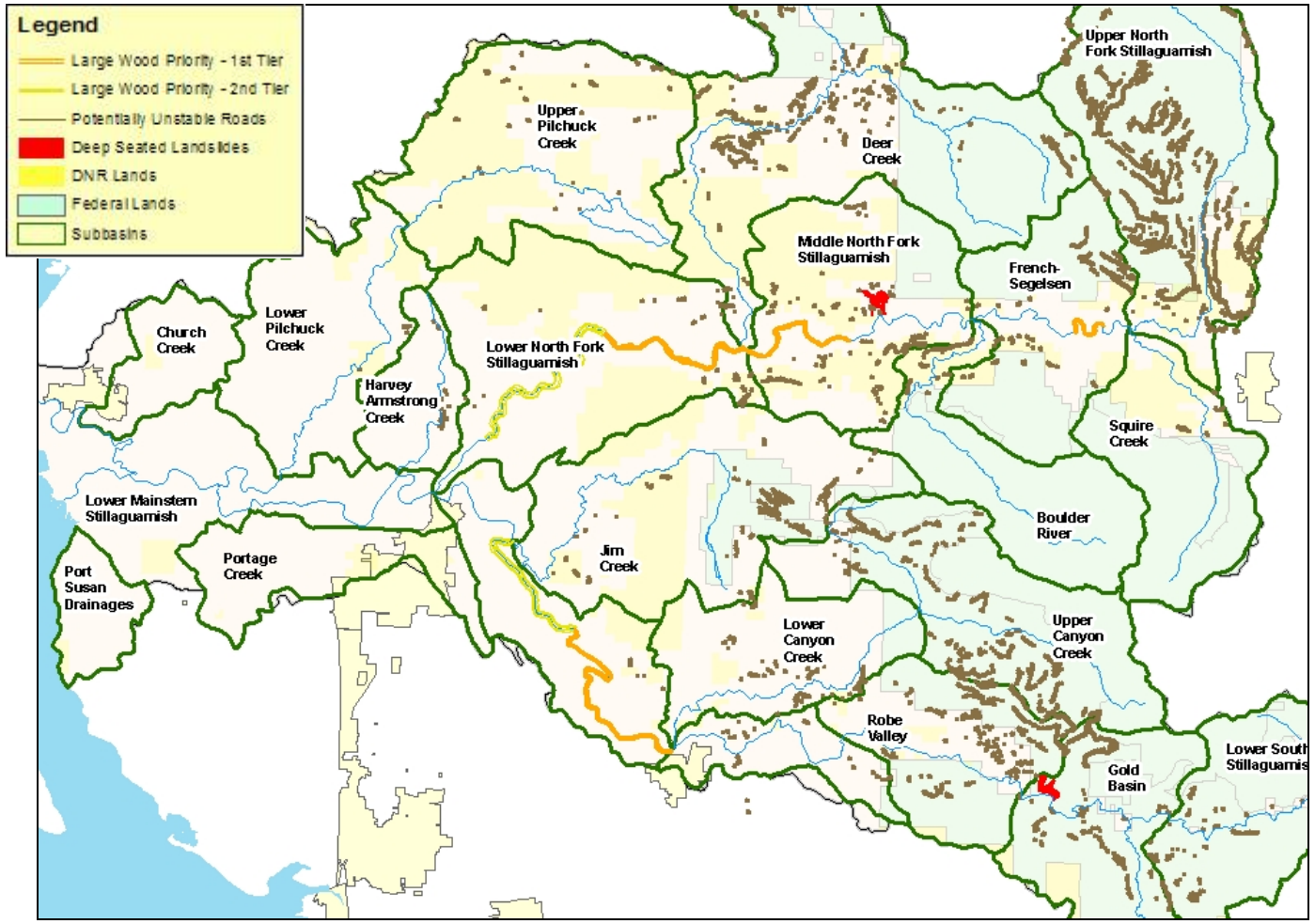

Figure 24. Priorities for Controlling Sediment in the Stillaguamish Watershed. Several areas have already been identified for action in the Stilly Chinook Plan (SIRC 2005). Potentially unstable roads occur where topography is steep and soils are susceptible to erosion or creation of landslides—close observation and maintenance is needed. Placing large wood to control sediment as shown above can help salmon and water quality.

Although voluntary measures should be the first course of action, this Plan recommends that local governments develop ordinances that prevent direct access of livestock to surface waters and perform enforcement where voluntary efforts are unsuccessful. All critical areas ordinances must address this problem to adequately protect stream habitat and support this *Action Plan*.

Provide treatment for logging road systems: Proper attention to the state of logging roads and their drainage facilities is needed to prevent sediment delivery to the watershed. Older roads, sediment control structures, and stormwater conveyance systems should be evaluated for maintenance, removal, or decommissioning. The choice of proper road maintenance or decommissioning should be done on a case-by-case basis.

Erosion control during construction activities: Good erosion control during land clearing activities is essential. Ecology's general construction permits and local clearing and grading ordinances should control this potential source of sediment.In urban or urbanizing areas, this plan strongly recommends infiltration of stormwater, preferably through the use of low impact development techniques. These techniques mimic natural hydrologic conditions in most cases.

Wastewater Treatment Facilities

Ecology reevaluates discharges from wastewater treatment plants (WWTP) every five years as part of its National Pollution Discharge Elimination System (NPDES) permitting process. At that time, their discharges must comply with the state's temperature standards at the edge of a mixing zone (WAC 173-201A-400).

A mixing zone is that portion of a water body adjacent to an effluent outfall where mixing results in dilution of the effluent with the receiving water. The standards specify a number of criteria that must be met during critical discharge conditions such as the size of the mixing zone in relation to the river width, and temperatures at the edge of the zone. The chronic mixing zone, by regulation, is limited to utilizing no more than 25 percent of either the flow or the width of the river.

Ecology established a general formula for determining the temperature wasteload allocations (T_{WLAs}) for WWTPs to be used in conjunction with static modeling. Static modeling assumes that the highest possible stream and effluent temperatures, lowest stream flows, and highest WWTP discharges all occur at the same time. The equation is as follows (Lawrence 2006):

$$T_{WLA} = (\text{summer maximum criterion} - 0.3) + (\text{chronic dilution factor}) \times (0.3)$$

As permits are renewed for the Arlington and Indian Ridge wastewater treatment plants (WWTPs), their discharges will be evaluated for compliance with T_{WLAs}. Warm Beach discharges will be evaluated to ensure compliance with state standards. Discharge limitations are evaluated in advance of the permit renewal process because of the substantial engineering that must be undertaken as part of WWTP operations and upgrading. The following is a general discussion of temperature TMDL compliance for each of the plants above.

Arlington WWTP

The city of Arlington is upgrading its WWTP to accommodate future growth. Ecology is working with the city to finalize their engineering report for the WWTP expansion and future

permitting. The new plant will provide secondary treatment using membrane filtration technology and ultraviolet light disinfection. Table 7 is a current estimate of the maximum allowable temperature for the Arlington WWTP during dry weather conditions and current and future conditions. Using the static modeling approach, Ecology predicts that Arlington discharges will meet state standards until approximately 2014.

At this time, the city has proposed that a more complex modeling of temperature effects of its discharge be conducted. Ecology has agreed that "dynamic modeling," which evaluates actual conditions rather than worse case conditions, may be acceptable. Ecology and the city will be collecting additional river flow and temperature data to improve the accuracy of the dynamic model before 2014. Ecology will reevaluate the city's discharge limitations as needed to ensure compliance with state standards and the *Stillaguamish River Temperature TMDL*.

Table 7. Estimated temperature wasteload allocations for the city of Arlington Wastewater Treatment Plant.

Arlington Flow (millions of gallons/day)	Dry Weather Chronic Dilution Factor	Estimated WLA for Temperature (^{o}C)*
1.1 (current)	39.7	29.1
2.56 (year 2025)	17.3	22.4

*Estimated WLAs are based on use of 7Q20 flows.

Warm Beach WWTP

Warm Beach Christian Camp and Conference Center has submitted an engineering report and plans and specifications for a new wastewater treatment plant using secondary treatment using membrane filtration and disinfection with ultraviolet light. Ecology has not established wasteload allocations for temperature for the Center's WWTP. It is expected that the Center will apply their treated wastewater to a horse pasture during the dry summer months and will relocate their discharge to a less sensitive area of Port Susan (away from First Channel) during wet weather months. The relocated discharge from the Center's WWTP will be required to meet state water quality standards when approved.

Indian Ridge Corrections Facility WWTP

Indian Ridge Corrections Center is a small facility formerly operated by the Washington State Department of Social and Health Services, but now operated by Snohomish County. The treatment process includes preliminary treatment through a mechanical fine screen, biological treatment in a SBR, followed by an ultraviolet (UV) disinfection system. The Indian Ridge WWTP is managed by a contractor under an NPDES permit issued to Snohomish County. Although the facility is closed, the contractor continues to maintain the WWTP on a weekly basis. Should Snohomish County reopen Indian Ridge, Ecology will request that the operators maintain daily effluent temperature records to ascertain compliance with the temperature requirements of this TMDL. Like Arlington WWTP, Indian Ridge discharges will be subject to the limitations set in the T_{WLA} equation noted earlier.

Figure 25. Riparian Restoration in the Stillaguamish Watershed. Many landowners in the Stillaguamish River are working to make the river safe for people and fish. This newly planted riparian area along the mainstem Stillaguamish in Silvana is getting good care by their owner who recently planted seed to improve conditions around the fledgling trees.

What Will Be Done, Who Will Do It?

The Stillaguamish River TMDL *Action Plan* addresses a wide range of watershed needs to resolve several different water pollution problems. Pollution inputs must be reduced and aquatic habitat must be improved. This plan builds on previous and ongoing efforts to protect and restore the Stillaguamish.

What other Improvement Plans are in place now? Several plans for improving water quality in the Stillaguamish Watershed have been prepared in previous years. Snohomish County completed the *Stillaguamish Watershed Action Plan* in 1990 as part of the WAC 400-12 process (SWM 1990). Although this is plan is over 15 years old, many of its findings are still applicable to the watershed and are included in this plan. Another important effort was the completion of the *Stillaguamish Watershed Chinook Salmon Recovery Plan* that was prepared in response to the listing of Puget Sound Chinook as an endangered species (SIRC 2005). *The Chinook Recovery Plan* also details actions needed to improve water quality, many of which are included in this plan.

Snohomish County also prepared a *North Urban Growth Areas Drainage Needs Report* that discusses flooding problems within the Arlington and Granite Falls urban growth areas (SWM 2002) and a *South Warm Beach Master Drainage Plan* (SWM 2006) that focused on both flooding and water quality. Although, the North UGA report did not examine water quality, it identified all of the County's stormwater outfalls, which could be useful for future stormwater work. The *South Warm Beach Drainage Plan* focused on flooding but also included a discussion of bacterial pollution problems. Additional wet weather monitoring suggested generally good water quality in the area but the County noted that additional monitoring of bacteria levels should be performed, presumably to track dry weather trends.

Local government and other organizations have worked together to prepare this *Action Plan.* There is no single solution to improving water quality in the Stillaguamish Watershed. Everyone will need to pitch in to solve the problem. If you want to see how you can help, the best place to start in right in your own backyard. If you want to go further, read about what your local government is already doing and how you can help them work for you. If you have a small farm, or a special interest in fish or wildlife, read about the activities sponsored by the Stilly Snohomish Fisheries Enhancement Task force or the Snohomish Conservation District. The following pages will tell you more about all of these organizations and how they are working to make Stillaguamish Watershed a safe place for people and fish.

Federal and Tribal Government

Environmental Protection Agency

The 1997 Memorandum of Agreement between the Environmental Protection Agency, Region 10 and Ecology requires that EPA and Ecology jointly evaluate the implementation of TMDLs in Washington.
These evaluations will address whether interim targets are being met, whether

implementation measures such as BMPs have been put into effect, and whether NPDES permits are consistent with TMDL wasteload allocations.
EPA provides technical assistance and funding to states and tribes to implement the Clean Water Act (CWA). For example, EPA's CWA Section 319 grants are combined with Ecology's grant and loan funds are made available to stakeholders through Ecology's annual Water Quality Grant and Loan Process. On occasion, the EPA also has other grant monies available (104(b)(3)) to address storm water pollution problems.

Recommended actions: The EPA should conduct research, support, and distribute information on pollution sources and source identification techniques, and continue to offer funding support for targeted projects at the local level.

Stillaguamish Tribe

The Stillaguamish Tribe Natural Resources Department administers a number of programs that contribute to understanding and improving watershed conditions that affect salmonid and other fish, shellfish, and wildlife resources of the Stillaguamish watershed and Port Susan. Programs and accomplishments include:

- Leadership and support for the Stillaguamish Implementation Review Committee and its goals of increasing fish and wildlife populations and improving water quality throughout the basin. Writing grant proposals for, and managing, projects involving salmon habitat protection and restoration and improvement of water quality and instream flows.
- Monthly water quality monitoring of 12 sites in Port Susan under a cooperative agreement with the Department of Health to assess conditions for commercial and recreational shellfish harvest.
- Quarterly water quality monitoring at 51 freshwater locations throughout the watershed, including a study of the effects of a flow enhancing structure on the upstream end of the Old Stillaguamish Channel and tide gates on Jorgenson Slough. The Tribe is also assessing the mercury levels associated with fine sediment throughout the basin and looking at fine sediment intrusion to artificial redds.
- Cooperative work with the Stillaguamish Flood Control District and the Warm Beach Community to determine local sources of fecal coliform using DNA-based tracing tools.
- Certification to negotiate CREP (Conservation Reserve Enhancement Program) contracts with landowners to plant riparian buffers and fence livestock away from streams to prevent or reduce fecal coliform pollution and continued bank erosion.
- Bank Savers Program, a for-profit native plant nursery that maintains native plant nursery stock and manages riparian planting and maintenance projects. Also the Natural Resources Department through grant funding from the Salmon Recovery Funding (SRF) Board, oversees a crew of inmates from Snohomish County Corrections, which does riparian preparation and planting. The riparian crew has engaged in at least 31 projects in the Stillaguamish Watershed. These projects have resulted in 4,400' of fencing, 14 miles of riparian streamside plantings (71.3 acres), using a total of 34,000 plants.

- Operation of a smolt trap on the Stillaguamish River to estimate the production of coho, chum, pink, steelhead, and chinook smolts. This project also documents long term trends in freshwater survival for Stillaguamish salmon populations.
- Operation of a hatchery on Harvey Creek and on the North Fork near Oso.
- Ongoing research on river processes affecting salmon and water quality.

The Stillaguamish Tribe has two grants (one a Centennial Fund grant and one a SRFB grant) to address excessive sediment inputs to the North Fork from the Steelhead Haven landslide. A new massive failure occurred in January 2006, pushing material 700 feet south, blocking the river and threatening homes. Emergency work by Snohomish County and the Corps of Engineers made a new channel to save the homes. The Tribe used the funding for design and construction of a 1400' log cribwall to provide landslide stabilization, add wood to the river, and reduce sediment input from the slide, which increases the river's width and reduces its depth leading to greater solar heating.

The Stillaguamish Tribe is also conducting a sediment study in six reaches of the North Fork Stillaguamish River to better understand fine sediment transport and deposition. The Tribe will correlate sediment deposition rates with juvenile Chinook emergence. This data on sediment transport will also be compared to a similar study being conducted by Snohomish County in the South Fork.

Recommended actions: The Stillaguamish Tribe is a sovereign nation. Ecology will work with the Tribe to support its continuing efforts to improve water quality in the watershed. This *Action Plan* makes the following recommendations for future action:

- Continue to provide leadership and support for the Stillaguamish Implementation Review Committee (SIRC). The SIRC, along with the Stillaguamish Clean Water District (CWD), are the focal points for the organization of salmon recovery and water quality improvement efforts in the watershed.
- Continue to seek support for Bank Savers and the Inmate Riparian Crew. Together they have a tremendous record of success in improving riparian habitat, adding channel complexity, replacing migration barriers and providing livestock exclusion fencing to protect and enhance the Stillaguamish River.
- The Tribe will add three Engineered Log Jams at the Hazel Hole (North Fork River Mile 22) during summer 2007. The tribe will work with the USFS to find a solution for the massive sediment input from the Gold Basin Landslide. The Tribe will increase its effort to determine fecal sources using DNA analysis.
- The Tribe is partnering with The Nature Conservancy and Ducks Unlimited on two major estuary restoration projects and is actively seeking other opportunities to improve habitat and water quality in the Stillaguamish estuary.

Tulalip Tribes

The Tulalip Tribes is a sovereign nation with land use authority within their reservation, which is located to the south of Stillaguamish River

basin. As signatories of the Treaty of Point Elliott of 1855, the Tulalip Tribes' adjudicated usual and accustomed area extends from the Canadian border south to Vashon Island and includes estuary and marine areas at the mouth of the Stillaguamish River in Port Susan. The Tulalip Tribes have a continuous interest in activities taking place outside of the reservation, particularly those that might affect the Tribes' cultural and archaeological resources and treaty-protected fishery resources.

The Tulalip Tribes share a common interest in and responsibility for the protection and enhancement of the environment. The Tulalip Tribes Natural and Cultural Resources Department conducts water quality monitoring in Port Susan and has an interest in targeting priority areas of the watershed and assessing success of implementation activities. The Tribes have supported a number of water quality, habitat, and fisheries-related studies of the Stillaguamish River watershed.

Recommended actions: Ecology will work with the Tribe to support its continuing efforts to improve water quality in the watershed. This *Action Plan* makes the following recommendations for future action:

- Participate in the Stillaguamish Implementation Review Committee (SIRC) and Stillaguamish Clean Water District activities. Tribal leadership is especially valuable in the deliberations of these organizations, which are the focal points for salmon recovery and water quality improvement efforts in the watershed.
- Perform water quality and habitat monitoring in Port Susan to assess conditions for commercial and recreational shellfish harvest.
- Work in partnership with Washington Department of Natural Resources in the implementation of Forest and Fish Rules to improve forest management protection of riparian habitat and forest road BMPs.
- Work in partnership with the US Forest Service to implement road abandonment, road treatment, and stream channel restoration projects including large wood placement, riparian planting, and other natural hydrologic and biological improvements.

U.S. Forest Service

The U.S. Department of Agriculture Forest Service (USFS) is a Federal agency that manages public lands in national forests and grasslands. The Forest Service is also the largest forestry research organization in the world, and provides technical and financial assistance to state and private forestry agencies. The mission of the USDA Forest Service is to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations. The Mount Baker-Snoqualmie National Forest (MBS) carries out this mission largely through the implementation of standards and guidelines in the 1990 *Land and Resource Management Plan* and amendments, including the 1994 *Northwest Forest Plan* (NWFP).

Under the NWFP the Stillaguamish River is designated as a Key Watershed, meaning restoration in the watershed is a higher priority than non-Key Watershed areas within the MBS. Rules for forest harvest levels, harvesting techniques, and road maintenance all play important roles in

protecting and restoring the natural functions that protect at-risk species and fish habitat within the watershed. Several key areas include roads maintenance and watershed restoration.

Road treatments: The MBS has performed a Roads Analysis to identify which roads are of greatest risk to water resources in the basin. The MBS has been aggressively treating roads for more than a decade to minimize or eliminate the risk of road failures and sediment-laden runoff to streams. With nearly 2,700 miles of roads on the MBS, this is a task-in-progress. A number of roads have been decommissioned and many miles of roads have been treated in the Stillaguamish watershed since the mid 1980s.

Past road treatments and decommissionings were funded using a combination of Knutson-Vandenberg funds (KV dollars, funds collected through timber sales to facilitate reforestation and other renewable resource work) and NWFP watershed restoration funding (available in the early years of the NWFP). Both of these funding sources have run out for the MBS, and funding is now being sought from other sources.

Watershed restoration: Watershed and aquatic habitat restoration on the MBS in the watershed since the mid-1980s has evolved and improved over time. Restoration activities range from road and hillslope stabilization treatments to bank stabilization and instream structure placement. Road treatments include storm proofing and decommissioning, and replacing culverts to improve fish passage. Riparian treatments are designed to promote better shade and bank stability, and in-channel work targets the introduction of large wood into the channel system. The Forest Service works with the public through information and education programs to reduce impacts of recreation activities.

In recent years, through partnerships with Snohomish Conservation District and others, the Forest Service has treated more than 35 miles of forest roads in the Deer Creek sub-basin (Table 8). The Forest Service has also placed large woody debris jams in Deer Creek, Higgins Creek, and Little Deer Creek in part to address temperature concerns.

The Forest Service also works to reduce impacts of recreation to riparian areas and is working to prevent invasive knotweed from infesting the upper watershed. Several areas of infestation in the lower South Fork watershed have been successfully treated by the Forest Service and Snohomish County Noxious Weed Control.

Recommended actions for the USFS**:** This *Action Plan* supports the Forest Service's continued efforts to seek funding for stream-protecting projects and encourages the agency to work creatively on projects to reduce the river's sediment load. The *Action Plan* recommends that the USFS focus on the following activities to improve water quality in the Stillaguamish Watershed.

- Provide community assistance and to State and local governments, forest industries, and private landowners, within existing authorities, to help protect and manage non-Federal forest and associated range and watershed lands to improve conditions in rural areas.

Table 8. USFS Road Treatment Activities in the Stillaguamish Watershed since 2000.

Year	Watershed	Treatment	Miles
2000	NF Stillaguamish	Decommission	1.3
	Canyon Creek	Stabilize/drainage upgrade	2.7
2001	Deer Creek	Drainage upgrade	4.8
2002	SF Stillaguamish	Drainage Upgrade	3.9
	Deer Creek	Drainage Upgrade	5.1
2003	SF Stillaguamish	Drainage Upgrade	7.3
2004	NF Stillaguamish	Decommission	1.5
	NF Stillaguamish	Stabilize and store	12.4
	SF Stillaguamish	Drainage Upgrade	7.5
	Little Deer Creek	Stabilize/Drainage Upgrade	12
	Squire Creek	Drainage Upgrade	2.1
2005	NF Stillaguamish	Drainage Upgrade	1.3
	SF Stillaguamish	Drainage Upgrade	0.1
	Little Deer Creek	Stabilize/Drainage Upgrade	5.2
2006	NF Stillaguamish	Drainage Upgrade	2.5
Total			69.7

- Seek adequate base funding for forest road maintenance activities to minimize additional sediment loading to the watershed.
- Continue to seek grant funds as needed where base funding is not available.
- Continue to implement the MOA with Ecology to minimize sediment delivery from roads. Complete Access and Travel Management Planning for the Stillaguamish River watershed to allow additional road treatments. A potential project is inventorying roads that should have access blocked.
- Explore ways to obtain additional enforcement support in areas of dispersed camping and recreation. Pursue additional public outreach and education concerning resource impacts from recreation activities.
- Explore additional study on the benefit of isolating or eliminating Gold Basin landslide sediment for improving water quality/fish habitat. Erosion and landslides in the Gold Basin campground on the South Fork are causing campground sites to be abandoned as they are lost. The MBS has determined that there are no reasonable places within the South Fork corridor to move the campground. This effort could lead to modification or removal of the Gold Basin campground if the benefit to fish habitat and public safety improvements are great enough.
- Investigate riparian areas on USFS lands that are upstream of locations shown to have high stream temperatures. Provide shading, wood debris placement, or use other techniques to reduce downstream temperatures.
- Monitor stream temperatures in the upper watershed in cooperation with Snohomish County and the tribes.

- Explore the use of Forest Stewardship Contracting to maximize restorative and maintenance work needed to control sediment discharge and maximize stream shading within the MSB.

State Government

Department of Ecology

Ecology has been delegated authority by the EPA to implement many aspects of the federal Clean Water Act. This includes the National Pollution Discharge Elimination System (NPDES) permitting and the Total Maximum Daily Load (TMDL) program. The Stillaguamish watershed is under the jurisdiction of Ecology's Northwest Regional Office (NWRO). To address the municipal stormwater permitting needs of this TMDL, the NWRO has one municipal stormwater engineer and three municipal stormwater specialists who provide full time technical assistance and auditing activities for the Phase I and Phase II municipal stormwater permits across the region. Ecology's headquarters staff helps identify and distribute education and outreach materials to stormwater permit holders.

The NWRO Water Quality Municipal unit has one permit manager that is assigned to write and assist with compliance issues for the Arlington, Warm Beach, and Indian Ridge Wastewater Treatment Plants (WWTPs). The NWRO also has a municipal enforcement specialist to help ensure compliance with all permit conditions.

Ecology's NWRO also has a team of six 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.

The NWRO provides one regional staff to provide technical assistance to private, state, and federal foresters as they implement their forestry management plans. Ecology headquarters works at the state level to adaptively manage the *Forest and Fish Plan*, which will be reevaluated in 2009.

Ecology has a Water Cleanup Specialist assigned to the implementation of the Stillaguamish TMDLs that will assist NPDES permit holders and other environmental agencies and groups. The NWRO recently hired a water quality monitoring specialist who is available to provide assistance in the development of ambient monitoring and source identification monitoring projects. Ecology's Environmental Assessment Program is expected to assist in effectiveness monitoring as this plan is put into effect and changes in water quality are likely to be measurable.

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 discussed under the section "Funding Opportunities." Ecology's Grant Specialists assist local government in the development of stream restoration and water quality improvement projects. Ecology is providing grant funding for several water

quality projects that are expected to improve water quality across Snohomish County (see discussion of Snohomish County activities later in this section) and is evaluating several projects now that will focus specifically on the Stillaguamish Watershed.

Recommended actions: Ecology has a wide variety of programs to assist in the implementation of this *Action Plan*. The following activities are key activities that need support:

- Continue providing the current and planned levels of support for overseeing compliance with all associated NPDES permits.
- Pursue additional resources to help address nonpoint pollution violations through field inspections, gaining voluntary compliance, and performing formal enforcement when necessary.
- Assist the Stillaguamish Implementation Review Committee (SIRC) in their efforts to coordinate water quality-related activities within the Stillaguamish Watershed.
- Be available as a resource to the Stillaguamish Clean Water District as needed.
- Continue to provide grant funding opportunities to assist in funding stream restoration, pollution identification and correction activities, and early implementation of low impact development.
- Meet or otherwise contact key watershed stakeholders no less than annually to determine the status of TMDL implementation. Ecology should lead additional meetings as requested and resources allow.
- Continue to track the number of well logs received that are located in the Stillaguamish Watershed and report this information to local governments annually.

Puget Sound Partnership

The newly formed Puget Sound Partnership (the Partnership) works to restore and protect the biological health and diversity of Puget Sound by restoring habitat functions and values; reducing the level of toxic chemicals nutrients, and pathogens entering Puget Sound fresh and marine waters; improving water quality and habitat by managing stormwater runoff; ensuring adequate in-stream flows; protecting ecosystem biodiversity; and building and sustaining the capacity of action. The Partnership is comprised of the Leadership Council, the Ecosystem Coordination Board, and a Science Panel. The Partnership staff is working with tribal and local governments, community groups, citizens and businesses, and state and federal agencies to carry out the 2007-2009 Puget Sound Conservation and Recovery Plan and to develop the long-term action agenda to achieve the recovery of Puget Sound by 2020.

The Partnership has a Snohomish County Regional Liaison that covers the Stillaguamish Watershed. The liaison works directly with local entities to help facilitate and coordinate a wide range of activities related to improving water quality in Puget Sound. The following specific Action Team priority program areas have direct relevance to this plan:

- Prevent harm from stormwater runoff. The Partnership promotes the education and involvement of the public in preventing harm from stormwater runoff. A key priority is

promoting **Low Impact Development** (LID) practices through education, regulatory assistance, and technical assistance.

- Prevent nutrient and pathogen pollution. The Partnership's goal is to educate and involve residents and others to enhance stewardship activities; increase scientific understanding to guide management activities; and to promote proper maintenance of septic tanks to prevent surface water pollution.

The Partnership will continue the work of the Puget Sound Action Team in providing important leadership promoting LID, an innovative approach to managing stormwater in new development and redevelopment. The Action Team prepared guidance on LID practices and assisted local governments in preparing ordinances to support this new development strategy (http://www.psp.wa.gov). The Action Team worked closely with the Washington Department of Health to update septic tank maintenance regulations and is now spearheading a new initiative to restore and preserve Puget Sound and its contributing water bodies.

Recommended actions: This plan encourages the Action Team to continue spearheading the development of updated models, written guidance, and other tools that will both educate and assist local governments in implementing LID practices within their jurisdictions. Continued focus on the issue of septic tank maintenance and management of stormwater pollution is also encouraged.

Specific tasks the Action Team is committed to completing include:

- Sponsoring a Master Builder's Built Green Conference in Snohomish County on March 13, 2007. PSAT will be promoting Low Impact Development at this conference.
- Partnering with Adopt-A-Stream to conduct a Low Impact Development Workshop in Everett, June 2007.
- Partnering with Snohomish County, Stillaguamish Tribe, and WSU Beach Watchers to conduct a shoreline landowner workshop at Warm Beach, July 2007. This will include public outreach and education on local water cleanup activities.
- Coordinating a radio show on KSER to discuss Low Impact Development.

Washington Department of Fish and Wildlife

The mission of the Washington Department of Fish and Wildlife (WDFW) is to provide sound stewardship of fish and wildlife. The health and well-being of fish and wildlife is important not only to the species themselves, but to humans as well. Often, when fish and wildlife populations are threatened, their decline can predict environmental hazards or patterns that also may have a negative impact on people.

The WDFW is an important partner in managing the Stillaguamish Watershed. The agency provides technical assistance regarding the design of restoration projects, reviews hydraulic permit approvals (HPAs), and participates in the Stillaguamish Implementation Review Committee activities to help craft and implement sound watershed management policies.

Recommended actions: This *Action Plan* encourages WDFW to continue working closely with the SIRC and other basin stakeholders to reinforce the relationship and importance of water quality to fish habitat. The WDFW should continue to provide rigorous regulatory oversight of activities that affect water quality and fish habitat. WDFW is also encouraged to provide guidance and technical assistance on understanding stream health through traditional water quality monitoring, use of benthic macroinvertebrate indices, or other techniques that improve our understanding of aquatic fish habitat.

Washington State Department of Transportation

The Washington State Department of Transportation (WSDOT) water quality program provides guidance and technical support to road planning, design, construction, and maintenance to help WSDOT enhance transportation project delivery and achieve compliance with the federal Clean Water Act and state water quality laws. Since 1995, WSDOT has been regulated under the Phase I Municipal Stormwater permit. Pursuant to that NPDES permit, WSDOT also submitted a stormwater management plan (SWMP) to Ecology in 1997.

WSDOT identified six elements in the 1997 SWMP as having the highest priority: (1) construction of structural stormwater BMP facilities; (2) monitoring and research related to stormwater BMPs; (3) erosion and sediment control programs; (4) attaining full funding for operations and maintenance programs; (5) watershed-based mitigation strategies; and (6) water quality-related training. These elements continue to be high priorities for WSDOT.

In recent years, WSDOT has begun monitoring fecal coliform levels in both treated and untreated stormwater runoff from state highways. Ecology is currently revising WSDOT's municipal stormwater permit for re-issuance in 2007.

Required and recommended actions: The anticipated TMDL-related actions that WSDOT will be required to undertake as part of its municipal stormwater permit are not included in Appendix C of this document. Ecology is developing those actions as it prepares to reissue the WSDOT permit later in 2007. Readers interested in TMDL-related permitted conditions for WSDOT should look in the appendix section of the draft permit, which is expected to be issued in mid to late 2007. Check Ecology's Water Quality Program website for the most up-to-date information (http://www.ecy.wa.gov/programs/wq/stormwater/municipal/wsdot.html).

This TMDL encourages WSDOT to undertake the following additional actions to reduce bacteria levels in Stillaguamish Watershed.

- Evaluate the potential for using bioretention and other techniques in right-of-ways to reduce stormwater volumes in areas addressed by this TMDL. Where research shows this approach is feasible, WSDOT should work with Ecology to develop a plan to implement this strategy in areas affected by this and other bacterial TMDLs.
- Evaluate, and implement where feasible, construction techniques that promote stormwater infiltration, such as the use of permeable pavement surfaces. Both new construction and retrofit applications should be examined.

Washington State Department of Agriculture

The Washington State Department of Agriculture (WSDA) administers the Dairy Nutrient Management Act (Chapter 90.64 Revised Code of Washington). This act requires dairy farmers to implement approved dairy nutrient management plans. WSDA has responsibility for inspecting dairies for compliance with state and federal water quality laws. By agreement with Ecology, WSDA will also inspect non-dairy livestock operations including any covered by the NPDES Concentrated Animal Feeding Operations (CAFOs) permit. WSDA coordinates with Ecology and local government regarding compliance of livestock operations.

aActions: The WSDA is committed to inspecting all dairies in the Stillaguamish watershed on an 18-24 month interval. If a problem is noted at the facility, follow-up inspections will be made and enforcement actions initiated as needed. WSDA will also routinely inspect any non-dairy operations covered under the NPDES CAFO permit and coordinate with Ecology on any compliance actions on such facilities. WSDA will coordinate with Ecology on responding to water quality complaints about other livestock operations.

Washington State Department of Natural Resources

The Washington State Department of Natural Resources (DNR) manages activities on private and State Trust forestlands in the Stillaguamish Watershed. Regulations administered by DNR protect existing mature riparian vegetation and allow for creation of intact riparian forests where they do not currently exist.

The DNR provides a number of valuable services to public and private forestry professionals. Relatively new tools designed to help foresters to identify areas where road building and harvesting can create a high risk to the environment include their Landslide Inventory and Landslide Hazard Zone analyses. Technical assistance to forest owners of all sizes is also available.

An important DNR program aimed at controlling sediment discharges from large private and State Trust forest lands is the Road Maintenance and Abandonment Program (RMAP). Under RMAP, all large industrial landowners, including DNR State Lands, were required to have submitted an inventory and rehabilitation plan for all roads within their ownership by December 31, 2005. These landowners have fifteen (15) years from that date to fix all identified issues. The issues specifically targeted by this program include road-related fish blockages and road segments on unstable slopes.

To help address similar problems in smaller forest parcels, small forest landowners can take advantage of the Family Forest Fish Passage Program, which is a cost share program designed for forestland owners that do not meet the requirements for RMAP to fix fish blockages related to forest roads.

Recommended actions: This plan places most emphasis on areas where no other existing federal or state plans are in place. However, it encourages all land managers to consult the *Action Plan.* This plan recommends the following actions by DNR to help improve water quality conditions in the Stillaguamish Watershed.

- Refer to this *Action Plan*, its related TMDL studies, and data collected during implementation, in the ongoing management of forestlands and revision of existing regulations and agreements.
- Participate in the SIRC to assist in the coordination of multiple state goals for the Stillaguamish Watershed (implement TMDLs, promote salmon recovery, and manage forests for production of lumber and wood products). Educate watershed stakeholders on DNR practices that promote healthy forest practices.
- Explore additional base funding, or grant funding, to perform cost effective improvements to stream morphology or riparian areas that would lead to a more rapid improvement in stream temperatures via improved riparian habitat, shade potential, and natural groundwater flows.
- Track progress and adaptively manage the RMAP and Family Forest Fish Passage Programs to ensure adequate funding and resources are available and success is achieved in the shortest reasonable timeframe.

Washington Department of Health

The Department of Health (DOH) Shellfish Division, under authority of Chapter 43.70 RCW, monitors marine water quality in commercial shellfish growing areas. Monitoring for fecal coliform Bacteria is conducted monthly by the Stillaguamish Tribe at 16 marine water quality stations in and adjacent to Port Susan under agreement with DOH for Shellfish harvest classification.

Recommended actions: This *Action Plan* recommends that DOH continue to support Ecology and the Island County and Snohomish Health Districts. Continued monitoring of bacteria levels in Port Susan is needed. The DOH should track the development of new tools for bacteria source identification and work with local health districts to put them to good use as they become available.

County and City Government

Snohomish County Government

The activities of several branches of Snohomish County Government can affect the overall water quality in the Stillaguamish Watershed. The bulk of water quality related activities are carried out by Snohomish County Public Works, which performs a variety of pollution identification and prevention activities. Snohomish County Planning and Development Services are also very important as it oversees building and land development activities and performs enforcement. Because past land use practices so greatly affect water quality, the activities of this department are especially important to pollution prevention.

Under requirements of the Growth Management Act, Snohomish County is updating its Critical Areas Ordinances. The ordinances will include protections for riparian buffers and wildlife habitat along streams and areas of groundwater recharge, such as wetlands, that can influence stream flow and temperature.

Snohomish County revised its shoreline management plan and submitted it to Ecology for approval during 2006. Planning staff received a copy of the "Shade Most Needed" map and GIS data documenting the high priority riparian shade locations summarized in Figure 7. The County included these priority shade locations as a data layer in the shoreline management plan (Lawrence 2006) for reference as the County reviews development proposals in the future.

As noted earlier, discharges from Snohomish County's stormwater management system are regulated under Ecology's municipal stormwater permit. Many of the activities contained in that permit will contribute to the reduction of bacteria and nutrient pollution in the Stillaguamish Watershed.

Snohomish County Public Works--Surface Water Management:

Surface Water Management (SWM) is involved in a wide range of water pollution control activities including education, water quality monitoring, riparian restoration, salmon recovery, native plant salvaging, and NPDES permit administration. Surface Water Management also provides funding for and coordinates with the Snohomish Conservation District.

Water quality is tracked through ambient monitoring, targeted source identification, and illicit discharge monitoring. Snohomish County SWM currently performs monthly water quality monitoring in the Stillaguamish Watershed in eight locations. Their data can be found on the internet at http://www.data.surfacewater.info.

Surface Water Management finalized the *Stillaguamish Watershed Management Plan* in 1990 and recently completed several Drainage Needs Reports for urban areas in the watershed. These reports provide valuable information on the hydrologic profile of water bodies within the unincorporated areas of the county's urban growth area (UGA). The county also has the following programs and projects in place to improve water quality in the Stillaguamish Watershed.

- Strong public outreach through educational programs for students, teachers, and the general public. The county has a native plant salvage program that generates hundreds of hours of volunteer time each year in watershed restoration projects. A full-time watershed steward is assigned to work with citizens on riparian restoration, small farm BMPs, and other water quality projects throughout the Watershed.
- A Water Pollution Control Ordinance (Chapter 7.53 Snohomish County Code) in March 1998. The ordinance prohibits the discharge of pollutants to ccunty Streams.
- As part of Phase I NPDES Municipal Stormwater Permit requirements, the county identifies and inspects storm sewer outfalls in the Stillaguamish watershed and other watersheds during dry weather through its illicit discharge detection and elimination program. This program will help control bacteria and nutrient discharges from the county stormwater system.
- Co-leadership and support, with the Stillaguamish Tribe, for the Stillaguamish Implementation Review Committee and its goals of increasing salmonid populations

and improving water quality throughout the basin. The county also supports the activities of the Stillaguamish Clean Water District.

- Riparian restoration work through discretionary and grant funding. The county received a grant from Ecology for the South Fork Big Trees Project. The goal of the project is to improve 4.6 miles (27 acres) of riparian area along the South Fork Stillaguamish. The county has also applied for funding to support a similar project in the North Fork.
- As part of the Animal Waste Control Project, Snohomish County has researched the problem of pet waste management at the residential and commercial level. Their pilot program is called the Pet Waste Management Campaign. The campaign will result in a strategy to reduce pet waste pollution in streams throughout the county. The county will also be providing a workshop and presentations to other local governments to share their findings and improve pet waste management in other areas. Their research indicates that pet waste management is strongly needed on private properties.
- The county has an Ecology funding grant project that is studying two urban stormwater issues: how to maximize Native Growth Protection Areas for removal of pollutants in stormwater and how to perform a low-cost stormwater capture and treatment retrofit in established residential neighborhoods. When completed, this project will provide guidance to all municipalities trying to reduce urban pollution to surface waters.
- The county is working with the Snohomish Health District to merge the health district septic system records with Surface Water Management's Geographic Information System (GIS), identify hot spots and target improvements, conduct sanitary surveys and provide technical assistance to landowners, and provide prevention-based landowner training to ensure proper system operation and maintenance. These projects address several of the top pollution reduction strategies outlined in this *Action Plan*.

Solid Waste Management Division: Solid Waste Management programs affect both pet waste and livestock waste management issues. In collaboration with Surface Water Management, Solid Waste Management develops educational materials on how to best manage pet wastes.

Snohomish County Planning and Development Services: Snohomish County Planning and Development Services (PDS) develop and administer county regulations for commercial and residential development as well as public projects. The PDS also enforces the Snohomish County Code as it relates to protection of water quality, implements the Critical Areas Regulations and other development regulations, and works closely with the agricultural community through its agricultural liaison and the Agricultural Advisory Board.

The activities of the PDS greatly affect the generation and treatment of stormwater prompting them to research stormwater BMPs and provide educational outreach to contractors on proper BMP use. Along with other parts of Snohomish County Government, the PDS is promoting Low Impact Development (LID) principles and has adopted an LID ordinance to help facilitate the use of this innovative stormwater management technique (Ordinance 30.63C). The County helps

sponsor the Sustainable Development Task Force, which is a public/private partnership dedicated to the adoption of strategies that protect the environment by promoting the wise use of building materials, energy efficiency, and the reduction or elimination of stormwater.

Snohomish County Parks and Recreation Department:

The Snohomish County Parks and Recreation Department oversees over 9,000 acres of public land for recreational use and conservation purposes. The Department works with other parts of county government to manage county lands, administers a variety of educational programs, and develops and maintains park facilities

Required and Recommended Actions: The anticipated actions that Snohomish County will be required to undertake as part of its municipal stormwater permit are listed in Appendix C of this document. The following actions are additional recommendations that the county should consider to help reduce bacterial and nutrient pollution, improve dissolved oxygen and temperature levels, and reduce sediment loading to the Stillaguamish Watershed.

- Fully implement the findings from the Animal Waste Control Project.
- Install pet waste education and collection stations in parks and recreational lands where pets are allowed and there is the potential for bacterial pollution to reach water bodies or stormwater conveyance systems.
- Implement LID aggressively in areas of new development and maximize the reduction of stormwater during redevelopment. 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.
- Continue to work in partnership with the Snohomish Health District in identifying and resolving pollution from onsite septic systems.
- Identify pollution sources through both ambient and targeted water quality monitoring. Source identification efforts are needed in both urban and rural areas.
- Make policies, procedures, and resources available to address areas where businesses (dog kennels, commercial equestrian facilities, etc.) or small farms are contributing bacterial pollution outside of the MS4 system.
- When technical assistance is inappropriate or ineffective, Code Enforcement is an essential follow up activity to remove known bacterial pollution sources and also a valuable deterrent to potential violators. Due to the temporal nature of many water pollution problems, Code Enforcement staff should work to ensure that referrals from Surface Water Management staff are addressed promptly.
- Annually track the number of referrals for investigation of Critical Areas Regulations and water quality ordinance violations and the actions taken on those referrals. Field staff should investigate and initiate contact with landowners quickly to identify and take action on potential threats to water quality such as the removal of native vegetation, direct access of livestock to surface water, improper placement of manure piles, and other practices that have a direct effect on surface water quality.

City of Arlington

The city of Arlington currently has a population of approximately 16,000 residents. About two thirds of the city is located within the Stillaguamish basin with about one mile of shoreline along the South Fork and mainstem of the Stillaguamish River. Portage Creek is the largest stream that flows through Arlington into the mainstem Stillaguamish River just west of the city. Land use within Arlington's portion of the watershed is a mix of residential, light industrial, and commercial properties. The city is expected to contain 30,500 residents by 2025.

The Stillaguamish River is critical to Arlington's utility operations. The city has an annual potable water demand of nearly 2.0 million gallons per day (MGD) on an average daily basis that is served to more than 5,000 connections. Approximately two-thirds of the city's water supply is obtained from wells within the basin, primarily from wells near the confluence with the South and North Forks which withdraw groundwater influenced by the water quality of the river. The remaining water supply is obtained from the Sultan River basin by purchase from the Snohomish County Public Utility District No. 1 (PUD).

Adjacent to the water utility, the city operates a 2.0 MGD wastewater treatment facility (WWTP) that discharges treated effluent subject to its National Pollution Discharge Elimination System (NPDES) permit requirements, to the river 400 feet downstream of the wells. The city is fortunate that much of the stormwater generated by the city is infiltrates into soils underlain by glacial outwash, but a significant portion of its stormwater does discharge with no treatment directly to the river.

Key elements of city environmental policy and other accomplishments include:

- Critical Areas Ordinance that prescribes buffer widths from 25 to 150 feet for properties along streams. Buffer widths depend on land type, land use and whether land use conversion is involved.
- Riparian plantings at 26 sites along a total of about five miles of streambank within the city limits.
- Awards for perfect permit compliance at the Arlington WWTP for the years 1998, 2000, 2001, and 2003.
- The city received the U.S. Environmental Protection Agency "Clean Water Partner for the 21st Century award.
- Water quality monitoring is performed in the Stillaguamish Watershed on the mainstem and South Fork Stillaguamish Rivers, in Portage, Prairie, and March Creeks, and at various stormwater outfalls.
- The city has worked with the Arlington Watershed Action Committee, the Portage Creek Stewardship Program and the Stillaguamish Implementation Review Committee (SIRC) to improve water quality and watershed processes.
- Arlington has also embraced the Tree City USA campaign, which requires cities to develop comprehensive urban/community forestry programs.

- *New Stormwater Standards:* The city is reviewing its development standards to investigate opportunities for the use of low impact development (LID). LID is currently accepted but formal specifications have not yet been adopted.
- The city creates composted biosolids at their WWTP for use as a soil amendment at city parks and other city properties. This TMDL encourages the use of biosolids to amend poor soils and improve moisture holding capabilities. This strategy is considered valuable for reducing stormwater volumes and improving natural hydrologic processes in areas that have undergone development.
- Municipal Code 22.04.070 requires pet owners to lease and pick up after their pets.

The city is covered under Ecology's new Phase II stormwater permit program, which Ecology issued in 2007. The city has created a stormwater utility to fund stormwater control activities and is developing its stormwater comprehensive plan. The city currently contracts out the cleaning of catch basins. Ecology's 1992 Stormwater Manual is currently in use and discussions on adopting the new Western Washington Stormwater Manual are ongoing. It is the city's long-term plan to use wetlands and natural systems instead of engineered systems to resolve and prevent environmental problems and assure that all stormwater discharges are consistent with its NPDES permit. A city has a website and sends quarterly newsletter to all residents. Key components of the basic Phase II program that will contribute to improving local water quality include:

- An increase in the city's capabilities to detect and eliminate illicit discharges and perform routine inspections of the city stormwater system.
- A continued commitment and increase of public involvement and outreach activities regarding water quality issues.

Required and recommended actions: The anticipated actions that the city of Arlington will be required to undertake as part of its municipal stormwater permit are listed in Appendix C of this document. The following actions are recommendations that the city should consider to help improve water quality in the Stillaguamish Watershed.

- Write articles in the quarterly newsletter at least once per year.
- Evaluate the need for any additional pet waste management stations within the city's portion of the watershed (both public and private areas) and install/maintain these stations where they are needed. Install 8 stations in 2007.
- Implement the TMDL-related stormwater permit requirements as soon as possible. The schedule for similar activities in the Swamp Creek Fecal Coliform Bacteria TMDL is recommended as a guide.
- Continue to show leadership on water quality and natural resource issues in the SIRC and other key watershed groups.
- Coordinate with Snohomish County Surface Water Management to identify sources of pollutants the city is receiving from upstream sources in the Portage Creek and Eagle Creek basins.

- Continued commitment to improving wetland and riparian areas to maintain stream flows, reduce bacteria and nutrient levels, and improve stream temperatures and dissolved oxygen levels.
- Evaluate pump stations for the presence of emergency overflow points that are not specifically authorized by Ecology. If unauthorized points are found to exist, they should be brought to the attention of Ecology's Municipal Permitting Unit, who will provide guidance, or oversight, as needed.
- Evaluate and validate whether approximately 26 sewer and stream crossings are points of contamination through seepage of untreated wastewater.
- Adopt the most current version of the Ecology Western Washington Stormwater Manual, or an equivalent manual.

Special Purpose Districts and Committees

Snohomish Conservation District

The Snohomish Conservation District (SCD) works with landowners and livestock owners throughout Snohomish County and on Camano Island to develop resource management plans. A principal focus of their work is surface water quality protection. The SCD provides information and a services including, but not limited to, riparian and instream restoration, soils, water quality, livestock husbandry, backyard conservation, pasture management, nutrient management, and residential LID retrofits.

The SCD provides technical assistance, farm plans and cost-share funds to help implement Best Management Practices using county, state and federal funding sources. TMDL-related BMPs that are recommended and implemented include: fencing livestock out of streams, improving pasture and nutrient management, installing gutters to keep water away from barnyard areas, composting and storage of manure, and planting riparian buffers. These BMPs help prevent the transport of mud, nutrients and manure to surface waters and improve watershed health overall.

The district also conducts water quality monitoring as part of many of its targeted projects. The SCD has a strong program of education and outreach including well-attended workshops and evening programs on Small Farms Management, Horses for Clean Water, and other topics. In July 2005, the SCD was awarded Centennial Grant funds to provide small farm BMP education, including riparian vegetation improvements, in the Harvey-Kackman-Armstrong, March, and Fish Creek subwatersheds. Water quality monitoring will be performed to educate residents and other stakeholders on current status of pollution levels in these creeks. The SCD also has received state Salmon Recovery Funds to control erosion from forest roads in the Segelsen Creek area.

Recommended actions: Ecology does not have authority to require specific actions of the SCD. However, this plan recommends the following activities and services the SCD should consider providing to improve water quality in the Stillaguamish Watershed:

- Perform targeted projects in small sub-basins to reduce bacterial pollution and improve

riparian habitat. This *Action Plan* highly recommends comprehensive projects that combine water quality monitoring, education, and implementation of BMPs. Outreach strategies should be designed to measure project effectiveness and improve success over time.

- Develop or support new and expanded financial assistance programs for farm planning and BMP implementation, as funding allows.
- Perform regular visits to small farms in proximity of water bodies or drainage conveyances to help ensure implementation of needed BMPs is taking place.
- Continue to work closely with other agencies and environmental groups to share information on farm plan development and BMP implementation. SCD should continue to balance the needs of these entities with the need for gaining and retaining trust among it clients.
- Provide web-based information on local water quality problems and solutions.
- Continue to develop farm plans and promote resource protection/conservation throughout the watershed.
- Continue to provide outreach/education through its newsletter *The NEXUS*, educational workshops, and farm tours.
- Continue providing LID technical assistance to private landowners and expand program.
- Continue road upgrade and abandonment projects in upper watershed with USFS.
- Continue implementation of the Conservation Reserve Enhancement Program (CREP) and similar efforts to improve near stream vegetation.

Snohomish Health District

The Snohomish Health District (SHD) has a wide variety of responsibilities to protect human health. Among its four major branches is its Environmental Health Division, which oversees permitting and inspection of various activities and facilities including food establishments, on-site septic systems, small and individual drinking water systems, public swimming pools, and solid waste disposal facilities. A major portion of the activities of the Water and Wastewater Section centers on permitting installation and repair of onsite sewage disposal systems.

Improperly functioning on-site septic systems and poorly handled solid waste can affect both dissolved oxygen and bacteria levels in the area of this plan. The SHD has the exclusive authority to enforce county and state codes regarding the treatment of residential wastewater by individual residential onsite septic systems. Similarly, they have specialized skills needed to investigate and evaluate onsite systems. Onsite septic systems are considered a very likely and significant contributor to many areas showing high bacteria levels during summer months. Therefore, the SHD is among the most crucial organizations in resolving the bacterial pollution problems within this TMDL area.

The SHD responds promptly to reports of failing systems or illegal septic system connections to surface waters. About 3,000 inspections of existing systems are performed annually. In recent years, the SHD has also taken steps to improve its ability to provide the public with valuable information on the location and proper operation of onsite septic systems. Homeowners can now get online information on the location of their septic systems at www.snohd.org (click on "septic as builts" in their A-Z Index, or call 425-339-5250). Currently, the public is accessing the system about 2,000 times per month.

The district will also help oversee new regulations that affect the operation and maintenance of onsite systems as of July 2007 (Chapter 246-272 WAC). These new state regulations require owners of mechanical onsite septic systems to have them inspected at least annually. Owners of conventional gravity systems must have their system inspected once every three years. These new requirements may result in the detection of previously unknown problems through the reporting of the private inspection staff. It should also help prevent premature failures that could lead to pollution of local surface waters.

The SHD is collaborating with Snohomish County Surface Water Management to develop a system for identifying and prioritizing on-site septic systems for inspection. Following the development of the prioritization system, the district will investigate two areas within the Stillaguamish Watershed to evaluate the operational health of the area's septic systems. The draft prioritization system should be completed in late 2007.

Recommended actions: Ecology does not have authority to require specific actions of the SHD. However, this *Action Plan* makes the following recommendations.

- Provide leadership on efforts to detect and correct failing septic systems that are contributing to pollution of fresh and marine surface waters. Based upon the success of its collaborative project with Snohomish County (or future process refinements) the district should develop adequate base funding to investigate and manage onsite septic performance across the county. Investigations should start with the high priority areas identified by the prioritization project with the county and expand as the district determines is necessary.
- Continue to respond promptly to reports of septic system failures, provide technical assistance and require corrective action where necessary.
- Distribute information developed as part of the grant program noted above to local governments when it is completed.
- Encourage continuing education regarding onsite septic system maintenance to prevent onsite septic system failures that could contribute to surface water pollution. Education strategies should address the effect of home ownership changes, new onsite systems as they are built, and maintenance reminders.
- This *Action Plan* highly recommends the establishment of adequate staffing and resources to meet the need for sanitary surveys and other direct investigative strategies to locate and resolve the problem of failing septic systems. If the collaborative project with Snohomish County SWM is shown to be effective, it should be replicated in other areas of the watershed needing investigation and possible correction.

Stillaguamish Flood Control District

The Stillaguamish Flood Control District (SFCD) manages a flood control system over a wide area in the lower Stillaguamish floodplain. The SFCD has a long history of working cooperatively with salmon recovery and water quality improvement efforts. Most recently, the SFCD constructed a flow-enhancement tidegate in an 8-mile estuarine channel of the Stillaguamish River, south of Stanwood. The new gate is designed to maintain the Old Channel's water quality by exploiting natural, tidally-induced cycles in the river's flow. District members also participate in the SIRC, Stillaguamish Clean Water District, and Snohomish County Agricultural Advisory Committee.

Recommended actions: Ecology does not have authority to require specific actions of the SFCD. However, this *Action Plan* makes the following recommendation.

- Continue to provide local leadership to improve water quality and riparian habitat within the district.
- Determine status as a secondary permittee to the Phase I/II municipal stormwater permits and act as needed.

Stillaguamish Clean Water District

The Stillaguamish Clean Water District was established in 1993 by Snohomish County Ordinance 96-080, Title 25 A, to improve drainage, water quality, fish habitat, and shellfish beds. This establishment of the district occurred after the state Department of Health determined that poor water quality in Port Susan cannot support the commercial havest of shellfish. Parcels in the district are assessed an annual fee to support the goals of the Clean Water District.

Originally called the Lower Stillaguamish Clean Water District, the Snohomish County council expanded the District's geographic coverage in 2005 to include the entire Stillaguamish watershed, excluding that portion within the Stillaguamish Flood Control District. Currently, 33 percent of fees are allocated to the Snohomish Conservation District to reduce pollution; 59.1 percent is allocated to water quality restoration activities administered by Snohomish County Surface Water Management in the Public Works Department, including funding of the Stillaguamish Steward position; and the remaining 7.9 percent is allocated to County Surface Water Management for local water quality restoration projects that are recommended by the Clean Water District Advisory Board.

Each year, the district funds several projects by the Stillaguamish Steward and the Conservation District. These projects include riparian restoration on private land and installation of native vegetation that will provide riparian shade when mature. In addition, the Board of the Clean Water District writes an annual letter of work priorities and recommended actions to the director of Snohomish County Surface Water Management. The annual letter to the director is another opportunity for this *Action Plan*'s recommendations for water quality improvement to be made more visible.

In 2006, the Clean Water District Citizens Advisory Board began to work more closely with Snohomish County Surface Water Management to make advisory meetings more productive and

its annual letter to SWM for priority activities more timely and effective. Snohomish County Surface Water Management responded with a comprehensive *State of the Stilly: Stillaguamish Clean Water District Report 2007* in April 2007. The report provides a basis for the Advisory Board to better understand watershed needs related to water quality, fish habitat and drainage in this watershed, so the Board can better advise Surface Water Management and County Council regarding work priorities, Clean Water District fee structure, and future reauthorizations of the Clean Water District. Table 9 summarizes the Clean Water District Advisory Board recommended work plan priorities for 2007.

Recommended actions: Continue to provide oversight and recommendations for administering Clean Water District Funds as well as provide a forum for watershed stakeholders to discuss key water quality issues.

Stillaguamish Implementation Review Committee (SIRC)

The Stillaguamish Implementation Review Committee (SIRC) is a watershed-based local stakeholder group established in the early 1990s. The SIRC's mission is to restore and maintain a healthy, functioning Stillaguamish River watershed by providing a local forum in which agencies, organizations, communities and the public can engage in a collaborative watershed-based process of decision-making and coordination. Its initial focus was to oversee implementation of the 1990 Stillaguamish Watershed Action Plan, which included 71 recommendations for controlling non-point pollution in the watershed.

In the mid-1990s, the SIRC added salmon habitat restoration issues to its scope. Since 1999, with leadership from the Stillaguamish Tribe and Snohomish County, the SIRC has served as the local citizens' committee for recommending prioritized lists of salmon habitat restoration projects to the Washington State Salmon Recovery Funding Board. SIRC has final oversight authority for lead entity projects, including salmon habitat project lists and the habitat restoration work schedule.

Currently, the following are member organizations of SIRC:

City of Arlington	City of Stanwood
Clean Water District Advisory Board	Federation of Fly Fishers
Mainstem Stillaguamish community	The Nature Conservancy
North Fork Stillaguamish community	South Fork Stillaguamish Community
Pilchuck Audubon Society	Snohomish Conservation District
Snohomish County Council	Snohomish County SWM
Stillaguamish Flood Control District	Stillaguamish Grange
Stillaguamish Tribe	Twin City Foods
Tulalip Tribes	U.S. Forest Service
Washington Dairy Federation	Washington Dept of Ecology
Washington Dept of Fish & Wildlife	Washington Dept of Natural Res.
Washington Farm Forestry Assoc.	WSU Cooperative Extension
Stillaguamish-Snohomish Fisheries Enhancement Task Force	

Table 9. Summary of Clean Water District Advisory Board priorities for 2007.

Work Plan Element	Requested by CWD Advisory Board	Status in 2007 SWM Work Plan
Warm Beach water quality	1. Septic survey using Kitsap protocols 2. Continue monitoring Creek #0456, outfall #298 3. Year-round targeted studies, including dry weather sampling 4. Sample waterfront discharges 5. Work with Stillaguamish Flood Control District and partners to clean up Warm Beach dike pond, First Creek outfall	1. This element is not funded for 2007. Pending adoption of its plan and availability of funding, Snohomish Health District may conduct a septic survey of the Warm Beach area as part of its draft Onsite Sewage System Management Plan. 2. Monitoring on the creek and the outfall will continue in 2007 under SWM's summer outfall monitoring program 3. This element unfunded for 2007. However, SWM will do IDDE sampling in the summer of 2007. 4. To be addressed in 2007. 5. SWM will coordinate with the Flood Control District and partners.
Fecal TMDL implementation focus area	Coordinate with agencies, implement clean up actions as needed.	The Washington State Department of Ecology is in charge of the TMDL program. Snohomish County continues to provide full participation and support throughout 2007.
Onsite septic systems	Septic Stewardship Program with Snohomish Health District	This is funded for 2007
Ambient water quality monitoring	New "State of the Waters" report	This is funded as part of the 2007 report for the CWD
Stillaguamish Watershed Steward	Continue supporting watershed steward activities	This is funded for 2007
Discretionary Fund	Continue discretionary fund	This is funded for 2007
Snohomish Conservation District	SCD should fund Farm Planner, continue to offer services	This is funded for 2007
Snohomish Health District participation	Support re-involvement of Snohomish Health District	Snohomish County will continue to work with the Snohomish Health District to support the District's re-involvement. The District issued a draft OSS Plan in early 2007 that includes proposed actions (pending funding availability) in the Warm Beach area and other locations.

In May 2005, the SIRC issued the *Stillaguamish (WRIA 5) Chinook Salmon Recovery Plan* (SIRC 2005) which recommends an integrated strategy for protecting and restoring Chinook salmon populations. The strategy includes recommendations for habitat restoration projects;

compliance and enforcement of existing regulations; policy and regulatory coordination; preliminary commitments and conditions to achieve recovery objectives; monitoring and adaptive management; and public outreach and coordination.

The *Chinook Salmon Recovery Plan* and Ecology's Stillaguamish Temperature TMDL share a common goal of reducing stream temperatures and improving fish habitat in many parts of the watershed. Both efforts seek to improve dissolved oxygen and temperature problems because of the critical role they play in the lives of salmonid fishes. Temperature is considered one of several habitat limiting factors contributing to the Chinook salmon population decline.

Recommended actions: This plan recommends that the SIRC continue to provide a forum for the coordination of salmon recovery and water quality improvement projects. The SIRC is the lead entity for guiding critical environmental projects in the Stillaguamish Watershed. For that reason, the SIRC should continue to promote projects that support this TMDL such as riparian restoration projects that include planting to block solar radiation, erosion control projects to reduce the river's sediment load, projects that restore connections with temperature-moderating groundwater, and bacterial pollution source identification and correction projects.

Nonprofit and Volunteer Organizations

Stilly Snohomish Fisheries Enhancement Task Force

The Stilly-Snohomish Fisheries Enhancement Task Force (Task Force) is a 501(c)(3) not-for-profit corporation, registered as a charitable organization with the Washington Secretary of State. The Task Force's mission is to ensure the future of salmon in the Stillaguamish, Snohomish, and Island County watersheds.
In meeting this challenge, Task Force activities also help to both reduce bacterial pollution and improve dissolved oxygen levels. Funding for Task Force activities comes from the Washington Department of Fish and Wildlife, National Fish and Wildlife Foundation, Salmon Recovery Funding Board, grants, donations, and fee-for-service contracts. A diverse board of directors that represents sport, commercial, and tribal fisheries, agriculture, forestry, as well as other interests guides activities. You can learn more about projects and volunteer opportunities with the Task Force at the website: http://www.stillysnofish.org/index.html.

The Task Force conducts volunteer events and stream restoration projects in the Stillaguamish watershed to improve water quality and fish habitat. Current and past projects include tree planting projects on Harvey, Kackman, Krueger, Prairie, Portage, and Glade Bekken Creeks. In cooperation with Snohomish County Parks and Recreation and the National Resources Conservation Service, the Task Force installed large wood structures in Portage Creek at the Portage Creek Wildlife Area. In addition, the Task Force continues its programs to educate landowners on tributary streams about watershed health, water quality, invasive knotweeds, and conduct knotweed control measures.

The Task Force brings education programs, including the Restoration Education for Young Stewards (REYS), to elementary through high school classrooms to provide hands-on opportunities for students to learn about water quality, salmon, and the importance of good stewardship of both land and water. Outreach helps to educate watershed residents about the

importance and value of mature native riparian vegetation in improving water quality and providing quality salmon habitat. Citizens living in the Stillaguamish watershed can volunteer to complete hands-on restoration activities and participate in educational programs that contribute to improved water quality.

Recommended actions: This *Action Plan* encourages the Task Force to seek funding and take the following actions to improve water quality in the Stillaguamish watershed:

- Improve riparian areas by controlling non-native invasive vegetation and replanting native trees and increasing buffer widths.
- Help landowners exclude of livestock from riparian areas.
- Perform door-to-door outreach to private citizens to perform pollution assessments and provide recommendations for improvement. This plan highly recommends innovative strategies that seek to improve traditional outreach approaches through process measurement and outreach surveys.
- Perform sub-basin water quality monitoring coordinated with education and outreach to private landowners in the sub-basins of the Stillaguamish watershed.
- Administer educational programs and outreach activities to increase and measure public awareness of water pollution issues including non-native invasive vegetation.
- Continue publishing the quarterly Watershed Review. At least two articles on Stillaguamish water quality problems/solutions should be included annually.

Local Businesses

Ecology will continue to work with the Puget Sound Action Team, WSDA, DOH, and other government organizations to help educate local businesses on actions they can take prevent bacterial and nutrient pollution and promote healthy riparian areas. Local governments will likely play a key role through the regulation of local businesses that have a potential to discharge bacteria to local waters. Most nonagricultural businesses are located in commercial areas with storm sewer coverage and therefore will be addressed through municipal stormwater permits. Dairies and concentrated animal feeding operations will work primarily with the WSDA.

Recommended actions: All local businesses should help to control and eliminate pollution originating from their business sites. Where there are activities that could result in the discharge of bacteria to local waters, this plan encourages the rigorous application of operational best management practices. Where those practices are not fully effective, structural changes should be made for the long-term protection of local waters.

- In urban areas, this plan strongly recommends that local businesses help reduce stormwater volumes wherever feasible. Land developers, architects, and construction companies are encouraged to learn more about Low Impact Development and use those practices. Mature forest vegetation should be retained to the maximum extent possible. Existing facilities and owners of privately managed stormwater systems should examine opportunities for LID retrofitting and control of pet and other animal wastes on their properties.

- As leaders of the community, business owners are encouraged to consider projects to improve the stewardship of the Stillaguamish Watershed through their philanthropic activities. Dairy and other farm owners are asked to work with local agencies to increase stream buffers to the meet National Resource Conservation Service standards at a minimum and to maximum TMDL-recommended widths to the extent possible. Farm owners should work with the SCD, Snohomish County, and other organizations to explore the use of CREP and other cost sharing/funding incentives. Other businesses can support the activities of the Stillaguamish Snohomish Fisheries Enhancement Taskforce or other entity performing work to improve local water quality.

Other Watershed Groups and Citizens

Local citizens play a critical role in improving the water quality of the Stillaguamish Watershed. Through a thoughtful review of one's daily activities, many citizens can have an immediate impact on local water quality by doing certain tasks differently. Local citizens can also communicate their interest in the environment to local elected officials, and educate others on how to improve water quality in the Stillaguamish.

Recommended actions: This *Action Plan* supports the work of watershed groups and citizens that seek to improve water quality through community awareness projects and on-the-ground efforts. The following activities and best management practices are needed to get the Stillaguamish River clean and healthy for people and fish.

- Call the Snohomish Conservation District to have a free farm plan prepared. Implement all activities needed to control water pollution (install or maintain fencing to keep livestock out of both perennial and intermittent streams, avoid directly watering animals in the stream by providing nose pumps or other facilities, direct barn gutters away from areas where animals are kept, etc.)
- Reduce or eliminate stormwater runoff by employing one or more of the following low impact development techniques where stormwater currently flows to a local stream or ditch.
    - Improve soil quality so it absorbs more water.
    - Install a rain garden
    - Do not replace gravel with traditional asphalt or concrete--consider pervious alternatives or other ways to soak in the stormwater.
- Work with the local government agencies and the Task Force to plant the largest buffer possible if you live next to a stream.
- Do not allow pet waste to build up in your yard and always pick up after your pet in urban areas.
- Do not allow car wash water to flow to your local creek or mix with stormwater. Wash your car on the grass or gravel and do not let it flow into the street.
- Get involved in stream rehabilitation activities if you have the time.

▪ How Will We Fund These Water Cleanup Activities?

There is no single source of funding to make Stillaguamish waters clean and cool again. In urban areas, local governments will be using money from their wastewater or stormwater management accounts that are funded through the monthly or annual payments of local residents. In some cases, citizens are being encouraged to look into their own budgets as they consider how they will manage pet waste, wash the family car in an environmentally friendly manner, plant trees, or install a rain gardens.

For larger projects, multiple sources of financial assistance are available through Ecology's grant and loan programs, local conservation districts, and other sources. Most of the funding opportunities are competitive and offered on an annual basis. Ecology TMDL staff will work with stakeholders to develop funding applications and prepare appropriate scopes of work that will help implement this *Action Plan*.

Funding is available from a number of the agencies mentioned in this document. The most popular funds used in our area are discussed below. There are many other funding sources, especially for projects that benefit both water quality and salmon.
A good source of information on funding sources is the Catalog of Federal Funding Sources for Watershed Protection website. This site provides a searchable database of financial assistance sources (grants, loans, cost-sharing) available to fund a variety of watershed protection projects. To learn more about the federal catalog, use the following link: http://cfpub.epa.gov/fedfund/

An important aspect of gaining funding is to have a clear need identified. It is recommended that you contact the grant specialist for the grant you are considering in order to obtain up-to-date information on current grant priorities, deadlines, and procedures. The following is a partial list of funding opportunities that are popular in western Washington.

Environmental Protection Agency

Environmental Education Grants Program

Education institutions, environmental and educational public agencies, and not-for-profit organizations are eligible for this funding which supports environmental education projects. These grants require non-federal matching funds for at least 25 percent of the total cost of the project. If project requests are $5,000 or less through a Regional Office or $100,000 or less through EPA Headquarters, chances of being funded increase. For more information contact Diane Berger @ (202) 260-8619, berger.diane@epa.gov, or on the Internet @ www.epa.gov/enviroed.

Ecology Funding Opportunities

Centennial/SRF/319 Fund

These three funding sources are managed by Ecology through one combined application program. Centennial and 319 funds are grants and the State Revolving Fund (SRF) is a low interest loan program and each is available to public entities. Grants require a 25 percent match.

They may be used to provide education/outreach, technical assistance, for specific water quality projects, or as seed money to establish various kinds of water quality related programs or program components.

At the time of this report, grant funds are available for riparian fencing, riparian re-vegetation, and alternative stock watering methods to reduce bacterial pollution. Funds are generally not available for making capital improvements to private property. However, eligibility rules can change so one should check at the beginning of each grant cycle. It is recommended that you contact Ecology directly to discuss and develop grant proposals.

Ecology's current policy does not allow the use of state grant funds to support activities required by NPDES permits. However, Ecology hopes to evaluate applications for projects going "over and above" permit requirements, which could still be eligible for assistance. Ecology has just begun revising Chapter 173-95A WAC--the regulations governing the use of Ecology financial assistance resources. Therefore this policy may change in 2007.

Low-interest loans are available to public entities for all the above uses, and have also been used as "pass-through" to provide low-interest loans to homeowners for septic system repair or agricultural best management practices (loan money can be used for a wider range of improvements on private property), for instance. Ecology's grant and loan cycle kicks off in September of each year with public meetings held throughout the state. See Ecology's webpage for more information on Ecology financial assistance opportunities as well as other funding sources. http://www.ecy.wa.gov/programs/wq/links/funding.html

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 environmental restoration and enhancement projects. Local governments, tribes, and state agencies must propose projects through Ecology staff. Projects seeking to reduce bacterial pollution are encouraged. Contact an Ecology Water Cleanup specialist to investigate fund availability and to determine if your project is a good candidate.

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. 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.

The Public Involvement and Education (PIE) Program

The PIE program was previously administered by the Puget Sound Action Team and expected to be continued by the Puget Sound Partnership. PIE dollars help citizens, schools, businesses, non-profits, local and tribal governments to:

- Create solutions to local pollution problems.
- Protect, preserve and restore habitat.
- Motivate people to be environmental stewards.
- Partner with others for lasting results.

PIE is not a grant program. Instead, through personal services contracts, services of individuals and organizations to educate and involve residents of Puget Sound are performed under contracts. Activities must be related to targeted elements of the 2005 - 2007 *Puget Sound Water Quality Work Plan*. If you would like to receive notification of PIE funding opportunities, e-mail or phone contact information to gwilliams@psp.wa.gov, 360-407-7311. To help you decide if PIE is the right program to fund your project, read through the current and past PIE project descriptions at http://www.psp.wa.gov.

Aquatic Lands Enhancement (ALEA) Program

The Aquatic Lands Enhancement Account (ALEA) Grant Program provides grant-in-aid support for the purchase, improvement, or protection of aquatic lands for public purposes, and for providing and improving access to such lands. It is guided by concepts originally developed by DNR, including re-establishment of naturally self-sustaining ecological functions related to aquatic lands, providing or restoring public access to the water, and increasing public awareness of aquatic lands as a finite natural resource and irreplaceable public heritage.

Any division of local or state government, as well as Native American Tribes, are eligible to apply if legally authorized to acquire and develop public open space, habitat, or recreation facilities. Federal agencies, nonprofit organizations, and private entities are not eligible, but are encouraged to seek a partnership with an eligible entity in order to pursue the public benefits the ALEA Grant Program supports.

ALEA Grant Program funds may be used for the acquisition (purchase), restoration, or improvement of aquatic lands for public purposes, and for providing and improving public access to aquatic lands and associated waters.

All projects must be consistent with the local shoreline master program and must be located on lands adjoining a water body that meets the definition of "navigable." Projects intended primarily to protect or restore salmonid habitat must be consistent with the appropriate lead entity strategy or regional salmon recovery plan. Recipients must provide at least 50 percent match. For more information, view the Office of the Interagency Committee website at http://www.iac.wa.gov/iac/grants/alea.htm.

USDA Programs

Conservation Reserve Enhancement Program (CREP)

The CRP is a voluntary program to establish forested buffers along streams where streamside habitat is a significant limiting factor for salmonids. In addition to providing habitat, the buffers improve water quality and increase stream stability. These same actions can also help reduce bacterial pollutant loadings to local waters. Land enrolled in CREP is removed from production and grazing, under 10-15 year contracts. In return, landowners receive annual rental, incentive, maintenance and cost share payments. The annual payments can equal 100 percent of the weighted average soil rental rate (incentive is 110 percent in areas designated by Growth Management Act). This program is now administered by both the Snohomish Conservation District and the Stillaguamish Tribe.

Conservation Reserve Program (CRP)

A voluntary program that offers annual rental payments, incentive payments for certain activities, and cost-share assistance to establish approved cover on eligible cropland. Administered by the Snohomish Conservation District, assistance is available in an amount equal to not more than 50 percent of the participant's costs in establishing approved practices; contract duration between 10-15 years.

Environmental Quality Incentives Program (EQIP)

This federally funded program is managed by Snohomish Conservation District. The EQIP program has the following features.

- Provides technical assistance, cost share payments and incentive payments to assist crop and livestock producers with environmental and conservation improvements on the farm.
- $5.8 billon over next 6 years (nationally).
- 75 percent cost sharing but allows 90 percent if producer is a limited resource or beginning farmer or rancher.
- Program funding divided 60 percent for livestock-related practices, 40 percent for crop land.
- Contracts are one to ten years.
- NO annual payment limitation; sum not to exceed $450,000 per individual/entity.

Snohomish Housing Authority

The Snohomish Housing Authority (SHA) is an independent agency that helps build stronger communities by providing affordable housing and assisting low-income residents in maintaining their homes through low interest loans. When low-income residents face the challenge of replacing a failing septic tank, SHA assistance may be an option. Borrowers need to be moderately low income; a family of two with income less than $45,000 or a family of four with income less than $56,000. Homeowners making less than $30,000 may be eligible for 0 percent loans. The home must be owner-occupied with a 20 percent equity stake and the housing authority loan must be in 2nd position. The maximum loan

is $40,000 for 30 years at 3 percent interest. You can contact the Snohomish Housing Authority by calling 425-290-8499 or at http://hasco.org.

Stillaguamish Clean Water District

Snohomish County WASHINGTON

The Stillaguamish Clean Water District is supported through a fee assessment on watershed property owners for projects related to drainage and improved water quality in Port Susan. Besides the portion administered by Snohomish County Surface Water Management for drainage and other improvement projects, some Clean Water District fees go to Snohomish Conservation District and the Clean Water District. The District distributes their Discretionary Fund of approximately $45,000 on an annual basis to support on-the-ground projects to improve water quality and aquatic habitat. The Clean Water District Citizens Advisory Board is charged with reviewing grant applications for these funds.

Measuring Progress toward Goals

The progress of this *Action Plan* will be measured by 1) assessing the pollution control activities underway or completed, and 2) direct measurement of water quality. The goal is for all areas of the Stillaguamish to consistently meet the Washington State Water Quality Standards for bacteria, dissolved oxygen, pH, and mercury by 2013. Ecology anticipates that if state and local coordination proceed as expected for increasing effective shade, temperature goals will be met by 2065.

For the purposes of this *Action Plan*, fresh water areas other than the three Port Susan drainages are expected to meet the bacteria criteria in Chapter 173-201A WAC. It is the goal of this plan is for those three waterbodies to meet the more stringent "extraordinary primary contact" bacteria criteria to aid in the recovery of shellfish uses in Port Susan.

To help gauge the progress of this plan's implementation, Ecology has chosen eleven geographically separated monitoring locations for evaluation of bacteria levels in the year 2010. Because the goal of the plan is to reach state standards by 2013, a 50 percent reduction in current bacteria levels is set as the interim target. Reductions in the 90th percentile value will be assessed as shown in Table 10.

Table 10. Interim targets for bacteria levels in the Stillaguamish Watershed.

Monitoring Location	Present 90th Percentile Value		2010 Interim 90th Percentile Target		90th %tile Standard
	Dry	Wet	Dry	Wet	
Pump Pond to Slough @ Warm B.	116	150	78.5	95.5	41
Glade Bekken @ Silvana Terrace Rd	838	365	519	282.5	200
Fish Creek at 5th Ave NE	852	790	526	495	200
Mainstem at I-5	218		209		200
Armstrong at Grandview Rd	486	516	343	358	200
Pilchuck at Jackson Gulch Rd	338		269		200
Jim Creek at Jordan Rd	590		395		200
Portage Creek at 212th St NE Bridge	808	420	504	310	200
Portage at 43rd	910	336	555	268	200
Church Creek/Jorgenson Slough @ Marine Dr	788	1292	494	746	200
Miller Creek	1780	8300	990	4250	200

Documenting Pollution Control Activities

In order to gauge the progress of meeting TMDL goals, Ecology will meet with municipal stakeholders no less than annually to share information on the state of water quality in the watershed and status of implementation activities. Water quality data, trends (where applicable), regulatory changes, new and innovative concepts, and funding sources will be discussed to

Figure 26. Water Quality Monitoring. Monitoring surface water helps us find where pollution is coming from and whether or not our implementation efforts have been, and continue to be, effective in protecting local streams.

evaluate the overall status of implementation. Ecology will solicit input from the workgroup at this time to help direct the adaptive management of this *Action Plan*. Ecology will track implementation no less than annually using the tracking table in Appendix D and through municipal stormwater permit program audits.

Direct Measurement of Water Quality

An essential part of this water cleanup effort is monitoring surface water quality. Monitoring is needed throughout the water cleanup process to identify polluted areas, contributing sources, and to verify that corrective actions have been, and remain effective in protecting local waters. Three types of water quality monitoring are needed to implement this *Action Plan*.

- Source Detection Monitoring (recommended)

- Special Purpose Studies (recommended)
- TMDL Effectiveness Monitoring (required/recommended)

Each of these monitoring strategies is discussed below for each TMDL target parameter.

Temperature

To determine the effectiveness of temperature management strategies within the Stillaguamish River watershed, regular monitoring is recommended. Continuously-recording water temperature monitors should be deployed from July through September to capture the critical conditions. Monitoring is recommended at least once every five years to capture a range of critical season conditions. The following locations are suggested for a minimal sampling program.

- Stillaguamish River at Norman Road
- South Fork Stillaguamish River near mouth
- North Fork Stillaguamish River near mouth
- Deer Creek near mouth
- Pilchuck Creek near mouth

Interim monitoring of the composition and extent of riparian vegetation is also recommended for both source identification and trend monitoring. The use of photogrammetry, remote sensing methods, or LIDAR methods could be considered. Projects should also consider evaluating plant survival, changes in canopy levels/effective shade, level of plant establishment/maintenance effort, and planting regime. Methods to measure effective shade at the stream center in various segments for comparison with the load allocations could employ hemispherical photography, angular canopy densiometers, or solar pathfinder instruments.

Special studies to aid in the long term reduction of stream temperatures might explore the relationship of localized high groundwater areas to mainstem recharge during summer months. The use of large woody debris placement to create new or improved cool water refuges, especially in areas where extensive areas of temperature impairment exist, would be a valuable project.

Bacteria, pH, Dissolved Oxygen

In order to track the effectiveness of this *Action Plan* in improving dissolved oxygen levels, narrowing pH fluctuations, and lower bacteria and mercury levels, this plan recommends the actions below. Although pH is not discussed specifically, it is anticipated that reductions in bacteria and nutrients, as well as improvements in dissolved oxygen levels, will result in improved pH levels.

Monitoring of bacteria levels: This *Action Plan* recommends monitoring at key compliance points (major confluences, selected main river reaches, key tributary subbasins) as part of a regularly scheduled monthly monitoring program. When there are significant resource constraints, intensive monitoring should be performed at no more than five year intervals, or when sufficient numbers of **best management practices** (**BMPs**) are in place, in order to

determine if state standards are being met. Should NPDES permittees choose early implementation of Option 2 for monitoring (see Appendix B), then the combination of Ecology long-term sites and NPDES sites will provide much of this data. Additional monitoring by the Stillaguamish Tribe is expected to provide the needed detail for most other areas of the watershed. Thus, there appears to be a good potential for meeting the effectiveness monitoring needs for bacteria. Monitoring of Port Susan fecal coliform levels is an ongoing need and should continue at the current level of intensity.

Source detection monitoring is needed in targeted subbasins to identify bacteria and nutrient sources, both point and nonpoint. Traditional "bracketing" techniques is one recommended method. Bracketing involves an initial characterization of key water segments followed by more intensive monitoring in problem areas as they are detected. Other techniques such as the use of sewage indicators (hardness, fluoride, methyl blue active substances, boron, potassium, ammonia nitrogen, optical brighteners) in illicit discharges is also recommended.

Because our experience in identifying bacteria sources is still in its early stages, special studies to quickly find bacteria sources are strongly recommended. Snohomish County intends on experimenting with the use of these parameters as part of their ambient monitoring program beginning in 2007. This work should be replicated if found to be successful in identifying bacteria sources. Improved methods of source tracking using other markers (chemical, genetic, etc.) should be explored and employed to promote both local and regional progress.

Monitoring of nutrient evels (as related to dissolved oxygen): In general, dissolved oxygen levels should be measured diurnally during critical periods in the early morning as part of watershed characterization and effectiveness monitoring efforts. Unusually high dissolved oxygen concentrations measured during afternoon monitoring may be an indicator of problems during other parts of the day. Analysis of soluble reactive phosphorus and total phosphorus should be performed as part of nutrient analyses aimed at improving dissolved oxygen levels that are depressed due to plant respiration at night. Pilchuck Creek at Jackson Gulch Road is one location needing a reduction in upstream nutrients (Lawrence and Joy 2005).

Dissolved oxygen levels can vary significantly due to local conditions in some streams (significant groundwater inputs for example) so continuous dissolved oxygen monitoring is not being recommended as part of all monitoring studies. For these reasons, salmon productivity and habitat-limiting factors in Portage, March, Pilchuck, and Kackman creeks, and Glade Bekken subbasin should be documented in order determine where the critical areas for dissolved oxygen compliance exist. Dissolved oxygen work in the tributary streams should follow this approach and monitoring efforts should include measurement of phosphorus levels and noted above.

In the mainstem Stillaguamish River below the city of Arlington, primary productivity response and hyporheic exchange rate changes related to seasonal low flows require more spatial and temporal definition to explain critical dissolved oxygen levels. Ecology expects to prepare a study of this area during 2007-8 if resources allow. The study will be conducted as soon as resources are available. The study should include monitoring of carbon, nitrogen, and

phosphorus loads from the upper basin, Harvey-Armstrong Creek, March Creek, unidentified nonpoint sources, and the Arlington WWTP as part of the study.

Monitoring of mercury levels: Ecology set four compliance points for compliance with mercury standards (see Appendix B). Total suspended solids (TSS) was established as a surrogate measure of mercury levels. Representative TSS levels should be evaluated at the compliance points once every five years, or as sediment best management practices are employed, to determine compliance with TMDL targets (Table B-8, Appendix B).

Monitoring required by NPDES Permits: This plan requires municipal stormwater permit holders to monitor and report on permit-related actions to reduce bacteria levels and to perform water quality monitoring. Several water quality monitoring options exist and any one of them will contribute to our future ability to understand pollution levels in the Stillaguamish Watershed and perform adaptive management as needed. All WWTPs will be required to monitor temperature, as well as phosphorus and nitrogen in effluent and receiving waters, especially during critical conditions. See Appendix C for details on NPDES monitoring requirements for stormwater permittees.

Effectiveness monitoring by Ecology: Ecology has a formal effectiveness monitoring process for evaluating progress in meeting TMDL goals. This process is conducted by Ecology's Environmental Assessment (EA) Program after reviewing TMDL targets and implementation activities. The EA Program evaluates current monitoring and implementation data, conducts additional monitoring as needed, and prepares a report to support the adaptive management process. Ecology effectiveness monitoring does not evaluate individual BMPs for their ability to reduce pollution levels.

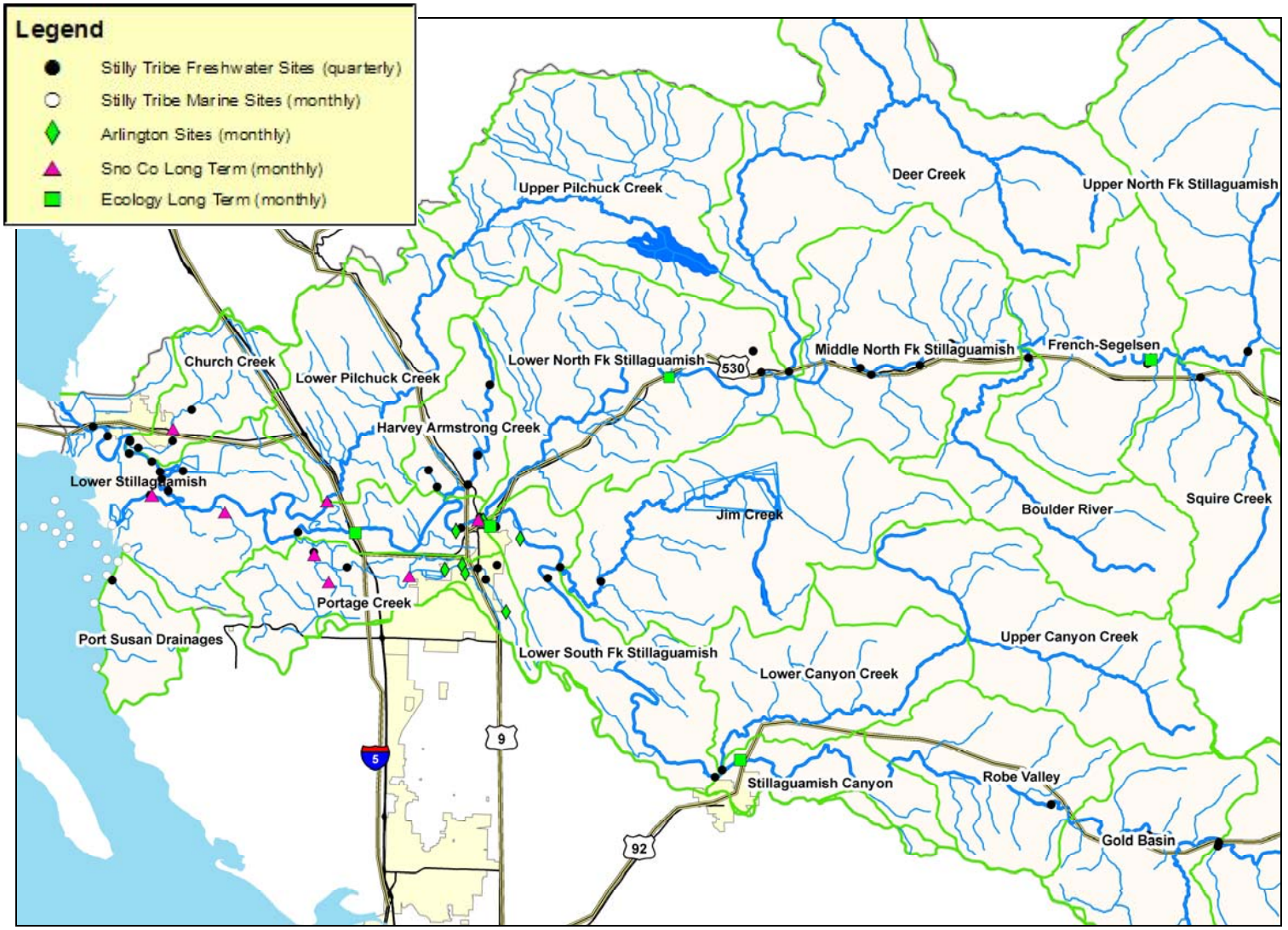

Figure 27. Current monitoring locations in the Stillaguamish Watershed and Port Susan.

Strategy for a Reasonable Assurance of Success

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 Stillaguamish Watershed and its bacteria, nutrient, and temperature pollution problems, both point and nonpoint sources exist. This *Action Plan* must provide a "reasonable assurance" that these sources will be reduced. Education, outreach, technical and financial assistance, permit administration, and enforcement will all be used to ensure that the goals of this plan are met.

Ecology believes that the following activities will lead to the successful implementation of this *Action Plan* and add to the assurance that pollution levels will be reduced and the waters of the Stillaguamish River will meet state standards.

NPDES Permit Programs

Four NPDES permit holders are directly affected by this *Action Plan*. Ecology's municipal stormwater permit program will address stormwater pollution from unincorporated Snohomish County, WSDOT, and from the cities of Arlington, Marysville, and Granite Falls. Discharges from WWTPs operated by the city of Arlington, Warm Beach Christian Campground and Conference Center, and Snohomish County (Indian Ridge) will also be regulated. Although Marysville and Granite Falls did not receive wasteload allocations, recent or anticipated expansions of their urban growth boundaries bring the possibility of new stormwater inputs and their associated pollution.

Water cleanup activities for Snohomish County, the city of Arlington, and the center are discussed elsewhere in this *Action Plan*. The WSDOT currently has an NPDES permit that will be reissued in the near future. Additional TMDL-related requirements are expected for the new WSDOT permit.

Although bacterial contributions from industrial sources were not identified as part of this plan, it is possible that the industrial permit program could be affected in the future with changes in the watershed's business community. TMDL-related permit conditions will be adaptively managed every five years at the time of permit re-issuance.

Ecology Funding Programs

Ecology has a Centennial Grant program that is widely used to help fund water cleanup activities. Several entities are working to reduce mercury and bacteria levels and water temperatures and to improve dissolved oxygen levels. Ecology is assisting Snohomish County to fund three projects that will eventually contribute to the reduction of bacterial pollution in the Stillaguamish watershed: Animal Waste Control Project, the North Creek Stormwater Management Project, the Onsite Septic Management Program, and the "Big Trees" riparian restoration program. Several of these efforts are focused in other TMDL areas but will provide valuable outreach tools, strategies, and other information that should be used in other urban areas in Washington State.

The Snohomish Conservation District is working in the basin through base funding provided through the Clean Water District, other base funding by Snohomish County and the Conservation Commission, and targeted funds provided by Ecology to work in Harvey-Armstrong and March Creeks. The Stillaguamish Tribe is also working in the basin using Ecology Centennial Grant funding to reduce sediment inputs from a large landslide area. Finally, the Stilly-Snohomish Fisheries Enhancement Task Force has applied to Ecology for funds to perform TMDL-related activities within the Stillaguamish watershed. If fencing and riparian restoration projects are identified, stakeholders can also work with Ecology's local Water Cleanup Specialist to explore funding through the Coastal Protection Funds.

Other Water Cleanup Activities

In addition to regulatory and grant funding programs in place through Ecology, there are other water cleanup activities underway, which are detailed in the "What will be done. Who will do it" section of this document. Among the participating entities not regulated by Ecology are the Snohomish Health District, Snohomish Conservation District, Stilly-Snohomish Fisheries Enhancement Task Force, US Forest Service, DNR, and Puget Sound Action Team.

Adaptive Management

The Stillaguamish Watershed TMDLs will use an adaptive management approach to ensure the success of this plan. Adaptive management could include adjusting best management practices, helping develop and fund additional water quality projects that address the required temperature and nutrient reductions, funding of additional education initiatives, and other means to improve water quality. For those areas with specified load reductions, if water quality standards are met without attaining the load reductions specified in previous Stillaguamish TMDL reports, then the objectives of this TMDL are met and no further reductions are needed. Additional work is needed to address the low dissolved oxygen levels below the Arlington WWTP as noted earlier.

This plan recommends a focus on BMP implementation to reduce bacteria, nutrient, and sediment loading for the next five years. This timetable coincides with the implementation of BMPs through the municipal stormwater permits. Because the establishment of riparian vegetation takes many years, this plan will measure progress on temperature reduction through an assessment of stream miles planted, percent survival of plants after five or more years, and average stand height. As new pollution sources are found that were not identified by this plan, they will be corrected through the appropriate authorities.

Ecology will document control measures and other activities as they are completed each year. Changes in water quality throughout the watershed will be evaluated when reductions are expected to be measurable. Long term monitoring stations maintained by Ecology, Snohomish County, the Stillaguamish Tribe, and the city of Arlington will be helpful in tracking change over time. The decision to schedule additional effectiveness

monitoring will depend on best professional judgment that measurable improvement in water quality is likely to have occurred, based on the annual review of available water quality data and implementation activities. If the planned activities are not effective, the implementation activities set out in this plan will be reexamined and modified as part of the adaptive management process.

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 the Department of Ecology to control and prevent pollution, to make and enforce rules, including water quality standards.

Entities with enforcement authority will be responsible for following up on any enforcement actions. Stormwater permittees will be responsible for meeting the requirements of their permits and enforcing local ordinances pertaining to stormwater discharge or water quality where in effect and applicable. Ecology will also be conducting audits of municipal stormwater permit programs and enforcement is an element of those permits.

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 Stillaguamish TMDL process to achieve clean water through voluntary control actions. Ecology will consider and issue notices of noncompliance in accordance with the Regulatory Reform Act in situations where the cause or contribution of cause of noncompliance with load allocations can be established.

Public Involvement

Ecology communicated with the public in several ways. Beginning in December 2006, Ecology staff met regularly with the following key stakeholders in the Stillaguamish Watershed as part of a TMDL Workgroup: Snohomish County, the city of Arlington, the Tulalip and Stillaguamish Tribes, the Snohomish Conservation District, USFS, Stilly/Snohomish Fisheries Enhancement Task Force. Ecology also worked with the Snohomish Health District, Stillaguamish Flood Control District, and the DNR to get their input on the status and needs for action within their service areas.

The advisory group convened on five occasions to facilitate discussions on the development of the TMDL and provide input. Members also reviewed and commented on drafts of several sections of the draft *Action Plan* between meetings. Meetings of the advisory group were held on the following dates:

- December 20, 2006
- January 17, 2007
- January 31, 2007
- February 21, 2007
- March 14, 2007

A public comment period provided opportunities for reviewing the draft Plan and ran from April 30, 2007 through May 25, 2007.

The draft plan was also put on Ecology's internet site at the following location:

http://www.ecy.wa.gov/programs/wq/tmdl/watershed/tmdl_info-nwro.html

Ecology gave a presentation to the public on May 9, 2007, at the monthly meeting of the Stillaguamish Implementation Review Committee (SIRC).

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Appendix A: Acronyms and Glossary

7-DADM: Seven-day average of the daily maximum temperatures. This is the arithmetic mean of seven consecutive measures of the daily maximum temperatures. The 7-DADM for any individual day is calculated by averaging that day's daily maximum temperature with the daily maximum temperature for the three days prior and the three days after that date.

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 beneficial 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.

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.

Critical Conditions: The time period where a water quality parameter reaches it's extremes. Critical conditions for temperature occur during the hottest parts of the summer when solar radiation is high and stream flows are low. Dissolved oxygen levels can also reach critical levels during warmer periods, especially at night when plant photosynthesis (where the plant makes oxygen) stops and plant respiration (where plants take in oxygen) begins.

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 percent sodium chloride, at pH 9.6, and at 10 degrees C and 45 degrees C.

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 nonself-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 twenty-four hours at 44.5 plus or minus 0.2 degrees Celsius. FC are “indicator” organisms that suggest the possible 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 of the nth root of a product of n factors, or 2) taking the antilogarithm of the arithmetic mean of the logarithms of the individual values.

Hyporheic Zone/Hyporheic Exchange: The hyporheic zone is defined as a subsurface volume of sediment and porous space adjacent to a stream through which stream water readily exchanges. In so-called "gaining" stream reaches, **groundwater** discharges into the stream, contributing to streamflow through streamside seeps or directly welling up through the streambed. In "losing" stream reaches, stream water infiltrates into a subsurface **aquifer** through the streambed or streambanks, causing a net loss of water to the stream. Hyporheic exchange is unique because the stream water that enters the subsurface (the hyporheic zone) can also reenters the stream at some point downstream.

Large Woody Debris: Large woody debris (LWD) is defined as a log, or collection of logs, that protrude into a stream. LWD enter the stream when trees die, are blown over, when channels migrate, or as a result of bank erosion or landslides. Once in the stream, this wood can store fine sediment, retain spawning gravels, form pools, create cool groundwater inputs, and provide cover and nutrients that promote favorable fish habitat.

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.

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): (i) 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 (ii) designed or used for collecting or conveying stormwater; (iii) which is not a combined sewer; and (iv) which is not part of a Publicly Owned Treatment Works (POTW) as defined in the Code of Federal Regulations at 40 CFR 122.2.

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.

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 National Pollutant Discharge Elimination System 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, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state as will or is likely to create a nuisance or render such waters harmful, detrimental, or injurious to the public health, safety, or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to 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.

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.

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.

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: Water Quality Standards, Previous 303(d) listings, Loading Allocations, and Wasteload Allocations

Table B-1. Water Quality Criteria for Bacteria in Washington State.

Designated Use	State Bacteria Criteria	
	Geometric Mean Value	Upper 10 Percent Cutoff Value[1]
Extraordinary Primary Contact: Waters providing extraordinary protection against waterborne disease or that serve as tributaries to extraordinary quality shellfish harvesting areas.	**50 cfu/100 mL**	**100 cfu/100 mL**
Primary Contact: 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	**100 cfu/100 mL**	**200 cfu/100 mL**
Secondary Contact: Activities where a person's water contact would be limited (e.g., wading or fishing) to the extent that bacterial infections of eyes, ears, respiratory or digestive systems, or urogenital areas would normally be avoided.	**200 cfu/100 mL**	**400 cfu/100 mL**

[1] No more than 10 percent of all samples may exceed this value.

Table B-2. New Ecology Standards for surface water temperatures. Where char spawning and rearing and Supplemental Spawning/Incubation criteria overlap, the more stringent criteria shall apply. All values expressed as the 7-Day Average Daily Maximum Temperature in degrees Celsius.

Stream Reach	Salmon spawning and rearing	Core summer habitat	Char spawning and rearing	Supplemental Spawning/ Incubation
Mainstem Stillaguamish	17.5	--	--	13(a)
Fish Creek	17.5	16(b)	--	--
Jim Creek	--	16,	12(c)(d)	13 (e)
Pilchuck Creek	17.5	16 (f),	12 (g)(h)(i)(j)	13(k)(l)
Deer Creek	--	16(m),	12(n)	13(o)
Brooks Creek	--	16(p)	12(q)	--
Dick's Creek	--	16,	12(r)	--
North Fork	--	16(s),	12(t)	13 (u)
South Fork	--	16(v),	12(w)	13(x)
Canyon Creek	--	16(y),	12(z)(aa)	13(bb)
Church Creek	--	16	--	--

(a) Oct 1 –May 15, from approximately river mile (RM) 5.5 to confluence with the north and south forks

(b) All waters above unnamed stream 0039, located about 0.05 RM upstream of confluence with Portage Creek

(c) Portion of Cub Creek above confluence w/unnamed tributary at approximate RM 3.9, (just above Twin Lakes).

(d) All waters, and tributaries, above the junction with Little Jim Creek (at approximately 14.8 on Jim Creek)

(e) Sept 15 – July, confluence to approximately RM 13 near crossing of mainstem Jim Creek w/Trafton Rd.

(f) Above Stanwood-Bryant Road (268th St), to headwaters, including tributaries, except where designated for char.

(g) Lake Cavanaugh and all tributaries above the outlet.

(h) All waters above the confluence with Bear Creek (~RM 16.5)

(i) For Pilchuck Creek's unnamed tributary at ~ RM 11.9,: All waters (including tributaries) above junction at ~ RM 0.9.

(j) Crain Creek: confluence of unnamed creek 0091 at ~RM 1.2, all waters upstream. From confluence of unnamed streams 0089 and 0088, ~0.6 miles upstream of confluence w/mainstem Crain Creek, all waters above confluence.

(k) Oct 1 – May 15, confluence with mainstem to river mile (RM) 3 (near crossing with Stanwood-Bryant Rd. (268th St).

(l) Feb 15 – July 1 from ~RM 3 (near Stanwood-Bryant Rd crossing) to RM 7 (¾ mile upstream State Route 9 crossing).

(m) Confluence to approximately RM 4.5, by unnamed stream 0176.

(n) All waters above (and including) unnamed stream 0176 (approximately RM 4.5).

(o) Sept 1 – July 2 from confluence to approximately RM 1.0

(p) Confluence to approximately RM 1.5 at the fork where 2 unnamed streams meet.

(q) Confluence of two unnamed streams (~RM 1.5) to headwaters, both streams.

(r) Confluence of the outlet from Myrtle Lake, all waters above the junction.

(s) Mouth to confluence w/ Boulder River (including tribs, except where designated for char)

(t) Boulder River, and the North Fork above Squire Creek.

(u) Sept 1 – July 1, mainstem up to ~ RM 36 (0.4 miles below Cascade Creek) and selected lower reaches of unnamed creek 0138, Rock Creek, Grant Creek, Lake Creek, unnamed creek 0168, Brooks Creek, Rollins Creek, Boulder River, French Creek, and Squire Creek. See http://www.ecy.wa.gov/biblio/0610038.html for specific locations.

(v) Confluence to the unnamed tributary at approximately RM 40 (about 3 miles before Cranberry Creek).

(w) From unnamed tributary at approximately RM 40 (~ 3 miles before Cranberry Creek) and above.

(x) Sep 15 – Jul 1, confl. to Mtn Loop Hwy (RM 34.7) & above Wiley Crk (RM 51.2) to above Boardman Crk, RM 53.7

(y) Confluence to approx. RM 6.3 (~1 mile above crossing with Jeep Trail, latitude 48.1242 longitude -121.8894).

(z) From RM 6.3 (about 1 mile above crossing with Jeep Trail) to headwaters.

(aa) Portion of unnamed tributary 0132 (begins at ~RM 3.2 of Canyon Creek) located above latitude 48.1459 longitude -121.9648 (3 RM from Canyon Creek confluence, includes Jordan Ponds).

(bb) Mainstem to confluence of the North and South Forks at ~RM 11.8.

Table B-3. Stillaguamish River basin (Water Resource Inventory Area 5) and Port Susan (WRIA 6) water bodies on the 1996/1998 Section 303(d) lists.

Old ID No.	New ID No.	Name	Parameters	1996 303(d)
WA-05-1016	QJ28UC	Fish Creek	Fecal Coliform	Yes
	HD76OJ	Harvey Creek	Fecal Coliform	No
	JU33JU	Jim Creek	Fecal Coliform	No
WA-05-1012	GH05SX	Jorgenson Slough (Church Creek)	Fecal Coliform	Yes
	IJ55EP	Lake Martha Creek	Fecal Coliform	No
	QE93BW	Old Stillaguamish River	Fecal Coliform	No
WA-05-1018	VJ74AO	Pilchuck Creek	Dissolved Oxygen	No
WA-PS-0020	390KRD	Port Susan	Fecal Coliform	Yes
WA-05-1015	OT80TY*	Portage Creek	Fecal Coliform, Dissolved Oxygen	Yes
WA-05-1010	QE93BW	Stillaguamish River	Fecal Coliform, Dissolved Oxygen, Arsenic	Yes/Yes No
WA-05-1010	ZO73WL	Stillaguamish River (Hat Slough)	Fecal Coliform, Dissolved Oxygen	No/Yes
WA-05-1020	WO38NV	N.F. Stillaguamish River	Fecal Coliform	Yes
WA-05-1050	SN06ZT	S.F. Stillaguamish River	Fecal Coliform, pH, Dissolved Oxygen	Yes/Yes/ No
	LU17DC	Unnamed Creek #0456	Fecal Coliform	No

Table B-4. Portions of the Stillaguamish River on the Washington State 303 (d) list for temperature in the 2004 Water Quality Assessment.

Waterbody Name	Township	Range	Section	Listing ID
Deer Creek	32N	07E	08	6454
	33N	07E	01	7188
	34N	07E	35	6455
Higgins Creek	32N	07E	20	7198
Little Deer Creek	34N	07E	35	6456
Pilchuck Creek	33N	05E	27	6450
	32N	05E	16	6448
	33N	06E	17	6447
	32N	05E	31	6449
South Slough	31N	04E	02	6452
Stillaguamish River	31N	05E	06	6565
	31N	05E	02	7244
	31N	04E	02	6453
Stillaguamish River, N.F.	32N	07E	10	15567
	32N	09E	7	6568
	32N	08E	6	15572
	31N	05E	2	6446
	32N	09E	10	6457
	32N	06E	15	6567
	32N	09E	22	7247
	33N	09E	22	6458
Stillaguamish River, S.F.	31N	05E	02	6566
	30N	08E	08	6460
	31N	06E	18	6451
	30N	08E	16	6459
	30N	07E	07	10587
Canyon Creek	30N	06E	12	15568
	30N	07E	06	6444
	30N	07E	03	15569
Jim Creek	31N	06E	08	15570
	31N	06E	16	15571
	31N	06E	07	6445

Table B-5. Summary of Loading Capacity and Wasteload and Load Allocations for Stillaguamish Reaches with both Fecal Coliform and Dissolved Oxygen Impairments

Water Body	WBID	Parameter	Current Load (cfu/day)	Loading Capacity: Target Geometric Mean (cfu) or Estimated Potential Minimum Dissolved Oxygen (mg/L) (or BOD in lb/day)	Total % Reduction Required	Percent of Load (estimate)	Wasteload or Load Allocation	NPDES Permit Holder or Nonpoint Source
March Creek	WI88QF	Fecal Coliform	9.35×10^{10}	10 cfu/100 mL	98	19	3.6×10^{8}	Arlington
						0.4	7.5×10^{6}	Snohomish Cty
						1.2	2.2×10^{7}	WSDOT
						79.4	1.5×10^{9}	Nonpoint
		Dissolved Oxygen (BOD_5 in lb/day)		6.5 mg/L (31)		2	(0.7)	Arlington
						0.1	(0.02)	Snohomish Cty
						0.2	(0.06)	WSDOT
						33	(10)	Background
						66	(20)	Nonpoint
Kackman Creek at 252nd	XB43NX	Fecal Coliform	1.79×10^{10}	33 cfu/100 mL	68	3.6	2.1×10^{8}	Snohomish Cty
						96.4	5.5×10^{9}	Nonpoint
		Dissolved Oxygen (BOD_5 in lb/day)		7 mg/L (10)		6	(0.6)	Snohomish Cty
						50	(5)	Background
						40	(4)	Nonpoint
Portage Creek at 212th NE	OT80TY	Fecal Coliform	4.16×10^{11}	25 cfu/100 mL	83	2.9	2.0×10^{9}	Snohomish Cty
						1.8	1.3×10^{9}	WSDOT
						95.3	6.7×10^{10}	Nonpoint
		Dissolved Oxygen (BOD_5 in lb/day)		6.5 mg/L (300)		4	(12)	Snohomish Cty
						3	(8)	WSDOT
						70	(210)	Background
						23	(70)	Nonpoint

Table B-5 (continued). Summary of Loading Capacity and Wasteload and Load Allocations for Stillaguamish Reaches with both Fecal Coliform and Dissolved Oxygen Impairments.

Water Body	WBID	Parameter	Current Load (cfu/day)	Loading Capacity: Target Geometric Mean (cfu) or Estimated Potential Min. Dissolved Oxygen (mg/L) (or BOD in lb/day)	Total % Reduction Required	Percent of Load (estimate)	Wasteload or Load Allocation	Source or NPDES Permit Holder
Portage Creek at 43rd NE	OT80TY	Fecal Coliform	3.69×10^{11}	45 cfu/100 mL	69	39	4.4×10^{10}	Arlington
						61	7.0×10^{10}	Nonpoint
		Dissolved Oxygen (BOD_5 in lb/day)		7 mg/L (250)		57	(142)	Arlington
						40	(100)	Background
						3	(8)	Nonpoint
Pilchuck Creek at Jackson Gulch Rd	VJ74AO	Fecal Coliform	4.89×10^{11}	38 cfu/100 mL	26	2.5	9.0×10^{9}	Snohomish County
						16.5	6.0×10^{10}	WSDOT
						81	2.9×10^{11}	Nonpoint
		Dissolved Oxygen (BOD_5 in lb/day)		8 mg/L (890)		3	(27)	Snohomish Coty
						20	(179)	WSDOT
						39	(350)	Background
						37	(330)	Nonpoint
Warm Beach Creek above WWTP	SH96KX	Fecal Coliform	3.11×10^{10}	47 cfu/100 mL	81	100	5.9×10^{9}	Nonpoint
		Dissolved Oxygen (BOD_5 in lb/day)		8 mg/L (20)		7	(1.4)	Snohomish County
						0	(0)	Warm Beach WWTP
						93	(18.6)	Background
Warm Beach Dike Pond (includes BOD loading from Warm Beach Creek, above)	SH96KX	Fecal Coliform	4.23×10^{10}	14 cfu/100 mL	92	4.3	1.5×10^{8}	Snohomish County
						95.7	3.2×10^{9}	Nonpoint
		Dissolved Oxygen (BOD_5 in lb/day)		6.5 mg/L (30)		5	(1.4)*	Snohomish Cty
						67	(20)	Background
						27	(8)	Nonpoint

*Load allocation of 1.4 lb BOD/day for Snohomish County carried from entry above for Warm Beach Creek

Table B-6. Summary of Loading Capacity and Wasteload and Load Allocations for Stillaguamish Reaches with Fecal Coliform Impairments

A. Port Susan and Discharges to Port Susan

Water Body	WBID	Current Bacteria Load (cfu/day)	Loading Capacity: Target Geometric Mean (cfu/100 mL)	Total Percent Reduction Required	Percent of Load (estimate)	Wasteload or Load Allocation	Source or NPDES Permit Holder
Port Susan	390KRD	Note 1	14	61	100	Note 1	Nonpoint
Unnamed Creek #0456	LU17DC	5.17×10^{10}	11	97	6.9	1.1×10^{8}	Snohomish County
					93.1	1.4×10^{9}	Nonpoint
Lake Martha Creek	IJ55EP	6.38×10^{10}	23	92	8.8	4.5×10^{8}	Snohomish County
					91.2	4.6×10^{9}	Nonpoint
Warm Beach Slough	IE90YH	Note 1	10	64	100	Note 1	Nonpoint
Agricultural Drain to Warm Beach Dike Pond	SH96KX	8.86×10^{9}	13	89	100	9.8×10^{8}	Nonpoint
Twin City Foods Drain #4	WC93GU	Note 1	18	88	100	Note 1	Nonpoint
West Pass of Old Stillaguamish Channel	XF13JD	6.1×10^{10}	3	97	100	9.0×10^{8}	Nonpoint
South Pass of Old Stillaguamish Channel	UJ01AO	2.45×10^{11}	11	75	100	6.1×10^{10}	Nonpoint
Hat Slough (Stillaguamish River) at Marine Drive	ZO73WL	5.79×10^{12}	36	36	100	3.71×10^{12}	Nonpoint

Note 1: Insufficient data to calculate load

Table B-6 (continued). Summary of Loading Capacity and Wasteload and Load Allocations for Stillaguamish Reaches with Fecal Coliform Impairments

B. Old Stillaguamish Channel Tributaries*

Water Body	WBID	Critical Condition Geometric Mean (cfu/100 mL)	Loading Capacity: Target Geometric Mean (cfu/100 mL)	Total Percent Reduction Required	Percent of Load (estimate)	NPDES Permit Holder o Nonpoint Source
Douglas Slough	AS64WF	40	13	68	100	Nonpoint
Irvine Slough	HS19KT	730	7	99	100	Nonpoint
Jorgenson Slough (lower Church Creek)	GH05SX	320	42	87	100	Nonpoint
Church Creek at Park	GH05SX	147	38	74	100	Nonpoint
Miller Creek at Miller Rd	KX60NO	311	28	91	100	Nonpoint
Twin City Foods Drain #1	JV77EY	406	24	94	100	Nonpoint
Twin City Foods Drain #2	JV77EY	285	3	99	100	Nonpoint
Twin City Foods Drain #3	JV77EY	1180	24	98	100	Nonpoint
Twin City Foods Drain #5	JV77EY	545	22	96	100	Nonpoint

* Discharges (flows) and fecal coliform loads will be calculated during development of the Old Stillaguamish Channel TMDL expected to be initiated in fall 2006. Because measurements of fecal coliform concentration made in 2001 (during sampling for this Stillaguamish TMDL) were so high, these fecal coliform reductions are recommended to support immediate cleanup planning and implementation.

Table B-6 (continued). Summary of Loading Capacity and Wasteload and Load Allocations for Stillaguamish Reaches with Fecal Coliform Impairments

C. Stillaguamish Mainstem and Tributaries Below Arlington

Water Body	WBID	Current Bacteria Load (cfu/day)	Loading Capacity: Target Geometric Mean (cfu/100 mL)	Total Percent Reduction Required	Percent of Load (estimate)	Wasteload or Load Allocation	NPDES Permit Holder or Nonpoint Source
Glade Bekken	FJ67XF	7.42×10^{10}	18	92	6.5	3.9×10^{8}	Snohomish County
					93.5	5.5×10^{9}	Nonpoint
Stillaguamish River at I-5	QE93BW	6.27×10^{12}	26	52	100	3.0×10^{12}	Nonpoint
Fish Creek	QJ28UC	7.4×10^{10}	32	81	5	7.0×10^{8}	Snohomish County
					95	1.3×10^{10}	Nonpoint
Armstrong Creek at Mouth	VP67JK	1.01×10^{11}	43	29	2.3	1.6×10^{9}	Snohomish County
					1.2	8.6×10^{8}	WSDOT
					96.5	6.9×10^{10}	Nonpoint
Armstrong Creek below Hatchery	VP67JK	Note 1	23	66	100	Note 1	Nonpoint
Harvey Creek at Grandview	HD76OJ	2.33×10^{10}	38	76	1.2	6.7×10^{7}	Snohomish County
					98.8	5.5×10^{9}	Nonpoint

Note 1: Insufficient flow data to calculate load

D. North and South Forks of the Stillaguamish River and Jim Creek

Water Body	WBID	Current Bacteria Load (cfu/day)	Loading Capacity: Target Geometric Mean (cfu/100 mL)	Total Percent Reduction Required	Percent of Load (estimate)	Wasteload or Load Allocation	NPDES Permit Holder or Nonpoint Source
N Fork Stilly (at mouth)	WO38NV	1.95×10^{12}	28	38	2.1	2.5×10^{10}	Snohomish County
					1.5	1.8×10^{10}	WSDOT
					96.4	1.2×10^{12}	Nonpoint
S Fork Stilly (at mouth)	SN06ZT	2.24×10^{12}	40	7	5.6	1.2×10^{11}	Arlington
					2.9	6.0×10^{10}	Snohomish County
					91.5	1.9×10^{12}	Nonpoint
Jim Creek at mouth	JU33JU	4.0×10^{11}	34	14	1.6	5.5×10^{9}	Snohomish County
					98.4	3.4×10^{11}	Nonpoint

Table B-7 . Summary of Loading Capacity and Load Allocations for the North Fork Stillaguamish to reduce periphyton biomass and address elevated pH measurements.

Water Body	WBID	Loading Capacity (Total Phosphorus)	Target Value Total Phosphorus (median seasonal value)	Percent of Load (estimate)	Load Allocation (Total Phosphorus)	Source
North Fork Stillaguamish River (km 15.2-28.3)	WO38NV	20 lb/day	0.01 mg/L	70	14 lb/day	Nonpoint
				30	6 lb/day	Background

Table B-8. Load Allocations for Stillaguamish Reaches with Mercury Impairments

Water Body	WBID	Loading Capacity (ug/L) (4-day average)	Target Value Total Suspended Solids (4-day average)	Percent of Load (estimate)	Load Allocation for TSS as surrogate for Mercury (mg/L)	Source
Stillaguamish River	QE93BW	0.012	65 mg/L	100	65	Nonpoint
North Fork Stillaguamish (upper – above RM 20)	WO38NV	0.012	13 mg/L	100	13	Nonpoint
North Fork Stillaguamish (lower – below Hazel slide at RM 20)	WO38NV	**0.012**	65 mg/L	100	65	Nonpoint
South Fork Stillaguamish (mouth)	SN06ZT	**0.012**	65 mg/L	100	65	Nonpoint

Table B-9. Recommended Fecal Coliform Limits and Wasteload Allocations for Three Wastewater Treatment Plants with NPDES Permits

Facility Name	Current FC Permit cfu/100 mL	Proposed Permit cfu/100 mL	WLA cfu/day
Indian Ridge Corrections Center WWTP	100	100	8.0×10^8
Arlington WWTP	200 / 400	39 / 128	3.0×10^9
Warm Beach Conference Center WWTP*	200 / 400	47 / 100	1.3×10^8
Warm Beach Conference Center WWTP**	-	11 / 26	3.1×10^7

* Assuming discharge to Warm Beach Creek at current maximum monthly flow of 0.075 MGD, and the discharge is allowed under special considerations.

** Assuming discharge to Hat Slough near the South Branch with maximum monthly flow of 0.075 MGD.

Summary of Temperature Wasteload Allocations for Wastewater Treatment Plants

Ecology established a general formula for determining the temperature wasteload allocations (T_{WLAs}) for wastewater treatment plants (WWTPs) used in conjunction with static modeling. Static modeling assumes that the highest possible stream and effluent temperatures, lowest stream flows, and highest WWTP discharges all occur at the same time. The equation is as follows (Lawrence 2006):

$$T_{WLA} = (\text{summer maximum criterion} - 0.3) + (\text{chronic dilution factor}) \times (0.3)$$

As permits are renewed for the Arlington, Warm Beach, and Indian Ridge wastewater treatment plants (WWTPs), their discharges will be evaluated for compliance with state standards. Discharge limitations are evaluated in advance of the permit renewal process because of the substantial engineering that must be undertaken as part of WWTP operations and upgrading. The following is a general discussion of temperature TMDL compliance for each of the plants above.

Arlington WWTP

The Arlington WWTP is expected to comply with the T_{WLA} until approximately 2014. Ecology and the city will be collecting additional information prior to that time to refine the model used to determine compliance with the *Stillaguamish River Temperature TMDL*. The table below provides an estimate of the T_{WLA} based on current knowledge and using a static modeling approach.

Arlington Flow (millions of gallons/day)	Dry Weather Chronic Dilution Factor	Estimated WLA for Temperature (^{o}C)*
1.1 (current)	39.7	29.1
2.56 (year 2025)	17.3	22.4

*Estimated WLAs are based on use of 7Q20 flows. Actual dilution factors may change based on new information and/or revised modeling approaches approved by Ecology.

Warm Beach Christian Camp/Conference Center WWTP

Ecology did not establish wasteload allocations for temperature for the Warm Beach WWTP. Discharges from the center's WWTP will be required to meet state water quality standards.

Indian Ridge Corrections Facility WWTP

This facility is currently closed. Should Snohomish County reopen Indian Ridge, Ecology will require that the operators maintain daily effluent temperature records to ascertain compliance with the temperature requirements of this TMDL. Indian Ridge discharges will be subject to the limitations set in the T_{WLA} equation noted earlier.

Appendix C: Special Requirements for Municipal Stormwater Permit Holders

Special Requirements for Permits Holders

Federal law requires applicable Total Maximum Daily Loads (TMDLs) to be addressed when water quality permits are issued. Where a TMDL has been approved, National Pollution Discharge Elimination System (NPDES) permits must contain effluent limits and conditions consistent with the TMDL (40 CFR 122.44(d)(1)(vii)(B), 40 CFR 122.34(e)(1)). Additionally, state law (RCW 90.48) does not permit the introduction of polluting matter into state waters. Although effluent limitations are typically expressed in a numerical form, effluent limitations for stormwater discharges from municipal separate storm sewer systems (MS4s) will be expressed in the form of Best Management Practices (BMPs).

Each municipality affected by this Water Quality Implementation Plan (*Action Plan*) faces variations in the number of potential source areas, types and numbers of land uses, financial constraints, and other issues that will affect the scope of TMDL-related activities within their jurisdiction. Ecology recognizes this and intends there to be flexibility in the development and implementation of BMPs and water quality monitoring programs associated with this plan. It should also be noted, however, that where surface waters have been identified as polluted, it is assumed that existing resources and programs alone are inadequate to address the problem and additional steps must be taken to resolve existing pollution problems.

To demonstrate progress toward meeting water quality standards, Ecology intends to include the following actions as permit requirements in Phase I and Phase II Municipal Stormwater NPDES permits for jurisdictions whose stormwater discharges are identified as sources of loadings to this TMDL. These requirements will be included in the first permit issued after the completion of this *Action Plan*. Subsequent permits may include different requirements, depending on the success of achieving the goals of the *Action Plan*. Requirements for the Washington State Department of Transportation are not included in this Appendix and will be addressed during the development of their NPDES permit.

1) Pollution Source Control Activities

No later than two years from the permit effective date, all municipal stormwater permit holders shall adopt and enforce an ordinance or other equivalent mechanism requiring the application of source control BMPs related to bacterial pollutants (equivalent to Volume IV of the 2005 Ecology Stormwater Management Manual for Western Washington) for the following existing land uses and activities that generate bacterial pollution.

Specifically, Volume IV, chapter 2, contains general information for implementing BMPs (section 2.1) and specific BMPs for 1) commercial animal handling areas (pg 2-10), 2) commercial composting facilities (pgs 2-11, 2-12), and 3) illicit connections to storm drains (pg 2-22). Where these activities are not occurring, no action is required. BMPs for commercial composting operations shall also be consistent with WAC 173-350-220, Solid Waste Handling Standards, Composting Facilities.

No later than two years from the permit effective date, permit holders that have land uses with domestic animals (cattle, horses, pets, etc.) that may discharge wastes to their MS4 shall adopt and enforce an ordinance or other equivalent mechanism that protects the MS4 from these sources, or develop pilot programs designed to control bacterial

pollution from these sources. A complaint-based response mechanism shall be sufficient to identify sites that are potentially pollution generating.

Where potential sources related to the land uses and activities above do exist, operational source control BMPs shall be required for all pollutant generating sources. Only in those cases where a facility is demonstrated to be causing a violation of surface water standards or is discharging illegally, shall structural source control BMPs be required as related to this TMDL. The provision for structural source control BMPs is not intended to apply to individual municipal stormwater outfalls.

2) Public Involvement

All municipal stormwater permit holders shall prepare a *TMDL Action Plan* (TAP) as a subsection of their Stormwater Management Program (SWMP). The purpose of the TAP is to facilitate the public's participation in advising on the development, implementation, and update of TMDL-related portions of the SWMP. The TAP shall include information on relevant activities being taken to reduce bacterial pollution and control substances that contribute to oxygen depletion in receiving waters. Typical actions include ordinances, inspection and enforcement resources and strategies, illicit discharge program elements, and water quality monitoring. Municipal stormwater permit holders shall evaluate and document the applicability of the following approaches in the TAP:.

- Receiving water sampling to identify bacterial pollution sources within targeted sub basins.
- Development and implementation of a Pet Waste Ordinance or other equivalent mechanism.
- Evaluate current water pollution ordinance enforcement capabilities.
- Evaluation of critical areas ordinance in relation to TMDL goals.
- Implementation of an educational program for K-12 students to increase their awareness of bacterial pollution problems.
- Investigation and implementation of methods that prevent additional stormwater bacterial pollution through stormwater treatment, reducing stormwater volumes from existing areas using low impact development retrofitting, and preventing additional sources of stormwater in association with new development using low impact development strategies.

3) TMDL Activity Documentation and Tracking

All municipal stormwater permit holders shall discuss program changes and TAP activities completed during the previous year in a subsection of their Stormwater Management Program (SWMP) annual report. The purpose of this requirement is to allow for the timely tracking and evaluation of TMDL-related permit requirements by Ecology and the public.

4) Public Outreach and Education

All municipal stormwater permit holders shall include bacteria and dissolved oxygen impairments from stormwater in their public outreach and education activities associated with Special Condition S5.C.10 (Phase I permit) or into one or more of the minimum measures in Special Condition S5.C.1.(a)i, ii, iii, or iv (Phase II permits). Permittees shall measure the understanding and adoption of the target behaviors among targeted audiences and update or modify their programs where improvement is not occurring.

5) Water Quality Monitoring

All municipal stormwater permit holders are responsible for performing, or contracting out, water quality monitoring in accordance with Options 1 or 2 below. This monitoring shall be described in a plan prepared in accordance with Ecology's *Guidelines for Preparing Quality Assurance Project Plans (QAPPs) for Environmental Studies* (Ecology Publication No. 01-03-003 or most current version). Phase II permit holders shall submit their QAPP to Ecology for approval within 120 days of the permit effective date.

Permit holders may rely on another entity to satisfy the monitoring component required by this TMDL. Permit holders that are relying on another entity to satisfy this monitoring obligation remain responsible for permit compliance if the other entity fails to perform the required monitoring.

In order to ensure consistency in their county-wide TMDL monitoring program, Phase I permittee Snohomish County has the option of following monitoring timelines and dates for submitting their QAPP, *Bacterial Pollution Remediation Plan, Early Action Plan* (if applicable) or other key TMDL documents following alternate timelines. Ecology recognizes that the county is affected by at least five different TMDLs. Snohomish county must obtain approval from Ecology for these alternate timelines within 120 days of the permit effective date.

Monitoring shall begin within 180 days of the permit effective date. The monitoring start date will be extended day for day if Ecology requires more than 30 days to review the QAPP. Permit holders shall choose one of two options outlined in Figure 2 and discussed below:

Option 1, Direct Measurement of Stormwater: The concentration and loading of bacteria to the Stillaguamish Watershed from stormwater within the permit holder's jurisdiction shall be estimated by sampling representative outfalls within the MS4 system. Specific sampling locations and frequencies of stormwater outfall monitoring will be reviewed and approved by Ecology's during its approval of the Quality Assurance Project Plan (QAPP) prepared as a requirement of the NPDES Permit.

Option 2, Indirect Measurement of Pollution Sources: Changes in bacterial levels in representative portions of the Stillaguamish River (Snohomish County) or Portage Creek (city of Arlington) as a result of stormwater inputs shall be estimated through

receiving water monitoring using flow duration or comparable analyses[7]. Measuring the effect of stormwater discharges in the receiving water as part of a regularly scheduled program is the approach recommended by this plan.

Within Option 2, permit holders may either a) measure water quality entering and leaving their jurisdiction or b) measure water quality at locations in Figure 1 as follows:

- Snohomish County shall monitor bacteria levels at the eight locations indicated in Figure B-2. As part of its cross-county TMDL-monitoring requirements, Snohomish County will also perform an additional illicit discharge detection and elimination project in the Stillaguamish Watershed during one year of the next permit cycle.
- The city of Arlington shall monitor bacteria levels at the eight locations indicated in Figure B-2 and perform flow monitoring at the sites indicated. Arlington may relocate upstream stations during the permit in consultation with Ecology if it is determined water quality standards are being met at those locations.

Option 2 monitoring must be performed at a frequency that will produce approximately 60 data points or more at each monitoring station over the five year permit cycle. The purpose of establishing data frequency requirements is to ensure that a reasonable amount of data will be collected when storm events are affecting the receiving water when a regularly scheduled ambient monitoring approach is used. Continuous flow monitoring at each monitoring point, or a representative location, must be performed to determine if a sampling event is affected, or dominated, by storm flows.

6) Coordination of Stormwater Management Activities

In association with Phase I permit condition S5.C(3), Snohomish County shall include the discussion of TMDL-related activities as part of the stormwater management coordination activities for physically connected and shared water bodies.

7) Illicit Discharge Detection and Elimination (IDDE)

The schedule and activities identified for the illicit discharge detection and elimination program in both the Phase I and Phase II permits shall be sufficient to meet TMDL requirements with the following clarifying conditions:

Phase I Permit—Snohomish County shall give strong consideration to prioritizing IDDE activities in areas where bacterial TMDLs are in place. All outfall screening shall include screening for sewage/septic sources and oxygen depleting substances. The county shall develop threshold values for responding to these pollution problems and initiating investigation/termination activities as defined in permit condition S5C8(b)(vii).

Phase II Permit—Water bodies addressed by a TMDL for bacteria shall be designated as high priority water bodies (see permit condition S.5.C.3.(c)(ii)) and

[7] Although the characterization of stormwater volumes and concentrations are less precise using this technique, the resulting data will also serve larger watershed goals to understand trends in water quality and the success of this TMDL. Characterization of stormwater effects using flow duration analysis is not intended to address other permit requirements for stormwater monitoring.

shall receive field assessments and screening prior to other receiving water bodies unless approved in writing from Ecology. The presence of sewage/septic system sources shall be investigated as part of all screenings.

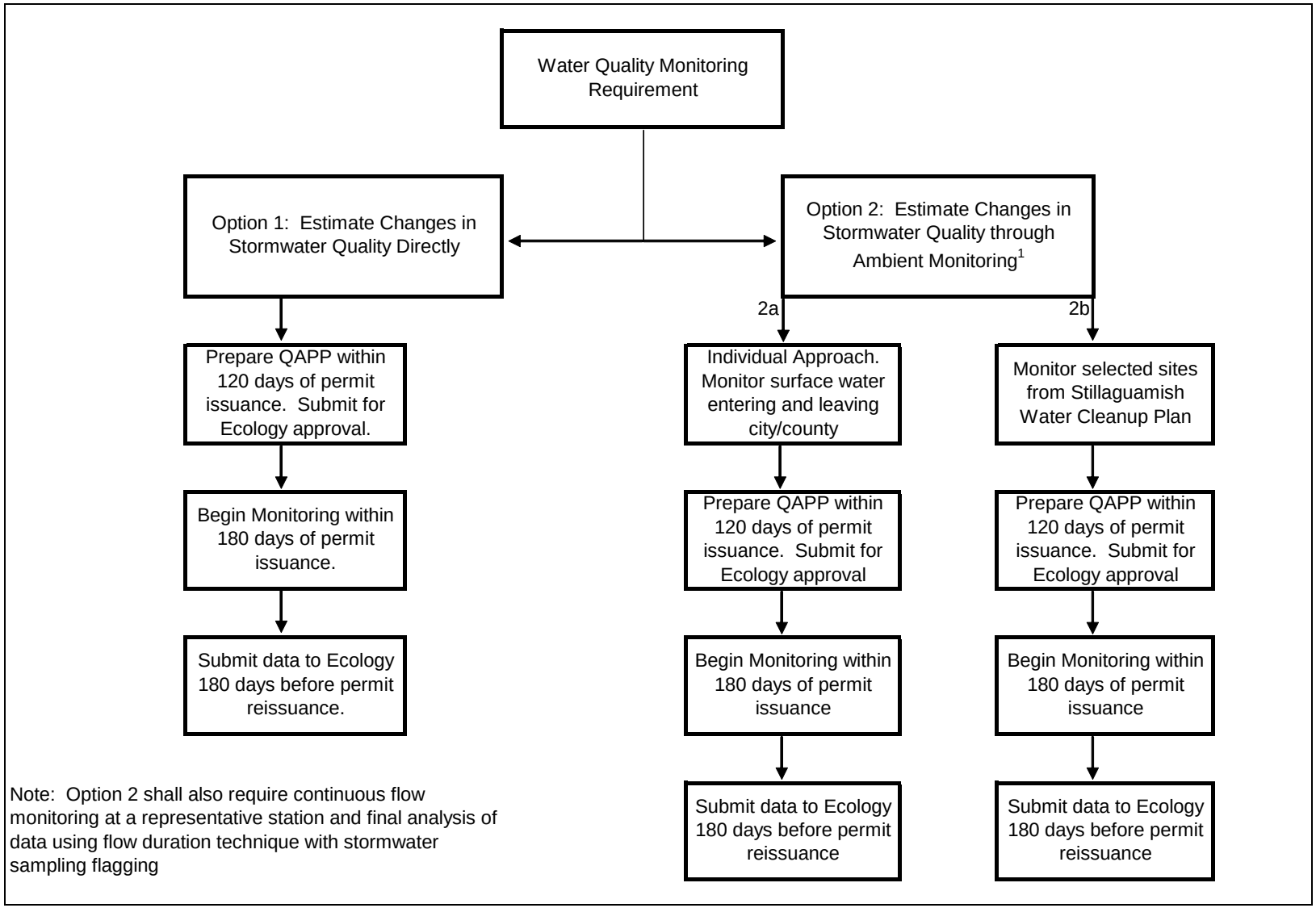


Figure C-1. Flowchart of basic NPDES/TMDL stormwater monitoring requirements. Permit holders may choose any one of the three monitoring paths provided above.

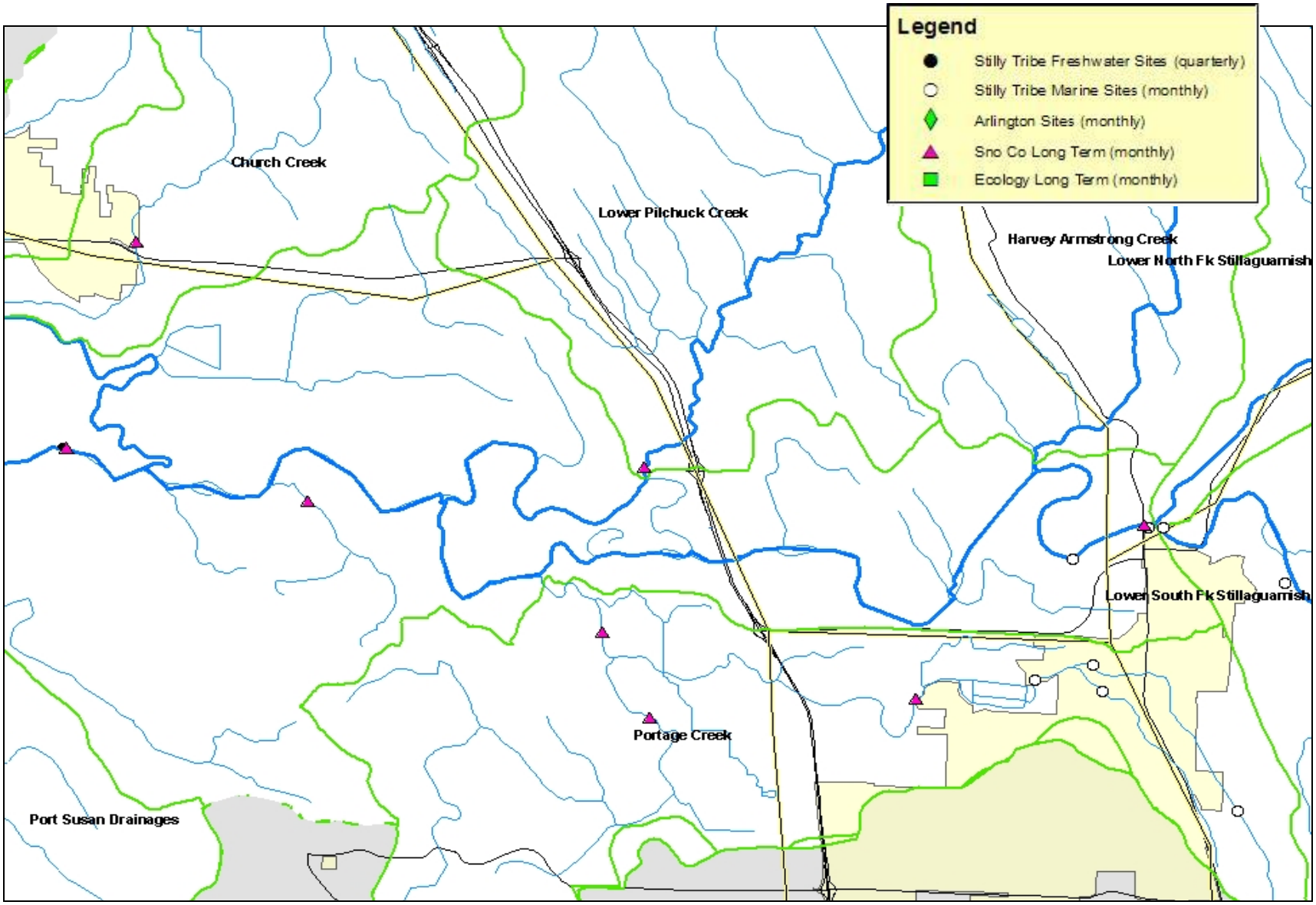


Figure C-2. Required monitoring stations under monitoring Option 2(b). Monitoring Option 2b establishes 16 locations to be monitored to determine changes in water quality over time. Approximately 60 samples should be collected at each site over a five year period. Accurate daily flow monitoring is needed at the flow monitoring reference sites throughout the monitoring period.

Appendix D: Implementation Schedule Tracking Sheets

Implementation Schedule Tracking Sheets

The action items listed in the following table reflect information contained in the Stillaguamish River Water Quality Implementation Plan. Some actions are voluntary in nature and others reflect activities that are anticipated to occur as a part of National Pollution Discharge Elimination System (NPDES) permits.

Timelines associated with the Municipal Stormwater Permits are based on the deadlines set forth in the permit as it was issued in January 2007. Actions and timelines associated with these and other stormwater permits are subject to change based upon the outcome of pending appeals or future permit modifications.

The table below lists many actions that are anticipated to be required by NPDES permit authority. Anticipated TMDL-related permit requirements are detailed in Appendix C of this document. The final legal requirements for NPDES permit holders are set forth in the permits themselves.

Water Cleanup Activities Tracking Sheet

Entity	Action	Year					
		2007	2008	2009	2010	2011	2012
Federal, State, and Tribal Governments							
U.S.E.P.A	Administer Clean Water Act (CWA) 319 Program						
	Provide CWA 104(b)(3) funding opportunities						
U.S. Forest Service	Provide technical assistance to state and private forest interests						
	Seek additional funding and address forest road maintenance						
	Seek funding and complete Access and Travel Management Plan						
	Continue noxious weed treatments in cooperation with the County Weed Board						
	Monitor stream temperatures in the upper watershed in cooperation with Snohomish County and the tribes						
	Investigate riparian areas on USFS lands that are upstream of locations shown to have high stream temperatures. Provide shading, woody debris placement, or other techniques to reduce downstream temperatures						
Stillaguamish Tribe	Perform quarterly fresh water monitoring for bacteria and temperature at up to 50 locations						
	Perform marine water monitoring at 10 locations on a monthly basis						
	Coordinate 10 miles of riparian restoration annually						
	Continue research on fine sediment transport and effects						
	Add 3 engineered log jams at Hazel Hole						
	Investigate riparian lands that are upstream of locations shown to have high stream temperatures. Work with landowners to provide shading, woody debris placement, or other techniques to reduce downstream temperatures						
Tulalip Tribe	Work in cooperation with USFS to correct or abandon failing forest roads and to restore stream channel morphology and riparian conditions.						
	Continue water quality and shellfish habitat monitoring of Port Susan.						
Washington Department of Agriculture	Inspect Stillaguamish dairies on a 18-24 month interval to ensure BMPs are in place						
	Assist local agencies in addressing bacterial pollution from non-dairy livestock operations including any Concentrated Animal Feeding Operations (CAFOs)						
Washington Department of Health	Provide technical assistance to local Island and Snohomish Health Districts						
	Continue support of marine monitoring in Port Susan						
Washington Department of	Fully fund and implement the Road Maintenance and Abandonment and Family Forest Fish Passage Program.						

Entity	Action	Year					
		2007	2008	2009	2010	2011	2012
Natural Resources	Investigate riparian areas on DNR lands that are upstream of locations shown to have high stream temperatures. Provide shading, woody debris placement, or other techniques to reduce downstream temperatures.						
	Complete development of Landslide Hazard Zone work where necessary. Refer to unique Stillaguamish Tribe Data where available.						
Department of Ecology	Convene meeting of the Stillaguamish TMDL Workgroup no less than annually						
	Provide State Revolving Fund (loan) & Centennial (grant) funding opportunities						
	Provide technical assistance for stormwater program and TMDL activities						
	Inspect construction sites with 1 acre or more of clearing to control sediment discharges						
	Evaluate Forest and Fish Plan and modify as needed.						
	Complete water quality management plan in conjunction with USFS.						
	Prepare TMDL effectiveness monitoring report (date approximated)						
Puget Sound Action Team	Administer PIE Personal Services Contracts to support water cleanup activities						
	Develop Low Impact Development tools and promote LID education and outreach						
	Provide technical assistance to local governments in support of water cleanup activities						
	Promote citizen stewardship through shoreline landowner workshops						
	Provide technical assistance to local governments in support of water cleanup activities						
Special Purpose Districts							
Snohomish Conservation District	Perform outreach and education on Ag BMPs, LID, and Backyard Conservation						
	Provide technical assistance & cost share to small farms, dairies & other livestock operations						
	Publish annual article on water quality issues in the Stillaguamish watershed						
	Provide engineering support for implementation of agricultural BMPs, LID, and erosion control measures.						
	Provide engineering support for implementation of agricultural BMPs, LID, and erosion control measures.						
	Implement the Stillaguamish sub-basin TMDL grant from Ecology						
	Inform landowners of other programs including but not limited to CREP, WRP, etc.						
	Support SCWD by formulating an annual work plan that includes a full time farm planner, outreach and technical assistance						
Snohomish	Distribute educational materials to watershed residents						

Entity	Action	Year					
		2007	2008	2009	2010	2011	2012
Health District	Respond to up to 5 requests for assistance to local government and environmental groups						
	Assist in development of sanitary survey criteria (county-wide program)						
	Perform survey of one selected high priority area as part of Centennial Grant project						
Citizens, Local Businesses, Local Organizations							
Stillaguamish/ Snohomish Fisheries Enhancement Task Force	Perform riparian restoration, plant 1 mile of riparian area per year						
	Publish at least 2 articles on Stillaguamish water quality annually in *The Watershed Review*						
	Apply for grant funding and execute a targeted educational outreach/restoration project in a selected subbasin in the Stillaguamish Watershed						
	Educate students at three or more schools in the Stillaguamish Watershed using the Restoration Education for Young Stewards Program						
Local Businesses, (as needed)	Follow operational BMPs to prevent discharge of bacterial pollutants						
	Implement Low Impact Development strategies in new development and redevelopment, Reduce existing or new stormwater volumes						
Citizens	Reduce stormwater contamination, pick up after pets, fertilize wisely, keep car wash water out of the stormwater system						
	Reduce stormwater volumes from private property as appropriate (soil augmentation, rain gardens, absorption swales						
	Educate neighbors on pollution prevention techniques						
	Implement agricultural BMPs on small farms & residential BMPs in urban/suburban areas						
County Government							
Snohomish County	Promote LID practices in new development and redevelopment						
	Conduct water quality monitoring (Phase I permit, TMDL-related, ambient monitoring)						
	Investigate water quality problems as reported on-line and by phone and track follow-up						
	Provide info. to assist the Snohomish Health District in identifying failing septic systems						
	Continue to fund a Stillaguamish Basin Steward						
	Participate in SIRC activities and coordinate with Arlington on shared MS4s						
	Provide web-based water quality information (monitoring data, volunteer and education opportunities, etc)						
	Meet 2x/year with Snohomish Conserv. Dist. to review farm plans & coordinate activities						
	Develop/implement educational program addressing bacterial pollution (MS4 area)						
	Inspect commercial facilities needing operational BMPs to control bacterial pollution						
	Execute Illicit Discharge Detection and Elimination Program						

Entity	Action	Year					
		2007	2008	2009	2010	2011	2012
	Prepare Bacterial Pollution Remediation Plan (schedule to be determined)						
	Enforcement of Critical Areas Regulations and Water Quality Ordinances						
	Develop and implement a program to promote proper management of pet wastes						
	Implement LID or other stormwater infiltration practices in public projects						
	Promote LID/stormwater infiltration in private development/redevelopment projects						
	Track water quality violation follow up actions and use of enforcement as needed						
	Implement the Big Trees project on the South Fork Stillaguamish						
	Implement the Big Trees project on the North Fork Stillaguamish						
	Perform riparian land use analysis to monitor progress in restoring full shade potentials						
City Government							
City of Arlington	Adoption of ordinances to address animal handling facilities						
	Enforcement of water quality, storm sewer protection, and critical areas ordinances						
	Illicit discharge detection and elimination program						
	o Develop Program						
	o Train Key Staff						
	o Prioritize water bodies for visual inspect.						
	o Train all field staff						
	o Complete field assessments						
	o Complete storm sewer mapping						
	o Remove illicit discharges that are found within 180 days						
	o Program is fully implemented						
	Public Education and Outreach—Implement or participate, 2 target audiences						
	Public Involvement—create opportunities to participate in SWMP development						
	Public Involvement—Prepare Bacterial Pollution Remediation Plan, report annually						
	Water Quality Monitoring—prepare Quality Assurance Project Plan (QAPP)						
	Water Quality Monitoring—perform monitoring						
	Develop and implement program for proper pet waste management throughout city						
	Work with Snohomish Health District on high priority septic areas if identified						
	Implement LID or other stormwater infiltration practices in public projects						
	Promote LID/stormwater infiltration in private development/redevelopment projects						

Entity	Action	Year					
		2007	2008	2009	2010	2011	2012
	1000’ of riparian planting						

Appendix E: Near-Stream Riparian Cover

Data from Purser et al. 2003

Subbasin land use, Stillaguamish Watershed, 2001. Data expressed as a percentage of total land area in the near-stream area (300' of each streamside).											
2001 Data	Mature Evergreen Forest	Medium Evergreen Forest	Deciduous Stands	Shrub/small trees	Grass	Bare Ground	Medium density development	High density development	Alpine rock/talus slope	Open Water	Unknown (shadow)
North Fork											
Boulder River	36	19	12	19	2	1	0	0	6	0	4
Deer Creek	28	28	10	24	3	1	1	2	1	0	1
French-Segelsen	13	15	22	36	7	4	1	0	0	0	0
Lower North Fk Stillaguamish	6	13	19	34	12	12	1	1	0	1	0
Squire Creek	16	16	23	35	7	3	1	0	0	0	0
Middle North Frk	10	15	23	38	7	5	1	1	0	1	0
Upper North Frk	33	33	11	18	3	1	0	0	0	0	0
Average	**20.3**	**19.9**	**17.1**	**29.1**	**5.9**	**3.9**	**0.7**	**0.6**	**1.0**	**0.3**	**0.7**
South Fork											
Gold basin	49	21	7	13	2	0	0	1	1	2	3
Jim Creek	16	20	21	29	7	5	1	0	0	1	0
Lower Canyon Creek	17	22	16	27	9	5	2	1	0	1	1
Lower South Fk Stilly	9	8	17	29	13	9	4	4	0	4	1
Robe Valley	26	19	18	25	4	1	1	1	1	2	1
Stillaguamish Canyon	32	28	11	18	3	2	1	2	0	1	2
Upper Canyon Creek	40	29	7	17	3	1	0	0	0	0	1
Upper South Frk	42	27	9	16	2	0	1	1	1	1	1
Average	**28.9**	**21.8**	**13.3**	**21.8**	**5.4**	**2.9**	**1.3**	**1.3**	**0.4**	**1.5**	**1.3**
Lower Stilly											
Church Creek	1	3	16	34	21	17	4	4	0	0	0
Harvey Armstrong Creek	4	16	19	32	13	14	1	1	0	0	0
Lower Stilly	3	4	9	28	19	22	6	6	0	4	0
Lower Pilchuck Creek	3	12	21	42	10	9	1	1	0	0	0
Port Susan Drainages	9	8	14	24	9	4	6	7	0	11	9
Portage Creek	1	3	15	30	17	21	5	6	0	1	0
Upper Pilchuck	14	21	19	33	7	2	1	1	0	1	1
Average	**5.0**	**9.6**	**16.1**	**31.9**	**13.7**	**12.7**	**3.4**	**3.7**	**0.0**	**2.4**	**1.4**

Stillaguamish Land Use by major basin, change in percent land cover from 1991 to 2001 (2001% composition -1991% land composition)											
Difference in 91/01 data. Bold indicates loss of veget. Italics show a gain in veget.	Mature Evergreen Forest	Medium Evergreen Forest	Deciduous Stands	Shrub/small trees	Grass	Bare Ground	Medium density development	High density development	Alpine rock/talus slope	Open Water	Unknown (shadow)
North Fork											
Boulder River	**3**	*-3*	**2**	0	0	0	0	0	0	0	*-2*
Deer Creek	**3**	*-5*	**4**	*-4*	**3**	**2**	0	*-1*	0	0	*-1*
French-Segelsen	**1**	*-2*	**7**	*-6*	**4**	*-3*	0	1	0	0	0
Squire Creek	*-2*	**1**	**8**	*-9*	**3**	*-3*	0	0	0	0	0
Lower North Fk	**1**	*-2*	**8**	*-6*	**10**	*-10*	**1**	0	0	*-1*	0
Middle North Frk	**2**	*-4*	**6**	*-7*	**6**	*-4*	0	*-1*	0	*-1*	0
Upper North Frk	**1**	*-3*	**5**	*-2*	*-1*	**1**	0	0	0	0	0
Average	***1.3***	*-2.6*	***5.7***	*-4.9*	***3.6***	*-2.4*	***0.1***	*-0.1*	**0.0**	*-0.3*	*-0.4*
South Fork											
Gold basin	**6**	*-7*	**1**	**3**	0	**1**	0	*-1*	0	*-1*	*-2*
Jim Creek	**3**	*-2*	**4**	*-3*	**4**	*-4*	0	0	0	*-1*	0
Lower Canyon Creek	**11**	**1**	**2**	*-5*	*-4*	*-2*	*-1*	*-1*	0	*-1*	*-1*
Lower South Fk Stilly	0	**2**	**9**	**2**	**7**	*-7*	*-2*	*-4*	0	*-4*	*-1*
Robe Valley	0	0	**1**	*-4*	*-1*	**8**	**1**	*-1*	*-1*	*-2*	*-1*
Stillaguamish Canyon	**2**	*-4*	**7**	**1**	*-1*	0	*-1*	*-2*	0	*-1*	*-2*
Upper Canyon Creek	**13**	*-6*	**1**	*-2*	*-2*	*-1*	0	0	0	0	*-1*
Upper South Frk	**3**	*-5*	**2**	0	**1**	**1**	-1	*-1*	0	*-1*	*-1*
Average	**4.8**	*-2.6*	**3.4**	*-1.0*	**0.5**	*-0.5*	*-0.5*	*-1.3*	*-0.1*	*-1.4*	*-1.1*
Lower Stilly and Tribs											
Church Creek	0	*-1*	**10**	*-2*	**6**	*-16*	*-2*	*-4*	0	0	0
Harvey Armstrong Creek	*-1*	*-7*	**10**	*-3*	**14**	*-13*	0	*-1*	0	0	0
Lower Pilchuck Creek	0	*-5*	**10**	*-8*	**12**	*-7*	0	*-1*	0	0	0
Lower Stilly	*-1*	0	**7**	*-6*	**22**	*-14*	*-1*	*-3*	0	*-4*	0
Port Susan Drainages	**5**	**9**	**8**	**4**	0	0	*-1*	*-7*	0	*-11*	*-9*
Portage Creek	0	0	**7**	*-2*	**20**	*-16*	*-3*	*-5*	0	*-1*	0
Upper Pilchuck	**7**	**5**	*-1*	*-12*	*-1*	**4**	**1**	*-1*	0	*-1*	*-1*
Average	**1.4**	**0.1**	**7.3**	*-4.1*	**10.4**	*-8.9*	*-0.9*	*-3.1*	***0.0***	*-2.4*	*-1.4*

Appendix F: Response to Comments

Response to Comments

The following summarized comments were received during the public comment period for the Stillaguamish River Water Quality Improvement Plan. Comments regarding factual inaccuracies, improved wording, or those that clarify policy positions by other government agencies have been directly incorporated into the text of the final Stillaguamish River Water Quality Improvement Plan (*Action Plan*). All other comments are summarized below. Some comments have been combined in order to avoid redundant responses to similar or related comments.

1. **Comment:** Page 28, Develop and implement an aggressive plan to control pet wastes. The recommended actions emphasize installation of pet waste stations in public places and Figure 12 includes a photo of one of these devices. Snohomish County Public Works' research (funded through a Department of Ecology Centennial Grant) suggests that recommendations to install pet waste stations in public places may allow jurisdictions to think they are addressing the problem, and may allow them to comply with regulations, without actually addressing the problem. The research shows that 89 percent of dog owners indicate their dog waste is dropped in yards. We recommend dropping the recommendation for installation of pet waste stations.

   This research found many jurisdictions that implemented pet waste cleanup programs in public spaces, however these programs fell into two categories: 1) those motivated by clean shoes, sidewalks and parks, not water quality, and 2) those that were motivated by water quality, but for lack of any other model, copied the actions of programs that were not water quality motivated.

   While there are certainly places where an emphasis on waste cleanup in public places is appropriate (such as beaches and where parks and trails adjoin waterways), our evidence suggests that pet waste programs need to address home and yard waste management. Snohomish County Public Works' survey results found that only 8 percent of residents report that all or most of their dog's waste is dropped on walks while 78 percent report that all or most is dropped in their yards.

Response: Ecology concurs that the County's research on pet waste management is valuable and should be consulted in the development of local pet waste management programs. In high density urban areas where there are little or no private yards, Ecology staff have observed considerable use of public locations for pet exercise and pet waste deposition--these areas have a particularly high potential for stormwater contamination. Pet waste stations in these public areas can educate pet owners about the public expectation that they will pick up after their pets and properly dispose of the waste. In response to this comment, Ecology has reworded the text on page 28 that refers to the development of pet waste management programs. The need to consult the County's research has been added and the reference to Figure 12 (pet waste education station) has been changed so it is not the focus of the recommendation.

2. Comment. p. 76, Required and Recommended Actions. The recommendation to annually track the number of referrals for investigation of Critical Areas Regulations and the action taken on those referrals is outside the scope of the TMDL. Referrals relating to the TMDL parameters are handled through the water quality complaint investigation program. We recommend deleting the reference to Critical Areas Regulations.

Response: The State of Washington's Growth Management Act (GMA) designates fish and wildlife conservation areas as critical areas. Because surface water quality is a critical element of fish habitat, and because several aspects of the GMA promote healthy surface water quality, Ecology believes that tracking compliance with ordinances relating to fish habitat can contribute to the overall management of those program areas, thus supporting local efforts to protect surface water quality. The recommendation to tally CAO-related responses also provides jurisdictions with the opportunity to count riparian protection efforts as partial implementation for this TMDL. Protection of riparian areas, which are addressed through GMA, is an important goal of this *Action Plan*.

3. Comment. Page 95, Monitoring of Bacteria Levels**.** The recommendation to monitor bacteria levels approximately once every five years is unclear. Sampling once every five years would not produce statistically useful results.

Response: In response to this comment, Ecology has revised the text to clarify that an ongoing, monthly monitoring program is the primary recommendation for measuring progress in improving bacteria levels. The purpose of Ecology including a general recommendation to characterize water quality on a frequency no less than once every five years is to recognize the potential problem of resource constraints.

4. Comment. p. C-4, Public Involvement. Ecology made no recommendations on buffer width and buffer vegetation and therefore should provide further guidance before including review of critical areas ordinances as an action item.

Response: Appendix C, item 4, calls for the development of the TMDL Action Plan (TAP). The purpose of the TAP is to help the public understand how local government policies and programs are being used to protect local waters. Item 4 discusses the need for permit holders to "…evaluate and document the applicability…" of six approaches to controlling pollution to surface waters, one being the use of critical areas ordinances (CAOs). Because the CAO is a mechanism for protecting local water quality, the Stillaguamish River Action Plan calls for a discussion of the CAO to ensure citizens are well informed of all actions being taken to protect local water quality.

The Action Plan prescribes effective shade levels instead of setting explicit buffer widths. It also makes other recommendations that relate to fish and wildlife conservation areas and to wetland areas. The extent to which these areas are protected, or enhanced, directly affects the amount of shade they provide, their ability to provide animal exclusion and filtering of surface water runoff, and the ability to recruit large woody debris over time. All of these recommendations could be included in a discussion of how CAO requirements protect water quality.

5. **Comment.** Page C-5, Public Outreach and Education. Increased public awareness of pollution sources is certainly a first step toward the goals of the TMDL, however, in practice it is clear that awareness itself is insufficient to produce improved water quality. On-the-ground actions and implementation of best management practices produce improved water quality.

   EPA guidance regarding public education and outreach on stormwater impacts states, "efforts to control stormwater pollution must consider individual, household, and public *behaviors and activities* … Most importantly the requirement is to give the public clear guidance on *steps and specific actions* that they can take to reduce their stormwater pollution-potential," [emphasis added].

   We therefore suggest the requirement for permit holders to increase awareness be changed to require permit holders to promote and facilitate public implementation of best management practices.

Response: Ecology concurs with the comments in the first two paragraphs above and, in response to this comment, has revised the language to mirror the language used in Special Conditions S5. in both the Phase I and Phase II permits. We also concur that facilitating implementation of best management practices (BMPs) by the public is needed. However, because a general requirement to facilitate public implementation of best management practices (BMPs) could be interpreted very broadly, Ecology has chosen not to use that specific language at this time. Ecology hopes to work with permittees in coming years to define those areas where local government could work closely with the public to implement BMPs on private property. Ecology will consider adding those actions as TMDL-related permit requirements in the next permit cycle and will encourage their implementation in the interim.

6. **Comment.** p. C-6, Option 2, Indirect Measurement of Pollution Sources. The requirements for flow monitoring are inconsistent. The bulleted text requires Snohomish County to perform flow monitoring at the eight water quality locations in Figure B-2 while the last sentence requires flow monitoring at representative locations to determine the effect of storm flows. Many of the water quality locations in Figure B-2 are not suitable for flow monitoring. We recommend that the reference to flow monitoring in the bulleted item be dropped. Flow monitoring at representative locations will be sufficient to meet Ecology's criteria.

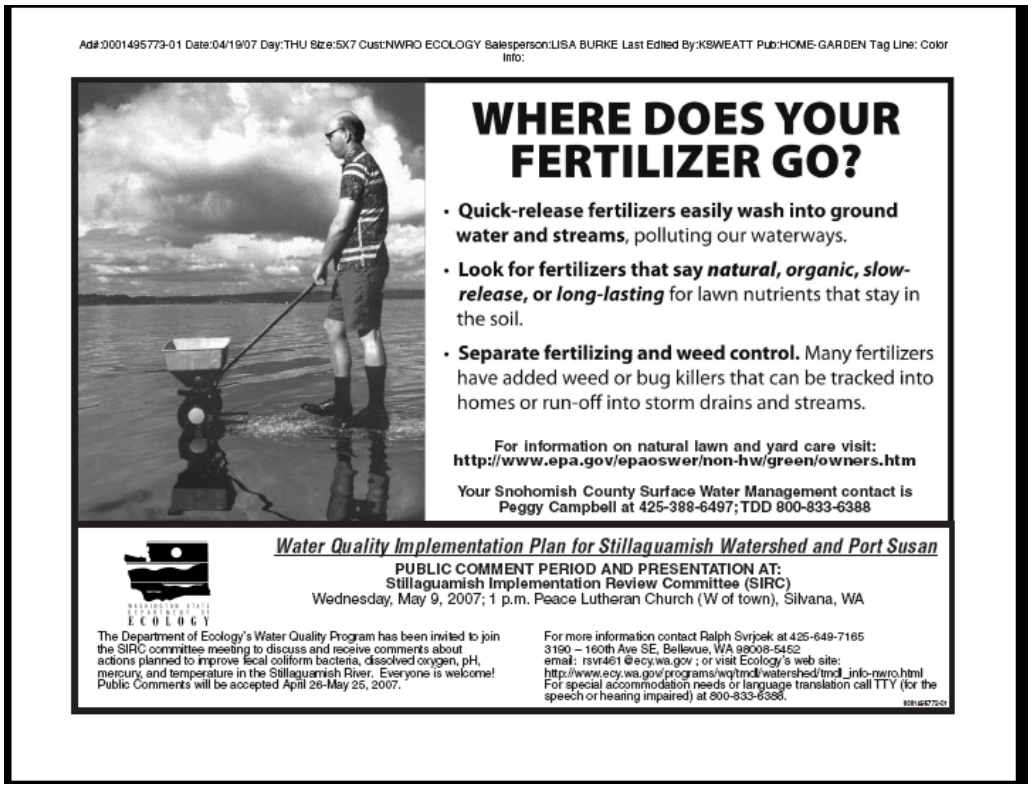
Response: Ecology agrees that the requirements are inconsistent as currently written. In the development of the Action Plan it was determined that representative monitoring would be sufficient; therefore, text has been removed to improve clarity on this issue.

7. **Comment.** p. C-6, Illicit Discharge and Detection and Elimination. Snohomish County does not conduct Outfall Reconnaissance Inventories as defined by Pitt, where the goal is to complete a walking survey on every stream mile. Walking streams is inefficient and impractical because access is only available on a limited number of parcels. Furthermore, many outfalls are obscured by vegetation during the summer and many streams have water levels too high for walking during the winter.

Response: Ecology concedes that surveying every stream mile is a challenge for Phase I permittees. This is due largely to the size of the service area involved and the subsequent increase in property access issues. For that reason, and in response to this comment, text has been revised to remove the reference to Outfall Reconnaissance Inventories for Phase I permittees. Ecology believes that walking streams can be effective because of the potential to identify a wide variety of pollution problems. Ecology does not concur that the process is impractical for smaller Phase II permittees.

Appendix G: Public Involvement Materials

Everett Herald Advertisement



Ad#:0001495773-01 Date:04/19/07 Day:THU Size:5X7 Cust:NWRO ECOLOGY Salesperson:LISA BURKE Last Edited By:KBWEATT Pub:HOME-GARDEN Tag Line: Color Info:

WHERE DOES YOUR FERTILIZER GO?

- **Quick-release fertilizers easily wash into ground water and streams**, polluting our waterways.
- **Look for fertilizers that say *natural, organic, slow-release,* or *long-lasting*** for lawn nutrients that stay in the soil.
- **Separate fertilizing and weed control.** Many fertilizers have added weed or bug killers that can be tracked into homes or run-off into storm drains and streams.

For information on natural lawn and yard care visit:
http://www.epa.gov/epaoswer/non-hw/green/owners.htm

Your Snohomish County Surface Water Management contact is Peggy Campbell at 425-388-6497; TDD 800-833-6388

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Water Quality Implementation Plan for Stillaguamish Watershed and Port Susan

PUBLIC COMMENT PERIOD AND PRESENTATION AT:
Stillaguamish Implementation Review Committee (SIRC)
Wednesday, May 9, 2007; 1 p.m. Peace Lutheran Church (W of town), Silvana, WA

The Department of Ecology's Water Quality Program has been invited to join the SIRC committee meeting to discuss and receive comments about actions planned to improve fecal coliform bacteria, dissolved oxygen, pH, mercury, and temperature in the Stillaguamish River. Everyone is welcome! Public Comments will be accepted April 26-May 25, 2007.

For more information contact Ralph Svrjcek at 425-649-7165
3190 – 160th Ave SE, Bellevue, WA 98008-5452
email: rsvr461@ecy.wa.gov ; or visit Ecology's web site:
http://www.ecy.wa.gov/programs/wq/tmdl/watershed/tmdl_info-nwro.html
For special accommodation needs or language translation call TTY (for the speech or hearing impaired) at 800-833-6388.

Arlington Times Display Ad

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Water Quality Implementation Plan for Stillaguamish Watershed and Port Susan

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Wednesday, May 9, 2007; 1:30 p.m.

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http://www.ecy.wa.gov/programs/wq/tmdl/watershed/tmdl_info-nwro.html

For special accommodation needs or language translation call TTY (for the speech or hearing impaired) at 800-833-6388

Department of Ecology Focus Sheet
http://www.ecy.wa.gov/biblio/0710035.html

Focus on Next Steps to Improve Water Quality in the Stillaguamish Watershed and Port Susan

from Ecology's Water Quality Program

Presentation and Public Comment

Wednesday May 9, 2007

Peace Lutheran Church in Silvana (west of town).

Meeting starts at 1 p.m.

The Clean Water Act requires a cleanup plan for these water bodies because they do not meet state standards for water quality.

Ecology worked with local and tribal governments, watershed groups, and individuals to put together this Draft Stillaguamish River Water Quality Implementation Plan (Action Plan).

The Action Plan details the activities needed to return the Stillaguamish River and Port Susan to good ecological health.

You can get a copy of the Action Plan to learn what actions are needed and how you can help. Let us know if you have more ideas.

Many areas have too much fecal coliform bacteria, too high temperatures, and not enough dissolved oxygen

Fecal coliform bacteria

Water samples collected in Port Susan and at many places throughout the Stillaguamish River watershed have concentrations of *fecal coliform bacteria* that exceed state water quality standards. This means that shellfish cannot be harvested commercially from Port Susan, and some reaches of the river may not be clean enough for swimming.

Dissolved oxygen

A second indicator of degraded water quality is the amount of dissolved oxygen in the water. At several locations in the watershed, during times of warm weather and late summer low flows there is not enough dissolved oxygen for healthy stream life.

Temperature

A third cause for concern is "warm" water temperatures throughout the watershed. Bathtub temperatures are great for swimming. However, during seasonally low streamflow in August and September, the water may be warm enough to stress or kill aquatic life, including salmonids, which require cold water with lots of dissolved oxygen. Tree removal and heavy sediment loads from upstream landslides and erosion reduce the amount of high quality salmon spawning habitat, and may contribute to stream temperature problems.

Clean up streams: What can you do?

Consider commenting on the Draft Stillaguamish River Water Quality Implementation Plan (Action Plan) in writing by May 25, 2007. The Action Plan contains many ideas about how you can help reduce pollution reaching the river right now. Businesses and residents in the watershed can make a difference in water quality by eliminating pollutants that are washed into streams when it rains and by protecting and restoring healthy streamside conditions. Your Watershed Steward will welcome your help and may be able to assist you in your efforts.

April 2007 07-10-035

Original printed on recycled paper

Some ways you can help

- Properly maintain your septic tank.
- Pick up pet waste from yards and sidewalks.
- Keep livestock wastes out of streams
- Keep fertilizers and pesticides from lawns, gardens, and farms from entering lakes and streams.
- Landscape without fertilizers and pesticides.
- Reduce non-absorbing/impervious surfaces.
- Plant trees and perform other activities to help local streams.
- Eliminate sediment washed from construction sites and other unprotected ground.
- Wash cars at carwashes or on lawns.
- Get involved in your local government's efforts to clean up the river.

Work with your neighbors, community association, or local citizens group for water quality.

Federal law requires clean up of polluted water

The Department of Ecology's (Ecology) Action Plan is part of the federal process for determining how much pollutant a water body can accept (also called the Total Maximum Daily Load or TMDL process). The Action Plan identifies potential fecal coliform pollution sources, the causes for low dissolved oxygen levels and high temperatures in the river, and what needs to be done so that these levels can improve to meet state standards.

The Action Plan addresses both nonpoint sources of pollution and point sources of pollution. Nonpoint pollution sources are those related to land uses, such as failing septic systems and improperly managed animal wastes that contain bacteria. Point pollution sources are those that send pollution directly to the stream by piped outfalls, for example, wastewater treatment plants and stormwater outfalls. The Action Plan outlines different strategies for nonpoint sources and point sources.

- Nonpoint sources are usually addressed through public outreach and education, local government land use controls, and voluntary actions by landowners.
- Point sources are covered by state wastewater discharge permits. Ecology works directly with permit holders to determine what actions should be taken to address the pollution.

How can you stay involved?

Citizen involvement is essential to making the Stillaguamish Watershed a better place for people and fish and keeping it that way. Many local organizations are actively working to restore water quality. Stay involved by participating in future watershed activities. For example:

- Get involved in the Stilly-Snohomish Fisheries Enhancement Task Force for on-the-ground community fish habitat restoration and water pollution prevention activities. Contact volunteer coordinator Cara Ianni at 425-252-6686 or info@stillysnofish.org, or see http://www.stillysnofish.org/ for more information.
- To get a no cost, no-risk environmental audit of streamside property, contact Stillaguamish Watershed Steward Jake Jacobson, 425-388-6428 or jake.jacobson@co.snohomish.wa.us.
- Find out how to determine whether your septic system is functioning properly by contacting the Snohomish Health District at 425-339-5250. They also post information about septics on their website: http://www.snohd.org/snoEnvHealth/www/waste.htm

- Learn how to reduce the impacts of your horses or livestock on local streams, while improving pasture productivity and reducing mud and weeds. Call the Snohomish Conservation District at 425-335-5634, or Email: amanda@snohomishcd.org
- Let your local elected officials know that clean water is important to you.

Past and future of the Action Plan

To reduce fecal coliform pollution, improve dissolved oxygen levels, and reduce stream temperatures will take the coordinated efforts of the local agencies, Native-American tribes, businesses, and residents in the watershed. The Action Plan to reduce pollution was developed by Ecology with help from all these groups. The plan is now available for local review and comment through May 25, 2007. To receive more information about the plan, see contact information below.

Find Ecology's draft Water Cleanup Action Plan here

Copies of the draft Water Cleanup Plan will be available at these locations:

1. Everett Public Library
   2702 Hoyt Ave
   425-257-8020

   Arlington Library
   135 N Washington Ave
   360-435-3033

   Stanwood Library
   9701 271st St NW
   360-629-3132

   Library hours: Monday – Thursday, 10 a.m. – 9 p.m.; Friday & Saturday, 10 a.m. – 5 p.m. (Everett until 6, Thurs.-Sat); Sunday 1 p.m. – 5 p.m. (Stanwood not open Sunday)
2. On the Internet: http://www.ecy.wa.gov/programs/wq/tmdl/watershed/tmdl_info-nwro.html
3. At Ecology's Bellevue Office (address is below), and the May 9, 2007 meeting.
4. To obtain a copy by mail, to ask questions or get information, or to send written comments; please contact:

Ralph Svrjcek, Water Cleanup Lead
Department of Ecology, Water Quality Program
3190 160th Avenue SE
Bellevue, WA 98008-5452

E-mail: rsvr461@ecy.wa.gov/ Phone: 425-649-7165

Stilly Water Quality Needs Your Help

If you need this publication in an alternate format, please call the DouGlas Palenshus at 425-649-7041. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.