Bear-Evans Watershed Temperature, Dissolved Oxygen and Fecal Coliform Bacteria Total Maximum Daily Load

Water Quality Implementation Plan

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Bear-Evans Watershed
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Water Quality Implementation Plan

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Thank you all.

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City of Sammamish
City of Woodinville
Friends of Cottage Lake
King Conservation District
King County Department of Natural Resources and Parks
King County Executive Horse Council
Muckleshoot Indian Tribe
Northeast Sammamish Sewer and Water District
Public Health Seattle-King County
Puget Sound Partnership
Snohomish Conservation District
Snohomish County
Snohomish Health District
Stewardship Partners
Union Hill Water Association
WA State Department of Transportation
Washington Water Trust
Woodinville Water and Sewer District
WRIA 8 Salmon Recovery Council
The citizens of the Bear-Evans watershed who have given their time to participate

Executive Summary

In June 2008, the Washington State Department of Ecology (Ecology) produced a TMDL to address fecal coliform bacteria in the Bear-Evans watershed (Ecology, 2008a). EPA approved the Bear-Evans bacteria TMDL in August 2008. In September 2008, Ecology produced the Bear-Evans Temperature and Dissolved Oxygen TMDL (Ecology, 2008b), which was approved by EPA the same month.

Following approval of the TMDLs, this water quality implementation plan (WQIP) was developed to address seven stream segments in the watershed that were listed as impaired for fecal coliform bacteria on the state's 2004 303(d) list and addressed in the June 2008 TMDL. The WQIP includes actions to address 18 stream segments listed as impaired for temperature and nine stream segments listed as impaired for dissolved oxygen (DO) on the State's 2008 303(d)-list. However, the plan applies to all stream segments and tributaries in the Bear-Evans watershed.

What is a total maximum daily load (TMDL)?

Under the federal Clean Water Act (CWA), each state is required to have its own water quality standards designed to protect beneficial uses. Every two years, states are required to prepare a list (the 303(d)-list) of water bodies (lakes, rivers, streams, or marine waters) that do not meet water quality standards. The CWA requires that a water quality improvement report or total maximum daily load (TMDL) be developed for each of the water bodies on the 303(d)-list. The TMDL identifies pollution problems in the watershed and then specifies how much pollution needs to be reduced or eliminated to achieve clean water.

Bear-Evans watershed and its water quality problems

The Bear-Evans watershed is located within the Cedar-Sammamish basin in Water Resources Inventory Area (WRIA) 8 in western Washington State (Figure ES 1). Bear Creek is the longest creek in the system, draining an area of 51 square miles in northern King and southern Snohomish Counties, including the cities of Redmond, Sammamish, and Woodinville. Evans Creek and Cottage Lake Creek are two major tributaries of Bear Creek.

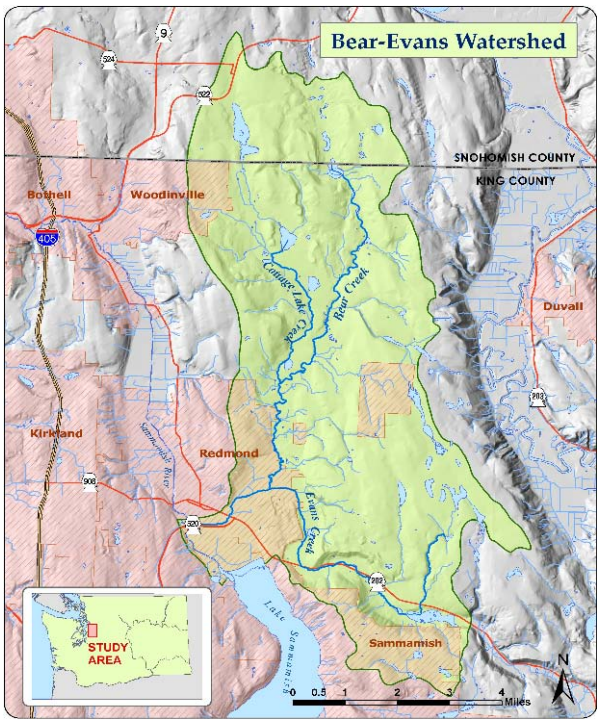

Figure ES 1. Bear-Evans Watershed

Bear Creek, Evans Creek, and Cottage Lake Creek have elevated levels of fecal coliform bacteria (an indicator of potential pathogens) and are found in certain reaches to be too warm with minimal dissolved oxygen (DO) for salmonids. Ecology set Washington State (State) water quality standards in the Bear-Evans watershed to protect the recreational

quality of these creeks at the highest level of "extraordinary primary contact" and protect their designated aquatic life use of "Core Summer Salmonid Habitat."

What will be done and who will help?

To improve water quality, actions must be applied on a watershed or sub-basin scale. Working at this level, there is a sense of shared responsibility for reducing upstream pollution sources. Implementation strategies to address the water quality problems are control excess bacteria and nutrient inputs into streams; provide more shade and improve riparian areas; protect cool ground water and enhance current summer baseflows; and perform monitoring to identify sources and document trends. The WQIP identifies specific actions and activities that will improve water quality. Key organizations involved in implementing the plan include counties, cities, and districts (water and sewer, conservation, and health), state agencies, non-profits, and volunteer groups. Many are already active partners in improving water quality in the watershed. In addition, local residents and businesses will also play an important role.

For the Bear Creek system to comply with the state's fecal coliform bacteria criteria during critical streamflow conditions, 57 to 91% reductions in current bacteria loadings are needed at the six stations monitored during the study. To meet criteria near the mouth of Bear Creek, an 88% reduction in current bacteria loadings will be needed from all upstream sources. (Ecology, 2008a)

The load allocation for both temperature and DO is the effective shade that would occur from system potential mature riparian vegetation. Effective shade load allocations are based on our best available knowledge and the use of modeling. The temperature and DO TMDL study determined that baseflow loss can be a significant factor in the Bear-Evans watershed and that stream temperatures are affected by baseflow. (Ecology, 2008b)

Measuring progress

In order to gauge the progress of water quality improvement, Ecology will convene a meeting of stakeholders at least annually to discuss the status of implementation activities. Water quality data, trends (where applicable), regulatory changes, new and innovative concepts, and funding sources will be discussed to evaluate the overall status of the TMDL. Ecology will solicit input from the workgroup at this time to help direct adaptive management of the TMDL. Compliance with state water quality bacteria criteria for "extraordinary primary recreation" (Chapter 173-201A WAC) should be achieved by 2015. Compliance with state water quality criteria for temperature and DO to protect "core summer salmonid habitat" should be achieved by 2050. TMDL targets are identified in terms of bacteria load percent reductions and percent increases in effective shade.

Public involvement

Since 2006, Ecology engaged the public and key Bear-Evans watershed stakeholders in several ways in the TMDL process to address temperature, DO, and fecal coliform bacteria problems. A stakeholder advisory group was formed and met five times (2006 to 2008) to provide input during the TMDL study developments. Ecology hosted two public meetings open to all watershed residents to learn about the TMDL efforts. To prepare the WQIP, Ecology began

working with key stakeholders in 2009 and continued through 2010 to assess their current and planned programs, activities, and policies that contribute to the TMDL goals.

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What is a Total Maximum Daily Load (TMDL)

Federal Clean Water Act requirements

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

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

The water quality assessment tells a more complete story about the condition of State waters. The assessment divides water bodies into five categories:

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

Category 2 – Waters of concern.

Category 3 – Waters with no data available.

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

- 4a. – Has an approved TMDL and it is being implemented.
- 4b. – Has a pollution control plan in place that should solve the problem.
- 4c. – Is impaired by a non-pollutant such as low water flow, dams, and culverts.

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

TMDL process overview

The CWA requires that a total maximum daily load (TMDL) be developed for each of the water bodies on the 303(d)-list. The TMDL identifies pollution problems in the watershed and then specifies how much pollution needs to be reduced or eliminated to achieve clean water. Then Ecology works with the local community to develop an overall approach to control the pollution, called the implementation strategy, and a monitoring plan to assess effectiveness of the water quality improvement activities. Once the federal Environmental Protection Agency (EPA) approves the TMDL, Ecology typically develops a *water quality implementation plan* (WQIP) within one year. This plan identifies specific tasks, responsible parties and timelines for achieving clean water.

Elements required in a TMDL

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

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

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

Identification of the contaminant loading capacity for a water body is an important step in developing a TMDL. EPA defines the loading capacity as "the greatest amount of loading that a water body can receive without violating water quality standards" (EPA, 2001). The loading capacity provides a reference for calculating the amount of pollution reduction needed to bring a water body into compliance with water quality standards. The portion of the receiving water's loading capacity assigned to a particular source is a "load" or "wasteload" allocation. By definition, a TMDL is the sum of all of the allocations, which must not exceed the loading capacity.

TMDL = Loading Capacity = sum of all WLAs + sum of all LAs + MOS

What part of the process are we in?

In June 2008, Ecology produced a TMDL to address fecal coliform bacteria in the Bear-Evans watershed (Ecology, 2008a) which was approved by EPA in August 2008. In September 2008, Ecology completed the Bear-Evans Temperature and DO TMDL (Ecology, 2008b) which was approved by EPA that same month. These TMDLs address seven fecal coliform bacteria listings on the 2004 303(d) list and eighteen temperature listings plus nine DO listings on the proposed 2008 303(d) list. However, the plan applies to all stream segments and tributaries in the Bear-Evans watershed. During Ecology's 2008 Water Quality Assessment, Ecology moved the impaired listings addressed by the Bear-Evans watershed TMDLs from Category 5 to Category 4a.

This WQIP details the specific actions needed to improve fecal coliform, temperature, and DO conditions in Bear-Evans watershed. This plan includes descriptions of the management roles, activities, and schedules for implementation partners in the watershed.

Bear-Evans Watershed

Watershed description

The Bear-Evans watershed, located in northern King and southern Snohomish Counties, drains approximately 51 square miles (132 km^2) of land area (King County, 1990), and includes portions of the cities of Woodinville, Redmond, and Sammamish (Figure 2). Three State highways cross parts of the watershed: State Route (SR) 520 passes along lower Bear Creek in Redmond; SR 202 stretches along portions of Evans Creek; and SR 522 bypasses the upper Cottage Lake Creek sub-basin in Snohomish County. Within this area, over 100 miles of stream channel, eight named lakes, and over 100 inventoried wetlands compose some of the most valuable salmon spawning habitat in central Puget Sound's Water Resource Inventory Area (WRIA) number 8 (King County, 1990).

The watershed is divided into three sub-basins: Bear Creek (14,300 acres, 57.8 km^2), Evans Creek (9,800 acres, 39.7 km^2), and Cottage Lake Creek (8,000 acres, 32.4 km^2). Bear Creek is the principal stream of the system, with Cottage Lake Creek and Evans Creek as its two major tributaries.

Bear Creek originates at about 480 feet above sea level in an extensive network of wetlands near Paradise Lake and Echo Lake. The creek then flows southerly for over twelve miles (19.3 km) through rural and suburban neighborhoods before joining the Sammamish River in the commercial district of the city of Redmond near State Route 520.

The watershed has vegetation typical of the state's western lowland forest ecosystems, which is dominated by evergreen conifers including Douglas fir, Western Hemlock, and Western Red Cedar. Understory growth includes shade-tolerant wild flowers. Wetland areas are predominantly scrub-shrub and forested wetlands, providing extensive areas of wildlife habitat and water storage. A unique resource in the watershed is Cold Creek, a cold-water spring and tributary to Cottage Lake Creek. This spring is a source of cooler water flowing into Bear Creek, with temperatures 5 to 7ºC cooler than the rest of the watershed (Kerwin, 2001).

Development has continued to occur in the watershed since the 1990s, and a much greater percent of the watershed is now in residential use than in 1990. The watershed is located within the U.S. Census Defined Urbanized Area and is, therefore, expected to expand with future population growth and urban development. In 2002, Snohomish County estimated the Bear-Evans watershed was 9% high impervious surface and 18% medium impervious surface[1] (Snohomish County, 2002). Lower portions of the watershed have expanding commercial and industrial zones, while all areas of the watershed show an increase in residential growth and density. Numerous woodlots and horse farms can still be found in the watershed.

[1] High impervious surface is described as "urban residential, commercial, and industrial; road, exposed rock, sedimented river, (and) sand/gravel bar." Medium impervious surface is described as "suburban residential and commercial, talus slope, bare earth, (and) sand."

Climate

The climate in the area is characterized by warm, dry summers and cool, wet winters. Most of the precipitation falls between October and April (Figure 1). Annual average precipitation in the basin varies between 40-45 inches.

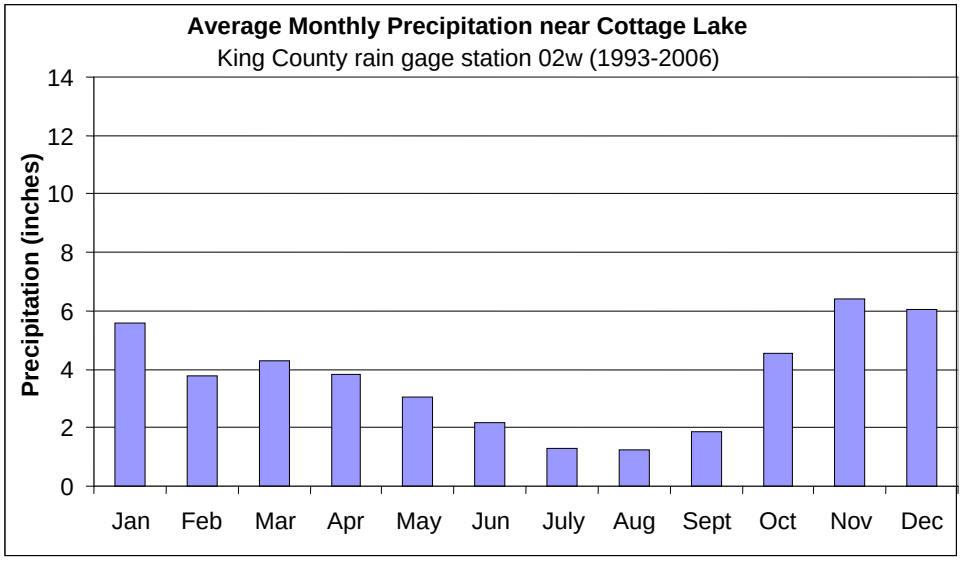

Figure 1. **Average monthly precipitation in Bear-Evans watershed.** Based on King County data from 1993 to 2006 at rain gage 02w on Cottage Lake Creek.

Resources

The Bear Creek system exhibits high-quality aquatic habitat, salmonid diversity and abundance, and a demonstrated contribution to the regional fishery resource (King County, 1990). Bear Creek and Cottage Lake Creek provide excellent spawning and rearing habitat for Chinook, Coho, Sockeye, and Kokanee salmon and steelhead trout. The higher level of habitat quality in Cottage Lake Creek is due to its forested wetlands and forested riparian corridor, as well as extensive, relatively undisturbed wetland complexes in its upper and middle reaches.

Chinook salmon have been occasionally observed in Evans Creek by Washington Department of Fish and Wildlife (WDFW) and by RH2 Engineering staff during 1999 to 2005. There have not been enough fish sightings in Evans Creek for fish use to be considered common.

Most of Bear Creek and Evans Creek, as well as their tributaries, are shallow and unsuitable for full-immersion swimming activities. Although public access to the creeks, lakes, and ponds in the watershed is largely limited to road crossings and a few parks, these water bodies are fully accessible to adjacent landowners and, in some cases, their neighbors.

Bear Creek provides important flow to the Sammamish River, which flows north through Redmond, Woodinville, Bothell, and into Lake Washington at Kenmore.

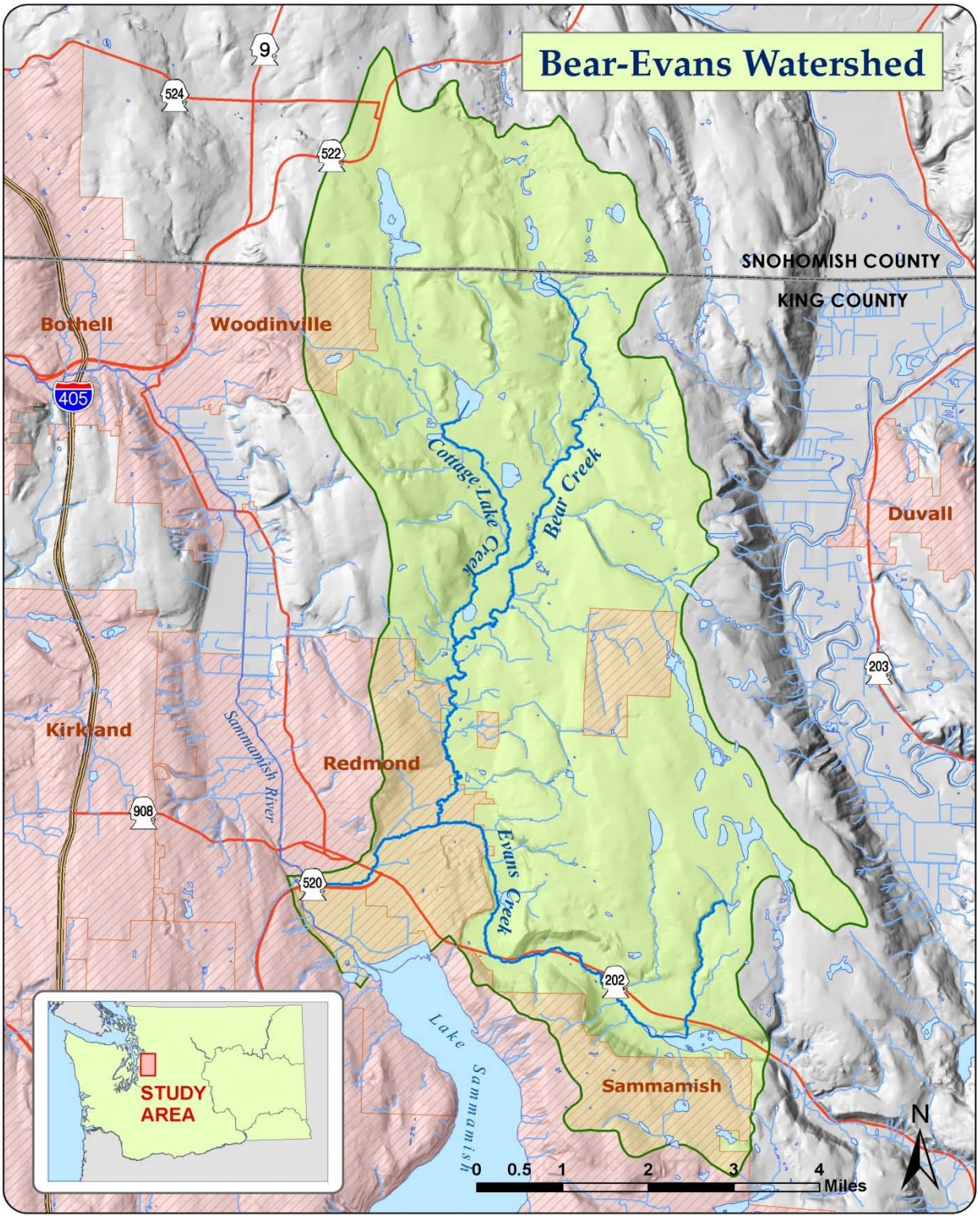

Figure 2 Bear-Evans watershed including the cities of Woodinville, Redmond, and Sammamish

Stream flows in the Bear Creek system are fed by ground water and surface runoff during rains. In addition to precipitation, ground water enhances the flows of Bear Creek and Evans Creek year-round. Ground water is also an important drinking water resource for the communities in the basin. Approximately 40% of Redmond's drinking water supply comes from groundwater wells that are at least partially replenished from aquifers beneath Bear Creek and Evans Creek valleys. The Northeast Sammamish Sewer and Water District (NESSWD) has five wells and two reservoirs in the area, providing water for over 10,000 people and sewer service for 15,000 people east of Lake Sammamish.

The Union Hill Water Association and the Sahalee and Bear Creek golf courses also rely on large volumes of ground water from the Bear-Evans watershed. The city of Redmond, NESSWD, and others are cooperative partners on the *Redmond-Bear Creek Valley Ground Water Management Plan* for water quantity and quality in the region. The Woodinville Water District imports water into the basin from the South Fork Tolt River watershed, and occasionally from the Cedar River watershed.

Exempt wells also take ground water from aquifers in the basin and return some of that water through irrigation and on-site septic system (OSSS) drainage. These wells provide water for a single home or groups of homes (limited to 5,000 gallons per day) and are excused from needing a State permit. There are approximately 400 exempt wells within the Bear-Evans watershed (Cook, 2008). The exact total amount of exempt well withdrawal volume is unknown.

Water quality monitoring

King County has monitored water quality monthly at six stations in the Bear-Evans watershed since 1974. The city of Redmond has sampled "Avondale Creek" monthly for fecal coliform bacteria at Station #35 since 2004 (Table 1 and Figure 3). Water quality in the Bear Creek sub-basin, including Cottage Lake Creek, is characterized using the monitoring sites at Cottage Lake Creek near Woodinville (N484) and in upper and middle Bear Creek (J484 and C484). Two sites in the Evans Creek sub-basin (B484 and S484) are used to characterize that area. The most downstream station, Bear Creek near the mouth below Redmond Way (O484), is the representative monitoring site for the entire Bear-Evans watershed. Redmond's Station #35 on an unnamed tributary to Bear Creek (AKA: Avondale Creek) is located at Avondale Road and 116th. In 2009 King County reduced its monitoring efforts and the station near the mouth (0484) is the only continuing monitoring site in 2010.

Table 1. Monitoring stations in Bear-Evans watershed.

Station	Description	Monitored By
N484	Cottage Lake Creek at Avondale Rd	King County
J484	Bear Creek (upper) at 133rd (Seidel Rd)	King County
35	Unnamed tributary to Bear Creek at Avondale Rd and 116th	City of Redmond
C484	Bear Creek (mid) at Bridge 119A on 95th Ave	King County
S484	Evans Creek (upper) at 50th St	King County
B484	Evans Creek (lower) at Union Hill Rd	King County
O484	Bear Creek (near mouth) 1 mi. above Sammamish River	King County

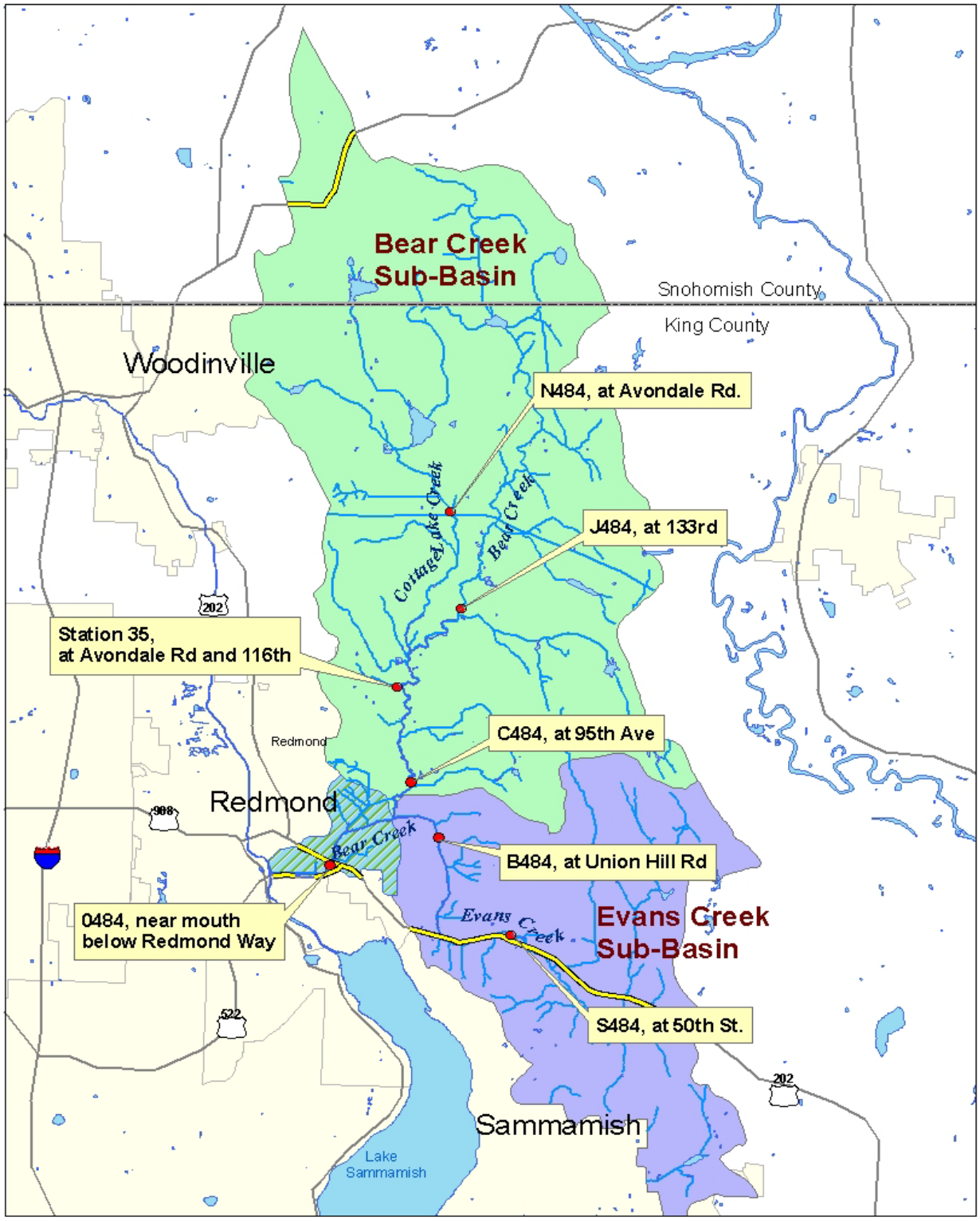

Figure 3. Sub-basins and monitoring stations in Bear-Evans watershed. The two major sub-basins are Bear Creek sub-basin (green) and Evans Creek sub-basin (purple). Station O484 near the mouth of Bear Creek represents the entire watershed including Lower Bear Creek.

Water quality problems

Fecal coliform bacteria

Fecal coliform bacteria may enter the aquatic environment directly from humans and animals via agricultural and stormwater runoff and wastewater. Disease-causing bacteria and viruses (i.e., pathogens) frequently coexist along with mostly harmless fecal coliform bacteria, which serve to indicate the potential for pathogens in the water. A high fecal coliform count generally means a greater presence of pathogens. Fecal coliform bacteria are excellent pathogen indicators because they are typically found in much higher numbers, are easier to detect in the laboratory, and grow under similar conditions as pathogens. Stream segments in the Bear-Evans watershed that are impaired for fecal coliform bacteria are shown in Figure 4. For specific listings, see Appendix B.

Ecology protects the recreational quality of Bear Creek, Evans Creek, and Cottage Lake Creek at the highest level ("extraordinary primary contact") because these freshwater streams feed into lakes [WAC 173-201A-600(1)(a)(ii)]. In these waters, the "fecal coliform organism levels must not exceed a geometric mean value of 50 colonies/100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) exceeding 100 colonies/100mL" [WAC 173-201A-200(2)(b), 2006 ed.]. Streams comply with the fecal coliform bacteria water quality criteria when they meet both the geometric mean (an average measurement) and the "not more than 10 percent" limits (a worst-case measurement). In applying both measurements, Ecology assures that bacteria levels in the previously-mentioned freshwaters will not cause an unacceptable risk to human health.

Table 2 shows a summary of potential fecal coliform bacteria sources. The potential sources of bacteria are further described in the *Bear-Evans Watershed Fecal Coliform Bacteria TMDL Report* (Ecology, 2008a).

Table 2. Potential sources of fecal coliform bacteria in the Bear-Evans watershed.

Source	Explanation
Urban stormwater	Conveys contaminated runoff from roads, parking lots, roofs, roadside ditches, yards, dumpsters and other areas. Stormwater may also convey nutrients that support bacteria re-growth in storm sewers and waterways.
Livestock, equestrian and commercial animal handling facilities	Improper management of manure and disposal of animal wastes.
Domestic wastewater/sewage	Potential leakage from municipal sanitary sewer lines and on-site septic systems; illicit cross-connections to stormwater system.
Domestic pet wastes	Runoff and drainage from dog walks and animal play areas; improper waste management and/or storage practices of domestic pet waste.
Wildlife (including avian)	Excrement from wildlife in the watershed such as beavers, raccoons, and coyotes; and excrement from avian sources associated with wetland areas and stormwater runoff.
Loss of riparian habitat	Not a source in itself, stream buffers with healthy riparian vegetation can help filter and treat pollutants.

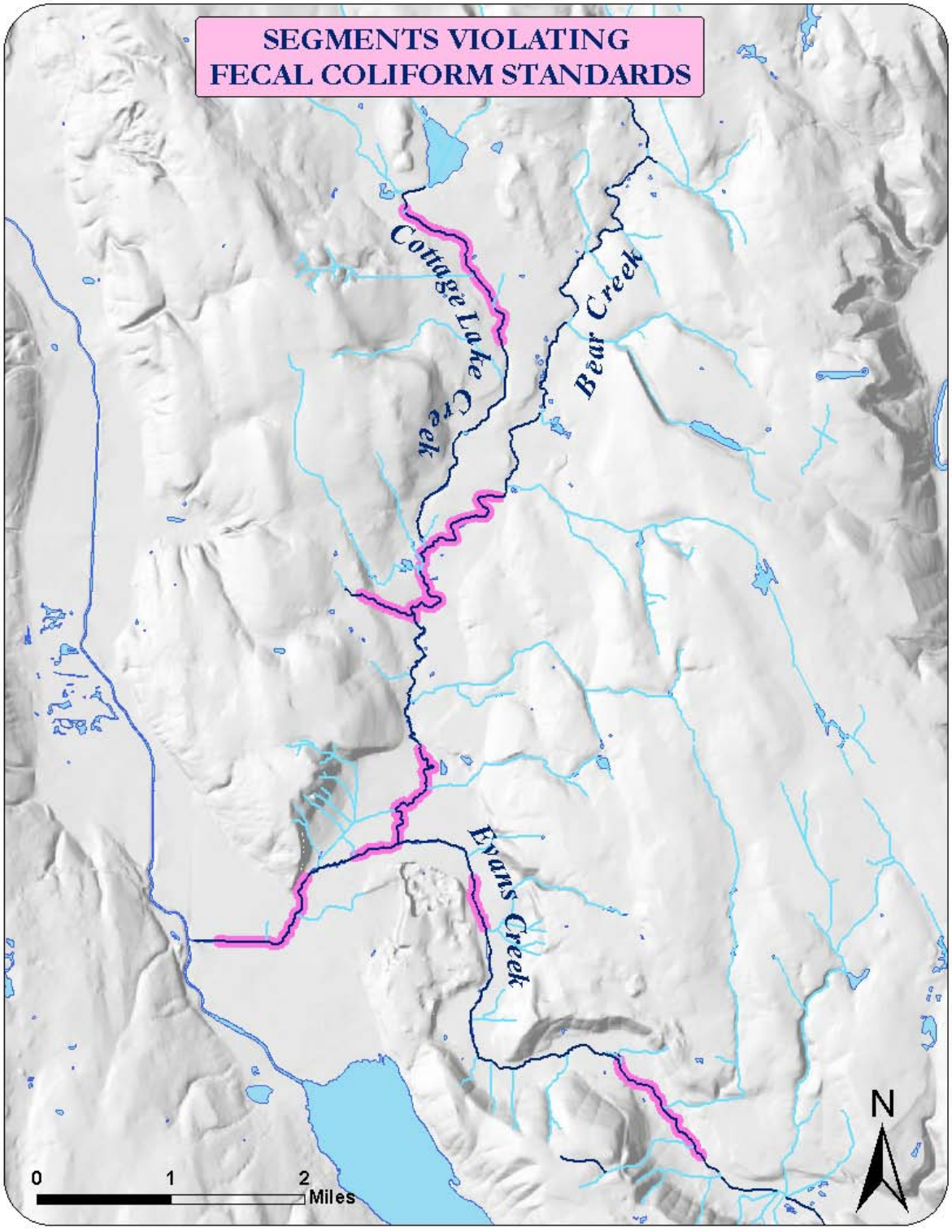

Figure 4. **Stream segments in Bear-Evans watershed impaired for fecal coliform bacteria and listed on the 2004 303(d)-list.** The listings are identified in Appendix B.

Temperature and Dissolved Oxygen

Temperature affects the physiology and behavior of fish and other aquatic life. Temperature may be the most influential factor limiting the distribution and health of aquatic life. The health of fish and other aquatic species also depends on maintaining an adequate supply of oxygen dissolved in water. Dissolved oxygen (DO) levels depend in part on stream temperatures and affect growth rates, swimming ability, susceptibility to disease, and the relative ability to endure other environmental stressors and pollutants. Parts of Bear Creek, Evans Creek, and Cottage Lake Creek are too warm and have minimal DO for the local salmon that migrate into the watershed to spawn and rear (Figure 5). For specific listings, see Appendix D.

Temperature levels fluctuate during the day and night (diurnally) in response to changes in solar radiation, climatic conditions, and river flows. Since the health of aquatic species is tied predominantly to the pattern of maximum temperatures, the State water quality criteria for temperature are expressed as the highest 7-day average of consecutive daily maximum temperatures (7-DADMax) occurring in a water body. To protect the designated aquatic life uses of "Core Summer Salmonid Habitat," the highest 7-DADMax temperature must not exceed 16°C (60.8°F) at a probability frequency of more than once every ten years on average [WAC 173-201A-200(c); 2006 ed.]. In addition, all portions of Bear Creek and Cottage Lake Creek, as well as Evans Creek downstream of river mile 0.8, must not exceed 13°C between September 15 and May 15.

When temperature criteria are violated, heat is considered the pollutant. Processes that increase the heat load in the Bear-Evans watershed include:

- Riparian vegetation disturbance that decrease stream surface shading and microclimate.
- Reduced exchange of cool ground water.
- Reduced summer baseflows (reducing the volume of water available to absorb heat).
- Tributaries discharging warm water into the mainstem.

Plants and algae produce oxygen through photosynthesis when sufficient light is available and, conversely, consume oxygen in the dark. DO levels will typically fluctuate day and night in response to changes in solar radiation and climatic conditions, as well as the respiratory requirements of aquatic plants and algae. Since the health of aquatic species is tied to daily minimum DO concentrations, the State's DO criteria are designed to protect the designated aquatic life use of "Core Summer Salmonid Habitat," which states that the one-day minimum DO level must not fall below 9.5 mg/L more than once every ten years on average [WAC 173-201A-200(c); 2006 ed.].

The concentration of DO within a water body is affected by many variables, including elevated temperatures and nutrients. Although the State's water quality standards do not contain numeric nutrient criteria for streams, nutrients can still contribute to violations of DO water quality criteria. Nutrients increase the growth of algae and other aquatic plants, which in turn respire and decompose through oxygen consuming processes. Nutrients can be derived from both natural and human-caused sources, including runoff from forests, farmland, yards, parks, pastures, roads and parking lots, and tributary inputs from wetlands and lakes. The potential factors of the temperature and DO problems in this WQIP are further described in the *Bear-Evans Watershed Temperature and Dissolved Oxygen TMDL Report* (Ecology, 2008b).

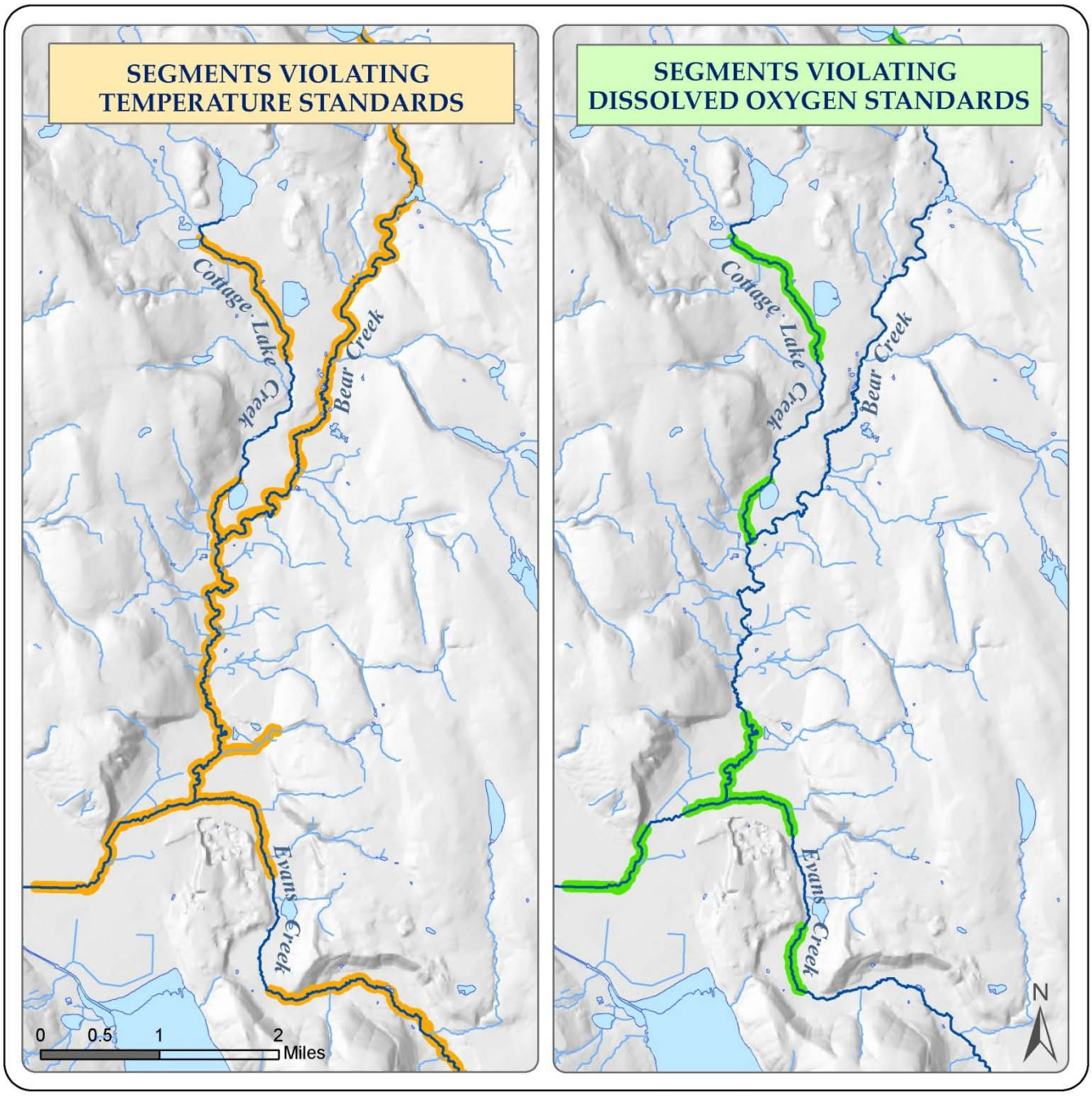

Figure 5. Stream segments in Bear-Evans watershed impaired for temperature and DO and listed on the 2004 303(d)-list. The listings are identified in Appendix B.

Establishing the TMDLs

Ecology conducted the Bear-Evans watershed TMDLs because the federal CWA requires that impaired streams be restored to meet State water quality standards through a TMDL process. Ecology's Northwest Regional Office (NWRO) prioritizes water bodies needing water quality improvement in the State's northwest watersheds approximately every five years. Producing these Bear-Evans watershed TMDLs is in accordance with that prioritization.

Ecology began engaging local partners on the temperature and DO TMDL in 2006. Ecology initiated the fecal coliform bacteria TMDL to coincide with that effort. EPA approved both Bear-Evans watershed TMDLs in 2008. The following sections highlight key findings from the two TMDLs that can help prioritize areas for implementation.

Bacteria loadings under different flow conditions

Bacteria concentrations (colony forming units (CFU) per 100 mL), streamflow (cubic feet per unit time), and bacteria loadings (concentration x flow = CFU per unit time), measured at different sites along a stream, help to inform us with regard to location, route, and severity of bacteria sources. The *Bear-Evans Watershed Fecal Coliform Bacteria TMDL Report* characterized bacteria loadings at six locations in the Bear-Evans watershed under five flow conditions: high flows; moist conditions; mid-range flows; dry conditions; and low flows (Ecology, 2008a).

To achieve compliance with the TMDL a statistical target is used as a goal. Ecology used Load Duration Curve analyses to estimate percent reductions of bacteria loadings needed for each of the flow conditions to meet 90th percentile targets set by the TMDL. The 90th percentile statistical calculations differ from the actual criterion set by Chapter 173-201A WAC, which states that "…not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value (*are*) exceeding 100 colonies/100 mL." Although different, the two methods are reasonably similar, and achieving either the 90th percentile or the "not more than 10%..." criterion at all locations and during all five flow conditions is expected to satisfy the TMDL requirements. The details for calculating the 90th percentile is described in a prior TMDL document (Ecology, 2008a) listed in the Reference section.

The streamflow condition during which bacteria loads need the greatest reduction is defined as the "critical flow condition." This is the time period when the largest fecal coliform bacteria problem is present. Areas of the watershed that require aggressive reductions in bacteria sources will have a high percentage reduction goal (greater than 60%), while areas with minor problems will have a low percent reduction value (less than 30%). To help prioritize resources and target areas for mitigation and implementation activities it is essential to distinguish the level of pollution across different flow conditions based on percent reductions (high = greater than 60%, medium = 30-60%, and low = less than 30%). Figure 6 shows the levels of relative pollution (high, medium, low) for stream segments along Bear Creek, Evans Creek, and Cottage Lake Creek.

LAs and WLAs for fecal coliform bacteria at the mouth of Bear Creek are shown in Table 3. For complete TMDL allocations throughout the Bear-Evans watershed, see Tables of 303(d)-listings & TMDL Allocations in Appendix B. Table 3 also shows that an annual fecal coliform reduction of 88% is needed at the mouth of Bear Creek to comply with the State's water quality standards. The TMDL assigned the responsibility for bacterial reductions to a combination of municipal stormwater permittees, all various nonpoint sources, and also allowed for a ten percent margin of safety (MOS). Table 3 further distributes the reductions needed by each source into allowable loadings from each source at various streamflow conditions.

WLAs for municipal stormwater permittees and LAs for the non-point sources were determined using formulas based on land area within the watershed and not on direct sampling of the stormwater outfalls. An explanation of the TMDL analytical framework can be found in Appendix E of the *Bear-Evans Watershed Fecal Coliform Bacteria Total Maximum Daily Load, Water Quality Improvement Report* (Ecology, 2008a).

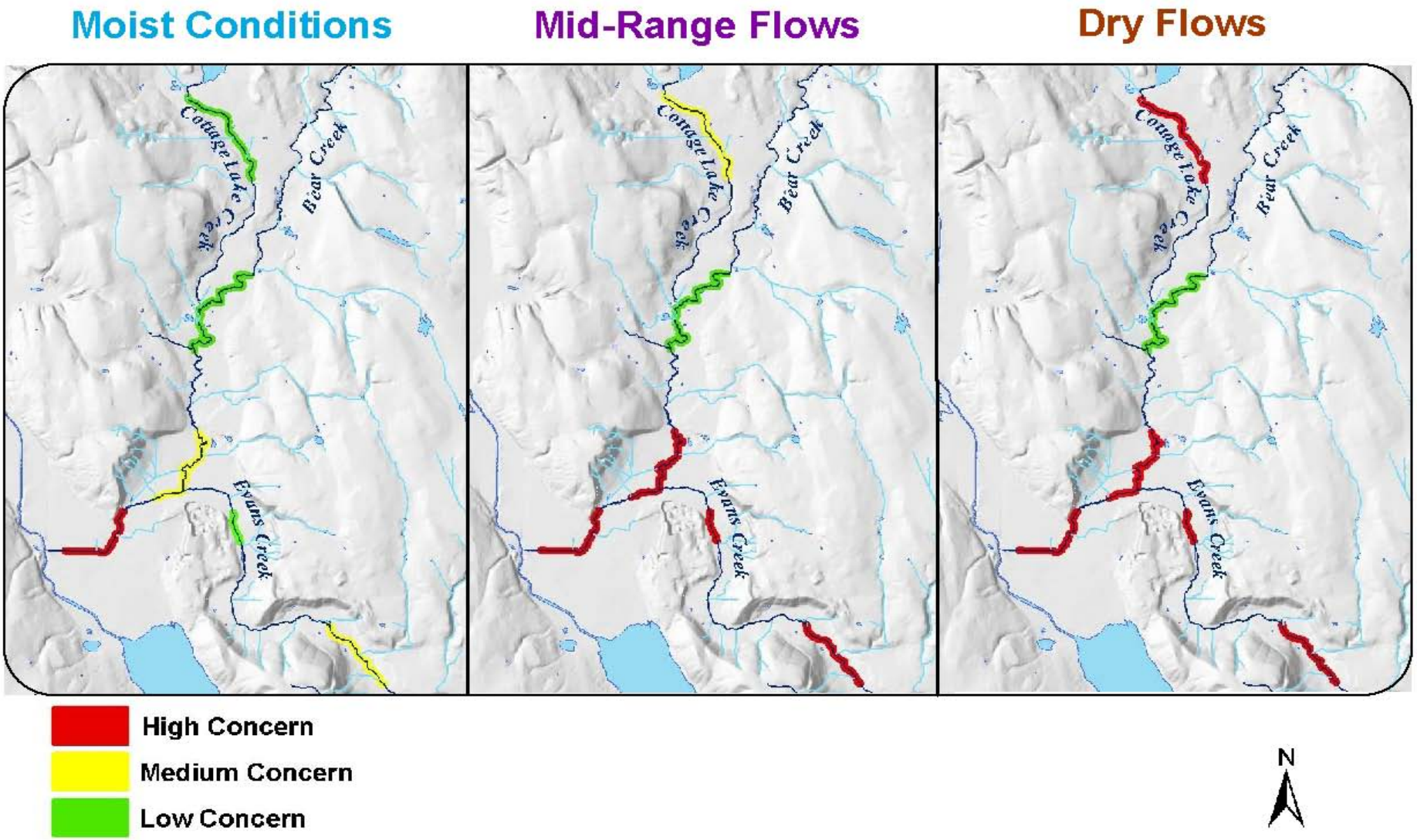

Figure 6. Relative levels of concern for fecal coliform bacteria pollution at stream segments under different flow conditions based on percent reductions needed to meet the bacteria 90th percentile target. Sites are of high concern (red) when they need the largest percent reductions in fecal coliform bacteria loadings (greater than 60%), medium concern (yellow) = 30-60% reductions needed, and low concern (green) = <30% reduction needed.

Table 3. **Daily LAs and WLAs set at Bear Creek near the mouth (Site O484).**

Bear Creek near mouth (Above Station O484)
Targets an 88% reduction in current bacteria loadings.

			Fecal Coliform Bacteria Loadings (billion colonies per day)				
			High flows	Moist weather flows	Mid-range flows	Dry weather flows	Low flows
TMDL (Loading Capacity Targets) 100%			268.00	120.00	62.80	33.00	20.80
		Allocation (%)					
MOS		10%	26.80	12.00	6.28	3.30	2.08
LAs		20.48%	54.87	24.52	12.86	6.77	4.26
WLAs	**Redmond**	9.24%	24.75	11.06	5.80	3.05	1.92
	Sammamish	7.50%	20.10	8.98	4.71	2.48	1.56
	Woodinville	2.56%	6.86	3.07	1.61	0.85	0.53
	King County	42.26%	113.23	50.60	26.55	13.96	8.79
	Snohomish County	7.41%	19.85	8.87	4.65	2.45	1.54
	WSDOT	0.55%	1.47	0.66	0.34	0.18	0.11

Riparian areas that lack effective shade

Vegetation shade can block solar radiation from reaching the surface of a waterbody. The fraction that is blocked is called the "effective shade." The Bear-Evans watershed temperature/DO TMDL estimated that the amount of effective shade lacking along Bear Creek, Evans Creek, and Cottage Lake Creek should be based on how much mature vegetation could potentially grow there (Figure 7). This information can be used as a first step in assessing potential restoration planting sites.

The tested temperature models predicted that the stream would be cooled by 5.2ºC, 5.7ºC, and 2.7ºC for Bear Creek, Evans Creek, and Cottage Lake Creek, respectively, if mature riparian vegetation were planted within 100-meter riparian buffer of the stream (Ecology, 2008b). A sensitivity analysis found that reducing the 100-meter buffer to 50 meters would not result in a significant increase in stream temperature (less than a 0.1ºC) in the three creeks.

Although vegetation closest to a stream's bank produces the greatest "effective shade," wider vegetation buffers provide other benefits that are important to the overall ecological integrity of the stream. The benefits include: cooler microclimate effect, reduced vulnerability to floods, reduced downstream flood peaks, reduced sediment erosion, improved stream bank stability, filtration of excess nutrients and surface runoff pollutants, improved aquatic habitat, and providing litter fall (dead leaves/detritus) as the basis of the food web for aquatic organisms.

While riparian vegetation reduces the rate of heating in the stream, it does not directly cool the water. Mature riparian vegetation blocks solar radiation and prevents solar heating of the stream substrate and surrounding shallow soil and creates a cool zone (microclimate) through which streams may flow and lose heat to the surrounding cooler stream bottom and stream bank.

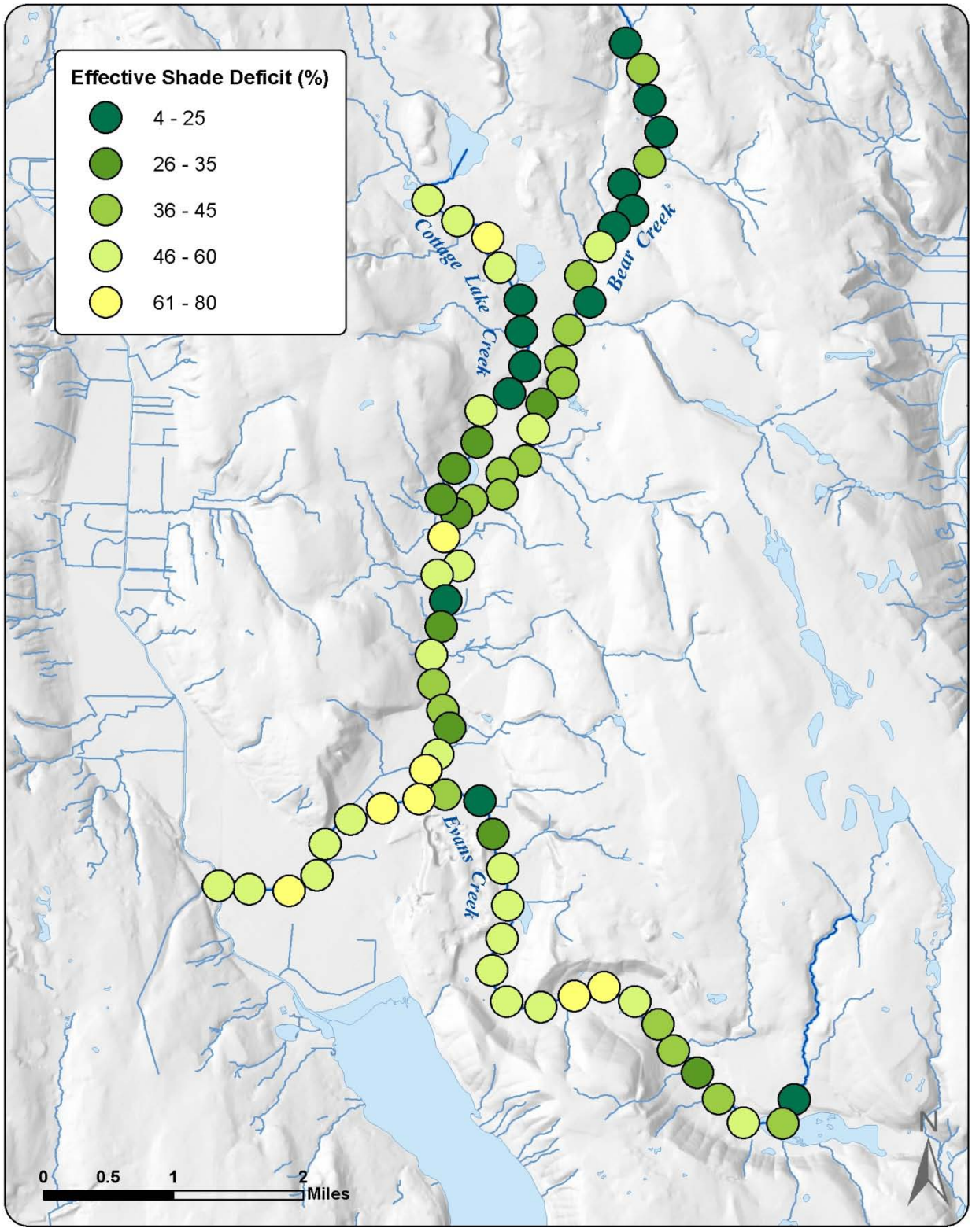

Figure 7. **Effective shade deficits in Bear-Evans stream system based on difference between current and system potential mature riparian vegetation (Ecology, 2008b).** Stream segments with the greatest effective shade deficits (61-80%) are indicated by yellow circles.

Groundwater inflows, however, may directly cool surface water temperatures and result in reduced downstream temperatures if the groundwater temperature is lower than the stream, and the rate of groundwater inflow is sufficiently large. The Bear-Evans watershed TMDL models also determined that improved summer baseflows can mitigate reduced shade and its downstream impacts. Thus, the TMDL requires a combined approach of shading riparian vegetation and increasing cooler groundwater baseflows in order to effectively reduce stream temperatures.

The TMDL established LAs for the effective shade and solar load needed to improve temperature and DO in Bear Creek as shown in Table 4. The TMDL determined shade and solar LAs for stream segments in Bear-Evans watershed during the critical summer season using typical solar conditions on July 24. Complete shade and solar load allocations for Bear-Evans watershed including Cottage Lake Creek and Evans Creek, are tabulated in Appendix B. As shown in Figure 7 and Table 4, the stream segment with the largest contiguous shade deficit is lower Bear Creek below its confluence with Evans Creek. Establishment of mature riparian vegetation is expected to improve stream temperatures and increase the stream's oxygen-carrying capacity, thereby indirectly improving DO concentrations.

Table 4. Effective shade and solar LAs on July 24 to improve temperature and DO conditions in Bear Creek. Potential effective shade is based on establishing system potential mature riparian vegetation.

Station	Distance from upstream boundary to end of reach (km)	CURRENT reach averaged effective shade (%)	CURRENT reach averaged solar heat load (W/m^2)	POTENTIAL reach averaged effective shade (%)	POTENTIAL reach averaged solar heat load (W/m^2)	Load Allocation	
						REQUIRED increase in effective shade (%)	REQUIRED decrease in solar load (W/m^2)
08BEAR11.0	0.0	52%	148	73%	83	21%	66
	0.5	42%	182	79%	67	37%	115
	1.0	66%	107	89%	35	23%	72
08BEAR10.1	1.5	94%	18	98%	5	4%	13
	2.0	46%	170	86%	45	40%	125
	2.5	82%	57	97%	9	15%	48
	3.0	85%	48	98%	5	14%	42
	3.5	86%	42	98%	5	12%	37
	4.0	52%	149	98%	5	46%	143
	4.5	59%	129	98%	6	39%	123
08BEAR08.1	5.0	81%	59	98%	5	17%	54
	5.5	60%	125	98%	5	38%	120
	6.0	47%	165	88%	39	41%	127
	6.5	44%	174	82%	57	37%	117
	7.0	64%	112	93%	23	28%	89
	7.5	39%	190	95%	17	56%	173
08BEAR06.5	8.0	45%	173	83%	53	38%	119
	8.5	53%	147	98%	5	45%	142
	9.0	56%	138	93%	23	37%	116
	9.5	58%	131	95%	15	37%	116
08BEAR05.4	10.0	65%	110	98%	5	34%	105
	10.5	20%	250	96%	12	76%	238
	11.0	43%	177	96%	12	53%	165
	11.5	47%	164	98%	5	51%	160
	12.0	79%	67	98%	5	20%	62
	12.5	61%	122	95%	15	34%	107
08BEAR03.7	13.0	46%	170	98%	5	53%	165
	13.5	56%	138	98%	6	42%	132
	14.0	59%	128	95%	17	36%	111
08BEAR02.8	14.5	55%	139	88%	38	32%	101
	15.0	48%	163	96%	12	48%	151
08BEAR02.1	15.5	31%	216	98%	5	68%	211
08BEAR02.0	16.0	31%	216	98%	5	68%	211
	16.5	22%	245	90%	30	69%	214
08BEAR01.3	17.0	50%	155	98%	5	48%	150
	17.5	45%	171	98%	5	53%	166
08BEAR00.9	18.0	42%	180	98%	6	56%	174
	18.5	27%	227	98%	5	71%	222
08BEAR00.3	19.0	45%	170	99%	4	53%	166
	19.4	44%	174	98%	7	53%	166

What Will Be Done

Overview

The Bear-Evans watershed is fortunate in having a number of organizations that are already implementing projects that will benefit water quality. These groups and actions will be identified later in the report, but the additional work needed is identified here. This WQIP summarizes the results from both the Bear-Evans watershed fecal coliform bacteria and the temperature/DO TMDLs, which contain strategies that will reduce bacteria, stream temperature, and nutrients (to increase DO). The State water quality criterion for fecal coliform bacteria is anticipated to be met by 2015. Since DO levels for these creeks are more sensitive to the stream temperature rather than nutrient levels, we anticipate the streams will achieve optimal protection for core summer salmonid habitat in 40 years or less. **Table 5** lists timeframes for meeting interim targets and water quality standards.

Table 5. **TMDL targets and goals for meeting water quality standards in Bear-Evans watershed.**

Water Quality Parameter	Interim Target	TMDL Goal
Fecal Coliform Bacteria	Meet Primary Contact Recreation Standards by December 2012	Meet Extraordinary Primary Contact Recreation by December 2015
Temperature	Protect summer spawning, rearing, and migration by 2025.	Protect core summer salmonid habitat by 2050.
Dissolved Oxygen	Protect summer spawning, rearing, and migration by 2025.	Protect core summer salmonid habitat by 2050.

The long-term success of TMDL implementation depends on how well work is prioritized and coordinated with other groups and projects across the Bear-Evans watershed. Managers can prioritize implementation projects using mapping tools such as Figure 6 and Figure 7. There is some overlap with implementation areas identified in other planning processes, such as the WRIA 8 Chinook Salmon Recovery Forum (Forum). Table 6 lists Bear-Evans stream reaches that the Forum considers priority for salmon protection and restoration activities (WRIA 8, 2005). Ecology recommends first implementing activities in areas already identified by other plans such as the WRIA 8 Salmon Recovery Plan. This can improve speed and efficacy of actions in those areas and help direct implementation in the remaining reaches. In addition to knowing where to work, managers also need to know what actions to implement. Table 8 contains implementation actions for different organizational partners.

Table 6. Priority streams in Bear-Evans Watershed for WRIA 8 Salmon Recovery (WRIA 8, 2005).

Tier Level	Bear-Evans Creeks
Tier 1 (top priority because core areas of high Chinook abundance and frequent use)	Upper Bear (Reaches 8-14) Lower Bear (Reaches 1-7) Cottage Lake Creek (Reaches 1-5)
Tier 2 (satellite areas of moderate Chinook abundance and moderately frequent use.	Evans Creek

Implementation strategy

Several agencies and groups in Bear-Evans watershed actively conduct educational and stream restoration projects that help remediate the water quality impacts to local creeks. Along with local governments, several volunteer groups such as Bear Creek Water Tenders actively plan and develop stream restoration and other watershed activities that will help improve water quality in the watershed's creeks. Significant riparian area and conservation easements were acquired by jurisdictions in the Bear-Evans watershed to help preserve habitat and water quality. Ecology supports additional acquisitions and easements to further protect water quality.

Key partners involved in implementing water quality improvement actions include, but are not limited to:

- WA State Department of Ecology
- WA State Department of Transportation
- Puget Sound Partnership
- WRIA 8 Salmon Recovery Council
- King County Department of Natural Resources and Parks
- Snohomish County
- City of Redmond
- City of Sammamish
- City of Woodinville
- Snohomish Conservation District
- King Conservation District
- Cascade Water Alliance
- Northeast Sammamish Sewer and Water District
- Union Hill Water Association
- Woodinville Water and Sewer District
- Snohomish Health District
- Public Health Seattle-King County
- Bear Creek Water Tenders
- Adopt-A-Stream Foundation
- Stewardship Partners
- Cascade Land Conservancy
- Washington Water Trust
- Friends of Cottage Lake
- King County Executive Horse Council
- Businesses
- Citizens

Appendix A describes the key partners involved in implementing the Bear-Evans watershed TMDLs.

Implementation strategies to reduce bacteria levels and improve temperature and DO levels in the Bear-Evans Creek system are provided below in Table 7. The primary participants in implementing these strategies are shown in the column on the right.

Table 7. Summary of implementation strategies needed to improve water quality in the Bear-Evans watershed.

Implementation Strategy	Key Partners
A. Control excess bacteria and nutrient inputs to streams and lakes	
1. Increase understanding of the area and land uses draining to the creeks to both the public and the governmental agencies involved.	Redmond, Sammamish, Woodinville, King County, Public Health Seattle-King County,
2. Continue to investigate and repair possible sewer leaks and failing onsite septic systems.	Public Health Seattle-KC, Snohomish Health District, King County, Snohomish Co., Redmond, Sammamish, Woodinville
3. Identify and eliminate illicit discharges to stormwater drainage systems.	Redmond, Sammamish, Woodinville, King County, Snohomish County, WSDOT
4. Implement structural and/or operational stormwater source control best management practices (BMPs) to address urban fecal bacteria source control.	Redmond, Sammamish, Woodinville, King County, Snohomish County
5. Preserve, restore and protect riparian vegetation to help filter out stormwater pollutants.	Redmond, Sammamish, Woodinville, King County, Snohomish County, Cascade Land Conservancy, Adopt-A-Stream Foundation, Snohomish Conservation District, King Conservation District
6. Properly manage domestic animal and livestock wastes.	Snohomish Conservation District, King Conservation District, Redmond, Sammamish, Woodinville, King County, Snohomish County, King County Executive Horse Council, Horses for Clean Water
7. Conduct public outreach and stewardship education to Bear-Evans watershed communities.	Adopt-A-Stream, Snohomish Conservation District,, King Conservation District, Redmond, Sammamish, Woodinville, King County, Bear Creek Water Tenders, Friends of Cottage Lake, King County Exec. Horse Council, Horses for Clean Water, Upper Bear Creek Com. Council, King County.

B. Provide more shade and improve riparian areas	
1. Assess potential planting sites along these creeks, particularly in the high shade deficit areas.	Adopt-A-Stream Foundation, Redmond, Sammamish, Northeast Sammamish Sewer and Water District, Snohomish Conservation District,
2. Promote invasive plant removal and plant colonizing species in riparian restoration projects to encourage natural riparian habitat.	Redmond, Sammamish, Woodinville, King County, Adopt-A-Stream Foundation, Cascade Land Conservancy, Bear Creek Water Tenders, Friends of Cottage Lake, King County Weed Board, Snohomish County Weed Board, Snohomish Conservation District, King Conservation District
3. Incorporate TMDL actions and incentives into local regulatory programs and policies that improve and protect local water quality.	Redmond, Sammamish, Woodinville, King County, Snohomish County.
C. Protect cool groundwater and enhance current summer baseflows	
1. Infiltrate clean stormwater and/or reclaimed water to the maximum extent practicable, including through the use of Low Impact Development (LID) practices where feasible.	Redmond, Sammamish, Woodinville, King County, Snohomish County.
2. Consider and, if possible, adopt economically-feasible alternative water sources to augment irrigation withdrawals (such as use of reclaimed water) and groundwater drinking water source.	King County, Redmond, NESSWD, Union Hill Water Association, Cascade Water Alliance, Washington Water Trust
3. Include TMDLs during State Environmental Policy Act (SEPA) application and review and other local land use planning reviews.	Redmond, Sammamish, Woodinville, King County, Snohomish County
4. Restore, protect, and/or create wetlands in areas that will increase groundwater recharge to benefit the stream and increase baseflow.	Redmond, Sammamish, Woodinville, King County, Snohomish County, WSDOT
5. Protect cool headwaters, wetlands, and sources of groundwater (e.g. seeps and springs).	Redmond, Sammamish, Woodinville, King County, Snohomish County
6. Increase water conservation in Bear-Evans watershed.	Ecology, King Co., Snohomish County, Redmond, NESSWD, Sammamish, Woodinville, Union Hill Water Assoc., Woodinville Water Dist., Cascade Water Alliance, Stewardship Partners, Adopt-A-Stream, Citizens, Businesses
7. Examine the feasibility of purchasing and transferring existing water rights.	Washington Water Trust
8. Reduce unauthorized water withdrawals through enforcement.	Ecology

9. Consider the adoption of policies or ordinances that limit or prohibit the drilling of "exempt" wells for irrigation or domestic water when it may affect baseflow to streams or alternative sources exist.	Redmond, Sammamish, Woodinville, King County, Snohomish County
D. Monitoring	
1. Continue monitoring efforts throughout the watershed to fill data gaps and characterize stream health and condition.	King County, Redmond, Sammamish, Woodinville, Snohomish County, Ecology, Snohomish Conservation District, WSDOT
2. Detect or track bacteria sources through targeted water quality monitoring.	Snohomish Conservation District, Ecology, King Co., Redmond
3. Incorporate stormwater sampling/temperature monitoring during critical periods.	Redmond, King County
4. Effectiveness monitoring of streams in Bear-Evans watershed to evaluate whether fecal coliform bacteria concentrations, temperature, and DO levels are meeting the goals of the TMDL.	Ecology and Partners

Organizational roles, actions, and schedules

Many local interests in the Bear-Evans watershed are involved with TMDL planning and implementation. Many others are involved in a wide variety of other planning and implementing activities. There is an excellent opportunity to dovetail the actions in this plan with these other related efforts. Coordinating all of the efforts should help achieve water quality improvements more quickly and efficiently. Ecology will continue to work closely with various basin interests to improve water quality in the watershed.

Implementation actions are intended to be specific enough to clearly identify the needed actions and results, yet general enough to allow some flexibility in carrying them out. Some actions will require further investigation prior to full implementation. Additionally, some actions can be carried out only if funding is provided, and funding decisions may be made over a period of months or years. Over time, the information may change as personnel and available funding are better defined. Once an organization agrees to implement actions identified in the plan, it is expected that these commitments will be completed, recognizing funding limitations.

Table 8 summarizes the organizations' activities and performance measures to improve water quality. These activities address the strategies in Table 7.

Table 8. **Summary of partners' activities and performance measures to improve water quality.**

Strategy from Table 7	TMDL Actions and activities	When actions will occur
WA State Department of Ecology		
C2, C8	Advocate for more resources directed at enforcement of unauthorized water withdrawals. Ecology should also encourage developers to not install exempt water wells where an economically-feasible alternative supply exists.	2010-2015
C3	Partner with the city of Redmond to develop a SEPA permitting process in which private parcel owners can participate to restore forested stream buffers in Redmond. Ecology and the city of Redmond will also contribute to purchasing and planting restoration projects.	2010
D2	Primarily in areas not already being monitored through Municipal Stormwater Permit requirements, perform bacteria source detection sampling in the basin (as resources allow), review data from partners, track trends in bacteria loading in Bear-Evans streams and provide technical assistance.	as needed
D4	Conduct effectiveness monitoring of bacteria loading and BMP implementation (as resources allow) five years after adoption of the TMDL. Conduct periodic compliance reviews of Municipal Stormwater Permit required activities.	2014
	Meet or otherwise contact key watershed stakeholders no less than annually to determine the status of TMDL implementation. Ecology will lead additional meetings as requested and resources allow.	annually
	To help evaluate the effectiveness of the Bear-Evans watershed TMDLs, Ecology will work with jurisdictional entities and grant recipients to develop a GIS tracking tool to record the removal and planting of shade producing trees within the Bear-Evans Creek riparian zone. This tool should also be able to indicate restoration project areas, land ownership, land uses and major changes to the watershed over time.	2011
WA State Department of Transportation		
A3	Notify responsible landowners, King Conservation District (KCD), Public Health Seattle-King County (PHSKC) or Ecology, as appropriate, if contamination from animal waste or sewage is identified or suspected entering road right-of-ways. Coordinate with KCD and PHSKC to provide technical assistance to landowners and local governments. Identify areas of overlapping, ambiguous and/or bordering jurisdictions and develop a list of principal contacts for each of these areas to respond to complaints and emergencies.	on-going
D1	Share findings from any water quality monitoring with Ecology.	on-going
A5, B1, B2	Complete the major restoration effort of the lower reach of Bear Creek in coordination with the city of Redmond.	2009-2013
A1	Map all WSDOT stormwater facilities, outfalls and areas of stormwater discharge to the Bear-Evans system.	2009-2014

WRIA 8 Salmon Recovery Council		
A7	Update the *Streamside Savvy* booklet and make it available online or in printed form.	2010-2011
	Develop messages about the importance of trees and how they relate to salmon recovery, global warming and quality of life. Share messages to participating jurisdictions.	2010-2011
	Coordinate WRIA 8 jurisdictions to jointly produce educational resources on why LID is important, what elements are included, and how to install and maintain low-impact landscapes.	2010-2011
B2, C4, C5	Seek funding for high priority projects from the WRIA 8 Chinook Salmon Conservation Plan that improve habitat and water quality in the Bear Creek/Cottage Lake Creek sub-basins.	2010-2015
B3	Develop a strategy and supporting materials to encourage landowner participation in King County's Public Benefit Rating System, which provides a property tax reduction as an incentive to preserve open space on private property.	2010-2011
King County		
A3	Respond to all illicit discharges and report to Ecology those that are considered threatening to public health.	on-going
	Consider bacteria TMDLs when prioritizing the county's municipal separate storm sewer systems (MS4) in urban/higher density rural sub-basins that will be screened for illicit connections.	2010-2012
	Continue raising public awareness of the county's Illicit Discharge Detection and Elimination (IDDE)/water quality complaint hotline.	2010-2012
A4, A5	Improve building permit compliance to protect water quality based on recommendations from *Improving Environmental Outcome: An Evaluation of Compliance and Recommendations for Improvement* (King County, 2009b). Recommendations included: require preconstruction meetings at all sites; do not issue certificate of temporary or final occupancy until drainage BMP's *and facilities* are in place; and routinely inspect sites, particularly during the wet season.	2010-2015
A4, C1	Implement the Bear Creek Water Quality Improvement Plan (Targeted Stormwater Retrofits), given available grant funding.	2009-2011
	Promote LID practices in new development and re-development projects as required and encouraged per King County Surface Water Design Manual.	on-going
A4	Address in operations and maintenance program policies and procedures to reduce fecal coliform in discharges from lands owned or maintained by the county, including parks, road right-of-ways, and stormwater treatment and flow control facilities (e.g., detention ponds). For example, install pet waste stations at parks.	on-going
A5, B2, C5	The Basin Steward will provide technical assistance for groups working in the watershed on water quality improvement efforts, e.g., King Conservation District, Snohomish Conservation District, Adopt A Stream Foundation, Bear Creek Water Tenders, Friends of Cottage Lake, etc.	on-going
	Seek funding to continue the Bear Riparian Restoration Program of small-scale habitat restoration projects in stream corridors within the Bear creek basin.	2008-2011

A5, B2, C5	Cottage/Cold Creek Acquisition to acquire and protect 35 acres (Nichols farm property) on Cottage Lake Creek	2010 – 2011
	Cottage Lake Creek Habitat Acquisition to acquire riparian habitat along approximately ½ mile of Cottage Lake Creek, near Avondale Road. (In Salmon Plan, but subject to available money.)	2011 - ?
	Cold Creek/Williams Mitigation Wetland Improvement to enhance topography, hydrology and riparian/wetland vegetation. $747K to enhance wetland hydrology, connectivity, and riparian function. Status: monitoring/maintenance of plants.	on-going
	Continue Noxious Weed Program activities as resources and funding allow to control purple loosestrife along upstream Bear Creek below the Snohomish County border in Rotary Park, Woodinville.	on-going
A5	Assist Ecology in documenting and reporting the status of TMDL implementation actions during Ecology's annual review of TMDL activities.	2010-2015
A6	Track and monitor compliance with the county's Livestock Ordinance. Ensure procedures under the escalating enforcement of KCC 9.12 are followed in response to water quality complaints.	on-going
A7	Implement policies and procedures that address stormwater issues and include integrated pest management planning to restrict and/or reduce pesticide and fertilizer use near areas of fish habitat.	on-going
	Continue working regionally to implement the Municipal Stormwater Permit outreach programs, including those through the STORM initiative.	on-going
B3	Maintain the Rural Stewardship Planning program and provide assistance as applicants seek it.	on-going
C1	Evaluate opportunities and/or barriers to the use of LID within the area served by the county's MS4 and identify measures to address the barriers.	on-going
C3	Conduct drainage reviews where necessary to allow for treatment considerations in accordance with the stormwater management program as required by the Municipal Stormwater Permit.	on-going
D2	Achieve expected outcomes from the *Cottage Lake Phosphorus Reduction Grant Project* (G0600071). Report results and findings to the Ecology.	2005 -2011
A5, B3, C1, C4, C5	Enforce the county's Critical Areas Ordinance, requiring buffers, limiting land clearing, protecting habitat, and encouraging LID.	on-going
Snohomish County		
A4	Address in operations and maintenance program policies and procedures to reduce fecal coliform in discharges from lands owned or maintained by the county, including parks, road right-of-ways, and stormwater treatment, and flow control facilities (e.g., detention ponds). For example, install pet waste stations at parks.	on-going

A5	Assist Ecology in documenting and reporting the status of TMDL implementation actions during Ecology's annual review of TMDL activities.	2010-2015
A7	Implement policies and procedures that address stormwater issues and include integrated pest management planning to restrict and/or reduce pesticide and fertilizer use near areas of fish habitat.	on-going
C1	Evaluate opportunities and/or barriers to the use of LID within the area served by the county's MS4 and identify measures to address the barriers.	on-going
D1	As resources allow, continue temperature monitoring in the Bear Creek head waters.	periodic
D2	Share lessons learned to Ecology and jurisdictions in the Bear-Evans watershed regarding the innovative 2010-2012 Fecal Coliform Bacteria TMDL Monitoring Program (Snohomish County, 2009).	2012-2013
City of Redmond		
A1	Build on Redmond Urban Watersheds Initiative (2008) conclusions: evaluate potential surface water quality contributions to Bear-Evans Creek system based on land uses within Redmond catchments/watersheds.	2009-2012
A5, B1, B2	Move Evans Creek to improve instream habitat, reduce industrial encroachment within buffers, reduce pollutant loadings from adjacent properties, and reconnect adjacent wetlands to Evans Creek (improving DO, temperature, and stormwater pollutant impacts).	2010-2015
A1	Identify and map potential fecal coliform bacteria and nutrient generating sources, such as farming and nursery operations, commercial composting facilities, animal boarding facilities (e.g., kennels, stables), and food establishments with the potential of run-off to the MS4 system or surface water and within the Bear-Evans watershed.	2010 – 2011
A2	Map septic systems within the city of Redmond.	2009 – 2010
A3, D2	Continue "in-pipe" camera inspections of citywide stormwater infrastructure.	2009 – 2012
	Designate Bear-Evans Creek as a high priority water body to conduct field assessments and screening for illicit connections and failing on-site septic systems (OSSSs).	2009 – 2012
	Continue to screen for bacteria sources (e.g., IDEXX tests for E.coli), such as sewage/septic sources, during all outfall and conveyance screenings conducted in the city's portion of the Bear-Evans watershed.	2011 – 2012
	Increase efforts to raise public awareness of the city's IDDE water complaint hotline.	2009 – 2012
A4	Address in operations and maintenance program policies and procedures to reduce fecal coliform in discharges from lands owned or maintained by the city, including parks, road right-of-ways, and stormwater treatment and flow control facilities (e.g., detention ponds). For example, install pet waste stations at municipal parks.	on-going
A5, B1, B2	Complete major restoration effort of lower Bear Creek in coordination with WSDOT.	2009 – 2014

A5, B1	Work with Ecology to streamline permit process for beneficial tree plantings on public property within city-designated riparian stream corridors, including tributaries to Bear Creek and Evans Creek.	2010-2011
A5	Implement and participate in public outreach/education activities on proper management of animal/livestock waste. Work with Ecology to use Farrel-McWhirter Park as a demonstration project for livestock management.	2009 – 2012
	Provide "Mutt Mitts" and educational signage for pet waste cleanup at selected city park sites within the Bear-Evans watershed.	2010
	Consider negotiating with garbage collection contractors to assure garbage dumpsters and trucks are built and maintained to prevent rodents and stormwater from getting in or waste water and debris from leaking out onto the ground.	2011
	Offer new opportunities for outreach/citizen participation through the Planning and Public Works' preparation of the Bear Creek Neighborhood Plan update (initiated 4/2009).	2009 – 2011
	Continue working regionally to implement Municipal Stormwater Permit outreach programs such as STORM.	2008 – 2012
	Assist Ecology in documenting and reporting the status of TMDL implementation actions during Ecology's annual review of TMDL activities.	2010 – 2015
A7	Implement policies and procedures that address stormwater issues and include integrated pest management planning to restrict and/or reduce pesticide and fertilizer use near areas of fish habitat.	on-going
B1, B2	Provide in-kind support to Adopt-A-Stream Foundation's Bear-Evans Urban/Suburban Riparian Enhancement Project.	2010 – 2013
B2	Continue to promote invasive plant removal and planting of colonizing species in riparian stream corridor restoration projects.	on-going
B3	Ecology and the city shall partner to develop a group SEPA permitting process in which private parcel owners can participate to restore forested stream buffers within Redmond. Ecology and city of Redmond will also contribute to purchasing and potentially planting restoration projects.	2010 – 2011
	Develop watershed management plan for Redmond's portion of the Bear-Evans watershed that will be adopted into the Redmond Comprehensive Plan.	2010 – 2011
C1	Continue actively working to retrofit stormwater infrastructure in urban centers as part of the city's downtown capital improvement projects.	2009 – 2012
	Evaluate opportunities and/or barriers to the use of LID within the area served by the city's MS4 and identify measures to address the barriers.	on-going
	Develop policies and development regulations that maximize LID techniques for stormwater management while protecting the city's drinking water aquifer. Limit exceptions to on-site stormwater management and increase the use of LID in new development and redevelopment projects. Require documentation of site characteristics as proof that infiltration of runoff is unfeasible to manage runoff on-site.	2009-2012
C3	Revise the city's SEPA checklist to incorporate review of TMDLs as part of SEPA determination.	2010

C8	Map exempt wells in the city's critical aquifer recharge area (6 square miles) which includes Bear Creek, Evans Creek and Sammamish River. Share maps with Ecology.	2009 – 2010
D3	Analyze the city's continuous temperature monitoring data collected from surface water sources during critical summer to late fall periods (2001-2009). Share report with Ecology.	2009 – 2011
City of Sammamish		
A3	Increase efforts to raise public awareness of the city's IDDE water complaint hotline.	2009-2012
	Consider designating any areas of the Evans Creek sub-basin, particularly in un-sewered areas or with older OSSSs as a high priority area for field assessments and screening for illicit connections and failing septic systems.	2010-2012
	Screen for bacteria sources (e.g., IDEXX tests for E.coli), such as sewage/septic sources, during all outfall and conveyance screenings conducted in the area served by the city's MS4 in the Bear-Evans watershed.	2010-2012
A4	Address in operations and maintenance program policies and procedures to reduce fecal coliform in discharges from lands owned or maintained by the city, including parks, road right-of-ways, and stormwater treatment and flow control facilities (e.g., detention ponds). For example, install pet waste stations at municipal parks.	on-going
A5	Assist Ecology in documenting and reporting the status of TMDL implementation actions during Ecology's annual review of TMDL activities.	2010-2015
A5, B1, C4	Explore partnering with Northeast Sammamish Sewer and Water District (NESSWD) to develop Evans Park Preserve with LID features. NESSWD can provide site plan assessment for riparian restoration and stormwater infiltration (as resources allow).	2010-2012
A7	Implement policies and procedures that address stormwater issues and include integrated pest management planning to restrict and/or reduce pesticide and fertilizer use near areas of fish habitat.	on-going
	Implement or participate in public education and outreach activities related to fecal coliform pollution in stormwater, such as pet/livestock waste, OSSS maintenance, stormwater pond maintenance, and LID techniques.	on-going
	Generate a *Featured LID Development* article in the city newsletter.	annually
C1	Develop or adopt guidance document to facilitate the use of the approaches outlined in the city's LID Ordinance.	2010-2011
	Evaluate opportunities and/or barriers to LID implementation within the area covered by the Municipal Stormwater Permit and measures that will address the barriers.	on-going
C3	Consider revising the city's SEPA checklist to incorporate review of TMDLs as part of SEPA determination.	2010-2011
City of Woodinville		
A3, D2	Screen for bacteria sources (e.g., IDEXX tests for E. coli.), such as sewage/OSSS, during all outfall and conveyance screenings conducted in the area served by the city's MS4 in the Bear-Evans watershed.	2010 - 2012
	Provide outreach to wineries on proper disposal of business waste products.	2009 - 2012

	Increase efforts to raise public awareness of the city's IDDE water complaint hotline.	2009 - 2012
A5	Assist Ecology in documenting and reporting the status of TMDL implementation actions during Ecology's annual review of TMDL activities.	2010-2015
A5, B1, B2	Continue conducting volunteer planting as part of the Sammamish Re-Leaf project.	2009 - 2025
	Explore grant opportunities to implement riparian restoration projects where needed.	2009 - 2011
A7	Participate in or implement public outreach/education activities on proper management of animal/livestock waste.	2009 - 2012
	Evaluate opportunities to install "Mutt Mitts" to control pet waste in any city parklands that lie within the Cottage-Bear Creek watershed.	2009 - 2012
	Coordinate with neighboring jurisdictions to participate in outreach/education programs on reducing pollutant discharges into stormwater.	2009 - 2012
	Survey residents to solicit input on current stormwater problem areas in the Cottage Bear Creek watershed.	2009
	Implement or participate in public education and outreach activities related to bacteria pollution in stormwater, such as pet waste, stormwater pond maintenance, and LID techniques, in the area served by the Woodinville MS4.	2009 - 2015
	Implement policies and procedures that address stormwater issues and include integrated pest management planning to restrict and/or reduce pesticide and fertilizer use near areas of fish habitat.	on-going
B3	Update the tree ordinance to include a city-wide goal to achieve at least 40% tree coverage.	2008 - 2009
A4	Address in operations and maintenance program policies and procedures to reduce fecal coliform in discharges from lands owned or maintained by the city, including parks, road right-of-ways, and stormwater treatment and flow control facilities (e.g., detention ponds). For example, install pet waste stations at municipal parks.	on-going
C1	Identify an established process by other jurisdictions to make incentives for developers to incorporate LID into projects.	2010 - 2011
	Evaluate opportunities and/or barriers to the use of LID within the area served by the city's MS4 and identify measures to address the barriers.	on-going
C3	Consider revising the city's SEPA checklist to incorporate review of TMDLs as part of SEPA determination.	2010-2011
D1	Track water temperature in major stormwater discharges to Bear Creek and determine its influence on the stream temperature.	
Snohomish Conservation District (SCD)		
A1, A4, A5, A6, A7	Achieve expected fecal coliform reduction outcomes from the *Collaborative Education in Bear Basins Grant Project* (G090018).	2008-2013
A7	Share results from the social marketing research on small farm owners and water quality to other watershed groups, including King Conservation District.	2010-2011

D2	Implement fecal coliform monitoring as part of the *Collaborative Education in Bear Basins Grant Project.*	2010-2013
King Conservation District (KCD)		
A5, B2	Assist landowners with implementing aquatic area enhancement projects along streams and wetlands.	on-going
A6, A7	Partner with Snohomish Conservation District to develop farm plans as part of the CD's grant project, G090018, in the Bear Creek sub-basin.	2010-2013
	Conduct outreach in priority areas, including, participate in two workshops or farm tours per year; participate in two fairs, festivals or community events per year; and provide soil testing services to landowners.	2010-2013
	Partner with Snohomish Conservation District to provide technical assistance and farm planning to landowners through site visits; rural and livestock services; and BMP workshops, implementation and guidance.	2010-2013
Cascade Water Alliance		
C2	Explore the possibility of providing economically-feasible alternative water sources (such as use of reclaimed water) to augment irrigation withdrawals and groundwater drinking water sources.	on-going
Sewer and Water Districts		
A1, A2	Provide maps of sanitary sewer lines to allow visual inspections of pipe crossings and areas where lines are close to streams. Share information on un-sewered areas or older OSSSs with local jurisdictions' IDDE programs.	2010-2012
C6	Identify high priority areas for potential ex-filtration and perform testing as needed.	2010-2015
Public Health Seattle-King County (PHSKC)		
A2, A3	Coordinate with other agencies (as appropriate) and not issue permits if a property is not in compliance, including: ▪ Building Remodels, Additions, or Replacement of Residential Structures ▪ Food establishment Annual OSSS Permits ▪ Change of use for facilities OSSS	on-going
	Make changes, as appropriate, to permitting requirements to require sellers to submit proof of successful professional OSSS inspection including as-built, location of system, and system components prior to transfer of property sale.	2007-2009
	Develop program to ensure these PHSKC reports on potential illicit connections or illicit discharges are forwarded to the appropriate agencies.	2010-2011
A2, A3	Provide training to other PHSKC inspectors, e.g., restaurant business inspectors, to recognize existing or potential illicit connections or illicit discharges. Cross-train with other enforcement/compliance inspectors from other county departments, e.g. DDES, Stormwater Services.	2010-2012
	Develop sanitary survey criteria (county-wide program) for assessing high-risk areas for failing OSSS. Make criteria available to local jurisdictions' IDDE programs.	2010-2011
A7	Support additional educational activities about OSSS maintenance in the Bear-Evans watershed. Coordinate with other organizations, when appropriate.	on-going
	Support educational activities about dumpster maintenance in the Bear-Evans watershed. Coordinate with other organizations, when appropriate.	

	Continue to provide training/education to realtors in identifying/reporting failing OSSS.	on-going
Adopt-A-Stream Foundation		
B1, B2	Achieve expected outcomes from the *Bear-Evans Urban/Suburban Riparian Enhancement Project* to improve riparian shade on private properties along Bear-Evans Creek System.	2010-2013
Stewardship Partners		
A7	Outreach to Bear and Sahalee golf courses in the Bear-Evans watershed on the salmon-safe certification program.	2010-2012
	Identify a golf course that could be a candidate for Ecology's Environmental Excellence Award.	2010-2011
C6	Share lessons learned to Ecology about the pilot salmon-safe certification program for golf courses.	2010
Cascade Land Conservancy		
B1, B2	Continue to coordinate the Green Redmond Partnership. Implement the 20-year plan to restore the urban forests in the city of Redmond, include efforts in riparian forest areas.	2008-2020
Washington Water Trust		
C6, C7	Explore expanding programs to develop volunteer agreements with golf courses.	2010-2011
Bear Creek Water Tenders, Friends of Cottage Lake and other citizen groups		
B2, C4, C5	Seek or support proposals for small grants, e.g. Community Salmon Fund, to conduct citizen-led restoration and enhancement efforts on private properties in the Bear-Evans watershed.	on-going
B2	Educate fellow neighbors and participate in volunteer restoration activities.	on-going

Potential municipal stormwater permit requirements

The current Phase I and Phase II Municipal Stormwater Permits include certain activities and BMPs that are required under the general language of the permit regardless of whether there is a TMDL established on local streams. In areas where a TMDL is in effect and a WLA is given to an MS4 permit holder, additional required activities may be included in the permit. At this time there are no additional requirements for Bear-Evans watershed stormwater permittees beyond meeting their WLA and compliance with the Stormwater Permit. Additional permit requirements may be included in the future, based on new data and adaptive management of the TMDL. The next round of municipal stormwater permitting is scheduled for 2012.

Adaptive management

Adaptive management involves testing, monitoring, evaluating applied strategies, and incorporating new knowledge into management approaches that are based on scientific findings. In the case of TMDLs, Ecology uses adaptive management to assess whether the actions initially identified as necessary to solve the identified pollution problems are the correct ones and whether they are working over time. As we implement these actions, the system will respond, and it will also change. Adaptive management allows us to fine-tune our actions to make them more effective, and to try new strategies if we have evidence that a new approach could help us to achieve compliance.

BMP requirements that address a TMDL will be adaptively managed over time to ensure that new data and knowledge are incorporated into management approaches and practices. Adaptive management may allow for more or less stringent requirements specific to TMDL WLAs as conditions change or new knowledge is acquired.

Compliance with the State's water quality fecal coliform bacteria criteria for extraordinary primary recreation should be achieved by 2015. An interim target of compliance with the primary contact bacteria criteria should be achieved by 2012. Compliance with State water quality criteria for temperature and DO to protect core summer salmonid habitat should be achieved by 2050. An interim target of compliance with the salmonid spawning, rearing, and migration should be achieved by 2025.

The Bear-Evans watershed TMDLs identified targets in terms of percent bacteria load reduction and increase in effective shade. If the State's water quality standards are achieved in the Bear-Evans stream network but WLAs and LAs are not, the TMDL will still be considered satisfied. This may be possible since TMDL targets were set using certain modeling assumptions that may change over time and may be altered by pollution correction actions. Partners will work together to monitor progress toward TMDL goals, evaluate successes, obstacles, changing needs, and make adjustments to the cleanup strategy as needed.

Ecology will adaptively manage implementation strategies and BMPs when water monitoring data show that TMDL targets are not being met or implementation actions are not producing the desired result. To adaptively manage the TMDL, Ecology will implement a feedback loop such as shown in Figure 8 consisting of the following steps:

Step 1. Activities in the water quality implementation plan are put into practice.

Step 2. Programs and BMPs are evaluated for technical adequacy of design and installation.

Step 3. The effectiveness of activities is evaluated by assessing new monitoring data and comparing it to the data used to set the TMDL targets.

Step 3a. If goals and objectives are achieved, implementation efforts are adequate as designed, installed, and maintained. Project success and accomplishments should be reported to continue implementation and increase public support.

Step 3b. If goals and objectives are not being met, then BMPs and the implementation plan will be modified or new actions identified. The new or modified activities are then applied as in Step 1.

Additional monitoring may be necessary to better isolate bacteria sources so that new BMPs can be designed and implemented to address all sources of bacteria pollution. It is ultimately Ecology's responsibility to assure that implementation is being actively pursued and the State's water quality standards are achieved.

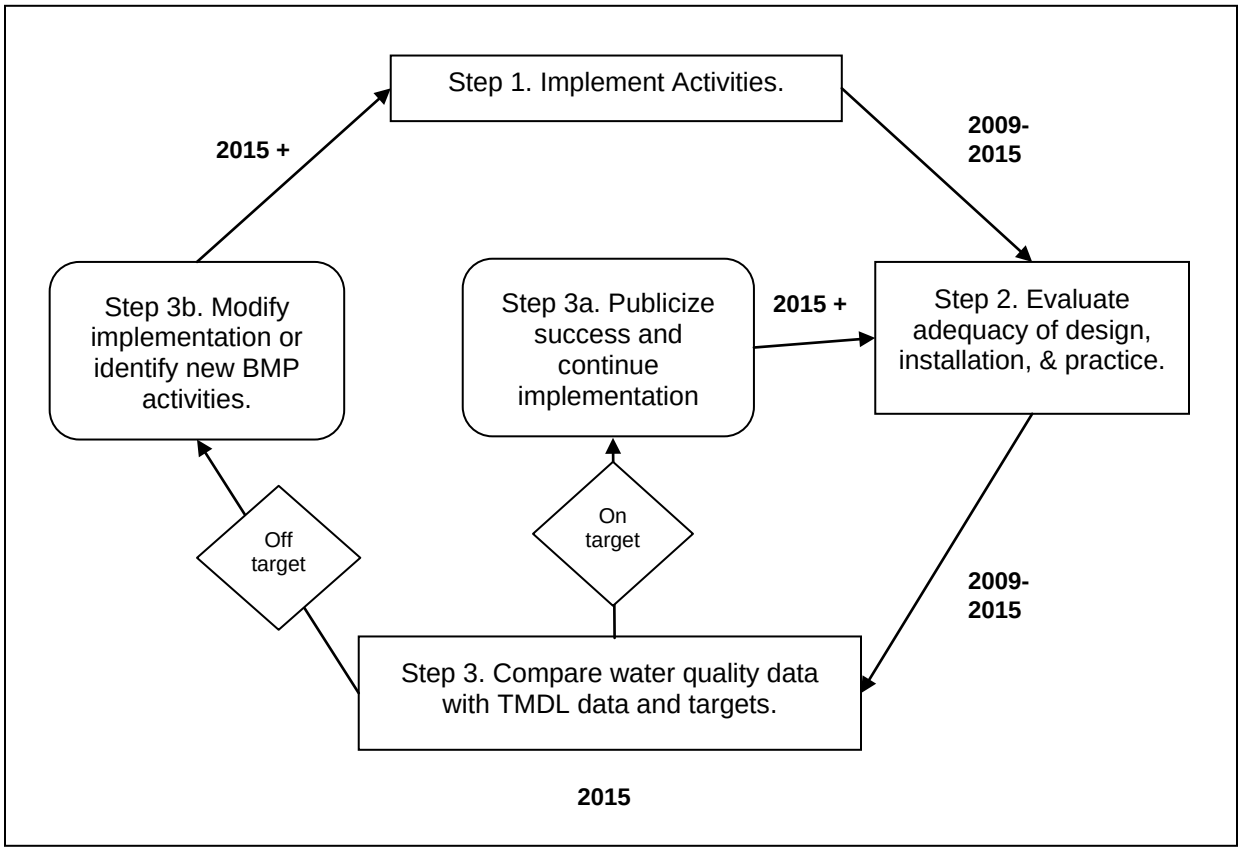

Figure 8. Feedback loop for determining need for adaptive management. *Dates are estimates and may change depending on resources and implementation status.*

Measuring Progress toward Goals

In order to gauge the progress of this TMDL implementation, Ecology will convene a meeting of municipal and community stakeholders annually to share information on the condition of water quality in Bear-Evans watershed and to report on the status of implementation activities. Water quality data, trends (where applicable), regulatory changes, new and innovative concepts, and funding sources will be discussed to evaluate the overall status of the TMDL. Ecology will solicit input from the workgroup to help direct the adaptive management of this TMDL. Ecology will track implementation annually, using Table 8 to track progress.

Ecology will continue to offer grant funding for water quality studies, stream restoration projects, BMP effectiveness evaluations, and for the development and implementation of monitoring programs through its annual Centennial Clean Water Fund.

Performance measures and targets

Compliance with State water quality bacteria criteria for extraordinary primary recreation should be achieved by 2015. An interim target of compliance with the primary contact bacteria standards should be achieved by 2012. Compliance with State water quality criteria for temperature and DO to protect core summer salmonid habitat should be achieved by 2050. An interim target of compliance with the salmonid spawning, rearing, and migration should be achieved by 2025.

The actions listed in Table 8 to improve water quality need to be tracked to determine:

- What activities were performed and where.
- Whether the actions worked and could be applied elsewhere.
- What practices should be considered for adaptive management, if necessary.
- If resources or other factors are preventing some actions from occurring.
- Whether this implementation plan is adequate to meet water quality standards.

Ecology will collect updates from each organization in Table 8 on an annual basis. This table will be used to track their TMDL implementation-related activities. Ecology will review the current status of the implementation activities in a meeting with the Stakeholder Advisory Committee each year.

Water quality monitoring

An essential part of this basin restoration effort is the monitoring of surface water, ground water, stormwater, and sediment quality for the purpose of understanding the health of the water bodies and identification of pollution sources. Monitoring is needed during all phases of the TMDL to identify polluted areas, contributing sources, and to verify that corrective actions have been implemented and are having a positive effect on the basins receiving waters.

Routine monitoring to determine if BMPs are effective at reducing pollution, and monitoring to search for pollution sources fall under this category.

Environmental monitoring can involve numerous groups and organizations collecting samples at a set schedule or as needed to determine current ambient conditions and pollutant concentrations, pollutant sources, or monitor events like storms. Examples can range from volunteer groups collecting air and stream temperatures to jurisdictions conducting mandatory stormwater sampling.

Identifying pollutant sources is important in implementing TMDLs because identification of each source problem is necessary in order to work on solutions. Monitoring may be required to determine suspected pollution sources of fecal coliform bacteria and nutrients. Identifying sources will likely require sampling sites not used during the TMDL studies. It allows local governments, stormwater permittees, and private groups to focus BMP implementation resources where they are most needed. Source-detection monitoring is used when pollution sources are not obvious and additional data are needed to track down the unknown or suspected causes. Events that typically trigger the need for targeted monitoring include:

- Whenever ambient water quality monitoring has identified exceptionally high bacteria levels on either a consistent or a sporadic basis.
- Wherever potential sources of bacteria are identified and need to be verified. Examples of potential problem areas include poorly managed animal confinement or recreation areas, drainage from waste dump areas, failing OSSS, or illicit discharges.

Effectiveness monitoring

Effectiveness monitoring determines if interim targets and water quality standards have been met and is typically conducted approximately five years after the WQIP is finished. Ecology's ability to conduct this monitoring depends upon the availability of resources. However, volunteers and local groups can also conduct monitoring to measure and estimate progress of the TMDLs for fecal coliform bacteria, temperature, and DO. This plan includes anticipated monitoring planned by other entities.

Monitoring data will be compared to interim targets to identify if progress has been made. If creeks in the watershed do not meet the interim targets, adaptive management will be applied and future effectiveness monitoring may be scheduled. Monitoring should focus on critical conditions, but sampling during all seasons is recommended. The same sites used to collect the TMDL data should also be used for effectiveness monitoring.

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. Those conducting restoration projects or installing BMPs will be responsible for monitoring plant survival rates and maintenance of improvements, structures, and fencing. Analyses of data or monitoring by Ecology to determine compliance with State criteria will be needed when water quality standards are believed to be achieved.

Funding Opportunities

Multiple sources of financial assistance for water cleanup activities are available through Ecology's grant and loan programs, local conservation districts, and other sources. Refer to the website (www.ecy.wa.gov/programs/wq/tmdl/TMDLFunding.html) for a list and descriptions of funding sources.

Table 9 describes several possible funding sources that may be available to implement activities necessary to correct water quality problems in Bear-Evans watershed. Ecology will work with stakeholders to prepare appropriate scopes of work for grant projects, assist with applying for grant opportunities as they arise, and will help grant applicants and other stakeholders in other ways to implement the TMDL.

Table 9. Possible funding opportunities to support implementation.

Sponsoring Entity	Funding Source	Eligible Activities
EPA	Environmental Education Grants www.epa.gov/enviroed/grants.html	Environmental education projects implemented by nonprofit organizations
Department of Ecology 3190 160th Ave SE Bellevue, 98008 (425) 425-7269	Clean Water Fund, Section 319, and State Revolving Fund www.ecy.wa.gov/programs/wq/funding Coastal Protection Fund (CPF) www.ecy.wa.gov/programs/sea/sea-grants.htm	Implementation, design, acquisition, construction, and improvement of water pollution control; Facilities and water pollution control related activities. Priorities include: implementing TMDL plans, keeping pollution out of streams and aquifers, modernizing aging wastewater treatment facilities, reclaiming and reusing waste water. CPF is discretionary monies made available to regional Ecology offices to support on-the-ground projects to perform environmental restoration and enhancement.
King County Department of Natural Resources 201 S. Jackson Suite 600 Seattle, 98104 (206) 296-6519	King County Grant Exchange, including six grant programs http://dnr.metrokc.gov/grants/ Community Salmon Fund (CSF) WaterWorks	Projects that protect or improve natural resources; such as water quality, salmon and wildlife habitat, reforestation, water conservation, and related educational efforts. CSF awards small-scale grants for salmon habitat protection and restoration projects that are marked by community involvement and watershed health benefits.

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Implementation projects and tools

The goal of the Bear-Evans Watershed WQIP for fecal coliform bacteria and temperature/DO is for the waters of the basin to meet the State's water quality standards. There is considerable interest and local involvement toward resolving the water quality problems in the Bear-Evans watershed. Numerous organizations and agencies are already engaged in stream restoration and source correction actions that will help resolve the water quality problems. The following activities and tools support this TMDL and add to the assurance that water quality impairments in the Bear-Evans watershed will meet State water quality standards.

On-going nonpoint source control

- The *Bear Creek Restoration* project is a partnership between the city of Redmond and Washington State Department of Transportation (WSDOT) to restore the lower portion of Bear Creek that runs alongside State Route 520. This partnership was established to enhance mitigation of highway impacts to existing stream buffers and wetland areas protected by local, state, and federal regulations.

  The creek will be moved further away from SR 520 and made more hospitable for salmon and other wildlife. The project will create more than 4,000 feet of enhanced channel, restore natural stream habitat, add logs and spawning gravel, restore streamside wetlands and backwater areas, and restore native trees and shrubs that will shade the channel. WSDOT contributed $8 million to the project recognizing the value of enhancing one of our area's most significant salmon-spawning streams. The remainder of the total $10 million project cost will be funded through Redmond's Capital Improvement Program and grants. Design of the project was initiated in the summer of 2009 and is expected to be completed in 2013.

- The *Bear-Evans Urban/Suburban Enhancement Project* is led by Adopt-A-Stream Foundation with the city of Redmond as an inter-local government partner. The project will work in high shade-deficient areas to encourage riparian restorations on urban streamside private properties along Bear Creek and Evans Creek. The project is funded by Ecology's 319 Grant Program and will receive in-kind match support from the city of Redmond.

- The *King County Cottage Lake Creek Habitat Acquisition Program* plans to acquire and protect 35 acres (Nichols farm property) on Cottage Lake Creek to preserve the hydrologic processes and water quality in Cottage Lake Creek and Bear Creek. Cold Creek, a valuable cold groundwater source, is also targeted for protection. King County completed the title work and the appraisal began in late 2009 (King County, 2009a). In addition, the county began work in 2010 to acquire a half-mile reach of Cottage Lake Creek near Avondale Road to preserve riparian habitat.

  King County's *Cold Creek Natural Area Plan* currently manages the Cold Creek Natural Area and adjacent Bassett Pond Natural Area. These natural areas cover about 250 acres in the upper reaches of Cottage Lake Creek and contain extensive wetland systems, numerous springs, and one of the highest quality salmon-bearing streams in the Bear Creek drainage basin. The King County basin steward manages this property.

King County's *Lakes and Small Habitat Restoration Program* is completing their Cottage Lake Phosphorous Reduction Project, funded by a Centennial Clean Water Grant. The aim of the project is to reduce phosphorus inputs to Cottage Lake by changing residents' behaviors through educational efforts, as well as by promoting and carrying out restoration along the lake and inlet shorelines. The project also includes reducing inputs of fecal coliform bacteria to Cottage Lake. In summer 2008, the county implemented a restoration project in Cottage Lake Creek where they worked with six property owners to restore about 0.75 acres of riparian habitat along ¼ mile of the left bank of Cottage Lake Creek. The Cottage Lake Inlets monitoring was completed as part of the evaluation effort.

- The *King County Bear Riparian Restoration Program* plans small-scale habitat restoration projects in stream corridors within the Bear Creek basin (in addition to Cedar River and Issaquah Creek basins). Projects include planting native vegetation, stabilizing eroding stream banks, restoring fish access, installing livestock fences, controlling invasive weeds, and providing technical assistance to landowners (King County, 2009a).

- As grant funding becomes available the *King County Bear Creek Water Quality Improvement (Targeted Stormwater Retrofits)* project will construct single or multiple treatment facilities to clean up stormwater discharges from the worst polluting, older developed areas that drain to the highest resource value reaches of the creek. The amount of the reduction of total suspended solids (TSS) in stormwater discharged to Bear Creek is yet to be determined. Reconnaissance started in 2009 to identify project sites (King County, 2009a).

- The *City of Redmond East Redmond Corridor Master Plan* focuses on the park properties along the eastern edge of the city. These parks include Juel, Farrel McWhirter, Conrad Olson, Perrigo, Martin, Arthur Johnson, and the Bear/Evans Creek Trail and Greenway. Once implemented, the plan will preserve land adjacent to the creeks, enhance adjacent vegetation, and create access for citizens to enjoy and appreciate the creeks. The parks included in this plan will remain lightly developed to highlight the boundary between urban and rural development types.

- The *City of Redmond Lower Evans Creek Rerouting* proposal supports rerouting of a segment of lower Evans Creek. Portions of the project are highlighted in the 2005 Chinook Salmon Conservation Plan (Project N432), aiding in protecting and enhancing habitat for the recovery of salmonid species. Evans Creek currently flows near several industrial parcels located east of Keller Farm. These parcels have a long history of heavy industrial uses (concrete fabrication, asphalt, creosoted lumber, disposal of construction debris and industrial wastes). Industrial activities are currently encroached within locally defined stream buffers. The industrial parcels are not served by the city's stormwater, wastewater, or domestic water infrastructure.

  Preliminary studies suggest that rerouting Evans Creek would be topographically feasible. The city already owns parkland and forested wetlands through which the new stream channel would be constructed, reconnecting wetlands and potentially improving all Evans Creek impairments. The project would permit enhanced protective buffering along both sides of the relocated creek, with substantial water quality benefits.

- The *Keller Farm Enhancement Proposal* to redevelop the 117-acre private property into a wetland mitigation bank is promoted and encouraged by the city and by the WRIA 8 Chinook Salmon Conservation Plan. Keller Farm is located at the intersection of Avondale Road and Union Hill Road and encompasses approximately 4500 feet of Bear Creek and the lower 1000 feet of Evans Creek. While the recent economic downturn resulted in cancellation of an initial proposal, the city hopes another financial sponsor will come forward in the future. Restoration of the stream, riparian, floodplain, buffer and wildlife habitat at Keller Farm would help reconnect groundwater flows to the creeks and, in turn, improve summer baseflow levels, as well as moderate stream temperatures.

Increasing awareness through educational efforts

- The *Stormwater Outreach for Regional Municipalities (STORM)* group is a regional outreach consortium comprised of staff from more than 60 Phase I and Phase II Municipal NPDES permit holders. With the public education and outreach requirements virtually identical in both the Phase I and Phase II permits, municipalities saw the advantage of combining their resources to create a strategy and campaign for outreach that would transcend jurisdictional boundaries. In 2007, the group was awarded a stormwater grant by Ecology to coordinate public education and outreach efforts related to stormwater pollution prevention over four years. A second grant from the Grants of Regional or Statewide Significance (GROSS) fund was awarded in 2009. King County funds and administers the 2007 grant and a SharePoint Server for the benefit of STORM members. Snohomish County administers the 2009 GROSS grant. Both counties and the city of Redmond are represented on the STORM's Steering Committee. STORM members coordinate with the Salmon Conservation Plan implementation efforts occurring at the WRIA level and with the Puget Sound Partnership.

- The Snohomish Conservation District (SCD) is coordinating the *Collaborative Education in Little Bear and Bear Creek Basins* (G0900018) in partnership with KCD. From 2008 to 2013, SCD will develop a targeted collaborative watershed education program that provides landowners with technical assistance and farm-planning needs. Specifically, they will use social marketing research to identify appropriate outreach strategies to small farm owners in sub-rural/urban watersheds.

- The Adopt-A-Stream Foundation's *Bear-Evans Suburban/Urban Riparian Enhancement* grant project (G1000329) will work with urban-suburban landowners to identify riparian restoration needs and implement creative restoration plans in the Bear Creek and Evans Creek watersheds. This effort will compile baseline information on riparian conditions; educate watershed residents about how to assure healthy creeks; create implementation plans; and work with willing landowners to implement projects. The project received an Ecology 319 Grant for 2010 to 2015.

- The WRIA 8 Salmon Recovery Council is developing a *Streamside Landowner Outreach Strategy* regarding alterations to habitat on rivers and streams. In 2009, WRIA 8 began researching streamside landowners' current beliefs, knowledge, behaviors, barriers to behavior change, and what would encourage them to have shorelines that better protect salmon. The strategy is to be completed in 2010. WRIA 8 is coordinating on the outreach

with SCD and Adopt-A-Stream Foundation, who are currently under Ecology grants to conduct outreach/education in the Bear-Evans watershed.

Technical assistance and voluntary efforts

- The *Green Redmond Partnership* between Cascade Land Conservancy and the city of Redmond plans to restore and manage all 1,035 acres of Redmond's forested parklands by 2028. The program supports a network of urban foresters, planners, and volunteers. The Forest Steward program enables active community volunteers to coordinate restoration work parties in forested parklands near their own neighborhoods.

- The *Redmond City-wide Water Conservation Program* includes a youth conservation program and a natural yard care program. The program also sponsors the annual Spring Garden Fair, a free community event featuring kids' activities, information booths, and seminars on water-wise gardening. The city is also an active participant in the regional water conservation program of the Cascade Water Alliance. The main focus of the program is hardware and rebate programs (washers, toilets, shower heads, landscaping) and covers all catchments/watersheds within the city.

- The *King County Waterways 2000 Program* initiated the Bear Creek Water Tenders, a voluntary program for property owners to participate in the Bear Creek community and to set a stewardship example for the rest of the watershed. The Waterways 2000 program and the Upper Bear Creek Conservation Area purchased over 1100 acres of high value aquatic land that is targeted for protection.

- The *King County Reclaimed Water Program* within the Wastewater Treatment Division has safely used reclaimed water since 1997 at its regional treatment plants in Seattle and Renton. King County currently produces 284 million gallons per year of Class A reclaimed water at two regional treatment facilities. Two treatment plants under construction (Carnation and Brightwater) will produce additional reclaimed water once they are operational. King County's reclaimed water will be available to customers along the effluent line and via pipeline to the Sammamish Valley area.

- The *King County Rural Stewardship Planning* is part of the *Public Benefit Rating System (PBRS)* which provides flexibility to property owners by streamlining permit processes and modifying some buffer requirements in exchange for a long-term commitment to protect natural resources in other ways through development of Rural Stewardship Plans. These plans should promote minimal disturbance of native soils and vegetation, decrease hydrologic changes by carefully siting developments and reducing development footprints, and promote on-site infiltration and dispersion techniques.

  By developing and implementing a Rural Stewardship Plan, the property owner can enroll in the PBRS. In return for preserving and managing resources, the land is assessed at a value consistent with its "current use" rather than the "highest and best use"; thereby, reducing the property taxes. Resources prioritized for protection include stream buffers, groundwater protection areas, threatened or endangered wildlife, farmland, forestland, public recreation, historic property and others.

- The *King Conservation District – Landowner Incentive Program* promotes stewardship of natural resources on private property by providing cost-share funding to assist landowner implementation of natural resource management practices in association with the district technical service programs. Eligible practices include heavy animal use protection areas, aquatic area buffer planting, waste storage facilities, and upland wildlife habitat enhancement. Cost-share reimbursement rates for approved projects range from 50% to 90%. The district expects to award 75 new cost-share contracts county-wide in year 2010.

Water quality monitoring and special studies

- The *King County Streams and Rivers Monitoring Program* has monitored six stations in the Bear Creek, Cottage Lake Creek, and Evans Creek since the 1970s. Due to budget constraints, the program eliminated all but one station in Bear-Evans watershed in 2009. The only remaining site is located at the mouth of Bear Creek (O484).

- The *King County Urban Planned Development Monitoring* performed stormwater monitoring during 2008 at the Trilogy and Redmond Ridge Urban Planned Developments. Grab sampling was performed for fecal coliform bacteria (King County, 2008).

- The *City of Redmond's Surface Water Quality Monitoring Program* is flexible, ongoing, and is modified as needed to address special issues across the city. The monitoring program includes six long-term and core sampling stations. The city is presently exploring developing a "stormwater" and structural BMP sampling program.

- The *Redmond Urban Watersheds Initiative (RUWI)* is a collaborative effort between the city, Ecology, and EPA to explore ways to reduce stormwater-related impacts to receiving waters in Redmond. The RUWI studies found that more widespread land-use zones with lower development levels offer the greatest opportunities for reducing the future growth of impervious surfaces, but also concluded that traditional planning and building practices that increase impervious surface will invariably result in more runoff and further declines in water quality (Redmond, 2008). Strategies to improve water quality in the city include maximizing infiltration of clean surface runoff; minimizing creation of new effective impervious surface; and installing key regional stormwater treatment facilities. The city plans to follow-up with a field study of the effectiveness of citywide stormwater BMPs.

Legal authority

- The *King County Water Pollution Code (K.C.C. 9.12)* requires that once an illicit connection to a storm sewer is discovered and confirmed, Stormwater Services (SWS) staff will notify the responsible party of the requirement to eliminate the connection. If the illicit connection is not removed, a formal notice and order with penalties is issued. If there is still no resolution, the county can remove the illicit connection and charge the property owner. SWS inspection staff conduct initial investigations of suspected illicit connections within seven days of receipt per SWS complaint investigation protocols. Once confirmed, the SWS Water Quality Compliance Program administers enforcement for removal of illicit connections. Illicit connections will be prioritized within the county's Water Quality Compliance Manual

as a first-tier priority. This should ensure that an illicit connection will be eliminated within six months of discovery.

PHSKC may be called upon to investigate reported or suspected illicit connections or discharges from facilities that it permits or inspects, such as failing OSSSs. Depending on available resources, staff will investigate within 21 days and, if confirmed, take appropriate enforcement action to eliminate the connection or discharge.

- The *King County Code 9.04 Surface Water Runoff Policy* and the Stormwater Design Manual requires and/or encourages the application of LID BMP techniques on nearly all new development and redevelopment projects that are subject to drainage review. County codes allow, encourage, and require the use of LID BMPs where feasible depending on the development, including specific measures used to minimize the disturbance of soils and vegetation. The Stormwater Design Manual requires use of a minimum amount of LID BMPs on most projects and allows LID BMPs to be used as the sole means of managing stormwater where feasible. The LID BMPs include preserving native vegetation and limiting impervious surface. The grading code limits the amount of clearing that may be done on rural residential-zoned properties. The zoning code prohibits clearing in stream and wetland buffers and limits clearing on steep slopes.

- The *King County's Water Quality Compliance Program* addresses complaints on both residential and commercial property in the unincorporated areas of the county. A water quality complaint hotline and database facilitates the county's Water and Land Resources Division's (WLRD) investigation of all drainage and water quality complaints, unless the complaint falls under another agency's jurisdiction. WLRD requires responsible persons to resolve drainage and water quality problems and/or implement on-site BMPs as outlined in the county's *Storm Water Pollution Control Manual*. WLRD relies on education and technical assistance to gain initial compliance with the Water Pollution (K.C.C.9.12) and Drainage Codes (K.C.C.9.04). WLRD will take enforcement action when there is clear violation of the Water Pollution or Drainage Code.

- The *King County Livestock Management Ordinance* (K.C.C.21A.30) requires that raising and keeping livestock minimize the adverse impacts of livestock on water quality and aquatic habitat in the county's watersheds. In addition, the *King County Zoning Ordinance* (K.C.C.21A.12.122) dictates that the minimum interior setback for any building used to house, confine, or feed swine shall be 90 feet, and for other livestock it shall be 25 feet. Manure storage areas shall be set back at least 35 feet and manure piles must be covered.

- The *King County Critical Area Ordinance (KCCAO)* was updated in 2004. Key elements of the regulations include:
    - 165-foot buffers on all rural lakes, rivers, streams, and marine shorelines that support salmonids. For urban areas and in rural areas for waters that do not support salmonids, the buffers are smaller.
    - Wetland buffers based on Ecology's wetland rating system, which are based on a combination of wetland category, habitat value, and development intensity.

- Limits on the amount of land clearing in rural areas. Vegetation management depends on stormwater requirements.

The KCCAO allows modification of standard aquatic, wetland and wildlife habitat conservation area buffers on properties zoned Rural Area residential when landowners submit an approved *Rural Stewardship Plan* that includes LID strategies.

- The *Public Health Seattle-King County Wastewater Program* has oversight of onsite sewage systems throughout the county in accordance with Chapter 246-272 WAC. PHSKC is responsible for assuring that installed, modified, or repaired OSSS in the county meet State and local regulations. Corrective actions are taken where there is evidence indicating that onsite systems are failing and introducing contaminants into waterways or stormwater systems. When the discharge is not under the direct regulatory oversight of PHSKC, the connection or discharge will be reported to other appropriate authorities.

- The *city of Redmond* initiated a Watershed Management Approach in 2010 to address water quality impairments, salmon recovery, strategize impact mitigation, stormwater engineering, and Western Washington Phase II Municipal Stormwater (NPDES) Permit requirements. Through taking a watershed approach, Redmond strives to go beyond meeting its NPDES requirements by developing a customized stormwater program based on receiving water conditions, contributing area conditions, and hydrologic modeling. Local adoption of watershed plans and implementation plans will be done through council resolution.

- Redmond currently applies new development and redevelopment stormwater management minimum requirements to sites below one acre; conducts private stormwater inspections that include inspection/cleaning of all private infrastructure (including flow/treatment facilities, catch basins, and conveyance) regardless of vintage; adopted local code prohibiting discharges in any stormwater infrastructure (public or private) and receiving waters; adopted local code allowing the city to require structural and non-structural source controls in existing development; and locally regulates NPDES permitted discharges (construction sites, industrial sites).

- *Redmond's Illicit Discharge Detection and Elimination (IDDE)* program will be fully implemented by August 15, 2011 in accordance with the city's NPDES Permit. The IDDE program tracks and maps discharge to any stormwater drainage system, city-wide, and enforces local code (see previous bullet). As part of IDDE investigations, the city already uses IDEXX tests for *E. coli* to detect and track sewage/septic sources, and other in-field tests to track sources of illicit discharges/connections. For example, in April 2009, the city corrected a sanitary line cross-connected to a stormwater catch basin that contributes runoff to Bear Creek.

  The city allows *On-site Stormwater Management/LID* practices for new development and redevelopment. The city's *Clearing, Grading and Stormwater Management Technical Notebook* (Issue 5, January 1, 2007) locally allows on-site stormwater management and credit in stormwater flow/treatment design for use of LID. The city adopted additional zoning requirements for planned residential development to provide incentives for LID techniques in residential projects in the city (Redmond, 2009). The city produced *Private*

Residential Development Guidance, which outlines incentives to incorporate LID concepts into residential developments. The city will measure and track implementation of LID practices by property managers.

Operations and Maintenance Policies and Procedures are in place to reduce fecal coliform bacteria and nutrients in discharges from lands owned or maintained by the city, including parks and road right-of-ways. The city operates a roofed vactor waste/street sweeping Decant Facility, which drains to the sanitary sewer; strategically places Mutt Mitts in parks to control pet waste; and participates in King County's Natural Yard Care Program to minimize nutrients in runoff. The city also established a local building code to require management of solid waste leaching (e.g., covers on dumpsters; floor drains under dumpsters to sanitary sewer). At Farrel-McWhirter Park, where Mackey Creek (tributary to Bear Creek) runs through the park, the city operates a horse arena and a children's animal farm. The city recently installed a manure compost facility, with an active aeration system, at the park. Citizens can pick up fresh compost for their gardens on a donation basis.

Redmond Operations and Maintenance Policies and Procedures have also been implemented to reduce pesticide use in park-maintained properties. Through the use of active management, cultural practices, and resource allocation, the use of pesticide products is being reduced. Practices may include sound plant selection; soil development and aeration; and the application of mulch to assist with plant establishment and inhibition of weed growth.

- The *City of Redmond Shoreline Master Program (Redmond Comprehensive Plan)* protects Class I stream segments, including all portions of Bear Creek and Evans Creek, within the city limits. This updated plan meets, and in some cases exceeds, the requirements of the Washington State Shoreline Management Act (6/2009). The city's updated Shoreline Master Program was adopted and given final approval in September 2009. The city's Critical Areas Ordinance protects riparian buffers on public and private lands up to 200 feet wide on each side of Class I streams.

- The *City of Redmond Wellhead Protection Ordinance (RMC 13.07)* was adopted in 2003 to prevent contamination to the city's drinking water wells that pump water from a shallow unconfined aquifer directly beneath the downtown area and the lower Bear Creek valley. The city encourages infiltration of *clean water* throughout the city, but requires treatment of infiltrating stormwater, and sometimes prohibits infiltration of stormwater, based on proximity to the wells. The ordinance also requires that any sewer leaks or failing OSSS be identified and repaired.

- The *City of Redmond City-wide Tree Protection Ordinance* covers those portions of the Bear Evans watershed that lie within the city limits. This ordinance establishes civil penalties and mitigation requirements for unpermitted removal of significant trees. The ordinance also requires mitigation for the removal of trees that have received the appropriate permit. The goal of the ordinance is to maintain significant trees or increase total tree canopy cover across the city. Tree preservation should ultimately help improve water temperatures in the city by providing shade and micro-climate benefits.

- The *City of Sammamish LID Ordinance* was adopted in 2008 per their Phase II Municipal Stormwater Permit. The city conducted a review of all other Public Works ordinances for requirements that might potentially impede the use of LID and made an effort to override these requirements within the LID Ordinance.

While Ecology is authorized under Chapter 90.48 RCW to issue State orders or take enforcement actions to achieve compliance with State water quality standards, it is the goal of all participants in the Bear-Evans watershed TMDL process to achieve clean water through actions initiated by watershed stakeholders. Adaptive management will be used to assess actions and fine-tune expectations over time. Ecology will consider and may issue notices of noncompliance in accordance with the Regulatory Reform Act in situations where the cause or contribution of cause of noncompliance with LAs or WLAs can be established.

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Conclusions

The Bear-Evans Temperature and Dissolved Oxygen TMDL verified that stream temperatures in the majority of the watershed exceeded the 16° C State water quality criterion, and minimum DO concentrations were lower than the 9.5 mg/L criterion at most sampling locations (Ecology, 2008b). Lakes upstream of Bear Creek and Cottage Lake Creek and wetlands in upper Evans Creek are potential sources of natural warming to watershed streams, but near-stream vegetation cover, channel morphology, and stream hydrology are also important factors that influence stream temperature.

The temperature and DO TMDL prescribes restoring system potential mature riparian shade, increasing infiltration of stormwater, and reducing the amount of effective impervious surface in the watershed. The LA for temperature and dissolved oxygen is the effective shade that would occur from system potential mature riparian vegetation throughout the watershed. The modeled increases in effective shade needed on mainstem Bear Creek range from 4% near Woodinville-Duvall Road to 76% near the confluence of Bear Creek and Cottage Lake Creek.

The Bear-Evans Fecal Coliform Bacteria TMDL set bacteria LAs and WLAs for five different flow ranges at six stations in the watershed. The TMDL determined that needed reductions at the six stations ranged from 57% to 91%. To meet standards near the mouth of Bear Creek, bacteria-loading reductions of 88% are needed (Ecology, 2008a).

Strategies to improve temperature, DO, and fecal coliform bacteria water quality in Bear-Evans watershed include assessing potential riparian planting sites, particularly in high shade-deficient areas, planting native species to provide more shade, and identifying and controlling excess fecal coliform bacteria and nutrient inputs to streams and lakes. Implementing temperature improvement in Bear-Evans watershed will also include protecting cool groundwater inputs to streams and enhancing current summer baseflows.

Implementation actions for temperature, DO, and bacteria include:

- Continue Bear Creek Riparian Restoration Program of small-scale habitat restoration projects in Bear-Evans stream corridors.
- Seek funding for high-priority projects from WRIA 8 Chinook Salmon Conservation Plan that improve habitat and water quality in Bear-Evans and Cottage Lake Creek sub-basins.
- Perform bacteria source detection sampling in the watershed, review data from partners, and track trends in bacteria monitoring in streams.
- Complete major restoration effort on lower Bear Creek in coordination with WSDOT and city of Redmond.
- Assess high risk areas for failing OSSSs and identify and correct them.
- Track and monitor compliance with the King County Livestock ordinance KCC 9.12, and ensure all the escalating enforcement procedures are followed in response to water quality complaints.

- Implement regulations and incentive programs to use LID in new development and re-development projects.

This implementation plan also supports existing programs and projects which assist the goals of these TMDLs such as Bear-Evans Urban/Suburban Enhancement Project; King County Waterways 2000 Program; King County Cottage Lake Creek Habitat Acquisition Program; City of Redmond East Redmond Corridor Master Plan; Collaborative Education in Little Bear; and Bear Creek Basins grant project, and the Green Redmond Partnership.

Funding sources to support implementation include the state Centennial Clean Water Fund and State Revolving Fund; State Salmon Recovery Funds; EPA Environmental Education Grants; and King County's Grant Exchange and Community Salmon Funds.

Given that implementation schedules are maintained, and the elements of this plan are attained, temperature and DO goals for core summer salmonid habitat are expected to be met by 2050. An interim target of compliance with standards for salmonid spawning, rearing, and migration is set for 2025. Compliance with State water quality standards for extraordinary primary contact recreation should be achieved by 2015.

Ecology and other watershed stakeholders will adaptively manage implementation strategies and BMPs when water quality monitoring data show that TMDL targets are not being met or implementation actions are not producing the desired result. Ecology will convene an annual meeting of stakeholders to discuss status of Bear-Evans watershed implementation actions and gauge progress of water quality improvement.

Summary of Public Involvement Methods

Since 2006, Ecology engaged the public and key stakeholders in several ways in the TMDL process to address temperature and DO, as well as fecal coliform bacteria problems in the Bear-Evans watershed. A stakeholder advisory group was formed and met five times from 2006 to 2008 to provide input during the TMDL study developments. Ecology hosted two public meetings for watershed residents to learn about the TMDL efforts.

To prepare this detailed implementation plan, Ecology began working with key Bear-Evans stakeholders in 2009 and continued through 2010 to assess their current and planned programs, activities, and policies that contribute to the TMDL goals. Meetings were held with the cities of Redmond, Woodinville and Sammamish; the Muckleshoot Tribe; KCD; SCD; King County and Snohomish County.

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Appendices

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Appendix A. Description of Implementation Partners

Federal, tribal, and state entities

U.S. Environmental Protection Agency

The 1997 Memorandum of Agreement between the Environmental Protection Agency (EPA), Region 10 and the Washington State Department of Ecology (Ecology) requires that EPA and Ecology jointly evaluate the implementation of total maximum daily loads (TMDLs) in the State of Washington (State). These evaluations address whether interim targets are being met, whether implementation measures such as best management practices (BMPs) have been put into effect, and whether National Pollutant Discharge Elimination System NPDES permits are consistent with TMDL wasteload allocations (WLAs).

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, 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 provides other grant monies (104(b)(3)) to address storm water pollution problems.

Washington State Department of Ecology

EPA delegated authority to Ecology to implement many aspects of the federal CWA. These include the NPDES permitting and the TMDL program. The Cedar-Sammamish-Lake Washington watershed (WRIA 8) is under the jurisdiction of Ecology's Northwest Regional Office (NWRO). To address the municipal permitting needs of this TMDL, the NWRO has one municipal stormwater engineer and three municipal stormwater specialists who provide technical assistance and auditing activities for the Phase I and Phase II municipal stormwater permits across the region. Ecology's headquarters also has several staff that can help identify and distribute education and outreach materials to stormwater permit holders.

Ecology has a water quality improvement lead assigned to the implementation of the Bear-Evans Watershed Temperature/DO TMDL who will assist the stormwater permit holders and other environmental agencies and groups. The NWRO also has 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 may assist in effectiveness monitoring as the TMDL is implemented.

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 managers assist local government in the development of stream restoration and water quality improvement projects.

Ecology will be responsible for organizing meetings of the stakeholders' workgroup annually and will lead additional meetings as requested by the workgroup.

Washington State Department of Transportation

The Washington State Department of Transportation (WSDOT) stormwater and watersheds program provides guidance and technical support to road planning, design, construction, and maintenance of State transportation projects. To achieve compliance with the federal CWA and state water quality laws, WSDOT prepares stormwater pollution prevention plans for major road projects; prepares annual NPDES compliance reports and plans; conducts mitigation stream restoration projects; and monitors water quality.

Since 1995, WSDOT has been regulated under Ecology's Phase I Municipal Stormwater permit. Pursuant to that NPDES permit, in 1997 WSDOT submitted a stormwater management plan (SWMP) to Ecology which identified six elements 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.

Ecology reissued the WSDOT's municipal permit in February 2009 with an effective date of March 4, 2009. WSDOT will actively participate in the TMDL process in cases where WSDOT facilities or operations are identified as important contributing sources to the pollutants being characterized in the TMDL. The current WSDOT's municipal stormwater permit does not include Bear-Evans watershed as an applicable TMDL area. However, Ecology may establish TMDL-related permit requirements based on this implementation plan through future permit modifications, administrative orders, or upon permit reissuance.

An important WSDOT project relating to lower Bear Creek will be the SR 520 widening next to Marymoor Park over the next several years. The *Bear Creek Restoration* project is a partnership between the city and WSDOT to restore the lower portion of Bear Creek that runs alongside SR 520. This partnership was established to manage mitigation of highway impacts to existing stream buffers and wetland areas protected by local, State and federal regulations.

The creek will be moved further away from SR 520 and made more hospitable for salmon and other wildlife. The project will create more than 4,000 feet of enhanced channel, restore natural stream habitat, add logs and spawning gravel, restore streamside wetlands and backwater areas, and restore native trees and shrubs that will shade the channel. WSDOT contributed $8 million to the project recognizing the value to enhance one of our area's most significant salmon-spawning streams. Construction on the project was initiated in the summer of 2009 and is expected to be completed in 2013.

Muckleshoot Indian Tribe

The Muckleshoot Indian Tribe's Usual and Accustomed Area (U&A) was determined in the U.S. Supreme Court case, U.S. v. Washington, for fisheries resources that are culturally and economically important to the Tribe. The U&A covers all or portions of several basins; the Lake Washington/Cedar/Sammamish watershed is one of these basins. The Bear- Evans system is part of the Washington/Cedar/Sammamish watershed. The Muckleshoot Indian Tribe Fisheries Division (MITFD) has an active resource protection staff and may assist in stream restoration and water quality improvement efforts. MITFD staff review permits for all of the

jurisdictions in the TMDL area and will continue to monitor these permits and restoration projects to evaluate whether the TMDL is implemented and not adversely affected by future land actions.

Puget Sound Partnership

In 2007, the State legislature established the Puget Sound Partnership (Partnership) to lead the recovery of Puget Sound to health by 2020. The Partnership replaced the Puget Sound Action Team in coordinating regional efforts to restore and protect the biological health and diversity of Puget Sound by protecting and enhancing Puget Sound's water and sediment quality, its fish and shellfish, and its wetlands and other habitats.

In 2008, the Partnership produced the 2020 Action Agenda that established science-based goals to achieve recovery and protection. The 2020 Action Agenda addresses habitat protection; toxic contamination; pathogen and nutrient pollution; stormwater runoff; water supply; ecosystem biodiversity; species recovery; and capacity for action.

The Partnership is working with tribal and local governments, community groups, citizens and businesses, and State and federal agencies to develop and carry out the Action Agenda. Seven geographic action areas were established around the Sound to address and tackle problems specific to those areas. Bear-Evans watershed of WRIA 8 is within the South Central Puget Sound Action Area.

The former Puget Sound Action Team provided important leadership in promoting low impact development (LID), an innovative approach to new development and redevelopment to prevent and better manage stormwater runoff.

WRIA 8 Cedar-Sammamish-Lake Washington Salmon Recovery Council

The WRIA 8 Salmon Recovery Council (SRC) is comprised of representatives of 27 local governments, businesses, community groups, and State and federal agencies that have worked together since 2000 to protect and restore salmon habitat. King and Snohomish Counties, and 25 cities in the watershed pooled resources to develop the *WRIA 8 Chinook Salmon Conservation Plan* which was ratified by all 27 jurisdictions in 2005 and approved by NOAA Fisheries as part of the Puget Sound Chinook Conservation Plan in 2007. The same jurisdictions now fund a small team to coordinate the implementation of the Puget Sound Chinook Conservation Plan.

In a mostly urban King County, Bear-Evans watershed is among the most important basins for salmon habitat. In the WRIA 8 Chinook Salmon Conservation Plan, many of the planned stream restoration projects can help improve water quality in the basin streams. Among their highest priority salmon restoration projects for Bear Creek and the WRIA 8 watershed is the Lower Bear Creek Restoration. The project will provide an enhanced channel alternative to the ditched and levied lower 3,000 feet of Bear Creek, including a new refuge confluence with the Sammamish River; add large woody debris; and restore riparian conditions.

Local governments participating in the WRIA 8 Chinook Salmon Conservation Plan are engaged in a number of actions to help salmon recovery in the watershed. Some of these actions relate to public education and outreach. In 2009, WRIA 8 conducted a gap analysis research to identify

current actions in WRIA 8 related to education and outreach (Sage Enviro, 2009). Many of the recommendations from the research are indicated as actions in this TMDL plan for WRIA 8 Salmon Recovery Council.

Local government resources

King County

King County is the most populated county in the State with the majority living in the county's 39 cities. The unincorporated portion covers 82% of the county land area (in 2007) but urban annexations are planned to expand urban growth areas over the next few years. The population forecast is that the county is expected to grow by an additional 15% by 2022 (PHSKC, 2007).

The *Department of Natural Resources and Parks (DNRP)*, through the Water and Land Resources Division (WLRD), has programs in watershed and natural resource stewardship, noxious weed control, and water quality monitoring. WLRD coordinates the Stormwater Management Program in accordance with the county's Phase I Municipal Stormwater Permit (Ecology, 2007a), which includes public involvement, structural stormwater control, and public education. WLRD also has a significant role in the county's source control, IDDE, and operations and maintenance programs.

- The *Stormwater Management Program (SWMP)* covers stormwater management in unincorporated King County and on county facilities located in other jurisdictions. The county updated their *Stormwater Pollution Prevention Manual* (SPPM) in 2009. The manual applies to those residential, commercial, industrial, governmental and agricultural activities in unincorporated King County that have potential to contribute to pollutants to stormwater runoff or directly to receiving waters. The manual includes BMPs on storage or processing of food items and storage of solid waste and food wastes (including Cooking Grease).

- The *Livestock Program* promotes proper livestock management practices and financially assists agricultural landowners with BMP implementation. Some of these BMPs include stream and wetland buffer fencing; native re-vegetation; manure storage structures; heavy use area protection; pasture restoration; roof runoff management; etc. The program implements the county's 1993 Livestock Management Ordinance (LMO), which supports the raising and keeping of livestock in a manner that minimizes the adverse impacts of livestock on water quality and salmonid fisheries habitat in King County watersheds. Proper management of manure will help reduce nutrient pollution in nearby streams. The LMO recommends the implementation of farm plans on those farms with livestock. The county provides cost-share funding for farm plan implementation, in concert with KCD.

- The *Regional Inflow and Infiltration (I&I) Program* within the Wastewater Treatment Division works with local sewer agencies to reduce the amount of peak wet weather flow entering the county's wastewater conveyance system. Reduction of I&I in the system has the potential to lower the risk of sanitary sewer overflows and decrease the costs of conveying and treating wastewater. It also leaves more ground water in shallow aquifers to assist stream baseflows.

The permitting agency for unincorporated King County is the *Department of Development and Environmental Services (DDES)*. DDES receives applications for development permits and reviews all stormwater site plans submitted. They are responsible for ensuring the county's *Surface Water Design Manual* requirements are applied to new development and redevelopment sites through inspections and permitting. The *Drainage Review* may be required by different DDES permits such as the grading permit process and these drainage reviews have a robust downstream analysis to show bacteria water quality impairment. DDES code enforcement officers investigate complaints of irresponsible or hazardous development that are also violations of King County Code, including zoning, housing and building, shorelines, and critical areas ordinances.

Snohomish County

Snohomish County has several departments that can affect the overall water quality in the upper Bear Creek sub-basin. 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.

- The *Surface Water Management* division of Public Works is involved in a wide range of water pollution control activities including education; water quality monitoring; riparian restoration; salmon recovery; native plant salvaging; and Phase I Municipal Stormwater Permit (Ecology, 2007a) administration. Education is conducted through targeted programs as well as through the activities of Watershed Stewards. Surface Water Management also provides funding for and coordinates with the SCD. Water quality is tracked through comprehensive ambient stream monitoring, targeted source identification, and illicit discharge monitoring.

  Surface Water Management conducts a number of grant-funded programs. The Animal Waste Control Project, which ended on March 1, 2008, researched the problem of pet waste management at the residential and commercial level. The Stormwater Management Project is studying how to maximize Native Growth Protection Areas for removal of pollutants in stormwater, and how to perform low-cost stormwater capture and treatment in residential neighborhoods. Surface Water Management is working with Snohomish Health District through an onsite system grant project to merge the Health District on-site 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 landowner training to ensure proper system operation and maintenance.

  Surface Water Management also implements continuous temperature monitoring across unincorporated Snohomish County. In 2009 and 2010, Snohomish County Surface Water Management placed temperature loggers in Bear Creek within the Paradise Valley Conservation Area. The loggers were deployed to help determine the effectiveness of the Critical Areas monitoring program.

- The *Solid Waste Management* division of Public Works has programs that affect both pet waste and livestock waste management issues. In collaboration with Surface Water Management, Solid Waste developed a brochure for county pet owners on how to best manage pet wastes.

- *Snohomish County Planning and Development Services (PDS)* develops and administers county development regulations for land use approvals and development permits. These regulations include environmental review under the State Environmental Policy Act (SEPA), critical area regulations, drainage, and grading. Effective September 30, 2010, new stormwater and land-disturbing activity (clearing and grading) regulations and rules (Snohomish County Drainage Manual and Engineering Design and Development Standards) went into effect pursuant to the county's Phase 1 Municipal Stormwater Permit. These regulations contain more stringent requirements to prevent, reduce, minimize, and treat stormwater impacts. The regulations have been upgraded to facilitate the use of LID BMPs and feasibility criteria. Together with Chapter 7.53 SCC (Water Pollution Control), these regulations protect water quality in Snohomish County. PDS enforces water quality violations under 7.53SCC.

  PDS works with the agricultural community through its agricultural liaison and the Agricultural Advisory Board. PDS promotes LID principles and supports the Sustainable Development Task Force, a public/private partnership that promotes wise use of building materials, energy efficiency, and the reduction of stormwater.

- *Snohomish County Parks and Recreation Department* oversees over 9,000 acres of public land for recreation and conservation, and works with other parts of county government to manage county lands, administer educational programs, and develop and maintain park facilities. Snohomish County, King County, and Cascade Land Conservancy secured funding in 2000 to purchase over 600 acres, now considered the Paradise Valley Conservation Area. Recent new acquisitions increased the conservation area to 789 acres. County Parks intends to use the Paradise Valley Conservation Area as a public educational interpretive center. Culvert replacement projects are also planned for publicly-owned areas of Meadow and Bear Creek Lanes, where existing drainage systems restrict Bear Creek under high flow conditions, creating downstream scour and water quality degradation.

Northeast Sammamish Sewer and Water District (NESSWD)

NESSWD serves mostly the city of Sammamish with two water customers in unincorporated King County, providing water for over 10,000 people and sewer service for 15,000 people east of Lake Sammamish. NESSWD receives its water entirely from groundwater sources located beneath the Sammamish Plateau and Evans Creek valley. They operate and manage five wells and two reservoirs in the area. Sewer facilities are located throughout the district.

NESSWD is committed to operate, maintain, and repair the water and sewer systems in a manner that does not adversely affect the environment. The district follows BMPs specifically designed to avoid or reduce impacts to aquatic habitat that might otherwise occur in the course of activities associated with the routine operation, replacement, and maintenance of sewer and water facilities. Additionally, the district participates in the following activities.

- The *Redmond-Bear Creek Valley Groundwater Management Plan*, which contains strategies to address the potential threats to groundwater quality and quantity in region. NESSWD developed the plan in partnership with King County and other local entities.

- *Local streams monitoring* by the NESSWD, which includes maintaining a groundwater, surface water, and atmospheric monitoring network in the Bear/Evans system. When the district constructs facilities near a stream, monitoring devices are placed in the stream to measure water quality. This ensures that construction run-off is carefully monitored and controlled. The district also collects rain data, which is used to study interactions between water systems operations and the local aquatic system. The district monitors temperature along Evans Creek for good stewardship and to detect if their construction of new facilities impacts temperature. In addition, in partnership with King County, the district provides real-time air temperature, water temperature, water level, and flow data for Evans Creek on its web site.

- The *King County's Inflow and Infiltration (I&I) Program*, which allows the district to maintain a very low level of I&I (or excess water that enters the sewer system unnecessarily). This means a lower amount of I&I enters the sewer system, therefore a greater amount of water remains in the local ecosystem. This is important for stream quantity, quality and fish habitat, as well as for the district's wells. Ground water recharges the district's wells, which allows the district to continue to provide high quality water to its customers.

Union Hill Water Association

Union Hill Water Association (Association) is a private, non-profit utility located in the rural area east of the city of Redmond. Homes in the Association's service area do not have sewer service and utilize on-site septic systems (OSSSs). The Association receives its water entirely from groundwater sources located in the Evans Creek Valley, and has two production wells serving approximately 6,700 people.

The Association promotes the protection of the environment, participates in the Redmond-Bear Creek Groundwater Management Plan, and is actively monitoring local ground and surface waters.

Woodinville Water and Sewer District

The Woodinville Water and Sewer District strives to provide (1) safe and reliable service to all their customers at an economical cost, (2) potable drinking water to all customers of the district, and (3) sanitary sewer service to all customers requesting service and who are located within the urban growth area. The district educates customers in the efficient use of water and safe disposal of wastewater. The district presently is the fifth largest district in King County, serving approximately 13,300 water customers and 2,500 sewer customers. Future predictions state that there may be 25,000 sewer and water connections by the year 2020.

City of Redmond

The city of Redmond is the seventh most populous city in King County, WA, (50,700 in 2007) and covers about 16.9 square miles. In 1963, the Evergreen Point Floating Bridge (SR 520) was completed, spanning Lake Washington and connecting Seattle to the eastside of the lake. This transportation corridor and the availability of relatively inexpensive land led to major land use

changes over the past 40 years. The city grew from a largely agricultural community to a highly developed residential and commercial community.

Redmond has been an active partner in improving water quality in the Bear-Evans watershed. The city accomplished numerous stream restoration projects identified in the Bear Creek Restoration Plan (King County, 1990) and the 2005 WRIA 8 Chinook Salmon Conservation Plan. All city-funded riparian restoration projects include a maintenance plan for invasive plant removal and supplemental planting of native species.

Redmond has been recognized as a *Tree City USA* for the past ten years. This program, sponsored by the National Arbor Day Foundation, recognizes a city's commitment to tree health, care, and protection. Annual recertification is required to maintain this designation.

Redmond's on-going public outreach program includes messages on stormwater runoff; pet waste control; natural yard care/fertilizer use; landscaping/buffers; street car washing; low impact development; and illicit discharges. The city's surface water quality monitoring program is flexible, ongoing, and is modified as needed to address special issues across the city. The monitoring program includes six long-term and core sampling stations. The city is presently exploring development of a stormwater and structural BMP sampling program.

In 2010 Redmond initiated a watershed approach to address water quality impairments, salmon habitat, and other issues within its jurisdiction. Through its Watershed Approach and Stormwater Management Program, the city strives to go beyond meeting its NPDES requirements by applying new development and redevelopment requirements below the one acre threshold; a private stormwater inspection program that inspects all private infrastructure (not just WQ/flow controls built to 2005 standards); regulation of pollution in stormwater/surface water citywide (not just public storm system); and more.

City of Sammamish

Located partially in the upper Evans Creek sub-basin, the city of Sammamish was incorporated in August 1999. Characterized predominantly by a suburban residential development, the city supports two primary commercial centers. As of January 2003, the city owned and operated 39.5 acres of developed park properties. In 2000, the city purchased the Evans Creek Preserve, a 178-acre property off of Highway 202, just north of the city limits. The preserve includes a variety of habitats including wetland, riparian and forested upland. There are several historical buildings and some areas overgrown with invasive plants. The city is currently developing its stormwater management program under the Phase II Municipal Stormwater Permit.

The city of Sammamish offers a yearly rain barrel sale to make barrels available to city residents at a reduced cost. The city also coordinates storm drain stenciling through volunteer programs.

City of Woodinville

The city of Woodinville has a population of about 9,194 in 2000 and covers a total area of 5.7 square miles. Portions of the city are in the upper Bear Creek sub-basin, primarily draining to Cold Creek, a tributary to Cottage Lake Creek. Cold Creek is a King County Class 2 stream which provides essential cool waters to the Cottage Lake Creek and Bear Creek system, especially in the critical summer and fall months.

The city's *Sammamish ReLeaf Project* is an annual volunteer event to engage citizens in restoring native habitat along the Sammamish River Trail by removing non-native invasive plants, debris transport to onsite bins and mulching cleared areas.

Woodinville plans to revise its tree ordinance to include a city-wide goal for achieving at least 40% tree coverage. In 2007 to 2008, the Woodinville community created a citizen advisory panel on sustainable development. A major goal of the city is to preserve vegetation and tree canopy.

Cascade Water Alliance

Cascade Water Alliance is an association of eight cities and water districts in the Puget Sound region, working together to supply water to meet the needs of its members in a cost-effective and environmentally sensitive manner. The Interlocal Contract that established Cascade in 1999 (amended) gives it the responsibility to:

- Purchase wholesale water from other regional suppliers.
- Coordinate conservation and supply management.
- Acquire, construct and manage water supply infrastructure.
- Foster regional water planning that provides adequate water for both people and fish.

Cascade is undertaking a coordinated water system plan with King County that will address water supply alternatives such as Lake Tapps. Cascade will begin planning the treatment and transmission facilities necessary to utilize Lake Tapps as a regional municipal water supply following the successful acquisition of properties, facilities, and water rights from Puget Sound Energy (Puget), the current lake owner and operator.

Snohomish Conservation District (SCD)

The SCD is a non-regulatory public agency that is a sub-unit of the State, created under RCW Chapter 89-08. The district assists residents with natural resource issues such as stream and wetland enhancement and restoration; water quality improvements; wildlife habitat enhancement; natural resource protection; and farm planning. Low-impact development and forestry issues are other areas where residents can receive technical assistance. The SCD annually hosts a conservation plant sale, workshops and tours, and participates in local and regional outreach events. The district can often assist residents with engineering designs and a cost-share program to help fund water quality improvements such as livestock fencing on streams; off-stream watering; manure management; sacrifice areas; roof runoff structures; and riparian corridor improvement. In addition, residents with livestock can receive advice on controlling noxious weeds, soil testing and pasture improvements.

In partnership with King Conservation District, SCD developed a targeted collaborative watershed education project to deliver technical information through workshops and on-site farm planning services. Targeted water quality monitoring will assess potential hot spots for fecal coliform bacteria. The project will be funded by Ecology's Centennial Grant program. The SCD web site can be found at http://snohomishcd.org/

King Conservation District (KCD)

The KCD is a non-regulatory municipal public agency created under Chapter 89 RCW that administers programs to conserve the natural resources of King County. KCD efforts focus on individual contact with farm owners and residents within all of King County. The goal of the district is to promote practices that maximize productive land use while conserving natural resources and protecting water quality through education, funding assistance, and cooperation.

KCD advises landowners on the implementation of BMPs to protect water quality and fish and wildlife habitat, and designs and installs stream enhancement projects. KCD holds classes, conducts farm tours, and provides financial assistance. KCD will partner with Snohomish CD on a Centennial Clean Water grant project focused on targeted collaborative watershed education.

Through the development of farm plans, KCD advises farm owners on practices that help improve water quality and protect fish and wildlife habitat. Such BMPs include proper animal waste management, streamside and wetland planting, and livestock fencing. The KCD also financially assists land owners through grants and cost-share funding for water quality-related farm practice improvements. The KCD developed approximately 59 small farm plans within the Bear-Evans watershed over the last 10 years. The more recent planning efforts address water quality concerns on these farms.

In addition, KCD awards grants for natural resource improvement projects in partnership with 35 cities and three watershed forums in King County. In 2009 the KCD, in partnership with the Lake Washington-Cedar-Sammamish Forum (WRIA 8), awarded a grant to Adopt-a-Stream Foundation to perform outreach and riparian restoration on private properties through 2012. In addition to this grant, KCD funded three WRIA 8 grants to King County to work with landowners to implement riparian restoration on properties along Cottage Lake Creek through 2014.

Snohomish Health District (SHD)

The Environmental Health Division of the SHD issues Solid Waste Permits for solid waste disposal sites and handling facilities in Snohomish County, provides regulatory oversight for the OSSS program, and investigates (and may take enforcement action related to) sewage discharge complaints. The SHD is responsible for investigating complaints of failed OSSS and requiring corrective measures such as OSSS maintenance, renovation, or hook-up to sewer systems where available. Unreported failing OSSSs have the potential to create a localized health threat as well as contribute to nutrient pollution in local surface waters.

In addition to certifying on-site system installers and licensing OSSS pumpers, the SHD educates homeowners on the proper operation and maintenance of OSSS. Ongoing implementation of such programs will help reduce future failures and prepare homeowners to recognize existing problems that may contribute to bacterial and nutrient pollution problems in upper Bear Creek.

Public Health Seattle-King County (PHSKC)

PHSKC enforces rules adopted by the Washington State Board of Health, including rules necessary to assure safe and reliable public drinking water and protect public health. PHSKC is

responsible for assuring that installed, modified, or repaired OSSS in King County meet State and local regulations. PHSKC is fee-funded and staffing, therefore, is geared primarily toward processing permit applications. There is little funding available to proactively find and properly correct failing OSSS throughout the county.

The ***Wastewater Program*** has oversight of OSSS throughout King County in accordance with Chapter 246-272 WAC. PHSKC requires pumpers and installers of OSSS to be county-certified. Staff of the Wastewater Program issue installation and repair permits for OSSS; investigate sewage complaints for OSSS; educate homeowners; and conduct enforcement. Corrective actions are taken where there is evidence indicating failing OSSS or illicit connections are putting contaminants into stormwater systems.

Currently, King County uses three methods to determine whether OSSS is functioning appropriately:

- Inspect permitted repairs.
- O&M reports submitted by professional inspectors.
- Complaints from third party (including citizens) about failing systems.

In addition, PHSKC regulates and inspects a variety of businesses (including restaurants) throughout the county and can identify and report potential illicit discharges or connections to the stormwater system. A program is being developed which will ensure these reports are forwarded to the appropriate agencies and the PHSKC staff are trained to recognize existing or potential illicit connections or illicit discharges. When the discharge is not under the direct regulatory oversight of PHSKC, the connection or discharge will be reported to the appropriate authority. Likewise, PHSKC may be called upon by King County DNRP's Stormwater Services staff to investigate reported or suspected illicit connections or discharges from facilities that it permits or inspects.

King County's Department of Development and Environmental Services (DDES) building applications and the PHSKC's OSSS permitting process allow for cross-agency checks and balances. Building applications or plans are submitted to DDES and are reviewed for ordinances and compliance related to critical and flood areas and other sensitive area issues.

In recent years, as required by legislature, PHSKC has placed a high priority on finding and correcting failing OSSS in Marine Recovery Areas (MRA), e.g., shellfish growing areas, bordering Puget Sound. In 2007, PHSKC developed the King County On-Site Septic System Management Plan (PHSKC, 2007) to address potential public health threat from OSSS in these MRAs. Future state funding commitments will be used primarily to help build systems or processes to assure that OSSS are monitored in MRAs. There are no MRAs in the Bear-Evans watershed. However, what is learned from activities implemented in MRAs can be expanded to other watersheds as funding allows.

Nonprofit and volunteer organizations

Bear Creek Water Tenders

Bear Creek Water Tenders is a very active group of people who care about the wetlands and streams in the Bear Creek watershed. They volunteer their time to preserve, protect, and restore

the wonderful natural heritage within Bear-Evans watershed. Water Tenders has existed since 1989 and has accomplished many activities including monitoring, salvaging native plants, removing non-native plants, adopting park conservation lands, community outreach, basin newsletter, and watershed advocacy. Ecology regularly reports progress to Water Tenders on Bear-Evans watershed TMDLs and receives valuable input and direction from the group. For information on how you can get involved visit their web site at www.watertenders.org.

Adopt-A-Stream Foundation (AASF)

AASF is a non-profit organization based in south Everett, Washington. Created in 1981, AASF's mission is to increase public awareness of the importance of the 3,000 miles of creeks, streams and rivers and fish in Snohomish County and to restore to health to those waterways damaged by people or nature.

AASF carries out its mission by producing and distributing environmental education materials nationally and internationally, conducting S*treamkeeper Academy*™ events for school and community groups throughout the Pacific Northwest, and providing local communities with stream and wetland restoration assistance. In addition, AASF is developing the Northwest Stream Center, a regional environmental learning facility that has stream and wetland ecology and fish and wildlife habitat as its central themes. AASF's long-term goal is to stimulate everyone to become a *Streamkeeper*™, taking actions necessary to protect and enhance their home watersheds.

In 2004, AASF conducted a culvert fish barrier and pollution identification survey in the Bear-Evans watershed, funded through a Centennial Grant from Ecology. They spent considerable effort educating citizens on the water quality, habitat, and fish passage requirements that salmonids need to achieve optimum survival. Interactions with residents revealed that many streamside residents are misinformed or lack knowledge regarding the salmon lifecycle and their habitat needs (AASF, 2004). Staff distributed several educational pamphlets. Their most effective outreach occurred when AASF field crews took the time to answer specific questions from streamside residents. Questions covered ways to address stream problems such as stream bank erosion, native riparian vegetation planting, flooding/drainage issues, and habitat creation for fish and wildlife.

For more information on how you can get involved visit their website at www.streamkeeper.org/foundation.htm.

Stewardship Partners

Stewardship Partners helps private landowners restore and preserve the natural landscapes of the State. They promote and implement incentive-based programs that encourage landowners to participate in fish and wildlife conservation and restoration activities while simultaneously meeting their economic needs through sustainable land management. They implement the Salmon-Safe program to ensure property owners and managers use the BMPs to avoid harm, and where appropriate, enhance and restore the health of stream ecosystems. Stewardship Partners offers this third-party certification program with established standards to farms, corporate and university campuses, residential development, and recently expanded it to golf courses.

In 2009, Stewardship Partners completed a *Pilot Salmon Safe Certification Standards for Golf Courses* as a guide for golf course owners and superintendents interested in designing, constructing, operating and managing golf courses in a manner that protects watersheds and enhances fish and wildlife habitat. The standards involve six key stewardship management categories that are in concert with the TMDL strategies:

1. Instream habitat protection and restoration.
2. Riparian, wetland, and locally significant vegetation protection and restoration.
3. Stormwater management.
4. Water use management (irrigation activities).
5. Erosion prevention and sediment control.
6. Chemical and nutrient containment.

Stewardship Partners completed the pilot salmon-safe certification for the following golf courses outside of the Bear-Evans watershed: Salish Cliffs, Meadow Park, and Glendale.

For more information visit: http://stewardshippartners.org.

Cascade Land Conservancy (CLC)

CLC Conservation Program conserves land in the central Puget Sound region, including King, Kittitas, Snohomish, Pierce, and Mason counties. In King County, the CLC negotiated to protect 99,657 acres. The CLC also has a Green Cities Partnership program which develops public-private partnerships with municipalities to develop community-based stewardship programs for forested parklands and natural open spaces.

In 2008, CLC initiated, with the city of Redmond, the Green Redmond Partnership. A strategic plan, published in spring 2009, lays out a 20-year timeline for restoring the urban forests. The partnership helps trains volunteer citizens to be Forest Stewards who are interested in being highly involved in planning and coordinating restoration on their local park. They receive special training and resources, so no experience is necessary. Program staff works with each Steward to create a restoration plan for their site and provide resources for Stewards to organize volunteer events to carry out the restoration.

Washington Water Trust (WWT)

WWT is a private, nonprofit organization established in 1998 to restore instream flows in Washington's rivers and streams. WWT works to benefit water quality, fisheries and recreation in Washington's rivers and streams by acquiring existing water rights from willing sellers through purchase, lease or gift.

WWT works cooperatively with farmers, ranchers, irrigation districts, tribes, public agencies, land trusts and other nongovernmental organizations to accomplish its stream restoration goals. The water trust works on small streams and tributaries where returning a small amount of water to the stream can have significant benefits. For more information, visit www.thewatertrust.org.

Friends of Cottage Lake (FOCL)

The FOCL is a grass-roots non-profit community organization committed to improving and defending the health and continued enjoyment of Cottage Lake and its environs. FOCL consists

of residents who live on or near Cottage Lake. They are currently involved in efforts to reduce nutrients in Cottage Lake as part of Cottage Lake Phosphorous TMDL (Ecology, 2007c). FOCL maintains a web site and publishes a newsletter to promote community outreach and education on water quality and other issues. You can learn more about their efforts to protect the water quality of Cottage Lake and its surrounding watershed by visiting http://friendsofcottagelake.org.

Upper Bear Creek Community Council

The purpose of the council is to inform, assist, and represent the community in dealing with King County government and other entities with respect to issues that affect the community. King County recognized the council as the unincorporated area council serving the Upper Bear Creek area. The council is a volunteer organization with an elected board. Residents are welcome and encouraged to participate by visiting www.upperbearcreek.com.

King County Executive Horse Council (KCEHC)

The KCEHC supports the horse industry and equestrian way of life by advocating for the protection and creation of equestrian trails and facilities. They are the official horse advisors to government and developers. The KCEHC promoted the creation of a trail ordinance, equestrian overlays, and trail language for comprehensive and community plans. They inventoried trails for community plans and developed educational brochures. The KCEHC publishes the Equestrian Trail Guide for King County and three brochures: *Share the Road with Horses*, *Basic Horse Management*, and *Trail Etiquette, Safety and Equipment.*

Horses for Clean Water (HFCW)

For the past ten years, HFCW has offered horse owners ways to care for horses that benefit the animals, the farm, the owner, the community, and the environment. They actively educate horse owners through classroom series, workshops, farm tours, and educational material development. Educational outreach is also achieved through partnerships between HFCW and many different conservation districts, natural resource agencies, extension offices, environmental groups, horse organizations and other equine professionals.

Educational presentations are done on mud management, manure management, pasture management, and naturescaping for horse farms. Also covered in these presentations are topics including composting manure; fencing; dust control; weed management; equine nutrition; seed choices; naturescaping on horse farms; and insect control. HFCW produces a monthly electronic newsletter, *The Green Horse*, which covers a variety of topics on horse management while encouraging a sustainable lifestyle. T*he Green Horse* is sent electronically to over 800 subscribers and is also available on their web site at www.horsesforcleanwater.com/index.html.

HFCW is funded by grants and contracts from different funding agencies and through individual consultations and sponsorship donations. Sponsorships allow HFCW to extend its educational outreach and to increase environmental and horse health awareness.

Local Businesses

Local businesses are responsible for taking actions to prevent pollution their activities may generate. In turn, local businesses can be partners in increasing public awareness on the local water quality issues in Bear Creek and Evans Creek. Private industries that rely on groundwater

sources or surface water withdrawals for irrigation, such as nurseries and golf courses, are encouraged to use stormwater BMPs and to consider alternative water sources to improve baseflow conditions to the streams.

Local Citizens

Local citizens play a critical role in improving the water quality of Bear Creek and Evans Creek. Many citizens can have an immediate impact on local water quality by doing certain tasks differently. By properly disposing of pet wastes and avoiding the addition of grass clippings or any other foreign substance to neighboring creeks bacteria and nutrient levels can be reduced. Local citizens can also get involved in stream rehabilitation, communicate their interest in the environment to local elected officials, and educate others on how to improve water quality in Bear-Evans watershed.

Property owners can take it upon themselves to enhance streamside riparian vegetation, minimize runoff of nonpoint sources of pollution from their yards, and repair of leaky OSSS.

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Appendix B. Tables of 303(d)-listings & TMDL Allocations

Table B-1. Streams in the Bear-Evans watershed on the 2004 303(d)-list for fecal coliform bacteria.

Water body/Station ID		Listing ID	Parameter	Water body ID	Township	Range	Section
Cottage Lake Creek	N484	13147	Fecal coliform	NO74J5	26N	06E	18
Bear Creek (upper)	J484	13146	Fecal coliform	EW54VY	26N	06E	30
Unnamed tributary	35	42154	Fecal coliform	EU47RU	26N	06E	30
Bear Creek (mid)	C484	13144	Fecal coliform	BA64JJ	25N	06E	06
Evans Creek (upper)	S484	13148	Fecal coliform	MI67EG	25N	06E	16
Evans Creek (lower)	B484	13142	Fecal coliform	MI67EG	25N	06E	07
Bear Creek (mouth)	O484	13133	Fecal coliform	WR69YU	25N	05E	12

Table B-2 (a-c). Daily LAs and WLAs for stations in the Bear Creek Sub-Basin: Cottage Lake Creek (N484), Upper Bear Creek (J484), and Mid Bear Creek (C484).

[a] Cottage Lake Creek (Above Station N484)
Targets a 76% reduction in current bacteria loadings.

			Fecal Coliform Bacteria Loadings (billion colonies per day)				
			High flows	**Moist flows**	**Mid-range flows**	**Dry flows**	**Low flows**
TMDL (Loading Capacity Targets)		100%	**51.20**	**25.60**	**16.40**	**9.18**	**5.90**
		Allocations (%)					
MOS		10%	5.12	2.56	1.64	0.92	0.59
LA		51.53%	26.40	13.20	8.47	4.73	3.04
WLAs	**Woodinville**	6.51%	3.34	1.67	1.07	0.60	0.38
	King Co.	17.82%	9.13	4.56	2.93	1.63	1.05
	Snohomish Co.	13.07%	6.70	3.35	2.15	1.20	0.77
	WSDOT	1.13%	0.58	0.29	0.19	0.10	0.07

[b] Upper Bear Creek (Above Station J484)
Targets a 57% reduction in current bacteria loadings.

			Fecal Coliform Bacteria Loadings (billion colonies per day)				
			High flows	**Moist flows**	**Mid-range flows**	**Dry flows**	**Low flows**
TMDL (Loading Capacity Targets)		100%	110.00	46.70	25.30	13.00	7.40
		Allocations (%)					
MOS		10%	11.00	4.67	2.53	1.30	0.74
LA		56.19%	62.00	26.30	14.20	7.28	4.16
WLAs	**King Co.**	27.43%	30.02	12.80	6.94	3.55	2.03
	Snohomish Co.	6.38%	7.03	2.98	1.61	0.83	0.47

[c] Mid Bear Creek (Above Station C484)
Targets a 78% reduction in current bacteria loadings.

			Fecal Coliform Bacteria Loadings (billion colonies per day)				
			High flows	**Moist flows**	**Mid-range flows**	**Dry flows**	**Low flows**
TMDL (Loading Capacity Targets)		100%	197.00	87.80	46.00	24.50	15.20
		Allocations (%)					
MOS		10%	19.7	8.78	4.60	2.45	1.52
LA		70.76%	139.00	62.00	32.60	17.30	10.70
WLAs	**Redmond**	1.52%	2.99	1.34	0.70	0.37	0.23
	Woodinville	1.14%	2.25	1.00	0.53	0.28	0.17
	King Co.	13.20%	25.90	11.60	6.08	3.24	2.00
	Snohomish Co.	3.27%	6.44	2.87	1.51	0.80	0.50
	WSDOT	0.10%	0.20	0.09	0.05	0.03	0.02

Table B-3. Daily LAs and WLAs set at stations in Evans Creek Sub-Basin: Upper Evans Creek (S484) and Lower Evans Creek (B484).

[a] Upper Evans Creek (Above Station S484)
Targets a 91% reduction in current bacteria loadings.

			Fecal Coliform Bacteria Loadings (billion colonies per day)				
			High flows	**Moist flows**	**Mid-range flows**	**Dry flows**	**Low flows**
TMDL (Loading Capacity Targets) 100%			33.70	15.00	8.02	4.02	2.33
		Allocations (%)					
MOS		10%	3.37	1.50	0.80	0.40	0.23
LA		79.36%	26.72	11.88	6.37	3.19	1.85
WLAs	**Sammamish**	4.87%	1.64	0.73	0.39	0.20	0.11
	King Co.	5.61%	1.89	0.84	0.45	0.23	0.13
	WSDOT	0.14%	0.05	0.02	0.01	0.006	0.003

[b] Lower Evans Creek (Above Station B484)
Targets a 63% reduction in current bacteria loadings.

			Fecal Coliform Bacteria Loadings (billion colonies per day)				
			High flows	**Moist flows**	**Mid-range flows**	**Dry flows**	**Low flows**
TMDL (Loading Capacity Targets) 100%			68.50	30.80	16.60	8.26	4.77
		Allocations (%)					
MOS		10%	6.85	3.08	1.66	0.83	0.48
LA		82.10%	56.27	25.32	13.65	6.78	3.92
WLAs	**Redmond**	0.77%	0.53	0.24	0.13	0.06	0.04
	Sammamish	2.63%	1.80	0.81	0.44	0.22	0.13
	King Co.	4.43%	3.03	1.37	0.74	0.37	0.21
	WSDOT	0.06%	0.04	0.02	0.01	0.005	0.003

Table B-4. Daily LAs and WLAs set at Bear Creek near the mouth (O484).

Bear Creek near mouth (Above Station O484)
Targets an 88% reduction in current bacteria loadings.

			Fecal Coliform Bacteria Loadings (billion colonies per day)				
			High flows	**Moist flows**	**Mid-range flows**	**Dry flows**	**Low flows**
TMDL (Loading Capacity Targets)		100%	268.00	120.00	62.80	33.00	20.80
		Allocations (%)					
MOS		10%	26.80	12.00	6.28	3.30	2.08
LA		20.48%	54.87	24.52	12.86	6.77	4.26
WLAs	**Redmond**	9.24%	24.75	11.06	5.80	3.05	1.92
	Sammamish	7.50%	20.10	8.98	4.71	2.48	1.56
	Woodinville	2.56%	6.86	3.07	1.61	0.85	0.53
	King Co.	42.26%	113.23	50.60	26.55	13.96	8.79
	Snohomish Co.	7.41%	19.85	8.87	4.65	2.45	1.54
	WSDOT	0.55%	1.47	0.66	0.34	0.18	0.11

Table B-5. Streams in the Bear-Evans watershed on the 2008 303(d)-list for temperature and DO.

Water Body (monitoring station)*	Listing ID	Parameter	Waterbody ID	Township	Range	Section
Bear Creek (KC O484)	4804	Temperature	WR69YO	25N	05E	12
Bear Creek (KC C484)	4811	Temperature	BA64JJ	25N	06E	06
Bear Creek (KC J484)	42095	Temperature	EW54VY	25N	06E	31
Bear Creek (KC J484)	4813	Temperature	EW54VY	26N	06E	30
Bear Creek (ECY 08BEAR01.3)	48602	Temperature	--	25N	05E	01
Bear Creek (ECY 08BEAR06.5)	48605	Temperature	--	26N	06E	20
Bear Creek (ECY 08BEAR08.1)	48606	Temperature	--	26N	06E	17
Bear Creek (ECY 08BEAR10.1)	48607	Temperature	--	26N	06E	08
Bear Creek (ECY 08BEAR11.0)	48608	Temperature	--	26N	06E	05
Bear Creek (ECY 08BEAR02.0, 08BEAR02.1, 08BEAR02.8)	42090	Temperature	--	25N	06E	06
Cottage Lake Creek (KC N484)	4814	Temperature	NO74JS	26N	06E	18
Cottage Lake Creek (ECY 08COTT00.4)	48590	Temperature	--	26N	06E	30
Evans Creek (KC S484)	4809	Temperature	MI67EG	25N	06E	06
Evans Creek (ECY 08EVAN00.8, 08EVAN01.2)	48236	Temperature	--	25N	06E	07
Evans Creek (ECY 08EVAN02.3, 08EVAN03.2)	48237	Temperature	--	25N	06E	17
Evans Creek (ECY 08EVAN04.7B, 08EVAN04.7T)	48238	Temperature	--	25N	06E	21
Evans Creek (ECY 08EVAN04.3)	48594	Temperature	--	25N	06E	16
Evans Creek (ECY 08EVAN07.2)	48596	Temperature	--	25N	06E	10
Bear Creek (Redmond 21)	42087	DO	NC11TV	25N	05E	12
Bear Creek (KC C484)	12687	DO	BA64JJ	25N	06E	06
Bear Creek (ECY 08BEAR11.0)	47472	DO	--	26N	06E	05
Cottage Lake Creek (KC N484)	12688	DO	NO74JS	26N	06E	18
Cottage Lake Creek (ECY 08COTT00.4)	47956	DO	--	26N	06E	30
Evans Creek (KC S484)	12689	DO	MI67EG	25N	06E	16
Evans Creek (KC B484)	12685	DO	MI67EG	25N	06E	07
Evans Creek (ECY 08EVAN01.7)	47962	DO	--	25N	06E	07
Evans Creek (ECY 08EVAN05.5)	47964	DO	--	25N	06E	22

*KC – King County ECY – Washington State Department of Ecology

Table B-6. Effective shade and solar LAs on July 24 to improve temperature and DO conditions in Bear Creek. Potential effective shade is based on establishing a system potential mature riparian vegetation.

Station	Distance from upstream boundary to end of reach (km)	CURRENT reach averaged effective shade (%)	CURRENT reach averaged solar heat load (W/m^2)	POTENTIAL reach averaged effective shade (%)	POTENTIAL reach averaged solar heat load (W/m^2)	Load Allocation	
						REQUIRED increase in effective shade (%)	REQUIRED decrease in solar load (W/m^2)
08BEAR11.0	0.0	52%	148	73%	83	21%	66
	0.5	42%	182	79%	67	37%	115
	1.0	66%	107	89%	35	23%	72
08BEAR10.1	1.5	94%	18	98%	5	4%	13
	2.0	46%	170	86%	45	40%	125
	2.5	82%	57	97%	9	15%	48
	3.0	85%	48	98%	5	14%	42
	3.5	86%	42	98%	5	12%	37
	4.0	52%	149	98%	5	46%	143
	4.5	59%	129	98%	6	39%	123
08BEAR08.1	5.0	81%	59	98%	5	17%	54
	5.5	60%	125	98%	5	38%	120
	6.0	47%	165	88%	39	41%	127
	6.5	44%	174	82%	57	37%	117
	7.0	64%	112	93%	23	28%	89
	7.5	39%	190	95%	17	56%	173
08BEAR06.5	8.0	45%	173	83%	53	38%	119
	8.5	53%	147	98%	5	45%	142
	9.0	56%	138	93%	23	37%	116
	9.5	58%	131	95%	15	37%	116
08BEAR05.4	10.0	65%	110	98%	5	34%	105
	10.5	20%	250	96%	12	76%	238
	11.0	43%	177	96%	12	53%	165
	11.5	47%	164	98%	5	51%	160
	12.0	79%	67	98%	5	20%	62
	12.5	61%	122	95%	15	34%	107
08BEAR03.7	13.0	46%	170	98%	5	53%	165
	13.5	56%	138	98%	6	42%	132
	14.0	59%	128	95%	17	36%	111
08BEAR02.8	14.5	55%	139	88%	38	32%	101
	15.0	48%	163	96%	12	48%	151
08BEAR02.1	15.5	31%	216	98%	5	68%	211
08BEAR02.0	16.0	31%	216	98%	5	68%	211
	16.5	22%	245	90%	30	69%	214
08BEAR01.3	17.0	50%	155	98%	5	48%	150
	17.5	45%	171	98%	5	53%	166
08BEAR00.9	18.0	42%	180	98%	6	56%	174
	18.5	27%	227	98%	5	71%	222
08BEAR00.3	19.0	45%	170	99%	4	53%	166
	19.4	44%	174	98%	7	53%	166

Table B-7. Effective shade and solar LAs on July 24 to improve temperature and DO conditions in Evans Creek. Potential effective shade is based on establishing system potential mature riparian vegetation.

Station	Distance from upstream boundary to end of reach (km)	CURRENT reach averaged effective shade (%)	CURRENT reach averaged solar heat load (W/m^2)	POTENTIAL reach averaged effective shade (%)	POTENTIAL reach averaged solar heat load (W/m^2)	Load Allocation	
						REQUIRED increase in effective shade (%)	REQUIRED decrease in solar load (W/m^2)
08EVAN05.5	0.0	82%	55	99%	3	17%	52
	0.5	43%	177	79%	66	36%	111
08EVAN04.7	1.0	18%	257	68%	101	50%	155
	1.5	35%	202	71%	91	36%	111
08EVAN04.3	2.0	48%	163	79%	64	32%	99
	2.5	43%	179	79%	66	36%	112
	3.0	37%	198	74%	81	37%	116
	3.5	36%	200	86%	43	50%	157
08EVAN03.2	4.0	30%	218	93%	21	63%	198
	4.5	30%	217	98%	6	68%	212
	5.0	33%	209	88%	38	55%	172
08EVAN.2.3	5.5	28%	223	88%	38	59%	185
	6.0	29%	221	87%	41	58%	180
08EVAN01.7	6.5	13%	273	72%	88	59%	185
	7.0	25%	235	78%	68	54%	167
08EVAN01.2	7.5	32%	214	84%	49	53%	165
08EVAN00.8	8.0	50%	155	82%	56	32%	100
	8.5	69%	97	90%	31	21%	66
08EVAN00.4	9.0	58%	132	99%	4	41%	128
08EVAN00.0	9.4	28%	226	99%	4	71%	221

Table B-8. Effective shade and solar LAs on July 24 to improve temperature and DO conditions in Cottage Lake Creek. Potential effective shade is based on establishing system potential mature riparian vegetation.

Station	Distance from upstream boundary to end of reach (km)	CURRENT reach averaged effective shade (%)	CURRENT reach averaged solar heat load (W/m^2)	POTENTIAL reach averaged effective shade (%)	POTENTIAL reach averaged solar heat load (W/m^2)	Load Allocation	
						REQUIRED increase in effective shade (%)	REQUIRED decrease in solar load (W/m^2)
08COTT03.3	0.0	42%	180	99%	4	56%	175
	0.5	44%	175	99%	4	55%	171
08COTT02.7	1.0	34%	207	99%	4	65%	203
	1.5	39%	191	99%	4	60%	187
08COTT02.2	2.0	79%	66	99%	4	20%	61
	2.5	77%	73	99%	4	22%	68
	3.0	78%	69	99%	4	21%	65
	3.5	75%	79	99%	4	24%	75
	4.0	43%	178	99%	4	56%	174
	4.5	72%	88	99%	4	27%	84
08COTT00.4	5.0	64%	113	99%	4	35%	109
	5.5	64%	111	99%	4	34%	107
	5.8	74%	82	99%	4	25%	78

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Appendix C. Glossary and Acronyms

Glossary

303(d)-list: Section 303(d) of the federal Clean Water Act requires Washington State periodically to prepare a list of all surface waters in the state for which designated uses of the water – such as for drinking, recreation, aquatic habitat, and industrial use – are impaired by pollutants and for which there is no EPA approved water quality improvement plan in place. 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.

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.

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

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

Fecal coliform (FC): That portion of the coliform group of bacteria which is present in intestinal tracts and feces of warm-blooded animals as detected by the product of acid or gas from lactose in a suitable culture medium within 24 hours at 44.5 plus or minus 0.2 degrees Celsius. FC bacteria 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 (average) of multiple sample values. A geometric mean, unlike an arithmetic mean, tends to dampen the effect of very high or low values, which might bias the mean if a straight average (arithmetic mean) were calculated. This is helpful when analyzing bacteria concentrations, because levels may vary anywhere from ten to 10,000 fold over a given period. The calculation is performed by either:

(1) taking the n^{th} root of a product of n factors, or (2) taking the antilogarithm of the arithmetic mean of the logarithms of the individual values.

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 loading capacity of a water body is the greatest amount of a substance that a water body can receive and still meet water quality standards.

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

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

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

Nonpoint source: Pollution that enters any waters of the state from any dispersed land-based or water-based activities, including but not limited to atmospheric deposition, surface water runoff from agricultural lands, urban areas, or forest lands, subsurface or underground sources, or discharges from boats or marine vessels not otherwise regulated under the NPDES program. Generally, any unconfined and diffuse source of contamination. Legally, a nonpoint source is any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act.

Pathogens: 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 five acres of land.

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

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

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

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 surfaces, such as lawns and playfields, construction sites, as well as dirt and gravel parking lots and roads.

Surface waters of the state: Lakes, rivers, ponds, streams, inland waters, marine waters, 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 TMDL may also include a reserve for future growth.

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.

Acronyms

7-DADMax… seven day average daily maximum
AASF…….Adopt A Stream Foundation
AKA…….. also known as
BMP…….. best management practice
C…… Celsius
CLC……Cascade Land Conservancy
CPF……..... Coastal Protection Fund
CWA……..Clean Water Act
DDES…….Department of Development and Environmental Services (King County)
DO…….….dissolved oxygen
ECY……Washington State Department of Ecology
EPA……Environmental Protection Agency
FC…….. fecal coliform (bacteria)
FOCL……. Friends of Cottage Lake
GIS…….Geographic Information System
HFCW……Horses for Clean Water
I&I……..inflow and infiltration
IDDE……..Illicit Discharge Detection Elimination
K.C.C.…… King County Code
KCCAO……. King County Critical Areas Ordinance
KCD……...King Conservation District
KCEHC……..King County Executive Horse Council
km…….. kilometer
LA……..load allocation
LID…….low impact development
LMO……...Livestock Management Ordinance (King County)
MITFD……...Muckleshoot Indian Tribe Fisheries Division
MOS……...margin of safety
MRA…….. Marine Recovery Area
MS4……municipal storm sewer system
NESSWD….Northeast Sammamish Sewer and Water District
NPDES……. National Pollutant Discharge Elimination System
NWRO……..(Ecology's) Northwest Regional Office
O&M…… operation and maintenance
OSSS…… onsite septic system
PBRS…… Public Benefit Rating System
PDS……...Planning and Development Services (Snohomish County)
PHSKC……. Public Health Seattle-King County
RMC……. Redmond Municipal Code
SCD…….. Snohomish Conservation District
SEPA…… State Environmental Policy Act
SHD…….. Snohomish Health District
SRC…….. Salmon Recovery Council
STORM…… Stormwater Outreach for Municipalities
SWMP…….. Stormwater Management Program (King County)
SWS……..Stormwater Services (King County)
TMDL……...total maximum daily load
TSS……... total suspended solids
U&A……. Usual and Accustomed Area
WAC…….Washington Administrative Code
WDFW……. Washington Department of Fish and Wildlife
WLA……. waste load allocation
WLRD…….. Water and Land Resources Division (King County)
WQIP……Water Quality Implementation Plan
WRIA…….... Water Resource Inventory Area
WSDOT……Washington State Department of Transportation
WWT…… Washington Water Trust