Union River Fecal Coliform Total Maximum Daily Load

Submittal Report

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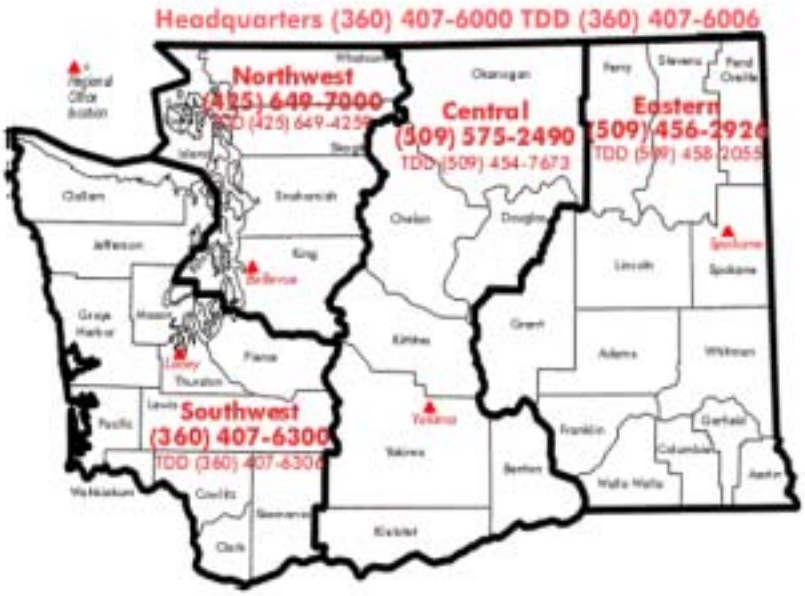

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Introduction

The Washington State Department of Ecology (Ecology) is establishing a total maximum daily load (TMDL) for fecal coliform bacteria in the Union River watershed. This TMDL (or Water Cleanup Plan) will address impairments of the beneficial uses of the Union River and its tributaries. Monitoring efforts by Ecology, the Washington State Department of Health, Mason County Department of Health Services, and Bremerton-Kitsap County Health District indicate that Union River has violated the Washington State Class AA standard for fecal coliform since 1990. A TMDL study was initiated to determine the loading capacity of the stream, identify nonpoint pollution sources of fecal coliform, and set load reductions along the stream corridor. The *Union River Fecal Coliform Total Maximum Daily Load Study* (Ward, et al., 2001 (Appendix B)) was completed in October 2001 and is available at Ecology's Northwest Regional Office and on the internet at http://www.ecy.wa.gov/biblio/0103038.html. This submittal report outlines the on-going and planned activities that will reduce fecal coliform pollution in the Union River.

Section 303(d) of the federal Clean Water Act mandates that the state of Washington establish Total Maximum Daily Loads (TMDLs) for surface waters that do not meet state water quality standards. The U.S. Environmental Protection Agency (EPA) has established regulations (40 Code of Federal Regulations (CFR) Part 130) and developed guidance for setting TMDLs (U.S. EPA, 1991).

Under the Clean Water Act, every state has its own water quality standards designed to protect, restore, and preserve water quality. Water quality standards consist of designated uses, such as cold water biota and drinking water supply, and numeric standards, to achieve those uses. When a waterbody fails to meet water quality standards after application of required technology-based controls, the Clean Water Act requires that the state place the waterbody on a list of "impaired" waterbodies and to prepare an analysis called a **TMDL**.

The goal of a TMDL is to ensure that the impaired waterbody will attain water quality standards within a reasonable period. A TMDL includes a written, quantitative assessment of water quality problem and of the pollutant sources that cause the problem. The TMDL determines the amount of a given pollutant, called the **loading capacity**, which can be discharged to the waterbody and still meet water quality standards and, subsequently, allocates that load among the various sources (if possible). If the pollutant comes from a discrete source (referred to as a **point source**) such as an industrial facility's discharge pipe, that facility's share of the loading capacity is a **wasteload allocation**. If the pollution comes from a diffuse source (referred to as a **nonpoint source**) such as a farm, that facility's share is a **load allocation**.

The TMDL must also consider seasonal variations and include a **margin of safety** that takes into account any lack of knowledge about the causes of the water quality problem or its loading capacity. The sum of the individual allocations and the margin of safety must be equal to or less than the loading capacity.

The general purposes of this submittal document are to:

- Provide an analysis of fecal coliform data of the Union River watershed from historical sampling and monthly sampling performed by Ecology during 1999;

- Identify potential nonpoint sources of fecal coliform (there are no point sources in the Union River basin);
- Summarize ongoing and planned actions that will allow the Union River watershed to meet fecal coliform water quality standards and summarize ongoing monitoring to verify whether standards are being met; and
- Fulfill requirements of the federal Clean Water Act.

A detailed implementation plan will be developed within one year after TMDL approval by EPA and will be based on the information presented in this document.

Components of the TMDL

The five components of any TMDL as required by the Clean Water Act are defined as:

Loading Capacity: The maximum amount of fecal coliform loading that a receiving water can absorb without violating the respective state water quality standard.

Wasteload Allocations: That portion of a receiving water's loading capacity that is allocated to existing or future point sources of fecal coliform pollution. There are no permitted point sources presently in the Union River watershed.

Load Allocations: Either that portion of a receiving water's loading capacity that is attributed to one of its existing or potential nonpoint sources of pollution or to natural background sources. This TMDL involves pollution sources that are exclusively nonpoint. Since calculating separate load allocations for each nonpoint source is exceedingly difficult due to the natural variability of fecal coliform bacteria, this TMDL sets instream water quality-based load allocations at the monitoring stations used in this study. The load allocations recommended at monitoring stations along the Union River and at the mouth of Bear Creek are set as percent reductions needed within the river segment and upstream tributaries associated with each station. Those percent reductions range from 8% to 38% within the Union River watershed. The fecal coliform targets are equivalent to the state Class AA fecal coliform water quality standard.

Margin of Safety: A margin of safety is applied to load allocations to account for uncertainty. Margins of safety were imparted to this TMDL by applying allocations determined for the most critical time of year to the entire year. The most critical period for fecal coliform bacteria in the Union River is during summer months.

Seasonal Variation: Water quality data collected in the Union River watershed show a pattern of seasonal variation. There is a primary increase in bacteria levels during the summer months and a secondary increase during the winter months (mainly November and December). This TMDL incorporates seasonal variation by calculating water quality statistics for each month of the year at each station.

Background

The Union River is located on the Kitsap Peninsula of Western Washington. The Kitsap Peninsula is the eastern portion of the Olympic Peninsula which extents into Puget Sound. Hood Canal borders the Kitsap Peninsula to the west and Puget Sound to the east. The Union River and its tributaries drain approximately 23 square miles (14,500 acres) of land in Kitsap and Mason Counties and flow into Lynch Cove at the southeastern end of Hood Canal, near the town of Belfair. The largest tributaries to the river are the Northeast Fork, Bear Creek, Hazel Creek and Courtney Creek (Figure 1).

The headwaters of the Union River begin approximately 5 miles west of Bremerton near the 1,760-foot high Gold Mountain. Elevations are generally higher in the western half of the basin and most of the tributaries such as Hazel Creek, Bear Creek, and Courtney Creek originate in this area. Although the river gradients are high in the western headwaters area, the mainstem is mostly a broad river valley with stream gradients near three percent. Basin soils consist of a highly erodible mix of glacial outwash silt, sand, and gravel. Because of the low stream gradient in the lower river basin, the river has only minor erosion problems. Most eroded material is deposited near the river mouth as alluvial floodplain and mudflat sediments.

The Union River basin is largely rural with few prominent urban areas or major point sources. Belfair, an unincorporated city located near the mouth, is the largest urban area in the basin. Belfair is designated an Urban Growth Area (UGA) and is currently working to meet requirements of the Growth Management Act, which includes sewerage. Casad Dam, located above McKenna Falls (a natural fish barrier), impounds the headwaters of the Union River to form the 93-acre Union River Reservoir in the upper watershed. The reservoir provides 65% of the drinking water for the City of Bremerton. The city maintains very strict water quality controls at the reservoir because it is one of the few unfiltered systems in the country. These water quality controls for drinking water area more restrictive than Washington State water quality fecal coliform standards. No public access is allowed in the Bremerton watershed above McKenna Falls and the access roads are gated and patrolled. The only activity that the city allows in the 3,000-acre watershed is managed forestry (Cahall, 2002).

Below McKenna Falls, the most common land uses are commercial/industrial, forestry, residential and hobby farm (small agricultural or livestock operations). Other land uses in the basin include Olympic View Sanitary Landfill, Bremerton National Airport, the Port of Bremerton Industrial Park, and several sand and gravel operations.

The lower Union River contains salmon habitat for small runs of chum, chinook, coho, cutthroat, and steelhead (CTC, 2000). Lynch Cove contains shellfish beds. Figure 1 is a map of the Union River watershed.

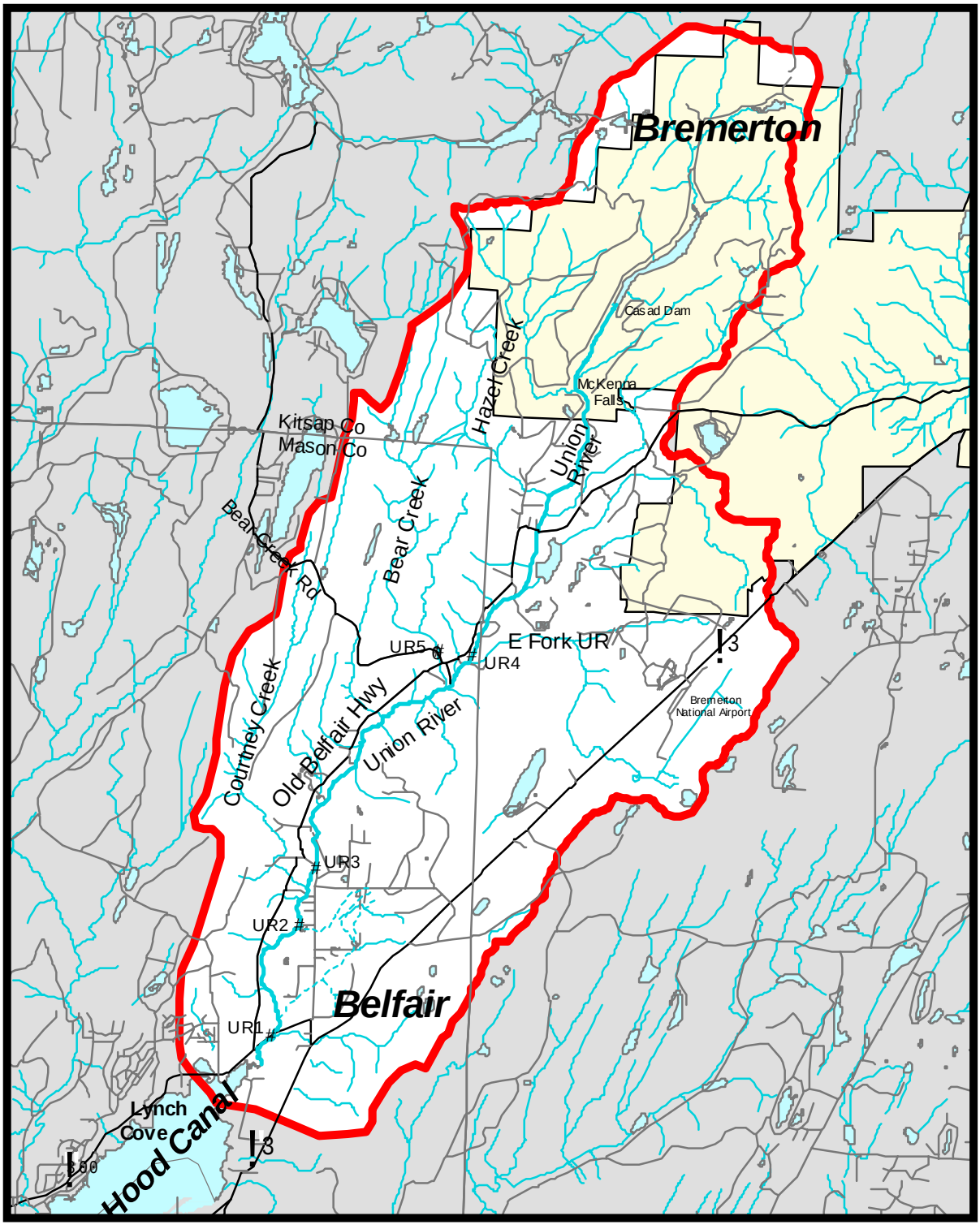

Figure 1. Union River Watershed. Map shows sampling station locations (UR1 through UR5), Union River and tributaries as mapped by the USGS plus additional tributaries mapped by commenter (dashed, locations are approximate).

Applicable Water Quality Standards

Within the state of Washington, water quality standards are published pursuant to Chapter 90.48 of the Revised Code of Washington (RCW). Authority to adopt rules, regulations, and standards as necessary to protect the environment is vested with Department of Ecology (Ecology). Under the federal Clean Water Act, the EPA Regional Administrator must approve the water quality standards adopted by the state (Section 303(c)(3)). These adopted standards protect the characteristic beneficial uses Washington has designated for its waterbodies (Washington Administrative Code (WAC), Chapter 173-201A). Water quality standards were last adopted in November 1997.

WAC Chapter 173-201A also designates all waterbodies into classes. The entire Union River system is Class AA. The WAC specifically designates Union River and tributaries from Bremerton Waterworks Dam (river mile 6.9) and above to the headwaters (source of Union River) as Class AA with the special condition of no waste discharges permitted. Hood Canal (Lynch Cove) is also designated as Class AA, and since Union River is tributary to Hood Canal and the WAC designates all unclassified surface waters tributary to Class AA waters as Class AA, all of Union River below the Bremerton Waterworks Dam is Class AA. The characteristic beneficial uses and the fecal coliform water quality criteria for this classification are listed below.

> *Characteristic uses. Characteristic uses shall include, but not be limited to, the following:*
> *(i) Water supply (domestic, industrial, agricultural).*
> *(ii) Stock watering.*
> *(iii) Fish and shellfish:*
> *Salmonid migration, rearing, spawning, and harvesting.*
> *Other fish migration, rearing, spawning, and harvesting.*
> *Clam, oyster and mussel rearing, spawning, and harvesting*
> *Crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing, spawning, and harvesting.*
> *(iv) Wildlife habitat.*
> *(v) Recreation (primary contact recreation, sport fishing, boating, and aesthetic enjoyment).*
> *(vi) Commerce and navigation.*
>
> [WAC 173-201A-030(1)(b)]

> *Water quality criteria:*
> *(i) Fecal coliform organisms:*
> *(A) Freshwater - fecal coliform organism levels shall both not exceed a geometric mean value of 50 colonies/100 mL and not have more than 10 percent of all samples obtained for calculating the geometric mean value exceeding 100 colonies/100 mL.*
>
> [WAC 173-201A-030(1)(c)(i)(A)]

The state water quality standards describe the averaging periods in the calculation of the geometric mean Fecal Coliform criterion:

> *In determining compliance with the fecal coliform criteria in WAC 173-201A-030, averaging of data collected beyond a thirty-day period,…shall not be permitted when such averaging would skew the data set so as to mask noncompliance periods*
>
> [WAC 173-201A-060(3)]

The EPA (Region 10) described the proper method for calculation of a 90th percentile fecal coliform density to correspond to the state's criterion:

> *A 90th percentile, for compliance with the fecal coliform water quality standard, shall be interpreted as the single data point that represents the largest ten percent (10%) of data points after ranking all applicable data points, from largest to smallest. For example: if a sample contains 1 to 19 data points, the 90th percentile shall be the data point with the largest value; if a sample contains 20 to 29 data points, the 90th percentile shall be the data point with the second largest value; and, if a sample contains 30 to 39 data points, the 90th percentile shall be the data point with the third largest value.*

The state water quality standards specifically describe the subject of implementation related to nonpoint sources of pollution:

> *Activities which generate nonpoint source pollution shall be conducted so as to comply with the water quality standards. The primary means to be used for requiring compliance with the standards shall be through best management practices required in waste discharge permits, rules, orders, and directives issued by the department for activities which generate nonpoint source pollution.*
>
> [WAC 173-201A-160(3)(a)]

EPA, Washington State, and other states have questioned for some time whether fecal coliform bacteria are an optimal indicator of pathogenic bacteria in water. At this time, Ecology is proposing to change its freshwater bacteria criteria (Hicks 2001) and base the new criteria upon the use of Escherichia coli (E. coli). E. coli is a subset of fecal coliform bacteria. Recent studies by Ecology and King County have shown that on average, 90-100% of fecal coliform bacteria are E. coli. A regression analysis of fecal coliform and E. coli levels in the Nooksack River revealed a close relationship between fecal coliform and E. coli levels (coefficient of variation (r^2) of 0.9865). More information on the proposed changes to the water quality standards can be found at http://www.ecy.wa.gov/programs/wq/swqs/index.html.

After conversion to the new standard, it will be desirable to monitor both fecal coliform bacteria and the new indicator simultaneously to evaluate trends in fecal coliform bacteria as well as measure compliance with the new standards. Because the sources of both of these indicator bacteria are the same and all or nearly all currently measured fecal coliform bacteria are assumed to be E. coli at this time, implementation activities for reducing either of these bacteria are identical and thus the change in the standards will not change the type of remedial activities needed in the Union River basin in relation to this TMDL.

Water Quality and Resource Impairments

Water quality sampling of the Union River since 1990 has shown that fecal coliform bacteria at several sampling locations exceeds Washington State's Class AA Standard of 50 fecal coliform colonies/ 100 mL (milliliters). Portions of shellfish beds in Lynch Cove adjacent to the mouth of Union River have been closed due to fecal coliform bacteria contamination starting in 1987. Mason County Department of Health Services (MCDHS) has created a shellfish protection district and programs as required by RCW 90.72.045 to address the shellfish closure problem. MCDHS initiated water quality sampling and sanitary surveys to track down sources of fecal coliform in Lynch Cove in the early 1990's. During this work, they sampled the lower Union River at the bridge of Highway 300 between August 1990 and August 1991 and found fecal coliform excursions above the Class AA Standard. These data resulted in listing the lower mainstem of the Union River on both the state's 1996 and 1998 Section 303(d) lists for fecal coliform. Table 1 presents a description of the specific listing. Ecology's Environmental Assessment Program and Bremerton-Kitsap County Health District (BKCHD) have also collected data since this time showing that the Union River exceeds fecal coliform standards at several sampling stations in the watershed. Excursions were found at stations from the mouth of Union River to river mile 4.5 at the Kitsap/Mason County line and in the Bear Creek Tributary as discussed below (Loading Capacity Analysis). A summary of data collected in the last ten years in the Union River watershed is included in the *Union River Fecal Coliform Total Maximum Daily Load Study* (Ward, et. al., 2001 (Appendix B)).

Table 1. Union River Fecal Coliform 303(d) Listing

Stream Name	1998 Waterbody ID Listing	1996 Waterbody ID Listing	WRIA	Township/ Range/ Section
Union River	MF56EG	WA-15-2010	#15	23N/01W/29

The public has an increased risk of illness after primary contact with the receiving water due to excessive bacteria concentrations. Consumption of bacteria contaminated shellfish in Lynch Cove also has an increased health risk.

Lynch Cove is a commercial shellfish harvest area and one of the state's largest recreational shellfish area. The Union River is one (of many) contributors of bacteria to Lynch Cove. Other potential sources include shoreline residences, stormwater, boat wastes and wildlife. Shellfish are filter feeders that pump large amounts of water through their bodies. This process can concentrate bacteria in their tissues, which causes little or no harm to the animal, but may pose health risks for human consumers.

Lynch Cove is on the 303(d) list for fecal coliform at the mouth of the Union River and at four more locations along the north shore of Lynch Cove. As mentioned above, portions of shellfish beds are closed to harvest. The fecal coliform reductions specified in this TMDL will lower fecal coliform inputs to Lynch Cove; however a TMDL must be completed to specifically address the additional sources of fecal coliform to the marine waters. This TMDL is not scheduled as of publication of this report.

As determined by Ecology in the *Union River Fecal Coliform Total Maximum Daily Load Study* (Ward, et al., 2001 (Appendix B)) and suggested by Kitsap and Mason Counties, the most probable sources of contamination to Union River are on-site sewage system failures, inadequate agricultural and livestock practices, pet wastes, and runoff from homes, highways and commercial businesses. Potential sources are discussed below.

- **Commercial and residential on-site sewage systems.**

  On-site sewage systems can be a source of pollutants to the river if they are sub-standard, failing, or located adjacent to a waterbody. Potential sources of bacteria, nutrients and other contaminants include: sewage from failing residential on-site sewage systems, inadequate community wastewater treatment systems, and accidental spills or illegal dumping from sewage collection. Greywater is also a potential source of bacteria and other contaminates.

  Greywater is wastewater from bathtubs, showers, bathroom sinks, washing machines, dishwashers and kitchen sinks. The W.S. Department of Health (DOH) regulates the use of greywater for subsurface irrigation. DOH stresses that greywater can contain harmful bacteria, viruses, and chemicals that pose a risk to public health and the environment if mishandled. Greywater cannot be discharged to the ground surface or surface water in Washington State. A wastewater permit must be obtained from a county health agency in order to use greywater for subsurface discharges. According to Bremerton-Kitsap County Health District greywater discharges to Union River have been detected.

  Approximately a tenth of the Union River watershed is residential and a significant portion is commercial. Currently there is no sewerage available therefore all properties have on-site sewage systems. Sewer system service is planned for portions of the Belfair UGA as discussed below in the Implementation Plan Development & Activities section, under Mason County Department of Health Services. Sewer system service is expected for the Port of Bremerton facilities at the Bremerton Airport and Olympic View Industrial Park eventually due to projected expansion as discussed in The Port of Bremerton section below. These sewer improvements will accommodate some residents and commercial sewage systems in portions of the Union River watershed, but not all; therefore proper operation and maintenance of existing systems is critical.

- **Urban and semi-urban stormwater run-off.**

  Insufficient stormwater control and treatment can cause excessive sedimentation and erosion, increased stream temperatures, and decreased dissolved oxygen levels. It can introduce bacteria, toxic chemicals, metals and other contaminants into receiving waters. Pet wastes deposited on curbs and paved surfaces may enter surface waters as runoff during storm events and contribute to shellfish bed bacterial contamination and excessive nutrient

pollution (Horner et al., 1994). The unincorporated city of Belfair and the Port of Bremerton facilities generate significant stormwater. Stormwater problems and plans are discussed below in the Implementation Plan Development & Activities section, under Mason County Department of Health Services and The Port of Bremerton, respectively

- **Small-scale farming or commercial horticultural activities.**
  Small-scale farming and commercial horticulture typically involve fertilizers, pesticides, and animal wastes that can impact nearby waterbodies. Homeowner use of fertilizers and pesticides can also impact waterbodies. Runoff from feedlots and manure piles, common in many agricultural areas, can be significant sources of bacteria, nitrogen and phosphorus pollution to surface and groundwater. Bacterial pollution from farms is implicated in many shellfish bed closures around the country. Small-scale or hobby farms make up a significant portion of land in the Union River watershed.

- **Wildlife.**
  Wildlife may contribute bacteria, nutrients, and particulate organic material, to surface waters, occasionally in significant amounts.

- **City of Bremerton biosolids land application program.**
  The City of Bremerton applies biosolids from their wastewater treatment plant to approximately 470 acres in the upper Union River watershed. Biosolids are organic semi-solid material derived from municipal sewage sludge that can be beneficially recycled but must meet strict quality standards for pathogens, animal attraction, and pollutant concentrations. Regulations found in RCW 70.95J provide Ecology and local governments with the authority and direction to meet federal regulatory requirements for managing municipal sewage sludge. Ecology and Bremerton-Kitsap County Health District provide oversight cooperatively for biosolids management in Kitsap County.

  The Bremerton biosolids permit allows land application of Class B treated biosolids on city owned forested areas between State Highway 3 and Old Belfair Highway, adjacent to the Gold Mountain Golf Course. Bremerton monitors their biosolids land application site for groundwater and surface water impacts and provides quarterly and annual reports. Local groundwater meets drinking water standards and surface water monitoring immediately downstream of the land application site in 2001 shows fecal coliform levels of 4 cfu/100 mL (City of Bremerton, 2002). Therefore, the Bremerton Biosolids program is not considered a source of fecal coliform contamination to the Union River.

- **Olympic View Sanitary Landfill**
  Olympic View Sanitary Landfill is located in the Union River basin approximately 10 miles southwest of the City of Bremerton and is currently the only operating solid waste landfill in Kitsap County. An extensive wetland complex of over 130 acres of freshwater wetlands is located north and west of the landfill and includes portions of the floodplain of the East Fork of the Union River. Landfilling at the site began in 1963 at which time the total landfill area was about 25 acres. After 1975, the site accepted mixed municipal solid waste, industrial waste, demolition waste, and other special waste. Today, the active landfill area occupies approximately 65 acres of the total 500-acre tract owned and operated by Olympic View Sanitary Landfill, Inc. Landfill leachate is collected and pre-

treated in the on-site lagoon system and the pre-treated leachate is trucked to the Bremerton Sewage Treatment Plant. Stormwater at the landfill is collected in a separate stormwater lagoon system and is covered under State Waste Discharge Permit #7271. Ecology will require implementation of technology-based pollution controls for stormwater from the landfill through the Stormwater Pollution Prevention Plan (SWPPP) associated with Permit #7271.

Past surface water monitoring at Olympic View landfill has included quarterly sampling and individual wetland monitoring and off-site monitoring events (Parametrix, 1992). Fecal coliform was measured in water samples collected at both background (run-on) and receiving water (run-off) sampling stations around the landfill. Fecal coliform pollution was documented as leaving the landfill site; however, many of the sampling results at background stations also exceeded standards indicating other sources were involved as well. Since the landfill began the closure process, surface water sampling was not considered useful for evaluating potential impacts of the landfill and was discontinued after 1998 (Geomatrix, 2001). The landfill is scheduled to be closed by the end of 2002 and the landfill owner-operator is required under an Agreed Order to perform closure monitoring. Ecology is working with Bremerton-Kitsap County Health Department to oversee the closure and will be making periodic inspections of the landfill and surrounding environs. While the landfill is considered a potential source of fecal coliform bacteria to the Union River, closure and post-closure monitoring of the site will help ensure that the Union River is not being contaminated from this potential source. Other additional monitoring surveys may be conducted in association with this TMDL to further characterize potential sources of bacteria in and around the landfill.

Seasonal Variation

Seasonal variation is addressed in this TMDL by calculating water quality statistics for each month of the year at each sampling station used in the *Union River Fecal Coliform Total Maximum Daily Load Study* (Ward, et. al., 2001 (Appendix B)). Fecal coliform data collected for this study show a pattern of seasonal variation. There is a significant increase in fecal coliform concentration during the summer months (beginning in May and lasting through August). This period of increased bacterial concentration coincides with the dry season when there is less flow in the Union River, indicating that there is a continuous, steady component to the pollution loading. The continuous, steady component is most likely attributed to on-site sewage system failures and wildlife. There is also a period of increased bacteria concentration during the winter months (mainly November and December). Bacteria concentrations in the winter months coincide with the wet season, indicating that there is a stormwater component to the pollution loading. The stormwater component is probably runoff from hobby farm activities and urban/semi-urban stormwater runoff (including pet wastes).

Loading Capacity Analysis

Identification of the loading capacity is an important step in developing TMDLs. The loading capacity provides a reference for calculating the amount of pollutant reduction needed to bring a waterbody into compliance with water quality standards. An allocation is defined as the portion of a receiving water's loading capacity that is assigned to a particular source. By definition, a TMDL is the sum of the allocations. EPA defines the loading capacity as "the greatest amount of loading that a water can receive without violating water quality standards."

Modeling Approach

The general approach for determining the loading capacity for fecal coliform has three parts to the analysis. First, a multivariate regression model is constructed that estimates fecal coliform levels from other variables such as season and flow. Second, fecal coliform levels are estimated from available flow data. This empirical model is used to increase sample size and to provide information on prediction uncertainty in order to define a margin of safety. Third, a cumulative frequency distribution is constructed using the estimated values and the statistical rollback method (Ott, 1995) applied to determine the loading capacity and load reductions needed to meet water quality standards.

Relationships between fecal coliform, flow, and season of data collected in the Union River and Bear Creek were investigated with multivariate regression techniques. Fecal coliform concentration was modeled using the following equation:

$$Log[Fecal\ coliform] = constant + log(flow) + log(flow)^2 + sin(2\pi t) + cos(2\pi t) + sin(4\pi t) + cos(4\pi t)$$

The data were log10-transformed to stabilize the variance. Linear and quadratic flow terms were included to capture linear and curvilinear relationships between flow and concentration. Seasonal functions (sin and cos) were used to account for seasonality on an annual cycle ($2\pi t$) and semiannual (($4\pi t$) cycles (where t= time in years). When a seasonal term was significant ($P<0.05$, where P is a statistical measure of probability), both terms with that cycle were included (Helsel and Hirsch, 1992). When the quadratic flow term was significant, both flow terms were included in the model. While this can inflate the estimates of standard error of the coefficients, it has no effect on model predictions. A smearing correction (Duan, 1983) was used to correct for bias in the predictions when converting from logarithmic space to normal space.

The empirical models derived were all found to be significant. A squared logarithmic space for flow was found to best represent each of the three models derived for four stations where flow data were available: UR2Tmbr, UR3River, UR4Arch, and UR5Bear. The bias corrected models were used for predicting the 1999 daily fecal coliform concentrations from flow and seasonality for these four stations. For those dates that flow data were not collected, the fecal coliform concentration measured for that same month was used. No flow data were collected near the mouth of the Union River at station UR1HY300, since the location is tidally influenced. For this location, the 12 monthly fecal coliform measurements were used for the analysis.

Loading Capacity

To determine the loading capacity requires more than just reducing the geometric mean since both criteria of the state water quality standard need to be met. The load must be reduced such that the entire distribution of values meets both criteria. One way to determine the reduction needed to meet both criteria of the standards is by using the approach of statistical rollback (Ott, 1995).

The statistical rollback method involves determining the (log) distribution statistics and calculating the 90th percentile based on the mean, standard deviation, and Z-score. The distribution is adjusted such that both the geometric mean and the 90th percentile criteria for bacteria in Class AA waters are met. The objective, for Class AA waterbodies, such as the Union River, are that the geometric mean will not exceed the criteria of 50 colony forming units (cfu) / 100 milliliters (mL) and no more than 10 percent of the values exceed 100 cfu/100mL. The geometric mean is then determined from the adjusted distribution and is compared with the standard for the geometric mean of 50 cfu/100mL. If the adjusted geometric mean is less than the first part criterion of 50 cfu/100mL, then the adjusted distribution meets the standard and represents the loading capacity in the receiving water. If the adjusted geometric mean is greater than the first part criterion of 50 cfu/100mL, the distribution is adjusted further until the criterion is met and represents the loading capacity as measured at that station.

From the distribution of the measured and estimated fecal coliform values, different percent reductions are needed at each location to meet the standard (Tables 2 to 6). **The geometric mean will need to be lower than the standards specify for station UR1Hwy300 (Table 2). At all other stations upstream, the 10th percentile fecal coliform criterion will need to be lower than the value specified in the standards in order to meet the geometric mean. This is based on the assumption that the distribution of fecal coliform will remain the same after the load reductions and the larger of the two criteria reductions will be needed to meet the standard overall.**

The water quality standards confine the period for calculating the geometric mean to 30-days only if longer averaging periods show compliance. Calculating the geometric mean using a period of data over 30-days is not appropriate since the result may mask noncompliance. The fecal coliform concentrations (both measured and estimated from the empirical model) verify that the water quality standard is not being met at all the stations during at least one month of the year. For example, the fecal coliform data collected at UR4Arch meets the criteria on an annual basis, but the standards are not met during the summer months.

Table 2. Load reductions needed to meet fecal coliform standards at Union River mile 0.4 (UR1Hwy300).

Date	Load Reduction Needed (%)	Geometric Mean Needed (cfu/100mL)	10% of Samples Cannot be over (cfu/100mL)
1999 (all months)	8%	44	100

Table 3. Load reductions needed to meet fecal coliform standards at Union River mile 1.3 (UR2Tmbr).

Date	Load Reduction Needed (%)	Geometric Mean Needed (cfu/100mL)	10% of Samples Cannot be Over (cfu/100mL)
January	0	50	100
February	0	50	100
March	0	50	100
April	0	50	100
May	17%	50	70
June	29%	50	63
July	36%	50	55
August	38%	50	54
September	30%	50	66
October	0	50	100
November	10%	50	50
December	0	50	100
Annual	9%	50	100

Table 4. Load reductions needed to meet fecal coliform standards at Union River mile 1.8 (UR3River).

Date	Load Reduction Needed (%)	Geometric Mean Needed (cfu/100mL)	10% of Samples Cannot be Over (cfu/100mL)
January	0	50	100
February	0	50	100
March	0	50	100
April	0	50	100
May	3%	50	65
June	17%	50	60
July	22%	50	51
August	21%	50	53
September	17%	50	55
October	13%	50	53
November	10%	50	57
December	4%	50	62
Annual	8%	46	100

Table 5. Load reductions needed to meet fecal coliform standards at Union River mile 4.5 (UR4Arch).

Date	Load Reduction Needed (%)	Geometric Mean Needed (cfu/100mL)	10% of Samples Cannot be Over (cfu/100mL)
January	0	50	100
February	0	50	100
March	0	50	100
April	0	50	100
May	3%	50	70
June	17%	50	57
July	17%	50	57
August	7%	50	62
September	0	50	100
October	0	50	100
November	3%	50	64
December	5%	50	65
Annual	0	50	100

Table 6. Load reductions needed to meet fecal coliform standards at Bear Creek (UR5Bear).

Date	Load Reduction Needed (%)	Geometric Mean Needed (cfu/100mL)	10% of Samples Cannot be Over (cfu/100mL)
January	0	50	100
February	0	50	100
March	0	50	100
April	0	50	100
May	0	50	100
June	12%	50	62
July	7%	50	75
August	0	50	100
September	0	50	100
October	0	50	100
November	0	50	100
December	0	50	100
Annual	0	50	100

Federal regulations allow TMDLs to be expressed in terms of "other appropriate measures" (40 CFR 130.2(i)). Although a fecal coliform TMDL can be presented as a load (cfu/day), the resulting numbers are of little value from a management perspective. For fecal coliform, it is more useful to represent the loading capacity as distribution concentrations and load reductions. Defining the loading capacity in these surrogate terms will allow monitoring data to be used to verify effectiveness of meeting the TMDL goals. Table 7 presents the load allocations for each station and Table 8 presents the allocation targets for the TMDL. The loading capacity at station

UR1HY300 could not be calculated since flow data was not collected. However, the fecal coliform data was sufficient to establish the load reductions target and TMDL surrogate measures.

Table 7. Loading capacity for fecal coliform in the Union River and Bear Creek.

Station	Reach	Load Reduction Needed (%)	Fecal Coliform Loading Capacity (cfu/day)
UR1HY300	Mouth to RM 1.3	8%	--
UR2Tmbr	RM 1.3 to RM 1.8	38%	4.8×10^{17}
UR3River	RM 1.8 to RM 4.5	22%	1.9×10^{12}
UR4Arch	RM 4.5 to Headwaters*	17%	1.7×10^{12}
UR5Bear	Bear Creek	12%	1.4×10^{12}

Table 8. TMDL allocation targets in the Union River and Bear Creek.

Station	Reach	Geometric Mean (cfu/100mL)	10% of Samples Cannot be Over (cfu/100mL)
UR1HY300	Mouth to RM 1.3	44	100
UR2Tmbr	RM 1.3 to RM 1.8	50	54
UR3River	RM 1.8 to RM 4.5	50	51
UR4Arch	RM 4.5 to Headwaters*	50	57
UR5Bear	Bear Creek	50	62

*This segment applies from RM 4.5 to McKenna Falls and headwaters of Union River tributaries that are downstream of McKenna Falls.

Load Allocations

Available information on the relative contributions from the various nonpoint sources contributing to exceedance of the fecal coliform standards in the Union River did not allow development of load allocations by source type. The most probable sources of contamination are on-site sewage system failures, inadequate agricultural and livestock practices, pet wastes, and runoff from homes, highways and commercial businesses. Available analytical tools do not exist that allow a determination of the expected percent reduction of fecal coliform loads from specific pollution control activities that could possibly be applied. Load allocations were developed as percent reductions within each segment of the river and its tributaries and are listed in Table 7. Table 8 lists the geometric means and 90^{th} percentiles required to meet the standard at each site for both parts of the criteria. The percent reductions required by each part of the criteria were compared for each month at each station (Tables 2-6), and the most restrictive criterion was used to establish the recommended target level or load allocation (Table 7). The statistical method used to set the targets is discussed in Ott (1995). These site-specific allocations will be used to monitor the success of source control management measures taken in each subbasin.

As noted in *Union River Fecal Coliform Total Maximum Daily Load Study* (Ward, et al., 2001 (Appendix B)), the City of Bremerton collects fecal coliform bacteria water samples above the study area at least five days per week at their McKenna Falls Intake Structure in compliance with the Safe Drinking Water Act/Surface Water Treatment Rule. Because this is an unfiltered water source for the city, 90% of the samples taken during the previous six months must be less than 20 fecal coliform colonies/100mL. The city has consistently found fecal coliform concentrations below this allowed amount (Cahall, 2001). **This TMDL applies to the entire Union River watershed. Specific load allocation targets apply to stream reaches and upstream tributaries as indicated in Table 8**. The segment beginning at sampling station UR4Arch and continuing to the headwaters applies to RM 4.5 to McKenna Falls and headwaters of Union River tributaries that are downstream of McKenna Falls.

Margin of Safety

The federal statute requires that a margin of safety be identified to account for uncertainty when establishing a TMDL. The margin of safety can be explicit in the form of an allocation, or implicit in the use of conservative assumptions in the analysis. One approach to setting a margin of safety is to set allocations based on conditions during the most critical period. In the above analysis of Union River bacteria data, the summer months are the critical period where fecal coliform standards are not being met. The management measures used for abating the fecal coliform pollution sources are not applied seasonally, but put into place for year-round treatment. Setting the loading capacity based on the most critical month will be protective of the other months of the year when standards are currently met. Using the critical period will serve as the inherent margin of safety for this TMDL.

Summary Implementation Strategy

Introduction

A summary implementation strategy (SIS) for the Union River fecal coliform TMDL is needed to meet the requirements of a TMDL submittal for approval as outlined in the 1997 Memorandum of Agreement between the U.S. Environmental Protection Agency and the Washington State Department of Ecology. Its purpose is to present a clear, concise, and sequential concept (i.e. vision statement) of how the Union River system will achieve Class AA fecal coliform water quality standards. The SIS includes an outline of how a more detailed implementation plan will be developed, those implementation activities that are planned or already underway by Ecology or other parties, a strategy for developing follow-up monitoring plans, a summary of public involvement methods, and potential funding needs and sources to make implementation of the plan a reality.

Overview

The implementation of the Union River Fecal Coliform TMDL will be guided by Washington's Water Quality Management Plan to Control Nonpoint Source Pollution (Ecology, 2000). This plan was developed to include all nonpoint source pollution control efforts by federal, state, tribal, and local governments as well as citizen groups. The development of the plan was a collaborative effort that identifies gaps in existing programs, sets a strategy for improving those programs, provides tools, recommends timelines, and outlines methods for determining success. The plan meets federal mandates in Section 319 of the Clean Water Act and Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990.

Ecology has authority to protect water quality under RCW 90.48, and will implement many of the nonpoint source control activities through local jurisdictions, resource agencies, and landowners. Ecology will also coordinate with and, when possible, facilitate joint projects and efforts with local watershed planning groups initiated under the watershed planning process set forth in Chapter 90.82 of the Revised Code of Washington (RCW) and the Washington State Salmon Recovery effort.

Ecology encouraged development of "400-12" plans by local government and watershed groups in accordance with Chapter 400-12 WAC: Local Planning and Management of Nonpoint Source Pollution. The purpose of Chapter 400-12 WAC is to reduce pollutant loading from nonpoint sources, prevent new sources from being created, enhance water quality and protect beneficial uses, which is closely tied to the purposes of this TMDL. Several plans were developed to address the Lower Hood Canal watershed. The most recent is the Lower Hood Canal Watershed Action Plan, 1994. The Lower Hood Canal Watershed Implementation Committee (LHCWIC) was appointed by Mason County Commissioners to oversee this plan. Washington Sea Grant is current reviewing the implementation of these plans and is reporting its findings to LHCWIC. Ecology recommends that the LHCWIC oversee the implementation nonpoint pollution source

controls of this TMDL in coordination with Lower Hood Canal Watershed Action Plan in order to combine resources and reduce redundancy.

This document inventories existing activities, evaluates how extensively they have been implemented, and assesses the effectiveness of current and past activities. The cooperation and coordination of local agencies are major factors in the successful implementation of nonpoint source control measures within the target timeframe.

Several local agencies have plans or existing programs to address the bacteria problem in Union River. For example, the Bremerton-Kitsap County Health District (BKCHD) initiated the Upper Union River Restoration Project in November 2001 to address pollution problems in the Kitsap County portion of the Union River. Mason Conservation District plans to initiate the Lower Union River Restoration Study with anticipated funds in September 2002 to address pollution problems in the Mason County portion of the Union River. These projects are discussed in detail in the Implementation Plan Development & Activities section below.

Outside of local government, several citizen groups, such as LHCWIC, are active in development and planning of activities to help reduce fecal coliform contamination in the Union River watershed. **Ecology anticipates that if these water quality programs and projects proceed as expected, by December 2007, all sampling stations within the Union River watershed will be within water quality standards for bacteria.**

Implementation Plan Development & Activities

This Summary Implementation Strategy was developed by Ecology, with the assistance of local health jurisdictions and conservation districts, citizen groups, and Tribes. The following is a description of government agencies, citizen groups, and higher education representatives that have regulatory authority, influence, information, resources or other involvement that will be included in the coordinated effort to implement the TMDL. A description of specific implementation activities and schedules is also included with each group to document on-going and planned activities to reduce fecal coliform. Ecology will lead the coordination effort for development and implementation of the Detailed Implementation Plan (required under the Memorandum of Understanding between Ecology and EPA) with consultation from the following groups.

Ecology

Ecology has been delegated authority under the federal Clean Water Act by the U.S. Environmental Protection Agency to establish water quality standards, administer the National Pollution Discharge Elimination System (NPDES) wastewater permitting program and enforce water quality regulations under Chapter 90.48 RCW. Ecology responds to complaints, conducts inspections, and issues NPDES permits as part of its responsibilities under state and federal laws and regulations. In cooperation with conservation districts, Ecology will pursue implementation of farm plans and "Best Management Practices" (BMPs) for small farms and may use formal enforcement, including fines, if voluntary compliance is unsuccessful.

Ecology has recently added resources in its Northwest Regional Office to conduct nonpoint water quality enforcement. These resources are dedicated to the investigation and compliance of nonpoint source activities that adversely impact salmon. The value of the Union River and its tributaries as home to several species of salmon will be considered as Ecology allocates its nonpoint compliance salmon recovery resources.

Ecology provides financial assistance to local governments, tribes, and conservation districts for water quality projects.

Mason Conservation District

Mason Conservation District, under the authority of Chapter 89.08 RCW, develops farm plans to protect water quality and provides animal waste management information, education and technical assistance to residents. They have some cost-share opportunities to help qualifying property owners correct fecal coliform pollution sources. Farmers receiving a Notice of Correction from Ecology or Mason County Department of Health Services will normally be referred to Mason Conservation District for assistance. When developing farm plans, the district uses guidance and specifications from the U.S. Natural Resources Conservation Service. Mason Conservation District has committed to tracking farm planning and implementation, including Geographic Information System mapping of best management practice (BMP) implementation in the Union River watershed.

Mason Conservation District and the Hood Canal Salmon Enhancement Group (HCSEG) have applied for a Centennial Clean Water Fund (CCWF) grant for fiscal year 2003 to initiate the Lower Union River Restoration Study. This study will include identification of fecal coliform contamination in the lower Union River and its estuary, remediation recommendations and implementation of controls for agricultural land use and failing on-site systems sources. This study will also plan stormwater runoff control and treatment for the Belfair UGA. If the grant is received, work is planned to be performed between September 2002 and December 2003. Fecal coliform monitoring will continue as funding allows through 2005.

Mason County Department of Health Services, under contract with Mason Conservation District will identify and correct fecal coliform source using site-by-site property parcel visits and inspections using their pollution identification and correction protocol. The Hood Canal Salmon Enhancement Group (HCSEG), also under contract, will collect water quality samples from the Union River, survey and test stormwater runoff from each commercial site for fecal coliform and other compounds. HCSEG will also complete a concept plan for stormwater management and control for the Belfair UGA.

Mason Conservation District and the Washington Sea Grant Program will partner to present community education and outreach programs in association with the Lower Union River Restoration Study.

Mason County Department of Health Services

Mason County Department of Health Services (MCDHS) has the authority to enforce rules adopted by the state Board of Health that include rules necessary to assure safe and reliable public drinking water and to protect the public health. They regulate on-site sewage systems in accordance with Chapter 246-272 WAC that requires on-site sewage system pumpers and installers be certified by the county.

Currently MCDHS collects water quality data in the Union River on a complaint basis only. There is no ambient water quality monitoring at this time. MCDHS will be subcontracted by Mason Conservation District to participate in the Lower Union River Restoration Study, if funded, as discussed above.

MCDHS is active in cleaning up fecal coliform contamination in Lynch Cove shellfish areas adjacent to the outfall of Union River. They have created a shellfish protection district and programs as required by RCW 90.72.045. Portions of shellfish beds in Lynch Cove have been classified as prohibited by Department of Health (DOH) due to bacteria contamination starting in 1987. Since then, MCDHS has been awarded grants to make public assessments and inspections of on-site sewage systems on properties in the Lower Hood Canal area. Shoreline on-site sewage systems were dye tested during the sanitary survey project. Several hundred sewage systems were found failing in the Lower Hood Canal. Most failing on-site sewage systems were repaired and water quality improvements made through this project allowed several shellfish beds to be re-opened to harvest. Funding for this work ended in December 1996.

MCDHS currently has CCWF grants to initiate or continue several water cleanup programs. The Lower Hood Canal Pollution Source Identification Project has been initiated in the area near Belfair State Park on the North Shore so that it may be re-opened to shellfish harvest. Most of the failing on-site sewage systems identified through a sanitary survey discussed above have been repaired, but sampling by DOH indicates increasing fecal coliform counts at some stations. The main purpose of this project is to identify the nonpoint pollution sources of fecal contamination along the waterfront area from Gladwin Road to Boad Haven Road on the North Shore of Lower Hood Canal. In a secondary goal, homeowners who refused access or had suspect designations during the previous survey will be contacted for permission to access and dye test as necessary. Enforcement actions will be taken by the Mason County to repair or replace these systems (as regular Mason County field work, not grant funded work). This project will be accomplished through research, survey, and prioritization of potential sources, technical assistance, education, and compliance action referrals when necessary.

MCDHS and the Lower Hood Canal Watershed Implementation Committee (LHCWIC) are also working to complete watershed cleanup and reopen the Lower Hood Canal to shellfish harvest with the funded Lower Hood Canal Operation and Maintenance Project for on-site sewage systems. LHCWIC requested an intense operation and maintenance program be implemented in the sensitive areas along the waterfront.

MCDHS was also awarded a grant to initiate its Threatened Area Response strategy in Lower Hood Canal. This funding allows the health department to pro-actively respond to shellfish beds downgraded to threatened before they are closed.

The unincorporated city of Belfair has been declared an Urban Growth Area (UGA) and, as such, under the State Growth Management Act, Mason County must develop a sewerage plan. Sewerage is limited to the declared UGA except under certain conditions such as significant health concerns. Through encouragement by MCDHS and the LHCWIC, county commissioners may include the north shore of Hood Canal along and adjacent to Lynch Cove in sewerage because of the public health risk posed by bacteria contaminated shellfish beds. DOH declared Lynch Cove a public health threat in March 2002. MCDHS proposes that the sewer system lines be extended from the Belfair UGA along the north shore of Lynch Cove to Boad Haven Road (past Belfair State Park) to include areas where high fecal coliform levels are detected and failing or inadequate on-site sewage systems are suspected to be the main cause. Sewerage is planned to extend northeast from Belfair along State Highway 3 to near the Kitsap/Mason County line. Additional funding is required to extend sewerage along the north shore of Lynch Cove. Therefore final plans are dependent on this funding. If funding is received, sewage will be built in approximately five years. Mason County also plans to construct a sewer treatment plant most likely located near the Kitsap county line that will utilize a wastewater reclamation facility to recycle water within the North Bay and Lower Hood Canal watersheds. Again final plans are dependent upon the receipt of additional funding. The Lower Union River Restoration Study will investigate and propose stormwater runoff control and treatment plans for the Belfair UGA.

Bremerton-Kitsap County Health District

Bremerton-Kitsap County Health District (BKCHD) has the authority to enforce rules adopted by the state Board of Health which include rules necessary to assure safe and reliable public drinking water and to protect the public health.

In response to the Union River fecal coliform problem, the Health District initiated the Upper Union River Restoration Project in November 2001. This project uses the Health District's Manual of Protocol: Fecal Coliform Bacteria Pollution Identification and Correction (PIC) Projects (BKCHD, 1999) to identify and correct fecal coliform pollution sources through intensive site-by-site property parcel visits and inspections. The protocol will address fecal coliform contamination from failing on-site sewage systems and inadequate animal waste management practices (livestock and/or pets). One objective of the project is to solicit and foster community support and stewardship of water quality through informing, education, and involving the public in the project area.

Approximately 200 residences and businesses in the Union River watershed between McKenna Falls and the boundary of Mason County are currently being surveyed to locate and correct sources of fecal coliform pollution. When failing on-site sewage systems are identified, BKCHD works with the property owner to ensure that repairs are consistent with state and local regulations and completed in a timely fashion. In necessary, enforcement of local on-site sewage regulations can be used. When inadequate livestock waste handling practices are identified (farms with unrestricted animal access to streams, or with improper manure management that is threatening water quality), property owners are referred to Kitsap Conservation District for technical assistance to develop a farm plan or at a minimum a waste management plan. When inadequate pet waste handling practices are identified, property owners are given educational material on proper management and reminded of their responsibilities as outline in local solid waste regulations. Improper animal waste management can be addressed through BKCHD's

solid waste regulations. Other identified sources of fecal coliform pollution will be referred to the appropriate agency for correction through enforcement of applicable regulations. After best management practices are installed, BKCHD conducts monitoring to see if they are having the desired effect.

BKCHD will continue to perform monthly monitoring of 6 stations in the upper Union River for the following parameters: fecal coliform bacteria, temperature, pH, conductivity, dissolved oxygen, turbidity and environmental parameters (rainfall amounts, air temperature, wind speed and direction, and tidal conditions). Property parcel visits and inspections are performed during the wet season to increase the likelihood of detecting properties with fecal coliform sources. After a property owner implements best management practices designed to minimize fecal coliform pollution, monitoring will be performed to evaluate the effectiveness. Fecal coliform and environmental parameters will be collected during this work.

A public meeting was held on November 8, 2001 to discuss the current water quality monitoring results and how the bacterial problem will be identified and corrected. BKCHD submitted the Upper Union River Post Corrective Action Monitoring Plan to Ecology March 2002 as part of the grant requirements. Fieldwork began on November 19, 2001 with parcel-by-parcel investigations to be completed by April 30, 2003. Corrective activities are estimated to be completed by September 30, 2003 and the final report will be submitted to Ecology by December 31, 2004.

BKCHD plans to prevent future water quality problems through an intensive public education campaign targeted at on-site system operation and maintenance and proper animal waste management practices.

BKCHD and Ecology provide oversight of the City of Bremerton Biosolids Land Application. Groundwater, surface water and soils are monitored closely and impacts are within guidelines of Ecology and EPA's Biosolids programs. Samplings stations on Union River tributaries downstream of the land application sites show fecal coliform levels well below standard. The program is successfully implemented with minimal impacts on the watershed.

Kitsap Conservation District

Kitsap Conservation District, under the authority of Chapter 89.08 RCW, develops farm plans to protect water quality and provides animal waste management information, education and technical assistance to residents similar to Mason Conservation District described above.

Kitsap Conservation District is under contract by Bremerton-Kitsap County Health District for the Upper Union River Restoration Project to provide animal waste management information, education and technical assistance. The Conservation District has developed a prioritized inventory of animal management sites in the Upper Union River watershed and will continue to assist landowners to develop and implement animal waste management plans or farm management plans as needed or directed by BKCHD. The Conservation District has identified and prioritized agricultural properties with water quality problems based on overall likelihood that current land management practices may result in surface or groundwater pollution. They identified five high priority sites, three medium-high sites, 14 medium, 15 low, and four sites

with an unknown priority. Agricultural parcels within the Kitsap County portion of the Union River watershed make up approximately 3% of the watershed. Farm surveys of those sites were completed between July and August 2001. BKCHD is currently using this information to prioritize properties for immediate investigation.

Hood Canal Salmon Enhancement Group

One of the 14 Salmon Enhancement Groups created in 1990 per the Washington State Legislature, the Hood Canal Salmon Enhancement Group (HCSEG) is a public, non-profit corporation. It is a volunteer organization dedicated to involving individuals and organizations to support and protect the region's salmonid populations for community, recreational, and economic benefits. Its mission is to protect and enhance the genetic diversity and populations of wild salmon in Hood Canal by the protection and restoration of habitats, water quality, education, wild salmon incubators and other means.

HCSEG will be under contract by Mason Conservation District for the Lower Union River Restoration Study as discussed above. They will collect water quality samples from the Union River, survey and test storm runoff from each commercial site for fecal coliform and other compounds. HCSEG will also complete a concept plan for stormwater management and control for the Belfair UGA; as well as develop and direct a watershed stewardship program for the Union River.

Lower Hood Canal Watershed Implementation Committee

Over 75 community members, during the past nine years, have volunteered thousands of hours and logged hundreds of miles to work together with businesses and agencies to preserve and protect the Lower Hood Canal. In 1994, community members helped develop the Lower Hood Canal Watershed Action Plan. Between 1994-1996, more community citizens advised Mason County on Lower Hood Canal Clean Water District closure response. In 1996, the Mason County Commissioners formed LHCWIC to review the watershed action plan and advise the County Commissioners. It includes citizens and representatives from the state and county agencies and the Skokomish Tribe. Meetings are held monthly to discuss watershed issues and monitor related program progress. LHCWIC coordinated the preparation of the proposal for the Lower Union River Restoration Study grant and will monitor progress of the program.

City of Bremerton

The City of Bremerton impounds the headwaters of the Union River with Casad Dam as drinking supply for the city. The city owns, protects and manages for forestry the 3,000-acre watershed above the dam. The area owned by the city is closed to the public, gated and patrolled. The only activity allowed is forestry which they manage. The water quality is exceptional (more than 96% of raw water samples have fecal coliform concentrations less than or equal to 20 colonies/100mL. The City of Bremerton is one of the few surface water supplies in the United States allowed to operate unfiltered (Cahall, 2002).

Since 1995, Bremerton has operated on a consistent firm yield of between 1880 and 2020 MG/yr, however, daily diversions are based on system demands. They meet or exceed their minimum downstream flows of 3 cfs (October through May), 2 cfs (June) and 1 cfs (July through September). Although the reservoir does provide some mitigation of high downstream flow during most high precipitation events, it is not a flood control structure – once the reservoir is full, all excess water overflows downstream.

The Union River and its tributaries drain a total area of 23.4 square miles. The 3.05 square mile watershed area above Casad Dam averaged 62 inches of precipitation (10,100 acre-feet) per year since 1957 (Cahall, 2002). Average streamflow curves for the Union River near Belfair indicate that groundwater is the primary contributor to river flow during summer, and direct surface water runoff becomes an important factor to streamflow beginning in September and October (Garling, et al., 1965). The year of the Union River TMDL study was a high flow year, however the majority of precipitation received in 1999 was during the winter months. The summer months received just below average rainfall (based on the 30 year average from 1958-1998). The bacteria levels detected during the 1999 sampling of the summer months (critical period) are representative of average summer month concentrations based on flow. Bremerton's flow monitoring should help ensure careful analysis of the effects of streamflow on water quality.

Bremerton is committed to maintaining the current standards of its watershed operation, including restriction of the watershed from the public.

Port of Bremerton Airport and Olympic View Industrial Park

The Port of Bremerton operates Bremerton National Airport and Olympic View Industrial Park on State Route 3, approximately eight miles southwest of Bremerton. Domestic wastewater from facilities at the airport and industrial park is discharged to a large on-site wastewater treatment system located within the Union River drainage basin. The Port's Large On-Site Sewage System (LOSS) has a design capacity of 72,500 gallons per day (gpd), and currently is operating at about 11,000 gpd. The Port's LOSS includes aerated treatment lagoons, a gravel filter and a 13-acre effluent drainfield area. The subsurface discharge from the Port of Bremerton's LOSS is permitted under state Waste Discharge Permit No. ST 7390. The Port samples the LOSS system influent and effluent twice annually and has stayed in compliance with their permit conditions since construction of the new LOSS in 1987.

Over the next ten years, the Port of Bremerton will be adding an 11-acre NE Campus Business Park to the Airport and Industrial Park complex. The new NE Campus will add domestic wastewater load to the Port's LOSS but this should not be problematic since the LOSS has been operating at about 15% capacity. The entire Port complex is expected to eventually receive sewer service from a regional sewage treatment plant, but plans are uncertain at this time. The Port of Bremerton received a CCWF grant to prepare the Stormwater Management Study for its business park extension.

Skokomish Indian Tribe

The Skokomish Tribe has been involved with habitat ambient monitoring in Union River watershed for the past 15 years and they participate in the Lower Hood Canal Watershed

Implementation Committee (LHCWIC). They currently do not collect water quality data on the Union River but are in support of the proposed Lower Union River Restoration Study by Mason Conservation District and Hood Canal Salmon Enhancement Group (HCSEG).

Washington State Department of Health

The Department of Health (DOH), under authority of Chapter 43.70 RCW, monitors marine water quality in commercial shellfish growing areas, including Lynch Cove and Hood Canal. Portions of shellfish beds adjacent to the outfall of the Union River have been threatened or closed starting in 1987 due to fecal coliform contamination.

Washington Sea Grant Program, University of Washington

Washington Sea Grant Program works with individuals and groups to better understand and conserve marine and coastal resources. It strives to meet the needs of ocean users while enhancing the environment and economy of the state, region and nation. More than the sum of individual efforts, Washington Sea Grant Program extends its capabilities through partnerships with agencies, industries and citizen groups. The mission of the program is to encourage the understanding, use, conservation and enhancement of marine resources and the marine environment through research, education, outreach and technology transfer.

A team of water quality education specialists provide technical assistance, public programs and materials to local governments, tribes, industries, schools, and other water resource users in this community. Through its outreach efforts, the team takes an active role in reducing water pollution from failing on-site sewage systems and other nonpoint pollution generators. The Washington Sea Grant Program is currently reviewing the implementation of the 400-12 nonpoint pollution watershed plans for all of Mason County's watersheds.

Union River Basin Protection Association

The Union River Basin Protection Association is a citizen group formed in 1992. They have been involved in the monitoring impacts of urbanization, Olympic View Sanitary Landfill, and gravel mining operations in the watershed. The association will participate in the Lower Union River Restoration Study as volunteers and will be invited to be on the steering committee.

Mason Matters

Mason Matters is a non-profit organization concerned with health-related issues that affect the quality of life in Mason County. Through the support of Mason General Hospital and Mason County Health they provide technical assistance, collect and disseminate information to increase community awareness, promote and coordinate new partners among existing service providers, establish collaborations and coalitions, secure funding, increase existing community capacity, and/or seed new organizations/programs to fill existing gaps in health service.

During September 2000, the group identified water quality as one of the most significant issues that provided the best opportunities for improvements through community action. They are currently creating a water quality status report. This report will support efforts such as measuring progress of existing plans and identifying opportunities for individual groups to align their efforts with other community groups.

Kitsap Peninsula Watershed Planning Unit

The mission of the Watershed Planning Unit for Water Resource Inventory Area 15, established under Chapter 90.82 RCW, includes developing a plan to address water quantity, water quality and habitat issues. Members represent various governments and interest groups in the community that can directly influence and participate in implementation activities. They include: agriculture, growth management, forestry, trout and salmon advocates, the Skokomish Flood Control Board, the Skokomish Tribe, the local Public Utility District, Mason County, Mason Conservation District, MCDHS, BKCHD, City of Bremerton, W.S. Department of Ecology, Washington Sea Grant, W.S. Department of Fish and Wildlife, W.S. Department of Natural Resources, W.S. Department of Health, W.S. Department of Transportation, W.S. Conservation Commission, the Puget Sound Water Quality Action Team, the U.S. Forest Service, the U.S. National Park Service, U.S. Fish and Wildlife, and U.S. National Marine Fisheries Service

Hood Canal Watershed Project

North Mason High School students, under the direction of environmental science teacher Karen Lippy, study Belfair Creek to locate sources of bacteria and determine the level of road runoff pollutants. This work has been done in cooperation with property owners, HCSEG, and the Belfair Water District. Using EPA bioassay methods in their study, students determined that the runoff from parking and highway surfaces contained harmful substances. Karen Lippy coordinated monitoring of approximately 100 high school students who monitor water quality, vegetation, birds and benthics in the lower Hood Canal.

The students will also participate in the Lower Hood Canal Restoration Study in water quality sample collection.

Puget Sound Water Quality Action Team

The Puget Sound Water Quality Action Team, under authority of Chapter 90.71 RCW, works with governments and organizations across the region to carry out the Puget Sound Water Quality Management Plan. Under different parts of the plan, agencies and governments provide technical and financial assistance to control pollution from on-site sewage systems, farm animal wastes and stormwater runoff. Support staff of the Action Team assist directly with programs to protect and restore shellfish harvesting in Lynch Cove. The Action Team also administers grant funds for public involvement and education projects.

The Puget Sound Water Quality Action Team is actively promoting the appropriate use of low impact development (LID) practices. They are involved in education and outreach to homeowners, businesses, developers and local governments. PSAT will be holding a West Sound LID Workshop for Kitsap, Jefferson and Clallam Counties in October 2002. The workshop is tentatively planned to be held in Port Townsend and Ecology will help promote the workshop for attendance by Union River watershed elected officials, local government staff, stakeholders, and developers.

Hood Canal Coordinating Council

The Hood Canal Coordinating Council (HCCC) is a council of governments consisting of Jefferson, Kitsap and Mason Counties, Port Gamble S'Klallam and Skokomish Tribes, and state and federal agencies. HCCC was established in 1985 to "improve regulatory decision-making and policy review by providing a forum for discussion of regional water quality related issues affecting Hood Canal." The council coordinates salmon, shellfish, and general water quality protection efforts in Hood Canal by providing public education and information about salmon recovery, water quality, and shellfish resource protection. They seek funding for salmon recovery planning and water quality protection efforts, and maintain a database of recovery projects and protection activities.

Reasonable Assurance

Local involvement and commitment to resolving fecal coliform problems in the Union River area are considerable. Organizations and their commitments under laws, rules, programs and contracts to resolve the bacteria problem are listed below. The following rationale help provide reasonable assurance that the Union River TMDL goals will be met by 2007.

- Conservation Districts in Mason and Kitsap counties have authority under Chapter 89.08 RCW to develop farm plans to protect water quality and provide animal waste management information, education and technical assistance to residents. Farmers receiving a Notice of Correction from Ecology or local health jurisdictions will normally be referred to the local conservation district for assistance. When developing farm plans, the district uses guidance and specifications from the U.S. Natural Resources Conservation Service.

- Mason County Department of Health Services (MCDHS) and Bremerton-Kitsap County Health District (BKCHD) have the authority to enforce rules adopted by the state Board of Health that include rules necessary to assure safe and reliable public drinking water and to protect the public health. DOH regulates Class A & AA public water supplies; local health districts regulate Class B systems and private wells. Local health districts regulate on-site sewage systems in accordance with Chapter 246-272 WAC and County Board of Health regulations.

- Kitsap County Surface and Storm Water Management (SSWM) program provides dedicated local funding to BKCHD and the Kitsap Conservation District for surface water monitoring and pollution identification and correction (currently used in Upper Union River Restoration Project). Currently the majority of the monitoring and PIC activities are funded by SSWM.

- BKCHD's Upper Union River Restoration Project is funded in part by a grant from Ecology and was initiated in November 2001. BKCHD's primary purpose in doing this project is to reduce fecal coliform levels in the Upper Union River and (if possible) remove the Upper Union River from the state's 303(d) list. To fulfill requirements of the grant, BKCHD must submit progress reports and complete the Upper Union River Post Corrective Action Monitoring Plan. If necessary, BKCHD has authority to enforce correction of failing on-site sewage systems or inadequate waste management practice pursuant to local on-site sewage system and solid waste regulations, respectively.

- Based on Mason County Department of Health Service's (MCDHS) recent success in abating the contamination of the South Shore and most of the North Shore of the Lower Hood Canal by location and repairing failing on-site systems, MCDHS and Mason Conservation District expect to reduce the bacteria levels in the Union River as outlined in their grant proposal for the Lower Union River Restoration Study and in Lynch Cove as outlined in other current grants and shellfish bed protection programs. The Lower Union River Restoration Study allows for fecal coliform monitoring after best management practices are initiated until 2005. Mason Conservation District has committed to tracking farm planning and implementation,

including Geographic Information System mapping of best management practice (BMP) implementation in the Union River watershed.

- The City of Bremerton is committed to maintaining the current standards of its drinking water supply operation in the Upper Union River Watershed. This includes restriction of the watershed from the public.

- The Urban Growth Area (UGA) designation of the unincorporated city of Belfair has triggered the requirement for a sewerage plan. Sewer service is planned to extend from Boad Haven Road northeast along Lynch Cove to Belfair and continue along Highway 3 to the near the Kitsap/Mason County line. Mason County also plans to construct a sewer treatment plant near the Kitsap county line that will utilize a wastewater reclamation facility to recycle water within the watershed. The Lower Union River Restoration Study will also plan stormwater runoff control and treatment for the Belfair UGA.

- The Union River watershed has several "hobby farms", which may discharge some fecal coliform pollution. Such nonpoint sources will be encouraged, through public outreach and technical assistance, to implement fecal coliform-reducing best management practices as part of the Upper Union River Restoration Project and the Lower Union River Restoration Study. Ecology may selectively apply its inspection/enforcement resources on focused surveys of small farms or other small animal feeding operations.

- Whenever applicable BMPs are not being implemented and Ecology has reason to believe that individual sites or facilities are causing pollution in violation of RCW 90.48.080, Ecology may pursue orders, directives, permits, or civil or criminal sanctions to gain compliance with the state's water quality standards. Ecology will enforce water quality regulations under Chapter 90.48 RCW.

- Washington State Department of Health will continue monitoring water quality in Lynch Cove and will downgrade any commercial shellfish growing area which no longer meets its classification criteria for harvesting. Such downgrades call attention to the sources contributing to the water quality problem and initiate shellfish closure response plans that address the sources.

Adaptive Management

Implementation of the Union River fecal coliform TMDL will be adaptively managed such that the Union River and its tributaries will meet Washington State's Water Quality Standards by 2007. Adaptive management methods that may be used to implement the Union River TMDL include: adjusting best management practices; modifying stream sampling frequency and/or locations to further delineate fecal coliform sources; conducting special inspections in identified source areas; helping develop and fund water quality projects that address fecal coliform pollution; local educational initiatives; and other means of conforming management measures to current information on the impairment.

TMDL requirements are satisfied when adequate sampling is attained that shows Washington State's Water Quality Standards are being met after best management practices have been successfully implemented. Sampling is adequate when it represents all climatic, hydrologic, and land use characteristics. If water quality standards are met without attaining the load allocation reductions specified in Tables 7 & 8, then the objectives of this TMDL are met and no further reductions are needed. If the load allocation reductions in Tables 7 & 8 are met, but the stream still does not meet water quality standards, then adaptive management methods listed above will be further employed to meet the objectives of this TMDL.

Ecology will monitor sampling performed during the Upper Union River Restoration Project and the Lower Union River Restoration Study as part of their CCFW grant requirements and will adaptively manage TMDL implementation measures accordingly.

On-going ambient monitoring conducted by BKCHD and DOH, as well as grant project monitoring mentioned above will assist in enabling the implementing jurisdictions to revise and shift implementation efforts as necessary in order to bring all tributaries back into compliance with water quality standards. Ecology will continue to offer grant funding for developing and implementing monitoring programs through its annual Centennial Clean Water Fund.

Summary of Public Involvement

The Draft Union River Fecal Coliform Bacteria TMDL was open for public comment from April 29 through May 30, 2002. The public comment period allows time to solicit public input and feedback on the draft TMDL which was available on the internet, at local libraries, and by mail during the public comment period. A public open house meeting was held at the Mary E. Theler Community Center, in Belfair on May 13, 2002, from 3-5 p.m. and 6:30-8:30 p.m. Advertisements for the public meeting and comment period consisted of display ads in the Mason County Journal Weekly (Shelton, WA on 4/18/02 and 4/25/02), Belfair Herald Weekly (Belfair, WA on 4/25/2002), and The Bremerton Sun Daily (Bremerton, WA from 4/20/02 to 4/23/02).

An Ecology Brief Sheet was mailed to local residents and interested persons and was distributed at the public open house meeting to announce the availability of the draft TMDL, the comment period, and the public meeting.

Ecology responded to all written public comments received during the stipulated public comment period of from April 29 through May 30, 2002. Comments regarding factual inaccuracies, improved wording, or those that clarify policy positions by other government agencies have been directly incorporated into the text of this final submittal report. All other comments are addressed in the Responsiveness Summary, included as Appendix A of this submittal. In order to avoid redundant responses to similar or related comments, some comments have been combined.

After submittal of the TMDL to EPA, Ecology will work with interested parties regarding development of a Detailed Implementation Plan. The plan will be submitted to EPA within one year of approval of the TMDL by EPA.

Monitoring Strategy

Over the next two years, Mason and Kitsap Conservation Districts will track farm planning and best management practices implementation in the Union River Watershed. Local health jurisdictions will monitor Union River water quality as outlined in CCWF and other grant agreements. The Lower Union River Restoration Study allows for fecal coliform monitoring after best management practices are initiated until 2005. DOH will continue monitoring Lynch Cove in connection with the current shellfish closure response plan. Ecology will propose additional monitoring if necessary for source identification or further clarification in determining whether TMDL goals are being met.

Identification of potential or actual sources of fecal coliform pollution is currently being done by BKCHD and will be done during the Lower Union River Restoration Study and MCDHS shellfish protection projects as funding allows. This work will focus cleanup actions and BMP implementation in areas where the greatest benefit can be gained.

Potential Funding Sources

The Centennial Clean Water Fund, Section 319 grants under the federal Clean Water Act, and State Revolving Fund loans are available to fund activities by jurisdictions to help implementation of the TMDL. CCWF is currently helping fund the Upper Union River Restoration Project and may fund the Lower Union River Restoration Study. Non-governmental organizations can apply to be funded by a 319 grant to provide additional assistance. If additional funding is necessary to reach standards, Ecology will work with the stakeholders to prepare appropriate scopes of work, to implement this TMDL, and to assist with applying for grant opportunities as they arise.

Grants through Ecology's Centennial Clean Water Fund, Section 319, and State Revolving Fund loans continue to provide funding resources that are available to fund activities to help implementation of the TMDL (water cleanup plan). The Puget Sound Water Quality Action Team administers Public Involvement and Education grants available for additional assistance. A limited amount of federal money is available through Kitsap and Mason Conservation Districts via the Conservation Reserve Enhancement Program for conservation easements and as cost-share for implementing agricultural best management practices (BMPs). The federal Natural Resources Conservation Service also administers federal money, the Environmental Quality Incentive Program, which provides cost share funds for BMPs on agricultural sites. Stream restoration activities are eligible for salmon restoration grants through various sources.

Currently, Centennial Clean Water Fund grants to MCDHS fund shellfish protection and response programs in Lynch Cove.

Abbreviations Index

BKCHD - Bremerton-Kitsap County Health District
BMP - Best Management Practice
CCWF - Centennial Clean Water Fund
CFR - Code of Federal Regulation
cfs - Cubic feet/second
cfu - Colony forming units
CTC - Concurrent Technologies Corporation
DOH - Department of Health
Ecology - Washington State Department of Ecology
EPA - U.S. Environmental Protection Agency
gpd - gallons per day
HCCC - Hood Canal Coordinating Council
HCSEG - Hood Canal Salmon Enhancement Group
LHCWIC - Lower Hood Canal Watershed Implementation Committee
LID - Low impact development
LOSS - Large On-Site System
MCDHS - Mason County Department of Health Services
MG/yr - million gallons/year
mL - Milliliters
NPDES - National Pollution Discharge Elimination System
PIC - Pollution Identification and Correction
RCW - Revised Code of Washington
RM - River mile
SIS - Summary implementation strategy
SSWM - Kitsap County Surface and Storm Water Management
TMDL - Total Maximum Daily Load
U.S. - United States
UGA - Urban Growth Area
W.S. - Washington State
WAC - Washington Administrative Code

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Appendix A: Responsiveness Summary

Response to Comments on the Draft Union River Water Cleanup Plan

The following is a summary of comments received on the Draft Union River Water Cleanup Plan (TMDL). Many of the comments resulted in revisions to the plan and report. Comments regarding factual inaccuracies, improved wording, or clarification have been directly incorporated into the text of this final submittal report. All other comments are addressed below. Similar or related comments have been combined.

1. **Comment:** The Union River TMDL submittal report states "the public has an increased health risk after contact with the receiving water since the respective Class AA characteristic uses are impaired by excessive bacteria concentrations" (page 9). This is a stretch since Class A supports primary contact recreation at double the FC concentrations (Part 1: 100, Part 2:200). In addition, the Federal Water Pollution Control Federation's fresh water swimming beach standard is (Part 1:200, Part 2: 400) – quadruple the Class AA standard. We recommend striking this statement and focusing more on the downstream impacts of the FC.

   Response: Bacteria water quality standards are based on accepted illness rates. EPA estimates a fecal coliform geometric mean of 200 colonies/ 100 ml would cause 8 illnesses per 1,000 swimmers at fresh water beaches and 19 illnesses per 1,000 swimmers at marine beaches (USEPA, 1986). People can become ill from primary contact of waters with a fecal coliform geometric mean of 50 colonies/100 ml and 100 colonies/100ml. Washington currently chooses a lower acceptable illness rate by setting Class AA & A standards at 50 colonies/100 ml and 100 colonies/100ml (geometric mean), respectively. Human consumption of shellfish contaminated by fecal coliform poses a health risk. Submittal report was revised according to this comment.

2. **Comment:** We recommend that greywater discharges and direct discharges of sewage be specifically referenced as sources of pollution. Several greywater discharges have been found in county surveys and the public must become more that greywater represents a human health risk as well.

   Response: Comment acknowledged. The submittal report was revised according to this comment.

3. **Comment:** We recommend that you discuss the original listing data in greater detail and include a map showing the specific segment that was listed.

   Response: As stated on Page 9 under Water Quality and Resource Impairments, the lower mainstem of the Union River in Township 23N, Range 1W, and Section 29 was listed for fecal coliform on the 1996 and 1998 303 (d) list due to sampling of the Union River at State Highway 300 bridge during a sanitary survey in 1990-1991. This triggered the TMDL study and process. More recent and more extensive data have been collected by Ecology's Environmental Assessment Program for the purposes of delineating fecal coliform extent and to determine fecal coliform loading to the river. These data show that fecal coliform levels are above the standard for Class AA at several locations along the river and in Bear Creek. This study is a more detailed and recent assessment of bacterial contamination in Union

River than the original listing data of 1990-1991 and allows for a more detailed baseline to compare future monitoring data following cleanup efforts. Please refer to Figure 1 for the location of the State Highway 300 bridge.

4. **Comment:** Does Ecology have the report for the 1990-91 Mason County shellfish project, which includes the measurements taken at the Highway 300 Bridge that originally placed the Union River on the 303(d) list?

   Response: Ecology does have this report and it is available upon request.

5. **Comment:** We recommend that you clarify that the Union River sewer improvements are planned for the Belfair area only. We suggest that the time frame for installing sewer systems in Belfair and Port of Bremerton areas is mentioned.

   Response: Over the next ten years, the Port of Bremerton will be adding an 11-acre NE Campus Business Park to the Airport and Industrial Park complex. The new NE Campus will add domestic wastewater load to the Port's LOSS but this should not be problematic since the LOSS has been operating at about 15% capacity. The entire Port complex is expected to eventually receive sewer service from a regional sewage treatment plant, but plans are uncertain at this time. The submittal report was revised according to this comment.

6. **Comment:** With regard to the sewer system planned for the Belfair area (Pages 22 and 23), the report states "…county commissioners plan to include north shore of Hood Canal along and adjacent to Lynch Cove in sewerage …". The *Belfair/Lower Hood Canal Water Reclamation Facility Plan* of July 2001 (recently approved by Ecology) does not recommend this extension, in part due to funding which has not been obtained. Extensions of sewerage outside of the UGA that were considered in the *Facility Plan* are "…Belfair State Park and the immediate shoreline areas…" and " Belfair State Park, Beards Cove, and other branch area…" (Sand Hill Road and Mission Creek Road).

   With regard to the treatment plant reclamation facility mentioned on page 23 of this document, two locations are being considered for processing sewerage according to the *Facility Plan*. They are: 1) near the Kitsap County line and 2) transmission to the existing plant at North Bay facility west of Allyn. Both of these options are outside the Lower Hood Canal Watershed and discharge into North Bay- Case Inlet.

   Response: According to Gary Yando, Director of Mason County Utilities/ Waste Management, sewer service eventually planned along the north shore of Lynch Cove will include the immediate areas around Belfair State Park. Both Mason County Public Works and Mason County Dept. of Health Services (MCDHS) are advocating that this sewer service extend to Boad Haven Road. Sewerage extension depends upon receipt of grant funding (Yando, 2002). Comments acknowledged. The submittal report was revised according to these comments.

7. **Comment:** The sewer service is not feasible to do in all of the Belfair Urban Growth Area (UGA). It is more important to address the stormwater runoff from State Highway 3 and commercial development in Belfair, which flows into the Union River.

   Response: Expected sewer service will not cover the entire UGA as discussed on page 21. Sewerage will accommodate some on-site sewer systems that are contributing fecal coliform to the Union River watershed and are therefore considered important. Ecology does not control or have direct influence over areas of local sewer service, but will advocate sewerage in areas where onsite systems are contributing pollution to local waterbodies.

8. **Comment:** Two fish-bearing streams and numerous culverts on State Highway 3 that discharge untreated stormwater to the Union River have been mapped and should be included in the map of Figure 1. They are potential contributors to the pollution problem of the Union River. Mason County has not identified these two streams; the DNR is working to retype them. When the proposed Belfair UGA was defined these streams were not identified. The Comprehensive plan calls for protection of the environmentally sensitive Union River basin and minimizes building on the steep slopes west of State Highway 3 where runoff goes into the watershed. Moving or redefining the UGA boundaries would accomplish this.

   Response: Figure 1 was updated to reflect the approximate location of these tributaries. They should be investigated during the Lower Union River Restoration Study. Ecology recommends that the tributaries are taken into account when sources of pollution are assessed in the Union River watershed, and sensitive riparian areas should be recognized when land use plans are developed.

9. **Comment:** "Belfair was declared an Urban Growth Area and as such has significant stormwater runoff and will develop a stormwater Plan". No current plan to develop a stormwater plan. Stormwater is a problem regardless of begin an UGA. Impervious surfaces should be included as increasing runoff and restricting flow back into the aquifer.

   Response: Mason County is not developing a formal stormwater plan as part of the UGA. Stormwater problems will be examined by Mason County as part of the proposed sewerage because stormwater runoff will affect sewerage construction; however Mason County will not develop a stormwater runoff control and treatment plan. HCSEG, as part of the Lower Union River Restoration Study will investigate stormwater runoff and develop a stormwater management and control concept plan. According to the study proposal, this plan will be coordinated with Mason County for funding and implementation. The final report will provide data and present control and treatment concepts for stormwater. This work is contingent on receipt of grant funding. Comment acknowledged. The submittal report was revised according to this comment.

10. **Comment:** Even though runoff is stated as being rare from the airport, it still could be a source of pollution. The implication is that it is not a source of pollution. There is no discussion of surface water or stormwater runoff from the airport and industrial park or the

new proposed business park. This can be a source of pollution that needs to be addressed just as stormwater runoff in Belfair must be considered.

Response: Port of Bremerton holds Industrial Stormwater General Permit No. SO3-000901 for stormwater discharges from Bremerton National Airport and the Olympic View Industrial Park. The permit, which expires November 18, 2005, requires that a stormwater pollution prevention plan be maintained and that operational and source control Best Management Practices (BMPs) be implemented. Most of the Port's airport stormwater is collected at a detention facility at the south end of the airport and flow from the south pond is perennial. Stormwater at the north end of the airport is collected in two primary catch basins and is tight-lined via pipes across State Highway 3 where it discharges to a tributary of the East Fork of the Union River. The airport began semi-annual sampling for toxics and metals in their stormwater in 2002, but has not instituted sampling for fecal coliform bacteria. With the attention on the Union River Fecal Coliform TMDL, the Port will add fecal coliform to their semi-annual stormwater sampling beginning in 2003. This submittal report was revised according to this comment.

11. **Comment:** Recommended text changes to Reasonable Assurance section, page 29.

Response: The purpose of this section is to give assurance (through regulatory authority, grant requirements, etc.) that cleanup activities will be done. Comments regarding text revision that only further explain how cleanup activities will be done were added under the Implementation Plan Development & Activities section, pages 20-28.

12. **Comment:** How will adaptive management be coordinated and implemented? The adaptive management discussion is not clear. It sounds that if the load reductions are met, but water quality standards are not, the location of measurements and timing will be changed so that water quality is met. In that case, the proposed Union River Restoration study team would not be able to determine load reductions.

Response: The adaptive management approach for the Union River bacteria TMDL will be coordinated with major stakeholders; especially those involved in monitoring river water quality. It is anticipated that during periodic meetings of involved agencies and watershed groups, watershed inspections, new water quality data, and any trends in the cumulative data will be reported and assessed by the group. Involved stakeholders will be consulted as to whether additional data, sampling stations, focus areas for inspection and/or enforcement, or other watershed initiatives should be considered.

Adaptive management is a strategy for addressing pollutant load uncertainty that emphasizes taking near term actions to improve water quality. An adaptive management approach provides for reassessment and revision of site-specific actions so as to improve the system of pollution controls in a watershed. The Draft Union River TMDL submittal discussion under Adaptive Management included statements intended to express the primacy of state water quality standards over the particular target reductions determined from the TMDL study (Tables 7 & 8). Changing location of sampling stations or increasing sampling frequency are options for acquiring more detailed data in order to improve the Union River water quality characterization. The sampling stations used in the TMDL study would not be abandoned

since, as the commenter indicates, they will be needed for determining whether the original targets have been met.

13. **Comment:** Gravel pits should also be mentioned as a potential pollution source that can affect water quality.

    Response: Gravel mines are typically sources of turbidity and sediment where there are mine discharges to surface water. While they are recognized as a potential pollution source, gravel mines are not known as significant sources of bacteria.

14. **Comment:** It was difficult to understand how the flow variation was 'corrected' for in the modeling (in Seasonal Variation section, page 12). No flow data are included in the technical report for the TMDL (Ward et al., 2001), and it is unclear whether flow variations due to regulation at Casad Dam are modeled for and whether the two peaks in FC levels, one November-December and another "summer", are taken into account. Could the wet weather influx of fecal coliform be coming from seasonal on-site sewage system failures?

    The equation on page 13 (in Modeling Approach section) is not clear. The formula is a general formula – what was the actual formula (constants, etc) that was used? What is flow and what are the units? The seasonal term 'P' is not defined and there is no indication of how it is determined. Terms of *pi* and π are used at different times. What does a "squared logarithmic space for flow" mean?

    Response: Fecal coliform concentration can respond to streamflow in several ways: 1) concentration may decrease if increased flows dilute the fecal coliform bacteria present; 2) concentration may increase as flows increase if runoff washes bacteria directly into the stream; or 3) anywhere in between because both processes operate simultaneously in different tributaries and over time. Rather than try to measure and model every potential source (which is prohibitively expensive) we chose to examine the general pattern of fecal coliform concentrations at several locations on the river over the entire year. The modeling was a two-step process. First, regression analysis, statistical procedure was employed using the monthly measured values of fecal coliform bacteria concentration (colony forming units, cfu/100ml) and streamflow (cubic feet per second, cfs) to estimate the relationship between these two parameters. The nature of the data (lots of low values with a few very high values) and the requirements of the statistical procedure necessitated that the data be log-transformed (i.e. the base 10 logarithms were used in the analysis). This is a common, well-accepted procedure and allows the results to be 'back-transformed' into the original units for easier understanding. Flow was also included in the equation as the logarithm of flow raised to the second power (squared). This was done to account for a nonlinear relationship. It is quite common for concentrations to increase as flows begin to rise and then level off as flows get extremely high (rather than to continue to increase). If you think about the mechanisms this makes sense. As flow increases, material along the shore is washed in. But as flows get higher, there is less stuff to wash in the stream and more water to dilute what is there. The sin and cosine terms were added to mimic the natural seasonal flow pattern of high winter flows and low summer flows.

Second, after the relationship of fecal coliform bacteria concentration and flow was estimated at each site we used the mean daily streamflow values at each site to estimate the concentration for each day.

Changes in flow due to regulation at Casad dam were not considered directly. We used the flows measured at the monitoring site. All fecal coliform data that met the quality control standards of our laboratory were used. The concept of flow-correction or flow-adjusted data is simple but the calculations can be complicated. Conceptually, we are interested in the concentration of fecal coliform bacteria and we know that the concentration is affected greatly by changes in flow. In order to better understand the nature of the 'fecal coliform problem' we need to 'adjust' or 'correct' the bacteria concentration data by accounting for the changes in flow. A straightforward example of this is estimating the average concentration when the concentration increases as flow increases. If we measure during low flows, the concentration is low. At high flows and the concentration is high. Two different answers for the same stream with no change in the sources of the bacteria. Adjusting flows allows us to compare these data. The constants and seasonality terms determined by the modeling are shown in the following table:

Site	Constant	Log(flow)	$Log(flow)^2$	$\sin(2\pi t)$	$\cos(2\pi t)$	$\sin(4\pi t)$	$\cos(4\pi t)$	correction
UR2	-4.824	5.653	1.058	-0.842	1.056	0	0	1.158
UR3	1.353	0.336	-0.038	-0.356	-0.295	0.001	0.094	1.034
UR4	1.796	-0.662	0.373	-0.214	-0.264	-0.096	0.240	1.052
UR5	0.656	0.326	0.437	-0.040	-0.655	-0.062	0.437	1.318

Statistical significance is based on the probability (P) that the results of the statistical test are due to chance alone. By convention, a "P" less than 0.05 (< 5% probability that the results would occur by chance) are called statistically significant.

pi and π are equivalent.

On-site system failures may be contributing to wet weather fecal coliform contamination in the Union River, but the primary source is probably stormwater driven runoff contaminated with animal wastes. Increased monitoring of Union River water quality (discussed in the Implementation Plan Development and Activities section, page 20) will assist in defining sources in greater detail.

15. **Comment:** <u>The report states that flow was not measured at the bridge because of tidal action. There is flow at the bridge all the time. The level of the water at the bridge can be affected by high tides and the flow reduced some</u>.

Response: Tidal influences at station UR1HWY300 (Union River at Highway 300 bridge) make it a sub-optimal flow-gaging site for several reasons. One of the objectives at a suitable stream-gaging site is to establish the relationship between stream discharge and

water surface elevation. This relationship can only be accurately determined at a free-flowing stream reach that does not have periodic backwater effects such as at a tidal-affected site. Another criterion at an appropriate gage site is that stream discharge remains constant during measurement. Finally, where water quality samples are collected at a gauging station, contaminants should not accumulate or migrate upstream because of periodic flow, precluding potential correlation of water quality and flow. All of these reasons contribute to the determination that UR1HY300 is not an ideal flow measurement site for the Union River. Water Quality at UR1HY300 is still of interest since bacteria samples collected there in 1990-91 caused the original placement of Union River on the state 303(d) impaired waterbodies list.

16. **Comment:** The TMDL is stated to apply to the entire river, however load reductions are not determined for any locations in the river above the archery range location at the Mason County border. Why were no measurements made? As there is a load reduction required at the archery range it is assumed that the pollution is coming from the river above this location. It is possible that there are greater load reductions than at the archery range required at specific locations in the river above that location.

    Response: Load reductions apply to segments of the river above that sampling location. Since there is no sampling station above station UR4 (at river mile 4.5), the load reduction determined at station UR4 applies from river mile 4.5 to the headwaters, exclusive of McKenna Falls its headwaters. The City of Bremerton demonstrates fecal coliform levels less than 20 cfu/100ml at McKenna Falls. It is possible that sources in the between McKenna Falls and station UR4 are not adequately characterized by the sampling performed in this TMDL study, but only a limited amount of stations could be sampled due to budget constraints. The sampling performed indicates that detailed surveying and fecal coliform reductions are needed in the both counties to fully delineate and reduce sources. Kitsap County has begun this detailed work. Mason County will soon begin this work if funding is received. The Adaptive Management section details what steps may be taken if monitoring following the institution of BMPs finds that fecal coliform reductions are not adequate to bring Union River to below water quality standards. However, the results of this study indicate that the reductions planned will be adequate to return the waterbody to standards.

17. **Comment:** Bremerton-Kitsap County Health District (BKCHD) is to complete fieldwork by April 2003 with corrective actions completed by Sept 2003 and final report by Dec 2004. It will take some time after identified corrective actions have been completed to assure that the water quality problems have been corrected. Will BKCHD continue to monitor water quality after September 2003 at the 5 stations and for how long?

    Response: Bremerton-Kitsap County Health District (BKCHD) has notified us that they are monitoring at 6 sampling stations in the Union River watershed. As added in the Reasonable Assurance section, page 29, Kitsap County Surface and Storm Water Management (SSWM) program provides dedicated local funding to BKCHD and the Kitsap Conservation District for surface water monitoring and pollution identification and correction (currently used in

Upper Union River Restoration Project). Currently the majority of the monitoring and PIC activities are funded by the dedicated SSWM funding.

18. **Comment:** The Mason Conservation District (MCD) grant proposal will start work in September 2002 and complete work by Dec 2003, with monitoring until Dec 2005. The follow-on monitoring efforts of both the BKCHD and MCD projects should be coordinated so that measurements are made at the same time so a record of the river can be determined at one time.

    Response: Ecology will encourage, to the extent possible, that sampling projects be coordinated in order to optimize sampling results and to obtain more complete characterizations of Union River water quality. However, it is not mandatory to sample the entire watershed on the same day to characterize pollution levels.

19. **Comment:** Will Ecology make measurements after the corrections have been made to determine the water quality of the river, or will Ecology rely on the measurements made under the two projects?

    Response: Ecology is very interested in additional monitoring to further identify and quantify pollution sources to the Union River and to monitor effectiveness of source control measures implemented as part of the TMDL. If existing monitoring programs are not sufficient for effectiveness monitoring, Ecology may initiate a monitoring study, or may support other projects or groups involved in monitoring bacteria in the Union River.

20. **Comment:** The Dec 2007 date for water quality to be within standards will require the CCWF grant to be approved and cooperation of residents and businesses.

    Response: Other than the extra points awarded to all TMDL-related projects, the rating process for Centennial Clean Water Fund (CCWF) grant applications is independent of Ecology or local community priorities for TMDLs. The Mason Conservation District CCWF grant proposal for the Lower Union River Restoration study would be a key project in bringing the Union River back to meeting water quality standards, but is not being solely relied upon for implementation of the TMDL. The commenter's point is well taken in that the Mason Conservation District project would be a key element of TMDL implementation, as will the cooperation and involvement of residences and businesses in the watershed.

21. **Comment:** The Hood Canal Salmon Enhancement Group (HCSEG) will be responsible for collecting the CCWF grant project samples rather than Mason County (pgs. 21, 24).

    Response: Comment acknowledged. The submittal report was revised in accordance with this comment.

22. **Comment:** The report says that BKCHD will include tidal conditions in their measurements. Tidal conditions will not affect the stream in the Kitsap portion of the river.

    Response: Collection of this data may not significantly affect the results of the study.

23. **Comment:** As both the Upper Union River Restoration Project and Lower Union River Restoration Study will be conducting education, operation & maintenance, and stewardship programs it would be best if these were coordinated or combined.

    Response: Effective education, operation & maintenance, and stewardship programs are very important to the success of both projects. Where feasible coordination of efforts among Mason County, Kitsap County, HCSEG and other watershed groups may enhance impact of this work, however this will be up to local groups to coordinate.

24. **Comment:** Puget Sound Water Quality Action Team-PSAT (Page 28) should educate homeowners and businesses on low impact development (LID).

    Response: Comment acknowledged. PSAT is involved in education and outreach to homeowners, businesses, developers and local governments on LID. PSAT promotes LID around the Puget Sound and will be holding a West Sound LID Workshop for Kitsap, Jefferson and Clallam Counties in October 2002. The workshop is tentatively planned to be held in Port Townsend and Ecology will help promote the workshop for attendance by Union River watershed elected officials, local government staff, stakeholders, and developers. The submittal report was revised according to this comment.

25. **Comment:** One issue not addressed in the commercial and residential septic systems source discussion is the impact from illegal dumping of septage pumped from septic tanks.

    Response: Comment acknowledged. The submittal report was revised according to this comment. The Ecology, MCDHS and BKCHD have the authority to enforce state and local solid waste regulations. Enforcement will be used against entities found illegally dumping septage.

26. **Comment:** A possible source of pollution is the application of pesticides or herbicides on an 80-acre Christmas tree farm just to the west of UR2Tmbr sampling station.

    Response: All pesticide and herbicide applications should be managed with great care to prevent excess amounts entering groundwater or stormwater runoff. This site is not considered a potential source of fecal coliform and therefore is not listed in the Water Quality and Resource Impairments, page 9. Ecology recommends that the Lower Union River Restoration Study considers nutrients in its sampling plan.

27. **Comment:** Small-scale farming or commercial horticultural activities (page 11) – This section should also address simple homes as well. Homeowners can easily buy and apply similar fertilizers and pesticides to their individual properties. Load Allocations section (page 18) – It is important to mention the impact of homes along this waterway. They can be a significant contributor to the mix of pollution generators.

    Response: Comment acknowledged. The submittal report was revised according to this comment.

28. **Comment:** My land is clean because its wild. Anyone who cleans the land is guilty of pollution. Only a fence on each side of the river will stop water pollution.

    Response: Landowner participation is critical to the cleanup effort of the Union River. Preventing animal and human waste, as well as pesticides, herbicides and other pollutants, from leaving individual properties along the river will help reduce bacteria and other pollutant levels in the river. Ecology appreciates this landowner's effort to prevent pollution of the Union River.

29. **Comment:** I would like to recommend that the current citizen and agency board appointed by the Mason County Commissioner, LHCWIC, be utilized as the sitting committee to review the TMDL process. This committee is responsible for tracking nonpoint pollution remediation efforts in the watershed. It would be a wise use of resources and prevent duplication of effort to have this group look at the 400-12 plan implementation as well as the TMDL implementation.

    Response: Ecology agrees with this suggestion and LHCWIC has agreed to monitor the progress of Union River cleanup as part of nonpoint pollution control oversight currently being done by the group. Comment acknowledged. The submittal report was revised according to this comment.

30. **Comment:** There is no mention of the Chapter 400-12 WAC nonpoint pollution watershed plan and how they could be incorporated into the recovery efforts in the Overview, page 19.

    Response: Comment acknowledged and the submittal report was revised according to this comment.

31. **Comment:** Table 7 shows station UR4Arch applies to stream reach river mile 4.5 to headwaters – Where are the headwaters? Do you mean at the base of McKenna Falls where the discharge from the City's watershed occurs? Or where Bear Creek enters the Union River? It is not clear. It implies in Table 7 that the City of Bremerton would have to reduce by 17% the already very low levels of coliforms.

    Response: Comment acknowledged. This segment applies from RM 4.5 to McKenna Falls and headwaters of Union River tributaries that are downstream of McKenna Falls. The City

of Bremerton collects fecal coliform bacteria water samples above the study area at least five days per week at their McKenna Falls Intake Structure in compliance with the Safe Drinking Water Act/Surface Water Treatment Rule. Because this is an unfiltered water source for the city, 90% of the samples taken during the previous six months must be less than 20 fecal coliform colonies/100mL. The city has consistently found fecal coliform concentrations below this allowed amount (Cahall, 2001). The submittal report was revised according to this comment.

32. **Comment:** Could the areas designated as "upper" and "lower" Union River be located on the map?

    Response: Comment acknowledged. Upper Union River applies to the portion of Union River in Kitsap County. Lower Union River applies to the portion of Union River in Mason County. The map in Figure 1 shows the Kitsap-Mason County line. The submittal report was revised according to this comment.

33. **Comment:** The City of Bremerton does use all its rights on the Union River as the right is instantaneous discharge only.

    Response: Comment acknowledged. The submittal report was revised according to this comment.

34. **Comment:** Critical Conditions and Margin of Safety (page 18) – Will this TMDL be protective of water quality during the critical period of a low flow year when, as you say, summer months are the critical period when the FC standard is not being met, and the year of the Union River study (1999) was a high flow year? Please explain how the margin of safety is protective during the critical low flow period of a low flow year.

    Response: The City of Bremerton impounds the headwaters of the Union River with Casad Dam as drinking supply for the city. They meet or exceed the minimum downstream flow requirements of 3 cfs (October through May), 2 cfs (June) and 1 cfs (July through September). These minimum flow requirements are protective of the Union River during the critical period as minimum flow requirements are higher than some natural low flow conditions. The reservoir also regulates flow such that high flow events are mitigated to the extent possible based on the capacity of the reservoir.

    Precipitation date from McKenna Falls shows that the Union River received more rainfall in 1999 than average. Total precipitation in 1999 was 90.53 inches. The 30-year average from 1958 to 1998 is 62.05 inches. The majority of this precipitation fell in the winter months and the summer months received just below average rainfall. The winter months received 83.31 inches (January through April and October through December) and the summer months received 7.22 inches (May through September). The 30 year average of summer months (May through September) from 1958 to 1998 is 8.76 inches. Therefore the critical period of 1999 was comparable to an average critical period. Considering the minimum flow

requirements of Casad Dam, setting the MOS as the critical period of 1999 should be protective of a low-flow year.

In addition, according to EPA guidance, the Margin of Safety (MOS) is to take into account any lack of knowledge concerning the relationship between BMP effectiveness and water quality. This may be done implicitly by using conservative model assumptions or explicitly by specifying a portion of the total TMDL as MOS. This MOS uses conservative assumptions. By setting the highest monthly reduction necessary to the entire year, the MOS is highly conservative during the majority of months of the year. On an annual basis reduction of fecal coliform levels by the amount recommended will substantially reduce fecal coliform in the basin. Another implicit MOS is the cumulative effect of reductions at upstream stations. Reduction of upstream stations will remove some portion of loading shown at stations downstream.

35. **Comment:** Applicable Water Quality Standards – Since Washington's water quality standards were last adopted in November 1997, you might want to include a statement about the schedule for adoption of the new standards. Also, if the new standards for bacteria are going to use a different indicator organism, you might want to include a paragraph about how this TMDL will or will not be affected by the new standards.

    Response: Comment acknowledged. The submittal report was revised according to this comment.

36. **Comment:** Lynch Cove is also listed on the 303(d) list for fecal coliform. When is the TMDL for Lynch Cove scheduled and how will the Union River TMDL affect the TMDL for Lynch Cove? It would be helpful to include a discussion of how this TMDL is protective of water quality in Lynch Cove.

    Response: Comment acknowledged. The submittal report was revised according to this comment.

37. **Comment:** You state that at all stations the 10th percentile fecal coliform criterion will need to be lower than the value specified in the standards in order to meet the geometric mean. Is this true for Union River mile 0.4 in Table 2?

    Response: No. Comment is acknowledged and the submittal report was revised in accordance with this comment. The Station UR1HWY300 has a target geometric mean adjusted lower than the value specified in the water quality standards in order to adjust its sample distribution meet the part 2: 90th percentile criterion of the standards.

38. **Comment:** The Olympic View landfill is not mentioned in the list of potential sources starting on page 10. The landfill should be discussed and the reasons why it is or is not a major source. Fecal sources such as bird droppings and disposable diapers could impact the landfill's discharge.

Response: Comment is acknowledged and the submittal report was revised in accordance with this comment.

39. **Comment:** On page 13 of *Union River Fecal Coliform Total Maximum Daily Load Study* (Ward, et al., 2001 (Appendix B)), there is an error regarding the Standard Method for fecal coliform MPN. On the chart listed Data Quality, Under "Method", second line from the bottom, SM18 MPN 9221C should read SM18 MPN 9221E. Section C is used for the estimation of bacterial densities. Section D is the actual fecal coliform MPN method Ecology used.

    Response: Comment is acknowledged.

Appendix B: Technical Report

Bound separately as Ecology Publication Number 10-03-038.
"Union River Fecal Coliform Total Maximum Daily Load Study"

Also may be accessed online at http://www.ecy.wa.gov/biblio/0103038.html

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