Palouse River Bacteria Total Maximum Daily Load

Water Quality Study Design (Quality Assurance Project Plan)

July 2007

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Authors

Nuri Mathieu, Jim Carroll, and Brenda Nipp
Environmental Assessment Program
PO Box 47600
Washington State Department of Ecology
Olympia, Washington 98504-7710

Study Codes

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Total Maximum Daily Load Study Code is PRRF34FC.

303(d) Listings Addressed in this Study

Listing ID	Waterbody Description	Parameter
16791	Palouse River	Fecal Coliform
6715	Rebel Flat Creek	Fecal Coliform
6714	Rebel Flat Creek	Fecal Coliform
6716	Rebel Flat Creek	Fecal Coliform

Waterbody Number: WA- 34-1030

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Approvals

Approved by:	June 2007
Elaine Snouwaert, Eastern Regional Office	Date
Approved by:	July 2007
Dave Knight, Unit Supervisor, Eastern Regional Office	Date
Approved by:	June 2007
Jim Bellatty, Section Manager, Eastern Regional Office	Date
Approved by:	June 2007
Patrick McGuire, Permit Manager, Eastern Regional Office	Date
Approved by:	July 2007
Jim Carroll, Project Manager, Environmental Assessment Program	Date
Approved by:	June 2007
Brenda Nipp, Principal Investigator and Environmental Information Management Data Coordinator, Environmental Assessment Program	Date
Approved by:	June 2007
Nuri Mathieu, Quality Assurance Project Plan Author, Environmental Assessment Program	Date
Approved by:	June 2007
George Onwumere, Unit Supervisor, Environmental Assessment Program	Date
Approved by:	June 2007
Gary Arnold, Section Manager, Environmental Assessment Program	Date
Approved by:	June 2007
Bill Kammin, Ecology Quality Assurance Officer	Date
Approved by:	June 2007
Stuart Magoon, Manchester Environmental Laboratory	Date

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Glossary of Acronyms

CD	Conservation District
EA Program	Environmental Assessment Program
EIM	Environmental Information Management (system)
EPA	U.S. Environmental Protection Agency
FC	Fecal coliform
IDEQ	Idaho Department of Environmental Quality
LIMS	Laboratory Information Management System
MEL	Manchester Environmental Lab
MF	Membrane Filter
NF	North Fork (a.k.a. Palouse River from Idaho border to Colfax)
NIST	National Institute of Standards and Technology
NPDES	National Pollutant Discharge Elimination System
ODEQ	Oregon Department of Environmental Quality
PCD	Palouse Conservation District
PDT	Pacific Daylight Savings Time
PST	Pacific Standard Time
QA/QC	Quality Assurance/Quality Control
RM	River Mile
RSD	Relative Standard Deviation
%RSD	Percent Relative Standard Deviation
SF	South Fork
TIR	Thermal Infra-red remote sensing
TMDL	Total Maximum Daily Load
USGS	US Geological Survey
UV	UltraViolet
WRIA	Watershed Resource Inventory Area
WSDOT	Washington State Department of Transportation
WWTP	Wastewater Treatment Plant

Abstract

The Palouse River, Rebel Flat Creek, and Cow Creek have been listed by Washington State under Section 303(d) of the Clean Water Act for non-attainment of Washington State fecal coliform bacteria criteria. The listings on the Palouse River and Rebel Flat Creek are based on sampling done by the Washington State Department of Ecology (Ecology) in 1988 and 1993-2001. The listing on Cow Creek is based on sampling done by Adams County Conservation District in 2003. Additional 303(d) listings exist within the Palouse River watershed for temperature, dissolved oxygen, and pH that are being addressed by other related studies.

U.S. Environmental Protection Agency requires states to set priorities for cleaning up 303(d) listed waters and to establish a Total Maximum Daily Load (TMDL) for each. A TMDL entails an analysis of how much of a pollutant load a waterbody can assimilate without violating water quality standards. The Palouse River TMDL study will address the 303(d) listings within the watershed with three separate Quality Assurance (QA) Project Plans: one for bacteria, one for temperature, and one for dissolved oxygen and pH.

This QA Project Plan describes the technical study that will monitor levels of fecal coliform bacteria in the Palouse River watershed and will form the basis for a bacteria TMDL. The study will be conducted by Ecology's Environmental Assessment Program.

What is a Total Maximum Daily Load (TMDL)?

Federal Clean Water Act Requirements

The Clean Water Act established a process to identify and clean up polluted waters. Under the Clean Water Act, each state is required to have water quality standards designed to protect, restore, and preserve water quality. Water quality standards are set to protect designated uses such as cold water biota and drinking water supply. The TMDL is a watershed cleanup plan designed to improve water quality.

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

Water Quality Assessment/Categories 1-5

The 303(d) list is part of the larger Water Quality Assessment. The Water Quality Assessment |is a list that tells a more complete story about the condition of Washington's water. This list divides waterbodies into five categories:

- Category 1 – Meets standards for parameter for which it has been tested.
- Category 2 – Waters of concern.
- Category 3 – Waters with no data available.
- Category 4 – Polluted waters that do not require a TMDL because:
  - 4a – Has a TMDL approved and its being implemented
  - 4b – Has a pollution control plan in place that should solve the problem
  - 4c – Is impaired by a non-pollutant such as low water flow, dams, culverts
- Category 5 – Polluted waters that require a TMDL—on the 303(d) list.

TMDL Process Overview

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

Elements Required in a TMDL

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

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

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

Total Maximum Daily Load Analyses: Loading Capacity

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

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

Why is Ecology Conducting a TMDL Study in This Watershed?

Ecology is conducting a TMDL study in the Palouse River watershed because there is one reach on the Palouse River exceeding surface water quality standards for fecal coliform (FC) bacteria. Furthermore, FC standard exceedances occur in sections of Rebel Flat Creek, Pleasant Valley Creek, and Cow Creek.

There is high interest in water quality issues in this basin, demonstrated by the level of cooperative sampling and water management currently occurring. Ecology hopes to build on previous efforts and work cooperatively with all contributing entities to generate a better understanding of FC issues in this watershed.

As part of this TMDL, Ecology will conduct field work during the summer of 2007 to characterize FC concentrations. The study will also establish load and wasteload allocations to reduce bacteria sources in the system to meet Washington State FC surface water quality standards.

Quality Assurance Project Plan will describe the study design for the Palouse River FC TMDL. Topics discussed include the watershed study area, project objectives, historical data, and field data collection plan.

Overview

The Palouse River and its tributaries flow through Water Resource Inventory Area (WRIA) 34 in southeastern Washington. The upper part of the watershed extends into western Idaho beyond Potlatch. The Idaho Department of Environmental Quality (IDEQ) developed a TMDL for the upper tributaries in the Idaho part of the Palouse River watershed. Ecology's technical study for the North Fork (NF) Palouse River FC Bacteria TMDL was completed in May 2004 (Ahmed, 2004) and the TMDL was approved in March 2005. The TMDL addressed bacteria pollution from just upstream of the confluence with the South Fork (SF) Palouse River in Colfax to the Washington-Idaho border. The Washington portion of the SF Palouse River was the subject of a one-year data collection project, which started in 2006 for a related multi-parameter TMDL study, which included FC.

The bacteria TMDL effort for 2007-2008 will focus on the mainstem Palouse River and the mouths of its major tributaries (Figure 1). The study area includes one waterbody segment on the Palouse River and three on Rebel Flat Creek impaired by FC as listed in the 2004 Clean Water Act Section 303(d) list (Table 1) (Ecology, 2006a). Listings on Cow Creek and Pleasant Valley Creek will not be addressed in this study. Pleasant Valley Creek will not be addressed due to resource constraints.

Implementation activities which should address the FC bacteria impairment in Cow Creek have been ongoing. An evaluation of these efforts is underway to determine if this listing can be reclassified to Category 4b (addressed by a water pollution control plan). For that reason this TMDL will only address the mouth of Cow Creek.

Table 1: WRIA 34 Fecal Coliform 2004 303(d) listings.

Listing ID	Waterbody Description	Parameter	Township	Range	Section
40662	Cow Creek	Fecal Coliform	18N	36E	14
16791	**Palouse River**	Fecal Coliform	15N	37E	26
42792	Pleasant Valley Creek	Fecal Coliform	19N	41E	34
6715	**Rebel Flat Creek**	Fecal Coliform	17N	41E	31
6714	**Rebel Flat Creek**	Fecal Coliform	17N	40E	25
6716	**Rebel Flat Creek**	Fecal Coliform	17N	41E	33

Bold represents fecal coliform bacteria listing directly addressed by this study.

Project Objectives

Objectives of the proposed study are as follows:

- Identify and characterize FC bacteria concentrations and loads from all major tributaries, point sources, and drainages into the mainstem Palouse River under various seasonal or hydrological conditions.

- Calculate percent reductions needed from sources and establish FC load allocations (for nonpoint sources) and wasteload allocations (for point sources) to protect beneficial uses, including primary and secondary contact.

- Identify relative contributions of FC loading to the mainstem Palouse River so clean-up activities can focus on the largest sources.

Watershed Description

The Palouse River basin is located primarily in Whitman County, Washington, and its headwaters are in Latah County, Idaho (Figure 1). The Palouse River flows along the border of Whitman, Adams, and Franklin Counties near its confluence with the Snake River. The Snake River flows into the Columbia River that flows into the Pacific Ocean. Palouse Falls (182 foot cliff) occurs six river miles upstream of the Palouse River's mouth. The section that extends roughly 54 river miles upstream from the SF Palouse River confluence is locally referred to as the NF Palouse River. Palouse River headwaters start within the Palouse Mountain Range in St. Joe National Forest (Resource Planning Unlimited, Inc., 2004).

The Palouse River is approximately 144 miles long, 120 miles of which is within Washington State and its watershed area is approximately 3,281 square miles (2,099,832 acres). The NF Palouse River basin area is approximately 495 square miles (316,799 acres) and contributes around 83% of the mean annual flow of the Palouse River at Colfax (Ahmed, 2004). The SF Palouse River basin area is approximately 344 square miles (219,943 acres) and joins the Palouse River at Colfax (Bilhimer et al., 2006).

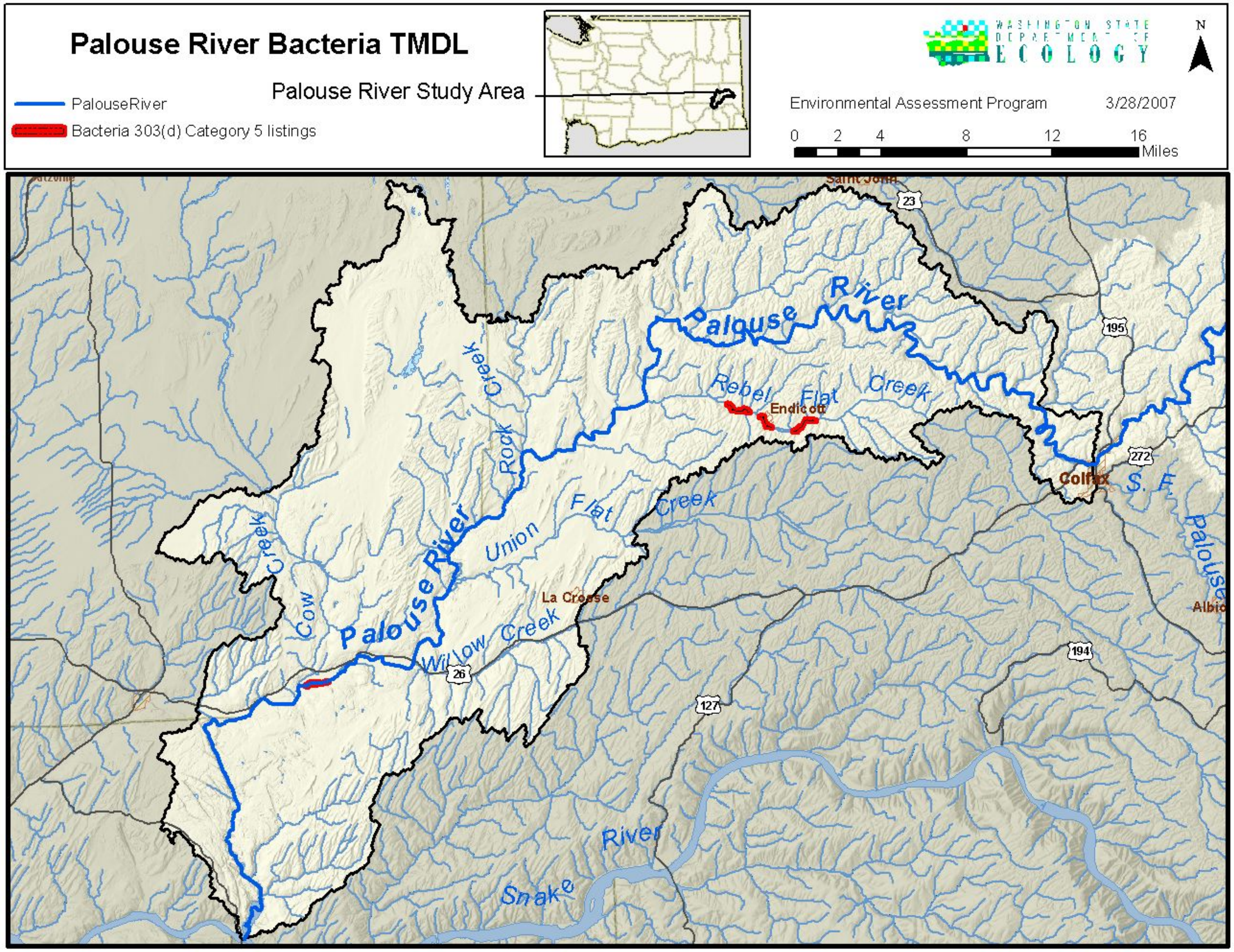

Figure 1: Palouse River Watershed.

Hydrology

The Palouse River system includes over 398 miles of streams. Major tributaries and their approximate relative percent contribution of drainage area are:

- Cow Creek 22.4%
- Palouse River Mainstem 17.2%
- North Fork Palouse River 14.9%
- Rock Creek 12.1%
- Union Flat Creek 9.6%
- Pine Creek 10.8%
- South Fork Palouse River 8.9%
- Cottonwood Creek 4.2%

(Golder Associates, Inc., 2004)

The United States Geological Survey (USGS) currently operates two streamflow gages on the Palouse River.

- USGS streamflow gage station #13351000 is located near Hooper, WA at river mile 19.6 downstream of the State Highway 26 Bridge and 0.3 miles upstream of Cow Creek confluence. This gage station captures 2,500 square miles of the Palouse River watershed. It began recording in 1897, ceased during 1916, then started again in 1951 till present.
- USGS streamflow gage #13345000 is located near Potlatch, ID at river mile 132.2 downstream of US Highway 95. This gage station near Potlatch captures 317 square miles of the Palouse watershed. It has recorded from 1914 to 1919, and 1966 to present.

Figures 2 and 3 depict the mean monthly flow of the Palouse River recorded at Hooper and Potlatch. Peak flows typically occur from January through March, and baseflows from August through September.

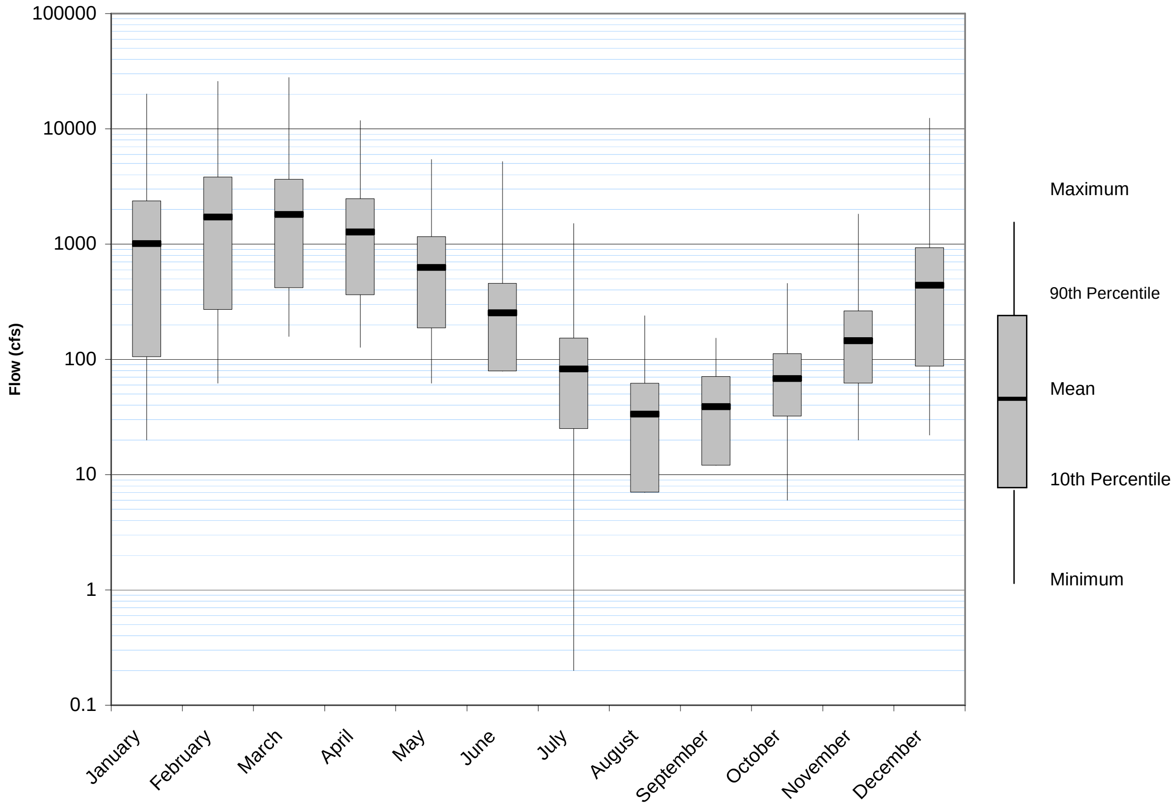

Figure 2. USGS stream gage mean monthly flows for the Palouse River near Hooper, WA.

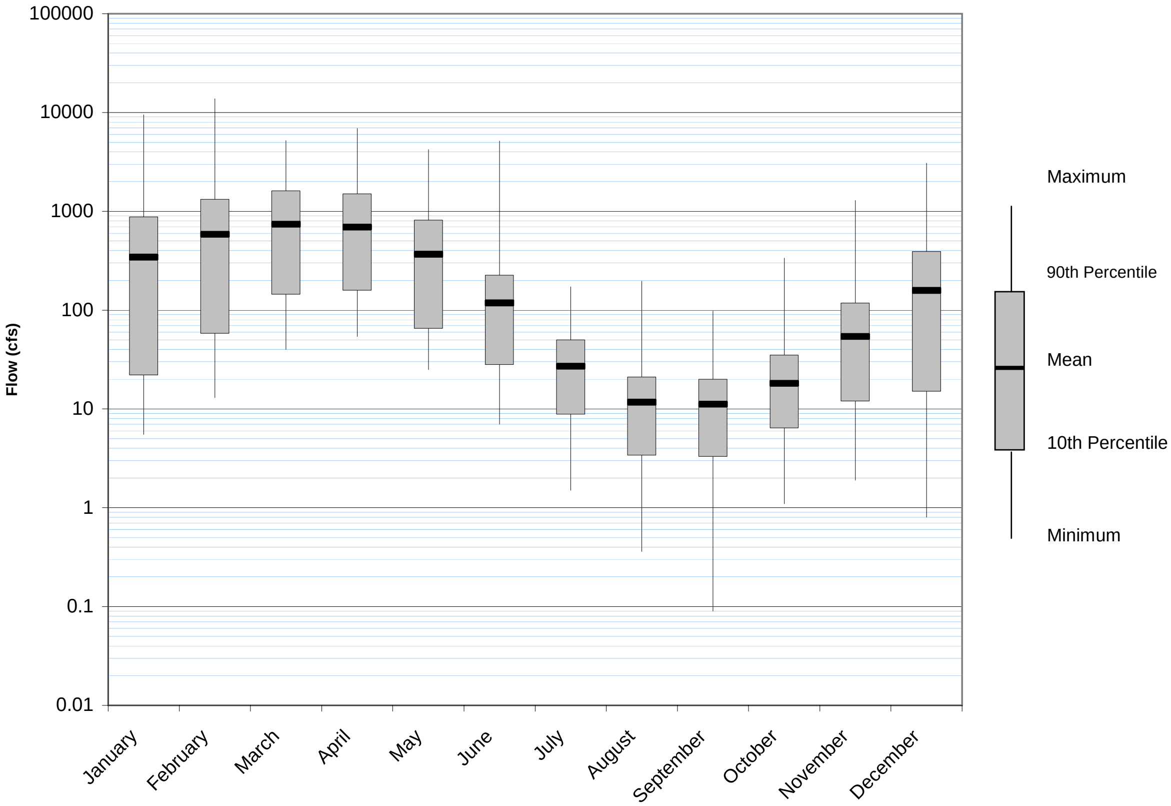

Figure 3. USGS stream gage mean monthly flows for the Palouse River near Potlatch, ID.

Land-Use Patterns

Land use within the study area is dominated by agriculture and rangeland with small rural city populations. Colfax (population about 3,000) is the largest town within the Palouse watershed not including the SF Palouse subbasin. The next largest town is Palouse (population about 1,000), followed by Garfield (population 630). Smaller towns, with populations not exceeding 350, are located within the watershed as well (WA OFM, 2005). Agricultural use of water from the Palouse River is limited to adjacent land. To date, slightly over 100 water rights exist that draw from the Palouse River. These surface water withdrawals are typically used for irrigation and stock. Rangeland mostly occurs in the scablands or the western region of the Palouse River watershed (Resource Planning Unlimited, Inc., 2004).

Geology

Around 110 million years ago, geologic activity forced giant granite slabs upward initiating the features of southeast Washington. Eventually regional volcanic activity began. Fissures opened as the Palouse River basin received intermittent lava flows 10-30 million years ago that filled valleys with Columbia River basin basalts. Receding ice-age glaciers coupled with an arid climate produced fine-grained sediment that was carried by prevailing winds. This wind-blown sediment, called loess, deposited on the basalt forming large dunes known as the Palouse formation. Immense Missoula floods occurred several times, washing away areas of loess, altering the landscape, and creating channeled scablands. These scablands comprise an area of approximately 15,000 square miles including segments of the Spokane, Snake, and Columbia Rivers (Resource Planning Unlimited, Inc., 2004 and Kuttel Jr., 2002).

Vegetation

Historically, the Palouse River watershed supported a variety of vegetation depending on sub-regional climate. For example, the eastern region of the watershed predominantly grew two types of perennial grass: Idaho fescue (*Festuca idahoensis*) and blue bunch wheatgrass (*Pseudoregneria spicata*). Shrubs included snowberry (*Symphoricarpos* spp.), black hawthorn (*Crataegus douglasii*), and rose (*Rosa* spp.) that grew often on the north aspect of the loess hills. Riparian areas in the eastern region commonly supported quaking aspen (*Populus tremuloides*) and cow parsnip (*Heracleum lanatum*) among other mentioned species herein.

Forest communities grew in the higher elevations of the eastern region. Such species included ponderosa pine (*Pinus ponderosa*), Douglas fir (*Pseudotsuga menziesii*), western red cedar (*Thuja plicata*), grand fir (*Abies grandis*), and western larch (*Larix occidentalis*), depending on aspect and available water. The forest understory included ocean spray (*Holodiscus discolor*), ninebark (*Physocarpus malvaceus*), serviceberry (*Amelanchier alnifolia*), snowberry, and wild rose.

Historically, wetlands existed across the watershed with the greatest amount in the northwest region. The highly diverse wetland vegetation was dominated by camas, forbs, sedges, rushes, and grasses.

The western region of the watershed was dominated by bluebunch wheatgrass. The western region riparian corridor also supported trees such as cottonwood (*Populus deltoids*), quaking aspen, mountain maple (*Acer glabrum*), and red alder (*Alnus rubra*). Currently, most of the Palouse Prairie has been converted to cropland (Resource Planning Unlimited, Inc., 2004).

Climate

The Palouse River watershed has a semi-arid climate. Annual precipitation in this watershed can range from 10 inches in the western region to 50 inches in the eastern region mountains of Idaho. Along the more mountainous eastern region, mean annual precipitation increases roughly seven inches with every 1,000 foot increase in elevation. Precipitation peaks during winter and falls primarily as snow especially in the mountains (Resource Planning Unlimited, Inc., 2004). A drought was declared in 2001 and 2005. Summer daily maximum air temperatures can range from mid-70ºF to mid-90ºF (around 21ºC to 35ºC) and occasionally over 100ºF (37.8ºC).

Potential Sources of Bacteria

Point Sources

Wastewater treatment plants (WWTPs) are point source contributors in the Palouse River watershed. Point source contributors, relative to this TMDL study, include sources that discharge either into an immediate tributary of the Palouse River or directly into the Palouse River (Table 2) (Ecology, 2006b). The Colfax and Endicott WWTPs discharge within the study area and will be addressed by this TMDL.

The Endicott treatment plant was upgraded in 2001 from an aging trickling filter facility with chlorine disinfection to an activated sludge secondary treatment plant with UltraViolet (UV) disinfection. The plant discharges to Rebel Flat Creek at river mile 5.9.

In Colfax, the wastewater treatment plant consists of aerated lagoons, infiltration cells, and chlorine disinfection. It discharges to the Palouse River below the confluence of the North and South Forks at river mile 89.5 (Ecology, 2006b).

Table 2. Point sources addressed in this study that discharge into the Palouse River or into an immediately associated tributary.

WWTP Facility	Facility Type	Permit Type	City	Permit #	Discharges to	Year Round/ Seasonal
Colfax WWTP	Municipal	Minor	Colfax	WA0020613B	Palouse	Year Round
Endicott WWTP	Municipal	Minor	Endicott	WA0023981C	Rebel Flat	Year Round

Wildlife and Background Sources

A wide variety of perching birds, upland game birds, raptors, and waterfowl are found within the Palouse River bacteria study area. Birds, elk, deer, moose, beaver, muskrat, and other wildlife in rural areas are potential sources of FC bacteria. Open fields and riparian areas lacking vegetation are attractive feeding and roosting grounds for some birds whose presence can increase FC counts in runoff.

Usually these sources are dispersed and do not elevate FC counts over state criteria. Sometimes animals are locally concentrated and can cause elevated counts. Concentrated bird or wildlife presence in the watershed will be noted during sampling surveys.

Nonpoint Sources

Nonpoint sources and practices are dispersed and not controlled by discharge permits. Several types of potential nonpoint sources are present in the study area. Range and pastured livestock with direct access to streams can be a source of FC contamination. Poor livestock or pet manure management on non-commercial farms is another source. Poorly constructed or maintained onsite septic systems are also potential sources in the watershed.

FC bacteria from nonpoint sources are transported to the creeks by direct and indirect means. Manure that is spread over fields during certain times of the year can enter streams via surface runoff or fluctuating water levels. Often livestock have direct access to water. Manure is deposited in the riparian area of the access points where fluctuating water levels, surface runoff, or constant trampling can transport the manure into the water. Some residences may have wastewater piped directly to waterways or may have malfunctioning on-site septic systems where effluent seeps to nearby waterways. Pet waste concentrated in public parks or private residences can be a source of contamination, particularly in urban areas. Swales, subsurface drains, and flooding through pastures and near homes can carry FC bacteria from sources to waterways.

Water Quality Standards and Beneficial Uses

Bacteria criteria are set to protect people who work and play in and on the water from waterborne illnesses. In Washington State, Ecology's water quality standards use FC as an *indicator bacteria* for the state's freshwaters (e.g., lakes and streams). FC in water *indicates* the presence of waste from humans and other warm-blooded animals. Waste from warm-blooded animals is more likely to contain pathogens that will cause illness in humans than waste from cold-blooded animals. The FC criteria are set at levels that are shown to maintain low rates of serious intestinal illness (gastroenteritis) in people.

A revised water quality standards' rule (Chapter 173-201A WAC) was adopted on July 1, 2003, replacing the previous rule established in 1997. The freshwater bacteria criteria portion of this version has recently been approved by EPA. Under the 1997 rule, the entire stretch of the mainstem Palouse River from the mouth to the river mile 89.6 was classified as Class B. According to the 2003 rule, the mainstem of the Palouse River from the mouth to Palouse Falls is now classified as *Primary Contact Recreation* water and from Palouse Falls to river mile 89.6 is classified as *Secondary Contact Recreation* water.

The *Primary Contact* use is intended for waters *where a person would have direct contact with water to the point of complete submergence including, but not limited to, skin diving, swimming, and waterskiing*. More to the point, however, the use is designated to any waters where human exposure is likely to include exposure of the eyes, ears, nose, and throat. Since children are also the most sensitive group for many of the waterborne pathogens of concern, even shallow waters may warrant primary contact protection. To protect this use category: *FC organism levels must not exceed a geometric mean value of 100 colonies/100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 200/colonies mL* [WAC 173-201A-200(2)(b), 2003 edition].

The *Secondary Contact* use is intended for waters *where a person's water contact would be limited (e.g., wading or fishing) to the extent that bacterial infections of the eyes, ears, respiratory or digestive systems, or urogenital areas would be normally avoided*. To protect this use category: *FC organism levels must not exceed a geometric mean value of 200 colonies/100 mL, with not more than 10 percent of all samples (or any single sample when less than ten* *sample points exist) obtained for calculating the geometric mean value exceeding 400/colonies mL* [WAC 173-201A-200(2)(b), 2003 edition].

Compliance is based on meeting both the geometric mean criterion and the 10% of samples (or single sample if less than ten total samples) limit. In Washington State FC TMDL studies, the upper limit statistic (i.e., not more than 10% of the samples shall exceed) has been interpreted as a 90^{th} percentile value of the log-normalized values (Cusimano, 1997; Joy, 2000; Sargeant, 2002). These two measures used in combination ensure that bacterial pollution in a waterbody will be maintained at levels that will not cause a greater risk to human health than intended. While some discretion exists for selecting sample-averaging periods, compliance will be evaluated for both monthly (if five or more samples exist) and seasonal (summer versus winter) data sets.

The criteria for FC are based on allowing no more than the pre-determined risk of illness to humans that work or recreate in a waterbody. The criteria used in the state standards are designed to allow seven or fewer illnesses out of every 1,000 people engaged in primary contact activities. Once the concentration of FC in the water reaches the numeric criterion, human activities that would increase the concentration above the criteria are not allowed. If the criterion is exceeded, the state will require that human activities be conducted in a manner that will bring FC concentrations back into compliance with the standard.

If natural levels of FC (from wildlife) cause criteria to be exceeded, no allowance exists for human sources to measurably increase bacterial pollution. The specific level of illness rates caused by animal versus human sources has not been quantitatively determined. However, warm-blooded animals (particularly those that are managed by humans and thus exposed to human derived pathogens as well as those of animal origin) are a common source of serious waterborne illness for humans.

Historical Data Review

Washington State Department of Ecology—Ambient Monitoring

Ecology has collected ambient monitoring data, including FC and streamflow, from the Palouse River at Hooper (Station 34A070) since 1974 (Ecology, 2006c). Data was not collected from this station from October 1974 to September 1977. Ambient monitoring records from this site contain FC bacteria counts that indicate non-compliance with water quality standards (Figure 6). FC counts and loads at 34A070 show a seasonal cycle. FC loads are determined by taking the number of colony forming units (cfu) per volume of the sample (e.g., cfu/100mL) and multiplying by the volume of streamflow over time (e.g., cubic feet per second). Concentrations are slightly higher in the months of June through October while loading is highest in fall, winter, and spring when flows are high (Figures 5-7).

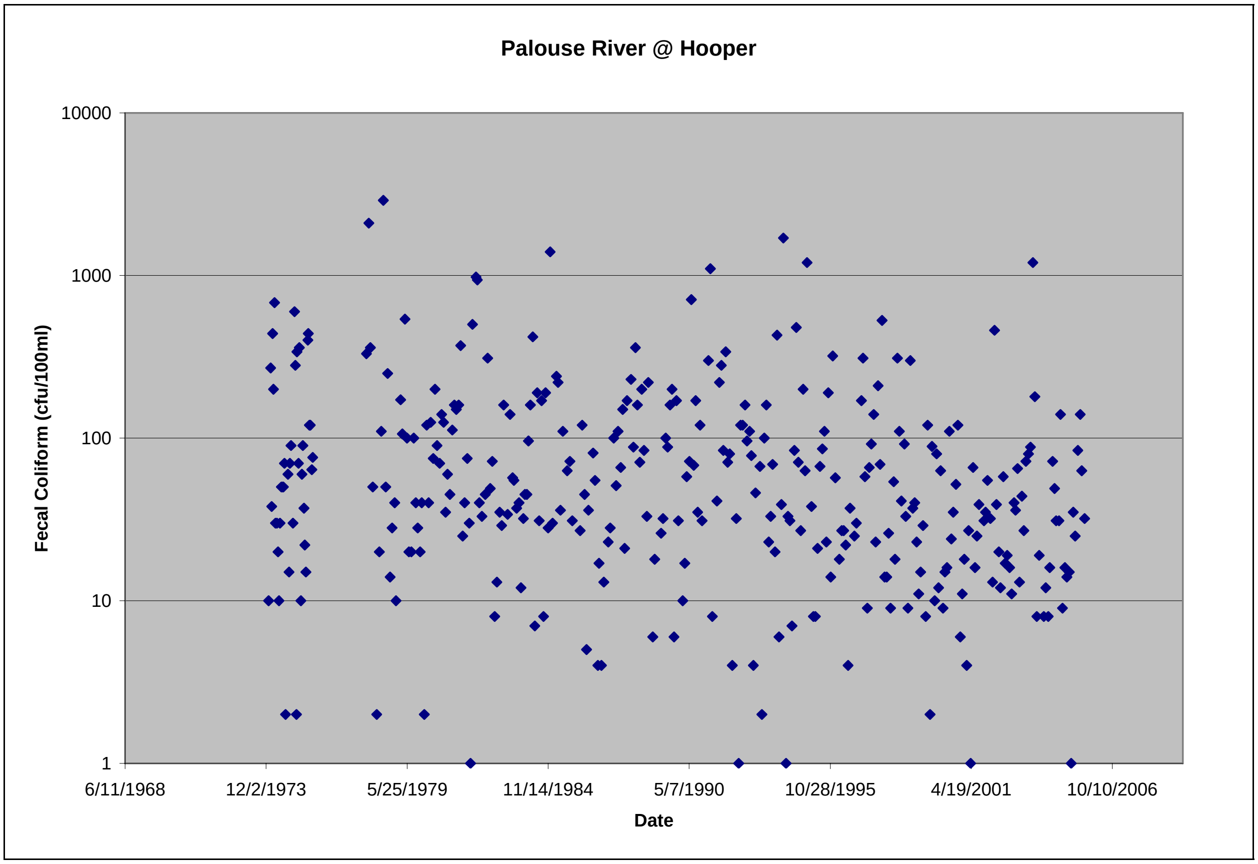

Figure 4. FC concentrations collected from the Palouse River at Hooper ambient monitoring station (34A070) from 1973 to 2005.

A recent historical data review for the SF Palouse River TMDL indicates that the annual mean FC concentrations and loads have dropped significantly since a gap in monitoring during October 1992 to September 1994 (Mathieu and Carroll, 2006). To maintain consistency, the historical data review in this QA Project Plan for the mainstem Palouse River focuses on data from 1994 to 2005.

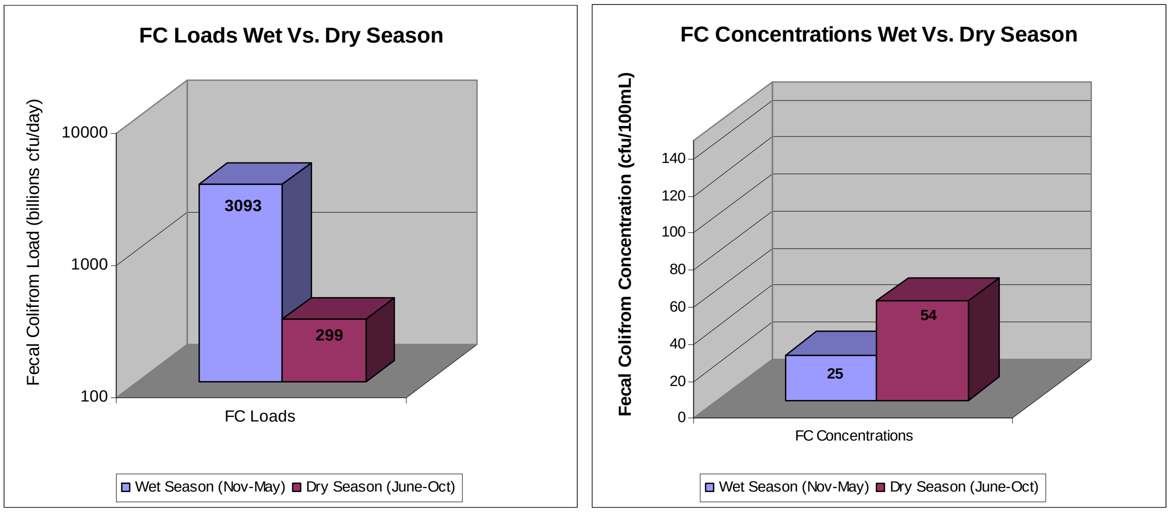

Figure 5. Comparison of FC loads and geometric mean concentrations during the wet and dry seasons for the Palouse River at Hooper (Station 34A070), 1994-2005.

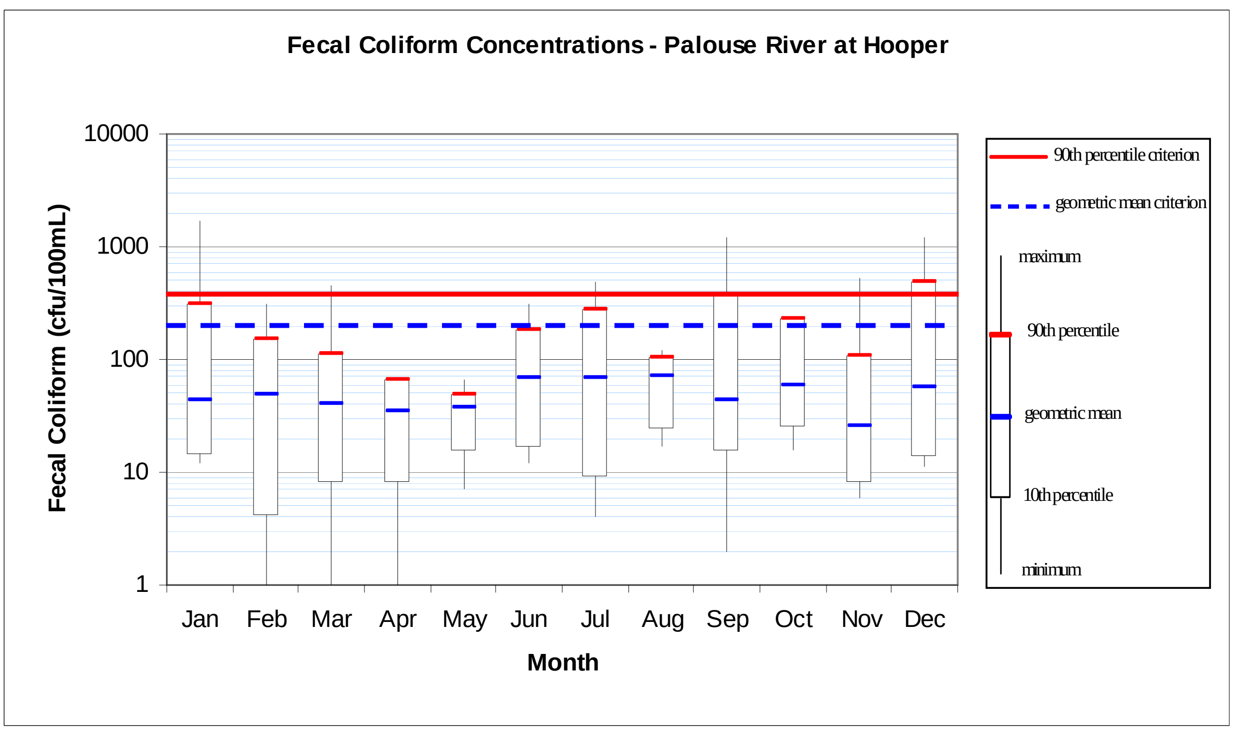

Figure 6. Palouse River at Hooper monthly average FC concentrations from Ecology's Ambient Monitoring Program, 1994-2005 (10 or more samples/month).

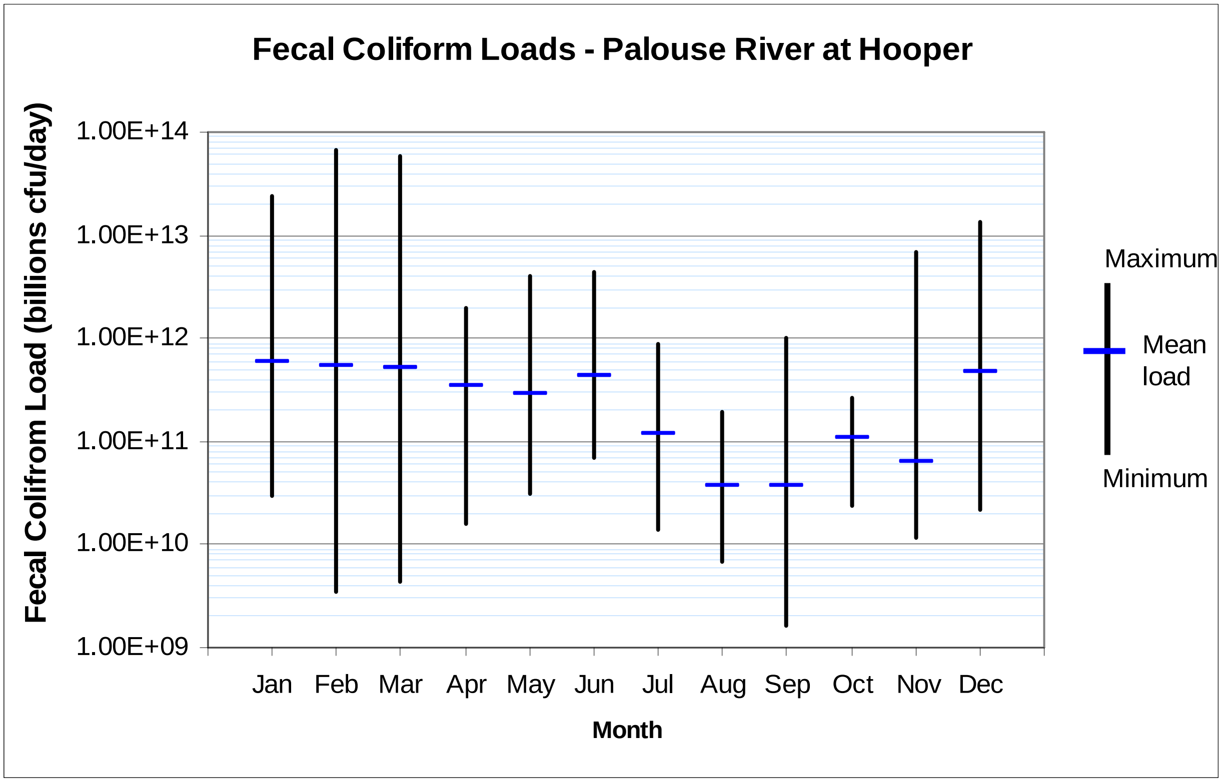

Figure 7. Palouse River at Hooper FC loads from Ecology's monthly Ambient Monitoring Program, from 1994 - 2005 (10 or more samples/month).

Washington State Department of Ecology and Palouse Conservation District—NF Palouse River FC TMDL

In 2004, Ecology completed an analysis of FC data and made TMDL recommendations for the NF Palouse River from the Washington-Idaho border to Colfax. A TMDL for bacteria was completed and approved by EPA in March 2005. The TMDL was based on long-term Ecology monitoring conducted from 1992-2003 and monitoring by the Palouse Conservation District at eleven stations from 2001-2003. Table 3 illustrates the target FC reductions for the NF Palouse River at River Mile 90.2 just upstream of the confluence with the SF Palouse River.

Table 3. Target FC reductions in the mainstem NF Palouse River at River Mile (RM) 90.2 (Ecology Station B) just upstream of the confluence with the SF Palouse River, 2001-2002.

Location	Period	Number of Samples	Geometric mean (cfu/100 mL)	90th percentile (cfu/100 mL)	Limiting basis for reduction	Target reduction (%)
Ecology Station B (RM 90.2)	Annual	12	37	313	90th percentile	36

Washington State Department of Ecology—Endicott Wastewater Treatment Plant and Rebel Flat Creek

In 1988, Ecology conducted a Class II inspection of the Endicott WWTP and the impact of its discharge to Rebel Flat Creek. The study observed violations of state water quality standards for FC in the WWTP effluent, as well as upstream and downstream of the plant on Rebel Flat Creek. FC concentrations on Rebel Flat Creek below the WWTP discharge outfall dropped dramatically from River Mile 5.9 to 5.6; which, when compared to instream chlorine results, indicates that chlorination was continuing to occur in Rebel Flat Creek. High concentrations at River Mile (RM) 7.7 and 5.4 were attributed to livestock with direct access to the creek in these areas (Wilms and Kendra, 1990). 303(d) listings for FC on Rebel Flat Creek are based on the results of this study.

The facility was upgraded in 2001 to an activated sludge secondary treatment plant with UV disinfection. Figures 8 and 9 display the monthly and weekly geometric means of self-monitoring results from 1994 to 2007. The results illustrate a decrease in FC concentrations following the completion of the new facility in 2001.

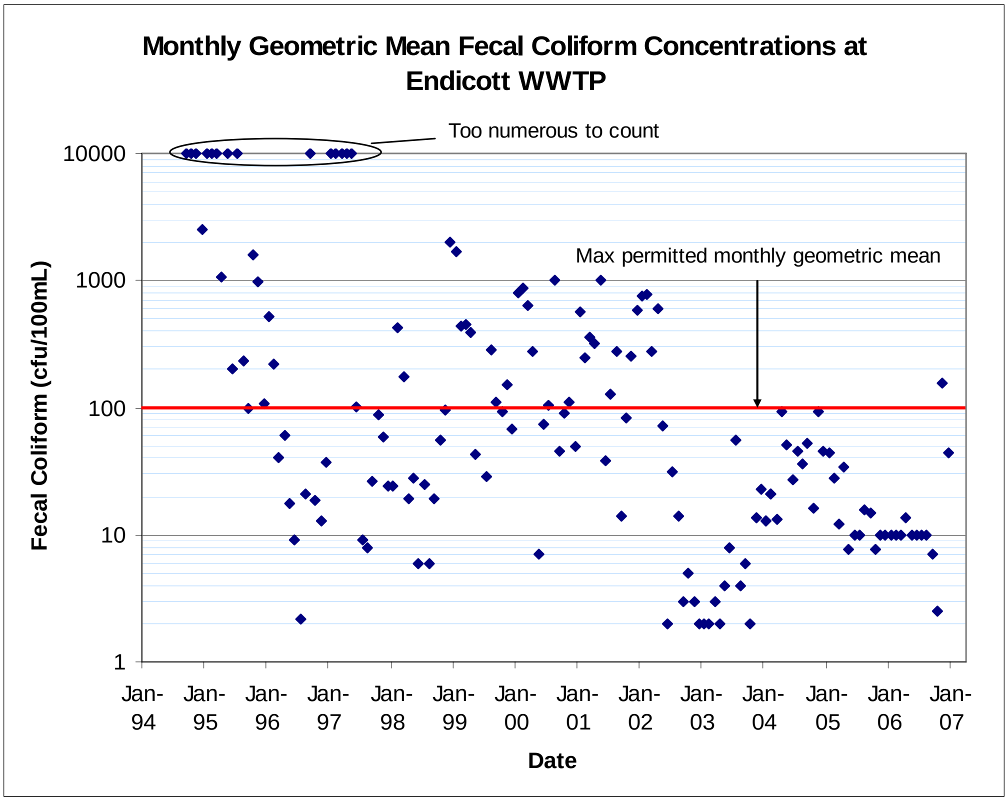

Figure 8. Monthly geometric mean bacteria data from Endicott WWTP effluent for 1994-2007.

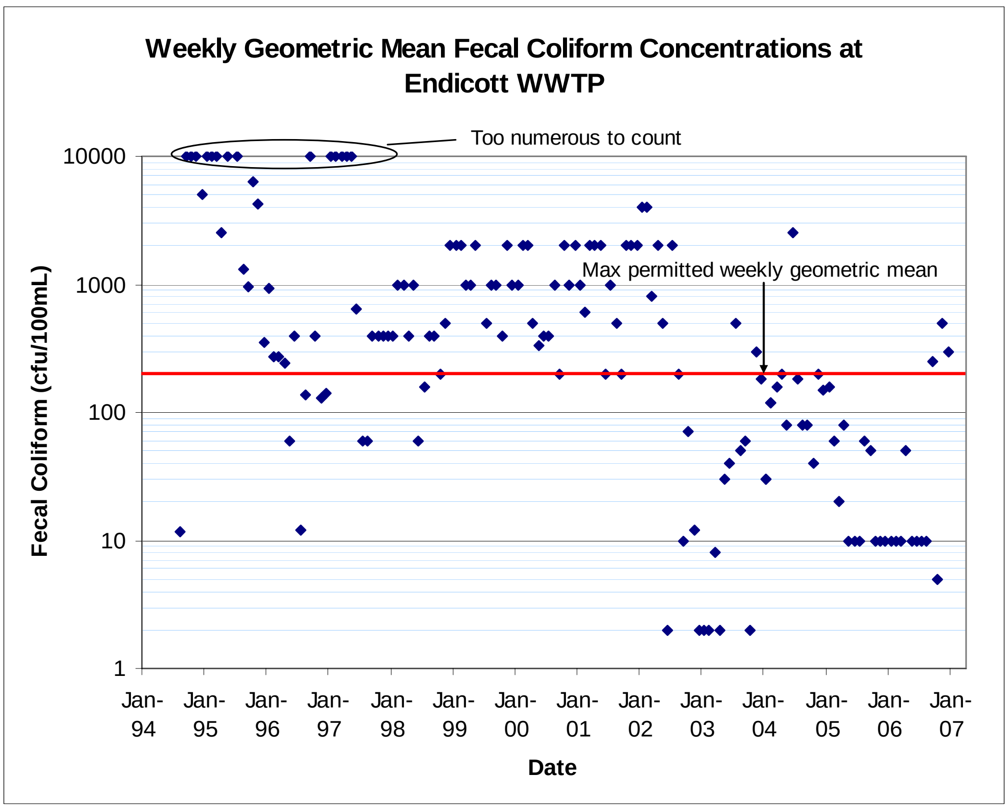

Figure 9. Weekly geometric mean bacteria data from Endicott WWTP effluent for 1994-2007.

Colfax Wastewater Treatment Plant

The Colfax WWTP is located at the western edge of Colfax off Highway 26. The plant uses chlorine to disinfect their treated effluent and discharges to the mainstem Palouse River below the confluence with the North and South Forks. Figures 10 and 11 illustrate the monthly and weekly geometric means of self-monitoring results from 1994 to 2007.

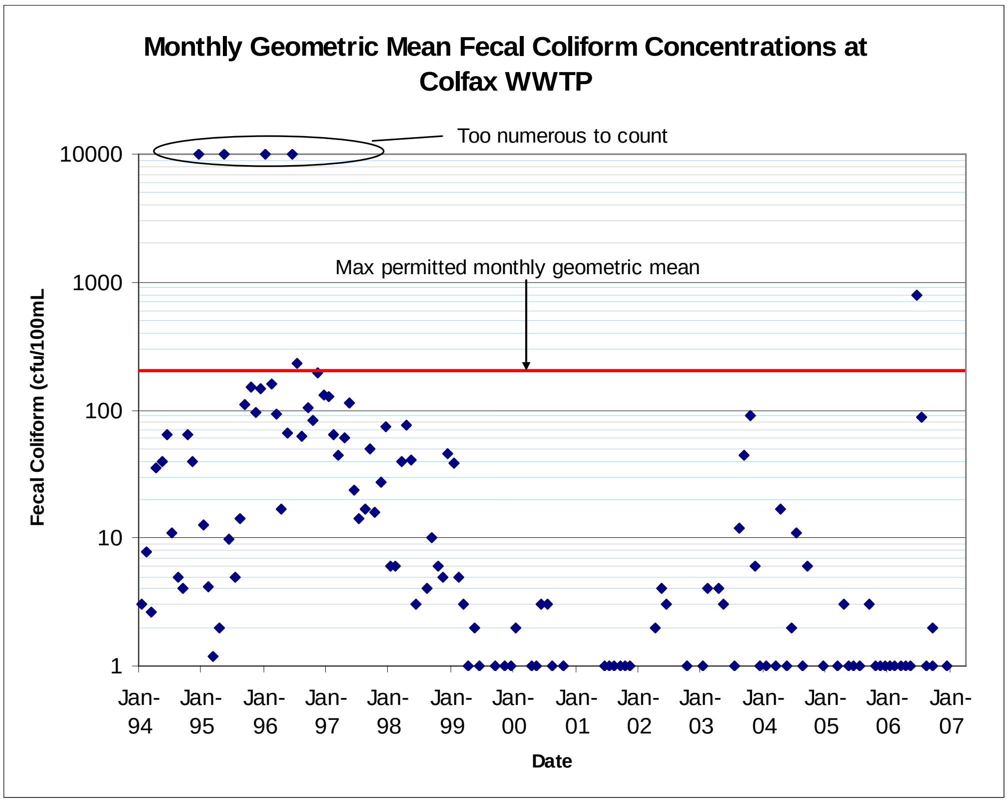

Figure 10. Monthly geometric mean bacteria data from Colfax WWTP effluent for 1994-2007.

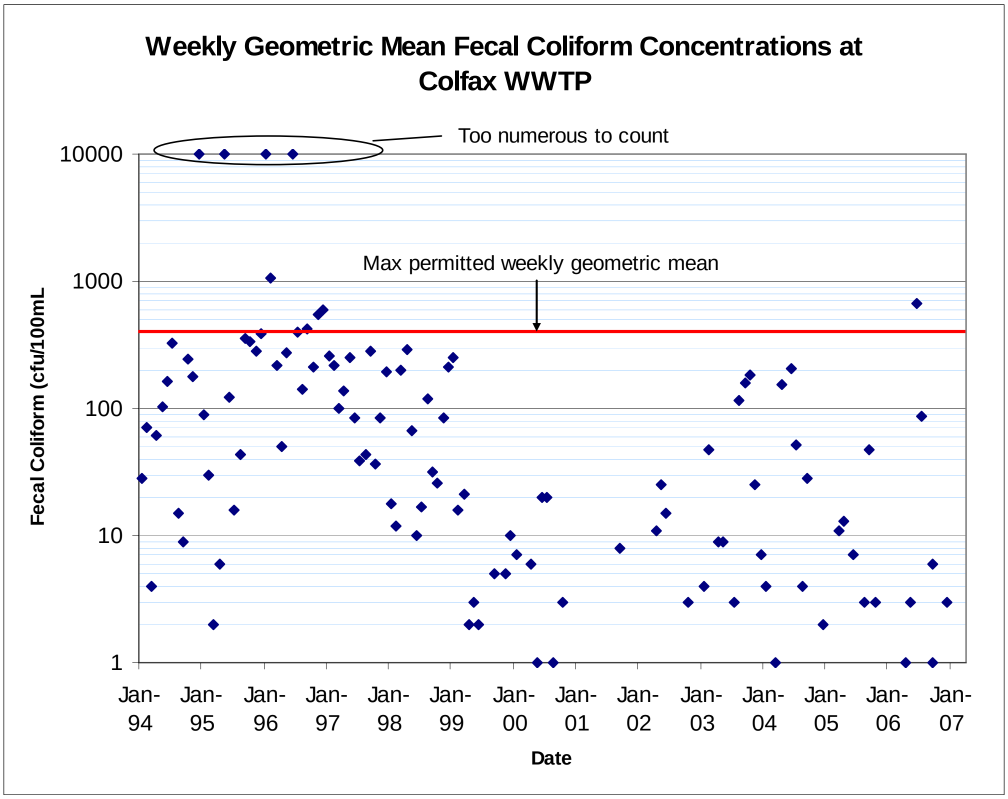

Figure 11. Weekly geometric mean bacteria data from Colfax WWTP effluent for 1994-2007.

Adams County Conservation District

Adams County Conservation District (CD) recently received funding from Ecology to conduct the Palouse River Watershed Implementation Project, which is designed to provide fencing, off-stream watering, and riparian enhancement within the watershed from 2006-2009. The project will also include monitoring to assess the impact of these implementation activities and provide support for the development of this and other TMDLs (Quast and Devore, 2005). Table 4 compares 2006 Adams CD monitoring results to state water quality criteria.

Table 4. FC data collected by Adams County Conservation District in 2006. Values that exceed state water quality criteria are highlighted.

Fecal Coliform Bacteria Violations Summary Table 2006			
Sites	**Description**	**Geomean Criteria**	**10% Criteria**
Class A		***Geomean <100***	***No more than 10% >200***
Cow Creek Hooper	Cow Creek near mouth at Gray Rd.	160	36.4%
Willow Creek	Willow Creek at RM 1.0 at Rock Springs Rd.	16	4.8%
Union Flat Creek	Union Flat Creek near mouth	133	33.3%
Rebel Flat Creek	Rebel Flat Creek near mouth	173	38.9%
Rock Creek	Rock Creek near mouth	16	0.0%
Class B		***Geomean <200***	***No more than 10% >400***
Adams Whitman Palouse	Palouse River at Adams-Whitman County Border	38	0.0%
Hooper Palouse	Palouse River at Ecology ambient monitoring site 34A070	26	0.0%
West Hooper Palouse	Palouse River at W. Hooper Bridge	36	4.8%
Palouse Winona	Palouse River near Winona	32	0.0%

Project Description

Study Design

The project objectives will be met through characterizing annual and seasonal FC bacteria loads in the Palouse River and its tributaries. FC concentrations will be monitored at the mouths of all major tributaries, point sources, and significant drainage/discharges. When possible, flow will be measured at all sites at the time of sampling.

The Palouse River Bacteria TMDL will use a fixed network of sites sampled bi-monthly throughout the course of the project, from June 2007 to May 2008.

Continuous streamflow data will be obtained from six stream gaging stations:

- Palouse River at Hooper (USGS).
- Palouse River above Rebel Flat Creek (Ecology).
- Palouse River at RM 66.7 (Ecology).
- SF Palouse River at the mouth (Ecology).
- NF Palouse River at the mouth (Ecology).
- Palouse River at the Washington-Idaho border (Ecology).

Ecology may also install staff gages at other sites to develop discharge rating curves based on stage.

Water Quality Sampling

The study will provide FC data sets to meet the following needs:

- Provide an estimate of the annual and seasonal geometric mean and 90^{th} percentile FC counts. The schedule should provide at least 24 samples per site. That includes 12 samples per site during each season (Wet season is typically December - May, Dry season is typically June - October).
- Provide reach-specific FC load and concentration comparisons in the Palouse River to define areas of increased FC loading (potentially due to malfunctioning on-site systems, livestock, wildlife, or manure spreading) or FC decreases (e.g., settling with sediment, die-off, dilution, or diversion).
- Help delineate any jurisdictional responsibilities for FC sources.

The sampling will occur twice a month from June 2007 to May 2008. The locations of the water quality stations are listed in Table 5 and can be seen in Figure 12. Stations were selected based on historical site locations and historical FC results. Major tributaries of the Palouse River will be sampled as close to their confluence with the mainstem as possible. There are 25 sampling sites: with 11 sites on the Palouse River mainstem, 2 sites from WWTP outfalls, and the remaining 12 sites on the tributaries to the Palouse River (Table 5).

Table 5. Fixed-network sites in the Palouse River Watershed.

Waterbody/ Source	Road Crossing or Access	Reason for Site
Palouse River (North Fork)	W. Railroad Ave. (behind Subway)	Boundary conditions @ Colfax
SF Palouse River	Railroad x-ing @ end of W. Railroad Ave.	Boundary conditions @ Colfax
Colfax WWTP	Hwy 26 @ Colfax	Treated wastewater effluent
Palouse River	Below mixing zone of WWTP effluent	Boundary conditions below Colfax
Dry Creek	Near mouth at Manning Rd.	Mouth of major tributary
Palouse River	RM 77.7 - Bridge crossing off Shields road near Diamond	Measure FC concentrations
Palouse River	Upstream of Little Valley Ck. @ Matlock Rd. bridge	Measure FC concentrations
Little Valley Creek	Near the mouth at Jones Rd.	Mouth of major tributary
Palouse River	Kackman Rd. bridge crossing	Measure FC concentrations
Downing Creek	At mouth near off Bridge @ Kackman Rd.	Mouth of major tributary
Palouse River	Upstream of Rebel Flat Ck @ Benge-Winona Rd.	Upstream of major tributary
Rebel Flat Creek	At Thera near grain elevators	Measure FC concentrations
Rebel Flat Creek	Upstream of Endicott @ Repp Rd.	Measure FC concentrations
Rebel Flat Creek	Downtown Endicott @ Endicott Rd. bridge	Measure FC concentrations
Endicott WWTP	Downtown Endicott	Treated wastewater effluent
Rebel Flat Creek	Downstream of Endicott @ Swent Rd.	Measure FC concentrations
Rebel Flat Creek	At the mouth near Winona	Mouth of major tributary
Palouse River	Upstream of Rock Creek off Troupe Rd.	Upstream of major tributary
Rock Creek	At Jordan Knott Rd. near Revere	Measure FC concentrations
Rock Creek	At the mouth; Troupe Rd. crossing	Mouth of major tributary
Union Flat Creek	At Winona South Rd.	Measure FC concentrations
Union Flat Creek	Near the mouth	Mouth of major tributary
Palouse River	Upstream of Willow Creek	Upstream of major tributary
Willow Creek	At the mouth near Gordon	Mouth of major tributary
Cow Creek	At Benge-Ralston Rd.	Measure FC concentrations
Cow Creek	Near the mouth; Gray Rd. bridge crossing	Mouth of major tributary
Palouse River	At Hooper; existing ECY (34A070) and USGS station	Measure FC concentrations
Palouse River	At West Hooper bridge	Measure FC concentrations

During each sampling run, FC samples will be collected at all sites (as well as chloride, total suspended solids, and turbidity) to better characterize water quality differences between sites. In addition, a Hydrolab will be used to collect temperature, conductivity, dissolved oxygen, and pH data at each station.

Data for this TMDL study will be collected in conjunction with Adams County Conservation District's (CD) Palouse Watershed Implementation Project. Sampling will be a joint effort between Ecology and Adams County CD and designed to meet the data requirements of both studies.

Sites may be added or removed from the sampling plan depending upon access and new information provided during the QA Project Plan review, field observations, and preliminary data analysis.

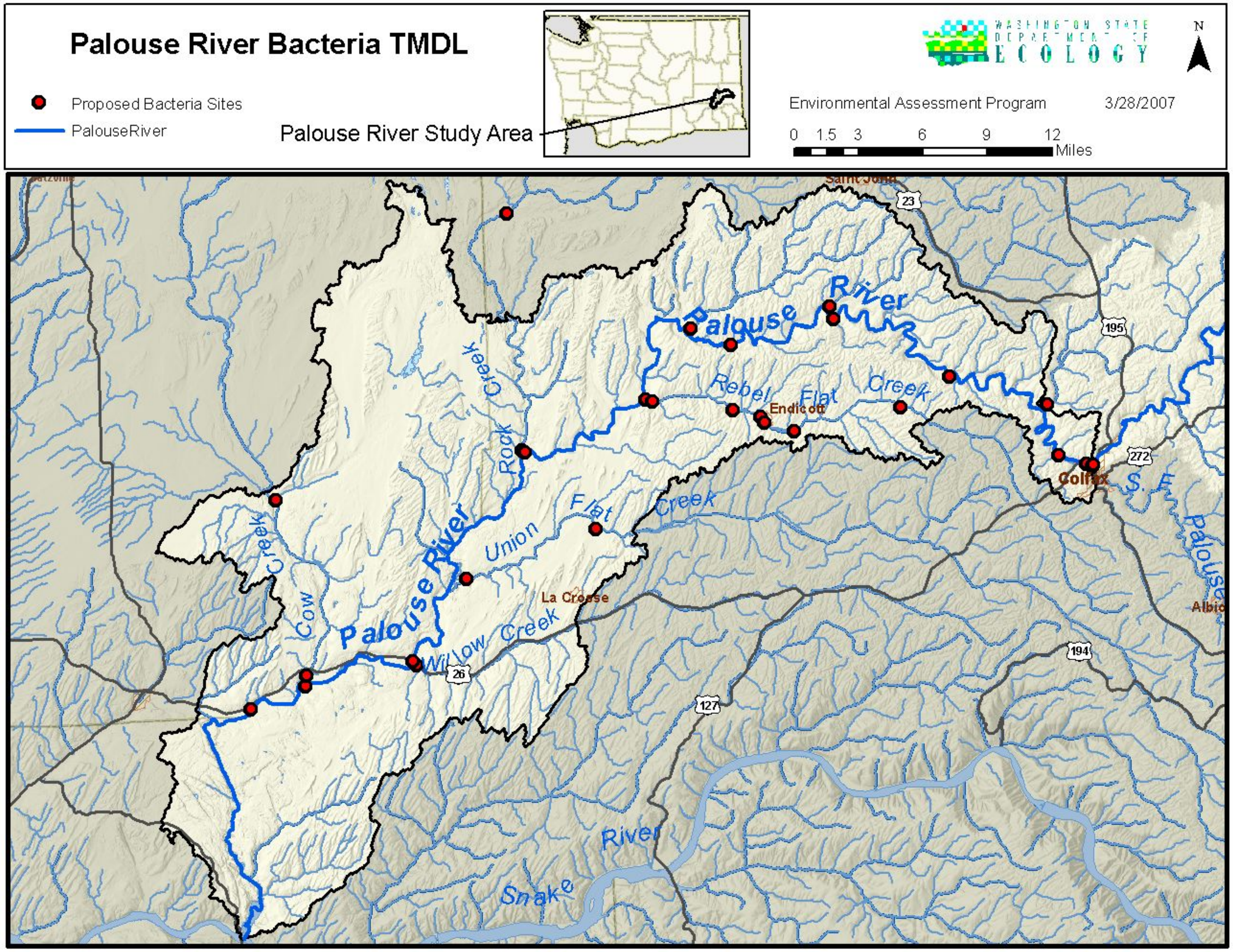

Figure 12. Map of the Palouse River Watershed showing proposed bacteria sampling sites.

Representativeness

The study was designed to have enough sampling sites and sufficient sampling frequency to adequately characterize FC spatial and temporal patterns in the watershed. FC values are known to be highly variable over time and space. Representative sampling variability can be somewhat controlled by strictly following standard procedures and collecting quality control samples: but natural, spatial, and temporal variability can contribute greatly to the overall variability in the parameter value. Resources limit the number of samples that can be taken at one site spatially or over various intervals of time.

Comparability

Samples collected at the Colfax and Endicott WWTPs will be collected, when possible, in conjunction with the routine samples collected by the WWTPs' operators. Ecology results will be compared to the results from each WWTP.

Completeness

EPA has defined completeness as a measure of the amount of valid data needed to be obtained from a measurement system to meet the study's objectives (Lombard, et al., 2004). The completeness goal for the Palouse River Bacteria TMDL is to correctly collect and analyze 100% of the FC samples for each of the sites. However, problems occasionally arise during sample collection that cannot be controlled, such as flooding or site access problems, that can interfere with this goal. A lower limit of 5 samples per season per site will be required for comparison to state criteria, which will easily be met for the core network sites and should be met for all other sites provided that not more than one, missed-sampling opportunity occurs.

WAC 173-201A states:

When averaging bacteria sample data for comparison to the geometric mean criteria, it is preferable to average by season and include five or more data collection events within each period….and [the period of averaging] should have sample collection dates well distributed throughout the reporting period.

Investigatory samples may be collected at sites not included in this QA Project Plan; or, if necessary, a site may be added to further characterize FC problems in an area. Such sampling that does not meet the lower limit criteria of 5 samples per season per site will still be useful for source identification and other analyses, but will not be used to set load or waste load allocations.

Laboratory Budget

The estimated laboratory budgets and lab sample loads in Table 6 are based on sampling each site twice a month. Since all months have more than one survey that occur on different weeks, weekly laboratory sample loads should not overload the microbiological units at Manchester Environmental Laboratory (MEL). Efforts will be made to keep the submitted number of samples within the estimate; however, more or fewer samples may be collected depending on field conditions.

Table 6. Palouse River Bacteria TMDL – The number of monthly sample submittals for each analysis, an estimate of the monthly analytical costs, and the total analytical cost estimate[1] for the project.

	FC (MF)	Replicates	Chloride	Replicates	Turbidity	Replicates	TSS	Replicates	Cost
June	50	10	50	5	50	5	50	5	$ 3,020
July	50	10	50	5	50	5	50	5	$ 3,020
August	50	10	50	5	50	5	50	5	$ 3,020
September	50	10	50	5	50	5	50	5	$ 3,020
October	50	10	50	5	50	5	50	5	$ 3,020
November	50	10	50	5	50	5	50	5	$ 3,020
December	50	10	50	5	50	5	50	5	$ 3,020
January	50	10	50	5	50	5	50	5	$ 3,020
February	50	10	50	5	50	5	50	5	$ 3,020
March	50	10	50	5	50	5	50	5	$ 3,020
April	50	10	50	5	50	5	50	5	$ 3,020
May	50	10	50	5	50	5	50	5	$ 3,020
Totals	600	120	600	60	600	60	600	60	$ 36,240

FC = fecal coliform; **TSS** = Total Suspended Solids.

[1] Costs include 50% discount for Manchester Laboratory

Sampling Procedures

Field sampling and measurement protocols will follow those listed in the Watershed Ecology Section (previously the Watershed Assessment Section) protocols manual (Ecology, 1993). Grab samples will be collected directly into pre-cleaned containers supplied by MEL and described in the MEL User's Manual (2005). Sample parameters, containers, volumes, preservation requirements, and holding times are listed in Table 7. Bacteria samples for laboratory analysis will be stored on ice and delivered to MEL within 24 hours of collection via Horizon Air and Ecology courier.

Grab samples will be collected using Watershed Ecology Section (WES) protocols (Ecology, 1993). Twenty percent of FC samples, and ten percent of all other parameters, will be duplicated in the field in a side-by-side manner to assess field and lab variability. Samples will be collected in the thalweg and just under the water's surface.

Table 7. Containers, preservation requirements, and holding times for samples collected during the Palouse River TMDL Study (MEL, 2005).

Parameter	Sample Matrix	Container	Preservative	Holding Time
Bacteria TMDL Monitoring				
Fecal Coliform	Surface water, WWTP effluent, & runoff	250 or 500 mL glass/poly autoclaved	Cool to 4ºC	24 hours
Chloride	Surface water, WWTP effluent, & runoff	500 mL poly[1]	Cool to 4ºC	28 days
Total Suspended Solids	Surface water, WWTP effluent, & runoff	1000 mL poly	Cool to 4ºC	7 days
Turbidity	Surface water, WWTP effluent, & runoff	500 mL poly[1]	Cool to 4ºC	48 hours

1 Chloride and Turbidity will be combined into one 500 mL bottle.

Measurement Procedures

Field measurements in Palouse River and its tributaries will include conductivity, temperature, pH, and Dissolved Oxygen (DO) using a calibrated Hydrolab MiniSonde®. DO will also be collected and analyzed using the Winkler titration method (Ecology, 1993). Laboratory methods are presented in the next section Table 9.

Estimation of instantaneous flow measurements will follow the Environmental Assessment Program protocol (Ecology, 2006). Flow volumes will be calculated from continuous stage height records and rating curves developed prior to, and during, the project. Stage height will be measured by a pressure transducer and recorded by a data logger every 15 minutes. All data loggers will be downloaded monthly. Staff gages will be installed at other selected sites. During the field surveys, streamflow will be measured at selected stations or staff gage readings will be recorded. A flow rating curve will be developed for sites with a staff gage.

Measurement Quality Objectives

Measurement quality objectives state the level of acceptable error in the measurement process. Precision is a measure of the variability in the results of replicate measurements due to random error (Lombard and Kirchmer, 2004). This random error includes error inherently associated with field sampling and laboratory analysis. Field and laboratory errors are minimized by adhering to strict protocols for sampling and analysis. Precision for replicates will be expressed as percent relative standard deviation (%RSD).

Microbiological and analytical methods, precision targets, and method resolution or reporting limits are listed in Table 8. The reporting limits of the methods listed in the table meet the expected range of results and the required level of sensitivity to meet project objectives. The laboratory's measurement quality objectives are documented in the MEL Lab Users Manual (MEL, 2005).

Table 8. Targets for precision and reporting limits for the measurement systems.

Analysis	Method	Field Replicate MQO	Lab Duplicate MQO	Reporting Limits and Resolution
Field Measurements				
Velocity[1]	Marsh McBirney Flow-Mate Flowmeter	0.1 ft/s	n/a	0.01 ft/s
Water Temperature[1]	Hydrolab MiniSonde®	+/- 0.1° C	n/a	0.01° C
Specific Conductivity[2]	Hydrolab MiniSonde®	+/- 0.5%	n/a	0.1 umhos/cm
pH[1]	Hydrolab MiniSonde®	0.05 SU	n/a	1 to 14 SU
Dissolved Oxygen[1]	Hydrolab MiniSonde®	5% RSD	n/a	0.1 - 15 mg/L
Dissolved Oxygen[1]	Winkler Titration	+/- 0.1 mg/L	n/a	0.01 mg/L
Laboratory Analyses				
Fecal Coliform – MF	SM 9222D	30% RSD[3]	40% RPD	1 cfu/100 mL
Chloride	EPA 300.0	5% RSD[4]	20% RPD	0.1 mg/L
TSS	SM 2540D	10% RSD[4]	20% RPD	1 mg/L
Turbidity	SM 2130	10% RSD[4]	20% RPD	1 NTU

[1] as units of measurement, not percentages.
[2] as percentage of reading, not RSD.
[3] replicate results with a mean of less than or equal to 20 cfu/100mL will be evaluated separately.
[4] replicate results with a mean of less than or equal to 5X the reporting limit will be evaluated separately.
SM = Standard Methods for the Examination of Water and Wastewater, 20th Edition (APHA et al., 1998).
EPA = EPA Method Code.
MF = Membrane Filter.

The targets for analytical precision of laboratory analyses in Table 8 are based on historical performance by MEL for environmental samples taken around the state by the WES Section (Mathieu, 2005a).

Bias is defined as the difference between the population mean and the true value of the parameter being measured (Lombard and Kirchmer, 2004). Bias is also a component of data accuracy; however, bias from the true value is very difficult to determine for this set of parameters. Calibration standards for microbiological analyses are not available. Bias in field measurements will be minimized by strictly following sampling and handling protocols.

Quality Control Procedures

Total variation for field sampling and laboratory analysis will be assessed by collecting replicate samples. Bacteria samples tend to have a high relative standard deviation (RSD) between replicates compared to other water quality parameters. Bacteria sample precision will be assessed by collecting replicates for approximately 20% of samples in each survey. MEL routinely duplicates sample analyses in the laboratory to determine laboratory precision. The difference between field variability and laboratory variability is an estimate of the sample field variability.

All samples will be analyzed at MEL. The laboratory's measurement quality objectives and quality control procedures are documented in the MEL Lab Users Manual (MEL, 2005). MEL will follow standard quality control procedures (MEL, 2005). Field sampling and measurements will follow quality control protocols described in Ecology (1993). If any of these quality control procedures are not met, the associated results may be qualified by MEL or the project manager and used with caution, or not used at all.

Standard Methods (APHA, AWWA, and WEF, 1998) recommends a maximum holding time of eight hours for microbiological samples (six hours transit and two hours laboratory processing) for non-potable water tested for compliance purposes. MEL has a maximum holding time for microbiological samples of 24 hours (MEL, 2005). Standard Methods (APHA, AWWA, and WEF, 1998) recommends a holding time of less than 30 hours for drinking water samples and less than 24 hours for other types of water tested when compliance is not an issue. Microbiological samples analyzed beyond the 24-hour holding time are qualified as estimates with a *J* qualifier code. MEL accepts samples Monday through Friday, which means Ecology can sample Sunday through Thursday.

To identify any problems with holding times, two comparison studies were conducted during the Yakima Area Creeks' TMDL (Mathieu, 2005b). A total of twenty FC samples was collected in 500 mL bottles and each split into two 250 mL bottles. The samples were driven to MEL within 6 hours. One set of the split samples was analyzed upon delivery. The other set was stored overnight and analyzed the next day. Both sets were analyzed using the membrane filter (MF) method. Replicates were compared to the Measurement Quality Objectives in Table 9.

The combined precision results between the different holding times yielded a mean RSD of 19%. This is comparable to the 23% mean RSD between field replicates for twelve Environmental Assessment (EA) Program TMDL studies using the MF method, suggesting that a longer (i.e., 24-hour) holding time has little effect on FC results processed by MEL. Samples with longer holding times did not show a significant tendency towards higher or lower FC counts compared to the samples analyzed within 6-8 hours.

Data Management Procedures

Field measurement data will be entered into a field book with waterproof paper in the field and then entered into EXCEL® spreadsheets (Microsoft, 2001) as soon as practical after returning from the field. This database will be used for preliminary analysis and to create a table to upload data into Ecology's Environmental Information Management (EIM) System.

Sample result data received from MEL by Ecology's Laboratory Information Management System (LIMS) will be loaded into EIM, then exported and added to a cumulative spreadsheet for laboratory results. This spreadsheet will be used to informally review and analyze data during the course of the project.

An EIM user study (JICA0001) has been created for this TMDL study and all monitoring data will be available via the internet. The Uniform Resource Locator address for this geospatial database is: apps.ecy.wa.gov/eimreporting. All data will be uploaded to EIM by the EIM data engineer.

All spreadsheet files, paper field notes, and Geographic Information System products created as part of the data analysis and model building will be kept with the project data files.

Audits and Reports

The project manager will be responsible for submitting quarterly reports and the final technical study report to the Water Quality Program TMDL coordinator for this project according to the project schedule. The project field lead will be responsible for completing the bacteria section of the quarterly report.

Data Verification and Validation

Laboratory-generated data reduction, review, and reporting will follow the procedures outlined in the MEL Users Manual (MEL, 2005). Lab results will be checked for missing and improbable data. Variability in lab duplicates will be quantified using the procedures outlined in the MEL Users Manual (MEL, 2005). Any estimated results will be qualified and their use restricted as appropriate. A standard case narrative of laboratory Quality Assurance/Quality Control results will be sent to the project manager for each set of samples.

Field notebooks will be checked for missing or improbable measurements before leaving each site. The EXCEL® Workbook file containing field data will be labeled *DRAFT* until data verification and validation are completed. Data entry will be checked by the field assistant against the field notebook data for errors and omissions. Missing or unusual data will be brought to the attention of the project manager for consultation. Valid data will be moved to a separate file labeled *FINAL.*

As soon as FC data are verified by MEL, the laboratory microbiologist will notify the field lead by e-mail or by phone of FC results greater than 200 cfu/100 mL. The field lead will then notify the Eastern Regional Office (ERO) Client Staff Contact and Water Quality Section Manager by e-mail of these elevated counts in accordance with EA Program Policy 1-03. The TMDL coordinator will notify local authorities or permit managers as appropriate.

Data received from LIMS will be checked for omissions against the *Request for Analysis* forms by the field lead. Data can be in EXCEL® spreadsheets (Microsoft, 2001) or downloaded tables from EIM. These tables and spreadsheets will be located in a file labeled *DRAFT* until data validity is completed. Field replicate sample results will be compared to quality objectives in Table 9. Data requiring additional qualifiers will be reviewed by the project manager. After data validity and data entry tasks are completed, all field, laboratory, and flow data will be entered into a file labeled *FINAL* and then into the EIM system. EIM data will be independently reviewed by another EA Program field assistant for errors at an initial 10% frequency. If significant entry errors are discovered, a more intensive review will be undertaken. At the end of the field collection phase of the study, the data will be compiled in a data summary. Quarterly progress reports will be available every 3 months throughout the 13 month data collection period of the project.

Data Analysis Procedures

Data analysis will include evaluation of data distribution characteristics and, if necessary, appropriate distribution of transformed data. Streamflow data will be frequently reviewed during the field data survey season to check longitudinal water balances. FC mass balance calculations will be performed on a reach basis. Estimation of univariate statistical parameters and graphical presentation of the data (box plots, time series, and regressions) will be made using WQHYDRO (Aroner, 2003) and EXCEL® (Microsoft, 2001) software.

Data will be applied to several TMDL methods of evaluation. The statistical rollback method (Ott, 1995) will be applied to FC data distributions to determine target count reductions along key reaches of each waterbody during critical conditions. Ideally, at least 20 data are needed from a broad range of hydrologic conditions to determine an annual FC distribution. If sources of FC vary by season and create distinct critical conditions, seasonal targets may be required. Fewer data will provide less confidence in FC reduction targets, but the rollback method is robust enough to provide general targets for planning implementation measures.

Data Quality (Usability) Assessment

The bacteria field lead will verify that all measurement and data quality objectives have been met for each monitoring station. If the objectives have not been met (such as %RSD for bacteria replicates exceeds the MQO or a Hydrolab was recording bad data), then the field lead and project manager will decide how to qualify the data and how it should be used in the analysis or whether it should be rejected.

Project Organization

The roles and responsibilities of Ecology staff are as follows:

Environmental Assessment Program

- *Jim Carroll, Project Manager, Water Quality Studies Unit, Headquarters (HQ)*: Responsible for overall project management. Defines project objectives, scope, and study design. Author of the QA Project Plan for Dissolved Oxygen, pH, and Nutrients. Responsible for development of TMDLs for temperature, bacteria, and other conventional parameters including model development and writing the technical report. Manages the data collection program. Coordinates field surveys with ERO staff. Responsible for data collection and data quality review.

- *Brenda Nipp, Principal Investigator, Directed Studies Unit, Eastern Operations Section*: Co-authors the QA Project Plan for Bacteria. Manages the data collection program. Coordinates or leads field surveys twice a month. Responsible for data collection, entering project data into the EIM system, and data quality review.

- *Scott Tarbutton, Field Investigator, Directed Studies Unit, Eastern Operations Section*: Assists or leads field surveys twice a month with ERO staff. Responsible for data collection, entering project data into the EIM system, and sample preparations and processing.

- *Nuri Mathieu, QAPP Author, Water Quality Studies Unit, HQ*: Co-author of the QA Project Plan for Bacteria.

- *Mitch Wallace, Hydrologist, Freshwater Monitoring Unit, Eastern Operations Section*: Responsible for deploying and maintaining continuous flow gages and staff gages. Responsible for producing records of streamflow data at sites selected for this study.

- *Tighe Stuart, Administrative Intern 2- Field Assistant, Directed Studies Unit, Eastern Operations Section*: Assists staff in field survey preparations, data collection, and sample processing.

- *Karol Erickson, Unit Supervisor, Modeling and Information Support Unit, HQ*: Reviews and approves the QA Project Plan, TMDL report, and the project budget.

- *Gary Arnold, Eastern Operations Section Manager, Eastern Operations Section*: Responsible for approval of the QA Project Plan and final TMDL report.

- *Stuart Magoon, Leon Weiks, and Pam Covey, Staff, Ecology Manchester Laboratory*: Provide laboratory staff and resources, sample processing, analytical results, laboratory contract services, and Quality Assurance/Quality Control (QA/QC) data. Review sections of the QA Project Plan relating to laboratory analysis.

- *Bill Kammin, Ecology Quality Assurance Officer, Environmental Assessment Program, HQ*: Reviews the QA Project Plan and all Ecology quality assurance programs. Provides technical assistance on QA/QC issues during the implementation and assessment of the project.

Water Quality Program

- *Elaine Snouwaert, TMDL Coordinator, Water Quality Program, Eastern Regional Office*: Serves as point of contact between Ecology technical study staff and interested parties. Coordinates information exchange, technical advisory group formation, and organizes meetings. Supports, reviews, and comments on QA Project Plan and technical report. Responsible for implementation, planning, and preparation of TMDL document for submittal to EPA.

- *Dave Knight, Watershed Unit Supervisor, Eastern Regional Office*:
  Responsible for approval of TMDL submittal to EPA.

- *Jim Bellatty, Section Manager, Eastern Regional Office*:
  Responsible for approval of TMDL submittal to EPA.

- *Patrick McGuire, Permit Manager, Eastern Regional Office*:
  Manages permits for and conducts inspections at the Colfax and Endicott WWTPs.

Project Schedule

Table 9. Project schedule for the South Fork Palouse River Total Maximum Daily Load study.

Environmental Information System (EIM) Data Set	
EIM Data Engineer	Brenda Nipp
EIM User Study ID	JICA0001
EIM Study Name	Palouse River Bacteria TMDL
EIM Completion Due	September 2008
Quarterly Reports	
Report Author Lead	Jim Carroll
Schedule:	
1st Quarter Report	August 2007
2nd Quarter Report	November 2007
3rd Quarter Report	February 2008
4th Quarter Report	May 2008
5th Quarter Report	August 2008
Final Report	
Report Author Lead	Jim Carroll
Schedule:	
Report Supervisor Draft Due	January 2009
Report Client/Peer Draft Due	February 2009
Report External Draft Due	April 2009
Report Final Due (original)	July 2009

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