Quality Assurance Project Plan

South Fork Palouse River
Fecal Coliform Bacteria
Total Maximum Daily Load Study

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June 2006

Publication Number 06-03-105

This plan is available on the Department of Ecology's website at
www.ecy.wa.gov/biblio/0603105.html

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June 2006

2004 303(d) Listings Addressed in this Study: WA-34-1020, WA-34-1024, WA-34-1025

Project Tracker Code: 05-008-04

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Abstract

The South Fork Palouse River, Paradise Creek, and Missouri Flat Creek have been listed by Washington State under Section 303(d) of the Federal Clean Water Act for non-attainment of Washington State fecal coliform bacteria criteria. The listings are based on sampling done by the Washington State Department of Ecology (Ecology) in 1987, 1991, and 1994-2001. Additional 303(d) listings exist within the South Fork Palouse River watershed for temperature, dissolved oxygen, pH, and ammonia.

The 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 South Fork Palouse River TMDL Study will address the 303(d) listings within the watershed with three Quality Assurance (QA) Project Plans: one for bacteria, one for temperature, and one for dissolved oxygen, pH, and ammonia.

This QA Project Plan describes the technical study that will monitor levels of fecal coliform bacteria in the South Fork Palouse River watershed, and will form the basis for a proposal to allocate contaminant loads to sources. The study will be conducted by Ecology's Environmental Assessment Program.

What is a Total Maximum Daily Load, or TMDL?

Federal Clean Water Act Requirements

The Clean Water Act established a process to identify and clean up polluted waters. Under the Act, each state is required to have its own 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.

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 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(s) for which it has been tested

Category 2 – Waters of concern

Category 3 – Waters with no data available

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

- 4a. – Has a TMDL approved and 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 – or the 303d list.

TMDL Process Overview

The Clean Water Act requires that a Total Maximum Daily Load (TMDL) be developed for each of the waterbodies on the 303(d) list. A TMDL identifies how much pollution needs to be reduced or eliminated to achieve clean water. Then Ecology works with the local community to develop (1) a strategy to control the pollution and (2) a monitoring plan to assess effectiveness of the water quality improvement activities.

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 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 also consider seasonal variations and include a margin of safety that takes into account any lack of knowledge about the causes of the water quality problem or its loading capacity. A reserve capacity for future loads from growth pressures is sometimes included 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 U.S. Environmental Protection Agency (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.

Introduction

Water quality monitoring has identified reaches of the South Fork Palouse River, Paradise Creek, and Missouri Flat Creek that do not meet state or federal water quality standards. As a result, these reaches have been included on Washington State's 303(d) list for 2004 (Figure 1 and Table 1).

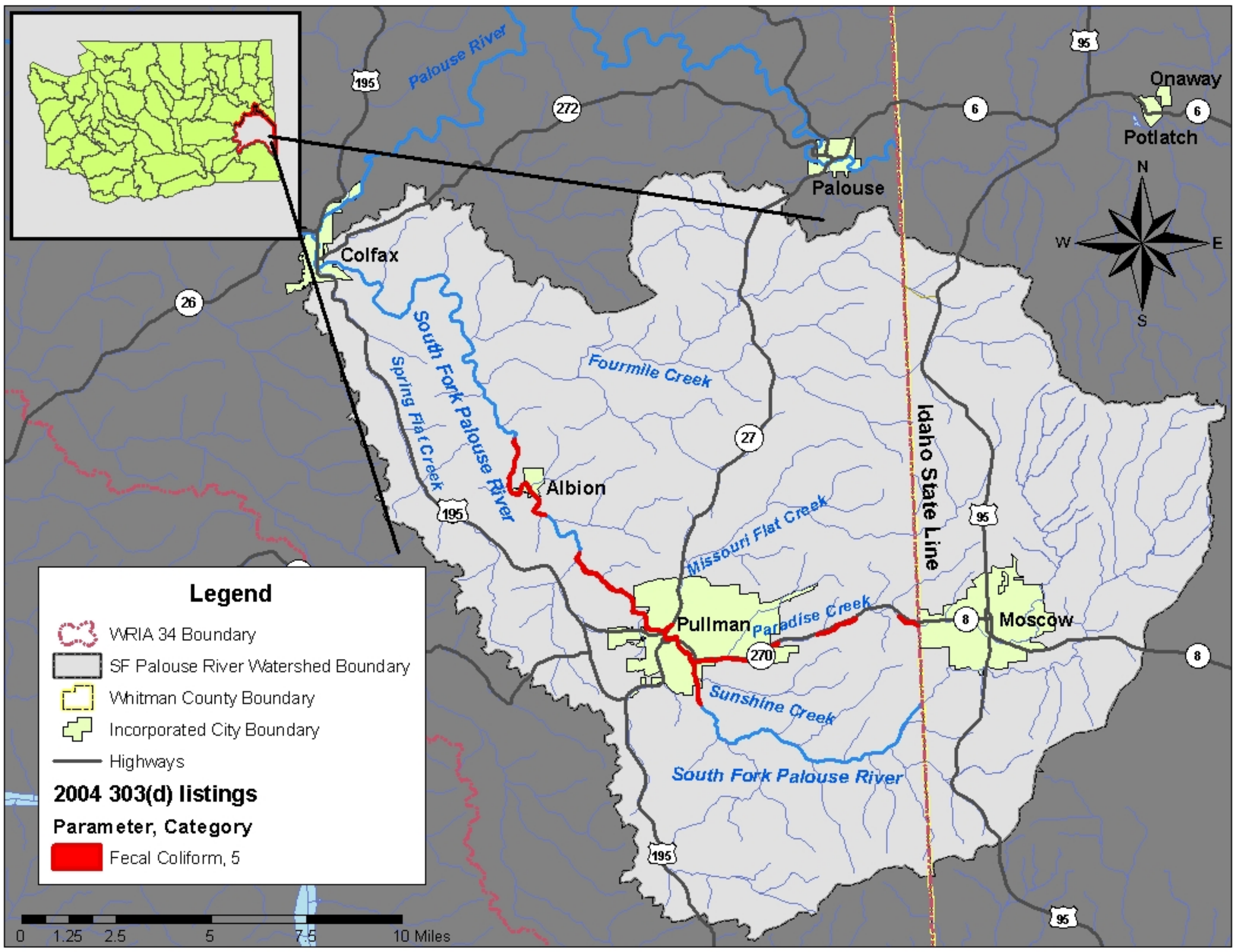

Figure 1. Study Area – South Fork Palouse River, Paradise Creek, and Missouri Flat Creek.

Table 1. Reaches of the South Fork Palouse River, Paradise Creek, and Missouri Flat Creek with Clean Water Act Section 303(d) listings (2004 list) that do not meet fecal coliform bacteria standards and will be addressed in the South Fork Palouse River TMDL study.

Waterbody	Township	Range	Section	2004 Listing ID
South Fork Palouse River	15N	45E	06	6707
	15N	44E	26	6708
	15N	44E	25	6709
	14N	45E	06	6710
	14N	45E	05	6711
	14N	45E	08	6712
	15N	44E	36	10448
	15N	44E	15	10450
	15N	44E	10	10452
Paradise Creek	14N	45E	04	10439
	14N	46E	05	10441
	14N	45E	01	10442
	14N	45E	03	10443
	14N	45E	05	10444
Missouri Flat Creek	14N	45E	05	6713

This Quality Assurance Project Plan describes the technical study that will develop fecal coliform bacteria TMDLs for the South Fork Palouse River and its tributaries. These TMDLs will set water quality targets to meet fecal coliform bacteria standards, identify key reaches for source reduction, and allocate pollutant loads to point and nonpoint sources.

The study will be conducted by Ecology's Environmental Assessment Program in cooperation with Ecology's Water Quality Program at its Eastern Regional Office as well as the Palouse Conservation District and other local governments.

The Idaho Department of Environmental Quality has completed a TMDL for Paradise Creek and several North Fork Palouse River tributaries and is in the early stages of developing a TMDL for the South Fork Palouse River in Idaho.

Ecology recently completed a TMDL for fecal coliform on the North Fork Palouse River based on monitoring conducted by the Palouse Conservation District and by Ecology (Ahmed, 2004). Ecology's TMDL efforts will now focus on the Washington segment of the South Fork Palouse River watershed.

There are additional fecal coliform listings in Water Resource Inventory Area (WRIA) 34, outside of the project area, on the mainstem Palouse River, Rebel Flat Creek, Cow Creek, and Pleasant Valley Creek. These listings will be addressed by a separate TMDL study in the near future.

Project Objectives

Objectives of the proposed study are as follows:

- Identify and characterize fecal coliform concentrations and loads from all tributaries, point sources, and drainages into the South Fork Palouse River under various seasonal or hydrological conditions, including stormwater contributions.

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

- Identify relative contributions of fecal coliform loading to the South Fork Palouse River so clean-up activities can focus on the largest sources.

- Collect nutrient samples for use in the upcoming dissolved oxygen, pH, and nutrient TMDL.

Water Quality Standards and Beneficial Uses

The Washington State water quality standards, set forth in Chapter 173-201A of the Washington Administrative Code (WAC), include designated beneficial uses, waterbody classifications, and numeric and narrative water quality criteria for surface waters of the state.

A revised water quality standards rule (Chapter 173-201A WAC) was adopted on July 1, 2003. The freshwater bacteria criteria portion of this version has recently been approved by EPA. The South Fork Palouse River is classified as Class A (excellent) according to the 1997 rule and is now considered *Primary Contact Recreation* water according to the 2003 rule.

Under the 2003 rule, freshwater waterbodies are required to meet water quality standards based on the beneficial uses of the waterbody. For fecal coliform bacteria, former Class A waters become *Primary Contact Recreation*. Examples of *Primary Contact* uses are swimming and other activities where the water and skin or body openings (e.g., eyes, ears, mouth, nose, and urogenital) come into direct and extended contact.

Numeric criteria for specific water quality parameters are intended to protect designated uses. Under the revised water quality standards, while the waterbody classification system has changed, the fecal coliform numeric target for each of the waterbodies included in this study has not. Freshwater standards for bacteria are listed below.

Fecal Coliform Bacteria

For Class A Freshwater (1997 rule) and freshwater Primary Contact Recreation (2003 rule): *"…fecal coliform organism levels shall both not exceed a geometric mean[1] value of 100 colonies/100 mL, and not have more than 10 percent of all samples obtained for calculating the geometric mean value exceeding 200 colonies/100 mL."*

The fecal coliform criteria have two statistical components, a geometric mean and an upper limit value that 10 percent of the samples cannot exceed. Fecal coliform samples collected randomly follow a lognormal distribution.

In Washington State fecal coliform TMDL studies, the upper limit statistic (i.e., not more than 10% of the samples shall exceed) has been interpreted as a 90th percentile value of the log-normalized values (Cusimano, 1997; Joy, 2000; Sargeant, 2002).

[1] The geometric mean is calculated as the nth root of the product of n numbers.

Background

Study Area

The South Fork Palouse River (SFPR) drains 295 square miles from its headwaters in Idaho to its confluence with the mainstem Palouse River at Colfax, Washington. The mainstem then drains into the Snake River at the convergence of Whitman, Franklin, Columbia, and Walla Walla counties. The SFPR sub-watershed is located in Whitman county of Eastern Washington and Latah County of North Idaho, within the larger Palouse River watershed. The portion of the Palouse watershed within Washington is known as Water Resource Inventory Area (WRIA) 34. Major tributaries to the SFPR include Paradise, Missouri Flat, Four Mile, and Spring Flat creeks. Smaller tributaries of interest within the study area include Sunshine, Airport Road, Dry Fork, Parvin, Rose, and Staley creeks.

Paradise Creek drains about 35 square miles from its headwaters at Moscow Mountain in Idaho to its confluence with the SFPR near the eastern Pullman city limits. The creek serves as the receiving waters for the Moscow Wastewater Treatment Plant (WWTP), located approximately 0.5 miles east of the state line. During low-flow periods (June to October), the WWTP discharge can account for up to 87% of the flow in Paradise Creek at the state line (Hallock, 1993).

Missouri Flat Creek originates north of Moscow in Idaho and flows west across the state border where it bends south, travels through Pullman along Highway 27/Grand Avenue, and converges with the SFPR near downtown Pullman. The 27-square-mile drainage area is influenced primarily by nonpoint agricultural runoff; however, the stretch of the creek within the Pullman city limits receives residential and commercial runoff from 26 separate storm drains.

Land use within the study area is dominated by dryland agriculture (Table 2) and interspersed with several clusters of urban population. The majority of population is concentrated around Washington State University in the city of Pullman and the University of Idaho in Moscow. Smaller communities include the towns of Colfax, at the mouth of the SFPR, and Albion, located along the SFPR between Pullman and Colfax (Figure 1). Major crops include spring and winter wheat, barley, peas, and lentils. These crops are produced without irrigation, thus the term "dryland agriculture" (RPU, Inc., 2002).

Table 2. Land use in the South Fork Palouse River watershed (RPU, Inc., 2002).

Land use	Acres	% of watershed
Cropland	154,764	82%
Urban use (including roadways)	15,100	8%
Forestland	11,324	6%
Rangeland	3,774	2%
Riparian/wetland	3,774	2%
Total	188,736	

Annual precipitation in this watershed can range from 15-25 inches of rain per year. A drought was declared in 2001, and the climatic condition has continued for the last several years. Summer daily maximum air temperatures can be in a range from mid-80ºF to mid-90ºF (around 29ºC to 35ºC) and occasionally over 100ºF (37.8ºC). There is a weather monitoring station at the Pullman/Moscow regional airport collecting data on air and dewpoint temperatures, wind speed and direction, barometric pressure, and weather observations.

The bedrock geology of this area is derived from the Priest Rapids member of the Wanapum Formation with the exception of a quartzite outcrop of the Kamiak Butte near the town of Albion. Holocene era alluvium and colluvium deposits occur along the SFPR valley (Bush and Garwood, 2005a and 2005b). Groundwater recharge and discharge are affected by geologic formations such as a syncline that was identified by Bush & Garwood (2005a and 2005b) with an axis longitudinal to the SFPR between Pullman and Albion, and two monoclines on the north and south within one to two miles of SFPR. The soils are primarily loess deposits that are well drained, moderately permeable silt loams of the Palouse-Athena association (Donaldson, 1980).

Potential Sources of Bacteria

Point Sources/ Permit Holders

Fecal coliform bacteria can be present in a wide variety of municipal and industrial wastewater and stormwater sources. No method is 100% effective at removing fecal coliform bacteria all of the time, so these bacteria can enter the receiving waters from these sources. Fecal coliform bacteria and other potential contaminants from industrial and municipal sources are regulated by various National Pollution Discharge Elimination System (NPDES), EPA, and general permits issued by Ecology.

The SFPR serves as receiving water for three WWTPs, at Albion and Pullman in Washington and at Moscow in Idaho (via Paradise Creek). The Pullman WWTP is a secondary treatment plant that provides seasonal nitrification and discharges to the SFPR at river mile (RM) 21.3. Wastewater is treated for pathogens using a chlorine gas and then dechlorinated using sulfur dioxide (Heffner, 1987).

The Albion WWTP consists of two facultative lagoons which drain to a chlorinator and effluent control structure before discharge to the SFPR at RM 14.1. The permit effluent limit for fecal coliform (monthly average of 200 cfu/100 mL) is routinely exceeded (monthly average of 434 cfu/100 mL); however, monthly effluent flow averages range between 0.03 and 0.1 million gallons per day (MGD) and, subsequently, fecal coliform loading to the SFPR is relatively minor (Ecology, 2006b). The permit allows the WWTP to discharge year round; however, discharges typically occur between January and May (Koch, 2006).

Treatment from the Moscow WWTP occurs in Idaho approximately 0.5 miles east of the state line. Effluent is treated for pathogens using chlorination/dechlorination and discharged at creek mile (CM) 6.9 of Paradise Creek. During periods of low flow, the Moscow WWTP comprises nearly the entire flow of Paradise Creek and the SFPR until confluence with the Pullman WWTP discharge (Pelletier, 1993). The plant received a number of upgrades in 2001, and the City of Moscow reports that they are currently in compliance with permit effluent limits.

Wildlife and Background Sources

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

Usually these sources are dispersed and do not elevate fecal coliform 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 readily 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 fecal coliform 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.

Fecal coliform 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 bring the manure into the water. Some residences may have wastewater piped directly to waterways or may have malfunctioning onsite 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 fecal coliform bacteria from sources to waterways.

Stormwater Sources

During precipitation events, rainwater washes the surface of the landscape, pavement, rooftops, and other impervious surfaces. This stormwater runoff can accumulate and transport fecal matter via stormwater drains to receiving waters and potentially degrade water quality (Lubliner, 2005).

NPDES Phase II stormwater regulations require stormwater permits for all municipalities located in urbanized areas, or cities outside of urbanized areas, that have a population of greater than 10,000. Ecology has completed a formal draft Phase II Municipal Stormwater Permit for Eastern Washington and is currently soliciting public comments. After reviewing all public comments, the permit will be revised, and then a final permit will be issued in late September 2006 at the earliest.

Pullman is not located within an urbanized area, but does have a population of greater than 10,000 and is likely to be regulated as a small municipal separate storm sewer system (MS4) under the permit. Washington State University may be required to be a secondary permittee to the city of Pullman permit. The data collected from the city and university stormwater discharge system, tributaries, and the SFPR will be used to assign a wasteload allocation to the city of Pullman under the new Phase II permit.

The study will also evaluate stormwater contributions from industrial stormwater permit holders (Table 3) and Washington State Department of Transportation (WSDOT) highways stormwater collection systems. A formal draft WSDOT Municipal Stormwater Permit will be made available for public comment in May 2006. The permit issuance date is dependent on the nature and volume of comments. Under the new general permit, WSDOT stormwater discharges will be required to meet Washington State surface water quality standards (Ecology, 2006b).

Table 3. Department of Ecology permitted industrial stormwater discharges in Pullman, WA

Permit Number	Site name	Site Address	City	Waterbody
SO3000979D	Horizon Air Pullman Moscow Airport	3200 Airport Complex N.	Pullman	Airport Road Creek
SO3000975D	Inter State Aviation Inc	Pullman-Moscow Airport	Pullman	Airport Road Creek
SO3004625A	Pullman City Of WWTP	N.W. 1025 Guy Street.	Pullman	South Fork Palouse River
SO3000942D	Pullman Moscow Regional Airport	RT. 3 Box 850	Pullman	Airport Road Creek
SO3004624A	Pullman, City Of Transit Facility	NW 775 Guy Street	Pullman	South Fork Palouse River
SO3000445D	United Parcel Service WAPUL	615 N Grand Ave	Pullman	Missouri Flat Creek

Historical Data Review

Hydrology

The U.S. Geological Survey (USGS) currently operates one streamflow gage on the SFPR in the town of Pullman (#13348000) with a 34-year record. This gage is downstream of Paradise Creek at the State Street crossing of the SFPR. Figure 2 summarizes mean monthly flow data at this station. There is also a USGS gage currently operating on Paradise Creek at the University of Idaho (#13346800) with a 27-year record.

There were six historical streamflow gages located on the SFPR and major tributaries. One historical station (SFPR at Colfax #13349200) contains flow data from a short period of record when the SFPR gage at Pullman was not in service. Mean monthly flow data for Missouri Flat Creek at Pullman (#13348500) is summarized in Figure 3.

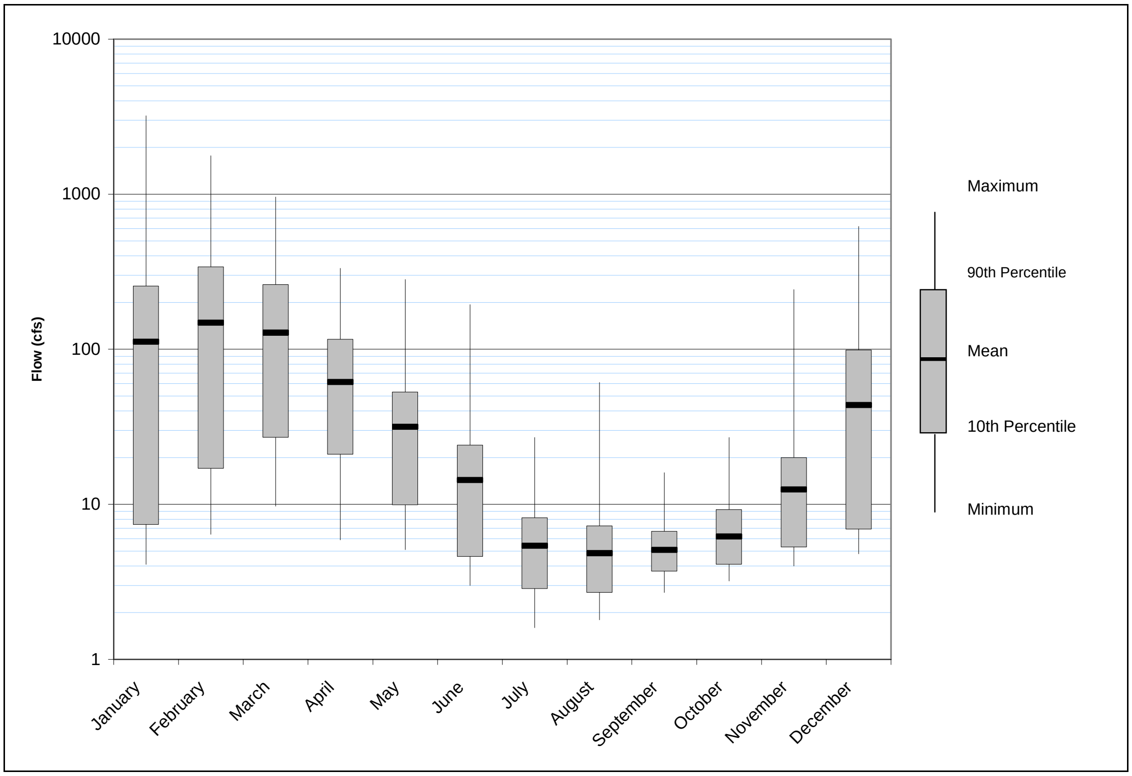

Figure 2. USGS stream gage mean monthly flows for the SFPR at Pullman from 1970 - 2004.

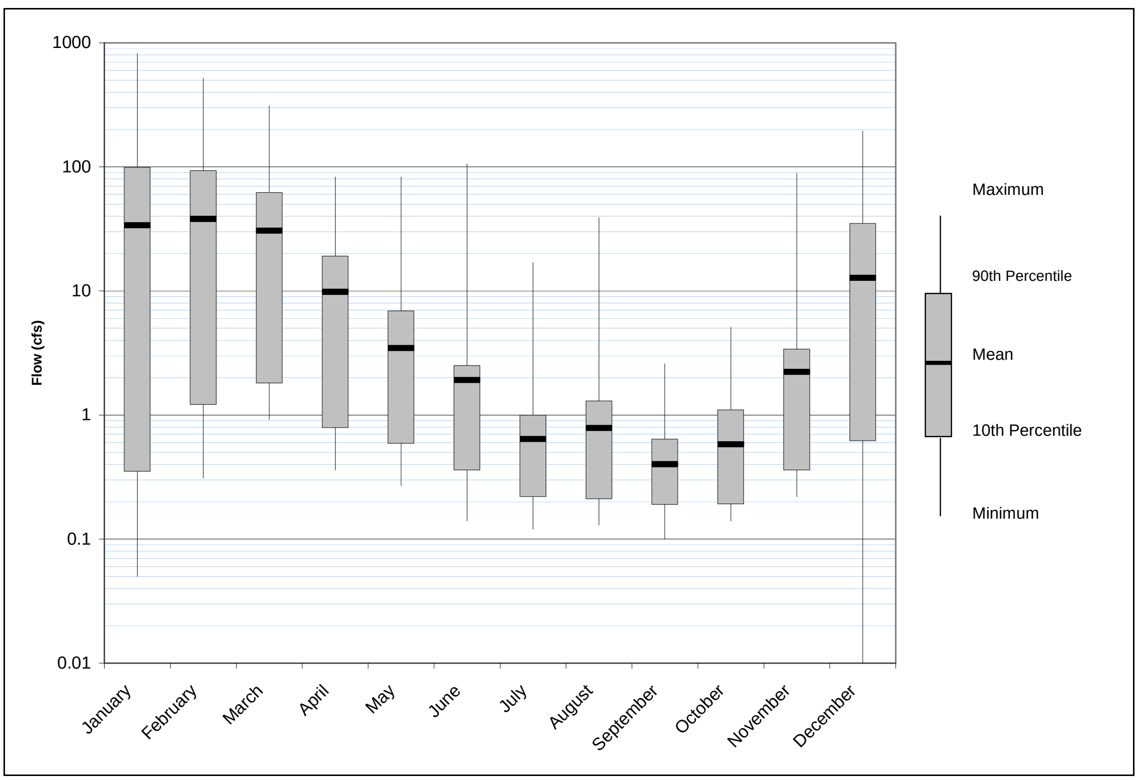

Figure 3. USGS stream gage mean monthly flows for Missouri Flat Creek at Pullman from 1970 - 1979.

Daily and seasonal variation in SFPR streamflows can be affected by the discharge of the Pullman WWTP. In turn, the magnitude of the Pullman WWTP discharge can be greatly affected by the Washington State University (WSU) school schedule.

Norm Glenn (1992) examined two weekly influent flow charts from the Pullman WWTP as part of a Class II inspection and found that the difference in peak influent flow, of approximately 2.5 mgd, between a week in July and a week in early October, was attributed to the large increase in the number of students living in town. Many more students were in town in October compared to the summer break time when few students remain in town. The two weekly influent flow charts exhibit a bimodal pattern in daily inflow volumes as the result of patterns of human water consumption; the pattern is stronger for the October data compared to the July data.

The dual daily-peak patterns (Figure 4) in the streamflow gage record at Colfax suggest that daily fluctuations may be controlled to a greater extent by patterns of human wastewater discharge to the river.

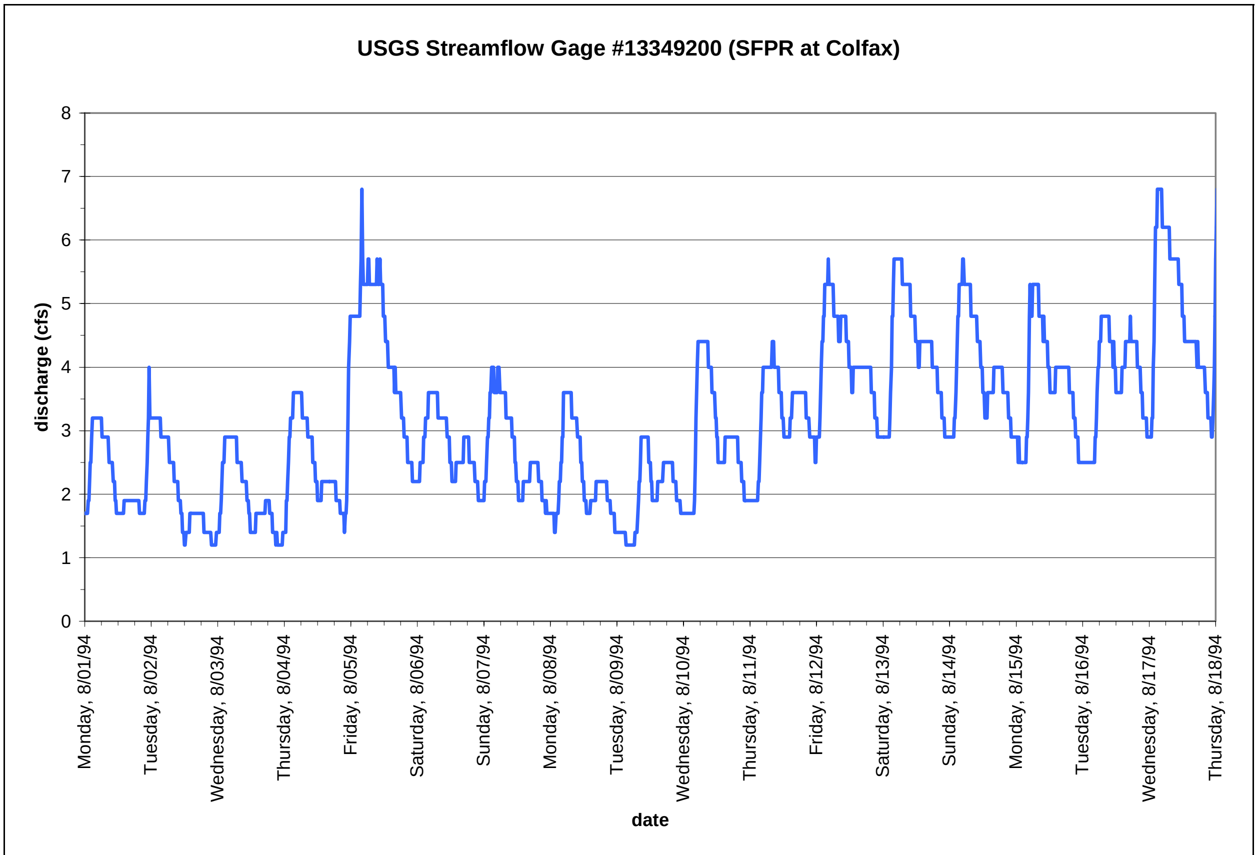

Figure 4. A closer look at a two-and-one-half week continuous streamflow record for the SFPR at Colfax showing the daily fluctuation in stream stage resulting from upstream point discharges.

Washington State Department of Ecology

Ecology has collected ambient monitoring data, including fecal coliform and streamflow, from the SFPR at Pullman (Station 34B110) since 1974 (Ecology, 2006c). Data was not collected from this station from October 1974 to September 1977 and from October 1992 to September 1994 (Figure 5).

Ambient monitoring records from this site contain numerous fecal coliform counts that indicate non-compliance with water quality standards. Fecal coliform counts and loads at 34B110 show a seasonal cycle. Fecal coliform loads are determined by taking the number of cfu over the volume of the sample (e.g. #cfu/100 mL) and multiplying by the volume of streamflow over time (e.g. cubic feet per second). Concentrations are higher during May through October, while loading is highest during the fall, winter, and spring when flows are high (Figures 6-8).

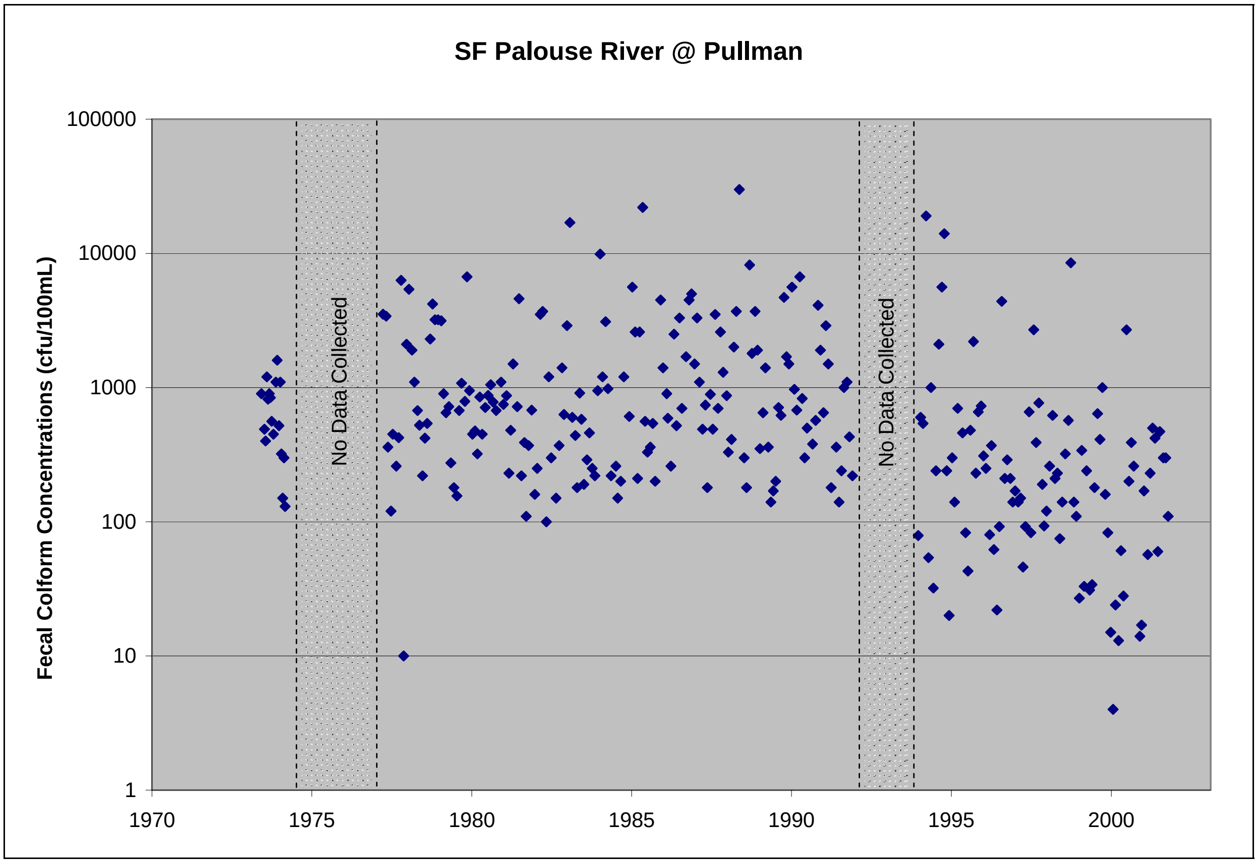

Figure 5. Fecal coliform concentrations collected at the SFPR at Pullman ambient monitoring station (34B110) from 1973 to 2002.

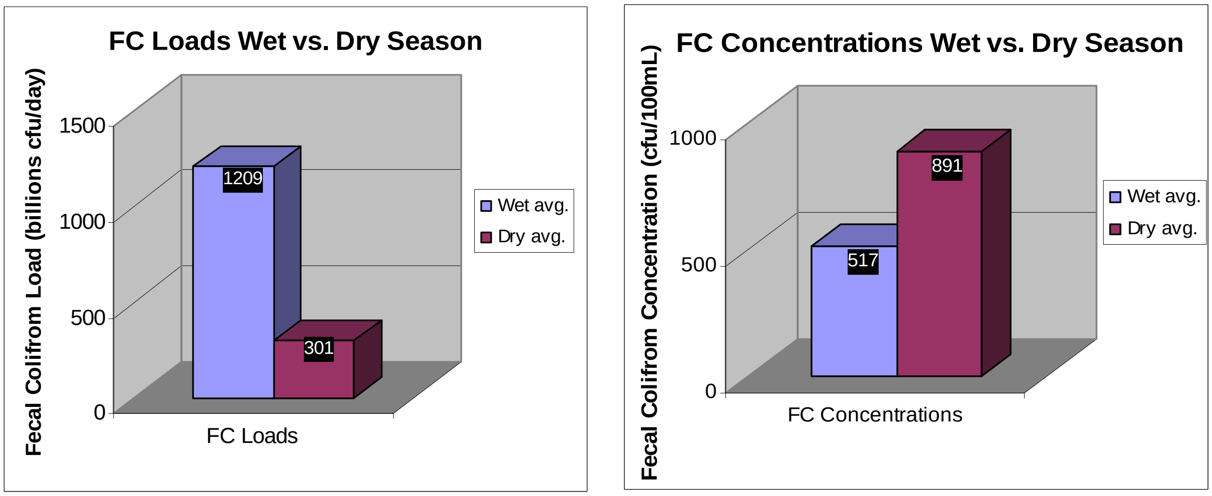

Figure 6. Comparison of fecal coliform loads and concentrations during the wet and dry seasons for the SFPR at Pullman (Station B34110), 1994-2004.

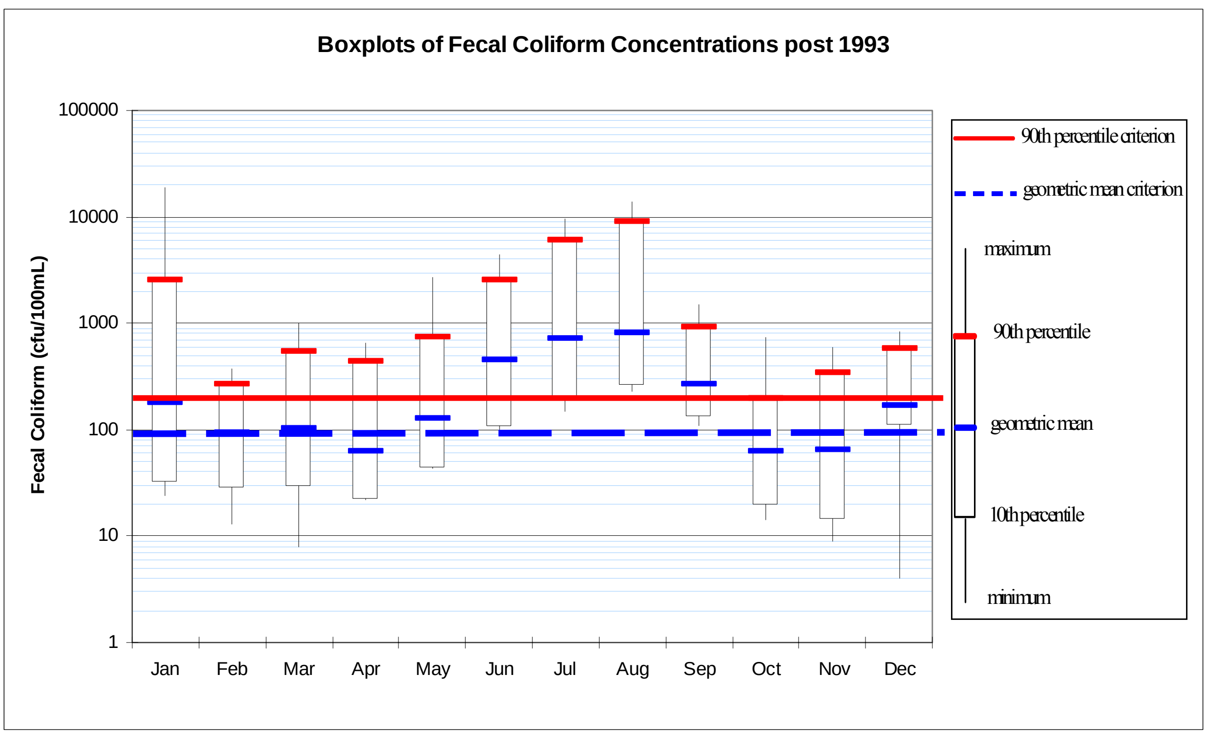

Figure 7. SFPR at Pullman monthly average fecal coliform concentrations from Ecology's Ambient Monitoring Program, 1994-2004 (nine or more samples/month).

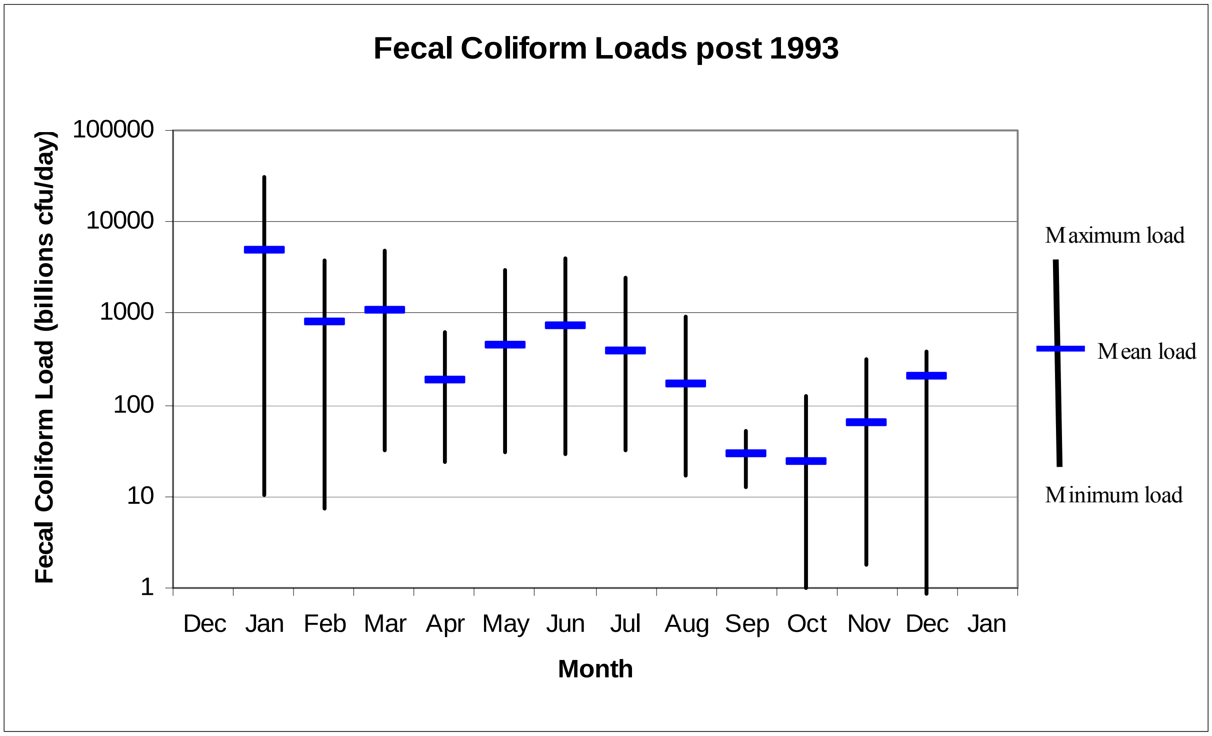

Figure 8. SFPR at Pullman fecal coliform loads from Ecology's monthly Ambient Monitoring Program, 1994 - 2004 (six or more samples/month).

Some ambient bacteria data were excluded from the analysis of seasonal patterns and trends. These data were excluded because they were collected during conditions that were not representative of typical streamflow conditions in the SFPR and therefore skewed average concentrations and loads (Table 4).

Table 4. Data excluded as outliers from analysis in the Quality Assurance Project Plan.

Date Sampled	Fecal Coliform (cfu/100mL)	Flow (cfs)	Reason for exclusion from analysis
8/7/1995	14000	59	flow is in 99th percentile of daily averages for month of August
5/5/1997	92	117	flow is in 99th percentile of daily averages for month of May
6/8/1998	2700	135	flow is in 99th percentile of daily averages for month of June
9/9/2003	7200	19.6	synoptic storm runoff; 0.73 inches of rain in preceding 36 hours

Annual mean fecal coliform concentrations and loads have dropped significantly since the gap in monitoring during October 1992 to September 1994; however, concentrations still exceed the state water quality criteria for bacteria. Due to this trend, data review and analysis focused on data collected after 1993.

Prior to 1993, fecal coliform concentration remained well above the state water quality criteria year-round, with slightly lower concentrations during the wet season, most likely caused by dilution from increased flows. After 1993, concentrations dropped significantly in the dry season and dramatically in the wet season.

Average monthly fecal coliform loads for 1994 – 2004 have dropped compared to loads prior to 1993 during February, April, and September through December. March, May, and August displayed a marginal decrease in average loads, while January, June, and July had a marginal increase.

In 1987, Joe Joy completed a two-day, low-flow survey on a five-mile stretch of the SFPR in Pullman. Concurrently, a Class II inspection of the wastewater treatment plant was performed by Marc Heffner (Heffner, 1987). The study observed high fecal coliform concentrations at the mouth of Missouri Flat Creek and subsequently downstream of its confluence on the SFPR. More high concentrations were discovered on the SFPR below its confluence with Paradise Creek and upstream of the South Street Bridge. Concentrations at the mouth of Paradise Creek and at SFPR above Paradise Creek were both low, indicating that the fecal coliform contamination came from an unknown source/s between Paradise Creek and South Street (Joy, 1987). Potential sources within this stretch include six storm drains.

Ecology completed a TMDL for ammonia in the SFPR in 1993. Some bacteria data were collected during the project including two intensive surveys in July and October of 1991, which coincided with Class II inspections of the Pullman and Albion WWTPs (Glenn, 1992). Supplemental ambient monitoring data from additional Ecology stations were also collected during water year 1992 (Table 5).

Table 5. Geometric mean (GM) and 90th percentile (90th) fecal coliform data collected from supplemental ambient monitoring stations during water year 1992.

	South Fork Palouse River				Paradise Creek			
	Station 34B110- SFPR @ Pullman		Near Johnson & Sand Road		Near mouth		Near state border	
	GM	90th	GM	90th	GM	90th	GM	90th
Annual	500	1640	141	1900	142	5100	113	1300
November - April	524	2340	79	824	63	15009	21	369
May - October	503	1050	220	2200	280	2730	454	2700
# of samples	11		11		11		11	
Criterion	100	200	100	200	100	200	100	200

State of Washington Water Research Center

The State of Washington Water Research Center at WSU collected data on the Idaho section of Paradise Creek from 1994-1995. Water quality monitoring was performed on multiple parameters including flow, temperature, pH, alkalinity, conductivity, suspended solids, ammonia, chloride, dissolved oxygen, nutrients, and bacteria. Data were collected for the Idaho Department of Environmental Quality; these data assisted them in the development of the 1998 TMDL for Paradise Creek in Idaho.

Bacteria samples were collected monthly at six stations on Paradise Creek and one station at the Moscow WWTP outfall. Geometric mean concentrations were calculated for each site, excluding six high concentrations labeled as outliers. The WWTP outfall and Paradise Creek below the WWTP outfall had geometric mean concentrations of 177 and 133 cfu/100 mL, respectively. When outlier data are included, these geometric means increase to 224 and 221 cfu/100 mL, respectively (Schnabel and Wilson, 1996).

Idaho Department of Environmental Quality

In 1997, the Idaho DEQ completed a Waterbody Assessment and TMDL for Paradise Creek. The TMDL set wasteload allocations for point sources and a load allocation for nonpoint sources based on data collected by the DEQ, Moscow WWTP, and State of Washington Water Research Center.

Fecal coliform wasteload allocations for the Moscow WWTP (Table 6) and the University of Idaho aquaculture facility were set based on meeting Washington State water quality criteria at the Washington-Idaho border. A load allocation was determined for nonpoint sources to Paradise Creek upstream of the WWTP outfall. Fecal coliform was not detected at the aquaculture facility, based on self-monitoring results by the University of Idaho; however, a wasteload allocation was set at 7.64×10^8 cfu/day, based on their design flow of 140 gpm and the Washington geometric mean criterion of 100 cfu/100 mL (IDEQ, 1997). Table 6 compares wasteload allocations set in the Paradise Creek TMDL to recent self-monitoring data from the Moscow WWTP.

Table 6. Comparison of wasteload allocations set in the Paradise Creek TMDL to recent self-monitoring data for the Moscow Wastewater Treatment Plant.

Parameter/ Time Period	Units	TMDL WLA	2005 WWTP data	
			mean	90th %
Fecal Coliform				
year round	cfu/100 mL	100	6	
year round	billions cfu/day	15.1	0.107	0.409
Total Suspended Solids				
year round	mg/L	15	1.45	2.18
year round	tons/yr	91	4	6

TMDL – Total Maximum Daily Load
WLA – Wasteload Allocation
WWTP – Wastewater Treatment Plant

Idaho Association of Soil Conservation Districts

The Idaho Association of Soil Conservation Districts monitored water quality on Paradise Creek and tributaries to the Palouse River in 2002 (Clark, 2003). No bacteria data were collected on Paradise Creek; however, fecal coliform and *E. coli* samples were collected twice per month at four sites along the SFPR from its headwaters on the southwest slopes of Moscow Mountain to the Washington-Idaho border. Bacteria samples were analyzed within 30 hours of collection using the most-probable number (MPN) method.

Figure 9 illustrates that fecal coliform concentrations are at least an order of magnitude above the Washington State criteria for geometric mean and 90th percentile. Fecal coliform and *E. coli* concentrations remained very high throughout the year and did not appear to be diluted by spring runoff or fall and winter storms. Clark (2003) notes that cattle, horses, and other livestock have direct access to the stream adjacent to or directly at all of these stations. Clark (2003) lists failing rural and suburban septic systems as another potential source of contamination.

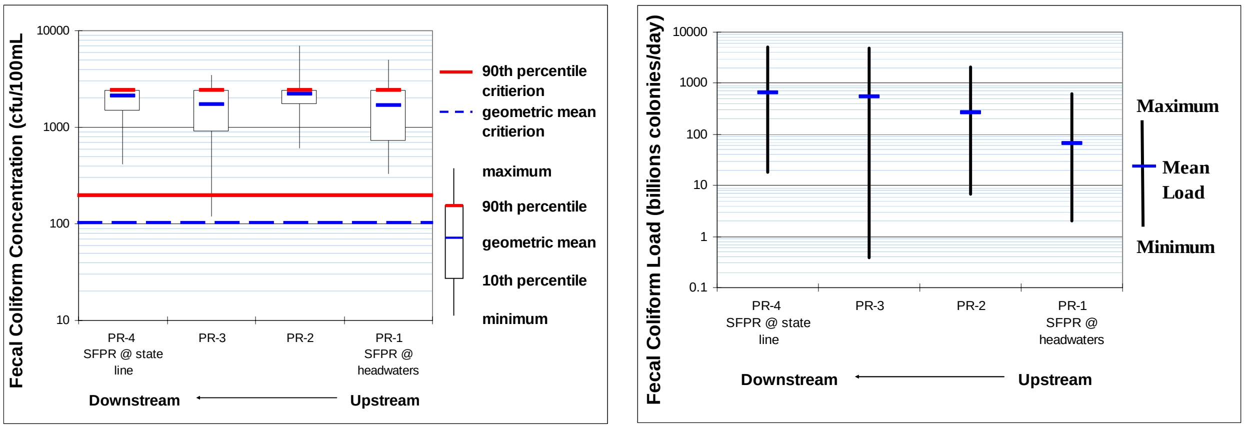

Figure 9. Fecal coliform concentrations and loads for the SFPR in Idaho during 2002.

Stormwater Monitoring

In 2005 and 2006, Ecology collected stormwater data for the *South Fork Palouse River Pesticide, PCB, and Fecal Coliform Stormwater Pilot Study* (Lubliner, 2005). The Quality Assurance Project Plan and sampling have been completed; however, the sampling results have not yet been verified or analyzed. The final report is scheduled to be available in August 2006.

Project Description

Study Design

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

The bacteria component of the SFPR TMDL will use a fixed network of core sites sampled bimonthly (twice a month) throughout the course of the project. During the wet season (November – April), an intensive network of sites also will be sampled twice a month. In addition, two to three synoptic storm-event surveys will be conducted during the course of the study (Table 7).

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

- SFPR at State Street crossing in Pullman (USGS).
- SFPR at Albion (Ecology, Stream Hydrology Unit).
- SFPR below Parvin Creek confluence (Ecology, Stream Hydrology Unit).
- SFPR just upstream of Colfax city limits (Ecology, Stream Hydrology Unit).
- Paradise Creek at the University of Idaho (USGS).
- Paradise Creek at the Washington-Idaho border (Ecology, Stream Hydrology Unit).
- Paradise Creek at the mouth (Ecology, Stream Hydrology Unit).

Ecology and the Stream Hydrology Unit will also install staff gages at other sites to develop discharge rating curves based on stage.

Fixed-Network sampling

Data from the fixed-network will provide fecal coliform data sets to meet the following needs:

- Provide an estimate of the annual and seasonal geometric mean and 90th percentile fecal coliform counts. The schedule should provide at least 26 samples per site for the core sites. That includes 13 samples per core site during each season (i.e., wet season = typically November – April; dry season = typically May - October). During the wet season, additional sites will be sampled twice a month providing at least 12 samples per site.
- Provide reach-specific fecal coliform load and concentration comparisons in the SFPR, Paradise Creek, and Missouri Flat Creek to define areas of increased fecal coliform loading (e.g. malfunctioning on-site systems, livestock, wildlife, or manure spreading) or fecal coliform decreases (e.g. settling with sediment, die-off, dilution, or diversion). With accurate streamflow monitoring, tributary and source loads also can be estimated.
- Help delineate jurisdictional responsibilities for fecal coliform sources.

The locations of the fixed-network water quality stations are listed in Tables 8 and 9 and can be seen in Figure 10 and 11. Stations were selected based on historical site locations and fecal coliform results. Major tributaries of the SFPR will be sampled as close to their confluence with the mainstem as possible. There are 53 sites in the intensive network and 26 sites in the core network, with 14 sites on the SFPR mainstem, 17 sites from storm drain or WWTP outfalls, and the remaining 22 sites on the tributaries to the SFPR.

During each sampling run, bacteria samples will be collected at all sites, while chloride, total suspended solids, and turbidity will be sampled at the core sites. During one sampling run each month and during storm network sampling runs, samples will be collected at all sites for bacteria, total suspended solids, turbidity, ammonia, nitrite/nitrate, orthophosphate, total phosphorous, total persulfate nitrogen, dissolved and total organic carbon, and alkalinity. Data from these additional parameters monitored during core sampling runs will be used to characterize the water quality of tributaries and outfalls within the SFPR basin. A general water quality assessment will help in the development of TMDLs for dissolved oxygen and pH.

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

Table 7. Proposed temporal distribution of the core site network, intensive site network, and synoptic storm events.

	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Core network	1	2	2	2	2	2	2	2	2	2	2	2	2
Intensive network							2	2	2	2	2	2	
Synoptic storm event		1*	1*	1*	1*	1*	1	1	1	1	1	1	1*

*Two to three storm events sampled in the months of November to April if possible; other months if necessary.

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Table 8. Fixed-network core sites in the South Fork Palouse River watershed.

Waterbody/ Source	Road Crossing or Access	Reason for Site	Storm Site
SF Palouse River	Sand Road near state line	Washington-Idaho border	X
	Off Johnson Road	Just outside Pullman city limits	X
	Entrance to Pro. Mall Plaza	Ambient site, below Sunshine Ck. confluence	
	South Street bridge	Good access; Identify FC sources	
	Kamiaken Street bridge	Good access; Identify FC sources	
	State Street bridge	Ambient site; Good access;	
	Hayward Road	Just downstream of Pullman WWTP outfall	X
	Albion Road/D Street bridge	Within Albion city limits	X
	Abbott Road	Downstream of Parvin Creek confluence	
	USGS Station (historical)	Just outside Colfax city limits	X
	End of B Ave.	Mouth of SFPR	X
Paradise Creek	Perimeter Dr. in Moscow, ID	Surface flow- background above WWTP	
	Off Moscow-Pullman Hwy.	Washington-Idaho border	X
	Sunshine Creek Road bridge	Large gap between stations	
	Bishop Boulevard	Mouth of Paradise Creek	X
Missouri Flat Creek	Kitzmiller Road	Just outside Pullman city limits	X
	Stadium Way	Upstream of storm drain outfall	
	Grand Ave. near Whitman St.	Mouth of Missouri Flat Creek	X
Dry Fork Creek	Fairmount Road	Just outside Pullman city limits	X
	Crestview Rd. and Grand Ave.	Identify FC sources	X
	Gas Station at 500 Grand Ave.	Good access; Identify FC sources	X
	Off Grand at SFPR confluence	Dry Creek at its mouth	X
Storm Drain WSU#1 to SFPR	Benewah St.	Identify FC sources	X
Storm Drain WSU#2 to SFPR	Main St. just east of Dilke Road	Identify FC sources	X
Storm Drain #120 to Missouri Flat Creek	Off Stadium Way; in Jack-in-the-Box lot	Identify FC sources	X
Pullman WWTP Outfall	1025 Guy St.	Treated wastewater effluent discharge	X
Four Mile Creek	Shawnee-Parvin Road	Mouth of Four Mile Creek	X
Spring Flat Creek	Small road off Hwy 195 near city limits	Just upstream of Colfax city limits	

SFPR – South Fork Palouse River
FC – Fecal coliform bacteria
WWTP – Wastewater treatment plant

Table 9. Fixed network wet season intensive sites in the South Fork Palouse River watershed.

Waterbody/ Source	Road Crossing or Access	Reason for Site	Storm Site
SF Palouse River	Shawnee Road	Upstream of Four Mile Creek confluence	
	Armstrong Road	West of Pullman city limits	
	Off Sand Road east of Busby	Before confluence with Staley Creek	
	Jennings Road	Identify FC sources	
Paradise Creek	Airport Road bridge	Upstream of Airport Road Creek confluence	
Missouri Flat Creek	Odonnell Road	Above industrial development N. of Pullman	
Storm Drain #360 to SFPR	Klemgard and Bishop	Identify FC sources	X
Storm Drain #320 to SFPR	Professional Mall plaza	Identify FC sources	X
Storm Drain #290 to SFPR	Manhole on Pro. Mall Blvd.	Identify FC sources	X
Storm Drain #260 to SFPR	South Street bridge	Identify FC sources	X
Storm Drain #180 to SFPR	Manhole on Morton St.	Identify FC sources	X
Storm Drain #170 to SFPR	Across railroad tracks from #180	Identify FC sources	X
Storm Drain #140 to SFPR	Under footbridge east of Kamiaken bridge	Identify FC sources	X
Storm Drain #120 to SFPR	Under Kamiaken St. bridge	Identify FC sources	X
Storm Drain WSU#3 to Paradise Ck.	Off Main St. just east of Johnson	Identify FC sources	X
Storm Drain #60 to Missouri Flat Creek	Off Grand Ave. near Larry St.	Identify FC sources	X
Storm Drain #200 to Missouri Flat Creek	Retaining wall at Grand Ave and Irving St.	Identify FC sources	X
Storm Drain #210 to Missouri Flat Creek	Retaining wall at Grand Ave and Irving St.	Identify FC sources	X
Moscow WWTP Outfall	Moscow-Pullman Hwy. across from Mall	Treated wastewater effluent discharge	
Albion WWTP Outfall	Shawnee-Parvin Road west of Albion	Seasonal wastewater effluent discharge	
Airport Road Creek	Off Main St. or Airport Road	Mouth of Airport Road Creek	X
Staley Creek	Off Johnson Rd; south of Busby	Mouth of Staley Creek	
Sunshine Creek	Old Moscow Highway	Mouth of Sunshine Creek	
Four Mile Creek	McIntosh Road	Just upstream of Rose Creek confluence	
Rose Creek	McIntosh Road	Mouth of Rose Creek	
Spring Flat Creek	Cooper and Lake Road	Mouth of Spring Flat Creek	
Unnamed Tributary	Pullman-Albion Road	Significant wet-season flow contribution	

SFPR – South Fork Palouse River
FC – Fecal coliform bacteria
WWTP – Wastewater treatment plant

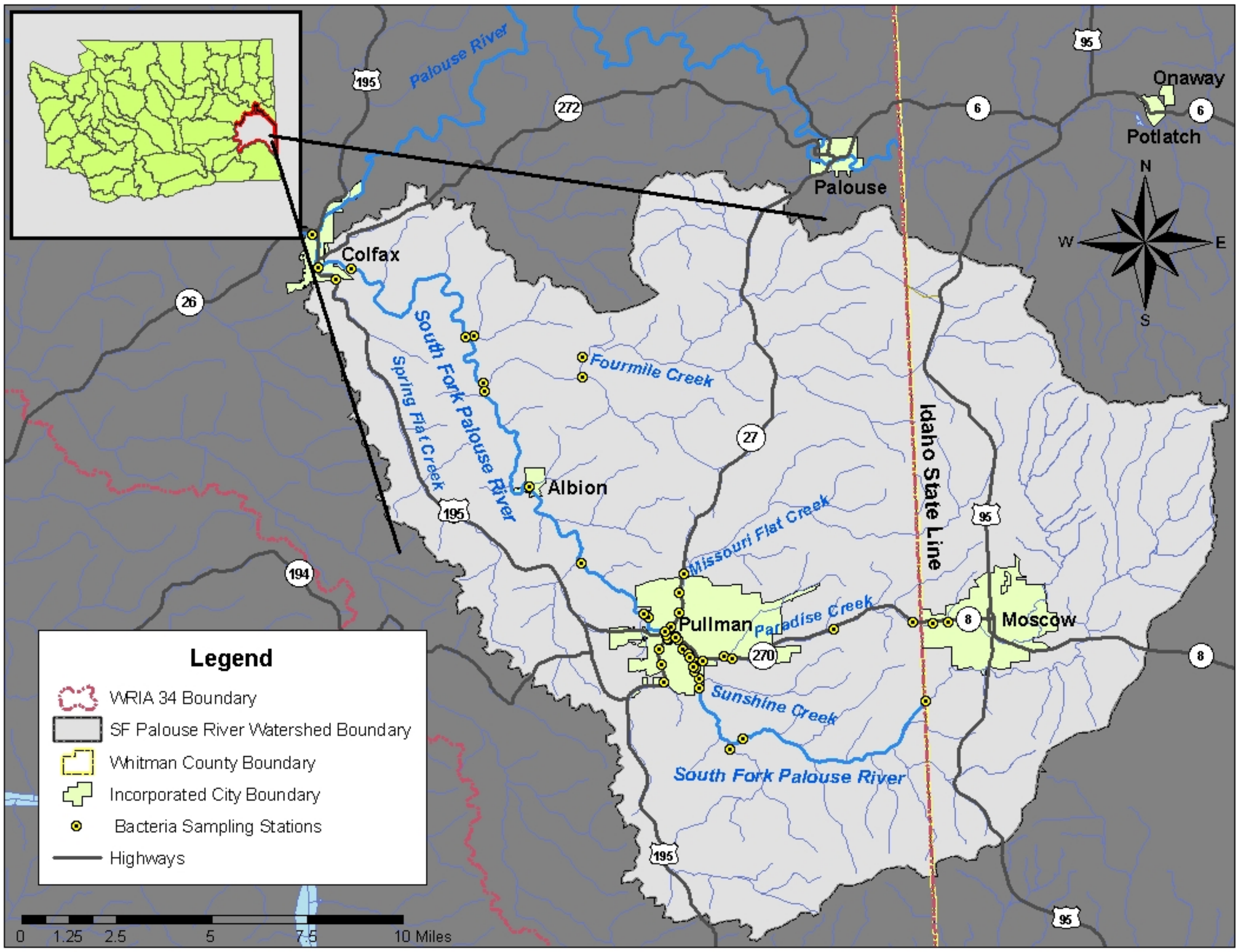

Figure 10. Map of the South Fork Palouse River watershed showing proposed TMDL sampling sites.

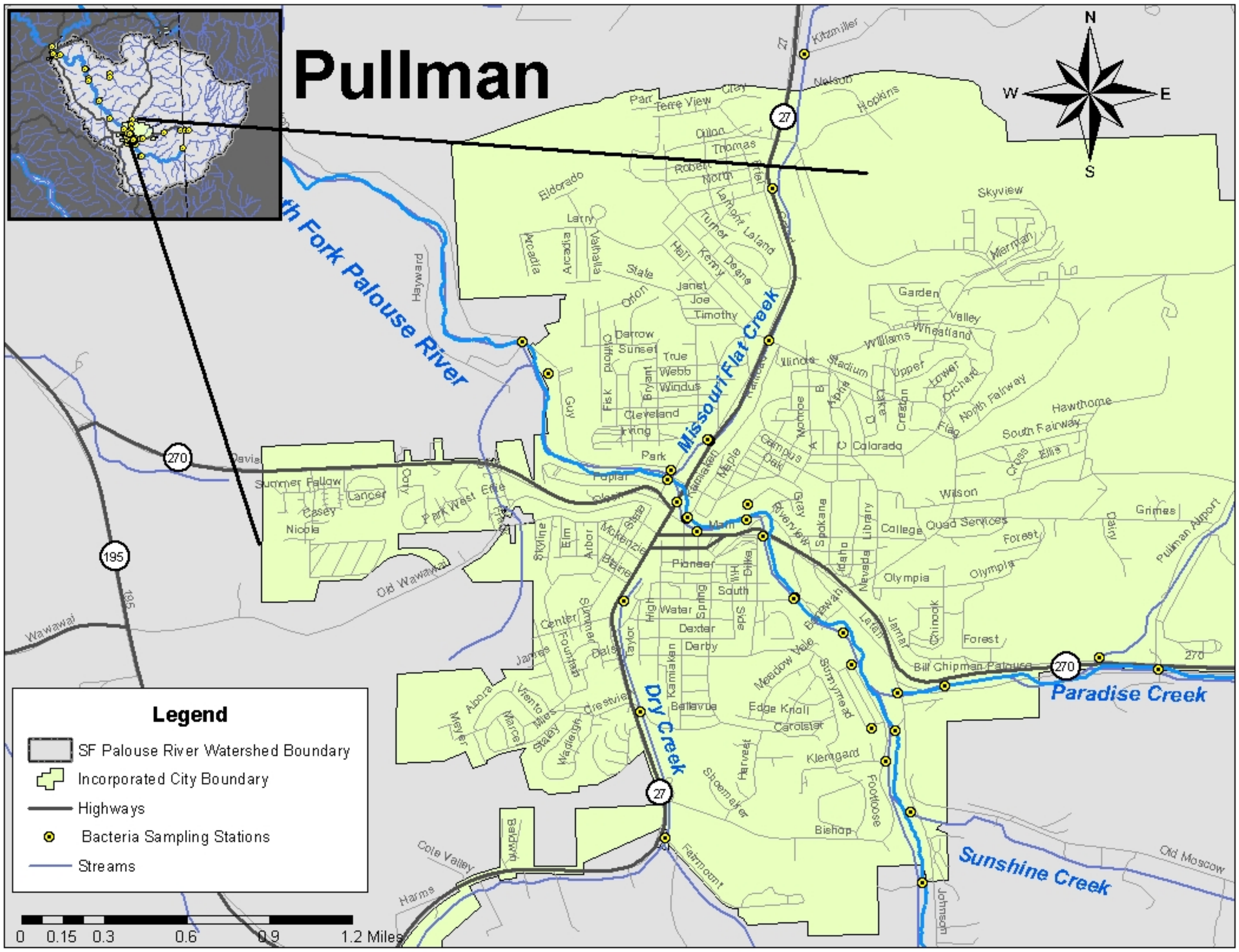

Figure 11. Map of the Pullman area showing proposed TMDL sampling sites.

Storm Monitoring

The purpose of storm monitoring is to better characterize potential sources of fecal coliform loading to the study area stream. Historical data suggests higher fecal coliform loading occurs during the winter and spring (Figures 6 and 8). Weather permitting, storm sampling will occur primarily during November through April. If sufficient rain and runoff do not occur during these months, the schedule will be adjusted. The project team will attempt to capture one storm event during the summer, low-flow season in order to characterize the impact of these events.

Two to three events will be sampled, with a storm event defined as a minimum 0.1 inches of rainfall in a 24-hour period preceded by no more than trace rainfall in the previous 24 hours (Ecology, 2002). The amount of rain that falls from the onset of rain to the time that sampling stops will be used to determine if a sampled storm meets the minimum criteria. For example if rain begins to fall at 8 am, sampling ends at 5 pm, and 0.04 inches of rainfall during that period of time, then the intensity of the rainfall is 0.04 inches per nine hours, or 0.107 inches per 24 hours. This storm event would just barely meet the minimum storm event definition of 0.1 inches per 24 hours. If the project team continued sampling after 5 pm, the intensity would fall below the minimum required. Samples collected after 5 pm would then be qualified in field notes and lab forms. Hydrologic and weather conditions, in addition to other factors, would be reviewed to determine the usability of the data.

One or more storms will likely be inadvertently captured during regularly scheduled sampling runs. These data will also be used to characterize storm events in the South Fork Palouse River watershed.

Streamflow will be measured or estimated using stage and rating curves or relationships with other monitoring locations when grab samples are collected. Daily rainfall data will be obtained from tipping-bucket rain gages.

The stormwater sampling sites will consist of 33 of the fixed network sites (Table 10). This includes a subset of 24 core storm sites for shorter storm events or for storm events where only one sampling team is available. The stormwater sampling plan also includes a set of nine sites where a second round of samples will be collected when time and staff resources allow. Stormwater NPDES permits are required to have corresponding wasteload allocations set in TMDL studies. Therefore, this study must determine wasteload allocations for the city of Pullman which will be regulated under the new Phase II Municipal Stormwater Permit for Eastern Washington.

Table 10. List of 33 potential stormwater sites in the South Fork Palouse River watershed.

Includes a subset of 24 core storm sites for shorter storm events or for storm events where only one sampling team is available. Also includes a set of nine sites where a second round of samples will be collected when time and staff resources allow.

Waterbody/ Source	Road Crossing or Access	Reason for Site	Core Storm	2nd Run
SF Palouse River	Sand Road near state line	Washington-Idaho border		
	Off Johnson Road	Just outside Pullman city limits	X	X
	Hayward Road	Just below Pullman WWTP outfall	X	X
	Albion Road/D Street bridge	Within Albion city limits		
	USGS Station (historical)	Just outside Colfax city limits		
	End of B Ave.	Mouth of SFPR		
Paradise Creek	Off Moscow-Pullman Hwy.	Washington-Idaho border		
	Bishop Boulevard	Mouth of Paradise Creek	X	X
Missouri Flat Creek	Kitzmiller Road	Just outside Pullman city limits	X	
	Grand Ave. near Whitman St.	Mouth of Missouri Flat Creek	X	X
Dry Fork Creek	Fairmount Road	Just outside Pullman city limits	X	
	Crestview Road and Grand Ave.	Identify FC sources		
	Gas Station at 500 Grand Ave.	Good access; Identify FC sources	X	
	Off Grand at SFPR confluence	Dry Creek at its mouth	X	X
Storm Drain WSU#1 to SFPR	Benewah St.	Identify FC sources	X	X
Storm Drain WSU#2 to SFPR	Main St. just east of Dilke Road	Identify FC sources	X	X
Storm Drain #120 to Missouri Flat Creek	Off Stadium Way; in Jack-in-the-Box lot	Identify FC sources	X	X
Pullman WWTP Outfall	1025 Guy St.	Treated WWTP effluent discharge		
Four Mile Creek	Shawnee-Parvin Road	Mouth of Four Mile Creek		
Storm Drain #360 to SFPR	Klemgard and Bishop	Identify FC sources	X	
Storm Drain #320 to SFPR	Professional Mall plaza	Identify FC sources	X	
Storm Drain #290 to SFPR	Manhole on Pro. Mall Blvd.	Identify FC sources	X	
Storm Drain #260 to SFPR	South Street bridge	Identify FC sources	X	
Storm Drain #180 to SFPR	Manhole on Morton St.	Identify FC sources	X	
Storm Drain #170 to SFPR	Across railroad tracks from #180	Identify FC sources	X	
Storm Drain #140 to SFPR	Under footbridge east of Kamiaken bridge	Identify FC sources	X	
Storm Drain #120 to SFPR	Under Kamiaken St. bridge	Identify FC sources	X	
Storm Drain WSU#3 to Paradise Ck.	Off Main St. just east of Johnson	Identify FC sources	X	
Storm Drain #60 to Missouri Flat Creek	Off Grand Ave. near Larry St.	Identify FC sources	X	
Storm Drain #200 to Missouri Flat Creek	Retaining wall at Grand Ave and Irving St.	Identify FC sources	X	
Storm Drain #210 to Missouri Flat Creek	Retaining wall at Grand Ave and Irving St.	Identify FC sources	X	
Pullman Transit Facility	775 Guy St.	Industrial permit holder		
Airport Road Creek	Off Main St. or Airport Road	Characterize airport permit holders	X	X

SFPR – South Fork Palouse River; FC – Fecal coliform bacteria; WWTP – Wastewater treatment plant

Representativeness

The study was designed to have enough sampling sites and sufficient sampling frequency to adequately characterize fecal coliform spatial and temporal patterns in the watershed. Fecal coliform 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. Laboratory and field errors are further expanded by estimate errors in seasonal loading calculations.

Comparability

Samples collected at the Pullman and Moscow wastewater treatment plants (WWTPs) will be collected, when possible, in conjunction with the routine samples collected by the WWTP operators. Ecology results will be compared to the results from each WWTP. Similarly, samples collected on the SFPR at the Washington-Idaho border will be collected in conjunction with samples collected by the Idaho Department of Environmental Quality (DEQ) for the TMDL on the SFPR in Idaho. The DEQ analyzes fecal coliform samples using a most probable number; Ecology will analyze samples collected at the state line using the most probable number method in order to increase the comparability of the data collected by both agencies. If the comparison of these results shows high variability, then sampling and laboratory methodologies will be reviewed and sampling will be repeated.

Completeness

EPA has defined completeness as a measure of the amount of valid data needed to be obtained from a measurement system (Lombard et al., 2004). The goal for the SFPR TMDL is to correctly collect and analyze 100% of the fecal coliform samples for each of the sites, plus 100% of the storm event samples. However, problems occasionally arise during sample collection that cannot be controlled – such as flooding, inadequate rain for storm sampling, or site access problems – that can interfere with this goal. A lower limit of five samples per season per site will be required for comparison to state criteria, which will be 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 fecal coliform problems in an area. Such sampling that does not meet the lower limit criteria of five samples per season per site will still be useful for source identification and other analyses, but will not be used to set load or wasteload allocations.

Laboratory Budget

The estimated laboratory budgets and laboratory sample loads in Tables 11 and 12 are based on the proposed schedule in Table 7. 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). The greatest uncertainty in the laboratory load and cost estimate is with the synoptic storm survey work. 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 11. The number of monthly sample submittals for each analysis, an estimate of the monthly analytical costs, and the total analytical cost estimate[2] for the project.

	FC (MF)	Reps.	Chloride	Reps.	Turb.	Reps.	TSS	Reps.	Cost
May (w/storm)	84	17	26	3	57	6	57	6	$ 3,729
June	72	15	45	5	45	5	45	5	$ 3,427
July	72	15	45	5	45	5	45	5	$ 3,427
August	72	15	45	5	45	5	45	5	$ 3,427
September	72	15	45	5	45	5	45	5	$ 3,427
October	72	15	45	5	45	5	45	5	$ 3,427
November (w/storm)	103	21	45	5	76	8	76	8	$ 4,884
December (w/storm)	103	21	45	5	76	8	76	8	$ 4,884
January	72	15	45	5	45	5	45	5	$ 3,427
February	72	15	45	5	45	5	45	5	$ 3,427
March	72	15	45	5	45	5	45	5	$ 3,427
April	72	15	45	5	45	5	45	5	$ 3,427
May	72	15	45	5	45	5	45	5	$ 3,427
Totals	1010	209	566	63	659	72	659	72	**$ 47,767**

Reps. = replicates for 20% (bacteria) or 10% (other) of the preceding column
FC = fecal coliform
Turb. = turbidity
TSS = total suspended solids
MF – membrane filter method

Table 12. Projected sample loads and lab costs for nutrient sampling.

	Nutrients	Reps.	TOC	Reps	DOC	Reps.	Alkalinity	Reps.	Cost
May	31	3	31	3	31	3	31	3	$ 4,828
June	19	2	19	2	19	2	19	2	$ 2,982
September	19	2	19	2	19	2	19	2	$ 2,982
December	19	2	19	2	19	2	19	2	$ 2,982
March	19	2	19	2	19	2	19	2	$ 2,982
Totals	107	11	107	11	107	11	107	11	$ 16,756

Reps. = replicates 10% of the preceding column
Nutrients = ammonia (NH_3), nitrite/nitrate (NO_2/NO_3), orthophosphate (OP), total phosphorous (TP), and total persulfate nitrogen (TPN)
TOC = total organic carbon
DOC = dissolved organic carbon

[2] 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 Manchester Environmental Laboratory (MEL) and described in the MEL Users Manual (2005). Sample parameters, containers, volumes, preservation requirements, and holding times are listed in Table 13. 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 protocols (Ecology, 1993). Twenty percent of fecal coliform samples 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 13. Containers, preservation requirements, and holding times for samples collected during the South Fork Palouse River TMDL Study (MEL, 2005).

Parameter	Container	Preservative	Holding Time
Fecal Coliform	250 or 500 mL glass/poly autoclaved	Cool to 4ºC	24 hours
Chloride	500 mL poly	Cool to 4ºC	28 days
Total Suspended Solids	1000 mL poly	Cool to 4ºC	7 days
Turbidity	500 mL poly	Cool to 4ºC	48 hours
Alkalinity	500 mL poly – No Headspace	Cool to 4°C; Fill bottle completely; Don't agitate sample	14 days
Ammonia	125 mL clear poly	H_2SO_4 to pH<2; Cool to 4ºC	28 days
Dissolved Organic Carbon	60 mL poly with: Whatman Puradisc™ 25PP 0.45um pore size filters	Filter in field with 0.45um pore size filter; 1:1 HCl to pH<2; Cool to 4°C	28 days
Nitrate/Nitrite	125 mL clear poly	H_2SO_4 to pH<2; Cool to 4ºC	28 days
Total Persulfate Nitrogen	125 mL clear poly	H_2SO_4 to pH<2; Cool to 4ºC	28 days
Orthophosphate	125 mL amber poly w/ Whatman Puradisc™ 25PP 0.45um pore size filters	Filter in field with 0.45um pore size filter; Cool to 4°C	48 hours
Total Phosphorous	60 mL clear poly	1:1 HCl to pH<2; Cool to 4°C	28 days
Total Organic Carbon	60 mL clear poly	1:1 HCl to pH<2; Cool to 4°C	28 days

Measurement Procedures

Field measurements in the SFPR and its tributaries will include conductivity, temperature, pH, and dissolved oxygen using a calibrated Hydrolab MiniSonde®. Dissolved oxygen will also be collected and analyzed using the Winkler titration method (Ecology, 1993).

Estimation of instantaneous flow measurements will follow the Stream Hydrology Unit protocols manual (Ecology, 2000). 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 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, and/or staff gage readings will be recorded. A flow rating curve will be developed for sites with a staff gage.

Measurement Quality Objectives

Sampling, laboratory analysis, and data evaluation steps have several sources of error that should be addressed by measurement quality objectives. Precision in laboratory measurements (measurement quality objectives) can be more easily controlled than field sampling variability. Precision needs to be as high as possible in the laboratory. Precision for bacteria field replicates is expressed as the relative standard deviation (RSD), and results should not exceed 30% RSD.

Microbiological and analytical methods, expected range of sample results, and method resolution are listed in Table 14. The expected range of sample results is based on historical data from similar watersheds. 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 and quality control procedures are documented in the MEL Lab Users Manual (MEL, 2005).

The targets for analytical precision of laboratory analyses in Table 14 are based on historical performance by MEL for environmental samples collected around the state by Ecology's Watershed Ecology Section (Mathieu, 2005a). Bias is also a component of data accuracy; however, bias from the true value is very difficult to determine for this set of parameters. Bias in field measurements will be minimized by strictly following sampling and handling protocols. Calibration standards for microbiological analyses are not available.

Table 14. Targets for precision and reporting limits for the measurement systems.

Analysis	Method	Duplicate Samples Relative Standard Deviation (RSD)	Reporting Limits and Resolution
Field Measurements			
Velocity[1]	Marsh McBirney Flow-Mate Flowmeter	0.1 ft/s	0.01 ft/s
Water Temperature[1]	Hydrolab MiniSonde®	+/- 0.1° C	0.01° C
Specific Conductivity[2]	Hydrolab MiniSonde®	+/- 0.5%	0.1 umhos/cm
pH[1]	Hydrolab MiniSonde®	0.05 SU	1 to 14 SU
Dissolved Oxygen[1]	Hydrolab MiniSonde®	5% RSD	0.1 - 15 mg/L
Dissolved Oxygen[1]	Winkler Titration	+/- 0.1 mg/L	0.01 mg/L
Laboratory Analyses			
Fecal Coliform – MF	SM 9222D	30% RSD[3]	1 cfu/100 mL
Chloride	EPA 300.0	5% RSD[4]	0.1 mg/L
Total Suspended Solids	SM 2540D	10% RSD[4]	1 mg/L
Turbidity	SM 2130	10% RSD[4]	1 NTU
Alkalinity	SM 2320	10% RSD[4]	10 mg/L
Ammonia	SM 4500-NH_3^-H	10% RSD[4]	0.01 mg/L
Dissolved Organic Carbon	EPA 415.1	10% RSD[4]	1 mg/L
Nitrate/Nitrite	4500-NO_3^- I	10% RSD[4]	0.01 mg/L
Total Persulfate Nitrogen	SM 4500-NO_3^-B	10% RSD[4]	0.025 mg/L
Orthophosphate	SM 4500-P G	10% RSD[4]	0.003 mg/L
Total Phosphorous	EPA 200.8	10% RSD[4]	0.001 mg/L
Total Organic Carbon	EPA 415.1	10% RSD[4]	1 mg/L

[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 20 cfu/100 mL will be evaluated separately.
[4] replicate results with a mean of less than or equal to 5X the reporting limit will be evaluated separately.

MF = Membrane filter method
SM = Standard Methods for the Examination of Water and Wastewater, 20th Edition (APHA, AWWA and WEF, 1998)
EPA = EPA method code

Quality Control Procedures

Total variation for field sampling and analytical variation will be assessed by collecting replicate samples. Bacteria samples tend to have a high relative standard deviation 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 the presence of bias in analytical methods. 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 will be qualified 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 nonpotable water tested for compliance purposes. MEL has a maximum holding time for microbiological samples of 24 hours (MEL, 2005) that is recommended by Standard Methods (APHA, AWWA, and WEF, 1998) for drinking water samples (<30 hours) and other types of water tested when compliance is not an issue (<24 hours). 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 20 fecal coliform samples were collected in 500 mL bottles and each split into two 250 mL bottles. The samples were driven to MEL within six 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 method. Replicates were compared to the measurement quality objectives in Table 12.

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 12 Environmental Assessment Program TMDL studies using the membrane filter method, suggesting that a longer (i.e., 24-hour) holding time has little effect on fecal coliform results processed by MEL. Samples with longer holding times did not show a significant tendency towards higher or lower fecal coliform counts compared to the samples analyzed within six to eight 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 Manchester Environmental Laboratory by Ecology's Laboratory Information Management System (LIMS) will be exported prior to entry into EIM 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 ID (JICA0000) has been created for this TMDL study and all monitoring data will be available via the internet once the project data have been validated. The URL address for this geospatial database is www.ecy.wa.gov/eim/. All data will be uploaded to EIM by the EIM data engineer once the data have been reviewed for quality assurance and finalized.

All spreadsheet files, paper field notes, and GIS 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 Ecology's 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/or 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 validity 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 fecal coliform data are verified by MEL, the laboratory microbiologist will notify the field lead by e-mail or by phone of fecal coliform results greater than 200 cfu/100 mL. The field lead will then notify Ecology's Eastern Regional Office client staff contact and Water Quality Program section manager by e-mail of these elevated counts in accordance with Environmental Assessment 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 12. 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 Environmental Assessment 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 three 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. Fecal coliform 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, 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 fecal coliform 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 fecal coliform distribution. If sources of fecal coliform vary by season and create distinct critical conditions, seasonal targets may be required. Fewer data will provide less confidence in fecal coliform 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 percent RSD for bacteria replicates exceeds the measurement quality objective 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,** *Water Quality Studies Unit, Project Manager*: 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.

- **Nuri Mathieu,** *Water Quality Studies Unit, Conventionals Field Investigator*: Author of the QA Project Plan for bacteria. Manages the data collection program. Coordinates intensive field surveys once a month with ERO staff. Responsible for data collection, entering project data into the EIM system, and data quality review.

- **Brenda Nipp**, *Water Quality Studies Unit, Conventionals Field Investigator*: Coordinates and conducts field surveys twice a month. Responsible for data collection in the field.

- **Chuck Springer**, *Stream Hydrology Unit, Hydrologist*: Responsible for deploying and maintaining continuous flow gages and staff gages. Responsible for producing records of streamflow data at sites selected for this study.

- **Scott Tarbutton,** *Nonpoint Studies Unit, Field Assistant*: Assists staff in field preparations, data collection, and sample processing.

- **Karol Erickson**, *Water Quality Studies Unit, Unit Supervisor*: Reviews and approves the QA Project Plan, TMDL report, and the project budget.

- **Will Kendra**, *Watershed Ecology Section, Section Manager*: Approves the QA Project Plan and final TMDL report.

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

- **Bill Kammin**, *Quality Assurance Officer*: 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:* Acts 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. Implements, plans, and prepares the TMDL document for submittal to EPA.

- **Dave Knight**, *Watershed Unit Supervisor, Eastern Regional Office*: Approves the TMDL submittal to EPA.

- **Jim Bellatty**, *Section Manager, Eastern Regional Office*: Approves the TMDL submittal to EPA.

Project Schedule

Table 15. Project schedule for the South Fork Palouse River TMDL study.

Environmental Information System (EIM) Data Set	
EIM Data Engineer	Brenda Nipp
EIM User Study ID	JICA0000
EIM Study Name	South Fork Palouse River Bacteria TMDL
EIM Completion Due	September 2007
Quarterly Reports	
Report Author Lead	Brenda Nipp
1st Quarter	August 2006
2nd Quarter	November 2006
3rd Quarter	February 2007
4th Quarter	May 2007
5th Quarter	August 2007
Final Report	
Report Author Lead	Jim Carroll
Draft to Supervisor	January 2008
Draft to Client/Peer	February 2008
Draft to External Reviewers	March 2008
Final Report on Web	June 2008

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Appendix.
Response to Comments on the Draft Quality Assurance Project Plan for the South Fork Palouse River Bacteria TMDL Study

The draft report, *Quality Assurance Project Plan for the South Fork Palouse River Bacteria TMDL Study,* was distributed to the South Fork Palouse River (SFPR) Technical Advisory Group on April 27, 2006. Comments were due by May 12, 2006.

Ecology received written comments from the city of Moscow in Idaho, Idaho Department of Environmental Quality, and University of Idaho, as well as the cities of Albion and Colfax in Washington and Washington State University. Ecology appreciates all comments received.

Minor comments (e.g., related to grammar) have been incorporated into the final Quality Assurance Project Plan (QAPP). The remaining comments are summarized below (as *italicized* text) with Ecology's response or action following each comment. These changes also have been incorporated into the final QAPP.

1. Several comments submitted noted that the classification of the South Fork (SF) Palouse River as a Class A waterbody may be inaccurate.

Marty O'Malley, Washington State University:

On page 9, second paragraph the SFPR is classified as a class A water body. If you check into the history of this designation (I have talked to various ERO people) the designation was made at a time when DOE was under significant pressure from EPA and the SFPR was not actually evaluate but was classified arbitrarily. It may be in the best interest of all involved that DOE re-evaluate this classification so that the TMDL can be set to attainable goals.

Les MacDonald, City of Moscow:

From QAPP: "The South Fork Palouse River is classified as Class A (excellent) according to the 1997 rule and is now considered Primary Contact Recreation *[MacDonald: Questionable as to whether this is realistic.]* water according to the 2003 rule."

Response: Chapter 173-201A of the Washington Administrative Code (WAC) assigned a classification to all waterbodies throughout the state. Some waterbodies were given specific classifications based on known conditions. These conditions included being located in more pristine areas, draining to a lake and other considerations. According to WAC 173-201A-120 "All other unclassified surface waters within the state are hereby classified Class A." The SF Palouse River falls under this classification. Changing SF Palouse River's Class A classification is outside the scope of the QAPP and the technical study. However, data from this study will lead to a better understanding about what is attainable for this system.

2. Several comments submitted noted that the Bacteria QAPP was unclear about the description and use of nutrients and other non-bacteria data collected during the study.

Jan Boll, University of Idaho:

The document is not very clear on the use of nutrient and other data collected during this study, other than saying it will be for future use in TMDLs. Does this mean these data are not subjected to a QAPP in as much detail as temperature and bacteria?

Marty O'Malley, Washington State University:

In the first paragraph of the abstract on page 4, ammonia should be replaced by nutrients or on page 8 in the project objectives' bullets replace nutrients with ammonia.

Les MacDonald, City of Moscow:

From QAPP: "A general water quality assessment will help in the development of TMDLs for dissolved oxygen and pH."
How about Temp D.O.

Response: A separate QAPP is being developed for dissolved oxygen (DO) and pH TMDL study. Opportunistic collection of nutrient and other non-bacteria data will be conducted as background data for the upcoming DO/pH/nutrient study.

The abstract on page 4 describes 303(d) listings within the SF Palouse basin. Nutrient sampling outlined in project objectives on page 9 will include sampling for ammonia, in addition to other nutrients.

The relationship between temperature and DO will be addressed by the upcoming DO/pH/ nutrient QAPP.

3. Several comments submitted raised questions about the storm-event sampling period:

Jan Boll, University of Idaho:

I am encouraged to see the inclusion of storm event sampling. This is a must to get accurate loading. I suggest the team reviews my comments and determines if the storm sampling planning may need adjustment for conditions in eastern Washington. Particularly, I think winter hydrology is most active between January and April, so event sampling should occur then. Snowmelt (and frozen soil conditions historically) can generate streamflows in addition to rain.

From QAPP: "Weather permitting, storm sampling will occur primarily during November through January."
I am wondering if planning for the period Jan-Apr is more appropriate given that usually provides the most winter/spring runoff.

From QAPP: "Three events will be sampled, with a storm event defined as a minimum 0.1 inches of rainfall in a 24-hour period preceded by no more than trace rainfall in the previous 24 hours"
While rainfall amounts are an indication of storm events, there is also snowmelt to be accounted for. Later in winter, as the watersheds become more saturated, small storms can generate more streamflow (and overland flow) than earlier in the season. I am not sure this criterium will reflect these patterns.

Response: The draft QAPP specified November to January as the primary timeframe for sampling, with the possibility of sampling storm events outside of this window depending on hydrologic conditions. Based on recommendation, the primary timeframe has been expanded from November to April. Actual storm-event sampling will depend on the hydrologic conditions of the current season.

4. Other comments addressed:

Marty O'Malley, Washington State University:

Page 11, under wildlife we do have moose in the watershed.

Response: Added.

Page 12, Stormwater Sources first paragraph. I am not sure I agree with the statement, particularly pavements and rooftops. Also, you have a citation but no reference.

Response: Reference added.

Page 13, table 3, change Paradise Creek to Airport Road Creek

Response: Table changed.

Finally, the plan should address the sampling sequence because when you are sampling a moving water system care must be taken to not contaminate subsequent samples by disturbing the water course and make sure that the timing is such that you are not sampling the same water repeatedly as it flows downstream.

Response: Ecology has many years of experience conducting field work and developing bacteria TMDLs. Ecology will take all precautions to ensure the collection of reliable and credible data in the SFPR.

Jan Boll, University of Idaho:

I also wonder if any efforts can be undertaken to determine the sources of bacteria, perhaps using Fecal Coliform/Fecal Streptococci ratios.

Response: Ecology is not planning on attempting to determine sources by this means due to lab budget constraints and uncertainty about the utility of the data.

From QAPP: For Class A Freshwater (1997 rule) and freshwater Primary Contact Recreation (2003 rule): "…fecal coliform organism levels shall both not exceed a geometric mean[3] value of 100 colonies/100 mL, and not have more than 10 percent of all samples obtained for calculating the geometric mean value exceeding 200 colonies/100 mL."
This statement does not specify the time period over which the mean is taken, assuming the mean is calculated at a sampling point.

Response: Unlike Idaho, Washington State water quality standards do not specify an exact timeframe for calculating the mean from a sampling point. General guidance from the standards 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." For this bacteria study, we will average by season and plan to collect a minimum of ten samples per season.

From QAPP: "FC loads are determined by taking the number of cfu over the volume of the sample (e.g. #cfu/100 mL) and multiplying by the volume of streamflow over time (e.g. cubic feet per second)."
It would help to explain how the load relates to the numeric criteria on page 9, which are expressed only as a concentration.

Response: Loads do not directly relate to the numeric criteria. Loads are used to calculate a mass balance of bacteria to help determine relative contributions from various sources and stream reaches.

From QAPP: "Two to three storm events sampled in the months of Nov. to January if possible; other months if necessary"
How many samples per event?

Response: Due to logistical constraints, only one round of sampling will occur at each site. If the storm persists, a second round of sampling may occur at select sites. See page 29 for further clarification.

[3] The geometric mean is calculated as the n^{th} root of the product of n numbers.

From QAPP: "Daily rainfall data will be obtained from tipping-bucket rain gages."
At existing climate stations?

Response: One rain gage will be installed at Ecology's weather station near Colfax. Others may be installed in Pullman depending on staff time and resources.

From QAPP: "Ecology results will be compared to the results from each WWTP"
What will be done if the comparison fails?

Response: We will review sampling and laboratory methodologies and repeat sampling.

From QAPP: "Table 9"
Not clear why there are storms included in May, and not in Jan-Apr (see comment above). Should May at bottom of column also have storm sampling?

Response: Storm-event sampling will not occur in May; that part of Table 9 is outdated and will be changed. Overall lab budget will remain the same.

From QAPP: "Precision for bacteria field replicates is expressed as the relative standard deviation (RSD) and results should not exceed 30% RSD"
This may be acceptable for FC. Is this intended also for nutrients and other parameters?

Response: No, separate measurement quality objectives (MQOs) for each parameter are listed in Table 12.

Tom Scallorn, City of Moscow:

Page 11: Point Sources, last paragraph. Please include data or comment that Moscow is in compliance with the fecal requirement of our permit.

Response: Added that Moscow reports being in compliance with permit.

Les MacDonald, City of Moscow:

From QAPP: "A TMDL identifies how much pollution needs to be reduced or eliminated to achieve clean water."
Is this the goal? What is the definition of "clean?"

Response: The goal of a TMDL is to meet water quality standards; likewise, the definition of "clean water" is that which meets water quality standards.

From QAPP: "Figure 1. Study Area"
Not very legible in black and white

Response: We acknowledge that in black and white the image is difficult to view. Furthermore, the image was compressed for email distribution. A PDF document which will include higher resolution images will soon be available from Ecology's website.

From QAPP: "Table 1."
Need more explanation (clarity) as to where these are located.

Response: Listings in Table 1 correspond to those illustrated on Figure 1. Further detail on location of water quality listings can be obtained from: www.ecy.wa.gov/programs/wq/links/wq_assessments.html.

From QAPP: "Project objectives."
[Add] Determine water body capacity

Response: Added the following language to project objectives: Calculate percent reductions needed from sources to meet the water quality standards.

From QAPP: "Dry Creek"
Dry Fork Creek?

Response: Changed.

From QAPP: "Table 3"
Paradise Creek change to Airport Creek.

Response: Table changed.

From QAPP: "The WWTP outfall and Paradise Creek below the WWTP outfall had geometric mean concentrations of 177 and 133 cfu/100 mL, respectively. When outlier data is included these geometric means increase to 224 and 221 cfu/100 mL respectively (Schnabel and Wilson, 1996)."
Not representative of current conditions due to plant upgrades in 2001

Response: This language is part of a historical data review and not a report of current conditions. Updated QAPP will note 2001 upgrades.

From QAPP: "Table 6."
Need to address this data in text.

Response: Information from table caption will be included in text.

From QAPP: "The fixed-network core sampling run and intensive sampling run will each occur once a month from May 2006 to May 2007 (Table 7). The locations of the fixed-network water quality stations are listed in Table 5"
Don't seem to match up with sites on page 21. Also sites in Table 5 and lots in Fig. 10

Response: We apologize for the confusion the in text. The table reference was not updated from an earlier version of the QAPP. Table 5 should read Tables 8 and 9. The stream gage sites listed on page 21 are included in Table 8, although they may have slightly different descriptions. Figure 10 includes all stations from Tables 8 and 9.

From QAPP: "Stations were selected based on historical site locations and FC results. Major tributaries of the SFPR will be sampled as close to their confluence with the mainstem as possible. There are 53 sites in the intensive network and 26 sites in the core network, with 14 sites on the SFPR mainstem, 17 sites from storm drain or WWTP outfalls, and the remaining 22 sites on the tributaries to the SFPR (Table 8)."
This whole section is confusing and needs to define the different types of sites.

Response: There are 53 total sites. The 26 core sites (Table 8) will be sampled bimonthly, year-round throughout the course of the project. The remaining 27 sites (Table 9) will be sampled bimonthly, but only during the wet season. We acknowledge that it is a complicated sampling scheme. Feel free to contact us for further clarification.

From QAPP: "Figures 10 & 11"
Too small to be legible. Enlarge and break into 2 parts. Move ahead of Tables 8 & 9.

Response: Figures 10 and 11 are intended to illustrate the general location of sampling sites and are to be used in conjunction with site descriptions in Tables 8 and 9.

From QAPP: "Three events will be sampled, with a storm event defined as a minimum 0.1 inches of rainfall"
Study design page 21 says 2 to 3 events.

Response: Changed from three events to two to three events.

From QAPP: "Table 10."
Is this different data than Table 9?

Response: Yes, Table 9 lists sites that will be sampled bimonthly during the wet season regardless of precipitation. Table 10 is a subset of sites from Tables 8 and 9 (see far right column of Tables 8 & 9) that will be sampled in an attempt to capture a storm event.

Kyle Steele, Idaho Department of Environmental Quality:

On page 28 under "Comparability" it states that IDEQ will have their bacteria samples analyzed for fecal coliform bacteria using a membrane filter (MF) method. The lab IDEQ uses does not perform the MF method.

Response: Department of Ecology will analyze any samples collected simultaneously with IDEQ using the most probable number (MPN) method. The QAPP has been updated to reflect these changes.