

Quality Assurance Project Plan

Water Quality Monitoring for Fecal Coliform Bacteria in Dobbs Creek

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Prepared by:

Betsy Dickes
Washington State Department of Ecology
Water Quality Program

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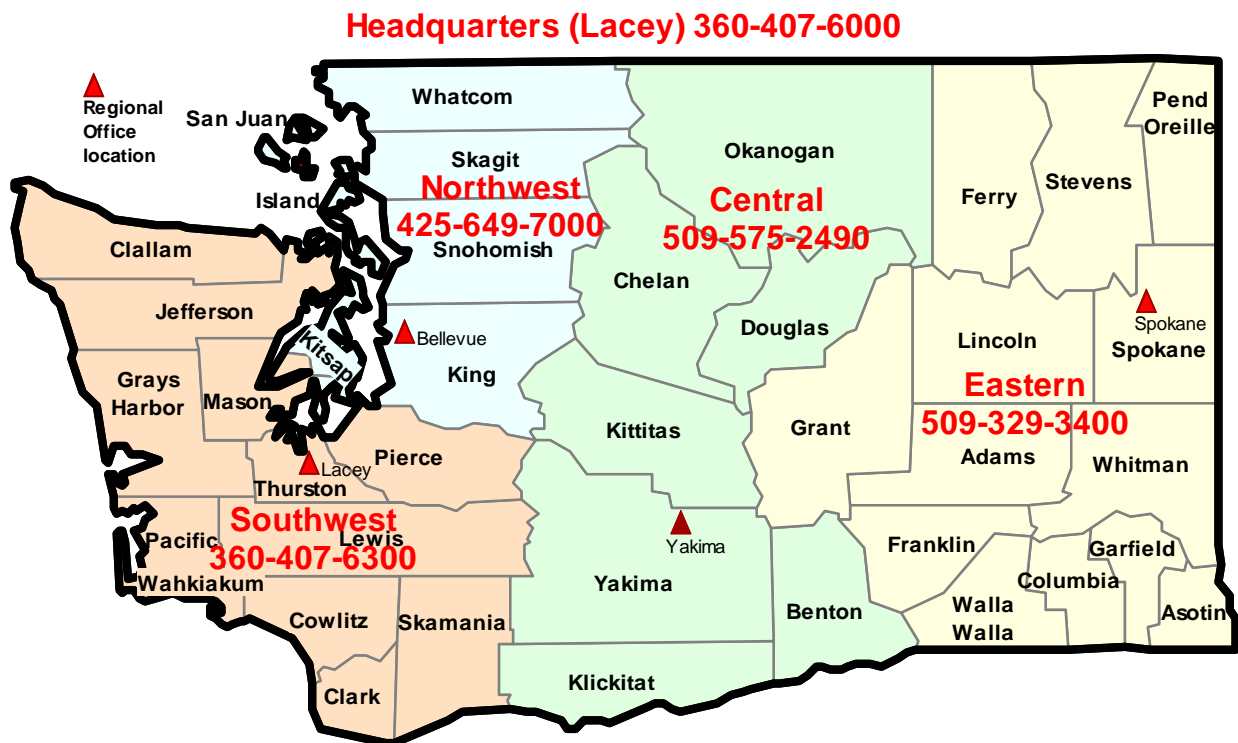
For more information contact:

Department of Ecology
Water Quality Program
Southwest Regional Office
P.O. Box 47775
Olympia, WA 98504-7775

Telephone: 360-407-6300

303(d) Listings Addressed in this Study

Dobbs Creek, Waterbody ID 40612, Fecal Coliform Bacteria
TRS 19N-01W-28.



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Accepted by:

1/16/08

Betsy Dickes, Project Manager, Water Cleanup and Technical Assistance Unit, Water Quality Program, Southwest Regional Office

Accepted by:

1/16/08

Kim McKee, Unit Supervisor, Water Cleanup /Technical Assistance Unit, Water Quality Program, Southwest Regional Office

Accepted by:

1/16/08

Garin Schrieve, Section Manager, Water Quality Program, Southwest Regional Office

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Abstract

Washington State Department of Ecology (Ecology) performed a Total Maximum Daily Load (TMDL) study for fecal coliform (FC) bacteria in the Henderson Inlet Watershed from December 2002 through April 2004. Ecology is required by the federal Clean Water Act to conduct a TMDL study for water bodies on the 303(d) list (list of impaired water bodies). One of the water bodies sampled was Dobbs Creek. The 2006 Henderson Inlet Watershed TMDL technical report identified Dobbs Creek as a source of FC bacteria to Henderson Inlet during wet season and storm events (Sargeant, et al., 2006). This water quality assurance project plan (QAPP) is designed to characterize FC bacteria concentrations in Dobbs Creek during the wet season.

Background

Dobbs Creek flows into Henderson Inlet (Figures 1 and 2). Dobbs Creek was placed on Ecology's 303(d) list for FC bacteria and pH as a result of past violations of state water quality standards. This QAPP is designed to characterize Dobbs Creek for FC bacteria. Other water quality impairments, for pH and dissolved oxygen, likely result from natural conditions (Sargeant, op. cit.) and will not be addressed in the plan.

Under the federal Clean Water Act of 1972, a Total Maximum Daily Load (TMDL) must be performed on all water bodies on the 303(d) list. A TMDL is the calculation of the maximum amount of pollutants that a water body can tolerate and still meet Washington State's Water Quality Standards, Chapter 173-201A of the Washington Administrative Code. The TMDL analysis determines the best ways to bring water bodies back into compliance with water quality standards. The TMDL developed for the Henderson Inlet Watershed included monitoring in Dobbs Creek (Sargeant, op. cit.). Environmental Protection Agency (EPA) approved the TMDL on January 8, 2007. Dobbs Creek is categorized as 4a (Appendix 1), impaired.

This monitoring study is the result of recommendations made in the Henderson Inlet Watershed TMDL technical report (Sargeant, op. cit.). Dobbs Creek had the highest bacterial loading to Henderson Inlet of all creeks sampled in that project. Additional sampling in the upper watershed during that TMDL did not show bacterial contributions from the upstream agricultural operation. Therefore, source identification was recommended.

Current state water quality standards classify Dobbs Creek as an Extraordinary Primary Contact Recreational water (Appendix 2). The standard for this classification requires that "Fecal coliform organism levels must not exceed a geometric mean value of 50 colonies/100 mL, with not more than 10% of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 100 colonies/ 100 mL" (Washington State Department of Ecology, 2006).

This water quality project is designed to further investigate FC bacteria levels in Dobbs Creek and to identify reaches with contamination problems. If source areas are suspected, the information will be provided to the TMDL lead and Technical Advisory Group. By meeting bacteria water quality standards in Dobbs Creek, it is likely that water quality will improve in Henderson Inlet as well.

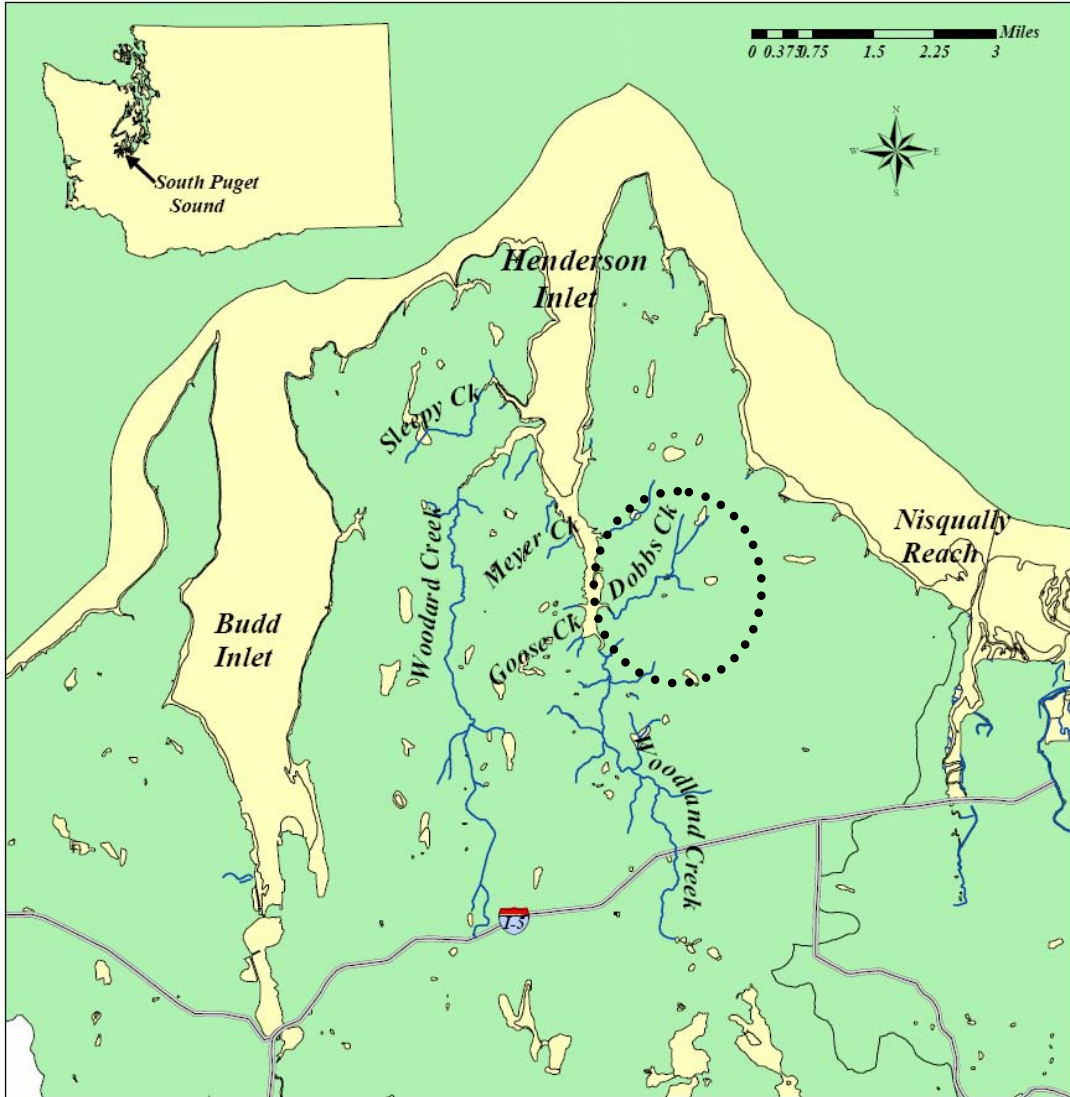


Figure 1. Dobbs Creek (area within dotted oval) and the surrounding area.

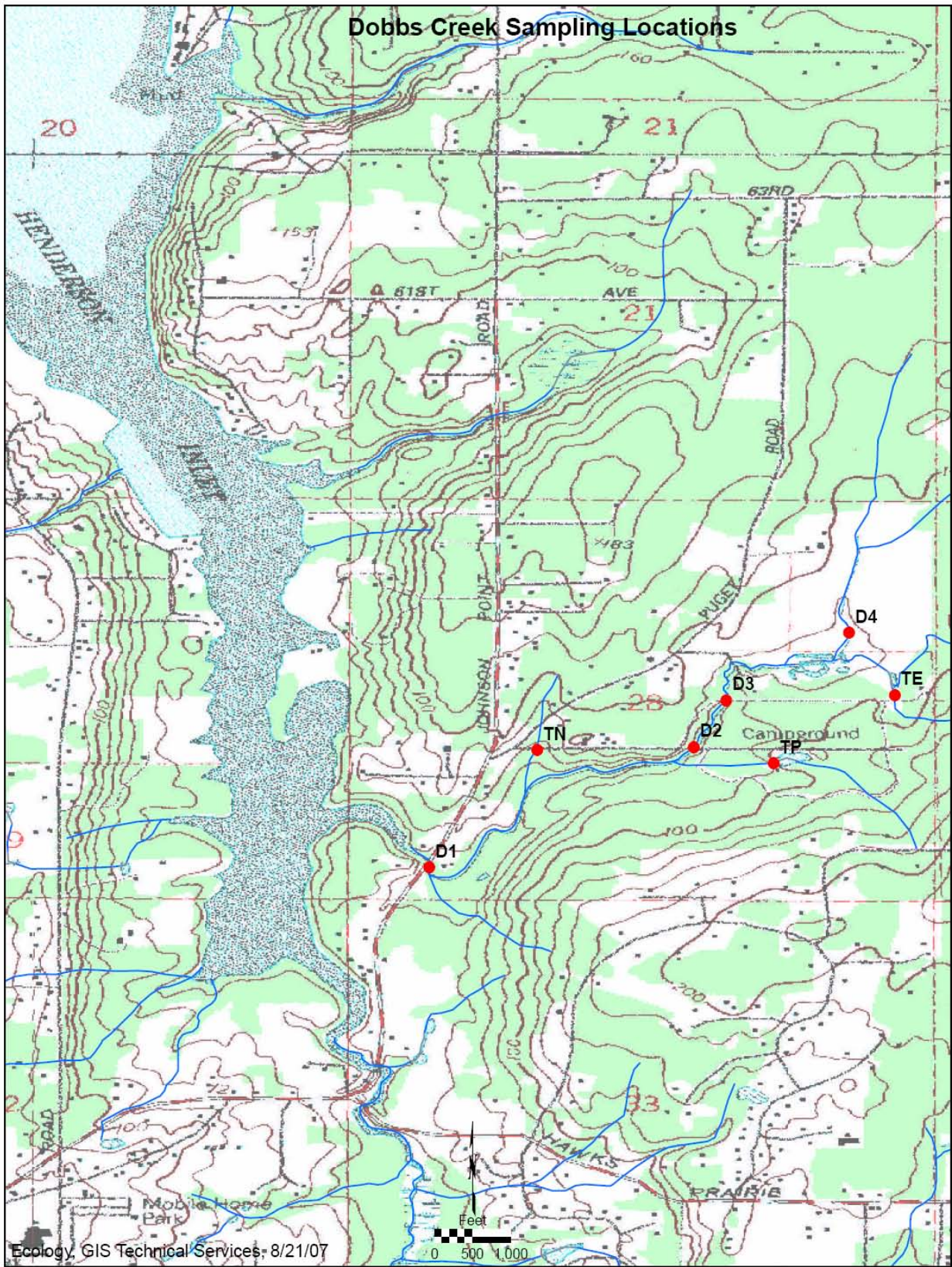


Figure 2. Dobbs Creek sampling locations.

Project Description

Dobbs Creek is 1.5 miles long. The primary land uses in the watershed are rural residential and agricultural. Agricultural activities dominate the upper watershed. Residential land use increases towards the mouth before entering Henderson Inlet. Potential sources for bacterial pollution in the watershed include failing on-site septic systems, domesticated animals, agriculture, and wildlife.

The project goal for water quality monitoring in Dobbs Creek is:

- Identify sources of FC bacteria in Dobbs Creek watershed.

Project objectives for Dobbs Creek water quality monitoring are:

- Collect water quality samples to be analyzed for FC bacteria.
- Assess compliance with State Extraordinary Primary Contact Recreational water quality standards for FC bacteria.
- Document current bacterial water quality conditions in Dobbs Creek that may be contributing to bacteria concentrations and impacts to shellfish beds in Henderson Inlet.

Sampling Process Design

Water samples will be collected from Dobbs Creek at least every other week from November 2007, through March 2008. Samples will be appropriately stored overnight in Ecology's chain-of-custody room. An Ecology courier will pick the samples up on the following morning and deliver them to Ecology's Manchester Environmental Laboratory (MEL). Field sampling will be designed around the 24-hour analytical holding time for bacteria and being able to sample the lowermost site (D1) during an outgoing low tide.

The mouth site and the mainstem site in the upper watershed are the same site used in the Henderson Inlet TMDL (Sargeant, op. cit.). Discharge will be measured at every site when conditions allow.

Table 1. Site description and locations.

DOBBS CREEK SITES						
Site Name	SITE DESCRIPTION	LATITUDE	LONGITUDE	RIVER MILE *	LAB NUMBER	
D1	Dobbs Creek (DC) where creek crosses Johnson Point Road near the estuary. Site is tidally influenced.	N47° 05" 55.5'	W123° 49" 13.1	0.06	wk#	4180
D2	First large bridge crossing DC after passing through Pleasant Forest Camp (PFC) main gate; at base of hill.	N47° 06" 11.7'	W122° 48" 38.2'	0.73	wk#	4182
D3	Bridge over DC on the Elm Road. Upstream of the PFC.	N47° 06" 17.8'	W122° 48" 34'	0.83	wk#	4183
D4	DC upstream of concentrated residential and downstream of agriculture.	N47° 06" 26.9'	W122° 48" 18.5'	1.23	wk#	4184
TN	First tributary coming in on right bank nearest mouth. Access to the right before you enter the PFC.	N47° 06" 11.2'	W122° 48" 57.5'	0.12	wk#	4185
TP	Tributary outfall from pond.	N47° 06" 10'	W122° 48" 29'	0.18	wk#	4186
TE	Tributary due east of D3. Upstream of the intersection with the tributary to the NNW.	N47° 06" 17.8'	W122° 48" 15'	0.18	wk#	4187
R1	<i>replicate = same as routine sample site</i>	<i>N47° nn" nn'</i>	<i>W122° nn" nn'</i>	RM*	wk#	4188
R2	<i>replicate = same as routine sample site</i>	<i>N47° nn" nn'</i>	<i>W122° nn" nn'</i>	RM*	wk#	4189

*obtained using a Garmin 76CSx handheld GPS

** to be verified for the report

The creek will be sampled downstream to upstream when possible. However, sampling D1 first, during an outgoing tide, may be logistically impossible due to daylight limitation. Samples will be placed into a dark ice-filled cooler as soon after collection as possible. The van will be locked whenever Ecology personnel are not at the vehicle.

Sampling Procedures

Safety

Field personnel have the authority to ensure their safety. Reviewing environmental conditions for safety will always be a priority before accessing a sampling site or conducting flow measurements. Personnel can refuse to proceed if they believe safety hazards are present.

Sampling

Standard Ecology Environmental Assessment Program protocols will be used for sample collection. Field sampling and measurement protocols will follow those described in *Field Sampling and Measurement Protocols for the Watershed Assessments Section* (Cusimano, 1993). Grab samples will be collected directly into pre-cleaned containers supplied by the laboratory and described in Manchester Environmental Laboratory (MEL, 2005). Plastic polyethylene bottles will be used to prevent bottle breakage and sample loss. Water samples will be collected by hand or using a sampling pole. Samples will be collected from the stream thalweg (center of flow). Samples will be collected from below the surface of the water to avoid collecting material caught in the surface film. Caution will be exercised not to stir up sediment beyond what will be necessary to complete flow measurements. Each sample will be labeled and immediately placed in a dark thermal cooler with ice. Samples will be kept in conditions between 0°C and 4°C until the samples are processed by the laboratory. Samples will be received at the Manchester Laboratory within 24 hours of collection.

The sample bottles will be labeled with:

- Project name
- Date
- Site name
- Name of lead sampler
- Laboratory ID number
- Analyte
- Sampling time

A waterproof loose-leaf field notebook will be used to record typical field data and any unusual occurrence that may have impacts on the project or sample results.

The project lead will provide training for anyone who is assisting with field work. This will include discussion of quality assurance and contamination prevention. Upon completion of sampling at each site, the notes will be reviewed by the project lead to ensure all activities were performed and records are legible.

The project lead will coordinate sampling dates, laboratory identification numbers, and methods with MEL, using standard Ecology protocol. The samples and completed *Laboratory Analysis Required* form will be picked up at the Ecology Headquarters Chain of Custody Room by the Manchester Courier. The cooler, containing the samples and ice, will be transferred to the lab vehicle using chain of custody protocol.

The mouth site, D1, is tidally influenced. Sampling will be coordinated to occur on an outgoing low tide. The tide will be determined using information for the Henderson Inlet tide station (Station ID 1099).

Storm Events

At least two storm events (>0.20 inches in the previous 24 hours) will be sampled, if possible.

Measurement Procedures

Table 2. Summary of sampling and analysis procedures for field and laboratory procedures.

Analysis	Method or Equipment	Estimated Range	Lower Reporting Limit	Holding Time	Preservation	Container	Estimated Samples
Fecal Coliform Bacteria	<u>Standard Methods</u> , Membrane Filter 9222D	0 - 1000 cfu/100mL	1cfu/100 mL	24 hours	Cool to 4°C	250 ml autoclaved poly-bottle	9
Water Velocity	Marsh-McBirney Flo-mate 2000	0-30 ft/s	0.05 ft/s	N/A	N/A	N/A	9

Quality Control Procedures

Variability that comes from field sampling and from laboratory analyses will be assessed by collecting replicate samples and by performing replicate analyses. Bacteria samples are inherently variable, compared to other water quality parameters. Bacteria sample precision will be assessed by collecting replicate samples at 20% of the sites. MEL will analyze a duplicate sample from each sampling event to determine the presence of bias in analytical methods. The difference between field variability and laboratory variability is an estimate of the field sample variability. Discharge measurements will be replicated at 10% of the sites.

All water samples will be analyzed at MEL following standard quality control procedures (MEL, 2005). Field sampling and measurements will follow quality control protocols described in *Field Sampling and Measurement Protocols for the Watershed Assessments Section* Cusimano (1993). If any of these quality control procedures are not met, the associated results will be qualified and

used with caution. Professional judgment and peer review will determine if the data are used in analysis.

Initial data were collected before this QAPP was formally approved. Those data will be identified in the final report. Methods used before final QAPP approval are no different than those subsequent to final approval. Field and laboratory methods are within the approved agency standard.

Data Quality Objectives

The measurement quality objectives are presented below in Table 3.

Table 3. Measurement Quality Objectives for Field and Laboratory Determinations.

Analysis	Accuracy percent deviation from true value	Precision Relative Standard Deviation (RSD)	Bias deviation from true value due to systematic error	Lower reporting Limits
Fecal Coliform Bacteria	N/A	20 - 50% RSD*	N/A	1 cfu/ 100mL
Water Velocity	±2% of reading +0.05 ft/s	0.1 ft/s	N/A	0.01 ft/s

*replicate results with a mean of less than or equal to 20cfu/100mL will be evaluated separately

Accuracy of measurements can be assessed by evaluating both precision and bias. Precision is a measure of data scatter due to random error, while bias is a measure of differences between a parameter value and the true value due to systematic errors. Precision will be quantified using relative standard deviation (%RSD). The target of 20-50% RSD for FC determinations is based on historical performances by MEL (Mathieu, 2006).

The laboratory's data quality objectives and quality control procedures are documented in the MEL Lab Users Manual (MEL, 2005) and the MEL Quality Assurance Manual (MEL, 2001).

Data Management Procedures

Data reduction, review, and reporting will follow the procedures outlined in MEL's Lab Users Manual (MEL, 2005). Laboratory staff will be responsible for internal quality control verification, proper data transfer, and reporting data to the project manager via the Laboratory Information Management System (LIMS).

All water quality data will be electronically transferred from LIMS into Ecology's Environmental Information Management (EIM) system. Data will be verified and 25% of the data entries will be selected at random and reviewed for errors. If errors are detected, another 25% will be reviewed until no errors are detected.

The project manager will assess the quality of the data received from the laboratory and collected in the field in reference to the measurement quality objectives. The review will be performed within one month of data collection and adjustments to field or laboratory procedures or the measurement quality objectives will be made, as necessary. The TMDL lead will be notified if major changes are made to the sampling plan. Data that do not meet objectives may be approved for use by the project manager, but this data will be qualified appropriately.

Elevated fecal coliform densities will be reported to the TMDL Lead as soon as possible. Data analyses will include evaluation of data distribution characteristics and, if necessary, appropriate data transformations. Estimation of univariate statistical parameters and graphical presentation of the data (e.g., box plots, time series, and regressions) will be made using Microsoft Excel software. Use of any additional statistical analysis will be determined based on results and time available. This study is not a TMDL or a formal effectiveness monitoring study.

Data Verification, Usability Determination, and Review

Data verification involves examining the data for errors, omissions, and compliance with quality control (QC) acceptance criteria. Once measurement results have been recorded, they are verified to ensure that:

- Data are consistent, correct, and complete, with no errors or omissions.
- Results for QC samples accompany the sample results.
- Established criteria for QC results were met.
- Data qualifiers are properly assigned where necessary.
- Data specified in Sampling Process Design were obtained.
- Methods and protocols specified in the QA Project Plan were followed.

The project lead is responsible for verifying that field data entries are complete and correct (e.g., decimal point missing from an entry or something doesn't look right, based on experience).

Qualified and experienced laboratory staff will examine lab results for errors, omissions, and compliance with QC acceptance criteria. Findings will be documented in each case narrative sent to the project lead. MEL is responsible for verifying their analytical results. Analytical data will be reviewed. It will be verified according to the data review procedures outlined in the Lab User's Manual (MEL, 2005). Results that do not meet quality assurance requirements will be labeled with appropriate qualifiers, and an explanation will be provided in a quality assurance memorandum attached to the data package.

Data usability determination will follow verification. This determination is parameter-specific and involves a detailed examination of the data package. Professional judgment will be used to determine whether data quality objectives have been met. The project lead will examine the

complete data package in detail to determine whether the procedures in the methods and procedures specified in this QAPP were followed. The usability determination will entail evaluation of field and laboratory results and relative standard deviation between field replicates. Adherence to established protocols should eliminate most sources of bias (Lombard and Kirchmer, 2004). Laboratory duplicates help estimate laboratory precision. Field replicates should indicate *overall* variability (environmental + sampling + laboratory).

Laboratory values below the detection limit will be assumed to be the detection limit for analysis purposes. Data from field replicates will be arithmetically averaged for data analysis.

Project Organization

The roles and responsibilities of Ecology staff involved in this project are provided below.

Betsy Dickes, *Project Manager, Water Quality Program, Southwest Regional Office (SWRO)*.

Responsible for overall project management. Defines final project objectives, scope, and study design. Responsible for writing the Quality Assurance Project Plan (QAPP).

Collects water samples. Conducts data review and analysis. Performs data entry into EIM.

Prepares final report. 360-407-6296 bedi461@ecy.wa.gov

Kim McKee, *Unit Supervisor, Water Quality Program, Southwest Regional Office (SWRO)*.

Responsible for review and approval of the QAPP and final report.

Garin Schrieve, *Section Manager, Acting, Water Quality Program, SWRO*.

Responsible for review and approval of the QAPP and final report.

Debby Sargeant, *Environmental Assessment Program*. Verifies sample locations. Reviews, and comments, on the QAPP and draft final report to ensure technical merit.

Deborah Case, *Environmental Assessment Program*. Receives and processes incoming samples. Ensures chain of custody.

Nancy Jensen, *Microbiologist, Environmental Assessment Program*. Analyzes samples for FC bacteria. Provides analytical results for concentration (number of colonies/100mL).

Leon Weiks, *Environmental Assessment Program*. Sample Courier. Picks up samples from headquarters cooler, ensuring chain of custody protocol is retained. Delivers coolers and specific number of appropriately cleaned sample bottles in time for sampling events.

Schedule

The following schedule may need to be updated periodically.

Completion of Final Approved QA Project Plan	January 2008
Sampling Start/End	November 2007 – May 2008
Draft Study Report	September 30, 2008
Final Report	November 30, 2008
Submit Data to the Environmental Information Management System (EIM)	October 31, 2008

Laboratory Budget

The laboratory budget in Table 4 includes all analyses that will be conducted for this project by Manchester Environmental Laboratory.

Table 4. Dobbs Creek Laboratory Cost Estimate for 2007/2008.

Parameter	No. of Events	Samples per Event	Total Samples	Cost per sample	Total Estimated Cost
Fecal coliform (MF)	13	9	117	\$21	\$2,457

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APPENDICES

Appendix 1. The Water Quality Assessment Categories.

Category 1. Meets Tested Criteria	Not known to be impaired	EPA approval and TMDL not required
Category 2. Waters of Concern		
Category 3. Lack of Sufficient Data		
Category 4. Impaired But Does Not Require A TMDL because:	Impaired	EPA approval and TMDL required
4a. Already has a TMDL		
4b. Has a Pollution Control Plan		
4c. Impaired but a TMDL is Inappropriate		
Category 5. Polluted Waters that Require a TMDL(303(d) List)		

Appendix 2. Water Quality Criteria for Fecal Coliform Bacteria.

Water Contact Recreation Bacteria Criteria in Freshwater	
Category	Bacteria Indicator
Extraordinary Primary Contact Recreation	Fecal coliform organism levels must not exceed a geometric mean value of 50 colonies/100 mL, with not more than 10% of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 100 colonies/100 mL.
Primary Contact Recreation	Fecal coliform organism levels must not exceed a geometric mean value of 100 colonies/100 mL, with not more than 10% of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 200 colonies/100 mL.
Secondary Contact Recreation	Fecal coliform organism levels must not exceed a geometric mean value of 200 colonies/100 mL, with not more than 10% of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 400 colonies/100 mL.

Bacteria, Fresh Waters

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

Use Categories

There are three use categories related to the freshwater bacteria criteria in Washington:

(1) The *Extraordinary Primary Contact* use is intended for waters capable of “providing extraordinary protection against waterborne disease or that serve as tributaries to extraordinary quality shellfish harvesting areas.” To protect this use category: “Fecal coliform organism levels must not exceed a geometric mean value of 50 colonies/100 mL, with not more than 10% of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 100/colonies mL.”

(2) 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 to be 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: “Fecal coliform organism levels must not exceed a geometric mean value of 100 colonies/100 mL, with not more than 10% 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.”

(3) 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: “Fecal coliform organism levels must not exceed a geometric mean value of 200 colonies/100 mL, with not more than 10% 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.”

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. 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.