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Quality Assurance Project Plan

Pussyfoot Creek and Second Creek Fecal Coliform Bacteria Characterization Monitoring

August 2012

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Publication Information

Each study conducted by the Washington State Department of Ecology (Ecology) must have an approved Quality Assurance Project Plan. The plan describes the objectives of the study and the procedures to be followed to achieve those objectives. After completing the study, Ecology will post the final report of the study to the internet.

The plan for this study is available on Ecology's website at
https://fortress.wa.gov/ecy/publications/SummaryPages/1210021.html

Data for this project will be available on Ecology's Environmental Information Management (EIM) website at www.ecy.wa.gov/eim/index.htm. Search User Study ID, BEDI0020.

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August 2012

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Abstract

The Puyallup River Watershed is in Water Resource Inventory Area (WRIA) 10. The watershed includes the White River which enters the right bank of the Puyallup River at approximately river mile (RM) 10.4. Both rivers have been on the Washington State's 303(d) list of impaired water bodies for not meeting contact recreation water quality standards for fecal coliform (FC) bacteria. Ecology conducted a FC bacteria TMDL study in the Puyallup River Watershed in October 2006 through September 2007 (Mathieu and James, 2011). Data collected during the TMDL identified that Pussyfoot Creek, a tributary to the Lower White River, was not meeting water quality standards. This quality assurance project plan (QAPP) describes a water quality study to further characterize FC bacteria concentrations in Pussyfoot Creek and an adjacent waterbody, Second Creek.

Background

The Puyallup and White Rivers are in WRIA 10 (Figure 1). The White River enters the right bank of the Puyallup River at approximately RM 10.4 (Williams, et al, 1975). Both rivers have been on Washington State's 303(d) list of impaired water bodies for not meeting contact recreation water quality standards for bacteria. The federal Clean Water Act of 1972 requires that Washington State develop a total maximum daily load study (TMDL) and implement activities that will bring the water bodies back into compliance with the standards.

Ecology conducted a fecal coliform (FC) bacteria TMDL study in the Puyallup River Watershed in October 2006 through September 2007 (Mathieu and James, 2011). To comply with Washington State water quality standards, the fecal coliform organism levels in the watershed must meet the Primary Contact Recreation criterion:

> Fecal coliform organism levels must not exceed a geometric mean value of 100 colonies/100mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean values exceeding 200 colonies/100mL (Ecology, 2006).

The TMDL identified water bodies that did not meet water quality standards for FC bacteria. Ecology and the local community developed a plan of implementation activities that would improve water quality (Mathieu and James, 2011). As part of this effort, Ecology was asked to conduct a more intensive characterization of FC bacteria concentrations in some of the impaired waterbodies. Two of those tributaries selected for further investigation, and recommended for the 2012 303(d) list, are 10.0048 (WRIA number and stream number from Williams, et al.) (Pussyfoot Creek) and 10.0050 (Second Creek) in the Buckley and Enumclaw area in SE King County. The land use in the upper watersheds is rural residential with hobby farms (e.g. horses, cattle, alpaca) and a few dairies. The Muckleshoot Indian Tribe (MIT) also requested that a FC bacteria study be conducted in these watersheds. The MIT wants to ensure that water quality meets the FC bacteria criterion where the water bodies enter the MIT Reservation.

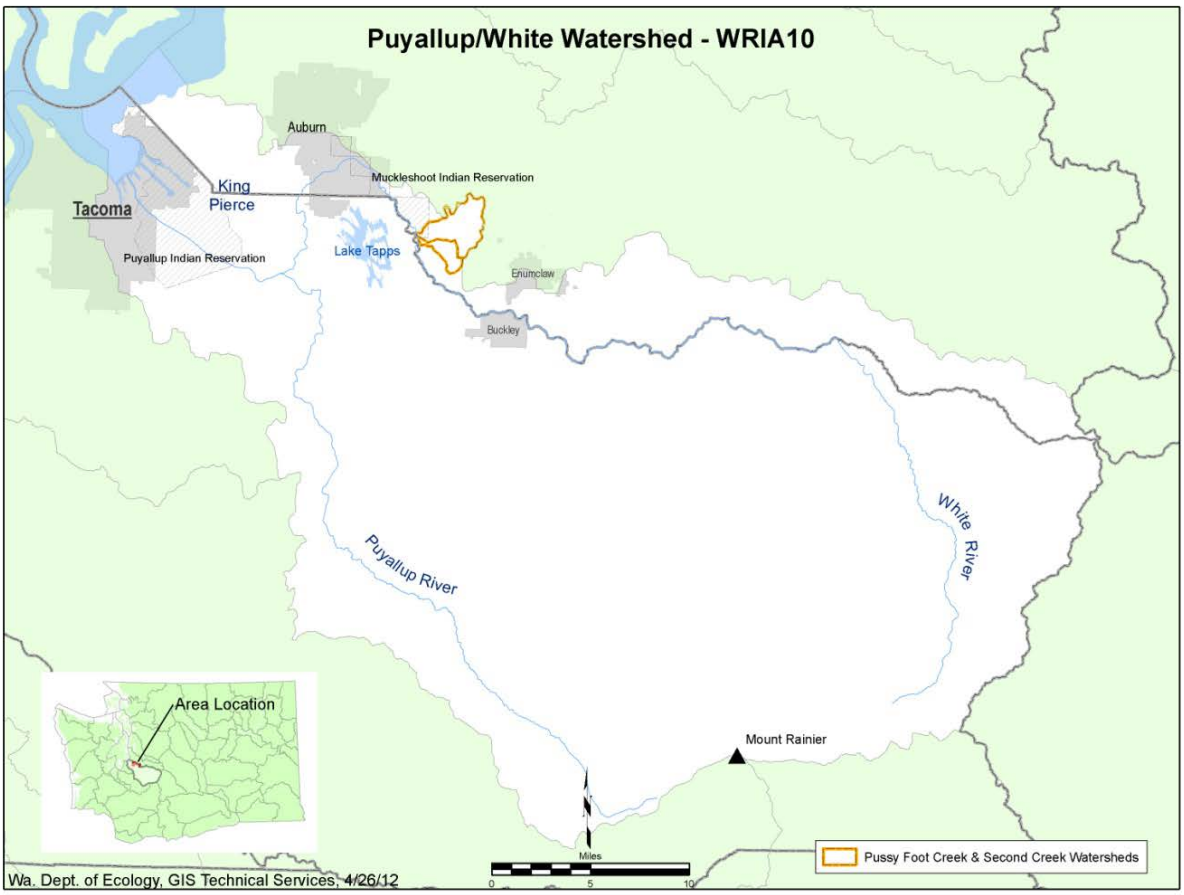

Figure 1. Map of WRIA 10 and watershed delineation of the study areas of Pussyfoot Creek and Second Creek.

Project Description

The goal of this study is to reduce FC contamination to the 303(d)-listed Lower White River.

The objectives of this study are to:

- Characterize FC concentrations in Pussyfoot Creek and Second Creek and accessible ditches draining into them.
- Compare results to the Primary Contact Recreation criterion.
- Use study results to guide implementation activities for cleaner water.

Pussyfoot and Second Creeks enter into the White River from the right bank (Figure 2). Pussyfoot enters at RM 15.45 and Second Creek enters just upstream at RM 15.5 (Williams, et al., 1975). The mouths and lower portions of both streams are in the MIT Reservation area. Ecology does not regulate waters in the MIT Reservation, but one sampling site, 10-UWN-0.2, will be within MIT Reservation boundaries. This is an important downstream location.

Permission to access tribal property was obtained from the landowner contingent on the presence of MIT staff.

The primary sampling locations are shown in Figure 2 and described in Table 1. Site 10-UNW-0.2 was the site on Pussyfoot Creek sampled during the TMDL. In this report the reference to the south fork (SF) of Pussyfoot Creek is not a formal designation but rather one to accommodate a site naming convention. The area has many roadside drainage ditches, and those associated with the main sampling sites will be sampled when deep enough to collect an uncontaminated sample. Additional sampling locations will be added to EIM and described in the final report.

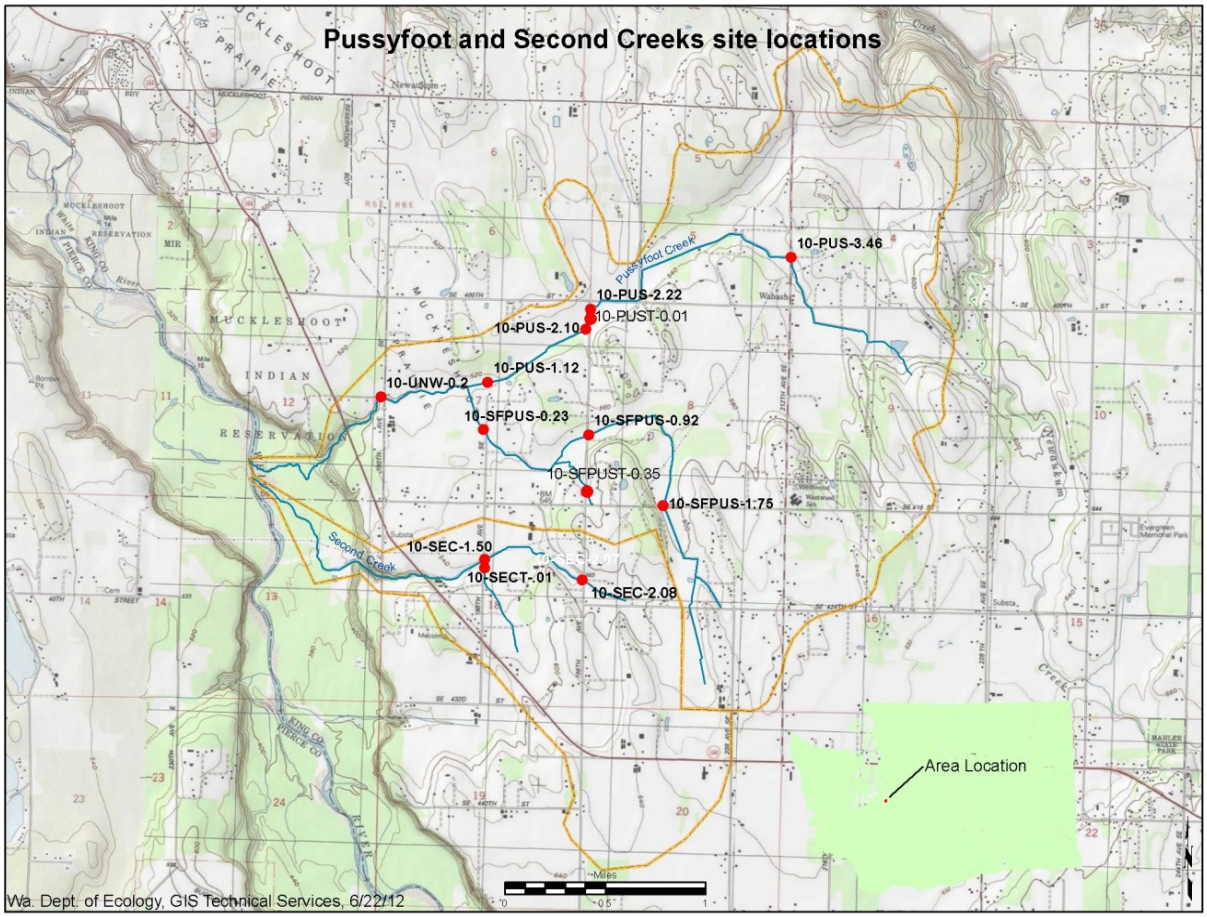

Figure 2. Study sample locations for Pussyfoot Creek and Second Creek.

Table 1. Sampling location ID and location descriptions.

Location ID	Primary Sample Location Description	Latitude	Longitude
Pussyfoot Creek			
10-UNW-0.2	Pussyfoot Creek at 180th St., creek mile (CM) 0.96, downstream side of road, - Muckleshoot Indian Reservation property	47.235762	-122.101820
10-PUS-1.12	Pussyfoot Creek at 188th St. at CM 1.12 (need permission to access)	47.236969	-122.090740
10-PUS-2.10	Pussyfoot Creek at 196th St. at CM 2.10, downstream side of road and culvert	47.241090	-122.080320
10-PUST-0.01	Mouth of tributary to Pussyfoot Creek at 196th St., upstream side of road, enters Pussyfoot Creek at left bank at CM 2.15	47.24159	-122.08002
10-PUS-2.22	Pussyfoot Creek at 196th at CM 2.22, upstream side of road, above ditches and culvert	47.242330	-122.080011
10-PUS-3.46	Pussyfoot Creek at 212th at CM 3.46 (north of 400th St.) on downstream side of road	47.246292	-122.058897
10-SFPUS-0.23	SF Pussyfoot Creek at 188th St. at CM 0.23, upstream side of road	47.233414	-122.090912
10-SFPUS-0.92	SF Pussyfoot Creek at 196th St, at CM 0.92, upstream side of road and fence	47.233297	-122.080097
10-SFPUS-1.75	SF Pussyfoot Creek at 416th St., at CM 1.75, downstream side of road	47.228460	-122.071685
10-SFPUST-0.35	Tributary to SF Pussyfoot Creek at 196th St. near 416 St., at tributary mile 0.35	47.229260	-122.080040
Second Creek			
10-SEC-1.50	Second Creek at 188th St. at CM 1.50, upstream side of road and tributary	47.224263	-122.090912
10-SECT- 0.01	Mouth of tributary to Second Creek at 188th St., enters at upstream side of road from left bank	47.224263	-122.090912
10-SEC-2.08	Second Creek at 196th St., at CM2.07, upstream side of road	47.22281	-122.07999

Organization and Schedule

Table 2 lists the people involved in this project. Tables 3 and 4 present the proposed schedule for this project.

Table 2. Organization of project staff and responsibilities.

Staff	Title	Responsibilities
Cindy James Water Quality Program Southwest Region Phone: 360-407-6556 Cindy.James@ecy.wa.gov	South Puget Sound Water Quality Management Area Water Cleanup Coordinator, Client/Field Assistant	Clarifies project scope. Provides review and approval of the Quality Assurance Project Plan (QAPP) and technical report. Provides field assistance.
Betsy Dickes Water Quality Program Southwest Region Phone: 360-407-6296 Betsy.Dickes@ecy.wa.gov	Project Manager/ Principal Investigator	Writes the QAPP. Conducts sampling. Conducts QA review of data, analyzes and interprets data, and enters data into Ecology's Environmental Information Management database. Writes the technical report.
Kim McKee Water Quality Program Southwest Region Phone: 360-407-6407	Unit Supervisor for the Project Manager	Provides review and approval of the project scope and budget, tracks progress, and approves the QAPP and technical report.
Bob Bergquist Water Quality Program Southwest Region Phone: 360-407-6271	Section Manager for the Project Manager	Provides review and approval of the project scope and budget, and approves the QAPP and technical report.
Dean Momohara Environmental Assessment Program Phone: 360-871-8801	Interim Laboratory Director	Provides review and approval of the QAPP. Provides laboratory staff and resources.
Mike Herold Water Quality Program Phone: 360-407-6434	Quality Assurance Coordinator	Provides review and approval of the QAPP.

Table 3. Proposed schedule for completing field and laboratory work, data entry into EIM, and reports.

Field and laboratory work	Due date	Lead staff
Field work initiated	Sept 2012	Betsy Dickes
Field work completed	Aug 2013	
Laboratory analyses completed	Sept 2013	
Environmental Information System (EIM) database		
EIM user study ID	BEDI0020	
Product	Due date	Lead staff
EIM data loaded	Oct 2013	Betsy Dickes
Final report		
Author lead / Support staff	Betsy Dickes	
Schedule		
Draft due to supervisor	July 2014	
Draft due to client/peer reviewer	Sept 2014	
Draft due to external reviewer(s)	Nov 2014	
Final (all reviews done) due to publications coordinator	Jan 2015	
Final report due on web	Feb 2015	

Table 4. Sampling dates for Pussyfoot and Second Creek.

	Pussyfoot Creek	**Second Creek**
2012		
Sept	4, 18	11
Oct	9, 23	8
Nov	6, 20	28
Dec	4, 18	19
2013		
Jan	8, 22	23
Feb	5, 19	20
Mar	5, 19	20
Apr	9, 23	24
May	7, 21	22
Jun	4, 18	19
Jul	9, 23	8
Aug	6, 20	7

Quality Objectives

Quality objectives are statements of the precision, bias, and lower reporting limits necessary to address project objectives. Precision and bias together express data accuracy (Table 5). Other considerations of quality objectives include representativeness and completeness.

Precision

Precision is the measure of variability in the results of replicate measurements due to random error. This random error includes error inherently associated with field sampling and laboratory analysis. Field and laboratory errors are minimized by following strict protocols for sampling and analysis. Precision for replicates will be expressed as percent relative standard deviation (RSD). RSD is the standard deviation of the replicates divided by the average of the replicates, expressed as a percentage. Precision quality will follow the guidelines established by Mathieu (2006). Ten to twenty percent of FC samples will be duplicated in the field in a side-by-side manner to assess field and lab variability.

Table 5. 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	**±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 (Mathieu, 2006)

Bias

Bias is a measure of the systematic error between an estimated value for a parameter and the true value. Systemic errors can occur through poor technique in sampling, sample handling, or analysis. We will minimize the bias through strict adherence to standard operating protocols (SOPs). Field staff will follow the SOPs for FC (Ward and Mathieu, 2011) and streamflow (Sullivan, 2007). Sample contamination will be prevented through careful sample collection.

Representativeness

Fecal coliform values are known to be highly variable over space and time. Representativeness will be assured through the use of standardized Ecology protocols (Ward and Mathieu, 2011). Following these protocols will establish comparability to the TMDL dataset.

Completeness

Completeness is a measure of the amount of valid data required from a measurement system. It will be assessed by examining:

- The number of samples collected compared to the sampling plan;
- The number of samples shipped and received at the Manchester Environmental Laboratory (MEL) in good condition;
- The laboratory's ability to produce usable results for each sample; and
- Sample results accepted by the project manager.

The objective for sampling completeness is 100%. However, at times there may be practical constraints, such as staff availability, weather/road conditions, and safety concerns, that may limit the ability of project staff to collect the number of samples or sample events expected. The other possibility is that a stream or ditch may be dry during any particular sampling event, particularly during summer.

Sampling Process Design (Experimental Design)

The assumption of this study is that sample size will be adequate to characterize bacteria concentrations in the watershed and identify potential problem areas for implementation activities. The TMDL found that high bacteria concentrations were non-seasonal. Samples will be collected twice a month on Pussyfoot Creek; it is assumed that we will catch at least one storm event during that time. Second Creek will be sampled once a month; this should be adequate to characterize this small watershed.

Sample sites were selected based on: previous sample location; access to the sampling location; quality of sample location for representative water collection and discharge measurements; and potential sources. Due to the small watershed size, samples will be collected from downstream to upstream to prevent contamination. The sampling sites are shown in Figure 2 and described in Table 1. The original sample site used for the TMDL was 10-UNW-0.2. Flow will be taken at that sample location as well as 10-SFPUS-0.23 and 10-PUS-2.10 to assist in interpreting bacteria concentrations.

Laboratory Budget

The cost for the Pussyfoot and Second Creek FC bacteria characterization project is estimated at $17, 351.28

Below are the cost details:

Pussyfoot Creek cost accounts for the 10 primary sites and 2 replicates. Adding on predicted 70% source identification (9 ditch locations) with 2 associated replicates =
(23 sites) (24 events) ($24.93/FC_MF sample) = $13,761.36

Second Creek cost accounts for the 3 primary sampling sites with 1 replicate. Adding on predicted 200% source identification (6 ditch locations) and 2 associated replicates =
(12 sites) (12 events) ($24.93/FC_MF sample) = $3589.92

Sampling Procedures

Safety

Reviewing environmental conditions for safety will always be a priority before accessing a sampling site. Personnel can refuse to proceed if they believe safety hazards are present.

Sampling

Standard Ecology protocols will be used for sampling fecal coliform bacteria (FC) as described in Joy (2006) and Ward and Mathieu (2011). Samples will be collected from downstream to upstream to avoid contamination. Flow measurements will be taken when site conditions allow at sample sites 10-UNW-0.2, 10-SFPUS-.23, and 10-PUS-2.10. Protocol will follow EAP024 by Sullivan (2007).

Staff will collect grab samples for FC directly into pre-cleaned containers supplied by the MEL (MEL, 2008). Plastic bottles will be used to prevent bottle breakage and sample loss. Samples will be collected in a manner to prevent bottle contamination and to avoid contamination with sediment. 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 < 10˚C until the samples are processed by the laboratory. Samples will arrive and be processed at the MEL within 24 hours of collection.

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

The project manager will provide training for anyone who is assisting with the fieldwork. This will include discussion of quality assurance and contamination prevention. Upon completion of

sampling at each site, the project manager will review the field notes. This will ensure all activities are performed and that the records are complete and legible.

The project manager 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 MEL courier. The courier will transport the samples to the MEL using chain of custody protocols.

Minimizing the spread of invasive species

Standard operating procedures to minimize the spread of invasive species will be followed (Parsons, et al., 2012). Specifically, hydrogen peroxide will be used to clean off boots and any gear that is used in the water.

Measurement Procedures

Table 6 summarizes sampling and analysis procedures for field and laboratory.

Laboratory analyses will be performed in accordance with the MEL User's Manual (MEL, 2008). The laboratory staff will consult with the project manager if there are any changes in procedures over the course of the project.

The field crew will communicate with the laboratory staff to ensure that laboratory resources are available. The project team will follow MEL procedures for sample notification and scheduling. With adequate communication, sample quantities and processing should not overwhelm the laboratory capacity.

Standard Ecology protocols will be used for sampling fecal coliform bacteria (FC) as described in Joy (2006) and Ward and Mathieu (2011). Field staff will measure instantaneous flows with a Marsh McBirney Flo-mate meter (Sullivan, 2007).

Table 6. Summary of sampling and analysis procedures for field and laboratory.

Analysis	Method	Estimated Range	Lower Reporting Limit	Holding Time	Preservation	Container
Fecal Coliform Bacteria	Standard Methods, Membrane Filter 9222D	0 - 1000 cfu/100mL	1cfu/100 mL	24 hours	Cool to 0 ºC - <10ºC	250 ml autoclaved poly-bottle
Water Velocity	Marsh-McBirney Flo-mate 2000, SOP EAP024	0-10 ft/s	0.05 ft/s	N/A	N/A	N/A

Quality Control Procedures

Variability that comes from field sampling and from laboratory analyses will be assessed by collecting replicate samples. Bacteria sample concentrations are inherently variable compared with other water quality parameters. Bacteria sample precision will be assessed through 10-20 percent replication. The MEL will analyze a duplicate sample from each sampling event to determine the presence of bias in analytical methods.

All water samples will be analyzed at MEL following standard quality control procedures (MEL, 2006). Field sampling will follow quality control protocols (Ward and Mathieu, 2011). 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.

The Marsh-McBirney flow meter will be zeroed and adjusted according to factory specifications. Replicate discharge measurements will be taken once per sampling event. Discharge data will be used to interpret fecal coliform data.

Data Management Procedures

Data reduction, review, and reporting will follow the procedures outlined in MEL's Lab Users Manual (MEL, 2008). 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).

The laboratory microbiologist will notify the project manager by e-mail when FC results are greater than 200 cfu/100 mL. Elevated FC concentrations will be reported to the South Puget Sound Water Quality Management Area Water Cleanup Plan Coordinator as soon as possible.

Water quality data will be electronically transferred from LIMS into an EXCEL® spreadsheet (Microsoft, 2007). Data will be verified and reviewed for errors. If any errors are found they will be corrected.

The project manager will upload the data into Ecology's Environmental Information Management (EIM) system after data verification and validation. An EIM user study identification number (BEDI0020) has been created for this study. All monitoring data will be available via the internet at www.ecy.wa.gov/eim/.

The project manager will assess the quality of the data received from the laboratory and collected in the field. The review of measurement quality objectives will be conducted and adjustments made to field or laboratory procedures as necessary. The South Puget Sound Water Quality Management Area Water Cleanup Plan Coordinator will be notified if major changes are made to the sampling plan.

Laboratory values below detection limit will be assumed to be the detection limit for analysis. Estimation of univariate statistical parameters and graphical presentation of the data will be made using EXCEL® software. Data will be looked at by wet season (November – June) and dry season (July – October).

Audits and Reports

MEL will submit laboratory reports and chain-of-custody records to the project manager. Documentation from the lab should include any quality control results associated with the data in order to evaluate the accuracy of the data and to verify that the quality objectives are met.

The project manager is responsible for verifying data completeness. The project manager is also responsible for writing the final technical report. The final report will include analyses of results that form the basis of conclusions and recommendations. The final report will undergo the peer review process by staff with appropriate expertise.

Data Verification and Validation

Data verification

Data verification involves examining the data for errors or omissions as well as examining the results for compliance with quality control acceptance criteria.

Qualified and experienced laboratory staff will examine lab results for errors, omissions, and compliance with quality control criteria. Analytical data will be reviewed; it will be verified

according to the data review procedures outlined in the MEL QA Manual (MEL, 2006). Results that do not meet quality assurance requirements will be labeled with appropriate qualifiers. Findings will be documented in each case narrative sent to the project manager.

Field data will be verified by the project manager. Staff will check field notebooks for missing or improbable measurements before leaving each site. Data entry will be checked against the field notebook data for errors and omissions.

Data validation

Data validation involves a detailed examination of the data package using professional judgment to determine it the MQOs for precision and bias have been met.

The project manager will examine the data for errors, omissions, and compliance with quality control criteria. Data will be checked to ensure that data entered into EXCEL® is consistent with field notebooks. Corrections will be made as needed. Validated data will be entered into EIM.

Data Quality (Usability) Assessment

The project manager will verify that all measurement and data quality objectives have been met for each monitoring station. If the objectives have not been met then consideration will be taken to qualify the data, how to use it in analysis, or whether it should be rejected. Decisions for data quality and usability will be documented.

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, et al., 2004). Laboratory duplicates estimate laboratory precision. Field replicates should indicate overall variability (environmental, sampling, and laboratory).

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