DEPARTMENT OF
ECOLOGY
State of Washington

Addendum to
Quality Assurance Project Plan

Colville River
Fecal Coliform
Total Maximum Daily Load Study

September 2012

Publication No. 12-03-116

Publication Information

Addendum

This addendum is an addition to an original Quality Assurance Project Plan. The addendum is not a correction (errata) to the original plan.

This addendum is available on the Department of Ecology's website at
https://fortress.wa.gov/ecy/publications/summarypages/1203116.html

Ecology's Activity Tracker Code for this study is 13-054.

Original Publication

Quality Assurance Project Plan: Colville River Fecal Coliform Total Maximum Daily Load Study

Publication No. 00-03-082.

The Quality Assurance Project Plan is available on the Department of Ecology's website at
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DEPARTMENT OF ECOLOGY

Environmental Assessment Program

September 11, 2012

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Dave Moore, Water Quality Program-ERO
James Bellatty, Water Quality Program-ERO

THROUGH: Jenifer Parsons, Interim Section Manager, Environmental Assessment Program

FROM: Andrew Albrecht, Environmental Assessment Program

SUBJECT: Addendum to Quality Assurance Project Plan for Colville River Fecal Coliform Total Maximum Daily Load Study
Activity Tracker Code: 13-054
Publication No: 12-03-116

A Total Maximum Daily Load (TMDL) study was completed in 2001 for the Colville River; however, data from Stevens County Conservation District identified listings that were not addressed in the original TMDL. This project will address the fecal coliform (FC) bacteria portion of the listing, and amend the existing TMDL.

This addendum documents several additions planned for the Colville River Fecal Coliform Total Maximum Daily Load Study.

cc: Randy Coots, Environmental Assessment Program
Dale Norton, Environmental Assessment Program
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Bill Kammin, Environmental Assessment Program
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Background

The Colville River Valley is located in the Northeast corner of Washington State, in Stevens County. Water Resource Inventory Area (WRIA) 59 is the location for this study (Figure 1). A Total Maximum Daily Load (TMDL) study was previously completed for the Colville River (Coots, 2002); however, data from Stevens County Conservation District (SCCD, 1993) identified listings that were not addressed in the original TMDL (Table 1). This project will address the fecal coliform (FC) bacteria portion of the listing, and amend the existing TMDL.

Table 1. Colville River tributaries 303(d) listings.

Listing ID	Creek Name	Parameter	2008 Category	Township	Range	Section
45569	Paye	Fecal Coliform	5	32N	40E	15
46161	Bulldog	Fecal Coliform	5	31N	40E	26
8525	Sheep	Fecal Coliform	5	30N	40E	16
46534	Sheep	Fecal Coliform	5	30N	40E	28
10085	Sheep	Fecal Coliform	4a	30N	40E	21

As part of the original TMDL study (FC) bacteria sampling was conducted March 2000 to March 2001(Coots, 2002). The sampling took place at 10 mainstem river sites and 15 tributary sites. The original Quality Assurance Project Plan (QAPP) describes the background for the work to be conducted in this addendum (Coots, 2000) .This addendum documents several additions planned for the Colville River Fecal Coliform Total Maximum Daily Load Study. These include:

- Collect FC bacteria and streamflow data at sampling sites in Paye Creek, Bulldog Creek, and Sheep Creek not included in the original TMDL.
- Develop percent reductions and load allocations to address the FC bacteria water quality listings.
- Make recommendations for implementation efforts in the watershed (Figure 1).
- Determine if land management changes have altered bacteria levels in the watershed since the 1993 sampling.

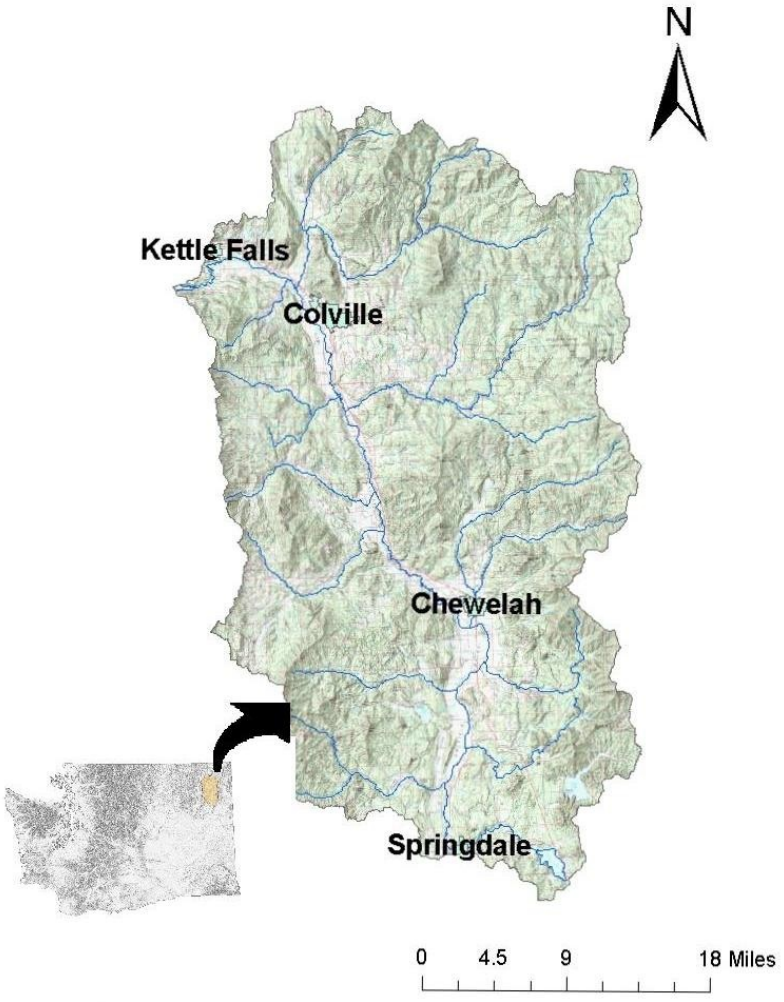

Figure 1. Colville River watershed – WRIA 59.

Study Design

Ecology has selected 12 total sample sites in Paye Creek, Bulldog Creek, and Sheep Creek that will be monitored for (FC) bacteria (Figures 2, 3, 4,) (Table 2).

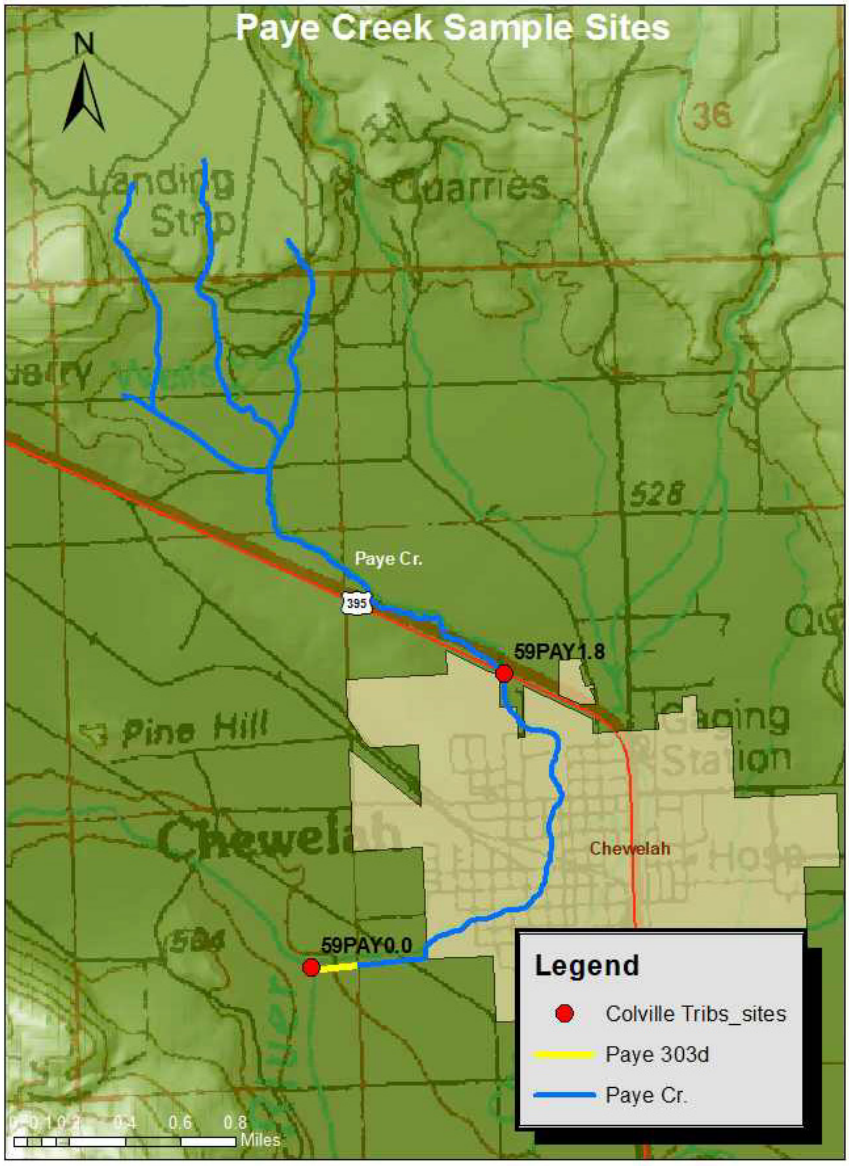

Figure 2. Paye Creek sample sites.

Figure 3. Bulldog Creek sample sites.

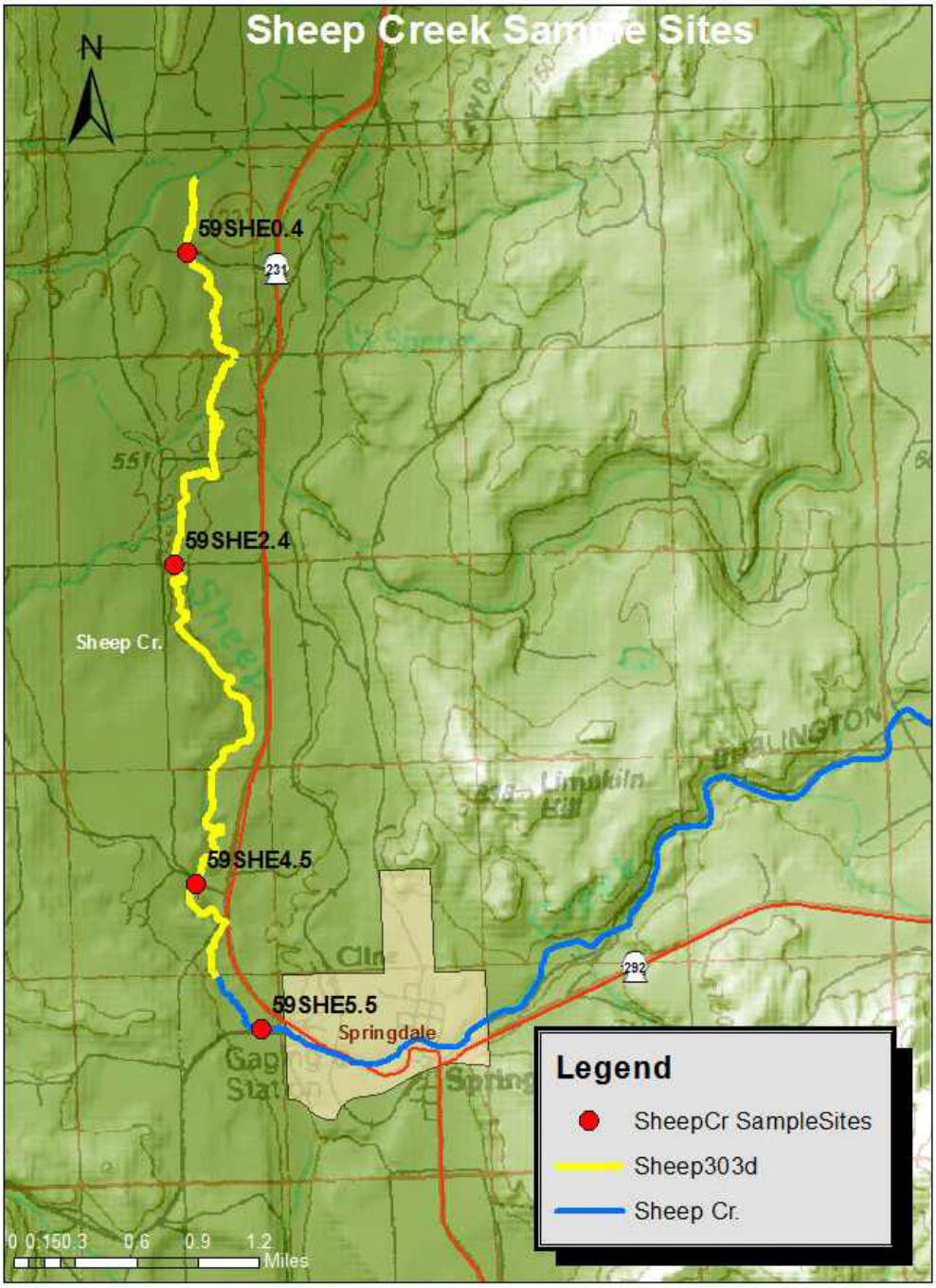

Figure 4. Sheep Creek sample sites.

Table 2. Colville River tributaries sample sites list.

Creek Name	Location Id.	Latitude	Longitude	Site Description
Paye	59PAY0.0	48.272797	-117.740742	Paye Cr. At Mouth
Paye	59PAY1.8	48.284	-117.703	Paye Cr. At Hwy 395 crossing
Bulldog	59BUL0.0	48.167839	-117.729482	Bulldog Cr. At Mouth
Bulldog	59BUL1.2	48.15651	-117.71553	Bulldog Cr. At Bulldog Cr. Rd. crossing
Bulldog	59BUL1.6	48.157	-117.747	Bulldog Cr. Near springs
Sheep	59SHE0.4	48.11443	-117.76494	Sheep Cr. At Deer Cr. Rd.
Sheep	59SHE2.4	48.09239	-117.76726	Sheep Cr. At Forest Center Rd. crossing
Sheep	59SHE4.5	48.0699	-117.76642	Sheep Cr. At Heseltine Rd. crossing
Sheep	59SHE5.5	48.060	-117.760	Sheep Cr. Near Springdale Hunters Rd. crossing

These sample sites were selected to address the FC bacteria water quality listings in each creek. Starting July 2012, Ecology will collect data at the fixed network of sampling sites twice a month for one year. At the time of sampling, flow measurements will be collected in order to calculate seasonal FC bacteria loads.

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

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

Sites may be added or removed from the sample plan depending upon new information provided during field observations and primary data analysis.

Sampling and Measurement Procedures

Grab samples will be collected with pre-cleaned containers supplied by MEL, described in the MEL User's Manual (2008). Samples will be collected under EAP standard operating procedures (www.ecy.wa.gov/programs/eap/quality.html). Sample parameters, containers, volumes, preservation requirements, and holding times are summarized in Table 3.

Table 3. Sample containers and holding times.

Parameter	Container	Preservative	Holding Time
FC	250 mL poly	Cool to 4°C	24 hours
Chloride	125 mL poly	Cool to 4°C	28 days
TSS	1000 mL poly	Cool to 4°C	7 days

All samples for laboratory analysis will be stored on ice and delivered to MEL within 24 hours of collection via Horizon Air and MEL courier.

Field measurements will include conductivity, temperature, pH, and dissolved oxygen using a calibrated Hydrolab MiniSonde. Estimation of instantaneous flow measurements will follow the EAP protocol (Ecology, 2009).

Measurement Quality Objectives

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

Microbiological and analytical methods, precision targets, and method resolution or reporting limits are listed in Table 4. The reporting limits of the methods listed in the table meet the expected range of results and the required level of sensitivity to meet project objectives. The laboratory's measurement quality objectives are documented in the MEL Users Manual (MEL, 2008). The targets for analytical precision of laboratory analyses in Table 4 are based on historical performance by MEL for environmental samples taken around the state by the Environmental Assessment Program (Mathieu, 2006).

Table 4. Targets for precision and reporting limits for the measurement systems.

Analysis	Method	Field Replicate MQO	Lab Duplicate MQO	Reporting Limits and Resolution
Field Measurements				
Velocity[1]	Marsh McBirney Flow-Mate Flowmeter	0.1 ft/s	n/a	0.01 ft/s
Water Temperature[1]	Hydrolab MiniSonde®	+/- 0.1° C	n/a	0.01° C
Specific Conductivity	Hydrolab MiniSonde®	+/- 10%	n/a	0.1 umhos/cm
pH[1]	Hydrolab MiniSonde®	0.2 SU	n/a	1 to 14 SU
Dissolved Oxygen[1]	Hydrolab MiniSonde®	5% RSD	n/a	0.1 - 15 mg/L
Laboratory Analyses				
Fecal Coliform – MF	SM 9222D	20% & 50% RSD[2]	20% & 50% RSD[2]	1 cfu/100 mL
Chloride	EPA 300.0	5% RSD[3]	5% RSD[3]	0.1 mg/L
TSS	SM 2540D	15% RSD[3]	15% RSD[3]	1 mg/L

[1] As units of measurement, not percentages.
[2] Two-tiered: 50% of replicates $\leq$ 20% RSD; RSD; 90% of replicates $\leq$ 50% RSD.
[3] Replicate results with a mean of less than or equal to 5X the reporting limit will be evaluated separately.

SM: Standard Methods for the Examination of Water and Wastewater, 20th Edition (APHA et al., 1998).
EPA: EPA Method Code.
MF: Membrane Filter.

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

Quality Control Procedures

Total variation for field sampling and laboratory analysis will be assessed by collecting replicate samples. Bacteria samples tend to have a high relative standard deviation (RSD) between replicates compared to other water quality parameters. Bacteria sample precision will be assessed by collecting replicates for approximately 20% of samples in each survey. Chloride and TSS sample precision will be assessed by collecting replicates for approximately 10% of samples in each survey. MEL routinely duplicates sample analyses in the laboratory to determine laboratory precision. The difference between field variability and laboratory variability is an estimate of the sample field variability.

All samples will be analyzed at MEL. The laboratory's measurement quality objectives and quality control procedures are documented in the MEL Users Manual (MEL, 2008). MEL will follow standard quality control procedures (MEL, 2008). Field sampling and measurements will follow quality control protocols described in Ecology's standard operating procedures (2009). If any of these quality control procedures are not met, the associated results may be qualified by MEL or the project manager and used with caution, or not used at all.

MEL has a maximum holding time for microbiological samples of 24 hours (MEL, 2008). Microbiological samples analyzed beyond the 24-hour holding time are qualified as estimates with a *J* qualifier code. MEL accepts samples Monday through Friday, which means Ecology can sample Sunday through Thursday.

Data Analysis Procedures

Data analysis will include evaluation of data distribution characteristics and, if necessary, appropriate distribution of transformed data. Streamflow data will be frequently reviewed during the field data survey season to check longitudinal water balances. FC mass balance calculations will be performed on a reach basis. Estimation of univariate statistical parameters and graphical presentation of the data (box plots, time series, and regressions) will be made using WQHYDRO (Aroner, 2003) and EXCEL® (Microsoft, 2010) software.

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

Organization, Schedule, and Laboratory Budget

The following is the project's staff organization, time schedule, and laboratory budget.

Organization

Table 5. Staff organization.

Name	Organization	Role	Phone Number
Martyn Quinn	WQ-ERO	Client	509-329-3472
Jim Ross	EAP-EOS	Project Manager	509-329-3425
Andrew Albrecht	EAP-EOS	QAPP Author/Principal Investigator/ EIM Data Engineer	509-329-3417
Scott Tarbutton	EAP-EOS	Technical Support	509-329-3453
Brian Gallagher	EAP-EOS	Field Assistance	509-329-3437
Jenifer Parsons	EAP-EOS	Interim Section Manager	509-457-7136
Joel Bird	MEL	Lab Director/Sample Transport	360-871-8808
Nancy Rosenbower	MEL	Sample Scheduling/Receipt	360-871-8827
Bill Kammin	EAP	Quality Assurance Officer	360-407-6964
Charlie Kessler	Stevens CD	Original Sampling Data Assistance	509-685-0937

WQ-ERO: Water Quality – Eastern Regional Office
EAP-EOS: Environmental Assessment Program – Eastern Operations Section
MEL: Manchester Environmental Laboratory
EAP-GWFF: Environmental Assessment Program – Groundwater Forest and Fish Unit
CD: Conservation District

Schedule

Table 6. Schedule.

Field and laboratory work	Due date	Lead staff
Field work completed	August 2013	Andrew Albrecht
Laboratory analyses completed	September 2013	
Environmental Information System (EIM) database		
EIM user study ID	AALB0001	
Product	Due date	Lead staff
EIM data loaded	October 2013	Andrew Albrecht
EIM QA	December 2013	Scott Tarbutton
EIM complete	January 2014	Andrew Albrecht
Final report		
Author lead / support staff	Andrew Albrecht / Scott Tarbutton	
Schedule		
Draft due to supervisor	March 2014	
Draft due to client/peer reviewer	March 2014	
Draft due to external reviewer(s)	April 2014	
Final (all reviews done) due to publications coordinator	May 2014	
Final report due on web	June 2014	

Laboratory Budget

Table 7. Laboratory budget.

Creek Name	Location ID	#Samples total/ perameter	FCMF Cost	TSS Cost	Chloride Cost	Conventional QC	Bacterial QC	Lab Cost/run	
Paye Cr.	59PAY0.0	24	23.88	11.42	13.50	24.92	47.76	121.48	
Paye Cr.	59PAY1.8	24	23.88	11.42	13.50	24.92	47.76	121.48	
Bulldog Cr.	59BUL0.0	24	23.88	11.42	13.50	24.92	47.76	121.48	
Bulldog Cr.	59BUL1.2	24	23.88	11.42	13.50	24.92	47.76	121.48	
Bulldog Cr.	59BUL1.6	24	23.88	11.42	13.50	24.92	47.76	121.48	
Sheep Cr.	59SHE.04	24	23.88	11.42	13.50	24.92	47.76	121.48	
Sheep Cr.	59SHE2.4	24	23.88	11.42	13.50	24.92	47.76	121.48	
Sheep Cr.	59SHE4.5	24	23.88	11.42	13.50	24.92	47.76	121.48	
Sheep Cr.	59SHE5.5	24	23.88	11.42	13.50	24.92	47.76	121.48	
		9	214.92	102.78	121.95	24.92	47.76	**512.33**	**Per Run**
		216	5,158.08	2,466.72	2,926.80	598.08	1,146.24	**12,295.92**	**Total**

The laboratory costs include a 50% discount for Manchester Environmental Laboratory.

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 as soon as practical after returning from the field. This database will be used for preliminary analysis and to create a table to upload data into Ecology's Environmental Information Management (EIM) System.

Sample result data received from MEL by Ecology's Laboratory Information Management System (LIMS) will be 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.

All monitoring data will be available in EIM, via the internet, once the project data have been validated. The URL address for this geospatial database is: www.ecy.wa.gov/eim/index.htm. All data will be uploaded to EIM by the EIM data engineer after the data have been reviewed for quality assurance and finalized.

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

Audits and Reports

Manchester Environmental Laboratory conducts performance and system audits for its procedures. Results of these audits are available upon request.

At the end of the 2012-2013 study, the project results will be published in the Colville River TMDL Addendum technical report and will contain at a minimum:

- Map of sampling locations.
- Summary table of data, as well as pertinent field notes.
- Discussion of data quality analysis and the significance of problems encountered.
- Evaluation of significant findings and recommendations for further action.

The final report will be prepared by June 2014.

Data Verification and Validation

Laboratory-generated data reduction, review, and reporting will follow the procedures outlined in the MEL Lab Users Manual (MEL, 2008). Lab results will be checked for missing and/or improbable data. Variability in lab duplicates will be quantified using the procedures outlined in the Lab Users Manual. 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 staff will check field notebooks for missing or improbable measurements before leaving each site. 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.

Data received from LIMS will be checked for omissions against the "Request for Analysis" forms by the field lead. Field replicate sample results will be compared to quality objectives in Table 4. 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 EIM. EIM data will be independently reviewed by another EAP field assistant for errors at an initial 10% frequency. If significant entry errors are discovered, a more intensive review will be undertaken.

References

APHA, AWWA, and WEF, 1998. Standard Methods for the Examination of Water and Wastewater 20th Edition. American Public Health Association, Washington, D.C.

Aroner, E. R., 2003. WQHYDRO: Water Quality/Hydrology Graphics/Analysis System, Portland, OR.

Coots, Randy, 2000. Quality Assurance Project Plan: Colville River Fecal Coliform Total Maximum Daily Load Study . Washington State Department of Ecology, Olympia, WA. Publication No. 00-03-082.
https://fortress.wa.gov/ecy/publications/SummaryPages/0003082.html

Coots, Randy, 2002. Colville River Fecal Coliform Total Maximum Daily Load Study Washington State Department of Ecology, Olympia, WA. Publication No. 02-03-036.
https://fortress.wa.gov/ecy/publications/SummaryPages/0203036.html

Ecology, 2009. Standard Operating Procedures (SOPs) for sampling, auditing, and field methodology. Washington State Department of Ecology, Olympia, WA.
www.ecy.wa.gov/programs/eap/quality.html

Lombard, S. and C. Kirchmer, 2004. Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies. Washington State Department of Ecology, Olympia, WA. Publication No. 04-03-030.
https://fortress.wa.gov/ecy/publications/SummaryPages/0403030.html

Mathieu, N., 2006. Replicate Precision for Twelve Total Maximum Daily Load (TMDL) Studies and Recommendations for Precision Measurement Quality Objectives for Water Quality Parameters. Washington State Department of Ecology, Olympia, WA. Publication No. 06-03-044.
https://fortress.wa.gov/ecy/publications/SummaryPages/0603044.html

MEL, Manchester Environmental Laboratory. 2012. Manchester Environmental Laboratory Users Manual. Tenth Edition. Washington Department of Ecology, Manchester, WA.

Microsoft, 2010. Microsoft Office XP Professional, Microsoft Corporation.

Ott, W.R., 1995. Environmental Statistics and Data Analysis. CRC Press LLC. Boca Raton, FL. 313 pages.

SCCD, 1993. Water Quality Summary for Colville River Watershed Ranking and Planning. Stevens County Conservation District, Colville, WA.