



DEPARTMENT OF
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State of Washington

Quality Assurance Project Plan

Asotin Creek

Fecal Coliform Bacteria Study

June 2010

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Quality Assurance Project Plan

Asotin Creek Fecal Coliform Bacteria Study

June 2010

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Signatures are not available on the Internet version.
ERO – Eastern Regional Office
CRO – Central Regional Office
EAP – Environmental Assessment Program
EIM – Environmental Information Management system

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Abstract

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 needed to achieve those objectives. After completion of the study, a final report describing the study results will be published and available online.

Asotin Creek is currently designated a Category 5 watershed for fecal coliform bacteria on the federal Clean Water Act 303(d) list. Category 5 indicates that there is a need for a Total Maximum Daily Load (TMDL) study.

Ecology's Water Quality Program is conducting improvements in the upper reaches of the Asotin Creek watershed. Due to this existing pollution control project, Ecology would like to determine whether Asotin Creek should be designated a Category 4b, thus requiring no TMDL. Additional monitoring is needed to address the source of recurring exceedances of Washington State's fecal coliform standards.

Ecology will monitor 8 sites every other week. Parameters monitored will include fecal coliform bacteria, nutrients, pH, temperature, conductivity, and dissolved oxygen. This monitoring effort will focus on the low flow period (July-October) of 2010.

Background

Asotin Creek is located in Asotin and Garfield Counties in southeast Washington State. The creek headwaters are located in the Blue Mountains at an elevation of 6200 feet. The mouth of the creek is located in the town of Asotin where the creek enters the Snake River at an elevation of 800 feet (WSU, 2000). The Asotin Creek watershed is approximately 208,000 acres. Major tributaries include George Creek, the North and South Forks of Asotin Creek, Lick Creek, and Charley Creek. Rangeland, cropland, and forestland are the predominant land uses within the Asotin Creek subbasin (Stovall, 2001). Residential areas represent a small portion of the watershed, with single-family homes and trailers next to Asotin Creek between river mile 0.5 (just upstream of the Highway 129 Bridge) and river mile 1.6.

Asotin Creek is currently listed on the 303(d) list as a Category 5 waterbody for fecal coliform bacteria (FC). Category 5 sites require TMDLs.

FC Bacteria and Category 5

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

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

Changes to Asotin Creek since Category 5 Listing

Monitoring conducted by Ecology in 1993 at the mouth of Asotin Creek was the basis for the Category 5 designation of Asotin Creek. Three of 12 samples exceeded 200 cfu/100 mL and the geometric mean was 101 cfu/100 mL.



Figure 1. Riparian buffer fencing.



Figure 2. Off-stream watering improvements.

The Asotin Creek Model Watershed Plan was completed in 1995. The plan and the associated 550 completed projects serve as an indication of what can be accomplished in prioritized watersheds on private lands with public support. Because of the plan's projects, many of the upper watershed water quality problems have been corrected. The following photos (Johnson 2002) demonstrate some of the improvements.

Ecology monitoring in water years 1997 and 2002 had one exceedance to the FC standard out of 24 samples. The exceedance occurred in March 2002, during a high flow event.

A [data assessment](#) for the WRIA¹ 35 planning committee done by HDR Engineering in 2005 (HDR, 2005) determined George Creek provided 57% of the FC load to Asotin Creek. However, HDR did not use actual flow data to calculate the loads. HDR suggested septic systems may have contributed to FC loads during 1998 but could not make the same determination for 1999. They stated, inconclusively, that failing septic systems may be a small source of FC in Asotin Creek. HDR also stated that their conclusions should be verified with flow and FC data from both Asotin and George Creeks.

As cited in the HDR report, between March 2005 and February 2007 at the city park site near the creek mouth, Asotin Conservation District monitoring indicated a geometric mean of 45 cfu/100 mL but 3 of the 24 samples collected exceeded 200 cfu/100 mL. None of the monitoring sites upstream had FC standard violations.

Data collected by Ecology in 2006 (Ross, 2007) indicated no water quality exceedances during four low-flow sampling events.

Four of the seven concentrations that exceeded the numeric standard occurred during low flows. Ecology would like to designate Asotin Creek into the 4b category. Before that can be done, the downstream bacteria loads need to be addressed. If the exceedances are due to faulty septic systems that can be corrected, the 4b designation could be attained.

Table 1. Exceedances of 200 cfu/100 mL water quality standard at the mouth of Asotin Creek.

Study Year	Exceedances	Organization
1993	Jan, May, Aug	Ecology
1997	None	Ecology
2002	March	Ecology
2005	May, July, Oct	Asotin Conservation District

¹ WRIA: Water Resource Inventory Area

Project Description

This study will concentrate on the lower reaches of Asotin and George Creeks. Ecology will collect data during the dry season to see if FC levels are elevated. Ecology will collect grab samples for FC, enterococci (ENT), chloride, and nitrates.

An increase in bacteria concentration, coupled with a difference in FC/ENT ratios, changes in conductivity and increases in chloride concentration has historically been linked to failing septic systems. A link will allow for the isolation of the failing septic systems and removal of sources of FC contamination.

The primary goals of this study are to:

- Collect credible data to determine the current listing status for FC on Asotin Creek.
- Evaluate impacts of septic systems in lower reaches of Asotin Creek.
- Determine influence of George Creek on bacteria loads in Asotin Creek.

To meet the stated goals, Ecology will:

- Collect field samples for FC, ENT, chloride, and nitrate/nitrite.
- Measure instantaneous flow, pH, dissolved oxygen (DO), conductivity, and temperature at sampling sites.
- Calculate FC/ENT and chloride/nitrate ratios from collected samples.
- Review all data for completeness, comparability, representativeness, and usability.

All sites, shown in Table 2, will be sampled for lab and field parameters. Samples will be collected twice a month from July through October. Figure 3 shows sampling sites.

Asotin Creek FC Study

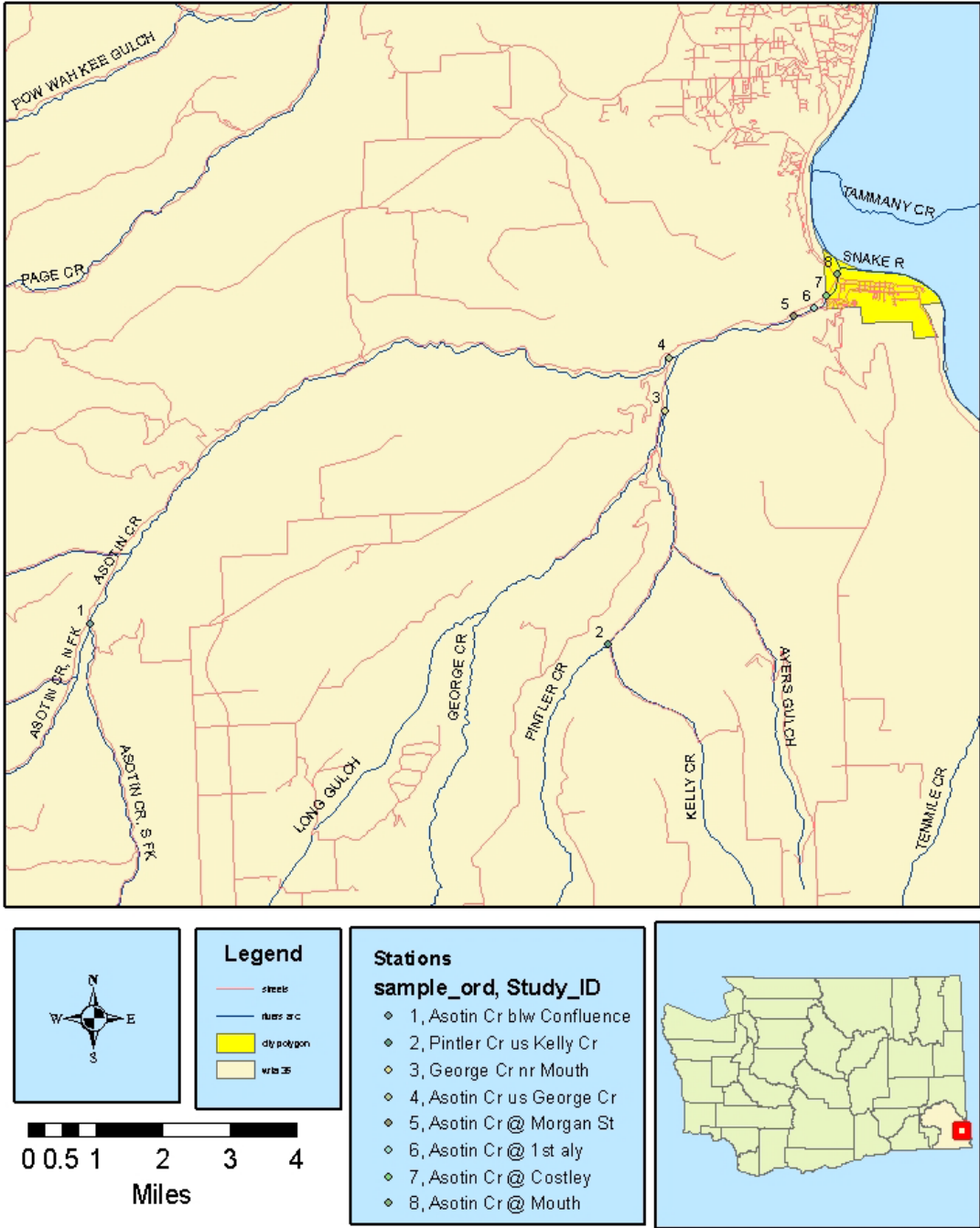


Figure 3. Asotin Creek sampling sites.

(blw = below; us = upstream; nr = near)

Sampling Process Design (Experimental Design)

Ecology will collect data every other week, from July to October 2010. Proposed sampling dates are: July 6 and 20; August 3, 17, and 31; September 14 and 28; October 12. If circumstances prevent sampling on a scheduled date, the sampling will be rescheduled as soon as possible.

Ecology will sample a reference site upstream of any land use to set background conditions. The study area will be divided into four short reaches to better isolate any identified sources of contamination. Table 2 lists proposed sampling locations, and Figure 3 shows sampling locations. Table 3 lists sampling parameters and Table 4 gives a project cost estimate.

Table 2. Proposed sampling locations.

Map ID	Site	Rationale	Latitude	Longitude
1	Asotin Cr ds confluence	Reference Site	46.273594	-117.292383
2	Pintler Cr us Kelly Cr	Baseline George/Pintler Creek	46.284844	-117.110490
3	George Cr @ mouth	Load from George Creek	46.325278	-117.106944
4	Asotin Cr us George Cr	Load before George Creek	46.325600	-117.108375
5	Asotin Cr @ Morgan Rd	Upper residences	46.333640	-117.069387
6	Asotin Cr @ 1 st Aly	Upstream groundwater sources	46.335056	-117.062775
7	Asotin Cr @ Costley Rd	Middle residences	46.337804	-117.058890
8	Asotin Cr @ mouth	End of residences	46.340214	-117.055980

ds = downstream.

us = upstream.

Table 3. Sampling parameters.

Site	Bacteria	Nutrients	Field	Flow
Asotin Cr ds confluence	FC ENT	NO2/NO3, chloride	Temp, DO, pH cond	No
Pintler us Kelly	FC, ENT	NO2/NO3, chloride	Temp, DO, pH cond	No
George Cr @ mouth	FC, ENT	NO2/NO3, chloride	Temp, DO, pH cond	Yes
Asotin Cr us George Cr	FC, ENT	NO2/NO3, chloride	Temp, DO, pH cond	Yes
Asotin Cr @ Morgan Rd	FC, ENT	NO2/NO3, chloride	Temp, DO, pH cond	Yes
Asotin Cr @ 1 st Aly	FC, ENT	NO2/NO3, chloride	Temp, DO, pH cond	Yes
Asotin Cr @ Costley Rd	FC, ENT	NO2/NO3, chloride	Temp, DO, pH cond	Yes
Asotin Cr @ mouth	FC, ENT	NO2/NO3, chloride	Temp, DO, pH cond	Yes

ds = downstream.

us = upstream.

cond = conductivity.

Table 4. Project cost estimate.

8 sites, 8 sample trips*	FC	ENT	NO2/NO3	chloride	Project total
Cost per sample**	23	39	13	13	
Totals	1656	2808	936	936	\$ 6336

*Each sample trip includes Quality Assurance samples for each parameter.

**Costs include 50% discount for Manchester Laboratory.

Sampling Procedures

Sampling procedures will follow the Ecology stream sample collection standard operating procedure (SOP) (Ward, 2007). Sample containers will be filled, tagged, and put on ice. The samples will be transported to Manchester Environmental Lab (MEL) via Alaska Airlines. Table 5 lists the sample size, containers, preservation time, and holding time for each parameter in this study. Sample containers will be provided by MEL.

Table 5. Sample containers, preservation times, and holding times.

Parameter	Container	Preservation time	Holding time
FC/ENT	250 mL autoclaved poly	Cool to 4°C	24 hours
Chloride	125 mL poly	Cool to 4°C	28 days
NO ₂ NO ₃ -N	125 poly	H ₂ SO ₄ to pH < 2, 4°C	28 days

Measurement Procedures

Temperature, pH, conductivity, and DO will be analyzed in the field using a Hydrolab multi-probe meter. Flow will be measured with a Marsh McBirney flow meter. All parameters not analyzed in the field will be analyzed by MEL.

Field measurements will follow approved EAP SOPs:

- EAP013 Determining Global Positioning System Coordinates.
- EAP011 Instantaneous Measurement of Temperature in Water.
- EAP023 Winkler Determination of Dissolved Oxygen.
- EAP024 Estimating Streamflow.
- EAP031 Measurement of pH in Freshwater.
- EAP032 Measurement of Conductivity in Freshwater.
- EAP033 Hydrolab® DataSonde and MiniSonde Multiprobes.
- EAP035 Measurement of Dissolved Oxygen in Surface Water.

Organization and Schedule

Table 6 lists the Ecology employees that are involved in this study.

Table 6. Organization of project staff and responsibilities.

Staff (all are EAP except client)	Title	Responsibilities
Chad Atkins Water Quality Program Eastern Regional Office Phone: (509) 329-3499	EAP Client	Clarifies scope of the project. Provides internal review of the QAPP and approves the final QAPP.
Karin Baldwin Water Quality Program Eastern Regional Office Phone: (509) 329-3472	Client's Unit Supervisor	Reviews the project scope and budget, tracks progress, reviews the draft QAPP, and approves the final QAPP.
Jim Ross Eastern Operations Section Eastern Regional Office Phone: (509) 329-3425	Project Manager, EIM Manager, and Principal Investigator	Writes the QAPP. Oversees field sampling and transportation of samples to the laboratory. Conducts QA review of data, analyzes and interprets data, and enters data into EIM. Writes the draft report and final report.
Scott Tarbutton Eastern Operations Section Eastern Regional Office Phone: (509) 329-3453	Field Assistant	Helps collect samples and records field information.
Gary Arnold Eastern Operations Section Phone: (509) 454-4244	Section Manager for the Project Manager	Provides internal review of the QAPP and approves the budget. Reviews the project scope and budget, tracks progress, reviews the draft QAPP, and approves the final QAPP.
Stuart Magoon Manchester Environmental Laboratory Phone: (360) 871-8801	Director	Approves the final QAPP.
William R. Kammin Ecology Phone: (360) 407-6964	Ecology Quality Assurance Officer	Reviews the draft QAPP and approves the final QAPP.

EAP – Environmental Assessment Program.

EIM – Environmental Information Management system.

QAPP – Quality Assurance Project Plan.

Table 7. Proposed project schedule.

Field and laboratory work	Due date	Lead staff
Field work completed	October 31, 2010	Jim Ross
Laboratory analyses completed	November 30, 2010	
Environmental Information System (EIM) database		
EIM user study ID	JROS0021	
Product	Due date	Lead staff
EIM data loaded	January 31, 2011	Ross
EIM QA	February 28, 2011	Sherratt
EIM complete	March 31, 2011	Ross
Final report		
Author lead / Support staff	Jim Ross / Scott Tarbutton and Andy Albrecht	
Schedule		
Draft due to supervisor	May 31, 2011	
Draft due to client/peer reviewer	July 31, 2011	
Draft due to external reviewer(s)	NA	
Final (all reviews done) due to publications coordinator (Joan)	September 30, 2011	
Final report due on web	October 31, 2011	

Quality Objectives

Table 8 lists the methods and quality objectives for field and laboratory measurements.

Hydrolab data will be qualified or rejected based on the post-calibration criteria in Table 8.

Table 8. Measurement quality objectives.

Analysis	Method	Accuracy	Precision RSD	Bias	Reporting Limits
Field Measurements					
Velocity	Marsh McBirney Flow-Mate® Flowmeter	0.1 ft/s	0.1 ft/s	N/A	0.01 ft/s
pH	SM 4500-H ⁺	0.05 S.U.*	0.05 S.U.	0.10 S.U.	1-14 S.U.
Temperature	SM 2550B	0.1°C	0.025°C	0.05°C	1°C to 40°C
Dissolved Oxygen	SM 4500-O C	15%	<5%	±5%	0.1 to 15 mg/L
Specific Conductivity	SM 2510B	10%	<10%	±5%	1 umhos/cm
Laboratory Analyses					
Nitrate and Nitrite Nitrogen	SM 4500-NO3 I	20%	<20%	±20%	10 ug/L
Chloride	SM4110C	20%	<20%	±20%	0.1 mg/L
Fecal Coliform	SM9222D	35%	40%	NA	1 cfu/100 mL
Enterococci	SM9230C	35%	40%	NA	1 cfu/100 mL

* S.U. = Standard Units.

* RSD = relative standard deviation

Quality Control Procedures

Field

Table 9 lists the field quality control (QC) samples for this project. Field QC will consist of replicate samples and field blanks. Replicate sampling procedure will consist of two samples taken at the same location at the same time. Field blanks will consist of deionized water that is processed as a sample (filtered, preserved, cooled) and shipped with the field samples to MEL.

Laboratory

MEL will follow their SOPs as described in their quality assurance manual (Manchester Laboratory, 2006). Laboratory QC will consist of lab control samples, method blanks, analytical duplicates, and matrix spikes (Table 9).

Table 9. Quality control sample frequency.

Parameter	Field		Laboratory			
	Blanks	Replicates	Check Standards	Method Blanks	Analytical Duplicates	Matrix Spikes
pH Conductivity Temperature Dissolved Oxygen	N/A	1/trip	In field	N/A	N/A	N/A
Nitrate and Nitrite Nitrogen Chloride	2/study	1/trip	1/batch	1/batch	1/batch	1/batch
Fecal Coliform Enterococci	NA	1/trip	N/A	1/batch	1/batch	N/A

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 field work. This database will be used for preliminary analysis and to create a table to upload data into Ecology's EIM system.

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

Data Verification

Laboratory-generated data reduction, review, and reporting will follow the procedures outlined in the Lab Users Manual (MEL, 2008). Lab results will be checked for missing and improbable data. Variability in lab duplicates will be quantified using the procedures outlined in the MEL Lab Users Manual. Any estimated results will be qualified and their use restricted as appropriate. A standard case narrative of laboratory quality assurance results will be sent to the project manager for each set of samples.

Field staff will check field notebooks for missing and improbable measurements before leaving each site. The field assistant will check data entry against the field notebook data for errors and omissions. The project manager for consultation will be informed of any missing or unusual data.

The field lead will check data received from LIMS for omissions against the "Request for Analysis" forms. Field replicate sample results will be compared to quality objectives in Table 8. The project manager will review data requiring additional qualifiers.

After data validity and data entry tasks are completed, a field assistant will enter all field, laboratory, and flow data into EIM. A second EAP field assistant will independently review EIM data for errors at an initial 10% frequency. If significant entry errors are discovered, a more intensive review will be undertaken.

Data Quality (Usability) Assessment

After the project data have been reviewed and verified, the project lead will determine if the data are of sufficient quality to meet the study objectives. The final report will discuss data quality and whether study objectives were met.

Audits and Reports

MEL participates in performance and system of their routine procedures. Results of these audits are available upon request.

At the end of the 2010 study, a final report will be published and will contain, at a minimum:

- Map and photos of sampling locations.
- Summary table of chemical and physical data, as well as pertinent field notes.
- Discussion of data quality and the significance of problems encountered.
- Comparison of sample results with Washington State water quality standards.
- Evaluation of significant findings and recommendations for further action.

The final report will be prepared by October 31, 2011.

References

- APHA, AWWA, and WEF, 1998. Standard Methods for the Examination of Water and Wastewater 20th Edition. American Public Health Association, Washington, D.C.
- Ecology, 1993. Field Sampling and Measurement Protocols for the Watershed Assessments Section. Washington State Department of Ecology, Olympia, WA. Publication No. 93-e04. www.ecy.wa.gov/biblio/93e04.html.
- HDR/EES, 2005. WRIA 35 Watershed Assessment Report.
- Johnson, Bradley, 2002. BPA Riparian Fencing and Alternative Water Development Projects Completed within Asotin Creek Watershed. Project No. 2000-05400, 14 pages. BPA Report DOE/BP-00006228-1.
- Joy, J., 2006. Standard Operating Procedure for Grab sampling – Fresh water, Version 1.0. Washington State Department of Ecology, Olympia, WA. SOP Number EAP015. 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. www.ecy.wa.gov/biblio/0403030.html.
- MEL, 2006. Manchester Environmental Laboratory Quality Assurance Manual. Manchester Environmental Laboratory, Washington State Department of Ecology, Manchester, WA.
- MEL, 2008. Manchester Environmental Laboratory Lab Users Manual, Ninth Edition. Manchester Environmental Laboratory, Washington State Department of Ecology, Manchester, WA.
- Oppenheimer, J. and K. Vigerstol, 2005. HDR Asotin Creek Fecal Coliform Data Assessment.
- Stovall, S., 2001. Draft Asotin Creek Subbasin Summary.
- Sullivan, L., 2007. Standard Operating Procedure for Estimating Streamflow, Version 1.0. Washington State Department of Ecology, Olympia, WA. SOP Number EAP024. www.ecy.wa.gov/programs/eap/quality.html.
- Swanson, T., 2007. Standard Operating Procedure for Hydrolab® DataSonde® and MiniSonde® Multiprobes, Version 1.0. Washington State Department of Ecology, Olympia, WA. SOP Number EAP033. www.ecy.wa.gov/programs/eap/quality.html.
- WAC 173-201A. Water Quality Standards for Surface Waters in the State of Washington. Washington State Department of Ecology, Olympia, WA. www.ecy.wa.gov/laws-rules/ecywac.html.

Ward, W.J., 2007. Collection, Processing, and Analysis of Stream Samples, Version 1.3. Washington State Department of Ecology, Olympia, WA. SOP Number EAP034. www.ecy.wa.gov/programs/eap/quality.html.

Washington State University, 2000. Asotin Creek Watershed Water Quality Monitoring Final Report. Center for Environmental Education, Washington State University, Pullman, WA.

Appendix. Glossary, Acronyms, and Abbreviations

Glossary

Ambient: Background or away from point sources of contamination.

Baseflow: The component of total streamflow that originates from direct groundwater discharges to a stream.

Clean Water Act: A federal act passed in 1972 that contains provisions to restore and maintain the quality of the nation's waters. Section 303(d) of the Clean Water Act establishes the TMDL program.

Conductivity: A measure of water's ability to conduct an electrical current. Conductivity is related to the concentration and charge of dissolved ions in water.

Dissolved oxygen (DO): A measure of the amount of oxygen dissolved in water.

Eutrophic: Nutrient rich and high in productivity resulting from human activities such as fertilizer runoff and leaky septic systems.

Fecal coliform: That portion of the coliform group of bacteria which is present in intestinal tracts and feces of warm-blooded animals as detected by the product of acid or gas from lactose in a suitable culture medium within 24 hours at 44.5 plus or minus 0.2 degrees Celsius. Fecal coliform bacteria are "indicator" organisms that suggest the possible presence of disease-causing organisms. Concentrations are measured in colony forming units per 100 milliliters of water (cfu/100 mL).

Geometric mean: A mathematical expression of the central tendency (an average) of multiple sample values. A geometric mean, unlike an arithmetic mean, tends to dampen the effect of very high or low values, which might bias the mean if a straight average (arithmetic mean) were calculated. This is helpful when analyzing bacteria concentrations, because levels may vary anywhere from 10 to 10,000 fold over a given period. The calculation is performed by either: (1) taking the nth root of a product of n factors, or (2) taking the antilogarithm of the arithmetic mean of the logarithms of the individual values.

Nonpoint source: Pollution that enters any waters of the state from any dispersed land-based or water-based activities. This includes, but is not limited to, atmospheric deposition, surface water runoff from agricultural lands, urban areas, or forest lands, subsurface or underground sources, or discharges from boats or marine vessels not otherwise regulated under the NPDES program. Generally, any unconfined and diffuse source of contamination. Legally, any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act.

Nutrient: Substance such as carbon, nitrogen, and phosphorus used by organisms to live and grow. Too many nutrients in the water can promote algal blooms and rob the water of oxygen vital to aquatic organisms.

Parameter: A physical chemical or biological property whose values determine environmental characteristics or behavior.

Pathogen: Disease-causing microorganisms such as bacteria, protozoa, viruses.

pH A measure of the acidity or alkalinity of water. A low pH value (0 to 7) indicates that an acidic condition is present, while a high pH (7 to 14) indicates a basic or alkaline condition. A pH of 7 is considered to be neutral. Since the pH scale is logarithmic, a water sample with a pH of 8 is ten times more basic than one with a pH of 7.

Pollution: Such contamination, or other alteration of the physical, chemical, or biological properties, of any waters of the state. This includes change in temperature, taste, color, turbidity, or odor of the waters. It also includes discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state. This definition assumes that these changes will, or are likely to, create a nuisance or render such waters harmful, detrimental, or injurious to (1) public health, safety, or welfare, or (2) domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or (3) livestock, wild animals, birds, fish, or other aquatic life.

Reach: A specific portion or segment of a stream.

Riparian: Relating to the banks along a natural course of water.

Streamflow: Discharge of water in a surface stream (river or creek).

Surface waters of the state: Lakes, rivers, ponds, streams, inland waters, salt waters, wetlands and all other surface waters and water courses within the jurisdiction of Washington State.

Total Maximum Daily Load (TMDL): A distribution of a substance in a waterbody designed to protect it from not meeting (exceeding) water quality standards. A TMDL is equal to the sum of all of the following: (1) individual wasteload allocations for point sources, (2) the load allocations for nonpoint sources, (3) the contribution of natural sources, and (4) a margin of safety to allow for uncertainty in the wasteload determination. A reserve for future growth is also generally provided.

Watershed: A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

303(d) list: Section 303(d) of the federal Clean Water Act requires Washington State to periodically prepare a list of all surface waters in the state for which beneficial uses of the water – such as for drinking, recreation, aquatic habitat, and industrial use – are impaired by pollutants. These are water quality limited estuaries, lakes, and streams that fall short of state surface water quality standards, and are not expected to improve within the next two years.

Acronyms and Abbreviations

Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database
FC	Fecal coliform bacteria
MEL	Manchester Environmental Laboratory
QA	Quality assurance
RSD	Relative standard deviation
SOP	Standard operating procedures
WRIA	Water Resources Inventory Area

Units of Measurement

°C	degrees centigrade
cfs	cubic feet per second
mg/L	milligrams per liter (parts per million)
S.U.	standard units
µg/L	micrograms per liter (parts per billion)
µS/cm	microsiemens per centimeter, a unit of conductivity