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Quality Assurance Project Plan

Olequa Creek
Dry Season Flow Characterization
In Winlock WA, Lewis County

June 2015

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Quality Assurance Project Plan

Olequa Creek Dry Season Flow Characterization in Winlock, WA, Lewis County

June 2015

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2.0 Abstract

The city of Winlock built a new wastewater treatment plant (WWTP) to meet the needs of its growing community. Construction was completed in 2008. The plant discharges its effluent into Olequa Creek (NPDES Permit No. WA0021199). This is a relatively small creek with an estimated low flow velocity of 0.152 ft/sec and critical low flow (7Q10) of about 4.82 cubic feet per second (cfs) (Ecology, 2007). Low summer flow in Olequa Creek may not provide enough dilution for the WWTP to meet its water quality-based effluent limits for temperature and copper. Ecology staff will measure streamflow in Olequa Creek during the months June through October to characterize streamflow conditions during low flow conditions. Monitoring during these months will capture the critical dry weather period (Gibbs and Olson, Inc., 2008). It will also characterize conditions during the Use Designation for Core Summer Habitat (Ecology, 2012). Flow monitoring will occur for two seasons: in 2015 and again in 2016. Ecology may use this information to evaluate potential changes to the city of Winlock's NPDES permit.

3.0 Background

The city of Winlock built a new wastewater treatment plant (WWTP) to meet the needs of its growing community. Construction was completed in 2008. The plant discharges its effluent into Olequa Creek (NPDES Permit No. WA0021199). This is a relatively small creek with an estimated low flow velocity of 0.152 ft/sec and critical low flow (7Q10) of about 4.82 cubic feet per second (cfs) (Ecology, 2007). Low summer flow in Olequa Creek may not provide enough dilution for the WWTP to meet its water quality-based effluent limits for temperature and copper. Ecology staff will measure streamflow in Olequa Creek during the months June through October to characterize streamflow conditions during low flow conditions. Monitoring during these months will capture the creeks critical dry weather period (Gibbs and Olson, Inc., 2008). It will also characterize conditions during the Use Designation for Core Summer Habitat (Ecology, 2012). Flow monitoring will occur for two seasons: in 2015 and again in 2016. Ecology may use this information to evaluate potential changes to the city of Winlock's NPDES permit.

3.1 Study area and surroundings

The information provided in this section was primarily obtained from the Winlock 2005 Comprehensive Plan (http://www.winlockwa.govoffice2.com/vertical/sites/%7B131FF39D-640A-4A04-8D6F-F1B120929459%7D/uploads/%7B25355772-5F6D-4D57-9E9A-D30C817C795A%7D.PDF).

The Olequa Creek watershed is in the northwest corner of WRIA 26 (Figure 1). The creek flows southwest through the city of Winlock then turns south where it flows into Cowlitz County and enters the Cowlitz River at RM 24.8. The creek is approximately 16 miles long. Olequa Creek is the receiving water for the effluent from the Winlock WWTP from its outfall #001 located at Latitude 46.48197 N and Longitude -122.94618 W (Figure 2).

Most of the area along Olequa Creek is within the 100-year Flood Boundary. The soils adjacent to Olequa Creek are typically Winston loam. The Winston series consists of very deep, well drained soils. Permeability is moderate to a depth of 35 inches and very rapid below this depth. Wetlands are common along the waterbodies in the area.

Olequa Creek and its tributaries provide habitat for trout (rainbow, cutthroat, and steelhead), Coho salmon, various sculpins, and spine sticklebacks. A variety of birds and mammals also find suitable habitat in the area.

The city of Winlock and its WWTP lay in a narrow valley at the confluence of Olequa Creek and King Creek. The climate in this area is typical of Washington west of the Cascade Mountains. Typically rainfall is light in the summer increasing in the fall and winter. In general, the Willapa Hills rise to the west and as you move east the landscape flattens out into prairie. The land north and south of the city also opens up into broad plains. The Burlington Northern Sante Fe Railroad is another prominent feature as it bisects the city in a north-to-south direction. The primary land use in the area is residential followed by agricultural uses.

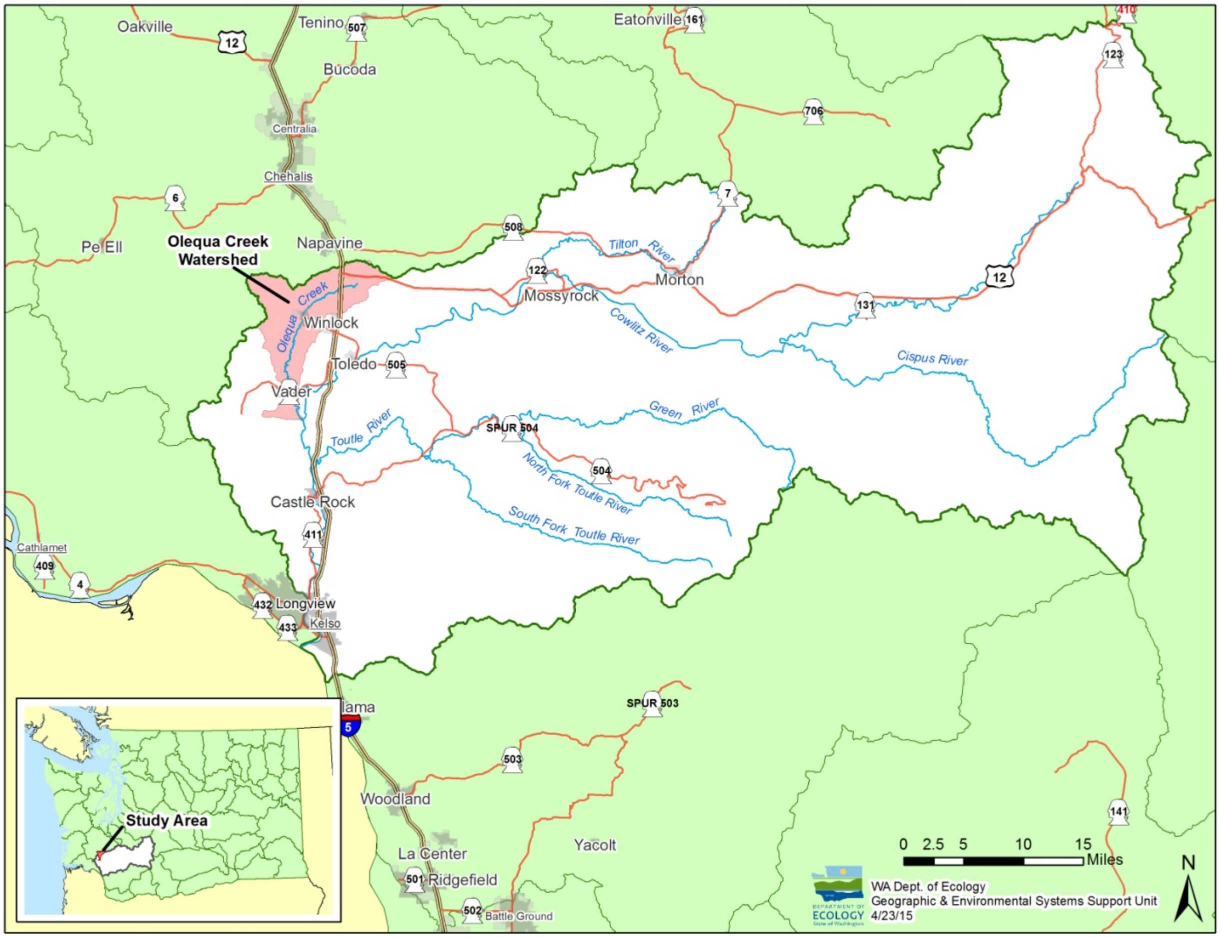

Figure 1. Overview of WRIA 26 and the Olequa Creek watershed.

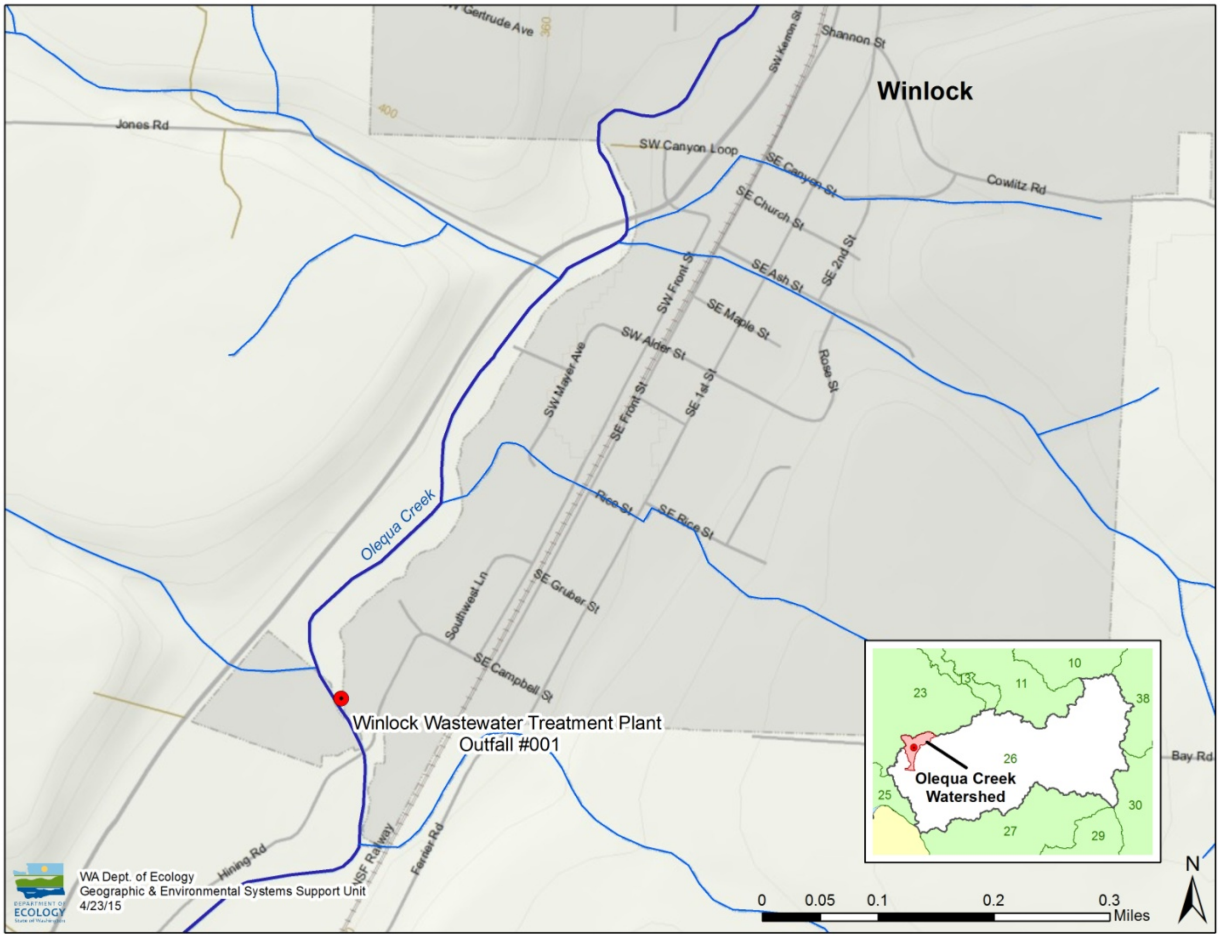

Figure 2. Location of the Winlock WWTP outfall #001. The cross-section for the flow measurements will be above the outfall but below any tributary or other inflow.

There are commercial and industrial facilities in the area, but are a small percentage of the overall land use.

3.1.1 Logistical problems

Low flow conditions are necessary for this study. Field dates will be scheduled to avoid rain events and elevated flow conditions. If an appropriate x-section cannot be located above the outfall, then a site will be located below the outfall but not below other hydraulic inputs. Data from the Winlock WWTP Data Monitoring Report will be used to subtract the WWTP effluent flows from the instream flow value.

3.1.2 History of study area

Olequa Creek is the city of Winlock's WWTP's receiving water. The WWTP was upgraded in 2008. However, it is unclear whether the water quality-based standards are being met with existing flow conditions.

3.1.3 Parameters of interest

Velocity is the only measurement being taken for this study. Streamflow will be calculated from those measurements.

3.1.4 Results of previous studies

The Olequa Creek stream flow in the Winlock area is not clearly documented. Available stream flow information is provided in Table 1.

Ecology conducted a receiving water study (Bernhardt, 1977) on Olequa Creek during summer low flow. They looked at the effects of wastes from the Winlock, Ryderwood, and Vader WWTPs. The specific method used for stream flow was not provided in the report. But the stream flow in Olequa Creek near Winlock was estimated at 7.02 cfs in September 1976. Apparently, Ecology also collected flow data in more recent years, but the raw data and associated report have not been located. However, it was documented in the Fact Sheet for Winlock's WWTP NPDES permit. This value, 4.82 cfs, was used to establish the calculated mixing zone boundaries (Gibbs and Olson Inc., 2005). Gibbs & Olson, Inc. also collected dry weather flow measurements in 2000 and 2001 (Marshall, 2015), but they chose to use the Ecology data (Diamant, 2015).

Table 1. Olequa Creek stream flow data from previous studies.

Data Source	Date	Flow (cfs)
Ecology	9/1976	7.02
Ecology	?	4.82
Gibbs & Olson, Inc.	9/28/2000	4.65
Gibbs & Olson, Inc.	8/29/2001	3.22

3.1.5 Regulatory criteria or standards

Not Applicable (NA)

4.0 Project Description

The city of Winlock built a new wastewater facility in 2008. The new plant has occasional difficulties meeting current permit requirements. Low summer flow in Olequa Creek may not provide enough dilution to allow Winlock to meet water quality standards. Ecology staff will measure Olequa's dry weather low flows for two years during the critical low flow period.

Facility Description
The new wastewater facility was improved with Membrane Bioreactors (MBR) and UV disinfection. The plant, however, continues to discharge effluent to Olequa Creek at the same outfall #001.

Olequa Creek's reported summer low flows result in low 2018 design year dilution values (Acute – 3.27:1, Chronic – 7.11:1). Therefore, temperature and copper effluent limits are difficult for the WWTP to meet.

Receiving Water Description
The following parameters were used to compute the dilution factors for design year 2018 (Phase 1) using Visual Plumes (Gibbs & Olson, Inc., 2005)

Olequa Creek 7Q10 low flow value - 4.82 cfs
Creek Velocity – 0.152 ft/sec
Depth of Creek - 0.9 feet
Width of Creek – 39.2 feet
Dry weather plant peak* daily flow 0.865 mgd - 1.34 cfs
Maximum* monthly dry weather flow 0.491 mgd - 0.76 cfs

Visual Plumes is not appropriate for receiving waters less than 5 feet deep so Ecology may revisit the dilution calculations once low flows are verified in Olequa Creek.

*The values are calculated using the lowest or highest 30 consecutive day period.

4.1 Project goals

The goal of this study is to measure flow (cfs) in Olequa Creek during the low flow critical condition. The data may be subsequently used by Ecology's SWRO Municipal Unit to evaluate the need for potential changes to the city of Winlock's NPDES permit.

4.2 Project objectives

The objectives of the study are:

- Collect velocity measurements (ft/sec) in Olequa Creek above Winlock's WWTP outfall during the critical low flow summer season (June through October). Use these data to calculate stream flow (cfs).
- Collect the velocity measurements once a month during low flow conditions.
- Collect the velocity measurements for two years during the critical low flow season.

4.3 Information needed and sources

NA

4.4 Target population

The target population for this study is the streamflow in Olequa Creek above the effluent from the Winlock WWTP. The flows will be taken once a month for two years during May through October.

4.5 Study boundaries

The Water Resource Inventory Area (WRIA) and 8-digit Hydrologic Unit Code (HUC) numbers for the study area are:

WRIA

- 26

HUC numbers

- 17080005

4.6 Tasks required

Streamflow measurements will be taken following the Standard Operating Procedure (SOP) established by Ecology's Environmental Assessment Program (EAP) for estimating streamflow. The SOP is EAP024 and was updated in 2013. The data will be entered into EAPs spreadsheet that calculates the streamflow using Microsoft Excel® (Microsoft, 2007). Field Sheets and a summary of the streamflow data will be provided to the client. The final stream flow value (cfs) will be entered into EIM.

4.7 Practical constraints

The Marsh-McBirney Flo-Mate 2000 has limited ability to collect flow measurements when the water is less than 2 inches.

Selecting sampling dates in advance is not productive since we will be looking for the driest time of each month. A variety of weather prediction sites will be used to determine the sampling date.

4.8 Systematic planning process

NA

5.0 Organization and Schedule

5.1 Key individuals and their responsibilities

Table 2. Organization of project staff and responsibilities.

Staff	Title	Responsibilities
Al Bolinger Water Quality Program (WQP), Municipal Unit SW Regional Office Phone: 360-407-6319	Client	Clarifies scope of the project. Provides internal review of the draft Quality Assurance Project Plan (QAPP) and approves the final QAPP.
Greg Zentner WQP, Municipal Unit, SW Regional Office Phone: 360-407-6368	Supervisor of Client	Clarifies scope of the project. Provides internal review of the draft Quality Assurance Project Plan (QAPP) and approves the final QAPP.
Betsy Dickes WQP, Water Cleanup Unit Phone: 360-407-6296	Project Manager/ Principal Investigator	Writes the QAPP. Conducts field measurements. Performs QA review of data, analyzes and interprets data, and enters data into EIM. Writes the draft report and final report.
Staff-variable WQP	Field Assistant	Records velocity information in the field.
Andrew Kolosseus WQP, Water Cleanup Unit Phone: 360-407-7543	Unit Supervisor for the Project Manager	Provides internal review of the draft and final QAPP, and approves the final QAPP. Tracks progress.
Rich Doenges Water Quality Program (WQP) SW Regional Office Phone: 360-407-6271	Section Manager for the Project Manager	Reviews the project scope and approves the budget, reviews the draft QAPP, and approves the final QAPP.
Randall Marshal Water Quality Program Phone: 360-407-6445	Quality Assurance Officer	Reviews the draft QAPP and approves the final QAPP.

5.2 Special training and certifications

The Principal Investigator has over 10 years of experience with water quality and taking flow measurements. The SOP EAP024 will be reviewed and retained on hand in the field for consultation if necessary.

5.3 Organization chart

See Table 2 in Section 5.1.

5.4 Project schedule

Table 3. Schedule for completing project tasks.

Field and laboratory work	Due date	Lead staff
Field work initiated	June 2015	Betsy Dickes
Field work completed	October 2016	
Environmental Information System (EIM) database		
EIM Study ID	BEDI0023	
Product	Due date	Lead staff
EIM data loaded year 1	December 2015	Betsy Dickes
EIM data loaded year 2	December 2016	
Data reporting		
Author lead	Betsy Dickes	
Schedule		
Summary data provided in a technical memo to supervisor	December 2015 and December 2016	
Summary data provided in a technical memo to client	December 2015 and December 2016	

5.5 Limitations on schedule

The study site will be identified so wading is safe during low flow conditions. Problems may arise if the weather conditions do not yield low flows, but with a flexible sampling schedule and one event per month, we should be able to measure representative low flows. The second year may be eliminated if the client decides one year is representative of low flow conditions.

5.6 Budget and funding

Approximately $1000 dollars will be necessary to have the flow meter calibrated by the manufacturer. This will cover calibration each year for two years.

6.0 Quality Objectives

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

6.1 Decision Quality Objectives (DQOs)

NA

6.2 Measurement Quality Objectives

Field sampling procedures and laboratory analyses inherently have associated uncertainty, which results in data variability. Measurement quality objectives (MQOs) state the acceptable data variability for a project. *Precision* and *bias* are data quality criteria used to indicate conformance with MQOs. The term *accuracy* refers to the combined effects of precision and bias (Lombard and Kirchmer, 2004). Table 4 summarizes the measurement quality objectives expected for this study.

Table 4. Measurement quality objectives for stream flow.

Parameter	Equipment	Manufacturer Calibration	Field Precision	Method	Accuracy (ft/sec)
Stream flow (cfs)	March McBirney Portable Flowmeter Model 2000	2/26/2015	10% RSD	EAP024	±2% of reading ± 0.05 (zero stability)

6.2.1 Targets for Precision, Bias, and Sensitivity

6.2.1.1 Precision

Precision is a measure of the variability in the results of replicate measurements due to random error.

Flow measurements will be made at a pre-selected x-section in the creek. A replicate flow measurement will be taken immediately after the completion of the initial x-section measurements. The precision will be measured back in the office after stream flow is calculated.

A field precision of 10% relative standard deviation (RSD) will be considered acceptable. If this precision is not achieved a return visit will be made to repeat field measurements.

6.2.1.2 Bias

Bias is defined as the difference between the sample value and true value of the parameter being measured. Bias in field measurements will be minimized by strictly following Ecology's measurement protocols and by taking a replicate flow measurement.

6.2.1.3 Sensitivity

Sensitivity is a measure of the capability of a method to detect a substance. It is commonly described as detection limit. The flow meter has a sensitivity of 0.05 ft/sec.

6.2.2 Targets for Comparability, Representativeness, and Completeness

6.2.2.1 Comparability

The previous flow measurements taken by Gibbs and Olson, Inc. used a Marsh McBirney meter (John Diamant, 2015). The Ecology SOP24 follows standard means for conducting x-sections for calculating streamflow. The Ecology spreadsheet for calculating streamflow is a standard recognized protocol.

6.2.2.2 Representativeness

Flow will be gathered routinely June through October. But, low flows will be targeted. Streamflow may be increased to weekly toward the end of the low flow season.

6.2.2.3 Completeness

The study site will be identified such that it can be waded safely during low flow conditions. And with only one event per month it is expected that 100% of the streamflow information will be collected. However, problems may arise with high water, malfunctioning flow meter, or other uncontrollable events. It is assumed that any of these problems can be worked around by returning for another visit during the month.

7.0 Sampling Process Design (Experimental Design)

7.1 Study Design

This study involves one site on Olequa Creek located above the WWTP outfall #001 and below any upstream inflows.

7.1.1 Field measurements

Flow measurements will be made monthly at an x-section of the creek above the WWTP outfall #001.

7.1.2 Sampling location and frequency

The sample location will be verified before the first sampling event in June (SOP EAP024). It will be located between the Winlock WWTP outfall #001 (Latitude 46.48197 N, Longitude -122.94618 W) and any upstream inflows to the creek (refer back to Section 3.1.1 for logistical options).

Velocity measurements will be taken across the stream once a month Juney 2015 – October 2015. Dry low flow events will be targeted. Flow measurements may be increased to once a week during September and October based on previous ability to capture lowest flow conditions.

7.1.3 Parameters to be determined

Velocity will be measured at an appropriate x-section of the creek located above the WWTP outfall #001. Streamflow will be calculated.

7.2 Maps or diagram

See Figure 1 and Figure 2.

7.3 Assumptions underlying design

NA

7.4 Relation to objectives and site characteristics

NA

7.5 Characteristics of existing data

NA

8.0 Sampling Procedures

8.1 Field measurement and field sampling SOPs

Velocity measurements will be taken using the Ecology EAP SOP24.

8.2 Containers, preservation methods, holding times

NA

8.3 Invasive species evaluation

Field staff will follow EAP's SOP070 on minimizing the spread of invasive species (Parsons et al., 2012). However, the Olequa Creek study area is not in an area of extreme concern. Staff will not wear felt soled boots. Only the one staff member will go into the creek. Gear that makes contact with the stream bottom will either be air dried for 48 hours or sprayed with 3% hydrogen peroxide and soaked for 15 minutes. For more information about minimizing the spread of invasive species you can review Ecology's webpage at www.ecy.wa.gov/programs/eap/InvasiveSpecies/AIS-PublicVersion.html.

8.4 Equipment decontamination

NA. There is no expectation that equipment will come into contact with high levels of contaminants. Decontamination procedures will be used for invasive species only as described in Section 8.3.

8.5 Sample ID

NA.

8.6 Chain-of-custody, if required

NA.

8.7 Field log requirements

A loose-leaved field notebook will be used to record the field flow measurements. The pages used for the sampling event will have the following information:

- Name and location of project
- Field personnel
- Any changes or deviations from the QAPP
- Environmental conditions
- Date, time, location
- Field measurement results (width, depth, velocity)
- Unusual circumstances that might affect interpretation of results

8.8 Other activities

Field staff will be trained by the Field Lead so they understand the equipment, the protocol, and the data they are recording. Field staff will be required to read the SOP EAP024 before they go out in the field.

9.0 Measurement Methods

9.1 Field procedures table/field analysis table

Table 5. Measurement methods.

Parameter	Matrix	Number of Samples	Expected Range of Results (cfs)	Field Method SOP	Replicate precision
Streamflow (cfs)	Water	1/month June – Oct for 2 years	2 - 5	EAP024	10%RSD

9.2 Lab procedures table

NA.

9.3 Sample preparation method(s)

NA.

9.4 Special method requirements

NA.

9.5 Lab(s) accredited for method(s)

NA.

10.0 Quality Control (QC) Procedures

There will be one flow and one replicate flow taken per event.

10.1 Table of field and lab QC required

NA.

10.2 Corrective action processes

The routine flow measurements and a replicate are expected to fall within 10% RPD of each other. If this MQO is not met a follow-up field event will be made with flow measurements taken again.

11.0 Data Management Procedures

11.1 Data recording/reporting requirements

The field staff taking the measurements will verbally express results from the measuring tape, depth, and meter velocity to the field assistant. The field assistant will repeat the values out loud as they are written. Both field staff will stay alert to values that don't make sense based on previous x-section information that day as well as data recorded on other events.

11.2 Laboratory data package requirements

NA.

11.3 Electronic transfer requirements

NA.

11.4 Acceptance criteria for existing data

NA.

11.5 EIM/STORET data upload procedures

All summarized streamflow data will be entered into EIM by December of each event year.

12.0 Audits and Reports

12.1 Number, frequency, type, and schedule of audits

NA.

12.2 Responsible personnel

NA.

12.3 Frequency and distribution of report

The Final report will be a memo with a table of monthly streamflow measurements and attached raw data. Annual reports will be provided in December of each field season.

12.4 Responsibility for reports

Betsy Dickes will be responsible for the memo containing the monthly streamflow data.

13.0 Data Verification

13.1 Field data verification, requirements, and responsibilities

The field lead will verify initial field data before leaving each site. This process involves checking the data sheet for omissions or outliers. If measurement data are missing or a measurement is determined to be an outlier, the x-section will be repeated.

After each sampling event the field lead will assess the replicate flow measurements and determine if the MQO was met. The field staff will review again any issues that may have caused the difference in flows (this should be caught in the field). Another field event will be scheduled.

13.2 Lab data verification

NA.

13.3 Validation requirements, if necessary

The Principal Investigator will perform all steps to validate field measurements, streamflow calculations, and the data provided in the final memo.

14.0 Data Quality (Usability) Assessment

14.1 Process for determining whether project objectives have been met

The MQOs will be evaluated after each event. If the replicates are not within 10 % RPD then a return event will be planned.

14.2 Data analysis and presentation methods

Velocity values will be entered into an Excel spreadsheet where the streamflow will be calculated. The summarized streamflow data value will be provided in a table showing the date and streamflow value. Raw velocity information will be provided by submitting the field sheets to the client.

14.3 Treatment of non-detects

NA

14.4 Sampling design evaluation

NA

14.5 Documentation of assessment

The assessment of the replicate flow measurements will be provided in the final end-of-the-year data memos.

15.0 References

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