QUALITY ASSURANCE PROJECT PLAN FOR
“WATER QUALITY SAMPLING IN THREE WATERBODIES”

August 4, 2011

Alaska Department of Environmental Conservation
Division of Water

A. PROJECT MANAGEMENT ELEMENTS

A.1 Title and Approvals:

Title: Surface Water Monitoring in the Chena Watershed for the Development of TMDLs-Water Quality Sampling in Three Waterbodies

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Signature: ________________________________ Date: _______________

Jayne Carlin EPA Project Manager Phone: (206) 553-8512
USEPA Region 10 email: carlin.jayne@epa.gov

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TABLE OF CONTENTS

A.3 DISTRIBUTION LIST

This list includes the names and addresses of those who receive copies of the approved QAPP and subsequent revisions.

Distribution List				
NAME	**POSITION**	**AGENCY/ Company**	**DIVISION/ BRANCH/SECTION**	**CONTACT INFORMATION**
Chandra McGee	ADEC Project Manager	ADEC DOW	WQSAR	Phone: (907) 451-2140 Email: chandra.mcgee@alaska.gov
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A.4 PROJECT TASK/ORGANIZATION

Duties and responsibilities of key individuals are listed below:

USEPA Region 10 Staff

- USEPA Region 10 Project Manager is Jayne Carlin. Ms. Carlin will be the primary contact for project related questions. She will be assisting in reviewing the QAPP and final report.

- USEPA Region 10 Quality Assurance Manager (QAM) is Gina Grepo-Grove. Ms. Grepo-Grove will assist in the development of the QAPP and approve it for USEPA Region 10, along with the USEPA Project Manager. She may also review data and/or audit monitoring activities.

- USEPA Region 10 303(d) Listing Specialist is Jill Gable. Ms. Gable will assist in the potential listing/delisting parameters from the Alaska Section 303(d) list, as well as potential TMDL development.

ADEC Staff

- ADEC Project Manager is Chandra McGee. Ms. McGee will be the primary contact for technical questions or other questions related to the project.
- ADEC Quality Assurance Officer (QAO) is Richard Heffern. Mr. Heffern will assist in development of the QAPP, if necessary, and approve it for ADEC along with the ADEC Project Manager. He may also review data and/or audit monitoring activities.
- ADEC Integrated Report Project Manager is Drew Grant. Mr. Grant will assist in the potential listing/delisting parameters from the Alaska Section 303(d) list, as well as potential TMDL development.

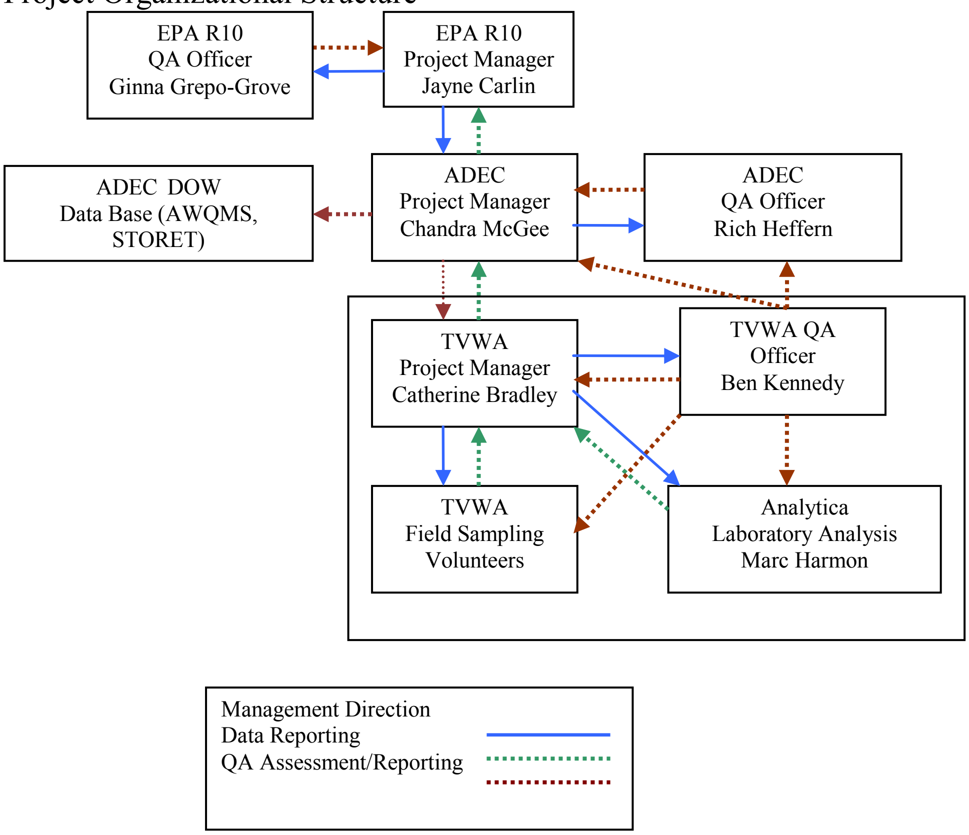
TVWA Staff

- TVWA Executive Director is Catherine Bradley. Dr. Bradley will be organizing volunteer activities, collecting samples throughout the project, compiling the data and reviewing data. She will also be preparing the quarterly and final reports for this project.
- TVWA third party reviewer for Data Review is Ben Kennedy, a TVWA Board Member. He will review the data for accuracy, precision, completeness and representativeness. He will coordinate with both the ADEC Project Manager and the TVWA Executive Director on any issue related to the data.
- TVWA volunteers will assist in the collection of field data and samples throughout the project. They will work with the TVWA Executive Director to maintain adequate quality control and the chain of custody for samples.

Analytica Staff

- Analytica Project Manager is Marc Harmon. Mr. Harmon will oversee the analysis of collected samples and will be the primary contact for analytical questions and method specific details.

Project Organizational Structure



A.5 PROBLEM DEFINITION/BACKGROUND AND PROJECT OBJECTIVES

A.5.1 Problem Definition

Waterbodies in the Chena River basin have been listed as impaired for certain pollutants (i.e. petroleum hydrocarbons, and sediment). Previous studies have collected data on petroleum hydrocarbons and resulted in delisting for all Chena River basin waterbodies, except for Noyes Slough, for that particular parameter. A TMDL is currently being prepared for petroleum related sheens for Noyes Slough. Sediment load has not been sampled at many locations, or during the range of flow conditions typically encountered in the watershed. Turbidity and suspended solids have been frequently monitored in this watershed as surrogate measures of sediment, but these parameters may or may not be directly related to settleable solids, which is the relevant ADEC standard of concern. This data gap is addressed by this project. This project is designed to collect sufficient information with which to make final decisions in support of Impaired Waterbody needs for the three major waterbodies in the Chena watershed (Chena River, Chena Slough and Noyes Slough).

A.5.2 Project Background

This project is for the Chena River Basin (United States Geological Survey (USGS) Hydrologic Unit Code (HUC) 19040506, which includes three streams that are on Alaska's Section 303(d) list: Noyes Slough (Alaska ID Number 40506-003), Chena Slough (Alaska ID Number 40506-002), and the Chena River (Alaska ID Number 40506-007). All three streams are currently classified as Category 5 streams and all are listed as impaired due to sediments, oil and grease, and petroleum hydrocarbons. Settleable solids will be evaluated in the 2011-12 because they have been identified as causes of impairment in this watershed and therefore need to be addressed quickly. In addition to sediment, oil and grease, and petroleum hydrocarbons, Noyes Slough is also listed as impaired due to residues (trash and sheens). A TMDL for residues (debris) was approved by EPA in June 2008 for this stream.

In addition to the impairments already included on the Section 303(d) list above, metals, fecal coliform, and nutrients have also been identified as potential threats in the Chena River Basin. These parameters, as well as the effects of excess nutrients (such as low dissolved oxygen and excess algae or Chlorophyll a) are also of future interest in this watershed.

Location

The Chena River is a tributary of the Tanana River and is located in interior Alaska entirely within the Fairbanks North Star Borough (Figure 1). The City of Fairbanks, which is Alaska's second largest city, is located in the lower portion of the Chena River Basin. The headwaters of the Chena River begin in the White Mountains about 145 km (90 mi) east of the city of Fairbanks. The river flows southwest to its confluence with the Tanana River in Fairbanks. The maximum length of the basin is 161 km (100 mi) and the maximum width is 64.5 km (40 miles). The Chena River drains an area of approximately 5,478 km^2 (2,115 mi^2).

Chena Slough (aka Badger Slough) begins at the City of North Pole and flows for approximately 27 km (17 mi) northwest through the City of North Pole, residential areas, and a park until it empties into the Chena River, 8 km (5 mi) east of Fairbanks (Figure 1). The Chena Slough watershed encompasses approximately 68 km^2 (26 mi^2).

Noyes Slough, located in the City of Fairbanks, is 5.5 miles long and is a tributary to the Chena River (Figure 1). Noyes Slough branches off to the north from the Chena River and returns to the north bank of the Chena River upstream of the confluence of the Chena River with the larger Tanana River. The slough is stagnant and is used mostly during the winter months for dog mushing, skiing, and dog walking. Noyes Slough and its adjacent wetlands provide habitat for beavers, muskrat, and waterfowl and spawning grounds for grayling and other fish (Kennedy et al. 2004). Noyes Slough is also a popular canoeing area and serves as a "living laboratory" where local elementary students observe local wildlife and learn about the value of clean waterways and the effects of urban pollution (Kennedy et al. 2004).

Hydrology

The Chena River begins in the mountains and flows to the lowlands of the watershed, which are a mosaic of wetlands and braided sloughs at the mouth of the river near Fairbanks. Water in the Chena River basin comes from precipitation, upstream flows, and groundwater (from unconfined aquifers). Chena River flow at Fairbanks ranges from 2.83 to 2,107 cubic meters per second (m^3/s) (100 to 74,400 cubic feet per second [cfs]), with an average flow of 38 m^3/s (1,344 cfs). High flows occur in the summer months (May through September) and low flows tend to occur in the winter months (November through April). Ice forms on the river in October and breaks up in April and May. The highest flows usually occur in May following spring rains and snow and ice-melt.

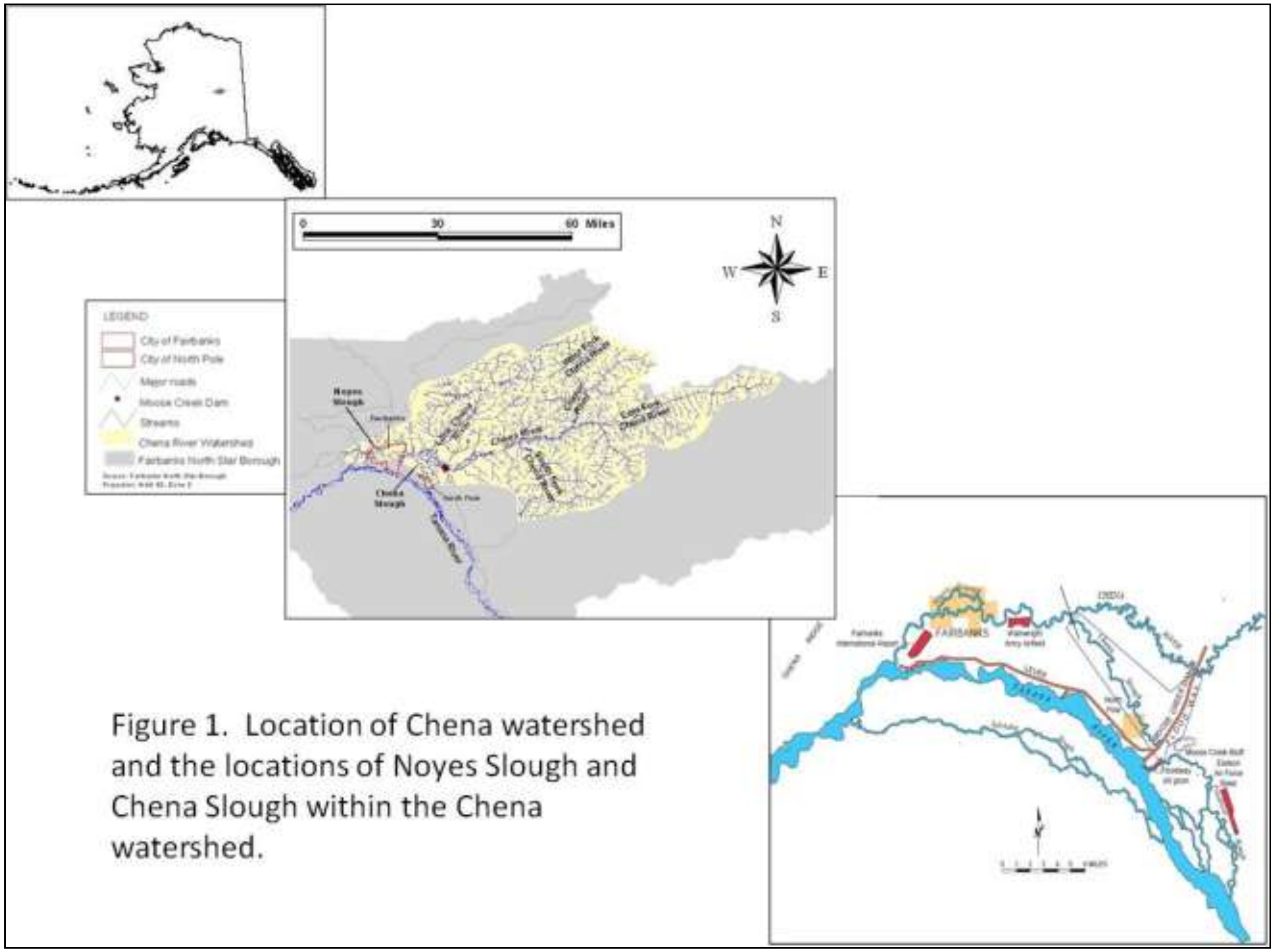


Figure 1. Location of Chena watershed and the locations of Noyes Slough and Chena Slough within the Chena watershed.

Flow in the Chena River Basin has been altered over the past 50 years because of flood-control structures on the Chena and Tanana Rivers. Moose Creek Dike was built across Chena Slough in 1945, blocking flow from the Tanana River. The 1967 flood on the Chena River resulted in the construction of a diversion dam (Moose Creek Dam), a floodway leading to the Tanana River, and a levee along the north bank of the Tanana River to avoid potentially severe flooding in Fairbanks.

Peak flows in the Chena River were reduced further in 1980 after the completion of the Chena River Lakes Flood Control Project, which was designed to limit Chena River flow through Fairbanks to 12,000 cubic feet per second (cfs) (Burrows et al. 2000 and Kennedy et al. 2004). The Moose Creek Dam is located approximately 17 miles east of Fairbanks and divides the Chena River into an upper and lower reach. The construction of the dam resulted in blocking many sloughs and side channels of the Tanana River. These waterbodies were once fed by Tanana River flows, but are now fed mainly by groundwater.

The Chena River Lakes Flood Control Project is operated only for flood control and does not permanently hold water upstream of the Moose Creek Dam. The Tanana-Kuskokwim Lowland below the dam is composed of pervious gravels, sands, and silts that let groundwater flow relatively freely. Chena River volumes can vary widely depending on the amount of flow into or out of the groundwater supply. Groundwater is considered to be an important element of the local hydrologic condition and flood control operations in the basin take groundwater conditions into account. To avoid expanses of standing water within the area downstream of Moose Creek Dam, a network of seepage collector channels has been installed to collect the water moving through the foundation gravels and route it to the Chena River.

Flow in Chena Slough and Noyes Slough has declined over the past 50 years because of construction of the Moose Creek dike and dam. The streamflow in Chena Slough is less than 100 cfs and mainly comes from groundwater (Scharfenberg 2004) as well as local runoff from disturbed areas such as roads and drainage ditches.

The reduction in peak flows in the Chena River likely resulted in reduced flows in Noyes Slough (Burrows et al. 2000 and Kennedy et al. 2004). These flow-reduction measures have also caused down-cutting (lowering) of the Chena River channel bed at the entrance to Noyes Slough, reducing the magnitude and duration of surface water flow from Chena River to the slough. Consequently, Noyes Slough is slowly drying up and flows will likely continue to decline without intervention to reverse the process.

Typically, Noyes Slough is navigable except during low flows. During very dry periods there is still standing water in the slough, but there is little to no flow. Many reaches of the slough are stagnant. At times of no surface water flow from the Chena River into Noyes Slough, pools of water in the deeper parts of the slough correspond to local groundwater levels, indicating input from groundwater. In winter, no water flows in the slough, and the channel is filled with ice and snow (Burrows et al. 2000 and Kennedy et al. 2004).

A.5.3 Project Objective(s)

The data collected in the project will be used to determine the impairment due to sediment present in the three focal streams.

A.6 PROJECT/TASK DESCRIPTION and SCHEDULE

A.6.1 Project Description

In addition to pH, conductivity, temperature, and dissolved oxygen, sediment samples will be collected at twelve sites distributed among the Chena River, Chena Slough, and Noyes Slough and analyzed by Analytica Laboratories (Fairbanks, AK) for settleable solids (Table 1). pH, conductivity, and temperature will be measured using Hanna multimeters. The dissolved oxygen measure will be taken using a YSI DO meter. The sediment sampling will be conducted using either isokinetic, depth-integrated (DI) and equal width increment (EWI) methodology or grab samples, dependent on stream flow. Sampling will occur approximately once each month in an attempt to capture sample parameters at a variety of flow stages (particularly, spring breakup, storm flow events, and base flow) from spring (thaw) to fall (freeze). Flow will be monitored using the USGS gage station at Fairbanks, AK (no. 15514000).

Table 1: Measured Parameters Included in this Study

Parameters	Sites	Sample Type	Sampling Frequency	Total number of samples	Sampling Duration
Dissolved Oxygen	12	I	approx. once each month	72	July 15-Freeze, 2011; Breakup-June 30, 2012
pH	12	I	approx. once each month	72	July 15-Freeze, 2011; Breakup-June 30, 2012
Temperature	12	I	approx. once each month	72	July 15-Freeze, 2011; Breakup-June 30, 2012
Conductivity	12	I	approx. once each month	72	July 15-Freeze, 2011; Breakup-June 30, 2012
Settleable Solids	12	DI-EWI or G	approx. once each month	72	July 15-Freeze, 2011; Breakup-June 30, 2012
Flow	1	Gathered from USGS gage station	daily	Collected daily throughout the sampling period	July 15-Freeze, 2011; Breakup-June 30, 2012

I= in situ; DI-EWI= depth integrated- equal width increment; G=grab.

A.6.2 Project Implementation Schedule

Table 2: Project Implementation Schedule				
Product	Measurement/ Parameter(s)	Sampling Site	Sampling Frequency	Time Frame
QAPP Preparation				July 1-July 15, 2011
Field Sampling	DO, pH, Temperature, Conductivity, Settleable Solids	All Sites	Approx. -monthly, corresponding with breakup, base flows, and storm events	August 15, 2011-June 30, 2012
	Stream Flow	Chena River USGS Gaging Station	Daily	August 15, 2011-June 30, 2012
Lab Analysis	Settleable Solids	All sites	Analyses within sample holding time requirements (48 hours)	August 15, 2011-June 30, 2012
Field Audit	Audit of field monitoring operations	All sites	< 30 days of project start-up	1/project; August 15-September 15, 2011
Data Analysis				August 15, 2011- June 20 2012
Data Review				August 15, 2011-June 30, 2012
Data Report				July 15, 2012

A.7 DATA QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

A.7.1 Data Quality Objectives (DQOs)

The overall data quality objective is the ensure that the current sediment levels within the Chena watershed (including the Chena River, Chena Slough, and Noyes Slough) are accurately characterized to support the listing or delisting of the pollutant within the watershed. The data derived from this project should be at a standard to assist in the development of a TMDL, restoration plan meeting requirements of 4b waterbodies, or required elements of the 319 watershed plan. Another objective is to provide sufficient data to address EPA's National Watershed Restoration Measure SP-12.

Project objectives include:

Monthly baseflow measurements of sediments (settleable solids) at multiple locations within the Chena watershed from spring to fall to characterize conditions and potentially locate sources of impairment due to sediment.

Measurements during the spring break-up period of sediments (settleable solids) at multiple locations within the Chena watershed.

Stormflow measurements from spring to winter for sediments (settleable solids) at multiple locations within the Chena watershed to properly characterize wet-weather driven loadings and associated sources.

The Alaska water quality standard for settleable solids is no measureable increase above natural conditions (for aquatic life) and less than a 5% increase in 0.1 mm to 0.4 mm fine sediment for water with anadromous fish, less than 30% increase by weight of fines in all other gravel beds.

A.7.2 Measurement Quality Objectives (MQOs)

Measurement Quality Objectives (MQOs) are a subset of DQOs. MQOs are derived from the monitoring project's DQOs. MQOs are designed to evaluate and control various phases (sampling, preparation, and analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the project's DQOs. MQOs define the acceptable quality (data validity) of field and laboratory data for the project. MQOs are defined in terms of the following data quality indicators:

- Detectability
- Precision
- Bias/Accuracy
- Completeness
- Representativeness
- Comparability

Detectability is the ability of the method to reliably measure a pollutant concentration above background. DEC DOW uses two components to define detectability: method detection limit (MDL) and practical quantification limit (PQL) or reporting limit (RL). The MDLs and PQLs of the collected parameters are summarized in Table 3.

Sample data measured below the MDL is reported as ND or non-detect. Sample data measured ≥ MDL but ≤ PQL or RL is reported as estimated data. Sample data measured above the PQL or RL is reported as reliable data unless otherwise qualified per the specific sample analysis.

Precision is the degree of agreement among repeated measurements of the same parameter and provides information about the consistency of methods. Precision is expressed in terms of the relative percent difference between two measurements (A and B).

For field measurements, precision is assessed by measuring replicate (paired) samples at the same locations and as soon as possible to limit temporal variance in sample results. Field and laboratory precision is measured by collecting blind (to the laboratory) field replicate or duplicate samples. For paired and small data sets project precision is calculated using the following formula:

$$P = \frac{(A - B)}{((A + B)/2)} \times 100$$

For larger sets of paired precision data sets (e.g. overall project precision) or multiple replicate precision data, use the following formula:

RSD = 100*(standard deviation/mean)

The required precisions (RSD) for the collected parameters are summarized in Table 3.

<u>Bias (Accuracy)</u> is a measure of confidence that describes how close a measurement is to its "true" value. Methods to determine and assess accuracy of field and laboratory measurements include, instrument calibrations, various types of QC checks (e.g., sample split measurements, sample spike recoveries, matrix spike duplicates, continuing calibration verification checks, internal standards, sample blank measurements (field and lab blanks), external standards), performance audit samples (DMRQA, blind Water Supply or Water Pollution PE samples from A2LA certified, etc. Bias/Accuracy is usually assessed using the following formula:

$$Accuracy = \frac{MeasuredValue}{TrueValue} \times 100$$

The required accuracies for the collected parameters are summarized in Table 3.

<u>Completeness</u> is a measure of the percentage of valid samples collected and analyzed to yield sufficient information to make informed decisions with statistical confidence. The goal is to complete 95%+ (or 68 of 72 samples) of the required monitoring. We estimate a minimum of 60 regular samples; 5 samples at 12 sites collected over a variety of flow conditions and 6 replicate samples, are needed to have sufficient data to reliably meet the project DQOs. Project completeness is determined for each pollutant parameter using the following formula:

$$\frac{T - (I+NC)}{T} \times (100\%) = \text{Completeness}$$

Where T = Total number of expected sample measurements.
I = Number of invalid sample measured results.
NC = Number of sample measurements not produced (e.g. spilled sample, etc).

Representativeness Representativeness of the data collected is part of sampling program developed by ADEC and outlined in the scope of work.

Comparability is a measure that shows how data can be compared to other data collected by using standardized methods of sampling and analysis. ***Comparability is shown by referencing the appropriate measurement method approved by as specified in federal and/or state regulatory and guidance documents/methods for the parameter/s to be sampled and measured*** (e.g., ASTM, Standard Methods, Alaska Water Quality Standards (http://www.dec.state.ak.us/water/wqsar/wqs/index.htm), EPA Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; National Primary Drinking Water Regulations; and National Secondary Drinking Water Regulations; Analysis and Sampling Procedures

http://www.epa.gov/fedrgstr/EPA-WATER/2007/March/Day-12/w1073.htm), etc.). Comparability between the results collected in this project and others will be ensured by following EPA Method 160.5 in the collection of sediment samples and the analysis of those samples for settleable solids.

Table 3: Project Measurement Quality Objectives (MQOs)

Group	Analyte	Method	MDL (µg/L)	PQL (µg/L)	Alaska WQS		Precision (RPD or RSD)	Accuracy (% Rec)
					Aquatic Life	Recreation/Drinking Water		
Settleable Solids	Settleable Solids	EPA 160.5	0.2 ml/L/hr	0.2 ml/L/hr	No measureable increase above natural condition	<5% increase in 0.1 mm to 0.4 mm fine sediment for waters with anadromous fish; <30% by weight of fines in gravel beds	±30%	NA
Water Quality	DO	In situ (electronic probe) EPA 360.1	NA	0.01 mg/L	>4.0 mg/L	>7 mg/l for anadromous fish; >5 mg/l for non-anadromous fish; < 17 mg/L	±20%	NA
	pH	In situ (electronic probe) EPA 150.1	NA	0.01 pH units	6.5 - 8.5; not vary by 0.5 from natural condition	6.5 - 8.5	±0.1 pH units	±0.1 pH units
	Temperature	In situ (electronic probe) EPA 170.1	NA	0.1°C	<20°C Migration routes < 15°C Spawning areas < 13°C Rearing areas < 15°C Egg /fry incubation < 13°C	<30°C	±0.2°C	±0.2°C
	Conductivity	In situ (electronic probe) EPA 120.1	NA	0-1: 0.001 1-10: 0.01 10-100: 0.1 (mS/cm)	NA	NA	± 10%	± 10%

NA = None available.

A.8 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

The monitoring supervisor, lab supervisor and project QA officer will work together to ensure that the necessary protocols are developed for safety, collection and processing of field samples, and the collection and processing of lab samples. Specifically, the monitoring supervisor will coordinate with the project QA officer and the lab supervisor to develop an agreed upon protocol for the water sample collection and delivery to the lab. The monitoring supervisor and the lab supervisor will be responsible for training and oversight necessary to assist field and lab staff, respectively

Table 4 lays out the specialized training that will be obtained prior to the beginning of work by the respective parties.

Table 4: Training

Specialized Training/Certification	Field Staff	Lab Staff	Monitoring Supervisor*	Lab Supervisor	Project QA Officer
Safety training	**X**	**X**	**X**	**X**	**X**
Water sampling techniques	**X**		**X**		**X**
Instrument calibration and QC activities for field measurements	**X**		**X**		**X**
Instrument calibration and QC activities for laboratory measurements		**X**		**X**	**X**
QA principles			**X**	**X**	**X**
QA for water monitoring systems			**X**		**X**
Chain of Custody procedures for samples and data	**X**	**X**	**X**	**X**	**X**
Specific EPA Approved Field Measurement Method Training	**X**		**X**		**X**
Specific EPA Approved Lab Analytical Method Training		**X**		**X**	**X**

*See Appendix for resume of the TVWA Project Manager who will supervise all monitoring.

A.9 DOCUMENTS AND RECORDS

All field activities and observations will be noted in a field logbook during fieldwork. The field logbook will be a bound document containing individual field and sample log forms. Information will include personnel, date, time, station designation, sampler, types of samples collected, and general observations. Any changes that occur at the site (e.g., personnel, responsibilities, deviations from the sampling plan) and the reasons for these changes will be documented in the field logbook. The logbook will identify onsite visitors (if any) and the number of photographs taken at the sampling location (if any). The field coordinator is responsible for ensuring that the field logbook and all field data forms are correct.

The descriptions will be clearly written with enough detail so that participants can reconstruct events later if necessary. Requirements for logbook entries will include the following:

- Logbooks will be bound, with consecutively numbered pages.
- Removal of any pages, even if illegible, will be prohibited.
- Entries will be made legibly with black (or dark) waterproof ink.
- Unbiased, accurate language will be used.
- Entries will be made while activities are in progress or as soon afterward as possible (the date and time that the notation is made should be noted, as well as the time of the observation itself). Each consecutive day's first entry will be made on a new, blank page.
- The date and time, based on a 24-hour clock (e.g., 0900 a.m. for 9 a.m. and 2100 for 9 p.m.), will appear on each page.
- When field activity is complete, the logbook will be entered into the project file.

In addition to the preceding requirements, the person recording the information must initial and date each page of the field logbook. If more than one individual makes entries on the same page, each recorder must initial and date each entry. The bottom of the page must be signed and dated by the individual who makes the last entry. The field team and task leader, after reading the day’s entries, also must sign and date the last page of each daily entry in the field logbook. Logbook corrections will be made by drawing a single line through the original entry allowing the original entry to be read. The corrected entry will be written alongside the original. Corrections will be initialed and dated and may require a footnote for explanation.

The type of information that may be included in the field logbook and/or field data forms includes the following:

- Names of all field staff
- A record of site health and safety meetings, updates, and related monitoring
- Station name and location

- Date and collection time of each sample
- Observations made during sample collection, including weather conditions, complications, and other details associated with the sampling effort
- Sample description
- Any deviation from the sampling plan.

Field log books and sample chain-of-custody forms will be completed for all samples and kept in the project file.

Laboratory data results for the contract laboratory are recorded on laboratory data sheets, bench sheets and/or in laboratory logbooks for each sampling event. These records as well as control charts, logbook records of equipment maintenance records, calibration and quality control checks, such as preparation and use of standard solutions, inventory of supplies and consumables, check in of equipment, equipment parts and chemicals are kept on file at the laboratory.

Any procedural or equipment problems are recorded in the field notebooks. Any deviation from this Quality Assurance Project Plan will also be noted in the field notebooks. Data results will include information on field and/or laboratory QA/QC problems and corrective actions.

Standard turnaround time for the analytical samples submitted to the contract laboratory should be no more than twenty (20) days.

In addition to any written report, data collected for the project will be provided electronically in a STORET compatible format, as detailed in the following web address:

https://www.state.ak.us/dec/water/wqsar/storetdocumentation.htm.

All records will be retained according to state records retention schedule.

Table 5: Project Documents and Records

Categories	Record/Document Types	Location	Retention Time
Site Information			
	Site characterization file	With Grantee	5 Years
	Site maps	With Grantee	5 Years
	Site pictures	With Grantee	5 Years
Environmental Data Operations	QA Project Plan	Grantee and DEC	5 Years
	Field Method SOPs	With Grantee	5 Years
	Field Notebooks	With Grantee	5 Years
	Sample collection/measurement records	Grantee and DEC	5 Years
	Sample Handling & Custody Records	Grantee and DEC	5 Years

	Inspection/Maintenance Records	Grantee and DEC	5 Years
Raw Data	Lab data (sample, QC and calibration) including data entry forms	Analytica Labs[b,] Grantee and DEC	5 Years
Data Reporting			
	Progress reports	Grantee and DEC	5 Years
	Project data/summary reports	Grantee and DEC	5 Years
	Lab analysis reports	Grantee and DEC	5 Years
Data Management	Data management plans/flowcharts	Grantee and DEC	5 Years
Quality Assurance	Control charts		
	Data quality assessments	Grantee and DEC	5 Years
	Site audits	Grantee and DEC	5 Years
	Lab audits	Grantee and DEC	5 Years
	QA reports/corrective action reports	Grantee and DEC	5 Years
	Response	Grantee and DEC	5 Years
	Performance Evaluation Samples	Grantee and DEC	5 Years

[a] Fairbanks Soil and Water Conservation District Suite B 590 University Ave., Fairbanks, AK 99709
[b]Analytica Group 475 Hall Street, Fairbanks, AK 99701
[c]ADEC Division of Water 610 University Ave., Fairbanks, AK 99708

I*n addition to any written report, data collected for a project will be submitted electronically to ADEC via a CD ROM, ZIP Disk or email ZIP file. All dates are to be formatted as "**MM-DD-YYYY**".*

B. DATA GENERATION AND ACQUISITION

B.1 SAMPLING PROCESS DESIGN (Experimental Design)

B.1.1 Define Monitoring Objectives(s) and Appropriate Data Quality Objectives

The monitoring objective of this project is to provide the data necessary to assess water quality conditions (with respect to dissolved oxygen, pH, temperature, conductivity, and settleable solids) at representative sites in the Chena River, Chena Slough, and Noyes Slough waterbodies. These conditions will be spatially distributed (see Figures 2-8) to identify any geographic variability in the measurements and to identify potential sources of pollutants. The parameters will also be temporally distributed to best characterize the parameters under a variety of environmental conditions.

Monthly base flow measurements of sediments (settleable solids) will be collected at twelve locations distributed around the Chena watershed from spring to fall (freezing) to characterize conditions and potentially locate sources of impairment due to sediment. In addition, measurements will also be taken during the spring break-up period.

The need to fully characterize the aqueous sediment load of Chena River, Chena Slough, and Noyes Slough requires samples to be taken at multiple locations at various times over the spring, summer, and early fall periods. Water quality in the Chena watershed is potentially affected by both point and non-point sources of sediment load, petroleum hydrocarbons, metals, and nutrients, as well as natural and anthropogenic sources that impact the Chena watershed at various times throughout the free-flowing season. Potential point sources include NPDES permitted discharges including Phase II stormwater discharges, CERCLA sites, and Brownfields. Nonpoint sources of impacts to water quality in the Chena watershed include erosion, runoff, re-suspension, and urbanization. Some of these sources occur naturally as well. Therefore, three types of sources exist: point anthropogenic, non-point natural, and non-point anthropogenic. These three will also exist under three flow regimes: baseflow, stormflow, and spring break-up. Each of the sources and flow regimes are examined in detail below.

Anthropogenic Point Sources

The impact of point source discharges to water quality is typically controlled by an NPDES permit. Examples of NPDES permits with active discharges in the Chena watershed include electricity generation, dewatering, and fish hatchery operations (ADEC, 2008). Phase II stormwater systems are possible point source contributors to the Chena watershed. Stormwater discharges are generated by runoff from urban land and impervious areas such as paved streets, parking lots, and rooftops during precipitation events.

Point source discharges often contain high concentrations of pollutants that can eventually enter nearby waterbodies. There are two Phase II permits (AKS-053406 and AKS-053414). Phase II permit AKS-053406 includes the City of Fairbanks, the City of North Pole, the University of Alaska – Fairbanks, and the Alaska Department of Transportation and Public Facilities – Northern Regional Office. Permit AKS-053414 includes the Fairbanks North Star Borough. These Phase II stormwater systems have multiple outfalls on all three water bodies to be examined. These outfalls collect stormwater from various size drainage areas and discharge it directly to the stream. A variety of pollutants including those for which these waterbodies are 303(d) listed could be in these discharges also due to runoff from impervious surfaces and overland flow. Multi-sector general permits may also be a point source of contaminants to the Chena watershed.

Non-Point Sources – Anthropogenic and Natural

The majority of anthropogenic non-point sources of sediment, petroleum hydrocarbons, metals, and nutrients are related to runoff over urbanized areas and impervious surfaces. Overland flow from natural runoff will occur during spring break-up and during periods of precipitation. During these times, both the amount of "new" sediment entering the stream and the amount of "old" sediment re-suspended are increased. Runoff from surfaces such as parking lots, roads, and impervious surfaces will increase the concentrations of petroleum hydrocarbons, oil and grease, and metals entering the streams, while runoff on managed lands will increase the nutrient load entering the stream. Targeted samples will be taken downstream of specific areas that are at increased susceptibility to this type of runoff. These targeted samples will be taken during times of turbulent flow (i.e., spring break-up and stormflow) to characterize the potential of these areas to add impairing pollutants to the Chena watershed. Two other non-point source discharges that may impact the water quality in the Chena watershed are CERCLA sites, also known as Superfund sites and Brownfields.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or Superfund was established to address abandoned hazardous waste sites (USEPA, 2007). The Superfund process involves the assessment of sites, placement of sites on the National Priorities List (NPL), and the establishment and implementation of cleanup process. There are three CERCLA sites that may impact the water quality of the Chena River watershed: Alaska Battery Enterprises, Arctic Surplus, and Fort Wainwright. Brownfield are lands that typically have hazardous substances and which are redeveloped and reused under the Brownfields program (USEPA, 2006). Understanding of Brownfield sites and information gathered during the site assessment and clean up can provide information on potential past and current sources of pollutants in a watershed. The Tanana Valley Watershed Association (TVWA) has received a Brownfields grant for an assessment of Noyes Slough. Noyes Slough has been designated as a Brownfield, and the TVWA's goal is to restore it to a natural recreational asset to the community of Fairbanks (Oasis, 2008). EPA has also selected the Fairbanks North Star Borough for two brownfield cleanup grants. The funds will be used to clean up the former City of Fairbanks landfill, which is contaminated with chromium, selenium, thallium, and PCBs. Funds will also be used to clean up the Universal Recycling, Inc. site which is contaminated with PCBs, metals, dioxins, recycled batteries, and waste oil. Intrusion of contaminated groundwater, overland flow of contaminated soils, as well as runoff from the contaminated sites is ways the Brownfields can discharge pollutants into the Chena watershed.

Spring Break-Up

Spring break up is a turbulent period when the snow pack and ice covered streams are beginning to melt and flow again. During this time there is a large volume of water that will be entering streams, as well as large volumes of runoff carrying sediment. Spring break-up will add to the sediment load of Chena watershed by runoff carrying sediment into the stream, but also by the re-suspension of materials previously deposited. Due to the high flows, the velocity of streams tend to be similar to storm conditions which may transport materials that would typically not be part of the aqueous sediment load downstream. To characterize the effects of spring break-up on the sediment load and pollutant levels of Chena watershed, multiple sites within the urbanized portion of the watershed as well as at reference sites in the watershed need to be measured with some frequency to determine, based on flow, when the spring break-up is beginning to diminish. Because the Chena River, Chena Slough and Noyes Slough are frozen prior to the spring break-up, the baseline condition cannot be measured until after spring break-up is completed. Therefore, spring break-up will be characterized prior to characterizing typical baseflow conditions during the summer months. As many as three sampling events may be conducted during spring break-up to characterize the pollutant load as break up begins, is in full flow, and is nearing its end depending on how long break-up lasts.

Baseflow

Baseflow contributions to the Chena watershed consist of spring fed, natural runoff from the surrounding watershed, as well as groundwater recharge. Several USGS stream gages are active in this watershed and will be used to identify flow distribution during the spring, summer and fall, as well as characterize baseflow in this system. Also, USGS flow data, combined with co-located sediment data collected in this project will enable ADEC to develop rating curves that can be used to develop loading estimates from point and nonpoint sources. Baseflow sampling for sediment and turbidity was conducted by ADEC in 2007 at several sites in a one time sampling survey. These data are useful for targeting sampling locations in this project and will be used with data collected in 2009 to assess current conditions for sediment.

To characterize the sediment load and pollutant concentration associated with baseflow conditions, multiple sampling events at various sites will be conducted during periods of little precipitation (generally June – late July). Ideally, baseflow characterization would be completed under 7Q10 condition or the lowest flow over seven days for the previous 10 years. Relatively low flow summer conditions will be used to determine the base flow through Chena River, Chena Slough and Noyes Slough and to predict the flow under 7Q10 conditions. Determining the sediment load in Chena watershed during these low flow conditions would aid in determining the natural sediment load and potential for nutrient eutrophication effects associated with baseflow conditions in Chena River, Chena Slough and Noyes Slough. Nutrient effects are typically not observed during storm events or spring break up, when flows are high and scour of algae is very prevalent. Generally speaking, streams (particularly higher gradient or high latitude streams) show the greatest potential for nutrient effects during warmer, lower flow periods when benthic algae can more readily grow and proliferate. By conducting baseflow sampling, storm flow sediment loads can be properly characterized to determine the increased amount of sediment and pollutant concentration associated with storm events of different magnitudes, and that associated with natural conditions. Monthly baseflow sampling will be conducted during those times when precipitation is limiting from May through September.

Stormflow

The typical period of precipitation in the form of rain for the Chena River watershed is late-July through September. Stormflow through the Chena watershed is characterized by increased discharge and velocity due to increased volume of runoff. The increased discharge and velocity will, like spring break-up, cause increases in the aqueous sediment load, as well as increase the potential for other pollutants to be present. Stormflow sampling is necessary to characterize sediment loading as well as loadings of other pollutants (e.g., metals, fecal coliform, nutrients) due to anthropogenic nonpoint and point source runoff. Storm events of different magnitudes will need to be characterized and will be by conducting monthly wet weather sampling in all three water bodies. It is not necessary to capture the same storm for each waterbody, but a minimum of one wet weather event per waterbody per month is required.

B.1.2 Characterize the General Monitoring Location/s

Site locations were selected to characterize the current potential of impairment to the Chena watershed due to sediment, PAHs, VOCs, dissolved metals, and eutrophication. Proximity to known sources, ease of access, and historic sampling locations were considered in selecting sites. Multiple sampling locations were selected for each of the three waterbodies to be characterized, and the rationale for these sites is discussed in more detail in Table 6.

Noyes Slough

Four surface water sampling locations were selected on Noyes Slough including Minnie St., O'Connor Rd., Aurora Dr., and Goldizen Rd. (Table 6, Figure 2). These locations have been historically sampled for sediment and surface water, and will be sampled again under other sampling programs particularly the Brownfield sediment investigation. At each location the sediment load will be sampled in stream using the methods described herein to establish the in-stream sediment load as compared to what is entering the stream. What is entering the stream will be characterized by measuring a paired stormwater outfall at each sample location. This paired approach will aid in determining the "natural" sediment load of Noyes Slough and what type of input of sediment is associated with the stormwater system. This approach is being conducted because no background natural condition is present for Noyes Slough due to the lack of natural headwaters and lack of a comparable natural slough that could serve as a surrogate. The selected sample locations will aid in determining the pollutant influx from multiple sources on Noyes Slough including stormwater outfalls, contaminated groundwater intrusion, and overland flow from contaminated surface soils (Table 3).

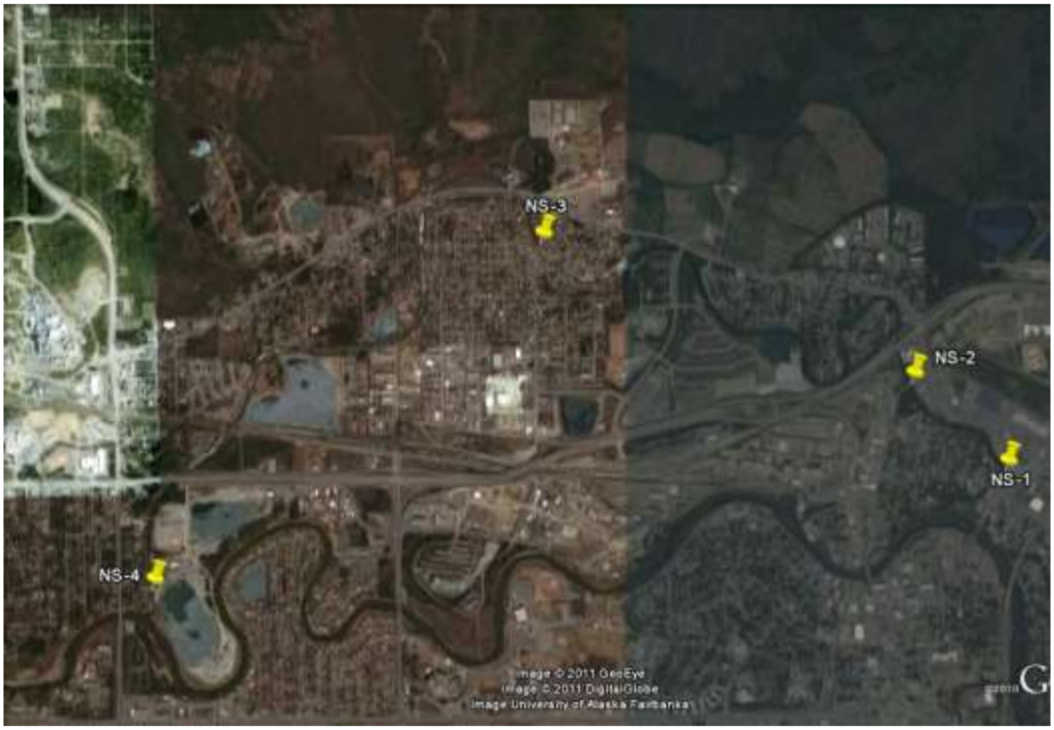


Figure 2. Overview of the Noyes Slough Sampling Locations.

Chena Slough

Four surface water sampling locations were selected on Chena Slough including Laurance Rd., Hurst Ave., Nordale Rd., and Persinger Dr. (Table 6, Figures 3-5). Ability to detect impairment from surrounding land use, ease of accessibility, and historical sampling were three of the main factors in selecting sites in Chena Slough. Due to the construction of Moose Creek Dam, Chena Slough was cut off from its original headwaters, thus a natural background relative to what is now the headwaters will be examined. Site, CS-1 at Laurance Road will provide the "natural" condition for Chena Slough, while sites CS-2, CS-3, and CS-4 are progressively downstream and will aid in the determination of urban influences on Chena Slough sediment and pollutant loads.

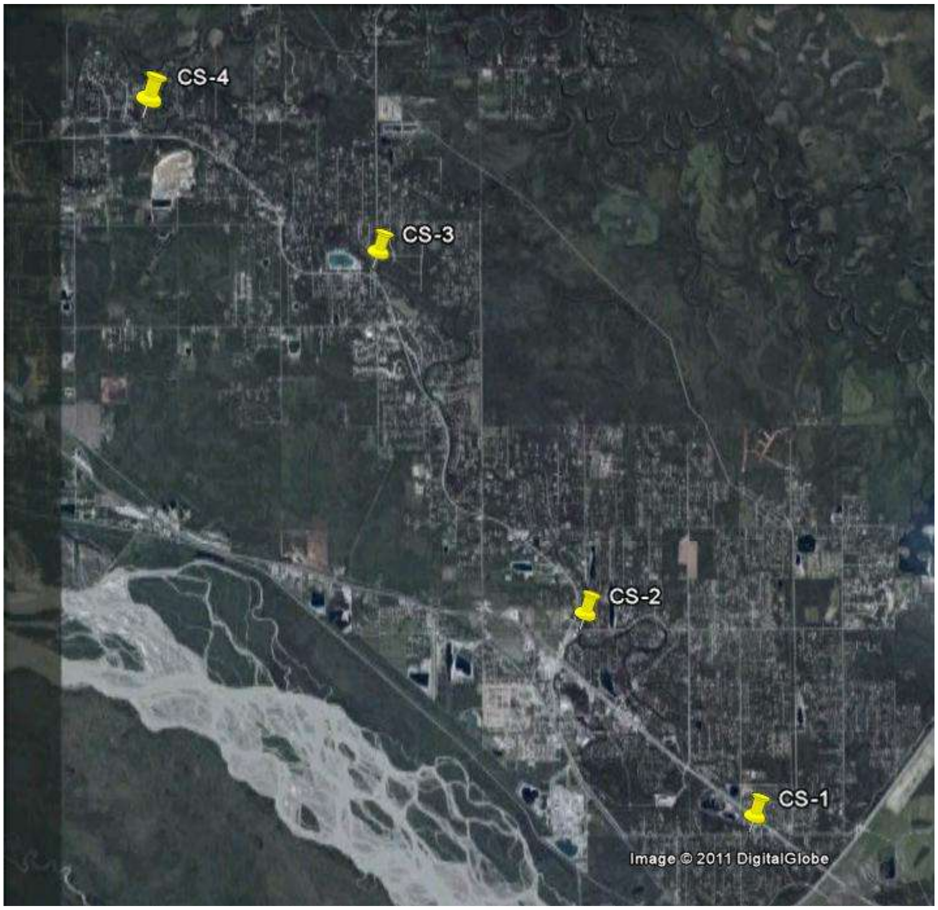


Figure 3. Overview of the Chena Slough sampling locations.

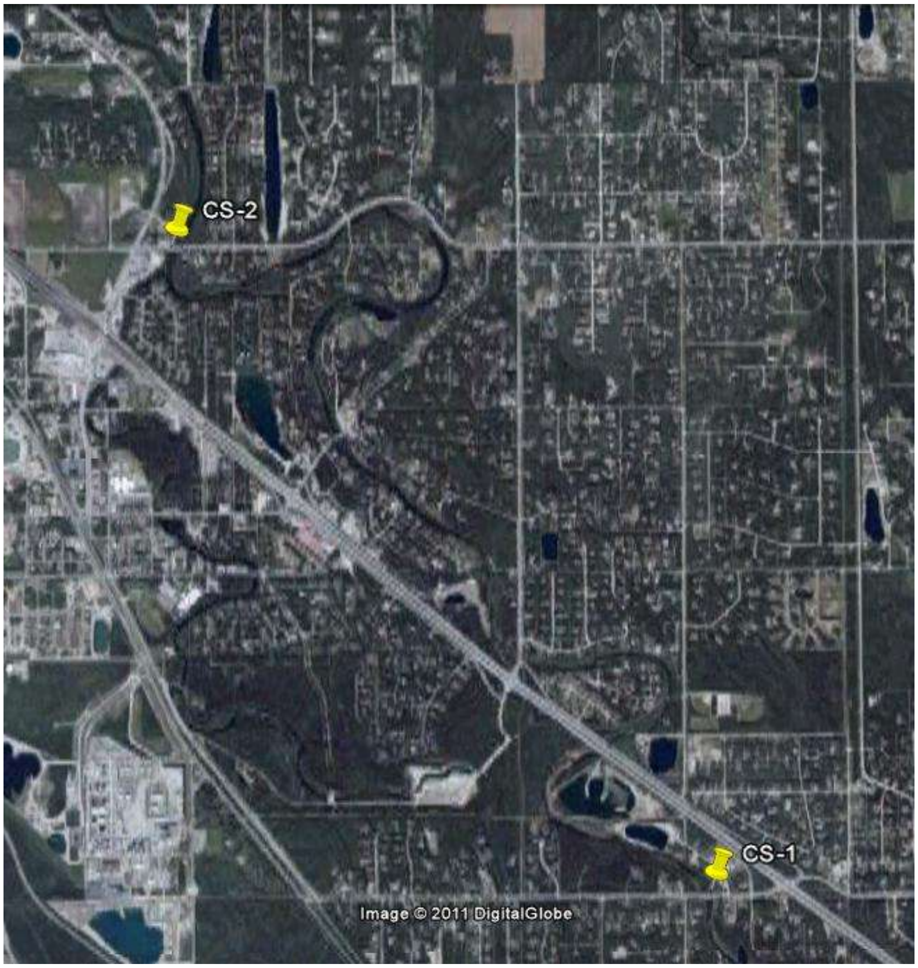


Figure 4. CS-1 (Laurance Rd.) and CS-2 (Hurst Rd.), upper end of Chena Slough.

Figure 5. CS-3 (Nordale Rd.) and CS-4 (Persinger Dr.), lower end of Chena Slough.

Chena River

Four surface water sampling locations were selected on Chena River including Rosehip Campground, Nordale Rd., Old Steese Hwy., and University Ave. (Table 6, Figure 6-8). All sites are accessible via road crossing. Chena River will be sampled at these locations to determine the impairment from urbanization on sediment and pollutant loads. The land use surrounding the sites, the ease of site access, as well as historical records of sampling were the main factors in selecting Chena River sites. Site CR-1, Rosehip Campground, will be used to determine the natural background condition of sediment in the Chena River. Site CR-2, Nordale Rd., will be used to evaluate the contribution of sediment from the Fairbanks metropolitan area. This site is upstream of significant urban influence but in close proximity to urbanized areas and is relatively unaffected by anthropogenic activities. Sites CR-3 and CR-4 will aid in determining the impact of urbanization, as well as the impact from both Noyes and Chena Sloughs.

Figure 6. CR-1, Rosehip Campground, Chena River.

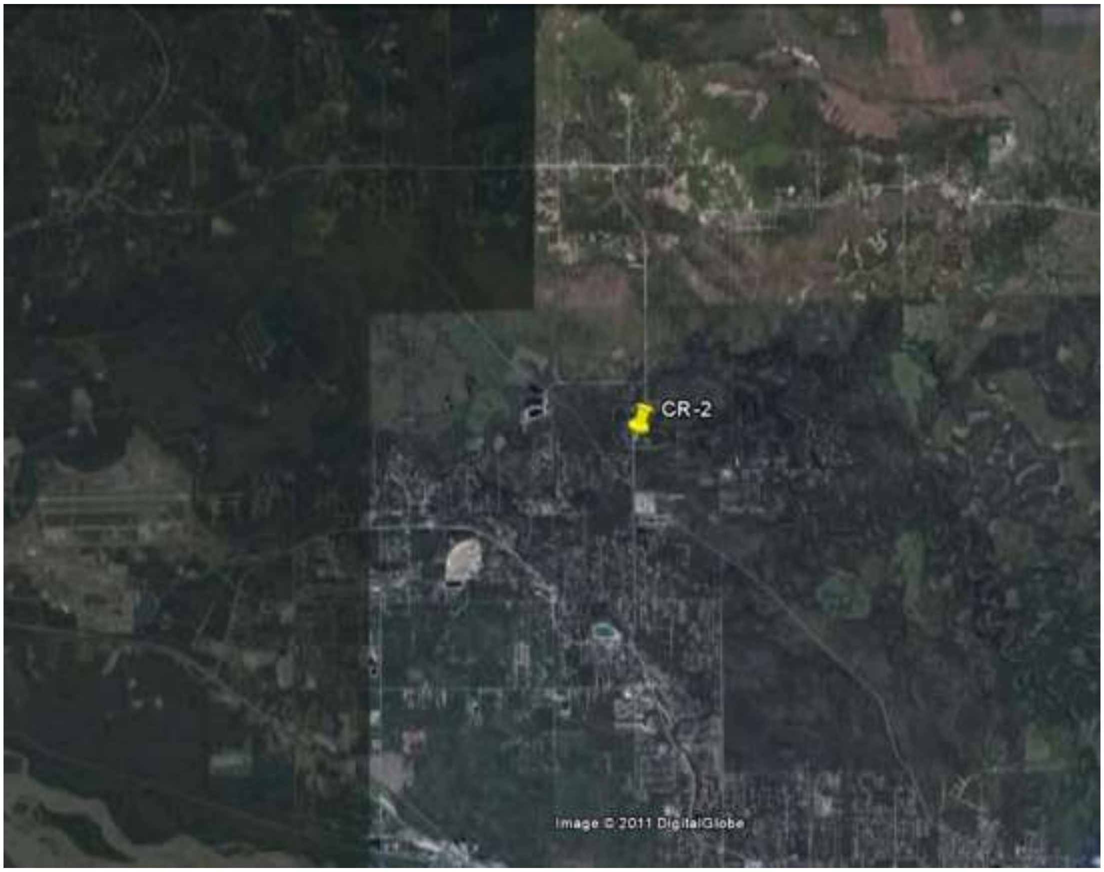


Figure 7. CR-2, Nordale Rd, Chena River.

Figure 8. CR-3, Old Steese Hwy, Chena River. CR-4, University Ave., Chena River.

Table 6: Site Location and Rationale					
Waterbody	**Site ID**	**Location**	**Latitude**	**Longitude**	**Site Description and Rationale**
Noyes Slough	NS-1	Minnie St.	64.849	-147.707	- First road crossing after Noyes Slough inlet from Chena River - provides access point - Historically sampled in 2000 SW sampling by NSAC; 2006/2007 Stormwater Sampling by USGS; 2007 ADEC (Site 11) sampling conducted downstream of Minnie St. - Brownfield assessment will be sampling sediment US and DS - Considered other area of concern due to solvents and petroleum measured in groundwater - Will establish (along with sampling in the Chena just US of Noyes Slough) the influence Chena has on sediment and other pollutants in Noyes Slough - 2 known stormwater outfalls upstream of Minnie St. bridge - outfall on downstream side of Minnie St. bridge will be sampled for sediment load
	NS-2	O'Connor Rd.	64.857	-147.725	- Noyes Slough can be accessed from bridge or sampling can be performed from bridge - Historically sampled downstream of O'Connor Road (2007 ADEC, Site 13) - downstream of area known to have groundwater contamination with solvents - Downstream of previously identified source of petroleum hydrocarbons, College Road Cleaners; other

					known sources of impairment including gravel pit dewatering – Walden Pond - Used to assess the Lemeta sub-division which was labeled an Other Area of Concern in the Brownfield assessment; which will be sampling sediment at one location between Illinois St. and O'Connor Road - 7 known stormwater outfalls between Illinois St. and O'Connor Road - stormwater outfall may not be able to be sampled from O'Connor Road; located upstream of road crossing on east side of Noyes Slough
	NS-3	Aurora Dr.	64.861	-147.761	- Noyes Slough can be accessed from bridge or sampling can be performed from bridge - Historically sampled in 2002 NSAC surface water sampling; 2001/2002 USGS sediment sampling; ADEC 2007 surface water sampling (Site 16) - 2001/2002 USGS sediment sampling indicated high levels of PAHs, metals, pesticides, PCBs - Brownfield assessment will be sampling sediment upstream of Aurora Dr. - can use this data to show whether petroleum is in the sediment (also one other location between Danby St. and Aurora Dr. is being sampled) - 10 known stormwater outfalls between Danby St. and Aurora Dr. - stormwater outfall on south side of Aurora Rd. crossing will be sampled; this has larger drainage area then outfall on north side.
	NS-4	Goldizen Rd.	64.844	-147.809	- Noyes Slough can be accessed from bridge or sampling can be performed from bridg - Historically sampled by ADEC, 2007 (Site 20); 2000 NSAC surface water sampling; 2001/2002 USGS sediment sampling; MS4 (2006, 2007, 2008) and continued annual monitoring - last road crossing before confluence with Chena River; can be used in conjunction with Chena River sampling to assess input to Chena from Noyes Slough - can be used to assess the input from gravel pit dewatering (H&H Gravel) - Brownfield assessment will be sampling sediment at two locations between Johansen Expressway and Goldizen Rd. - 1 known stormwater outfall between Johansen Expressway and Goldizen Rd. which will need to be the one sampled - MS4 conducts annual monitoring of this location for oil and grease, turbidity, DO, conductivity, pH, chloride, and redox potential, but only during thawed conditions (assuming base flow sampling)
Chena Slough	CS-1	Laurence Rd.	64.733	-147.289	- Chena Slough can be accessed from bridge or sampling can be performed from bridge - Historically sampled - 2007 ADEC surface water sampling; - Will be used to evaluate the headwater of Chena Slough; the relatively "natural" condition of Chena Slough since the dam was put in (don't believe dam will be removed to restore Chena Slough to it's "natural" condition)
	CS-2	Hurst Rd.	64.762	-147.344	- Chena Slough can be accessed from bridge or sampling can be performed from bridge - Historically sampled - 2007 ADEC surface water sampling; Scharfenberg 2004; USGS 2002/2003;

					MS4 (2006, 2007, 2008) and continued annual monitoring - Used to evaluate runoff from City of North Pole; as well as input from Beaver Springs Creek - MS4 conducts annual monitoring of this location for oil and grease, turbidity, DO, conductivity, pH, chloride, and redox potential, but only during thawed conditions (assuming base flow sampling); - USGS 2002/2003 sediment sampling indicated increased levels of manganese, silver, zinc, as well as detected concentration of 2,6-dimethylnapthalene; other organic compounds were undetected but reporting limit was elevated (100 µg/kg)
	CS-3	Nordale Rd.	64.814	-147.41	- Chena Slough can be accessed from bridge or sampling can be performed from bridge - Historically sampled - 2007 ADEC surface water sampling; Scharfenberg 2004; USGS 2002/2003 - Used to evaluate runoff from North Pole and tributary that joins Chena Slough just upstream of sample location
	CS-4	Persinger Dr.	64.835	-147.487	- Chena Slough can be accessed from bridge or sampling can be performed from bridge - Historically sampled - 2007 ADEC surface water sampling; Scharfenberg 2004; USGS 2002/2003 - will be used along with Chena River sampling to evaluate the input to the Chena River from Chena Slough
Chena River	CR-1	Rosehip Campground			-site accessed off Chena Hot Springs Rd, milepost 27 -located within the Chena River State Recreation Area, above last residential area of Pleasant Valley -will be used to establish natural background
	CR-2	Nordale Rd.	64.846	-147.410	- site accessed off of Silver Lining Rd. - no bridge crossing - Historically sampled downstream by ADEC (2007) - Site 6; USGS 2002/2003 - Site is located upstream of Chena Slough, thus can differentiate what is from Chena River and what is from Chena Slough at downstream Chena River site; - Will be used to evaluate impairment from Chena Slough and City of North Pole; - site upstream of Little Chena River confluence; - low level of urbanization surrounding site; - USGS 2002/2003 sediment sampling did not indicate detections of organic compounds in sediment but reporting limit was high (350 µg/kg); sediment did have increased levels of metals including iron, selenium, and zinc
	CR-3	Old Steese Hwy	64.846	-147.709	- access from Old Steese Highway road crossing - historically sampled upstream at New Steese Highway (Site 3) ADEC, 2007; MS4 (2006, 2007, 2008); USGS 2002/2003 - site just upstream of Noyes Slough inlet, thus will be used to evaluate runoff from the urbanized areas of Fairbanks as well as evaluate source input to Noyes Slough; - site also upstream of Aurora Energy NPDES outfall - MS4 conducts annual monitoring of this location for oil and grease, turbidity, DO, conductivity, pH, chloride, and redox potential, but only during thawed conditions (assuming base flow sampling) - USGS 2002/2003 sediment sampling indicate no detection of organic compounds but reporting limit

					was elevated (480 µg/kg)
	CR-4	University Ave.	64.841	-147.812	- site access available from University Ave. bridge - Historically sampled by ADEC (2007) Site - 2; - site is located downstream of both Noyes Slough confluence and Aurora Energy NPDES outfall; - site is located on downstream end of city of Fairbanks, thus evaluation of input from Fairbanks at this site; - MS4 conducts annual monitoring at four other locations between CR-2 and CR-3 for oil and grease, turbidity, DO, conductivity, pH, chloride, and redox potential, but only during thawed conditions (assuming base flow sampling) - USGS 2002/2003 sediment sampling indicate no detection of organic compounds but reporting limit was elevated (300 µg/kg)

B.2 SAMPLING METHOD REQUIREMENTS

Samplers should wear disposable gloves and safety eyewear, if needed, and observe precautions while collecting samples, remaining aware of the potential chemical and biological hazards present. The project sampling staff collecting samples will take care not to touch the insides of bottles or lids/caps during sampling.

B.2.1 Sample Types

Samples will be listed as "composite" or "grab" on the Chain-of- Custody or Transmission Form and in field logbook or field data sheets.

B.2.2 Sample Containers and Equipment

Sample containers will be supplied by the analytical laboratory (Table 7). Commercially available pre-cleaned jars will be used, and the laboratory will maintain a record of certification from the suppliers. Sample containers will be clearly labeled at the time of sampling. Labels will include the project name, sample location and number, sampler's initials, analysis to be performed, date, and time.

The sediment load sampling device will be rinsed with site water between sampling stations. The equipment will be kept wrapped in plastic bags until the time of use, when it will be rinsed again with site water.

Table 7: Preservation and Holding Times for the Analysis of Samples					
Analyte	Matrix	Container	Necessary Volume	Preservation and Filtration	Maximum Holding Time
Residue (settleable solids)	Surface Water	P, FP, G	1 L	Cool <6°C, do not freeze	48 hours

P = polyethylene, FP = flouropolymer, G = glass, PA = autoclavable plastic

B.2.3 Sampling Methods

Sampling methods will follow those approved by ADEC in Alaska's water quality standards including the use of Imhoff cones and grab samplers (i.e., DH-48, Kemmer bottle, or other similar device). Sampling methods for the chemical characterization of surface water at both base flow and other flow conditions are based on methods previously used in Chena River watershed.

Surface Water – Sediment Load

Sampling in the Chena River watershed involves instrument measurements made directly in the field, as well as collecting samples for laboratory analysis. Flowing stream water is collected using either an isokinetic, depth-integrated or nonisokinetic sampling methods. This plan assumes that the number of depth-integrated samples required can be reduced because the stream is well mixed. In order to validate this assumption, each time a station is sampled, four in-situ parameters (oxygen, pH, specific conductance and temperature) will be measured at each selected sampling point. If the stream appears well mixed (i.e, values are within 5% of each other which is within typical measurement error), the composite sample will be collected from depth-integrated samples drawn at these selected sampling points (Table 8). If variability is excessive, additional depth-integrated sampling points (max 10) will be required for that particular station (USGS, 2006).

Once stream variability has been assessed, collection of a water sample that is both horizontally and vertically integrated will commence. If the maximum stream velocity observed (i.e., at the USGS gauging station) is greater than or equal to 1.5 ft/sec and under 9.0 ft/sec an isokinetic equal width increment (EWI) composite sample will be generated using an approved USGS sampler (DH48 Depth-Integrating Suspended Sediment Sampler). If maximum stream velocity is under 1.5 ft/sec, a non-isokinetic equal-width increment composite sample will be generated. At this time, no sampling method for velocities over 9 ft/sec has been developed (USGS, 2006).

Table 8. Number of depth-integrated samples required by stream width (MDNR, 2006). Modified from USGS National Field Manual for the Collection of Water Quality Data (Chapter A4.) (http://water.usgs.gov/owq/FieldManual/chapter4/html/chap.4contents.html)

Width of waterway (ft.)	Minimum # of Depth-Integrated Samples
0 - 25	1
25 – 100	3
100 – 250	5
250 – 500	7
>500	9

The EWI composite sample will be generated by collecting individual depth integrated samples at each specified sampling point (USGS, 2006). These samples will then be composited in a churn splitter, with a minimum volume of 2 liters after which appropriate samples bottles will be filled. Water depth at each sampling point will be recorded on the field data sheets. Protocols for surface water grab sampling will generally follow the *USGS National Field Manual for the Collection of Water Quality Data* (USGS Variously Dated) and EPA SOP #2013 (EPA 1994). More detailed procedures on the sampling and collection procedures can be found at http://pubs.water.usgs.gov/twri9A.

In addition to collecting grab samples for pollutant analyses, general water quality parameters (temperature, pH, conductivity, and dissolved oxygen) will be measured directly in the field at each location and at each sampling event using field meters.

B.3 SAMPLE HANDLING AND CUSTORY REQUIREMENTS

Individual samples for analysis will be placed in the appropriate pre-cleaned sample containers. To ensure sample integrity specific sampling and documentation procedures will be followed. These procedures will include labeling containers prior to sampling, extensive sample and site information recording, appropriate sample handling and comprehensive chain-of-custody procedures. Sample and site information will be recorded in the field notebooks. Holding times for each sample analysis type will be met.

Sample documentation procedures will include project field notebooks, chain-of-custody forms and sample labels. Specific information such as site identification, sample identification numbers, sampling observations and sample collection time and date will be recorded in field notebooks. Additionally, photographic documentation will be collected during the sampling event.

Samples are in custody if they are in the custodian's view, stored in a secure place with restricted access, or placed in a container secured with custody seals. A chain-of-custody record will be signed by each person who has custody of the samples and will accompany the samples at all times. Copies of the chain-of-custody will be included in laboratory and QA/QC reports. At minimum, the form will include the following information:

- Site name
- Field coordinator's name and team members responsible for collection of the listed samples
- Collection date and time of each sample
- Sampling type (e.g., composite or grab)
- Sampling station location
- Number of sample containers
- Requested analysis
- Sample preservation information
- Name of the carrier relinquishing the samples to the transporter, noting date and time of transfer and the designated sample custodian at the receiving facility.

The field coordinator, as the designated field sample custodian, will be responsible for all sample tracking and chain-of-custody procedures for samples in the field. The sample custodian will be responsible for final sample inventory and will maintain sample custody documentation. The custodian will complete chain-of-custody forms prior to removing samples from the sampling vessel. Upon transferring samples to the laboratory sample custodian, the field coordinator will sign, date, and note the time of transfer on the chain-of-custody form.

The original chain-of-custody form will be transported with the samples to the laboratory. The laboratory will also designate a sample custodian who will be responsible for receiving samples and documenting their progress through the laboratory analytical processes. Each custodian will ensure that the chain-of-custody and sample tracking forms are properly completed, signed, and initialed upon transfer of the samples.

Upon receipt of the samples by the laboratory, the laboratory sample custodian will inventory the samples by comparing sample labels to those on the chain-of-custody document. The custodian will enter the sample number into a laboratory tracking system by project code and sample designation. The custodian will assign a unique laboratory number to each sample and will be responsible for distributing the samples to the appropriate analyst or for storing samples in an appropriate secure area.

Sample Handling and Transport

Sample coolers and packing materials will be supplied by the analytical laboratories. Individual sample containers will be placed into a sealed plastic bags. Samples will then be packed in a cooler lined with a large plastic bag. Ice in sealed plastic bags or "blue ice" will then be placed in the cooler to maintain a temperature of <4ºC. When the cooler is full, the chain-of-custody form will be placed into a ziplocked bag and taped on the inside lid of the cooler.

The coolers will be clearly labeled with sufficient information (i.e., name of project, time and date container was sealed, person sealing the cooler, and company name and address) to enable positive identification.

Waste Disposal

Any excess water remaining after processing will be returned to the collection site. All disposable materials used in sample collection and processing, such as paper towels and gloves, will be disposed of properly. Liquid wastes from decontamination of the sampling equipment will be disposed into the sanitary sewer system.

B.4 ANALYTICAL METHODS AND REQUIREMENTS

Water quality analytical methods that will be used throughout this project are outlined below. All analysis methods used for this program are EPA-approved. The contracted laboratory (Analytica) is an ADEC drinking water certified laboratory. The contracted laboratory's Quality Management Plan (QMP) will be on file with ADEC detailing their quality assurance procedures. Laboratory turnaround time is 20 business days. Any issues regarding analytical data quality will be resolved by the Grantee's project manager and project QA Officer through discussions with the laboratory project manager.

Sampling Parameters

Dissolved Oxygen will be measured in mg/L, and is representative of the amount of dissolved oxygen available in solution at the time of the measurement. Dissolved oxygen will be measured using a YSI 650 MDS multi-probe meter, or an equivalent meter.

Conductivity is a measure of the electrical conductance, or the amount of dissolved salts and ionized chemical species found in solution in a particular water sample. Conductivity will be measured in µS/cm using a YSI 650 MDS multi-probe meter, or an equivalent meter.

pH measurements are made in the Standard Unit (SU) logarithmic scale, and provide information on the levels of H^+ and OH^- ions in solution, or the acid and base properties of a water sample. pH will be measured using a YSI 650 MDS multi-probe meter, or an equivalent meter.

Temperature will be reported in °C, and will be measured using a YSI 650 MDS multi-probe meter or an equivalent meter.

Sediment measured as settleable solids employ the ADEC standard settling method specified in Note 15 in 18 AAC 70 based on EPA Method 160.5, using a 1 liter Imhoff Cone with a 45 minute settling/stir/15 minute settling time. The volume of settleable matter is then recorded in ml/liter. The sub-contracted lab staff will measure settleable solids using the Imhoff cone method after collecting the samples from the field staff.

Under direction of the Project Manager, project staff will ensure that all equipment and sampling kits used in the field meet EPA-approved methods.

B.5 QUALITY CONTROL REQUIREMENTS

Quality control activities in the field will include adherence to documented procedures and the comprehensive documentation of sample collection information included in the field notebooks. A rigidly enforced chain-of-custody program will ensure sample integrity and identification. The chain-of-custody procedure documents the handling of each sample from the time the sample was collected to the arrival of the sample at the laboratory.

B.5.1 Field Quality Control (QC) Measures

Quality Control measures in the field include but are not limited to:

- Proper cleaning of sample containers and sampling equipment.
- Maintenance, cleaning and calibration of field equipment/ kits per the manufacturer's and/or laboratory's specifications, and field Standard Operating Procedures (SOPs).
- Chemical reagents and standard reference materials are used prior to expiration dates.

- Proper field sample collection and analysis techniques.
- Correct sample labeling and data entry.
- Proper sample handling and shipping/transport techniques.
- Field replicate measurements (1 replicate measurement/10 field measurements).

Field replicate measurements of pH, conductivity, dissolved oxygen, and water temperature will be performed at every sampling event. Field replicate samples will be made on 10% of the collected settleable solids samples (approximately 7). These replicates will be equally distributed among sites and sampling events. In addition, equipment calibration verification checks will be conducted prior to and following each sampling event.

Table 9: Field Quality Control Samples

Field Quality Control Sample	Measurement Parameter	Frequency		QC Acceptance Criteria Limits
		Frequency of Occurrence	Total # of QC Type Samples	
Field Replicate Measurement	pH, conductivity, dissolved oxygen, water temperature	Every sampling event	3 replicates for each measurement type	See the required precision levels for each parameter in Table 3.
Field Replicate Measurement	Settleable solids	10% of samples	1 replicate sample	
Calibration Verification Check Standard	pH, conductivity, dissolved oxygen	Every sampling event	Prior to and following each sampling event	

B.5.2 Laboratory Quality Control (QC) Measures

Quality Control in laboratories includes the following:

- Laboratory instrumentation calibrated with the analytical procedure,
- Laboratory instrumentation maintained in accordance with the instrument manufacturer's specifications, the laboratory's QAP and Standard Operating Procedures (SOPs),
- Laboratory data verification and validation prior to sending data results to ADEC and/or permitted facility.

The sub-contracted lab will provide analytical results after verification and validation by the laboratory QA Officer. The laboratory must provide all relevant QC information with its summary of data results so that the project manager and project QA officer can perform field data verification and validation, and review the laboratory reports. The project manager reviews these data to ensure that the required QC measurement criteria have been met. If a QC concern is identified in the review process, the Project Manager and Project QA Officer will seek additional information from the sub-contracted laboratory to resolve the issue and take appropriate corrective action/s.

There are not specified laboratory QC requirements for the analysis of settleable solids. However, lab replicate analyses will be conducted on 10% of the samples received by the lab. For those collections, water samples will be collected in 2L volumes which will be split in the lab and settleable solids analysis will be performed on each 1L sample. The lab's QC precision criterion for this measurement is 30%. In addition, contract laboratories typically are required to participate in EPA's DMR QA study annually. The DMR QA subjects analytical laboratories to proficiency testing to determine their ability to accurately measure a known concentration of test material. Analytical laboratories typically analyzed QA samples for all parameters that they routinely analyze for clients. The results of the 2010 DMR QA study will be submitted by the contract laboratory, and the results of the 2011 DMR QA study currently underway can be submitted upon completion.

B.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE REQUIREMENTS

Prior to a sampling event, all sampling instruments and equipment are to be tested and inspected in accordance with the manufacturers' specifications. All equipment standards (thermometers, multi-meters, etc) are calibrated appropriately and within stated certification periods prior to use.

Monitoring staff will document that required acceptance testing, inspection and maintenance have been performed. Records of this documentation should be kept with the instrument/equipment kit in bound logbooks or data sheets.

Contracted and sub-contracted laboratories will follow the testing, inspection and maintenance procedures required by EPA Clean Water Act approved methods and as stated in the respective laboratory's QAP and SOPs.

B.7 INSTRUMENT CALIBRATION AND FREQUENCY

Field instruments will be calibrated where appropriate prior to using the instruments. If equipment and/or kits require calibration immediately prior to the sampling event, the calibration date will be recorded in the operator's field logbook or field data sheets. When field instruments require only periodic calibration, the record of this calibration will be kept with the instrument. The project manager will ensure that instruments are calibrated correctly and appropriate documents recorded and retained.

The surface water samplers (i.e., DH-48) used to collect surface water samples will be routinely inspected to verify that it is working properly. Routine maintenance of the sampler will be conducted prior to each sampling event. Maintenance will include a visual inspection that all parts are present, attached correctly and devoid of any obvious contamination. The project manager will coordinate ordering replacement parts and repairing samplers.

Sub-contracted laboratories will follow the calibration procedures found in its QAP and the laboratory's Standard Operating Procedures (SOPs). Specific calibration procedures for regulated pollutants will be in agreement with the respective "EPA Approved" Clean Water Act Pollutant methods of analysis. Field and/or Laboratory calibration records will be made available to ADEC upon request.

B.8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

All sample collection devices and equipment will be appropriately cleaned prior to use in the monitoring project.

All sample containers, tubing, filters, etc. provided by a laboratory or by commercial vendor, will be certified clean for the analyses of interest. The sampling manager/person will make note of the information on the certificate of analysis that accompanies sample containers to ensure that they meet the specifications and guidance for contaminant-free sample containers for the analyses of interest.

No standard solutions, buffers, or other chemical additives will be used if the expiration date has passed. It is the responsibility of the sampling manager or his/her designee to keep appropriate records, such as logbook entries or checklists, to verify the inspection/acceptance of supplies and consumables, and restock these supplies and consumables when necessary.

Contracted and sub-contracted laboratories will follow procedures in their laboratory's QAP and SOPs for inspection/acceptance of supplies and consumables.

B.9 DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)

This project will not utilize any non-measured sources of data.

B.10 DATA MANAGEMENT

The success of a monitoring project relies on data and their interpretation. It is critical that data be available to users and that these data are:

- Of known quality,
- Reliable,
- Aggregated in a manner consistent with their prime use, and
- Accessible to a variety of users.

Quality Assurance/Quality Control (QA/QC) of data management begins with the raw data and ends with a defensible report, preferably through the computerized messaging of raw data.

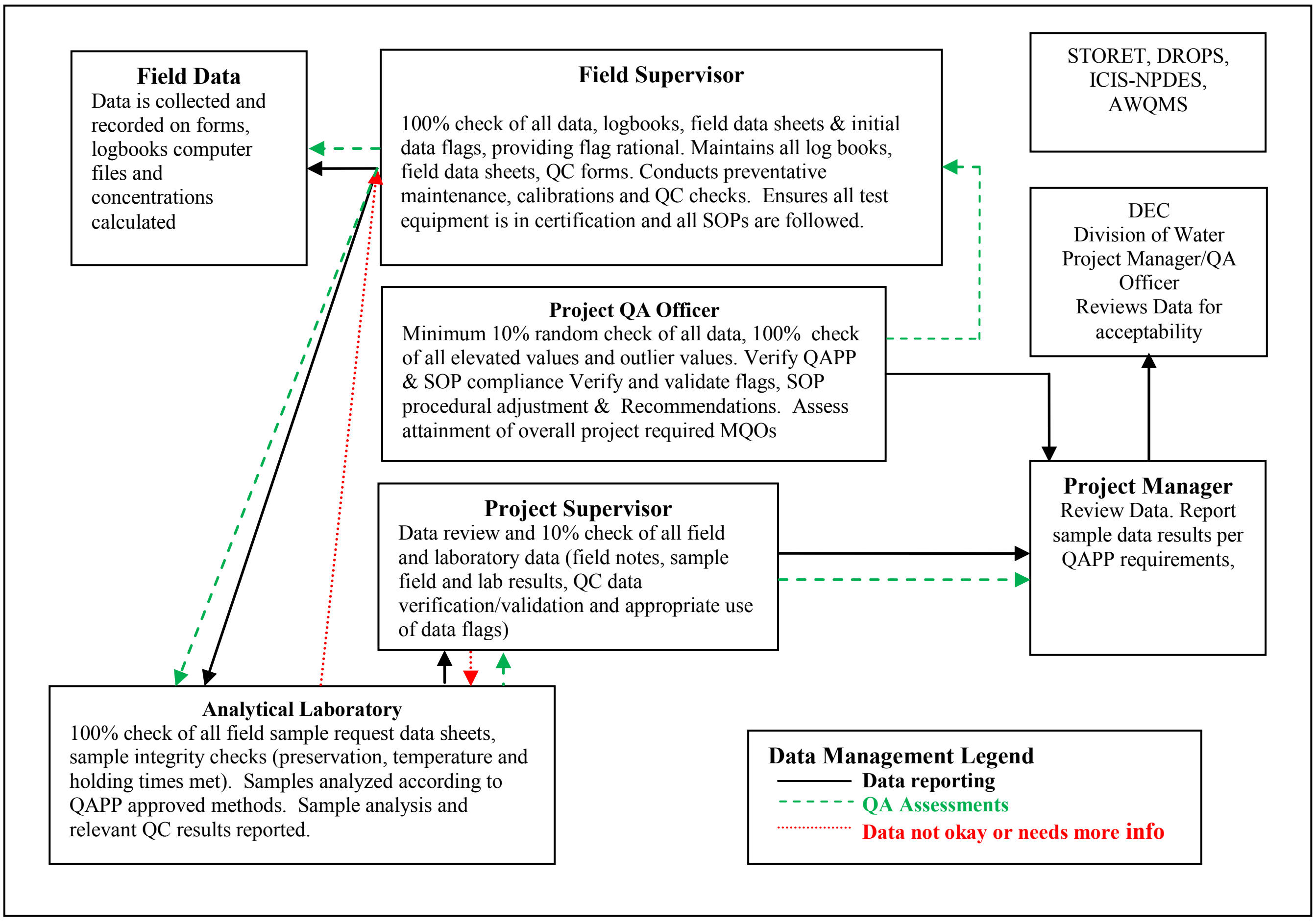
Various people are responsible for separate or discrete parts of the data management process:

- The field samplers are responsible field measurements/sample collection and recording of data and subsequent shipment of samples to laboratories for analyses. They assemble data files, which includes raw data, calibration information and certificates, QC checks (routine checks), data flags, sampler comments and meta data where available. These files are assembled and forwarded for secondary data review by the sampling supervisor.
- Laboratories are responsible to comply with the data quality objectives specified in the QAPP and as specified in the laboratory QAP and method specific SOPs. Validated sample laboratory data results are reported to the sampling coordinator/supervisor/project supervisor.
- Secondary reviewers (sampling coordinator/supervisor/project supervisor) are responsible for QC the review, verification and validation of field and laboratory data and data reformatting as appropriate for reporting to STORET, AQMS, ICI-NPDES, DROPS (if necessary), and reporting validated data to the project manager.

- The project QA officer is responsible for performing routine independent reviews of data to ensure the monitoring projects data quality objectives are being met. Findings and recommended corrective actions (as appropriate) are reported directly to project management.
- The project manager is responsible for final data certification
- DEC DOW Project Manager/QA Officer/AQS data entry staff conducts a final review (tertiary review) and submits the validated data to STORET, AQMS, ICI-NPDES.

Data Storage and Retention

Data management files will be stored on a secure computer or on a removable hard drive that can be secured. Laboratory Records will be retained by the contract laboratory for a minimum of five years. Project records will be retained by the lead organization conducting the monitoring operations for a minimum of five years, preferably longer. Site location and retention period for the stored data will be specified in Table 5.



C. Assessements

C.1 ASSESSMENTS AND RESPONSE ACTIONS

<u>Field Assessments (each pollutant)</u>

- Precision (replicate) sample measurements. Replicate sampling measurements will be conducted on the project's field-assessed parameters (pH, conductivity, dissolved oxygen, and water temperature) at every sampling event. Precision criteria are specified in the Measurement Quality Objectives (MQO) table (Table 3). In addition, calibration verification checks will be performed on the equipment prior to and after each sampling event.

<u>Field samples collected for subsequent laboratory analysis (each pollutant)</u>

- Replicate field samples for settleable solids analysis will be collected at 10% of the sampling events (approximately 7 samples). These samples will be equally distributed across sites and sampling events. Furthermore, replicate lab analysis will be performed on 10% of the samples (approximately 7 samples) distributed across analysis batches. Precision criteria for the replicates are specified in the Measurement Quality Objectives (MQO) table (Table 3).

<u>On-Site Assessments</u>

- Inspection of field monitoring operations for compliance with QAPP requirements.
- Laboratory Audit (if concerns arise regarding laboratory data quality)
- Audit of project field measurement data results.

<u>Project Data Assessments</u>

- Audits of Monitoring Data for reproducibility of results from recalculation/reconstruction of field/lab unprocessed data.
- Calculation of monitoring project's overall achieved precision, accuracy and data completeness compared to QAPP defined precision, accuracy and data completeness goals.

Should the sampling staff, laboratory personnel or project's Quality Assurance (QA) Officer find errors in sampling or analysis, the project's QA Officer will notify the Project Manager, DEC Project Manager/QA Officer and the party responsible for the error or deficiency and recommend methods of correcting the deficiency. The responsible party will then take action to correct the problem and will report corrections to the Project QA Officer and Project Manager, DEC Project Manager/QA Officer..

The Project QA Officer and ADEC's QA Officer will review the QA/QC procedures used for the sampling and analytical program. Procedures for this review are included in Section D2 to meet the data quality criteria specified in A7. The Project Quality Assurance Officer will report these assessment records in the Draft and Final Reports.

C.2 REVISIONS TO QAPP

Annually the QAPP will be reviewed and revised as needed. Minor revisions may be made without formal comment. Such minor revisions may include changes to identified project staff (but not lead project staff: QA project officer, project manager, sampling manager, contracted laboratories), QAPP distribution list and/or minor editorial changes.

Revisions to the QAPP that affect stated monitoring Data Quality Objectives, Method Quality Objectives, method specific data validation *"critical"* criteria and/or inclusion of new monitoring methods must solicit input/ and pre-approval by DEC DOW QA Officer/DEC Project Management before being implemented.

C.3 QA REPORTS TO MANAGEMENT

Sampling results will be summarized in the draft and final reports completed for this project. These reports will include the results of project assessments listed above. Reports will be submitted to the ADEC Project Manager. Email updates will be submitted to the ADEC Project Manager after the sampling event providing notification of any issues or problems for which corrective actions will be taken. The results of all corrective actions or data quality assessments will be reported to the ADEC Project Manager/QA Officer upon completion.

The analytical laboratory will submit monthly reports of analysis completed during that calendar month. Lab reports will include full documentation of laboratory data including check in, chain-of-custodies, bench sheets, and results of quality control associated with each batch of samples analyzed.

The necessary QA reports to management are outlined in Table 10.

Table 10. QA Reports to Management

QA Report Type	Contents	Presentation Method	Report Issued by	Reporting Frequency	
				As Required	Year
On-site Field Inspection Audit Report	Description of audit results, audit methods and standards/equipment used and any recommendations	Written text and tables, charts, graphs displaying results	Project QA Officer/auditor	✔	
Field Split Sample Report	Evaluation/comparison of result of split sample results from different laboratories, audit method.	Written text and tables, charts, graphs displaying results	Project QA Officer/auditor	✔	
On-site Labororatory Audit Report	Description of audit results, audit methods and standards/equipment used and any recommendations	Written text and tables, charts, graphs displaying results	Project QA Officer/auditor	✔	
Corrective Action Recommendation	Description of problem(s); recommended action(s) required; time frame for feedback on resolution of problem(s)	Written text/table	QA Officer/auditor	✔	
Response to Corrective Action Report	Description of problem(s), description/date corrective action(s) implemented and/or scheduled to be implemented	Written text/table	Project Manager overseeing sampling and analysis	✔	
Data Quality Audit	Independent review and recalculation of sample collection/analysis (including calculations, etc) to determine sample result. Summary of data audit results; findings; and any recommendations	Written text and charts, graphs displaying results	ProjectQA Officer	✔	
Quality Assurance Report to Management	Project executive summary: data completeness, precision, bias/accuracy	Written text and charts, graphs displaying results	Project QA Officer	✔	✔

D. DATA VALIDATION AND USABILITY

D.1 DATA REVIEW, VERIFICATIONAND VALIDATION REQUIREMENTS

Analytical results will be reviewed and validated in accordance with United States Environmental Protection Agency (USEPA) documents, including the *USEPA Guidance on Environmental Data Verification and Validation* (EPA QA/G-8), 2002b. The Project QA Officer will conduct data review and validation using the following methods on 10% of the primary project samples, including their associated quality control replicates and laboratory quality control samples:

- A review of sample handling and analytical and field data for completeness, accuracy, holding time compliance, and quality control (QC) sample frequency compliance.
- Evaluation of the accuracy and precision of field replicate samples.
- Assignment of data qualifiers, when necessary, to reflect limitations identified in the data assessment process.
- Estimation of data completeness.

D.2 VERIFICATION AND VALIDATION METHODS

The following procedures will be used to determine if data meets the data quality objectives and criteria specified in Section A7. If data QA/QC procedures do not meet the specified criteria, ADEC's Quality Assurance Officer will review all field and laboratory records to determine the cause. If equipment failures are limiting the usability of the data, calibration and maintenance procedures will be reviewed and changed as needed. If sampling or analytical procedures are causing the failures, methods will be reviewed to resolve the errors. Any changes or modifications to quality control procedures will be approved by ADEC prior to inclusion in the QAPP.

Review of Sample Handling

Proper sample handling techniques are required to ensure sample integrity. During data review, the sample handling procedures identified below are evaluated by ADEC's QA Officer to determine potential effects on data quality.

- Review of field sample collection and preservation procedures to determine whether they were completed in accordance with the requirements specified by the analytical methods.
- 100% data validation check of all elevated values and outlier values.
- Review of chain-of-custody documentation to ensure control and custody of the samples was maintained.
- Review of sample holding times between sample collection, extraction, and analysis (see Table 4 in Section B3).
- Review of sample conditions upon receipt at the contract laboratory.
- Review of Quality Assurance/Quality Control (QA/QC) Samples. Specific procedures for review of QA/QC samples are included in the sections below.

Reporting Limits

The reporting limits are the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory conditions. For many analytes, the reporting limit analyte concentration is selected by the laboratory as the lowest non-zero standard in the calibration curve. Sample reporting limits vary based on sample matrix and dilution of the samples during analysis. Reporting limits should be equal to or below the RLs provided in Table 1 for each method.

Data Qualification

Qualifiers will be applied to QC samples when acceptance criteria are not met and corrective action is not performed or is unsuccessful (Table 11). These same qualifiers will be applied to the associated sample data, as defined in the following table.

Table 11. Data Qualifiers

Qualifier	Description
J	The analyte was positively identified, the quantitation is estimated.
U	The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit (MDL).
F	The analyte was positively identified but the associated numerical value is below the reporting limit (RL).
R	The data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.
B	The analyte was found in an associated blank, as well as in the sample.
M	A matrix effect was present.
H	Analysis was performed outside of the recommended holding time.

Completeness

Completeness is calculated by the Project QA Officer after the QC data have been evaluated, and the qualifiers have been applied to the sample data. Invalid results, broken or spilled samples, and samples that are unable to be analyzed for other reasons are included in the assessment of completeness. The criteria and calculation to determine completeness are provided in Section A7. If data cannot be qualified to meet completeness goals, the ADEC Project Manager/QA Officer will be consulted with to determine if additional sampling should be performed to accomplish data quality objectives.

D.3 RECONCILIATION WITH USER REQUIREMENTS

The Project Manager will review all data deliverables upon receipt from the lab.
Laboratory results will be checked for data qualifiers entered by the lab to ensure that sample collection and preservation procedures were adequate and that laboratory analysis procedures met quality assurance objectives. Any outstanding issues will be addressed immediately with the lab and/or sampling staff to ensure that project quality assurance objectives are met.

The Project Manager and Project QA Officer will review and validate the data prior to reporting the data to DEC. If there are any problems with quality sampling and analysis, these issues will be addressed immediately and methods will be modified to ensure that data quality objectives are being met. Modifications to monitoring will require notification and approval by ADEC and subsequent edits to the approved QAPP.

Only data that have been validated and qualified, as necessary, shall be provided to ADEC Division of Water and entered into the AQMS and STORET data base.

APPENDIX. Resume of Dr. Catherine Bradley, Project Manager, TVWA Executive Director

CATHERINE A. BRADLEY, PH.D.

4635 Darlene Way, Fairbanks, AK 99712
Telephone: 907-488-1281
E-mail: katydid.bradley@gmail.com

EDUCATION

2006-2009 — **University of Georgia**, Athens, GA 30602
Ph.D. in Ecology (December 2009)

2003-2005 — **Emory University**, Atlanta, GA 30322
pursuing Ph.D. in Population Biology, Ecology, and Evolution

Spring 2000 — **University of Mississippi**, Oxford, MS 38677
Semester abroad study in Belize, Central America

1997-2000 — **Tulane University**, New Orleans, LA 70118
B.S. in Ecology and Evolution (August 2000)

RESEARCH EXPERIENCE

Doctoral Candidate — University of Georgia, Odum School of Ecology
August 2003-2009
Advisor: Dr. Sonia Altizer, Associate Professor
Contact Number: 706-542-9251

- Independently designed and implemented a project to explore the association between urban habitat structure and West Nile Virus (WNV) exposure in wild passerine populations
- Trained and supervised field assistants in the summer field seasons (2004, 2005, 2006)
- Skilled in avian field techniques, bacteriology and molecular biology
- Developed methods to quantitatively describe the structure and quality of a habitat using handheld GPS units, ArcGIS, aerial photography, spatial and geospatial analyst
- Utilized R statistical software to perform data analysis
- Managed field data, land use data, and sample analysis tracking in a MS Access database
- Successfully obtained grants to finance research costs
- Managed seed grant budgeting and purchasing
- Lead author of three papers published in peer-reviewed journals

Student Conservation Association Intern
October 2000-August 2001

U.S. Fish and Wildlife Service, Warm Springs Regional Fisheries Center
Supervisor: Dr. William Wayman, Fisheries Biologist
Contact Number: 706-655-3382

- Assisted in research exploring cryopreservation methods for endangered Sturgeon species, Rainbow trout, and the Robust Redhorse
- Conducted field research in Georgia, South Carolina, Michigan, and Montana
- Assisted in wild fish sampling and data collection, necropsy, and organ and tissue collection as part of the USFWS Wild Fish Health Survey

PROFESSIONAL EXPERIENCE

Executive Director
May 2011- Present

Tanana Valley Watershed Association

Christy Everett, Board President
Contact Number: 907-460-0941

- Primarily responsible for the daily operation of the Association under the strategic guidance of the Board of Directors
- Responsible for the implementation of existing programs (Adopt-A-Stream and Noyes Slough Clean Up)
- Manages existing grants, agreements, and partnerships; cultivating new relationships
- Develops community outreach materials and facilitates its distribution (newsletter, website, community meetings)
- Manages financial records and accounting for the Association

Fisheries Biologist
April 2008-May 2011

Nez Perce Tribe, Department of Fisheries Resource Management Research Division
Supervisor: Sherman Sprague, Project Leader
Contact Number: 208-621-3585

- Biologist II for the Spring Chinook Salmon Supplementation Project
- Developed and managed a database in MS Access to compile all data collected in the project's activities
- Primarily responsible for the calculation, summary, and reporting of viable salmonid population performance measures
- Lead author of the 2008, 2009, and 2010 Annual Reports
- Lead author of the 2010 proposal for B-run Steelhead Supplementation Monitoring in the Clearwater River Subbasin (funded)
- Performed statistical analyses, wrote reports, and developed presentations for a five-year review of the supplementation project (January 2009)
- Responsible for creating and updating maps of project areas and all spatial data related to the project
- Conducted water quality analyses and benthic macroinvertebrate community assemblage characterizations in study tributaries
- Project coordination with Idaho Fish and Game (Idaho Supplementation Studies and the Hatchery Database Technical Committee), and the Columbia River Inter-Tribal Fisheries Commission (Relative Reproductive

Success studies)
- Obtained the Watershed Management Training Certificate through the EPA's Watershed Academy (2010)
- CPR/First Aid Certified

Watershed Biologist
June 2007- October 2007

Nez Perce Tribe, Department of Fisheries Resource Management
Habitat and Watershed Division
Supervisor: Rebecca Lloyd, Project Leader
Contact Number: 208-843-7144

- Conducted road decommissioning surveys in preparation for removal
- Supervised road obliteration projects
- Conducted stream surveys utilizing the protocols for Rapid Bioassessment of Wadeable Streams (EPA)
- Performed fish passage analyses to prioritize culvert replacement/removal
- Assisted in streambank stabilization projects and noxious weed surveys

Biology Teacher
August 2001-June 2003

Manchester High School Manchester, Georgia
Supervisor: John Stephens, Principal
Contact Number: 706-846-8445

- Prepared and taught courses in General and Advanced Biology, Human Anatomy and Physiology

PUBLICATIONS

Bradley, C.A. and Altizer, S. 2005. Parasites hinder monarch butterfly flight: implications for disease spread in migratory hosts. Ecology Letters 8: 290-300.

Bradley, C.A. and Altizer, S. 2007. Urbanization and the ecology of wildlife diseases. Trends in Ecology and Evolution 22(2): 95-102.

Bradley, C.A., Gibbs, S.E.J., and Altizer, S. 2008. Urban land use predicts West Nile Virus exposure in songbirds. Ecological Applications 18: 1083-1092.

MEETING PRESENTATIONS

Wildlife disease in urban landscapes: Patterns of West Nile virus infections in its avian reservoir hosts. 2006 Ecological Society of America Annual Meeting. Memphis, TN.

Nez Perce Tribal Hatchery Spring Chinook in Lolo Creek. 2009 Tribal Supplementation Symposium. Orofino, ID.

Dam Removal and Anadromous Fish Reintroductions in the Clearwater Subbasin. 2010 Columbia River Inter-Tribal Fisheries Commission (CRITFC) Tribal Salmon Reintroduction Workshop. Pendleton, OR.