Watershed Health and Data Analysis Project

April 2021

Quality Assurance Project Plan

Alaska Department of Environmental Conservation
Division of Water

A. Project Management Elements

A.1 Title and Approvals

Title: Quality Assurance Project Plan for Water Quality Monitoring Sampling and Analysis Activities

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A.2 Distribution List

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

Table 1: Distribution List

NAME	POSITION	AGENCY/ Company	DIVISION/BRANCH/ SECTION	CONTACT INFORMATION
Chandra McGee	DEC Project Manager	DEC	Division of Water/ WQSAR / Monitoring and Assessment Program	907 451-2140 chandra.mcgee@alaska.gov
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John Clark	DEC QA/QC Officer	DEC	Division of Water/ WQSAR/QA	907-269-3066 john.clark@alaska.gov

A.3 Project Task/Organization

Dues and responsibilities of key individuals are listed below:

A.3.1 DEC Staff:

- **Project Manager** – Responsible for overall technical and contractual management of the project.

- **Project Field Coordinator –** Responsible to ensure all monitoring complies with the QAPP specified criteria. This is accomplished through routine technical assessments of the sample collection, analysis and data reporting process. Assessments may include, but are not limited to activities such as: on-site field audits, data audits, QA review of blind lab performance evaluation samples, and lab audits. Will supply offices with necessary equipment for sampling and track

equipment and supple usage. These assessments are performed independent of overall project management. Will assume the role of Lead Field Sampler if required for regional office needs.

- **DEC QA/QC Officer** – Responsible for QA review and approval of plan and oversight of QA activities ensuring collected data meets project's stated data quality goals.

- **Regional Lead Field Sampler** – Responsible for sampling preparation, sample collection, sample preservation, transportation of samples to laboratory for analysis, receipt of data and transmittal of data to Project Coordinator. The individual will procure personal equipment of field personnel, coordinate with laboratories in planning sampling equipment needs, obtain supplies for and prepare daily sampling kits prior to departure for field location, travel to the field location, prepare necessary preservatives while in the field, perform site reconnaissance, collect site specific parameters, collect water samples, prepare samples for shipping, transport samples to laboratory, alert laboratory of successful sampling event, receive data from laboratory, verify sample result data is reliable and submit the data and all applicable QA/QC results to the DEC Project Manager/Coordinators.

- **Regional Field Support Personnel** – Responsible for accompanying Lead Field Sampler into the field and supporting Lead Field Sampler during sampling. The individual will travel with the Lead Field Sampler to the field location, accompany the Lead Field Sampler to sampling sites, and support Lead Field Sampler in sampling tasks.

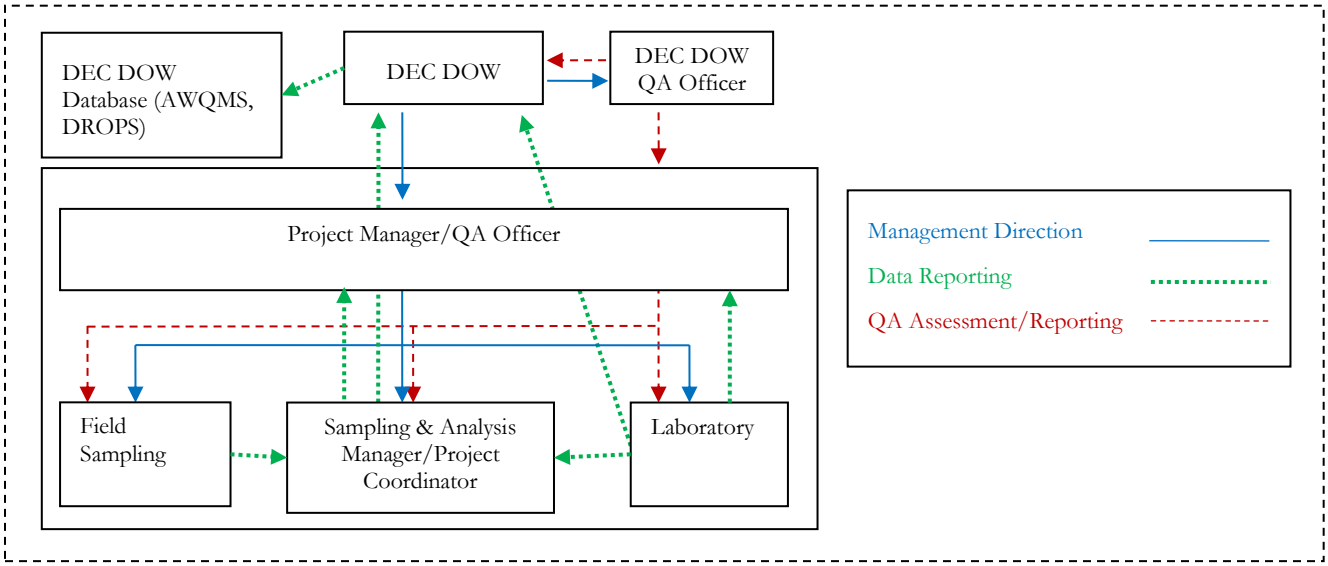


Figure 1. WHADA Project Organizational Structure

A.4 Project Definition/Background and Project Objectives

A.4.1 Project Definition

The purpose of this pilot program is to collect data and assess the health of priority waterbodies in Alaska. Data gathered by this project may be used to make management decisions and determine whether waterbodies meet regulatory standards and support designated uses while meeting minimum Alaska

Consolidated Assessment and Listing Methodology (CALM) requirements. Management decisions for public health and safety should be based on specific data (e.g., activities, sanitary surveys) including identification of possible impacts from pollution sources. Data must be indicative of water quality conditions to adequately assess the conditions of a waterbody to make the appropriate decision. Due to the inherent uncertainty involved with sampling and analytical determination of water quality, decisions will be made when there is no reason to doubt the accuracy of the sample.

Following the pilot year for WHADA, DEC will continue monitoring priority waterbodies upstream and downstream of urban impact in Alaska to collect two years of data. The selected waterbodies include the following:

- Campbell Creek (Southcentral, Anchorage)
- Chena River (Interior, Fairbanks)
- Chester Creek (Southcentral, Anchorage)
- Jordan Creek (Southeast, Juneau)
- Little Susitna River (Southcentral, Wasilla)
- Little Campbell Creek (Southcentral, Anchorage)
- Ship Creek (Southcentral, Anchorage)
- Soldotna Creek (Southcentral, Kenai Peninsula)
- Wasilla Creek (Southcentral, Wasilla)

These watersheds were selected based on several factors including classification, data needs, and logistics. All listed watersheds are noted as Alaska Clean Water Actions (AWCA) High Priority Waterbodies with concerns over pollutant threats, namely pathogens. The data generated from this program will provide valuable information in the assessment of designated uses in each of the watersheds. Each waterbody is located within reasonable distance of DEC regional offices and accessible for sampling.

All sample locations will be assigned a unique identification code based on a sample designation scheme designed to suit the needs of the field personnel, data management, and data users. Sample identifiers will consist of three components separated by dashes. Table 2 and Figure 2 contain the location and site descriptions of the sample sites. The first component is used to identify the program name, for example: WHADA = Watershed Health and Data Analysis. The second component is used to identify where the sample originated, for example: LCCr = Little Campbell Creek. The third component is used to identify the river mile on the system where the samples were taken. In total, an example of a sample ID would be: WHADA-LCCr-11. However, if there is an existing sample location, the original sample ID will be used for continuity purposes. An activity ID will be used to document each unique sampling event. See reference maps in Appendix A for maps of specific sample locations and reaches.

Table 2: Site Location and Rationale

Site ID	Latitude	Longitude	Site Description
WHADA-LCCr-7.5	61.113357° N	-149.708905° W	Little Campbell Creek Upper Huffman Trail Parking Lot
WHADA-LCCr-2.1	61.14747° N	-149.8531° W	Sandlewood Place bridge over Little Campbell Creek
WHADA-ShCr-12.4	61°13'27.85"N	-149°37'48.63"W	Ship Creek USGS Ship Creek Gage Station: USGS 15276000
WHADA-ShCr-11	61.225249° N	-149.649700° W	Parking lot by bridge off Arctic Valley Road
WHADA-ShCr-1.3	61.223325° N	-149.874344° W	Ship Creek Trail access by DOC office
AnchBact20-01	61.177817° N	-149.825138° W	Located by bridge in Campbell Creek Park
Cam6	61.139387° N	-149.921810° W	Located by bridge before Campbell Lake
Che33	61.20574° N	-149.717616° W	Trail off dead end of E 17th Avenue
Che3	61.20476° N	-149.899965 W	Bridge from Valley of the Moon Park
WHADA-ChRi-45.3	64.794410° N	-147.191477° W	Chena River Campsite Loop for Moose Creek Dam/Reservoir
WHADA-ChRi-6.0	64.840286° N	-147.817681° W	Chena River BLM Fairbanks Office
WHADA-JoCr-2.3	58.366569° N	-134.577272° W	Jordan Creek on private property
WHADA-JoCr-1.5	58.3581518° N	-134.5748575° W	Jordan Creek Juneau Airport
WHADA-SoCr-4.5	60.515281° N	-150.976461° W	Soldotna Creek Access Point
WHADA-SoCr-0.05	60.484042° N	-151.056150° W	Mouth of Soldotna Creek
WHADA-LSuRi-86	61.716992° N	-149.231439° W	Little Susitna River USGS Hatcher Pass Gage Station - USGS 15290000
WHADA-LSuRi-55	61.626496° N	-149.805957° W	Little Susitna River ADFG Stream Gage Station
WA01	61.66149° N	-149.18843° W	Wasilla Creek Upstream at Crabb Circle Crossing
WA04	61.56728° N	-149.3143° W	Wasilla Creek Downstream at overpass with Parks Hwy

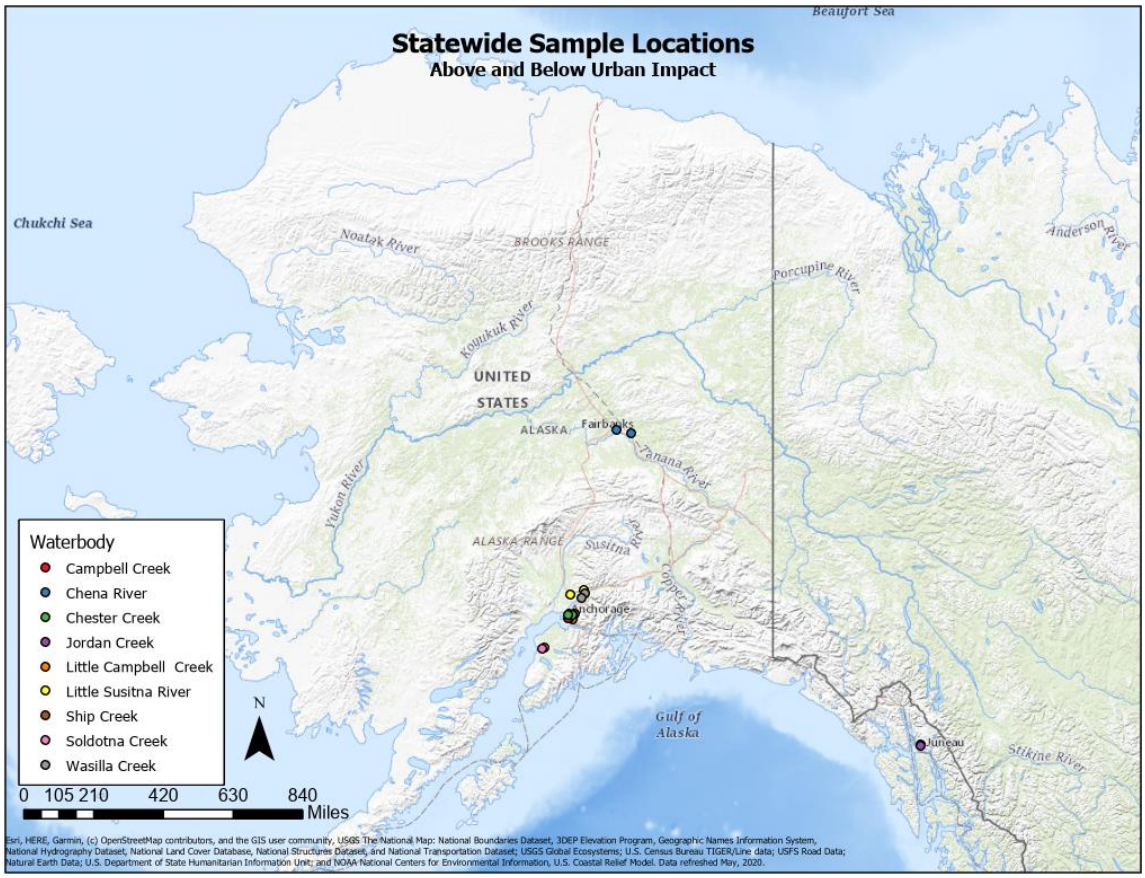


Figure 2. Statewide sample locations for WHADA Program

A.4.2 Project Background

DEC routinely leads watershed monitoring efforts throughout Alaska to gain an understanding of present water quality conditions throughout the state. This project initiates a localized effort for regional offices to assess conditions in local high priority watersheds. The design of the project mimics current and previous sampling surveys completed throughout Alaska to ensure data comparability with other ongoing statewide monitoring efforts including Bureau of Land Management (BLM)'s Assessment, Inventory and Monitoring Strategy (AIM), US Environmental Protection Agency (EPA)'s National Rivers and Streams Assessment (NRSA) and Great Lakes Beach Sanitary Surveys. Combining core parameters (i.e., water chemistry, physical habitat, and biological) from each survey has developed the Watershed Health and Data Analysis (WHADA) Program into a powerful tool to examine priority watersheds in Alaska. Methodology for sampling protocols can be found at:

- BLM's AIM National Aquatic Monitoring Framework: Field Protocol for Wadeable Lotic Systems (2017)
- EPA's NRSA 2018-19 Field Operations Manual Wadeable (2019)
- EPA's Great Lakes Beach Sanitary Survey User Manual (2013)

A.4.3 Project Objective(s)

The primary objective of this project is to characterize the environmental conditions of high priority watersheds. Data gathered by this project will be used in determining whether waterbodies meet regulatory

standards and support designated uses while meeting minimum data requirements under 2020 Alaska Consolidated Assessment and Listing Methodology (CALM).

A.5 Project/Task Description and Schedule

A.5.1 Project Description

DEC will collect water and biological samples, conduct a physical habitat survey, and take field measurements at six priority watersheds throughout Alaska (listed in the A.4.1 Project Definition) at above and below urban impact locations. Samples will be analyzed in a DEC-approved laboratory for selected parameters outlined in Table 3. The goal of this project is to determine whether selected waterbodies meet regulatory standards and support designated uses while meeting minimum data requirements under 2020 CALM.

A.5.2 Project Implementation Schedule

Table 3 includes the implementation schedule and sampling frequency for selected parameters and methods.

Table 3: Implementation Schedule for Selected Parameters and Methods

Product	Measurement/ Parameter(s)	Sampling Site	Sampling Frequency	Time Frame
Field Sampling	Ambient air temperature, Aqua TROLL 500 handheld sonde (pH, conductivity, DO, temperature, turbidity)	All sites	Monthly	May -October
Field Survey	Physical Habitat Survey (Sanitary Survey, Fish Cover, Canopy Cover, Buffer Width and Conditions), Streamflow	All Sites	2/ sampling season	Spring and Fall
Lab Analysis	Benthic Macroinvertebrates (taxonomy)	All Sites	1/ sampling season	Spring
Lab Analysis	Pathogens (Fecal and E. Coli)	All sites	Five times	Within a 30-day period following the first sampling event
Lab Analysis	Water Chemistry (Nitrogen, Phosphorous, Dissolved Metals and Cations, Hg, DOC, Hardness)	All sites	Each sample event	May – October
Field Audit	Audit of field monitoring operations	All sites	1/office location/year	May - October

A.6 Data Quality Objectives and criteria for Measurement Data

A.6.1 Data Quality Objectives (DQOs)

Data Quality Objectives (DQOs) are qualitative and quantitative statements which are derived from the DQO Process that:

- Determine the environmental conditions of high priority watersheds and compare these values to water quality standards regulatory limits and 2020 CALM metrics for fresh surface waters.
- The data needed for this project includes water chemistry characteristics and concentrations, physical habitat characteristics, and indicator organism concentrations. The ultimate goal of the project is to monitor high priority watersheds to determine current conditions of the watersheds and if the watersheds meet regulatory limits for water quality standards and 2020 CALM metrics. If the data collected meets reporting requirements, the watersheds can be monitored and classified according to the CALM requirements to be listed as attaining or as impaired if they do not meet standards and metrics for designated uses. For WQS pollutants, compliance with WQS is determined be specific measurement requirements. The measurement system is designed to produce water pollutant concentration data that are of the appropriate quantity and quality to assess compliance.

A.6.2 Measurement Quality Objectives (MQOs)

Measurement Quality Objectives (MQOs) are a subset of 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 MDL is the minimum value which the instrument can discern above background but no certainty to the accuracy of the measured value. For field measurements the manufacturer's listed instrument detection limit (IDL) can be used.

- The PQL or RL is the minimum value that can be reported with confidence (usually some multiple of the MDL).

Note: The measurement method of choice should at a minimum have a practical quantification limit or reporting limit 3 times more sensitive than the respective DEC WQS and/or permitted pollutant level (for permitted facilities).

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 (RPD) 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 lab samples. For paired and small data sets project precision is calculated using the following formula:

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

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

RSD = 100*(standard deviation/mean)

Note: Precision assessed only when both paired values ≥:

- 5 times PQL (fecal coliforms SM 9222D)
- 5 times PQL (E. coli SM 9222B)

Bias (Accuracy) 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:

$$Accuracy = \frac{Measured\ Value}{True\ Value} \times 100$$

Completeness is a measure of the percentage of valid samples collected and analyzed to yield sufficient information to make informed decisions with statistical confidence. As with representativeness, data completeness is determined during project development and specified in the QAPP. Project completeness is determined for each pollutant parameter using the following formula:

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

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).

This project has a goal of 80% data completeness. Completeness will be assessed on an individual basis for every watershed. For comparison with the geometric mean standard, 140 individual sampling events are planned per year for water chemistry analysis from all six selected watersheds. A minimum of five unique and valid samples (per sample location) are also required to assess compliance with the water quality indicator standards for bacteria sampling within 30 days. Inclusion of data for waterbodies in the Integrated Report requires two years of data collection.

Representativeness is determined during project development and specified in the QAPP. Representativeness assigns what parameters to sample for, where to sample, type of sample (grab, continuous, composite, etc.) and frequency of sample collection.

Comparability is a measure that shows how data can be compared to other data collected by using standardized methods of sampling and analysis.

Monitoring shall be conducted in accordance with EPA-approved analytical procedures by state certified or equivalent laboratories and in compliance with 40 CFR Part 136, Guidelines Establishing Test Procedures for Analysis of Pollutants, as listed in Table 4. Field parameters will be measured using an In-Situ Aqua Troll 500 multiparameter sonde or an equivalent sonde (minimum resolution of 0.1 °C or better) over a 15-minute average. Device must be calibrated prior to sampling event. Data sheets from the Aqua Troll will be downloaded electronically to DEC's database. Macroinvertebrates samples will be sorted and identified to a specified taxonomic level with count data included. All taxonomic data will be completed by Society for Freshwater Science certified taxonomists. Sample collection devices must be rinsed in sample water prior to collection of samples.

Each sampling location is fixed and located by a GPS coordinates at each waterbody. The locations do not change throughout the sampling season, but the area of sampling may change due to targeted parameters during a sampling event. Sampling is conducted in accordance with protocols established by BLM's Assessment, Inventory, and Monitory (AIM) Framework Manual (2017) and EPA's National Aquatic Resource Surveys (NRSA) 2018-19 Field Operations Manual Wadeable (2017) and the Great Lakes Sanitary Survey User Manuel (2013).

Table 4: Project Measurement Quality Objectives

Group	Analyte	Method	MDL	PQL	Precision (RPD)	Accuracy
Fecal Indicator Organisms	Fecal coliforms	SM 9222D, membrane filtration (MF)	1 cfu/100mL	1cfu/100mL	± 60%	NA
	E. Coli	SM 9222B	1 cfu/100mL	1 cfu/100mL	±60%	NA
Water Chemistry	Dissolved Metals[1] (Cadmium, Copper, Lead, Selenium, Zinc)	200.7 or 200.8 (field filtered)	NA	NA	±10%	±10%
	Dissolved Major Cations[2]	200.7	NA	NA	± 0.05 or ±10%	± 0.05 or ±10%
	Total Nitrogen	SM 4500N	0.2 mg/L	0.02 mg/L	± 0.01 or ±10%	± 0.01 or ±10%
	Nitrate/Nitrite	SM 4500 NO2B	0.0032 mg/L	N/A	±10%	±10%
	Nitrogen, Total Kjedahl (TKN)	4500N org	0.69 mg/L	1.0 mg/L	±10%	±10%

[1] Detection and Quantification limits for dissolved metals are dependent on sample volume and hardness.

[2] Detection and Quantification limits for dissolved cations are dependent on sample volume and hardness.

	Total Phosphorous	SM 4500	0.2 mg/L	4 mg/L	± 2 or ±10%	± 2 or ±10%
	Dissolved Organic Carbon	SM 5310B	N/A	0.20 mg C/L	± 0.10 or ±10%	± 0.10 or ±10%
	Mercury	1631C or 245.1	N/A	0.5 ng Hg/L	±10%	±10%
	Hardness	SM 2340B	N/A	N/A	±10%	±10%
Field	Temperature	170.1	-5 °C	N/A	0.01°C	± 0.1 °C
	pH	4500-H+	0 pH	N/A	0.01 pH	± 0.1 pH unit
	Dissolved Oxygen	1003-8-2009	0 mg/L	N/A	0.01 mg/L	± 0.1 mg/L
	Specific Conductance	2510	0 µS/cm	N/A	0.1 µS/cm	± 0.5%
	Turbidity	SM 20 2130B	0 NTU	N/A	0.01 NTU	± 0.5 NTU

A.6.3 Data Validation and Verification

All data generated shall be validated in accordance with the QA/QC requirements specified in the methods and the technical specification outlined in this QAPP. Raw field data will be maintained by the Program staff who collect it. Raw laboratory data shall be maintained by the laboratory. The laboratory may archive the analytical data into their laboratory data management system. All data will be kept a minimum of 5 years.

The summary of all laboratory analytical results will be reported to the Project Coordinator/Manager staff. Protocols for laboratory data validation and verification are listed in Section B.4.2 and as specified in the laboratory's QAP and SOPs.

Staff will verify that equipment used to collect field data is reading within acceptable limits before each sampling event using calibration solution. After sampling is completed, staff will complete a post verification check on equipment using calibration solution. Staff will bracket the verification tests around the results of field measurements. Staff will record the date, name of equipment operator, calibration solution lot number and expiration date, reading of the standard solution, and verification pass/fail in a logbook kept with the field instrument. Further explanation of calibration and verification requirements may be found in the QA Checklist document in the WHADA files under Data.

Unacceptable data (i.e., data that do not meet the QA measurement criteria of precision, accuracy, representativeness, comparability, and completeness) will not be used or if used, the problems with the data will be clearly defined, flagged appropriately and data use clearly delimited and justified. Any action taken to correct QA/QC problems in sampling, sample handling, and analysis must be noted. Under the direction of the Project Manager/Coordinator, project staff will document any and all QA/QC corrective actions taken.

The Project Manager/Coordinator or his/her designee is responsible for reviewing electronic or paper data sheets for accuracy and completeness within 48 hours of each sample collection activity, if possible. The Project Manager/Coordinator or his/her designee will compare the sample information in the electronic or paper field sheets with the laboratory analytical results to ensure that no transcription errors have occurred, and to verify project QC criteria have been met (e.g., samples preserved and sample hold times met as required by QAPP and method, relative percent difference (RPD) results for blind sample replicates).

RPD's greater than the project requirements will be noted. The Project Manager/Coordinator, along with supervisors and/or the Project QA Officer, if necessary, will decide if any QA/QC corrective action will be taken if the precision, accuracy (bias) and data completeness values exceed the project's MQO goals.

The Project Manager/Coordinator and the QA/QC Officer will review and validate data against the Project's defined MQOs prior to final reporting stages. 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 to DEC and subsequent edits to the approved QAPP.

Only data that have been validated and qualified, as necessary, shall be provided to DEC Division of Water and entered into the applicable database (AWQMS, ICI-NPDES, DROPS, WQX).

A.7 Special Training Requirements/Certification

The DEC Project Coordinator currently serves as DEC's Watershed Health and Data Analysis (WHADA) program coordinator and has experience in administrating water quality monitoring programs. The experience associated with their duties allows them to be effective in carrying out duties as Project Coordinator. The DEC Project Coordinator will attend either AIM Field Methods Training hosted by BLM or AIM, NRSA Regional Field Training hosted by EPA, or other appropriate training every two years for continued training and certification in field sampling methodology. Additional staff may attend the training as time and cost constraints permit.

For regional offices, the Project Coordinator is responsible for coordinating local office efforts for field sampling, including equipment and supplies procurement, planning and leading field sampling events, and preliminary QA/QC field data.

The Project QA Officer is the DEC DOW's Quality Assurance Officer. His training and experience allow him to successfully fulfill his duties as Project QA Officer.

The Project Manager has experience with laboratory contracts and high-level administration of water quality monitoring programs. The Project Manager will work with DEC to contract with laboratories for planned analysis of samples. The Project Manager will ensure all sample analysis will use comparable samples to those used in AIM, NRSA, and Sanitary Survey samples for comparability of results. Subcontracted laboratories performing analytical work must have the requisite knowledge and skills in execution of the analytical methods being required. Information on laboratory staff competence is usually provided in each lab's Quality Management (QMP) and/or Quality Assurance Plan (QAP). The laboratories to be used during the 2020 field season, will be Alaska Drinking Water certified microbiological laboratories, or maintain equivalent certification. It is the responsibility of the contracted lab to maintain a current copy of the laboratory's QA Plan and attendant method specific SOPs on file with the Project Manager/QA Project Manager and DEC DOW QA Officer during the duration of laboratory use.

DEC Project Manager: Chandra McGee

DEC Project Coordinator: Meredith Witte

DEC QA Officer: John Clark

Table 5: Training Requirements

Specialized Training/Certification	Field Staff	Project Manager	Project Coordinator	Project QA Officer
Safety training	**X**	**X**	**X**	**X**
Water sampling techniques	**X**	**X**	**X**	**X**
Instrument calibration and QC activities for field measurements	**X**	**X**	**X**	**X**
QA principles				**X**
Chain of Custody procedures for samples and data	**X**	**X**	**X**	**X**
DEC Microbiological Drinking Water Certification	Certification for microbiological analysis is limited to the individually certified analyst.			

A.8 Documents and Records

DEC will use an electronic tablet to digitally record field measurements and physical habitat surveys in an electronic field survey. Additional paper field data sheets will be provided to all field crews in case of technical or equipment failures (Appendix B). The lead field sampler is responsible for ensuring that all field data forms are correct.

Field activities and observations will be recorded in the electronic field survey during fieldwork. Any comments or descriptions will be noted in the comments with enough detail so that participants can reconstruct events later if necessary. Survey results and field data sheets will include descriptions of any changes at the site, in particular, personnel and responsibilities or deviations from the QAPP/SAP as well as the reasons for the changes. Requirements for the electronic field survey and field data sheet entries will include the following:

- 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 included, as well as the time of the observation itself).
- Each entry will have its own unique identifier for the sampling event.
- Unbiased, accurate language will be used.
- If paper copies of the field data sheets are submitted, entries will be made legibly with black (or dark) waterproof ink.
    - Data or other information that has been entered incorrectly will be corrected by drawing a line through the incorrect entry and initialing and dating the lined- through entry. Under no circumstances should the incorrect material be erased, made illegible or obscured so that it cannot be read.
    - Additional procedures, if necessary, will follow the ADEC DOW Compliance SOP: Logbooks, April 1, 2020 while filling in the paper forms.
- Any deviation from the sampling plan will be included in the comments of the field data form.
- When field activity is complete, the electronic field survey form will be submitted and entered into the project file.

In addition to the preceding requirements, the person recording the information must have an additional field crew member review the data entry, either on the electronic survey application or the paper copy of the data sheets. If no additional field crew member is available, the Project Manager/Coordinator will review the information after the electronic survey or paper copy of the data is uploaded to DEC file system, prior to submittal to the applicable database. After data review is complete, the field crews will submit the data electronically to the database (e.g., AWQMS, ICI-NPDES, DROPS, WQX). Regional staff will conduct the

first round of quality assurance reviews, including field and laboratory datasets. Staff will then request a QA review from the Project Coordinator or Quality Assurance Office. After secondary QA review is completed, data will be uploaded electronically into AWQMS and will be considered for Integrated Report reporting and ATTAINS entry. The type of information that may be included in the electronic survey and/or paper 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, environmental conditions, complications, and other details associated with the sampling effort
- Photo log

Field datasheets and sample chain-of-custody forms will be completed for all samples and kept in the "Field Datasheets" and "Lab COCs" folders in the Watershed Health and Data Analysis filing system. Chain of custodies will be named as "[Lab name]-COC-YYYYMMDD." If multiple chain-of-custodies are submitted on the same day, a "_2" will follow the date or increasing number with additional chain-of-custodies. Laboratory data results from the laboratories are recorded on laboratory data sheets, bench sheets and/or in laboratory logbooks for each sampling event and kept in the reports files for the pertinent lab in the Watershed Health and Data Analysis filing system using the lab report number as the name for the file. These records as well as control charts, 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. All dates are to be formatted as "YYYYMMDD".

Any procedural or equipment problems are recorded as a comment in the electronic survey application or paper field survey Deviation from this Quality Assurance Project Plan will also be noted as a comment in the electronic survey application or paper field survey. Data results will include information on field and/or laboratory QA/QC problems and corrective actions.

In addition to any written report, data collected for the project will be provided electronically in an AQWMS compatible format.

All records will be retained electronically for a minimum of five years within DEC. Table 6 includes a description of types of records/document types that may be included.

Table 6: Project Documents and Records

Categories	Record/Document Types
Site Information	Site maps
	Site pictures
Environmental Data Operations	QA Project Plan
	Field Method SOPs
	Field Notebooks
	Sample collection/measurement records
	Sample Handling & Custody Records
	Inspection/Maintenance Records
Raw Data	Lab data (sample, QC and calibration) including data entry forms
	Sanitary Survey Forms
Data Reporting	Progress reports
	Project data/summary reports
	Lab analysis reports
Data Management	Data quality assessments
	Site audits
	Lab audits
	QA reports/corrective action reports
	Corrective Action Response

B. Data Generation and Acquisition

B.1 Sampling Process Design (Experimental Design)

Watershed quality monitoring will be conducted at waterbodies designated by DEC, and selected sample locations will be representative of the local area. Water samples will be analyzed to determine water chemistry characteristics for the selected waterbodies, including common water chemistry parameters (e.g., bacteria, total nitrogen and phosphorous, dissolved metals, mercury, hardness, and DOC) with results reported as concentrations per mL water.

Waterbodies will be sampled at locations above and below urban impact in accordance with sampling manuals (BLM 2017; USEPA 2013 and 2017) developed for national water assessment programs. Water chemistry and biological samples will be collected at selected sampling locations following the sampling procedures outlined in the NRSA 2018-19 Field Operations Manual Wadeable (2019). Physical habitat surveys will be completed in accordance with sampling procedures outlined in the BLM AIM Manual (2017). Sanitary Surveys will be completed using similar methodology to the Great Lakes Sanitary Survey outlined in the user manual (2013). These protocols were selected for comparability of data with national programs and repeatability throughout Alaska, maximizing the impact of the data.

For each sample collected, the date and time will be noted. Sample containers will be delivered to labs for analysis within hold times for accurate results.

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

Project schedule and tasks may be adjusted as needed due to unplanned or unavoidable events.

MONITORING PROJECT TASKS

TASK 1: Staff Training. Project Coordinator and Project Manager will arrange and lead annual training for DEC Regional Staff on sampling techniques for WHADA. Training will occur prior to the start of fieldwork to include necessary sampling protocols.

Task 2: Develop Lab Bottles Order. Project Coordinator will arrange bottle order with the contracted labs to analyze the selected parameters. Multiple labs may be contracted if needed due to lab analysis availability and reporting limits.

Task 3: Sample. Samples will be collected following using the methods outlined, stored and transported to the approved lab within hold times, and in good condition. DEC staff will record observations and sampling results in an electronic field survey application on a tablet or a paper copy of the survey if needed in the field. DEC staff will take photos as each site during each sampling event to capture current conditions. Photos will include upstream, downstream, left and right banks, and any additional photos required to document the site. Photos will be named as "[Site ID Name] [Location] [Date]".

The six waterbodies selected for sampling include: Chena River, Soldotna Creek, Jordan Creek, Little Susitna River, Ship Creek, and Little Campbell Creek. DEC staff will work with any property owner(s) within these monitoring locations for sampling purposes or permit needs. DEC staff will conduct outreach as necessary to inform the public about events.

Electronic or paper copies of the surveys, chain of custody forms, and site photos will be provided to the DEC Project Manager the day of sampling or the following morning.

TASK 4: Laboratory Analysis. Contracted laboratories will analyze water quality, bacteria, and biological samples for selected parameters from the six selected watersheds using the listed methods in Table 3. One (1) replicate sample will be completed per 10 sampling events for each office to be analyzed for quality assurance. Analytical data results electronically reported to the DEC Project Manager within 36 hours of the sampling event or when available from the laboratory. Lab reports will be maintained and stored inhouse by DEC.

Task 5: Initial Data Upload. DEC Regional Staff will compile and enter the project data into DEC developed template which will be transferred to the DEC water quality database (AWQMS). DEC will update the GIS geodatabase and map showing the results of the monitoring effort in NAD83/Alaska Albers.

Task 6: QA/QC Check. DEC Regional staff and QA Officer will review data from electronic data sheets and lab analysis reports. Data review and correction will be completed as needed for the AWQMs database. In the event of issues identified in lab results or field data during QA, additional QA review will occur.

Task 7: Reporting. DEC Project Coordinator will publish a field report at the end of each sampling season to summarize field efforts and will draft and publish a final report of findings and conclusions of the WHADA pilot program.

At the end of the two-year pilot program study, DEC will evaluate all sample results, and publish a draft and final report of findings and conclusions. Field report design should follow 2017-2019 AKMAP monitoring field reports prepared by DEC for survey results from the National Rivers and Streams Assessment Surveys.

The final report will include background information, and the project need, objectives, and approach taken to meet the project objects. The report will evaluate and describe project accomplishments, the environmental benefit, and suggest future actions. The report will include narrative description and tabular/graphical formats to evaluate the monitoring results. The report will include a quality assurance review describing the integrity of the reported analytical results as present in the QAPP and data quality objectives. Appendices will include all project data or refer to a web link and appropriate references.

Task 8: Outreach. Communicate the progress and sampling results and WHADA importance to Alaskans. This will include the development of outreach material to communicate the WHADA program and sampling results to Alaskans. Outreach should include reports on sample analysis results, area-appropriate communications or presentations, or others as needed. The Project Coordinator will develop reports on sample analysis reports. Each participating office will create one social media post per field season and will create area-appropriate communications or presentations upon request by the local community. Outreach material will be approved by DEC.

- Draft and final outreach material
- Draft and final public presentation

B.1.2 Identify the Site-Specific Sample Collection Location(s), Parameters to be Measured, and Frequencies of Collection

Sampling sites have been selected, however, site coordinates may be altered based on field reconnaissance and present conditions. Table 3 in Section A.5.2 details parameters to be taken at each site, the sampling frequency, and the sampling dates.

B.2 Sampling Method Requirements

Methodology for specific sampling protocols can be found at:

- BLM's AIM National Aquatic Monitoring Framework: Field Protocol for Wadeable Lotic Systems (2017)
- EPA's NRSA 2018-19 Field Operations Manual Wadeable (2019)
- EPA's Great Lakes Beach Sanitary Survey User Manual (2013)

B.2.1 Sample Types

Laboratory samples will be listed as "grab" or "composite" on the Chain-of-Custody forms and data sheets while field samples will be listed as "in-situ" as defined below.

Grab Samples – Sample bottles will be filled sequentially, normally being filled to the shoulder of the bottle, leave a small space for expansion and mixing. The laboratory will provide sampling instructions with the sample bottles for specific samples

Composite Samples – Sample bottles will be filled with multiple individual samples taken over a period of time, distance, or other interval and combined in a common container. The laboratory will provide sampling instructions with the sample bottles for specific samples

In-Situ Samples – In-situ water chemistry samples will be taken as an average over 15 minutes for the Aqua Troll or similar equipment used in the field. Prior to deployment of equipment at the sample site, field crews must verify that the equipment will record parameter readings for the timed average.

B.2.2 Sample Containers and Equipment

Field crews will follow the sampling guidelines listed in NRSA, Sanitary Survey, and AIM Fieldwork Manuals for wadeable streams. Field data and observations should be recorded in the electronic field data sheets. If technical issues occur, data will be entered on paper field sheets provided by DEC (Appendix B). Some observations may include presence/number of wildlife, human impact, field parameters collected with a portable meter (VuSitu Aqua Troll 500 or similar), weather conditions, and physical habitat survey. DEC field crews will take photos at each site during sampling to document current site conditions at each sampling event which will be included in the photo log for each sampling event.

The sample container, preservation, and holding time requirements are tabulated below:

Table 7: Preservation and Holding Times for the Analysis of Samples

Analyte	Matrix	Container	Necessary Volume	Preservation and Filtration	Maximum Holding Time
Temperature	Surface Water	N/A, direct measurement	N/A, Direct Measurement	N/A, direct measurement	N/A, direct measurement
Fecal Coliform	Surface Water	G, PA	100 mL	Cool <4°C; do not freeze, 0.0008% $Na_2S_2O_3$	6 hours (field) 2 hrs lab prep (**note:** time not additive)
E-Coli	Surface Water	G, PA	100 mL	Cool <4°C; do not freeze, 0.0008% $Na_2S_2O_3$	6 hours (field) 2 hrs lab prep (**note:** time not additive)
Nitrate/Nitrite	Surface Water	PA	100 mL	Cool < 4°C, do not freeze H_2SO_4 preserved	48 hours
Total Kjedahl Nitrogen (TKN)	Surface Water	PA	250 mL	Cool < 4°C, do not freeze H_2SO_4 preserved	28 days
Total Phosphorous	Surface Water	PA	250 mL	Cool < 4°C, do not freeze H_2SO_4 preserved	28 days
Total Metals (Dissolved)	Surface Water	PA	250 mL	Cool < 4°C, do not freeze Filter in field or lab, HNO_3 preserved	6 months
Dissolved Organic Carbon	Surface Water	G	250 mL	Cool < 4°C, do not freeze Filter in field or lab, H_2SO_4 preserved	28 days
Mercury	Surface Water	PA	250 mL	Cool < 4°C, do not freeze, HNO_3 preserved	28 days
Hardness	Surface Water	PA	250 mL	Cool < 4°C, do not freeze Filter in field or lab, HNO_3 preserved	6 months
Macro-invertebrates	Biological	PA	NA	Fill jars 1/3 full with material and preserve with 95% ethanol	Indefinite

Notes:
G = glass, PA = autoclavable plastic, PC = polycarbonate

B.3 Sample Handling and Custody Requirements

B.3.1 Sample Custody Procedures

Samples and sample containers will be maintained in a secure environment from the time the bottles leave the laboratory until the samples are received at the laboratory. The laboratories will maintain custody of bottles and samples using their normal custody procedures.

Samples must be in the sampler's possession or in a cooler sealed with signed and dated friable evidence tape on opposing sides of the cooler. When the cooler is sealed, the method of securing the samples must be such that tampering with samples or bottles is not possible. The cooler must be secured so that the lid cannot be removed without breaking the evidence tape or cutting the lock.

Transfer of samples will be accomplished using the laboratory's Chain-of-Custody (COC) form. When samples are transferred between personnel, such transfer will be indicated on the COC form with signature, date, and time of transfer. The COC will remain with the samples, sealed inside the cooler, until received by the laboratory. DEC will provide a copy of the contracted lab COC for staff to use during field work.

If custody is broken at any time during sample transfer, a note must be made on the COC form accompanying the sample. Upon receipt at the laboratory, the laboratory sample custodian will make note if a breach of custody has occurred (for example, if a custody seal has broken during transport).

B.3.2 Shipping Requirements

Packaging, marking, labeling, and shipping of samples will comply with all regulations promulgated by the U. S. Department of Transportation in 49 CFR 171-177. Staff should receive the necessary training for shipping samples or consult with the contracted laboratory for shipping instructions.

Samples collected in glass bottles will be individually packaged in sealed plastic bags prior to storage in a cooler. Samples collected in plastic bottles may be placed in the cooler with sufficient padding (e.g., bubble wrap, cardboard, etc.) to limit movement of the bottles in the cooler during transport. The sealed plastic bags and plastic sample bottles will be placed into a bag-lined cooler with ice sealed in plastic bags or gel-ice/blue-ice to maintain a temperature of less than four degrees C. A temperature blank, 250 or 500 mL in size, will be placed in the cooler. Temperature will be measured prior to shipment and upon receipt at the lab. The chain of custody (COC) form will be placed in a plastic bag within the cooler. The cooler will be taped closed securely using packing tape at the last sampling site. If the cooler is being transported by the field crew member directly to the laboratory, tape is not mandatory.

The six-hour holding time limitation for the bacteria samples must be met. To accomplish this, this project will use a combination of transportation to get the samples from waterbodies to laboratory within the specified hold time. For those projects without laboratories in their communities, samples will be packaged at the sampling site, driven by car to the nearest airport, picked up by a courier, and then delivered to the laboratory. Other projects will deliver samples directly to the contracted laboratory. All regional offices will transport bacteria samples to contracted local labs for bacteria analysis. Water chemistry samples will be delivered to contracted local laboratories within 48 hours to meet the hold times. Macroinvertebrate samples will be sent to the contracted lab following sampling storage procedures laid out in the Sampling Protocols document (Witte 2020). All laboratories are listed in Table 8.

Table 8: Sample Transport Chain Information for Samples

Office	Business Type	Samples	Name	Address	Hours	Contact Information	Transport Leg	Estimated Transit Time
Anchorage*	Direct to laboratory	Bacteria & Water Chemistry	ARS Aleut Analytical	3710 Woodland Dr., Suite 900 Anchorage, AK 99517	M-F 8:00 am – 5:00 pm	(907) 258-2155	Motor Vehicle	90 minutes
Anchorage*	Direct to laboratory	Bacteria & Water Chemistry		200 West Potter Drive Anchorage, AK 99518	M-F 8:00 -			
Wasilla	Direct to laboratory	Bacteria & Water Chemistry	ARS Aleut Analytical	701 E Parks Hwy #206 Wasilla, AK 99654	M-W 8:00 am – 5:00 pm	(907) 373-5400	Motor Vehicle	60 minutes
Soldotna*	Direct to laboratory	Bacteria & Water Chemistry	ARS Aleut Analytical	3710 Woodland Dr., Suite 900 Anchorage, AK 99517	M-F 8:00 am – 5:00 pm	(907) 258-2155	Aircraft	3 hours
Juneau	Direct to laboratory	Bacteria	Admiralty Environmental, Inc.	641 W Willoughby Ave, Juneau, AK 99801	M-Th 8:00 am – 3:30 pm	(907) 463-4415	Motor Vehicle	30 minutes
		Water Chemistry	ARS Aleut Analytical	3710 Woodland Dr., Suite 900 Anchorage, AK 99517	M-F 8:00 am – 5:00 pm	(907) 258-2155	Aircraft	4 hours
Fairbanks	Direct to laboratory	Bacteria & Water Chemistry	ARS Aleut Analytical	475 Hall St. Fairbanks, AK 99701	M-W 8:00 am – 3:00 pm	(907) 456-3116	Motor Vehicle	60 minutes
All Offices	Direct to laboratory	Macros	Cole Ecological, Inc.	15 Bank Row, Suite B	-	(413) 774-5515	Aircraft	12 hours

				Greenfield, MA 01301				

*Bacteria samples must be dropped off at the Anchorage lab by 3:00 pm, Monday through Thursday.

B.4 Quality Control Requirements

Table 3 lists the percent of field and laboratory replicates to be used for quality control (see section A.6.2 for discussion on calculation of precision and accuracy). The precision of field and laboratory measures will be calculated using the equation in section A.6.2. Data measurements that do not meet the limits described in A.6.2 may or may not be used in the final report depending on degree to which limits are not met. However, the report will clearly flag any and all data of questionable value along with a brief description of the problem and any justification why data should be considered for use. Daily field records (a combination of electronic and paper field data sheets) will make up the main documentation for field activities. As soon after collection as possible, field notes, data sheets, and chain-of-custody forms will be scanned to create an electronic record. Field data will be hand-entered into the database.

An example Data Management Flow Chart (Figure 3) provides a visual summary description of the data flow/management process for environmental data collected in support of DEC's Division of Water decision making processes. Revisions may be made as appropriate for the monitoring project.

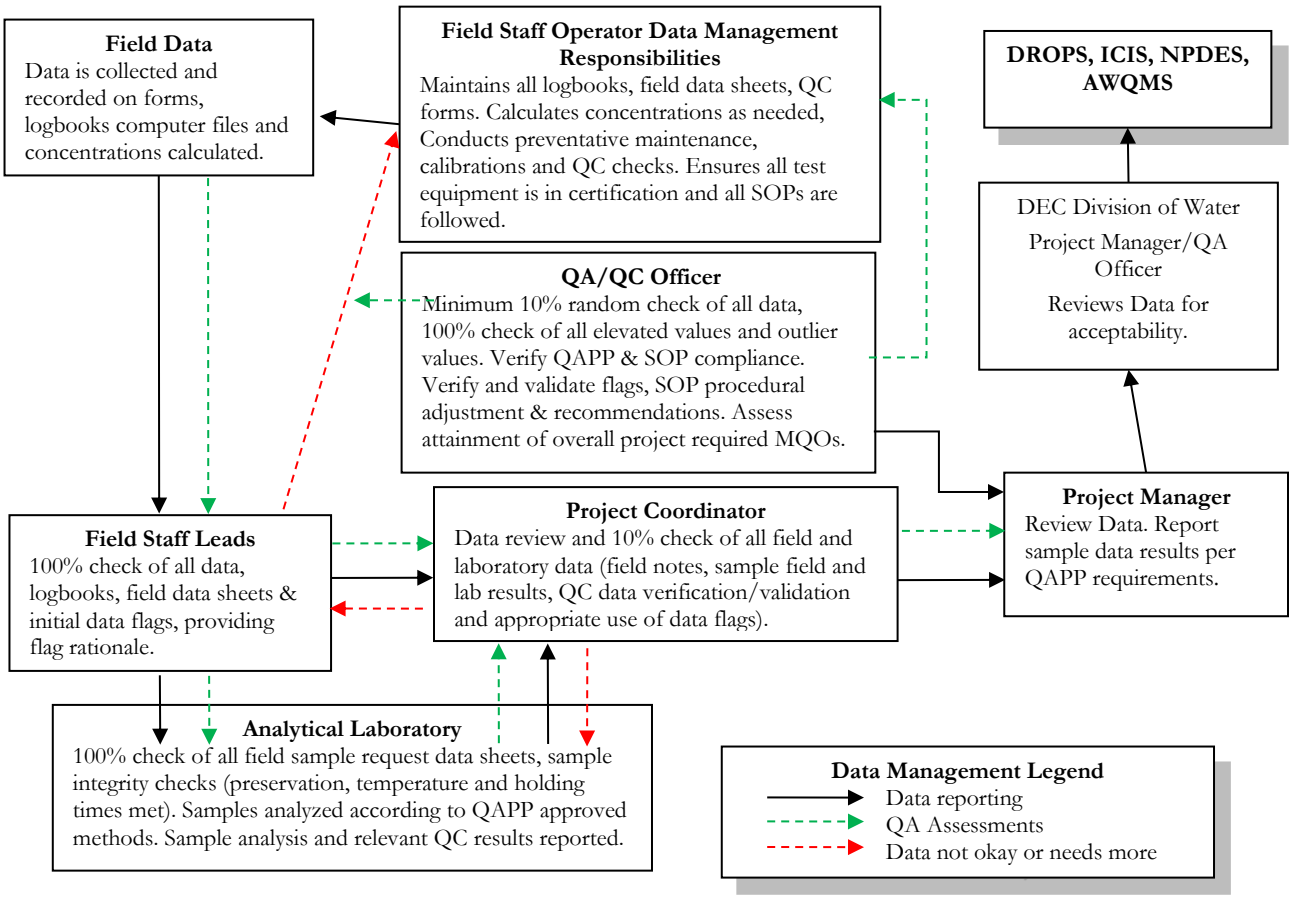


Figure 3. Data Management Flow Cart

Field sample replicates will be collected at a count of one sample per analyte per 10 sampling events (alternating between sampling locations). The water chemistry sample will be divided as needed for sample bottles per sampling round, according to laboratory instructions. Additional water samples will be collected

for E. coli and fecal population densities. Biological samples, up to four bottles, will be collected during expanded sampling procedures for benthic macroinvertebrate samples. The purpose of field sample replicates is to assess sampling and laboratory precision and overall method variability for the watershed monitoring project.

For laboratory analyses, contract laboratories will submit quality control results along with sample analytical results. Laboratory Quality Control will include duplicates, holding times, sample temperatures upon receipt of sample at lab and blanks. Laboratory precision criteria should be within WHADA MQO criteria provided in Section A.6.

B.4.1 Field Quality Control

Quality control activities in the field will include adherence to documented procedures and the comprehensive documentation of sample collection information included in electronic field survey. 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.

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 manufacturers 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 at a minimum of one sample for each analyte per sampling event.

Analytical methods used on the project have been approved and documented by EPA, Standard Methods, or ASTM. These methods will be used as project-specific protocols to document and guide analytical procedures. Adherence to these documented procedures will ensure that analytical results are properly obtained and reported.

B.4.2 Laboratory Quality Control (QC) Measures

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

Laboratories detail QC procedures used in their laboratory Quality Assurance Plan and method specific SOPs 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).
- Specific QC activities prescribed in the project's QAPP.

- Laboratory data verification and validation prior to sending data results to DEC.

Contracted and sub-contracted laboratories 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.

B.4.3 QA Reports to Management

Following field and laboratory quality control measurements, quality analysis reports will be filed with the Project Coordinator and/or Project Manager. Table 9 details the report requirements for submittal to the Project Coordinator and/or Project Manager.

Table 9: QA Reports to Management

QA Report Type	Contents	Presentation Method	Report Issued by	Reporting Frequency	
				As Required	Annual
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/ Coordinator/ Manager	✔	1/ Office
Corrective Action Recommendation	Description of problem(s); recommended action(s) required; time frame for feedback on resolution of problem(s)	Written text/table	Project QA Officer/ Coordinator/ Manager	✔	
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/ Coordinator 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	Project QA Officer	✔	
Quality Assurance Report to Management	Project executive summary: data completeness, precision, bias/ accuracy	Written text and charts, graphs displaying results	Project QA Officer	✔	✔

B.5 Instrument Calibration and Frequency

Field instruments shall 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 electronic field datasheets or equipment logs. When field instruments require only periodic calibration, the record of this calibration should be kept with the instrument. The Project Coordinator will delegate a field project team member to ensure that instruments are calibrated correctly and appropriate documents recorded and retained. Sensors for field equipment (i.e., temperature, pH, and conductivity) will be replaced according to manufacturer's recommendations. If abnormal readings occur, the manufacturer will be contacted for assistance or replacement of field equipment. Field project team members will follow the QA Checklist document in the Watershed Health and Data Analysis files to calibrate, verify, and validate field equipment readings.

Contracted and 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 DEC upon request.

B.6 Inspection/Acceptance of Supplies and Consumables

All reagents, calibration standards, and kit chemicals are to be inspected to ensure that expiration dates have not been exceeded prior to use in the monitoring project.

Pre-cleaned sample containers will be obtained from the lab with the appropriate preservation method included. Coolers, gel ice, temperature blanks, and chain-of-custody forms will be provided by the contract laboratory prior to field mobilization. Qualified staff will check all field equipment and supplies to ensure that their technical specifications have been met before use. Any deviances during inspection procedures will be remedied by the project manager and recorded in the electronic or paper field data sheets. If re-sampling becomes necessary, replacements will be made.

No standards, 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 field data sheets, 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.7 Data Acquisition Requirements (Non-Direct Measurements)

Topographic non-direct measurements (e.g., maps, charts) will be conducted using USGS derived materials. All geographical materials will be listed according to their source, year, and scale. GPS information will be documented by including collection device make and model number, geographic coordinate system, degree of accuracy (minimum of three satellite signals), and calibration information. GIS information will include GIS software program and model, source information, and geographic coordinate system.

C. Assessment and Oversight

C.1 Assessment and Response Actions

Assessment audits are independent evaluations of the monitoring project that are performed by the Project's QA Officer or his/her designee. These audits may include (but are not limited to) any of the following: on-site field surveillance, on-site laboratory audits, performance evaluation samples, blind sample duplicates/ replicates (precision samples), field split samples, data quality audits, and/or data reviews. The number and types of assessments are dependent upon the monitoring project's intended data uses.

C.1.1 On-Site assessments to be performed under the WHADA Program

- One on-site field audit will be completed at each regional office to evaluate sampling protocols and survey techniques. Audits will evaluate whether procedures used for sample collection, preservation, shipping and hold times, and sample receipt at lab are in compliance with QAPP requirements.

C.1.2 Project Data Assessments

- Audits of Monitoring Data for reproducibility of results from recalculation/reconstruction of field/lab data.
- Calculation of monitoring project's overall achieved precision, accuracy, and data completeness compared to QAPP defined precision, accuracy, and data completeness goals. Method specific precision, accuracy, and data completeness criteria are specified in the Project MQO Table 3 of section A.6.2.
- End of monitoring project QA summary report. Describes whether project data quality objectives and measurement quality objectives were obtained. Identifies whether exceedances of Alaska's Water Quality Standards were measured, attainment with CALM metrics, water quality monitoring problems encountered, and corrective actions that were taken.

C.2 Revisions to QAPP

This QAPP will be reviewed and revised annually or earlier as needed. Minor revisions may be made without formal comment. Such minor revisions may include changes to identified project staff, QAPP distribution list, and or minor editorial changes.

Revisions to the QAPP that affect state 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 Manager or Coordinator before being implemented.

D. References

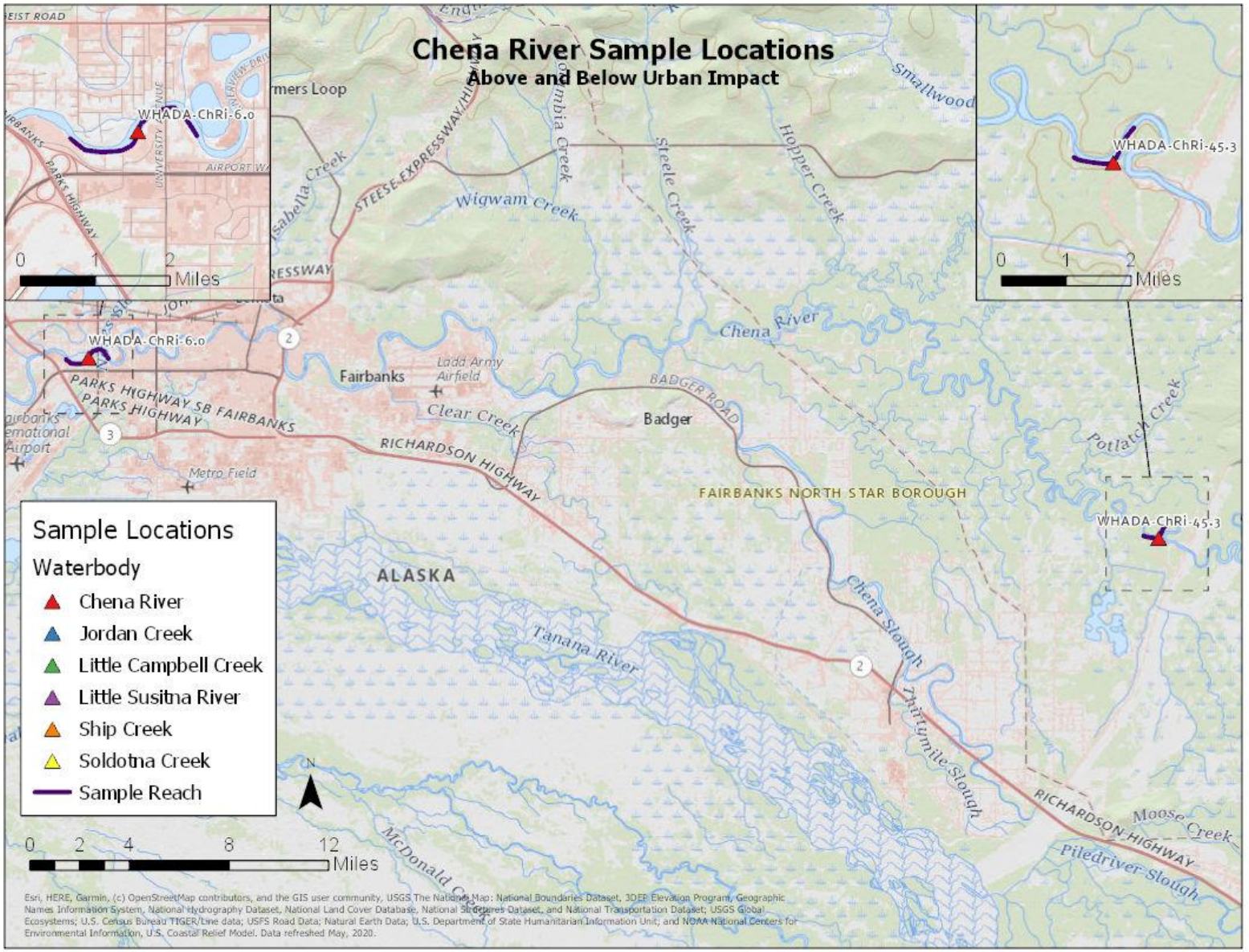
Bureau of Land Management. 2017. AIM National Aquatic Monitoring Framework: Field Protocol for Wadeable Lotic Systems. Tech Ref 1735-2. U.S. Department of the Interior, Bureau of Land Management, National Operations Center, Denver, CO.

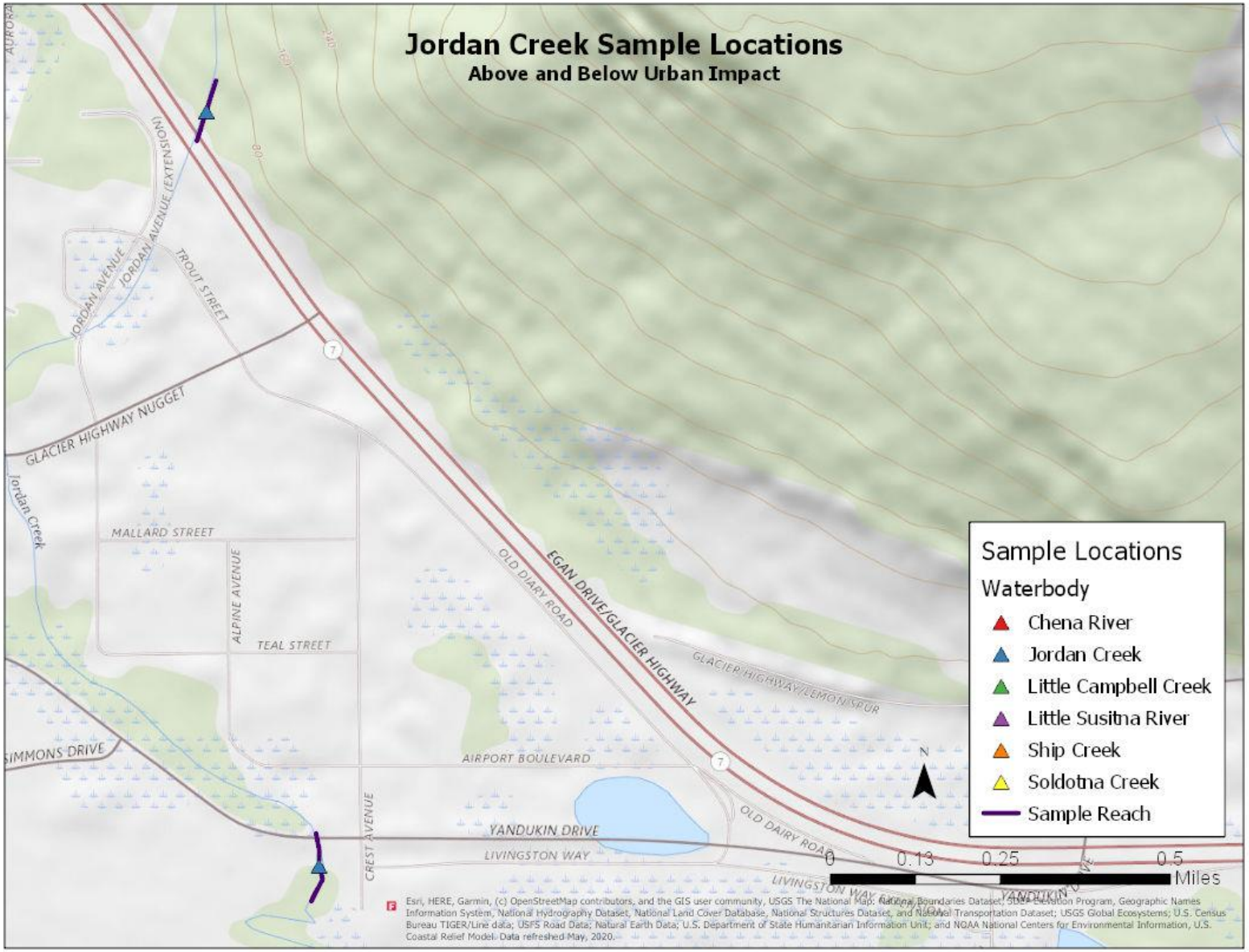
USEPA. 2013. Great Lakes Beach Sanitary Survey User Manual. EPA-823-B-06-001. U.S. Environmental Protection Agency, Office of Water Washington, DC.

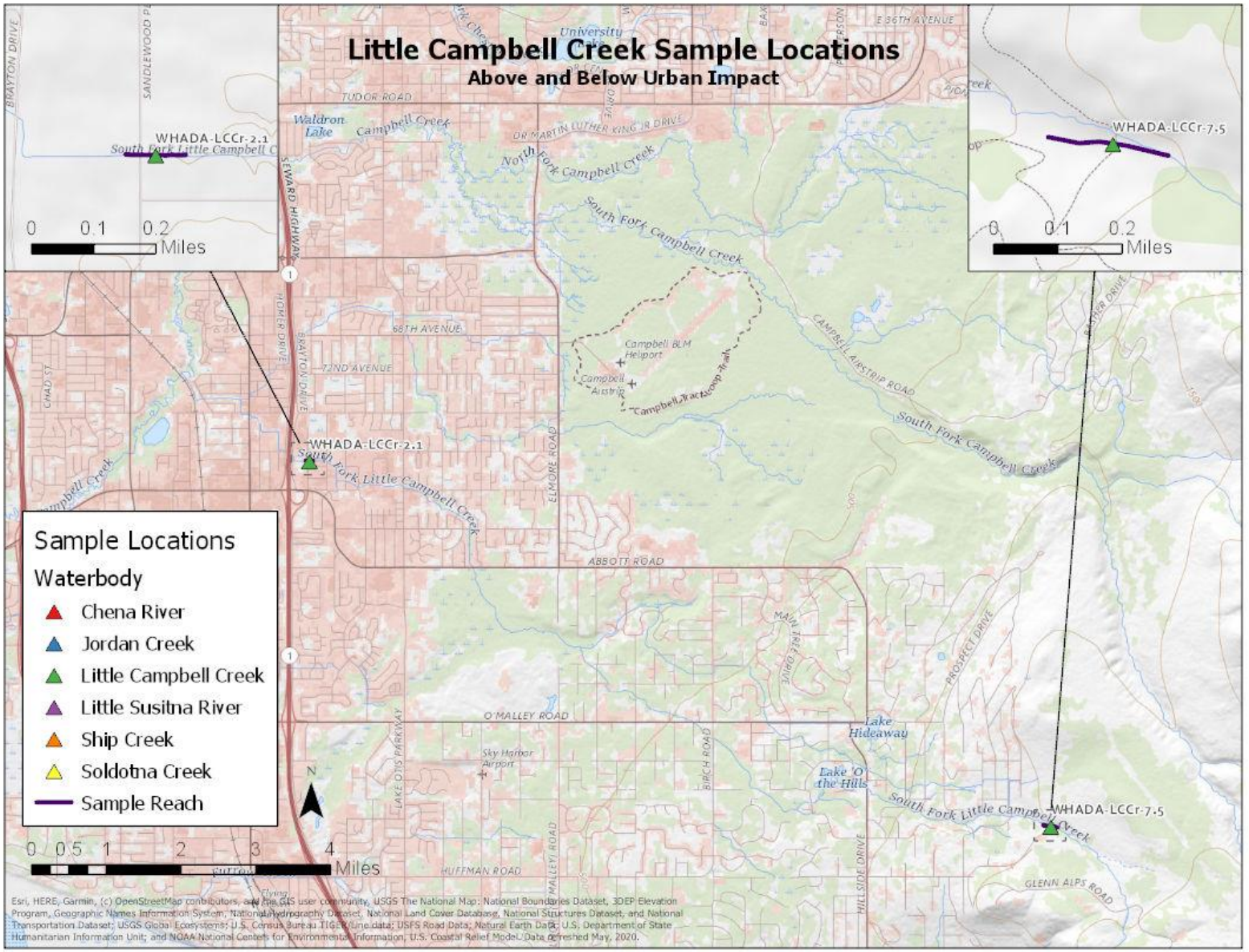
USEPA. 2017. National Rivers and Streams Assessment 2018/19: Field Operations Manual – Wadeable. EPA-841-B-17-003a. U.S. Environmental Protection Agency, Office of Water Washington, DC.

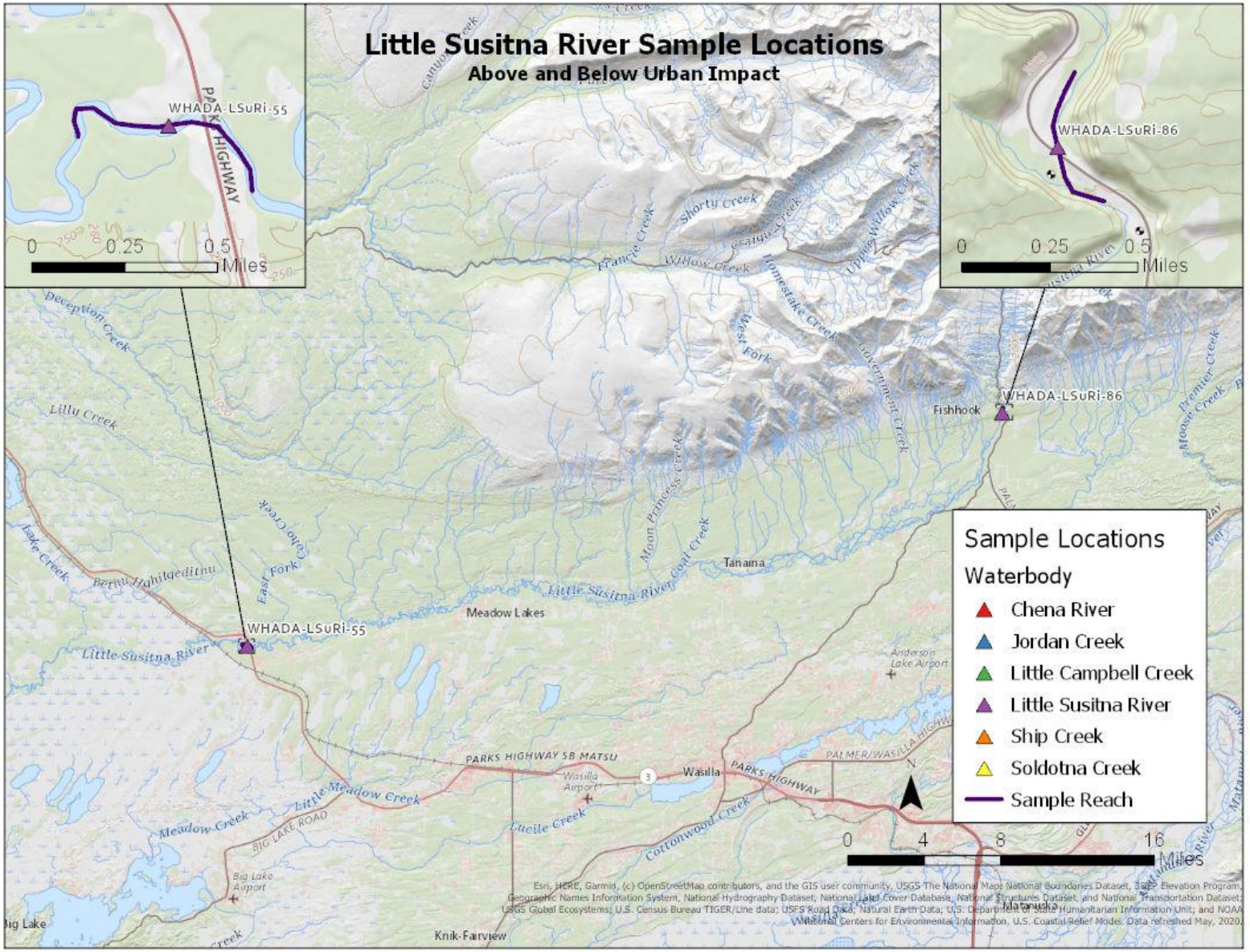
Appendix A

Sample Location Maps


Chena River Sample Locations
Above and Below Urban Impact
WHADA-ChRi-6.0
WHADA-ChRi-45.3
Fairbanks
Ladd Army Airfield
Badger
Metro Field
Chena River
Clear Creek
Wigwam Creek
Steele Creek
Hopper Creek
Columbia Creek
Isabella Creek
Smallwood
Potlatch Creek
Chena Slough
Tanana River
Piledriver Slough
Moose Creek
McDonald Creek
PARKS HIGHWAY
PARKS HIGHWAY SB FAIRBANKS
RICHARDSON HIGHWAY
STEESE EXPRESSWAY
BADGER ROAD
AIRPORT WAY
UNIVERSITY AVENUE
FAIRBANKS NORTH STAR BOROUGH
ALASKA
Sample Locations
Waterbody
Chena River
Jordan Creek
Little Campbell Creek
Little Susitna River
Ship Creek
Soldotna Creek
Sample Reach
0 2 4 8 12
Miles
0 1 2
Miles
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community, USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed May, 2020.


Jordan Creek Sample Locations
Above and Below Urban Impact
Sample Locations
Waterbody
Chena River
Jordan Creek
Little Campbell Creek
Little Susitna River
Ship Creek
Soldotna Creek
Sample Reach
0
0.13
0.25
0.5
Miles
N
GLACIER HIGHWAY NUGGET
JORDAN AVENUE
JORDAN AVENUE/EXTENSION
TROUT STREET
Jordan Creek
MALLARD STREET
ALPINE AVENUE
TEAL STREET
EGAN DRIVE/GLACIER HIGHWAY
OLD DIARY ROAD
GLACIER HIGHWAY/LEMON SPUR
AIRPORT BOULEVARD
SIMMONS DRIVE
CREST AVENUE
YANDUKIN DRIVE
LIVINGSTON WAY
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community, USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed May, 2020.


Little Campbell Creek Sample Locations
Above and Below Urban Impact
WHADA-LCCr-2.1
WHADA-LCCr-7.5
Sample Locations
Waterbody
Chena River
Jordan Creek
Little Campbell Creek
Little Susitna River
Ship Creek
Soldotna Creek
Sample Reach
0 0.1 0.2 Miles
0 0.5 1 2 3 4 Miles
TUDOR ROAD
DR MARTIN LUTHER KING JR DRIVE
68TH AVENUE
72ND AVENUE
ABBOTT ROAD
O'MALLEY ROAD
HUFFMAN ROAD
GLENN ALPS ROAD
SEWARD HIGHWAY
BRAYTON DRIVE
ELMORE ROAD
CAMPBELL AIRSTRIP ROAD
PROSPECT DRIVE
HILLSIDE DRIVE
BIRCH ROAD
LAKE OTIS PARKWAY
Waldron Lake
Campbell Creek
North Fork Campbell Creek
South Fork Campbell Creek
South Fork Little Campbell Creek
Campbell BLM Heliport
Campbell Airstrip
Campbell Tract Loop Trail
Lake Hideaway
Lake 'O' the Hills
Sky Harbor Airport
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community, USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed May, 2020.


Little Susitna River Sample Locations
Above and Below Urban Impact
WHADA-LSuRi-55
WHADA-LSuRi-86
PARKS HIGHWAY
0 0.25 0.5 Miles
Sample Locations
Waterbody
Chena River
Jordan Creek
Little Campbell Creek
Little Susitna River
Ship Creek
Soldotna Creek
Sample Reach
0 4 8 16 Miles
Meadow Lakes
Tanaina
Fishhook
Wasilla
Knik-Fairview
Big Lake
Little Susitna River
Deception Creek
Lilly Creek
Lake Creek
Berry Highlgeditthu
East Fork Cabin Creek
Moon Princess Creek
Coat Creek
Little Susitna River
Meadow Creek
Little Meadow Creek
Lucile Creek
Cottonwood Creek
Shorty Creek
Craigie Creek
Francie Creek
Willow Creek
Upper Willow Creek
Homestake Creek
West Fork
Government Creek
Moose Creek
Premier Creek
PARKS HIGHWAY SB MATSU
PALMER/WASILLA HIGHWAY
BIG LAKE ROAD
Wasilla Airport
Big Lake Airport
Anderson Lake Airport
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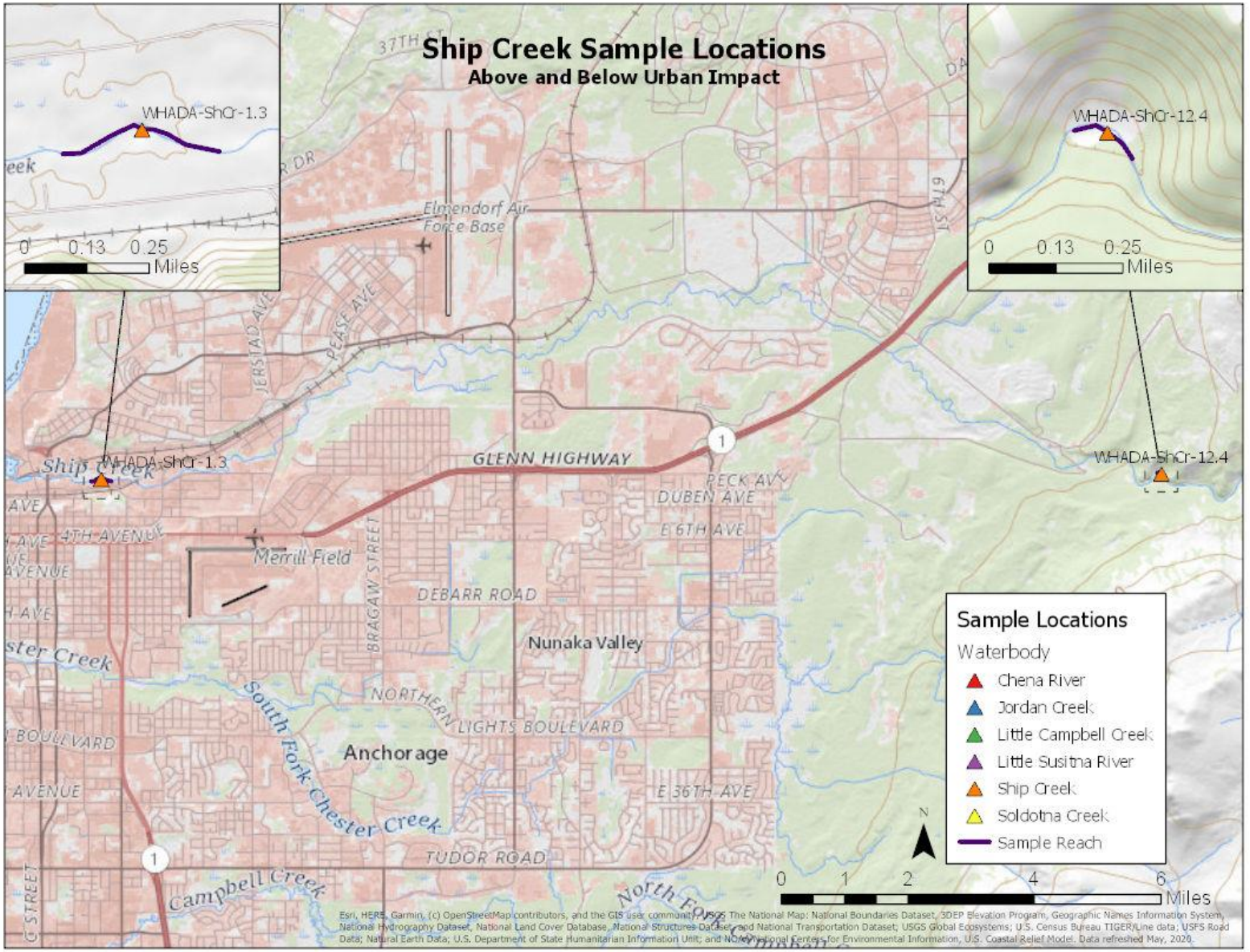
Ship Creek Sample Locations
Above and Below Urban Impact
WHADA-ShCr-1.3
WHADA-ShCr-12.4
0 0.13 0.25 Miles
Elmendorf Air Force Base
GLENN HIGHWAY
Merrill Field
DEBARR ROAD
Nunaka Valley
Anchorage
South Fork Chester Creek
Campbell Creek
TUDOR ROAD
E 36TH AVE
E 6TH AVE
DUBEN AVE
PECK AVE
BRAGAW STREET
NORTHERN LIGHTS BOULEVARD
Sample Locations
Waterbody
Chena River
Jordan Creek
Little Campbell Creek
Little Susitna River
Ship Creek
Soldotna Creek
Sample Reach
N
0 1 2 4 6 Miles
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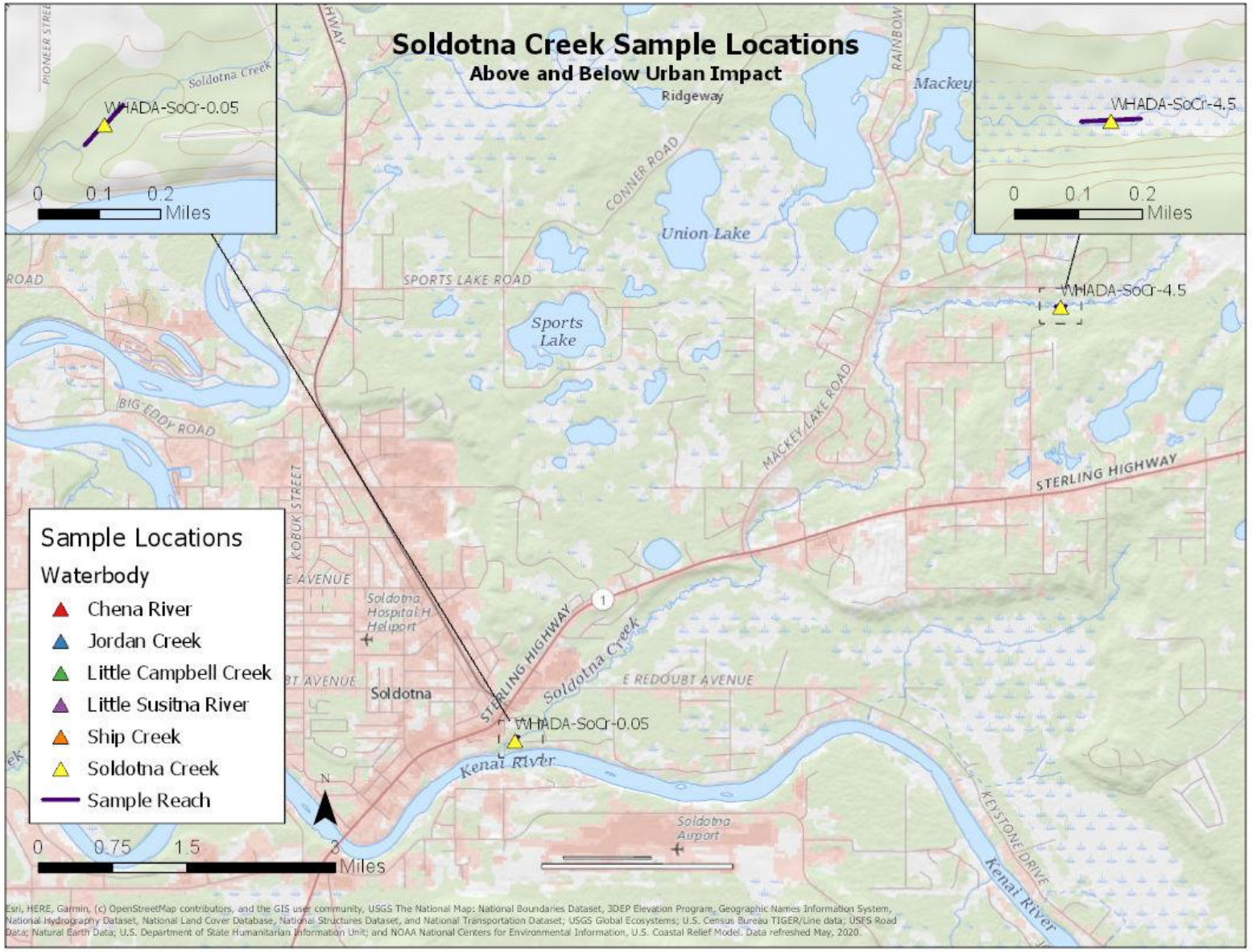
Soldotna Creek Sample Locations
Above and Below Urban Impact
WHADA-SoCr-0.05
WHADA-SoCr-4.5
0 0.1 0.2 Miles
Sample Locations
Waterbody
Chena River
Jordan Creek
Little Campbell Creek
Little Susitna River
Ship Creek
Soldotna Creek
Sample Reach
0 0.75 1.5 3 Miles
Ridgeway
Mackey
Union Lake
Sports Lake
SPORTS LAKE ROAD
CONNER ROAD
BIG EDDY ROAD
MACKEY LAKE ROAD
STERLING HIGHWAY
KOBUK STREET
E REDOUBT AVENUE
Soldotna
Soldotna Hospital Heliport
Soldotna Creek
Kenai River
Soldotna Airport
KEYSTONE DRIVE
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Appendix B

Sample Survey

WHADA Survey						
Date:		Sample ID:				
Crew Leader:			Sample Site Comments:			
Crew Member:						
Crew Member:						
Site Sampled:	O Yes	O No				
Site Conditions						
Site Verification Location	O X-Site (Mid-Stream)	O X-Site (Bank)	X-Site Elevation (m):			
How recent was the last rain?	O Less than 24 hrs	O More than 24 hrs	O More than 48 hrs	O More than 72 hrs		
Last rain intensity	O Misting	O Light Rain	O Steady Rain	O Heavy Rain	O Other	
Weather Conditions	O Clear	O Partly Cloudy	O Mostly Cloudy	O Raining	O Hailing	O Snowing
Beaver Signs	O Absent	O Rare	O Common	Last Rainfall (Inches)		
Beaver Flow Modifications	O None	O Minor	O Major	Water Withdrawals	O Absent	O Present
Water Chemistry (Field and Lab Samples)						
Operator		Time Collected:				
Instrument Type:		Instrument Serial Number:				
Where did you deploy the sonde at the sample site?	O X-Site	O Other				
Parameters						
Did you collect a 15 minute recording?	O Yes	O No	Comments:			
Air Temperature (°C)						
Pathogens						
Pathogens sampled:	O E. Coli	O Fecal Coliform	Pathogen sample collection location	O X-Site	O Other	
Time Collected (hh:mm):			Depth Collected (m):			
Time Delivered to Lab (hh:mm):			Sample Volume (mL):			
Sanitary Survey Questions						
Height of Waves (m):		Wave Intensity:	O Calm	O Normal	O Rough	
Algae Present?	O Yes	O No	Floatable Litter Present:	O Yes	O No	
Living Wildlife Present:	O Yes Number: ___	O No	Deceased Wildlife Present:	O Yes, Number: ____	O No	Total People at Site

Wildlife Species Comment:	

Benthic Macroinvertebrates						
Number of Transects Collected: (Out of 11 Total)		Number of Jars Collected:		Did you preserve your sample in the field?	O Yes	O No
Benthic Comments:						

Discharge			
Velocity Area:		Stream Gage:	
Discharge Wetted Width (m):		Stream Gage Name/SN:	
VA Q Value (m^3/s)		Stream Gage Q Value (m^3/s)	
Discharge Comments:			

Physical Habitat			
Bankfull Width 1 (m):		Average Bankfull (m) (BW1+BW2+BW3+BW4+BW5)/5	
Bankfull Width 2 (m):		**Total Reach** Average Bankfull * 20 or a *minimum* of 150m	
Bankfull Width 3 (m):			
Bankfull Width 4 (m):		**Transect Length (m):** Total Reach/10	
Bankfull Width 5 (m):			

Transect A

Fish Cover
0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)

Category	0	1	2	3	4
Filamentous Algae	O 0	O 1	O 2	O 3	O 4
Macrophytes	O 0	O 1	O 2	O 3	O 4
Woody Debris > 0.3m (Big)	O 0	O 1	O 2	O 3	O 4
Brush/Woody Debris <0.3 (Small)	O 0	O 1	O 2	O 3	O 4
Live Trees or Roots	O 0	O 1	O 2	O 3	O 4
Overhanging Vegetation =<1m of Surface	O 0	O 1	O 2	O 3	O 4
Undercut Banks	O 0	O 1	O 2	O 3	O 4

Boulders	O 0	O 1	O 2	O 3	O 4
Artificial Structures	O 0	O 1	O 2	O 3	O 4

Bank Measurements
Note: If an undercut bank, measure bank angle as 180 – measured angle

Left Bank Angle:		Left Bank Undercut Distance (m):		Wetted Width (m):	
Right Bank Angle		Right Bank Undercut Distance (m):		Bar Width (m):	
Bankfull Width (m):		Bankfull Height (m):		Incised Height (m):	

Canopy Cover
Densiometer (0-17 Max)

Center Up		Center Right		Center Left	
Center Down		Left		Right	

Riparian Vegetation Cover Type
D = Deciduous, C = Coniferous, E = Broadleaf Evergreen, M = Mixed, N = None
0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)

		Left Bank					Right Bank				
Canopy (>5m high)	Canopy Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	BIG Trees (Trunk>0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Small Trees (Trunk < 0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Understory (0.5 – 5m high)	Understory Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Ground Cover (<0.5mhigh)	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4

Human Influence
0 = Not Present, P >= 10m plot, C = Within 10m plot, B = On bank

Wall/Dike/Revetment/ Riprap/Dam	O 0	O P	O C	O B	O 0	O P	O C	O B
Buildings	O 0	O P	O C	O B	O 0	O P	O C	O B
Pavement/Cleared Lot	O 0	O P	O C	O B	O 0	O P	O C	O B
Road/Railroad	O 0	O P	O C	O B	O 0	O P	O C	O B
Pipes (Inlet/Outlet)	O 0	O P	O C	O B	O 0	O P	O C	O B
Landfill/Trash	O 0	O P	O C	O B	O 0	O P	O C	O B
Park/Lawn	O 0	O P	O C	O B	O 0	O P	O C	O B
Row Crops	O 0	O P	O C	O B	O 0	O P	O C	O B
Pasture/Range/ Hayfield	O 0	O P	O C	O B	O 0	O P	O C	O B

Logging Operations	O 0	O P	O C	O B	O 0	O P	O C	O B
Mining Operations	O 0	O P	O C	O B	O 0	O P	O C	O B

Transect A Comments:	

Transect B

Fish Cover
0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)

Category	O 0	O 1	O 2	O 3	O 4
Filamentous Algae	O 0	O 1	O 2	O 3	O 4
Macrophytes	O 0	O 1	O 2	O 3	O 4
Woody Debris > 0.3m (Big)	O 0	O 1	O 2	O 3	O 4
Brush/Woody Debris <0.3 (Small)	O 0	O 1	O 2	O 3	O 4
Live Trees or Roots	O 0	O 1	O 2	O 3	O 4
Overhanging Vegetation =<1m of Surface	O 0	O 1	O 2	O 3	O 4
Undercut Banks	O 0	O 1	O 2	O 3	O 4
Boulders	O 0	O 1	O 2	O 3	O 4
Artificial Structures	O 0	O 1	O 2	O 3	O 4

Bank Measurements
Note: If an undercut bank, measure bank angle as 180 – measured angle

Left Bank Angle:		Left Bank Undercut Distance (m):		Wetted Width (m):	
Right Bank Angle		Right Bank Undercut Distance (m):		Bar Width (m):	
Bankfull Width (m):		Bankfull Height (m):		Incised Height (m):	

Canopy Cover
Densiometer (0-17 Max)

Center Up		Center Right		Center Left	
Center Down		Left		Right	

Riparian Vegetation Cover Type
D = Deciduous, C = Coniferous, E = Broadleaf Evergreen, M = Mixed, N = None
0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)

		Left Bank					Right Bank				
Canopy	Canopy Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N

	BIG Trees (Trunk>0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Small Trees (Trunk < 0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Understory (0.5 – 5m high)	Understory Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Ground Cover (<0.5mhigh)	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4

Human Influence 0 = Not Present, P >= 10m plot, C = Within 10m plot, B = On bank								
Wall/Dike/Revetment/ Riprap/Dam	O 0	O P	O C	O B	O 0	O P	O C	O B
Buildings	O 0	O P	O C	O B	O 0	O P	O C	O B
Pavement/Cleared Lot	O 0	O P	O C	O B	O 0	O P	O C	O B
Road/Railroad	O 0	O P	O C	O B	O 0	O P	O C	O B
Pipes (Inlet/Outlet)	O 0	O P	O C	O B	O 0	O P	O C	O B
Landfill/Trash	O 0	O P	O C	O B	O 0	O P	O C	O B
Park/Lawn	O 0	O P	O C	O B	O 0	O P	O C	O B
Row Crops	O 0	O P	O C	O B	O 0	O P	O C	O B
Pasture/Range/ Hayfield	O 0	O P	O C	O B	O 0	O P	O C	O B
Logging Operations	O 0	O P	O C	O B	O 0	O P	O C	O B
Mining Operations	O 0	O P	O C	O B	O 0	O P	O C	O B

Transect B Comments:	

Transect C					
Fish Cover 0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)					
Category	O 0	O 1	O 2	O 3	O 4
Filamentous Algae	O 0	O 1	O 2	O 3	O 4
Macrophytes	O 0	O 1	O 2	O 3	O 4
Woody Debris > 0.3m (Big)	O 0	O 1	O 2	O 3	O 4
Brush/Woody Debris <0.3 (Small)	O 0	O 1	O 2	O 3	O 4
Live Trees or Roots	O 0	O 1	O 2	O 3	O 4

Overhanging Vegetation =<1m of Surface	O 0	O 1	O 2	O 3	O 4
Undercut Banks	O 0	O 1	O 2	O 3	O 4
Boulders	O 0	O 1	O 2	O 3	O 4
Artificial Structures	O 0	O 1	O 2	O 3	O 4

Bank Measurements
Note: If an undercut bank, measure bank angle as 180 – measured angle

Left Bank Angle:		Left Bank Undercut Distance (m):		Wetted Width (m):	
Right Bank Angle		Right Bank Undercut Distance (m):		Bar Width (m):	
Bankfull Width (m):		Bankfull Height (m):		Incised Height (m):	

Canopy Cover
Densiometer (0-17 Max)

Center Up		Center Right		Center Left	
Center Down		Left		Right	

Riparian Vegetation Cover Type
D = Deciduous, C = Coniferous, E = Broadleaf Evergreen, M = Mixed, N = None
0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)

		Left Bank					Right Bank				
Canopy (>5m high)	Canopy Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	BIG Trees (Trunk>0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Small Trees (Trunk < 0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Understory (0.5 – 5m high)	Understory Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Ground Cover (<0.5mhigh)	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4

Human Influence
0 = Not Present, P >= 10m plot, C = Within 10m plot, B = On bank

Wall/Dike/Revetment/ Riprap/Dam	O 0	O P	O C	O B	O 0	O P	O C	O B
Buildings	O 0	O P	O C	O B	O 0	O P	O C	O B
Pavement/Cleared Lot	O 0	O P	O C	O B	O 0	O P	O C	O B
Road/Railroad	O 0	O P	O C	O B	O 0	O P	O C	O B
Pipes (Inlet/Outlet)	O 0	O P	O C	O B	O 0	O P	O C	O B

Landfill/Trash	O 0	O P	O C	O B	O 0	O P	O C	O B
Park/Lawn	O 0	O P	O C	O B	O 0	O P	O C	O B
Row Crops	O 0	O P	O C	O B	O 0	O P	O C	O B
Pasture/Range/ Hayfield	O 0	O P	O C	O B	O 0	O P	O C	O B
Logging Operations	O 0	O P	O C	O B	O 0	O P	O C	O B
Mining Operations	O 0	O P	O C	O B	O 0	O P	O C	O B

Transect C Comments:	

Transect D

Fish Cover
0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)

Category	O 0	O 1	O 2	O 3	O 4
Filamentous Algae	O 0	O 1	O 2	O 3	O 4
Macrophytes	O 0	O 1	O 2	O 3	O 4
Woody Debris > 0.3m (Big)	O 0	O 1	O 2	O 3	O 4
Brush/Woody Debris <0.3 (Small)	O 0	O 1	O 2	O 3	O 4
Live Trees or Roots	O 0	O 1	O 2	O 3	O 4
Overhanging Vegetation =<1m of Surface	O 0	O 1	O 2	O 3	O 4
Undercut Banks	O 0	O 1	O 2	O 3	O 4
Boulders	O 0	O 1	O 2	O 3	O 4
Artificial Structures	O 0	O 1	O 2	O 3	O 4

Bank Measurements
Note: If an undercut bank, measure bank angle as 180 – measured angle

Left Bank Angle:		Left Bank Undercut Distance (m):		Wetted Width (m):	
Right Bank Angle		Right Bank Undercut Distance (m):		Bar Width (m):	
Bankfull Width (m):		Bankfull Height (m):		Incised Height (m):	

Canopy Cover
Densiometer (0-17 Max)

Center Up		Center Right		Center Left	
Center Down		Left		Right	

Riparian Vegetation Cover Type
D = Deciduous, C = Coniferous, E = Broadleaf Evergreen, M = Mixed, N = None
0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)

		Left Bank					Right Bank				
Canopy (>5m high)	Canopy Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	BIG Trees (Trunk>0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Small Trees (Trunk < 0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Understory (0.5 – 5m high)	Understory Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Ground Cover (<0.5mhigh)	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4

Human Influence
0 = Not Present, P >= 10m plot, C = Within 10m plot, B = On bank

Wall/Dike/Revetment/ Riprap/Dam	O 0	O P	O C	O B	O 0	O P	O C	O B
Buildings	O 0	O P	O C	O B	O 0	O P	O C	O B
Pavement/Cleared Lot	O 0	O P	O C	O B	O 0	O P	O C	O B
Road/Railroad	O 0	O P	O C	O B	O 0	O P	O C	O B
Pipes (Inlet/Outlet)	O 0	O P	O C	O B	O 0	O P	O C	O B
Landfill/Trash	O 0	O P	O C	O B	O 0	O P	O C	O B
Park/Lawn	O 0	O P	O C	O B	O 0	O P	O C	O B
Row Crops	O 0	O P	O C	O B	O 0	O P	O C	O B
Pasture/Range/ Hayfield	O 0	O P	O C	O B	O 0	O P	O C	O B
Logging Operations	O 0	O P	O C	O B	O 0	O P	O C	O B
Mining Operations	O 0	O P	O C	O B	O 0	O P	O C	O B

Transect D Comments:	

Transect E

Fish Cover
0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)

Category	O 0	O 1	O 2	O 3	O 4
Filamentous Algae	O 0	O 1	O 2	O 3	O 4
Macrophytes	O 0	O 1	O 2	O 3	O 4
Woody Debris > 0.3m (Big)	O 0	O 1	O 2	O 3	O 4
Brush/Woody Debris <0.3 (Small)	O 0	O 1	O 2	O 3	O 4
Live Trees or Roots	O 0	O 1	O 2	O 3	O 4
Overhanging Vegetation =<1m of Surface	O 0	O 1	O 2	O 3	O 4
Undercut Banks	O 0	O 1	O 2	O 3	O 4
Boulders	O 0	O 1	O 2	O 3	O 4
Artificial Structures	O 0	O 1	O 2	O 3	O 4

Bank Measurements
Note: If an undercut bank, measure bank angle as 180 – measured angle

Left Bank Angle:		Left Bank Undercut Distance (m):		Wetted Width (m):	
Right Bank Angle		Right Bank Undercut Distance (m):		Bar Width (m):	
Bankfull Width (m):		Bankfull Height (m):		Incised Height (m):	

Canopy Cover
Densiometer (0-17 Max)

Center Up		Center Right		Center Left	
Center Down		Left		Right	

Riparian Vegetation Cover Type
D = Deciduous, C = Coniferous, E = Broadleaf Evergreen, M = Mixed, N = None
0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)

		Left Bank					Right Bank				
Canopy (>5m high)	Canopy Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	BIG Trees (Trunk>0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Small Trees (Trunk < 0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Understory (0.5 – 5m high)	Understory Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Ground Cover (<0.5mhigh)	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4

Human Influence
0 = Not Present, P >= 10m plot, C = Within 10m plot, B = On bank

Wall/Dike/Revetment/ Riprap/Dam	O 0	O P	O C	O B	O 0	O P	O C	O B
Buildings	O 0	O P	O C	O B	O 0	O P	O C	O B
Pavement/Cleared Lot	O 0	O P	O C	O B	O 0	O P	O C	O B
Road/Railroad	O 0	O P	O C	O B	O 0	O P	O C	O B
Pipes (Inlet/Outlet)	O 0	O P	O C	O B	O 0	O P	O C	O B
Landfill/Trash	O 0	O P	O C	O B	O 0	O P	O C	O B
Park/Lawn	O 0	O P	O C	O B	O 0	O P	O C	O B
Row Crops	O 0	O P	O C	O B	O 0	O P	O C	O B
Pasture/Range/ Hayfield	O 0	O P	O C	O B	O 0	O P	O C	O B
Logging Operations	O 0	O P	O C	O B	O 0	O P	O C	O B
Mining Operations	O 0	O P	O C	O B	O 0	O P	O C	O B

Transect E Comments:	

Transect F

Fish Cover
0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)

Category	O 0	O 1	O 2	O 3	O 4
Filamentous Algae	O 0	O 1	O 2	O 3	O 4
Macrophytes	O 0	O 1	O 2	O 3	O 4
Woody Debris > 0.3m (Big)	O 0	O 1	O 2	O 3	O 4
Brush/Woody Debris <0.3 (Small)	O 0	O 1	O 2	O 3	O 4
Live Trees or Roots	O 0	O 1	O 2	O 3	O 4
Overhanging Vegetation =<1m of Surface	O 0	O 1	O 2	O 3	O 4
Undercut Banks	O 0	O 1	O 2	O 3	O 4
Boulders	O 0	O 1	O 2	O 3	O 4
Artificial Structures	O 0	O 1	O 2	O 3	O 4

Bank Measurements
Note: If an undercut bank, measure bank angle as 180 – measured angle

Left Bank Angle:		Left Bank Undercut Distance (m):		Wetted Width (m):	
Right Bank Angle		Right Bank Undercut Distance (m):		Bar Width (m):	

Bankfull Width (m):		Bankfull Height (m):		Incised Height (m):	
Canopy Cover Densiometer (0-17 Max)					
Center Up		Center Right		Center Left	
Center Down		Left		Right	

Riparian Vegetation Cover Type
D = Deciduous, C = Coniferous, E = Broadleaf Evergreen, M = Mixed, N = None
0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)

		Left Bank					Right Bank				
Canopy (>5m high)	Canopy Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	BIG Trees (Trunk>0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Small Trees (Trunk < 0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Understory (0.5 – 5m high)	Understory Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Ground Cover (<0.5mhigh)	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4

Human Influence
0 = Not Present, P >= 10m plot, C = Within 10m plot, B = On bank

Wall/Dike/Revetment/ Riprap/Dam	O 0	O P	O C	O B	O 0	O P	O C	O B
Buildings	O 0	O P	O C	O B	O 0	O P	O C	O B
Pavement/Cleared Lot	O 0	O P	O C	O B	O 0	O P	O C	O B
Road/Railroad	O 0	O P	O C	O B	O 0	O P	O C	O B
Pipes (Inlet/Outlet)	O 0	O P	O C	O B	O 0	O P	O C	O B
Landfill/Trash	O 0	O P	O C	O B	O 0	O P	O C	O B
Park/Lawn	O 0	O P	O C	O B	O 0	O P	O C	O B
Row Crops	O 0	O P	O C	O B	O 0	O P	O C	O B
Pasture/Range/ Hayfield	O 0	O P	O C	O B	O 0	O P	O C	O B
Logging Operations	O 0	O P	O C	O B	O 0	O P	O C	O B
Mining Operations	O 0	O P	O C	O B	O 0	O P	O C	O B

Transect F Comments:	

Transect G					
Fish Cover 0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)					
Category	O 0	O 1	O 2	O 3	O 4
Filamentous Algae	O 0	O 1	O 2	O 3	O 4
Macrophytes	O 0	O 1	O 2	O 3	O 4
Woody Debris > 0.3m (Big)	O 0	O 1	O 2	O 3	O 4
Brush/Woody Debris <0.3 (Small)	O 0	O 1	O 2	O 3	O 4
Live Trees or Roots	O 0	O 1	O 2	O 3	O 4
Overhanging Vegetation =<1m of Surface	O 0	O 1	O 2	O 3	O 4
Undercut Banks	O 0	O 1	O 2	O 3	O 4
Boulders	O 0	O 1	O 2	O 3	O 4
Artificial Structures	O 0	O 1	O 2	O 3	O 4

Bank Measurements Note: If an undercut bank, measure bank angle as 180 – measured angle					
Left Bank Angle:		Left Bank Undercut Distance (m):		Wetted Width (m):	
Right Bank Angle		Right Bank Undercut Distance (m):		Bar Width (m):	
Bankfull Width (m):		Bankfull Height (m):		Incised Height (m):	

Canopy Cover Densiometer (0-17 Max)					
Center Up		Center Right		Center Left	
Center Down		Left		Right	

Riparian Vegetation Cover Type D = Deciduous, C = Coniferous, E = Broadleaf Evergreen, M = Mixed, N = None 0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)											
		Left Bank					Right Bank				
Canopy (>5m high)	Canopy Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	BIG Trees (Trunk>0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Small Trees (Trunk < 0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Understor	Understory Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N

	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Ground Cover (<0.5mhigh)	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4

Human Influence 0 = Not Present, P >= 10m plot, C = Within 10m plot, B = On bank								
Wall/Dike/Revetment/ Riprap/Dam	O 0	O P	O C	O B	O 0	O P	O C	O B
Buildings	O 0	O P	O C	O B	O 0	O P	O C	O B
Pavement/Cleared Lot	O 0	O P	O C	O B	O 0	O P	O C	O B
Road/Railroad	O 0	O P	O C	O B	O 0	O P	O C	O B
Pipes (Inlet/Outlet)	O 0	O P	O C	O B	O 0	O P	O C	O B
Landfill/Trash	O 0	O P	O C	O B	O 0	O P	O C	O B
Park/Lawn	O 0	O P	O C	O B	O 0	O P	O C	O B
Row Crops	O 0	O P	O C	O B	O 0	O P	O C	O B
Pasture/Range/ Hayfield	O 0	O P	O C	O B	O 0	O P	O C	O B
Logging Operations	O 0	O P	O C	O B	O 0	O P	O C	O B
Mining Operations	O 0	O P	O C	O B	O 0	O P	O C	O B

Transect G Comments:	

Transect H

Fish Cover 0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)					
Category	O 0	O 1	O 2	O 3	O 4
Filamentous Algae	O 0	O 1	O 2	O 3	O 4
Macrophytes	O 0	O 1	O 2	O 3	O 4
Woody Debris > 0.3m (Big)	O 0	O 1	O 2	O 3	O 4
Brush/Woody Debris <0.3 (Small)	O 0	O 1	O 2	O 3	O 4
Live Trees or Roots	O 0	O 1	O 2	O 3	O 4
Overhanging Vegetation =<1m of Surface	O 0	O 1	O 2	O 3	O 4

Undercut Banks	O 0	O 1	O 2	O 3	O 4
Boulders	O 0	O 1	O 2	O 3	O 4
Artificial Structures	O 0	O 1	O 2	O 3	O 4

Bank Measurements
Note: If an undercut bank, measure bank angle as 180 – measured angle

Left Bank Angle:		Left Bank Undercut Distance (m):		Wetted Width (m):	
Right Bank Angle		Right Bank Undercut Distance (m):		Bar Width (m):	
Bankfull Width (m):		Bankfull Height (m):		Incised Height (m):	

Canopy Cover
Densiometer (0-17 Max)

Center Up		Center Right		Center Left	
Center Down		Left		Right	

Riparian Vegetation Cover Type
D = Deciduous, C = Coniferous, E = Broadleaf Evergreen, M = Mixed, N = None
0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)

		Left Bank					Right Bank				
Canopy (>5m high)	Canopy Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	BIG Trees (Trunk>0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Small Trees (Trunk < 0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Understory (0.5 – 5m high)	Understory Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Ground Cover (<0.5mhigh)	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4

Human Influence
0 = Not Present, P >= 10m plot, C = Within 10m plot, B = On bank

Wall/Dike/Revetment/ Riprap/Dam	O 0	O P	O C	O B	O 0	O P	O C	O B
Buildings	O 0	O P	O C	O B	O 0	O P	O C	O B
Pavement/Cleared Lot	O 0	O P	O C	O B	O 0	O P	O C	O B
Road/Railroad	O 0	O P	O C	O B	O 0	O P	O C	O B
Pipes (Inlet/Outlet)	O 0	O P	O C	O B	O 0	O P	O C	O B
Landfill/Trash	O 0	O P	O C	O B	O 0	O P	O C	O B
Park/Lawn	O 0	O P	O C	O B	O 0	O P	O C	O B

Row Crops	O 0	O P	O C	O B	O 0	O P	O C	O B
Pasture/Range/ Hayfield	O 0	O P	O C	O B	O 0	O P	O C	O B
Logging Operations	O 0	O P	O C	O B	O 0	O P	O C	O B
Mining Operations	O 0	O P	O C	O B	O 0	O P	O C	O B
Transect H Comments:								

Transect I					
Fish Cover 0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)					
Category	O 0	O 1	O 2	O 3	O 4
Filamentous Algae	O 0	O 1	O 2	O 3	O 4
Macrophytes	O 0	O 1	O 2	O 3	O 4
Woody Debris > 0.3m (Big)	O 0	O 1	O 2	O 3	O 4
Brush/Woody Debris <0.3 (Small)	O 0	O 1	O 2	O 3	O 4
Live Trees or Roots	O 0	O 1	O 2	O 3	O 4
Overhanging Vegetation =<1m of Surface	O 0	O 1	O 2	O 3	O 4
Undercut Banks	O 0	O 1	O 2	O 3	O 4
Boulders	O 0	O 1	O 2	O 3	O 4
Artificial Structures	O 0	O 1	O 2	O 3	O 4

Bank Measurements Note: If an undercut bank, measure bank angle as 180 – measured angle					
Left Bank Angle:		Left Bank Undercut Distance (m):		Wetted Width (m):	
Right Bank Angle		Right Bank Undercut Distance (m):		Bar Width (m):	
Bankfull Width (m):		Bankfull Height (m):		Incised Height (m):	

Canopy Cover Densiometer (0-17 Max)					
Center Up		Center Right		Center Left	
Center Down		Left		Right	

Riparian Vegetation Cover Type D = Deciduous, C = Coniferous, E = Broadleaf Evergreen, M = Mixed, N = None 0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)

		Left Bank					Right Bank				
Canopy (>5m high)	Canopy Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	BIG Trees (Trunk>0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Small Trees (Trunk < 0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Understory (0.5 – 5m high)	Understory Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Ground Cover (<0.5mhigh)	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4

Human Influence 0 = Not Present, P >= 10m plot, C = Within 10m plot, B = On bank								
Wall/Dike/Revetment/ Riprap/Dam	O 0	O P	O C	O B	O 0	O P	O C	O B
Buildings	O 0	O P	O C	O B	O 0	O P	O C	O B
Pavement/Cleared Lot	O 0	O P	O C	O B	O 0	O P	O C	O B
Road/Railroad	O 0	O P	O C	O B	O 0	O P	O C	O B
Pipes (Inlet/Outlet)	O 0	O P	O C	O B	O 0	O P	O C	O B
Landfill/Trash	O 0	O P	O C	O B	O 0	O P	O C	O B
Park/Lawn	O 0	O P	O C	O B	O 0	O P	O C	O B
Row Crops	O 0	O P	O C	O B	O 0	O P	O C	O B
Pasture/Range/ Hayfield	O 0	O P	O C	O B	O 0	O P	O C	O B
Logging Operations	O 0	O P	O C	O B	O 0	O P	O C	O B
Mining Operations	O 0	O P	O C	O B	O 0	O P	O C	O B

Transect I Comments:	

Transect J

Fish Cover 0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)					
Category	O 0	O 1	O 2	O 3	O 4
Filamentous Algae	O 0	O 1	O 2	O 3	O 4

Macrophytes	O 0	O 1	O 2	O 3	O 4
Woody Debris > 0.3m (Big)	O 0	O 1	O 2	O 3	O 4
Brush/Woody Debris <0.3 (Small)	O 0	O 1	O 2	O 3	O 4
Live Trees or Roots	O 0	O 1	O 2	O 3	O 4
Overhanging Vegetation =<1m of Surface	O 0	O 1	O 2	O 3	O 4
Undercut Banks	O 0	O 1	O 2	O 3	O 4
Boulders	O 0	O 1	O 2	O 3	O 4
Artificial Structures	O 0	O 1	O 2	O 3	O 4

Bank Measurements
Note: If an undercut bank, measure bank angle as 180 – measured angle

Left Bank Angle:		Left Bank Undercut Distance (m):		Wetted Width (m):	
Right Bank Angle		Right Bank Undercut Distance (m):		Bar Width (m):	
Bankfull Width (m):		Bankfull Height (m):		Incised Height (m):	

Canopy Cover
Densiometer (0-17 Max)

Center Up		Center Right		Center Left	
Center Down		Left		Right	

Riparian Vegetation Cover Type
D = Deciduous, C = Coniferous, E = Broadleaf Evergreen, M = Mixed, N = None
0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)

		Left Bank					Right Bank				
Canopy (>5m high)	Canopy Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	BIG Trees (Trunk>0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Small Trees (Trunk < 0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Understory (0.5 – 5m high)	Understory Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Ground Cover (<0.5mhigh)	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4

Human Influence
0 = Not Present, P >= 10m plot, C = Within 10m plot, B = On bank

Wall/Dike/Revetment/ Riprap/Dam	O 0	O P	O C	O B	O 0	O P	O C	O B
Buildings	O 0	O P	O C	O B	O 0	O P	O C	O B

Pavement/Cleared Lot	O 0	O P	O C	O B	O 0	O P	O C	O B
Road/Railroad	O 0	O P	O C	O B	O 0	O P	O C	O B
Pipes (Inlet/Outlet)	O 0	O P	O C	O B	O 0	O P	O C	O B
Landfill/Trash	O 0	O P	O C	O B	O 0	O P	O C	O B
Park/Lawn	O 0	O P	O C	O B	O 0	O P	O C	O B
Row Crops	O 0	O P	O C	O B	O 0	O P	O C	O B
Pasture/Range/ Hayfield	O 0	O P	O C	O B	O 0	O P	O C	O B
Logging Operations	O 0	O P	O C	O B	O 0	O P	O C	O B
Mining Operations	O 0	O P	O C	O B	O 0	O P	O C	O B

Transect J Comments:	

Transect K					
Fish Cover 0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)					
Category	O 0	O 1	O 2	O 3	O 4
Filamentous Algae	O 0	O 1	O 2	O 3	O 4
Macrophytes	O 0	O 1	O 2	O 3	O 4
Woody Debris > 0.3m (Big)	O 0	O 1	O 2	O 3	O 4
Brush/Woody Debris <0.3 (Small)	O 0	O 1	O 2	O 3	O 4
Live Trees or Roots	O 0	O 1	O 2	O 3	O 4
Overhanging Vegetation =<1m of Surface	O 0	O 1	O 2	O 3	O 4
Undercut Banks	O 0	O 1	O 2	O 3	O 4
Boulders	O 0	O 1	O 2	O 3	O 4
Artificial Structures	O 0	O 1	O 2	O 3	O 4

Bank Measurements Note: If an undercut bank, measure bank angle as 180 – measured angle					
Left Bank Angle:		Left Bank Undercut Distance (m):		Wetted Width (m):	
Right Bank Angle		Right Bank Undercut Distance (m):		Bar Width (m):	
Bankfull Width (m):		Bankfull Height (m):		Incised Height (m):	

Canopy Cover Densiometer (0-17 Max)					
Center Up		Center Right		Center Left	

Center Down		Left		Right	

Riparian Vegetation Cover Type
D = Deciduous, C = Coniferous, E = Broadleaf Evergreen, M = Mixed, N = None
0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)

		Left Bank					Right Bank				
Canopy (>5m high)	Canopy Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	BIG Trees (Trunk>0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Small Trees (Trunk < 0.3m DBH)	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Understory (0.5 – 5m high)	Understory Type	O D	O C	O E	O M	O N	O D	O C	O E	O M	O N
	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
Ground Cover (<0.5mhigh)	Woody Shrubs & Saplings	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4
	Non-Woody Herbs, Grasses, & Forbs	O 0	O 1	O 2	O 3	O 4	O 0	O 1	O 2	O 3	O 4

Human Influence
0 = Not Present, P >= 10m plot, C = Within 10m plot, B = On bank

Wall/Dike/Revetment/ Riprap/Dam	O 0	O P	O C	O B	O 0	O P	O C	O B
Buildings	O 0	O P	O C	O B	O 0	O P	O C	O B
Pavement/Cleared Lot	O 0	O P	O C	O B	O 0	O P	O C	O B
Road/Railroad	O 0	O P	O C	O B	O 0	O P	O C	O B
Pipes (Inlet/Outlet)	O 0	O P	O C	O B	O 0	O P	O C	O B
Landfill/Trash	O 0	O P	O C	O B	O 0	O P	O C	O B
Park/Lawn	O 0	O P	O C	O B	O 0	O P	O C	O B
Row Crops	O 0	O P	O C	O B	O 0	O P	O C	O B
Pasture/Range/ Hayfield	O 0	O P	O C	O B	O 0	O P	O C	O B
Logging Operations	O 0	O P	O C	O B	O 0	O P	O C	O B
Mining Operations	O 0	O P	O C	O B	O 0	O P	O C	O B

Transect K Comments:	

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