South Dakota Quality Assurance Project Plan for Northwestern Great Plains Reference Site Development Project

Department of Agriculture and Natural Resources

Watershed Protection Program

August 7, 2025

Version I

Contents

A3: List of Tables

A4. Project Purpose, Problem Definition, and Background

Nutrient enrichment is one of the main causes of impairment to aquatic systems nationwide according to the EPA. South Dakota currently has literature-based exceedance thresholds for nitrogen and phosphorus, but these thresholds are based on a large regional reference site analysis using National Rivers and Streams Assessment data. The EPA recommended that South Dakota should build nutrient impairment thresholds based on the state's regional-specific reference sites. South Dakota also seeks to collect data to potentially develop regional thresholds for Selenium, Aluminum, and Sodium adsorption ratio (SAR). However, South Dakota lacks the necessary reference site capacity in the Northwestern Great Plains (NWGP) ecoregion to establish thresholds for nutrients, Aluminum, Selenium, and SAR. SD DANR has established nutrient-related narrative water quality criteria located in ARSD 74:51:01. EPA has directed states to develop protective numeric thresholds to better assess nutrients. Based on the nutrient-related narrative criteria, these numeric thresholds are presented in Table 3 in Appendix C. To build a robust reference condition for use in impairment threshold establishment, reference sites need to be identified and validated in the NWGP.

Currently no reference sites have been identified in the NWGP. Several projects funded by SD DANR Watershed Protection and carried out by South Dakota State University (SDSU) sampled water quality, fish, macroinvertebrates, and habitat across the NWGP. These efforts laid the groundwork for reference site development in the western plains of South Dakota. Suehring (2017) developed an approach to assess watershed condition that used the EPA's Analytical Tools for Landscape Assessment (ATtILA) to analyze landscape spatial data to assess human impact in the NWGP. This tool provides scores ranging from 0-100 for Hydrologic Unit Code 12 (HUC12) watersheds in the NWGP based on 6 metrics related to water quality that had sufficient variability, lacked redundancy, and accounted for the most variation in a principal components analysis. HUC12 catchments will be referred to as "catchments" for the remainder of this document. The resulting watershed condition scores (WCS) provide a means of ranking catchments by human disturbance. Catchments that are least disturbed may be assessed to determine if they meet reference site validation criteria. The SDSU projects also developed indices of biotic integrity for macroinvertebrates (Keuhl 2017) and fish (Kaiser 2017) that will be used in the NWGP REFDEV project to validate candidate reference sites.

It is important to follow through with all the components of reference site development in South Dakota to avoid the potential of adopting EPA nutrient-based standards or impairment thresholds developed at larger regional scales. Developing meaningful thresholds based on a localized regional reference site approach will help avoid erroneous 303(d) listings and other issues that could arise (standards changes) with adopting inappropriate standards.

This project operates under the overarching quality assurance requirements of EPA, SD DANR and the DANR Watershed Protection Program. For this grant opportunity, data acquisition, analysis and storage will follow SD DANR WPP SOP Vol 1, the SD DANR WPP program QAPP and the SD DANR Quality Management Plan (QMP) (Revision VI, January 2023).

This project is funded with Clean Water Act Section 106 Supplemental Monitoring funds. The EPA point of contact for the 106 Supplemental Monitoring grant is Darrel Williams.

Goals and Objectives:

The goal of this monitoring project is to develop a reference site network that can be used to establish water quality assessment criteria. The criteria will incorporate multiple ecological lines of evidence and impairment thresholds needed to evaluate aquatic life use support for wadable-perennial streams in the Northwestern Great Plains (NWGP) ecoregion of western South Dakota.

A primary objective is to identify at least one reference site in each Level IV Ecoregion of the NWGP. Ideally, more than one reference site would be identified. This will be achieved by collecting water quality, habitat and biological data at sites located in catchments with watershed conditions scores in the top 10th percentile for each level IV ecoregion in the NWGP. A selection of targeted "bad" sites selected from the lowest 10% of watershed conditions scores in each Level IV Ecoregion represent most disturbed conditions and will be used in the validation process for comparison to candidate reference sites. To achieve validation, candidate reference sites must differ significantly from most disturbed sites. Sites from past SDSU projects were selected randomly and will also be compared to candidate reference sites. Two ecoregions lack sufficient water resources for assessment and will be excluded from the study.

A5: Project Description and Schedule

This project will use a targeted sampling design to identify and validate reference sites. Catchments in the NWGP will be ranked by the WCS generated by Suehring (2017). Catchments with WCS scores in the top 10th percentile will be selected from each Level IV Ecoregion as candidate reference catchments. These catchments represent the least disturbed streams in the NWGP. Catchments in the bottom of the WCS distribution, below the 90th percentile for each Level IV Ecoregion, represent most disturbed conditions and will be selected as targeted "bad" sites.

Candidate reference and most disturbed catchments will be screened for the presence of wadable, perennial streams with Strahler stream orders ranging from 3-7. Higher ordered streams will be excluded from the study. The NWGP is a harsh environment for aquatic life, with frequent and persistent drought conditions. The availability of water is often the most critical factor for aquatic life. Because streams of a higher order are typically larger with greater discharge, they are less impacted by drought conditions that significantly affect lower ordered streams. Streams with a Strahler stream order greater than 7 are also typically too deep to wade in many places, making sampling with wadable protocols more difficult.

Catchments without wadable, perennial streams in stream orders 3-7 will be excluded from the study. If few other candidate reference and most disturbed catchments have streams that meet the project criteria, catchments in the 10-25th percentile range may be added to the study to increase the chances of identifying a reference site in each Level IV Ecoregion.

Catchments with streams that meet project criteria will be examined for a suitable sampling location. Sites will be located in the lowermost end of each catchment, at least 1000 meters upstream of any confluence with a larger order stream, and upstream of any potential sources of ecological stress, such as ranch homesteads, roads, or NPDES point source discharges. Sites may not be located on tribally affiliated lands. Landowners will be contacted to obtain permission for sampling to occur on their property. If landowners at the primary location do not grant permission, a site will be selected on the

next landowner's property upstream of the primary location. If permission is not granted at the second site, a third will be identified and permission will be sought. This process will continue until a landowner is found within the catchment that will allow sampling to occur on their property. If no landowner in the catchment grants permission, that catchment will be excluded from the study.

Sampling sites are listed in Appendix A. Field crews will visit the site in the summer of 2025 during the index period of June 1 to September 30. Sites will be sampled for water quality, habitat, fish and macroinvertebrates. All data collection will be performed by DANR. Laboratory analysis will be performed by the State Public Health Lab, Mid Continent Testing Labs, Inc. and Rhithron Associates, Inc.

The reference site validation process ensures that candidate reference sites represent least disturbed conditions and show greater biotic integrity than most disturbed sites, as well as randomly selected sites. The macroinvertebrate and fish IBI scores for each candidate reference site will be compared to the distribution of data from most disturbed site using box and whisker plots to show separation between the 75^{th} percentile of reference sites and the 25^{th} percentile of most disturbed sites. Candidate reference site results will be compared to data from randomly selected sites sampled by SDSU in past projects, as well, using the same method.

It is possible that either fish or macroinvertebrate IBI may not be a suitable indicator of reference condition. If few reference sites are identified where both macroinvertebrate and fish IBI score show separation from non-reference sites, only one IBI score may be used for reference site validation. In general, macroinvertebrates represent local site conditions while fish are more indicative of broader watershed conditions because fish have greater mobility.

Water quality sampling will be conducted using protocols in Standard Operating Procedures for Field Samplers Volume I and will consist of a grab sample at each site along with in situ measurement with a multi-meter sonde for dissolved oxygen, temperature, specific conductance, and pH. Water samples will be analyzed for the parameters listed in Table 1.

Habitat and fish and macroinvertebrate communities will be characterized using sampling protocols outlines in Standard Operating Procedures for Field Samplers Volume II. Fish and macroinvertebrate collection will provide data that can be used to calculate metrics and scores for IBIs developed by SDSU. Habitat data collection will provide a data set that may be used to develop a habitat condition index for the NWGP.

Project data will be recorded in forms developed in the Survey123 application. Form templates are included in Appendix D. Two forms were developed in Survey123. One form is for entering habitat transect data including stream cross-section data and bank information, while the other form is for fish collection results, channel slope, transect flow velocities, water sample collection and multi-meter field measurements.

Deliverables from this project will include:

- A set of validated reference sites.
- Spreadsheets containing results from site visits.
- Water quality data from each site entered in the NR92 database.

A6. Information/Data Quality Objectives and Performance/Acceptance Criteria

The primary data driven objective for the NWGP reference site development project is to identify candidate reference sites and provide a dataset to validate them as reference sites that can be used to develop local ecoregion-based criteria.

In addition to the SOP requirements from EPA Region 8, DANR will follow the criteria for deciding if data quality objectives have been met in terms of Completeness, Representativeness, Comparability, Precision, and Accuracy.

Completeness is a measure of the amount of valid data obtained from measurement systems compared to the amount that expected to be obtained under optimum conditions. For a set of data to be utilized with confidence to assess a parameter for a waterbody, the data must be complete, ie., there must be enough valid data from analysis to facilitate making the assessment. The dataset will be considered complete as long as 90% of planned samples are collected and analyzed.

Representativeness expresses the degree to which data accurately and precisely represents the characteristics of that which is being measured. All samples will be collected in such a manner and at such sites to be representative of the medium from which they are taken. Data collection sites will be located near the downstream end of each least disturbed catchment to best represent the impacts of the landscape on the stream.

Comparability expresses the confidence with which one data set can be compared to another. Comparability can be measured and assessed through the use of standard, published sampling and analytical data. The comparability of data is achieved by the commitment of SD DANR staff, local coordinators, project partners and contracted laboratories to use standardized methods, where possible, including the SD DANR SOP volume 1 and 2, EPA-approved analytical methods, standard methods, or documented modifications thereof which provide equal or better results. All analytical results will be reported in appropriate concentration values and units to facilitate comparison.

Precision is a measure of the reproducibility of the measurement when an analysis is repeated. It is reported in Relative Percent Difference (RPD) or Relative Standard Deviation (RSD). Precision will be assessed through field duplicate and lab duplicate analyses. Collection of field blanks will also make sure there is no cross contamination.

Accuracy is a measure of how much of the constituent actually present is determined. It shows how close the sample value is to the “true” value. Accuracy will be assessed through the project by the collection of field blanks and duplicates. Also, following QA/QC practices will help ensure that accuracy is accounted for.

Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest. The term "detection limit" is closely related to sensitivity and is often used synonymously. All detection-limits for lab analytes are adequate for determining whether sample results meet project goals and SD water quality criteria for E. coli, TSS, dissolved oxygen, specific conductance, pH, and water temperature.

Please refer to Section 7.0 and 8.0 of the SD DANR WPP SOP Volume 1 for measurements of precision and accuracy and specific procedures for corrective actions.

A7: Distribution List

The current version of the Quality Assurance Project Plan (QAPP) will be posted on the DANR website. It will also be saved under the file pathway; N:/WATRSHED/QAQC – SOP/QAPP.

Table 1: Distribution List

Name	Title
Bill Smith	Division Director
Paul Lorenzen	Administrator Watershed Protection Program, Manager II
Alan Wittmuss	Team Leader/Environmental Scientist Manager I Assessment Team
Kris Dozark	Team Leader/Environmental Scientist Manager I Implementation Team
Jesse Wilkens	Project Officer/Environmental Scientist IV

All personnel involved with assessment and implementation sampling activities for the South Dakota Department of Agriculture and Natural Resources, Watershed Protection Program (SD DANR WPP) shall receive a copy of this plan and therefore should be thoroughly familiar with WPP sampling policies, management structure, and procedures. Compliance with QAPP elements results in data collection and management that is valid and suitable for use in implementation, water quality and (TMDL) Total Maximum Daily Load assessments projects, other programs, and projects.

A8: Project Organization

The following individuals are responsible for the design and implementation of this project:

Roles and Responsibility

The Northwestern Great Plains Reference Site Development Project (NWGP REFDEV) officer will be responsible for identifying candidate reference sites and targeted “bad” sites for sampling. Jesse Wilkens will serve as the project officer for the NWGP REFDEV project and will be responsible for obtaining landowner permissions and coordinating field work efforts.

DANR staff will collect all samples, and the project officer will coordinate with:a

- The State Public Health Lab in Pierre, SD
- Mid Continent Testing Labs, Inc. in Rapid City, SD
- Rhithron Associates, Inc. in Missoula, MT
  for assessment of samples.

Management Responsibilities

No extramural funding is associated with this project.

Quality Assurance (QA) Responsibilities

The DANR QA Office, Tyler Frideres, will be responsible for interpreting the validity of the data.

Laboratory analysts at the State Public Health Lab, Mid Continent Labs, and Rhithron Associates will be responsible for:

- Conducting laboratory analyses according to their approved Standard Operating Procedures (SOPs)
- Ensuring all field documentation submitted with samples has been satisfactorily completed

The project officer Jesse Wilkens will ensure that:

- All samples are collected according to laboratory guidance
- SOPs from the labs and the SD DANR WPP are followed

Field Responsibilities

All samples will be collected by state staff and will follow all QAPP guidance and SOP methods.

Laboratory Responsibilities

- The State Public Health Lab and Mid Continent Labs will be responsible for the laboratory analysis of water samples.
- Rhithron Associates, Inc. will be responsible for the laboratory analysis of aquatic macroinvertebrate samples.

Laboratory and Field Audit Responsibilities

- Laboratory audits will occur as specified in the QA procedures of the State Public Health Lab, Mid Continent Labs, and Rhithron Associates.
- All field sampling will be conducted by DANR staff.
- No field audits will be conducted as part of this project.

The project officer will ensure that:

- The QAPP is followed as approved
- All DANR staff have access to the most current version of the QAPP and necessary project documents
- All personnel are informed of project requirements prior to any sampling

QAPP Review and Approval Responsibilities:
Staff included on the signature page of the QAPP have the authority and responsibility in their roles to review and approve this QAPP.

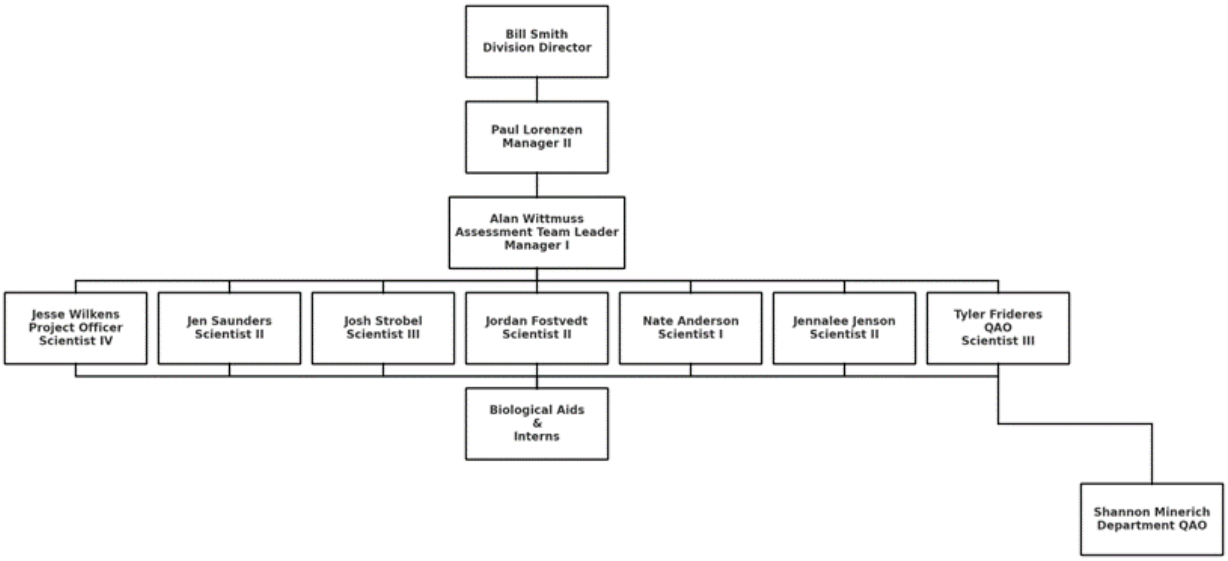
A9. Project Quality Assurance Manager Independence

The Quality Assurance Officer for the Watershed Protection Program (WPP), Tyler Frideres, will participate in the development of QA/QC reports; however, he will not be involved in data migration, data assessment result verification, or web portal management. This separation of duties ensures that the QAO remains independent from Environmental Information Output (EIO) processes and maintains an objective role in data quality oversight.

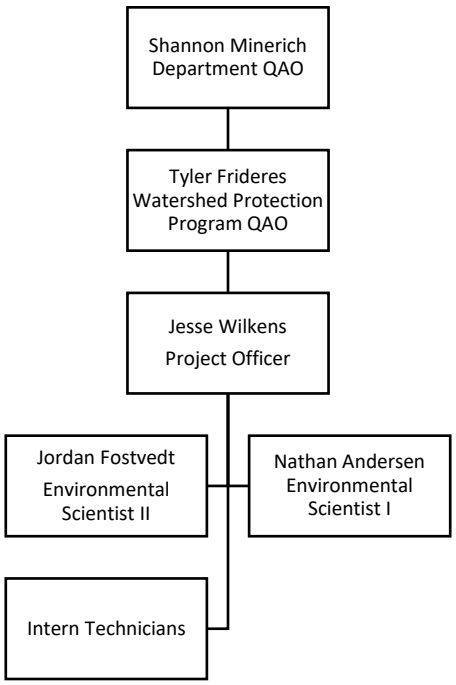
A10. Project Organization Chart and Communications

The following organizational chart outlines the roles, responsibilities, and reporting structure for personnel involved in the Northwestern Great Plains Reference Site Development Project. This structure ensures clear lines of authority, promotes accountability, and supports the consistent implementation of quality assurance measures throughout the duration of the project. While Jesse Wilkens serves as the Project Officer responsible for coordinating project activities and data collection efforts, all scientific staff ultimately report to Alan Wittmuss, the Assessment Team Manager. Interns (biological aides) are directly supervised by the project's core scientific staff, ensuring day-to-day tasks are performed in accordance with established protocols. The Project Officer and, if necessary, the Program QAO will communicate with laboratories involved in this project to address quality concerns and issues. Quality Assurance for the project is managed by Tyler Frideres, who serves as the Program QAO and reports directly to Shannon Minerich, the Department QAO. If necessary, the Department QAO will address issues with an EPA Officer. This structure facilitates effective communication, oversight, and adherence to EPA data quality standards.

Organizational Chart: Northwestern Great Plains Reference Site Development Project



Quality Control Communication Chart: Northwestern Great Plains Reference Site Development Project



A11: Special Training and Certification

Jesse Wilkens, the Project Officer, holds ultimate responsibility for ensuring the quality and integrity of all data collected under this project. In this capacity, Jesse oversees a team composed of experienced full-time employees and closely supervised biological aides. All personnel involved in Environmental Information Operations (EIO) are selected based on their qualifications, training, and relevant experience.

Full-time staff possess the technical expertise necessary to meet project objectives and are audited routinely, while biological aides receive direct supervision and guidance to ensure consistency with established protocols. The Project Officer maintains continuous oversight of field activities to ensure that all personnel conducting EIO perform their duties in accordance with project standards and EPA requirements.

Certification of a South Dakota Scientific Collector's Permit is required for fish collection and has been obtained. All certifications are discussed with the Quality Assurance Officer, Tyler Frideres.

The QAO participates in field training on the first day of each field season and will document the training in the annual QA/QC report. Any training-related issues or deficiencies identified during the first site visit will be addressed immediately and recorded in the corrective action section of the annual report. Jesse Wilkens is responsible for maintaining a digital record of all training activities and certifications on the DANR shared drive.

A12: Documents and Records

Documentation and record collection is an integral part of maintaining proper QA protocols. The project officer, Jesse Wilkens, will make sure that before any sampling is done, that all partners have a copy of the most current version of the project QAPP and all relevant SOPs. Prior to project sampling, Jesse will also make sure that all sampling sites have been entered into the NR92/WISKI database with the correct results and latitude and longitude. All water quality data will be stored indefinitely on a SQL server and backed up to the state IT system. Habitat and biological data will be stored in Survey123, which is an ArcOnline product, as well as Microsoft Excel files until a database suitable for habitat and biological data is available. South Dakota DANR will make sure that all field notes documented will be sent to EPA Region 8 upon their request. Water sample lab sheets and bottle labels are presented in Appendix B, while Survey123 field form examples are presented in Appendix D.

The Project Coordinator is responsible for QAPP control, ensuring only the most current QAPP and SOPs are in use. All records will be reviewed for completeness and stored in the program's network folder with access provided to project personnel.

At the completion of the project, all project data, documentation and records will be given to the project officer and stored. All lab results from sampling will be sent from Mid Continent Labs and the South Dakota State Health Lab to the project officer. The project officer will make sure that all documentation is put into the associated folder. All records and documents will be maintained in accordance with the South Dakota Bureau of Administration Records Management retention provisions found at: https://boa.sd.gov/central-services/records-management.aspx. Document control information is recorded in the Teams Quality channel on the Master Document List.

B. Implementing Environmental Information Operations

Guidance, tools, and templates used to develop this QAPP include the Quality Assurance Project Plan Standard (CIO 2105-S-02.1), EPA Region 8 QAPP Review Crosswalk (CIO-2105-S-02). Guidance was also provided by Watershed Protection Program QAQC officer Tyler Frideres and technical support was provided from DANR QA/QC officer Shannon Minerich.

B1. Identification of Project Environmental Information Operations

EIOs will be conducted in accordance with standardized field protocols designed to meet the specific objectives of the project. These protocols ensure that data collection methods are consistent, scientifically sound, and aligned with the overall purpose of the monitoring project. Activities such as water quality sampling are carried out using approved procedures that support reliable, reproducible results.

To satisfy the project's data quality objectives and meet performance and acceptance criteria outlined in Elements A4 and A6, all data collection efforts are designed with precision and quality control in mind. Methods are selected and implemented to ensure that collected data are representative, comparable, and meet defined thresholds for accuracy and completeness. Quality assurance and quality control measures are integrated throughout the EIO process, and all personnel are trained to adhere to these standards. Continuous oversight by Jesse Wilkens and periodic reviews and internal audits by the QAO ensure ongoing compliance with data quality expectations.

B2. Methods for Environmental Information Acquisition Sampling Design (Experimental Design):

Sampling Design (Experimental Design):

Water chemistry, habitat and biological data will be collected at candidate reference sites and most disturbed sites. Candidate reference sites will be located on the downstream ends of least disturbed catchments, while most disturbed sites will be located on the downstream ends of most disturbed catchments. Water chemistry parameters in Table 1 will be collected at each site. Fish and macroinvertebrate assemblages will be characterized and multi-metric IBI scores will be generated for fish and macroinvertebrates for each site. Results from candidate reference sites will be compared to most disturbed sites for reference site validation.

Table 1. Water chemistry parameters for analysis in the NWGP Reference Site Development Project.

Water Chemistry Parameters	
Total Phosphorus	Dissolved Calcium*
Nitrate/Nitrite	Dissolved Magnesium*
Ammonia as N	Dissolved Sodium*
Total Kjeldahl Nitrogen	Dissolved Selenium
Total Dissolved Solids	Recoverable Aluminum
Total Suspended Solids	Dissolved Organic Carbon

Total Hardness

*For Sodium Adsorption Ratio calculation

Sampling Schedule:

Sampling will occur between June 1 and September 30 in the years 2025, 2026, and 2027. If project goals have not been achieved after 2027, the project may continue into future years. Sampling between June 1 and September 30 provides an index period, so data results are comparable. Otherwise, biological results would otherwise be skewed by seasonal factors.

Sample Identification:

Catchments targeting for sampling have been selected by the State of South Dakota and can be found in Appendix A. Specific sampling locations will be determined after landowner permission has been granted, and will be identified on the chain of custody form when a sample is sent to Mid Continent Labs or the South Dakota State Health Lab.

Sample Bottles:

Samples will be collected following the protocols in Standard Operating Procedures for Field Samplers Volume I. Total Phosphorus, Total Kjeldahl Nitrogen, Ammonia as N, and nitrate/nitrite will be analyzed from the nutrient bottle (500 mL) which will be preserved with 1 mL sulfuric acid. Total suspended solids and total dissolved solids will be analyzed from the mineral bottle (250 mL). Water for dissolved metals will be collected in a 1-liter bottle and then filtered. Filtrate will be deposited in a 250 mL bottle and preserved with nitric acid. Recoverable Selenium will be collected in a 250 mL bottle. The nutrient, mineral and metals bottles will be supplied by Mid Continent Labs. Chlorophyll-a will be collected in a 1L brown bottle supplied by SD DANR.

Sampling Methods

All sampling and analysis procedures follow the protocols described in the SD DANR Watershed Protection Program Standard Operating Procedures, specifically Volume 1 (Rev. May 2018) and Volume 2 (Rev. May 2018). These SOPs include all required field and laboratory methods, as well as preservation techniques, QA/QC procedures, and sample handling requirements. No deviations or modifications from the SOPs are currently planned.

The Project Coordinator (Jesse Wilkens) is responsible for ensuring all field personnel have access to the most current SOPs, which are stored on the DANR shared network drive N:\WATRSHED\QAQC\QAPPs\SOPs and QAPPs\2018 Volume I or II. SOPs are reviewed and updated by the Quality Assurance Officer (Tyler Frideres), in coordination with program managers, and version history is maintained within each document.

Samples and measurements for candidate reference and most disturbed sites are collected by DANR staff using the following method:

1. Determine the preliminary mean stream width (PMSW) by measuring the width across the stream in 5 locations within the estimated reach to be sampled.
2. Place 11 transect markers equidistantly along the reach.
    a. If the stream has a width less than 10m, the transects will be 3 times the PMSW apart.
    b. If the stream has a width greater than 10m, the transects will be 2 times the PMSW

apart.

c. If PMSW is less than 4m, use 150m as a minimum reach length.
d. The middle transect (transect F) is the determined location of the stream site.

3. Water quality is sampled at transect F.
    a. Calibrate YSI multi-probe sonde.
    b. Fill the cooler with ice and label bottles.
    c. Rinse the nutrient, mineral, metals and chlorophyll-a sample bottles and caps 3 times with sampling water.
    d. Collect grab samples by positioning the open end of the bottle toward the current flow and away from the hand of the collector. Plunge the bottle to avoid surface scum and fill to the bottle shoulder at a depth of 15 cm to 30 cm.
    e. To preserve the mineral and chlorophyll-a bottles, place them in a cooler with ice.
    f. To preserve the nutrient bottle, add 1 mL of concentrated sulfuric acid (H_2SO_4). Invert the bottle to mix and place in a cooler with ice.
    g. To preserve the dissolved metals bottle, the sample must be filtered with a 0.45-micron filter within 15 minutes of sample collection. Distilled water is first run through the filter. After vacuum filtration, discard filtered distilled water. Pour enough sample water (minimum of 120 mL) from one of the extra one-liter bottle(s) into the upper chamber of the filtration device and filter. After filtering is complete pour the filtered water in the lower receiver into the pre-labeled 250mL HDPE plastic bottle. Preserve the recoverable metals sample by adding one ampoule of HNO_3 to the sample bottle(s) (provided by the laboratory) to bring the sample(s) below a pH of 2 standard units.
    h. To preserve the recoverable metals bottle, add one ampule HNO_3 provided by the lab to bring the sample below a pH of 2 standard units.
    i. All sample bottles must reach and maintain a temperature of 6°C or less. standard units.
    j. Take a multi-meter measurement from the stream by placing it in a flowing section of the stream and allowing the values to stabilize.
    k. Record YSI values for water temperature, specific conductance, pH, and dissolved oxygen on the lab datasheet.
    l. Deliver the nutrient and mineral bottles to Mid Continent Labs within the proper hold time of 48 hours for the A bottle and 28 days for the B bottle, recoverable metals, and dissolved metals bottles. Ensure that preservation temperature is kept. Either in the field or at the Rapid City DANR lab, filter the chlorophyll-a sample using a glass fiber filter within the holding time of 48 hours. Filters will be frozen and sent to the South Dakota State Health Lab for analysis within the 28-day holding time for frozen chlorophyll-a samples.

4. Collect an aquatic macroinvertebrate sample. A 30 second sample will be taken with a D-frame net at each of the 11 transects beginning at the most downstream and combined for a composite sample.
    a. Samples are either taken by the left bank, right bank, or middle of the stream. At the first site, randomly determine which location to start at, and continue up the stream in the pattern of left, center, and then right, only sampling in one of the locations for

each transect.

b. Position the D-frame net in the stream so the opening faces upstream. Disturb a $1m^3$ area in front of the net for 30 seconds, allowing invertebrates and debris to flow into the net.
c. Combine all 11 samples into a seine bucket and rinse in the stream.
d. Place the contents of the bucket into jars, only filling the jar ¾ full.
e. Cover the contents of each jar with 90% Ethanol to preserve the macroinvertebrates.
f. Send samples to Rhithron Labs for analysis.

5. Fish collection. The stream will either be seined or electroshocked to sample for fish.
    a. For seining, start at the most downstream site and work upstream, holding the ends of the seine on each bank of the stream. Use a standard bag seine with 3/16 inch to ¼ inch mesh and 4 to 6 feet in height depending on the depth.
    b. For electroshocking, set the voltage and frequency at an adequate level depending on the specific conductance of the stream. Further adjustments to the voltage and frequency may need to be made to get the optimal fish shocking efficiency.
    c. Once fish are collected, identify, sort, weigh, measure, and count the fish in each species.
    d. Record values in an excel document or other data collection platform and collect photo vouchers of each fish species.
6. Habitat measurements.
    a. Record the number and type of pools present, the number of runs/glides, the number and length of riffles, and any other habitat type.
    b. Take water slope measurements. Use a land survey slope transit and a graduated survey rod. The rod is placed where the bank meets the water.
    c. Take bearing measurements between each transect. The primary measurement is the degree closest to the most downstream transect. Include the percentage of the stream section between the transect that is covered by that bearing. If the bearing does not cover 100% of the stream section, including secondary and/or tertiary bearings with coverage percentages.
    d. Take stream velocities at ¼, ½, and ¾ of the stream width at each transect using the SonTek FlowTracker II.
    e. Note any large woody debris, where it's located, what angle, and how large it is.
    f. Take measurements of station location and water depth at these locations on both the left and right banks: flood-prone, bank full, channel bottom, and edge of water. Also take depth measurements at ¼, ½, and ¾ widths across the stream and note the bank full height.
    g. Take measurements of streambank and riparian features at each transect on both the left and right bank including dominant bank substrate, presence of bank slumpage, bank height, bank angle, streambank length, percent streambank vegetated, eroded, or deposited, riparian buffer width, presence of overhanging vegetation, undercut bank length, submergent macrophytes, emergent macrophytes, riparian land use, animal vegetation use, riparian vegetation type, and age class of riparian trees.
    h. Take measurements of canopy cover at each transect. One measurement is taken at

both the right and left bank, and four measurements in the center, one facing each direction of the stream.

i. Take measurements of bed substrate by sampling 8 evenly spaced locations on the bed of the stream.

All sampling should follow the standard operating procedures for DANR. SOP methods can be found in the SD DANR WPP SOP Volumes 1 and 2.

Site Disturbance:

Ensure that the sample site is not disturbed prior to sample collection. When sampling a site, take the water samples and YSI measurements first, invertebrate samples next, fish samples after that, and habitat measurements last. When taking the water samples, take them from the bank and avoid disturbing the water.

Field Duplicates:

A field duplicate is collected in the same manner as a regular sample. The duplicates are given their own sample number and labeled as "duplicate" for the sample type. The field duplicate sample is factored into the total number of samples. A field duplicate will be collected for every 10 samples.

Blank:

A field blank is treated in the same manner as a regular sample. The blanks are given their own sample number and labeled as "blank." The field blank sample is factored into the total number of samples (e.g., one sample plus one duplicate and one field blank for a total of three samples). Field blanks should be filled with deionized water. A blank will be collected for every 10 samples.

Corrective Actions:

Corrective actions for deficiencies will be addressed immediately in the field or after lab receipt (documentation errors). Corrective actions include but are not limited to; discarding improperly collected or handled samples, re-sampling, and correcting labels or COC's. The State of South Dakota will work to fix any issues or deficiencies with sample collection and documentation.

Laboratory Analysis

Water samples will be analyzed by Mid Continent Testing Labs, Inc. in Rapid City, SD. Lab methods used by Mid Continent Testing are listed in Table 2. Macroinvertebrate samples will be analyzed by Rhithron Associates, Inc. in Missoula, MT. Rhithron will use standard sorting protocols to achieve representative subsamples of a minimum of 300 organisms. Organisms will be individually examined by a certificed taxonomist and identified to the lowest practical level using appropriate published taxonomic references and keys. Chlorophyll-a samples will be analyzed by the SD State Health Lab. Fish samples will be analyzed in the field and photo vouchers will be confirmed by state fish biologists. Habitat will be analyzed by DANR staff. IBIs and HCIs will be determined by DANR staff using all the data collected. All analysis will follow EPA approved methods.

Table 2. Lab methods used by Mid Continent Labs for water sample analysis.

Analyte	Method
Total Phosphorus	SM 4500-P E

Nitrate/Nitrite	SM 4500-NO3F
Ammonia as N	Timberline-001
Total Kjeldahl Nitrogen	EPA 351.2
Total Dissolved Solids	SM 2540 C
Total Suspended Solids	SM 2540 D
Total Hardness	SM 2340 B
Dissolved Calcium*	SM 3111 B
Dissolved Magnesium*	SM 3111 B
Dissolved Sodium*	SM 3111 B
Dissolved Selenium	EPA 200.8
Recoverable Aluminum	EPA 200.8
Dissolved Organic Carbon	SM 5310 C

Turnaround Time:

The standard turnaround times from Mid Continent Labs are acceptable (within 30 days) and if faster turnaround times are required the lab will be notified via comments on the chain of custody form or via personal communication.

Existing Information

Data collected during the previously mentioned SDSU research projects was used in the design of this project. Watershed Condition Scores from Seuhring 2017 were used to identify least and most disturbed HUCs for site selection. Keuhl 2017 and Kaiser 2017 developed IBIs that will be used for scoring fish and macroinvertebrate communities. The site data collected during these projects may also be used for comparison to candidate reference sites. The project officer reviewed these projects and determined that data quality objectives were met. The data collected by Keuhl and Kaiser were precursors to this project and used the same methods, so results are directly comparable.

Environmental Technology:

Environmental technology is not use for this project and is therefore not addressed in this QAPP.

B3. Integrity of Environmental Information

Each lab being used follows EPA-approved methods and maintains accreditation for the applicable analytes and sample types regarding this project.

For water samples, all bottles will be stored on ice or refrigerated (4-6°C). All sample bottles will be delivered to Mid Continent Labs before the 48 hour hold time for the A bottle and can only be accepted Monday – Friday. Coordination of sampling schedule will be arranged to accommodate this, and sampling will occur Monday – Thursday.

Chlorophyll-a samples will be either field filtered or filtered in the DANR Rapid City lab within the filtering holding time of 48 hours. Frozen filters will be held in a freezer in the DANR Rapid City lab and will be shipped to the SD State Health Lab approximately monthly to meet the 28 day holding time for frozen chlorophyll-a filters.

Dissolved metals samples will be field filtered within 15 minutes of sample collection and, along with recovered metals bottles, stored on ice until delivery to Mid Continent Labs.

The samples will be received accompanied by the datasheets containing the agency code, sample date, time, sampler, source water, station ID, site location, project, project ID, type of sample, medium, depth, YSI measurements, bottle types sent and analytes to be tested.

For macroinvertebrate samples, all bottles will be preserved with 90% ethanol and will be shipped to Rhithron labs with all necessary information. The chain of custody form can be found under the pathway address; N:\WATRSHED\REFDEVA\Forms and Lists\REFDEVA Chain of Custody.

B4: Quality Control

South Dakota DANR staff will meet quality assurance/quality control (QA/QC) requirements and ensure that procedures including field duplicates, field blanks, field techniques, holding times, and datasheets are completed. Jesse Wilkens, the project officer will evaluate blanks and duplicates of all samples and will check equipment to determine if acceptability requirements have been met. QC information will be evaluated as results are received from the lab. Corrective actions will be taken as deemed necessary by the PO and QA officer. Any corrective actions will then be reviewed for effectiveness. The South Dakota DANR field staff will follow their own QA/QC requirements of 20% (10% blanks and 10% replicates). The State Public Health Lab and Mid Continent Labs will also follow their procedures for QA/QC. For more information on how precision, accuracy, and completeness is calculated refer to the current version of the Quality Assurance Project Plan (QAPP) on the DANR website). It will also be saved under the file pathway; N:/WATRSHED/QAQC – SOP/QAPP.

Field Duplicate:

The field duplicate samples will provide an indication of variability withing the sampling. Selection of sites for duplication is determined by field staff.

Field Techniques:

DANR field staff will ensure that all samples are collected using proper techniques and following EPA approved methodology.

Field Blank:

A sterile bottle containing ultra-pure deionized water will be provided to the State Public Health Lab or Mid Continent Labs as a field blank. The blank sample should be treated like all other samples for the remainder of the field visit, during transportation and shipment.

Holding Times:

A maximum holding time of 48 hours for the mineral bottle, 28 days for the nutrient bottle, 48 hours for unfiltered chlorophyll-a samples, and 28 days for filtered, frozen chlorophyll-a samples will be followed for the project as identified in the DANR SOP and analytical methods.

Chain of Custody Form:

Chain-of-Custody forms are used to handle and track samples from field collection to delivery to Mid Continent Labs, Rhithron Associates, Inc and the SD State Health Lab. Chain-of-custody forms will be supplied by SD DANR and will be held until completion of the project.

Existing Information:

The projects by Seuring, Kaiser and Keuhl were reviewed by scientists in the DANR Watershed Protection Program to determine if the findings of those projects, most notably the Watershed Condition Score developed by Seuring and the IBIs developed by Kaiser and Keuhl, meet the needs of this current project. It was determined that the IBIs and WCS are representative of conditions and populations in the region and that QC activities were sufficient for the needs of this project.

No models are used in this project.

B5: Instrument/Equipment Testing, Inspection, and Maintenance

Calibration of the YSI multi-probe should be completed the morning of sampling at the sampling location. Optical dissolved oxygen (ODO) will be calibrated by placing the sensor in the calibration cup with 1/8 of an inch of water and the threads of the cup should be loosened from the base. Conductivity and pH will be calibrated by placing enough calibration solution in the clean calibration cup to cover the sensor. Conductivity calibration solution for DANR is produced by the State Public Health Lab and is 1,410 µs/cm at 25°C. pH will be calibrated at both 7.00 and 10.00 at 25°C. When calibrating, follow the on-screen guide on the YSI multi-probe for each calibration. Calibration is documented internally on the YSI.

The SonTek FlowTracker II will be calibrated prior to the sampling trip following the instructions in the technical manual.

All YSI and SonTek units are inspected periodically, roughly weekly, for damage and proper function. Sensors are cleaned, if necessary. Units are stored in a climate controlled laboratory at the DANR Rapid City field office. Spare parts and sensors, such as pH and optical DO sensors, are available if needed and can be ordered if they are currently not on hand. Electrofishing units are inspected at each use and are sent to the manufacturer annually to inspect wave length form and proper function.

Any errors with calibration or proper function of any equipment will be communicated to the project officer prior to sampling.

B6: Inspection/Acceptance of Supplies and Consumables

Inspection and acceptance of supplies and services for this project are handled through a defined quality control process designed to ensure that all equipment and materials meet performance standards prior to deployment. Jordan Turgeon, the Equipment Manager, is responsible for conducting annual checks of all field equipment and supplies. This includes evaluating the condition and functionality of instrumentation, verifying calibration standards, and ensuring that all equipment is field-ready.

As the Quality Assurance Officer (QAO), Tyler Frideres oversees the documentation and verification process. Equipment and supply logs are maintained and updated annually as part of the QA/QC Annual Report. This log provides traceable documentation of inspection outcomes and is reviewed to ensure consistent adherence to project standards. Routine testing of instrumentation is performed throughout

the field season, including verification of temperature probes against NIST-traceable thermometers obtained from the State Health Lab to ensure accuracy and traceability.

Vendors supplying scientific instrumentation or calibration standards are required to provide supporting documentation, such as calibration certificates and traceability records, confirming that equipment meets applicable performance specifications. It is the vendor's responsibility to ensure that supplied items conform to all applicable S-2 requirements and to disclose any limitations or deviations at the time of delivery.

B7: Environmental Information Management

Information management occurs on several levels. First, sample collection must be completed in a manner to ensure the quality, compatibility, and timeliness of the data collected. Once collected and organized, it must be available for review, analysis, and interpretation. Ultimately, the data may be used in several aspects: to assess water quality of the waterbody based on beneficial use and provide general information to other interested organizations and the general public.

Field notes for each site will be recorded on a field datasheet, and include the following:

- Sampler(s) name(s)
- State location ID
- Date sample collected
- Time sample collected
- Additional observations

Water quality sample results, field measurements, and metadata from this project are transmitted via email in Microsoft Excel spreadsheets from Mid Continent Labs to the Watershed Protection Program database coordinator, who enters the data into the WISKI and NR92 databases. Data is reviewed for erroneous values by the project officer before it is marked as approved for public sharing.

Hard copies of field datasheets, chain-of-custody forms and laboratory results are scanned and saved in electronic format under the file pathway: N/WATRSHED/Biological Monitoring and Assessment. Data are reviewed by the Project Coordinator for accuracy prior to analysis. Backups of all electronic records are maintained by South Dakota Project Coordinator and Jen Saunders, the database manager, to prevent data loss or corruption. All water quality data is saved in the NR92/WISKI databases, and all habitat and biological data is stored in Survey123 and ArcOnline, as well as in Microsoft Excel sheets on the N drive.

Reference Site Validation:

The reference site validation process ensures that candidate reference sites represent least disturbed conditions and show greater biotic integrity than most disturbed sites, as well as randomly selected sites. The macroinvertebrate and fish IBI scores for each candidate reference site will be compared to the distribution of data from most disturbed site using box and whisker plots to show separation between the 75th percentile of reference sites and the 25th percentile of most disturbed sites. Candidate reference site results will be compared to data from randomly selected sites sampled by SDSU in past projects, as well, using the same method.

It is possible that either fish or macroinvertebrate IBI may not be a suitable indicator of reference condition. If few reference sites are identified where both macroinvertebrate and fish IBI score show separation from non-reference sites, only one IBI score may be used for reference site validation. In general, macroinvertebrates represent local site conditions while fish are more indicative of broader watershed conditions because fish have greater mobility.

Computer hardware/software requirements:

There are no requirements for computer hardware or software for this project.

C1: Assessment and Response Actions

The State of South Dakota is responsible for field sample collection and QA/QC procedures. Corrective actions for deficiencies will be addressed immediately in the field or will be resolved through collaboration of project staff. Any identified non-conformances and their associated corrective actions will be documented in field audit forms or QA memos and summarized in the annual QA/QC report prepared by the QAO.

The State of South Dakota will use the following assessments for REFDEV:

- **Surveillance**:
  The Project Officer, Jesse Wilkens, will ensure that all QA/QC components are being followed. Informal in-field reviews will occur during the first field event of each season to ensure sampling procedures align with SOPs.
- **Peer Review**:
  Peer review may be performed before a project starts and after a project is completed. Staff members will review the NWGP Reference Site Development Project for completeness, accuracy, and proper documentation.
- **Systems Audit**:
  A full-scale systematic, qualitative review of equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of the SD DANR WPP program will be completed by the SD DANR QAO, Tyler Frideres, every year to evaluate SD DANR WPP QA/QC Procedures. The QAO operates independently from field operations and does not participate in data collection, ensuring an unbiased evaluation of QA performance.

The Project Officer (Jesse Wilkens), in coordination with the QAO, is responsible for implementing any required corrective actions. All response actions will be developed, documented, and tracked through project records and included in the annual QA/QC report. The final documentation of all response actions will be available to EPA Region 8 upon request.

C2: Reports to Management

On an annual basis the SD DANR WPP QAO, Tyler Frideres, will submit a quality assurance report to the SD DANR QAO, Shannon Minerich, who in turn reports the information to EPA and the Program

Administrator in an annual report covering the NWGP Reference Site Development Project. All reports will also be sent to the Team Leader and Administrative Leader. The report should include the following:

- Assessment results of measurement data, accuracy, precision, and completeness
- Results of performance and system audits
- Quality assurance issues and resolutions
- Corrective actions and resolutions
- List/update all documents/forms in the Quality Teams Channel DANR Master Documents List (this includes QAPPs, SAPs, PIPs, SOPs, all forms)
- A list of training activities including dates
- Annual QAPP reviews and all revisions need to be accompanied by the EPA QAPP checklist and the DANR QAPP Supplemental Requirements checklist.
- Any other requirements listed in individual QAPPs (reviews, training, reports to management)
- Revisions to Standard Operating Procedures and Quality Assurance Project Plans.
- Record all staff training on the Quality Teams Channel – DANR QA Training excel spreadsheet.

D1: Environmental Information Review

The objective of data review is to assess whether the data collected achieved the quality objectives of the project. All analytical data generated for the Watershed Protection Program by a laboratory undergoes reduction and report preparation by the respective laboratory.

Laboratory reports are reviewed by the Project Officer and the SD DANR WPP QAO for reasonableness. This includes verifying consistency between field-recorded metadata (e.g., sample date, time, site ID, and depth) and lab-reported information. Field data sheets are compared with the chain-of-custody and laboratory results to confirm accuracy.

Verification includes checking completeness of sample sets, adherence to hold times, and proper labeling and documentation. Validation involves confirming that laboratory QA/QC requirements were met (e.g., field blank results, duplicate precision, and instrument calibration).

Performance and acceptance criteria established in Section A6 (e.g., minimum 90% completeness, acceptable Relative Percent Difference for duplicates) will be applied during the review to assess data quality. In addition, all reviews will consider the data quality indicators (DQIs) described in A6, including precision, accuracy, completeness, representativeness, comparability, and sensitivity.

Findings from the data review and any identified issues or corrective actions will be documented by the QAO in QA review logs and summarized in the annual QA/QC report. Outcomes of the review process will be communicated to the Project Officer and Program Administrator. If issues require corrective action, they will be addressed in coordination with the laboratory or field team and tracked until resolved.

D3: Usability Determination

All data and related information obtained during this project will be assessed and interpreted by SD DANR to determine whether it meets the quality objectives and intended uses outlined in this QAPP. This includes confirming the data are appropriate for supporting reference site validation and broader water quality assessments.

Following the data review and verification process (see Section D2), results will be compared to project goals and decision-making needs. If any limitations are identified—such as incomplete data, QA/QC failures, or inconsistent results—they will be communicated to the Project Officer and Program Manager. SD DANR will evaluate whether the data are sufficient for use or whether corrective actions, such as re-sampling or supplemental analysis, are needed.

All usability limitations and final determinations will be documented in the QA/QC report and shared with stakeholders, as applicable.

Signature Page

X

Shannon Minerich
State QA/QC Officer

X

Tyler Frideres
Program QA/QC Officer

X Jesse Wilkens

Jesse Wilkens
Project Officer

X

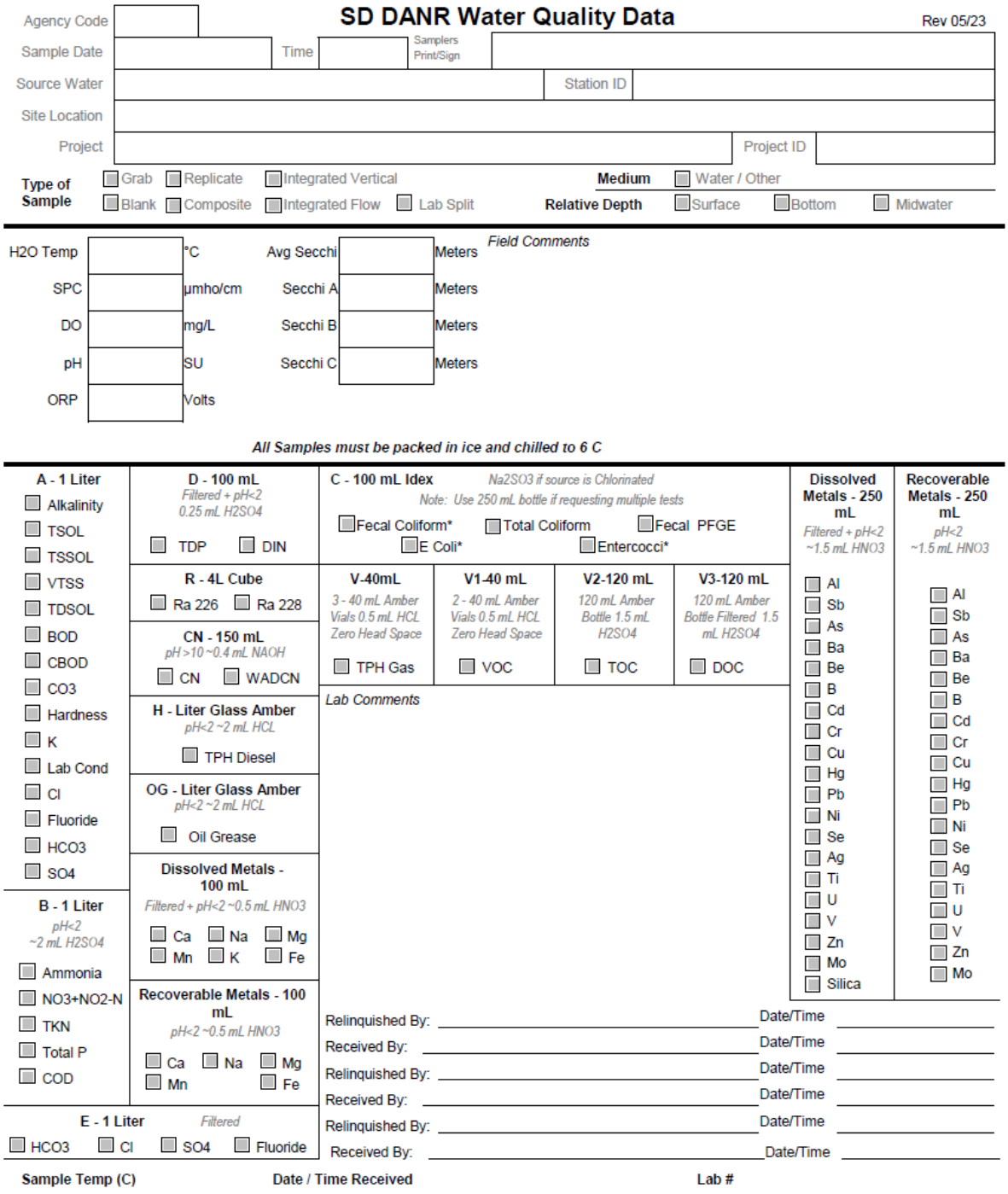
Alan Wittmuss
WPP Assessment Team Leader

Appendix A

Table 3. Sites that will be sampled in 2025 for the Northwestern Great Plains Reference Site Development Project. Sites will be sampled between June 1 and September 30, 2025. Specific timing for the sampling of each site will be dependent on flow conditions, where the site must be below bankfull elevation but with at least 50% of the sampling reach containing water.

StationID	Site Description	Lat	Long	Waterbody
WRD30	Owl Creek-Ruben Creek	44.8666	-103.904	Owl Creek
WRD40	Outlet Deep Creek	45.1752	-102.243	Deep Creek
WRD27	Lower Crow Creek	44.7092	-103.857	Crow Creek
WRD45	Cottonwood Creek-Black Pipe Creek	43.69992	-101.227	Black Pipe Creek
WRD72	Cyclone Ditch-Rapid Creek	44.00912	-103.039	Rapid Creek
WRD47	Lower Gray Eagletail Creek	43.40045	-100.98	Gray Eagletail Creek
WRD76	Haystack Butte	45.31007	-102.736	Antelope Creek
WRD14	Jones Creek-South Fork Grand River	45.65389	-103.292	South Fork Grand River
WRD15	Lower Clarks Fork Creek	45.61098	-103.35	Clarks Fork Creek
WRD16	Arnett Creek	45.91522	-103.898	Arnett Creek
WRD60	City of Buffalo-South Fork Grand River	45.57132	-103.53	South Fork Grand River
WRD59	Wagon Creek-Little Missouri River	45.75044	-103.881	Little Missouri River
WRD25A	Owl Creek-Bull Creek	44.82865	-103.829	Owl Creek
WRD38A	Spur Creek	45.14365	-103.529	Spur Creek
WRD39A	Dry Creek-North Fork Moreau River	45.21819	-103.052	North Fork Moreau River

Appendix B



SD DANR Water Quality Data Rev 05/23

Agency Code | Sample Date | Time | Samplers Print/Sign | Source Water | Station ID | Site Location | Project | Project ID

Type of Sample: Grab, Replicate, Integrated Vertical, Blank, Composite, Integrated Flow, Lab Split

Medium: Water / Other

Relative Depth: Surface, Bottom, Midwater

H2O Temp	°C	Avg Secchi	Meters	*Field Comments*	
SPC	µmho/cm	Secchi A	Meters		
DO	mg/L	Secchi B	Meters		
pH	SU	Secchi C	Meters		
ORP	Volts				

All Samples must be packed in ice and chilled to 6 C

A - 1 Liter
- Alkalinity
- TSOL
- TSSOL
- VTSS
- TDSOL
- BOD
- CBOD
- CO3
- Hardness
- K
- Lab Cond
- Cl
- Fluoride
- HCO3
- SO4

B - 1 Liter *pH<2 ~2 mL H2SO4*
- Ammonia
- NO3+NO2-N
- TKN
- Total P
- COD

D - 100 mL *Filtered + pH<2 0.25 mL H2SO4*
- TDP
- DIN

R - 4L Cube
- Ra 226
- Ra 228

CN - 150 mL *pH >10 ~0.4 mL NAOH*
- CN
- WADCN

H - Liter Glass Amber *pH<2 ~2 mL HCL*
- TPH Diesel

OG - Liter Glass Amber *pH<2 ~2 mL HCL*
- Oil Grease

Dissolved Metals - 100 mL *Filtered + pH<2 ~0.5 mL HNO3*
- Ca, Na, Mg, Mn, K, Fe

Recoverable Metals - 100 mL *pH<2 ~0.5 mL HNO3*
- Ca, Na, Mg, Mn, Fe

E - 1 Liter *Filtered*
- HCO3, Cl, SO4, Fluoride

C - 100 mL Idex *Na2SO3 if source is Chlorinated*
Note: Use 250 mL bottle if requesting multiple tests
- Fecal Coliform*, Total Coliform, Fecal PFGE, E Coli*, Entercocci*

V-40mL	V1-40 mL	V2-120 mL	V3-120 mL
3 - 40 mL Amber Vials 0.5 mL HCL Zero Head Space	*2 - 40 mL Amber Vials 0.5 mL HCL Zero Head Space*	*120 mL Amber Bottle 1.5 mL H2SO4*	*120 mL Amber Bottle Filtered 1.5 mL H2SO4*
TPH Gas	VOC	TOC	DOC

Lab Comments

Dissolved Metals - 250 mL *Filtered + pH<2 ~1.5 mL HNO3*
- Al, Sb, As, Ba, Be, B, Cd, Cr, Cu, Hg, Pb, Ni, Se, Ag, Ti, U, V, Zn, Mo, Silica

Recoverable Metals - 250 mL *pH<2 ~1.5 mL HNO3*
- Al, Sb, As, Ba, Be, B, Cd, Cr, Cu, Hg, Pb, Ni, Se, Ag, Ti, U, V, Zn, Mo

Relinquished By: _____ Date/Time _____
Received By: _____ Date/Time _____
Relinquished By: _____ Date/Time _____
Received By: _____ Date/Time _____
Relinquished By: _____ Date/Time _____
Received By: _____ Date/Time _____

Sample Temp (C) **Date / Time Received** **Lab #**

Figure 1. Water chemisty chain of custody form for the NWGP REFDEV project.

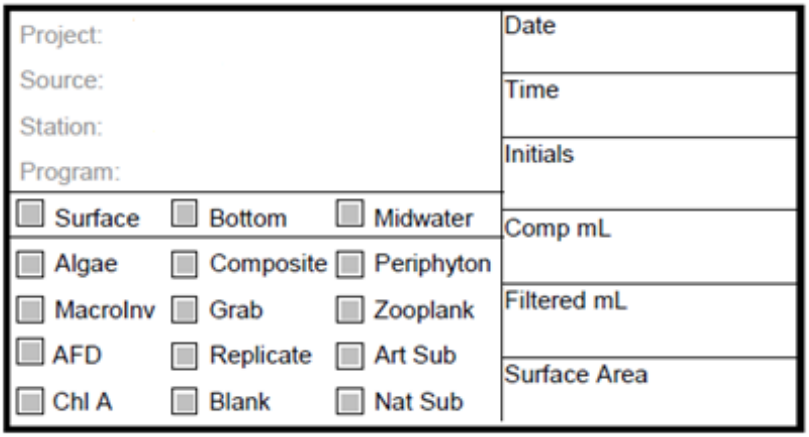


Figure 2. Biological sample label for the NWGP REFDEV project.

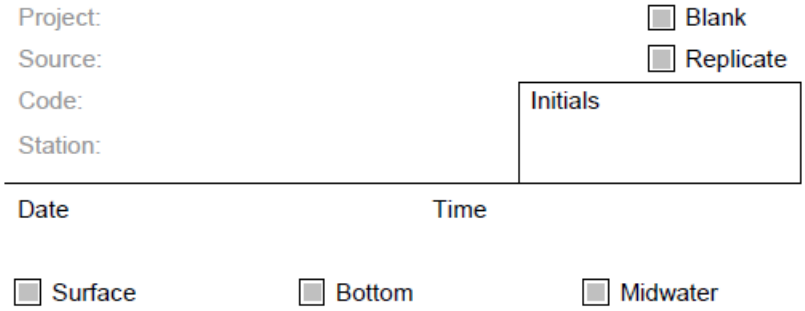


Figure 3. Water chemistry bottle label for the NWGP REFDEV project.

Appendix C

Narrative Nutrient Thresholds

Table 3. Narrative nutrient targets for Ecoregion 43.

Nutrient Targets for Ecoregion 43	
Total Phosphorus (mg/L)	0.087
Total Nitrogen (mg/L)	0.93

Selenium Criteria

Table 4. Selenium water quality criteria.

Selenium Water Quality Criteria	
Human Health Value Concentration (ug/L)	4,200
Chronic Freshwater Aquatic Life Value Concentrations (ug/L)	5
Acute Freshwater Aquatic Life Value Concentrations (ug/L)	The (0.996)CMC = 1/[fl/CMC1) + (f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and CMC1 and CMC2 are 185.9 Fg/L and 12.82 Fg/L, respectively.
All threshold values presented in this table apply only to uses 2-3-4-5-6-9	

Sodium Adsorption Ratio

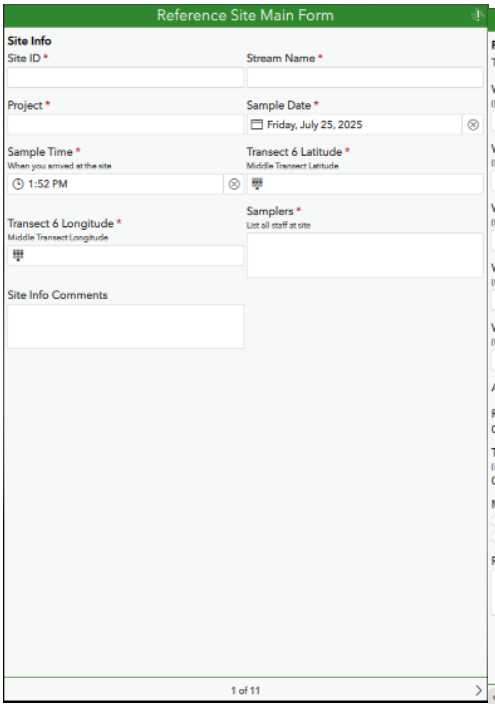
Sodium adsorption ratio is a calculated value that evaluates the sodium hazard of irrigation water based on the Gapon equation and expressed by the mathematical expression:

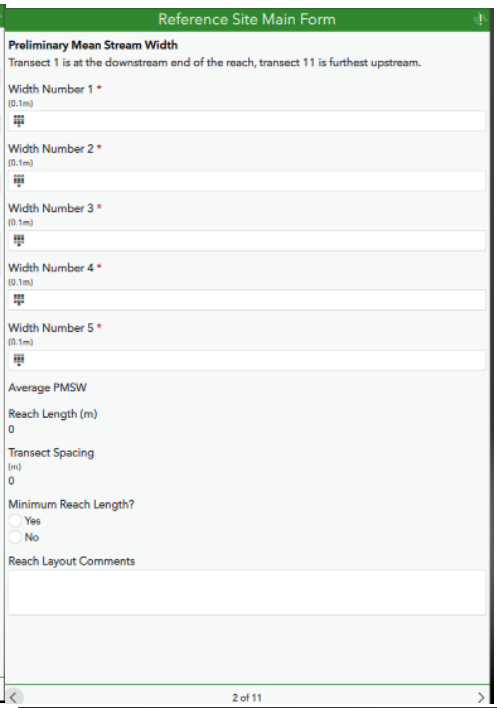
$$\frac{Na^{+}}{\sqrt{\frac{Ca^{+2} + Mg^{+2}}{2}}}$$

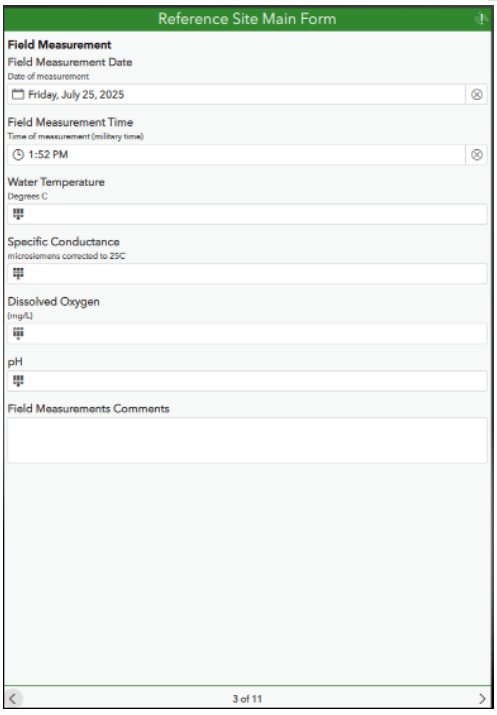
The result of this calculation must be less than or equal to 10.

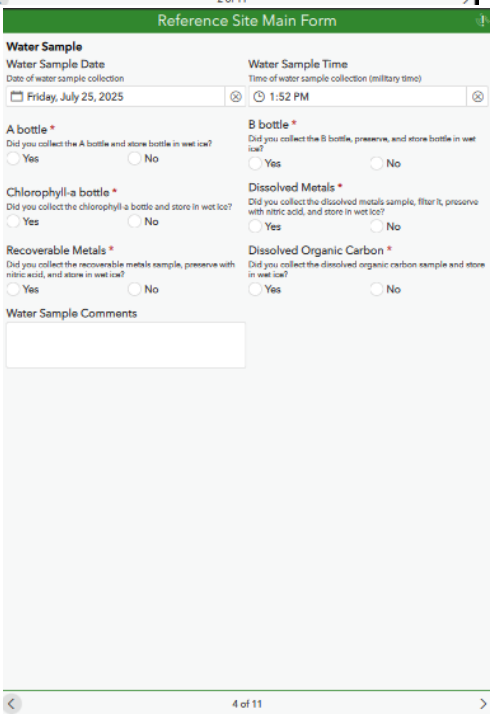
Appendix D

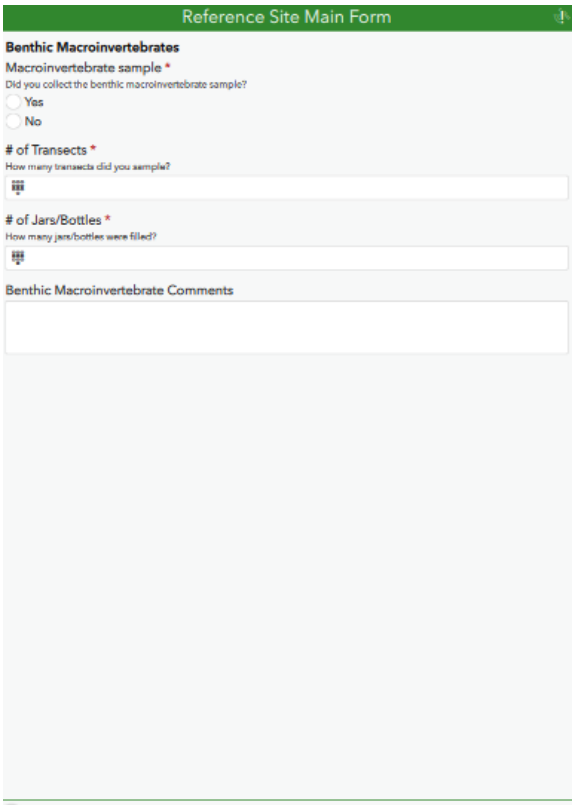
Survey123 Data Collection Forms

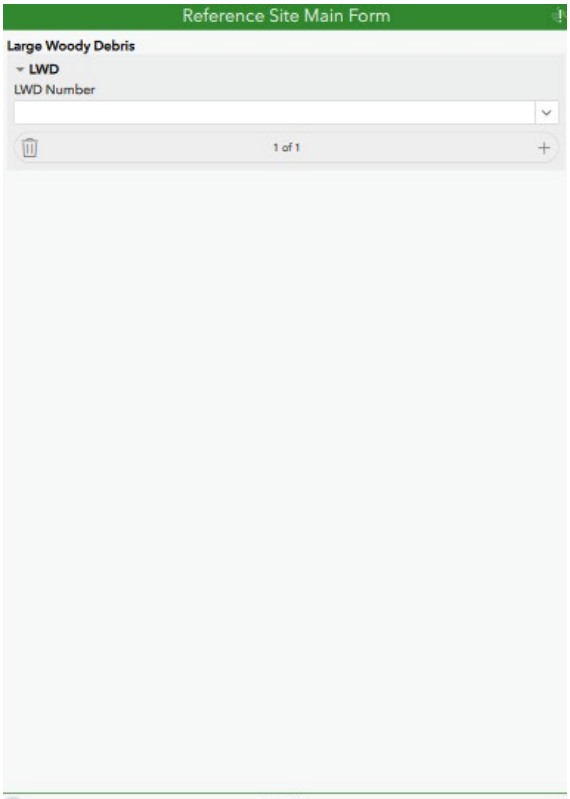


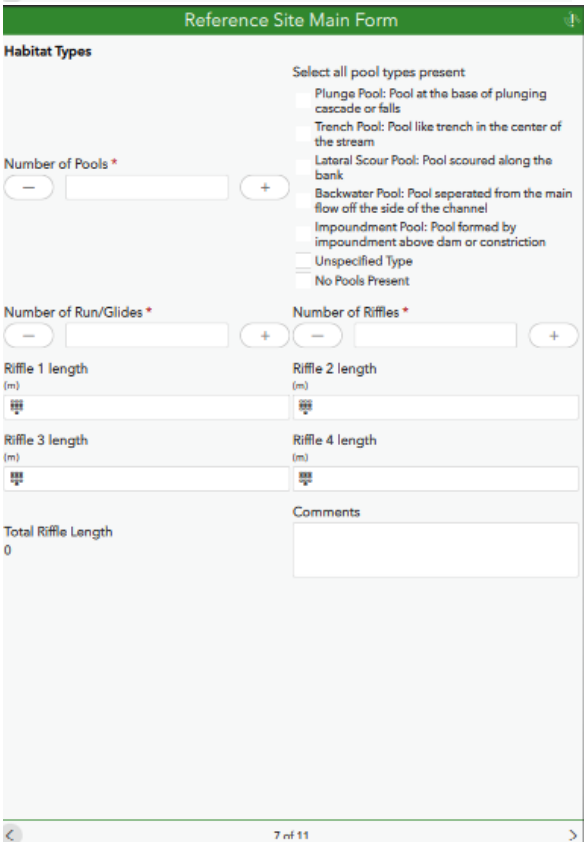


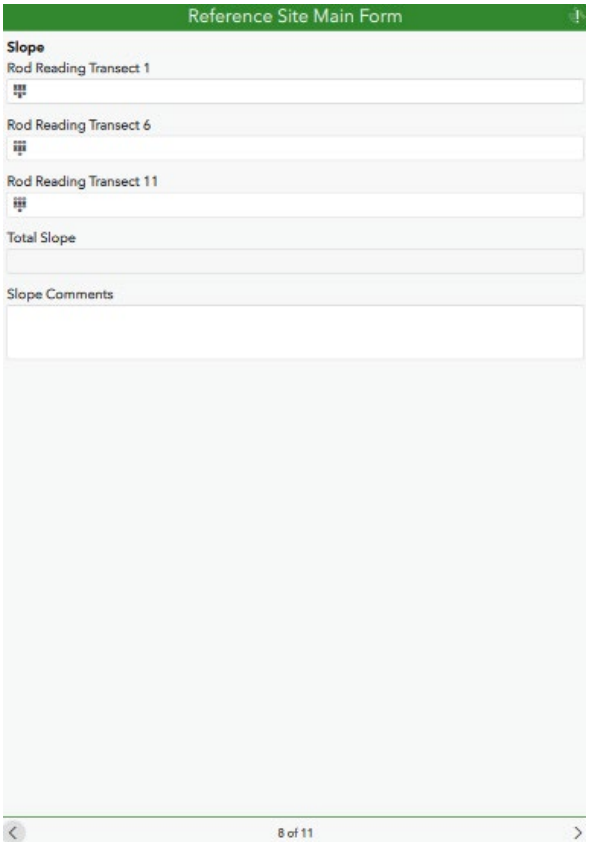


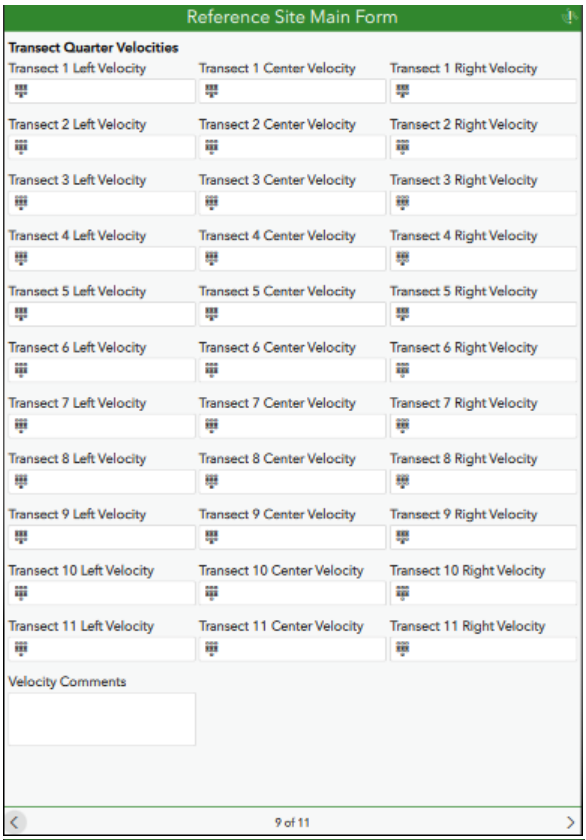



Reference Site Main Form
Benthic Macroinvertebrates
Macroinvertebrate sample *
Did you collect the benthic macroinvertebrate sample?
Yes
No
# of Transcects *
How many transects did you sample?
# of Jars/Bottles *
How many jars/bottles were filled?
Benthic Macroinvertebrate Comments
5 of 11


Reference Site Main Form
Large Woody Debris
LWD
LWD Number
1 of 1
6 of 11


Reference Site Main Form
Habitat Types
Number of Pools *
Select all pool types present
Plunge Pool: Pool at the base of plunging cascade or falls
Trench Pool: Pool like trench in the center of the stream
Lateral Scour Pool: Pool scoured along the bank
Backwater Pool: Pool seperated from the main flow off the side of the channel
Impoundment Pool: Pool formed by impoundment above dam or constriction
Unspecified Type
No Pools Present
Number of Run/Glides *
Number of Riffles *
Riffle 1 length
(m)
Riffle 2 length
(m)
Riffle 3 length
(m)
Riffle 4 length
(m)
Comments
Total Riffle Length
0
7 of 11


Reference Site Main Form
Slope
Rod Reading Transect 1
Rod Reading Transect 6
Rod Reading Transect 11
Total Slope
Slope Comments
8 of 11


Reference Site Main Form
Transect Quarter Velocities
Transect 1 Left Velocity
Transect 1 Center Velocity
Transect 1 Right Velocity
Transect 2 Left Velocity
Transect 2 Center Velocity
Transect 2 Right Velocity
Transect 3 Left Velocity
Transect 3 Center Velocity
Transect 3 Right Velocity
Transect 4 Left Velocity
Transect 4 Center Velocity
Transect 4 Right Velocity
Transect 5 Left Velocity
Transect 5 Center Velocity
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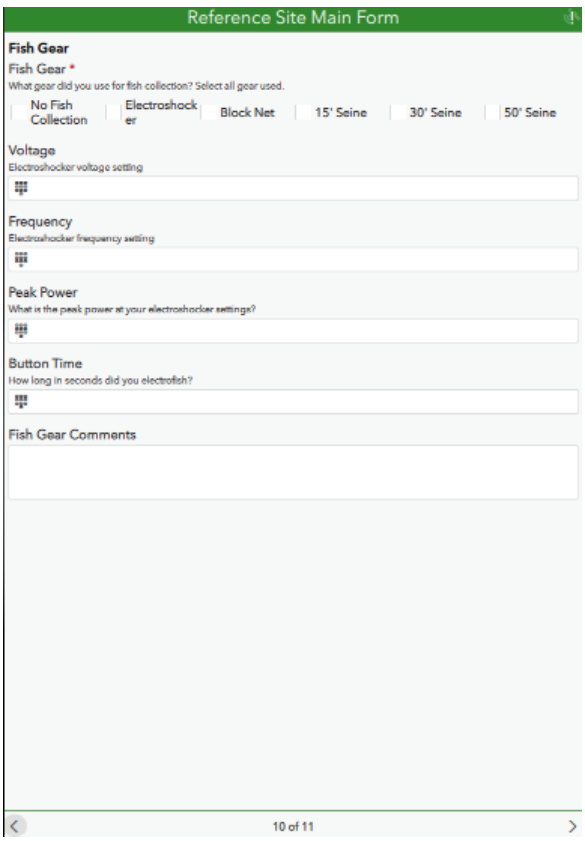
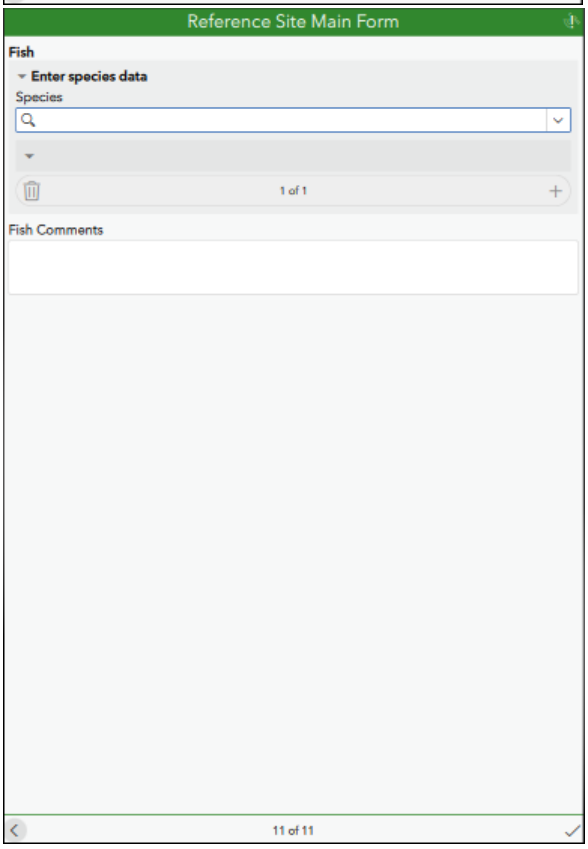
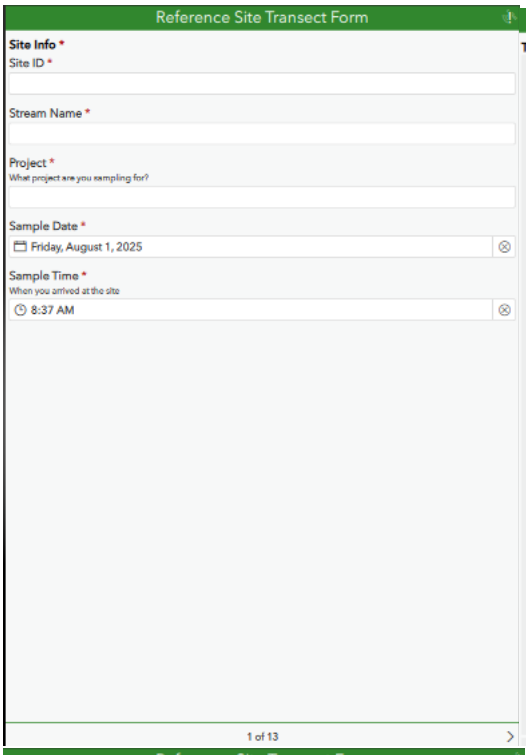
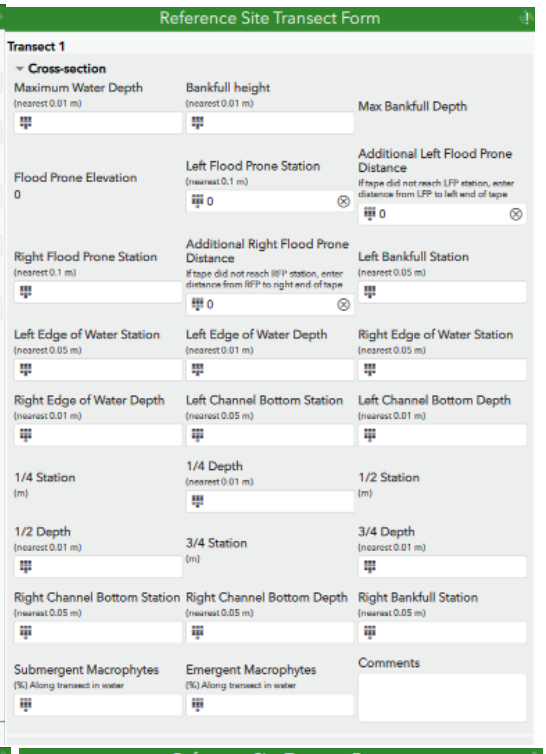
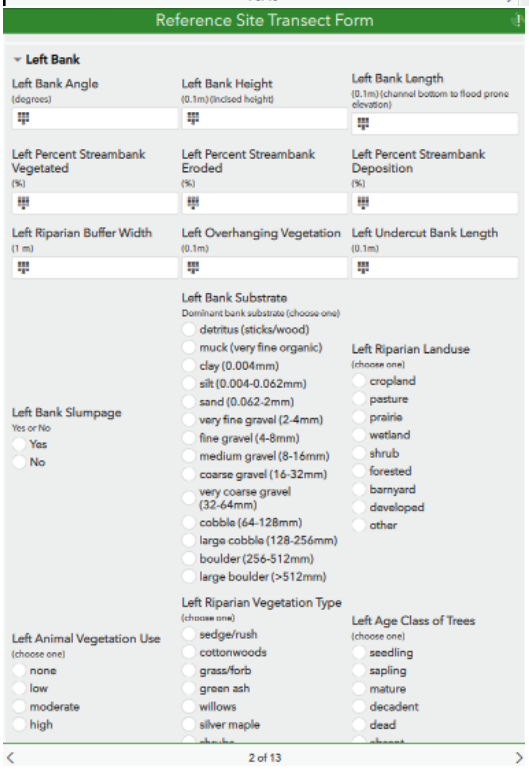
Transect 8 Center Velocity
Transect 8 Right Velocity
Transect 9 Left Velocity
Transect 9 Center Velocity
Transect 9 Right Velocity
Transect 10 Left Velocity
Transect 10 Center Velocity
Transect 10 Right Velocity
Transect 11 Left Velocity
Transect 11 Center Velocity
Transect 11 Right Velocity
Velocity Comments
9 of 11

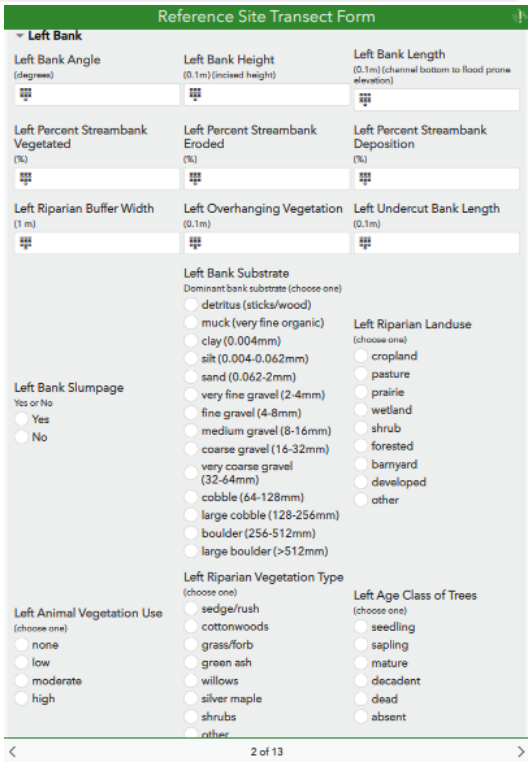

Reference Site Main Form
Fish Gear
Fish Gear *
What gear did you use for fish collection? Select all gear used.
No Fish Collection
Electroshocker
Block Net
15' Seine
30' Seine
50' Seine
Voltage
Electroshocker voltage setting
Frequency
Electroshocker frequency setting
Peak Power
What is the peak power at your electroshocker settings?
Button Time
How long in seconds did you electrofish?
Fish Gear Comments
10 of 11


Reference Site Main Form
Fish
Enter species data
Species
1 of 1
Fish Comments
11 of 11

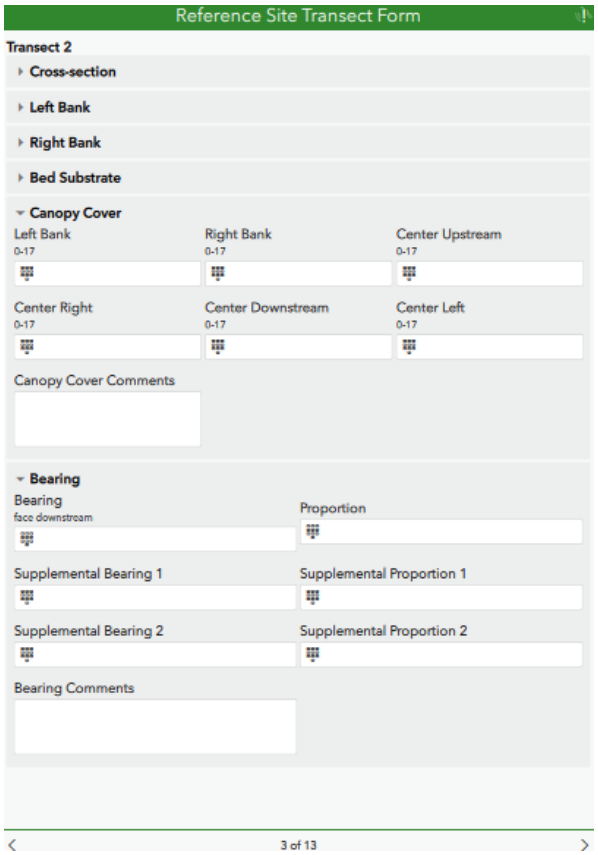

Reference Site Transect Form
Site Info *
Site ID *
Stream Name *
Project *
What project are you sampling for?
Sample Date *
Friday, August 1, 2025
Sample Time *
When you arrived at the site
8:37 AM
1 of 13


Reference Site Transect Form
Transect 1
Cross-section
Maximum Water Depth
(nearest 0.01 m)
Bankfull height
(nearest 0.01 m)
Max Bankfull Depth
Flood Prone Elevation
0
Left Flood Prone Station
(nearest 0.1 m)
Additional Left Flood Prone Distance
If tape did not reach LFP station, enter distance from LFP to left end of tape
Right Flood Prone Station
(nearest 0.1 m)
Additional Right Flood Prone Distance
If tape did not reach RFP station, enter distance from RFP to right end of tape
Left Bankfull Station
(nearest 0.05 m)
Left Edge of Water Station
(nearest 0.05 m)
Left Edge of Water Depth
(nearest 0.01 m)
Right Edge of Water Station
(nearest 0.05 m)
Right Edge of Water Depth
(nearest 0.01 m)
Left Channel Bottom Station
(nearest 0.05 m)
Left Channel Bottom Depth
(nearest 0.01 m)
1/4 Station
(m)
1/4 Depth
(nearest 0.01 m)
1/2 Station
(m)
1/2 Depth
(nearest 0.01 m)
3/4 Station
(m)
3/4 Depth
(nearest 0.01 m)
Right Channel Bottom Station
(nearest 0.05 m)
Right Channel Bottom Depth
(nearest 0.05 m)
Right Bankfull Station
(nearest 0.05 m)
Submergent Macrophytes
(%) Along transect in water
Emergent Macrophytes
(%) Along transect in water
Comments


Reference Site Transect Form
Left Bank
Left Bank Angle
(degrees)
Left Bank Height
(0.1m) (incised height)
Left Bank Length
(0.1m) (channel bottom to flood prone elevation)
Left Percent Streambank Vegetated
(%)
Left Percent Streambank Eroded
(%)
Left Percent Streambank Deposition
(%)
Left Riparian Buffer Width
(1 m)
Left Overhanging Vegetation
(0.1m)
Left Undercut Bank Length
(0.1m)
Left Bank Substrate
Dominant bank substrate (choose one)
detritus (sticks/wood)
muck (very fine organic)
clay (0.004mm)
silt (0.004-0.062mm)
sand (0.062-2mm)
very fine gravel (2-4mm)
fine gravel (4-8mm)
medium gravel (8-16mm)
coarse gravel (16-32mm)
very coarse gravel (32-64mm)
cobble (64-128mm)
large cobble (128-256mm)
boulder (256-512mm)
large boulder (>512mm)
Left Riparian Landuse
(choose one)
cropland
pasture
prairie
wetland
shrub
forested
barnyard
developed
other
Left Bank Slumpage
Yes or No
Yes
No
Left Riparian Vegetation Type
(choose one)
sedge/rush
cottonwoods
grass/forb
green ash
willows
silver maple
Left Age Class of Trees
(choose one)
seedling
sapling
mature
decadent
dead
Left Animal Vegetation Use
(choose one)
none
low
moderate
high
2 of 13


Reference Site Transect Form
Left Bank
Left Bank Angle
(degrees)
Left Bank Height
(0.1m) (incised height)
Left Bank Length
(0.1m) (channel bottom to flood prone elevation)
Left Percent Streambank Vegetated
(%)
Left Percent Streambank Eroded
(%)
Left Percent Streambank Deposition
(%)
Left Riparian Buffer Width
(1 m)
Left Overhanging Vegetation
(0.1m)
Left Undercut Bank Length
(0.1m)
Left Bank Substrate
Dominant bank substrate (choose one)
detritus (sticks/wood)
muck (very fine organic)
clay (0.004mm)
silt (0.004-0.062mm)
sand (0.062-2mm)
very fine gravel (2-4mm)
fine gravel (4-8mm)
medium gravel (8-16mm)
coarse gravel (16-32mm)
very coarse gravel (32-64mm)
cobble (64-128mm)
large cobble (128-256mm)
boulder (256-512mm)
large boulder (>512mm)
Left Riparian Landuse
(choose one)
cropland
pasture
prairie
wetland
shrub
forested
barnyard
developed
other
Left Bank Slumpage
Yes or No
Yes
No
Left Riparian Vegetation Type
(choose one)
sedge/rush
cottonwoods
grass/forb
green ash
willows
silver maple
shrubs
other
Left Age Class of Trees
(choose one)
seedling
sapling
mature
decadent
dead
absent
Left Animal Vegetation Use
(choose one)
none
low
moderate
high
2 of 13


Reference Site Transect Form
Bed Substrate
Choose one
detritus (sticks/ wood)
muck (very fine organic)
clay (0.004mm)
silt (0.004-0.062mm)
sand (0.062-2mm)
very fine gravel (2-4mm)
fine gravel (4-8mm)
medium gravel (8-16mm)
coarse gravel (16-32mm)
very coarse gravel (32-64mm)
cobble (64-128mm)
large cobble (128-256mm)
boulder (256-512mm)
large boulder (>512mm)
2 of 13


Reference Site Transect Form
Transect 2
Cross-section
Left Bank
Right Bank
Bed Substrate
Canopy Cover
Left Bank
0-17
Right Bank
0-17
Center Upstream
0-17
Center Right
0-17
Center Downstream
0-17
Center Left
0-17
Canopy Cover Comments
Bearing
Bearing
face downstream
Proportion
Supplemental Bearing 1
Supplemental Proportion 1
Supplemental Bearing 2
Supplemental Proportion 2
Bearing Comments
3 of 13