Small Watershed Rotating Basin Monitoring Program
Basin Group 3, Cycle 5
(Lower North Canadian, Lower Canadian, Lower Arkansas)

QUALITY ASSURANCE PROJECT PLAN

FY2023/2024 §319(h)
EPA Grant # C9-996100-22
Project 3, Output 3.1

Submitted by:

Oklahoma Conservation Commission
Water Quality Division
2800 N. Lincoln Blvd., Suite 200
Oklahoma City, Oklahoma 73105

Phone: (405) 522-4732

Effective Date:
April 2023

This page intentionally left blank.

A1 TITLE AND SIGNATURE PAGE

Oklahoma Conservation Commission, Water Quality Division
Quality Assurance Project Plan
for the
Small Watershed Rotating Basin Monitoring Program
Basin Group 3, Cycle 5
FY2023/2024 §319(h), EPA Grant # C9-996100-22, Project 3, Output 3.1

Approving Officers:

Name: **Brooks Tramell** – Director of Monitoring, Assessment, & Wetlands Programs, Oklahoma Conservation Commission, Water Quality Division

Signature:________________________________ Date:____________

Name: **Dan Dvorett**–Technical Programs Director\ QA Officer, Oklahoma Conservation Commission, Water Quality Division

Signature:________________________________ Date:____________

Name: **Lynda Williamson –** Environmental Grants Manager, Oklahoma Office of the Secretary of Energy and Environment

Signature:________________________________ Date:____________

Name: **Nikole Witt –** Project Officer, Region VI United States Environmental Protection Agency

Signature:________________________________ Date:____________

Name: **Nelly Smith –** Office of Water Quality, Region VI United States Environmental Protection Agency

Signature:________________________________ Date:____________

This page intentionally left blank.

A2 TABLE OF CONTENTS

LIST OF TABLES

A3 DISTRIBUTION LIST

U.S. EPA Region VI approved copies of this Quality Assurance Project Plan (QAPP) are listed in Table 1.

Table 1. Distribution List for receiving copies of this Quality Assurance Project Plan

Name	Organization	E-mail	Phone
Dan Dvorett	Oklahoma Conservation Commission	Dan.dvorett@conservation.ok.gov	(405) 365-2276
Brooks Tramell	Oklahoma Conservation Commission	Brooks.tramell@conservation.ok.gov	(405) 534-6997
Lynda Williamson	Office of the Secretary of Energy and Environment	Lynda.williamson@ee.ok.gov	(405) 522-7143
Nikole Witt	U.S. EPA Region VI	Witt.Nikole@epa.gov	(214) 665-7431

A4 PROJECT/TASK ORGANIZATION

Personnel of the Oklahoma Conservation Commission (OCC), Water Quality Division will perform all tasks necessary to complete this project. The primary decision maker is Shanon Phillips, Director of the Water Quality Division. Current team members include Shanon Phillips, Greg Kloxin, Jason Ramming, Brooks Tramell, and Dan Dvorett. The OCC personnel involved, and their responsibilities are listed below.

Trey Lam, Executive Director, OCC

Responsible for all operations of OCC including Water Quality Division operations.

Shanon Phillips, Director, OCC Water Quality Division

Responsible for all OCC Water Quality Division programs, and the final decision making authority within the Water Quality Division. The Director is, in addition to administrative duties, responsible for coordinating and expediting management of OCC watershed projects, both within the OCC and with contracted agencies.

Greg Kloxin, Assistant Director, OCC Water Quality Division

Second in OCC Water Quality Division command. In addition to specific duties assigned by the Director, this position is primarily responsible for the design and implementation of the Commission's nonpoint source programs including water quality, biological and habitat monitoring, implementation of best management practices, and education programs.

Brooks Tramell, Director of Monitoring, Assessment, & Wetlands Programs, OCC Water Quality Division

This position is responsible for all field-sampling activities and, as an integral part of all monitoring projects, participates in establishing Data Quality Objectives. He has the lead responsibility for maintaining standard operating procedures for all field activities and the supervision, coordination, and training of the field investigative personnel. Brooks is also responsible for oversight of Nathan Carter as he identifies, enumerates, and catalogs fish collections collected by the OCC. This includes a thorough and complete review of all fish collection data as well as a taxonomic review.

Jason Ramming, Monitoring Coordinator, OCC Water Quality Division

Responsible for scheduling sampling events and employee schedules as well as coordination with the ODAFF laboratory. Responsible for field supervision of monitoring activities, collection of field data and samples, land use and landowner surveys, submission of samples to the laboratory, equipment maintenance, and various related duties. Responsible for tracking and coordinating the replacement of monitoring supplies as well as maintenance and repair of field meters. Reviews and assists with updating and revising standard operating procedures.

Wes Shockley, Monitoring Specialist III, OCC Water Quality Division

Responsible for field supervision of monitoring activities, collection of field data and samples, land use and landowner surveys, submission of samples to the laboratory, equipment maintenance, and various related duties. Reviews and assists with updating and revising standard operating procedures.

Joey Dyer, Monitoring and Assessment Specialist, OCC Water Quality Division

Responsible for field supervision of monitoring activities, collection of field data and samples, land use and landowner surveys, submission of samples to the laboratory, equipment maintenance, and various related duties. Reviews and assists with updating and revising standard operating procedures and project QAPPs. This position also involves technical writing and data analysis responsibilities.

Jake Swanson, Monitoring and Assessment Specialist, OCC Water Quality Division

Responsible for field supervision of monitoring activities, collection of field data and samples, land use and landowner surveys, submission of samples to the laboratory, equipment maintenance, and various related duties. Reviews and assists with updating and revising standard operating procedures and project. This position also involves technical writing responsibilities.

Leonard Moore, Monitoring and Assessment Specialist, OCC Water Quality Division

Responsible for field supervision of monitoring activities, collection of field data and samples, land use and landowner surveys, submission of samples to the laboratory, equipment maintenance, and various related duties. Reviews and assists with updating and revising standard operating procedures and project. This position also involves technical writing responsibilities.

Jake Lekband, Monitoring and Assessment Specialist, OCC Water Quality Division

Responsible for field supervision of monitoring activities, collection of field data and samples, land use and landowner surveys, submission of samples to the laboratory, equipment maintenance, and various related duties. Reviews and assists with updating and revising standard operating procedures and project. This position also involves technical writing responsibilities.

Nathan Carter, Monitoring Specialist II, OCC Water Quality Division

Responsible for field supervision of monitoring activities, collection of field data and samples, land use and landowner surveys, submission of samples to the laboratory, equipment maintenance, and various related duties. Reviews and assists with updating and revising standard operating procedures and QAPPs. Also identifies fish samples and either performs subsampling of macroinvertebrate collections or trains and oversees the subsampling of macroinvertebrate samples to prepare them for taxonomic ID. Nathan has achieved certification in the identification of the major macroinvertebrate groups and will identify the samples.

Karla Spinner, Records Management Specialist, OCC Water Quality Division

Manages the Division's database including, entering, and retrieving water quality field and laboratory records; receives and reviews source documents; proofs previously entered records and makes routine corrections. Karla also initiates and handles correspondence relating to records management including: water quality field and laboratory records, policies, and procedures. She produces documents of various levels of complexity, including records summaries. Karla also retrieves data and helps with data analysis for reporting.

Dan Dvorett, Technical Programs Manager/QA Officer, OCC Water Quality Division

Lead technical writer, data analyst, and field investigator. Dan is responsible for the drafting and review of the technical reports and other information from the Division. Dan is also responsible for all Quality Assurance efforts implemented for this project. To maintain independence of QA/QC procedures, Dan Dvorett is not involved in any data collection activities.

Sarah Gilmer, Environmental Specialist, OCC Water Quality Division

Assists the Technical Programs Manager with writing technical reports, analyzing data and Quality Assurance efforts. Sarah is also responsible for acquiring and documenting landowner permission to access sampling locations. To maintain independence of QA/QC procedures, Sarah Gilmer is not involved in any data collection activities.

Maryanne Dantzler-Kyer, Environmental Projects Coordinator

The Environmental Projects Coordinator administers environmental projects for all water quality grants and associated reporting requirements. Maryanne will be responsible for maintaining the official, approved QA Project Plan.

Shellie Willoughby, GIS Specialist, OCC Water Quality Division

The primary responsibility is to provide Geographical Information System support to the Division. Primary responsibilities include: 1) Accurate and precise input of spatial data into the GIS system; 2) responsible for QA procedures for the digitizing process; 3) works with field personnel to coordinate the collection of spatial data in an efficient and accurate manner; 4) spatial analysis of water quality data; 5) QA development, modeling, map generation, and spatial links to data.

The organizational flow chart is available in the Quality Management Plan (OCC 2021a).

A5 PROBLEM DEFINITION/BACKGROUND

Nonpoint source (NPS) pollution, generally resulting from land runoff of pollutants, is a leading cause of water quality impairments nationwide and in Oklahoma. Monitoring and assessment are critical steps towards identifying the extent of water quality impairments, as well as the potential causes and sources of degradation.

The Clean Water Act has charged each State's Nonpoint Source (NPS) pollution agency with two primary tasks: 1) identify all waters being impacted by NPS pollution and 2) develop a management program describing NPS pollution activities to be implemented to correct identified problems. In addition, each State's NPS agency is tasked with identifying and cooperating with all programs and entities to achieve implementation of NPS controls. Furthermore, each State's NPS agency must report on the status of programs addressing NPS impacts and improving water quality.

To fully address NPS pollution in Oklahoma, the OCC initiated a new monitoring program in 2001, the "Small Watershed Rotating Basin Monitoring Program," which is coordinated with other monitoring programs in the state. The Rotating Basin program is comprised of four stages, as described in the revised *OCC Nonpoint Source Management Plan* (OCC 2019). The first stage includes a comprehensive, coordinated investigation and analysis of the causes and sources of NPS pollution throughout the State—Ambient Monitoring. The second stage involves more intensive, specialized monitoring designed to identify specific causes and sources of NPS pollution—Diagnostic Monitoring. The data from diagnostic monitoring can be used to formulate an implementation plan to specifically address the sources and types of NPS pollution identified in diagnostic monitoring. The third stage of monitoring, conducted during the execution of this implementation plan, is designed to perform, or undertake remedial and/or mitigation efforts to address the NPS problems—Implementation Monitoring. Finally, the fourth stage evaluates the effectiveness of the implementation through assessment and post-implementation monitoring—Success Monitoring.

In the more than 20 years since the initiation of the Small Watershed Rotating Basin Monitoring Program, approximately 250 sites have been sampled comprehensively throughout the state, resulting in an extensive database. Continuity in monitoring methods at fixed monitoring locations has been a crucial component to identifying and remediating NPS-derived impairments in Oklahoma. As the fifth cycle of the program continues and sites are revisited, NPS impacts can be examined in the context of the initial data. Additionally, each cyclical return to a subset of planning basins, allows for the expansion of monitoring protocols to new locations. Rotating Basin

Program data has and continues to be a foundational component of the state's Integrated Report, submitted biennially.

A6 PROJECT/TASK DESCRIPTION

The goal of the Rotating Basin Project is to monitor the majority of 11-digit watersheds located entirely within the State of Oklahoma. Sample collection at the outlet of the watershed allows for a general representation of water quality for the entire watershed. Watersheds that do not have perennial water present and watersheds that are actually a segment of a larger river being sampled by another agency will not be monitored. When the designated watershed is in a large river segment, the OCC will consider monitoring a stream with perennial water that is a tributary to that large river. All sites will be located far enough upstream of the receiving waterbody so backwater effects will be negated. This includes alluvial water of the receiving waterbody as well as surface water. The sites selected for monitoring are subject to confirmation by a field visit. Lack of landowner permission, lack of perennial water, and closed county roads are some of the reasons why a monitoring site may have to be rejected or moved. When possible, preference is given to retaining stream monitoring locations from previous rotating basin cycles. Where the watershed is monitored by another entity for other purposes, the site will be dropped if the monitoring meets the NPS assessment data quality objectives.

This Quality Assurance Project Plan (QAPP) encompasses Task 1, "Fifth Cycle Monitoring in the Lower North Canadian, Lower Canadian, and Lower Arkansas Rivers" of the OCC 2023/2024 Project 7 Workplan. As part of the Rotating Basin Project, the OCC will target sampling a total of approximately 59 sites in the Lower North Canadian, Lower Canadian, and Lower Arkansas Watersheds (Table 2 and Appendix I) over the course of two years. However, the final number and exact locations of monitoring stations may change due to site suitability or access restrictions. For this fifth cycle the selected sites will be sampled starting in June 2023 and continue through May 2025.

The Lower North Canadian Basin is located in the central portion of the state. The basin includes at least portions of McIntosh, Hughes, Okfuskee, Okmulgee, Creek, Seminole, Cleveland, Pottawatomie, Lincoln, Logan, Oklahoma, Canadian, Dewey, and Blaine Counties.

The Lower Canadian Basin is located in the eastern central part of the state and covers at least portions of Cleveland, Pontotoc, Pottawatomie, Seminole, Hughes, Pittsburg, Latimer, Muskogee, McIntosh, Oklahoma, McClain, Garvin, and Haskell Counties.

The Lower Arkansas Basin is in the eastern central part of the state and borders Arkansas. It includes at least portions of Creek, Osage, Tulsa, Wagoner, Okmulgee, Muskogee, McIntosh, Haskell, Pittsburg, Latimer, LeFlore, Sequoyah, Adair, Delaware, and Cherokee Counties.

Table 2: Rotating Basin 3.5 Site List. The final list of monitoring locations may vary based on access permission limitations or unsuitable environmental conditions. New monitoring locations will not be designated with a final waterbody ID (WBID) until inclusion is finalized. * Denotes a stream where only bacteria samples will be collected.

Site Name	WBID	Latitude	Longitude	County
Alabama Creek	OK520500-01-0200D	35.3355	-96.1446	Okfuskee
Ash Creek	OK120410-01-0110E	35.7883	-95.6653	Muskogee
Ballard Creek	OK121700-03-0370G	36.1063	-94.5646	Adair
Battle Creek	OK121700-06-0040G	36.2104	-94.6844	Delaware
Bear Creek	OK520700-05-0170A	35.7102	-97.1174	Lincoln
Big Creek	OK220100-02-0080B	34.7692	-94.4981	LeFlore
Big Skin Bayou	OK220200-01-0030K	35.3981	-94.6576	Sequoyah
Bird Creek	OK520800-01-0050M	35.0336	-96.4235	Hughes
Black Fork of Poteau River	OK220100-02-0040P	34.7600	-94.4901	LeFlore
Brazil Creek	OK220100-03-0010G	35.1388	-94.7690	LeFlore
Brushy Creek	OK220600-03-0010L	34.8014	-95.6547	Pittsburg
Camp Creek*	OK520700-03-0220D	35.7660	-96.5830	Creek
Canadian Sandy Creek	OK520600-03-0010D	34.8119	-96.7036	Pontotoc
Captain Creek	OK520700-05-0140H	35.6811	-97.0799	Lincoln
Caston Creek	OK220100-01-0180B	34.9578	-94.7386	LeFlore
Cloud Creek: E090	OK120410-02-0010	35.7113	-95.6314	Muskogee
Coal Creek	OK220600-02-0010F	34.9695	-95.8520	Pittsburg
Dry Creek	OK520700-04-0020F	35.6848	-96.6949	Lincoln
Elk Creek (Cherokee)	OK121700-02-0180G	35.7292	-94.9040	Cherokee
Elk Creek (McIntosh)	OK120400-02-0190F	35.5223	-95.5031	McIntosh
Fourche Maline Creek	OK220100-04-0020H	34.9199	-94.9453	LeFlore
Gaines Creek	OK220600-04-0010F	34.8955	-95.4370	Latimer
Gar Creek	OK520510-00-0080C	35.3768	-96.5355	Seminole
George's Fork of Dirty Creek	OK120400-02-0110D	35.4935	-95.2454	Muskogee
Greenleaf Creek: N4450	OK120400-10-0120	35.7085	-95.0918	Cherokee
Hog Creek	OK520810-00-0030D	35.3195	-97.2497	Cleveland
Holson Creek	OK220100-04-0030G	34.8794	-94.8531	LeFlore
Little Deep Fork	OK520700-06-0010D	35.6996	-96.2104	Creek
Little Wewoka Creek	OK520500-02-0090D	35.2318	-96.2957	Hughes
Longtown Creek	OK220600-01-0070P	35.1804	-95.4728	Pittsburg
Manard Bayou	OK120400-01-0280E	35.7942	-95.1634	Muskogee
Mill Creek	OK220600-01-0100J	35.2201	-95.8036	McIntosh
Montezumah Creek: Cherry Rd	OK520700-01-0220	35.5218	-95.9994	Okmulgee
Mountain Fork of San Bois Creek	OK220200-04-0050J	35.0762	-95.1385	Haskell
Nuyaka Creek	OK520700-02-0200D	35.5954	-96.2121	Okfuskee
Opossum Creek	OK520700-05-0200C	35.7100	-97.1639	Cleveland
Peaceable Creek	OK220600-03-0050F	34.8519	-95.6542	Pittsburg

Site Name	WBID	Latitude	Longitude	County
Peacheater Creek	OK121700-05-0120B	35.9551	-94.6962	Adair
Peavine Creek	OK121700-05-0190F	35.9045	-94.6229	Adair
Pecan Creek (Muskogee)	OK120410-01-0030D	35.7842	-95.4497	Muskogee
Pecan Creek (Pottawatomie)	OK520800-02-0080C	35.2032	-97.1182	Pottawatomie
Polecat Creek	OK120420-02-0050B	35.9197	-96.2815	Creek
Polecat Creek*	OK120420-02-0050G	36.0151	-96.0297	Creek
Quapaw Creek	OK520700-04-0260C	35.6221	-96.8196	Lincoln
Sallisaw Creek	OK220200-03-0010C	35.4646	-94.8618	Sequoyah
Sallisaw Creek *	OK220200-03-0010G	35.5775	-94.8292	Sequoyah
Salt Creek (Creek)	OK520700-03-0100B	35.6962	-96.4765	Creek
Salt Creek (Seminole)	OK520800-03-0010D	35.0490	-96.6676	Seminole
San Bois Creek	OK220200-04-0010G	35.2011	-95.0444	Haskell
Snake Creek (Tulsa)	OK120410-01-0220G	35.8860	-95.8724	Tulsa
South Fork Dirty Creek	OK120400-02-0030H	35.4503	-95.2169	Muskogee
Steely Hollow Creek	OK121700-03-0120G	35.9769	-94.9230	Cherokee
Sugar Loaf Creek	OK220100-01-0160G	34.9989	-94.5756	LeFlore
Taloka Creek	OK220300-00-0020M	35.2958	-95.1331	Haskell
Telemay Hollow Creek	OK121700-03-0140G	36.0381	-94.8990	Cherokee
Turkey Creek	OK520510-00-0100F	35.3772	-96.6479	Seminole
Tyner Creek	OK121700-05-0090J	35.9956	-94.7500	Adair
Vian Creek	OK220200-02-0130E	35.5074	-94.9837	Sequoyah
Wewoka Creek	OK520500-02-0010C	35.2187	-96.2135	Hughes

Rotating Basin sites will be monitored for physical and chemical parameters on a fixed, preset interval schedule, approximately every five weeks from June 2023 to May 2025. A fixed interval of 35 days reduces seasonal bias, and allows for the collection of 20 total samples at each site over the course of the project. Samples will be collected during both base flow and high flow conditions. Parameters that will be collected include: turbidity, pH, dissolved oxygen (DO), alkalinity, conductivity, water temperature, instantaneous discharge, nitrate (NO_3), nitrite (NO_2), orthophosphate (PO_4), total phosphorous (TP), total Kjeldahl nitrogen (TKN), chloride (Cl), sulfate (SO_4), total suspended solids (TSS), total dissolved solids (TDS), and total hardness. Ammonia (NH_3) will be assessed three times a year during the summer season of May 1 – September 30. *Escherichia coli* will be monitored monthly during the recreational season of May 1 – September 30.

In addition, sites will be monitored twice yearly for benthic macroinvertebrates and benthic habitat during the two-year collection period. The sample collections are evenly divided between the winter and summer dry periods, thus utilizing the most stable index periods for the state. Fish and instream habitat will be monitored once during each rotation cycle. This frequency was selected to minimize the impact on fish populations within small streams. Habitat assessments include measurements of instream cover, pool bottom substrate, pool variability, canopy cover, presence of rocky riffles and runs, base flow discharge, channel alteration, channel sinuosity, bank stability, bank vegetative stability, and dominant vegetation.

Additional timelines and available resources for the completion of this project are listed in the *"FY 2023/2024 §319(h) Project 3, Ambient Cycle 3.5 and Implementation Monitoring Program" Workplan.*

A7 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

A7.1 PROJECT OBJECTIVES AND DECISIONS

The objectives of this project are to assess the water quality of Oklahoma streams as affected by NPS pollution, identify threatened and impaired systems, and ascertain the potential source of pollutants leading to degradation.

This monitoring program will consider the following decisions in the context of Oklahoma Water Quality Standards (OWQS) and the Use Support Attainability Protocol (USAP) to address NPS pollution (OWRB 2014).

1. Which waterbodies are not supporting beneficial uses due to NPS pollution?
2. Which waterbodies show elevated or increasing levels of NPS pollutants which may threaten water quality?
3. What is (are) the source(s) and magnitude of pollutant loading(s) within threatened or impaired waterbodies?
4. What land uses or changes thereof constitute sources or potential sources for pollutants causing beneficial use impairment?
5. What are the actual levels of pollution that prevent the attainment of the mandate of the CWA?

A7.2 ACTION LEVELS/LIMITS

The support status of each stream site for the agriculture, aesthetics, primary body contact, and fish and wildlife propagation beneficial uses will be evaluated for all monitoring locations. Water quality numerical and narrative criteria will be used to determine use attainment status, when available, in a manner consistent with the Oklahoma Water Resources Board's (OWRB) Use Support Assessment Protocol (USAP) (OWRB 2013).

Biological and habitat assessments will be used in addition to physical and chemical data as a direct measure of fish and wildlife beneficial use support status in a manner consistent with OWRB's Oklahoma Water Quality Standards (OWQS) and USAP. All monitoring data will be compared to the appropriate reference site(s) and OWQS to determine use attainment status. Protocols for determining beneficial use support (USAP) are found in the Oklahoma Administrative Code 785:46-15 (OWRB 2013). When a use attainment status is undetermined for fish using USAP methodologies, the Oklahoma Index of Biotic Integrity (OKIBI), may be used to make an assessment following guidance outlined in the Oklahoma Continuing Planning Process (CPP) (ODEQ 2012). Streams will be considered non-supporting when OWQS are violated as determined by criteria and rules listed in OAC 785:46-15. Parameters not addressed in OAC 785:46-15 will be assessed using applicable state and federal rules and regulations to determine non-support. Determination of habitat condition will be based on the habitat assessment scoring modified from Plafkin et al. (1989).

For regions or biological communities for which biocriteria are unspecified, condition assessment will follow the decision matrices in the EPA Rapid Bioassessment Protocols (RBPs) guidance document (Plafkin et al. 1989). The condition of the fish community will be based on indices of species richness, community quality, and by comparison to a reference stream(s) or a composite reference condition as shown in the EPA RBPs. The condition of the benthic macroinvertebrate community will also be assessed with the various indices presented in the RBPs (Plafkin et al. 1989) and as developed by the OCC staff.

Sample size for all parameters will meet or exceed the requirements set forth in USAP in the Oklahoma Water Quality Standards monitoring and decision protocols 785:46-15 for beneficial use support determination.

Method detection levels (Table 3) are at concentrations significantly lower than water quality criteria, listed in OAC 785:46-15, used to determine use support status, and therefore support sound decision-making related to project action levels.

A7.3 Data Quality Indicators

To make correct project decisions, it is critical that the data generated are of known and acceptable quality. Data Quality Indicators (DQIs) are used to define acceptable data quality and are detailed for specific parameters in the sections below. DQIs presented in this QAPP primarily pertain to sample collection, processing and analyses undertaken by OCC. DQIs for laboratory analyses are detailed in the USEPA approved Oklahoma Department of Agriculture, Food and Forestry (ODAFF) State Environmental Laboratory Quality Assurance Plan. DQIs include precision, accuracy/bias, representativeness, comparability, completeness, and sensitivity.

A7.3.1 Precision

Precision is a measure of repeatability under similar conditions. Precision for measurement endpoints is generally assessed as the relative percent difference between a sample and a concurrently collected field duplicate sample. Precision requirements for water quality parameters are listed in Table 3. For water quality parameters, as a general rule, precision must be within + or - 20% (USEPA 2021, April 8). Duplicate samples are taken from at least 5% of monitoring locations in accordance to OCC SOPs (OCC 2021c).

The precision and accuracy criteria presented in the Oklahoma Department of Agriculture, Food and Forestry (ODAFF) State Environmental Laboratory Quality Assurance Plan is suitable for this study. ODAFF ensures data quality through the use of analysis of control charts for precision and accuracy following Section 1020 of Standard Methods (1992). With these charts, Warning Limits of + or - 2 standard deviations and Control Limits of + or - 3 standard deviations are established. General acceptance limits for field duplicates are based on Table 1020:I of the Standard Methods (1992).

Table 3: Method Detection Limits and Acceptable Limits for Field Duplicates.

Parameter	Method	Meter / Lab	Acceptable precision duplicates	Method Detection Level*
Dissolved Oxygen	4500-G	YSI ProPlus	80-120%	0.1 mg/L
Conductance	2510-B	YSI ProPlus	80-120%	1.0 uS/cm
pH	4500 H-B	YSI ProPlus	80-120%	1.0 S.U.
Temperature	2550	YSI ProPlus	80-120%	-5ºC
Instantaneous Discharge	Electromagnetic; incremental, velocity-area	Marsh McBirney or Ott MF Pro	75-125%	0.1 cfs
Alkalinity	2320-B	Hach Kit	80-120%	10 mg/L
Hardness	2340-B	Hach Kit	80-120%	10 mg/L
Turbidity	2130-B	Hach 2100P/Q	80-120%	0.01 NTU
Ammonia	4500	ODAFF	80-120%	0.015 mg/L
Total Kjeldahl Nitrogen	4500-N-C	ODAFF	80-120%	0.11 mg/L
Nitrate	4500-NO3-D	ODAFF	80-120%	0.02 mg/L
Nitrite	4500 NO2	ODAFF	80-120%	0.02 mg/L
Ortho Phosphorus	4500 P E	ODAFF	80-120%	0.005mg/l
Total Phosphorous	4500 P-B-E	ODAFF	80-120%	0.01 mg/L
Total Suspended Solids	2540-O	ODAFF	80-120%	10.0 mg/L
Total Dissolved Solids	160.1	ODAFF	80-120%	10.0 mg/l
Sulfate	4500-SO4-E	ODAFF	80-120%	0.2 mg/L
Chloride	4500-C	ODAFF	80-120%	0.5 mg/L
E. Coli	1603	ODAFF	25.9%**	------

*Method detection limits reported by ODAFF Environmental Laboratory using Method 1030E from Standard Methods (APHA, AWWA, WPCF 1992).
**USEPA 2006

Acceptable precision for biological and habitat samples are listed in Table 4. Macroinvertebrate precision will be quantified with spatial replicates at a frequency of 10% of samples. Fish and habitat precision will be assessed with temporal replicates at a frequency of one replicate sample per lead collector or approximately 5-10% of samples. Precision metrics for habitat and biological metrics will be based on the RPD of the relevant multimetric indices outlined in section A7.2.

Table 4: Acceptable Precision for Biological Assessment Field Replicates

Activity	Parameter	Precision (RPD)
Fish collection: seine/electrofish	OKBioCrit/OKIBI	20%
Benthic macroinvertebrate collection	IBI	15%
Habitat assessment	Habitat Assessment Score	15%

A7.3.2. Bias/Accuracy

Bias as a measure of inaccuracy introduced through contamination of field samples, will be assessed through the collection of field blanks at 5% of study sites according to OCC SOPs (OCC 2021c). Sampling events associated with field blanks above detection limits will be flagged.

A7.3.3. Representativeness

Representativeness is a measure of how well the collected data represent the environmental conditions at the time of sampling. The primary verification of representativeness is if precision and accuracy DQIS are met. Additionally, representativeness is assessed qualitatively through verification of sample handling methods, chain of custody procedures, sample preservation, and sample holding time limits. The SOPs (OCC 2021c) and methods outlined in this QAPP were designed so sampling would be conducted to account for the normal spatiotemporal variability encountered at sample locations. Frequency and length of sampling were designed to maximize the representativeness of collected samples.

A7.3.4 Completeness

Completeness is a measure of what percentage of the target sample number is valid for application towards project decisions. Data will be considered complete for a specific parameter if there are enough samples to complete a use support assessment. For most water quality parameters 50% completeness (10/20 samples) is sufficient to follow USAP. For bacteria (10/10 samples), fish (1/1 sample) and macroinvertebrate samples (4/4 samples), 100% completeness is necessary. Attempts will be made to sample with sufficient frequency to meet the completeness DQI. However, given the uncertainty associated with sampling in wadeable streams, due to weather conditions and access limitations, it may not be feasible.

A7.3.5 Comparability

Comparability is the degree to which the results of this study can be compared to others. Comparability is ensured by following USEPA approved SOPs for data collection and standard laboratory methods. The methods for collection and analyses outlined in this QAPP are largely unchanged since the commencement of the Rotating Basin Monitoring Program approximately 20 years ago. Quality assurance measures such as yearly field audits help to maintain consistency of sampling methods and maximize comparability.

A7.3.6 Method Sensitivity

Sensitivity is a measure of the ability of a method to quantify a parameter at a value that is relevant to action levels. Method detection limits are presented in Table 3 and are of suitable sensitivity to meet project goals.

A8 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

Project staff are required to have degrees and/or experience with biological or other applicable sciences. Project staff must be familiar with the OCC SOP document (OCC 2021c) and all training will follow the methods outlined in that document. Extra training will be provided when new SOPs are developed. All monitoring staff will attend a yearly training and review of SOPs coordinated by the QA officer. Each year, monitoring staff are required to sign acknowledgment of receipt and review of updates to SOPs.

New monitoring staff are required to complete internal training to gain competence in field and office procedures, prior to collecting or processing data independently. In-house training will be conducted for the proper use and maintenance of all meters and digital titrators used for water quality measurements. Training of field crews will be done through dry run exercises in the laboratory to familiarize field crews with sample collection, sample preservation, instrument operation, calibration, and maintenance. Field exercises will be conducted to familiarize field crews with SOPs. Initiation of independent water quality monitoring, following training, requires sign-off by the monitoring coordinator and QA officer.

In order to be certified to lead fish collections and habitat assessments, new staff must complete an examination to document proficiency in fish identification and sampling procedures. Investigators are tested for identification abilities with a regionally relevant assemblage of fish fauna before fish collections begin. These fish are comprised of species that are typically found in Oklahoma stream systems. The majority of the test specimens include fish with larger body sizes that are typically field identified and/or found in large numbers. Species of special concern such as the Arkansas River Shiner are covered during training to ensure compliance with the US Fish and Wildlife Service's threatened and endangered species permit guidance. A test score of 98% or better must be achieved before the investigator will be a field crew leader. Investigators that score under 98% will not collect without direct supervision of a certified crew leader. All previously certified fish collectors must complete a similar fish identification exam with 98% accuracy to maintain certification to lead fish surveys. Ideally, recertification will occur yearly but will be completed every two years at a minimum. Additionally, to lead a fish collection, new staff need to complete a habitat assessment within 15% RPD of the habitat score of a concurrent assessment completed by certified collectors.

The QA officer is responsible for ensuring all required trainings are completed. Documentation of staff certifications and trainings are stored on the OCC server, and maintained by the QA officer.

A9 DOCUMENTATION AND RECORDS

The QA officer will be responsible for the distribution of this QAPP to team members following approval and updates, and all versions will be housed on the OCC server. All electronic reports and documents generated during the course of this project will be stored on both OCC servers and state of Oklahoma cloud-based servers. Files on OCC servers are backed up nightly. Physical copies of records will be maintained for at least five years following project completion or digitized to the OCC server.

All field observations and data (water quality, habitat, fish, and macroinvertebrates) will be recorded in a standardized data format in field sheets on waterproof paper or electronic field notebooks. Standardized datasheets are documented in OCC SOPs (OCC 2021c). Data acquired during this project will be collected and stored in accordance with Table 5 according to the type of data and intended use. Semi-annual reports will document progress towards achieving project goals and the Final Report will document project outcomes. The lead technical writer is responsible for reporting requirements, as well as delivery of semi-annual and final reports to EPA, though other project staff may be involved in writing as needed.

Table 5: Documentation and Format of Data Collected During Project

Data Type	Primary reporting format	Computer format	Final reporting format	Final data archive
Water quality field parameters	Paper or electronic field summary sheets	OCC Water Quality Database	Tables, graphs, etc.	STORET, OCC Water Quality Database & Library or Warehouse
Field parameters, QA, calibration	Standardized field sheets and/or digital reports	OCC Water Quality Database	QA Summary Report	OCC Water Quality Library or Warehouse
Water quality lab analysis	Lab report sheets and/or digital reports	OCC Water Quality Database	Tables, graphs, etc.	STORET, OCC Water Quality Database & Library or Warehouse
Water quality lab analysis - blanks, duplicates	Lab report sheets and/or digital reports	OCC Water Quality Database	QA Summary Tables	OCC Water Quality Database & Library or Warehouse
Field notes	Standardized Field sheets	OCC Water Quality Database	Final report as appropriate	OCC Water Quality Library
Habitat assessment	Standardized Field sheets	OCC Water Quality Database	Habitat metrics	OCC Water Quality Database & Library or Warehouse
Fish collections	Standardized Fish Collection Sheets and Laboratory Data Sheets	OCC Water Quality Database	Tolerance & diversity indices; final report and list of species collected	OCC Water Quality Database & Library or Warehouse; OK Museum of Natural History & EPA BIOS when appropriate
Benthic macroinvertebrate collections	Standardized Macroinvertebrate Collection Sheets and Laboratory Data Sheets	OCC Water Quality Database	Tolerance, diversity, list of species collected and other indices	OCC Water Quality Database & Library or Warehouse; EPA BIOS when appropriate

B MEASUREMENT AND DATA ACQUISITION

B1 SAMPLING PROCESS DESIGN

In order to determine the support status of each site and the causes of impairment, water quality sampling, biological monitoring, land use assessment, and habitat assessments will be conducted. Water quality analysis will consist of monitoring of turbidity, pH, dissolved oxygen (DO), alkalinity, conductivity, water temperature, instantaneous discharge, nitrate (NO_3), nitrite (NO_2), orthophosphate (PO_4), total phosphorus (TP), total Kjeldahl nitrogen (TKN), chloride (Cl), sulfate (SO_4), total suspended solids (TSS), total dissolved solids (TDS), and total hardness. Water quality samples will be collected 20 times per rotation per site, except for ammonia, which will be assessed 6 times per rotation and *Escherichia coli* 10 times per rotation. Ammonia (NH_3) and *Escherichia coli* will be monitored each year from May through September, three times for ammonia and five times for *E. coli*. Observations and quantities of odor, excessive bottom deposits, surface scum, oil/grease, and foam will be recorded to support the aesthetics beneficial use support. Biological monitoring will consist of a one-time collection of fish, a one-time habitat assessment, and semi-annual collections of benthic macroinvertebrates (two summer sets and two winter sets). The timing of sampling collection is detailed in Tables 6.

Table 6: Project Activities

Task Description	Initiate task	Complete task
QAPP	February 2023	April 2023
Monitoring for routine physical and chemical (including bacteria) parameters	June 2023	May 2025
Fish and habitat collections	June 2023	September 2024
Benthic invertebrates – winter and summer collections	June 2023	March 2025

Sampling for the project will be initiated in June 2023. Each site will be sampled for physical/chemical parameters at the frequency listed in Table 7. Each Rotating Basin site will be sampled approximately every 35 days or 10 times/year. During the recreational period (May through September) ammonia and *Escherichia coli* will be collected concurrently with routine physical and chemical data (every 35 days). However, sampling schedules may need to be adjusted due to temporary access restrictions, equipment failure or unsuitable environmental conditions. If additional samples are necessary to attain sufficient sample sizes for beneficial use determination, additional sample dates will be selected to maximize temporal coverage. If a site becomes permanently inaccessible or site conditions no longer meet the requirements detailed in this QAPP, a replacement site may be attempted at an alternate bridge crossing on the same stream. If no suitable replacement site can be identified (due to unsuitable site conditions or access restrictions) an inaccessible or unsuitable site may be removed from this project.

Summer (June 1 through September 15) and winter (January 1 to March 15) benthic macroinvertebrate collections will be completed twice per year over the two-year rotating basin project duration. One fish collection will be performed at each site. These collections will be completed during the summer and early fall months. If conditions are not appropriate for fish collections in 2023, they will be completed in 2024. Bacteria will be collected monthly during the recreational season months of May through September of both years.

Table 7: Sampling Frequency

Parameter	Collection Frequency
Physical and chemical field parameters	With each collection (fish and water quality collections)
Chemical "lab samples"	10 X / year fixed interval sampling, every 35 days
Benthic Macroinvertebrates	2 in summer / 2 in winter 2023 - 2025
Fish	Once (summer collections) 2023 or 2024
Flow	With each sample collection and habitat assessment.
Habitat	Once (with fish) 2023 or 2024
Bacteria	Monthly May - September 2023 and 2024

Fifty-nine sites were selected as potential monitoring locations in the Lower North Canadian, Lower Canadian and Lower Arkansas Watersheds for this monitoring cycle (Table 2 and Appendix I), but that number may change due to site suitability or access restrictions. Sites were selected to maximize coverage of all HUC-11 watersheds within the study area, with the monitoring location ideally located as close to the outlet of the HUC-11 as practicable. Care was taken to select sites out of areas that may be within the flood pool of lakes or within the backwater zone near confluences of other streams. Prior to the commencement of sampling, each site is verified for suitability of conditions necessary to complete monitoring activities. These visits also generate the basic geographic information including a legal description and latitude/longitude.

B2 SAMPLING METHODS REQUIREMENTS

All sampling procedures that will be utilized will follow the OCC SOP document (OCC 2021c) and include, *in-situ* water chemistry, water chemistry grab samples, benthic macroinvertebrates, fish, and habitat assessments. Copies of all OCC SOPs are on file at the EPA Region 6 Office in Dallas, TX. Implementation of corrective action for any failure in the sampling process is the responsibility of the Director of Monitoring, Assessment, and Wetlands Programs.

B3 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Sample handling, labeling and delivery will all follow approved SOPs (OCC 2021c). Each sample container is labeled on site with indelible ink. Information included is as follows: site name, waterbody identification number, date and time of collection, and the type of preservative used. The collector of the samples is responsible for seeing that each sample is labeled as it is collected. Samples, as they are collected, will be preserved as shown in Table 8.

Table 8: Acceptable Containers, Preservatives, and Holding Times for Each Parameter

Parameter	Container	Preservative	Holding Time
Dissolved Oxygen	*in situ*	N/A	N/A
Conductivity	*in situ*	N/A	N/A
pH	*in situ*	N/A	N/A
Temperature	*in situ*	N/A	N/A
Instantaneous Discharge	*in situ*	N/A	N/A
Hardness	plastic	Ice	7 days
Alkalinity	plastic	Ice	24 hours
Turbidity	plastic	Ice	24 hours
Ammonia Nitrogen	plastic	Ice, H_2SO_4 within 24 hours	28 days
Total Kjeldahl Nitrogen	plastic	Ice, H_2SO_4 within 24 hours	28 days
Nitrate/Nitrite	plastic	Ice, H_2SO_4 within 24 hours	28 days
Ortho Phosphorus	plastic	Ice	48 hours
Total Phosphorous	plastic	Ice, H_2SO_4 within 24 hours	28 days
Total Suspended Solids	plastic	Ice	7 days
Sulfate	plastic	Ice	28 days
Chloride	plastic	Ice	28 days
Total Dissolved Solids	plastic	Ice	7 days
Benthic macroinvertebrates	glass	Ethanol	N/A
Fish	plastic	Fixative: Formalin Preservative: Ethanol	N/A
E. coli	plastic	Ice, <10º C	6 hrs/24 hrs/48 hr[1]

[1] For standard violation 6 hr holding time is required; for OCC purposes 24 hr is preferred but 48 hrs is acceptable

A chain of custody form is submitted with each group of samples (refer to OCC SOP "Chain of Custody and Sample Labeling"; OCC 2021c). The chain of custody form includes the following information: project name, samplers, date and time of collection, site name, parameters to be analyzed, waterbody identification number, number of containers submitted, and any pertinent remarks. For water samples, the chain of custody form is signed and dated by the receiving laboratory officer and a laboratory number is assigned to each sample. Assigned laboratory numbers are listed on the chain of custody form. A copy of the chain of custody form is left at the laboratory and the original is filed by date in the OCC Water Quality Library. For fish and macroinvertebrate samples, the chain of custody form is signed and dated by the receiving taxonomist, and the original is filed with relevant field datasheets in the OCC Water Quality Library.

The Quality Assurance Manager for the Oklahoma Department of Agriculture, Food and Forestry (ODAFF) Laboratory, is responsible for all laboratory operations. The Inorganic Section Supervisor for the ODAFF laboratory is responsible for proper receipt, handling, and disbursement of samples. The ODAFF Inorganic Section Supervisor also oversees all water quality analytical procedures.

B4 ANALYTICAL METHODS REQUIREMENTS

Field analytical procedures are described in the OCC SOP document (OCC 2021c). The methods and meters required to perform field water quality analyses are listed in Table 9. Reporting of failures in field analytical procedures and the implementation of corrective action for any failure in field analytic procedures is the responsibility of the Director of Monitoring, Assessment, and Wetlands Programs.

Table 9: Parameters, Methods, Meters, Method Detection Levels and expected Accuracy for Each Water Quality Parameter

Parameter	Method	Meter	Method Detection Level	Meter Accuracy
Dissolved Oxygen	4500G	YSI Professional Plus	0.1 mg/l	> of 2% or 0.2 mg/L
Conductivity	2510B	YSI Professional Plus	1.0 uS	> of 1% or 10 us/cm
pH	4500H-B	YSI Professional Plus	1.0 S.U.	0.2 units
Temperature	2550	YSI Professional Plus	-5º C	0.2 ºC
Instantaneous Discharge	electromagnetic	Marsh McBirney or Ott MF Pro	0.1 cfs	n/a
Alkalinity	2320B	Hach digital titrator	10 mg/l	> of 10% or 10 ppm
Hardness	2340B	Hach digital titrator	10 mg/l	> of 10% or 10 ppm
Turbidity	2130B	Hach 2100P/Q	0.01 NTU	> of 5% or 1 ntu

Laboratory procedures are described in detail in the ODAFF Laboratory Quality Assurance Plan. Reporting of failures in laboratory analytical procedures and implementation of corrective action for any failure in laboratory procedures is the responsibility of ODAFF Laboratory Director, who is responsible for all aspects of the laboratory operation. Irreconcilable analytical problems and contract management with the laboratory is the responsibility of the OCC Water Quality Division Director.

B5 QUALITY CONTROL REQUIREMENTS

For water chemistry samples, field blank, replicate, and duplicate will be collected at a minimum of 5% of sampling sites in accordance with the OCC Master SOP document (OCC 2021c). Field blanks are expected to contain concentrations below method detection level. Target precision values for duplicate samples are listed for each parameter in Table 3. Historic performance of TKN and TP duplicate precision indicates that a combination of laboratory analytical limitations and field processing steps makes achieving acceptance criteria challenging (OCC 2021b). Possible improvements to sample storage and analysis are currently being evaluated, and will be implemented with the goal of improving duplicate precision for those parameters. Target duplicate RPD will remain 20% for TKN and TP, but for the duration of this project, 25% duplicate RPD for TKN and TP will be considered acceptable. If acceptance criteria are exceeded corrective actions may consist of, but are not limited to, review and re-evaluation of sample collection protocols, additional training for data collectors, and review of data. Upon data review, concurrently collected data may be flagged or removed from analyses.

Laboratory uses of internal QC checks are described in the ODAFF Laboratory Quality Assurance Plan. The ODAFF laboratory uses a frequency of at least ten percent of all samples analyzed for analysis of blanks, spikes, and duplicates. An approved copy of the ODAFF Laboratory Quality Assurance Plan is submitted to EPA Region VI on an annual basis with the OCC Quality Management Plan.

Quality control of fish and benthic macroinvertebrate collections will be achieved through replicate sampling at monitoring locations. Fish community temporal replicates will be collected at a frequency of at least one sample per lead collector to evaluate and ensure sample representation and to assess gear effectiveness. The desired collection rate for replicate benthic macroinvertebrate samples is 10% or one replicate for every 10 sites visited. However, suitable replicate habitat locations may be rare depending upon the stream condition and flow. Therefore, replicate samples collected at a frequency of 5% are acceptable. Acceptable precision values for replicate biological samples are listed in Table 4. If acceptance criteria are exceeded corrective actions may consist of, but are not limited to, review and re-evaluation of sample collection protocols, additional training for data collectors, and review of data.

Quality control of macroinvertebrate sorting will be achieved using replicate subsamples to quantify sub-sampling precision and bias. All staff that sort macroinvertebrate samples will be required to process one replicate subsample from a randomly selected sample. Sorting precision will measured as RPD of the macroinvertebrate IBI, with acceptance criteria of 15%. Sorting bias will be measured as Percent Sorting Efficiency (PSE), with acceptance criteria of 90%. To determine and calculate PSE a QA officer will review the processed sample for any missed organisms. If acceptance criteria are exceeded corrective actions may consist of, but are not limited to, review of sampling protocols and additional training for sample processors.

Quality control of laboratory processing of fish and macroinvertebrate identification will be achieved through taxonomic review of a subset of samples by a second taxonomist. At least two diverse fish samples and at least ten macroinvertebrate samples will be subjected to taxonomic review. For both macroinvertebrate and fish precision measures include percent taxonomic difference (PTD) and percent difference in enumeration (PDE) with acceptance criteria of 15% and 5% respectively. Additionally, the difference in percent taxonomic completeness (PTC) between taxonomists should be less than 10%. When acceptance criteria are exceeded corrective action may include but will not be limited to quality control of additional samples, as well as evaluation and review of discrepant taxa.

Additionally, fish identified outside of their reported ranges will be forwarded to a second taxonomist for confirmation. Any identification discrepancies will be reported to the Quality Assurance Officer to determine the need for remediation.

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION & MAINTENANCE

OCC will maintain all field instruments. Maintenance of field instruments is generally not complex and primarily consists of battery and probe replacement, cleaning, replacement of buffers and other solutions, and proper storage. Maintenance typically follows OCC SOPs. If SOPs do not cover maintenance, the pertinent user’s manual is referenced for further information.

Any equipment requiring maintenance beyond that listed above will be shipped to a certified repair agent. If an instrument fails to perform up to its specifications, it is returned to the factory or factory representative for service. All field equipment can be replaced on short notice by back-up units. All backup units are tested each quarter regardless of meter use. The Quality Assurance Officer maintains meter performance records. The monitoring coordinator will coordinate with staff to ensure equipment is functional, and procure replacements for any defective equipment.

B7 INSTRUMENT CALIBRATION AND FREQUENCY

All meters will be inspected and tested before they are taken into the field to ensure that they are in proper working condition. Meter calibration procedures are detailed in OCC SOPs (OCC 2021c) and follow manufacturer recommendations for protocols and acceptance criteria. Dissolved Oxygen (DO), and pH sensors are calibrated prior to any sampling event. Conductivity, temperature and turbidity undergo calibration checks prior to sampling and subsequent recalibration/reconditioning if acceptance criteria are not met. Reconditioning procedures are detailed in OCC SOPs (OCC 2021c) and generally involve following manufacturer cleaning guidelines. Each meter's calibration/quality check is recorded on a standardized "Sampling Episode Sheet" (in OCC SOPs). Records for daily instrument calibration are maintained on the OCC database and hardcopies are filed in the OCC library. If calibration continues to fail following reconditioning, defective sensors will be sent for repairs or replaced.

Multimeters (DO, pH, conductivity and temperature), digital titrators (alkalinity and hardness) and turbidimeters undergo quarterly calibration checks to test functionality. Conductivity, DO, pH, alkalinity, hardness, and turbidity meters are calibrated against known standards to assess accuracy. Accuracy acceptance criteria are established based on manufacturer specifications and listed in Table 9 as well as OCC SOPs (OCC 2021c). When accuracy targets are not met during quarterly calibration, corrective action may include, but is not limited to, sensor reconditioning or replacement. Data from quarterly calibration is compiled by the QA officer to document sensor performance and assess sensors in need of servicing or replacement. Quarterly calibration data is maintained on the server and referenced to a unique meter number.

B8 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES

Equipment and supplies needed to complete this project are detailed in the Equipment, Supplies and Tracking SOP (OCC 2021c). All supplies will be inspected for completeness and integrity upon receipt. All reagents are checked for expiration dates and shelf life. Damaged, incomplete, and expired supplies will not be used and will be returned to the supplier. Supplies will be checked quarterly for expiration. If supplies are deemed expired, damaged, or contaminated, they will be disposed of in a proper manner and replaced immediately.

B9 NON-DIRECT MEASUREMENTS

Data acquired for use in this project from outside sources will be reviewed for completeness, quality, and how it meets the data quality objectives. All data from outside sources will be cited appropriately. The primary outside data used for Rotating Basin is GIS data, obtained through the

State of Oklahoma Office of Geographic Information, which is housed in the OCC. All GIS data is publicly available. GIS data is used to create maps showing potential monitoring sites, and these maps are used to obtain landowner permission to access property for monitoring. Field staff are able to verify GIS data using handheld GPS units when they visit monitoring sites. Any discrepancies are reported directly to the GIS staff at the OCC.

B10 DATA MANAGEMENT

Detailed instructions for recording field data are found in the OCC SOP (OCC 2021c) document. The "Data Receipt" SOP outlines the procedure for delivery, storage, review and processing of field data, including Quality Assurance checks for completeness and accuracy of data.

Primary storage of data will be an *Access*® database housed on the OCC Network on the Oklahoma State server operated and maintained by the Information and Services Division of the Oklahoma Office of Management and Enterprise Services (OMES). This database will be maintained and managed by the Records Management Specialist. A directory of the database will be maintained for ease of retrieving data for specific projects. All project related files are backed up nightly. Backup of files is redundant and permanent backup and permanent storage of files occurs routinely by backup media and storage in multiple protected vaults.

Access database software was selected upon consulting with several agencies including EPA Region 6 and has been used for many years. This commonly used database is compatible with the EPA STORET system. Data is easily exported from *Access* to spreadsheet programs. Data manipulation statistics will generally be done in spreadsheets or on statistics software such as Minitab® and Program R (R Core Team 2013). All quality assured and appropriate data collected by the OCC will be entered into the EPA STORET system.

OCC is in the process of uploading all historic and current data records into the Ambient Water Quality Monitoring System (AWQMS), which is a web-based data management system. The two main goals of changing the primary data storage system from *Access* to AWQMS are (1) ease of external access, and (2) ease of upload to STORET. However, until full functionality of data storage and retrieval is achieved with AWQMS, *Access* will remain the primary data storage system.

Personnel with access to primary data storage are limited to the Program Director, Assistant Director, Records Management Specialist, and personnel as designated by the Program Director and Assistant Program Director. External data requests are managed by the Records Management Specialist. Anti-virus software is installed on all OCC computers.

C ASSESSMENT/OVERSIGHT

C1 ASSESSMENTS AND RESPONSE ACTIONS

The assessment activities outlined in Table 10 are designed to maintain data integrity and accuracy from collection through analyses and reporting. Assessment involves field audits to appraise staff adherence to SOPs, as well as review of data management, analyses, and reporting.

Table 10: Assessment and Response Actions

ASSESSMENT	RESPONSE
Field Systems Audit: Early in the sampling program and once each year, each field procedure will be compared with the written SOP for compliance. Field audits will be performed by the QA Officer and Director of Monitoring, Assessment, and Wetlands Programs and will include inspection of all equipment used and system performance.	Any inconsistency/deficiency affecting data quality between the SOP and the procedures observed will be reported to the Monitoring Director and appropriate field personnel. Response to any inconsistency or deficiency will be the responsibility of the Monitoring Director and QA Officer and may include additional training, purchase of additional equipment, changes in personnel, and revision of the SOP. Depending on the problem, additional assessments may be recommended. Records of all field audits are retained by the Quality Assurance Officer and Monitoring Director.
Data Management Review: Data management protocol requires frequent communication between data management and the QA Officer. The data management system will be reviewed, in detail, quarterly for backup status and data completeness.	Data management and resolution of data entry problems are the responsibility of the Records Management Specialist.
Data Reporting & Interpretation Review: Each report, prior to release, undergoes an internal review process of the technical writers, Project Officer, and Division Director.	The technical writing staff will resolve comments and difference of data interpretation.

C2 REPORTS TO MANAGEMENT

Any issues discovered during QA/QC procedures will be reported by the OCC QA officer to the USEPA Region 6 Project Officer when they are identified. Reporting will enumerate efforts to remediate any deviation from the protocols and procedures outlined in this document.

D DATA VALIDATION AND USABILITY

D1 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

Data are continuously reviewed as they are collected, processed and analyzed. Data are flagged when acceptance criteria (Sections A7 and B5) are exceeded, or if field or laboratory methods deviated from SOPs (e.g. violation of holding times, broken chain of custody). When problems are identified the corrective actions in section B5 are implemented to reduce the likelihood of continued issues and resolution is documented. The QA officer, Director of Monitoring and any relevant field or laboratory staff will review flagged data to assess suitability for use in assessment.

D2 VALIDATION AND VERIFICATION METHODS

Through the data management process as described in Section B10 and the "Data Receipt" SOP (OCC SOP 2020b), data is reviewed several times. Data validation is an integral part of this process. All data will routinely be reviewed for abnormalities, inconsistencies, or unusual results. If any of these occur, the data will be traced back to look for possible causes of the error. In the event that no error is found, the data will be assumed to be normal and appropriate for use in project reports and in decision-making. If an error is found and no resolution can be arrived at concerning its source or cause, the data will be discarded. Implementation of corrective action for any failure in the data validation procedure is the responsibility of the Quality Assurance Officer.

D3 RECONCILIATION WITH DATA QUALITY OBJECTIVES

Measurement quality requirements will be calculated and compared with the DQOs to confirm that the correct type, quality, and quantity of data have been collected for this project. Any observed shortcomings and any necessary caveats regarding the study conclusions will be fully described in the final report.

E BIBLIOGRAPHY

APHA, AWWA,WPCF. 1992. Standard Methods for Examination of Water and Waste Water 18th edition. American Public Health Association. Washington, DC.

ODEQ (Oklahoma Department of Environmental Quality). 2012. Continuing Planning Process. Oklahoma City, Oklahoma.

OWRB (Oklahoma Water Resource Board). 2013. Implementation of Oklahoma's Water Quality Standards, Chapters 45 and 46, Subchapter 15: Use Support Assessment Protocols (USAP). Oklahoma Administrative Code 785:45 and 46-15. Oklahoma City, Oklahoma.

OCC (Oklahoma Conservation Commission), Water Quality Division. 2021a. Quality Management Plan. Oklahoma Conservation Commission, Oklahoma City, Oklahoma.

OCC (Oklahoma Conservation Commission), Water Quality Division. 2011b. Small Watershed Rotating Basin Monitoring Program: Annual Quality Control Report: Basin 2.4. Oklahoma Conservation Commission, Oklahoma City, Oklahoma.

OCC (Oklahoma Conservation Commission), Water Quality Division. 2021c. Standard Operating Procedures. Oklahoma Conservation Commission. Oklahoma City, Oklahoma.

OCC (Oklahoma Conservation Commission, Water Quality Division. 2019. Oklahoma's Nonpoint Source Management Program 2019-2029. Oklahoma Conservation Commission. Oklahoma City, Oklahoma.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish. U.S. Environmental Protection Agency - Office of Water. Washington, D.C. USEPA/444/4-89-001.

R Core Team. 2013. A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/

USEPA (2021, April 8) . *Module 1 of Quality Assurance Project Plan Development Tool, Guidance on Preparing a QA Project Plan.* https://www.epa.gov/quality/module-1-quality-assurance-project-plan-development-tool-guidance-preparing-qa-project-plan

USEPA. 2006. Method 1603: Escherichia coli (E. coli) in Water by Membrane Filtration Using Modified membrane-Thermotolerant Escherichia coli Agar (Modified mTEC). EPA-821-R-06-011. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

Appendix I: Map of Oklahoma Planning Basins and RB 3.5 Monitoring Sites