Small Watershed Rotating Basin Monitoring Program
Basin Group 4, Cycle 5
(Washita and Upper Red)

QUALITY ASSURANCE PROJECT PLAN

FY2023/2024 §319(h)
EPA Grant # C9-996100-22
Project 7, Output 7.1

Submitted by:

Oklahoma Conservation Commission
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A PROJECT MANAGEMENT AND INFORMATION/DATA QUALITY OBJECTIVES

A2 APPROVAL PAGE

Oklahoma Conservation Commission, Water Quality Division
Quality Assurance Project Plan
for the
Small Watershed Rotating Basin Monitoring Program
Basin Group 4, Cycle 5
FY2023/2024 §319(h), EPA Grant # C9-996100-22, Project 7, Output 7.1

Approving Officers:

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

Signature:______________________________ Date:____________

Name: **Dan Dvorett**–Quality Assurance Manager (QAM), Oklahoma Conservation Commission, Water Quality Division

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Signature:______________________________ Date:____________

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Signature:______________________________ Date:____________

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A4 PROJECT PURPOSE, PROBLEM DEFINITION AND 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 Oklahoma Conservation Commission (OCC) initiated a novel 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. 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.

This QAPP covers monitoring activities to be completed for the 5th cycle of ambient monitoring (Stage 1) in streams of the Washita and Upper Red River Basins (Basin 4; Appendix I). The goal of the Rotating Basin Project is to monitor water chemistry, habitat and biotic communities (fish and macroinvertebrates) at 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.

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.

In addition to this QAPP, the OCC Quality Management Plan (QMP; OCC 2023a) serves as a guidance document for QA procedures for environmental information operations (EIOs) completed for all Water Quality Division (WQD) projects. Where the QMP sets WQD policies and procedures for maintaining data quality, this QAPP specifically guides QA operations for the fifth cycle of ambient stream monitoring in Basin 4. Water Quality Division (WQD) Standard Operating Procedures (SOPs; OCC 2023b) provide more detailed methods for all EIOs described in this QAPP. This QAPP, along with the OCC QMP and WQD SOPs ensure that all data collected are of the quality necessary to assess and report on stream quality and meet the performance criteria outlined in Section A.6.

A5 PROJECT TASK DESCRIPTION

This Quality Assurance Project Plan (QAPP) encompasses Task 1, "Fifth Cycle Monitoring in the Washita and Upper Red River Basins" of the OCC 2023/2024 Project 7 Workplan. As part of the Rotating Basin Project, the OCC will sample approximately 69 sites in the Washita and Upper Red Watersheds (Table 1 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.

The Rotating Basin Project targets stream monitoring locations at the outfall of the majority of 11-digit watersheds located entirely within the State of Oklahoma. However, several considerations are weighed to determine if a watershed is appropriate to sample, or if a monitoring location is better suited further upstream. 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.

The Washita and Red River Basins are located in the southwest portion of the state. The basins include at least portions of 26 counties including, Beckham, Bryan, Caddo, Canadian, Carter, Comanche, Cotton, Custer, Garvin, Grady, Greer, Harmon, Jackson, Jefferson, Johnston, Kiowa, Love, Marshall, McClain, Murray, Pontotoc, Roger Mills, Stephens, Tillman and Washita Counties.

Rotating Basin sites will be monitored for physical and chemical parameters on a fixed, preset interval schedule, approximately every five weeks from June 2024 to May 2026. 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. Nine streams, representing legacy bacteria listings on the impaired waterbody list will be monitored for *E. coli* only, and the remaining 60 streams will be monitored for all water chemistry parameters (Table 1).

Table 1: Rotating Basin 4.5 Site List. The final list of monitoring locations may vary based on access permission limitations or unsuitable environmental conditions. * Denotes a stream where only bacteria samples will be collected.

Site Name	WBID	Latitude	Longitude	County
Barnitz Creek: E1010	OK310830-03-0200L	35.5514	-99.0230	Custer
Beaver Creek (Cotton)	OK311210-00-0010D	34.3913	-98.1828	Cotton
Beaver Creek (Custer)	OK310830-03-0190C	35.5324	-98.9584	Custer
Big Sandy Creek	OK310800-01-0090G	34.2303	-96.6362	Johnston
Bitter Creek (Grady)	OK310820-01-0030D	35.0006	-97.8442	Grady
Blue Beaver Creek*	OK311310-02-0060G	34.6307	-98.5523	Comanche
Boggy Creek	OK310830-03-0100C	35.3060	-98.8790	Washita
Buckhorn Creek	OK310800-02-0220C	34.4263	-96.9508	Murray
Buffalo Creek (Beckham)	OK311510-02-0090D	35.3207	-99.8676	Beckham
Caddo Creek: Hwy 77	OK310800-03-0010M	34.2457	-97.1432	Carter
Cavalry Creek	OK310830-03-0070D	35.2770	-98.8525	Washita
Chigley Sandy Creek	OK310800-02-0190D	34.5135	-97.1222	Murray
Cobb Creek	OK310830-06-0050K	35.2908	-98.5941	Caddo
Criner Creek	OK310810-02-0050D	34.8552	-97.4962	McClain
Deep Red Creek	OK311310-03-0010D	34.2177	-98.4001	Cotton
Delaware Creek: Hwy 9	OK310830-01-0030D	35.0721	-98.1741	Caddo
East Cache Creek	OK311300-03-0010M	34.9386	-98.4444	Caddo
Elk Creek: E1330	OK311500-03-0030B	35.0877	-99.1736	Kiowa
Elm Fork of Red River	OK311800-00-0010M	34.9265	-99.5023	Greer
Finn Creek	OK310810-02-0020D	34.8550	-97.4240	McClain
Fish Creek	OK311800-00-0130G	35.0192	-99.8804	Greer
Fivemile Creek (Caddo)*	OK310830-06-0080D	35.3050	-98.6080	Caddo
Glasses Creek	OK310800-01-0020M	34.0855	-96.7319	Marshall
Guy Sandy Creek	OK310800-02-0130D	34.5209	-97.0267	Murray
Haystack Creek	OK311800-00-0040D	34.9584	-99.5616	Greer
Hickory Creek: HWY 77S	OK311100-02-0010M	34.0126	-97.0834	Love
Ionine Creek*	OK310820-01-0160L	35.1456	-98.0463	Grady
Kickapoo Sandy Creek*	OK310810-01-0050G	34.6080	-97.1630	Murray
Laflin Creek*	OK310810-02-0200G	34.9279	-97.7273	Grady

Site Name	WBID	Latitude	Longitude	County
Lake Creek	OK310830-06-0040J	35.2762	-98.5306	Caddo
Lake Creek: Hwy 6, Greer Co.	OK311510-01-0040D	35.0553	-99.3776	Greer
Little Beaver Creek	OK311210-00-0050D	34.4203	-98.1416	Cotton
Little Deep Red Creek	OK311310-03-0040E	34.2772	-98.6793	Tillman
Little Elk Creek (Washita)	OK311500-03-0050A	35.2189	-99.0805	Washita
Little Hauani Creek	OK311100-01-0120B	33.9997	-96.9175	Marshall
Little Washita River	OK310820-02-0010A	34.9725	-97.8693	Grady
Medicine Creek	OK311300-04-0060H	34.7720	-98.5800	Comanche
Mill Creek: Lower	OK310800-01-0190G	34.2307	-96.8131	Johnston
Mud Creek: Hwy 89	OK311100-04-0010G	34.0040	-97.5697	Jefferson
Oil Creek	OK310800-01-0240P	34.3186	-96.9332	Johnston
Otter Creek (Tillman)	OK311500-01-0080F	34.5593	-99.1412	Tillman
Pennington Creek	OK310800-01-0120G	34.2415	-96.6831	Johnston
Quartermaster Creek	OK310840-01-0060B	35.6823	-99.3207	Custer
Rainy Mountain Creek	OK310830-02-0060G	35.0924	-98.7439	Kiowa
Red Creek (Jefferson)	OK311100-01-0290D	33.9550	-97.7700	Jefferson
Roaring Creek	OK310810-02-0170B	34.8930	-97.7233	Grady
Rock Creek (Murray)	OK310800-02-0122L	34.5447	-96.9591	Murray
Rush Creek (Garvin)	OK310810-01-0090S	34.7320	-97.3356	Garvin
Salt Creek (Garvin)	OK310810-03-0080G	34.5430	-97.4050	Garvin
Sandstone Creek	OK310840-02-0020C	35.5930	-99.5090	Roger Mills
Sandy Creek (Jackson)	OK311600-01-0040G	34.4100	-99.6210	Jackson
Stinking Creek	OK310830-04-0030K	35.1891	-98.1264	Caddo
Stinking Creek: Hwy 9	OK310830-02-0020F	35.0946	-98.6468	Kiowa
Sugar Creek	OK310830-05-0010D	35.1170	-98.1970	Caddo
Sweetwater Creek*	OK311510-02-0120D	35.3350	-99.9710	Beckham
Tepee Creek: N2130	OK311500-01-0110F	34.8700	-99.1843	Kiowa
Timber Creek	OK311510-01-0090G	35.2910	-99.5820	Beckham
Trail Creek (Washita)	OK311500-03-0070D	35.1600	-99.2280	Washita
Turkey Creek (Custer)	OK310830-03-0260W	35.4843	-99.1170	Custer
Turkey Creek (Beckham)*	OK311510-02-0060G	35.2592	-99.7234	Beckham
Turkey Creek: N1980	OK311600-02-0060J	34.6115	-99.4390	Jackson
Walnut Bayou	OK311100-03-0010G	33.9165	-97.2825	Love
Washita River: N1950	OK310840-02-0010V	35.6031	-99.5184	Roger Mills
West Cache Creek	OK311310-02-0010M	34.2750	-98.3880	Cotton
West Elm Creek	OK311800-00-0170G	35.0750	-99.9600	Beckham
West Otter Creek*	OK311500-02-0040G	34.6669	-98.9950	Kiowa
Wildhorse Creek: Tatums	OK310810-03-0010R	34.5020	-97.4570	Carter
Willow Creek (Caddo)*	OK310830-06-0030H	35.2673	-98.4473	Caddo
Winter Creek	OK310810-02-0220G	34.9713	-97.7742	Grady

In addition, streams (excluding bacteria only 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 7, Ambient Cycle 4.5 and Implementation Monitoring Program" Workplan.*

A6 INFORMATION/ DATA QUALITY OBJECTIVES AND PERFORMANCE/ ACCEPTANCE CRITERIA

A6.1 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 (ODEQ 2023).

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?

A6.2 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 Use Support Assessment Protocol (USAP) (ODEQ 2023).

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 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 252:740-15 (ODEQ 2023). 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 252:740-15. Parameters not addressed in OAC 252:740-15 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).

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 252:740-15 for beneficial use support determination.

Method detection levels (Table 2) are at concentrations significantly lower than water quality criteria, listed in OAC 252:740-15, used to determine use support status, and therefore support sound decision-making related to project action levels.

A6.3 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.

A6.3.1 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 2. 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 with OCC SOPs (OCC 2023b).

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 2: 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 3. 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 A6.2.

Table 3: 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%

A6.3.2. 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 2023b). Sampling events associated with field blanks above detection limits will be flagged.

A6.3.3. 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 2023b) 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.

A6.3.4 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.

A6.3.5 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.

A6.3.6 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 2 and are of suitable sensitivity to meet project goals.

A7 DISTRIBUTION LIST

U.S. EPA Region VI approved copies of this Quality Assurance Project Plan (QAPP) are listed in Table 4.

Table 4. Distribution List for receiving copies of this Quality Assurance Project Plan

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

A8 PROJECT 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 planning 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

Shanon Phillips is the senior manager, 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, Project, Director of Monitoring, Assessment, & Wetlands Programs, OCC Water Quality Division

Brooks Tramell is the project operations manager. 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.

Dan Dvorett, Quality Assurance Manager (QAM) and Technical Programs Director OCC Water Quality Division

Dan is responsible for the drafting and review of the technical reports and other information from the Division. Dan is also the QAM for the Water Quality Division. The QAM is responsible for planning, documenting, coordinating, and assessing QAPPs, as well as other QA/QC documentation, and can discuss quality issues with the senior manager directly.

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.

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.

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, and technical writing.

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.

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.

A complete organizational flow chart is available in the Quality Management Plan (OCC 2023a).

A9 PROJECT QUALITY ASSURANCE MANAGER INDEPENDENCE

The Water Quality division employs a Quality Assurance Officer (QAM) who is responsible for the management of the Division's Quality Program as documented in the QMP (OCC 2023a). The QAM is responsible for generating and updating required quality assurance documents(QMPs and QAPPs), as well as the standard operating procedures (SOPs; OCC 2023b) for the data collection efforts necessary for all projects. The QAM ensures organizational data quality objectives (DQO), outlined in each project QAPP are met through systematic data review, trainings and field audits.

The QAM functions independently of data collection activities and has the authority to conduct independent oversight of OCC's Quality Program. However, the QAM possesses responsibilities beyond routine QA activities. In situations where the QAM cannot maintain independence from environmental information operations, QA responsibilities are delegated to additional QA staff. The QAM is supported by technical staff who are not engaged in data collection. The QAM and Operations Manager do not have authority to sign for each other on quality assurance documents, including this QAPP. QAM independence is documented in the WQD QMP (OCC 2023a).

The QAM reports to the Director Of Monitoring, Assessment and Wetlands (DMAW), but has a direct line of communication to Water Quality Division (WQD) leadership.

A10 PROJECT ORGANIZATION CHART AND COMMUNICATION

The Organizational Chart for the portion of OCC's WQD involved in this project, is diagramed in Appendix II. The full WQD organizational chart, and executive leadership organizational chart can be found in the QMP (OCC 2023a). The direct line of communication between the QAM and WQD leadership is denoted by a dotted line. The WQD director reports directly to the OCC Agency Director.

Upon approval, this QAPP is provided electronically to all staff involved in EIOs. Non-conformance to QAPP is determined by the QAM through routine coordination with project staff including but not limited to, quarterly QA sessions, yearly field audits, and routine QA/QC of delivered data. The resolution necessary to resolve discrepancies is dependent upon the issues encountered but is generally completed by revisiting the data quality standards outlined in this QAPP and the WQD QMP (OCC 2023a) as well as methods outlined in SOPs (OCC 2023b) with project staff. As needed, QA discrepancies are brought to the attention of the Operations Manager and the Senior Manager for resolution.

A11 PERSONNEL TRAINING/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 2023b) 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 QAM. 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 QAM.

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 QAM is responsible for ensuring all required trainings are completed, and staff are qualified to complete required EIOs. Documentation of staff certifications and trainings are stored on the OCC server and maintained by the QAM.

A12 DOCUMENTS AND RECORDS

The QAM 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 2023b). Data acquired during this project will be collected and stored in accordance with Table 5 according to the type of data and intended use.

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

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.

B IMPLEMENTING ENVIRONMENTAL INFORMATION OPERATIONS

B1 IDENTIFICATION OF ENVIRONMENTAL INFORMATION OPERATIONS

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 sampling 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. 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 2024
Monitoring for routine physical and chemical (including bacteria) parameters	June 2024	May 2026
Fish and habitat collections	June 2024	September 2025
Benthic invertebrates – winter and summer collections	June 2024	March 2026

Sampling for the project will be initiated in June 2024. 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 2024, they will be completed in 2025.

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

Sixty-nine sites (including 9 bacteria only sites) were selected as potential monitoring locations in the Washita and Upper Red Basins for this monitoring cycle (Table 1 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.

Monitoring locations are sampled with sufficient frequency and with sufficient quality to assess stream support status. Adequate site selection, sampling frequency, and consistency in methods (OCC 2023b) along with Quality Control (QC) measures built into all steps of data collection and processing (described in Section B4), as well as routine assessment (described in Section C), ensure that acceptance and performance criteria (described in section A6) are met.

B2 METHODS FOR ENVIRONMENTAL INFORMATION ACQUISISION

All data collection efforts outlined in B1 will adhere to methods detailed in the OCC SOP document (OCC 2023b) and include, *in-situ* water chemistry, water chemistry grab samples, benthic macroinvertebrates, fish, and habitat assessments. SOP updates and maintenance are the responsibility of the QAM. Minor updates to existing SOPs occur on a yearly basis. However, any changes will require USEPA acceptance of revised SOPs prior to usage for this project. 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.

Sample handling, labeling and delivery will all follow approved SOPs (OCC 2023b). 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 2023b). 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.

Field analytical procedures are described in the OCC SOP document (OCC 2023b). 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	-5° C	0.2 °C
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.

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 are 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.

B3 INTEGRITY OF ENVIRONMENTAL INFORMATION

Integrity of samples is maintained through systematic sample handling, labeling, preservation and custody documentation. These procedures are provided in Section B2 above but outlined in greater detail in the "Chain of Custody and Sample Labeling" , "Inorganic and Bacteria Sample Collection", "Macroinvertebrate Collection, Subsampling and Picking", and "Fish Collection" SOPs (OCC 2023b).

Laboratory analyses are completed by the ODAFF Laboratory and 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.

B4 QUALITY CONTROL

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 2023b). Field blanks are expected to contain concentrations below method detection level. Target precision values for duplicate samples are listed for each parameter in Table 2. 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. 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 3. 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 is 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 the QAM 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 QAM to determine the need for remediation

B5 INSTRUMENTS/EQUIPMENT CALIBRATION, TESTING, INSPECTION AND 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 (OCC 2023b). 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 QAM maintains meter performance records. The monitoring coordinator will coordinate with staff to ensure equipment is functional, and procure replacements for any defective equipment

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 2023b) 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 2023b) and generally involve following manufacturer cleaning guidelines. Each meter's calibration/quality check is recorded on a standardized "Sampling Episode Sheet" (OCC 2023b). 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 2023b). 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 QAM 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.

B6 INSPECTION/ACCEPTANCE OF SUPPLIES AND SERVICES

Equipment and supplies needed to complete this project are detailed in the Equipment, Supplies and Tracking SOP (OCC 2023b). 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.

B7 ENVIRONMENTAL INFORMATION MANAGEMENT

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 also uploads data records into the Ambient Water Quality Monitoring System (AWQMS), which is a web-based data management system. 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.

Detailed instructions for recording field data are found in the OCC SOP (OCC 2023b) document. The "Data Receipt" SOP outlines (OCC 2023b) the procedure for delivery, storage, review and processing of field data, including Quality Assurance checks for completeness and accuracy of data.

C ASSESSMENT, RESPONSE ACTION AND 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. Once all data have been collected, and initial QA/QC checks completed, the QAM compiles a project QA Report, documenting any deviation from performance criteria, as well as corrective actions taken.

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 for all monitoring staff by the QAM 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 QAM 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 QAM and Monitoring Director.
Data Management Review: Data management protocol requires frequent communication between data management and the QAM. 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 OVERSIGHT AND REPORTS TO MANAGEMENT

The OCC QAM is responsible for oversight of assessment activities, and reports to the Operations Manager and Senior Manager any issues that cannot be resolved directly with project staff. The QAM provides the final Project QA report to all project staff. Any irreconcilable issues discovered during QA/QC procedures will be reported by the OCC QAM 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 ENVIRONMENTAL INFORMATION REVIEW AND USABILITY DETERMINATION

D1 ENVIRONMENTAL INFORMATION REVIEW

Data are continuously verified as they are collected, processed and analyzed for completeness and correctness. Data verification is built into electronic data collection forms by utilizing validation rules on data entry. Furthermore, field investigators and QA staff each perform manual verification on all data collected. Data are flagged when acceptance criteria (Sections A6) are exceeded, or if field or laboratory methods deviated from SOPs (e.g. violation of holding times, broken chain of custody). If errors cannot be resolved, the data will be excluded from analysis and reporting.

When problems are identified, the corrective actions in section B4 are implemented to reduce the likelihood of continued issues, and resolution is documented. Implementation of corrective action for any failures identified during verification is the responsibility of the QAM.

Final data validation is completed by the QAM through an analytical review of the complete dataset's conformance to performance criteria and suitability for usage towards overall project objectives, which is then documented in the project QA Report.

D2 USABILITY DETERMINATION

Data usability is continuously evaluated during the data verification process (Section D1). The final data validation completed during the project QA Report serves as a measure of the usability of the overall dataset for the intended purposes and decisions outlined in this QAPP. Measurement quality will be calculated and compared with the performance criteria and overall DQOs to ensure data of the correct type, quality, and quantity have been collected for this project. Any observed shortcomings and any necessary caveats regarding the study conclusions will be fully described in the QA Report and project Final Report. The QAM is responsible for the determination of data usability.

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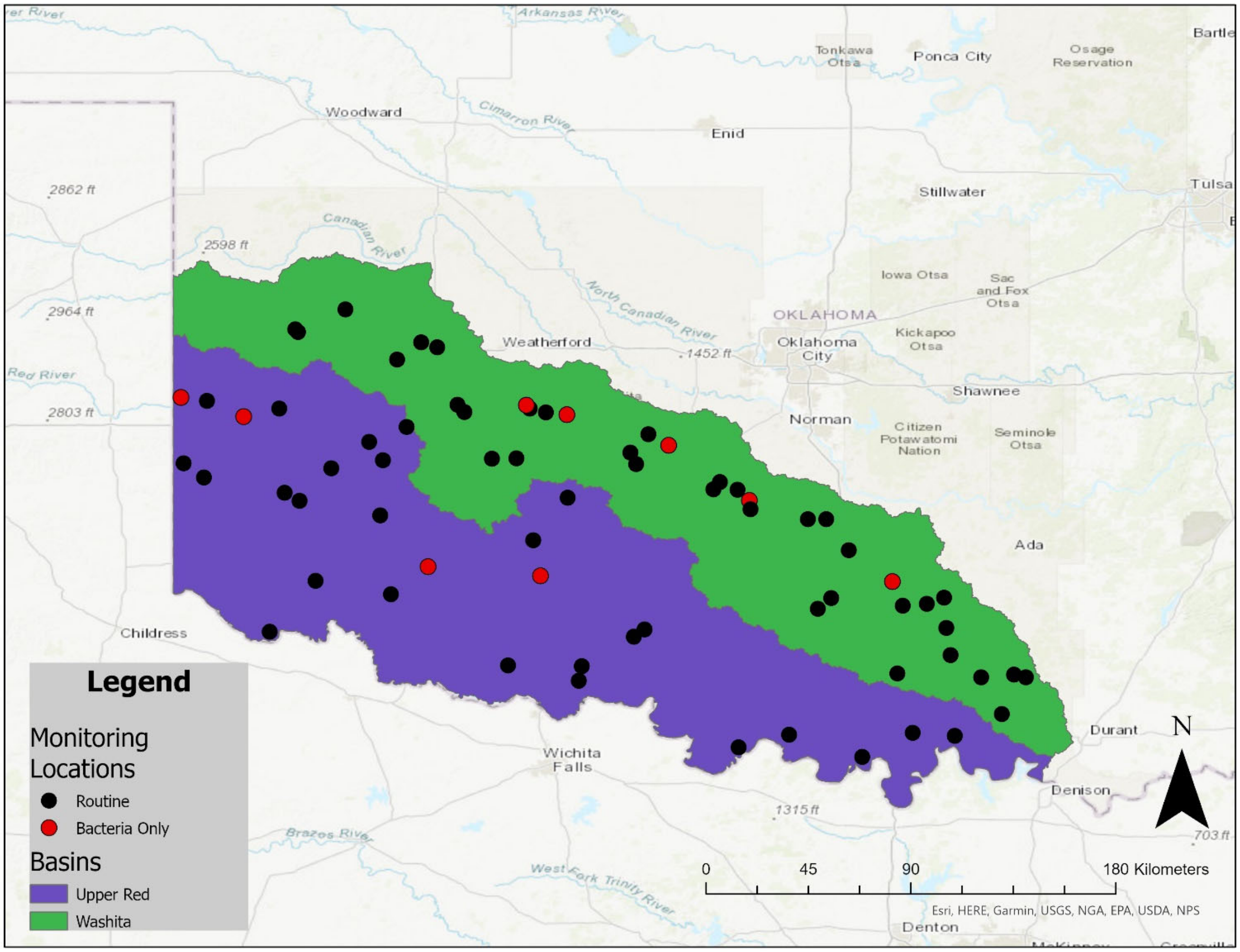
Appendix I: Map of Oklahoma Planning Basins and RB 4.5 Monitoring Sites



APPENDIX II: ORGNAIZATIONAL CHART