Small Watershed Rotating Basin Monitoring Program
Basin Group 5, Cycle 4
(Lower Red Basin)

QUALITY ASSURANCE PROJECT PLAN

FY2019/2020 §319(h)
EPA Grant # C9-996100-20
Project 7, Output 7.1

Submitted by:

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A1 TITLE AND SIGNATURE PAGE

Oklahoma Conservation Commission Water Quality Division

Priority Watershed Projects Water Quality Monitoring: Quality Assurance Project Plan FY 2020 §319(h), C9-996100-20, Project 6, Output 6.4.2.g

Approving Officers:

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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
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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. Additionally, Brooks coordinates and authorizes the purchasing of all water quality monitoring equipment.

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.

Leonard Moore, Monitoring Specialist II, OCC Water Quality Division

Responsible for 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 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 responsibilities.

Meghan Knight, Monitoring and Assessment Specialist, OCC Water Quality Division

Responsible for 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 in 2020.

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.

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.

Shelby Burridge, Environmental Projects Coordinator

The Environmental Projects Coordinator administers environmental projects for all water quality grants and associated reporting requirements. Shelby 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 2019a).

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 (2014)*. 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 19 years since the initiation of the Small Watershed Rotating Basin Monitoring Program, approximately 240 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 fourth cycle of the program progresses 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.

As part of the Rotating Basin Project, the OCC will target sampling a total of approximately 52 sites in the Lower Red River Basins over the course of two years. This Quality Assurance Project Plan (QAPP) encompasses Task 1, “Fourth Cycle Monitoring in the Lower Red River Basin” of the OCC 2019/2020 Project 7 Workplan. Sixty one sites were selected as potential monitoring locations in the Lower Red River Basin for this monitoring cycle (Table 2 and Appendix I). This includes multiple sampling locations within close proximity on the same stream, so that the best location could be targeted for monitoring after reconnaissance. Additionally, some sampling locations may need to be moved or removed due to lack of suitable conditions at newly selected sites or landowner access restrictions. Therefore, the target number of sampling locations is 52, but that number may change due to site suitability or access restrictions.

During the first two cycles 43 sites were sampled. Prior to the third cycle, 4 sites were dropped due to lack of landowner permissions for a total of 39 sample locations. In the fall of 2019, the site list was revisited and sites were added or moved to ensure proper coverage. For this fourth cycle, the selected sites will be sampled starting in June 2020 and continue through May 2022.

The Lower Red River basin is located in the southeastern portion of the state. The basin includes at least portions of Atoka, Bryan, Choctaw, Coal, Hughes, Johnston, Latimer, LeFlore, McCurtain, Murray, Pittsburg, Pontotoc, and Pushmataha Counties.

Table 2: Rotating Basin 5.4 Site List. Sites highlighted in gray indicate multiple sites in close proximity; the best monitoring location among these sites will be selected following field reconnaissance and processing of access permissions.

Site Name	Latitude	Longitude	County	WBID
Beech Creek	34.48680	-94.5392	McCurtain	OK410210-06-0320G
Big Eagle Creek	34.48990	-94.6842	McCurtain	OK410210-06-0160I
Big Sandy Creek: 1550	34.76680	-96.3310	Hughes	OK410400-06-0260G
Billy Creek	34.68220	-94.7759	LeFlore	OK410310-02-0070C
Black Fork of Little River	34.47290	-95.2171	Pushmataha	OK410210-03-0020C
Blue River: Egypt Rd.	34.19700	-96.4477	Johnston	OK410600-02-0010F
Blue River: HWY 22	34.14280	-96.4012	Johnston	OK410600-01-0290U
Blue River: HWY 48	34.08980	-96.3683	Bryan	OK410600-01-0290J
Bokchito Creek	34.01360	-96.1225	Bryan	OK410600-01-0090G
Buck Creek	34.33940	-95.6417	Pushmataha	OK410300-03-0420C
Buffalo Creek	34.72290	-95.2695	Latimer	OK410310-03-0030N
Buffalo Creek: Lower	34.36950	-94.6225	McCurtain	OK410210-06-0020G
Caddo Creek: Blue Rd	33.99740	-96.1908	Bryan	OK410600-01-0140G
Caddo Creek: HWY 70	34.00540	-96.1932	Bryan	OK410600-01-0140J
Caney Boggy Creek: Lower	34.71820	-96.1757	Coal	OK410400-06-0120G
Caney Creek	34.18600	-96.0581	Atoka	OK410400-02-0200G
Caney Creek: HWY 69	34.24280	-96.2186	Atoka	OK410400-03-0020C
Cedar Creek: East of Finley	34.32960	-95.4812	Pushmataha	OK410300-03-0020M
Chickasaw Creek: Cumberland	34.46160	-96.0268	Atoka	OK410400-05-0420K
Chickasaw Creek: Samata Ford	34.44690	-96.0331	Atoka	OK410400-05-0420G
Clear Boggy Creek	34.50550	-96.3542	Coal/Pontotoc	OK410400-03-0230K
Clear Creek	33.94050	-95.1204	McCurtain	OK410100-01-0480E
Clear Creek: E2080	33.99730	-95.1482	McCurtain	OK410100-01-0490S
Clear Creek: E2115	33.94660	-95.1313	McCurtain	OK410100-01-0490P
Cloudy Creek	34.32470	-95.2234	Pushmataha	OK410210-02-0300C
Cow Creek	34.50680	-94.4939	McCurtain	OK410210-06-0350G
Cypress Creek	34.06950	-95.0193	McCurtain	OK410210-01-0070D
Delaware Creek	34.40700	-96.4244	Johnston	OK410400-03-0240M
East Fork of Glover River	34.35570	-94.8721	McCurtain	OK410210-09-0010G
Hanubby Creek: HWY 109	33.95360	-95.6057	Choctaw	OK410400-01-0080G
Honobia Creek	34.54800	-94.9329	LeFlore	OK410210-03-0150H
Island Bayou	33.85360	-96.1652	Bryan	OK410700-00-0040G
Island Bayou: Longcreek Rd (N3850)	33.83310	-96.2512	Bryan	OK410700-00-0040M
Island Bayou: Romia Rd (N3830)	33.85710	-96.2048	Bryan	OK410700-00-0040J
Keel Creek: HWY 31	34.60770	-96.1448	Coal	OK410400-06-0100D
Lick Creek	33.95410	-95.7819	Choctaw	OK410400-01-0130G
Lick Creek: E2100	33.96790	-95.7404	Choctaw	OK410400-01-0130B
Lick Creek: N4080	33.95030	-95.7646	Choctaw	OK410400-01-0130E

Site Name	Latitude	Longitude	County	WBID
Lukfata Creek	33.96820	-94.7662	McCurtain	OK410210-07-0010G
Luksuklo: HWY 70	34.04280	-94.5973	McCurtain	OK410210-04-0020G
McGee Creek	34.50660	-95.8305	Atoka	OK410400-07-0010L
Mineral Bayou	34.04390	-96.3471	Bryan	OK410600-01-0300G
Muddy Boggy: Division Rd.	34.46930	-96.1783	Atoka	OK410400-05-0270Q
Muddy Boggy: E1770	34.44750	-96.1702	Atoka	OK410400-05-0270M
North Boggy Creek	34.60780	-96.0172	Atoka	OK410400-08-0010E
Norwood Creek	33.71330	-94.6075	McCurtain	OK410100-01-0050H
One Creek	34.31680	-95.4699	Pushmataha	OK410300-03-0060F
Panther Creek	34.78130	-96.3135	Hughes	OK410400-06-0240G
Rock Creek: East of Broken	34.08410	-94.4904	McCurtain	OK410200-03-0010G
Salt Creek: Grisso	34.63660	-96.1611	Coal	OK410400-06-0090G
Sand Creek	33.85300	-96.5499	Bryan	OK410700-00-0260G
Sandy Creek	34.21600	-96.4619	Johnston	OK410600-02-0020G
Sincere Creek: CR 368	34.78440	-96.4591	Pontotoc	OK410400-06-0290K
Sincere Creek: HWY 48	34.78960	-96.4415	Pontotoc	OK410400-06-0290G
Spencer Creek: N4310	34.15570	-95.3650	Choctaw	OK410300-02-0140F
Sulphur Creek	33.94660	-96.0499	Bryan	OK410600-01-0030G
Tenmile Creek: HWY 2	34.29820	-95.6637	Pushmataha	OK410300-03-0270C
Terrapin Creek: Lower	34.25510	-95.0981	Pushmataha	OK410210-02-0150G
Waterhole Creek	33.85300	-94.9135	McCurtain	OK410100-01-0340D
West Fork of Glover River:	34.30890	-94.9359	McCurtain	OK410210-08-0010M
Whitegrass Creek: Lower	33.88110	-95.8513	Choctaw	OK410400-01-0210G

Rotating Basin sites will be monitored for physical and chemical parameters on a fixed, preset interval schedule, approximately every five weeks from June 2020 to May 2022. 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 2019/2020 §319(h) Project 7, Ambient Cycle 5.4 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 - 10% except for parameters approaching detection limits, where practical considerations require a wider range of acceptable precision and accuracy. Duplicate samples are taken from at least 5% of monitoring locations in accordance to OCC SOPs (OCC 2019b).

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 for low level field duplicates	Acceptable precision for high level field duplicates	Method Detection Level*
Dissolved Oxygen	4500-G	YSI ProPlus	90-110%	90-110%	0.1 mg/L
Conductance	2510-B	YSI ProPlus	90-110%	90-110%	1.0 uS/cm
pH	4500 H-B	YSI ProPlus	90-110%	90-110%	1.0 S.U.
Temperature	2550	YSI ProPlus	90-110%	90-110%	-5ºC
Instantaneous Discharge	Electromagnetic; incremental, velocity-area	Marsh McBirney or Ott MF Pro	75-125%	75-125%	0.1 cfs
Alkalinity	2320-B	Hach Kit	90-110%	90-110%	15 mg/L
Hardness	2340-B	Hach Kit	90-110%	90-110%	0.5 mg/L
Turbidity	2130-B	Hach 2100P/Q	90-110%	90-110%	0.01 NTU
Ammonia	4500	ODAFF	75-125%	90-110%	0.015 mg/L
Total Kjeldahl Nitrogen	4500-N-C	ODAFF	75-125%	90-110%	0.01 mg/L
Nitrate	4500-NO3-D	ODAFF	75-125%	90-110%	0.01 mg/L
Nitrite	4500 NO2	ODAFF	75-125%	90-110%	0.01 mg/L
Ortho Phosphorus	4500 P E	ODAFF	75-125%	90-110%	0.005mg/l
Total Phosphorous	4500 P-B-E	ODAFF	75-125%	90-110%	0.005 mg/L
Total Suspended Solids	2540-O	ODAFF	75-125%	90-110%	1.0 mg/L
Total Dissolved Solids	160.1	ODAFF	75-125%	90-110%	1 mg/l
Sulfate	4500-SO4-E	ODAFF	75-125%	90-110%	0.1 mg/L
Chloride	4500-C	ODAFF	75-125%	90-110%	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 2019b). 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 2019b) 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

Principal investigators for this project are required to have degrees and/or experience with biological or other applicable sciences. Investigators must be familiar with the OCC SOP document (OCC 2019b) 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. 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.

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 the OCC server. Physical copies of records will be maintained for at least five years following project completion, or digitized to the OCC server. 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.

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 2019b). 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.

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	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 2020	March 2020
Monitoring for routine physical and chemical (including bacteria) parameters	June 2020	May 2022
Fish and habitat collections	June 2020	September 2021
Benthic invertebrates – winter and summer collections	June 2020	March 2022

Sampling for the project will be initiated in June 2020. 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. Though, sampling schedules may need to be adjusted due to temporary access restrictions, equipment failure or unsuitable environmental conditions. 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 2020, they will be completed in 2021. 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 2020 - 2022
Fish	Once (summer collections) 2020 or 2021
Flow	With each sample collection and habitat assessment.
Habitat	Once (with fish) 2020 or 2021
Bacteria	Monthly May - September 2020 and 2021

Sixty one sites were selected as potential monitoring locations in the Lower Red River Basin 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 2019b) 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 2019b). 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, <10° 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 2019b). 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 2019b). 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^{o} C	0.2 ^{o}C
Instantaneous Discharge	electromagnetic	Marsh McBirney or Ott MF Pro	0.1 cfs	n/a
Alkalinity	2320B	Hach digital titrator	1.5 mg/l	> of 10% or 10 ppm
Hardness	2340B	Hach digital titrator		> 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 2019b). 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. 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. A replicate benthic macroinvertebrate sample will collected at a rate of at least 10% or one replicate for every 10 sites visited. 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 2019b) 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 2019b) 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.

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 2019b). 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 2019b). 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 2019b) 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 <u>ASSESSMENT/OVERSIGHT</u>

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 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 2019b), 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.

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Appendix I: Map of Oklahoma Planning Basins and RB 5.4 Monitoring Sites