Texas Nonpoint Source Grant Program

Monitoring the Effectiveness of Regenerative Agriculture Approaches on Water Quality in Integrated Crop/Livestock Systems

TSSWCB Project Number 21-53

Revision #0

Quality Assurance Project Plan

Texas State Soil and Water Conservation Board

Prepared by:

Texas A&M AgriLife Research

Effective Period: Upon TSSWCB Approval through January 2023

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A1 APPROVAL PAGE

Quality Assurance Project Plan for *Monitoring the Effectiveness of Regenerative Agriculture Approaches on Water Quality in Integrated Crop/Livestock Systems*

Texas State Soil and Water Conservation Board (TSSWCB)

Name: Jett Preston
Title: Project Manager (PM)

Signature:______________________________ Date: 8/3/2021

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Name: Charles Coufal, Sr.
Title: QC, Data Manager

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Name: Anthony Pennartz
Title: Field Supervisor

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A3 DISTRIBUTION LIST

Organizations, and individuals within, which will receive copies of the approved QAPP and any subsequent revisions include:

Texas State Soil and Water Conservation Board (TSSWCB)
1497 Country View Lane
Temple, Texas 76504

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Name: Mitch Conine
Title: QAO

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P.O. Box 1658; Vernon, TX 76384

Name: Paul DeLaune
Title: QAO, Project Lead

Name: Charles Coufal, Sr.
Title: QA, Data Manager

Name: Anthony Pennartz
Title: Field Supervisor

List of Acronyms

AgriLife	Texas A&M AgriLife Research at Vernon
AWRL	Ambient Water Reporting Limit
BMP	Best Management Practice
CAR	Corrective Action Report
CFU	Colony-Forming Unit
CNMPs	Comprehensive nutrient management plans
COC	Chain of Custody
CRP	Clean Rivers Program
DI	Deionized
DO	Dissolved Oxygen
DQO	Data Quality Objective
DMRG	Data Management Reference Guide
EMC	Event Mean Concentration
EPA	Environmental Protection Agency
FOTG	Field Office Technical Guide
GIS	Geographical Information System
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LIMS	Laboratory information system
LOQ	Limit of Quantitation
NELAC	National Environmental Laboratory Accreditation Committee
NELAP	National Environmental Laboratory Accreditation Program
NMPs	Nutrient Management Plans
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint source pollution
NRCS	USDA-Natural Resource Conservation Service
PM	Project Manager
QA	Quality Assurance
QC	Quality Control
QAM	Quality Assurance Manual
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QPR	Quarterly Progress Report
Research	Texas A&M AgriLife Research
RPD	Relative Percent Difference
SAML	Soil and Aquatic Microbiology Laboratory
SLOC	Station Location Request
SM	Standard Method
SOP	Standard Operating Procedure
SWAT	Surface Water Assessment Tool
SWCD	Soil and Water Conservation District
SWQM	Surface Water Quality Monitoring

SWQMIS	Surface Water Quality Monitoring Information System
TCEQ	Texas Commission on Environmental Quality
TMDL	Total Maximum Daily Load
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TSSWCB	Texas State Soil and Water Conservation Board
TWDB	Texas Water Development Board
TWRI	Texas Water Resources Institute
USGS	United States Geological Survey
Vernon	Texas A&M AgriLife at Vernon Environmental Soil Science Laboratory
WQMP	Water Quality Management Plan

A4 PROJECT/TASK ORGANIZATION

The following is a list of individuals and organizations participating in the project with their specific roles and responsibilities:

TSSWCB

Jett Preston, PM

Responsible for ensuring that the project delivers data of known quality, quantity, and type on schedule to achieve project objectives. Provides the primary point of contact between Texas A&M AgriLife Research and TSSWCB. Tracks and reviews deliverables to ensure that tasks in the workplan are completed as specified in the contract. Notifies the TSSWCB QAO of significant project nonconformances and corrective actions taken as documented in quarterly progress reports (QPR) from Texas A&M AgriLife Research Project Lead.

Mitch Conine, QAO

Reviews and approves QAPP and any amendments or revisions and ensures distribution of approved/revised QAPPs to TSSWCB participants. Responsible for verifying that the QAPP is followed by Texas A&M AgriLife Research. Assists the TSSWCB PM on QA-related issues. Coordinates, reviews, and approves QAPPs and amendments or revisions. Conveys QA issues to appropriate TSSWCB management. Monitors implementation of corrective actions. Coordinates and conducts audits. Determines that the project meets the requirements for planning, quality assurance (QA) quality control (QC), and reporting under the TSSWCB Texas Nonpoint Source Grant Program.

Texas A&M AgriLife Research

Paul DeLaune, Project Lead, QAO

Responsible for ensuring that project tasks and other requirements in the contract are executed on time and with the QA/QC requirements in the system as defined by the contract and in the project QAPP. Submits accurate and timely deliverables to the TSSWCB PM. Responsible for coordinating attendance at conference calls, trainings, meetings, and related project activities with the TSSWCB. Responsible for verifying that the QAPP is distributed to and followed by Texas A&M AgriLife Research. Responsible for the facilitation of audits and the implementation, documentation, verification, and reporting of corrective actions. Reports status, issues, and progress of the overall project to TSSWCB PM.

Responsible for coordinating development and implementation of Texas A&M AgriLife Research’s QA program including writing, maintaining, and distributing the QAPP, any appendices and amendments, and monitoring its implementation. Ensures data collected for the project is of known and acceptable quality and adheres to the specifications of the QAPP. Responsible for identifying, receiving, and maintaining project quality assurance records. Responsible for coordinating with the TSSWCB to resolve QA-related issues.

Notifies the TSSWCB PM of circumstances which may adversely affect the quality of data. Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques. Implements or ensures implementation of corrective actions needed to resolve nonconformance noted during assessments. Provides copies of QAPP and any amendments or revisions to each project participant.

Charles Coufal, QA, Data Manager

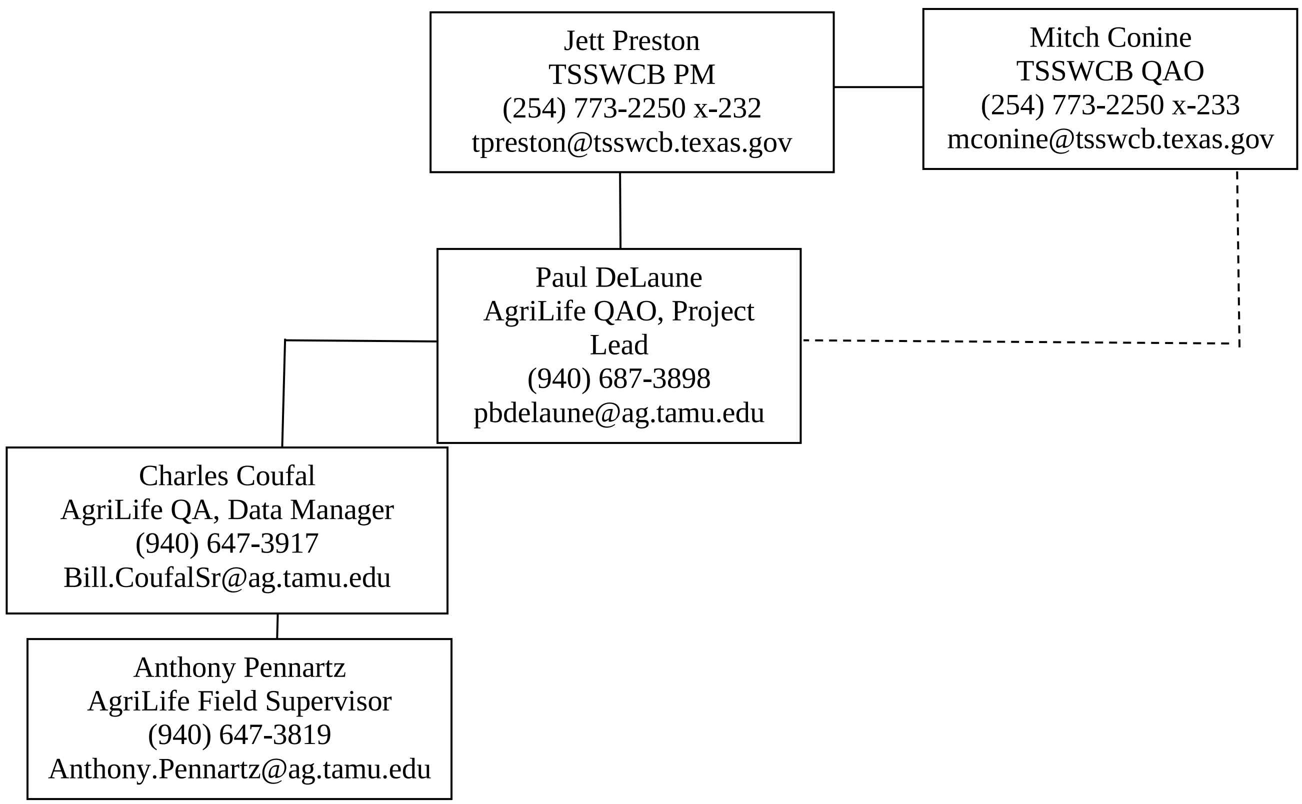
Provides laboratory quality assurance/quality control and responsible for notifying the AgriLife QAO if laboratory procedures in the QAPP need to be updated. Responsible for ensuring that laboratory personnel involved in generating analytical data have adequate training and a thorough knowledge of the QAPP and all SOPs specific to the analysis or task performed and or supervised. Responsible for making sure QA/QC requirements of this QAPP are met for data generated. Enforces corrective actions as required and is responsible for supervision of laboratory personnel involved in generating analytical data for this project. Responsible for traceability of laboratory standards and reagents, completeness and acceptability of chain of custody forms, and ensuring laboratory instrument and calibration data is complete. Responsible for the analytical sensitivity of laboratory instrumentation to levels consistent with this QAPP. Performs laboratory bench-level reviews and ensures that all laboratory samples are analyzed for all parameters.

Responsible for acquisition, verification, and transfer of data to the TSSWCB PM. Oversees data management for the project. Performs data quality assurances prior to transfer of data to the TSSWCB. Ensures that the data review checklist is complete and data is submitted with appropriate codes. Provides the point of contact for the TSSWCB PM to resolve issues related to the data and assumes responsibility for the correction of any data errors.

Anthony Pennartz, Field Supervisor

Responsible for supervising all aspects of the sampling and measurement of surface waters and other field parameters. Responsible for the collection of water samples and field data measurements in a timely manner that meet the quality objectives specified in Section A7 (Table A7.1), as well as the requirements of Sections B1 through B8. Responsible for field scheduling, staffing, and ensuring that staff is appropriately trained. Reports status, problems, and progress to Project Lead.

Figure A4.1 Organization Chart



A5 PROBLEM DEFINITION/BACKGROUND

Healthy soils help optimize inputs and maximize nutrient and water use efficiencies. Converting cropping systems from conventional tillage to conservation or no-till enhances soil health by increasing soil organic matter content and carbon. In order to increase soil carbon and potentially reduce irrigation water requirements and improve water quality, soil health promoting practices such as conservation tillage, cover crops, and irrigation management practices must be incorporated. In 2009, the United States accounted for 25% or nearly 70 million acres of the World's acres in no-till (Derpsch et al., 2010). However, practice adoption in Texas remains low. Within the US, recent reports estimate that conservation tillage is used on the majority of acres planted to wheat (67%), corn (65%), and soybeans (70%); whereas only 40% of cotton acres were under conservation tillage (Claassen et al., 2018). Furthermore, cotton under conservation tillage within the Southern Great Plains region was less than 30% compared to nearly 70% in the Southeastern US (Claassen et al., 2018). This report also highlighted that over 60% of planted cotton acres followed a low-residue crop, suggesting continuous cotton cropping systems. Realized time, labor, and fuel savings yield higher economic returns relative to unsustainable tillage practices are the driving forces for adoption. The numerous environmental benefits that improved soil health produces are an added bonus.

Conservation tillage has long been promoted as a practice to promote soil and water conservation (Unger et al., 1991). Such practices are critical in semi-arid environments where water is often the limiting factor to crop production. While this is even more critical in rainfed environments, it is also important under irrigated agriculture where depleting aquifer supplies leads to deficit irrigation and/or the transition to dryland agriculture that could make producers more reliant on conservation management practices (Baumhardt et al., 2009). Excessive tillage with low residue input and retention degrades soil physical quality, decreases soil organic carbon (SOC), and potentially reduces crop yield (Lal, 2003, 2015; Blanco-Canqui et al., 2004).

Incorporating cover crops into cropping systems that promote soil health and water infiltration can further reduce soil erosion, increase nutrient use efficiency, increase soil carbon, improve soil physical properties, increase water infiltration into soil, increase soil organic carbon, protect water quality, and aid in weed control. Research has validated these effects; however, results can vary by location and season. Potential reductions in soil moisture may occur when implementing cover crops (Dabney et al., 2001; Balkcom et al., 2007), but are dependent on rainfall distribution relative to crop development. Rainfall events following cover crop termination enables soil surface water recharge and usually provides adequate soil moisture in humid regions to facilitate cash crop planting (Balkcom et al., 2007). Winter cover crops have been increasingly used to scavenge residual N in the soil after crop harvest to reduce NO3 leaching and increase N supply for succeeding crops. Studies have shown that non-legume cover crops, such as rye and annual ryegrass, are more effective in reducing residual soil N (Kuo et al., 1997; Vyn et al., 1999) and N leaching (McCracken et al., 1994; Bergstrom and Kirchmann, 2004) than legumes or non-cover cropped soil. This impact is even more important in regions such as the proposed demonstration area in Texas where elevated NO3 levels in groundwater are widespread.

Regenerative agriculture has recently gained much attention and has numerous definitions varying upon the source defining the term. In short, regenerative agriculture promotes the use of crop rotation, cover crops, and no-tillage with decreased use of pesticides and inorganic fertilizer and eventual eradication. Hence, another staple of regenerative agriculture is the use of animal manure or compost. Mismanagement of animal manures has led to numerous water quality issues, thus management of manure and/or compost applications must be closely managed and monitored, especially in areas with little experience with organic amendments. The Rodale Institute (https://rodaleinstitute.org/why-organic/issues-and-priorities/water-pollution/) states that organic amendments holds soil together and holds water better due to increased organic matter.

Initial research in the proposed study area has shown that no-till and cover crops can increase infiltration rates, increase irrigation water use efficiency, reduce runoff volumes, reduce soil erosion, reduce sediment bound phosphorus and ammonium, and affect bacteria levels in surface runoff. However, producers continue to question the advantages of no-till and cover crops as evident through low adoption rates. Although adoption rates have been low, interest in soil health promoting practices continue to increase. Expressed concerns continue to be costs associated with cover crop implementation, conservation tillage, and cover crop water use. Although sediment and sediment bound nutrient losses have been reduced due to soil health promoting practices, the impact on dissolved nutrients (which are directly bioavailable in surface waters) have been mixed. Demonstrations evaluating the effectiveness of these practices could spur further interest and adoption within the region and across similar environments, providing important information to producers and downstream end users.

A6 PROJECT/TASK DESCRIPTION

Previous research and demonstrations in the proposed region have shown initial crop production and off-site impact reduction successes using cover crops, conservation tillage, and/or regenerative agriculture in semi-arid agricultural environments. However, adoption of soil health promoting practices remain low in the Southern Great Plains, thus increasing the need for expanded demonstration and technology transfer to producers. We propose to incorporate cover crops and practices into long-term conservation tillage systems to demonstrate how soil health promoting practices can improve water capture and water quality while sustaining agronomic and economic goals. Collectively, widespread adoption of soil health promoting practices will improve water quality by improving water infiltration rates, soil water holding capacity, soil moisture conditions, and reducing irrigation water needs.

The demonstration site will evaluate the impact of crop rotation, cover crops, and grazing on water quality within an integrated crop/livestock system. Our goal is to construct 12 1.5+ acre catchments equipped with automatic water samplers. Soil health promoting practices will be evaluated and compared to a standard management practice. Evaluated practices include 1) no-till; 2) no-till with a legume cover crop; 3) no-till with a mixed species cover crop; and 4) regenerative agriculture. Treatments 3 and 4 will be similar; however, treatment 4 will receive organic amendments and reduced pesticide inputs. The cropping system will consist of a cotton-wheat system, with the wheat utilized for graze and grain (dual-use) when conditions allow for adequate forage. Cover crops will be grazed as conditions allow. The mixed species will consist of a legume/grass mix comprising of the most regionally successful cover crops as evident from past research.

All water samples will be analyzed for nitrate, ammonium, total bound nitrogen, dissolved organic phosphorus, total phosphorus, total suspended solids, total solids, soluble organic carbon, and total carbon. Edge of field water samples will also be analyzed for E. coli. Soil samples will be analyzed for nitrate, ammonium, phosphorus, organic C, and other nutrients of interest. Cover crops will be clipped to determine C:N nitrogen content and total accumulated nitrogen.

Table A6.1. Project Plan Milestones

Task	Project Milestones	Agency	Start	End
2.1	QAPP development for activities in Tasks 3 and 4.	AgriLife Research	M1	M6
2.2	Implement QAPP and revise and amend as necessary	AgriLife Research	M3	M24
3.1	Continue operating and maintain 12 edge of field runoff monitoring stations	AgriLife Research	M1	M24

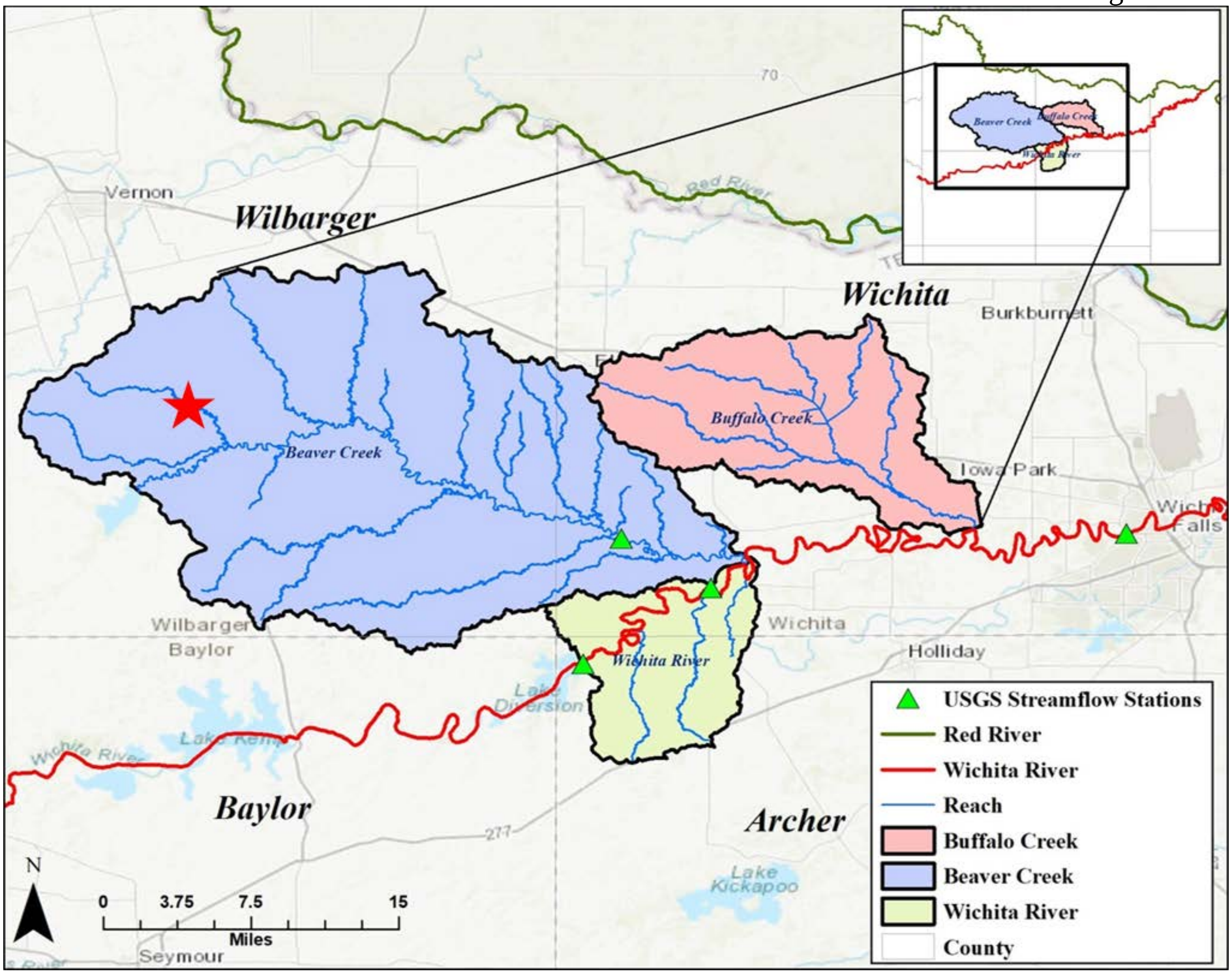


Figure A6.1. Map of proposed study region in the Texas Rolling Plains. Edge of field monitoring site is indicated by the red star within the Beaver Creek Watershed.

A7 QUALITY OBJECTIVES AND CRITERIA

Our primary objective is to demonstrate and quantify the effects of improved soil health generated by implementing conservation tillage with cover crops and regenerative agriculture by measuring changes in infiltration rates, soil water holding capacities, surface runoff volume, erosion, off-site agrochemical transport, crop yield, crop quality, and economics across Southern Great Plains production systems. This will be accomplished by initiating the assessment of water quality improvements resulting from implementation of conservation practices within the Texas Rolling Plains. Nutrients, sediment, and bacteria will be the focus of this assessment. A replicated watershed catchment approach will be utilized to document impacts.

While this project is focused within the Beaver Creek watershed, its sampling design and intent is to detect short-term water quality changes at the field and farm scale because of implementation of regenerative agricultural approaches in the watershed. No part of this project is intended to quantify changes in water quality within Beaver Creek. However, the long-term goals of the TSSWCB NPS Program are to improve all waters of the state, and the goals of this project are consistent in that BMP implementation efforts will eventually have benefits to water quality in Beaver Creek and adjacent impaired water bodies.

Ambient Water Reporting Limits and Laboratory Reporting Limits

Ambient water reporting limits (AWRLs) are reporting specifications at **or below** which data for a parameter must be reported to be compared with freshwater screening criteria. The AWRLs specified in Table A7.1 are the program-defined reporting specifications for each analyte and yield data acceptable to meet project objectives. The limit of quantitation (LOQ) is the minimum level, concentration, or quantity of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. The laboratory is required to meet the following:

- The laboratory's LOQ for each analyte must be at or below the AWRL as a matter of routine practice.

- The laboratory will demonstrate and document its ability to quantitate at its LOQ for each analyte by running an LOQ Check Sample for each analytical batch of TMDL samples analyzed.

Acceptance criteria are defined in Section B5.

Precision

Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. It is a measure of agreement among replicate measurements of the same property, under prescribed similar conditions, and is an indication of random error.

Laboratory precision is assessed by comparing replicate analyses of laboratory control samples in the sample matrix (e.g. deionized water) or sample/duplicate pairs in the case of bacteria analysis. Precision results are compared against measured performance specifications and used during evaluation of analytical performance. Program-defined measurement performance specifications for precision are defined in Table A7.1 Field splits are used to assess the variability of sample handling, preservation, and storage, as well as the analytical process for conventional parameters. They are prepared by splitting samples in the field. Control limits for field splits are defined in Section B5.

Tab7le A7.1 - Measurement Performance Specifications

PARAMETER	MATRIX	UNITS	METHOD	AWRL	Limit of Quantitation (LOQ)	LOQ Check Standard %Rec	PRECISION (RPD of LCS/LCSD)	BIAS (% Rec. LCS/LCSD mean)	Laboratory Performing Analysis
Total Suspended Solids (Total Non-filterable Residue)	Water	mg/L	APHA 2540D	4	4	NA	20%	80-120%	AgriLife
Total Solids	Water	mg/L	APHA 2540B	4	4	NA	20%	80-120%	AgriLife
Total Bound N	Water	mg/L	EN 12260 Replacement for EPA 351.2 Rev. 2	0.05	0.05	70-130%	20%	80-120%	AgriLife
Total C/Total Organic Carbon	Water	mg/L	EPA 415.1	0.05	0.05	70-130%	20%	80-120%	AgriLife
Soluble Reactive P (Ortho-P)	Water	mg/L	EPA 365.1	0.06	0.06	70-130%	20%	80-120%	AgriLife
Total Phosphorus	Water	mg/L	EPA 365.1	0.06	0.06	70-130%	20%	80-120%	AgriLife
Nitrate/nitrite-Nitrogen	Water	mg/L	EPA 300.0 2.1	0.05	0.05	70-130%	20%	80-120%	AgriLife
E. coli[1]	Water	cfu/100 mL	EPA 1603	1	1	NA	10%	NA	AgriLife
Discharge	Water	m^3	Bubble Flow Meter/ Area-velocity sensor	NA	NA	NA	NA	NA	Field
Precipitation	Water	mm	Rain Gauge	NA	NA	NA	NA	NA	Field

[1] *E. coli* samples should always be processed as soon as possible and within 8 hours. When transport conditions necessitate delays in delivery longer than 6 hours, the holding time may be extended, and samples must be processed as soon as possible and within 24 hours.

Bias

Bias is a statistical measurement of correctness and includes multiple components of systemic error. A measurement is considered unbiased when the value reported does not differ from the true value. Bias is determined through the analysis of laboratory control samples and LOQ Check Samples prepared with verified and known amounts of all target analytes in the sample matrix (e.g. deionized water, sand, commercially available tissue) and by calculating percent recovery. Results are compared against measurement performance specifications and used during evaluation of analytical performance. Program defined measurement performance specifications for bias are specified in Table A7.1.

Representativeness

Representativeness is a measure of how accurately a monitoring program reflects the actual water quality conditions. The representativeness of the data is dependent on 1) the sampling locations, 2) the number of samples collected, 3) the number of years and seasons when sampling is performed, 4) the number of depths sampled, and 5) the sampling procedures. Site selection and sampling of all pertinent media and use of only approved analytical methods will assure that the measurement data represents the conditions at the site. The goal for meeting total representation of the sampled water is tempered by the availability of time and funding. Representativeness will be measured with the completion of samples collected in accordance with the approved QAPP and sampling plan.

The goals of this project are to evaluate quality and quantity of runoff from small catchments and farms over time. Sampling will be conducted with automated instruments programmed to collect flow-weighted samples during runoff events from small plots. This will allow for targeted events to be sampled.

Comparability

Confidence in the comparability of datasets from this project and those for similar uses is based on the commitment of project staff to use only approved sampling and analysis methods and QA/QC protocols in accordance with quality system requirements and as described in this QAPP. Comparability is also guaranteed by reporting data in standard units, by using accepted rules for significant figures, and by reporting data in a standard format as specified in this QAPP.

Completeness

The completeness of the data is basically a relationship of how much of the data is available for use compared to the total potential data. Ideally, 100% of the data should be available. However, the possibility of unavailable data due to accidents, insufficient sample volume, broken or lost samples, etc. is to be expected. Therefore, it will be a general goal of the project(s) that 90% data completion is achieved.

A8 SPECIAL TRAINING/CERTIFICATION

No special certifications are required. However, new field and lab personnel will receive training in proper sampling techniques and sample analysis. Before actual sampling or analysis occurs, they will demonstrate their ability to properly calibrate equipment and perform field sampling or analysis procedures.

A9 DOCUMENTS AND RECORDS

The documents and records that describe, specify, report, or certify activities, requirements, procedures, or results for this project and the items and materials that furnish objective evidence of the quality of items or activities are listed in Table A9.1.

Table A9.1 Project Documents and Records

Document/Record	Location	Retention	Form
QAPP, amendments, and appendices	AgriLife	5 years	Paper or Electronic
Chain of custody records	AgriLife	5 years	Paper or Electronic
Corrective action reports	AgriLife	5 years	Paper or Electronic
Laboratory QA manuals and/or SOPs	AgriLife	5 years	Paper or Electronic
Lab equipment calibration records & maintenance logs	AgriLife	5 years	Paper or Electronic
Lab data reports/results	AgriLife	5 years	Paper or Electronic
Field SOPs	AgriLife	5 years	Paper or Electronic
Field notebooks/data sheets	AgriLife	5 years	Paper or Electronic
Field equipment maintenance logs	AgriLife	5 years	Paper or Electronic
QPRs/final report/data	AgriLife	5 years	Paper or Electronic

QPRs will note activities conducted in connection with the water quality monitoring program, items or areas identified as potential problems, and any variations or supplements to the QAPP. Corrective Action Reports (CARs) will be utilized when necessary. CARs that result in any changes or variations from the QAPP will be made known to pertinent project personnel and documented in an update or amendment to the QAPP. All QPRs and QAPP revisions will be distributed to personnel listed in Section A3. A blank CAR form is presented in Appendix A, a blank chain-of-custody (COC) form is presented in Appendix B, blank bacteriological data log sheet is presented in Appendix C, an ISCO® sampler maintenance log is presented in Appendix D, the data review checklist and summary are included in Appendix E and the sample collection SOP is included in Appendix F. The TSSWCB may elect to take possession of records at the conclusion of the specified retention period.

Laboratory Test Reports

Test/data reports from the laboratory must document the test results clearly and accurately. Routine data reports should include the information necessary for the interpretation and validation of data. At a minimum, test reports (regardless of whether they are hard copy or electronic) should include the following:

- Sampling Location
- Plot ID
- Date/Time Collected

- Name of Sample Collector
- Date/Time Received
- Name of Sample Receiver
- Analysis Performed
- Analysis Dilution Factor Utilized if Any
- Written DQO Data from Table A7.1
- Units of measurement
- Sample Volume Processed
- Name of Person Processing Sample and Recording Results
- Sample Analysis Results
- Narrative of any QA/QC deviations or failures that may affect sample quality

QAPP Revision and Amendments

Until the work described is completed, this QAPP shall be revised as necessary and reissued annually on the anniversary date or revised and reissued within 120 days of significant changes, whichever is sooner. The last approved versions of QAPPs shall remain in effect until revised versions have been fully approved; the revision must be submitted to the TSSWCB for approval before the last approved version has expired. If the entire QAPP is current, valid, and accurately reflects the project goals and the organization's policy, the annual re-issuance may be done by a certification that the plan is current. This will be accomplished by submitting a cover letter stating the status of the QAPP and a copy of new, signed approval pages for the QAPP.

QAPP amendments may be necessary to reflect changes in project organization, tasks, schedules, objectives, and methods; address deficiencies and nonconformance; improve operational efficiency; and/or accommodate unique or unanticipated circumstances. Written requests for amendments are directed from the AgriLife Project Lead to the TSSWCB PM and are effective immediately upon approval by the TSSWCB PM and QAO. Amendments to the QAPP and the reasons for the changes will be documented and distributed to all individuals on the QAPP distribution list by the AgriLife Project Lead or designee. Amendments shall be reviewed, approved, and incorporated into the next revision of the QAPP.

B1 SAMPLING PROCESS DESIGN

Sample Design Rationale

The goal of the monitoring program is assessment of water quality at the edge-of-field as affected by conservation management practices, including no-till, cover crops, and grazing management. Edge-of-field monitoring sites are implemented to quantify non-point source pollutant loading in the watershed and the effectiveness of conservation practices implemented to reduce pollutant loading. In total, there are 12 edge-of-field monitoring stations adjacent to each other. Data collected through this project will be utilized to illustrate and ultimately educate producers on the water quality impacts of conservation practice implementation. Practice efficacy regarding bacteria, nutrient, and sediment removal will be demonstrated. Constituents measured and analyzed are included in Table B1.1.

Table B1.1. Sampling Constituents

Parameter	Matrix	Status	Reporting Units	Applicable Monitoring Type
Discharge	Water	Critical	m^3	Runoff
Precipitation	Water	Non-critical	mm	Runoff
Ortho-Phosphate Phosphorus	Water	Critical	mg/L	Runoff
Total Phosphorus	Water	Critical	mg/L	Runoff
Total Suspended Solids	Water	Critical	mg/L	Runoff
Nitrate/nitrite-Nitrogen	Water	Critical	mg/L	Runoff
Total Bound Nitrogen	Water	Critical	mg/L	Runoff
E. coli	Water	Critical	cfu/100 mL	Runoff

Monitoring Sites

To achieve the identified goals of the project, monitoring sites in Table B1.2 and Figure B1.1 and B1.2 were identified and located in the Beaver Creek watershed. Sites consist of treatments and controls to provide data for a subsequent replicated watershed assessment of water quality. Edge-of-field sites are located on the downslope side of fields. The field has been in continuous no-till wheat since 2001, with the exception of canola in 2014. Each constructed catchment (1-2 acres in size) will be equipped with 1 foot H-flumes installed in the flow path and earthen berms route flow into and through the flume. H-flumes equipped with flow modules to provide a stage-discharge relationship for flow rate measurement. Each station uses a Teledyne ISCO® Avalanche refrigerated sampler to automatically collect water quality samples and to measure and store flow rate. A rain gauge installed at the site measures precipitation.

Table B1.2. NWQI effectiveness sample sites and monitoring frequency

Station ID	TCEQ Station ID	Station Type	Monitoring Frequency	Collecting Entity	County
1	NA	Field	Runoff Event	AgriLife	Wilbarger
2	NA	Field	Runoff Event	AgriLife	Wilbarger
3	NA	Field	Runoff Event	AgriLife	Wilbarger
4	NA	Field	Runoff Event	AgriLife	Wilbarger
5	NA	Farm	Runoff Event	AgriLife	Wilbarger
6	NA	Farm	Runoff Event	AgriLife	Wilbarger
7	NA	Farm	Runoff Event	AgriLife	Wilbarger
8	NA	Farm	Runoff Event	AgriLife	Wilbarger
9	NA	Farm	Runoff Event	AgriLife	Wilbarger
10	NA	Farm	Runoff Event	AgriLife	Wilbarger
11	NA	Farm	Runoff Event	AgriLife	Wilbarger
12	NA	Farm	Runoff Event	AgriLife	Wilbarger

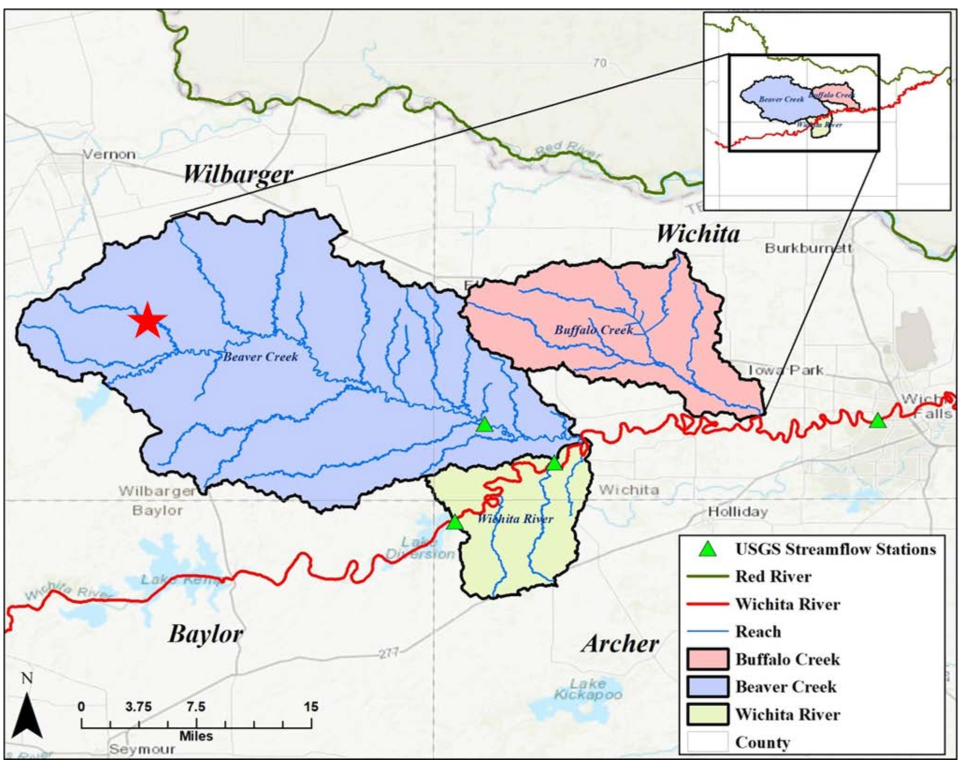


Figure B1.1. General edge of farm and edge of field sampling site location denoted by red star.

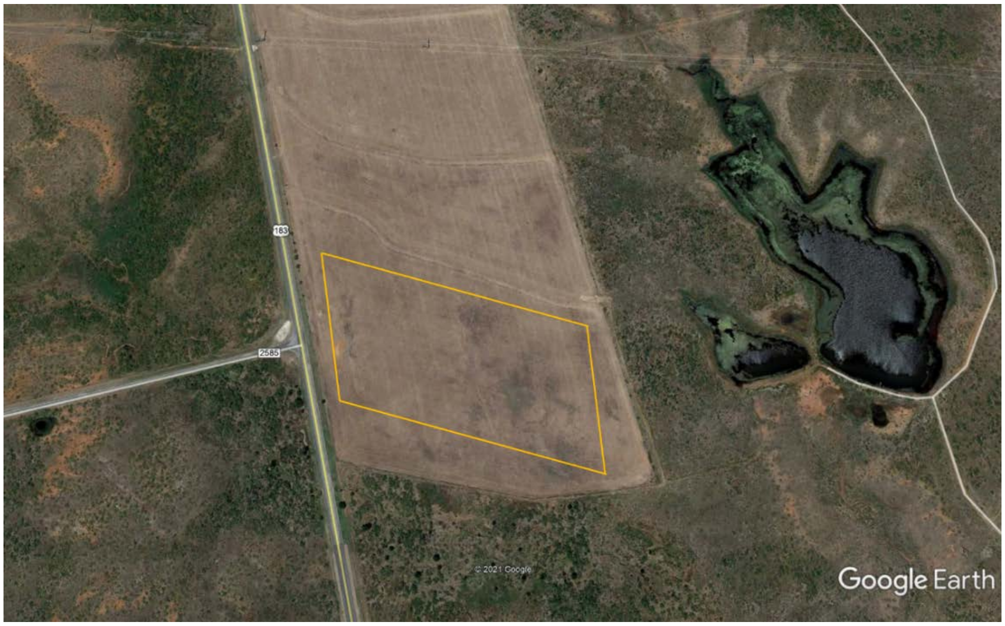


Figure B1.2. Google earth image of edge of field sampling site location.

Sampling Regime

This project is focused on establishment of monitoring sites and continued operation. Monitoring will begin upon QAPP approval in summer 2021 and will be carried through January 2023. For runoff events, flow data and flow-weighted water quality samples will be collected at twelve edge-of-field sites as generated by natural storm events with ISCO® Avalanche refrigerated samplers. AgriLife will collect samples from the edge-of-field as appropriate. A single bottle configuration will be utilized, and a 100 mL sample will be collected per 50 gal of measured flow.

Once samples are collected (or removed from the ISCO® automatic stormwater samplers), they are prepared in the field and transported to the Environmental Soil Science Laboratory at Texas A&M AgriLife Research at Vernon. The laboratory is located 10 miles from the field collection sites. Samples will be analyzed as noted in Tables A7.1 and B2.1. All sites are accessible to AgriLife through landowner permission.

B2 SAMPLING METHODS

Specific requirements for sampling are outlined in the following sections. Sample volume, container types, minimum sample volume, preservation requirements, and holding time requirements are listed in Table B2.1.

Table B2.1. Sample Storage, Preservation and Handling Requirements

Parameter	Matrix	Container	Preservation	Minimum Sample Volume	Holding Time
Total Phosphorus	Water	Plastic	Acidify w/ H_2SO_4 to pH 2, 4°C, dark	125 mL	28 days
*E. coli**	Water	Sterile bottles or Sealable sterile plastic bags	<6°C, dark	100 mL	8 hr / 24 hr*
Ortho-Phosphate Phosphorus	Water	Plastic Bottles	4°C, 0.45 µm filter, HCl to pH 2, dark	125 mL	28 days
Nitrate/nitrite-Nitrogen	Water		4°C, 0.45 µm filter, HCl to pH 2, dark	125 mL	28 days
Total/ Total Suspended Solids	Water		4°C, dark	125 mL	7 days
Total Bound Nitrogen	Water		4°C, dark	125 mL	28 days
Total & Total Organic C	Water		4°C, dark	125 mL	28 days
Total Bound Nitrogen	Water		4°C, dark	125 mL	28 days

**E. coli* samples should always be processed as soon as possible and within 8 hours. When transport conditions necessitate delays in delivery longer than 6 hours, the holding time may be extended for non-regulatory samples (edge-of-field/farm) but must be processed as soon as possible and within 24 hours. The holding time clock starts when the automatic sampler pulls the first sample.

Collection of Flow-Weighted Composite Samples

Flow-weighted composite samples from edge-of-field/farm watershed sites will be collected using refrigerated ISCO® Avalanche full-size portable samplers with single bottle configuration into clean polyethylene 5-gallon square bottles for runoff events with more than 5 mm of runoff volume. Following each event, each 5-gallon bottle will be replaced with a clean bottle that has been washed with acid water, rinsed three times with tap water and three times with deionized (DI) water, air dried upside down and on its side to allow complete drying and finally, capped when completely dry.

Collection of flow-weighted composite samples will allow calculation of event mean concentrations of *E. coli* and nutrients for each rainfall runoff event at the field level and allow a determination of total annual loadings to be developed. A minimum of 500 ml will be collected by automatic samplers. After the first sample is collected until sample retrieval the Avalanche cools the refrigerated compartment to 1°C +/- 1. One hour after the last sample of the program is taken, the Avalanche adjusts its control to maintain the samples at 3°C +/- 1. Flow from each watershed site will be measured with flow modules. This, in combination with the EMCs, will allow calculation of bacteria and nutrient loading for each runoff event. Flow and precipitation data is downloaded at least monthly using an ISCO® 581 Rapid Transfer Device or directly onto laptop with flowlink software.

Runoff Event Holding Time

Runoff samples in the 5-gallon bottles will be retrieved from the refrigerated ISCO® samplers, thoroughly mixed, and sub-samples transferred to appropriate containers as outlined in Table B2.1 and transported in ice to Vernon for analysis. The beginning of a storm event is defined as the point in time that flow exceeds the enable levels and the end of the storm is when flow is below the enable level and when more rain (flow increases) is not expected within 2 hours. At the end of the storm, the storm sample should be collected and the ISCO® reset for the next event.

For *E. coli* sub-samples from the well-mixed 5-gallon bottle, a minimum volume of 125 collected by automatic samplers will be poured into sterile Whirl-Pak bags or IDEXX bottles and stored in ice until delivered to Vernon. Edge-of-field/farm *E. coli* samples must be removed from automatic samplers, transported to Vernon, processed, and placed in the incubator within 24 hours of the start of the stormwater runoff event, that is, from the first automatically collected stormwater sample. This applies even when storm events exceed 24 hours (although not expected due to the small size of the drainage areas involved).

All samples will be transported by AgriLife in ice to the lab for analysis. All filtration and incubation will be performed in the laboratory. Samples must be stored at 4°C until processed in each lab. In the event *E. coli* samples cannot be collected, transported, processed and incubated within 24 hours, samples will still be analyzed but it will be noted that the target holding time was not met.

Processes to Prevent Cross Contamination

To prevent cross-contamination, runoff subsamples will be transferred directly from the 5-gallon sampler bottle into the containers they will be transported to the lab. Field QC samples as discussed in Section B5 are collected to verify that cross-contamination has not occurred.

Documentation of Field Sampling Activities

Field activities are documented as needed in field notes. For all water samples collected, station ID, sampling date and time, sample type, and sample collector's name/signature are recorded on the sample container and COC.

Recording Data

All field and laboratory personnel follow the basic rules for recording information as follows:

- Legible writing in indelible ink with no modifications, write-overs or cross-outs;
- Correction of errors with a single line followed by an initial and date; and
- Close-outs on incomplete pages with an initialed and dated diagonal line.

Deviations from Sampling Method Requirements or Sample Design, and Corrective Action

Examples of deviations from sampling method requirements or sample design include but are not limited to, such things as inadequate sample volume due to spillage or container leaks, failure to preserve samples appropriately, contamination of a sample bottle during collection, storage temperature and holding time exceedance, sampling at the wrong site, etc. Any deviations will invalidate resulting data and may require corrective action. Corrective action may include for samples to be discarded and re-collected. It is the responsibility of the AgriLife QAO to ensure that the actions and resolutions to the problems are documented and that records are maintained in accordance with this QAPP. In addition, these actions and resolutions will be conveyed to the TSSWCB PM both verbally and in writing in the QPRs and by completion of a CAR.

CARs document: root cause(s); programmatic impact(s); specific corrective action(s) to address any deviations; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and the means by which completion of each corrective action will be documented. CARs will be included with QPRs. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TSSWCB immediately both verbally and in writing.

B3 SAMPLE HANDLING AND CUSTODY

Chain-of-Custody

Proper sample handling and custody procedures ensure the custody and integrity of samples beginning at the time of sampling and continuing through transport, sample receipt, preparation, and analysis. The COC form is used to document sample handling during transfer from the field to the laboratory. The sample number, location, date, changes in possession and other pertinent data will be recorded in indelible ink on the COC. The sample collector will sign the COC and transport it with the sample to the laboratory. At the laboratory, samples are inventoried against the accompanying COC. Any discrepancies will be noted at that time and the COC will be signed for acceptance of custody. In the instance that the field sample collector and laboratory sample processor are one and the same, a field-to-lab COC will be unnecessary. A copy of a blank COC form used on this project is included as Appendix B.

Sample Labeling

Samples will be labeled on the container with an indelible, waterproof marker. Label information will include site identification, date, sampler’s initials, and time of sampling. The COC form will accompany all sets of sample containers.

Sample Handling

Following collection, water samples will be placed in ice in an insulated cooler for transport to the appropriate laboratory. At the laboratory, samples will be placed in a refrigerated cooler dedicated to sample storage. The Laboratory Director has the responsibility to ensure that holding times are met with water samples. The holding time is documented on the COC. Any problem will be documented with a CAR.

Failures in Chain-of-Custody and Corrective Action

All failures associated with chain-of-custody procedures as described in this QAPP are immediately reported to the AgriLife Project Lead and QAO. These include such items as delays in transfer, resulting in holding time violations; violations of sample preservation requirements; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc. The AgriLife Project Lead and AgriLife QA will determine if the procedural violation may have compromised the validity of the resulting data. Any failures that have reasonable potential to compromise data validity will invalidate data and the sampling event should be repeated. The resolution of the situation will be reported to the TSSWCB PM in the QPRs. Corrective action reports will be prepared by the AgriLife QAO and submitted to the TSSWCB PM along with the QPR.

B4 ANALYTICAL METHODS

The analytical methods are listed in Table A7.1 of Section A7. Laboratories collecting data under this QAPP are compliant with the NELAC™ Standards, where applicable. Copies of laboratory SOPs are retained by AgriLife and are available for review by the TSSWCB. Laboratory SOPs are consistent with EPA requirements as specified in the method.

Standards Traceability

All standards used in the laboratory are traceable to certified reference materials. Standards preparation is fully documented in lab manuals. The reagent bottle will be labeled in a way that will trace the reagent back to preparation.

Analytical Method Modification

Only data generated using approved analytical methodologies as specified in this QAPP will be submitted to the TSSWCB. Requests for method modifications will be documented and submitted for approval to the TSSWCB QAO. Work will only begin after the modified procedures have been approved.

Failures in Measurement Systems and Corrective Actions

Failures in field and laboratory measurement systems involve, but are not limited to, such things as instrument malfunctions, failures in calibration, blank contamination, quality control samples outside QAPP defined limits, etc. In many cases, the field technician or lab analyst will be able to correct the problem. If the problem is resolvable by the field technician or lab analyst, then they will document the problem and complete the analysis. If the problem is not resolvable, then it is conveyed to the lab director or field supervisor as appropriate, who will make the determination in coordination with the AgriLife QAO. If the analytical system failure may compromise the sample results, the resulting data will not be reported to the TSSWCB as part of this project. The nature and disposition of the problem is reported on the CAR and submitted with the QPR to the TSSWCB PM.

CARs document: root cause(s); programmatic impact(s); specific corrective action(s) to address any deviations; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and the means by which completion of each corrective action will be documented. In addition, significant conditions will be reported to the TSSWCB immediately both verbally and in writing.

B5 QUALITY CONTROL

Table A7.1 lists the required accuracy, precision, and completeness limits for the parameters of interest. Specific requirements are summarized in Table B5.1 and described below.

Table B5.1. Required Quality Control Analyses

Parameter	Matrix	LOQ	LOQ Check Std	LCS	Lab Dup	Field Blank	Field Split	Method Blank
Total Suspended Solids	*Water*	√	√	√	√	√	√	√
Dissolved Reactive Phosphorus	*Water*	√	√	√	√	√	√	√
Total Phosphorus	*Water*	√	√	√	√	√	√	√
Nitrate/nitrite-Nitrogen	*Water*	√	√	√	√	√	√	√
Total Bound Nitrogen	*Water*	√	√	√	√	√	√	√
Total/Organic Carbon	*Water*	√	√	√	√	√	√	√
E. coli	*Water*	*NA*	*NA*	*NA*	√	*NA*	*NA*	√

Limit of Quantitation (LOQ)

The laboratories will analyze a calibration standard (if applicable) at the LOQ on each day samples are analyzed. Calibrations including the standard at the LOQ will meet the calibration requirements of the analytical method or corrective action will be implemented.

LOQ Check Standard

A LOQ check standard consists of a sample matrix (e.g., deionized water, sand, commercially available tissue) free from the analytes of interest spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is used to establish intra-laboratory bias to assess the performance of the measurement system at the lower limits of analysis. The LOQ check standard is spiked into the sample matrix at a level less than or near the LOQ for each analyte for each batch of samples that are run.

LOQ check standards are carried throughout the preparation and analytical process and are run at a rate of one per analytical batch. A batch is defined as samples that are analyzed together with the same method and personnel, using the same lots of reagents. The percent recovery of the LOQ check standard is calculated using the following equation in which %R is percent recovery, SR is the sample result, and SA is the reference concentration for the check standard:

$$\%R = SR/SA * 100$$

Measurement performance specifications are used to determine the acceptability of LOQ Check Standard analyses as specified in Table A7.1.

Laboratory Control Sample (LCS)

A LCS consists of a sample matrix (e.g., deionized water, sand) free from the analytes of interest spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is used to establish intra-laboratory bias to assess the performance of the measurement system. The LCS is spiked into the sample matrix at a level less than or near the midpoint of the calibration for each analyte. The LCS is carried through the complete preparation and analytical process. LCSs are run at a rate of one per analytical batch. Results of LCSs are calculated by percent recovery, which is defined as 100 times the measured concentration, divided by the true concentration of the spiked sample. The following formula is used to calculate percent recovery, where %R is percent recovery; SR is the measured result; and SA is the true result:

$$\%R = SR/SA * 100$$

Measurement performance specifications are used to determine the acceptability of LCS analyses as specified in Table A7.1.

Laboratory Duplicates

A laboratory duplicate is prepared by taking aliquots of a sample from the same container under laboratory conditions and processed and analyzed independently. A laboratory control sample duplicate (LCSD) is prepared in the laboratory by splitting aliquots of an LCS. Both samples are carried through the entire preparation and analytical process. LCSDs are used to assess precision and are performed at a rate of one per batch. A batch is defined as samples that are analyzed together with the same method and personnel, using the same lots of reagents. For most parameters, precision is calculated by the relative percent difference (RPD) of LCS duplicate results as defined by 100 times the difference (range) of each duplicate set, divided by the average value (mean) of the set. For duplicate results, X_1 and X_2, the RPD is calculated from the following equation:

$$RPD = (X_1 - X_2)/\{(X_1+X_2)/2\} * 100$$

Bacteriological duplicates are a special type of laboratory duplicate. Bacteriological duplicate analyses are performed on samples from the sample bottle on a 10% basis. Results of bacteriological duplicates are evaluated by calculating the logarithm of each result and determining the range of each pair. Measurement performance specifications are used to determine the acceptability of duplicate analyses. The specifications for bacteriological duplicates in Table A7.1 apply to samples with concentrations >10 cfu/100 mL.

Method blank

A method blank is a sample of matrix similar to the batch of associated samples that is free from analytes of interest and is processed simultaneously with and under the same conditions as the samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. The method blank is carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination from the analytical process. The analysis of method blanks should yield values less than the LOQ. For very high-level analyses, the blank value should be less than 5% of the lowest value of the batch, or corrective action will be implemented.

Field Blank

For each storm event, deionized water will be placed in a clean 5-gallon ISCO® bottle and then processed as a field blank. A field blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check the effectiveness of decontamination procedures. It is collected in the same type of container as the environmental sample, preserved in the same manner and analyzed for the same parameter. The analysis of field blanks should yield values lower than the LOQ. When target analyte concentrations are very high, blank values must be less than 5% of the lowest value of the batch or corrective action will be implemented.

Field Split

A field split is a single sample subdivided by field staff immediately following collection and submitted to the laboratory as two separately identified samples according to procedures specified in the *TCEQ SWQM Procedures, Volume 1*. Split samples are preserved, handled, shipped, and analyzed identically and are used to assess variability in all of these processes. Field splits are collected for 10 percent of samples or upon each sampling event if less than 10 samples are collected.

Failures in Quality Control and Corrective Action

Sampling QC excursions are evaluated by the AgriLife Project Lead, in consultation with the AgriLife QAO. Because differences in sample results are used to assess the entire sampling process, including environmental variability, the arbitrary rejection of results based on pre-determined limits is not practical. Therefore, the professional judgment of the AgriLife Project Lead and QAO will be relied upon in evaluating results. Rejecting sample results based on wide variability is a possibility. Notations of field split excursions and blank contamination are noted in the QPR and the final QC Report.

Corrective action will involve identification of the cause of the failure where possible. Response actions will typically include re-analysis of questionable samples. In some cases, a site may have to be re-sampled to achieve project goals.

Laboratory measurement quality control failures are evaluated by the laboratory staff. The disposition of such failures and the nature and disposition of the problem is reported to the Vernon data manager. The Vernon QA and Data Manager will discuss with the AgriLife Project

Lead. If applicable, the AgriLife Project Lead will include this information in the CAR and submit with the QPR which is sent to the TSSWCB PM.

CARs document: root cause(s); programmatic impact(s); specific corrective action(s) to address any deviations; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and the means by which completion of each corrective action will be documented. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TSSWCB immediately both verbally and in writing.

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

To minimize downtime of all measurement systems, spare parts for field and laboratory equipment will be kept in the field monitoring vehicle and laboratory as appropriate. All field measurement and sampling equipment, in addition to all laboratory equipment, must be maintained in a working condition. All field and laboratory equipment will be tested, maintained, and inspected in accordance with manufacturer's instructions. Records of all tests, inspections, and maintenance will be maintained in lab and field notebooks. These records will be available for inspection by the TSSWCB.

Maintenance of the ISCO® automated samplers will be conducted at least monthly and documented on an ISCO® Sampler Maintenance form (Appendix D). The SOP for ISCO® sampler maintenance and sample retrieval conducted by AgriLife is included in Appendix G.

In summary, field staff will check ISCO® samplers for the following:

i. Sampler tube (not clogged or holding water)
ii. Stage Adjustment +/- ___ft
iii. Dessicant strength OK
iv. Download data
v. Solar panel output _____ v
vi. Battery under load _____ v
vii. Pump test
viii. Mow/weed eat (as needed); remove debris if present
i. Twice annual test bubble flow meter

Failures in any testing, inspections, or calibration of equipment will result in a CAR and resolution of the situation will be reported to the TSSWCB PM in the QPR. The CARs will be maintained by the AgriLife Project Lead and the TSSWCB PM.

B7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

All instruments or devices used in obtaining environmental data for this project will be calibrated according to and at the frequency recommended by the equipment manufacturer's instructions as each instrument have a specialized procedure for calibration and a specific type of standard used to verify calibration.

All calibration procedures will meet the requirements specified in the approved methods of analysis and the frequency of calibration as well as specific instructions applicable to the analytical methods recommended by the equipment manufacturer will be followed. These procedures are documented in instrument specific SOPs or the laboratory QAM. All information concerning calibration will be recorded in a calibration logbook by the person performing the calibration and will be accessible for verification during a laboratory audit.

Standards used for instrument or method calibrations shall be of known purity and be National Institute of Standards and Technology traceable whenever possible; when not available, standards shall be of American Chemical Society or reagent grade quality, or of the best attainable grade. All certified standards will be maintained traceable with certificates on file in the laboratory. Dilutions from all standards will be recorded in the standards log book and given unique identification numbers. The date, analyst initials, stock sources with lot number and manufacturer, and how dilutions were prepared will also be recorded in the standards log book.

Failures in any testing, inspections, or calibration of equipment will result in a CAR and resolution of the situation will be reported to the TSSWCB PM in the QPR. The CARs will be maintained by the AgriLife Project Lead and the TSSWCB PM.

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

All standards, reagents, media, plates, filters, and other consumable supplies are purchased from manufacturers with performance guarantees, and are inspected upon receipt for damage, missing parts, expiration date, and storage and handling requirements. Labels on reagents, chemicals, and standards are examined to ensure they are of appropriate quality, initialed by staff member and marked with receipt date. Volumetric glassware is inspected to ensure class "A" classification, where required. Media will be checked as described in quality control procedures. All supplies will be stored as per manufacturer labeling and discarded past expiration date. In general, supplies for microbiological analysis are received pre-sterilized, used as received, and not re-used.

B9 NON-DIRECT MEASUREMENTS

Only data collected directly under this QAPP will be submitted to the TSSWCB.

Data collected by the TCEQ, the USGS, and Texas Clean Rivers Program partners that meet the data quality objectives of this project may be useful in providing historical water quality perspective. The collection and qualification of the TCEQ and USGS data are addressed in the TCEQ Surface Water Quality Monitoring QAPP. The collection and qualification of the Texas CRP data are addressed in the Texas Clean Rivers Program QAPPs.

Geospatial data available from various local, regional, state, and federal organizations may be used for cartographic purposes. Maps developed for reports will be for illustrative purposes. Geospatial data utilized in maps of the study area may include land use, precipitation, soil type, ecoregion, TCEQ monitoring location, TCEQ permitted outfall, gage location, city/county/state boundary, stream hydrology, reservoir, drought, road, watershed, municipal separate storm sewer system, urbanized area, basin, railroad, recreational area, area landmark, aerial photography, and park information. The above data come from the following reliable sources: United States Geological Survey (USGS), Texas Natural Resources Information System (TNRIS), TCEQ, and US Census Bureau. Geospatial data from these sources are accepted for use in this project to develop maps based on the reputability of these data sources and the fact that there are no known comparable sources for these data. Geospatial data will be cited in reports.

Other data that are compiled and published by other entities may also be used in preparing project reports. This may include long-term precipitation, ecoregion, and stream flow data, agricultural census data on livestock, wildlife population estimates, and groundwater resource information such as aquifer boundaries and well locations. Sources of these data are the USGS, National Weather Service, US Census Bureau, US Department of Agriculture (USDA) National Agricultural Statistics Survey, Texas Parks and Wildlife Department (TPWD) and the Texas Water Development Board (TWDB). Data collected by these entities are assumed to have been verified and validated according to the requirements of the respective programs. Data compilations created for this project will be visually screened for errors. Data will be cited in reports.

B10 DATA MANAGEMENT

Field Collection and Management of Samples

All field collection will be completed as described in Section B2 of the QAPP. A COC is filled out in the field for each sampling event noting the site name, time and date of collection, sample type, comments, sample collector's name, and other pertinent data. Samples collected will be labeled with site identification, date, sampler's initials, and time of sampling and transported to the laboratory as outlined in B3. The COC and associated sample bags/bottles are submitted to laboratory analyst, with relinquishing and receiving personnel both signing and dating the COC.

Laboratory Data

Once the samples are received at Vernon, samples are logged and stored as described in Table B2.1 until processed. The COC will be checked for number of samples, proper and exact I.D. number, signatures, dates, and type of analysis specified. If any discrepancy is found, proper corrections will be made. All COC and analytical data will be manually entered into Ana-Lab's laboratory information management system (LIMS). The LIMS files are backed up weekly on a redundant server system. Data manually entered in the LIMS system are reviewed for accuracy to ensure that there are no transcription errors. Electronic copies of data and scanned images of original data sheets are housed in the individual laboratories for a period of five years following the conclusion of the project. Any COC's and analysis records related to QA/QC of lab procedures will be housed at the respective lab. All pertinent electronic data files will be backed up quarterly on an external hard drive and stored in separate area away from the computer. All electronic files will be archived upon completion of the project and stored with the final report for 5 years.

Data Validation

Following review of laboratory data, any data entry that is not representative of environmental conditions, because it was generated through poor field or laboratory practices, will not be submitted to the TSSWCB PM. This determination will be made by the Project Co-Leads, AgriLife QAO, TSSWCB QAO, and other personnel having direct experience with the data collection effort. This coordination is essential for the identification of valid data and the proper evaluation of that data. The validation will include the checks specified in Section D2.

Data Dissemination

At the conclusion of the project, AgriLife PM will provide the project electronic spreadsheet to the TSSWCB PM, along with the final report. The TSSWCB PM may elect to take possession of all project records. However, summaries of the data will be presented in the final report. AgriLife will deliver presentations to stakeholder meetings along with other venues to disseminate project findings as appropriate.

C1 ASSESSMENTS AND RESPONSE ACTIONS

Table C1.1 presents types of assessments and response actions for data collection activities applicable to the QAPP.

Table C1.1. Assessments and Response Actions

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring Oversight	Continuous	AgriLife	Monitoring of project status and records to ensure requirements are being fulfilled.	Report to TSSWCB in QPR.
Internal Monitoring Systems Audit of Program Subparticipants	Dates to be determined by the AgriLife	AgriLife	Field sampling, handling, and measurement; facility review; and data management as they relate to the project	45 days to respond in writing to the AgriLife. AgriLife will report problems to TSSWCB in QPR.
TSSWCB Monitoring Systems Audit	Dates to be determined by TSSWCB	TSSWCB	Field sampling, handling, and measurement; facility review; and data management as they relate to the project	45 days to respond in writing to TSSWCB to address corrective actions
Laboratory Inspections	Dates to be determined by TSSWCB	TSSWCB	Analytical and quality control procedures employed at project laboratories	45 days to respond in writing to TSSWCB to address corrective actions

Internal audits of data quality and staff performance to assure that work is being performed according to standards will be conducted by all entities. Audits will be documented and initialed by the pertinent Project Co-Lead, PM, or Director. If audits show that the work is not being performed according to standards, immediate corrective action will be implemented and documented.

The TSSWCB QAO (or designee) may conduct an audit of the field or technical systems activities for this project as needed. Each entity will have the responsibility for initiating and implementing response actions associated with findings identified during the on-site audit. Once the response actions have been implemented, the TSSWCB QAO (or designee) may perform a follow-up audit to verify and document that the response actions were implemented effectively. Records of audit findings and corrective actions are maintained by the TSSWCB PM and AgriLife I QAO. Corrective action documentation will be submitted to the TSSWCB PM with the QPR. If audit findings and corrective actions cannot be resolved, then the authority and responsibility for terminating work is specified in agreements or contracts between participating organizations.

Corrective Action Process for Deficiencies

Deficiencies are any deviation from the QAPP. Deficiencies may invalidate resulting data and may require corrective action. Corrective action may include for samples to be discarded and re-collected. Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff. It is the responsibility of each respective entity's PM, in consultation with the TWRI QAO, to ensure that the actions and resolutions to the problems are documented and that records are maintained in accordance with this QAPP. In addition, these actions and resolutions will be conveyed to the TSSWCB PM both verbally and in writing in the QPRs and by completion of a CAR. All deficiencies identified by each entity will trigger a corrective action plan.

Corrective Action Report

CARs should:

- Identify the problem, nonconformity, or undesirable situation
- Identify immediate remedial actions if possible
- Identify the underlying cause(s) of the problem
- Identify whether the problem is likely to recur, or occur in other areas
- Evaluate the need for Corrective Action
- Use problem-solving techniques to verify causes, determine solution, and develop an action plan
- Identify personnel responsible for action
- Establish timelines and provide a schedule
- Document the corrective action

The status of CARs will be included with QPRs. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TSSWCB immediately.

The PM of each respective entity is responsible for implementing and tracking corrective actions. Records of audit findings and corrective actions are maintained by the PM of each respective entity. Audit reports and corrective action documentation will be submitted to the TSSWCB with the QPR.

C2 REPORTS TO MANAGEMENT

Laboratory Data Reports

Laboratory data reports contain the results of all specified QC measures listed in section B5. This information is reviewed by the AgriLife QAO and compared to the pre-specified acceptance criteria to determine acceptability of data before forwarding to the AgriLife Project Lead. This information is available for inspection by the TSSWCB PM.

Reports to TSSWCB Project Management

Quarterly Progress Report – QPRs will be generated by the AgriLife PM and will note activities conducted in connection with the water quality monitoring program, items or areas identified as potential problems, and any variation or supplement to the QAPP.

Technical Report – A technical report will be generated by AgriLife and will describe the overall approach and findings of Phase 1 of the project.

Corrective Action Documentation – Records of all quality assurance audits and associated corrective actions will be submitted to the TSSWCB PM with the QPRs. CARs will be utilized when necessary (Appendix A) as described under Sections B3, B4, and B5 in the QAPP. Any situation which, if not corrected by the AgriLife PM, may have a serious effect on validity or integrity of the data, will be reported to the TSSWCB PM immediately verbally and followed up in writing. CARs that result in changes or variations from the QAPP will be made known to pertinent project personnel, documented in an update or amendment to the QAPP and distributed to personnel listed in Section A3. CARs will be maintained in an accessible location for reference at AgriLife.

Monitoring Systems Review Audit Report – Following any audit performed by the AgriLife Project Lead (or designee), a report of findings, recommendations, and responses are sent to the TSSWCB PM in the QPR.

D1 DATA REVIEW, VERIFICATION, AND VALIDATION

Data verification is a systematic process for evaluating performance and compliance of a set of data to determine its completeness, correctness, and consistency using the methods and criteria defined in the AgriLife QAO, and this QAPP. Validation refers to those processes taken independently of the data-generation processes to evaluate the technical utility of the verified data with respect to the planned project objectives. Validation provides an overall level of confidence in the reporting of the data based on the methods used.

All data obtained from field and laboratory measurements will be reviewed and verified for conformance to project requirements, and then validated against the data quality objectives which are listed in Section A7. Only those data which are supported by appropriate quality control data and meet the data quality objectives defined for this project will be considered acceptable. This data will be submitted to the TSSWCB.

The procedures for verification and validation of data are described in Section D2. The AgriLife PM is responsible for ensuring that field data are properly reviewed and verified for integrity. The AgriLife Project Lead is responsible for ensuring that laboratory data are scientifically valid, defensible, of acceptable precision and bias, and reviewed for integrity. The AgriLife Data Manager will be responsible for ensuring that all data are properly reviewed, verified, and submitted in the required format to the project database. The AgriLife QAO is responsible for validating a minimum of 10% of the data produced in each task. Finally, the AgriLife PM, with the concurrence of the AgriLife QAO, is responsible for validating that all data to be reported meet the objectives of the project and are suitable for reporting to TCEQ.

D2 VERIFICATION AND VALIDATION METHODS

All field and laboratory data will be reviewed, verified, and validated to ensure they conform to project specifications and meet the conditions of end use as described in Section A7 of this document. Data review, verification, and validation will be performed using self-assessments and peer and management review as appropriate. The data review tasks to be performed include evaluation of:

- Sample documentation complete; samples labeled
- Field QC samples collected as prescribed in QAPP
- COC complete
- NELAP Accreditation current
- Holding times not exceeded
- Collection, preparation, and analysis consistent with QAPP
- Bacteriological records complete
- QC samples analyzed at required frequency
- QC results meet performance and program specifications
- Results, calculations, transcriptions checked
- Laboratory bench-level review performed
- All laboratory samples analyzed for all parameters
- Nonconforming activities documented
- Outliers confirmed and documented; reasonableness check performed
- Absence of transcription error confirmed
- Sampling and analytical data gaps checked
- Verified data log submitted
- 10% of data manually reviewed

Potential errors are identified by examination of documentation and by manual or computer-assisted examination of corollary or unreasonable data. If a question arises or an error is identified, the PM or personnel responsible for generating the data will work to resolve the issue. Issues, which can be corrected, are corrected and documented. If an issue cannot be corrected, the responsible party will consult with the AgriLife PM to establish the appropriate course of action, or the data associated with the issue are rejected and not reported to the TSSWCB PM. Field and laboratory reviews, verifications, and validations are documented.

After the field and laboratory data are reviewed, another level of review is performed once the data are combined into a dataset. This review step is performed by the PM. Data review, verification, and validation tasks to be performed on the dataset include, but are not limited to, the confirmation of laboratory and field data review, evaluation of field QC results, additional evaluation of anomalies and outliers, analysis of sampling and analytical gaps, and confirmation that all parameters and sampling sites are included in the QAPP.

Another element of the data validation process is consideration of any findings identified during the monitoring systems audit conducted by the TSSWCB PM. Any issues requiring corrective action must be addressed, and the potential impact of these issues on previously collected data will be assessed. After the data are reviewed and documented, the Project Lead, and PM validates that the data meet the data quality objectives of the project and are suitable for reporting to TSSWCB PM.

If any requirements or specifications of the QAPP are not met, based on any part of the data review, it will be documented and submitted to the TSSWCB PM with the data. This information is communicated to TSSWCB PM by AgriLife Project Lead in the Technical Report.

D3 RECONCILIATION WITH USER REQUIREMENTS

Data produced in this project will be analyzed and reconciled with project data quality requirements. Data meeting project requirements will be used by AgriLife and to evaluate pollutant loading reductions achieved by conservation practices.

APPENDIX A. CORRECTIVE ACTION REPORT

Corrective Action Report

CAR #:______________

Date:____________________ Area/Location:_____________________

Reported by:____________________ Activity:__________________________

State the nature of the problem, nonconformance, or out-of-control situation:

____
____
____
____
____

Possible causes:

____
____
____

Recommended corrective action:

____
____
____

CAR routed to:________________________________

Received by:__________________________________

Corrective Actions taken:

____
____
____
____

Has problem been corrected? YES NO

Immediate Supervisor:_______________________________

Project Leader:__________________________________

Quality Assurance Officer:___________________________

APPENDIX B. CHAIN-OF-CUSTODY FORM

Project: ***Integrated Crop/Livestock Systems***	**Remarks:** **Field to AgriLife Vernon Lab**
Name and signature of collector:	

Station ID	**Sample ID**	**Media Code**	**Sample Type**	**Preservative**	**Collection Date**	**Time**

Relinquished by Vernon Field Supervisor:	Date:	Time:	Received for Vernon lab by:	Date:	Time:
Laboratory Notes:					

APPENDIX C. BACTERIOLOGICAL DATA LOG SHEET

Bacteriological Data Log Sheet-Membrane Filter															
			Time					Colony Count			Temperature				
Sample Location	**Sample Date**	**Sampler Initials**	Collected	Filtered Incubator #1	Incubator #2	Counted	**Volume Filtered**	Colony Count X	100 mL vol. filtered	#/100 mL	Initial ©	Final ©	**Analyst Initials**	**Turbidity**	**Comments**

Flow depth | |
Estimated flow | |

20 NTU Turbidity Standard | |

APPENDIX D. ISCO® SAMPLER MAINTENANCE

ISCO Sampler Maintenance Sheet

Date
Time Site
Data Downloaded
Dessicant changed Y / N
Sampler Tube (not clogged/holding water) Y / N
Bubbler rate sec/bubble ____
Water Level (bubbler reading) ft ____
Water Level (actual reading) ft ____
Strainer Cleaned Y / N
Battery Voltage volts ____
Solar Panel Voltage output volts ____
Battery Load Test Good / Bad
Comments/Problems: ____

Date
Time Site
Data Downloaded
Dessicant changed Y / N
Sampler Tube (not clogged/holding water) Y / N
Bubbler rate sec/bubble ____
Water Level (bubbler reading) ft ____
Water Level (actual reading) ft ____
Strainer Cleaned Y / N
Battery Voltage volts ____
Solar Panel Voltage output volts ____
Battery Load Test Good / Bad
Comments/Problems: ____

Date
Time Site
Data Downloaded
Dessicant changed Y / N
Sampler Tube (not clogged/holding water) Y / N
Bubbler rate sec/bubble ____
Water Level (bubbler reading) ft ____
Water Level (actual reading) ft ____
Strainer Cleaned Y / N
Battery Voltage volts ____
Solar Panel Voltage output volts ____
Battery Load Test Good / Bad
Comments/Problems: ____

Date
Time Site
Data Downloaded
Dessicant changed Y / N
Sampler Tube (not clogged/holding water) Y / N
Bubbler rate sec/bubble ____
Water Level (bubbler reading) ft ____
Water Level (actual reading) ft ____
Strainer Cleaned Y / N
Battery Voltage volts ____
Solar Panel Voltage output volts ____
Battery Load Test Good / Bad
Comments/Problems: ____

Date
Time Site
Data Downloaded
Dessicant changed Y / N
Sampler Tube (not clogged/holding water) Y / N
Bubbler rate sec/bubble ____
Water Level (bubbler reading) ft ____
Water Level (actual reading) ft ____
Strainer Cleaned Y / N
Battery Voltage volts ____
Solar Panel Voltage output volts ____
Battery Load Test Good / Bad
Comments/Problems: ____

Date
Time Site
Data Downloaded
Dessicant changed Y / N
Sampler Tube (not clogged/holding water) Y / N
Bubbler rate sec/bubble ____
Water Level (bubbler reading) ft ____
Water Level (actual reading) ft ____
Strainer Cleaned Y / N
Battery Voltage volts ____
Solar Panel Voltage output volts ____
Battery Load Test Good / Bad
Comments/Problems: ____

APPENDIX E. DATA REVIEW CHECKLIST AND SUMMARY

DATA REVIEW CHECKLIST

QAPP Title: ____

Effective Date of QAPP: ____________________________

Data Format and Structure		**Y, N, or N/A**
A.	Are there any duplicate *Tag Id* numbers in the Events file?	
B.	Do the *Tag* prefixes correctly represent the entity providing the data?	
C.	Have any *Tag Id* numbers been used in previous data submissions?	
D.	Are TCEQ station location (SLOC) numbers assigned?	
E.	Are sampling *Dates* in the correct format, MM/DD/YYYY with leading zeros?	
F.	Are the sampling *Times* based on the 24 hour clock (e.g. 13:04) with leading zeros?	
G.	Is the *Comment* field filled in where appropriate (e.g. unusual occurrence, sampling problems, unrepresentative of ambient water quality)?	
H.	*Submitting Entity, Collecting Entity, and Monitoring Type* codes used correctly?	
I.	Are the sampling dates in the *Results* file the same as the one in the *Events* file for each Tag Id?	
J.	Are values represented by a valid parameter code with the correct units?	
K.	Are there any duplicate parameter codes for the same *Tag Id*?	
L.	Are there any invalid symbols in the *Greater Than/Less Than* (*GT/LT*) field?	
M.	Are there any *Tag Ids* in the *Results* file that are not in the *Events* file or vice versa?	
Data Quality Review		**Y, N, or N/A**
A.	Are all the “less-than” values reported at the LOQ? **If no, explain on next page**.	
B.	Have the outliers been verified and a "1" placed in the *Verify_flg* field?	
C.	Have checks on correctness of analysis or data reasonableness been performed?	
D.	Have at least 10% of the data in the data set been reviewed against the field and laboratory data sheets?	
E.	Are all parameter codes in the data set listed in the QAPP?	
F.	Are all stations in the data set listed in the QAPP?	
Documentation Review		**Y, N, or N/A**
A.	Are blank results acceptable as specified in the QAPP?	
B.	Were control charts used to determine the acceptability of field duplicates?	
C.	Was documentation of any unusual occurrences that may affect water quality included in the *Event* table’s *Comments* field?	
D.	Were there any failures in sampling methods and/or deviations from sample design requirements that resulted in unreportable data? **If yes, explain on next page**.	
E.	Were there any failures in field and/or laboratory measurement systems that were not resolvable and resulted in unreportable data? **If yes, explain on next page.**	
F.	Was the laboratory’s TNI Accreditation current for analysis conducted?	

Data Set Information

Data Source:

Date Submitted:

Tag_ID Range:

Date Range:

Comments:

Please explain in the space below any data discrepancies discovered during data review including:

- Inconsistencies with AWRL specifications or LOQs
- Failures in sampling methods and/or laboratory procedures that resulted in data that could not be reported to the TCEQ
- Include completed Corrective Action Reports with the applicable Progress Report

□ I certify that all data in this data set meets the requirements specified in Texas Water Code Chapter 5, Subchapter R (TWC §5.801 et seq) and Title 30 Texas Administrative Code Chapter 25, Subchapters A & B.

□ This data set has been reviewed using the Data Review Checklist.

AgriLife Data Manager:

Date:

APPENDIX F. RUNOFF WATER QUALITY DATA COLLECTION SOP

ISCO Sample Collection SOP

During/after every runoff event:

a. Retrieve sample bottle from ISCO® at all field and farm outlets **within 24 hr of the first sample**
b. Shake the 5 gal storm bottle and **immediately** fill five sample bottles and one 200 mL Whirl-Pak (Label: **Study Number, site ID #, date(mm/dd/yyyy)**).
c. Insert clean sample bottle into ISCO® and reset for next event
d. Transport all samples in ice to Ana-Lab.

Maintenance equipment check (minimum monthly for all sites)

a. Check ISCO® sampler

ix. Sampler tube (not clogged or holding water)
x. Stage Adjustment +/- ___ft
xi. Dessicant strength OK
xii. Download data
xiii. Solar panel output _____ v
xiv. Battery under load _____ v
xv. Pump test
xvi. Mow/weed eat (as needed); remove debris if present
ii. Twice annual test bubble flow meter