Clean Water Act §319(h) Nonpoint Source Grant Program

Water Quality Monitoring in the Buck Creek Watershed and Facilitation of Buck Creek Watershed Partnership

TSSWCB Project # 10-06

Quality Assurance Project Plan

Texas State Soil and Water Conservation Board

Revision 1

prepared by

Texas AgriLife Research - Texas Water Resources Institute
Texas AgriLife Research and Extension Center at Vernon

Effective Period: upon approval thru April 30, 2013

Questions concerning this quality assurance project plan should be directed to:

Lucas Gregory
TWRI Quality Assurance Officer
lfgregory@ag.tamu.edu

-or-

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Section A1: Approval Sheet

Water Quality Monitoring in the Buck Creek Watershed and Facilitation of Buck Creek Watershed Partnership

United States Environmental Protection Agency (USEPA), Region VI

Name: Curry Jones
Title: USEPA Chief State/Tribal Programs Section

Signature: _____ Date:_____

Name: Henry Brewer
Title: USEPA Texas Nonpoint Source Project Officer

Signature: _____ Date:_____

Texas State Soil and Water Conservation Board (TSSWCB)

Name: Mitch Conine
Title: TSSWCB Project Manager (PM)

Signature: _____ Date:_____

Name: Pamela Casebolt
Title: TSSWCB Quality Assurance Officer (QAO)

Signature: _____ Date:_____

Texas AgriLife Research and Extension Center at Vernon (AgriLife Vernon)

Name: Paul DeLaune, Ph.D.
Title: Assistant Professor; Project Co-Leader

Signature: _____ Date:_____

Texas AgriLife Research - Texas Water Resources Institute (TWRI)

Name: Kevin Wagner
Title: TWRI, Associate Director; Project Co-Leader

Signature: _____ Date:_____

Name: Lucas Gregory
Title: TWRI Project Manager & QAO

Signature: _____ Date:_____

Section A2: Table of Contents

List of Tables

List of Figures

List of Acronyms and Abbreviations

AgriLife Vernon	Texas AgriLife Research and Extension Center at Vernon
AWRL	Ambient Water Reporting Limit
BMPs	best management practices
CAR	corrective action report
CR	county road
CFU	colony forming units of bacteria
COC	chain of custody
CRP	Texas Clean Rivers Program
CWA	Clean Water Act
DO	dissolved oxygen
DQO	data quality objectives
E. coli	Escherichia coli
FM	Farm to Market Road
GPS	global positioning system
mTEC	membrane Thermotolerant *E. coli*
NELAC	National Environmental Laboratory Accreditation Conference
NIST	National Institute of Standards and Technology
NPS	nonpoint source
PM	project manager
QA	quality assurance
QAO	quality assurance officer
QAPP	quality assurance project plan
QC	quality control
QPR	quarterly progress report
RPD	relative percent deviation
RRA	Red River Authority of Texas
SH	state highway
SM	Standard Methods for the Examination of Water and Wastewater
SOP	Standard Operating Procedure
SWCD	Soil and Water Conservation District
TCEQ	Texas Commission on Environmental Quality
TMDL	total maximum daily load
TSSWCB	Texas State Soil and Water Conservation Board
TWQI	Texas Water Quality Inventory
TWRI	Texas Water Resources Institute
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UV	ultraviolet light
WPP	Watershed Protection Plan

Section A3: Distribution List

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

United States Environmental Protection Agency, Region VI

6WQ-AT
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

Name: Curry Jones
Title: USEPA Chief State/Tribal Programs Section

Name: Henry Brewer
Title: USEPA Texas Nonpoint Source Project Officer

Texas State Soil and Water Conservation Board

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Name: Mitch Conine
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Name: Pamela Casebolt
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1500 Research Parkway, Suite 110
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Name: Kevin Wagner
Title: TWRI Associate Director; Project Coordinator

Name: Lucas Gregory
Title: TWRI Project Manager & QAO

Texas AgriLife Research and Extension Center at Vernon

PO Box 1658
Vernon, TX 76385

Name: Paul DeLaune, Ph.D.
Title: Assistant Professor; Project Co-Leader

Section A4: Project/Task Organization

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

USEPA – Provides project oversight and funding at the federal level.

Henry Brewer, USEPA Texas Nonpoint Source Project Officer
Responsible for overall performance and direction of the project at the federal level. Ensures that the project assists in achieving the goals of the clean water act (CWA). Reviews and approves the quality assurance project plan (QAPP), project progress, and deliverables.

TSSWCB – Provides project oversight and funding at the state level.

Mitch Conine, TSSWCB PM
Responsible for ensuring that the project delivers data of known quality, quantity, and type on schedule to achieve project objectives. Tracks and reviews deliverables to ensure that tasks in the workplan are completed as specified.

Pamela Casebolt, TSSWCB QAO
Reviews and approves the QAPP and any amendments or revisions and ensures distribution of approved/revised QAPPs to TSSWCB and USEPA participants. Responsible for verifying that the QAPP is followed by project participants. Determines that the project meets the requirements for planning, quality assurance/quality control (QA/QC), and reporting. Monitors implementation of corrective actions. Coordinates or conducts audits of field and laboratory systems and procedures.

TWRI – Provides the primary point of contact between the TSSWCB and the project contractors. Tracks and reviews deliverables to ensure that tasks in the workplan are completed as specified. Responsible for coordination, review, and delivery of quarterly project reports (QPRs) and the watershed protection plan (WPP). Responsible for maintaining and updating the Buck Creek web site.

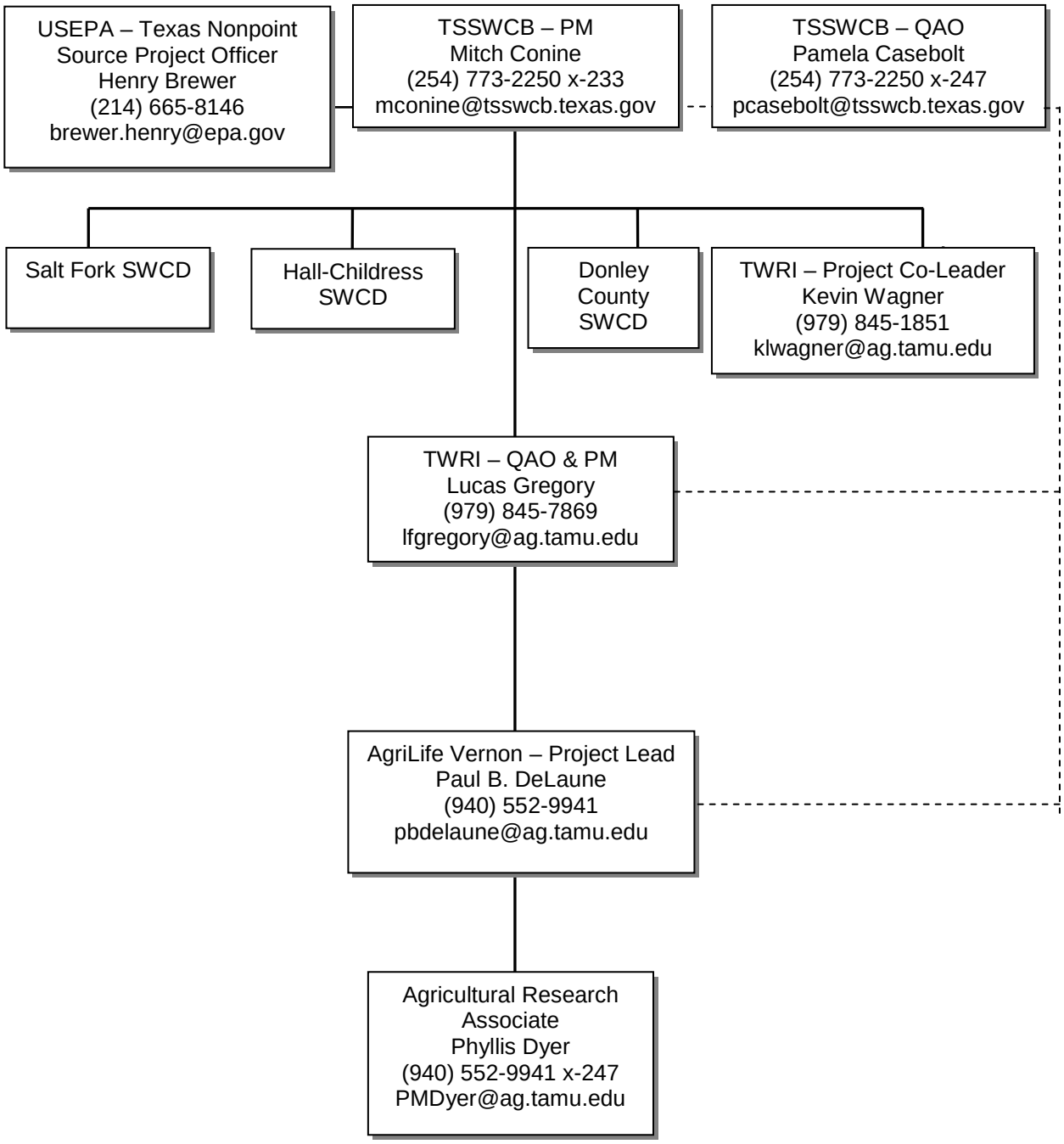
Kevin Wagner, TWRI Associate Director; Project Co-Leader
Responsible for ensuring that tasks and other requirements in the contract are executed on time and as defined by the grant workplan; assessing the quality of work by participants; submitting accurate and timely deliverables and costs to the TSSWCB; and coordinating attendance at conference calls, meetings, and related project activities.

Lucas Gregory, TWRI Project Manager & QAO
Responsible for determining that the QAPP meets the requirements for planning, QA/QC, and reporting activities conducted by TWRI.

AgriLife Vernon – Responsible for collection of ambient and storm water samples. Responsible for data analysis. Responsible for the processing and enumeration of *E. coli* for water body assessment purposes. AgriLife Vernon will contribute to the development of QPRs.

Dr. Paul B. DeLaune, Assistant Professor; Project Co-Leader
Responsible for coordinating and supervising field sampling activities. Responsible for ensuring that field personnel have adequate training, equipment, and a thorough knowledge of standard operation procedures (SOPs) specific to the analysis or task performed and/or supervised. Responsible for ensuring that 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 workplan and in the QAPP. Responsible for verifying that the data produced are of known and acceptable quality. Responsible for ensuring adequate training and supervision of all activities involved in generating analytical data for this project. Responsible for news releases, public presentations, and publications including accuracy of data disseminated concerning ongoing activities in the Buck Creek watershed. Responsible for the facilitation of audits and the implementation, documentation, verification, and reporting of corrective actions. Responsible for submitting accurate and timely data analyses and other materials for QPRs and final reports to TWRI.

Figure A.4-1. Project Organization Chart



Section A5: Problem Definition/Background

Buck Creek (Segment 0207A) is a small, unclassified waterbody situated within the Red River Basin of Texas and joins with the Lower Prairie Dog Town Fork of the Red River (Segment 207) to form the Red River above Pease River (Segment 0206). This stream segment is located within Ecoregion 27, the Central Great Plains. Small streams within this region are typically characterized by widely varying flows and high levels of dissolved salts, generally originating from saltwater seeps and springs. Buck Creek is situated within a rural, agricultural landscape in the southeastern portion of the Texas panhandle.

Land use in the watershed is predominantly row crops and grasslands. Rainfall averages approximately 21 inches annually. During periods of rainfall, bacteria [*fecal coliform* (*E. coli*, specifically)] originating from aquatic birds, wildlife, livestock, inadequately treated sewage, and/or failing septic systems may be washed into the streams and can be measured well after a rain event has occurred. These organisms are normally found in wastes of warm-blooded animals and are generally not harmful to human health, but may indicate the presence of pathogens that can cause disease.

The State of Texas currently requires that water quality in Buck Creek be suitable for fishing, swimming, wading and a healthy aquatic ecosystem. However, data evaluated by TCEQ from periodic water quality monitoring indicates that bacteria levels are sometimes elevated in the creek. As a result, Buck Creek was initially placed on the *Texas 303(d) List* in 2000 and has remained on this list through its most recent iteration, the *2008 303(d) List.* Although these data points provide an indicator of a potential water quality problem, the data do not provide conclusive evidence of persistent impairment; rather, it suggests a temporal recurring phenomenon.

As TSSWCB is the lead agency for the State of Texas in abating agricultural NPS pollution, the TSSWCB took the lead in Buck Creek, working closely with the Hall-Childress, Donley County, and Salt Fork SWCDs, RRA, TWRI, AgriLife Vernon and the Texas AgriLife Extension Service. Initially, TSSWCB funded the *Bacterial Monitoring for the Buck Creek Watershed* (TSSWCB Project 03-07) to verify the impairment and assess the levels of *E. coli* throughout the watershed. Through this project and beginning in May 2004, AgriLife Vernon collected data twice-monthly at 15 sampling sites throughout the watershed. Data collected did indicate that *E. coli* levels were periodically elevated, thus warranting the development of a WPP for Buck Creek. At the conclusion of that project, data collected were submitted to TCEQ for inclusion in the SWQMIS for use in the assessment for the *Texas Water Quality Inventory and 303(d) List.*

Therefore, the TSSWCB funded project 06-11 entitled "*Watershed Protection Plan Development for Buck Creek*". Data collection continued through this project at 7 of the original 15 sites and bacterial source tracking was added to gain further knowledge of sources contributing to the *E. coli* loading in Buck Creek. Water samples were also collected for nitrate analysis during that project as a nitrate concern was included in the *2006 TWQI.* This continued data collection further verified that periodic elevations of *E. coli* levels continue to exist. Currently, the Buck Creek WPP is under development and should be completed by the end of calendar year 2010. As

the WPP has not yet been completed and reviewed for consistency with the 9 elements, it is anticipated that WPP implementation funding through Clean Water Act §319(h) nonpoint source grants will not be requested until the FY2011 funding cycle at the earliest. Therefore, this would result in a lapse in data collection efforts resulting in at least a 1, if not 2, year gap in water quality data.

As a result, this 2-year project is warranted to provide for interim water quality data collection efforts. Maintaining an effective monitoring program will provide critical water quality data that will be used to judge the effectiveness of WPP implementation efforts and serve as a tool to quantitatively measure water quality restoration. This effort will continue stakeholder engagement through semi-annual newsletters, maintaining the project website, and hosting 2 annual stakeholder meetings. Continuing these efforts is critical to effectively bridging the gap between projects that developed the Buck Creek WPP and actually beginning WPP implementation efforts.

Section A6: Project/Task Description

General Project Description

This project provides for water quality monitoring in the Buck Creek watershed between the time that the Buck Creek WPP is developed and substantial WPP implementation begins.

TWRI will coordinate the development of a QAPP that outlines QA procedures and protocols for field sampling and lab analysis that is consistent with *EPA Requirements for Quality Assurance Project Plans (QA/R-5)* and the *TSSWCB Environmental Data Quality Management Plan.*

AgriLife Vernon will conduct monthly and biased flow (stormflow influenced flow) sampling at Sites 3, 5, 6, 10A, 10C, 11, and 13 (see Figure A6.1 and Table A6.1). This subset of sampling sites was selected for multiple reasons including funding limitations, spatial distribution throughout the watershed and because of the lack of water at several of the original sample sites. Over the course of a previous 3-year watershed assessment project (TSSWCB 03-07), sites 1 and 9 yielded 0 samples, site 2 yielded only 7 and site 8 yielded only 5 samples. Sites 10B and 12 were excluded due to their proximity to other sites. Samples will be collected for *E. coli* enumeration and nitrate analysis at AgriLife Vernon. Stream flow will be recorded in conjunction with water sample collection. AgriLife Vernon will also collect field parameters including temperature, specific conductance, pH and dissolved oxygen levels. All data will be submitted to TSSWCB for inclusion into SWQMIS for future water quality assessments. AgriLife Vernon will develop a narrative data summary.

TWRI will also oversee the development and distribution of 4 semi-annual newsletters and ensure that the project website is kept up-to-date. TWRI and AgriLife Vernon will host and facilitate meetings of the Buck Creek stakeholders at a minimum of once annually for a total of 2 planned meetings. These meetings will be held to provide updates on the status of monitoring efforts, progress in identifying implementation funding, and movement towards water quality restoration.

Water Quality Data Collection and Analysis

AgriLife Vernon will conduct routine water quality monitoring collecting water samples, field parameters (DO, pH, temperature, specific conductance) and streamflow. Samples will be collected once monthly from 7 sampling sites in the Buck Creek watershed (Sites 3, 5, 6, 10A, 10C, 11, and 13). Total number of samples budgeted for collection through this subtask is 126; however, the number actually collected will likely be lower due to the ephemeral nature of the creek.

AgriLife Vernon will conduct biased flow water quality monitoring following 6 storm events and will collect water samples for bacterial enumeration and nitrate level assessments, field parameters (DO, pH, temperature, specific conductance) and streamflow rates. Samples will be collected from the 7 sampling sites monitored in the Buck Creek watershed as designated above.

Total number of samples budgeted for collection through this subtask is 42. Due to the rapid rise and fall of Buck Creek and the lack of automated streamflow monitoring, first-hand landowner knowledge is used as a gauge to determine when biased flow will be collected. When rain is expected or radar data indicate rainfall, a series of 3 landowners on Buck Creek are contacted to glean first-hand information. The typical thresholds used to trigger a biased flow sampling event are at least 1 inch of rainfall and/or noted increases in streamflow by landowners. Biased flow sampling is typically conducted after the rain event has subsided and any danger to the sampling crew has subsided. This is typically within 48 hours of the end of the event.

AgriLife Vernon will enumerate *E. coli* colonies in water samples collected in subtasks 3.1 and 3.2 using EPA Method 1603. *E. coli* counts will be recorded electronically and in hard copy format.

AgriLife Vernon will assess nitrate levels in water samples collected in subtasks 3.1 and 3.2 using EPA Method 353.2. Nitrate concentrations will be recorded electronically and in hard copy format.

AgriLife Vernon will record and store all water quality data in electronic and hard copy formats. TWRI will transfer quarterly monitoring data from activities in Task 3 to TSSWCB for inclusion in TCEQ SWQMIS. Data will be transferred in the correct format using the TCEQ file structure, along with a completed Data Summary, as described in the most recent version of TCEQ *Surface Water Quality Monitoring Data Management Reference Guide*. Data Correction Request Forms will be submitted to TSSWCB whenever errors are discovered in data already reported. TWRI will also provide necessary information on this monitoring regime to RRA for inclusion in the Coordinated Monitoring Schedule

Figure A.6-1. Buck Creek Sampling Site Map

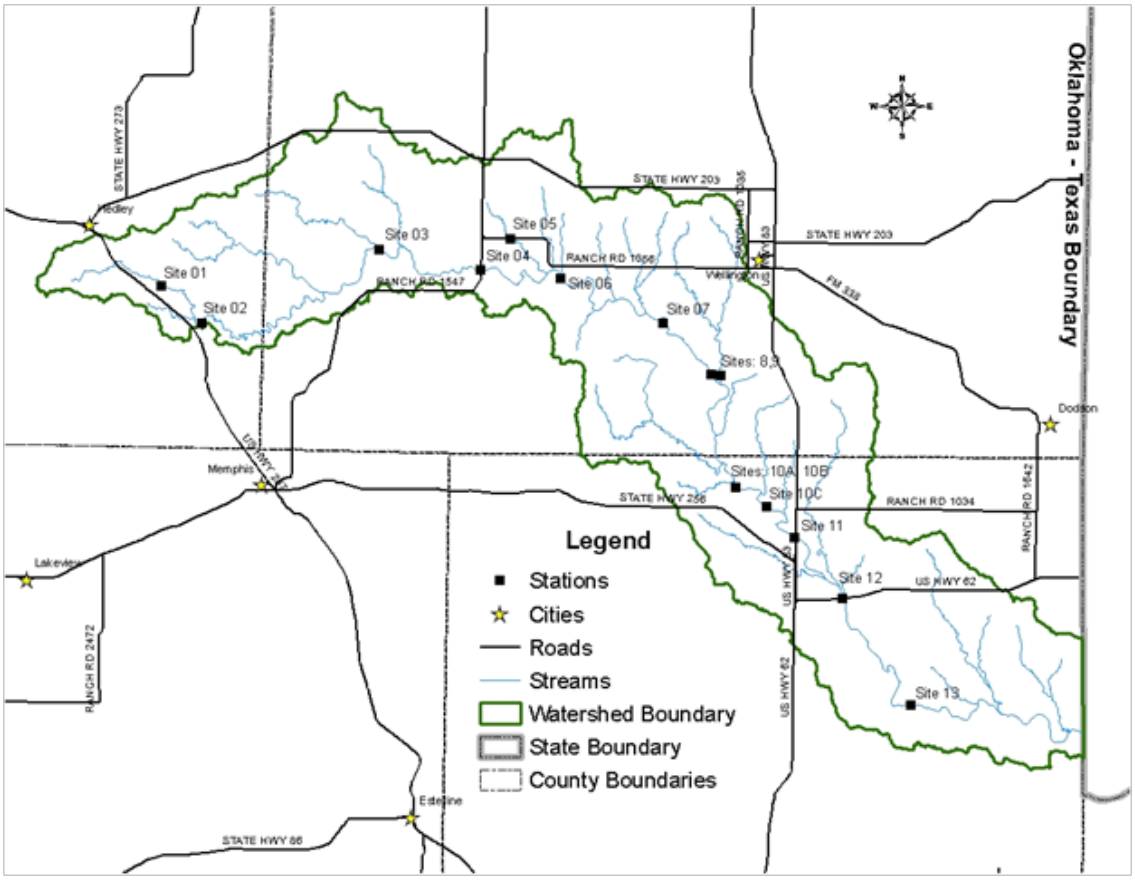


Table A.6-1. Quality Assured Project Plan Milestones

TASK	PROJECT MILESTONES	AGENCY	START	END
2.1	Develop DQOs and QAPP for review by USEPA.	AgriLife Vernon, TWRI	M1	M3
2.2	Approve QAPP.	TSSWCB & USEPA	M4	M30
3.1	AgriLife Vernon will perform routine monthly sampling (grab sampling) at Sites 3, 5, 6, 10a, 10c, 11, 13 on Buck Creek	AgriLife Vernon	M4	M30
3.2	Collect 6 biased flow samples at Sites 3, 5, 6, 10a, 10c, 11, 13 on Buck Creek	AgriLife Vernon	M4	M30
3.3	Enumerate *E. coli* collected in tasks 3.1/3.2 using EPA Method 1603	AgriLife Vernon	M4	M30
3.4	Assess nitrates in samples collected in tasks 31/3.2 using EPA Method 353.2	AgriLife Vernon	M4	M30
3.5	Record data electronically and submit to TSSWCB quarterly for inclusion in TCEQ SWQMIS	AgriLife Vernon, TWRI	M4	M30

Section A7: Quality Objectives and Criteria for Data Quality

The objective of this section is to ensure that data collected meets the data quality objectives (DQOs) of the project. One objective is to identify areas of elevated bacteria and nitrates loadings in Buck Creek. A second objective is to monitor micro-watersheds through data collection and analysis, and provide data to inform SWCD's, stakeholder committee, and landowners of any potential or existing water quality issues and/or problems. Achievement of these objectives will support decisions for implementation of appropriate best management practices (BMPs) in order to reduce fecal bacteria levels in the Buck Creek watershed to comply with existing water quality standards.

Following are actions that will be undertaken by this project to assess bacterial pollution within Buck Creek Watershed:

- Routine ambient and stormwater monitoring will be conducted to asses water quality as related to bacterial and nitrate pollution in Buck Creek by in-stream water sampling

Routine ambient monitoring as well as stormwater monitoring will meet the as DQOs listed above by providing critical information about the spatial and temporal variation in bacteria and nitrate levels in Buck Creek during baseflow and storm flow conditions. These data will provide continued water quality data that clearly indicate whether overland flow or direct deposition/bacteria growth instream are the driving factors influencing monitored bacteria levels. Nitrate loadings will also be elucidated in this same manner illustrating whether overland flow during and after storm events is the primary source of nitrate loading to the stream or if direct contributions through groundwater/surface water interactions are the more dominant factor.

The measurement performance criteria to support the project objective are specified in Table A.7-1.

When sufficient flow (above 7Q2 or 0.1 cfs) is present, routine grab samples will be collected on a monthly basis. During routine sampling, measurements of dissolved oxygen (DO), conductivity, pH, salinity, stream flow, and water temperature will be obtained *in situ*. Water samples will be analyzed for *E. coli* and nitrates.

Table A.7-1. Data Quality Objectives for Measurement Data

NA = Not applicable; mg/L = milligrams per liter; col = colonies; mL = milliliters; m/s = meters per second; µS/cm = microsiemens per centimeter; ft = feet; m = meters; °C = degrees Celsius

Parameter	Units	Method Type	Method	Method Description	Parameter Code	AWRL[1]	Precision of Laboratory Duplicates	Accuracy[2]	Precision (RPD of LCS/ LCSD)	Percent Complete[3]
Field Parameters:										
Days Since Last Significant Precipitation	Days	Observation	TCEQ SOP V-1	Field observation	72053	NA	NA	NA	NA	90
Flow Severity	1-no flow 2-low 3-normal 4-flood 5-high 6-dry	Visual Observation	TCEQ SOP V-1	Field observation	01351	NA	NA	NA	NA	90
Flow	cfs	Handheld meter	TCEQ SOP V-1	Automated Instrument	00061	NA	NA	NA	NA	90
Flow Method	1-gage 2-electric 3-mechanical 4-weir/flume 5-Doppler	Handheld meter	TCEQ SOP V-1	Automated Instrument and Calculation	89835	NA	NA	NA	NA	90
Water Level	m	Manual measurement	USGS	Meter stick	NA	NA	NA	NA	NA	90
Water Temperature	˚C	Handheld meter	USEPA 170.2	Automated Instrument	00020	0.2	NA	±0.25	NA	90
Specific Conductance	µS/cm	Handheld meter	SM 2510-B	Automated Instrument	00094	20 µS/cm	NA	±2% of range	NA	90
Dissolved Oxygen	mg/L (ppm)	Handheld meter	USEPA 360.1	Automated Instrument	00300	2.0	NA	±0.2	NA	90
pH	pH units	Handheld meter	USEPA 150.1	Automated Instrument	00400	0.2	NA	±0.2	NA	90

Table A.7-1. continued

Parameter	Units	Method Type	Method	Method Description	Parameter Code	AWRL [1]	Precision of Laboratory Duplicates	Accuracy [2]	Precision (RPD of LCS/ LCSD)	Percent Complete [3]
Lab Parameters:										
Salinity	ppt	Handheld meter	SM 2520-B	Automated Instrument	00480	0.01 ppt	NA	±0.01	NA	90
Nitrate/nitrite – N, total	mg/L	Colorimetric	USEPA 353.2	Automated Instrument	00630	.05	NA	NA	20	90
E. coli in water	CFU/ 100 mL	Membrane filter culture on modified mTEC agar	USEPA 1603	Membrane Filter	31648	1	3.27* ΣRlog/n	NA	NA	90

[1] minimum detection limits for field parameters represent manufacturer specifications and will be used for the AWRL in this instance.
[2] Manufacturer specifications are presented for accuracy limits and method detection limits for field parameters.
[3] The objective is for 90% of the data to be collected.

Ambient Water Reporting Limits (AWRLs)
The AWRL establishes the reporting specification at or below which data for a parameter must be reported based on given freshwater screening criteria. The AWRLs specified in Table A7.1 are the program-defined reporting specifications for each analyte and yield data of acceptable quality for assessment.

Precision
The precision of laboratory data is a measure of the reproducibility of a result from repeated analyses. It is strictly defined as a measure of the closeness with which multiple analyses of a given sample agree with each other. Precision is assessed by repeated analyses of a sample. For quantitative microbiological analyses, the method to be used for calculating precision is the one outlined in *Standard Methods for the Examination of Water and Wastewater,* 21st Edition, section 9020 B.8.b.

$$RPD_{bacteria} = (\log X_1 - \log X_2)$$

The relative percent deviation (RPD) $_{bacteria}$ should be lower than 3.27 ΣRlog/n, where Rlog is the difference in the natural log of duplicates for the first 15 positive samples.

Field splits are used to assess the variability of sample handling, preservation, and storage, as well as the analytical process, and are prepared by splitting samples in the field. Control limits for field splits are defined in Section B5.

Accuracy
Accuracy is a statistical measurement of correctness and includes components of systemic error. A measurement is considered accurate when the result reported does not differ from the true situation. Performance limits for all measured parameters are specified in Table A.7-1.

An additional element of accuracy is the absence of contamination. This is determined through the analysis of field blank samples of sterile water taken to the field and processed in a manner identical to the sample. Requirements for field blank samples are discussed in Section B5.

Bias
Bias is a statistical measurement of correctness and includes multiple components of systematic 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 prepared with verified and known amounts of all target analytes in the sample matrix and by calculating percent recover. Results are compared against measurement performance specifications and used during evaluation of analytical performance.

Sensitivity
Sensitivity is a measure that is used to determine a method's detection limits. The detection limit of quantitative methods is defined as the minimum concentration of a substance that can be measured with a given level of confidence that the analyte concentration is greater than zero (*QA/QC Guidance for Laboratories Performing PCR Analyses on Environmental Samples* USEPA, 2004). For presence/absence methods, the detection limits the minimum concentration

of analyte that produces a positive response with a given level of confidence. The detection limits can be expressed as the minimum number of organisms or of the target sequence copy number in a given volume. Many uncertainties can affect the detection limit; some are:

- The matrix from which the organism is located
- The detection of microbes that are inactivated by physical and chemical disinfectants

Representativeness

Data collected under this project will be considered representative of ambient water quality conditions. Representativeness is a measure of how accurately a monitoring program reflects the actual water quality conditions typical of a receiving water. 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 procedures will assure that the measurement data represent the conditions at the site. The goal for meeting total representation of the water body and watershed is tempered by the availability of time, site accessibility, and funding. Representativeness will be measured with the completion of sample collection in accordance with the approved QAPP.

Comparability

The comparability of the data produced is predetermined by the commitment of the staff to use only approved QA/QC procedures as described in this QAPP. Comparability is also guaranteed by reporting all ambient, high flow, and QC data for evaluation by others by reporting data in standard units.

Completeness

The completeness of the data is a measure of how much of the data is available for use compared with the total potential data. Ideally, 100% of the data would be available. However, the possibility of unavailable data due to accidents, weather, 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. Should less than 90% data completeness occur, the TWRI PM will initiate corrective action. Data completeness will be calculated as a percent value and evaluated with the following formula:

% completeness = (SV X 100) / ST

Where: SV = number of samples with a valid analytical report
ST = total number of samples collected

Section A8: Special Training Requirements/Certifications

All personnel involved in sampling, sample analyses, and statistical analyses have received the appropriate education and training required to adequately perform their duties. No special certifications are required. AgriLife Vernon personnel involved in this project have been trained in the appropriate use of field equipment, laboratory equipment, laboratory safety, cryogenics safety, and all applicable SOPs.

The AgriLife Vernon laboratory is accredited by National Environmental Laboratory Accreditation Conference (NELAC) and certified for USEPA method 1603. This method is a quantitative method used to analyze *E. coli* and yields a direct count of bacteria in water based on the development of bacteria colonies that grow on the surface of the membrane filter. This method consists of filtering a water sample thru a membrane that retains the bacteria, placing the membrane on a modified mTEC agar, incubated at 35±0.5°C for 2 hours to resuscitate the injured or stressed bacteria, and then incubated at 44.5±0.2°C for 22 hours. This modified method eliminates the transfer of the membrane filter to another substrate. The target colonies on modified mTEC agar are red or magenta in color after the incubation period.

As a part of the NELAC approval process, the AgriLife Vernon Lab had to select a stand-alone name for their facility. The name selected is the “Texas AgriLife Research Vernon Water Quality Laboratory.”

Section A9: Documentation and Records

Hard copies of general maintenance records, all field data sheets, COC forms, laboratory data entry sheets, calibration logs, and corrective action reports (CARs) will be archived by each laboratory for at least five years. In addition, AgriLife Vernon will archive electronic forms of all project data for at least five years. All electronic data are backed up on an external hard drive monthly, compact disks weekly, and is simultaneously saved in an external network folder and the computer's hard drive. A blank CAR form is presented in Appendix A, a blank COC form is presented in Appendix B, and blank field data reporting forms are presented in Appendix C.

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. 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.

The TSSWCB may elect to take possession of records at the conclusion of the specified retention period.

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 station 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 nonconformances; improve operational efficiency; and/or accommodate unique or unanticipated circumstances; Written requests for amendments are directed from the TWRI Project Leader or designee 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 TWRI Project Leader or designee. Amendments shall be reviewed, approved, and incorporated into a revised QAPP during the annual revision process.

Section B1: Sampling Process Design (Experimental Design)

One main goal of this project is to continue engaging the stakeholder group that has participated in the development of the WPP for the Buck Creek watershed. The other primary goal of this project is to continue monitoring subwatersheds through data collection and analysis, and provide data to inform SWCDs and landowners of any potential or existing water quality issues and/or problems. In addition, water samples will be analyzed to determine the spatial and temporal distribution of bacteria entering the stream. This information will be instrumental in providing a baseline of data for monitoring the success of future BMP implementation in the watershed following the completion of the WPP. Achievement of these objectives will support the goals and objectives outlined in the draft Buck Creek WPP as well as the requirements of Key Element I. The waterborne constituents that will be measured are shown in Table B1-1.

Table B1-1. Waterborne Constituents

Parameter	Status	Reporting Units
Laboratory Parameters		
Nitrates	Critical	milligrams per liter (mg/L)
Escherichia coli	Critical	cfu/100ml
Field Parameters		
Dissolved Oxygen	Non-critical	milligrams per liter (mg/L)
Potential Hydrogen (pH)	Non-critical	pH standard units
Specific Conductance	Non-critical	microsiemens per centimeter (µS/cm)
Water Temperature	Non-critical	degrees Celsius (°C)
Salinity	Non-critical	parts per thousand (ppt)
Water Level	Non-critical	Meters (m)
Flow	Critical	cubic feet per second (cfs)
Flow Severity	Critical	1-no flow, 2-low, 3-normal, 4-flood, 5-high, 6-dry

The sampling program is designed to characterize water quality of both base and high flow conditions in Buck Creek and its tributaries respectively through the collection of routine and biased flow samples. Water quality grab samples will be collected at monthly intervals for all constituents. Routine grab samples will be scheduled for collection on monthly basis but will only be taken if water is flowing at sampling sites. Sampling locations are described in Table B.1-2. Physical parameters that will be measured *in situ* during routine sampling and include flow rate, specific conductance, DO, pH, salinity, and water temperature. Sites that are dry or with pooled water will be noted on the field data sheet and not sampled. Water quality samples collected as part of the routine sampling schedule will be analyzed for bacteria and nitrates.

In order to obtain representative results, ambient water sampling will occur on a routine schedule over the course of 18 months, capturing dry and runoff-influenced events at their natural frequency. There will be no prejudice against rainfall or high flow events, except that the safety of the sampling crew will not be compromised in case of lightning or flooding; this is left up to the discretion of the sampling crew.

Storm water sampling will occur at the sampling sites listed in Table B.1-2, if accessible, during or after 6 separate rainfall events if they occur during that course of the project. Safety will be the primary concern when collecting these samples. If the research technician feels that their safety is in jeopardy, they will not collect samples. Should storm influenced flow be present during scheduled routine sampling events, data collected will be recorded as biased flow data. The stream will be allowed to return to baseflow conditions following this event and then then routine sample will be collected unless the next scheduled routine sampling event arrives first.

In the instance that a sampling (Table B.1-2.) site is inaccessible, no sample will be taken and will be documented in the field notebook. If, near the end of the study, the TSSWCB PM/QAO agrees that the sampling has not achieved good representativeness of typical conditions, the final sampling event(s) may be restricted to target a particular environmental condition (e.g., rainfall).

Table B.1-2. Buck Creek Sampling Site Locations

CR= County Road; FM= Farm to Market Road; SH= State Highway; Cnty= County; Lat=Latitude; Long= Longitude

Site	TCEQ Station ID	Subwatershed & General Location	° Lat.	North	° Long.	West
BC-03	20365	CR 40; Collingsworth Cnty	34	51' 25.47"	100	28' 00.93"
BC-05	20367	FM 1056; Collingsworth Cnty	34	51' 50.00"	100	22' 48.10"
BC-06	20368	CR 110; Collingsworth Cnty	34	50' 33.04"	100	20' 46.70"
BC-10A	20371	SH 256; Scrivner Ranch; Childress Cnty	34	43' 46.40"	100	13' 41.00"
BC-10C	20373	SH 256; Scrivner Ranch; Childress Cnty	34	43' 07.80"	100	12' 27.20"
BC-11	15811	US 83; Childress Cnty	34	42' 08.60"	100	11' 19.50"
BC-13	20376	CR 19; Chilldress Cnty	34	36' 39.90"	100	06' 39.40"

Lat. and Long. are reported in minutes (') and seconds(")

Section B2: Sampling Method Requirements

Water Samples

Typically, water samples will be collected directly from the stream (midway in the stream channel) into sterile wide-mouthed polypropylene bottles or bags. All sample containers will be labeled with the following information:

- collection date
- collection time
- sample location
- and sampler's initials

Care will be exercised to avoid the surface microlayer of water, which may be enriched with bacteria and not representative of the water column. In cases where, for safety reasons, it is inadvisable to enter the stream bed, and boat access is not practical, staff will use a clean bucket and rope from a bridge to collect the samples from the stream. If a bucket is used, care will be taken to avoid contaminating the sample. Specifically, technicians must exert care to ensure that the bucket and rope do not come into contact with the bridge. The bucket must be thoroughly rinsed between stations. Buckets are also to be sanitized between sampling stations with a bleach- or isopropyl alcohol-soaked wipe. The first bucketful of water collected from a bridge is used to rinse the bucket. Rinse water is not returned to the stream, but is instead disposed of away from the sampling site to ensure that the collected sample will not be affected by the bleach or alcohol residual. Samples are collected from subsequent buckets of water. This type of sampling will be noted in the field records.

Water temperature, stream flow, pH, specific conductivity, salinity, and DO will be measured and recorded *in situ* with a multiprobe whenever samples are collected. All field measurements will be conducted in accordance with the methods listed in Table B.4-1. Measurements will only be taken if water is flowing. If a site is not flowing but pooled or dry, that will be noted on the field data sheet. All samples will be transported in an iced container to the laboratory for analysis.

Table B.2-1. Container Types, Preservation Requirements, Temperature, Sample Size, and Holding Time Requirements.

Parameter	Matrix	Container	Preservation	Temperature	Sample Size	Holding Time
nitrates	water	sterile plastic container	acid	4°C	125 ml	28 days
E. coli	water	sterile plastic bag	none	4°C	125 ml	6 hours[1]

[1] 6 hours to deliver to laboratory. In the case that this 6-hour holding time is not met, the *E. coli* quantitative count will be flagged and not reported, though the *Bacteroidales* PCR will still be valid.

Documentation of Field Sampling Activities

Field sampling activities are documented on field data reporting forms as presented in Appendix C. Field observations (flow severity and days since last significant precipitation) are based on SOPs in the *TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue* (December 2003). All sample information will be logged into a field log. The following will be recorded for all water sampling:

- station ID
- location
- sampling time
- date
- water depth
- flow rate
- sample collector's name/signature

Detailed observational data are recorded including water appearance, weather, biological activity, stream uses, unusual odors, specific sample information, days since last significant rainfall, estimated hours since rainfall began (if applicable), and flow severity.

Recording Data

For the purposes of this section and subsequent sections, all field and laboratory personnel follow the basic rules for recording information as documented below:

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

Failures in Sampling Methods Requirements and/or Deviations from Sample Design and Corrective Action

Examples of failures in sampling methods and/or deviations from sample design requirements include but are not limited to such things as sample container problems, sample site considerations, etc. Failures or deviations from the QAPP are documented on the field data reporting form and reported to the AgriLife Vernon Project Leader. The AgriLife Vernon Project Leader will determine if the deviation from the QAPP compromises the validity of the resulting data. The AgriLife Vernon Project Leader, in consultation with the TSSWCB QAO will decide to accept or reject data associated with the sampling event, based on best professional judgment. The resolution of the situation will be reported to the TSSWCB in the QPR.

Section B3: Sample Handling and Custody Requirements

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 and inter-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. Sample numbers will then be recorded into a laboratory sample log, where the laboratory staff member who receives the sample will sign it. 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, samples will be placed on ice in an insulated cooler for transport to the laboratory. At the laboratory, samples will be placed in a refrigerated cooler dedicated to sample storage. The Laboratory Supervisor has the responsibility to ensure that holding times are met with water, nitrate and fecal 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 COC procedures are to be immediately reported to the TSSWCB PM. Failures 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 Project Leader and the TSSWCB PM/QAO will determine if the procedural violation may have compromised the validity of the resulting data. Any failure that potentially compromises data validity will invalidate data, and the sampling event should be repeated. The resolution of the situation will be reported to the TSSWCB in the QPR. The CARs will be maintained by the TSSWCB PM.

Section B4: Analytical Methods Requirements

E. coli in water samples will be isolated and enumerated by laboratory personnel using modified mTEC agar, USEPA Method 1603 (USEPA 2006). The modified mTEC method is a single-step method that uses one medium and does not require testing using any other substrate. The modified medium contains a chromogen, 5-bromo-6-chloro-3-indolyl-ß-D-glucuronide, which is catabolized to glucuronic acid and a red- or magenta-colored compound by *E. coli* that produce the enzyme ß-D-glucuronidase. This enzyme is the same enzyme tested for using the MUG substrate and UV fluorescence in other *E. coli* assays. A complete listing of methodology used to analyze water and fecal samples for bacteria is given in Appendix D.

All laboratory sampling areas and equipment will be sterilized with at least one or in any combination of the following methods--ethyl alcohol, bleach, UV light, or autoclave. All disposables will be placed in a heat-resistant biohazard bag and autoclaved prior to disposal.

Table B.4-1. Laboratory Analytical Methods

Parameter	Method	Equipment Used
Laboratory Parameters		
nitrates	USEPA 353.2	Skalar SAN++ Analyzer
Escherichia coli	USEPA 1603	Filtration apparatus, incubator
Field Parameters		
Dissolved Oxygen	USEPA 360.1	YSI Multiprobe
pH	USEPA 150.1	YSI Multiprobe
Specific Conductance	SM 2510 B	YSI Multiprobe
Salinity	SM2520 B	YSI Multiprobe
Water Temperature	USEPA 170.2	YSI Multiprobe
Flow Severity	TCEQ SOP V-1	Field observation
Flow	TCEQ SOP V-1	Global Water Flow Probe
Water level	USGS	Meter stick

USEPA = Methods for Chemical Analysis of Water and Wastes, March 1983
SM = Standard Methods for Examination of Water and Wastewater, 21st edition
SOP = Standard Operating Procedure
USGS = Techniques of Water Resources Investigations, Book 3, Chapter A8, 1980

Section B5: Quality Control Requirements

Table A.7-1 lists the required accuracy, precision, and completeness limits for the parameters of interest. It is the responsibility of the Project Leader to verify that the data are representative. The Project Leader also has the responsibility of determining that the 90 percent completeness criteria is met, or will justify acceptance of a lesser percentage. All incidents requiring corrective action will be documented through use of CARs (Appendix A). Laboratory audits, sampling site audits, and quality assurance of field sampling methods will be conducted by the TSSWCB QAO or their designee at least once per the life of the project.

Field Blanks

Field blanks consist of sterile distilled water that is taken to the field and transferred to the appropriate container in precisely the same manner as a field sample during the course of a sampling event. They are used to assess contamination from field sources such as airborne materials, carryover from prior sampling sites, and containers. A field blank should be included for each sampling event. The analysis of field blanks should yield a value of no colonies detected.

Laboratory Blanks

Laboratory blanks, or negative controls, consist of 100-ml aliquots of sterile distilled water that are processed in the same manner as a field sample, at the beginning and the end of a sample set. They are used to assess the sterilization techniques employed throughout the sample process. Laboratory blanks will be included at the beginning and the end of the sample set for each sampling event. The analysis of laboratory blanks should yield a value of no colonies detected. For *Bacteroidales* PCR, a laboratory blank will be analyzed with each batch of samples to ensure no cross-contamination occurs during sample processing. In addition, no template negative controls will be analyzed for each batch of ERIC and *Bacteroidales* PCR.

Matrix spikes (MS)

A matrix spike is an aliquot of sample spiked with a known concentration of the analyte of interest. Percent recovery of the known concentration of added analyte is used to assess accuracy of the analytical process. The spiking occurs prior to sample preparation and analysis. Matrix spike samples are routinely prepared and analyzed at a rate of 10% of samples processed or one per batch whichever is greater. The MS may be spiked at a level less than or equal to the midpoint of the calibration or analysis range for each analyte. The MS is used to document the accuracy of a method due to sample matrix and not to control the analytical process. Percent Recovery (%R) is defined as 100 times the observed concentration, minus the sample concentration, divided by the true concentration of the spike. MS recoveries are indicative of matrix-specific biases and are plotted on control charts maintained by the laboratory. Measurement performance specifications for matrix spikes are not specified in this document, and MS data should be evaluated on a case-by-case basis.

The formula used to calculate percent recovery, where %R is percent recovery; SSR is the observed spiked sample concentration; SR is the sample concentration; and, SA is the spike added; is:

$$\%R = (SSR - SR)/SA * 100$$

Positive Control

AgriLife Vernon will maintain live *E. coli* in tryptic soy broth and kept refrigerated until needed. Each time a set of samples is run a positive control will be performed in the lab using the same media and 1 ml of live *E. coli* which will be added to 99 ml of sterile distilled water that will be run through the filter funnel system and the filter placed on the media. This control should always be positive for *E. coli* after recommended incubation time. In addition, positive controls will be analyzed for each batch of *E. coli* ERIC-PCR and RiboPrinting, and *Bacteroidales* PCR.

Failures in Quality Control and Corrective Action

Notations of blank contamination will be noted in the QPR. Corrective action will involve identification of the possible cause (where possible) of the contamination failure. Any failure that has 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 in the QPR. CARs will be maintained by the Project Leader and the TSSWCB PM.

Section B6: Equipment Testing, Inspection, & Maintenance Requirements

To minimize downtime of all measurement systems, spare parts for field and laboratory equipment will be kept in the laboratory, and 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 and recommendation in Standard Methods for the Examination of Water and Wastewater, 21st Edition. Maintenance and inspection logs will be kept on each piece of laboratory equipment and general maintenance checklists will be filled out for field sampling equipment, by the field technician, prior to each sampling event.

Records of all tests, inspections, and maintenance will be maintained and log sheets kept showing time, date, and analyst signature. These records will be available for inspection by the TSSWCB.

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 in the QPR. CARs will be maintained by the Project Leader and the TSSWCB PM.

Table B.6-1. Equipment Inspection and Maintenance Requirements

Equipment	Relevant Testing, Inspection and Maintenance Requirement
D.O. meter	SM 9020 B 3.a
Conductivity meter	SM 2510 B 2.c
pH meter	SM 4500-H^+ B 2 b
Thermometers	SM 9020 B 3.a
Water deionization units	SM 9020 B 3.d
Media dispensing apparatus	SM 9020 B 3.f
Autoclaves	SM 9020 B 3.h
Refrigerator	SM 9020 B 3.i
Ultra Low Freezer	SM 9020 B 3.j
Membrane filter equipment	SM 9020 B 3.k
Ultraviolet sterilization lamps	SM 9020 B 3.l
Biological safety cabinet	SM 9020 B 3.m
Incubators	SM 9020 B 3.o
Glassware and plastic ware	SM 9020 B 4.a
Utensils and containers	SM 9020 B 4.b
Dilution water bottles	SM 9020 B 4.c
Flow Meter	Product Owner’s Manual
Skalar Auto Analyzer	Manufacturer’s Recommendations

Section B7: Instrument Calibration and Frequency

All instruments or devices used in obtaining environmental data will be calibrated prior to use. Each instrument has a specialized procedure for calibration and a specific type of standard used to verify calibration. The instruments requiring calibration are listed below in Table B.7-1.

All calibration procedures will meet the requirements specified in the USEPA-approved methods of analysis. The frequency of calibration as well as specific instructions applicable to the analytical methods recommended by the equipment manufacturer will be followed. All information concerning calibration will be recorded in a calibration logbook by the person performing the calibration and will be accessible for verification during either a laboratory or field audit.

All instruments or devices used in obtaining environmental data will be used according to appropriate laboratory or field practices. Written copies of SOPs are available for review upon request.

Standards used for instrument or method calibrations shall be of known purity and be National Institute of Standards and Technology (NIST) traceable whenever possible. When NIST traceability is 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 in the QPR. CARs will be maintained by the Project Leader and the TSSWCB PM.

Table B.7-1. Instrument Calibration Requirements

Equipment	Relevant Calibration Requirement
D.O. meter	SM 4500-O G 3.c
Conductivity meter	SM 2510 B 4.a
pH meter	SM 4500-H^+ B 2 b
Flow Meter	Product Owner's Manual
Skalar Auto Analyzer	Manufacturer Recommendations

Section B8: Inspection/Acceptance Requirements for 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.

Section B9: Data Acquisition Requirements (Non-direct Measurements)

The data used to establish current bacterial loadings in the Buck Creek watershed are the result of quarterly sampling conducted through TCEQ's CRP. Buck Creek is an unclassified waterbody and as such, has not been sampled at the same quarterly intervals as the classified waterbody into which it flows. Buck Creek has been on an intermittent sampling regime as required by TCEQ's CRP in which only 14 *E. coli* samples (with 7 excedances of >394colonies per 100ml) and 20 fecal coliforms (with 12 excedances of >400 colonies per 100ml) have been collected over the course of a 5-yr period and represented only one site on a 54-mile waterbody.

Additionally, water quality data collected under two other projects conducted in the Buck Creek watershed will also be utilized in this project. These data were collected under approved QAPPs and for the following projects:

1. Data collected under the *Bacterial Monitoring for the Buck Creek Watershed* project (TSSWCB Project 03-07) where taken in accordance with the approved QAPP for the project and encompasses data collected from November 1, 2003 to September 30, 2007. Data that may be used from this project include water quality, rainfall and stream flow information.
2. Data collected under the *Watershed Protection Plan Development for Buck Creek* (TSSWCB Project 06-11) where taken in accordance with the approved QAPP for the project and encompass data collected and analyzed from October 2007 to June 2010. Data that may be used from this project include water quality, rainfall and stream flow information.

The data acquired in these projects have been collected and analyzed using identical assessment objectives, sampling techniques, laboratory protocols and data validation procedures as the current project.

Data collected during the course of this project will provide additional water quality monitoring data that will aid in assessing improvements in water quality as the Buck Creek WPP is implemented.

Section B10: Data Management

Field Collection and Management of Routine Samples

Field staff will visit sampling sites on a monthly basis to collect grab water samples and measure field water quality parameters. Site identification, date, time, personnel, water depth, measurements of field parameters, and any comment concerning weather or conditions at the site are noted on a field data sheet. One field data sheet is filled out in the field for each site visited. An example of a field data sheet is shown in Appendix C. If no flow is observed at a site, samples will not be collected but information about the site visit will be recorded on the field data sheet and the site noted as pooled with no flow or dry. Information on the dates that sites were visited when no flow occurred will be recorded into a separate MS Excel workbook.

Field staff will measure DO, pH, water temperature, flow rate, salinity, and specific conductance at each stream site, using calibrated multi-sonde equipment. Flow rate will be recorded using a flow meter. Measurements read from the instruments will be recorded on the field data sheet. Grab samples will be collected at the site, and an identification number (either a sample identification number or a site code) will be written in permanent marker on the outside of the sterile polypropylene sample bags.

Site codes are marked on sample bags in the field. The COC forms will be used if the collecting technician is in fact not the same person receiving samples into the lab. Site name, time of collection, comments, and other pertinent data are copied from the field data sheets to the COC.

All COC and field observations data will be manually entered into an electronic database. The electronic database will be created in Microsoft Excel software on an IBM-compatible microcomputer with a Windows XP Operating System. The project database will be maintained on the computer's hard drive, which is also simultaneously saved in an external network folder. All pertinent Buck Creek data files will be backed up monthly on an external hard drive and stored in a fire proof location. Current data files will be backed up on CD-RWs weekly and stored in separate area away from the computer.

Original data recorded on paper files will be stored for at least five years in a locked, restricted-access, fire-resistant storage area. Electronic data files will be archived to CD-ROM after approximately one year, then maintained in the above storage area.

Laboratory Data

All field samples will be logged upon receipt; COC forms (if applicable) will be checked for number of samples, proper and exact I.D. number, signatures, dates, and type of analysis specified. The TSSWCB will be notified if any discrepancy is found and laboratory analysis will not occur until proper corrections are made. All samples will be stored at 4ºC until analysis. Bacteriological samples will be given a unique identification number and logged into the Microsoft Excel based database used to store field data. All backup and safety features of this database are the same as explained above. Enumerated bacteriological data will be manually

entered into the database system for electronic storage. At least 10% of all data manually entered in the database will be reviewed for accuracy by the Project Leader to ensure that there are no transcription errors. Hard copies of data will be printed and housed in the AgriLife Vernon laboratory for a period of five years. Any COC's and bacteriological records related to QA/QC of bacteriological procedures will be housed at AgriLife Vernon.

Data Reporting

Data transmission between labs (AgriLife Vernon to TWRI) occurs electronically. In the event that data files are too large to send via Email, a copy of the data set is copied to a CD-RW disc and mailed to the appropriate party. Data are recorded in Microsoft Excel format and submitted to the respective entity. AgriLife Vernon maintains the project database and follows the guidelines listed above in protecting the data from corruption or loss.

Data will be reported according to the standards of the TSSWCB. Data intended to be submitted by TSSWCB to TCEQ for inclusion in SWQMIS for use in 305(b) assessments will be reported in a format consistent with *TCEQ Surface Water Quality Monitoring Data Management Reference Guide* (TCEQ 2010).

Data Dissemination

The Project Co-Leader will provide data to TWRI quarterly for verification and transmission to TSSWCB and will also provide a copy of the complete project electronic database via recordable CD-ROM media to the TSSWCB PM at the end of the project. The TSSWCB may elect to take possession of all project records. However, summaries of the data will be presented in the final project report.

Section C1: Assessments and Response Actions

The following table presents the types of assessments and response action for activities applicable to this QAPP.

Table C.1-1. Assessments and Response Actions

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring Oversight, etc.	Continuous	TWRI and AgriLife Vernon	Monitoring of the project status and records to ensure requirements are being fulfilled. Monitoring and review of contract laboratory performance and data quality	AgriLife Vernon and TWRI will report to TSSWCB PM via QPR.
Laboratory Inspections	Once per life of project (each lab)	TSSWCB QAO	Analytical and QC procedures employed at the laboratory	AgriLife Vernon, have 45 days to respond in writing to the TSSWCB QAO to address corrective actions
Monitoring Systems Audit	Once per life of project	TSSWCB QAO	The assessment will be tailored in accordance with objectives needed to assure compliance with the QAPP. Field sampling, handling and measurement; facility review; and data management as they relate to the project	AgriLife Vernon has 45 days to respond in writing to the TSSWCB QAO to address corrective actions

Corrective Action

The AgriLife Vernon Project Leader is responsible for implementing and tracking corrective action procedures as a result of audit findings. Records of audit findings and corrective actions are maintained by the TSSWCB QAO.

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.

Section C2: Reports to Management

QPRs will be generated by TWRI 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. CARs will be utilized when necessary (Appendix A) and will be maintained in an accessible location for reference at AgriLife Vernon. 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.

Section D1: Data Review, Validation, and Verification

All data obtained from field and laboratory measurements will be reviewed and verified for integrity, continuity, reasonableness, and conformance to project requirements, and then validated against the DQOs outlined in Section A7. Only those data that are supported by appropriate QC data and meet the DQOs defined for this project will be considered acceptable for use.

The procedures for verification and validation of data are described in Section D2, below. AgriLife Vernon is responsible for ensuring that field and laboratory data collected are properly reviewed, verified, and submitted in the required format for the project database. TWRI is responsible for validating that all data collected meet the DQOs of the project are suitable for submission to TSSWCB.

Section D2: Validation and Verification Methods

All data will be verified to ensure they are representative of the samples analyzed and locations where measurements were made, and that the data and associated QC data conform to project specifications. The Project Leader is responsible for the integrity, validation, and verification of the data each field and laboratory task generates or handles throughout each process. The field and laboratory QA tasks ensure the verification of field data, electronically generated data, and data on COC forms and hard copy output from instruments.

Verification, validation, and integrity review of data will be performed using self-assessments and peer review, as appropriate to the project task, followed by technical review by the manager of the task. The data to be verified are evaluated against project specifications (Section A7 and Section B5) and are checked to ensure the verification of raw data for errors, especially errors in transcription, calculations, and data input. Potential outliers are identified by examination for unreasonable data, or identified using computer-based statistical software such as SAS. If a question arises or an error or potential outlier is identified, the manager of the task responsible for generating the data is contacted to resolve the issue. Issues that can be corrected are corrected and documented electronically or by initialing and dating the associated paperwork. If an issue cannot be corrected, the task manager consults with the TSSWCB QAO to establish the appropriate course of action, or the data associated with the issue are rejected.

The AgriLife Vernon Project Leader and TWRI are responsible for validating that the verified data are scientifically sound, defensible, of known precision, accuracy, integrity, meet the DQOs of the project, and are reportable to the TSSWCB.

Table D.2-1. Data Review, Verification, and Validation Procedures

Data to be Verified	Field† Supervisor	Laboratory Supervisor	PM/QAO Task‡
Collection and analysis techniques consistent with QAPP	X	X	X
Field QC samples collected for all parameters as prescribed in the QAPP	X		
Field documentation complete	X		
Instrument calibration data complete	X	X	
Sample documentation complete	X	X	
Field QC results within acceptance limits	X		
Chain of custody complete/acceptable	X	X	
Sample preservation and handling	X	X	
Holding times met	X	X	
Instrument calibration data	X	X	
COC complete	X	X	
QC samples within acceptance limits		X	
Instrument readings/printouts	X	X	
Laboratory data verification for integrity, precision, accuracy, and validation		X	
Laboratory data reports accurate		X	
Data entered in required format	X	X	
Absence of transcription error verified	X	X	
Reasonableness of data checked	X	X	
Sampling and analytical data gaps rectified	X	X	
Nonconformances documented	X	X	X
Data formatted for SWQMIS		X	X

† Field and Laboratory Supervisor may be the same person for AgriLife Vernon
‡ TSSWCB PM / QAO will monitor data for QA/QC purposes as needed.
All other entities are required to inspect 100% of the data prior to approval

Section D3: Reconciliation with User Requirements

Data produced by this project will be evaluated against the established DQOs and user requirements to determine if any reconciliation is needed. Reconciliation concerning the quality, quantity or usability of the data will be reconciled with the user during the data acceptance process. Corrective Action Reports will be initiated in cases where invalid or incorrect data have been detected. Data that have been reviewed, verified, and validated will be summarized for their ability to meet the data quality objectives of the project and the informational needs of water quality agency decision-makers and watershed stakeholders.

The final data for the project will be reviewed to ensure that it meets the requirements as described in this QAPP. Data summaries along with descriptions of any limitations on data use will be included in the final report.

References

Standard Methods for the Examination of Water and Wastewater, 21st Edition, 2005.

TCEQ. 2010. "Surface Water Quality Monitoring Data Management Reference Guide." http://www.tceq.state.tx.us/assets/public/compliance/monops/water/wdma/dmrg/dmrg_complete.pdf

TCEQ SOP,V1 - TCEQ Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, 2008 (RG-415)

USEPA. 2006. "*Escherichia coli* in Water by Membrane Filtration Using Modified Membrane-Thermotolerant *Escherichia coli* (modified m-TEC) Agar." EPA-821-R-06-011. July 2006.

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 Record

CHAIN OF CUSTODY RECORD

Project:	**Remarks:**
WPP Development for Buck Creek	**Field to AgriLife Vernon Lab**
Name and signature of collector:	**Air bill #**

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

Relinquished by Vernon Lab Tech:	Date:	Time:	Received for AgriLife El Paso lab by:	Date:	Time:

Laboratory Notes:

Media Code: (**FW**) Fecal Isolate from Water Sample; (**FF**) Fecal isolate from Feces; (**FS**) Fecal Sample; (**SS**) Sewage Sample

Appendix C: Field Data Reporting Form

ML0001

AgriLIFE RESEARCH
Texas A&M System

Improving Life Through Science and Technology

Vernon Water Quality Laboratory
NELAC Accredited: T104704480-10-1
National Lab Code: TX 02640

Date:		Station Location:					TCEQ ID:	
Time:		Basin/Reach/Segment:	0207A				HUA No:	11120105
County:		Monitoring Type:					Rainfall Event:	**Yes NO**
Site ID Number:		Sample Chain of Custody Number:	504286-__					
Tech(s):				Section-	Midpoint	Depth	Veocity	Discharge:
Storet Code:		Salinity_____ TDS_____		1				
00300		Dissolved Oxygen (mg/L)		2				
00400		pH (Standard Units)		3				
00094		Specific Conductance		4				
00010		Water Temp °C		5				
01351		Flow: 1 none 2low 3normal 4flood 5high 6dry		6				
00061		Flow(CFS) Lab complete shaded area		7				
89835		Flow: 1 Gauge 2 Electronic 3 Mechanical		8				
		4 Wier/Flume 5 Doppler		9				
20424		Water Clarity: 1 Excellent 2 Good 3 Fair		10				
		4 Poor 5 Other:_____		11				
89969		Water Color: 1 Brown 2 Reddish 3 Green		12				
		4 Black 5 Clear 6 Other_____		13				
89971		Water Odor: 1 Sewage 2 Oily/Chem 3 Sulfur		14				
		4 Musky 5 Fishy 6 None 7 Other_____		15				
00021		Air Temp °F		16				
89966		Weather: 1 Clear 2 Partly Cloudy 3 Cloudy		17				
		4 Rain 5 Other_____		18				
89965		Wind: 1 Calm 2 Slight 3 Moderate 4 Strong		19				
		Direction: **N NE NW E SE S SW W**		20				
72053		Significant Precipitation (<or>Days)			Total Flow in CFS:			
Water Sample Depth:			Split: **YES NO**				Photos: **YES NO**	
Biological Activity:								
Comments:								

Lab Reporting Only: AW: 1___ 2___ 3___4___5___ E. coli _____ Dup_____ Nitrates_____ Dup_____
Water Isolates: **A B C D E**