Assessment of Contact Recreation Use Impairments and Watershed Planning for Five Tributaries of the Little Brazos River (LBR Tributaries Bacteria Assessment) TSSWCB Project #08-54

Quality Assurance Project Plan

Revision No. 1

Prepared by
Brazos River Authority
Waco, Texas

Funding Source:

Texas State Soil and Water Conservation Board
Total Maximum Daily Load Program

Effective Period: November 2008 to May 2010

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

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A1 Approval Sheet

Quality Assurance Project Plan (QAPP) for TSSWCB Project #08-54, *Assessment of Contact Recreation Use Impairments and Watershed Planning for Five Tributaries of the Little Brazos River (LBR Tributaries Bacteria Assessment).*

Texas State Soil and Water Conservation Board (TSSWCB)

Name: Loren Henley
Title: TSSWCB Project Manager

Signature: _____ Date: _____

Name: Donna Long
Title: TSSWCB Quality Assurance Officer

Signature: _____ Date: _____

Brazos River Authority (BRA)

Name: Jay Bragg
Title: BRA Project Manager

Signature: _____ Date: _____

Name: Tiffany Morgan
Title: BRA Environmental Services Manager

Signature: _____ Date: _____

Name: Kay Barnes
Title: BRA Quality Assurance Officer

Signature: _____ Date: _____

Name: Ahmed Kadry, Ph.D.
Title: BRA Laboratory Manager

Signature: _____ Date: _____

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A2 Table of Contents

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)
PO Box 658
Temple, TX 76503

Name: Loren Henley
Title: TSSWCB Project Manager

Name: Donna Long
Title: TSSWCB Quality Assurance Officer

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Name: Tiffany Morgan
Title: BRA Environmental Services Manager

Name: Kay Barnes
Title: BRA Quality Assurance Officer

Name: Ahmed Kadry, Ph.D.
Title: BRA Laboratory Manager

Name: Jack Davis
Title: BRA Field Operations Manager

List of Acronyms

AWRL	Ambient Water Reporting Limit
BMP	Best Management Practice
BRA	Brazos River Authority
CAR	Corrective Action Report
COC	Chain of Custody
CRP	Clean Rivers Program
CWA	Clean Water Act
DOC	Demonstration of Capability
DMP	Data Management Plan
DMRG	Data Management Reference Guide
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
ESL	BRA Environmental Services Laboratory
GIS	Geographic Information System
LCS	Laboratory Control Sample (formerly Laboratory Control Standard)
LCSD	Laboratory Control Sample Duplicate (formerly Laboratory Control Standard Duplicate)
LIMS	Laboratory Information Management System
LOD	Limit of Detection
LOQ	Limit of Quantitation (formerly reporting limit)
NCR	Nonconformance Report
NELAC	National Environmental Lab Accreditation Conference
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
PO	Project Officer
QA/QC	Quality Assurance/Quality Control
QAM	Quality Assurance Manual
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QAS	Quality Assurance Specialist
QMP	Quality Management Plan

RPD	Relative Percent Difference
SLOC	Station Location Form
SOP	Standard Operating Procedure
SWQM	Surface Water Quality Monitoring
SWQMIS	Surface Water Quality Monitoring Information System
TCEQ	Texas Commission on Environmental Quality
TMDL	Total Maximum Daily Load
TSSWCB	Texas State Soil and Water Conservation Board
TSWQS	Texas Surface Water Quality Standards
WQI	Water Quality Inventory
WWTF	Waste Water Treatment Facility

A4 Project/Task Organization

Texas State Soil and Water Conservation Board

Loren Henley
TSSWCB Project Manager
Maintains a thorough knowledge of work activities, commitments, deliverables, and time frames associated with project. Develops lines of communication and working relationships between BRA and TSSWCB. Tracks deliverables to ensure that tasks are completed as specified in the contract. Responsible for ensuring that the project deliverables are submitted on time and are of acceptable quality and quantity to achieve project objectives. Participates in the development, approval, implementation, and maintenance of the QAPP. Assists the TSSWCB QAO in technical review of the QAPP. Responsible for verifying that the QAPP is followed by the BRA. Notifies the TSSWCB QAO of particular circumstances that may adversely affect the quality of data derived from the collection and analysis of samples. Enforces corrective action.

Donna Long
TSSWCB Quality Assurance Officer
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 project participants. Determines that the project meets the requirements for planning, quality assurance (QA), quality control (QC), and reporting under the CWA §319(h) NPS Grant Program. Monitors implementation of corrective actions. Coordinates or conducts audits of field and laboratory systems and procedures.

Brazos River Authority

Jay Bragg
BRA Project Manager
Responsible for ensuring tasks and other requirements in the contract are executed on time and are of acceptable quality. Monitors and assesses the quality of work. Coordinates attendance at conference calls, training, meetings, and related project activities with the TSSWCB. Responsible for verifying the QAPP is followed and the project is producing data of known and acceptable quality. Ensures adequate training and supervision of all monitoring and data collection activities. Complies with corrective action requirements.

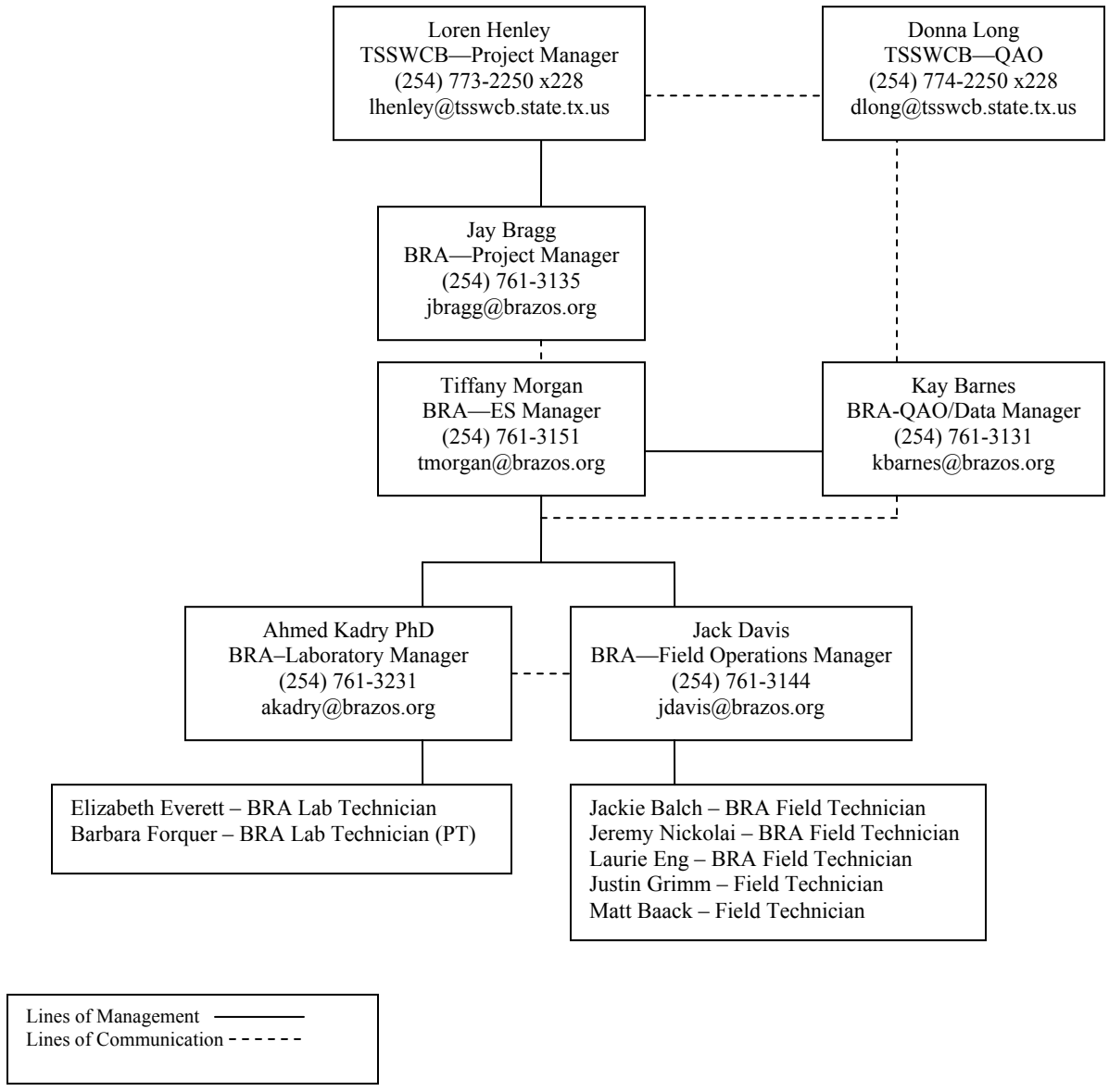
Tiffany Morgan
BRA Environmental Services Manager
Reports to the Technical Services Manager and oversees field data collections, environmental laboratory operations, and data management activities. The majority of these activities are directly related to a regional project. The Environmental Services Manager provides technical guidance and assistance to regional environmental projects, including initiating, planning, facilitating, and executing of projects. The Environmental Services Manager is solely responsible for the implementation of quality management (planning, assurance, and control) for field, laboratory, and data management operations.

Kay Barnes
BRA QAO and Project Data Manager
Responsible for coordinating development and implementation of the QA program. Responsible for writing and maintaining the QAPP. Responsible for maintaining records of QAPP distribution, including appendices and amendments. Monitors the implementation of the QAM and the QAPP within the laboratory to ensure complete compliance with QA objectives as defined by the contract and in the QAPP. Conducts internal audits to identify potential problems and ensure compliance with written SOPs. Responsible for supervising and verifying all aspects of the QA/QC in the laboratory. Responsible for maintaining written records of sub-tier commitment to requirements specified in this QAPP. Responsible for identifying, receiving, and maintaining project QA records. Responsible for coordinating with the TSSWCB QAS to resolve QA- related issues. Notifies the BRA Project Manager and TSSWCB Project Manager of particular circumstances which may adversely affect the quality of data. Responsible for validation and verification of all data collected according to Section D2 procedures and acquired data procedures after each task is performed. Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques. Conducts laboratory inspections. Develops, facilitates, and conducts monitoring systems audits. Performs validation and verification of data before the report is sent to the TSSWCB. Insures that all QA reviews are conducted in a timely manner from real-time review at the bench during analysis to final pass-off of data to the QA officer. Responsible for the acquisition, verification, and transfer of data to the TSSWCB. Oversees data management for the study. Performs data QA prior to transfer of data to TSSWCB. Responsible for transferring data to the TSSWCB in the acceptable format. Ensures data are submitted according to workplan specifications. Provides the point of contact for the TSSWCB Data Manager to resolve issues related to the data.

Ahmed Kadry, PhD
BRA Laboratory Manager
Responsible for supervision of laboratory personnel involved in generating analytical data for this project. 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 analyses or task performed and/or supervised. Responsible for oversight of all operations, ensuring that all QA/QC requirements are met, and documentation related to the analysis is completely and accurately reported. Enforces corrective action, as required. Develops and facilitates monitoring systems audits.

Jack Davis
BRA Field Operations Manager
Responsible for supervising all aspects of the sampling and measurement of surface waters and other parameters in the field. Responsible for the acquisition of water samples and field data measurements in a timely manner that meet the quality objectives specified in Section A7 (Table A.1), as well as the requirements of Sections B1 through B8. Responsible for field scheduling, staffing, and ensuring that staff are appropriately trained as specified in Sections A6 and A8.

Figure A4.1. Organization Chart - Lines of Communication



A5 Problem Definition/Background

The central watershed of the Brazos River consists of one classified water body, the Brazos River above Navasota River (Segment 1242), and a number of unclassified waterbodies on tributary systems. This segment extends from the Lake Brazos Dam in Waco 183 miles downstream to its confluence with the Navasota River southeast of College Station and its watershed encompasses approximately 2,705 square miles. Land use in the watershed is generally agricultural with two urban areas (Waco and Bryan/College Station) and a few large industrial facilities and quarries.

In 2002 a water quality data analysis determined that eight unclassified water bodies within the central watershed had bacteria concentrations exceeding state water quality standards for contact recreation. As a result these waterbodies were placed on the Texas §303(d) List of Impaired Waters. Three additional unclassified segments were added to the 2006 §303(d) List bringing the total number of water quality impairments (bacteria) on segment 1242 to eleven.

Five of the waterbodies impaired for bacteria are located within very close proximity of each other in Robertson County and share similar land use and water quality characteristics. They are all tributaries to the Little Brazos River (Segment 1242E). The five waterbodies in this project's study area are Campbells Creek (Segment 1242I), Mud Creek (Segment 1242K), Pin Oak Creek (Segment 1242L), Spring Creek (Segment 1242M), and Walnut Creek (Segment 1242O). The study area encompasses 327 square miles, almost entirely within Robertson County. The land use in the area is primarily agricultural with several small communities.

The 2006 §303(d) List identifies all five segments in the study area as Category 5c, meaning that the waterbody does not meet applicable water quality standards for one or more designated uses by one or more pollutants and that additional data and information will be collected before a TMDL is scheduled.

TCEQ and TSSWCB established a joint technical Task Force on Bacteria TMDLs in September 2006 charged with making recommendations on cost-effective and time-efficient bacteria TMDL development methodologies. The Task Force recommended the use of a three-tier approach that is designed to be scientifically credible and accountable to watershed stakeholders. The tiers move through increasingly aggressive levels of data collection and analysis in order to achieve stakeholder consensus on needed load reductions and strategies to achieve those reductions. In June 2007 the TCEQ and TSSWCB adopted the principles and general process recommendations into an updated joint-agency TMDL guidance document.

In accordance with the *Memorandum of Agreement Between the TCEQ and the TSSWCB Regarding TMDLs, Implementation Plans, and Watershed Protection Plans,* the TSSWCB has agreed to take the lead role in addressing the bacteria impairments for the five segments in the study area. Through this and associated projects, the TSSWCB and BRA will work with local stakeholders to progress through the data collection and analysis components of the first two tiers of the Task Force recommended three-tier approach.

The objective of this project is to provide sufficient water quality data to characterize bacteria loadings across the various flow regimes at a number of locations throughout the study area.

A6 Project/Task Description

BRA will conduct routine ambient monitoring at 10 sites once every two weeks, collecting field (water temperature, pH, dissolved oxygen, dissolved oxygen saturation, specific conductance), flow, and bacteria (*E. coli*) parameter groups. The sampling period extends over 19 months and includes 410 sample events.

BRA will conduct effluent monitoring at three WWTFs once every two weeks, collecting field (water temperature, pH, dissolved oxygen, dissolved oxygen saturation, specific conductance), flow, and bacteria (*E. coli*) parameter groups. The sampling period extends over 19 months and includes 123 sample events.

BRA will conduct biased-flow monitoring under high flow (storm event influenced) conditions at the 10 streams sites and 3 WWTF sites during at least 12 storm events, collecting field (water temperature, dissolved oxygen, dissolved oxygen saturation, specific conductance), flow, and bacteria grabs (*E. coli*) parameter groups. The sampling period extends over 19 months and includes 156 sample events.

BRA will establish and maintain continuous flow monitoring gages at 5 sites (1 per segment). These sites shall be located as close to the confluence with the Little Brazos River as is feasible. Continuous sampling will extend over 19 months.

BRA will conduct two biological assessement events on the Little Brazos River in order to evaluate the cumulative impact of the impaired segments on stream health and biological communities.

BRA will transfer the data obtained from these monitoring activities to TSSWCB, at least quarterly, for inclusion in the TCEQ SWQMIS.

BRA will cooperate with Texas AgriLife Research to conduct a load duration curve (LDC) analysis of all historic and existing water quality monitoring data from the study area and refine those LDCs using water quality monitoring data collected through this project.

See Appendix B for the project-related work plan tasks related to data collection and schedule of deliverables for a description of work defined in this QAPP.

See Section B1 for monitoring to be conducted under this QAPP.

Revisions to the QAPP

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 most recently approved QAPPs shall remain in effect until revisions have been fully approved; reissuances (i.e., annual updates) must be submitted to the TSSWCB for approval before the last version has expired. If the entire QAPP is current, valid, and

accurately reflects the project goals and organization's policy, the annual reissuance may be done by a certification that the plan is current. This can be accomplished by submitting a cover letter stating the status of the QAPP and a copy of new, signed approval pages for the QAPP.

Amendments

Amendments to the QAPP 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. Requests for amendments are directed from the BRA Project Manager to the TSSWCB Project Manager in writing. The changes are effective immediately upon approval by the TSSWCB Project Manager and Quality Assurance Officer.

Amendments to the QAPP and the reasons for the changes will be documented, and revised pages will be forwarded–to all persons on the QAPP distribution list by the BRA QAO. Amendments shall be reviewed, approved, and incorporated into a revised QAPP during the annual revision process or within 120 days of the initial approval in cases of significant changes.

A7 Quality Objectives and Criteria

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.

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.

Laboratory precision is assessed by comparing replicate analyses of sample/duplicate pairs in the case of bacterial analysis. Precision results are compared against measurement performance specifications and used during evaluation of analytical performance. Program-defined measurement performance specifications for precision are defined in Table A7.1.

Representativeness

Site selection, the appropriate sampling regime, the sampling of all pertinent media, and use of only approved analytical methods will assure that the measurement data represents the conditions at the site. Water quality data that are collected on a routine frequency are separated by approximately even time intervals. At a minimum, samples are collected over at least two seasons (to include inter-seasonal variation) and over two years (to include inter-year variation) and includes some data collected during an index period (March 15- October 15). Although data may be collected during varying regimes of weather and flow, the data sets will not be biased toward unusual conditions of flow, runoff, or season. The goal for meeting total representation of the water body will be tempered by the potential funding for complete representativeness.

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 that 90% data completion is achieved.

Comparability

Confidence in the comparability of routine data sets for this project and for water quality assessments 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 rounding figures, and by reporting data in a standard format as specified in Section B10.

Limit of Quantitation

AWRLs (Table A7.1) are used in this project as the *limit of quantitation* specification, so data collected under this QAPP can be compared against the TSWQS. Laboratory *limits of quantitation* (Table A7.1) must be at or below the AWRL for each applicable parameter.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria are provided in Section B5.

Table A7.1 Measurement Performance Specifications for Instream and Effluent Monitoring

Parameter	Units	Matrix	Method	Parameter Code	AWRL	LOQ	Recovery at LOQ (%)	Precision (RPD of LCS/LCSD)	Bias % Rec. of LCS	Completeness (%)
pH	pH/ units	water	SWQM Vol. 1	00400	NA	NA	NA	NA	NA	90
DO	mg/L	water	SWQM Vol. 1	00300	NA	NA	NA	NA	NA	90
DO % Saturation	%	Water	SWQM Vol. 1	00301	NA	NA	NA	NA	NA	90
Conductivity	uS/cm	water	SWQM Vol. 1	00094	NA	NA	NA	NA	NA	90
Temperature	°C	water	SWQM Vol. 1	00010	NA	NA	NA	NA	NA	90
Flow	cfs	water	TCEQ SOP	00061	NA	NA	NA	NA	NA	90
Flow Measurement Method	1=gage; 2=electric; 3=mechanical; 4=weir/flume; 5=doppler	water	SWQM Vol. 1	89835	NA	NA	NA	NA	NA	90
Flow severity	1=no flow; 2=low; 3=normal; 4=flood; 5=high; 6=dry	water	TCEQ SOP V1	01351	NA	NA	NA	NA	NA	90
Present Weather	1=clear; 2=partly cloudy; 3=cloudy; 4=rain; 5=other	NA	TCEQ SOP V1	89966	NA	NA	NA	NA	NA	90
Wind Intensity	1=calm; 2=slight; 3=moderate; 4=strong	NA	TCEQ SOP V1	89965	NA	NA	NA	NA	NA	90
Days since last significant rainfall	days	NA	TCEQ SOP V1	72053	NA	NA	NA	NA	NA	
E. coli	MPN/100ml	water	Colilert System	31699	1	1	NA	0.53	NA	90

References: USEPA *Methods for Chemical Analysis of Water and Wastewater*, Manual #EPA-600/4-79-020.
American Public Health Association, American Water Works Association and Water Environment Federation, *Standard Methods for the Examination of Water and Waste Water*, 20th Ed.
TCEQ *SWQM Procedures*, Volume 1.

Table A7.2 Measurement Performance Specifications for Biological Monitoring

Parameter	Units	Matrix	Method	Parameter Code	AWRL	LOQ	Recovery at LOQ (%)	Precision (RPD of LCS/LCSD)	Bias %Rec. of LCS	Completeness (%)
Biological Data Reporting Units	1=number of individuals from subsample; 2=number of individuals/ft^2; 3=number of individuals/m^2; 4=total number in kicknet	Water	TCEQ SOP, V2	89899	NA	NA	NA	NA	NA	90
Benthic Sampler	1=Surber; 2=Ekman; 3=kicknet; 4=Petersen; 5=Hester-Dendy	Water	TCEQ SOP, V2	89950	NA	NA	NA	NA	NA	90
Area of snag surface sampled	m^2	Water	TCEQ SOP, V2	89975	NA	NA	NA	NA	NA	90
Undercut bank at sample point	%	Water	TCEQ SOP, V2	89921	NA	NA	NA	NA	NA	90
Overhanging brush at sample point	%	Water	TCEQ SOP, V2	89922	NA	NA	NA	NA	NA	90
Gravel substrate at sample point	%	Water	TCEQ SOP, V2	89923	NA	NA	NA	NA	NA	90
Sand substrate at sample point	%	Water	TCEQ SOP, V2	89924	NA	NA	NA	NA	NA	90
Soft bottom at sample point	%	Water	TCEQ SOP, V2	89925	NA	NA	NA	NA	NA	90
Macrophyte bed at sample point	%	Water	TCEQ SOP, V2	89926	NA	NA	NA	NA	NA	90
Snags and brush at sample point	%	Water	TCEQ SOP, V2	89927	NA	NA	NA	NA	NA	90
Bedrock at sample point	%	Water	TCEQ SOP, V2	89928	NA	NA	NA	NA	NA	90
Benthic Organisms, None Present	NA	Water	TCEQ SOP, V2	90005	NA	NA	NA	NA	NA	90
Mesh Size, any net or sieve, average bar (diagonal measurement) for benthic collection	cm	NA	TCEQ SOP, V2	89946	NA	NA	NA	NA	NA	90
Stream Order	#	NA	TCEQ SOP, V1	84161	NA	NA	NA	NA	NA	90
Ecoregion (Texas Ecoregion Code)	#	NA	TCEQ SOP, V1	89961	NA	NA	NA	NA	NA	90

Parameter	Units	Matrix	Method	Parameter Code	AWRL	LOQ	Recovery at LOQ (%)	Precision (RPD of LCS/LCSD)	Bias %Rec. of LCS	Completeness (%)
Total Taxa Richness, Benthos	#	Water	TCEQ SOP, V2	90055	NA	NA	NA	NA	NA	90
Diptera Taxa	#	Water	TCEQ SOP, V2	90056	NA	NA	NA	NA	NA	90
Ephemeroptera Taxa	#	Water	TCEQ SOP, V2	90057	NA	NA	NA	NA	NA	90
Intolerant Taxa, Benthos	#	Water	TCEQ SOP, V2	90058	NA	NA	NA	NA	NA	90
Individuals as EPT Taxa	%	Water	TCEQ SOP, V2	90060	NA	NA	NA	NA	NA	90
Chironomidae	%	Water	TCEQ SOP, V2	90062	NA	NA	NA	NA	NA	90
Tolerant Taxa, Benthos	%	Water	TCEQ SOP, V2	90066	NA	NA	NA	NA	NA	90
Grazers	%	Water	TCEQ SOP, V2	90020	NA	NA	NA	NA	NA	90
Gatherers	%	Water	TCEQ SOP, V2	90025	NA	NA	NA	NA	NA	90
Filterers	%	Water	TCEQ SOP, V2	90030	NA	NA	NA	NA	NA	90
Dominance (3 Taxa)	%	Water	TCEQ SOP, V2	90067	NA	NA	NA	NA	NA	90
Biological Data Reporting Units	1=number of individuals from sub-sample; 2=number of individuals/ft^2; 3=number of individuals/m^2; 4=total number in kicknet	Water	TCEQ SOP, V2	89899	NA	NA	NA	NA	NA	90
Kicknet Effort, area kicked	m^2	Water	TCEQ SOP, V2	89903	NA	NA	NA	NA	NA	90
Kicknet Effort, minutes kicked	minutes	Water	TCEQ SOP, V2	89904	NA	NA	NA	NA	NA	90
Snags and Shoreline Sampling Effort, minutes picked	minutes	Water	TCEQ SOP, V2	89905	NA	NA	NA	NA	NA	90
Number of individuals in benthic RBA sub-sample (∀ 100)	#	Water	TCEQ SOP, V2	89906	NA	NA	NA	NA	NA	90

Parameter	Units	Matrix	Method	Parameter Code	AWRL	LOQ	Recovery at LOQ (%)	Precision (RPD of LCS/LCSD)	Bias %Rec. of LCS	Completeness (%)
Benthic Sampler	1=Surber; 2=Ekman; 3=kicknet; 4=Petersen; 5=Hester-Dendy	Water	TCEQ SOP, V2	89950	NA	NA	NA	NA	NA	90
Undercut bank at sample point	%	Water	TCEQ SOP, V2	89921	NA	NA	NA	NA	NA	90
Overhanging brush at sample point	%	Water	TCEQ SOP, V2	89922	NA	NA	NA	NA	NA	90
Gravel substrate at sample point	%	Water	TCEQ SOP, V2	89923	NA	NA	NA	NA	NA	90
Sand substrate at sample point	%	Water	TCEQ SOP, V2	89924	NA	NA	NA	NA	NA	90
Soft bottom at sample point	%	Water	TCEQ SOP, V2	89925	NA	NA	NA	NA	NA	90
Macrophyte bed at sample point	%	Water	TCEQ SOP, V2	89926	NA	NA	NA	NA	NA	90
Snags and brush at sample point	%	Water	TCEQ SOP, V2	89927	NA	NA	NA	NA	NA	90
Bedrock at sample point	%	Water	TCEQ SOP, V2	89928	NA	NA	NA	NA	NA	90
Benthic Organisms, None Present	NA	Water	TCEQ SOP, V2	90005	NA	NA	NA	NA	NA	90
Mesh Size, any net or sieve, average bar (diagonal measurement) for benthic collection	cm	NA	TCEQ SOP, V2	89946	NA	NA	NA	NA	NA	90
Stream Order	#	NA	TCEQ SOP, V1	84161	NA	NA	NA	NA	NA	90
Ecoregion (Texas Ecoregion Code)	#	NA	TCEQ SOP, V1	89961	NA	NA	NA	NA	NA	90
Total Taxa Richness, Benthos	#	Water	TCEQ SOP, V2	90055	NA	NA	NA	NA	NA	90
EPT Index, Abundance	#	Water	TCEQ SOP, V2	90008	NA	NA	NA	NA	NA	90
Biotic Index (HBI)	NA	Water	TCEQ SOP, V2	90007	NA	NA	NA	NA	NA	90
Chironomidae	%	Water	TCEQ SOP, V2	90062	NA	NA	NA	NA	NA	90

Parameter	Units	Matrix	Method	Parameter Code	AWRL	LOQ	Recovery at LOQ (%)	Precision (RPD of LCS/LCSD)	Bias %Rec. of LCS	Completeness (%)
Dominant Taxon, Benthos	%	Water	TCEQ SOP, V2	90042	NA	NA	NA	NA	NA	90
Dominant FFG	%	Water	TCEQ SOP, V2	90010	NA	NA	NA	NA	NA	90
Predators	%	Water	TCEQ SOP, V2	90036	NA	NA	NA	NA	NA	90
Ratio of Intolerant:Tolerant taxa, Benthos	NA	Water	TCEQ SOP, V2	90050	NA	NA	NA	NA	NA	90
Total Trichoptera as Hydropsychidae	%	Water	TCEQ SOP, V2	90069	NA	NA	NA	NA	NA	90
Non-insect taxa	#	Water	TCEQ SOP, V2	90052	NA	NA	NA	NA	NA	90
Collector-gatherers	%	Water	TCEQ SOP, V2	90025	NA	NA	NA	NA	NA	90
Total number as Elmidae	%	Water	TCEQ SOP, V2	90054	NA	NA	NA	NA	NA	90
Nekton, none captured	NA	Water	TCEQ SOP, V2	98005	NA	NA	NA	NA	NA	90
Electrofishing effort, duration of shocking	seconds	Water	TCEQ SOP, V2	89944	NA	NA	NA	NA	NA	90
Seining effort	# of hauls	Water	TCEQ SOP, V2	89947	NA	NA	NA	NA	NA	90
Combined length of seine hauls	meters	Water	TCEQ SOP, V2	89948	NA	NA	NA	NA	NA	90
Seining effort, duration	minutes	Water	TCEQ SOP, V2	89949	NA	NA	NA	NA	NA	90
Seine Minimum Mesh Size, net average bar, Nekton	in	Water	TCEQ SOP, V2	89930	NA	NA	NA	NA	NA	90
Seine Maximum Mesh Size, net average bar, Nekton	in	Water	TCEQ SOP, V2	89931	NA	NA	NA	NA	NA	90
Net length	meters	Water	TCEQ SOP, V2	89941	NA	NA	NA	NA	NA	90
Electrofishing method	1=boat; 2=backpack; 3=tote barge	Water	TCEQ SOP, V2	89943	NA	NA	NA	NA	NA	90
Area seined	m^2	Water	TCEQ SOP, V2	89976	NA	NA	NA	NA	NA	90

Parameter	Units	Matrix	Method	Parameter Code	AWRL	LOQ	Recovery at LOQ (%)	Precision (RPD of LCS/LCSD)	Bias %Rec. of LCS	Completeness (%)
Stream Order	#	NA	TCEQ SOP, V1	84161	NA	NA	NA	NA	NA	90
Ecoregion (Texas Ecoregion Code)	#	NA	TCEQ SOP, V1	89961	NA	NA	NA	NA	NA	90
Total number fish species	#	Water	TCEQ SOP, V2	98003	NA	NA	NA	NA	NA	90
Total native cyprinid species, fish	#	Water	TCEQ SOP, V2	98032	NA	NA	NA	NA	NA	90
Total benthic invertivore species, fish	#	Water	TCEQ SOP, V2	98052	NA	NA	NA	NA	NA	90
Total benthic species, fish	#	Water	TCEQ SOP, V2	98053	NA	NA	NA	NA	NA	90
Total sunfish species (except bass)	#	Water	TCEQ SOP, V2	98008	NA	NA	NA	NA	NA	90
Total intolerant fish species	#	Water	TCEQ SOP, V2	98010	NA	NA	NA	NA	NA	90
Tolerant individuals (excluding Western Mosquitofish), fish	%	Water	TCEQ SOP, V2	98070	NA	NA	NA	NA	NA	90
Omnivore individuals, fish	%	Water	TCEQ SOP, V2	98017	NA	NA	NA	NA	NA	90
Invertivore individuals, fish	%	Water	TCEQ SOP, V2	98021	NA	NA	NA	NA	NA	90
Piscivore individuals, fish	%	Water	TCEQ SOP, V2	98022	NA	NA	NA	NA	NA	90
Total Individuals seining	#	Water	TCEQ SOP, V2	98039	NA	NA	NA	NA	NA	90
Total Individuals electroshocking	#	Water	TCEQ SOP, V2	98040	NA	NA	NA	NA	NA	90
Individuals/seine haul	#	Water	TCEQ SOP, V2	98062	NA	NA	NA	NA	NA	90
Individuals/minute electroshocking	#	Water	TCEQ SOP, V2	98069	NA	NA	NA	NA	NA	90
Individuals as non-native species	%	Water	TCEQ SOP, V2	98033	NA	NA	NA	NA	NA	90
Individuals w/ disease/anomalies	%	Water	TCEQ SOP, V2	98030	NA	NA	NA	NA	NA	90

Parameter	Units	Matrix	Method	Parameter Code	AWRL	LOQ	Recovery at LOQ (%)	Precision (RPD of LCS/LCSD)	Bias %Rec. of LCS	Completeness (%)
Streambed slope over evaluated reach (from USGS map)	NA	Water	TCEQ SOP, V2	72052	NA	NA	NA	NA	NA	90
Approximate drainage area above the most downstream transect from USGS map	km^2	Water	TCEQ SOP, V2	89859	NA	NA	NA	NA	NA	90
Stream Order	#	Water	TCEQ SOP, V2	84161	NA	NA	NA	NA	NA	90
Length of stream	km	Water	TCEQ SOP, V2	89860	NA	NA	NA	NA	NA	90
Lateral transects made	#	Water	TCEQ SOP, V2	89832	NA	NA	NA	NA	NA	90
Average stream width	meters	Water	TCEQ SOP, V2	89861	NA	NA	NA	NA	NA	90
Average stream depth	meters	Water	TCEQ SOP, V2	89862	NA	NA	NA	NA	NA	90
Channel Flow Status	1=no flow; 2=low; 3=moderate; 4=high	Water	TCEQ SOP, V2	89848	NA	NA	NA	NA	NA	90
Maximum pool width at time of study	meters	Water	TCEQ SOP, V2	89864	NA	NA	NA	NA	NA	90
Maximum pool depth in study area	meters	Water	TCEQ SOP, V2	89865	NA	NA	NA	NA	NA	90
Total stream bends	#	Water	TCEQ SOP, V2	89839	NA	NA	NA	NA	NA	90
Well-defined stream bends	#	Water	TCEQ SOP, V2	89840	NA	NA	NA	NA	NA	90
Moderately defined stream bends	#	Water	TCEQ SOP, V2	89841	NA	NA	NA	NA	NA	90
Poorly defined stream bends	#	Water	TCEQ SOP, V2	89842	NA	NA	NA	NA	NA	90
Riffles	#	Water	TCEQ SOP, V2	89843	NA	NA	NA	NA	NA	90
Dominant substrate	1=clay; 2=silt; 3=sand; 4=gravel; 5=cobble; 6=boulder; 7=bedrock; 8=other	Water	TCEQ SOP, V2	89844	NA	NA	NA	NA	NA	90

Parameter	Units	Matrix	Method	Parameter Code	AWRL	LOQ	Recovery at LOQ (%)	Precision (RPD of LCS/LCSD)	Bias %Rec. of LCS	Completeness (%)
Avg. % of substrate gravel >2mm	%	Water	TCEQ SOP, V2	89845	NA	NA	NA	NA	NA	90
Avg. % instream cover	%	Water	TCEQ SOP, V2	84159	NA	NA	NA	NA	NA	90
Stream Cover Types	#	Water	TCEQ SOP, V2	89929	NA	NA	NA	NA	NA	90
Avg. % stream bank erosion potential	%	Water	TCEQ SOP, V2	89846	NA	NA	NA	NA	NA	90
Avg. stream bank angle	degrees	Water	TCEQ SOP, V2	89847	NA	NA	NA	NA	NA	90
Avg. width natural riparian vegetation	meters	Water	TCEQ SOP, V2	89866	NA	NA	NA	NA	NA	90
Avg. % trees as riparian vegetation	%	Water	TCEQ SOP, V2	89849	NA	NA	NA	NA	NA	90
Avg. % shrubs as riparian vegetation	%	Water	TCEQ SOP, V2	89850	NA	NA	NA	NA	NA	90
Avg. % grasses and forbs as riparian vegetation	%	Water	TCEQ SOP, V2	89851	NA	NA	NA	NA	NA	90
Avg. % cultivated fields as riparian vegetation	%	Water	TCEQ SOP, V2	89852	NA	NA	NA	NA	NA	90
Avg. % other as riparian vegetation	%	Water	TCEQ SOP, V2	89853	NA	NA	NA	NA	NA	90
Avg.% tree canopy coverage	%	Water	TCEQ SOP, V2	89854	NA	NA	NA	NA	NA	90
Overall Aesthetics	1=wilderness; 2=natural; 3=common; 4=offensive	Water	TCEQ SOP, V2	89867	NA	NA	NA	NA	NA	90
Texas Ecoregion Code	#	Water	TCEQ SOP, V2	89961	NA	NA	NA	NA	NA	90
Land development impact	1=unimpacted; 2=low; 3=moderate; 4=high	Water	TCEQ SOP, V2	89962	NA	NA	NA	NA	NA	90
24-Hr D.O. Avg.	mg/l	Water	TCEQ SOP, V1	89857	NA	NA	NA	NA	NA	90
Max Daily DO	mg/l	Water	TCEQ SOP, V1	89856	NA	NA	NA	NA	NA	90
Min Daily DO	mg/l	Water	TCEQ SOP, V1	89855	NA	NA	NA	NA	NA	90

Parameter	Units	Matrix	Method	Parameter Code	AWRL	LOQ	Recovery at LOQ (%)	Precision (RPD of LCS/LCSD)	Bias %Rec. of LCS	Completeness (%)
#DO measurements during 24-Hrs	# meas.	Water	TCEQ SOP, V1	89858	NA	NA	NA	NA	NA	90
24-Hr Avg. water Temperature	° Celsius	Water	TCEQ SOP, V1	00209	NA	NA	NA	NA	NA	90
Max Daily water Temperature	° Celsius	Water	TCEQ SOP, V1	00210	NA	NA	NA	NA	NA	90
Min Daily water Temperature	° Celsius	Water	TCEQ SOP, V1	00211	NA	NA	NA	NA	NA	90
# water temp measurements during 24-Hrs.	# meas.	Water	TCEQ SOP, V1	00221	NA	NA	NA	NA	NA	90
24-Hr Avg. Spec Conductance	uS/cm	Water	TCEQ SOP, V1	00212	NA	NA	NA	NA	NA	90
Max Spec Conductance	uS/cm	Water	TCEQ SOP, V1	00213	NA	NA	NA	NA	NA	90
Min Spec Conductance	uS/cm	Water	TCEQ SOP, V1	00214	NA	NA	NA	NA	NA	90
# Spec Conductance measurements during 24-Hrs.	# meas.	Water	TCEQ SOP, V1	00222	NA	NA	NA	NA	NA	90
Max Daily pH	Standard units	Water	TCEQ SOP, V1	00215	NA	NA	NA	NA	NA	90
Min Daily pH	Standard units	Water	TCEQ SOP, V1	00216	NA	NA	NA	NA	NA	90
# pH measurements during 24-Hrs.	# meas.	Water	TCEQ SOP, V1	00223	NA	NA	NA	NA	NA	90
24-Hr Salinity Avg.	ppt	Water	TCEQ SOP, V1	00218	NA	NA	NA	NA	NA	90
Max Daily Salinity	ppt	Water	TCEQ SOP, V1	00217	NA	NA	NA	NA	NA	90
Min Daily Salinity	ppt	Water	TCEQ SOP, V1	00219	NA	NA	NA	NA	NA	90
# salinity measurement during 24-Hrs	# meas.	Water	TCEQ SOP, V1	00220	NA	NA	NA	NA	NA	90

TCEQ SOP, V1 - *TCEQ SWQM Procedures, Volume 1: Physical and Chemical Monitoring Methods*, 2008 (RG-415).

TCEQ SOP, V2 - *TCEQ SWQM Procedures, Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data*, 2005 (RG-416)

A8 Special Training/Certification

Field personnel will receive training in proper sampling and field analysis. Before actual sampling or field analysis occurs, they will demonstrate to the Field Operations Manager their ability to properly operate the samplers and retrieve samples. The Field Operations Manager will document the proficiency of individual field staff within each of their field training books.

Field personnel will receive training on the set up and routine maintenance on the ISCO 4230 Flowmeter used for continuous flow monitoring.

Field personnel will receive training on the calibration and operation of the SonTek Doppler Flowmeter and the RiverCat Flowmeter for taking flow measurements.

BRA must ensure that laboratories analyzing samples under this QAPP meet the requirements contained in section 5.4.4 of the NELAC standards (concerning Review of Requests, Tenders and Contracts).

A9 Documents and Records

Laboratory Test Reports

- Test/data reports from the laboratory will document the test results clearly and accurately. Routine data reports will be consistent with the NELAC standards (Section 5.5.10) and include the information necessary for the interpretation and validation of data.

The information in test reports will be consistent with the information that is needed to prepare data submittals to TSSWCB.

Reports will be consistent with the NELAC standards and will include any additional information critical to the review, verification, validation, and interpretation of data.

Electronic Data

Data will be submitted to the TSSWCB in the event/result format specified in the *TCEQ Data Management Reference Guide* (DMRG) for upload to the Surface Water Quality Monitoring Information System (SWQMIS). The Data Summary as contained in Appendix C of this document will be submitted with the data.

A station location request (SLOC) will be submitted to TCEQ for each sampling site in order to obtain a station identification number.

All reported Events will have a unique TagID (see DMRG). TagIDs used in this project will be seven-character alphanumerics with the structure of the two-letter Tag prefix followed by a five digit number.

Reporting Entity, Monitoring Entity, and Monitoring Type will reflect the project organization and monitoring type in accordance with the DMRG. The proper coding of Monitoring Type is essential to accurately capture any bias toward certain environmental condition (for example, high flow events). The TSSWCB QAO should be consulted to assure proper use of the Monitoring Type code.

Records and Documents Retention Requirements

Document/Record	Location at BRA	Retention	Form
QAPP, amendments, and appendices	Central Files	5 years	Paper
QAPP distribution documentation	Central Files	5 years	Paper/Electronic
Training records	Central Files	5 years	Paper/Electronic
Field notebooks or field data sheets	Central Files	5 years	Paper
Field equipment calibration/maintenance l	Central Files	5 years	Paper
COC records	Central Files	5 years	Paper
Field SOPs	Central Files	5 years	Paper
Laboratory QA manuals	QAO Office	5 years	Paper/Electronic
Laboratory SOPs	Lab	5 years	Paper/Electronic
Laboratory procedures	Lab	5 years	Paper
Instrument raw data files	Lab	5 years	LIMS Electronic
Instrument readings/printouts	Lab	5 years	Paper
Laboratory data reports/results	Lab	5 years	Paper
Laboratory equipment maintenance logs	Lab	5 years	Paper
Laboratory calibration records	Lab	5 years	LIMS Electronic
Corrective action documentation	Lab	5 years	Paper/Electronic

B1 Sampling Process Design (Experimental Design)

To provide sufficient water quality data to characterize bacteria loadings across the various flow regimes, BRA will conduct routine ambient monitoring once every two weeks at ten sites. Currently routine monitoring is conducted quarterly at one site Campbells Creek at SH 6 (16395). When authorization to enter wastewater treatment facilities (WWTF) at Calvert, Bremond and Franklin is obtained from both the TCEQ and the respective municipalities, BRA will conduct effluent monitoring at the three WWTFs once every two weeks in an effort to estimate possible contributions from wastewater discharges. BRA will conduct biased-flow monitoring under high flow (storm event) conditions at the same ten stream sites and three WWTFs during at least twelve storm events. BRA will conduct biological monitoring on the Little Brazos River below the confluence of the tributaries to assess the cumulative impact of the impaired segments on stream health and biological communities.

Field data and samples will be collected following procedures detailed in the *TCEQ SWQM Procedures, Volume **1:**Physical and Chemical Monitoring Methods, 2008 (RG-415).*

Table B1.1 Monitoring Sites

Segment	Site Number	Site Description	Latitude Longitude	Sample Matrix	Monitoring Frequencies					
					Field	Flow	*E. coli*	Biased Flow	Continuous Flow	Biological
1242E	11591	Little Brazos River @ SH 21	30.6417 -96.5208	Water	2	2	---	---	---	2
1242I	16395	Campbells Creek @ Old Hearne Rd	30.789 -96.486	water	41∗	41∗	41∗	12**	22 Months	---
1242I	20561	Campbells Creek @ Jack Rabbit Lane	30.7904 -96.4547	water	41∗	41∗	41∗	12**	---	---
1242K	16402	Mud Creek @ SH 6	30.94681 -96.6473	water	41∗	41∗	41∗	12**	22 Months	---
1242K	20562	Mud Creek @ CR 260	30.97753 -96.56803	water	41∗	41∗	41∗	12**	---	---
1242L	16401	Pin Oak Creek @ DS of SH 6	30.851 -96.565	water	41∗	41∗	41∗	12**	22 Months	---
1242L	20563	Pin Oak Creek @ CR 391	30.8900 -96.51298	water	41∗	41∗	41∗	12**	---	---
1242M	16394	Spring Creek @ SH 6/US190	30.80224 -96.5122	water	41∗	41∗	41∗	12**	22 Months	---
1242M	20564	Spring Creek @ Jack Rabbit Lane	30.83556 -96.48972	water	41∗	41∗	41∗	12**	---	---
1242O	16403	Walnut Creek @ SH 6	31.01022 -96.7025	water	41∗	41∗	41∗	12**	22 Months	---

Segment	Site Number	Site Description	Latitude Longitude	Sample Matrix	Monitoring Frequencies					
					Field	Flow	*E. coli*	Biased Flow	Continuous Flow	Biological
1242O	20565	Walnut Creek @ Nesbit Rd/Tidwell Road	31.08906 -96.63129	water	41*	41*	41*	12**	---	---
1242O	TX002 3442	Bremond WWTF Outfall†	Not available	water	41*	41*	41*	12**	---	---
1242K	TX005 4020	Calvert WWTF Outfall†	Not available	water	41*	41*	41*	12**	---	---
1242K	TX002 1318	Franklin WWTF Outfall†	Not available	water	41*	41*	41*	12**	---	---

* Sampling (instream and WWTF) once every two weeks from November 2008 to May 2010

** Storm events over 19 months (November 2008 through May 2010)

†Pending authorization from the WWTP operators and TCEQ

B2 Sampling Methods

Field Sampling Procedures

Field sampling will be conducted according to procedures documented in the *TCEQ SWQM Procedures Volume 1: Physical and Chemical Monitoring Methods, 2008 (RG-415) and Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data, 2007* (*RG-416)*.

Flow-gauging stations will be added at five sites. Flow gauges will be programmed to take hourly flow measurements.

Biased-flow monitoring will be conducted at all routine sample locations within 48 hours of the Robertson County area experiencing a precipitation event of 0.45 inch or more within 12 hours. Precipitation amounts will be determined using the National Weather Service's Hourly Mean Areal Precipitation Estimates for the site at Brazos River at Valley Junction (30.82956°N - 96066062°W).

Routine sample collection will follow the field sampling procedures for conventional and microbiological parameters documented in the *TCEQ SWQM Procedures Volume 1: Physical and Chemical Monitoring Methods, 2008 (RG-415)*.

The sample volumes, container types, minimum sample volume, preservation requirements, and holding time requirements are specified in table B2.

Table B2 Instream and Effluent Monitoring

Parameter	Matrix	Sample Type	Container	Preservation	Sample Volume	Holding Time
E. coli	water	Grab	100 ml IDEXX bottle	ice, dark	100 ml	8 hours

Processes to Prevent Cross Contamination

Procedures outlined in the *TCEQ SWQM Procedures* outline the necessary steps to prevent cross-contamination of samples. These include such things as direct collection into sample containers and the use of commercially pre-cleaned sample containers.

Documentation of Field Sampling Activities

Field sampling activities are documented on the Field Data Sheet as presented in Appendix F. For all visits, station ID, location, sampling time, sampling date, sampling depth, preservatives added to samples, and sample collector's name/signature are recorded. Values for all measured field parameters are recorded. Detailed observational data are recorded including water appearance, weather, biological activity, stream uses, unusual odors, specific sample information, missing parameters, days since last significant rainfall, and flow severity.

The following will be recorded for all visits:

1. Station ID
2. Sampling Date
3. Location
4. Sampling depth
5. Sampling time
6. Sample collector's name/signature
7. Values for all field parameters
8. Detailed observational data, including:
    a. water appearance
    b. weather
    c. biological activity
    d. unusual odors
    e. pertinent observations related to water quality or stream uses (e.g., exceptionally poor water quality conditions/standards not met; stream uses such as swimming, boating, fishing, irrigation pumps, etc.)
    f. watershed or instream activities (events impacting water quality, e.g., bridge construction, livestock watering upstream, etc.)
    g. specific sample information (number of sediment grabs, type/number of fish in a tissue sample, etc.)
    h. missing parameters (i.e., when a scheduled parameter or group of parameters is not collected)

Recording Data

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

1. Legible writing in indelible, waterproof ink with no modifications, write-overs or cross-outs;
2. Changes should be made by crossing out original entries with a single line, entering the changes, and initialing and dating the corrections.
3. Close-outs on incomplete pages with an initialed and dated diagonal line.

Deficiencies, Nonconformances and Corrective Action Related to Sampling Requirements

Deficiencies are defined as unauthorized deviation from procedures documented in the QAPP. Nonconformances are deficiencies which affect quality and render the data unacceptable or indeterminate. Deficiencies related to sampling methods requirements include, but are not limited to, such things as sample container, volume, and preservation variations, improper/inadequate storage temperature, holding-time exceedances, and sample site adjustments.

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and reported to the cognizant field or laboratory supervisor who will notify the BRA QAO. The BRA

QAO will notify the BRA Project Manager of the potential nonconformance within 24 hours. The BRA staff member identifying the deficiency will initiate a record on the Deficiency Worksheet to document the deficiency.

The BRA QAO, in consultation with BRA Project Manager (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the deficiency worksheet will be completed accordingly. If it is determined a nonconformance does exist, the BRA QAO in consultation with BRA Project Manager will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the BRA QAO by completion of a Nonconformance Report.

Nonconformance Reports (NRs) document: root cause(s); programmatic impact(s); specific corrective action(s) to address the deficiency; 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. NRs will be included with quarterly progress reports. 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 Sampling Handling and Custody

Sample Labeling

Samples from the field are labeled on the container with an indelible marker. Label information includes:

1. Sample Number, Bottle Letter, and Site Number
2. Date and time of collection
3. Sample Depth
4. Initials of collector

Sample Handling

Samples are collected in the field and stored in coolers on ice. Samples are delivered to the Authority's water quality laboratory in coolers with field data sheets (COC Forms) attached. The laboratory staff examines each sample container for anomalies and ensures that all container information matches the information on the appropriate field data sheet. If the information is present and correct, the lab staff will receive the samples by signing the field data sheet "received by" block and entering the samples into the laboratory sample log book. At this instant, the samples become the responsibility of the Authority's water quality laboratory.

Internal sample handling, custody, and storage procedures for laboratory are described in the BRA's Environmental Laboratory Quality Manual and Sample Receiving SOP.

Sample Tracking

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.

A sample is in custody if it is in actual physical possession or in a secured area that is restricted to authorized personnel. The field data sheet serves as the COC form to document sample handling during transfer from the field to the laboratory. The following information concerning the sample is recorded on the field data sheet form (See Appendix G).

1. Date and time of collection
2. Site identification
3. Sample matrix
4. Number of containers
5. Residual chlorine
6. Preservative used
7. Was the sample filtered
8. Analyses required
9. Name of collector

10. Custody transfer signatures and dates and time of transfer

Deficiencies, Nonconformances and Corrective Action Related to Chain-of Custody

Deficiencies are defined as unauthorized deviation from procedures documented in the QAPP. Nonconformances are deficiencies which affect quality and render the data unacceptable or indeterminate. Deficiencies related to chain-of-custody include but are not limited to delays in transfer, resulting in holding time violations; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc.

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and reported to the cognizant field or laboratory supervisor who will notify the BRA QAO. The BRA QAO will notify the BRA Project Manager of the potential nonconformance within 24 hours. The BRA staff member identifying the deficiency will initiate a record on the Deficiency Worksheet to document the deficiency.

The BRA QAO, in consultation with BRA Project Manager (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the deficiency worksheet will be completed accordingly. If it is determined a nonconformance does exist, the BRA QAO in consultation with BRA Project Manager will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the BRA QAO by completion of a Nonconformance Report.

Nonconformance Reports (NRs) document: root cause(s); programmatic impact(s); specific corrective action(s) to address the deficiency; 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. NRs will be included with quarterly progress reports. 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.

B4 Analytical Methods

The analytical methods are listed in Table A.1 of Section A7. Laboratories collecting data under this QAPP are compliant with the NELAC Standards.

Copies of laboratory SOPs are retained by the BRA 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 field and laboratory are traceable to certified reference materials. Standards and reagent preparation is fully documented and maintained in a standards log book. Each documentation includes information concerning the standard or reagent identification, starting materials, including concentration, amount used and lot number; date prepared, expiration date and preparer's initials/signature. The bottle is labeled in a way that will trace the standard or reagent back to preparation. Standards or reagents used are documented each day samples are prepared or analyzed.

Deficiencies, Nonconformances and Corrective Action Related to Analytical Methods

Deficiencies are defined as unauthorized deviation from procedures documented in the QAPP. Nonconformances are deficiencies which affect quality and render the data unacceptable or indeterminate. Deficiencies related to field and laboratory measurement systems include but are not limited to instrument malfunctions, blank contamination, quality control sample failures, etc.

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and reported to the cognizant field or laboratory supervisor who will notify the BRA QAO. The BRA QAO will notify the BRA Project Manager of the potential nonconformance within 24 hours. The BRA staff member identifying the deficiency will initiate a record on the Deficiency Worksheet to document the deficiency.

The BRA QAO, in consultation with BRA Project Manager (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the deficiency worksheet will be completed accordingly. If it is determined a nonconformance does exist, the BRA QAO in consultation with BRA Project Manager will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the BRA QAO by completion of a Nonconformance Report.

Nonconformance Reports (NRs) document: root cause(s); programmatic impact(s); specific corrective action(s) to address the deficiency; 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. NRs will be included with quarterly

progress reports. 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.

B5 Quality Control

Sampling Quality Control Requirements and Acceptability Criteria

Detailed laboratory QC requirements are contained within the ES Laboratory QM.

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*. 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.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria

Method Specific QC requirements – QC samples, other than those specified later this section, are run (e.g., sample duplicates, positive control, negative control, and media blank) as specified in the methods. The requirements for these samples, their acceptance criteria or instructions for establishing criteria, and corrective actions are method-specific.

Detailed laboratory QC requirements and corrective action procedures are contained within the individual laboratory quality manuals (QMs). The minimum requirements that all participants abide by are stated below.

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 bacteriological duplicate is considered to be 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 as specified in Table A7.1. The specifications for bacteriological duplicates in Table A7.1 apply to samples with concentrations >10 MPN/100mL.

Deficiencies, Nonconformances and Corrective Action Related to Quality Control

Deficiencies are defined as unauthorized deviation from procedures documented in the QAPP. Nonconformances are deficiencies which affect quality and render the data unacceptable or indeterminate. Deficiencies related to Quality Control include but are not limited to quality control sample failures.

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and reported to the cognizant field or laboratory supervisor who will notify the BRA QAO. The

BRA QAO will notify the BRA Project Manager of the potential nonconformance within 24 hours. The BRA staff member identifying the deficiency will initiate a record on the Deficiency Worksheet to document the deficiency.

The BRA QAO, in consultation with BRA Project Manager (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the deficiency worksheet will be completed accordingly. If it is determined a nonconformance does exist, the BRA QAO in consultation with BRA Project Manager will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the BRA QAO by completion of a Nonconformance Report.

Nonconformance Reports (NRs) document: root cause(s); programmatic impact(s); specific corrective action(s) to address the deficiency; 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. NRs will be included with quarterly progress reports. 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

Flow gauge testing and maintenance requirements are contained with Appendix E of this document.

All instream sampling equipment testing and maintenance requirements are detailed in the *TCEQ SWQM Procedures*. Equipment records are kept on all field equipment and a supply of critical spare parts is maintained by the BRA Field Supervisor.

All laboratory tools, gauges, instrument, and equipment testing and maintenance requirements are contained within laboratory QM(s). Testing and maintenance records are maintained and are available for inspection by the TSSWCB. Instruments requiring daily or in-use testing may include, but are not limited to, water baths, ovens, incubators, refrigerators, and laboratory pure water. Critical spare parts for essential equipment are maintained to prevent downtime. Maintenance records are available for inspection by the TSSWCB.

B7 Instrument/Equipment Calibration and Frequency

Calibration and operation procedures for the SonTek Doppler flowmeter are included in Appendix F of this document. Calibration and operation procedures for the RiverCat flowmeter are included in Appendix F. Calibration requirements for the ISCO 4230 Flowmeter is included in Appendix E of this document.

Hydrolab calibration requirements are contained in the *TCEQ SWQM Procedures.*. Post calibration error limits and the disposition resulting from error are adhered to. Data not meeting post-error limit requirements invalidates associated data collected subsequent to the pre-calibration and are not submitted to the TSSWCB.

Detailed laboratory calibrations are contained within the ESL QAM.

B8 Inspection/Acceptance of Supplies and Consumables

New batches of supplies are tested and the results recorded in the appropriate logbook before use to verify that they are not contaminated. The ESL QAM provides additional details on acceptance requirements for laboratory supplies and consumables.

B9 Non-direct Measurements

Historical data will be retrieved from the SWQMIS. Historical data were collected and analyzed consistently with *TCEQ SWQM Procedures* under the SWQM QAPP or CRP QAPP or EPA approved Brazos/Navasota QAPP and therefore are considered representative of ambient conditions and will be comparable to data collected under this project. Table B9.1 shows the date range of data for each of six existing sites for which SWQMIS has historical data. The mean and median will be computed for each parameter as well as the number of water quality criteria exceedances, as applicable. This information will be compared statistically to the results of data collected under this project. Due to the historical data's comparability to the data collected under this project, there are not limitations on their use.

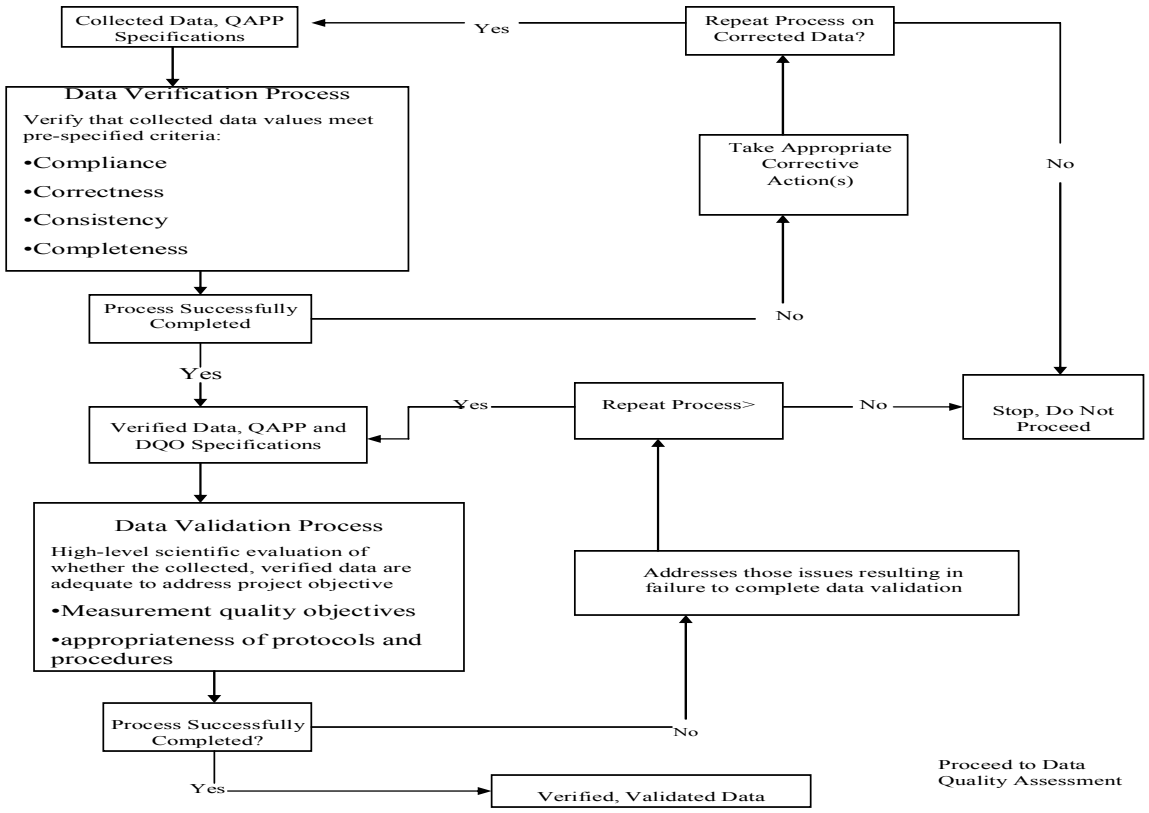
Table B9.1 Historical Data

Site Number	Site Name	Date Range of Historical Data
11591	Little Brazos River @ SH 21	05/97 – 08/99 and 09/07 – 08/08
16394	Spring Creek @ SH 6/US190	09/99 – 08/07
16395	Campbells Creek @ Old Hearne Rd	09/99 – 08/00 and 09/05 – 08/08
16401	Pin Oak Creek @ downstream of SH 6	09/98 – 08/07
16402	Mud Creek @ SH 6	09/98 – 08/07
16403	Walnut Creek @ SH 6	09/98 – 08/07

B10 Data Management

Data Management Process

Figure B10.1 Data Flow



Data Path

Samples are collected and are transferred to the laboratory for analyses as described in Sections B1 and B2. Sampling information (e.g. site location, date, time, sampling depth, etc.) is used to generate a unique sampling event in an interim database built on an autogenerated alphanumeric key field. Measurement results from both the field data sheets and laboratory data sheets are manually entered into the interim database for their corresponding event. Customized data entry forms facilitate accurate data entry. Following data verification and validation, the data are exported from the interim database to prepare ASCII delimited text files for reporting in TCEQ

format. Once TSSWCB approval of the data is obtained, the interim data are appended to the primary database.

Record-keeping and Data Storage

BRA recordkeeping and document control procedures are contained in the BRA Environmental Services QAM and this QAPP. Original field and laboratory data sheets are stored in the BRA Central Files in a fireproof file in accordance with the record-retention schedule in Section A9. There is a Differential and Transaction Log backup of the database every four hours. A full backup is done once a week. The backup process is done by the SQL software. A tape backup is made of the entire system every night and transmitted to an offsite facility for storage.

Data Verification/Validation

The control mechanisms for detecting and correcting errors and for preventing loss of data during data reduction, data reporting, and data entry are contained in Sections D1, D2, and D3.

Laboratory technicians review all data before finalizing data reports, if needed and the sample is still within holding time the technician will reanalyze samples not meeting QA requirements. The Laboratory Manager reviews all data following analysis and checks for calculation errors or data entry errors. The BRA QAO performs a third review of data to determine validity within this QAPP.

Data that is not valid, for quality reasons, is rejected by the data manager, and the corresponding LIMS data is automatically sent to a “Rejected Data” table.

Forms and Checklists

See Appendix F for the Field and Laboratory Data Sheets.
See Appendix C for the Data Summary.

Data Handling

Water Quality Database (LIMS) – The BRA’s laboratory database serves as a repository of water sample tracking and water quality analysis data until all appropriate tests and analyses have been performed and the results have undergone quality control review. The database resides on the Authority’s network server, as described above, and is maintained through third party software application named SampleMaster by Accelerated Technology Laboratories, Inc. Laboratory staff maintains the database through Dell OptiPlex® GX520-1 Pentium®-based computers provided with Microsoft Access® as the front end and Microsoft SQL® as the back end. Data input and access to the laboratory water quality database are restricted by password and network access to the Environmental Chemist, Laboratory Technician, Quality Assurance and Data Manager and the IT Project Administrator/Database Analyst. These data also are reported to the TSSWCB, TCEQ, Texas Water Development Board, and other agencies.

Hardware and Software Requirements

Hardware configurations are sufficient to run Microsoft Access 2003 under the Windows Server 2003 operating system in a networked environment. Information resources staff are responsible for assuring hardware configurations meet the requirements for running current and future data management/database software as well as providing technical support. Software development and database administration are also the responsibility of the information resources department. Information resources develop applications based on user requests and assures full system compatibility prior to implementation.

Information Resource Management Requirements

BRA information technology (IT) policy is contained in IT SOPs which are available for review at BRA offices.

C1 Assessments and Response Actions

Table C1.1 Assessments and Response Actions

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring Oversight, etc.	Continuous	BRA Project Manager	Monitoring of the project status and records to ensure requirements are being fulfilled.	Report to TSSWCB in Quarterly Progress Reports
Laboratory Inspection	At least once per life of the project; dates to be determined by the TSSWCB	TSSWCB QAO	Analytical and quality control procedures employed at the laboratory	30 days to respond in writing to the TSSWCB to address corrective actions
Monitoring Systems Audit	At least once per life of the project; dates to be determined by TSSWCB	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	30 days to respond in writing to the TSSWCB to address corrective actions
Laboratory Inspection	Based on work plan and or discretion of BRA	BRA QAO	Analytical and quality control procedures employed at the laboratory and the contract laboratory	30 days to respond in writing to the BRA QAO to address corrective actions
Monitoring Systems Audit	Based on work plan and or discretion of BRA	BRA 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	30 days to respond in writing to the BRA QAO to address corrective actions
Site Visit	At least once per fiscal year; dates to be determined by TSSWCB	TSSWCB PM	Status of activities. Overall compliance with work plan and QAPP	As needed

Corrective Action

The BRA Environmental Services Manager 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 both the TSSWCB PM and the BRA QAO.

If audit findings and corrective actions cannot be resolved, then the authority and responsibility for terminating work is specified in the TSSWCB QMP and in agreements or contracts between participating organizations.

C2 Reports to Management

Reports to TSSWCB Project Management

All reports detailed in this section are contract deliverables and are transferred to the TSSWCB in accordance with contract requirements.

Quarterly Progress Report – Summarizes the BRA' activities for each task; reports problems, delays, and corrective actions; and outlines the status of each task's deliverables.

Final Project Report – Summarizes the BRA activities for the entire project period including a description and documentation of major project activities; evaluation of the project results and environmental benefits:

- monitoring data files and Data Summary;
- Technical Report characterizing trends and variability in historical water quality monitoring data;
- Technical Report characterizing trends and variability in collected water quality monitoring data.

Reports to BRA Project Management

Environmental Services Manager and QA Manager conduct bimonthly management review reports to cover QA/QC activities, data completion, and status of project objectives.

D1 Data Review, Verification, and Validation

For the purposes of this document, data verification is a systematic process for evaluating performance and compliance of a set of data to ascertain its completeness, correctness, and consistency using the methods and criteria defined in the ESL QAM, SOPs, and this QAPP. Validation means those processes taken independently of the data-generation processes to evaluate the technical usability of the verified data with respect to the planned objectives or intention of the project. Additionally, validation can provide a level of overall 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 DQOs which are listed in Section A7. Only those data which are supported by appropriate quality control data and meet the measurement performance specification defined for this project will be considered acceptable and used in the project.

The procedures for verification and validation of data are described in Section D2. The BRA Field Supervisor is responsible for ensuring that field data are properly reviewed and verified for integrity. The Laboratory Supervisor is responsible for ensuring that laboratory data are scientifically valid, defensible, of acceptable precision and bias, and reviewed for integrity. The BRA Data Manager will be responsible for ensuring that all data are properly reviewed and verified, and submitted in the required format to the project database. The BRA QAO is responsible for validating a minimum of 10% of the data produced in each task. Finally, the BRA Project Manager, with the concurrence of the BRA 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 to the project task. The data review tasks to be performed by field and laboratory staff are listed in the first two sections of Table D2, respectively. 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 manager of the task responsible for generating the data is contacted to resolve the issue. Issues which can be corrected are corrected and documented. If an issue cannot be corrected, the task manager consults with higher level project management to establish the appropriate course of action, or the data associated with the issue are rejected. 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 data set. This review step as specified in Table D2 is performed by the BRA Data Manager and QAO. Data review, verification, and validation tasks to be performed on the data set 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 QAO. 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 BRA Project Manager validates that the data meet the DQOs of the project and are suitable for reporting to TSSWCB.

If any requirements or specifications are not met, based on any part of the data review, the responsible party should document the nonconforming activities and submit the information to the BRA Data Manager with the data. This information is communicated to the TSSWCB by the BRA in the Data Summary.

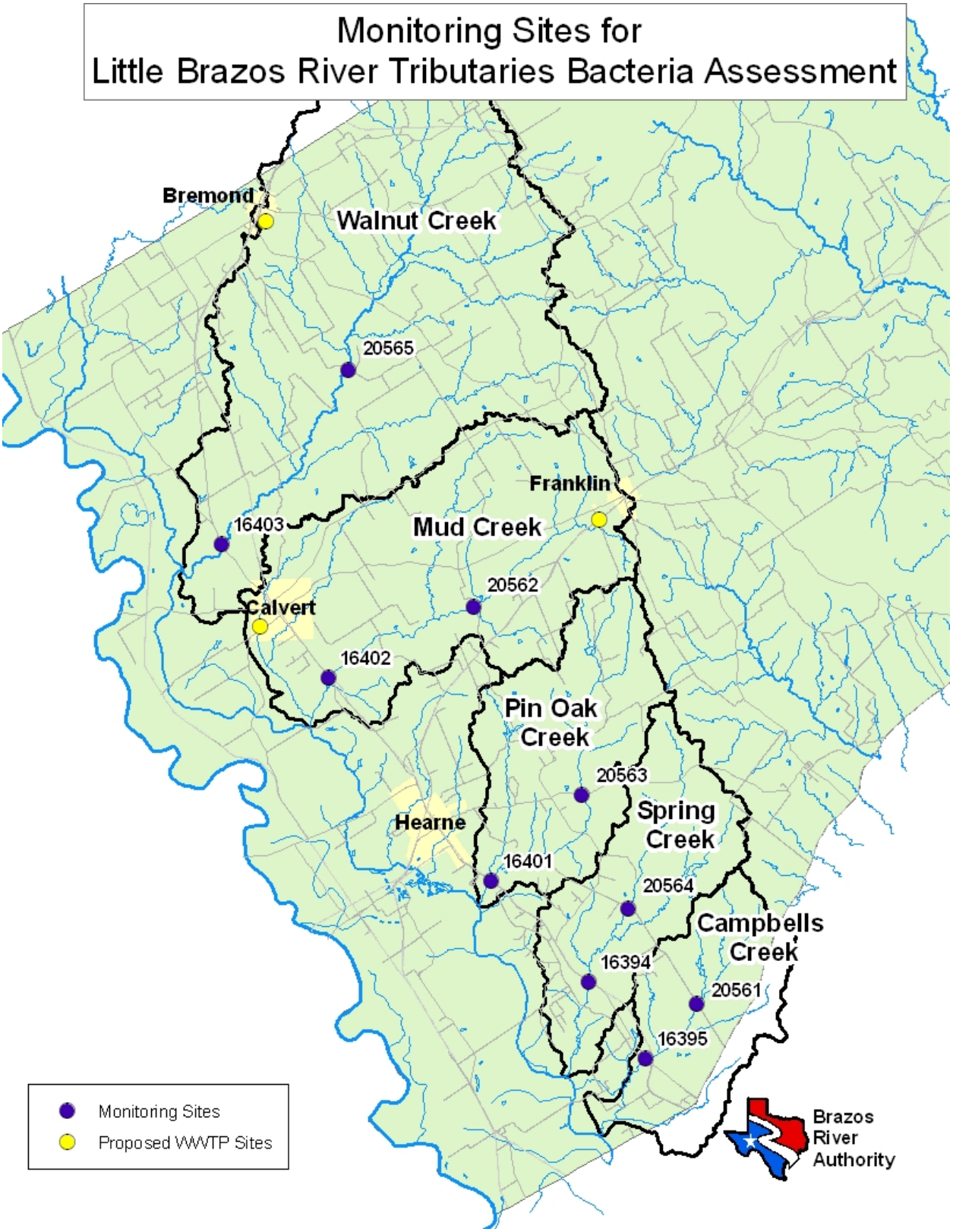
Table D2.1: Data Review Tasks

Field Data Review	**Responsibility**
Field data reviewed for conformance with data collection, sample handling and COC, analytical and QC requirements	Field Operations Manager / QAO
Post-calibrations checked to ensure compliance with error limits	Field Operations Manager / QAO
Field data calculated, reduced, and transcribed correctly	Field Operations Manager / QAO
Laboratory Data Review	**Responsibility**
Laboratory data reviewed for conformance with data collection, sample handling and COC, analytical and QC requirements to include documentation, holding times, sample receipt, sample preparation, sample analysis, project and program QC results, and reporting	Laboratory Manager / QAO
Laboratory data calculated, reduced, and transcribed correctly	Laboratory Manager / QAO
LOQs consistent with requirements for AWRLs.	Laboratory Manager / QAO
Analytical data documentation evaluated for consistency, reasonableness and/or improper practices	Laboratory Manager / QAO
Analytical QC information evaluated to determine impact on individual analyses	Laboratory Manager / QAO
All laboratory samples analyzed for all parameters	Laboratory Manager / QAO
Data Set Review	**Responsibility**
The test report has all required information as described in Section A9 of the QAPP	BRA Data Manager / PM
Confirmation that field and laboratory data have been reviewed	BRA Data Manager / PM
Data set (to include field and laboratory data) evaluated for reasonableness and if corollary data agree	BRA Data Manager / PM
Outliers confirmed and documented	BRA Data Manager / PM
Field QC acceptable (e.g., field splits and trip, field and equipment blanks)	BRA Data Manager / PM
Sampling and analytical data gaps checked and documented	BRA Data Manager / PM
Verification and validation confirmed. Data meets conditions of end use and are reportable	BRA Data Manager / PM

D3 Reconciliation with User Requirements

Data produced in this project, and data collected by other organizations (e.g., USGS, TCEQ, etc.), will be analyzed and reconciled with project data quality requirements. Data meeting project requirements will be used by TSSWCB and other project partners to assess sources of bacteria through data analysis and modeling in order to facilitate local decision-making. Additionally, data meeting project requirements will be submitted to the TCEQ for use in the biennial CWA §305(b) assessment for the *Texas Water Quality Inventory and 303(d) List*, and for TMDL development, stream standards modifications, and permit decisions as appropriate. Data which do not meet requirements will not be submitted to SWQMIS nor will be considered appropriate for any of the uses noted above.

Appendix A. Area Location Map


Monitoring Sites for
Little Brazos River Tributaries Bacteria Assessment
Bremond
Walnut Creek
20565
Franklin
Mud Creek
16403
20562
Calvert
16402
Pin Oak
Creek
20563
Spring
Creek
Hearne
16401
20564
Campbells
Creek
16394
20561
16395
Monitoring Sites
Proposed WWTP Sites
Brazos
River
Authority

Appendix B. Work Plan Excerpt

Tasks, Objectives and Schedules				
Task 5:	Surface Water Quality Monitoring			
Costs:	$ 202,232			
Objective:	To provide sufficient water quality data to characterize bacteria loadings across the various flow regimes at a number of locations throughout the study area.			
Subtask 5.1:	BRA will conduct routine ambient monitoring at 10 sites once every two weeks, collecting field, flow and bacteria parameter groups. Five of these sites shall be the same as those in Subtask 5.4. The sampling period extends over 22 months. Total number of sample events scheduled for collection through this subtask is 480. Currently, routine ambient monitoring is conducted quarterly at 1 station by BRA (16395). BRA will avoid duplicative routine ambient monitoring at site 16395.			
	Start Date:	Month 3	Completion Date:	Month 24
Subtask 5.2:	BRA will conduct effluent monitoring at 3 WWTFs once every two weeks, collecting field, flow and bacteria parameter groups. The sampling period extends over 22 months. Total number of sample events scheduled for collection through this subtask is 144. Coordination between TPDES permittees and the TCEQ Regional Office will be required.			
	Start Date:	Month 3	Completion Date:	Month 24
Subtask 5.3:	BRA will conduct biased-flow monitoring under high flow (storm event influenced) conditions at the 10 stream sites (Subtask 5.1) and the 3 WWTFs (Subtask 5.2) during at least 12 storm events collecting field, flow and bacteria parameter groups (grab samples). The sampling period extends over 22 months. Total number of sample events budgeted for collection through this subtask is 156.			
	Start Date:	Month 3	Completion Date:	Month 24
Subtask 5.4:	BRA will establish, and maintain, continuous flow monitoring gages at 5 sites (1 per segment). These sites shall be located as close to the confluence with the Little Brazos River as is feasible. Continuous sampling extends over 22 months.			
	Start Date:	Month 3	Completion Date:	Month 24
Subtask 5.5:	BRA will conduct biological monitoring at least once on the Little Brazos River to assess the cumulative impact of the impaired segments on stream health and biological communities.			
	Start Date:	Month 3	Completion Date:	Month 24
Subtask 5.6:	BRA will transfer monitoring data from activities in Task 5 to TSSWCB for inclusion in the TCEQ SWQMIS at least quarterly. 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*. BRA will submit Station Location Requests as needed to obtain TCEQ station numbers for new monitoring sites. Data Correction Request Forms will be submitted to TSSWCB whenever errors are discovered in data already reported. BRA will post monitoring data from activities in Task 5 to the BRA website in a timely manner.			
	Start Date:	Month 3	Completion Date:	Month 24
Subtask 5.7	BRA will cooperate with TAMU BAEN, through TSSWCB project 08-55, to 1) conduct an LDC analysis of all historic and existing water quality monitoring data from the study area, and 2) refine those LDCs using water quality monitoring data collected through this project (Subtasks 5.1-5.4).			
	Start Date:	Month 3	Completion Date:	Month 21
Deliverables	• Station Location Request Forms (as needed) in electronic format • Monitoring data files and Data Summary in electronic format • Data Correction Request Forms (as needed) in electronic format • Monitoring data updates posted to the BRA website • Technical Report characterizing trends and variability in historical water quality monitoring data • Technical Report characterizing trends and variability in collected water quality monitoring data			

Appendix C. Data Summary

Data Summary

Data Information

Data Source: **Brazos River Authority _ MS Access Database**

Date Submitted: _____

Tag_ID Range: _____

Date Range: _____

Comments

Please explain in the space below any data discrepancies including:

- **Inconsistencies with AWRL specifications;**
- **Failures in sampling methods and/or laboratory procedures that resulted in data that could not be reported to the TCEQ; and**
- **Other discrepancies.**

_____
_____
_____
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_____
_____

Planning Agency Data Manager_____

Date: _____

Appendix D. Flow Logger and Automated Sampler SOP

Bubbler Flow Meter Specifications
Isco Model 4230

1.0 INSTRUMENT

A. There shall be furnished a recording, totalizing open channel flow meter suitable for portable or fixed-site monitoring. A bubbler system shall be used to measure level.

1.1 BUBBLER

A. A pressure transducer in the flow meter shall measure the liquid level. An internal air compressor shall provide a continuous supply of air to the bubble tube. The bubble tube shall be 1/8 in. (0.32 cm) inside diameter and 50 ft. long. The flow meter shall include automatic bubble line purge to minimize plugging of the bubble tube.

B. The level measurement range of the bubbler shall be from 0.01 to 10 feet (0.003 to 3.05 m). The level shall be measured with a maximum error of +/- 0.005 feet (+/- 0.002 m) over a range of 0.01 to 1.0 feet (0.003 to 0.31 m), +/- 0.010 feet (+/- 0.003 m) over a range of 0.01 to 5.0 feet (0.003 to 1.52 m), and +/- 0.035 feet (+/- 0.011 m) from 0.01 to 10 feet (0.003 to 3.05 m). The temperature coefficient shall be +/- 0.0003 times the level in feet times the temperature change from 77 degrees F (+/- 0.00054 times the level in meters times the temperature change from 25 degrees C) over the compensated temperature range of 32 to 140 degrees F (0 to 60 degrees C).

C. The flow meter shall include automatic drift compensation to periodically reference both sides of the transducer to atmospheric pressure and automatically compensate for errors due to temperature, warm-up and long-term drift. After a 5 minute warm-up period, automatic drift compensation shall correct the zero level to +/- 0.002 feet (+/- 0.0006 m) at intervals between 2 and 15 minutes.

1.2 FLOW METER

A. Measured liquid level readings shall be converted into corresponding flow rate readings using internal conversion algorithms. The flow meter shall contain conversions for V-notch weirs, rectangular weirs with and without end contractions, Cipolletti weirs, Isco Flow Metering Inserts, and Parshall, Palmer-Bowlus, Leopold-Lagco, trapezoidal, H, HS and HL flumes. For monitoring in applications using the Manning formula in round, U-shaped, rectangular and trapezoidal channels, the flow meter shall accept information for channel shape and size, and slope and roughness coefficient. The flow meter shall accept 4 sets of level-flow rate points, with up to 50 pairs of points in each set. The flow meter shall accept a two-term, level-flow rate polynomial equation.

B. The flow meter shall contain a tactile keypad and a 2 line, 80 character, backlit alphanumeric liquid crystal display (LCD). The LCD shall visually prompt the user through the programming sequence. The LCD shall display level, flow rate, and total flow. The totalizer on the LCD shall be resettable. The LCD shall display the signal strength from the ultrasonic sensor to aid in installation and troubleshooting.

C. The internal data storage memory in the flow meter shall have a capacity of 80,000 bytes, divided into up to 12 user-defined partitions. Each partition shall be programmable to store level, and flow rate. Timing for the data storage shall be selectable in 1, 2, 5, 10, 15, 30, 60, or 120 minute intervals. Each partition shall be programmable to operate in either rollover, slate or triggered slate mode. The internal data storage memory in the flow meter shall be programmed using a windows based software program on an IBM PC or compatible computer. The software shall also retrieve stored data from the flow meter, and generate graphs and reports from stored data. The computer shall communicate with the flow meter using a 2400 baud telephone modem in the flow meter. Windows based software shall be supplied with the flow meter.

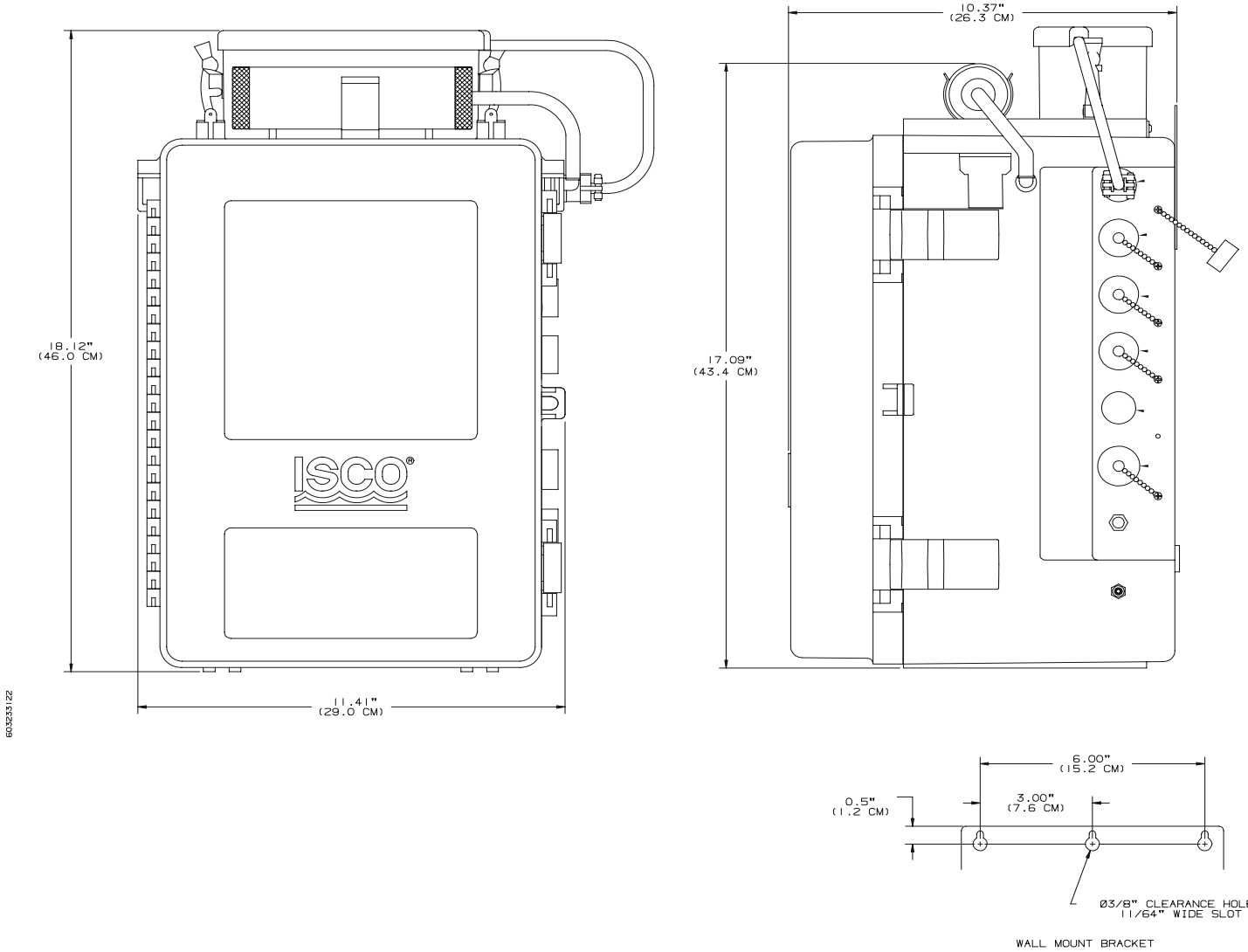
D. The flow meter shall have an RS-232 serial output to transmit information on all of its current readings. The data on the serial output shall be in ASCII format with values separated by commas. The serial output shall be at 1200, 2400, 4800 or 9600 baud. The flow meter shall output this data in response to the reception of a command on the serial port. The flow meter shall also be programmable to automatically transmit this data on a periodic time interval. The data shall include the flow meter description, ID number, model number, date and time, battery voltage, level, flow rate, and total flow.

E. The program memory in the flow meter shall be non-volatile, programmable flash memory. The program memory shall be capable of being updated via the serial port on the flow meter without opening the enclosure.

F. The flow meter shall require 12 volt DC power for operation. Power shall be supplied from a user-supplied 12 V DC source. An external 12 DC connect cable shall be supplied with the flow meter.

G. The flow meter shall be housed in a rugged, lockable, watertight, dust-tight, corrosion resistant (self-certified NEMA 4X and IP65) enclosure. The enclosure shall include a carrying strap, wall mounting bracket and a clear polycarbonate window for viewing the LCD and printer without opening the enclosure. An internal, easily replaceable, rechargeable desiccant canister shall keep the inside of the flow meter free of moisture.

Isco 4230 Bubbler Flow Meter



Appendix E. Flow Measurement Methods

SonTek Flow Tracker Steps

1. Vent the handheld controller.
2. Press the **Yellow** button to turn on unit.
3. Press **ENTER** for Main Menu.
4. From the Main Menu, press **3** to Start Data Run.
5. Press **1** to specify file name. This will be the LIMS#. Use the numbered keys for either number or letters. Press **ENTER**.
6. Press **9** to accept name.
7. Press **1** to enter Site name. This will be the station ID #. Use the numbered keys for either numbers or letters. Press **ENTER**.
8. Press **2** to specify operator. Use the numbered keys for either number or letters. Press **ENTER**.
9. Press **9** when ready to start data collection.
10. Press **ENTER**.
11. Press **1** to "Run Test" on the first measurement of the day. Press **2** to "Skip Test" on subsequent measurements.
12. Press **LEW/REW** to indicate right edge water or left edge water. This will be Station 0 and a depth of 0. The location may vary depending how the tag line is setup. If your tape is setup so that the waters edge is at zero then enter location as Zero. If the waters edge is at a different number then enter the measurement at the waters edge.
13. Press **Next Station**.
14. Press **Set Location**. Enter you distance away from the edge. Press **ENTER**.
15. Press **Set Depth**. Enter depth. Press **ENTER**.
16. If everything is correct, press **Measure**. If you make a mistake and need to change location or depth you can do so before you press Measure.
    NOTE: If you press measure and it gives you a QC Boundary Good, Fair, Poor question you can either reposition or move obstacles or just press whatever it says to just go ahead and take the measurement. (follow the screen instructions. Best and Good are good, I try to improve Fair and Poor).
17. After 40 seconds either a velocity measurement or QC warnings will be displayed. If you see a QC WARNING, determine if you need to repeat measurement, move obstacles, or adjust location. See common QC warnings. If you feel you need to repeat the measurement, press **2** and repeat measurement**.** If you are satisfied with the measurement press **1** to accept. The FlowTracker will automatically advance to the next Station.
18. Repeat Steps 13-16.
    NOTE: For each consecutive station the FlowTracker will default to the next location in the same increment as the station before. In most cases this will be correct and you will only need to change the depth for each station and press Measure. If you feel velocity or depth increases significantly, shorten you increments by using **Set Location**.
19. When you get to the last station you will almost always have to **Set Location** because it will be shorter than the other sections. Press **End Section**. Depth will be automatically set to 0.
20. Press **End Section** again. FlowTracker will then remind you of any QC errors, look for stations with > 10 % of the flow. Add a station before or after those stations. Press **End Section** when complete. Review GC errors again.

21. Press **1** to End Section.
22. Press **ENTER.**
23. This is the point of no return. Changes can not be made to the measurement after this step. Press **Calculate Discharge.** Press **Calculate Discharge** again.
24. Press **0** to Exit.

Answers to Typical Questions:

1. Abort will only abort the one measurement you are taking. If you press it, you will be able to Accept or Repeat the measurement. If you want to chuck the whole thing, you have to at least get to the point where you can End Section and Calculate Discharge. You can begin again but will have to start over and come up with a new file name.
2. Delete will only delete things you enter, like file name when you are typing or location or depth.
3. If you do forget to enter depth or location, when the measurement is finished, just press 2 to repeat measurement and you can reenter set depth or location before you press measure.
4. You can redo a measurement at anytime BEFORE you completely End Section. You just have to input the correct location. It may ask you a few questions to make sure you want to redo the location, but it can be done.

Common QC Warnings:

1. High Angle- As long as the sensor is perpendicular to the tape, you are fine.
2. High Spikes- Note your velocity reading. Check for obstacles and repeat. If you get the warning again see if velocities from first and second measurements are consistent. If they are accept reading. If not adjust probe and repeat.
3. SNR variation- Repeat once.

For the whole list see the manual software release notes Frimware 3.1 Software 2.10

SonTek RiverCat Quick Guide

SERIAL #M51 LICENSE #:914-495-672

1) Turn System ON:

Once the RiverCat has been assembled and the radio has been connected to the PC; turn on the RiverCat by pushing the Red Power Button. A series of red & green lights will flash on.

2) Open RiverSurveyor 4.60:

a) Double click the RiverSurveyor icon to open program.
b) Click on the "Systems" icon.
c) Choose the Comm port the "ADP" is connected.
d) Make sure Baud Rate is 9600.
e) Click "OK".

3) Connect to ADP:

a) Once the instrument is "Found", click on the "Go To ADP Setup" box.
b) A status bar should appear as the software communicates with the ADP.
c) Under Utilities on the right side: Click on Set System Time.
d) Adjust clock or Click on "Match to Computer Time".
e) Once the clock is adjusted, click on "Close".

4) Calibrate the Compass:

a) NOTE: Perform this operation outside and away from metal objects
b) Under Utilities on the right side: Click on "Calibrate Compass"
c) This will open a new box; choose "Start"
d) Slowly and gently rock the RiverCat side-to-side & front to back while rotating at least 720 degrees. Take at least 1 – 2 minutes for this process.
e) Once the rotation is complete, Select "Stop".
f) A report will appear on the quality of the calibration. Repeat the calibration if necessary. Otherwise, Click on "Close".

5) Create a File:

Under "Basic Settings" Tab:

a) Type in File name (up to 5 characters)
b) Adjust the averaging interval as required – refer to manual about averaging intervals.
c) Enter the "Magnetic Declination".
d) Enter the "Water Salinity".
e) Enter the Depth of Transducer head mounted below the water surface.

Under the "Profiling Range" Tab:

a) Enter the Maximum Depth of the water to be measured.
b) The "Number of Cells", "Cell Size", and "Blanking Distance" will automatically be calculated by the software. Manual adjustment is available.

Under the "Advanced Settings" Tab:

a) Select the type of coordinate system – default is "ENU".
b) Ensure that Bottom Track has "YES" selected.
c) Recorder should be "Disabled".
d) Temperature Mode – "Measured".
e) Click "OK"
f) "Transferring Files" Status bar should appear.
g) Both "ADP" and "Btrack" on the bottom right side of the screen should be Green.

6) Collect Data

a) Near the top left side of the screen, click on the Green Triangle (Play Button).
b) A status bar with "Interfacing with the ADP" and then "Verifying Settings" will appear.
c) Click on the Red Circle (Record Button) to begin recording data
d) Select "Left or Right Bank"
e) Enter the Measured Distance from the edge of water.
f) Select Bank Type – Sloped or Vertical.
g) After a pass has been completed, Click on the Red Circle again.
h) Enter the Ending Distance to the edge of water.
i) To make another pass, repeat steps 6c through 6h.
j) Once all of the measurements have been completed, Select the Black Box (Stop Button).
k) The system will disconnect from the PC.

NOTES:

1) To change units (English to Metric); Select File and then Configuration.
2) To view collected data, Select File and then Discharge Summary.
3) For Best Results the boat speed should be slower or the same as the measured water speed (velocity). The Bs/Ws box will be black when the speeds are similar; Yellow when boat speed is 1X the velocity; Red when boat speed is 2X the velocity.

SonTek Technical Support: 858.546.8327

Appendix F. Field and Laboratory Data Sheets

BRAZOS RIVER AUTHORITY
FIELD DATA SHEETS FOR SAMPLES COLLECTED FOLLOWING SWQM VOL.I

LIMS #/SITE ID #: _____
SITE NAME: _____
DATE: _____
TIME: _____
COLLECTORS: Baack Grimm
RUN: Little Brazos Tributary
Hydrolab SN# 46 47 51 05B 106 608 347 348 349

TNRCC Test Code		Description
89966		SKIES: 1=CLEAR, 2=PT/CLOUDY, 3=CLOUDY, 4=RAIN
89965		WIND: 1=CALM, 2=SLIGHT, 3=MOD, 4=STRONG
00078		TRANSPARENCY, SECCHI DISC (METERS)
89861		AVG STREAM WIDTH (METERS)
01351		FLOW SEVERITY: 1=NO FLOW, 2=LOW, 3=NORMAL, 4=FLOOD, 5=HIGH, 6=DRY
89835		FLOW METHOD: 1=USGS, 2=MARSH MCBIRNEY, 3=MECH, 4=WEIR/FLUE, 5=DOPPLER
00061		STREAM FLOW INSTANTANEOUS (CFS)
89926		AQUATIC VEGETATION @ COLLECTION SITE (PERCENT)
72053		DAYS SINCE LAST SIGNIFICANT PRECIPITATION (DAYS)

	Temp	D.O.	Specific Conductance	pH	Salinity	DO	Cl Res	Other:	
	(ºC)	(mg/L)	(µs/cm)	(s.u.)	(ppt)	(% Sat.)	(mg/L)		
DEPTH	00010	00300	00094	00400	00480	00301			Sample Type
Surface 0.3m									*E. coli*

COMMENTS

All Samples collected preserved on ice.

Meters into feet: Multiply by 3.281 Feet into meters: Multiply by 0.3048

Receiver's Signature Form Completed by:

Time of Receipt: _____ Date of Receipt: _____

MPN Total Coliform and *Escherichia coli* Analysis - IDEXX, BRA-017

Actual "In" Time _____

Run Name _____ Run Date _____ Incubator ID _____ **Take out between** _____ **and** _____

Run ID _____

Start Temp. (°C) Upper Shelf _____ End Temp. (°C) Upper Shelf _____ Sample# on Upper Shelf _____

Corrected Temp. (°C) _____ Corrected Temp. (°C) _____ Thermometer ID _____

Start Temp. (°C) Lower Shelf _____ End Temp. (°C) Lower Shelf _____ Sample#('s) on Lower Shelf _____

Corrected Temp. (°C) _____ Corrected Temp. (°C) _____ Thermometer ID _____

(Is Temperature 35 +/- 0.5°C??)

LIMS Number - TCEQ Monitoring Station Number	Time of Collection	Dilution Factor	Sample Set Time	# of Large wells Positive	# of Small wells Positive	MPN Reading from Table (Total Coliform)	MPN Reading x Dilution Factor (MPN/100ml)	# of Large wells Fluorescent	# of Small wells Fluorescent	MPN Reading from Table (*E. coli*)	MPN Reading x Dilution Factor (MPN/100ml)	31699 - Reported *E. coli* concentration (MPN/100ml)
1.												
2.												
3.												
4.												
5.												
6.												
7.												
8.												
9.												
10.												
11.												
12.												
13.												
14.												
15.												

Notes: _____

Lot Numbers: Media _____ Trays _____ 125 ml Bottles _____ 290 ml Bottles _____ DI Water _____ Pipettes _____

Samples Set by _____

Samples Read on _____ at _____ by _____ **Media Type:** Colilert 18 Colilert 24