Tidal Stream Use Assessment Phase II
Quality Assurance Project Plan
Revision #0

Segment Numbers 2001 and 2003

Date submitted to TCEQ: 03/10/2008.
FY 2007 - 09 Categorical 106 Water Pollution Control Program Grant
Federal Grant # 98665304

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Total Maximum Daily Load Program
Chief Engineer's Office, Water Programs
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This QAPP is effective for a period of one year from approval date.

Questions concerning this QAPP should be directed to:
Janet Nelson

A1 APPROVAL PAGE

Texas Commission on Environmental Quality
Chief Engineer's Office, Water Programs

Faith Hambleton, Program Manager — Date
Total Maximum Daily Load Program

Jason Leifester, Project Manager — Date
Total Maximum Daily Load Program

Office of Compliance and Enforcement
Compliance Support Division

Stephen Stubbs, Manager — Date
Quality Assurance Program

Kyle Girten, Quality Assurance Specialist — Date
Quality Assurance Program

Texas Parks & Wildlife Department

Janet Nelson, Project Manager and Quality Assurance Officer — Date

Lower Colorado River Authority

Gary Franklin LCRA Project Manager — Date

Hollis Pantalion, LCRA Quality Assurance Officer — Date

Note: The Texas Parks & Wildlife Department Quality Assurance Officer will secure written documentation (such as the letter in Appendix G) from each sub-tier project participant that is not signing the QAPP (e.g., subcontractors, other units of government, laboratories) stating the organization's awareness of and commitment to requirements contained in this quality assurance project plan and any amendments or revisions of this plan. The Texas Parks & Wildlife Department Quality Assurance Officer will maintain the documentation as part of the project's quality assurance records, and will ensure that the document is available for review. **Copies will also be submitted as deliverables to the TMDL Project Manager within 30 days of QAPP approval.**

A2 TABLE OF CONTENTS

A3 DISTRIBUTION LIST

Texas Commission on Environmental Quality
P.O. Box 13087
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(512) 356-6023

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Dharhas Pothina
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U.S. Environmental Protection Agency Region 6
Water Quality Division
1445 Ross Avenue
Suite # 1200 MC 6WQAT
Dallas, TX 75202-2733

Teresita Mendiola, Project Officer
(214) 665-7144

Note: The Texas Parks & Wildlife Department Quality Assurance Officer will provide copies of this project plan and any amendments or revisions of this plan to each person on this list and to sub-tier project participant, e.g., subcontractors, other units of government, laboratories. The Texas Parks & Wildlife Department Quality Assurance Officer will document receipt of the plan and maintain this documentation as part of the project's quality assurance records. This documentation will be available for review and will also be submitted to the TMDL Project Manager within 30 days of TCEQ QAPP approval.

List of Acronyms

(NOTE: Use only acronyms that apply to this QAPP. Add any that are needed for this specific project)

AWRL	Ambient Water Reporting Limit
BOD5	5-day Biochemical Oxygen Demand
CAR	Corrective Action Report
CBOD	Carbonaceous Biochemical Oxygen Demand
CFU	Colony-Forming Unit of Bacteria
COC	Chain of Custody
COD	Chemical Oxygen Demand
CRP	Clean Rivers Program
CWA	Clean Water Act
DOC	Demonstration of Capability
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DMRG	Data Management Reference Guide
EPA	Environmental Protection Agency
FOD	Field Operations Division
GPS	Global Positioning System
ISO/IEC	International Standard Organization/International Electrotechnical Commission
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 (formerly Method Detection Limit or MDL)
LOQ	Limit of Quantification (formerly Reporting Limit or RL)
MS	Matrix Spike
MDMA	Monitoring Data Management and Analysis
MPN	Most Probable Number
NELAC	National Environmental Laboratory Accreditation Conference
NPS	Nonpoint Source
QA/QC	Quality Assurance/Quality Control
QAO	Quality Assurance Officer
QAM	Quality Assurance Manual (or Manager)
QAP	Quality Assurance Plan
QAPP	Quality Assurance Project Plan
QAS	Quality Assurance Specialist
QMP	Quality Management Plan
RL	Changed to LOQ
RPD	Relative Percent Difference
SOP	Standard Operating Procedure
SWQM	Surface Water Quality Monitoring
SWQMIS	Surface Water Quality Monitoring Information System (formerly TRACS)
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TCEQ	Texas Commission on Environmental Quality
TOC	Total Organic Carbon
TPWD	Texas Parks and Wildlife Department
TSS	Total Suspended Solids
TSWQS	Texas Surface Water Quality Standards
USGS	United States Geological Survey
VOA	Volatile Organic Analyses

A4 PROJECT/TASK ORGANIZATION

Description of Responsibilities

U.S. EPA Region 6

Teresita Mendiola EPA Project Officer
Responsible for managing the project for EPA. Reviews project progress and reviews and approves applicable QAPP and QAPP amendments.

TCEQ Chief Engineer's Office
Water Programs

Faith Hambleton
TMDL Program Manager
Responsible for managing the TCEQ TMDL Program and supervises TMDL staff. Oversees the development of QA guidance for the TMDL Team to ensure sure it is within pertinent frameworks of the TCEQ. Reviews and/or approves all TMDL Projects, QA audits, QAPPs, agency QMPs, corrective action reports, work plans, and contracts. Enforces corrective action where QA protocols are not met. Ensures TCEQ TMDL personnel are fully trained.

Jason Leifester
TMDL Project Manager
Responsible for ensuring that the project delivers data of known quality, quantity, and type on schedule to achieve project objectives. Provides the primary point of contact between the Texas Parks & Wildlife Department and the TCEQ. Tracks and reviews deliverables to ensure that tasks in the work plan are completed as specified in the contract. Reviews and approves QAPP and any amendments or revisions and ensures distribution of approved/revised QAPPs to TCEQ participants. Responsible for verifying that the QAPP is followed by the Texas Parks & Wildlife Department. Notifies the TCEQ QAS, TMDL QAS, and TMDL Program Manager of significant project nonconformances and corrective actions taken as documented in CARs and/or quarterly progress reports from Texas Parks & Wildlife Department Project Manager.

TCEQ Compliance Support Division

Kyle Girten
TMDL Quality Assurance Specialist
Assists the TCEQ TMDL QAS, Program Manager, and Project Manager on QA-related issues. Coordinates reviews and approves QAPPs and amendments or revisions. Prepares and distributes annual audit plans. Conveys QA problems to appropriate TCEQ management. Monitors implementation of corrective actions. Coordinates and conducts audits. Ensures maintenance of QAPPs and audit records for the TMDL program.

Texas Parks & Wildlife Department

Janet Nelson
Texas Parks & Wildlife Department Project Manager
The Texas Parks & Wildlife Department Project Manager is responsible for ensuring that tasks and other requirements in the contract are executed on time and with the quality assurance/quality control requirements in the system as defined by the contract and in the project QAPP; assessing the quality of subcontractor/participant work; submitting accurate and timely deliverables to the TCEQ TMDL Project Manager; and coordinating attendance at conference calls, training, meetings, and related project activities with the TCEQ. Responsible for verifying that the QAPP is distributed and followed by the Texas Parks & Wildlife Department (including all subcontractors) and that the project is producing data of known and acceptable quality for reporting to the TCEQ. Responsible for ensuring adequate training and supervision of all activities involved in generating analytical and field data, including the facilitation of audits and the implementation, documentation, verification and reporting of corrective actions.

Janet Nelson
Texas Parks & Wildlife Department Quality Assurance Officer
Responsible for coordinating development and implementation of the Texas Parks & Wildlife Department QA program. Responsible for writing and maintaining QAPPs and monitoring its implementation. Responsible for maintaining records of QAPP distribution, including appendices and amendments. Ensures the data collected for the project is of known and acceptable quality and adheres to the specifications of the QAPP. Responsible for maintaining written records of sub-tier commitment to requirements specified in this QAPP. Responsible for identifying, receiving, and maintaining project quality assurance records. Responsible for compiling and submitting the QA report. Responsible for coordinating with the TCEQ QAS to resolve QA-related issues. Notifies the Texas Parks & Wildlife Department Project Manager and TCEQ Project Manager of particular circumstances which may adversely affect the quality of data. Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques. Conducts assessments of participating organizations during the life of the project as noted in Section C1. Coordinates and monitors deficiencies, nonconformances and corrective actions, and completes CARs. Also implements or ensures implementation of corrective actions needed to resolve nonconformances noted during assessments.

James Tolan
Texas Parks & Wildlife Department Data Manager
Responsible for the acquisition, verification, and transfer of data to the TCEQ TMDL Project Manager. Oversees data management for the project. Performs data quality assurances prior to transfer of data to TCEQ in the format specified in the SWQM Data Management Reference Guide, 2007 or most recent version. Ensures that the data review checklist is completed and data is submitted with appropriate codes. Provides the point of contact for the TCEQ TMDL Project Manager to resolve issues related to the data and assumes responsibility for the correction of any data errors.

James Tolan

Texas Parks & Wildlife Department Field Supervisor Aransas River

Responsible for supervising all aspects of the sampling and measurement of surface waters and other parameters in the field. Responsible for the collection of water samples and field data measurements in a timely manner that meet the quality objectives specified in Section A7 (Table A7.1), as well as the requirements of Sections B1 through B8. Responsible for field scheduling, staffing, and ensuring that staff are appropriately trained. When monitoring activities include TCEQ entities the field supervisor shall coordinate with the TCEQ Project Manager. Reports status, problems, and progress to Texas Parks & Wildlife Department Project Manager.

Janet Nelson

Texas Parks & Wildlife Department Field Supervisor Mission River

Responsible for supervising all aspects of the sampling and measurement of surface waters and other parameters in the field. Responsible for the collection of water samples and field data measurements in a timely manner that meet the quality objectives specified in Section A7 (Table A7.1), as well as the requirements of Sections B1 through B8. Responsible for field scheduling, staffing, and ensuring that staff are appropriately trained. When monitoring activities include TCEQ entities the field supervisor shall coordinate with the TCEQ Project Manager. Reports status, problems, and progress to Texas Parks & Wildlife Department Project Manager.

LCRA ELS Laboratory

Alicia C. Gill

Lower Colorado River Authority Environmental Laboratory, Laboratory Manager

Responsible for supervision of laboratory personnel that generate analytical data for the project. Responsible for ensuring NELAC accreditation is obtained and kept current in order to analyze TCEQ samples. 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 laboratory operations ensuring that all QA/QC requirements are met, documentation related to the analysis is complete and adequately maintained, and that results are reported accurately. Responsible for ensuring that corrective actions are implemented, documented, reported and verified.

Hollis Pantalion

Lower Colorado River Authority Laboratory Quality Assurance Officer

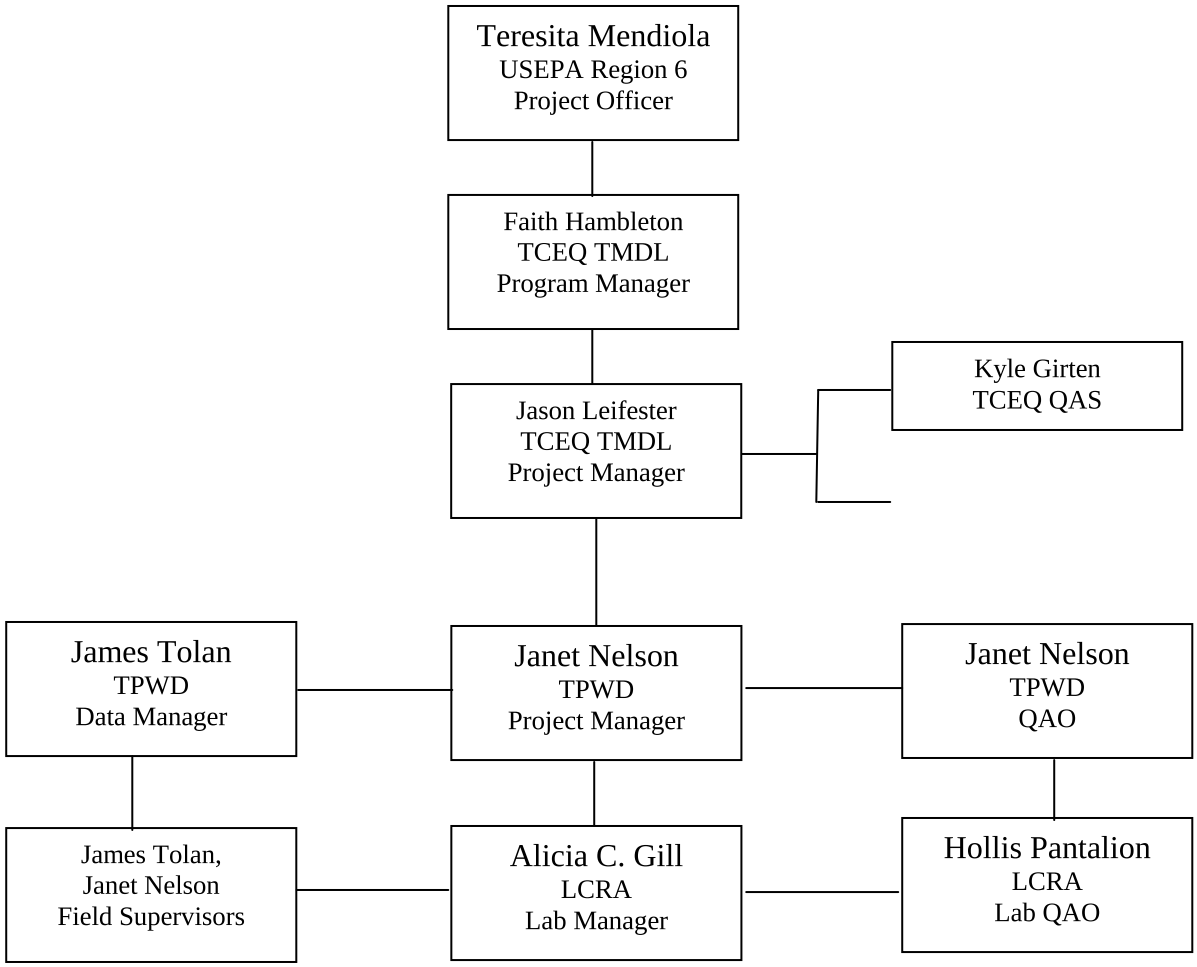
Monitors the implementation of the QAM/QAP within the laboratory to ensure complete compliance with project data quality objectives as defined by the contract and in the QAPP. Conducts in-house audits to ensure compliance with written SOPs and to identify potential problems. Responsible for verifying all aspects of the QA/QC in the laboratory. Ensures 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.

Gary Franklin
Lower Colorado River Authority - Environmental Laboratory Services Project Manager
Responsible for quality assurance of analyses performed by LCRA's Environmental Laboratory Services. Responsible for laboratory and field staff corrective action communication with LCRA QAO. Performs validation and verification of data before the report is sent to the primary contractor.

Kim Withers
Texas A&M University at Corpus Christi
Research Scientist
Responsible for analysis of benthic fauna samples.

Dharhas Pothina
Texas Water Development Board
Responsible for analysis of flow data.

Figure A4.1 Organization Chart



A5 PROBLEM DEFINITION/BACKGROUND

Tidal streams are highly productive transitional areas between the freshwater of the rivers and the saltwater of the bays. Tidal streams serve as nurseries for many fish and shellfish, including many important commercial and recreational species. Routine monitoring of several tidal streams have revealed dissolved oxygen measurements which are not meeting state water quality standards. Water quality management of these streams has been difficult because prior studies on these streams have led to questions concerning the appropriateness of current dissolved oxygen standards. These systems are naturally quite variable over space and time, and these earlier studies suggest that the dissolved oxygen concentration did not appear to be one of the major structuring factors in the physical, chemical, or biological components of ecosystem health.

A use attainability analysis on five tidal streams in Texas completed in 2007 introduced a new assessment methodology to integrate the physical, chemical, and biological components of ecosystem health. This project will apply this methodology to data collected in a new sampling effort on the Mission River Tidal (Segment 2001) and the Aransas River Tidal (Segment 2003). Also, existing data sets for additional tidal streams from the Texas coast will be provided by the TCEQ (and potentially TPWD) to be examined using this new assessment methodology. These additional data sets will include at least the following stream segments: Oyster Bayou (Segment 2423A), Dickinson Bayou Tidal (Segment 1103), Cedar Lakes Creek (Segment 2442), Highland Bayou Diversion Canal (Segment 2424), Texas City Pump Canal (Segment 2437), Armand Bayou Tidal (Segment 1113), and Halls Bayou (Segment 2432). The objective of this project is to further develop the methodology for assessing the health of tidal streams, and give a better understanding of the overall gradient of tidal stream health in Texas, with application to ongoing and future research on other tidal streams along the Texas coast.

A6 PROJECT/TASK DESCRIPTION

The work to be performed and the products to be produced are described in detail in the project work plan (see Appendix A). Maps of the monitoring sites and a monitoring table listing sites, parameters, and monitoring dates are provided in Appendix B.

QAPP Revision

Until the work described is completed, this QAPP shall be revised as necessary and reissued annually on the anniversary date, or revised and reissued within 120 days of significant changes, whichever is sooner. The last approved versions of QAPPs shall remain in effect until revised versions have been fully approved; the revision must be submitted to the TCEQ for approval before the last approved version has expired. If the entire QAPP is current, valid, and accurately reflects the project goals and the organization's policy, the annual re-issuance may be done by a certification that the plan is current. This 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 Texas Parks & Wildlife Department Project Manager to the TCEQ TMDL Project Manager in writing using the TMDL QAPP Amendment form. The TCEQ PM will consult with the TCEQ QAS to determine if the changes are substantive. The changes are effective immediately upon approval by the TCEQ TMDL Project Manager and Quality Assurance Specialist, or their designees, and the EPA Project Officer (if applicable). Amendments to the QAPP and the reasons for the changes will be documented, and copies of the approved QAPP Expedited Amendment form will be distributed to all individuals on the QAPP distribution list by the TPWD 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

The work performed during this project will support the further development of a methodology to assess the ecosystem health of tidal streams. The measurement performance specifications to support the project objective are specified in Table A7.1.

The QAPP is reviewed by the TCEQ to help ensure that data generated for the purposes described herein are scientifically valid and legally defensible. This review process will also help ensure that data have been collected and analyzed in a way that guarantees its reliability.

Table A7.1 - Measurement Performance Specifications

PARAMETER	UNITS	METHOD	PARAMETER CODES	AWRL	Limit of Quantitation (LOQ)	LOQ Check Standard %Rec	PRECISION (RPD of LCS/LCSD)	BIAS (% Rec. LCS/LCSD mean)	Laboratory Performing Analysis
Field Parameters									
pH	*pH units*	*EPA 150.1and TCEQ SOP v1*	*00400*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
DO	*mg/L*	*EPA 360.1and TCEQ SOP v1*	*00300*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Conductivity	*uS/cm*	*EPA 120.1and TCEQ SOP v1*	*00094*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Temperature	*◦C*	*EPA 170.1and TCEQ SOP v1*	*00010*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Secchi Depth	*meters*	*TCEQ SOP v1*	*00078*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Days since last significant rainfall	*days*	*TCEQ SOP v1*	*72053*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Flow	*cfs*	*Acoustic Dopple4*	*00061*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Flow Severity	*1-no flow, 2-low, 3-normal, 4-flood, 5-high, 6-dry*	*TCEQ SOP v1*	*01351*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Salinity	*ppt*	*SM 2520 and TCEQ SOP v1*	*00480*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
24-hour Dissolved Oxygen Monitoring Parameters									
24-Hr D.O. Avg.	*mg/l*	*TCEQ SOP v1*	*89857*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Max Daily DO	*mg/l*	*TCEQ SOP v1*	*89856*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Min Daily DO	*mg/l*	*TCEQ SOP v1*	*89855*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
# DO measurements during 24-Hrs	*# meas.*	*TCEQ SOP v1*	*89858*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*

24-Hr Avg. water Temperature	*◦ Celsius*	*TCEQ SOP v1*	*00209*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Max Daily water Temperature	*◦ Celsius*	*TCEQ SOP v1*	*00210*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Min Daily water Temperature	*◦ Celsius*	*TCEQ SOP v1*	*00211*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
# water temp measurements during 24-Hrs.	*# meas.*	*TCEQ SOP v1*	*00221*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
24-Hr Avg. Spec Conductance	*uS/cm*	*TCEQ SOP v1*	*00212*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Max Spec Conductance	*uS/cm*	*TCEQ SOP v1*	*00213*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
# Spec Conductance measurements during 24-Hrs.	*# meas.*	*TCEQ SOP v1*	*00222*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Max Daily pH	*Standard units*	*TCEQ SOP v1*	*00215*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Min Daily pH	*Standard units*	*TCEQ SOP v1*	*00216*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
# pH measurements during 24-Hrs.	*# meas.*	*TCEQ SOP v1*	*00223*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
24-Hr Salinity Avg	*ppt*	*TCEQ SOP v1*	*00218*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Max Daily Salinity	*ppt*	*TCEQ SOP v1*	*00217*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Min Daily Salinity	*ppt*	*TCEQ SOP v1*	*00219*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
# salinity measurement during 24-Hrs	*# meas.*	*TCEQ SOP v1*	*00220*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Conventional Parameters									
TSS	*mg/L*	*SM2540D*	*00530*	*4.0*	1	*NA*	*20*	NA	LCRA
Alkalinity, total	*mg/L*	*SM2320B*	*00410*	*20*	10	NA	*20*	80 - 120	LCRA
TDS (dried at 180 degrees C)	*mg/L*	*SM2540C*	*70300*	*10.0*	10	*NA*	*20*	80-120	LCRA

Sulfate	*mg/L*	*EPA 300.0*	*00945*	*5*	5	*70-130*	*20*	*80-120*	LCRA
Chloride	*mg/L*	*EPA 300.0*	*00940*	*5*	5	*70-130*	*20*	*80-120*	LCRA
Ammonia-Nitrogen, Total	*mg/L*	*EPA 350.1*	*00610*	*0.1*	0.02	*70-130*	*20*	*80-120*	LCRA
*Ortho-Phosphate Phosphorus – field filtered < 15 min.****	*mg/L*	*EPA 300.0 Rev. 2.1 (1993)*	*00671*	*0.04*	0.04	*70-130*	*20*	*80-120*	LCRA
Total Phosphate-Phosphorus	*mg/L*	*EPA 365.4*	*00665*	*0.06*	0.06	*70-130*	*20*	*80-120*	LCRA
Nitrate/nitrite-Nitrogen, Total	*mg/L*	*SM4500-NO3-H* *Back-ups EPA 300.0 EPA 353.2*	*00630*	*0.05*	0.02	*70-130*	*20*	*80-120*	LCRA
Nitrite-Nitrogen	*mg/L*	*EPA 300.0*	*00615*	*0.02*	NA	*NA*	*20*	*80-120*	LCRA
Nitrate-Nitrogen, Total	*mg/L*	*EPA 300.0*	*00620*	*0.02*	NA	*NA*	*20*	*80-120*	LCRA
Total Kjeldahl Nitrogen	*mg/L*	*EPA 351.2*	*00625*	*0.2*	0.2	*70-130*	*20*	*80-120*	LCRA
Chlorophyll-a	*ug/L*	*EPA 446.0* *EPA 445*	*32211* *70953*	*3*	2	*NA*	*20*	*80-120*	LCRA
Pheophytin-a	*ug/L*	*EPA 446* *EPA 445*	*32218* *32213*	*3.0*	2	*NA*	*NA*	*NA*	LCRA
CBOD	*mg/L*	SM 5210B	*00307*	*NA*	NA	*NA*	*30*	*70-130*	LCRA
Volatile Suspended Solids	*mg/L*	EPA 160.4	00535	NA	NA	*NA*	NA	NA	LCRA
Clay	*%*	EPA 600/2-78054	49900	NA	NA	NA	NA	NA	LCRA
Silt	*%*	EPA 600/2-78054	49906	NA	NA	NA	NA	NA	LCRA
Sand	*%*	EPA 600/2-78054	49925	NA	NA	NA	NA	NA	LCRA

Gravel	*%*	EPA 600/2-78054	80256	NA	NA	NA	NA	NA	LCRA
TOC	*mg/kg*	SM5310B	81951	1500**	1500	*65-135*	30	65-135	LCRA
Percent solids	*% by weight*	SM 2540G	NA	N/A	NA	*NA*	20	80-120	LCRA

**Based on range statistic as described in Standard Methods, 20th Edition, Section 9020-B, "QA/QC - Intralaboratory QC Guidelines." This criterion applies to bacteriological duplicates with concentrations >10 org/100 mL or 10 MPN/100 mL.

***Use parameter code 00671 for orthophosphate-phosphorus if the sample will be filtered <15 minutes after collection, otherwise use parameter code 70507.

Nekton

PARAMETER	UNITS	MATRIX	METHOD	PARAMETER CODE
Seining effort	# of Hauls	Water	TPWD	89947
Combined length of seine hauls	meters	Water	TPWD	89948
Otter trawl width	meters	Water	TPWD	89953
Otter trawl effort	minutes	Water	TPWD	89907

Benthos

PARAMETER	UNITS	MATRIX	METHOD	PARAMETER CODE
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	Bottom		89899
Benthic suction coring device	m^2	Bottom	Onuf et al.	89950
Ekman dredge	device	Bottom	TPWD	89950

Total taxa (taxa richness)	#	Bottom		90055
PercentDominance (3 taxa)	%	Bottom		90067
Percent Dominant Taxon, Benthos	%	Bottom		90042
Soft bottom at collection point	%	Bottom		89925
Number of total species in sample	#	Bottom		90004
Diversity benthos		Bottom		90000

References for Table A7.1:

United States Environmental Protection Agency (USEPA), "Methods for Chemical Analysis of Water and Wastes," Manual #EPA-600-4-79-020

American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF), "Standard Methods for the Examination of Water and Wastewater," 20th Edition, 1998 (NOTE: The 21st edition may be cited if it becomes available).

TCEQ SOP v1 - *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue,* December 2003 (RG-415) or subsequent editions.

TCEQ SOP v2 – *Surface Water Quality Monitoring Procedures Volume 2:Methods for Collecting and Analyzing Biological Community and Habitat Data, 2005 (RG-416) or subsequent editions.*

American Society for Testing and Materials (ASTM) Annual Book of Standards, Vol 11.02

Ambient Water Reporting Limits and Laboratory Reporting Limits

Ambient water reporting limits, or AWRLs, are the specifications at or below which data for a parameter must be reported to be compared with the freshwater or marine screening criteria. The AWRLs specified in Table A7.1 are the program-defined reporting specifications for each analyte and yield data acceptable to meet the project objectives. The limit of quantitation (LOQ) [formerly know as the reporting limit (RL)] is the minimum level concentration, or quantity of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. The AWRL and LOQ for target analytes and performance limits for LOQs are set forth in Table A7.1.

Note: While the AWRL is the highest acceptable level that can be reported for a given parameter, the TPWD should consider all possible uses of the data and may specify the limit of quantitation (LOQ) accordingly.

The laboratory is required to meet the following:

- The laboratory's LOQ for each analyte must be at or below the AWRL as a matter of routine practice.
- The laboratory will demonstrate and document on an ongoing basis the laboratory's ability to quantitate at its LOQ for each analyte by running an LOQ check standard each time that TMDL samples are analyzed.

Acceptance criteria are defined in Section B5.

Precision

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

Laboratory precision is assessed by comparing replicate analyses of laboratory control samples in the sample matrix (e.g. deionized water, sediment, commercially available tissue) or sample/duplicate pairs in the case of bacteria analysis. Precision results are compared against measured performance specifications and used during evaluation of analytical performance. Program-defined measurement performance specifications for precision are defined in Table A7.1

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

Bias

Bias is a statistical measurement of correctness and includes components of systemic error. A measurement is considered unbiased when the value reported does not differ from the true value.

Lab bias is verified through the analysis of laboratory control samples and LOQ Check Standards prepared with known and verified concentrations of all target analytes in the sample matrix (e.g. deionized water, sediment, commercially available tissue) and by calculating percent recovery. Results are compared against measured performance specifications and used during evaluation of analytical performance. Program-defines measurement performance specifications for bias are specified in Table A7.1.

Representativeness

Most data collected will be considered representative of ambient water quality conditions. Site selection, the appropriate sampling regime, the sampling of all pertinent media according to TCEQ SOPs, or other method as noted, and use of only approved analytical methods will assure that the measurement data represents the conditions at the site.

Comparability

Confidence in the comparability of data sets from this project and those for similar uses is based on the commitment of project staff to use only approved sampling and analysis methods and QA/QC protocols in accordance with quality system requirements and as described in this QAPP. Comparability is also guaranteed by reporting data in standard units, by using accepted rules for significant figures, and by reporting data in a standard format as specified in the *Data Management Plan* (Appendix E), SWQM DMRG, and other data reporting forms included in this QAPP.

Completeness

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

A8 SPECIAL TRAINING/CERTIFICATION

Field personnel will receive training in proper sampling and field analysis. Before actual sampling or field analysis occurs, they will demonstrate to the TPWD QA Officer their ability to properly calibrate field equipment and perform field sampling and analysis procedures. Training will be documented and retained by TPWD.

Contractors and subcontractors 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). Laboratory analysts have a combination of experience, education, and training to demonstrate knowledge of their function.

Global Positioning System (GPS) training and certification are required in accordance with TCEQ Operating Policies 8.12: Global Positioning System. Certification can be obtained by: 1) completing an agency training class, 2) completing a suitable training class offered by an outside vendor, or 3) by providing documentation of sufficient GPS expertise and experience.

A9 DOCUMENTS AND RECORDS

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

Table A9.1 Project Documents and Records

Document/Record	Location	Retention	Form
QAPP, amendments, and appendices	TPWD	5 years	Paper
QAPP distribution documentation	TPWD	5 years	Paper
Field notebooks or field data sheets	TPWD	5 years	Paper
Field equipment calibration/maintenance logs	TPWD	5 years	Paper
Chain of custody records	TPWD	5 years	Paper
Field corrective action documentation	TPWD	5 years	Paper
Laboratory sample reception logs	LCRA	5 years	Electronic
Laboratory corrective action documentation	LCRA	5 years	Electronic
Laboratory QA manuals	LCRA	5 years	Electronic
Laboratory SOPs	LCRA	5 years	Electronic
Laboratory data reports	TPWD	5 years	Paper
Laboratory data verification for integrity, precision, bias and validation	LCRA	5 years	Paper/Electronic
Laboratory equipment maintenance logs	LCRA	5 years	Electronic
Laboratory calibration records	LCRA	5 years	Paper/Electronic*
Laboratory corrective action documentation	LCRA	5 years	Electronic
Progress report/final report/data	TPWD/TCEQ.	3 years	Paper/Electronic*

*Electronic files will be provided in Excel or Word format as applicable.

Laboratory Records must be retained in accordance with the NELAC standards (NELAC standards Section 5.4.12).

Laboratory Data Reports

Data reports from the laboratory will report the test results clearly and accurately. The test report will include the information necessary for the interpretation and validation of data and will include the following:

- name and address of the laboratory
- name and address of the client
- a clear identification of the sample(s) analyzed
- identification of samples that did not meet QA requirements and why (e.g., holding times exceeded)
- date of sample receipt
- sample results

- field split results (as applicable)
- clearly identified subcontract laboratory results (as applicable)
- a name and title of person accepting responsibility for the report
- project-specific quality control results to include LCS sample results (% recovery), LCS duplicate results (%RPD), equipment, trip, and field blank results (as applicable), and RL confirmation (% recovery)
- narrative information on QC failures or deviations from requirements that may affect the quality of results

Electronic Data

Data will be submitted electronically to the TCEQ in will be provided in Excel. . A completed data review checklist (see Appendix F) will accompany each set of electronic data.

B1 SAMPLING PROCESS DESIGN

See Appendix B for sampling process design and monitoring schedule associated with data collected under this QAPP.

B2 SAMPLING METHODS

Field Sampling Procedures

The Texas Parks & Wildlife Department will follow the field sampling procedures documented in the TCEQ *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue, 2003 (RG-415)* and *Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data, 2005 (RG-416)* unless otherwise noted. Procedures for biological, Land use/ Land cover analysis and habitat sampling are outlined in the work plan and attached documents.

Sample Volume, Container Types, Minimum Sample Volume, Preservation Requirements, and Holding Time Requirements may vary depending on the laboratory and field QA/QC measures. Typical requirements are given below**.**

Table B2.1 Field Sampling and Handling Procedures

Parameter	Matrix	Container	Preservation	Sample Volume	Holding Time
TSS/VSS	water	high density polyethylene	< 6º C, dark	200 mL	7 days
TDS	water	high density polyethylene	< 6º C, dark	100 mL	7 days
Chloride	water	high density polyethylene	< 6º C, dark	100 mL	28 days
Sulfate	water	high density polyethylene	< 6º C, dark	100 mL	28 days
Total Phosphorus	water	high density polyethylene	< 6º C, dark, pH<2 with H_2SO_4	100 mL	28 days
ortho-Phosphorus	water	high density polyethylene	< 6º C, dark	100 mL	48 hours
Total Kjeldahl Nitrogen	water	high density polyethylene	< 6º C, dark, pH<2 with H_2SO_4	100 mL	28 days
Nitrate Nitrogen	water	high density polyethylene	< 6º C, dark	100mL	48 hrs
Nitrite Nitrogen	water	high density polyethylene	< 6º C, dark	100 mL	48 hrs
Ammonia-Nitrogen	water	high density polyethylene	< 6º C, dark, pH<2 with H_2SO_4	100 mL	28 days
CBOD5	water	high density polyethylene	< 6º C, dark	1000 mL	48 hrs
Chlorophyll-a	water	Amber high density polyethylene	< 6º C, dark	500 mL	filter < 48 hrs; filter may be stored 30 days
Pheophytin-a	water	Amber high density polyethylene	< 6º C, dark	500 mL	filter < 48 hrs; filter may be stored 30 days
TOC	sediment	glass	< 6º C	500 g	14 days
% Solids	sediment	glass	< 6º C	500g	14 days
Grain Size	sediment	glass	< 6º C		14 days

Sample Containers

LCRA will provide disposable sample containers that are purchased pre-cleaned for conventional parameters and are used for sampling performed by TPWD. Dark, plastic bottles are used for the collection of chlorophyll samples. Plastic, sealed 125 milliliter sterile bottles are used for bacteriological analysis. These bottles may have 1% sodium thiosulfate tablets added. Certificates are maintained in a notebook by the LCRA.

Processes to Prevent Cross Contamination

The TCEQ *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue* (2003) outlines the necessary steps to prevent cross-contamination of samples. These may include direct collection into sample containers. Field QC samples as discussed in Section B5 are collected to verify that cross-contamination has not occurred.

Documentation of Field Sampling Activities

Field sampling activities are documented on field data sheets as presented in Appendix C. Flow work sheets and multi-probe calibration records are part of the field data record. 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 also recorded. Detailed observational data are recorded including water appearance, weather, biological activity, stream uses, watershed or instream activities, unusual odors, specific sample information, missing parameters (items that were to have been sampled that day, but weren't), days since last significant rainfall, and flow severity.

Recording Data

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

1. Legible writing in indelible, waterproof ink with no modifications, writeovers 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.

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

Examples of deviations from sampling method requirements or sample design include but are not limited to such things as inadequate sample volume due to spillage or container leaks, failure to preserve samples appropriately, contamination of a sample bottle during collection, storage temperature and holding time exceedance, sampling at the wrong site, etc. Any deviations from the QAPP and appropriate sampling procedures may invalidate resulting data and may require corrective action. It is the responsibility of the TPWD Project Manager, in consultation with the TPWD QAO, to ensure that the actions and resolutions to the problems are documented and that records are maintained in accordance with this QAPP. In addition, these actions and resolutions will be conveyed to the TMDL Project Manager either verbally or in writing in the project progress reports and by completion of a corrective action report (CAR).

B3 SAMPLE HANDLING AND CUSTODY

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 Chain of Custody (COC) form is a record that documents the possession of the samples from the time of collection to receipt in the laboratory (See Appendix D for sample form).

Sample Labeling

Samples are labeled on the container with an indelible, waterproof marker. Label information includes the site identification, the date and time of sampling, sample type (e.g., conventional water parameters, organics), the preservative added.

Sample Handling

Samples collected will be handled following the guidelines presented in Chapter 5 of the *TCEQ Surface Water Quality Monitoring Procedures Manual (Volume 1)*. Water samples representative of the study area will be collected, handled and preserved for routine chemical parameters.

Water samples will be collected before any other work is done at each sample location site to guarantee representativeness. The samples will be collected at a depth of approximately 0.3 m from the surface of the water column. In cases where the mixed surface layer is very shallow extreme care will be taken to avoid contaminating the sample with debris from the bottom or material floating on the surface.

High density polyethylene containers (HDPE) will be used to collect water for analysis. Pre-acidified container will be used to reduce the pH to less than 2. The acidified container will be marked with an “X” on the cap, designating that it is chemically preserved. Each container will be labeled per LCRA labeling guidelines and chain of custody. All samples will be placed in coolers immediately being at least half full of ice for preservation at < 6º C and transportation to the analytical laboratories within holding times.

A field split will be collected every tenth water sample. If ten samples are not taken during a single month, a field split will be collected each month there is sampling.

The samples will be transported or shipped to the designated laboratory within the required holding times for the various parameters being analyzed. The sample custody will be transferred to the laboratory custodian and the samples left there for analyses.

LCRA laboratory will handle samples internally according to the LCRA QAS.

Failures in Chain-of-Custody and Corrective Action

All failures associated with chain-of-custody procedures as described in this QAPP are immediately reported to the TPWD Project Manager. These include such items as delays in transfer, resulting in holding time violations; violations of sample preservation requirements; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc. The TPWD Project Manager in consultation with the TPWD QAO will determine if the procedural violation may have compromised the validity of the resulting data. Any failures that have reasonable potential to compromise data validity will invalidate data. The resolution of the situation will be reported to the TCEQ TMDL Project Manager in the project progress report. Corrective Action Reports will be prepared by the TPWD QAO and submitted to TCEQ TMDL Project Manager along with project progress report.

B4 ANALYTICAL METHODS

The analytical methods are listed in Table A7.1 of Section A7. Procedures for laboratory analysis will be in accordance with the most recently published edition of *Standard Methods for the Examination of Water and Wastewater*, the latest version of the TCEQ *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue* (2003), *Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data* (2005), 40 CFR 136, or other reliable procedures acceptable to TCEQ.

Laboratories collecting data under this QAPP are, at a minimum, compliant with the NELAC standard. A Copy of laboratory QSM is retained by TPWD and are available for review by the TCEQ. 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 preparation is fully documented and maintained in a standards log book. Each documentation includes information concerning the standard identification, starting materials, including concentration, amount used and lot number, date prepared, expiration date and preparer's initials or signature. The reagent bottle will be labeled in a way that will trace the reagent back to preparation.

Analytical Method Modification

Only data generated using approved analytical methodologies as specified in this QAPP will be submitted to the TCEQ.

Failures in Measurement Systems and Corrective Actions

Failures in field and laboratory measurement systems involve, but are not limited to such things as instrument malfunctions, failures in calibration, blank contamination, quality control samples outside QAPP defined limits, etc. In many cases, the field technician or lab analyst will be able to correct the problem. If the problem is resolvable by the field technician or lab analyst, then they will document the problem on the field data sheet or laboratory record and complete the analysis. If the problem is not resolvable, then it is conveyed to the LCRA Laboratory Supervisor, who will make the determination and notify the TPWD QAO. If the analytical system failure may compromise the sample results, the resulting data will not be reported to the TCEQ as part of this study. The nature and disposition of the problem is reported on the data report which is sent to the TPWD Project Manager. The TPWD Project Manager will include this information and submit with the Progress Report which is sent to the TCEQ TMDL Project Manager. The TPWD Project Manager will include this information in the CAR and submit with the Progress Report which is sent to the TCEQ TMDL Project Manager.

B5 QUALITY CONTROL

Sampling Quality Control Requirements and Acceptability Criteria

The minimum Field QC Requirements are outlined in the *TCEQ Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue* (2003) and *Volume 2: Methods for Collecting and analyzing Biological Community and Habitat Data* (2005), or other sources as noted. Specific requirements are outlined below. Field QC samples are reported with the laboratory data report (See Section A9 and C2).

Field splits - A field split is a single sample subdivided by field staff immediately following collection and submitted to the laboratory as two separate, identified samples according to procedures specified in the *SWQM Procedures*. Split samples are preserved, handled, shipped, and analyzed identically and are used to assess variability in all of these processes. Field splits apply to conventional samples only. One field split will be collected some time during the collection of the first ten samples. This should be done at different stations on different sampling trips. If more than ten but fewer than twenty samples are collected on a sampling trip, two field splits will be collected.

The precision of field split results is calculated by relative percent difference (RPD) using the following equation:

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

A 30% RPD criteria will be used to screen field split results as a possible indicator of excessive variability in the collection and analytical system. If it is determined that meaningful quantities of constituent (i.e., >5 times the RL) were measured and analytical variability can be eliminated as a factor, then variability in field split results will primarily be used as a trigger for discussion with field staff to ensure samples are being handled in the field correctly. Some sample results or batches of samples may be invalidated based on the examination of all extenuating information. Professional judgment during data validation will be relied upon to interpret the results and take appropriate action.

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, surrogates, internal standards, continuing calibration samples, interference check samples, 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 are contained within each individual method and laboratory quality assurance manuals (QAMs). The minimum requirements that all participants abide by are stated below. Lab QC sample results are reported with the laboratory data report (see Section C2 and A9).

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

LOQ Sediment and Tissue Samples – When considering LOQs for solid samples and how they apply to results, two aspects of the analysis are considered: (1) the LOQ of the sample, based on the “real-world” in which moisture content and interferences affect the result and (2) the LOQ in the QAPP which is a value less than or equal to the AWRL based on an idealized sample with zero % moisture.

The LOQ for a solid sample is based on the lowest non-zero calibration standard (as are those for water samples), the moisture content of the solid sample, and any sample concentration or dilution factors resulting from sample preparation or clean-up.

To establish solid-phase LOQs to be listed in Table A7.1 of the QAPP, the laboratory will adjust the concentration of the lowest non-zero calibration standard for the amount of sample extracted, the final extract volume, and moisture content (assumed to be zero % moisture). Each calculated LOQ will be less than or equal to the AWRL on the dry-weight basis to satisfy the AWRL requirement for sediment and tissue analyses. When data are reviewed for consistency with the QAPP, they are evaluated based on this requirement. Results may not “appear” to meet the AWRL requirement due to high moisture content, high concentrations of non-target analytes necessitating sample dilution, etc. These sample results will be submitted to the TCEQ with an explanation on the data summary as to why results do not appear to meet the AWRL requirement.

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

The LOQ check standard is carried through the complete preparation and analytical process. LOQ Check Standards are run at a rate of one per analytical batch. A batch is defined as samples that are analyzed together with the same method and personnel, using the same lots of reagents.

The percent recovery of the LOQ check standard is calculated using the following equation in which %R is percent recovery, SR is the sample result, and SA is the reference concentration for the check standard:

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

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

<u>Laboratory Control Sample (LCS)</u> - An LCS consists of a sample matrix (e.g., deionized water, sand, commercially available tissue) free from the analytes of interest spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is used to establish intra-laboratory bias to assess the performance of the measurement system. The LCS is spiked into the sample matrix at a level less than or near the mid point of the calibration for each analyte. In cases of test methods with very long lists of analytes, LCSs are prepared with all the target analytes and not just a representative number, except in cases of organic analytes with multipeak responses.

The LCS is carried through the complete preparation and analytical process. LCSs are run at a rate of one per analytical batch. A batch is defined as samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples.

Results of LCSs are calculated by percent recovery (%R), which is defined as 100 times the measured concentration, divided by the true concentration of the spiked sample.

The following formula is used to calculate percent recovery, where %R is percent recovery; SR is the measured result; and SA is the true result:

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

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

<u>Laboratory duplicate</u> – A laboratory duplicate is prepared by taking aliquots of a sample from the same container under laboratory conditions and processed and analyzed independently. A laboratory control sample duplicate (LCSD) is prepared in the laboratory by splitting aliquots of

an LCS. Both samples are carried through the entire preparation and analytical process. LCSDs are used to assess precision and are performed at a rate of one per batch. A batch is defined as samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples. For most parameters, precision is calculated by the relative percent difference (RPD) of LCS duplicate results as defined by 100 times the difference (range) of each duplicate set, divided by the average value (mean) of the set. For duplicate results, X_1 and X_2, the RPD is calculated from the following equation.

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

A bacteriological duplicate is considered to be a special type of laboratory duplicate and applies when bacteriological samples are run in the field as well as in the lab. 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 org./100mL.

<u>Matrix spikes (MS)</u>- Matrix spikes are prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Percent recovery of the known concentration of added analyte is used to assess accuracy of the analytical process. The spiking occurs prior to sample preparation and analysis. Spiked samples are routinely prepared and analyzed at a rate of 10% of samples processed, or one per batch whichever is greater. A batch is defined as samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples. The information from these controls is sample/matrix specific and is not used to determine the validity of the entire batch. The MS is spiked at a level less than or equal to the midpoint of the calibration or analysis range for each analyte. Percent recovery (%R) is defined as 100 times the observed concentration, minus the sample concentration, divided by the true concentration of the spike.

The results from matrix spikes are primarily designed to assess the validity of analytical results in a given matrix and are expressed as percent recovery (%R). The laboratory shall document the calculation for %R. The percent recovery of the matrix spike is calculated using the following equation in which %R is percent recovery, SSR is the observed spiked sample concentration, SR is the sample result, and SA is the reference concentration of the spike added:

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

Measurement performance specifications for matrix spikes are not specified in this document.

The results are compared to the acceptance criteria as published in the mandated test method. Where there are no established criteria, the laboratory shall determine the internal criteria and document the method used to establish the limits. For matrix spike results outside established criteria, corrective action shall be documented or the data reported with appropriate data qualifying codes.

Laboratory equipment blank - Laboratory equipment blanks are prepared at the laboratory where collection materials for metals sampling equipment are cleaned between uses. These blanks document that the materials provided by the laboratory are free of contamination. The QC check is performed before the metals sampling equipment is sent to the field. The analysis of laboratory equipment blanks should yield values less than the reporting limit. Otherwise, the equipment should not be used.

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

Failures in Quality Control and Corrective Action

Sampling QC excursions are evaluated by the TPWD Project Manager, in consultation with the TPWD QAO. In that differences in sample results are used to assess the entire sampling process, including environmental variability, the arbitrary rejection of results based on pre-determined limits is not practical. Therefore, the professional judgment of the TPWD Project Manager and QAO will be relied upon in evaluating results. Rejecting sample results based on wide variability is a possibility.

Corrective action will involve identification of the cause of the failure where possible. Response actions will typically include re-analysis of questionable samples.

Laboratory measurement quality control failures are evaluated by the laboratory staff. The disposition of such failures and the nature and disposition of the problem is reported to the TPWD Laboratory QAO. The Laboratory QAO will discuss with the TPWD Project Manager. If applicable, the TPWD Project Manager will include this information in the CAR and submit it with the Progress Report which is sent to the TCEQ TMDL Project Manager.

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

All sampling equipment testing and maintenance requirements are detailed in the TCEQ *Surface Water Quality Monitoring Procedures*. Sampling equipment is inspected and tested upon receipt and is assured appropriate for use.

All laboratory tools, gauges, instrument, and equipment testing and maintenance requirements are contained within laboratory QAM(s).

B7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

The minimum Field QC Requirements are outlined in the *TCEQ Surface Water Quality Monitoring Procedures Manual* (Volume 1). Field instruments (for example, multi-parameter datasondes) will be calibrated against known standards, following the specified procedures, within 24-hours prior to sampling. Standards will not be used if they have expired (exceeded shelf life clearly labeled on standards container). If a field instrument does not pass pre-sampling calibration, it will not be used to collect data. Within 24-hours following sampling, field instruments will be checked against calibration standards to ensure that measurements are within required limits. Data collected by instruments which do not meet the post-calibration check requirements will be suspect and not reported to the TCEQ for assessment purposes. Pre- and post- sampling calibrations will be recorded.

Detailed laboratory calibrations are contained within the QAM(s).

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

TPWD evaluates items and services received from suppliers upon delivery. TPWD bases these evaluations on defined acceptance criteria such as task specifications, product specifications, technical requirements, and quality requirements. The Project Manager or designee determines whether a product or service meets the established acceptance criteria.

TPWD will not use items or services that do not meet acceptance criteria. Corrective actions may range from repair or replacement of defective deliverables to re-award of procurements. State statutes, contract provisions, and TPWD Procurement procedures are the basis for initiating corrective actions.

B9 NON-DIRECT MEASUREMENTS

This data is not intended to be submitted to SWQMIS database. However, data collected that meet the data quality objectives of this project may be useful in satisfying the data and informational needs of this project.

B10 DATA MANAGEMENT

Data Management Protocols are addressed in the Data Management Plan which is in Appendix E of this document.

C1 ASSESSMENTS AND RESPONSE ACTIONS

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

Table C1.1 Assessments and Response Actions

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring Oversight, etc.	Continuous	TPWD Project Manager	Monitoring of the project status and records to ensure requirements are being fulfilled. Monitoring and review of contract laboratory performance and data quality	Report to TCEQ in Quarterly Report. Ensure project requirements are being fulfilled.
Laboratory Inspections	Dates to be determined by the TCEQ lab inspector	TCEQ Laboratory Inspector	Analytical and quality control procedures employed at the laboratory and the contract laboratory	30 days to respond in writing to the TCEQ to address corrective actions
	Annually	LCRA QAO		Implements corrective action. Inspection Report will be available for review by TCEQ.
Monitoring Systems Audit	Dates to be determined by TCEQ	TCEQ QAS	Field sampling, handling and measurement; facility review; and data management as they relate to the TMDL Project	30 days to respond in writing to the TCEQ to address corrective actions
	Annually	TPWD QAO		Report sent to TCEQ Project Manager. Resolves any deficiencies.

Corrective Action

The TPWD Project 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 the TCEQ TMDL Project Manager and TPWD Project Manager and/or Quality Assurance Officer. Corrective action documentation will be submitted to the TCEQ TMDL Project Manager with the progress report.

C2 REPORTS TO MANAGEMENT

Laboratory Data Reports

Laboratory data reports contain the results of all specified QC measures listed in section B5, including but not limited to field equipment blanks, trip blanks, field blanks, laboratory duplicates, field splits, laboratory control standards, matrix spikes, AWRL/LOQ verification, laboratory equipment blanks, and method blanks. This information is reviewed by the TPWD QAO and compared to the pre-specified acceptance criteria to determine acceptability. This information is available for inspection by the TCEQ.

Reports to TCEQ Project Management

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

Monitoring Systems Review Audit Report - Following any audit performed by the TPWD, a report of findings, recommendations and responses are sent to the TCEQ project manager in the quarterly/monthly progress report.

Reports by TCEQ Project Management

Contractor Evaluation - The TPWD is evaluated in a Contractor Evaluation by the TCEQ annually for compliance with administrative and programmatic standards. Results of the evaluation are submitted to the TCEQ Financial Administration Division, Procurements and Contracts Section.

D1 DATA REVIEW, VERIFICATION AND VALIDATION

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

The TPWD 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 accuracy, and reviewed for integrity. The TPWD Data Manager will be responsible for ensuring that all data are properly reviewed and verified, and submitted in the required format as described in the SWQM Data Management Reference Guide, 2007 or latest version, to the TCEQ Project Manager.

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. The staff and management of the respective field, laboratory, and data management tasks are responsible for the integrity, validation and verification of the data each task generates or handles throughout each process. The field and laboratory tasks ensure the verification of raw data, electronically generated data, and data on chain-of-custody forms and hard copy output from instruments.

Data verification, validation and integrity review of data will be performed using self-assessments and peer review, as appropriate to the project task, followed by technical review by the manager of the task. The data to be verified (listed by task in Table D2.1) are evaluated against project specifications (Section A7) and are checked for errors, especially errors in transcription, calculations, and data input. Potential outliers are identified by examination for unreasonable data, or identified using computer-based statistical software. If a question arises or an error or potential outlier is identified, the manager of the task responsible for generating the data is contacted to resolve the issue. Issues which can be corrected are corrected and documented electronically or by initialing and dating the associated paperwork. If an issue cannot be corrected, the task manager consults with higher level project management to establish the appropriate course of action, or the data associated with the issue are rejected. The performance of these tasks is documented by completion of the data review checklist (Appendix F) by the TPWD Data Manager.

The TPWD Project Manager and QAO are each responsible for validating that the verified data are scientifically valid, legally defensible, of known precision, accuracy, integrity, meet the data quality objectives of the project, and are reportable to TCEQ. One element of the validation process involves evaluating the data again for anomalies. The TPWD QAO or Project Manager may designate other experienced water quality experts familiar with the water bodies under investigation to perform this evaluation. Any suspected errors or anomalous data must be addressed by the manager of the task associated with the data, before data validation can be completed.

A second element of the validation process is consideration of any findings identified during the monitoring systems audit conducted by the TPWD QAO or TCEQ QAS assigned to the project. Any issues requiring corrective action must be addressed, and the potential impact of these issues on previously collected data will be assessed. Finally, the TPWD Project Manager, with the concurrence of the QAO validates that the data meet the data quality objectives of the project and are suitable for reporting to TCEQ.

Table D2.1 Data Verification Procedures

Tasks	**Responsible Entity/Individual**
Field Data Review	
Field data reviewed for conformance with data collection procedures, sample handling and chain of custody, analytical and QC requirements	TPWD/ field supervisor LCRA/ Lab
Post calibrations checked to ensure compliance with error limits	TPWD/ field supervisor
Field data calculated, reduced, and transcribed correctly	TPWD/ Data Manager
Laboratory Data Review	
Laboratory data reviewed for conformance for conformance with data collection, sample handling and chain of custody, analytical and QC requirements to include documentation, holding times, sample receipt, sample preparation, sample analysis, project and program QC results, and reporting	LCRA/ Lab
Laboratory data calculated, reduced, and transcribed correctly	LCRA/ Lab
LOQs consistent with requirements for AWRLs	LCRA/ Lab
Analytical data documentation evaluated for consistency, reasonableness and/or improper practices	LCRA/ Lab
Analytical QC information evaluated to determine impact on individual analyses	LCRA/ Lab
All laboratory samples analyzed for all parameters	LCRA/ Lab
Data Set Review	TPWD/ Data Manager
The test report has all required information as described in Section A9 of the QAPP	TPWD/ Data Manager
Confirmation that field and lab data have been reviewed	TPWD/ Data Manager
Data set (to include field and laboratory data) evaluated for reasonableness and if corollary data agree	TPWD/ Data Manager
Outliers confirmed and documented	TPWD/ Data Manager
Field QC acceptable (e.g., field splits and trip, field and equipment blanks)	TPWD/ Data Manager

Tasks	Responsible Entity/Individual
Sampling and analytical data gaps checked and documented	TPWD/ Data Manager
Verification and validation confirmed. Data meets conditions of end use and are reportable	TPWD Project Manager

D3 RECONCILIATION WITH USER REQUIREMENTS

These data, and data collected by other organizations (e.g., USGS, TCEQ, etc.), may be subsequently analyzed and used by the TCEQ for TMDL development, stream standards modifications, permit decisions, and water quality assessments. Data which do not meet requirements will not be considered appropriate for any of the uses noted above.

APPENDIX A. WORK PLAN

Overview and Purpose

The Texas Commission on Environmental Quality (TCEQ) is responsible for administering provisions of the constitution and laws of the State of Texas to promote judicious use and the protection of the quality of waters in the State. A major aspect of this responsibility is the continuous monitoring and assessment of water quality to evaluate compliance with state water quality standards which are established within Texas Water Code §26.023 and Title 30 Texas Administrative Code §§307.1-307.10.

Tidal streams are highly productive transitional areas between the freshwater of the rivers and the saltwater of the bays. Tidal streams serve as nurseries for many fish and shellfish, including many important commercial and recreational species. Routine monitoring of several tidal streams have revealed dissolved oxygen measurements which are not meeting state water quality standards. Water quality management of these streams has been difficult because prior studies on these streams have led to questions concerning the appropriateness of current dissolved oxygen standards. These systems are naturally quite variable over space and time, and these earlier studies suggest that the dissolved oxygen concentration did not appear to be one of the major structuring factors in the physical, chemical, or biological components of ecosystem health.

A use attainability analysis on five tidal streams in Texas completed in 2007 introduced a new assessment methodology to integrate the physical, chemical, and biological components of ecosystem health. This project will apply this methodology to data collected in a new sampling effort on the Mission River tidal (Segment 2001) and the Aransas River Tidal (Segment 2003). Also, existing data sets for additional tidal streams from the Texas coast will be provided by the TCEQ (and potentially TPWD) to be examined using this new assessment methodology. These additional data sets will include at least the following stream segments: Oyster Bayou (Segment 2423A), Dickinson Bayou Tidal (Segment 1103), Cedar Lakes Creek (Segment 2442), Highland Bayou Diversion Canal (Segment 2424), Texas City Pump Canal (Segment 2437), Armand Bayou Tidal (Segment 1113), and Halls Bayou (Segment 2432). The objective of this project is to further develop the methodology for assessing the health of tidal streams, and give a better understanding of the overall gradient of tidal stream health in Texas.

Tasks

TASK 1: **PROJECT ADMINISTRATION**

Objective: Performing Party shall manage all administrative functions required to support the Tidal Streams Use Assessment, which shall include:

- informative and timely quarterly progress reports
- timely and accurate monthly reimbursement forms, including only

allowable costs submitted for reimbursement and proper backup documentation to support allowable costs
- participation in fiscal monitoring reviews
- adherence to TCEQ contract provisions
- budget monitoring and cost accountability
- participation in meetings or conference calls, or both, as appropriate
- oversight of all subcontractor duties
- participation in contractor evaluation

Deliverables: 1.1 Performing Party must submit quarterly progress reports, which shall include:

- Status of deliverables for each task
- Narrative description of activities for each task, including monitoring
- Description of anticipated work for following quarter

Due Dates: 12/21/07; 3/21/08; 6/21/08; 9/21/08; 12/21/08; 3/21/09; 6/21/09; 9/21/09; 12/21/09; 3/21/10; 6/21/10; 9/21/10; 12/21/10; 3/21/11; 6/21/11

1.2 Monthly reimbursement forms: purchase voucher, 269a, 269a1-4

Due Dates: The 21st of each month

1.3 Copies of signed sub-agreements - submit with following quarterly progress report

Due Dates: Must be submitted to TCEQ in the quarter in which it is signed

1.4 Participation in meetings and telephone calls with TCEQ staff

Due Dates: As needed; dates to be determined as project progresses

TASK 2: QUALITY ASSURANCE

Objective: Performing Party shall prepare and submit a draft and final quality assurance project plan (QAPP) that is approvable by the TCEQ. A TMDL QAPP Shell document will be provided by the TMDL Project Manager for use in development of the QAPP. No environmental data collection can occur without an approved QAPP. The QAPP includes the monitoring plan.

The need to amend the QAPP may arise throughout the duration of this project. The TMDL Project Manager will provide an amendment form as guidance for preparing amendments. All amendments made throughout the duration of the project will be incorporated into the annual update (see below). If no amendments were necessary throughout the duration of the original QAPP, then a reissuance letter stating the original QAPP is still accurate along with new original signature pages will be routed to all signatories.

Performing Party shall provide, as needed, corrective action reports (CARs) to document deviations from sampling method requirements or sample design, failures associated with chain-of-custody procedures, or failures in field and laboratory measurement systems.

If the project extends beyond one year, Performing Party must provide an annual update 60 days prior to anniversary of signing date of original QAPP or previous annual update(s) to ensure approval prior to subsequent years of sampling. This will allow for a seamless transition between years or sampling events, or both, and prevent sampling delays for future work. Participate in and conduct quality assurance-related auditing activities as outlined in the QAPP shell.

Deliverables:

2.1 Draft project QAPP (using current modified TMDL QAPP shell)
Due Date: 60 days after contract signed

2.2 Final project QAPP (signed by all appropriate parties)
Due Date: Two weeks from receipt of TCEQ comments

2.3 QAPP amendments
Due Date: Within two weeks of the time the need for an amendment has been identified

2.4 QAPP corrective action reports
Due Date: As needed with following quarterly progress report

2.5 Monitoring systems review audit report on field sampling, handling and measurement, facility review, and data management as they relate to the project
Due Date: Annually during years of field sampling on June 1

2.6 QAPP annual update or reissuance letter
Due Date: 60 days prior to anniversary of signing date of original QAPP or previous annual update(s)

2.7 Participate in TCEQ quality assurance audit
Due Date: As needed

TASK 3: HISTORICAL DATA

Objective: Performing Party shall review and analyze available relevant historical data, including:

- Conduct a survey of available biological, hydrological, water, and sediment quality data and information on potential pollutant sources to better characterize the factors affecting water quality for tidal portions of Mission and Aransas Rivers
- Acquire and analyze the existing data from the additional streams identified in Section V using assessment methodology developed for prior tidal streams study (under Contract 582-2-48657)

Deliverables: 3.1 Draft historical data report on tidal portions of Mission and Aransas Rivers

Due Date: 120 days after contract signed

3.2 Final historical data report, incorporating TCEQ comments

Due Date: Two weeks from receipt of TCEQ comments

3.3 Draft report on analysis of existing data sets

Due Date: 7/15/08

3.4 Final report on analysis of existing data sets

Due Date: Two weeks from receipt of TCEQ comments

TASK 4: MONITORING

Objective: Performing Party monitoring in Mission River Tidal and Aransas River Tidal shall be conducted with respect to techniques used and lessons learned during the prior tidal streams study (under Contract 582-2-48657). Monitoring shall include:

- instream and riparian habitat assessment
- physicochemical profiles
- short-term 24-hour deployments
- water chemistry for a variety of parameters of concern
- flow using acoustic Doppler equipment
- nekton by seining and trawling
- sediment and benthic macroinvertebrates

Performing Party shall select, with consent of TCEQ, three fixed sampling stations will be selected for each stream, characteristic of the upper, middle, and lower tidal reaches. Collections shall occur twice each in the spring, summer, and fall of 2008 and 2009, resulting in a total of 12 sampling efforts.

Performing Party shall provide a narrative description of the sampling work performed during the previous quarter, including the number of sampling events and the types of monitoring conducted, and a list of anticipated sampling activity for the next quarter.

Deliverables: 4.1 Habitat assessment and physicochemical, water chemistry, flow, nekton, sediment, and benthic monitoring, and provide details of the sampling activities (both conducted and anticipated) as described in Task 4:

Due Dates: Submit narrative descriptions with quarterly progress reports

TASK 5: DATA MANAGEMENT AND REPORTING

Objective: Performing Party shall submit habitat, physicochemical, 24-hour, water chemistry, flow, nekton, sediment, and benthic monitoring data to the TCEQ Project Manager.

Deliverables: 5.1 Electronic copies of all habitat, physicochemical, 24-hour, water chemistry, flow, nekton, sediment, and benthic data files in text or Excel spreadsheet format along with completed data review checklist found in QAPP shell.

Due Dates: Submit data as available with quarterly progress reports, with all data for each year of sampling submitted within 90 days of final receipt of all analyses from laboratory/laboratories used

TASK 6: LANDCOVER ANALYSIS

Objective: Using available spatial data sets of land use/ land cover for subject watersheds and recent and historical water quality and biological data, and other available data as appropriate, delineate an area sufficient to encompass the contributing basin of the stream segments in question. Analysis including (but not limited to) determining amount of different land cover types contributing to the runoff to the streams, amount of impervious cover in the watershed, and human population density in the watershed will be conducted.

Deliverables: 6.1 Initial maps of Mission River Tidal and Aransas River Tidal, including locations of monitoring stations

Due Date: 90 days after contract signed

6.2 Final landcover analysis for Mission River Tidal and Aransas River Tidal

Due Date: 6/30/09

6.3 Written methodology for GIS analysis

Due Date: 6/30/10

6.4 Final map production for Mission River Tidal and Aransas River Tidal

Due Date: 11/15/10

TASK 7: DEVELOPMENT OF FINAL REPORTS

Objective: Performing Party shall use assessment methodology developed for prior tidal streams study (under Contract 582-2-48657) to develop a detailed report for the Mission River Tidal and Aransas River Tidal. Work on the draft report shall commence upon receipt of the final benthic lab results, anticipated to be approximately six months after the last sampling event. The report shall:

- include a detailed analysis of the flow data gathered for the

Mission River Tidal and Aransas River Tidal

- correlate factors in the watersheds with the water quality conditions
- correlate water quality data with biological data
- recommend the aquatic life uses of the streams

Performing Party shall develop a comprehensive final project report that examines the results for the five streams in the prior tidal streams study (Cow Bayou Tidal - 0511, Lost River - 0801, Tres Palacios Creek Tidal - 1501, Garcitas Creek Tidal – 2453A, and West Carancahua Creek Tidal – 2456A) and the additional existing tidal streams data sets identified in Section V in conjunction with the results of this study to give a better understanding of the overall gradient of tidal stream health in Texas. Performing Party shall provide recommendations for future work needed to develop a preliminary index of biotic integrity gradient for tidal streams along the Texas coast.

Deliverables:

7.1 Draft report on Mission River Tidal and Aransas River Tidal
Due Date: 11/15/10

7.2 Final report on Mission River Tidal and Aransas River Tidal
Due Date: Two weeks from receipt of TCEQ comments

7.3 Draft comprehensive final project report
Due Date: 5/15/11

7.4 Final comprehensive project report
Due Date: Two weeks from receipt of TCEQ comments

7.5 Presentation on final project report at TCEQ headquarters
Due Date: May 2011 (exact date to be determined)

APPENDIX B. SAMPLING PROCESS DESIGN AND MONITORING SCHEDULE

APPENDIX B. SAMPLING PROCESS DESIGN AND MONITORING SCHEDULE

Sample Design Rationale

The sample design is based on the program requirements of the Total Maximum Daily Load Program. The TCEQ, and the TPWD through contract with the TCEQ, has been tasked with providing data and information to apply a new assessment methodology to integrate the physical, chemical, and biological components of tidal ecosystem health. The environmental data collected under this QAPP must be collected and evaluated with a high degree of confidence that the data are scientifically valid, of known quality, and legally defensible. Also see Appendix A for more information about the sample design and rationale.

Site Selection Criteria

Three fixed sampling stations will be selected in each stream: one station characteristic of the upper tidal reach, one characteristic of the middle, and one characteristic of the lower tidal reach.

The sampling sites will be selected from a landscape perspective. TPWD personnel trained in landscape ecology, estuarine ecology and estuarine biology will visit the two streams. Sample sites will be selected according to vegetation types present. The lower tidal reach station (Station 3) will have *Spartina alterniflora* present and the landscape will noticeably flatten out. At the middle station (Station 2), the vegetation will be dominated by species that are far more brackish-water tolerant. In the upper station (Station 1), vegetation more tolerant of freshwater will be present. For example, oak and elm trees will be present at Station 1, and the banks of the creek are usually steeper with a much deeper channel than in the middle or lower stations.

Sampling protocol

It is proposed to sample physicochemical, water chemistry, nekton, benthos and flow in Aransas River Tidal and Mission River Tidal six times annually for two consecutive years. Replicate seasonal sampling will take place twice each in the spring, summer, and fall of 2008. The entire sampling protocol will be repeated in 2009, resulting in a total of 12 sampling efforts. . Instream and riparian habitat classification and land cover/land use analysis will be conducted once during the study.

Physicochemical Profiles

Field physicochemical data profiles will be measured using instantaneous water quality reading instruments calibrated to the manufacturers' specifications. Temperature, dissolved oxygen, salinity, and pH data will be recorded approximately 0.3 m below the surface and 0.3 m above the bottom at each station. Secchi depth will also be recorded.

Short-Term 24-hour Deployments

Multiparameter logging sondes will be deployed at each sampling station on each study stream.

Temperature, dissolved oxygen, salinity, and pH will be logged every half-hour for 24 hours. The sondes will be deployed with the sensors approximately 0.3 m below the water surface. Calibration records will be retained for each deployment.

Water samples

Water samples will be collected at a depth of 0.3 m from the bottom at the same stations and same times as the physicochemical data collection. Samples will be collected for laboratory analysis for each parameters of concern, including:

Total dissolved solids (TDS)
Chloride
Sulfate
Total Kjeldahl nitrogen (TKN)
Ammonia-nitrogen
Nitrate-nitrogen
Nitrite-nitrogen
Total phosphorus
Orthophosphate
Chlorophyll-a
Pheophyton
Carbonaceous biochemical oxygen demand-5 day (CBOD5)
Total suspended solids (TSS)
Volatile suspended solids (VSS)

Nekton

Nekton will be collected at the same stations within the same week as the physiochemical data and water samples. Fish collections will be made by seining and trawling. Catch per unit effort (CPUE) for seining will be recorded as the total number of each species per foot seined at each site; CPUE for trawling will be the total number of individuals collected per hour of trawling. Fish will be identified in the field, enumerated and measured to the nearest millimeter. Nekton that can not be identified in the field will be preserved on ice or in formalin and transported to the lab for identification. Voucher specimens of each species will be retained in 10% formalin to allow second identification verification. Voucher specimens too large to fit in a five-gallon bucket will be photographed for verification of identification.

Trawls

A 10-ft otter trawl will be used. Trawling will be conducted for three five-minute intervals (not covering the same area) at constant engine speed of 1300 revolutions per minute (RPM) or approximately 3 mph. If the trawl duration lasts at least three minutes before becoming entangled, it will be considered an adequate trawl.

Seines

A 30-foot straight seine that is 8 feet deep using a 3/16 delta material with double floats and double lead weights will be used. An effective seine haul is one that is not affected by hang-ups or lifting the net off the bottom. Because of a narrow shelves and a steep channel profiles on the side of many of the sampling stations in tidal streams, one end of the seine may be walked or held against the bank while the remainder of the seine is deployed perpendicular to the shore with the boat then maneuvered back in an arc to shore with the boat. At each sampling location, seine pulls will be repeated until a linear distance of 125 feet of shoreline has been covered.

Tidal Stream Macrobenthos Identification/Enumeration

Sediment and Benthic Macroinvertebrate/Infaunal Collections

Benthic infaunal data will be collected by TPWD staff using a benthic suction coring device or a Petite Ponar depending on bottom substrate suitability for each gear type. At each station, benthic organisms will be collected the mid-channel area. Three replicate samples will be collected in the area. Each replicate will be individually labeled and processed separately. Whole collections will be first placed in a 500-micron mesh bag, field-washed to remove the majority of the sediment, and preserved in 10% buffered formalin with Rose Bengal. Benthic infaunal community samples will be delivered to TAMUCC for identification and enumeration. Sediment samples will be collected with the same gear as the benthic infaunal communities and analyzed for grain size, total organic carbon, and percent solids.

Project Objectives and Description of Work

TPWD personnel will collect benthic samples from 3 Stations in 2 Tidal Streams along the Texas coast every 6 weeks from March 2008 through November 2008 and repeat the sampling March 2009 to November 2009 (3 replicates/station/sampling event = 18 samples/event; 12 sampling events = 216 total samples. Samples will then be delivered to the Center for Coastal Studies for washing, sieving, identification and enumeration. The purpose of this component of is to determine macrobenthic species composition and abundance for each tidal stream station. The laboratory evaluations will be based on methods described in “Section 3-Benthic Macroinvertebrate Methods Macrobenthic Assessment” of EMAP Laboratory Methods Manual-Estuaries, Volume 1: Biological and Physical Analyses (U.S. EPA, 1995). The sample will first be washed, sieved, and placed into major taxonomic groups, then identified to species and counted before obtaining biomass amounts. A senior taxonomist will oversee and periodically review the work performed by technicians.

Laboratory data (i.e. major taxon group sorts, species identifications and counts, and QC checks) are recorded on printed worksheets. These raw data are maintained by the laboratory and made available upon request to TPWD/TCEQ management/QA personnel. The benthic laboratory will transcribe hardcopy data into a standardized electronic format jointly developed and agreed to by the participating agencies. The data report will list by station, the taxonomic groups to species, within reason, the number of individual organisms per group, and biomass amounts. The data report will be submitted (hardcopy and computer-readable formats) to James Tolan and/or Janet Nelson (TPWD). The QC data will be summarized in a hardcopy table or narrative and included with the final data package. In addition, a narrative report will be included in a cover letter explaining any difficulties or irregularities encountered during the assessments (e.g., taxonomic problems, sample integrity, extraneous sample material).

Experienced undergraduate students will assist Center project personnel in the washing and sieving portion of the project. Experienced Natural Resource Specialists, under supervision of Dr. Withers with extensive experience in benthic ecology, will do identification, enumeration, and biomass of macrobenthic organisms. An established regime of in-house QC checks will be adhered to in which a portion of each technician's work is reviewed by a senior taxonomist; a failed check will require that all of that technician's samples, since the last passed check, be re-sorted or re-identified (depending on the assigned task). The same type of QC checks will apply throughout the process of washing, sieving, identifying and quantifying, and biomassing the benthos; technicians and taxonomists will have their work verified by a peer or more senior taxonomist. The QC checks will be documented in a laboratory notebook that will be available to TPWD/TCEQ QA personnel upon request. The benthic data will be subject to an audit of data quality during the 2-year period following the completion of the benthic community assessments.

Analyses and reporting will include major taxon sorts, species identifications, counts and biomass. The reporting will include both a hard copy and electronic database and a short summary report of the results.

Research Personnel
Laboratory work will be conducted at the Center for Coastal Studies (CCS). Experienced undergraduate students will conduct work involving the washing and sieving portion of the project. Experienced Natural Resource Specialists under direct supervision of senior research scientists will conduct all identification and enumeration of species in benthic samples. Dr. Kim Withers, CCS Research Scientist and Adjunct Professor of Biology will do immediate laboratory supervision and verification. Dr. Withers has 18 years experience in benthic ecology.

Flow

A SonTek Argonaut XR acoustic Doppler current meter will be deployed at the middle station in each of the two streams for at least 60 hours (in order to record flow over multiple tidal cycles) during each sampling trip. The Argonaut XR will be deployed on the bottom of the stream within 7 m of the shore. This instrument will average and record measurements in water velocity, direction and water height over 5-minute intervals. The bottom-mounted, up-looking SonTek Argonaut XR acoustic Doppler velocimeter (ADV) will be used to measure stream flow direction and velocities over periods of time to include at least one complete tidal cycle. A total of approximately twelve flow measurements will be performed, each spanning several tidal cycles. The Texas Water Development Board's (TWDB's) role in the project is to analyze tidal stream flow data that TPWD staff collect. TWDB staff will also assist in initial site installation design and collect supporting flow data using Sontek Rivercat pontoon mounted mini-ADP. The Rivercat will be used to collect a discharge measurement and the channel cross section at the XR deployment site. This data will be used to relate the average velocity data collected by the XR to a discharge measurement.

TWDB has broad experience with the collection and analysis of flow data in tidal streams and channels. TWDB will use standard methods for analysis of acoustic Doppler profiler data. Data to be extracted will include tidal and residual components of flow, as well as summary discharge and velocity data. TWDB will provide results of analyses in hardcopy format, the format of which will be jointly developed and agreed to by the participating agencies. TWDB will also provide data reports electronically, the format of which will be jointly developed and agreed to by the participating agencies.

Instream and Riparian Habitat Classification

Habitat data will be collected in the spring (April) of 2008. Habitat characteristics will be surveyed according to methods outlined in the U. S. Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP) document entitled, "Field Operations and Methods Manual for Non-Wadeable Streams" (Lazorchak et al. 2000) except where noted. Habitat classification will be conducted a single time for each river (Mission and Aransas) at 3 sampling reaches per stream. Each sampling reach will be subsampled at 11 transects (Lazorchak et al. 2000), and the transect locations will be recorded using a global positioning system. For a more detailed description of the methodology used to sample each of the following variables refer to Lazorchak et al. (2000). Variables to measure include: 1) a thalweg (i.e., maximum depth) profile along the length of each stream sampling reach that includes an estimate of bottom substrate type and channel habitat type; 2) an estimate of littoral (i.e., channel bank) depth and substrate type along the margin of the channel at each transect location; 3) an estimate of the coverage of large woody debris in each channel reach; 4) a measurement of channel physical characteristics which includes channel wetted width, presence of bars or islands and their width if present, bankfull width, bankfull height, channel incised height, and bank angle/degree of bank undercutting; 5) an estimate of canopy cover along channel banks using a densiometer; 6) another measure of riparian vegetative structure involving separate visual estimates of canopy, understory and groundcover vegetation; 7) an estimate of fish cover and aquatic vegetation within the channel; and 8) an estimate of the degree of human influence in the immediate sampling area around transects. The portion of the EMAP methodology pertaining to "legacy trees" will not be include in this study as well as the section on invasive/alien plant species. Channel sinuosity will also be estimated using geographical information system analysis. The length of each stream reach will be measured along the channel of the stream "as the fish swims". Then the straight line distance from start of reach to end of reach will be determined "as the crow flies". Then the channel length will be divided by the straight length. The larger the number is the more sinuous the stream (Kaufmann et al. 1999). Densiometer measurements will be taken following the manufacturer's instructions rather than the method suggested by Lazorchak et al. (2000). Measurements of channel margin depth and substrate type will be estimated using a polyvinyl chloride (PVC) pole along banks where the water is too deep to reach the bottom. Because coastal streams have a very low gradient, channel slope as discussed in Lazorchak et al. (2000) will not be measured. The presence of power lines will also be added to the portion of the method measuring human influence.

Landcover /Land use Classification

Landcover will be developed for Aransas River tidal and Mission River tidal. An area sufficient to encompass the contributing basin of the stream segments in question will be delineated. This will be done from either USGS Hydrologic Unit data where available, or from the National Elevation Dataset digital elevation model using algorithms developed by Environmental System Research Institute, Inc. (ESRI). Analysis including, but not limited to, determining amount of different Landcover types contributing to the runoff to the streams, amount of impervious cover in the watershed, and human population density in the watershed will be conducted.

Landcover Classification Procedures

Landcover will be developed using Erdas, Inc. Imagine Image Processing Software. Each watershed will be mapped separately using a "cluster busting" unsupervised classification algorithms. LandSat 7 ETM+ data acquired by the State of Texas will be used to map the landcover. The LandSat data will be subset to each watershed and an initial unsupervised classification will be performed. The results of this algorithm will be consolidated to 4 classes: water and marsh, exposed /lightly vegetated, woody and herbaceous. Each class will then be used to subset the original LandSat data and another unsupervised classification will be run, resulting in 50 clusters. These pixel groups will then be assigned, by an analyst, to a particular Landcover class. Landcover classes are based upon the The Nature Conservancy's Terrestrial Vegetation of the Southeastern United States (Weakley et al., 1998). Additional classes for exposed lands and urban/industrial classes will be added to the schema. Once all the clusters for all four subsets of the data have been assigned to a landcover class, they will be reintegrated into one dataset. The landcover data will be clumped so that the minimum mapping unit is at least one (1) acre, using the CLUMP and ELIMINATE routines in Imagine.

The landcover will be verified using data collected in the field with a global positioning system device for positional accuracy. Data will be collected by randomly selecting a driving route and stopping every 0.5 mile to collect points. At least 10 points per landcover class will be collected. Data recorded for each point will include landcover class, 3 visually dominant plant species, if applicable, and a direction and offset from the road. Minimum offset will be at least 40 meters. Accuracy will be at least 85% in all core landcover classes. Core landcover classes will be grassland, shrub-land, marsh, open water, upland forest, bottomland forest, mesic forest, agricultural lands, and urban/industrial. Data will be re-analyzed and ancillary datasets used to increase accuracy until the above condition is satisfied. The accuracy assessment process will be repeated. This iterative process will be repeated until the minimum accuracy for each core landcover class is satisfied.

Deliverables for Mission/Aransas Rivers Tidal

Physical, chemical, and biological data collected in the Mission River Tidal and the Aransas River Tidal will be integrated into the new assessment methodology developed during the Tidal Stream UAA. A final report will be delivered to TCEQ upon completion.

Incorporation of TCEQ datasets

Assessing ecosystem health and assigning site-specific uses and criteria within tidally influenced portions of river basin and coastal basin waters is currently complicated by the relative dearth of contemporaneously collected information. The physical/chemical/and or biological datasets comprising historical collections (e.g., special studies) undertaken by TCEQ and others will be incorporated into the standardized Tidal Stream Assessment Methodology, and those samples will be compared to the recent collections of the UAA studies from the middle and upper Texas coast. These historical studies represent additional information from disparate tidal systems that may help to reveal the Biocriteria for Tidal Streams that would have applicability over large spatial scales.

Historical data sets to be included in this standardized Tidal Stream Assessment Methodology are Oyster Bayou, Dickinson Bayou, Cedar Lake Creek, Highland Bayou diversion canal and Texas City pump canal for the years of 1991, 1992 and 1993. Also included will be Armand Bayou and Halls Bayou for 2002 and 2003.

Historical datasets will first be standardized to the meet the assumptions of the Tidal Stream Assessment Methodology. This methodology relies heavily on the non-parametric ordination techniques. Multidimensional scaling (MDS) procedures are used to identify the configurations of the different datasets (e.g., biological, physiochemical, habitat. etc.). Distinction among stations located on a common stream (in terms of its biological communities, physical, and chemical properties), as well as the differences among them in relation to the reference condition, are evaluated. Here, the goal of the MDS is to assess any agreement between the biological "picture" and the more traditional physical and chemical "picture". Spearman's rank correlation is used to quantify the degree of agreement between these contemporaneous datasets. The natural separation of the "biological" and the "physical and/or chemical" measurements are also evaluated with the same rank correlation method.

The biological communities will be further assessed with the Average Taxonomic Distinctness measure. Any significant differences among the historical study streams and the UAA streams will be identified with the Analysis of Similarity (ANOSIM) procedure. The ANOSIM procedure is valid for not only the biological communities, but also for the physical and chemical constituents as well. The variables most responsible for the separations seen in the ANOSIM are identified with the Similarity Percentages (SIMPER) procedure. From this, a suite of indicator taxa can be identified, and their sensitivity to variability in the physical and chemical datasets assessed. Core metrics that include information about the taxonomic breath of the study locations can then be developed. Determining the gradient from impaired to unimpaired waterbodies, through the use of these developed biocriteria, provides the basis for an assessment technique with broad spatial applicability.

While the level of effort in these historical special studies datasets may not be as robust as the UAA studies (lower seasonal resolution, spatial resolution, temporal resolution, etc.), every effort will be made to incorporate as much of this historical information as possible. This is especially true for the biological data, as sub-methods within the standardized Tidal Stream Assessment Methodology allowing for the analysis of presence/absence information.

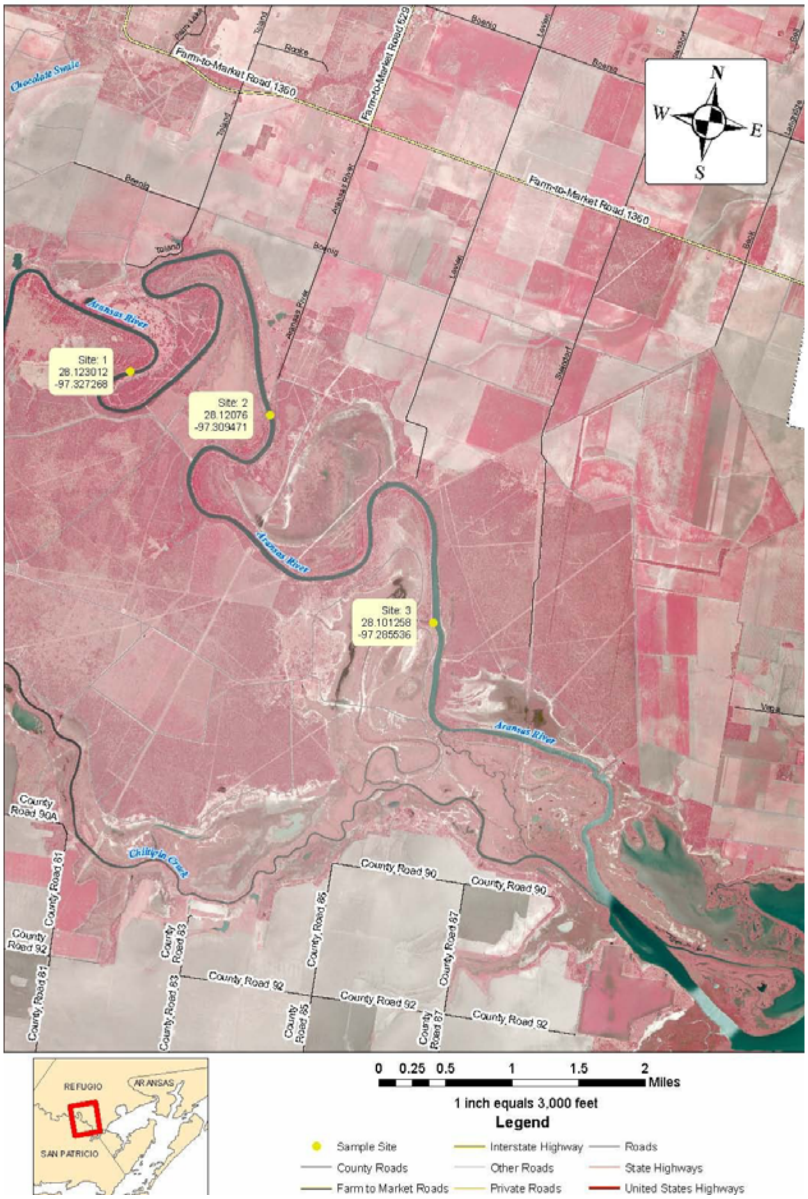
A separate report from the Mission/Aransas report will be delivered to TCEQ with data analysis and data interpretation of the historical special studies datasets.

Critical vs. non-critical measurements

All data collected for the TCEQ TMDL Program, whether entered into the SWQMIS database or not, are considered critical.

Monitoring Sites

Aransas River Sample Sites



Mission River Sample Sites

Table 1 Sample Design and Monitoring Schedule, FY 2008 through FY2010
TCEQ Region 14 Basin ID 20

Site	Segment	Station ID	Lat/Long	Long descriptions	Start date	End date	24hr	AqHab	Benthics	Nekton	Convl	Flow	Sediment	Field
Aransas site 1	2003	AR1	28.123012 -97.327268	Aransas River Tidal 19.5 Km upstream of confluence of Chiltipin Creek	Spring 2008	Fall 2009	12	1	12	12	12	12	12	12
Aransas site 2	2003	AR2	28.12076 -97.309471	Aransas River Tidal 12.4 Km upstream of confluence of Chiltipin Creek	Spring 2008	Fall 2009	12	1	12	12	12	12	12	12
Aransas site 3	2003	AR3	28.101258 -97.285536	Aransas River Tidal 5.1 Km upstream of confluence of Chiltipin Creek	Spring 2008	Fall 2009	12	1	12	12	12	12	12	12
Mission site 1	2001	MR1	28.202704 -97.237389	Mission River Tidal 6.2 km upstream of FM 2678	Spring 2008	Fall 2009	12	1	12	12	12	12	12	12
Mission site 2	2001	MR2	28.189843 -97.235658	Mission River Tidal 3.0 Km upstream of FM 2678	Spring 2008	Fall 2009	12	1	12	12	12	12	12	12
Mission site 3	2001	MR3	28.182855 -97.192278	Mission River Tidal 1.2 km downstream of the confluence of Melon Creek	Spring 2008	Fall 2009	12	1	12	12	12	12	12	12

24hr. DO: temperature, dissolved oxygen, specific conductance, salinity, depth, and pH.
Aquatic Habitat: see Appendix B- Instream and Riparian Habitat Classification.
Benthic Infauna: see Appendix B- Sediment and Benthic Macroinvertebrate/Infaunal Collections
Nekton: see Appendix B- Nekton.
Conv.: see Appendix B- Water samples.
Flow: recording flow meter installed for at least 24 hours, target is for longer installation covering duration of all sampling activities per interval
Field: temperature, dissolved oxygen, pH, specific conductance, salinity, depth, days since last significant rainfall, flow, flow severity, and Secchi depth.

APPENDIX C. FIELD DATA REPORTING FORM

Water / Sediment Data Form

Personnel______________________ Arrival Time_____________ Date____________

Station ID______________ Description______________________________________

Location: _____________________ N _____________________ W

Weather_____________________Water Conditions______________________________

Tide________________ Wind Speed/Dir________/________

Human Use Angling/Swimming/Boating/Other: ________________ Max Depth_________ft

----

Water Samples:

Surface samples: 1 4-L cubitainer and 3 1- L cubis (one with 2 ml H_2SO_4 added). Depth samples do not require the 4-L cubi. Place on ice immediately.

Depth: 0.3 m Below Surface ___m ___m 0.3 m Above Bottom_

Tag # ______________ ___________ ___________ ______________

Time ______________ ___________ ___________ ______________

Field Split: Tag#_____________ Depth__________ Time_________

Equipment blank:Tag#_____________ Depth__________ Time_________

Water Column Profiles:

Depth	__________	__________	___________	___________
Temp (°C)	__________	__________	___________	___________
pH (s.u)	__________	__________	___________	___________
D.O. (mg/L)	__________	__________	___________	___________
DO sat (%)	__________	__________	___________	___________
SpCond (mS/cm)	__________	__________	___________	___________
Sal (ppt)	__________	__________	___________	___________
Secchi (m)	__________			

Comments:

Water / Sediment Data Form

Sonde Deployment

Sonde ID______________________

Deployed: Date______________ Time______________ Depth_________________

Retrieved: Date______________ Time______________ Depth_________________

Sediment/Benthics Samples

Sediments - Sampled by : Ekman / Core (Circle One)

Mid-channel: Tag #______________________ Depth (m)________

Side of channel: Tag #______________________ Depth (m)________

Benthics - Sampled by : Ekman / Core (Circle One)

Start Time______________ End Time______________

Preserved in Formalin and Rose Bengal

Tag #	Grab Location	Depth (m)
______________	Middle	__________
______________	Middle	__________
______________	Middle	__________
______________	Middle	__________
______________	Middle	__________
______________	Middle	__________
______________	Middle	__________
______________	Middle	__________
______________	Middle	__________
______________	Middle	__________

Comments:

Tidal Streams Use Attainability Sampling Form: SonTek Argonauts

Stream name and site description:____

Latitude/longitude of deployment point (degrees:minutes:seconds):______________________________

Sampling personnel:____

Date and time installed:________________________________

Apparent direction of flow (upstream, downstream or slack) when installed:___________________

Date and time retrieved:___________________

Apparent direction of flow (upstream, downstream or slack) when retrieved:___________________

Water Depth at deployment point:______________________

Approximate distance from right shore:________ Approximate distance from left shore:________

Compass Calibration	Horizontal score= Vertical score= Ambient magnetic field strength score=
Diagnostic file location	
Instrument configuration settings	English or Metric
Average sampling interval (seconds)	
Sampling interval (seconds)	
Cell begin	0.5 m (1.62 ft)
Cell end (= water depth)	
Magnetic declination	
Water salinity	

Additional comments regarding installation:

Additional comments regarding retrieval:

Chain-of-Custody TPW-MIA/UAA (Attachment)

Sampling Trip – Date ________________________

Benthic Sample Log

Tidal Stream	Tag #

Calibration Form

Calibration Date:_______________ Post Calibration Date:__________________
Sonde unit #_________________ Calibration Tech:____________________
Battery Voltage __________

pH

pH 7 initial __________ Calibrated to __________ calibrated: Yes /No

pH10/4 initial __________ Calibrated to __________ calibrated: Yes /No

pH 7 std exp date:__________ pH 10/4 std exp date:___________

Post calibration: pH 7 ___________ pH10/4 ___________

D.O. (mg/L)

Barometric pressure_________ (in Hg) * 25.4 ________ (mm Hg) _________ (Millibars)

Amb. temp________(C) Initial DO_________ Expected__________ Calibrated to ________

Post calibration: Expected DO___________ Current DO____________

SpCond (uS/cm)

Cal. value @25C ___________ Amb. temp. ___________ Corrected value _____________

Initial reading ______________ Calibration successful/within limits? Yes/No

Post calibration: Calibration value ____________ (mS/cm) Unit reading _______________

Logging set up

Logging interval:__________________

Begin time/date:___________________ Stop time/date:___________________

Dump performed?_________________ File name:_______________________

Nekton Voucher Label Form

TX: County_____________ Date_______

Stream Name________________

UAA Site #_________________

Collectors__________________

Collection Method__________

Bottle #____________________

Species____________________

Total Number_______________

TL Min-Max________________

70% Ethanol

TX: County_____________ Date_______

Stream Name________________

UAA Site #_________________

Collectors__________________

Collection Method__________

Bottle #____________________

Species____________________

Total Number_______________

TL Min-Max________________

70% Ethanol

TX: County_____________ Date_______

Stream Name________________

UAA Site #_________________

Collectors__________________

Collection Method__________

Bottle #____________________

Species____________________

Total Number_______________

TL Min-Max________________

70% Ethanol

TX: County_____________ Date_______

Stream Name________________

UAA Site #_________________

Collectors__________________

Collection Method__________

Bottle #____________________

Species____________________

Total Number_______________

TL Min-Max________________

70% Ethanol

TX: County_____________ Date_______

Stream Name________________

UAA Site #_________________

Collectors__________________

Collection Method__________

Bottle #____________________

Species____________________

Total Number_______________

TL Min-Max________________

70% Ethanol

TX: County_____________ Date_______

Stream Name________________

UAA Site #_________________

Collectors__________________

Collection Method__________

Bottle #____________________

Species____________________

Total Number_______________

TL Min-Max________________

70% Ethanol

Nekton
Data Form

Personnel________________________________ Start Date___________Start Time_____________ Stop Date____________Stop Time____________

Station ID__________________ Station Description ____

Gear Use

TRAWL: Width 10 ft. # Hauls 3 Duration of Hauls ____________________
STRAIGHT SEINE: Length (**circle one**) 10 ft. 30 ft. # Hauls _______ Duration of Hauls _______ Combined Length _______m
BOAT ELECTROFISHER: Range (High____ Low____) Pulses/sec ______ % on ______ Amps ______ Duration 900 seconds
GILL NET: Mesh Sizes (in.) 1, 2, 3, 4 Length 100 ft. Duration of Set ______ (hrs)

Habitat Sampled (circle all that apply):
sand mud clay overhanging vegetation macrophyte (type :_________________) bulkhead
cypress knees woody debris other (____)

Comments:
____
____
____

Haul No. or Mesh size	Species	Total Length (mm)																			Total Number	Anomalies*

Haul No. or Mesh size	Species	Total Length (mm)																			Total Number	Anomalies*

PHAB: CHANNEL/RIPARIAN TRANSECT FORM - RIVERS (Side 1) Reviewed by (Initial) ______

SITE ID: ____________________ DATE: ____/____/2 0 0_

TRANSECT: ☐ A ☐ B ☐ C ☐ D ☐ E ☐ F ☐ G ☐ H ☐ I ☐ J ☐ K ☐ X

Chosen bank side (facing downstream): ☐ Left ☐ Right

LITTORAL SUBSTRATE INFORMATION

SHORE DOM	SHORE SEC	BOTTOM DOM	BOTTOM SEC	CLASS: BOTTOM SUBSTRATE FROM (X ONE): ☐ Judgement -or- ☐ OBS. @ 5 Littoral Depths — Flag
RS	RS	RS	RS	RS = Bedrock (Smooth) - (Larger than a car)
RR	RR	RR	RR	RR = Bedrock (Rough) - (Larger than a car)
LB	LB	LB	LB	LB = Large Boulder (1000 to 4000 mm) - (Meterstick to car)
SB	SB	SB	SB	SB = Small Boulder (250 to 1000 mm) - (Basketball to Meterstick)
CB	CB	CB	CB	CB = Cobble (64 to 250 mm) - (Tennis ball to Basketball)
GC	GC	GC	GC	GC = Coarse Gravel (16 to 64 mm) - (Marble to Tennis ball)
GF	GF	GF	GF	GF = Fine Gravel (2 to 16 mm) - (Ladybug to marble)
SA	SA	SA	SA	SA = Sand (0.06 to 2 mm) - (Gritty - up to Ladybug size)
FN	FN	FN	FN	FN = Silt / Clay / Muck - (Not Gritty)
HP	HP	HP	HP	HP = Hardpan - (Firm, Consolidated Fine Substrate)
WD	WD	WD	WD	WD = Wood - (Any Size)
OT	OT	OT	OT	OT = Other (Write comment below)

DEPTH

SONAR (X.X)	POLE (X.X)	FLAG

LARGE WOODY DEBRIS

[illegible] Flag: ____ CHECK IF UNMARKED ARE ZERO ☐

DIAMETER LARGE END	Wholly or partly within active channel: LENGTH 1.5-5 m	5-15 m	>15 m	Dry but in flood plain/bankfull channel: LENGTH 1.5-5 m	5-15 m	>15 m
0.3 - 0.6 m						
0.6 - 0.8 m						
0.8 - 1.0 m						
> 1.0 m						

BANK CHARACTERISTICS

	XXX (m)	FLAG
Wetted Width		
Bar Width		
Bankfull Width		
Bankfull Height		
Incised Height		

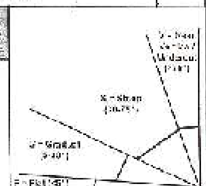
BANK ANGLES (CIRCLE ONE)

V

S

G

F



TRANSECT LOCATION

INTENDED transect spacing (xxx m) ☐ ACTUAL transect spacing (xxx m) ☐

Arrival Time ____:____ Leave Time ____:____

Channel width used to Define Reach (Stream width at X-site) ________ m

Reach length (40 * X-site width) ________ m

	Latitude - dd mm ss.s	Longitude - ddd mm ss.s	Flag
1. Location	___ ___ ___.___	___ ___ ___.___	
2. (Back Up)	___ ___ ___.___	___ ___ ___.___	

Notes:

Flag	Comments

Flag Codes: [illegible] Explain all flags in comments section on this side or on Side 2 of this form.

42066

PHAB: CHANNEL/RIPARIAN TRANSECT FORM - RIVERS (Side 2)

Rev'd by (init.):

SITE ID: ____________ DATE: __ / __ / 2 0 0 _

TRANSECT: ☐ A ☐ B ☐ C ☐ D ☐ E ☐ F ☐ G ☐ H ☐ I ☐ J ☐ K ☐ X

Chosen bank side (facing downstream): ☐ Left ☐ Right

VISUAL RIPARIAN ESTIMATES

0 = Absent (0%)
1 = Sparse (<10%)
2 = Moderate (10-40%)
3 = Heavy (40-75%)
4 = Very Heavy (>75%)

D = Deciduous
C = Coniferous
E = Broadleaf Evergreen
M = Mixed
N = None

RIPARIAN VEGETATION COVER (10m x 20m Plot)	Left Bank	Right Bank	Flag
Canopy (>5 m high)			
Vegetation Type	D C E M N	D C E M N	
BIG Trees (Trunk >0.3 m DBH)	0 1 2 3 4	0 1 2 3 4	
SMALL Trees (Trunk <0.3 m DBH)	0 1 2 3 4	0 1 2 3 4	
Understory (0.5 to 5 m high)			
Vegetation Type	D C E M N	D C E M N	
Woody Shrubs & Saplings	0 1 2 3 4	0 1 2 3 4	
Non-Woody Herbs, Grasses, & Forbs	0 1 2 3 4	0 1 2 3 4	
Ground Cover (<0.5 m high)			
Woody Shrubs & Saplings	0 1 2 3 4	0 1 2 3 4	
Non-Woody Herbs, Grasses, and Forbs	0 1 2 3 4	0 1 2 3 4	
Barren, Bare Dirt or Duff	0 1 2 3 4	0 1 2 3 4	

HUMAN INFLUENCE (0 = Not Present; P = >10m; C = Within 10m; B = On Bank)	Left Bank	Right Bank	Flag
Wall/Dike/Revetment/Riprap/Dam	0 P C B	0 P C B	
Buildings	0 P C B	0 P C B	
Pavement/Cleared Lot	0 P C B	0 P C B	
Road/Railroad	0 P C B	0 P C B	
Pipes (Inlet/Outlet)	0 P C B	0 P C B	
Landfill/Trash	0 P C B	0 P C B	
Park/Lawn	0 P C B	0 P C B	
Row Crops	0 P C B	0 P C B	
Pasture/Range/Hay Field	0 P C B	0 P C B	
Logging Operations	0 P C B	0 P C B	
Mining Activity	0 P C B	0 P C B	
Power Lines	0 P C B	0 P C B	

FISH COVER/ OTHER

COVER CATEGORIES:
0 = Absent (0%)
1 = Sparse (<10%)
2 = Moderate (10-40%)
3 = Heavy (40-75%)
4 = Very Heavy (>75%)

(Include Flag)	In Channel Cover (0-4)	Flag
Filamentous Algae	0 1 2 3 4	
Macrophytes	0 1 2 3 4	
Woody Debris >0.3 m (BIG) diam >5 m long	0 1 2 3 4	
Brush/Woody Debris <0.3 m (SMALL)	0 1 2 3 4	
Live Trees in Stream	0 1 2 3 4	
Overhanging Veg. ≤1 m above water surface	0 1 2 3 4	
Undercut Banks	0 1 2 3 4	
Boulders/Ledges	0 1 2 3 4	
Artificial Structures	0 1 2 3 4	

CHANNEL CONSTRAINT

DISTANCE FROM SHORE TO RIPARIAN VEGETATION (m; xxx) ____

CIRCLE ONE

C	Channel is Constrained
B	Channel is in Broad Valley but Constrained by Incision
N	Channel is in Narrow Valley but NOT very constrained.
U	Channel is Unconstrained in Broad Valley.

CHECK ONE

☐ YES I COULD READILY SEE OVER THE BANK.

☐ NO I COULD NOT READILY SEE OVER THE BANK.

CANOPY DENSIOMETER (0-17 max) BEND ONE ON THE 1 TO 17 MAX

UP	
DOWN	
LEFT	
RIGHT	
FLAG	

Flag	Comments

Flag Codes: K = No measurement made; U = Suspect measurement; F1, F2, etc. = flags assigned by each field crew. Explain all flags in comments section on this side or on Side 1 of this form.

42065

Rev. 04/06/2009 2/8/2 Rv. Channel/Riparian

PHAB: THALWEG PROFILE FORM - RIVERS

Reviewed by (Initial): ______

SITE ID: ____________________ DATE: ___ / ___ / 2 0 0 _

TRANSECT: ☐ A-B ☐ B-C ☐ C-D ☐ D-E ☐ E-F ☐ F-G ☐ G-H ☐ H-I ☐ I-J ☐ J-K

SUBSTRATE CODES	CHANNEL HABITAT CODES	OTHER
BH = BEDROCK/HARDPAN (SMOOTH OR ROUGH) - (LARGER THAN A CAR) BL = BOULDER (250 TO 4000 mm) - (BASKETBALL TO CAR) CB = COBBLE (64 TO 250 mm) - (TENNIS BALL TO BASKETBALL) GR = COARSE TO FINE GRAVEL (2 TO 64 mm) - (LADYBUG TO TENNIS BALL) SA = SAND (0.06 TO 2 mm) - (GRITTY - UP TO LADYBUG SIZE) FN = SILT/CLAY/MUCK - (NOT GRITTY) OT = OTHER (COMMENT ON OTHER SIDE)	PO = Pool GL = Glide RI = Riffle RA = Rapid CA = Cascade FA = Falls DR = Dry Channel	Off Channel = Off Channel or Backwater

REMEMBER: A = Upstream end of Reach and K = Downstream end of Reach.

THALWEG PROFILE

STATION	SNAG (circle one)	DEPTH (Either) SONAR (ft.XX)	DEPTH (Either) POLE (m) X.X	SUBSTRATE Circle one Substrate Code for each station	CHANNEL HABITAT Circle one Channel Habitat Code for each station	OFF CHAN. (circle one)	FLAG
1	Y N			BH BL CB GR SA FN OT	PO GL RI RA CA FA DR	Y N	
2	Y N					Y N	
3	Y N			BH BL CB GR SA FN OT	PO GL RI RA CA FA DR	Y N	
4	Y N					Y N	
5	Y N			BH BL CB GR SA FN OT	PO GL RI RA CA FA DR	Y N	
6	Y N					Y N	
7	Y N			BH BL CB GR SA FN OT	PO GL RI RA CA FA DR	Y N	
8	Y N					Y N	
9	Y N			BH BL CB GR SA FN OT	PO GL RI RA CA FA DR	Y N	
10	Y N					Y N	
11	Y N			BH BL CB GR SA FN OT	PO GL RI RA CA FA DR	Y N	
12	Y N					Y N	
13	Y N			BH BL CB GR SA FN OT	PO GL RI RA CA FA DR	Y N	
14	Y N					Y N	
15	Y N			BH BL CB GR SA FN OT	PO GL RI RA CA FA DR	Y N	
16	Y N					Y N	
17	Y N			BH BL CB GR SA FN OT	PO GL RI RA CA FA DR	Y N	
18	Y N					Y N	
19	Y N			BH BL CB GR SA FN OT	PO GL RI RA CA FA DR	Y N	
20	Y N					Y N	

FLAG	COMMENT

Flag codes: K = Sample not collected; U = Suspect sample; F1, F2, etc. = misc. flag assigned by field crew. Explain all flags in comment section.

2002 Phab - Thalweg River Wad 11/25/2002

42163

APPENDIX D. CHAIN-OF-CUSTODY FORM

ENVIRONMENTAL LABORATORY SERVICES CHAIN OF CUSTODY RECORD
(Do Not Write in Shaded Areas)

Page ______ of ______ Target Due Date: ______

COC#: ______ Work Order #: ______

Company/Facility: ______

Billing TO: ______ PO: ______

TAT requested ______ working days

Results TO: ______ Phone No.: ______

NOTE: Submission of samples to Environmental Laboratory Services constitutes the submitter's full terms and conditions printed on the back of this form.

Check Special Regulatory Permitting Requirements
❑ None ❑ NPDES ❑ RCRA ❑ SDWA ❑ ______

Sampled By: ______

Relinq. By: ______	Rec'd. By: ______	Relinq. By: ______	**Reporting Requirements**
Date: ______	Date: ______	Date: ______	❑ Fax ❑ EDI ❑ Non-standard	Fax number: ______
Time: ______	Time: ______	Time: ______	Fax name: ______

Received in Lab By:	Date: / Time:	Method of Transport:	Temp.: ______ °C Sample Condition: ______

Surcharge for RUSH ______ %	Lab Mgmt. Approval for Rush	Login Review: ______ Date: ______

LAB I.D. #	Sample Point Description	Matrix	Sample Date	Sample Time	Container Volume	Container Type	Preservatives	pH
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

INORGANICS

❑ Alkalinity, Total
❑ Bicarbonate
❑ Carbonate
❑ Hydroxide
❑ Phenolphthalein
❑ BOD5
❑ Bromide
❑ Carbon, Tot. Org. (TOC)
❑ CBOD5
❑ Chloride
❑ Chlorine, Residual
❑ Chlorophyll
❑ Color
❑ COD
❑ Conductivity
❑ Cyanide, Amenable
❑ Cyanide, Total
❑ Dry Weight
❑ Fluoride
❑ Grain Size (12 sieves)
❑ Hardness, Total
❑ Nitrogen, Ammonia
❑ Nitrogen, Ammonia (Dist.)
❑ Nitrogen, Nitrate
❑ Nitrogen, Nitrate/Nitrite
❑ Nitrogen, Nitrite
❑ Nitrogen, Organic
❑ Nitrogen, Total
❑ Nitrogen, Total Kjeldahl
❑ Oil and Grease (Liq. Ext.)
❑ Oil and Grease (HEM)
❑ pH
❑ Phenolics, Total
❑ Phosphorus
❑ Phosphorus, Ortho
❑ Phosphorus, Total
❑ Silica
❑ Solids, Settleable
❑ Sulfate
❑ Sulfide
❑ TDS
❑ TSS
❑ Texture
❑ TPH (418.1)
❑ TPH (TX 1005)
❑ TSS
❑ Turbidity
❑ VSS

ORGANICS

❑ Screen
❑ Chlorinated Pesticides
❑ PCBs
❑ Organophos. Pesticides
❑ Herbicides
❑ VOCs
❑ BTEX only
❑ BTEX/MTBE only
❑ MTBE only
❑ Lab Search
❑ Semi-VOAs (BNAs)
❑ Semi-VOA (Acids)
❑ Semi-VOA (BN) only
❑ PAH only
❑ Lab Search

MICROBIOLOGY

❑ Coliform
❑ E. coli
❑ Fecal Coliform
❑ Fecal Streptococcus
❑ Heterotrophic count
❑ Total Coliform

METALS (by ICP unless specific DL requested)
❑ Total ❑ Dissolved ❑ Other ______

	DL		DL
❑ Aluminum		❑ Silver	
❑ Antimony		❑ Sodium	
❑ Arsenic		❑ Strontium	
❑ Barium		❑ Thallium	
❑ Beryllium		❑ Tin	
❑ Bismuth		❑ Titanium	
❑ Boron		❑ Vanadium	
❑ Cadmium		❑ Zinc	
❑ Calcium			
❑ Chromium			
❑ Cobalt			
❑ Copper		❑ RCRA Metals as Total (8)	
❑ Iron		❑ ICP Screen (32 elements)	
❑ Lead			
❑ Lithium			
❑ Magnesium			
❑ Manganese			
❑ Mercury by CVAA			
❑ Molybdenum			
❑ Nickel			
❑ Potassium			
❑ Selenium			

OTHERS (List below)
❑ ______
❑ ______
❑ ______
❑ ______
❑ ______
❑ ______

TNRCC 7 DAY LEACHATE

❑ Total TNRCC
❑ TNRCC Metals
❑ All Organics
❑ Volatiles
❑ BNAs
❑ Pesticides
❑ Herbicides

RCRA

❑ TCLP ❑ SPLP
❑ ZHE
❑ BNA
❑ All
❑ All Organics
❑ BNA's
❑ Herbicides
❑ Pesticides
❑ VOA's
❑ Benzene only
❑ RCRA Metals
❑ Lead only
❑

❑ RCI
❑ Corrosivity
❑ Reactivity
❑ Ignitability

Special Instructions: ______

APPENDIX E. DATA MANAGEMENT PLAN

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Data Management Process

During each sampling trip, one TPWD staff person will be designated to serve as the central data recorder for all data connected on that trip. All data sheets will be provided to James Tolan, the Data Manager, and to Janet Nelson, the Project Manager. Laboratory data will be received from the LCRA Laboratory. Data will be put into electronic form using Microsoft Word and Excel. Electronic files will be stored on the TPWD network. Quality checks will be made on all data which is keyed into electronic format. All data will be backed up daily on an external hard drive connected to the Data Manager's primary workstation, and weekly on an external hard drive located off-site (TPWD secure network). Once a month, all data will be backed up on compact disk.

Water quality field measurements and sample data collection are to be performed according to *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue* (December, 2003).

For all data except for lab analysis data from the LCRA lab, this describes the flow of data: Field record -> Data Manager -> electronic system -> Project Manager (data validation checklist). Electronic data will flow from the lab to the TPWD Data Manager. After review and formatting the data will go to the TCEQ Project Manager.

Personnel -

James Tolan will act as Data Manager and will supervise data collection from Aransas River Tidal. Janet Nelson will provide data from Mission River Tidal. Kim Withers (Texas A&M-Corpus Christi, sub-contractor) will provide benthic invertebrate data to the Data Manager. LCRA Lab will provide the water and sediment data to the Data Manager.

LCRA Lab personnel ->
Texas A&M-Corpus Christi -> -> Data Manager -> electronic system ->
TPWD Filed Central Data Recorder -> Project Manager
(data validation checklist)

Systems Design - Hardware and Software Requirements –

The project will use Microsoft Office suite (Office 2000, Professional Edition), principally Excel, Word, and Access, operating under Windows XP environment.

Data Dictionary - Terminology and field descriptions are included in the *SWQM Data Management Reference Guide, 2007* or most recent version.

Quality Assurance/Control - See Section D of this QAPP.

Migration/Transfer/Conversion -

All data generated during this project will be input to a database by a TPWD employee. The data will be entered within 45 days of arrival to the Data Manager from either the sampling teams or TCEQ Laboratory. TPWD will generate a list of data points, one for each sample, for confirmation and completion of the QA/QC checklist. The employee entering the data will confirm the data points in the checklist and provide that information to the Data Manager. The Data Manager will check the confirmation data and generate the quarterly report and email it to the TCEQ Project Manager and the TPWD Project Manager. The TPWD Project Manager will copy the file to hard disk and to a compact disk for backup.

Backup/Disaster Recovery -

The computer system is tied to a network with a server that can hold data electronically for backup. Data will be stored each time an action occurs, whether it is a review action, report action, transfer action, or copying action. As data is downloaded or input into the database, backup copies will be made on compact disks. As data is received from the LCRA Laboratory, backup copies will be made. Archiving of backup data takes place on a daily basis from the TPWD network server. Electronic backup of data will be archived at TPWD Headquarters in the Resource Protection Division office.

Archives/Data Retention - Complete original data sets are archived on permanent media (magnetic tape) and retained on-site by the TPWD for a retention period specified in the original QAPP approved by the TCEQ Project Manager. Hard copies of all field data, QA/QC checklists and the quarterly reports will also be kept on file at the TPWD office (Coastal Fisheries Division, Ecosystem Resource Assessment Team, Science and Policy Branch) at 3000 South IH-35, Suite 320. Electronic files will be transferred to the TCEQ Project Manager by email and followed up by a backup hard copy using the U.S. Postal Service. All documents will be kept for a period of 5 years or as stipulated by the TCEQ.

Information Dissemination - Project updates will be provided to the TMDL Project Manager in progress reports. Environmental data collected as part of the project described in this QAPP will be accessible to the general public from the TCEQ once the data has undergone the QA/QC protocol described herein. Information will be disseminated to the individuals that are listed in the distribution list of this document or those individuals/entities who receive permission from the TCEQ Project Manager for receipt of the data.

APPENDIX F. DATA REVIEW CHECKLIST

TCEQ TMDL Program Data Review Checklist

QAPP Title:

____

Effective Date of QAPP:_________________________

Y, N, or N/A

Data Format and Structure

A.	Are there any duplicate *Tag ID* numbers?	______
B.	Are the *Tag prefixes* correct?	______
C.	Are all *Tag ID* numbers 7 characters?	______
D.	Are TCEQ station location (SLOC) numbers assigned?	______
E.	Are sampling *Dates* in the correct format, MM/DD/YYYY?	______
F.	Is the sampling *Time* based on the 24-hour clock (e.g. 13:04)?	______
G.	Is the *Comment* field filled in where appropriate (e.g. unusual occurrence, sampling problems, unrepresentative of ambient water quality)?	______
H.	Submitting Entity Code, Collecting Entity Code, and Monitoring Type Code used correctly?	______
I.	Is the sampling date in the *Results* file the same as the one in the *Events* file?	______
J.	Values represented by a valid parameter code with the correct units?	______
K.	Are there any duplicate parameter codes for the same *Tag Id*?	______
L.	Are there any invalid symbols in the Greater Than/Less Than (*GT/LT*) field?	______
M.	Are there any tag numbers in the *Results* file that are not in the *Events* file?	______
N.	Have confirmed outliers been identified? (with a “1" in the Verify_flg field)	______
O.	Have grab data (bacteria, for example) taken during 24-hr events been reported separately as RT samples?	______

Data Quality Review

A.	Are all the values reported at or below the LOQ/AWRL? If no, explain on next page.	______
B.	Have the outliers been verified?	______
C.	Checks on correctness of analysis or data reasonableness performed? e.g.: Is ortho-phosphorus less than total phosphorus? Are dissolved metal concentrations less than or equal to total metals?	______
D.	Have at least 10% of the data in the data set been reviewed against the field and laboratory data sheets?	______
E.	Are all parameter codes in the data set listed in the QAPP?	______
F.	Are all stations in the data set listed in the QAPP?	______
G.	Was all data collected in accordance with the approved QAPP?	______

Documentation Review

A.	Are blank results acceptable as specified in the QAPP?	______
B.	Were all chain-of-custody forms and/or field data sheets filled out completely and accurately?	______
C.	Were all holding times confirmed?	______
D.	Were control charts used to determine the acceptability of field duplicates?	______
E.	Was documentation of any unusual occurrences that may affect water quality included in the Event file Comments field?	______
F.	Were there any failures in sampling methods and/or deviations from sample design requirements that resulted in unreportable data? If yes, explain on next page.	______
G.	Were there any failures in field and laboratory measurement systems that were not resolvable and resulted in unreportable data? If yes, explain on next page.	______

Describe any data reporting inconsistencies with LOQ/AWRL specifications. Explain failures in sampling methods and field and laboratory measurement systems that resulted in data that could not be reported to the TCEQ. (attach another page if necessary):

____

____

____

____

____

____

____

____

Date Submitted to TCEQ: ______________________________

Tag ID Series: ______________________________________

Date Range: ____

Data Source: _______________________________________

Comments (attach README.TXT file if applicable):

____

____

____

____

Lead Organization Data Manager: ____Date: ___________

Data was collected as specified in the QAPP? Yes No (based on the responses above)

Did the contractor describe any data reporting inconsistencies with the LOQ/AWRL specifications? Yes No
If yes, ensure the data was not reported to the TCEQ.

Did the contractor list any failures in sampling methods, field measurements, and/or laboratory measurements? Yes No
If yes, ensure the data was not reported to the TCEQ.

TMDL Project Manager:____Date:____________

APPENDIX G. EXAMPLE LETTER

APPENDIX G. EXAMPLE LETTER TO DOCUMENT ADHERENCE TO THE QAPP

TO: *(name)*
(organization)

FROM: Janet Nelson
Texas Parks & Wildlife Department

RE: Tidal Stream Use Assessment Phase II

Please sign and return this form by (*date*) to:

(*address)*

I acknowledge receipt of the referenced document(s). I understand the document(s) describe quality assurance, quality control, data management and other technical activities that must be implemented to ensure the results of work performed will satisfy stated performance criteria.

____
Signature Date

Note: Copies of the signed letter should be sent by the Lead Organization to the TCEQ TMDL Project Manager within ***30 days*** *of the approval of the QAPP by the TCEQ.*