Texas Nonpoint Source Grant Program

Surface Water Quality Monitoring to Support Phase 1: Data Collection and Development of Essential Components for the Mill Creek Watershed Protection Plan

TSSWCB Project Number 14-57
Revision #2

Quality Assurance Project Plan

Texas State Soil and Water Conservation Board

Prepared by

Houston-Galveston Area Council
and
Texas A&M AgriLife Research

Effective Period: Upon TSSWCB approval through May 31, 2016
(with Annual Updates Required)

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

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A1 APPROVAL PAGE

Surface Water Quality Monitoring to Support Phase 1: Data Collection and Development of Essential Components for the Mill Creek Watershed Protection Plan

Texas State Soil and Water Conservation Board (TSSWCB)

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Jana Lloyd
TSSWCB Project Manager (PM)

_____Date:_____
Mitch Conine
TSSWCB Quality Assurance Officer (QAO)

Texas A&M AgriLife Research (AgriLife)

_____Date:_____
Jake Mowrer
Project Leader

AgriLife will secure written documentation from each sub-tier project participant (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 added appendices of this plan. AgriLife will maintain this documentation as part of the project's quality assurance records, and will be available for review. H-GAC will also have copies of this documentation for their permanent records.

Houston-Galveston Area Council (H-GAC)

_____Date:_____
Todd Running
Project Manager

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Jean Wright
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Pam Hickman
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Daniel Bowen
Lab Quality Assurance Officer (QAO)

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List of Acronyms and Abbreviations

AgriLife	Texas A&M AgriLife Research
ASTM	American Society for Testing and Materials
AWRL	Ambient Water Reporting Limit
BMP	Best Management Practices
BRA	Brazos River Authority
CAR	Corrective Action Report
CFU	Colony Forming Units
COC	Chain-of -Custody
CR	County Road
CRP	Clean Rivers Program
DM	Data Manager
DMRG	Data Management Reference Guide
DO	Dissolved Oxygen
Eastex	Eastex Environmental Laboratory
FY	Fiscal Year
H-GAC	Houston-Galveston Area Council
LCS	Laboratory Control Sample
LOD	Limit of Detection
LOQ	Limit of Quantitation
MC WPP	Mill Creek Watershed Protection Plan
mL	Milliliters
MPN	Most Probable Number
NELAC	National Environmental Laboratory Accreditation Committee
NELAP	National Environmental Laboratory Accreditation Program
NPS	Nonpoint Source
PM	Project Manager
QA	Quality Assurance
QAM	Quality Assurance Manual
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative Percent Difference
SA	Sample Amount (reference concentration)
SM	Standard Methods
SOP	Standard Operating Procedure
SR	Sample Result
SWQM	Surface Water Quality Monitoring
SWQMIS	Surface Water Quality Monitoring Information System
TCEQ	Texas Commission on Environmental Quality
TKN	Total Kjeldahl Nitrogen
TSS	Total Suspended Solids
TSSWCB	Texas State Soil and Water Conservation Board
TSWQS	Texas Surface Water Quality Standards
USEPA	US Environmental Protection Agency
USGS	US Geological Survey
WPP	Watershed Protection Plan

A3 DISTRIBUTION LIST

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

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TSSWCB PM

Mitch Conine
TSSWCB QAO

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Project Leader

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Project QAO, Sr. Environmental Planner

Eastex Environmental Laboratory (Eastex)
P.O. Box 1089
Coldspring, TX 77331

Pam Hickman
Laboratory Manager

Daniel Bowen
Laboratory Quality Assurance Officer

AgriLife will provide copies of this project plan and any amendments or appendices of this plan to each person on this list and to each sub-tier project participant, e.g., subcontractors, other units of government, laboratories. AgriLife will document distribution of the plan and any amendments and appendices, maintain this documentation as part of the project's quality assurance records, and will be available for review.

A4 PROJECT/TASK ORGANIZATION

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

Texas State Soil and Water Conservation Board (TSSWCB)

Jana Lloyd, TSSWCB PM
Responsible for ensuring that the project delivers data of known quality, quantity, and type on schedule to achieve project objectives. Responsible for submitting data sets to TCEQ's Data Management and Analysis Team. Provides the primary point of contact between AgriLife, H-GAC, TSSWCB and TCEQ. Tracks and reviews deliverables to ensure that tasks in the workplan are completed as specified in the contract. Responsible for verifying that the QAPP is followed by the H-GAC. Notifies the TSSWCB QAO of significant project non-conformances and corrective actions taken as documented in quarterly progress reports from AgriLife and H-GAC.

Mitch Conine, TSSWCB QAO
Reviews and approves the project QAPP and any amendments or revisions and ensures distribution of approved/revised QAPPs to TSSWCB participants. Assists the TSSWCB Project Manager on QA-related issues. Coordinates reviews and approvals of QAPPs and amendments or revisions. Conveys QA problems to appropriate TSSWCB management. Monitors implementation of corrective actions. Coordinates and conducts audits.

Texas A&M AgriLife Extension (AgriLife)

Jake Mowrer, Project Leader
Responsible for managing the project for AgriLife. Reviews project progress and reviews and approves QAPP and QAPP amendments.Responsible for implementing and monitoring MC WPP requirements in the contract and the QAPP. Responsible for maintaining records of QAPP distribution, including appendices and amendments. Responsible for maintaining written records of sub-tier commitment to requirements specified in this QAPP. Coordinates project planning activities and work of project partners. Ensures QAPP is followed by project participants and that project is producing data of known quality. Ensures that subcontractors are qualified to perform contracted work.

Houston-Galveston Area Council (H-GAC)

Todd Running, H-GAC Project Manager and Field Supervisor
Responsible for ensuring tasks and other requirements in contracts, QAPPs, and QAPP amendments and appendices are executed on time and are of acceptable quality. Ensures monitoring systems audits are conducted to ensure QAPPs are followed and the project is producing data of known quality. Ensures that contractor lab is qualified to perform contracted work. Ensures AgriLife project managers are notified of deficiencies and corrective actions and

that issues are resolved. Responsible for supervising sample collection, processing, handling, holding and reporting activities to ensure compliance with monitoring requirements.

Jean Wright
H-GAC Quality Assurance Officer (QAO)
Responsible for coordinating the implementation of the QA program. Responsible for writing and maintaining the QAPP and monitoring its implementation. Responsible for maintaining records of QAPP distribution, including appendices and amendments. Responsible for identifying, receiving, and maintaining project QA records. Responsible for coordinating with the H-GAC PM and AgriLife PM to resolve QA-related issues. Notifies the H-GAC Project Manager of particular circumstances which may adversely affect the quality of data. Coordinates and monitors deficiencies and corrective action. Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques. Conducts monitoring systems audits on project participants to determine compliance with project and program specifications, issues written reports, and follows through on findings. Ensures that field staff is properly trained and that training records are maintained. Coordinates field personnel to ensure all monitoring is conducted as stated in approved QAPP. Responsible for validation and verification of all data collected according to Table A7.1 and QC specifications and acquired data procedures after each task is performed.

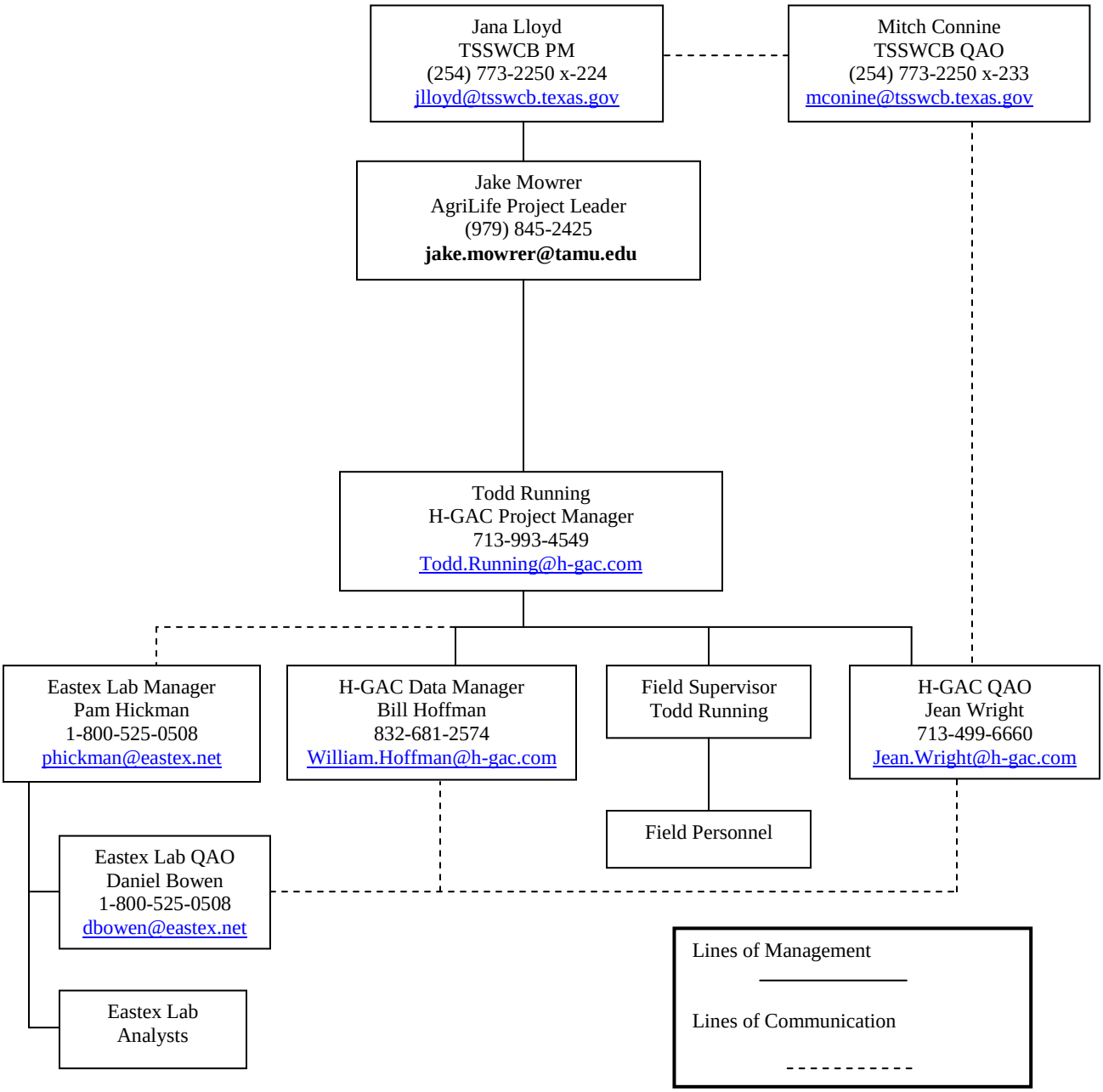
Bill Hoffman
H-GAC Data Manager (DM)
Responsible for ensuring that field data are properly reviewed and verified. Formats project data for QAO review. Coordinates and maintains records of data verification and validation. Completes the data summary reports, prepares the electronic data deliverables for submission to the TCEQ Data Management and Analysis team, and serves as primary contact with the TCEQ Data Management and Analysis team with respect to data management and data delivery . Submits data sets to TCEQ Data Management and Analysis Team via TSSWCB PM. Maintains quality-assured data on the H-GAC's internet sites.

<u>Eastex Environmental Laboratory (Eastex)</u>

Pam Hickman
Laboratory Director - Eastex Environmental Laboratory (Contract Lab)
Responsible for producing quality analytical data for samples collected and submitted by H-GAC. Maintains verification of procedures establishing the level of quality. Responsible for sending data and COC forms to H-GAC within time specified in contract.

Daniel Bowen
Eastex Lab QAO
Checks training, competency, and re-training of technicians. Performs verification and validation procedures to confirm quality data is issued to clients. Performs other QA/QC duties and checks associated with lab activities. Resolves out-of-control issues. Conducts internal lab audits.

Figure A4.1 Project Organizational Chart*-- Lines of Communication



* See Project/Task Organization in this section for a description of each position's responsibilities.

A5 PROBLEM DEFINITION/BACKGROUND

Mill Creek (Segment 1202K) is a 256,000-acre watershed in the Brazos River Basin. From the headwaters located in western Washington County, the creek flows 14 miles southeast through Austin County to its confluence with the Brazos River 3.9 miles north of FM1458 in the City of San Felipe, Texas. The City of Bellville, with a population slightly more than 4,100 is located in the lower reach of the watershed. While the city covers an area of 2.664 square miles, not all of the city limits are within the Mill Creek watershed. The City of Industry, covering only 1.1 square miles and having a population of approximately 300, is situated midway up the western fork of Mill Creek. The unincorporated town of Burton, covering 1.2 square miles and having a population of 300, is located near the headwaters of the east fork of Mill Creek.

Mill Creek was identified as impaired on the 2012 303(d) list due to bacterial contamination. Data used for the 2012 Integrated Report were 25 samples taken during the 7-year period between December 2003 and November 2010. The geometric mean of these data for *E. coli* bacteria was 177 colony forming units per 100 milliliters (cfu/100 mL), which exceeds the state standard of 126 cfu/100 mL.

The 2012 Texas Integrated Report lists the source of the bacteria impairment for Mill Creek as unknown. Watershed reconnaissance performed on Mill Creek as part of the Recreational Use Attainability Analysis (RUAA) pilot project conducted in 2007 noted that land in the watershed is used predominantly for agricultural purposes with over 56% under some form of production. The RUAA also noted the presence of only two wastewater treatment plants in the watershed leaving all other commercial and residential structures being serviced by on-site sewer facilities (OSSFs) for wastewater treatment and disposal.

The 2010 Brazos River Authority's (BRA) Basin Highlights Report indicated concerns for bacteria and an impaired fish community; suggesting that Mill Creek had poor habitat to support a large and diverse fish population. Also mentioned were likely concerns for DO, nutrients, and chlorophyll a. The 2012 and 2013 BRA Basin Highlights Reports identify Mill Creek as not supporting its designated contact recreation use due to bacteria impairment.

The Houston-Galveston Area Council (H-GAC) conducts surface water quality monitoring under the auspices of the Texas Clean Rivers Program (CRP). Currently, H-GAC and other local CRP partners collect valid, representative environmental data to accurately assess water quality conditions in the region and to support effective water quality decision making. Routine samples are collected from classified streams, reservoirs, and bay segments to monitor for the attainment of uses and numerical criteria. Unclassified water bodies are also monitored in response to perceived risk for pollution and/or to define water quality. H-GAC will conduct in-stream water quality monitoring at 9 targeted locations on a monthly basis for 10 months for selected parameters in support of the Watershed Protection Plan (WPP) development.

The purpose of this Quality Assurance Project Plan (QAPP) is to clearly delineate H-GAC's Quality Assurance (QA) policy, management structure, and procedures which will be used to implement the QA requirements necessary to verify and validate the surface water quality data collected. The QAPP is reviewed by the Texas State Soil & Water Conservation Board (TSSWCB) to help ensure that data generated are scientifically valid and legally defensible. This process will ensure that data collected under this QAPP and submitted to the Texas Commission on Environmental Quality (TCEQ) Surface Water Quality Monitoring Information System (SWQMIS) database have been collected and managed in a way that guarantees its reliability and, therefore, may be used in water quality assessments, watershed

protection plan (WPP) development, establishing water quality standards, making permit decisions, and used by other programs deemed appropriate by the TCEQ or the TSSWCB.

A6 PROJECT/TASK DESCRIPTION

AgriLife will conduct work performed under this project associated with technical and financial supervision, preparation of status reports, and coordination with local stakeholders, data analysis and development of the final project report. AgriLife will facilitate the Mill Creek Watershed Stakeholders Group and appropriate Work Groups in order to efficiently and effectively achieve project goals and summarize activities and achievements made throughout the course of this project.

H-GAC will conduct all surface water quality monitoring, sample collection, and data preparation for submission to SWQMIS, as required. Sample analysis will be performed by Eastex Laboratory located in Coldspring, TX. All monitoring procedures and methods will follow the guidelines prescribed in this QAPP and the most current versions of TCEQ's *Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring (RG-415).*

Following input from local stakeholders, numerous sites on Mill Creek and several tributaries were selected for monitoring. H-GAC will monitor 9 stations on a monthly basis collecting field and flow data along with water quality samples that will be analyzed for conventional and bacteria parameters. The sampling period extends over 10 months, generating a total of 90 routine samples. Routine monitoring will be pre-scheduled on approximately the same days each month as soon as the QAPP is approved. Sampling will be conducted as scheduled as long as conditions do not create a safety hazards for the field crew. Sampling will reconvene as soon as the hazard has ceased or been eliminated.

Biased flow monitoring will be conducted at 13 stations three times during the 10 month period. When rainfall events generate measurable flow at the four storm water stations located in the upper portion of the watershed, those four sites plus the nine routine stations will be monitored generating biased flow data. The four sites selected in the upper watershed are frequently dry during most of the year and experience flow only when enough rain has fallen to generate runoff. H-GAC and AgriLife will monitor weather fronts moving through the area so the field crew can be alerted to potential monitoring events. However, these biased flow monitoring events are not aimed at collecting the first flush. Rather, monitoring will only be conducted if the field crew receives confirmation from local contacts that there is flowing water at the upper watershed sites and samples can actually be collected.

Figure A6.1 illustrates the Mill Creek watershed and the selected monitoring locations for this project. The sites designated by the green circles are the routine monitoring stations which are also monitored during biased flow events. The orange triangles are the 4 extra sites collected during biased flow events in addition to the 9 routine sites. Table A6.1 lists the monitoring stations, their geographical locations and the monitoring schedule.

Figure A6.1 Mill Creek Monitoring Stations

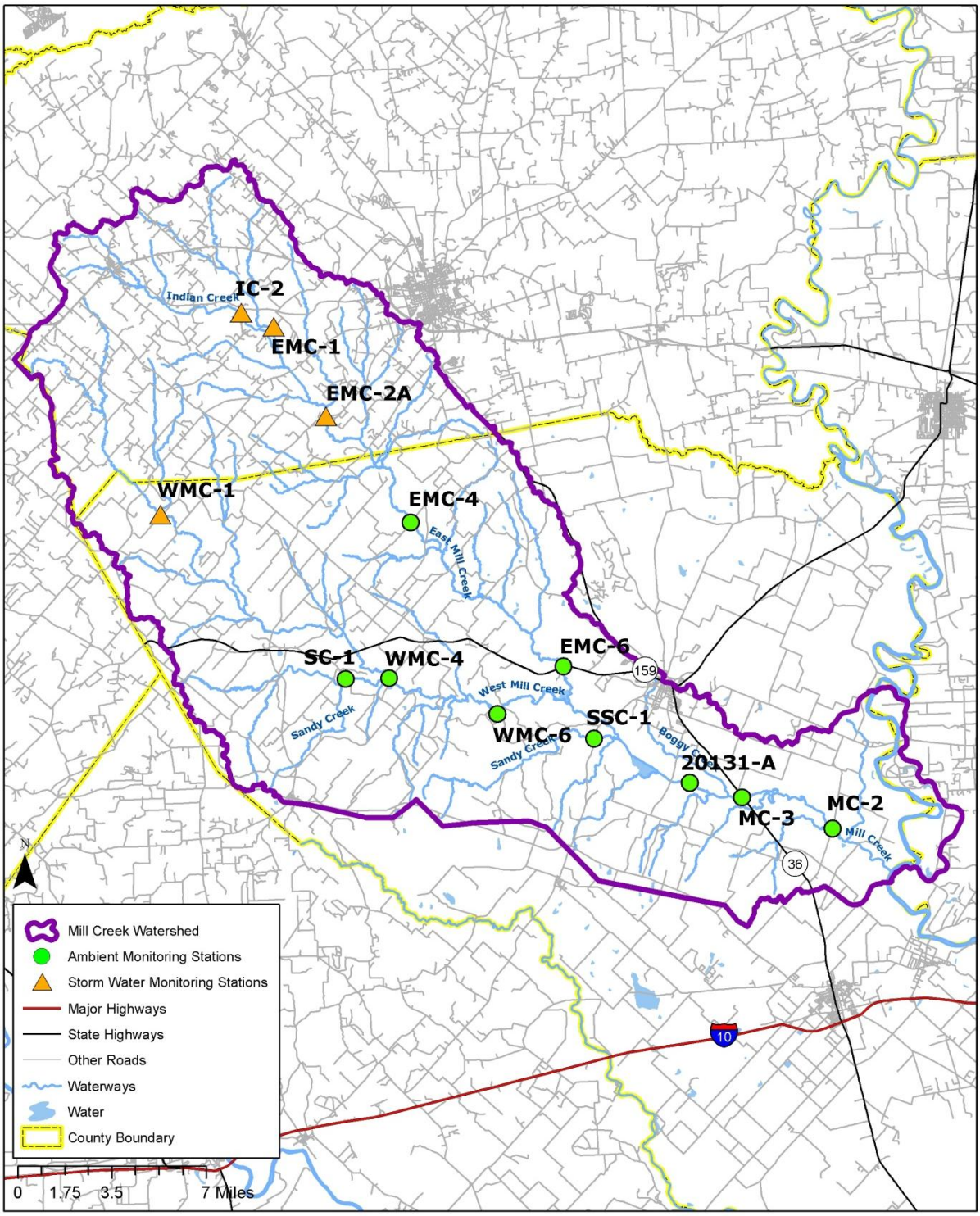


Table A6.1 Monitoring Stations and GIS Locations

Site	TCEQ Station ID	Site_ID	Latitude Decimal	Long Decimal	Description
13*	21589	IC-2	30.154482	-96.514878	Indian Creek at CR 2/Beckermann Rd, 300 meters south of CR 25 and 9 kilometers west of Brenham.
12*	21587	EMC-1	30.146670	-96.494839	East fork of Mill Creek at Indian Creek Ln/CR 28A, 0.75 km SW of intersection of CR 28 and Indian Creek Ln.
11*	21588	EMC-2a	30.097393	-96.464984	East Mill Creek at FM332, 7.5 km SW of intersection of FM332 and CR 389.
10*	21586	WMC-1	30.046920	-96.567711	West fork of Mill Creek at Wolfe Rd approximately 3.0 km NW of intersection of FM 389 and Wolfe Rd.
9	21585	EMC-4	30.039449	-96.413137	East fork Mill Creek at Bleiblerville Rd. About 1.5 km northwest of TCEQ station ID 20133.
8	21584	EMC-6	29.959612	-96.320151	East fork Mill Creek at FM 159/Old Nelsonville Rd, 1.5 km west of intersection of Koy Rd and FM 159.
7	21583	SC-1	29.955764	-96.455117	Sandy Creek at New Breman Rd approximately 5 km southeast of the city of Industry.
6	21582	WMC-4a	29.9557127	-96.4276336	West Mill Creek at Tiemann Rd, east of Industry.
5	21581	WMC-6	29.935733	-96.360328	West fork Mill Creek adjacent to small lake between Artists Cir Dr and John Schoelikopf Rd approximately 7.7 km west of the Mill Creek Rd and Kuykendall Rd
4	21580	SSC-1	29.921135	-96.301334	Sandy Creek at Mill Creek Rd southwest of Bellville
3	21579	20131-A	29.89679	-96.25499	Mill Creek at FM 2429 5.13 km upstream of SH 36 and 5.25 km downstream of Mill Creek Road at approximately 5.78 km south of the City of Bellville in Austin County
2	21578	MC-3	29.886502	-96.210053	Little Boggy Creek at Hwy 36 south of Bellville
1	21577	MC-2	29.869637	-96.155232	Mill Creek at FM331, immediately downstream of bridge.
	* Denotes storm water monitoring sites.				

Each quarter (three times during the 10 month period), a full suite of lab parameters will be analyzed (See Table A7.1b). During the other seven months, fewer lab parameters will be tested (See Table A7.1c) and during the biased flow events, even fewer lab parameters will be tested (See Table A7.1d). The same field parameters will be collected during every monitoring event (See Table A7.1a).

H-GAC will manage monitoring data in support of the Mill Creek WPP. H-GAC will submit monitoring data on a quarterly basis to TCEQ Data Management and Analysis Team via TSSWCB PM, using required formatting and protocols. H-GAC will also provide copies of all data submission documents to AgriLife.

AgriLife will summarize the results and activities of this project for possible inclusion in the BRA's *Clean Rivers Program Basin Highlights Report*. Additionally, AgriLife will develop a final Assessment Data Report summarizing water quality data collected. AgriLife will provide a baseline assessment of water quality to stakeholders prior to BMP implementation and having a discussion of interim short-term progress in achieving the Mill Creek WPP water quality goals.

Table A6.2 presents project milestones pertaining to this project.

Table A6.2 Project Milestones

TASK	PROJECT MILESTONES	AGENCY	START	END
2.1	Develop QAPP for review by TSSWCB.	H-GAC & AgriLife	6/2014	8/2014
2.2	Submit revisions to QAPP as necessary.	H-GAC & AgriLife	8/2014	11/2015
3.1	Monitor 9 routine sites monthly, collecting field, conventional, flow and bacteria parameter groups.	H-GAC	8/2014	11/2015
3.3	Transfer monitoring data on a quarterly basis to TCEQ Data Management and Analysis Team. Submit station location requests to TCEQ, if required. Submit data correction requests, if errors are discovered in reported data.	H-GAC	8/2014	11/2015
3.4	Summarize water quality data and conduct statistical and trend analysis.	AgriLife	8/2014	11/2015

Amendments

Amendments to this QAPP may be necessary to reflect changes in project organization, tasks, schedules, objectives, and methods; address deficiencies and nonconformance; improve operational efficiency; and/or accommodate unique or unanticipated circumstances. Requests for amendments are directed from the contractor Project Manager to the TSSWCB NPS Project Manager in writing. The changes are effective immediately upon approval by the TSSWCB NPS Project Manager.

Amendments to the QAPP and the reasons for the changes will be documented, and full copies of amendments will be forwarded to all persons on the QAPP distribution list by the TSSWCB or H-GAC QAO.

A7 QUALITY OBJECTIVES AND CRITERIA FOR DATA QUALITY

The purpose of the water quality monitoring described in this QAPP is to collect surface water quality data that can be used to characterize water quality conditions in the Mill Creek watershed and support development of a Watershed Protection Plan (WPP). The water quality data and evaluations of water quality conditions will be communicated to the public and the Mill Creek Watershed Stakeholders to support adaptive management of the Mill Creek WPP and expand public knowledge on Mill Creek water quality data.

Systematic watershed monitoring is defined by sampling that is planned for a short duration (1 to 2 years) and is designed to: screen waters that would not normally be included in the routine monitoring program, monitor at sites to check the water quality situation, and investigate areas of potential concern. Due to the limitations regarding these data (e.g., not temporally representative, limited number of samples), the data will be used to determine whether any locations have values exceeding the TCEQ's water quality criteria and/or screening levels (or in some cases values elevated above normal).

Biased flow monitoring is targeted toward certain flow conditions. Since the four sites selected from the upper watershed are frequently dry during most of the year, the biased flow events for this project will be conducted following rainfall events that create measurable flow runoff at those four stations. These biased flow monitoring events are not aimed at collecting the first flush. Rather, monitoring will only be conducted if the field crew receives confirmation from local contacts that acceptable flow conditions exist at the four sites.

The measurement performance specifications to support the project objectives for a minimum data set are specified in Tables A7.1a, b, c, and d below.

Ambient Water Reporting Limits (AWRLs)

AWRLs establish the reporting specification at or below which data for a parameter must be reported to be compared with freshwater screening criteria. The AWRLs specified in Table A7.1 are the program-defined reporting specifications for each analyte and yield data acceptable for TCEQ water quality assessment. The limit of quantitation (LOQ) is the minimum level, concentration, or quantity of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. The following requirements must be met in order to report results to the TCEQ SWQMIS:

- The laboratory's LOQ for each analyte must be at or below the AWRL as a matter of routine practice
- The laboratory must demonstrate its ability to quantitate at its LOQ for each analyte by running an LOQ check sample for each batch of samples analyzed.

Table A7.1a - Field Measurement Performance Specifications for Routine Systematic and Biased Flow Monitoring Events

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
Temperature	ºC	water	SM 2550 and TCEQ SOP, V1	00010	NA[1]	NA	NA	NA	NA	Field
Specific Conductance	µS/cm	water	EPA 1201 and TCEQ SOP, V1	00094	NA[1]	NA	NA	NA	NA	Field

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
pH	standard units	water	EPA 150.1 and TCEQ SOP, V1	00400	NA[1]	NA	NA	NA	NA	Field
DO	mg/L	water	SM 4500-O G. and TCEQ SOP, V1	00300	NA[1]	NA	NA	NA	NA	Field
Depth of Bottom of water body at sample site	meters	water	TCEQ SOP, V2	82903	NA[1]	NA	NA	NA	NA	Field
Transparency, Secchi Disc	meters	water	TCEQ SOP, V1	00078	NA[1]	NA	NA	NA	NA	Field
Days since precipitation event	days	other	TCEQ SOP V1	72053	NA[1]	NA	NA	NA	NA	Field
Flow Stream, Instantaneous	cfs	water	TCEQ SOP, V1	00061	NA[1]	NA	NA	NA	NA	Field
Flow method	1-gage 2-electric 3-mechanical 4-weir/flume 5-doppler	water	TCEQ SOP, V1	89835	NA[1]	NA	NA	NA	NA	Field
Flow severity	1-no flow 2-low 3-normal 4-flood 5-high 6-dry	water	TCEQ SOP, V1	01351	NA[1]	NA	NA	NA	NA	Field
Stream Flow Estimate (CFS)	cfs	water	TCEQ SOP, V1	74069	NA[1]	NA	NA	NA	NA	Field
Maximum pool width at time of study[2]	meters	other	TCEQ SOP V2	89864	NA[1]	NA	NA	NA	NA	Field
Maximum pool depth at time of study[2]	meters	other	TCEQ SOP V2	89865	NA[1]	NA	NA	NA	NA	Field
Pool length[2]	meters	other	TCEQ SOP V2	89869	NA[1]	NA	NA	NA	NA	Field
% pool coverage in 500 meter reach[2]	%	other	TCEQ WOP V2	89870	NA[1]	NA	NA	NA	NA	Field
Wind Intensity (1=calm, 2=slight,3=mod, 4=strong)	NU	other	NA	89965	NA	NA	NA	NA	NA	Field
Present Weather (1=clear,2=ptcldy, 3=cldy,4=rain, 5=other)	NU	other	NA	89966	NA	NA	NA	NA	NA	Field
Water Surface (1= calm,2=ripple,3=wave,4=whitecap)	NU	water	NA	89968	NA	NA	NA	NA	NA	Field
Water Color (1=brownish, 2=reddish,3=greenish,4=blackish, 5=clear,6=other)	NU	water	NA	89969	NA	NA	NA	NA	NA	Field
Water Odor (1=sewage,2=oily/chemical,3=rotten egg,4=musky, 5=fishy,6=none, 7=other)	NU	water	NA	89971	NA	NA	NA	NA	NA	Field

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
Water clarity (1=excellent,2=good,3=fair,4=poor)	NU	water	NA	20424	NA	NA	NA	NA	NA	Field
Turbidity, observed (1=low,2=medium, 3=high)	NU	water	NA	88842	NA	NA	NA	NA	NA	Field
Primary contact, observed activity (# of people observed)	# of people observed	other	NA	89978	NA	NA	NA	NA	NA	Field
Evidence of primary contact recreation (1=observed, 0=not observed)	NU	other	NA	89979	NA	NA	NA	NA	NA	Field

1 Reporting to be consistent with SWQM guidance and based on measurement capability.
2 Parameters for pools to be reported only if pooled conditions are sampled as outlined under the TCEQ Interim Guidance for Routine Surface Water Quality Monitoring During Extended Drought.

References for Table A7.1a:

- 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, (or most recent version)
- TCEQ SOP, V1 - TCEQ Surface Water Quality Monitoring Procedures Manual, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, August 2012 or most recent editions (RG-415)

Table A7.1b - Measurement Performance Specifications for Routine Systematic Monitoring Events Collected Three times over 10 Months.

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
Residue, Total nonfiltrable (TSS)	mg/L	water	SM 2540 - D	00530	4	1	NA	NA	NA	Eastex
Chloride (mg//L as CL)	mg/L	water	SM 4500 Cl- C	00940	5	5	70-130	20	80-120	Eastex
Sulfate (mg/L as SO4)	mg/L	water	ASTM D516	00945	5	5	70-130	20	80-120	Eastex
Turbidity, Lab Nephelometric Turbidity Units	NTU	water	SM 2130B	82079	0.5	0.5	NA	NA	NA	Eastex
Nitrogen, Ammonia, Total (mg/L as N)	mg/L	Water	SM4500 NH3-G	00610	0.1	0.1	70-130	20	80-120	Eastex
Nitrogen, Kjeldahl, Total (mg/L as N)	mg/L	water	SM 4500 – Norg C and SM4500-NH_3 B	00625	0.2	0.2	70-130	20	80-120	Eastex
Nitrite+Nitrate, total one lab determined value (mg/L as N)	mg/L	water	SM 4500 – NO_3 F	00630	0.05	0.02	70-130	20	80-120	Eastex
Phosphorus, Total, Wet Method (mg/L as P)	mg/L	water	SM 4500-P E	00665	0.06	0.02	70-130	20	80-120	Eastex

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
Orthophosphate phosphorus, diss, mg/L, Field Filtered <15 min	mg/L	water	SM 4500-P E	00671	0.04	0.02	70-130	20	80-120	Eastex
Orthophosphate phosphorus, diss, mg/L, Filtered >15 min	mg/L	water	SM 4500-P E	70507	0.04	0.02	70-130	20	80-120	Eastex
Chlorophyll-a, spectrophotometric acid method	µg/L	water	EPA 446.0	32211	3	3	NA	20	80-120	Eastex
Pheophytin, spectrophotometric acid method	µg/L	water	EPA 446.0	32218	3	3	NA	NA	NA	Eastex
E. coli, , Colilert, IDEXX method MPN/mL	MPN/100 mL	water	Colilert-18[4]	31699	1	1	NA	0.5[3]	NA	Eastex
E. coli, Colilert, IDEXX, holding time	hours	other	NA	31704	NA	NA	NA	NA	NA	Eastex

3 This value is not expressed as a relative percent difference. It represents the maximum allowable difference between the logarithm of the sample result and the logarithm of the duplicate result. See Section B5.

4 *E.coli* samples analyzed by IDEXX Colilert-18 should always be processed as soon as possible and within 8 hours. When transport conditions necessitate delays in delivery longer than 6 hours, the holding time may be extended and samples must be processed as soon as possible and within 30 hours.

References for Table A7.1b:

- 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 or most recent version
- TCEQ SOP, V1 - TCEQ Surface Water Quality Monitoring Procedures Manual, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, August 2012 or most recent editions (RG-415)

Table A7.1c - Measurement Performance Specifications for Routine Systematic Monitoring Events Collected Seven Times Over 10 Months.

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
Residue, Total nonfiltrable (TSS)	mg/L	water	SM 2540 - D	00530	4	1	NA	NA	NA	Eastex
Nitrogen, Ammonia, Total (mg/L as N)	mg/L	Water	SM4500 NH3-G	00610	0.1	0.1	70-130	20	80-120	Eastex
Nitrogen, Kjeldahl, Total (mg/L as N)	mg/L	water	SM 4500 – Norg C and SM4500-NH_3 B	00625	0.2	0.2	70-130	20	80-120	Eastex
Nitrite+Nitrate, total one lab determined value (mg/L as N)	mg/L	water	SM 4500 – NO_3 F	00630	0.05	0.02	70-130	20	80-120	Eastex
Phosphorus, Total, Wet Method (mg/L as P)	mg/L	water	SM 4500-P E	00665	0.06	0.02	70-130	20	80-120	Eastex
Orthophosphate phosphorus, diss, mg/L, Field Filtered <15 min	mg/L	water	SM 4500-P E	00671	0.04	0.02	70-130	20	80-120	Eastex

Orthophosphate phosphorus, diss, mg/L, Filtered >15 min	mg/L	water	SM 4500-P E	70507	0.04	0.02	70-130	20	80-120	Eastex
Chlorophyll-a, spectrophotometric acid method	µg/L	water	EPA 446.0	32211	3	3	NA	NA	NA	Eastex
Pheophytin, spectrophotometric acid method	µg/L	water	EPA 446.0	32218	3	3	NA	NA	NA	Eastex
E. coli, , Colilert, IDEXX method MPN/mL	MPN/100 mL	water	Colilert-18[6]	31699	1	1	NA	0.5[5]	NA	Eastex
E. coli, Colilert, IDEXX, holding time	hours	other	NA	31704	NA	NA	NA	NA	NA	Eastex

5 This value is not expressed as a relative percent difference. It represents the maximum allowable difference between the logarithm of the sample result and the logarithm of the duplicate result. See Section B5.

6 *E.coli* samples analyzed by IDEXX Colilert-18 should always be processed as soon as possible and within 8 hours. When transport conditions necessitate delays in delivery longer than 6 hours, the holding time may be extended and samples must be processed as soon as possible and within 30 hours.

References for Table A7.1c:

- 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 Online Edition,(or most recent version)
- TCEQ SOP, V1 - TCEQ Surface Water Quality Monitoring Procedures Manual, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, August 2012 most recent editions (RG-415)

Table A7.1d - Measurement Performance Specifications for Biased Flow Monitoring Events (Up to three events during 10 month period.)

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
Residue, Total nonfiltrable (TSS)	mg/L	water	SM 2540 - D	00530	4	1	NA	NA	NA	Eastex
Nitrogen, Ammonia, Total (mg/L as N)	mg/L	Water	SM4500 NH3-G	00610	0.1	0.1	70-130	20	80-120	Eastex
Nitrogen, Kjeldahl, Total (mg/L as N)	mg/L	water	SM 4500 – Norg C and SM4500-NH_3 B	00625	0.2	0.2	70-130	20	80-120	Eastex
Nitrite+Nitrate, total one lab determined value (mg/L as N)	mg/L	water	SM 4500 – NO_3 F	00630	0.05	0.02	70-130	20	80-120	Eastex
Phosphorus, Total, Wet Method (mg/L as P)	mg/L	water	SM 4500-P E	00665	0.06	0.02	70-130	20	80-120	Eastex
Orthophosphate phosphorus, diss, mg/L, Field Filtered <15 min	mg/L	water	SM 4500-P E	00671	0.04	0.02	70-130	20	80-120	Eastex
Orthophosphate phosphorus, diss, mg/L, Filtered >15 min	mg/L	water	SM 4500-P E	70507	0.04	0.02	70-130	20	80-120	Eastex
E. coli, , Colilert, IDEXX method MPN/mL	MPN/100 mL	water	Colilert-18[8]	31699	1	1	NA	0.5[7]	NA	Eastex

E. coli, Colilert, IDEXX, holding time	hours	other	NA	31704	NA	NA	NA	NA	NA	Eastex

7 This value is not expressed as a relative percent difference. It represents the maximum allowable difference between the logarithm of the sample result and the logarithm of the duplicate result. See Section B5.

8 *E.coli* samples analyzed by IDEXX Colilert-18 should always be processed as soon as possible and within 8 hours. When transport conditions necessitate delays in delivery longer than 6 hours, the holding time may be extended and samples must be processed as soon as possible and within 30 hours.

References for Table A7.1d:

- 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 or most recent version
- TCEQ SOP, V1 - TCEQ Surface Water Quality Monitoring Procedures Manual, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, August 2012 or most recent editions (RG-415)

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, sand, commercially available tissue) or sample/duplicate pairs in the case of bacterial analysis. Precision results are compared against measurement performance specifications and used during evaluation of analytical performance. Program-defined measurement performance specifications for precision are defined in Tables A7.1b-d.

Bias

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

Representativeness

For Routine Sampling

Site selection, the appropriate sampling regime, the sampling of all pertinent media according to TCEQ *Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring*, and use only of approved analytical methods will assure that the measurement data represents the conditions at the monitoring sites. Representativeness will be measured with the completion of sample collection in accordance with the approved QAPP.

Routine data collected for the project and submitted to TCEQ for water quality assessments is performed on a routine frequency. At a minimum, samples will be collected over at least two seasons (to include inter-seasonal variation) and will include some data collected during an index period (March 15 thru October 15). Routine systematic water quality data are collected on a monthly frequency and are separated by approximately even time intervals. The data sets collected during routine monitoring will not be biased toward unusual conditions of flow, runoff, or season.

Representativeness
For Biased Flow (Storm Event) Sampling

An appropriate sampling regime and use of only approved analytical methods will help assure that the measurement data accurately represents storm events with differing flow conditions. Water quality data will be obtained from a maximum of 3 storm water events during the study period of 10 months. Every biased flow sampling event must adhere to a minimum of 72 hours antecedent dry period throughout the watershed. However, none of the biased flow monitoring events will be collecting first flush flow.

Due to limitations imposed by the sites, distance to travel, sampling procedures, and/or equipment, this biased flow monitoring will represent storms with a minimum precipitation of 0.5 inches. Plus, samples will be collected only if measurable flow is detected at one or more of the four sites found in the upper watershed which are typically found to be dry. Representative storm events must also have the potential to affect downstream monitoring locations. The four sites include one site on the West Fork of Mill Creek and three sites on the East Fork of Mill Creek. At least one event will be conducted during or following a rain event which has created a few inches of continuous runoff flow at the upper monitoring sites in the watershed. At least one event will be conducted during high flow or near bank-full conditions at the same sites. Local observers will confirm flow conditions at the four upstream monitoring sites to initiate H-GAC's response.

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.

Comparability

Confidence in the comparability of routine data sets for this project and for water quality assessments is based on the commitment of project staff to use only approved sampling and analysis methods and QA/QC protocols in accordance with quality system requirements and as described in this QAPP and in the most recent version of the TCEQ SWQM SOPs. Comparability is also guaranteed by reporting data in standard units, by using accepted rules for rounding figures, and by reporting data in the format required for submission to SWQMIS.

Laboratory measurement quality control requirements and acceptability criteria are provided in Section B5.

Laboratory measurement quality control requirements and acceptability criteria are provided in Section B5.

A8 SPECIAL TRAINING/CERTIFICATION

Monitoring staff personnel receive training in proper sampling and field data collection. Before independent sampling or data collection occurs, staff demonstrate to the Field Operations Supervisor (or designee) their ability to properly calibrate field equipment and perform field sampling and data

collection procedures. Field personnel training is documented and retained in the Training Records file maintained by H-GAC's QAO. The documentation is available during monitoring systems audits.

Contractors and subcontractors will ensure that laboratories analyzing samples under this QAPP meet the requirements contained in The NELAC Institute (TNI) Standards, Volume 1, Module 2, Section 4.5.5 (Subcontracting of Environmental Tests).

A9 DOCUMENTS AND RECORDS

The documents and records that describe, specify, report, or certify activities are listed In Table A9.1. All records are kept for a minimum of seven years after the end of the project.

Table A9.1a Project Documents and Records for AgriLife

Document/Record	Location	Retention*	Format
QAPPs, amendments and appendices	AgriLife	7 years	Paper/ Electronic
QAPP distribution documentation	AgriLife	7 years	Paper
Field data sheets , copies	AgriLife	7 years	Paper
Field instrument print outs, copies	AgriLife	7 years	Paper/Electronic
Field staff training records, copies	AgriLife	7 years	Paper
Field equipment calibration/maintenance logs, copies	AgriLife	7 years	Paper
Chain of custody records, copies	AgriLife	7 years	Paper
Corrective Action Documentation	AgriLife	7 years	Paper

*Retention period in paper format/electronic format.

Table A9.1b Project Documents and Records for H-GAC

Document/Record	Location	Retention*	Format
QAPPs, amendments and appendices	H-GAC	7 years	Paper/ Electronic
QAPP distribution documentation	H-GAC	7 years	Paper
Field data sheets	H-GAC	7 years	Paper
Field instrument print outs	H-GAC	7 years	Paper/Electronic
Field staff training records	H-GAC	7 years	Paper
Field equipment calibration/maintenance logs	H-GAC	7 years	Paper
Chain of custody records	H-GAC	7 years	Paper
Field SOPs	H-GAC	7 years	Paper

Document/Record	Location	Retention*	Format
Corrective Action Documentation	H-GAC	7 years	Paper/Electronic

*Retention period in paper format/electronic format.

Table A9.1c Project Documents and Records for Eastex Lab

Document/Record	Location	Retention*	Format
QAPPs, amendments and appendices	H-GAC	7 years	Paper/ Electronic
Chain of custody records	Eastex	7 years	Paper
Laboratory QA Manuals	Eastex	7 years	Paper
Laboratory SOPs	Eastex	7 years	Paper
Laboratory data reports/results	Eastex	7 years	Paper
Laboratory staff training records	Eastex	7 years	Paper
Instrument printouts	Eastex	7 years	Paper
Laboratory equipment maintenance logs	Eastex	7 years	Paper
Laboratory calibration records	Eastex	7 years	Paper
Corrective Action Documentation	Eastex	7 years	Paper

*Retention period in paper format/electronic format.

All H-GAC records, including notebooks, binders, and electronic files of technical staff, will be archived by H-GAC for at least seven years after the end of the project. Electronic data are stored on individual computers and on the network servers. The network servers are backed up nightly. After one week, data tapes are sent off-site to an electronic storage warehouse where they are held for 8 weeks. At the end of that 8 week period, the tapes are sent back to H-GAC to be re-used to back-up the servers again and the cycle begins again. In the event of a catastrophic systems failure, the tapes can be used to restore the lost data. Data generated on the day of the failure may be lost, but can be reproduced from raw data in most cases.

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

Laboratory Test Reports

Test/data reports from the laboratory will document the test results clearly and accurately. Reporting of the data will follow standard formats and protocols for *TNI Volume 1 Module 2 Section 5.10* and include the information necessary for the interpretation and validation of data. If needed for alternate types of reporting by TSSWCB, requirements and procedures for reporting data are provided below.

Eastex is the contract lab for H-GAC's monitoring program. The final lab data for H-GAC's program are submitted by Eastex directly to H-GAC's Data Manager. It is reformatted as needed and validated prior to submission to the TSSWCB PM. Team. Eastex lab reports are generated to include the following information but not all of this information is sent to H-GAC but is available upon request;

1) The title "Test Report" or other identifying statement (the lab offers several report formats);
2) Name and address of laboratory, and phone number with name of contact person;
3) A unique identification number and the total number of pages, with all pages sequentially numbered;
4) Name and address of client;
5) Description and unambiguous identification of the sample(s) including the client identification code (i.e. station information);
6) Identification of results for any sample that did not meet sample acceptance requirements per A7.1 tables;
7) Date and time of receipt of sample, date and time of sample collection, sample matrix, and time of sample preparation and/or analysis if the required holding time for either activity is less than or equal to 30 hours;
8) Identification of the test method used plus its LOQ and LOD;
9) Reference to sampling procedure (grab or composite);
10) Any deviations from, additions to or exclusions from SOPs, and any conditions that may have affected the quality of results, and including the use and definitions of data qualifiers;
11) Measurements, examinations and derived sample results, supported by tables, graphs, sketches and photographs as appropriate, and any failures identified; identification of whether data are calculated on a dry weight or wet weight basis; identification of the reporting units such as µg/l or mg/kg;
12) Clear identification of all test data provided by outside sources, such as subcontracted laboratories, clients, etc.;
13) Clear identification of numerical results with values below the Reporting Limit, and
14) Identification of accreditation status per analysis.

Electronic Data

Data will be submitted electronically to the TCEQ Data Management and Analysis Team and/or project partner for review in the Event/Result file format. A completed Data Summary (see example in Appendix D) will be submitted with each data submittal.

A9.2 Codes for Data Submittals

Sample Description	Tag Prefix	Submitting Entity	Collecting Entity	Monitoring Type Code
Routine monitoring to establish baseline conditions	*TX*	*TX*	*HG*	*RT*[2]
Monitoring during rainfall runoff for the intent of BMP effectiveness monitoring	*TX*	*TX*	*HG*	*BFLF*

1) RT[2] - Sampling scheduled in advance without intentionally trying to target any certain environmental condition. The sampling seeks to set a baseline for the site. Sample will be collected regardless of the conditions encountered.
2) BFLF - Sampling only occurs if a certain flow regime is encountered. The ultimate goal of the sampling effort is to define or quantify the amount of loading of a certain parameter or parameters the water body is receiving.

Revisions and Amendments to the QAPP

Until the work described is completed, this QAPP shall be revised as necessary and reissued annually on the anniversary date, or revised and reissued within 120 days of significant changes, whichever is sooner.

The last approved version of the QAPP shall remain in effect until a revised version has been fully approved; the revision must be submitted to the TSSWCB for approval before the last approved version has expired. If the entire QAPP is current, valid, and accurately reflects the project goals and the organization's policy, the annual re-issuance may be done by a certification that the plan is current. This will be accomplished by submitting a cover letter stating the status of the QAPP and a copy of new, signed approval pages for the QAPP.

Amendments to the QAPP may be necessary to address incorrectly documented information or to reflect changes in project organization, tasks, schedules, objectives, and methods; address deficiencies and nonconformance; improve operational efficiency; and/or accommodate unique or unanticipated circumstances. Requests for amendments will be directed from the AgriLife Project Manager to the TSSWCB Project Manager electronically. Amendments are effective immediately upon approval by the AgriLife Project Manager, H-GAC Project Manager, H-GAC Project QAO, the TSSWCB Project Manager, the TSSWCB QAO and the Eastex QAO (if applicable). They will be incorporated into the QAPP by way of attachment and distributed to personnel on the distribution list by the H-GAC Project Manager or designee. Amendments shall be reviewed, approved, and incorporated into a revised QAPP during the annual revision process.

B1 SAMPLING PROCESS DESIGN

The sample design was developed to provide critical supporting data and information necessary for development of a watershed protections plan for Mill Creek. Utilizing historical knowledge of the watershed and after conducting a reconnaissance of the watershed, project participants developed a sampling plan to ensure a comprehensive water monitoring strategy within the watershed. In this project, routine systematic and bias flow monitoring is designed to evaluate water quality during a variety of spatial, seasonal and meteorological conditions. The water quality data and evaluations of water quality conditions will be communicated to the public and the Mill Creek stakeholders to support adaptive management of the Mill Creek WPP and expand public knowledge of Mill Creek water quality data.

Routine data collected from Mill Creek, the East and West Forks of Mill Creek and three other tributaries will be used to support development of a watershed protection plan for Mill Creek and may be assessed by the TCEQ as part of the Integrated Report. Achievable water quality objectives and priorities and the identification of water quality issues were used to develop the work plan, in accordance with available resources.

This data collection effort involves routine water quality monitoring using procedures consistent with the TCEQ SWQM program for the purpose of data entry into the statewide database maintained by the TCEQ. To this end, some general guidelines were followed when selecting sampling sites, as basically outlined below, and discussed thoroughly in the *TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring*. Overall consideration is given to accessibility and safety. All monitoring activities have been developed with the TSSWCB project #14-57 in mind.

1. Locate stream sites so that samples can be safely collected from the centroid of flow. Centroid is defined as the midpoint of that portion of stream width which contains 50 percent of the total flow. If few sites are available for a stream segment, choose one that would best represent the water body, and not an unusual condition or contaminant source. Avoid backwater areas or eddies when selecting a stream site.

2. Because historical water quality data can be very useful in assessing use attainment or impairment, sampling stations with current or past monitoring data have higher preference in selection criteria.

3. Routine monitoring sites were selected to characterize water quality within UGSG Hydrological Units delineated on a subwatershed level (with only slight modifications) so data may be used in future modeling efforts.

Sites should be accessible. Flow measurement will be made during routine and biased flow monitoring events unless unsafe conditions exist.

See Tables A6.1 and A7.1a-d for sampling process design information and monitoring tables associated with data collected under this QAPP.

Table B1.1 Monitoring Stations and Sampling Process Design

Site	TCEQ Station ID	Site-ID	Latitude Decimal	Longitude Decimal	Description	Seg ID	Collected By	Monitor Type	Bacteria	Conven-tionals	Flow	Field
13*	21589	IC-2	30.154482	-96.514878	Indian Creek at Beckermann Rd/CR 2, 300 meters south of CR 25 and 9 kilometers west of Brenham.	TBD	HG	BFLF	3	3	3	3
12*	21587	EMC-1	30.146670	-96.494839	East fork of Mill Creek at Indian Creek Ln/CR 28A, 0.75 km SW of intersection of CR 28 and Indian Creek Ln.	1202K	HG	BFLF	3	3	3	3
11*	21588	EMC-2a	30.097393	-96.464984	East Mill Creek at FM332, 7.5 km SW of intersection of FM332 and CR 389.	1202K	HG	BFLF	3	3	3	3
10*	21586	WMC-1	30.046920	-96.567711	West fork of Mill Creek at Wolfe Rd approximately 3.0 km NW of intersection of FM 389 and Wolfe Rd.	1202K	HG	BFLF	3	3	3	3
9	21585	EMC-4	30.039449	-96.413137	East fork Mill Creek at Bleiblerville Rd. About 1.5 km northwest of TCEQ station ID 20133.	1202K	HG	RT[2]	10	10	10	10
9	21585	EMC-4	30.039449	-96.413137	East fork Mill Creek at Bleiblerville Rd. About 1.5 km northwest of TCEQ station ID 20133.	1202K	HG	BFLF	3	3	3	3
8	21584	EMC-6	29.959612	-96.320151	East fork Mill Creek at FM 159/Old Nelsonville Rd, 1.5 km west of intersection of Koy Rd and FM 159.	1202K	HG	RT[2]	10	10	10	10

Site	TCEQ Station ID	Site-ID	Latitude Decimal	Longitude Decimal	Description	Seg ID	Collected By	Monitor Type	Bacteria	Conven-tionals	Flow	Field
8	21584	EMC-6	29.959612	-96.320151	East fork Mill Creek at FM 159/Old Nelsonville Rd, 1.5 km west of intersection of Koy Rd and FM 159.	1202K	HG	BFLF	3	3	3	3
7	21583	SC-1	29.955764	-96.455117	Sandy Creek at New Breman Rd approximately 5 km southeast of the city of Industry.	TBD	HG	RT[2]	10	10	10	10
7	21583	SC-1	29.955764	-96.455117	Sandy Creek at New Breman Rd approximately 5 km southeast of the city of Industry.	TBD	HG	BFLF	3	3	3	3
6	21582	WMC-4a	29.9557127	-96.4276336	West Mill Creek at Tiemann Rd, east of Industry.	1202K	HG	RT[2]	10	10	10	10
6	21582	WMC-4a	29.9557127	-96.4276336	West Mill Creek at Tiemann Rd, east of Industry.	1202K	HG	BFLF	3	3	3	3
5	21581	WMC-6	29.935733	-96.360328	West fork Mill Creek adjacent to small lake between Artists Cir Dr and John Schoelikopf Rd approximately 7.7 km west of the Mill Creek Rd and Kuykendall Rd	1202K	HG	RT[2]	10	10	10	10
5	21581	WMC-6	29.935733	-96.360328	West fork Mill Creek adjacent to small lake between Artists Cir Dr and John Schoelikopf Rd approximately 7.7 km west of the Mill Creek Rd and Kuykendall Rd	1202K	HG	BFLF	3	3	3	3

Site	TCEQ Station ID	Site-ID	Latitude Decimal	Longitude Decimal	Description	Seg ID	Collected By	Monitor Type	Bacteria	Conven-tionals	Flow	Field
4	21580	SSC-1	29.921135	-96.301334	Sandy Creek at Mill Creek Rd southwest of Bellville	TBD	HG	RT[2]	10	10	10	10
4	21580	SSC-1	29.921135	-96.301334	Sandy Creek at Mill Creek Rd southwest of Bellville	TBD	HG	BFLF	3	3	3	3
3	21579	20131-A	29.89679	-96.25499	Mill Creek at FM 2429 5.13 km upstream of SH 36 and 5.25 km downstream of Mill Creek Road at approximately 5.78 km south of the City of Bellville in Austin County	1202K	HG	RT[2]	10	10	10	10
3	21579	20131-A	29.89679	-96.25499	Mill Creek at FM 2429 5.13 km upstream of SH 36 and 5.25 km downstream of Mill Creek Road at approximately 5.78 km south of the City of Bellville in Austin County	1202K	HG	BFLF	3	3	3	3
2	21578	MC-3	29.886502	-96.210053	Little Boggy Creek at Hwy 36 south of Bellville	TBD	HG	RT[2]	10	10	10	10
2	21578	MC-3	29.886502	-96.210053	Little Boggy Creek at Hwy 36 south of Bellville	TBD	HG	BFLF	3	3	3	3
1	21577	MC-2	29.869637	-96.155232	Mill Creek at FM331, immediately downstream of bridge.	1202K	HG	RT[2]	10	10	10	10
1	21577	MC-2	29.869637	-96.155232	Mill Creek at FM331, immediately downstream of bridge.	1202K	HG	BFLF	3	3	3	3

* Denotes storm water monitoring sites or potential sites.

1) RT^2 - Sampling scheduled in advance without intentionally trying to target any certain environmental condition. The sampling seeks to set a baseline for the site. Sample will be collected regardless of the conditions encountered.

Nine routine monitoring sites were selected to provide spatial distribution of data in the watershed. (See Table B1.1.) These sites were selected based upon input from local residents regarding the presence of water year round. Monthly routine monitoring at each site includes field, conventional, and bacterial parameter groups. Analytical results will be used to characterize water quality throughout the watershed. There may be times, during dry weather conditions, when there is no water in the stream in some of the subwatersheds. Those visits will be documented but no water quality samples will be collected. During periods when water is not flowing, a flow severity of either No Flow (1) or Dry (6) will be recorded and reported. In addition, when pooled conditions exist, an Instantaneous Flow for parameter 00061 will be reported as 0. When the stream is dry no record is reported for parameter 00061. If waters are pooled at a station, not flowing, and pools meet guidelines as outlined in the TCEQ *Interim Guidance for Routine Surface Water Quality Monitoring During Extended Drought*, water samples will be collected and analyzed as routine samples. The additional parameters of maximum pool width, maximum pool depth, pool length, and % pool coverage in 500 meter reach will also be reported. Routine monitoring in this project will complement existing routine ambient monitoring being conducted by TCEQ.

Lab Parameters for the various monitoring events are listed in Table B1.2 below. The parameters were chosen to get the most relevant tests analyzed for the various scenarios while maximizing the budget.

Table B1.2 – Lab Parameter List for Various Monitoring Activities

Quarterly sampling (full suite of lab parameters)	Monthly monitoring (other than quarterly)	Storm water monitoring (biased flow events)
TSS	TSS	TSS
Chloride (mg//L as CL)		
Sulfate (mg/L as SO4)		
Turbidity, NTU		
Nitrogen, Ammonia, Total (mg/L)	Nitrogen, Ammonia, Total (mg/L)	Nitrogen, Ammonia, Total (mg/L)
Nitrogen, Kjeldahl, Total (mg/L)	Nitrogen, Kjeldahl, Total (mg/L)	Nitrogen, Kjeldahl, Total (mg/L)
Nitrite+Nitrate-N, total one lab determined value (mg/L)	Nitrite+Nitrate-N, total one lab determined value (mg/L)	Nitrite+Nitrate-N, total one lab determined value (mg/L)
Phosphorus, Total, Wet Method (mg/L)	Phosphorus, Total, Wet Method (mg/L)	Phosphorus, Total, Wet Method (mg/L)
Orthophosphate phosphorus, diss, mg/L, Field Filtered <15 min	Orthophosphate phosphorus, diss, mg/L, Field Filtered <15 min	Orthophosphate phosphorus, diss, mg/L, Field Filtered <15 min
Orthophosphate phosphorus, diss, mg/L, Filtered >15 min	Orthophosphate phosphorus, diss, mg/L, Filtered >15 min	Orthophosphate phosphorus, diss, mg/L, Filtered >15 min
Chlorophyll-a, spectrophotometric method	Chlorophyll-a, spectrophotometric method	
Pheophytin, spectrophotometric method	Pheophytin, spectrophotometric method	
E. coli, , Colilert, IDEXX method MPN/mL	*E. coli*, , Colilert, IDEXX method MPN/mL	*E. coli*, , Colilert, IDEXX method MPN/mL
E. coli, Colilert, IDEXX, holding time	*E. coli*, Colilert, IDEXX, holding time	*E. coli*, Colilert, IDEXX, holding time

B2 SAMPLING METHODS

Field Sampling Procedures

Field sample and data collection will be conducted according to procedures documented in the most current version of *TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring*. Specifications outlined in Table B2.1 reflect additional requirements for sampling for the project and/or provide additional clarification.

Table B2.1 Sample Storage, Preservation and Handling Requirements for H-GAC. Samples Analyzed at Eastex Environmental Laboratory

Parameter	Matrix	Container	Preservation	Sample Volume	Holding Time
TSS	water	Plastic	Cool to 4°C	1 L	7 days
Turbidity	water	Plastic	Cool to 4°C	50 mL[4]	48 hours
Sulfate	water	Plastic	Cool to 4°C	100 mL[4]	28 days
Chloride	water	Plastic	Cool to 4°C	100 mL[4]	28 days
E. coli IDEXX Colilert	water	Sterile Plastic w/ sodium thiosulfate	Cool to <6°C but not frozen	120 mL	8 hours[1]
TKN	water	Plastic	Cool to 4°C H_2S0_4 to pH <2	500 mL[3]	28 days
Ammonia-N	water	Plastic	Cool to 4°C H_2S0_4 to pH <2	125 mL[3]	28 days
Nitrite + nitrate-N	water	Plastic	Cool to 4°C, H_2SO_4 to pH <2	125 mL[3]	28 days
Phosphorus-P, total	water	Plastic	Cool to 4°C H_2S0_4 to pH <2	125 mL[3]	28 days
Orthophosphate Phosphorus[5]	water	Plastic	Cool to 4°C	250 mL	48 hours
Chlorophyll-*a* *(w/ Pheophytin calculation)*	water	Brown plastic	Dark & iced before filtration; Dark & frozen after filtration	4 L	Filtered w/in 48 hours; after filtered, then frozen up to 23 days

[1] *E.coli* samples analyzed by IDEXX Colilert-18 should always be processed as soon as possible and within 8 hours. When transport conditions necessitate delays in delivery longer than 6 hours, the holding time may be extended and samples must be processed as soon as possible and within 30 hours.
[3] Five tests are analyzed from one 1L plastic bottle.
[4] One 500 mL plastic container is used to collect these three samples.
[5] Preservation occurs within 15 minutes of sample collection.

Sample Containers

Certificates from sample container manufacturers are maintained in a notebook by Eastex Lab as appropriate. Information about the various sample containers is described below.

All sample containers are provided to H-GAC by their contract lab, Eastex. The lab performs and tracks required QC procedures for all bottles purchased.

- Pre-cleaned, plastic, disposable sample containers are used for conventional parameters.
- Sterile, sealed, 120 mL plastic, disposable bottles with a sodium thiosulfate tablet added, are used for bacteriological samples.
- Pre-cleaned, plastic, disposable, brown, polyethylene, 4-liter cubitainers are used for chlorophyll-*a* samples.

- A new disposable, 0.45 micron capsule filters is used at every monitoring site for samples requiring field filtration.
- The tubing used by H-GAC to field filter ortho phosphate phosphorus samples is re-used. H-GAC's contract lab (Eastex) cleans the tubing between each use by washing each piece with a 10 % nitric acid solution and a 10% Hydrochloric acid solution. Each tube is triple rinsed with D.I. water between and after the 2 acid washes, then hung and allowed to air dry. The lab individually packages each tube in a zip-lock style, plastic baggie and performs QC testing to assure that no contamination results from the washing procedure.
- When preservation is required for particular parameters, the acid is added to the container in the field by field personnel immediately after samples are collected.

Processes to Prevent Contamination

Procedures in the *TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring* outline the necessary steps to prevent contamination of samples, including direct collection into sample containers, when possible. Field QC samples (identified in Section B5) are collected to verify that contamination has not occurred.

Documentation of Field Sampling Activities

Field sampling activities are documented on field data sheets (see Appendix A). The following will be recorded for all visits:

- station ID
- sampling date
- sampling time
- sampling depth
- sample collector's name/signature
- values for all field parameters, including flow and flow severity
- detailed observational data, where appropriate, including:
  - water appearance
  - weather
  - biological activity
  - unusual odors
  - pertinent observations related to water quality or stream uses (i.e., exceptionally poor water quality conditions; stream uses such as swimming, boating, fishing, irrigation pumps)
  - watershed or instream activities (i.e., bridge construction, livestock watering upstream)
- missing parameters (i.e., when a scheduled parameter or group of parameters is not collected)

Recording Data

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

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

Sampling Method Requirements or Sample Processing Design Deficiencies and Corrective Action

Examples of sampling method requirements or sample design deficiencies 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. Corrective action may include for samples to be discarded and re-collected. It is the responsibility of the H-GAC Project Manager, in consultation with the H-GAC Project QAO, to ensure that the actions and resolutions to problems are documented by completion of a corrective action report (CAR) and that records are maintained in accordance with this QAPP. In addition, these actions and resolutions will be conveyed to the AgriLife Project Manager who will inform the TSSWCB Project Manager in writing in the project progress reports.

The definition of and process for handling deficiencies and corrective action are defined in Section C1.

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. The following information concerning the sample is recorded on the COC form (See Appendix B).

- Date and time of collection
- Site identification
- Sample matrix, indicated by the test group code
- Number of containers and container type ID designation
- Preservative used or if the sample was filtered, indicated by test group code
- Analyses required, indicated by the test group code
- Name of collector
- Custody transfer signatures and dates and time of transfer
- Name of laboratory accepting the sample

Sample Labeling

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

- Site identification
- Date of sampling
- Time of sampling
- Preservative added, if applicable

Sample Handling

After collection of samples is complete, sample containers are immediately stored in an ice chest for transport to the Eastex laboratory. Ice chests remain in the possession of the field technician or in the locked vehicle until being delivered to the lab. After submission to the Esatex laboratory, the samples remain in the log-in room until log-in is completed, then they are stored in the refrigeration unit or given to an analyst for immediate analysis. Only authorized laboratory personnel handle samples received by the laboratory. Eastex Environmental Laboratory Quality Manual (QM), most current version, addresses samples relinquished to the lab.

Sample Tracking Procedure Deficiencies and Corrective Action

All deficiencies associated with COC procedures and described in this QAPP are immediately reported to the H-GAC Project Manager or QAO. These include such items as delays in transfer resulting in holding time violations; violations of sample preservation requirements; incomplete documentation, including signatures; possible tampering of samples; and broken or spilled samples. The H-GAC Project Manager, in consultation with the AgriLife PM and H-GAC Project QAO, will determine if the procedural violation may have compromised the validity of resulting data. Any failures that have reasonable potential to compromise data quality will invalidate data, and the sampling event should be repeated, if feasible. The resolution of the situation will be reported to the TSSWCB Project Manager in the project progress report. CARs will be prepared by the H-GAC personnel and summarized by the H-GAC PM for submittal to the AgriLife Project Manager for inclusion with project progress report.

The definition of and process for handling deficiencies and corrective action are defined in Section C1.

B4 ANALYTICAL METHODS

The analytical methods, associated matrices, and performing laboratories are listed in Table A7.1 of Section A7. The procedures for laboratory analysis shall 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, 40 CFR Part 136, or other reliable procedures acceptable to the TSSWCB.

Laboratories collecting data under this QAPP are compliant with the NELAC® standards, at a minimum. Copies of laboratory SOPs are available for review by the TSSWCB.

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/signature. Reagent bottles are labeled to trace the reagent back to preparation. Table A7.1, Measurement Performance Specifications, lists the methods to be used for field and laboratory analyses.

Deficiencies, Nonconformances and Corrective Action Related to Quality Control

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

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and reported to the pertinent field or laboratory supervisor who will notify the H-GAC Project Manager. A Corrective Action Report to document the deficiency is written for each deficiency.

The H-GAC Project Manager, in consultation with the AgriLife PM and H-GAC Project QAO (and other affected individuals/organizations), will determine whether the deficiency could affect data quality. If it is determined the item in question does not affect data quality and therefore is not a valid nonconformance, the CAR will be completed accordingly and closed. If it is determined a nonconformance does exist, the H-GAC Project Manager, in consultation with the AgriLife PM and H-GAC Project QAO, will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented in the CAR (see Appendix E).

The definition of and process for handling deficiencies and corrective action are defined in Section C1.

The TCEQ has determined that analyses associated with the qualifier codes (e.g. “holding time exceedance”, “sample received unpreserved”, “estimated value”) may have unacceptable measurement uncertainty associated with them. Therefore, data with these types of problems shall be clearly qualified prior to submittal to the TCEQ Data Management and Analysis Team. Additionally, any data collected or analyzed by means other than those stated in the QAPP, or data suspect for any reason shall be appropriately qualified (see SWQM DMRG November 2013 or most recent version for data qualifiers). TCEQ will review the data and load data approved by the TSSWCB Project Manager into SWQMIS.

B5 QUALITY CONTROL

Laboratory Measurement Quality Control Requirements and Acceptability Criteria

Batch
A batch is defined as environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same NELAP-defined matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 25 hours. An **analytical batch** is composed of prepared environmental samples (extract, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.

Method Specific QC requirements
QC samples, other than those specified in this section (i.e., sample duplicates, surrogates, internal standards, continuing calibration samples, interference check samples, positive control, negative control, and media blank), are analyzed as specified in the methods. The requirements for these samples, their acceptance criteria or instructions for establishing criteria, and corrective actions are method-specific.

Detailed laboratory QC requirements and corrective action procedures are contained within the individual laboratory SOPs. The minimum requirements to which all participants abide by are stated below.

Comparison Counting

For routine bacteriological samples, repeat counts on one or more positive samples are required, at least monthly. If possible, compare counts with an analyst who also performs the analysis. Replicate counts by the same analyst should agree within 5 percent, and those between analysts should agree within 10 percent. Record the results.

Limit of Quantitation (LOQ)

The laboratory will analyze a calibration standard (if applicable) at the LOQ on each day calibrations are performed. In addition, a LOQ check sample will be analyzed with each analytical batch. Calibration results, including the standard at the LOQ listed in Table A7.1a-d, will meet the calibration requirements of the analytical method or corrective action will be implemented.

LOQ Check Sample

A LOQ check sample 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. The LOQ check sample is carried through the complete preparation and analytical process and run at a rate of one per analytical batch. 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 sample is spiked into the sample matrix at a level less than or near the LOQ for each analyte in each analytical batch of samples analyzed. If it is determined that sample results exceeded the high range of the calibration curve, samples should be diluted or run on another curve. For samples run on batches with calibration curves that do not include the LOQ, a check sample will be run at the low end of the calibration curve.

The percent recovery of the LOQ check sample 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 sample:

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

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

Laboratory Control Sample (LCS)

A LCS consists of a sample matrix (e.g. deionized water) free from the analytes of interest spiked with verified known amounts of analyte. 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 equal to the mid-point of the calibration curve 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. The LCS is carried through the complete preparation and analytical process and run at a rate of one per batch.

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.

Laboratory Duplicates

A laboratory duplicate is an aliquot taken from the same container as an original sample 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.

For most parameters, except bacteria, precision is evaluated using the relative percent difference (RPD) between duplicate LCS 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, X1 and X2, the RPD is calculated from the following equation:

$$RPD = |(X1 - X2)/\{(X1+X2)/2\} * 100|$$

For bacteriological parameters, precision is evaluated using the results from laboratory sample duplicates. Bacteriological duplicate are collected on a 10% frequency (or once per sampling run, whichever is more frequent). These duplicates will be collected in sufficient volume (200 mL or more) for analysis of the sample and its laboratory duplicate from the same container.

The base-10 logarithms of the results from the original sample and its duplicate are calculated. The absolute value of the difference between the two logarithms will be compared to the precision criterion in Tables A7.1b-d. If the difference in logarithms is greater than the precision criterion, the data are not acceptable for use under this project and will not be reported to TSSWCB. Results from all samples associated with that failed duplicate (usually a maximum of 10 samples) will be considered to have excessive analytical variability and will be qualified as not meeting project QC requirements.

The precision criterion in Tables A7.1b-d for bacteriological duplicates applies to only samples with concentrations > 10 MPN/100 mL. Field splits are not collected for bacteriological analyses.

Matrix spike (MS)

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. The components to be spiked shall be specified by the mandated analytical method. 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).

Matrix spikes indicate the effect of the sample on the precision and accuracy of the results generated using the selected method. The frequency of matrix spikes is specified by the analytical method, or a minimum of one per preparation batch, whichever is greater. To the extent possible, matrix spikes prepared and analyzed over the course of the project should be performed on samples from different sites.

The percent recovery of the matrix spike is calculated using the following equation, where %R is percent recovery, SSR is the concentration measured in the matrix spike, SR is the concentration in the unspiked sample and SA is the concentration of analyte that was added:

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

Matrix spike recoveries are compared to the acceptance criteria 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. Eastex uses matrix spike recovery limits of 80-120 for parameters where a spike solution is available. These recoveries are monitored with QC charts to help determine interferences or detect trends. Matrix spikes that fail to meet these guidelines are reanalyzed if possible. An alternate sample may be used to help determine whether the problem was specific to that sample. If matrix spikes are not achievable within 80-120 % recovery then this recovery is flagged as exceeding the control limit on the QC report.

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 blanks are performed at a rate of once per preparation batch. The method blank is used to document contamination from the analytical process. The analysis of method blanks should yield values less than the LOQ. For very high-level analyses, the blank value should be less than 5% of the lowest value of the batch, or corrective action will be implemented. Samples associated with a contaminated blank shall be evaluated as to the best corrective action for the samples (e.g., reprocessing or data qualifying codes). In all cases the corrective action shall be documented.

The method blank shall be analyzed at a minimum of one per preparation batch. In those instances for which no separate preparation method is used (example: volatiles in water) the batch shall be defined as environmental 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.

Deficiencies, Nonconformances and Corrective Action Related to Quality Control

Deficiencies are defined as unauthorized deviations from procedures documented in the QAPP or other applicable documents. Nonconformances are deficiencies that affect data quantity and/or quality and render the data unacceptable or indeterminate. Deficiencies related to QC include but are not limited to field and laboratory QC sample failures.

Deficiencies are documented in logbooks, field data sheets, etc., by field or laboratory staff and reported to the appropriate field or laboratory supervisor who will notify the H-GAC Project Manager. The H-GAC Project Manager will notify the AgriLife QAO of the potential nonconformance. The H-GAC QAO will initiate a CAR to document the deficiency.

The AgriLife Project Leader or Co-Leader, in consultation with H-GAC Project QAO (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the CAR will be completed accordingly and the CAR closed. If it is determined a nonconformance does exist, the AgriLife Project Manager in consultation with the AgriLife QAO will

determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the AgriLife QAO by completion of a CAR (see Appendix E).

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

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

All sampling equipment testing and maintenance requirements are detailed in the *TCEQ Surface Water Quality Monitoring Procedure:, Volume 1*. Sampling equipment is inspected and tested upon receipt and is assured appropriate for use. Equipment records are kept on all field equipment and a supply of critical spare parts is maintained.

All laboratory tools, gauges, instrument, and equipment testing and maintenance requirements are contained within laboratory SOPs.

B7 INSTRUMENT CALIBRATION AND FREQUENCY

Field equipment calibration requirements are contained in the *TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring*. Post-calibration error limits and the disposition resulting from error are adhered to. Data not meeting post-error limit requirements invalidate associated data collected subsequent to the pre-calibration and are not submitted to the TCEQ Data Management and Analysis Team.

Detailed laboratory calibrations are contained within the laboratory QM and SOPs.

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Chemicals for analysis are tested by the supplier and meet or exceed ACS certification, where applicable. All supplies and consumables received by Eastex Laboratory are inspected upon receipt for damage, missing parts, expiration dates, and storage and handling requirements by appropriate laboratory personnel. Labels on reagents, chemicals, and standards are examined to ensure they are of appropriate quality, initialed by staff member and marked with receipt date. Volumetric glassware is inspected to ensure class "A" classification, where required. All laboratory tools, gauges, instrument, and equipment testing and maintenance requirements are contained within laboratory SOPs.

B9 NON-DIRECT MEASUREMENTS

Non-directly measured data, secondary data, or acquired data involves the use of data collected under another project, and collected with a different intended use than this project. The acquired data still meets the quality requirements of this project, and is defined below. The following data source(s) will be used for this project:

Rainfall data will be acquired from multiple sources to report parameter code 72053 (Days Since Precipitation Event) with each set of water quality data submitted to TCEQ. Each partner will use the internet source that best addresses the rainfall events occurring closest to but upstream of or within the drainage area affecting their various monitoring stations. Historical rainfall data is accessible on these web sites to determine the "number of days since" requirement for reporting the 72053 parameter code. These sites include:

- National Oceanic and Atmospheric Administration's (NOAA's) National Climatic Data Center (NCDC) (http://www.ncdc.noaa.gov/). The NCDC is responsible for preserving, monitoring, assessing, and providing public access to the nation's climate and historical weather data and information
- Weather Underground (http://www.wunderground.com/) which collects and maintains precipitation data from numerous sources in the selected area

The USGS National Water Information System (NWIS) web interface can also be used to determine when a significant change in flow occurred at the various flow gages operated around the state of Texas. The web site http://waterdata.usgs.gov/tx/nwis/current/?type=flow can display discharge data in graph or tabular format to determine days when runoff affected the stream.

Flow data from the United States Geological Survey (USGS) Station 08111700, Mill Creek near Bellville, Texas, is collocated with monitoring station 11576. Flow data from this USGS station will be used for this project. USGS gage station data will be used throughout this project to aid in determining flow through the watershed. Rigorous QA checks are completed on gage data by the USGS and the data are approved by the USGS and permanently stored at the USGS. This data may be submitted to the TCEQ under parameter code 00061 (Instantaneous Flow) or parameter code 74069 (Estimated Flow) depending on the proximity of the monitoring station to the USGS gage station.

For evaluating trends, historical data from SWQMIS will be included in the statistical dataset as well as samples collected during the study period by the TCEQ under the SWQM Program.

B10 DATA MANAGEMENT

Data Management Process

Data is received by H-GAC from all partners, including H-GAC's own data monitoring program. Each partner has a paragraph below which gives a brief description of their data submission process.

When data is submitted to H-GAC, the data is saved in "Raw Data" folders. When H-GAC begins to process the data, it is saved into a "Working Data" folder so H-GAC always has the original data submittal in electronic format as an archive. Data is processed by H-GAC's Data Manager (a SAS Operator) and H-GAC's QAO before being submitted to TSSWCB for review and approval. Upon approval, TSSWCB will submit the data to TCEQ's Data Management and Analysis Team in the format

specified in the *SWQM Data Management Reference Guide*, November 2013 or most recent version, for additional review and formatting approval. H-GAC's full data procedure is described in Appendix F – Data Management Process.

H-GAC's field sheets are kept in a three ring binder at the Data Manager's desk. The calibration sheets, field sheets, and COCs are reviewed by the QAO before any data entry is made. If there are nonconformances such as failed calibration, the QAO writes instructions in a different colored ink on the related field sheet regarding data entry. Then the instructions are initialed and dated.

Electronic data from datasondes and flow-measurement devices are downloaded into a raw data folder and printed out to be attached to field sheets. These electronic files are imported into an Access database. Field data is entered in this Access database by the H-GAC Data Manager and saved in a secured network drive ("Working Data"). It is reviewed for accuracy and completeness by either the H-GAC Data Manager or QAO (but not the person who performed the original data entry). When associated lab data is received from the lab, the electronic files are also saved in the "RAW Data" folder. The Access database in the "working" file becomes the input file for SAS processing.

SAS code has been written to process both the field and laboratory datasets. Following initial SAS processing and investigation of flagged records, a draft Data Summary is compiled by the H-GAC DM. Details of any data changes are documented in the Data Summary. All SAS output is saved on secured network drives that are backed up regularly by IT staff. The DM provides the QAO with the draft Data Summary for review. The H-GAC QAO review of the datasets and the Data Summary is documented and provided to the H-GAC DM for further investigation, verification, or change. This record of the QAO review is retained with the data review package. See H-GAC's Data Management Flow Chart in Appendix C to see the various tables and Flagged Records reports that are created during the data review process.

Data Dictionary - Terminology and field descriptions are included in the *SWQM Data Management Reference Guide*, November 2013 or most recent version. The following table contains the codes used by H-GAC when submitting data under this QAPP. The parameters associated with each sample and the sampling frequency by station are presented in Tables A7.1a-d.

Table B10.1 –Sampling Entity Data Submission Codes

Name of Monitoring Entity	Tag Prefix	Submitting Entity	Collecting Entity
Houston-Galveston Area Council	TX	TX	HG

Data Errors and Loss

H-GAC stores original electronic data as "Raw Data" files. These files are saved in the original format and other than changing the name of a file, remains unchanged. Any changes to a data file are saved in the "Working Data" folders. In these folders, data is merged, formatted, and converted to the correct reporting units before SAS processing begins. After SAS is applied, the files are stored in ACCESS tables. An ACCESS database is made for each data set. In this database there are several folders where all reports and modifications are documented. There is an INPUT folder, an OUTPUT folder, Draft Matrix

tables which should show all the data as reformatted and ready to be converted into the EVENT/RESULTS format for TCEQ. All changes, validation, and verification actions on the data are documented in a Data Review Summary Report which accompanies each data set submittal (Appendix D).

Copies of e-mails and communications with partners are printed and attached to the data set for traceability.

H-GAC water samples are sent to Eastex Lab for analysis. Field data sheets are collected by the Data Manager for input to an Access Database, review for outliers, and reasonableness. H-GAC's QAO reviews the data for transcription accuracy and reasonableness. A Data Summary Sheet is submitted to TCEQ Data Management and Analysis Team with each data set.

Details of the Eastex *Data Reduction and Review* is described in the Laboratory's Quality Assurance Manual, (most current version), Sections 8.1.

Record Keeping and Data Storage

As each data set is processed by H-GAC, all hard copies of data and/or field forms are organized into packets. All correspondences or reports related to the data set are to be printed and placed in the packet of information. Including but not limited to the QAO review comments, the draft and final Data Summary Reports/Sheets. Any other documentation related to that specific data set is also to be attached. Each packet of information is placed in a file storage box for long term storage.

H-GAC field investigators submit electronic data along with hard copies of field sheets and COC forms to H-GAC's Data Manager. Electronic data is stored in folders on the H-GAC network as "originals" and as copies for data management, verification, and validation. Daily and weekly backups are completed on H-GAC's server. Hard copies are filed in filing cabinets or file boxes for use as needed. Data more than 2 years old is sent for off-site storage according to H-GAC procedures. All data is maintained for at least seven (7) years by H-GAC.

Copies of data submissions sent to the TCEQ Data Management and Analysis Team are kept on the H-GAC's network server. The network server is backed up nightly.

Details of the Eastex *Document Control System* is described in the Laboratory's Quality Assurance Manual, (most current version), Sections 8.4.

Data Handling, Hardware, and Software Requirements

H-GAC maintains several networked computers to store and manage water quality data. All computers are equipped with at least Windows XP and Office 2007 which includes MS Excel 2007 and MS Access 2007. The DM's computer also includes Oracle 9 to assist with screening, management and reformatting the data to TCEQ's specifications. Additionally, the SAS software is available on the DM's and another computer if an alternate SAS Operator is needed.

The laboratory database is housed on a Eastex server and backed up each evening. The LIMS runs on a Windows operating systems. Details of the Eastex *Electronic Record Storage* system is described in the Laboratory's Quality Assurance Manual, (most current version), Sections 8.4.

Information Resource Management Requirements

Data will be managed in accordance with the DMRG, and applicable H-GAC information resource management policies. H-GAC includes an Information Resource Management Department responsible for maintaining all computer hardware and software, including but not limited to servers, network accounts, data back-ups, security, firewalls, etc. Daily management is conducted along with regular maintenance and upgrades to the system.

The stations to be monitored for this project will be assigned TCEQ station IDs through TCEQ's SLOC process described in TCEQ's most current DMRG. Global Positioning System (GPS) equipment may be used as a component of the information required by the Station Location (SLOC) request process for creating the certified positional data that will ultimately be entered into the TCEQ's SWQMIS database. Positional data obtained by H-GAC staff members using a Global Positioning System will follow the TCEQ's OPP 8.11 and 8.12 policy regarding the collection and management of positional data. All positional data to be entered into SWQMIS will be collected by a GPS certified individual with an agency approved GPS device to ensure that the agency receives reliable and accurate positional data. Certification can be obtained in any of three ways: completing a TCEQ training class, completing a suitable training class offered by an outside vendor, or by providing documentation of sufficient GPS expertise and experience.

In lieu of entering coordinates collected with a Global Positioning System, positional data may be acquired using a Geographical Information System (GIS) and verified with photo interpolation using a certified source, such as USGS Digital Ortho Quarter-Quadrangles (DOQQs), Google Earth or Google Maps. The verified coordinates and map interface can then be used to develop a new station location.

C1 ASSESSMENTS AND RESPONSE ACTIONS

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

Table C1.1 Assessment and Response Requirements

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring Oversight, etc.	Continuous	H-GAC	Monitoring of the project status and records to ensure requirements are being fulfilled	Report to AgriLife in monthly reports
Status Monitoring Oversight, etc.	Continuous	AgriLife	Monitoring of the project status and records to ensure requirements are being fulfilled	Report to TSSWCB in Quarterly Report
Monitoring Systems Audit of H-GAC	Dates to be determined by TSSWCB	TSSWCB QAO	Field sampling, handling and measurement; facility review; and data management as they relate to the TSSWCB project #14-57	30 days to respond in writing to the TSSWCB to address corrective actions
Laboratory Inspection	Dates to be determined by TSSWCB	TSSWCB QAO	Analytical and quality control procedures employed at the Eastex laboratory	30 days to respond in writing to the TSSWCB to address corrective actions

Corrective Action Process for Deficiencies

Deficiencies are any deviation from the QAPP, *Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring*, SOPs, or the *DMRG*. Deficiencies may invalidate resulting data and require corrective action. Repeated deficiencies should initiate a Corrective Action Plan (CAP). Corrective action for deficiencies may include for samples to be discarded and re-collected. Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff, are communicated to H-GAC Project Manager (or other appropriate staff), and should be subject to periodic review so their responses can be uniform, and their frequency tracked. It is the responsibility of the H-GAC Project Manager, in consultation with the H-GAC 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 AgriLife's Project Manager or QAO both verbally and in writing in the project progress reports and by completion of a CAP. In the event a deficiency results in qualifying data already put in SWQMIS Production, H-GAC's Data Mgr. will prepare the required documentation as specified in the DMRG Data Correction Request protocol and submit to AgriLife and TSSWCB. TSSWCB's PM will review, approve and submit the Data Correction Request to TCEQ's Data Management and Analysis Team.

Corrective Action

CAPs should:

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

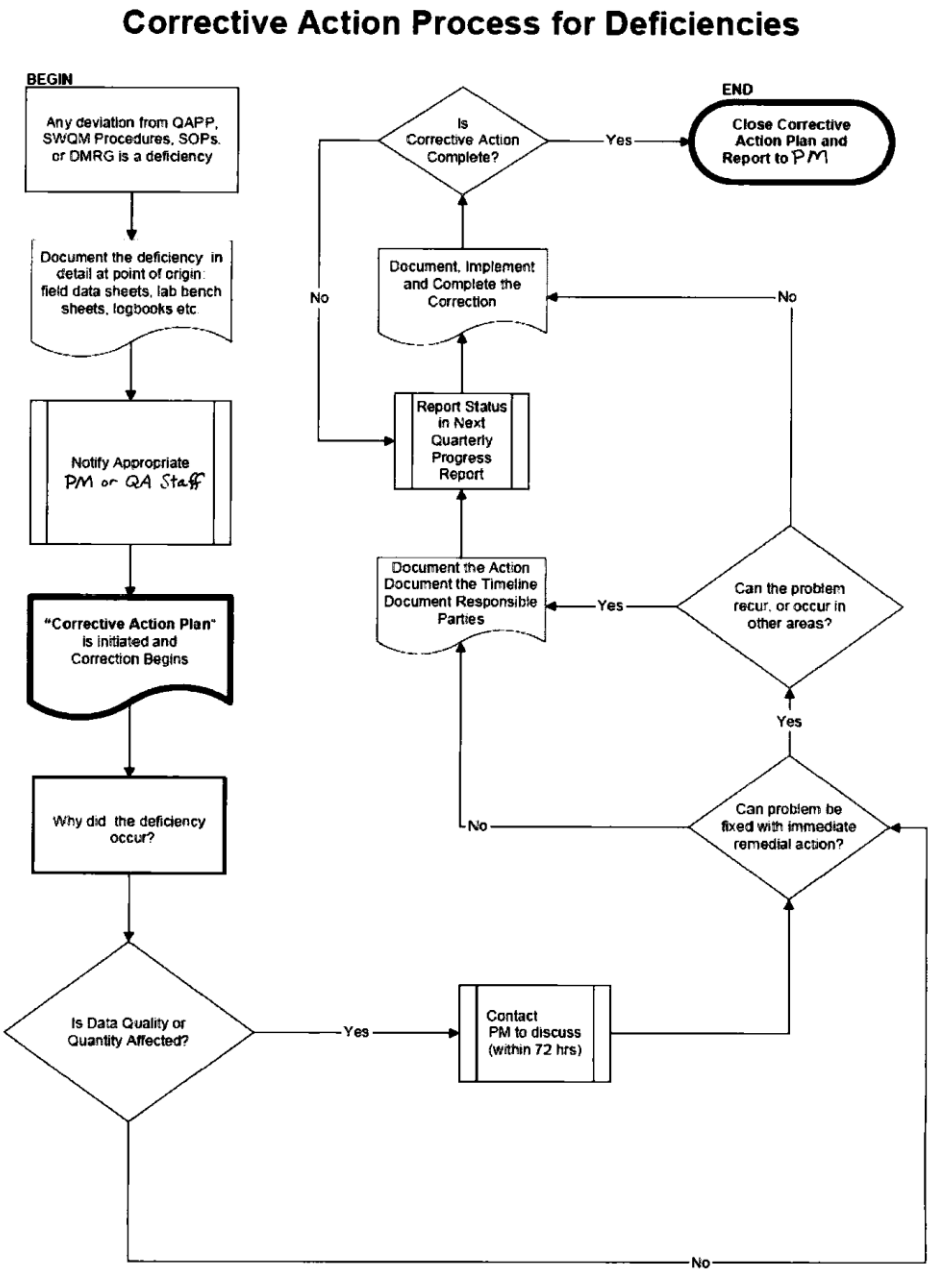
To facilitate the process a flow chart has been developed (see figure C1.1: Corrective Action Process for Deficiencies on the next page).

Status of CAPs will be included with progress reports. In addition, significant conditions which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data will be reported to the AgriLife and TSSWCB immediately.

The H-GAC Project Manager or their designee is responsible for implementing and tracking deficiencies and corrective actions in a pre-CAP log. Records of audit findings and corrective actions are maintained by the H-GAC Project Manager. Audit reports and corrective action documentation will be submitted to the AgriLife and TSSWCB with the Progress Report.

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

Figure C1.1 Corrective Action Process for Deficiencies



C2 REPORTS TO MANAGEMENT

Reports to AgriLife Project Management

As part of H-GAC's overall data review procedure, the Eastex Laboratory Manager reviews all laboratory QC data results prior to reporting to H-GAC. Any QC deficiencies are documented by a corrective action report (CAR), which are kept by the Eastex QAO. The H-GAC Project QAO or DM reviews the data results and generates a CAR for any that do not pass project criteria. Any problems associated with sample collection, handling, log-in, or other situations are also documented with CARs. Pertinent supervisors, QAOs, and the TSSWCB Project Manager all review the CARs and provide input and evaluation as necessary prior to data being approved for use or submission to SWQMIS. Project status, assessments and significant QA issues will be dealt with by the H-GAC Project Manager who will determine whether it will be included in reports to AgriLife and TSSWCB Project Management.

Reports to TSSWCB Project Management

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

Quarterly Report - Summarizes AgriLife and H-GAC activities for each task; reports monitoring status, problems, delays, and corrective actions; and outlines the status of each task's deliverables.

Monitoring Systems Audit Report and Response - Following any audit performed by the TSSWCB, a report of findings, recommendations and response is included in the quarterly progress report sent to TSSWCB via AgriLife.

D1 DATA REVIEW, VERIFICATION, AND VALIDATION

For the purposes of this document, the term verification refers to the data review processes used to determine data completeness, correctness, and compliance with technical specifications contained in applicable documents (i.e., QAPPs, SOPs, analytical methods). Validation refers to a specific review process that extends the evaluation of a data set beyond method and procedural compliance (i.e., data verification) to determine the quality of a data set specific to its intended use.

All field and laboratory will be reviewed and verified for integrity, completeness, reasonableness, and conformance to project requirements, and then validated against the project objectives and measurement performance specifications listed in Tables A7.1a-d. Only those data supported by appropriate quality control data and meet the measurement performance specifications defined for this project will be considered acceptable, and will be reported to TCEQ Data Management and Analysis Team for submittal to SWQMIS.

D2 VERIFICATION AND VALIDATION METHODS

All field and laboratory data will be reviewed, verified and validated to ensure they conform to project specifications and meet the conditions of end use as described in Section A7 of this document.

Data review, verification, and validation will be performed using self-assessments and peer and management review as appropriate to the project task. The data review tasks to be performed by field and laboratory staff are listed in the first two sections of Table D.2.1, respectively. Potential errors are identified by examination of documentation and by manual examination of corollary or unreasonable data. If a question arises or an error is identified, the manager of the task responsible for generating the data is contacted to resolve the issue. Issues that can be corrected are corrected and documented. If an issue cannot be corrected, the task manager consults with higher level project management to establish the appropriate course of action, or the data associated with the issue are rejected. Field and laboratory reviews, verifications, and validations are documented.

After the field and laboratory data are reviewed, another level of review is performed once the data are combined into a data set. This review step as specified in Table D2.1 is performed by the H-GAC Data Manager and QAO. Data review, verification, and validation tasks to be performed on the data set include, but are not limited to, the confirmation of laboratory and field data review, evaluation of field QC results, additional evaluation of anomalies and outliers, analysis of sampling and analytical gaps, and confirmation that all parameters and sampling sites are included in the QAPP.

Another element of the data validation process is consideration of any findings identified during the monitoring systems audit conducted by the TSSWCB QAO. Any issues requiring corrective action must be addressed, and the potential impact of these issues on previously collected data will be assessed.

After the data are reviewed and documented, the H-GAC Project QAO validates that the data meet the data quality objectives of the project and are suitable for reporting to TCEQ Data Management and Analysis Team for submittal to SWQMIS. Data Management and Analysis Team prepares the test upload to the production environment of SWQMIS but waits for TSSWCB Project Manager approval of the dataset before completing the upload.

If any requirements or specifications of the TSSWCB project #14-57 are not met, based on any part of the data review, the responsible party shall document the nonconforming activities with a CAR, which will be reviewed by the H-GAC Data Manager with the data in the Data Summary. This information is communicated to the TSSWCB and AgriLife by the H-GAC Project Manager. Depending on the nonconformance, affected data will be flagged or not transmitted to TCEQ Data Management and Analysis Team for submittal to SWQMIS.

Table D2.1: Data Review Tasks for H-GAC

H-GAC Data to be Verified	Field Task	Laboratory Task (Eastex Lab)	Lead Organization Data Manager Task
Sample documentation complete; samples labeled, sites identified	H-GAC QAO	Sample Custodian.	
Field instrument pre- and post-calibration results within limits	H-GAC QAO		
Field QC samples collected for all analytes as prescribed in the TCEQ *Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring*	H-GAC QAO		
Standards and reagents traceable	H-GAC QAO	Lab QAO	
Chain of custody complete/acceptable	H-GAC QAO	Sample Cust.	H-GAC Data Mgr
NELAP Accreditation is current		Lab QAO	
Sample preservation and handling acceptable	H-GAC QAO	Sample Custodian.	
Holding times not exceeded		Lab QAO	H-GAC Data Mgr
Collection, preparation, and analysis consistent with SOPs and QAPP	H-GAC QAO	Lab QAO	
Field documentation (e.g., biological, stream habitat) complete	H-GAC QAO		
Instrument calibration data complete	H-GAC QAO	Lab QAO	
Bacteriological records complete		Lab QAO	
QC samples analyzed at required frequency	H-GAC QAO	Lab QAO	H-GAC Data Mgr
QC results meet performance and program specifications		Lab QAO	
Analytical sensitivity (Minimum Analytical Levels/Ambient Water Reporting Limits) consistent with QAPP		Lab QAO	
Results, calculations, transcriptions checked	H-GAC QAO	Technical Director	
Laboratory bench-level review performed		Head Technician	
All laboratory samples analyzed for all parameters		Lab QAO	
Corollary data agree		Lab QAO	H-GAC Data Mgr
Nonconforming activities documented	H-GAC QAO	Lab QAO	H-GAC QAO
Outliers confirmed and documented;	H-GAC QAO	Lab QAO	H-GAC Data Mgr &

H-GAC Data to be Verified	Field Task	Laboratory Task (Eastex Lab)	Lead Organization Data Manager Task
reasonableness check performed			H-GAC QAO
Dates formatted correctly	H-GAC Data Mgr		H-GAC Data Mgr
Depth reported correctly	H-GAC Data Mgr		H-GAC Data Mgr
TAG IDs correct	H-GAC Data Mgr		H-GAC Data Mgr
TCEQ Station ID number assigned	H-GAC Data Mgr		H-GAC Data Mgr
Valid parameter codes	H-GAC Data Mgr		H-GAC Data Mgr & H-GAC QAO
Codes for submitting entity(ies), collecting entity(ies), and monitoring type(s) used correctly	H-GAC Data Mgr		H-GAC Data Mgr
Time based on 24-hour clock	H-GAC Data Mgr		H-GAC Data Mgr
Absence of transcription error confirmed	H-GAC Data Mgr & H-GAC QAO	Technical Director	H-GAC Data Mgr
Absence of electronic errors confirmed	H-GAC Data Mgr & H-GAC QAO	Technical Director	H-GAC Data Mgr
Sampling and analytical data gaps checked (e.g., all sites for which data are reported are on the coordinated monitoring schedule)	H-GAC Data Mgr & H-GAC QAO		H-GAC Data Mgr & H-GAC QAO
Field QC results attached to data review checklist	H-GAC Data Mgr & H-GAC QAO		H-GAC Data Mgr
Verified data log submitted	H-GAC Data Mgr		H-GAC Data Mgr
10% of data manually reviewed	H-GAC Data Mgr & H-GAC QAO	Technical Director	H-GAC Data Mgr & H-GAC QAO

D3 RECONCILIATION WITH USER REQUIREMENTS

Data produced in this project, and data collected by other organizations (i.e., TCEQ, etc.), will be analyzed and reconciled with project data quality requirements. Data meeting project requirements will be used in the implementation of the Mill Creek WPP and will be submitted to TCEQ SWQMIS for use as appropriate in the development of the biennial Texas Integrated Report for Clean Water Act Sections 305(b) and for WPP development, water quality standards development, and permit decisions. Data which do not meet requirements will not be submitted to SWQMIS nor will be considered appropriate for any of the uses noted above.

.

Appendix A. Field Data Sheet

H-GAC – Ambient Monitoring Data Sheet

Date: _____/_____/_____ Station: MC-2 Mill Creek at FM 331, southeast of Bellville

Time (military):_____ Samples Collected by:_____

Total Water Depth at sampling location	meters		# of Days Since Last Significant Rainfall	
Sampling Depth	meters			
Water Temperature	°C			
Specific Conductance	µS/cm			
Salinity	‰	N/A		
pH	standard units			
Dissolved Oxygen	mg/L			

Secchi disk or tube	Observed Turbidity	Water Clarity	Water Color	Water Odor	Present Weather	Wind Intensity	Water Surface	Flow Severity	Tide Stage
									N/A
meters	1 – low 2 – medium 3 – high	1 – excellent 2 – good 3 – fair 4 – poor	1 – brownish 2 – reddish 3 – greenish 4 – blackish 5 – clear 6 – other	1 – sewage 2 – oily/chemical 3 – rotten egg 4 – musky 5 – fishy 6 – none 7 – other	1 – clear 2 – partly cloudy 3 – cloudy 4 – raining 5 – other	1 – calm 2 – slight 3 –moderate 4 – strong	1 – calm 2 – ripples 3 – waves	1 – no flow 2 – low 3 – normal 4 – flood 5 – high 6 – dry	1 – low 2 – falling 3 – slack 4 – rising 5 – high

Flow	cfs	
Flow Method	1 – gage 2 – electric 3 – mechanical 4 – weir/flume 5 – Doppler	
Estimated Flow	cfs	
Primary Contact, # of People Observed (1-10, >10)		
Evidence of Primary Contact, (1- Observed, 0 - Not Observed)		

Maximum Pool Width	meters	
Maximum Pool Depth	meters	
Pool Length	meters	
Percent Pool Coverage in 500 meter Reach	%	
Comments or Observation		

Fresh (non-tidal) ✓

Marine (tidal) _____

Containers	Preservatives	Analyses	Requested
1 x 500 mL Plastic	Iced	TSS, Turbidity	
1 x 1 L Plastic	Iced, H_2SO_4	TKN, NH3, NO2+NO3, TPO4 Orthophos	
1 x 500 mL Plastic	Iced	CL, SO4	
1 x 100 mL Sterile Plastic	Iced	Bacteria: *E. coli*	
1 x 1000 mL Brown Plastic	Iced	Chlorophyll a and Pheophytin	

Field Split? Yes____ No____

If no,
Date of last split:_____ Surveyor SN:_____ Sonde SN:_____

Updated: July 22, 2014

Appendix B. Chain of Custody Form

U

EASTEX ENVIRONMENTAL LABORATORY, INC.

P. O. Box 859
Coldspring, Texas 77331
(409) 653-3249 * (281) 350-4080

P. O. Box 631375
Nacogdoches, Texas 75963-1375
(409) 569-8879 * Fax (409) 569-8951

REPORT TO:

1 Company
Address
Attn.
Phone #
Fax #

INVOICE TO:

2 Company
Address
Attn.
Phone #
Fax #
P.O. #

8 ANALYSIS REQUESTED

Sampler's Name (please print)

Sampler's Signature

Project Number

3 Project Name

7 Containers

4 Sample ID	Date	Time	5 C/G	DO	PH	Cl2	Flow	Temp	6 Matrix	#Con	Size	Type	Pres

Relinquished By: (Signature) Received By: (Signature) Date Time

Relinquished By: (Signature) Received By: (Signature) Date Time

Remarks:

Received Iced: Yes / No

LAB USE ONLY

Checked In By: (Signature) Date Time

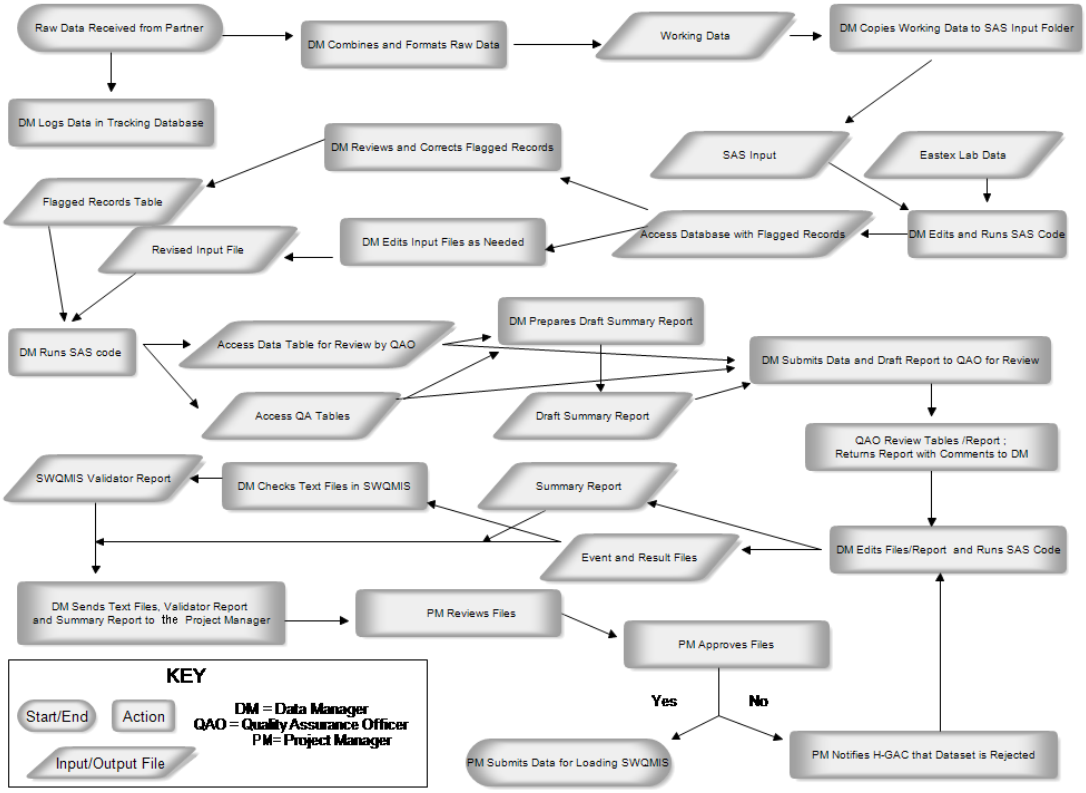
Logged In By: Date Time

White Copy-Follows Samples
Yellow Copy-Laboratory
Pink Copy-Client Copy

SEE BACK FOR INSTRUCTIONS

Appendix C

Data Management Flow Chart



Appendix D Data Summary Report

Data Information

Data Source: _____

Date Submitted: _____

Tag_id Range: _____

Date Range: _____

Comments

Please explain in the space below any data discrepancies including:

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

-
-
-
-
-
-
-

H-GAC Data Manager: _____

Date: _____

H-GAC QAO: _____

Date: _____

Appendix E Corrective Action Report

Corrective Action Plan		
Report No.:	Issued By:	Date Issued:
Monitoring Entity Involved:		Date Closed:
Description of deficiency:		
Root Cause of deficiency:		
Programmatic Impact of deficiency:		
Does the seriousness of the deficiency require immediate reporting to the TCEQ? If so, when was it?		
Corrective Action to address the deficiency and prevent its recurrence:		
Proposed Completion Date for Each Action:		
Individual(s) Responsible for Each Action:		
Method of Verification:		

Appendix F Data Management Process

H-GAC's Surface Water Quality Data Management Process

1. When the data manager receives field and laboratory data from individual local partners (including H-GAC's monitoring crew), all electronic files are saved in the partner's 'Raw Data' folder. The data may be in the form of Excel spreadsheets, Access tables, scanned field data collection forms, or files downloaded directly from field instrumentation. If data summary checklists have been submitted as electronic files, they are also stored in this folder. Hard copies of data, data summary checklists, calibration records, or other physical data are filed for subsequent data entry by H-GAC staff and for reference during the data review and validation process. In addition, receipt of all Clean Rivers Program data is documented in the "CRP Data Tracking" database, currently found at Q:\CE\Clean Rivers\DATA\Data\CRP Data Tracking.accdb.

Attention: No modifications or corrections are made to files in the raw data folders.

2. Raw data files are then copied to the partner's "Working Data" folder. All modifications to the data prior to SAS processing are performed on the files in the "Working Data" folders only. Compilation of the submitted data, where necessary, is performed by the H-GAC data manager. This may involve manual data entry into an Access data entry form, re-formatting of Excel or Access tables, and other data management tasks as needed. In addition, identifying information such parameter names in the raw data files replaced by TCEQ parameter codes (specific information is found below). Because the measurement performance specifications found in the A7.1 table may vary from one QAPP to another, the working data file must not include data collected under two different QAPPs. The file may, however, contain information from more than one month within the fiscal year covered by an individual QAPP.

3. Field and laboratory data for specific sample sites (monitoring stations) are combined where necessary to create one record containing all observations made at the sample site. Field and laboratory data are merged using SAS SQL. In most cases, tables are created by joining the data are joined on equivalent monitoring station ID, sample date, and end depth values. If not already present in the datasets, the TCEQ monitoring station ID must be added, and the format of the date field must be consistent in the files to be combined. Much of the data formatting is affected by SAS code.

    a. Note 1: this step is not necessary for City of Houston HHS and Harris County datasets.

    b. Note 2: The electronic data submitted by Eastex Laboratory must be transposed before combination with corresponding field data. This is most efficiently accomplished using SAS PROC TRANSPOSE.

4. The fields (columns) in the compiled dataset are renamed and reformatted to comply with SWQM data management guidelines. Consult the most recent version of TCEQ's "Data

Management Reference Guide for Surface Water Quality Monitoring "for further information. SAS can be used to rename fields, but the raw data must be inspected to ensure the partner has not changed the name of a field.

5. The fields containing sample site, sample date, sample time, and sample depth are renamed STATION_ID, ENDDATE, ENDTIME, and ENDDEPTH respectively. This can be accomplished programmatically with SAS code.

6. The parameter names used by the partner are replaced by the TCEQ parameter code. Precede the code number with an "S" to ensure that the data is read into SAS files as text data. This can be accomplished programmatically with SAS code.

   a. Example: The field or column for dissolved oxygen must be relabeled "S00300" prior to SAS processing.

7. The units of measurement as reported by the partner may not comply with SWQM guidelines. In most cases the SAS code will make the conversion to the correct units. If it is discovered that the code for conversion has not been written or is incorrect, or if the partner does not report the results consistently, manual conversion of the units may be necessary. In many cases, the SAS code will flag any records reported in the wrong units for other reasons (below or above screening values, for example), and the correction can be made using SAS.

8. If the SAS code does not include an algorithm for reformatting dates and times, the data manager ensures that these data are formatted as mm/dd/yyyy and hh:mm respectively.

9. Any parameters that are not included in the A7.1 table for the partner should be removed from the dataset. In most cases, the SAS code specifies the parameters (storet codes) that are to be included in the output text files. It may be necessary to modify the SAS code if unwanted parameters appear in the final dataset.

   Note: While references appear in this document to modification of the SAS code, these are for expository purposes only. The code should only be modified by a person who is very familiar with SAS programming in general, and the SWQM processing code in particular.

10. When a database table(s) or Excel spreadsheet containing all field and laboratory data has been compiled and reformatted as described above, it is saved to the SAS input folder within the "SAS Data Processing" folder (currently at Q:\CE\Clean Rivers\DATA\SAS_Data_Processing) as an Access 2002-2003 database or an Excel 97-2003 file. Note that the version of SAS (9.1.2) in use at H-GAC cannot import or export Office 2007 file types. The input file should be renamed to include a code identifying the partner and the date range of the data.

11. As part of SAS processing, tables containing laboratory – specific quantitation limits, TCEQ minimum and maximum screening values, and site name / monitoring station ID correspondences are imported for comparison to the partner data. At the beginning of the

period under which a specific QAPP is applicable, the data manager ensures that the tables containing this information correspond (where applicable) to the A7.1 tables. The data manager updates these tables at other times as needed.

12. The data manager modifies the SAS program used for the partner's most recent dataset for processing of the current data.

    a. Open and save the SAS program with the same name as the new input file.

    b. Find all references to input and output files within the program, and replace them with the name of the new input file.

    c. Save changes to the program.

    d. Run the program through the step where "Flagged_Records_1" is created.

13. The SAS program creates a new Access database in the "Access" folder within the "SAS Data Processing" folder. The database should have the same name as the input file.

    a. The database contains at least two tables: The "Input_Data_Matrix" that contains all data in the input file, and the "Flagged_Records_1" table.

14. The data manager updates the "CRP Data Tracking" database to include the date of initial SAS processing. (This step will be skipped for non-CRP data.)

15. The "Flagged_Records_1" table identifies questionable data that must be investigated by the data manager. The table is generated from comparisons against screening levels to identify outliers, quantitation limit tables to identify improperly reported data, and a variety of other comparisons. The program includes algorithms to identify the following:

    a. Reported values beyond TCEQ screening limits (outliers)
    b. Values reported as negative numbers
    c. Illegal values (e.g.,, results for qualitative parameters that are not in the range of allowed values)
    d. Reported orthophosphate that exceeds the reported total phosphate
    e. Total constituents below dissolved constituent
    f. TDS/conductance ratio outside 0.55-0.70
    g. TDS less than total hardness
    h. Nitrate+nitrite concentration is less than nitrite concentration
    i. TDS less than chloride and sulfate;
    j. Inconsistent observed turbidity and water clarity results
    k. Inconsistent water surface and wind intensity results

16. The data manager is responsible for reviewing each flagged record against available raw data, data submittal checklists from the partner agency, instrument calibration records, and so forth, and where necessary obtaining additional information from the partner agency in order to determine the appropriate action to be taken. The flagged records table contains a variety of fields for documenting the disposition of the problem. In summary, a flagged record is accepted (on the basis of verification by the data manager), replaced with a corrected value, or deleted. A code is entered into the "Action" column, the "Verification Method" code is entered, and the initials of the responsible party are entered in the "Verified By" column.

    a. "Verification Method" codes currently in use are DR (document review) and PJ (professional judgment).

17. At present, there is a subset of data quality problems that cannot be identified or corrected using the flagged records table. It may be necessary to make changes to the input file to correct some errors and inconsistencies identified during subsequent review by the data manager or quality assurance officer.

18. All written communications with the staff of partner agencies that are made during the data verification process are printed and retained with the final data package that is retained by H-GAC. Documentation of telephone conversations are also retained.

19. Before changes are made to each data set, the data manager creates a "Data Summary Report/Sheet" for that specific data set. The data summary report is created from the most recent data summary report for that partner agency and saved with the name of the current data set. All changes to the data and/or action taken on the data set are documented in this report. In addition, summary narratives discussing missing data, outliers that were verified and accepted, explanations of variations in reporting the data, failure to meet A7.1 LOQs, and so forth are also included. Pertinent information from the data submittal checklist submitted by the partner agency is also included in the final report. This report is submitted to TCEQ PM (or TSSWCB PM as appropriate) with each data set.

20. The data submittal checklist submitted by the partner agency or contract lab is reviewed for the following, at minimum:

    a. If the quality control information included in the report indicates that data has been reported that did not meet the measurement performance specifications of the A7.1 tables, it will be removed from the dataset. The removal will be noted on the "Data Summary Report/Sheet."

    b. If the quality control information included in the report indicates that data has been reported that did not meet method-specific quality control criteria, the impact on data usability will be evaluated. Data may be removed from the dataset if legal defensibility is questionable. The removal will be noted on the "Data Summary

Report/Sheet."

c. The post-calibration error limits in the partner agency's data submittal checklist shall be checked against requirements, as well as raw calibration records if available.

d. Reports of missing data, and the reasons that the data is missing (QC failure, spilled sample, could not sample site, etc.)

21. The SAS program is re-run following action on all flagged records. The flagged records table is read back into the process, and a variety of new tables and files are created. The most important of these are the "Draft_Data_Matrix" and the pipe-delimited text files that are submitted directly to the PM (TCEQ or TSSWCB).

    a. The portion of the SAS code that assigns TAG ID numbers is edited prior to generating the second group of tables and files.

22. The data manager queries a subset of data from the "Draft_Data_Matrix" table and reviews it against hard-copy raw data to check for random transcription errors. A sufficient number of records are selected so that when added to the flagged records previously evaluated, at least ten percent of submitted data has been verified against raw data. The query results are printed and retained with the data package as a record of data review.

23. The data manager creates and views a 'totals' query of the "Draft_Data_Matrix" table to identify missing records that have not been addressed in the data summary report.

24. Additional Access tables can be created and exported from SAS for targeted reviews. Currently, tables are produced that list the parameters and number of results, compare the stations sampled to the current CMS (or list of approved monitoring stations if not part of CMS) to identify problems of several types, and a table linking station IDs and dates to USGS flow gage stations to identify missing flow measurements.

25. The data manager completes the draft data summary report, and updates the "CRP Data Tracking" database with the date the draft was completed.

26. The summary report is submitted to the quality assurance officer (QAO). The "Draft_Data_Matrix" and draft summary are reviewed by the QAO , who identifies all values that, in the QAO's judgment, are unreasonable, are unverified outliers, or are otherwise questionable. Written comments and concerns are returned to the data manager for further investigation and correction of the dataset (where warranted). Newly identified discrepancies are investigated and documented on the data summary report.

27. The data manager reviews the written comments, takes the appropriate action, and documents any additional actions needed on the data summary report. In most cases, the SAS program will be run at least one more time, although a new flagged records table is not routinely created. In the event there has been extensive modification of the input dataset, a

new flagged records table must be created. The written comments from the QAO, with annotations by the data manager, are retained with the data package as a record of data review and modification (where applicable). The date of data summary report approval is added to the "CRP Data Tracking" database.

28. Text files are created by the SAS program. The data is first submitted to the SWQMIS Test database (the validation algorithm) to obtain a validation report, which is saved on the H-GAC CRP network drive; the files and Data Summary Report are then emailed to the Project Manager at TCEQ (or TSSWCB PM for other projects).

    a. The data manager copies the event and result files to the desktop.
    b. Each file is edited to remove the header line (field names).
    c. The data manager logs into the SWQMIS system, and submits the files and data summary report as described in the SWQMIS user's guide (http://www.tceq.state.tx.us/assets/public/compliance/monops/water/wqm/swqmis_users_guide.pdf , retrieved 8/10/2010).
    d. If the system identifies validation errors, upload is canceled and the validation errors are investigated and corrected. In some cases this may involve editing the text files only. If this option is selected, document changes to text files appropriately. It may be most convenient to document minor changes to the text files in the "Comments" section of the appropriate record in the "CRP Data Tracking" database.
    e. When no validation errors are found, the upload is completed, and a validator report is created and saved report (with a unique file name) as an html file.
    f. The data manager reviews the validator report to identify remaining discrepancies between the dataset, data summary report, and A7.1 table requirements that may have been missed. The appropriate actions, to include resubmission of the data to obtain a revised validator report, are performed.
    g. The text files, data summary report, and validator report are e-mailed to the TCEQ or TSSWCB Project Manager.
    h. The validator report is saved in the "Data Review and Submission Docs" folder at Q:\CE\Clean Rivers\DATA\Data\Data Review and Submission Docs."

29. The data manager updates the "CRP Data Tracking" database to include the date the files were sent to TCEQ, and add hyperlinks to the data summary and validator reports. (Does not apply to TSSWCB projects.)

30. If the TCEQ or TSSWCB Project Manager identifies further problems with the dataset, the appropriate action is taken and revised datasets or data correction requests (where appropriate) are submitted. Written communications with the TCEQ or TSSWCB project manager are printed and retained on file with the data package to serve as a record of validation and modification of the dataset.

31. When the dataset is accepted by TCEQ) and loaded into SWQMIS, the H-GAC data manager updates the "CRP Data Tracking" database to include the acceptance date. (Does not apply to TSSWCB projects. Rather, H-GAC PM is notified of successful submission to

be reported in month or quarterly reports.)

32. All data management activities are documented in an Access database maintained by the Data Manager. The database contains details of receipt, processing, submission, and acceptance by TCEQ, and includes hyperlinks to raw and final datasets, data summary reports, and data validation reports.