QUALITY ASSURANCE PROJECT PLAN (QAPP)

Initiating Water Quality Sampling of Stormwater Treatment Wetlands in Galveston Bay Watershed

GLO Contract No. 19-043-000-B077
Coastal Management Program- Cycle 23

Prepared by:

Texas A&M Agrilife Extension Service
Texas Community Watershed Partners
Stormwater Wetland Program

Effective Period: One year from date of final approval

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

Christie Taylor
1335 Regents Park Drive, Suite 260
Houston, TX 77058
979-399-4009
cctaylor@tamu.edu

Table of Contents

Distribution List

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

GLO/Coastal Management Program
1700 Congress Ave.
Austin, TX 78701-1495
Name: Ben Wilson
Title: CMP Project Manager

Clear Lake City Water Authority
900 Bay Area Blvd
Houston, TX 77058
Name: Jennifer Morrow
Title: General Manager
Name: John Branch
Title: Board President

Exploration Green Conservancy Board
2323 Clear Lake City Blvd. Suite 180, Box 265
Houston, TX 77062
Name: Frank Weary
Title: President

MD Anderson Cancer Center
Name: Iris Clawson
Title: MDA Facilities/ Operations Manager
Name: Jim Power
Title: MDA Facilities/ Operations Chief Engineer

TAMU Agrilife Extension
1335 Regents Park Drive, Ste 260
Houston, TX 77058
Name: Christie Taylor
Title: Extension Program PM
Name: Charriss York
Title: Extension Program QA Officer

List of Abbreviations

CMP…….. Coastal Management Program

DO…….. Dissolved Oxygen
EPA…….. Environmental Protection Agency
Extension……...Texas A&M Agrilife Extension Services
GLO……General Land Office
NOAA…… National Oceanic and Atmospheric Association
NPS……Nonpoint Source
PM……..Project Manager
QA……..Quality Assurance
QAO……...Quality Assurance Officer
QAPP……Quality Assurance Project Plan
SOP……Standard Operating Procedure
TAMUG……. Texas A&M University Galveston
TCWP……. Texas Community Watershed Partners
TPH……Total Petroleum Hydrocarbons
TSS……Total Suspended Solids

Project / Task Organization

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

GLO Coastal Management Program (CMP)

Ben Wilson, CMP PM
Provides the primary point of contact between the Extension and CMP. Tracks and reviews deliverables to ensure that tasks in the workplan are completed as specified in the contract.

TAMU Agrilife Extension

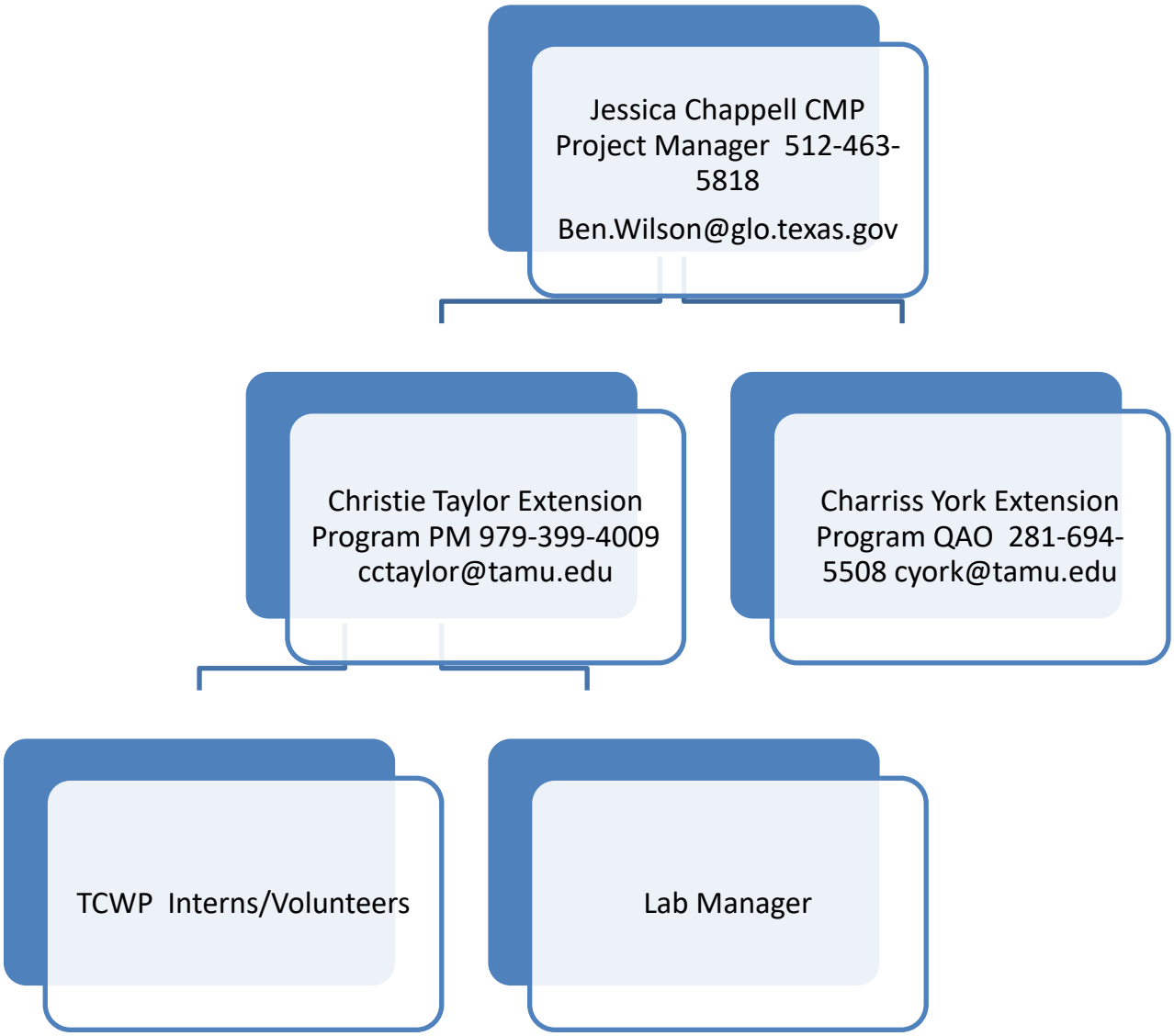
Christie Taylor, Extension Program PM
The PM is the primary contact between the CMP and the Extension. The PM drafts the QAPP, any QAPP revisions as needed, progress reports, signage, graphic and textual deliverables for the project. The PM oversees the collection of samples, reporting and analysis of data as outlined in the QAPP. Ensures that all staff involved in collections have been trained in collection procedure, programming of ISCO 6712 samplers, and use of YSI multiprobe for sample data collection. As well as ensuring all field documentation is handled properly and reported back to the PM.

Charriss York, Extension Program QA Officer
The QAO reviews the chain of custody forms a makes sure the transfers to the lab happen as specified in the QAPP. The QAO verifies the successful transfer of data from the lab to the Extension Program PM. The QAO enforces any corrective action, as required. Assures that all staff involved in collection of samples are competent on ISCO 6712 and YSI multiprobe.

LAB

Lab Manager
Responsible for supervision of laboratory personnel involved in generating analytical data for this project. Responsible for ensuring that laboratory personnel involved in generating analytical data have adequate training and a thorough knowledge of the all SOPs specific to the analyses or task performed and/or supervised. Responsible for oversight of all laboratory operations, ensuring that all QA/QC requirements are met, and documentation related to the analysis is completely and accurately reported. Responsible for ensuring laboratory corrective actions are implemented, documented, reported and verified. Enforces corrective action, as required.

Figure 1.1 Project Organizational Chart- Lines of Communication



PROJECT TITLE

Initiating Water Quality Sampling of Stormwater Treatment Wetlands in Galveston Bay Watershed

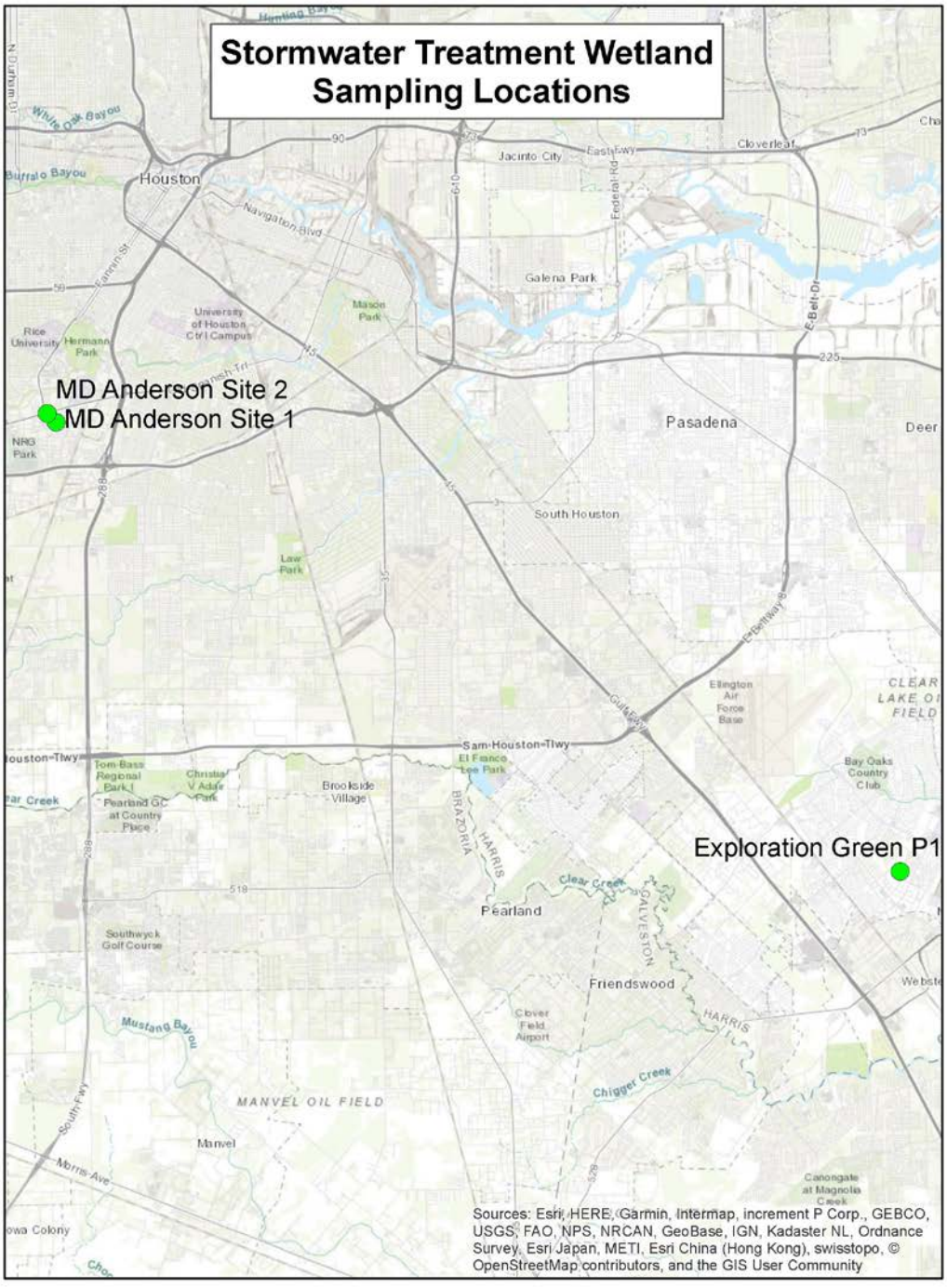
A. GENERAL DESCRIPTION OF STUDY:

A1. Problem:

Currently, water quality data is limited for stormwater treatment wetlands in the lower Galveston Bay watershed. As more wetlands are implemented to demonstrate this relatively new Best Management Practice, there is a need for robust water quality data to verify the effectiveness of the technique, or to guide modifications in the design of subsequent prototypes.

Texas Community Watershed Partners (TCWP) as part of the TAMU Agrilife Extension proposes to develop a QAPP for a water quality monitoring protocol and sample three stormwater wetland locations designed and planted by TCWP in the Galveston Bay Area. Location 1: The University of Texas Research Park stormwater wetland is a 0.33-acre stormwater wetland basin on the UT MD Anderson Cancer Center's South Campus in the Texas Medical Center. The basin mitigates a 3 acre parking lot expansion, and is in the Brays Bayou watershed which is listed impaired. Location 2: Exploration Green Conservation and Recreation Area is transforming the defunct Clear Lake Golf Course into a stormwater detention facility with five segments ("Phases") each containing a lake, habitat island, and walking trails. The 200-acre site receives stormwater runoff from an approximately 2000-acre predominantly suburban watershed, which is itself in the Armand Bayou watershed, 303 (d) listed as impaired by the US EPA. Phase 1 is a 14-acre lake containing 6 acres of wetlands planted 2016-2018. Location 3: MD Anderson parking lot expansion at the corner of Fannin and Old Spanish Trail in 1800 block of Old Spanish Trail. This is a 0.62 acre site that collects stormwater from the parking lot expansion. This site was just completed in June 2019 and recently planted.

Figure A1.1 Sampling Location Map



A2. Background:

TCWP TAMU AgriLife Extension and project partners are designing and implementing stormwater wetland demonstration projects in various basin types and watersheds. In contrast to the standard detention basin, basins that incorporate stormwater wetlands can provide a multiplicity of benefits: water quality, wildlife habitat, aesthetics and recreation. The stormwater wetlands are being designed to retain water for approximately 48-72 hours post storm event to allow the wetlands to remove debris, sediments and harmful chemicals and bacteria before the water is released downstream and into Galveston Bay. However, there has not been sufficient studies of the effectiveness of these designs on improving water quality.

For example, in one study of Mason Park marsh, the region's first constructed treatment wetland in Houston, TX results were inconclusive due to extreme drought [Guillen UHCL 2012]. The other study of this site was conducted by citizen science, but there are limited other studies of this type of constructed wetland in our area which to compare the data.

In a similar study of this BMP design from Pine Lake, Georgia, research shows that using wetlands and bioretention features reduce the amount of total coliform*, E. coli,* and conductivity thus improving the quality of water discharged from the stormwater wetland. This study collected water samples after storm events that occurred after a 48 hour antecedent dry period. They also collected influent and effluent samples at the same time [Styes, Zarus, and Ryan April 2015 Stormwater- Magazine].

As development increases, so does the requirement for drainage infrastructure, but currently, standard stormwater basins are ecologically and aesthetically bleak. Stormwater wetlands provide a method of combining multiple functions into a single site. Gaining data on the stormwater wetland practice is necessary as the technique is promoted for its multiplicity of benefits. The project will look at the water quality data aspect of the stormwater wetland BMP and provide quality and comparable data for this BMP in the lower Galveston Bay Watershed.

Data will be available on the TCWP website at https://tcwp.tamu.edu/stormwater/wetlands/stormwater-wetland-water-quality-monitoring-project/ and thus accessible for decision makers effecting change in drainage infrastructure planning. Stormwater wetland effects on water quality are documented in other areas of the U.S. and internationally, [Center for Watershed Protections's National Pollutant Removal Database for Stormwater Treatment Practices] but there is less documentation of Houston regional stormwater wetlands. Data from local demonstration projects can result in the better buy-in by local decision makers.

A3. Project Task Description:

Project Objective:

The project will generate data of known and acceptable quality to accurately depict the amount of water quality improvements provided by stormwater wetlands at the selected demonstration sites within the Galveston Bay Watershed.

Each of the three locations will be sampled at the influent and effluent sites for five consecutive months to provide data in cooler and warmer weather. There will be portable ISCO 6712 samplers located at a minimum of one influent and effluent site to

collect samples at location 1 and 3 (the 2 MDA locations, in the medical center complex). There will be one ISCO sampler at the outfall site only of location 2 (exploration Green Phase 1, Clear Lake City, Houston, Texas) and grab samples collected near the inflow site with GPS coordinates recorded for each influent collection. A minimum of 10 up to a maximum of 24 samples taken from each of the three locations. Up to 5 samples will be collected at the influent sites during qualifying rainfall events and up to 5 samples from the effluent sites during qualifying rainfall events. Then TCWP staff will attempt to return and sample the effluent sampler again 24-48 hours after the qualifying event (up to 5 events), pending there was not another rain event within that time and the collection time doesn't fall on a weekend when couriers are not available, to determine if water quality changes the longer the water is in contact with the wetland before being released to the receiving body. For the purpose of this sampling method, qualifying rainfall events will be those preceded by a minimum of 48 hour dry period. Each sampler will be given a distinct number. Samples will be collected by TCWP staff and transferred to NELAP certified lab for testing.

Parameter to be tested for all samples include pH, TSS, DO, specific conductivity, nitrite, nitrate, total phosphorus, ammonia and E. coli. The approximately 16 samples from the M. D. Anderson location sites will be additionally tested for heavy metals and total petroleum hydrocarbons because the watershed at this location is almost totally composed of adjacent parking lots.

Lab results will be delivered as both electronic and hard copies to the extension program PM and the extension program QAO. The lab results and analysis will be compiled by the extension program PM. Lab results and graphic representation of water quality changes will be uploaded to the designated webpage on the TCWP website (https://tcwp.tamu.edu/stormwater/wetlands/stormwater-wetland-water-quality-monitoring-project/) by the extension program PM. Line and/or bar graphs will show parameter values per event (date) for influent sites and parameter value per event (date) for effluent sites. There will also be a trend graphic for effluent sites 24hr after event or 48hr after event depending on location site conditions. The measured data from the influent site and effluent site for each location will be compared using a series of paired t-test for each parameter. Each parameter will be graphed as linear trend analysis.

In order to produce results in a timely manner, the water quality sampling project will follow the timeline described in Table A3.1

Table A3.1

Task	**Project Milestones**	**Start**	**End**
1.1	Develop QAPP	M4	M9
1.3	Contract NELAP certified lab	M4	M6
2.2	Begin sampling and reporting data to webpage	M12	M16
3.5	Present data	M17	M18

A4. Quality Objectives and Criteria

The project objective is to evaluate and quantify the effectiveness of constructed stormwater wetlands on water quality. The purpose of collecting influent and effluent samples at the time of the storm event is to verify that the water is being treated to a measureable degree during the capture by the wetland basin. This method is comparable to other studies of stormwater wetlands as best management practices. The purpose of the follow up effluent sample 24-48 hours after the initial event is to determine if the delayed release of the stormwater is providing any significant continuation of improved water quality the longer the water is in contact with the wetland basin.

Table A4.1: Quality Objectives

Procedure	Completeness	Precision	Representativeness	Comparability
Collect water quality samples using automated sampling equipment ISCO 6712 and YSI multiprobe in the field	It is the goal of this project to have 90% of all potential data available for use in reporting and analysis.	The degree to which measurement of the same location under similar conditions conform to themselves. Agreement between replicate samples	Ensure the number of samples taken at each site is enough to accurately characterize the water quality conditions of each site during storm events that produce measurable runoff	Dedication to using approved sampling and analysis methods. Report data in standard units; according to known laboratory practices. So data can be compared to other local SWQM data and national projects of similar BMPs.

A5. Special Training / Certifications

TCWP staff involved in collection of samples will be trained on the ISCO 6712 set up and collection procedures, rain gauge, flow loggers and chain of custody procedures. Sample collecting staff will be trained in YSI sonde calibration protocols according to manufacturer's manual for calibration procedures. A list of trained TCWP staff will be maintained by the Extension QAO.

NELAP lab accreditations will be available for review.

A6. Documents and Records

Records produced by this project will consist of the results of data collection, data monitoring, and data analysis. Progress reports on data collection, processing and analysis will be submitted quarterly.

Laboratory Test Reports must document the test results clearly and accurately. The data reports should include information necessary for the interpretation and validation of data. The requirements for reporting data are as follows

- Name of client
- Sample name
- Sample matrix
- Date and time of collection
- Units of measure
- Date and time of sample receipt
- Date and time of sample analysis
- Indication of Method used
- Identification of samples that did not meet QA requirements and why
- Certification of NELAP compliance on a result by result basis

Data will be reported on the dedicated project webpage https://tcwp.tamu.edu/stormwater/wetlands/stormwater-wetland-water-quality-monitoring-project/) on the TCWP website. Tabular and graphical representation of the data will be reported on the webpage semi-quarterly as available for each of the three locations. Data validation and QA checks will be conducted by the Extension QAO. Copies of data documentation generated by the Extension program project personnel will be stored on the server. The Extension will ensure against catastrophic loss of data (e.g. physical damage/data loss due to fire or storm damage) by storing data backups offsite at a secure location utilizing the TAMU Syncplicity cloud through TAMU system. The data report and web-based products will be organized according to sample site location. Hard copies will be kept in a waterproof/ fireproof safe.

The final assessment data report will be produced electronically and as a hard copy, and all files used to produce the report will be saved electronically by TAMU for at least five years and will be available for transfer to the CMP PM.

Table A6.1: Project Quality Assurance Documents and Records

Document/Record	Location	Retention	Form
QAPP, amendments, and appendices	TAMU	5 years	Electronic/ Paper
QAPP distribution documentation	TAMU	5 years	Electronic
Chain of Custody Forms, Field Notes, and Sample Results	TAMU	5 years	Electronic/ Paper
Quarterly Progress Reports, data collection, data monitoring, data analysis	TAMU	5 years	Electronic/ Paper
Presentations and white paper	TAMU	5 years	Electronic/ Paper
Final report	TAMU	5 years	Electronic/ Paper
All Backups	TAMU	1 year	Electronic

B. MEASUREMENT AND DATA ACQUISITION

B1. EXPERIMENTAL DESIGN

The experimental design of this project aims to demonstrate the effectiveness of constructed stormwater wetlands as a BMP for improved water quality in stormwater detention. Three different constructed wetland sites were chosen. The sites are different sizes and at different stages of completeness, MD Anderson UTRP basin site completed in 2018, the Exploration Green Nature Park Phase 1 stormwater wetland which was completed in Fall 2018 and the MD Anderson Proton Therapy Parling Lot Expanson Wetland was completed and planted in June 2019. The sites are located in two different sub-watersheds of the Galveston Bay Watershed, Brays Bayou (MD Anderson sites 1 and 3) and Clear Creek (Exploration Green).

TableB1.1 Location Description

Location	Site	Latitude Longitude	Sample code	Start Date	End Date	Mode of Sampling	Sample Matrix	Monitoring Frequency
MD Anderson UTRP	Influent	**To Be Recorded at Time of Install**	101-#	Sept. 2019	Feb. 2020	automatic	water	Up to 8x within 5 months; with qualifying rainfall event

MD Anderson UTRP	Effluent	**To Be Recorded at Time of Install**	102-#	Sept. 2019	Feb. 2020	automatic	water	Up to 16x within 5 months; with qualifying event
Exploration Green Park Phase 1	Influent	**To Be Recorded at Time of Install**	201-#	Nov. 2019	April 2020	Grab sample only	water	Up to 8x within 5 months; with qualifying rainfall event
Exploration Green Park Phase 1	Effluent	**To Be Recorded at Time of Install**	202-#	Nov. 2019	April 2020	automatic	water	Up to 16x within 5 months; with qualifying event
MD Anderson Site 2 Parking Lot Expansion	Influent	**To Be Recorded at Time of Install**	301-#	Mar. 2020	Aug. 2020	automatic	water	Up to 8x within 5 months; with qualifying rainfall event
MD Anderson Site 2 Parking Lot Expansion	Effluent	**To Be Recorded at Time of Install**	302-#	Mar. 2020	Aug. 2020	automatic	water	Up to 16x within 5 months; with qualifying event

This experiment will compare water quality parameters at the influent and effluent sites of each basin location. Automated samples will be located at the influent and effluent sites for five consecutive months according to the schedule provided in Table B1.1. Up to eight samples will be collected at each influent site and a maximum of 16 samples from each effluent site. Samples will be collected within the first 24 hours after the rainfall event at both the influent and effluent sites for that location. Then a follow up effluent sample will be collected 24-48 hours after rainfall event. Twenty-four hours for smaller shallow basins and forty-eight hours for the larger retention basin at Exploration Green. Rainfall amounts will be measured using an ISCO 674 tipping bucket rain gauge at each location. Rainfall amount will be recorded on the field collection data form. Data will be collected for storms producing 0.29 inches or more of rain preceded by a 48-72 hour dry period. At location 1 MD Anderson site, up to 4 storm events will be tested for the runoff parameters heavy metals and TPH. The ISCO 6712 automated sampler with the a 730 bubble flow meter with accompanying power supply will be secured at the inflow and outflow points of the constructed wetland and will be used to collect both inflow and outflow composite samples and flow volume data. There will be at least one modem at each location, most likely attached to the influent sampler. The modem allows remote access to the sampler as well as the capability to send text messages to a dedicated number when the sampler program initiates and stops to inform the staff when the sample is ready to be collected and sent to the lab. The use of modems along with monitoring of the weather reports and predicted rainfall amounts from local sources will help to insure the specific hold times for bacteriological samples are not exceeded.

B1.2 Experimental Method Summary by Location

Location	Inflow Volume	Inflow Pollutant Concentration	Outflow Volume	Outflow Pollutant Concentration	Means of computing Pollution Load Reduction
MD Anderson UTRP Basin	Measured with ISCO 730 bubble flow meter attached to ISCO 6712 automated sampler triggered to collect at 15 minute intervals after the minimum flow measure available is met. A 450mL sample will be taken every 30 minutes for the duration of the storm event and composited in a 9L bottle.	Direct laboratory measurements of composite samples.	Measured with ISCO 730 bubble flow meter attached to ISCO 6712 automated sampler triggered to collect at 15 minute intervals after the minimum flow measure available is met. A 450mL sample will be taken every 30 minutes for the duration of the storm event and composited in a 9L bottle. And the automated sampler will be used to take another sample 24 hours later Flow volume will be	Direct laboratory measurements of composite samples.	Measured load of inflow minus measured load of outflow

			recorded from the ISCO 730 bubble flow meter.		
Exploration Green Nature Park Phase 1	Measured with ISCO 730 bubble flow meter attached to ISCO 6712 automated sampler triggered to collect at 15 minute intervals after the minimum flow measure available is met. A 450mL sample will be taken every 30 minutes for the duration of the storm event and composited in a 9L bottle.	Direct laboratory measurements of composite samples.	Measured with ISCO 730 bubble flow meter attached to ISCO 6712 automated sampler triggered to collect at 15 minute intervals after the minimum flow measure available is met. A 450mL sample will be taken every 30 minutes for the duration of the storm event and composited in a 9L bottle. And the automated sampler will be used to take another sample 24 hours later Flow volume will be	Direct laboratory measurements of composite samples.	Measured load of inflow minus measured load of outflow

			recorded from the ISCO 730 bubble flow meter.		
MD Anderson Site 2 Parking Lot Expansion	Measured with ISCO 730 bubble flow meter attached to ISCO 6712 automated sampler triggered to collect at 15 minute intervals after the minimum flow measure available is met. A 450mL sample will be taken every 30 minutes for the duration of the storm event and composited in a 9L bottle.	Direct laboratory measurements of composite samples.	Measured with ISCO 730 bubble flow meter attached to ISCO 6712 automated sampler triggered to collect at 15 minute intervals after the minimum flow measure available is met. A 450mL sample will be taken every 30 minutes for the duration of the storm event and composited in a 9L bottle. And the automated sampler will be used to take another sample 24 hours later Flow volume will be	Direct laboratory measurements of composite samples.	Measured load of inflow minus measured load of outflow

			recorded from the ISCO 730 bubble flow meter.		

B2. SAMPLING METHODS

Field Sampling Procedures

Field sampling data will be documented on Field Data Reporting Form (Appendix B). For all sampling visits, location id, sampling time, sampling date, sample collector's name and signature, rainfall amount, sample volumes, preservatives added to samples are recorded. Values for measured field parameters are recorded on the Field Data Reporting Form. The field data notebook should also include any visual observations, and time since last recorded rainfall event, etc. Basic rules for recording information for this project are

1. Legible writing in indelible, waterproof ink with no modifications, cross-outs, write-overs,
2. Changes should be made by crossing out original entry with 1 single line, entering the change and initial and date corrections,
3. Closeouts on incomplete pages with an initialed and dated diagonal line.

An YSI Professional Series multiprobe will be used to measure dissolved oxygen (DO), specific conductance, pH, and water temperature and this data will be recorded on the field data reporting form.

Automated Sampling Procedures

Automated samplers will be programmed in accordance with manufacturer user guides for automatic sampler data collection. At least one sampler per location, most likely the influent site will be equipped with modem to allow for text messaging from sampler to dedicated staff phone number to alert when the sampler program is initiated, completed or there is a problem with the sampler. Ice or gel pack will be added to the insulated sampler bases as necessary to maintain the appropriate temperature for the samples. Sample bottles and coolers for sample storage and sample pick up will be provided by the lab. Sample types, container types, minimum sample volume, preservation requirements and hold times are specified in Table B2.1. Samples will be collected in one large composite sample and separated into the appropriate sample containers for transport to the lab. Then the courier will be contacted for pick up samples.

Table B2.1 Sampling Protocol

Parameter	Matrix	Sample Type	Container	Preservation	Sample Volume	Hold Time
E.coli	water	composite	Sterile, plastic	Sodium Thiosulfate $<6^0$ C	100ml	8 hours

TSS	water	composite	Plastic or glass	<6^0C	1000ml	7 days
NO3 + NO2	water	composite	Plastic or glass	Sulfuric acid <6^0 C	500ml	28 days
Total Phosphorus	water	composite	Plastic or glass	Sulfuric acid <6^0 C	500ml	28 days
Ammonia as N	water	composite	Plastic or glass	Sulfuric acid <6^0 C	500ml	28 days
Heavy Metals	water	composite	Plastic	On ice <6^0 C	1000ml	6 months
Mercury	water	composite	Plastic	On ice <6^0 C	1000ml	28 days
TPH	water	composite	Plastic or glass	Hydrochloric acid <6^0 C	40ml vials (3x)	14 days to extraction 14 days from extraction to analysis

B3. SAMPLE HANDLING AND CUSTODY

Sample Labeling

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

1. Site identification
2. Date and time collected
3. Preservative added, if applicable
4. Sample type(i.e. analysis) to be performed

Sample Handling

Samples are collected at the field site after each qualifying rain event by AgriLife Extension staff and then labeled and appropriately preserved for laboratory analysis. Once preserved, the samples will be packaged in coolers by field staff according to laboratory specifications.

Samples will be transferred from TCWP to NELAP certified lab by courier. Samples analyzed by a sub-contracted laboratory will be documented on a chain of custody (COC) from that laboratory. A copy of the COC and custody procedures from the participating laboratory is found in Appendix C.

Upon receipt, the condition of the samples, including any abnormalities or departures from the standard condition will be recorded. All samples will have a traceable COC. Every sample accepted will be logged into a secure electronic database. Each sample is given a unique Lab ID number that is listed on the report for the sample. Samples that do not meet volume, preservation, hold time, temperature requirements will be

qualified and the Extension PM will be contacted for guidance. All samples requiring thermal preservation are considered acceptable if the arrival temperature is within +/- 2^0 C of required temperature of the method specified range. Where applicable the lab verifies chemical preservation using readily available techniques prior to or during sample preparation or analysis. Samples are handled and prepared as directed in the lab's analytical SOP for each analysis. Laboratory SOPs will be provided as an appendix to this QAPP once the contract is finalized.

B4. ANALYTICAL METHODS

Laboratories reporting data under this QAPP must be NELAP accredited for the appropriate parameters, methods and matrices.

- *Analytical methods*
- *Quality control tests*
- *Non-Direct Measurements*

  All acquired raw data must be NELAP-accredited.

Table B4.1 Measurement Performance Specifications

Parameter	Units	Matrix	Method	PAREMETER CODE	AWRL	Limit of Quantitation (LOQ	PRECISION (RPD of LCS/LCSD)	BIAS (%Rec. of LCS)	LOQ CHECK STANDARD %Rec	Lab
Field Parameters (Water Column)										
Rainfall	Inches	Water	gauge	46529	NA	NA	NA	NA	NA	Field
pH	pH. units	water	YSI multiprobe	00400	NA	NA	NA	NA	NA	Field
DO	mg/L	water	YSI multiprobe	00300	NA	NA	NA	NA	NA	Field
Conductivity	uS/cm	water	YSI multiprobe	00094	NA	NA	NA	NA	NA	Field
Flow	Gallons	water	ISCO flow meter		NA	NA	NA	NA	NA	Field
Temperature	^{0}C	Water	YSI multiprobe		NA	NA	NA	NA	NA	Field
Conventional Parameters (Water)										
Ammonia-N	mg/L	water	SM 4500-N G	00610	0.1	0.02	20	80-120	70-130	Eastex
T-PO4-P	mg/L	water	SM 4500-P E	00665	0.06	0.06	20	80-120	70-130	Eastex
TPH	mg/L	water	TCEQ 1005	NA	NA	NA	NA	NA	NA	Eastex
Heavy metals	mg/L	water	EPA 200.8	NA	NA	NA	NA	NA	NA	Eastex
Mercury	mg/L	water	EPA 245.1	NA	NA	NA	NA	NA	NA	Eastex
NO3 +NO2	mg/L	water	SM 4500-NO3 F	00630	0.05	0.02	20	80-120	70-130	Eastex
E.coli		water	Idexx Laboratories Colilert 18	31699	1	NA	0.5	NA	NA	Eastex
TSS	mg/L	water	SM2540 D	00530	4	1	20	80-120	NA	Eastex

B5. QUALITY CONTROL

B5.1 Instrument/ Equipment testing, inspection and maintenance

Automated sampler testing and maintenance are reference at the following locations:
ISCO 6712: http://www.isco.com/manuals/UP001DT6.pdf

ISCO 730 Bubble Module: http://www.isco.com/manuals/UP001ATF.pdf

YSI Professional Plus hand held multiprobe: http://www.ysi.com/File%20Library/Documents/Manuals/605596-YSI-ProPlus-User-Manual-RevD.pdf

Equipment records are kept on all field equipment and a supply of critical spare parts is maintained by the AgriLife Extension Field Supervisor.

All laboratory tools, gauges, instruments and equipment testing and maintenance requirements are contained within the laboratory QAMs. Testing and maintenance records are maintained and available.

B5.2 Instrument Calibration and Frequency

All instruments and devices used in obtaining environmental data will be calibrated prior to use as needed. Calibration methods are contained in the manufacturer's instruction manuals reference above. YSI multiprobes will be calibrated before and after sampling, following protocols outlined in the SWQM Procedures volume 1. Calibration reagents are stored at TCWP offices. The reagents are catalogued as they are received and used.

Calibration procedures for laboratory equipment will be included in the SOPs attached to this QAPP after contract finalization.

B5.3 Inspection / Acceptance of Supplies and Consumables

The laboratory QA officer and laboratory technical director oversee all required checks of supplies and chemicals and assure all records are complete. These include all routine and non-routine maintenance acivities and reference material verifications.

Field sampling equipment is tested by extension staff prior to use, any changes or calibrations are noted in the field notebook and field data reporting sheets. All sample bottles are provided by Eastex and undergo inspection before they are delivered to the Extension office. Probe calibration solutions are maintained per manufacturer suggestions.

B6. DATA MANAGEMENT

Field staff will visit sites following qualifying rainfall events to collect samples and download flow data. On each visit notes will be made on the field data recording sheets and the field notebook. If no samples are collected or there is a problem with the collection of samples the visit will be recorded into the field notebook. If visits are made to calibrate, maintenance, or otherwise check the equipment these site visits will also be recorded in the field notebook.

Samples collected on-site will be labelled for transportation to the laboratory. Site name, time of collection, comments and other data will be copied from field notebook to COC. The COC and sample bottles will be submitted to laboratory analyst with relinquishing and receiving signatures on COC filled out by the field researcher.

All field data will be manually entered into an electronic spreadsheet. The spreadsheet will be created using Microsoft Excel software. The spreadsheet will be stored on the PM computer as well as Syncplicity and shared with the QAO. All files will be backed up monthly to an external hard drive. The QAO will check 10 percent of all the manually recorded spreadsheet entries to the field records to ensure there were no transcription errors. The tables, charts and graphs created from the data analysis will be uploaded to the dedicated webpage monthly.

All paper records and electronic files will be stored for at least five years by the Extension office.

C. Assessments and Oversight

C1. Assessments and Response Actions

The following table identifies the types of assessments and response actions for project activities applicable to this QAPP.

Table C1.1 Assessments and Response Requirements

Assessment Activity	Schedule	Responsible Party	Scope	Response Requirement
Status Monitoring	Continuous	Extension PM	Monitor project status and records to ensure requirements are being fulfilled.	Quarterly reports to CMP PM
Monitoring Systems Audit	Dates to be determined by CMP PM/ Extension QAO	CMP PM Extension QAO	To ensure field sampling, handling, and measurements are happening in accordance with the QAPP. Review data management as it relates to this project.	Complete CAP And / or Response to CMP PM in a timely manner

Deficiencies are any deviations from the QAPP or equipment manual protocols. Deficiencies may invalidate resulting data and may require corrective action. Corrective action may include samples being discarded and recollected. Deficiencies are documented in the field logbook, field data sheets, etc. by field or laboratory staff. It is the responsibility of the Extension PM, in consultation with the Extension QAO, to ensure that the corrective actions and resolutions to the problems are documented and records are maintained in accordance with the QAPP. In addition, these actions and resolutions are reported to the CMP PM in writing in email, quarterly progress reports and by completion of CAP.

C2. Reports to Management

All the reports in this section are contract deliverables for the AgriLife Extension and are transferred to the CMP PM in accordance with contract requirements.

The QAPP, associated appendices and amendments detail the sample handling and data reporting for this project.

Quarterly Progress Reports summarize activities for each task; reports moitoring status, problems, delays, corrective actions; and outlines the status of each deliverable task.

Final Project Report summarizes the activities for the entire project period including a description and documentation of major project activities, evaluation of project results and environmental benefits and a conclusion drawn from the research.

D. Data Validation and Usability

D1. Data Review, Verification, and Validation

For the purpose of this document, data verification is a systematic process for evaluating performance and compliance of a set of data to ascertain its completeness, correctness, and consistency using the methods and criteria defined in the QAPP. Validation means the processes taken independently of data generation processes to evaluate the technical usability of verified data with respect to the objectives or intention of the project.

All data obtained from the field and laboratory measurements will be reviewed and verified for conformance to project requirements, and the validated against the data quality criteria in section A4 of this QAPP. Data which are supported by these verification and validation controls will be considered acceptable and reported on the webpage.

D2. Verification and Validation Methods

All data will be verified by Extension PM to ensure they are representative of the samples analyzed and the locations where the measurements were made and that the data and quality control measures were made accurately in accordance with the project specifications.

The staff and management of the respective field, laboratory, and analysis and data management tasks are responsible for the integrity, verification, and validation of the data each task generates or handles throughout each process of the project.

The data to be verified (listed in Table D2.1) are evaluated for against performance specifications (section B4) and are checked for errors in transcription, calculations, and data input. If an error is found the person who entered the data will be notified to address the issue. Issues that can be corrected are corrected and documented electronically or by initialing and dating the appropriate paperwork. If the error cannot be corrected the data associated with the error will be rejected and not reported.

Table D2.1 Data Verification Procedures

Data to be Verified	Field Task	Laboratory Task	Extension Data Management Task
Sample documentation complete, sample labeled, site id	Y	Y	
Field samples collected	Y		
Standards and reagents	Y	Y	

traceable			
Sample preservation and handling acceptable	Y	Y	
COC Complete	Y	Y	
Hold times not exceeded	Y	Y	
Collection, Preparation, Analysis consistent with SOPs and QAPP	Y	Y	Y
Field Documentation	Y		
Instrument calibration	Y	Y	
QC samples analyzed at required frequency	Y	Y	Y
QC results meet performance specifications	Y	Y	Y
Analytical Sensitivity consistent with QAPP		Y	Y
Results , calculations, transcriptions checked	Y	Y	Y
Laboratory samples analyzed for all parameters		Y	
Nonconforming activities documented	Y	Y	Y
Outliers confirmed and documented; reasonableness			Y

checked			
Results reported in standard measures and formats			Y
Sampling and data gaps documented and checked	Y	Y	Y
10 % data manually reviewed			Y
Data, Analysis, Results reported on webpage quarterly			Y

D3. Reconciliation with User Requirements

Data collected from this project will be analyzed and reported on the dedicated webpage located on the TCWP website and in a final white paper to the CMP to show the performance of stormwater wetlands as a BMP. The purpose is to show the reduction in NPS loadings of water that has passed through the stormwater wetland. The paper will discuss the limitations of the data collected. The results will be used by local officials as they review ordinances and design standards for future stormwater retention in their communities. Data will also be used in AgriLife Extension outreach programs to provide unbiased, science-based, quality assured data on the effectiveness of stormwater wetlands for reducing NPs loadings on the Texas Gulf Coast.

Appendix A: Contract Scope of Work

Contract: 19-043-000-B077
Project Name: Initiating Water Quality Sampling of Stormwater Treatment Wetlands in Galveston Bay Watershed
Subrecipient: Texas A&M AgriLife Extension Service

Project Description:
Texas A&M AgriLife Extension Service (AgriLife) and their project partners are designing and implementing stormwater wetland demonstration projects in various basin types and watersheds. In contrast to the standard detention basin, basins that incorporate stormwater wetlands can provide a multiplicity of ecological benefits to water quality, habitat, and recreation. Currently, water quality data to assess the effectiveness of stormwater treatment wetlands is limited in the lower Galveston Bay watershed. As more wetlands are implemented as green infrastructure Best Management Practices, more robust water quality data is needed to verify the effectiveness of the technique and guide modifications in the design of subsequent wetland prototypes.

Using CMP Cycle 23 funds, AgriLife proposes to develop a Quality Assurance Project Plan (QAPP) covering water quality monitoring protocol and sample three stormwater wetland sites designed and planted by Texas A&M in the Galveston Bay Area. Sampling will occur at three locations: Exploration Green Conservation and Recreation Area, Phase 1, MD Anderson Site 2 Parking Lot Expansion on the corner of Fannin and Old Spanish Trail and the University of Texas Research Park stormwater wetland on the UT MD Anderson Cancer Center's South Campus in the Texas Medical Center. Sites will be sampled during qualifying rain events. An expected average of 2 events per month. The plan is to collect samples on 8 events per site which will provide data on 72 samples over the sampling period (11 months).will give data on 39 events over the sampling period (15 months). AgriLife will prepare the results for dissemination in a white paper, presentations, and on AgriLife system websites.

Project Budget:

	CMP	Subrecipient	Third Party	Project Totals
Salaries	$43,838.00	$14,321.00	$0.00	$58,159.00
Fringe	$14,752.00	$4,818.00	$0.00	$19,570.00
Travel	$780.00	$0.00	$0.00	$780.00
Supplies	$650.00	$0.00	$0.00	$650.00
Equipment	$10,000.00	$0.00	$0.00	$10,000.00
Contractual	$0.00	$0.00	$0.00	$0.00
Other	$8,506.00	$0.00	$8,667.00	$17,173.00
Subtotal:	$78,526.00	$19,139.00	$8,667.00	$106,332.00

Indirect	$0.00	$24,546.00	$0.00	$24,546.00
Total:	$78,526.00	$43,685.00	$8,667.00	$130,878.00

Special Award Conditions:

1. This project must be completed as described in this work plan.
2. The GLO and/or NOAA must approve any changes in the scope of work or budget requests that change the total project cost.
3. CMP and NOAA logos, including appropriate acknowledgment statement, must be printed on education/outreach materials, signs, final reports and/or publications.
4. Data must be shared in the appropriate manner as specified in the contract.
5. The subrecipient must coordinate with the GLO prior to issuing press releases, conducting media events, or otherwise engaging in media related communications for this project.

Task 1: Develop Project Methodology/Quality Assurance

A QAPP will be written to provide a detailed project methodology, including data collection in accordance with a NELAP certified lab. A NELAP lab will be contracted for analysis of the samples and will assist with the development of the protocol. Based on the protocol, automated sampling equipment (e.g. ISCO 6712) and accessories will be selected and purchased.

Task 1 Deliverables:

1. Quality Assurance Project Plan (QAPP)
   Due Date: 3/20/2019
2. Selection and purchase of automated monitoring equipment and accessories, set-up and trial testing
   Due Date: 8/20/2019
3. National Environmental Laboratory Accreditation Program (NELAP) lab selected and contracted
   Due Date: 3/20/2019

Task 2: Water Quality Sampling

The standard parameters for water quality will be tested: total suspended solids, conductivity, dissolved oxygen, nitrate and nitrite, total phosphorous, ammonia and E. coli. Additional compounds of interest at the MD Anderson site are heavy metals and total petroleum hydrocarbons, because the watershed of the basin is almost entirely composed of the adjacent parking lot. Both composite and grab samples will be taken following each qualifying rain event. A portable automated sampler (e.g. ISCO 6712) will be placed at both the inflow and outflow of the wetland basin. The set of samplers will be at each of the three stormwater wetland sites for 5 months, allowing for sampling in both cool and warm seasons.

Task 2 Deliverables:

1. Map showing sample site locations

Due Date: 2/15/2019
2. Quarterly data reports to GLO and posted to Texas Community Watershed Partners (TCWP) website's dedicated project page
   Due Date: 07/31/2020
3. Photographs of samplers and signs in place at each of the three sites
   Due Date: 04/30/2020

Task 3: Data Sharing and Outreach

To share the results of this project, AgriLife will create a dedicated project webpage at the TCWP website (tcwp.tamu.edu). This page will be updated over the course of the project. As results accumulate from the lab analyses, they will be summarized graphically to distribute them via presentations, a white paper, and the internet. Data will be shared with local entities, such as the Harris County Flood Control District.

Professors at Texas A&M University - Galveston (TAMU-G) will incorporate the Exploration Green sites into the curriculum of their chemistry and microbiology lab coursework. Students will visit the monitoring sites and discuss the equipment, methods and objectives of this project.
Movable signage to inform the public will be designed and produced to place at the stormwater wetland sites during monitoring. The signage will briefly describe the study, participants, and provide a link and a Quick Response Code (QRC) to the project website. AgriLife will submit the signage design to GLO for approval.

Task 3 Deliverables:

1. Notification of dedicated webpages established for the project
   Due Date: 2/1/2019
2. Draft signage design
   Due Date: 2/1/2019
3. Final signage design
   Due Date: 2/15/2019
4. Photos of TAMUG student site visits
   Due Date: 07/31/2020
5. Copies of the presentations and white paper summarizing and graphically representing data
   Due Date: 07/31/2020

Task 4 Description: Project Monitoring & Reporting

AgriLife will prepare and submit all reports, deliverables, and requests for reimbursement as required in the contract, to CMPReceipts@GLO.TEXAS.GOV. Quarterly progress reports are due to CMPReceipts@GLO.TEXAS.GOV on the 10th day of every month starting with January 10, 2019. Requests for reimbursement are to be submitted in a timely manner to CMPReceipts@GLO.TEXAS.GOV, as specified in the contract.

The final report will summarize work completed under each project task and include photos of outreach efforts.

Task 4 Deliverables:

1. Quarterly progress reports and requests for reimbursement
   Due Date: As specified in contract
2. Draft final report
   Due Date: 8/15/2020
3. Final report
   Due Date: 8/31/2020
4. Project closeout form
   Due Date: 8/31/2020

Appendix B: Field Data Recording Sheet

Field Data Recording Sheet

Date: _____ Collected By: _____

Location: _____ Event #: _____

Site ID:		Rainfall Amount		Air Temp.		Water Temp.		DO		Specific Conductance		pH		24 Hr.	48 Hr.		Bottle Collected #:

Field Observations:

Appendix C: Chain of Custody

EASTEX ENVIRONMENTAL LABORATORY, INC.

P. O. Box 1089 * Coldspring, TX 77331 (800) 525-0508 * FAX (936) 653-3172

P. O. Box 631375 * Nacogdoches, TX 75963-1375 (936) 569-8879 * FAX (936) 569-8951

www.eastexlab.com

REPORT TO:

(1) Company
Address
Attn.
Phone #
Fax #

INVOICE TO:

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

(8) ANALYSIS REQUESTE

Sampler's Name (please print)

Sampler's Signature

Project Number

(3) Project Name

(7) Containers

Remarks:

Order ID	(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 Received Iced: Yes / No

Relinquished By: (Signature) Received By: (Signature) Date Time Received Iced: Yes / No

Relinquished By: (Signature) Received and/or Checked In By: (Signature) Date Time Received Iced: Yes / No

LAB USE ONLY Sample Condition Acceptable Yes / No | Temp °C: | * Therm ID | Logged In By: (Signature) Date Time

Alternate Check In (Signature) Date Time

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

SEE BACK FOR INSTRUCTIONS

Chain of Custody Revision 2: 03/24/17

*Thermometer has 0.0 factor and recorded temperature is actual temperature.

Eastex Environmental Laboratory, Inc.

INSTRUCTIONS

Please be complete and accurate when filling out the Chain-of-Custody sheet, as all information will be printed on the final lab report.

1 REPORT TO:	Name of company, address, #'s, and where you want the report sent.
2 INVOICE TO:	Name of company, address, #'s, and where you want the report sent.
3 PROJECT NAME:	What you will call this sample.
4 SAMPLE ID:	How you will refer to this sample.
5 SAMPLE TYPE:	C3=3pt Comp. C6=6pt Comp. C12=12hr Comp. C24=24hr Comp. G=Grab
6 MATRIX:	DW=Drinking Water WW=Wastewater SO=Soil/Sludge OL=Oils FL=Filter LE=Leachate SD=Solid RE=Resin OT=Other
7 CONTAINER(S)	
SIZE:	1=Gallon 2=1/2 Gallon 3=Quart/Liter 4=Pint 5=1/2 pt (250 ml) 6=125 ml/4 oz. 7=60 mls/2 oz 8-Vial 9=Other
TYPE:	P=Plastic G=Glass T=Teflon S=Sterile
PRESERVATIVE:	C=Chilled S=Sulfuric Acid N=Nitric Acid B=Base/Caustic Z=Zn Acetate H=Hydrochloric Acid ST=Sodium Thiosulfate O=Other
8 ANALYSIS REQUESTED	Please be as specific as possible when listing which samples get what results.

Appendix D: Eastex Lab Bid and Requirement Specifications

Eastex Environmental Laboratory PO Box 1089 Coldspring, Texas 77331

Christina Taylor
Extension Program Specialist
Stormwater Wetlands Program
Texas Community Watershed Partners
Texas A&M AgriLife Extension Service

March 6, 2018

Response for Bid – Texas Community Watershed Partners Stormwater Quality Project
Grant Award Number NA18NOS4190153

Thank you for the opportunity to bid on your analyses.

Eastex Environmental Laboratory is very familiar with the analysis requirements for this task. We are an approved Clean River Program Laboratory and have been meeting the bacteriological holding times for these projects in the Houston/Galveston area. We have 3-4 Field Technicians in the Houston/Galveston area daily and coordinate sample pick-up for similar tasks regularly.

We are TNI accredited, HUB Certified laboratory and have been servicing the Houston/Galveston area for the past 32 years meeting our clients analytical needs. Eastex Environmental performs all items in the tasks at our facilities under our scope of accreditation. All analytical procedures will be conducted according to NELAP procedures, EPA Standards, AWWA and TCEQ guidelines. The procedures include the following, as a minimum requirement: comparisons against known standards in each run; one in ten sample duplicates and a monthly review against known spiked samples. Detection Limits will be our normal reporting limits unless otherwise specified by project requirements. The price includes sample bottles, pick-up, coolers as needed and delivery of data.

Enclosed you will find the following:

Section 1 – Bid Documents

Bid Specification with Scope of Services,

Section 2 - HUB Certificate,

Once again, thank you for this opportunity. If you need any additional information or any further assistance, please feel free to call me at 936-653-3249 or 1-800-525-0508. You may also visit our website at www.eastexlabs.com .

Respectfully,

Kathleen Harrott

Kathleen Harrott, Technical Director, Eastex Environmental Laboratory, Inc.

Appendix E: Eastex Laboratory NELAP Accreditations

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

August 08, 2018

9489 0090 0027 6008 6739 69

CERTIFIED MAIL

Ms. Tiffany Guerrero
Eastex Environmental Laboratory, Inc. - Coldspring
P. O. Box 2089
Coldspring, TX 77331-1089

Re: Amendment application

Dear Ms. Guerrero:

Based on the amendment request submitted on April 05, 2018, I am enclosing an updated NELAP accreditation certificate and Fields of Accreditation listing. They replace the previous ones issued on November 01, 2017.

Please review the enclosures for accuracy and completeness. Your laboratory's accreditation is valid until the expiration date on the certificate and scope, contingent on continued compliance with the standards for accreditation and requirements of the state of Texas.

Please let me know if I can provide any additional information regarding this matter. You may also contact me at (512) 239-1990 or *ken.lancaster@tceq.texas.gov*.

Sincerely,

Ken Lancaster
Manager, Laboratory & Quality Assurance Section

Enclosures

Appendix F: Eastex Laboratory SOP
(Attached upon receipt)