

Gilleland Creek Total Maximum Daily Load (TMDL)
Stormwater Retrofit Implementation
Quality Assurance Project Plan

University of Texas
Austin, TX 78712

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Nonpoint Source Program CWA §319(h)
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and the U.S. Environmental Protection Agency
Federal ID #99614616

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

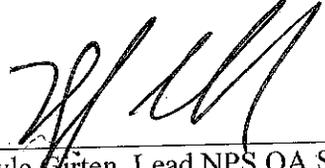
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A1 APPROVAL PAGE

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

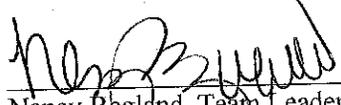
Monitoring Division

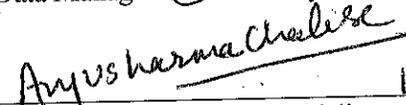
 12 Oct 2012
J. Steven Gibson, TCEQ QA Manager Date
Not by

 10/12/12
Kyle Girtten, Lead NPS QA Specialist Date
Quality Assurance Team

Water Quality Planning Division

 10/9/12
Kerry Niemann, Team Leader Date
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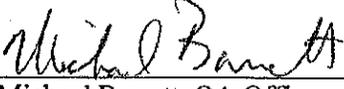
 10/9/12
Nancy Ragland, Team Leader Date
Data Management and Analysis

 10/9/2012
Anju Chalise, NPS QA Specialist Date
Nonpoint Source Program

 10/8/12
Bill Carter, TCEQ NPS Project Manager Date
Project Manager, Nonpoint Source Program

University of Texas at Austin


Michael Barrett, Univ. of Texas 10/3/12
Date


Michael Barrett, QA Officer 10/3/12
Date

Lower Colorado River Environmental Laboratory Services


Alicia C. Gill, Laboratory Manager 10/3/2012
Date


Hollis Pantalion, Laboratory QA Officer 10/3/12
Date

The University of Texas at Austin will secure written documentation from additional project participants (e.g., subcontractors, laboratories) stating the organization's awareness of and commitment to requirements contained in this quality assurance project plan and any amendments or revisions of this plan. The University of Texas at Austin will maintain this documentation as part of the project's quality assurance records. This documentation will be available for review. Copies of this documentation will also be submitted as deliverables to the TCEQ NPS Project Manager within 30 days of final TCEQ approval of the QAPP. (See sample letter in Attachment 1 of this document.)

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A3 DISTRIBUTION LIST

The Lead NPS QA Specialist will provide original versions of this project plan and any amendments or revisions of this plan to the TCEQ NPS Project Manager and the University of Texas Project Manager. The TCEQ NPS Project Manager will provide copies to the TCEQ Data Management and Analysis Team Leader and EPA Project Officer within two weeks of approval. The TCEQ NPS Project Manager will document receipt of the plan and maintain this documentation as part of the project's quality assurance records. This documentation will be available for review.

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Leslie Rauscher, Project Officer
(214) 665-2773

The University of Texas will provide copies of this project plan and any amendments or revisions of this plan to each project participant defined in the list below. The University of Texas will document receipt of the plan by each participant and maintain this documentation as part of the project's quality assurance records. This documentation will be available for review.

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Alicia C. Gill, Laboratory Manager
(512) 473-3200

Hollis Pantalion, Laboratory Quality Assurance Officer
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List of Acronyms

AWRL	Ambient Water Reporting Limit
BMP	Best Management Practice
CAP	Corrective Action Plan
COC	Chain of Custody
CRWR	Center for Research in Water Resources
CWA	Clean Water Act
DOC	Demonstration of Capability
DMP	Data Management Plan
DMRG	Data Management Reference Guide
DM&A	Data Management and Analysis
DQO	Data Quality Objective
EMC	Event Mean Concentration
EPA	Environmental Protection Agency
GIS	Geographic Information System
GPS	Global Positioning System
IT	Information Technology
LCRA	Lower Colorado River Authority
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LOD	Limit of Detection
LOQ	Limit of Quantitation
NELAC	National Environmental Laboratory Accreditation Conference
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
PO	Project Officer
QA/QC	Quality Assurance/Quality Control
QAM	Quality Assurance Manual
QAO	Quality Assurance Officer

QAPP	Quality Assurance Project Plan
QAS	Quality Assurance Specialist
QMP	Quality Management Plan
RPD	Relative Percent Difference
SLOC	Station Location
SOP	Standard Operating Procedure
SWQM	Surface Water Quality Monitoring
SWQMIS	Surface Water Quality Monitoring Information System
TCEQ	Texas Commission on Environmental Quality
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
TSWQS	Texas Surface Water Quality Standards
TxDOT	Texas Department of Transportation
UT	University of Texas
UV	Ultraviolet
WQI	Water Quality Inventory

A4 PROJECT/TASK ORGANIZATION

TCEQ

Monitoring Division

Kyle Girten

Lead NPS QA Specialist

Assists the TCEQ Project Manager in QA related issues. Serves on planning team for NPS projects. Participates in the planning, development, approval, implementation, and maintenance of the QAPP. Determines conformance with program quality system requirements. Coordinates or performs audits, as deemed necessary and using a wide variety of assessment guidelines and tools. Concurs with proposed corrective actions and verifications. Monitors corrective action. Provides technical expertise and/or consultation on quality services. Provides a point of contact at the TCEQ to resolve QA issues. Recommends to TCEQ management that work be stopped in order to safe guard project and programmatic objectives, worker safety, public health, or environmental protection.

Water Quality Planning Division

Kerry Niemann, Team Leader

NPS Program

Responsible for management and oversight of the TCEQ NPS Program. Oversees the development of QA guidance for the NPS program to be sure it is within pertinent frameworks of the TCEQ. Monitors the effectiveness of the program quality system. Reviews and approves all NPS projects, internal QA audits, corrective actions, reports, work plans, and contracts. Enforces corrective action, as required. Ensures NPS personnel are fully trained and adequately staffed.

Bill Carter

TCEQ NPS Project Manager

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

Anju Chalise

NPS Quality Assurance Specialist

Assists Lead QAS with NPS QA management. Serves as liaison between NPS management and Agency QA management. Responsible for NPS guidance development related to program quality assurance. Serves on planning team for NPS projects. Participates in the development, approval, implementation, and maintenance of the QAPP.

Rebecca Ross

NPS Data Manager

Responsible for coordination and tracking of NPS data sets from initial submittal through NPS Project Manager review and approval. Ensures that data is reported following instructions in the Surface Water Quality Monitoring Data Management Reference Guide (January 2012, or most current version). Runs automated data validation checks in SWQMIS and coordinates data verification and error correction with NPS Project Managers' data review. Generates SWQMIS summary reports to assist NPS Project Managers' data reviews. Provides training and guidance to NPS and Planning Agencies on technical data issues. Reviews QAPPs for valid stream monitoring stations. Checks validity of parameter codes, submitting entity code(s), collecting entity code(s), and monitoring type code(s). Develops and maintains data management-related standard operating procedures for NPS data management. Serves on planning team for NPS projects.

University of Texas

Michael Barrett

University of Texas Project Manager

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

Michael Barrett

University of Texas QAO

Responsible for coordinating development and implementation of the QA program. Responsible for writing and maintaining the QAPP. Responsible for maintaining records of QAPP distribution, including appendices and amendments. Responsible for maintaining written records of sub-tier commitment to requirements specified in this QAPP. Responsible for identifying, receiving, and maintaining project quality assurance records. Responsible for coordinating with the TCEQ QAS to resolve QA-related issues. Notifies the contractor Project Manager and TCEQ Project Manager of particular circumstances which may adversely affect the quality of
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data. Responsible for validation and verification of all data collected according with Table 4 procedures and acquired data procedures after each task is performed. Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques. Conducts laboratory inspections. Develops, facilitates, and conducts monitoring systems audits.

Alicia C. Gill

Laboratory Manager

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

Hollis Pantalion

Laboratory QAO

Monitors the implementation of the QAM and the QAPP within the laboratory to ensure complete compliance with QA objectives as defined by the contract and in the QAPP. Conducts internal audits to identify potential problems and ensure compliance with written SOPs. Responsible for supervising and verifying all aspects of the QA/QC in the laboratory. Insures that all QA reviews are conducted in a timely manner from real-time review at the bench during analysis to final pass-off of data to the QA officer.

Michael Barrett

University of Texas Data Manager

Responsible for the acquisition, verification, and transfer of data to the TCEQ. Oversees data management for the study. Performs data quality assurances prior to transfer of data to TCEQ. Responsible for transferring data to the TCEQ in the Event/Result file format specified in the DMRG. Ensures data are submitted according to workplan specifications. Provides the point of contact for the TCEQ Data Manager to resolve issues related to the data.

Michael Barrett

University of Texas Field Supervisor

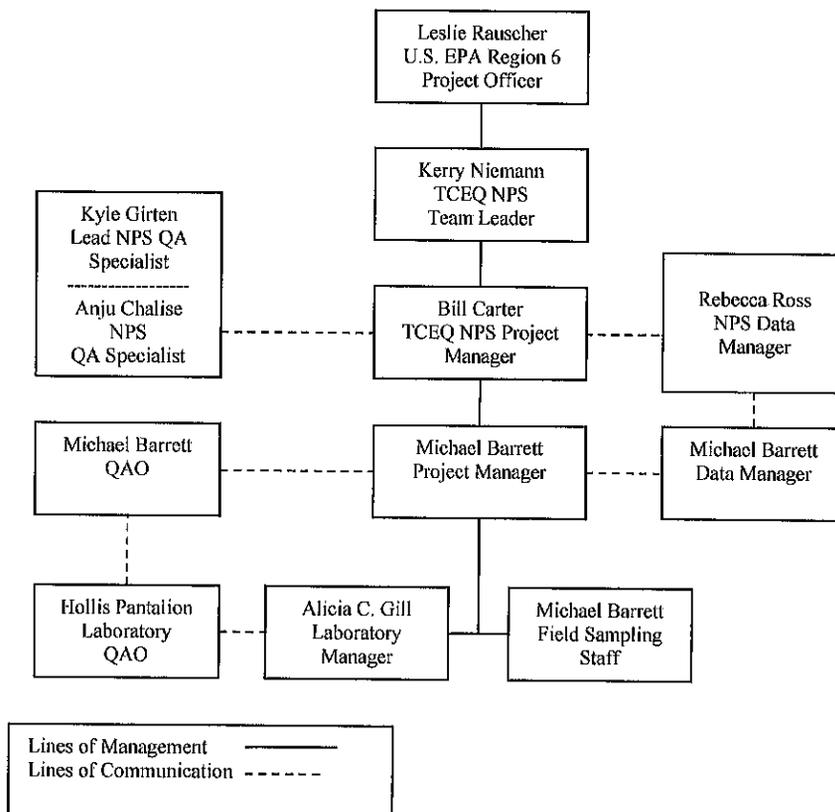
Responsible for supervising all aspects of the sampling and measurement of surface waters and other parameters in the field. Responsible for the acquisition of water samples and field data measurements in a timely manner that meet the quality objectives specified in Section A7 (Table A.1), as well as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

U.S. EPA Region 6

**Leslie Rauscher
 EPA Project Officer**

Responsible for managing the CWA Section 319 funded grant on the behalf on EPA. Assists the TCEQ in approving projects that are consistent with the management goals designated under the State's NPS management plan and meet federal guidance. Coordinates the review of project workplans, draft deliverables, and works with the State in making these items approvable. Meets with the State at least semi-annually to evaluate the progress of each project and when conditions permit, participate in a site visit on the project. Fosters communication within EPA by updating management and others, both verbally and in writing, on the progress of the State's program and on other issues as they arise. Assists the regional NPS coordinator in tracking a State's annual progress in its management of the NPS program. Assists in grant close-out procedures ensuring all deliverables have been satisfied prior to closing a grant.

Figure A4.1. Organization Chart – Lines of Communication



A5 PROBLEM DEFINITION/BACKGROUND

High levels of bacteria in excess of acceptable standards for contact recreational designated use have been documented for Gilleland Creek in northeast Travis County resulting in its inclusion in TCEQ's draft 2004 Federal Clean Water Act 303(d) List. In June 2005, Lower Colorado River Authority (LCRA) prepared a study titled, "Assessment of Water Quality Impairment of Gilleland Creek" for the TCEQ to determine the source of bacterial contamination in Gilleland Creek and to perform additional monitoring. This report reviewed historic water quality data and reaffirmed the 303(d) Listing of Gilleland Creek for high bacteria. LCRA stream monitoring also showed increased bacteria levels after rainfall runoff events in Gilleland Creek.

Project staff compared the graph slopes of load duration curves representing *E. coli* conditions in dry and wet weather to determine whether bacteria concentrations vary in response to runoff events. If the source of bacteria was point source, one would expect to see different slopes for the dry and wet weather events as a result of dilution. However, at all but one site, the slopes of wet and dry weather data were not significantly different, further supporting the case that the bacteria loading to Gilleland Creek is of a nonpoint source origin. Probable nonpoint sources of pollution in the Gilleland Creek watershed include malfunctioning septic tanks, storm sewers, agriculture practices, pet and wildlife waste, and other natural sources. No monitoring or analysis has been conducted to determine the relative magnitude of these nonpoint sources; however, much of the upper part of the watershed in Pflugerville where bacteria standards have been routinely exceeded consist of urban areas, similar to those being monitored as part of this effort.

These urban areas lack stormwater quality controls, but do include numerous flood control basins. The objective of this effort is to retrofit one of these facilities to determine whether it is possible to substantially increase bacteria removal by retaining stormwater in the facilities for a significant length of time beyond the end of the storm event to increase die-off of bacteria and to provide additional removal of suspended solids and nutrients. Monitoring of this modified flood control system will provide the data needed to determine whether this strategy, which is part of the Implementation Plan for the watershed TMDL, will reduce pollutant loadings to Gilleland Creek.

Many urban areas in the US have stormwater systems that are similar to the Pflugerville portion of the Gilleland Creek watershed. There are essentially no facilities built specifically to address water quality concerns; however, flood control basins are widespread. Retrofitting the drainage system to incorporate standalone water quality facilities would be prohibitively expensive because of the lack of available space in the built environment and because of hydraulic constraints associated with the existing system. The objective of this project is to determine the degree that modified flood control facilities will reduce the input of bacteria and other pollutants discharged from urban areas. The modification of flood control facilities is not required by Pflugerville's MS4 permit, nor is it a measure in their Stormwater Management Program.

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If successful, the modification of flood control basins in many other parts of Texas and the rest of the US offers a cost effective way to address TMDLs in urban areas. For instance, Harris County is the location of numerous segments listed for bacteria impairment. That area also lacks an installed base of water quality facilities, but flood control basins are widespread. Consequently, successful implementation in the Gilleland Creek watershed could provide a template for addressing bacteria and other impairments in this and other locations.

This QAPP is reviewed by the TCEQ to help ensure that data generated for the purposes described above are scientifically valid and legally defensible. This process will ensure that all data submitted to SWQMIS have been collected and analyzed in a way that guarantees their reliability and therefore can be used in programs deemed appropriate by the TCEQ.

A6 PROJECT/TASK DESCRIPTION

The key element to address stormwater loadings of bacteria to Gilleland Creek is an assessment of the potential of retrofitting existing flood control facilities (stormwater detention basins) to perform as water quality facilities to reduce bacteria concentrations. This is potentially a very productive approach, because flood control facilities are widespread in this watershed.

The Gilleland Creek Water Quality Treatment BMP Implementation Project listed as Management Measure 3.0 is a pilot program to determine whether substantial pollutant reduction is possible in a retrofitted flood control facility. Project goals are to achieve 50% reduction in *E. coli* levels and 50% reduction in total phosphorus, and total suspended solids in the BMP outflow. The City of Austin Small Watershed Report indicates that residential areas are significant sources of indicator organisms in wet weather discharges from residential communities. Consequently, reduction in concentration and loads from these areas would be expected to substantially improve receiving water quality.

One of the concerns about the quality of Gilleland Creek is that it is an effluent dominated stream with high levels of nutrients that could result in eutrophication. Consequently, this project will also analyze for a more complete suite of nutrient forms including dissolved phosphorus, TKN, and nitrate+nitrite to determine the effect of basin retrofit on these additional constituents.

The study design includes the monitoring of two flood control basins in the Gilleland Creek watershed. One of the basins will be retrofit with an automated valve, which will allow all of the runoff from the contributing watershed to remain in the basin for any arbitrary length of time. The valve will automatically open after a period of time (initially 24 hours) and allow the runoff to discharge to the Creek. The second basin will act as a control site and have water quality monitoring equipment installed to evaluate the bacteria concentrations from a standard flood control basin. Automatic samplers will be installed to collect influent and effluent water quality samples from both basins.

Reduction in bacteria concentrations are expected as a result of sedimentation and exposure to sunlight. Recent experiments conducted in the graduate program at the University of Texas using water and sediment collected from Gilleland Creek, indicates that a substantial amount of bacteria is associated with sediment. The geometric mean initial concentration of *E. coli* of samples that contained streambed sediments in addition to the stream water was three times greater than that in the plain stream water. Additionally, the maximum initial concentration of *E. coli* in the samples with sediment was almost five times greater than the maximum concentration observed in the samples containing just stream water. These results indicate that the resuspension of sediments can cause inland streams to exceed surface water quality standards. Consequently, we expect that improved sedimentation in the flood control facilities will result in a substantial reduction in bacteria concentrations.

This project is similar in many ways to a previous study conducted by the University of Texas for the Texas Department of Transportation (TxDOT). In that study, a sedimentation basin in northwest Austin was retrofit with an automated outlet, similar to that proposed in this project. The previous study documented a 91% reduction in Total Suspended Solids (TSS) and a 52% reduction in total phosphorus. Bacteria reduction was not measured; however, there are a variety of reasons to expect a substantial improvement. First of all, bacteria are typically attached to solids, so removal of solids (particularly the smaller fraction) will reduce bacteria concentrations. In addition, there was a substantial amount of research in the 1950's on die-off of bacteria in wastewater ponds. Much of this reduction is associated with exposure to the Ultraviolet (UV) radiation in sunlight, which will also be an effective mechanism in the retrofit flood control basins.

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

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

Revisions to the QAPP

Until the work described is completed, this QAPP shall be reissued annually on the anniversary date, or revised and reissued prior to any significant changes being made in activities, whichever comes first. Reissuances and annual updates must be submitted to the TCEQ for approval at least 90 days before the last approved version has expired. If the QAPP expires, the QAPP is no longer in effect and the work covered by the QAPP must be halted. If the entire QAPP is current, valid, and accurately reflects the project goals and the organization's policy, the annual re-issuance may be done by a certification that the plan is current. This can be accomplished by submitting a cover letter stating the status of the QAPP and a copy of new, signed approval pages for the QAPP. If the QAPP needs to be updated to incorporate amendments made earlier in the year or to incorporate new changes, a full annual update is required. This is accomplished by submitting a cover letter, a document detailing changes made, and a full copy of the updated QAPP (including signature pages).

Amendments

Amendments to the QAPP may be necessary to reflect changes in project organization, tasks, schedules, objectives, and methods; address deficiencies and nonconformances; improve operational efficiency; and/or accommodate unique or unanticipated circumstances. Requests for amendments are directed from the contractor Project Manager to the TCEQ Project Manager in writing using the QAPP Amendment shell. The changes are effective immediately upon approval by the TCEQ NPS Project Manager and Quality Assurance Specialist, or their designees, and the EPA Project Officer (if necessary).

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 Contractor QAO. Amendments shall be reviewed, approved, and incorporated into a revised QAPP during the annual revision process or within 120 days of the initial approval in cases of significant changes.

A7 QUALITY OBJECTIVES AND CRITERIA

An important objective of all monitoring projects is ensuring that the reported data is accurate enough to support the project objectives. Stormwater quality typically has substantial variability within and between storms, with coefficients of variation typically about 1.0, which means that the standard deviation is approximately as large as the average of all measurements. Because of this variability, observing statistically significant differences in quality between monitoring locations requires either a very large number of samples, or that the differences between the sites is substantial – on the order of 50% or more. Most monitoring projects are limited in the number of samples either by the length of the project, the number of storm events, or analytical cost, so the number of samples is usually quite modest. In practice, what this means is that observed changes in constituent concentrations in BMPs will only be statistically significant if the removal is substantial. The positive aspect of having large variability in runoff concentrations is that small errors in measuring constituent concentrations that result from longer than normal holding times or laboratory errors will have little or no impact on the results of the project. Nevertheless, very stringent procedures, described below, will be followed to ensure the most accurate results are obtained.

Only data collected that have a valid parameter code in Table A7.1 will be stored in SWQMIS. Any parameters listed in Table A7.1 that do not have a valid TCEQ parameter code assigned will not be stored in SWQMIS. Quantitative and qualitative information regarding measurement data needed to measure basin efficiency are provided below.

Precision

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

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

Laboratory precision is assessed by comparing replicate analyses of 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 Table A7.1.

Table A7.1 Measurement Performance Specifications for BMP Effectiveness Monitoring

PARAMETER	UNITS	MATRIX	METHOD	PARAMETER CODE	AWRL*	Limit of Quantitation (LOQ)	Recovery at LOQ (%)	PRECISION (RPD of LCS/LCSD)	BIAS %Rec. of LCS	Completeness (%)
Nitrate/Nitrite – N	mg/l	Water	SM4500 NQ3H	00630	.05	0.02	70-130	20	80-120	75
Total Kjeldahl Nitrogen	mg/L	Water	EPA 351.2	00623	0.2	0.2	70-130	20	80-120	75
Total Phosphorus	mg/L	Water	EPA 365.4	00665	.06	0.02	70-130	20	80-120	75
Dissolved P	mg/L	Water	EPA 365.4	00666		0.02	70-130	20	80-120	75
<i>E. coli</i>	MPN/100 mL	Water	SM 9223B**	31699	1	1	NA	0.50*	NA	75
Residue, Total nonfilterable	mg/L	Water	SM 2540 D	00530	4	1	NA	20	80-120	75
rainfall	inches during storm	Water	TCEQ SOP	82553	NA	NA	NA	NA	NA	75
Days Since Precipitation Event (Days)	Days	Water	TCEQ SOP	72053	NA	NA	NA	NA	NA	NA
Influent and Effluent Flow	cfs	Water	ISCO flow meter	NA	NA	NA	NA	NA	NA	NA
Holding Time, E. Coli, IDEXX Colilert	Hours	Water	NA	31704	NA	NA	NA	NA	NA	NA

* This value is not expressed as a relative percent difference. It represents the maximum allowable difference between the logarithm of the result of a sample and the logarithm of the duplicate result. See Section B5.
 References: US EPA Methods for Chemical Analysis of Water and Wastewater, Manual #EPA-600/4-79-020. American Public Health Association, American Water Works Association and Water Environment Federation, *Standard Methods for the Examination of Water and Waste Water*, 20th Ed., Texas Commission on Environmental Quality *Surface Water Quality Monitoring Procedures*, Volume 1, October 2008.

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 Standards prepared with verified and known amounts of all target analytes in the sample matrix (e.g. deionized water, sand, commercially available tissue) 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 bias are specified in Table A7.1.

Representativeness

A variety of storm event sizes will be monitored to ensure representativeness of the data collected. In general only storms exceeding 0.25 inches of precipitation will provide sufficient sample for analysis. The largest event sampled will have approximately 1.0 inches of precipitation. The goal of the project is to collect and analyze 10 events spread approximately evenly through the one year of monitoring. If the basins contain water from a previous event, no sampling will occur.

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 75% 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 TCEQ SOPs. Comparability is also guaranteed by reporting data in standard units, by using accepted rules for rounding figures, and by reporting data in a standard format as specified in Section B10.

Limit of Quantitation

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

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

Analytical Quantitation

To demonstrate the ability to recover at the limit of quantitation, the laboratory will analyze an LOQ check standard for each batch of samples run.

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

A8 SPECIAL TRAINING/CERTIFICATION

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. Any positional data obtained by Nonpoint Source Program grantees 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.

Positional data 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. Contractors must agree to adhere to relevant TCEQ policies when entering GPS-collected data.

In lieu of entering certified GPS Coordinates, positional data may be acquired with a GPS and verified with photo interpolation using a certified source, such as Google Earth or Google Map. The verified coordinates and map interface can then be used to develop a new SLOC. Staff responsible for operating the automated samplers and flow loggers will undergo a one day training event by the equipment manufacturer.

Field personnel will receive training in proper sampling and field analysis. Before actual sampling or field analysis occurs, they will demonstrate to the QA officer (in the field), their ability to properly operate the automatic samplers and retrieve the samples. The QA officer will sign off each field staff in their field logbooks.

Contractors and subcontractors must ensure that laboratories analyzing samples under this QAPP meet the requirements contained in TNI Volume 1 Module 2, Section 4.5.5 (concerning Review of Requests, Tenders and Contracts).

A9 DOCUMENTS AND RECORDS

For each monitored event, the following data will be included in the data report package. The influent and effluent hydrograph will be provided. These figures will also indicate the time at which individual sample aliquots were collected and rainfall amounts. An Excel spreadsheet will be included that summarizes all the chemical analyses for that event.

Laboratory Test Reports

Test/data reports from the laboratory must document the test results clearly and accurately. Routine data reports should be consistent with TNI Volume 1, Module 2, Section 5.10 and include the information necessary for the interpretation and validation of data. The requirements for reporting data and the procedures are provided.

Test reports (regardless of whether they are hard copy or electronic) will include the following:

- Sample results
- Units of measurement
- Sample matrix
- Dry weight or wet weight (as applicable)
- Station information
- Date and time of collection
- Sample depth
- LOQ and LOD (formerly referred to as the reporting limit and the method detection limit, respectively), and qualification of results outside the working range (if applicable)
- Certification of TNI compliance on a result by result basis

Electronic Data

Data will be submitted to the TCEQ in the event/result format specified in the DMRG.

Records and Documents Retention Requirements

Document/Record	Location	Retention	Form
QAPP, amendments, and appendices	Org.	5 years	Paper
QAPP distribution documentation	Org.	5 years	Paper
Training records	Org.	5 years	Paper
Field notebooks or field data sheets	Org.	5 years	Paper
Field equipment calibration/maintenance	Org.	5 years	Paper
Chain of custody records	Org.	5 years	Paper
Field SOPs	Org.	5 years	Paper
Laboratory QA manuals	Lab	5 years	Electronic
Laboratory SOPs	Lab	5 years	Electronic
Laboratory procedures	Lab	5 years	Electronic
Instrument raw data files	Lab	5 years	Electronic
Instrument readings/printouts	Lab	5 years	Electronic
Laboratory data reports/results	Lab	5 years	Electronic
Laboratory equipment maintenance logs	Lab	5 years	Electronic
Laboratory calibration records	Lab	5 years	Electronic
Corrective action documentation	Lab	5 years	Electronic

B1 SAMPLING PROCESS DESIGN (EXPERIMENTAL DESIGN)

The sample design rationale for this study is based on the intent to demonstrate improved removal of phosphorus, nitrogen, sediment, and *E. coli* in the modified flood detention basin as compared to a similar, unmodified facility.

This project is designed to implement the Gilleland Creek Total Maximum Daily Load Implementation Plan (TMDL I-Plan). UT will facilitate a pilot project to determine the effectiveness of retrofitting a flood control facility to hold water (for an initial test period of 24 hours) to reduce bacterial loads from the effluent. Reduction in bacteria concentrations are expected as a result of sedimentation and exposure to sunlight. The objective of this project is to determine the degree that modified flood control facilities will reduce the input of bacteria and other pollutants discharged from urban areas. Project goals are to achieve a 50% reduction in *E. coli* and a 50% reduction in total phosphorus and sediment by retrofitting two existing flood control basins with monitoring equipment; one basin will serve as the control, while the other serves as the test facility.

Sample Collection Methods

There are two principal methods for collection of stormwater samples for quality analysis, grab and composite samples. Grab samples are collected instantaneously and provide a snap shot of

the water quality at an instant in time. Grab samples are widely used in the characterization of receiving water quality under the assumption that a sufficient number of samples collected at random times relative to the underlying hydrologic condition will result in an average value that well represents the condition of the receiving water. Grab samples that are collected on a predetermined schedule have the advantage of being scheduled on a day and time when access to laboratories is facilitated. Unless the sampling location is located in an extremely remote location, transporting the sample to the lab within six hours for bacteriological analysis is quite feasible.

The use of single grab samples for assessing the performance of stormwater treatment facilities has long been discouraged. As reported by the International BMP Database team, "The results from a single grab sample generally are not sufficient to develop reliable estimates of the event mean concentration (EMC) for the pollutant or pollutant load because stormwater quality tends to vary dramatically during a storm event" (Geosyntec and Wright Water Engineers, 2009). Without an estimate of the EMC, determination of the overall performance of the treatment system is not possible.

Another sampling approach is to combine appropriate portions of each grab sample to form a single composite sample for analysis, but this is generally impractical because many storms occur after dark when safety concerns limit access to sampling locations. Moreover, manual monitoring can be more costly than automated monitoring if the monitoring program encompasses more than a few storm events. For these reasons, many monitoring programs have found that the use of automated monitoring equipment and methods are more appropriate for compiling composite stormwater samples than manual monitoring.

If detecting peak concentrations is not essential, composite sampling can be a more cost-effective approach for estimating EMCs and pollutant loads. A composite sample is a mixture of a number of individual sample "aliquots." The aliquots are collected at specific intervals of time or flow during a storm event and combined to form a single sample for laboratory analysis. Thus, the composite sample integrates the effects of many variations in stormwater quality that occur during a storm event (Geosyntec and Wright Water Engineers, 2009). One concern about monitoring for *E. coli* is that the changes in concentration might occur in the sample container over the course of the event; however, this seems to be a constraint that will be difficult to overcome. Our expectation for this project is that the reduction in concentration will be substantial (>50%) and that if all samples are subject to the same conditions, a sufficient performance estimate for a reduction of this magnitude should be possible even with small changes in *E. coli* concentrations over time.

Proposed Sampling Strategy

Samples will be collected from the influent and discharge of the control and test basins located in the Gilleland Creek watershed. The sections below describe how these situations differ and recommend a holding time criterion for bacteriological analysis that is feasible for all of these situations.

Discharge Samples

The objective of the effluent monitoring is to collect samples that represent the EMC of the basin discharge. Discharge samples of treated runoff will be collected using automated sampling equipment as flow weighted composite samples. The samplers will be programmed to take equal volume aliquots (300 mL), which will provide an EMC for the selected constituents. Sample pacing will be determined after observing the runoff volume for the first few events prior to beginning monitoring. At least 8 aliquots of runoff must be collected to ensure representativeness of the sample. This means that the sample pacing will be set as the volume of runoff from a 0.25 inch storm divided by 8. Sample collection will end at either the end of runoff or when 32 individual aliquots (volume of collection container is 9.6L) have been collected.

Ice will be placed in the base holding the sample bottle so that the sample will remain below 6 degrees C throughout the sampling process, which will be confirmed by measuring the temperature at the time the samples are retrieved by the field personnel. The critical issue for sample collection and analysis is the holding time that must be met for the results to be considered valid.

Since the basins are operated differently (the control basin discharge will be based solely on outlet opening size and the test basin will be using an outlet controlled by an automated valve), timing of the sample collection will differ between the basins. In the control basin, discharge of runoff will begin shortly after runoff begins entering the basin. Consequently, these samples will only slightly lag those collected by the influent sampler at the same basin.

Discharge from the test basin will not occur until (initially set for) 24 hours following the initiation of runoff when the automated valve opens. Consequently, another trip to the site will be required to collect the samples at this location. Sample collection will commence with the opening of the automated valve and continue until the basin is substantially drained. Although a six hour holding time is preferred, a six hour holding time from the time the first aliquot is collected is infeasible since draining the basin (and sampling duration) will likely take most of a day.

Consequently, we are proposing that a holding time of 24 hours for bacteriological analysis be adopted and that this be measured from the time the first aliquot is collected. This same holding time will be adopted for all samples collected from all stations during the course of the project. If the time for the basins to drain will exceed 24 hours, then when feasible, field staff will pick up the composite sample bottle in time to meet the 24-hour holding time and replace it with a new, clean one to be collected after the basin empties but within 24 hours. The two samples will together provide the basis for a pollutant load calculation for the entire discharge event.¹

¹ Any bacteria data submitted for upload to SWQMIS which are associated with samples that exceed the 24-hour holding time will contain the holding time qualifier. An acknowledgment and explanation of the degree to which bacteria data are associated with holding times longer than 24 hours will be added to all other uses to be made of the data.

Influent Samples

Influent samples of urban runoff will also be collected using automated sampling equipment as flow weighted composite samples. The samplers will be programmed to take equal volume aliquots (300 mL), which will provide an EMC for the selected constituents. Sample pacing will be determined after observing the runoff volume for the first few events prior to beginning monitoring. At least 8 aliquots of runoff must be collected to ensure representativeness of the sample. This means that the sample pacing will be set as the volume of runoff from a 0.25 inch storm divided by 8. Sample collection will end at either the end of runoff or when 32 individual aliquots (volume of collection container is 9.6L) have been collected. Ice will be placed in the base holding the sample bottle so that the sample will remain below 6 degrees C throughout the sampling process. This will be confirmed by measuring the temperature at the time the samples are retrieved by the field personnel.

During the period of flow meter calibration, a sample will be collected of the influent to each basin and tested for free chlorine using a field test procedure (Hach Model CN-66 or equivalent). The presence of free chlorine in stormwater is highly unusual, but this step is being taken to ensure that the results are not compromised. If chlorine is found to be present, sodium thiosulfate will be added to the sample collection bottles prior to sampled events to reduce changes in E. coli concentration during the holding period. Holding times for E. coli will be the same as for the discharge samples.

References

Geosyntec and Wright Water Engineers, 2009, Urban Stormwater BMP Performance Monitoring, accessed 12/15/11 at URL:
<http://www.bmpdatabase.org/Docs/2009%20Stormwater%20BMP%20Monitoring%20Manual.pdf>

Table B1.1 Monitoring Sites

Site Description	Latitude Longitude	Station ID	Start Date	End Date	Sample Matrix	Monitoring Frequency (per year)	Comments
COPPERHEAD DETENTION BASIN INFLUENT 70 METERS SOUTH AND 5 METERS WEST OF COPPERHEAD DRIVE AND TORTOISE STREET	30.462485 -97.648614	21170	9/1/12	8/31/13	water	10	Sampling tied to rainfall
COPPERHEAD DETENTION BASIN EFFLUENT 30 METERS SOUTH AND 15 METERS EAST OF COPPERHEAD DRIVE AND TORTOISE STREET	30.462783 -97.648357	21171	9/1/12	8/31/13	water	10	Sampling tied to rainfall
PON COURT DETENTION BASIN INFLUENT 70 METERS SOUTH AND 5 METERS WEST OF INTERSECTION OF PON COURT AND JERUSALEM DRIVE	30.463607 -97.651888	21168	9/1/12	8/31/13	water	10	Sampling tied to rainfall
PON COURT DETENTION BASIN EFFLUENT 100 METERS SOUTH AND 27 METERS EAST OF INTERSECTION OF PON COURT AND JERUSALEM DRIVE	30.463440 -97.651436	21169	9/1/12	8/31/13	water	10	Sampling tied to rainfall

B2 SAMPLING METHODS

Field Sampling Procedures

Field monitoring and sample collection for all constituents other than bacteria will be conducted in accordance with the Geosyntec and Wright Water Engineers, 2009, Urban Stormwater BMP Performance Monitoring, and the TCEQ Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue (2012), where applicable. Sampling and analysis for bacteria will be conducted in accordance with the relevant guidance from Teledyne ISCO, which will be determined at the time the equipment is purchased. For this project, every bacteria sample will be a composite sample collected by an auto sampler. The first two documents cited above require bacteria samples to be collected as grab samples and not composites. Both manuals also specify bacteria analyses be completed within 8 hours of the sample being collected. However, Standard Methods, 20th ed., Section 9060B allows a holding time of up to 24 hours for sampling not performed for regulatory compliance. All composited bacteria samples will be delivered to the lab in ice and analyzed within 24 hours of collecting the first 'sip'. These deviations from standard protocol are supported by standard method references referenced in the footnotes of table A7.1. Since this is a research project with no regulatory component, a flow-weighted composite will best represent the storm load.²

A SOP for the automated flow meter and automated sampler data collection is attached as Appendix E of this document. Each sampler will contain one 9.6L container, so samples are composited as the individual aliquots are collected.

Because of the difficulty in getting representative split samples in the field, splitting and preservation of the sample will occur at the Lower Colorado River Authority Environmental Laboratory Services. The sample volumes, container types, minimum sample volume, preservation requirements, and holding time requirements are specified in Table B2.1.

² "Flow-weighted composite samples are more suitable for estimating EMCs and pollutant loads." Geosyntec and Wright Water Engineers, 2009, Urban Stormwater BMP Performance Monitoring Manual, p. 4-20. "Significantly more studies and more representative data (i.e., flow-weighted composites and/or multiple grab samples during an event) are needed for all BMP types to increase the confidence of performance estimates with regard to bacteria." Wright Water Engineers and Geosyntec, International Stormwater BMP Database Pollutant Category Summary: Fecal Indicator Bacteria, December 2010, p. 25.

Table B2.1 BMP Effectiveness Monitoring

Parameter	Matrix	Sample Type	Container	Preservation	Sample Volume	Holding Time
Nitrite+nitrate-N	Water	Composite	HDPE	Ice, < 6 C Not Frozen, pH<2 with H2SO4	250 mL	28 days
TKN – N	Water	Composite	HDPE	Ice, < 6 C Not Frozen, pH<2 with H2SO4	250 mL	28 days
Total Phosphorus-P	Water	Composite	HDPE	Ice, < 6 C Not Frozen, pH<2 with H2SO4	250 mL	28 days
Dissolved Phosphorus – P	Water	Composite	HDPE	Filtration, Ice, < 6 C Not Frozen, pH<2 with H2SO4	250 mL	28 days
<i>E. coli</i>	Water	Composite	Sterile	Ice, <6 C, NaS2O3 (as appropriate)	125 mL	24 hours
Residue, Total nonfiltrable	Water	Composite	HDPE	Ice, < 6 C Not Frozen	1 L	7 days

Processes to Prevent Cross Contamination

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

Documentation of Field Sampling Activities

Field sampling activities are documented on the Field Data Reporting Form as presented in Appendix F. For all sample collection visits, station ID, location, sampling time and date, and sample collector’s name/signature are recorded. Values for sample volume and temperature are recorded. Unusual observational data are also recorded including water appearance, unusual odors, etc.

Recording Data

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

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

Sampling Method Requirement or Sampling Process Design Deficiencies and Corrective Action

Examples of sampling method requirement 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 University of Texas Project Manager, in consultation with the University of Texas 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 NPS Project Manager both verbally and in writing in the project progress reports and by completion of a corrective action plan (CAP).

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

B3 SAMPLE HANDLING AND CUSTODY

Sample Labeling

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

1. Site identification
2. Date and time of collection

Sample Handling

Samples are collected at the field site after each rain event, labeled and placed on ice. Once iced, the samples will be driven directly to the LCRA laboratory if open or stored in the 4° cooler at the Center for Research in Water Resources until the lab opens.

At the laboratories, the documentation of the COC is verified and laboratory staff signs the COC indicating receipt of the samples. The samples are checked to verify that the samples are properly

preserved, sample container condition, sample volume and that holding times have not been exceeded. Sample temperatures are checked to document that the samples have been cooled to assist in preservation. After laboratory receipt of the samples, the samples are logged into the LIMS and made available to laboratory staff for analysis. If, due to extenuating circumstances, samples are required to be analyzed at a subcontract laboratory, proper chain of custody procedures are followed to show transfer of sample custody.

Field staff makes every effort to ensure meeting the 24 hour holding time for bacteria analysis and will strive to deliver the samples to the laboratory as soon as possible for analysis. Field personnel communication with the laboratory to initiate laboratory staff preparation for the arrival of bacteria samples is very important and will reduce the time between relinquishing of samples to the lab and actual reagent addition and incubation of the bacteria samples. Holding times are also verified by the laboratory QAO.

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 COC form is used to document sample handling during transfer from the field to the laboratory and among contractors. The following information concerning the sample is recorded on the COC form (See Appendix G).

1. Date and time of collection
2. Site identification
3. Sample matrix
4. Number of containers
5. Preservative used
6. Was the sample filtered
7. Analyses required
8. Name of collector
9. Custody transfer signatures and dates and time of transfer
10. Bill of lading (*if applicable*)

Sample Tracking Procedure Deficiencies and Corrective Action

All deficiencies associated with chain-of-custody procedures as described in this QAPP are immediately reported to the Contractor Project Manager. These include such items as delays in transfer, resulting in holding time violations; violations of sample preservation requirements; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc. The University of Texas Project Manager in consultation with the

University of Texas QAO will determine if the procedural violation may have compromised the validity of the resulting data. Any failures that have reasonable potential to compromise data validity will invalidate data, and the sampling event should be repeated. The resolution of the situation will be reported to the TCEQ NPS Project Manager in the project progress report. Corrective Action Plans will be prepared by the Contractor QAO and submitted to TCEQ NPS Project Manager along with project progress report.

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

B4 ANALYTICAL METHODS

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

Copies of laboratory SOPs are retained by the contractor and are available for review by the TCEQ. Laboratory SOPs are consistent with EPA requirements as specified in the method.

Standards Traceability

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

Analytical Method Deficiencies and Corrective Actions

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

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

The TCEQ has determined that analyses associated with the qualifier codes (holding time exceedance, estimated value, etc.) may have unacceptable measurement uncertainty associated with them. This will immediately disqualify analyses from submittal to SWQMIS. Therefore, data with these types of problems should not be reported to the TCEQ. Additionally, any data collected or analyzed by means other than those stated in the QAPP, or data suspect for any reason should not be submitted for loading and storage in SWQMIS.

B5 QUALITY CONTROL

Sampling Quality Control Requirements and Acceptability Criteria

Sampling Quality Control Requirements and Acceptability Criteria

Field Split - A field split is a single sample subdivided by field staff immediately following collection and submitted to the laboratory as two separately identified samples according to procedures specified in the *SWQM Procedures*. Split samples are preserved, handled, shipped, and analyzed identically and are used to assess variability in all of these processes. Field splits apply to conventional samples only. Field splits will be collected one per 10 samples.

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

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

A 30% RPD criteria will be used to screen field split results as a possible indicator of excessive variability in the sample handling and analytical system. If it is determined that elevated quantities of analyte (i.e., > 5 times the LOQ) were measured and analytical variability can be eliminated as a factor, then variability in field split results will primarily be used as a trigger for discussion with field staff to ensure samples are being handled in the field correctly. Some individual sample results may be invalidated based on the examination of all extenuating information. The information derived from field splits is generally considered to be event specific and would not normally be used to determine the validity of an entire batch; however, some batches of samples may be invalidated depending on the situation. Professional judgment during data validation will be relied upon to interpret the results and take appropriate action. The qualification (i.e., invalidation) of data will be documented on the Data Review Checklist and Summary. Deficiencies will be addressed as specified in this section under Quality Control or Acceptability Requirement Deficiencies and Corrective Actions.

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 TNI-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 later this section, are run (e.g., sample duplicates, surrogates, internal standards, continuing calibration samples, interference check samples, positive control, negative control, and media blank) as specified in the methods. The requirements for these samples, their acceptance criteria or instructions for establishing criteria, and corrective actions are method-specific.

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

Limit of Quantitation (LOQ) – The laboratory will analyze a calibration standard (if applicable) at the LOQ on each day calibrations are performed. In addition, an LOQ check standard will be analyzed with each analytical batch. Calibrations including the standard at the LOQ will meet the calibration requirements of the analytical method or corrective action will be implemented.

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

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

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

necessitating sample dilution, etc. These sample results will be submitted to the TCEQ with an explanation on the Data Review Checklist and Summary as to why results do not appear to meet the AWRL requirement.

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

The LOQ check standard is carried through the complete preparation and analytical process. LOQ Check Standards are run at a rate of one per analytical batch.

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

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

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

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

The LCS is carried through the complete preparation and analytical process. LCSs are run at a rate of one per preparation 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 prepared by taking aliquots of a sample from the same container under laboratory conditions and processed and analyzed independently. A laboratory control sample duplicate (LCSD) is prepared in the laboratory by splitting aliquots of an LCS. Both samples are carried through the entire preparation and analytical process. LCSDs are used to assess precision and are performed at a rate of one per preparation batch.

For most parameters, precision is calculated by the relative percent difference (RPD) of LCS duplicate results as defined by 100 times the difference (range) of each duplicate set, divided by the average value (mean) of the set. For duplicate results, X_1 and X_2 , the RPD is calculated from the following equation: *(If other formulas apply, adjust appropriately.)*

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

A bacteriological duplicate is considered to be a special type of laboratory duplicate and applies when bacteriological samples are run in the field as well as in the lab. Bacteriological duplicate analyses are performed on samples from the sample bottle on a 10% basis. Results of bacteriological duplicates are evaluated by calculating the logarithm of each result and determining the range of each pair.

Measurement performance specifications are used to determine the acceptability of duplicate analyses as specified in Table A7.1. The specifications for bacteriological duplicates in Table A7.1 apply to samples with concentrations > 10 org./100mL.

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

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. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Percent recovery of the known concentration of added analyte is used to assess accuracy of the analytical process. The spiking occurs prior to sample preparation and analysis. Spiked samples are routinely prepared and analyzed at a rate of 10% of samples processed, or one per preparation batch whichever is greater. The information from these controls is sample/matrix specific and is not used to determine the validity of the entire batch. The MS is spiked at a level

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less than or equal to the midpoint of the calibration or analysis range for each analyte. Percent recovery (%R) is defined as 100 times the observed concentration, minus the sample concentration, divided by the true concentration of the spike.

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

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

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

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

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 must be documented.

The method blank shall be analyzed at a minimum of once 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.

Quality Control or Acceptability Requirement Deficiencies and Corrective Actions

Sampling QC excursions are evaluated by the Contractor Project Manager, in consultation with the Contractor QAO. In that differences in sample results are used to assess the entire sampling process, including environmental variability, the arbitrary rejection of results based on pre-determined limits

is not practical. Therefore, the professional judgment of the University of Texas Project Manager and QAO will be relied upon in evaluating results. Rejecting sample results based on wide variability is a possibility. Field blanks for trace elements and trace organics are scrutinized very closely. Field blank values exceeding the acceptability criteria may automatically invalidate the sample, especially in cases where high blank values may be indicative of contamination which may be causal in putting a value above the standard. Notations of field split excursions and blank contamination are noted in the quarterly report and the final QC Report. Equipment blanks for metals analysis are also scrutinized very closely.

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

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

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

Automated sampler testing and maintenance requirements are contained with Appendix H of this document.

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

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

B7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

Calibration requirements for the automated monitoring equipment are included in Appendix I of this document.

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

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

New batches of supplies are tested before use to verify that they function properly and are not contaminated. The laboratory QAM provides additional details on acceptance requirements for laboratory supplies and consumables.

B9 NON-DIRECT MEASUREMENTS

The project final report will include calculations of load reductions based on the observed performance of the retrofit facility. Three items are required to calculate annual load reduction: 1) the average change in concentration across the retrofit facility for the targeted constituents, 2) the average annual rainfall, and 3) the runoff coefficient for the test watershed. The change in concentration for targeted constituents is the difference in the concentrations entering and leaving the facility. The runoff coefficient will be determined by dividing the measured runoff volume (using flow meters installed at the site) by the rainfall depth (measured at a rainfall gauge at the site). The only non-direct measurement that will be employed in this calculation is the historical average rainfall for this area, which will be determined from the annual rainfall at the Austin airport. No other data from non-direct measurement sources will be used for this project.

B10 DATA MANAGEMENT

Field Collection and Management of Samples

Field staff will visit sites immediately following rainfall events to collect samples and download flow data. In addition, these sites will be visited weekly to maintain equipment. On days when samples are collected at the site, site identification, date, time, personnel, water volume collected, sample temperature, and any comments about unusual conditions at the site are noted in the field data reporting form.

Samples collected at the site will be labeled for transportation to the laboratory. Site name, time of collection, comments, and other pertinent data are copied from the field data reporting form to the COC. The COC and accompanying sample bottles are submitted for laboratory analysis.

All field observations and data will be manually entered into an electronic spreadsheet. The electronic spreadsheet will be created in Microsoft Excel software on an IBM-compatible microcomputer with a Windows 7 Operating System. The project spreadsheet will be maintained on the computer's hard drive, which is also simultaneously saved in a network folder. All pertinent data files will be backed up daily on an external hard drive.

Original data recorded on paper files will be stored for at least five years. Electronic data files will be archived to CD after approximately one year, and then stored with the paper files for the remaining 4 years.

Two ASCII (DOS) pipe delimited text files of the sampling results will be provided to the TCEQ Project Manager for inclusion in SWQMIS. The first of these is the sample/events file, and the second is the results file. Each will be formatted as described in the most recent DMRG.

Laboratory Data

All field samples will be logged upon receipt, COC's (if applicable) will be checked for number of samples, proper and exact I.D. number, signatures, dates, and type of analysis specified. The field technician will be notified if any discrepancy is found and proper corrections made. All samples will be stored at 4°C until analysis.

Data generated at the laboratory will be preserved in the manner required by their TNI certification.

Personnel

Section A4 lists responsibilities and lines of communication for data management personnel.

Data Management Process

Samples are collected by field staff and transferred to the laboratory for analyses as described in Sections B1 and B2. Sampling information (e.g. site location, date, time, etc.) is entered in a project spreadsheet. Measurement results from both the field data sheets and laboratory data sheets are manually entered (by field and laboratory staff, respectively) into the spreadsheet for their corresponding event. Customized data entry forms facilitate accurate data entry.

See Appendix J for the Data Management Process Flow Chart

Record-keeping and Data Storage

University of Texas record keeping and document control procedures are contained in the water quality sampling and laboratory standard operating procedures (SOPs) and this QAPP. Original field and laboratory data sheets are stored in the University of Texas offices in a fireproof file in accordance with the record-retention schedule in Section A9. One copy of the spreadsheet is backed up daily and stored on a hard drive at a remote location. If necessary, disaster recovery will be accomplished by information resources staff using the backup spreadsheet.

Archives/Data Retention

Complete original data sets are archived on permanent *DVD* media and retained on-site by the Contractor for a retention period specified in section A9.

Data Verification/Validation

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

Forms and Checklists

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

Data Dictionary

Terminology and field descriptions are included in the SWQM DMRG (2012 or most recent version). For the purposes of verifying which entity codes are included in this QAPP, a table outlining the entities that will be used when submitting data under this QAPP is included below.

Name of Monitoring Entity	Sample Description	Tag Prefix	Submitting Entity	Collecting Entity	Monitoring Type Code
Center for Research in Water Resources	Monitoring during rainfall runoff	UA	UA	UA	BF

Data Handling

Data are processed using the Microsoft Excel 2007 suite of tools and applications. Data integrity is maintained by the implementation of password protections which control access to the database and by limiting update rights to a select user group. No data from external sources are maintained in the database. The database administrator is responsible for assigning user rights and assuring database integrity.

Hardware and Software Requirements

Hardware configurations are sufficient to run Microsoft Excel 2007 under the Windows 7 operating system in a networked environment. Information Resources staff are responsible for assuring hardware configurations meet the requirements for running current and future data management/database software as well as providing technical support. Software development and database administration are also the responsibility of the information resources department. Information Resources develops applications based on user requests and assures full system compatibility prior to implementation.

Information Resource Management Requirements

University of Texas information technology (IT) policy is contained in IT SOPs which are available at <http://www.utexas.edu/cio/policies/>.

Quality Assurance/Control

See Section D of this QAPP
 NPS Rev 1.2

C1 ASSESSMENTS AND RESPONSE ACTIONS**Table C1.1 Assessments and Response Requirements**

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring Oversight, etc.	Continuous	UT Project Manager	Monitoring of the project status and records to ensure requirements are being fulfilled.	Report to TCEQ in Quarterly Report
Monitoring Systems Audit	Dates to be determined by TCEQ	TCEQ QAS	The assessment will be tailored in accordance with objectives needed to assure compliance with the QAPP. Field sampling, handling and measurement; facility review; and data management as they relate to the NPS Project	30 days to respond in writing to the TCEQ to address corrective actions
Laboratory Inspection	Based on work plan and or discretion of contractor	UT QAO	Analytical and quality control procedures employed at the laboratory and the contract laboratory	30 days to respond in writing to the contractor QAO to address corrective actions
Monitoring Systems Audit	Based on work plan and or discretion of contractor	UT QAO	The assessment will be tailored in accordance with objectives needed to assure compliance with the QAPP. Field sampling, handling and measurement; facility review; and data management as they relate to the NPS Project	30 days to respond in writing to the contractor QAO to address corrective actions
Site Visit	Dates to be determined by TCEQ	TCEQ PM	Status of activities. Overall compliance with work plan and QAPP	As needed

Corrective Action Process for Deficiencies

Deficiencies are any deviation from the QAPP, SWQM Procedures Manual, SOPs, or Data Management Reference Guide. Deficiencies may invalidate resulting data and may require corrective action. Corrective action may include for samples to be discarded and re-collected. Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff. It is the responsibility of the University of Texas Project Manager, in consultation with the University of Texas 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 NPS Project Manager both verbally and in writing in the project progress reports and by completion of a corrective action plan (CAP).

Corrective Action

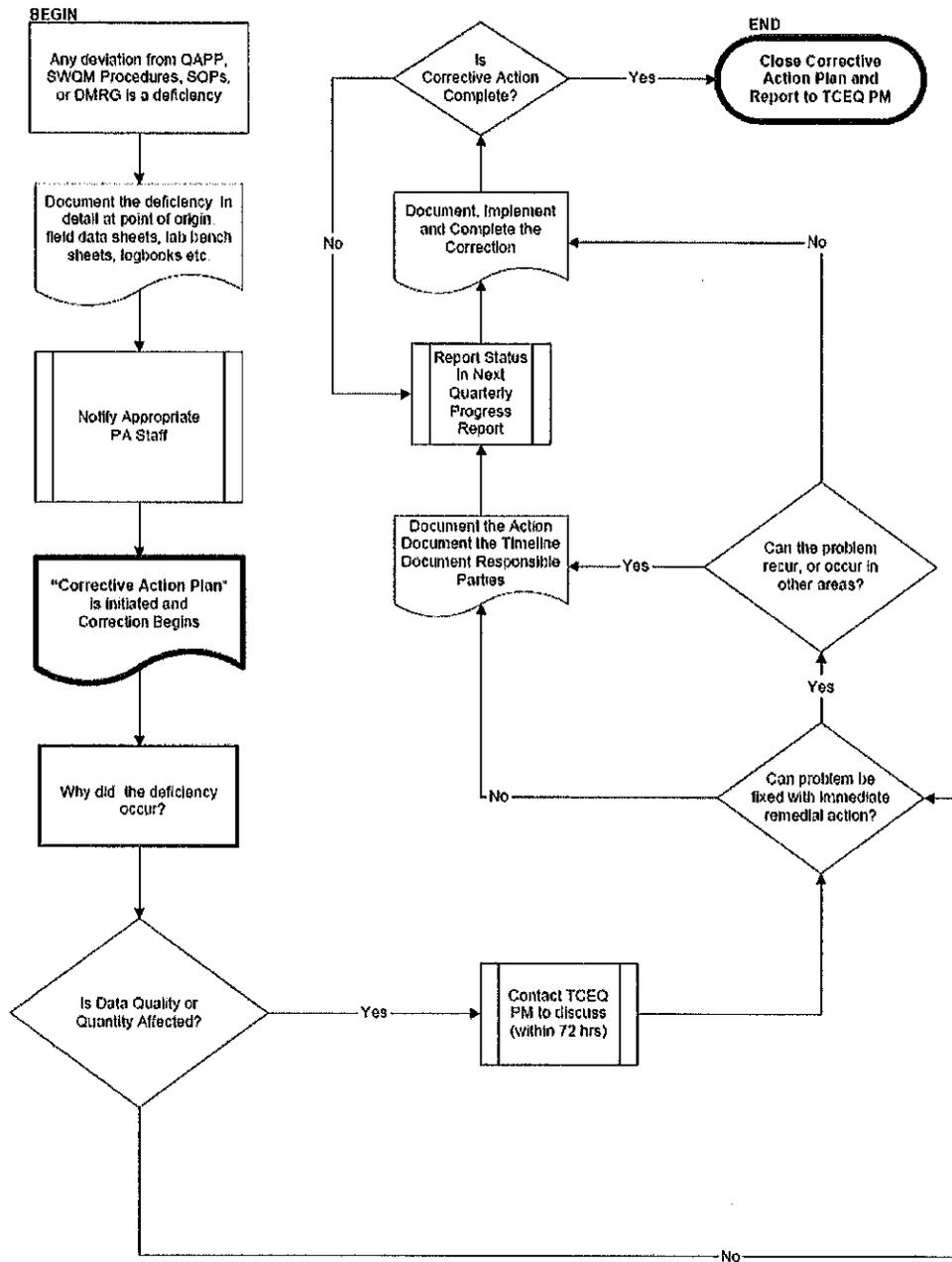
CAPs should:

- 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).

Figure C1.1 Corrective Action Process for Deficiencies

Corrective Action Process for Deficiencies



Status of CAPs will be documented on the Corrective Action Status Table (See Appendix K) and included with Quarterly Progress Reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TCEQ immediately.

The University of Texas Project Manager is responsible for implementing and tracking corrective actions. Corrective action plans will be documented on the Corrective Action Plan Form (See Appendix L) and submitted, when complete, to the TCEQ Project Manager. Records of audit findings and corrective actions are maintained by both the TCEQ and the University of Texas QAO. Audit reports and corrective action documentation will be submitted to the TCEQ with the Quarterly Progress Report.

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

C2 REPORTS TO MANAGEMENT

Reports to TCEQ Project Management

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

Monitoring Systems Audit Report and Response - Following any audit that is performed, a report of findings, recommendations and response is sent to the TCEQ in the quarterly progress report.

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

BMP Development and Implementation Report – Provides details and photo documentation of the activities and work completed under Task 3 in the project Scope of Work.

Water Quality Monitoring and Data Analysis Report – Provides details of the water quality data results, analysis, and load reductions achieved.

Contractor Evaluation - The Contractor participates in a Contractor Evaluation by the TCEQ annually for compliance with administrative and programmatic standards.

Final Project Report - Summarizes the Contractor's activities for the entire project period including a description and documentation of major project activities; evaluation of the project results and environmental benefits; and a conclusion.

Reports to Contractor Project Management

Laboratory test reports (Section A9) will be submitted to UT Project Management on a quarterly basis. The laboratory test reports contain QC information which is reviewed by the UT Project Manager/QAO. Project status, assessments and significant QA issues will be dealt with by the UT Research Project Manager who will determine whether it will be included in reports to the TCEQ Project Management.

Reports by TCEQ Project Management

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

D1 DATA REVIEW, VERIFICATION, AND VALIDATION

For the purposes of this document, data verification is a systematic process for evaluating performance and compliance of a set of data to ascertain its completeness, correctness, and consistency using the methods and criteria defined in the QAPP. Validation means those processes taken independently of the data-generation processes to evaluate the technical usability of the verified data with respect to the planned objectives or intention of the project. Additionally, validation can provide a level of overall confidence in the reporting of the data based on the methods used.

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

The procedures for verification and validation of data are described in Section D2, below. The University of Texas Field Supervisor is responsible for ensuring that field data are properly reviewed and verified for integrity. The Laboratory Supervisor is responsible for ensuring that laboratory data are scientifically valid, defensible, of acceptable precision and bias, and reviewed for integrity. The University of Texas Data Manager will be responsible for ensuring that all data are properly reviewed and verified, and submitted in the required format to be loaded into SWQMIS. The Contractor QAO is responsible for validating a minimum of 10% of the data produced in each task. Finally, the University of Texas Project Manager, with the concurrence of the University of Texas QAO, is responsible for validating that all data to be reported meet the objectives of the project and are suitable for reporting to TCEQ.

D2 VERIFICATION AND VALIDATION METHODS

All data will be verified to ensure they are representative of the samples analyzed and locations where measurements were made, and that the data and associated quality control data conform to project specifications. The staff and management of the respective field, laboratory, and data management tasks are responsible for the integrity, validation and verification of the data each task generates or handles throughout each process. The field and laboratory tasks ensure the verification of raw data, electronically generated data, and data on chain-of-custody forms and hard copy output from instruments.

Verification, validation and integrity review of data will be performed using self-assessments and peer review, as appropriate to the project task, followed by technical review by the manager of the task. The data to be verified (listed in table D2.1) are evaluated against project performance specifications (Section A7) and are checked for errors, especially errors in transcription, calculations, and data input. If a question arises or an error is identified, the manager of the task responsible for generating the data is contacted to resolve the issue. Issues which can be corrected are corrected and documented electronically or by initialing and dating the associated paperwork. If an issue cannot be corrected, the task manager consults with the higher level project management to establish the appropriate course of action, or the data associated with the issue are rejected and not reported to the TCEQ. The performance of these tasks is documented by completion of the Data Review Checklist and Summary (Appendix C).

The University of Texas Project Manager and QAO are each responsible for validating that the verified data are scientifically valid, defensible, of known precision, bias, integrity, meet the data quality objectives of the project, and are reportable to TCEQ. One element of the validation process involves evaluating the data again for anomalies. Any suspected errors or anomalous data must be addressed by the manager of the task associated with the data, before data validation can be completed.

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

Table D2.1 Data Verification Procedures

Data to be Verified	Field Task	Laboratory Task	Lead Organization Data Manager Task
Sample documentation complete; samples labeled, sites identified	Y	Y	
Field QC samples collected for all analytes as prescribed in the TCEQ <i>SWQM Procedures Manual</i>	Y		
Standards and reagents traceable	Y	Y	
Chain of custody complete/acceptable	Y	Y	
Sample preservation and handling acceptable	Y	Y	
Holding times not exceeded	Y	Y	
Collection, preparation, and analysis consistent with SOPs and QAPP	Y	Y	Y
Field documentation (e.g., biological, stream habitat) complete	Y		
Instrument calibration data complete	Y	Y	
Bacteriological records complete	Y	Y	
QC samples analyzed at required frequency	Y	Y	Y
QC results meet performance and program specifications	Y	Y	Y
Analytical sensitivity (Minimum Analytical Levels/Ambient Water Reporting Limits) consistent with QAPP		Y	Y
Results, calculations, transcriptions checked	Y	Y	
Laboratory bench-level review performed		Y	
All laboratory samples analyzed for all parameters		Y	
Corollary data agree	Y	Y	Y
Nonconforming activities documented	Y	Y	Y
Outliers confirmed and documented; reasonableness check performed			Y
Dates formatted correctly			Y
Depth reported correctly			Y
TAG IDs correct			Y
TCEQ ID number assigned			Y
Valid parameter codes			Y
Codes for submitting entity(ies), collecting entity(ies), and monitoring type(s) used correctly			Y
Time based on 24-hour clock			Y
Absence of transcription error confirmed	Y	Y	Y
Absence of electronic errors confirmed	Y	Y	Y

Data to be Verified	Field Task	Laboratory Task	Lead Organization Data Manager Task
Sampling and analytical data gaps checked (e.g., all sites for which data are reported are on the coordinated monitoring schedule)	Y	Y	Y
Field QC results attached to data review checklist			Y
Verified data log submitted			Y
10% of data manually reviewed			Y

D3 RECONCILIATION WITH USER REQUIREMENTS

Data collected from this project will be analyzed by the University of Texas and other Gilleland Creek watershed stakeholders to report the performance of the BMPs and the measured reductions in NPS loadings. The percentage of pollutant removal achieved for each event monitored will be calculated as:

$$\% \text{ Concentration Reduction} = (1 - \text{Concentration out} / \text{Concentration in}) \times 100$$

The observed load reduction will also be calculated for each event and for the entire period of monitoring for both of the monitored basins as:

$$\text{Load Reduction} = 1 - (\text{Concentration out} \times \text{Volume out}) / (\text{Concentration in} \times \text{Volume in})$$

The load reduction will then be normalized by the amount of rainfall associated with the monitored event (or series of events) as:

$$\text{Normalized Load Reduction} = \text{Load Reduction} / \text{Rainfall depth}$$

This normalized value will then be used to estimate annual load reduction as:

$$\text{Annual Load Reduction} = \text{Normalized Load Reduction} \times \text{Average Annual Rainfall}$$

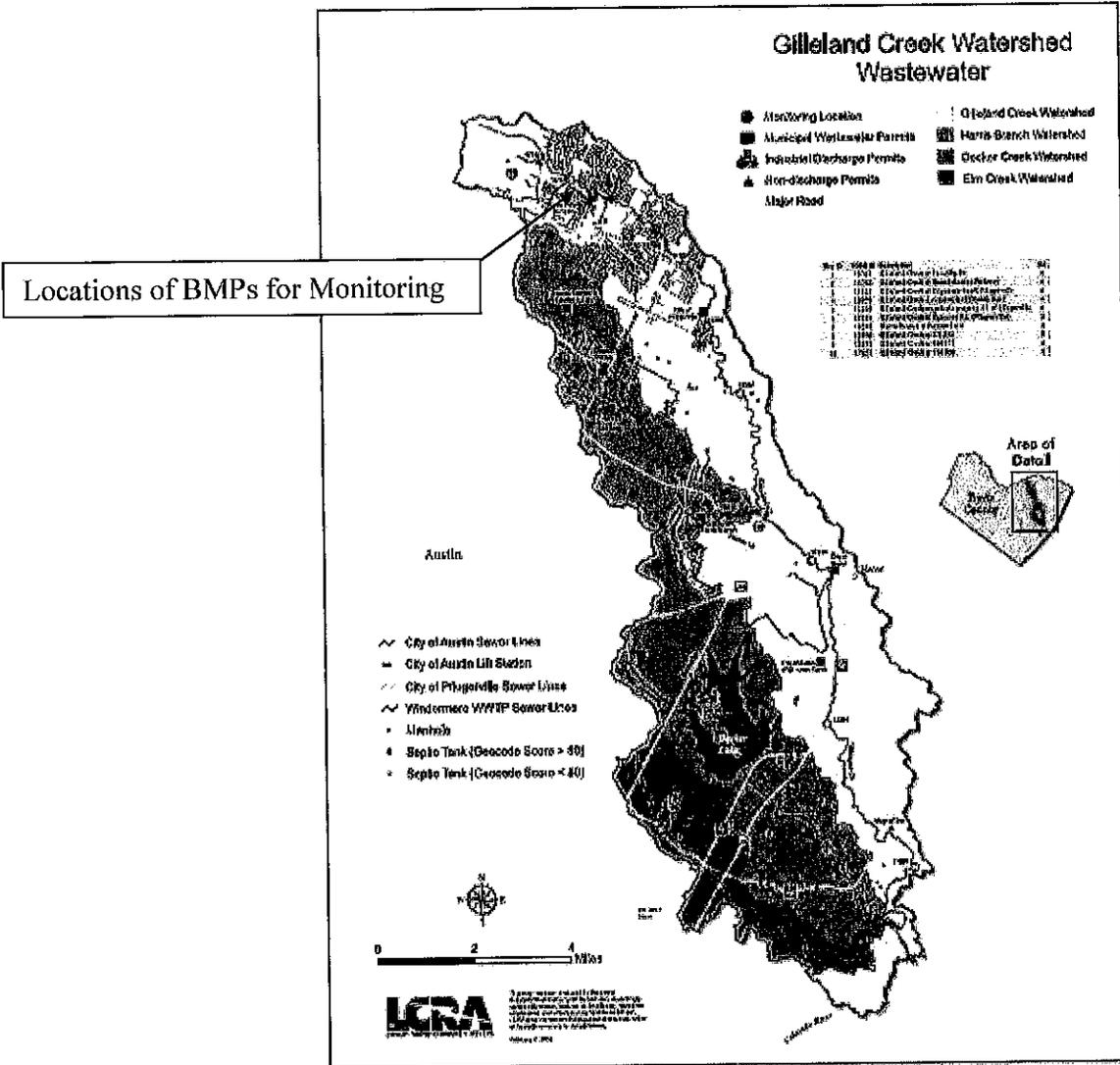
Where the average annual rainfall is approximately 32 inches.

In addition, statistical tests will be used to determine whether the observed changes in concentration are statistically significant. If the differences between influent and effluent concentrations are normally distributed (or can be transformed to that distribution by taking the logarithm of the differences) a paired t-test will be performed for each basin to determine whether the influent and effluent concentrations are significantly different. If the data are not normally distributed, the non-parametric equivalent to the paired t-test (Wilcoxon signed rank test) will be performed.

A statistical comparison of the performance of the two basins will also be made. If the measured discharge concentrations are normally distributed (or can be transformed to that distribution by taking the logarithm of the concentrations) a t-test will be performed on the discharge concentrations from the control and test sites. If the data are not normally distributed, the non-parametric equivalent to the t-test, the Mann Whitney test, will be performed. A p-value of 0.10 will be used as the threshold for determining significance. All the statistical tests will be performed using Minitab (State College, PA).

Only BMP monitoring data meeting data quality objectives in this QAPP will be used in the project.

APPENDIX A. AREA LOCATION MAP



APPENDIX B. WORK PLAN

Subtask 1.1: Project Oversight – The CRWR will provide technical and fiscal oversight of the staff and/or subgrantee(s)/ subcontractor(s) to ensure Tasks and Deliverables are acceptable and completed as scheduled and within budget. With the TCEQ Project Lead authorization, the CRWR may secure the services of subgrantee(s)/ subcontractor(s) as necessary for technical support, repairs and training. Project oversight status will be provided to the TCEQ with the Quarterly Progress Reports (QPRs).

Subtask 1.2: Quarterly Progress Reports (QPRs) – Progress will be reported to the TCEQ by the 15th of the month following each state fiscal quarter for incorporation into the Grant Reporting and Tracking System (GRTS). The Reports are to include the following:

- Status of deliverables for each task

Narrative description in Progress Report format

Subtask 1.3: Reimbursement Forms – Reimbursement forms will be submitted to the TCEQ by the last day of the month following each state fiscal quarter. For the last reporting period of the project, Reimbursement Forms are required on a monthly basis, specifically for the months of June, July, and August.

Subtask 1.4: Contract Communication – The CRWR will participate in a post-award orientation meeting with TCEQ within 30 days of contract execution. The CRWR will maintain regular telephone and/or email communication with the TCEQ Project Manager regarding the status and progress of the project in regard to any matters that require attention between QPRs. This will include a call or meeting each January, April, July, and October. Minutes recording the important items discussed and decisions made during each call will be attached to each QPR. Matters that must be communicated to the TCEQ Project Manager in the interim between QPRs may include:

- Requests for prior approval of activities or expenditures for which the contract requires advance approval or that are not specifically included in the scope of work
- Notification in advance when CRWR has scheduled public meetings or events, initiation of construction, or other major task activities under this contract

Information regarding events or circumstances that may require changes to the budget, scope of work, or schedule of deliverables; these events or circumstances must be reported within 48 hours of discovery.

Subtask 1.5: Annual Report Article – The CRWR will provide an article for the Nonpoint Source Annual Report upon request by the TCEQ. This report is produced annually in accordance with Section 319(h) of the Clean Water Act (CWA), and it is used to report Texas' progress toward meeting the CWA § 319 goals and objectives and toward implementing its

strategies as defined in the Texas Nonpoint Source Management Program. The article will include a brief summary of the project and describe the activities of the past fiscal year.

Subtask 2.1: QAPP Planning Meetings – The CRWR will schedule QAPP planning meetings with the TCEQ Project Manager, Quality Assurance staff, technical staff, management, and contractors, to implement a systematic planning process, based on the elements of the TCEQ NPS QAPP Shell. The information developed during the planning meetings will be incorporated into a QAPP. Additional planning meetings may also be conducted to determine if any changes need to be made to an existing QAPP. The determination of where the data resides (and how it should be coded) will be determined during the QAPP planning meeting.

Subtask 2.2: QAPP for Monitoring – A monitoring plan will be developed that describes in detail the procedures for sample collection and analysis. It is assumed for budgeting purposes that 10 paired samples will be collected during storm events for the two facilities. The plan will describe the criteria for storm sampling (event size, antecedent dry period, seasonal issues, etc.) and provide details on how the automatic samplers will be programmed. Constituents will be identified for analysis and will include, at a minimum, total suspended solids (TSS), fecal coliform, e coli, and enterococcus.

The CRWR will develop and submit to the TCEQ a QAPP with project specific DQOs consistent with the *EPA Requirements for QAPPs (QA/R5)* format and the TCEQ NPS QAPP Shell 120 days prior to the initiation of any data collection. All of the monitoring procedures and methods prescribed in the QAPP will be consistent with the guidelines detailed in the TCEQ Surface Water Quality Monitoring Procedures, Volume 1 and 2. The QAPP will be developed by the CRWR with technical assistance from TCEQ Project Manager, Quality Assurance staff, technical staff, management, and contractors. The QAPP will be approved by the TCEQ.

Subtask 2.3: QAPP Update – CRWR will provide input to TCEQ 60 days prior to the end of the effective period of the QAPP and will develop annual QAPP revisions no less than 45 days prior to the end of the effective period of the QAPP.

Subtask 2.4: QAPP Amendments – Amendments to the QAPP and the reasons for the changes will be documented by CRWR and revised pages will be forwarded to all persons on the QAPP distribution list by the Contractor Quality Assurance Officer. Amendments shall be reviewed, approved, and incorporated by the City into a revised QAPP during the annual revision process or within 120 days of the initial approval in cases of significant changes.

Subtask 2.5: Data Submittals – CRWR will review, verify, and validate water quality monitoring data before it is submitted to the TCEQ. The City will submit to the TCEQ biannually (twice per year) and at least one month prior to use, or prior to presenting to stakeholders. The City will submit a semi-annual report of water quality data consistent with TCEQ formatting requirements for upload into the Surface Water Quality Monitoring Information System (SWQMIS).

Subtask 3.1: Develop Conceptual Retrofit Plans – There are several options to consider for how retrofit a flood control basin. These include the type of control option (butterfly valves, ball valves, inflatable bladders, etc.) and where these would be placed to minimize cost and maximize operational effectiveness. There is also a question of whether to locate the control within the main discharge outlet or to construct a secondary outlet, so that in the case of equipment failure the flood control outlet would operate unimpeded

Subtask 3.2: Obtain Permits and Approval – Approval from the facility owners (MUD or homeowner association) will be sought. Permits will be obtained for the proposed facility modification from the appropriate regulatory agency – likely either the City of Austin or Pflugerville. This step may also require several modifications of the conceptual plans developed in Task 3.1.

Subtask 3.3: Rehabilitate Selected Basins – The two basins selected for monitoring have not had adequate maintenance in many years. This task involves removal of trees, trash and debris, and accumulated sediment. The outlet will be modified to eliminate standing water.

Subtask 3.4: Retrofit Facility and Install Monitoring Equipment – The selected facility will be modified as described in Task 3.1. Water quality monitoring equipment will be installed and calibrated at both the retrofit site and the control site. Equipment will be placed in tamper resistant field boxes for security. This work will be performed primarily by the graduate student assigned to this project.

Subtask 3.5: BMP Development and Implementation Report – UT will submit a report after the completion of stormwater retrofit. The report will provide details and photo documentation on the activities and completion of work conducted under Task 3.

Subtask 4.1: Stormwater Monitoring - Monitoring of the two retrofit facilities will occur for a period of one year or until 10 paired samples have been collected from each of the facilities. Samples collected during this time will be transported to the LCRA Environmental Laboratory for analysis.

Subtask 4.2: Data Analysis – Data collected during the analysis will be analyzed by the graduate student to determine whether the retrofitted facilities reduce the concentrations of indicator bacteria in stormwater discharges. The data will be analyzed to determine its statistical distribution. Appropriate statistical tests, either paired t-test or Wilcoxon signed rank test depending on the distribution of the data, will be used to quantify the certainty of pollutant reduction. In addition, the discharge data will be analyzed to determine whether the bacteria concentrations are less than the contact recreation threshold.

Subtask 4.3: Load Reductions – CRWR will provide load reductions achieved by the detention basin retrofit for *E.coli*, nitrogen, phosphorus, and sediment.

Subtask 4.4: Water Quality Monitoring and Data Analysis Report – CRWR will provide a report detailing water quality data results, analysis and load reductions achieved.

Task 5: Final Report Development – CRWR will provide a final report communicating the findings of the study.

Schedule of Deliverables

**UT - Gilleland Creek
 Total Maximum Daily Load (TMDL) Stormwater Retrofit Implementation
 Schedule of Deliverables**

Schedule of Deliverables Based on Anticipated Project Funding/Initiation Date

Task No.	Deliverable	Due Date
1.1	Project oversight status	With QPR's
1.2	Quarterly Progress Reports	The 15 th of the month following each state fiscal quarter
1.3	Quarterly Reimbursement Request Forms	The last day of the month following each state fiscal quarter, for the last reporting period of the project, reimbursement forms are required on a monthly basis
1.4	Post Award Meeting	Within 30 days of contract execution
1.4	Post Award Meeting Minutes	Within 15 days of Post Award Meeting
1.4	Quarterly conference call or meeting with the TCEQ Project Manager & Minutes	The second month of each state fiscal quarter
1.5	Project Annual Report Article	Upon TCRQ Request
2.1	QAPP Planning Meeting	Within 2 months of contract execution
2.1	QAPP Planning Meeting minutes	Within 15 days of QAPP Planning Meeting
2.2	Draft - QAPP with project specific DQOs consistent with the EPA Requirements for Quality Assurance Project Plans (QA/R5) format	Within 4 months of contract execution
2.2	Final QAPP with project specific DQOs consistent with the EPA Requirements for Quality Assurance Project Plans (QA/R5) format	Within 6 months of contract execution
2.3	Draft QAPP Updates submitted to the TCEQ Annually	Annually before previous signature approval date
2.3	Final QAPP Updates submitted to the TCEQ Annually	Annually before previous signature approval date
2.4	Draft QAPP Amendments	75 days prior to change in sampling plan implemented
2.4	Final QAPP Amendments	45 days prior to change in sampling plan implemented
2.5	Data Submittals	With QPR's
3.1	Develop Conceptual Retrofit Plans	Within 6 months of contract execution
3.2	Obtain Permits and Approval	Within 10 months of contract execution
3.3	Rehabilitate Selected Basins	Within 10 months of contract execution
3.4	Retrofit Facility and Install Monitoring Equipment	Within 14 months of contract execution

3.5	BMP Development and Implementation Report	Within 18 months of contract execution
4.1	Storm Water Monitoring	Within 32 months of contract execution
4.2	Data Analysis	Within 34 months of contract execution
4.3	Load Reductions	Within 34 months of contract execution
4.4	Water Quality Monitoring and Data Analysis Report	Within 34 months of contract execution
5.1	Draft -Final Report	Within 34 months of contract execution
5.2	Final Report	Within 36 months of contract execution
6.3	Results of the study Presented to Stakeholders	Within 36 months of contract execution

APPENDIX C. DATA REVIEW CHECKLIST AND SUMMARY

NPS DATA REVIEW CHECKLIST AND SUMMARY

A completed checklist must accompany all data sets submitted to the TCEQ by the Contractor.

QAPP Title: _____

Effective Date of QAPP: _____

Data Format and Structure	Y, N, or N/A
A. Are there any duplicate <i>Tag Id</i> numbers in the Events file?	
B. Do the <i>Tag</i> prefixes correctly represent the entity providing the data?	
C. Have any <i>Tag Id</i> numbers been used in previous data submissions?	
D. Are TCEQ station location (SLOC) numbers assigned?	
E. Are sampling <i>Dates</i> in the correct format, MM/DD/YYYY with leading zeros?	
F. Are the sampling <i>Times</i> based on the 24 hour clock (e.g. 13:04) with leading zeros?	
G. Is the <i>Comment</i> field filled in where appropriate (e.g. unusual occurrence, sampling problems, unrepresentative of ambient water quality)?	
H. <i>Submitting Entity, Collecting Entity, and Monitoring Type</i> codes used correctly?	
I. Are the sampling dates in the <i>Results</i> file the same as the one in the <i>Events</i> file for each <i>Tag Id</i> ?	
J. Are values represented by a valid parameter code with the correct units?	
K. Are there any duplicate parameter codes for the same <i>Tag Id</i> ?	
L. Are there any invalid symbols in the <i>Greater Than/Less Than (GT/LT)</i> field?	
M. Are there any <i>Tag Ids</i> in the <i>Results</i> file that are not in the <i>Events</i> file or vice versa?	
Data Quality Review	Y, N, or N/A
A. Are all the "less-than" values reported at the LOQ? If no, explain on next page.	
B. Have the outliers been verified and a "1" placed in the <i>Verify_flg</i> field?	
C. Have checks on correctness of analysis or data reasonableness been performed? e.g.: Is ortho-phosphorus less than total phosphorus? Are dissolved metal concentrations less than or equal to total metals?	
D. Have at least 10% of the data in the data set been reviewed against the field and laboratory data sheets?	
E. Are all parameter codes in the data set listed in the QAPP?	
F. Are all stations in the data set listed in the QAPP?	
Documentation Review	Y, N, or N/A

A.	Are blank results acceptable as specified in the QAPP?	
B.	Were control charts used to determine the acceptability of field duplicates?	
C.	Was documentation of any unusual occurrences that may affect water quality included in the <i>Event table's Comments</i> field?	
D.	Were there any failures in sampling methods and/or deviations from sample design requirements that resulted in unreportable data? If yes, explain on next page.	
E.	Were there any failures in field and/or laboratory measurement systems that were not resolvable and resulted in unreportable data? If yes, explain on next page.	
F.	Was the laboratory's TNI Accreditation current for analysis conducted?	

Data Set Information

Data Source:

Date Submitted:

Tag_ID Range:

Date Range:

Comments:

Please explain in the space below any data discrepancies discovered during data review including:

- Inconsistencies with AWRP specifications or LOQs
- Failures in sampling methods and/or laboratory procedures that resulted in data that could not be reported to the TCEQ
- Include completed Corrective Action Reports with the applicable Progress Report

I certify that all data in this data set meets the requirements specified in Texas Water Code Chapter 5, Subchapter R (TWC §5.801 et seq) and Title 30 Texas Administrative Code Chapter 25, Subchapters A & B.

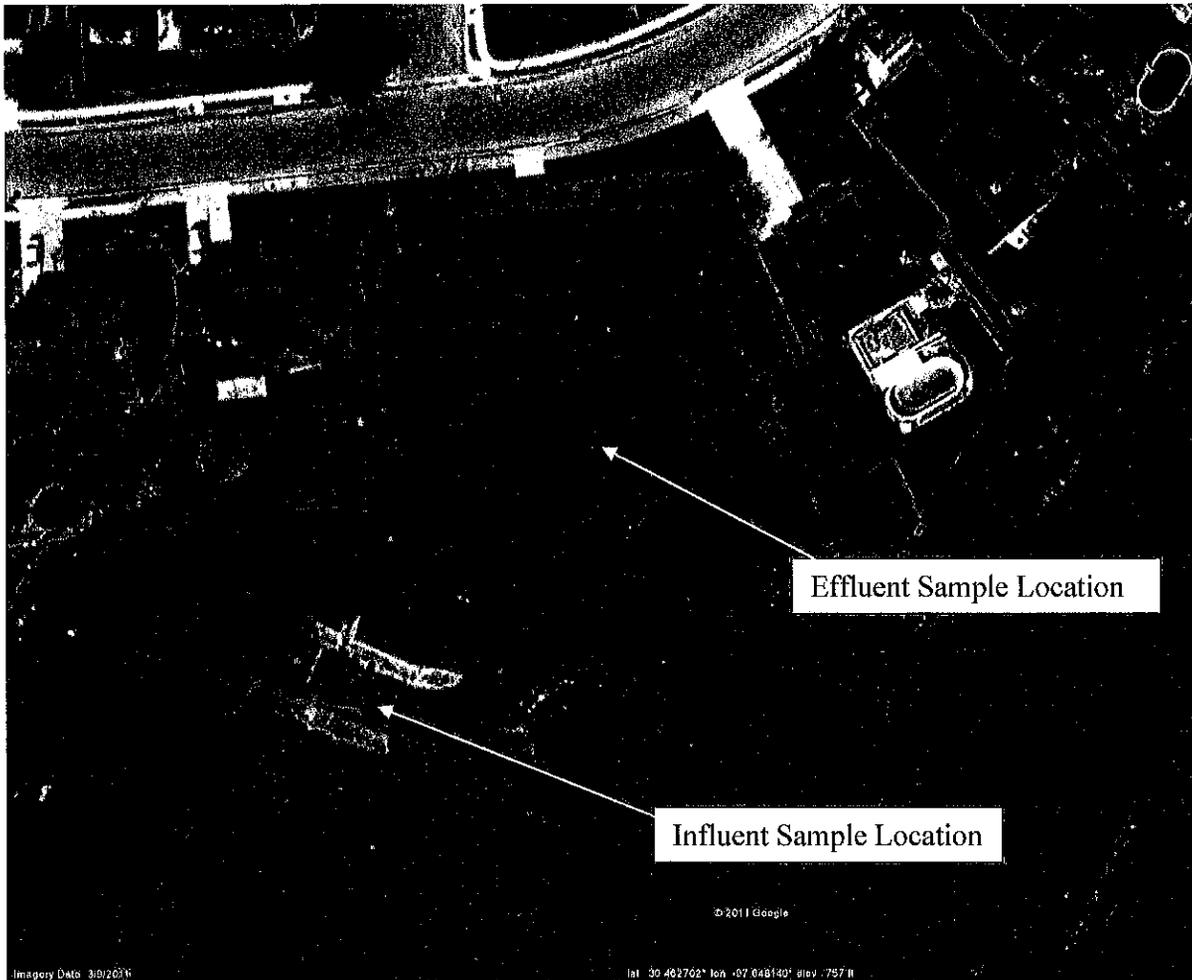
This data set has been reviewed using the Data Review Checklist.

University of Texas Data Manager: Michael Barrett

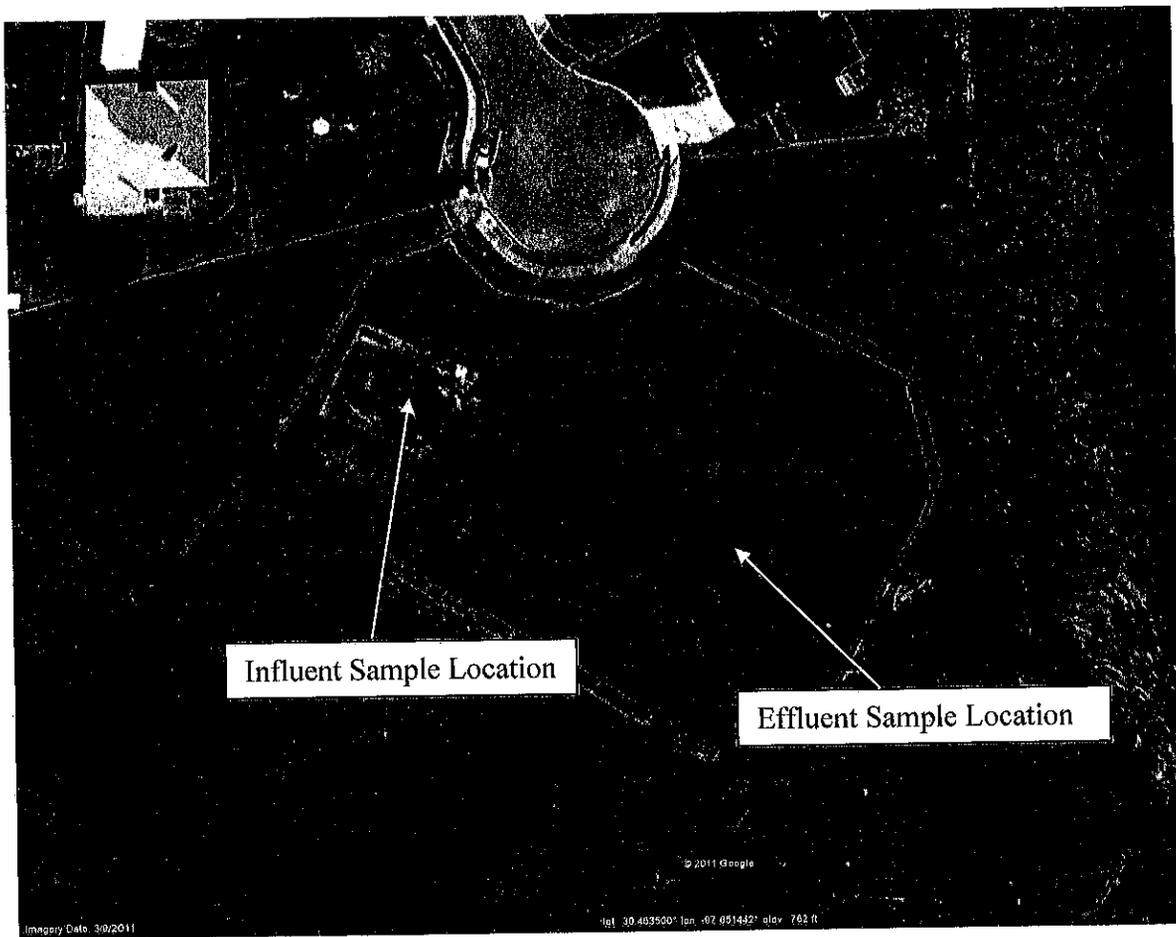
Date:

APPENDIX D. DETAILED SITE LOCATION MAP

Copperhead Basin



Pon Court Basin



APPENDIX E . FLOW LOGGER AND AUTOMATED SAMPLER SOP

ISCO 3700 Field SOP

The ISCO 3700 automatic sampler is a portable programmable liquid sampler. The sampler can be set in a flow based sample collection mode, the triggers for which will be determined after the initial few storm events during the sampling period. The sampler is set to hold one propylene bottle of 9 L for composite sampling.

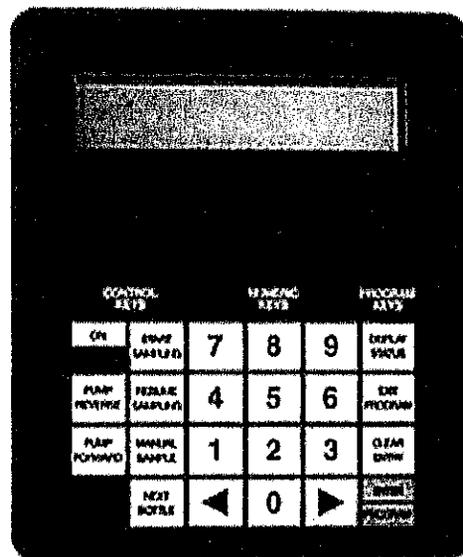
Procedure:

The equipment will be configured and programmed according to the manufacturer’s guidelines. The following is the SOP for obtaining samples from the ISCO 3700 after a rain event.

Take to the field:

- Empty ISCO bottle
- ISCO bottle lid
- Gloves

Use this ISCO button interface graphic as reference:



1. When you get to a plot, use the 3 black rubbery hooks to unlatch the top of the ISCO from the base. This will open to the control panel part.

2. The screen should display the date.
3. If there is a flashing star after the date, that means the sampler collected samples. If there is not a star, close the lid back up, and move on to the next plot. If there is a star, continue with the directions.
4. Press the "Display Status" button.
5. With "Review" flashing, press the "Enter" button.
6. Press the right arrow button twice so that "Results" is flashing. Press the "Enter" button.

[REVIEW, PRINT]
PROGRAM INFORMATION

7. The first few screens will tell you about the program that is running: When it was started and the volume of the samples. Use the right arrow button to scroll through these screens.

PRINT PROGRAM [NO],
SETTINGS, RESULTS]

8. As you scroll through (using the right arrow button), the sample times will show up. Record the following things: a. Bottle number b. Date sampled c. Time sampled d. The date you collected the samples
9. You can use the Chain Of Custody (COC) form, or use your own form and then transcribe the data onto a clean COC form.
10. The Sample ID is done in the form:
Site Name -- Event Number

11. In the third column of the COC, three timestamps should be listed per line.
12. Also in the COC, the "retrieval date" is the date when you collected the samples from the field, and the "collection date" is when the ISCO actually sucked the water up (the date on the ISCO screen).
13. When you're done downloading (writing down) the data from the ISCO screen, the last screen will look like this:

REVIEW PROGRAM [NO],
SETTINGS, RESULTS]

14. With "No" flashing, press the "Enter" button.
15. Now press the "Stop" button.
16. Press the "Start Sampling" button.
17. With "Start" flashing, press the "Enter" button.
18. The next screen will ask at which bottle to start. Bottle 1 should already be there, so press the "Enter" button.
19. Replace the lid of the top of the ISCO, and fasten with the black rubbery hooks.
20. Unfasten the 3 metal hooks farther down the ISCO.

21. Take the top of the ISCO off and set it aside. Be careful of the many wires that are attached to the different parts of the machine. Also, try not to set it down in a really muddy place.
22. Cap the bottle in the ISCO base and label.
23. Remove the base from the concrete pad, and place a new base in its place.
24. Replace the top section of the ISCO, and fasten the metal hooks back.
25. If you want, you can use the lids to the ISCO bases for easier transport back to the car. They have handles that are easier to hold.
26. Stir the water in the stilling well around to get the sediments back into suspension. Take a sample in a labeled bottle.
27. Clean out the stilling wells by bailing out the water with the scoop. When you get to the end, pull the plug out and let the remaining water drain out. Be sure to put the cork back in.
28. Take the sample back to the LCRA lab for splitting and preservation.

References:

TELEDYNE ISCO, 2010, 3700 *PORTABLE AUTOMATIC*

APPENDIX F. FIELD DATA REPORTING FORM

FIELD DATA SHEET

Time/Date: _____ Collected by: _____

Rain Event # _____ Inches: _____

Site	Volume Collected	Sample Temperature	Unusual Observations (color, odor, etc.)
Copperhead Influent			
Copperhead Effluent			
Pon Ct. Influent			
Pon Ct. Effluent			

APPENDIX G. CHAIN-OF-CUSTODY FORM

**APPENDIX H. AUTOMATED SAMPLER TESTING AND MAINTENANCE
REQUIREMENTS**

Obtained from manufacturer's website:
<http://www.isco.com/products/manuals1.asp?PL=201&GP=20110>

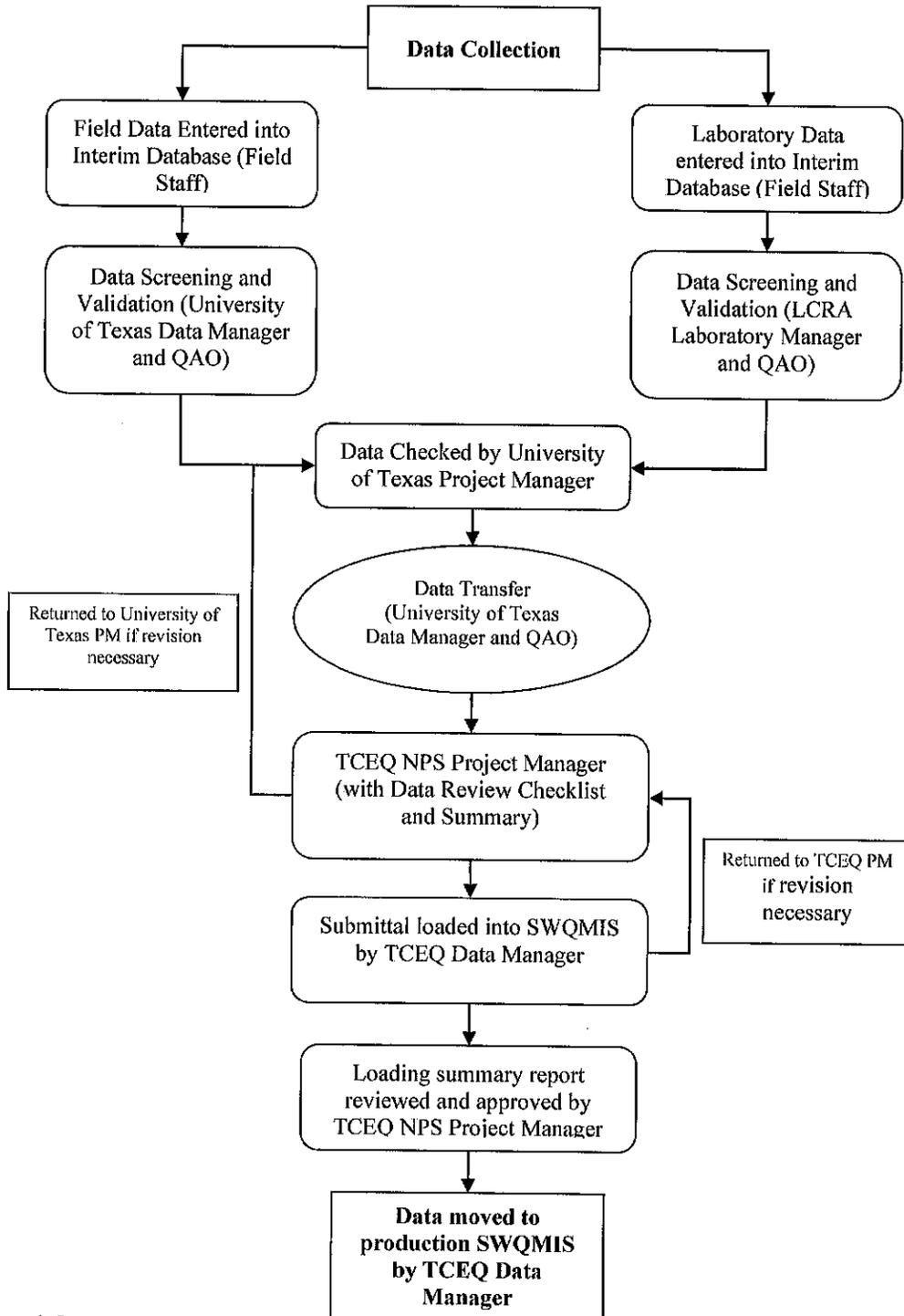
**APPENDIX I. AUTOMATED SAMPLER TESTING AND CALIBRATION
REQUIREMENTS**

Obtained from manufacturer's website:
<http://www.isco.com/products/manuals1.asp?PL=201&GP=20110>

APPENDIX J. DATA MANAGEMENT FLOW CHART

Data Submittals – CRWR will review, verify, and validate water quality monitoring data before it is submitted to the TCEQ. The CRWR will submit to the TCEQ biannually (twice per year) and at least one month prior to use, or prior to presenting to stakeholders. The CRWR will submit a semi-annual report of water quality data consistent with TCEQ formatting requirements for upload into the Surface Water Quality Monitoring Information System (SWQMIS).

Draft NPS Data Management Process Flow Chart



APPENDIX K: CORRECTIVE ACTION STATUS TABLE

APPENDIX L: CORRECTIVE ACTION PLAN FORM

Appendix L - Corrective Action Plan Form

Corrective Action Plan		
Issued by: _____	Date Issued _____	Report
No. _____		
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		
Date Corrective Action Plan Closed?		

ATTACHMENT 1: Example Letter to Document Adherence to the QAPP

TO: Michael Barrett
University of Texas

FROM: (name)
(organization)

RE: University of Texas, Gilleland Creek Total Maximum Daily Load (TMDL) Stormwater
Retrofit Implementation Quality Assurance Project Plan

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

(address)

I acknowledge receipt of the "Gilleland Creek Total Maximum Daily Load (TMDL) Stormwater Retrofit Implementation Quality Assurance Project Plan, Revision Date". I understand that the document describes quality assurance, quality control, data management and reporting, and other technical activities that must be implemented to ensure the results of work performed will satisfy stated performance criteria.

My signature on this document signifies that I have read and approved the document contents. Furthermore, I will ensure that all staff members participating in activities covered under this QAPP will be required to familiarize themselves with the document contents and adhere to the contents as well.

Signature

Date

Copies of the signed forms should be sent by the Contractor to the TCEQ NPS Project Manager within 60 days of TCEQ approval of the QAPP.