# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

*Protecting Texas by Reducing and Preventing Pollution*

February 13, 2013

Kim Jones
Texas A&M University at Kingsville
Institute for Sustainable Energy and the Environment
917 W. Avenue B
Kingsville, Texas 78028

Re: Lower Rio Grande Valley Low-Impact Development Implementation and Education Quality Assurance Project Plan (QAPP)

Approved: February 12, 2013 (Next update due February 12, 2014)
QAPP Revision Date: December 18, 2012

Dear Dr. Jones:

The above named QAPP has been approved. The original document and signature pages are enclosed as documentation of approval.

In accordance with the terms of the QAPP, **please ensure that copies of this document and any subsequent amendments are distributed to each sub-tier participant as noted in Section A3 of the QAPP.** This approval letter must be available for review during a monitoring systems audit.

Should you have questions, please contact me at (512) 239-0425.

Sincerely,

Kyle Girten
Quality Assurance Specialist

enclosure

cc: Sharon Coleman, Senior Quality Assurance Specialist, MC 165
Tim Cawthon, Project Manager, MC 203

# Lower Rio Grande Valley
# Low-Impact Development Implementation and Education
# Quality Assurance Project Plan

Texas A&M University - Kingsville
Kingsville, TX, 78363

Funding Source:

Nonpoint Source Program CWA §319(h)
Prepared in cooperation with the Texas Commission on Environmental Quality
and the U.S. Environmental Protection Agency
Federal ID# 99614615

Effective Period: One year from date of final approval

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

Kim D Jones
Director, Institute for Sustainable Energy and the Environment
917 W. Ave B
Kingsville, TX 78363
(361) 593-2069
kfkdj00@tamuk.edu

# A1 APPROVAL PAGE

## TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

**Monitoring Division**

Sharon Coleman 02/12/2012
Sharon Coleman, TCEQ QA Manager Date

2/12/13
Kyle Girten, Lead NPS QA Specialist Date
Quality Assurance Team

**Water Quality Planning Division**

for Vacancy 2/11/13
Kerry Niemann, Team Leader Date
Nonpoint Source Program

2/11/13
Nancy Ragland, Team Lead Date
Data Management and Analysis

Anju Sharma Chalise 2/11/13
Anju Chalise, NPS QA Specialist Date
Nonpoint Source Program

Tim Cawthon 2/11/13
Tim Cawthon, TCEQ NPS Project Manager Date
Project Manager, Nonpoint Source Program

**Texas A&M University - Kingsville**

Kim D. Jones, Principal Investigator and Project Manager — Date 2/6/13

Augusto Sanchez, QA Officer — Date 02-06-13

Augusto Sanchez, Assistant Project Manager — Date 02-06-13

Augusto Sanchez, Field Supervisor — Date 02-06-13

**Contractor Laboratory Name**

**Ana-Lab Corp.**

Bill Peery, Laboratory Manager — Date 1/30/2013

Dr. Paul Zhang, Laboratory QA Officer — Date 1/30/2013

**Brownsville Public Utility Board**

Lee R Atkinson, Laboratory Manager — Date 1/31/2013

Texas A&M University – Kingsville (TAMUK) 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. Texas A&M University - Kingsville 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.)

# A2 TABLE OF CONTENTS

# 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 Texas A&M University - Kingsville 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.

Nancy Ragland, Team Leader
Data Management and Analysis
MC-234
(512) 239-6546

**U.S. Environmental Protection Agency Region 6**
**State/Tribal Section**
**1445 Ross Avenue**
**Suite # 1200**
**Dallas, TX 75202-2733**
Leslie Rauscher, Project Officer
(214) 665-2773

Texas A&M University - Kingsville will provide copies of this project plan and any amendments or revisions of this plan to each project participant defined in the list below. Texas A&M University - Kingsville 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.

**Texas A&M University - Kingsville**
**917 W. Ave B MSC 213, Kingsville, TX 78363**

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Texas A&M University-Kingsville
917 W. Avenue B, MSC 213
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Ana-Lab Corp.
PO Box 9000
Kilgore, TX 75663
(903) 984-5914

Dr. Paul Zhang, Laboratory Quality Assurance Officer
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Lee Roy, Laboratory Manager
Brownsville Public Utilities Board.
1425 Robinhood Drive, P.O. Box 3270
Brownsville, TX 78523-3270
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Tim Cawthon
Nonpoint Source Program, MC-203
Texas Commission on Environmental Quality
(512) 239-0845
Tim.cawthon@tceq.texas.gov

**List of Acronyms**

| | |
|---|---|
| ACW | Arroyo Colorado Watershed |
| AWRL | Ambient Water Reporting Limit |
| BMP | Best Management Practice |
| BOD | Biochemical Oxygen Demand |
| BPUB | Brownsville Public Utility Board |
| CAP | Corrective Action Plan |
| CAR | Corrective Action Report |
| COC | Chain of Custody |
| CWA | Clean Water Act |
| DO | Dissolved Oxygen |
| DOC | Demonstration of Capability |
| DMP | Data Management Plan |
| DMRG | Data Management Reference Guide |
| DM&A | Data Management and Analysis |
| DQO | Data Quality Objective |
| EPA | Environmental Protection Agency |
| GIS | Geographic Information System |
| GPS | Global Positioning System |
| ISEE | Institute for Sustainable Energy and the Environment at TAMUK |
| IT | Information Technology |
| LCS | Laboratory Control Sample |
| LCSD | Laboratory Control Sample Duplicate |
| LEED | Leadership in Energy and Environmental Design |
| LID | Low Impact Development |
| LOD | Limit of Detection |
| LOQ | Limit of Quantitation |
| LRGV | Lower Rio Grande Valley |
| MS | Matrix Spike |
| NELAC | National Environmental Laboratory Accreditation Conference |
| NPDES | National Pollutant Discharge Elimination System |
| NPS | Nonpoint Source |
| OPP | Operating Policy and Procedure |
| PI | Principal Investigator |
| 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 |
| QM | Quality Manual |
| QMP | Quality Management Plan |
| RPD | Relative Percent Difference |
| SLOC | Station Location |
| SOP | Standard Operating Procedure |
| STEI | South Texas Environmental Institute at TAMUK |
| SWQM | Surface Water Quality Monitoring |
| SWQMIS | Surface Water Quality Monitoring Information System |
| SWTF | Storm Water Task Force |
| TAMUK | Texas A&M University- Kingsville |
| TBD | To Be Determined |
| TCEQ | Texas Commission on Environmental Quality |
| TSS | Total Suspended Solids |
| TKN | Total Kjeldahl Nitrogen |
| TMDL | Total Maximum Daily Load |
| TSWQS | Texas Surface Water Quality Standards |
| TSSWCB | Texas State Soil and Water Conservation Board |
| TWDB | Texas Water Development Board |
| VNC | Valley Nature Center |
| WPP | Watershed Protection Plan |
| WQI | Water Quality Inventory |
| | |

# A4 PROJECT/TASK OGANIZATION

## TCEQ

### Field Operations Support 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.

**Tim Cawthon**
**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.

TAMUK

**Kim D. Jones**
**TAMUK 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.

**Augusto Sanchez**
**TAMUK Assistant Project Manager**
Support the Project Manager in the project execution as a whole. Coordinate effort between TCEQ-TAMUK and TAMUK-subcontractors to help ensure tasks and other requirements in the contract are executed on time according to what is stated in the QAPP and corrective action compliance as required.

**Augusto Sanchez**
**TAMUK 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 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.

**Javier Guerrero**
**TAMUK Project Designer**
Designer is responsible for overseeing the design of each BMP to be implemented in this project; providing support to project engineers, architects, and other project supervisors; and supervising project contractors. Designer will ensure BMP design specifications promote efficient BMP performance and provide guidance for water quality monitoring. Designer is responsible for construction management during the construction/installation phase and for quality assurance. The project Designer will be in continuous communication with the Project Manager, QAO, Field Supervisor and other project supervisors.

Bill Peery **Ana Lab 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.

Dr. Paul Zhang **Ana Lab 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. Performs validation and verification of data before the report is sent to the contractor. 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.

**Lee Roy, BPUB Laboratory Manager**
Responsible for supervision of laboratory personnel involved in generating analytical data for *e. coli* concentration. 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.

**Augusto Sánchez**

**TAMUK 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 (January 2012, or most current version). 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.

**Augusto Sanchez**
**TAMUK 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.

**City of Brownsville**

**Joe Hinojosa**
**Subcontract coordinator (Task 5)**
Mr. Hinojosa will report to TAMUK Project Manager for ensuring tasks and other requirements in the subcontract between TAMUK and the City of Brownsville are executed on time and are of acceptable quality.

**City of San Juan**

**René Jaime**
**Subcontract coordinator (Task 6)**
Ms. Cruz will report to TAMUK Project Manager for ensuring tasks and other requirements in the subcontract between TAMUK and the City of San Juan are executed on time and are of acceptable quality.

**The Valley Nature Center**

**Martin Hagne**
**Subcontract coordinator (Task 7)**
Mr. Hagne will report to TAMUK Project Manager for ensuring tasks and other requirements in the subcontract between TAMUK and the Valley Nature Center are executed on time and are of acceptable quality.

**City of La Feria**

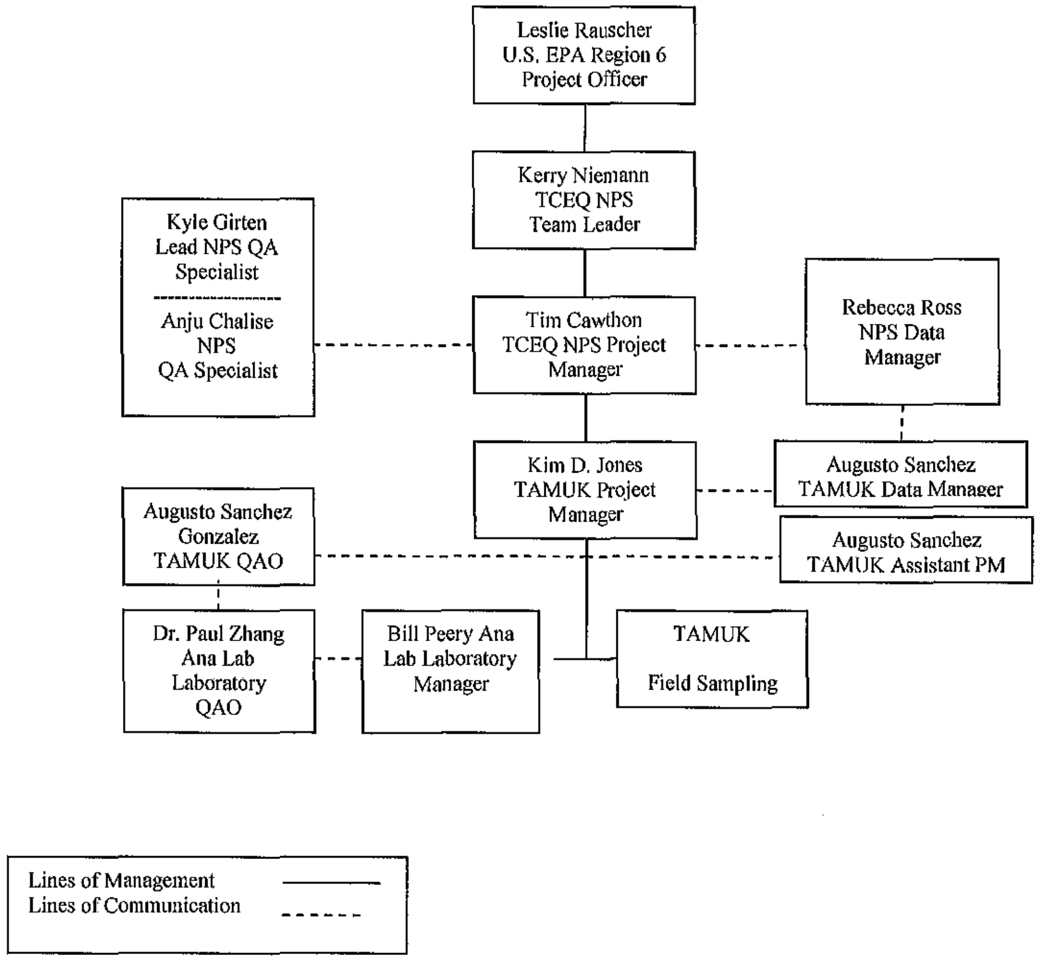
**Irene Szedlmeyer**
**Subcontract coordinator (Task 8)**

Mr. Szedlmeyer will report to TAMUK Project Manager for ensuring tasks and other requirements in the subcontract between TAMUK and the City of La Feria are executed on time and are of acceptable quality.

**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

The Arroyo Colorado flows through Hidalgo, Cameron and Willacy Counties in the Lower Rio Grande Valley of Texas into the Laguna Madre (See Appendix A). As a result of high bacteria levels, low dissolved oxygen (DO) levels, and legacy pollutants in fish tissue the Arroyo Colorado does not currently meet State Surface Water Quality Standards. In response, a local effort was initiated to develop a watershed protection plan (WPP), and the Arroyo Colorado Watershed Partnership was formed. As a result of their efforts, the "Watershed Protection Plan for the Arroyo Colorado, Phase I" was developed and released in 2007.

One of the goals of the WPP is to increase awareness of, and promote development options that incorporate elements of, Smart Growth and low impact development (LID). The basic idea behind LID is to manage urban storm water runoff by keeping as much storm water runoff as possible on-site to give the water a chance to infiltrate into the soil. This can be achieved using on-site measures such as vegetated swales, rain gardens, green roofs, porous pavement and larger-scale practices such as retention ponds.

The Lower Rio Grande Valley (LRGV) continues to be one of the fastest-growing areas in the United States. With urbanization ever increasing, the remaining public lands in the region will face ever increasing pressure to accommodate off-site rainwater discharges from encroaching developments, subdivisions, and planned communities. Incorporating successful Best Management Practices (BMPs) into facility infrastructure and amenities at public lands will optimize the benefits and reduce the negative impacts from storm water runoff. Runoff that undergoes effective pre-treatment, or sediment capture, will provide benefits to affected areas. Eventually, applicable and enforceable LID ordinances will be proposed to local government councils with the expected benefits supported with data gathered from the projects identified in this project. Moreover, proven LID and Green Technologies engineered into area construction and development projects will assist in minimizing pressures from area urbanization to benefit the entire region. Thus, as urbanization continues at a rapid rate, public support for LID practices and their use in new construction is necessary to mitigate the threats of NPS pollution in storm water runoff and to reduce pollutant loads to the Arroyo Colorado.

The measureable water quality parameters for monitoring the effectiveness of the BMPs are Total Kjeldahl N (TKN), Total Phosphorus, Sediments (TSS). These pollutants have been known to cause the low levels of DO currently present in the Arroyo Colorado. Bacteria (E. Coli) is the other parameter to be evaluated as current bacteria levels have been higher than the current limits in stream sections 2201 (tidal) and 2202 (above tidal).

LID feature designs and monitoring efforts will be focused on an assessment of the cost, feasibility and functionality (for the LRGV region) of all BMPs tested in this project. The ultimate goal is to develop codes and ordinances or, at minimum, incentives for the community and public/private land developers to implement LID practices. To achieve this goal, data analysis to calculate total and peak flow reductions as well as water quality improvement (in average terms and for specific rain events) will be accomplished for each BMP.

Funding for the project has been provided through the CWA 319(h) program with matching funds provided by TAMUK and the cities. Data collected as a result of the project will be used to demonstrate the effectiveness of the LID practices in accordance with EPA guidelines. These demonstrations will be accomplished by evaluating the efficiency of pollutant removal and reduced storm water runoff for each LID demonstration subproject.

This QAPP is reviewed by the TCEQ to help ensure that the 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

This project will have as an objective that LID measures are put into practice in various cities in the LRGV and within the Arroyo Colorado Watershed, in the most cost effective manner The cities and entities involved propose to design, construct and maintain structures and facilities using LID technology. TAMUK will use faculty, staff and graduate students to collect monitoring data from the sites and use it to evaluate the water quality (as budget permits) and quantity benefits of the LID practices, taking into account the unique aspects of each LID site. There will be a thorough assessment of the five LID practices (green roofs, rainwater harvesting, pervious pavements, runoff bioswales and wetland treatment) being implemented in this project. With regular quarterly monitoring and event monitoring for each heavy rain (more than one inch in 24 hours), the performance of the five LID practices in storm water runoff mitigation will be measured and evaluated. Four entities and five sites were chosen for implementation of LID practices in this project. Appendix A shows a map of the sites.

**City of Brownsville Park Project:**

The City will construct park amenities with LID technology at Monte Bella Trail Park in Brownsville to optimize recreational and ecological use of this park, and evaluate the effectiveness of the BMPs in removing NPS pollution and reducing storm water runoff. The sampling plan for the BMPs is described in Section B1. The LID practices will include:

- A 10,800 sq. ft. pervious cover parking lot.
- A green roof on top of a 1200 sq. ft bathroom facility. Rainwater harvesting cisterns will collect storm water runoff from the roof and the captured water will be reused at the facility.
- A 1 mile pervious cover walking trail (with a 15-35 foot swath). The walking trail alone will constitute 185,010 sq. ft. of modified cover.

**City of San Juan:**

The City of San Juan will implement LID practices at the Amigos del Valle Building in the City of San Juan, and evaluate the effectiveness of the BMPs at removing NPS pollution and reducing storm water runoff. The sampling plan for the BMPs is described in Section B1.
The LID Practices will include:

- A green roof. The roof at Amigos del Valle is 74' x 42' and the green portion of the roof will encompass 75 % of that area. Some of the roof area will not be developed as a green roof to provide for the maintenance and monitoring activities for a conventional roof installation.
- A rainwater collection system to collect storm water from the roof.
- Rain gardens and biofilters/swales surrounding the building.

**The Valley Nature Center (Weslaco, TX):**

The Valley Nature Center (VNC) in Weslaco, TX will enhance their facilities and site with LID practices, and evaluate the effectiveness of the BMPs at removing NPS pollution and reducing storm water runoff. The sampling plan for the BMPs is described in Section B1.
The LID Practices will include:

- A green roof demonstration area utilizing native vegetation along with an irrigation system.
- A rain water collection system, utilizing the remainder of the roof, which will include two cisterns on two sides of the new building, a gutter system, a basic gravity feed valve and overflow to the wetland exploration area, and a solar pump feed to an in-ground irrigation system for native landscaping.
- A pervious surface grass paver service road around the new building and pervious modular system sidewalks.
- A wetland exploration area behind the new building in the six-acre nature park. Wetland construction will include excavation, construction, and native wetland and riparian plantings.

**City of La Feria**

To evaluate local LID practices, the City proposes to construct two LID projects and compare construction costs, evaluate performance, and publicize the results. The City seeks to construct a 12,571 square foot parking lot for its soon to be constructed Recreation Center and a 10,000 square foot parking lot at its Public Works Warehouse, a former produce packing shed.

The goal at each site will be to achieve no less than 50% reduction in total suspended solids in the storm water runoff from the parking lots during a storm the intensity and duration of which has a 10-year return frequency. At the Recreation Center project, the BMPs will include a permeable surface, subsurface detention, and rain gardens/biofilters. At the public works facility project, a conventional parking surface combined with bioswales/rain gardens/biofilters will be constructed.

TAMUK researchers and City engineers will design the LID features to include at least 2 types of applications of pervious surfacing and designs of subsurface foundation applications. The project team will incorporate new data from the bio-filters, and the pervious surface applications for demonstration outreach activities and predictive modeling. TAMUK researchers and City engineers will design the LID features to help minimize NPS pollution runoff from the site and to improve the water quality of any urban runoff that is discharged from the site. Future LID features may include a rain harvesting system at this location.

While significant load reductions are the expected outcome of the tasks outlined in this proposal, the exact impact of LID technologies have not yet been extensively evaluated in the LRGV region. Table A6.1 shows some estimated predicted load reductions for the proposed BMP types.

**Table A6.1 LID BMP load reduction estimates for LRGV Project**

| **LID BMP: Porous pavement parking lot and walking trails** | **Estimated loading (lb/acre/inch of precip.) from urban runoff** | **Assumed Removal % of pollutant for this BMP due to reduced runoff (Jefferies, 2004)** | **Potential load reductions (lb/acre/in of precip.) for BMP** |
|---|---|---|---|
| BOD | 5.4 | 50 | 2.7 |
| Total Nitrogen | 0.68 | 50 | 0.34 |
| Total Phosphorous | 0.18 | 50 | 0.09 |
| TSS | 13.5 | 50 | 6.75 |
| | | | |
| **LID BMP: Green roof implementation** | **Estimated loading (lb/acre/inch of precip.) from urban runoff** | **Assumed Removal % of pollutant for this BMP due to reduced runoff** | **Potential load reductions (lb/acre/in of precip.) for BMP** |
| BOD | 5.4 | 25 | 1.3 |
| Total Nitrogen | 0.68 | 25 | 0.17 |
| Total Phosphorous | 0.18 | 25 | 0.04 |
| TSS | 13.5 | 25 | 3.37 |
| | | | |
| **LID BMP: Storm water wetlands and bio swales** | **Estimated loading (lb/acre/inch of precip.) from urban runoff** | **Assumed Removal % of pollutant for this BMP due to reduced runoff (Fletcher et al., 2004)** | **Potential load reductions (lb/acre/in of precip.) for BMP** |
| BOD | 5.4 | 40 | 2.1 |
| Total Nitrogen | 0.68 | 20 | 0.13 |
| Total Phosphorous | 0.18 | 60 | 0.10 |
| TSS | 13.5 | 40 | 5.4 |

**Table A6.2 Schedule for Construction and Assessment**

| Task No | Deliverable | Reporting | Start | Due |
|---|---|---|---|---|
| 2.1 | QAPP Planning Meeting | | 7/2011 | 7/2011 |
| 2.2 | Draft QAPP Submitted to TCEQ | | 09/2011 | 12/2011 |
| 3.3 | Input to the Project Sampling Plan and QAPP | In QAPP | 09/2012 | 12/2011 |
| 3.1 | Analytical Approach Technical Memoranda | | 08/2012 | 07/2012 |
| 2.2 | Final QAPP Submitted to TCEQ | | 06/12 | 07/2012 |
| 7.1 | Design Report (VNC) | | 11/12 | 11/12 |
| 3.2 | Analysis of the anticipated performance of practices | In Design Reports | 11/12 | 11/12 |
| 6.1 | Design Report (San Juan) | | 11/12 | 11/12 |
| 5.1 | Design Report (Brownsville) | | 11/12 | 11/12 |
| 8.1 | Design Report (La Feria) | | 11/12 | 11/12 |
| 7.1 | Certificate of Completion (VNC) | | 02/2013 | 02/2013 |
| 6.1 | Certificate of Completion (San Juan) | | 02/2013 | 02/2013 |
| 6.1 | Bid Documentation (San Juan) | | 08/2012 | 12/2012 |
| 7.1 | Bid Documentation (VNC) | | 08/2012 | 08/2012 |
| 8.1 | Bid Documentation (La Feria) | | 08/2012 | 08/2012 |
| 8.1 | Certificate of Completion (La Feria) | | 08/2012 | 09/2012 |
| 5.1 | Certificate of Completion (Brownsville) | | 04/2013 | 04/2013 |
| 5.1 | Bid Documentation (Brownsville) | | 02/2013 | 02/2013 |
| 2.3 | Data collection | | 02/2013 | 03/2014 |
| 4.4 | Technical Guidance for LID practices | | | 5/5/2013 |
| 3.4 | LID Assessment Report | In Final Report | 01/2014 | 6/1/2014 |
| 4.1 | Report evaluating LID practices | In Final Report | 01/2014 | 6/1/2014 |
| 9.1 | Draft Final Report | | 04/2014 | 6/1/2014 |
| 9.1 | Final Report | | 06/2014 | 8/31/2014 |

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 is sooner. Re-issuances 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 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 non-conformances; 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

The quantitative and qualitative information needed to monitor the effectiveness of the BMPs are given in table A7.1 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.

**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 (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Rainfall for duration of the storm event | Inches | Other | Guage | 46530 | NA | NA | NA | NA | NA | 90 |
| Flow volume for Duration of Storm Event | Cubic feet | Water | ISCO flow meter, Flume, Weir | 50052 | NA | NA | NA | NA | NA | NA |
| Influent and Effluent Flow* | Cubic feet per minute (CFM) | Water | flow bubbler meter, | NA | NA | NA | NA | NA | NA | 90 |
| BOD | mg/L | Water | SM 5210 B | 00310 | 2 | 2 | 84.6 - 115 | NA | NA | NA |
| Residue, Total Nonfilterable (TSS) | mg/L | Water | SM 2540 D | 00530 | 4 | 4 | NA | 20 | 80-120 | 90 |
| Total Kjeldahl N | mg/L | Water | SM 4500 NH3 E | 00625 | 0.05 | 1 | 70-130 | 20 | 80-120 | 90 |
| Total Phosphorus | mg/L | Water | SM 4500 PE | 00665 | .05 | 1 | 70-130 | 20 | 80-120 | 90 |
| *E—coli**** Auto-sampler | MPN/100mL | Water | SM 9223-B | 31699 | 1 | 1 | NA | 0.5** | NA | |

***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

* In BMPs like pervious pavements the inflow will be calculated by using rainfall height and surface area. No instrumentation will be installed in these cases.

**Based on range statistics as described in Standard Methods, 21st Ed. Section 9020-B, Quality Assurance/Quality Control – Interlaboratory Quality Control Guidelines. This criterion applies to bacteriological duplicates with concentrations >10 MPN/100mL or >10org/100mL.

***E. coli samples analyzed by SM 9223-B should always be processed as soon as possible and within 24 hours.

### 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. deioinized 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.

**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. deioinized 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**

Site selection, the appropriate sampling regime, the sampling of all pertinent media according to TCEQ SOPs, and use of only approved analytical methods will assure that the measurement data represents the conditions at the site. Rain event data will be collected to measure water quantity, quality (when possible) and estimate load reduction. A rain gauge with data logger will be installed at every site to have a more accurate information about the rain event. The monitoring will start from the date the BMP is fully installed to the 33rd month after the contract execution. Although data may be collected during varying regimes of weather and flow, the data sets will not be biased toward unusual conditions of flow, runoff, or season.

**Completeness**

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

**Comparability**

Confidence in the comparability of routine data sets for this project and for water quality assessments is based on the commitment of project staff to use only approved sampling and analysis methods and QA/QC protocols in accordance with quality system requirements and as described in this QAPP and in 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

No special certifications are required. However, field personnel will receive training in proper sampling. Before actual sampling occurs, field personnel will demonstrate to the TAMUK Lead and TAMUK QAO their ability to properly perform field sampling procedures. Laboratory analysis will be performed by NELAC certified labs as per TCEQ requirements.

Global Positioning Systems (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 the 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 Station location.

# A9 DOCUMENTS AND RECORDS

**Laboratory Test Reports**

Test/data reports from the laboratory must document the test results clearly and accurately. Routine data reports should be consistent with the 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. The data reports will include

- Sample results
- Units of measurement
- Sample matrix
- Dry weight or wet weight (as applicable)
- Station information
- Date and time of collection
- 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 NELAC compliance on a result by result basis
- Title of report and unique identifiers on each page
- Name/address of the laboratory
- Name/address of the client
- A clear indication of the sample(s) analyzed
- Date and time of sample receipt
- Identification of method used
- Identification of samples that did not meet QA requirements and why (e.g. holding times exceeded)
- Cleary identified subcontract laboratory results (as applicable)
- Name/title of person accepting responsibility for the report
- Project-specific quality control results to include field split results (as applicable); equipment, trip, and field blank results (as applicable); and precision, bias, and LOQ check standard results
- Narrative information on QC failures or derivations from requirements that may affect the quality of results or is necessary for verification and validation of data.

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

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

This should be based on the process that has been worked out with the Contractor and is documented in Section D1 and D2 of this document.

The NELAC certified laboratory's process for reporting data or relevant portions of the laboratory's SOP or quality manual will be submitted as a separate file with the QAPP.

**Electronic Data**

Data will be submitted to the TCEQ in the event/result format specified in the TCEQ Data Management Reference Guide (DMRG; January 2012 or most recent version) for upload to the Surface Water Quality Monitoring Information System (SWQMIS). The Data Review Checklist and Summary as contained in Appendix D of this document will be submitted with the data.

The submitting entity will submit a station location request (SLOC) directly to the TCEQ Data Manager through SWQMIS for each sampling site to obtain a station identification number. If submitting entity does not have access to the SWQMIS, TCEQ Project Manager will assist the submitting entity to get the access. TCEQ Project Manager should be copied on all the correspondence throughout the process. The TCEQ Project Manager will ensure that submitting entity actually requests SLOCS before submitting any data to the TCEQ. Project personnel should seek guidance from the TCEQ Data Manager regarding proper use of EPA station types when preparing SLOCs. No data can be submitted to the TCEQ until station identification numbers have been assigned to the sites.

TAMUK will review, verify, and validate water quality monitoring data before it is submitted to the TCEQ. Data will be submitted to TCEQ quarterly and at least 1 month prior to use, or prior to presenting to stakeholders. Water quality data consistent with TCEQ formatting requirements will be submitted for upload into the Surface Water Quality Monitoring Information System (SWQMIS). Data submittal will follow the deliverable schedule and continue till May 2014.

All reported Events will have a unique TagID (see DMRG). A Tag Prefix must be requested from the TCEQ in accordance with the DMRG where the Submitting Entity does not already have one. TagIDs used in this project will be seven-character alphanumerics with the structure of the two-letter Tag prefix followed by a four digit number and ending with the character "N": for example - AK1234N, AK1235N, etc.

Submitting Entity, Collecting Entity, and Monitoring Type codes will reflect the project organization and monitoring type in accordance with the DMRG. The proper coding of Monitoring Type is essential to accurately capture any bias toward certain environmental condition (for example, high flow events). The Monitoring Type code is BF, since all sampling will be tied to rainfall events.

Tag Prefix = AK
Submitting Entity = AK
Collecting Entity = AK

**Records and Documents Retention Requirements**

**Table A9.1 Duration and form in which data will be recorded**

| Document/Record | Location | Retention | Form |
|---|---|---|---|
| QAPP, amendments, | TAMUK, TCEQ | 5 years | Paper/Electronic |

| | | | |
|---|---|---|---|
| and appendices | | | |
| QAPP distribution documentation | TAMUK | 5 years | Paper |
| Chain of custody records | TAMUK | 5 years | Paper |
| Corrective action documentation | TAMUK | 5 years | Paper |
| Laboratory data reports/results | TAMUK, TCEQ | 5 years | Paper/Electronic |
| Progress reports/final report/data | TAMUK, TCEQ | 5 years | Paper/Electronic |

## B1 SAMPLING PROCESS DESIGN

The experimental design of the project aims to demonstrate the effectiveness of Low Impact Development BMPs to be constructed within the public facilities mentioned above (section A7) in reducing total and peak flows of stormwater which lead to improved water quality. Each of these BMPs will have its own sampling criteria and the data collected will involve estimation of suspended solids and nutrients loading reductions into urban runoff as well as engineering performance data for a site typical of the LRGV, for subsequent use in designing these BMPs within the region.

The five LID BMPs that will be assessed in this study are:

- Permeable pavements designed as functional parking lots and walking trails.
- Bioretention facilities (rain garden/bioswale) vegetated BMPs that collects runoff from nearby areas.
- Rainwater harvesting systems.
- Green Roof.
- The treatment wetland will be designed to collect and treat run off with native aquatic plants.

The water quality improvements tests (for proof of concept purposes only) encompass evaluating the following water quantity and quality parameters for each system installed:

- Total runoff volume/event
- Rainfall
- Total Kjeldahl N (TKN)
- Total Phosphorus
- Sediments; TSS
- *E. coli*

Design and sampling parameters for the BMPs are site specific and will be explained case by case since each site has different configuration and (in some cases) the same type of BMP will be tested in more than one location (e.g. Pervious parking lot in City of La Feria and City of Brownsville).

The required instrumentation for data collection and monitoring is listed below. The number of instruments and its distribution will vary at each location; details are presented when each site's monitoring strategy is described and in Table B1.3. The list of instruments and peripheral equipment to be used are:

- Rain Gauge model ISCO 674 (or equivalent): Tipping bucket type.
- Automated water samplers model ISCOM 6700FR (or equivalent): Programmable.
- Water level sensor (Rugged TROLL 100 In-Situ Inc. or equivalent): Piezoresistive measurement.
- Interface device ISCO Signature flow (or equivalent): multiple sensor connectivity
- Flow rate metering insterts (ISCO or equivalent)
- Flowlink software

Rain events designated relevant for study (sampling and testing) will be those of 0.25 in of precipitation or higher over the period of 1 hr. According to the TWDB records, only10% of the rain events in the LRGV region report lower precipitation values. In addition, events of this kind should generate enough runoff to activate the triggers of the automated samplers (estimated using the smallest drainage area of BMPs implemented in this project, Brownsville RHS; see tables B1.1 and B1.2). The BMPs to be studied in this project will be designed to capture the volume of a rain event of 2.5 in/24 hrs (unless otherwise indicated); 75% of the rain events in this region report lower daily precipitation levels. Thus, at least 67% (90% x 75%) of rain events will be potentially sampled and captured by the BMPs, those events above 0.25 in and with daily values below 2.5in, before runoff is generated. The minimum flow set point for sampling (which is roughly correlated to precipitation levels) is adjustable (with prior TCEQ project manager approval) if the first sets of analyses reflect a different correlation between precipitation and runoff flow rate. Every flow event with measureable quantities will be evaluated for flow reduction regardless if they qualify for sampling or not.

In Table B1.1 each BMP to be implemented is listed and its corresponding location. This table provides an overview of the entire project where the dimensions of each LID feature are specified, along with the location of each site and the water quality parameters to be measured.

From section A5 it was concluded that high bacteria concentrations in the Arroyo Colorado is one reason for this water body's impairment. In this project, bacteria will be tested only for those BMPs' with runoff that typically contains the highest concentration of bacteria according to literature[1]: parking lots (Table B1.2). Bacteria will also be tested in the constructed wetland at the VNC. Details of frequency of sampling/testing are specified later in this document.

[1] Shaver, E., etal "Fundamentals of Urban Runoff Management: Technical and Institutional Issues". NALMS, 2nd Ed. 2007 and Burnhart, M., et a. "Sources of bacteria in Wisconsin Stormwater". WDNR, 1991.

**Table B1.1 Sites location, included BMP's and characteristic**

| Location | | Type of BMP | Characteristics |
|---|---|---|---|
| Brownsville | Latitude: 25°57'16.51"N Longitude: 97°32'29.40"W | Pervious parking lot | 10,800 sq ft |
| | | Pervious walking trails | 185,010 sq ft |
| | | Green Roof | 1000sq ft; two 3,000 gal cisterns |
| Amigos del Valle | Latitude: 26°11'41.32"N Longitude: 98° 9'46.84"W | Rainwater collection system | One 5,000 gal cistern |
| | | Green Roof | 3,000 sq ft with irrigation system |
| | | Rain Garden | 300 sq ft |
| | | Linear bioswale | 30 linear feet |
| Valley Nature Center | Latitude: 26° 9'31.33"N Longitude: 97°59'50.44"W | Rainwater collection system | Two 5,000 gal cisterns |
| | | Green Roof | 200 sq ft with irrigation system |
| | | Pervious walking trails | 4,000 sq ft |
| | | Pervious service road | 2,800 sq ft |
| | | Wetland | 0.5 Ac |
| La Feria | Latitude: 26° 9'1.31"N Longitude: 97°49'59.76"W | Pervious parking lot | 12,571 sq ft |
| | | Bioswale | 1,200 linear ft |

Triggers (initiation points) for automatic water quality sampling will be adjusted after collecting flow and volume data from a few initial storm events. Flow measurements will be recorded using data loggers. Data from these events will be used to adjust the triggers for the remainder of the experimental period sampling events. The intention is to collect representative water samples through the acquisition of flow data for the entire event in order to plot the hydrograph. Once the site-specific hydrograph is known, triggers may be adjusted (with TCEQ PM authorization) for later sampling, however any historical sampling event can be related back in the time dimension to a specific section of the hydrograph. The following table (B1.2) illustrates the initial trigger flow set points for the three BMPs equipped with automatic sampling, as well as initial sampling intervals. These set points are only estimates but are set very low to capture several small rainfall event samples.

**Table B1.2 Summation of the sampling triggers and sampling interval for the BMPs equipped with automatic samplers**

| BMP | Inflow | | | Outflow | | |
|---|---|---|---|---|---|---|
| | Automatic Sampling | Initial Trigger | Initial sampling intervals | Automatic Sampling | Initial Trigger | Initial sampling intervals |

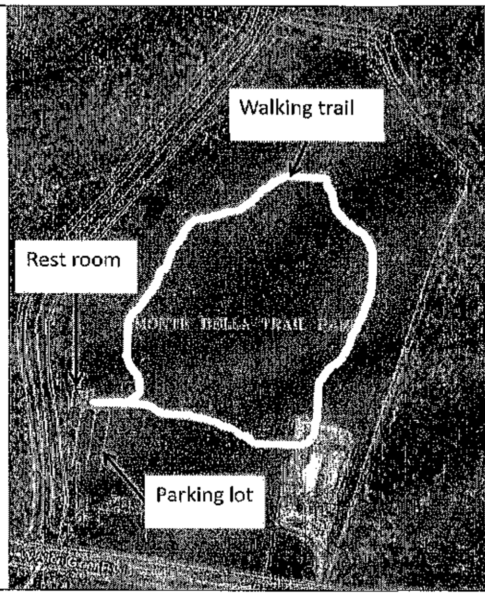
| | | | | | | |
|---|---|---|---|---|---|---|
| Treatment wetland | Yes | $5.41x10^{-6}$ m3/s | 15min | Yes | $2x10^{-6}$ m3/s | 30 min |
| Rain Garden | Yes | $5.41x10^{-6}$ m3/s | 15 min | Yes | $2x10^{-6}$ m3/s | 30 min |
| Linear Bioswale | Yes | $5.41x10^{-6}$ m3/s | 15 min | Yes | $2x10^{-6}$ m3/s | 30 min |

## Location descriptions and sampling details

### Monte Bella Park, Brownsville

The City of Brownsville is proposing to construct sorely needed park amenities at Monte Bella Trail Park to optimize recreational and ecological use of this green space. As depicted in Figure B1.1, the proposed distribution of the BMP's includes a pervious parking lot and walking trails, a green roof and rainwater collection system on top of the restrooms.

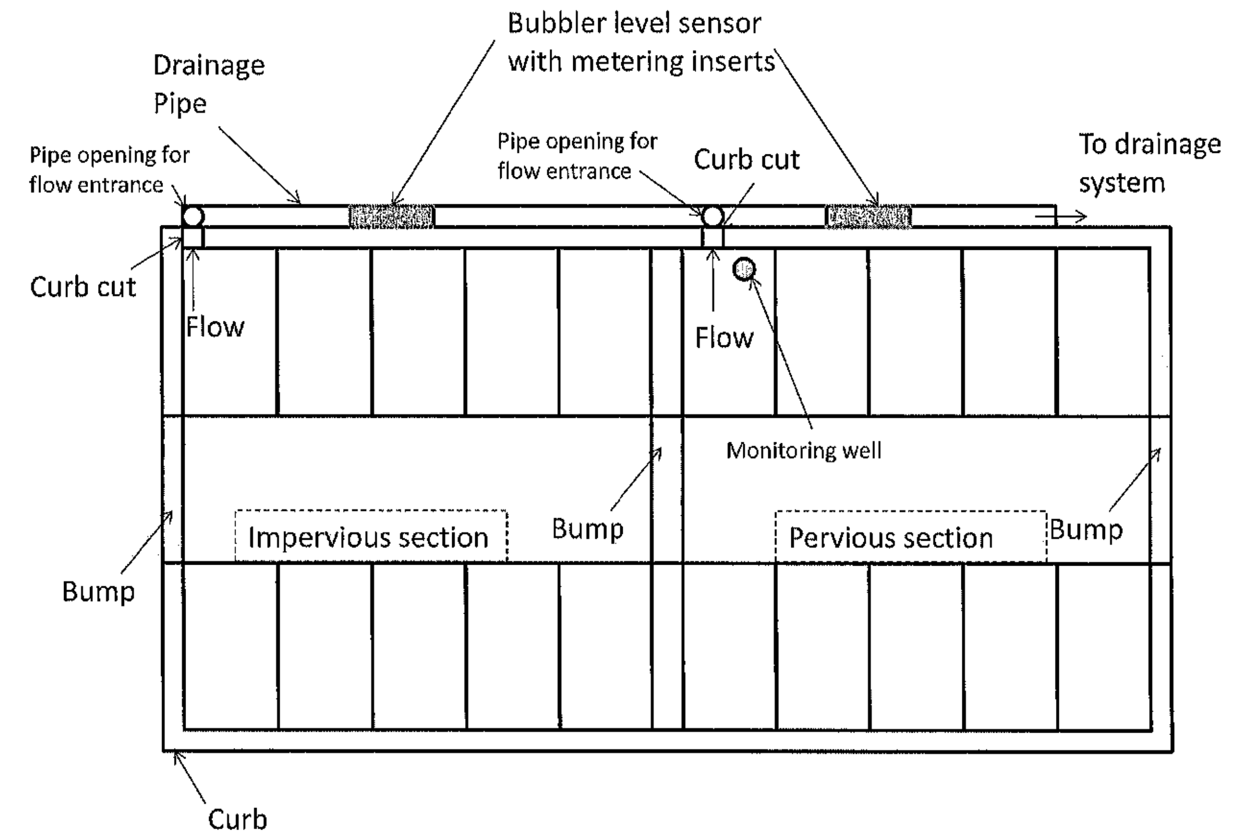
**Fig. B1.1. Monte Bella Park in Brownsville. Layout indicating the locations of correspondent BMPs**




*Pervious parking lot*

The newly constructed parking lot will incorporate permeable and traditional impervious surface. The design rationale is to provide the pervious section with underground storage (voids in the gravel bed) and perform as a stormwater infiltration system; if rainfall volume exceeds the storage capacity the surface runoff will be channeled to a non-paved area for infiltration/evaporation after prober flow measurements are taken. Runoff quality will be measured, and storage will be estimated (based on subsurface void percentage and rainfall measured). Inflow through the porous section will be estimated from rainfall measured by a rain gauge (ISCO 674 or equivalent) to be installed on the property while the outflow will be measured with bubbler level sensors connected to a logging device (ISCO Signature Flow or equivalent). Runoff volume from both sections will also be measured and samples will be collected manually at the curb cut (before entering the discharge pipe) in a discrete (grab sampling) approach (see Figure B1.3). During the runoff event just one discrete sample will be collected at the beginning (first flush); this applies to both sections pervious and impervious.

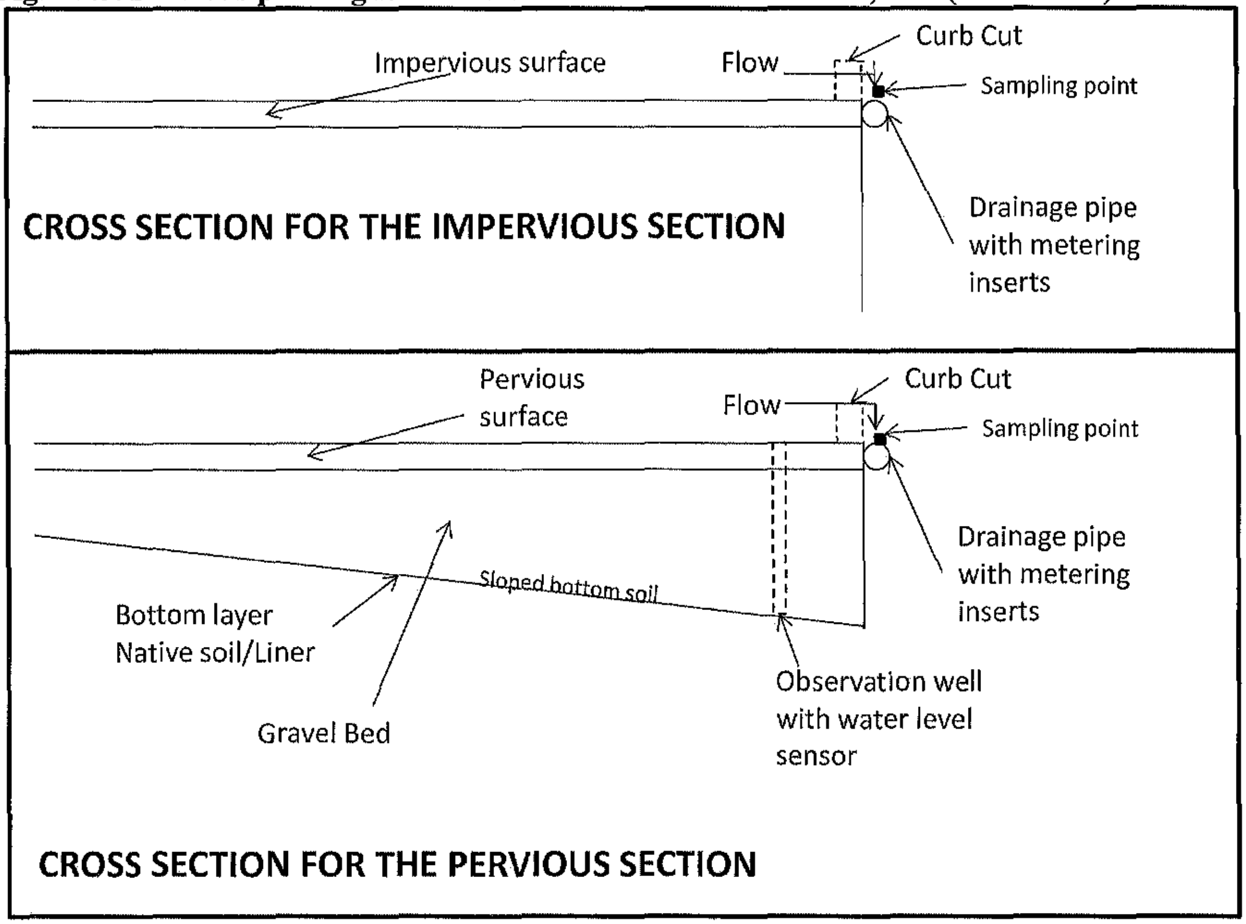
**Fig. B1.2. Pervious parking lot layout at Monte Bella Park. Brownsville, Tx. (schematics)**




** Samplers will be located as close as possible to the curb cuts before the runoff enters the drainage pipe.

The parking lot will be partitioned into two sections, one for each type of pavement. The entire parking lot will be isolated from external run-on by the surrounding curb or by elevating the surface to a height above the surrounding area. The pervious section will have ten parking spaces and a traffic bump will separate the runoff of each section to avoid commingling of flow from one section to the other. For both sections there will be a curb cut where all the runoff will exit the parking lot to a drainage channel/pipe adjacent to the lot. This channel/pipe will have two bubbler level sensors with metering inserts located downstream of the inlet (curb cut) of each section. The bubblers will measure the flow rate coming from both sections (see Figure B1.3). One of the sensors will be measuring the commingled flow from both sections and the runoff from the pervious pavement section will be calculated as the difference between the total commingled flow and the upstream measurement of the impervious section.
Water samples will be collected before runoff enters the channel to avoid a commingled sample (see figure B1.3). In addition, the water level underneath the pavement surface will monitored with an observation well equipped with a pressure transducer (Rugged TROLL 100 or equivalent)

**Fig. B1.3. Pervious parking lot at Monte Bella Park. Brownsville, Tx. (schematics)**

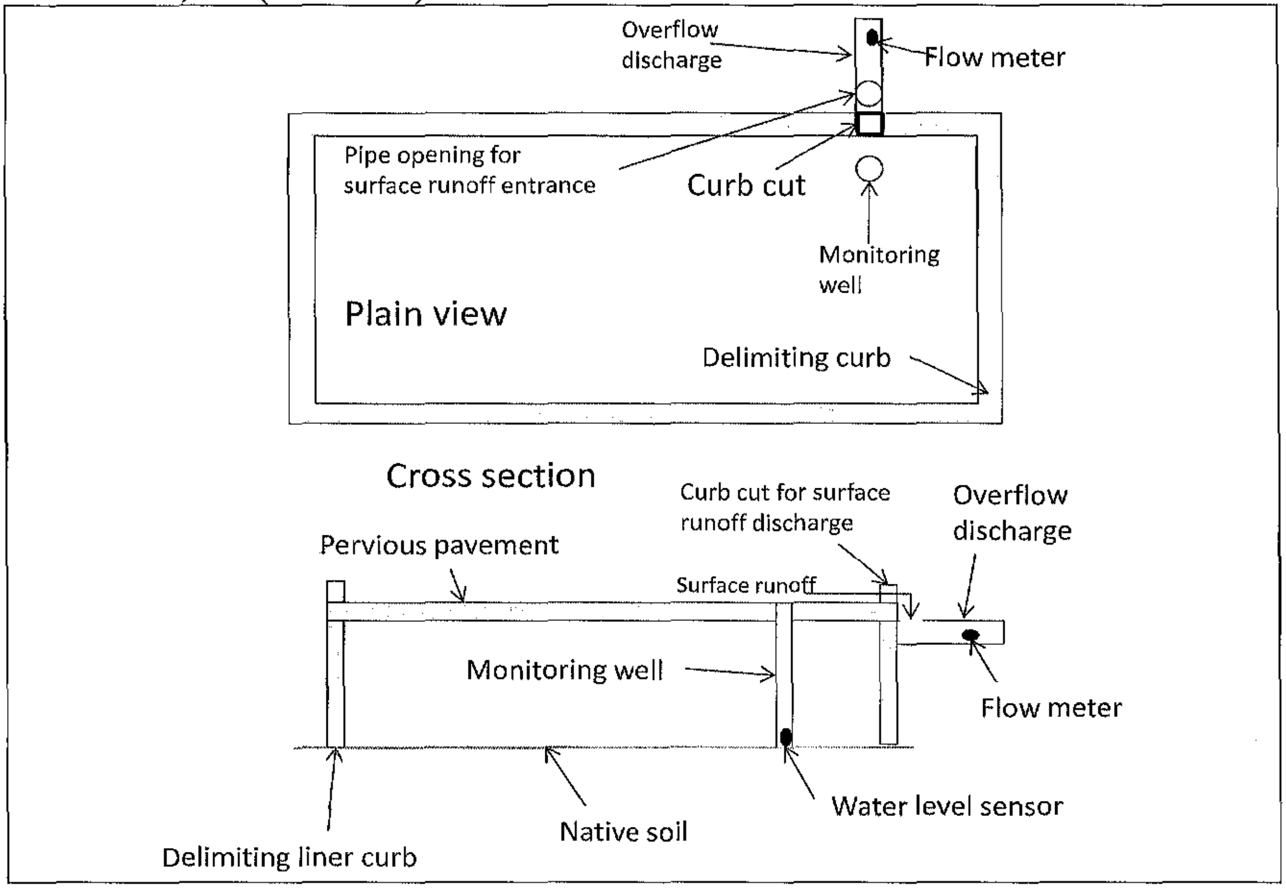



Using this water level, the total volume of porous pavement and the void percentage of the parking lot sub-base, the volume of water stored will be calculated (see Figure B1.3).

*Pervious walking trails*

The walking trails will be constructed to allow subsurface water storage/infiltration. A graded section of 50 linear ft will be isolated from external run-on (curb on the sides and slight concrete bumps across the trail) and an observation well will be placed to monitor subsurface water level. Inflow will be calculated from the rainfall information collected by the rain gauge. Grab water samples will be collected from the overflow discharge pipe in a discrete manner. The surface runoff will be discharged to a non-paved area for infiltration/evaporation through the discharge pipes indicated in the figure below. During the runoff event one discrete sample will be collected at the beginning (first flush); this applies to both sections pervious and impervious.

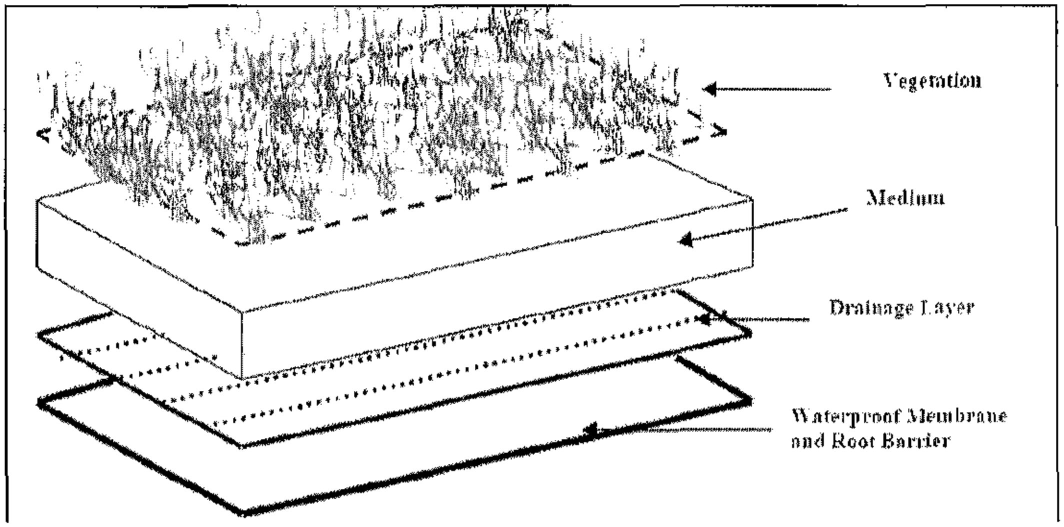
**Fig. B1.4. Pervious walking trails and instrumentation setup at Monte Bella Park, Brownsville, Tx. (schematics)**




*Green Roof*

The green roof BMP will include a collection barrel to measure the amount of runoff from the green roof section and a location for sampling. The BMP will feature one roof with two different plant species. The roof will be divided into two sections to compare two types of plants and their performance.

**Fig. B1.5. Green roof structure**

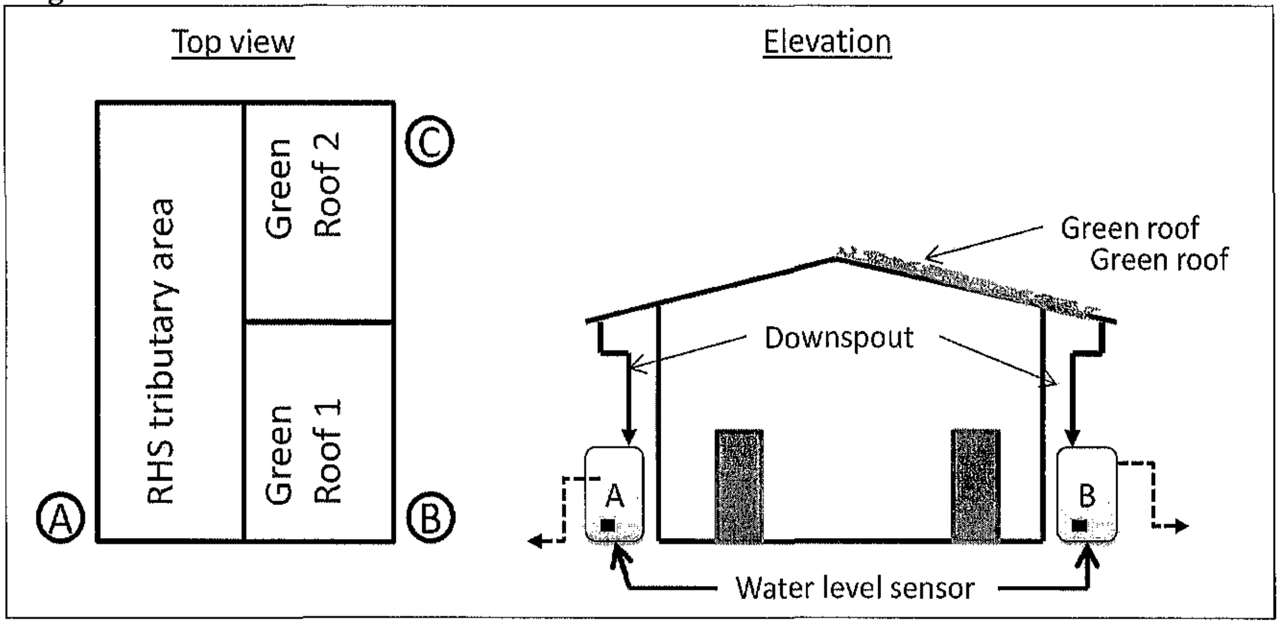



The green roof will consist of the plant layer, soil mix (medium), drainage layer, waterproof membrane and roofing material as Figure B1.5 shows. Plants will be selected to withstand minimal maintenance within the native species of the Lower Rio Grande Valley region

The green roof will be monitored for total rainfall, and runoff on a continuous basis. It will be installed on the restroom building in the park. The monitoring setup will consist of a rain gauge with data logger for measuring the inflow volume into the green roof. The runoff will be collected in cisterns (one for each section; separate gutter system will be installed) from which grab samples can be taken at the end of each storm event to measure the effectiveness of green roofs in reducing volume. These cisterns (see Table B1.1) will have a pressure transducer at the bottom to monitor water level to calculate the volume of stored water; it is the intention to use the water for irrigation once the corresponding data and water samples are collected. The tanks will have features to release water when it has reached the maximum storage level (see figure B1.6). The excess water will be released to a non-paved area near the restroom. A conventional rainwater collection system for a third section of roof will be implemented to collect supplemental water for use in the building. The volume of water in this third conventional roof collection cistern will also be monitored with a transducer and collected for sampling on a periodic basis (See Figure B1.6).

All the cisterns to be installed at this site will be emptied after each rain event once samples are collected. These grab samples will contain runoff collected during the rain event. Before collection, the water will be stirred to ensure a representative sample is taken.

**Figure B1.6. Restroom Schematics**

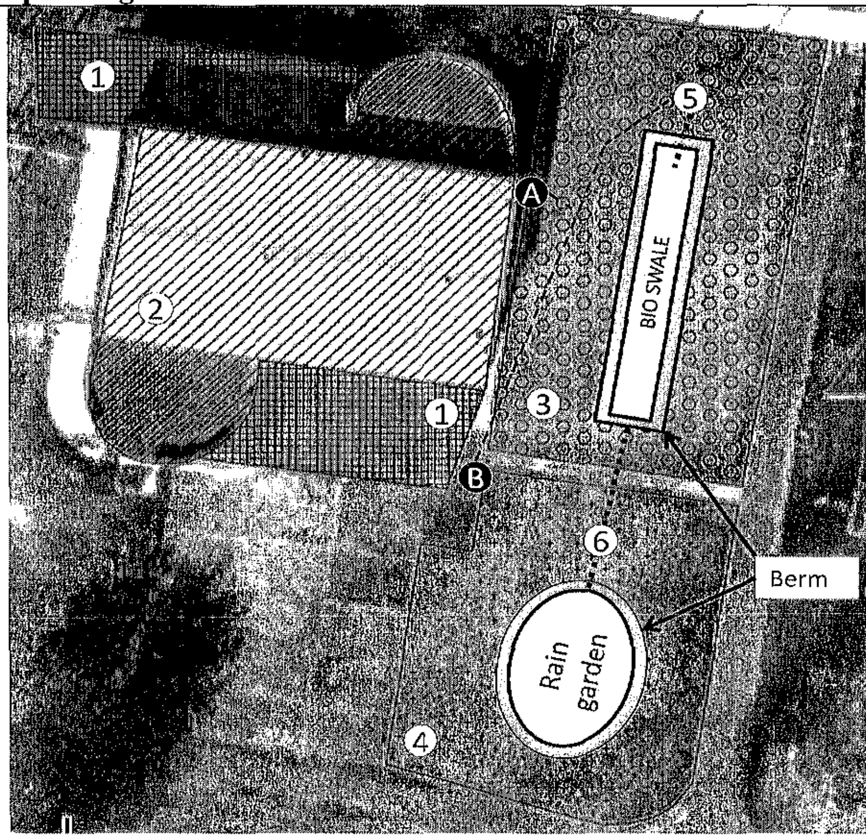



A: RHS cistern
B/C: Green roof runoff cistern (each section of green roof will have different vegetation array)
Dashed line coming out of cisterns: Overflow to non-paved area.

**Amigos del Valle Center. San Juan, Tx.**

The City of San Juan, is repairing the roof of the Amigos del Valle Center and will integrate the BMP's specified in Table B1.1 for the entire facility. Figure B1.7 presents a layout with the distribution of the LID features at the community center.

**Figure B1.7. Amigos del Valle Center. Layout indicating the locations of corresponding BMPs**



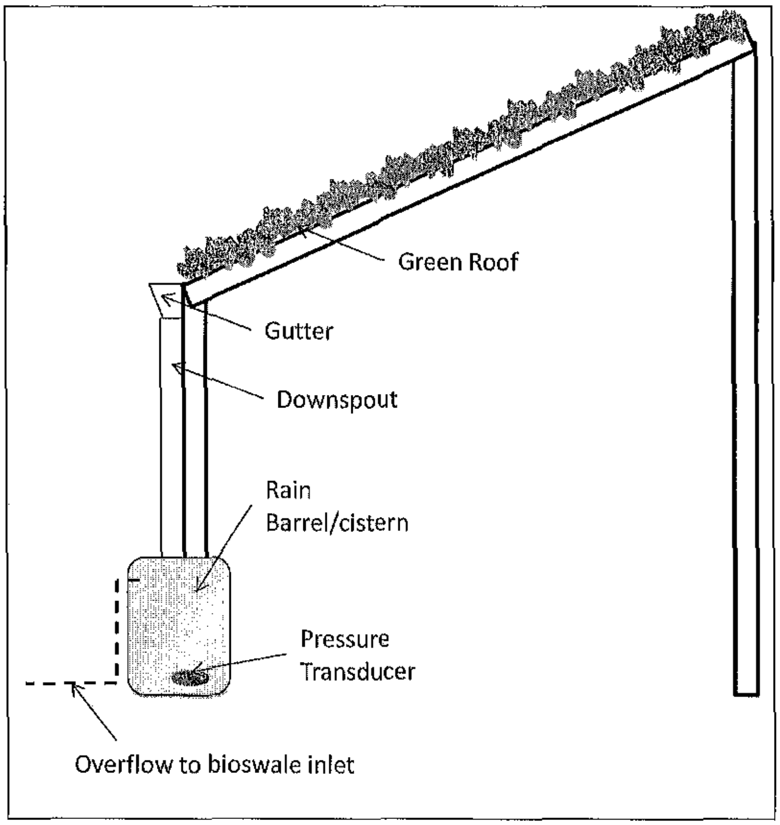

1: Green roof (squared grid hatch)
2: Catchment area for rain water harvesting system (diagonal lines hatch)
3: Bioswale catchment area (unfilled circle hatch)
4: Rain garden catchment area (cross hatch)
5: Runoff inlet bioswale
6: Runoff inlet to rain garden
A: RHS cistern
B: Green roof cistern
Dashed line: overflow pipe from cisterns to bioswale inlet.
Dotted line: Bioswale-rain garden connection pipe.

*Green Roof*

As noted in the figure above, two areas of the roof at the Center will be configured to receive and maintain a mix of vegetation (while both plant types will be drought tolerant, one will be a shallow rooted groundcover type and the other a more robust species such as Smooth Cordgrass or equivalent). These two sections have a slope of 24°. Each section will be planted with two different plant species (native to the LRGV region). The high slope (for green roof standards) is one factor that will differentiate this facility from others in the area. Irrigation will be specially designed because of the slope; an irrigation system will be installed for the beds to supply water during dry periods. The results obtained from this facility will demonstrate how the sloped roof affects its water retention capabilities for applications in the LRGV region.

The green roof water inflow will be estimated with a nearby rain gauge to be installed at the Center. The outflow will be collected in rain barrels/cisterns located at outfall of a downspout from each roof section. A pressure transducer will be installed at the bottom of the container to monitor the water level and calculate the runoff volume (Figure B1.8)

**Figure B1.8. ADV Center green roof schematic with rain barrel/cistern**



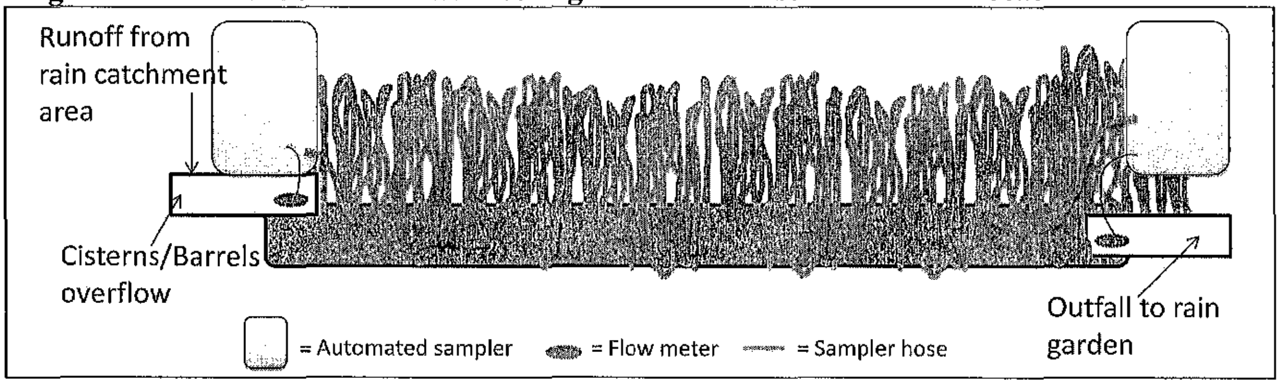

Samples for water for quality tests will be collected from grab sampling. In the case when a rain event precipitation volume exceeds the green roof and cistern holding capacities, the excess water will be directed to a bioswale/channel garden that will be installed near the building Just one green roof section will be monitored and results will be replicated for the other section.

All the cisterns to be installed at this site will be emptied after each rain event once samples are collected (within 24hrs after storm ceases). These grab samples will contain runoff collected during the rain event. Before collection, the water in the tank will be stirred to ensure a representative sample is taken.

*Bioswale*

This BMP will be constructed at the east side of the building and will receive excess run off from the corresponding rain catchment area* (see figure B1.7) and cistern overflows. All the inflows will be channeled to a convergence pipe which will discharge the water into the upflow end of the swale. A flow meter and an automated water sampler will be installed at the discharge end of the swale. A berm around the BMP will prevent additional run-on volume from any other source but the inlet pipe.

**Figure B1.9. ADV Center bioswale configuration and instrumentation location.**



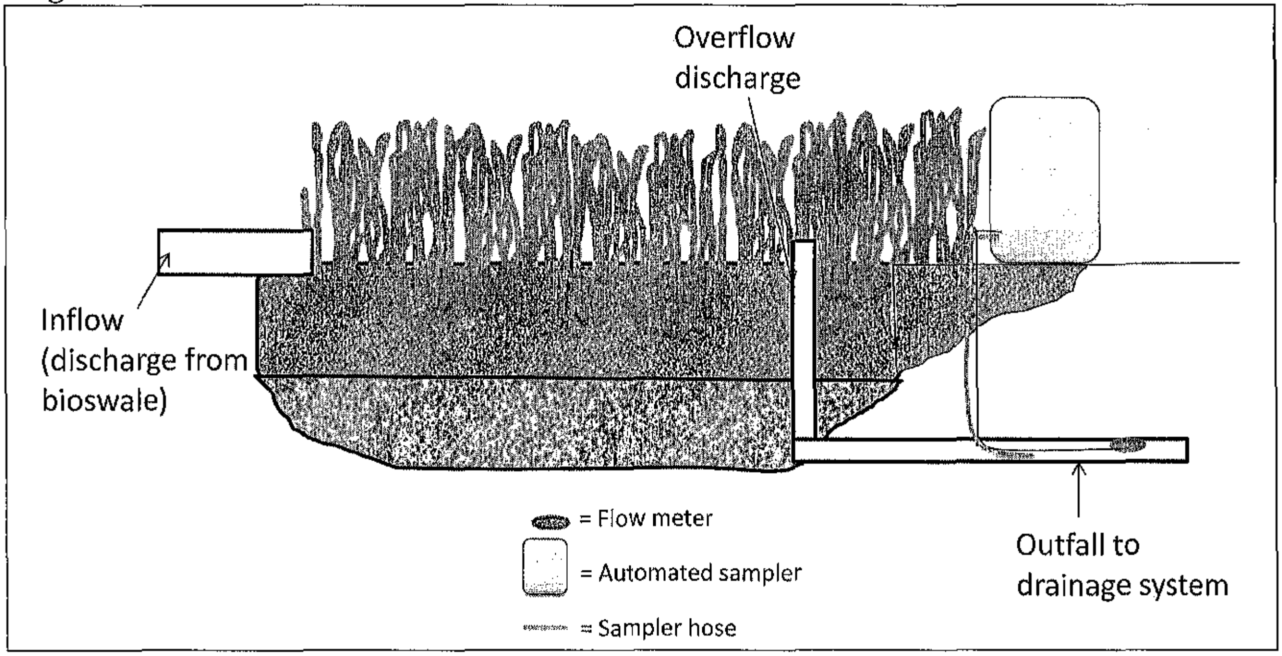

At the outfall, another sampler and flow meter will be installed to obtain water quality and quantity information of the stormwater passing through the BMP (Figure B1.9). The flow meters will be synchronized with the samplers based on the initial trigger parameters specified in Table B1.1; the trigger parameters can be adjusted as needed according the local rainfall patterns and flow rates measured, after consultation with the TCEQ Project Manager. The bioswale will be planted with suitable native vegetation on the slopes and base channel to reduce erosion as well as act as a potential filter strip. The design parameter for the swale overtopping is a precipitation of 1.5 in./24 hours.

*Rain Garden*

Since the bioswale will discharge into a nearby rain garden, the water quality and quantity at the swale's outlet will be the same at the rain garden's inlet. Any overflow from the rain garden can be sampled and measured in an overflow pipe at the far end of the feature (See Figure B1.10).

* Catchment area: An area characterized by all runoff being conveyed to the same outlet point, in this case, the BMP inlet.

**Figure B1.10. ADV Center Rain Garden schematic and instrumentation location.**




A surface overflow pipe will drain water to an underground pipe for automated sampling. A flow meter will measure the overflow of the entire rain event, and samples will encompass the first flush. As in the bioswale the flow meter and the sampler can be synchronized; sampling will take place once the flow rate trigger value is reached.

*Rainwater Harvesting System*

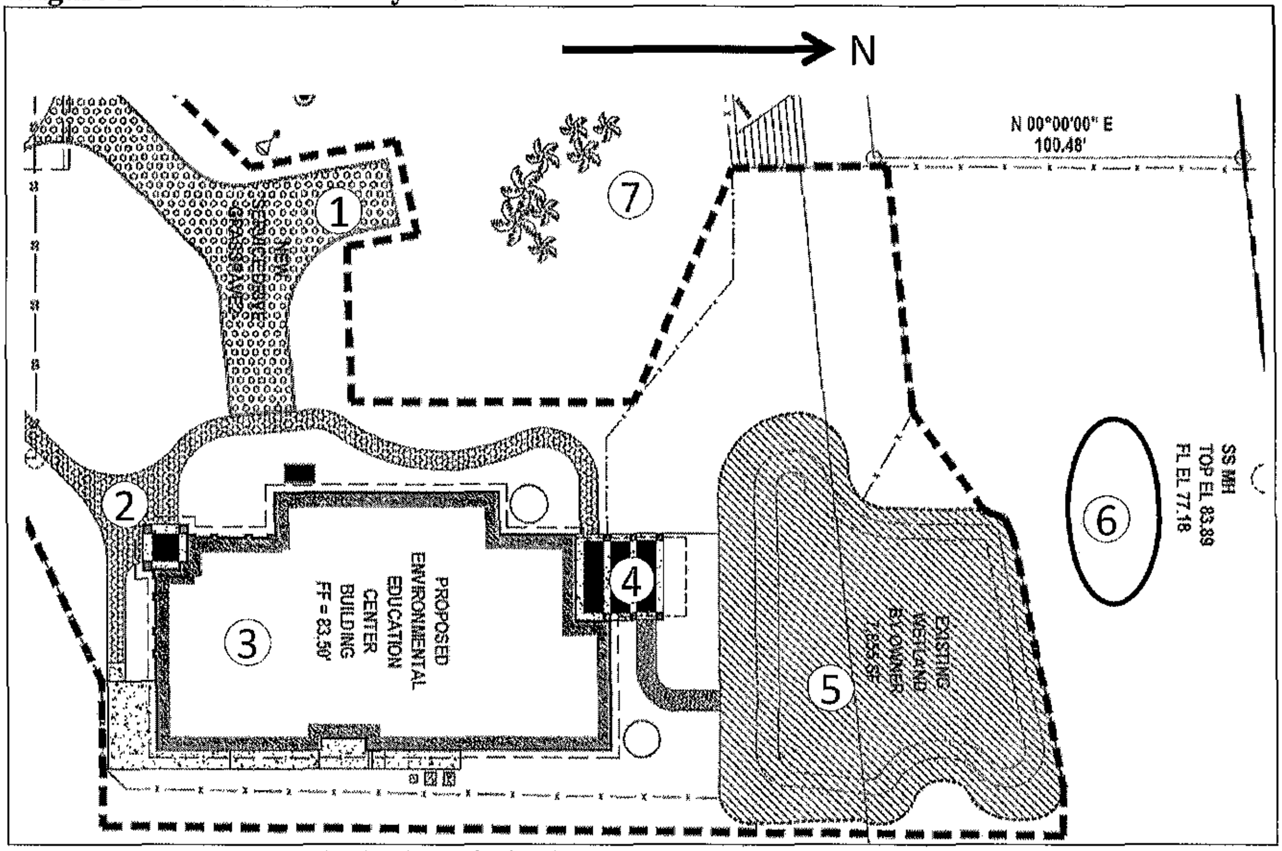
The rainwater harvesting BMP will consist of a section of the conventional roof located at the Amigos del Valle Community Center. The system will have a gutter with leaf guard and a downspout draining to the rainwater harvesting cisterns after the first flush is diverted.

The total runoff volume can be calculated by multiplying the area of roof, the roof runoff coefficient and rainfall depth. Under the current set up, a 1.5 inch rainfall should fill the rain barrels to capacity assuming a roof coefficient of 1. The barrels are equipped with pressure transducers that will monitor the depth of water in the cisterns continuously. Since the volume of water over the roof area can be estimated from the rain gauge and the volume of water in the barrels will be monitored, the overall flow reduction can be calculated. The barrels will be equipped with overflow pipes at the top that discharge into the bioswale inlet (see dashed line in Figure B1.7). As in the cisterns that collect water from the green roof, water samples can be sampled manually or with composite samplers for water quality testing.

**Valley Nature Center. Weslaco, Tx.**

The VNC will implement a project that will integrate five different LID BMPs in the new section of the Center Park where the new building will be constructed. Figure B1.11 presents the layout of the entire facility; the LID BMPs are highlighted.

**Figure B1.11. VNC BMP layout.**



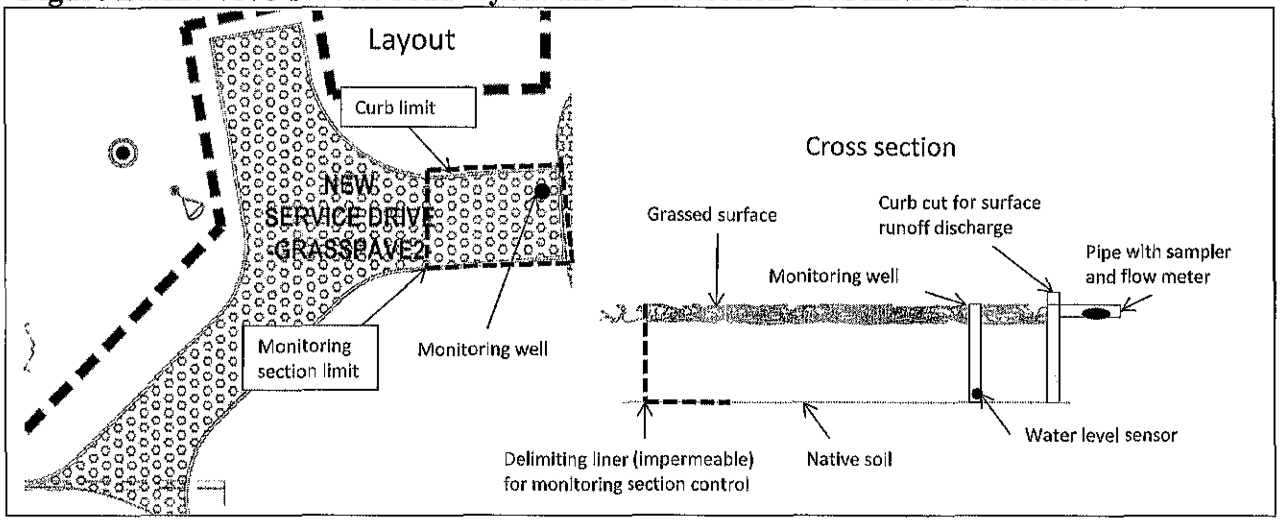

1: Pervious service roads (hollow circles hatch).
2: Pervious walking trails (hollow star hatch).
3: Rainwater harvesting catchment area.
4: Green roof
5: Wetland (diagonal lines hatch)
6: Vegetated cell (existing)
7: Overflow discharge area

*Pervious service road*

This BMP will use a grass paver system from Invisible Structures Inc. (or equivalent) which is a different porous pavement approach than other locations in the Valley. It will consist of a high resistance plastic grid overlaying the road sub-base. The grid will be covered by an amended (high infiltration rate) soil mixture where grass seeds will be planted by using sod or hydroseeding. This section will be surrounded by a curb to prevent run-on from other areas of the site.

An observation well will be provided with an inlet from the subsurface of the service road and the water level will be measured with a pressure transducer. In the rare case when the rainfall volume exceeds the storage capacity, the water will exit the observation well and it will be channeled to the overflow discharge area (see Figure B1.11 section marked with number (7) for infiltration/evaporation. At the curb cut, runoff water samples can be collected manually. During the initial sampling and monitoring period the driveway will be seldom used (a condition necessary for this kind of pavement to develop a healthy grass cover). .

**Figure B1.12: VNC service road layout and cross section with instrumentation.**



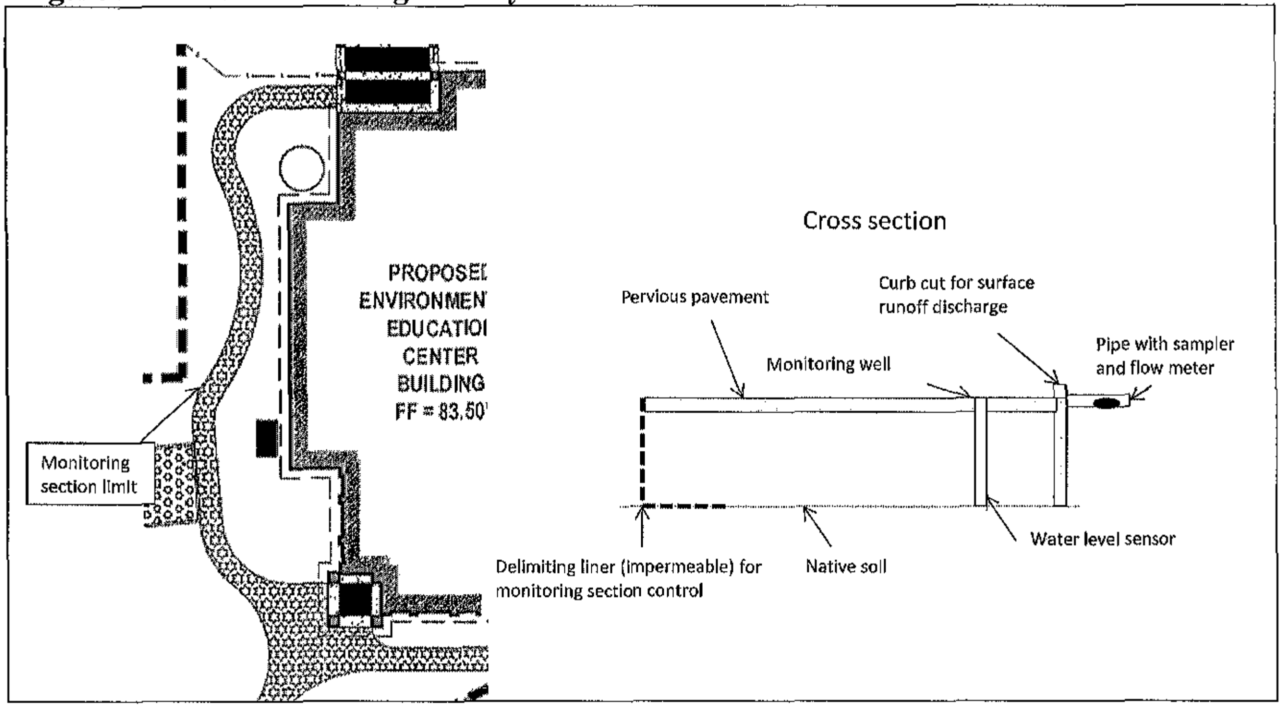

Performance evaluation of this, water quality data collected will be compared to a rainfall water quality from literature.

*Pervious walking trails*

Only a segment about 50 ft long within the walking trail at the VNC will be planned for monitoring runoff. This section will be surrounded by a barrier (curbs and liner) that will keep it isolated from any run-on from surrounding areas. Additionally, the section of study will be elevated relative to the rest of the trail to ensure only direct rainfall will be collected.

As shown in figure B1.13, inflow will be calculated with the information gathered by the rain gauge and water level in the observation well. The surface runoff will be channeled to the overflow discharge area in figure B1.11 as well as the overflow from the service road. In the monitoring well, a pressure transducer will be placed to measure the water level and samples will be collected manually from the discharge pipe placed at curb cut.

**Figure B1.13: VNC Walking trail layout and cross section with instrumentation.**




*Rainwater harvesting system*

This BMP (number 3 in Figure B1.11) will be designed to fully collect a 2.5 in rain fall/over 24 hours over the roof area. The system will have gutters and downspouts with leaf guards and a first flush diverter. The inflow will be calculated using the measured rainfall multiplied by the area of the collection roof; a pressure transducer in the cistern will monitor the water level to estimate the volume stored (i.e. flow reduction); samples will be collected manually. The overflow will be discharged into the VNC wetland.

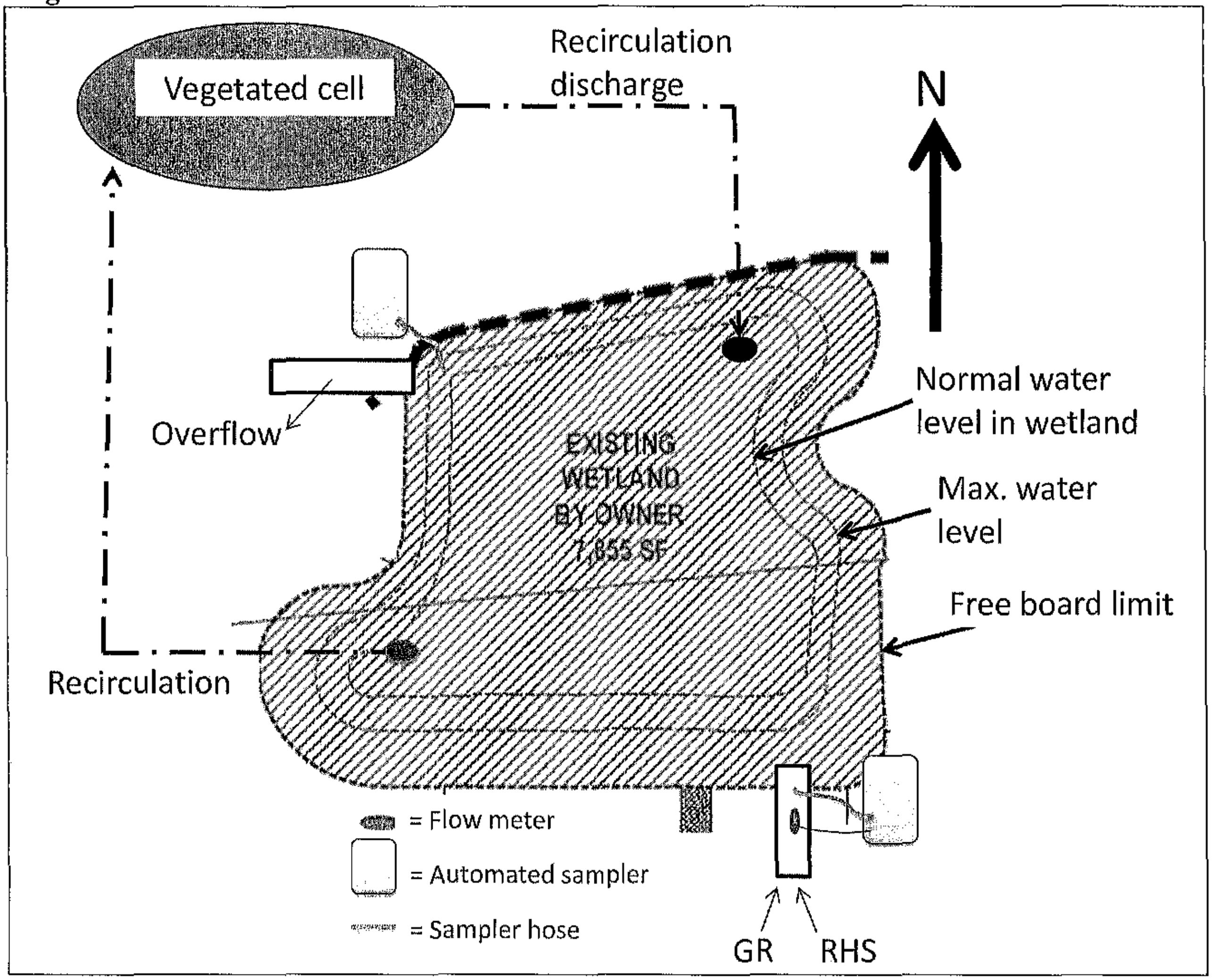
*Green roof*

The green roof at the VNC will be connected to a system to collect the runoff in the cistern from which grab samples will be taken at the end of each rainfall event selected for monitoring. This cistern will have a pressure transducer to monitor water level that will be used to calculate the volume of stored runoff; the collected water will be used for irrigation on the property once the corresponding data and water samples are collected. The tanks will have features to release water when it has reached the maximum storage level. The excess water will be released into the stormwater wetland or nearby rain gardens.

*Treatment wetland*

The wetland will be designed as shown in Fig. B1.14 and planted with native vegetation cell for treatment and minimal maintenance and a larger cell for stormwater retention; accumulation of direct rainfall on both cells, supplemental water (to keep wet conditions during dry periods) and overflow of from green roof and RHS cisterns will be accounted as inflow. Outflow and water quality (for all inputs and outputs) will be studied quantitatively and qualitatively. All of runoff influent will be collected and discharged into a pipe where a flow meter and an automated water sampler will be gathering data and aliquots, correspondingly (runoff influent will only go to the existing wetland, not the vegetated cell). This will normally behave as a closed system. In the case of a heavy storm or a sequence of rain events that may cause the wetland reach its maximum capacity, an overflow pipe will direct the water to an excess spillover area north of the VNC facility (noted with the number 7 in figure B1.11); the overflow discharge area is a natural basin where the water naturally infiltrates (according to VNC personnel).

**Figure B1.14. VNC Wetland schematic**



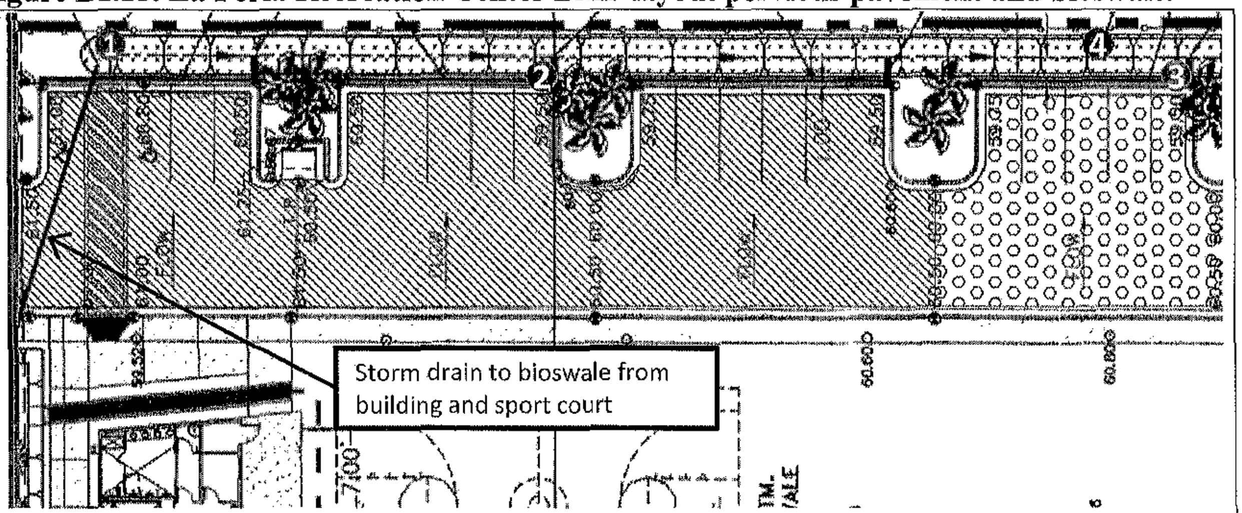

GR: Green roof's cistern overflow; RHs: Rain water harvesting system overflow

Since the wetland is at a high point, topographically speaking, the inflows will be direct rainfall (tributary area delimited by the free board highest point) and overflow from the green roof and RHS, as previously noted. This BMP will have a solar pump to recirculate the water through a vegetated cell for treatment, to avoid water stagnation and flow short circuiting. The recirculation point (noted in Figure B1.14) is where the solar pump intake will be located. The pump will take the water to the vegetated cell north the wetland (see Figure B1.11, number 6) that is 3.5ft (aprox.) higher than the wetland surface. From this pond the water will return to a wetland (at the recirculation discharge point see figure B1.14, Dash-dot). Water quantity and quality of inflow and in the wetland will be monitored with flow meters and automated samplers as shown in the figure above. Since this wetland will mainly operate as a retention-treatment device (like a rain garden) it is privileged to monitor the water quality in the water body rather than at the overflow discharge.

**City of La Feria Recreation Center**

The Recreation Center in the city of La Feria will incorporate an LID pervious parking lot consisting of five stalls and a driveway access (section hatched with unfilled circles in Figure B1.15); a control section of the parking lot (non-LID paver section, fourteen stalls and proportional drive way area; segment hatched with diagonal lines in figure below) will be monitored to compare the two sections and confirm the BMP performance. Each section will be isolated from receiving external runoff through elevation and/or curbing and its inflow will be estimated with a rain gauge that will be installed at the site. Additionally, a bioswale will be installed next to the parking lot which will receive runoff from the control section, the overflow the pervious section and runoff from building and sport court area (see figure). The design storm event is to collect and store 1.5 in rainfall over 24 hours.

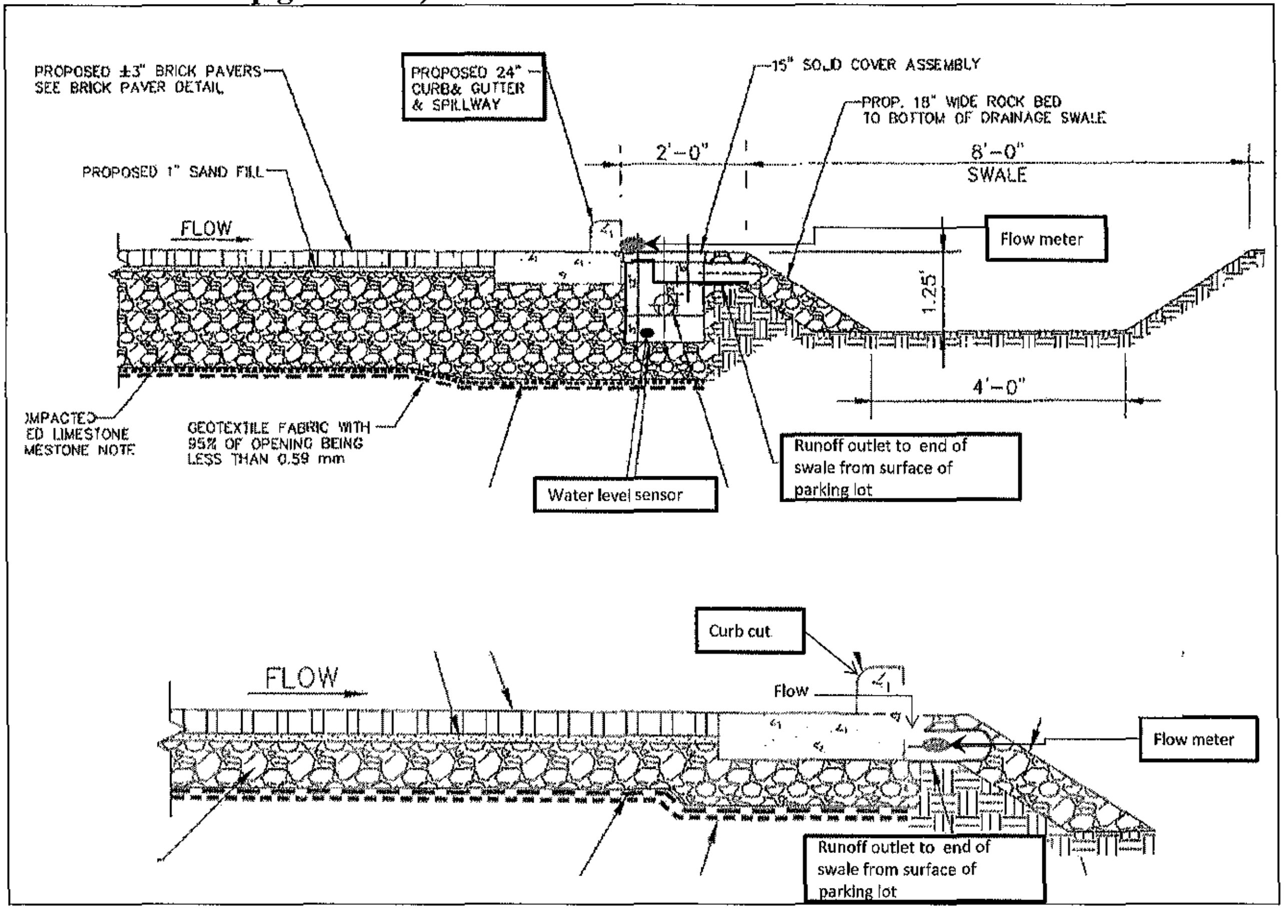
**Figure B1.15. La Feria Recreation Center BMP layout pervious pavement and bioswale.**




** Dot hatch area: bioswale; diagonal hatch area: conventional paver pavement; open circle hatch area: pervious pavement

1: Bioswale inlet (stormwater from buildings and sport courts). An automated sampler and flow meter will be installed at this point.
2: Runoff discharge from non LID paver parking lot (6 in. gravel bed). Samples to be grabbed manually from overflow pipe.
3: Overflow discharge from LID pervious pavement
4: Discharge to the municipal drainage system. Flow meter and automated water sampler to be installed in this outfall.

**Figure B1.16. La Feria Parking lot cross section (top: LID 18 in deep gravel bed; bottom: non-LID 6 in deep gravel bed)**



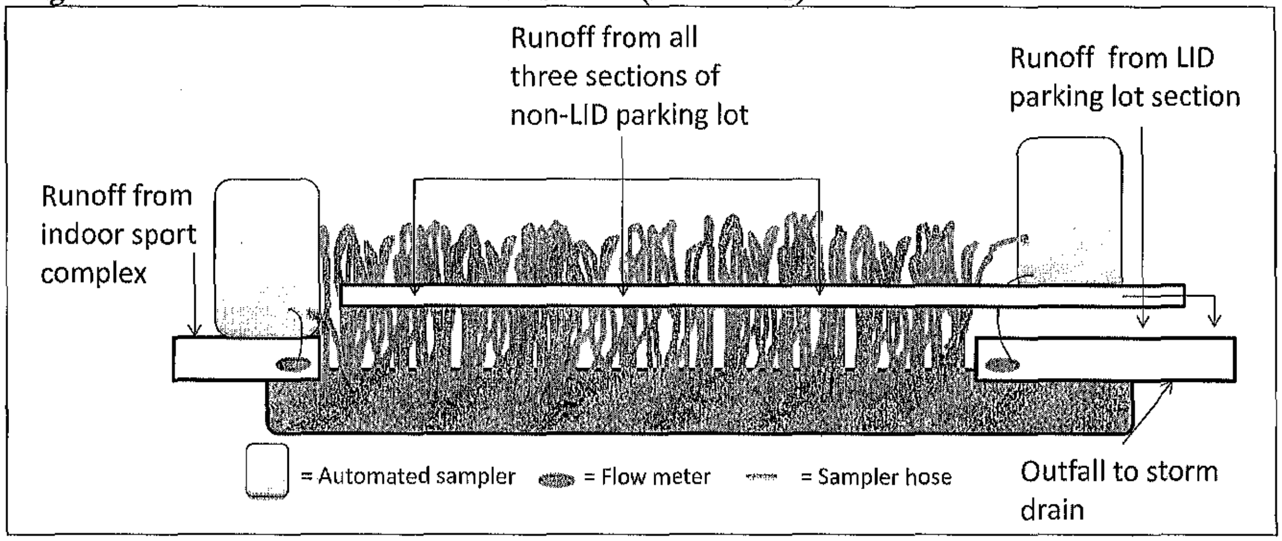

Runoff quantity and quality will be measured at the discharge pipes (where samplers will be located.), and storage will be estimated (based on subsurface void percentage and rainfall measured). Inflow through the porous section will be estimated from rainfall measured by a rain gauge (ISCO 674 or equivalent) to be installed on the property while the outflow will be measured with bubbler type flow meters. The conventional paver (not for stormwater management purposes) section runoff volume will also be measured and samples will be collected manually at the outfall (see Figure B1.15).

Pavers made from waste concrete will be used as a paving material; its performance will be compared to the performance and cost of other materials that will be applied at the Brownsville site (traditional concrete pavers) and the VNC (grass pavers). It is also important to highlight the fact that the parking lot will be actively used during the sampling and monitoring periods.

*Bioswale*

This BMP will be located next to the parking lot and will receive run off from the sport complex parking area and conveyed to the upstream end of the bioswale (see figure B1.5) where a flow meter and an automated sampler will be installed. A berm around the BMP will prevent additional run-on discharge from any other source but the inlet pipe.

**Figure B1.17. La Feria bioswale cross section (schematics).**




At the outfall, another sampler and flow meter will be installed to obtain water quality and quantity information of the runoff passing through the BMP (Figure B1.17). The flow meters will be synchronized with the samplers based on the initial trigger parameters specified in Table B1.1; the trigger parameters can be adjusted as needed according to the local rainfall patterns and flow rates measured, after consultation with the TCEQ Project Manager. The bioswale will be planted with suitable native vegetation on the slopes and base channel to reduce erosion as well as act as a potential filter strip. The design parameter for the swale overtopping is a precipitation of 1.5 in. As shown in figure above, the runoff from the parking lot will be channeled through a separate pipe and will be discharged downstream from the outflow sampler to avoid comingled flows in the bioswale.

**Sampling plan summary tables**

**Table B1.3. Instrumentation to be used per type of BMP**

| BMP | Inflow | | Outflow | | Storage | |
|---|---|---|---|---|---|---|
| | Quantity | Quality | Quantity | Quality | Quantity | Quality |
| Impervious Parking lot | Rain Gauge (ISCO 674 or equivalent) | NA | Flow meter* (ISCO Signature or equivalent) | Manual grab | NA | NA |
| Pervious parking lot | Rain Gauge (ISCO 674 or equivalent) | NA | Flow meter* (ISCO Signature or equivalent) | Manual grab | Pressure transducer ( Troll 100 or equivalent) | Manual grab (from discharge pipes) |
| Pervious walking trails | Rain Gauge (ISCO 674 or equivalent) | NA | Flow meter (ISCO Signature or equivalent) | Manual grab | Pressure transducer ( Troll 100 or equivalent) | Manual grab (from discharge pipes) |
| Green Roof | Rain Gauge (ISCO 674 or equivalent) | NA | NA | NA | Pressure transducer ( Troll 100 or equivalent) | Manual grab (from cistern) |
| Rainwater collection system | Rain Gauge (ISCO 674 or equivalent) | NA | NA | NA | Pressure transducer ( Troll 100 or equivalent) | Manual grab (from cistern) |
| Rain Garden | Flow meter (ISCO Signature or equivalent) | Automated sampler (ISCO 6700 or equivalent) | Flow meter (ISCO Signature or equivalent) | Automated sampler (ISCO 6700 or equivalent) | NA | NA |
| Linear bioswale | Flow meter (ISCO Signature or equivalent) | Automated sampler (ISCO 6700 or equivalent) | Flow meter (ISCO Signature or equivalent) | Automated sampler (ISCO 6700 or equivalent) | NA | NA |
| Wetland | Flow meter (ISCO Signature or equivalent) | Automated sampler (ISCO 6700 or equivalent) | Flow meter (ISCO Signature or equivalent) | Automated sampler (ISCO 6700 or equivalent) | NA | NA |

* Monte Bella park is using flume with pressure meter method.
NA: Not applicable

**Table B1.4. Total Samples Taken for each Parameter at each BMP**

| Site | Type of BMP | Parameter | Rain events to sample and test* | Type of Sample** |
|---|---|---|---|---|
| Monte Bella Park | Pervious parking lot | TSS | 6 | Discrete |
| | | E.coli | 4 | Discrete |
| | | BOD | 6 | Discrete |
| | Pervious walking trails | TSS | 6 | Discrete |
| | | E.coli | 4 | Discrete |
| | | BOD | 6 | Discrete |
| | Green Roof | TSS | 6 | Discrete |
| | | N | 6 | Discrete |
| | | P | 6 | Discrete |
| | | BOD | 6 | Discrete |
| | Rainwater collection system | TSS | 6 | Discrete |
| Amigos del Valle | Rainwater collection system | TSS | 6 | Discrete |
| | Green Roof | TSS | 6 | Discrete |
| | | N | 6 | Discrete |
| | | P | 6 | Discrete |
| | | BOD | 6 | Discrete |
| | Rain Garden | TSS | 6 | Composite |
| | | N | 6 | Composite |
| | | P | 6 | Composite |
| | | E. coli | 4 | Composite |
| | | BOD | 6 | Composite |
| | Linear bioswale | TSS | 6 | Composite |
| | | N | 6 | Composite |
| | | P | 6 | Composite |
| | | E. coli | 4 | Composite |
| | | BOD | 6 | Composite |
| Valley Nature Center | Rainwater collection system | TSS | 6 | Discrete |
| | Green Roof | TSS | 6 | Discrete |
| | | N | 6 | Discrete |
| | | P | 6 | Discrete |
| | | BOD | 6 | Discrete |
| | Pervious walking trails | TSS | 6 | Discrete |
| | | E.coli | 4 | Discrete |
| | | BOD | 6 | Discrete |
| | Pervious service road | TSS | 6 | Discrete |
| | | E.coli | 4 | Discrete |

| | | | | |
|---|---|---|---|---|
| | | BOD | 6 | Discrete |
| | Treatment Wetland | TSS | 6 | Composite |
| | | N | 6 | Composite |
| | | P | 6 | Composite |
| | | E. coli | 4 | Composite |
| | | BOD | 6 | Composite |
| La Feria Sport Complex | Pervious parking lot | TSS | 6 | Discrete |
| | | E.coli | 4 | Discrete |
| | | BOD | 6 | Discrete |
| | Traditional parking lot | TSS | 6 | Discrete |
| | | E.coli | 4 | Discrete |
| | | BOD | 6 | Discrete |
| | Bioswale | TSS | 6 | Composite |
| | | N | 6 | Composite |
| | | P | 6 | Composite |
| | | E. coli | 4 | Composite |
| | | BOD | 6 | Composite |

* Tied to rainfall. Number reflects the minimum samples to take in the entire duration of the project.

** Only one sample of water will be taken in each rain event characterized regardless the type of sampling specified.

**Table B1.5. Station location details**

| Site | TCEQ ID** | Monitoring Station Description | Longitude Latitude ** | Sample Matrix | Minimum Total Estimated Sampling Events* | Mode of sampling | Additional data to be collected | Minimum Total Estimated Inflow/Outflo/ Storage Volume Measurement Events *** | Comments |
|---|---|---|---|---|---|---|---|---|---|
| Monte Bella Park | TBD | Inflow (rain gauge) | TBD | Water | NA | NA | Precipitation depth (in) and intensity (in/hr) | 10 | Data collection tied to rainfall. Inflow volume will be calculated using BMP catchment area |
| | TBD | Outflow impervious parking lot | TBD | Water | 6 | Manual, Discrete | Flow rate (cfs) | 10 | Tied to rain event strong enough to generate runoff to the trigger level |
| | TBD | Outflow pervious parking lot | TBD | Water | 6 | Manual, Discrete (from discharge pipes) | Flow rate (cfs) | 10 | Tied to rain event strong enough to generate runoff to the trigger level |
| | TBD | Storage pervious parking lot | TBD | Water | NA | NA | water level (in) | 10 | Tied to presence of water. Volume will be calculated using BMP catchment area |
| | TBD | Storage in RHS cistern | TBD | Water | 6 | Manual, Discrete | water level (in) | 10 | Tied to presence of water. Volume will be calculated using BMP catchment area |
| | TBD | Storage in green roof cistern 1 | TBD | Water | 6 | Manual, Discrete | water level (in) | 10 | Tied to presence of water. Volume will be calculated using BMP |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | catchment area |
| | TBD | Storage in green roof cistern 2 | TBD | Water | 6 | Manual, Discrete | water level (in) | 10 | Tied to presence of water. Volume will be calculated using BMP catchment area |
| | TBD | Outflow walking trail | TBD | Water | 6 | Manual, Discrete | Flow rate (cfs) | 10 | Tied to rain event strong enough to generate runoff to the trigger level |
| | TBD | Storage walking trail | TBD | Water | NA | NA | water level (in) | 10 | Tied to presence of water. Volume will be calculated using BMP catchment area |
| Amigos del Valle Center | TBD | Inflow (rain gauge) | TBD | Water | NA | NA | Precipitation depth (in) and intensity (in/hr) | 10 | Data collection tied to rainfall. Inflow volume will be calculated using BMP catchment area |
| | TBD | Storage in RHS cistern | TBD | Water | 6 | Manual, Discrete | water level (in) | 10 | Tied to presence of water. Volume will be calculated using BMP catchment area |
| | TBD | Storage in green roof cistern | TBD | Water | 6 | Manual, Discrete | water level (in) | 10 | Tied to presence of water. Volume will be calculated using BMP catchment area |
| | TBD | Inflow Bioswale | TBD | Water | 6 | Automated, composite | Flow rate (cfs) | 10 | Tied to rain event strong enough to generate runoff to the trigger level |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | TBD | Outflow Bioswale/ Inflow Rain Garden | TBD | Water | 6 | Automated, composite | Flow rate (cfs) | 10 | Tied to rain event strong enough to generate runoff to the trigger level |
| | TBD | Outflow Rain Garden | TBD | Water | 6 | Automated, composite | Flow rate (cfs) | 10 | Tied to rain event strong enough to generate runoff to the trigger level |
| Valley Nature Center | TBD | Inflow (rain gauge) | TBD | Water | NA | NA | Precipitation depth (in) and intensity (in/hr) | 10 | Data collection tied to rainfall. Inflow volume will be calculated using BMP catchment area |
| | TBD | Outflow pervious service road | TBD | Water | 6 | Manual, Discrete (from discharge pipes) | Flow rate (cfs) | 10 | Tied to rain event strong enough to generate runoff to the trigger level |
| | TBD | Outflow pervious walking trail | TBD | Water | 6 | Manual, Discrete | Flow rate (cfs) | 10 | Tied to rain event strong enough to generate runoff to the trigger level |
| | TBD | Storage walking trail | TBD | Water | NA | NA | water level (in) | 10 | Tied to presence of water. Volume will be calculated using BMP catchment area |
| | TBD | Storage service road | TBD | Water | NA | NA | water level (in) | 10 | Tied to presence of water. Volume will be calculated using BMP catchment area |
| | TBD | Storage in RHS cistern | TBD | Water | 6 | Manual, Discrete | water level (in) | 10 | Tied to presence of water. Volume will be calculated using BMP catchment area |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | TBD | Storage in green roof cistern | TBD | Water | 6 | Manual, Discrete | water level (in) | 10 | Tied to presence of water. Volume will be calculated using BMP catchment area |
| | TBD | Inflow wetland | TBD | Water | 6 | Automated, composite | Flow rate (cfs) | 10 | Tied to rain event strong enough to generate runoff to the trigger level |
| | TBD | Outflow wetland | TBD | Water | 6 | Automated, composite | Flow rate (cfs) | 10 | Tied to rain event strong enough to generate runoff to the trigger level |
| La Feria Sport Complex | TBD | Inflow (rain gauge) | TBD | Water | NA | NA | Precipitation depth (in) and intensity (in/hr) | 10 | Data collection tied to rainfall. Inflow volume will be calculated using BMP catchment area |
| | TBD | Outflow impervious parking lot | TBD | Water | 6 | Manual, Discrete | Flow rate (cfs) | 10 | Tied to rain event strong enough to generate runoff to the trigger level |
| | TBD | Outflow pervious parking lot | TBD | Water | 6 | Manual, Discrete (from discharge pipes) | Flow rate (cfs) | 10 | Tied to rain event strong enough to generate runoff to the trigger level |
| | TBD | Storage pervious parking lot | TBD | Water | NA | NA | Water level (in) | 10 | Tied to presence of water. Volume will be calculated using BMP catchment area |
| | TBD | Inflow Bioswale | TBD | Water | 6 | Automated, composite | Flow rate (cfs) | 10 | Tied to rain event strong enough to generate runoff to the trigger level |
| | TBD | Outflow Bioswale | TBD | Water | 6 | Automated, composite | Flow rate (cfs) | 10 | Tied to rain event strong enough to |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | generate runoff to the trigger level |

NA. Not Applicable
* Table B1.4 specifies the number of events samples to be taken for each parameter.
** No monitoring data will be collected or submitted to TCEQ before SLOC request are submitted and only data with a valid TCEQ Monitoring Station ID will be stored in SWQMIS.
*** Inflow/outflow volume measurements will be taken every minute for values equal or greater than the specified trigger. (see table B1.2)

# B2 SAMPLING METHODS

### Field Sampling Procedures

A SOP for the automated sampler data collection is attached as Appendix E of this document. Field sampling will be conducted according to procedures documented in the *TCEQ Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, 2008.*

Sample volume, container types, minimum sample volume, preservation requirements, and holding time requirements for each analytical test collected are given in table B2.1. Preservation of all samples is performed in the field immediately upon collection, within 15 minutes.

**Table B2.1 Storage, Preservation and Handling Requirements**

| Parameter | Container | Minimum Sample Volume (ml) | Preservation | Maximum Storage |
|---|---|---|---|---|
| Total Kjeldahl N | Plastic or Glass | 250 | p H< 2 (ADD $H_2SO_4$), 4° C | 28d |
| Total Phosphorous | Plastic | 250 | p H< 2 (ADD $H_2SO_4$), 4° C | 28d |
| TSS | Plastic or Glass | 1000 (based on turbidity) | 4°C | 7d |
| BOD | Plastic or Glass | 300 | 4°C | 48h |
| *E.coli* | Plastic or Glass | 100 | 4°C | 24h |

### 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 visits, station ID, location, sampling time, sampling date, sampling depth, preservatives added to samples, and sample collector's name/signature are recorded. Values for all measured field parameters are recorded. Detailed observational data are recorded including water appearance, weather, biological activity, stream uses, unusual odors, specific sample information, missing parameters, days since last significant rainfall, and flow severity.

### 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 TAMUK Project Manager, in consultation with the TAMUK 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 the container with an indelible marker. Label information includes:

1. Site identification
2. Date and time of collection
3. Preservative added, if applicable
4. Designation of "field-filtered" *(for metals)* as applicable
5. Sample type (i.e., analysis(es)) to be performed

### Sample Handling

Samples are collected at the field site after each rain event, labeled and appropriately preserved for laboratory analysis. Once preserved, the samples will be packaged according to the specifications of the subcontracted NELAC certified laboratory and transported to the contracted laboratory by courier.

The details concerning how the samples are logged in at the laboratory, how they are examined for documentation and preservation, how holding times are insured etc, will be provided once a decision is made on selection of the NELAC certified laboratory.

**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 TAMUK Project Manager in consultation with the TAMUK 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 A7.1. Laboratories collecting data under this QAPP are compliant with the NELAC 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.

## BMP Design Approach

The design reports will include estimation of anticipated load reductions for each BMP and estimation of anticipated flow volume into and out of each BMP. Anticipated flow volumes will allow for proper sizing and/or site-specific design specifications of the BMPs. For rainwater harvesting BMPs the annual roof runoff and total water demands of a site need to be evaluated in order to determine the optimal storage capacity. The anticipated performance will be compared to the actual performance so that design specifications for these BMPs can be more realistically set for future installations. BMP-specific equations and pollutant concentrations will be obtained from available scientific literature and cited within report. Local data such as monthly precipitation, lake evaporation rates, and evapotranspiration (ET) rates will be obtained from certified sources such as the National Climatic Data Center, the Texas Water Development Board, and the Texas ET Network. Anticipated load reductions will be presented in lbs/year for each BMP type. All design reports must be approved by the TCEQ Project Manager."

## BMP Measured Performance Approach

This section describes how BMP performance will actually be measured, using monitoring data obtained from the study. This data will be compared to the anticipated performance in the design reports so that design specifications for BMPs can be more realistically set for future installations.

The data collected with the instrumentation installed at each BMP will be processed to calculate flow, volume and contaminant load reduction. In Table B4.1 are enlisted the data outputs of the equipment.

**Table B4.1 Data source and output by BMP**

| Type of BMP | Data source* | Data output |
|---|---|---|
| Green roof | Rain gauge | Inflow: in of precipitation |
| | pressure transducer | Water level in cistern: in |
| | water sample | Water quality parameters in the tank: mg/l, MPN/100 ml |
| RHW | Rain gauge | Inflow : in of precipitation |
| | pressure transducer | Water level in cistern: in |
| | water sample | Water quality parameters in the tank: mg/l, MPN/100 ml |
| Pervious parking lot | Rain gauge | Inflow : in of precipitation |
| | pressure transducer | Water level in gravel bed: in |
| | flow meter | Outflow BMP: ft3/hour |
| | water sample | Water quality parameters outflow: mg/l, MPN/100 ml |
| Pervious walking trail | Rain gauge | Inflow : in of precipitation |
| | pressure transducer | Water level in gravel bed: in |
| | flow meter | Outflow BMP: ft3/hour |
| | water sample | Water quality parameters outflow: mg/l, MPN/100 ml |
| Bioswale | Rain gauge | Inflow : in of precipitation |
| | flow meter | Inflow BMP: ft3/hour<br>Outflow BMP: ft3/hour |
| | water sample | Water quality parameters inflow: mg/l, MPN/100 ml<br>Water quality parameters outflow: mg/l, MPN/100 ml |
| Rain garden | Rain gauge | inflow: in of precipitation |
| | flow meter | Inflow BMP: ft3/hour<br>Outflow BMP: ft3/hour |
| | water sample | Water quality parameters inflow: mg/l, MPN/100 ml<br>Water quality parameters outflow: mg/l, MPN/100 ml |
| Wetland | Rain gauge | inflow: in of precipitation |

| | | |
|---|---|---|
| | flow meter | Inflow BMP: ft3/hour<br>Outflow BMP: ft3/hour |
| | water sample | Water quality parameters inflow: mg/l, MPN/100 ml<br>Water quality parameters outflow: mg/l, MPN/100 ml |

* All instruments are capable to measure at a defined time interval.

*Green roof*

Volume reduction:

- The height of precipitation ($P_i$) will be multiplied by the green roof square-footage (AGR) to calculate the total volume of rainfall on the BMP ($V_p$).
- The overflow will be stored in the cistern adjacent to the roof, where the pressure transducer reading will be converted to water level ($L_{GR}$), hence, the overflow volume can be calculated($V_{OfGR}$).
- The difference between the volume of precipitation and volume in the tank will be volume reduction ($V_R$).

Average flow reduction:

- The volume reduction will be divided by the time of precipitation ($t_{Pi}$) to calculate the flow reduction.

Total storm event contaminant load reduction

- Samples will be collected and contaminant concentration will be obtained from the NELAC certified lab after samples are shipped and analyzed.
- Concentration will be multiplied by the volume reduction to calculate load reduction.

Average contaminant load reduction per unit of time.

- The Total storm event contaminant load reduction will be divided by the duration of the storm event to calculate the Average contaminant load reduction per unit o time.

Total yearly load reduction

- The total contaminant load reduction of each sampled precipitation will be divided by the rainfall inches of its corresponding event.
- A weighted average of all characterized events will be calculated and the resulting value will be multiplied by the total rain inches in that year. The result will be the estimated annual load reduction by the BMP.

*Rainwater Harvesting System*

Volume reduction:

- The height of precipitation will be multiplied by the roof square-footage to calculate the total volume of rainfall on the BMP.
- The overflow will be stored in the cistern adjacent to the roof, where the pressure transducer reading will be converted to water level; hence, the overflow volume can be calculated.
- The difference between the volume of precipitation and volume in the tank will be volume reduction.

Average flow reduction:

- The volume reduction will be divided by the time of precipitation to calculate the flow reduction.
-

Total storm event load reduction.

- Samples will be collected and contaminant concentration will be obtained from the NELAC certified lab after samples are shipped and analyzed.

- Concentration will be multiplied by the volume reduction to calculate load reduction.

Average load reduction per unit of time
- The total storm event load reduction will be divided by the duration of the event.

Total yearly load reduction
- The total contaminant load reduction of each sampled precipitation will be divided by the rainfall inches of its corresponding event.
- A weighted average of all characterized events will be calculated and the resulting value will be multiplied by the total rain inches in that year. The result will be the estimated annual load reduction by the BMP.

*Pervious parking lot*
Volume reduction:
- The height of precipitation will be multiplied by the pavement square-footage to calculate the total volume of rainfall on the BMP.
- Runoff flow rate will be measured at the curb cut/discharge pipe and multiplied by the time it flowed to calculate runoff volume.
- The difference between the volume of precipitation and runoff volume will be the reduction.

*For those BMPs that have a control (Monte Bella Park and La Feria), the volume reduction will be subtracted to the one calculated for the pervious section.

Flow reduction:
- The volume reduction (calculated above) will be divided by the time of precipitation to calculate the flow reduction.

Total storm event load reduction.
- Samples will be collected and contaminant concentration will be obtained from the NELAC certified lab after samples are shipped and analyzed.
- Concentration will be multiplied by the volume reduction to calculate load reduction.

Average load reduction per unit of time
- The total storm event load reduction will be divided by the duration of the event.

Total yearly load reduction
- The total contaminant load reduction of each sampled precipitation will be divided by the rainfall inches of its corresponding event.
- A weighted average of all characterized events will be calculated and the resulting value will be multiplied by the total rain inches in that year. The result will be the estimated annual load reduction by the BMP.

*Pervious walking trail.*
Volume reduction:
- The height of precipitation will be multiplied by the pavement square-footage to calculate the total volume of rainfall on the BMP.
- Runoff flow rate will be measured at the curb cut/discharge pipe and multiplied by the time it flowed to calculate runoff volume.

- The difference between the volume of precipitation and runoff volume will be the reduction.

*For those BMPs that have a control (Monte Bella Park and La Feria), the volume reduction will be subtracted to the one calculated for the pervious section.

Average flow reduction:

- The volume reduction (calculated above) will be divided by the time of precipitation to calculate the flow reduction.

Total storm event load reduction.

- Samples will be collected and contaminant concentration will be obtained from the NELAC certified lab after samples are shipped and analyzed.
- Concentration will be multiplied by the volume reduction to calculate load reduction.

Average load reduction per unit of time

- The total storm event load reduction will be divided by the duration of the event.

Total yearly load reduction

- The total contaminant load reduction of each sampled precipitation will be divided by the rainfall inches of its corresponding event.
- A weighted average of all characterized events will be calculated and the resulting value will be multiplied by the total rain inches in that year. The result will be the estimated annual load reduction by the BMP

*Bioswale*

Volume reduction:

- The height of precipitation will be multiplied by the square-footage of the BMP to calculate the total volume of direct rainfall on the BMP.
- Total inflow volume will be the sum of volume of direct precipitation, overflow from cisterns (in the case of Amigos del Valle), and the flow measured at the inlet (runoff generated by the tributary area)
- Runoff flow rate will be measured at the upstream pipe and multiplied by the time it flowed to calculate runoff volume entering the BMP.
- The difference between runoff volume entering and runoff volume exiting the BMP (measured at the downstream end) will be the volume reduction.

Average flow reduction:

- The volume reduction will be divided by the time of precipitation to calculate the flow reduction.

Total storm event load reduction.

- Samples will be collected and contaminant concentration will be obtained from the NELAC certified lab after samples are shipped and analyzed.
- Inflow volume and concentration will be multiplied (inflow load) and the result will subtracted by the product of outflow volume times its concentration (outflow load) to calculate the load reduction.

Average load reduction per unit of time

- The total storm event load reduction will be divided by the duration of the event.

Total yearly load reduction
- The total contaminant load reduction of each sampled precipitation will be divided by the rainfall inches of its corresponding event.
- A weighted average of all characterized events will be calculated and the resulting value will be multiplied by the total rain inches in that year. The result will be the estimated annual load reduction by the BMP

*Rain garden*
Volume reduction:
- The height of precipitation will be multiplied by the tributary square-footage to calculate the total volume of rainfall on the BMP.
- Total inflow volume will be the sum of volume of precipitation and overflow from bioswale (in the case of Amigos del Valle)
- Runoff flow rate will be measured at the upstream pipe and multiplied by the time it flowed to calculate runoff volume entering the BMP.
- The difference between runoff volume entering and runoff volume exiting the BMP (measured at the overflow drain piped) will be the volume reduction.

Average flow reduction:
- The volume reduction will be divided by the time of precipitation to calculate the flow reduction.

Total storm event load reduction.
- Samples will be collected and contaminant concentration will be obtained from the NELAC certified lab after samples are shipped and analyzed.
- Inflow volume and concentration will be multiplied (inflow load) and the result will subtracted by the product of outflow volume times its concentration (outflow load) to calculate the load reduction.

Average load reduction per unit of time
- The total storm event load reduction will be divided by the duration of the event.

Total yearly load reduction
- The total contaminant load reduction of each sampled precipitation will be divided by the rainfall inches of its corresponding event.
- A weighted average of all characterized events will be calculated and the resulting value will be multiplied by the total rain inches in that year. The result will be the estimated annual load reduction by the BMP

*Wetland**
Volume reduction:
- The height of precipitation will be multiplied by the tributary square-footage to calculate the total volume of rainfall on the BMP.
- Total inflow volume will be the sum of volume of precipitation and overflow from cisterns (in the case of Valle Nature Center)
- Runoff flow rate will be measured at the inlet pipe and multiplied by the time it flowed to calculate runoff volume entering the BMP.

- The difference between runoff volume entering (plus precipitation volume) and volume exiting the BMP (measured at the outlet drain piped) will be the volume reduction.

Average flow reduction:
- The volume reduction will be divided by the time of precipitation to calculate the flow reduction.

Total storm event load reduction.
- Samples will be collected and contaminant concentration will be obtained from the NELAC certified lab after samples are shipped and analyzed.
- Concentration will be multiplied by the volume reduction to calculate load reduction.

Average load reduction per unit of time
- The total storm event load reduction will be divided by the duration of the event.

Total yearly load reduction
- The total contaminant load reduction of each sampled precipitation will be divided by the rainfall inches of its corresponding event.
- A weighted average of load reduction of all characterized events will be calculated and the resulting value will be multiplied by the total rain inches in that year. The result will be the estimated annual load reduction by the BMP

* The runoff from the rooftop of the gazebo on the wetland (VNC) will be assumed has the same water quality as the runoff from the main building. The runoff quality discharging in the wetland from the boardwalk will be taken from authoritative literature.

**Uncertainty**

Based on the sampling plan and the analytical approach, the methodology presents the following uncertainties:

*Flow measurement*

Flow rates will be measured using bubbler flow meters that will be activated when the measurement reach the trigger values. These values will be adjusted to capture a representative hydrograph, however, the optimal trigger values could be different for storm events with different intensities and durations.

*Load reduction calculations*

The single grab sample will provide information from a specific point of the hydrograph and not the entire (or several points) of the spectrum. Also, first flush samples can lead to overestimation of load reductions. Under a back-to-back rain events scenario, assumptions to calculate load reductions may be less valid. Special considerations based on scientific literature will be taken to address these uncertainties.

**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 TAMUK Laboratory Supervisor, who will make the determination and notify the TAMUK 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 TAMUK Manager. The TAMUK 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, non-conformances, and corrective action are defined in Section C1.

## B5 QUALITY CONTROL

### 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.

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

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

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, than 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 NELAC-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 dryweight basis to satisfy the AWRL requirement for sediment and tissue analyses. When data are reviewed for consistency with the QAPP, they are evaluated based on this requirement. Results may not appear to meet the AWRL requirement due to high moisture content, high concentrations of non-target analytes necessitating sample dilution, etc. These sample results will be submitted to the TCEQ with an explanation on the Data 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  reparation 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 midpoint of the calibration for each analyte. In cases of test methods with very long lists of analytes, LCSs are prepared with all the target analytes and not just a representative number, except in cases of organic analytes with multipeak responses.

The LCS is carried through the complete preparation and analytical process. LCSs are run at a rate of one per 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, X1 and X2, the RPD is calculated from the following equation: *(If other formulas apply, adjust appropriately.)*

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

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 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 highlevel analyses, the blank value should be less then 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 TAMUK Project Manager, in consultation with the TAMUK 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 TAMUK 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 TAMUK Laboratory QAO. The Laboratory QAO will discuss with the TAMUK Project Manager. If applicable, the TAMUK 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

## B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

Automated sampler testing and maintenance requirements are obtained from the manufacturer's website (http://www.isco.com/products/manuals1.asp?PL=201&GP=20110 ). 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

All instruments or devices used in obtaining environmental data will be calibrated prior to use as needed. Detailed laboratory calibration methods are contained in the manufacturer's instruction manual.

Each instrument has a specialized procedure for calibration and a specific type of standard used to verify calibration. The instruments that might require calibration are listed below in Table B7.1.

All calibration procedures will meet the requirements specified in the EPA approved methods of analysis. The frequency of calibration as well as specific instructions applicable to the analytical methods recommended by the equipment manufacturer will be followed. All information concerning calibration will be recorded in a calibration logbook by the person performing the calibration and will be accessible for verification during either a laboratory or field audit.

All instruments or devices used in obtaining environmental data will be used according to appropriate laboratory or field practices. Written copies of SOPs are available for review upon request.

Failures in any testing, inspections, or calibration of equipment will result in a CAR and resolution of the situation will be reported to the TCEQ in the quarterly report. The CARs will be maintained by the Project Leader and the TCEQ PM.

**Table B7.1. Instrument Calibration Requirements**

| Equipment | Relevant Calibration Requirement |
|---|---|
| ISCO 3700Sampler | Product Owner's Manual |
| ISCO accQmin Flow Meter | Product Owner's Manual |
| ISCO 674 Rain Guage | Product Owner's Manual |
| In-Situ Inc., Rugged TROLL 100 | Product Owner's Manual |

Data not meeting post-error limit requirements invalidates associated data collected subsequent to the pre-calibration and are not submitted to the TCEQ.

## 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

Only data collected directly under this QAPP will be submitted to the SWQMIS database. All data collected under this QAPP and any acquired or non-direct measurements will comply with all requirements/guidance of the associated project(s) and QAPP(s). Any non-direct measurement, or acquired data should be noted as such.

## 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 systematically to maintain equipment. Site identification, date, time, personnel, water depth, measurements of field parameters, and any comment concerning weather or conditions at the site are noted in the field notebook. A field notebook is filled out in the field for each site visit. If no flow is observed at a site, samples will not be collected but information about the site visit will be recorded in the field notebook.

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 notebook to the COC. The COC and accompanying sample bags/bottles are submitted to laboratory analyst, with relinquishing and receiving signature section will be accompanied by COC sheets filled out by the field technician.

All COC, 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 XP/Vista/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 weekly 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.

### 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.

Current data files will be backed up on r/w CD's weekly and stored in separate area away from the computer. At least 10% of all data manually entered in the database will be reviewed for accuracy by the TAMUK PM/QAO to ensure that there are no transcription errors. Hard copies of data will be printed and housed in the laboratory for a period of five years.

**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, sampling depth, etc.) is used to generate a unique sampling event in an interim database built on an autogenerated alphanumeric key field. Measurement results from both the field data sheets and laboratory data sheets are manually entered (by field and laboratory staff, respectively) into the interim database for their corresponding event. Customized data entry forms facilitate accurate data entry. Following data verification and validation, the data are exported from the interim database into the Event/Result format required for submission to TCEQ's SWQMIS (as described in the SWQM DMRG January 2012 or later version). Once TCEQ approval of the data is obtained, the interim data are loaded into SWQMIS by TCEQ data managers.

See Appendix K for the Data Management Process Flow Chart.

**Record-keeping and Data Storage**
TAMUK 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 TAMUK offices in a fireproof file in accordance with the record-retention schedule in Section A9. Two copies of the database are backed up each Friday on magnetic tape. One copy is stored in a fireproof safe in the TAMUK office, and one copy is stored off-site. If necessary, disaster recovery will be accomplished by information resources staff using the backup database.

**Archives/Data Retention**
**Complete original data sets are archived on permanent *(hardcopy/external and internal hard drive)* 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 D for the Data Review Checklist and Summary.

**Data Dictionary**

Terminology and field descriptions are included in the SWQM DMRG (January 2012 or most recent version). Note that a new Monitoring Type Code for automatic samplers is under development by TCEQ and will be incorporated when available. 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 | Tag Prefix | Submitting Entity | Collecting Entity | Monitoring Type Code |
|---|---|---|---|---|
| *TAMUK, Kingsville, TX* | *AK* | *AK* | *AK* | *BF* |

**Data Handling**

Data are processed using the Microsoft Excel 2003/2007 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 2003/2007 under the Windows XP/Vista/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**

The agency's information technology (IT) policy is available at http://nis.tamu.edu/Home/IT_Policy.php .

**Quality Assurance/Control**

See Section D of this QAPP

## C1 ASSESSMENTS AND RESPONSE ACTIONS

**Table C1.1 Assessments and Response Requirements**

| Assessment Activity | Approximate Schedule | Responsible Party | Scope | Response Requirements |
|---|---|---|---|---|

| Assessment Activity | Approximate Schedule | Responsible Party | Scope | Response Requirements |
|---|---|---|---|---|
| Status Monitoring Oversight, etc. | Continuous | TAMUK Project Manager | Monitoring of the project status and records to ensure requirements are being fulfilled. | Report to TCEQ in Quarterly Report |
| Laboratory Inspections | Dates to be determined by the TCEQ lab inspector | TCEQ Lab Inspector | Analytical and quality control procedures employed at the laboratory and the contract laboratory | 30 days to respond in writing to the TCEQ to address corrective actions |
| 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 | TAMUK 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 | TAMUK 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 TAMUK Project Manager, in consultation with the TAMUK 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).

## Corrective Action Process for Deficiencies

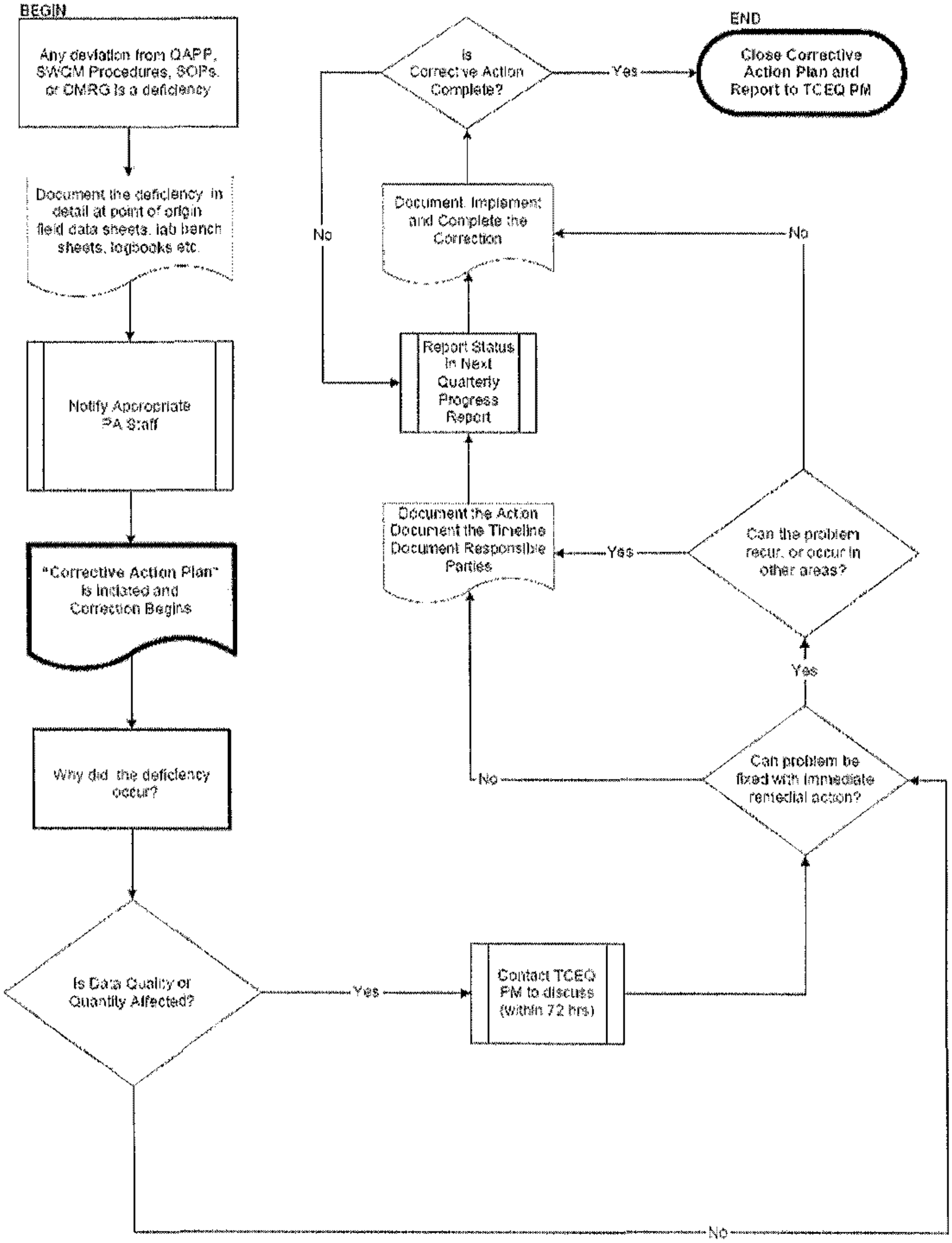



**Figure C1.1 Corrective Action Process for Deficiencies**

Status of CAPs will be documented on the Corrective Action Status Table (See Appendix L) 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 TAMUK Project Manager is responsible for implementing and tracking corrective actions. Corrective action plans will be documented on the Corrective Action Plan Form (See Appendix M) and submitted, when complete, to the TCEQ Project Manager. Records of audit findings and corrective actions are maintained by both the TCEQ and the TAMUK 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 performed by the Basin Planning Agency, 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.

Monitoring System Audit Response - The contractor will respond in writing to the TCEQ within 30 days upon receipt of a monitoring system audit report to address corrective actions.

BMP Evaluation Report- The contractor will prepare a report summarizing the results of monitoring and evaluation of the effectiveness of the BMPs, and comparing the estimated performance of the practices with the actual measure results.

Contractor Evaluation - TAMUK 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 data reports contain QC information which is then reviewed by the TAMUK Project Manager/QAO. Project status, assessments and significant QA issues will be dealt with by the TAMUK 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 for entry into SWQMIS.

The procedures for verification and validation of data are described in Section D2, below. The TAMUK 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 TAMUK Data Manager will be responsible for ensuring that all data are properly reviewed and verified, and submitted in the required format to TCEQ for loading in SWQMIS. The TAMUK QAO is responsible for validating a minimum of 10% of the data produced in each task. Finally, the TAMUK Project Manager, with the concurrence of the TAMUK 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 for storage in SWQMIS. The performance of these tasks is documented by completion of the Data Review Checklist and Summary (Appendix D).

The TAMUK 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 TAMUK 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 SWQM Procedures Manual | 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 | |
| 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 |
| 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 |
| 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 |

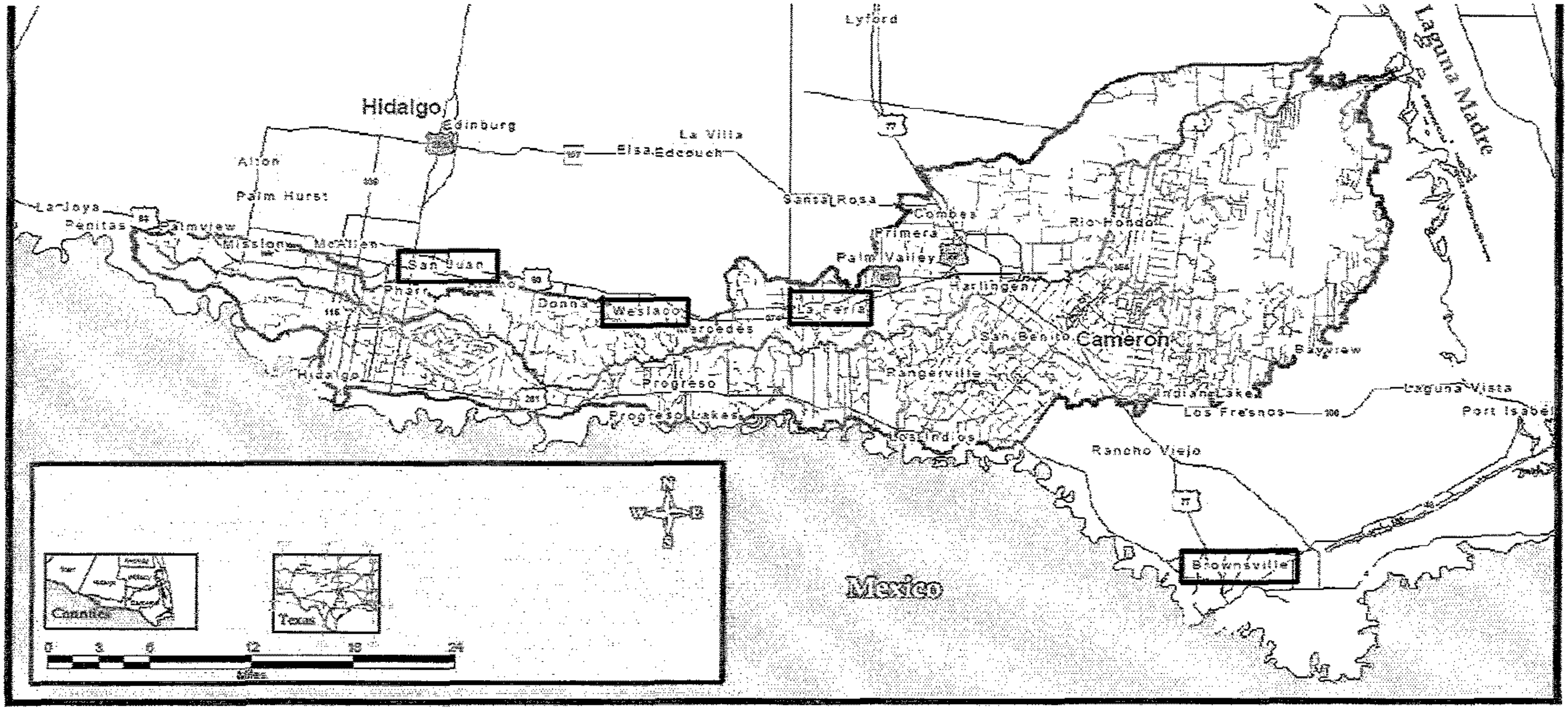
## D3 RECONCILIATION WITH USER REQUIREMENTS

Extension education programs are designed to target specific audiences and to deliver current, unbiased, science-based information and technology. The objective of the evaluation conducted under this QAPP is to provide the Extension education program with unbiased, science-based, quality assured data on the effectiveness of low impact development best management practices for reducing nutrient and sediment contamination of storm water. No other decisions will be made by the project team based on the data collected.

These data, and data collected by other organizations, may however be subsequently analyzed and used for model development. Thus, data which do not meet project data quality objectives will not be submitted to the TCEQ nor will be considered appropriate for any of the uses noted above.

Moreover, to monitor the effectiveness of the BMPs on the education and outreach activities, visitor record keeping and surveys to measure public awareness of BMPs benefits and stormwater runoff control and its impact in the community will be analyzed. Educational activities are intended to be delivered to a wide range of audiences, from elementary school students to land developers. The survey copies will be maintained by the City partner and results tabulated and recorded for evaluation as the project progresses. After, review by the project team and TCEQ, the results should be amenable for distribution at stakeholder meetings and/or website publication. The survey instruments will be developed with input from the project team.

# APPENDIX A. AREA LOCATION MAP




Arroyo Colorado Watershed with site project location. Adapted from Arroyo Colorado Watershed Protection Partnership (http://arroyocolorado.org/media/2472/2005LocationMap.pdf. Logged on November 06 2011)

# APPENDIX B. WORK PLAN

## Contract 582-11-11100 Scope of Work

| Tasks, Objectives and Schedules (Replicate or modify table as needed) | | | | | | |
|---|---|---|---|---|---|---|
| **Task 2:** | **Quality Assurance** | | | | | |
| **Costs:** | **Federal:** | **$10,500** | **Non-Federal:** | **$2,266** | **Total:** | **$12,766** |
| **Objective:** | To develop data quality objectives (DQOs) and quality assurance/control (QA/QC) activities to ensure data of known and acceptable quality are generated through this project. | | | | | |
| **Subtask 2.1:** | **Quality Assurance Project Plan (QAPP) Planning Meetings** – TAMUK 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. | | | | | |
| | **Start Date:** | Month 1 | **Completion Date:** | Month 3 | | |
| **Subtask 2.2:** | **QAPP** – TAMUK will develop and submit to TCEQ a QAPP with project specific DQOs consistent with the *EPA Requirements for Quality Assurance Project Plans (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 TAMUK project team with technical assistance from TCEQ Project Manager, Quality Assurance staff, technical staff, management, and contractors. The QAPP must be approved by TCEQ before data collection begins. | | | | | |
| | **Start Date:** | Month 2 | **Completion Date:** | Month 5 | | |
| **Subtask 2.3:** | **Data Collection** – Collect water quality data to evaluate the effectiveness of the following BMPs:<br>• Green Roof - Monitor the flow rate, total suspended solids (TSS), Biochemical Oxygen Demand (BOD), Nitrogen (N) and Phosphorous (P) in the inlet and outlet of green roof and control roof during dry season quarterly and during storm events.<br>• Porous Pavement - Monitor the flow rate, TSS, BOD, N, P and oil/grease in the inlet and outlet of porous pavement during dry season quarterly and during storm events.<br>• Wetland - Monitor the flow rate, TSS, BOD, N and P in the inlet and outlet of wetland during dry season quarterly and during storm events.<br>• Rain Harvesting - Monitor the flow quantities in the inlet and outlet of cisterns during dry season quarterly and during storm events. | | | | | |
| | **Start Date:** | Month 5 | **Completion Date:** | Month 31 | | |
| **Subtask 2.4:** | **QAPP Update** –TAMUK 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. | | | | | |
| | **Start Date:** | Month 15 | **Completion Date:** | Month 29 | | |

| | | | | |
|---|---|---|---|---|
| **Subtask 2.5:** | **QAPP Amendments** – Amendments to the QAPP and the reasons for the changes will be documented by TAMUK 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 TAMUK into a revised QAPP during the annual revision process or within 120 days of the initial approval in cases of significant changes. | | | |
| | **Start Date:** | Month 6 | **Completion Date:** | Month 29 |
| **Subtask 2.6:** | **Data Submittals** – TAMUK will review, verify, and validate water quality monitoring data before it is submitted to the TCEQ. TAMUK will submit data consistent with TCEQ formatting requirements for upload into the Surface Water Quality Monitoring Information System (SWQMIS) to TCEQ quarterly and at least one month prior to use, or prior to presenting to stakeholders. | | | |
| | **Start Date:** | Month 9 | **Completion Date:** | Month 32 |
| **Deliverables** | • QAPP Planning Meeting<br>• Draft and Final QAPP<br>• Draft and Final QAPP Annual Updates<br>• Draft and Final QAPP Amendments<br>• Data Submittals<br>• Water quality monitoring non-conformances will be reported to the TCEQ Project Manager and included in QPRs | | | |

| Tasks, Objectives and Schedules (Replicate or modify table as needed) | | | | | | |
|---|---|---|---|---|---|---|
| **Task 3:** | Water Quality Monitoring and Assessment | | | | | |
| **Costs:** | **Federal:** | **$159,506** | **Non-Federal:** | **$92,834** | **Total:** | **$252,340** |
| **Objective:** | Develop and implement a strategy to estimate and then verify the NPS pollutant load reductions of LID practices and the water quality benefits to the receiving waters. | | | | | |
| **Subtask 3.1:** | **Develop Analytical Approach** – Develop analytical approach for verifying NPS pollutant load reductions of LID practices and water quality benefits to the receiving waters. | | | | | |
| | **Start Date:** | **Month 1** | **Completion Date:** | **Month 3** | | |
| **Subtask 3.2:** | **LID Design** – Provide input on the design of the LID practices to determine the estimated NPS pollutant load reductions expected from the LID practices. | | | | | |
| | **Start Date:** | **Month 1** | **Completion Date:** | **Month 6** | | |
| **Subtask 3.3:** | **Sampling Plan** – Provide input to the project sampling plan and quality assurance plan to ensure data is collected to verify the pollution reduction effectiveness of the LID practices. | | | | | |
| | **Start Date:** | **Month 1** | **Completion Date:** | **Month 5** | | |
| **Subtask 3.4:** | **BMP Evaluation Report** – Prepare a report summarizing the results of monitoring and evaluation of the effectiveness of the BMPs, and comparing the estimated performance of the practices with the actual measure results. | | | | | |
| | **Start Date:** | **Month 12** | **Completion Date:** | **Month 36** | | |

| | |
|---|---|
| **Deliverables** | • Analytical approach technical memoranda,<br>• Design report for individual LID practices presenting an analysis of the anticipated performance of the practices,<br>• Provisions of the project sampling plan and quality assurance plan sufficient to obtain the data necessary to verify the actual performance of the LID practices, and<br>• Report assessing the performance of the LID practices. |

| Tasks, Objectives and Schedules (Replicate or modify table as needed) | | | | | | |
|---|---|---|---|---|---|---|
| **Task 5:** | Design and Construction of Park Amenities and Placement of Education Materials (City of Brownsville) | | | | | |
| **Costs:** | **Federal:** | **$133,350** | **Non-Federal:** | **$66,350** | **Total:** | **$199,700** |
| **Objective:** | Design and construct park amenities including parking lot, walking trail, and LID engineered restroom facility. Conduct education and outreach regarding environmental stewardship and LID technologies, enhance public awareness and understanding of the problem, and monitor storm water quality and quantity data after construction. | | | | | |
| **Subtask 5.1:** | **Design and Construct LID Elements** – The City of Brownsville and its partners are working to give students and families safe access to better environmental educational opportunities. Design, bid, purchase materials, and construct the following LID elements:<br>• 10,800 square foot pervious cover parking lot,<br>• 185,010 square foot pervious cover walking trails,<br>• 200 sq. ft., green roof with irrigation system and utilizing native vegetation, and<br>• rain water collection system including two 3,000 gallon cisterns on two sides of the new building, gutter system, basic gravity feed valve and overflow to wetland exploration area, and solar pump feed to an in-ground irrigation system. | | | | | |
| | **Start Date:** | **Month 1** | **Completion Date:** | **Month 4** | | |
| **Subtask 5.2:** | **Conduct Education and Outreach** – Install interpretive and informational signage. Distribute educational materials. Participate in LID promotional activities. | | | | | |
| | **Start Date:** | **Month 5** | **Completion Date:** | **Month 12** | | |
| **Deliverables** | • Design report, bid documentation, certificate of completion of construction of LID elements<br>• Documentation of educational activities<br>• Documentation of participation in LID promotional activities. | | | | | |

| Tasks, Objectives and Schedules (Replicate or modify table as needed) | | | | | | |
|---|---|---|---|---|---|---|
| **Task 6:** | Construction of a Green Roof on the Amigos Del Valle Building (City of San Juan) | | | | | |
| **Costs:** | **Federal:** | **$190,700** | **Non-Federal:** | **$128,000** | **Total:** | **$318,700** |
| **Objective:** | To construct LID and "green technology" components of the Amigos Del Valle building, enhance public awareness and understanding of NPS pollution, and monitor storm water quality and quantity data before, during, and after construction. | | | | | |

<table>
<tr><td>Subtask 6.1:</td><td colspan="4">Design and Construct LID Elements – Design, bid, purchase materials and construct LID elements of the existing Amigos Del Valley facility. Design, bid, purchase materials, and construct the following LID elements:<br>• Repair existing roof and install a new 74' x 42' roof foundation for a future new green roof installation,<br>• Rain water collection system, including one 5,000 gallon cistern (may vary in size) on one side of the building, gutter system, basic gravity feed valve and overflow to wetland exploration area, solar pump feed to an in-ground irrigation system, and interpretive signage,<br>• Green roof demonstration area, including interpretive signage and a 3,000 sq. ft., green roof with irrigation system, utilizing native vegetation, and<br>• 300 sq. ft. rain garden and 30 linear feet of bioswale.</td></tr>
<tr><td></td><td>Start Date:</td><td>Month 1</td><td>Completion Date:</td><td>Month 12</td></tr>
<tr><td>Subtask 6.2:</td><td colspan="4">Conduct Education and Outreach – Provide storm water and NPS pollution environmental education, incorporating the project LID construction, green roof area, and storm water monitoring results, targeting local residents, school children, educators, and community leaders and decision makers to enhance public awareness and understanding. Continue to provide on-site environmental education to visitors, highlighting the LID practices and technologies incorporated into the design of the facilities, with an emphasis on their importance to future development and responsible natural resource management. Provide informational signage regarding LID practices and monitoring efforts demonstrated at the facility.</td></tr>
<tr><td></td><td>Start Date:</td><td>Month 12</td><td>Completion Date:</td><td>Month 36</td></tr>
<tr><td>Subtask 6.3:</td><td colspan="4">Evaluate the Effectiveness of Education and Outreach – Evaluate the effectiveness of the environmental education component of the project through the following activities:<br>• Track the numbers of visitors, including school children, educators, community leaders, local residents, Winter Texans, and nature tourists from across the state and around the globe,<br>• Track visitor understanding of the problem and BMP solutions, measured through short, voluntary surveys of visitors, and<br>• Administer brief pre-tests and post-tests to intensive life-science program participants on knowledge and understanding of LID purposes and practices and how these practices affect environmental health and public safety.</td></tr>
<tr><td></td><td>Start Date:</td><td>Month 12</td><td>Completion Date:</td><td>Month 36</td></tr>
<tr><td>Deliverables</td><td colspan="4">• Design report, bid documentation, certificate of completion of construction of LID elements<br>• Documentation of educational activities<br>• Report on the results of the evaluation of the effectiveness of education and outreach activities</td></tr>
</table>

<table>
<tr><td colspan="7">Tasks, Objectives and Schedules (Replicate or modify table as needed)</td></tr>
<tr><td>Task 7:</td><td colspan="6">Valley Nature Center Environmental Education and LID Demonstration Facility (Welasco, TX)</td></tr>
<tr><td>Costs:</td><td>Federal:</td><td>$147,000</td><td>Non-Federal:</td><td>$110,000</td><td>Total:</td><td>$257,000</td></tr>
<tr><td>Objective:</td><td colspan="6">To construct LID components of the new Valley Nature Center Environmental Education Facility, enhance public awareness and understanding of the problem in 10,000 Valley Nature Center visitors annually, and monitor storm water quality and quantity data before, during, and after construction.</td></tr>
</table>

| | | | | |
|---|---|---|---|---|
| **Subtask 7.1:** | **Design and Construct LID Elements** – Design, bid, purchase materials, and construct LID elements of the new Valley Nature Center Environmental Education Center:<br><br>• Rain water collection system, including two 5,000 gallon cisterns on two sides of the new building, gutter system, basic gravity feed valve and overflow to wetland exploration area, solar pump feed to an in-ground irrigation system, and interpretive signage,<br>• Green roof demonstration area, including interpretive signage and a 200 sq. ft., green roof with irrigation system, utilizing native vegetation,<br>• Pervious surface grass paver service road and sidewalks, including a 2,800 sq. ft. service road, 4,000 sq. ft. of pervious modular system sidewalks around the new building, and interpretive signage,<br>• Half-acre wetland exploration area within the Valley Nature Center's six-acre nature park, including excavation, construction, native wetland and riparian plantings, and interpretive signage. Boardwalks and other amenities will be installed, and<br>• Interpretive and informational signage. | | | |
| | **Start Date:** | **Month 1** | **Completion Date:** | **Month 24** |
| **Subtask 7.2:** | **Conduct Education and Outreach** – Provide storm water and NPS pollution environmental education, incorporating the project LID construction, wetland exploration area, and storm water monitoring results, targeting local residents, school children, educators, and community leaders and decision makers to enhance public awareness and understanding. Through collaboration with a wide variety of public and private sector partners, the Valley Nature Center currently provides service annually to 15,000 school children, over 10,000 nature visitors, and nearly 60,000 adults and children who benefit from a variety of in-school and outreach programs.<br><br>Continue to provide on-site environmental education to 10,000 visitors annually, highlighting the LID practices and technologies incorporated into the design of the facilities, with an emphasis on their importance to future development and responsible natural resource management. Provide informational signage regarding LID practices and monitoring efforts demonstrated at the Valley Nature Center. | | | |
| | **Start Date:** | **Month 12** | **Completion Date:** | **Month 36** |
| **Subtask 7.3:** | **Evaluate the Effectiveness of Education and Outreach** – Evaluate the effectiveness of the environmental education component of the project.<br><br>• Track the numbers of visitors, including: school children and educators, community leaders, local residents, Winter Texans, and nature tourists from across the state and around the globe<br>• Track visitor understanding of the problem and BMP solutions measured through short, voluntary surveys of visitors, teachers, parents, and older students, and<br>• Administer brief pre-tests and post-tests to intensive life-science program participants on knowledge and understanding of LID purposes and practices and how these practices affect environmental health and public safety. | | | |
| | **Start Date:** | **Month 12** | **Completion Date:** | **Month 36** |
| **Deliverables** | • Design report, bid documentation, certificate of completion of construction of LID elements<br>• Documentation of educational activities<br>• Report on the results of the evaluation of the effectiveness of education and outreach activities | | | |

| Tasks, Objectives and Schedules (Replicate or modify table as needed) | |
|---|---|
| **Task 8:** | City of La Feria LID BMP - Pervious Surface Demo Projects |

<table>
<tr><td>Costs:</td><td>Federal:</td><td>$155,000</td><td>Non-Federal:</td><td>$103,333</td><td>Total:</td><td>$258,333</td></tr>
<tr><td>Objective:</td><td colspan="6">To construct LID BMP parking lots to demonstrate to elected officials and the development community that LID BMPs can reduce pollutant loadings in urban runoff while being cost-competitive with conventional parking lots and storm water detention designs.</td></tr>
<tr><td rowspan="2">Subtask 8.1:</td><td colspan="6">Design, bid, purchase materials, and construct LID elements within the 12,571 square foot pervious surface parking lot for its soon to be constructed Recreation Center and within a 10,000 square foot conventional pavement parking lot at the Public Works facility.<br>• LID pervious surface with biostrip (rain garden) / bioswale landscape (600 LF) area using native vegetation.<br>• Conventional surface with biostrip (rain garden) / bioswale landscape (600 LF) area using native vegetation.</td></tr>
<tr><td>Start Date:</td><td>Month 1</td><td colspan="2">Completion Date:</td><td colspan="2">Month 36</td></tr>
<tr><td rowspan="2">Subtask 8.2:</td><td colspan="6">Local residents, school children, educators, community leaders, and decision makers will be educated regarding storm water, NPS pollution, and ways to reduce NPS pollution through:<br>• Short, outdoor, walking visits at both sites. If a site visit requires indoor classroom space, the adjacent proposed La Feria Recreation Center will have a multi-purpose room and a small auditorium. Restrooms will also available at the Recreation Center. The Recreation Center site and the Public Works facility are located within 2,400 feet of each other. Additionally, the La Feria Middle School and La Feria High School are located just a few blocks away from the Public Works facility and an elementary school is located across the street from the proposed Recreation Center site. On-site environmental education will highlight the LID practices and technologies incorporated into the design of the parking facilities, with an emphasis on their importance to future development and responsible natural resource management.<br>• Informational signage about NPS pollution, LID practices implemented at the sites, and the monitoring being conducted.<br>• Press releases upon award of the grant, completion of construction, and to report the results of monitoring.</td></tr>
<tr><td>Start Date:</td><td>Month 1</td><td colspan="2">Completion Date:</td><td colspan="2">Month 36</td></tr>
<tr><td rowspan="2">Subtask 8.3:</td><td colspan="6">Evaluate the effectiveness of the environmental education component of the project by:<br>• Tracking the numbers of visitors including: school children, educators, community leaders, and local residents.<br>• Tracking visitor understanding of the NPS problem and BMP solutions, measured through:<br>    o Short, voluntary surveys of visitors, particularly teachers, parents, and older students<br>    o When possible, brief pre- and post-tests, to intensive life-science program participants, on knowledge and understanding of LID purposes and practices, and how these practices affect environmental health and public safety</td></tr>
<tr><td>Start Date:</td><td>Month 1</td><td colspan="2">Completion Date:</td><td colspan="2">Month 36</td></tr>
<tr><td>Deliverables</td><td colspan="6">• Design report, bid documentation, certificate of completion of LID elements<br>• Documentation of educational activities<br>• Documentation of participation in LID promotional activities</td></tr>
</table>

| **Task 9:** | Final Report | | | | | |
|---|---|---|---|---|---|---|
| **Costs:** | **Federal:** | **13,842** | **Non-Federal:** | **40,799** | **Total:** | **54,641** |
| **Objective:** | To produce a final report that summarizes all project activities completed and conclusions reached and that contains the reports completed under previous tasks either in the text or the appendices. | | | | | |
| **Subtask 9.1:** | **Draft Final Report** - TAMUK will provide a draft final report summarizing all project activities, findings, and the contents of all previous deliverables, referencing and/or attaching them as web links or appendices. This comprehensive, technical report will provide analysis of all activities and deliverables under this scope of work. The report will include the following information:<br>Title<br>Table of Contents<br>Executive Summary<br>Introduction<br>Project Significance and Background<br>Methods<br>Results and Observations<br>Discussion<br>Summary<br>References<br>Appendices | | | | | |
| | **Start Date:** | Month 30 | **Completion Date:** | Month 33 | | |
| **Subtask 9.2:** | **Final Report** – TAMUK will revise the draft report to address comments provided by the TCEQ Project Manager. The final report will be submitted to the TCEQ Project Manager and subsequently to EPA. | | | | | |
| | **Start Date:** | Month 33 | **Completion Date:** | Month 36 | | |
| **Deliverables** | • Draft Final Report<br>• Final Report | | | | | |

# 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 *Tag Id* numbers in the Events file? | |
| B. | Do the *Tag* prefixes correctly represent the entity providing the data? | |
| C. | Have any *Tag Id* numbers been used in previous data submissions? | |
| D. | Are TCEQ station location (SLOC) numbers assigned? | |
| E. | Are sampling *Dates* in the correct format, MM/DD/YYYY with leading zeros? | |
| F. | Are the sampling *Times* based on the 24 hour clock (e.g. 13:04) with leading zeros? | |
| G. | Is the *Comment* field filled in where appropriate (e.g. unusual occurrence, sampling problems, unrepresentative of ambient water quality)? | |
| H. | *Submitting Entity, Collecting Entity, and Monitoring Type* codes used correctly? | |
| I. | Are the sampling dates in the *Results* file the same as the one in the *Events* file for each Tag Id? | |
| J. | Are values represented by a valid parameter code with the correct units? | |
| K. | Are there any duplicate parameter codes for the same *Tag Id*? | |
| L. | Are there any invalid symbols in the *Greater Than/Less Than* (*GT/LT*) field? | |
| M. | Are there any *Tag Ids* in the *Results* file that are not in the *Events* 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 *Verify_flg* field? | |
| C. | Have checks on correctness of analysis or data reasonableness been performed?<br>e.g.: Is ortho-phosphorus less than total phosphorus?<br>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 *Event* table's *Comments* 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 NELAC 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 AWRL 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.

**TAMUK Data Manager:**

**Date:**

# APPENDIX D. AUTOMATED SAMPLER SOP

## ISCO 3700 Field SOP

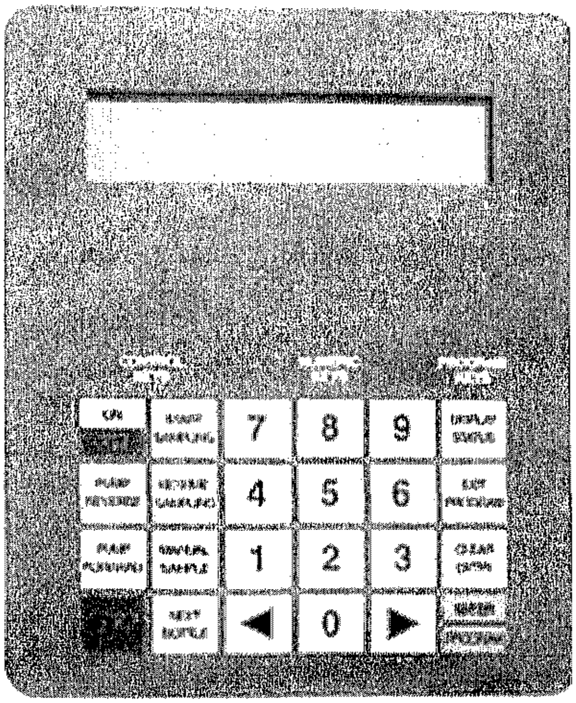
The ISCO 3700 automatic sampler is a portable programmable liquid sampler. The sampler can be set in a flow based sample collection mode, the triggers for which will be determined after the initial few storm events during the sampling period. The sampler is set to hold 24 wide mouthed polypropylene bottles of 1000 ml each for composite or discrete 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 bottles in bases
ISCO bottles lids
ISCO base lids
Scoop for emptying the stilling wells
Stilling well sample bottles (1/2 liter Nalgene)
Gloves

Use this ISCO button interface graphic as reference:




Important note: Do NOT step in the flumes!
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.
The screen should read:

```
SAMPLER INHIBITED!
10:35        20-JUN-04
```

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.

Press the "Display Status" button.

With "Review" flashing, press the "Enter" button.

```
[REVIEW, PRINT]
PROGRAM INFORMATION
```

Press the right arrow button twice so that "Results" in flashing. Press the "Enter" button.

```
PRINT PROGRAM [NO,
SETTINGS, RESULTS]
```

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 though these screens.

As you scroll through (using the right arrow button), the sample times will show up. Record the following things:

Bottle number

Date sampled

Time sampled

The date you collected the samples

You can use the Chain Of Custody (COC) form, or use your own form and then transcribe the data onto a clean COC form.

The Sample ID is done in the form:

Plot letter Event Number – Bottle Number

(for example, plot E, event 18, bottle 3 would be E18-3)

In the third column of the COC, three timestamps should be listed per line.

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).

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]
```

With "No" flashing, press the "Enter" button.

Now press the "Stop" button.

Press the "Start Sampling" button.

With "Start" flashing, press the "Enter" button.

The next screen will ask at which bottle to start. Bottle 1 should already be there, so press the "Enter" button.

```
START SAMPLING
BOTTLE 1 (1-24)
```

Replace the lid of the top of the ISCO, and fasten with the black rubbery hooks.

Unfasten the 3 metal hooks farther down the ISCO.

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.

Cap all of the bottles in the ISCO base, and label them by number.

Remove the base from the concrete pad, and place a new base in its place.
Replace the top section of the ISCO, and fasten the metal hooks back.
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.
Stir the water in the stilling well around to get the sediments back into suspension. Take a sample in a labeled bottle.
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.
Take the samples back to the lab for preservation and packaging to be sent out to the NELAC lab.

References:

Teledyne ISCO, 2010, *3700 Portable Automatic Sampler Instruction Manual*, Lincoln, NE

# APPENDIX E. FIELD DATA REPORTING FORM

Lower Rio Grande Valley Low-Impact Development Implementation and Education

**FIELD DATA SHEET**

Site Name:____________ Date: ____________ Collected by: _____________
Rain event #_________ Inches: _________ Air Temperature: __________

**Permeable Pavement**

| Treatment | Replicate | # Bottles Collected | Remarks |
|---|---|---|---|
| Porous concrete | PC 1 | | |
| Porous concrete | PC 2 | | |
| Porous concrete | PC 3 | | |
| Interlocking pavers | IP 1 | | |
| Interlocking pavers | IP 2 | | |
| Interlocking pavers | IP 3 | | |
| Grass Pavers | GP 1 | | |
| Grass Pavers | GP 2 | | |
| Grass Pavers | GP 3 | | |
| Porous Asphalt | PA 1 | | |
| Porous Asphalt | PA 1 | | |
| Porous Asphalt | PA 1 | | |
| Impervious Concrete | IC 1 | | |
| Impervious Concrete | IC 2 | | |
| Impervious Concrete | IC 3 | | |

**Rain Garden**

| Sampling location | # Bottles collected | Remarks |
|---|---|---|
| Inflow | | |
| Outflow | | |

**Wetland**

| Sampling location | # Bottles collected | Remarks |
|---|---|---|
| Inflow | | |
| Outflow | | |

**Lower Rio Grande Valley Low-Impact Development Implementation and Education**

**FIELD DATA SHEET**

Site Name:____________ Date: ____________ Collected by: _____________
Rain event #_________ Inches: __________ Air Temperature: ____________

**RAINWATER HARVESTING**

**Experimental plots**

| **Plot ID** | **Water meter reading** | **Grab sample collection** | | **Remarks** |
|---|---|---|---|---|
| P1 | | Y | N | |
| P2 | | Y | N | |
| P3 | | Y | N | |
| P4 | | Y | N | |

**Rainwater Barrels**

| **Barrel type** | **Water meter reading** | **Remarks** |
|---|---|---|
| **300 L** | | |
| **500 L** | | |
| **1500 L** | | |
| **2500 L** | | |

**Lower Rio Grande Valley Low-Impact Development Implementation and Education**

**FIELD DATA SHEET**

Site Name:____________ Date: ____________ Collected by: _____________
Rain event #_________ Inches: _________ Air Temperature: __________

**GREEN ROOF**

| Treatment | Replicate | Grab sample collected | | Remarks |
|---|---|---|---|---|
| T 1 | R 1 | Y | N | |
| T 1 | R 2 | Y | N | |
| T 1 | R 3 | Y | N | |
| T 1 | R 4 | Y | N | |
| T 2 | R 1 | Y | N | |
| T 2 | R 2 | Y | N | |
| T 2 | R 3 | Y | N | |
| T 2 | R 4 | Y | N | |
| T 3 | R 1 | Y | N | |
| T 3 | R 2 | Y | N | |
| T 3 | R 3 | Y | N | |
| T 3 | R 4 | Y | N | |
| T 4 | R 1 | Y | N | |
| T 4 | R 2 | Y | N | |
| T 4 | R 3 | Y | N | |
| T 4 | R 4 | Y | N | |

# APPENDIX F. CHAIN-OF-CUSTODY FORM

**Chain-of-Custody Form (COC)**

***Lower Rio Grande Valley Low-Impact Development Implementation and Education***
**Texas A&M University - Kingsville , 917 W. Ave B, Kingsville, TX 778363, Phone: 361-593-2069**

**(Permeable Pavement/Rain Garden/Wetland)**

Site Name____________ Plot ID____________ Retrieval Date____________
Rainfall Event # ____________ Collected by____________

| Sample ID | Collection Date | Time of Collection |
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Relinquished By-----------------------------Date-----------------------------Time------------------------

Relinquished By-----------------------------Date-----------------------------Time------------------------

Relinquished By-----------------------------Date-----------------------------Time------------------------

Relinquished By-----------------------------Date-----------------------------Time------------------------

**Chain-of-Custody Form (COC)**

***Lower Rio Grande Valley Low-Impact Development Implementation and Education***
**Texas A&M University - Kingsville , 917 W. Ave B, Kingsville, TX 778363, Phone: 361-593-2069**

**(Rainwater Harvesting/Green Roof)**
Site Name:___________ Retrieval Date_________ Rainfall Event # ________
Collected by____________

| Plot ID | Sample ID | Collection Date | Time of Collection |
|---|---|---|---|
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| Plot ID | Sample ID | Collection Date | Time of Collection |
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| Plot ID | Sample ID | Collection Date | Time of Collection |
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| Plot ID | Sample ID | Collection Date | Time of Collection |
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Relinquished By-----------------------------Date-----------------------------Time------------------------

Relinquished By-----------------------------Date-----------------------------Time------------------------

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# APPENDIX G. AUTOMATED SAMPLER TESTING AND MAINTENANCE REQUIREMENTS

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

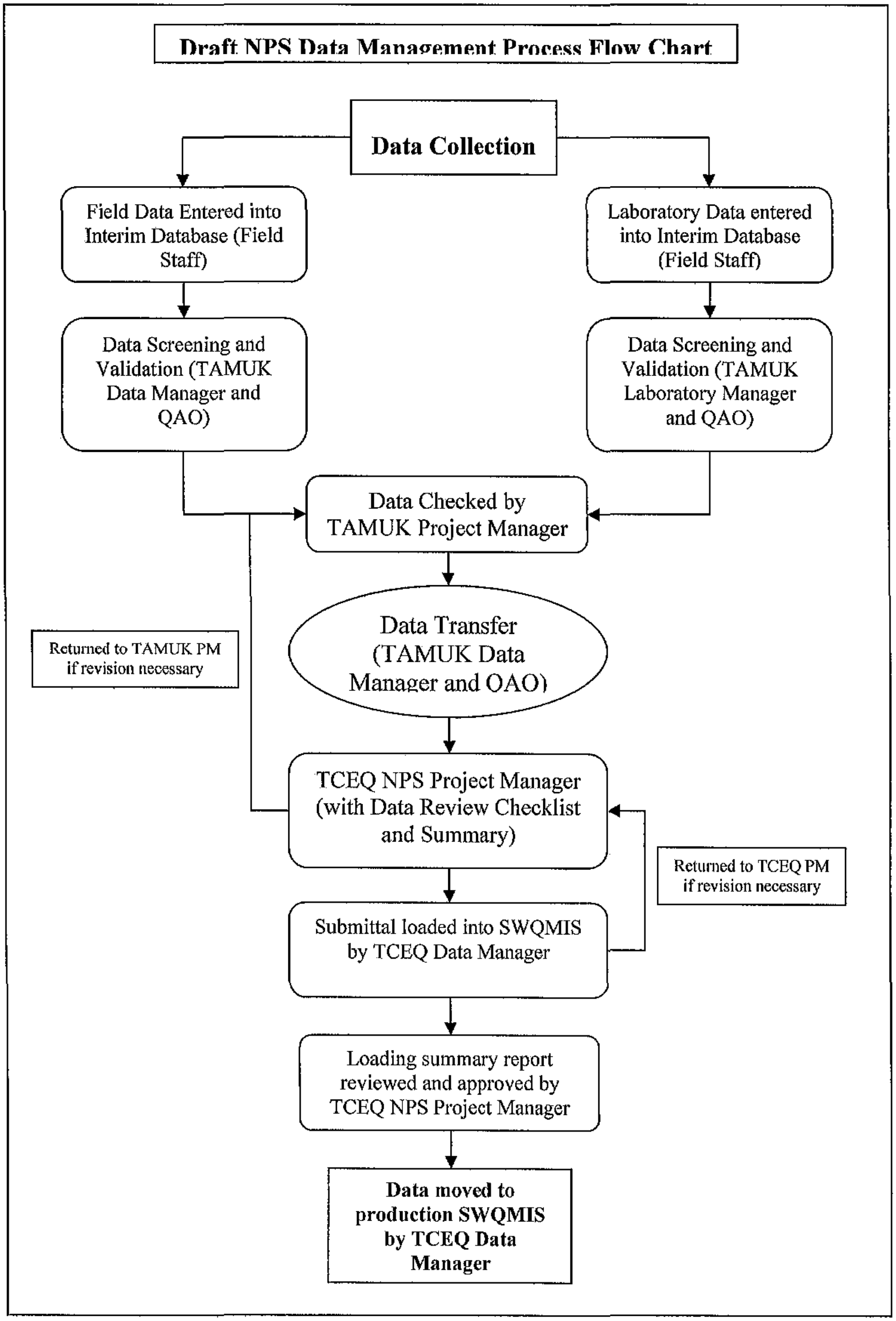
# APPENDIX H. AUTOMATED SAMPLER TESTING AND CALIBRATION REQUIREMENTS

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

# APPENDIX I. FIELD AND LABORATORY DATA SHEETS

Provided upon selection of NELAC accredited lab.

# APPENDIX J. DATA MANAGEMENT FLOW CHART


Draft NPS Data Management Process Flow Chart
Data Collection
Field Data Entered into Interim Database (Field Staff)
Laboratory Data entered into Interim Database (Field Staff)
Data Screening and Validation (TAMUK Data Manager and QAO)
Data Screening and Validation (TAMUK Laboratory Manager and QAO)
Data Checked by TAMUK Project Manager
Data Transfer (TAMUK Data Manager and QAO)
Returned to TAMUK PM if revision necessary
TCEQ NPS Project Manager (with Data Review Checklist and Summary)
Returned to TCEQ PM if revision necessary
Submittal loaded into SWQMIS by TCEQ Data Manager
Loading summary report reviewed and approved by TCEQ NPS Project Manager
Data moved to production SWQMIS by TCEQ Data Manager

# APPENDIX K. CORRECTIVE ACTION STATUS TABLE

## Appendix K - Corrective Action Status Table

| Corrective Action # | Date Issued | Description of Deficiency | Action Taken | Date Closed |
|---|---|---|---|---|
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# 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?** |

# Appendix M
# EXAMPLE LETTER TO DOCUMENT ADHERENCE TO THE QAPP

TO: (name)
(organization)

FROM: Kim Jones, PhD
Texas A&M University-Kingsville

RE: Contractor Name, QAPP Title

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

700 University Blvd.
MSC 213
Kingsville, TX. 78363

I acknowledge receipt of the Lower Rio Grande Valley Low-Impact Development Implementation and Education Quality Assuranc Project Plan (Revision date: November 2012). 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.*