Wastewater/Manure Management System Demonstration Project
Quality Assurance Project Plan
Revision #2
Q-TRAK # 05-321

Brazos River Authority
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Nonpoint Source Protection Program CWA § 319 (h)
Prepared in cooperation with the Texas Commission on Environmental Quality and the U.S. Environmental Protection Agency
Federal ID No. C9996146070

Effective Period: QAPP approval date through May 2007

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

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A1 APPROVAL PAGE

Environmental Protection Agency

Randall Rush 9/1/06
Randall Rush — Date
EPA Project Officer

Donna R. Miller 9-6-06
Donna Miller — Date
State Tribal Programs Section Chief
Approving Official

Texas Commission on Environmental Quality

Monitoring Operations Division

NA
Steve Spaw — Date
Monitoring Operations Director

for PR 6/8/06
Patrick Roques — Date
Water Quality Monitoring and Assessment Section Manager

Laurie Curra 6/8/2006
Laurie Curra — Date
Program Manager, NPS Team

Carol Whittington 6/6/06
Carol Whittington — Date
Project Manager, NPS Team

Laurie Curra 6/8/2006
Laurie Curra — Date
NPS Project Quality Assurance Specialist

Compliance Support Division

KB 6/8/06
Jose A. Franco, — Date
Compliance Support Division Director

Steve Stubbs 6/9/06
Steve Stubbs — Date
Quality Assurance Manager

6/8/06
Kyle Girten — Date
TCEQ Quality Assurance Specialist
Quality Assurance Section

Texas State Soil and Water Conservation Board

T J Helton — Date
Project Manager

Donna Long — Date
Quality Assurance Officer

Brazos River Authority

Jay Bragg — Date
Project Manager

Kay Barnes — Date
Quality Assurance Officer

Gayle B. Haecker — Date
Environmental Services Manager

Texas Cooperative Extension Soil, Water and Forage Testing Laboratory

Sam Feagley — Date
Project Manager/Quality Assurance Officer

Texas Institute for Applied Environmental Research (TIAER)

Bill Bethel — Date
TIAER Project Manager

Nancy Easterling — Date
TIAER Quality Assurance Officer

Mark Murphy — Date
TIAER Laboratory Manager

Dianne Swanson — Date
TIAER Laboratory Quality Assurance Officer

TIAER will secure written documentation from each sub-tier project participant (e.g., subcontractors, other units of government, laboratories) stating the organization's awareness of and commitment to requirements contained in this quality assurance project plan and any amendments or revisions of this plan. TIAER will maintain this documentation as part of the project's quality assurance records, and will be available for review. (See sample letter in Attachment 1 of this document.)

A2 TABLE OF CONTENTS

LIST OF ACRONYMS

AWRL	**Ambient Water Reporting Limit**
BMP	**Best Management Practices**
BRA	**Brazos River Authority**
CAR	**Corrective Action Report**
COC	**Chain-of Custody**
CNMP	**Comprehensive Nutrient Management Plan**
DOC	**Demonstration of Capability**
DQO	**Data Quality Objective**
EOF	**Edge-of-field**
EPA	**Environmental Protection Agency**
FY	**Fiscal Year**
GPS	**Global Positioning System**
LCS	**Laboratory Control Standard**
LMU	**Land Management Unit**
MDMA	**Monitoring Data Management & Analysis**
NCR	**Non-conformance report**
NPS	**Nonpoint Source**
QA	**Quality Assurance**
QAM	**Quality Assurance Manual**
QAO	**Quality Assurance Officer**
QAPP	**Quality Assurance Project Plan**
QAS	**Quality Assurance Specialist**
QC	**Quality Control**
QMP	**Quality Management Plan**
RPD	**Relative Percent Deviation**
RL	**Reporting Limit**
SOP	**Standard Operating Procedure**
SWQM	**Surface Water Quality Monitoring**
TIAER	**Texas Institute for Applied Environmental Research**
TMDL	**Total Maximum Daily Load**
TCEQ	**Texas Commission on Environmental Quality**
TRACS	**TCEQ Regulatory Activities and Compliance System**
TSSWCB	**Texas State Soil and Water Conservation Board**
TSWQS	**Texas Surface Water Quality Standards**
WMT	**Watershed Management Team**

A3 DISTRIBUTION LIST

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Dallas, Texas 75202-2733

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Mark Murphy
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Nancy Easterling
(254) 968-9548

Laboratory Quality Assurance Officer
Dianne Swanson
(254) 968-9587

Note: The TIAER Quality Assurance Officer will provide copies of this project plan and any amendments or revisions of this plan to each sub-tier project participant. The TIAER Quality Assurance Officer will document receipt of the plan by sub-tier participants and maintain this documentation as part of the project's quality assurance records. This documentation will be available for review and will also be submitted to the NPS Project Manager within 60 days of QAPP approval.

A4 PROJECT/TASK ORGANIZATION

Description of Responsibilities

ENVIRONMENTAL PROTECTION AGENCY

Randall Rush
EPA Project Officer

The EPA Project Officer (PO) is responsible for programmatically and financially managing, on EPA's behalf, all CWA Section 319 funded grants and associated projects that the State of Texas receives. The EPA PO also manages other federal allocations as designated. The PO assists the State in approving projects that are consistent with the management goals designated under the State's NPS management plan and meet federal guidance. The PO coordinates reviews of project work plans, QAPPs, draft deliverables, and works with the State in making these items approvable. The PO also 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. The PO 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. The PO assists the regional NPS coordinator in tracking a State's annual progress in its management of the NPS program. The PO assists in grant close-out procedures ensuring all deliverables have been satisfied prior to closing a grant.

TCEQ

Laurie Curra
NPS Program Manager

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, where QA protocols are not met. Ensures that all TCEQ NPS personnel are fully trained, and NPS projects are adequately staffed. Elevates problems and issues requiring resolution to TCEQ management.

Kyle Girten
NPS Lead Quality Assurance Specialist

Assists the TCEQ Project Manager in QA related issues. Participates in the development, approval, implementation, and maintenance of the QAPP. Determines conformance with program quality system requirements. Conveys quality related problems to an appropriate TCEQ manager. 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.

Carol Whittington
NPS Project Manager

Maintains a thorough knowledge of work activities. 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. 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.

Eric Reese
NPS Data Manager

Responsible for tracking and verifying of NPS data. Maintains data storage system for NPS quality assured datasets. Coordinates correction of data errors with TCEQ NPS Project Managers and contractor Data Managers. Provides training and guidance to contractors on technical data issues. Reviews and approves data-related portions of project-specific QAPPs. Performs technical reviews of project-specific Data Management Plans. Develops and maintains Standard Operating Procedures for NPS data management.

Laurie Curra
NPS Project 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 special projects.

TEXAS STATE SOIL AND WATER CONSERVATION BOARD

T J Helton
TSSWCB Project Manager

Responsible for project management for the TSSWCB and coordination of project activities with the EPA and BRA. Responsible for facilitating technical review and certification of the comprehensive nutrient management plan and best management practices implemented as part of the project.

Donna Long
TSSWCB Quality Assurance Officer

Responsible for determining that the Project Plan meets the requirements for planning, quality control, quality assessment, and reporting under the Section 319 program. Conducts audits of field and laboratory systems and procedures.

BRAZOS RIVER AUTHORITY

Jay Bragg
Brazos River Authority Project Manager

Responsible for implementing NPS requirements in contracts, QAPPs, and QAPP amendments and appendices. Coordinates basin planning activities and work of basin partners. Ensures monitoring systems audits are conducted to ensure QAPPs are followed by planning agency participants and that projects are producing data of known quality. Ensures that subcontractors are qualified to perform contracted work. Ensures NPS project managers and/or QA Specialists are notified of circumstances which may adversely affect quality of data derived from collection and analysis of samples. Responsible for transmitting all data collected by TIAER that meets the data quality objectives of the project to the TCEQ.

Gayle B. Haecker
Brazos River Authority Environmental Services Manager

Responsible for the Authority's lab, field, and data management operations.

Kay Barnes
Brazos River Authority Quality Assurance Officer/Data Manager

Responsible for writing and maintaining basin QAPPs, amendments and appendices. Responsible for determining if all data collected meet the data quality objectives of the project and are suitable for reporting to the TCEQ. Assists with conduct of monitoring systems audits for planning agency projects.

TEXAS COOPERATIVE EXTENSION SOIL, WATER AND FORAGE TESTING LABORATORY

Sam Feagley
TCE Project Manager/Quality Assurance Officer

Responsible for communication with the Laboratory Director and Laboratory Supervisor for supervision of laboratory personnel involved in generating analytical data for the project to ensure that laboratory personnel involved in generating analytical data have adequate training of all SOPs specific to the analyses or task performed and/or supervised including any special requirements, if any, for samples of individual projects. Responsible for documentation of all QA/QC requirements of this QAPP are met, documentation related to the analysis is complete and adequately maintained, and that results are reported accurately. Responsible for ensuring that corrective actions are implemented, documented, reported and verified.

TEXAS INSTITUTE FOR APPLIED ENVIRONMENTAL RESEARCH

Bill Bethel
TIAER Project Manager and Project Field Operations Supervisor

Responsible for implementing and monitoring NPS requirements in contracts, QAPPs, and QAPP amendments and appendices. Ensures monitoring systems audits are conducted to ensure QAPPs are followed by TIAER participants and that projects are producing data of known quality. Ensures that subcontractors are qualified to perform contracted work. Ensures NPS project managers and/or QA Specialists are notified of deficiencies and nonconformances, and that issues are resolved. Responsible for validating that data collected are acceptable for reporting to the BRA and TCEQ. Responsible for supervising sampling and oversight of project activities. Responsible for field scheduling, staffing, and ensuring that staff are appropriately trained.

Responsible for supervising all field project activities which involves sampling and oversight of waste management related activities. 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. Reports status, problems, and progress to TIAER project manager.

Nancy Easterling
TIAER Quality Assurance Officer and Project Data Manager

Responsible for coordinating the implementation of TIAER's QA program. Responsible for coordinating the writing and maintenance of the QAPP and monitoring its implementation. 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 TIAER Project Manager of particular circumstances that may adversely affect the quality of data. Coordinates and monitors deficiencies, nonconformances and corrective action. Coordinates and maintains records of data verification and validation. Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques. Conducts monitoring systems audits on project participants to determine compliance with project and program specifications, issues written reports, and follows through on findings. Ensures that field staff are properly trained and that training records are maintained. 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 acceptable format. Ensures that the data review checklist is completed and data are submitted with appropriate codes and data. Provides the point of contact for the TCEQ Project Manager to resolve issues related to the data and assumes responsibility for the correction of any data errors.

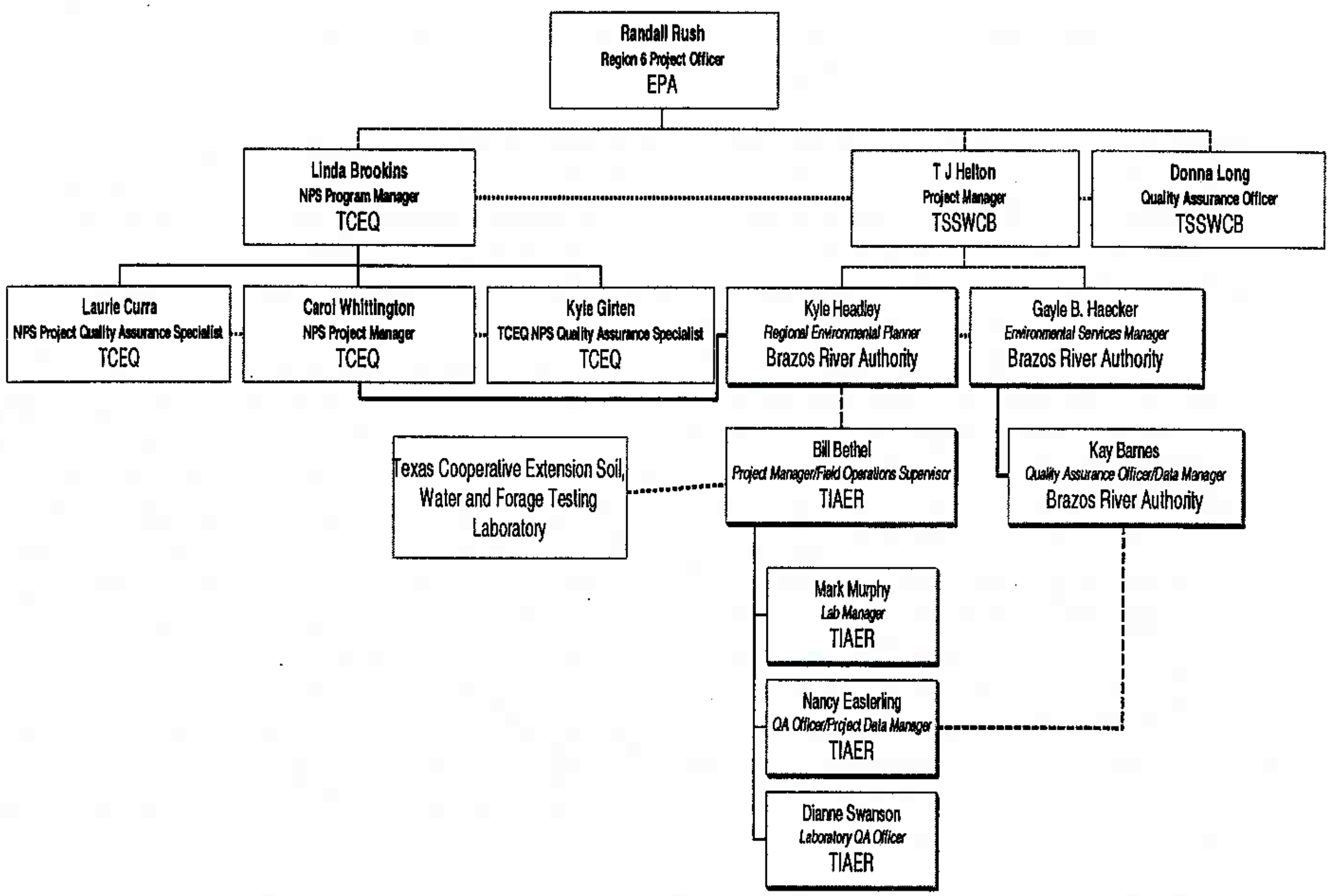
Dianne Swanson
TIAER Laboratory Quality Assurance Officer

Monitors the implementation of the QAM/QAP within the laboratory to ensure complete compliance with project data quality objectives as defined by the contract and in the QAPP. Conducts in-house audits to ensure compliance with written SOPs and to identify potential problems. Responsible for 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 primary contractor. Ensures that all QA reviews are conducted in a timely manner from real-time review at the bench during analysis to final pass-off of data to the QA Officer.

Mark Murphy
TIAER Laboratory Manager

Responsible for supervision of analytical laboratory personnel involved in generating analytical data for the 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 compiling QC statistics. Responsible for oversight of all laboratory operations ensuring that all QA/QC requirements are met, documentation related to the analysis is complete and adequately maintained, and that results are reported accurately. Responsible for ensuring that corrective actions are implemented, documented, reported and verified. Monitors the implementation of the quality assurance protocols within the laboratory to ensure complete compliance with project data quality objectives as defined by the contract and in the QAPP. Responsible for supervising and verifying all aspects of the QA/QC in the laboratory.

Figure 1. PROJECT ORGANIZATION CHART



— Line of Supervision
--- Line of Communication

A5 PROBLEM DEFINITION/BACKGROUND

The purpose of this QAPP is to clearly delineate TIAER QA policy, management structure, and procedures which will be used to implement the QA requirements necessary to verify and validate the water quality data collected. The QAPP is reviewed by the TCEQ to help ensure that data generated for the purposes described above are scientifically valid and legally defensible.

The purpose of this project is to monitor the reduction of phosphorus in the waste stream and its subsequent application to dairy waste application fields upon implementing a certified nutrient management plan (CNMP) and utilizing methane digester technology to reduce nonpoint source pollution loadings in the North Bosque River watershed. Segment 1226 (North Bosque River) is impaired according to the 1998 State of Texas 303(d) list, which is the relevant year of listing for this watershed's total maximum daily load (TMDL) development. This segment appeared on the Texas Commission on Environmental Quality (TCEQ) TMDL Development Basin Schedule for 1998. Water quality data contributed by the Texas Institute for Applied Environmental Research (TIAER) including low dissolved oxygen, elevated levels of ammonia nitrogen, nitrite/nitrate nitrogen, chlorophyll a, orthophosphate phosphorus, bacteria, and total phosphorus were found in the watershed. Modeling results show this is the result of contaminants originating from municipal wastewater treatment plants, animal feeding operations (AFOs), and animal waste application fields (WAFs). TCEQ approved two TMDLs for phosphorus in the North Bosque River Segments 1226 and 1255 on February 9, 2001, which were subsequently submitted to and approved by the United States Environmental Protection Agency (USEPA). The Implementation Plan for the two North Bosque River segments was approved by TCEQ in late 2002 and the Texas State Soil & Water Conservation Board (TSSWCB) in early 2003 (TCEQ and TSSWCB, 2002). This project will assess the effectiveness of the digester's ability to reduce phosphorus, as one potential solution for nonpoint source related phosphorus reduction measures in the North Bosque River watershed. Additional specifications of the problem to be addressed under this QAPP are described in Appendix A, the project workplan.

Agencies cooperating in this project include BRA, TCEQ, TSSWCB and TIAER. See Appendix E for the TCEQ/BRA workplan that discusses the overall project. The BRA is responsible for coordination of the overall project and has subcontracted with TIAER to perform water quality monitoring for the digester system, edge-of-field, and intermittent stream sites. In addition, TIAER will provide oversight of activities occurring on the farm in relation to waste management, digester construction and CNMP implementation. The TSSWCB has provided the funding for the edge of field and intermittent stream monitoring portion of this project. TIAER will utilize the TCE Soil, Water & Forage Testing Laboratory for soil, forage and manure analysis.

A6 PROJECT/TASK DESCRIPTION

See Appendices A and G for the project-related work plan tasks and schedule of deliverables for a description of work defined in this QAPP.

Monitoring of the digester system will be accomplished using a two-phase approach. During stage one, wastewater samples will be collected on a monthly basis at nine specific monitoring points within the digester system to evaluate system effectiveness. See Appendix B for more detail on the parameters to be measured at individual digester stations. To fine tune the system and maximize phosphorus reduction, adjustments may be made to the system using the monitoring results gathered during the start-up phase. Following the start-up phase, the monitoring plan will be scaled down to monitor standard operations. During the second phase of standard operation, the system will be monitored using grab samples at the same nine locations on a weekly basis. The wastewater, digester discharge, high-rate oxidation (HRO) pond, and separation pond will be monitored on a weekly basis for temperature, conductivity, dissolved oxygen and pH. The digester solids and separation solids will be analyzed for percent solids, NO_2-N+NO_3-N, TKN, and total P each time solids are removed. More complete information regarding the start-up and standard operations phases and a detailed diagram of the digester sampling sites can be found in Appendix B.

Water samples will be collected from intermittent stream and application field sampling sites only during rainfall events with sufficient runoff to trigger automated samplers. When sufficient overland water flow exists, water samples will be collected from project sampling sites using automatic samplers. Laboratory analysis will be performed for orthophosphate phosphorus, total phosphorus, total suspended solids, ammonia, total Kjeldahl nitrogen, and nitrite-plus-nitrate nitrogen. The measurement performance criteria to support the project objectives for a minimum data set are specified in Table A7.1. Water samples will only be analyzed if they meet preservation requirements and holding times. Datalogger printouts will be checked routinely to ensure that samples come from a rainfall event rather than from some anomaly. Load reductions for phosphorus will be calculated using the pre-digester collected data versus post-digester collected data.

Additionally, soil tests and forage samples will be collected before and after digester installation to measure phosphorus reductions. Soil, water, and forage samples will be analyzed within the estimated accuracy and precision limits of measured parameters to insure data quality (Table A7.1). The Texas Cooperative Extension (TCE) Soil, Water and Forage Testing Laboratory will provide analysis for soil, forage and manure samples collected under this project. The TIAER Analytical Laboratory will analyze the water and wastewater samples.

Activities associated with collection of direct data for this project are presented briefly below. See Appendix A and Appendix G for details on these activities.

- *Appendix A, Task 2*—Site assessment, preparation and installation of edge-of-field/intermittent channel monitoring equipment
- *Appendix A, Task 3*—Collection and analysis of water quality data from edge-of-field/intermittent channel monitoring
- *Task added after workplan was approved*—Lagoon and manure nutrient content assessment
- *Appendix G* —Collection and analysis of water quality data from digester

See Appendix B for sampling design and monitoring pertaining to this QAPP.

Data Collection Activities to Date:

Appendix A

Since approval of the original QAPP, all activities under Task 2, regarding site assessment and installation of monitoring equipment, have been completed.

Task 3.1, edge-of-field sampling, is presently being conducted as weather conditions permit. All runoff samples have been collected and analyzed in accordance with the requirements of this QAPP.

Task 3.2, the collection and analyses of soil data was resumed in August 2005. Analyses were conducted by Texas Cooperative Extension (TCE) Soil, Water and Forage Testing Laboratory in College Station, Texas and by A&L Plains (A&L Plains) Agricultural Laboratory, Inc. in Lubbock, Texas. Soil data received from a laboratory other than TCE is considered as non-direct measurements (Section B9). Soil data considered as non-direct measurements were also collected by project personnel and analyzed by A&L Plains prior to installation of the digester.

Forage samples were collected on five occasions in accordance with Task 3.3 and analyzed in accordance with this QAPP.

Appendix G

Phase 1 monthly collection and analyses of digester grab samples, Task 4.1, was begun in October 2005. No samples were collected in March 2006 due to repairs being made to the digester system. Sampling was resumed in April 2006. Results of sample analyses are being forwarded to CES to be used to calibrate the system for maximum phosphorus reduction efficiency and electricity generation.

Amendments to the QAPP

Revisions to the QAPP may be necessary to reflect changes in project organization, tasks, schedules, objectives, and methods; to improve operational efficiency; and to accommodate unique or unanticipated circumstances. Requests for amendments are directed from the TIAER Project Manager to the NPS Project Manager in writing. They are effective immediately upon approval by the TIAER Project Manager, TIAER QAO, the NPS Project Manager, the NPS Lead QA Specialist, and the NPS Project QA Specialist. They will be distributed by the TIAER Project Manager and incorporated into the QAPP by way of attachment and distributed to personnel on the distribution list.

Expedited Changes

Expedited Changes to the QAPP should be approved before implementation to reflect changes in project organization, tasks, schedules, objectives, and methods, address deficiencies and non-conformance, improve operational efficiency and accommodate unique or unanticipated circumstances. Requests for expedited changes are directed from the contractor Project Manager to the TCEQ Project Manager in writing. They are effective immediately upon approval by the TCEQ Project Manager and Quality Assurance Specialist.

Expedited changes to the QAPP and the reasons for the changes shall be documented, and revised pages shall be initialed by the TCEQ Project Manager and QAS, the EPA Project Officer, and the TIAER Project Manager, then distributed to all persons on the QAPP distribution list by the TIAER QAO. Expedited changes 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 main objective for this project is to collect data to evaluate the effectiveness of methane digester technology on reducing phosphorus in dairy waste. The major data quality objective is to evaluate phosphorus reductions in the waste stream at locations throughout the digester system, in intermittent channels that receive runoff from the demonstration farm, and in rainfall runoff from a liquid waste application field. Data from waste application fields will be collected prior to installation of the digester to establish a baseline against which to compare the post-digester phosphorus component in rainfall-induced runoff from the waste application field. Secondary objectives of the project include assessments of changes in phosphorus concentration associated with the phosphorus reduction technology in 1) manure from the confinement area, 2) soil tests from application fields (being performed by a private consultant in addition those collected under the project), and 3) estimates of nutrients removed from the forage grown on waste application fields. Another objective is to ensure that reductions in phosphorus are not accompanied by increases in concentrations of other constituents. The other constituents, which are listed in Table A7.1, will be measured to determine changes in their concentrations.

See Appendix B Figure 3 for the dairy site selected for this project.

The measurement performance specifications to support the project objectives for a minimum data set are specified in Table A7.1 and in the text following. Note: Due to the high concentrations of solids and nutrients in wastewater and storm samples, samples will not be filtered in the field.

Table A7.1 Measurement Performance Specifications

PARAMETER	UNITS	METHOD[1]	PARAMETER CODE	AWRL	Laboratory Reporting Level	Precision (RPD of LCS/LCSD/ sample dup)	BIAS (% Rec. of LCS/LCSD mean)	ACCURACY (% Rec. of CCVs)	Lab
Water and Wastewater Parameters									
Total Suspended Solids, TSS[2]	mg/L	EPA 160.2	00530	4.0	4.0	20	80-120[2]	NA	TIAER
Ammonia-Nitrogen, dissolved	mg/L	EPA 350.1[3]	00608	0.02	0.02	20	80-120	90-110	TIAER
Ortho-Phosphate Phosphorus, dissolved; lab filtered	mg/L	EPA 365.2	70507	0.04[1]	0.005	20	80-120	90-110	TIAER
Nitrate/nitrite-Nitrogen, dissolved	mg/L	EPA 353.2[3]	00631	0.04	0.04	20	80-120	90-110	TIAER
Total Kjeldahl Nitrogen	mg/L	EPA 351.2, modified[4]	00625	0.20	0.20	20	80-120	80-120	TIAER
Total Phosphorus	mg/L	EPA 365.4, modified[4]	00665	0.06	0.06	20	80-120	80-120	TIAER
Wastewater Parameters[5]									
Total Dissolved Solids, TDS[2]	mg/L	SM 2540 C	70300	10	10	20	80-120[2]	NA	TIAER
Total Solids, TS[2]	mg/L	SM 2540 B	00500	10	10	20	80-120[2]	NA	TIAER
Total Volatile Solids, TVS[2]	mg/L	SM 2540 E	00505	NA	10	20	80-120[2]	NA	TIAER
Total Fixed Solids, TFS[2]	mg/L	SM 2540 E	00510	NA	10	20	80-120[2]	NA	TIAER
Biochemical Oxygen Demand	mg/L	EPA 405.1	00310	2.0	2.0	NA	NA	NA	TIAER
Digester and Separation Pond Solids Parameters									
Percent Solids	%	SM 2540 G	None	NA	0.1	NA	NA	NA	TIAER
Nitrate Nitrogen, extractable	mg/Kg	SSSA 38-1148	None	NA	1	NA	NA	80-120	TIAER
Total Kjeldahl Nitrogen	mg/Kg	EPA 351.2, modified[4]	None	NA	4	NA	NA	80-120	TIAER
Total Phosphorus, TP	mg/Kg	EPA 365.4, modified[4]	None	NA	4	NA	NA	80-120	TIAER

PARAMETER	UNITS	METHOD[1]	PARAMETER CODE	AWRL	Laboratory Reporting Level	Precision (RPD of LCS/LCSD/ sample dup)	BIAS (% Rec. of LCS/LCSD mean)	ACCURACY (% Rec. of CCVs)	Lab
Soil Parameters									
Extractable Phosphorus	mg/kg	Mehlich III, (TCE SOP 0079)	None	NA	1.0	20	80-120%	NA	TCE Lab
Extractable Potassium	mg/kg	Mehlich III, (TCE SOP 0079)	None	NA	5.0	20	80-120%	NA	TCE Lab
Nitrate Nitrogen, extractable	mg/kg	Dorich and Nelson, (TCE SOP 0014)	None	NA	1.0	20	80-120%	NA	TCE Lab
Forage Parameters									
Total Nitrogen	mg/kg	Sweeney (TCE SOP 0075)	None	NA	200	20	80-120%	NA	TCE Lab
Total Phosphorus	mg/kg	Feagley et al. (TCE SOP 0036)	None	NA	200	20	80-120%	NA	TCE Lab
Manure Parameters									
Total Nitrogen	mg/kg	Sweeney (TCE SOP 0073)	None	NA	200	20	80-120%	NA	TCE Lab
Total Phosphorus	mg/kg	Havlin and Soltanpour (TCE SOP 0074)	None	NA	200	20	80-120%	NA	TCE Lab
Field Parameters									
pH	pH/ units	EPA 150.1 and TCEQ SOP	00400	NA	NA	NA	NA	NA	TIAER Field
Temperature	° C	EPA 170.1 and TCEQ SOP	00010	NA	NA	NA	NA	NA	TIAER Field
Conductivity	uS/cm	EPA 120.1 and TCEQ SOP	00094	NA	NA	NA	NA	NA	TIAER Field
Dissolved Oxygen	mg/L	EPA 360.1 and TCEQ SOP	00300	NA	NA	NA	NA	NA	TIAER Field

1 In case of equipment malfunction and resulting holding time issues, alternate back-up analytical methods include the following: EPA 325.1-3 for chloride; EPA 350.2-3 for NH_3; EPA 351.1-4 (modified as per footnote 5) for TKN; EPA 300.0, EPA 352.1, EPA 353.1-3, and EPA 354.1 for NO_2-N+NO_3-N, EPA 300.0 and EPA 365.2 and lab-filtered EPA 365.2 (code 70507) for PO_4-P, EPA 365.4 (modified as per footnote 6) for total P. If an alternative method is necessitated, all QC, AWRLs, recovery, precision, and bias limits required by TCEQ will be followed

2 Based upon email communications between Mark Murphy of TIAER and Steve Gibson and Kyle Girten of TCEQ, the TIAER laboratory has evaluated historical data for a Celite standard on TSS analysis, sodium chloride for TDS and potassium hydrogen phthalate for TVS and will use the limits derived from control charts. Preliminary data indicate that these limits, which are 80-120% for bias and 20% for precision, may be sufficient for TDS as well, and can therefore be applied to all solids analyses for the first year of the project. The control charts for the solids analyses will be evaluated when enough data is collected, and limits may be modified during the next QAPP revision.

3 Due to the composition of the samples, field filtration is not feasible so the samples will be filtered as soon as possible after submission to the laboratory.

4 Modification of the TKN method involves using copper sulfate as the catalyst instead of mercuric sulfate. A memorandum dated May 21, 1999, was sent from William Telliard, Director of EPA's Analytical Methods Staff, stating that EPA believes that it is acceptable to make the substitution as long as all method specified performance are met. Modification of the total phosphorus method involves using copper sulfate as the catalyst instead of mercuric sulfate. The EPA procedure for TKN states that the digestate may also be used in TP determination. Documentation of TIAER's ability to achieve acceptable performance using the modification is kept by the TIAER analytical laboratory. TP and TKN on solids samples are done in a dilution with deionized water and calculated to a dry weight basis.

5 Parameters in this section are measured only in wastewater. Parameters measured in both water and wastewater are listed in the section above.

References for Table A1.7:

American Public Health Association (APHA), American Water Works Association (AWWA), Water Environment Federation (WEF), "Standard Methods for the Examination of Water and Wastewater," 20th Edition, 1999.

Dorich, R.A., and D.W. Nelson. 1984. Evaluation of manual cadmium reduction methods for determination of nitrate in potassium chloride extracts of soils. Soil Sci. Soc. Am. J. 48:72-75.

Feagley, S.E., M.S. Valdez, and W.H. Hudnall. 1994. Papermill sludge, phosphorus, potassium, and lime effect on clover grown on a mine soil. J. Environ. Qual. 23:759-765.

Havlin, J.L. and P.N. Soltanpour. 1989. A nitric acid plant digest method for use with inductively coupled plasma spectrometry. Comm. Soil Sci Plant Anal. 14:969-980.

Mehlich, A. 1984. Mehlich-3 soil test extractant: A modification of Mehlich-2 extractant. Communications in Soil Science and Plant Analysis 15:1409-1416

SSSA – Soil Science Society of America. 1996. Methods of Soils Analysis, part 3: Chemical Methods. SSSA, Madison, WI.

Sweeney, Rose A. Generic combustion method for determination of crude protein in feeds: Collaborative study. J. Assoc. Off. Anal. Chem. 72: 770-774.

TCE (Texas Cooperative Extension) - procedure used by TCE Soil, Water, and Forage Testing Laboratory

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

Ambient Water Reporting Limits

The AWRL establishes the reporting specification at **or below** which data for a parameter must be reported to be compared with freshwater screening criteria. The AWRLs specified in Table A7.1 are the program-defined reporting specifications for each analyte and yield data acceptable for routine water quality monitoring. The reporting limit is the lowest concentration at which the laboratory will report quantitative data within a specified recovery range. The laboratory will meet two requirements in order to report meaningful results to the TCEQ:

- The laboratory's reporting limit for each analyte will be at **or below** the AWRL.
- The laboratory will demonstrate and document on an ongoing basis the laboratory's ability to quantitate at its reporting limits.

Acceptance criteria are defined in Section B5.

Precision

Precision is a statistical measure of the variability of a measurement when a collection or an analysis is repeated and includes components of random error. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions.

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 standards. Precision results are plotted on quality control charts, which are based on historical data and used during evaluation of analytical performance. Program-defined measurement performance specifications for laboratory control standard/laboratory control standard duplicate pairs 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 verified through the analysis of laboratory control standards prepared with certified reference materials and by calculating percent recovery. Results are plotted on quality control charts, which are calculated based on historical data and used during evaluation of analytical performance. Program-defined measurement performance specifications for laboratory control standards are specified in Table A7.1.

For soil samples, bias is verified through laboratory media standard results compared to replicated results of the same sample on a large volume basis. For vegetation, bias is verified through the analysis of laboratory media standards prepared with certified reference materials (NIST or NIST traceable standards). Therefore, bias will be determined in these analyses by comparing results of laboratory media standards to the historical average or to the certified reference results for NIST standards. Proper equipment calibration will serve to verify the bias for manure samples. Performance limits for bias are listed 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. The data collected for this project are not considered representative of ambient water quality and, therefore, are not suitable for the current TRACS database.

Comparability

Confidence in the comparability of fixed/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.

Completeness

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

A8 SPECIAL TRAINING/CERTIFICATION

New field personnel will receive training in proper sampling and field analysis. Before actual sampling or field analysis occurs, they will demonstrate to the designee appointed by the QA Officer their ability to properly calibrate field equipment and perform field sampling and analysis procedures. Training will be documented and retained in the personnel file and be available during a monitoring systems audit.

Laboratory analysts have a combination of experience, education, and training to demonstrate knowledge of their function. Laboratories have documented training records for each test that an analyst performs. Training is performed prior to analyzing samples and annually thereafter.

TIAER personnel involved in use of Global Positioning System (GPS) for water sampling station locations have been trained in the appropriate use of GPS and have been certified by the TCEQ. No other special certifications are required. See Attachment 2 for TCEQ's GPS policy.

A9 DOCUMENTS AND RECORDS

The documents and records that describe, specify, report, or certify activities are listed in Table A9.1.

Data will be submitted to the TCEQ at the end of the project in the event/result format specified in the TCEQ Data Management Reference Guide (DMRG). The data will not be immediately loaded to TRACS; rather, it will be stored in a temporary Nonpoint Source database which mirrors the TRACS structure. This will allow for eventual uploading should TRACS data management policies be modified to accommodate this type of data. This project will be identified in the temporary database as project "A" which will be reflected in the content of several data elements as discussed below.

Table A9.1 Project Documents and Records

Document/Record	Location	Retention (yrs)	Format
QAPPs, amendments and appendices	TIAER	5 years	Paper
QAPP distribution documentation	TIAER	5 years	Paper
QAPP distribution documentation	TCE Lab	5 years	Paper
Training Records	TIAER	5 years	Paper/Electronic
Training Records	TCE Lab	5 years	Paper/Electronic
Field SOPs	TIAER	5 years	Paper
Laboratory QA Manuals	TIAER Lab	5 years	Paper
Laboratory QA Manuals	TCE Lab	5 years	Paper
Laboratory SOPs	TIAER Lab	5 years	Paper
Laboratory SOPs	TCE Lab	5 years	Paper
Field staff training records	TIAER	5 years	Paper
Field equipment calibration /maintenance logs	TIAER	5 years	Paper
Chain of custody records	TIAER	5 years	Paper
Laboratory calibration records	TIAER Lab	5 years	Paper/Electronic
Laboratory calibration records	TCE Lab	5 years	Electronic
Laboratory instrument printouts	TIAER Lab	5 years	Paper/Electronic
Laboratory instrument printouts	TCE Lab	5 years	Electronic
Laboratory data reports/results	TIAER	5 years	Paper
Laboratory equipment maintenance logs	TIAER Lab	5 years	Paper
Laboratory equipment maintenance logs	TCE Lab	5 years	Paper
Corrective Action Documentation	TIAER	5 years	Paper

Data collection sites will be assigned an interim Station Identification Number which will consist of the letter "A" followed by an integer beginning with "A1" and continuing sequentially for additional stations. A Station Location Request Form (SLOC) as described in the DMRG will be submitted to the Project Manager for each sampling site. Project personnel should seek guidance from the TCEQ Project Manager and/or Data Manager regarding proper use of EPA station types when preparing SLOCs.

Unique identifiers (TagIDs) for the event and results will begin with an integer and end in the letter "A" (e.g., 1A, 2A, 3A, etc.). This will avoid conflict with current TRACS TagIDs which are seven digit alphanumerics beginning with one or more alpha characters.

Source and Program Codes will reflect the project organization of BRA reporting the data, TIAER collecting the data, and data collection targeted toward NPS data as follows:

Source Code 1	Source Code 2	Program Code
BR	TA	NP

Laboratory Data Reports

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

- name and address of the laboratory
- name and address of the client
- a clear identification of the sample(s) analyzed
- identification of samples that did not meet QA requirements and why (e.g., holding times exceeded)
- date of sample receipt
- sample results
- a name and title of person accepting responsibility for the report
- project-specific quality control results to include LCS sample results (% recovery), LCS duplicate results (%RPD), equipment, trip, and field blank results (as applicable), and RL confirmation (% recovery)
- narrative information on QC failures or deviations from requirements that may affect the quality of results.

Electronic Data

Project data will be submitted electronically to the TCEQ in a format appropriate for TRACS data, although data will not be entered into TRACS at this time. A completed Data Review Checklist will be provided with each data submittal.

B1 SAMPLING PROCESS DESIGN

See Appendix B for sampling process design information and monitoring tables associated with data collected under this QAPP. Locations of digester sites, intermittent steam sites, and the edge-of-field site are included as Figure 2 and Figure 3 in Appendix B.

B2 SAMPLING METHODS

Field Sampling Procedures

Field sampling will be conducted according to the sampling handling procedures described in Section B3 and in Appendix B.

Sample volume, container types, minimum sample volume, preservation requirements, and holding time requirements are presented in Table B2.1.

Table B2.1 Sample Storage, Preservation and Handling Requirements

Parameter	Matrix	Container	Preservation	Sample Volume	Holding Time
Total Suspended Solids	water/wastewater	plastic	4º C	400 mL	7 days
Ammonia-Nitrogen	water/wastewater	plastic	4º C, pH<2 with H_2SO_4 after filtration	150 mL	filter ASAP; 28 days until analysis
Ortho-Phosphorus, lab filtered	water/wastewater	plastic	4º C	150 mL	filter ASAP; 48 hrs until analysis
Nitrite+Nitrate Nitrogen	water/wastewater	plastic	4º C, pH<2 with H_2SO_4 after filtration	150 mL	filter ASAP; 28 days until analysis
Total Kjeldahl Nitrogen	water/wastewater	plastic	4º C, pH<2 with H_2SO_4	200 mL	28 days
Total Phosphorus	water/wastewater	plastic	4º C, pH<2 with H_2SO_4	150 mL	28 days
Percent Solids	Wastewater/solids	plastic or glass	4º C	400 mL	7 days
Total Nitrogen	Manure/solids	plastic	Air dried	100 g	6 months
Total Phosphorus	Manure/solids	plastic	Air dried	100 g	6 months
Extractable Phosphorus	soil	plastic	air dried	250 g	6 months
Extractable Potassium	soil	plastic	air dried	250 g	6 months
Extractable Nitrate Nitrogen	Soil/solids	plastic	air dried	250 g	6 months
Total Nitrogen	forage	paper	air dried	100 g	6 months
Total Phosphorus	forage	paper	air dried	100 g	6 months
Total Dissolved Solids	wastewater	plastic or glass	4º C	400 mL	7 days

Parameter	Matrix	Container	Preservation	Sample Volume	Holding Time
Total Solids	wastewater	plastic or glass	4º C	400 mL	7 days
Total Volatile Solids	wastewater	plastic or glass	4º C	400 mL	7 days
Total Fixed Solids	wastewater	plastic or glass	4º C	400 mL	7 days
Biochemical Oxygen Demand (5 day)	wastewater	plastic or glass	4º C	1000 mL	48 hours
Percent Solids	wastewater	plastic or glass	4º C	400 mL	7 days

Sample Containers

The sample containers for most water samples are plastic bottles. (Note: Analysis for trace metals or other analytes requiring ultra clean techniques are not performed at the TIAER laboratory for this project.) Wide-mouthed plastic containers will be used to collect all wastewater samples. Clean plastic bags will be used to collect soil and forage samples.

Plastic sample containers are cleaned for reuse by washing them in hot, soapy (non-phosphate) water. The bottles are rinsed first in warm tap water, then with 1 N HCl, and finally rinsed at least three times in type II ASTM water. They are placed on a rack to dry.

Processes to Prevent Contamination

Procedures outlined in the TCEQ Surface Water Quality Procedures Manual outline the necessary steps to prevent contamination of samples. These include direct collection into sample containers, when possible. Field QC samples (identified in Section B5) are collected to verify that contamination has not occurred.

Documentation of Field Sampling Activities

Field sampling activities are documented on field data sheets, which are included in Appendix C. The following will be recorded for all visits:

1. Station ID
2. Location
3. Sampling time
4. Sampling date
5. Sampling depth (if appropriate)
6. Sample collector's name/signature
7. Values for all measured field parameters (may be recorded electronically in sonde)
8. Preservative added, if applicable
9. Detailed observational data (as appropriate), including:
    - water appearance
    - weather
    - days since last significant rainfall

10. Other observational data (as applicable), including:
    - activities in contributing watershed or digester area that could impact water quality (events impacting water quality, e.g., livestock watering upstream, etc.)
    - unusual odors
    - specific sample information (number of grabs, type, etc.)
    - missing parameters (i.e., when a scheduled parameter or group of parameters is not collected)

Recording Data

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

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

Deficiencies, Nonconformances and Corrective Action Related to Sampling Requirements

Deficiencies are defined as unauthorized deviations from procedures documented in the QAPP or other applicable documents. Nonconformances are deficiencies that affect quality and render the data unacceptable or indeterminate. Deficiencies related to sampling methods requirements include, but are not limited to, such things as sample container, volume, and preservation variations, improper/inadequate storage temperature, holding-time exceedances, and sample site adjustments.

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and are reported to the cognizant field or laboratory supervisor via a corrective action report (CAR). The supervisor notifies the TIAER Project Manager if the deficiency has the potential of being a nonconformance. The TIAER Project Manager will notify the TIAER QAO of the potential nonconformance within 24 hours.

The TIAER Project Manager, in consultation with TIAER QAO (and other affected individuals/ organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore, is not a valid nonconformance, the CAR will be completed accordingly and closed. If it is determined a nonconformance does exist, the TIAER Project Manager in consultation with the TIAER QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented on the CAR.

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

B3 SAMPLE HANDLING AND CUSTODY

Chain-of-Custody

The COC system described in this QAPP replaces the "tag" system as described in the SWQM Manual.

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.

Water quality data are generated in the field and the TIAER analytical laboratory. A chain of custody (COC) form is used to record sample identification parameters and to document the submission of samples from the field staff to the analytical laboratory staff. Each COC has space to record data for at least 15 separate samples. A copy of the COC is found in Appendix D. For samples collected by automated samplers that will be composited, a computer printout for each site showing aliquot volumes should be attached to the COC. For grab samples, a field data sheet for each site is attached to the COC. COCs and accompanying data sheets are kept in three-ring binders in the TIAER office for at least five years.

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 subcontract laboratories. The following information concerning the sample is recorded on the COC form (See Appendix D). The list of included items should match the COC form in Appendix D. These are standard requirements for COC forms. All COC forms to be used in the project are included in Appendix D for the TCEQ's review.

1. Date and time of collection
2. Site identification
3. Sample matrix
4. Number of containers, if applicable
5. Preservative, if applicable
6. Test group code to indicate required analyses
7. Name of collector
8. Custody transfer signatures and dates and time of transfer
9. Bill of lading, if applicable

Sample Labeling

Water and wastewater samples are labeled on the container with an indelible marker. Label information includes:

1. Station identification
2. Time of sampling (or bottle number for composited samples)

These two unique identifiers can be matched with data on Chain of Custody forms when submitting samples. All samples are submitted on a daily basis and given a unique sample number. This sample identification number, time, date and station location serve to match the sample with the data on the COC. All water and wastewater samples are submitted to the laboratory on ice. Project samples do not require additional types of preservation. No samples for this project are field filtered.

Sample Handling

Each sample container is labeled in the field with the identification stated above. Water and wastewater samples are preserved on ice in a cooler while they are being transported to the laboratory. The field staff member documents in a field data sheet, COC form, or sample bench sheet the station, date, time, location, and sample type. A sample identification number is assigned to water and wastewater samples at the TIAER office and is written on the sample container and on the COC. The sample number, location, date, changes in possession and other pertinent data are recorded in ink on the COC, which accompanies all sets of sample containers. The field staff member transfers possession of the samples to a laboratory staff member or alerts a laboratory staff member and leaves the sample containers, COCs and other paperwork in a secured area. The field staff member and the laboratory staff member both sign and date the COC. Copies of the COC form used on this project are included as Appendix D.

Grab Wastewater Samples and *In Situ* Measurements. Field staff will visit sampling stations associated with the digester to collect grab samples and measure physicochemical parameters. Station identification, date and time, personnel, and comments concerning weather or conditions at the station are recorded on a field data sheet. A field data sheet is included in Appendix C.

Grab wastewater samples are collected at the station, and the station identification and time of collection are written in waterproof marker on the outside of the wide-mouth plastic sample bottles. The bottles are placed in an iced chest for transportation to TIAER laboratory. Field staff measure dissolved oxygen, pH, water temperature, and conductivity at appropriate stations, using calibrated multisonde equipment. Measurements of field parameters made by multisondes are recorded on field data sheets for input into to the TIAER database.

Unique sample identification numbers are obtained in TIAER's sample processing room, then written in waterproof marker on the sample bottles and on the COC forms. Sample bottles being processed are typically placed in order of collection time, so the order of the sample bottles matches the order of the field data and the COC sample ID numbers, reducing transcription errors. Station name, time of collection, comments, and other pertinent data are copied from the field data sheets to the COC. Field data sheets are attached to the COC. The COC, data entry sheets, and accompanying sample bottles are submitted to the laboratory, with relinquishing and receiving personnel both signing and dating the COC.

Wet Weather (Storm) Samples. Stormwater runoff will be collected from the automated sampling sites with ISCO automatic sampling devices during each rainfall event that is of sufficient intensity and duration to trigger the automatic sampling devices. The automatic sampler timers will be programmed with a sampling regime developed by TIAER, which may be adjusted as individual collection sites warrant. After a rainfall event, the ISCO samplers will be inspected within 30 hours to retrieve all water samples that have been collected. Bottle numbers, corresponding to order of collection and placement in the ISCO carousel, are written in waterproof ink on the sample containers, along with the site name. Properly collected water samples from ISCO samplers will be transported to the TIAER laboratory on a daily basis. Labeled storm sample containers and the COC are delivered to the laboratory for compositing and analysis.

ISCO flow meters are downloaded in the field onto field laptop computers to obtain sample collection times and corresponding flow data. Data from the laptops are uploaded to a TIAER computer on which a flow-weighting program developed by TIAER is run. The flow meter data are used to calculate the amount of liquid from each storm sample bottle that should be used in the composite sample. Storm samples are then composited in the laboratory and analyzed.

Soil Samples. Soil samples will be air-dried for at least 24 hours immediately after collection prior to shipping to the TCE Laboratory for analysis. Each soil sample will be placed in a soil sample bag, with sample identification marked on the outside of the sample bag. The label on the soil sample bag will contain the sample identification number, the dairy location, the LMU, and the depth(s) from which the sample was taken. Soil sample bags containing soil samples will be boxed and shipped to TCE Soil, Water, and Forage Testing Laboratory, College Station, Texas the day after sample drying. A "Soil Sample Information Form" (Appendix D) will be completed in duplicate. One copy of the soil sample information form will accompany the composite samples to the to TCE Laboratory and one copy will be included in the project file at TIAER.

Forage Samples. Each forage sample will be oven-dried, then immediately placed in a paper sack, sealed, and marked with sample identification on the outside of the sack. The sample identification will identify the dairy and the LMU from which the sample was taken. Paper sacks containing forage samples will be boxed and immediately shipped to TCE Soil, Water, and Forage Testing Laboratory, College Station, Texas. A "Forage/Feed/Plant Tissue Sample Information Form" (Appendix D) will be completed in duplicate. One copy of the sample information form will accompany the composite samples to the TCE Laboratory and one copy will be included in the project file at TIAER.

Manure Samples. Manure samples will be double bagged in sealable plastic bags and marked with sample identification on the outside of both bags using a waterproof marker. The sample identification will identify the dairy and the manure pile(s) from which the sample was taken. Plastic bags containing manure samples will be boxed and shipped to TCE Soil, Water, and Forage Testing Laboratory, College Station, Texas immediately after collection. A "Biosolid Sample Information Form" (Appendix D) will be completed in duplicate. One copy of the sample information form will accompany the manure samples to the TCE Laboratory and one copy will be included in the project file at TIAER.

Laboratory Analysis and Data Collection

A test group code is marked on the COC by the field staff to designate the type of analytes to be measured for each sample. Upon receipt of samples and COC, the laboratory staff member compares the time of collection and the shortest holding time for the required analyses against the time of receipt to ensure that sufficient time has been allowed to complete the analyses. When analyses are complete, the laboratory staff check again to see whether the samples were analyzed within the holding time. This can become an issue when quality control checks are not met and the analysis must be repeated. Laboratory staff consistently monitor the remaining time for analyses and work to ensure that samples are analyzed within holding time restraints.

Aliquots of each sample are used by the laboratory staff in running the various analytical procedures. The sample number is marked on all containers to which aliquots are transferred. Aliquots are filtered, as necessary, and analyzed as per standard operating procedures. Data pertaining to analyte measurements are recorded in bound personal logbooks, which are specific to each procedure and analyst. According to the type of analysis, measurement data produced in the laboratory is either printed out from the automated analytical equipment, read from screens on equipment and copied into logbooks, or copied to Excel spreadsheets that calculate concentrations. Printouts of data from analytical equipment and from Excel spreadsheets are taped into the bound notebooks. Measurement data are copied from the notebooks to the computer database or are transferred directly from analytical instruments through a data-reviewed LIMS. Physicochemical data are downloaded from the sondes and transferred electronically to the SAS database.

Backup/Disaster Recovery

The Unix drive and the network server are backed up daily to a tape drive. In the event of a catastrophic systems failure, the tapes can be used to restore the data. Data generated on the day of the failure may be lost, but can be reproduced from raw data in most cases.

Archives/Data Retention

Original data recorded on paper files are stored for at least five years. Data in electronic format are stored on tape drives in a climate controlled, fire-resistant storage area on the Tarleton State University campus.

Deficiencies, Nonconformances and Corrective Action Related to Chain-of-Custody

Deficiencies are defined as unauthorized deviations from procedures documented in the QAPP or other applicable documents. Nonconformances are deficiencies, which affect quality and render the data unacceptable or indeterminate. Deficiencies related to chain-of-custody include but are not limited to delays in transfer, resulting in holding time violations; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc.

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and reported to the cognizant field or laboratory supervisor who will notify the TIAER Project Manager. The TIAER Project Manager will notify the TIAER QAO of potential nonconformances within 24 hours. The TIAER Project Manager, in consultation with TIAER QAO (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and, therefore, is not a valid nonconformance, the CAR will be completed accordingly and closed. If it is determined a nonconformance does exist, the TIAER Project Manager in consultation with the TIAER QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented on the CAR.

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

B4 ANALYTICAL METHODS

The analytical methods, associated matrices, and performing laboratories are listed in Table A7.1 of Section A7. Procedures for laboratory analysis will be in accordance with the most recently published edition of *Standard Methods for the Examination of Water and Wastewater*, the latest version of the *TCEQ Surface Water Quality Monitoring Procedures Manual*, 40 CFR 136, or other reliable procedures acceptable to the TCEQ. Exceptions to this include analyses and sample matrices for which no regulated methods exist, or where EPA has not approved any method with adequate sensitivity. The analytical methods chosen to provide soils data include methods outlined in the Soil Science Society of America Soil Methods Book and used by the Texas Cooperative Extension Soil, Water, and Forage Testing Laboratory. The analytical methods chosen to provide forage tissue data and manure nutrient values are those used by the Texas Cooperative Extension Soil, Water, and Forage Testing Laboratory and are listed in Table A7.1.

Copies of TIAER laboratory SOPs are retained by the TIAER and are available for review by the TCEQ. Copies of TCE laboratory SOPs are retained by the TCE laboratory and are available for review by the TCEQ.

Standards Traceability

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

Analytical Method Modification

Only data generated using TCEQ-approved analytical methodologies specified in this QAPP will be submitted to the TCEQ. Requests for method modifications will be documented on form TCEQ-10364, the *TCEQ Application for Analytical Method Modification*, and submitted for approval to the TCEQ Quality Assurance Section. Approval by the TCEQ will be granted or denied based on review of the application, specifically the section documenting an initial demonstration of method equivalency conducted by the laboratory. Work will only begin after the modified procedures have been approved.

Deficiencies, Nonconformances and Corrective Action Related to Analytical Methods

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

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and are reported to the cognizant field or laboratory supervisor via a corrective action report (CAR). The supervisor notifies the TIAER Project Manager if the deficiency has the potential of being a nonconformance. The TIAER Project Manager will notify the TIAER QAO of the potential nonconformance within 24 hours.

The TIAER Project Manager, in consultation with TIAER QAO (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore, is not a valid nonconformance, the CAR will be completed accordingly and closed. If it is determined a nonconformance does exist, the TIAER Project Manager in consultation with the TIAER QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented on the CAR.

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

The TCEQ has determined that analyses associated with the remark codes "holding time exceedance," "sample received unpreserved," "estimated value," etc. may have unacceptable measurement uncertainty associated with them. Therefore, data with these types of problems are not be reported to the BRA, TSSWCB and TCEQ.

B5 QUALITY CONTROL

Sampling Quality Control Requirements and Acceptability Criteria

The minimum Field QC Requirements are outlined in the *TCEQ Surface Water Quality Monitoring Procedures Manual.* Specific requirements are outlined below. Field QC sample results are submitted with the laboratory data report (see Section A9.).

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 Manual. 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 (not soil, manure, or forage samples) and are collected on a 10% basis or one per batch, whichever is greater. The precision of field split results is calculated by relative percent difference (RPD) using the following equation:

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

A 30% RPD criteria will be used to screen field split results as a possible indicator of excessive variability in the collection and analytical system. If it is determined that meaningful quantities of constituent (i.e., >AWRL) 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 sample results or batches of samples may be invalidated based on the examination of all extenuating information. Professional judgment during data validation will be relied upon to interpret the results and take appropriate action. The qualification (i.e., invalidation) of data will be documented on the Data Summary. Deficiencies will be addressed as specified in this section under Deficiencies, Nonconformances, and Correction Action related to Quality Control.

Quality control for soil analyses does not include analysis of blanks or standards.

TIAER Laboratory Measurement Quality Control Requirements and Acceptability Criteria

Detailed laboratory QC requirements and corrective action procedures are contained within the individual laboratory quality assurance manuals (QAMs). The minimum requirements that TIAER abides by are stated below. Lab QC sample results are submitted with the laboratory data report (see Section A9.).

<u>AWRL/Reporting Limit Verification</u>

The laboratory's reporting limit for each analyte will be at or below the AWRL. To demonstrate the ongoing ability to recover at the reporting limit, the laboratory will analyze a calibration standard (if applicable) at or below the reporting limit on each day Nonpoint Source Program samples are analyzed.

Two acceptance criteria will be met or corrective action will be implemented. First, calibrations including the standard at the reporting limit will meet the calibration requirements of the analytical method. Second, the instrument response (e.g., absorbance, peak area, etc.) for the standard at the reporting limit will be treated as a response for a sample by use of the calibration equation (e.g., regression curve, etc.) in calculating an apparent concentration of the standard. The calculated and reference concentrations for the standard will then be used to calculate percent recovery (%R) at the reporting limit using the equation:

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

where CR is the calculated result and SA is reference concentration for the standard. Recoveries must be within 75-125% of the reference concentration.

When daily calibration is not required (e.g., EPA Method 624), or a method does not use a calibration curve to calculate results, the laboratory will analyze a check standard at the reporting limit on each day Nonpoint Source Program samples are analyzed. The check standard does not have to be taken through sample preparation, but must be recovered within 75-125% of the reference concentration for the standard. The percent recovery of the 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:

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

If the calibration (when applicable) or the recovery of the calibration or control standard is not acceptable, corrective actions (e.g., re-calibration) will be taken to meet the specifications before proceeding with analyses of NPS samples.

The laboratory will report results of quantitation checks with the data.

Laboratory Control Standard (LCS) - A LCS consists of analyte-free water spiked with the analyte of interest prepared from standardized reference material. The LCS is spiked into laboratory-pure water at a level less than or equal to the mid-point of the calibration curve for each analyte. The LCS is carried through the complete preparation and analytical process. The LCS is used to document the bias of the analytical process. LCSs are run at a rate of one per batch. Results of LCSs are calculated by percent recovery (%R), which is defined as 100 times the measured concentration, divided by the true concentration of the spiked sample.

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

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

Performance limits and control charts are used to determine the acceptability of LCS analyses. Project control limits are specified in Table A7.1.

Laboratory Duplicates - A laboratory duplicate is prepared in the laboratory by splitting aliquots of an LCS. Both samples are carried through the entire preparation and analytical process. LCS duplicates are used to assess precision and are performed at a rate of at least one per batch of 20 samples, or once per day, whichever is greater.

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

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

Performance limits and control charts are used to determine the acceptability of duplicate analyses. Project control limits are specified in Table A7.1.

Matrix spike (MS) - A matrix spike is an aliquot of sample spiked with a known concentration of the analyte of interest. Percent recovery of the known concentration of added analyte is used to assess accuracy of the analytical process. The spiking occurs prior to sample preparation and analysis. Spiked samples are routinely prepared and analyzed at a rate of 10% of samples processed, or one per batch whichever is greater. 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 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:

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

MS recoveries are plotted on control charts and used to control analytical performance. Measurement performance specifications for matrix spikes are not specified in this document.

Method blank - A method blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in the sample processing and analyzed with each batch. The method blank is carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination from the analytical process. The analysis of method blanks should yield values less than the reporting limit. For very high-level analyses, the blank value should be less then 5% of the lowest value of the batch, or corrective action will be implemented.

Additional method specific QC requirements - Additional QC samples are run (e.g., special LCS studies, continuing calibration samples) as specified in the methods. The requirements for these samples, their acceptance criteria, and corrective action are method-specific.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria for Texas Cooperative Extension Soil, Water, and Forage Testing Laboratory

The TCE Laboratory will determine the precision of their analyses. Annual laboratory audits will be conducted by TCE QA officers.

Table B5.1 outlines the required analytical quality control for the parameters of interest. There will be no spiked sample analyses due to the different adsorptive capacities of different soil, manure, and forage types for most of the measured parameters. Adding analytes to soils, manure, and forage would yield varying results due to the chemical properties of soils.

Table B5.1

Parameters	Matrix	Blank	Standard	Lab Duplicate
Extractable Nitrate-Nitrogen	Soil	A	A	B
Extractable Phosphorus	Soil	A	A	B
Extractable Potassium	Soil	A	A	B
Total Nitrogen	Manure	A	A	B
Total Phosphorus	Manure	A	A	B
Total Nitrogen	Forage	A	A	B
Total Phosphorus	Forage	A	A	B

A Where specified, blanks and standards shall be performed each day that samples are analyzed
B Where specified, duplicate analyses shall be performed every 30 samples each day that samples are analyzed. At least one duplicate sample shall be run each day of analyses.

The use of approved sampling and analytical methods will ensure that measured data accurately represent field conditions. Table A7.1 lists the required accuracy limits for the parameters of interest. The completeness of the data will be affected by the reliability of the equipment, frequency of field and laboratory errors or accidents, and unexpected events; however, the general goal requires 90 percent data completion.

In the database, missing values will be left as blanks. Graphical screening of the data will be used to highlight questionable data points. Questionable data will be traced through the COC forms, CARs, and, as necessary, through research laboratory notebooks and field data sheets to ensure that data are properly entered. Changes will be made only if an error is found in transcription into the database. Values determined to be below the laboratory method detection limit will be noted as such in the comment column of the database and used in statistical analyses as one-half the method detection limit, as recommended by Gilliom and Helsel (1968) and Ward et al. (1988). Values that are greater than the upper method detection will be diluted or re-extracted at a lower soil-to-extractant ratio and reanalyzed.

It is the responsibility of the TCE project manager to verify that the data are representative. The chemistry data's precision, accuracy, and comparability generated in the TCE Laboratory will be the responsibility of the laboratory director. The TCE project manager has the responsibility of determining that the 90 percent completeness criteria is met, or will justify acceptance of a lesser percentage. All incidents at TCE requiring corrective action will be documented through use of corrective action reports.

Deficiencies, Nonconformances and Corrective Action Related to Quality Control

Deficiencies are defined as unauthorized deviations from procedures documented in the QAPP. Nonconformances are deficiencies, which affect quality and render the data unacceptable or indeterminate. Deficiencies related to quality control include but are not limited to field and laboratory quality control sample failures.

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and are reported to the cognizant field or laboratory supervisor via a corrective action report (CAR). The supervisor notifies the TIAER Project Manager if the deficiency has the potential of being a nonconformance. The TIAER Project Manager will notify the TIAER QAO of the potential nonconformance within 24 hours.

The TIAER Project Manager, in consultation with TIAER QAO (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore, is not a valid nonconformance, the CAR will be completed accordingly and closed. If it is determined a nonconformance does exist, the TIAER Project Manager in consultation with the TIAER QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented on the CAR.

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

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

All sampling equipment testing and maintenance requirements are detailed in the *TCEQ Surface Water Quality Monitoring Procedures Manual.* Sampling equipment is inspected and tested upon receipt and is assured appropriate for use. Equipment records are kept on all field equipment and a supply of critical spare parts is maintained. Automated samplers are inspected at least every two weeks. A general maintenance (GM) sheet (Appendix C) is completed to ensure that the equipment is in good working order. If problems cannot be remediated on-site during the inspection, required adjustments or repairs will be made as soon as possible. The GM sheet is also filled out when samples are retrieved during rainfall runoff events.

All laboratory tools, gauges, instrument, and equipment testing and maintenance requirements are contained within laboratory standard operating procedures. Testing and maintenance records are maintained and are available for inspection by the TCEQ. Instruments requiring daily or in-use testing 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 CALIBRATION AND FREQUENCY

Field equipment calibration requirements are contained in the *TCEQ Surface Water Quality Monitoring Procedures Manual.* Post-calibration error limits and the disposition resulting from error are adhered to. Data not meeting post-error limit requirements invalidate associated data collected subsequent to the pre-calibration and are not submitted to the TCEQ.

Detailed laboratory calibrations are contained within the standard operating procedures. TIAER standard operating procedures identify all tools, gauges, instruments, and other sampling, measuring, and test equipment used for data collection activities affecting quality that must be controlled and, at specified periods, calibrated to maintain bias within specified limits. Calibration records are maintained, are traceable to the instrument, and are available for inspection by the TCEQ. Equipment requiring periodic calibrations includes, but are not limited to, thermometers, pH meters, balances, incubators, and analytical instruments.

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

All new batches of field and laboratory supplies are inspected and tested before use to ensure that they are adequate and not contaminated. Supplies are inspected upon receipt to confirm shipping condition, quality requirements, and quantity. Chemicals, reagents and standards are logged into an inventory database that documents grade, lot number, manufacturer, dates received, opened & emptied. All reagents shall meet ACS grade or equivalent where required. Acceptance criteria are detailed in organization's standard operating procedures. The laboratory standard operating procedures provide additional details on acceptance requirements for laboratory supplies and consumables.

B9 NON-DIRECT MEASUREMENTS

The following acquired or non-direct measurement data will be collected for this project, none of which will be submitted to the TRACS database as part of this project:

- Analytical results from soil samples collected on project dairy fields prior to and during this project will be available for use in the overall project analysis and BMP effectiveness. These soil data, which were collected as part of the CNMP development, come from soil samples collected by TIAER and analyzed by the A&L Plains Agricultural Laboratory, Inc. in Lubbock, Texas. Copies of SOPs and QA manuals are available from the A&L Plains Agricultural Laboratory. Additionally, a decision was made by project personnel to allow a private consultant to take soil samples for the participating dairy farmer in order to meet current TCEQ permit requirements. Soil samples taken by the consultant have been sent to various labs all of which have SOPs and QA manuals on site for review. Any non-direct soil data used for the project will be representative and of comparable quality with data that is currently accepted by TCEQ and EPA.
- During the project period, TCEQ regulations changed and began requiring that soil testing be performed using ICP analysis. The initial 2003 soil analyses for the project sites had been analyzed with colorimetric techniques. TIAER and TCEQ project managers conferred about the problem of not being able to directly compare colorimetric results with ICP results. Project managers determined that in order for the 2003 soil analysis results to be useful, 2005 soil analysis should be performed using the same protocols and methods. Therefore, the 2005 soil samples will be collected with the same sampling techniques and protocols used in 2003 and sent to the TCE Laboratory where each sample will be homogenized and split into two subsamples, one of which will be sent to the A&L Plains Laboratories. The TCE Laboratory will analyze their subsamples using ICP analysis, in accordance with the project QAPP and new TCEQ regulations. The A&L Plains Laboratory will analyze their subsamples using colorimetric analysis to allow for comparisons between the 2003 and 2005 samples. The A&L Plains Laboratory analysis is not covered under this QAPP and project funds will not be used to cover the analytical costs.
- Prior to and concurrent with this project, TIAER will operate three side-by-side field plots, funded by other project(s), to provide additional data sets for establishing nutrient contributions from waste application fields with various management practices. This study is covered by the quality assurance plan (TIAER, 2003) referenced below. Each field plot will be about 0.5 acre in size. These field plots of improved pasture (Coastal bermuda grass) will first be managed to receive agronomic application of commercial fertilizers for a period of approximately one year. In subsequent years, one plot will remain as a control. One of the remaining two plots will be managed for manure application according to NRCS Field Office Technical Guide 590 and the other according to allowable rates in typical TCEQ dairy permits. A flowmeter will measure water level at five-minute intervals at a flume installed at each site. Storm samples will be collected with automated samplers during every runoff event of sufficient magnitude to initiate sampler intake. Nutrients and TSS will be analyzed in the field plot samples. Any non-direct field plot data used for the project will be representative and of comparable quality.

References

TIAER (Texas Institute for Applied Environmental Research). 2003. United States Department of Agriculture Bosque River Initiative Quality Assurance Project Plan, Revision 5. TIAER, Tarleton State University, Stephenville, TX.

B10 DATA MANAGEMENT

Data Management Process

Section B3 contains a detailed discussion of how samples are handled from collection through delivery to the laboratories. Included within that discussion is a description of how station information is taken and recorded on COC and other data forms. This section continues with the manner in which data are handled by TIAER until they are submitted to BRA, TSSWCB, and TCEQ. In addition, this section outlines the data management associated with samples submitted to the TCE Laboratory.

TIAER Personnel

TIAER personnel responsible for data generation and collection are listed by position below.

Water Quality Monitoring Staff are responsible for correctly recording station identification data on field data sheets and COC forms, measuring field parameters with multisondes and ensuring the electronic data are sent to the data manager to be uploaded to TIAER's SAS water quality database, downloading flow meters and uploading the information to PCs so that it will be available for running TIAER's compositing program for storm event samples and other needs, recording, as necessary, storm event begin times and end times for proper calculations in the compositing program.

Laboratory Analysts are responsible for collection of analytical results from automated analyzers and analytical procedures, correctly transferring those data to personal logbooks and then to the Access entry table, running TIAER's compositing program and using the output to determine how many milliliters of each aliquot to use in producing a composited storm sample.

Personnel responsible for data validation, input, and transfer are listed below.

Data Analysts, Field Supervisors, Laboratory Manager and QAO- responsible for screening data for anomalies and mistakes before and after entry into the TIAER databases

Laboratory Staff and Data Entry Technicians - responsible for entry of COC, field, and laboratory data into a Microsoft Access entry table

Laboratory Manager - responsible for verifying that all identification (COC) and laboratory data entered for each sample are correct according to the information on the COC, field data sheets, and personal laboratory notebooks, and transferring the data from the Access entry table to the Access water quality database. Also responsible for making corrections and changes to the database and maintaining an audit trail of the changes.

Data Manager - responsible for importing data from the Access database and electronic multisonde measurements into the TIAER water quality database in SAS, maintaining the TIAER water quality database, ensuring that the data are in the proper format for submission to TRACS, and transferring the data to BRA and to TCEQ for entry into TRACS.

Data Management Plan Implementation - A flow chart is provided below that- traces the path of data analyzed in the TIAER laboratory from their generation in the field or laboratory to their final use and storage.

Generation of Physicochemical Data in the Field (TIAER Water Quality Monitors)

↓

Generation of Chemical Data (TIAER Laboratory Analysts)

↓

Data Screening and Validation (TIAER Field Supervisor and Laboratory Manager)

↓

Data Entry (TIAER Data Entry Technician, Lab Manager, Data Manager)

↓

Data Screening for Verification and Outliers (TIAER Data Analysts and QAO)

↓

Data Transfer (TIAER Data Manager and QAO)

↓

TIAER Project Manager

↓

Returned to submitter for revision, if necessary

Field measurements and sample data collection are performed according to SWQM Procedures Manual (GI-252) unless the parameter/measurement is based on an alternative method as specified in Table A1. Section B3 of this document describes procedures for standard record-keeping, document control, data storage and retrieval on electronic media, detecting and correcting errors and preventing loss of data and data entry to databases.

TIAER Water Quality Data Entry - As described in Section B3, generated data entered on the COCs and in laboratory logbooks are input into the LIMS database. Afterwards, a data analyst reviews the COCs for correctness, abnormalities, and problems. Station names, appropriateness of data values, legibility of writing, completeness of data, dates and times, bottle numbers, start and end times of composited samples, comments and all other data on the sheets are reviewed. Any questions or abnormalities are investigated, relying largely on field data sheets, general maintenance sheets, field technicians, laboratory notebooks, sampler printouts, compositing program printouts, and laboratory personnel. Any errors are crossed out with a single line, initialed and dated and the correct data are added. Corrective action reports are completed, as appropriate.

After receiving a batch of COCs, the Laboratory Manager opens the LIMS entry table and verifies that all data entered for each sample are correct according to the information on the COC form and data entry sheets. After checking all the data on the forms, the Laboratory Manager initials the forms and sends them to the Data Manager, who files them in a three-ring binder sequentially by sample number.

COC binders are maintained on file for at least five years.

After a batch of COCs has been verified, the Laboratory Manager transfers the data from the Access entry table to the Access water quality database and notifies the Data Manager that new data have been added. The Data Manager exports the entire Access water quality database to a text file which is then imported to a SAS water quality database.

Before data are analyzed for projects, they are screened for outliers and other abnormalities by a data analyst. All necessary records are checked to resolve problems. If errors are found, the data are corrected on the COC or data entry form with a single line and the initials and date. The Laboratory Manager and Data Manager are consulted before and after correction.

A SAS program is run that converts data to the correct format for TRACS. The resulting file can be transferred to BRA, TSSWCB, and TCEQ via an FTP submission or other electronic method. Note: Data will be submitted in pipe-delimited format with events and results files in the event that this type of data can be used by TRACS in the future.

TIAER Data Errors and Loss

Migration/Transfer/Conversion - File transfer protocols used for ensuring proper exportation of data from the TIAER database include the data quality assurance procedures integral to the data system.

Backup/Disaster Recovery - The Unix drive and the network server are backed up daily to a tape drive located in a climate controlled, fire-resistant storage area on the Tarleton State University campus. In the event of a catastrophic systems failure, the tapes can be used to restore the data in less than one day's time. Data generated on the day of the failure may be lost, but can be reproduced from raw data in most cases.

Archives/Data Retention - Original data recorded on paper files are stored for at least five years. Data in electronic format are stored on tape drives. Complete electronic data sets are archived on tape backup and retained on the Tarleton State University campus in a fire-resistant storage area managed by the Tarleton CIS department.

TIAER Record Keeping and Data Storage

Individual laboratory notebooks, which contain printouts of laboratory data and hand written observations and data, are kept by individual analysts. When lab notebooks are filled, they are stored for at least five years by the laboratory manager. A copy of field data sheets for grab samples, which are filled out by field operations staff, are attached to the COC. The original field data sheet is filed in a three-ring binder, according to site location and project, and stored in the field operations room for at least five years. The printout downloaded from the flowmeter, which shows times of sample collection, is attached to the COC of storm samples. Data from flow meters are stored electronically; printouts of flow data are filed in three-ring binders chronologically by site for at least five years. Printouts of electronically generated rainfall data are filed chronologically in three-ring binders for at least five years. COCs and attached documents are stored in numerical order in three-ring binders in the TIAER Data Manager's office for at least five years. All electronic records are stored for a minimum of five years on personal computers and TIAER's network server, which is backed regularly up by tape drive. TIAER's Access and SAS databases are backed up daily on the Tarleton tape drive.

TIAER Data Handling, Hardware, and Software Requirements

The TIAER chemistry laboratory employs the following data handling software on personal computer stations for data on many of the analyzed parameters:

- Orthophosphate phosphorus is analyzed on the Beckman DU-64 Spectrophotometer using Quant II Linear software.
- Nitrate+nitrite nitrogen, total phosphorus, ammonia and total Kjeldahl nitrogen are analyzed on the Perstorp Flow Solution with the associated Alpkem Softpac data program or La Chat QuickChem Autoanalyzer.

The TIAER Laboratory Manager is responsible for review of calculations and charts made by these programs. Biometric analyses are computed using Excel spreadsheets and SAS programs. Microsoft Excel is used for general spreadsheet computation and laboratory control charting of quality control parameters.

The TIAER field operations staff uses multisondes to record field measurements.

The TIAER laboratory data are stored in an Access database, then are uploaded to a SAS database on a Unix server. SAS programs are used to screen data for outliers, compile data sets, and analyze data trends.

As part of the data review process, checks on written data compared to TIAER data in the SAS database are used to ensure that the hardware/software configurations are correctly storing and retrieving data.

Texas Cooperative Extension Soil, Water, and Forage Testing Laboratory

As TCE laboratory analyses are completed, laboratory personnel will provide the sample results to the respective TCE study manager. Results will be compiled and submitted to the TIAER project manager who will review the data for completeness, comparability and appropriate identification.

Information Resource Management Requirements

Data submitted to BRA will be screened by the TIAER Quality Assurance Officer prior to submission to ensure that all data records use the proper format and contain all required information.

Information Dissemination - Submission of the data produced for this project will be transferred from TIAER to BRA and from BRA to TSSWCB, TCE and TCEQ as deemed appropriate.

C1 ASSESSMENTS AND RESPONSE ACTIONS

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

Table C1.1 Assessments and Response Requirements

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring Oversight, etc.	Continuous	TIAER	Monitoring of the project status and records to ensure requirements are being fulfilled	Report to BRA in Quarterly Report
Monitoring Systems Audit	Dates to be determined by TCEQ NPS	TCEQ	Field sampling, handling and measurement; facility review; and data management as they relate to NPS	30 days to respond in writing to the TCEQ to address corrective actions
Monitoring Systems Audit	Dates to be determined by TIAER	TIAER	Field sampling, handling and measurement; facility review; and data management as they relate to NPS	30 days to respond in writing to TIAER. PA will report problems to TCEQ in Progress Report.
Laboratory Inspection	Dates to be determined by TCEQ	TCEQ Laboratory Inspector.	Requirements appearing in lab SOPs and QAPP, ISO/IEC Guide 25, applicable EPA methods and Standard Methods, 40 CFR 136, and other documents applicable to NPS programs including portions of the Texas Administrative Code and the Code of Federal Regulations.	30 days to respond in writing to the TCEQ to address corrective actions

Corrective Action

The TIAER Project Manager is responsible for implementing and tracking corrective action procedures as a result of audit findings. Records of audit findings and corrective actions are maintained by the NPS, BRA and TIAER Project Managers. Corrective action documentation will be submitted to the BRA on a quarterly basis with the 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.

Corrective actions include identification of root causes and a methodology for correcting the problems. The effect of the problem on the quality of the data is ascertained and documented on the

CAR. The programmatic impact (up to and including the removal of data from the database) of the deficiency must be ascertained and documented. The impact of deficiencies must be made on a case-by-case basis in consultation with the BRA Project Manager.

C2 REPORTS TO MANAGEMENT

TIAER Laboratory Data Reports

Laboratory data reports contain the results of all specified QC measures listed in section B5, including but not limited to laboratory duplicates, laboratory control standards, and calibrations. This information is reviewed by the TIAER QAO and compared to the pre-specified acceptance criteria to determine acceptability of data before forwarding to the TIAER Project Manager. This information is available for inspection by the BRA.

Reports to TIAER Project Management

Laboratory results from TCE Soil, Water, Manure and Forage, Testing Laboratory will be sent to TIAER Project Management following the completion of soil, manure and forage sample analysis. Results of QC samples and copies of relevant corrective action reports will be included with the laboratory results.

Reports to BRA Project Management

TIAER project participants submit written quarterly progress reports to the BRA Project Manager concerning the status of each project task, including data collection activities, for which they are responsible. Any issues or problems associated with the quality of the data are reported to the BRA Project Manager through the use of Corrective Action Reports.

Reports to TCEQ Project Management

Quarterly Progress Report – BRA will summarize the TIAER activities for each task; reports problems, delays, and corrective actions; and outlines the status of each task's deliverables.

Monitoring Systems Review Audit Report/Laboratory Audit Report and Response - Following any audit performed by TIAER, a report of findings, recommendations and response is sent to the BRA project manager in the quarterly progress report.

Final Project Report - Summarizes the Brazos River Authority's and subcontractors' 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 TSSWCB Project Management

Quarterly Progress Report – BRA will summarize the TIAER activities for each task; reports problems, delays, and corrective actions; and outlines the status of each task's deliverables.

Monitoring Systems Review Audit Report/Laboratory Audit Report and Response - Following any audit performed by TIAER, a report of findings, recommendations and response is sent to the BRA project manager in the quarterly progress report.

Final Project Report - Summarizes the Brazos River Authority's and subcontractors' 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 by TCEQ Project Management

Contractor Evaluation - BRA 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, Procurements and Contracts Section.

D1 DATA REVIEW, VERIFICATION, AND VALIDATION

All field and laboratory data will be reviewed by the generating entity and verified for integrity and continuity, reasonableness, and conformance to project requirements, and then validated against the data quality objectives, which are listed in Section A7. Only those data, which are supported by appropriate quality control data and meet the data quality objectives defined for this project will be considered acceptable, and will be reported to BRA, TSSWCB, and TCEQ.

The procedures for verification and validation of data are described in Section D2, below. The TIAER Field Supervisor is responsible for ensuring that field data are properly reviewed and verified for integrity. The TIAER Laboratory Manager is responsible for ensuring that analytical laboratory data are scientifically valid, defensible, of acceptable precision and accuracy, and reviewed for integrity. The TIAER Data Manager will be responsible for ensuring that all data are properly reviewed and verified, and submitted in the required format to the project database. The TIAER QAO is responsible for validating the data. Finally, the TIAER Project Manager, with the concurrence of the TIAER 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 field and laboratory data will be reviewed, verified and validated by the generating laboratory to ensure they conform to project specifications and meet the conditions of end use as described in Section A7 of this document. The TIAER QAO will also review the data submitted by the TCE Laboratory as part of the verification and validation process.

Data review, verification, and validation will be performed using self-assessments and peer and management review as appropriate to the project task. The information to be reviewed, verified, and validated (listed by task and responsible party in Table D2.1) is evaluated against technical and project specifications and checked for errors, especially errors in calculations, data reduction, and transcription. Potential errors are identified by examination of documentation and by manual (and computer-assisted) examination of corollary or unreasonable data. If a question arises or an error is identified, the manager of the task responsible for generating the data is contacted to resolve the issue. Issues, which can be corrected are corrected and documented. If an issue cannot be corrected, the task manager consults with higher-level project management to establish the appropriate course of action, or the data associated with the issue are rejected. Field and laboratory reviews, verifications, and validations will be documented.

Data validation tasks to be addressed by TIAER include, but are not limited to, the confirmation of lab and field data review, evaluation of field QC results, additional evaluation of anomalies and outliers, analysis of sampling and analytical gaps, and confirmation that all parameters and sampling sites are included in the QAPP. 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 annual monitoring systems audit conducted by the TCEQ Quality Assurance Specialist 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 TIAER Project Manager validates that the data meet the data quality objectives of the project and are suitable for reporting to BRA, TCEQ and TSSWCB. Pertinent information having to do with inconsistencies with reporting limit specifications; failures in sampling methods and/or laboratory procedures resulting in unavailable data; etc. will be provided on the Data Summary when the data are submitted to the to BRA, TCEQ, and TSSWCB.

Table D2.1 Data Review, Verification, and Validation Tasks

Task	Verification	Validation	Responsibility
Field data reviewed for conformance with data collection, sample handling and chain of custody, analytical and QC requirements	✔		Field Operation Supervisor
Post-calibrations checked to ensure compliance with error limits	✔		Field Operation Supervisor
Field data calculated, reduced, and transcribed correctly	✔		Field Operation Supervisor
Laboratory data reviewed for conformance with data collection, sample handling and chain of custody, and analytical and QC requirements to include documentation, holding times, sample receipt, sample preparation, sample analysis, project and program QC results, and reporting	✔		Laboratory Manager
Laboratory data calculated, reduced, and transcribed correctly	✔		Laboratory Manager
Reporting limits consistent with requirements for "Ambient Water Reporting Limits."	✔	✔	Laboratory Manager
Analytical data documentation evaluated for consistency and/or improper practices	✔	✔	Laboratory Manager
Analytical QC information evaluated to determine impact on individual analyses	✔	✔	Laboratory Manager
All laboratory samples analyzed for all parameters	✔	✔	Laboratory Manager
Data set (to include field and laboratory data) evaluated for reasonableness and if corollary data agree	✔	✔	Laboratory Manager, QAO
Data review, verification, and validation performed and deviations documented		✔	Laboratory Manager, QAO
Outliers confirmed and documented		✔	QAO
Field QC acceptable (e.g., field splits)		✔	Laboratory Manager
Sampling and analytical data gaps checked and documented		✔	QAO
Verification and validation confirmed. Data meets conditions of end use and are reportable		✔	TIAER Project Manager

D3 RECONCILIATION WITH USER REQUIREMENTS

The data collected in this project can be used by TCEQ and other agencies as part of efforts to address nonpoint source pollution issues in impaired watersheds. Data that do not meet requirements will not be submitted to BRA, TSSWCB or TCEQ nor will be considered appropriate for any of the uses noted above. The data produced for this project are not considered representative of ambient water quality and are therefore not appropriate for submission to the SWQM portion of TRACS.

Samples collected from this project will be analyzed by the TIAER and TCE laboratories and reported to project partners for evaluation of the measured reductions of phosphorus in the waste stream at locations throughout the digester system. The percentage of phosphorus removal achieved, as a result of the system performance, will be one of several criteria examined by TIAER and other entities in the design and sizing of similar waste management systems to be constructed on other dairies.

APPENDIX A. Work Plan:

Wastewater/Manure Management System Demonstration: Edge-of-Field Monitoring
Texas State Soil and Water Conservation Board
FY03 CWA Section 319(h)
Project 03-14 Workplan

Problem/Need Statement: The basis for this project is to monitor the reduction of phosphorus to dairy waste application fields upon implementing a CNMP and utilizing methane digester technology to reduce nonpoint source (NPS) pollution loadings in the North Bosque River watershed from agricultural activities. Segment 1226 (North Bosque River) is impaired according to the 1998 State of Texas 303(d) list, which is the relevant year of listing for this watershed's total maximum daily load (TMDL) development. This segment appeared on the Texas Commission on Environmental Quality (TCEQ) TMDL Development Basin Schedule for 1998. Water quality data contributed by the Texas Institute for Applied Environmental Research (TIAER), low dissolved oxygen and elevated levels of ammonia nitrogen, nitrite/nitrate nitrogen, chlorophyll *a*, orthophosphorus, bacteria and total phosphorus were found in the watershed. Modeling results show this is the result of contaminants originating from municipal wastewater treatment plants, animal feeding operations (AFOs), and animal waste application fields (WAFs). TCEQ approved two TMDLs for phosphorus in the North Bosque River for Segments 1226 and 1255 on February 9, 2001, which were subsequently submitted to and approved by the United States Environmental Protection Agency (USEPA). The Implementation Plan for the two North Bosque River segments was approved by TCEQ in late 2002 and the Texas State Soil & Water Conservation Board (TSSWCB) in early 2003. This project will address the need for nonpoint source related phosphorus reduction measures in the North Bosque River watershed.

General Project Description: The primary focus of the 319(h) program is to provide funds to states to implement technical assistance/best management practices (BMPs) that abate or reduce NPS pollution. This particular project focuses on the use of a technology related BMP to address NPS pollution that occurs with the disposal of dairy waste.

This project is dependent upon and is a subset of a larger project effort led by the Brazos River Authority (entitled "Dairy Waste Management System Demonstration") to construct a methane digester at a cooperating dairy and then to monitor the impacts of phosphorus reduction strategies achievable through the use of methane digesters. Entities involved in the actual design and construction of the project include the Brazos River Authority (BRA), Texas Farm Bureau (TFB), Texas Commission on Environmental Quality (TCEQ), USDA-Natural Resource Conservation Service (NRCS), Texas State Soil and Water Conservation Board (TSSWCB), Texas Institute for Applied Environmental Research (TIAER), Texas A&M University, Cascade Earth Sciences (CES), and the Altria Group Inc.

The TSSWCB will contract with BRA who will then subcontract with TIAER. TIAER will monitor rainfall induced runoff from and soil test phosphorus in liquid waste disposal fields located on the cooperating dairy, the Broumley Dairy, in the North Bosque River watershed to determine the reduction of NPS pollution and provide data to other entities concerning the levels of phosphorus reduction that can be achieved through methane digester technology used in conjunction with a CNMP. The runoff monitoring effort will make use of automated sampling systems in TIAER's possession that will be made available to this project. Laboratory analysis of samples will be conducted using TIAER's water quality laboratory.

This project consists of installing and operating edge-of-field monitoring equipment on the Broumley Dairy to show the effects of methane digester technology on the phosphorus waste stream. Dairies dispose of both liquid and solid waste by land applying the waste. The nutrient values associated with this waste are typically imbalanced and the overapplication of phosphorus that results creates adverse water quality impacts. Phosphorus laden runoff has been connected with excessive algae growth, which in turn causes detrimental effects on water bodies. Best management practices are often utilized to address this issue. This project seeks to examine the reduction capabilities of methane digester technology on the liquid component of the waste stream. Methane digesters are proven to reduce the phosphorus component in dairy waste, and thus this project will identify reductions associated with the phosphorus removal capabilities of the system.

In order to compare the before and after effects of the methane digester on nutrient losses at the dairy, TIAER will install monitoring equipment and perform soil sampling prior to the construction and operation of the digester. In addition, the BRA project will incorporate a CNMP for the facility. The *Implementation Plan for Soluble Reactive Phosphorus in the North Bosque River Watershed* (2002) developed by the TSSWCB and the TCEQ incorporates CNMPs as a measure to reduce phosphorus loadings in the river. The CNMP being developed as part of this overall project will address the entire farm system in order to protect water quality by reducing phosphorus loadings to waste application fields. The CNMP will be designed to ensure that waste application fields do not exceed the application rates required by the NRCS Practice Standard for Nutrient Management (Code 590) and any other applicable guidance and permit requirements. Nutrient management, manure and wastewater handling and storage, land treatment, record keeping, feed management, and other utilization activities are to be considered in development of this CNMP. The CNMP will also consider inclusion of innovative methods to reduce phosphorus loadings such as use of phosphorus feed management practices, removal of waste from the dairy facility, and capture and treat systems. The implementation of the CNMP will assist in the achievement of water quality goals set forth in the State's TMDL Implementation Plan for the North Bosque River. Realizing that both the digester and the CNMP will impact nutrient values and application rates, TIAER will operate monitoring equipment and conduct soil testing prior to the culmination of these activities so that reductions in wastewater nutrients can be more accurately quantified.

Installation of monitoring equipment will require trained personnel to address the runoff characteristics and topography of the waste application fields to be monitored. Automated samplers and runoff flumes will be placed at locations where natural flow occurs during storm events in effort to minimize installation costs. However, it may be necessary to perform site work to direct flow if the landscape does not properly lend itself naturally. TIAER has special experience and knowledge from previous projects that pertain to edge-of-field monitoring. The transfer of technology and experience via the personnel TIAER makes available to this project will be essential to the success of this component of the project.

TIAER will produce a final report 1) describing the implementation strategies resulting from the digester operation and CNMP implementation and 2) summarizing the monitoring data findings. Additionally, the findings from this project will be transferred to the BRA project for the preparation of educational materials related to the use of methane digester technology, CNMP implementation, and reduced phosphorus loadings to waste application fields.

Section A.1 represents the workplan submitted to BRA for the Wastewater/Manure Management System Demonstration Project. The workplan focuses only on the edge-of-field monitoring data collection activities of the contract.

Section A.1 Wastewater/Manure Management System Demonstration: Phase I—Edge-of-field Monitoring Work Plan and Schedule

This portion of the project will monitor and evaluate the phosphorus reduction capabilities of a state of the art methane digester installed on a dairy facility in the North Bosque River watershed operating in conjunction with a comprehensive nutrient management plan (CNMP). Edge-of-field monitoring will be initiated to determine the level of phosphorus reduction associated with the wastewater that has undergone treatment using methane digester technology and applied in accordance with the dairy's CNMP. Monitoring will occur on the liquid application fields used by the dairy operator to determine nonpoint source pollution reductions. Work plan activities will be performed by the Texas Institute for Applied Environmental Research (TIAER) at Tarleton State University under a subcontract with the Brazos River Authority (BRA).

Task 1: Coordination with Broumley Dairy personnel, Brazos River Authority, Farm Bureau, and Cascade Earth Sciences.

Objective: To establish coordination among the entities performing duties under this grant, to ensure coordination with participating entities involved in the installation of the methane digester, and to provide project reporting.

Task 1.1 Conduct initial meeting of performing and cooperating entities.

Task 1.2 Conduct interim meetings with performing and cooperating entities as needed

Task 1.3 Coordinate project with overall BRA digester project through common meetings and common personnel

Task 1.4 Preparation of quarterly reports. [Final report provided under Task 4.]

Task 1.5 Transfer project results to produce educational materials as part of the broader BRA project.

Deliverables

- Minutes of meetings with performing and cooperating entities with list of meeting attendees
- Quarterly reports

Task 2: Site assessments and installation edge-of-field monitoring equipment

Objective: To strategically assess and install not more than three (3) monitoring stations on liquid waste application fields

Task 2.1 Determine sampling stations locations. Utilize USGS topographical maps and information from project site assessment to determine flow characteristics of the landscape. Evaluate areas of waste application fields conducive to sheet flow and channelized runoff. Select no more than three (3) sites in liquid waste application fields with an edge-of-field location exhibiting channelized flow. Obtain GPS coordinates for sampling stations.

Task 2.2 Prepare landscape for the proper capture of rainfall induced runoff and install monitoring equipment.

Deliverables

- Maps showing actual locations of fields to be monitored
- GPS locations of sampling stations

Task 3: Implementation of edge-of-field monitoring

Objective: To collect and analyze soils, water quality, and runoff data at edge-of-field stations in order to assess phosphorus reduction capacities of the system. Preparation of the Quality Assurance Project Plan (QAPP) and Data Quality Objectives will be accomplished under a separate, more comprehensive grant project. The QAPP will include not only the edge-of-field and soil sampling, but will also address the Dairy Waste Management System performance as a whole.

Task 3.1 Conduct edge-of-field sampling on no more than three (3) stations, perform routine maintenance on monitoring equipment, perform laboratory analysis and enter data into functional and readily accessible databases. Laboratory analysis will be performed for orthophosphate (soluble phosphorus), total phosphorus, and total suspended solids. To determine any effects on nitrogen in runoff, ammonia, total Kjedahl nitrogen, and nitrite-nitrate analysis will be performed.

Task 3.2 Conduct soil sampling and analyses

Task 3.3 Conduct forage sampling and analysis. Keep records of timing and amount of nutrient applications and of other management practices above each station.

Deliverables

- Collection of data directed into appropriate databases

Task 4: Development of final report

Objective: Develop a report detailing the activities and effectiveness of this project

Task 4.1 Perform analyses of data to evaluate any changes in soil test phosphorus and runoff nutrient characteristics

Task 4.2 Produce final report detailing water quality and soil test improvements resulting from the methane digester operation and the CNMP implementation

Deliverables

- Final report predicting water quality improvements associated with the methane digester technology and CNMP implementation.

Wastewater/Manure Management System Demonstration: Edge-of-Field-Monitoring Schedule of Milestones

Task	Project Milestones	Start	End
1	Overall project coordination	September 2003	August 2006
1.1	Initial meeting	September 2003	October 2003
1.2	Interim meetings	November 2003	August 2006
1.3	Coordination with overall BRA project	September 2003	August 2006
1.4	Quarterly progress reports	January 2004	August 2006
1.5	Transfer results	September 2003	August 2006
2	Site assessment and installation	September 2003	January 2004
2.1	Determine sampling site locations	September 2003	October 2003
2.2	Install equipment	October 2003	January 2004
3	Implementation and operation of monitoring	September 2003	June 2006
3.1	Conduct edge-of-field monitoring	January 2004	June 2006
3.2	Conduct annual soil testing	January 2004	May 2006
3.3	Collect forage samples	January 2004	June 2006
4	Development of final report	March 2006	August 2006
4.1	Perform analyses of data	March 2006	July 2006
4.2	Present data in final report	July 2006	August 2006

APPENDIX B. Sampling Process Design and Monitoring Schedule (Plan)

Sample Design Rationale

The sample design is scheduled to provide data to characterize changes in phosphorus concentrations in liquid dairy waste associated with phosphorus reduction technologies. Changes in phosphorus and other nutrients in the waste stream and various matrices associated with dairy waste application will be monitored before and after the implementation of phosphorus reduction technologies.

Stormwater runoff from dairies, which can potentially affect water quality in receiving streams, will be monitored to evaluate the phosphorus reduction technologies at the whole farm level. Three sites will be operated as an "upstream-downstream approach" with pre- and post-digester and comprehensive nutrient management plan (CNMP) implementation monitoring data collection. Two intermittent stream sites will be located immediately upstream of the majority of the dairy operation. The two intermittent streams join together on the dairy operation forming one stream. The downstream exit of the stream from the operation will be monitored as a third site. By obtaining streamflow data and before and after data, this monitoring scheme allows data interpretation and analysis to account for the influence of weather, most notably rainfall runoff. Statistical comparison of before and after data will allow evaluation of any changes in the water quality afforded by the digester operation and implementation of the CNMP.

Unfortunately, a major field receiving liquid wastes is not amenable to an upstream-downstream approach, since its drainage is separate from the stream drainage system. Hence, the field will be monitored with a single edge-of-field site. Monitoring will occur for both pre- and post-implementation. Streamflow will be measured at this site, as at the other three stations, which allows correction for rainfall variation, and statistical measures will be applied to determine any changes in water quality.

The other monitoring for the study will occur at sites representing the influent and effluent to the digester and other treatment units. The first phase (Phase I) of the water quality monitoring will be used to optimize the performance of all treatment units. Under optimized operating conditions from Phase I, Phase II monitoring will allow nutrient removal efficiency to be determined for each treatment unit and for the system as a whole with phosphorus being the key parameter.

Site Selection Criteria for Special Studies

This project involves the collection of non-ambient data that will be used to gauge the effectiveness of the methane digester system and the impacts of the land-applied dairy effluent on water quality. The data collection effort involves monitoring nutrient content of samples associated with various aspects of dairy manure, rather than sites that are representative of ambient water quality conditions. Digester sampling locations have been chosen to effectively monitor the reduction in phosphorus as the liquid dairy effluent moves through various stages of the digester. Monitoring data collected during the start-up phase will allow fine-tuning of the digester to maximize phosphorus reduction capabilities and energy generation activities. Monitoring stations associated with stormwater runoff were chosen to evaluate the impacts of land applied waste that has been processed using the phosphorus reduction capabilities of the digester system, including both liquid and solid dairy wastes.

Wet Weather Sampling at Edge-of-field and Intermittent Channel Stations

The project will incorporate four automated samplers installed in fields and intermittent streambeds on the dairy farm. Water samples will be collected by the samplers throughout periods of rainfall runoff and will be analyzed for nutrients and TSS. The sampling stations will be monitored with the intent of obtaining as much data prior to the installation and operation of the digester and for one year after installation and operation.

One sampler will be located at the downgradient edge of a field to which liquid manure is applied. Runoff from the field will be directed through a flume or weir, where automated samples will be collected and water level will measured. Runoff data from this site will be used to evaluate reductions in nutrient levels associated with land application of liquid manure treated by the digester.

The other three samplers will be located in dry channels through which water flows during periods of rainfall runoff, two on the upgradient side of the farm and one on the downgradient side of the farm. The sampling design is based on an upstream-downstream strategy to distinguish nutrient levels coming onto the farm from those exiting the property. This whole-farm approach attempts to evaluate the effectiveness of the entire CNMP and is based on the assumption that no manure from the dairy will impact the upstream sites.

Stormwater runoff will be collected throughout each rainfall event using automated samplers. Each sampler unit consists of a weatherproof, lockable instrument shelter; a solar battery powered system; programmable ISCO Model 3700 Water Sampler; and an ISCO Model 4230 or 3230 Bubble Flow Meter. The flow meter activates the sampler when the water rises to a predetermined level and records water level in five-minute intervals. The intermittent sites will be programmed to take samples at a level of 0.12 feet above the current water level. The edge of field sampler is set to trigger at a rise of 0.06 feet within the flume. The ISCO 3700 water sampler contains a set of 24 one-liter polyethylene bottles, which are filled according to a programmed, site-specific sampling regime developed by TIAER. The sampling sequence was designed to provide a greater frequency of sampling during the earlier portion or first flush of a runoff event. Once activated, samplers are programmed to retrieve one-liter samples until the water level recedes to pre-activation levels.

After each rainfall event, the samplers are inspected within 30 hours to retrieve all water samples that have been collected. Properly collected water samples from ISCO samplers are transported to the TIAER laboratory for analysis on a daily basis. Individual samples collected during each 24-hour period are composited in the laboratory. The compositing strategy is based on flow-weighting, using either the hydrograph of the storm event or, for sites without a rating curve, on a calculated approximation based on channel area and measured depth. Total Kjeldahl nitrogen, ammonia nitrogen, nitrite + nitrate nitrogen, total phosphorus, orthophosphate phosphorus, and total suspended solids will be measured at the automated sites.

All automatic sampling equipment is inspected at least once every other week (bi-weekly) and serviced as needed.

At all three sampling stations, a water level meter will measure water level at five-minute intervals. A flume or weir will be installed on the one edge-of-field station, and water level measured during runoff events will be used to calculate flow from the liquid application field using the standard equation.

At the three intermittent channel sampling stations, rating curves will be developed by measuring flow and water level simultaneously over a range of water level conditions. Velocity measurements will be performed using a SonTek Flow Tracker™ Acoustic Doppler Velocimeter or a Global Water Flow Probe™ calibrated to a Teledyne-Gurley™ Model 622F Type AA current meter in the Tarleton State University Department of Hydrology fluids laboratory. Velocity and stream level measurements will follow the RWA protocols set forth in TCEQ's *Receiving Waters Assessment Procedures Manual* (GI-253). TIAER personnel will use the stream flow measurement form shown in Table B-3 of the RWA manual.

Because flow in dry channels typically rises and falls quickly and unpredictably, it is possible that a sufficient number of measurements cannot be obtained to develop a reliable rating curve. In that case, estimates of flow will be made using the level measurements with Manning's equation or an alternate method approved by USGS.

Digester (Grab) Samples
The methane digester will be monitored to establish the levels of nutrient reductions associated with this phosphorus reduction technology. Digester system monitoring will consist of two phases. The initial or start-up phase will consist of monitoring the digester at nine stations within the system on a monthly basis. The resulting monitoring data will be used to calibrate the system for maximum phosphorus reduction efficiency and electricity generation. This phase of monitoring will require the evaluation of numerous parameters that will not be measured after the system has been calibrated. Locations of the sampling sites are shown on Figure 2.

<u>Phase 1</u>
The nine sampling locations associated with digester and the analytes to be monitored on a monthly basis during the initial phase of monitoring after digester installation (up to one year) are as follows:

DG001 - wastewater collected after recirculation basin; analyzed for total solids, total dissolved solids (TDS), total volatile solids, total fixed solids, BOD_5, NO_2-N+NO_3-N, TKN, total P, ortho-phosphate phosphorus, temperature, conductivity, DO and pH.

2. DG002 - digester discharge; analyzed for total solids, total dissolved solids, total volatile solids, total fixed solids, BOD_5, NO_2-N+NO_3-N, TKN, total P, ortho-phosphate phosphorus, temperature, conductivity, DO and pH.
3. DG003 - HRO pond outlet; analyzed for total solids, NO_2-N+NO_3-N, TKN, total P, temperature, conductivity, DO and pH.

4. DG004 - Separation pond outlet; analyzed for total solids, NO_2-N+NO_3-N, total P, temperature, conductivity, DO and pH.
5. DG005 - digester solids; analyzed for TDS, percent solids, NO_2-N+NO_3-N, TKN, and total P. *Note: The digester solids will be analyzed upon removal.*
6. DG006 - Separation pond solids; analyzed for TDS, percent solids, NO_2-N+NO_3-N, TKN, and total P. *Note: The separation solids will be analyzed upon removal.*
7. DG007 - wastewater from storage pond 2, which will be used for irrigation; analyzed for TDS, NO_2-N+NO_3-N, TKN, total P, temperature, conductivity, DO, and pH.
8. DG008 - wastewater from storage pond 3; analyzed for TDS, NO_2-N+NO_3-N, TKN, total P, temperature, conductivity, DO, and pH.
9. DG009 - wastewater from storage pond 4; analyzed for TDS, NO_2-N+NO_3-N, TKN, total P, temperature, conductivity, DO, and pH.

Analytical parameters listed in Table A7.1 may be measured at any sampling site on the project dairy, as deemed necessary to appropriately monitor and improve digester efficiency. Analysis of scheduled parameters may indicate that additional analytes and/or sampling events at established sample points are necessary in order to make adjustments that maximize the phosphorus removal capability of the digester.

Phase 2

During the second phase (year two), which consists of standard operation of the digester, the system will be monitored using grab samples at the same nine locations for a reduced number of analytes. Water samples will be collected on a weekly basis during the second phase while solid samples will continue to be collected upon solids removal from the system. Sampling locations and associated analytes and field parameters to be monitored are as follows:

1. DG001 – DG004 (wastewater, digester discharge, high-rate oxidation (HRO) pond, and separation pond) will be monitored on a weekly basis for NO_2-N+NO_3-N, TKN, total P, temperature, conductivity, dissolved oxygen and pH.
2. DG005 – DG006 (digester solids and separation solids) will be monitored as solids are removed for percent solids, NO_2-N+NO_3-N, TKN, and total P.
3. DG007 – DG009 (wastewater to be used for irrigation) will be analyzed for total solids, NO_2-N+NO_3-N, TKN, total P, temperature, conductivity, dissolved oxygen and pH.

Analytical parameters listed in Table A7.1 may be measured at any sampling site on the project dairy, as deemed necessary to appropriately monitor and improve digester efficiency. Analysis of scheduled parameters may indicate that additional analytes and/or sampling events at established sample points are necessary in order to make adjustments that maximize the phosphorus removal capability of the digester.

Although the project objective is determination of phosphorus reduction in dairy wastewater, other analytes are measured to determine alternate effects of the system on manure content. Additionally, data on solids associated with the wastewater digestion process will enable further evaluation of the methane digestion system on manure content.

Soil, Forage and Manure Samples.
Soil samples will be collected on an annual basis and will be analyzed using the routine analysis by the TCE Soil, Water & Forage Testing Laboratory in College Station, TX. Analytes to be analyzed extractable (P), extractable potassium (K), and nitrate-nitrogen (NO_3-N). Samples will be collected for each land management unit (LMU) specified in the CNMP and no less than 15 subsamples will be collected and combined to produce a composite sample that is representative of the LMU.

Forage samples will be collected just prior to harvest of each crop. Samples will be collected using a 4 ft^2 (0.37 m^2) sampling frame randomly placed at least three different locations within each land management unit. Vegetation will be cut to a height consistent with the harvest equipment. Forage yield will be estimated by TIAER staff on a dry matter basis by weighing all sample material from each frame. Three subsamples from each sample will be weighed and put in a drying oven at 131° F (55° C) for at least 48 hours. Subsamples will then be re-weighed to obtain a dry weight. The dry weight of each subsample will be divided by its fresh weight to obtain an estimate of percent moisture. After drying and re-weighing, a composite sample of the three subsamples will be collected. For tissue analysis, the composite sample from each land management unit will be sent to the TCE Soil, Water, and Forage Testing Laboratory for analysis of percent crude protein and total-P. Tissue analysis along with yield values will be used to estimate the removal of N and P as forage harvested from each plot.

Manure samples will be collected prior to and after the digester is operational. Manure will be collected one time prior to the start of digester activities from the stockpiles of manure located on the dairy that are being used for solid waste application. After digester activities are in place, manure samples will be collected on a quarterly basis from the compost resulting from the solids generated from the digester and the separation pond. In each sampling event, five or more subsamples will be collected and composited into one sample for analysis. The samples will be analyzed by the TCE Soil, Water, and Forage Testing Laboratory for total phosphorus and total nitrogen. The results of the analysis will aid in making appropriate recommendations regarding solid waste disposal on application fields and in compliance with CNMP provisions.

Monitoring Sites for FY 2003-04

Monitoring Tables for monitoring year beginning January 2004 are presented in Table B1.1. A diagram of the digester sampling (DG###) sites is included as Figure 2. Sampling station locations for the edge-of-field and intermittent channel stations will be provided once site specific conditions have been evaluated.

Table B1.1 Sample Design and Schedule, For Start-up Phase (1 year)

Segment	TCEQ Region	Site Description	Station ID/TCEQ ID #	Mon Resp	Mon Type	Conventional	Soil[1]	Forage[1]	Flow	Field
NA	NA	Edge-of-field outlet of waste disposal field receiving only liquid waste	BD001 18309	TA	SS	DBR[2]	1 per LMU[3]	Once per cutting	DBR	
NA	NA	Intermittent upstream channel site	BD002 18308	TA	SS	DBR[2]	1 per LMU[3]	Once per cutting	DBR	
NA	NA	Intermittent upstream channel site	BD003 18306	TA	SS	DBR[2]	1 per LMU[3]	Once per cutting	DBR	
NA	NA	Intermittent downstream channel site	BD004 18307	TA	SS	DBR[2]	1 per LMU[3]	Once per cutting	DBR	
NA	NA	Dairy wastewater after recirculation basin	DG001	TA	SS	ADI[4]			12	12[5]
NA	NA	Digester discharge at digester outlet	DG002	TA	SS	ADI[4]				12[5]
NA	NA	High-rate oxidation (HRO) pond at HRO outlet	DG003	TA	SS	ADI[6]				12[5]
NA	NA	Separation pond at separation pond outlet	DG004	TA	SS	ADI[7]				12[5]
NA	NA	Digester solids at solids removal point	DG005	TA	SS	DRS[8]				12[5]
NA	NA	Separation solids at solids removal point	DG006	TA	SS	DRS[8]				12[5]
NA	NA	Storage Pond 2	DG007	TA	SS	ADI[7]				12[5]
NA	NA	Storage Pond 3	DG008	TA	SS	ADI[7]				12[5]
NA	NA	Storage Pond 4	DG009	TA	SS	ADI[7]				12[5]

[1]Soil and forage samples will be taken from the area that drains to the sampling site.
[2]DBR= Determined by rainfall runoff events; Conventional parameters for wet weather samples include NH_3, TKN, NO_2-N+NO_3-N, total P, PO_4-P, and TSS.
[3] Soil test data gathered previously by TIAER for use in development of the comprehensive nutrient management plan may be available for use in place of additional sampling.
[4]ADI = After digestion installation, sampling will occur on a monthly basis. Conventional parameters for wastewater include TDS, TSS, TVS, BOD, NH_3, NO_2-N+NO_3-N, TKN, total P, PO_4-P. Additional parameters included in Table A7.1 may be added as deemed necessary.
[5] Field parameters include water temperature, conductivity, DO, and pH.
[6] After digestion installation, sampling will be monthly. Conventional parameters include TDS, TSS, NO_2-N+NO_3-N, filtered TKN, and filtered total P. Additional parameters included in Table A7.1 may be added as deemed necessary.
[7] After digestion installation, sampling will be monthly. Conventional parameters include TDS, TSS, NO_2-N+NO_3-N, TKN, and total P. Additional parameters included in Table A7.1 may be added as deemed necessary.
[8] DRS = Dependent on frequency of removal of solids after digestion installation. Conventional parameters include TDS, NO_2-N+NO_3-N, TKN, and total P. Additional parameters included in Table A7.1 may be added as deemed necessary.

re 2 Digester Sampling Points

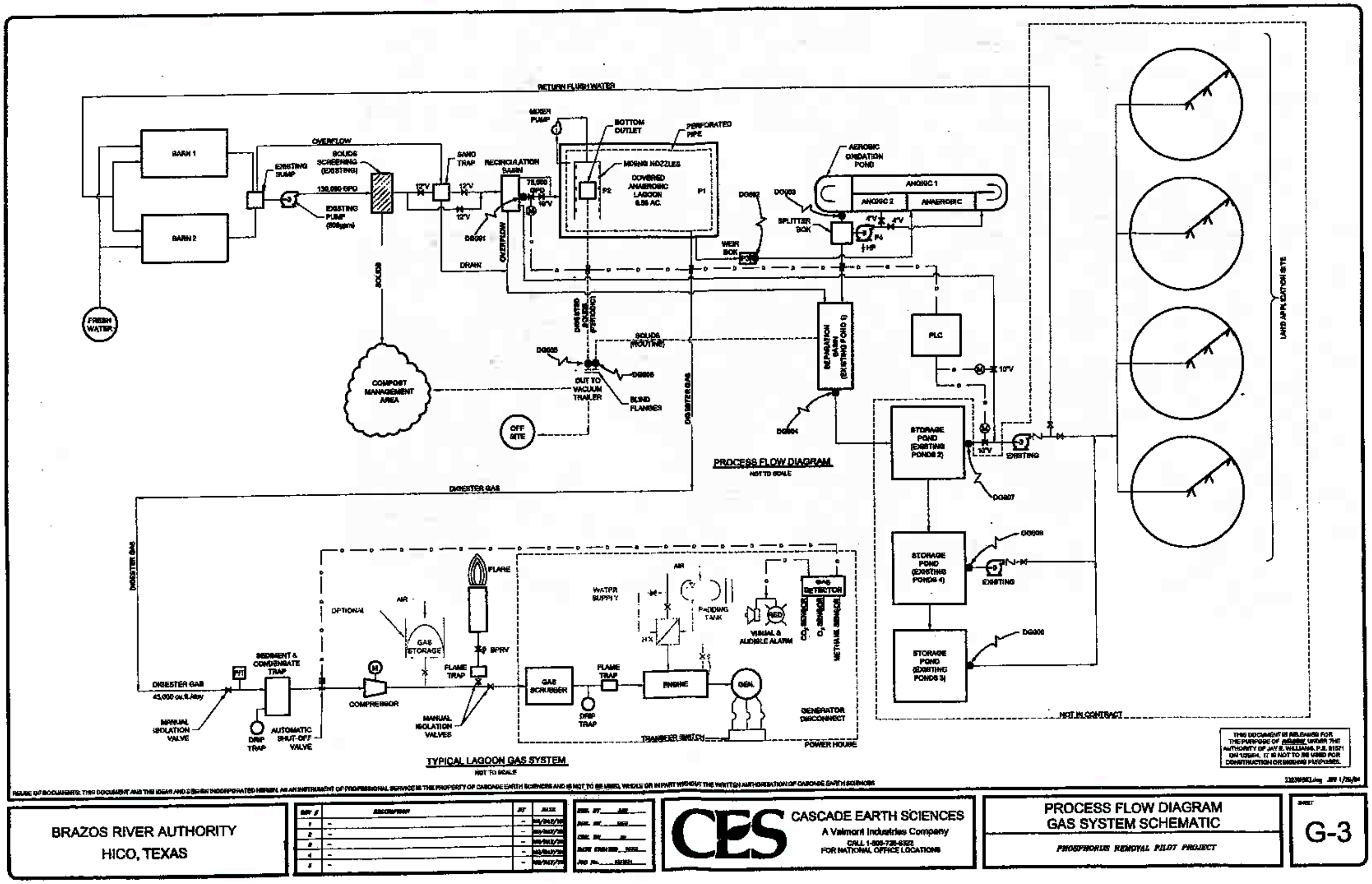
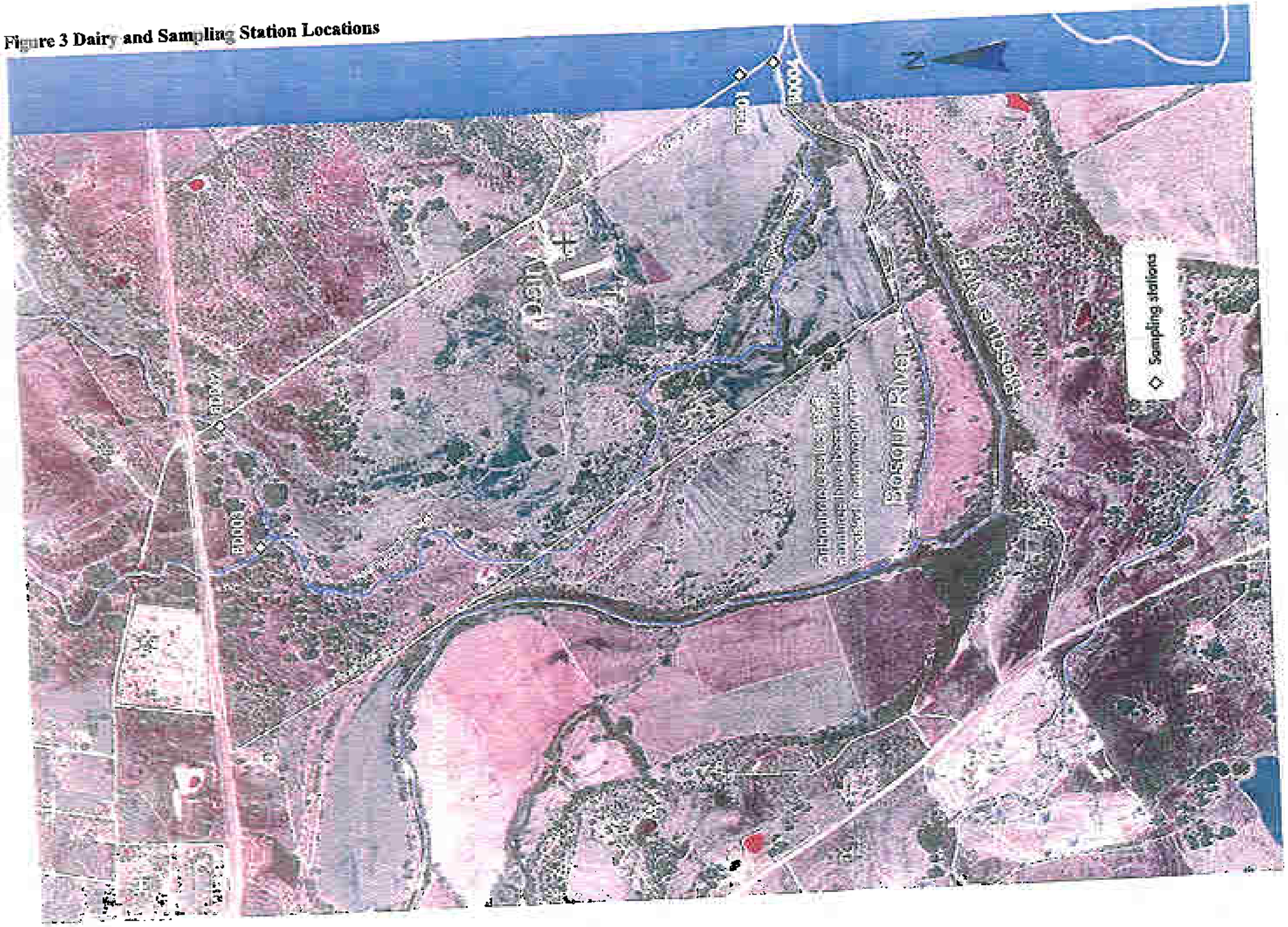


Figure 3 Dairy and Sampling Station Locations



APPENDIX C. Field Data Sheets

Field Data Sheet
Routine Digester Grab Samples

Date__________________ **Investigator (s)**____

General Comments____

Site:	Comments:	Temp C	Cond us	DO mg/L	pH
Time:					
Approx. stream depth:	Sample #:				

Site:	Comments:	Temp C	Cond us	DO mg/L	pH
Time:					
Approx. stream depth:	Sample #:				

Site:	Comments:	Temp C	Cond us	DO mg/L	pH
Time:					
Approx. stream depth:	Sample #:				

Site:	Comments:	Temp C	Cond us	DO mg/L	pH
Time:					
Approx. stream depth:	Sample #:				

Site:	Comments:	Temp C	Cond us	DO mg/L	pH
Time:					
Approx. stream depth:	Sample #:				

Site:	Comments:	Temp C	Cond us	DO mg/L	pH
Time:					
Approx. stream depth:	Sample #:				

Site:	Comments:	Temp C	Cond us	DO mg/L	pH
Time:					
Approx. stream depth:	Sample #:				

Site:	Comments:	Temp C	Cond us	DO mg/L	pH
Time:					
Approx. stream depth:	Sample #:				

Site:	Comments:	Temp C	Cond us	DO mg/L	pH
Time:					
Approx. stream depth:	Sample #:				

Site:	Comments:	Temp C	Cond us	DO mg/L	pH
Time:					
Approx. stream depth:	Sample #:				

General Maintenance and Storm Sample Collection

SITE________ DATE _________ TIME (CST)________ INITIALS _______

Level _____________ Enable __________ callout______

Desiccants: OK Changed

Flowmeter SPA652 4230 3230

Sampler:

Display		Reset to SI		Yes	No
		Reset arm to bottle 1			Yes
		Checked distributor arm nut			
Time Interval:	Uniform		Reset start time		Yes Time_____
	NonUniform		Reset start time No		
Sampling Interval:	Time	Flow			
Line:	OK	Clear	Damaged		Silted/Clogged
	Purged	Acid Washed		Test sample collected (monthly)	
	Position in arm	OK	Reset		
Pump tubing	Current counts				Alarm counts
	Changed		Reversed		Checked all connections
	Reset counter		# counts		Restart sampler YES
Bubbler: XS	OK	Silted	Scoured		Requires new survey
Line	OK	Clear	Damaged		Requires new survey
TB Rain Gauge:	Clear	Cleaned		Weekly inches recorded	
QA rain gauge:	Clear	Cleaned		Weekly inches collected _____	
Downloaded:	**Sampler**		**Flowmeter**		Met **Viewed graph**

Color Code:

Bottles used for composite:

Comments:

APPENDIX D. Example of Chain-of-Custody Form

TiAER

CHAIN OF CUSTODY

Page______ of______

Project Name/No.	Project Manager/Person(s) Requesting Sample	Sampler(s)

Sample No.	Test group code	Date	Time	Site ID	Sample Type	Preservative	Containers	# of bottles	Comments (if applicable)	(if applicable)	Disposed
10000									bottles:	end time/date:	
10000									bottles:	end time/date:	
10000									bottles:	end time/date:	
10000									bottles:	end time/date:	
10000									bottles:	end time/date:	
10000									bottles:	end time/date:	
10000									bottles:	end time/date:	
10000									bottles:	end time/date:	
10000									bottles:	end time/date:	
10000									bottles:	end time/date:	
10000									bottles:	end time/date:	
10000									bottles:	end time/date:	
10000									bottles:	end time/date:	
10000									bottles:	end time/date:	
10000									bottles:	end time/date:	
10000									bottles:	end time/date:	

Relinquished by:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Date/Time:	Received by:	Date/Time:

Sample Types: G=Grab SG=Storm Grab O=Other F=Flow Based Composite M=Multisonde P=Periphytometer

Container Types: P=Plastic D=Dark M=Multiple G=Glass V=VOA

Update 26Jan05

APPENDIX E. TCEQ/BRA Workplan

DAIRY WASTE MANAGEMENT SYSTEM DEMONSTRATION

Background:

Dairies in the North Bosque and Leon watersheds generally range in size from 500 to 2,000 cows. Most dairy operations apply manure and wastewater on agricultural fields as part of their waste management activities. Water quality data from the North Bosque TMDL model is showing a correlation between runoff from dairy waste application fields and high phosphorus concentrations in the river. Dairy producers in the North Bosque River watershed are now being faced with the challenge of how to remove or reduce the amount of phosphorus in the waste streams that may be subject to land application. This will likely require changes in dairy waste management practices.

The Brazos River Authority (BRA), the United States Department of Agriculture (USDA)/Natural Resources Conservation Service (NRCS), the Texas Farm Bureau (TFB), Altria, and the Texas Institute for Applied Environmental Research (TIAER), are collectively proposing to demonstrate a dairy waste management alternative that will assist dairy producers in the North Bosque and Leon River watersheds with minimizing or eliminating negative environmental impacts on the watershed. The proposal is to design, construct, and implement an integrated dairy waste management system on a selected dairy in the North Bosque River watershed. A permitted dairy producer, in good regulatory standing, has been recruited and approved to showcase the technology on his farm as a waste management model for the benefit of other producers in the watersheds. The demonstration technology will be designed to achieve the following goals:

- Implement a dairy waste management system capable of reducing the majority of the soluble phosphorus load (up to 80%) on a selected dairy
- Evaluate the economic criteria of project viability

CWA, Section 319 funds will be used to support certain aspects of the construction, maintenance and operation of the manure management system as well as document the effectiveness of its performance. This project is expected to last for a period of two years and will be funded be in the amount of $747,427 ($448,456 - Federal, $298,971 - Local Match). Other federal, state and private Partners are expected to contribute a significant amount of in-kind match to complete construction and support of the system (estimated total completion cost: $1,100,000). With a separate funding source, the TFB has already entered into an agreement with a private environmental consultant, to conduct a feasibility study and develop the preliminary designs for the waste management system. The consultant will also be providing final system design, technical assistance, construction oversight, and system operations assistance.

Conceptual Design of Technology:

The primary goal of the proposed technology is to provide phosphorus removal economically via separation, anaerobic digestion, oxidation, and composting. The conceptual design of the treatment system consists of two phases:

Treatment Operation

The treatment system at the selected dairy has been designed to accommodate 90,000 gallons per day flow and will consist of three integrated components: screening, anaerobic digestion, and oxidation. Water levels and retention times will be controlled for optimum system efficiency throughout the operation.

Manure will be flushed or scraped from the free stall barns and screened through a conventional separator for solids removal. The solids removed will be composted and the wastewater pumped to lagoon where anaerobic digestion will take place. The digester will consist of a sloped, lined, and covered lagoon. Within the lagoon, the incoming organic material is treated for a specified detention period. Phosphorus is broken down in the lower fermentation zone while lighter density methane floats upwards to be collected with subsurface apparatus and transported to an on-site generator. The gas will be used to provide heating and electrical energy for use on the dairy or sold to the grid. Every month, the digested sludge material accumulated at the bottom of the lagoon will be pumped out to the compost management area for composting.

After digestion, the wastewater stream will then be gravity fed through a 2 ft. lined pond for additional phosphorus removal via oxidation. The pond will consist of a track of channels lined with cedar planks. A mechanical paddlewheel will generate flow and facilitate algae growth during the oxidation process. The algae blooms will introduce oxygen into the effluent water and reduce odor. The pond is expected to be low maintenance.

After oxidation, the effluent will be piped to one of two concrete separation basins. Algae from the oxidation pond will settle out and be removed for composting. If necessary, a chemical precipitant such as lime can be added to the waste water for additional phosphorus removal. The liquid portion will be decanted to an existing storage pond for use as flush water in the free stall barns or irrigation on adjacent pasture lands.

Composting Operation

This phase will consist of the placement, turning and production of composted manure. The digested manure solids from the treatment and separation operations will be turned using dedicated equipment. After the composting process is complete, the product can then be sold or reused on-site as bedding.

DESIGN, CONSTRUCTION, OVERSIGHT, AND START-UP
OBJECTIVE 1: PROJECT MANAGEMENT AND OVERSIGHT

Project management and administration activities include, but are not limited to the following: project coordination with TCEQ, TIAER, TFB, the consultant and other appropriate parties and subcontractors, quarterly reporting, and project reimbursement functions. Other aspects of project management may include participation in Contractor Evaluations; solicitation, preparation and execution of subcontracts which conform to TCEQ/EPA requirements; update provisions reflecting any changes relating to personnel, subcontractors and equipment purchases; participation in conference calls and other related activities

Task 1.1 BRA will prepare and submit quarterly progress reports and reimbursement requests to the TCEQ. Progress reports will detail all activities completed within the preceding time period, address any scheduling shortfalls, detail any significant problems, include the status of deliverables for each task as well as narrative descriptions of the progress and findings of each task.

Deliverables:

- Progress Reports (submitted quarterly) which include
  - status of deliverables for each objective
  - narrative description in Progress Report format
- Reimbursement Forms (purchase voucher, 269a, and 269a 1-4) and Small and/or Minority Owned Forms
- Business Report (where applicable, to document why Good Faith Effort did not result in the utilization of a small and/or minority owned business)
- Participation in Contractor Evaluation (as scheduled)
- Participation in meetings, conference calls, etc. with TCEQ/EPA
- Copies of subcontracts

OBJECTIVE 2: SYSTEM DESIGN AND PERMITTING

The consultant will complete the Final Engineering Design with input from BRA, TFB, TIAER, and the cooperating dairy owner. The final plans and specifications will show all the major aspects of the wastewater/manure management system. The consultant will have primary responsibility for developing a construction schedule which details all aspects of the project from equipment and materials purchase/receipt, through construction, and into start-up. The consultant, with input from BRA and the cooperating dairy owner, will be responsible for submitting applications to the TCEQ to obtain the permits or authorizations required to construct and operate all portions of the Dairy Waste Management System. The consultant will provide copies of the final permits or authorizations to the cooperating dairy owner and BRA.

Task 2.1 Upon approval of all parties involved, BRA will submit the Final Engineering Design for the dairy waste management system to the TCEQ.

Task 2.2 BRA will provide TCEQ the proposed schedule for the construction and start-up of the waste management system.

Task 2.3 The consultant will submit the applications for the required permits or authorizations

Task 2.4 BRA will provide TCEQ the final permits or authorizations received from the TCEQ permitting division.

Deliverables:

- Final Engineering Design Drawings
- Proposed construction and start-up schedule
- Final permits or authorizations

OBJECTIVE 3: SYSTEM PERFORMANCE AND EFFECTIVENESS MONITORING

With the appropriate input from the consultant and BRA, TIAER will design a Field Sampling Plan (FSP) to address both the dairy waste management system operations as well as edge-of-field monitoring to determine potential impacts from rainfall runoff from the affected properties. The FSP will be designed to verify that the system has been constructed according to the final engineering design specifications, that the system is functioning as designed, document ongoing performance and measure the phosphorus reduction capabilities of the treatment system. Prior to the initiation of the sampling activities associated with the FSP, TIAER will develop and receive TCEQ and EPA approval of a Quality Assurance Project Plan (QAPP) for the data and sample collection efforts specified in the FSP.

Task 3.1 TIAER, with input from TCEQ, BRA and the consultant, will prepare the FSP, which will be used as a tool for verifying proper system construction and functional capabilities, determining edge-of-field run off impacts, documenting system performance and to measuring phosphorus reduction capabilities.

Task 3.2 TIAER will develop and submit to BRA a draft and final QAPP, which will incorporate the FSP. BRA will review and submit the document to TCEQ. The document will be prepared in accordance with the guidelines for QAPP documents established by TCEQ and EPA.

Deliverables:

- Field Sampling Plan
- Draft QAPP
- Final QAPP

OBJECTIVE 4: SYSTEM CONSTRUCTION, OVERSIGHT AND TECHNICAL ASSISTANCE

The BRA will secure a subcontractor to perform the construction of the waste management system in accordance with the Final Engineering Design specifications. Direct daily oversight of the construction phase will be the responsibility of the consultant, with coordination, as needed, from BRA, TFB, TIAER and TCEQ. The consultant will communicate any construction delays or change order requests to BRA. BRA will disseminate the information to the other entities involved. TIAER will be responsible for providing oversight of on-going operational activities at the project dairy to ensure continual compliance with applicable TCEQ and EPA rules and regulations during the construction and start-up of the waste management system.

Task 4.1 Secure the services of a qualified subcontractor to complete the installation, retrofit, and construction phase of the project. The selection process will be administered by BRA, with technical assistance and input from the consultant, TFB, and TIAER.

Task 4.2 BRA will draft the contract for the construction as outlined in the Final Engineering Design specifications, with input from the other entities.

Task 4.3 The consultant will provide the daily oversight of the dairy waste management system construction phase and provide BRA with frequent progress updates.

Task 4.4 TIAER will provide oversight and technical assistance to the dairy cooperator as needed to ensure day-to-day operations of the facility are performed consistent with all permit requirements and any applicable equipment operations guides or manuals during construction and start-up of the Dairy Waste Management System. TIAER will immediately notify the dairy cooperator of potential site problems and recommend corrective actions for the dairy to remain in good standing for the duration of the project. TIAER will also notify BRA of any non-compliance issues that arise. Monthly updates of the site visits and associated activities will be provided to BRA.

Deliverables:

- Provide TCEQ a copy of the construction contract
- Notify TCEQ of start and completion of construction phase
- Monthly Updates throughout construction and start-up
- Notification of noncompliance as appropriate

OBJECTIVE 5: EDGE-OF-FIELD AND START-UP MONITORING

TIAER will perform the monitoring of the dairy waste treatment system during the start-up mode to verify proper system design and system functionality as described in the QAPP/FSP. TIAER will initiate the edge-of-field monitoring as outlined in the QAPP/FSP before the system has reached its start-up mode to provide background data before the system is operational. This objective will require communications and cooperation between the dairy producer, TIAER, and the consultant.

Task 5.1 TIAER will conduct the system monitoring and evaluation as described in the QAPP/FSP.

Task 5.2 TIAER will conduct the edge-of-field sampling as outlined in the QAPP/FSP.

Deliverables:

- Report of the Functional Status of the System
- Report of Edge-of-Field Monitoring Results

OBJECTIVE 6: REPORTING AND EVALUATION

Activities related to this demonstration project will be reported by BRA to the TCEQ, EPA and other appropriate parties through the preparation and distribution of an Objectives Summary Report (OSR) which will summarize the results accomplished under Objectives 2 through 5.

The Deliverables under each Objective will be used as references to produce the OSR. This report will summarize activities, including final engineering design, construction, oversight, monitoring and system start-up.

Task 6.1 BRA will coordinate the development of the OSR with input from TIAER, TFB, The consultant, and the cooperating dairyman. BRA will then distribute the report as requested by TCEQ.

Task 6.2 The OSR will be made available on appropriate web sites.

Deliverables:

- Objectives Summary Report (hard copy and web available)

APPENDIX F. Data Review Checklist

		✔, ✘, or N/A
Data Format and Structure		
A.	Is the file in the correct format (e.g. ASCII pipe delimited)?	______
B.	Are there any duplicate Tag Id numbers?	______
C.	Are the Tag prefixes correct?	______
D.	Are all Tag Id numbers 7 characters?	______
E.	Are TCEQ station location (SLOC) numbers assigned?	______
F.	Are sampling Dates in the correct format, MM/DD/YYYY?	______
G.	Is the sampling Time based on the 24 hour clock (e.g. 13:04)?	______
H.	Is the Comment field filled in where appropriate (e.g. unusual occurrence, sampling problems, unrepresentative of ambient water quality)?	______
I.	Source Code 1, 2 and Program Code used correctly and are valid?	______
J.	Is sampling date in Results file the same as those in the Events file?	______
K.	Values represented by a valid parameter (STORET) code with the correct units and leading zeros?	______
L.	Are there any duplicate STORETs for the same Tag Id?	______
M.	Are any invalid symbols in Greater Than/Less Than (GT/LT) field	______
N.	Are any tag numbers in the Results file that are not in Events file?	______
O.	Are confirmed outliers identified with a "1" in the remarks field?	______
Data Quality Review		
A.	Are all the values reported at or below the appropriate AWRL?	______
B.	Have the outliers been verified?	______
C.	Checks on correctness of analysis or data reasonableness performed? e.g.:Is ortho-phosphorus less than total phosphorus? Are dissolved metal concentrations less than or equal to total metals?	______
D.	Have at least 10% of the data been reviewed against the field and laboratory data sheets?	______
E.	Are all STORET codes in the data set listed in the QAPP?	______
F.	Are all stations in the data set listed in the QAPP?	______
Documentation Review		
A.	Are blank results acceptable as specified in the QAPP?	______
B.	Were control charts used to determine acceptability of field duplicates?	______
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 any failures in field or laboratory measurement systems not resolvable and resulted in unreportable data? If yes, explain on next page.	______

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

Date Submitted to TCEQ:

TAG Series:
Date Range:
Data Source:
Comments (attach README.TXT file if applicable):

TIAER's Data Manager Signature:

Date:

APPENDIX G. Workplan: Wastewater/Manure Management System Demonstration: Phase II—Oversight of Waste Management Related Activities and Water Quality Monitoring

Texas Institute for Applied Environmental Research
CWA Section 319(h)

Problem/Need Statement: The basis for this project is to provide assistance and oversight of activities related to the construction of a state of the art methane digester. The methane digester will be implemented to address nonpoint source pollution related issues in the North Bosque River watershed. Construction of the facility and implementation of a CNMP will reduce the amount of phosphorus that is applied dairy waste application fields thus reducing nonpoint source (NPS) pollution loadings in the North Bosque River watershed stemming from agricultural activities. Segment 1226 (North Bosque River) is impaired according to the 1998 State of Texas 303(d) list, which is the relevant year of listing for this watershed's total maximum daily load (TMDL) development. This segment appeared on the Texas Commission on Environmental Quality (TCEQ) TMDL Development Basin Schedule for 1998. Water quality data contributed by the Texas Institute for Applied Environmental Research (TIAER), low dissolved oxygen and elevated levels of ammonia nitrogen, nitrite/nitrate nitrogen, chlorophyll *a*, orthophosphorus, bacteria and total phosphorus were found in the watershed. Modeling results show this is the result of contaminants originating from municipal wastewater treatment plants, animal feeding operations (AFOs), and animal waste application fields (WAFs). TCEQ approved two TMDLs for phosphorus in the North Bosque River for Segments 1226 and 1255 on February 9, 2001, which were subsequently submitted to and approved by the United States Environmental Protection Agency (USEPA). The Implementation Plan for the two North Bosque River segments was approved by TCEQ in late 2002 and the Texas State Soil & Water Conservation Board (TSSWCB) in early 2003. This project will address the need for nonpoint source related phosphorus reduction measures in the North Bosque River watershed.

General Project Description: The primary focus of the 319(h) program is to provide funds to states to implement technical assistance/best management practices (BMPs) that abate or reduce NPS pollution. This particular project focuses on the use of a technology related BMP to address NPS pollution that occurs with the disposal of dairy waste.

This project is a part a larger project effort led by the Brazos River Authority (entitled "Dairy Waste Management System Demonstration") to construct an on-farm system that includes waste collection, solids separation, composting, anaerobic digestion, methane and electricity generation, biological phosphorus reduction, and whole farm nutrient management. The monitoring efforts will help document the overall phosphorus reduction achievable through the use of the entire system. Entities involved in the project include the Environmental Protection Agency (EPA), Brazos River Authority (BRA), Texas Farm Bureau (TFB), Texas Commission on Environmental Quality (TCEQ), USDA-Natural Resources Conservation Service (NRCS), Texas State Soil and Water Conservation Board (TSSWCB), Texas Institute for Applied Environmental Research (TIAER), Texas Cooperative Extension, United Cooperative Services, United States Department of Energy, Cascade Earth Sciences (CES), and the Altria Group Inc.

This project will consist of two phases. Phase I includes building the system and 2) conducting oversight of the dairy operations to assure compliance with TCEQ regulations. The BRA will subcontract with TIAER to provide the following Phase I activities: 1) provide coordination with dairy personnel and other cooperating entities 2) provide assistance to the participating dairy farmer in managing his operation within TCEQ guidelines and develop an understanding of system components in preparation for system monitoring (Phase II) activities, and 3) develop a quality assurance project plan (QAPP) for the overall BRA project which will include the monitoring of the system and edge-of-field monitoring of waste application fields receiving waste processed using the methane digester technology. Phase II will allow for continuation of all Phase I activities and add the following activities: 1) water quality monitoring of digester system, and 2) an economic evaluation of the system.

Tasks, Objectives, Schedules, and Estimated Costs:

Task 1: Coordination with Broumley Dairy personnel, Brazos River Authority, Farm Bureau, and Cascade Earth Sciences.

Objective: To establish coordination among the entities performing duties under this grant, to ensure coordination with participating entities involved in the installation of the methane digester, and to provide project reporting.

Task 1.1 TIAER will participate in coordination of meetings and activities associated with the overall BRA project

Task 1.2 Preparation of quarterly reports

Deliverables

- Quarterly reports

Task 2: Provide oversight of waste management related activities on the Broumley Dairy

Objective: To provide assistance to participating dairy farmer with issues related to waste management

Task 2.1 Monitor activities related to the construction and implementation of the methane digester

Task 2.2 Assist participating dairy farmer with the development and implementation of a CNMP

Task 2.3 Assist participating dairy farmer in complying with TCEQ permit requirements

Deliverables

- Quarterly progress reports

Task 3: Development of QAPP

Objective: To develop and have approved a QAPP for the overall BRA "Wastewater/Manure Management System Demonstration Project." The QAPP will include edge-of-field monitoring, soil sampling, and monitoring of the Dairy Waste Management System performance as a whole.

Task 3.1 Develop data quality objectives and prepare and have approved a Quality Assurance Project Plan (QAPP)

Task 3.2 Revise QAPP as needed to meet project objectives and goals.

Deliverables

- Draft QAPP
- Final approved QAPP

Task 4: Water Quality Monitoring of the Digester System

Objective: To perform system effectiveness monitoring of the dairy waste treatment system.

Task 4.1 The digester will be monitored monthly at nine sampling points within the system for one year following initial startup of the digester to determine the system effectiveness. Laboratory analysis will be conducted for total solids, total dissolved solids, total volatile solids, total fixed solids, BOD, nitrite-nitrate nitrogen, total Kjeldahl nitrogen, total phosphorus, orthophosphate phosphorus, biomass, and percent solids. Field parameters will be collected monthly and will include temperature, electrical conductivity, dissolved oxygen, and pH.

Task 4.2 The digester will be monitored at nine sampling points within the system during the standard operation phase (2nd year of digester operation) to determine the system effectiveness. Laboratory analysis will be conducted on a monthly basis at nine sampling sites for nitrite-nitrate nitrogen, total Kjeldahl nitrogen, total phosphorus, and percent solids. Field parameters (temperature, electrical conductivity, dissolved oxygen, and pH) will be also collected at the sites on a weekly basis.

Task 4.3 Laboratory results will be transferred to CES for technical and operational assistance.

Deliverables

- Water quality analysis results directed into appropriate databases

Task 5: Economic Analysis of the Digester System

Objective: To perform an economic analysis on the digester system placing emphasis on the phosphorus reduction component of the system

Task 5.1 Gather information regarding waste management costs and activities in order to conduct a thorough analysis of the economic viability of digester systems.

Task 6: Final Project Reporting

Task 6.1 Develop final report/fact sheets/educational materials on project findings including analyzing data collected Task 4 (phosphorus removal capability of the digester system) and Task 5 (analysis of the economic viability of digester system). Additionally, findings from the edge-of-field monitoring and CNMP implementation (covered under a separate TSSWCB contract) could be included.

Deliverables

- Final report on the economic viability of the digester and phosphorus removal capabilities of the digester system
- Fact sheets/educational materials concerning project findings (economic analysis, phosphorus removal capabilities, water quality monitoring)

Wastewater/Manure Management System Demonstration: Phase II—Oversight of Waste Management Related Activities and Water Quality Monitoring
Schedule of Milestones

Task	Project Milestones	Start	End
1	Overall project coordination	December 2003	August 2007
1.1	Coordination with overall BRA project	December 2003	August 2007
1.2	Quarterly progress reports	March 2004	August 2007
2	Oversight of Activities	December 2003	August 2007
2.1	Monitor activities related to methane digester activities	January 2004	August 2007
2.2	Assist farmer with CNMP development and implementation	December 2003	August 2007
2.3	Provide assistance related to TCEQ compliance	January 2004	August 2007
3	Develop QAPP	December 2003	January 2004
3.1	Approved QAPP	December 2004	March 2004
3.2	QAPP Revisions	September 2004	August 2007
4	Digester System Effectiveness Monitoring	September 2004	August 2005
4.1	Digester Water Quality Monitoring—Start-up phase	May 2005	April 2006
4.2	Digester Water Quality Monitoring—Standard Operation	May 2006	April 2007
4.3	Transfer results and coordinate with CES on system effectiveness monitoring	May 2005	August 2007
4.4	Final report on phosphorus reduction capability of digester system	May 2007	August 2007
5	Economic Analysis of Digester System	May 2005	August 2007
5.1	Gather information regarding waste management costs and activities	May 2005	April 2007
6	Final Project Reporting	May 2007	August 2007
6.1	Final report/factsheets/educational materials covering findings gathered under tasks 4 and 5	May 2007	August 2007

Wastewater/Manure Management System Demonstration
Texas Institute for Applied Environmental Research
FY05 Clean Water Act, Section 319(h) Project

PROJECT BUDGET

	Federal	Non-Federal (Match)	Total
1. PERSONNEL			
Oversight			
Hauck, L. Assistant Director (42 hours)	$1,858	$494	$2,352
Bethel, B. Research Associate (2580 hours)	$41,783	$11,107	$52,890
Jones, H. Research Associate (624 hours)	$11,094	$2,949	$14,043
Houser, J. Research Scientist (416 hours)	$8,913	$2,369	$11,282
McFarland, A. Research Scientist (80 hours)	$2,416	$642	$3,058
QAPP/Data Management			
Easterling, N. Research Associate (291 hours)	$5,985	$1,592	$7,577
Rogers, J. Sr. Programmer/Analyst (42 hours)	$839	$223	$1,062
Laboratory			
Murphy, M. Laboratory Manager (166 hours)	$3,744	$995	$4,739
Schwartz, G. Research Assistant (416 hours)	$5,911	$1,571	$7,482
Hunter, J. Sr. Research Assistant (416 hours)	$5,218	$1,387	$6,605
Rodriguez, J. Research Assistant (416 hours)	$4,982	$1,324	$6,306
Hunt, V. Technician (416 hours)	$3,445	$916	$4,361
Economic Analysis			
Osei, E. Research Economist (398 hours)	$8,896	$2,365	$11,261
Tanter, A. Research Associate (294 hours)	$3,529	$938	$4,467
Other			
Swanson, D. Information Specialist (248 hours)	$4,489	$1,194	$5,683
Gosdin, D. Computer Graphics Specialist (40 hours)	$597	$159	$756
Subtotal Personnel	$113,699	$30,225	$143,924
2. FRINGE BENEFITS	$26,653	$7,085	$33,738
Total Personnel and Fringe	$140,352	$37,310	$177,662
3. TRAVEL			$2,899
Gas for oversight of activities	$1,464	$976	
Gas for ATV ($10 month)	$275	$184	
4. EQUIPMENT			
5. SUPPLIES			
Laboratory reagents	$2,398	$1,599	$3,997

6. CONTRACTUAL

7. CONSTRUCTION

8. OTHER			$2,588
Documents/Educational Flyers	$180	$120	
Vehicle Maintenance	$240	$160	
Laboratory Waste	$191	$128	
Maintenance-Laboratory equipment	$851	$568	
ATV Maintenance	$60	$40	
Postage	$30	$20	
TOTAL DIRECT COSTS	$146,041	$41,105	$187,146
INDIRECT COSTS* (56% of total salaries)	14,604	65,993	80,597
TOTAL BUDGET	$160,645	$107,098	$267,743

* Indirect costs are calculated as follows:
—Indirect cost for the federal portion of the grant is equal to 10% of the total direct costs less contractual and equipment
—The total indirect cost is equal to total salaries multiplied by 56% (Tarleton State University's indirect rate)
—Indirect cost for the non-federal portion of the grant is equal to the difference between total salaries multiplied by the indirect rate of 56% minus 10% of the total direct costs

ATTACHMENT 1 Example Letter to Document Adherence to the QAPP

TO: (name)
(organization)

FROM: (name)
(organization)

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

(address)

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

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Signature Date

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