

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

NONPOINT SOURCE SUMMARY PAGE

September 1, 2003 --- August 31, 2006

1. **Title of Project:** Wastewater/ Manure Management System Demonstration: Edge-of-Field Monitoring
2. **Project Goals/Objectives:** This 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 (NPS) reductions. A final report will be developed assessing the preexisting and post-implementation effects of the project. Soil sampling and water quality monitoring will be utilized to gauge the impacts on water quality.
3. **Project Tasks:**
 - (1) Coordination with participating dairy producer, Brazos River Authority, Texas Farm Bureau, and Cascade Earth Sciences.
 - (2) Site assessments and installation of edge-of-field monitoring equipment
 - (3) Implementation of edge-of-field monitoring
 - (4) Development of final report
4. **Measures of Success:** Demonstrate improvements in water quality and soil test results of waste application fields receiving waste treated by a methane digester and managed under a comprehensive nutrient management plan (CNMP).
5. **Project Type:** Statewide (); Watershed (X); Demonstration (X); Other ().
6. **Waterbody Type:** River (X); Groundwater (); Other ().
7. **Project Location:** North Bosque River, Segment 1226
8. **NPS Management Program Reference:** 1999 Texas Nonpoint Source Pollution Assessment Report and Management Program
9. **NPS Assessment Report Status:** Impaired (X); Impacted (); Threatened (); TMDL (X); Other ().
10. **Key Project Activities:** Hire Staff (); Monitoring (X); Regulatory Assistance (); Technical Assistance (X); Education (X); Implementation(X); Demonstration (X); Other ().
11. **NPS Management Program Elements:** Milestones from the "1999 Texas Nonpoint Source Pollution Assessment Report and Management Program," which will be implemented include: (1) reducing nonpoint source loadings in the North Bosque River watershed by utilizing phosphorus reduction technology to improve water quality (2) Coordinating with federal, state, and local programs, (3) Committing to technology transfer, technical support, administrative support, and cooperation between agencies and programs for the prevention of NPS pollution.
12. **Project Costs:** Federal (\$96,081); Non-Federal Match (\$64,055); Total Project (\$160,136).
13. **Project Management:** Texas State Soil and Water Conservation Board; Cooperating Entities: Brazos River Authority, Texas Institute for Applied Environmental Research
14. **Project Period:** September 1, 2003 through August 31, 2006

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WORK PLAN

September 1, 2003 --- August 31, 2006

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.

Tasks, Objectives, Schedules, and Estimated Costs:

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

Performing entity: TIAER

Costs: Federal \$3,976; Non-Federal \$2,948; Total \$6,924

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

Performing entity: TIAER

Costs: Federal \$23,866; Non-Federal \$11,346; Total \$35,212

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

Performing entity: TIAER

Costs: Federal \$49,818; Non-Federal \$35,940; Total \$87,758

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 Kjeldahl 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

Performing entity: TIAER

Costs: Federal \$18,421; Non-Federal \$13,821; Total \$32,242

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.

Project Management:

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**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

Itemized Budget Justification

The project leader will be Ms. Heather Jones, Research Associate, who will spend an estimated 3 percent of her time (176 hrs) providing administration and coordination of this project. Technical project oversight will be provided by Dr. Larry Hauck, Assistant Director, who is budgeted for less than 1 percent of his time (48 hrs) to the project.

Field operations staff have the largest allocation to the project for the purpose of installing the three automated sampling stations, performance of soil and forage sampling, storm sample retrieval, and operation and maintenance of the automated sampling equipment over 30 months of monitoring. Operation and maintenance includes weekly visits to download water level data and to ensure proper function of all equipment. Additional field operations staff time is dedicated to the overall BRA digester project and portion of that allocation will be used to maintain and operate the three stations over the 30-month monitoring period. Among the five field staff assigned to the project, there is nearly a staff year of time (1,908 hrs) assigned to the project.

The TIAER analytical laboratory is staffed by the lab manager, three chemists (a senior research assistant and two research assistants), and a research technician. To analyze an estimated sample load of 270 storm samples these staff will each average almost 3 percent (combined 724 hrs) allocation to the project over 30 months of monitoring.

Quality assurance activities and database storage will be performed by Ms. Nancy Easterling, Research Associate and Mr. Jim Rogers, Senior Programmer/Analyst respectively. Ms. Easterling is dedicated at 164 hrs over the project duration to provide quality assurance and quality control activities on this project. Mr. Rogers is assigned at 240 hrs or approximately 5 percent to this project and will perform activities involving storage and updating of water level and flow databases and maintenance of the database containing water quality data.

Dr. Anne McFarland, Research Scientist, and Mr. Todd Adams, Sr. Research Assistant, will conduct data analyses and develop the final report. Mr. Adams is also a member of the field operations staff, and his hours have already been accounted for under field operations. Dr. McFarland is allocated to this project 360 hrs to allow completion of data analyses, report writing, and transfer of data and findings as necessary to the overall BRA digester project at the Broumley Dairy.

Appreciable expenditures on supplies are expected with this project. TIAER will be providing at no project cost three ISCO automated water level recording and sampling systems and sheet metal housing for each system, which if purchased new for this project would cost over \$20,000. Each station installation will likely require a large flume (estimated cost of \$4,800 each), dirt work, tractor rental, etc. Estimated cost of all these supplies is approximately \$19,000. Other project expenditures for this project are relatively minor and are provided in the object class budget table.

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

Texas Institute for Applied Environmental Research
 FY 03 CWA Section 319(h) Agricultural/Silvicultural Nonpoint Source Program

Project Budget

September 1, 2003 – August 31, 2006

OBJECT CLASS BUDGET	Hourly Rate	Project (hours)	Federal	Non-Fed	Total
1. PERSONNEL					
Field Operations					
Sr. Research Assist.	\$18.90	340	\$4,739	\$1,687	\$6,426
Research Assoc.	\$20.18	248	\$3,691	\$1,314	\$5,005
Sr. Research Assist.	\$14.79	300	\$3,273	\$1,165	\$4,438
Research Assist.	\$13.23	200	\$1,951	\$695	\$2,646
Research Assoc.	\$19.08	820	\$11,539	\$4,105	\$15,644
Analytical Laboratory					
Lab Manager	\$30.16	132	\$2,936	\$1,045	\$3,981
Research Assist.	\$13.45	144	\$1,429	\$508	\$1,937
Technician	\$9.05	144	\$961	\$342	\$1,303
Sr. Research Assist.	\$14.43	152	\$1,617	\$576	\$2,193
Research Assist.	\$16.23	152	\$1,819	\$648	\$2,467
Data Analysis and Technical Assistance					
Research Assoc.	\$23.12	176	\$3,001	\$1,068	\$4,069
Sr. Prog/Analyst	\$24.12	240	\$4,269	\$1,519	\$5,788
Assistant Director	\$53.24	48	\$1,884	\$671	\$2,555
Research Assoc.	\$20.22	164	\$2,446	\$871	\$3,317
Computer Graphics Specialist	\$15.45	24	\$274	\$97	\$371
Information Specialist	\$21.37	16	\$252	\$90	\$342
Research Scientist	\$33.30	360	\$8,840	\$3,146	\$11,986
<i>Subtotal Personnel</i>			\$54,921	\$19,547	\$74,468
2. FRINGE BENEFITS					
27.9% for Staff			\$15,315	\$5,451	\$20,766
<i>Subtotal 1. and 2.</i>			\$70,236	\$24,998	\$95,234
3. TRAVEL					
			\$885	\$315	\$1,200
4. EQUIPMENT					
			\$6,508	\$0	\$6,508
5. SUPPLIES					
Flumes			\$4,112	\$3,780	\$7,892
Bobcat Rental			\$1,106	\$394	\$1,500
Dirt for dikes/berms			\$885	\$315	\$1,200
Misc. supplies to install sites			\$553	\$197	\$750
Appurtances for samplers			\$738	\$262	\$1,000

Consumables, laboratory	\$848	\$302	\$1,150
<i>Subtotal Supplies</i>	\$8,242	\$5,250	\$13,492
6. CONTRACTUAL	\$0	\$0	\$0
7. CONSTRUCTION	\$0	\$0	\$0
8. OTHER			
Soils, effluent & forage samples	\$590	\$210	\$800
Vehicle maintenance	\$221	\$79	\$300
Laboratory wastes	\$516	\$184	\$700
Laboratory maintenance	\$148	\$52	\$200
<i>Subtotal Other</i>	\$1,475	\$525	\$2,000
TOTAL DIRECT COSTS	\$87,346	\$31,088	\$118,434
INDIRECT COSTS (56% of personnel)	\$8,735	\$32,967	\$41,702
TOTAL BUDGET	\$96,081	\$64,055	\$160,136