Demonstration of Waste Management System Utilizing Constructed Wetlands

Stephenville, Texas

Final Report

FY 1994

319(h)

Texas Nonpoint Source Project

Texas

Demonstration of Waste Management System

Utilizing Constructed Wetlands

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Texas Agricultural/Silvicultural Nonpoint Source Management Program
FY 94 CWA 319(h) Grant

EXECUTIVE SUMMARY

Between June 1994 and September 30,1997 work was conducted to design, construct, vegetate, and monitor water quality from a constructed wetland project in Erath County, Texas.

Summaries of the program element accomplishments are:

Project Coordination and Management:
Formal and informal meetings and tours were conducted regarding the constructed wetland project.

System Planning and Design:
The field survey concluded on July 12, 1994 and the engineering design completed on May 23, 1995.

Construction of the System:
The bid was awarded on the constructed wetland on July 10, 1995 with the final construction completed on December 7, 1995.

Technology Transfer and Education:
News articles were written, educational displays and presentations were given, reports and publications were developed, one slide presentation was developed, a sign board was erected at the entrance to the site, and tours/field days were conducted at the wetland site.

Water Quality Monitoring:
A Quality Assurance Project Plan was developed in March 1996. Water quality monitoring was initiated in April 1997. The monitoring phase of this project was shortened because the producer retired from the dairy business. Final water samples were taken September 30, 1997.

Economic Feasibility Testing:
All tasks for the constructed wetland project were completed with the exception of this activity. The dairy producer secured a nutritional computer program to utilize for feed adjustment, for the economic component of the project in June 1995. A harvesting platform was developed in the wetland cells and protein analysis was conducted in June 1997, but the dairy herd was sold on July 18, 1997. Economic feasibility testing of the production of a protein source could not be completed because of the retirement of the producer.

NONPOINT SOURCE MANAGEMENT PROGRAM FOR
AGRICULTURAL/SILVICULTURAL ACTIVITIES IN ERATH COUNTY
EPA FY 1994 Sec.319(h)

FINAL REPORT

COVERING ACTIVITIES FROM SEPTEMBER 1994 THROUGH SEPTEMBER 1997

INTRODUCTION

The emphasis of this project was to demonstrate a constructed wetland as an animal waste management system component and to develop adequate animal waste systems, technologies, and policies that are currently needed by dairy producers in the county and statewide. In Erath County confined animal feeding is a prevalent component of the present-day dairy operation. Control of water quality near a confined area is a major issue. The project contained six tasks:

1. Project Coordination and Management: To foster coordination among entities performing duties under this grant and to encourage exchange of ideas as the project unfolds.

2. System Management and Design: To plan and design a water quality plan (including design, planning, operations, and maintenance of a constructed wetland system), meeting the needs of the dairy producer and water quality requirements of the State of Texas.

3. Construction of the System: Provide positive guidance in the layout, construction, and final certification of the demonstration dairy constructed wetland system.

   (Includes Phase II Additional Construction of the System)
   Task 1.1 Reconstruct the anaerobic lagoon.
   Task 1.2 Construct the settling basin
   Task 1.3 Provide for certification of liner or lack of hydrologic connection.
   Task 1.4 Provide for necessary adaptations and additions to the system as outlined in the justification.

4. Technology Transfer and Education: To initiate a comprehensive, broad-based education campaign to demonstrate project activities to the dairy industry.

5. Water Quality Monitoring (Revised): To determine nutrient content of wastewater. To acquire sufficient data to determine the impact of dairy waste management systems, specifically the constructed single wetland system, on water quality. The revision of this element incorporates the use of an innovative eight-cell design wetland system rather than the single wetland system.

6. Economic Feasibility Testing: To determine the feasibility of implementing the constructed wetland based on the incentive of expected water quality improvement and economic returns based on production of a protein source for dairy rations.

This final report summarizes accomplishments of the major tasks.

ACCOMPLISHMENTS BY PROGRAM ELEMENT

PROGRAM ELEMENT 1: Project Coordination and Management

Task 1.1 Conduct initial meeting of involved entities

- A meeting was held June 20, 1994 with EPA, TSSWCB, and NRCS to determine agency responsibility for the project. NRCS State Office engineering staff agreed to provide design assistance with a completion date anticipated by February 1, 1995.

- A field tour was conducted by the participating agencies on June 23, 1994. The O'Bryan Dairy was selected as the demonstration site.

- A meeting was held on June 29, 1994 with the dairy owners to finalize criteria for the project and to determine final interest. The O'Bryan's were willing to participate and provide monies for their part of the project funding.

Task 1.2 Report to interested parties.

- NRCS provided quarterly report to TSSWCB on January 12, 1995 indicating the progress of the project.

- NRCS provided copies of published news articles and roster of January 31, 1995 information meeting to EPA on February 7, 1995.

- NRCS provided quarterly report to TSSWCB on April 1, 1995 and June 30, 1995 indicating progress of the project.

- Report was made by NRCS project staff on August 14, 1995 to state office for expenditures to be forwarded to TSSWCB for documentation.

- NRCS provided quarterly report to TSSWCB and NRCS State Office indicating progress of the project on September 30, 1995.

- NRCS reported to TSSWCB concerning the completion of project construction on December 7, 1995.

- NRCS project staff reported to NRCS-EPA liaison (December 7, 1995) advising of project construction completion.

- NRCS project staff provided quarterly report to TSSWCB on January 2, 1996.

- NRCS project staff provided quarterly report to TSSWCB on Aril 2, 1996.

- A quarterly report on the wetland project was provided to TSSWCB by NRCS on July 8, 1996.

- NRCS project staff provided quarterly report to TSSWCB on September 30, 1996.

- NRCS project staff provided quarterly report to TSSWCB on April 8, 1997.

- NRCS project staff provided quarterly report to TSSWCB on July 8, 1997.

Task 1.3 Conduct interim meetings of involved and interested parties as needed.

- A field tour of the project site was conducted on January 31, 1995. Agency representatives attending the meeting were NRCS, EPA, TSSWCB, TAEX, TIAER, SWCD's, and UTA.

- From April 1 through July 1, 1995 NRCS met with the O'Bryans on numerous occasions to finalize plans for the development of the project. The dairy owners have documented a log of individuals that have contacted them regarding the project.

- On April 12, 1995 NRCS met with University of Texas at Arlington (UTA) regarding wastewater treatment proposal for the project.

- NRCS met with Texas Association of Dairymen on May 1, 1995 to emphasize the importance of the demonstration project.

- On June 12, 1995 the Texas Institute for Applied Environmental Research (TIAER) and NRCS met to review the final waste management plan for the project, including the constructed wetland.

- TSSWCB and NRCS met on June 13, 1995 to review the final design of the project and discussed the components to be installed.

- The dairy owners, EPA, TSSWCB, and NRCS met on June 30, 1995 to review documentation required for reporting on the project.

- NRCS staff met with Dublin Concerned Citizens on October 17, 1995 to present information on the constructed wetlands project. Eight people attended the meeting.

- On October 11, 1995 NRCS and TAEX personnel conducted an informational meeting on the wetland project to the Hico Civic Club. Twenty-four people attended the meeting.

- On October 19, 1995, NRCS prepared for American Society of Agricultural Engineer's meeting to review the constructed wetland project. Slides of the project were selected for the presentation.

- NRCS water quality project staff met with District Conservationist on October 19, 1995 to review project site accomplishments. Seed was ordered for project vegetation.

- TNRCC Commissioner reviewed project site with Erath County Extension personnel on October 24, 1995.

- NRCS met with TSSWCB on November 6, 1995 to review the constructed wetland project. A news article on the project will be developed in December 1995.

- On November 15, 1995, NRCS met with Tarleton State University agricultural students to review the constructed wetland project. Twenty-seven students were present for the meeting.

- NRCS, TAEX, and water quality specialists from Texas A and M University reviewed the project site on November 27, 1995. The purpose of the meeting was to develop a plan of action for promotion of the constructed wetland project.

- NRCS and TAEX water quality project staff reviewed the constructed wetland site with TAMU Engineering Department, TAMU Wildlife and Wetland Ecology Department, TAEX, and TWRI on November 30, 1995. TAMU personnel expressed an interest in touring the site during the second National Workshop "On The Use Of Constructed Wetlands For Animal Waste Management" in May 1996

- NRCS, UTA, and TIAER personnel met on December 1, 1995 to tour the site and discuss water quality monitoring of the constructed wetland.

- NRCS project staff provided a tour of the site to Tarleton State University dairy science students on December 7, 1995. Seven students attended the tour.

- NRCS and TAEX water quality staff met with TAMU Horticulturist on December 8, 1995 to exchange information on aquatic plant habitat. The development of a factsheet for state-wide distribution on how to establish aquatic plants was discussed.

- NRCS project staff provided tour and design information on the constructed wetland to local dairy operators on January 6, 1996.

- NRCS project staff provided tour and information on February 21, 1996 to employees from Texas Christian University on the wetland demonstration

- On February 22, 1996, NRCS project staff made preparations for the planting of the aquatic cells at the site. Volunteers from Tarleton State University Range and Dairy Science Clubs will plant the wetland cells.

- On July 25, 1996 project staff project staff provided a tour of the wetland to NRCS national, regional, and state office personnel.

- Project staff provided a tour of the wetland site to NRCS employees from Nebraska and New Jersey on July 31, 1996.

- NRCS project staff provided a tour of the wetland site to NRCS Environmental Engineering Core Discipline Team on September 9, 1996.

- NRCS and TAEX provided a tour of the wetland site to Texas A and M University agronomy class on October 15, 1996. Fourteen people attended the tour.

- On December 6, 1996 project staff met with plant materials specialist to view the site and plan vegetative plantings.

- On May 22, 1997 local project staff provided a tour of the wetland site to NRCS, NHQ Water Quality Coordinator.

Task 1.4 Contract Administration.

- On April 26, 1995 the Draft Operation and Maintenance Plan was submitted to the dairy owners for their review and comments.

- On July 7, 1995 NRCS water quality staff reviewed the final draft of the Memorandum of Understanding and Contract with TIAER for monitoring responsibilities.

- Inspection of the site by dairy owners, contractor, and NRCS was performed on November 16, 1995. This field review was the check prior to the final inspection of the project. Only minor items were noted for completion.

- On December 4, 1995 NRCS project staff reviewed wetland cell species with Plant Material Specialist and TSSWCB. Only approved wetland species will be planted in the constructed cells.

- NRCS staff contacted four companies selling aquatic plants. Information on cost and availability of the wetland plants was requested on December 6, 1995.

- Project sign was ordered on December 6, 1995. The original sign was damaged by wind earlier in the year (new sign installed on December 15, 1995).

- NRCS State Office staff administrated invitation for Bids (SCS-8-TX-95). Construction inspector was furnished from the Stephenville Watershed Office. The construction contract of the wetland site was completed on December 7, 1995

PROGRAM ELEMENT 2: System Planning and Design

Task 2.1 Plan and Design a Water Quality Management System.

- A field survey was initiated and completed on July 7, 1994 for topographic information for the design of the constructed wetland. TSSWCB and NRCS Field Office and Area Office staff participated in the survey.

- On July 12, 1994 the site topographic information was sent to the NRCS State Office for map generation.

- NRCS Area Soil Scientist conducted a preliminary exploration of the soil information on July 19, 1994.

- On December 7, 1994 a soils investigation was conducted by NRCS of the excavation points for the lagoon, waste storage pond, and wetland cells. The soil samples were sent to NRCS Regional Technical Center Soils Laboratory in Ft. Worth, Texas for analysis.

- NRCS project staff contacted wetland plant supply sources for input and consideration of selecting aquatic plants for the wetland cells on December 18, 1994.

- NRCS Area Office engineering staff met with dairy owners to finalize the animal waste system design on January 24, 1995. The design was sent for contract development.

- On May 23, 1995 NRCS State Office engineering staff completed the design work for the constructed wetland.

Task 2.2 Review BMP Selection and Adopt BMP and Constructed Wetland Design Criteria. Make Recommendations.

- NRCS met with dairy owners and contractor on July 20, 1994 to provide information for use in determining a bid for the flush system and mechanical separator for the waste system.

- On August 9, 1994 the cost estimate for the flush system was received by NRCS from the contractor. Estimates were reviewed with the dairy owners.

- NRCS project staff met with dairy owners on October 3, 1994 to review BMP selection of a mechanical separator for the waste system.

- On November 17 and 20, 1994 NRCS project staff met with dairy owners and contractors to determine BMP's and review quotes for the waste system.

- NRCS staff met with dairy owners and contractor on December 10, 1994 for final design and construction cost of the manure handling system.

Task 2.3 Review Completed Design. Make Needed Changes or Amendments.

- On May 23, 1995 the waste management plan was completed. The completed plan was reviewed at the Pre-Bid conference held in Dublin, Texas.

Task 2.4 Submit Water Quality Management Plan to TSSWCB for Certification.

- On July 19, 1995 NRCS water quality staff submitted the O'Bryan Dairy Water Quality Management Plan (WQMP) to the NRCS Field Office for processing and concurrence of the Upper Leon SWCD and TSSWCB.

- A completed copy of the water quality management plan was forwarded to TSSWCB in Temple, Texas on June 7, 1995.

Task 2.5 Design Report submitted to EPA/TNRCC

- NRCS submitted a design report to EPA and TNRCC on March 1, 1995.

- NRCS submitted a design report to EPA and TNRCC on May 1, 1995.

- A completed design report was submitted to EPA and TNRCC on June 7, 1995 by NRCS project staff.

PROGRAM ELEMENT 3: Construct the System.

Task 3.1 Establish Which BMPs will be Used.

- On December 1, 1994 the consideration of BMPs was completed with the dairy owners by NRCS. The selected practices were targeted for design.

- From April 1 through July 1, 1995 NRCS project staff met with the dairy owners numerous times by phone calls and one-on-one conferences. The dairy owners decided on the management practices to incorporate into the overall dairy system during this time period.

- Although not covered for cost sharing under 319(h), the dairy owners have secured cost share funds through SB503 for other conservation practices. The practices were utilized in conjunction with the overall dairy enterprise (April 1-July 1, 1995). The following conservation practices were completed under SB503 funding:

  Brush management
  Waterway shaping
  Vegetation and fertilization
  Leveling old terraces
  Establishment of vegetative cover

- From April 1-July 1, 1995 the dairy owners completed the shaping of the confined pen area to provide drainage to the 319(h) waterway. A 32 foot, 12,000 gallon water storage with flush valve was purchased as part of the feedlane flushing system.

Task 3.2 Solicit Construction Contractors' Bids for Construction Phase.

- NRCS project staff contacted a representative of the Texas Excavation Contractors Association on February 22, 1995, to determine interest in construction of the system. A meeting of the Contractors Association is scheduled in Dublin, Texas in March 1995 to view the prospective site.

- A Pre-Solicitation Notice, Project No. SCS-8-TX-95 was submitted to extend invitations for bidding the Constructed Wetlands Site on April 19, 1995.

- NRCS project staff and Civil Engineering Technician viewed site on May 4, 1995.

- On May 8, 1995 Contracting Official Technical Representative viewed the site

- NRCS Construction Inspector and Engineering Technicians staked the site on May 10-11, 1995.

- On May 22, 1995 clearing and grubbing boundaries were marked for the site.

- A Pre-Bidding Conference was held on May 23, 1995 at the First National Bank Conference Room in Dublin, Texas to review the design and tour the site. A total of fifteen individuals or firms, including the dairy owners was present at the conference.

- On May 26, 1995 an amendment of solicitation was issued reflecting changes of the May 23rd Pre-Bidding Conference.

- June 9, 1995, 2:00 PM was the final date for bid presentation.

Task 3.3 Award Contract for Installation and Vegetation.

- Four bids were received and opened on June 9, 1995. Bids ranged from $188, 956.25 to $326, 679.50. One contractor was present at the bid opening. The apparent low bidder was notified.

- On July 10, 1995 a bid was awarded on the constructed wetland.

- NRCS project staff and Watershed construction crew met with contractor at a Pre-Construction Conference on July 20, 1995.

Task 3.4 Construct and Certify Waste Management System, with Constructed Wetland Component.

(Includes Phase II Additional Construction of the System)
Task 1.1 Reconstruct the anaerobic lagoon.
Task 1.2 Construct the settling basin
Task 1.3 Provide for certification of liner or lack of hydrologic connection.
Task 1.4 Provide for necessary adaptations and additions to the system as outlined in the justification.

- Construction activities began on August 8, 1995 with the construction of the wasted storage pond.

- Filter fabric silt fences were installed around the construction site on August 15, 1995.

- On August 18, 1995 construction of the wetland cells started.

- Construction of the waste storage pond and topsoil spoil area was completed on August 31, 1995. Installation began on the waste storage pond liner.

- On September 5, 1995 installation of the waste storage pond liner was completed.

- The liner test was performed for waste storage pond liner certification on September 6, 1995.

- On September 8, 1995 de-watering of the existing lagoon started. Wastewater and sludge was pumped to adjacent and designated fields.

- Construction of the waste treatment lagoon started on September 16, 1995.

- Construction of the waterways started on September 20, 1995.

- Installation began on September 26, 1995 of the of the recycle pipeline from the waste storage pond to the flush tank.

- The dairy owners installed the flush tank on September 27, 1995.

- Concrete forming work started on October 12, 1995 for the inlet protection to the waste storage pond.

- Ditching of the fresh water line to the wetland cells started on October 12, 1995.

- Contractor poured concrete to finish inlet protection to the waste storage pond on October 17, 1995. Work started on the catch basin and settling basin areas.

- Concrete was poured and finished in the catch and settling basin areas from October 19-24, 1995.

- The seed for the vegetative work was delivered to the watershed office on October 20, 1995.

- On October 23, 1995 the contractor began forming the concrete slope drain outlet.

- Plumbing work started on the wetland cells on October 25, 1995.

- Contractor began excavation of the trenches for wastewater line and emergency spillway overflow lines on October 27, 1995.

- The contractor requested thirty additional day to complete the project on November 2, 1995.

- The vegetation of embankments, wetland cells and disturbed areas started on November 19, 1995.

- From November 19 to December 7, 1995, the following items were installed at the site: three phase electricity for the recycle and irrigation pumps; hay bale sediment blocks in the waterways; three inch discharge line from the lagoon to the wetland cells; six inch discharge line from the wetland cells to the waste storage pond concrete inlet protector; ten inch flex hose from catch basin to settling and drying tank cells; seeding of embankments, disturbed areas and waterways; construction of the site fence; and mulching disturbed areas with Coastal Bermudagrass.

- On December 7, 1995 the final contract review for completeness was performed.

PROGRAM ELEMENT 4: Technology Transfer and Education

Task 4.1 Utilize News Media (radio, TV, news magazines, etc.) to Disseminate Information on the Project.

- Two news articles were published in the Dublin Citizen and the Stephenville Empire Tribune on November 24 and 28, 1994. The Texas Dairy Review published an article on the constructed wetland project in the December 1994 issue.

- The Country World Magazine (Sulphur Springs, Texas) published an article on the constructed wetland project in their January 1995 issue.

- Future Farmers Magazine (Wisconsin) completed a news article on the wetland project for publication in February 1995.

- NRCS and EPA met on February 14, 1995 to develop format for signboard to be installed at the project site.

- Slides, color photographs, and a video started during January 1 – March 31, 1995. Development of this educational material is scheduled to be on going throughout the duration of the project.

- NRCS project staff provided an educational display at the Comanche County Dairy Field Day (March 30, 1995) on the constructed wetland project.

- The Upper North Bosque HUA Project brochure was updated on April 24, 1995 to include the constructed wetland project. The handouts were utilized for educational purposes at meetings, conferences, tours and field days.

- On May 1, 1995, NRCS staff delivered a presentation on the constructed wetland project to the Texas Association of Dairymen. The mayors of Waco and Clifton, State Representatives, Chamber of Commerce from Waco and Clifton, dairy producers and State and Federal agency personnel attended the meeting (twenty-four attending).

- NRCS staff received quote for signboard to be erected at the entrance to the site on May 1, 1995. A groundbreaking ceremony is planned with all involved agencies and interested public participants after the construction is complete. News coverage is slated for attendance from the Dublin Citizen, Stephenville Empire Tribune, Texas Dairy Review, and Waco Tribune Herald.

- NRCS staff contacted a flying service to on May 26, 1995 to obtain aerial photos of the site. Photos of the wetland site will be taken weekly during the construction period.

- NRCS project staff worked with Public Affairs Specialist from the State Office on June 6, 1995 in the development of educational materials on the constructed wetland.

- On June 7, 1995, NRCS staff conducted a field review of the wetland project with news media, Texas Agricultural Extension Service, Texas Agricultural Experiment Station, and NRCS. Eight people attended the field review.

- The Stephenville Empire Tribune developed a feature article on the constructed wetland for Dairy Day. NRCS project staff sent copies of the article to TSSWCB, EPA, TAEX, and NRCS State Office on June 12, 1995.

- On June 15, 1995 NRCS project staff coordinated with District Conservationist in Mississippi to tour the constructed wetland site with County Commissioners, Farm Bureau, and dairy owners.

- NRCS project staff consulted with Fossil Rim Wildlife Refuge in Glen Rose, Texas on the use of constructed wetland technology to treat exotic animal waste in the park area. Five agency representatives attended the meeting on June 19, 1995.

- NRCS and TAEX personnel met with various individuals in planning demonstrations utilizing the constructed wetland on June 27 and 28, 1995.

- NRCS project staff ordered the sign on July 10, 1995 for the constructed wetland dedication ceremony.

- A news article was completed about the constructed wetland on August 15, 1995. The article was delivered to the Stephenville Empire Tribune, Dublin Citizen, Country World, and the Texas Dairy Review.

- NRCS Public Affairs Specialist utilized poster display and photos of the constructed wetland at the Heart of Texas fair in Waco from October 10-15, 1995. Approximately 179,000 people attended the fair and viewed the display of the constructed wetland project.

- NRCS State Office engineering staff presented information on the constructed wetland at the American Society of Agricultural Engineers annual meeting in Austin, Texas on October 31, 1995. Thirty-five people attended the meeting.

- On October 31, 1995 NRCS District Conservationists from Stephenville and Comanche utilized photos of the constructed wetland in the Upper Leon and Cross Timbers SWCD Annual Reports.

- NRCS and TAEX Upper North Bosque HUA project staff utilized photos of the constructed wetland in the Hydrologic Unit Area Annual Report on November 3, 1995. This report was submitted to USDA water quality staff in Washington, D.C.

- On January 23, 1996 NRCS staff provided a site tour and information to Stephenville Empire Tribune for the development of a news article.

- NRCS project staff developed a brochure on the constructed wetland on January 31, 1996. The brochure will be used to distribute educational information on the wetland project.

- The wetland cells were planted using student volunteers from Tarleton State University Range and Dairy Science Clubs and Dublin Vocational Agriculture on March 21, 1996. Others participating in the planting of the wetland cells were: Upper Leon SWCD, Cross Timbers SWCD, NRCS, TIAER, TAEX, TAES, and TSSWCB. Representatives from Western Dairy Magazine and the Dublin Citizen were present to develop news articles about the wetland demonstration. Sixty-seven people participated in the planting of the wetland cells.

- On March 25, 1996 NRCS staff provided a tour and project information to eighteen representatives from the Brazos River Authority.

- NRCS provided an educational display on the wetland project at the KCOM Dairy Field Day in Comanche on March 28, 1996. Eight hundred people attended the field day.

- On April 11, 1996 wetland project information was provided to Texas Farmer Stockman Magazine by NRCS project staff.

- NRCS delivered an educational slide presentation (April 26, 1996) concerning the constructed wetland to the Dublin Rotary Club (twenty-seven present).

- On May 16, 1996 NRCS project staff provided a tour and information to persons involved with the 2nd National Workshop on Constructed Wetlands for Animal Waste Management. One hundred fourteen people attended the tour.

- NRCS project staff presented information on the wetland project to the Water Quality Technology Transfer Conference in Sulphur Springs, Texas on May 22, 1996 (35 people Present).

- On September 16, 1996 NRCS staff provided a tour of the wetland project for Progressive Farmer Magazine representative.

- NRCS project staff submitted the O'Bryan Dairy Project to the National Wetland Awards and Environmental Law Institute for consideration in their wetland award programs on December 12, 1996.

Task 4.2 Conduct two (2) field days open to the public, demonstrating progress and results of demonstration dairy.

- On July 22, 1995 NRCS project staff provided a tour of the constructed wetland, hosting participants from Mississippi. Thirty-four people participated in the tour.

- Upper Leon and Cross Timbers SWCD's completed a letter of invitation to the dedication ceremony for the constructed wetland on August 11, 1995.

- On August 28, 1995 the dedication ceremony and tour of the constructed wetland was held. Forty-one agency representatives and the general public attended.

- NRCS hosted tour of the constructed wetland project for five TSSWCD representatives on September 15, 1995.

PROGRAM ELEMENT 5: Water Quality Monitoring (Revised).

Task 5.1 Prepare Water Quality Objectives (Revised).

- NRCS and TIAER staff met in Stephenville, Texas on March 5, 1997 to discuss water quality monitoring at the wetland site.

- TIAER staff developed Quality Assurance Project Plan (QAPP) in March 1997 for water quality monitoring at the wetland site.

Task 5.2 Prepare a QAPP and Submit to EPA for Approval 60 Days Prior to Sampling (Revised).

- QAPP was signed and approved by EPA on June 6, 1997. QAPP was received by TSSWCB on June 12, 1997,

Task 5.1 Establish Monitoring Sites at Locations to Accurately Capture and Assess Nutrient Runoff Loading.

- Texas Institute for Applied Environmental Research (TIAER) submitted a cost estimate to NRCS project staff, for water quality sampling and laboratory analysis for the constructed wetland project on November 17, 1994.

- On June 12, 1995, NRCS project staff presented a copy of the final waste management plan to TIAER showing the layout of the final wetland components.

- NRCS received a cooperative agreement from TIAER for the monitoring on July 10, 1995.

- TIAER received formal contract from NRCS for monitoring on October 11, 1995

- On October 31, 1995, NRCS reviewed the finished wetland site with TIAER for monitoring locations.

- NRCS project staff met with TIAER at the wetland site on December 1, 1995. The lagoon was approximately one-third full and preliminary water samples were collected for analysis.

Task 5.2 Utilize Updated Data in Model Predictions to Evaluate Movement of Nutrients in Different Management Scenarios.

- On September 13, 1995, NRCS project staff discussed concerns of using EPIC and APEX for model predictions with staff at Blackland Research Center.

- NRCS project staff met with TIAER on October 31, 1995 to adapt EPIC and APEX computer models to actual and differing scenarios on the wetland site.

- On April 1, 1996 NRCS staff installed a weather station on the waste system lagoon to measure, record, and submit weather data to TIAER and NRCS. Local NRCS project staff will download the weather station monthly.

Task 5.3 The Texas Institute of Applied Environmental Research will Monitor 14 Sample Points (Influent and Effluent to the Lagoon, Effluent of the Eight Wetland Cells, and Influent and Effluent to the Waste Storage Pond) and Collect Composite Samples, as Outlined in the QAPP.

- NRCS project staff obtained a soil sample from the wetland cells to determine nutrient content of the plant medium on February 22, 1996.

- On March 8, 1996 NRCS and TIAER staff met to discuss computer modeling and upgrade the program that will be incorporated on the wetland system.

- On April 24, 1997 initial sampling was conducted by TIAER. Water samples were collected from lagoon, storage pond, and wetland cells.

- Water samples were collected on May 7, 1997 but no inflow or outflow was observed in the wetland cells by TIAER.

- TIAER staff took water samples from the lagoon on May 21, 1997. System drains were clogged for several days before this sampling period.

- TIAER staff performed entire sampling routine on June 5, 1997.

- Dairy herd was sold on July 18, 1997. Producer continued to flush the parlor to keep the system functioning. The primary cells received inflow but only the top two secondary cells were outflowing.

- Entire sampling routine was performed on July 24, 1997 by TIAER staff.

- Water samples were taken from the wetland site on August 7, 1997 by TIAER staff. All cells were receiving inflow. The fourth cell was the only cell with no out flow.

- TIAER staff collected water samples at the wetland site on August 20, 1997. Water flow was exiting from the top three cells but not the fourth.

- Sampling was performed on September 3, 1997 by TIAER staff. Water flow was entering the cells but no flow was exiting any cell.

- Water samples were taken on September 18, 1997 by TIAER staff from the lagoon, storage pond, primary cells # 1 and # 2 inflow, and secondary cell # 2 outflow.

- On September 30, 1997 no flow was observed into or out of the cells during sampling by TIAER staff. Water samples were taken from the lagoon, storage pond, and primary cells # 1 and # 2 inflow.

Task 5.4 Analyze Samples for Nutrient Content, Fecal Coliform, and Field Parameters Using Procedures Established in the QAPP.

- Water sample analysis was conducted by TIAER for the constructed wetland site on the following dates:
  April 24, 1997, Initial sampling
  May 7, 1997, Routine sampling
  May 21, 1997, Sampling from lagoon
  June 7, 1997, Routine sampling
  July 24, 1997, Routine sampling
  August 7, 1997, Routine sampling
  August 20, 1997, Routine sampling
  September 3, 1997, Routine sampling
  September 18, 1997, Sampling from lagoon, storage pond, and three cells
  September 30, 1997, Sampling from lagoon, storage pond and two cells

PROGRAM ELEMENT 6: Economic Feasibility Testing.

Task 6.1 Record Weights of Cattle at Beginning of Project.
Task 6.2 Harvest Plants Grown in the Wetland and Utilize Feedstock in Rations Fed to Said Cattle.

- From April 1 through June 30, 1997 the following was completed:

  Steve O'Bryan developed a harvesting platform in the wetland cells. A drying and weighing site was developed for duckweed at Tarleton State University. Duckweed was harvested from the cells and nutrient analysis was conducted. The duckweed analysis indicated 35 percent crude protein.

Task 6.3 Record Weight Change of Cattle Periodically.
Task 6.4 Summarize the Effectiveness of Utilizing Feedstock From Wetland in Dairy Rations.

The dairy producer secured a nutritional computer program to utilize for feed adjustment, for the economic component of the project in June 1995. The dairy herd was sold on July 18, 1997 before economic feasibility testing of the production of a protein source could be started.

DELIVERABLES:

Program Element 1: Development of a coordinated process for demonstration of an animal waste management system, emphasizing the utilization of a constructed wetland.

See Appendix A.

- A meeting was held June 20, 1994 with EPA, TSSWCB, and NRCS to determine agency responsibility for the project. NRCS State Office engineering staff agreed to provide design assistance with a completion date anticipated by February 1, 1995.

- NRCS provided quarterly reports to TSSWCB on January 12, 1995; April 1, 1995; June 30, 1995; September 30, 1995; January 2, 1996; April 2, 1996; July 8, 1996; September 30, 1996; April 8, 1997; and July 8, 1997 indicating progress of the project.

- A field tour of the project site was conducted on January 31, 1995. Agency representatives attending the meeting were NRCS, EPA, TSSWCB, TAEX, TIAER, SWCD's, and UTA.

- NRCS reported to TSSWCB concerning the completion of project construction on December 7, 1995.

- NRCS project staff reported to NRCS-EPA liaison (December 7, 1995) advising of project construction completion.

- NRCS and TAEX water quality project staff reviewed the constructed wetland site with TAMU Engineering Department, TAMU Wildlife and Wetland Ecology Department, TAEX, and TWRI on November 30, 1995. TAMU personnel expressed an interest in touring the site during the second National Workshop "On The Use Of Constructed Wetlands For Animal Waste Management" in May 1996.

Program Element 2: Startup, interim, and completion reports reviewing the technological options and design criteria. Quarterly reports and final reports.

See Appendix B.

- A field survey was initiated and completed on July 7, 1994 for topographic information for the design of the constructed wetland. TSSWCB and NRCS Field Office and Area Office staff participated in the survey.

- On December 7, 1994 a soils investigation was conducted by NRCS of the excavation points for the lagoon, waste storage pond, and wetland cells. The soil samples were sent to NRCS Regional Technical Center Soils Laboratory in Ft. Worth, Texas for analysis.

- NRCS staff met with dairy owners and contractor on December 10, 1994 for final design and construction cost of the manure handling system.

- NRCS Area Office engineering staff met with dairy owners to finalize the animal waste system design on January 24, 1995. The design was sent for contract development.

- On July 19, 1995 NRCS water quality staff submitted the O'Bryan Dairy Water Quality Management Plan (WQMP) to the NRCS Field Office for processing and concurrence of the Upper Leon SWCD and TSSWCB.

- A completed copy of the water quality management plan was forwarded to TSSWCB in Temple, Texas on June 7, 1995.

- NRCS submitted a design report to EPA and TNRCC on March 1, 1995.

- NRCS submitted a design report to EPA and TNRCC on May 1, 1995.

- A completed design report was submitted to EPA and TNRCC on June 7, 1995 by NRCS project staff.

Program Element 3: Certification document to TSSWCB showing animal waste system is complete and it meets Texas water quality standards. Quarterly reports and final reports.

(Includes Phase II Additional Construction of the System)
Task 1.1 Reconstruct the anaerobic lagoon.
Task 1.2 Construct the settling basin
Task 1.3 Provide for certification of liner or lack of hydrologic connection.
Task 1.4 Provide for necessary adaptations and additions to the system as outlined in the justification.

See Appendix C.

- On December 1, 1994 the consideration of BMPs was completed with the dairy owners by NRCS. The selected practices were targeted for design.

- A Pre-Solicitation Notice, Project No. SCS-8-TX-95 was submitted to extend invitations for bidding the Constructed Wetlands Site on April 19, 1995.

- NRCS project staff and Watershed construction crew met with contractor at a Pre-Construction Conference on July 20, 1995.

- Construction activities began on August 8, 1995 with the construction of the wasted storage pond.

- On August 18, 1995 construction of the wetland cells started.

- Construction of the waste treatment lagoon started on September 16, 1995.

- Construction of the waterways started on September 20, 1995.

- The vegetation of embankments, wetland cells and disturbed areas started on November 19, 1995.

- On December 7, 1995 the final contract review for completeness was performed.

- NRCS reported to TSSWCB concerning the completion of project construction on December 7, 1995.

- NRCS project staff reported to NRCS-EPA liaison (December 7, 1995) advising of project construction completion.

Program Element 4: News articles showing before and after effects of the project, and wetland/water quality relationships. Slide presentation/video showing installation of the project. Quarterly reports and final report.

See Appendix D

- Two news articles were published in the Dublin Citizen and the Stephenville Empire Tribune on November 24 and 28, 1994. The Texas Dairy Review published an article on the constructed wetland project in the December 1994 issue.

- The Country World Magazine (Sulphur Springs, Texas) published an article on the constructed wetland project in their January 1995 issue.

- NRCS and EPA met on February 14,1995 to develop format for signboard to be installed at the project site.

- The Upper North Bosque HUA Project brochure was updated on April 24, 1995 to include the constructed wetland project. The handouts were utilized for educational purposes at meetings, conferences, tours and field days.

- NRCS project staff worked with Public Affairs Specialist from the State Office on June 6, 1995 in the development of educational materials on the constructed wetland.

- The Stephenville Empire Tribune developed a feature article on the constructed wetland for Dairy Day. NRCS project staff sent copies of the article to TSSWCB, EPA, TAEX, and NRCS State Office on June 12, 1995.

- A news article was completed concerning the constructed wetland on August 15, 1995. The article was delivered to the Stephenville Empire Tribune, Dublin Citizen, Country World, and the Texas Dairy Review.

- On August 28, 1995 the dedication ceremony and tour of the constructed wetland was held. Forty-one agency representatives and the general public attended.

- NRCS hosted tour of the constructed wetland project for five TSSWCD representatives on September 15, 1995.

- NRCS and TAEX Upper North Bosque HUA project staff utilized photos of the constructed wetland in the Hydrologic Unit Area Annual Report on November 3, 1995. This report was submitted to USDA water quality staff in Washington, D.C.

- NRCS project staff developed a brochure on the constructed wetland on January 31, 1996. The brochure will be used to distribute educational information on the wetland project.

- The wetland cells were planted using student volunteers from Tarleton State University Range and Dairy Science Clubs and Dublin Vocational Agriculture on March 21, 1996. Others participating in the planting of the wetland cells were: Upper Leon SWCD, Cross Timbers SWCD, NRCS, TIAER, TAEX, TAES, and TSSWCB. Representatives from Western Dairy Magazine and the Dublin Citizen were present to develop news articles about the wetland demonstration. Sixty-seven people participated in the planting of the wetland cells.

- On April 11, 1996 wetland project information was provided to Texas Farmer Stockman Magazine by NRCS project staff.

- NRCS project staff presented information on the wetland project to the Water Quality Technology Transfer Conference in Sulphur Springs, Texas on May 22, 1996 (35 people Present).

- On September 16, 1996 NRCS staff provided a tour of the wetland project for Progressive Farmer Magazine representative.

- NRCS project staff submitted the O'Bryan Dairy Project to the National Wetland Awards and Environmental Law Institute for consideration in their wetland awards program on December 12, 1996.

- The O'Bryan Constructed Wetland Project was included in the final report publication for the Upper North Bosque River HUA Project in 1999 (page 9) relating to new and innovative technologies for waste management treatment.

Program Element 5: Reports indicating alternatives based on conclusions on monitoring results. Model results utilized to indicate wastewater contaminates prior to BMPs and after installation of BMPs. Quarterly reports and final report summarizing data, producer acceptance, and alternatives.

See Appendix E.

- NRCS project staff met with TIAER on October 31, 1995 to adapt EPIC and APEX computer models to actual and differing scenarios on the wetland site.

- On April 1, 1996 NRCS staff installed a weather station on the waste system lagoon to measure, record, and submit weather data to TIAER and NRCS. Local NRCS project staff will download the weather station at the site monthly.

- QAPP was signed and approved by EPA on June 6, 1997. QAPP was received by TSSWCB on June 12, 1997,

- Water samples were taken and analyzed by TIAER at the constructed wetland site on the following dates:

  April 24, 1997, Initial sampling
  May 7, 1997, Routine sampling
  May 21, 1997, Sampling from lagoon
  June 7, 1997, Routine sampling
  July 24, 1997, Routine sampling
  August 7, 1997, Routine sampling
  August 20, 1997, Routine sampling
  September 3, 1997, Routine sampling
  September 18, 1997, Sampling from lagoon, storage pond, and three cells
  September 30, 1997, Sampling from lagoon, storage pond and two cells

Note: The dairy herd was sold on July 17, 1997 before completion of the monitoring period, but water analysis from the constructed wetland site indicates an improvement in water quality for most of the constituents tested.

Program Element 6: A report summarizing the expected economic feasibility of implementing a constructed wetland as a component of an animal waste management system, and requests by dairy producers on how to utilize this technology on their dairies.

Steve O'Bryan developed a harvesting platform in the wetland cells. A drying and weighing site was developed for duckweed at Tarleton State University. Duckweed was harvested from the cells and nutrient analysis was conducted. The duckweed analysis indicated 35 percent crude protein.

The dairy herd was sold on July 17, 1997 before this program element could be completed.
All tasks for the constructed wetland project were completed with the exception of this activity. The dairy producer secured a nutritional computer program to utilize for feed adjustment, for the economic component of the project in June 1995. A harvesting platform was developed in the wetland cells and protein analysis was conducted in June 1997. Economic feasibility testing of the production of a protein source could not be completed because of the retirement of the producer.

Appendix A

DATE 1/12/95 TIME 0800

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
239 E. McNEILL STEPHENVILLE, TEXAS 76401

UPPER NORTH BOSQUE RIVER HYDROLOGIC UNIT AREA

PHONE # (817-965-3213)
FAX # (817-965-2492)

FAX COVER SHEET
TOTAL OF PAGES INCLUDING COVER PAGE 4

TO: Linnie Winkleman TSSWCB PHONE/FAX #: 817 773 3311

INSTRUCTION: Here is a Fax Copy of the report for 319 Project on the Constructed Wetland.

Any questions or Comments - Plse advise -

FROM: Jack L. White
Upper North Bosque River HUA
Program Manager
NRCS, Stephenville

DEMONSTRATION of WASTE MANAGEMENT SYSTEM UTILIZING CONSTRUCTED WETLANDS

Task 1: Project Coordination and Management

Task 1.1 Conduct initial meeting of involved parties.
(Milestone date August 1, 1994)
(100% complete)

- June 20, 1994, a meeting was held with EPA, TSSWCB and NRCS to determine agency responsibility for the project. NRCS State Office engineering staff agreed to provide design assistance for the waste management system. Final design completion date anticipated by February 1, 1995.

- June 23, 1994, a field tour was conducted of the participating agencies on the O'Bryan Dairy which was selected as the demonstration site.

- June 29, 1994, I met with the dairy owners to finalize criteria for the project to determine final interest. They were willing to participate and provide monies for their part of the project funding.

Task 1.2 Report to interested parties.

Task 1.3 Conduct interim meetings of involved and interested parties as needed.

Task 1.4 Contract administration.

Task 2: System Planning and Design
(Milestone date December 1, 1994)

Task 2.1 Plan and design a water quality management system.

- July 7, 1994, a field survey was initiated and completed for topographic information for designing. TSSWCB's Dublin Regional Office, Stephenville and Comanche Field Office NRCS staff along with Jack White, Stephenville Area Office NRCS Staff participated in the field survey.

- July 12, 1994, topographic information was sent to the State Office for map generation.

- July 19, 1994, Area Soil Scientist, James Greenwade conducted a preliminary exploration of the soils information on the demonstration site and provided a report of the findings.

- December 7, 1994, a soils investigation was conducted by James Greenwade, Area Soil Scientist, Jerry Walker, Water quality engineer and myself of the excavation points for the lagoon, waste storage pond and wetland cells. Soil samples sent to NRCS Regional Technical Center soils laboratory in Ft. Worth for analysis.

- December 18, 1994, I contacted the Apache Landscape Service for input and consideration of selecting aquatic plants for wetland cells.

Visits, phone conversations and mailings, to numerous to mention, were conducted throughout the design period to determine the dairy producers ideas and personal preference.
(90% complete)

Task 2.2 Review BMP selection:

- July 20, 1994. I met with Lloyd and Gloria O'Bryan and AgPro manure handling sales representative. I provided AgPro with topographic information for use in determining a bid price for a flush system and mechanical separator.
- August 9, 1994. I received drawings and cost estimate from AgPro. Reviewed manure handling bid with the O'Bryans.
- October 3, 1994. I met with Lloyd and Gloria O'Bryan to review BMP selection with regards to the use of AgPro Mechanical solid separator.
- November 17, 1994, I met with the O'Bryan and Alpha DeLaval to determine use of their product for manure separation.
- November 20, 1994. I met with the O'Bryan and Alpha DeLaval to review quote for manure handling system.
- December 10, 1994, I met with the O'Bryans and Alpha DeLaval for final design and construction cost.

(100% complete)

Task 2.3 Review completed design.
(Completion date January 20, 1995)

Task 2.4 Submit water quality management plan to TSSWCB for certification.

- July 19, 1994, I submitted the O'Bryan Dairy Water Quality Management Plan (WQMP) to the NRCS Field Office for processing and concurrence of the Upper Leon SWCD and TSSWCB. (100% complete) Recently, producer purchased additional land. WQMP needs revising.

(75% complete)

Task 2.5 Design report submitted to EPA.
(Completion date March 1, 1995)

Task 3: Construction of the System
(Completion date September 1, 1995)

Task 3.1 - Establish which BMP's will be used.
(100% complete)

December 1, 1994. BMP consideration completed and design targeted for concurred BMP's. Delays regarding BMP selection were due to private companies attempting to sell their systems to producer for demonstration and advertisement.

Task 3.2 - Solicit construction contractors bids.
(Completion date March 1, 1995)

Task 3.3 - Award contract for installation and vegetation.
(Completion date March 1, 1995)

Task 3.4 - Construct and certify waste management components.
(Completion date September 1, 1995)

Task 4: Technology Transfer

Task 4.1 - Utilize news media to disseminate information on the project.

- 2 news paper articles were published in the Dublin Citizen and the Stephenville Empire Tribune on November 24 and 28 respectively. Texas Dairy Review magazine published an article in the December issue, also. The Country World magazine is scheduled for an article in January's issue out of Sulphur Springs.

Task 4.2 - Conduct 2 field days open to the public, demonstrating progress and results of the demonstration dairy.

Task 5: Water Quality Monitoring

(Completion date May 1, 1997)

Task 5.1 - Establish monitoring sites at locations to accurately capture and assess nutrient runoff loading.

- Tarleton Institute For Applied Environmental Research (TIAER) submitted a cost estimate for water quality sampling and laboratory analysis for the duration of the project.

(Completion date November 1, 1995)

Task 5.2 - Utilize updated data in model predictions to evaluate movement of nutrients under different management scenarios.

(Completion date May 1, 1997)

Task 5.3 - Monitor nutrient loadings entering/exiting constructed wetland field.

(Completion date May 1, 1997)

Task 6: Economic Feasibility Testing

(Completion date May 1, 1997)

Task 6.1 - Record weights of cattle at beginning of project.

- Producer has purchased a nutritional computer program for use in the project. O'Bryan's son will use computer program and documented analysis for production of his Master's Thesis at Tarleton State University.

(Completion date May 1, 1997)

Task 6.2 - Harvest plants grown in wetland and utilize feedstock in rations fed to cattle.

Task 6.3 - Record weight change of cattle periodically.

- O'Bryan has purchased a set of scales for use in cattle weighing to determine weight changes of test cattle.

Task 6.4 - Summarize the effectiveness of utilizing feedstock from Wetland in dairy rations.

(Completion date May 1, 1997)

DATE 31 MAR 95 TIME _____

UNITED STATES DEPARTMENT OF AGRICULTURE | NATURAL RESOURCES CONSERVATION SERVICE | 239 E. McNEILL STEPHENVILLE, TEXAS 76401

UPPER NORTH BOSQUE RIVER HYDROLOGIC UNIT AREA

PHONE # (817-965-3213)
FAX # (817-965-2492)

FAX COVER SHEET
TOTAL OF PAGES INCLUDING COVER PAGE 3

TO: Lennie Winkelman TSSWCB PHONE/FAX #: 817 773 3311

INSTRUCTION: 319 Project — Constructed Wetland — Progress Report for "new" reporting period on Federal FY Quarters.

FROM: Jack L. White
Upper North Bosque River HUA
Program Manager
NRCS, Stephenville

DEMONSTRATION of WASTE MANAGEMENT SYSTEM UTILIZING
CONSTRUCTED WETLANDS
(FOR THE PERIOD JANUARY 1 - MARCH 31, 1995)

Task 1: Project Coordination and Management

Task 1.1 Conduct initial meeting of involved parties.
(Milestone date August 1, 1994)
(100% complete)

Task 1.2 Report to interested parties.

- January 12, I provided a quarterly report to TSSWCB indicating progress of Project.
- February 7, I provided Petra Sanchez, EPA, copies of 3 published news articles and a copy of the roster of January 31 meeting for information.

Task 1.3 Conduct interim meetings of involved and interested parties as needed.

- January 31, Conducted a meeting and field tour of Project site with EPA/TSSWCB/NRCS. Others present were TAEX, TIAER, SWCD's and UTA.

Task 1.4 Contract administration.
(Milestone date June 1, 1994)

Task 2: System Planning and Design
(Milestone date March 1, 1994)

Task 2.1 Plan and design a water quality management system.

- Jerry Walker and Jerry Stanford met with the O'Bryans on January 24 to finalize design. Design to be set for contract development.

(90% complete)

Task 2.2 Review BMP selection:
(100% complete)

Task 2.3 Review completed design.
(Completion date April 15, 1995)

Task 2.4 Submit water quality management plan to TSSWCB for certification. (75% complete)

Task 2.5 Design report submitted to EPA/TNRCC.
(Completion date May 1, 1995)

Task 3: Construction of the System
(Completion date September 1, 1995)

- Although not covered for demonstration under this 319 project, the producer has secured cost share funds through SB503 TSSWCB for other conservation practices. These practices will be utilized as part of the overall dairying enterprise. The following conservation practices have been completed under SB502 funding: Brush Management, Waterway shaping, and leveling old terraces. Scheduled for completion are establishment of vegetative cover on 50 acres of old cropland fields and waterway, pipeline, troughs, and fencing. Producer has secured contracting bids for the installation of an Irrigation System, pump and pipeline. Additionally, producer has completed grading and shaping of confined pen area to provide a more positive drainage to the 319 waterway.

Task 3.1 - Establish which BMP's will be used.
(100% complete)
Task 3.2 - Solicit construction contractors bids.
(Completion date April 15, 1995)
- February 22, I contacted a representative of the Texas Excavation Contractors Association for interest in construction of the system. A meeting of the Contractors Association is scheduled for Dublin in March or April to view the prospective site.
Task 3.3 - Award contract for installation and vegetation.
(Completion date May 1, 1995)
Task 3.4 - Construct and certify waste management components.
(Completion date September 1, 1995)

Task 4: Technology Transfer

Task 4.1 - Utilize news media to disseminate information on the project.
- The Country World Magazine (Sulphur Springs) published an article in January's issue.
- Farm Futures Magazine (Wisconsin) completed a news article on the project and other items for publication in February.
- February 1, Began preparations for development and purchase of a sign board to be erected at the entrance to the Project site.
- February 14, Met with Petra Sanchez and Carl Hutcherson (NRCS) on plans and format for the sign board.
- Slides, color photographs and video has started and will be on-going throughout duration of project.
Task 4.2 - Conduct 2 field days open to the public, demonstrating progress and results of the demonstration dairy.

Task 5: Water Quality Monitoring
(Completion date May 1, 1997)
Task 5.1 - Establish monitoring sites at locations to accurately capture and assess nutrient runoff loading.
(Completion date November 1, 1995)
Task 5.2 - Utilize updated data in model predictions to evaluate movement of nutrients under different management scenarios.
(Completion date May 1, 1997)
Task 5.3 - Monitor nutrient loadings entering/exiting constructed wetland field.
(Completion date May 1, 1997)

Task 6: Economic Feasibility Testing
(Completion date May 1, 1997)

Task 6.1 - Record weights of cattle at beginning of project.
(Completion date May 1, 1997)
Task 6.2 - Harvest plants grown in wetland and utilize feedstock in rations fed to cattle.
Task 6.3 - Record weight change of cattle periodically.
Task 6.4 - Summarize the effectiveness of utilizing feedstock from Wetland in dairy rations.

DEMONSTRATION of WASTE MANAGEMENT SYSTEM UTILIZING
CONSTRUCTED WETLANDS
(FOR THE PERIOD APRIL 1 - JULY 1, 1995)

Program Element 1: Project Coordination and Management

Since Project inception, numerous meetings, conferences and consultations have been provided. Companies interested in project parameters contacted me and/or the O'Bryans to promote and demonstrate various products and theories directed toward water quality and this project. All products and systems were considered and in consultation with the O'Bryans, most were denied. The O'Bryans were very instrumental in considering all options for design criteria while spending long personal hours contemplating alternatives. The involvement of the constructed wetland component, on a dairy, is not known in Texas, as far as aquatic plant growth, harvesting and feeding. The O'Bryans and myself discussed the wetland process at length pursuing any individual or company who may possess a working knowledge or expertise of aquatic plant characteristics. Lloyd and Gloria O'Bryan posses the enthusiasm and motivation to make this project a useful, workable and profitable project. All parties that have dealt with the O'Bryans have left with a positive attitude.

Task 1.1 Conduct initial meeting of involved parties.
(June 23, 1994 - TSSWCB, EPA, NRCS)
(September 26, 1994 - TIAER)
(100% complete)

Task 1.2 Report to interested parties.
- April 1, I provided the required quarterly report to the TSSWCB indicating progress of Project.
- June 30, 1995, I provided this quarterly report to TSSWCB and NRCS.

Task 1.3 Conduct interim meetings of involved and interested parties as needed.
- Meetings with the O'Bryan's were conducted on numerous occasions throughout the planning and designing process to develop and finalize plans for Project development. The O'Bryans are keeping a communication log of individuals that have contacted and talked about the project. This documentation is a part of their contribution to the project.
- April 12, 1995, Dr. Andrew Kruzic, University of Texas at Arlington submitted a proposal to utilize a wastewater treatment system utilizing Zeolite as a treatment amendment. Project criteria are being investigated and awaiting final decision.
- May 1, 1995, Met with Texas Association of Dairymen at Hico, to discuss NRCS activities in the Upper North Bosque River. The O'Bryan Constructed Wetland was emphasized as an important project under development.
- June 12, 1995, I provided a copy of the final waste management plan including the constructed wetland component to Larry Hauck of Texas Institute For Applied and Environmental Research (TIAER) showing layout and location of constructed wetland components. This will be used to align monitoring activities.

- June 13, 1995, I provided a copy of the final design to Dan Hayes, Engineer with the TSSWCB Dublin Regional Office and discussed the components to be installed.

Task 1.4 Contract administration.
- April 26, 1995, Draft Operation and Maintenance plan sent to O'Bryan for review and comment.

Activities Planned for July 1 - September 30, 1995:
1. Complete Operation and Maintenance plan.
2. Review and sign contract between TSSWCB and NRCS.
3. Review and sign contract between NRCS and TIAER.
4. Provide quarterly reports to TSSWCB and NRCS on project activities and progress.

Program Element 2: System Planning and Design
(Milestone date March 1, 1994)
(100% Competed)

Prior to project inception, the O'Bryans requested an animal waste management design for their dairy. Since project initiation, the O'Bryans worked with design engineer, Jerry Walker, on every aspect of the design and were required to make difficult decisions accordingly. They were instrumental in deciding appropriate Best Management Practices to install.

Task 2.1 Plan and design a water quality management system.
- Jerry Walker and the Temple State Office Engineering staff successfully completed design work of the Project.
(May 23, 1995)
(100% complete)

Task 2.2 Review BMP selection:
(April 12, 1995)
(100% complete)

Task 2.3 Review completed design.
- May 23, 1995, The waste management plan was completed. The plan was reviewed at the Pre-Bid Conference held in Dublin.
(100% Complete)

Task 2.4 Submit water quality management plan to TSSWCB for certification.
- June 7, 1995, A completed copy forwarded to TSSWCB in Temple.
(100% complete)

Task 2.5 Design report submitted to EPA/TNRCC.
- June 7, 1995, A completed design was forwarded to EPA for information.
- June 7, 1995, A completed design was forwarded to Texas Natural Resources Conservation Commission for information.
(100% complete)

PROGRAM ELEMENT 2 IS COMPLETED AS OF JUNE 7, 1995.

Program Element 3: Construction of the System
(Construction completion date scheduled for October 1, 1995)
(Vegetation completion date scheduled for Spring 1996)

- Although not covered for cost sharing under 319(h), the O'Bryans have secured cost share funds through SB503 for other conservation practices. These practices are utilized in conjunction with the overall dairying enterprise. The following conservation practices were completed under SB503 funding: Brush Management, waterway shaping, vegetation and fertilization, leveling old terraces and establishment of vegetative cover on 50 acres of cropland fields. Scheduled for completion in 1995 are pipeline, troughs, and fencing. Producer has secured contracting bids for installation of an Irrigation System, pump and pipeline, to be installed in 1995. Additionally, the O'Bryans completed shaping of the confined pen area to provide drainage to the 319(h) Waterway. A 32 foot, 12,000 gallon water storage and flush valve was purchased as part of the feedlane flushing system. Shading for livestock will be completed, in 1995, to entice cattle closer to the feedlane. This part of the system is to effectively manage manure in a smaller, less confined area.

Task 3.1 - Establish which BMP's will be used.

Through numerous meetings, one-on-one conferences and phone conversations, Mr. and Mrs. O'Bryan decided on BMP's to incorporate into the overall dairy system.

(100% complete)

Task 3.2 - Solicit construction contractors bids.
(Completion date June 23, 1995)

- April 19, 1995, Pre-Solicitation Notice, Project No. SCS-8-TX-95 was submitted to extend an invitation for bidding the Constructed Wetland Project.
- April 25, 1995, CBD received Solicitation No. SCS-8-TX-95.
- May 4, 1995, Floyd A. Taylor, Civil Engineering Technician and Jack L. White, Program Manager viewed the construction site for information and familiarization.
- May 8, 1995, Tom Beach, Contracting Officer Technical Representative and Floyd A. Taylor, visited the site for familiarization.
- May 10, 1995, Floyd A. Taylor, Salvador Abreo, Construction Inspector, Victor Rice Surveying Technician, and Adam Rangel, Surveying Technician staked the construction site for site showing.
- May 10, 1995, Issued Invitation For Bid.
- May 11, 1995, Tim Buscha, Civil Engineer, Salvador Abreo, Construction Inspector, Victor Rice, and Adam Rangel completed staking the construction site for site showing.
- May 22, 1995, Salvador Abreo and Robert Gehrels marked clearing and grubbing boundaries for site showing.
- May 23, 1995, A Pre-Bidding Conference was held in the First National Bank Conference Room, in Dublin, to review the design and tour the construction site. A total of 15 individuals or firms were present for the conference, as was Lloyd O'Bryan.
- May 26, 1995, An amendment of Solicitation was issued reflecting changes of the May 23rd Pre-Bid Conference.
- June 9, 1995, 2:00 pm final date for bid presentation.

(100% Complete)

Task 3.3 - Award contract for installation and vegetation.

- June 9, 1995, At 2:00 pm, 4 bids were received and opened. Bids ranged from $188,956.25 to $326,679.50. 1 contractor was present at the bid opening. Apparent low bidder was noted and will not be accepted as low bidder until contractor satisfies portions in the bid package.

(Completion date July 15, 1995)
(90% Complete)

Task 3.4 - Construct and certify waste management components.

(Completion date October 11, 1995)
(5% Complete)

Activities Planned for July 1 - September 30, 1995:

1. Award formal contract to apparent low bidder.
2. Commence formal contract obligations to install the animal waste management system and Constructed Wetland.

Program Element 4: Technology Transfer

Photographic development depicting "before" project initiation was done and is continuing as the project unfolds and develops. Although not specified by date, slides are being taken showing before, during and eventually after project development. NRCS Public Affairs Specialist will assist in the development of a poster display using photos of the project as it progresses.

Task 4.1 - Utilize news media to disseminate information on the project.

- March 30, 1995, Provided booth display at the Comanche County Dairy field Day where water quality information and the O'Bryan Constructed Wetland Project was presented.
- April 24, 1995, the Hydrologic Unit Project brochure was updated and utilized at informational gatherings indicating the proposed Constructed Wetland project as a forthcoming project of significance.
- May 1, 1995, I made a presentation to the Texas Association of Dairymen meeting concerning NRCS activities and the involvement of the 319(h) program and SB503 with reference to the O'Bryan Constructed Wetland Project. 24 in attendance. Mayors of Waco and Clifton, State Representatives, Chambers of Commerce from Waco and Clifton, dairy producers and State and Federal agency personnel attended the meeting.
- May 1, 1995, received quote for development of sign board to be erected at the entrance to the Project site. Initiation of sign development or completion will not be made until clearance of the contractor. A "Ground Breaking" ceremony is planned with all agencies and interested public participants after contractor acceptance. News coverage is slated for attendance from Dublin Citizen, Stephenville Empire Tribune, Texas Dairy Review and Waco Tribune Herald.
- May 26, 1995, Contacted Edwin Fitzgerald Flying Service to commence aerial coverage of Project site. Aerial photos will be obtained and as construction commences and depending upon speed of awarded contractor, aerial coverage will be at least once per week throughout the construction period.
- June 7, 1995, Edwin Fitzgerald successfully completed aerial photography of the Project site and film was processed.

- June 6, 1995, Worked with Gail Chandler, NRCS Public Affairs Specialist, Temple to develop and conduct a 6th grade water quality classroom at the O'Bryan Dairy. Classroom scheduled for April 1996.

- June 7, 1995, I conducted a field and design review of the constructed wetland project with Andy Kilpatrick, Waco Tribune Herald Newspaper, Amy Kinney, Dr. Bruce Lesikar, Dr. Joe McFarland, Dr. Forest Mitchell with Texas Agricultural Extension Service and Texas Agricultural Experiment Station, Gail Chandler and Ronnie Boston, Natural Resources Conservation Service. (8 in attendance.) Additional visits are planned for feature article development during the construction phase of the project. Received copy of news article published June 12 and was sent to TSSWCB, EPA and NRCS for information. Additional copies delivered by TAEX to College Station and Stephenville Resident Director.

- June 12, 1995, Stephenville Empire Tribune developed a feature article for Dairy Day. The articled featured the Constructed Wetland as a component to the waste management system.

- June 15, 1995, I visited with Dale Bullock, District Conservationist in Mississippi to coordinate a tour scheduled for August 22, 1995. A group of Commissioners, Farm Bureau and dairy owners will tour Erath County to visit the Constructed Wetland Project and other dairy operations.

- June 19, 1995, Met with Kirby Frye, Fossil Rim Wildlife Refuge, Glen Rose, Texas on the use of Constructed Wetlands to treat exotic animal waste in the park area. The use of filter strips and constructed wetland pond(s) could have applicability to the exotic wildlife farm. Attendees were Kirby Frye, Wildlife Refuge Manager, Dr. Forest Mitchell TAES, Amy Kinney, TAEX, Ronnie Boston, Leon-Bosque RC&D and myself.

- June 23, 1995, Amy Kinney and myself met with Ronnie Boston, RC&D, Kirby Frye and Inger Myher to visit the potential Constructed Wetland sites. Potential site has similar characteristics to the O'Bryan in that 3000# Rhinos are washed daily and the rinsate allowed to flow toward the water course.

- June 27, 1995, Met with Dr. Andy Kruzic and Dick Smith on the O'Bryans for demonstration of Zeolite on overland flow and de-nitrification of the aquatic cells. Demonstration will be initiated in April 1996. Systems and products donated to the Project.

- June 28, 1995, Met with Amy Kinney, TAEX, Tom Goff and Lance Frazier of Native Environmental Services for use of enzymes in effluent. A 4 month study using enzymes will be undertaken. All products and services donated to the Project.

Task 4.2 - Conduct 2 field days open to the public, demonstrating progress and results of the demonstration dairy.

Activities Planned for July 1 - September 30, 1995:

1. Order Project sign for Constructed Wetland showing key players.
2. Erect Project sign at entrance of construction site.
3. Provide weekly to biweekly aerial coverage during Project construction.

4. O'Bryans will commence their portion of the Project installing the flush tank and flush valve, extending the feedlane, provide temporary fencing around work site, install shades and locate troughs under shades, permanent fencing, livestock pipelines, troughs, pumping plant and irrigation system.
5. Commence development of poster board depicting sequence of events.
6. Develop slide presentation to be duplicated and sound added.
7. Conduct 1 field day during later part of construction to interested persons, news medias and agency personnel.

Program Element 5: Water Quality Monitoring
(Completion date May 1, 1997)

Task 5.1 - Establish monitoring sites at locations to accurately capture and assess nutrient runoff loading.
- June 12, 1995, I provided a copy of the final waste management plan including the constructed wetland component to Larry Hauck showing layout of constructed wetland components.
(Completion date November 1, 1995)

Task 5.2 - Utilize updated data in model predictions to evaluate movement of nutrients under different management scenarios.
(Completion date May 1, 1997)

Task 5.3 - Monitor nutrient loadings entering/exiting constructed wetland field.
(Completion date May 1, 1997)

Activities Planned for July 1 - September 30, 1995:
1. Install weather station.
2. Begin preliminary monitoring data.
3. Review and complete criteria for monitoring and secure contract from TIAER.

Program Element 6: Economic Feasibility Testing
(Completion date May 1, 1997)
- June 1, 1995, producer O'Bryan has secured a Nutritional Computer Program to utilize for feedstuff adjustment through the project. The Tarleton State University has offered O'Bryan's son, Steve, the use of the laboratory to run plant chemistry on selected feedstuffs from the wetland cells.

Task 6.1 - Record weights of cattle at beginning of project.
(Completion date May 1, 1997)

Task 6.2 - Harvest plants grown in wetland and utilize feedstock in rations fed to cattle.

Task 6.3 - Record weight change of cattle periodically.

Task 6.4 - Summarize the effectiveness of utilizing feedstock from Wetland in dairy rations.

Activities Planned for July 1 - September 30, 1995:

UNITED STATES
DEPARTMENT OF
AGRICULTURE

NATURAL RESOURCES
CONSERVATION
SERVICE

239 E. McNEILL
STEPHENVILLE, TEXAS
76401

UPPER NORTH BOSQUE RIVER HYDROLOGIC UNIT AREA PROJECT

October 2, 1995

To: Dee Carlson
Texas State Soil and Water Conservation Board
Temple, Texas 76501

Re: EPA 319 Quarterly Report (Constructed Wetland) and Phase II

Attached, please find the Constructed Wetland Project and Phase II quarterly report on the O'Bryan Dairy. The reporting period is from July 1 through September 30, 1995.

Any questions, please advise.

Jack L. White

Jack L. White
Program Manager
Upper North Bosque River HUA
NRCS, Stephenville

cc: Dick Babcock, ASC, NRCS, Temple
Allan Colwick, WQC, NRCS, Temple

DEMONSTRATION of WASTE MANAGEMENT SYSTEM UTILIZING
CONSTRUCTED WETLANDS
and
PHASE II

(FOR THE PERIOD JULY 1 - SEPTEMBER 30, 1995)

PROGRAM ELEMENT 1: PROJECT COORDINATION and MANAGEMENT

Task 1.1 Conduct initial meeting of involved parties.
(June 23, 1994 - TSSWCB, EPA, NRCS)
(September 26, 1994 - TIAER)
(100% complete)

Task 1.2 Report to interested parties.

- August 14, 1995 - Made report to Natural Resources Conservation Service (NRCS) State Office for In-Kind and actual cash expenditures to be forwarded to TSSWCB for documentation.
- September 30, 1995 - Made quarterly report to Texas State Soil and Water Conservation Board (TSSWCB) and NRCS State Office.

Task 1.3 Conduct interim meetings of involved and interested parties as needed.

- June 30, 1995. Lloyd and Gloria O'Bryan, owners, Bo Spoonts, Suzanne Cardwell, Dee Carlson, TSSWCB, Alan Colwick and Jack White, NRCS, met to review In-Kind criteria and documentation required for reporting.

Task 1.4 Contract administration.

- July 7, 1995. Reviewed final draft of Memorandum of Understanding and Contract to Texas Institute for Applied Environmental Research (TIAER) for monitoring responsibilities. Contract for monitoring will be developed for contract period.

Activities Planned for October 1- December 31, 1995:
- October 3, 1995 - Submit quarterly report.
- October 1995 - submit current In-Kind and cash expenditures for documentation and progress.

PROGRAM ELEMENT 2: SYSTEM PLANNING and DESIGN
(Milestone date March 1, 1994)
(100% Competed)

Task 2.1 Plan and design a water quality management system.
(May 23, 1995)
(100% complete)

Task 2.2 Review BMP selection:
(April 12, 1995)
(100% complete)

Task 2.3 Review completed design.
(May 23, 1995)
(100% Complete)

Task 2.4 Submit water quality management plan to TSSWCB for certification.
(June 7, 1995)
(100% complete)
Task 2.5 Design report submitted to EPA/TNRCC.
(EPA - June 7, 1995)
(TNRCC - June 7, 1995)
(100% complete)

PROGRAM ELEMENT 2 IS COMPLETED AS OF JUNE 7, 1995.

PROGRAM ELEMENT 3: CONSTRUCTION OF THE SYSTEM
(Milestone date November 1995)

Task 3.1 - Establish which BMP's will be used.
(100% complete)
Task 3.2 - Solicit construction contractors bids.
(June 23, 1995)
(100% Complete)

Task 3.3 - Award contract for installation and vegetation.

- July 10, 1995 - Roy Huffstutler, from Comanche, was awarded contract for project construction.
- July 20, 1995 - Met with Roy Huffstutler, Watershed construction crew and Lloyd O'Bryan on Pre-Construction conference.

(100% Complete)

Task 3.4 - Construct and certify waste management components.

- August 8, 1995 - Roy Huffstutler commenced construction activities. Began construction waste storage pond.
- August 15, 1995 - Installed filter fabric silt fences around construction site.
- August 18, 1995 - Began construction of wetland cells.
- August 31, 1995 - Completed construction of waste storage pond and topsoil spoil area. Began installation of waste storage pond liner.
- September 5, 1995 - Completed waste storage pond liner placement.
- September 6, 1995 - Liner test was performed for waste storage pond liner certification.
- September 8, 1995 - Commenced dewatering existing lagoon; pumping wastewater and sludge to adjacent and designated fields.

Note: For a period of two weeks from September 11 - September 22, a total of 5.9" of rain fell on project hampering operations and progress.

- September 16, 1995 - Began construction of waste treatment lagoon.
- September 20, 1995 - Began construction of waterways.
- September 26, 1995 - Began installation of recycle pipeline from waste storage pond to flush tank.
- September 27, 1995 - Waste treatment lagoon near completion.

- September 27, 1995 - Flush tank installed by owner.
(45% Complete)

Activities Planned for October 1- December 31, 1995:
- November 1995 - complete construction and certify system.

PROGRAM ELEMENT 4: TECHNOLOGY TRANSFER

Task 4.1 - Utilize news media to disseminate information on the project.

- July 10, 1995 - I ordered sign for the "Dedication" ceremony.
- July 14, 1995 - Received sign for Dedication.
- August 14, 1995 - Edwin Fitzgerald, C&F Aviation commenced aerial coverage of the construction site on a weekly basis.
- August 15, 1995 - Completed news article and delivered to The Stephenville Empire Tribune, Dublin Citizen, Country World and Texas Dairy Review for publication. NRCS Public Affairs will contact television network for coverage.
- August 29, 1995 - News article from Stephenville Empire Tribune was published.
- September 1995 issue of the Texas Dairy Review magazine, published a news article on the Dedication ceremony.

Task 4.2 - Conduct 2 field days open to the public, demonstrating progress and results of the demonstration dairy.

- July 22, 1995 - Provided tour hosting Mississippi participants for their Conservation tour. (34 People present).
- August 11, 1995 - Upper Leon and Cross Timbers SWCD completed letter of invitation to the Dedication Ceremony to be held on August 28, 1995. Letters mailed this date.
- August 28, 1995 - Held "Dedication" ceremony and toured construction site with agency personnel and the general public. (41 in attendance).
- September 15, 1995 - hosted field and progress tour of the constructed wetland site with 5 members of TSSWCB.
(50% Complete)

Activities Planned for October 1- December 31, 1995:
- Complete second scheduled field day of finished system.

PROGRAM ELEMENT 5: WATER QUALITY MONITORING
(Completion date May 1, 1997)

Task 5.1 - Establish monitoring sites at locations to accurately capture and assess nutrient runoff loading.

- July 10, 1995 - Received Cooperative Agreement to TIAER for monitoring.
(Completion April 1996)
(10% Complete)

Task 5.2 - Utilize updated data in model predictions to evaluate movement of nutrients under different management scenarios.
- September 13, 1995 - Jack White visited and expressed concerns to the Blackland Research Center using EPIC or APEX for model predictions.

(Completion date May 1, 1997)

Task 5.3 - Monitor nutrient loadings entering/exiting constructed wetland field.

(Completion date May 1, 1997)

Activities Planned for October 1- December 31, 1995:
- December, 1995 - Commence preliminary (benchmark) effluent testing of milking center wastewater.

PROGRAM ELEMENT 6: ECONOMIC FEASIBILITY TESTING
(Completion date May 1, 1997)

Task 6.1 - Record weights of cattle at beginning of project.

Task 6.2 - Harvest plants grown in wetland and utilize feedstock in rations fed to cattle.

Task 6.3 - Record weight change of cattle periodically.

Task 6.4 - Summarize the effectiveness of utilizing feedstock from Wetland in dairy rations.

Activities Planned for October 1- December 31, 1995:

DEMONSTRATION of WASTE MANAGEMENT SYSTEM UTILIZING
CONSTRUCTED WETLANDS
and
PHASE II

(FOR THE PERIOD OCTOBER 1 - DECEMBER 31, 1995)

PROGRAM ELEMENT 1: PROJECT COORDINATION and MANAGEMENT

Task 1.1 Conduct initial meeting of involved parties.
(June 23, 1994 - TSSWCB, EPA, NRCS)
(September 26, 1994 - TIAER)
(100% complete)

Task 1.2 Report to interested parties.
- December 07, 1995 - Jack White talked to Melissa Burns, TSSWCB and informed of Project construction completion. Video field day will be scheduled for February.
- December 07, 1995 - Jack White talked to Carl Hutcherson advising of Project construction completion. Carl will relay progress to EPA - NPS Manager.

Task 1.3 Conduct interim meetings of involved and interested parties as needed.
- October 10, 1995 - Jack White made presentation of Project activity to the Dublin Concerned Citizens meeting. I handed out pamphlets and answered questions concerning the O'Bryan project and other water quality issues. (8 present).
- October 11, 1995 - Jack White and Amy Kinney made a Project presentation at the Hico Civic Club luncheon. We discussed the Projects on-site wastewater treatment systems and the O'Bryan Constructed Wetland Project. (24 present).
- October 17, 1995 - Jack White selected and ordered aerial and ground photos for enlargement for display and promotion.
- October 19, 1995 - Jack White ordered duplicate slides for Jerry Walker to use in his presentation at the ASAE meeting on October 31, 1995.
- October 19, 1995 - Jack White and Stephenville District Conservationist, Randy Moore reviewed Project site and accomplishments. Moore ordered seed for Project vegetation.
- October 24, 1995 - TNRCC Commissioner, Ralph Marquez reviewed Project site with Joe Pope Erath County Extension Agent.
- October 27, 1995 - I received conformation, Dr. Andy Kruzic's Zeolite demonstration was funded. Dr. Kruzic will use the demonstration on the lower edge of waste treatment lagoon for nitrogen utilization. Water quality data will be collected by TIAER.
- November 06, 1995 - Jack White reviewed and discussed O'Bryan Project with Melissa Burns, TSSWCB. A news article to follow in December.
- November 1[illegible], 1995 - 27 members from Tarleton State University agriculture class visited the Project site.
- November 27, 1995 - Jack White and Amy Kinney reviewed Project site with Harold Stone, and Frank Hazen, TIAER, to develop a plan of action for [illegible] of the constructed wetland projects.

- November 30, 1995 - Jack White and Amy Kinney reviewed Project site with Dr. Ann Kenimer, TAMU Agricultural Engineering Department, Paul DuBowy, TAMU Wildlife and Wetland Ecology, Ric Jensen, TWRI, Nancy Cole TAEX Horticulture, Ben Wo, TAMU and Craig Idol, TAEX. Paul DuBowy indicated O'Bryan Dairy will be toured at the 2nd National Workshop "On The Use Of Constructed Wetlands For Animal Waste Management" in May 1996.

- December 01, 1995 - Jack White toured Project site with Dr. Andy Kruzic, UTA, Dick Smith, retired EPA engineer and Larry Hauck, TIAER on Kruzic's overland flow demonstration. TIAER will collect water sample next week for preliminary analysis and submit results to Kruzic and myself for information.

- December 06, 1995 - Jack White provided tour information and guidance to Tarleton State University Dairy Science class under the direction of Dr. Tim Brown. 18 present.

- December 07, 1995 - Jack White provided tour information and guidance to Tarleton State University Dairy Science class under the direction of Dr. Tim Brown. 7 present.

- December 08, 1995 - Jack White and Amy Kinney toured Project site with Jenifier Bradley, TAMU horticulturist. Jenifier will advise operators on aquatic plant habitat in New Mexico. She will also produce a "How to" factsheet for state-wide distribution.

Task 1.4 Contract administration.

- November 16, 1995 - Jack White, Tom Beach, Dennis Clute, Floyd Taylor, Lloyd O'Bryan and Roy Hufstutler performed the check prior to final inspection. Minor items noted and submitted to Roy for completion.

- December 01, 1995 - Tom Beach and Floyd Taylor met with Roy Hufstutler, Contractor for modification to Project.

- December 04, 1995 - Jack White talked to James Alderson about wetland cell species and companies that sell and plant wetland cells. TSSWCB will plant wetland cells with approved species.

- December 06, 1995 - Jack White contacted 4 aquatic plant representatives for catalog, available plant species, and cost. Requested recommendations for same.

- December 06, 1995 - Jack White reordered O'Bryan Demonstration sign that was damaged during a wind storm.

- December 07, 1996 - Jack White, Tom Beach, Alan Colwick, James Stautzenberger, Floyd Taylor, Lloyd O'Bryan, Randy Moore and Roy Hufstutler performed the "Final" inspection of the construction site.

- December 15, 1995 - Jack White received the new sign for the Project. I will remove old sign and install new sign at entrance of the Project site.

- SCS-8-TX-95 is being administered by the NRCS State Office staff with the Construction Inspector furnished from the Stephenville Watershed Office. Construction contract is completed as of December 07, 1995, final certification date.

(December 07, 1995)
(100% complete)

Activities Planned for the January 01 - March 31, 1996:

Submit Quarterly Report (quarterly) report to TSSWCB and NRCS State Office.

PROGRAM ELEMENT 2: SYSTEM PLANNING and DESIGN

(Milestone date March 1, 1994)

(100% Competed)

Task 2.1 Plan and design a water quality management system.

(May 23, 1995)

(100% complete)

Task 2.2 Review BMP selection:

(April 12, 1995)

(100% complete)

Task 2.3 Review completed design.

(May 23, 1995)

(100% complete)

Task 2.4 Submit water quality management plan to TSSWCB for certification.

(June 07, 1995)

(100% complete)

Task 2.5 Design report submitted to EPA/TNRCC.

(June 07, 1995)

(June 07, 1995)

(100% complete)

PROGRAM ELEMENT 2 IS COMPLETED AS OF JUNE 7, 1995.

PROGRAM ELEMENT 3: CONSTRUCTION OF THE SYSTEM

Task 3.1 - Establish which BMP's will be used.

(100% complete)

Task 3.2 - Solicit construction contractors bids.

(June 23, 1995)

(100% Complete)

Task 3.3 - Award contract for installation and vegetation.

(July 10, 1995 - Construction)

(100% Complete)

Task 3.4 - Construct and certify waste management components.

- October 12, 1995 - Contractor began forming and steel work for concrete on the inlet protection to the waste storage pond.
- October 12, 1995 - Contractor began ditching the fresh water line to the wetland cells.
- October 17, 1995 - Contractor poured and finished inlet protection on waste storage pond.
- October 17, 1995 - Contractor began forming catch basin and settling basin areas.
- October 19-24, 1995 - Contractor poured and finished concrete in catch and settling basins.
- October 19, 1995 - Seed for vegetative areas was ordered.
- October 20, 1995 - Seed for vegetative work was received and delivered to watershed office, furnished by NRCS.
- October 23, 1995 - Contractor began forming concrete slope drain outlet in Waste Lagoon.
- October 24, 1995 - Contractor poured and finished walls of the catch and settling basin and the slope drain outlet.
- October 25, 1995 - Contractor began plumbing work on the wetland cells.
- October 27, 1995 - Contractor excavated trenches for waterline line and emergency spillway overflow lines.

- November 02, 1995 - Contractor requested extension of time limitations of Project. Requested 30 additional days to complete.
- November 19, 1995 - Contractor began vegetation of embankments, wetland cells and disturbed areas.

- Summary of completed components as of November 01, 1995:
  Sediment filter fabric silt fences.
  Waste storage pond (excavation and liner).
  Waste lagoon (dewatering, excavation and liner).
  3" - Recycle line from waste storage pond to flush tank, with pump control wires in same channel.
  Concrete waste storage pond inlet protection chute.
  Flush lane catch basin.
  Settling and drying tank. (Settling Basin).
  Waste lagoon slope drain from settling and drying tank.
  Waterways (1-5) (excavation and topsoil).
  Excavation of wetland cells.
  Construction of middle ridge and 8" equalization pipe in wetland cells.
  Brush removal and disposal.
  6" PVC discharge line from settling and drying tank to waste lagoon.

November 1-4, 1995 - 1.75" of rain were recorded on the site. Contractor discontinued construction. Waterways functioned and minor damage to the waterway was incurred. Concrete areas ready for pouring have to be re-worked due to sedimentation. Waste storage pond caught about 2' of rainfall runoff.
November 06, 1995 - 0.35" of rain fell on work site.

- Summary of completed components from November 01-24, 1995:

  WSP slope drain and apron catch basin.
  1.25" fresh water pipeline to wetland cells.
  Emergency overflow and 3" wastewater pipelines.
  WSP recycle pump and apertures.
  Wetland cells freshwater risers and plumbing.
  Final shaping of waterways.
  Apertures to pipelines. (Air release, pressure relief, clean outs and manholes).
  2 - Staff gauges in WSP.
  Wetland cells - 24" wastewater risers and plumbing.
  8" emergency overflow pipe from waste lagoon to waste storage pond.
  170' - 10" PVC from drip shed to settling and drying tank.
  Removal of existing 10" PVC from drip shed to existing lagoon.

November 19, 1995 - 0.57" rain fell on construction site. No work performed 11/20 due to wet conditions.

  Installation of 3-phase electricity for recycle and irrigation pumps.
  Hay bale sediment blocks in waterways.
  8" discharge line from lagoon to wetland cells.
  6" discharge line from wetland cells to waste storage pond concrete inlet protector.

10" flex hose from catch basin to settling and drying tank cells.

Seeding of embankments, disturbed areas and waterways.
Construction of site fence.
Mulching disturbed areas with Coastal Bermudagrass.
November 27, 1995 - all work completed with the exception of testing the recycle pump and installing 10" flex hose from catch basin to drying and settling tank.
November 28, 1995 - Contractor began demobilization of equipment from Project site.
- December 07, 1995 - Performed "Final" contract review for completeness. Tested recycle pump for operation.

(December 07, 1995)
(100% Complete)

PROGRAM ELEMENT 3 IS COMPLETED AS OF DECEMBER 07, 1995.

Activities Planned for January 01- March 31, 1996:
- Vegetate wetland cells with various species for testing.

PROGRAM ELEMENT 4: TECHNOLOGY TRANSFER

Task 4.1 - Utilize news media to disseminate information on the project.
- October 10-15, 1995 - Gail Chandler, NRCS Public Affairs Specialist, Temple, utilized HUA poster display and photos for the Heart of Texas (HOT) Fair in Waco. Project display included the O'Bryan Constructed Wetland Project and other wetland projects in the HUA. Approximately 179,000 attended and viewed display of O'Bryan Project and HUA Projects.
- October 31, 1995 - Jerry Walker, NRCS engineer, gave a presentation of the Constructed Wetland Project to the American Society of Agricultural Engineers meeting in Austin. (35 in attendance).
- October 31, 1995 - Randy Moore and Ted Simpson, District Conservationist at Stephenville and Comanche, respectively utilized photos from the O'Bryan "Dedication" Ceremony in the Upper Leon and Cross Timbers SWCD Annual Report.
- November 03, 1995 - Jack White and Amy Kinney utilized photos of the O'Bryan Constructed Wetland Project in the Hydrologic Unit Annual Report submitted to Washington, D.C.
- November 28, 1995 - Jack White and Amy Kinney ordered additional enlargements of selected photos from Project inception to current date.
- December 18, 1995 - Jack White received enlarged color photos and slide sets for promotion of Project.
Task 4.2 - Conduct 2 field days open to the public, demonstrating progress and results of the demonstration dairy.

(August 28, 1995)
(50% Complete)

Activities Planned for January 01- March 31, 1996:
Conduct second public field day of completed system. (March).
Prepare paper for submission to the 2nd Annual Constructed Wetlands for Animal Waste Management workshop scheduled for May 15-18, 1996, on the construction and vegetation of the Project.

Prepare for 2nd Annual Constructed Wetlands for Animal Waste Management workshop scheduled for May 15-18, 1996. Tour scheduled for May 16.

PROGRAM ELEMENT 5: WATER QUALITY MONITORING
(Completion date May 1, 1997)

Task 5.1 - Establish monitoring sites at locations to accurately capture and assess nutrient runoff loading.

- July 10, 1995, Cooperative Agreement to TIAER was received for monitoring.
- October 11, 1995 - TIAER received formal contract from NRCS to commence monitoring activities.
- October 31, 1995 - Jack White reviewed finished Project site with Larry Hauck, TIAER, for monitoring site locations.
- November 08, 1995 - Jack White and Randy Moore met with TIAER on monitoring and EPIC and APEX needs.
- December 01, 1995 - Jack White met with Larry Hauck, TIAER on monitoring locations, on the site. Lagoon approximately one third full. Preliminary water sample drawn for analysis.

(December 01, 1995)
(100% Complete)

Task 5.2 - Utilize updated data in model predictions to evaluate movement of nutrients under different management scenarios.

- October 31, 1995 - Jack White contacted Larry Hauck and Joan Flowers, TIAER to adapt EPIC and APEX computer modeling programs for actual case and different scenarios on the Project site.

(Completion date May 1, 1997)

Task 5.3 - Monitor nutrient loadings entering/exiting constructed wetland field.

(Completion date May 1, 1997)

Activities Planned for January 01- March 31, 1996:

- Commence monitoring of sampling points, as plants are established.

PROGRAM ELEMENT 6: ECONOMIC FEASIBILITY TESTING
(Completion date May 1, 1997)

Task 6.1 - Record weights of cattle at beginning of project.

Task 6.2 - Harvest plants grown in wetland and utilize feedstock in rations fed to cattle.

Task 6.3 - Record weight change of cattle periodically.

Task 6.4 - Summarize the effectiveness of utilizing feedstock from Wetland in dairy rations.

Activities Planned for January 01- March 31, 1996:

Copy

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
239 E. McNEILL
STEPHENVILLE, TEXAS
76401

UPPER NORTH BOSQUE RIVER HYDROLOGIC UNIT AREA PROJECT

April 1, 1996

To: B.O. Spoonts
Texas State Soil and Water Conservation Board
Temple, Texas 76501

Re: EPA 319 Quarterly Report (Constructed Wetland) and Phase II

Attached, please find the Constructed Wetland Project and Phase II quarterly report on the O'Bryan Dairy. The reporting period is from January 1 through March 31, 1995.

Any questions, please advise.

Jack L. White
Program Manager
Upper North Bosque River HUA
NRCS, Stephenville

cc: Dick Babcock, ASC, NRCS, Temple
Allan Colwick, WQC, NRCS, Temple

DEMONSTRATION of WASTE MANAGEMENT SYSTEM UTILIZING
CONSTRUCTED WETLANDS
and
PHASE II

(FOR THE PERIOD JANUARY 01 - MARCH 30, 1996)

PROGRAM ELEMENT 1: PROJECT COORDINATION and MANAGEMENT

Task 1.1 Conduct initial meeting of involved parties.
(June 23, 1994 - TSSWCB, EPA, NRCS)
(September 26, 1994 - TIAER)
(100% complete)

Task 1.2 Report to interested parties.
- January 02, 1996 - Made quarterly report to NRCS and TSSWCB.

Task 1.3 Conduct interim meetings of involved and interested parties as needed.
- January 06, 1996 - Jack White provided tour and design information to 2 local dairy operators referencing the settling basin and recycling system.
- January 11, 1996 - Jack White and James Alderson developed planting specifications for the wetland cells.
- February 9, 1996 - NRCS State Office solicited bid proposals to 3 individuals for aquatic plants. Response date scheduled for March 01. Plant delivery date scheduled for March 20, 1996.
- February 21, 1996 - Jack White provided tour information to Dr. Ray Drenner, Texas Christian University, for proposed demonstration project using algae and Talipa for phosphorus utilization.
- February 22, 1996 - Jack White made preparations for the planting of the aquatic cells. Cells will be planted with students from the Tarleton State University Range and Dairy Science Clubs. Luncheon arrangements and refreshments are being investigated. Began making contacts for news coverage for the field day. Sent out letters and began making contacts for volunteers to assist with planting and other outreach projects.
- February 26, 1996 - Provided design information to Joan Flowers and Tina Coan, TIAER, on the BOD loading rate and cell size.
- February 27, 1996 - Jack White provided tour information to Eric Chasteen and Darrell Williamson of the Texas Natural Resource Conservation Commission (TNRCC).
- March 01, 1996 - Jack White provided tour information to Marvin Garza and 2 other TNRCC employees.
- March 01, 1996 - Met with Dr. Andy Kruzic and 3 graduate students concerning his demonstration and research project. Project will commence with grass planting and construction work of containment system for overland flow demonstration. Project to commence in April, 1996.

- March 04, 1996 - State Office Plant Materials Specialist contacted Brian Kruger, low bidder for aquatic plants. 1538 plants to be delivered to the site on March 20, 1996.

Task 1.4 Contract administration.
(December 07, 1995)
(100% complete)

Activities Planned for April 01- June 30, 1996:
* Provide tour and information to 4 TNRCC inspectors.

PROGRAM ELEMENT 2: SYSTEM PLANNING and DESIGN
(Milestone date March 01, 1994)
(100% Competed)

Task 2.1 Plan and design a water quality management system.
(May 23, 1995)
(100% complete)

Task 2.2 Review BMP selection:
(April 12, 1995)
(100% complete)

Task 2.3 Review completed design.
(May 23, 1995)
(100% Complete)

Task 2.4 Submit water quality management plan to TSSWCB for certification.
(June 07, 1995)
(100% complete)

Task 2.5 Design report submitted to EPA/TNRCC.
(June 07, 1995) EPA
(June 07, 1995) TNRCC
(100% complete)

**** PROGRAM ELEMENT 2 IS COMPLETED AS OF JUNE 7, 1995.****

PROGRAM ELEMENT 3: CONSTRUCTION OF THE SYSTEM

Task 3.1 - Establish which BMP's will be used.
(100% complete)

Task 3.2 - Solicit construction contractors bids.
(June 23, 1995)
(100% Complete)

Task 3.3 - Award contract for installation and vegetation.
(July 10, 1995 - Construction)
(100% Complete)

Task 3.4 - Construct and certify waste management components.
(December 07, 1995)
(100% Complete)

**** PROGRAM ELEMENT 3 IS COMPLETED AS OF DECEMBER 7, 1995.****

PROGRAM ELEMENT 4: TECHNOLOGY TRANSFER

Task 4.1 - Utilize news media to disseminate information on the project.

- January 18, 1996 - Made final preparations with Paul DuBowy for the 2nd National Workshop - Constructed Wetlands for Animal Waste Management to be held in May, 1996. O'Bryan's Wetland Project to be tour site for the conference on May 16, 1996.
- January 23, 1996 - Provided tour and site information to Christi Mays, Stephenville Empire Tribune. She will develop a news article on the O'Bryan project to be published in February.
- January 31 - Jack White developed brochure depicting the Constructed Wetland project. The brochure will be published and distributed for information of the Project. Comments from 3 reviewers returned on March 05, 1996.
- February 07, 1996 - I submitted "draft" copy of wetland brochure I developed for the Project to the NRCS State Office for review and publishing.
- February 12, 1996 - Provided tour information to NRCS engineering, Plant Materials, Agronomy staff and Texas Institute for Applied Environmental Research staff. (7 in attendance).
- February 24, 1996 - The news article developed by Christi Mays was in the Sunday edition of the Empire Tribune and covered one full page. Distributed copies to NRCS State Office, TSSWCB, and EPA.
- February 26, 1996 - Provided 10 slides to Melissa Burns, TSSWCB to be used for 319 presentation.
- March 6, 1996 - I presented a poster and conference presentation at the 1996 Water Quality Monitoring and Assessment Seminar in Bandera. (55 in attendance).
- March 18, 1996 - Jack White and David Gregory flagged wetland site for plant location. Erected replacement sign at the front entrance.
- March 20, 1996 - Wetland plants delivered to site. 1538 bare root plants unloaded and placed at planting sites.
- March 21, 1996 - Planted the wetland cells using students from the Tarleton State University Range Science and Dairy Science Clubs, and Dublin Vocational Agriculture. Others participating were: Upper Leon SWCD, Cross Timbers SWCD, NRCS, TIAER, TAEX, TAES, and TSSWCB. (67 participated). Vicki Boyd, Western Dairy Magazine and Keri Lanting, Dublin Citizen were present and will develop news articles.
- March 25, 1996 - Provided tour and project information to 18 members of the Brazos River Authority Board of Directors and field personnel.
- March 28, 1996 - Provided booth at the KCOM Dairy Field Day in Comanche. Project literature and O'Bryan Wetland on display. (800 in attendance).
- March 30, 1996 - Made poster and information of the Project at the Native Plant and Heirloom Festival in Stephenville. (Approximately 500 in attendance).

Task 4.2 - Conduct 2 field days open to the public, demonstrating progress and results of the demonstration dairy.

(August 28, 1995)
(100% Complete)

Activities Planned for April 01- June 30, 1996:

* Conduct second field day and tour open to the public demonstrating completed and functioning system. Target date set for May, 1996.
* Make wetland project presentation at the Technology Transfer meeting in Sulphur Springs in April, 1996.
* Conduct tour for Texas Watch 2000 conference on April 21.
* Display Project photos and information at the Southwest Dairy Field Day held at the Ray Johnston Dairy, in Comanche County, on May 9, 1996.
* Make presentation of the O'Bryan Constructed Wetland Project at the 2nd National Workshop - Constructed Wetlands for Animal Waste Management on May 15, 1996.
* Conduct tour of the O'Bryan facilities for the 2nd National Workshop - Constructed Wetlands for Animal Waste Management on May 16.
* Publish O'Bryan brochure. Distribute when received from publishing.

PROGRAM ELEMENT 5: WATER QUALITY MONITORING
(Completion date May 1, 1997)

Task 5.1 - Establish monitoring sites at locations to accurately capture and assess nutrient runoff loading.
(November 01, 1995)
(100% Complete)

Task 5.2 - Utilize updated data in model predictions to evaluate movement of nutrients under different management scenarios.
(Completion date May 1, 1997)

Task 5.3 - Monitor nutrient loadings entering/exiting constructed wetland field.

- February 22, 1996 - I obtained a soil sample from the wetland cells to determine nutrient content of the plant medium. Also collected samples from the settling and drying tank (settling basin) for analysis. Delivered soil test results to TIAER.
- March 08, 1996 - I met with Joan Flowers, TIAER on computer modeling and upgrade of program to be incorporated on the wetland system.
- March 18, 1996 - Obtained analysis of lagoon sample taken by TIAER for preliminary conditions.

(Completion date May 1, 1997)

Activities Planned for April 01- June 30, 1996:

* Commence monitoring program.

PROGRAM ELEMENT 6: ECONOMIC FEASIBILITY TESTING
(Completion date May 1, 1997)

Task 6.1 - Record weights of cattle at beginning of project.

- March 30, 1996 - Lloyd began construction of test pen area.

Task 6.2 - Harvest plants grown in wetland and utilize feedstock in rations fed to cattle.

Task 6.3 - Record weight change of cattle periodically.

Task 6.4 - Summarize the effectiveness of utilizing feedstock from Wetland in dairy rations.

Activities Planned for April 01- June 30, 1996:

Copy

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
239 E. McNEILL
STEPHENVILLE, TEXAS
76401

UPPER NORTH BOSQUE RIVER HYDROLOGIC UNIT AREA PROJECT

July 8, 1996

To: Justin Hester
Texas State Soil and Water Conservation Board
Temple, Texas 76501

Re: EPA 319 Quarterly Report (Constructed Wetland) and Phase II

Attached, please find the Constructed Wetland Project and Phase II quarterly report on the O'Bryan Dairy. The reporting period is from April 01 through June 30, 1996.

Any questions, please advise.

Jack L. White
Program Manager
Upper North Bosque River HUA
NRCS, Stephenville

cc: Dick Babcock, ASC, NRCS, Temple
Allan Colwick, WQC, NRCS, Temple

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
239 E. McNEILL
STEPHENVILLE, TEXAS
76401

UPPER NORTH BOSQUE RIVER HYDROLOGIC UNIT AREA PROJECT

July 8, 1996

To: B.O. Spoonts
Texas State Soil and Water Conservation Board
Temple, Texas 76501

Re: EPA 319 Quarterly Report (Constructed Wetland) and Phase II

Attached, please find the Constructed Wetland Project and Phase II quarterly report on the O'Bryan Dairy. The reporting period is from April 1 through July 31, 1996.

Any questions, please advise.

Jack L. White
Program Manager
Upper North Bosque River HUA
NRCS, Stephenville

cc: Dick Babcock, ASC, NRCS, Temple
Allan Colwick, WQC, NRCS, Temple

DEMONSTRATION of WASTE MANAGEMENT SYSTEM UTILIZING
CONSTRUCTED WETLANDS
and
PHASE II

(FOR THE PERIOD APRIL 01 - JUNE 30, 1996)

PROGRAM ELEMENT 1: PROJECT COORDINATION and MANAGEMENT

Task 1.1 Conduct initial meeting of involved parties.
(June 23, 1994 - TSSWCB, EPA, NRCS)
(September 26, 1994 - TIAER)
(100% complete)

Task 1.2 Report to interested parties.
- April 02, 1996 - Made quarterly report to NRCS and TSSWCB.

Task 1.3 Conduct interim meetings of involved and interested parties as needed.
- April 10, 1996 - James Alderson, Jack White, and Brian Kruger of Apache Landscape Services, planted 234 additional Bulrush plants in cell 4B. Duckweed plants scheduled for delivery next month when water becomes available.
- May 03, 1996 - Jack White, James Alderson and Lloyd O'Bryan planted an additional 86 wetland plants in cell 3A. Plants were donated from the Galveston Bay Project.
- June 24, 1996 - Jack White, Leo Johnson, and Lloyd O'Bryan planted Shoreline Reedgrass in Cell 4A.
- June 28, 1996 - Jack White, Leo Johnson, Lloyd O'Bryan and Morris Houck from Plant Materials Center in Knox City, planted Eastern Gamagrass and Alamo Switchgrass in cell 4A.

Task 1.4 Contract administration.
(December 07, 1995)
(100% complete)

Activities Planned for July 01 - September 30, 1996:
- July 10, 1996 - Incorporate Duckweed into Cells 1A and 2A. Also, plant 100 Giant Cutgrass plants in Cell 4A.

PROGRAM ELEMENT 2: SYSTEM PLANNING and DESIGN

(Milestone date March 01, 1994)
(100% Competed)

Task 2.1 Plan and design a water quality management system.
(May 23, 1995)
(100% complete)

Task 2.2 Review BMP selection.
(April 12, 1995)
(100% complete)

Task 2.3 Review completed design.
(May 23, 1995)
(100% Complete)

Task 2.4 Submit water quality management plan to TSSWCB for certification.

(June 07, 1995)
(100% complete)

Task 2.5 Design report submitted to EPA/TNRCC.
(June 07, 1995) EPA
(June 07, 1995) TNRCC
(100% complete)

**** PROGRAM ELEMENT 2 IS COMPLETED AS OF JUNE 7, 1995.****

PROGRAM ELEMENT 3: CONSTRUCTION OF THE SYSTEM

Task 3.1 - Establish which BMP's will be used.
(100% complete)

Task 3.2 - Solicit construction contractors bids.
(June 23, 1995)
(100% Complete)

Task 3.3 - Award contract for installation and vegetation.
(July 10, 1995 - Construction)
(100% Complete)

Task 3.4 - Construct and certify waste management components.
(December 07, 1995)
(100% Complete)

**** PROGRAM ELEMENT 3 IS COMPLETED AS OF DECEMBER 7, 1995.****

PROGRAM ELEMENT 4: TECHNOLOGY TRANSFER

Task 4.1 - Utilize news media to disseminate information on the project.

- April 11, 1996 - Provided project information to Shannon Linderoth, Texas Farmer Stockman magazine.
- April 16, 1996 - Provided slide presentation to the Dublin Rotary Club on the O'Bryan's Wetland Project. (27 present).
- May 01, 1996 - Jack White, Melissa Burns and Lloyd O'Bryan provided tour information to AMPI journalist. Article to appear in AMPI Magazine circulated throughout AMPI's participants.
- May 16, 1996 - Provided tour and project information to persons involved with the 2nd National Workshop on Constructed Wetlands for Animal Waste Management. (114 attending). Video taping was completed during the tour and will be aired at a later date, showing 319(h) Projects.
- May 22, 1996 - Jack White made Project activities presentation at the Technology Transfer meeting held in Sulphur Springs, Texas. (35 present).
- June 2, 1996 - A news article appeared in the Stephenville Empire Tribune and the Texas Dairy Review regarding the tour for the 2nd National Workshop on Constructed Wetlands for Animal Waste Management.
- June 10-14, 1996 - Project staff setup display at the Town and Country Bank of HUA activities highlighting the O'Bryan Constructed Wetland Project, as part of "June is Dairy Month".

- June 14, 1996 - Jack White received an issue of the Texas Farmer Stockman magazine which contained an article on the O'Bryan Constructed Wetland Project.

- June 20, 1996 - Received an article from Country World magazine, developed by Melissa Burns, TSSWCB, on the O'Bryan 319(h) Project.

Task 4.2 - Conduct 2 field days open to the public, demonstrating progress and results of the demonstration dairy.

(August 28, 1995)

(100% Complete)

Activities Planned for July 01 - September 30, 1996:

- Assist TIAER with video for Best Management Practices on the O'Bryan Dairy.
- Assist Americorp with video on the O'Bryan Dairy.

PROGRAM ELEMENT 5: WATER QUALITY MONITORING

(Completion date May 1, 1997)

Task 5.1 - Establish monitoring sites at locations to accurately capture and assess nutrient runoff loading.

(November 01, 1995)

(100% Complete)

Task 5.2 - Utilize updated data in model predictions to evaluate movement of nutrients under different management scenarios.

(Completion date May 1, 1997)

- April 01, 1996 - NRCS erected a weather station on the Waste Treatment Lagoon to measure, record, and submit weather data to TIAER and NRCS engineering. Jack White will download the information and provide to NRCS State Office.
- May 08, 1996 - Gene Lindemann, Allan Colwick, Jack White and Lloyd O'Bryan added a water temperature component to the weather station, along with a water elevation marker.

Task 5.3 - Monitor nutrient loadings entering/exiting constructed wetland field.

- April 3, 1996 - received preliminary data from TIAER on the Waste Treatment Lagoon.
- May 26, 1996 - Jack White contracted a local lagoon pumper to fill the wetland cells from water in the waste storage pond.
- May 31, 1996 - Jack White purchased pump, pipe and fittings for Lloyd to use to maintain water volume in the wetland cells.
- June 18, 1996 - Jack White received another lagoon sample from TIAER as part of the monitoring portion of the Project.
- June 10, 1996 - Lloyd and Steve O'Bryan poured the north curb of the feedlane extension.
- June 18, 1996 - Lloyd and Steve O'Bryan poured the south curb of the feedlane extension.

Activities Planned for July 01 - September 30, 1996:
- Download weather station monthly.
- July - Add Giant Cutgrass plants to Cell 4A.
- July - Completed feedlane extension floor and final plumbing of the storage tank.

PROGRAM ELEMENT 6: ECONOMIC FEASIBILITY TESTING
(Completion date May 1, 1997)

Task 6.1 - Record weights of cattle at beginning of project.

Task 6.2 - Harvest plants grown in wetland and utilize feedstock in rations fed to cattle.

Task 6.3 - Record weight change of cattle periodically.

Task 6.4 - Summarize the effectiveness of utilizing feedstock from Wetland in dairy rations.

Activities Planned for July 01 - September 30, 1996:
- July - Add Duckweed to Cells 1A and 2A.

X

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
239 E. McNEILL
STEPHENVILLE, TEXAS
76401

UPPER NORTH BOSQUE RIVER HYDROLOGIC UNIT PROJECT

9/30/96

TO: Justin Hester
Texas State Soil and Water Conservation Board
Temple, Texas 76501

Re: 319(h) Quarterly Report (Constructed Wetland) and Phase II

Attached, please find the Constructed Wetland and Phase II report for the reporting period form July 1, 1996 to September 30, 1996.

Any questions, please advise.

Jack L. White
Upper North Bosque River Hydrologic Unit Area
Program Manager
Natural Resources Conservation Service, Stephenville

DEMONSTRATION of WASTE MANAGEMENT SYSTEM UTILIZING
CONSTRUCTED WETLANDS
and
PHASE II

(FOR THE PERIOD JULY 01 - SEPTEMBER 30, 1996)

PROGRAM ELEMENT 1: PROJECT COORDINATION and MANAGEMENT

Task 1.1 Conduct initial meeting of involved parties.
June 23, 1994 - TSSWCB, EPA, NRCS)
September 26, 1994 - TIAER)
(100% complete)

Task 1.2 Report to interested parties.
- July 08, 1996 - Made quarterly report to NRCS and TSSWCB.

Task 1.3 Conduct interim meetings of involved and interested parties as needed.
- July 10, 1996 - Incorporated Duckweed into Cells 1A and 2A. Also, planted 100 Giant Cutgrass plants in Cell 4A.
- July 25, 1996 - Conducted a field tour of the system with John Burt, USDA-NRCS Washington, Shirley Gammon, NRCS Regional Office, Allan Colwick, NRCS State Office, Randy Moore, NRCS Stephenville Field Office and John Bennett, Cross Timbers Soil and Water Conservation District.
- July 29, 1996 - Lloyd O'Bryan planted additional Duckweed into Cell 2A.
- July 31, 1996 - Provided tour information to Lincoln Nebraska and New Jersey Natural Resources Conservation Service employees along with State Office.
- September 09, 1996 - Conducted field tour to Natural Resources Conservation Service Environmental Engineering Core Discipline Team meeting.
- September 11, 1996 - Conducted a tour of Erath County along with the Hydrologic Unit Area project area to Larry Rana, Office of Communications, NHQ and Barbara Lefner, Public Affairs Specialist. Tour consisted of the Project constructed wetland sites, including the O'Bryan. Larry is upgrading NHQ's files.

Task 1.4 Contract administration.
(December 07, 1995)
(100% complete)

Activities Planned for October 01 - December 31, 1996:

PROGRAM ELEMENT 2: SYSTEM PLANNING and DESIGN

(Milestone date March 01, 1994)

(100% Competed)

Task 2.1 Plan and design a water quality management system.

(May 23, 1995)

(100% complete)

Task 2.2 Review BMP selection.

(April 12, 1995)

(100% complete)

Task 2.3 Review completed design.

(May 23, 1995)

(100% Complete)

Task 2.4 Submit water quality management plan to TSSWCB for certification.

(June 07, 1995)

(100% complete)

Task 2.5 Design report submitted to EPA/TNRCC.

(June 07, 1995) EPA

(June 07, 1995) TNRCC

(100% complete)

**** PROGRAM ELEMENT 2 IS COMPLETED AS OF JUNE 7, 1995.****

PROGRAM ELEMENT 3: CONSTRUCTION OF THE SYSTEM

Task 3.1 - Establish which BMP's will be used.

(100% complete)

Task 3.2 - Solicit construction contractors bids.

(June 23, 1995)

(100% Complete)

Task 3.3 - Award contract for installation and vegetation.

(July 10, 1995 - Construction)

(100% Complete)

Task 3.4 - Construct and certify waste management components.

(December 07, 1995)

(100% Complete)

**** PROGRAM ELEMENT 3 IS COMPLETED AS OF DECEMBER 7, 1995.****

PROGRAM ELEMENT 4: TECHNOLOGY TRANSFER

Task 4.1 - Utilize news media to disseminate information on the project.

- July, 1996 - Received issue of the Western Dairy Magazine from Vicki Boyd editor. O'Bryan was featured on the cover of the magazine with a very impressive write-up.

- September 16, 1996 - Conducted field tour for magazine article development to Karl Wohlshohl, Progressive Farmer.

Task 4.2 - Conduct 2 field days open to the public, demonstrating progress and results of the demonstration dairy.

(August 28, 1995)

(100% Complete)

Activities Planned for October 01 - December 31, 1996:

PROGRAM ELEMENT 5: WATER QUALITY MONITORING

(Completion date May 1, 1997)

Task 5.1 - Establish monitoring sites at locations to accurately capture and assess nutrient runoff loading.

(November 01, 1995)

(100% Complete)

Task 5.2 - Utilize updated data in model predictions to evaluate movement of nutrients under different management scenarios.

(Completion date May 1, 1997)

Task 5.3 - Monitor nutrient loadings entering/exiting constructed wetland field.

Activities Planned for October 01 - December 31, 1996:

- Download weather station monthly.

PROGRAM ELEMENT 6: ECONOMIC FEASIBILITY TESTING

(Completion date May 1, 1997)

Task 6.1 - Record weights of cattle at beginning of project.

Task 6.2 - Harvest plants grown in wetland and utilize feedstock in rations fed to cattle.

- July 10, 1996 - Added Duckweed to Cells 1A and 2A.
- July 29, 1996 - Added additional Duckweed plants to cell 2A only. Duckweed of different specie.

Task 6.3 - Record weight change of cattle periodically.

Task 6.4 - Summarize the effectiveness of utilizing feedstock from Wetland in dairy rations.

Activities Planned for October 01 - December 31, 1996:

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
239 E. McNEILL
STEPHENVILLE, TEXAS
76401

UPPER NORTH BOSQUE RIVER HYDROLOGIC UNIT PROJECT

1/14/97

TO: Justin Hester
Texas State Soil and Water Conservation Board
Temple, Texas 76501

Re: 319(h) Quarterly Report (Constructed Wetland) and Phase II

Attached, please find the Constructed Wetland and Phase II quarterly report for the period October 1 - December 31, 1996..

Any questions, please advise.

Jack L. White
Upper North Bosque River Hydrologic Unit Area
Program Manager
Natural Resources Conservation Service, Stephenville

DEMONSTRATION of WASTE MANAGEMENT SYSTEM UTILIZING
CONSTRUCTED WETLANDS
and
PHASE II

(FOR THE PERIOD OCTOBER 01 - DECEMBER 31, 1996)

PROGRAM ELEMENT 1: PROJECT COORDINATION and MANAGEMENT

Task 1.1 Conduct initial meeting of involved parties:
June 23, 1994 - TSSWCB, EPA, NRCS)
September 26, 1994 - TIAER)
(100% complete)

Task 1.2 Report to interested parties.
- September 30, 1996 - Made quarterly report to NRCS and TSSWCB.

Task 1.3 Conduct interim meetings of involved and interested parties as needed.
- October 15, 1996 - Jack White and Amy Kinney provided tour and information on the O'Bryan project to Texas A&M University agronomy science class. 14 in attendance.
- October 17, 1996 - Jack L. White and Amy S. Kinney met with Prairie View A&M, Texas A&M and TAEX personnel to tour the constructed wetland project. 8 in attendance.
- December 11, 1996 - Jack White met with Alan Colwick, Jerry Walker, Amy Kinney to view the operation of the newly installed flush valve. Flush and feedlane completed and functional.
- December 06, 1996 - I met with Lloyd O'Bryan and Morris Houck, Plant Materials Specialist, Knox City to view the waste disposal field adjacent to the constructed wetland site. Three species of Eastern Gamagrass will be planted for waste utilization. Planting date: January 07, 1997.
- December 12, 1996 - I submitted Lloyd and Gloria O'Bryan to the National Wetland Awards and Environmental Law Institute for consideration in the Wetlands Award Program.

Task 1.4 Contract administration.
(December 07, 1995)
(100% complete)

Activities Planned for January 01 - March 31, 1997:
January - Plant waste disposal fields adjacent to dairy site.
February - Provide tour and information to Deputy Under Secretary for Conservation, Tom Hebert.
February - Provide tour and information to NRCS State Office and TIAER personnel.

PROGRAM ELEMENT 2: SYSTEM PLANNING and DESIGN

(Milestone date March 01, 1994)
(100% Competed)

Task 2.1 Plan and design a water quality management system.
(May 23, 1995)
(100% complete)

Task 2.2 Review BMP selection.

(April 12, 1995)
(100% complete)

Task 2.3 Review completed design.
(May 23, 1995)
(100% Complete)

Task 2.4 Submit water quality management plan to TSSWCB for certification.
(June 07, 1995)
(100% complete)

Task 2.5 Design report submitted to EPA/TNRCC.
(June 07, 1995) EPA
(June 07, 1995) TNRCC
(100% complete)

**** PROGRAM ELEMENT 2 IS COMPLETED AS OF JUNE 7, 1995.****

PROGRAM ELEMENT 3: CONSTRUCTION OF THE SYSTEM

Task 3.1 - Establish which BMP's will be used.
(100% complete)

Task 3.2 - Solicit construction contractors bids.
(June 23, 1995)
(100% Complete)

Task 3.3 - Award contract for installation and vegetation.
(July 10, 1995 - Construction)
(100% Complete)

Task 3.4 - Construct and certify waste management components.
(December 07, 1995)
(100% Complete)

**** PROGRAM ELEMENT 3 IS COMPLETED AS OF DECEMBER 7, 1995.****

PROGRAM ELEMENT 4: TECHNOLOGY TRANSFER

Task 4.1 - Utilize news media to disseminate information on the project.
- November issue of Progressive Farmer contained an article of the Project.

Task 4.2 - Conduct 2 field days open to the public, demonstrating progress and results of the demonstration dairy.
(August 28, 1995)
(100% Complete)

Activities Planned for January 01 - March 31, 1997:

PROGRAM ELEMENT 5: WATER QUALITY MONITORING
(Completion date May 1, 1997)
- (1 year extension requested on November 14, 1996.

Task 5.1 - Establish monitoring sites at locations to accurately capture and assess nutrient runoff loading.
(November 01, 1995)
(100% Complete)

Task 5.2 - Utilize updated data in model predictions to evaluate movement of nutrients under different management scenarios.
(Completion date May 1, 1997)

Task 5.3 - Monitor nutrient loadings entering/exiting constructed wetland field.

Activities Planned for January 01 - March 31, 1997:
- Download weather station monthly.

PROGRAM ELEMENT 6: ECONOMIC FEASIBILITY TESTING
(Completion date May 1, 1997)

Task 6.1 - Record weights of cattle at beginning of project.

Task 6.2 - Harvest plants grown in wetland and utilize feedstock in rations fed to cattle.

Task 6.3 - Record weight change of cattle periodically.

Task 6.4 - Summarize the effectiveness of utilizing feedstock from Wetland in dairy rations.

Activities Planned for January 01 - March 31, 1997:
Commence monitoring activities as the lagoon and wetland cells have filled.

UNITED STATES DEPARTMENT OF AGRICULTURE	NATURAL RESOURCES CONSERVATION SERVICE	239 E. McNEILL STEPHENVILLE, TEXAS 76401

UPPER NORTH BOSQUE RIVER HYDROLOGIC UNIT PROJECT

7/8/97

TO: Justin Hester
Texas State Soil and Water Conservation Board
Temple, Texas 76501

Re: 319(h) Quarterly Report

Attached, please find the Demonstration of a Waste Management System Utilizing Constructed Wetlands and Phase II quarterly report for the period April 1 - June 30, 1997.

Any questions, please advise.

Jack L. White
Upper North Bosque River Hydrologic Unit Area
Program Manager
Natural Resources Conservation Service, Stephenville

DEMONSTRATION of WASTE MANAGEMENT SYSTEM UTILIZING CONSTRUCTED WETLANDS and PHASE II

(FOR THE PERIOD APRIL 01 - JUNE 30, 1997)

PROGRAM ELEMENT 1: PROJECT COORDINATION and MANAGEMENT

Task 1.1 Conduct initial meeting of involved parties:
June 23, 1994 - TSSWCB, EPA, NRCS)
September 26, 1994 - TIAER)
(100% complete)

Task 1.2 Report to interested parties.
- April 8, 1997 - Made quarterly report to Texas State Soil and Water Conservation Board.

Task 1.3 Conduct interim meetings of involved and interested parties as needed.
- I provided tour to NHQ Water Quality Coordinator, Dan Smith, on May 22. CREES attended.
- Steve O'Bryan conducted tours to the Tarleton State University Dairy, Range, and Agronomy classes with 110 students and professors participating.
- I met with NRC Plant Materials personnel to review and discuss the Eastern Gamagrass field plots.
- I provided tour guidance to the Teachers Workshop participants. 28 in attendance.

Task 1.4 Contract administration.
(December 07, 1995)
(100% complete)

Activities Planned for July 01 - September 30, 1997, 1997:
- Conduct and host a second tour for the Teachers Workshop held on July 15.

PROGRAM ELEMENT 2: SYSTEM PLANNING and DESIGN

(Milestone date March 01, 1994)
(100% Competed)

Task 2.1 Plan and design a water quality management system.
(May 23, 1995)
(100% complete)

Task 2.2 Review BMP selection.
(April 12, 1995)
(100% complete)

Task 2.3 Review completed design.
(May 23, 1995)
(100% Complete)

Task 2.4 Submit water quality management plan to TSSWCB for certification.
(June 07, 1995)
(100% complete)

Task 2.5 Design report submitted to EPA/TNRCC.
(June 07, 1995) EPA
(June 07, 1995) TNRCC
(100% complete)

**** PROGRAM ELEMENT 2 IS COMPLETED AS OF JUNE 7, 1995.****

PROGRAM ELEMENT 3: CONSTRUCTION OF THE SYSTEM

Task 3.1 - Establish which BMP's will be used.
(100% complete)

Task 3.2 - Solicit construction contractors bids.
(June 23, 1995)
(100% Complete)

Task 3.3 - Award contract for installation and vegetation.
(July 10, 1995 - Construction)
(100% Complete)

Task 3.4 - Construct and certify waste management components.
(December 07, 1995)
(100% Complete)

**** PROGRAM ELEMENT 3 IS COMPLETED AS OF DECEMBER 7, 1995.****

PROGRAM ELEMENT 4: TECHNOLOGY TRANSFER

Task 4.1 - Utilize news media to disseminate information on the project.

Task 4.2 - Conduct 2 field days open to the public, demonstrating progress and results of the demonstration dairy.
(August 28, 1995)
(100% Complete)

Activities Planned for July 01 - September 30, 1997:

PROGRAM ELEMENT 5: WATER QUALITY MONITORING

Task 5.1 - Establish monitoring sites at locations to accurately capture and assess nutrient runoff loading.
(November 01, 1995)
(100% Complete)

Task 5.2 - Utilize updated data in model predictions to evaluate movement of nutrients under different management scenarios.

Task 5.3 - Monitor nutrient loading entering/exiting constructed wetland field.
- TIAER began monitoring activities on May 4, 1997.

Activities Planned for July 01 - September 30, 1997:
- Download weather station monthly.
- Continue monitoring of sample points.

PROGRAM ELEMENT 6: ECONOMIC FEASIBILITY TESTING

Task 6.1 - Record weights of cattle at beginning of project.

Task 6.2 - Harvest plants grown in wetland and utilize feedstock in rations fed to cattle.
- Steve O'Bryan developed a harvesting platform in the wetland cells for research.
- Steve O'Bryan developed a drying and weighing site for Duckweed at TSU.
- Steve O'Bryan harvested Duckweed and began running nutrient analysis. Duckweed analysis indicates Duckweed at 35% crude protein.
- Steve O'Bryan completed Internet searches on Duckweed as a feed supplement.

(10% Complete)

Task 6.3 - Record weight change of cattle periodically.

Task 6.4 - Summarize the effectiveness of utilizing feedstock from Wetland in dairy rations.

Activities Planned for July 01 - September 30, 1997:

Commence cattle feeding operations for the study in mid July.

TEXAS STATE SOIL AND WATER CONSERVATION BOARD

311 North 5th
P.O. Box 658
Temple, Texas 76503-0658
(817) 773-2250
Fax (817) 773-3311

February 15, 1994.

Mr. Jack White
HUA Coordinator
239 East McNeill
Stephenville, Texas 76401-4390

Dear Mr. White:

Enclosed is a schedule for our upcoming meeting with the U.S. Environmental Protection Agency in Dallas February 28, 1994. You will also find enclosed a map to the meeting location.

You are scheduled for Monday, February 28, 1994, at 1:30pm for discussion of your Artificial Constructed Wetland project. If you have any questions, please feel free to contact me or a member of my staff.

Sincerely,

Bo Spoonts
Director of Statewide Management Program

319 Project Meeting
Jan 31, 1995

Name	Address	Agency	Phone
Alvin Riddle	103-B Poindexter (Cleburne)	NRCS	817-645-7711
Floyd E. Ormsby III	Rt. 2 Box 141D (Cleburne)	SWCD	817-645-7673
Petra Sanchez	6 WRAS Dallas 75202 1445 Ross Ave Suite 1200		214-665-6686
Carl Hutcherson	"	"	(214) 665-8081
Mike Bira	"	EPA Clean Lakes Program	214-665-6668
Jerry Stafford	239 E. McNeil Stephenville	NRCS	817-965-3213
David Beyer	239 E McNeil Stephenville	NRCS	" " "
Tom Conry	P.O. Box 7555 Waco, TX 76714	B.R.A.	817-772-6010
Monnie W. Edwards	239 S. Virginia Stephenville, TX	NRCS	817-965-5093
Stan Ellison	103-B Poindexter, Cleburne, TX 76031	NRCS	(817) 645-7711
Allen Colwick	101 S. Main Temple TX 76501	NRCS	(817) 774-1255
James Neighbors	101 S. Main	Temple TX 76501	817 774-1224
Tim Brocha	101 S. Main	Temple TX 76501	(817) 774-1236
Terry Walker	101 S Main	Temple TX 76501	(817) 774-1217
Jim Rickman	PO Box 6567	Ft Worth, TX 76115	(817) 334 5242
Bo Spoonts	PO Box 658	Temple TX	76503 817 773-2250
Larry Hauck	Mail Stop T-220	Stephenville	76402 817 968-9561
Tim Jones	"	"	817 968 9560
Bruce Lesikar	TAMUS, 306 Scoates Hall	College Station,	77843 409 845-7455
Suzanne Cardwell	TX State Soil & Water Conservation Bd. Box 658, Temple, TX		76503 817-773-2250
Daniel Hayes	TSSWCB 611 E Blackjack	Justin TX	817 491-9014
Todd Oneth	"	"	" "
Lennie Winkelman	TSSWCB Box 658, Temple, TX		76503 817 773-2256
Andy Kruzic	UTA P.O. Box 19308	Arlington	76019 8172733822

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
Temple Watershed Construction Office
7300 N. Interstate HWY 35
Temple, TX 76501

Subject:
ADS - Acquisition, Procurement, Contracts
Contract No. 50-7442-5-101, O'Bryan Dairy
Waste Management System

Date: November 7, 1995

To: L. Dennis Medlin
State Conservation Engineer
Natural Resources Conservation Service

A check prior to final inspection for the subject site, has been scheduled for Thursday, November 16, 1995 at 10:00 A.M. We will meet at the Site on Thursday.

Thomas P. Beach
Contracting Officer's Technical Representative

cc: James Stautzenberger, Contracting Officer, NRCS, Temple
Dennis Clute, SCE (Acting), NRCS, TWCO
Herbert T. Cunningham, ASTC(FO), NRCS, San Angelo, TX
Randy Moore, DC, NRCS, Stephenville F.O., TX
Jerry Walker, Wastewater Management Engineer, NRCS, Temple, TX
Jack White, Upper North Bosque Hydrologic Unit, Stephenville, TX
Floyd Taylor, Construction Inspector, O'Bryan Dairy
Roy Hufstutler, Roy Hufstuler Construction Co., Commanche, TX

United States Department of Agriculture

Natural Resources Conservation Service

101 South Main Street
Temple, Texas
76501-7682

December 13, 1995

Mr. Roy Hufstutler
Roy Hufstutler Construction Company
1001 N. Houston
Comanche, Texas 76442

Dear Mr. Hufstutler:

As Contracting Officer, I hereby make formal acceptance of all work required under Contract 50-7442-5-101 for construction of the O'Bryan Dairy Waste Management System, Erath County, Texas.

Acceptance is effective December 7, 1995.

Sincerely,

James E. Stautzenberger
Contracting Officer

cc: Merchants Bonding Company (Mutual)
P.O. Box 26720
Austin, Texas 78755-0720

bc: Tom Beach, COTR, NRCS, Temple WSCO
Floyd Taylor, CI, NRCS, Stephenville WSCO
Dennis Clute, Acting CE, NRCS, Temple WSCO
Dennis Medlin, SCE, NRCS, Temple
Don Gilmore, SDE, NRCS, Temple
Larry Goertz, HE, NRCS, Temple
Kanand Brooks, Jr., ASC-FO, NRCS, Bryan
O'Gene Barkemeyer, ASC (Tech), NRCS, Temple
Richard D. Babcock, ASC (Programs), NRCS, Temple

United States
Department of
Agriculture

Soil
Conservation
Service

101 South Main Street
Temple, Texas
76501-7682

December 14, 1995

Mr. Robert G. Buckley
Executive Director
Texas State Soil and Water
Conservation Board
P.O. Box 658
Temple, TX 76503-0658

Dear Bob:

We have made our final inspection and certification of completion of the O'Bryan Dairy EPA 319 Constructed Wetland. See the enclosed completion report.

We anticipate that the final payment will be made within the next several weeks and planting of the forage wetland grasses should begin in January. Our staff will need to coordinate with you on the plantings and funding for this work. It was mutually agreed that we would provide funding for the certification of the liner of the ponds and your agency would provide funding for installation of the wetland plants.

Sincerely,

FOR

HARRY W. ONETH
State Conservationist

Enclosure

cc: Richard D. Babcock, ASC(Programs), Temple
Len Pardee, NPS Project Officer, EPA, Dallas
Carl Hutcherson, EPA(IAG), Dallas
Tom Cunningham, ASC(F), San Angelo
Jack White, PM, Upper North Bosque HUA, Stephenville
Gene Barkemeyer, ASC(Technology), Temple
Bo Spoonts, TSSWCB, Temple

Appendix B

UNITED STATES
DEPARTMENT OF
AGRICULTURE

SOIL
CONSERVATION
SERVICE

339 E. McNEILL
STEPHENVILLE, TEXAS
76401-4390

UPPER NORTH BOSQUE RIVER HYDROLOGIC UNIT AREA

July 8, 1994

To: Gary A. Batte
Area Conservationist
SCS, Stephenville

Re: O'Bryan Dairy - Constructed Wetland Project Progress

The O'Bryan Dairy scheduled for field survey on July 5-7 was completed as scheduled. The survey was an intensive survey and was completed on time. The survey party consisting of Terry Oliver, Ray Hale SCS, Dan Hayes and Martha Jenicek, TSSWCB went extremely well and was conducted very professionally. The dairy owners, Lloyd and Gloria O'Bryan were impressed with the professionalism and courtesy offered by the survey party.

Terry Oliver will download the program and send to the state office for plotting and return to this office for design. Jerry Walker will intercept the file and proceed with the plotting at the state office. He will mail the finished survey back to the Area Office. This should be accomplished next week. Designing should commence at this time.

TSSWCB personnel expressed a concern to follow the planning through it's entirety. They indicated, they assist with the field survey and never view the finished product.

Jack L. White
Upper North Bosque River HUA
Program Manager
SCS, Stephenville

JUL 25 1994

United States Department of Agriculture | Soil Conservation Service | 1707 N. General Bruce Dr. Suite 1 Temple, TX 76504-2474

Subject: Soil Investigation O'Bryan Dairy

Date: July 21, 1994

To: Jack White
NLR Coordinator
SCS, Stephenville, Texas

File Code: 430

On July, 19,1994 I conducted a soil investigation on the O'Bryan Dairy in Erath County, south of Dublin on soil sheet 71, along with personnel from the Texas Soil and Water Conservation Board.

The soil map and soil delineations were checked to see if there were any inclusions that would affect the planned artificial wetland on this property. The soil map as published in the Erath County Soil Survey is accurate for the scale it is published. There is a map unit of DfC Duffau fine sandy loam, 3 to 5% slopes that is along the slope below the pens . Most of this delineation is within the range of the Duffau series but along the lower part of the slope the soil contains more clay than typical beginning about 40 inch depth.

When final plans and exact location of wetlands are known I will make a detail soil investigation of those areas. If you have any questions please call.

Thanks,

James M Greenwade
Soil Scientist
SCS, Temple

cc: Gary Batte, SCS, Stephenville, Texas
Jerry Stanford, SCS, Stephenville, Texas

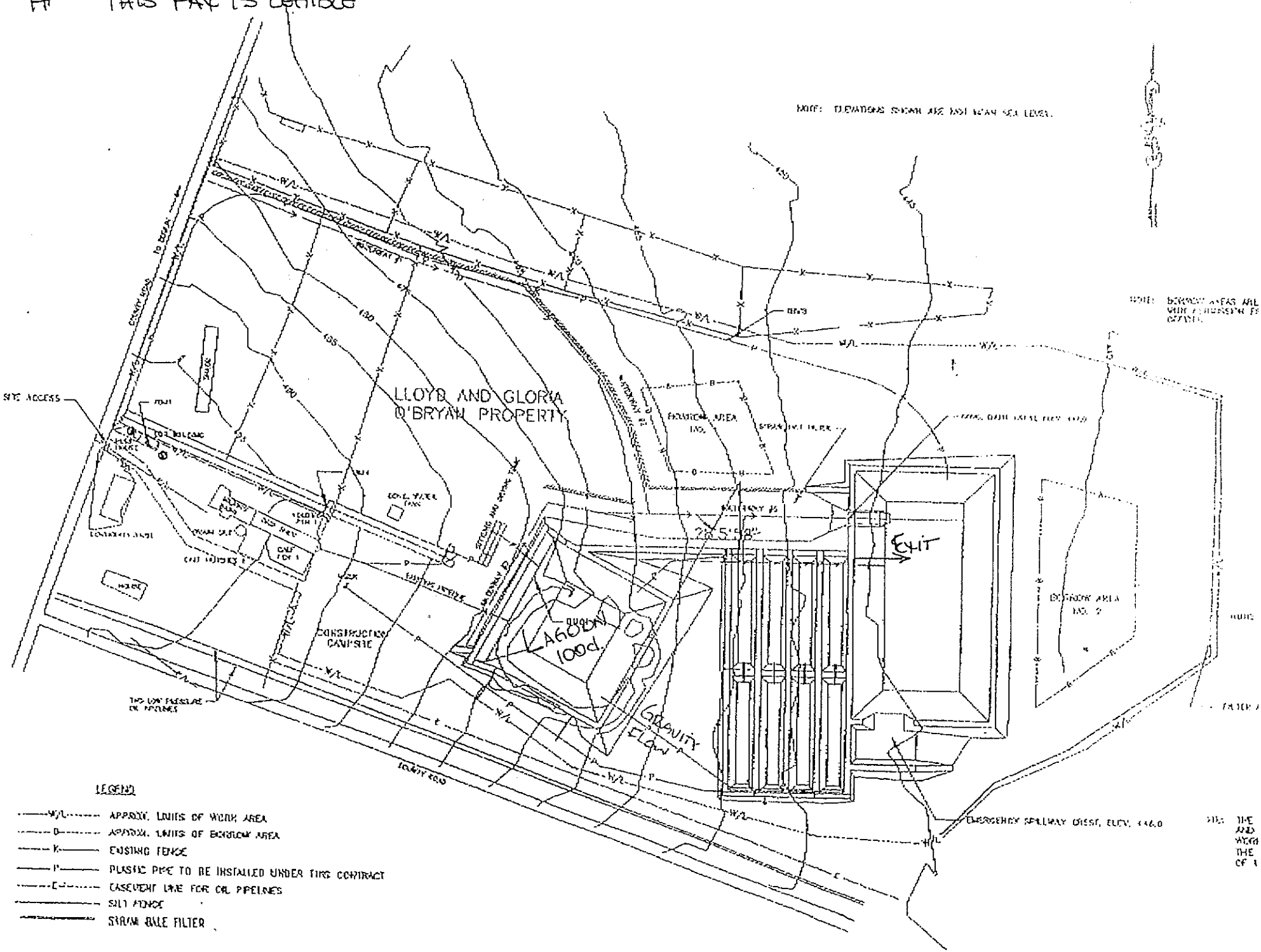
O'Bryan Dairy, Crain Co, Inc

Sample #	depth
1A	0"-12"
1B	12"-40"
1C	40"-60"
1D	60"-70"
1E	70"-90"
2A	0"-10"
2B	10"-36"
3A	0-12
3B	12-33
3C	33-70
3D	70-90
4A	0"-8"
4B	8"-60"
4C	60"-90"

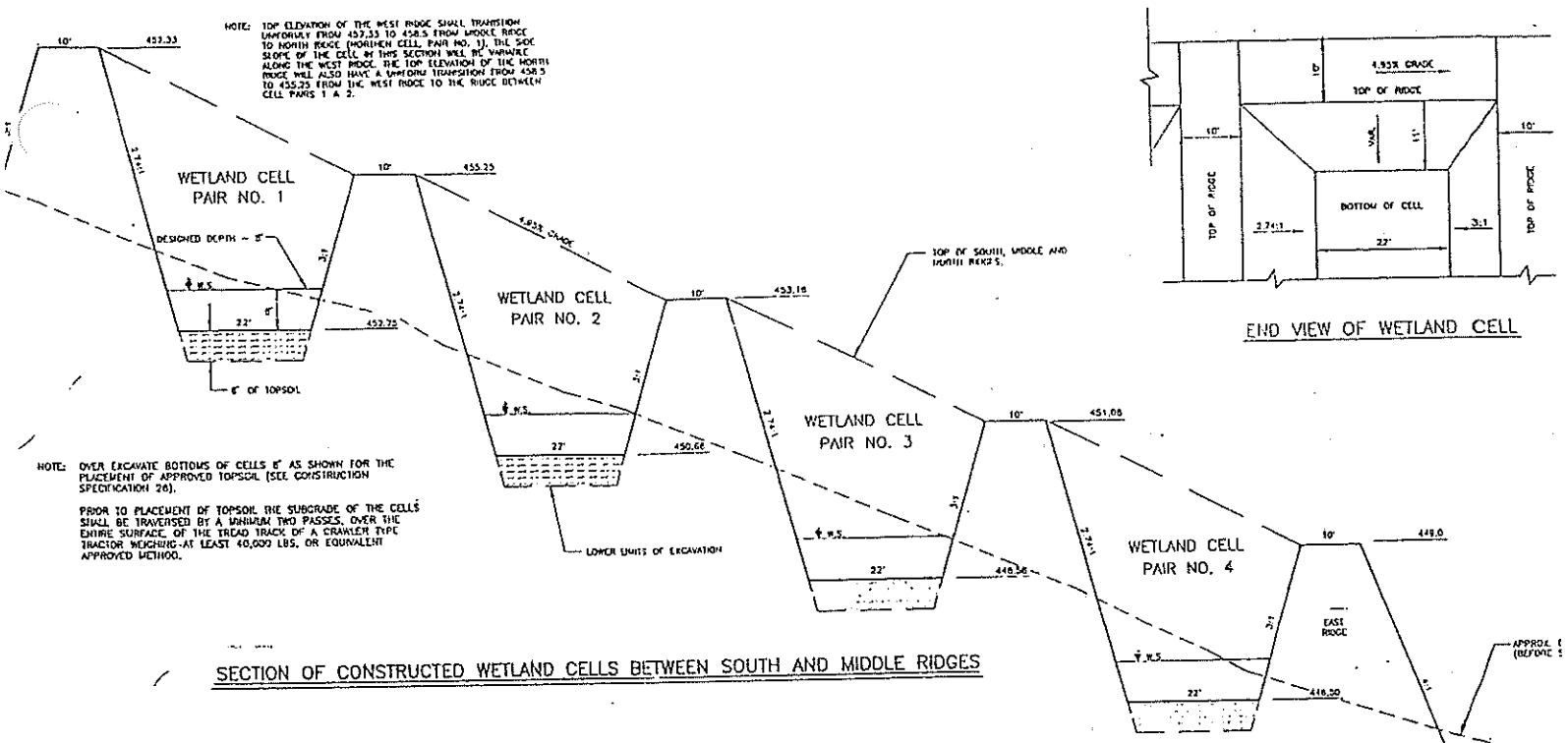
Sample #	depth
6A	0-12
6B	12-60
[redacted]	
7A	0-8
7B	8-50
7C	50-60
8A	0-6
8B	6-52
8C	52-70
11A	0-10
11B	10-36
11C	36-45
11D	45-60

[redacted] 2 week turnaround

H THIS FAX IS LEGIBLE

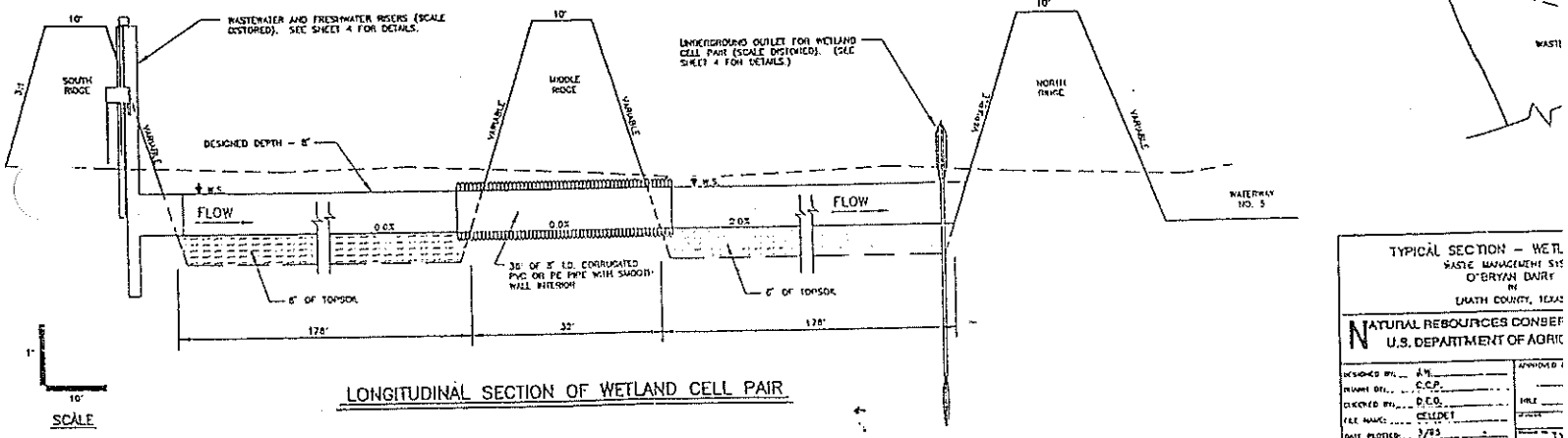


GENERAL PLAN



SECTION OF CONSTRUCTED WETLAND CELLS BETWEEN SOUTH AND MIDDLE RIDGES

END VIEW OF WETLAND CELL



LONGITUDINAL SECTION OF WETLAND CELL PAIR

TYPICAL SECTION – WETL
WASTE MANAGEMENT SYS
O'BRYAN DAIRY
IN
ERATH COUNTY, TEXAS

NATURAL RESOURCES CONSER
U.S. DEPARTMENT OF AGRIC

DESIGNED BY: J.M.
DRAWN BY: C.C.P.
CHECKED BY: D.E.O.
FILE NAME: CELLDET
DATE PLOTTED: 3/95

A. Golwich

A Quick Look at the NRCS "Technical Requirements for Constructed Wetlands"

William H. Boyd PE
Environmental Engineer, Midwest NTC

"Technical Requirements for Constructed Wetlands for Agricultural Wastewater Treatment" was issued in response to a growing desire to apply this technology in agricultural waste management systems. This "quick look" is an explanation and justification for specific elements in the document.

Not a Practice Standard

The decision was made to issue this document instead of a practice standard for the following reasons:

1) Conservation Practice Standards are based on research, conservation field trials, and accumulated knowledge and experience. At the time this document was issued our knowledge of the technology, performance, and utility of constructed wetlands for agricultural wastewater treatment is very limited.

2) Conservation Practice Standards are issued to provide uniformity in the application of proven technology. We wanted to leave room for flexibility and innovation as the technology for constructed wetlands was developing.

3) Conservation Practice Standards should be limited to the technical criteria with which a conservation practice is designed, implemented, and operated. There were policy, program, and regulatory concerns associated with this practice we wanted to communicate as we released information on this technology.

Rather than a practice standard the technical requirements are an assemblage of the current understanding of planning, designing, constructing, operating and maintaining of constructed wetlands for agricultural wastewater treatment in the current legal and program environment. They provide technical, program, and policy guidance to the State Conservation Engineer to develop site specific specifications for the installation, operation, maintenance, and monitoring of constructed wetlands.

"No Jurisdictional Wetlands"

We asked that constructed wetlands be sited outside the limits of jurisdictional wetlands for the following reasons:

1) There was some talk of using or enhancing existing wetlands for wastewater treatment. The idea has technical merit, however, because many of these wetlands are considered as waters of the United States, discharges into these wetlands must themselves meet state discharge standards. While natural wetlands may be enhanced to improve the quality of unregulated non-point runoff, State and Federal laws preclude their use for wastewater treatment.

2) The regulation of wetlands is both complex and changing. Attempts to define wetlands and the implications of property rights continues to be both scientifically and politically volatile. As a result there are many unanswered questions concerning the construction, operation, and maintenance of constructed wetlands on jurisdictional wetlands.

3) The addition of agricultural wastewater to an existing wetland could have an adverse impact on the endemic functions and values of that wetland.

The Role of Constructed Wetlands in Waste Management Systems

Replace or reduce land application

Constructed wetlands are often viewed as a "treat and release" component of an agricultural waste management system. They receive attention because it is believed that their use will reduce the cost associated with storage and land application. This is not necessarily so.

The effectiveness of constructed wetlands to treat wastewater is seasonal. Storage of wastewater will still be necessary during the seasons of the year when the wetland is not able to provide the desired level of treatment. Temporary storage continues to be required to contain runoff generated by precipitation up to and including the 25 year frequency 24 hour duration event. In the wastewater flow path this storage is positioned before the constructed wetland to allow the wetland to be loaded at a controlled rate. Additional storage is necessary at the outlet of the constructed wetland to prevent an unlawful discharge in the event that the constructed wetland fails to provide the desired level of treatment.

For a constructed wetland to function as a utilization alternative the potential pollutants in agricultural wastewater must be volatilized to the atmosphere, removed

through the harvest of hydrophytic (wetland) vegetation, or allowed to accumulate in the wetland. If the pollutants are allowed to accumulate in the wetland the wetland must have an adequate attenuation capacity (pollutant storage capacity) for the life of the practice, and a plan for the use of the area after the attenuation capacity is no longer adequate. In addition, for a constructed wetland to function as a utilization alternative the volume of evapotranspiration must exceed both the volume of precipitation and the volume of the wastewater discharged to the constructed wetland. Otherwise there is an effluent which must either be applied to the land, recycled or discharged.

Pretreatment Requirements

Pretreatment is required to remove most settleable and floating solids including organic and nonbiodegradeable materials such as plastics and grease before they are discharged into constructed wetlands. This prevents rapid filling of the constructed wetland and obstruction of the design flow In most cases it is necessary for the successful survivable of the hydrophytic vegetation. Pretreatment is also necessary to reduce concentration of constituents in the wastewater. Target concentrations resulting from wastewater pretreatment should be approximately 1,500 mg/l total solids and 100 mg/l ammonia. When using the "Field Test Method" described below the BOD5 loading should be less than 112 kg/(ha o day) [100 lbs/(acre o day)]. Pretreatment can sometimes be accomplished using lagoons and settling basins. Dilution and mixing may be necessary before the wastewater enters the constructed wetland.

Design Requirements

Two methods are presented to determine the physical dimensions of the wetland. Though these methods are considered state of the art, neither of them have been thoroughly evaluated for the treatment of agricultural wastewater over an extended period of time at a variety of locations.

THE PRESUMPTIVE METHOD: The Presumptive Method may be used if samples of the wastewater to be treated by the wetland can not be tested prior to design. This method first determines a surface area and then checks for an adequate hydraulic residence time. This method presumes the amount of BOD5 produced by the animals and the amount lost through the selected pretreatment method. It then uses these values

with an areal BOD5 loading rate of 65 lbs./(acre o day) to determine the surface area required for the wetland. The hydraulic residence time for the presumptive method must be at least twelve days.

The equation used to calculate the hydraulic residence time for the Presumptive Method is:

$$t = SA \times D \times P/Q$$

where t = hydraulic residence time, days
SA = surface area, sq-ft
D = flow depth, ft
Q = flow rate, cu-ft/day
P = the ratio of the volume of the constructed wetland occupied by the water to the volume of the constructed wetland occupied by the volume of the plants and the volume of the water.

THE FIELD TEST METHOD: The Field Test Method should be used when samples of the wastewater to be treated by the wetland can be tested prior to design. The Field Test Method first determines an acceptable hydraulic residence time and then uses this to determine the required spatial dimensions. The equation for the hydraulic residence time includes an adjustment for the water temperature and for the easily settleable BOD solids entering the wetland.

The hydraulic residence time equation for the Field Test Method is:

$$t = 2.7(\ln Ci - \ln Ce + \ln A)/1.1(T-20)$$

where t = hydraulic residence time, days
Ci = the influent BOD5 concentration, mg/l
Ce = the effluent BOD5 concentration, mg/l
A = the fraction of BOD not removed as settleable solids near the head of the constructed wetland,
T = water temperature, oC.

"No Discharge" Systems

To comply with Federal and State regulations, Agricultural Waste Management Systems are planed and implemented to permit discharge from storms up to and including the 24 hour duration, 25 year frequency precipitation event. Exceptions are made when the owner secures an NPDES permit or the equivalent approval from the State regulatory agency.

The technology for constructed wetlands for treatment of agricultural wastewater is not developed to the point that the we can predict that the effluent from the wetland will meet state discharge standards. For this reason the plan

for a waste management system which includes a constructed wetland component must either secure approval from the state regulatory agency to discharge, or also include a plan for the management of effluent from the wetland. If approval for discharge is granted, the plan may have to address testing of the effluent to determine whether it is meeting state discharge standards before effluent is released.

Due to the difficulty and expense of continuous testing the technical requirements call for a wetland effluent storage facility to hold the treated effluent until the proper testing can be performed. Because the effluent in the storage facility may not prove suitable for discharge the plan must also call for a back-up alternative to either recycle or utilize the effluent.

Monitoring Requirements

Monitoring is required for some program related constructed wetlands and desired for them all. Emphasis is placed on monitoring to:

1) Determine the overall performance of the system,

2) Define the physical, chemical, and biological processes active in the system, and

3) Evaluate plant species, and planting and management techniques.

The data collected through this monitoring will be used with research data to refine the technical requirements in the future. It should also provide the information we needed to prepare a conservation practice standard.

Appendix C

PRE-SOLICITATION NOTICE (Construction Contract)	1. PROJECT NO.	2. DATE OF NOTICE	3. DATE SOLICITATION DOCUMENTS AVAILABLE (Approx.)	FORM APPROVED OMB NUMBER
	SCS-8-TX-95	4/27/95	5/10/95	9000-0037

The project number in Items 1 and 16 may be the same as the Invitation or Proposal Number.

4. OFFERS TO BE RECEIVED BY (at place specified for receipt of offers)	A. TIME	B. DATE (Month, day, year)	5. TIME FOR COMPLETION (Calendar days)
	2:00 ~~A.M.~~ P.M.	June 9, 1995	79

6A. ISSUING OFFICE (Name, address, and ZIP code)	7. PROJECT TITLE AND LOCATION
USDA-Natural Resources Conservation Service 101 South Main Street Temple, Texas 76501-7682	O'Bryan Dairy Waste Management System Erath County, Texas

RETURN NOTICE TO THIS ADDRESS

6B. ~~BOOKKKK~~ FAX NO.	6C. TELEPHONE NO. (Include area code)
(817) 774-1295	(817) 774-1221

INSTRUCTIONS: a. Solicitation Documents will be issued upon receipt of your affirmative response to this Pre-Solicitation Notice by the DUE DATE set forth in Item 15. b. If a charge is required under Item 8A, your affirmative response must include a check or money order in the applicable amount, made payable to Agency (shown in Item 9). Refund (when specified in Item 8B) will be made upon your return of the bid documents in good condition, without marks, notes, or mutilations, within 20 calendar days after the final date for receipt of offers. c. The Issuing Office, at its discretion, may make bid documents available to plan rooms of the Associated General Contractors, Chambers of Commerce, Dodge Reports, and other similar contractors' commercial service facilities. d. Bid guarantee is required with any bid in excess of $25,000. Bid guarantee shall be in the amount of 20 percent of the amount of the bid, or $3,000,000, whichever is less. For bid guarantee purposes, the amount of the bid is the aggregate of the Lump Sum Base Bid, all Alternates (if any), and the product(s) of each unit price (if any) multiplied by the applicable number of units shown on the Bid Form. e. NOTICE TO SMALL BUSINESS FIRMS: A program for the purpose of assisting qualified small business concerns in obtaining certain bid, payment, or performance bonds that are otherwise not obtainable is available through the Small Business Administration (SBA). For information concerning SBA's surety bond guarantee assistance, contact your SBA District Office.

8A. CHARGE FOR SOLICITATION DOCUMENTS	8B. IS THIS CHARGE REFUNDABLE?	9. MAKE CHECK PAYABLE TO:
None	☐ YES ☐ NO N/A	N/A

10. ESTIMATED COST RANGE OF PROJECT		11. OFFERS COVERING THE PROJECT RESTRICTED TO SMALL BUSINESS?	12. SUBCONTRACTING PLAN REQUIRED?
A. FROM	B. TO		
000.00	$ 250,000.00	☐ YES ☒ NO	☐ YES ☒ NO

13. DESCRIPTION OF WORK (Physical characteristics)

Construction of an animal waste management system located approximately four (4) miles South of Dublin, Erath County, Texas.

OVER FOR CONTINUATION

(If additional space is needed use reverse)

IMPORTANT: FAILURE TO COMPLETE AND RETURN THIS PART OF THE NOTICE TO THE ISSUING OFFICE, AT THE ADDRESS IN ITEM 6A, ON OR BEFORE THE DUE DATE SHOWN IN ITEM 15, MAY RESULT IN YOUR NAME BEING REMOVED FROM OUR MAILING LIST.

14. ACTION REQUESTED (Check applicable box)		15. DUE DATE
A. I AM INTERESTED IN BIDDING ON THIS PROJECT AS A: ☐ PRIME CONTRACTOR ☐ PRINCIPAL SUBCONTRACTOR	B. I AM NOT INTERESTED IN BIDDING ON THIS PROJECT. RETAIN MY NAME ON YOUR MAILING LIST.	June 7, 1995
NO. OF SET(S) YOU REQUIRE OF SOLICITATION DOCUMENTS: Limit of one (1) set	C. REMOVE MY NAME FROM YOUR MAILING LIST.	16. PROJECT NO. SCS-8-TX-95

17. NAME, ADDRESS (City, State, ZIP Code) AND TELEPHONE NUMBER OF FIRM

____ SMALL BUSINESS ____ LARGE BUSINESS

____ MINORITY BUSINESS ____ WOMAN OWNED

18. NAME AND TITLE OF FIRM REPRESENTATIVE	19. SIGNATURE OF REPRESENTATIVE	20. DATE SIGNED

INSPECTION OF WORK SITE: A Pre-Bid Conference and Site Visit will be conducted:

Date: May 23, 1995

Time: 10:00 A.M. Local Time

Location: NRCS Watershed Constuction Office
221 East McNeill
Stephenville, Texas

DESCRIPTION: Construction of an animal waste management system consisting of a waste lagoon, constructed wetland, and waste storage pond. The project is located approximately 4 miles South of Dublin, Erath County, Texas. The work is to be completed within 79 calendar days after receipt of the Notice to Proceed. The Estimated Price Range is $100,000.00 to $250,000.00. All responsible sources may submit a bid which shall be considered by the agency.

ITEMS OF WORK - ESTIMATED QUANTITIES:

Filter Fabric Silt Fence 1,400 Lin. Ft.
Hay Bale Filters - 330 Lin. Ft.
Concrete - 82.0 Cu. Yds.
Reinforcement, Steel Bar - 4,337 Lb.
Reinforcement, Welded Wire Fabric - 3,430 Sq. Ft.
Pipe, PVC, Plastic, 1 1/4" - 985 Lin. Ft.
Pipe, PVC, Plastic, 3" - 2,310 Lin. Ft.
Pipe, PVC, Plastic, 6" - 155 Lin. Ft.
Pipe, PVC, Plastic, 8" - 210 Lin. Ft.
Pipe, PVC, Plastic, 10" - 380 Lin. Ft.
Pipe, PVC, Plastic, 12" - 40 Lin. Ft.
Underground Outlet - 4 Each
Fence, Barbed Wire - 2,925 Lin. Ft.

OTHER ITEMS:

Mobilization & Demobilization - 1 Job
Pollution Control - 1 Job
Construction Surveys - 1 Job
Dewatering, Waste Lagoon - 1 Job
Waterways - 1 Job
Excavation, Common - 1 Job (approximately 28,000 Cu. Yds.)
Earthfill - 1 Job (approximately 21,000 Cu. Yds.)
Contractor Quality Control - 1 Job
Wastewater Submersible Pump - 1 Job
Chisel Plowing - 1 Job
Disking - 1 Job
Application of Fertilizer - 1 Job
Mechanical Seeding - 1 Job
Hay Mulching - 1 Job

SOLICITATION NO. SCS-8-TX-95

O'BRYAN DAIRY WASTE MANAGEMENT SYSTEM
ERATH COUNTY, TEXAS

USDA-NATURAL RESOURCES CONSERVATION SERVICE (NRCS)

(formerly known as)
(USDA-Soil Conservation Service)

PRE-BID CONFERENCE & SITE SHOWING
MAY 23, 1995
10:00 A.M.

Conference Room
First National Bank of Dublin
825 N. Patrick
Dublin, Texas

BID OPENING: JUNE 9, 1995
2:00 P.M., LOCAL TIME

LOCATION: ROOM 134
USDA-Natural Resources Conservation Service
101 South Main Street
Temple, Texas

HAND CARRIED BIDS: PRIOR to 1:45 P.M. on the date specified for bid opening, bids may be delivered to the Contracts Section on the second floor of the NRCS office building.

FROM 1:45 P.M. until 2:00 P.M. on the date specified for bid opening, bids may be delivered to Bid Opening Officer in Room 134 on the first floor of the NRCS office building.

United States Department of Agriculture
Natural Resources Conservation Service
7300 N. Interstate Hy. 35
Temple, TX 76501

"DRAFT"

Subject:
ADS - Acquisition, Procurement, Contracts
Solicitation No. SCS-8-TX-95, O'Bryan Dairy Waste Management System
Erath County, Texas

Date: May 23, 1995

To:
James Stautzenberger
Contracting Officer
NRCS, Temple, Texas

File code: 120-11-11-13-5

A site showing was held on the subject site on May 23, 1995. Offerers present at the site showing are attached. The Service was represented by: James Stautzenberger, CO, Temple, TX; Thomas P. Beach, COTR, Temple, TX., Floyd Taylor, Construction Inspector, Temple TX., Others present Jerry Walker, Design Engineer, Tim Bushsa, Agricultural Engineer, ~~District Conservationist~~.

James Stautzenberger, CO, covered the first portion of the discussions concerning Contract Administration of the solicitation. I discussed the second portion of discussions concerning the Safety, Construction Specifications, Drawings, corrections, changes, and the Site visit.

The following items were discussed and emphasized at the site showing.

THE CONTRACT

H.11 ACCIDENT PREVENTION, SCS SUPPLEMENT TO OSHA PART 1926, page 17

The Contractor shall comply with applicable OSHA safety regulations 1926 The Contracting Officer will notify the Contractor of any noncompliance with these requirements. If the Contractor refuses to comply with these requirements all or part of the work will be stopped until corrective action is taken.

The Government Inspector will have delegated authority to suspend work for non compliance with safety requirements.

OSHA emphasizes several specific safety items which must be understood b the Contractor prior to bidding this job. Among these items are the requirements for:

1. First aid certificates,
2. First aid facilities,
3. Dust control,
4. Roll-over protective structures,

United States Department of Agriculture
Soil Conservation Service
101 South Main Street
Temple, Texas
76501-7682

June 14, 1995

Mr. Robert G. Buckley
Executive Director
Texas State Soil and Water
Conservation Board
P.O. Box 658
Temple, TX 76503-0658

Dear Bob:

Enclosed is your copy of the abstract of the bids for Solicitation No. SCS-8-TX-95 for the Nonpoint Source 319 Environmental Protection Agency grant "O'Bryan Dairy Waste Management System, Erath County, Texas."

The bids received in response to this solicitation were somewhat more than the NRCS Engineer's estimate of $167,000 for the construction effort. Please note that there was some uncertainty expressed by the contractors regarding the amount of organic materials in the existing lagoon that will be removed during construction. This most probably had an impact on prices.

However, the bids reflect current market conditions for this work as specified. Therefore, it is requested that additional funding be provided for this worthwhile demonstration project.

If it is possible to provide additional funding, it would be most helpful if such arrangements may be made by June 27, 1995. The most favorable time for construction is rapidly approaching and timely award and commencement of construction will facilitate the project work.

Sincerely,

Acting

HARRY W. ONETH
State Conservationist

Enclosure

cc w/enclosure:
Richard D. Babcock, ASC (Programs), NRCS, Temple, TX
Jack White, PM, Upper North Bosque HUA, NRCS, Stephenville, TX
James Moore, TSSWCB, Temple, TX
Carl Hutcherson, EPA/NRCS, Dallas, TX
James Stautzenberger, NRCS, Temple, TX
Petra Sanchez, EPA, Dallas, TX

04 DEC

United States Department of Agriculture
Natural Resources Conservation Service
7300 N. Interstate Hwy 35
Temple, Texas 76504-6624

Subject: ADS - Contracts - Final Inspection, Contract No. 50-7442-5-101, O'Bryan Dairy Waste Management System

Date: November 30, 1995

To: James E. Stautzenberger, CO
NRCS - Temple, Texas

A final inspection for the subject site, will be held on Thursday, December 7, 1995, at 10:00 AM. We will meet on site.

Thomas P Beach

Thomas P. Beach
Contracting Officer's Technical Representative

cc: L. Dennis Medlin, State Conservation Engineer, Temple
Dennis N. Clute, Project Construction Engineer, Temple
Herbert T. Cunningham, Jr., ASTC(FO), San Angelo
Randy Moore, DC, Stephenville F.O.
Jerry Walker, Waste Management Engineer, Temple
Jack White, Project Coordinator, Stephenville
Floyd Taylor, Construction Inspector, Stephenville
Roy Hufstutler Construction Co., Comanche, TX

(cc)

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
239 E. McNEILL
STEPHENVILLE, TEXAS
76401

UPPER NORTH BOSQUE RIVER HYDROLOGIC UNIT AREA PROJECT

December 6, 1995

To: Tom Cunningham
Assistant State Conservationist
NRCS, San Angelo

Re: 319 (h) Project - O'Bryan Constructed Wetland

I am pleased to announce the construction phase is completed with the "Final" review due Thursday, December 7, 1995 @ 10:00. Members of the State Office and contractor Roy Hufstetler will be present.

During my visits with Mr. and Mrs. O'Bryan, we verbally agreed any field days, tours or activities will be coordinated through me. This was to offset distractions during critical working times and prevent unscheduled visits. After all this is a working dairy and the animals are aware of additional activity.

The Project is completed and I would appreciate if you would pass this information along to the Management Staff. This is by no means an effort to prevent anyone from viewing the system, it's just a precaution Mr. and Mrs. O'Bryan and I agreed too. This procedure will ensure the continued good, friendly working relationship he has extended to all persons throughout the Project.

An invitation to view the system is always open to any office that would like to visit whether in San Angelo Zone or others.

I appreciate your assistance with this request as I do not want to jeopardize the current working relationship the O'Bryan's and I have developed.

Thanks,

Jack L. White
Upper North Bosque River HUA
Program Manager
NRCS, Stephenville

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
101 South Main
Temple, Texas
76501-7682

December 29, 1995

Larry M. Hauck, P.E.
Texas Institute for Applied Environmental Research
Tarleton State University
Tarleton Station, Box T-258
Stephenville, Texas 76402

Dear Larry:

The construction work on the O'Bryan dairy is just about completed and we will soon be planting the wetland cells. The monitoring phase of the 319 project will be getting underway shortly.

Before we can do monitoring and claim reimbursement for it, we must have the EPA approved Quality Assurance Project Plan (QAPP). Item II of Agreement No. 68-7442-5-249 states this is the responsibility of TIAER. Please give me a status report on when NRCS may receive the draft QAPP for review/comment.

Hope you had a great holiday season.

Sincerely,

Gene

EUGENE R. LINDEMANN, P.E.
Environmental Engineer

cc: Jack White, NRCS, Stephenville
Richard Babcock, NRCS, Temple
O'Gene Barkemeyer, NRCS, Temple
Norman Bade, NRCS, Temple
Jerry Walker, NRCS, Temple
James Alderson, NRCS, Temple

Appendix D

NVILLE
Empire-Tribune
November 28, 1994
Serving Stephenville, Dublin and Hico

Dublin test site announced

By BRIAN BETHEL
The Empire-Tribune

Indian Rock Dairy about six miles outside of Dublin may be soon be the focus of the entire dairy industry.

That's because the 249-cow dairy will be the subject of an Environmental Protection Agency study on manure management and odor control. And if it works, it could set new standards.

"That's the whole purpose [of the study], to see if there is a better, more economical method of waste and odor control," said Lloyd O'Bryan, owner of the dairy.

The project will be under the direction of Jack White, program manager for the Natural Resources Conservation Service, formerly the Soil Conservation Service.

The project will install a complete waste

Dublin dairy to participate in animal waste treatment study

management system on Indian Creek Dairy that adheres to guidelines set by the Texas Natural Resource Conservation Commission (TNRCC).

> *"We're very interested to see how [the test system] will turn out. It could help a lot of dairymen."*
>
> Lloyd O'Bryan
> Dairy owner

Waste water will be separated to remove solid particles, and will then enter a lagoon for a 140 to 160-day treatment period.

After the material exits the lagoon, it will be moved into specially constructed "wetland cells" — areas where aquatic plants and bacteria will treat the waste water, cleansing it further.

At the final stage of the process, the material will be placed in a waste storage pond for land application or recycling.

O'Bryan said the dairy conversion was scheduled to be put in place and in operation sometime in the early spring.

He said the dairy was planning to implement a similar program on its own, one of t primary reasons Indian Rock was chosen be an EPA demonstration dairy.

"We were planning to implement a wa management system," he said. "This progr will allow us to be a demonstration dairy fo system that may become widely used if i proven effective."

The success of the project depends on t effectiveness of nutrient usage. If the efflue is not degrading to the stream, then tl TNRCC may adjust its views on agricultu discharge under controlled conditions - especially if the project proves that was management practices can reduce, alleviate facilitate disposal.

"We're very interested to see how [the te system] will turn out," O'Bryan said. " could help a lot of dairymen."

Citizen

Dublin, Texas 76446

35¢

Thursday, November 24, 1994

EPA funds research project on local dairy

The Environmental Protection Agency has funded a dairy demonstration project on a Dublin dairy which could have far reaching implications for manure management and odor control.

Indian Rock Dairy, owned by Lloyd and Gloria O'Bryan, is located six miles south of Dublin on Fleming Road.

The project is designed to gather research data on aquatic vegetation to determine if treated water can be safely discharged into streams which is currently prohibited by Texas law.

"The project will install a complete waste management system adhering to the Texas Natural Resources Conservation Commission (TNRCC) requirements," said Jack White, program manager for the Natural Resources Conservation Service, formerly the Soil Conservation Service.

"Essentially, the waste water entering the system is separated to remove solids, then enters a lagoon for a 140-160 day treatment period. Exiting the lagoon, effluent reaches the constructed wetland cells where aquatic plants and bacterial action treat the waste water, then on to a waste storage pond for land application or recycling."

If the effectiveness of nutrient utilization is such the effluent is not degrading to the stream, then the TNRCC should take a look at allowing agriculture to discharge," he said.

The project attempts to demonstrate a waste management practice that may reduce, alleviate or facilitate waste disposal," he added.

1/4/12/94

EPA funds Dublin dairy demonstration project

The Environmental Protection Agency (EPA) has funded a dairy demonstration project on the Lloyd and Gloria O'Bryan (Indian Rock) Dairy located 6 miles south of Dublin on the Fleming Road. The demonstration will highlight the use of a constructed wetland to provide a polishing effect of wastewater. "The project will install a complete waste mangement system adhering to the Texas Natural Resources Conservation Commission (TNRCC) requirements" said Jack White, Program Manager of the Natural Resources Conservation Service, formerly the Soil Conservation Service. The constructed wetland is planned to treat wastewater by use of aquatic vegetation for nutrient removal. The project is designed to gather research data on aquatic vegetation to determine the degree of nutrient utilization of each specie. Innovations will be tested with manure management and odor control.

"Essentially the wastewater entering the system is separated to remove solids, then enters a lagoon for a 140-160 day treatment period. Exiting the lagoon, effluent reaches the constructed wetland cells where aquatic plants and bacterial action treat the wastewater, then on to a waste storage pond for land application or recycling" White said. "Texas being a no discharge state, will not allow discharge ot the receiving stream."

"If the effectiveness of nutrient utilization, and economic feasibility. Monitoring will characterize the quality and quantity of effluent from wetland cells to determine overall performance of the system. Economic feasibility and environmental response has not been examined because data constructed wetlands to influence water quality is the reason for interest demonstrate a waste manangement practice that may reduce, alleviate or facilitate waste disposal," said White.

**Jack L. White, Upper North Bosque River HUA*

Fisheries expert says Hybi don't pan out for Texas p

Texas pond owners should just say no to dealers who try to sell them hybrid mixes of bluegill and sunfish, according to a Texas A&M University fisheries expert.

Coppernose bluegill are a much better choice for Texas ponds and lakes, according to Joe Lock, fisheries specialist with the Texas Agricultural Extension Service in Overton.

Out-of-state dealers typically advertise that the hybrid panfish will reach weights of 2 1/2 to 3 pounds, but this claim rarely pans out, Lock said.

"I guess it's theoretically possible, but I've never seen it happen except where they are intensively fed. In the ordinary pond situation maybe one in 10,000 will get that large."

If not fed, the hybrids typically grow to about 1/4 pound. Some may reach a pound if the pond owner regularly feeds them, he said.

Another drawback is the stocked sunfish hybrid's first and subsequent spawns result in degenerate, off-type sunfish.

"Like any hybrid, they're what you might call reproductively hindered," Lock said.

The reverted sunfish are predators and will compete with young bass for food.

Coppernose bluegill, on the other hand, if stocked with bass, will grow to the same size as the hybrid sunfish, but will breed true and serve as a food supply for the bass. Plus, there are many Texas fish dealers who supply coppernose bluegills at a price comparable to that of the out-of-state hybrid sunfish.

Many pond owners are reluctant to stock ponds with bluegill because the species not only will spawn in the spring but also in the fall and summer. Pond owners fear bluegills will overpopulate the pond and crowd out bass and other fish by sheer weight of numbers.

Pond owners can easily avoid this scenario by following a few simple management rules, Lock said, such as not over harvesting bass during the first season of fishing and stocking the right

EPA to fund Dublin dairy demonstration project

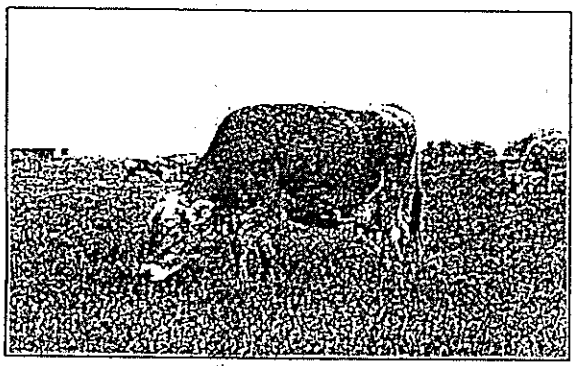
Effect of man-made wetland on wastewater to be studied

By MARY M. CRYER
Country World Staff

An innovative demonstration project is in the planning stages in Central Texas, where researchers will gather information about the use of man-made wetlands as a method of treatment for dairy wastewater runoff.

The experiment will be conducted on the Indian Rock Dairy in Dublin, which is owned by Lloyd and Gloria O'Brien, and will highlight the use of a constructed wetland to provide a polishing effect on wastewater, according to Jack White, program manager of the Natural resources Conservation Service (formerly the Soil Conservation Service).

"The project will install a complete waste management system adhering to the Texas Natural Resource Conservation Commission (TNRCC) requirements," White said.



An experiment of a man-made wetland that treats dairy wastewater runoff, similar to a test in Ohio, will begin in Dublin soon. Staff photo

The man-made wetland will treat the wastewater through nutrient removal by aquatic vegetation. Data will be collected on the plants to determine the degree of nutrient utilization of each species.

Researchers also plan to test other applications of the wetland, including manure management and odor control methods.

The project initiates an extensive monitoring scheme for understanding aquatic plant response, White said, as well as nutrient utilization and economic feasibility.

Though no work has been done on the project yet, those involved say the wetland will be up and running sometime this year.

Water coming off the wetland subdivisions, or cells, will be tested for quality and quantity to determine the overall performance of the system.

No research data on the economic feasibility and environmental response of using wetlands to treat dairy effluent is available, so this fact-gathering project is one of the first of its kind in the state.

Using a man-made wetland for animal waste control is not a new idea, however. Research studies have been completed in other states and scientists have found the method to be successful both in dairy and feedlot scenarios.

A feedlot located in Ohio uses a constructed wetland to treat runoff from the operation. The wetland covers more than 100 acres downhill from the feedlot.

Giant settling basins serve as collection sites for solid waste, and the runoff then flows downhill to the actual wetland, where it is further diluted with runoff from cropland.

The water does not become clean simply as a result of the dilution effect of the cropland runoff, nor is it purified by the aquatic plants alone.

A combination of those two factors and the cleaning action of the microbes attached to the stems of the plants and to the decaying matter on the bottom of the wetland serves to provide the filtering action needed to clean the water.

The Dublin project will use a setup similar to the one used by the Iowa feedlot.

"Essentially, the wastewater entering the system is separated to remove solids, then enters a lagoon for a 140-160 day treatment period," White said.

"Exiting the lagoon, effluent reaches the constructed wetland cells where aquatic plants and bacterial action treat the wastewater, then on to a waste storage pond for land application or recycling," he said.

Since Texas is a no-discharge state, White continued, the law does not allow discharge of the wetland-treated wastewater into a receiving stream. But if the aquatic plants remove nutrients and return the water to an acceptable state, it is possible that those rules may change.

"If the effectiveness of nutrient utilization is such that the effluent is not degrading to the receiving stream, then the TNRCC

should take a look at allowing agriculture to discharge," White said.

Use of wetlands for water tr[illegible]ment has advantages [illegible] advantages, and the [illegible] ill provide a chance to [illegible]uate each.

Benefits include odor reduction and reduction of land needed for spreading activity, say Iowa researchers involved in the feedlot project.

> **"The ability of constructed wetlands to influence water quality is the reason for interest in research and evaluation for use on wastewater management."**
>
> Jack White, TNRCC program manager

In fact, by reducing the amount of nitrogen in the effluent, they have found the waste odor to be reduced by over 35 percent.

Development of a two-acre wetland can reduce the amount of land needed by more than 75 percent, stud[illegible]e shown, which can [illegible] an option for those d[illegible]n who don't have the land base needed for spreading activity.

Some detractors of the water treatment method say that by removing the nutrients from the water, fertilizing with the wastewater is not an option.

Rules and regulations governing the use of wetlands for this purpose are not complete, but regulators will be studying the option closely.

"The ability of constructed wetlands to influence water quality is the reason for interest in research and evaluation for use on wastewater management," White concluded.

"It attempts to demonstrate a waste management practice that may reduce or alleviate a serious waste disposal problem.

Cows have keener senses of hearing and s[illegible]ll than humans. [illegible]he help of a stiff breeze, a cow can detect odors from six miles away.

Winter grazing has some risks

Plans for turning cattle out to graze an alfalfa field in winter should be accompanied by plans for preventing bloat as they begin consuming the palatable forage.

The safest grazing time is during late fall and winter after most alfalfa foliage has been frozen by a hard freeze. The most dangerous time for bloat is when recent lush growth has been frosted with light freezes, points out John Caddel, Oklahoma Cooperative Extension Service alfalfa specialist.

Various alfalfa producers use several practices to try to prevent bloat when cattle are grazing their fields in winter. Some practices that have been effective in various situations include:

- Providing a commercial bloat prevention for several days before grazing and continuing it for several days into grazing.
- Filling cattle with dry grass or hay before turning the out on alfalfa.
- Checking cattle several times a day at the start of grazing.
- Giving cattle a choice of also eating dry feed or fairly mature grass when grazing alfalfa.
- Not turning hungry cattle onto lush alfalfa any time.
- Not turning cattle out to graze alfalfa early in the morning.

LLOYD AND GLORIA O'BRYAN DAIRY

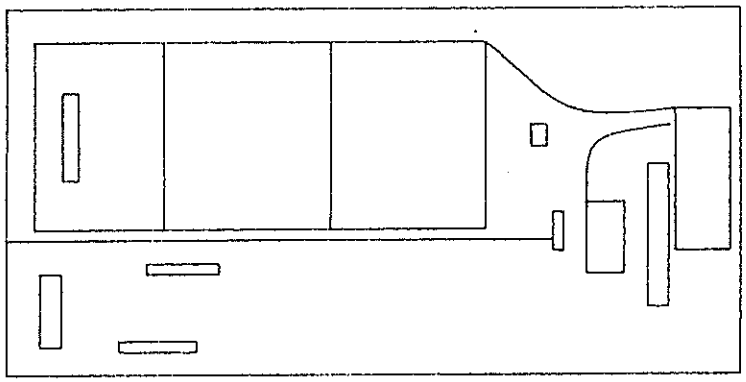
DEMONSTRATING INNOVATIVE TECHNOLOGY IN PROTECTING NATURAL RESOURCES

PROJECT OBJECTIVES:

DEMONSTRATE A CONSTRUCTED WETLAND AS AN ANIMAL WASTE MANAGEMENT SYSTEM COMPONENT

PROJECT OBJECTIVES:

EVALUATE ROLE OF NATURAL TREATMENT PROCESS TO CONTROL NONPOINT SOURCE POLLUTION



COOPERATIVE EFFORT:

NATURAL RESOURCES CONSERVATION SERVICE

TEXAS AGRICULTURAL EXTENSION SERVICE

ENVIRONMENTAL PROTECTION AGENCY

TEXAS STATE SOIL AND WATER CONSERVATION BOARD

TEXAS INSTITUTE FOR APPLIED ENVIRONMENTAL RESEARCH

Upper North Bosque

Hydrologic Unit Area Project

Background: The Upper North Bosque River Hydrologic Unit Area (HUA) Project is a cooperative effort aimed at assisting agricultural producers in reducing nonpoint source water pollution. State and federal agencies are targeting their resources and working cooperatively with producers, commodity organizations, city and county officials, and the general public to improve water quality. The project is located in central Texas.

Objectives: The primary goal of the project is to reduce fecal coliform and nutrient levels in the Upper North Bosque River. Project personnel provide educational, technical, and cost-share assistance to dairy producers on design and implementation of dairy waste management systems. Demonstrations of efficient dairy waste management systems that help in achieving pollution control are important to the project goals. In addition, educational programs also are offered to rural and urban homeowners on the adoption of best management practices (BMPs) that protect surface and ground water quality.

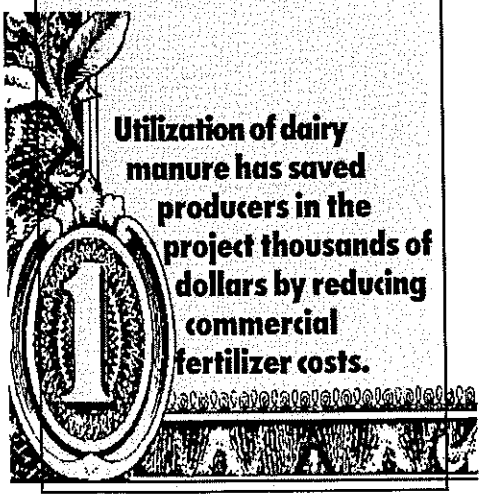
Project Size: 290,040 acres

Start Date: 1990

Counties: Hamilton and Erath

Land Use: 24.1% Pastureland, 9.0% Cropland/ Hayland, 7.3% Urban, and 59.6% Other

Production: Dairy products, peanuts, hay, orchard crops, and beef cattle

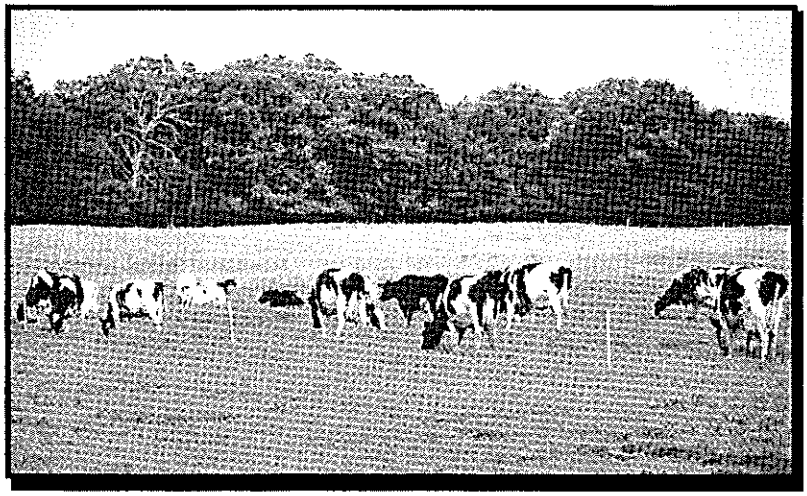


Proven Impacts:

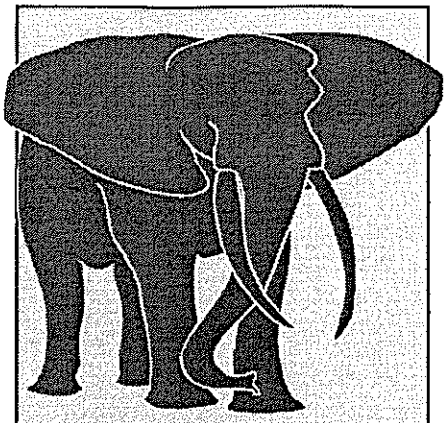
- Stream monitoring from 1991 through 1994 revealed an average reduction of 75% of fecal coliform and a 77% reduction of nitrate.
- Approximately 44,541 tons of dairy manure have been effectively utilized on 2,531 acres of cropland each year as a result of producer adoption of waste utilization, proper waste application rates, and year-round forage systems.
- Demonstration activities have shown that approximately 50% of the nitrogen applied from manure is available to crop plants the first year of application.
- Adoption of waste utilization, soil testing, and nutrient management plans by 40 dairies in the project has resulted in the utilization of an estimated 1,781,640 pounds of previously unused or under used nitrogen from manure.
- Adoption of waste utilization, soil testing, and nutrient management plans by 40 dairies in the project has resulted in the utilization of an estimated 890,920 pounds of previously unused phosphorus in manure.
- Adoption of waste utilization, soil testing, and nutrient management plans by 40 dairies in the project has resulted in the utilization of an estimated 2,004,345 pounds of previously unused potassium from manure.
- Since 1991, an estimated $445,410 has been saved through the use of dairy manure instead of commercial nitrogen fertilizer.
- Through the use of dairy manure, an estimated $222,705 has been saved in the reduction of commercial phosphorus application since the inception of the project.
- Producers in the project, who are using dairy manure as fertilizer, have saved $400,869 with the reduction of potassium inorganic fertilizer usage since 1991.
- Eleven dairies in the project have adopted water conservation practices that have reduced ground water consumption by an average of two gallons per cow per day with a cumulative reduction of 154 acre-feet of ground water per year.
- Water conservation practices adopted by 11 dairies in the project have resulted in a cumulative reduction of 4,553,010 gallons of wastewater produced per year.
- Reductions in ground water use and wastewater production have resulted in an electricity savings of about $350 per dairy per year on 11 dairies in the project.
- Adoption of pasture and hayland planting by 37 producers on 1,400 acres in the project has resulted in a reduction of 16,800 tons of sediment loss from the edge-of-field.

Recycling water from milking equipment and tractor-scraping manure and wastes from feeding lanes rather than flushing with water has reduced water consumption by 68% in an 850 cow dairy.

- 28 dairies in the project planted winter cover crops on 1,060 acres of waste disposal fields. This practice has resulted in an estimated reduction of 16,960 pounds of nitrogen loss.
- 57 dairies have installed 91 waste storage ponds that remove an average 70% of the total solids from dairy wastewater.



Dairy cattle in the project area enjoy a cleaner and safer environment through BMPs being implemented by producers.



By planting winter crops, producers have reduced nitrogen loss by the amount of 16,960 pounds – approximately two full-grown elephants.

Ongoing Activities:

- The Southwest Dairy Field Day that the project hosts every other year is attended by over 700 producers and exhibitors.
- Educational materials and programs reach over 20,000 people each year.
- The project has had over 166 media items and 19 newsletter segments since its beginning in 1991.
- Water quality and environmental concern discussions are given twice each year by project personnel to agricultural students at a local high school.

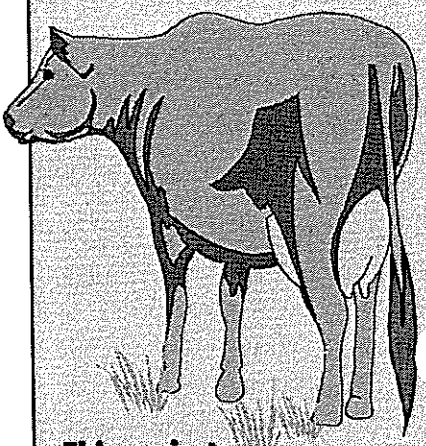
Water quality monitoring is done in cooperation with U.S. Geological Survey and the Brazos River Authority.

Ongoing Activities, continued:

- Four computer software programs that have been developed within the project are still in use. These programs primarily help with manure and water worksheets.
- TEX*A*Syst, a pollution risk assessment program, has been used to provide producers with information regarding farmstead and wellhead protection.
- Continuing project demonstrations include an irrigation scheduling and soil moisture monitoring demonstration with three peanut produers, a vegetative filter-strip demonstration to minimize nutrient and sediment loss from fields, an annual forage system demonstration on annual ryegrass, sorghum-sudangrass, and sorghum-sudangrass/wheat rotation, and an integrated pest management demonstration evaluating biological, chemical, and mechanical control of fly populations on dairy farms.

Project Perspective:

- This project encompasses the only wetland in Texas specifically maintained for dairy waste.
- Results of this project to date clearly show agricultural producers' willingness to implement needed practices to protect the environment when they are provided with adequate information about the need coupled with educational and technical assistance to facilitate implementation. Financial assistance also has been invaluable in some cases.



This project has the only dairy waste wetland in the state.

This project is a joint venture of the Texas Agricultural Extension Service and the U.S. Department of Agriculture Cooperative State Research, Education and Extension Service, Natural Resources Conservation Service and Consolidated Farm Service Agency in conjunction with the Texas State Soil and Water Conservation Board and local districts. Other cooperating agencies include the U.S. Environmental Protection Agency, the U.S. Geological Survey, the Texas Natural Resource Conservation Commission, the Brazos River Authority, the Tarleton Institute of Applied Environmental Research, and the Texas Agricultural Experiment Station.

Funds for this publication were derived partially from support by the Cooperative State Research, Education and Extension Service, U.S. Department of Agriculture under special project number UNBR-94-EHUA-1-0109.

8:20 a.m. Nonpoint Source Pollution Program in the Clean Water Act Reauthorization and Related Programs of the Environmental Protection Agency. Petra Sanchez, *EPA Region VI, Dallas, TX.*

8:40 a.m. New Subchapter K Regulations. Mark McFarland, *TNRCC, Austin, TX.*

9:00 a.m. Nonpoint Source Pollution and Related Programs of the Texas Agricultural Extension Service. Bruce Lesikar, *TAEX, College Station, TX.*

9:20 a.m. National Perspectives Regarding Extension Water Quality Programs. Andrew Weber, *CSREES, Washington D.C.*

9:40 a.m. National Perspectives Regarding Natural Resources Conservation Service Water Quality Programs. Dan Smith, *NRCS, Washington, D.C.*

10:00 a.m. Break

Session IV Moderator
Charles "Buddy" Clark
Texas State Soil and Water Conservation Board
Menard, TX

10:20 a.m. Perspectives of Agriculture's Response to Nonpoint Source Pollution. John Sweeten, *TAEX, College Station, TX.*

10:40 a.m. Lake Fork Creek Hydrologic Unit Area Project. Ed Hanslick, *TNRCC* and Billy Brown, *TAEX, Sulphur Springs, TX.*

11:10 a.m. Upper North Bosque River Hydrologic Unit Area Project. Amy Kinney, *TAEX* and Jack White, *NRCS, Stephenville, TX.*

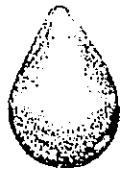
11:40 a.m. Discussion

12:00 p.m. Adjourn

Agencies Involved

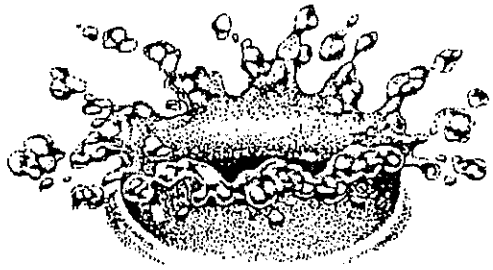
TAEX - Texas Agricultural Extension Service
NRCS - Natural Resources Conservation Service
CFSA - Consolidated Farm Service Agency
TSSWCB - Texas State Soil and Water Conservation Board
TNRCC - Texas Natural Resources Conservation Commission
CSREES - Cooperative State Research, Education and Extension Service
TAES - Texas Agricultural Experiment Station
EPA - Environmental Protection Agency
USGS - United States Geological Survey
TFB - Texas Farm Bureau
TWDB - Texas Water Development Board

1995 USDA and State of Texas Water Quality Projects Review



Kiva Inn
Abilene, TX

May 30, 31 and June 1, 1995



1995 USDA and State of Texas Water Quality Projects Review

Kiva Inn
Abilene, TX

May 30, 31 and June 1, 1995

Tuesday, May 30

12:00-1:00 p.m. *Registration*
(outside Ballroom, Kiva Inn)

Session I Moderator
B. L. Harris
Professor and Soils Specialist
Texas Agricultural Extension Service
College Station, TX

1:00 p.m. Opening Remarks and Introductions.

1:10 p.m. Seco Creek Water Quality Demonstration Project. Philip Wright, *NRCS* and Tim Steffens, *TAEX, Hondo, TX.*

1:40 p.m. Juniper Control Consequences for Water Conservation. W. Dugas, *TAES, Temple, TX.*

2:00 p.m. USGS Water Quality Studies in Seco Creek. David Brown, *USGS, San Antonio, TX.*

2:20 p.m. Incorporating Water Quality Project Activities into County Programs. Wayne Scholtz, *TAEX,* and Lynn Post, *NRCS, Hondo, TX.*

2:40 p.m. Agricultural and Silvicultural "319" Nonpoint Source Programs of the Texas State Soil and Water Conservation Board. Bo Spoonts, *TSSWCB, Temple, TX.*

3:00 p.m. Break

Session II Moderator
Allan Colwick
State Water Quality Coordinator
Natural Resources Conservation Service
Temple, TX

3:20 p.m. Texas Farm Bureau Statewide Water Quality Survey Results. Ned Meister, *TFB, Waco, TX.*

3:40 p.m. Consolidated Farm Service Agency Water Quality Cost-Sharing and Related Programs. Darrel Davis, *CFSA, College Station, TX.*

4:00 p.m. TEX*A*Syst Wellhead Protection Program. Frank Mazac, *TAEX, College Station, TX.*

4:20 p.m. Seymour Aquifer Hydrologic Unit Area Project. Danny Lambert, *NRCS* and Bo Whittaker, *TAEX, Haskell, TX.*

5:00 p.m. Corpus Christi Bay Watershed Modeling Program. Charles Baird, *NRCS Temple, TX.*

5:20 p.m. Water Quality Programs of the TX Water Development Board. Robert Ozment, *TWDB, Austin, TX.*

5:40 p.m. Discussion

6:00 p.m. Adjourn

Wednesday, May 31

8:00 a.m. ***Depart from front of Kiva Inn on buses for tour of Seymour Aquifer Hydrologic Unit Area Project.*** Tour guides - Danny Lambert, *NRCS,* Bo Whittaker, *TAEX* and Max Stapleton, *TAEX.*

6:00 p.m. Return to Kiva Inn

Thursday, June 1

Session III Moderator
Darrel Davis
Chief of Conservation Division
Consolidated Farm Service Agency
College Station, TX

7:50 a.m. Review of tour and introductions

8:00 a.m. Nonpoint Source Pollution Programs of the Texas Natural Resources Conservation Commission. Arthur Talley,
TNRCC, Austin, TX.

United States Department of Agriculture
Soil Conservation Service
101 South Main Street
Temple, Texas
76501-7682

SUBJECT: INF - Trip Report 6-8-95

TO: H. Harold Bryant FILE CODE: 260
State Public Affairs Specialist

On June 5th, I used the watershed model to educate teachers about nonpoint source pollution at the Summer Institute in Stephenville. The Summer Institute is a teacher workshop sponsored by the Farm Bureau. Twenty-three elementary school teachers from across the state attended the week long workshop. The Institute was created to teach the teachers about agriculture. They were very enthusiastic about my program and each of them received a teacher packet.

I worked with Jack White, project manager for the Upper North Bosque River Hydrologic Unit Project, on several information items on May 6th:

1. We finalized arrangements for May 7th's media tour of constructed wetlands.

2. We designed a series of interchangeable displays for specific identified audiences to be used on a table top Skyline display.

3. I advised Jack on different aspects of purchasing a Skyline display and put him in contact with a Skyline representative.

4. We began planning a workshop for the sixth grade students in Erath County for next spring. The workshop will focus on water quantity and water quality.

On June 7th; Jack White, Ronnie Boston, and I gave an exclusive tour to the agriculture reporter for the Waco Tribune Harold newspaper. This tour of constructed wetlands resulted from talking with the reporter while he covered another NRCS event held at Waco in May.

Jack White did an excellent job of orchestrating the tour. After I informed Jack of the reporter's interest in constructed wetlands and the idea of the tour, he arranged for the various technical experts to attend and the site locations.

The tour was great. It covered constructed wetlands at a home, on a dairy, on an industrial site, and even a trial constructed wetland designed to treat a subwatershed. The reporter left with a greater understanding of constructed wetlands and with a greater appreciation of our agency, the work we are doing, and the partnerships we have formed to better address major conservation issues in Texas.

The reporter was very enthusiastic about what he had learned about constructed wetlands. He originally came for a story, but when he left, he stated he would make it into a series of feature stories covering various aspects of constructed wetlands. The first feature story is to appear in this Sunday's paper on June 11th.

Gail T. Chandler

GAIL T. CHANDLER
Public Affairs Specialist

cc: Kenton Ingles, DSC, Temple
Kanand Brooks, AC, Stephenville AO
Jack White, HUP Mgr., Stephenville AO
Ronnie Boston, RC&D, Glen Rose
Daniel Parr, Acting DC, Stephenville FO

Wetlands eyed for N. Bosque waste

Tank would process bacteria from upstream cattle

By ANDREW L. KILPATRICK
Tribune-Herald staff writer

STEPHENVILLE — Researchers and engineers are studying the use of constructed wetlands as a way to process pollution in the North Bosque River, particularly the waste from cattle in upstream Erath County.

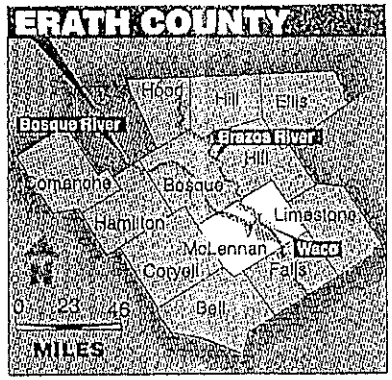
The dairies of Erath County are among the major polluters of the river. Unprocessed waste from the county's 70,000 cattle can get into the creeks when it rains, then make its way into the Bosque and downstream to Lake Waco, which supplies Waco's drinking water.

At places along the North Bosque, the amount of fecal coliforms — bacteria found in the bowels of warmblooded animals — is five times the government-suggested limit.

A constructed wetland would help process waste from dairies, municipalities and agricultural land to improve the quality of water in the North Bosque.

The Upper North Bosque Hydrologic Unit Project draws from the resources of the Texas Agricultural Extension Service, the Natural Resources Conservation Services and the Consolidated Farm Services Agency.

In the last few years, the Brazos River Authority, the agency that manages the North Bosque, has studied the water quality of the river and found heightened



Staff graphic- J. Jeffers

levels of fecal coliforms.

Fecal coliforms are used to gauge if animal waste is getting into a river. A water sample is filtered, and the filter paper is placed on a culture in a petri dish. The surveyor then counts the number of colonies that grow in the culture. Government officials have determined how many colony-forming units per part of water a river can handle.

"The stream standards are 200 colony-forming units for 100 milliliters of water, and at three sites in the North Bosque, water exceeded 1,000 cfus," said Carla Guthrie, a BRA water quality technician. "About 40 percent of our (testing) sites equal or exceed stream standards 50 percent of the time."

The amount of nitrates and phosphates, or nutrients, in the river was down this year, but Tom Conry, a BRA water quality planner, warns that the previous data were collected when the river was running high and the current data when it was down. The

Please see WATER, Page 4A

June 12, 1995

WATER

Constructed wetlands studied for N. Bosque

☐ From Page 1A

river tends to stir the nitrates and phosphates off the bottom when the river has a high flow.

The cattle are not the only source of pollution for the Bosque. There are seven waste water treatment plants along the river and rural septic systems that do not work properly, and fertilizer on crops and lawns washes into creeks during rain.

A river is able to process a certain amount of pollutants naturally, so one of the keys to protecting a river is to control the pollutants that get into it.

There are three ways to clean wastewater, said Joe McFarland, a researcher at Stephenville Agricultural Research and Extension Service: the traditional wastewater treatment plant; land treatment, in which waste is collected and sprayed in controlled amounts on a field; or a constructed wetland.

At a research station in Stephenville called the SWAMP — Stephenville Wetlands Applications Management Project — McFarland and other scientists are working on making constructive wetlands effective in this area.

A constructed wetland is basically a tank with plants that absorb nutrients and microorganisms that break down impurities in the water as it flows through it. The water may be visible, or it may flow inside a gravel pit.

To demonstrate nature's ability to clean water, McFarland drew several jars of water from a series of ponds that are in the SWAMP. The water from the first pond was a dark green, but with each successive pond the water paled.

McFarland would like to see this process mimicked in a constructed wetland currently being built in the SWAMP.

Bruce Lesikar, an extension agricultural engineer who designs constructed wetlands, said researchers will look for plants that will be effective in the Texas weather and will study the rate at which the water needs to pass through the wetland.

Jack White, who works with the Natural Resources Conservation Service, and Amy Kinney of the Texas Agricultural Extension Service are working on a constructed wetland to be put in at a dairy in Erath County.

The waste will be washed out of the dairy and collected in a lagoon, then run through a constructed wetland before going to another lagoon.

The water then will be pumped back to the dairy, where it will be used to wash out the waste. The animal waste is held and processed at the farm and does not flow off in a creek, White said.

If successful, the design could be used at dairies to prevent runoff and protect rivers from pollution.

Another source of pollution is failed septic systems in rural areas. Constructed wetlands are being used in a couple of homes in the Stephenville area.

The wastewater from the home is collected in a tank and then run through a lined pit filled with gravel, Lesikar said. The pit has plants in it that absorb nutrients and micro-organisms on the rocks that break down the impurities.

The water is collected at the end of the wetland and then used to irrigate a garden through an underground pipe.

The systems are in use elsewhere in the country, and their main obstacle in Texas is that contractors lack experience installing them, Lesikar said.

Staff photo — Andrew L. Kilpatrick

Jack White (from left), Amy Kinney, Bruce Lesikar and Ronnie Boston, who make up part of a team studying constructed wetlands in Stephenville, stand on a constructed wetland that processes the waste from the home behind them.

NEWS RELEASE

USDA-NATURAL RESOURCES
CONSERVATION SERVICE
Gail T. Chandler
(817) 774-1228

Immediate Release

STEPHENVILLE, TX, AUGUST 28, 1995---Lloyd and Gloria O'Bryan of Dublin, Texas, are modern-day pioneers in the area of water quality in the dairy industry. They are currently building the first constructed wetland in the state of Texas designed to treat dairy animal waste.

A dedication ceremony and tour of the innovative wetland was held Monday at the O'Bryan Dairy which is located four miles south of Dublin in Erath County. State Representative Arlene Wohlgemuth of District #58 and State Conservationist Wes Oneth of the USDA-Natural Resources Conservation Service (NRCS) were among the many dignitaries attending the ceremony and tour sponsored by the Cross Timbers Soil and Water Conservation District and the Upper Leon Soil and Water Conservation District.

Currently in use to treat municipal waste water in several Texas communities, constructed wetlands are not yet approved to treat effluent from confined animal waste systems. According to Jack White, NRCS Project Manager for the Upper North Bosque River Watershed RUA; this project will demonstrate the performance and feasibility of using constructed wetlands as an animal waste management system. Dairy operators throughout the state will be able to see

first hand how constructed wetlands improve water quality and increase their economic returns. Jerry Walker, NRCS engineer who designed the constructed wetland, stated construction on the project should be completed by mid-October.

Most of the funding for this new and innovative project was provided by the Environmental Protection Agency. Petra Sanchez, environmental scientist with EPA said, "We (EPA) are glad to fund these types of projects which promote the voluntary aspect and offer landowners alternatives to solve environmental problems. People will choose the best option to solve their problems, if they are offered a choice," Sanchez added.

Larry Hauck, research scientist for the Texas Institute for Applied Environmental Research (TIAER) informed the audience, "We need as many animal waste management alternatives as possible for flexibility. One size does not fit all when it comes to animal waste management systems. Constructed wetlands are a new technology and little data exists. TIAER will closely monitor this project which will provide much of the research data needed in this area," Hauck concluded.

According to John Compher of the Sierra Club, "This is one of the greatest environmental advances in the dairy industry in a long time." Compher added the Sierra Club is very interested in the environmental impacts of this project.

After touring the O'Bryan Dairy constructed wetland; Amy Kinney, Texas Agricultural Extension Service Project Manager for the Upper North Bosque River Watershed HUA, led State Representative Wohlgemuth and others to additional sites where new and innovative technology is being applied to improve water quality in the Upper North Bosque River watershed.

The O'Bryan Dairy constructed wetland project is sponsored by EPA, USDA-NRCS, Texas Agricultural Extension Service, Texas State Soil and Water Conservation Board, Upper Leon Soil and Water Conservation District, and the Cross Timbers Soil and Water Conservation District.

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CONSTRUCTED WETLAND FOR DAIRY ANIMAL WASTE

Indian Rock Dairy
Dublin, Texas
August 28, 1995
9:30 a.m.

WELCOME, INTRODUCTION, AND DEDICATION:

Norman Moore.....Chairman of the Board
Upper Leon Soil & Water Conservation District

SPEAKERS

Wes Oneth.....State Conservationist, Natural Resources Conservation Service

Petra Sanchez.....Environmental Scientist
Environmental Protection Agency

Allan Colwick.....Water Quality Coordinator
Natural Resources Conservation Service

James Moore.....Engineer
Texas State Soil and Water Conservation Board

Amy Kinney.....Extension Associate, Project Manager, Texas Agricultural Extension Service
Upper North Bosque River Project

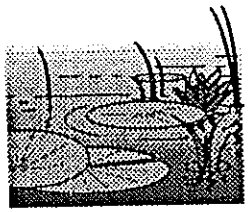
Larry Hauck.....Research Scientist, Texas Institute for Applied Environmental Research

Lloyd O'Bryan.....Dairyman and Owner of Indian Rock Dairy

TOUR OF PROJECT:

Jerry Walker.....Project Engineer, Natural Resources Conservation Service

REFRESHMENTS.....Furnished by Dr. Pepper
Dublin, Texas



Project Description

The first of its kind in the state, this constructed wetland for dairy animal waste is designed to improve water quality. Constructed wetlands are currently in use to treat municipal waste water in Texas, but are not yet approved to treat effluent from confined animal waste systems.

This project will demonstrate the performance and feasibility of using a constructed wetland as an animal waste management system. Dairy operators throughout the state will be able to see first hand how constructed wetlands improve water quality and increase their economic returns.

Assignments of this project are to plan, design, and construct an appropriate water quality management system utilizing constructed wetlands to treat dairy animal waste; collect and analyze waste water samples; determine the economic feasibility of the project; certify the use of constructed wetlands for dairy animal waste management systems; and to launch a comprehensive education campaign.

Sponsors of the Constructed Wetland Project

Environmental Protection Agency
USDA-Natural Resources Conservation Service
Texas Agricultural Extension Service
Texas State Soil and Water Conservation Board
Upper Leon Soil and Water Conservation District
Cross Timbers Soil and Water Conservation District

NAME	Address	AGENCY
Allan Colwick	101 S. Main Temple	NRCS
Dennis Medlin	" " "	"
JERRY Walker	#2 Sextant	NRCS
Mike James	1004 Lime Rock DR. Round Rock TX 78681	JEM Inc.
Jan James	Rt 1 Box 78J Comanche, Tx,	Upper Leon SWCD
Nancy Jewell	Stephenville	NRCS.
Donnell Hays	Dublin	TSSWCB
~~Steven Jones~~	Dublin	TSSWCB
Bo Spoonts	311 N. 5th, Temple	TSSWCB
Todd Oneth	Stephenville	TSSWCB
Larry Hauck	PO Box T-0410 Stephenville	TIAER
JAMES MOORE	P.O. Box 658 TEMPLE	TSSWCB
Suzanne Cardwell	TSSWCB, Temple TX	
DEE CARLSON	TSSWCB Temple	
Arlene Wohlgemuth	PO Box 609 - Burleson, TX	TX. HOUSE
[illegible]	P.O. Box 91 Morgan Mill Tx	
[illegible]	" "	
MARK KLOSTER	P.O. Box 307 Dublin	Dublin C of C.
Van N. Walker	P.O. Box 7555 Waco	Brazos River Authority
Gail Chandler	101 S. Main, Temple	NRCS
John Compton	1608 Velma, Copperas Cove	Sierra Club
Doug [illegible]	6'' [illegible]	TIAER AND
[illegible] Sewell	401 Grand	
Larry Fisher	1445 Ross Ave, Dallas, Tx	EPA
[illegible]	Rt 2 Box 770 - STEPHENVILLE,	AG KONE
Troy Baughman	NRCS	Temple
Bill Powell	~~NRCS~~ Stephenville	Stephenville NRCS

Pedro Sanchez EPA/1445 Ross Ave
Suite 1200 Dallas 75202

Carl Hutcherson 1445 Ross Ave. Dallas Tx EPA/NRCS

New technology to help solve Erath dairy dilemma

BY BARRY SHLACHTER
Fort Worth Star-Telegram

Erath County, which produces huge amounts of effluent at its 200 dairy farms, moved closer yesterday toward new technology to treat what has been a difficult issue for the area.

Federal and state officials dedicated a constructed wetland that, when completed by mid-October, will take effluent from Lloyd and Gloria O'Bryan's Indian Rock Dairy Farm and turn it into clean water, said Gail Chandler, a spokeswoman for the U.S. Department of Agriculture's Natural Resources Conservation Service.

Similar man-made wetlands have been used to clean industrial and municipal wastes. Other farm-related pilot projects have begun in Wisconsin, Mississippi and Oregon. But the Erath County wetland is the first in Texas, said Randy Moore, the service's district conservationist for Erath County.

John Compher, an executive committee member of the Sierra Club's Texas chapter, praised the constructed wetland approach as "one of the greatest environmental advances in the dairy industry in a long time."

"We're real expectant with this approach," said Compher, a retired Army photographer. "I think it'll work — at least at this dairy farm. It's a far cry from the lagoon system that the dairy farms are using today. It can be a great advantage for the Leon and Bosque watershed and a great place for waterfowl."

In recent years, environmentalists have contended that runoff from Erath County dairies has polluted water supplies downriver. Moore said that nearly all of the county's dairies now have waste-management systems that meet required standards, or are working toward them.

At the O'Bryans' farm, the waste will first go into a primary lagoon system where it will be broken down by microorganisms into a murky water. The fluid will then flow through three gravity-fed, clay-lined "wetland" ponds where cattails, bulrushes and other vegetation will further purify it. The resulting water can then be recycled on the farm, Moore said.

Monitoring will be conducted by Tarleton State University's Institute for Applied Environmental Research. The project is being funded mainly by the Environmental Protection Agency with some additional support from the Texas State Soil and Water Conservation Board.

"It's on the cutting edge," said Gloria O'Bryan, who also runs the Daylight Donut Shop in Dublin. "What I'm excited about is that it could change the whole way people dairy. And it could solve a whole lot of problems — not just at dairies but reach into hog operations, all kinds of wastes."

TEXAS A&M UNIVERSITY
Department of Wildlife & Fisheries Sciences

18 December 1995

Mr. Jack White
USDA-NRCS
239 E. McNeill
Stephenville, TX 76401-4390

Dear Jack:

With this letter I would like to extend to you an invitation to participate in the Second National Workshop on Constructed Wetlands for Animal Waste Management in Fort Worth, Texas, 15-18 May 1996. I would like you (and Amy Kinney) to consider participating in the field tour in Erath County on Thursday, 16 May, and discuss your ongoing project on constructed wetlands for dairy wastewater at the O'Brien Dairy. The talk would be 30 minutes in length (20-25 minute talk plus 5-10 minutes for questions). Additionally you (and Amy) would lead the tour of your constructed wetland site. You would need to prepare a paper which can be published in the proceedings (and an abstract which we can provide attendees at the conference).

In exchange for your participation, I can pay for your travel and hotel room, and I also can provide money for per-diem expenses ($140) and several copies of the proceedings. Unfortunately, I am unable to provide you with an honorarium.

I will contact you to see if it would be possible for you to participate in the workshop. Please consider joining us in Fort Worth. I look forward to your talk on constructed wetlands.

Sincerely,

Paul J. DuBowy, Ph.D.
Associate Professor

Room 210, Nagle Hall • College Station, Texas 77843-2258 • (409) 845-5777; FAX (409) 845-3786 • EM: p-dubowy@tamu.edu

Constructed wetland cells to treat non-point source pollution.

Upper North Bosque River Hydrologic Unit Area Project

Annual Project Report

Fiscal Year 1995

Managing Dairy Waste with Constructed Wetlands

Jack L. White
USDA Natural Resources Conservation Service
Stephenville, Texas

J. D. Walker and E. R. Lindemann
USDA Natural Resources Conservation Service
Temple, Texas

A massive effort is currently underway in Texas to discover efficient and cost-effective methods of managing animal waste. The first of its kind in Texas, this project evaluates the use of a constructed wetland to treat dairy effluent. It specifically appraises the constructed wetland, used in conduction with other best management practices, as a component of a dairy waste management system.

Eight wetland cells, 22 ft. x 176 ft., bottom dimension, were constructed on a diary in Erath County in December 1995, and planted to aquatic plants in March 1996. Monitoring began in 1997. Ten laboratory parameters and four field parameters are being monitored at 18 sampling sites. Data is being gathered to update design procedures and test water quality tolerance of wetland species. The project will also evaluate existing NRCS engineering design procedures, system performance, treatment efficiency of aquatic plants, and system operation and maintenance requirements.

Treatment of dairy animal waste begins when water flushes the feedlane, carrying manure to a catch basin. Water and effluent then drain to a settling basin where manure solids are allowed to settle to the bottom while evaporation removes some of the liquid from the effluent. Milking parlor wastewater bypasses the catch basin and enters directly into the settling basin. Next, liquid from the settling basin drains to the anaerobic treatment lagoon where it is processed for 100 days. At this point, the wastewater flows through four pair of wetland cells where aquatic plants remove excess nutrients, and additional aerobic and anaerobic treatment takes place. Finally, the processed wastewater is stored in a waste storage pond where it is recycled as flush water for the feedlane or applied as fertilizer on growing crops.

Initial findings reveal producer acceptance and commitment are imperative to the success of this type of system. Precise topographic surveys of slopes, drainage, and physical features are essential for design purposes. It is critical that effluent solids are removed before entering the wetland system. For even system flow, the bottoms of the wetland cells must be level. Size of the drainage outlets directly impact the flow of the effluent. Serious consideration should be given to climate adaptability when selecting aquatic plants. Further evaluation is needed.

An overview shot of the first constructed wetland in Texas designed to treat animal waste at the O'Bryan Dairy in Dublin. The lagoon, at left, filters the water into the wetland cells, center, and then into the waste storage pond, at right.

Central Texas dairy utilizes new waste management technology

By MELISSA BURNS
Information Specialist
Texas State Soil and Water Conservation Board

The O'Bryan Dairy in Erath County is on the forefront of waste management technology with the construction of the first wetland system in Texas designed to treat animal waste.

Dairy owners Lloyd and Gloria O'Bryan are working with state and federal agencies in a three year cooperative project to demonstrate how a constructed wetland can be used as an animal waste management system to improve water quality. The project will also examine the economic feasibility for the producer to enter into a mutually beneficial relationship to build a waste treatment unit, which also provides a marketable feed stock.

The project, which is located south of Dublin, is a voluntary demonstration project funded under the Texas Nonpoint Source (NPS) Pollution Management Program. The U.S. Environmental Protection Agency (EPA) provides funding under the Clean Water Act through the Texas State Soil and Water Conservation Board (TSSWCB), which is the lead agency for the state's agricultural/silvicultural nonpoint source (NPS) pollution program. Funding is provided to implement activities that will demonstrate ways to control and prevent NPS pollution, which is usually associated with runoff from agriculture/silviculture, urban stormwater and construction activities.

> The constructed wetland is created by altering landscapes and soil properties to create man-made units that simulate natural wetlands and provide many uses and benefits, such as improved water quality, wildlife habitats, improved aesthetics and educational areas.

"Erath County is the largest milk producing county in the state with 196 producers," said Jack White, project coordinator with the Natural Resources Conservation Service (NRCS). "During the past four to five years, the number of dairy cattle have increased dramatically causing the management of waste to become almost as time consuming and important as tending to the animals."

"With the increase in rules and regulations regarding confined animal feeding operations, dairy operators are searching for efficient and effective waste management systems," said White. "After seeing the benefits of constructed wetlands in other states and their beneficial use in treating municipal waste water - why not demonstrate their performance and feasibility as an animal waste management system."

"It is a never-ending battle everyday to keep the lots maintained, especially when manpower and time is so limited," said O'Bryan. "We are wanting to show how the constructed wetland system will help manage the waste better with reduced manpower and time, which then can be directed toward managing the herd. I am even looking at healthier animals due to a cleaner environment and more time available to care for them."

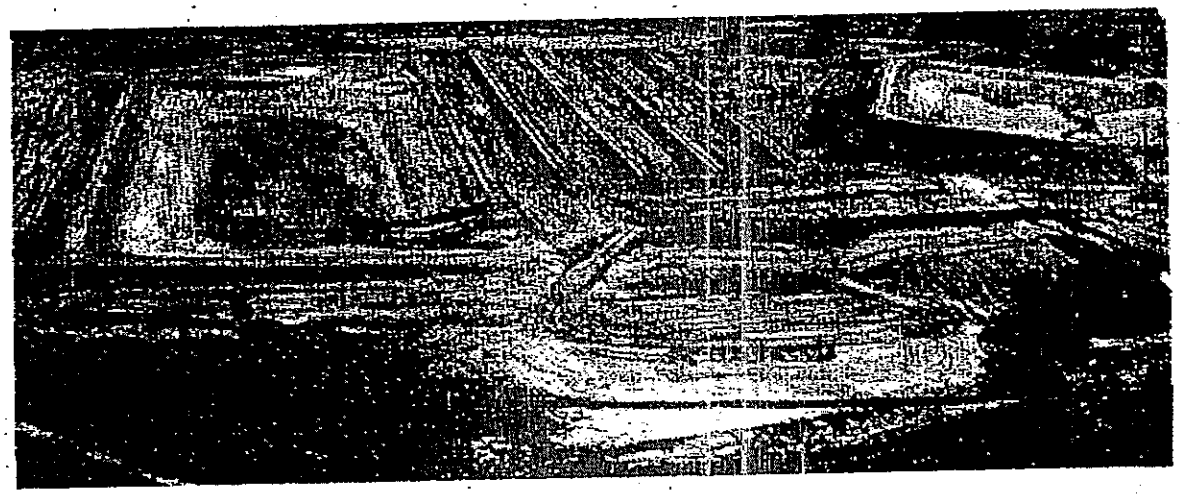
The constructed wetland is created by altering landscapes and soil properties to create man-made units that simulate natural wetlands and provide many uses and benefits, such as improved water quality, wildlife habitats, improved aesthetics and educational areas.

> "The benefit for the producer will hopefully be a new approved animal waste management system that can bring them into compliance with state laws while the public benefits from cleaner water."

"Future plans include workshops to demonstrate how the system operates and to educate producers throughout Texas about animal waste management systems and the benefits," said White. "The benefit for the producer will hopefully be a new approved animal waste management system that can bring them into compliance with state laws while the public benefits from cleaner water."

For more information on this project, or to request information on NPS pollution or to submit a potential project for NPS development, contact the Texas State Soil and Water Conservation Board at (817)-773-2250.

O'Bryan Dairy uses wetland for waste



The O'Bryan Dairy—located south of Dublin in Erath County is involved in an ongoing project that includes construction of a wetland for a waste management system. The dairy is owned by Lloyd and Gloria O'Bryan.

The O'Bryan Dairy located south of Dublin in Erath County is on the forefront of waste management technology with the construction of the first wetland system in Texas designed to treat animal waste.

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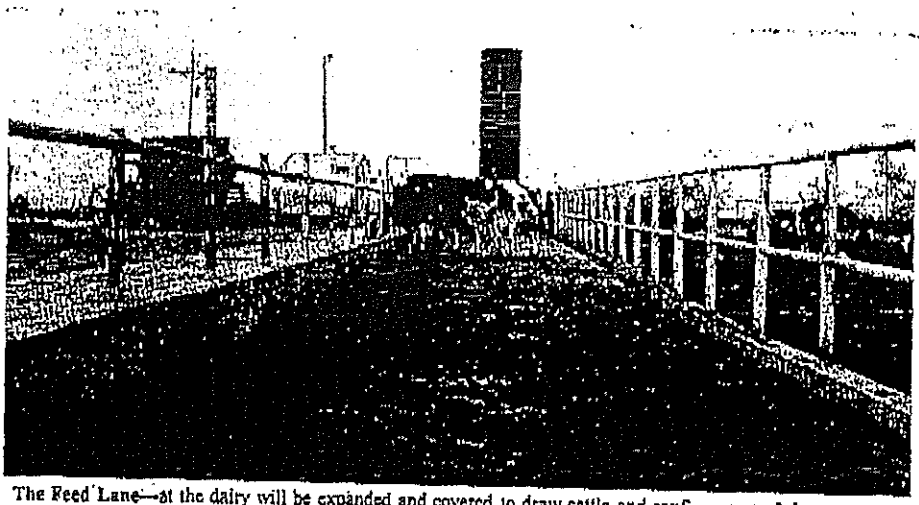
See O'Bryan on Page 7



The Feed Lane—at the dairy will be expanded and covered to draw cattle and confine most of the waste.

O'Bryan

Continued from Page 1

provides a marketable feed stock.

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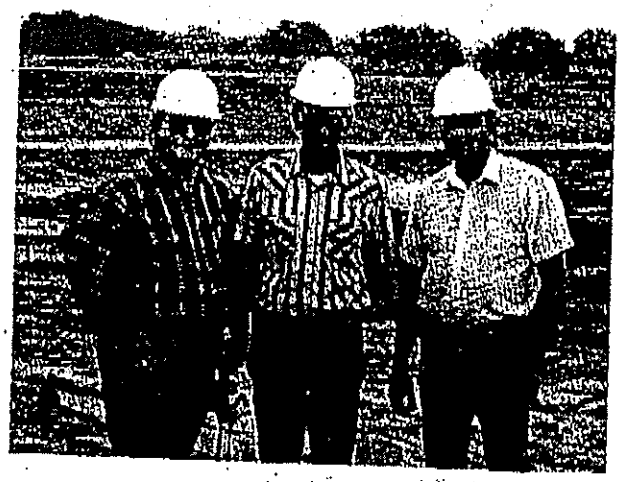
**This article was written by Melissa Burns of the TSSWCB.*



Project Coordinators—Byron "Bo" Spoonts, TSSWCB; Lloyd O'Bryan, dairy owner, and Jack White of the NRCS view the preliminary building of the contructed wetland at the O'Bryan Dairy.

Form Approved - OMB No. 0578-0024

U.S. DEPARTMENT OF AGRICULTURE
Soil Conservation Service

SCS-PER-003
8-89

THE EARTH TEAM
AGREEMENT FOR SPONSORED VOLUNTARY SERVICES

NAME OF SPONSOR/ORGANIZATION *(Print)*
DUBLIN WETLAND PLANTING GROUP

ADDRESS *(Street, city, state, Zip code)*
Dublin, Texas

Privacy Act Statement

Following information is provided to comply with the Privacy Act (PL 93-579). U.S.C. 301 and 7 CFR 260 authorize acceptance of the information requested on this form. The data will be used to contact applicants and to interview, screen, and select them for volunteer assignments. Furnishing this data is voluntary.

1. **Description of work to be performed:** provide labor to assist in planting of wetland plants in a constructed wetland on the O'Bryan Dairy on or about March 21, 1996.

2 The above-described work will be contributed to the Soil Conservation Service. Except as provided below, the work performed by the participants will not confer on them or on our employees or officers the status of federal employees.

3 We will provide the Soil Conservation Service with a listing of participants and man-hours or man-days contributed to accomplish the work in item 1 above.

4 We will obtain parental or guardian consent for each individual under 18 years of age and will comply with child labor laws.

5 Jack White is hereby designated to serve as our liaison with the Soil Conservation Service in day-to-day operations under this agreement.

6 We understand that either the Soil Conservation Service, or we, may cancel this agreement at any time by notifying the other party.

SIGNATURE	DATE
Jack L. White	3/1/96

ACCEPTANCE FOR THE SOIL CONSERVATION SERVICE

The Soil Conservation Service agrees, while this agreement is in effect, to:

1. Provide such materials, equipment, and facilities as are available and needed in performing the work described above.

2. Finance necessary incidental expenses of sponsored participants to the extent such expenses cannot be borne by the sponsor, and to the extent Soil Conservation Service funds are available. The maximum Soil Conservation Service funding of such incidental expenses shall be set forth in an accompanying financial plan for each fiscal year or portion of a fiscal year.

3. Consider sponsored participants as federal employees for the purpose of tort claims and compensation for work injuries, to the extent not covered by the sponsor. Authorization by PL 97-98.

4. Authorize sponsored participants to operate federal motor vehicles when necessary provided the individual holds a valid state driver's license.

SIGNATURE	TITLE	UNIT	DATE
[signature]	State Water Quality Coor.	USDA - NRCS	4/4/96

TERMINATION OF AGREEMENT

AGREEMENT TERMINATED ON *(Month, Day, Year)*	SIGNATURE OF SOIL CONSERVATION OFFICER

S

SEE REVERSE SIDE

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ESPONSES To The
anting

Confirmations -
JAme AFFILIATION

O'BRYAN WETLAND PLANTING
21 MARCH 96
9:00

NUMBER IN PARTY

Plse CALL JC Cook
817 842-5850
" " 5409 FOR
NUMBER — TNX
RESPONSE NO LATER
THAN 13 MARCH

teve Jones TSSWCB	(4) ✓	2		
uzanne Cardwell TSSWCB	(1) ✓	1		
ack L. White NRCS	(1)			
James Alderson NRCS	(1) --			
Ed Simpson NRCS	(1) ✓			
en Criswell NRCS	(1) ✓			
Bo Sparonts TSSWCB	(1) ✓	1		
Melissa Burns TSSWCB	(1)	1		
ALLAN COLWICK NRCS	(1) —	12		
Dublin Vo. Ag.	(14) ✓	15		
TSU - Dairy	(15) ✓			
Carl Hutcherson	(1) ✓			
Lynn Pardee	(1) ✓	(43)		
Jerry Walker	(1) ←	(44)	1	
TSU - Range	(12) ✓	56		
Joe McFarland	(1)		1	
Forrest Mitchell	(1) —	58	1	
Vicki Boyd	(1)	(59)	1	

~~Kevin [illegible]~~
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TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

March 5, 1996

Mr. Jack White
Program Manager - UNBRHUP
Natural Resources Conservation Service
239 East McNeill
Stephenville, Texas 76401

Dear Jack:

On behalf of Darrell Williams and I, thank you for your time and effort in making the Lloyd and Gloria O'Bryan dairy tour an interesting and beneficial event. We would also like to express our gratitude to the O'Bryans who took time out of their busy schedule to show us around. We thoroughly enjoyed the tour and visiting with them. The slides that were taken of the many best management practices that were being implemented were a success.

Thanks again and best regards.

Sincerely,

Eric S. Chasteen
Agriculture Section
Agriculture and Watershed Management Division

cc: Darrell Williams, Manager

Dublin
Citizen

TEXAS PRESS ASSOCIATION AWARD WINNER 1995

50¢

Dublin, Texas 76446

Thursday, March 28, 1996

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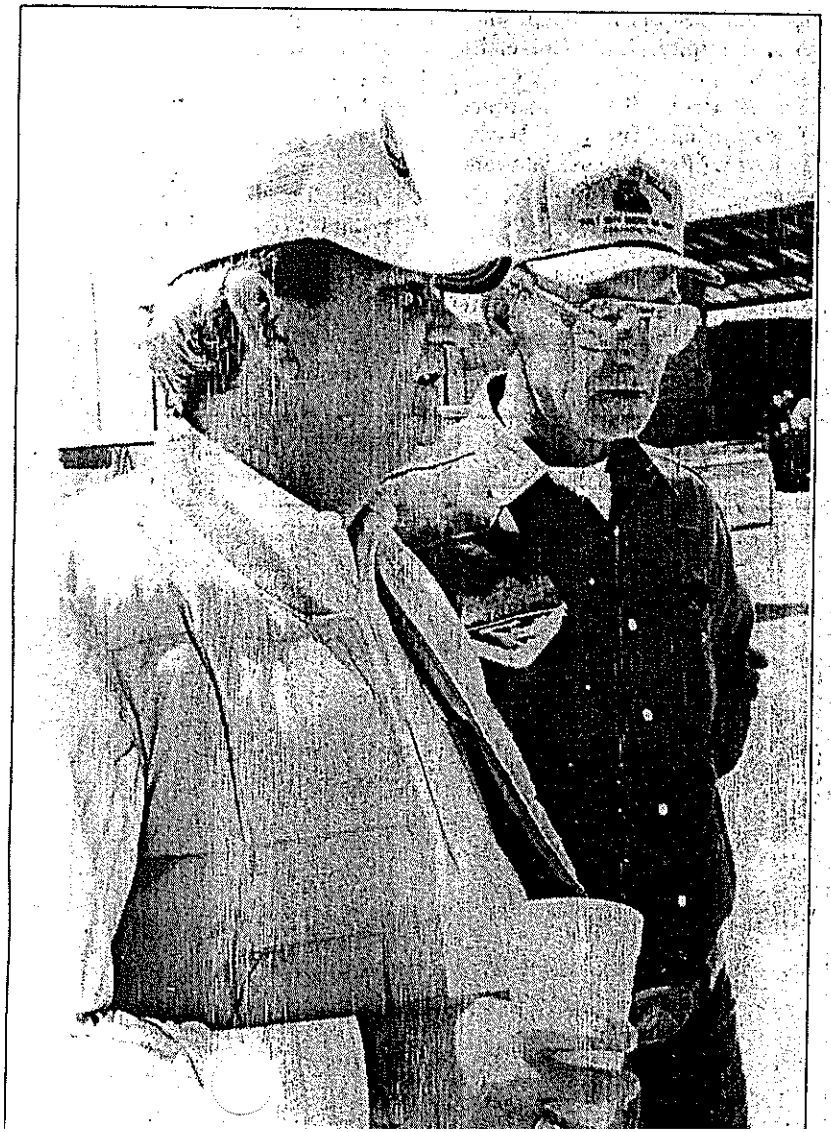
story page 10



Dairy launches unique wetlands project

By KARI LANTING
Contributing Writer

The eyes of waste water management specialists across the nation are on a Dublin dairy's new wetland system which is designed to treat the dairy industry's most abundant and least desirable by-product -- cow manure.

Dairy owners Lloyd and Gloria O'Bryan are working with state and federal agencies in a three-year cooperative project which will demonstrate how a constructed wetland can be used as an animal waste management system to improve water quality.

The project will also examine the economic feasibility for the producer to build a waste treatment unit, which also provides a marketable feed stock.

The O'Bryan project is a long-time vision of Jack White, the Natural Resources Conservation Service program manager for the Upper North Bosque River Project -- a vision which moved a step closer to reality last week when more than five dozen volunteers arrived at the O'Bryan dairy to plant the wetland cell with aquatic plants.

Volunteers came ... the Institute of this project which is the first of its kind in Texas.

"For years now, I have read about wetlands and felt we could adapt the concept to waste management in Texas," White said. "There is currently no data available on dairy operations like this so this will give us the opportunity to study and learn."

Dairy owner Lloyd O'Bryan said it is a never ending job to keep the dairy lots maintained.

"We want to show how the constructed wetland system will help better manage the waste," O'Bryan said.

"It was three years ago this April since we started talking to Jack White about this project," O'Bryan said. "It sounded like the wetland project could work and would benefit the dairyman."

The constructed wetland is created by altering landscapes and introducing wetland plant life and organisms which assist in the removal of pollutants from waste water. The manmade unit called cells simulate natural wetlands and provide many uses and benefits such as improved water quality, wildlife habitats, aesthetics and educational areas.

Gravity brings the waste water from the milking barn and flush lanes in the cow lots to a settling basin where solids are allowed to settle.

A front end loader then picks up the semi-solid waste and stockpiles

See WETLAND page 7

FARM PROGRESS COMPANIES
Texas Farmer-Stockman

April 26, 1996

Mr. Jack White
239 E. McNeill
Stevenville, TX 76401

Dear Mr. White:

Thank you for agreeing to be interviewed for our magazine. I appreciate your time, insight and information.

Following is a draft of a story I have written which includes your comments from our conversation about the O'Bryan wetland project. Please review the copy for accuracy and give me a call at (512) 310-9940 or fax me at (512) 310-9942 if you have any thoughts or suggestions. If I do not hear from you, this report will appear in print similar to the copy you have received.

Thanks again for your cooperation. It's a pleasure to work with you.

Sincerely,

Shannon Linderoth

Shannon Linderoth
associate editor

301 Hesters Crossing, Suite 130 • Round Rock, TX 78681-6914 • Tel: 512/310-9940 • Fax: 512/310-9942

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
101 South Main
Temple, Texas
76501-7682

September 23, 1996

Mr. Jack White
USDA - NRCS
239 East McNeill
Stephenville, Texas 76401 - 4390

Dear Jack:

I want to thank you for participating in the USDA South Central Region Environmental Engineer Core Discipline Team meeting in Stephenville on Thursday, September 12. Your presentation and comments helped make our second workshop a great success.

Your presentation on the Upper North Bosque River HUA and the O'Bryan dairy constructed wetland was very informative. Your chronological development of the project gave the team members a good picture of the many tasks necessary to get the project to where it is today. Your on-site explanations of various components of the system indicated that the project was, and is, time consuming. Your good working relations with the producer, Lloyd O'Bryan, was evident as he reviewed the project with us.

I also want to thank you for taking care of the local arrangements for the meeting - the motel, the meeting place, and the van. Texas NRCS could not have hosted this meeting without your assistance.

Once again, thank you for all your efforts in making the second meeting of the Environmental Engineer core discipline team a great success.

Sincerely,

Gene

EUGENE R. LINDEMANN, P.E.
Chairman
South Central Region Environmental Engineer
Core Discipline Team

cc: Wes Oneth, SCT, NRCS, Temple
O'Gene Barkemeyer, ASC (Technology), NRCS, Temple
Freddie Williams, ASC (Operations), NRCS, Temple
Allan Colwick, WQS, NRCS, Temple
Tom Cunningham, ASC (FO), NRCS, San Angelo

PROGRESSIVE FARMER

9/30/96

TO: Jack White, NRCS, Stephenville

FR: KARL WOLFSHOHL
SOUTHWEST EDITOR
6502 SLIDE ROAD #420
LUBBOCK, TX 79424
PHONE: 806-798-8300
FAX: 806-798-1727

Greetings Jack,

Here is the proof of the version of the Manmade Wetlands article after all sources have responded, made their changes, and we've reached a couple of other sources.

You will see we've taken some of the explanation of how the O'Bryan system operates and placed it off by itself, for use in explaining the infographic that our artist is designing. This will be the main illustration point for the article, but I believe an environmental portrait of you and Lloyd will also be used.

I wanted you to see this last version because it contains a change in Lloyd's quote that you sent in, saying you all would like to prove water coming from the system is "as clean or cleaner than water in the receiving stream."

Is this correct? Hate to bug you with details, but we want this to be accurate.

If it isn't, please flag us by early this afternoon so we can make it right.

Pleasure working with you. Thanks!

Karl

Dairy Constructed Wetland Project

An Alternative to Nutrient Management

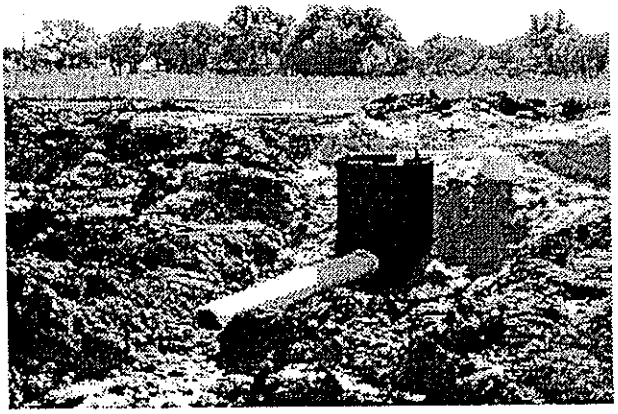
As the largest producer of milk in Texas, Erath Conty is home to the first constructed wetland on a dairy operation.

Typical animal waste storage ponds or treatment lagoons cost from $10,50,000 to construct and the annual maintenance cost for these systems in increasing. Therefore, we must look for viable means of handling dairy waste nuritents.

One such alternative being evaluated is the Indian Rock Dairy Constructed Wetland Project. If the demonstration proves the concept vialbe, the "polishing" of wastewater could be consdierred for discharging into receiving streams. Currently in Texas, agricultural waste is not allowed to discharge to any state waters.

Technical Attributes of the Project

The constructed wetland project, designed by the USDA Natural Resources Conservation (NRCS), includes a settling basin, waste treatment lagoon, 4 paired wetland cells, and waste storage pond for confined pen runoff collection. The settling basin is designed to hold 7-day manure storage from the milking parlor and flushed feedlane. The waste treatment lagoon is designed for 100 day detention. Detention in the wetland cells is 12-days with a depth of 8 inches in each cell.



Each vegetated wetland cell has a surface area of 0.11 acre with 1.83 feet freeboard. The lagoon, waste storage pond and wetland cells are required by Texas Natural Resources Conservation Commission (TNRCC) to retain a 25 year -24 hour storm event. Contaminated runoff from the confined pen area will be routed to the waste storage pond through waterways. Constructed wetland cells will discharge to storage facilities to be recycled or land applied.

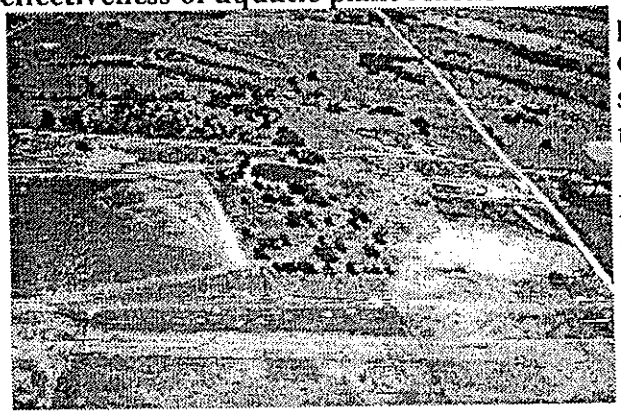
Time Frame For the Wetland Project

The entire waste management systemm, including the wetland component of the system, was completed in January, 1996. This project has the opportunity to evaluate design parameters, aquatic plant eficiency, composition, selection, economics of construction, aquatic plants as an alternative feed source, and operation and maintenance.

Monitoring of nutirent usage by aquatic plants will be collected and disseminated by the Texas Institute for Applied Environmental Reserach (TIAER) until August 1997. Ten sample points are identified with fourteen water smapling parameters. Computer modeling is updated as monitor samples are analyzed.

Goals, Objectives and Issues

The primary goal of the project is to determine and define and alternative solution to the handling and management of animal waste. the project intends to evluate the effectiveness of aquatic plant reaction to concentrated daiy waste. The effect of aquatic plants determines if the "polished" effluent can be delivered to the receiving stream without causing degradation of the water body.



Economic responsibilities lie with the dairy producer to provide feeding trial data, operation and maintenance and guide evluations of the overall system, so that lessons learned may be transferred. This demonstration is conducted to determine the treatment of milkhouse waste, wastewater, and feedland funoff by the constructed wetland. Dairy operations are under scrutiny because of potential impace on water quality. No data on constructed wetlands on a dairy operation, exist in Texas.

Funding For The Constructed Wetland Project

Design, construction, and monitoring cost for the Constructed Wetland Project was furnished through EPA, Region VI, representing their portion of the contract to be 60% and the dairy owners, Lloyd and Gloria O'Bryan, suppying 40% of the Project cost. Funding is issued through the Texas State Soil and Water conservation Board (TSSWCB) to NRCS.

Cost shre, through the texas senate bill 503 program assist dairy owners to install waste utilization practices on wasate disposal field. Milstones and accounting of in-kind and acutal expenditures represent the NRCS Program Managers responsibility to the EPA.

Sixty percent of the monitoring cost is paid to TIAER and the remaining 40% is dontated, byt TIAER, to the in-kind servcie required by Environmental Projection

Agency (EPA).

General Plan Of The Dairy Constructed Wetland Project

Wetland treatment effectiveness is a function of retention time and assimilative capacity of the vegetation and sediments to retain and recycle certain nutrients. Using a wetland with secondary treated effluent is of major significance in terms of final effluent "polishing" and retention of suspended solids.

When possible, a credible engineering firm should be utilized to provide a cost effective design to enhance the natural process involved with the use of constructed wetlands. If possible, the wetland should fit comfortably into the natural landscape and be aesthetically appealing.

For More Information Contact:

Amy S. Moravec
Texas Agricultural Extension Service
Rt. 2 Box 1
Stephenville, TX 76401
(817) 968-4144

E-mail Click for comments/messages.

Jack White
Natural Resource Conserveration Service
239 E. McNeill
Stephenville, TX 76401
(817) 965-3213

E-mail Click for comments/messages.

Top of Page Home District 8 Home Page

TAMU Stephenville Research and Extension Center WWW Server
(http://stephenville.tamu.edu/)

Part of the Texas A&M University System
Route 2, Box 1
Stephenville, Texas 76401

This page is maintained by JSR.

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WASHINGTON, D.C. 20036

PHONE: (202) 939-3800
FAX: (202) 939-3868
E-MAIL: eli@eli.org

March 24, 1997

Jack L. White
U.S. Department of Agriculture
Natural Resources Conservation Service
239 E. McNeil
Stephenville, TX 76401

Dear Mr. White:

Although your nominee was not among those selected to receive a 1997 National Wetlands Award, I want to thank you on behalf of the Environmental Law Institute and the U.S. Environmental Protection Agency for submitting a nomination for Lloyd And Gloria O'Bryan. We received a record number of impressive nominations this year, and choosing the winners was extremely difficult.

The 1997 Awards ceremony will be held on Capitol Hill in Washington, D.C. on May 8, 1997. We would be delighted if could join us in honoring an outstanding group of individuals for their substantial, yet largely unsung achievements. You will receive a formal invitation to the ceremony within the next few weeks.

Although your nominee did not win an award this year, we appreciate your participation in the awards program, and we invite you to submit again in the future. The Awards Program is a unique and important forum for recognizing outstanding contributions to wetlands protection, restoration, and education, and its success depends upon the voluntary efforts of nominators like yourself. Thank you once again for participating.

Sincerely,

Jessica Bennett
Director, Wetlands Program

NATIONAL WETLANDS CONSERVATION ALLIANCE

National Wetlands Conservation Alliance

National Association of Conservation Districts
509 Capitol Court, NE
Washington, DC 20002-4946

May 1, 1997

Jack L. White
USDA Natural Resources Conservation Service
239 E. McNeil
Stephenville, TX 76401

Dear Jack,

Your nomination of Lloyd and Gloria O'Bryan for a 1997 National Wetlands Award was much appreciated. Enclosed is a copy of the letter and "Certificate of Recognition" from the National Wetlands Conservation Alliance that we have just mailed.

Nearly a third of the 120 nominees, including those for implementing on-the-ground wetlands conservation, received assistance from NRCS and conservation district offices. You also deserve to be congratulated for it is through your efforts that citizens like Lloyd and Gloria are motivated and given the technical assistance they need to be successful stewards of the land.

In November you will receive a request for nominations for the 1998 awards to be presented next May. The application form will be similar to last year's; due by the first of January. We hope to receive even more nominations for the 1998 awards for landowners who have restored and conserved wetlands.

We hope you are planning activities this month to celebrate American Wetlands Month. As part of the celebration I urge you to note the accomplishments of your nominee in your newsletter and through stories in your local newspapers. You may also want to highlight others who have done similar work and tell the public where they can see restored agricultural wetlands. Most landowners are proud of their conservation efforts and would be glad to arrange for public visits to their wetlands.

Sincerely,

Gene Whitaker
Director

cc: State Conservationist

NATIONAL WETLANDS CONSERVATION ALLIANCE

National Wetlands Conservation Alliance
National Association of Conservation Districts
509 Capitol Court, NE
Washington, DC 20002-4946

May 1, 1997

Lloyd & Gloria O'Bryan
Indian Ridge Dairy
Rt. 1 Box 22
Dublin, TX 76446

Dear Lloyd and Gloria,

The National Wetlands Conservation Alliance wishes to take this opportunity to congratulate you having been nominated for a *1997 National Wetlands Award.* This awards program, sponsored by the Environmental Law Institute and the U.S. Environmental Protection Agency, recognizes individuals who have demonstrated outstanding innovation or excellence in wetlands conservation. This program is only able to recognize a few of the many outstanding individuals nominated for their efforts to conserve and restore wetlands.

The National Wetlands Conservation Alliance is an informal partnership of private organizations and government agencies working to facilitate voluntary landowner wetlands restoration, enhancement and conservation. We support and encourage coordination of landowner wetlands education and information, technical assistance, and funding programs to help landowners be better stewards of their wetlands. Your work is an outstanding example of how individuals can use wetlands to protect water quality. We take pride in presenting you the enclosed certificate in recognition of your wetlands conservation accomplishments. Your use of constructed wetland cells to polish effluent generated from milkhouse and feedlot runoff leads the way for others to use this natural approach to protecting water quality for all Texans.

I encourage you to keep up the good work and, by your example, lead others to fully recognize and conserve the value of all our Nation's wetlands.

Congratulations,

Gene A. Whitaker
Director

phone 202-547-6223; Fax 202-547-6450; E-MAIL: WetlandG@erols.com

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June 30, 1997

Jack White, Project Coordinator
USDA - NRCS
239 E McNeil
Stephenville, TX 76401-4390

Dear Jack:

Thanks again for your time and expertise in explaining the constructed wetland at the dairy to the group of teachers at the Summer Agricultural Institute back in June. From the comments I received, they really appreciated your patience in explaining the process and answering the questions they had. The entire project was very interesting to them and they talked about it several times throughout the week.

We would like to do the same thing again for the second session on Tuesday, July 15, beginning at about 3:00 p.m. We will again meet in the parking lot of the Ag Building on the Tarleton State University campus and proceed to the dairy under your direction.

If there is a problem with this schedule, please let me know as soon as possible.

We look forward to seeing you in July. In the meantime, if you have questions or need more information, please feel free to give me a call at (254) 751-2608.

Sincerely,

Tad Duncan, Associate Director
Research, Education and Policy Development

TD/vm

WATER QUALITY
HYROLOGIC UNIT PROJECT

PROBLEMS IN THE UPPER NORTH BOSQUE

The Bosque River flows through a high density dairy production region and then southward to Lake Waco, an urban water supply reservoir.

The Upper North Bosque River Watershed is comprised of 290,040 acres (453.2 square miles) and located in north-central Texas. The Bosque River flows southward to Lake Waco, which serves as a water supply reservoir for more than 200,000 people in the city of Waco and surrounding communities. In the late 1980s, the region experienced dramatic growth in the dairy industry. The combined herd grew by 148% to over 50,000 cows, while producer numbers increased by only 12% to 188 farms. The nature of dairy farms in the region was changing; however, technologies for managing these large, concentrated herds were not well understood. As a result, some serious problems began to occur.

In 1989, the Upper North Bosque River Watershed was listed in the Clean Water Act Section 319 Management Program for Agricultural and Silvicultural Nonpoint Source Water Pollution in Texas which was developed by the Texas State Soil and Water Conservation Board. The report identified the North Bosque River as a "known" water quality problem area where nonpoint sources were contributing to excess loadings of nutrients and fecal coliform bacteria. Water monitoring stations in the river had identified 13 violations of the fecal coliform standard (200 colonies/100 ml), with values as high as 270,000 bacterial colonies per 100 milliliters of water. Fish kills and other evidence of water pollution were being reported. Obviously, raw waste materials were directly entering into the surface water system.

Fish kills in ponds and creeks were an obvious sign of water quality problems.

The lack of adequate treatment and proper disposal of animal waste from dairies was becoming a conspicuous problem in the watershed. Less than one-third of the dairy operations had installed adequate waste disposal systems. The confinement of large herds (>500 head) on small land acreages further intensified the problem. In 1990, the Texas Water Commission, the state water quality regulatory agency, adopted regulations which placed new and more stringent requirements on dairies to meet water quality goals. However, few resources were available to producers to enable them to meet these new demands and remain economically viable.

Increases in the number and size of dairy herds in the project area created greater water resource concerns.

In addition, several other potential sources of nutrient and bacterial contamination existed in the watershed and were known to be contributing to the problem. Unregulated and failing on-site sewage treatment systems and inadequate management of municipal waste treatment plants had been documented. Improper use of fertilizers and pesticides in both rural and urban applications also compounded the problem. Due to extensive media coverage, it was widely known that significant water pollution problems were present and an even greater potential for adverse impacts existed. The urgent need for an aggressive and targeted water resource management program was clear.

Failing on-site wastewater treatment systems presented another major threat to water quality in the Bosque River.

As a result, the Upper North Bosque River Hydrologic Unit Project was initiated in 1990 as part of the Presidential Water Quality Initiative. This USDA and State of Texas cooperative project has involved personnel from numerous state and federal agencies, universities and local and regional organizations. The ultimate goal of the project has been to effect measurable reductions in potential nonpoint source contaminant levels in surface runoff and ground water in the Bosque River watershed. This goal has been achieved.

The Upper North Bosque River Watershed comprises an area of 290,040 acres (453.2 square miles) in north-central Texas.

PROJECT OBJECTIVES AND ACTIONS

The primary objectives of the Upper North Bosque River Hydrologic Unit Project were:

1) Through education, establish a thorough recognition and understanding of all existing and potential sources and best management practices and systems for the effective control of both point and nonpoint source water pollution; and

2) Achieve rapid, voluntary adoption of best management practices and systems by agricultural producers and other citizens to significantly reduce the potential for pollution of surface and ground water.

The Upper North Bosque River Watershed is impacted by a combination of urban and rural/agricultural land use systems. To achieve the project goals, efforts were directed at all major potential sources of pollution including livestock (dairy/beef) management systems, irrigated and dryland crop production, and urban land use. Three action items were defined and implemented to target these major land use types:

- Provide direct technical, educational and financial assistance to dairy farmers for the design, installation and management of cost-effective and environmentally sound livestock waste management systems to protect water resources;

- Provide direct technical, educational and financial assistance to agricultural growers regarding proper use of fertilizers and pesticides to reduce potential surface and ground water pollution; and

- Educate local citizens concerning domestic and municipal sources of nutrients and microorganisms and regarding proper design and management of on-site wastewater treatment systems.

PROJECT PERSONNEL

The Upper North Bosque River Project was created and managed as a unified, team effort. The lead agencies were the USDA Natural Resources Conservation Service (formally the Soil Conservation Service), the Texas Agricultural Extension Service, the USDA Farm Services Agency and the Texas State Soil and Water Conservation Board. Other project partners were the Texas Agricultural Experiment Station, U.S. Geological Survey, U.S. Environmental Protection Agency, Texas Natural Resource Conservation Commission, Texas Institute for Applied Environmental Research and the Texas Department of Agriculture.

Project team members and representatives of several cooperating agencies attend the opening of a new technology demonstration site.

To maximize coordination, project personnel from the lead agencies were co-located in the project area in Stephenville, Texas. Operational costs were significantly reduced by this process, while regular (almost daily) communication and programming efforts among project staff were significantly enhanced. These factors also facilitated the implemen- tation of cooperative demonstration and training programs and provided project clientele with easy access to information and assistance through the project.

SUCCESSFUL PROGRAMS AND IMPACTS

The following sections of this report document the specific issues which were targeted by the Upper North Bosque River Hydrologic Unit Project, the major programs implemented to address those issues and the most significant impacts which were achieved.

Dairy Waste Management

Controlling potential nonpoint source pollutant losses from livestock waste was the single most important goal of the project. In 1990, there were 88 dairies in the Bosque River watershed ranging greatly in size, from about 25 milking head to over 2000 milking head. By 1995, there were 127 dairies in the project area. In Erath County alone, annual solid manure production totaled over 175,000 tons per year. However, livestock waste management is a complex issue which must address both control of the amount or volume of waste generated and proper methods for handling, storage and beneficial reuse of the material. Thus, a multitude of economic and logistical constraints had to be considered as management systems were tailored to meet the needs of this diverse industry.

Solid manure production in Erath County alone was over 175,000 tons per year, representing a significant management challenge.

Project Impacts

- Design and installation of effective dairy waste management systems was the single most critical component of project success. It required establishing a process by which all wastes generated by a facility will be collected, stored, treated, transferred and eventually beneficially reused. Initial program tasks targeted significant educational, technical and financial assistance efforts toward system installation on all dairies in the project area. The goal of the project was to install a waste management system on all 88 dairies in the project area. However, due to increases in farm numbers during the project, this goal was not only met but was exceeded. A total of 103 dairy waste management systems were designed and installed.

Construction of 1 of the 103 new waste management systems installed during the project.

- Wastewater storage and treatment are important to prevent direct discharges of contaminated water. The use of primary and secondary lagoons can significantly reduce contaminant levels and enable more flexible reuse of the material. Demonstrations conducted on three dairies were utilized to show how a two-stage lagoon system could reduce total solids by 69.3%, volatile solids by 80.3%, volatile suspended solids by 86.0%, and chemical oxygen demand by 88.8%. These educational efforts helped promote installation of 103 new lagoon systems on dairies during the project.

Two-stage lagoon systems can reduce pollutant levels by 69 to 89% and enhance the opportunity for reuse in crop irrigation.

- One of the key ways to reduce pollution potential and increase farm profitability is to reduce wastewater generation. An evaluation of dairy farm water use was conducted on 11 dairies which were instrumented with in-line water meters. Weekly meter readings were taken to determine water use for sanitation and waste management. Fresh water use ranged from 11.8 to 75.3 gallons/cow/day (gcd) with an average of 41.2 gcd. There was significant potential for improvement. For example, by replacing a flush system with a scrape/hand wash process and installing a water recycling system, fresh water use was reduced by approximately 75% from 80 to 20 gcd. The 60 gcd savings in fresh water use translated into a reduction of 2.5 million cubic feet of water per year for an average dairy. This information was utilized in educational programs which encouraged the development and installation of 127 dairy water management systems in the project area. Water conservation practices adopted by these dairies have reduced wastewater production by over 5,343,000 gallons per year.

Conversion from a milking center flush system to a scrape/hand wash system reduced wastewater generation by 75%.

- Collection and delivery of milking center wastewater to the lagoon system reduce the volume of wastewater and solids which must be handled. This provides an economic benefit to the dairy and reduces the volume of waste generated by the facility. Over 19,886 feet of underground outlets to transport milking center wastewater to lagoons were installed during the project.

- Traditionally, solid manure is land applied onto pasture and cropland adjacent to the dairy. On many farms in the project area, application rates were exceeding recommended rates for crop production. In addition, many farmers also were applying supplemental commercial inorganic fertilizers unnecessarily to ensure crop yields.

Implementation of 101 nutrient management plans by producers reduced nitrogen and phosphorus loadings in the watershed by an estimated 2,199,588 and 1,099,880 pounds, respectively.

Demonstrations were initiated to show how combinations of manure and commercial fertilizer could be used to ensure optimum crop production while protecting water resources. Consistent with these efforts, a total of 101 nutrient management plans were designed and implemented in the project area. Manure application rates were reduced by an average of 20 tons per acre per year. Nitrogen and phosphorus loadings into the watershed were reduced by an estimated 2,199,588 and 1,099,880 pounds, respectively. In addition, this effective process of nutrient cycling has saved over $989,837 in commercial fertilizer costs for agricultural producers in the region.

- Manure and wastewater are typically applied to warm-season forage grasses to accomplish beneficial reuse. However, these species become dormant during the winter and significant losses of unused nutrients can occur in rainfall runoff. Demonstrations were used to show how a continuous cropping system using winter forages, such as ryegrass, could be managed to enable year-round application and effective utilization of the nutrients contained in manures and wastewater.

Conservation cropping systems, such as ryegrass interseeded into coastal bermudagrass to enable year-round nutrient uptake, were implemented by producers on 11,643 acres.

Results demonstrated that growers could substantially enhance forage yields while protecting water resources. This helped facilitate the installation of conservation cropping systems for manure management on over 11,643 acres in the project area.

- The use of alternative crops for land application was recognized as an important method for reducing over-application of manure. Demonstrations were installed to show how manure could be used in the production of peanuts and vegetable crops. Results showed how solid manure application rates up to 15 tons per acre could be applied to peanuts with no adverse effects on crop yield or soil properties.

Demonstrations documented how solid manure can be applied to row crops, like peanuts, to improve distribution of waste and increase crop yields.

Many farmers also have begun to take advantage of this important nutrient source as a means to reduce fertilizer costs.

- Soil, manure and wastewater testing are important components of an effective waste management system. Demonstrations were utilized to show how testing enables determination of proper nutrient application rates and ensures that regulatory thresholds are not exceeded. Project staff also conducted testing campaigns annually to promote use of this best management practice by all agricultural producers. A total of 3010 samples were analyzed during the project, increasing the use of this BMP by 167% compared to pre-project levels.

- Project staff realized very early that one of the most under-utilized best management practices was calibration of manure spreaders to ensure proper land application rates. Demonstrations were conducted regularly at tours and field days to demonstrate simple and effective techniques for rapid calibration of various types of solid manure spreaders. Project staff assisted more than 120 producers with proper calibration of their manure spreaders.

More than 120 producers were assisted with proper calibration of manure spreaders to ensure correct waste application rates.

In addition, a convenient pocket-size reference card with instructions and rate tables was developed and distributed through the project to over 250 producers.

- Livestock access to riparian zones and other sensitive areas has direct and significant impacts on water resources through nutrient and bacterial loading and damage to and erosion of streambanks. Initially, many dairies allowed uncontrolled access to waterways which often served as a livestock water source. Through the project, major emphasis was placed on identifying techniques to protect these areas using alternative water supplies, feed supplements and fencing.

A total of 76,760 feet of fencing was installed by producers during the project to prevent livestock access to sensitive riparian areas.

As a result, many producers modified supplement placement activities, installed alternative water supply systems and a total of 76,760 feet of fencing was installed during the project to directly control livestock access to these critical areas.

- Mechanical solids separators reduce loading rates of organic solids and nutrients entering wastewater treatment and storage facilities. Demonstrations conducted through the project utilizing six different separators showed that significant reductions in total solids and nutrient levels could be achieved.

Mechanical solids separators reduce loading rates of organic solids and nutrients entering wastewater treatment and storage facilities.

This increases the duration of lagoon storage capacity and reduces subsequent loading rates on land application sites. The harvested material can then be used alternatively for purposes such as livestock bedding or as a mulch or compost for nursery crops.

- Vegetative filter strips significantly reduce potential nutrient losses from land application fields. A major demonstration project was installed on an 1100 cow dairy in the project area to demonstrate proper design and management of this BMP. Dairy manure was applied at rates of 10, 15 and 20 tons per acre to a bermudagrass hayfield above filter strips ranging in width from 10 to 75 feet.

A field demonstration evaluated filter strip width requirements. Filter strips significantly reduce nutrient and sediment losses from land application fields and were installed by producers at 167 locations during the project.

Results showing how filter strips with a minimum width of 35 feet could dramatically reduce phosphorus losses in runoff were presented to dairymen at field days and in demonstration reports. During the project, buffer strips were installed at 167 locations on over 140 acres to protect adjacent creeks and streams.

- Diversions reduce the volume of rainfall and sediment which becomes contaminated by animal waste and must then be routed into the waste treatment lagoon system. This can provide a significant economic benefit by reducing the size of the storage facility and the costs associated with pumping and cleanout. Most importantly, diversions decrease the amount of wastewater and lower the potential for surface and ground water contamination. More than 24,476 feet of diversions were installed by producers during the project.

- Composting of dairy manure significantly reduces waste volume and increases the handling characteristics for transport and land application. Demonstrations were conducted on several operating dairies in the project area to show how composting

Composting of dairy manure significantly reduces waste volume and increases the handling characteristics for transport and land application. Some dairymen are now converting manure into a marketable product.

can be incorporated into the waste management system to produce a more marketable product. Project staff also worked with commercial composting operations to establish multiple facility cooperatives.

- New and innovative technologies such as constructed wetlands have the potential to redefine and improve upon traditional concepts for waste management. Project personnel installed an operational constructed wetland on a 450 cow dairy in Erath County. Monitoring of this site showed how a wetland can significantly reduce pollutant levels in wastewater, producing an effluent which is of very high quality.

An 8-cell constructed wetland designed for a 450 cow dairy demonstrated a new and innovative concept in waste management.

Over 375 producers, media representatives and personnel from other water resource agencies toured the site, and this technology is now considered a viable option for effective wastewater management.

- The use of Integrated Pest Management practices on dairies is important to control potential pesticide contamination of runoff water which is land applied. Traditionally, premise insecticide sprays were used at least 3 to 4 times per week.

Integrated pest management practices for fly control, such as self-treatment devices, reduced pesticide spray applications by 91%.

In the project, demonstrations were utilized to show how biological control, animal self-treatment devices and bait stations could reduce pesticide use for the control of flies. A mail-out survey subsequently documented that these new technologies have been implemented on over 75% of the dairies in the project area. This has resulted in a 91% reduction in premise broadcast insecticide applications.

- *Cryptosporidium parvum* is a microscopic organism which lives as a parasite in the intestinal tracts of people and a wide variety of animals, especially young cattle. *Cryptosporidium* infection in people became a major concern in 1993 when several outbreaks occurred across the county which were attributed to contamination of water by livestock waste. To address this concern in the Upper North Bosque Project, a demonstration was conducted to identify and evaluate potential sources and management practices for control of *Cryptosporidium*. Fecal material and surface water samples were collected from two dairies in the project and analyzed for pathogens.

The study concluded that *Cryptosporidium* is most commonly associated with young animals and that careful management of calf holding facilities (hutches) can greatly reduce incidence of the disease. A factsheet discussing the characteristics of *Cryptosporidium* and proper management practices for control of the disease was developed and disseminated to dairy producers within the project area and throughout the state.

Educational programs helped producers understand how to prevent the spread of the dangerous parasite *Cryptosporidium*, which can be present in the manure of young cattle.

Cropland Management

Cropland in the project area accounts for only 9% (20,720 acres) of the total land use; however, potential impacts on both water quality and quantity are substantial. Major crops in the project area are peanuts, hay crops, orchard crops (peaches, pecans) and small grains. Most of these crops are produced on relatively sandy soils and part of the area overlies the Trinity Aquifer Recharge Zone. Pesticides and fertilizers can migrate into the ground water system by leaching or as runoff recharge.

Major crops in the project area are peanuts, hay crops, orchard crops (peaches, pecans) and small grains.

To successfully implement a watershed based water resource management program, it was essential that best management practices also be established on these areas. Project staff developed special educational materials and programs to target potential nonpoint source pollution from cropland in the project area.

Project Impacts

- Best management practices for nutrient, pesticide and irrigation water management were implemented on over 70% (14,500 acres) of the cropland in the Upper North Bosque River Project area. These practices included use of conservation tillage and cropping systems, vegetative filter strips, irrigation methods and timing, and nutrient and pesticide management.

Water quality best management practices, such as conservation tillage, were implemented by producers on over 70% of the cropland in the project area.

- Conservation cropping and tillage systems include management practices which conserve soil and water, and reduce potential nonpoint source nutrient and pesticide losses. Examples include cover cropping, reduced tillage and residue management. The importance of these practices was stressed throughout the project and as a result, recommended conservation systems were implemented on over 11,643 acres of cropland in the project area. Sediment losses from cropland areas have been reduced by more than 30%.

- Proper nutrient management is important due both to environmental and economic benefits. Achieving "Maximum Economic Yield" (greatest dollar return per acre) relies upon careful management of inputs such as fertilizers and pesticides to lower production costs. Soil testing and the use of proper rates, methods and timing of fertilizer application were demonstrated at five locations during the project. One demonstration showed how proper timing and placement of phosphorus fertilizer can maximize crop yields while reducing the potential for surface runoff losses of nutrients. Soil test campaigns conducted by the project staff analyzed over 450 soil samples and provided fertilizer rate recommendations. Nutrient management BMPs are now consistently utilized by producers on over 12,000 acres of the cropland in the project area and loadings of nitrogen and phosphorus have been reduced by over 20%. This amounts to a reduction in potential loading of more than 400,000 pounds of fertilizer material since 1990.

Soil testing by producers reduced nitrogen and phosphorus applications by over 20%, amounting to a loading rate reduction of more than 400,000 pounds of fertilizer.

- Integrated pest management (IPM) is a component of the integrated crop management concept which has significantly reduced pesticide use in the project area. IPM utilizes routine crop scouting to evaluate pest infestations and determine whether economic thresholds have been reached. Timing and method of pesticide application can then be carefully tailored to control the target pest. For example, up to three insecticide applications were being used to control pecan weevils in the project area.

Integrated Pest Management (IPM) programs used scouting and carefully timed applications to reduce pesticide loading by more than 60,000 pounds.

IPM systems for control of pecan weevils were demonstrated using new circular weevil traps to determine weevil emergence and properly time insecticide application schedules. Through these efforts, scouting for insects and use of high efficiency insecticides increased significantly. This resulted in a 66% reduction in pesticide use for pecan weevil control.

- Vegetative filter strips represent an important tool in the battle to prevent nutrient, pesticide and sediment losses from cropland into surface water streams and lakes. Native and introduced grass species were evaluated for their ability to reduce pollutant losses from cropland fields at two locations in the Upper North Bosque River Project area. Results showed that species such as eastern gamagrass are well adapted to the region and can provide significant reductions in nutrient and sediment losses. In addition, they provide an economic benefit by serving as a forage species. To date, over 140 acres of filter strips have been installed by producers in the project area.

- Traditional irrigation practices in this region included sideroll sprinkler irrigation which often results in uneven and excessive water application. This can greatly increase the potential for certain pesticides and fertilizers to be lost by leaching or as tailwater runoff. Project staff established two demonstration sites which highlighted potential water saving technologies such as LEPA (Low Engery Precision Application) and their related environmental benefits. Installation of seven of these new pivots with low pressure drop nozzles to reduce evaporational losses has resulted in a 15 to 20% increase in irrigation efficiency and a significant reduction in potential nonpoint source pollutant losses.

Low Energy Precision Application (LEPA) increases irrigation efficiency by up to 20% and reduces potential nutrient and pesticide losses compared to traditional systems.

- Proper rates and timing of irrigation can be difficult to determine, but are important to reduce potential tailwater runoff and leaching losses from agricultural cropland. Irrigation management demonstrations were conducted at five locations during the project. Each site was equipped with in-line flow meters to measure irrigation water amounts and gypsum blocks or soil tensiometers were placed in the soil to monitor moisture status. As a result, improved irrigation management practices were implemented by growers on 13 production fields covering more than 4,700 acres of cropland.

- In orchard production systems, the use of traditional sprinkler irrigation can increase potential leaching losses of nutrients and pesticides. Project staff implemented demonstrations of automated, microsprinkler and drip irrigation systems to improve irrigation efficiency and reduce deep percolation. Many producers have since adopted this technology due to environmental and economic benefits.

Microsprinkler irrigation systems were installed for orchard production systems to prevent deep percolation and runoff of water and reduce losses of nutrients and pesticides.

- Chemigation, the application of fertilizers and pesticides through the irrigation system, is an effective technique for agricultural chemical application. However, improper rates and/or methods of application can lead to serious contamination of water resources. Demonstrations were installed to show proper design, installation and operation of chemigation systems. This included the use of backflow protection devices to prevent contamination of wells and other irrigation water supplies. Training programs were provided to over 320 agricultural producers during the project concerning proper use and management of agricultural chemicals. Over 60 backflow prevention devices were installed as a result of these activities.

Over 60 backflow prevention devices were installed by producers to prevent contamination of water wells during chemigation.

- Fully automated weather stations were installed at two locations in the watershed to provide information to the state-wide PET Network. PET stands for Potential EvapoTranspiration, or the evaporation of water from the soil combined with the transpiration of water from plant leaves. Based on weather conditions, the water requirements of individual crops can be determined from the PET. The benefit comes by enabling growers to properly schedule irrigation water applications to meet crop needs, with little or no excess. This substantially reduces the potential for leaching or runoff losses of potential pollutants. The network has a web site at http://www.agen.tamu.edu/pet which receives thousands of hits each month and enables more efficient use of valuable water resources.

Fully automated weather stations were installed at two locations in the watershed to help growers properly time irrigations and thereby reduce nutrient and pesticide losses.

Urban Water Quality

Small rural communities, such as Hico, and larger urban areas, such as Stephenville, both have the potential to impact the quality of water resources. Many of the same pollutants commonly associated with agriculture (nutrients, pesticides, sediment, etc.) can be contributed by activities occurring in these small towns and cities. Nevertheless, many urban citizens are unaware of the serious potential impacts on water quality of even small quantities of nutrients and pesticides used around their homes and businesses.

Urban centers play an important role in both water quality protection and water conservation.

Although the major focus of the Upper North Bosque River Project was to address potential water pollution from livestock and cropland management systems, many of the same concepts and technologies for resource management were directly applicable in the urban environment. Educational programs and demonstrations were used to show urban citizens that the task of water resource management is shared by all those that inhabit and influence the watershed.

Project Impacts

- One key example of the relationships between urban and agricultural practices is evident in the need to use soil testing for lawn, garden and landscape nutrient management. Soil testing programs were conducted in Stephenville and surrounding areas to reduce excess fertilizer use and educational programs were conducted to promote proper selection and timing of fertilizer application. As a result, the use of soil testing in the urban sector increased dramatically during the project. Soil testing campaigns conducted by the project analyzed more than 1,008 samples from lawns and gardens, and provided recommendations for proper fertilizer management.

Soil testing campaigns conducted in urban areas generated more than 1008 samples and provided correct recommendations for lawn and garden fertilizer application.

- The Master Gardener Program trains volunteers to provide community outreach in urban regions where high volume demand occurs. Project staff assisted with Master Gardener programs which trained over 120 volunteers who now provide fellow citizens with information and recommendations on best management practices for proper landscape management and water resource protection. This peer assistance program has proven to be highly effective in achieving enhanced recognition and use of best management practices in urban communities.

- Wastewater generated by rural residents is a significant source of ground and surface water pollution in the project area.

Constructed wetlands utilize special plant species to accumulate nutrients, provide time for decomposition of organic matter, and transpire excess water which could carry pollutants through the soil and into ground water.

Many of the failing systems are in low income areas where residents cannot afford to install and maintain innovative/alternative treatment systems. To address this concern in the Upper North Bosque Project Area, three field demonstrations were implemented to show how constructed wetlands can be used in wastewater treatment. Constructed wetlands utilize special plant species to accumulate nutrients, provide time for decomposition of organic matter, and transpire excess water which could carry pollutants through the soil and into ground water. More than 1,500 people visited these demonstration sites as part of education and training programs. As an additional result of these efforts, local developers now consider constructed wetlands technology as a viable alternative for home sites, as well as large-scale housing complexes.

- Wellheads represent direct entry points for all types of potential pollutants. Improper wellhead construction and the presence of large numbers of abandoned wells were a major concern in the watershed. Demonstrations and training programs were conducted to show proper techniques for wellhead design and abandoned well closure. As a result of these programs, 45 wellhead management plans were developed and over 75 water samples were collected for testing.

- Youth education provides a basis for social change in terms of water quality protection and water conservation habits. Project staff developed educational programs on watershed protection directed toward primary and secondary schools and provided educational tours and hands-on activities to over 811 students. In addition, training programs were presented to over 98 teachers to assist them in development of teaching modules for students addressing water resource protection.

Youth education was an important part of the project with contacts to over 811 students and teachers in and near the project area. Here, elementary school students take a tour of the dairy constructed wetland.

- The TEX*A*Syst program (modified version of Farm*A*Syst) was implemented in the project in 1996. TEX*A*Syst contains 10 bulletins addressing major pollution concerns such as wellhead protection, petroleum products, fertilizers, pesticides, domestic and livestock waste, and household hazardous waste. This voluntary self-assessment process enabled home and landowners to evaluate potential pollution risks on their property and identify corrective actions. Demonstrations have included proper closure of abandoned wells, fertilizer and chemical storage and effective separation distances for petroleum products and septic drain fields. TEX*A*Syst materials were distributed to more than 60 individuals in the project area. In addition, a TEX*A*Syst web site was developed and has received more than 200,000 hits.

Educational Programs

The successes described above were achieved through a coordinated, multi-faceted approach of information and education. The Upper North Bosque River Project team utilized a broad range of

technology transfer tools to promote expanded adoption and continued application of recommended water quality best management practices. These programs have included:

- 236 educational programs, trainings and tours were presented to over 85,327 people during the course of the project. For example, the Dairy Pollution Prevention Workshop in March 1994 provided training on dairy waste management to 125 local dairymen, and the On-Site Wastewater Treatment Constructed Wetlands Workshop in September 1997 provided training to 52 individuals on alternative wastewater management systems.

- 36 field days were conducted to provide training and continuing education to dairymen and farmers and resulted in over 1,440 direct contacts in the project area.

Field days and tours provided more than 1440 direct contacts with agricultural producers in the project area.

- 26 new factsheets, bulletins and demonstration reports addressing nutrient, pesticide and animal waste management were developed and distributed to farmers and citizens throughout the project area.

- 17 new slide sets and 4 videos were developed and utilized in education and training programs on topics including animal waste management, petroleum product storage, fertilizer and pesticide management, and on-site septic systems.

Certainly, the most extensive program impacts have been achieved through media contacts. These efforts have facilitated technology transfer not only in the project area, but throughout the state, nationally and internationally. Project activities and recommended management systems have been featured in:

- 359 news articles and 25 radio programs focusing on water quality and quantity issues and best management practices were utilized to reach thousands of individuals locally and throughout the region. Examples include an information article on the Bosque Project's dairy constructed wetland published in the Texas Dairy Review, which is distributed to over 5,000 dairymen and related industries in the project area and across the state, and 5 articles in the Country World Magazine which has a distribution of 10,000 copies.

- Presentations made to seven international groups and at 16 state and national conferences, including the 2nd International Conference on Constructed Wetlands for Animal Waste Management which was hosted by the Upper North Bosque River Project and attended by 150 individuals. Tours and educational

programs also were provided to water resource managers from South Africa, Mexico and Australia.

- Two TransTexas Video Network (TTVN) teleconferences which enabled producers and agency personnel to share information on effective management strategies and technological advances being utilized across the state.

Partnerships for Success

The accomplishments of the Upper North Bosque River Project have been made possible through dedicated, cooperative efforts among state and federal agencies, state and local organizations and individuals. These efforts have enabled the project to meet and exceed all project goals. Below are examples of some of the cooperative programs which were conducted to improve coordination and to develop and strengthen partnerships during the project:

- As a first step, a 12 member Local Coordinating Committee was established to provide guidance and input into the project. This group consisted of local community leaders, citizens and dairy producers who were direct stakeholders in the project. The group met quarterly or as needed and assisted in development of the Annual Project Plan of Operations, program planning and in project assessment.

- Regular meetings were held with local civic groups and organizations such as the Chamber of Commerce, Rotary Clubs, Hico Community Organization and Kiwanis Club to inform members of project activities and to gain their support for the watershed program.

- A joint project with the Texas Agricultural Experiment Station implemented a sub-watershed constructed wetland. This special wetlands project is designed to evaluate the potential for large-scale, in-stream wetlands to remove contaminants originating from multiple sources. The first of its kind, this project has been toured by congressional representatives from Washington, D.C.

The subwatershed constructed wetlands project was a cooperative effort which has produced important information on the use of wetlands for removing pollution from streams.

- Cooperative work with the USDA Agricultural Research Service and the Blackland Research Center enabled validation of watershed and hydrologic models which are utilized throughout the country. GIS data bases were developed which are now being utilized by local and regional management and governmental entities to implement watershed management plans.

- Cooperative work with the U.S. Geological Survey enabled enhanced stream monitoring in the project area and documented water quality improvements which were achieved through the project.

- Most importantly, local partnerships with soil and water conservation districts, towns and cities, river authorities, and individual land owners played a crucial role in project success. Many local dairymen donated their time, land, equipment and other resources to help demonstrate and encourage adoption of best management practices in the project area and throughout the industry.

Many local dairymen and farmers donated their time, land, equipment and other resources to help find solutions and protect the water resources.

THE FUTURE

When the Upper North Bosque River Project first began, the dairy industry was in a state of turmoil with new and increased regulatory restrictions, but few resources to enable them to meet the challenges. Through the project, new technologies and management systems were identified and made available. Information, technical and financial assistance programs were implemented to make change and improvement possible. Although more remains to be done, the knowledge and information developed through this watershed project will continue to be felt in the region for years to come. Both water resource management practices and policies have been, and will continue to be, affected by the accomplishments of this successful water resource management program.

United States Department of Agriculture

This project is a joint venture of the Texas Agricultural Extension Service and the U.S. Department of Agriculture Cooperative State Research, Education and Extension Service, Natural Resources Conservation Service and Farm Service Agency in conjunction with the Texas State Soil and Water Conservation Board and local districts. Other cooperating agencies include the U.S. Environmental Protection Agency, the U.S. Geological Survey, the Texas Natural Resource Conservation Commission and the Texas Agricultural Experiment Station.

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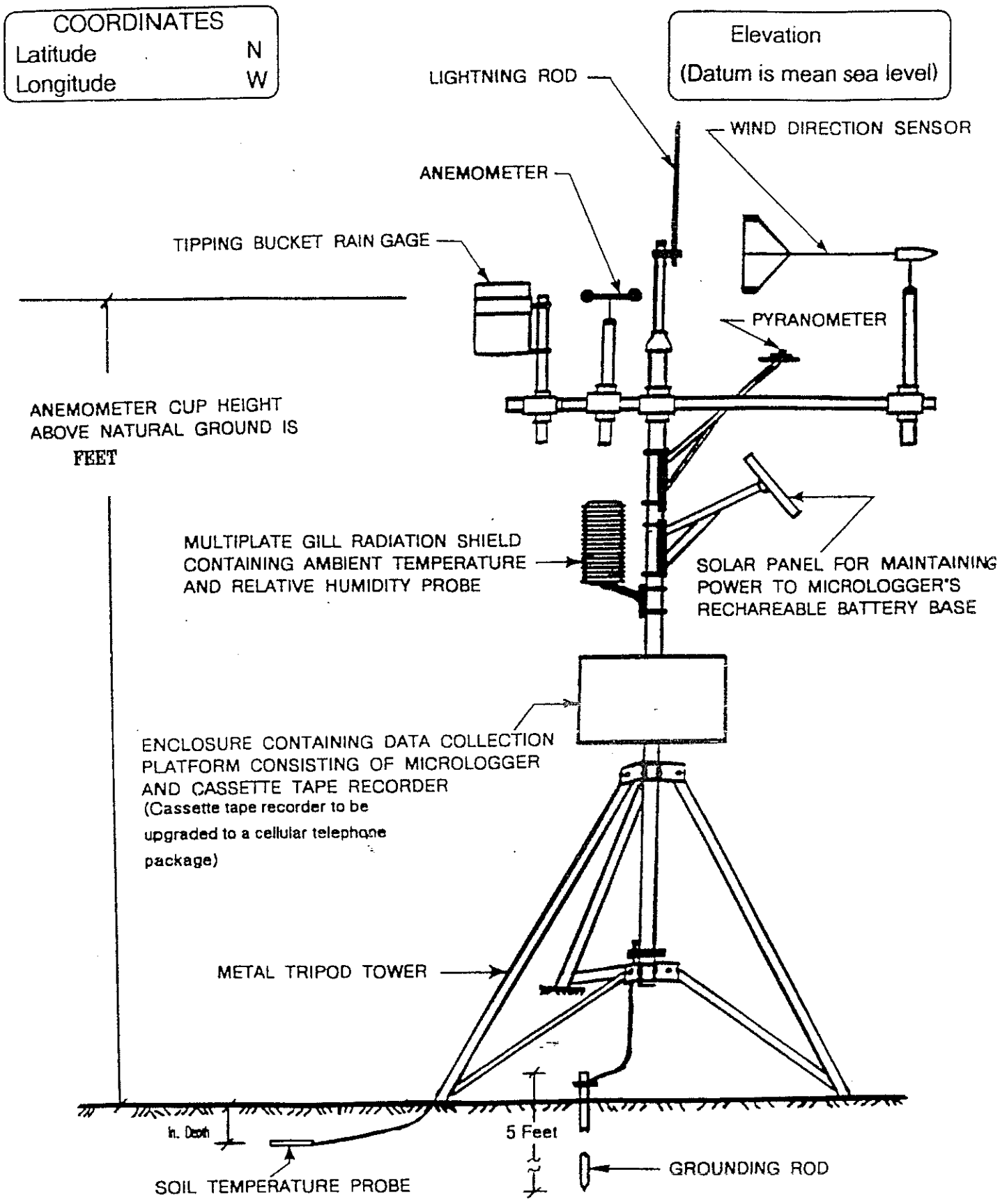
Appendix E

AUTOMATIC WEATHER STATION



WEATHER DATA FOR O'BRYAN'S CONSTRUCTED WETLANDS DEMONSTRATION PROJECT SITE

APRIL 1996

DATE	HOUR	RAINFALL (In.)	AIR TEMP (Deg F)	RELATIVE HUMIDITY (Percent)	WIND SPEED (MPH)	WIND DIRECTION (Deg from N)	SOIL TEM @ 5" (Deg F)	SOLAR RADIATION (kW/m2)	VOLTAGE (Volts)	MAX AIR TEMP (Deg F)	MIN AIR TEMP (Deg F)	MAX REL HUM (Percent)	MIN REL HUM (Percent)
04 -01-96	1200	0.00	61.87	23.23	1.820	141.1	*	13.980	14.23	63.55	60.54	26.86	21.35
04 -01-96	1300	0.00	64.31	21.24	1.803	101.6	59.78	20.650	14.20	66.91	62.34	25.44	19.00
04 -01-96	1400	*	66.54	19.15	7.400	113.8	62.56	*	14.13	67.32	65.65	20.73	17.71
04 -01-96	1500	*	67.89	16.86	7.180	103.5	64.15	*	14.12	69.00	66.60	19.58	15.02
04 -01-96	1600	*	69.37	16.85	7.670	117.2	65.92	*	14.10	70.70	68.39	18.44	15.49
04 -01-96	1700	*	70.30	17.44	7.350	111.2	67.16	*	14.10	71.40	69.56	18.91	15.82
04 -01-96	1800	*	69.51	17.59	8.570	116.2	67.67	*	14.02	70.20	68.74	18.44	16.49
04 -01-96	1900	*	66.26	21.09	6.067	116.3	67.43	*	12.96	68.75	63.51	23.22	18.11
04 -01-96	2000	*	61.47	24.34	5.040	115.9	66.63	*	12.89	63.27	59.87	25.86	22.89
04 -01-96	2100	*	58.41	26.77	4.207	116.1	65.56	*	12.86	59.87	56.91	28.10	25.66
04 -01-96	2200	*	56.32	28.42	3.374	116.9	64.46	*	12.84	56.93	55.51	29.39	27.90
04 -01-96	2300	*	54.14	31.64	4.242	127.0	63.41	*	12.82	55.51	52.88	33.17	29.39
04 -01-96	0	*	52.22	33.35	4.762	128.0	62.41	*	12.80	52.88	51.21	34.93	32.17
04 -02-96	100	*	50.66	34.70	4.775	139.6	61.48	*	12.79	51.21	49.77	36.15	33.85
04 -02-96	200	*	48.97	36.29	4.747	144.3	60.60	*	12.78	49.65	48.33	37.83	35.08
04 -02-96	300	*	48.44	34.24	5.287	137.2	59.76	*	12.77	48.71	48.23	35.95	33.00
04 -02-96	400	*	47.66	37.02	5.500	151.4	58.98	*	12.76	48.35	47.27	38.93	33.60
04 -02-96	500	*	47.64	42.09	6.169	145.5	58.26	*	12.76	48.12	47.15	44.45	38.86
04 -02-96	600	*	46.24	46.12	4.133	158.5	57.60	*	12.75	47.15	45.83	46.88	44.12
04 -02-96	700	*	46.08	47.36	4.419	154.9	56.98	*	12.75	47.42	44.88	49.99	45.21
04 -02-96	800	*	49.94	44.18	5.197	149.2	56.46	*	12.75	53.91	47.42	48.70	39.66
04 -02-96	900	*	58.69	35.40	9.610	151.5	56.42	*	13.07	62.17	54.15	40.94	30.87
04 -02-96	1000	*	64.91	27.32	13.560	150.9	57.12	*	14.16	67.26	62.29	32.01	24.32
04 -02-96	1100	*	68.01	23.75	13.730	156.4	58.44	*	14.24	69.85	66.64	25.66	22.02
04 -02-96	1200	*	69.56	22.83	14.670	157.9	60.25	*	14.17	71.90	68.60	24.56	20.80
04 -02-96	1300	*	71.10	23.29	13.520	164.5	62.24	*	14.13	72.80	70.30	25.08	21.47
04 -02-96	1400	*	70.60	21.72	13.300	159.5	64.13	*	14.12	71.80	69.24	25.35	18.38
04 -02-96	1500	*	72.10	18.71	13.830	153.7	65.53	*	14.09	73.40	70.40	20.99	17.16
04 -02-96	1600	*	71.70	19.26	14.190	151.5	66.75	*	14.08	73.10	70.90	20.11	18.37
04 -02-96	1700	*	71.40	19.02	14.680	145.9	67.65	*	14.08	72.30	70.30	20.38	17.36
04 -02-96	1800	*	69.07	20.83	13.180	141.8	67.97	*	13.29	70.40	67.81	21.53	20.18
04 -02-96	1900	*	66.02	23.49	11.460	144.6	67.69	*	12.90	67.69	64.01	25.17	21.06
04 -02-96	2000	*	62.54	26.36	9.050	141.7	66.99	*	12.87	64.13	61.29	27.67	25.17
04 -02-96	2100	*	60.60	29.73	7.900	137.8	66.13	*	12.84	61.30	59.99	31.91	27.67
04 -02-96	2200	*	59.98	35.76	8.120	137.8	65.29	*	12.82	60.14	59.78	41.20	31.91
04 -02-96	2300	*	60.16	46.01	8.270	140.7	64.56	*	12.81	60.40	59.90	50.20	41.33
04 -02-96	0	*	59.78	53.88	7.830	148.2	63.95	*	12.80	60.40	59.19	56.39	50.20
04 -03-96	100	*	57.43	61.75	5.596	154.7	63.41	*	12.79	59.19	56.08	66.29	56.53
04 -03-96	200	*	56.10	68.32	6.305	157.0	62.85	*	12.78	56.58	55.61	71.20	65.88
04 -03-96	300	*	54.95	74.20	6.955	148.7	62.25	*	12.77	55.61	54.42	76.80	71.20
04 -03-96	400	*	54.08	79.20	7.660	157.5	61.68	*	12.76	54.54	53.71	81.90	76.80
04 -03-96	500	*	55.11	81.40	8.640	165.6	61.18	*	12.76	56.25	53.71	82.60	80.00
04 -03-96	600	*	56.15	80.90	6.914	145.9	60.84	*	12.76	56.60	55.27	83.50	79.60
04 -03-96	700	*	55.15	84.60	7.250	147.7	60.62	*	12.76	55.63	54.78	85.40	83.50
04 -03-96	800	*	57.78	80.90	11.560	149.1	60.41	*	12.76	59.11	55.75	84.50	77.90
04 -03-96	900	*	61.20	71.20	13.660	161.6	60.46	*	12.97	63.65	58.74	78.70	64.58
04 -03-96	1000	*	63.96	64.49	14.920	176.4	60.90	*	13.71	66.02	62.77	66.71	60.79
04 -03-96	1100	*	66.86	60.03	14.890	172.5	61.80	*	14.19	68.60	65.48	62.50	57.59
04 -03-96	1200	*	69.25	56.91	13.840	167.6	63.20	*	14.17	70.90	67.74	59.80	54.48
04 -03-96	1300	*	72.00	52.58	13.860	173.4	64.94	*	14.10	74.10	70.50	55.55	50.16
04 -03-96	1400	*	73.80	49.43	13.780	177.6	66.79	*	14.08	74.80	72.40	52.10	47.67
04 -03-96	1500	*	75.40	46.54	13.020	183.0	68.47	*	14.04	76.60	74.40	48.79	44.36
04 -03-96	1600	*	76.40	44.65	12.570	179.7	69.92	*	14.02	77.80	75.60	46.57	42.34
04 -03-96	1700	*	77.00	42.30	11.540	172.5	70.90	*	14.01	77.50	76.20	44.75	40.99
04 -03-96	1800	*	76.60	42.47	11.510	164.4	71.40	*	13.66	77.30	75.90	44.68	41.19
04 -03-96	1900	*	73.70	48.85	10.270	143.7	71.30	*	12.91	75.90	71.60	53.02	44.82
04 -03-96	2000	*	69.99	55.06	8.300	140.7	70.70	*	12.87	71.40	69.24	56.14	53.29
04 -03-96	2100	*	69.02	55.88	9.830	139.2	69.96	*	12.85	70.00	67.96	59.59	53.73
04 -03-96	2200	*	67.36	63.30	11.270	145.0	69.17	*	12.83	67.98	66.67	65.98	59.99
04 -03-96	2300	*	65.76	69.90	11.470	152.1	68.46	*	12.82	66.79	64.88	73.00	65.98
04 -03-96	0	*	64.16	75.60	8.980	160.6	67.80	*	12.80	64.89	63.34	78.20	73.00
04 -04-96	100	*	62.60	81.50	7.410	164.5	67.18	*	12.79	63.34	61.68	84.90	78.40
04 -04-96	200	*	61.36	86.50	6.951	189.9	66.58	*	12.78	61.80	60.61	88.30	84.80
04 -04-96	300	*	60.26	89.50	7.400	164.8	66.01	*	12.77	60.63	59.90	90.70	88.40
04 -04-96	400	*	59.24	92.00	4.710	207.7	65.47	*	12.76	59.92	58.48	93.10	90.50
04 -04-96	500	*	57.44	95.80	2.679	198.9	64.92	*	12.75	58.23	55.85	96.90	92.20
04 -04-96	600	*	55.33	93.10	5.558	236.6	64.35	*	12.74	56.10	54.42	100.00	88.20
04 -04-96	700	*	54.74	91.00	6.673	266.3	63.83	*	12.74	55.39	54.30	92.80	90.20
04 -04-96	800	*	57.01	95.40	9.600	320.1	63.48	*	12.74	58.15	55.39	96.90	93.20
04 -04-96	900	*	55.01	90.10	14.750	187.3	63.27	*	12.74	55.98	54.28	94.00	87.10
04 -04-96	1000	*	54.43	83.30	15.160	151.3	63.10	*	12.75	54.78	53.93	87.20	78.60
04 -04-96	1100	*	55.16	74.00	17.720	64.2	63.01	*	12.95	56.10	54.52	78.70	68.58
04 -04-96	1200	*	55.73	68.59	14.530	145.0	63.15	*	13.20	56.44	54.87	69.05	64.87
04 -04-96	1300	*	55.39	65.01	13.170	210.2	63.37	*	13.11	56.44	54.51	67.97	61.11
04 -04-96	1400	*	55.66	60.03	15.260	268.3	63.59	*	13.84	57.03	53.99	63.19	56.80
04 -04-96	1500	*	53.54	61.42	14.040	291.0	64.03	*	13.27	54.35	52.69	63.88	59.50
04 -04-96	1600	*	52.87	61.46	12.740	240.5	64.09	*	13.03	53.19	52.59	64.48	59.65
04 -04-96	1700	*	52.10	64.83	13.920	97.3	63.86	*	12.89	52.84	51.41	70.70	60.05
04 -04-96	1800	*	52.42	63.86	15.010	86.4	63.43	*	12.84	52.63	52.15	64.92	62.50
04 -04-96	1900	*	52.73	62.78	14.200	31.7	62.97	*	12.81	52.88	52.51	64.04	61.62
04 -04-96	2000	*	52.64	64.60	9.610	34.5	62.51	*	12.78	52.86	52.51	65.72	63.44
04 -04-96	2100	*	52.15	66.21	16.640	18.5	62.10	*	12.76	52.63	51.79	67.61	64.98
04 -04-96	2200	*	50.32	75.30	10.910	152.8	61.68	*	12.74	52.15	48.18	87.10	65.47
04 -04-96	2300	*	47.42	90.20	12.470	228.2	61.06	*	12.72	48.18	47.09	92.80	85.90
04 -04-96	0	*	46.49	93.80	12.510	182.3	59.68	*	12.71	47.23	46.17	95.80	88.60
04 -05-96	100	*	45.31	94.60	15.040	54.7	58.07	*	12.70	46.17	44.12	96.20	92.80
04 -05-96	200	*	43.52	96.50	18.110	43.1	57.09	*	12.69	44.12	43.15	98.00	94.10
04 -05-96	300	*	42.92	98.70	17.010	38.0	56.14	*	12.68	43.17	42.69	99.40	97.30
04 -05-96	400	*	42.77	98.20	14.640	38.6	55.32	*	12.68	42.94	42.45	99.10	97.10
04 -05-96	500	*	42.50	97.30	16.570	24.9	54.81	*	12.68	42.71	42.34	98.50	95.60
04 -05-96	600	*	42.03	97.70	15.980	57.2	54.40	*	12.67	42.59	41.50	99.00	96.20
04 -05-96	700	*	40.84	96.50	15.550	123.9	53.91	*	12.67	41.72	40.30	97.80	94.50

* - Sensors broke or programmed wrong

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

JUN 6 1996

Mr. Byron O. Spoonts, Jr.
Director, Statewide Management Program
Texas State Soil & Water Conservation Board
311 North 5th St.
P.O. Box 658
Temple, TX 76503-0658

Re: Approval of the Quality Assurance Project Plans (QAPP) for "Demonstration of a Waste Management System Utilizing Constructed Wetlands" for FY 94 Nonpoint Source Grant

Dear Mr. Spoonts:

The above QAPP, which was sent to us on April 1, 1996, has been reviewed and is approved. The completed signature pages and one copy of the QAPP are enclosed.

We appreciate your efforts in support of generating quality data for the Nonpoint Source Program. If you have any questions, please call me at (214) 665-8086.

Sincerely yours,

Len A. Pardee

Len A. Pardee
Texas Nonpoint Source Program
Grants Section

Enclosures

QUALITY ASSURANCE PROJECT PLAN
FOR
TASK 5. WATER QUALITY MONITORING
OF THE COOPERATIVE PROJECT ENTITLED
DEMONSTRATION OF WASTE MANAGEMENT SYSTEM
UTILIZING CONSTRUCTED WETLANDS
(SPONSORED BY LANDOWNER, TSSWCB, USEPA AND NRCS)

SUBMITTED BY THE

TEXAS INSTITUTE FOR APPLIED ENVIRONMENTAL RESEARCH
TARLETON STATE UNIVERSITY

PLAN PREPARED BY NANCY EASTERLING,
TEXAS INSTITUTE FOR APPLIED ENVIRONMENTAL RESEARCH
MARCH 1996

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

JUN 6 1996

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Sincerely yours,

Len A. Pardee

Len A. Pardee
Texas Nonpoint Source Program
Grants Section

Enclosures

Quality Assurance Project Plan
for the
Texas Institute for Applied Environmental Research
for Water Quality Monitoring and Measurement Activities Relating to
the Cooperative 319 Nonpoint Source Project Grant Entitled
Demonstration of Waste Management System Utilizing Constructed Wetlands

Section A1: Title and Approval Sheet

United States Environmental Protection Agency

Name: Leonard Pardee
Title: Texas Nonpoint Source Project Officer
Signature: Leonard C. Pardee Date: 6/5/96

Name: Richard Hoppers
Title: ~~Chief~~, Assistance and ~~Outreach~~ Branch
Signature: Richard Hoppers Date: 6/7/96

Texas State Soil and Water Conservation Board

Name: Byron Spoonts
Title: Quality Assurance Manager
Signature: Byron Spoonts Date: 3-29-96

USDA - Natural Resources Conservation Service

Name: Eugene R. Lindemann
Title: Environmental Engineer
Signature: Eugene R. Lindemann Date: 3-29-96

Texas Institute for Applied Environmental Research

Name: Larry Hauck
Title: Assistant Director of Environmental Sciences
Signature: Larry Hauck Date: 3/01/96

Name: Mark Murphy
Title: Laboratory Manager
Signature: Mark Murphy Date: 3/1/96

Concurrence Sheet:

Texas State Soil and Water Conservation Board
Name: ~~Deirdre Carlson~~ B.O. Spoonts, Jr.
Title: Project Manager
Signature: INTERIM Date: 3/29/96

USDA - Natural Resources Conservation Service
Name: Richard D. Babcock
Title: Assistant State Conservationist (Programs)
Signature: Date: 3/29/96

Name: Allan B. Colwick
Title: State Water Quality Coordinator
Signature: Date: 3/22/96

Name: James S. Alderson
Title: Plant Materials Specialist
Signature: Date: 3/22/96

Name: Jerry D. Walker
Title: Water Management Engineer
Signature: Jerry D. Walker Date: 3/22/96

Name: Jack L. White
Title: Project Coordinator
Signature: Jack L. White Date: 3/8/96

Landowner Lloyd O'Bryan
Signature: Lloyd A. O'Bryan Date: 3/28/96

Texas Institute for Applied Environmental Research
Name: Tina Coan
Title: Project Manager
Signature: Tina Coan Date: 3/3/96

Name: Nancy Easterling
Title: Quality Assurance Manager
Signature: Nancy Easterling Date: 3/1/96

Section A2: Table of Contents

Section A3: Distribution List

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

- United States Environmental Protection Agency

  Name: Leonard Pardee
  Title: Texas Nonpoint Source Project Officer

  Name:
  Title:

- Texas State Soil and Water Conservation Board

  Name: Deirdre Carlson
  Title: Agricultural Project Manager

  Name: Byron Spoonts
  Title: Quality Assurance Manager

- USDA Natural Resources Conservation Service

  Name: Richard D. Babcock
  Title: Assistant State Conservationist (Programs)

  Name: Allan B. Colwick
  Title: State Water Quality Coordinator

  Name: James S. Alderson
  Title: Plant Materials Specialist

  Name: Jerry D. Walker
  Title: Water Management Engineer

  Name: Eugene R. Lindemann
  Title: Environmental Engineer

  Name: Jack L. White
  Title: Project Coordinator

- Landowner Lloyd O'Bryan

- Texas Institute for Applied Environmental Research

  Name: Larry Hauck
  Title: Assistant Director of Environmental Sciences

  Name: Tina Coan
  Title: Project Manager

  Name: Mark Murphy
  Title: Laboratory Manager

  Name: Nancy Easterling
  Title: Quality Assurance Manager

Section A4: Project/Task Organization

Leonard Pardee, Texas Nonpoint Source Project Officer
United States Environmental Protection Agency, Region 6
Responsible for overall performance and direction of the project at the federal level. Approves the final products and deliverables.

United States Environmental Protection Agency, Region 6
Responsible for determining that the Project Plan meets the Federal requirements for planning, quality control, quality assessment and reporting.

Byron Spoonts, Quality Assurance Manager
Texas State Soil and Water Conservation Board
Responsible for tracking project administration.

Deirdre Carlson, TSSWCB Project Manager
Texas State Soil and Water Conservation Board
Responsible for overseeing the implementation of the proposed demonstration project.

Suzanne Cardwell, Contract Manager
Texas State Soil and Water Conservation Board
Responsible for tracking project progress and expenditures.

Richard D. Babcock, Assistant State Conservationist
Natural Resources Conservation Service
Responsible for overall performance and direction of all programs involving Texas NRCS participation.

James S. Alderson, Plant Materials Specialist
Natural Resources Conservation Service
Responsible for selection, procurement, planting and evaluation of aquatic vegetation in wetland cells.

Jerry D. Walker, Water Management Engineer
Natural Resources Conservation Service
Responsible for design and overseeing operation of waste management system and evaluation of aquatic vegetation.

Eugene R. Lindemann, Quality Assurance Manager
Natural Resources Conservation Service
Responsible for determining that the Project Plan meets the requirements for planning, quality control, quality assessment and reporting.
Responsible for installation, operation and maintenance and data acquisition of on-site portable weather station, and for evaluation of aquatic vegetation.

Allan B. Colwick, NRCS Project Manager
Natural Resources Conservation Service
Responsible for overseeing the implementation of the project, tracking project progress and expenditures, and all required reporting to TSSWCB.

Jack L. White, Upper North Bosque River HUA Project Coordinator
Natural Resources Conservation Service
Responsible for overseeing/supervising project on-site, providing public information services, data dissemination, and technology transfer.

Lloyd O'Bryan, Landowner
Responsible for overall operation and maintenance of waste management system.

Ron Jones, Executive Director
Texas Institute for Applied Environmental Research (TIAER)
Responsible for overall operation, integrity and success of TIAER at Stephenville, Texas.

Larry Hauck, Assistant Director of Environmental Sciences
Texas Institute for Applied Environmental Research (TIAER)
Responsible for coordinating cooperation between TIAER and NRCS.

Tina Coan, TIAER Project Manager
Texas Institute for Applied Environmental Research
Responsible for tracking project at the TIAER level and overseeing water sampling, laboratory analysis and data management.

Nancy Easterling, Quality Assurance Manager
Texas Institute for Applied Environmental Research (TIAER)
Responsible for determining that the Project Plan meets the requirements for planning, quality control, quality assessment and reporting.

Mark Murphy, Laboratory Manager
Texas Institute for Applied Environmental Research (TIAER)
Responsible for overseeing laboratory analysis of water samples.

Project Organizational Chart

United States Environmental Protection Agency, Region 6
Leonard Pardee, Texas Nonpoint Source Project Officer

Texas State Soil and Water Conservation Board
Byron Spoonts, Quality Assurance Manager
Deirdre Carlson, Project Manager
Suzanne Cardwell, Contract Manager

Natural Resources Conservation Service
Richard D. Babcock, Assistant State Conservationist
James S. Alderson, Plant Materials Specialist
Jerry D. Walker, Water Management Engineer
Eugene R. Lindemann, Quality Assurance Manager
Allan B. Colwick, Project Manager
Jack White, Upper North Bosque River HUA Project Coord

Landowner Lloyd O'Bryan

Texas Institute for Applied Environmental Research
Ron Jones, Executive Director
Larry Hauck, Assistant Director of Environmental Sciences
Tina Coan, Project Manager
Mark Murphy, Laboratory Manager
Nancy Easterling, Quality Assurance Manager

Section A5: Problem Definition / Background

Agriculture is a major component of the economy of Erath County, Texas. Erath County is the major dairy producing area in the state. During the past five years, the number of dairy producers and animal numbers have increased dramatically. Development of adequate waste management systems, technologies and policies currently are critical to dairy producers of the county, surrounding counties, and the state. In Erath County, confined area feeding is a prevalent component of present day dairy operations. Control of water quality near confined feeding areas comprises a major environmental concern.

A 1994 assessment of the nation's waters required by Clean Water Act Section 305(b) found agriculture to be the pollution source in 72 percent of impaired river miles and 56 percent of impaired lake acres (EPA, 1994). Wastewater lagoons on confined animal feeding operations (CAFOs) constitute a source of this agricultural pollution. Periodic dewatering of lagoons maintains adequate capacity in lagoons; the effluent is land applied to fields on which plants are grown. Under adverse conditions, however, dewatering can result in polluted runoff emanating from the application sites.

The main objective for the NRCS wetland project is to demonstrate management systems which improve environmental quality as shown by reduced concentrations of key indicators. Results of the demonstration will convey to dairy operators the need for enhancement of water quality measures. Collected data will enhance technological ability to improve design criteria for wastewater and runoff management systems.

The emphasis of the overall project is to demonstrate the constructed wetland as an animal waste management system component and to determine whether there are sufficient economic benefits to encourage dairy operators to enter into a "co-generation" type of relationship to produce a waste treatment unit and a marketable feed stock.

Constructed wetlands have been employed in municipal wastewater treatment plants in various parts of the country to treat sewage effluent. Plants grown in the wetlands serve to uptake nutrients from sewage wastes, thus reducing the pollutant content. The Natural Resources Conservation Service (NRCS) of the United States Department of Agriculture intends to establish a series of constructed wetland cells which receive dairy lagoon effluent in order to demonstrate the use of constructed wetlands as a component practice of a dairy waste management system. The demonstration wetland cells will be established on the O'Bryan Dairy, south of Dublin in western Erath County, Texas.

The project's surface water quality monitoring program involves measurement of physical parameters of water at sites associated with wetland cells, collection of water samples from those sites, chemical analyses of those samples and data analyses of the water quality measurements

from those sites. The water quality monitoring will be performed by the Texas Institute for Applied Environmental Research (TIAER). The tasks associated with TIAER's surface water quality monitoring program are described in Section A6 "Project/Task Definition."

Beneficiaries of this project will include dairy owners/operators and residents who use river systems potentially impacted by CAFOs for recreational and domestic uses. Additional beneficiaries will be those whose communities or watersheds implement strategies recommended as a result of this project.

Section A6: Project / Task Description

The purposes of Task 5 of the NRCS Wetland Project are as follows:

(1) To demonstrate the use of a constructed wetland as a component practice of a dairy waste management system.
(2) To characterize the quantity and quality of the inflow and outflow water associated with constructed wetland cells receiving dairy lagoon effluent in order to determine the overall performance of the system.
(3) To define, within the limits of a routine water quality sampling scheme, the physical, chemical, and biological processes active in the system in order to refine and develop design procedures and design parameters used to proportion systems needed to meet water quality goals.

The major program elements associated with Task 5 of this project are described below.

Program Element One: Design and Construction of Wetland Cells
The wetland cells were designed by NRCS using the Presumptive Method which is based on guidelines developed by Dr. Donald Hammer. The constructed wetland is based on a BOD_5 loading rate of 65 lbs/acre/day and a minimum hydraulic residence time of 12 days. During normal operation a volume of wastewater equal to average daily wastewater production will be delivered as inflow to the 4 cell pairs (8 individual cells).

Program Element Two: Sampling Design
Selection of the appropriate water quality parameters to be measured and frequency of sampling represent further important elements of the sampling design. The number and location of sampling sites throughout the dairy waste management system will be determined.

Program Element Three: Planting of Wetland Cells
Introduction of plants to each constructed cell will be managed to ensure an adequate number of healthy plants to readily establish the nutrient uptake capabilities of the wetland.

Program Element Four: Water Sampling Techniques and Measurement of Field Parameters
Sampling will be done manually with aliquots combined to obtain composite samples at each site. Appropriate and consistent measurement and sampling techniques and equipment will be used. Appropriate quality control techniques will be established for field measurements and handling of samples.

Program Element Five: Chemical Analysis
An appropriate EPA-approved analytical method will be selected for each water quality constituent of interest. Maximum holding times must be compatible with sampling and analysis schedules. Appropriate quality control will be established for handling of samples.

Program Element Six: Data Management
Databases will be established to maintain the data in usable form. Appropriate documentation will be maintained to ensure integrity of the data. Procedures to detect invalid database entries are integral to data management.

Program Element Seven: Data Analysis
Appropriate and acceptable methods of analyzing the data will be used.

Project milestones are provided in Table A6-1.

Table A6-1 Project Milestones

DATE	MILESTONE
December 1995	Wetland cells constructed
March 1996	Quality Assurance Project Plan prepared and submitted
March 1996	Wetlands planted
May 1996	Database established
June 1996	Water Monitoring initiated, if plants are adequately established
June 1996	Chemical analyses initiated
April, July, October 1996 January, April, July, October 1997	Quarterly Reports
November 1997	Water Monitoring Completed
February 1998	Draft Data Analysis Report submitted

Section A7: Data Quality Objectives for Measurement Data

In order to meet the NRCS Wetland Project Task 5 purposes stated in Section A6: Project/Task Description, data will be collected to demonstrate whether nutrient loadings in lagoon effluent treated by constructed wetlands are significantly lower than loadings in lagoon effluent without additional treatment. Four pairs of wetland cells will be evaluated in order to quantify nutrient reduction by paired cells and individual cells within each pair. Biweekly composite samples will be obtained and analyzed for the parameters listed in Table A7-1, which also lists precision, accuracy and practical quantity limits. EPA-approved procedures will be used for all water sample analyses performed in the TIAER chemistry laboratory.

Flow measurement to the 4 cell pairs from the waste lagoon will be calculated using the general orifice equation ($Q = CA\sqrt{2gH}$) and measuring the head (H) on the orifice and verified using direct volume flow measurements. The orifice diameters (5mm) were designed with a self-cleaning velocity to prevent clogging. The planned orifice head on cells 1A, 2A, 3A and 4A (Figure B1-1) varies from 16.8 feet to 23.0 feet with a variation in expected flow rate of just over 0.3 gpm (from 1.88 gpm to 2.20 gpm). A staff gauge will be installed in the waste lagoon for manually determining head on the orifices. NRCS *may attempt* to install an automatic water level device interfaced with the weather station micrologger. This would provide automatically recorded hourly head readings on the orifices. Flow to the storage pond from the wetland cell system will be calculated using direct volume flow measurements.

Overall project management will be conducted by NRCS. Cell design, planting regimes and maintenance of plants will be the responsibility of NRCS. Weather station maintenance and monitoring will be the responsibility of NRCS. Water quality sampling and analyses will be undertaken by TIAER. Database management and data analyses will be conducted by TIAER.

The spatial boundaries of the project include the Lloyd and Gloria O'Bryan Dairy in Erath County, approximately 4 miles south of Dublin, Texas. More specifically, the project will include the wastewater lagoon, eight constructed wetland cells, a common drainage conduit, flush/recirculation system, and a waste storage pond.

The contractual limits of the section 319 project monitoring is a multi-year period beginning September 12, 1995 and ending September 30, 1997.

Table A7-1 Accuracy and Precision Limits of Measured Parameters

NUTRIENT/POLLUTANT	Precision Limits (PD)	Accuracy Limits	Estimated Practical Quantity Limits
Laboratory Parameters			
Ammonia Nitrogen	10%	80-120%	0.2 mg/L
Total Kjeldahl Nitrogen	10%	80-120%	0.1 mg/L
Nitrate Nitrogen	10%	80-120%	0.025 mg/L
Nitrite Nitrogen	10%	80 - 120%	0.025 mg/L
Orthophosphate Phosphorus	10%	80-120%	0.1 mg/L
Total Phosphorous	10%	80-120%	0.1 mg/L
Total Suspended Solids	10%	80-120%	50 mg/L
Total Dissolved Solids	10%	80-120%	50 mg/L
Fecal Coliform Bacteria	NA	NA	20 colonies/100 mL
Chemical Oxygen Demand	10%	80 - 120%	30 mg/L
Field Parameters			
Dissolved oxygen	NA	NA	1.0 mg/L
Potential hydrogen (pH)	NA	NA	0.1 pH units
Conductivity	NA	±1% of range*	10 µmhos/cm*
Water Temperature	NA	NA	0.1 °C

* Manufacturer's specifications

Data collection and analyses will meet a 90 percent confidence level for data completeness. Although 100 percent of collected data should be available, accidents, insufficient sample volume, or other problems must be expected. A goal of 90 percent data completeness will be required for data usage. Should less than 90 percent data completeness occur, the Program Manager will initiate corrective action. Data completeness will be calculated as a percent value and evaluated with the following formula:

$$\text{Percent completeness} = \frac{SV \times 100\%}{ST}$$

Where: SV = number of samples with a valid analytical report
ST = total number of samples collected

TIAER will determine the precision of its chemical analyses. This will be accomplished by completing the entire analysis of a duplicate sample once per batch or once per 10 samples, whichever is the greater frequency. Percent deviation of duplicate analyses (X_1 and X_2) will be calculated using the formula:

$$\text{Percent Deviation} = \frac{(X_1 - X_2)}{(X_1 + X_2)} \times 100\%$$

The accuracy of the analytical process will be monitored by determining the percent recovery of a spiked quantity of the parameter in question. The following formula will be utilized to determine percent recovery:

$$\text{Percent Recovery} = \frac{SSR-SR}{SA} \times 100\%$$

Where: SSR = spiked sample result
SR = unspiked sample result
SA = spike added

Database checks for validity will be performed on an on-going basis. Data will be reviewed for abnormalities or any unusual results. Any unusual results will be traced for error sources. In the event no error is found, the data will be assumed normal and appropriate for decision determinations. If an error is found and cannot be resolved, the data will be discarded.

The TIAER Project Manager will coordinate with the Laboratory Manager and Field Supervisor to ensure that proper protocols are utilized. Table A7-1 shows the study limits established for accuracy and precision.

Section A10: Documentation and Records

Quarterly reports will note activities conducted in connection with the monitoring program, items or areas identified as potential problems, and any variations or supplements to the QAPP. Corrective Action Report forms (CARs) will be utilized when necessary (Appendix A). Activities conducted throughout the year, items or areas identified as potential problems, and any variations or supplements to the QAPP will be included in quarterly reports. Variations from the QAPP and subsequent CARs will result in supplements to the QAPP which will be made known to all pertinent project personnel. Data completeness for the quarter will be included in quarterly reports.

A data analysis report will comprise the final report for this project. The report will document the water quality monitoring, in-situ measurements, chemical analyses, and data analyses.

Hard copies and electronic forms of all raw data, laboratory analyses, documentation records, calibration logs, and all original data will be archived by TIAER for at least five years.

Section B1: Sampling Process Design (Experimental Design)

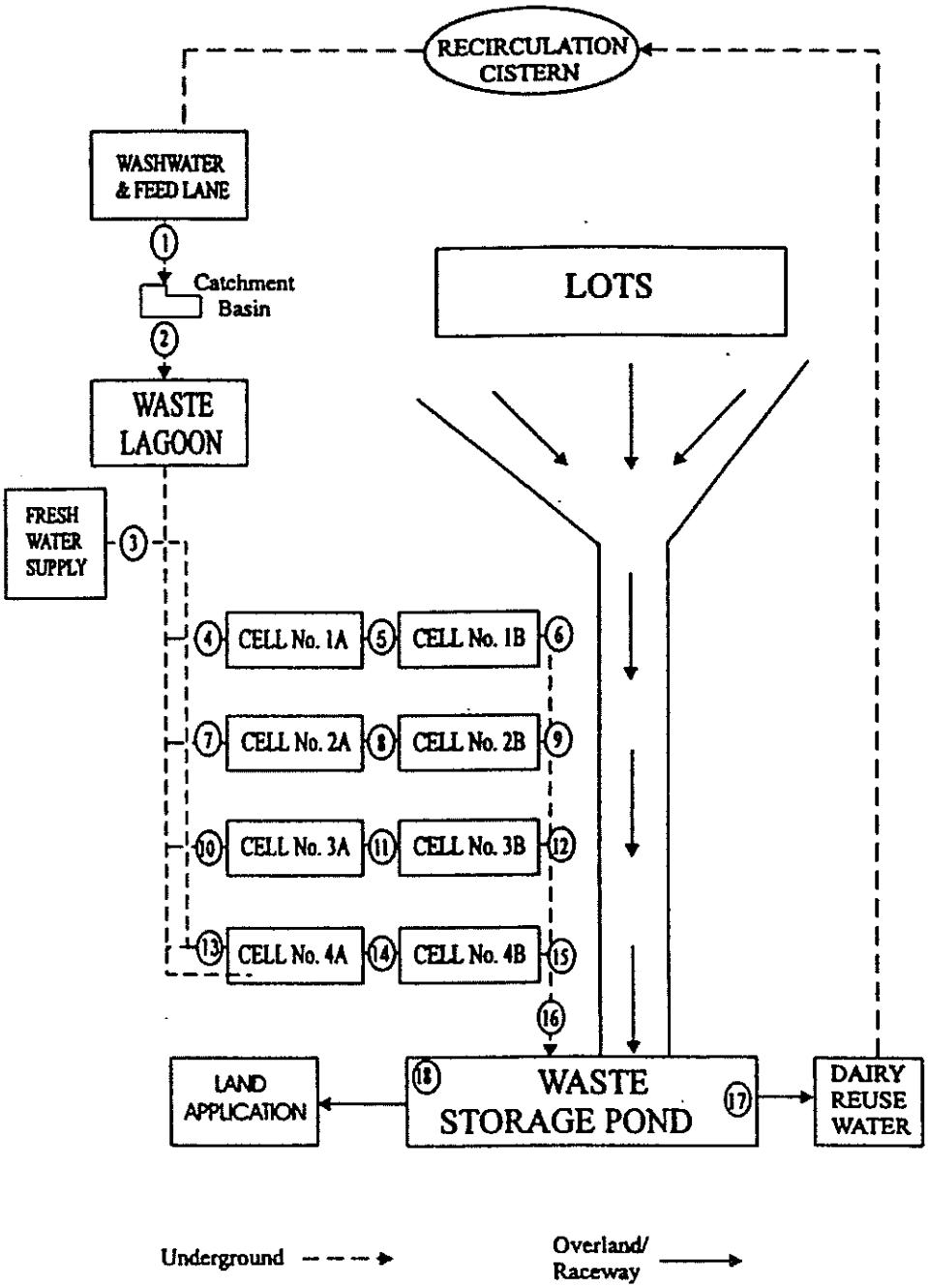
This sampling program is designed to obtain data concerning water quality from water associated with a dairy waste lagoon, constructed wetland cells and waste storage pond. Sampling sites are chosen to enable the determination of the nutrient reduction or loading from each component of the waste management system. The 18 sampling sites in the project are described in Table B1-1 and illustrated in Figure B1-1.

Table B1-1 Sampling Site Locations

SITE #	LOCATION	USED TO MONITOR
1	Between feed lanes/parlor and catch basin	Concentrations in total manure diluted with flush water
2	Between catch basin and waste lagoon (lagoon influent)	Concentrations in liquid phase of raw manure diluted with flush water
3	Fresh water supply	Nutrient concentrations in on-site well water
4	Influent to CWC* 1A	Lagoon effluent, control for treatment by CWCs 1A & 1B
5	Between CWC 1A and 1B	Treatment by CWC 1A
6	Discharge from CWC 1B	Treatment by CWC 1B
7	Influent to CWC 2A	Lagoon effluent, control for treatment by CWCs 2A & 2B
8	Between CWC 2A and 2B	Treatment by CWC 2A
9	Discharge from CWC 2B	Treatment by CWC 2B
10	Influent to CWC 3A	Lagoon effluent, control for treatment by CWCs 3A & 3B
11	Between CWC 3A and 3B	Treatment by CWC 3A
12	Discharge from CWC 3B	Treatment by CWC 3B
13	Influent to CWC 4A	Lagoon eflfuent, control for treatment by CWCs 4A & 4B
14	Between CWC 4A and 4B	Treatment by CWC 4A
15	Discharge from CWC 4B	Treatment by CWC 4B
16	Common drainage conduit below all cells	Combination of all treatments
17	North edge of waste storage pond	Treatment by waste storage pond & entire system
18	South edge of waste storage pond	Treatment by waste storage pond & entire system

* CWC - constructed wetland cell

Figure B1-1 Schematic of Sampling Sites



If sites 4, 7, 10 and 13, all of which are used to monitor lagoon effluent, show no significant variation in concentrations, only site 4 will continue to be monitored. If sites 17 and 18, which are both used to monitor treatment by the waste storage pond and the entire system, show no significant variation in concentrations, only site 17 will continue to be monitored.

TIAER will examine a variety of chemical, bacterial and physical parameters characterizing water samples taken from the sampling sites. The measured waterborne constituents are shown in Table B1-2. Parameters are designated as either *critical*, i.e., required to characterize water quality, or *non-critical*, i.e., descriptive parameters. Table B1-2 also lists the units in which each parameter is reported.

Table B1-2 Waterborne Constituents

Parameter	Status	Reporting Units
Laboratory Parameters		
Ammonia Nitrogen	Critical	mg/L
Total Kjeldahl Nitrogen	Critical	mg/L
Nitrate Nitrogen	Critical	mg/L
Nitrite Nitrogen	Critical	mg/L
Orthophosphate Phosphorous	Critical	mg/L
Total Phosphorous	Critical	mg/L
Total Suspended Solids	Critical	mg/L
Total Dissolved Solids	Critical	mg/L
Fecal Coliform Bacteria	Critical	colonies/100 mL
Chemical Oxygen Demand	Critical	mg/L
Field: Water Parameters		
Dissolved Oxygen	Non-critical	mg/L
Potential hydrogen (pH)	Non-critical	pH standard units
Conductivity	Non-critical	µmhos/cm
Water Temperature	Non-critical	°C

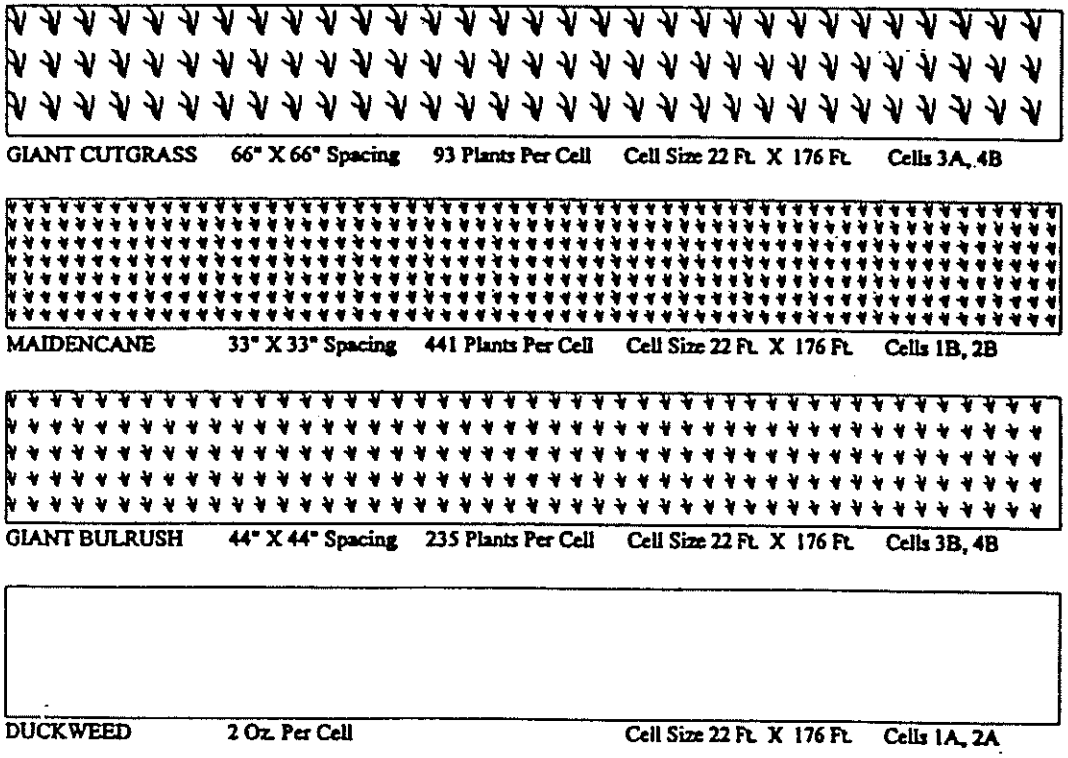
Water quality samples will be collected at bi-weekly intervals from sites which have flow to evaluate water quality on a periodic basis. Each sample submitted for chemical analysis will consist of a composite of up to three grab aliquots taken at intervals of at least one hour from each sampling site. Field parameters will be measured at each site at the beginning and at the end of the composite sampling period.

Flow rates into the upper cells (1A, 2A, 3A and 4A) of each cell pair will be calculated using the orifice equation and measured heads on the orifice. The orifice equation will be validated by volumetric measurements of the individual orifices and compared to the equation. Any needed calibration for accuracy will be achieved by adjusting the discharge coefficient (C). As a minimum, one daily head reading will be observed and recorded by the landowner for flow calculations. Flow to the storage pond from the wetland cell system will be calculated using direct volume flow measurements.

Vegetation in the wetland cells will be burned or harvested as needed to prevent excessive buildup of biomass. Caution will be exercised during any burning of the biomass due to exposed PVC pipe material and adjacent coastal burmudagrass. Cells should be flooded to maximum depth just prior to burning. Removing top growth encourages tillering and keeps plants healthy and vigorous. Duckweed will be harvested for use in the dairy feed rations and will be analyzed for nutrient value for use as supportive, anecdotal data. Figure B1-2 gives the typical plant species, plant spacing, the quantity planted and their locations within the individual cells. Each cell is 22 feet wide and 176 feet long at its bottom dimension.

On-site atmospheric conditions (precipitation, ambient temperature, wind speed, wind direction, relative humidity and solar radiation) will be monitored with a portable weather station. Although weather data will be supportive data, it will be utilized in evaluating various components of the waste management system as they are affected by climatic conditions. Concentrations of the measured water quality parameters are affected by the amount of precipitation. Knowledge concerning individual plant species response to annual climatic conditions will be useful in evaluating dominance patterns of the hydrophytic vegetation.

Figure B1-2 Typical Plant Spacings for Constructed Wetlands



Section B2: Sampling Methods Requirements

Physical parameter measurements, nutrient aliquots and fecal coliform samples are the three components of the project's water monitoring regime. Two measurements of the physical parameters, up to three nutrient aliquots, and one fecal coliform sample will be taken at each site per sampling day.

The field parameters to be measured on site are water temperature, pH, specific conductivity and dissolved oxygen. They will be measured using a Hydrolab Datasonde, displayed by a Hydrolab Scout and recorded in a field notebook, with site, date, time, and data noted for each parameter. The field parameters will be measured at each site after the first set of aliquots is obtained and again after the last set of aliquots is obtained. Monitoring personnel will exercise extreme caution when working on embankment slopes, especially on the internal slopes of the waste lagoon and the waste storage pond which will have greater water depths.

Routine grab samples will be collected in 500 mL HDPE bottles having a diameter of at least 35 millimeters, as recommended by the 18th edition of *Standard Methods for the Examination of Water and Wastewater,* section 1060A. Aliquots will completely fill the bottle and will be tightly capped and placed in an iced container immediately. Each aliquot bottle will be marked with the site, date, time and aliquot number. One sample will be collected per site at hour intervals if flow is present, for a possible total of three samples per site. One exception is the fresh water site, which will have only one nutrient aliquot taken per sampling day. If flow is not observed at a site, the technician will note the lack of flow in the field notebook.

One water sample for fecal coliform analysis will be taken separately in a sterile 125 mL HDPE bottle at each site in conjunction with the last set of aliquots. The filled sample bottle will be capped and placed in an iced container immediately.

After all aliquots and samples are collected, they will be transported in an iced container to the TIAER field office where the aliquots for each site will be combined in equal portions into one large container. The containers will then be transferred to the TIAER chemistry laboratory for analysis.

Inflows to and outflow from cell pairs will be calculated as discussed in Sections A7 and B1. The waste treatment system was designed, staked on the ground, and constructed under the supervision of the NRCS. The detailed design (design report, design completed folder, and "as-built" plans) are on file in the NRCS State Office in Temple, Texas. The Waste Management Plan is on file in the NRCS field office in Stephenville, Texas. The design completed folder also contains copies of the Operation and Maintenance Agreement and Plan, the Operation and

Maintenance Agreement, and the Operation and Maintenance Plan. These documents state the specific responsibilities of the landowner and are included as Appendix B.

To provide additional information, sampling sites will be monitored following rainfall events of 3 inches or greater. If events of this magnitude do not occur during a four month period, the required amount of precipitation will be lowered so that data following a rainfall event is obtained. Only one sample per site, i.e., no aliquots, will be collected.

All on-site sampling equipment, e.g., water level recorder and weather station, will be inspected at least once every fortnight and serviced as needed. Table B2-1 lists the analytical procedures and handling methods to be used for each parameter. Sampling and analysis will be performed by the TIAER personnel under the supervision of the Project Manager.

Table B2-1 Analytical Procedures and Handling Methods

Parameter	Method(s)	Sample Size	Container	Preservation	Holding Time
Ammonia nitrogen	EPA[1] 350.1	1 liter	HDPE[4]	pH <2 H_2SO_4, 4°C	28 days
Total Kjeldahl nitrogen	EPA 351.1	125 mL	HDPE	pH <2 H_2SO_4, 4°C	28 days
Nitrate/nitrite nitrogen	EPA 353.2	250 mL	HDPE	pH <2 H_2SO_4, 4°C	28 days
Orthophosphate phosphorous	EPA 365.2	125 mL	HDPE	4°C	48 hours
Total phosphorous	EPA 365.4, 365.2	125 mL	HDPE	pH <2 H_2SO_4, 4°C	28 days
Total suspended solids	EPA 160.2	250 mL	HDPE	4°C	7 days
Total dissolved solids	EPA 160.1	250 mL	HDPE	4°C	7 days
Fecal Coliform	SM[2] 9222D	125 mL	HDPE, sterile	4°C	6 hours
Chemical Oxygen Demand	Hach[3] 8000	125 mL	HDPE	H_2SO_4, 4°C	28 days
Dissolved Oxygen	EPA 360.1	NA	NA	NA	immediate
Potential hydrogen (pH)	EPA 150.1	NA	NA	NA	immediate
Conductivity	SM2510B	NA	NA	NA	immediate
Water temperature	EPA 170.1	NA	NA	NA	immediate

[1] EPA - Methods for Chemical Analysis of Water and Wastes, March 1983
[2] SM - Standard Methods for the Examination of Water and Wastewater, 18th edition
[3] Hach Dr/2000 Spectrophotometer Procedures Manual, 9-1-91
[4] HDPE - high density polyethylene bottle

All corrective action is the responsibility of the Project Manager. Corrective action will be documented in writing on a Corrective Action Report Form (Appendix A).

Section B3: Sample Handling and Custody Requirements

Each aliquot and fecal coliform sample container will be marked in the field with the site number, date, time of collection, sample type (fecal or chemical) and aliquot number. The field technician will carefully document this data as well as narrative information regarding weather condition, flow conditions and any unusual observations in a designated field notebook. Upon arrival at the TIAER field office, nutrient aliquots will be composited according to instructions in Section B1: Sampling Process Design. Sample numbers will then be assigned to fecal coliform and nutrient samples by the field technician. The field technician will then transfer site and sample information onto the Chain of Custody/Data Entry Form (COC/DEF) following standard TIAER procedures, as delineated in standard operating procedure OMP-F-100. The COC/DEF will be signed and dated by both the field technician and a laboratory technician upon transferral of samples to the TIAER chemistry laboratory. Any intermediate or subsequent changes in sample possession or custody will be documented on the COC/DEF. A copy of the COC/DEF is included as Appendix C.

Section B4: Analytical Methods Requirements

Dissolved oxygen, water temperature, conductivity and pH of water samples collected for this project will be measured in the field. The remainder of the parameters listed in Table B2-1 will be analyzed by the TIAER Laboratory at Tarleton State University in Stephenville, Texas. A listing of analytical methods, equipment, and estimated method detection limits used by the laboratory are provided in Table B4-1. Standard operating procedures have been established for all procedures undertaken by TIAER staff which concern water quality monitoring and analysis.

In the event of a failure in the analytical system, the Project Manager will be notified. The Laboratory Manager and the Project Manager will then determine if the existing sample integrity is intact, if re-sampling can and should be done, or if the data should be omitted.

Table B4-1 Analytical Methods Requirements

Parameter	Method	Equipment Used	Estimated MDL*
Ammonia nitrogen	EPA 350.1	Perstorp Analytical Autoanalyzer	0.016 mg/L
Total Kjeldahl nitrogen	EPA 351.1	Perstorp Analytical Autoanalyzer with Tecator block digester	0.116 mg/L
Nitrate/nitrite nitrogen	EPA 353.2	Perstorp Analytical Autoanalyzer	0.004 mg/L
Orthophosphate phosphorous	EPA 365.2	Beckman DU64 Spectrophotometer	0.009 mg/L
Total phosphorous	EPA 365.4, 365.2	Perstorp Analytical Autoanalyzer with Tecator block digester	0.074 mg/L
Total suspended solids	EPA 160.2	Sartorius AC21P or Mettler AT261 Analytical Balance, Oven	10 mg/L
Total dissolved solids	EPA 160.1	Sartorius AC21P or Mettler AT261 Analytical Balance, Oven	10 mg/L
Fecal Coliform	SM 9222D	Incubator, filtering apparatus	40 colonies/100mL
Chemical Oxygen Demand	Hach 8000	Hach DR 2000	6 mg/L
Dissolved oxygen	EPA 360.1	Hydrolab Datasonde	± 0.2 mg/L
Potential hydrogen (pH)	EPA 150.1	Hydrolab Datasonde	±0.2 units
Specific Conductance	SM 2510B	Hydrolab Datasonde	µmhos/cm
Water temperature	EPA 170.1	Hydrolab Datasonde	±0.15°C

* MDL - Method Detection Limit, as determined September, 1993. To be redetermined periodically.

Section B5: Quality Control Requirements

The TIAER Laboratory will determine the precision of their analyses. Quality assurance of field sampling methods will be conducted by annual testing of sample collection and handling skills through the use of replicate samples, field blanks and field performance audits.

All laboratory analyses will have the precision and accuracy of data determined on the particular day that the data are generated. This normally requires the analysis of a minimum of one duplicate and one spike each time a particular chemical parameter is measured. Larger batches of samples require that additional precision and accuracy checks be made on 10 percent of the total batch. Depending on the analysis, certain methodologies require that water blanks, standards and reagent blanks be analyzed to verify that no instrument or chemical problem will affect data quality. Table B5-1 outlines the required analytical quality control for the parameters of interest.

The use of approved sampling and analytical methods will ensure that measured data accurately represents the conditions at each monitoring site. The comparability of the data produced is predetermined by the commitment of the TIAER laboratory staff to use only EPA-approved or EPA-recommended analytical methods. Table A7-1 in Section A7 "Data Quality Objectives" 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.

It is the responsibility of the TIAER Project Manager to verify that the data are representative. The data's precision, accuracy, and comparability will be the responsibility of the Laboratory Manager. The Project Manager also has the responsibility of determining that the 90 percent completeness criteria is met, or will justify acceptance of a lesser percentage. All incidents requiring corrective action will be documented through the use of Corrective Action Reports (Appendix A).

Table B5-1 Required Quality Control Analyses

Parameter	Blank	Standard	Duplicate	Spike
Ammonia nitrogen	A	A	B	B
Total Kjeldahl nitrogen	A	A	B	B
Nitrate/nitrite nitrogen	A	A	B	B
Orthophosphate phosphorous	A	A	B	B
Total phosphorous	A	A	B	B
Total suspended solids	A	None	B	None
Total dissolved solids	A	None	B	None
Fecal coliform bacteria	A	None	B	None
Chemical Oxygen Demand	A	A	A	A
Dissolved oxygen	None	None	None	None
Potential hydrogen (pH)	None	A	None	None
Temperature	None	None	None	None
Conductivity	None	C	None	None

A - Where specified, blanks and standards shall be performed each day that samples are analyzed.

B - Where specified, duplicate and spike analyses shall be performed on a 10% basis each day that samples are analyzed. If one to 10 samples are analyzed on a particular day, then one duplicate and one spike analyses shall be performed.

C - At a minimum, a standard is used to calibrate analytical equipment before the first sample and after the last sample during each bi-weekly sampling period.

Section B6: Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Individual Standard Operating Procedures (SOPs) have been established for each procedure used by TIAER in monitoring water quality. Schedules for testing, inspection, and maintenance for each piece of equipment are included in the SOPs. All equipment testing, inspection and maintenance will meet the requirements specified by the EPA. SOPs are on file in the TIAER office and are available on request.

Section B7: Instrument Calibration and Frequency

All instruments or devices used in obtaining environmental measurement data will be calibrated prior to use. Each instrument has a specialized procedure for calibration and may have a specific type of standard used to verify calibration. All calibration procedures will meet the requirements specified in the EPA-approved methods of analysis. The frequency of calibration recommended by the equipment manufacturer, as well as any instructions specified by applicable analytical methods, will be followed. All records of calibration will be logged by the person performing the calibration, archived by the Laboratory Manager, and will be accessible for verification during either a laboratory or field audit.

Laboratory equipment and devices needing calibration and recalibration are numerous and varied. All equipment will have verifiable calibration documentation maintained and available for inspection in the laboratory. Laboratory standards will be checked prior to use to verify that the concentrations are those which are prescribed for the analytical method.

All calibration procedures used in the field or laboratory will meet or exceed the calibration frequencies published in the test methods used for this project. Additional calibration procedures may be conducted if laboratory personnel determine additional calibration is warranted as beneficial to this project.

Section B8: Inspection/Acceptance Requirements for Supplies and Consumables

All supplies and consumables received by the TIAER laboratory are inspected upon receipt for damage, missing parts, expiration date, and storage and handling requirements. Labels on reagents, chemicals, and standards are examined to ensure they are of appropriate quality, initialed by staff member and marked with receipt date. Volumetric glassware is inspected to ensure class "A" classification, where required. TIAER's Standard Operating Procedure-Q-102 *Material Acceptance Criteria* details these procedures.

Section B9: Data Acquisition Requirements (Non-Direct Measurements)

Water quality determinations at sampling sites will be based entirely on data collected during the time-frame of this monitoring program. No other databases or literature files (other than site histories and weather data) will be utilized to evaluate the water quality at sampling sites.

Section C1: Assessments and Response Actions

The commitment to use approved equipment and methods when obtaining environmental samples and producing field or laboratory measurement must involve periodic verification that designated equipment and methods are utilized and that they are being employed correctly. This verification constitutes the annual field performance audit. Field investigators will be observed during actual field operations to verify that equipment and procedures are properly applied.

All laboratory samples will have the precision and accuracy of data determined on the particular day that the data were generated. Depending on the analysis, certain methodologies require that water blanks, standards, and reagent blanks be analyzed to verify that no instrument or contamination problem will affect data quality.

To minimize downtime of all measurement systems, all field measurement and sampling equipment, in addition to all laboratory equipment, will be maintained in good working condition. Also, backup equipment or common spare parts will be made available if any piece of equipment fails during use so that repairs or replacement can be made quickly, allowing measurement tasks to be resumed.

Data collection and analytical results will be reviewed semi-annually by the Project Manager to ensure that the data collection program is obtaining results sufficient to meet project objectives. During this semi-annual review, any necessary modification to the data collection efforts will be implemented to improve the integrity, validity and usefulness of the data.

Section C2: Reports to Management

Quarterly reports, as discussed in Section A10 and according with the schedule in Table A6-1, will be submitted by TIAER to NRCS.

The field measurement and sampling for the project will be done according to the approved workplan. The Laboratory Manager will report on the proper implementation of the procedures outlined in this QAPP and thereby on the status of the data quality. The Quality Assurance Manager will be informed by the Project Manager of any quality assurance problems encountered and solutions adopted through the use of CARs.

The main QA report for this program will be an annual quality assurance report prepared by TIAER. The report will contain a quality assurance section to address the accuracy, precision and completeness of the measurement data. It will also discuss any problems encountered and solutions made. This QA report is the responsibility of the Laboratory Manager with assistance, if required, from the Quality Assurance Manager and Project Manager.

A data analysis report will be prepared after data gathering and analysis have been completed. This report will include results of chemical, biological and physical measurements taken throughout the project, average concentrations at each site and estimates of load reductions. A draft report will be given to NRCS for review; the final report will incorporate necessary revisions.

Section D1: Data Review, Validation, and Verification Requirements

The Project Manager, Laboratory Manager, and monitoring team personnel will be responsible for reviewing, validating and verifying the measurement and sample data and the routine assessment of measurement procedures for precision and accuracy.

Whenever the procedures and guidelines established in this QAPP fail to meet the specified levels of data quality, corrective actions in the form of CARs will be required. Corrective action may be initiated by any staff member, including the Quality Assurance Manager, if variances from proper protocol are noted. The responsibility to see that corrective actions are made will be the responsibility of the TIAER Project Manager or Laboratory Manager. Each manager may also initiate corrective action on his own initiative, if situations arise that require immediate attention. Documentation of any corrective action procedures will be provided by the appropriate manager, along with the results of the implemented changes through the use of CARs.

Section D3: Reconciliation with Data Quality Objectives

Data completeness in this project will be relative to the number of samples taken from sites which meet the sampling criteria and from the number of bi-weekly sampling events. Accidents in handling, shipping and laboratory analysis may also reduce the completeness of the sampling program. It will be the goal of this project to achieve 90 percent completeness.

Representativeness and comparability of data, while unique to each individual collection site, is the responsibility of the TIAER Project Manager. By following the guidelines described in this QAPP, and through careful sampling design, the data collected in this project will be representative of the actual field conditions and comparable to similar applications. Representativeness and comparability of laboratory analyses will be the responsibility of the Laboratory Manager.

The TIAER Project Manager will review the final data to ensure that it meets the requirements as described in this QAPP.

Appendix A Corrective Action Report

Corrective Action Report
SOP-Q-105-1
CAR #:_____

Date:_____ Area/Location:_____

Reported by:_____ Activity:_____

State the nature of the problem, nonconformance or out-of-control situation:

_____
_____
_____
_____
_____

Possible causes:

_____
_____
_____

Recommended Corrective Actions:

_____
_____
_____

CAR routed to:_____
Received by:_____

Corrective Actions taken:

_____
_____
_____
_____

Has problem been corrected?: YES NO

Immediate Supervisor:_____

Program Manager:_____

Quality Assurance Officer:_____

Appendix B Operation and Maintenance Agreement and Plan

OPERATION AND MAINTENANCE AGREEMENT AND PLAN

WASTE MANAGEMENT SYSTEM
Constructed Wetland Demonstration Project
Lloyd and Gloria O'Bryan Dairy
Erath County, Texas

Operation and maintenance of this system will be the responsibility of the landowner, and subject to periodic inspection and review by the Texas State Soil and Water Conservation Board(TSSWCB). A copy of the operation and maintenance agreement and plan follows:

OPERATION AND MAINTENANCE AGREEMENT

THIS AGREEMENT made on the _____ day of _____, 1995, is among the Texas State Soil and Water Conservation Board, State of Texas, called the TSSWCB; the Natural Resources Conservation Service, United States Department of Agriculture, called the NRCS; and the following individuals referred to as the Owners:

Lloyd and Gloria O'Bryan
Rt 1, Box 22
Dublin, Texas 76446

The Owners, TSSWCB, and NRCS agree to carry out the terms of this agreement for the operation and maintenance of the practices installed under the O'Bryan Dairy Waste Management System, Constructed Wetland Demonstration Project, Erath County, Texas.

The practices covered by this agreement are identified as follows:

Waste Management System Component Practices

I. GENERAL

A. The Owners will:

1. Be responsible for operating and performing or having performed all needed maintenance of practices, as determined by either TSSWCB or the Owner, without cost to TSSWCB or NRCS.

2. Obtain prior TSSWCB approval of all plans, designs, and specifications for maintenance work deviating from the O&M plan and of plans and specifications for any alteration to the structural practices.

3. Be responsible for the replacement of parts or portions of the practices which have a physical life of less duration than the evaluated life of the practice.

4. Prohibit the installation of any structure or facility that will interfere with the operation of maintenance of the practices.

5. Notify TSSWCB of any agreement to be entered into with other parties for the operation or maintenance of all or any part of the project practice, and provide TSSWCB with a copy of the agreement after it has been signed by the Owners and the other party.

6. Comply with the PROPERTY MANAGEMENT STANDARDS set forth in 7 CFR 3015.160-3015-175, and all applicable Federal, State and local laws.

7. Provide TSSWCB personnel the right of free access to the project practice at any reasonable time for the purpose of carrying out terms of the agreement.

B. TSSWCB and NRCS will upon request of the Owners and to the extent that its resources permit, provide consultive assistance in the operation, maintenance, and replacement practices.

II. Operation and Maintenance Plan (O&M Plan)

An O&M plan for each practice included in this agreement is attached to and becomes a part of this agreement.

III. Inspection and Reports

A. The Owners will inspect the practices as specified in the O&M plan.

B. TSSWCB or State land-administering agency may inspect the practices at any reasonable time during the period covered by this agreement. At the discretion of the Executive Director, TSSWCB personnel may assist the Owner in inspection. At the discretion of the State Conservationist, NRCS personnel, at the request of the Owners, may assist the Owners in inspection.

C. A written report will be made of each inspection and provided to others as outlined in the O&M plan.

IV. Time and Responsibility

The Owners' responsibility for operation and maintenance begins when a practice is partially installed or completed and accepted by the Owner or is determined complete by NRCS. This responsibility shall continue for a period of 10 years from the completion of construction. This does not relieve the Owners' liability, which continues throughout the life of the measure or until the measure is modified to remove potential loss of life or property.

V. Records

The Owners will maintain in a centralized location a record of all inspections and significant actions taken, cost of performance, and completion date with respect to operation and maintenance. TSSWCB may inspect these records at any reasonable time during the term of the agreement.

Name of Owners:_____

_____

This action was authorized at a meeting with the owners named immediately above on _____(date), at _____(location).

Witness:_____ Title_____

TEXAS STATE SOIL AND WATER CONSERVATION BOARD

By:_____

Title:_____

Date:_____

UNITED STATES DEPARTMENT OF AGRICULTURE, NATURAL RESOURCES CONSERVATION SERVICE

By:_____

Title:_____

Date:_____

OPERATION AND MAINTENANCE PLAN

A written inspecton report will be completed by the Owners at least annually. The Owners will maintain in a centralized location a record of all such inspections and significant actions taken, cost of performance, and completion date with respect to operation and maintenance. A copy of each report should be furnished to the TSSWCB after completion.

The following items of operation and maintenance are to receive attention in addition to those required by the operation and maintenance agreement:

A. Inspection Plan:

1. Carefully inspect the entire system immediately after the first storm producing significant runoff.

2. Lagoon, Constructed Wetland, and Waste Storage Pond: Inspect at least annually and after unusual storm events. Inspect for abnormal cracking(longitudinal and transverse) on crown, berms and slopes; for excessive or irregular settlements; or "slippage" of slopes. Vegetation will be maintained on all structures to prevent erosion. Weeds and woody vegetation will be controlled. All woody vegetation will be removed from the inside slopes of the structures at least annually. The water level in the waste storage pond will be maintained below the 25 year 24 hour storm runoff marker within 21 days after a runoff event. Every 3 to 5 years or as needed the lagoon should be dewatered and sludge removed by agitation and pumping. Storage levels in the wetland cells and waste storage pond should be monitored. If storage is significantly decreased by sediment or solids deposition the structures should be cleaned out. The Liner or lack of hydrologic connection must be maintained in each structure. Woody vegetation will not be allowed to grow within a distance that might cause liner damage due to tree root penetration. No animals or construction activity which, in the opinion of the professional supplying the liner certification, could potentially damage the liner, will be allowed in the pool area of any of the structures after certification. If there is mechanical or structural damage to the liner after certification(i.e., cleanout activities), it will be evaluated by an NRCS Engineer, Professional Engineer, or groundwater scientist within 30 days of damage. Liner maintenance, or corrective action and recertification, if necessary, will be obtained and action recorded. If the emergency spillway functions on the waste storage pond it will be inspected for damage and repaired as needed. Inspect the downstream slopes and area immediately downstream of embankments for evidence of seepage. Neither the wetland cells or the Lagoon are equipped with an emergency spillway. Inspect the lagoon and wetland embankments for signs of overtopping and excessive erosion.

3. Waterways 1, 2, 3, 4, and 5: Inspect for any buildup of manure or sediment. Check for trails ,road traffic, etc. that is limiting capacity. Inspect for excessive erosion of the channel bottom and side slopes; for undesirable vegetative or woody growth. Check for adequacy of protective vegetative cover. Waterways 2 and 3 should be kept mowed to maintain design capacity. These waterways have flatter grades which will tend to silt up if vegetation is too dense.

4. Concrete chute to convey rainfall runoff into waste storage pond and concrete slope drain outlet to convey drainage from the wetland cells and lagoon into the waste storage pond: Inspect for differential settlement; abnormal cracking, concrete and foundation movement. erosion and undermining of cutoff walls; or deterioration of concrete. Document any maintenance needed.

5. Fresh water and waste water delivery pipelines and underground outlets: Inspect to determine that all valves, air vents, floats, risers, screens, pressure relief valves, orifices, and open inlets and outlets are operational, free from leaks, and obstruction. Check the pipelines for leaks or obstructions. Look for accumulations of solids in the delivery lines. Utilize cleanouts as necessary to remove clogs. Inspect drainage pipes installed through lagoon wetland cell and waste storage pond embankments for deterioration; displacement (lateral and vertical), and for seepage escape at downstream slope interface. Inspect underground outlets for breakage or deterioration; deterioration of coatings or materials; and the vertical inlet for accumulations of debris.

6. Flush Tank(10,000 gal flush tank equipped with 12" hooded flush valve): Inspect the flush tank to insure that solids have not significantly reduced storage capacity. Clean out tank as necessary. Insure that all inlet and outlet valves, float controllers, and water level indicators are operational and free from obstruction.

7. Flushed milking parlor and drip shed (existing):Inspect for signs of overtopping of waste transfer pipeline inlet. Determine if positive drainage is being maintained. Document any needed maintenance.

8. Flushed feedlane: Inspect for differential settlement; excessive cracking, concrete and foundation movement. Determine if positive drainage is being maintained. Check for solids buildup which would indicate changes in flush volume or timing are needed. Inspect secured steel tubing safety gate, installed to prevent vehicle and cattle access to the flush gutter, for deterioration or damage. Repair or replace gate, as necessary.

9. A roof will be placed over the flushed feedlane to exclude rainfall runoff from the settling basin and lagoon. This structure will also provide some shelter for cattle during wet or hot weather. Inspect this structure to insure structural stability and positive drainage away from the feedlane. Document any needed maintenance.

10. Combined flush gutter and catch basin: Inspect system operation to check for signs of overtopping. If overtopping is evident adjust flush volume or duration. This structure may require periodic manual removal of solid waste accumulations. The waste material removed should be stored in such a way that rainfall runoff will enter the confinement system. Document any maintenance needed.

11. Concrete Settling Basin/Drying tank: Inspect for differential settlement; excessive cracking, concrete and foundation movement. Clean solid material from underground outlet riser and slotted wood screen as needed to insure proper drainage of the settling basin. Solids collected and stockpiled from the settling basin should be land applied or stockpiled in an are which drains into the confinement system.

12. Constructed Wetland: The vegetation in the constructed wetland will be inspected for plant population and vigor. Results of water quality tests conducted by Texas Institute for Applied Environmental Research(TIAER) will be available on both inflow and outflow from the wetland cells. If nitrogen levels appear to be impacting plant vigor, or inadequate wastewater is available to produce inflow, the freshwater inflow pipeline will be used to provide water for dilution of waste water or to supplement waste water supply. Inspect Inlet mixing Tanks for signs of deterioration.

13. Recycle and irrigation pumps: Determine if pumps, water level pump controllers and signal wires, are in operating condition. Check electrical control panels to insure it is enclosed and free from trash.

14. Irrigation system: Inspect the system to insure it is operational. Check for leaky joints, worn or stopped up nozzles, and stuck sprinkler heads. Examine system during operation to insure runoff is not resulting from irrigation application. Grease and lube system according to manufacturer recommendations, if applicable. Drain and properly secure system during winter months or during extensive periods of non-use.

15. Fencing to exclude livestock from the RCS: Inspect for evidence of livestock in the excluded area. Inspect the condition of the fence to determine if it will exclude livestock. Document needed maintenance.

16. Vegetation of disturbed construction area: Check all areas where vegetation was planted or is required in the Conservation Plan of Operation. Determine if the cover is meeting the intended purpose and providing erosion control. Document if the cover needs maintenance(fertilization, weed control, or re-establishment).

17. Fencing - new pen fencing: (Not part of Contract): Inspect the condition of the pen fence to determine if it will contain livestock. Document needed maintenance.

18. Vegetation - grass planting on waste utilization areas (Not part of Contract): Check all areas where vegetation was planted to provide waste utilization areas. Determine if the vegetation is serving the intended purpose and document if the cover requires maintenance(fertilization, weed control, or re-establishment.)

19. Construction of waterway on property to control rainfall runoff outside the immediate area of the dairy to meet needs of Total Water Quality Management Plan (Not part of Contract): Inspect for excessive deposits of sedimentation; eroded areas; condition of vegetative cover, and need for weed control or fertilization.

B. Maintenance Plan:

On all structures remove debris and trash; maintain coatings; tighten loose attachment bolts; replace excessively deteriorated parts, surfaces or coatings; remove undesirable vegetative growth; restore excessively eroded slopes and channel bottoms and control grade; maintain protective vegetative cover by weed control and fertilization, remove excessive vegetation by mowing or shredding.

On concrete structures: repair eroded or undermined areas around the cutoff walls; repair deteriorated concrete surfaces.

Prepared by:

Jerry D. Walker, P.E.
Water Management Engineer
NRCS, Temple, Texas

Appendix C Chain-of-Custody/Data Entry Form

CHAIN OF CUSTODY

TIAER

Page _____ of _____

Project Name/No	Project Manager/Person Requesting Sample	Samplers Name

Sample No	Color Code	Date	Time Military	Site #	Sample Type	Sample Interval	Comments
10000							
10000							
10000							
10000							
10000							
10000							
10000							
10000							
10000							
10000							
10000							
10000							

Relinquished By	Date	Time	Received By
Relinquished By	Date	Time	Received By
Relinquished By	Date	Time	Received By

SAMPLE TYPES V = Volunteer F = Flow Based Composite T = Time Based Composite S = Sequential G = Grab

Water Quality Data y Sheet (for all samples) Page ____ of ____

LABORATORY ANALYSIS ONLY!!!!

Entered by: Verified by:

Sample No	Color Code	Date	Time Military	Site #	Sample Type	Sample Interval	NO2-N	NO3-N	o-PO4	TP	NH3-N	TKN	TSS	Turb NTU'S	COD	Fecal Coliform	Chl-a mg/m3	BOD 5-day	
10000																			
10000																			
10000																			
10000																			
10000																			
10000																			
10000																			
10000																			
10000																			
10000																			
10000																			
10000																			
Received By			Date		Time		Signature												

COMMENTS FOR ENTRY IN DATA COLUMNS

IM = Instrument malfunction
EF = Equipment failure
TE = Technician Error

QC = Quality Control failed
STAT = Statistically close

HTE-L = Holding time Exceeded - Lab
HTE-F = Holding Time Exceeded - Field
INT = Interference
TNTC = Too Numerous to Count

Texas Institute for Applied Environmental Research

TIAER

31 July, 1997

Mr. Jerry Walker
USDA Natural Resources Conservation Service
101 S. Main
Temple, Texas 76501-7682

RE: Quarterly Progress Report for Section 319 NRCS Wetlands Project
Interagency Contract 95-13
Agreement Number 68-7442-5-249

Dear Mr. Walker:

This quarterly report includes activities through July 31, 1996 for the above referenced project. All activities are associated with Task 2.5 of Program Element 2, Wetlands Sampling and Monitoring.

- April 24, 1997: Initial sampling event after establishment of wetland plants. Samples of water from lagoon, storage pond, and wetland cells were collected.
- May 7, 1997: Water samples from project sites were collected. It should be noted, however, that no inflow nor outflow was observed through the wetland cells.
- May 21, 1997: System drain lines had been clogged for several days before scheduled sampling. Although flow had resumed shortly prior to sampling, samples from the lagoon only were obtained for analysis.
- On June 5, 1997, the entire sampling routine was performed.
- Due to project complications, bi-weekly sampling was not performed June 19, July 3, nor July 17.
- On July 24, 1997, the entire sampling routine was performed.

Laboratory analytical procedures are performed after the samples are returned to TIAER. Note: Analysis of July 24 samples are not complete at the time of this report. Data collected prior to the July 24th sampling event are presented in an enclosed chart.

Tarleton State University • Box T0410, Tarleton Station • Stephenville, Texas 76402 • (817) 968-9567 • FAX (817) 968-9568

If you have any question regarding this progress report, please contact me at (817) 968-9548 or Larry Hauck at (817) 968-9561.

Best regards,

Nancy Easterling

Nancy Easterling
TIAER Project Manager

xc: L.M. Hauck, B. Spoonts

Enclosures

DATA FROM THE O'BRYAN WETLANDS

April 24, 1997 Sampling Data

	LAGOON		WETLAND CELLS						STORAGE
CONSTITUENT	Inflow		Inflow		between		Outflow		POND
NO2-N		Cell Pair #1	0.008	-	0.010	-	0.008		North & South sites
mg/L		Cell Pair #2	0.013	-	0.010	-	0.007		0.015
		Cell Pair #3	0.007	-	0.005	-	0.002		0.012
		Cell Pair #4	0.007	-	0.015	-	0.006		
	0.014	**Avg**	0.009		**0.010**		**0.006**	Avg	**0.014**
NO3		Cell Pair #1	0.26	-	0.24	-	0.20		
mg/L		Cell Pair #2	0.25	-	0.28	-	0.26		0.16
		Cell Pair #3	0.36	-	0.13	-	0.10		0.16
		Cell Pair #4	0.27	-	0.24	-	0.20		
	0.27	**Avg**	**0.29**		**0.22**		**0.19**	Avg	**0.16**
OPO4		Cell Pair #1	10.20	-	5.64	-	3.44		
mg/L		Cell Pair #2	8.67	-	6.91	-	5.15		0.57
		Cell Pair #3	8.63	-	3.66	-	2.73		0.27
		Cell Pair #4	7.40	-	9.73	-	2.95		
	9.29	**Avg**	**8.73**		**6.49**		**3.57**	Avg	**0.42**
TP		Cell Pair #1	41.7	-	36.9	-	32.4		
mg/L		Cell Pair #2	40.4	-	41.7	-	27.0		16.4
		Cell Pair #3	41.9	-	21.2	-	15.4		18.1
		Cell Pair #4	41.9	-	41.1	-	25.7		
	39.3	**Avg**	**41.5**		**35.2**		**25.1**	Avg	17.3
NH3		Cell Pair #1	30.3	-	15.1	-	10.5		
mg/L		Cell Pair #2	26.6	-	16.1	-	9.7		6.3
		Cell Pair #3	34.7	-	4.5	-	0.7		5.8
		Cell Pair #4	30.1	-	19.6	-	10.0		
	38.9	**Avg**	**30.4**		**13.8**		**7.7**	Avg	**6.1**
TKN		Cell Pair #1	143	-	112	-	103		
mg/L		Cell Pair #2	137	-	131	-	63		46
		Cell Pair #3	160	-	82	-	54		45
		Cell Pair #4	158	-	129	-	78		
	156	**Avg**	**150**		**113**		**75**	Avg	**46**
TSS		Cell Pair #1	181	-	294	-	259		
		Cell Pair #2	267	-	376	-	154		119
		Cell Pair #3	373	-	260	-	296		92
		Cell Pair #4	120	-	154	-	266		
	660	**Avg**	**235**		**271**		**244**	Avg	106
COD		Cell Pair #1	1510	-	1280	-	1110		
mg/L		Cell Pair #2	1460	-	1510	-	990		627
		Cell Pair #3	1560	-	858	-	825		605
		Cell Pair #4	1640	-	1220	-	1120		
	1690	**Avg**	**1543**		**1217**		**1011**	Avg	**616**
F Coli		Cell Pair #1	108,000	-	NA	-	9,600		
estimates		Cell Pair #2	64,000	-	NA	-	4,930		NA
		Cell Pair #3	143,000	-	NA	-	220		NA
		Cell Pair #4	230,000	-	NA	-	3,200		
	NA	**Avg**	**136250**	-	NA	-	**4488**	Avg	

DATA FROM THE O'BRYAN WETLANDS													
May 7, 1997 Sampling Data													
		LAGOON					WETLAND CELLS						STORAGE
PARAMETER		Inflow			Inflow		between		Outflow				POND
NO2-N				Cell Pair #1	<0.005	-	<0.005	-	<0.005			North & South sites	
mg/L				Cell Pair #2	<0.005	-	<0.005	-	0.008			N.	0.013
				Cell Pair #3	<0.005	-	<0.005	-	<0.005			S.	0.016
		Lagoon		Cell Pair #4	<0.005	-	<0.005	-	<0.005				
		0.010		**Avg**	**<0.005**		**<0.005**		**>.0002**			Avg.	**0.015**
NO3				Cell Pair #1	0.18	-	0.03	-	0.02				
mg/L				Cell Pair #2	0.07	-	0.04	-	0.05			N.	0.12
				Cell Pair #3	0.12	-	0.05	-	0.03			S.	0.18
		Lagoon		Cell Pair #4	0.44	-	0.11	-	0.07				
		0.19		**Avg**	**0.20**		**0.06**		**0.04**			Avg.	**0.15**
OPO4				Cell Pair #1	9.09	-	10.20	-	12.20				
mg/L				Cell Pair #2	–	-	11.00	-	11.40			N.	3.73
				Cell Pair #3	8.76	-	7.14	-	11.00			S.	2.60
		Lagoon		Cell Pair #4	13.30	-	14.60	-	10.10				
		54.40		**Avg**	**8.04**		**10.81**		**11.18**			Avg.	**3.17**
TP				Cell Pair #1	28.2	-	22.5	-	24.0				
mg/L				Cell Pair #2	25.0	-	22.5	-	20.7			N.	28.4
				Cell Pair #3	28.2	-	19.6	-	15.8			S.	24.5
		Lagoon		Cell Pair #4	42.2	-	35.9	-	31.7				
		124.0		**Avg**	**30.9**		**25.1**		**23.1**			Avg.	**26.5**
NH3				Cell Pair #1	17.8	-	7.16	-	9.2				
mg/L				Cell Pair #2	2.5	-	1.7	-	5.4			N.	7.2
				Cell Pair #3	10.2	-	0.6	-	2.5			S.	7.1
		Lagoon		Cell Pair #4	36.4	-	17.5	-	4.1				
		73.8		**Avg**	**16.7**		**6.7**		**5.3**			Avg.	**7.2**
TKN				Cell Pair #1	92	-	74	-	76				
mg/L				Cell Pair #2	53	-	49	-	61			N.	45
				Cell Pair #3	77	-	50	-	26			S.	41
		Lagoon		Cell Pair #4	158	-	97	-	77				
		315		**Avg**	**95**		**68**		**60**			Avg.	**43**
TSS				Cell Pair #1	130	-	225	-	378				
				Cell Pair #2	156	-	98	-	190			N.	176
				Cell Pair #3	308	-	273	-	<10			S.	106
		Lagoon		Cell Pair #4	120	-	154	-	266				
		388		**Avg**	**179**		**188**		**209**			Avg.	**141**

	LAGOON			WETLAND CELLS						STORAGE
PARAMETER	Inflow			Inflow		between		Outflow		POND
COD		Cell Pair #1	1150	-	1510	-	1070			
mg/L		Cell Pair #2	970	-	805	-	980		N.	665
		Cell Pair #3	1050	-	800	-	435		S.	640
	Lagoon	Cell Pair #4	1470	-	980	-	1100			
	1640	**Avg**	**1148**		**779**		**896**		Avg.	**653**
F Coli		Cell Pair #1	9,190	-	117	-	639			
estimates		Cell Pair #2	-	-	-	-	-		N.	8,290
		Cell Pair #3	2,700	-	-	-	-		S.	12,600
	Lagoon	Cell Pair #4	210,000	-	-	-	-			
	>600,000	**Avg**	**73963**	-		-			Avg.	**10445**
Temp*C	Lagoon								STORAGE POND	
	20.5	Field parameters not measured in wetland cells								21.5
		due to low volume and no inflow/outflow.								
Cond*	2580									1463
umhos/ cm										
pH*	8.04									8.21
DO*	0.65									1.01
mg/L										

DATA FROM THE O'BRYAN WETLANDS										
21-May-97	Sampling Data									
	NO2	NO3	OPO4	TP	NH3	TKN	TSS	COD	estimated F Coli	
Site	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	colonies/ 100 mL	
Lagoon:	0.030	0.37	14.70	93.9	51.4	798	1225	--	>600,000	
(inflow)										

DATA FROM THE O'BRYAN WETLANDS									
JUNE 5, 1997 SAMPLING DATA									
	LAGOON		WETLAND CELLS						STORAGE
CONSTITUENT	Inflow		Inflow		between		Outflow		POND
		Cell Pair #1	0.018	-	0.014	-	0.016	North & South sites	
NO2-N		Cell Pair #2	0.020	-	0.012	-	0.013	N	0.030
mg/L		Cell Pair #3	0.020	-	0.019	-	0.018	S	0.030
		Cell Pair #4	0.020	-	0.020	-	0.015		
	0.030	**Avg**	**0.020**		**0.016**		**0.016**	**Avg**	**0.030**
		Cell Pair #1	0.21	-	0.05	-	0.07		
NO3		Cell Pair #2	0.17	-	0.13	-	0.03	N	0.28
mg/L		Cell Pair #3	0.22	-	0.11	-	0.03	S	0.10
		Cell Pair #4	0.12	-	0.07	-	0.03		
	0.23	**Avg**	**0.18**		**0.09**		**0.04**	**Avg**	**0.19**
		Cell Pair #1	7.79	-	4.30	-	6.06		
OPO4		Cell Pair #2	12.50	-	4.74	-	3.19	N	6.52
mg/L		Cell Pair #3	12.50	-	13.00	-	11.30	S	6.23
		Cell Pair #4	12.30	-	4.93	-	5.22		
	13.60	**Avg**	**11.27**		**6.74**		**6.44**	**Avg**	**6.38**
		Cell Pair #1	46.2	-	28.1	-	30.9		
TP		Cell Pair #2	45.6	-	23.0	-	16.1	N	14.2
mg/L		Cell Pair #3	43.8	-	46.4	-	25.6	S	15.6
		Cell Pair #4	49.3	-	27.7	-	25.6		
	61.3	**Avg**	**46.2**		**31.3**		**24.6**	**Avg**	**14.9**
		Cell Pair #1	34.8	-	3.8	-	0.7		
NH3		Cell Pair #2	41.7	-	6.4	-	0.3	N	3.4
mg/L		Cell Pair #3	40.8	-	21.7	-	3.6	S	3.5
		Cell Pair #4	42.0	-	6.2	-	0.2		
	--	**Avg**	**39.8**		**9.5**		**1.2**	**Avg**	**3.4**
		Cell Pair #1	169	-	68	-	82		
TKN		Cell Pair #2	155	-	85	-	52	N	35
mg/L		Cell Pair #3	147	-	154	-	36	S	37
		Cell Pair #4	143	-	75	-	39		
	298	**Avg**	**154**		**95**		**52**	**Avg**	**36**
		Cell Pair #1	353	-	516	-	516		
TSS		Cell Pair #2	240	-	520	-	360	N	66
mg/L		Cell Pair #3	373	-	380	-	104	S	88
		Cell Pair #4	373	-	192	-	360		
	1130	**Avg**	**335**		**402**		**335**	**Avg**	**77**

	LAGOON		WETLAND CELLS						STORAGE
CONSTITUENT	Inflow		Inflow		between		Outflow		POND
		Cell Pair #1	est. 1540	-	st. 1130	-	1080		
COD		Cell Pair #2	est. 1480	-	st. 1090	-	est. 96	N	47
mg/L		Cell Pair #3	est. 1480	-	est. 880	-	40	S	51
		Cell Pair #4	est. 1420	-	st. 1080	-	70		
	est. 2057	**Avg**	--		--		**298**	**Avg**	**49**
		Cell Pair #1	124,000	-	720	-	986		
F Coli		Cell Pair #2	141,000	-	90	-	18	N	991
estimates		Cell Pair #3	148,000	-	8,090	-	2,000	S	1,440
		Cell Pair #4	1,390	-	802	-	360		
	>600,000	**Avg**	**103,598**		**2426**		**841**	**Avg**	**1216**
		Cell Pair #1	25.1	-	24.6	-	23.4		
temp		Cell Pair #2	25.7	-	23.7	-	24.3	N	27.2
		Cell Pair #3	23.1	-	24.0	-	22.3	S	27.5
		Cell Pair #4	24.8	-	23.6	-	26.6		
	26.8	**Avg**	**24.7**		**24.0**		**24.2**	**Avg**	**27.4**
		Cell Pair #1	2290	-	1915	-	1675		
cond		Cell Pair #2	2140	-	1915	-	1468	N	1379
		Cell Pair #3	2495	-	1710	-	1447	S	1395
		Cell Pair #4	2355	-	2165	-	1460		
	2510	**Avg**	**2320**		**1926**		**1513**	**Avg**	**1387**
		Cell Pair #1	7.7	-	8.1	-	8.1		
pH		Cell Pair #2	8.0	-	8.0	-	8.6	N	8.7
		Cell Pair #3	7.3	-	7.7	-	7.2	S	8.7
		Cell Pair #4	7.5	-	8.5	-	8.2		
	7.6	**Avg**	**7.6**		**8.1**		**8.0**	**Avg**	**8.7**
		Cell Pair #1	0.48	-	2.15	-	0.57		
DO		Cell Pair #2	2.17	-	0.89	-	8.14	N	7.32
		Cell Pair #3	0.11	-	0.17	-	0.45	S	9.18
		Cell Pair #4	0.05	-	0.52	-	7.55		
	0.15	**Avg**	**0.70**		**0.93**		**4.17**	**Avg**	**8.25**

Texas Institute for Applied Environmental Research

TIAER

MEMORANDUM

DATE: December 4, 1998

TO: Justin Hester, TSSWCB

FROM: Nancy Easterling

RE: O'Bryan Dairy Final Quarterly Report

Justin,
I'm sending the final quarterly report from the O'Bryan Dairy Wetland Project. Hopefully, this will help with the continuation of the project.

Good luck,
Nancy

Tarleton State University · Box T0410, Tarleton Station · Stephenville, Texas 76402 · (254) 968-9567 · FAX (254) 968-9790

TIAER

s Institute for Applied Environmental Research

November 4, 1997

Mr. Jerry Walker
USDA Natural Resources Conservation Service
101 S. Main
Temple, Texas 76501-7682

Subject: Final Quarterly Report for Section 319 NRCS Wetlands Project
Interagency Contract 95-13
Agreement Number 68-7442-5-249

Dear Mr. Walker:

This quarterly report includes activities through September 30, 1997 for the above referenced project. All activities are associated with Task 2.5 of Program Element 2, Wetlands Sampling and Monitoring.

- July 24, 1997: The milking herd had been sold on July 18, but Mr. O'Bryan was continuing to flush the parlor to keep the system functioning. The primary cells all received inflow but only the top two secondary cells had outflow. The formerly ubiquitous duckweed was largely gone from the first two primary cells, but was still plentiful in the second and third secondary cells. Water in the storage pond was fairly dark and bubbling, but due to miscommunication between samplers, the nutrient sample from the pond was not collected.

- August 7, 1997: All cells were receiving inflow. The fourth cell had less inflow than the other cells and was the only cell with no outflow. The lower two cells contained more plants and less water than the upper two cells. Water samples from project sites were collected during a fairly hard rain. For this reason, only two aliquots and one Hydrolab reading were taken per site and only one velocity measurement was taken at the inflow of each primary cells. The heavy rain likely caused increased outflow measurements.

- August 20, 1997: All cells received inflow. Flow was exiting from the top three cells, but not from the fourth. Duckweed had returned to the first primary cell, but not the second. Again, the lower two cells contained more plants and less water than the upper two cells.

- September 3, 1997: Flow was measured going into the cells, but no flow was exiting the cells. The sampling routine was performed for information purposes.

- September 18, 1997: No flow was observable into or out of the cells. Samples were taken from the lagoon, storage pond, primary cells #1 and #2 (inflow), and secondary cell #2 outflow for information purposes. No standing water was observed in the third nor fourth cells, although the plants were ubiquitous.

- September 30, 1997: No flow was observable into or out of the cells. Samples were taken from the lagoon, storage pond, primary cells #1 and #2 (inflow) for information purposes.

Because conditions at the wetlands site were changing and water was not always flowing, I checked with Gene Lindemann to ask whether we should continue gathering data into the latter part of September and he indicated that he would like as much data as possible.

Water quality data associated with each site during each sampling event for this quarter are attached. In addition, inflow and outflow data for the cells for all project sampling events are included on one sheet. Data from sampling prior to July 24, 1997 were included in previous quarterly reports.

I will be sending a diskette with the data from the entire sampling period to you soon. It will be in Excel, version 7.0 for Windows 95. If you would like me to save it in a different format, or if you have any question regarding this progress report, please contact me or Larry Hauck at (254) 968-9567.

Best regards,

Nancy Easterling

Nancy Easterling
TIAER Special Projects Coordinator

Enclosures

cc: L.M. Hauck, B. Spoonts

DATA FROM THE O'BRYAN WETLANDS
JULY 24, 1997 SAMPLING DATA

CONSTITUENT	LAGOON Inflow		WETLAND CELLS Inflow	between	Outflow	STORAGE POND
		Cell Pair #1	0.003	0.003	0.003	North & South sites
NO2-N		Cell Pair #2	0.008	0.003	0.003	
mg/L		Cell Pair #3	0.020	0.003	0.015	
	Lagoon	Cell Pair #4	0.011	No outflow		No nutrient
	0.003	Avg	**0.011**	**0.003**	**0.007**	sample
		Cell Pair #1	0.01	0.02	0.02	
NO3		Cell Pair #2	0.01	0.01	0.02	
mg/L		Cell Pair #3	0.03	0.07	0.08	
	Lagoon	Cell Pair #4	0.08	No outflow		
	0.02	Avg	**0.03**	**0.03**	**0.04**	
		Cell Pair #1	0.91	5.75	9.34	
OPO4		Cell Pair #2	1.67	7.63	8.39	
mg/L		Cell Pair #3	7.33	14.90	14.10	
	Lagoon	Cell Pair #4	2.46	No outflow		
	13.4	Avg	**3.09**	**9.43**	**10.61**	
		Cell Pair #1	29.4	20.5	17.1	
TP		Cell Pair #2	31.0	22.7	18.3	
mg/L		Cell Pair #3	41.4	34.9	22.9	
	Lagoon	Cell Pair #4	29.0	No outflow		
	35.8	Avg	**32.7**	**26.0**	**19.4**	
		Cell Pair #1	36.00	7.10	8.74	
NH3		Cell Pair #2	37.60	17.20	5.00	
mg/L		Cell Pair #3	30.90	35.40	10.30	
	Lagoon	Cell Pair #4	38.80	No outflow		
	48.90	Avg	**35.83**	**19.90**	**8.01**	
		Cell Pair #1	111.0	80.0	43.5	
TKN		Cell Pair #2	111.0	79.5	34.8	
mg/L		Cell Pair #3	135.0	105.0	34.8	
	Lagoon	Cell Pair #4	114.0	No outflow		
	126.0	Avg	**117.8**	**88.2**	**37.7**	

		Cell Pair #1	222		454		144			
TSS		Cell Pair #2	288		528		216			
mg/L		Cell Pair #3	372		310		98			
	Lagoon	Cell Pair #4	206		No outflow					
	194	Avg	**272**		**431**		**153**			
		Cell Pair #1	913		1100		616			
COD		Cell Pair #2	1020		836		638			
mg/L		Cell Pair #3	935		715		572			
	Lagoon	Cell Pair #4	957		No outflow					
	1040	Avg	**956**		**884**		**609**			
		Cell Pair #1	est 10,300		est 300		est 455			
F Coli		Cell Pair #2	32,000		est 1000		2000		N	<2000
estimates		Cell Pair #3	est 37,000		est 9000		est 900		S	est 100
	Lagoon	Cell Pair #4	37,000		No outflow					
	220,000	Avg	**est 29,075**		**est 3433**		**est 1118**		**Avg**	**est 900**
Note: Strong interference by yellow colonies. Actual fecals counts could be higher.										
		Cell Pair #1	27.10		27.10		25.80			
temp		Cell Pair #2	27.06		26.50		24.40		N	28.38
Centigrade		Cell Pair #3	26.70		24.80		23.80		S	28.89
	Lagoon	Cell Pair #4	27.40		No outflow					
	27.70	Avg	**27.07**		**26.13**		**24.67**		**Avg**	**28.64**
		Cell Pair #1	2565		2510		2575			
cond		Cell Pair #2	2530		2615		2450		N	1421
uS/cm		Cell Pair #3	2640		2485		2020		S	1476
	Lagoon	Cell Pair #4	2620		No outflow					
	2640	Avg	**2589**		**2537**		**2348**		**Avg**	**1449**
		Cell Pair #1	7.86		8.32		8.28			
pH		Cell Pair #2	8.07		8.00		7.71		N	8.93
		Cell Pair #3	7.62		7.42		7.33		S	8.82
	Lagoon	Cell Pair #4	7.69		No outflow					
	7.53	Avg	**7.81**		**7.91**		**7.77**		**Avg**	**8.88**
		Cell Pair #1	*		*		*			
DO		Cell Pair #2	*		0.36		0.24		N	0.27
mg/L		Cell Pair #3	0.53		0.30		0.33		S	0.26
	Lagoon	Cell Pair #4	0.86		No outflow					
	0.08	Avg	**0.70**		**0.33**		**0.29**		**Avg**	**0.27**
		* Reading was off scale for at least one measurement								
Note: In-situ data (temperature, conductivity, pH, and DO) in table are the average of two measurements.										
	Water quality parameters in cells are the result of three composited samples.									
	Lagoon and storage pond measurements result from one sample only.									

DATA FROM THE O'BRYAN WETLANDS
AUGUST 7, 1997 SAMPLING DATA

	LAGOON		WETLAND CELLS						STORAGE
CONSTITUENT	Inflow		Inflow		between		Outflow		POND
		Cell Pair #1	0.019	-	0.014	-	0.016		South site only
NO2-N		Cell Pair #2	0.020	-	0.009	-	0.010		
mg/L		Cell Pair #3	0.017	-	0.017	-	0.020		
		Cell Pair #4	0.013	-	0.011	-	0.018		
	0.040	**Avg**	**0.017**		**0.013**		**0.016**	S	0.015
		Cell Pair #1	0.03	-	0.04	-	0.06		
NO3		Cell Pair #2	0.06	-	0.03	-	0.07		
mg/L		Cell Pair #3	0.05	-	0.05	-	0.56		
		Cell Pair #4	0.42	-	0.25	-	0.46		
	0.74	**Avg**	**0.14**		**0.09**		**0.29**	S	0.14
		Cell Pair #1	6.59	-	8.76	-	9.29		
OPO4		Cell Pair #2	5.64	-	7.17	-	4.78		
mg/L		Cell Pair #3	6.59	-	11.50	-	9.91		
		Cell Pair #4	6.40	-	11.00	-	9.91		
	10.00	**Avg**	**6.31**		**9.61**		**8.47**	S	8.41
		Cell Pair #1	27.4	-	20.0	-	16.0		
TP		Cell Pair #2	36.5	-	19.3	-	10.3		
mg/L		Cell Pair #3	26.0	-	18.4	-	13.4		
		Cell Pair #4	30.4	-	21.8	-	13.6		
	16.3	**Avg**	**30.1**		**19.9**		**13.3**	S	11.7
		Cell Pair #1	42.30	-	9.85	-	4.01		
NH3		Cell Pair #2	39.50	-	11.90	-	0.51		
mg/L		Cell Pair #3	38.20	-	29.40	-	7.80		
		Cell Pair #4	30.60	-	8.36	-	6.44		
	25.10	**Avg**	**37.65**		**14.88**		**4.69**	S	2.40
		Cell Pair #1	111.0	-	64.6	-	53.8		
TKN		Cell Pair #2	136.0	-	91.3	-	46.8		
mg/L		Cell Pair #3	106.0	-	65.9	-	38.3		
		Cell Pair #4	106.0	-	55.2	-	37.5		
	63.8	**Avg**	**114.8**		**69.3**		**44.1**	S	24.4
		Cell Pair #1	236	-	283	-	142		
TSS		Cell Pair #2	405	-	552	-	134		
mg/L		Cell Pair #3	184	-	46	-	53		
		Cell Pair #4	660	-	968	-	52		
	122	**Avg**	**371**		**462**		**82**	S	71

		Cell Pair #1	880	-	957	-	814		
COD		Cell Pair #2	1130	-	1080	-	814		
mg/L		Cell Pair #3	803	-	550	-	572		
		Cell Pair #4	1020	-	814	-	561		
	616	**Avg**	**958**		**850**		**690**	S	473
		Cell Pair #1	EST 30,000 INT	-	7,000	-	2900		
F Coli	Intense	Cell Pair #2	EST 11,000 INT	-	43,000	-	5800		
estimates	interference	Cell Pair #3	EST 35,000 INT	-	12,000	-	EST 117000 INT		
	present	Cell Pair #4	EST 10,000 INT	-	210,000	-	EST 230,000 INT		
	>600,000	**Avg**	**est 21,500**		**68,000**		**est 89,000**	S	NA
Note: Strong interference by yellow colonies. Actual fecals counts could be higher.									
		Cell Pair #1	23.83	-	NA	-	23.33		
temp		Cell Pair #2	23.37	-	23.12	-	23.21		
		Cell Pair #3	25.07	-	23.94	-	22.14		
		Cell Pair #4	25.41	-	23.36	-	NA		
	NA	**Avg**	**24.42**		**23.47**		**22.89**	S	NA
		Cell Pair #1	2540	-	NA	-	2820		
cond		Cell Pair #2	2540	-	2670	-	2770		
		Cell Pair #3	2580	-	2570	-	2670		
		Cell Pair #4	2580	-	2680	-	NA		
	NA	**Avg**	**2560**		**2640**		**2753**	S	NA
		Cell Pair #1	8.33	-	NA	-	8.59		
pH		Cell Pair #2	8.40	-	7.66	-	8.87		
		Cell Pair #3	7.82	-	8.20	-	7.67		
		Cell Pair #4	7.62	-	8.38	-	NA		
	NA	**Avg**	**8.04**		**8.08**		**8.38**	S	NA
		Cell Pair #1	0.32	-	NA	-	0.32		
DO		Cell Pair #2	0.42	-	0.21	-	0.32		
		Cell Pair #3	0.29	-	0.29	-	0.54		
		Cell Pair #4	0.16	-	0.32	-	NA		
	NA	**Avg**	**0.30**		**0.27**		**0.39**	S	NA
Note: Due to heavy rainfall during sampling event,									
In-situ data (temperature, conductivity, pH, and DO) reflect one measurement and									
Water quality parameters in cells are the result of two composited samples.									
Lagoon and storage pond measurements result from one sample only.									

DATA FROM THE O'BRYAN WETLANDS
AUGUST 20, 1997 SAMPLING DATA

	LAGOON		WETLAND CELLS					STORAGE POND	
CONSTITUENT	Inflow		Inflow		between		Outflow		
		Cell Pair #1	0.004	-	0.006	-	0.003	North & South sites	
NO2-N		Cell Pair #2	0.003	-	0.003	-	0.003	N	0.020
mg/L		Cell Pair #3	0.014	-	0.019	-	0.004	S	0.020
	Lagoon	Cell Pair #4	0.003	-	0.003	-	0.003		
	0.003	Avg	**0.006**		**0.008**		**0.003**	Avg	**0.020**
		Cell Pair #1	0.12	-	0.17	-	0.36		
NO3		Cell Pair #2	0.57	-	0.20	-	0.04	N	0.12
mg/L		Cell Pair #3	0.12	-	0.09	-	0.05	S	0.12
	Lagoon	Cell Pair #4	0.11	-	0.04	-	0.02		
	0.01	Avg	**0.23**		**0.13**		**0.12**	Avg	**0.12**
		Cell Pair #1	5.56	-	8.97	-	8.37		
OPO4		Cell Pair #2	5.43	-	6.22	-	3.85	N	6.70
mg/L		Cell Pair #3	4.04	-	11.00	-	12.00	S	7.11
	Lagoon	Cell Pair #4	5.75	-	8.66	-	18.90		
	4.80	Avg	**5.20**		**8.71**		**10.78**	Avg	**6.91**
		Cell Pair #1	23.3	-	20.5	-	14.8		
TP		Cell Pair #2	22.7	-	19.3	-	9.81	N	12.0
mg/L		Cell Pair #3	22.3	-	19.7	-	15.1	S	13.7
	Lagoon	Cell Pair #4	24.0	-	13.8	-	20.5		
	20.3	Avg	**23.1**		**18.3**		**15.1**	Avg	**12.9**
		Cell Pair #1	28.50	-	4.18	-	2.21		
NH3		Cell Pair #2	24.40	-	6.75	-	0.99	N	0.46
mg/L		Cell Pair #3	24.50	-	31.40	-	12.80	S	0.51
	Lagoon	Cell Pair #4	26.10	-	5.56	-	1.95		
	24.80	Avg	**25.88**		**11.97**		**4.49**	Avg	**0.49**
		Cell Pair #1	87.8	-	73.5	-	38.2		
TKN		Cell Pair #2	86.6	-	63.3	-	40.8	N	27.4
mg/L		Cell Pair #3	87.6	-	69.9	-	44.2	S	27.6
	Lagoon	Cell Pair #4	90.4	-	56.3	-	18.8		
	89.8	Avg	**88.1**		**65.8**		**35.5**	Avg	**27.5**
		Cell Pair #1	158	-	364	-	77		
TSS		Cell Pair #2	180	-	193	-	90	N	47
mg/L		Cell Pair #3	181	-	224	-	20	S	58
	Lagoon	Cell Pair #4	178	-	244	-	5		
	184	Avg	**174**		**256**		**48**	Avg	**53**

		Cell Pair #1	762	-	966	-	618				
COD		Cell Pair #2	786	-	840	-	726		N	474	
mg/L		Cell Pair #3	762	-	576	-	504		S	486	
	Lagoon	Cell Pair #4	810	-	852	-	348				
	320	Avg	**780**		**809**		**549**		Avg	**480**	
		Cell Pair #1	est 909	-	est 600	-	est 1000				
F Coli		Cell Pair #2	est 1450	-	est 3000	-	est 100		N	est 90	
estimates		Cell Pair #3	est 1000	-	2100	-	est 1800		S	330	
	Lagoon	Cell Pair #4	est 1100	-	est 1270	-	est 300				
	est 3000	Avg	**est 3500**		**est 1750**		**est 800**		Avg	**est 210**	
		Cell Pair #1	25.96	-	25.51	-	26.51				
temp		Cell Pair #2	26.19	-	26.28	-	26.09		N	27.81	
Centigrade		Cell Pair #3	25.62	-	24.78	-	24.12		S	27.76	
	Lagoon	Cell Pair #4	26.58	-	25.28	-	25.15				
	27.03	Avg	**26.09**		**25.46**		**25.47**		Avg	**27.79**	
		Cell Pair #1	2310	-	1143	-	2270				
cond		Cell Pair #2	2365	-	1645	-	2300		N	1500	
uS/cm		Cell Pair #3	456	-	2530	-	1990		S	1505	
	Lagoon	Cell Pair #4	2495	-	2590	-	1600				
	2385	Avg	**1907**		**1977**		**2040**		Avg	**1503**	
		Cell Pair #1	8.07	-	8.45	-	8.80				
pH		Cell Pair #2	8.00	-	8.49	-	8.85		N	8.62	
		Cell Pair #3	8.12	-	7.89	-	7.57		S	8.63	
	Lagoon	Cell Pair #4	7.67	-	8.68	-	7.75				
	7.99	Avg	**7.97**		**8.38**		**8.24**		Avg	**8.63**	
		Cell Pair #1	0.35	-	1.62	-	1.93				
DO		Cell Pair #2	0.53	-	1.19	-	0.57		N	2.34	
mg/L		Cell Pair #3	1.63	-	0.19	-	0.29		S	2.67	
	Lagoon	Cell Pair #4	0.37	-	0.67	-	1.23				
	1.13	Avg	**0.72**		**0.92**		**1.01**		Avg	**2.51**	

Note: In-situ data (temperature, conductivity, pH, and DO) in table are the average of two measurements.
Water quality parameters in cells are the result of three composited samples.
Lagoon and storage pond measurements result from one sample only.

DATA FROM THE O'BRYAN WETLANDS
SEPTEMBER 3, 1997 SAMPLING DATA

	LAGOON		WETLAND CELLS			STORAGE POND	
CONSTITUENT	Inflow			Inflow	between	Outflow			
			Cell Pair #1	0.018	0.020	0.020		North & South sites	
NO2-N			Cell Pair #2	0.020	0.015	0.019		N	0.030
mg/L			Cell Pair #3	0.018	0.030	0.040		S	0.020
	Lagoon		Cell Pair #4	0.030	No water				
	0.020		Avg	**0.022**	**0.022**	**0.026**		Avg	**0.025**
			Cell Pair #1	0.02	0.05	0.20			
NO3			Cell Pair #2	0.17	0.07	0.02		N	0.03
mg/L			Cell Pair #3	0.07	0.08	0.34		S	0.03
	Lagoon		Cell Pair #4	0.07	No water				
	0.10		Avg	**0.08**	**0.07**	**0.19**		Avg	**0.03**
			Cell Pair #1	5.87	9.76	10.10			
OPO4			Cell Pair #2	5.96	8.65	6.16		N	8.12
mg/L			Cell Pair #3	5.34	8.33	8.24		S	5.13
	Lagoon		Cell Pair #4	5.52	No water				
	6.02		Avg	**5.67**	**8.91**	**8.17**		Avg	**6.63**
			Cell Pair #1	22.1	23.4	19.2			
TP			Cell Pair #2	18.8	23.2	9.8		N	10.4
mg/L			Cell Pair #3	18.9	15.1	11.2		S	9.5
	Lagoon		Cell Pair #4	17.5	No water				
	20.0		Avg	**19.3**	**20.6**	**13.4**		Avg	**10.0**
			Cell Pair #1	27.00	3.43	2.84			
NH3			Cell Pair #2	21.90	3.26	0.42		N	0.27
mg/L			Cell Pair #3	18.80	16.9	3.65		S	0.51
	Lagoon		Cell Pair #4	16.60	No water				
	26.10		Avg	**21.08**	**7.86**	**2.30**		Avg	**0.39**
			Cell Pair #1	74.5	78.8	38.1			
TKN			Cell Pair #2	76.3	101.0	47.3		N	26.5
mg/L			Cell Pair #3	72.9	44.0	31.6		S	23.9
	Lagoon		Cell Pair #4	72.2	No water				
	63.3		Avg	**74.0**	**74.6**	**39.0**		Avg	**25.2**
			Cell Pair #1	203	695	46			
TSS			Cell Pair #2	174	619	170		N	102

mg/L			Cell Pair #3	171	60	50		S	47
	Lagoon		Cell Pair #4	166	No water				
	79		Avg	**179**	**458**	**89**		Avg	**75**
			Cell Pair #1	810	1420	768			
COD			Cell Pair #2	792	1580	936		N	540
mg/L			Cell Pair #3	756	552	606		S	473
	Lagoon		Cell Pair #4	774	No water				
	672		Avg	**783**	**1184**	**770**		Avg	**507**
			Cell Pair #1	3400	est 200	est 164			
F Coli			Cell Pair #2	3100	est 500	est 173		N	est 100
estimates			Cell Pair #3	4500	260	est145		S	4100
	Lagoon		Cell Pair #4	3700	No water				
	est 100		Avg	**3675**	**est 320**	**est161**		Avg	est 2100
			Cell Pair #1	25.01	24.64	23.66			
temp			Cell Pair #2	25.65	24.51	24.40		N	27.64
Centigrade			Cell Pair #3	25.43	23.36	22.30		S	27.66
	Lagoon		Cell Pair #4	26.20	No water				
	26.76		Avg	**25.57**	**24.17**	**23.45**		Avg	**27.65**
			Cell Pair #1	1677	2730	1603			
cond			Cell Pair #2	1571	2575	2870		N	1570
uS/cm			Cell Pair #3	2585	2025	1965		S	1580
	Lagoon		Cell Pair #4	2060	No water				
	2345		Avg	**1973**	**2443**	**2146**		Avg	**1575**
			Cell Pair #1	8.53	8.52	8.72			
pH			Cell Pair #2	8.43	8.73	8.79		N	9.06
			Cell Pair #3	7.71	8.05	7.68		S	9.01
	Lagoon		Cell Pair #4	7.63	No water				
	8.12		Avg	**8.08**	**8.43**	**8.40**		Avg	**9.04**
			Cell Pair #1	1.12	0.82	0.54			
DO			Cell Pair #2	1.55	0.62	1.37		N	2.84
mg/L			Cell Pair #3	0.27	1.16	0.75		S	1.38
	Lagoon		Cell Pair #4	0.46	No water				
	1.77		Avg	**0.85**	**0.87**	**0.89**		Avg	**2.11**

Note: In-situ data (temperature, conductivity, pH, and DO) in table are the average of two measurements.

Water quality parameters in cells are the result of three composited samples.

Lagoon and storage pond measurements result from one sample only.

DATA FROM THE O'BRYAN WETLANDS
September 18, 1997 Sampling Data

CONSTITUENT		
	Lagoon	0.011
NO2-N	Cell Pair #1 Primary Cell	0.006
mg/L	Cell Pair #2 Primary Cell	0.020
	Cell Pair #2 Secondary Cell	0.009
	Storage Pond S	0.011
	Storage Pond N	0.012
NO3	Lagoon	0.04
mg/L	Cell Pair #1 Primary Cell	0.01
	Cell Pair #2 Primary Cell	0.01
	Cell Pair #2 Secondary Cell	0.06
	Storage Pond S	0.03
	Storage Pond N	0.03
OPO4	Lagoon	7.80
mg/L	Cell Pair #1 Primary Cell	11.50
	Cell Pair #2 Primary Cell	16.60
	Cell Pair #2 Secondary Cell	13.00
	Storage Pond S	5.10
	Storage Pond N	4.79
TP	Lagoon	29.9
mg/L	Cell Pair #1 Primary Cell	23.8
	Cell Pair #2 Primary Cell	37.4
	Cell Pair #2 Secondary Cell	44.1
	Storage Pond S	16.1
	Storage Pond N	13.0
NH3	Lagoon	17.00
mg/L	Cell Pair #1 Primary Cell	2.91
	Cell Pair #2 Primary Cell	1.73
	Cell Pair #2 Secondary Cell	0.92
	Storage Pond S	0.92
	Storage Pond N	0.55
TKN	Lagoon	84.4
mg/L	Cell Pair #1 Primary Cell	63.3
	Cell Pair #2 Primary Cell	132.0
	Cell Pair #2 Secondary Cell	171.0
	Storage Pond S	40.0
	Storage Pond N	27.3

No flow occurred into nor out of cells.
Single grab samples were taken in cells in which water was standing, lagoon, and storage pond.
Samples were taken for information purposes.

COD	Lagoon	798
mg/L	Cell Pair #1 Primary Cell	1100
	Cell Pair #2 Primary Cell	2060
	Cell Pair #2 Secondary Cell	1960
	Storage Pond S	564
	Storage Pond N	516
F Coli	Lagoon	est 1900
estimates	Cell Pair #1 Primary Cell	est 1450
	Cell Pair #2 Primary Cell	est 2000
	Cell Pair #2 Secondary Cell	est 3000
	Storage Pond S	<40, est 0
	Storage Pond N	<40, est 0
TSS	Lagoon	206
	Cell Pair #1 Primary Cell	200
	Cell Pair #2 Primary Cell	842
	Cell Pair #2 Secondary Cell	7550
	Storage Pond S	115
	Storage Pond N	79

DATA FROM THE O'BRYAN WETLANDS				
September 30, 1997 Sampling Data				
CONSTITUENT				
	Lagoon	0.040		No flow occurred into nor out of cells.
NO2-N	Cell Pair #1 primary cell	0.014		Single grab samples were taken in cells in which
mg/L	Cell Pair #2 primary cell	0.016		water was standing, lagoon, and storage pond.
	Storage Pond	3.260		Samples were taken for information purposes.
NO3	Lagoon	0.10		
mg/L	Cell Pair #1 primary cell	0.03		
	Cell Pair #2 primary cell	0.05		
	Storage Pond	0.24		
OPO4	Lagoon	9.35		
mg/L	Cell Pair #1 primary cell	11.70		
	Cell Pair #2 primary cell	12.40		
	Storage Pond	5.84		
TP	Lagoon	20.4		
mg/L	Cell Pair #1 primary cell	21.9		
	Cell Pair #2 primary cell	32.5		
	Storage Pond	14.7		
NH3	Lagoon	17.30		
mg/L	Cell Pair #1 primary cell	1.54		
	Cell Pair #2 primary cell	3.90		
	Storage Pond	0.31		
TKN	Lagoon	67.2		
mg/L	Cell Pair #1 primary cell	68.0		
	Cell Pair #2 primary cell	132.0		
	Storage Pond	36.0		
TSS	Lagoon	278		
	Cell Pair #1 primary cell	236		
	Cell Pair #2 primary cell	922		
	Storage Pond	162		
COD	Lagoon	918		
mg/L	Cell Pair #1 primary cell	1170		
	Cell Pair #2 primary cell	2620		
	Storage Pond	418		
F Coli	Lagoon	41000		
estimates	Cell Pair #1 primary cell	est 364		
	Cell Pair #2 primary cell	est 2000		
	Storage Pond	est 64		

FLOW DATA FOR O'BRYAN WETLAND CELLS

FLOWS AT O'BRYAN DAIRY WETLAND CELLS

	Inflow (gpm)	Outflow (gpm)
April 24,1997		
Cell Pair #1	1.98	1.36
Cell Pair #2	1.87	3.07
Cell Pair #3	0.57	0.90
Cell Pair #4	2.19	5.06
May 21, 1997		
Cell Pair #1	0.883	0.000
Cell Pair #2	0.000	0.108
Cell Pair #3	0.000	0.002
Cell Pair #4	0.000	0.184
June 5, 1997		
Cell Pair #1	1.02	0.13
Cell Pair #2	1.00	1.00
Cell Pair #3	0.05	1.36
Cell Pair #4	0.43	0.20
July 24, 1997		
Cell Pair #1	1.85	0.12
Cell Pair #2	1.80	0.29
Cell Pair #3	1.98	0.00
Cell Pair #4	0.61	0.00
August 7, 1997		
Cell Pair #1	1.72	11.00
Cell Pair #2	1.65	5.90
Cell Pair #3	2.02	5.00
Cell Pair #4	0.67	0.00
August 20, 1997		
Cell Pair #1	2.25	2.53
Cell Pair #2	2.10	2.53
Cell Pair #3	2.33	2.16
Cell Pair #4	0.80	0.00
September 3, 1997		
Cell Pair #1	1.14	0.00
Cell Pair #2	1.23	0.00
Cell Pair #3	0.91	0.00
Cell Pair #4	0.51	0.00

No flow measurements taken due to lack of flow in the cells:
May 7, 1997
September 18, 1997
September 30, 1997