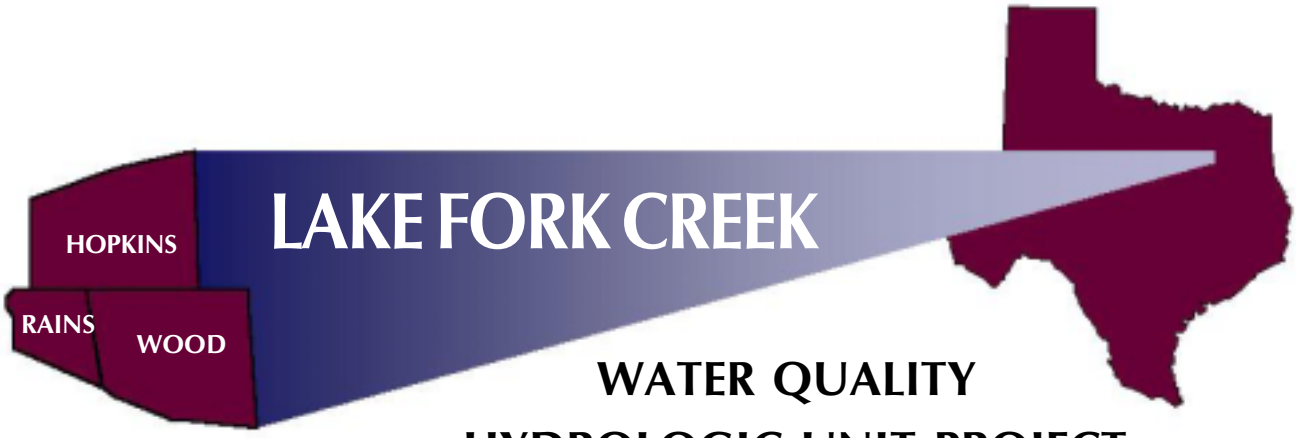


LAKE FORK CREEK

WATER QUALITY HYDROLOGIC UNIT PROJECT

WATER QUALITY ISSUES

The Lake Fork Creek Watershed is comprised of 276,540 acres in portions of Hopkins, Rains and Wood Counties of northeast Texas. Major streams in the area, including Lake Fork Creek, flow south or southeasterly and discharge into Lake Fork Reservoir. Lake Fork Reservoir covers more than 33,995 acres and is a highly regarded recreational lake utilized for fishing, swimming and boating by rural and urban residents. In addition, it serves as a source of municipal water for the City of Dallas and other nearby cities and towns.

In 1991, there were approximately 225 dairies with a total of more than 43,500 head of dairy cattle within the Lake Fork Creek Hydrologic Unit Area (USGS HU 12010003). The average facility maintained a herd size of 175 head on approximately 165 total acres. However, there were an estimated 800 operational facilities in the region making it the most substantial concentration of the dairy industry in the state. In addition, this region was a major center for poultry production, with a total of 40 commercial operations in the project area.

Lake Fork Creek Reservoir, a 33,995 acre waterbody, is an important water supply and recreational facility in northeast Texas.

With 225 dairies and 40 poultry production facilities, livestock waste management was a major issue in the project area.

Citizen complaints and concerns about water quality related to the livestock industry were increasing. The Sabine River Authority, who owns and operates the reservoir, had conducted monitoring programs within the watershed for more than 15 years and had begun to document cases of elevated nutrient levels and fecal coliform bacteria levels in excess of the 200 colonies/100 ml standard in water of the Lake Fork Reservoir.

In 1990, the Lake Fork 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 Lake Fork Creek as a known water quality problem area where nonpoint sources were contributing to excess loadings of nutrients and fecal coliform bacteria.

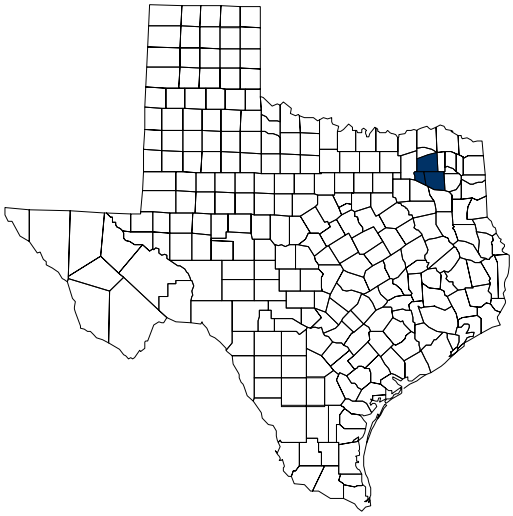
The lack of adequate treatment and proper disposal of animal waste from dairy operations was becoming a conspicuous problem in the watershed. Less than one-fourth of the dairy operations had installed adequate waste disposal systems. In 1990, the Texas Water Commission, which is the state water quality 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.

Inadequate waste management systems on many of the dairy farms 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 some municipal waste treatment plants had been documented. Improper use of inorganic fertilizers and pesticides in both rural and urban applications also was a source of concern. There was an obvious need for an aggressive and targeted water resource management program.

Failing on-site wastewater treatment systems presented another major threat to water quality in the Lake Fork Watershed.

As a result, the Lake Fork Creek Hydrologic Unit Project was initiated in 1991 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 in the Lake Fork Creek Watershed.



The Lake Fork Creek Watershed comprises an area of 276,540 acres in northeast Texas.

PROJECT OBJECTIVES AND ACTIONS

The primary objectives of the Lake Fork Creek Hydrologic Unit Project were:

1) To increase awareness and understanding of the potential causes of nonpoint source pollution and to identify effective best management practices and systems for protection of water resources.

2) To facilitate 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.

Like most watersheds, the Lake Fork Creek project area is impacted by a combination of land use systems. To achieve the project goals, efforts were directed at all major potential sources of pollution including livestock (dairy/poultry) management systems, pasture and row 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 and poultry 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, pesticides and microorganisms and regarding proper design and management of on-site wastewater treatment systems.

PROJECT PERSONNEL

The Lake Fork Creek Project was developed and managed by a multi-agency project team. The lead agencies were the USDA Natural Resources 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 Sabine River Authority, 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.

To enhance overall project coordination, personnel from the lead agencies were co-located within the project area in Sulphur Springs, Texas. This investment significantly reduced operational costs, while enabling regular (daily) communication and programming efforts among the project staff. These factors also facilitated the implementation 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 Lake Fork Creek Hydrologic Unit Project, the major programs implemented to address those issues and the most significant impacts which were achieved.

Livestock Waste Management

The principal objective of the Lake Fork Creek Project was to identify, design and implement best management practices and alternative systems to reduce and/or eliminate potential pollution from the livestock industry. Dairies in this region are characteristically much smaller, family operations which function on a more limited resource basis than their counterparts in other areas of the state. As a result, adequate financial resources to subsidize implementation of new and improved waste management technologies often are not available. Thus, major emphasis in the project was placed on identifying economical system designs and management alternatives which could be implemented by producers.

The climate of the region also is a major factor which contributes to waste management problems and concerns. The average annual precipitation in this region is 44 inches which is reasonably well distributed throughout the year. This consistent and comparatively high rainfall produces unique livestock and waste management challenges for producers. The land is bisected by numerous creeks, streams and small drainage ways which function to convey runoff from the land. Typical open lot and pasture type dairy production systems were highly subject to pollutant losses under these conditions and were the primary forces of the project.

Small, limited-resource dairy operations characteristic of the region were the primary focus of the Lake Fork Project

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 efforts targeted significant educational, technical and financial assistance toward system installation on a minimum of 100 dairies in the project area. However, due to an excellent response by producers in the region and dedicated efforts by USDA-NRCS staff, this goal was not only met but was exceeded. A total of 129 animal waste management systems were designed and installed during the project.

Construction of one of the 129 new waste management systems installed during the project.

- Collection and storage of wastewater and contaminated runoff are crucial to prevent direct discharges of pollutants into surface and ground water. The use of primary and secondary lagoon systems can significantly reduce contaminant levels and enable more flexible reuse of the water for crop irrigation. Demonstrations conducted on 4 dairies were utilized to show how lagoon systems can reduce total solids by up to 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 114 new lagoon systems on dairy facilities in the project area.

Design and installation of 114 wastewater storage lagoons helped to dramatically reduce potential runoff losses of nutrients and fecal bacteria.

- Mechanical solids separators reduce loading rates of potential pollutants entering wastewater storage and treatment facilities. Demonstrations conducted through the project using six different separators showed that significant reductions in total solids and nutrient levels could be achieved. 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. In many cases, it produces a marketable product which can be removed from the facility for beneficial reuse.

Mechanical solids separators reduce loading rates of organic solids and nutrients entering wastewater treatment and storage facilities, and increase the opportunity for beneficial reuse.

- Overgrazing can severely damage vegetative cover and increase the potential for runoff losses of nutrients, sediment and bacteria. Educational programs and demonstrations were conducted to promote proper stocking densities and grazing management. Producers were assisted with evaluating alternative management systems and conversion programs. As a result, over 124,104 acres were incorporated into pasture and hayland management systems to improve productivity and reduce the potential for nonpoint source pollutant losses.

Producers incorporated over 124,104 acres of land into pasture and hayland management systems to improve productivity and reduce potential pollutant losses

- High intensity grazing systems are another significant tool which can be used to control animal grazing pressure, increase the vigor and regrowth potential of crops and enhance animal performance. Significant

effort in the project was directed at demonstrating and encouraging the adoption of HILF (**H**igh **I**ntensity **L**ow **F**requency) rotational grazing systems which utilize multiple small paddocks or pastures to control animal access and impacts. As a result, approximately 2370 acres of land in the project area were converted to planned grazing systems.

High Intensity Low Frequency (HILF) rotational grazing systems were installed on over 2300 acres to reduce runoff losses of nutrients and bacteria caused by overgrazing.

- Beneficial reuse of solid manure is typically accomplished by application onto land adjacent to the dairy. However, on many farms in the project area application rates were exceeding recommended rates for crop production. 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 126 waste management plans were designed and implemented in the project area. Average rates of manure application were reduced by 15 tons per acre per year and nitrogen and phosphorus loadings into the watershed were reduced by an estimated 3,605,254 and 1,588,756 pounds, respectively. In addition, this effective process of nutrient cycling has saved over $1,566,757 in commercial fertilizer costs for agricultural producers in the region.

Implementation of 126 waste management plans by producers reduced nitrogen and phosphorus loadings in the watershed by an estimated 3,605,254 and 1,588,756 pounds, respectively.

- One of the most common errors made in land application of biosolids is failure to properly calibrate spreader equipment. Demonstrations were conducted during tours and field days to show producers simple techniques for rapid calibration of various types of equipment. Project staff assisted more than 125 producers with recommendations and guidelines for proper calibration and operation of manure spreaders. In addition, a convenient, pocket-sized reference card with instructions and rate tables was developed and distributed to producers in the project area.

More than 125 producers were assisted with proper calibration of manure spreaders to ensure correct waste application rates.

- Inorganic fertilizers often must be used to supplement manure applications to provide the correct ratio and rate of plant nutrients for optimum crop growth. However, many farmers were applying excess rates of supplemental inorganic fertilizers to ensure crop yields, failing to account for nutrients in the manure. Soil, manure and wastewater testing are critical components of a sound nutrient management program. Annual

testing campaigns were conducted during the project with a total of 3,820 samples being analyzed, representing a more than 175% increase in the use of this best management practice in the project area. As a result, applications of nitrogen and phosphorus in the watershed were reduced by an average of 138 and 60 pounds per acre per year, respectively.

Annual soil, manure and effluent testing programs generated over 3,820 samples, increasing use of this important BMP by more than 175%.

- 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. 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 4,345 acres in the project area.

- The use of alternative crops for land application was recognized as an important method

Conservation cropping systems, such as ryegrass interseeded into coastal bermudagrass to enable year-round nutrient uptake, were implemented by producers on 4,345 acres.

for reducing over-application of manure. Demonstrations were installed to show how manure can be used in the production of watermelons and vegetable crops. Results showed how solid manure application rates up to 10 tons per acre could be applied with no adverse effects on crop yield or soil properties. Many farmers have begun to take advantage of this important nutrient source as a means to reduce fertilizer costs.

Demonstrations documented how solid manure can be applied to vegetable crops, like watermelons, to improve distribution of waste and increase crop yields.

- Efforts also were made to identify new crops having the potential to help growers make more effective use of nutrients contained in livestock manures. Demonstrations were conducted to show how crops not typically grown in the region, such as alfalfa, can be successfully produced. More importantly, alfalfa has a high demand for phosphorus, the most critical nutrient contributing to nonpoint source pollution.

- Effective distribution of wastewater was a major concern in this region, primarily due to the high rainfall and deep sandy soils that are characteristic of the area. Many producers had inadequate irrigation systems for transporting these materials to fields where they could be properly utilized. A major emphasis was placed on identification of these facilities and on coordination with producers to design improved wastewater management systems. As a result of these efforts, a total of 78 pumping plants and more than 140,421 feet of irrigation water conveyance pipeline were installed during the project.

A total of 78 pumping plants and more than 140,421 feet of irrigation water pipeline were installed to enable beneficial reuse of wastewater.

- Control of animal traffic to and from the holding pens and milking center is important in pasture type operations to protect the vegetation in high use areas. Once these areas become denuded, they are a major potential source of pollutant runoff during rainfall events. Field trials and demonstrations were conducted to evaluate alternative materials, such as fly ash, limestone and highway base material, for use in design of stock trails and walkways and to encourage adoption of this best management practice. During the project, over 42,440 feet of stock trails and walkways were installed to assist in preventing denuding in high traffic areas.

Over 42,440 feet of constructed stock trails and walkways were installed to reduce pollutant runoff and erosion in these high traffic areas.

- Access of livestock to riparian zones and other sensitive areas has direct and significant adverse impacts on water resources through nutrient and bacteria loading and erosion of streambanks. Because of the large number of steams and drainage ways in the region, major emphasis was placed on controlling livestock access to these areas. Field days and tours were used to show how livestock movement can be more effectively managed by placement of watering facilities and use of fencing. Through the project, over 124,146 feet of fencing was installed to control livestock access to these critical areas.

Over 124,146 feet of fencing was installed to control livestock access to critical areas.

- Vegetative filter strips significantly reduce potential nutrient and sediment losses from land application fields. However, proper design, installation and management of

these buffer zones is essential to maintain their effectiveness. Demonstrations were utilized to show producers effective management and use of vegetative buffer strips and through the project, over 980 acres of filter strips were installed.

Vegetative filter strips help remove potential pollutants from runoff water before they can enter streams. Over 980 acres of filter strips were installed through 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 can be incorporated into the waste management system to produce a more marketable product. Project staff also worked with commercial composting operations to promote the establishment of multiple facility cooperatives.

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.

- A major new concern which surfaced during the project was that of *Cryptosporidium*. *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 country which were attributed to contamination of water by livestock waste. To address this concern in Texas, 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 several dairies and analyzed for pathogens. Results indicated that *Cryptosporidium* infection is most commonly associated with young animals and that careful management of calf holding facilities 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 6.1 percent (16,777 acres) of the total land use; however, potential impacts on water quality from nutrients and pesticides are substantial. Major crops in the project area are forages, vegetables, cantaloupe and watermelon. Most of these crops are produced on deep sandy soils which are subject to leaching losses of pesticides and fertilizers. To successfully implement a watershed-based water resource management system, 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.

Major crops in the project area are forages, vegetables, cantaloupe and watermelon grown on deep sandy soils which are vulnerable to leaching of nutrients and pesticides.

Project Impacts

- Best management practices for nutrient, pesticide and irrigation water management were implemented on over 91% (15,280 acres) of the cropland in the Lake Fork Creek Project Area. These practices included use of conservation tillage and cropping systems, vegetative filter strips, and nutrient and pesticide management.

Water quality best management practices, such as conservation tillage, were implemented by producers on over 91% 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. Potential nutrient and pesticide losses from cropland were reduced by more than 40%.

- 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 4 locations during the project. Soil test campaigns conducted by project staff analyzed over 350 soil samples and provided fertilizer rate recommendations. Nutrient management BMPs are now consistently utilized by producers on over 12,500 acres of the cropland in the project area and loadings of nitrogen and phosphorus have been re-

duced by over 20%. This amounts to a reduction in potential loading of more than 250,000 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 250,000 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 then can be carefully tailored to control the target pest. Through these efforts, scouting for insects and use of high efficiency insecticides increased substantially. This resulted in significant reductions in pesticide use for vegetable production.

Integrated Pest Management (IPM) programs used scouting and carefully timed applications to reduce pesticide loading.

- 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 field borders. Results showed that several species mixtures 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 managed harvest forage species. To date, over 813 acres of filter strips have been installed by producers in the project area.

- Application of pesticides is often essential to ensure high quality, consistent crop production. However, improper rates and/or methods of application can lead to serious contamination of water resources. Demonstrations were utilized to show proper storage, handling and application of pesticides in various types of crop production 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 925 agricultural producers during the project concerning proper use and management of agricultural chemicals.

Training on proper storage, handling, and application of pesticides was provided to over 925 producers through the project.

Homestead Water Quality

Environmental pollutants can originate from a wide range of sources. Small rural communities have the potential to impact the quality of water resources since many of the same pollutants commonly associated with agriculture are used around the home. Nevertheless, many homeowners are unaware of the serious potential impacts on water quality of even small quantities of nutrients, pesticides and petroleum products used around their homes and businesses.

In addition, on-site septic systems are a major potential source of both nutrients and fecal bacteria. Evidence indicated that poorly designed and failed septic systems were contributing to water quality problems in the project area.

Small communities and homesteads play an important role in both water quality protection and water conservation.

Although the major focus of the Lake Fork Creek Project was to address potential water pollution from livestock production systems, many of the same concepts and technologies for resource management are directly applicable in situations associated with homes and businesses. Educational programs and demonstrations were used to show citizens of rural communities and rural homeowners that the task of water resource management is shared by all those that inhabit and influence the watershed.

Successful Programs and Impacts

- One key example of the relationship between urban and agricultural practices is evident in the need to use soil testing for lawn, garden and landscape nutrient management. Soil testing campaigns and educational programs were conducted in Sulphur Springs and surrounding areas to promote proper fertilizer selection and timing of 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 608 samples from lawns and gardens and provided recommendations for proper fertilizer management.

Soil testing campaigns conducted in urban areas generated more than 608 samples and provided correct recommendations for lawn and garden fertilizer application.

- Enhancing citizen involvement in water quality protection programs is crucial for their ultimate success. 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 178 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 and rural communities.

- 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 concern in the watershed. Demonstrations and training programs were provided to over 350 individuals to show proper techniques for wellhead design and abandoned well closure.

- Wastewater generated by rural residents is a significant source of ground and surface water pollution in the project area. 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 Lake Fork Creek Project Area, educational programs regarding proper system management and operation and the use of constructed wetlands were provided to over 250 individuals. 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. As a result of these efforts, local developers now consider constructed wetlands technology as a viable alternative for home sites, as well as larger scale housing complexes.

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.

- Youth education provides a basis for social change in terms of water quality protection and water conservation habits. Project staff toured area schools with the Southwest Dairy Mobil Classroom and presented demonstrations and lectures to over 556 students on dairy and other agricultural production systems. In addition, a 4-H School Enrichment Program addressing water resource protection was developed by staff and presented to 96 elementary students.

"Youth education was an important part of the project with contacts to over 679 students and teachers in the project area."

- 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 75 individuals in the project area. In addition, a TEX*A*Syst web site (http://www.waterhome.com) 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 Lake Fork Creek Hydrologic Unit 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:

Field days and tours provided more than 4,235 direct contacts with agricultural producers in the project area. Special tours called "Walk-About" highlighted successful water quality BMPs on local dairy farms.

- 128 educational programs, trainings and tours were presented to over 8,527 people during the course of the project. For example, the Northeast Texas Dairy Short Course held in Hopkins County in November 1992 provided training in livestock waste management and water quality protection to 112 dairy producers. In 1998, the East Texas Dairy Conference held in Winnsboro focused on the economics of sustained environmental management.

- 33 field days and tours were conducted to provide training and continuing education to dairymen and farmers and resulted in over 4,235 direct contacts in the project area. For example, a unique program titled "Walk-Abouts" was developed by project personnel and involved tours of local dairies which had successfully implemented water quality best management practices through the project.

- 22 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.

- 12 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:

- 277 news articles and 415 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 28 information articles addressing water quality management practices and project activities in Country World Magazine which is distributed to over 10,000 producers and businesses in

the project area and throughout Texas.

- Development and publication of a special project newsletter called **The Grazer** which provided information on planned grazing systems and pasture and hayland management for sound economic and environmental production. **The Grazer** was distributed to over 200 livestock producers in the project area, as well as producers and agency personnel in Texas, Arkansas, Oklahoma, Louisiana, Florida, North Carolina and Wisconsin.

- 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 Lake Fork Creek Hydrologic Unit 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:

- To facilitate local input and guidance, an 18 member Local Coordinating Committee was established for the project. This group consisted of local community leaders, citizens and agricultural 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.

- To help mobilize citizens in the project area, local civic groups and organizations such as the Lions Club, Professional Ag Workers Association, Chamber of Commerce, Rotary Clubs and Kiwanis Club were routinely updated to inform members of project activities and to gain their support for the watershed program.

- Joint projects with the Texas Agricultural Experiment Station were utilized to evaluate and demonstrate new technologies which could then be implemented by producers in the watershed. These efforts included the evaluation of new forage species and cropping systems to enhance nutrient utilization, and new livestock manure management systems to improve the potential for beneficial reuse.

- 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. The EPIC (Environmental Productivity Impact Calculator) model was utilized to evaluate alternative production systems and help in selecting those which were most environmentally and economically effective.

- Cooperative work with the Sabine River Authority, Texas Institute for Applied Environmental Research and 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.

Local dairymen and farmers donated time, land, equipment and other resources to help find solutions and protect the water resources.

Moving Forward

When the Lake Fork Creek Hydrologic Unit 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.

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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