LIVESTOCK AND THE ENVIRONMENT

Rethinking Environmental Policy, Institutions & Compliance Strategies

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TO THE
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SETTING THE STAGE

This Interim Report addresses the efforts of the Texas Institute for Applied Environmental Research (TIAER) to come to grips with issues related to dairy pollution in the Upper North Bosque River Basin in Erath County, Texas. This area, designated by the Texas State Soil and Water Conservation Board (TSSWCB) as having the state’s primary agricultural nonpoint-pollution problem, is a microcosm of problems and issues raised nationwide in the livestock and poultry industries. TIAER’s research effort utilizes a novel approach to resolve environmental problems. The approach is based on three fundamental principles:

1) Environmental research in biology, physical sciences, policy, and institutions, when designed to benefit public policy, is interrelated and is most appropriately conducted in a multi-disciplinary environment.

2) Democratic processes must be recognized, understood and used in an open research process where research teams are directly linked to affected interest groups, government institutions, and elected officials.

3) Meaningful, long-term policies can best be addressed, developed and implemented in an arena where all affected groups are empowered.

The Institute, through partnerships, employs the strengths of various universities, governments, and the private sector to achieve workable solutions in a time frame that is useful and within the constraints of increasingly limited public funding.

Current environmental policy, institutions, and compliance strategies are the outgrowth of concerns expressed a quarter century ago for industrial and municipal pollution. Specific concerns were directed to the health effects of industrial practices. The first major legislation was the Clean Air Act passed in 1970, followed by amendments to the Federal Water Pollution Control Act (also known as the Clean Water Act) in 1972 and major amendments in 1977 and 1987. Since then this country has invested approximately $1.4 trillion in 1990 constant dollars to implement U.S. environmental policies (Brimelow and Spencer, 1992). Clearly, two decades ago agriculture was not perceived as a major priority for pollution abatement.

POLICY AND INSTITUTIONS

The initial concerns voiced by interest groups and eventually addressed by Congress were primarily related to point sources of pollution. Point-source, or end-of-pipe, pollution problems have distinguishing characteristics, policies, and solutions. They are easy to identify and measure; success can be achieved by meeting national performance standards through source reduction, treatment and discharge; and violations are easy to detect as is the success of the abatement strategy. Although the initial goal of the Clean Water Act was to achieve fishable and swimmable waters, this intent was replaced to a great degree by the goal of meeting established performance standards (Federal Water Pollution Control Act amendments of 1972 Section 101(a)(2), 33 USCA Section 1251(a)(2)).
New technologies, production practices, and economies of scale and size have encouraged the proliferation of large concentrated animal feeding operations (CAFOs) in the livestock and poultry industries during the past decade. Most of the regulatory activity has been directed toward these types of facilities. Operators of large dairies in Erath County, however, argue that government regulatory agencies cannot resolve complicated pollution issues in watersheds by targeting only larger operations, particularly when they are intermingled in the same watershed with significant numbers of smaller dairies for which permits are not required.

In 1972, when the Clean Water Act was established, few envisioned small dairy operations coming under the regulatory net of government. Current decisions to bring these operations into compliance with environmental objectives are also decisions to tackle a whole new set of policy and institutional issues. State and federal agencies face the reality of addressing agricultural pollution issues with regulatory programs designed two decades ago for point-source pollution problems and with policies and institutions developed for entities unlike smaller agricultural enterprises. Issues concerning small agricultural enterprises, even in the livestock sector alone, are far more complicated than those unfamiliar with agriculture might expect.

Private sector entities, who are price makers, and government have borne the brunt of regulation over the past quarter century. However, the concept that the "polluter pays" is largely a myth. In truth, the consumer/taxpayer bears the major cost for cleaning up the environment through increased prices. Even in the short term this has been the overwhelming experience.

The initial cost of compliance for industry, although very important, was secondary to predictability of compliance/regulatory programs. Uncertainty in the regulatory environment creates unacceptable risks for major investment decisions by industry. Therefore, industry opted for higher costs on the front end of the regulatory program in order to ensure predictability for major investments on the back end. Well-financed firms (price makers), that can immediately internalize the cost of compliance and pass it to the consumer, function well in this process. Governmental entities who have taxing authority also have the capacity to function in this environment.

The quest for predictability produced the current regulatory programs which are underpinned by administrative law/adversarial procedures. This process in turn resulted in the proliferation of environmental lawyers and engineers who are necessary requisites for success in the current regulatory environment. Smaller agricultural enterprises, who are price takers, may struggle with the costs associated with contemporary regulatory/compliance programs.

Regulated entities increasingly cite agriculture as the remaining large industry to be brought into compliance with national environmental objectives (Clean Water Act Reauthorization Conference, Arlington, Virginia, October 1991). They are quick to point out that the cost associated with imposing increas-
INGLY stringent regulations on industry and municipalities are higher than the cost of regulating agricultural pollution and will improve water quality significantly less.

Current environmental policy is tailored to the needs and capabilities of major industry. Present environmental institutions and regulatory strategies would likely be very different had agriculture, instead of industry, been brought into compliance over the past twenty years. Initial attempts to abate agricultural pollution have focused on incremental changes to current policies and regulations rather than on careful inquiry into the nature of the problem and the capacity of agriculture to respond to alternative abatement strategies. Development of appropriate new strategies and institutions has been hampered by world view, in and outside of government, as well as by traditional impediments to any innovation within government (R.P.C., Inc., 1973).

As agriculture is brought into compliance with environmental objectives, the pivotal question becomes:

*Will policy and compliance strategies be modified to recognize the distinct differences in the pollution problems addressed and the industry being regulated?*

The dairy industry in Erath County has a rich heritage. The first commercial production started in 1891 and was squelched in 1893 by extreme weather conditions. The first Jersey herd was established in Erath County in 1917 and the first cheese plant opened in Stephenville in 1937. By the mid-1950s the industry had switched from Jersey to Holstein herds. As early as the mid-1970s the county's dairy herds were larger than national averages. The U.S. average was 31 cows, while 45 percent of the dairies in the county had more than 50 cows, and 22 percent had more than 100. By 1987 a dichotomous producer structure had truly emerged. The average U.S. dairy had 50 cows, while Erath County averaged 189. Even with this high average, almost half of the dairies remained under the 100-cow size. In 1992, large-scale producers with more than 250 cows numbered 52 in the county. The largest Erath County dairy currently milks 3500 cows, with a total herd size of approximately 4200 cows. One other illustration is perhaps the most enlightening; in 1980 there were 181 dairies with a cumulative herd of 19,903 cows. By April 1989, there were 187 dairy operations with a cumulative herd of 48,542 cows. This represents a 148 percent increase in number of cows, with only a 3 percent increase in dairies.

In twenty years, Erath County's annual milk sales increased from $10 million in 1972 to $144 million in 1991. Additionally, a burgeoning infrastructure has developed to support the dairy industry, including hay and commodity suppliers, equipment dealerships, repair services, banking services, and a host of associated industries.
Nonpoint pollution is a wet-weather phenomenon that poses significant problems in isolating sources and quantifying loads. Pollution problems and the success of abatement strategies must be dealt with on a watershed basis. Measurement of nonpoint pollution, a key to successful abatement, has the following complications:

1) relatively large number of diverse sources of water pollution;
2) chemical similarity of agricultural pollutants to other pollutant types;
3) complex interactions that occur in the overland flow and waterways draining agricultural land;
4) potential for varying effluent quality from municipal sewage-treatment plants and other point-source treatment facilities;
5) stochastic storm events and runoff flows;
6) complex geologic conditions that affect the downward movement of contaminants and;
7) large expenditures required for sampling equipment, laboratory analysis, and manpower.

A review of current literature reveals these difficulties will likely lead to increased reliance on pollution prevention, through the use of strategies similar to traditional United States Department of Agriculture (USDA) conservation programs, rather than on traditional abatement strategies associated with point-source pollution (Compare, Rasmussen (1991) (EPA Region 10 Director suggests many alternatives to current command-and-control programs)).

The challenge is multifaceted. Policies that have evolved over the past 20 years must be evaluated in light of new initiatives directed to agriculture. Institutions must also be evaluated to determine their capacity to achieve new policy objectives and forge linkages between the Environmental Protection Agency (EPA) and USDA as they move to bring the industry into compliance. Components critical to successful management of agricultural pollution are:

- prevention and control technologies for operations scattered over diverse natural resource bases;
- programs to provide education, technical assistance, incentives, and regulations to achieve compliance goals;
- monitoring programs to measure individual sources and load contributions;
- procedures for transfer of successful strategies to other watersheds.

The threat of ground-water contamination represents the greatest potential for catastrophic consequences because most of Erath County is totally dependent on ground water. At a time when both the Paluxy and the Bosque reservoir projects are stalled, water conservation and protection are paramount.

Much uncertainty exists concerning the potential for ground-water contamination in Erath County. The county’s major aquifer is relatively deep with plentiful supplies. However, shallow perched aquifers and large recharge zones for the Trinity and Paluxy aquifers are also located in the area, which has a variety of
soils and geologic formations. All these factors add significant uncertainty to the issue, which can be resolved only through major ground-water studies. Confirmation of ground-water contamination in areas with long histories of concentrated animal feeding operations (CAFOs) has fueled a heated debate.

Siting of industry-sized dairies, particularly as related to nuisance odor problems, is currently the most divisive issue associated with the dairy industry. Few individuals, as evidenced by the number of protested permits, want to live near large dairy operations. Proposed solutions range from land-use planning options, which require large buffer zones between dairies and their neighbors, to right-to-farm notions, where living with dairy odor is viewed as the appropriate response.

Surface-water pollution is the most common complaint heard by agencies working in the county. Most complaints originate from either downstream neighbors or a local association, the Cross Timbers Concerned Citizens (CTCC). Between 1988 and 1991, complaints regarding water quality in streams, small reservoirs, and Soil Conservation Service lakes were common. During the first six months of 1992, after the Texas Water Commission (TWC) completed a permitting program to bring larger dairy operations into regulatory compliance, the number of complaints significantly decreased.

The dairy industry is a major contributor to the economy of Erath County and the greater Cross Timbers area. Preliminary results from an economic impact study being conducted by TIAER show that total local expenditures associated with milk production by dairies in the Cross Timbers region amount to an estimated $227 million per year, based on the 1991 production year. The study, when completed, will analyze impacts by large, medium, and small dairies. A local citizens group has raised questions regarding the negative impacts that large dairies may have on the community. All major issues related to economic impact will be analyzed and published by the end of the calendar year 1992.

The Institute has used a Committee for Constituency Development (CFCD) to represent the interests of all affected groups, to provide proper focus for issues and research opportunities, and to recommend policy options. The committee is chaired by State Senator Robert Glasgow, who has maintained an active role in resolving dairy-pollution issues.

The CFCD meets as needed during the year. Members are empowered by the opportunity to make their voices heard by those who have the power to change the status quo. Although representatives of state and federal agencies are not named as CFCD members, they are invited to attend each meeting, and are often called upon to answer questions about agency policies and perspectives. When the debate is polarized, the CFCD provides an opportunity to hear all sides of the issues. The CFCD improves the empowerment of those with a stake in the policy process and coordination of the overlapping processes of policy design, implementation, and evaluation.
The following is a list of TIAER accomplishments during the past two years:

- policy and institutional studies concerning CAFOs
- instrumentation of the Upper North Bosque River watershed to determine water quality
- diurnal studies of reservoir water using hourly measurements of chemical parameters over a 24-hour period
- sampling of reservoirs and permanent stream sites in the watershed on a regular basis
- sampling of intermittent streams after rainfall events
- chemical and biological analyses of baseline conditions of the watershed
- initial modeling of the chemical and physical parameters associated with sampling sites throughout the watershed
- initial investigation of ground water quality associated with lagoon liners and soil characteristics
- initiation of air-quality research to develop enforceable policies in association with the Texas Air Control Board (TACB) and the Texas Agricultural Extension Service (TAEX)
- design of approved waste-management plans for four area dairies
- demonstrations of alternative waste-management technologies on small, unpermitted dairy farms
- analyses of impacts of the dairy industry on the local economy
- production of a siting procedure guideline to direct potential dairy operators to environmentally sound locations that facilitate the permitting process
- monitored 82 percent of the permitted dairies on a monthly basis and 88 percent of the unpermitted dairies on a quarterly basis to determine Best Management Practices (BMPs) usage and compliance with TWC regulations
- held 7 educational seminars for dairy operators concerning alternative waste-management options, regulations and compliance strategies;
- performed a feasibility study for composting in the present regulatory environment
- served as co-project manager with Iowa State University in obtaining a 3-year EPA-sponsored grant to conduct "Livestock and the Environment: A National Pilot Project". Other research partners include Texas Agricultural Extension Service, Texas Agricultural Experiment Station, University of Texas Bureau of Economic Geology, University of Texas Center for Research in Water Resources.
RECOMMENDATIONS

Institute staff developed the following recommendations after working with the Committee for Constituency Development (CFCD) and focus groups. Initial recommendations were developed through two focus groups, one composed of area dairy farmers and the other of concerned citizens. Each group met separately to discuss their recommendations. Votes were not taken; the goal was to develop consensus where possible. The two sets of recommendations were compared for similarities and differences. (See Appendices A, B, and C.) After reviewing the focus group recommendations and discussing them with the CFCD, the Institute developed the following set of recommendations.

I. Current government policies and strategies for dealing with pollution should be modified to ensure that state environmental objectives are achieved, to reflect the peculiarities of agricultural pollution associated with concentrated animal feeding operations and to meet the needs and capabilities of the agricultural producer.

A. The current complaint-driven enforcement program of the Texas Water Commission and Texas Air Control Board should be augmented by an inspection program similar to that of the Texas Department of Health. Regular inspection reports should provide more environmental protection and predictability than the current complaint-driven system.

B. The Texas Water Commission inspection/enforcement activities should first be directed toward permitted dairies. Inspectors should have adequate training in the agricultural sciences, enabling them to identify on-site problems, provide limited on-site technical assistance, suggest alternative Best Management Practices, and refer dairy operators to appropriate institutions for expertise.

C. Owners of smaller concentrated animal feeding operations who cannot afford environmental lawyers and engineers should have access to alternative compliance programs. The Texas State Soil and Water Conservation Board (TSSWCB), because of its unique institutional relationship with the United States Department of Agriculture and local Soil and Water Conservation Districts, should be properly funded to carry out these programs. To provide predictability to the small producer, the TSSWCB should develop an implementation plan that:

1) places a priority on dairies that have the greatest potential for pollution; and

2) outlines, for each farmer, the schedule that must be met to come into compliance.

It is expected that these unpermitted dairies would normally come under Texas Water Commission enforcement activity resulting from complaints or referral by the TSSWCB for noncompliance. Individual wastewater management plans developed by entities other than the Soil Conservation Service should meet the technical guides developed for the local Soil & Water Conservation District.
D. All concentrated animal feeding operations (CAFOs) should come into compliance with state environmental laws. Timetables for compliance, however, should consider the following factors:

1) operations that pose the greatest environmental risk;
2) availability of economically feasible Best Management Practices for unpermitted CAFOs;
3) capacity and response time of United States Department of Agriculture agencies and its state counterparts to provide technical assistance, low-interest loans, and cost-share programs.

E. The “no-discharge” policy for concentrated animal feeding operations should be reviewed to determine if technologies exist to produce an effluent that is acceptable for discharge under conditions other than the 25-year, 24-hour storm event.

F. Guidelines for establishing enforcement penalties for illegal discharges from concentrated animal feeding operations should be reviewed and more carefully restructured. Frequent but predictable penalties of a smaller magnitude would be more effective than rare penalties of great magnitude.

G. Regulatory agencies should, to the extent practical, accelerate the permitting process for new dairy operations and for modification to existing operations that will be used for the following:

1) legitimate research and demonstration efforts directed to evaluate Best Management Practices, technologies, and production practices; and
2) improved production practices or wastewater-treatment technologies and practices that result in better waste management.

Special care should be taken to ensure that these provisions do not become a “loophole” for avoiding established permitting procedures.

H. National standards for compliance should be established. All permitted concentrated feeding operations of like kind should, to the extent practicable, be subject to uniform environmental standards and enforcement.

I. The Texas Water Commission and Texas Air Control Board presently do not conduct on-site investigations of permitted operations to ensure that facilities are constructed according to plans submitted; therefore, all permits should be prepared and certified by registered professional engineers.

II. Regulations and permits for air and water quality should provide predictability and protection to both the producer and those potentially affected by concentrated animal feeding operations. Care should be given to develop regulations that accurately portray the state’s expectations of individual operations. Regulations should be updated when they significantly violate the above principles.
III. Local complaint-resolution procedures should be developed. Local governmental entities, either county government or special districts, should be authorized or created to make initial determinations as to the validity and severity of complaints filed against concentrated animal feeding operations. Procedures for appeal should be developed for those parties dissatisfied with the local decision.

IV. Most agricultural enterprises, unlike previously regulated industries, cannot pass compliance cost to the consumer through product price. Consideration should be given to the use of traditional and innovative funding programs to assist producers in coming into compliance.

A. Governmental support programs, including United States Department of Agriculture cost-share programs, should be expanded and operated more efficiently to award funds to qualifying producers in a shorter time frame. Particular attention should be given to a state-funded cost-share program.

B. Low-interest loan programs or guaranteed private loans used to install waste-management practices should be implemented by the state.

C. Innovative private sector programs funded from increased milk prices, which give bonuses or rebates to producers who use environmentally sound production practices, should be evaluated. If proven feasible, steps should be taken to implement the program at the national level.

D. Programs of the General Land Office and the Texas Department of Agriculture, which encourage technological and private sector solutions to environmental problems, should be expanded.

E. The state and Environmental Protection Agency should explore the applicability of a trade-off policy for solving nonpoint-pollution problems.

V. Special attention must be given to siting practices for new concentrated animal feeding operations.

A. The Texas Agricultural Extension Service should develop special education programs directed to realtors and the financial community in regions of the state where concentrated feeding programs are prevalent.

B. The Texas State Soil and Water Conservation Board should maintain and improve the siting guidelines developed by the Texas Institute for Applied Environmental Research and assist new producers, statewide, in the selection of appropriate sites.

C. Real estate contracts of sale should contain clauses alerting potential buyers to the state’s regulatory process for concentrated animal feeding operations.

D. In sensitive aquifer recharge areas, clearly proven technology and production practices should be required of concentrated animal feeding opera-
OVERVIEW & RECOMMENDATIONS

E. State and county governments should consider the creation of special agricultural districts. This sensitive issue can be approached from the standpoint of private landowners requesting the county to declare large tracts of land in agricultural areas as special use for concentrated animal feeding operations. Legislation authorizing the creation of such districts for new planning and development should be sponsored.

VI. Funding for research on the following environmental issues should be implemented or continued.

A. The newly established water quality monitoring program of the Upper North Bosque River Basin should be continued by the Texas Institute for Applied Environmental Research (TIAER). TIAER, in conjunction with its research partners, including the United States Geological Survey, Texas State Soil and Water Conservation Board, Brazos River Authority, Texas Agricultural Experiment Station, Texas Agricultural Extension Service, Texas Water Commission and others, should:
   1) determine the applicability and adequacy of Best Management Practices (BMPs) being recommended by regulatory authorities;
   2) develop methods to determine pollution loadings by land use type and BMPs implementation. These methods should be transferable to other watersheds;
   3) enhance existing models to better predict water quality changes as a function of land use practices or adoption of better waste-disposal methods. These models should be transferable to other watersheds.

B. Funding to Texas Institute for Applied Environmental Research and Texas Agricultural Extension Service through the Texas Air Control Board should be continued for the development of technology and policy leading to enforceable air-quality standards.

C. The Texas State Soil and Water Conservation Board and the Texas Water Commission, focusing on the dairy pollution problem in Erath County, should commit the necessary resources to develop and implement a pilot program to abate pollution from agricultural sources. Special attention should be given to determining the sources of all pollution in the county.

D. The Brazos River Authority in conjunction with Texas Institute for Applied Environmental Research should assess the impact of pollution from the City of Stephenville on the Bosque River.

E. Texas Institute for Applied Environmental Research and the Texas Agricultural Experiment Station should give special attention to the evaluation and employment of innovative Best Management Practices for smaller, unpermitted concentrated animal feeding operations.

F. The Bureau of Economic Geology, in conjunction with the Texas Water
Development Board, should be funded to continue the ground-water studies in Erath County initiated with funds from the Environmental Protection Agency through the "Livestock and the Environment: A National Pilot Project."

G. The City of Stephenville should be encouraged to seek federal and state funding through the Texas Water Commission and the Texas Water Development Board to construct and demonstrate the feasibility of a regional municipal solid waste-composting facility with a manure-composting component, which would generate a commercial product while reducing the quantity of both municipal and agricultural wastes. The state should support this project to encourage cross media solutions to environmental problems.
An opportunity to experiment with a new paradigm for conducting applied environmental research and policy analysis produced the set of policy recommendations outlined in the Overview and Recommendations section. These recommendations represent an intermediate product from an on-going research process that emphasizes involvement from all stakeholders in the policy outcomes from the process. The focus of the Institute's current research is to analyze and to participate in a policy process underway at the federal, state, and local levels. In this process, the rules for promoting environmental quality and abating agricultural pollution in Erath County and other livestock-producing regions are under revision in a dynamic joint process of policy design and implementation. There are two types of stakeholders. The first are those with a vested interest in changes in property rights resulting from the policy process, including:

- agricultural producers subject to a changing set of environmental policies,
- citizens actively concerned about the establishment and implementation of policies to ensure environmental protection,
- businesses that depend on the agricultural sector for income.

The second are those with a more indirect stake in the policy process, since it affects their professional roles and agencies, including:

- municipalities grappling with solid-waste disposal issues and management of water-treatment facilities to ensure that drinking water-quality and sewage-effluent standards are met,
- local, state, and federal government agencies that implement environmental policies,
- scientific researchers who analyze the effectiveness of Best Management Practices and technologies designed to abate pollution, and
- governmental decision makers, journalists, and scientific researchers who evaluate environmental-policy implementation and outcomes.

In 1989, the Texas State Soil and Water Conservation Board (TSSWCB) designated the Upper North Bosque River as the watershed most severely affected by agricultural nonpoint pollution in Texas. The Texas Water Commission (TWC) levied fines totaling $142,460 on five dairy producers whose practices were deemed part of the local pollution problem. Public hearings, attended by rural landowners who shared fence rows or waterways with dairies or potential dairy sites, were an attempt to clarify property rights. These actions spotlighted the urgency of the agricultural-pollution problem. There were conflicting assertions about what should be done.

Necessity breeds innovation. The formation of the Institute in April 1990 was a response to the need for a comprehensive approach for effectively channeling stakeholders' energy and concerns into positive progress on policy solutions. The Institute's on-going mission is to forge a new research paradigm with suffi-
cient flexibility and scope to manage complex problem sets. Its initial task is to design a research paradigm and a policy-making process, working in tandem to generate comprehensive analysis and management of agricultural pollution. Published scientific research results offer only incomplete measurements of trends in pollution levels in watersheds affected by both agricultural and non-agricultural nonpoint pollution. Because of the character of agricultural pollution, it is difficult to establish causal linkages between measured pollutants and the particular polluters in a watershed. Sound science is necessary to resolve this conflict, but additional components are required. Issues of policy, institutions, funding, and economics must also play a part in a successful resolution of environmental policy dilemmas.

The Institute recognizes that an effective environmental-policy process requires flexibility and responsiveness to a diverse set of stakeholders' concerns. It requires scientific researchers, policy analysts, and those who implement policy to work together, untangling complex trade-offs and establishing the best course of action when no single policy emerges to satisfy all stakeholders. In the current institutional framework for environmental-policy development, however, scientific researchers work in organizations apart from those who design and implement policy. Stakeholders in policy outcomes have limited access to both scientists and policy makers. Pragmatic compromises and innovative strategies are easily overlooked. Failures in policy implementation and dissatisfaction with policy outcomes result from the absence of mechanisms for communication and coordination in the research process.

The unique innovation offered in the Institute’s research paradigm is the establishment of a mechanism to facilitate collaboration among stakeholders in the policy process: the Committee for Constituency Development (CFCD). The CFCD was formed to tackle complex environmental-policy issues when high levels of conflict and involvement from diverse sets of stakeholders constitute obstacles to and opportunities for the environmental-policy making process. The CFCD's purpose is to create a forum for all stakeholders to voice their viewpoints. The CFCD gives stakeholders a seat at the table where policy decisions take shape; whereas, before, no table existed. The CFCD opens and formalizes communication channels, which previously had been blocked or non-existent.

The CFCD meets every three or four months. It is chaired by an individual or a team of individuals with the power to shape current and future environmental policies. Participation in the CFCD process empowers by creating an opportunity for those with divergent viewpoints to be heard by
those with the power to change the status quo. Although representatives of state and federal agencies are not named as CFCD members, they are invited to each meeting, and are often called upon to answer questions about agency policies and perspectives. When debate is polarized, the CFCD provides an opportunity to hear all sides of the issues. The Institute's recent CFCD process focused on TWC and Texas Air Control Board (TACB) efforts to site and regulate larger dairy operations and the impasse between dairy operators, who believe their production and management practices comply with TWC permit standards, and concerned citizens who assert that their property rights to clean water and fresh air are violated by neighboring dairies. In Erath County, the CFCD held meetings between June 1990 and September 1992. Those involved in policy design and implementation attended the CFCD meetings to determine what other stakeholders saw as working and as not working. The CFCD forum provides an opportunity for research scientists to receive feedback regarding whether they are asking the right questions, and a resource of new, unanswered research questions. The CFCD is a success to the extent that it empowers those with a stake in the policy-making process, and that it improves coordination and collaboration in the overlapping processes of policy design, implementation, and evaluation.

The composition of the CFCD is important. The chairperson's stature and accessibility compels people to attend meetings. Senator Robert Glasgow chaired the CFCD during the agricultural-pollution dilemma in Erath County, and will communicate his impressions and agenda for action to the Texas Senate and the state government, formally and informally. The mix of members comprising the CFCD was carefully selected to represent all relevant viewpoints. Important criteria for CFCD operation include:

- representation by peer leaders of important stakeholder groups,
- attention to group dynamics with both poles of the continuum of policy disputes anchored, to ensure all tough questions are raised,
- agreement from the outset that the CFCD membership will not vote; rather, their goal is to reach consensus, and
- willingness to participate effectively, which requires time, interest, and knowledge.

The Institute's working hypothesis is that the CFCD process, used effectively, can design viable environmental policies, improve all stakeholders' satisfaction with policy outcomes, and reduce the costs of policy development. The key to success is to identify areas of consen-
sus and develop strategies to build and expand on the agreed-upon points of consensus. Once stakeholders have articulated areas of consensus, the CFCD as a group is empowered to make policy recommendations, and to negotiate consensus between polarized groups. Identifying and probing points of disagreement among stakeholders is of equal importance so that these can be addressed directly. Otherwise, dissent among important stakeholders undermines the successful implementation of policies. In summation, the CFCD succeeds when it does the following:

• achieves empowerment through information,
• delineates points of legitimate difference,
• reaches consensus on major issues, and
• provides a forum for focus and review of research activities.

The CFCD process for evaluation and development of environmental policy on agricultural pollution in the Upper North Bosque watershed and the research activities that support this process have been the focal points of the Institute's activities since April 1990. At that time the Institute, in conjunction with the TSSWCB, started work on education and demonstration projects in the Upper North Bosque watershed through the EPA under the Federal Water Pollution Control Act (Clean Water Act), section 319 program. An important issue that surfaced early in the CFCD process was the need for a comprehensive assessment of the nonpoint-pollution problem in the Upper North Bosque watershed, which included the following:

• evidence of pollution,
• ability to identify sources of pollution and to establish causal linkages,
• trends in pollution levels over time, and
• ability to assess effectiveness of pollution-abatement technologies and management practices.

Answers to these complex scientific questions play an important role in appropriate and efficient policy formation. Without sound scientific evidence to provide credible pollution assessments, one alleged polluter blames another for problems downstream. The Institute responded to this dilemma by careful instrumentation of the Upper North Bosque watershed to monitor water quality, laying the groundwork for long-term basic scientific research to determine the impacts of the dairy industry, other agricultural activities, city water-treatment facilities, and other nonpoint sources in the watershed.

Through its involvement in dairy waste-management issues, the Institute has started research on solid-waste management issues. In the Upper North Bosque watershed, the Institute is working with the City of Stephenville to look at alternative solid-waste management strategies. For Erath County, there is likely to be synergy between solutions to dairy-waste management and solid-waste management issues. Building on this experience, the Institute plans further
involvement in research on recycling and solid-waste management at the state level.

The Institute has a core staff of nine full-time professionals and approximately 20 technicians and administrative staff members. Rather than conduct all research on-site, the Institute’s role is in framing research problems and in maintaining linkages between the research process and the stakeholders in the policy process through the CFCD. Once a problem is framed, the Institute forms partnerships with experts at other universities to collaborate on conducting the research, and on reiterating with the CFCD. Research partnerships developed for projects undertaken by the Institute include the following entities:

- Texas A&M University - Blackland Research Center
  Blackland will develop models for enhanced understanding of water-quality trends observed in the Upper North Bosque watershed,
- University of Texas - Center for Research in Water Resources (CRWR)
  CRWR will design and review monitoring for hydrologic and surface-water quality research,
- University of Texas - Bureau of Economic Geology (BEG)
  BEG will study and model ground water hydrology and water quality,
- Texas A&M University - Texas Agricultural Extension Service (TAEX)
  Dr. John Sweeten, TAEX, will monitor odor associated with dairies and evaluate technologies designed to mitigate against odor,
- Texas A&M University - Texas Agricultural Experiment Station
  Economists will assist in conducting an economic analysis of the impact of the dairy industry on the Cross Timbers region, and
- Iowa State University - Center for Agriculture and Rural Development
  Co-project manager of "Livestock and the Environment: A National Pilot Project".

From the earliest CFCD meetings, the Institute has recognized the importance of the federal role in environmental-policy formation as a major force. Orchestration of meaningful local and state policies to mitigate the nonpoint-pollution dilemma facing the Upper North Bosque watershed requires effective coordination and participation in the policy process at the federal level. For example, when specifically applied to concentrated animal feeding operations, the EPA’s National Pollution Discharge Elimination System (NPDES) policies have the potential to override whatever local and state policies are implemented. From its inception, the Institute has followed carefully the development of federal environmental and agricultural policies that make a difference in management of nonpoint pollution at the watershed level. The Institute’s thinking on the CFCD’s contribution to the joint policy design and implementation process sparked the imagination of those at the national level grappling with the issue of how to control pollution from confined animal feeding operations. In 1991, in partner-
ship with the Center for Agriculture and Rural Development at Iowa State University, the Institute successfully attained EPA funding to conduct what the EPA's Office of Policy, Planning and Evaluation has earmarked to be a definitive piece of research on livestock and the environment at the national level. In late 1992, a national CFCD will be formed to represent those with a stake in environmental policy formation pertaining to dairy, beef, swine and poultry operations nationwide.

The objective of “Livestock and the Environment: A National Pilot Project” is to determine technologies, management methods, policies, and institutional settings that can reduce the environmentally negative impacts of livestock production, while generating a national livestock industry that is economically viable and competitive in increasingly international markets.

Research on dairy pollution in Erath County, Texas will serve as a baseline study. These baseline results, along with satellite studies conducted to parameterize cutting-edge waste-management and production technologies nationwide and around the world, will be used to construct cross-species, interregional, and national analytical systems. These systems will be used to evaluate the implications of alternative environmental policy scenarios on the economic viability and competitiveness of the livestock sector, on indicators of environmental quality, and on the sustainability of U.S. livestock-production systems.
Environmental policy, generally speaking, is a governmental objective to achieve or maintain particular conditions in the natural environment. Most commonly the policies and their implementing programs are defined generally by legislative act and more specifically through administrative rulemaking, agency interpretation, and actual implementation history. Programs are implemented by designated governmental institutions, e.g., the U.S. Environmental Protection Agency (EPA) or the Texas Water Commission.

A. OVERVIEW

Texas' environmental and agricultural policy framework espouses a linkage of environmental protection objectives to maintenance of economic stability. Thus, it is Texas' policy "to maintain the quality of water in the state consistent with the public health and enjoyment, the propagation and protection of terrestrial and aquatic life, the operation of existing industries, and the economic development of the state ..." (Water Code section 26.003). Among the state's agricultural policies are the goals of "provid[ing] for the conservation of soil and related resources of this state and for the control and prevention of soil erosion" (Agriculture Code section 201.001 (West 1992 Supp.)), consistent with Art. XVI, section 59a of the Texas Constitution, which declares as "public rights and duties" the "conservation and development of all of the natural resources of this State," including within its meaning flood control, reclamation, forest conservation, and navigation. At the same time, improvement of economic conditions in agriculture, such as broadening the markets and demand for all agricultural or horticultural products, are supported in state policy. (Agriculture Code section 12.006, describing powers and duties of the Agriculture Commissioner).

The state and federal governments have aggressively undertaken steps to improve their understanding of agricultural pollution and related policies. In its last session the State Legislature charged the state's River Authorities with creating regional water-quality assessments that are to "include a review of wastewater discharges, nonpoint source pollution, nutrient loading, education and involvement in water quality issues, local and regional pollution prevention efforts, and other factors that affect water quality within the watershed" (Water Code section 26.0135 (a)). And, the state has continued to fund environmental research activities associated with the state's public universities.

B. POLLUTION CONTROL FOR CONCENTRATED ANIMAL FEEDING OPERATIONS

Not all agricultural activities that pose possible pollution risk are regulated by state, local, or federal authorities. The present focus is upon concentrated animal feeding operations (CAFOs), given the nature of wastes involved coupled with public interest in the area. The containment of, and later land application of nutrients in the form of animal manure is subject to an EPA program and a
Texas Water Commission program, but the application rates of chemical fertilizers are not. One rationale is that the use of manure wastes on land in Texas is considered secondary to the disposal mission, whereas the use of chemical fertilizers is pointed toward matching cropping needs. Smaller manure-producing facilities posing a lower pollution risk are also subject to less imposing regulatory conditions (although discharge to state waters is prohibited), including an exemption from permitting requirements. Program changes over time are expected in a field as volatile as environmental regulation. Improved scientific understanding of the role of agricultural sources in pollution loading is a likely consequence of the ongoing studies and demonstration projects.

Nonpoint-source impacts are difficult to quantify, as to natural or human factors. Nevertheless, EPA believes that 76 percent of impaired lake acres, 65 percent of impaired stream miles, and 45 percent of impaired estuarine square miles are impacted by nonpoint-source pollution. Agriculture adversely affects 50 percent to 70 percent of the assessed surface waters. The sources are soil erosion from cropland and overgrazed pastures, and runoff of animal wastes, chemical fertilizers, and pesticides. About 1 percent to 5 percent of assessed surface waters are impacted by land-disposal activities, defined by EPA as leakage from septic tanks and land application of sewage sludge. (U.S. General Accounting Office, GAO/RCED-91-10 and EPA, 1986).

Given the state and federal regulatory focus on the large-scale CAFOs, (manure-generating agricultural industry), the Institute has undertaken research of the scientific, economic, and policy aspects of agricultural pollution and the dairy industry in north and central Texas. The Institute has conducted extensive field studies in Erath County and economic and institutional studies covering a wider geographic area. These studies will be developed to cover a broader base of the concentrated animal feeding industry through future research efforts in cooperation with other universities throughout the U.S.

The principal programs applicable to management of wastes from CAFOs in Texas are the state and federal water-quality programs under the jurisdiction of the Texas Water Commission and EPA, respectively. The other area of focus is air pollution, although this is an area not yet as well developed as water-quality regulation in the critical area (for CAFOs) of odor regulation.

In Texas, odor control is addressed through the Air Control Board’s application of the Texas Air Control Act to “livestock animal feedlots” containing more than 1000 animals (TACB Standard Exemption No. 62 excludes sites below that size). There is no separate parallel federal odor-control program (compare the discussion of the NPDES water-quality program below). The odor program does not apply if the operation is characterized as a natural source, a calculation that may take account of site location, or may be determined on a blanket basis, regardless of location, taking account of the kinds of things involved in the agricultural operation. See, generally, State of Texas v. F/R Cattle
Co., Inc., 828 S.W.2d 303 (1992, Ct. of App., Eleventh Dist., Eastland)(The calf-feeding operation was not recognized as a natural source even though located in a concentrated dairying area). The Institute and Texas Agricultural Extension Service have ongoing research of odor-control technologies and of the Air Control Board’s regulatory program.

The key feature of the state’s water-quality program in this area is the general policy that there shall be no discharge of waste material to the waters of the state, 31 TAC 321.31 (West 1989), and that the means of achieving that objective are implementation of Best Management Practices (BMPs) for containment of wastes on site and distribution of wastes on agricultural lands in a manner consistent with agronomic capacities of the fields (a function of soil type and plant nutrient needs that varies from crop to crop). (31 TAC 321.37(a)(2) (West 1989)). This program has been implemented by the Water Commission from 1985 to the present time; guidelines adopted in 1985 were promulgated as regulations in 1987. The “no discharge” criterion, now part of both the federal and state programs, dates to a general state guideline developed in the 1970s and a corresponding regulation at the federal level implemented as part of the National Pollutant Discharge Elimination System program first implemented by the U.S. EPA.

In 1969 the State had recognized that about 90% of the 1.4 million cattle on feed in the state did not have adequate pollution controls. In response to this recognition, in the 1970s the Texas Department of Water Resources (later incorporated into the Texas Water Commission) developed a design criterion guideline requiring containment of a 25-year, 24-hour storm event. After 5 years, about 95% of the beef cattle on feed were held in systems thought to meet that standard. (Sweeten, 1989).

The EPA had first adopted this criterion as part of the federal National Pollutant Discharge Elimination System (NPDES) program in 1974 (39 Fed.Reg. 5706), establishing that sites meeting the definition of discharger or sites over a specific size were designated “point sources” subject to a permit requirement. The state responded again to concerns over animal waste-caused water degradation with the development of “technical guidelines” in 1985; in 1987 the Commission adopted these guidelines as regulations that are the basis of current regulations. In both instances the Commission involved university specialists in the process of developing the standards. (See Baumfalk, 1989).

The 25-year, 24-hour storm containment design criterion is one of the technological standards of the NPDES feedlot regulations adopted under the authority of the Federal Water Pollution Control Act, as amended in 1972. (There are two types of standards in this program, technological and water-quality based). “No discharge” in the Texas and federal programs is defined in actual terms (a discernible physical discharge of wastes to the waters of U.S. violates the standard) and by the design criterion. The principal design criterion provides
that 100% of rainfall in a 25-year, 24-hour rain event that comes in contact with animal waste must be contained (usually in waste water lagoons), or there is a "discharge" within the meaning of the federal and state programs. (See 31 TAC 321.35 (West 1989)).

As characterized in a draft general NPDES permit issued in July of 1992, EPA's NPDES permit requirement will apply to all dairy facilities with more than 700 mature dairy cattle (not distinguished as to milkers, dry cows, or others) and to sites with more than 200 dairy cattle if the dairy discharges to the navigable waters of the U.S. through a ditch, flushing system, or if directly to the waters of the U.S. Put another way, sites with 200 mature cattle that do not meet the 25-year, 24-hour design criterion for wastewater containment will be brought under the permitting requirement. Most sites would be permitted under the proposed general permit, but site-specific permitting is possible. Again, failure to meet the 25-year, 24-hour design standard would place a site in the category of discharger. (57 Fed.Reg. 32475 (1992)). A herd size criterion triggers the Texas Water Commission permit requirement also, although all operations in the state, regardless of size, must abide by the policy objectives of the program through a permit by rule. 31 TAC 321.34 (West 1992 Supp.) In the case of dairies the threshold size for permitting is 250 milking head. 31 TAC 321.33(d)(1) (West 1989).

Citizens' enforcement provisions are a key distinguishing feature of the state and federal programs; the federal NPDES program is enforceable through citizens' suits, and there is no comparable provision in the state program, although citizens' complaints made to the Water Commission or Air Control Board are routinely investigated and may lead to enforcement actions. See, Carr v. Alta Verde Industries, Inc., 931 F.2d 1055 (5th Cir. 1991) (Citizens had authority to sue over Federal Water Pollution Control Act program violations at a cattle operation) and State of Texas v. F/R Cattle Co., Inc., 828 S.W.2d 303 (1992, Ct. of App., Eleventh Dist., Eastland) (Citizens' complaints led to enforcement action from the Texas Air Control Board).

An NPDES permit, in theory, could allow discharges to the navigable waters; in practice, NPDES site-specific and general permits are drawn so as to strive for the no-discharge management objective, or site permitting is simply not enforced at all. (EPA's Office of Policy, Planning and Evaluation has recognized that between EPA's Regional Offices and states with NPDES delegation there are fewer than 10% of sites eligible by existing size criteria permitted under the NPDES program. (Long (draft), 1992)) The Commission's program does not permit discharge to the waters of the U.S. Dischargers would be subject to the NPDES program in any event, and, technically, it can be posited that at this time legal authority to permit discharges from concentrated animal waste facilities to the waters of the U.S. is vested with EPA's NPDES program, and will remain there until Texas has an EPA-approved NPDES program in the area of feedlot
regulation. Again, the Texas Water Commission’s program for all concentrated animal feeding facilities at this time is based upon a technological “no discharge” standard.

The Commission’s program describes possible BMPs in its permit-by-rule provisions, and incorporates BMPs into issued permits. BMPs are specific operational design criteria which take account of site characteristics, economics, opportunities and constraints. (31 TAC 321.43 (West 1992 Supp.)) The NPDES program requires “new source performance standards” in permits for newly constructed lots, but less rigorous “best practicable control technology economically achievable” (BCT) for conventional pollutants at facilities in existence prior to permitting. Toxic or other pollutants considered not conventional are subject to a rigorous “best available technology economically achievable” (BAT) standard at facilities in existence prior to permitting. The NPDES program considers BMPs to be possible special permit conditions over and above the other technological standards. The Commission’s program, requiring BMPs, is site specific. A recently permitted site in Erath County was the first required to have a “double lined” waste lagoon protected by rip rap construction methods. (Lledroc Farm-West). It is now accepted practice that special conditions in permits are a dominant part of the Commission’s program, yet would appear to be less significant in the NPDES program as proposed recently for EPA Region 6 states Louisiana, Oklahoma, Texas and New Mexico, which do not have NPDES authority in the area of feedlots. (57 Fed.Reg. 32475 (1992)).

BMPs typically involve “structural and nonstructural controls as well as operation and maintenance procedures” and may be categorized according to environmental objective, target pollutant, environmental media affected, and management approach. Effectiveness is rated according to impact on pollution loads, acceptance by agriculture, cost, and ease of implementation and maintenance. Farmers who have undertaken the practices outside of the context of required permit terms, as a general matter, have done so in response to the availability of financial and technical support. (Logan, 1990).

The Commission’s program has demonstrated that enforcement against dischargers of animal waste is potentially quite awkward administratively. In an internal memo the Commission staff has noted that it has the burden of proving a substantial potential for environmental impact, which is quite difficult without witnesses that have observed actual polluted water discharge. Optimally, a water sample analyzed for constituents of interest (e.g., nitrogen series, phosphorous, fecal coliform, etc.), along with a measurement or estimate of discharge flow rate, and photographs of the discharge would be available. Alternatively, the Commission would like “[a]ny information that will enable us to demonstrate that the existing waste facilities, if any, are inadequate and therefore pose a potential for significant impact.” These data may include the size and storage capacity of basins, acreage of lots and other areas draining into the retention
basins, pond liners, soil type, and proximity to aquifers and aquifer recharge areas. In addition, for enforcement purposes the Commission would like information on the history of citizens' complaints about environmental practices at the site, inspection history of the facility, and statements from any witnesses to discharge, e.g., adjacent landowners, willing to so testify in Austin. (Bohm Falk, 1989).

Traditional agricultural agencies are a significant element in environmental policy at this time, although this is a role that has grown in importance only in the last few years. The agricultural agencies, including divisions of the USDA and state counterparts promote environmentally sound agricultural practices through cost-share, technical assistance, educational, and other programs. The USDA has a long, rich tradition of trying to be the friend of the agriculture industry, through promotion of price stabilization programs, incentive-based voluntary conservation programs (which may include direct subsidization), and production research. In its evolving environmental policy role it has maintained its traditional voluntary program approaches, leaving regulatory enforcement roles to the programs under jurisdiction of EPA and state counterparts. (U.S. General Accounting Office, GAO/RCED-90-162; see Rice, 1979). Farmers have been found to favor tax credits over subsidization programs, but the cost-share (subsidization) programs are more precise in terms of purpose. (See van Es and Keasler, 1979).

The USDA Secretary’s responsibilities now include farm economy, food stamps, food safety, quality, market integrity, and environmental issues. Through its large number of field offices, USDA maintains a link with farmers, ranchers, and consumers (literally, USDA has an office in every county in the U.S. given its involvement with both farm programs and urban programs (e.g., food stamps)). (U.S. General Accounting Office, GAO/RCED-91-168).

C. Evolution of Today's Regulatory Program
U.S. pollution-control policy today is the offspring of policies and programs directed to industrial and municipal sources in the 1960s and 1970s. Agriculture has been a part of the programs from at least the time of implementation of the Federal Water Pollution Control Act amendments of 1972. Its role was narrowly defined; it was not a significant object of the programs, and it did not participate in program development. And, it has only in the last few years undertaken the task of becoming a full participant. The highly diverse character of the agriculture industry, its large number of individual participants, and the level of sophistication required for full participation in regulatory development (both legislative and administrative rulemaking) suggest that participation in regulatory development on an equal par with participants of long-standing (e.g., the industry groups, environmental groups, etc.) will not come easily. The "seat at the table" is there; effectiveness of participation on the part of agriculture is the lingering
question.

Several well-publicized events in the 1960s and 1970s drew public attention to environmental matters. Industrial waterways caught on fire. For example, the Houston Ship Channel linking the Port of Houston with Galveston Bay burned in 1966. Oil spills from off-shore oil-production sites and mishaps of oil-shipping vessels, particularly the Santa Barbara Channel spill, were front-page news. Land preservation issues, including protection of the Grand Canyon National Park from water development projects, led to public celebrations of Earth Day; the creation of the Environmental Protection Agency by Executive Order in 1970; and the beginning of major, broad-based federal involvement in environmental matters following passage of the National Environmental Policy Act of 1969 (NEPA). (See, Petulla, 1987, listing "environmental pressures and legislation since World War II"). Initial regulatory programs of this period focused upon the most readily identifiable sources of air and water pollution, that is, those sources discharging identifiable wastes at specific points.

This approach paralleled that of older common law doctrine and statutory structure, which establishes liability for sites with a demonstrable causative link to the alleged pollution, but added the regulatory process to achieve program efficacy. The older doctrines and statutes remain in force, for the most part, but newer regulatory programs were placed at the cutting edge of policy development, a large part of which was directed to uniformity of application. Thus, while common law standards applied to redress livestock-nuisance impacts almost 400 years ago (Aldred's Case, 77 Eng. Reports 816 (1610)) remain viable today, with very similar cases still being heard (See Wheeler, 1992), the framework of policy beginning in the 1960s and 1970s became point source regulatory programs.

The older principles and standards are sometimes incorporated into the newer programs. For example, an older pollution liability statute in the U.S., the Rivers and Harbors Appropriation Act of 1899, section 10, better known as the Refuse Act (codified at 33 U.S.C.A. 407 (1986)), providing that "[i]t shall not be lawful to ... discharge ... any refuse matter of any kind or description whatever ..." into navigable waters, and naming as within its scope discharges from several kinds of point sources, e.g., mills, manufacturing establishments, floating crafts, etc., was incorporated into the federal water-quality regulatory program for several years, although that role has been discontinued. (Ex.Org. No. 11574 (1970), revoked by Ex.Org. No. 12553 (1986)). Much like the common law, however, the Refuse Act remains on the books. (See Rogers, 1986).

In water pollution, the early programs implemented by the states directed health officials to abate nuisances and protect water supplies. These were directed to point sources. Recognizing the general ineffectiveness of these programs, in 1965 the Congress stepped up the scope of the Federal Water Pollution Control Act, a statute of long-standing but little force prior to the 1965 amendments. The amendments created a new agency, the Federal Water Pollution Control Administration, to implement a national program of water pollution control.
Control Administration (which would become part of the EPA in 1970). The most noteworthy (and most controversial) provisions of this act established a complicated means of establishing water-quality standards for interstate streams. The focus remained on point sources, but in the context of stream conditions rather than discharge-effluent conditions. The so-called “tributaries” provision allowed the Government to bring actions to abate any discharge “which reduces the quality of such waters below the water standards” even if the material causing the deterioration of water quality was discharged into a tributary of the waters subject to the standard. (Clarenbach, 1967).

In 1972 the Federal Water Pollution Control Act was amended to shift focus from stream water-quality standards to effluent standards, while retaining the focus upon point sources of pollution. There has been a recurring tension between the water-quality standards and effluent-standards approaches: “[w]idespread experience with the water quality standards in the 1960s supplied the empirical ammunition for the spread of the effluent standards in the 1970s that made the case for a partial reversion back to the water quality standards in the 1980s that substantiated again the need for unforgiving controls at the source in the 1990s.” (Rogers 1986a).

The state and federal pollution control programs dating from the Clean Air Act of 1970 and the 1972 amendments to the Federal Water Pollution Control Act were keyed to a regulated community that could come into compliance with applicable programs. That is, it was perceived the industries and municipalities subject to controls for industrial plants, power-generating facilities, or water-treatment plants, through exercise of government-finance powers or a capacity to pass costs through to the marketplace, could respond successfully to implementation of national environmental-protection programs. The problems to be addressed were readily discernible both as to sources and impacts of discharge. As a consequence there was a concurrent maturing of the regulated community and these programs to the present time.

Reliance by all parties on experts in administrative law practices before the regulating agencies, political lobbying in the areas of agency rulemaking and legislative initiatives, and technical program elements (e.g., expertise of environmental engineers, chemists, biologists, geologists, etc.) became commonplace and continues today. The problems tackled in the first stages of contemporary environmental regulation in the U.S. were serious, but also shared characteristics of relatively easy detection, capacity of a regulated community to respond to national initiatives (and even promote national standards as a means of balancing cost of compliance as between competitors in the same industry). Agriculture, however, was not involved to the same degree as the local governments and point-source industries in the early stages of these programs. Hence, policy makers now recognize that agriculture is, because of its different kind of experience base from working with voluntary programs from the traditional agricul-
tural agencies, not at the same point in ability to react and participate in development of command-and-control and other programs to address pollution-control issues associated with agricultural operations.

The pollution sources EPA and state counterpart agencies brought under the earlier air and water quality programs were industrial processes (e.g., manufacturing plants or municipal sewage-treatment facilities). Thus, technological containment or abatement of the pollution from the processes was considered either actually feasible or at least an attainable goal. Sources not as easily measured, detected, or as well understood from a technological perspective did not receive the same level of attention. For example, in the concentrated animal feeding industry certain categories of facilities were designated regulatable water pollution "point sources" in federal regulations issued by EPA in the early 1970s, but in practice the sites were more likely to be subject to general state guidelines without the force of law.

Realized nonpoint-source control costs, including agricultural storm drainage and irrigation return flows, have grown from $567 million in 1972 to a projected $893 million in 1995, for an increase of 57.5 percent. Relative to point-source expenditures, however the levels have remained low and are projected to be a lower percentage of point-source expenditure in 1995 than was the case in 1972, declining from 6.6 percent in 1972 to 1.9 percent in 1995. (Carlin, 1990).

In Texas, state authorities did not develop enforceable water-quality program regulations until 1987 in the area of concentrated animal facilities, although efforts to control pollution from feedlot sources had been underway for several years by that time. Moreover, as the vast majority of agricultural sites with concentrated animal feeding components were well below the threshold-size criterion for the EPA program, or were small enough to escape the concerns of state authorities promoting voluntary environmental-protection measures with guidelines, the industry enjoyed almost an exemption from the environmental programs. Also, one of the widely recognized pollution aspects of CAFOs, odor nuisance, was completely omitted from federal air pollution programs (presumably because of questions of enforceability because of difficulty of quantitative measurement, etc.), and is subject to great limitation in the Texas program, either through a right-to-farm law limiting the time in which nuisance actions can be brought against agricultural operations, or through application of the terms of the Texas Clean Air Act exempting from the jurisdictional definition of air pollution natural sources (which has exempted feedlots in some, but not all cases). See, State of Texas v. F/R Cattle Co., Inc., 828 S.W.2d 303 (1992, Ct. of App., Eleventh Dist., Eastland).

The attention that agriculture did receive in this period was keyed to its relationship with the chemical industry (e.g., pesticide use and handling), operations defined as "point sources" for purposes of the National Pollutant Discharge Elimination System (NPDES) program under the Federal Water Pollution Con-
trol Act amendments of 1972, and more traditional land and soil conservation programs, some of which dated back to the New Deal period. Agriculture received a measure of attention in regional planning undertaken in the Federal Water Pollution Control Act section 208 program in the 1970s, but the program was not of long duration and fell short of original expectations. A similar, but broader-based program under the same act, as amended in 1987, the section 319 program, funded more studies of agricultural pollution and again brought concerns in this area to the fore. The central objective has remained planning and program implementation through the states.

In 1985 and 1990 far greater emphases on pollution prevention and preservation of lands of environmental significance were made part of the Farm Bill (the Food Security Act of 1985 (FSA), and the Food, Agriculture, Conservation, and Trade Act of 1990 (FACTA)). These Farm Bill provisions encourage use of vegetative filter strips to help control farmland runoff (a possible pathway of manure wastes), denies some forms of USDA benefits to those farming designated former wetlands or highly erodible lands (the swampbuster and sodbuster provisions), and provide for water quality incentives and technical assistance. (See US General Accounting Office, GAO/RCED-90-162 and Center for Resource Economics, 1992).

To recap, industrial point sources were the focus of the basic environmental programs first implemented in the 1970s. These sources were considered the highest risk and at the same, were considered manageable. Industry participated fully in the program-development process and continues to maintain a significant presence today. This participation has spawned a sub-industry of experts in Administrative Law practice before the regulatory agencies, and technical experts in standard setting and regulatory economics. Industry has adapted to the regulatory programs and, more importantly, to the ongoing administrative processes affecting the programs. The principal stage is Washington, D.C. Most of the programs are cooperative federalism programs actually administered at the state level, but the federal authorities, mainly the EPA, have the role of setting national maximum standards. Especially at the height of the environmental movement, the industry players were quite wary of the prospect of programs varying in significant degree from state to state. Most federal pollution-control programs today are of the cooperative federalism variety, meaning that states may implement the basic programs, subject to federal oversight, if they adhere to maximum national standards set by the federal regulators.

Agriculture, on the other hand, has not been a full participant in this process, and is just beginning to realize the consequences of current initiatives to control pollution from livestock and other agricultural activities. Moreover, agriculture, acting through its closely aligned federal agency, the USDA, has generally fought uniform national standards and farm-by-farm regulation (preferring a status quo of state and local response to pollution-control issues). The
1972 amendments to the Federal Water Pollution Control Act gave EPA apparent authority to become very active in the regulation of agriculture through the 208 planning process and other means. Among EPA's first activities under the act was to develop effluent guidelines for feedlots. This program, years later considered to be quite reasonable, initially sent shock waves through the agricultural community. USDA took the initiative, however, and coordinated research efforts with EPA, acted to bring EPA together with agricultural interests, and averted fears that EPA would permit "every farm," impose uniform national standards, or force compliance actions without proper justification of need. The ensuing research led to a site-specific BMP program, recognition that BMPs have an economic impact on operations, and recognition that water-quality management at the farm level must be part of an overall program of production practices and water management. And, by the late 1970s the agency recognized that equating reduction of pollutant load with the costs of BMPs would be important over the long term (Murphy, 1979).

As shown in the accompanying figure, Water Quality Agency Structure, the structures of the USDA and EPA are quite distinguishable. In the water-quality area specifically, the USDA has a substantial effort directed through its local agencies. The EPA, on the other hand, operates ten regional offices and most local activity is run through state counterpart agencies, most of which function out of centralized offices.
D. Forces Contributing to Program Development

Faced with the emerging environmental policy political scene in the late 1960s, industry recognized a need for a national basis to the programs. It was felt that uniform standards would simplify the environmental management efforts of companies with multiple locations. Also, national lobbying organizations could monitor important developments, and competition located in states historically softer on pollution controls would be faced with costs similar to those incurred elsewhere in the same industry. Moreover, centralizing the source of regulation, it was felt, would enhance predictability of program development. Industry is accustomed to long-range economic planning and sought stability of regulatory standards, and predictability of future program development for economic purposes. Today there are generally national standards and the content of administrative rules, and even expected agency behavior, are generally well-known in industry. What is not as easy to ascertain at any moment is an assessment of rule finality in a political sense, which, again, was an early objective of industry.

In retrospect, industry may have second thoughts about the desirability of a strong national program, given the high costs and the difficulties the principal federal environmental agency, the EPA, has had in implementing its programs. As a percentage of Gross Domestic Product (GDP), the U.S. was well in front of European countries in pollution-control expenditures in 1985 (e.g., the U.S. spent 1.67 percent of GDP on pollution control; the United Kingdom spent 1.25 percent on the same). Water-quality expenditures in the U.S., for example, were (rounded off and in 1986 dollars) were $9.1 billion in 1972, rose to $34.4 billion in 1987, and are projected to be $57.5 billion in the year 2000. (Carlin, 1990).

The EPA has a staff of 18,000 and a $4.5 billion annual budget. Of course, at some point industry must develop and construct the technologies demanded in new regulations. Part of the difficulty, from industry's perspective, has been the evolution of the counterveiling political force of litigious environmental groups. The environmentalist lobby is currently operating on an annual budget of about $600 million, primarily through 20 major organizations that maintain a presence in Washington, D.C. (Brimelow and Spencer, 1992).

The EPA has fallen short of expectations from all sectors, becoming something of a pawn in a struggle between the Congress and Executive in the last decade. The agency has been made subject to "unrealistic deadlines," the courts have routinely rejected the agency's efforts to allow itself flexibility in implementation, and "the White House, OMB, and congressional appropriation committees have simultaneously resisted subsequent agency efforts to comply with strict judicial mandates." (Lazarus, 1991).

The original fears of industry regarding program inconsistency remain, and are seen at a very local level as well as more generally. Programs addressing technological and operations standards that may have location-specific differences to account for unique feature of the sites sometimes appear inconsistent to
the public. Dairy-operations regulation in Texas is beginning to appear that way to some. For illustration, the Lledroc Farm-West (an Erath County dairy permitted for more than 900 cows in 1992 and now operating) has an obligation to perform water-quality analyses on certain downstream, off-site impoundments, is not allowed to dispose of manure solids on the same approximately 180-acre tract containing the cow yards and milking parlor, must protect waste lagoon embankment walls with riprap, and must provide a two-foot clay liner under lagoons, a so-called “double liner.”

Some comparable dairies in the county (in terms of milking head numbers and operations design), have a one-foot liner under waste lagoons, no riprap requirement for the waste lagoons, no off-site water sampling requirements, and no special conditions regarding the location of manure disposal (other than as to the amount of acreage that must be maintained for the purpose). So, special conditions of the Lledroc site, notably the presence of nearby off-site reservoirs and residents living in the immediate area, caused the Commission to impose some variations from the norm in the conditions of its permit. Environmentalists have used the Lledroc example to posit that the present Texas Water Commission regulatory program is flawed, in that it is leading to some discrepancies between different permits, among other things.

E. Some Turning Points in Policy Development
Passage of the National Environmental Policy Act (NEPA) in 1969 is considered a milestone in the development of U.S. environmental policy. The act mandates environmental assessments and possible environmental-impact statements for major federal actions significantly affecting the environment. The consequence of these studies has been the development of data regarding environmental conditions in the U.S.; in the earlier years of NEPA implementation, the act was credited with forming the rationale for several later programs. The NEPA statement of purpose still bears relevance in contemporary policy considerations. This was “to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.” 42 U.S.C.A. section 4331(a).

Proposed NEPA language, which would have guaranteed as a fundamental right a healthful environment, and hence would have established a more substantive aspect to the statute, was ultimately drawn as the recognition that each person “should enjoy a healthful environment.” Id., (c). But the basic NEPA formula of detailed environmental studies as predicate for government action is now a fixture in many states' parallel programs and recurs in specialized programs, including some in agriculture. It is now so well-established a procedure in the federal government as to be almost second nature. NEPA's across-the-board application has not, however, led to agency consolidation in the environmental-policy arena.
Hence, the federal water programs can be broadly organized along the lines of agricultural programs versus industrial/municipal programs. This is in part a consequence of the committee structure of the Congress and parallel division of administrative responsibility between USDA and other agencies. Legally speaking, a distinction is drawn between nonpoint-source and point-source pollution, but some sources, such as CAFOs (e.g., feed lots) and ancillary waste-disposal areas have characteristics of both, depending upon management practices and how one defines point source and nonpoint source. A field fertilized with manure from a feed lot may be a nonpoint source, but the same waste material is from a point source at the lot itself. The terms have different meanings in different contexts and are at best difficult concepts. The Federal Water Pollution Control Act defines point source as “any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged.” (33 U.S.C.A. section 1362(14)).

The reason for the distinction, as suggested, may in part be a function of congressional committee “turf,” in that the point/nonpoint distinction most obviously draws a border between most land-farming activities and most industrial processes. This rationale considers jurisdictional allocation as a significant factor in the point/nonpoint dichotomy; generally this is the idea that “[p]oint sources are big problems requiring federal solutions. Nonpoint source are all the other problems that are best left to the states.” Other theories invoked to explain the distinction drawn in the statute consider analogues to trespass law (point sources are considered active contributors of polluting material to waters; non-point source are passive); controllability (effluent at the end of the pipe is easy to control); historic containment (sources recognized as containable historically were point sources); the tragedy of the commons (a certain measure of hopelessness accompanies nonpoint-source pollution); natural events (the typical nonpoint pollution is caused, at least in part, by natural events beyond human control); and culpability (as in the case of typical common law tort doctrines, point sources are those for which responsibility is easily demonstrable). None of these notions fully answer the policy question of why there should be a distinction between point and nonpoint source control under the law. (Rogers 1986d).

A major policy objective remains the notion that the “polluter pays” for the consequences of pollution and, in particular, for the cost of meeting regulatory conditions. These costs, public and private, may include capital expenditures and operating costs. EPA has estimated and projected that private sector costs were 61.2% of an annualized U.S. pollution control cost of $26.5 billion in 1972, but will be 60.0% of an annualized cost of $147.9 billion in 2000. (Carlin, 1990). The public costs, of course, are met by traditional government revenue stream sources, debt and taxation. Private sector costs must be met through present and
future business revenue streams, including, possibly, a portion of profit margins, debt, equity financing, tax credits, cash-flow service, etc. In general, industry in a position to pass costs through to the marketplace will do so. Some heavy polluting industries, however, have found this was not completely possible. (Compare Crosson, 1983). Agriculture has generally required assistance from government to respond to regulatory initiatives in this area, although the degree of assistance actually necessary is a subject of debate and differs depending on the commodities involved. Europeans have found the costs of agricultural pollution controls were being borne in part through government programs, as has been the case in the U.S. as well. (Manle, 1991, discussing European programs).

A. DESCRIPTION OF INSTITUTIONS
The agencies of greatest interest in the area of agricultural pollution control at this point in Texas include the Texas Water Commission, Texas Air Control Board, State Soil and Water Conservation Board, the several state River Authorities, the General Land Office, the U.S. Environmental Protection Agency, and the several sub-agencies of the U.S. Department of Agriculture, including the Soil Conservation Service and Agricultural Stabilization and Conservation Service. Permitting programs for CAFOs are administered by the Texas Water Commission and Texas Air Control Board. The programs are independent, although recent inter-agency agreements indicate an intent of the agencies to streamline inspections so that representatives of both agencies will attend inspections simultaneously if possible. In 1993 the two agencies will merge. Although it does not have a regulatory program at this time, the Texas State Soil and Water Conservation Board and its member Districts have statutory responsibility in the area of nonpoint pollution from agriculture. River Authorities are presently engaged in some research activities that will include nonpoint source pollution. These different programs and agencies, and their current activities are summarized below.

The Texas Water Commission assumed regulatory authority in the area of water pollution on September 1, 1985, assuming most of the function of the prior Texas Department of Water Resources. The statutory framework for its water quality program is codified in ch. 26 of the Water Code, which is patterned after the Federal Water Pollution Control Act in many respects. The Commission’s authority is quite broad: “Waste discharges or impending waste discharges covered by provisions of this chapter are subject reasonable rules or orders adopted or issued by the commission in the public interest. The commission has the powers and duties specifically prescribed by this chapter and all other powers necessary or convenient to carry out its responsibilities.” (Water Code section 26.011).

The State Soil and Water Conservation Board is “the state agency responsible for implementing the constitutional provisions and state laws relating to the conservation and protection of soil resources.” Ag. Code 201.001 (1991 Supp.).
In addition, the Board is directed that it "shall plan, implement, and manage programs and practices for abating agricultural and silvicultural nonpoint source pollution." Ag. Code 201.026 (1991 Supp.). The Board currently has an advisory role under several programs in such areas as pesticides (Ag. Code 76.009(g)), hazardous waste (Health and Safety Code 361.024(b)), uranium milling sites (H & S Code 401.111(b)), and surface mining (Nat. Res. Code 131.139(a)), among others. Its role in the area of nonpoint source pollution has been reaffirmed in recent enactments, the Clean Rivers Act (S.B. 818, 72nd Session), and the consolidation of the Air Control Board and Water Commission (S.B. 2, 72nd Session). A study of 136 Clean Water Act section 208 "Areawide Water Treatment Management Plans" by Beck showed that the most common choice of implementing agency for water pollution issues involving agriculture are soil conservation districts. The studied plans did not call for regulatory programs typically, but for an expansion of voluntary efforts. (Beck, 1985).

A bill which passed the State Senate in the 72nd Legislature, but which was not finally passed by the House, S.B. 35 (72nd, not enacted) would have carved out an active role for the Board in a permitting program for agricultural sources. Working in cooperation with a new state agency which that bill would have created, the Board would have had authority to 1) issue, renew or amend uncontested permits; 2) propose and review rules and environmental quality standards relating to agricultural pollution; 3) resolve complaints against operators, subject to review by an Executive agency; and 4) serve as lead agency in consultations with federal agencies for all agricultural pollution programs. It is expected that the Board will have a role in addressing agricultural pollution in the future, whether through that type of program or some other.

Those that favor implementation of environmental programs through "traditional program channels" argue that the programs will be responsive to farmers' constraints. (Batie, Shabman and Kramer, 1986). Some argue that in an application of that type the districts should be drawn along watershed boundaries, and that the districts should have land-use regulation authorities. (Davidson, 1989). The State Soil and Water Conservation Board's local District's have authority (following petition of 50 district landowners) to adopt possible local land-use control measures in narrowly defined areas. These controls would be limited to directives in the areas of erosion-control engineering (e.g., terracing), cultivation methods (e.g., contour cultivation), cropping programs, and retirement of highly erodible lands. (Agriculture Code section 201.121).

The several Texas River Authorities have a role established in the 72nd Session of the Legislature in S.B. 818, the Texas Clean Rivers Act, amending Chapter 26 of the Texas Water Code. The act directs the Texas Water Commission and the River Authorities in Texas to conduct certain information gathering related to water quality and water quality management. The data collected
pursuant to this act will be compiled for reports to the Governor, Lieutenant Governor, and Speaker of the House of Representatives prior to December of each even numbered year (in advance of sessions of the Legislature). River Authorities report before October of each even numbered year to the Governor and others. (Water Code Sec 26.0135 (d)(West 1992 Supp.). The activities under the act are paid for by assessments against "all users of water and wastewater permit holders in the watershed according to the records of the commission generally in proportion to their right, through permit or contract, to use water from and discharge wastewater in the watershed." (Water Code section 26.0135(h) (West, 1992 Supp.)).

The act requires the TWC to complete regional water quality assessments by watershed/river basin taking account of policy and scientific findings. Thus, these assessments "include a review of wastewater discharges, nonpoint source pollution, nutrient loading, education and involvement in water quality issues, local and regional pollution prevention efforts, and other factors that affect water quality within the watershed". (Sec. 26.0135 (a).) River Authorities are to "assist in the coordination and development of assessments and reports" through "organizing and leading a steering committee which includes representatives of all appropriate state agencies, political subdivisions, and other governmental bodies" that may have an interest in the river basin. (Sec. 26.0135 (b)).

A draft proposal for a memorandum of understanding between the Brazos River Authority and the Texas Water Commission would have provided for the BRA to conduct agricultural compliance inspections of dairies in Erath and Comanche counties. The program would have been part of the overall Clean River Act program, and probably would have been funded through fees generated under the overall program. This proposal has been set aside by the agencies pending consideration of other alternatives by the State Legislature in the 73rd Session. (BRA, 1992).

The State Attorney General’s Office backed a proposal before the 72nd Session of the State Legislature that would have removed a measure of enforcement discretion from the state agencies (the Water Commission, Department of Health, and Air Control Board) and, essentially, left significant enforcement powers in the AG’s Office. These included the right to compromise matters, with corresponding administrative orders to be issued by the agencies. The same proposed act would have expanded criminal liability to the "discharge ... of any pollutant into any water ... unless the waste or pollutant is discharged in strict compliance with all required permits or with a valid and currently effective order issued or rule adopted by the appropriate regulatory agency." The measure did not pass, but reflects the ongoing deliberation over the proper institutional structure of Texas environmental protection agencies. (S.B. 827, 72nd Legislature, not enacted).

The USDA is today the U.S. Government’s third largest agency, expend-
ing $46 billion in fiscal 1990, and employing approximately 110,000 personnel directly and 17,000 through county Agricultural Stabilization and Conservation Service (ASCS) offices. Most work outside of Washington, D.C. in field offices. The wide distribution of employees and offices is considered a direct link between the Department and farmers and ranchers. Recent efforts to reduce the number of field offices and to consolidate some of the several sub-agencies have been met with resistance. (U.S. General Accounting Office, GAO/RCED-91-168).

There are many types of regulatory programs but most fall within a common framework. Often programs can be described with a “carrot” or “stick” metaphor, suggesting the image of a recalcitrant donkey being tempted with a carrot or beaten with a stick. The main types are: 1) voluntary without economic incentives; 2) voluntary with economic incentives such as tax credits or subsidies; and, 3) mandatory with either positive (e.g., tax deduction, subsidies) or negative (e.g., fines, financial responsibility rules) incentives. (van Es and Keasler, 1979). The latter—the “stick” type—are traditionally known as “command-and-control” programs, and until recently have been the mainstay of the U.S. EPA. The former, largely voluntary programs, are more typical of USDA agencies and state counterparts.

B. INTERPLAY OF VOLUNTARY AND REGULATORY PROGRAMS: AN EXAMPLE FROM OUTSIDE OF TEXAS

An example of the interplay of these approaches is the regulation of dairies in Washington following institutional studies under the Federal Water Pollution Control Act section 208 program in the 1970s, and that program’s recent revision. The 208 studies, initially in the dairying region north of Seattle in the Snohomish River Valley, began with an institutional inventory using public workshops involving the public at large and the dairy farming community.

Field studies confirmed that water quality problems in the river basin (Snohomish Basin) were localized, not severe, but large in total amounts of contaminants entering the stream system. Three large dairies in the basin were under NPDES permit at the start of the 208 project. Farmers correctly felt that only a few sites were causing most of the problems. Farmers distrusted the state agencies, particularly the Department of Ecology, because of its sporadic bouts with zealous enforcement and a perceived lack of farm knowledge. Lastly, the local conservation districts did not want a regulatory role. Other agricultural agencies, the SCS and Extension Service, were not interested in or able to undertake regulatory roles either.

An Ag Working Committee, consisting of staff from SCS, Extension Service, Agricultural Stabilization and Conservation Service (ASCS), farmers, and URS Company (contractor on the 208) evolved from a review role to a developmental role for the institutional component of the study. The group
considered all inputs from farmers. Mandatory BMPs were rejected, but a totally voluntary program was known to be unacceptable to EPA. Thus, a third approach, featuring voluntary programs backed up by a regulatory mechanism was recommended.

The regulatory backup was considered necessary in any event because participants noted the persistence of "problem farms" that were not likely to be led into compliance through a voluntary program. The two conservation districts with jurisdiction in the basin were designated as lead agencies, with authority to pursue the program objectives of 1) education and technical assistance, 2) financing and funding, 3) incentives, and 4) monitoring and enforcement.

The state changed its water quality standards to establish that compliance with BMPs would be sufficient for meeting water quality standards. BMPs were not well understood at the time, and by doing this the State avoided the threat of enforcement against operators in compliance with the operations criteria established while study of BMP effectiveness was evaluated, thus averting an awkward enforcement program. This overall approach, the involvement of conservation districts, followed by potential enforcement from the state regulatory authority, was adopted for the entire State of Washington. (Rice, 1979).

Recently, Washington fortified its program of regulation over CAFOs by adding a new permit requirement. However, it is expected that most sites with plans meeting SCS technical specifications in place will be exempt from the requirement. This is part of Washington's delegation under the Federal Water Pollution Control Act and is subject to EPA approval. The new regulatory unit has a small operating staff and does not anticipate significant problems. (Velthuzien, 1992). Thus, a relatively mature program (in place since the 1970s) has nearly met its objectives through voluntary efforts with an enforcement program possible; the enforcement program is now being implemented and is expected to be successful with a very small staff for a state with over 1000 dairies. Although at a state level, the overall program resembles a merger of USDA-style programs and EPA-style programs.

C. Cooperation of Federal Agencies

EPA and USDA are cooperating in development of new environmental programs for agriculture, according to a 1992 draft agreement, and may develop additional alternatives to the command-and-control method. EPA and USDA have employed cooperative arrangements in the past. (See, e.g., 7 CFR 650.7 regarding the cooperation of USDA and EPA on National Environmental Policy Act issues).
The strengths of existing Texas programs of regulation directed to control of pollution from CAFOs are that, in terms of process protections, the hearings practices and complaint response practices of the agencies are affording citizens and operators ample opportunity for communication with the agencies. These communications help the programs mature and become more effective over time. In addition, the permitting process is well suited for development of site-specific technical records. The participation in the overall process has led some to pursue changes in the regulations. Therefore, the hearings process has furthered some possible improvements in the overall program. The USDA programs, including an ongoing SCS effort in Erath County to assist some dairy operators with technical waste system designs and the ASCS cost share programs, seem to foster good relations between the regulated community and government.

The state programs are strongly influenced by the corresponding federal efforts to abate pollution. As noted, the Texas Water Commission’s basic water quality legislation is patterned after the Federal Water Pollution Control Act, as amended. Of course, the most significant design criterion for waste handling on concentrated animal feeding facilities—the 24-hour, 25-year storm event containment criterion, has origin in the federal program. Many perceive this as a strength of the existing program, particularly those now supporting national standards.

The enforcement experience, now built up in the agriculture area, but including other program elements for many years, is a key strength of the command-and-control agencies, the Water Commission, Air Control Board, and EPA. The field experience with agriculture and the network of contacts through local county offices are key strengths of the USDA agencies and the State Soil and Water Conservation Board and its Districts. The River Authorities in Texas has strong local contacts as well, although the background with regard to agriculture is not nearly as well developed as is the case with the agriculture agencies.

The EPA and other implementing agencies are adjusting the present environmental programs to assume an increased posture in the agricultural sector. This is exhibited by revision of the NPDES program for CAFOs in EPA’s Region 6 states of Texas, Oklahoma, New Mexico and Louisiana. (57 Fed.Reg. 32475). Improved functioning of existing programs can also be achieved through changes in implementation strategy. Often, the programs have built-in tracks that can allow a measure of flexibility in implementation without major rulemaking or legislative action. For example, the Texas Water Commission regulations now includes an alternative dispute resolution mechanism, highlighted by the policy pronouncement that the Commission “encourage[s] the resolution and early settlement of all contested matters through voluntary settlement precessures. It is the affirmative responsibility of each commission employee to effectuate this policy.” (31 TAC 264.1 (West, 1992 Supp.)). The dispute resolution alternative mechanism does not apply to enforcement actions (section 264.3), which remain
subject to a more formal evidentiary hearings process. In the case of permit applications informal procedures may be undertaken at any time after the application is complete. (section 264.7(a)). A more formal procedure applies to permit proceedings only after the executive director has determined whether or not a draft permit should issue. (section 264.7(b). This alternative dispute resolution aspect of the program has the potential of alleviating some of the burden of the permitting process, which can be expensive for protesters and applicants alike.

Notwithstanding the potential of improvement through the existing programs, however, the distinguishing features of nonpoint and point source pollution suggest that the present programs are not a perfect fit for the redress of agricultural pollution. Nonpoint pollution is difficult to quantify, monitor, control precisely, and, if addressed through command-and-control regulations, difficult to make subject to systematic enforcement. Inspecting all sources would require an “army of enforcers” that society is not likely to tolerate. (Rogers, 1986c).

It is anticipated also that, particularly given the government’s ongoing role in support of agriculture through market intervention activities, subsidization, and educational and technological assistance, financial support will become necessary as the regulatory programs reach further into the agriculture sector. At this time, for example, the brunt of compliance costs have been borne by larger “industrial sized” dairies and other CAFOs.

A. SOME OPERATIONS ARE NOT REGULATED CLOSELY, DUE TO SIZE LIMITS ON THOSE NEEDING PERMITS

The Texas system, that is, the Water Commission and Air Control Board programs for pollution controls at concentrated animal feeding facilities, by design leaves out a substantial number of operations. As indicated previously, the Water Commission program omits dairy sites with fewer than 250 milking head from site-specific permitting (although all sites must meet a no discharge standard through permit-by-rule), and the Air Control Board only addresses those sites over the size of 1000 head. This distinction reflects both an assessment, generally, of relative risk of pollution (larger sites are a greater risk), and agency resource allocation. There are probably far too many facilities for a classical command-and-control program embracing all, if the program is to be administered at present staffing levels. An enormous staff would be required to monitor just the 2,000 dairies in Texas, to say nothing of the swine, poultry, and beef feeding industries, among others.

B. AGRICULTURE AND CITIZENS INTERESTED IN REGULATION OF AGRICULTURE MUST ADJUST TO THE ADMINISTRATIVE PROCESS IN THIS FIELD

Regulatory development (the process of proposing draft regulations and later rulemaking) has become a battleground. In early 1992 the Texas Water Commission circulated draft rule proposals for the regulation of CAFOs. The draft rules,
as the existing program regulations, addressed multiple livestock species. Hence the draft proposal was of interest to several different livestock groups, and a broad base of environmental groups and the general citizenry. Commentary from interested groups and individuals indicated some disagreement as to the best shape of future programs and whether new regulations, or new enforcement strategies (either under the current regulations or new ones) would be most desirable.

One downside of the rather prolonged consideration of the draft proposal has been a rush on the part of the regulated community to apply for new or amended permits under the current program. Representatives of the Cross Timbers Concerned Citizens group have indicated that this development in 1992 stretched their financial resources for planned protesting of permits (one focus of the group's protests has been its objections to the current regulations). Thus, an unintended consequence of the uncertainty of the Commission's program has been an increase in permitting activity, particularly in the area of permit amendments, with a corresponding decline in full process participation by all affected parties.

The relationships agriculture enjoys with the USDA agencies, which have farm-level contact through several agencies, is going to continue to be a factor. But regulatory development activities will not likely come from that sector. The USDA has resisted assumption of a regulatory role in waste management. It prefers the traditional educational, technical assistance, and financial assistance role developed in the soil conservation context. It has a large staff, but directing this staff to an enforcement role would be difficult in this context. (Other USDA agencies, such as the U.S. Forest Service, have a role that is more akin to traditional command-and-control regulation, but the personnel involved are different than any that would likely become involved in animal-waste management. The Forest Service's regulatory program concerns management of public lands, not private lands.)

C. The Cost of Coming into Compliance Is High, and Is Not Recoverable from the Marketplace
Developing a waste management system, whether for permitting or filing a plan with the Texas Water Commission, can be an expensive endeavor for agriculture. Participating in the ongoing process of regulatory development, legislative action, or even becoming involved in local hearings can be burdensome for the small dairyman. For all participants the hearings process is considered somewhat unpredictable—the process can yield apparently contradictory results and become quite protracted. For illustration, the Lledroc Farm-West was awarded a permit in early 1992 after first filing an application in mid 1990. The matter was the subject of seven separate hearings in Stephenville and two sessions before the Texas Water Commission. Lledroc is now operating, but its permit process is
held out as an illustration by environmentalists and the dairy industry alike as an example of how arduous the process can be.

The capacity of a regulated community to implement environmental policy, of course, is a function of the cost of implementation and the ability and willingness of the parties in that community to meet the cost. Industries that behave as highly competitive “price takers” may find participation reduces profit margin, or reduces the availability of capitalization for other purposes. A common argument raised by agricultural producers from all sectors is that the producers, as price takers, are unable to pass the costs of environmental controls on to consumers of agricultural products. (See, Davidson, 1989).

This argument has widespread appeal in the agricultural community. To agriculture the question is simple—producers do not have the capacity to change prices for agricultural commodities. That is, producers, whether operating in the highly regulated or unregulated commodity sectors, perceive the market place as having competitive characteristics on the micro level. For example, 200,000 farms in the U.S. produce dairy products in a highly regulated market. However, the individual dairy operators do not have the power to recover pollution control costs from the market any more so than producers of the least regulated commodities, such as beef, swine, and poultry. (Compare Meier, 1985).

The ASCS has indicated that a good portion of available cost share funds are not utilized for waste management systems at this time. Moreover, those sites using the funds may not be the sites in greatest need of improvement on the basis of risk, but may simply reflect the determination of the owners to achieve compliance. The fact that some monies are being unused suggests that for some facilities the level of support available (in terms of percentage, total amount, or both) may be perceived as inadequate.

This state of affairs has led to suggestions that the traditional agricultural agencies engage in programs mixing voluntary and incentive aspects, or that local institutions similar to special water districts (these may include districts handling distribution of irrigation water in the Southwest or drainage in the upper Midwest) undertake the task of solving agricultural pollution problems. The localized institutional response would be more popular politically, would spread costs through the district, and would utilize the districts’ corporate financial ability (bonding against general revenues, increasing taxing, obtaining government monies from other agencies). (Davidson, 1989). The local voluntary approach, using soil conservation districts for implementation, proved most popular in the programs to abate agricultural pollution established as part of the Federal Water Pollution Control Act section 208 planning at the state level. (Beck, 1985).

It is widely recognized that voluntary programs aimed at getting agricultural operations to adopt BMPs can have an impact, but there are both supporters and detractors of the practice. Davidson asserts “[t]here is little, if any, precedent
in our experience of government to suggest that the problem of erosion and nonpoint pollution can be solved by asking landowners to regulate themselves," (Davidson 1989), making the point that the implementation history of soil conservation practices in agriculture has been largely shaped by the availability of support funding. Of course, the fact that cost share is an important factor in gaining compliance can be argued the other way, namely that without the funding support most operations in the industry can not tolerate the cost of pollution protection. Thus, the behavior history from ASCS’s experience with dairy waste systems in Texas (not all available funds applied for or used), and long-standing experiences with soil conservation throughout the nation, may indicate a tenuous capacity of agriculture to meet the costs of new environmental programs.

Cost-share levels have been surprisingly high in some instances, also suggesting to some close followers of the manure regulation scene around the nation that adjustments are politically achievable (and perhaps, therefore, some operators may be waiting for adjustments to the programs before going forward). To date, the variation is probably for the most part associated with risk factors; higher risk locations are more likely to get the larger share of cost share, although that is not to say that all cost share allocations are risk based. A 100-cow Maryland dairy is to receive the equivalent of an 87.5 percent cost share to implement BMPs, including construction of a bridge across a water way and other waste containment structures. The site is upstream of recreational reservoirs surrounded by residential housing. The state has coordinated the cost share that includes PL-566 funds from the SCS, and funds from various other federal and state sources. (EPA 1992).

The regulation of odor from CAFOs remains a daunting task and probably must be brought into control before the water quality programs can fully mature. Many persons complaining to water quality agencies about dairying practices have odor complaints as well. The Texas Water Commission and Texas Air Control Board are initiating joint inspections of facilities. The two agencies, of course, will merge in 1993. One problem with odor control is that large-scale programs to address odor will require technological advances in detection and measurement not now fully developed, and perhaps will require management practices that will add to expense of operating concentrated animal feeding operations. The control technologies known now include manure treatments (e.g., bioremediation), gas capture, soil treatments, such as incorporation of wastes in soils, and dispersion (e.g., siting far enough away from neighbors to avoid conflict). (Sweeten, 1988).

The Missouri Division of Natural Resources actually discontinued enforcement of odor control regulations because of the high cost and its inability to develop definitive rules. Recently a Missouri private nuisance action, in which neighbors sought an injunction and money damages against a large hog operation, led to a ruling favoring the defendant on the injunction issue, and a jury verdict favoring
the defendant on damages claims. The court had rejected claims that the action was barred by Missouri's right to farm law. The most convincing evidence, in the view of the defendants' counsel, was expert and lay testimony that the operation was in compliance with all rules and regulations and was carefully operated, using state-of-art technology. (Wheeler, 1992).

Zoning has been the traditional means of minimizing neighbor conflict due to odors. To some degree odors are considered an inevitable consequence of concentrated animal feeding operations. Some states have established agricultural areas, the consequence of which is neighbor complaints similar to nuisance actions in character which are resolved through an informal administrative process. See, Iowa Code Ann. section 176B.1-13 (1990). Many states, including Texas, have enacted right-to-farm laws, designed generally to protect land owners against nuisance actions if there have been no changes in conditions for some period (typically one year), and if other conditions are satisfied. In practice these laws have not proven effective. (See Wheeler, 1992 and Oppedal, 1988). Texas municipalities may enact zoning ordinances to locate odor-causing facilities in certain areas, but counties (with minor exception) do not have that authority. (See, generally, the Texas Local Government Code).

Odor-control policies, in effect, can have similar results to land-use planning objectives. These are, thus, similar to the traditional role of local government and may meet political resistance when directed from the state or national level. With limited county powers in Texas, however, it is expected that the state presence in the field will continue. See State of Texas v. F/R Cattle Co., Inc., 828 S.W.2d 303 (1992, Ct. of App., Eleventh Dist., Eastland).
THE DAIRY PRODUCTION SECTOR IN TRANSITION

Complex changes are in progress in the dairy industry. Growth trends in dairy production have historical roots and multiple causes. Structural changes in the dairy industry have regional aspects and have influenced producers' choices among dairy technologies. The purpose of this section is to describe and analyze the transition in dairy production and then to outline environmental policy issues likely to make a difference in dairy production and dairy policy.

GROWTH TRENDS IN THE DAIRY INDUSTRY

Increasingly, during the past 58 years, fewer cows on fewer dairies have produced more milk. When the United States Department of Agriculture (USDA) started its agricultural statistical reporting in 1934, approximately 4.5 million U.S. farms milked approximately 24.5 million dairy cows (on average, 5.4 cows per farm). Average annual milk production in 1934 was 40.3 hundredweight per cow per year (CWT/cow/year). In 1987, 202,068 dairies and approximately 10.3 million cows supplied the nation's milk (an average dairy milked 51 cows). Average annual milk production in 1987 was 138.02 CWT/cow/year. In 1990, average annual milk production was 140.6 CWT/cow/year. In the three years from 1987 to 1990, the dairy industry achieved production gains that matched those of the eleven-year period of 1934-1945 (U.S. Commerce Department: USDA).

Since 1965, the annual increase in output per cow has been relatively constant, at 1.5 percent to 2.0 percent per year; simultaneously, milk consumption per capita had grown less rapidly than output per cow (Office of Technology Assessment - OTA). Consumer demand for milk is inelastic: even when dairy producers have more milk to sell and milk prices fall, there is little change in the amount of milk that consumers are willing to buy. From 1965 to 1989, annual milk production increased from approximately 125 billion tons to approximately 145 billion tons, despite a dramatic reduction in milk production capacity. Nationwide, cow numbers dropped from approximately 15 million in 1965 to 10.1 million in 1989 (OTA).

Observed trends toward fewer dairy farms, higher annual milk production per cow, and increases in the average numbers of cows per dairy have several causes:

- technological change
- costs of production
- economies of size
- economies of scale
- management.

TECHNOLOGICAL CHANGE

Producers' adoption of new technologies has been essential to the transition in dairy production. On-farm technological progress and, accordingly, higher milk production have had several effects on dairy output and productivity.
production has been achieved through dairy producers' adoption of artificial insemination and related breeding innovations, improvements in animal nutrition and forage testing, participation in Dairy Herd Improvement Association (DHIA) record-keeping, experimentation with automated feeding equipment and three-times-a-day milking, and improvements in dairy housing.

**Costs of Production**

Empirical studies (OTA, Holt, Pagano and Holt, Matulich) show that as dairy-farm size (number of cows milked) increases, the per-unit cost of producing milk falls. An OTA comparison (1991) of milk production cost figures across regions for 1985 showed the highest costs for small herds in Minnesota, Pennsylvania and New York (as high as $18/CWT), dropping to $13/CWT for 600-cow herds in California and Arizona, leveling to approximately $12/CWT for 1000- to 1400-cow herds in California and New Mexico.

Similar patterns in per-unit cost figures were observed in detailed data on costs and returns for 16 representative dairies in eight states (Holt) collected as a basis for economic analysis of policy options considered for the 1990 farm bill by Texas A&M's Agricultural and Food Policy Center (AFPC). In many states models of representative dairies were built for both moderate and large dairies. This data set captures significant differences in the dairies producing milk across the U.S. In all cases, the assets-per-cow and the debt-per-cow are lower for a larger representative dairy than for a smaller representative dairy operating in the same location. Across regions, a significant contributor to differences in dairy investment costs is land prices. Simulations conducted using this data and the FLIPSIM model (a farm-level policy simulator) show a greater number of representative large dairies than small dairies likely to gain equity and survive over time (Richardson, Schwart).

In June 1992, in conjunction with a collaborative research project between the Institute and Texas A&M, a methodology modeled after AFPC panel data collection techniques was used to compile detailed data on representative small, medium, and large dairies (as defined above) in Erath County (Pagano and Holt). These data corroborate the statistics from other regions. In Erath County, a representative large dairy has lower per-unit costs of producing milk than a representative small or medium-sized dairy.

The type of dairy production system in place plays a role in determining the share of production costs for feed, housing, and labor. Purchased feed is the major variable expense for dairies in the South and West, accounting for approximately 50 percent of total production costs (OTA, Pagano and Holt). In contrast, for the average U.S. dairy in 1980, feed costs accounted for only 38 percent of total production costs (Knutson). Feed costs constitute a small share of production costs on dairies where grain, hay, and silage are produced on the farm. Dairy- housing expenditures make a difference in comparative production costs. Texas dairy operators using dry-lot systems spend 30 percent less on housing than the national average (Knutson). As an indication of differences in housing investments, a representative Vermont 65-cow dairy has assets of $10,040 per
cow; a representative 720-cow dairy in Erath County has assets of $2098 per cow. Labor costs differ as a share of costs of production; in the Upper Midwest and Northeast, milk production is typically a family business with no hired labor; in the South and the West, wages constitute a large share of production costs. A representative 1000-cow dairy in Erath County hires 18 laborers (Pagano and Holt).

**Economies of Size and Scale**

It is possible to draw inferences concerning economies of size based on cost-of-production data; however, to estimate short- and long-run cost curves and to analyze economies of scale (technological efficiencies that account for differences in economic performance across dairies) requires technology-specific data more detailed than regional averages used to report costs of production. Matulich (1978) developed long-run average cost curves for California dairies (including milking, housing, and feeding technologies but not waste management). His analysis showed substantially lower milk production costs per cow as herd size increased from 375 to more than 450 cows, and more gradual economies of size as dairies grew to 1200-cow herds. Matulich attributed lower average costs of production to the combined effects of economies of size (efficiency attributed to optimal herd size) and economies of scale (the extent to which technologies function at optimal cost-efficiency).

For larger California dairy herds (up to 3600 cows) Matulich documented neither cost advantages below the per-unit costs for a 1200-cow herd, nor any higher per-unit costs as herd size increased. Economic theory postulates a U-shape for long-run average cost curves. To date no empirical research on costs of dairy production or on economies of size or scale has documented a case where the per-unit costs of milk production increase as herd size increases. Contrary to economic theory, available economic analyses (OTA, Holt, Pagano and Holt, Matulich) suggest an L-shaped rather than a U-shaped long-run average cost curve associated with dairy production, as shown above. If future environmental policies force dairies to internalize a larger share of the costs of externalities from dairy production (air and water pollution), then the shape of long-run dairy cost curves is likely to change.

Several caveats apply, however, to the notion that large dairies are more successful than small dairies. Dairies with land and equipment paid for may produce milk at a lower cost than larger, more technically sophisticated dairies that are highly leveraged. Asset fixity makes a difference. Among 16 representa-
tive farms in eight states, large dairies reported lower debt per cow and fewer assets per cow than for smaller dairies (Holt). Nonetheless, in every region there exist small-scale dairies with relatively low liabilities that yield acceptable rates of return without investments in technological innovations geared to achieve economies of size or scale.

**MANAGEMENT**

Good management is the key to successful technological innovation and, therefore, to sustained productivity and competitiveness in milk production. According to Novakovic and Baker (1992),

better managers can and do exist on small farms and not all large farms are well managed; nonetheless, well-managed farms are likely to grow in size and as they do owners can begin to hire labor, preserve more of their time for management, and afford to hire more specialized skills to assist them in the management function.

Good management is necessary, but not sufficient, for growth. Dairies trying to grow may be constrained by the availability of investment capital, rather than by management capacity. Whatever the size or scale of the production technology in place, good management is essential to cost-efficient milk production. Over the past decades, as the number of dairy farms and of milk cows has dropped, the value of good management has increased among the dairies remaining in production.

Milk is produced in every state in the contiguous U.S. There is significant heterogeneity in regional dairy production and across producers even within the same region, related to differences in production systems in place and evolving technological innovation, and to differences in responsiveness to dairy policies.

Milk output per cow varies significantly across regions (OTA). These differences are reflected in aggregate milk production figures. The national average annual production was 142.4 CWT/cow in 1989. Highest average production levels were registered in the Pacific region (California and Washington) at 175.27 CWT/cow in 1989, and in the Mountain region (including Arizona) at 161.34 CWT/cow. The Southern Plains region (Texas and Oklahoma) ranked third in 1989 with average annual production of 131.17 CWT/cow. In 1991, the average annual production on a representative 1000-cow Erath County, Texas, dairy was 188.6 CWT/cow (Pagano and Holt).

Differences in milk production per cow are an important explanation for regional shifts in dairy production. From 1980 to 1989 overall milk production increased 12.3 percent. Contributions from the Pacific, Mountain, and Southern Plains regions increased by 40.9 percent, 40 percent, and 34.8 percent, respectively. Contributions from the traditional dairy regions (the Northeast and the Upper Midwest) grew at a rate lower than the national average (see table on following page).

Weather and climate have an important impact on differences in milk
output per cow. California has "nearly ideal weather conditions for milk production. Low rainfall, low humidity and warm temperatures are associated with: 1) less investment in facilities and equipment, 2) fewer herd health problems, 3) less energy expense for maintenance of animal body temperature, and 4) less labor for herd care" (Knutson). To the extent that these weather and climate conditions are met, milk production per cow increases, particularly under large-scale dairy production systems. The leading U.S. dairy producing counties are shown in the map following this section.

Changes in the Structure of the Dairy Production Sector

Emerging technological innovations in dairy housing, nutrition, and waste-management offer both economies of scale and of size, particularly for dairy production in warm, semi-arid regions. As a result, during the past decade a "dichotomous production structure" (Knutson) has emerged:

- **Traditional dairy farmers** grow most of their own forage and protein-grains. They farm more acreage than they need for waste disposal.

- **Specialized dry-lot milk producers** grow crops only as a by-product of waste disposal, and specialize in milk production. They tend to be large-scale operations with high milk output per cow, relative to their smaller dairy neighbors.

Structural change toward a two-type producer structure is not strictly a regional phenomenon. Specialized dry-lot milk production systems exist in virtually every state. The number of large-scale dairies is growing. Nationwide, the number of dairies with more than 500 cows almost doubled between 1974 and 1987, growing from 661 to 1268 (Census of Agriculture).

Dairy industry analysts note that "specialized dairies tend to develop in clusters. This clustering seems to happen because of the simultaneous development of an infrastructure of input industries around a group of specialized dairies" (Knutson, 77). When these clusters develop, in the short run there can be shifts in the balance of milk supplies and in relative costs (and profit margins) intra-regionally, and inter-regionally.

Federal milk marketing orders, federal and regional pricing policies, and dairy cooperatives together constitute a complex system, in place and evolving since the 1930's. The objective of this system as a whole is to address and promote market stability, efficiency, and equity and to address imbalances in prices and markets over time, including those caused by shifts in comparative advantage because of changes in consumer demand for dairy products, changes in transportation and production costs, and technological innovation (Babb). During adjustment periods, federal and regional dairy policies have been criticized for magnifying price effects and temporary inequities from shifting comparative advantage. Despite significant scrutiny, overall evaluations of the performance of institutions and policies to regulate dairy produc-
tion and marketing have been positive. Federal dairy policy trends for the 1990's suggest low probabilities that national dairy support prices will increase, which enhances the importance of regional comparative advantages in production. "With reduced prospects for increasing the size of the pie, interest will then turn to dividing the pie" (Babb, 2). In the coming decade, environmental-policy considerations are increasingly likely to make a difference in regional competitiveness issues.
Trends and changes in the Texas dairy industry, and in particular in Erath County and the surrounding Cross Timbers region, is a microcosm illustrative of the transition in dairy production taking place nationwide.

The diversity of dairy operations in Texas is considerable. The phenomenon of a dichotomous producer sector is not new to Texas. In 1974, 98 percent of the dairies in El Paso County had more than 100 cows; in Hopkins County, then the leading milk-producing county in Texas, only 53 percent of dairies had more than 100 cows (Texas Agricultural Statistics).

In 1991, Erath County milk production outpaced output from dairies in Hopkins County because of growth in the dairy industry in Erath County and in the surrounding Cross Timbers region. Among the top Texas dairy producing counties (see Table and Map), El Paso County is dominated by large dry-lot operations; Hopkins, Johnson, Archer, and Wood counties are dominated by traditional dairy farms (less than 200 cows). Erath and Comanche counties are characterized by a mixed dairy-production sector: both large-scale dry-lot milk production, and smaller, traditional dairy farms.

A MICROCOSM OF THE TRANSITION IN DAIRYING: ERATH COUNTY

Growth in the Erath County and Cross Timbers dairy sector has been dramatic and recent. In 1969, Erath County dairies produced approximately 131.4 million pounds of milk from 13,800 cows (Texas Agricultural Statistics Service). In 1992, Erath County’s milk production will exceed a billion tons from approximately 70,000 cows (estimated from Texas Milk Marketing Report monthly figures for 1992). The purpose of the following section is to describe the
dairy industry in Erath County and its role in the region’s economic base.

THE ECONOMIC BASE OF THE CROSS TIMBERS REGION
Erath County and surrounding counties are characterized by economic diversity and vitality. Statistics published by the Texas State Comptroller ranked Erath County fifth in economic growth among 205 rural Texas counties from 1985 to 1990 (Stephenville Chamber of Commerce). The ranking is based on an index that reflects the number of jobs created, percentage change in employment, and percentage change in growth sales. During this period, gross sales increased 28.1 percent, and employment in the county increased by 23.3 percent, with 1864 jobs created. Erath County's 4.3 percent unemployment rate is less than Texas and national averages. Population in Erath almost doubled between 1960 and 1990, from 16,236 to 28,300. The population of the five-county Cross Timbers region (Erath, Bosque, Hill, Comanche, and Hamilton counties) was 68,761 in 1990, a 24-percent increase since 1960.

Agriculture plays a major role in the economic base for Erath and neighboring counties. Agricultural sales in Erath County totaled $190 million in 1990, with milk sales accounting for $140 million. In 1991, milk sales were approximately $144 million. A statue of a Holstein on Stephenville’s downtown square symbolizes the economic influence of milk sales on Erath County. When erected in 1972, “Moola” represented $10 million in annual milk sales. Other agricultural activities important to the Erath County economy include beef cattle production ($23 million in 1991), peanut production (8000 acres worth $5.6 million in 1991), and other crop production ($14 million in 1991).

Erath County has developed a strong manufacturing base, separate from the agricultural sector. Eight major manufacturing firms, including subsidiaries of three Fortune 500 companies, employ 13,500 people (Stephenville Chamber of Commerce). Stephenville is the retail trade center for a trade region of 72,000; gross sales for the county increased by 28.1 percent from 1985 to 1990 (Stephenville Chamber of Commerce). Tarleton State University, a part of the Texas A&M University System, plays an integral role in the community's economy. Its student enrollment was 6500 in 1991-92. Tarleton State University is one of Texas’ fastest growing universities.

THE DAIRY INDUSTRY IN ERATH COUNTY
Erath County's first recorded settling of a dairying family places them and their milked longhorns in the county in 1877; they milked for family consumption. Commercial production started in 1891, but was squelched in 1893 by a winter drought. A Jersey herd was re-established in 1917. The Triangle Cheese and Produce Company opened in Stephenville in 1937. In the 1950s, Erath County dairy farmers changed from Jersey to Holstein herds.

In 1974, the average U.S. dairy had 31 cows. Approximately 55 percent (133 of 241) of Erath's dairies in 1974 had less than 50 cows. Fifty-four dairies had 50 to 100 cows, and 54 had more than 100 cows (Census of Agriculture).
The trend toward a dichotomous producer structure started in Erath County before the national trend was evident. In 1987, the average U.S. dairy had 50 cows, and in Erath County the average dairy had 189 cows (Census of Agriculture). Twenty-six percent of Erath's dairies had less than 50 cows, 14 percent had 50 to 100 cows, and 60 percent had more than 100 cows. In 1992, large-scale dairy producers with more than 250 cows numbered 52 in Erath County. The largest dairy in the county milks 3500 cows from a total herd of 4200.

In 20 years, Erath County's "Moola" (milk sales) increased from $10 million in 1972 to $144 million in 1991. A burgeoning infrastructure has developed to support the dairy industry in Erath County and the greater five-county Cross Timbers region; it includes feed suppliers, veterinarians, equipment dealers, repair services, and banking services. Cross Timbers dairies include 198 small dairies (less than 200 cows), 77 medium dairies (milking more than 200 but less than 600), and 21 large dairies (milking more than 600). Total local expenditures associated with milk production by the 296 dairies in the five-county region amount to an estimated $227 million per year, based on the 1991 production year. Local expenditures by dairies for their operating expenses (variable costs) amount to approximately $3,314 per cow per year.

During the Committee for Constituency Development (CFCD) process, the Cross Timbers Concerned Citizens (CTCC) pointed out that the effects of the dairy industry's growth in the Cross Timbers region have not all been positive. They expressed concerns about:

- the deteriorating condition of roads and bridges,
- increases in participation in public assistance programs (food stamps and Medicare),
- overcrowded and under-funded schools, and
- higher crime rates.

Specifically, they said that feed-delivery and milk-hauling trucks cause significant wear and tear on secondary roads. The CTCC expressed concern that low-wage employees of dairies may be adding to the burden on the region's social service infrastructure. These potential negative effects of growth, although difficult to quantify, will be described in the Institute's forthcoming economic-impact-analysis report. A comprehensive input-output analysis to estimate the impact of the dairy industry on the Cross Timbers region's economy is in progress. This analysis is based on profiles of dairy production, costs and returns for representative small, medium, and large dairies in 1991 (collected by the Institute) and the most up-to-date available published data on other economic sectors in the region.
In 1989, dairy interests in Erath County, Texas, were at odds with adjacent landowners and local environmental groups. The area had long fostered a dairy industry, but during the previous decade the industry began to assume a different character. In the period from 1980 to 1989 there was a significant shift from the area’s traditional small dairy personality to one in which industry-sized dairies comprised an increasingly significant proportion of the total. In 1980 there were 181 dairies with a cumulative herd of 19,903 cows. By April 1989, there were 187 dairy operations with a cumulative herd of 48,542 cows. This represents a 148 percent increase in number of cows with only a 3 percent increase in dairies (Texas Milk Market Administrative Office, August 1992).

The area was changing and traditional attitudes were being challenged. Some local dairy farmers enlarged their herds in keeping with emerging specialized dairy husbandry practices and economies of scale and size. Many of the larger dairy operators moving to the Erath County area during the mid-1980s came with production practices and views developed in areas having different regulatory and governmental institutions. Some operators came from low-rainfall areas requiring the capture of a much smaller volume of runoff water. Other dairy producers from out of state had operated large open-lot dairies on small acreage that were zoned for agricultural use. Dairies in California’s Chino Valley typically have 675 cows per 40 acres and may share fence lines with expensive condominiums and attractive business centers. Under these circumstances the dairy farmer did not have to be concerned about odor and its impact on neighboring landowners. Water quality regulations were strict but were not enforced stringently because of political implications, according to Roger Turner, environmental specialist with the State Water Resources Control Board in California (Turner, Spring 1990, Speakers Symposium at Tarleton State University).

Landowners in rural Erath County had grown used to neighboring dairy farms that milked 200 or fewer cows. These farms were generally located on tracts of land that inherently provided a large enough buffer from adjacent landowners to preclude nuisance odor problems. Wastewater from dairy operations simply ran across the dairy property into the nearest stream. No one, including state regulatory authorities, seemed concerned. Although there are scattered examples of Erath County dairy farmers’ being brought under the Texas Water Commission (TWC) permit authority because of neighbors’ complaints as far back as the 1970s, there is little evidence of TWC regulatory authority in the area through the mid-1980s.

As new dairy farmers moved to the area throughout the 1980s and local dairies increased their herd sizes, there was little reason for dairy operators to expect problems from neighbors or state regulatory agencies. Although the TWC had regulatory authority, the unspoken rule was simply to respond to complaints. In the latter half of the 1980s, Texas experienced shortfalls in its budget/finance programs. State agencies responded primarily to those environmental issues with
broad exposure and to interest groups that complained about specific issues. The TWC was not prepared to deal with a new regulatory program of the magnitude required for concentrated animal feeding operations (CAFOs). At that time, the state was regulating 3,700 industrial/municipal permits. Using the definition for CAFOs developed by the TWC, there were potentially 250 new permits to be added, and ultimately another 2,160 dairy operations that were subject to the no-discharge rule. The magnitude of the TWC’s expanded program was overwhelming.

**Initial Environmental Concerns of Adjacent Landowners**
Rapid growth in the industry during the mid-1980s led to increasing alarm on the part of some community members about environmental deterioration that was both visual and odiferous. This concern spurred increased citizen complaints to the TWC and provoked national interest. In June 1989, a hearing before the Subcommittee on Department Operations, Research, and Foreign Agriculture of the Committee on Agriculture, House of Representatives, was held in Erath County to consider the impact on water quality by the local dairy industry. A neighbor of one large dairy described her experience this way:

> It has since grown into an everyday problem with continued seepage into the creek and contaminated pasture runoff from the two large irrigation guns that Mr. _____ employs. An even greater health threat has emanated out of the resulting boom in the fly and mosquito population. Compound this with a most horrible odor, the stench of thousands of pounds of soured manure, so bad that you cannot go outside without retching on some days (House of Representatives Subcommittee Hearing. 1989).

One witness, speaking for the Cross Timbers Concerned Citizens (CTCC), a group formed to combat dairy pollution, expressed concern regarding ground water contamination after his well water showed an elevated nitrate-nitrogen level of 8.5 mg/L. (The Environmental Protection Agency (EPA) drinking water limit is 10 mg/L.) He also stated that several area shallow wells had tested positive for fecal coliform bacteria and suggested that the contamination was due largely to dairy pollution. He further asserted that dairy runoff collecting in area ponds and lagoons over aquifer recharge zones provided a pathway for pollutant migration to ground water (House of Representatives Subcommittee Hearings, 1989).

Continuing environmental concern led to an increase in the quantity and stridency of complaints to the TWC during the late 1980s, a number of which were referred for enforcement. Dr. Clyde Bohmfalk, Director of the Water Quality Division, Texas Water Commission, noted that all of the enforcement orders issued at that time and 90 percent of the pending orders were for Erath County, which had only eight percent of the state’s dairies. Dr. Bohmfalk also stated that “…the Commission staff has documented surface-water contamination
from waste material from a number of dairies in the area... evidenced by elevated fecal coliform bacteria, organic material and nutrients common to animal waste.” He further stated that because of the increased number of complaints, the TWC allocated additional staff and resources to address the problems “created by some of the inadequate waste management practices” (House of Representatives Subcommittee Hearing, 1989).

**GOVERNMENTAL RESPONSE**

In April 1987 the TWC, in consultation with specialists from universities and agricultural interest groups, revised its technical guidelines for CAFOs and adopted them as rules of the agency. The TWC then embarked on a locally targeted permitting campaign.

Responding to an unprecedented number of complaints, the TWC initiated an aggressive inspection program in the spring of 1989 that resulted in several enforcement orders followed by stiff penalty assessments. This operation, in keeping with typical industry compliance strategies, did not allow time for traditional agricultural approaches, such as the United States Department of Agriculture-Agriculture Stabilization and Conservation Service (USDA-ASCS) cost-share programs, to respond to the enforcement crackdown.

**INITIAL EFFECTS ON THE DAIRY INDUSTRY**

The dairy sector, unaccustomed to being treated as an industry rather than as part of the family farm community, was stunned by the fines it considered excessive. Area dairy operators resented being targeted to serve as examples for the rest of the state. Agriculture has historically depended on the USDA institutional organizations, utilizing voluntary programs supported by technical assistance and cost-share programs. Dairy operators, spurred by this attention and anxious to comply with regulations, began requesting waste-management plans with cost-sharing programs of the USDA-ASCS and Soil Conservation Service (SCS) in unprecedented numbers. A waiting period of up to 18 months ensued because of increased demand for services. Current SCS estimates suggest its initiatives will require an additional seven years to bring the Upper North Bosque dairies into compliance with state regulations.

The EPA/TWC no-discharge policy appeared unrealistic to the dairy operators as they attempted to design waste-management facilities for cumulative rainfall events. Even the best of these plans have encountered problems during the past three years due to unusual weather patterns.

The permitting process for agriculture has become an administrative rule-making process during the past four years. Early permits required minimal controls, but the most recent ones include stringent criteria and costly monitoring controls and contained up to 32 special provisions. This situation places most of the area’s newly permitted dairies on an uneven economic playing field.

Economic hardships created by environmental compliance costs have also put area dairy operators at a disadvantage because other dairies statewide are...
not subject to the same level of regulatory scrutiny. Local dairy farmers, hurt by this process and by declining milk prices, have become proactive.

Permitted-dairy operators argue that small dairies should be subject to the same regulatory inspection process as the large dairies. They feel that while the permitting process has brought them into compliance, they are still blamed for continued water-quality problems for which the small dairies are responsible. They also charge that it is an unfair hearing process that allows special permit requirements to be added, seemingly at the whim of protesters. These dairy farmers contend that additional permit requirements should be documented with research, first to prove a problem exists, and then that the special provision effectively abates it.

Dairy operators have also charged that local community members, especially those connected with the Cross Timbers Concerned Citizens (CTCC), continue to harass them with unsubstantiated complaints to the TWC. As one dairy owner stated recently, "These daily calls to the Texas Water Commission reporting 'permitted' dairies is right on the fine line of harassment. The Texas Water Commission is flooded with calls with unfounded complaints that they must check out, thus keeping the one inspector for 21 counties, including Erath County, so busy he cannot take care of other business that needs his attention." Opposition to permits at hearings, they argue, constitutes another form of harassment that delays the permitting process and increases their costs, both for facility construction and for legal fees accrued during the permitting process.

**GOVERNMENTAL REACTION**
The TWC issued amended draft regulations governing CAFOs for public comment in the fall of 1991. These regulations incorporated most of the special permit requirements that have been added to recent permits. After CAFO operators and lobbyists objected to these regulations, declaring that the agency had not allowed enough time to determine the effectiveness of existing rules, the TWC tabled them until it could reorganize its Water Quality Section to include an Agricultural Section. The draft rules were reissued for public comment after the creation of the Agricultural Section, but the agency has again shelved the rules.

EPA Region 6 has issued draft regulations for a general permit for CAFOs that mirror those formulated by the TWC. Public hearings for these regulations are pending.

**ADJACENT LANDOWNER AND ENVIRONMENTAL RESPONSE**
The CTCC, with a membership of more than 200, charges that the TWC caters to the dairy industry and is doing little to abate pollution in the area. During the recent furor over new regulations, they charge that the TWC allowed the industry to write its own regulations. This view was reinforced, in their minds, when the agency allowed its Agricultural Council, composed of CAFO lobbyists, to review the rules with agency staff, excluding environmental groups. This was followed by shelving the rules.
The CTCC further charges that the agency has dragged its feet on establishing a program for regular permit inspections, noting that, according to TWC officials, the agency conducted only about 10 percent of its required inspections this past year. They have long asserted that inspectors located in Waco cannot respond quickly enough to witness instances of discharge when complaints are filed.

They answer the dairy operators' charges of harassment by asserting that approximately 72 percent of their complaints have been declared valid by the TWC, with the time lag between complaint and inspection responsible for the percentage not being higher. They insist that if they had confidence the CAFO rules were adequate and that permit applications were designed and reviewed by qualified engineers, there would be no need to contest each hearing. The CTCC alleges that a faction of the dairy industry has subjected them to harassment as well--disrupting their open meetings, jeopardizing members' jobs by threats of boycott to employers, and other threats.

INSTITUTE ACTIVITY

Amid this contentious atmosphere, the Institute has worked to draw these diverse interests together into a meaningful dialogue with strategies for consensus development and empowerment in an open research process. Through formation of a Committee for Constituency Development (CFCD), TIAER has sought to inform, educate, and develop understanding among all affected interest groups. During the past two years, the CFCD, composed of dairy operators, environmental groups and community leaders, has addressed the major concerns of these groups.

Contemporary abatement programs and strategies have, in large part, failed to address the difficult scientific issues associated with regulating nonpoint pollution. They have also failed to confront tough policy and institutional issues. New technologies, production practices, and the economies of size and scale have promoted the proliferation of industry-sized CAFOs in the livestock and poultry industries during the past decade. These large CAFOs are no longer located primarily in sparsely populated arid areas, as they were in past years. Larger permitted operations argue that governmental regulatory agencies cannot address complicated pollution issues in watersheds by singling out only the larger operations, particularly when larger operations are intermingled in the same watershed with a large number of smaller dairies for which permits are not required.

State and federal regulatory agencies are breaching the agricultural industry's resistance to environmental controls. In 1972, when the Clean Water Act was established, few envisioned 100-cow dairy operations coming under the regulatory net of government. Current decisions to bring these operations into compliance with environmental objectives also tackle a whole new set of policy and institutional issues. State and federal agencies are faced with addressing.
agricultural-pollution issues with regulatory programs designed two decades ago for point-source pollution problems and with policies and institutions developed for entities unlike smaller agricultural enterprises. Issues concerning small agricultural enterprises, even in the livestock sector alone, are far more complicated than those unfamiliar with agriculture might expect. There is a limited track record for dealing with these problems and there are no solutions that can be taken off the shelf.

Initial concerns expressed by interest groups and eventually addressed by the Congress were primarily related to point sources of pollution. Point-source, or end-of-pipe, pollution problems have distinguishing characteristics, policies, and solutions:

- sources are easy to identify and measure,
- treatment and discharge can be used to meet national performance standards for effluent discharge,
- violations are easy to detect,
- successful abatement is easy to verify

Although the initial goal of the Clean Water Act was to achieve fishable and swimmable waters, this intent was to a great degree replaced by the goal of meeting established performance standards. (Federal Water Pollution Control Act, Amendment of 1972, Section 101(a)(2), 33 USCA Section 1251(a)(2))

A cursory review of the literature reveals that a lengthy debate has taken place during the past two decades regarding the degree of difficulty associated with abating agricultural-nonpoint pollution. Although pollution emanating from CAFOs is technically point source, waste management practices change its character to nonpoint pollution. Solutions to problems from CAFOs have been approached from the standpoint of no discharge. Abatement strategies typically revolve around the construction of containment structures for wastewater generated on-site and implementation of BMPs for land disposal of solid and liquid wastes. The challenge with these abatement strategies lies in the proper installation of lagoon liners to protect ground water and in the management of waste disposal. Solid and liquid wastes must be applied in a manner that does not contaminate surface water and ground water during rainfall events. Typical nonpoint-pollution problems are thereby created through abatement strategies used to control the original point source.

**Regulatory Compliance Considerations**

It is much easier to document unauthorized discharges from traditional point sources than from CAFOs. An additional difficulty in documenting noncompliance of CAFOs is the large number of agricultural facilities and their highly dispersed nature. The volume and diversity of the operations render traditional enforcement practices financially unfeasible.

Discharge permits for municipal and industrial sectors specify stream
water-quality standards for effluent. The permittee must analyze effluent samples regularly to ensure that these standards are met. Dairy operators, however, are not given the option to discharge wastewater, presumably because of low quality treatment. Discharges are allowed only if rainfall exceeds the 25-year, 24-hour storm event.

While a facility with a no-discharge permit is less expensive to operate because of the absence of sophisticated treatment facilities and effluent-analysis costs, the dairy operator is required to maintain a fail-safe waste-management plan to guard against cumulative rainfall events. The total rainfall from closely spaced events often exceeds the 25-year, 24-hour storm, resulting in discharges. Cumulative storms during January-February 1992 prompted 28 requests to discharge, according to the TWC District 3 office.

Such rainfall events have caused dairy farmers and the TWC to rethink current waste-management practices and have encouraged the use of innovative technologies for waste reduction and advanced waste treatment. As agriculture begins its difficult climb into the compliance arena, it will need direction and guidance from the regulatory institutions regarding appropriate avenues for compliance. The challenge lies in developing strategies to ensure that producers incorporate the necessary practices into their daily management program.

While regulatory and funding agencies promote the use of scientifically-proven technologies and management practices, they have no mechanism to support the evaluation of innovative technologies. Innovations in livestock-waste treatment technology are met with institutional barriers. The USDA-ASCS cannot cost-share new technology options, nor can the USDA-SCS implement them if they are not approved in their regional manuals. This is true even though the same technologies may be approved in other regions. Therefore, transfer of technology is impeded by the very institutions that endeavor to promote the concept.

Environmental groups and the dairy sector criticize the complaint-driven nature of the TWC regulatory process. The agency, long accustomed to the continuous nature of point-source discharges and associated enforcement programs, has developed a regional districting program that does not allow quick responses to rainfall-driven nonpoint discharges. Delayed response to rainfall events, coupled with the lack of regular inspections for permitted facilities, perpetuates the inefficiency inherent in this system.

Success in agricultural-pollution abatement will ultimately be measured by the water quality in streams and lakes. The practices that contribute to improved water quality must be identified, requiring major governmental commitments to expensive monitoring and modeling efforts. All sources of pollution in a watershed must be identified and quantified, and the success of abatement determined (see Appendix F). Although point sources normally have controlled discharges, excessive rainfall can overwhelm these systems, resulting in
nonpoint discharge as well. As pollution from agriculture and other sources is confronted, the overall success of point-source abatement strategies may again be brought into question, particularly their success during rainfall events.

Pollution from CAFOs has an added dimension that complicates state agency compliance programs. Nuisance odor from large CAFOs motivates many of the protests to proposed permits for new operations. It is the typical “not in my backyard” (NIMBY) issue.

The lack of quantitative measurement standards for odor from CAFOs frustrates the development of enforceable policies. Contaminants creating traditional air pollution, but not dairy odor, have been quantified. Therefore, no odor standards have been developed for regulatory use.

The problem is further complicated because Texas counties have no ordinance-making power to implement local controls for NIMBY-type problems. Others view the relatively weak county government system as positive. Whether it is positive or not, the lack of authority at the county level places state agencies in the difficult position of solving nuisance-odor problems. State programs developed in this fashion tend to “paint with a broad brush,” making it difficult to accommodate local differences and preferences. Lack of local control also means that complaints must be resolved from the state capitol, rather than the local area.

Currently, the major burden of financing abatement strategies falls on the polluter; the “polluter pays.” However, few firms actually pay for compliance out of profits. Companies make initial capital investments in equipment and management to meet established performance standards then pass the cost to the consumer through the price of the product. Affected governments at local levels simply increase taxes to pay for needed equipment and management to drive environmental compliance programs. (Brimelow and Spencer, 1992.) Traditional agricultural enterprises, whose prices are primarily determined by government price-support programs or by market forces, will continue to have problems passing the cost of compliance to the consumer in the short to intermediate term.

INSTITUTIONAL CONSIDERATIONS
The EPA and state counterparts have been the primary players in achieving public environmental objectives. They have used compliance strategies that could be implemented by state agencies with regional inspection and enforcement programs. The agencies typically have no grassroots presence. Programs designed to achieve compliance from CAFOs will require agency personnel at local levels of government.

The USDA and state counterparts have a strong local presence and are experienced in working with farmers to achieve conservation goals. The USDA has traditionally worked with farmers through voluntary programs. Program success depends on the attractiveness of the technical assistance, incentives, and cost-share programs. This system, by itself, achieved little success in Erath County. Even with significant cost share programs available to dairy farmers, few
came into compliance with TWC regulations prior to enforcement action by the agency.

**BROADENING THE FOCUS**

Currently regulated entities increasingly cite agriculture as the remaining large industry yet to be brought into compliance with environmental objectives (Clean Water Act Reauthorization Conference, Arlington, Virginia, October 1991). They point out that cost associated with imposing increasingly stringent regulations on industry and municipalities are higher than the cost of regulating agricultural pollution and will improve water quality significantly less.

Major firms are active in the environmental policy arena. They are involved in research and policy-development issues, monitoring EPA and environmental group initiatives, and proposing alternative strategies. These groups are not hesitant to appeal EPA rulings they believe are unfair; they have the expertise to deal with agency experts on all issues, including congressional initiatives and enforcement action. They are also active in the political process, i.e., supporting elected officials who tend to represent industry positions on the environment. Smaller agricultural enterprises are limited in these capacities.

Throughout the twenty-year history of the Clean Air Act and the Clean Water Act, the EPA has worked on a common set of problems with regulated entities. A balance of power has developed over the years, notably among industry, municipalities, and the EPA. All three entities have financial power, political strength, and experience.

While CAFOs are undoubtedly covered by initial policy enunciation, it should be emphasized that problems in agriculture were not considered of sufficient magnitude in the minds of the public or Congress to demand significant attention. This is the essence of the problem concerning current agricultural pollution issues. In too many instances, the problem is being approached as if its parameters were well understood and appropriate solutions are available. Bringing agriculture into this policy debate brings up important questions:

- Can agriculture be an effective player, given current policy, institutions and compliance strategies?
- Are agricultural industries capable of responding to current EPA regulatory programs?
- Can EPA be expected to bring compliance to a new set of problems that defy command-and-control strategies and a complaint-driven regulatory process?
- As agriculture is brought into compliance with environmental objectives, will policy and compliance strategies be modified to recognize distinct differences in the type of pollution and industry being regulated, or will the industry adapt as it copes with the contemporary policy regulatory framework?
The location of a dairy can affect both the economic costs and environmental impacts of dairy operations. The importance of siting a dairy is most often viewed in terms of the potential for complaints from neighbors. Substantial expenses are normally incurred during the process of coming into compliance with environmental regulations. Objections to the facility or site can greatly elevate these costs. Permit hearings, which are required when parties protest the issuing of a permit, can greatly increase the costs through legal fees and additional permit provisions, which can require additional waste-management facilities, technologies, and practices.

A significant aspect of siting involves the costs of the construction and maintenance of waste-management facilities. The site's soil profile, topography, and proximity to surface water and ground water are environmental siting considerations that can make substantial differences in the cost of regulatory compliance. These factors can dictate the type and amount of facilities required to be built and the management practices that must be implemented. The costs of
constructing the facilities greatly influence the economic viability of the dairy.

Proximity to populated areas, including attention to predominant wind direction, and the number of nearby dairies, are siting considerations because of increased potential for complaints. While there is a real concern for surface and ground-water pollution, complaints against the siting of dairies can often be traced to the sentiment of “Not In My Back Yard” (NIMBY). A review of complaints against dairies in the study area from 1988 through the present reveals approximately 82 percent of the complaints exhibited a profile consistent with a NIMBY-based motivation, i.e., the complainant lodged protest against a single dairy. Odor and other nuisance conditions seem to drive the costly complaint process.

Some siting parameters that were traditionally considered positive, such as close proximity to streams, are now seen as liabilities because of the potential for environmental contamination. Location near a large number of other dairies increases the availability of 3-phase electricity and the access to support industries. However, clustered dairy operations often increase the likelihood of complaints because of nuisance conditions and the increased threat of water pollution. These complex effects make siting a difficult issue for dairy operators and their neighbors.

Solutions must be found to minimize nonpoint-pollution and nuisance potential. Voluntary adherence to traditional siting criteria has not adequately solved these problems, as evidenced by the continuing number of contested permits for new dairies. The Institute has developed a siting guide (see Research Initiatives) that serves as a tool for more thorough site evaluation. Although the guideline provides information for proper siting, the issue becomes one of whether siting guidelines will be voluntarily utilized. Use of innovative technology and operational practices can also provide solutions, although at greater costs. Other solutions include county zoning initiatives or additional rule-making by the TWC and the Texas Air Control Board (TACB) to address siting concerns.

As dairy herds increase in size and number, the issue of air contamination, as related to nuisance odors, becomes increasingly important. Texas, like other states, does not yet have odor standards for CAFOs. While many air-pollutant species have industry standards, no quantitative measurement standards have been determined for odor. Only dairies with more than 1000 cows are required by the TACB to have permits. TACB’s enforcement programs rely on the qualitative judgment of inspectors. Weather, time of day, dairy management practices, and other time-dependent factors make reliance on the TACB inspectors an uncertain avenue for pursuing complaints. Concerns about water pollution are, therefore, seen as more likely to get results. Lack of zoning in rural areas makes odor a contentious issue. Many of the possible solutions would involve property rights issues and could result in more problematic disputes than presently exist.
Air contamination from concentrated livestock operations involves not only those pollutants that contribute to nuisance odors, but also includes methane emissions that contribute to global warming. Anaerobic treatment of livestock wastes accounts for 6 percent to 10 percent of the total methane emissions from human-related activities (Roos, EPA, April 1992). Mitigation of methane emissions is an important factor in stabilizing atmospheric concentrations of methane.

Although surface water is not a primary water resource within the study area, nonpoint pollution from this watershed does impact the downstream users of Lake Waco, which is subject to elevated nutrient levels (TWC, 1986). This impact is felt through added water treatment costs, reservoir clean-up expenditures, and loss of recreational benefits. Users are concerned that the degraded water quality of the Upper North Bosque watershed contributes to these problems.

Locally, surface-water impacts are noticeable through aesthetic degradation of streams and ponds and reduced recreational use of the SCS PL-566 floodwater-retarding structures. Fish kills in area reservoirs give evidence to lowered surface-water quality.

Dairy interests argue that they are not the only agricultural source of pollution and that municipal and industrial impacts are significant, but largely ignored when evaluating water quality in the study area. The various contributions must be distinguished before a watershed management plan that addresses all aspects of point and nonpoint sources of pollution can be developed.

Compliance monitoring for nonpoint-pollution abatement presents unique challenges for regulatory agencies. The diffuse nature of nonpoint pollution makes it difficult to monitor without expensive technology such as automatic sampling equipment. Sources of contamination are difficult to isolate after the pollutants enter the stream course. Nitrate from dairy waste becomes indistinguishable from nitrogen derived from commercial fertilizer applied to croplands or neighborhood lawns. Fecal coliform contamination from septic system discharge is difficult to distinguish from livestock sources. Without local TWC agents to observe discharges during rainfall events, compliance is difficult to enforce.

Watershed monitoring for nonpoint-pollution evaluation is both difficult and expensive because of the dependence of this type of pollution on rainfall events. TIAER's monitoring program for the Upper North Bosque watershed is one of the first rural intermittent watersheds to provide the extensive information necessary to determine the impact of nonpoint pollution on receiving streams and reservoirs.

Existing USGS and TWC monitoring stations located on the North Bosque River were established to analyze the impacts of point-source pollution. The number of small tributaries and reservoirs between nonpoint sources and the existing stations preclude meaningful evaluation of the amount contributed by
various sectors (dairy, farm, municipal and industrial stormwater) to the loading of nutrients and other pollutants. The Institute’s sampling stations evaluate contributions from municipal and agricultural components. (See Map F.) Automatic water-sampling and flow-measurement equipment to capture flow-based events in intermittent streams are strategically placed throughout the basin. (See Research Initiatives.) This program, in the long term, will provide necessary data to evaluate load contributions from each sector for better determination of BMP effectiveness. Varying rainfall runoff patterns require monitoring over a minimum five-year period to establish trends that contribute to loading.

The Trinity aquifer, the major source of water for Erath County, provides Stephenville, agricultural industries, and rural residents with high-quality water. The county also has a shallow ground-water supply in the Paluxy Formation, which serves many rural residents. Ground-water levels range from about 20 feet to 600 feet. The dairy industry is the largest area user, consuming a minimum of 80 gallons per day per cow, or 4.5 million gallons of water per day for Erath County, approximately twice as much as the city of Stephenville. At a time when both the Paluxy and Bosque reservoir projects are stalled, ground-water conser-
vation and protection are paramount.

Agricultural practices that pollute ground-water resources will ultimately result in adverse economic impact for all sectors of the community. Evidence of the critical nature of ground-water problems cited in *Water for Texas* (Texas Water Development Board (TWDB), 1984), includes the lowering of ground-water levels, inadequate ground-water supplies for growth needs of small cities, and the deterioration of ground-water quality.

Although contamination from agriculture is not necessarily the major source of ground-water pollutants, it has been determined that agricultural contamination of ground water should be considered a unique element in the development of management strategies (Batie, et al, 1989):

- agricultural nonpoint sources are difficult and expensive to manage;
- the pollution potential of contaminants and the effectiveness of control methods tend to be site specific;
- monitoring and testing procedures are difficult and expensive;
- there is considerable resistance to traditional “polluter pays” regulation;
- the health and safety implications of ground-water contamination are not well documented.

Sources of contamination related to dairy operations are the confinement corrals, waste-application fields, and wastewater lagoons. A preliminary TIAER study of five dairy lagoons indicates that ineffective lagoon systems can serve as pathways for ground-water contamination. (See Research Initiatives.) Land application of wastes also affords opportunity for ground-water contamination through leaching of nutrients and requires further study. While TAEX studies in the High Plains show minimal contamination from feedlot surfaces, differing geology and differences in density and compaction between beef and dairy feedlots require closer examination of local conditions.

A recent EPA study concluded that ground-water protection measures should consider appropriate reductions in pesticide and fertilizer use, site-specific assessments for targeting vulnerable ground water, identification and protection of ground-water recharge areas, and well-head protection areas. Additionally, water conservation measures and identification of problem pesticides should continue to be developed. (EPA, 1991.)

Accurately gauging the degree of compliance and determining the success of the TWC regulatory program requires a compliance-monitoring program. TIAER has been conducting a Dairy Compliance Survey to accomplish this goal. The primary purpose of the survey is to assist in determining the effectiveness of the BMPs used to achieve compliance. If monitoring efforts do not show a significant improvement in water quality over time, the reason will need to be determined. At this point, it will be important to have documentation regarding the
degree to which permit provisions and BMPs have been followed. Without this information, it will not be possible to attribute the lack of improvement to either breaches in compliance performance or to the ineffectiveness of recommended BMPs. In order for the research of TIAER and its partners to be meaningful, these compliance studies must be continued throughout the life of the research program. The integrity of the survey process is critical. It must be carried out within established parameters to be statistically reliable.
RESEARCH & EDUCATION INITIATIVES

The Texas Institute for Applied Environmental Research (TIAER) was initially funded through the Environmental Protection Agency (EPA) under the Section 319 Clean Water Act and began studying the impact of agricultural pollution on the Upper North Bosque watershed. Under the 319 mandate, the Institute outlined a program to educate and demonstrate Best Management Practices (BMPs) to dairy farmers. The program is divided into performance components that include surface and ground water monitoring, compliance monitoring, mathematical modeling, evaluation of siting criteria and BMPs, and educational and technical assistance programs. Baseline information and compliance histories are compiled in order to measure improvements in water quality attributable to increased compliance with the Texas Water Commission (TWC) rules.

Agricultural pollution can be related to land use patterns within a watershed. The isolation of nutrient contributions due to various types of land usage can be accomplished through the delineation of sub-basins. Determination of nutrient loading rates for each type of land use within each sub-basin can then be ascertained. BMPs can subsequently be developed to allow the basin to assimilate a reduced load while maintaining a viable ecosystem. Although the focal point of concern from local citizens and environmental groups is pollution from dairy farms in the Upper North Bosque River Basin, these issues cannot be properly addressed in isolation from other pollutant loading in the watershed.

Determining the extent of agricultural pollution is difficult for many reasons:

1) relatively large numbers of diverse sources of water pollution,
2) chemical similarities of agricultural pollutants to other pollutant types,
3) potential for varying effluent quality from municipal sewage-treatment plants and other point-source treatment facilities,
4) complex interactions that occur in the overland flow and waterway draining agricultural land,
5) stochastic storm events and runoff flows,
6) complex geologic conditions that affect the downward movement of contaminants, and
7) large expenditures required for sampling equipment, laboratory analysis and manpower.

Agricultural activity contributes more than 50 percent of nonpoint pollution in lakes and rivers. Nutrients (nitrogen and phosphorus) are responsible for 13 percent of the pollutants in rivers and 59 percent in lakes (USDA 1991). Potential sources of pollutants from dairy wastes include wastewater lagoons, feeding corrals, and fields upon which liquid and solid wastes are applied. Contamination from these sources may enter streams through runoff or migrate downward from the soil surface into ground water.

The watershed monitoring concept allows delineation of source contributions of agricultural pollution and generates information that can be used by
concentrated animal feeding operations (CAFOs) to implement BMPs that are environmentally sound and economically feasible. As BMPs are implemented throughout the watershed, monitoring must be conducted over a relatively long time frame in order to fully determine their impacts on water quality improvement. TIAER monitoring efforts should be continued for an additional four years in order to detect seasonal and annual variations, the implementation of BMPs through time and delays in environmental response.

The Upper North Bosque watershed provides an excellent opportunity to monitor the effects of livestock operations on receiving waters. The 359 square mile watershed contains approximately 94 dairies with a total of approximately 26,000 milking head. Forty-five of these dairies are permitted, while the remainder have fewer than 250 cows and do not require a permit (See Map A). The majority of other agricultural activities are limited to rangeland and forage production. The North and South Forks of the North Bosque River originate in northern Erath County and converge just north of Stephenville. The watershed extends to the United States Geological Survey (USGS) North Bosque gauge station at Hico, Texas. The watershed also contains 41 Soil Conservation Service (SCS) PL-566 floodwater retarding structures which control runoff from 202 square miles and impound approximately 1200 surface acres of water. These structures are designed to retain the flow of intermittent streams, allowing deposition of sediments and the release of water at a controlled rate. Twenty-five of the 41 PL-566 structures are directly impacted by dairies (SCS, 1992).

In September 1991, through the infusion of state funds, the Institute expanded its research program to include policy and institutional issues. Solutions to scientific problems, although necessary to resolution of agricultural-pollution issues, are in themselves not sufficient to bring the required compliance. Equally important in the research process is attention to government policies and institutions that have developed over the last two decades to address
environmental problems.

The figure on the preceding page illustrates the workplan adopted to accomplish the monitoring and modeling research objectives. The workplan for policy and institutional research objectives are illustrated in the Policy and Institutional Initiatives section.

There are legitimate research questions regarding the appropriateness of current policies and institutions related to agricultural industries and pollution problems. The current regulatory policies and institutional framework were not designed to abate agricultural pollution, nor to meet the needs and abilities of the agricultural producers. Environmental objectives must be met; the critical question is how.

The watershed concept used under the 319 program is being expanded to isolate and identify livestock contributions to agricultural pollution. In September 1992, EPA funding for “Livestock and the Environment: A National Pilot Project” (NPP) permitted the Institute to broaden its research. In conjunction with its partners, TIAER will use a mass balance approach to watershed pollution issues and will delineate various sources of pollution that include dairy, other agricultural operations, industrial, and municipal contributors.

The methods developed here will be applied to other watersheds and other livestock species throughout the nation. The expanded scope of work afforded under the NPP will include comprehensive ground-water and air-quality programs, intensive modeling that incorporates both water quality and economic considerations, and development of policy and institutional strategies that foster agricultural-pollution abatement.

TIAER has developed a siting guide to encourage sound environmental planning for CAFOs. Proper siting can greatly reduce the economic costs and environmental impact of dairy operations. The TIAER siting guide outlines a set of procedures to lead dairy operators through TWC regulations that govern their operations and addresses specific rules that should be considered when siting a new dairy.

This guideline incorporates specific criteria designed to minimize environmental risks in the decision-making process and outlines a procedure to lead the dairy farmer through a site-evaluation process. The process begins with an evaluation of geographic factors that include topography and an assessment of the importance of slope in both siting the corrals and application fields. It aids dairy farmers in locating their sites on topographic maps that will provide information for determining slope as well as surface-water locations and wells. The guide directs dairy farmers to area Flood Hazard Boundary Maps that delineate the 100-year floodplain, a crucial factor in siting. It also refers them to the TWC’s DRASTIC Environmental Sensitivity map, which describes the degree of environmental hazard associated with their sites. The guide also stresses the
importance of soils in site selection, especially with regard to crops, corrals, and lagoon locations. (See Maps B, C, and D.)

Use of the guide is not limited to siting new installations. Existing operations can be reevaluated, using the same siting criteria, with respect to placement of concentrated feeding areas, lagoons, and waste-application fields. In the Upper North Bosque study area, approximately 45 percent of the dairies are currently permitted. Significant investments in waste-management facilities for agricultural-pollution abatement will be required for the remainder of the dairies, which have less than 250 milking head. Informed decisions, using these management tools, will make compliance with the TWC regulations easier, and can aid in the economic and environmental planning process. This information has been transferred to the Texas State Soil and Water Conservation Board (TSSWCB) and is being disseminated through the Soil Conservation Service District office. The guide will be updated as new information and maps are developed.

To some extent, the complexity of the siting process in Texas depends on how county ordinance-making power is viewed. Some see county zoning as a cure for problems related to nuisance while others maintain that complex and ambiguous problems would be created by the use of zoning. Texas counties do not generally have zoning authority comparable to that of municipalities. (See, generally, Local Government Code Chs. 231, 233, and 241). The Texas Legislature, at the insistence of strong agricultural and real estate lobbies, has refused to grant ordinance-making power to county governments except in rare instances. Without these powers in place at the local level, state regulatory agencies are faced with dilemma of dealing with local odor and general nuisance issues through centralized offices in the state capitol. Currently, complaints made in Erath County are dealt with through a complicated and expensive regulatory process underpinned by administrative law/adversarial proceedings. Complaints that lead to enforcement cause the dairy farmer to leave the dairy, hire an attorney and perhaps an engineer, and travel to the headquarters of regulatory authorities. There is no opportunity for complaint resolution at the local level, which would decrease the cost to government, dairy farmers, and local citizens.

**ALTERNATIVE SOLUTIONS**

Alternative solutions to siting problems, especially those that relate to nuisance odors, include county zoning initiatives and additional rule-making by regulatory agencies. Other alternatives involve innovative technologies and operational practices (see Appendix D).

CAFOs can be located in parks, similar to industrial parks. The CAFO parks may provide an alternative to current siting considerations and also reduce both agricultural pollution and nuisance factors. Several herds located within the park would utilize a shared wastewater-treatment system and a shared buffer zone to abate nuisance conditions. Use of free stall barns and innovative technologies would eliminate the need to contain large volumes of contaminated
corral runoff and minimize land requirements for waste disposal. The location of multiple dairies on one large tract could result in significant cost savings. This concept holds a promising answer for the large dairy operator who does not want to farm land for waste-disposal purposes or worry about the continued uncertainties of waste-management criteria.

TIAER plans to begin evaluating the feasibility of this concept in November 1992. This evaluation will utilize experts in multi-disciplinary forums to examine alternative technologies, production practices, economic feasibility,
permitting strategies, financing, location, size, and special environmental considerations, and legal/institutional issues. Through the use of advanced multidisciplinary research forums, TIAER expects to complete the feasibility study prior to March 1993.

The Institute has recently initiated an air-quality monitoring program in cooperation with the Texas Agricultural Extension Service (TAEX) with funding from the Texas Air Control Board (TACB) and EPA. This program will investigate the quantitative relationship of nuisance odors to the chemical constituents of manure and wastewater. It will also explore the way in which these odors move from the dairy site. TIAER is currently installing meteorological equipment at three study sites.

The TAEX will measure threshold levels of odor using a Barneby-Cheney Scentometer at dairy sites. TIAER will then collect air samples for chemical analysis. Mass spectrometry-gas chromatographic methods will be used to fingerprint the chemical composition of the odiferous air. The presence and concentration of those species to which odor is attributed can then be determined. Detection and quantification of extremely low concentrations of the odorous compounds will challenge this program. Dispersion modeling will also evaluate the manner in which odors are distributed. Future studies conducted under the NPP will investigate the specific sources of odor--the lagoons, corrals, and application fields.

TIAER, in the spring of 1993, will launch a biogas utilization demonstration project in conjunction with the EPA Global Change Division and the Governor's Energy Council. This project will focus on the capture of methane emissions from dairy lagoons that can be used to fuel on-site milk-chilling equipment. Capture and utilization of methane will reduce infrared-absorbing methane concentrations in the atmosphere, and reduce odor from anaerobic dairy lagoons. This demonstration has the added benefit of providing an economic return to the dairy operator.

Wastes generated by the local dairy industry have the potential to contaminate the ground-water resources of the Upper North Bosque River Basin. Pathogens and soluble contaminants such as ammonium, nitrate, and phosphorus from these wastes may migrate from the soil surface through the vadose zone (the unsaturated soil/rock interface between the root zone and the water table) and, ultimately, into ground-water reserves. They can also move laterally to an outcrop, resulting in surface-water contamination.

The hydrogeologic environment below corrals, lagoons, and waste application fields determines the potential for ground-water contamination. While the ability of wastewater to migrate through the subsurface has proven to be dependent upon soil permeability and adsorptive properties, the movement of water
through the vadose zone has not been well documented.

Although Texas Water Development Board (TWDB) studies in this area have shown no widespread contamination of ground water, there is a concern in the community that it is only a matter of time before it occurs. In order to prevent future contamination, it is important to determine the potential for contaminant migration by studying the movement of water and contaminants through the unsaturated vadose zone. This information will allow the appropriate structural controls and BMPs to be implemented to ensure continued viability of the aquifer.

The lagoons used to retain dairy wastewater have been the primary focus for concerns related to ground-water contamination. TIAER recently conducted a preliminary investigation of contamination of the vadose zone associated with dairy wastewater lagoons. (Nelson, 1992). This study, conducted in cooperation with the EPA, TWDB, TWC Ground Water Section, TSSWCB, and United States Department of Agriculture-Soil Conservation Service (USDA-SCS), focused on the chemical and microbiological analysis of soil and perched water samples within the vadose zone. Borings were conducted adjacent to five dairy lagoons. For this initial study, the selected sites represented older lagoons with in-situ (natural) liners that had not been built using the stricter criteria of recent permit requirements—those lagoons offering the greatest potential for seepage. These sites were also selected based on their ability to provide representative soil profiles upon which lagoons are typically located and their relative proximity to shallow ground water (Paluxy Aquifer). (See Map D.)
Of the five lagoons investigated, three showed elevated contaminant levels. These lagoons were in-situ impoundments located on the three most permeable soils studied. In one case, elevated ammonium levels, typically associated with dairy wastewater lagoons, were evidenced in the perched water samples, along with elevated nitrate and total dissolved solids. In two other cases, elevated nitrate and TDS levels were found in perched water samples. These elevated levels indicate that the dairy facility is the source of contamination. However, because of the proximity of the corral areas and application fields to the lagoon and the relatively low ammonium levels found at these two sites, the source of contamination could not be further isolated. It could not be determined if high ammonia concentration in wastewater had oxidized to nitrate, or if the nitrate contamination originated from the corrals or disposal fields.

Further and more sophisticated research is needed. Pending studies, in cooperation with the University of Texas Bureau of Economic Geology and the TWDB, will focus on the development of recharge maps for the region to highlight critical areas to aid in siting criteria determinations. This work is funded under the NPP. The Institute is also seeking additional funding for these partnerships to conduct a definitive study that will couple findings from drilling and sampling of the Paluxy and Trinity aquifers with nitrogen isotope analysis for delineation of contaminant sources. Ground-water modeling will also be conducted to simulate the transport of contaminants through the root zone, vadose zone and saturated zone (aquifer). Because of the high costs associated with ground-water drilling and monitoring investigations, modeling will be relied upon extensively to provide valuable information regarding the fate and transport of nutrients through the strata.

TIAER has implemented a watershed sampling program to monitor agricultural pollution abatement. As part of the watershed sampling concept, Map E illustrates how the sub-basins of the Bosque River watershed have been isolated by sampling sites to determine the nutrient loading contributions. TIAER currently has 24 monitoring stations throughout the watershed. These sites include six PL-566 structures, selected because they provide a stable body of water in an area where streams are almost exclusively intermittent. They act as settling basins for agricultural runoff and, where heavily impacted, exhibit characteristics of the cumulative effects of nutrient and other nonpoint pollutant loading. These sites were selected to evaluate areas with varying land use types.

Intermittent stream sites upstream of these structures are monitored to determine nutrient contributions to the water body. Sites downstream of the PL-566 structures are monitored to observe the assimilative function of the floodwater-retarding structures. Sites at the mouths of the main tributaries of the Upper North Bosque River are monitored to determine the agricultural pollution contributions from each sub-basin. The program also includes stations on the main
stem of the Upper North Bosque River below the Stephenville sewage-treatment facility, at the base of the watershed at Hico, Texas, and at a location between these sites that includes the impact of two intermediate tributaries. (See Map 1)

Routine monitoring of the basin began in April 1991 with the EPA approval of the TIAER Quality Assurance Project Plan. The first year’s data established baseline information that includes seasonal variations. Subsequent monitoring will allow season-to-season and year-to-year comparisons to be made with regard to improvements in water quality due to increased compliance. The Institute’s first complete sampling year, 1991, had the highest rainfall of record according to the National Weather Service’s measurements in The Dallas-Fort Worth area, which has the closest station reporting cumulative figures. Data from the wettest year must be compared with that from normal years to more accurately characterize the water quality in the watershed.

Five of the stream-monitoring sites are currently equipped with automatic water-quality sampling and flow-measurement devices that are activated by flow. This allows for sample and data collection on a continual basis over the time frame of stormwater runoff. The collection and laboratory analysis of these storm-generated samples is crucial to determinations of nutrient loading to the stream. While “grab” samples are effective in point-source pollutant determinations, they have limited usefulness in studying nonpoint pollu-
Varying distances from the contaminant source to the stream and varying flow rates make load determinations from grab sampling impossible. Continuous sampling on a flow-rate basis is required to determine nutrient loading to the stream.

An intensive study of two of the PL-566 structures is currently being conducted under USDA-SCS funding. One structure receives runoff primarily from pasture land with no dairies and limited cropland. This site provides the baseline data for water quality and serves as a reference site for ecological comparisons. The second PL-566 structure receives runoff from three permitted dairies and one unpermitted facility having a total of 1135 milking head.

This study is designed to develop a physical, chemical, and biological database that will identify long-term indicators of how effectively the agricultural industry is controlling nonpoint pollution. This project will monitor and evaluate the efficiency of BMPs and nutrient load reductions associated with their implementation. Agricultural practices upstream from these impoundments are reflected in the current water-quality status and associated changes in aquatic community structure. These impoundments act as oxidation ponds to assimilate nutrient loads from the watershed. When overloaded, classic pollution indicators are manifested: algal blooms, low dissolved oxygen concentrations, fish-kills and a shift in benthic community structure toward more pollution-tolerant organisms.

Preliminary data in Table 1 demonstrates the adverse impact waste disposal can have on these impoundments. Site #2, with no significant dairy or cropland influence, maintains low nutrient and chlorophyll-a concentrations. The most obvious difference between the two reservoirs is the depth of the photic zone, which represents the effective depth of light penetration that controls photosynthesis. The relatively deep photic zone of Site #2 allows the growth of rooted aquatic vegetation. Conversely, Site #9, with heavy agricultural impact, has a much shallower photic zone due to high concentrations of algae, as evidenced by excessive chlorophyll-a concentrations. Significant differences in nutrient concentrations in the inflow tributaries and the impoundments were observed.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Parameters Measured at Selected Reservoirs</th>
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<tbody>
<tr>
<td>Parameter</td>
<td>Site #2 Unimpacted</td>
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<tr>
<td>Nitrate Nitrogen (mg/L)</td>
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<tr>
<td>Ammonia Nitrogen (mg/L)</td>
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</tr>
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<td>Chlorophyll a (ug/L)</td>
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</tr>
<tr>
<td>Photic Zone Depth (ft)</td>
<td>8.00</td>
</tr>
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</table>

These impoundments are monitored to determine their assimilative capacity for nutrients in their respective watersheds. This information will pro-
vide the load reduction targets for BMP implementation necessary to maintain healthy aquatic ecosystem. Diurnal studies conducted seasonally by TIAER at each reservoir document significant differences in the daily fluctuation of dissolved oxygen. Low concentrations of dissolved oxygen are the primary cause of fish kills in small reservoirs. A diurnal study conducted in July of 1991 indicated a wide variation in dissolved oxygen concentrations, ranging from 12.2 mg/L during the day when photosynthetic activity is at its peak to 4.6 mg/L during the night, at highly impacted Site #9. In contrast, dissolved oxygen concentrations at Site #2 remained relatively constant with a range of 8.3 mg/L during the day to 6.3 mg/L at night.

The paired-reservoir study demonstrates the adverse impacts of excessive nutrient loading on the PL-566 impoundments and also demonstrates the manner in which these structures moderate the nutrient loading downstream. Average nutrient concentrations at upstream monitoring sites are significantly greater than within the reservoirs. This suggests that nutrient concentrations are modified both by biological uptake and sedimentation within the PL-566 structures. While both reservoirs are highly productive from an ecological standpoint, the nonpoint-pollution impacts are evidenced by changes in the biologic community structures of primary producers and benthic organisms. Differences in primary producers (those organisms capable of producing oxygen through photosynthesis) are quite apparent within the two reservoirs. Site #2, with little nonpoint-pollution impact, has a deep photic zone and is dominated by rooted aquatic plants with a smaller population of suspended algae. On the other hand, Site #9, with a shallower photic zone, is incapable of supporting a rooted aquatic plant community except in the shallow water around the periphery. This reservoir does, however, support a large algal community as indicated by the high chlorophyll-a concentrations. Algae, which are susceptible to abrupt environmental changes, can die quickly in great numbers. The ensuing decomposition uses available oxygen, resulting in fish kills.

The taxonomic identification and enumeration of benthic organisms (bottom dwellers) indicate a greater number of taxonomic groups within reservoir Site #2, with 20 families represented, as opposed to 12 families within reservoir Site #9. The classification of organisms into functional feeding groups, which represent various ecological niches within the particular habitat, can be useful in assessing the health of a community. The benthic organisms inhabiting Site #2 included a wider variety of feeding groups with greater uniformity in their distribution, which is indicative of a healthy biotic community, as compared to Site #9.

It is well documented that certain species of aquatic organisms are more tolerant of pollution effects. In highly impacted water bodies, the number of pollution sensitive organisms tends to decrease, allowing more tolerant organisms to dominate the community structure. The Ephemeroptera-Plecoptera-
Trichoptera (EPT) Taxa represents the number of pollution sensitive families within each reservoir, with six families observed in Site #2 as compared to four families within Site #9.

The stream monitoring stations are located on Map F. These sites are monitored on a monthly basis for physical and chemical parameters. Biological parameters are monitored quarterly at main stem stream sites and reservoir sampling stations. Additionally, stations on five of the intermittent streams are equipped with automatic water-sampling equipment capable of capturing data from rainfall runoff events.

Nutrient concentration information, coupled with flow data, can be used to derive loading rates, which are necessary to determine the full impact of downstream water quality and evaluate improvements due to BMP implementation. Although nutrient concentrations may fall within current stream water quality standards, they may represent high loading levels during periods of excessive rainfall. Conversely, high nutrient concentrations during periods of low flow may reflect low nutrient loading.

Stream nutrient concentrations generally exhibit a wider range of values following rainfall events when flow rates vary by several orders of magnitude. Instantaneous discharge values for the North Bosque River recorded at the USGS stream gage at Hico, Texas (TIAER monitoring Site #24) have ranged from essentially no flow to more than 27,000 cubic feet per second recorded during the historic floods of December 1991. Peak nutrient concentrations were generally observed within one hour following a rise in stream water level. This "first flush" phenomenon, which contributes significantly to loading rates, is difficult to detect using grab-sampling methodologies.

The observed loading rates for the Upper North Bosque River watershed varies considerably depending on the flow characteristics. The nitrate-loading rates calculated for January 1992 at Site #24 ranged from 3055 pounds per day during stable flow conditions to more than 9300 pounds per day following a storm event. Without accurate flow measurements, nutrient concentration values can often be misleading; the nitrate concentration quoted above was recorded at 1.29 milligrams per liter during the high loading period, as opposed to 2.95 during low flow conditions.

Future efforts will include the addition of several sampling sites to further delineate contributions to nonpoint pollution from municipal and industrial stormwater, cropland, dairies, and other sources. Monitoring will continue during the next four years to accomplish the following objectives:

• continue the surface-water quality monitoring program that defines the "natural" and assimilatory capacity of the stream and reservoirs within the study area;
• determine the water-quality degradation for surface and ground-water due to increased dairy populations, improper system design and con-
construction, inadequate management, and rainfall runoff that exceed the
design criteria;

- utilize models to simulate water-quality improvement as a function of
  predicted changes in land use, wastewater-disposal methods and
  adopted BMPs that minimize nonpoint pollution;

- propose alternative environmental and waste-management policy
  guidelines;

- establish criteria to determine air-quality standards related to CAFO
  nuisance odors;

- evaluate alternative BMPs for solid- and liquid-waste control.

**COMPUTER MODELING**

Mathematical modeling is an integral part of the TIAER research initiative.
Models are recognized as valuable tools in the analysis of water-resource issues
and can significantly improve the understanding of linkages between farming
practices and water quality. These simulation models are currently used by the
TIAER research staff to estimate the effects of existing and planned BMPs, thus
minimizing the uncertainty associated with the evaluation of nonpoint-pollution
impacts on surface and ground water.

TIAER is using Erosion/Productivity Impact Calculator (EPIC), a field-scale model, to estimate the effectiveness of BMPs. This model allows the
simulation of soil, weather, and management effects on the fate and transport of
nutrients for individual field areas. Model enhancements to accommodate simu-
lation of conservation practices such as filter strips, terraces and buffer zones are
currently being adapted for this model in cooperation with TAEX.

Utilizing the extensive weather and soil data available for the Erath
County area, the EPIC model will be used to evaluate the various management
options relating to crop production and waste-disposal issues. Soil type, slope,
and weather patterns for each specific area are used in the model. A multitude of
options available for each area include decisions relating to the crop type and
rotations, timing and frequency of harvests, and timing, frequency and quantity
of waste and fertilizer applications. The collection of actual physical data for all
combinations for evaluation is virtually impossible. Computer models, however,
can effectively evaluate the available options and aid in the selection of those
combinations that reduce nonpoint-source loads while maintaining high levels of
crop production. EPIC model applications to specific areas will facilitate the
adoption and implementation of those practices that are most effective in reduc-
ing nonpoint-pollution loads.

TIAER is using Simulator for Water Resources in Rural Basins-Water
Quality (SWRRB-WQ) to simulate the current watershed loadings and predict
load reductions achieved through BMP implementation. While EPIC predicts
surface runoff and nonpoint pollution for field areas, SWRRB-WQ operates
A comprehensive study of two small watersheds within the Upper North Bosque drainage basin is being performed in conjunction with the 319 surface-water monitoring program to provide calibration data for watershed modeling. This research, funded by SCS, monitors runoff loads from each watershed and the associated responses of the PL-566 reservoirs. Validation of the SWRRB-WQ model will allow the expansion of modeling activities to larger geographical areas for the assessment of watershed-based nonpoint-pollution loadings.

TIAER has initiated cooperative research programs with model developers at Blackland Research Center, TAEX, and SCS to enhance current EPIC-WQ and SWRRB-WQ model capabilities. These enhancements will permit the simulation of conservation practices such as filter strips and buffer zones; provide for the validation of vadose zone transport components of EPIC; and allow for the simulation of PL-566 reservoirs and their effects on downstream water quality.

The Institute’s Compliance program is a multifaceted approach that encourages compliance with TWC regulations through the use of educational seminars, one-on-one technical assistance, and demonstration projects. An important component of this work involves evaluating the effectiveness and economic feasibility of current and innovative BMPs. The program also includes a Dairy Compliance Survey to monitor the degree of regulatory compliance through the implementation of BMPs.

Compliance Survey
TIAER’s Dairy Compliance Survey was initiated to determine the degree of compliance with TWC regulations for permitted and non-permitted dairies in the Upper North Bosque River watershed. It is a critical component of the TIAER monitoring program that parallels surface water monitoring. As water monitoring determines the degree to which water quality does or does not improve during the next four years, the survey determines how both compliance and management practices affect that process. If water quality does not significantly improve with time, the survey can delineate whether it is due to compliance failures or ineffective BMPs. The survey must be continued to provide the statistical base necessary to analyze these cause and effect relationships.

The survey monitors compliance improvements through time and detects how external factors such as cumulative rainfall events affect compliance. This survey records environmental structural controls such as lagoons, waste-management practices, such as buffer-zone maintenance, and record-keeping for waste application on a regular basis. Using survey information, improvements in compliance can be tied to load reductions in receiving waters.

The Dairy Compliance Survey is voluntary. It is conducted monthly for...
permitted facilities and on a quarterly basis for non-permitted dairies. Of the 45 permitted operations in the study area, 37 have elected to participate in the ongoing survey. Of the 49 non-permitted dairies, 43 participate in the survey.

**PERMITTED DAIRIES**

Initial results from the survey indicate that while adequate containment facilities are in place on permitted dairies, the proper management of these structural controls and subsequent disposal of the wastes pose a greater challenge in the abatement of agricultural pollution. Although the implementation of structural BMPs, such as containment lagoons, requires a substantial capital investment, the management of these structures requires continual monitoring and careful planning on the part of the producer, and is equally important to nonpoint-pollution abatement goals. The survey of 37 permitted facilities during October 1991 documents that all have control structures for point-source discharges from the milking parlor, and 97 percent have control structures for nonpoint-pollution runoff for open corral areas.

The percentage of permitted facilities maintaining adequate freeboard in final lagoons ranged from a low of 32 percent in February 1992 to a high of 88 percent in July 1991. The greatest number of discharges from containment lagoons was also recorded in February 1992, following the unusually heavy rainfall from December 1991 through February 1992.

Compliance with proper wastewater-disposal methods was also observed on a monthly basis. The degree of compliance ranged from 100 percent in November 1991 to a low of 64 percent in February 1992. Observations for wastewater disposal are limited to noting whether wastewater is applied to saturated or frozen fields and whether it results in ponding, puddling, or runoff. Visual observations preclude determinations of proper application rates for crop nutrient uptake. Observations for the maintenance of buffer zones were the lowest in January 1992, with a 31 percent compliance rating. It should be noted that percentages are based on the number of dairies observed disposing of wastes, rather than on the total number of dairies surveyed.

Compliance with proper solid-manure disposal techniques, indicated by application on perennial crops with buffer zones or on annual crops with manure disced into the soil, ranged from less than 30 percent up to 90 percent. TWC currently requires that manure application on annual crops be disced within 48 hours of application. The survey observation of manure application documents whether manure was disced in at the time of observation, not that it was disced in within the 48-hour time period following application.

Relatively low compliance percentages, less than 50 percent, were recorded in the areas of record keeping and soil analyses. Additionally, less than 25 percent of the dairies surveyed were observed to have freeboard markers or staffs in their final containment lagoons. In response to these low compliance observations, TIAER concentrated its educational and technical assistance
programs in these areas. A computer software application was developed by TIAER and distributed to assist producers in maintaining accurate waste-disposal and soil-analysis records. Following extensive educational efforts, the percentage of dairies maintaining waste-disposal records increased by 42 percent. Similarly, the percentage of dairies performing annual soil analyses on waste-disposal areas increased by 31 percent.

The increase in the number of dairies maintaining waste-disposal records is encouraging. A question, however, in a TIAER survey of area dairy farmers, designed to gauge the producers' knowledge of the amount of manure and nitrogen applied to fields, indicated that less than ten percent could quantify the amount of manure applied. Future educational efforts should focus on methods for determining amounts of manure and nitrogen available for use in waste-management or crop-production decisions.

Lagoon management, such as the proper installation and placement of freeboard markers and proper fencing, is important for the protection of ground water and surface water. Maintaining adequate freeboard for the containment of runoff from the 25-year, 24-hour storm event, as required by TWC, is difficult if not impossible to monitor without the aid of lagoon staffs and could result in the unauthorized discharge of wastes. Fencing of lagoons to prevent access to livestock is also a required by TWC to protect the integrity of the in-situ or placed clay liner. This particular aspect of lagoon management is very important because violations of this provision may increase the potential for ground-water contamination.

NON-PERMITTED DAIRIES

The compliance survey, conducted quarterly for non-permitted dairies, indicates that 62 percent have structural controls for containment of milking-parlor wastes and 40 percent have similar structures for the containment of nonpoint-pollution runoff from open-lot areas. Although 62 percent have structural controls in place and 74 percent provide adequate barriers to prevent the access of livestock to lagoons, only one facility had freeboard markers installed in final lagoons. Economic factors pose a major obstacle to the implementation of waste-containment structures, particularly for smaller, unpermitted operations. Financial assistance is currently available to producers through federal cost-share programs to defray some of the costs. However, waiting periods of up to two years are common for technical assistance requests for design and implementation of management plans.

The percentage of non-permitted dairies maintaining adequate freeboard ranged from a low of 28 percent during the first quarter of 1992 to 74 percent in the summer of 1991. The greatest number of discharge violations was recorded during the first quarter of 1992, with 10 dairies (40 percent of those with containment structures) exhibiting evidence of discharge.

The compliance survey also allows for the documentation of manage-
ment-practice implementation throughout the study period. The results tabulated for non-permitted dairies also show an increase in those maintaining waste-disposal records and performing soil analyses with an increase of greater than 25 percent for each. The compliance increases are thought to be a direct result of educational activities by TIAER and other state and federal agencies to increase producer awareness of BMP effectiveness in addition to regulatory requirements.

Compliance survey results related to wastewater containment varied considerably with weather conditions for permitted and unpermitted facilities. This indicates that TWC regulations and design capacities for lagoons are inadequate for "back-to-back" rainfall events. Area dairy farmers are vulnerable to TWC enforcement during closely spaced rainfall events. Although dairy farmers can be in compliance with TWC rules and design standards, they may still violate the no-discharge policy during back-to-back rainfall events.

**BMP Evaluation**

In order to provide technical assistance and promote BMP implementation through educational efforts, the Institute must continually evaluate current and new technologies with regard to their application and effectiveness on different dairy operations. The study area contains three distinct types of dairy operations:

- **Pasture-type operations** where the herd is driven from pasture to milking-parlor -- These operations require only small lagoons for process water from the parlor;
- **Open-lot operations**, in which the herd is kept in a confined area -- These operations must contain process water and rainfall runoff from corrals and also manage solid wastes that accumulate in the corrals;
- **Free-stall barns**, which house milking herds under a roof so that runoff from corrals is eliminated -- Free-stall operations often use recycled process water from the lagoon to flush the barns.

BMPs and technologies for each type of operation require management of liquid and solid wastes, which has become the major environmental issue for CAFOs across the country.

Wastewater management must include collection and containment of the parlor process water and rainfall runoff from the confined feeding area. In order to manage wastewater better, dairy operators must focus on reducing the volume of water by decreasing the corral area and installing structural diversions to prevent water from running onto the corrals. These practices are being illustrated through TIAER demonstration projects.

Guttered free-stall barns, illustrated on the following page, can eliminate the need to contain corral runoff and ease waste-management problems. While free-stall barns have been widely used in other regions of the country, they have not yet gained broad acceptance in Texas. Only one free-stall dairy, housing a herd of 1200 cows, is currently in operation in the study area. A second one, planned for 200 cows, is currently under construction as part of a TSSWCB &
TIAER cooperative demonstration project. This project will demonstrate the effectiveness and economic feasibility of a free-stall operation for the small dairy.

Water-conservation technologies to reduce process wastewater should also be considered in waste-management planning. TAEX, under its 319 grant, demonstrated conservation practices that include water reuse and recycling on four permitted dairies in the study area. These practices can greatly reduce the required lagoon capacity, an advantage when constructing containment lagoons under current stricter criteria.

Wastewater-management practices should also concentrate on reducing the nutrient loading to lagoons in order to prevent the build-up of solids in the lagoon and to facilitate microbial degradation of wastes before land application.

The build-up of solids reduces the lagoon’s holding capacity and requires costly dredging procedures. Because dredging can jeopardize the integrity of the lagoon liner, the liner must be recertified following the procedure. The Institute is currently evaluating the effectiveness of different solid-separating systems. One TIAER demonstration project is implementing a solids settling basin and another is utilizing a hydrocyclone-type separator to reduce organic loading to the lagoons.

The TWC regulations prohibit irrigation on saturated or frozen fields as a
method of increasing lagoon freeboard. During periods of cumulative rainfall, it becomes increasingly difficult for dairy operators to meet this regulation. This makes lagoon management a critical part of the waste-management plan. Lagoon staffs capable of accurately monitoring freeboard are an essential part of this management. TIAER is using several demonstration projects to show the construction, installation, and effectiveness of this management tool.

The Institute is examining the possible use of other options such as constructed wetlands and rock-reed filter systems for wastewater treatment. These systems might be designed to treat wastewater to a degree that would allow either re-use or possible discharge if stream water quality standards are met.

Wastewater that has been treated through anaerobic digestion in lagoons, is applied to fields as part of the waste-management program. Application fields and crops must be able to accept liquid or solid waste at a rate that is sustainable. While the TWC provides crop nutrient-demand information to aid the dairy farmer in determining application rates, this information should be updated to include new hybrid species currently in use. TIAER is developing a partnership with the local Texas Agricultural Experiment Station to conduct this research.

Proper waste-management dictates conservation practices that will maintain both soil and

\[ \text{Diagram of Open Lot Dairy} \]

\begin{itemize}
  \item \text{Solid Disposal}
  \item \text{Liquid Disposal}
  \item \text{Grass Waterway}
  \item \text{Filter Strip}
  \item \text{Buffer Zone}
\end{itemize}
wastes on the field. The use of edge-of-field grassed filter strips, terraces, and grassed waterways serve to reduce erosion and abate agricultural pollution. Grassed buffer zones around field perimeters are required to absorb excess wastewater and prevent discharge. TIAER is using a complement of these practices on all demonstration projects.

In addition to structural controls, record-keeping is a prime management practice to ensure compliance with current regulations. Records of lagoon capacity, application rates and amounts for liquids and solids disposal fields and soil analyses are essential for effective waste management. The implementation of structural controls without commitment to maintenance and operation of facilities can only result in breaches of pollution-abatement requirements. TIAER has developed a computerized waste application record-keeping program being distributed to area dairy farmers to aid in proper waste management.

Low cost, low technology solutions for waste management need to be developed and demonstrated for operators of dairies with less than 250 head. Some of these options include:

- **Overland flow** of wastewater over crops--Crop and soils should be capable of nutrient uptake without undue percolation below the root zone.
- **Constructed wetlands** for secondary treatment when available disposal land is limited or soil is inadequate for healthy crop production;
- **Oxidation ditches** as a secondary treatment alternative.

These and other innovative waste treatment alternatives need to be evaluated. TIAER is currently seeking cooperators to evaluate these alternatives.

**EDUCATION AND TECHNICAL ASSISTANCE**

Educational and technical assistance efforts of the Institute focus on the implementation of BMPs necessary to achieve compliance with the TWC no-discharge policy. The Institute, under its 319 project, has conducted seven educational seminars that focused on existing and new technologies and practices that aid in compliance. Topics ranged from guidance on accurate measurement of waste-application rates to new technologies for waste treatment such as constructed wetlands. The Institute has provided technical assistance to numerous dairy operators, including recommendations for BMP implementation that consider siting conditions and the type and size of dairy operation.

TIAER initiated three on-farm demonstration projects in cooperation with the TSSWCB and SCS that provide small-dairy farmers with guidelines and recommendations to implement waste-management plans. These on-going demonstrations, using BMPs discussed in the previous section, stress wastewater reduction, proper lagoon design, and proper management, resulting in compliance with the no-discharge policy of the TWC regulations. The Institute conducted two field days to allow area dairy operators to observe the effectiveness of these practices.
The Institute is also exploring alternatives to land application of solids to reduce nonpoint-pollution loading. Composted manure becomes a marketable product for the dairy operator instead of a liability. In addition to on-farm composting, which presents problems in quality control and marketing, TIAER is working to bring a regional composting or manure-sterilization plant to the area.

TIAER is working with the City of Stephenville to determine the feasibility of establishing a regional compost facility that could include forging partnerships with other municipalities. The city, having voted recently to close its landfill, considers composting its most viable alternative to solid-waste disposal. The city is now considering plans to utilize dairy manure and Associated Milk Producers, Inc. cheese plant wastewater to increase the quality of its compost and produce a more marketable product. They are also considering options to compost solid waste and manure as separate operations that will result in products of different grades.

Another challenge in abating agricultural pollution lies in prescribing new policy initiatives and institutional arrangements. Elements from current policies and institutions should be incorporated with innovative ideas, yielding proposals with a high probability for success in meeting environmental objectives. They should also meet the needs and capabilities of agricultural enterprise, and be affordable to the industry and the taxpayer.

Innovative solutions can best be developed in an environment where all affected interest groups are empowered through information and are provided a seat at the table where policy issues are debated and recommendations formulated. Democratic processes, fundamental to the establishment and implementation of policy, must be recognized and utilized by research groups charged with making policy recommendations. The research groups should be multi-disciplinary, reflecting the highly interrelated nature of questions of science, policy and institutions.

The vehicle utilized by TIAER to serve these functions was the Committee for Constituency Development (CFCD). Members reflected the broad range of interest groups associated with the problem. Dairy farmers anchored one pole of interest in the CFCD, while environmental groups and concerned neighbors of dairy farmers anchored the other. The goal of the CFCD was to reach consensus on as many issues as possible. The Committee was chaired by State Senator Robert Glasgow, who has a long history of involvement regarding agricultural pollution. The Chair, in groups of this nature, must have the ability to make a difference in governmental outcomes.

The following figure illustrates the workplan adopted to accomplish the policy and institutional research objectives.

The first year of the program was spent in the empowerment process, developing an understanding of the issues related to science and policy. The
second year focused on prioritizing issues and developing recommendations. Issue priorities were first discussed in general by the entire CFCD. Issue refinement and recommendations were then developed through separate focus groups composed of local dairy farmers and concerned citizens (See Appendices A, B, and C). Recommendations of both groups were presented to the full CFCD for their discussion.

There was significant success with the CFCD process but there were also limitations. The goal of establishing meaningful dialogue through an empowerment process went well for the first eighteen months. Problems arose when the Chairman of the TWC initiated independent dialogue with lobby groups representing agriculture, but not with the concerned citizens of the area. Even though a number of important issues of consensus were reached, this aberration caused concerned citizens to consider themselves no longer empowered and they resorted to lawsuits, in association with the Lone Star Chapter of the Sierra Club, against a number of dairies in the Erath County area.
MAJOR POINTS OF CONSENSUS

1. INCREASED GOVERNMENTAL PARTICIPATION

The dairy industry and concerned citizens recommended a stronger governmental presence in Erath County. TWC and TACB, the Texas counterparts to EPA, have no local offices. They do not provide substantial technical assistance, nor do they regard this as a part of their job. During the past two years, the TWC has shown considerable reluctance to commit to local involvement. They understand that, as more of agriculture is required to be in compliance with state environmental objectives, the cost for local enforcement and technical assistance will be prohibitive. The two focus groups, however, requested a local office for enforcement officials so that complaint issues can be dealt with more rapidly and decisively.

A routine TWC inspection program, similar to that used by the Texas Department of Health, was called for by both groups. This program would alleviate much of the need for the complaint-driven system, which is liked by neither side. Proper training of TWC inspectors was a requirement mentioned by all parties.

Local government participation in environmental programs outside city limits is a major problem for state regulatory agencies. Texas counties have no ordinance-making power and little prospect that the state legislature will grant them this authority in the near future. Without this power at the local level, the responsibility for providing technical expertise and resolving disputes concerning spatial land-use issues remains with TWC and TACB regulatory authority. The dairy farmers and the concerned citizens agreed that initial local resolution of complaints is preferable to decisions from state agencies.

2. EXPANDED ROLE FOR TSSWCB

Dairy farmers and concerned citizens in the CFCD recommended that the TSSWCB, through its local Soil and Water Conservation Districts, assume a greater responsibility for bringing unpermitted dairy farmers into compliance with TWC regulatory programs. The USDA has the personnel in place to provide assistance needed by small farmers. The TWC has the necessary regulations and enforcement programs to ensure smaller farmers move into USDA type voluntary programs. Improved policies and institutional arrangements are necessary ingredients for successful abatement programs. (See Appendix E.)

The TSSWCB must be properly funded to be effective in this program. Although the Board cannot assume regulatory authority because of constitutional problems, it can initiate innovative strategies, in concert with TWC regulatory and enforcement programs, to provide incentives for voluntary compliance. Those farmers choosing not to voluntarily comply with TSSWCB plans would be brought into the expensive TWC administrative law/adversarial regulatory program. Those farmers who do not maintain compliance would be
subject to the TWC complaint-driven regulatory procedures. The details of the proposed new compliance program would be developed in an Erath County pilot program currently under discussion by TWC and TSSWCB.

3. REGULATIONS AND COMPLIANCE

The two groups also agreed that all dairy farmers should be brought into compliance with environmental objectives. TIAER, through on-going economic research, has determined that the average small-dairy farmer is not financially strong. The Institute recommends that regulatory authorities focus their efforts on operations posing the greatest environmental risk. They should also consider the availability of economically feasible BMPs and the capacity of USDA agencies and their state counterparts to provide technical assistance, low-interest loans, and cost-share programs.

The groups agreed that the no-discharge rule under which dairies currently operate should be reviewed to identify production practices, treatment facilities, or technologies that meet established discharge standards, thereby qualifying for discharge into public waters. The rationale is twofold:

1) The increase in industry-sized dairies generates the potential for clustering these operations and using production practices and technologies which could effectively and economically treat wastewater for discharge; and

2) through enhanced treatment of wastewater from dairies located on large tracts of land, particularly in higher rainfall areas, discharge standards may be met.

Other points of consensus include the need for improved siting practices for new dairy operations and measures to assist dairy farmers with the economic burden of coming into compliance with environmental regulations.

Two issues revealed major disagreement between the groups. The concerned citizen group proposed a moratorium on the siting of new, large dairies in Erath County until better rules are developed by the TWC and used to bring existing dairies into compliance. Dairy industry advocates were incensed at this recommendation and, after noting some support for the proposal from the CFCD, began an intensive county wide campaign to express support for the dairy industry. The Institute has maintained that moratoriums are a poor means of achieving policy objectives and should be considered only after state regulatory authorities have failed to achieve acceptable levels of pollution abatement.

The other point of major disagreement focused on the adequacy of current TWC regulations to solve pollution problems. The TWC proposed new rules in the fall of 1991. The Cross Timbers Concerned Citizens supported new rules, while area dairy farmers and other agricultural interest groups opposed changes. Ultimately the TWC rescinded the proposed new rules until further evaluation was made.

It is important that the effects of the TWC's currently recommended
BMPs be evaluated. The BMPs, however, must be in place before their effectiveness can be determined, so the Institute has maintained that the most important step the TWC can take is to properly enforce existing rules. It is imperative that the degree of compliance be determined during the term of the monitoring program. If pollution levels do not decline, there will be the inclination by regulatory agencies to move to more stringent and costly BMPs when perhaps the problems lies with enforcement and not the BMP. Results of TIAER's research should determine whether the problem lies with the adequacy of the BMP or with the compliance of dairy farmers.

The question of new rules, however, seems to be a moot point. EPA Region 6 has produced a set of general rules and has announced public hearing dates. Area dairy farmers recognize that new rules are inevitable, but are striving to prevent the inclusion of what they consider particularly onerous provisions. This activity by EPA Region 6 is in keeping with proposals being discussed in the Washington EPA headquarters. A recent draft report by EPA, points out that "livestock waste may account for up to 20 percent of water pollution nationally. Ultimately EPA will determine the current and potential effectiveness of NPDES and other programs in controlling feedlot waste." The report goes on to conclude that "livestock waste poses a significant threat to water-based ecosystems, often causes large economic damages that can take years to reverse, and poses a number of threats to human health. Given the widespread nature of the pollution and the severity of the impacts resulting from poor management of waste, EPA must insure that its NPDES program is being implemented adequately and that it should undertake additional measures to assure protection of all media, including ground-water and air resources" (Long, (Draft), 1992).

The goals of the 319 project, now realized, will anchor the integrated, multidisciplinary effort required to successfully engage the long-term objectives of the Institute. Beginning in September 1992, the NPP will enable a team of research organizations, universities, environmental and agricultural interest groups to extend and broaden TIAER's research objectives to encompass national livestock-pollution issues. The NPP will allow this integrated research effort to establish a working prototype that can contribute to a national paradigm.
I. FUNDING SOURCES TO AID IN COMPLIANCE

1. GOVERNMENTAL SUPPORT PROGRAMS
   - Should be managed more efficiently to avoid delays in implementation;
   - Qualifications, timing, and other cost-share requirements should be reviewed to make the programs more workable; could be modeled after programs that work in other states; private contractors might design management plans to accelerate implementation;
   - Better coordination between USDA and EPA initiatives for pollution abatement would lead to more efficient use of funds.

2. LOW-INTEREST LOANS
   - Should be guaranteed by the State for the good of both the environment and dairy farmers.

3. INCENTIVE PROGRAM FUNDED BY DAIRY PROCESSORS TO PROVIDE INCREASED MILK PRICES PRODUCERS WHOSE DAIRY OPERATIONS MEET SPECIFIC ENVIRONMENTAL CRITERIA.
   - Should be done nationally;
   - Needs to be studied more thoroughly;
   - Must be implemented so it does not end up costing farmers money in the long run;
   - Could be used to enhance the image of producers and vendors;
   - Needs to be coordinated carefully with relevant producer organizations.

II. PRESENT REGULATORY SYSTEM

1. INSPECTIONS
   - More inspectors and inspections are needed;
   - Inspections serve to increase compliance;
   - Inspection record can establish a history of compliance;
   - Inspectors should be properly trained for dairy compliance work;
   - Monthly TDH and TWC inspections could be combined.

2. DISCHARGE
   - Key concepts, such as “discharge” and “clean water”, should be defined more clearly;
   - Research should be directed to determining conditions under which discharge may be tolerable. For example, the ecosystem should be able to assimilate some discharge when the cumulative rainfall is greatly above normal levels. Discharge of water meeting minimum standards should be allowed;
   - Individual dairy operators should be given flexibility in developing compliance strategies;
   - Experimental permits should be allowed to encourage new methods of dealing with wastewater.

3. COMPLIANCE
   - Dairy farmers should comply with TWC regulations and related permits;
   - National standards for compliance should be applied, subject to implementation by the states;
   - Standards should be applied evenly throughout each state.

4. COMPLAINTS
   - Only neighbors within a minimum distance from a dairy should be able to make complaints; a one-mile radius is suggested;
   - The foundation for the compliance system should not rest on complaints; but it should be recognized that complaints will inevitably be part of the system.
A process for resolving complaints at the local level is needed. There should be some type of accountability for making frivolous claims which end without a violation being found; it is expensive for the TWC to follow up on all the unsubstantiated complaints. It should be recognized that most complaints concern flies and nuisance that are not related to water quality. The complaint system leads to selective enforcement; therefore, a regular inspection system should be implemented.

III. PROPOSED CHANGES AND RELATED ISSUES

1. NEW REGULATIONS
   - New regulations should not be approved until it has been shown that proper implementation of the old regulations does not adequately solve pollution problems. Dairy farmers from operations of all sizes need to work together to come up with workable solutions for implementation issues.
   - Liaison personnel from governmental entities should be available to work out complaints, and local administrative processes should be available when that fails.

2. SITES FOR NEW DAIRIES
   - Real estate practices should include thorough site investigation prior to purchase for dairy purposes; this should be encouraged with professional real estate organizations, lending institutions, and through governmental loan programs.
   - Real estate contracts of sale should contain a clause alerting the potential buyer to the State permitting process.

3. NON-DAIRY POLLUTION
   - The Water Commission should have an even-handed policy for addressing the environmental problems typically associated with dairies; pollution of water in our area comes from many sources.
   - Dairies should be fined no more rigorously than other sources of water pollution, including municipalities.

4. EDUCATION
   - Education about both dairies and environmental issues is a necessary element of the overall environmental protection effort.
   - The economic impact of the dairies should be included in the educational process.

5. COMPLIANCE
   - A voluntary compliance program for non-permitted small dairy farms that could comply with TWC rules and regulations without going through the administrative law process.
   - This voluntary program could be administered by the TSSWCB, the state agency with agriculture NPS pollution authority.
   - The TSSWCB could provide educational support, technical assistance and incentives which would enable the agricultural sector to move into compliance.
   - Dairies who do not voluntarily comply will be subject to traditional TWC regulatory process.
B: CONCERNED CITIZENS FOCUS GROUP RECOMMENDATIONS

I. FUNDING SOURCES FOR WASTE MANAGEMENT

1. LOW INTEREST LOANS
   • Low-interest loans would support improved compliance.
   • Funding for low-interest loans is limited. Use of these funds to support new dairies should be avoided, as this will dilute the supply of funds for existing sites which have compliance problems.

2. COST SHARE FUNDS
   • Cost-share programs, funded by the SCS and others, should be expanded. More personnel and funds are needed to address waste issues.

3. PRIVATE SECTOR INCENTIVES
   • There have been proposals for milk processors to pay enhanced milk prices to producers meeting specified environmental compliance criteria. In general, this appears to be a potential boon to large dairies that, under a well-managed environmental program, would presumably already be in compliance. The idea seems to resemble a subsidy program designed to help small producers, but which results in helping the larger operations.

II. PRESENT REGULATORY SYSTEM

1. INSPECTIONS
   • Routine inspections to observe the day-to-day operations of dairies should be part of the regulatory program.
   • Inspectors need specific training in the area of dairy compliance with wastewater regulations;
   • If dairymen are in compliance with regulations, they should not object to inspections;
   • Frequency of inspections should be related to size of dairy and to compliance history.

2. DESIGN OF WASTE MANAGEMENT PLANS
   • The present regulations do not adequately address waste system engineering criteria and management practices;
   • Dairies complying with specific rules can still discharge due to both inadequate rules and poor management;
   • Inadequacy of current rules impedes effective enforcement of “no discharge.”

3. COMPLIANCE CRITERIA
   • Performance objectives may reasonably vary according to dairy size and other environmental risk factors. The rules should take into account the quantitative and qualitative differences between large and small dairies.

4. ENFORCEMENT AND THE COMPLAINT SYSTEM
   • Enforcement is currently the only check against poorly engineered waste systems and improper management practices.
   • There should be a larger Water Commission staff of trained enforcement personnel available locally in the principal dairy centers of the State.
   • Standardization of enforcement fines, both as to the amount of the fines and the conditions under which fines will be levied, must be part of the program. The level of the fines under this standardized scheme should properly reflect the magnitude of the environmental risk or severity of rule infringement.
III. REGULATORY CHANGES AND RELATED ISSUES

1. NEW REGULATIONS REQUIREMENTS
   • Design and certification of waste management facilities by professional engineers and approval by TWC engineers;
   • Ground water protection of lots, storage areas, silage;
   • Greater distances of application fields and lagoons from wells;
   • Increased buffer zones to abate water and air pollution;
   • Liner installation specifications and in-situ permeability testing;
   • Standards for air quality;
   • Increased acreage for disposal of wastes;
   • More emphasis on BMPs—buffer zones, filter stripes, terracing, etc.;
   • Incorporation of windrose charts into siting criteria.

2. LOCAL RESOLUTION OF NUISANCE ISSUES
   • A peer group at the local level should be formed to address problems as they develop. This peer group should be tied to local government; perhaps under leadership of a county judge, and should include a representative cross section of the County.

3. NEW DAIRY SITES
   • Halt in new permit issuance until new rules are adopted;
     Necessary for new permits (>250 head) and herd increases;
     Necessary until we get rules in which we have confidence and an enforcement process that works;
   • Need to determine impact of dairies on ground water before increasing herd density in the area;
   • New dairies risk having to retrofit facilities installed before new regulations are in place.

4. POLLUTION ISSUES
   • The Water Commission by rule should designate aquifer recharge areas as lands unsuitable for dairying and prevent new sites from being developed in those areas.
   • Each application should include an environmental impact assessment, which may be based upon documentation developed through government research and site-specific conditions. The assessment should consider the cumulative impact of dairying in the area, and should adequately consider the suitability of the site.

5. EDUCATION
   • Certification in waste management practices should be a pre-requisite of site permitting.

6. DEVELOPMENT
   • Support development of compliance programs coordinated by TIAER, BRA, and SCS for small (<250) dairies that minimize the economic burden of compliance and consider:
     • Enhanced availability of cost-sharing;
     • Extended time frame for compliance;
     • Development of innovative, low-cost waste management technologies.
     • Special research permits to test new management practices should be allowed insofar as they represent valid research and are not just a loophole.
FUNDING SOURCES TO AID IN COMPLIANCE*

GOVERNMENTAL SUPPORT PROGRAMS (COST SHARE)
✓ Support programs should be expanded with more funding and more personnel;
✓ Support programs should be operated more efficiently to avoid delays in awarding funds to qualifying dairies.

DAIRY FARMERS
• Qualifications, timing, and other cost-share requirements should be reviewed to make the program more workable;
• Better coordination between the USDA and EPA initiatives for pollution abatement would lead to more efficient use of funds.

CONCERNED CITIZENS
• Cost-share programs should be expanded specifically for smaller, existing dairies.

LOW-INTEREST LOANS
✓ Low-interest loans support improved compliance, and are therefore beneficial to the environment;

DAIRY FARMERS
• Low-interest loans should be guaranteed by the State;

CONCERNED CITIZENS
• Funds for low-interest loans are limited, so they should be available for existing dairies only;

PRIVATE SECTOR INCENTIVES
✓ Support improved compliance through bonuses or rebate program for producers whose dairy operations meet specific environmental criteria.
✓ More thorough study should be done before implementation of incentive programs.

DAIRY FARMERS
• Must be coordinated with relevant producer organizations;
• Incentive programs must be implemented so the farmer does not pay more money in the long run;
• The programs should be implemented nationally to keep a level playing field;

CONCERNED CITIZENS
• Must be coordinated with the government participants in the market;
• The incentive program may end up like subsidy programs which help large operations more than small ones.

* CHECKS INDICATE ITEMS OF CONSENSUS
## INSPECTIONS

- More inspectors and inspections needed;
- Routine inspections could reduce complaints and avoid selective enforcement;
- Increased inspections are preferable to complaints;
- Proper training of inspectors is essential.

### DAIRY FARMERS
- Monthly TWC and TDH inspections could be combined;

### CONCERNED CITIZENS
- Frequency of inspections should be related to size of dairy and compliance history;

## PERMIT REGULATIONS AND COMPLIANCE

- All dairy farmers should comply with TWC regulations and related permits;

### DAIRY FARMERS
- Research should be directed to determine conditions under which discharge may be tolerable;
- Individual dairy operators should be given flexibility in developing compliance
- National standards for compliance should be applied; standards should be applied evenly throughout the state;
- Key concepts such as "discharge" and "clean water" should be more clearly defined
- There should be some type of accountability for making frivolous claims which end without a violation being found; it is expensive for the TWC to follow up on numerous unsubstantiated complaints.

### CONCERNED CITIZENS
- Poor management, inadequate system design, and regulations that are too lenient can allow a dairy to discharge, even though it is in compliance.
- Present regulations do not adequately address waste system engineering criteria and management practices;
- Compliance criteria could vary according to dairy size and other environmental risk factors;
- Standardization of enforcement fines (both for amount and conditions) must be part of the program;
- Fines should reflect the magnitude of the environmental risk and the severity of rule infringement;
- Response time for complaints should be improved; TWC staff should be available locally in the principal dairy centers of the State.
- Increased numbers of trained inspectors would improve enforcement resulting from complaints.
NEAR REGULATIONS

DAIRY FARMERS

New regulations should not be approved until it has been shown that proper implementation of the present regulations does not adequately solve pollution problems;

• Only neighbors within a minimum distance from a dairy should be able to complain.

CONCERNED CITIZENS

New regulations are necessary for the following reasons:
• Rules are needed that inspire confidence and can, therefore, reduce confrontation in the community;
• An effective enforcement process must be included;
• Impacts of the existing herd density to the ground water are not yet known.

The new regulations should contain the following criteria:
• Design of waste water facilities by a professional engineer and approval by a TWC engineer;
• Ground water protection, including lots, storage areas and silage, and proper spacing of wells;
• Linear installation specifications;
• In-situ permeability testing;
• Air quality standards, including coordination with water protection measures that adversely impact air resources;
• Windrose charts included in dairy siting criteria;
• New regulations should be in place before any new permits are issued; however application and site investigations should be accepted during the interim;
• Emphasis on best available technologies and management practices;
• Operations criteria, including regular soil testing and monitoring of application rates and conditions.

SITING ISSUES

• Real estate practices should include thorough site investigation prior to purchase for dairy purposes;

• Each application should include an environmental impact assessment, which will include the cumulative impact of dairying in the area;
• Real estate contracts of sale should contain a clause alerting the potential buyer to the State permitting process;

• Aquifer recharge areas are unsuitable for dairying; no new dairies should be allowed in recharge areas;

NUISANCE ISSUES
✓ A process for resolving complaints at the local level is needed.

DAIRY FARMER
• Liaison personnel from governmental entities should be available to work out complaints, and a local administrative process should be available if that effort fails;

CONCERNED CITIZENS
• Local peer groups tied to local government should be used, perhaps under the leadership of a county judge, and should include a representative cross section of the county.

EDUCATION
DAIRY FARMER
• Education about both dairies and environmental protection efforts should be made public.
• The economic impact of the dairies should be included in the educational process.

CONCERNED CITIZENS
• Certification in waste management practices should be a prerequisite of site permitting, similar to other professionals working with wastes, with required refresher courses.

COMPLIANCE PROGRAMS
✓ A voluntary compliance program for non permitted small dairies would be beneficial; TSSWCB or perhaps the BRA could administer the program, providing educational support, technical assistance and incentives which would enable the agricultural sector to move into compliance;
✓ Dairies who do not voluntarily comply will be subject to traditional TWC regulatory process.
✓ Experimental permits should be allowed.

DAIRY FARMER
• Experimental permits encourage new methods of dealing with waste water.

CONCERNED CITIZEN
• Experimental permit issued only for valid research; must not be simply a loophole.
Much of the conflict in the area relates to the siting of new dairies and is tied to the “Not in My Back­yard” (NIMBY) syndrome. Proposed solutions include buffer zones, innovative technology and production practices, agricultural parks, and acceptance of natural consequences of agricultural practices. These are more fully explained below.

1) Buffer zones and land use/spatial considerations
   a) current practice: voluntary selection by dairy owners of sites that leave sufficient buffers between proposed operations and neighboring landowners;
   b) alternative practice: buffer zones mandated through government regulatory programs.

2) Innovative technology and production practices that decrease or abate wastewater and nuisance odor problems. Freestall dairies and other alternatives that are both economically feasible and acceptable to new dairy operators in the area could greatly improve the negative environmental impacts associated with large open-lot operations. Freestalls eliminate the need to capture water from rainfall events, thereby eliminating the problems from back-to-back rainfall events which sometime exceed lagoon capacities. Freestalls can be combined with other technologies (such as new hydrocyclone solid separators, constructed wetlands and rockreed filters) and with new production practices. Dairies using these combinations have the potential to decrease nuisance odors and eliminate the disposal of wastewater and solids through land application, thus eliminating nonpoint pollution from new dairy operations.

3) Creation of “CAFO parks”, which combine new technologies and production practices with buffer zones through a unique permitting process. (See illustration on following page.) These agricultural use areas will be designed to be protected from nuisance/odor complaints. In municipal areas the notion of industrial parks is common. The challenge in rural areas, where multiple uses of land resources are not always compatible, is to protect neighboring landowners from negative environmental impacts and provide dairy operators with certainty that their operations will not be subject to frivolous complaints. The CAFO park would be located on a large tract of land, perhaps two to five thousand acres. The idea is to locate multiple dairy operations in close proximity to one another in the center of the large tract of land utilizing cutting-edge technology and production practices described above. The individual production units should realize significant cost saving by locating in the park because they have no need to purchase land in excess of the minimum amount needed for operation of the dairy, probably less than twenty-five acres. The production facilities would also utilize a common waste treatment facility which should yield significant cost savings. Waste solids produced from new solid separators would be utilized for bedding in the freestall barn and the excess sold to landscapers and others as a substitute for peat moss. The scale of operations and technology utilized would insure a predictable quantity and quality of material for marketing. The large buffer zone around production facilities using the described practices and technologies should negate significant odor problems. As currently envisioned the entire park including all production units would be permitted at one time. Permitting requirements would rest on technology employed in much the same way current permits are utilized to regulate major industry. The success of the venture will require economic feasibility, dairy producers who see the venture as an acceptable alternative to present siting and production practices, cooperation by governmental regulatory agencies, support from environmental groups and concerned citizens in the area, support by county officials and the Texas legislature. Research on odor and other potential environmental impacts would be conducted by TIAER, TAEX, and TAES. The primary...
goal is to develop threshold indices for nuisance odor and alternative odor and wastewater management technologies and treatment alternatives. Until the threshold criteria are approached, the dairy park would be permitted to expand the number of production units on an individual basis. The buffer zone around the park could be utilized for support facilities and operations that compliment the dairy industry. Areas near the perimeter of the area might be utilized for employee and dairy owner housing.

4) Acceptance of odors that naturally occur from large operations in rural areas. The basis of this alternative rests on Texas' right to farm law. The position taken by advocates for this alternative is that large dairy operations are farms just as small operations are farms and particularly that the odors produced occur from natural processes.
E: Alternative Agriculture Compliance Program
Appendix F

F: Hydrologic Cycle-Potential Pollution Sources

[Diagram showing the hydrologic cycle and potential pollution sources.]
The Texas Institute for Applied Environmental Research at Tarleton State University was approved by the Texas A&M University System Board of Regents in March 1990 and officially opened April 1, 1990. The 72nd Legislature established the Institute under the Texas Education Code as part of the Texas A&M System, effective June 5, 1991, and appropriated funds for its operation and research activities.

The enabling legislation states that the Institute's mandate is to:

"(1) conduct applied research on environmental issues that have public policy implication;

"(2) provide a setting for environmental studies that focus on the interface between government and the private sector;

"(3) provide national leadership on emerging environmental policy; and

"(4) establish interdisciplinary programs or partnerships with public or private institutions of higher education, governmental agencies, or private entities to develop and implement new policies, technology, strategies and relationships" (Texas Education Code section 87.004.)

The Institute was established to impact environmental policy at state and national levels. Partnerships with universities, agencies, and the private sector are developed to accomplish this objective. These partnerships build on the strengths of each entity to produce an effective, efficient program.

The Institute is a multidisciplinary research organization. It conducts environmental field studies, mathematical modeling, governmental institutions research, regulatory compliance evaluations, traditional law and policy studies, and constituency committee activities designed to further policy development. The Institute research activities are focused to direct attention to implementation in the policy arena. One unique aspect of the Institute's approach is its use of constituency groups composed of representatives of diverse interest groups.
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