AgriLIFE RESEARCH & EXTENSION
Texas A&M System

TEXAS A&M UNIVERSITY

COLLEGE OF AGRICULTURE AND LIFE SCIENCES

TR-391
2010

Provide Assistance to Improve Water Quality in Hood County

By
Bruce Lesikar, Justin Mechell, Brent Clayton & Ryan Gerlich
Department of Biological and Agricultural Engineering, Texas AgriLife Extension Service,
Texas A&M University

Prepared for
U.S. Department of Agriculture's Natural Resources Conservation Service
Agreement # 69-7442-9-486

Texas Water Resources Institute Technical Report No. 391
Texas A&M University System
College Station, Texas 77843-2118

September 2010

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Texas Water Resources Institute
make every drop count

Table of Contents
for
Provide Assistance to Improve Water Quality in Hood County

We would like to acknowledge the U.S. Department of Agriculture's Natural Resources Conservation Service for funding the Providing Assistance to Improve Water Quality in Hood County project.

Tables

Final Report
Texas AgriLife Extension Service
Texas Water Resources Institute

Provide Assistance to Improve Water Quality in Hood County

FY 09 Federal Appropriated Funds
USDA-NRCS Agreement # 69-7442-9-486

INTRODUCTION

The overall goal for this project was to provide a mechanism to educate local stakeholders about water quality issues that affect Lake Granbury. This project provided an assessment of existing and potential water quality threats related to on-going non-point source (NPS) water pollution within the Lake Granbury Watershed. The Texas Water Resources Institute (TWRI) and Texas AgriLife Extension Service are assisting Brazos River Authority (BRA) and Texas Commission on Environmental Quality (TCEQ) to develop a Watershed Protection Plan (WPP) aimed to improve and protect water quality within the Brazos River Basin. Educational information developed during this project provided Federal, State and local decision makers with a variety of mechanisms that can be employed to prevent additional degradation of water quality in the watershed.

PROJECT BACKGROUND

Lake Granbury is a critical water supply in North Central Texas, providing water for over 250,000 people in more than 15 cities. It provides water for industrial use, including cooling water for a natural gas–fired steam electric power plant and the Comanche Peak nuclear power plant. It is also a recreation haven for local water enthusiasts. Declining water quality in Lake Granbury has begun to negatively affect the use of the lake. The economy in Hood County is closely tied to Lake Granbury and the environmental condition of the lake is crucial to the county's residents.

Recent studies by the BRA have detected contamination of fecal coliform bacteria in several areas of the lake, primarily in coves with poor water circulation. As a result, BRA will work with the TCEQ and a consortium of local entities and federal and state agencies to implement an integrated WPP designed to reduce bacterial contamination. This project is funded by the U.S. Environmental Protection Agency (EPA) under CWA Section 319.

One source of fecal coliform bacteria is on-site wastewater treatment systems. While there are eight permitted wastewater treatment plants in Hood County, a substantial portion of the developed area around Lake Granbury, which lies wholly within Hood County, is unincorporated subdivisions that do not have sewage collection systems and centralized sewage treatment facilities. The population served by the existing permitted wastewater treatment plant facilities is estimated to be less than 50 percent of the current county population. There are an estimated 9,000 septic tanks located around Lake Granbury, with absorption fields installed on small lots in close proximity to the lake. Most of the inhabited areas around the lake exist on man-made coves. The coves are shallow, dead-end bodies of water with little mixing or interaction with the main body of the reservoir. Many of these systems were installed before the 1997 On-Site Sewage Facility (OSSF) rule changes. The 1997 rule changes required a site and soil evaluation to determine the site's capacity to treat wastewater. An on-site wastewater treatment system was

then selected based on the ability to effectively treat the wastewater. New development in areas without centralized collection and treatment systems rely on individual on-site wastewater treatment systems for their wastewater infrastructure.

In 1993 a cooperative study between the Texas Water Commission, the BRA and the Hood County Health Unit first identified an increase in fecal coliform levels in the lake. The *On-site Wastewater Treatment Units at Lake Granbury and the Possible Impact Upon the Water Quality of the Lake Study* identified the most notable area of concern to be in the man-made coves.

In 1995 a study titled, *Survey of Conditions and Impact of Septic Tank Pollution on the Water Quality in Lake Granbury*, indicated that the soils in which septic tanks are installed around Lake Granbury are generally not well-suited for septic tanks and absorption fields. Another finding was that almost all on-site systems around the lake include absorption fields that do not provide a capacity that would comply with current State criteria.

The combination of previous studies indicate a concern for water quality from on-site sewage systems and forecasts show that Hood County's population will likely increase from its current level of about 42,000 persons to more than 78,000 persons by the year 2030. With this information in mind, the development of a feasibility study to bring a regional sewage system to Hood County and eliminate the on-site sewage facilities was completed in 2000. The *Hood County Regional Sewerage System Feasibility Study* was a cooperative effort between BRA and the Hood County Intergovernmental Coalition. The estimated capital costs for this regional wastewater facility was estimated to be approximately $149,900,000 with annual operation and maintenance costs estimated to be approximately $16,231,000.

Beginning in May 2001, BRA began collecting water quality samples on a monthly basis at over 50 cove locations. Some of the locations showed no elevated concentrations of *E. coli* and were later discontinued. Other locations were added after a year of monitoring as new information was acquired on possible source locations. The data generated from this effort indicates that many of the canals on Lake Granbury are impacted by *E. coli* issues that raise concern for public health and contact recreation. The data also indicates that the water quality in the coves is most influenced by the surrounding land use, rather than by the main body of the lake.

PROJECT ACCOMPLISHMENTS

In order to help correct existing water problems and protect the future of Lake Granbury, the residents and lake users need a better understanding of lake water quality issues and applicable best management practices. Therefore, the objectives of this project were to:

- Hold public meetings to educate stakeholders and clients within the watershed about water quality and its protection.
- Provide public educational programs to help achieve improved water quality.
- Conduct training events on proper operation and maintenance of on-site wastewater treatment systems and collective facilities.

Overall Summary

Since January 2007, a team of Texas AgriLife Extension Service educators led by Dr. Bruce Lesikar, Professor and Associate Department Head in the Department of Biological and Agricultural Engineering at Texas A&M University, have developed more than 20 generalized and watershed-specific fact sheets about various topics including fecal coliform contamination and sources, on-site wastewater treatment, collective wastewater treatment systems, graywater systems, pet waste management, nutrient and sediment loading, landscape chemicals, and management practices to minimize loadings, including urban and agricultural NPS.

As a result of project funding numerous courses have been held regarding various topics relating to on-site wastewater treatment systems. A wastewater practitioner training was held describing the design, installation, operation, maintenance, and trouble-shooting of on-site wastewater treatment systems. Three short courses reaching 46 individuals were conducted that increased awareness of the impacts that malfunctioning wastewater treatment systems have on water quality. Three educational programs reaching 91 key stakeholders were conducted that discussed proper operation and maintenance of septic and graywater systems to limit the risk of bacterial contamination in the lake.

A protocol was developed to determine the effectiveness of wastewater treatment systems utilizing dye testing and site and soil evaluation methods. Intensive evaluations of three on-site wastewater treatment systems located on canals were conducted. Septic system performance for removal of bacterial contaminants was assessed and an evaluation protocol was used to evaluate additional subdivisions around the lake.

Public education to increase awareness of water quality impacts due to stormwater has been conducted. Fact sheets, presentations and posters describing contaminant sources and water conservation management techniques to minimize contaminant transport to the lake have been developed and delivered. Two Master Gardener Specialist trainings on rainwater harvesting were held reaching approximately 30,000 people and resulting in numerous public education activities utilizing direct and indirect educational methods. A demonstration site showing various stormwater best management practices has also been implemented near the Hood County Extension Office.

Past Year

During the past year, several presentations were made to more than 180 individuals at public meetings and educational programs to homeowners and practitioners, on topics including water quality standards, on-site wastewater treatment system maintenance, regional collection systems, identification of malfunctioning on-site wastewater treatment system, rainwater harvesting, stormwater management and groundwater management. The on-site wastewater treatment systems program addresses the needs of both practitioners and homeowners. Marty Vahlenkamp, Texas AgriLife Extension Service agent in Hood County was instrumental in hosting educational programs and sharing information with the public, such as discussing watershed management, bacterial sources and best management practices (BMPs) on a local television station. Along with these presentations, team members worked with the North Central Texas Council of Governments and the Hood County Extension agent to distribute water quality information through Public Service Announcements and the local media.

On-site Wastewater Treatment Systems

The wastewater practitioners participated in a training program describing the use of advanced treatment units to remove contaminants of concern from the wastewater titled, *Analyzing High Strength Waste*. The response rate to the evaluation survey was 95 percent (21 of 22). However, not all questions were answered by each participant. Of the 21 individuals responding to the survey, 21 reported that they gained knowledge through participation in the course and 21 stated that they would recommend this course to other wastewater professionals. Table 1 below shows the assessment of the participants' knowledge gained on various topics presented in the training. Table 2 details the number and percent of those participants reporting who indicated that knowledge was gained on specific topics.

Table 1. Percent knowledge gained on various topics through participation in the course.

Percent Knowledge Gained:	**% Knowledge Gain**
Wastewater constituents	35.4
Hydraulic loading to commercial wastewater treatment systems	47.9
Organic loading to commercial wastewater treatment systems	60.5
Organic loading rate to soil treatment areas	53.2
How to evaluate treatment train components to predict effluent quality	52.4
How residential management practices impact organic loading	40.8
How microscopic analysis assists in evaluating healthy microbial treatment conditions	67.5
How to incorporate flow equalization into treatment trains	46.5
How to analyze commercial wastewater treatment systems	79.4
How to evaluate commercial management practices to determine wastewater hydraulic and organic loading rates.	62.2

Table 2. Number and percent of participants indicating knowledge gained on specific topics.

Percent reporting an increase in knowledge:	# of Increases	Number	% Knowledge Increased
Wastewater constituents	16	20	80.0
Hydraulic loading to commercial wastewater treatment systems	20	21	95.2
Organic loading to commercial wastewater treatment systems	21	21	100.0
Organic loading rate to soil treatment areas	19	21	90.4
How to evaluate treatment train components to predict effluent quality	17	21	81.0
How residential management practices impact organic loading	17	21	81.0
How microscopic analysis assists in evaluating healthy microbial treatment conditions	17	21	81.0
How to incorporate flow equalization into treatment trains	20	20	100.0
How to analyze commercial wastewater treatment systems	20	21	95.2
How to evaluate commercial management practices to determine wastewater hydraulic and organic loading rates.	19	21	90.5
Sampling practices for monitoring wastewater treatment systems	16	21	76.2

Another important item to asses regarding training programs is the willingness of participants to adopt BMPs as a result of participating in the training. Table 3 details the responses of the course participants.

Table 3. Assessment of willingness to adopt practices as a result of participation in the course.

Indicate your intentions regarding adoption of the following practice(s), or indicate whether you have already adopted them:	Will not adopt	Undecided	Probably will adopt	Adopted already	Tried it before; discontinued application	Number
Utilize evaluation forms to review residential systems	0	9	9	2	0	20
Utilize evaluation forms to evaluate commercial systems	0	8	10	1	0	19
Specify hydraulic loading rate for system components in the design	0	6	11	2	0	19
Specify organic loading rate for system components in the design	0	5	9	4	0	18
Specify operation and maintenance requirements for system components in the design	0	6	9	4	0	19
Utilize flow equalization in systems with peak flows	0	6	11	1	0	18

Two general homeowner trainings on septic system maintenance are still scheduled to be held in September 2010. These classes will be 1-2 hour informational classes for homeowners wanting to understand more about their on-site wastewater treatment system. These classes are designed to present base information on the function and maintenance of on-site wastewater treatment systems. At the time of this report, the trainings have not yet been held. Final participant numbers and evaluation information will be presented in the final project quarterly report that will be submitted October 8, 2010.

Rainwater Harvesting

In June 2009 a Master Gardener Specialist Course on Rainwater Harvesting was held in Hood County. The topic of rainwater harvesting is used to convey messages about water and stormwater management, pollution control and the importance of educating others. The course was comprised of both classroom instruction and field demonstrations. During the course, participants were able to help in the installation of rainwater harvesting systems that became part of a demonstration site located near the Extension office. These systems are a stormwater management BMP that teaches basic hydrology and water management. Many participants increased their water literacy through implementing a rainwater harvesting project. They learned about the quantity of water running off a surface and the contaminants that can be absorbed by the water as it runs across a surface. They learned how the volume of water generated during a rainfall event is quantified. In addition, the amount available for capture from a specific size surface was calculated. Ultimately, the participants learned valuable information that will assist them in making informed decisions regarding management and protection of critical water resources. Tables 4 and 5 detail the number of individuals who gained knowledge on various topics presented in the course and the percent knowledge that was gained.

Table 4. Number and percent of individuals whom reported knowledge gained on the retrospective pre-post evaluation on various topics (out of 31 responses).

Topics	Number	Percent
Understanding of how rainwater addresses water quality and quantity issues:	20	64.5
Understanding of stormwater and its impact on the environment:	21	67.7
Understanding of rangeland watersheds:	26	83.9
Understanding of collection and storage of harvested rainwater:	24	77.4
Understanding of filtration and sanitation of harvested rainwater:	27	87.1
Understanding of how landscaping affects water usage:	23	74.2
Understanding of how a soil storage and infiltration system works:	23	74.2
Understanding of how rainwater can be used to water wildlife:	24	77.4
Understanding of how raingardens can be used to harvest rainwater:	26	83.9
Understanding of how to implement a youth education session:	28	90.3

Table 5. Retrospective pre-post test results of percent knowledge gained by participants on various topics (out of 31 responses).

Topics	% Knowledge Gain
Understanding of how rainwater addresses water quality and quantity issues:	27.6
Understanding of stormwater and its impact on the environment:	32.1
Understanding of rangeland watersheds:	42.4
Understanding of collection and storage of harvested rainwater:	30.1
Understanding of filtration and sanitation of harvested rainwater:	45.5
Understanding of how landscaping affects water usage:	24.4
Understanding of how a soil storage and infiltration system works:	40.4
Understanding of how rainwater can be used to water wildlife:	38.3
Understanding of how raingardens can be used to harvest rainwater:	62.0
Understanding of how to implement a youth education session:	52.6

Printed and Distributed Fact Sheets

In order to facilitate dissemination of information and educational materials developed in cooperation with this project, copies of multiple fact sheets were printed for distribution. The factsheets printed include: *What is the Fate of Your Rainfall; What is the Fate of Your Rainfall: Leader Guide*; *What is the Fate of Your Rainfall: Flip Chart*; *Lawn Fertilization and Environmental Impacts*; and *Living on the Water's Edge*.

The publication series titled, *What is the Fate of Your Rainfall?*, explains what happens to rainwater in a watershed and discusses practices that can help prevent excess runoff, avoid erosion, increase forage or plant production and protect water quality. The goal for this training program is to increase the audience knowledge about water movement through the landscape so they are prepared to adopt practices to enhance and protect water resources. Specific learning objectives for this educational program include:

- Understand the movement of water through the water cycle
- Understand the concept of a watershed
- Understand how land cover and management determine the path of rainwater
- Understand practical implementation of rainwater harvesting for water storage in the soil, groundwater and surface reservoirs
- Understand the effect that increased impervious areas have on water movement in the watershed
- Understand the water and land management options that decrease runoff and promote infiltration

The leader guide and flip chart associated with the *What is the Fate of Your Rainfall?* fact sheet helps guide users of the rainfall simulators that have been distributed throughout the area. The rainfall simulator is a demonstration aid consisting of a frame to hold landscape trays, rain trays and water collection containers. The landscape trays represent various land uses present in our watersheds. The rain trays simulate rainfall on the landscape bins. The water collection containers collect surface runoff and percolated groundwater thus allowing a visual evaluation of rainfall distribution between surface water and groundwater.

The publications titled, *Lawn Fertilization: Environmental Impacts* and *Living on the Water's Edge*, were also printed this past year to facilitate educational programs. The *Living on the Water's Edge* fact sheet explains steps that people living near streams or lakes should take to minimize their environmental impact and improve water quality. The *Lawn Fertilization: Environmental Impacts* fact sheet explains how to fertilize and manage your lawn while minimizing risk for harming the environment. In addition to the previously mentioned publications, fact sheets regarding pet waste management and on-site wastewater treatment systems were distributed by Marty Vahlenkamp to homeowners educating them on the importance of the proper waste management from all potential sources of bacteria and nutrients.

News Articles

One avenue of educating the public is through the distribution of newspaper articles. In the past year, the project team composed four articles to be distributed to local media outlets around the Lake Granbury area. These articles highlight four aspects of urban living that can affect water quality, and what the average homeowner can do to protect that water quality. These four topics are about the proper management of wildlife on your property, pet waste, on-site wastewater systems and proper lawn maintenance.

Watershed Protection Planning

The project team worked with BRA and TCEQ to incorporate current and future educational activities into the education and outreach plan for the Lake Granbury WPP. The final draft of this plan was presented and approved by the stakeholders at the July 2010 meeting. The stakeholders have been informed about available funding options to facilitate implementation of the plan. The stakeholders have also been informed that education and outreach to the watershed area will continue as the plan moves into the implementation phase.

Administration

The administrative task of this project was managed by the Texas Water Resources Institute (TWRI), part of Texas AgriLife Research, the Texas AgriLife Extension Service and the College of Agriculture and Life Science and Texas A&M University. Besides reviewing and submitting quarterly and final reports and conducting meetings, TWRI created and maintains a website that contains copies of all the fact sheets, other educational publications and reports. The website can be accessed at lakegranbury.tamu.edu. TWRI also assisted BRA and TCEQ with developing a stakeholder group for the development of a WPP for the Lake Granbury Watershed.

FUTURE WORK/CONCLUSION

The educational programs provided through this project will lead to a change in behavior and create a sense of ownership of Lake Granbury and ultimately lead to improved water quality. In looking forward to FY 2010, Texas AgriLife Extension Service specialists will continue to work with BRA, TCEQ, the Texas AgriLife Extension agent in Hood County and local watershed stakeholders to develop and present information on how to protect and improve water quality. Major activities will include development of additional fact sheets, continuing to work with Lake Granbury stakeholders, and conducting informational meetings for homeowner associations, practitioners and local officials. Demonstration projects will also be implemented describing BMPs with a potential for reducing bacterial contamination of local water resources.