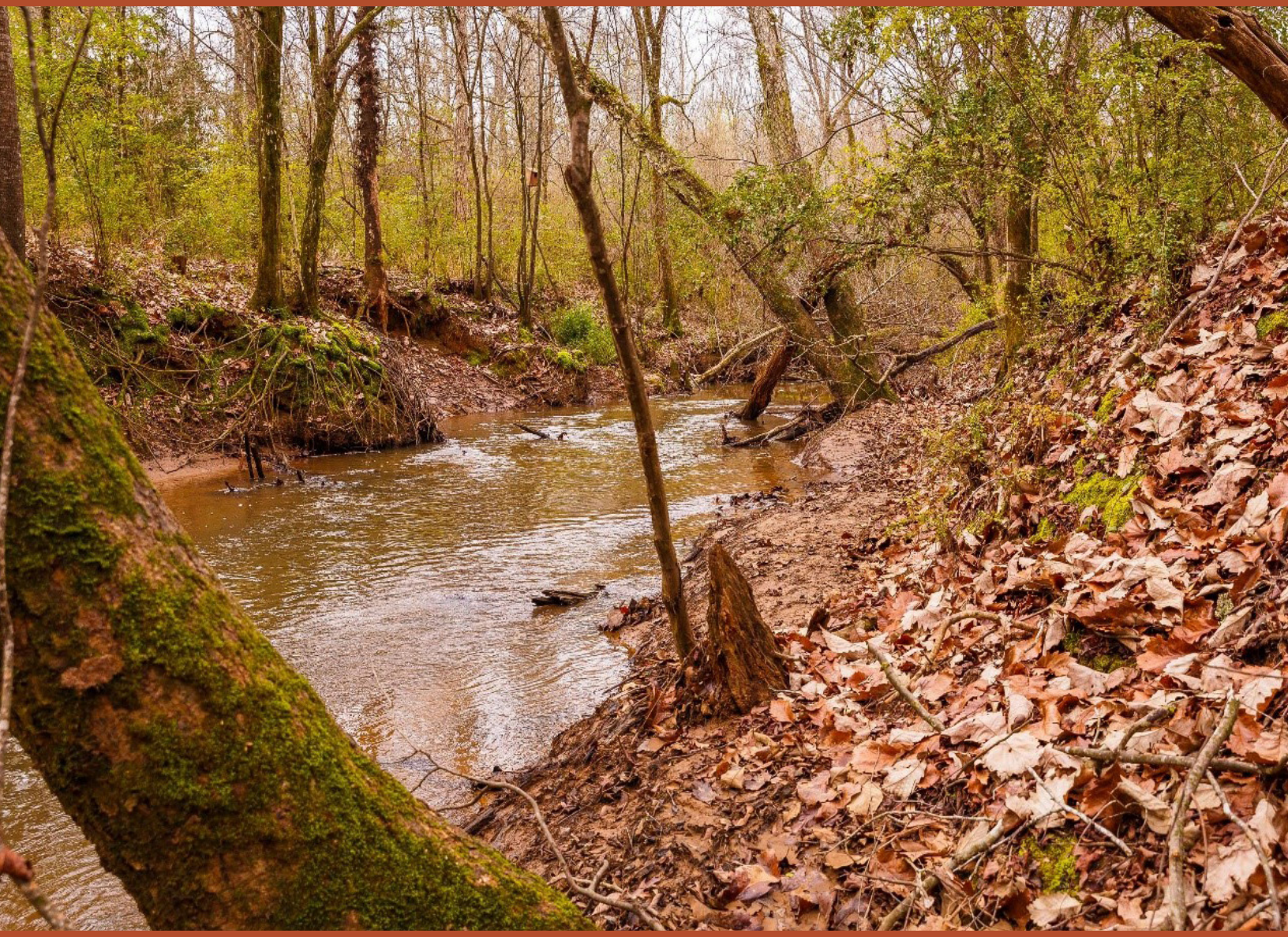
Attoyac Bayou Watershed Protection Plan – On-site Sewage Facility Remediation

Texas Water Resources Institute TR-522
January 2020



Texas Water Resources Institute
make every drop count

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Texas Commission on Environmental Quality Project
Contract No. 582-17-70355

Scoggins Lake, Attoyac Bayou Watershed. Photo by Ed Rhodes.

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Contents

Acronym List

ANRA	Angelina & Neches River Authority
BOD	Biological oxygen demand
CEU	Continuing education unit
CFU	Colony-forming units
CRP	Texas Clean Rivers Program
DR	Designated representative
EPA	United States Environmental Protection Agency
g	Gram
gal	Gallon
L	Liter
mL	Milliliter
OSSF	On-site sewage facility
SEP	Supplemental Environmental Projects
TCEQ	Texas Commission on Environmental Quality
TN	Total nitrogen
TP	Total phosphorus
TSS	Total suspended solids
TWRI	Texas Water Resources Institute
WPP	Watershed protection plan

Tributary of the Attoyac Bayou. Photo by Ed Rhodes.

Project Overview

In the Attoyac Bayou Watershed Protection Plan (WPP), which was developed by the Attoyac Bayou Watershed Partnership in the spring of 2015, failing on-site sewage facilities (OSSFs) were listed as one of the major concerns for water quality impairment in the area. Stakeholders identified the need for technical and financial assistance support to address this concern. The Attoyac Bayou Watershed Protection Plan Implementation – On-Site Sewage Facility Remediation project, contract #582-17-70355, was developed by the Texas Water Resources Institute (TWRI), the Angelina & Neches River Authority (ANRA) and the Pineywoods Resource Conservation and Development to provide needed assistance. The project built upon a previous project funded by the Texas Commission on Environmental Quality (TCEQ), the Lake Sam Rayburn OSSF Program Support and Attoyac Bayou OSSF Remediation project, led by ANRA. Through the Lake Sam Rayburn OSSF project, ANRA installed 26 OSSFs, conducted monthly in-stream water quality monitoring and began exploring the possibility of developing a database for monitoring OSSF status at the watershed level. The Attoyac Bayou OSSF project's success is partially due to the previous work done in the area by ANRA and earlier project partners.

The primary goals of the Attoyac Bayou OSSF project were to educate homeowners on proper OSSF operation and maintenance and the importance of keeping effluent out of their local waterbodies and to repair and replace failing systems for low income households. The project team was able to install 24 systems in the watershed—ten more than originally planned—through Clean Water Act 319 funding as well as leveraged funds from external sources. The project team also had over 270 education contact hours with local stakeholders during the project.

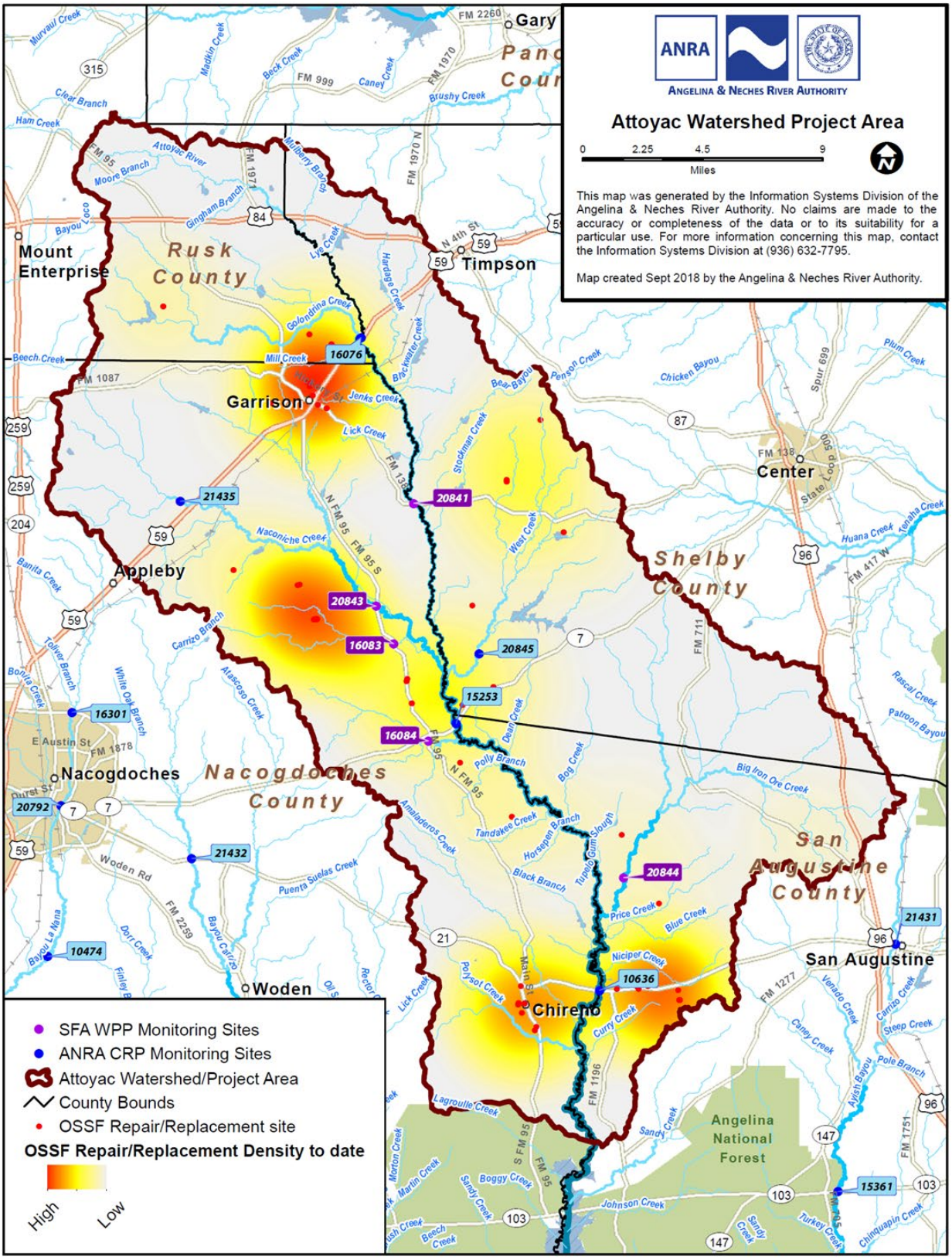
OSSF System Installations

The project team prioritized which systems to repair or replace based on application order, proximity to waterways, functionality, existing system age and income level of the household. The average household income level was $23,382 and the median was $22,908. One system was replaced in San Augustine County, two were replaced in Rusk County, five in Shelby County and 16 in Nacogdoches County. The project also acquired cost share from external sources to replace additional systems, including funds from ANRA and TCEQ's Supplemental Environmental Projects (SEPs).

Table 1: *Location of OSSFs repaired or replaced by this program, their funding source, and number of people in each household.*

	County	Number in Household	Closest Stream (yards)	Funding Source
1	Nacogdoches	5	475	Project
2	Nacogdoches	2	191	Project
3	Nacogdoches	4	230	Project
4	Nacogdoches	1	216	Project
5	Nacogdoches	3	333	Project
6	Nacogdoches	1	597	ANRA
7	Nacogdoches	1	227	Project
8	Nacogdoches	1	78	Project
9	Nacogdoches	2	79	Project
10	Nacogdoches	1	125	SEP
11	Nacogdoches	2	35	Project
12	Nacogdoches	2	377	SEP
13	Nacogdoches	2	518	Project
14	Nacogdoches	1	267	Project
15	Nacogdoches	2	593	Project
16	Nacogdoches	2	326	Project
17	Rusk	2	86	SEP
18	Rusk	2	309	SEP
19	San Augustine	1	171	ANRA
20	Shelby	1	246	SEP
21	Shelby	1	123	Project
22	Shelby	2	122	Project
23	Shelby	4	185	SEP
24	Shelby	2	10	Project

Map of OSSF Repair and Replacement Sites



OSSF Site Photos

Included here is a selection of photos from replacement sites funded by the Attoyac Bayou OSSF project. All photos were taken by licensed OSSF inspectors during the inspection prior to replacement. Potential identifying items have been blacked out for privacy.

***Above**: Failing OSSF in front yard of residence. Dark area shows wet effluent seeping through the soil to the surface.*
***Below, left**: Drainpipe above ground coming from toilet in house.*
***Below, right**: Area of sunken dead grass and sections of healthy grass indicate OSSF failure.*


Above, left: *Straight pipe coming from toilet in house; contents being dumped below residence.*
Above, right: *Partially buried, broken HDPE drainpipe coming from residence.*
Below, left*: Wet area indicates OSSF failure as effluent seeps to surface from failing system.*
Below, right: *Drainpipe from residence dumping effluent into field behind house.*


***Above, left**: Drainpipe coming from toilet inside residence. Standing sewage water near house.*
***Above, right**: Drainpipe coming from toilet inside residence.*
***Below**: Drainpipe coming from toilet inside residence.*

Estimated Load Reductions

Replacing failing OSSF systems results in the reduction of nonpoint source pollutant loading in the Attoyac Bayou as numbers of bacteria, nutrients and biological oxygen demand (BOD) are reduced through the proper treatment of effluent. Using literature values and equations from the Attoyac Bayou Watershed Protection Plan, below are the estimated daily load reductions this project generated (Gregory et al. 2014). Each estimated load reduction is calculated based on the number of people in each household, shown in Table 1.

Daily Potential *E. coli* Load Reduction Calculations

The total estimated *E. coli* load reduction for the 24 systems installed was 1.245E+14 colony-forming units (cfu) per 100 milliliters (mL). The calculations used are below:

$$\boldsymbol{E.coli\ Load\ Reduction} = \#\ of\ OSSFs\ addressed * 1.00E{+}7\ cfu/100mL * 70\ ((gallons/person)/day) * 3785.2\ mL/gallon * \#\ persons/household$$

Assumptions in this equation Include:

- 1.00E+7 cfu/100mL = *E. coli* concentration in OSSF effluent as reported by Horsley and Witten 1996
- 3785.2 mL/gallon = number of milliliters in a gallon
- 70 gallons (gal) per person per day = estimated discharge in OSSFs as reported by Horsley and Witten 1996

Daily Potential Total Nitrogen (TN) Load Reduction Calculations

The total estimated influent load for the 24 systems installed was 540 grams (g) TN per day, and the total estimated effluent load was 54.05 g TN/day, for a total TN load reduction of 486.45 g TN/day. The calculations used are below:

$$\boldsymbol{TN\ Load\ Reduction} = OSSF\ influent\ load - OSSF\ effluent\ load$$

$$\boldsymbol{OSSF\ influent\ load} = 11.5\ g\ TN/person/day * \#\ persons/household * 1{,}000\ mg/g$$

$$\boldsymbol{OSSF\ effluent\ load} = OSSF\ Influent\ Load * (1 - Aerobic\ System\ Treatment\ Efficiency)$$

Assumptions in this equation Include:

- Influent Load = 11.5 g TN/person/day * production per person per day in OSSF effluent as reported by EPA 2002
- Aerobic System Treatment Efficiency = a percentage-based loading reduction factor calculated by dividing the mean OSSF influent constituent concentration (g/person/day * 1000 / (gal/person/day * 3.785 liters [L]/gal)) by the maximum treated effluent concentration as reported in Tables 3-7 and 3-19 respectively in EPA 2002
    - For TN removal, efficiency is 90%

Daily Potential Total Phosphorus (TP) Load Reduction Calculations

The total estimated influent load for the 24 systems installed was 70.5 g TP/day, and the total estimated effluent load was 8.46 g TP/day, for a total TP load reduction of 62.04 g TP/day. The calculations used are below:

$$\boldsymbol{TP\ Load\ Reduction} = Estimated\ OSSF\ influent\ load - Estimated\ OSSF\ effluent\ load$$

$$\boldsymbol{Influent\ Load\ Calculation} = 1.5\ g\ TP/person/day * \#\ persons/household * 1{,}000\ mg/g$$

$$\boldsymbol{Effluent\ Load\ Calculation} = Influent\ Load * (1 - Aerobic\ System\ Treatment\ Efficiency)$$

Assumptions in this equation Include:

- Influent Load = 1.5 g TP/person/day * production per person per day in OSSF effluent as reported by EPA 2002
- Aerobic System Treatment Efficiency = a percentage-based loading reduction factor calculated by dividing the mean OSSF influent constituent concentration (grams/person/day * 1000 / (gallons/person/day * 3.785 L/gal)) by the maximum treated effluent concentration as reported in Tables 3-7 and 3-19 respectively in EPA 2002
    - For TP, efficiency is 88%

Daily Potential Total Suspended Solids (TSS) Load Reduction

The total estimated influent load for the 24 systems installed was 2,585 g TSS/day, and the total estimated effluent load was 77.55 g TSS/day, for a total TSS load reduction of 2,507.45 g TSS/day. The calculations used are below:

$$\boldsymbol{TSS\ Load\ Reduction} = Estimated\ OSSF\ influent\ load - Estimated\ OSSF\ effluent\ load$$

$$\boldsymbol{Influent\ Load\ Calculation} = 55\ g\ TSS/person/day * \#\ persons/household * 1{,}000\ mg/g$$

$$\boldsymbol{Effluent\ Load\ Calculation} = Influent\ Load * (1 - Aerobic\ System\ Treatment\ Efficiency)$$

Assumptions in this Equation Include:

- Influent Load = 55 g TSS/person/day * production per person per day in OSSF effluent as reported by EPA 2002
- 2.12 persons per household average from Nacogdoches, Rusk, San Augustine and Shelby counties (Table 10. Attoyac Bayou WPP)
- Aerobic System Treatment Efficiency = a percentage-based loading reduction factor calculated by dividing the mean OSSF influent constituent concentration (grams/person/day * 1000 / (gallons/person/day * 3.785 L/gal)) by the maximum treated effluent concentration as reported in Tables 3-7 and 3-19 respectively in EPA 2002
    - For TSS, efficiency is 97%

Potential 5-Day Biological Oxygen Demand (BOD_5) Load Reduction

The total estimated influent load for the 24 systems installed was 2,350 g BOD_5/day, and the total estimated effluent load was 47 g BOD_5/day, for a total BOD_5 load reduction of 2,303 g BOD_5/day. The calculations used are below:

$$\boldsymbol{BOD_5\ Load\ Reduction} = Estimated\ OSSF\ influent\ load - Estimated\ OSSF\ effluent\ load$$

$$\boldsymbol{Influent\ Load\ Calculation} = 50\ g\ BOD_5/person/day * \#\ persons/household * 1{,}000\ mg/g$$

$$\boldsymbol{Effluent\ Load\ Calculation} = Influent\ Load * (1 - Aerobic\ System\ Treatment\ Efficiency)$$

Assumptions in this Equation Include:

- Influent Load = 50 g BOD_5/person/day * production per person per day in OSSF effluent as reported by EPA 2002

- 2.12 persons per household average from Nacogdoches, Rusk, San Augustine and Shelby counties (Table 10. Attoyac Bayou WPP)
- Aerobic System Treatment Efficiency = a percentage-based loading reduction factor calculated by dividing the mean OSSF influent constituent concentration (grams/person/day * 1000 / (gallons/person/day * 3.785 L/gal)) by the maximum treated effluent concentration as reported in Tables 3-7 and 3-19 respectively in EPA 2002
    - For BOD_5, efficiency is 98%

Education and Outreach Activities

The project team developed educational materials and used educational materials created by related OSSF projects to educate residents on OSSF operation and maintenance. Throughout the life of the project, the team handed out paper copies and emailed information to interested homeowners. All applicants received educational brochures when applying and recipients were educated on proper maintenance through the process of repairing and replacing their systems. The Attoyac Bayou OSSF project specifically hosted a Homeowner Septic System Training class in September 2017 with 35 attendees and an OSSF Professionals continuing education unit (CEU) course in May 2018 with 14 attendees. The team also reached homeowners through newsletters sent through the Attoyac Bayou WPP stakeholder list, press releases and a news story developed by the local television news station KTRE: https://www.ktre.com/2019/11/21/webxtra-qualifying-east-texans-can-now-apply-new-home-septic-systems/.

In conjunction with the Texas State Soil and Water Conservation Board's Attoyac Bayou WPP Implementation project, stakeholders were educated on OSSF operation and maintenance at the following events:

Presentation Date	Event Title	Number of Attendees	Location
7/11/2017	ANRA CRP Stakeholder Meeting	20	Lufkin, TX
7/13/2017	Attoyac Bayou Stakeholder Meeting	22	Nacogdoches, TX
9/7/2017	Homeowner Septic System Training	35	Nacogdoches, TX
11/7/2017	Texas Watershed Stewards Workshop	35	Nacogdoches, TX
5/30/2018	ANRA CRP Stakeholder meeting	20	Lufkin, TX
11/1/2018	Pineywoods RC&D Annual Board Meeting	30	Nacogdoches, TX
11/7/2018	Texas Well Owner Network	52	Lufkin, TX
5/15/2019	OSSF Professional CEU Class	15	Lufkin, TX
6/17/2019	ANRA CRP Stakeholder Meeting	20	Lufkin, TX
12/10/2019	Attoyac Bayou Stakeholder Meeting	14	Nacogdoches, TX

Geodatabase Development

One goal of the Attoyac Bayou OSSF project was to recommend options to standardize OSSF data collection across the watershed. Since county lines and watershed boundaries do not often align, there

were inconsistencies found in the data available for the entire watershed. The project team met with the Designated Representatives (DRs) in each county over the course of the project to explore interest and opportunities for database aggregation, and a report was developed as a deliverable of this project. That report, which details the background of the initiative and the suggested next steps, can be found on the Attoyac Bayou website at http://attoyac.tamu.edu. Overall, the team has made progress in the watershed by getting each county to commit to standardizing their data collection. In the next phase of the Attoyac Bayou OSSF project, the project team will work closely with DRs to digitize records and determine the basic information that will be collected for OSSFs.

Future OSSF Repair and Replacement Programing

The Attoyac Bayou OSSF project has been well received in the community as it is a visible activity with clear impact that is occurring literally in the stakeholder's backyards. Many of the recipients of this grant would not have been able to pay for a repair, replacement or initial installment of a system on their own. A project that assists with funding for these homeowners for a tangible output helps convince them and their neighbors that achieving water quality is a feasible goal. The project team looks forward to the next phase of the project, the Attoyac Bayou Watershed Protection Plan Implementation – On-Site Sewage Facility project, contract #582-20-10177.

Acknowledgements

The implementation of the Attoyac Bayou OSSF project would not be the success that it is without the residents of the Attoyac Bayou Watershed and these state and community partners:

Angelina & Neches River Authority
Castilaw Environmental Services
Nacogdoches County
Nacogdoches County Environmental Health and Safety Department
Pineywoods Resource Conservation & Development, Inc.
Rusk County
San Augustine County
Shelby County
Stephen F. Austin State University WET Center
Texas A&M AgriLife Extension Service
Texas A&M Healthy Texas Initiative
Texas Commission on Environmental Quality
Texas Forestry Association
Texas State Soil and Water Conservation Board
Texas Water Resources Institute
USDA Natural Resource Conservation Service
US Environmental Protection Agency

Citations

EPA 2002. *Onsite Wastewater Treatment Systems Manual*. EPA/625/R-00/008.

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Horsley and Witten, Inc. 1996. *Identification and Evaluation of Nutrient and Bacterial Loadings to Maquoit Bay, New Brunswick and Freeport, Maine*. Barnstable, MA: Horsley and Whitten, Inc. Environmental Services. Final Report. Submitted to Casco Bay Estuary Project, Portland, ME.

Wooded wetland near the Attoyac Bayou. Photo by Ed Rhodes.