

# Preventing Water Quality Contamination through the Texas Well Owner Network (TWON)

## FINAL REPORT

TSSWCB Contract #10-04

### Prepared for:

Texas State Soil & Water Conservation Board

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TEXAS A&M  
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**T W O N**  
T E X A S  
Well Owner  
NETWORK



  
Texas Water  
Resources Institute  
*make every drop count*

Funding provided by the Texas State Soil & Water Conservation Board through a Clean Water Act 319(h) Nonpoint Source Grant from the U.S. Environmental Protection Agency

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## List of Acronyms

BAEN	Department of Biological and Agricultural Engineering, Texas A&M University
BMPs	Best management practices
EPA	U.S. Environmental Protection Agency
MCL	Maximum Contaminant Level
SCSC	Department of Soil and Crop Sciences, Texas A&M University
TMDL	Total maximum daily load
TSSWCB	Texas State Soil and Water Conservation Board
TWON	Texas Well Owner Network
TWRI	Texas Water Resources Institute
WPP	Watershed protection plan
USGS	U.S. Geological Survey

## Acknowledgements

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Special acknowledgement is given to:

- Well owners who invested their time to attend the Texas Well Owner Network trainings and screenings
- U.S. Environmental Protection Agency and Texas State Soil and Water Conservation Board for providing support for these efforts.
- AgriLife county Extension agents for their support and coordination
- Watershed coordinators and river authorities for their participation and presenting local watershed information.
- Groundwater conservation districts for presenting information on local groundwater conditions and challenges

## Executive Summary

The Texas A&M AgriLife Extension Service (AgriLife Extension) through the Departments of Soil and Crop Sciences (SCSC) and Biological and Agricultural Engineering (BAEN) and the Texas Water Resources Institute (TWRI) conducted 14 well owner trainings and 43 well owner screenings throughout the state of Texas through the TSSWCB project 10-04 “*Preventing Water Quality Contamination through the Texas Well Owner Network*” funded through a Clean Water Act 319(h) nonpoint source grant from the Texas State Soil and Water Conservation Board (TSSWCB) and the U.S. Environmental Protection Agency (EPA).

Private well owners are independently responsible for monitoring the quality of their well water, and they are frequently at greater risk for exposure to compromised water quality. Since management and protection of private, domestic and irrigation water sources are under the control of the landowner, they depend primarily on education rather than regulation to protect their well water.

To help in educating landowners about well water quality testing, protection and management, TWRI, SCSC and BAEN, parts of AgriLife Extension at Texas A&M University, developed the Texas Well Owner Network (TWON) with the funding and support from TSSWCB and EPA. TWON was designed to deliver science-based, community-responsive education curriculum and focused on protecting groundwater quality and aquifer integrity.

TWON trained Texans regarding water quality and best management practices for protecting wells and surface waters, which will avert off-site transport of contaminants (bacteria and nutrients) to surface waters, prevent contamination of underlying aquifers and safeguard the water quality and health of landowners and their families.

TWON is an effective tool used in support of watershed protection planning and total maximum daily load implementation efforts where investigations indicate bacterial and nutrient contributions. This was achieved by (1) development of TWON curriculum; (2) delivery of TWON educational materials and trainings; and (3) evaluation and assessment of the program so needed modifications and improvements could be made.

## Introduction

More than 1,000,000 private water wells in Texas provide water to citizens in rural areas and increasingly, to those living on small acreages at the burgeoning rural-urban interface. Public drinking water supplies are generally of good quality and are monitored through requirements of the federal Safe Drinking Water Act; however, private well owners are independently responsible for monitoring the quality of their wells and frequently at greater risk for exposure to compromised water quality. Management and protection of private, domestic and irrigation water sources are under the control of the landowner, and therefore, depend primarily on education rather than regulation.

The U.S. Geological Survey (USGS, DeSimone et al. 2009) reported that nitrate was the most commonly detected contaminant in private wells derived from man-made sources at concentrations greater than the U.S. Environmental Protection Agency's (EPA) Maximum Contaminant Levels (MCL) for public water supplies. A second finding potentially affecting a greater portion of the population was that total coliform bacteria, a broad group that includes bacteria from soil, water and animal feces, were detected in 34% of sampled wells. The MCL goal for coliform bacteria, including *Escherichia coli*, in drinking water is zero because this group is a predictor of the probable presence of pathogenic bacteria.

These broad findings of the USGS study are similar to those reported in Texas. For 2003–2008, Texas Water Development Board reported that for the 3,861 private water wells sampled, the percentage of wells exceeding the nitrate MCL varied from 2% to 50% each year, depending on which regions of Texas were targeted for sampling ([www.twdb.state.tx.us/mapping/](http://www.twdb.state.tx.us/mapping/)). Moreover, results of well screenings conducted by the Texas A&M AgriLife Extension Service from 2003–2009 indicate that about 33% of Texas' private wells contain fecal coliform bacteria.

The two categories of the most common private well pollutants, fecal coliform bacteria and nutrients, also are the most frequent cause of stream impairment or concern in Texas. It is likely that in many cases, local release of fecal coliform bacteria and nutrients is not limited to contamination of the property owner's private well and these contaminants are transported off-site and contribute to pollutant loadings in surface water bodies.

To address these issues affecting both surface water and groundwater, the Texas Water Resources Institute (TWRI) and the Departments of Soil and Crop Sciences (SCSC) and Biological and Agricultural Engineering (BAEN), parts of AgriLife Extension at Texas A&M University, developed the Texas Well Owner Network (TWON) designed to deliver a science-based, community-responsive education curriculum. TWON focused on protecting groundwater quality and aquifer integrity, but also complemented the successful Texas Watershed Stewards program by emphasizing best management practices (BMPs) addressing potential contamination of surface water by sources also contaminating private domestic and irrigation wells and jeopardizing aquifer integrity.

With Clean Water Act 319(h) funding from the EPA through the Texas State Soil and Water Conservation Board (TSSWCB), the *Preventing Water Quality Contamination through the Texas Well Owner Network* program trained Texans regarding water quality and BMPs for protecting their wells and surface waters, which will avert off-site transport of contaminants (bacteria and

nutrients) to surface waters, prevent contamination of underlying aquifers, and safeguard the water quality and health of landowners and their families. As a result, this program supported ongoing watershed protection planning (WPP) efforts being conducted by TSSWCB and others by expanding the reach of these programs to additional audiences and resulting in greater awareness, knowledge and implementation of BMPs for water quality improvement and protection.

Because improved understanding of water quality, human impacts and management practices to improve well and surface water quality help to forestall off-site transport of coliform bacteria and nutrients to surface waters, TWON is an effective tool to be used in support of WPP and total maximum daily load (TMDL) implementation efforts where investigations indicate bacterial and nutrient contributions. This was achieved by (1) development of TWON curriculum; (2) delivery of TWON educational materials and trainings; and (3) evaluation and assessment of the program so that needed modifications and improvements could be made.

### *TWON Materials*

TEX\*A\*Syst is a series of publications developed in 1996 to help rural residents assess the risk of groundwater pollution, and to describe BMPs that can help protect groundwater. Since the TEX\*A\*Syst publications were developed roughly 18 years ago, they required updating to reflect current laws and regulations guiding private well maintenance and management, and development of improved BMPs for protecting groundwater. SCSC hired a TWON Coordinator to assist with updating the TEX\*A\*Syst materials and renamed them to accompany the TWON educational materials.

Additionally, the TWON team developed and adapted other educational resources to create a science-based, community-responsive TWON education curriculum and handbook, which is used to train private well owners.

Finally, to increase delivery of these educational materials to a greater audience, the educational materials were transformed into an online format that is more readily available to the public. These materials are on the TWON website at <http://twon.tamu.edu/publications/>.

### *TWON Trainings and Screenings*

SCSC worked with TSSWCB and other state and local organizations to select locations for well water screenings (*Well Informed*) and trainings (*Well Educated*) to be conducted during this project. SCSC coordinated efforts with organizations already involved in WPP/TMDL processes or that are planning future WPP/TMDL processes.

Through this project, 14 *Well Educated* trainings were conducted with more than 700 private well owners who attended to become familiar with groundwater resources, septic system maintenance, well maintenance, water conservation, water quality and water treatment. In addition, 43 *Well Informed* events were delivered throughout the course of the project to provide wellhead protection information and recommendations for remediating well contamination. Participants could also collect and bring their own well water for analysis. Almost 3,000 water samples were analyzed through the *Well Educated* and *Well Informed* events.

## Program Development

Through this project, a TWON Coordinator was hired to lead development of educational materials and curriculum to use in conjunction with the TWON *Well Educated* and *Well Informed* programs. Part of the materials included revising the 18-year-old TEX\*A\*Syst materials, which were retitled as TWON Fact Sheets and significantly updated to reflect changes/improvements in laws and regulations and private well management, maintenance and protection. Updated publications can be found through the AgriLife Extension bookstore and include:

- [\*Private Drinking Water Well Basics \(ESC-013\)\*](#)
- [\*Storage and Handling of Pesticides to Protect Groundwater \(ESC-016\)\*](#)
- [\*Improving Petroleum Product Storage \(ESC-017\)\*](#)
- [\*Managing Hazardous Materials to Protect Groundwater \(ESC-018\)\*](#)
- [\*Managing Livestock Holding Pens to Protect Groundwater \(ESC-019\)\*](#)
- [\*Animal Manure Storage to Protect Groundwater \(ESC-020\)\*](#)
- [\*Managing Fertilizers to Protect Groundwater \(ESC-023\)\*](#)
- [\*Maintaining Your Septic System to Protect Well Water \(ESC-015\)\*](#)

Beyond the Tex\*A\*Syst materials, additional TWON Fact Sheets were developed:

- [\*Hydraulic Fracturing and Your Private Water Well \(ESC-012\)\*](#)
- [\*Protect Your Water Well During Drought \(ESC-014\)\*](#)

A TWON curriculum, including a handbook for participants, standardized presentations for program delivery and program materials for online delivery were developed for use in carrying out the *Well Educated* TWON 6-hour trainings. Specific components of the curriculum include:

- Watershed and groundwater hydrology and the importance to neighbors and the public of safeguarding aquifer integrity and groundwater quality
- Proper siting of drinking water wells and avoiding improper well construction techniques
- Proper maintenance and protection of the wellhead
- Solid and hazardous household waste management
- Aging and failure of wells
- Locating and properly plugging abandoned wells
- Improperly sited and functioning on-site wastewater treatment systems
- Maintenance, aging and failure of on-site wastewater systems
- Water quality assessment and testing
- Effects of land use changes on well water quality
- Options for water treatment
- Successful methods of sharing TWON information with neighbors and community

The TWON handbook, *Texas Well Owner Network: Well Owner's Guide to Water Supply (B-6257)*, is located online [on the TWON website](#), or a hard copy can be ordered [through the AgriLife Extension Bookstore](#).

SCSC, working with BAEN, TWRI, TSSWCB and others, selected priority locations for these events. SCSC coordinated these efforts with state agencies and organizations already involved in WPP/TMDL processes or that are planning future WPP/TMDL processes in specific watersheds.

## Implementation

Programs were held in the priority watersheds selected by the TWON team and TSSWCB. With assistance from SCSC, TWRI developed and disseminated informational materials to actively market *Well Informed* water screenings and *Well Educated* TWON trainings including news releases, internet postings, newsletter announcements, public/conference presentations, flyers, etc. TWRI also included information on the TWON program in their *txH2O* magazine, *Conservation Matters* e-letter and helped get releases out through *AgriLife Today* as well as through the TWRI Facebook page and Twitter. In addition, a TWON “Well Read” electronic newsletter was developed and sent out occasionally with updates and links to resources regarding groundwater and wells. As a result of these materials, popular media in the watersheds where these programs were to be held also ran some of these releases. The list of TWON articles that were published can be found in Table 1.

Fourteen *Well Educated* 6-hour TWON trainings were delivered through this project to a total of 745 participants to increase local understanding of the factors that can adversely impact well water quality and provide access to the knowledge and tools that can be employed to prevent and/or resolve them. Trainings were delivered by the TWON Coordinator and a combination of the BAEN and SCSC Program Specialists and the SCSC Assistant Professor and Extension Specialist. The TWON handbook was distributed to all participants, the standardized presentations were delivered, well water samples were collected and analyzed and additional resources such as the TWON Fact Sheets were available in print as well as online.

*Well Informed* water screening events were delivered to provide wellhead protection information and recommendations for remediating well contamination, as needed. Screenings were delivered by the SCSC Assistant Professor and Extension Specialist, TWON Coordinator and/or the SCSC Program Specialist, as appropriate. While 30 well screening events were in the original scope of work, 43 screening events were delivered during the course of this project. These *Well Informed* screening events included an overview of the topics discussed in more detail during the comprehensive *Well Educated* TWON trainings.

For both *Well Informed* screening and *Well Educated* training events, participants arrive with private well water samples, collected using the Soil, Water and Forage Testing Laboratory water collection procedures (<http://soiltesting.tamu.edu/files/waterweb1.pdf>), which were screened for fecal coliform bacteria, nitrate and salinity concentrations. The participants’ cost for the screenings was typically around \$5–\$15 per sample. For those with positive results, remediation instructions and/or a recommendation and instructions were given for sending follow-up samples to an accredited National Environmental Laboratory Accreditation Conference laboratory to perform drinking water analyses.

During most of the trainings, results of bacterial screenings are not available before the training is completed. Bacterial screening results and, as appropriate, remediation instructions or recommendation for additional testing are forwarded to the participants, which allows participants to receive bacterial screening results privately. As a result of the *Well Educated* training, participants more clearly understand the relationships between practices in or near the well and the quality of water available for drinking and irrigation by their families and by other families pumping from the same formation.



The list of watersheds, dates and locations for the completed TWON *Well Educated* trainings and *Well Informed* screenings are in Tables 2 and 3. In addition, a map showing attendee volumes at each location is in Figure 2.



**Figure 1.** Attendees at the *Well Educated* program learn how to protect their well water and were able to have their well water analyzed.

**Table 1.** List of news releases and articles published about TWON *Well Educated* and *Well Informed* Programs, totaling 66 media mentions.

<b>Media Source</b>	<b>Title</b>	<b>Date</b>
Johnson City Record Courier	<a href="#">Time Is Now to Test Private Water Well</a>	4/14/2011
Kingsville Record and Bishop News	<a href="#">Water well screening available</a>	5/1/2011
Ag News	<a href="#">Well screenings, results provided by Texas Well Owner Network</a>	5/4/2011
TSSWCB Conservation News	<a href="#">Well screenings, results provided by Texas Well Owner Network</a>	5/12/2011
My Sou Texas	<a href="#">Well Owner Network to provide water well screenings</a>	5/22/2011
Jacksboro Newspapers	Test your well May 31	5/24/2011
Ag News	<a href="#">AgriLife Extension specialist appointed project coordinator for Texas Well Owner Network</a>	7/7/2011
North Texas e-News	AgriLife Extension specialist appointed Project Coordinator for TWON	7/8/2011
Victoria Advocate	<a href="#">Extension Agent: Have you tested your private water well</a>	7/12/2011
Drovers Cattle Network	<a href="#">Water well owners advised to practice conservation during historic drought</a>	7/20/2011
Texas Ground Water.org	<a href="#">AgriLife Extension Expert: Water well owners advised to practice conservation during historic drought</a>	7/20/2011
Ag News	<a href="#">Water Well owners advised to practice conservation during historic drought</a>	7/20/2011
The Farmer-Stockman	<a href="#">Extension Specialist Tapped as Coordinator for Well Owner Network Program</a>	7/21/2011
TSSWCB Conservation News	<a href="#">AgriLife Extension Expert: Water Well owners advised to practice conservation during historic drought</a>	7/21/2011
My Plainview	<a href="#">Well owners advised to practice conservation during drought</a>	7/24/2011
Sealy News	<a href="#">Residents to take advantage of water well screening</a>	12/1/2011
KXAN	<a href="#">National Groundwater Awareness Week</a>	3/14/2012
Barton Springs/Edwards Aquifer Conservation District	Water Well Check-up	3/16/2012
Herald Democrat.com	<a href="#">Meeting planned to discuss local groundwater characteristics</a>	6/3/2012

Media Source	Title	Date
North Texas e-News	<a href="#">Groundwater characteristics, contaminants and sustainability discussed in Bonham</a>	6/27/2012
Country World	<a href="#">Well and water regulations undergo change</a>	7/16/2012
Victoria Advocate	<a href="#">Network offers water well screening</a>	12/27/2012
AgriLife Today	<a href="#">Well-owner training set Jan. 31 in Seguin</a>	1/14/2013
Texas Farm Bureau	<a href="#">Private well users invited to free management training</a>	1/15/2013
AgriLife Today	<a href="#">AgriLife Extension sets water well screening program in Coke County</a>	1/28/2013
AgriLife Today	<a href="#">Well-owner training set Feb. 27 in Boerne</a>	2/12/2013
Texas Farm Bureau	<a href="#">Well Owner Network to host seminar Feb. 27 in Boerne</a>	2/13/2013
SA Express News mysanantonio.com	<a href="#">Educational seminar set for well owners</a>	2/19/2013
Focus Daily News	<a href="#">Well-owner training set Feb. 27 in Boerne</a>	2/26/2013
AgriLife Today	<a href="#">Texas Well Owner Network training slated for March 28 in Wellington</a>	3/5/2013
TSSWCB Conservation News	<a href="#">Texas Well Owner Network training slated for March 28 in Wellington</a>	3/7/2013
AgriLife Today	<a href="#">Water-well owner training set for April 9 in Lubbock</a>	3/13/2013
AgriLife Today	<a href="#">Well-owner training set April 10 in Haskell</a>	3/22/2013
Water World	Well-Owner Training Set April 10 in Haskell	3/22/2013
Farm Progress	<a href="#">Texas Well Owner Training March 28 At Wellington</a>	3/22/2013
Myhighplains.com	<a href="#">Texas Well Owner Network Training Today in Wellington</a>	3/28/2013
Texas Farm Bureau	<a href="#">TWON to host well owner training June 20, Killeen</a>	3/28/2013
The Vindicator-Liberty County	<a href="#">Water Well Screening Day in Liberty and San Jacinto is April 24</a>	3/29/2013
Reporter News- Your Abilene Online	<a href="#">Well-owner training/water screening set in Haskell</a>	3/31/2013
San Marcos Daily Record	Water well training set for owners	4/30/2013
Wilson County News	<a href="#">Water-well owner training set for May 9</a>	5/1/2013
Texas Farm Bureau	<a href="#">Water well screening slated for May 9, Lockhart</a>	5/3/2013

<b>Media Source</b>	<b>Title</b>	<b>Date</b>
AgriLife Today	<a href="#">Water-well owner training set for June 1 in Junction</a>	5/13/2013
Texas Farm Bureau	<a href="#">Water well training June 1, Junction</a>	5/14/2013
AgriLife Today	<a href="#">Water-well owner training set for May 9 in Lockhart</a>	5/18/2013
Clearwater UWCD	<a href="#">Texas Well Owner Network</a>	5/23/2013
AgriLife Today	<a href="#">Water-well owner training set June 20 in Killeen</a>	5/24/2013
Killeen Daily Herald	<a href="#">Water well screening scheduled for Monday</a>	6/7/2013
KWTX 10	<a href="#">Killeen: Make Sure Your Water Well is Well, Free Training Thursday</a>	6/18/2013
AgriLife Today	<a href="#">Water well owner training in Llano successful</a>	7/16/2013
AgriLife Today	<a href="#">Water-well owner training set for Sept.12 in Wimberley</a>	8/16/2013
Wharton Journal Spectator	<a href="#">Local well water tested on Sept. 16</a>	8/28/2013
Texas Farm Bureau	<a href="#">Well Owner Network to host well management training Sept. 12, Wimberley</a>	8/28/2013
weatherforddemocrat.com	Water-well owner training set for Oct. 2 in Weatherford	9/14/2013
AgriLife Today	<a href="#">Water-well owner training set for Oct. 2 in Weatherford</a>	9/16/2013
AgriLife Today	<a href="#">Water-well owner training set for Oct. 10 in Charlotte</a>	9/17/2013
Texas Farm Bureau	<a href="#">Free training to address private water well management Oct. 10, Charlotte</a>	9/17/2013
AgriLife Today	<a href="#">Water well owner training set for Oct. 22 in Fort Stockton</a>	9/30/2013
AgriLife Today	<a href="#">Water-well owner training set for Oct. 23 in San Angelo</a>	10/1/2013
Mineral Wells Index	Free training program for residents whose water source comes from a well	10/1/2013
Bandera County Courier	<a href="#">Time to test your private water well?</a>	10/10/2013
AgriLife Today	<a href="#">Texas Well Owner network to offer water well screening Nov. 6 in Bandera</a>	10/15/2013
San Angelo Standard Times	<a href="#">Training offered for well owners</a>	10/20/2013
AgriLife Today	<a href="#">Water well owner training set for Nov. 19 in Uvalde</a>	11/1/2013
Press Zoom	<a href="#">Water well owner training set for Nov. 19 in Uvalde</a>	11/1/2013

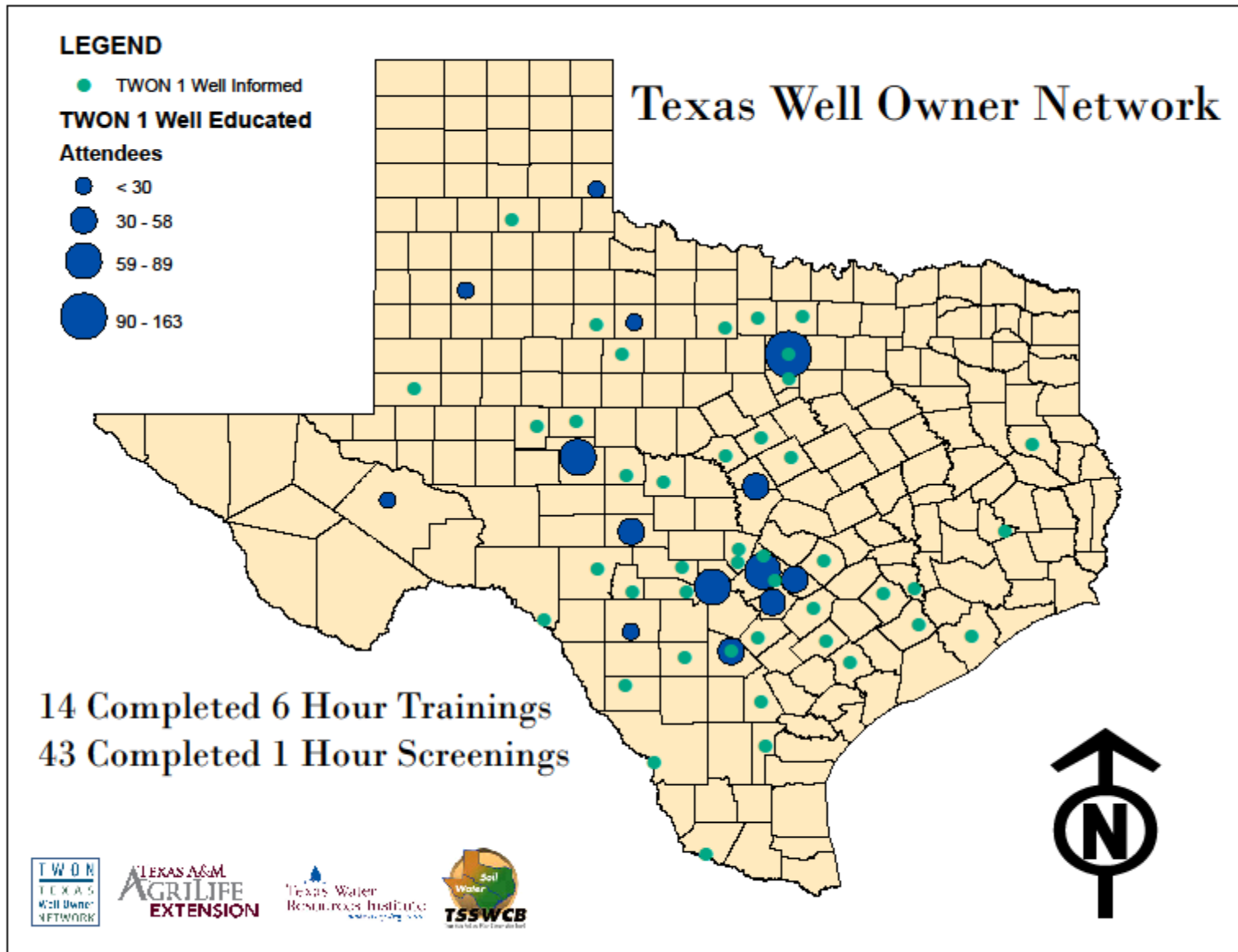
**Table 2.** Through the TWON program, 14 *Well Educated* 6-hour trainings were conducted in watersheds selected by the TWON team and TSSWCB.

<b>Watershed</b>	<b>Major Aquifer</b>	<b>Date</b>	<b>City</b>	<b>County</b>	<b>Attendees</b>
Geronimo Creek	Edwards	January 31, 2013	Seguin	Guadalupe	48
Upper Cibolo Creek	Trinity	February 27, 2013	Boerne	Kendall	76
Buck Creek	Blaine	March 28, 2013	Wellington	Collingsworth	22
Ogallala Aquifer	Ogallala	April 9, 2013	Lubbock	Lubbock	17
Seymour Aquifer	Seymour	April 10, 2013	Haskell	Haskell	29
Plum Creek	Carrizo-Wilcox/Edwards	May 9, 2013	Lockhart	Caldwell	37
Upper Llano River	Edwards-Trinity	June 1, 2013	Junction	Kimble	40
Lampasas River	Trinity/ Edwards	June 20, 2013	Killeen	Bell	58
Cypress Creek	Trinity / Edwards	September 12, 2013	Wimberley	Hays	89
Upper West Fork Trinity	Trinity	October 2, 2013	Weatherford	Parker	163
Atascosa River	Carrizo-Wilcox	October 10, 2013	Pleasanton	Atascosa	38
Pecos River	Trinity	October 22, 2013	Fort Stockton	Pecos	15
Middle & South Concho Rivers	Trinity	October 23, 2013	San Angelo	Tom Green	87
Leona River	Edwards	November 19, 2013	Uvalde	Uvalde	26
<b>TOTAL ATTENDEES</b>					<b>745</b>

**Table 3.** Through the TWON program, 43 *Well Informed* water screenings were conducted in watersheds selected by the TWON team and TSSWCB.

<b>Watershed</b>	<b>Major Aquifer</b>	<b>Date</b>	<b>City</b>	<b>County</b>	<b>Samples</b>
Middle Colorado	Trinity	April 4, 2011	Goldthwaite	Mills	93
Nueces Headwaters	Edwards-Trinity	April 13, 2011	Leakey	Real	42
West Nueces	Edwards-Trinity	April 14, 2011	Rock Springs	Edwards	41
San Marcos	Trinity	April 18, 2011	Johnson City	Blanco	58
Pedernales	Trinity	April 19, 2011	Blanco	Blanco	28
San Fernando	Gulf Coast	May 2, 2011	Alice	Jim Wells	40
Los Olmos	Gulf Coast	May 4, 2011	Rio Grande City	Starr	73
Lower Colorado - Cummins	Gulf Coast	May 18, 2011	Columbus	Colorado	35
Upper West Fork Trinity	Trinity	May 31, 2011	Jacksboro	Jack	91
Salt Fork Brazos	Seymour, Blaine	June 1, 2011	Aspermont	Stonewall	5
Lower Guadalupe	Gulf Coast	July 27, 2011	Victoria	Victoria	141
Upper Nueces	Carrizo-Wilcox	October 4, 2011	Carrizo Springs	Dimmit	32
Middle Nueces	Carrizo-Wilcox	October 6, 2011	Laredo	Webb	37
Middle Brazos - Palo Pinto	Seymour	October 11, 2011	Graham	Young	13
Middle Brazos - Palo Pinto	Trinity; Woodbine	October 12, 2011	Weatherford	Parker	72
Lake Granbury	Trinity; Woodbine	October 24, 2011	Granbury	Hood	75
San Bernard River North	Gulf Coast	January 9, 2012	Sealy/Columbus	Austin	104
San Bernard River South	Gulf Coast	March 8, 2012	Angleton	Brazoria	80
Paint	Seymour	March 21, 2012	Anson	Jones	33
Onion and Barton Creeks	Edwards - Trinity	April 16, 2012	Dripping Springs	Hays	111
North Concho River	Edwards	May 14, 2012	Sterling City	Sterling	5
Concho River	Edwards-Trinity	May 16, 2012	Eden	Concho	33
Brady Creek	Edwards-Trinity	June 6, 2012	Brady	McCulloch	77
Upper Guadalupe River	Edwards-Trinity	July 9, 2012	Kerrville	Kerr	50
Leon River	Trinity	September 12, 2012	Hamilton	Hamilton	126
Colorado River	Carrizo-Wilcox	October 4, 2012	Bastrop	Bastrop	170

<b>Watershed</b>	<b>Major Aquifer</b>	<b>Date</b>	<b>City</b>	<b>County</b>	<b>Samples</b>
Attoyac Bayou	Carrizo-Wilcox	October 17, 2012	Nacogdoches	Nacogdoches	18
San Fernando	Gulf Coast	October 31, 2012	George West	Live Oak	40
Lower Frio	Carrizo-Wilcox	November 2, 2012	Pearsall	Frio	51
Monument-Seminole Draws	Ogallala	November 13, 2012	Andrews	Andrews	114
Elm and Sandies Creek	Gulf Coast	January 7, 2013	Cuero	DeWitt	99
Peach Creek	Carrizo-Wilcox	January 9, 2013	Gonzales	Gonzales	143
Colorado River	Edwards-Trinity	February 11, 2013	Robert Lee	Coke	22
Red River	Ogallala	March 25, 2013	Silverton	Briscoe	20
Upper San Marcos River	Edwards - Trinity	April 16, 2013	San Marcos	Hays	121
Trinity River	Gulf Coast	April 24, 2013	Shepherd	San Jacinto	67
Pecos River	Edwards-Trinity	June 5, 2013	Del Rio	Val Verde	36
Leon River	Trinity	June 10, 2013	Gatesville	Coryell	26
San Antonio River	Carrizo-Wilcox	June 12, 2013	Floresville	Wilson	18
San Bernard River	Gulf Coast	September 16, 2013	Wharton	Wharton	191
Middle Brazos - Palo Pinto	Trinity	October 28, 2013	Granbury	Hood	52
Upper West Fork Trinity	Trinity	October 30, 2013	Decatur	Wise	127
Medina	Trinity	November 6, 2013	Bandera	Bandera	98
<b>TOTAL SAMPLES</b>					<b>2,908</b>



**Figure 2.** Map of TWON *Well Informed* screenings and *Well Educated* trainings with attendee volumes.



## Evaluation

To measure both knowledge and behavior changes of individuals participating in the program, evaluations were developed and delivered. SCSC developed and delivered pre-test/post-test evaluations to evaluate increased knowledge by participants at TWON trainings regarding program principles, appropriate BMPs and other activities; to address proper private well management; to evaluate participant satisfaction with the program; and to evaluate participant's intentions to change their behavior as a result of the TWON training. Outcomes for the programs are shown below:

Knowledge gained as measured by pre/post-tests administered at the trainings: pre-test scores averaged 54% correct answers, while post-test scores averaged 84% correct.

- Post-training evaluation:
  - 99% of participants were satisfied with the *Well Educated* training.
  - The value of participating in the program as estimated by attendees was an average of \$752 or a total of \$1,331,810 for all 2013 participants.
- Intentions to Adopt Behavior Change:
  - 86% of participants will test their well annually.
  - 85% of participants will pump their septic system regularly.
  - 94% of participants will remove hazards from their well house.
  - 88% of participants with a deteriorated or open well will plug or cap the well.

In addition, a 6-month follow-up survey was developed and delivered online to assess behavior changes adopted and other activities, such as the number of neighbors contacted, by TWON training participants. The online survey link is emailed to past participants 6 months after attending the training. SCSC analyzes the results using descriptive, correlational and analysis of variances statistical procedures. Outcomes from the 6-month follow-up are shown below:

- Six-month follow-up survey results:
  - 74% shared the resources/materials with others who were not at the training.
  - 89% of those needing to clean out hazards from their well house had done so.
  - For participants with septic tanks that needed pumping, 55% had pumped their septic tanks within 6 months following the program. An additional 28% were planning to have their tanks pumped soon.
  - 38% of participants with unused/deteriorated wells had plugged those wells as a result of the TWON program, and another 25% planned to plug their unused/deteriorated wells soon.
  - 71% of participants who had wells near contamination sources (pet shelters, livestock yards, etc.) moved the sources following the program, and another 29% had plans to move sources soon.

## Conclusion

The development and implementation of the TWON *Well Educated* trainings and *Well Informed* screenings was and continues to be highly successful. The materials developed during this project, such as the TWON Fact Sheets and handbook, were and continue to be used for trainings and screenings to help educate landowners on how to protect and manage their well water.

Through this initial project, *Well Educated* trainings were delivered to 745 participants to increase local understanding of factors that can adversely impact well water quality and provide access to the knowledge and tools that can be employed to prevent and/or resolve them. The TWON handbook was distributed to all participants, standardized presentations were delivered, water well samples were collected and analyzed and additional resources such as the TWON Fact Sheets are available in print or online. As a result of the *Well Educated* training, participants have the ability to clearly understand the relationships between practices in or near the well and the quality of water available for drinking and irrigation by their families and by other families pumping from the same formation.

*Well Informed* water screening events were delivered to provide wellhead protection information and recommendations for remediating well contaminates. There were 43 screening events delivered during the course of this project including more than 2,900 water samples.

Evaluations were given to all participants to measure both knowledge and behavior changes of individuals participating in the programs. A pre-test/post-test was developed and delivered. Outcomes showed that most participants were satisfied with the events and the majority of participants intend to adopt behavior changes, such as testing their well water annually, pumping their septic system regularly, removing hazards from their well house and plugging or capping deteriorated or open wells.

In addition, 6-month follow-up surveys showed that 74% of participants had shared the resources and materials with others who were not at the training. Also, most of those participants needing to clean out hazards from their well house had already done so. For participants with septic tanks needing to be pumped, 55% had them pumped within the 6 months, and an additional 28% were still planning to have them pumped soon.

The efforts above are continuing and expanding through TSSWCB project 13-08 “*Statewide Delivery of the Texas Well Owner Network.*”