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Contract #582-14-43863
# Purpose

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PURPOSE

We are proud to present an overview of program activities and accomplishments of Texas Stream Team’s (TST) efforts for the Fiscal Years 2015 (September 1, 2014 – August 31, 2015) and 2016 (September 1, 2015 – August 31, 2016). This report includes program activities funded under the Clean Water Act Section 319(h) grant provided by the Texas Commission on Environmental Quality (TCEQ) and United States Environmental Protection Agency (EPA). Matching funds come from volunteer hours and time spent by TST partners participating in the program.

Since its formation in 1991, Texans have come to the Texas Stream Team program in search of answers to water quality questions and concerns. Resource managers have used TST’s data as supplemental information to support their water quality studies. Citizens often ask, “How safe is my water?” Science teachers have come in search of real-world activities to enhance their presentations of scientific information and concepts. Students use TST to help their research objectives and professional development.

Texas Stream Team has developed an extensive network of natural resource management agencies, natural resource experts, stakeholders, teachers, students, and citizen scientists with the overall goal of increasing stakeholder involvement in water resource related issues. Texas Stream Team achieves this goal through two major components of the program – citizen scientists water quality monitoring and environmental education.

Texas Stream Team is administered through The Meadows Center for Water and the Environment (The Meadows Center) at Texas State University (TXSTATE). Texas Stream Team supports and enhances public outreach objectives identified by stakeholders and supports government priorities, including the federal Nonpoint Source Program (NPS), the state’s Total Maximum Daily Load Program (TMDL), the Texas Clean Rivers Program (CRP), and the state’s Surface Water Quality Monitoring Program (SWQM).
MEETING TEXAS STREAM TEAM GOALS

Short-term Goals

- Data Collection and Assessment
- Education and Outreach (With a focus on high priority nonpoint source pollution-impacted watersheds)

Long-term Goals

- Focus TST resources on impaired watersheds
- Support the implementation of state, regional, and local programs to prevent nonpoint source pollution through TST monitoring, assessment, and education
- Support state, regional, and local programs during the implementation of strategies defined in Total Maximum Daily Load Implementation Plans (TMDLs) and Watershed Protection Plans (WPPs)
- Develop partnerships to facilitate collective and cooperative approaches to manage nonpoint source pollution
- Increase overall public awareness of nonpoint source pollution issues and prevention strategies
- Enhance public participation and outreach by providing forums for citizens and industry to contribute their ideas and concerns about water quality

Citizen Scientists Water Quality Monitoring and Resources for Teachers

<table>
<thead>
<tr>
<th>BY THE NUMBERS</th>
<th>2015</th>
<th>2016</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>monitoring events</td>
<td>2,432</td>
<td>2,625</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hours spent sampling</td>
<td>4,880</td>
<td>5,865</td>
<td></td>
<td></td>
</tr>
<tr>
<td>miles traveled</td>
<td>64,981</td>
<td>62,123</td>
<td></td>
<td></td>
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<tr>
<td>sites monitored</td>
<td>274</td>
<td>219</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher Workshops TST participated in</td>
<td>3</td>
<td>6</td>
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Trainings and Education

**BY THE NUMBERS**

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<thead>
<tr>
<th></th>
<th>2015</th>
<th>2016</th>
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</thead>
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<tr>
<td>Core water quality trainings conducted</td>
<td>53</td>
<td>44</td>
</tr>
<tr>
<td>New Texas Stream Team Citizen Scientists</td>
<td>425</td>
<td>267</td>
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<tr>
<td>Advanced trainings conducted</td>
<td>4</td>
<td>3</td>
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<tr>
<td>TST Citizen Scientists certified in advanced monitoring</td>
<td>52</td>
<td>48</td>
</tr>
<tr>
<td>Education and Outreach events TST participated in</td>
<td>38</td>
<td>27</td>
</tr>
<tr>
<td>Individuals served by water quality presentations</td>
<td>3,451</td>
<td>2,002</td>
</tr>
<tr>
<td>New TST Water Quality Instructors</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Resources for Participants

**TST Website and Online Community Forum Objective**

TST built a beta-version online community of practice forum for those working in water resource protection and/or citizen science in Texas and those interested therein. The community forum was designed to allow dynamic interaction among community members through member profiles, shared calendars, discussion forums, file sharing, and other such tools. The forum allows discussions to be organized into topic areas; subgroups can be created based on specific interest areas or regions.

**Features**

This online forum will include features where participants may do the following:

- post questions, photos, relevant news articles and partner newsletters
- share TST-related testimonies
- share water quality monitoring-, environmental education- and community engagement-related resources
- submit volunteer wish lists
- share fundraising and sponsorship ideas
• publicize events for water quality trainings, education and outreach and watershed based planning
• provide feedback to TST staff
• brainstorm with other participants
• reference watershed protection information (WPP/TMDL activities, etc)
• plus more.

Participants

1. TST Partners and Groups
2. Citizen Scientists
3. Watershed Planning Interest Groups
4. General Public

Tabs

• Home: Texas Stream Team and purpose of Community Forum
• Discussion Topics
• Participant tabs
• TST Feedback
• Resource Section with file sharing capabilities
• Calendar to include trainings, education events, conferences, meetings, etc.

TST staff will seek additional feedback from TCEQ, TST partners and citizen scientists with the goal of launching the forum site in early 2017.
WATER QUALITY DATA COLLECTION

Objective

All submitted data collected under the QAPP undergoes quality assurance processes, is entered into the TST Database and is included in the TST Dataviewer. Data are assessed in data summary reports that highlight the status of water quality at reported monitoring sites.

Dataviewer

Texas Stream Team at The Meadows Center is the receptacle for all of the TST citizen scientist water quality monitoring that comes in from around the state. The data undergo quality assurance by a Quality Assurance Officer and are then displayed on the Dataviewer. The Dataviewer is an SQL Server database that has an interactive Google Maps-based interface where the general public can go and look at TST activity across Texas. Each monitoring site is represented on the map and viewers can click on a site to see the historical water quality data for that area. Citizen scientists can also log on to the Dataviewer and submit their water quality data to TST online, making the process from data collection to public dissemination of the data quicker and more efficient.

Texas Stream Team Citizen Scientists monitored 274 sites around the state in FY2015 and submitted a total of 2,432 monitoring events for the year. Texas Stream Team Citizen Scientists monitored 219 sites in FY2016 and submitted a total of 2,625 monitoring events for the year. TST submitted citizen monitoring data from 2015 and 2016 to the EPA STORET Database. STORET (STOrage RETrieval Data Warehouse) is the US Environmental Protection Agencies repository for water quality, biological, and physical data. The database is used by state and federal agencies, universities, and private citizens.

Data Summary Reports

Data Summary Reports are watershed wide analyses of selected TST citizen water quality data. These reports look at the average values of the parameters collected for the watershed as well as provide an analysis of each site monitored. The reports cite the Texas Surface Water Quality Standards to give the reader a reference as to the quality of the water in the watershed, but these reports are not used as an assessment of water quality by the state. Instead, these reports are used to notify the public about the quality of water in Texas, provide long-term baseline data, and to provide resource managers with supplemental data that can help with the decision-making process. Once a Data Summary Report is completed, it is sent to TCEQ for review. It is then distributed to partners and TST citizen scientists, after addressing TCEQ comments. All TST Data Summary Reports are posted on the TST website (www.joinstreamteam.org/Service/TexasStreamTeam/datamaps/DataReports.html) and are available to the public.
Data Summary Reports Completed by TST in FY 2015 and FY 2016:

- Lake Worth Watershed Data Report (Lake Worth has an approved TMDL).
- Geronimo Creek Watershed Data Report (Geronimo Creek has an approved Watershed Protection Plan).
- Salado Creek Watershed Data Report (Salado Creek has an approved TMDL).
- Carters Creek Watershed Data Report (Carters Creek is currently implementing a TMDL Plan).

*Students at Texas State University using secchi disks at a core water quality monitoring training – Spring Lake in San Marcos, Texas.*
CITIZEN SCIENCE

Objective

Engage a statewide network of a minimum of 350 citizen scientists annually in activities related to water quality. The citizen scientists will monitor at least 250 sites across Texas.

Participants

An average of 685 people participated in TST monitoring each month in 2015. These citizen scientists volunteered 4880 hours of time to monitoring, and drove a total of 64,981 miles in 2016. An average of 788 people participated in TST monitoring each month in 2016. These citizen scientists volunteered 5,865 hours of time to monitoring, and drove a total of 62,123 miles in 2015. Many groups are organized so that at least two people go out to monitor a site to save on time, for efficiency, and for safety reasons. A total of 493 sites were monitored, 294 in 2016, and 219 in 2017.

Trainings

Texas residents become certified citizen scientists with TST by undergoing the Core Water Quality Monitoring Training. This is a three phase training process during which the trainee learns how to measure water quality parameters including temperature, dissolved oxygen, pH, and conductivity. The trainee also learns why these parameters are important and how non-point source pollution can impact the quality of water. Forty-five Core Water Quality Monitoring Trainings were conducted in FY 2015, and 373 people became certified Texas Stream Team Water Quality Citizen Scientists. Texas Stream Team Staff conducted 11 Core Water Quality Monitoring Trainings. Forty-four Core Water Quality Monitoring Trainings were conducted in FY 2016, and 267 people became certified Texas Stream Team Water Quality Citizen Scientists. Texas Stream Team Staff conducted 13 Core Water Quality Monitoring Trainings.

Texas Stream Team continued working with its partners to offer the TST Paddlers Water Quality Monitoring Trainings. These trainings teach the citizen scientists how to conduct core water quality monitoring while in kayaks and canoes. Eight Paddlers trainings were conducted by TST staff and 52 people were trained in 2015. Two Paddlers trainings were conducted by TST staff and 14 people were trained in 2016.

Texas Stream Team citizen scientists can increase involvement with TST by taking the Advanced Non-Point Source (NPS) Suite Training. Once certified, an advanced monitor can begin taking samples to test for nitrates, phosphates, turbidity, E. coli bacteria, and streamflow. These measurements, in addition to the core water quality parameters, provide a more complete profile of the quality of water at a monitor’s site. Texas Stream Team conducted 4 Advanced NPS Suite Trainings and certified a total of 52 citizen scientists in 2015, with one of these trainings being conducted by TST staff, and 3 conducted by a Certified Instructor. Texas Stream Team conducted 3 Advanced NPS Suite Trainings and certified a total of 48 citizen scientists in 2016. Two trainings were conducted by TST staff and 1 conducted by a Certified Instructor.
Texas Stream Team’s ability to monitor water bodies across the state is due, in large part, to its ever-expanding network of TST Certified Instructors. Certified Instructors are citizen scientists who have undergone official “Train the Trainer” Certification. The first phase of the certification is to assist a Certified Instructor in a training workshop. The second phase is to lead a training workshop under the supervision of a Certified Instructor. Once certified as an Instructor, a new Certified Instructor can then schedule and conduct trainings at their convenience. Texas Stream Team staff supports Certified Instructors by loaning kits, when necessary, assisting in monitoring plans, and entering the newly certified citizen scientists’ information into the database. Two TST Citizen Scientists became Certified Instructors in FY15. Two TST Citizen Scientists became Certified Instructors in FY16.

### BY THE NUMBERS

<table>
<thead>
<tr>
<th>Events</th>
<th>2015</th>
<th>Participants</th>
<th>Events</th>
<th>2016</th>
<th>Participants</th>
</tr>
</thead>
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<tr>
<td>45</td>
<td>Core Trainings</td>
<td>373</td>
<td>44</td>
<td>Core Trainings</td>
<td>267</td>
</tr>
<tr>
<td>11</td>
<td>Core Trainings by TST Staff</td>
<td>123</td>
<td>13</td>
<td>Core Trainings by TST Staff</td>
<td>107</td>
</tr>
<tr>
<td>34</td>
<td>Core Trainings by Partners/Volunteers</td>
<td>250</td>
<td>29</td>
<td>Core Trainings by Partners/Volunteers</td>
<td>166</td>
</tr>
<tr>
<td>8</td>
<td>Paddlers Trainings</td>
<td>52</td>
<td>3</td>
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</tr>
<tr>
<td>8</td>
<td>Paddlers Trainings by TST Staff</td>
<td>52</td>
<td>2</td>
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</tr>
<tr>
<td>0</td>
<td>Paddlers Trainings by Partners/Volunteers</td>
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<td>1</td>
<td>Paddlers Trainings by Partners/Volunteers</td>
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<tr>
<td>4</td>
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<td>52</td>
<td>3</td>
<td>Advanced Trainings</td>
<td>37</td>
</tr>
<tr>
<td>3</td>
<td>Advanced Trainings by TST Staff</td>
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<td>3</td>
<td>Advanced Trainings by TST Staff</td>
<td>37</td>
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<tr>
<td>1</td>
<td>Advanced Trainings by Partners/Volunteers</td>
<td>7</td>
<td>0</td>
<td>Advanced Trainings by Partners/Volunteers</td>
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<tr>
<td></td>
<td>Angler Trainings by TST Staff</td>
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<td>2</td>
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<td>30</td>
</tr>
</tbody>
</table>
Paddler Program

The Texas Stream Team implemented a full protocol for kayaking/canoeing (informally known as the “Paddler” program) to offer Paddler training sessions to the public in 2015. These training sessions involve learning about Texas Stream Team basics, including watershed awareness, non-point source pollution, and proper boating safety. Citizen scientists then become familiar with usage of the ExTech ExStik II (“probe”) monitoring kit to test for water temperature, water clarity, dissolved oxygen, pH, specific conductivity, and field observations. Instruction takes place in both a classroom setting and while paddling on a nearby lake, river, or stream.

In addition to the land-based Texas Stream Team monitoring regime where sites are designated by a lat/long location and added into an established monitoring plan, paddler citizen scientists have the option of selecting a desired river basin with the help of TST staff and then record their lat/long locations and monitoring results as they go. Their data are then submitted to TST’s Database Manager and are submitted to the online Dataviewer. Once the data are reviewed and approved for quality assurance and proper monitoring techniques, sites are created by the Database Manager based on the locations monitored and the data is made available to the public.

Although the Paddlers program has mostly been limited to participants in the Austin, San Marcos, and San Antonio areas over the past two years, one TST Paddlers training was recently held in Corpus Christi and plans to expand the program statewide are currently being formulated by TST staff. The following is a summary of Texas Stream Team Paddlers trainings held over the last fiscal year.
Texas Stream Team staff held at least 4 paddler trainings between September 2015 to June 2016. The first training was held in conjunction with the University of Texas’s Longhorn Stream Team chapter and had 10 participants. The second training was held at REI’s downtown Austin location with the assistance of REI staff. The third paddler training was held at REI’s downtown Austin location on April 9 and featured four participants from UTSA and the South Bexar County Stream Team chapter. A fourth Paddler training was held at Aransas Pass on June 1 and had approximately 10 participants. This training was held in partnership with Coastal Bend Kayaks and Texas A&M – Corpus Christi. Texas State University’s River Inspired Student Effort (RInSE) and the San Marcos River Rangers also held a Paddler training that featured 8 participants.

A TST citizen scientist uses a Secchi disk to determine water clarity on Spring Lake, San Marcos, Texas.

**Angler Program**

The aim of the TST angler pilot program is to:

- Reach out to fishing organizations and outdoor enthusiasts who wish to become citizen scientists;
- Provide anglers across Texas with resources to assess the health of aquatic ecosystems in remote locations that land-based monitors may not be able to access;
- To protect and conserve fishing sites and waterways for anglers across Texas.

Texas Stream Team’s Anglers program includes teaching citizen scientists basic angling techniques (when applicable) and report additional field observations related to healthy fish populations.

TST has partnered with the non-profit organization, Fishing’s Future, to connect more kids to nature and family activities, teach environmental stewardship, increase awareness for the protection,
conservation and restoration of aquatic natural resources, and increase participation in recreational angling activities.

Protocol for recording Angler citizen science data differs slightly from past monitoring plans and may be accessed online (http://www.meadowscenter.txstate.edu/Service/TexasStreamTeam/Programs/anglers.html). In order to respect the privacy of anglers and their prized fishing spots, the exact lat/long coordinate where data is taken will not be published online and will be held strictly within TST’s internal databases. However, general river or stream segment(s) where angler monitoring takes place and the results will be made publicly available.

**Angler Program Trainings**

TST held a pilot training for the Anglers program for the Fredericksburg Flyfishers group in February 2016 and attended the OctoberFisch event in Junction in October 2016 to officially kick off the Angler program. Additional angler and monofilament materials are publicized with standard TST trainings and all TST education programs and awareness campaigns.

**OVER 500 CITIZENS LEARNED ABOUT TEXAS STREAM TEAM WATER RESOURCE PROTECTION EFFORTS IN A SINGLE EVENT.**

*Texas Stream Team Education Booth at the Shrimporee Festival: “I Pledge to Take Care of our Texas Waters.” Photo by Jenna Walker*
Texas Stream Team held a booth at the Shrimporee event in Aransas Pass on June 10-12, 2016 where we spoke about Texas Stream Team, watersheds, monofilament fishing line, our partnership with the Science and Spanish Club Network, non-point source pollution, and passed out 200 monofilament bags. Folks signed a pledge to help protect clean rivers and bays. Kids enjoyed a “pin the fin on the dolphin” game. TST staff sold Remarkable Riparian books plus other Meadows Center educational books and distributed posters of the regional bay system. Over 500 citizen scientists learned about Texas Stream Team water resource protection efforts in a single event. Additional angler and monofilament materials were publicized with standard TST trainings and all TST education programs and awareness campaigns.

Submitting Data

Angler citizen scientists will complete the standard datasheet to submit water quality and submit a separate online form or physical paper form with angler data until the new dataviewer is created to support additional data types. Anglers may voluntarily submit any documentation of fish caught, such as size, species, and any illnesses or health defects observed within any caught specimens. Anglers are also encouraged but not required to submit any photographs of healthy fish caught.

Your Remarkable Riparian Field Guide: Riparian Bull’s Eye Evaluation Tool

The newly expanded third edition of Your Remarkable Riparian Field Guide covers most of Texas’ watersheds and includes valuable tools for teaching land owners, creek side communities, conservationists, students and nature enthusiasts how to improve riparian areas.

Texas Stream Team staff worked with the guide’s editors to craft the Riparian Bull’s-Eye Evaluation tool included in the Field Guide so that citizen scientists can assess and collect data on the health of local riparian areas. Riparian health data can be reported in conjunction with water quality data. The Remarkable Riparian field guide content and the Riparian Bull’s-Eye evaluation tool may also be integrated into educational workshops and water quality trainings.
Partners

Texas Stream Team continues to forge new partnerships with organizations across the state. Partner organizations include non-profit and non-governmental organizations, universities, primary and secondary schools, Texas Parks and Wildlife, cities, counties, inter-local councils, and river authorities. The partnerships are focused on collaborations where TST Citizen Scientists Water Quality Monitoring and TST educational materials are in line with the partner’s goals of increasing awareness of water resources. Partner organizations receive a number of benefits from their partnership with TST, including technical assistance, outreach materials, customized data reports and datasets, support with education and outreach activities, professional networking opportunities, building stakeholder involvement through citizen science, collaborative grant writing and fundraising, assistance with implementing water quality improvement plans, and recognition in the TST newsletter and on their website. These partnerships, as well as the existing partners, are critical to reaching the maximum number of stakeholders possible. The following are new partnerships that were initiated during FY 2015 and 2016.

2015

The Center for Coastal Studies, Nueces River Authority, and Coastal Bend Bays Foundation

Texas Stream Team is partnering with The Center for Coastal Studies, Nueces River Authority, and Coastal Bend Bays Foundation to support citizen scientists in the Corpus Christi area. These organizations are involved in the Petronila Creek TMDL, Oso Creek/Oso Bay TMDL, Corpus Christi Bay TMDL, and Lower Nueces River WPP. TST worked with these partners to recruit and train citizen scientists in the area who will monitor sites in these watersheds as part of the effort to collect water quality data and inform the public on water quality issues. The partners will provide support by equipping the citizen scientists and assigning them sites to monitor. In the future these organizations will have trained TST Instructors on their staff that will be able to certify additional citizen scientists.
The University of Texas at Austin
The University of Texas at Austin's Division of Recreational Sports has partnered with TST to create a Longhorn Stream Team. The UT Rec has an outdoor leadership class that they offer to students where they learn outdoor skills such as backpacking, camping, rock climbing, wilderness survival, First Aid/CPR, and aquatic skills such as kayaking and swift water rescue. The outdoor leadership class also includes environmental stewardship, and UT Rec has decided to include water quality monitoring as part of the curriculum. All of the students are trained in the TST Paddlers Water Quality Monitoring Protocol and join the Longhorn Stream Team. These students then participate in kayaking trips on rivers around Texas including the Colorado, Pedernales, Guadalupe, and Frio Rivers, and an annual trip to the Rio Grande in Big Bend. While out on these river trips, the Longhorn Stream Team conducts water quality monitoring at designated stations and submits the data to TST.

The Longhorn Stream Team

REI
Texas Stream Team is partnering with REI (Recreational Equipment Inc.) a sporting goods cooperative. REI offers outdoor education classes to the public, and the REI store in Austin is now offering TST Paddlers training on a quarterly basis. Those who attend the class will be trained on how to conduct water quality monitoring according to the TST Paddlers Protocol. The trainings take place in the REI classroom at the store, and then the group takes kayaks out on Lady Bird Lake to complete their training.
2016

Texas Tech University – Junction
Texas Stream Team is partnering with Texas Tech University – Junction to support citizen scientists within Junction, Kerrville, and Fredericksburg. This organization is primarily involved in both core and advanced citizen scientist activities in the Upper Llano River Watershed Protection Plan. TST worked with TTU-Junction to recruit citizen scientists in the area who will monitor sites in the Upper Llano River and surrounding watersheds as part of the effort to collect water quality data and inform the public on water quality issues. The partners will provide support by equipping the citizen scientists and submitting data to TST.

Texas Parks and Wildlife
Texas Stream Team has partnered with Texas Parks and Wildlife to offer core trainings at McKinney Falls State Park in Austin, TX, and Blanco State Park at Blanco, TX. TPWD is involved in promoting citizen science activities in state parks across Texas. TST worked with TPWD to recruit citizen scientists within both state parks who will monitor sites on the Blanco River at Blanco SP and Onion Creek at McKinney Falls SP. TPWD will provide citizen scientists with monitoring equipment when able and has one certified instructor with plans to train more. Future trainings are already being scheduled for Lockhart State Park and Balmorhea State Park in the fall and winter of 2016.

Texas State University
In addition to the River Inspired Student Effort (RINSE), a new student-led Texas Stream Team chapter has been established on the Texas State University campus in San Marcos with assistance from TST student workers as well as the departments of Chemistry and Geography. The group will establish new sites and monitor existing sites with guidance from the San Marcos River Foundation and the San Marcos River Rangers. The first meeting of the organization took place on September 6 and additional meetings and recruitment efforts will be ongoing throughout Fall 2016. The organization has already purchased one kit with funds donated by the American Chemistry Society, another student group on campus who will work in close partnership with the TXST Stream Team.
Groups

Texas Stream Team encourages its citizen scientists to seek involvement with other interested people to form monitoring groups. Monitoring groups can range from a handful of interested citizens organizing on a grass-roots level, to existing groups of volunteers, such as the Texas Master Naturalists, that want to make water quality monitoring a part of their program. Texas Stream Team seeks to work with, and recruit, already existing groups whenever possible.

Stephen F. Austin Stream Team
A new TST group was formed of Stephen F. Austin students. The group will monitor in the Angelina and Neches River Basins and are supported by the TST partner, the Texas Conservation Alliance.

Good Water Master Naturalists – Williamson County, TX
The Good Water Master Naturalists have established core and advanced monitoring activities within the Brazos River Watershed in Williamson County. Texas Stream Team currently supports their monitoring activities, and they have initiated conversations with nearby municipalities to potentially partner with them in the near future.

Balcones Canyonlands Master Naturalists – Travis County, TX
The Balcones Canyonlands Master Naturalists have undergone core and advanced trainings and will eventually monitor within the Colorado River Watershed. Their current activities are supported by Texas Stream Team, but they may be folded into LCRA/CRWN monitoring activities in the future.

UTSA Paddlers – San Antonio, TX
The University of Texas-San Antonio Paddlers trained at REI in Austin and are planning to monitor the Medina River in San Antonio. Their activities are currently supported by Texas Stream Team.

Partner Meeting

2015

The 2015 Annual Statewide Partner Meeting was held at The Meadows Center for Water and the Environment on August 27, 2015. Partners that attended included:

- U.S. Environmental Protection Agency
- Texas Commission on Environmental Quality
- Lower Colorado River Authority
- Austin Youth River Watch
- University of Texas at Austin
- Baylor University
- City of Waco
- Guadalupe Blanco River Authority
- San Marcos River Foundation
- Nueces River Authority
- Cibolo Nature Center

The EPA gave a presentation on the Clean Water Rule Redefinition of US Waters. TCEQ gave an update on the 319 Program. The Meadows Center for Water and the Environment gave an update on Texas Stream Team and the Cypress Creek Project. The Longhorn Stream Team, Austin Youth River Watch, and the San Marcos River Rangers gave talks on how they use Texas Stream Team as part of
their programs. Colin McDonald with The Texas Tribune gave a presentation on his project, “The Disappearing Rio Grande.”

2016

The 2016 Texas Stream Team Annual Partner Meeting took place on September 28th, 2016 via the online webinar host, Zoom Video Conferencing. TST staff provided a brief overview of TST and the 25th Anniversary. They spoke about partner involvement, the Remarkable Riparian book for sale and the Riparian Bull’s-Eye Tool to be used by TST citizen scientists. They also gave an update about the Paddler/Angler/Diver programs, the new TST website and the Community Forum Site to be coming soon. Will requested that all partners let us know how many kits they have, who they were purchased by, and any other needs. Will also spoke about probe kit maintenance, life expectancy of the probes, troubleshooting, etc.

Partners in attendance:

• Texas State Aquarium
• San Marcos River Foundation
• Austin Youth River Watch
• Baylor University
• Houston-Galveston Area Council

• NE Texas Master Naturalists
• Upper Llano Watershed Coordinator
• Northwest Vista Community College – San Antonio
• Texas Stream Team Staff

Webinar vs. In-Person Meeting:

Overall, the webinar meeting was a success and a nice alternative to meeting in person to save time and money on travel for all participants. Participants had the option of joining the meeting online or calling in to the meeting. TST staff gave an online powerpoint presentation. Questions and discussion were encouraged throughout the presentation via phone or online chat. TST staff will gauge partner interest in hosting future annual meetings in person or via webinar.

Regional Meetings

2015

Two Regional Meetings were held during FY 2015. On June 13, 2015 Texas Stream Team hosted the Central Texas Regional Meeting at the Cibolo Nature Center in Boerne, TX. Texas Stream Team staff gave an update on the program. Donna Taylor with the Cibolo Nature Center gave an update on the CNC Stream Team. Ryan Bass gave a talk on the Cibolo Watershed Protection Plan. Rachel Sanborn gave a talk about the San Marcos River Rangers. There were 20 people in attendance.

Texas Stream Team hosted the second Regional Meeting at the South Texas Botanical Gardens in Corpus Christi, TX on July 29, 2015. Texas Stream Stream Team gave a presentation on what the program does and how to get involved. The Center for Coastal Studies spoke to the group about its partnership with Texas Stream Team. Coastal Bend Bays Foundation spoke about the Oso Creek/Oso Bay TMDL. The Nueces River Authority gave a presentation on the Petronila Creek TMDL. They were 28 people in attendance. Those in attendance went to a TST Core Water Quality Monitoring
Training the following day and became certified monitors and will monitor on Oso Creek/Bay, Nueces River, Petronila Creek, and Corpus Christi Bay.

2016

Three Regional Meetings were held during FY 2016. The first Texas Stream Team Regional Meeting was held at the River Legacy Living Science Center in Arlington, TX from 9 am -12 pm. Twenty-three partners and volunteers attended. TST staff spoke to the group on February 25, 2016 about TST new programs and protocol. The staff discussed ideas on additional funding opportunities and held a Q&A session. Rich Grayson gave an update from the Aquatic Alliance. TST staff conducted an optional probe kit training following the meeting and talked one-on-one with several volunteers that are wanting to create a new site, obtain a kit, etc.

The second Texas Stream Team Regional Meeting was held at Paris Junior College in Paris, TX on February 27, 2016 from 9 am -12 pm. Twenty partners and volunteers attended. Jenna spoke to the group about TST new programs and protocol. The Northeast Texas Stream Team Leader, Delores McCright, spoke about ways to share kits and step up monitoring efforts in the region. The group discussed ideas on additional funding opportunities and held a Q&A session. TST staff led an optional probe kit training following the meeting and talked one-on-one several volunteers that are wanting to create a new site, obtain a kit, etc.

The third Texas Stream Team Regional Meeting was held at Oso Bay Wetland Education Center in Corpus Christi, TX on June 9, 2016 from 5 – 7 p.m. Fifteen partners and volunteers attended. TST staff spoke to the group about TST new programs and protocol. Erin Hill of Texas A&M University – Corpus Christi gave an update about TAMU-CC monitoring efforts. The group discussed ideas on additional funding opportunities and held a Q&A session. TST staff also spoke with several volunteers one-on-one about creating new sites, obtaining a kits, salinity levels, etc. Texas Stream Team led a standard training, a probe and angler training and an advanced training the following day in Corpus Christi.
WATERSHED EDUCATION AND OUTREACH

Objective

Provide watershed education to 4,000 people annually on nonpoint source pollution and other water quality issues.

Spring Lake Education Program

The Meadows Center for Water and the Environment aims to use its location at Spring Lake – the headwaters of the San Marcos River, to offer watershed education to visitors. The Meadows Center for Water and the Environment’s Spring Lake Outdoor Education Program offers educational activities to visiting students from schools across the state. TST has a suite of activities that can be offered to students from elementary schools, middle schools, and high schools. These activities include using The Enviroscape 3D Watershed Model, and using the Texas Stream Team Water Quality Monitoring Kit to demonstrate water quality sampling. TST gave 20 presentations to 1100 students at Spring Lake in FY 2015. In addition, TST staff conducted 18 education and outreach events around the state to another 2351 people. TST gave 8 presentations to 525 students at Spring Lake in FY 2016. In addition, TST staff conducted 19 education and outreach events around the state to another 1477 people.

BY THE NUMBERS

<table>
<thead>
<tr>
<th></th>
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<td>20</td>
<td>Events</td>
<td>8</td>
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</tr>
<tr>
<td></td>
<td>at Spring Lake</td>
<td>Participants</td>
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<tr>
<td></td>
<td>1,100</td>
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<tr>
<td></td>
<td>Events Statewide</td>
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<tr>
<td></td>
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</table>
Partner Education Programs

2015

Texas Stream Team incorporated its activities into the programs of 3 partners in 2015.

*UT Outdoor Leadership Class*
TST Paddlers Training is a required part of the University of Texas at Austin Division of Recreation’s Outdoor Leadership Class.

*REI*
TST Paddlers training is now being offered as one of the outdoor classroom activities at REI in Austin.

*Neches River Adventures*
TST is also working with Neches River Adventures, a nonprofit organization that takes students on field trips up the Neches River near Beaumont. While on the boat, the students stop at a location and do water quality monitoring. TST has provided Neches River Adventures with a field guide that they can distribute to the students. The field guide allows the students to record their water quality monitoring results. It also has information on the types of water quality parameters they are measuring, why they are important to measure, and how they can be impacted by nonpoint source pollution.

2016*

Texas Stream Team incorporated its activities into the programs of 8 partners in 2016.
Fishing’s Future
Texas Stream Team worked with Fishing’s Future to incorporate water quality monitoring, fishing line removal, and NPS/watershed protection into their existing programming. This program aims to connect children to nature, strengthen family relationships, teach a conservation ethic, and increase participation in recreational angling. There are chapters across the United States, a few in Europe, and most are located in south Texas.

Shield Ranch – El Ranchito Camp
El Ranchito is a nature-immersion camp serving children and youth from low-income families. It is comprised of two core programs: Nature Discovery Camp and Conservation Corps. In the summer of 2016, Texas Stream Team partnered with El Ranchito to offer a macroinvertebrate activity for roughly 50 campers over two days. Jenna Walker and Briane Willis led the activity in Rocky Creek at Shield Ranch, collecting and identifying macroinvertebrates with campers and discussing water quality.

Texas Aquatic Science
Texas Aquatic Science is a holistic and comprehensive science curriculum exploring molecules to ecosystems, and headwaters to ocean. The curriculum (which is TEKS-aligned for grades 6-12), teacher guide, and associated learning materials are free for the public to use and may be accessed online (http://texasaquaticsscience.org/). It was developed in partnership between The Meadows Center, Texas Parks and Wildlife, and the Harte Research Institute for Gulf of Mexico Studies. Several of the TAS activities directly correlate with TST activities, including water quality testing, macroinvertebrate sampling, and a watershed model. Other activities will be incorporated into TST’s menu of activities.
Science Teachers Association of Texas
TST staff attended the Science Teachers Association of Texas conference in Central Texas in January 2016. She presented TST activities and menu of services to hundreds of local teachers. They plan to continue attending these events.

Informal Science Education Association of Texas
TST staff attended the Informal Science Education Association of Texas in February 2016. They networked, spread the word about TST programs and activities, and attended a series of informative sessions. TST staff plans to continue participating in this group.

Wildlife Viewing and Nature Tourism Academy
TST staff attended the Wildlife Viewing and Nature Tourism Academy in June 2016 to explore citizen science opportunities, project ideas, and techniques for engaging a more diverse audience in protecting the natural world.

Texas Parks and Wildlife Department
TST worked with Texas Parks and Wildlife Department on a new Water and Watershed curriculum specifically aimed at Master Naturalists (MN). Texas Waters Day launched the new curriculum produced by Texas Parks and Wildlife Department, Texas Waters: Exploring Texas Water and Watersheds and the new Texas Waters Specialist certification program at the Annual MN State Meeting in October 2016. Through this program, they are developing a corps of well-informed volunteer specialists who provide education, outreach, and service dedicated to the beneficial management of aquatic resources and aquatic habitats within their communities for the State of Texas. Texas Stream Team volunteer opportunities are included in the volunteer section of the program’s website.

Student Conservation Association
In 2016, TST partnered with Student Conservation Association to create a report on an environmental education program for the Houston community. This afterschool program would be led by a series of Houston park and recreation sites throughout the school yard and would engage the children in water resources, environmental justice, and habitat restoration (among others). The report, developed by TST staff, included the educational components that are vital for a successful and engaging program, as well as timeline, steps to implementation, and sample lesson plans. If developed, the program would be designed to meet the needs of the community and connect to local resources.

Texas State Aquarium
Texas Stream Team received the Wildlife Care, Conservation, and Research grants through Texas State Aquarium in 2014 and 2015. These grants funded the creation of Monofilament Finders, a new TST citizen scientist program aimed at keeping fishing line out of the environment for the well-being of humans, wildlife, and habitats. Participants are trained how to safely remove fishing line, identify and recycle monofilament, and report their data to TST. Staff handed out nearly 500 fishing line collection bags with attached safety protocol sheets since December 2015. An informational video about the dangers of fishing line left in the environment was produced in late 2015. There is now a monofilament fishing line recycling receptacle at Spring Lake with more bags and protocol cards available to the public.

To grow the partnership with the Aquarium, TST staff have attended two special events in Corpus Christi. One was a celebration of Earth Day in April 2016, which reached about 300 people. The
second was a celebration of World Ocean’s Day in June, which reached at least 350 people. Both events were heavily attended, with TV interviews filmed for local stations, and hundreds of visitors introduced to this nonpoint source pollutant. We will continue to collaborate on events and projects in the coming months.

*The incorporation of TST into several of the partner organizations during 2016 was facilitated by funds from the Ewing Halsell Foundation. These include part of the El Ranchito camp, Science Teachers Association of Texas mini-conference, the Informal Science Education Association of Texas’ annual conference, and the Wildlife Viewing and Nature Tourism Academy. This grant supported the implementation of Texas Aquatic Science across the state of Texas in formal classrooms and informal educational sites, thereby connecting thousands of students each year with aquatic science. TST staff involvement in the program during the first half of 2016 was also made possible by this generous support. See attached Ewing Halsell final report for further details.

**Interpretative Signage**

Interpretive signage exploring water quality, water quantity, and native-scaping techniques were installed at Spring Lake throughout 2016. Two upright panels face the glass-bottom boat dock and introduce audiences to Texas Stream Team and nonpoint source pollution. These large signs are bilingual in Spanish and English. The demonstration gardens at the entrance to the natural area show the beauty and resilience of native plants in the yard. Roughly 125,000 people, including 33,000 K-12 children and all incoming freshmen at Texas State University, visit Spring Lake each year and will view these signs. Additional signs are in the development stage, including water conservation and rainwater harvesting topics.

![Texas Stream Team and Nonpoint Source Pollution sign at Spring Lake in San Marcos, Texas.](image)

**Educational Videos**

Texas Stream Team received the Wildlife Care, Conservation, and Research grants through Texas State Aquarium in 2014 and 2015. These grants funded the creation of Monofilament Finders, a new TST citizen scientist program aimed at keeping fishing line out of the environment for the well-being of
humans, wildlife, and habitats. The Meadows Center staff produced an informational video about the dangers of fishing line left in the environment, which is part of the Monofilament Finders training procedure. A second version includes Spanish subtitles. Video link: https://vimeo.com/144893469

In 2016, Texas Stream Team staff worked with Aerial Viewpoints to create a video introducing Texas Stream Team, nonpoint source pollution and the probe kit as an alternative to the standard core monitoring kit. A second version includes Spanish subtitles. Video link: https://vimeo.com/173791220

**Teacher Workshops**

**2015**

Texas Stream Team participated in one teacher workshop and hosted 2 workshops at The Meadows Center for Water and the Environment in 2015. The first workshop was for elementary school teachers. Fourteen teachers attended the workshop on August 3, 2015 where they received TEKS aligned science activities that they could teach to their students. The second workshop was held on August 4, 2015 and seventeen high school teachers attended. The teachers learned how to incorporate TEKS aligned science activities (including Texas Stream Team monitoring) in their science classes. TST also participated in the “Mix it Up” Teacher Workshop hosted by Texas State University. Twenty-eight high school teachers were certified in Texas Stream Team Core Water Quality Monitoring during this workshop on July 10, 2015.

**2016**

Thanks to a generous grant from the Ewing Halsell Foundation, The Meadows Center partnered with Texas Parks and Wildlife (TPWD) and Texas A&M University – San Antonio to begin the Texas Aquatic Science (TAS) pilot project (Appendix 1). For this project, The Meadows Center planned three main areas for research and implementation. The first area was formal education training and the pilot program with TPWD as the lead coordinator. The second component was informal education and training at The Meadows Center. The third focus was Texas Aquatic Science outreach and implementation in the San Antonio region. Another part of The Meadows Center’s involvement includes maintaining a website (water-texas.org) as an additional resource for educators across the state.

To enhance the use and functionality of the H2O-designed education materials and curricula, The Meadows Center worked with Texas Parks and Wildlife to conduct eight teacher workshops. TPWD and The Meadows Center staff led these teacher workshops that introduced the curriculum and materials, and familiarize attendees with several Texas Aquatic Science activities.

Roughly 39 teachers and 3,322 students participated in the pilot. As of late summer 2016, there were roughly 67 TAS certified field sites, each attracting thousands of visitors each year. The The Meadows Center staff participated in six different events throughout the year. In addition, roughly 338 field trips visited Spring Lake where students participated in water resource activities and lessons.

Roughly 30,000 students visit Spring Lake annually, with the majority of then participating in TAS activities. Hundreds of additional people have been introduced to TAS at special events, conferences, and programs.
Newsletters

Texas Stream Team published 3 newsletters in FY 2015 and 3 newsletters in FY 2016. The newsletters contained information on TST activities during the past quarter. There were also articles on TST partnerships across the state, and each newsletter contained a citizen scientist spotlight that focused on an individual that participated with TST.
# TST in the News

Below are some of the news articles that highlight TST programs:

<table>
<thead>
<tr>
<th>Date</th>
<th>Title</th>
<th>Featured In</th>
<th>Link to Article</th>
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<tbody>
<tr>
<td>3-Feb-15</td>
<td>Oil spill fuels Texas State research</td>
<td>The University Star</td>
<td><a href="http://archive.star.txstate.edu/node/3200.html">http://archive.star.txstate.edu/node/3200.html</a></td>
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<tr>
<td>10-Jun-15</td>
<td>Meadows Center partners with REI Outdoor School to offer paddle boarding</td>
<td>The University Star</td>
<td><a href="https://star.txstate.edu/2015/06/10/meadows-center-partners-with-rei-outdoor-school-to-offer-paddle-boarding/">https://star.txstate.edu/2015/06/10/meadows-center-partners-with-rei-outdoor-school-to-offer-paddle-boarding/</a></td>
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<tr>
<td>9-Jul-15</td>
<td>Cypress Creek Corner: From Drought to Deluge</td>
<td>Wimberley View</td>
<td><a href="https://files.acrobat.com/a/preview/b8b08441-38b4-44a9-8109-2be189082070">https://files.acrobat.com/a/preview/b8b08441-38b4-44a9-8109-2be189082070</a></td>
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<tr>
<td>1-Oct-15</td>
<td>Cypress Creek Corner: Measure it!</td>
<td>Wimberley View</td>
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<tr>
<td>1-Nov-15</td>
<td>Cypress Creek Corner: A visit with a friend</td>
<td>Wimberley View</td>
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<td>29-Dec-15</td>
<td>Texas Stream Team works to protect wildlife</td>
<td>The University Star</td>
<td><a href="https://star.txstate.edu/2015/12/29/texas-stream-team-works-to-protect-wildlife/">https://star.txstate.edu/2015/12/29/texas-stream-team-works-to-protect-wildlife/</a></td>
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<tr>
<td>Date</td>
<td>Title</td>
<td>Featured In</td>
<td>Link to Article</td>
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</tr>
<tr>
<td>20-Jan-16</td>
<td>Water Quality program outlined with fly fishers</td>
<td>Fredericksburg Standard – Radio Post</td>
<td>(in print only)</td>
</tr>
<tr>
<td>27-Jan-16</td>
<td>Group Aims to Collect Abandoned Fishing Line</td>
<td>Texas Tribune</td>
<td><a href="http://www.texastribune.org/2016/01/26/group-aims-collect-abandoned-fishing-line/">http://www.texastribune.org/2016/01/26/group-aims-collect-abandoned-fishing-line/</a></td>
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<td>15-Feb-16</td>
<td>Sugar Land Texas Stream Team needs volunteers to monitor water quality</td>
<td>Fort Bend Star</td>
<td><a href="http://www.fortbendstar.com/sugar-land-texas-stream-team-needs-volunteers-to-monitor-water-quality/">http://www.fortbendstar.com/sugar-land-texas-stream-team-needs-volunteers-to-monitor-water-quality/</a></td>
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<td>6-Mar-16</td>
<td>Project in the works would restore habitat to Olmos Creek</td>
<td>San Antonio Express News</td>
<td><a href="http://www.expressnews.com/news/local/article/Project-in-the-works-would-restore-habitat-to-6873713.php">http://www.expressnews.com/news/local/article/Project-in-the-works-would-restore-habitat-to-6873713.php</a></td>
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<td>31-May-16</td>
<td>Dream Team</td>
<td>Inspire Coastal Bend Magazine</td>
<td><a href="http://inspirecoastalbendmag.com/2016/05/dream-team/">http://inspirecoastalbendmag.com/2016/05/dream-team/</a></td>
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<tr>
<td>5-Jun-16</td>
<td>In vast floods. Texas grapples with more spills</td>
<td>El Paso Times</td>
<td><a href="http://www.elpasotimes.com/story/news/2016/06/05/vast-floods-texas-grapples-more-spills/85450632/">http://www.elpasotimes.com/story/news/2016/06/05/vast-floods-texas-grapples-more-spills/85450632/</a></td>
</tr>
</tbody>
</table>
TARGETED WATERSHEDS

A major goal of Texas Stream Team is to become more integrated into the Watershed Protection Plans (WPP) and Total Maximum Daily Load (TMDL) Implementation Plans that are occurring in watersheds across the state. TST aims to achieve this goal by collaborating with state, regional, and local programs to prevent nonpoint source pollution through TST monitoring, assessment, and education. Texas Stream Team Citizen Scientists collect water quality data that can be used in characterizing the water quality within a watershed. They can also monitor the effectiveness of Best Management Practices that are implemented due to a WPP or TMDL. Citizen science water quality monitoring is also a valuable education and outreach tool that gives stakeholders an opportunity to become engaged in the process of protecting their watersheds.

Watershed Protection Plans

Texas Stream Team Citizen Scientists are currently monitoring water quality in the following watersheds that are developing or implementing Watershed Protection Plans:

- Arroyo Colorado
- Attoyac Bayou
- Bastrop Bayou
- Cedar Bayou
- Cypress Creek
- Dickinson Bayou
- Geronimo Creek
- Plum Creek
- San Bernard River
- Upper Cibolo Creek
- Upper San Marcos River

A Watershed Protection Plan has been developed for Cypress Creek, soon to be implemented.
Total Maximum Daily Loads

Texas Stream Team Citizen Scientists are currently monitoring water quality in the following watersheds that are developing or implementing Total Maximum Daily Load Plans:

- Austin Area Watersheds
- Carters Creek
- Colorado River
- Gilleland Creek
- Lake Worth
- North Bosque
- Orange County Watersheds
- Oso Creek/Oso Bay
- Salado Creek
- Trinity River
- Upper Guadalupe River

*A Total Maximum Daily Load Plan is being implemented for the Colorado River.*

Partner Collaborations

Texas Stream Team is collaborating with and providing additional support to the following partners who are active in local watershed planning and protection activities (WPPs and TMDLs):

- Center for Coastal Studies – Texas A&M University Corpus Christi
- Clean Rivers Program Steering Committee
- Cibolo Nature Center
- City of New Braunfels
- Coastal Bend Bays Foundation
- Collins Academy
- Cypress Creek Watershed Protection Plan Stakeholder Group
- Guadalupe Blanco River Authority
- Houston-Galveston Area Council
- North Texas Council of Governments
- Nueces River Authority
- Plum Creek Stakeholder Committee
- San Antonio Clean Tech Water Forum
- San Marcos River Foundation
- Texas Water Resource Institute – Texas A&M University
- Wimberley Valley Watershed Association
Presentations were given to stakeholders from the Oso Creek TMDL and the general public in 2015 and 2016 regarding Texas Stream Team and potential uses of data. These meetings were convened as part of an effort to educate the community about ongoing water quality and watershed management initiatives in the Oso and nearby watersheds. Information was provided by TST staff and TST partner Center for Coastal Studies at Texas A&M Corpus Christi.

Also in March 2016, at the Clean Rivers Program Steering Committee Meeting (held at Guadalupe-Blanco River Authority Headquarters) a presentation was given about TST programs, uses of citizen science data and activities for education, outreach community engagement and watershed protection planning. TST available curricula, teacher trainings available resource guides, publications, signage content and assistance in developing monitoring plans also were featured.

In August 2016, TST presented to the Hays Trinity Groundwater Conservation District (HTGCD) Board and members of the public in Wimberley, TX. The presentation provided an update and summary of Watershed Protection Plan activities but also included a brief component about the efforts of TST citizen scientists in the watershed, how their data was used and what the role of TST data will be during implementation of the plan.

In May 2016, TST staff presented to the Plum Creek Stakeholder Committee and members of the general public about watershed planning “lessons learned,” watershed efforts across the region, the role of citizen science in watershed protection planning, and specific data uses and outcomes of TST data collected in Plum Creek.

In October 2015, TST hosted a booth and multiple demonstrations and discussions at the San Antonio Clean Tech Water Forum. The sixth annual forum included discussion panels and presentations/talks from the San Antonio Mayor and Councilmen, Chair of the Texas Water Development Board, San Antonio Water Supply CEO, President of the Texas A&M University San Antonio, President of the Rivard Report and Directors of the Meadows Center for Water and the Environment and the Nature Conservancy. TST activities included multiple water quality demonstrations, exhibition of monitoring kits, presentations of data and discussions centered on how to utilize TST activities in municipal and educational efforts.

TST presented information about citizen science programs, applications for water quality data in watershed planning, TST watershed services (including assistance with developing baseline data, education and outreach, community engagement, and creating and tracking matching funds through volunteer citizen science efforts) at a TWRI (TCEQ, TSSWCB and EPA) hosted Watershed Coordinator Round Table Meeting in San Marcos in August 2015.

In March 2016, Wimberley Valley Watershed Association, the Cypress Creek Watershed Protection Plan Stakeholders and other local organizations interested in watershed protection convened a meeting. A presentation was given to nearly 75 Cypress Creek Watershed land owners about the Cypress Creek Watershed Protection Plan, including: nonpoint source pollution threats to the watershed; how individual urban, suburban and rural residents contribute NPS pollution; ways citizens can prevent or minimize pollution; and how to become involved in citizen science and TST activities.
Watershed Planning Reporting

A draft report summarizing statewide watershed planning needs, opportunities and potential TST services was submitted to TCEQ in May 2015 and resulted in a menu of tools, resources and services that TST could provide to support the application for, creation and implementation of WPPs and TMDLs across the state. The report also contained information about known limitations and barriers to progress and potential activities that could be used to streamline WPP development processes, improve efficiency and increase accuracy, validity, stakeholder participation and overall success of WPP completion and implementation.

In August 2015, a draft supplementary report provided a potential action plan utilizing TST tools, resources and services to further community efforts to apply initiate and develop WPPs. In the Spring of 2016, TST staff conducted a statewide survey of Watershed Coordinators to gauge interest in TST Watershed Services offerings and to determine if current TST activities in WPPs in development or implementation were meeting watershed and community needs. Survey results were assessed and used to narrow potential TST efforts and locations for services previously determined in the action plan, including a list of interested communities and planning efforts to include in 2017-2018 TST work plans. Outreach and communication with these communities will be ongoing.

Collaborative Grantwriting Opportunities

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<th>Date</th>
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<th>Funding Agency</th>
<th>Partner (if any)</th>
<th>Amount Requested</th>
<th>Status</th>
<th>Notes</th>
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<td>May-2015</td>
<td>Expanding Environmental Education and Interpretation at Spring Lake (including watershed based and water quality education, demonstrations and resources).</td>
<td>Texas State University Environmental Services Committee</td>
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<td>Oct-2015</td>
<td>Lion's Club grant</td>
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<td>Oct-2015</td>
<td>Captain Planet Foundation grant</td>
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<td>Crockett Elementary</td>
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<td>Nov-2015</td>
<td>Wildlife Care, Conservation and Research Program</td>
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<td>Awarded</td>
<td>To develop Monofilament Finders Program</td>
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<td>Nov-2015</td>
<td>Project Coastal Environmental Action Network (Project C.L.E.A.N.)</td>
<td>NOAA community based marine debris removal program</td>
<td>Spanish &amp; Science Club Network</td>
<td>$135,717; $135,717 match</td>
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## Collaborative Grantwriting Opportunities (continued)

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<th>Date</th>
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<th>Partner (if any)</th>
<th>Amount Requested</th>
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<td>Nov-2015</td>
<td>Proposal to EPA Urban Waters for Engaging Coastal Bend Communities in Water Resource Management, Citizen Science and Education - TST Partnerships</td>
<td>EPA</td>
<td>Science and Spanish Club Network</td>
<td>$57,027; $7,500 match</td>
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<td>Jan-2016</td>
<td>Project Coastal Environmental Action Network (Project CLEAN)</td>
<td>NOAA Marine Debris Prevention Program</td>
<td>Spanish &amp; Science Club Network</td>
<td>$60k; $33k match</td>
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<td>Jul-2016</td>
<td>Trash Free Waters</td>
<td>EPA/American Chemistry Council</td>
<td>Trinity River Basin communities</td>
<td>$55,000</td>
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<td>Oct-2016</td>
<td>Wildlife Diversity grant</td>
<td>Texas Parks and Wildlife</td>
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<td>$29,700</td>
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<td>Nov-2016</td>
<td>Wildlife Care, Conservation and Research Program</td>
<td>Texas State Aquarium</td>
<td></td>
<td>$15k</td>
<td>Awarded</td>
<td>To expand TST activities in the Coastal Bend area</td>
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</tbody>
</table>

Texas Stream Team also assisted multiple partners with submitting grants and foundation proposals:

<table>
<thead>
<tr>
<th>Date</th>
<th>Grant/ Proposal Title</th>
<th>Funding Agency</th>
<th>Partner</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>EPA Urban Waters Small Grant - Water Quality Education Program for Middle Schools</td>
<td>EPA</td>
<td>Houston-Galveston Area Council</td>
<td>Not funded</td>
</tr>
<tr>
<td>2015</td>
<td>Develop water quality/watershed and water conservation based educational programming for use in Houston Community Centers</td>
<td>Onestar/Americorps</td>
<td>Student Conservation Association</td>
<td>Awarded</td>
</tr>
<tr>
<td>2015</td>
<td>Proposal to Support Environmental Education in the Houston-Galveston Area</td>
<td>EPA Five Star</td>
<td>Student Conservation Association</td>
<td>Funded</td>
</tr>
<tr>
<td>2015</td>
<td>SCA Sims Bayou Tidal Riparian Buffer Project</td>
<td>TCEQ</td>
<td>Student Conservation Association</td>
<td>Funded</td>
</tr>
<tr>
<td>Date</td>
<td>Grant/ Proposal Title</td>
<td>Funding Agency</td>
<td>Partner</td>
<td>Status</td>
</tr>
<tr>
<td>------</td>
<td>-------------------------------------------------------------------------------------</td>
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<td>-----------------</td>
</tr>
<tr>
<td>2015</td>
<td>Urban Waters - Community-based Water Quality Monitoring and Environmental Education</td>
<td>EPA</td>
<td>UT Rio Grande Valley</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>Wrote letter of support to seek match for 5 TST core monitoring kits from the East Texas Woods and Waters Foundation</td>
<td>East Texas Woods and Waters Foundation</td>
<td>East Texas Chapter Master Naturalists</td>
<td>Awarded $2500</td>
</tr>
<tr>
<td>2016</td>
<td>Wildlife Diversity grant</td>
<td>Texas Parks and Wildlife</td>
<td></td>
<td>NOT funded</td>
</tr>
<tr>
<td>2016</td>
<td>CO-OP grant (university internal review)</td>
<td>Texas Parks and Wildlife</td>
<td>Health &amp; Human Services (TxState), TPWD</td>
<td>Pending</td>
</tr>
</tbody>
</table>

Additional grant-writing support was offered to the following TST partners:

**2015**

- Coastal Bend Bays Foundation
- Houston- Galveston Area Council (HGAC)

**2016**

- Science and Spanish Club Network
- Rio Grande International Study Center
- Fishing’s Future
- Houston- Galveston Area Council (HGAC)
- Friends of Blanco State Park
CONCLUSION

TEXAS STREAM TEAM HAS COMPLETED THE 2015-2016 CONTRACT and has met all of the deliverables of the contract. Texas Stream Team staff looks forward to expanding the program through more partnerships, more monitoring, and more education and outreach events with the new 18-month contract with TCEQ to continue its mission of improving watershed stewardship through citizen science and environmental education.
APPENDIX 1/1 —

IMPROVING STEM SUBJECT LEARNING
IN AUSTIN - SAN ANTONIO REGION
REPORT TO EWING HASELL FOUNDATION
SEPTEMBER 2016
IMPROVING STEM SUBJECT LEARNING IN AUSTIN - SAN ANTONIO REGION

REPORT TO EWING HASELL FOUNDATION - SEPTEMBER 2016

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III. NEXT STEPS 25
I. INTRODUCTION

The grant that The Meadows Center for Water and the Environment received from Ewing Halsell in 2015 was transformational in several ways and had ripple effects across the state of Texas. The findings of the program that related to increasing STEM opportunities through Texas Aquatic Science are explored in this final report. Recommendations for other organizations and next steps are also included.

The project research focused on evaluation of the use and effectiveness of the water science curriculum, Texas Aquatic Science. Texas Aquatic Science is a pathway for STEM education providing educators a comprehensive water curriculum, textbook and teaching guide aligned with TEKS and integrated with experiential place-based field sites, mobile and interactive technologies, and comprehensive on-line teaching options, including 225 on-line aquatic science video lessons.

In advance of initiating data collection, 8 teacher workshops were held training 167 middle through high school teachers in Texas covered by Austin, Dallas, East Texas, Houston, Rio Grande Valley, and San Antonio regions. All attendees were invited to participate in this pilot project during the 2015-2016 school year, involving them in assessment, evaluation, and subsequent improvement of the water curriculum.

A. Team Members and Roles

Emily Warren, Project Oversight
Johnnie Smith, Coordinating Site Certification – Texas Parks and Wildlife Department
Rudy Rosen, Study Design & San Antonio Outreach – Texas A&M University
Susan Hankins, Formal Project Coordinator & Liaison
Sonja Mlenar, TAS Implementation at Spring Lake
Erin Scanlon, Formal Assessment Development and Analysis
Briane Willis, Informal Assessment Development and Analysis
II. FINDINGS

A. Formal Education Training and Pilot Program

1. OVERVIEW
A pilot study was conducted to determine 1) the effectiveness of the TAS curriculum on student learning about aquatic science concepts and 2) the range of implementations of the TAS curriculum into middle and high school classrooms and a description of which implementation practices worked most effectively. In order to address the goal of the research, an Aquatic Science Conceptual Inventory (ASCI) was developed and administered to middle and high school students across the state of Texas enrolled in classes where the TAS curriculum was implemented. Throughout the pilot study teachers were asked to complete three separate surveys; a Baseline Questionnaire, a group of Monthly Reports, and a Post-Instruction survey.

Teachers in the state of Texas were given the opportunity to attend a workshop about the Texas Aquatic Science (TAS) curriculum. At this workshop teachers were introduced to the TAS curriculum and shown how to implement this curriculum into their courses. The purpose of this study was 1) to determine the effectiveness of the TAS curriculum on students’ understanding of aquatic science concepts and their appreciation of water as a natural resource and 2) to determine the best practices related to the implementation of the TAS curriculum in Texas classrooms. The questions guiding this inquiry were:

1. How effective is TAS as a curricular system in helping learners grasp the importance of water to life and their part in conserving water as a valuable resource?
2. How effective are the materials in a supporting role to TAS as a curricular system?
3. What are the differences in effectiveness of the curriculum when delivered with variability?
4. How effective is the Teacher Guide in supporting the curricular system?
5. Are there appreciable differences in curricular effectiveness between teachers with printed versus online Teacher Guide?

The desired outcomes for this inquiry were:

1. Identification of any best practices in approach, utilization, or delivery of the curricular system.
2. Use of the evaluation analysis to build quality improvement into future curricular changes.
3. Creation of best practices clearinghouse for educator’s use across the state.
4. Determine the background of the teachers relative to preparedness to teach the curriculum.
5. Determine the method used to integrate this curriculum with current program taught.
6. Determine if the curriculum was taught with outside activities. How often were activities
used versus lecture style teaching?

The following sections will include a discussion of the measures used in this study and their administration protocols, the data collected, the analytic techniques employed, the findings from their analytic techniques, a discussion of the results, conclusions from the study, and finally future directions for this line of inquiry.

II. Measures and Administration

In order to measure the effectiveness of the Texas Aquatic Science (TAS) curriculum, a two-pronged approach was employed. The first prong was to measure one aspect of the effect of the curriculum on the students. In order to determine how much aquatic science content the students learned over the course of the semester an Aquatic Science Conceptual Inventory (ASCI) was developed by taking 28 questions from the end of chapter questions from the Texas Aquatic Science (TAS) textbook. One question was added as an attention check to ensure the students were actively reading the questions and answering choices while completing the assessment. Another 3 questions were added about students’ attitudes and beliefs about water, conservation, and their role in water conservation. Two versions of the ASCI were developed; one for middle school students and one for high school students each with grade appropriate questions.

The ASCI was administered via Survey Monkey to students from classes from 18 separate teachers across the state of Texas. These teachers were employing the TAS curriculum in some form into their classes. The ASCI was administered near the start of the semester (pre-test) and for a second time near the end of the semester (post-test).

The second prong of the effectiveness study was to determine how the teachers implemented the TAS curriculum into their courses and to determine their attitudes and beliefs about the curriculum as a whole. Three separate measures were used to measure the data from the teachers; namely a Baseline Questionnaire, Monthly Reports, and a Post-Instruction Survey. The Baseline Questionnaire was developed to measure information about the teachers’ background, their classroom and school environment, the teachers’ goals for implementing the TAS curriculum into their course(s), teachers’ incoming attitudes about the TAS curriculum and teaching in general, and the teachers’ demographic information. The Questionnaire consisted of 38 questions that were Likert and open-ended in nature. The Baseline Questionnaire was administered during the first three weeks of the semester in which the teachers were implementing the TAS curriculum into their courses.

The Monthly Report survey was developed to provide a forum for teachers to give status updates on how implementing the TAS curriculum in their courses was going. The Monthly Reports were designed to be compact and short enough for teachers to be able to complete the surveys monthly without requiring an inordinate amount of time and effort on the already over-burdened teachers. These reports consisted of 17 questions that were Likert and open-ended in nature. The teachers were tasked with completing a survey monthly via Survey Monkey.
Finally, a Post-Instruction survey was developed to be administered at the end of the semester in which the teachers were implementing the TAS curriculum into their courses. This survey is composed of 14 Likert style questions and 15 open-ended questions for a total of 29 questions. The Post-Instruction survey was intended to measure teachers’ attitudes and beliefs about the TAS curriculum and its implementation in their courses as well as their suggestions for best practices and changes to the TAS curriculum.

III. DATA COLLECTED

STUDENT DATA
All of the student data was collected via Survey Monkey administration of the ASCI in each class in which the TAS curriculum was implemented. Of the 39 teachers that attended the TAS curriculum workshop and agreed to participate in the study, 18 teachers had their students complete at least one administration of the ASCI. Of these 18, 10 teachers only had their students complete the pre-test (with no post-test administration), 2 teachers only had their students complete the post-test (with no pre-test administration), and 6 teachers had their students complete both pre-test and post-test administration of the ASCI. After removing students with incomplete data for each administration, there were 943 students (681 high school and 262 middle school students) that completed the pre-test and 320 (287 high school and 33 middle school students) that completed the post-test. Due to IRB constraints, the names and most demographic information about each student could not be collected. The only personal information about students collected was their teacher’s name and the class for which they were completing the assessment. Therefore, there is not a way to tie students’ pre-test scores with their associated post-test scores. How this affected the analysis is described in the Methods section below.

TEACHER DATA
Of the 39 teachers who agreed to participate in the study, 22 teachers completed the Baseline Questionnaire. The Monthly Reports were intended to be completed monthly at the teachers’ convenience. Unfortunately, due to IRB constraints, the Monthly Report survey did not include a place for teachers to include their name or demographic information. This was done so as to ensure that teachers feel comfortable sharing their actual experiences and viewpoints without the worry that the information would get back to their administrators. While this seemed to have contributed to an open and honest evaluation of the curriculum by the teachers, it made it impossible to determine which reports were submitted by which teachers as well as to tie their Monthly Report responses to their Baseline Questionnaire and Post-Instruction survey responses. In total there were 61 monthly reports submitted via Survey Monkey. It is likely there were some teachers who submitted multiple reports and others that submitted one or no reports.

The Post-Instruction survey was intended to be administered after the end of the semester in which teachers were implementing the TAS curriculum. Due to differences in scheduling type (e.g.,
block vs. traditional scheduling, semesters vs. trimesters) at the schools where the curriculum was implemented the end of the semester came at different times for different schools. Therefore, at the beginning of January the Post-Instruction survey became available to teachers to submit their responses. The teachers were prompted to complete the survey after they had completed their courses but this guideline was not strictly observed or enforced. At the end of the data collection period (July) only 9 teachers had submitted Post-Instruction surveys. For similar reasons as the Monthly Reports, the Post-Instruction survey did not collect information about the teachers that could identify them or their school.

Due to the low response rate to the Survey Monkey version of the Post-Instruction survey, a written copy was given to 13 teachers during the TAS Summit at the end of July. The purpose of the TAS Summit was to provide a forum for briefing after implementing the curriculum as well as an opportunity to share the preliminary results of the curriculum pilot study with the teachers. Before any of the results from the pilot study were shared with the teachers, they were asked to complete a written version of the Post-Instruction survey that included a place for teachers to include their name. This allowed for a larger sample of responses to this survey as well as afforded the opportunity to complete teachers’ responses on the Baseline Questionnaire with their Post-Instruction survey responses. While the teachers’ participation in the study was not as high as was anticipated, interesting results could still be gleaned from the limited responses.

iv. Methods

Student Data
The data needed to be separated into pre-test and post-test data in order to conduct the analysis. First data for each teacher was identified and the first date was considered pre-test data and the second data was considered post-test data. Then for teachers that did not have both pre-test and post-test data, data collected near the start of the semester was considered pre-test and data collected near the end of the semester was considered post-test data.

The first part of data analysis is data screening where you look at the data to make sure everything looks correct (i.e. all the values fall within the expected range, there is a small amount of missing data, there are no extreme values). One way to screen the data is to investigate the basic descriptive statistics of all the variables in the data set. Shown below is a list of the variables and the definitions of these variables for the TAS student data set:

- Teacher: Ranges from 1-18 which is the unique identifier for each teacher
- Score: Scores for each individual responder (considered pre-test and post-test scores are from independent students)

Teacher Data
All of the teacher data (except the second iteration of Post-Instruction survey data which was
collected via paper and pencil) was collected online via Survey Monkey. The responses to the Likert style questions ranged from strongly disagree to strongly agree with neutral in the middle. The responses to these questions were categorized to show the general trend of responses from the teachers.

The open-ended questions were analyzed using Thematic Analysis. Thematic analysis is a qualitative data analysis technique whereby themes, either emergent or established, are identified in the data set. Thematic analysis allows the researcher to identify latent or manifest themes in the teachers’ responses as a way to determine and categorize these responses. For this study, both latent and manifest emergent themes were identified.

v. DATA ANALYSIS

After the data were screened, analysis was conducted using IBM SPSS.

The Baseline Questionnaire measured numerous background characteristics of the teachers participating in the study as well as information about their school settings and their implementation plans. For example, 50% of the teachers had been teaching for eleven or more years (11 out of 22 responders), 36% of the teachers had been teaching for 6-10 years, and the remaining 14% had been teaching for less than 6 years. Most of the teachers’ highest education level was a bachelor’s degree (64%) and highest education level achieved by the teachers was a master’s degree (36%). 77% of the teachers took a traditional route to certification while the other 33% took an alternative route.

One of the purposes of this pilot study was to determine how the TAS curriculum was implemented differently depending on the school settings. In this study, teachers from schools across the state of Texas participated. Of these schools 21% were urban, 47% were suburban, and 32% were set in a small town. Also, the majority of the schools that participated in the study were high school level with roughly a quarter of the schools being middle schools. Another school characteristic is the school’s Title 1 eligibility. In order for a school to be Title 1 eligible a high proportion of the students attending the school must be from low-income families (Programs: Improving Basic Programs Operated by Local Educational Agencies). Of the schools participating in this study 55% of teachers indicated that their school was Title 1 eligible. This combined information allows for a small cross-section of the types of classes in the state of Texas where this curriculum can be implemented.

Teachers also were asked to describe their teaching style as a way of determining the similarities and differences between the classroom culture and pedagogy as employed by the teachers. Thematic analysis of teachers responses yielded 29% of the teachers described their teaching style as involving hands-on activities. For example, one teacher said:

“Exposing students to hands on lessons so they become part of their learning experience.”

57% of teachers expressed that their teaching style involved inquiry and interactive pedagogies.
Teachers described having their students engage in inquiry tasks and promoting active engagement on the part of the students. For example, one teacher said:

“Inquiry and traditional with lots of hands on.”

In this excerpt the teacher explicitly references inquiry-based instruction as well as implicitly describes a classroom practice that allows for student interaction in the course (e.g., hands-on activities).

The Baseline Questionnaire also asked teachers to describe how they planned on implementing the TAS curriculum into their courses. Most of the teachers (50%) indicated that they planned to implement the TAS curriculum into an Aquatic Science course with others implementing the curriculum into fifth grade (9%), sixth grade (9%), seventh grade (9%), and eighth grade science classes (5%). Thematic analysis of teachers’ implementation plans indicated that 30% of teachers planned to implement the entire TAS curriculum into their courses, 40% of teachers planned to use the TAS curriculum to supplement another curriculum, and 55% of teachers planned on implementing a specific curriculum component into their course.

Another group of questions on the Baseline Questionnaire were Likert style (responses ranging from strongly disagree to strongly agree). Figure 1, below, shows teachers’ conceptions of their schools’ administrations’ support of their professional development. This shows that over 90% of teachers agree that their administration is supportive of their professional development.

![Figure 1: Teachers responses to Baseline Questionnaire question about their schools’ administrations’ support of their professional development. Teachers also rated their access to the materials and resources required to implement the TAS curriculum into their courses and their responses are shown in Figure 2. At the start of the semester, 67% of teachers](image-url)
agreed that they had all the materials and resources required to implement the curriculum.

![Bar chart depicting teacher responses](image)

**Figure 2: Teachers' Baseline Questionnaire responses rating their access to the materials and resources needed to implement the TAS curriculum into their courses.**

Finally, the Baseline Questionnaire probed the teachers’ incoming conceptions of the usefulness and possible benefits of implementing the TAS curriculum into their courses. 100% of the teachers predicted that the TAS curriculum would benefit their students. Also, 85% of teachers were committed to making the TAS curriculum work in their courses, shown in Figure 3. Both of these responses from teachers lead to the conclusion that at the start of the semesters teachers were invested in the TAS curriculum and its use in their classes.

**Teacher Data: Monthly Report**

Due to the fact that the Monthly Report did not collect teachers’ names or other identifying information, the Monthly Report data will be reported in aggregate. The purpose of the Monthly Report was to allow a forum for teachers to check in, record what parts of the TAS curriculum they used in the previous month, and describe how the implementation is progressing. One of the points of interest was which chapters of the textbook teachers were employing in their classrooms. Figure 4, below, shows the chapters teachers reported to have employed in their course for all the Monthly Reports. This shows that the chapters were relatively commonly employed in the courses with chapters 2 (Water: The Ultimate Recyclable), 7 (Aquifers and Springs), 11 (Bays and Estuaries), 13 (Fishing for Conservation), and 14 (Water for People and the Environment) employed the least.
Teachers also indicated the percentage of the curriculum used in their class(es) that was based off of the TAS curriculum and their responses are shown in Figure 5, below. The largest usage category was 0-10% (27% of responses). The other categories had similar percentage of responses. Simply put, this implies that the usage of the TAS curriculum has varied amongst the teachers.
In addition to the TAS textbook, the teachers were given access to a teacher’s guide that contained many supplementary activities to the textbook. The Monthly Report also probed which of these supplementary materials the teachers employed in their classes each month (results shown in Figure 6). The most commonly employed curricular element was the supplemental videos (47% of responses) while the other elements were much less commonly employed.

The textbook was published in a traditional paper format but was also made available in an online format. One of the guiding questions for this inquiry was pertaining to which version of the textbook the teachers employed and which helped support student learning the best. The Monthly Report data indicated that 67% of teachers used both the online and printed versions, 22% used the printed version only, and 11% solely used the online version. One of the largest comments in relation to the version of book used was that the teachers did not have access to online resources in the classroom for their students and were therefore forced to use the printed version.

The Monthly Report also probed teachers’ attitudes and beliefs about how the implementation of the TAS curriculum was proceeding in their courses over the previous month. These questions were Likert-style. The teachers were asked to rank the effectiveness of the TAS curriculum in their classes; these responses are shown in Figure 7. 79% percent of the teachers agreed that the TAS curriculum they implemented in their course over the previous month was effective in their course. Only one responder (out of 57, 2%) indicated that the TAS curriculum was not effective in their course over the past month.
Teachers were also asked to rank the effectiveness of the TAS curriculum in supporting their students learning about aquatic science. The responses for this question are shown in Figure 8. Most of the teachers (86%) agree that the TAS curriculum is effective in assisting their students to learn about aquatic science.

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**Figure 7:** Monthly Report teachers’ responses about the effectiveness of the TAS curriculum in their classes over the previous month.

**Figure 8:** Monthly Report teachers’ responses to the effectiveness of the TAS curriculum in assisting their students to learn about aquatic science.
One important purpose of the Monthly Reports was to determine what changes the teachers would like to see made to the TAS curriculum and their rationales for these changes. Thematic analysis of teachers’ responses to this prompt yielded 37% of the teachers advocated for no changes to be made to the curriculum. Another change advocated for by 19% of the teachers was the inclusion of grade level variations. Teachers requested higher level curriculum for the older high school students and lower level curriculum for the middle school students. For example, one teacher said:

“I did change the curriculum somewhat because I needed a lower level for my students since they are 5th and 6th graders.”

While another teacher said:

“It [TAS curriculum] is not appropriate for older students – seniors for example.”

A final theme showcased teachers advocating for more alternate activities for the listed student activities in the teacher guide. Teachers described issues related to lack of materials, lack of funding, weather restrictions, and non-compatible classroom environments. For example, one teacher said:

“Some of the activities seem a bit costly or require longer class period.”

Teachers were also asked to describe changes they would make to the supplemental curricular materials (e.g., videos, career connections, flash cards). Nearly half of the teachers (49%) suggested no changes while another 7% stated that they liked the curricular materials as they are. One common suggested change was related to the videos. Teachers commented that the videos were monotonous, did not keep the attention of the students, and had too many static images. For example, one teacher said:

“The videos done by the author could be done a bit better. The images change so infrequently that the students lose interest.”

**Teacher Data: Post-Instruction Survey**

The final data source for the teacher-related data was the Post-Instruction Survey. The data presented here was collected via paper and pencil at the TAS Summit. There were two parts to the Post-Instruction survey; one part that contained Likert-style questions and a second part that contained open-ended questions.

Thematic analysis was conducted on the open-ended questions to identify relevant, emergent themes. The first few open-ended questions were intended to probe teachers’ attitudes and opinions about the TAS curriculum and its implementation in their courses. 33% of teachers said their favorite part of the TAS curriculum were the hands-on activities from the teacher guide. For example, a teacher said their favorite part was:
“Hands on activities that led to higher level inquiry and thought. Students were part of learning experience so made a connection.”

Another favorite component of the TAS curriculum expressed by 25% of the teachers was the textbook and teacher guide. One teacher stated

“The teacher’s guide with activities was the best part of the curriculum because it helped me make my lessons more tangible to their lives.”

In contrast to teachers’ previous opinions about the videos, 17% of responders indicated that their favorite part of the curriculum was the videos. One teacher expressed that the videos helped in this teacher’s flipped classroom. This survey also asked teachers about their least favorite part of the curriculum. 17% of the responders stated their least favorite part of the curriculum was the videos. This implies that there was not a consensus from the teachers about the quality and value of the videos as implemented in their classrooms.

Teachers were also asked about their biggest success in implementing the curriculum into their courses. One theme was related to positively changing the students’ affective characteristics (e.g., motivation, interest level, emotions). One teacher said the following

“My student[s] truly became more focused on water management. Coming from an agricultural/rural community where our #1 industry is farming & ranching my students were “aware of water” but not so much their personal ability to impact water usage & quality.”

This quote is interesting because the teacher indicated that the curriculum is helping students be aware of water and its use in their environment which is one of the main goals of the TAS curriculum.

After the teachers had implemented the TAS curriculum in their classes, they were asked overall how the implementation of the TAS curriculum went. The teachers’ responses are shown in Figure 9. 92% of teachers agree that implementing the TAS curriculum into their courses went well.
All of the teachers indicated that they think the TAS curriculum enhanced their classes, that they would use the TAS curriculum in their courses again, that the TAS curriculum was effective in helping their students grasp their part in conserving water as a valuable resource, and that the TAS curriculum was effective in helping their students grasp the importance of water to their lives. Overall, all of these results reflect that the teachers felt positively about the curriculum, its implementation in their courses, and its effect on their students. One teacher said:

“I believe the TAS was an integral part and necessary to my AQSCI course because it made the content relatable and relevant to students who live in Texas.”

### vi. Discussion

The results of this pilot study indicate that students performed significantly better on an Aquatic Science Conceptual Inventory (ASCI) after completing an aquatic science course where the Texas Aquatic Science (TAS) curriculum was implemented. This data was collected by the teachers in each of their individual classrooms. Teachers were given information about how to administer the ASCI to their students but none of the researchers for the pilot study were present during this data collected. Therefore, the faithfulness of the teachers’ administration of the ASCI to the students cannot be determined. Also, teachers were asked to have their students complete the ASCI in the first and last two weeks of the semester where the TAS curriculum was implemented. The completion date for the ASCI for each student was recorded and a few teachers did not follow the requested administration timeline for the ASCI. This means that the pre-test and post-test data may be skewed because the pre-tests were not completed before much aquatic science was covered and the post-tests were not completed after most of the aquatic science was covered.

Finally, one of the assumptions underlying the Analysis of Variance (ANOVA) statistical procedure conducted was that the pre-test and post-test data were completely independent of each other (e.g.,
post-test scores do not depend on the pre-test scores). In the student data set this assumption is not met; most of the students took both the pre-test and the post-test which implies that their pre-test and post-test scores should be correlated. The assumption was imposed on the data set in order to be conservative in the interpretation of the results. It cannot be assumed that the students that took the pre-test are exactly the same students that took the post-test due to attrition, absences, etc.

This pilot study also revealed that overall teachers had a positive reaction to the curriculum and its implementation into their courses. Of note is the difference in administration of the Post-Instruction survey versus the administration for the Baseline Questionnaire and the Monthly Reports. Due to the low response rate (N=9) for the online version of the Post-Instruction survey, this survey was again administered via paper and pencil at the TAS Summit. This means that the three surveys were not all administered in the same mode which may have caused differences in responses (e.g., teachers complained of hand cramps and difficulties in writing all their responses on the paper and pencil version of the Post-Instruction survey). One issue with the data collection process for the Monthly Report surveys is that the teachers were not asked to report their name along with their submitted data. This made the comparison of teachers’ Monthly Report data with their Baseline Questionnaire and Post-Instruction survey data impossible. Therefore, claims about how teachers’ backgrounds and prior teaching and preparation characteristics affected their implementation of and attitudes about the TAS curriculum was also not possible. In future iterations of this line of research, teachers should be asked to report their names or unique identifiers for all surveys.

vii. Recommendations

For the pilot program data gathering, the first recommendation is to gain IRB approval to collect student names. By collecting student names with the promise of anonymizing the data in the future, this will allow for the unit of analysis to be the student (by allowing for tying the student pre- and post-test data). This will allow for much more fine-grained statistical analysis of the student data.

Another recommendation is to make the pre-test and post-tests more difficult. In our project, the mean pre-test score on the ASCI-M was 53.4%, which is pretty high. This could be considered evidence that the ASCI is too easy. For a second year of the project, the ASCI could be re-written to include more difficult questions that focus less on isolated concepts that can be memorized but instead on broader, more context-rich concepts that are aligned with the large issues of aquatic science.

Many teachers did not have their students complete post-tests (8 out of 18 teachers that had the students complete pre-tests did not have corresponding post-tests). Further incentivizing, promoting, or enforcing the teachers’ participation in the research portion of the project would yield a more robust data set that will allow us to answer the desired research questions. For instance, a monthly gift card drawing for teachers who have submitted their monthly reports could increase reporting rates, as well as offering a “final” gift for teachers who had their students participate in both pre- and post-tests (i.e. supplies for a designated classroom activity).

Frequent and on-going communication with teachers is important as it keeps the participants
feeling supported and consistently reminded to report how the project is going. Providing a blog for teachers to communicate with each other, share photos, help others with a lab, etc. would create a better sense of community for project participants. Interested teachers could use the blog to set up social events to share their experiences and get to know each other more. Ending the school year with a special event summit, with an additional raffle, could cement the collaborative relationships in this community. Another recommendation is to offer a paper copy option of the pre- and post-tests for teachers who have limited computers in the classroom. This could make it easier for all students to take the pre- and post-tests.
B. Informal Education and Training at The Meadows Center

1. 2015-2016 School Year Teacher Survey

Spring Lake hosts 30,000 field trip students each year. Students participate in hands-on and experiential activities that relate to water resources, ecosystem health, and endangered species. Students and teachers complete a pre- and post-field trip survey to assess learning. Teachers have the option of completing an end-of-year evaluation of the field trip experience. At the end of the 2015-2016 school year, 25 teachers completed this additional survey. These teachers reached roughly 657 total students during that school year.

The first four questions covered the field trip experience in the format of a Likert Scale. To Question 1, 66% of respondents answered that they “Strongly Agree” with the statement “The Spring Lake field trip supported my curriculum this year.” For Question 2, 88% of respondents said they “Strongly Agree” with the sentence, “If given the option, I will bring another class to Spring Lake on a field trip.” Question 3 stated “I will recommend this field trip to colleagues and other teachers,” which garnered a 79% “Strongly Agree” response. Question 4, “How would you rate this field trip compared to other trips you have attended?” elicited a 52% “Excellent” response, and 44% “Very Good” response.

Question 5 was intended to identify a change in student behavior over time. The question requested that teachers ask their class to, “Raise your hand if you have improved your water conservation habits since going on the field trip to Spring Lake.” Of the roughly 657 total surveyed in the classroom, 489 raised their hands, accounting for 74% of the students.

The remaining questions were demographic. Of teachers surveyed, 64% work at a Title I school and 36% do not. Fewer teachers answered the ethnic make-up question. Totals were: .3% American Indian or Alaska Native; 3% Asian; 7% Black or African American; 39% Hispanic or Latino; .5% Native Hawaiian or other Pacific Islander; and 48% White or Caucasian, accounting for 562 students surveyed. Even fewer teachers answered the final question relating to sex, with 267 students marked as Female and 280 students marked as Male.

These results show strong teacher appreciation and support for the field trip program at Spring Lake. They also highlight a change in student behavior (i.e. conserving water) over time. Question 6 indicates more than half of the schools serve students from low-income families. The results align with several years of positive feedback for field trips at Spring Lake. Further investigation in years past confirm that teachers do come back for repeat field trips.
The Spring Lake field trip supported my curriculum this year.

Answered: 24  Skipped: 1

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Total 24
If given the option, I will bring another class to Spring Lake on a field trip.

Answered: 25   Skipped: 0

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Comments (0)
II. UTSA Prep Student Survey

1. Survey Overview
During June and July 2016, nearly 700 UTSA prep students visited Spring Lake. These groups participated in hands-on and experiential activities that related to water resources, ecosystem health, and endangered species. Several of these were site-specific, adapted versions of Texas Aquatic Science activities. At least 492 of the students completed a pre- and post-field trip survey to evaluate student knowledge. The survey was a mixture of quantitative and qualitative, totaling 6 questions with 3 open-ended questions.

For the Pre-Test, question 1 asked the students to “Raise your hand if you think there will always be enough clean water for people, wildlife, and our environment.” Sixty-two of students surveyed raised their hands in agreement. Question 2 asked them to “Raise your hand if you know what aquifers are and how they are important,” which prompted 327 students to raise their hands. Question 3 requested that students “Raise your hand if you know what wetlands are and how they are important.” A total of 274 students did so.

The Post-Test included 3 questions that mirror the Pre-Test questions, plus a further inquiry. Question 1 asked “Raise your hand if you think you can do something to have an impact on the amount of clean water available for people, wildlife, and the environment.” Of the 492 students surveyed, 408 held this belief. The follow-up question asked “How?” Roughly 39% of responses related to conserving water, such as “taking shorter showers” and “turning faucets off when not in use.” Roughly 23% of responses focused on “limiting pollution,” “not littering,” and “picking up trash.” The third group accounted for 14% of responses, referencing another type of action, such as “volunteering,” “riding bicycles,” “installing composting toilets,” “collecting rainwater,” and “organizing environmental cleanups.” The last two categories garnered 8% of responses each, relating to reusing/filtering water and an “other” category (“limit construction,” “become president/dictator,” “become hunter-gatherers,” or become “a water lawyer”).

Post-Test question 2 asked “Raise your hand if you know how to protect aquifers.” Of surveyed respondents, 362 raised their hands. The follow-up question once again asked, “How?” Forty-eight percent of students responded with some iteration of “do not litter,” “do not pollute,” and “pick-up trash.” Nineteen percent offered water conservation tactics. Fifteen percent of respondents were categorized as a “light touch” on the land, and included suggestions such as “don’t touch it,” “only drill in responsible areas,” and “prohibit infrastructure.” Nine percent of answers related to taking action, such as “volunteer,” “don’t use gas,” and “report problems.” The “other” category for this question accounted for 7% of responses, including “regulate it,” “stop acid rain,” “develop alternate sources of H2O,” and “let people know it’s there.”

Question 3 requested that students “Raise your hand if you know how to protect wetlands.” Of
the 492 students surveyed, 357 raised their hands. The follow-up question specifically asked “Who benefits from healthy wetlands?” Seventeen percent of responses were categorized as animals. Twelve percent related to humans. Eleven percent said plants. Five percent said either “everyone” or “living organisms.” Three percent said non-living organisms, including “soil” and “cities.” Roughly half of responses were placed in the “other” category and included “don’t pollute,” “get rid of invasives,” and “don’t build there.” The conclusion is that there was a misunderstanding regarding the written question.

2. METHODOLOGY
The survey was implemented by Spring Lake Education staff who led each group during the field trip. The pre-trip questions were administered at the start of the program, and the post-trip questions at the end of the program. Students raised their hands to answer the questions and the educator counted the hands as “yes” responses. No data were noted for “no” responses, which is a limitation explored below.

The results were analyzed by the Informal Education Specialist and reviewed by the Assessment Development and Analysis consultant. The results were input into Excel and organized by group. The open-ended responses (qualitative data) were coded and summarized above. The quantitative data were analyzed to identify the P-Value and Practical Significance.

3. QUANTITATIVE ANALYSIS RESULTS
Questions 2 and 3 of the survey were statistically analyzed to determine the effectiveness of the field trip programming using Excel and IBM SPSS. No statistically significant relationship was found between attending the Spring Lake field trip and increased student knowledge about aquifers (question 2). This highlights a need for deeper aquifer discussions and activities on the field trip. However, a statistically significant relationship was found between attending the field trip and student knowledge relating to wetlands (question 3).

4. LIMITATIONS
The analysis was conservative. We looked at the percentage of group answers (n=25), rather than individual student answers. If “no” answers had been recorded in addition to “yes” answers, more data points would have been documented to expand the sample size. Consequently, some data was lost through this process, but this approach was based on the limited time for surveys during the program.

Analysis also pointed to a level of acquiescence bias, or group voting. Because of the group setting, students may have felt compelled by others to raise or not raise their hands to answer the questions. The lack of anonymity might have also contributed to response rates.

Some feedback from the educators included some student confusion regarding the questions. There was also comments about this student group being particularly despondent during the survey. Future surveys will have less complex and more engaging questions. Spring Lake Education staff were trained
to use a series of the TAS activities during the school year, including 1.9 Investigating Water Quality; 5.2 Competition within Spring Lake; 6.3 The Hunt for Biodiversity; 8.3 Where Do I Live? What Do I Eat?; 8.5 Invertebrate Sampling; 10.5 Field Trip to a Wetland; and 14.3 What’s the Pollution. These activities will continue to be offered for all visiting groups looking for educational programming.

5. Recommendations
The first recommendation is to bring education staff into the process at the start of the school year would allow for roughly 10-months of activity integration, survey implementation, and evaluation. Similarly, training staff early, in a full range of the activities, increases the effectiveness of the implementation. Another recommendation is to provide the updated activity options for field trips at the start of the school year or before teachers schedule their visits, which could expand the number of participants in the new programming.

III. Texas Aquatic Science Participation at Spring Lake
The Meadows Center officially became the first Texas Aquatic Science Certified Field Site in 2015. Some 27,578 students visiting Spring Lake during the 2015-2016 school year participated in STEM programming on-site. These activities included exploring the native aquaria, investigating macro-invertebrates, spotting species in the wetlands, and further learning about water resources in Central Texas. The students also participated in pre- and post-program surveys.

IV. Texas Aquatic Science Certified Field Sites
There are now over 60 Texas Aquatic Science Certified Field sites across the state (see map below). A series of organizations responded to a request for information, including number of participants in TAS programming. Over 35,000 children (under 18) experienced TAS programming at the following sites:

- Armand Bayou Nature Center,
- Baytown Nature Center,
- Canyon Lake Gorge,
- Dallas Arboretum,
- Dogwood Canyon Audubon Center,
- Elm Fork Education Center,
- Galveston Island State Park,
- John Bunker Sands Wetland Center,
- Lewisville Lake Environmental Learning Area,
- Meridian State Park,
• Nueces Delta Preserve,
• Oso Bay Wetlands Preserve & Learning Center,
• The Splash Exhibit and Sheffield Education Center,
• Texas Tech University-The Outdoor School,
• University of North Texas, and
• WaterWorks Education Center – City of Houston.

The following map shows the certified field sites in the State of Texas.
C. San Antonio Outreach Efforts

A. Overview

i. Informal Education at Spring Lake
Special attention was paid to the San Antonio region for this project. During the 2015-2016 school year, 6,144 students from San Antonio and the surrounding area attended field trips at Spring Lake. They participated in STEM learning and Texas Aquatic Science activities while exploring the natural and cultural resources. Spring Lake Education staff introduced them to topics of water resources, habitat, endangered species, and a range of other topics.

ii. Texas Aquatic Science Certified Field Sites
There are 11 Texas Aquatic Science Certified Field Sites in and around San Antonio. They are:

- Blanco State Park,
- Canyon Lake Gorge,
- Guadalupe River State Park,
- Hill Country State Natural Area,
- Lavaca-Navidad River Authority,
- The Meadows Center for Water and the Environment,
- Mitchell Lake Audubon Center,
- Riverside Nature Center,
- San Antonio River Authority,
- Seguin Outdoor Learning Center, and
- Seminole Canyon State Park and Historic Site.

These sites offer several of the TPWD designated field site activities, including 1.9 Water Quality; 3.3 Land Use in our Watershed; 6.4 Measuring Populations; 8.5 Assessing Stream Health with Invertebrate Sampling; 10.5 Field Trip to a Wetland; and 13.5 Fish Sampling and Ecosystem Assessment. Some sites, similarly to The Meadows Center, offer others that are not designated as field site activities.

The San Antonio region outreach efforts included sharing the resources and materials, offering assistance with activity adaptation and site certification, meeting with organizational leaders, and exploring collaborative opportunities. Our team connected with the following organizations in Central Texas:

- Barton Springs Edwards Aquifer Conservation District,
• Carpe Diem charter school in San Antonio,
• The Doseum,
• Edwards Aquifer Authority,
• Great Hearts School,
• Hill Country Science Mill,
• Keystone School,
• Mitchell Lake Audubon Center - Texas Audubon Nature Centers,
• San Antonio Botanical Garden,
• San Antonio River Authority,
• San Antonio Water System,
• Texas State Aquarium, and
• Witte Museum.

B. RECOMMENDATIONS
The first recommendation is to utilize existing relationships with organizations to create open-contexts for communication during this outreach process. Without such a relationship, it was more challenging to directly connect with the organization and share these resources. Another recommendation is to meet in-person, since this was seen as the most effective way of connecting organizations, exploring STEM-education possibilities, and discussing applying or implementing Texas Aquatic Science. A final recommendation is to initiate the outreach process early. This allowed our team to provide expertise regarding how to effectively integrate STEM and TAS activities into the organization’s existing programs.
III. NEXT STEPS

The nature of TAS makes it well suited for charter school contexts. A second phase of the project could focus effort on charter schools in Central Texas to increase STEM learning. Charter schools could also be more easily linked to informal learning sites, thereby creating a relationship that allows students to participate in long-term programs or service learning projects.