

Texas Stream Team Final Report: Contract #582-21-10084

September 14, 2020 – October 2023



Perinales River at Pedernales Falls State Park. © Susan Vineyard



THE MEADOWS CENTER
FOR WATER AND THE ENVIRONMENT
TEXAS STATE UNIVERSITY
TEXAS STREAM TEAM



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Prepared in cooperation with the Texas Commission on Environmental Quality and the U.S. Environmental Protection Agency.

The Texas Stream Team encourages life-long learning about the environment and people's relationship to the environment through its multidisciplinary community science programs. We also provide hands-on opportunities for Texas State University students and inspire future careers and studies in natural resource related fields. Preparation of final reports serve as contract deliverables for granting entities, but they also serve as valuable educational experiences for the students and staff that prepare the reports. Texas Stream Team values the staff contributions and recognizes each individual for their role. The following staff and student workers assisted in the preparation of this report and are acknowledged for their contributions:

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- Essential Element 1 - Goal 5: Ensure Clean and Safe Water for All Communities
- Essential Element 2 - Objective 5.2: Protect and Restore Waterbodies and Watersheds
- Essential Element 3 - Non-point Source Pollution Control (Clean Water Act Section 319). Project period: 9/14/2020-10/31/2023

Meadows Report 23-002

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TEXAS STATE UNIVERSITY

TEXAS STREAM TEAM

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PROJECT SIGNIFICANCE AND BACKGROUND

Texas Stream Team at The Meadows Center for Water and the Environment (the Meadows Center) is dedicated to facilitating environmental stewardship by empowering a statewide network of concerned stakeholders in a collaborative effort to promote water quality education and nonpoint source pollution reduction. Through water quality monitoring, data collection and analysis, and educational programs, Texas Stream Team and our partner organizations work to expand the public's understanding of how human activity impacts water quality in Texas. Participation in the Texas Stream Team community science program influences individuals to adopt activities that positively impact water quality and mitigate the effects of nonpoint source pollution while involving them directly in watershed protection plans and community science initiatives.

Throughout the past year, Texas Stream Team has worked to support and enhance the public outreach objectives and priorities identified under the Texas Commission on Environmental Quality's Federal 319(h) Nonpoint Source Pollution Program, with a special emphasis placed on promoting services to organizations and partners identified as interested in, or actively developing a watershed protection plan. Increasing Texas Stream Team's services to these stakeholders, as well as working to expand community scientist monitoring in these areas, engages communities in the process of watershed stewardship and nonpoint source pollution reduction.

At the beginning of the contract reporting period, Texas Stream Team staff experienced significant challenges posed by the COVID-19 pandemic. Operations shifted to focus on streamlining program organization, trainings, updates, virtual resources, and many other activities included in this report. Throughout the duration of the contract, Texas Stream Team has worked to increase the program's efficiency and accuracy. As well as revitalize the program's resources to ensure accessibility for our community scientists, partners, and stakeholders across the state. These collective efforts have amplified the scope and scale of environmental monitoring, bridging gaps in traditional scientific research. Continue reading to learn more about the community engagement efforts, training programs, and strategic initiatives described in this report.

Texas Stream Team Community Science Trainings

Texas Stream Team offers several trainings for people to get involved with Texas Stream Team and monitor Texas' valuable natural resources. Currently, Texas Stream Team offers:

- [Standard Core Water Quality Community Scientist Training](#) – monitors basic parameters such as conductivity, dissolved oxygen, pH, total depth, water and air temperature, field observations, and water transparency using a chemical Standard Core kit.
- [Probe Core Water Quality Community Scientist Training](#) - monitors basic parameters such as conductivity, dissolved oxygen, pH, total depth, water and air temperature, field observations, and water transparency using digital probe meters.

- [E. coli Bacteria Water Quality Community Scientist Training](#) - involves performing tests for E. coli to assess the potential risk of contact recreation in a water body.
- [Advanced Water Quality Community Scientist Training](#) – monitors parameters such as nitrate-nitrogen, orthophosphate, turbidity, and streamflow using an Advanced monitoring kit.
- [Macroinvertebrate Bioassessment Community Scientist Training](#) - assess the health of lakes, rivers, streams, or estuaries based on the aquatic insects that live there.
- [Riparian Evaluation Community Scientist Training](#) - assess the health of lakes, rivers, streams, or estuaries based on the riparian habitat.



Figure 1: Community scientists participating in Texas Stream Team's Advanced Training in San Marcos on 6/19/2021. Photo by Cooper Peterson.

STUDY AREA

Texas Stream Team is dedicated to facilitating environmental stewardship by empowering a statewide network of concerned stakeholders in a collaborative effort to promote a healthy and safe environment. For this contract, Texas Stream Team has placed special emphasis on areas with an accepted or developing watershed protection plan, where stakeholders are interested in focused monitoring on the parameter of concern in their watershed. These watershed protection plans are highlighted in Figure 2 below. Due to COVID-19, Texas Stream Team held trainings via Zoom and advertised to these specified locations shown in the map below, as well as areas outside the watershed protection plans.



Figure 2: Texas Stream Team TCEQ contract #10084 study area. Map created by the Nonpoint Source Program of TCEQ, July 2023. [Access here.](#)

SUMMARY OF TASKS

For this contract, Texas Stream Team worked to increase community science in targeted watersheds. The dedicated work of Texas Stream Team staff and community scientists contributed to the success of the project goals and expansion of our program activities. The project's scope of work included six main tasks and subsequent deliverables that fell within each task:

- Project Administration
- Quality Assurance
- Data Reporting and Dataviewer Management
- Community Science Activities
- Watershed Services
- Watershed Education and Outreach

The information within this section highlights each specific task and the completed deliverables.

Project Administration

Project administration involved overseeing and coordinating the work, ensuring technical and financial supervision, and preparing status reports. This included tasks such as project oversight, submitting progress reports, maintaining communication with the Texas Commission on Environmental Quality, and providing a project article upon request. Regular budget updates and discussions with the Texas Commission on Environmental Quality were also included in the project's administrative tasks.

Quality Assurance

The process involved various subtasks: arranging Quality Assurance Project Plan planning meetings, creating a Quality Assurance Project Plan with project-specific Data Quality Objectives, conducting annual reviews and updates of the Quality Assurance Project Plan, submitting draft Quality Assurance Project Plan amendments for review, and providing Corrective Action Reports when necessary. These measures ensure that data quality is maintained, and any deviations or issues are promptly addressed.

Data Reporting And Dataviewer Management

A key objective of Texas Stream Team is maintaining and regularly updating our [Datamap](#) and [Dataviewer](#) systems. This includes managing and organizing the vast amount of water quality data collected by community scientists and trainers. By maintaining these platforms, Texas Stream Team can efficiently generate reports that provide comprehensive insight into water quality trends, patterns, and changes over time via our Data Summary Reports, highlighted below. Texas Stream Team staff also makes the data available to the public via semi-annual submissions to the Environmental Protection Agency's Water Quality Exchange portal.

Data Activity Reports were submitted each quarter of the contract to communicate the number of community scientists trained, active monitors, and number of monitoring events taking place within the program.

Additionally, Texas Stream Team staff constructed a sizeable Water Quality Monitoring Technique Study throughout this contract to evaluate potential enhancements to our monitoring protocols and equipment. Continuing to stay up to date on the latest equipment and research allows for our data to be as comparable to professional monitoring as possible.

Details of the Water Quality Monitoring Technique Study and Data Summary Reports can be found below.

DATA SUMMARY REPORTS

Data Summary Reports utilize maps to effectively visualize and illustrate community scientist water quality data specific to each watershed. These reports not only present the raw data but also provide comprehensive analysis, enabling a holistic understanding of water quality conditions within each watershed. These reports are invaluable for stakeholders, researchers, and decision-makers seeking a deeper understanding of water quality conditions in various watersheds across Texas.



Figure 3: Brushy Creek Data Summary Report cover page.

The data presented in Data Summary Reports should be considered in conjunction with other relevant water quality reports. Such sources include, but are not limited to:

- Texas Surface Water Quality Standards.
- Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d).
- Texas Clean Rivers Program partner reports, such as Basin Summary Reports and Basin Highlight Reports.
- Total Maximum Daily Load Reports.
- Texas Commission of Environmental Quality and Texas State Soil and Water Conservation Board Nonpoint Source Programs' funded reports, including Watershed Protection Plans.

Data summary reports completed by Texas Stream Team within the contract period include:

- [Oso Creek and Oso Bay](#) (December 2020)
- [Blanco River](#) (March 2021)
- [Pedernales River](#) (June 2021)
- [Brushy Creek](#) (August 2021)

All Texas Stream Team Data Summary Reports are available online at the Texas Stream Team [Data and Research](#) webpage.

WATER QUALITY MONITORING TECHNIQUE STUDY

To complement the data enhancement portion of this contract, Texas Stream Team conducted a Water Quality Monitoring Technique Study to evaluate the efficiency and cost effectiveness of our current water quality monitoring equipment. Furthermore, the study considered factors such as data accuracy, ease of use, and durability. By conducting this study, Texas Stream Team aimed to help its staff make informed decisions regarding the maintenance and replacement needs of our equipment. In addition, it aimed to ensure Texas Stream Team employed the most effective monitoring methods.

The study led to several program advancements. Including the beta-testing and launching of the Texas Stream Team electronic [Environmental Monitoring Form](#). Historically, community scientist water quality data was recorded on a [paper form](#) and submitted to Texas Stream Team as a physical copy or email. The electronic [Environmental Monitoring Form](#) gives community scientists an electronic option through the ESRI Survey123 platform. As a result of this advancement, Texas Stream Team has been able to streamline data review and entry processes by having access to data from community scientists in real time.

Another benefit of the electronic entry process is that it contains built-in rules to prevent common data recording mistakes. This works by rejecting unlikely values and mandating fields of high importance. As a result, the data entry process is quicker, and the data collected is more reliable overall.

Additionally, this study made the following advancements:

- Texas Stream Team staff will work to incorporate information from use of the densiometer and clinometer to support the riparian habitat assessment indicators currently in use.
- Staff will recommend community scientists use the Hach 100 mL volume bottles of deionized water for the sterile diluent associated with the field blank for E. coli bacteria monitoring. The distilled water will be recommended as the alternate source.
- The turbidity tube and conversion of centimeters to nephelometric turbidity units will be implemented in trainings and by community scientists using the advanced kit for water quality monitoring.
- Use of probes for measuring water quality will continue to be reviewed and sought to improve upon the technique and data quality.
- Coastal water quality trainings and community scientist monitoring will include the use of a refractometer for salinity measurements.
- Texas Stream Team staff will continue to upgrade conductivity meters across the state as resources are available to improve upon data quality.

Community Science Activities

PARTNERSHIPS AND GROUPS

Beyond the primary objective of increasing program efficiency, Texas Stream Team had an additional goal – to foster engagement, expansion, and fortification of its partnerships and community scientist groups. This objective sought to further facilitate the growth of Texas Stream Team entities and bolster the capabilities of various groups within the program. Texas Stream Team's efforts included the formation of three new community scientist groups and three new partnerships.

During the contract reporting period, the following groups were established or revised:

- McLennan Community College
- Roadrunner Stream Team
- Coppell High School ECO Club

Additionally, the following partnerships were established:

- City of Frisco
- Kellie Dowden Bridge City ISD
- Brazos Valley Texas Master Naturalists

Texas Stream Team's partnerships and groups form the cornerstone of our community science program, serving as dedicated entities at the forefront of water quality monitoring initiatives. By forging these partnerships, Texas Stream Team aims to ensure ongoing and routine water quality monitoring by supporting new and existing groups with monitoring kits and supplies, while creating collaboration among stakeholders to collectively support our shared goals. These collaborations are designed to be sustainable and long-lasting, enabling us to work together with our partners and

groups towards water resource preservation and enhancement. Through these efforts, trainings (see Texas Stream Team Community Scientist Trainings section), and outreach events (see Watershed Education and Outreach section) we were able to engage over 400 community scientists annually in activities related to water quality. These numbers are reflected quarterly through partner forms, group monitoring plans, Data Activity Reports, and training documentation.

By actively investing in the growth and collaboration of these integral stakeholders, Texas Stream Team aims to create a more robust and impactful collective effort in safeguarding the state's environmental well-being.

STATEWIDE PARTNER MEETING

STREAM TEAM FEST

— Celebrating 30 Years of Citizen Science —

In commemoration of our 30th year, Texas Stream Team organized and hosted a statewide partner meeting called "[Stream Team Fest](#)." This event served as an opportunity to celebrate the program's achievements while gathering valuable input and feedback to advance Texas Stream Team's objectives and improve volunteer and support efforts. Over 100 individuals were reached through the event, which featured presentations, panels, an award ceremony, and workshops conducted by 13 esteemed environmental professionals serving as guest speakers. Guest speakers included:

- **Kerry Niemann**, Planning and Implementation Section Manager, Water Quality Planning Division – [Texas Commission on Environmental Quality](#)
- **Brian Fontenot**, Region 6 Nonpoint Source Coordinator – [US Environmental Protection Agency](#)
- **Rachel Renz**, Life Scientist & Region 6 Citizen Science Coordinator – [US Environmental Protection Agency](#)
- **Mitchel Sabourin**, Educational Outreach Intern – [Texas State University Office of Sustainability](#) & [Bobcat Stream Team](#) President
- **Dave Buzan** (Original Texas Watch Leader), Aquatic Ecologist – [Atkins](#)
- **Jason Pinchback**, Coastal Resources Manager – [General Land Office](#)
- **Mike Bira**, Retired Environmental Scientist – [US Environmental Protection Agency Region 6](#)
- **Travis Tidwell**, Aquatic Biologist – [Texas Parks & Wildlife Department Kills and Spills Region I](#)
- **Rachel Sanborn**, Director of Operation – [San Marcos River Foundation](#)
- **Christopher Morris**, Environmental Coordinator II – [City of Dallas](#)
- **Desiree Jackson**, Vice President – [Bobcat Stream Team](#)
- **Todd Running**, Manager, Community & Environmental Planning – [Houston-Galveston Area Council](#)
- **Kelly Albus**, Extension Program Specialist III – [Texas A&M AgriLife Research & Extension](#)

TEXAS STREAM TEAM COMMUNITY SCIENTIST TRAININGS

A pivotal component in fortifying and expanding Texas Stream Team entities is the comprehensive training of volunteers. Due to COVID-19 shutdowns, trainings at the beginning of this contract occurred online. By providing thorough and ongoing training opportunities, Texas Stream Team endeavors to equip its volunteers with the necessary knowledge and skills, thus empowering them to make meaningful contributions to the program's objectives and reinforcing the overall effectiveness of the initiative. To achieve this, Texas Stream Team organized trainings, listed below in Table 1.

Table 1: Texas Stream Team trainings performed throughout the contract period.

DATE	TRAINING TYPE	TARGET GROUP
10/15/2020	Riparian Evaluation	Statewide
10/17/2020	Riparian Evaluation	Statewide
11/8/2020	Standard Core	Texas State University, Bobcat Stream Team
11/23/2020	Standard Core	San Antonio River Authority
12/5/2020	Riparian Evaluation	Statewide
2/27/2021	Standard Core	San Marcos region
3/13/2021	Riparian Evaluation	Statewide
3/27/2021	E. coli Bacteria	Statewide
3/27/2021	Standard Core	Texas State University, Bobcat Stream Team
4/10/2021	Standard Core	Texas State University, Bobcat Stream Team
4/17/2021	Standard Core	Roadrunner Stream Team, San Antonio region
4/24/2021	Standard Core	Roadrunner Stream Team, San Antonio region
4/25/2021	Standard Core	San Marcos region
4/28/2021	Standard Core	San Antonio River Authority
6/19/2021	Advanced	San Marcos region

Moreover, this contract encompassed the training of new Texas Stream Team trainers. Trainers are certified to lead Texas Stream Team trainings and help increase the number of community science activities across the state. Trainers are an essential link between Texas Stream Team and local communities. During the contract period, Texas Stream Team staff trained the following community scientists as trainers:

- Kayla Miller, City of Fort Worth – Standard Core Training
- Scott Rippeth, Roadrunner Stream Team – Standard Core Training
- Chandani Rana, City of Grand Prairie – Standard Core Training

By training new community scientists and trainers, Texas Stream Team bolstered its capacity to collect data and raise awareness.

REGIONAL OUTREACH MEETINGS

In effort to effectively manage and inform our vast population of community scientists, trainers, and partners, Texas Stream Team attended or hosted regional events.

In January 2021, Texas Stream Team hosted its Annual Trainer Meeting virtually, with 26 trainers in attendance. The meeting served as a platform to share program updates, resources, and goals. One significant goal was the creation of comprehensive training manuals to ease trainers' responsibilities and provide detailed guidance to volunteers. These manuals offer valuable information, step-by-step instructions, and essential references for community scientists throughout their involvement. By making these manuals available on the website, Texas Stream Team ensures a reliable reference tool for volunteers after their training, enabling trainers to conduct efficient sessions and focus on empowering participants. The meeting also introduced various new resources, fostering communication and collaboration among trainers to promote continuous improvement and standardization in training methodologies. Training manuals are available on the Texas Stream Team [website](#) and continue to undergo updates and improvements as the program evolves. The annual Trainer Webinar also introduced several new resources, including the Texas Stream Team Supply Order Form, Equipment Form, Trainer Enrollment Form, Partner Activity Report Form, and New Monitoring Site Request Form.

In addition to hosting the Annual Trainer Meeting, Texas Stream Team participated in the Urban Riparian Symposium conference where we presented virtually on our Riparian Evaluation Community Scientist Training. This presentation garnered significant attention from our partners, highlighting collaboration opportunities. By showcasing the value of community science as a tool for assessing riparian health, we encouraged partners and potential partners to explore ways of integrating community-driven data into their conservation efforts. During the presentation, we also had the opportunity to educate audiences about watershed functions and promote watershed protection projects.

FIELD AUDIT SESSIONS

In an ongoing effort to enhance the Texas Stream Team program, we have developed comprehensive documentation for Core Training Field Audit Sessions. This updated documentation showcases the latest protocols and equipment, providing clear and descriptive information about the Field Audit Session procedures. Links to updated monitoring forms are also included, offering more guidance on conducting and requesting Field Audit Sessions. To further support accuracy in community scientist water quality data, we have released a helpful [Field Audit Session YouTube video](#).

These resources are essential in maintaining high standards of data collection and promoting a deeper understanding of water quality. Our ultimate goal is to ensure the accuracy and reliability of the data collected by Texas Stream Team volunteers. By offering accessible resources, we aim to reach a broader audience, including youth populations that have been previously excluded from water quality monitoring activities due to barriers such as training requirements and equipment maintenance.

RIPARIAN EVALUATION COMMUNITY SCIENTIST MANUAL

Riparian Evaluation is a newer training within the Texas Stream Team program. In the program's initial stages, the absence of a comprehensive manual posed a challenge.

However, thanks to a crucial amendment, Texas Stream Team successfully crafted a comprehensive Riparian Evaluation manual. This manual now encompasses essential introductory insights into riparian areas and their pivotal influence on water quality. Moreover, it delves into intricate protocols, quality control procedures, and equipment particulars. The manual functions as an exhaustive guide, offering an immersive understanding of all aspects pertaining to the Riparian Evaluation training within the Texas Stream Team program. It not only lays the groundwork for subsequent field guides, presentations, and supplementary training materials but also solidifies the program's educational foundation.

JUNIOR MONITORING AMBASSADOR PROGRAM

To diversify the current community scientist population and include youth trainees, Texas Stream Team staff conducted a feasibility study for a Junior Monitoring Ambassador Program. The work accomplished through this initiative complements Texas Stream Team's ongoing efforts in water curriculum development and collaboration with Texas students and educators. Establishment of this program provides an accessible avenue for teachers to engage their students directly in Texas Stream Team monitoring activities, seamlessly integrating hands-on learning experiences into their curriculum. By participating in the program, teachers can guide their students in an official monitoring group, providing a structured framework for their involvement.

Moreover, this program opens opportunities for Texas Stream Team to involve other community members under the age of 14 in monitoring activities by assisted monitoring activities. This inclusive approach ensures that youth populations have the opportunity to develop a connection with their local water resources and actively contribute to water quality monitoring efforts. The collaboration between Texas Stream Team, educators, and students through this program creates a panoramic approach to environmental education and engagement. By aligning curriculum, training opportunities, and community involvement, Texas Stream Team maximizes its impact.

As Texas Stream Team continues to evolve, our commitment to inclusivity and targeted programming remains steadfast. By focusing on enhancing accessibility, we aim to break down barriers and ensure that a diverse array of individuals can actively participate and contribute to our water quality efforts. Through these strides, Texas Stream Team aspires to continue structuring programs that meet the specific needs of various groups.

WATERSHED SERVICES

Watershed health stands as a pivotal element within the core mission of Texas Stream Team. As an organization dedicated to monitoring and safeguarding water resources, Texas Stream Team recognizes the significance of supporting watershed protection plans. For this reason, providing support and fostering collaboration with watershed coordinators or project leads was an additional aspect of the work described in this report.

In early 2021, Texas Stream Team collaborated with the Shoal Creek Watershed Action Plan staff on the development of their watershed protection plan. Texas Stream Team contracted Tom Hegemier of Doucet and Associates to develop a model for the Shoal Creek Watershed Action Plan. The SELECT model was refined to assess surface runoff

pollutant loads, focus on bacteria, and addressed input from the Texas Commission on Environmental Quality. Water quality modeling was used to develop the best management practices plan to manage bacteria and meet state contact recreation criteria. The modeling identified individual best management practices and the pollutant load managed by each to meet the watershed protection plan project goals. This initiative played a crucial role in facilitating the effective implementation of accepted watershed protection plans throughout Texas.

Other ways Texas Stream Team was able to assist watershed coordinators in achieving their goals included support in applications for in-kind funds, community science initiatives, and assistance with water quality monitoring and data collection. Table 2 summarizes the project leads and watershed coordinators included in this endeavor.

Table 2: Watershed coordinator partners and watersheds reached throughout the contract period.

COORDINATOR & ORGANIZATION	WATERSHED
Carla Ethridge – Clean Rivers Program Manager	Angelina & Neches
Kendall Guidroz – Houston-Galveston Area Council	Clear Creek Tidal, Bastrop Bayou, San Bernard
Phillip Brown - New Braunfels	Dry Comal/Comal Watershed
Dani Apodaca – Lower Colorado River Authority Monitoring Coordinator	Lower Colorado River Basin
Erin Hill - Center for Coastal Studies Texas A&M University Corpus Christi	Coastal Bend Watershed, Oso Creek, Nueces River
David Baker - Wimberley Valley Watershed Association	Cypress Creek, Guadalupe River
Robin Gary - Wimberley Valley Watershed Association	Cypress Creek, Guadalupe River
Lauren Strack - New Braunfels	Dry Comal/Comal Watershed
Lee Gudgell - Guadalupe-Blanco River Authority	Guadalupe River Basin
Elizabeth Edgerton - Guadalupe-Blanco River Authority	Guadalupe River Basin
Sarah Cunningham – Mission Aransas National Estuarine Research Reserve	Mission and Aransas Watershed
Sky Lewey - Nueces River Authority	Nueces River Basin
Chandani Rana - City of Grapevine	Trinity River
Christopher Morris - City of Dallas	Trinity River
Sierra De Silva, Shoal Creek Conservancy	Shoal Creek Watershed
Rachel Sanborn - San Marcos River Rangers	Upper San Marcos River, Guadalupe River

This collaborative approach not only strengthens the overall resilience of our watersheds but also enables the Texas Stream Team program to address challenges on a broader scale. By supporting these coordinators, we can ensure the availability of accurate and comprehensive information for informed decision-making and targeted interventions. Texas Stream Team is grateful to work alongside dedicated organizations and contribute to the development of watershed protection plans throughout the state.

WATERSHED EDUCATION AND OUTREACH

Texas Stream Team recognizes the value of watershed education as a tool for promoting community science and data collection efforts. By fostering a shared understanding of the value of Texas waterbodies, our efforts can leverage resources, expertise, and community support to implement effective watershed management practices and initiatives. For this reason, Texas Stream Team sought to provide watershed education to 5,500 individuals on nonpoint source pollution and activities that support water management. These activities included education activities on site through our Spring Lake Education division, partner education programs, curriculum development, research, and spreading the word to our network via quarterly newsletters. Texas Stream Team also conducted a feasibility study for developing a patch program to engage more with youth.

SPRING LAKE EDUCATION ACTIVITIES

Texas Stream Team activities are integrated into the Meadows Center's Spring Lake Education program. Due to COVID-19 shutdowns, the Texas Commission on Environmental Quality approved Texas Stream Team substituting the Enviroscape tasks with virtual and in-person micro field trips developed through our Spring Lake Education program.

Outreach efforts included virtual field trips, where students learned about watersheds through watershed model demonstrations. The field trips explored topics such as Freshwater Turtles of Spring Lake and Threatened and Endangered Species of San Marcos. Four schools participated, including Buda, Cactus Ranch, Jim Plain, and Colonies North Elementary schools. This resulted in over 290 elementary students and teachers reached.



Figure 4: Virtual field trip held on 5/29/2021 for Jim Plain Elementary School.

Traditionally Texas Stream Team and the Meadows Center attended and helped plan The Groundwater to Gulf Teacher Conference, but due to the uncertainty of COVID-19, the conference did not take place in 2021. Instead, we were able to host 197 Texas State preservice teachers on site during their scheduled lab classes. This hour-and-a-half tour included an aquarium visit, wetlands boardwalk, glass-bottom boat tour, and macroinvertebrate bug-picking activity. During the tour, the tour guide discussed the significance of Spring Lake to the threatened and endangered species that can only be found in this unique environment as well as the important role wetlands play in our ecosystem. This tour, like all our tours, engaged the preservice teachers in hands-on lessons about community science, water quality, and environmental stewardship. The preservice teachers were also able to earn Texas Environmental Education Advisory Committee and Continuing Professional Education credit for their attendance.

PARTNER EDUCATION PROGRAMS

Texas Stream Team has forged a valuable collaboration with Texas A&M AgriLife and the Texas Water Resources Institute to host ACCESS Water Workshops throughout the state. The workshops were designed to inform middle and high school teachers of community science, and how to implement various types of community science projects into their classrooms. Educators were provided the opportunity to enhance students' understanding of fundamental hydrology concepts, such as the water cycle, water quality, and water-related issues. As part of this initiative, over 100 students and educators were reached and empowered to cultivate a generation of environmentally conscious community members.



Figure 5: ACCESS Water Workshop in San Angelo hosted on 10/19/2022.

WATER EDUCATION CURRICULUM

Texas Stream Team worked to revise existing water curriculum and develop a comprehensive Texas Stream Team Texas Essential Knowledge and Skills document for students from kindergarten through high school. This concerted effort aimed to equip students with a deeper understanding of water resources and foster a sense of stewardship towards our vital waterways. Outcomes of this task included a comprehensive Texas Stream Team Water Education Curriculum packet and information sheets that provide lessons and hands-on educational activities. This packet covers topics such as groundwater, the water cycle, drinking water, macro-invertebrates, watersheds, water pollution, and aquifers. By working closely with educators, through the duration of this contract and after, Texas Stream Team can ensure that the curriculum aligns with current educational standards and incorporates the latest scientific research and best practices.

The education portion of this contract played a significant role in achieving multiple objectives. It not only served as a means to develop strong connections with educators and schools across the state, but also inspired awareness, understanding, and engagement among the target audience of Texas students. The updated curriculum can be found on our [Educators](#) page.

WEBSITE MAINTENANCE AND UPDATES

Regular maintenance and updates took place to the [Texas Stream Team](#) website throughout the contract. Updates include updating resources online, updating our public data, displaying new partnerships (see Partnerships and Groups section), displaying new trainers (see Texas Stream Team Community Scientist Trainings section), and adding over 75 training and partner events to our online calendar.

PATCH PROGRAM DEVELOPMENT

A brief feasibility study was conducted for creating a water quality monitoring patch program that could be developed by Texas Stream Team, and then distributed to local central Texas scouting groups. The goal of this portion was to take an old program that had stalled in development, and re-start conversations with Capital Area Boy Scouts of America chapter to get their assistance in developing the program materials, as well as ensuring the program requirements fall in line with scouting organization's standards in awarding patches and merit badges to scouts. However, due to the lack of staff time from both the Boy Scouts of America and Texas Stream Team, past failed attempts to create similar programs, and an overall lack of responsiveness from Boy Scouts of America staff, the result showed little feasibility to successfully create a patch program to the degree we were hoping for. Because of this, Texas Stream Team decided to move forward with developing only the Junior Monitor Ambassador Program in-house to fill the gap in youth monitoring. See the Junior Monitor Ambassador Program above for more information.

RESEARCH

Escherichia coli (*E. coli*) is commonly used as a freshwater fecal indicator bacteria of potential pathogen contamination for assessing risk associated with contact recreational use of surface-waters. Yet, monitoring for *E. coli* bacteria does not identify sources of

fecal contamination; it can only indicate fecal contamination is occurring. Without a clear understanding of fecal contamination sources, communities cannot implement best management practices targeting reductions of bacteria pollution in local waterways. Despite the use of microbial source tracking to identify host-specific sources of fecal contamination, the high cost makes microbial source tracking impractical to implement by volunteer community scientists or rural communities with limited funding.

For this reason, inexpensive alternatives to microbial source tracking are highly sought. As a supplement to *E. coli* bacteria monitoring, research evaluated two fluorometric methods in a spring-fed, freshwater stream in the Texas Hill Country with no permitted point sources, a history of elevated *E. coli* bacteria levels and high density on-site septic facilities. The first method involved optical brightener absorption to an organic cotton tampon where ultraviolet light exposure was used as a qualitative fluorescent presence/absence test. The second method involved extended ultraviolet light exposure of water samples resulting in a quantitative ratio differentiating between organic matter and optical brightener fluorescence to minimize false positives. The first method proved useful in determining the presence or absence of optical brighteners in surface water but failed to calculate the number of optical brighteners present. However, this method can be utilized as a community-based early warning system for human fecal contamination. The second method proved useful in quantifying the number of optical brighteners present in surface water, and, when combined with fecal indicator bacteria monitoring, can be used to identify sources of human fecal contamination from sewage wastewater in surface water.

The research conducted will strengthen bacteria monitoring for the Texas Stream Team community scientists program.



NEWSLETTERS

The Waterways newsletter connects community scientists, partners, and other interested parties across the state with the latest updates from Texas Stream Team. The newsletter includes information about upcoming trainings, Texas Stream Team events, partner events, a community scientist spotlight, and more. The Waterways newsletter allows Texas Stream Team to promote partner activities and show appreciation for the exemplary work of our community scientists.

Within the contract period, Texas Stream Team published four newsletters, which can be accessed on the Texas Stream Team News [webpage](#).

AMOUNT OF PROJECT FUNDING AND AMOUNT SPENT

The total amount of funding awarded for this contract was \$458,046. Project costs for this contract were allocated for supplies and travel for providing trainings in and supplies to community scientists in priority areas. The goal of this was to streamline and ensure community scientists transition effortlessly to monitoring water quality in their area once certified.

The total cost share (40%) requirement for this contract totaled to \$305,364. Cost share for this contract has been obtained from Texas Stream Team community scientist monitoring activities that is calculated using the Independent Sector's estimated national value of each volunteer hour, and the International Revenue Service standard mileage rate. In-kind match is also obtained from Texas State University's waived indirect costs, which is calculated using Texas State University's indirect cost rate, to cover this contract's cost share requirement.

All contract dollars will be spent down by the end of the contract. Table 3 below includes a breakdown of the contract budget.

Table 3: Authorized budgeted expenditures for work performed through Texas Stream Team's contract #10084.

BUDGET CATEGORY	TOTAL PROJECT COSTS
Salary/Wages	\$257,994.58
Fringe Benefits	\$96,945.17
Travel	\$19,879.70
Supplies	\$20,206.00
Equipment	\$0.00
Contractual	\$16,500.00
Construction	\$0.00
Other	\$4,880.00
Total Direct Costs	\$416,405.45
Indirect Costs	\$206,133.55
Other In-Kind Contributions	\$140,871.00
Total Contract Cost	\$763,410.00
Cost Share (40%)	\$305,364.00
TCEQ Reimbursement Amount (60%)	\$458,046.00

DISCUSSION

Challenges

The COVID-19 pandemic presented the main challenge for this contract, particularly during its initial stages. The widespread shutdowns and restrictions imposed significantly affected Texas Stream Team's operations. As in-person gatherings became untenable, we had to swiftly adapt to the new circumstances to continue fulfilling our contractual obligations.

One of the most significant impacts was on our events and trainings. With traditional in-person gatherings not feasible, we had to find innovative ways to conduct trainings virtually and maintain monitoring activities safely in person. The shift to virtual events required careful planning and implementation to ensure effective communication and engagement with participants.

Despite the obstacles, Texas Stream Team demonstrated remarkable resilience and dedication. We successfully leveraged virtual platforms and technology to host a series of online events, allowing us to proceed with several crucial components of the contract. The flexibility and support provided by the Texas Commission on Environmental Quality played a vital role in enabling us to adapt swiftly and continue delivering on our commitments.

Lessons Learned

In addition to the collective experience of adapting to ever-growing technology through virtual lessons, this contract provided us with a valuable lesson in the significance of conducting technique studies. Immersing ourselves in extensive research and dedicating time to studying the main components of the Texas Stream Team program, such as water quality equipment, new trainings, and the junior monitoring program, proved to be immensely beneficial.

By investing time and effort into these studies, our staff had the opportunity to gain a deeper understanding of the intricacies involved in each aspect of the program. This extensive research allowed us to explore best practices, examine emerging technologies, and assess various methodologies. Furthermore, we engaged in consultations with partners and experts in the field, gaining valuable insights and feedback that enriched our decision-making processes. Taking a long-term approach to these technique studies allowed us to thoroughly evaluate and prioritize our internal needs and goals. As we gathered a wealth of external information and collaborated with stakeholders, we were able to develop a comprehensive game plan for enhancing the Texas Stream Team program's key activities.

This valuable lesson has not only strengthened our team's expertise and decision-making capabilities but has also contributed to the overall effectiveness and credibility of the Texas Stream Team program. We will continue to prioritize research, technique studies, and strategic planning to foster ongoing growth and excellence in our water quality monitoring initiatives.

Looking to the future, we are inspired by the progress made and excited about the opportunities that lie ahead. Texas Stream Team remains committed to its mission, and we are eager to further expand our impact. We extend our heartfelt gratitude to all stakeholders, partners, and team members who contributed to the success of this project.



THE MEADOWS CENTER
FOR WATER AND THE ENVIRONMENT

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