The Upper San Marcos River Watershed Protection Plan: Implementation Phase I Final Report

Report: 2020-04
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The Meadows Center
for Water and the Environment
Texas State University

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Acknowledgments

The Meadows Center for Water and the Environment encourages life-long learning about the environment and people's relationship to the environment through its multidisciplinary 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. The Meadows Center values the staff contributions and recognizes each individual for their role. The following staff assisted in the preparation of this report and are acknowledged for their contributions:

- Dr. Sandra Arismendez, Water Quality Monitoring Coordinator
- Anna Huff, Communications Manager
- Aspen Navarro, Program Coordinator
- Allyson Schlandt, Research Assistant

Additionally, the Meadows Center acknowledges that all Upper San Marcos River Watershed efforts would not have been possible without our dedicated partners:

- Doucet & Associates
- Edwards Aquifer Authority
- Edwards Aquifer Habitat Conservation Plan
- Guadalupe-Blanco River Authority
- Hays County
- Hill Country Alliance
- Mermaid Society of Texas
- San Marcos Greenbelt Alliance
- San Marcos Lions Club
- San Marcos River Foundation
- The City of San Marcos
- Texas Clean Rivers Program
- Texas Master Naturalists - Hays County Chapter
- Texas State Soil and Water Conservation Board
- Texas State University
- Texas Stream Team
- United States Environmental Protection Agency

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Watershed Services

Prepared for:

Texas Commission on Environmental Quality

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PROJECT BACKGROUND

The Upper San Marcos River Watershed Protection Plan (USMR WPP), formerly known as the San Marcos Watershed Initiative, began the development stage in 2012 after the Upper San Marcos River (segment 1814) was included on the Texas Commission on Environmental Quality (TCEQ) 303(d) list of impaired waterways for exceeding total dissolved solids (TDS) standards. The original steering committee, in collaboration with The Meadows Center for Water and the Environment, created the WPP by conducting data analysis, identifying potential sources of nonpoint source pollution, and determining structural and nonstructural best management practices (BMPs) to preserve water quality and reduce stormwater runoff.

The WPP received approval from the TCEQ and the United States Environmental Protection Agency (EPA) in 2018. In August of 2018, the TCEQ awarded the Meadows Center Clean Water Act Section 319(h) grant funds disseminated from the EPA to begin implementation phase I of the WPP with the steering committee, partners, and stakeholders. Table 1 below outlines the current USMR committee members. Awarded funds gave the watershed team the launching-pad needed to fulfill the watershed mission statement: a healthy watershed that supports a clean, clear, and flowing San Marcos River for the future as it was in the past.

Table 1. List of WPP Committee Members

Committee Member	Representing Organization
Dr. Kimberley Meitzen, Committee Chair	Texas State University
Mike Ohlendorf	Agriculture/Ranch/Rural Landowner
Chris Wood	Developers/Real Estate
Melani Howard	City of San Marcos
Jane Hughson	City of San Marcos, Mayor, Landowner
Alexandra Thompson	Hays County
Virginia Condie	San Marcos River Foundation
Kristina Tolman	Edwards Aquifer Authority
Paul Murray	San Marcos Greenbelt Alliance
Gena Fleming	Landowner
Elizabeth Edgerton	Guadalupe-Blanco River Authority

Implementation aspects in the WPP includes enhancing education and water quality through education and outreach and demonstration projects. The following education and outreach activities were conducted during the duration of this contract:

- 7 stakeholder meetings to provide project updates, resources, and discussion;
- 2 workshops related to water quality for the public to gain a better understanding and initiate water quality practices at home;
- Ordinance, code, regulation review and pollutant reduction estimates report to review ordinances from river authorities, cities, and groundwater districts that impact water quality within the watershed;
- 1 ordinance review workshop with the City of San Marcos and Hays County staff to present ordinance review findings and potential needs;

- 1 StoryMap tour that includes all BMP demonstrations in the watershed;
- 1 utility bill stuffer for the city, county, university, and local NGOs to utilize and pass out to the public to reduce water use at home; and
- 2 interpretive signage installed at BMP demonstration sites to provide explanations and descriptions of how they are protecting the watershed.

In addition to education and outreach, two BMP projects were installed to combat potential contaminants and other nonpoint source pollutants from reaching the river. BMPs are structural, vegetative, or managerial practices that are implemented to treat, prevent, or reduce pollution from entering our waterways via stormwater runoff. Stormwater runoff occurs when rain and water can no longer soak into the ground due to oversaturation, and instead flows over the ground surface; picking up pollutants along the way before making its way into the nearest body of water. The WPP team along with staff from the City of San Marcos and Texas State University collaborated to implement two BMPs in the watershed:

1. **Hutchison Biofiltration Pond:** this biofiltration pond is located at the intersection of Hutchison and CM Allen Drive. Biofiltration ponds function similarly to rain gardens, but on a larger scale. The Hutchison biofiltration pond specifically captures stormwater runoff received from downtown San Marcos, the runoff then filters through engineered soils and native plants to remove pollutants, and the treated stormwater is eventually passed through an underdrain and released into the San Marcos River. The Hutchison biofiltration pond has the following benefits to the watershed:
    a. Removes pollutants such as sediment, metals, and bacteria from entering our waterways.
    b. Reduces the potential for landscape erosion.
2. **Hogtrap Retrofit:** this BMP is designed to divert stormwater from the northern edge of Texas State University campus that is known for receiving an excess amount of runoff while reducing hillside erosion. The retrofit included repairing and improving a series of storm inlets and piping below the hill's surface to divert excess stormwater runoff during rain events. Further repairs and stabilization to the hillside were completed to prevent continued erosion. The Hogtrap provides the following benefits to the watershed:
    a. Removes pollutants such as sediment, metals, and bacteria from entering Sessom Creek, which flows into the San Marcos River.
    b. Reduces landscape erosion.
    c. Improves the drainage of the surrounding area, which reduces the intensity of flooding.

The two BMP locations are extremely important due to their proximity to the river's mainstem and tributaries. Both BMPs were completed in April of 2020, and educational signage was installed by the end of the contract.

Additional project highlights include a major rebranding to commemorate recent EPA approval. Rebranding initiatives consisted of a new name, logo, newsletter, and website. Along with the new rebranding, two new full-time staff members joined the Meadows Center's Watershed Services team to support and fulfill the mission of the WPP; Aspen Navarro was hired as the Program Coordinator in July 2019, and Sandra Arismendez joined as the Water Quality Monitoring Coordinator in November 2019. The two have already made an excellent team with their combined knowledge, expertise, and tireless work ethic.

Continue reading to learn more about the Upper San Marcos River watershed, the deliverables accomplished within this implementation phase, water quality results and load reductions, and recommendations for future iterations of this WPP.

STUDY AREA

The USMR watershed is located in San Marcos, Texas, a city with a population over 60,000 and lies along the I-35 corridor between Austin and San Antonio. Mostly a rural watershed, the USMR spans 4.5 miles in its entirety, from its headwaters at Spring Lake to its confluence with the Blanco River. San Marcos is located in Central Texas, an area that has experienced rapid development and population growth and is expected to continue growing for the next 20 years. San Marcos is also home to Texas State University's main campus, which has an enrollment of almost 40,000 students who live within the city or commute to campus daily. In addition to population and development growth, San Marcos receives thousands of tourists a year as many are drawn to the constant temperature and clarity of the Upper San Marcos River. These factors (growing population, high contact recreational use, peak tourist season in the summer, etc.) make a WPP pertinent for unique rivers such as the USMR. As central Texas continues to see a trend of rapid population growth, proactive management of natural resources is more important than ever to ensure excellent water quality and quantity for generations to come.

The watershed is located in a transition zone between the Edwards Plateau and Blackland Prairies, resulting in varied elevation. Moving eastward through the watershed, the topography slopes downward, reaching the lowest elevations at the San Marcos River, the ultimate destination for runoff from all of the subbasins. Small acreage agricultural/ranching lots and low-density suburban development are the dominant land uses in the rural, non-urbanized areas of the watershed. The most urbanized section of the watershed falls within the city of San Marcos. Relying primarily on spring-flow from the Edwards Aquifer, the USMR also receives periodic flow from four subbasins: Sink Creek, Purgatory Creek, Willow Creek, and Sessom Creek. The USMR is not only an important resource for citizens within the watershed, but also provides habitat for eight species listed as threatened or endangered by the United States Fish and Wildlife Service. Figure 1 below shows a map of the entire watershed, including its subbasins.

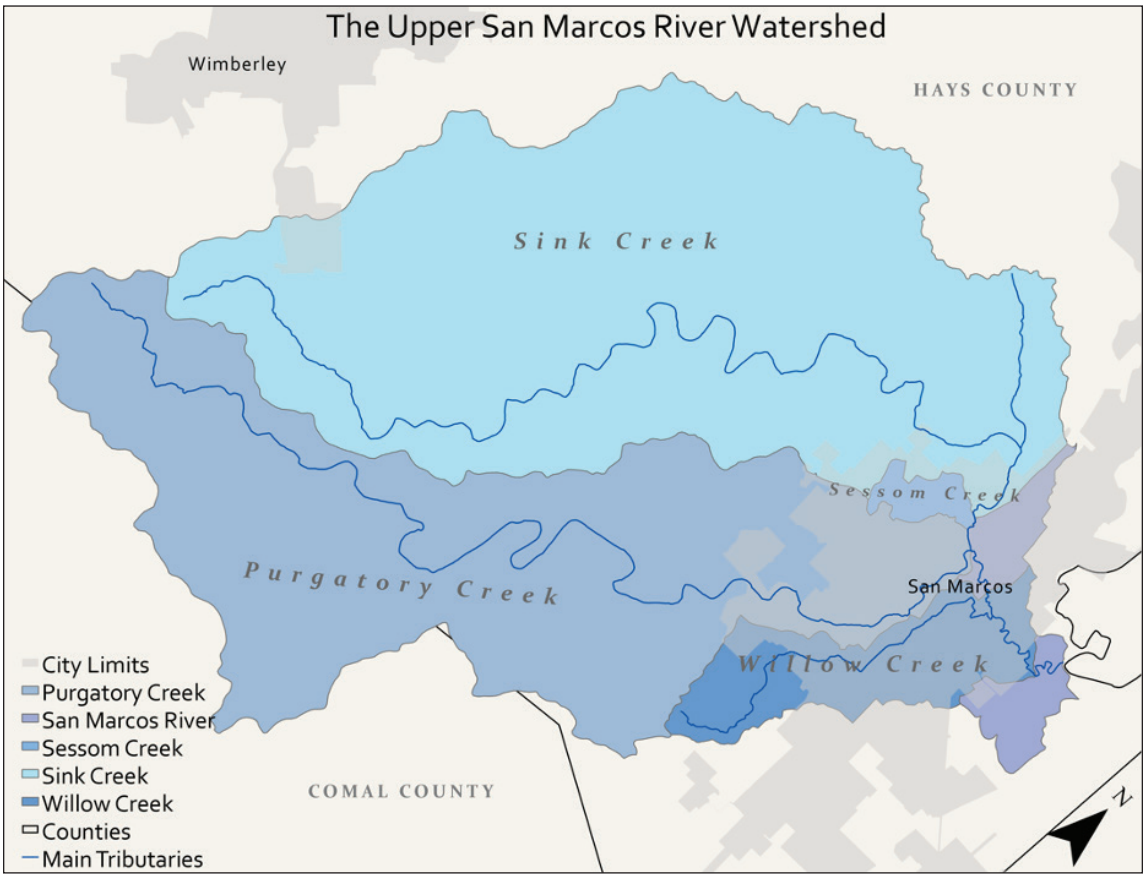

Figure 1. The Upper San Marcos River Watershed.

WATER QUALITY RESULTS ACHIEVED/ESTIMATED LOAD REDUCTIONS

Water Quality Results

The purpose of Task 6 – Monitoring Efforts within implementation phase I was to analyze surface, storm, and ground water quality data collected by watershed partners to determine changes and trends in water quality as the management measures described in the WPP are implemented.

Surface (Figure 2), ground, and storm water quality data were acquired from the Guadalupe-Blanco River Authority (GBRA), Texas Stream Team, City of San Marcos (COSM), US Geological Survey (USGS) and Texas Water Development Board (TWDB) and analyzed for this report. Reports from the Edwards Aquifer Habitat Conservation Plan (EAHCP) were acquired and reviewed but due to the voluminous datasets collected by entities implementing the EAHCP, those data were not included in this report. Instead, the reader is directed to their website for more information.

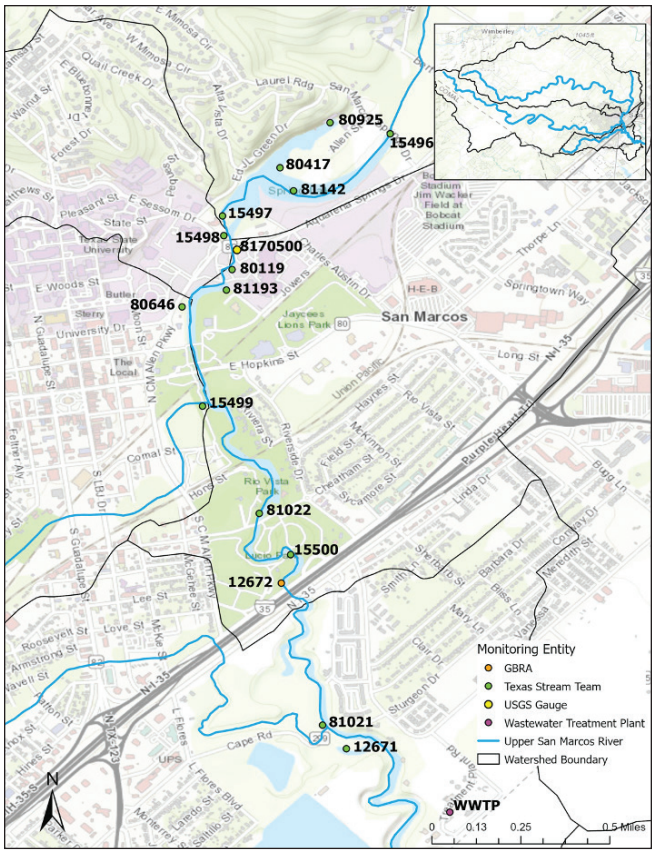

Figure 2: Surface Water monitoring sites within the USMR.

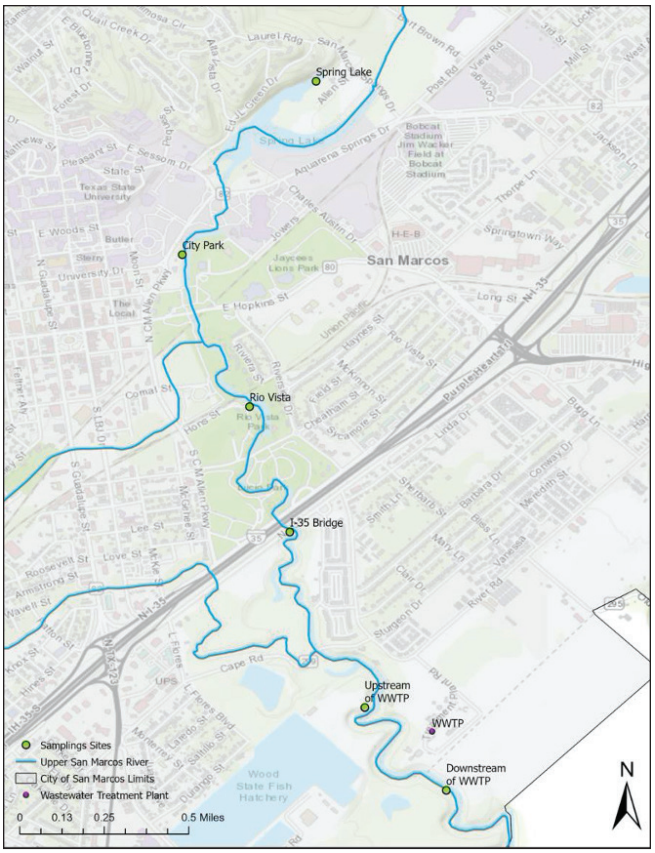

Figure 3: Sites monitored for *E.coli* weekly by the City of San Marcos.

The USMR was on the 2010 TCEQ CWA§303(d) list for total dissolved solids (TDS), however it is not currently listed as impaired on the 2020 list. Water quality monitoring data collected by the GBRA at one site on the USMR and the Texas Stream Team citizen scientist data from 8 of 15 sites indicate TDS concentrations are not supportive of the TCEQ water quality standard and USMR WPP targets.

The TDS trend analysis conducted on the GBRA data revealed an increasing long- term trend (1992-2020) and a decreasing seven-year trend (2013-2020), although both relationships were weak ($r_2 < 0.5$). The GBRA long-term and seven-year data means TDS exceeded the standard and targets. Notably, all TDS

means for the Texas Stream sites in the below Spring Lake area (BSLA), located along the centralized section of the USMR with more dense urbanization, exceeded the water quality standard. While only one site in the Spring Lake area (SLA) group, two in the northwest of IH35 (NW35) group, and one in the southeast of IH35 (SE35) group exceeded the water quality standard, some of these occurrences are not unexpected given the USMR WPP modeled predictions for TDS (The Meadows Center, 2018).

Chloride concentrations resulting from the GBRA data met the TCEQ water quality standard and WPP targets. Although the long-term trend analysis showed a decreasing trend, the seven-year trend analysis showed an increasing trend (r_2=0.617).

GBRA sulfate concentrations met the TCEQ water quality standard and WPP targets, however both the long-term and seven-year trend analyses revealed increasing trends. The seven-year trend analysis showed an increasing trend (r_2=0.445) for sulfate concentrations over time, similar to that for chloride. Mean GBRA and Texas Stream Team dissolved oxygen values met the 6.0 mg/L aquatic life use criteria and WPP targets. However, a decreasing trend in dissolved oxygen (r_2<0.05) was observed.

Mean nitrate-nitrogen and phosphorous values met the TCEQ water quality standard and WPP targets. Trends for nitrate-nitrogen (r_2>0.05) increased in the long-term analysis and decreased in the seven-year time frame. Similar results were observed for phosphorous, but the long-term trends decreased, while the seven-year trend increased.

The GBRA *E. coli* geometric mean (65.5 MPN/100 mL) was well below the primary contact recreation use criterion and WPP targets. However, the seven-year geometric mean (89.9 MPN/100 mL) was greater than the long-term geometric mean. Only a few *E. coli* sampling events were documented in the Texas Stream Team Waterways Dataviewer (n=16), but the geometric mean for all samples (115.2 CFU/100 mL) fell below the TCEQ water quality standard.

The COSM stormwater monitoring (Figure 3) *E. coli* geometric means at all sites met the water quality standard and WPP targets, however there was a longitudinal increase in geometric means from the upstream to downstream sites. A report from the EAHCP, collected water samples from 12 storm events in 2018 and noted they contained very high concentrations of *E. coli* that exceeded the contact recreation limits (Schwartz et al., 2019). Conceivably the stormwater events sampled by the COSM and the EAHCP programs varied in type, size, and duration, resulting in different outcomes.

The USMR WPP established targets for oil and grease. However, no oil and grease monitoring data were identified in any of the partner monitoring programs. Therefore, no analysis of this type occurred. USGS streamflow discharge data in the USMR resulted in a decreasing trend in streamflow (r2=0.3375) for the project period. However other recent studies in the USMR resulted in predominantly above average spring flows in the San Marcos Spring system (EAHCP, 2019).

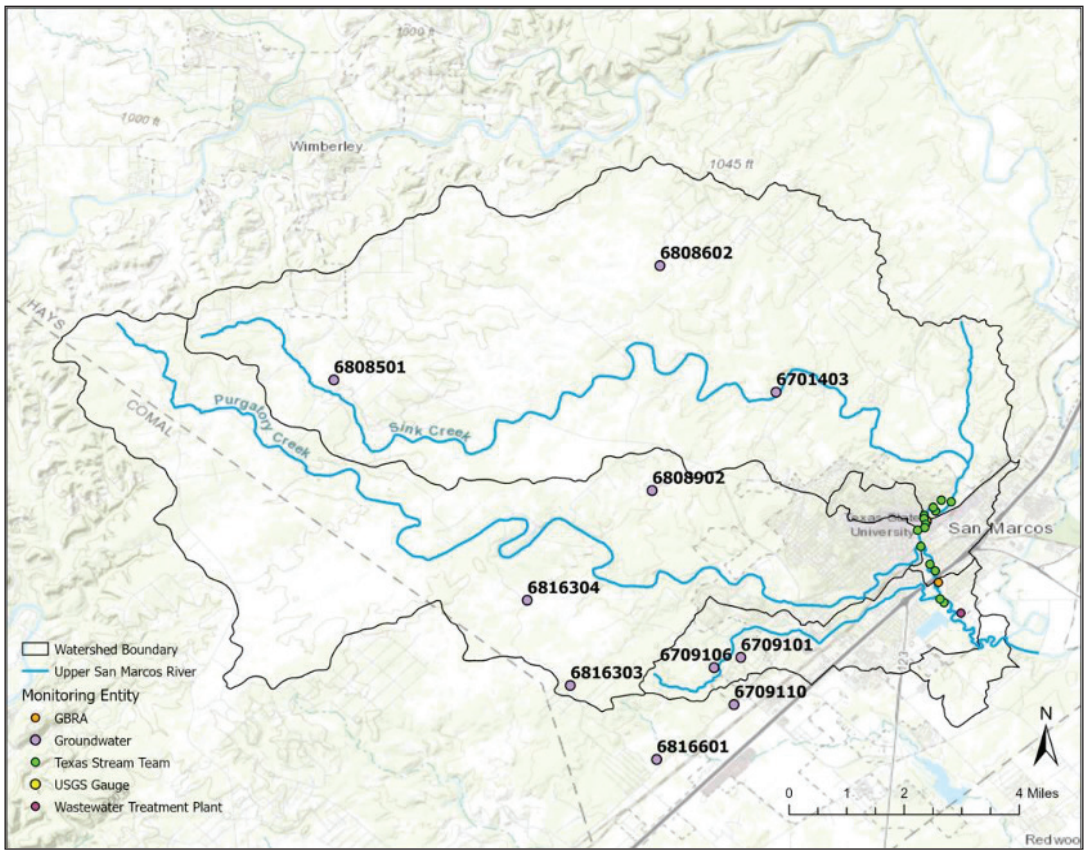

Figure 4: Groundwater monitoring sites within the watershed.

Groundwater level (Figure 4) data was identified in the TWDB groundwater database (GWEB), however it was monitored irregularly. The groundwater quality data identified in the watershed was sporadic at best with only one event at one well taking place during the project period for this report.

Evidence of nonpoint source pollution in the USMR watershed is supported by results of the parameters analyzed in this study. TDS continues to exceed the water quality thresholds, while other parameters revealed mixed and/or strong increasing trends and have the potential for future exceedances of water quality criteria. Therefore, it is paramount for partners to continue monitoring and assessing the responses of this diverse and dynamic system given the explosive growth and subsequent development currently taking place in the USMR watershed.

Estimated Load Reduction Calculations

Development in the USMR watershed is expected to increase, with rural land uses converting to intense urban developments. Increased impervious cover associated with urbanization can lead to increased pollutant concentrations. In addition, the installation of drainage systems and concrete channels can result in pollutant loadings being delivered to waterways faster and in greater concentrations than in undeveloped areas with natural drainage systems. Urbanization has also been shown to fragment the landscape, potentially impacting biodiversity. The installation of the two BMP demonstrations are crucial in mitigating the potential impacts to the watershed aforementioned.

These demonstrations projects help to improve water quality, enhance water supplies, and serve as guidance for residents, developers, and stakeholders to replicate. The BMP sites were determined based on their ability to improve water quality by capturing and/or treating stormwater runoff before making its way to the USMR.

The Hutchison biofiltration pond, installed at Hutchison Street and CM Allen Intersection, is in a crucial location for the USMR as it acts as a last line of defense against pollutants from downtown before reaching the USMR.

Hutchison Pond estimated annual load reduction calculations:

- 7900 pounds per year total suspended solids (TSS) managed
- 17 pounds per year total phosphorus (TP) managed
- 67.5 pounds per year total nitrogen (TN) managed
- 5.53x10^12 MPNs *E.coli* per managed per year

The Hogtrap Retrofit installed along Matthew's Street is located along Sessom Drive. This northern area of campus receives runoff from roughly 9 acres and is 74-percent impervious cover. Needless to say, the hillside on the Hogtrap retrofit receives a significant amount of runoff. The retrofit's outlet deposits into Sessom Creek, a major tributary to the USMR.

Hogtrap estimated annual load reduction calculations:

- 24.2 tons per year total suspended solids (TSS) managed
- 2.4 pounds per year total phosphorus (TP) managed
- 1.46 pounds per year total nitrogen (TN) managed
- 1.52x10^7 MPN *E.coli* managed per year

See Appendix I for load reduction calculation methodology.

TASKS AND FINAL APPROVED QUARTERLY PROGRESS REPORT

The project's scope of work included seven main tasks and subsequent deliverables that fell within each task. The information within this section highlights each specific task, the objective, and the summarized deliverables. The final approved quarterly progress report (QPR) can be found in Appendix II, which provides further detail into each completed deliverable, the date of submission, and the date approval was received by the TCEQ project manager.

Task 1: Project Administration

Objective: *To effectively administer, coordinate, and monitor all work performed under this project including technical and financial supervision and preparation of status reports.*

Deliverables completed under this task:

- Quarterly Progress Reports (QPRs)
- Reimbursement forms
- Post-Award Orientation Meeting Notes with action-items
- Conference Call Meeting Notes with action-items
- Coordination Meeting with EPA
- Annual Report Article and Pictures
- Contract Budget Updates
- Annual Budget Updates

Task 2: Quality Assurance

Objective: *To refine, document, and implement data quality objectives (DQOs) and quality assurance/quality control (QA/QC) activities that ensure data of known and acceptable quality are generated by this project.*

Deliverables completed under this task:

- Quality Assured Project Plan (QAPP) Planning Meeting Notes
- Draft and Final QAPPs
- QAPP Annual Reviews and Revisions
- Draft and Final QAPP Amendments

Task 3: Demonstration and Water Quality Protection BMPs

Objective: *To oversee installation of functioning NPS pollutant control technologies which will educate the public concerning the pollution reduction benefits of management measures, low impact development (LID), and green infrastructure. BMPs will also serve as pilots to determine accurate NPS reductions. Informational signage at each BMP will include more information about the watershed, NPS, water quality threats, city efforts and resources for the general public to explore LID, green infrastructure, and watershed stewardship activities.*

Deliverables completed under this task:

- BMP Selection Methodology Report; including final BMP selection, and calculation of pollution reduction estimates
- Timeline for BMP construction
- Notification of Bid solicitations
- Notification when subcontractors hired
- BMP Design Reports
- Quarterly BMP installation progress
- BMP Post-Construction Reports
- Documentation of completion of the Downtown BMP, including photo documentation
- Documentation of completion of the Sessom Creek BMP, including photo documentation
- Descriptive signs designed, manufactured and photo documentation of signs installed at each BMP site.

Task 4: Education and Outreach Activities

Objective: *to enhance the implementation of the WPP through the engagement of the community in education and outreach activities, including meetings, events, workshops, print materials, website and signage. These activities will reach broad audiences and create a greater understanding among residents of their role in protecting water quality. Efforts will also increase awareness of water quality protection and mitigation efforts at the city, county, non-governmental organization (NGO) and other partners levels.*

Deliverables completed under this task:

- Hiring/assignation of Watershed Coordinator
- Quarterly stakeholder meetings
- Two water quality and NPS community workshops
- Website maintained and linked with partner sites
- Utility bill stuffers, brochures, handout templates
- One watershed tour and accompanying materials developed

Task 5: Analysis of Ordinances, Codes, and Regulations Impacting Water Quality

Objective: *To conduct an analysis of the efficacy and potential pollution reduction associated with updated ordinances, codes, and regulations.*

Deliverables completed under this task:

- Ordinance, Code, Regulation Review and Pollutant reduction estimates report
- One Ordinance workshop with city and county staff

Task 6: Coordination of Water Quality Monitoring and Analyses/Data Acquisition

Objective: *To coordinate water quality monitoring performed during this project by partners, including coordination of any routine and continuous surface water quality and stormwater monitoring. Monitoring may be performed by City of San Marcos, the Guadalupe-Blanco River Authority (GBRA), the Texas*

State University Environmental Health, Safety and Risk Management staff, the Hays Trinity Groundwater Conservation District (HTGCD), the Habitat Conservation Plan (HCP), and the Texas Stream Team.

Deliverables completed under this task:

- Track monitoring efforts of partners
- Compilation of acquired data
- Annual Water Quality Data Summary and Analysis Report

Task 7: Final Report

Objective: *To produce a Final Report that summarizes all activities completed and conclusions reached during the project. The Final Report must describe all project activities and identify and discuss the extent to which project goals and purposes have been achieved, and the amount of funds actually spent on the project. The Final Report should emphasize successes, failures, lessons learned, and should include analyses estimating the projects' water quality improvements and/or load reductions if applicable. The Final Report must summarize all of the Task Reports in either the text or as appendices.*

Deliverables completed under this task:

- Draft Final Report
- Address TCEQ/EPA Comments
- Final Report

AMOUNT OF FUNDING AND AMOUNT SPENT

The total amount of funding awarded at the execution of the contract was: $299,522. This amount includes both federal and in-kind match. In-kind match can consist of services, materials, or labor provided by partner organizations as opposed to monetary support. For federal level grant, 60-percent of funds comes from federal dollars, and 40-percent comes from match dollars. Therefore, the standard 60/40 distribution breakdown is as follows:

- **Federal:** $179,713
- **In-Kind Match:** $119,809

For this contract, all in-kind funds were met with the costs from constructing the two BMP demonstration projects, which were completed in collaboration with the City of San Marcos and Texas State University.

All contract dollars were spent down by the end of the contract. Table 2 below includes a breakdown of the contract budget.

Table 2. Breakdown of Project Budget

Task/Activity	TCEQ Reimbursable Portion (federal)	Grantee Match Portion (Non-federal)	Total
Project Administration	$17,882	$5,365	$23,247
Quality Assurance	$5,981	$1,794	$7,775
Demonstration BMPs	$88,241	$92,267	$180,608
Education and Outreach	$18,055	$5,417	$23,472
Ordinance Analysis	$34,086	$10,226	$44,312
Coordination/Analysis of Monitoring	$10,350	$3,105	$13,455
Final Report	$5,118	$1,535	$6,653
Total	**$179,713**	**$119,809**	**$299,522**

DISCUSSIONS

Lessons Learned

Due to delayed BMP finalization, the QAPP had to be amended towards the end of FY19, long after contract execution and therefore, some tasks under Task 6 - Data Acquisition were hindered:

- Task #9814 - Compilation of Acquired Data Posted on Website - unable to graphically show data on the website and had to result in including an embedded link.
- Task #9816 - FY19 Annual Water Quality Data Summary and Analysis - unable to produce due to QAPP needing to be finalized before acquisition could begin. The subsequent tasks for FY20 were able to be completed however, there was no data for prior years to compare to.

Another slight hindrance that occurred, was the delayed timeline for BMP completion. The contract language planned for all in-kind match to come from the construction costs of the two BMP projects. However, the Hutchison Pond was delayed on several occasions due to weather and timeline alterations on construction. The Hogtrap was completed on-time but was not scheduled for completion until the end of the project timeline. Because of this, match reporting was delayed to the last two quarters of the contract due to there being no match to report.

Recommendations

There are four main recommendations moving forward for future watershed implementation contracts:

1. Have back up match contributions to prevent delayed match reporting or set strict BMP installation timelines.
2. Continue focusing on BMP demonstration projects in highly visible locations to maximize education and overall project visibility.
3. Maximize BMP effectiveness and outreach by incorporating materials and activities to help homeowners replicate BMPs in their home. Examples include: a homeowner BMP guide, BMP demonstration workshops, and BMP Q&A sessions.
4. Continue adding to the online BMP StoryMap tour to sustain a user-friendly and easily navigable platform to track watershed progress and accomplishments.

APPENDIX I

Amendment # 1
to the Upper San Marcos Watershed Protection Plan (WPP) Implementation:
Quality Assurance Project Plan
(QAPP)

Texas State University – San Marcos
The Meadows Center for Water and the Environment
San Marcos, Texas 78666

Funding Source:

Nonpoint Source Program CWA §319(h)
Prepared in cooperation with the Texas Commission on Environmental Quality
and the U.S. Environmental Protection Agency
Federal ID #99614622
QTRAK# 19-362

Effective Date: Upon date of final approval of the amendment

Questions concerning this QAPP should be directed to:

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Justification: This amendment is differentiating between pollutant load reduction calculations to be used on the different BMP installations described in subtasks 3.1 and 3.2 of Appendix B; no work is being added to those subtasks. Pollutant load reduction calculations are covered under subtask 3.3. In the original QAPP, the same pollutant load reduction calculations were going to be used for both BMPs, although after further research, the methods for the Sessom Creek Stormwater Retrofit/Stream Restoration BMP (subtask 3.2) needed to be updated in the QAPP.

This amendment is changing the method of calculating pollutant load reductions for the Sessom Creek Stormwater Retrofit/Stream Restoration BMP (Subtask 3.2). The two sites in this project, described in subtasks 3.1 and 3.2, are retrofits of different BMP types. The Downtown Stormwater Retrofit BMP (Subtask 3.1) is the retrofit of a biofiltration pond and the Sessom Creek Stormwater Retrofit/Stream Restoration BMP (Subtask 3.2) is the retrofit of a streamside stormwater outfall. Since they are different BMP types, the method of water quality treatment, and therefore the calculation of pollutant load reductions, is different.

The process described below to calculate load reductions for the Sessom Creek Stormwater Retrofit/Stream Restoration BMP (Subtask 3.2) is based on the methods used in the *North Concho River Improvement/Bank Stabilization Project* that was funded by the CWA 319(h) program. The *North Concho River Improvement/Bank Stabilization Project* was a streamside project and similar in location to the Sessom Creek Stormwater Retrofit BMP. Based on the best professional judgment of the project subcontractor (an engineer with Doucet & Associates), the method and numbers from the *North Concho River Improvement/Bank Stabilization Project* will be applicable to the San Marcos site.

Summary of Changes:

Section	Page #	Change	Justification
D3	32	Adding method of TSS load reduction calculation for Hogg Trap	Adding the new method based on the *North Concho River Improvement/Bank Stabilization Project* specifically for the Hogg Trap BMP.
D3	32	Adding bacteria load reduction calculation for Hogg Trap	Using new reference listed above.
D3	32	Adding method of TN load reduction calculation for Hogg Trap	Using new reference listed above.
D3	32	Adding method of TP load reduction calculation for Hogg Trap	Using new reference listed above.
References	38	Adding reference	New load reduction calculations were based on this reference.

Detail of Changes:

D3 RECONCILIATION WITH USER REQUIREMENTS

BMP Load Management Calculation Approach (Subtask 3.3 in Appendix B)
Load reductions will be calculated for total nitrogen (TN), total phosphorus (TP), *E. coli*, and TSS for each

BMP using the following methods:

Downtown Stormwater Retrofit BMP (Subtask 3.1 in Appendix B)

For TSS load reductions, the TCEQ "Complying with the Edwards Aquifer Rules: Technical Guidance on Best Management Practices" (RG-348) Section 3 will be used.

For TN, TP, and *E. Coli*, using the following approach.
References:

City of Austin (COA) Environmental Criteria Manual, Sept 7, 2018

Users Guide to the BMP SELECT Model, 2013, WERF

For TN and TP

Average annual load (pounds) managed per year = (influent concentration – effluent concentration (COA Tables 1-10, 1-11 and SELECT tables 3 and 4) X contributing area (acres) x average annual rainfall Hays County (33 inches) X Runoff coefficient based on impervious cover (COA Table 1-9) x 0.226 (conversion factor to yield pounds per year).

The influent concentration minus the effluent concentration will be based on the BMP used.

For *E. coli*

Average annual colonies managed per year = (influent concentration – effluent concentration (COA Tables 1-10, 1-11 and SELECT tables 3 and 4) X 10 (cfu per liter) X contributing area (feet squared) x average annual rainfall Hays County (33 inches) x (1/12) x runoff coefficient based on impervious cover (COA Table 1-9) x (7.48 gal/cubic foot) X (3.79 liters/gallon)

Sessom Creek Stormwater Retrofit/Stream Restoration BMP (Subtask 3.2 in Appendix B)

For TSS load reductions:
Determine the amount of soil that will not be eroded due to the proposed stabilization improvements.

The volume of soil that is excavated prior to the emplacement of the bank stabilization components will be measured in cubic feet based on the length X width X depth; this will equal the volume of managed material. The volume will be converted to pounds based on the unit soil weight. Soil types will be viewed onsite and compared with the Soil Survey of Comal and Hays Counties. The Soil Survey of Comal and Hays Counties will be used to define the unit soil weight to define the total suspended solids managed in pounds.

For TN:
Using the reference from the North Concho Project, there is 26.2 ppm N at a 12-inch sample depth which converts to 104.8 pounds/acre. This is converted to pounds per cubic foot which results in 0.0024058 pounds per cubic foot. Then, multiply the amount of soil that will not be eroded by 0.0024058 to define the nitrogen load reduction in pounds.

For TP:
Using the procedure above, it was found that there is 0.0039577 pounds of phosphorus per cubic foot. To determine the phosphorus reduction, multiply the amount of soil that will not be eroded by 0.0039577 to

define the load in pounds.

For Bacteria:
Using the reference from the North Concho Project, bacteria was found in the upper 6cm of the soil and 88% of the soil samples collected contained bacteria. The research document found that 16 MPN/g persisted in the soils. (The *North Concho River Improvement/Bank Stabilization Project Final Report* uses MPN and cfu interchangeably)

E. coli in MPN = Surface area of soil (cm squared) prevented from eroding X 6cm X 0.88 x 454 grams/pound X 16 MPN/gram X unit weight of soil (pounds/cubic foot) X (1 cubic foot/28317 cubic centimeters).

MPN = 1.354 X (X centimeters squared) X unit weight of soil (pounds per cubic foot)

References

American Public Health Association, American Water Works Association and Water Environment Federation, *Standard Methods for the Examination of Water and Waste Water*, latest online edition.

Guadalupe-Blanco River Authority. *NELAP Credentials.* < http://www.gbra.org/lab.org/lab>. Last accessed December 16, 2016.

Guadalupe-Blanco River Authority. *2015-2016 Clean Rivers Program Quality Assurance Project Plan; Guadalupe-Blanco River Authority.*

Texas Stream Team. *Surface Water Quality Monitoring Project Quality Assurance Project Plan.* Updated 2016.

TCEQ SOP: Texas Commission on Environmental Quality *Surface Water Quality Monitoring Procedures*, Volume 1: RG-415, August 2012.

Upper Colorado River Authority. *North Concho River Improvement/Bank Stabilization Project.* < *https://www.tceq.texas.gov/assets/public/waterquality/nps/projects/10082FinalReport.pdf*>. Last accessed August 28, 2019.

US EPA Methods for Chemical Analysis of Water and Wastewater, Manual #EPA-600/4-79-020.

Distribution: QAPP Amendments will be distributed to all personnel on the original QAPP by the Contractor Project Manager. Records of distribution will be maintained by TXSTATE.

Adherence Letters: TXSTATE will secure written documentation from additional project participants stating the organization's awareness of and commitment to requirements contained in this QAPP amendment. TXSTATE will maintain this documentation as part of the project's quality assurance records. This documentation will be available for review in the event of an audit. Copies of this documentation will also be submitted as deliverables to the TCEQ NPS Project Manager within 30 days of final TCEQ approval of the

*grayed out tasks were not complete/requested				
ID#	Sub Task #	Deliverable	Current Due Date	Date Sent
9741	1.2	QPR (FY19Q1)	12/15/18	12/14/18
9742	1.2	QPR (FY19Q2)	03/15/19	03/15/19
9743	1.2	QPR (FY19Q3)	06/15/19	06/17/19
9744	1.2	QPR (FY19Q4)	09/15/19	09/13/19
9745	1.2	QPR (FY20Q1)	12/15/19	12/13/19
9746	1.2	QPR (FY20Q2)	03/15/20	03/12/20
9747	1.2	QPR (FY20Q3)	06/15/20	06/11/20
9748	1.2	QPR (FY20Q4)	09/15/20	in progress
9749	1.3	Invoice (FY19Q1)	12/30/18	12/21/19
9750	1.3	Invoice (FY19Q2)	03/30/19	04/04/19
9751	1.3	Invoice (FY19Q3)	06/30/19	06/30/19
9752	1.3	Invoice (FY19Q4)	09/30/19	09/27/19
9753	1.3	Invoice (FY20Q1)	12/31/19	12/31/19
9754	1.3	Invoice (FY20Q2)	03/31/20	03/31/20
9755	1.3	Invoice (FY20Q3)	06/30/20	06/29/20
9756	1.3	Invoice (FY20Q4)_June	07/30/20	in progress
9757	1.3	Invoice (FY20Q4)_July	08/30/20	in progress
9758	1.3	Invoice (FY20Q4)_Aug	10/15/20	in progress
9760	1.4	Conference Call (FY19Q2)	01/15/19	01/09/19
9761	1.4	Conference Call (FY19Q3)	04/15/19	04/15/19
9762	1.4	Conference Call (FY19Q4)	07/15/19	06/27/19
9763	1.4	Conference Call (FY20Q1)	10/15/19	10/08/19
9764	1.4	Conference Call (FY20Q2)	01/17/20	01/17/20
9765	1.4	Conference Call (FY20Q3)	04/15/20	04/03/20
9766	1.4	Conference Call (FY20Q4)	07/15/20	07/16/20
9759	1.4	Post-Award Mtg (Notes within 2 days of mtg)	10/05/18	10/16/18
9767	1.5	EPA Coordination Mtg (Upon Request)	08/31/19	N/A
9768	1.6	Annual Report Article (If requested)	08/01/20	07/20/20
9769	1.7	FY20 Annual Budget Update	01/31/20	03/12/20
9770	2.1	QAPP Planning Mtg Notes	10/05/18	10/16/18
9771	2.2	Draft QAPP	01/15/19	01/09/19
9772	2.2	Final QAPP	04/15/19	04/09/19
9773	2.4	1st QAPP Certification (due within 90 days of annivesary date)*Date will be adjusted once QAPP executed	05/01/20	04/14/20
9774	2.4	2nd QAPP Certification (due within 90 days of annivesary date)*Date will be adjusted once QAPP executed	01/15/21	N/A
9775	3.1	BMP Installation Progress (Quarterly reported in QPR)	08/31/20	N/A

ID#	Sub Task #	Deliverable	Current Due Date	Date Sent
9777	3.1	Downtown BMP bid solicitations, via the City of San Marcos	07/31/19	06/20/19
9779	3.1	Downtown BMP construction plans and design report	08/31/19	06/20/19
9780	3.1	Downtown BMP photo documentation of completion	06/15/20	04/27/20
9782	3.1	Downtown BMP Post-Construction Report	06/30/20	06/25/20
9776	3.1	Downtown BMP selection report and timeline	07/31/19	07/24/19
9781	3.1	Downtown BMP signage installed	06/30/20	06/17/20
9778	3.1	Downtown BMP subcontractors hired	08/01/19	06/20/19
9784	3.2	Sessom BMP Bid solicitations	11/30/19	11/22/19
9786	3.2	Sessom BMP Construction Plans and Design Report	11/30/19	01/10/20
9787	3.2	Sessom BMP photo documentation of completion	05/30/20	04/27/20
9789	3.2	Sessom BMP Post-Construction Report	06/30/20	06/25/20
9783	3.2	Sessom BMP Selection Report and BMP timeline	11/30/19	01/10/20
9788	3.2	Sessom BMP Signage installed	08/31/20	08/20/20
9785	3.2	Sessom BMP Subcontractors hired	01/31/20	11/22/19
9790	4.1	Documentation of Watershed Coordinator position filled	12/01/19	01/09/19
9791	4.1	Stakeholder Mtg (FY19Q2)	02/28/19	02/21/19
9792	4.1	Stakeholder Mtg (FY19Q3)	05/31/19	05/16/19
9793	4.1	Stakeholder Mtg (FY19Q4)	08/31/19	07/18/19
9794	4.1	Stakeholder Mtg (FY20Q1)	11/30/19	11/04/19
9795	4.1	Stakeholder Mtg (FY20Q2)	02/29/20	02/25/20
9796	4.1	Stakeholder Mtg (FY20Q3)	06/30/20	06/22/20
9797	4.1	Stakeholder Mtg (FY20Q4)	08/31/20	08/26/20
9798	4.2	Workshop/Outreach Event (1 of 2)	09/30/19	09/27/19
9799	4.2	Workshop/Outreach Event (2 of 2)	08/31/20	07/29/20
9809	4.3	Documentation of one watershed tour and accompanying materials developed	06/15/20	05/19/20
9808	4.3	Utility bill stuffers, brochures, and handout templates	06/15/20	04/27/20
9800	4.3	Website maintenance (FY19Q1)	12/15/18	01/09/19
9801	4.3	Website maintenance (FY19Q2)	03/15/19	03/15/19
9802	4.3	Website maintenance (FY19Q3)	06/15/19	06/17/19
9803	4.3	Website maintenance (FY19Q4)	09/15/19	09/13/19
9804	4.3	Website maintenance (FY20Q1)	12/15/19	12/13/19
9805	4.3	Website maintenance (FY20Q2)	03/15/20	03/12/20
9806	4.3	Website maintenance (FY20Q3)	06/15/20	06/11/20

ID#	Sub Task #	Deliverable	Current Due Date	Date Sent
9807	4.3	Website maintenance (FY20Q4)	09/15/20	in progress
9810	5.1	Ordinance, Code, Regulation Review and Pollutant Reduction Estimates Report	08/26/20	08/26/20
9811	5.3	Documentation of one ordinance workshop with city and county staff	08/31/20	08/26/20
9812	6.1	FY19 List of partners and associated monitoring efforts	08/31/19	08/27/19
9813	6.1	FY20 List of partners and associated monitoring efforts	06/01/20	06/01/20
9814	6.2	FY19 Compilation of acquired data posted on website	08/31/19	08/13/19
9815	6.2	FY20 Compilation of acquired data posted on website	06/01/20	06/01/20
9816	6.3	FY19 Annual Water Quality Data Summary and Analysis Report	08/31/19	N/A
9817	6.3	FY20 Annual Water Quality Data Summary and Analysis Report	06/08/20	06/08/20
9818	7.1	Draft Final Report	06/01/20	06/01/20
9819	7.1	Final Report	08/07/20	08/06/20

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