# Best Management Practices Post Construction Report

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

Report: 2020-05
**September 2020**




The Meadows Center
for Water and the Environment
Texas State University

**Authors:**

Aspen Navarro,
*Program Coordinator, The Meadows Center*

Ally Schlandt,
*Research Assistant, The Meadows Center*

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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 individuals and organizations assisted in the preparation of this report and are acknowledged for their contributions:

- The City of San Marcos
- Tom Hegemier P.E., Senior Project Manager – Doucet and Associates
- Anna Huff, Communications Manager – The Meadows Center for Water and the Environment
- Aspen Navarro, Program Coordinator – Watershed Services
- Allyson Schlandt, Research Assistant – Watershed Services

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


**Prepared by:**

*The Meadows Center for Water and the Environment, Texas State University*
Watershed Services

**Prepared for:**

*Texas Commission on Environmental Quality*

*Funding for this project was provided in part by the US Environmental Protection Agency through the Texas Commission on Environmental Quality.*

**September 2020**

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The Meadows Center
for Water and the Environment
Texas State University

601 University Drive, San Marcos Texas 78666
512.245.9200 | MeadowsCenter@txstate.edu | www.MeadowsWater.org

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# INTRODUCTION

Development in the Upper San Marcos River (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.

To alleviate the impacts on water quality as a result of increasing development and construction, two best management practice (BMP) projects were implemented in the USMR Watershed (Figure 1) throughout the grant contract period from 2018-2020. 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 two BMP projects include:

- Biofiltration Pond – Hutchison Pond located at Hutchison Street and CM Allen Intersection
- Erosion Control and Increased Stormwater Capacity – Hogtrap Retrofit located at Matthews Street Hillside along Sessom Dr.

Both BMP projects were completed in April of 2020 and this report summarizes the characteristics of each project along with their load reduction calculations.

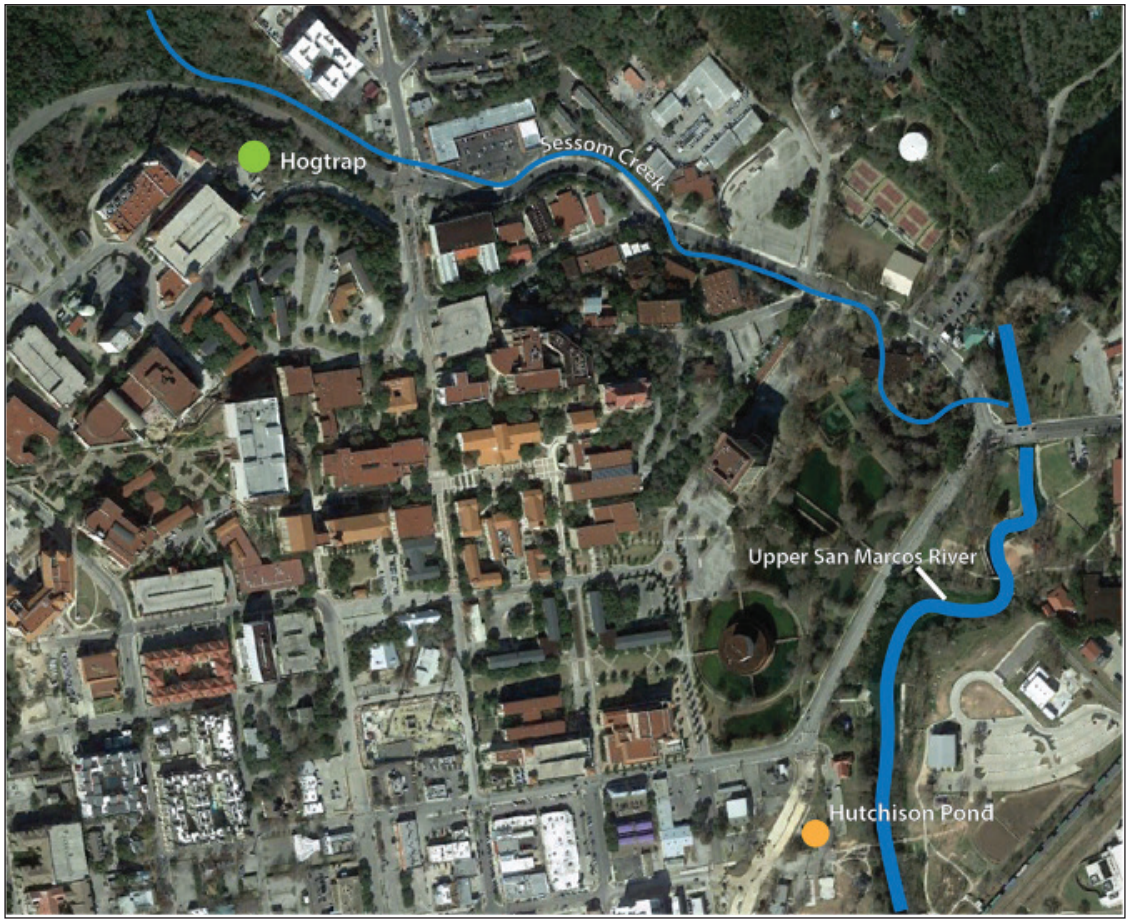


**Figure 1.** Location map of BMP projects.

# BEST MANAGEMENT PRACTICES PROJECTS

The methodology used for calculating load reductions for both BMPs was approved in the most recently amended Quality Assurance Protect Plan (QAPP) which can be found in Appendix A.

The following provides design, image(s), cost, load reduction calculations, and other BMP specifics. The BMPs are also available to view virtually through a guided StoryMap that is available to view here.

## Biofiltration Pond

One existing biofiltration pond BMP, also known as Hutchison Pond (Figure 2), was retrofitted at Hutchison Street and CM Allen Intersection. The pond is located within the Urban Stormwater Management District, as shown in Code SMTX (Appendix B), a document that provides rules and guidelines for development within San Marcos that was adopted and approved in 2018. Section 6.1.1.4 of Code SMTX (Appendix B) states that "All temporary and permanent Best Management Practices (BMPs) required in the approved watershed protection plan must be constructed, operated, and maintained in accordance with the standards, criteria and requirements in the Section 86.531 of the San Marcos MS4 Ordinance found in Chapter 86, Article 8, Division 2 of the San Marcos City Code, the City's Stormwater Technical Manual, TCEQ Edwards Aquifer Protection Program rules and the TCEQ Technical Guidance on Best Management Practices, RG 348." (Code SMTX, 2018).

### Hutchison Pond Specifications

- **Pond dimensions:** approx. 5,500 sqft
- **Subbasin:** The USMR main stem
- **Total Cost:** $103,576.00
- **BMP Summary:** The Hutchison pond (Figure 2) is located near City Park, a popular river access point for recreational uses. The pond is one of several biofiltration areas built or retrofitted along CM Allen and Hutchison by the City of San Marcos. Being in close proximity to the main stem of the San Marcos River, it acts as a last line of defense against pollutants that are picked up from the nearby downtown square from entering the river. The pond was constructed using engineered soils and native plants that filter out pollutants from runoff and passes the treated stormwater through a pipe below the surface that eventually deposits into the San Marcos River.
- **Material Components:** The pond was constructed with engineered soils, and planted with native vegetation
- **Estimated Annual Load Reduction Calculations:**
  - 7,900 pounds of total suspended solids (TSS) managed per year
  - 17 pounds of total phosphorus (TP) managed per year
  - 67.5 pounds of total nitrogen (TN) managed per year
  - 5.35x10^12 MPNs E.coli per managed per year

See Appendix A (QAPP) for Load Reduction Calculation methodology.

**Figure 2.** The completed Hutchison Biofiltration Pond (photo courtesy of Allyson Schlandt).

## Erosion Control and Increased Stormwater Capacity

The Matthews Street "Hogtrap" (Figure 3) was another retrofit of an existing stormwater management measure that had been constructed by Texas State University but needed upgrading. The "Hogtrap" project consists of a series of pipes below the surface of a hillside, that diverted stormwater runoff from the Texas State University and deposited it into Sessom Creek, a main tributary to the USMR. The retrofit included increasing the capacity of the pipes, as well as repairing the hillside (Figure 4) which had been heavily eroded and re-enforcing it with preventative measures to prevent further erosion. Construction projects completed by Texas State University are exempt from Code SMTX rules such as Section 6.1.1.4 listed above. However, if the construction takes place within the Edwards Aquifer Recharge Zone, then they must comply to the regulations enforced by the TCEQ.

### Hogtrap Specifications

- **Drainage Area:** ~9 acres
- **Size:** approx. 250 ft.
- **Subbasin:** Sessom Creek
- **Total cost:** $326,460.561
- **BMP Summary:** The drain inlet, and hillside were constructed using concrete, reinforcing steel, geosynthetic soil stabilization textiles, and broken stone for erosion control. The Matthews Street hillside was repaired and reconstructed with erosion preventative measures. The existing stormwater pipe buried below the surface that eventually deposits into Sessom Creek was upgraded to a larger capacity to handle the stormwater runoff that accumulates from the Texas State University campus. The steep slope was rapidly eroding and conveying a large amount of sediment and associated pollutants to Sessom Creek. As noted in Figure 4 above, the project and bank treatment resolved a large area of existing erosion.
- **Material Components:**
- **Estimated Annual Load Reduction Calculations:**
    - 24.2 tons of total suspended solids (TSS) managed per year
    - 2.4 pounds of total phosphorus (TP) managed per year
    - 1.46 pounds of total nitrogen (TN) managed per year
    - 1.52x10^7 MPN E.coli managed

Per the Landmark Construction Plans, erosion width managed = 25 feet. Project length from Station 1+86 to 3+40 equals 154 feet resulting in a project area of 3,850 square feet that converts to 3,576,650 square centimeters. Clay soil weighs about 100 pounds per cubic foot. Per the equation in the approved QAPP dated November 13, 2019:

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

See Appendix C (Landmark Engineering Certification letter)

**Figure 3.** The completed Hogtrap Retrofit, showing the inlet before the piping goes below the surface. (Photo courtesy of Joey Kristoff)

**Figure 4.** View of the repaired hillside from Sessom Drive. (Photo courtesy of Joey Kristoff)

# APPENDIX A

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:

Nick Dornak
Director of Watershed Services
Texas State University
601 University Drive
San Marcos, TX 78666
512-245-6697
NickDornak@txstate.edu

**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

# APPENDIX B



**B.** Payments collected by the City shall be kept separate from other revenue of the City. Funds can only be used within the same watershed where they were collected and shall be dedicated solely to the purchase of land or construction of the following:

1. Retrofit and regional water quality Best Management Practices;
2. Regional detention and floodplain storage; or
3. Projects to increase flow conveyance.

**C.** Any development required to implement the stormwater fee or approved alternatives shall run with the land and any subsequent modification of the parcel that requires more site or building area shall require subsequent action to satisfy the stormwater management fee requirement.

### Section 6.1.1.4 Compliance with City and TCEQ Rules

**A.** All temporary and permanent Best Management Practices (BMPs) required in the approved watershed protection plan must be constructed, operated and maintained in accordance with the standards, criteria and requirements in the Section 86.531 of the San Marcos MS4 Ordinance found in Chapter 86, Article 8, Division 2 of the San Marcos City Code, the City's Stormwater Technical Manual, TCEQ Edwards Aquifer Protection Program rules and the TCEQ Technical Guidance on Best Management Practices, RG 348.

**B.** Property owners responsible for maintenance of permanent BMPs, as determined in accordance with Section 3.9.1.7, shall maintain, repair and report on such activities in accordance with the San Marcos MS4 Ordinance, Section 86.531.

**C.** The development applicant shall provide the City a copy of TCEQ's approval of the Water Pollution Abatement Plan prior to receiving a City development permit.

### Section 6.1.1.5 Calculation of Impervious Cover

**A. Submittal of a series of applications prohibited.** A person may not submit a series of applications for approval of any type of watershed protection plan for distinct sites on a single tract of property nor divide such land into smaller parcels for the purpose of increasing the impervious cover limit on the property. If the Responsible Official determines that an application involves a violation of this subsection, the Responsible Official will apply the impervious cover limitation for the entire tract of property, including those portions already developed, to the application.

**B. Computation of Impervious Cover.** The measurement of impervious cover shall be in accordance with Section 3.9.1.3 of this Development Code. Pervious cover credit will not be allowed for pervious pavements on the EARZ.

# APPENDIX C

**Landmark**
**Engineering, Inc.**

Texas Board of Professional Engineers
Firm Registration Number F-16288

January 10, 2020

Ms. Aspen Navarro, B.S.
Program Coordinator - Watershed Services
The Meadows Center for Water and the Environment - Texas State University
601 University Drive
San Marcos, Texas 78666
aspennavarro@txstate.edu

**RE: Pollution Load Calculations for Sessom Creek Stormwater Retrofit/Stream Restoration BMP (Subtask 3.2)**

I, Javier Barajas, P.E. with Landmark Engineering, Inc. certify that the Sessom Hog Trap BMP will meet the following minimum qualifications; it is located in "Reach 1" of Sessom Creek, a highest identified priority area, has significant pollution loading from stormwater, excellent visibility and accessibility and a contributing drainage area greater than one acre. In summary, pollutant mitigation/management rates calculated are as follow:

- TSS (Total Suspended Solids) Load Reduction: 435.6 Tons
- TN (Total Nitrate Nitrogen) Load Reduction: 26.3 lbs
- TP (Total Phosphorus) Load Reduction: 43.2 lbs
- E. coli Load Reduction: 273,820,720.7 MPN

Calculations performed were per *Amendment #1 to the Upper San Marcos Watershed Protection Plan (WPP), Implementation Quality Assurance Project Plan (QAPP), Federal Grant ID #99614622; EPA Q-TRAK #19-362* approved by the Texas Commission on Environmental Quality (TCEQ) on November 3, 2019. The unknown is the time that it has taken for this area to be eroded. The totals above need to be divided by the years that the erosion/loading issue has been occurring in order of determining an approximate yearly rate of any future potential pollution mitigation.

Based on aerial information, it appears that the Sessom Hog Trap BMP was put in-place between the year 2001 and 2002; therefore, assuming constant yearly loading rates for the overall rates calculated above per the site and as found in current conditions and using the year 2002 as the starting year, future yearly loading removal rates would be generally as follow:

- TSS (Total Suspended Solids) Load Reduction: 24.2 Tons
- TN (Total Nitrate Nitrogen) Load Reduction: 1.46 lbs
- TP (Total Phosphorus) Load Reduction: 2.4 lbs
- E. coli Load Reduction: 15,212,262.3 MPN

5811 Blue Bluff Road, Austin, Texas 78724
Ph (512) 913-5080 · Fax (512) 628-3528

Please feel free to contact me should you have any questions or need additional information. I may be reached by phone at (512) 913-5080 or by email at jbarajas@landmarkces.com.

Sincerely,


Javier Barajas, P.E.

Attachments: Calculations and Supporting information

LE
Inc.




The Meadows Center
for Water and the Environment
Texas State University

601 University Drive, San Marcos Texas 78666
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