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# Flood Management Evaluation Memorandum

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TO: Lauren Graber  
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DATE: April 12, 2023

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PROJECT: LCRA Contract No. 5809  
Halff AVO 43796.001

SUBJECT: **FME ID: 101000027**  
**Project Sponsor: Bastrop County**  
**Project Name: FM 812 at Little Alum Creek**

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On September 15, 2022, the Lower Colorado-Lavaca Regional Flood Planning Group (RFPG) approved the evaluation of this Flood Management Evaluation (FME) to identify, evaluate and recommend additional potentially feasible Flood Mitigation Projects (FMP).

## Introduction

Bastrop County identified FM 812 crossing Little Alum Creek as high importance to increase the level of service and provide safe access to residential areas to use as their primary ingress and egress. To advance the project from an FME to an FMP additional work is required to meet the Texas Water Development Board (TWDB) FMP requirements. Items needed to advance the project to an FMP include updating the H&H analysis to incorporate Atlas 14 rainfall data, a no adverse impact evaluation, and updating the cost estimate. This memorandum provides an updated analysis for the FM 812 crossing Little Alum Creek and includes all required items to advance the project to an FMP.

## Project Location and History

FM 812 is located in western Bastrop County between Red Rock, TX and State Highway 21 as shown in **Figure 1**. FM 812 is a major collector roadway. Little Alum Creek crosses FM 812 through 2 – 7' x 7' box culverts. The Walnut Creek Flood Protection Planning (FPP) study, dated March 2018, identified FM 812 crossing Little Alum Creek as a potential flood mitigation project. The proposed solution from the Walnut Creek FPP watershed study was to replace the existing culverts with a bridge and channel benching to lower water surface elevations and provide a higher level of service for the road.

Shortly after the Walnut Creek FPP watershed study was completed the TWDB advanced six (6) watershed studies through the Federal Emergency Management Agency's (FEMA's) Cooperating Technical Partner (CTP) Risk Mapping, Assessment, and Planning (Risk MAP) Project for Fiscal Year 2017 (FY17). The FY 17 CTP Risk MAP Project included all watersheds within the Lower Colorado-Cummins (LCC) watershed, of which the Walnut Creek watershed is included. This CTP Risk MAP Project was completed in April 2020 and will hereafter be referred as the LCC watershed study. The LCC watershed study updated the Walnut Creek FPP watershed study using NOAA

Atlas 14 rainfall data and 2017 LiDAR terrain data. The existing FM 812 crossing Little Alum Creek was updated in the LCC watershed study, but no flood mitigation project was proposed in the LCC watershed study. However, the LCC watershed study is considered the best available data and considered existing conditions for this analysis.



**Figure 1: Study Area Location**

## Modeling Analysis

The following sections provide an overview of the data, hydrologic analysis, and hydraulic analysis used to identify the existing condition flood risk.

### Data Collection and Site Visits

Half obtained and reviewed, or performed the following items:

- Bastrop County Flood Protection Planning Study for the Walnut Creek watershed dated March 2018
- TWDB CTP Flood Risk Project Mapping Activity Statement No. 14 for the Lower Colorado-Cummins Watershed dated April 2020
- Site visit on February 9, 2023
- Ground survey completed in February 2023
- Subsurface Utility Engineering (SUE) desktop analysis conducted in February 2023
- Environmental desktop analysis conducted in March 2023

The LCC watershed study was the foundation of this updated analysis. It used the following items for its analysis:

- Terrain Data: StratMap 2017 Central Texas LiDAR
- Soils Data: 2019 Natural Resource Conservation Service (NRCS) Web Soil Survey
- Land Use Data: 2011 National Land Cover Database
- Rainfall: NOAA Atlas 14

### Hydrology

Below outlines the methodologies used for the hydrologic analysis:

- Modeling Software: HEC-HMS version 4.2
- Rainfall Data: NOAA Atlas 14, 24-hour duration, frequency storm temporal distribution
- Initial Losses: Initial and Constant loss method
- Hydrograph Approach: Snyder’s Unit Hydrograph method
- Routing: Modified Puls
- Areal Reduction: Depth-area computations using TP-40

**Table 1** below provides peak flows of Little Alum Creek at FM 812 from both the Walnut Creek FPP watershed study and LCC watershed study. The change in peak flows between the 2 watershed studies is due to the change in rainfall data from USGS rainfall to Atlas 14 rainfall.

**Table 1: Peak Flows Comparison**

River Sta	Model	2-yr	10-yr	25-yr	50-yr	100-yr
27004	FPP	840	1770	2200	2500	2900
	LCC	1050	1790	2100	2400	2700
22725	FPP	920	2600	3200	3900	4600
	LCC	1150	2600	3200	3700	4300
16099	FPP	860	2600	3300	4000	4800
	LCC	1150	2600	3300	3800	4400
15955	FM 812					
13603	FPP	880	2700	3500	4200	5100
	LCC	1150	2700	3500	4000	4700
12790	FPP	930	2800	3600	4400	5300
	LCC	1150	2800	3600	4200	4900
9059	FPP	990	3000	3900	4800	5900
	LCC	1270	3100	4000	4700	5500
2426	FPP	1000	3000	4000	5000	6100
	LCC	1290	3200	4200	5000	5800

## Hydraulics

Below outlines the methodologies used for the hydraulic analysis:

- Modeling Software: HEC-RAS version 5.0.3, 1D steady-state simulation
- Boundary Conditions: Downstream normal depth

## Existing Condition Flood Risk

### FEMA Floodplain

Little Alum Creek is a FEMA regulated stream with Zone A designated floodplain on the Flood Insurance Rate Map (FIRM) Map Number 48021C0325E, dated January 19, 2006. FEMA is currently in the process of updating the Flood Insurance Study (FIS) for Bastrop County, Texas and Incorporated Areas. The preliminary FIS study, Number 48021CV000C, will become effective May 9, 2023. The preliminary FEMA FIS for Little Alum Creek is based on the LCC watershed study.

### Existing Conditions

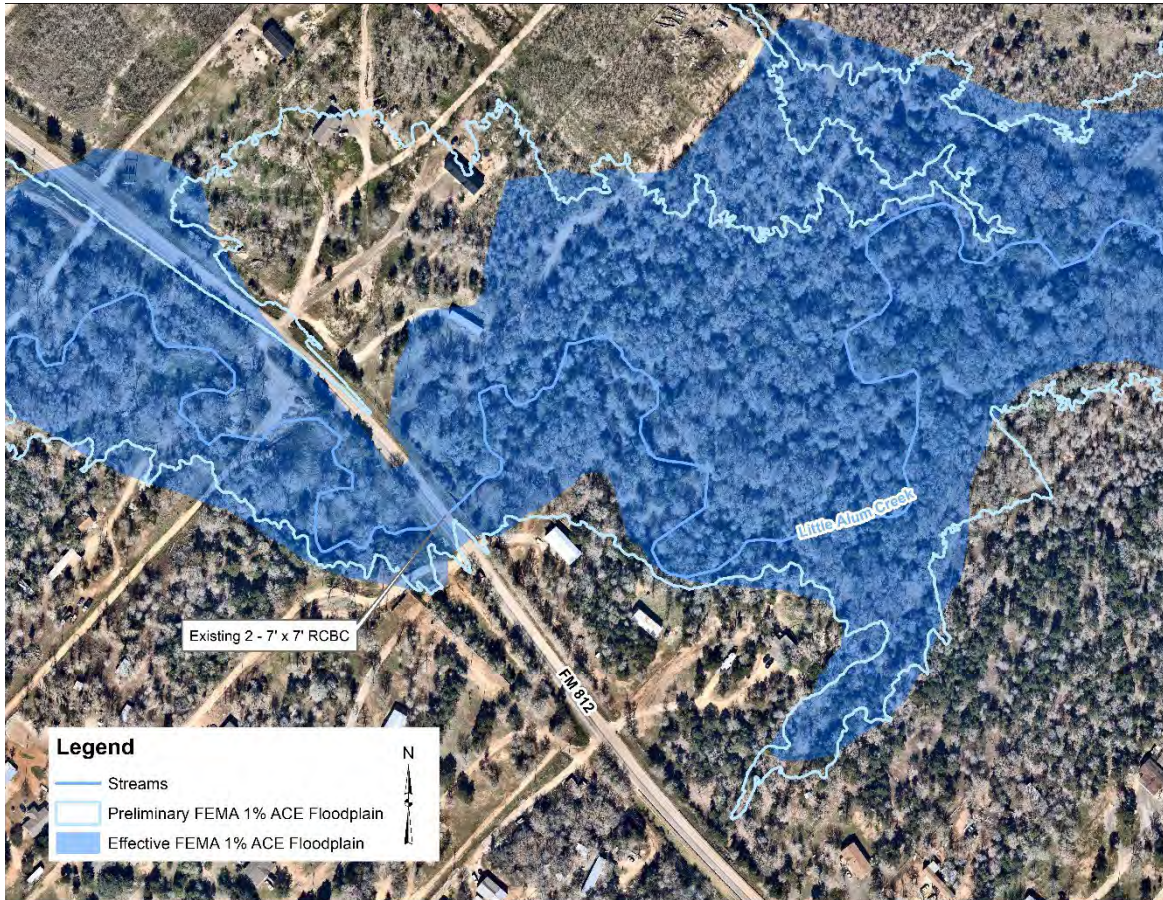
The existing structure is 2 – 7' x7' box culverts. Little Alum Creek is heavily wooded resulting in lower velocities and conveyance which cause higher water surface elevations. As a result, the crossing does not have a 2-year level of service. **Table 2** summarizes the existing roadway flood risk for FM 812. In addition to the road overtopping, there is one residential structure located near FM 812 in the FEMA effective 100-year floodplain.

**Table 2: FM 812 Existing Flood Risk**

Roadway	Existing Overtopping Depth (ft)					Level of Service
	2-yr	10-yr	25-yr	50-yr	100-yr	
FM 812	0.36	1.98	2.32	2.52	2.74	< 2-year

**Figure 2** below shows the Little Alum Creekeffective FEMA 100-year floodplain and the preliminary FEMA 100-year floodplain (effective May 9, 2023) at FM 812. Also seen in the figure is the residential structure within the effective FEMA 100-year floodplain.





**Figure 2: Existing Condition Flood Risk**

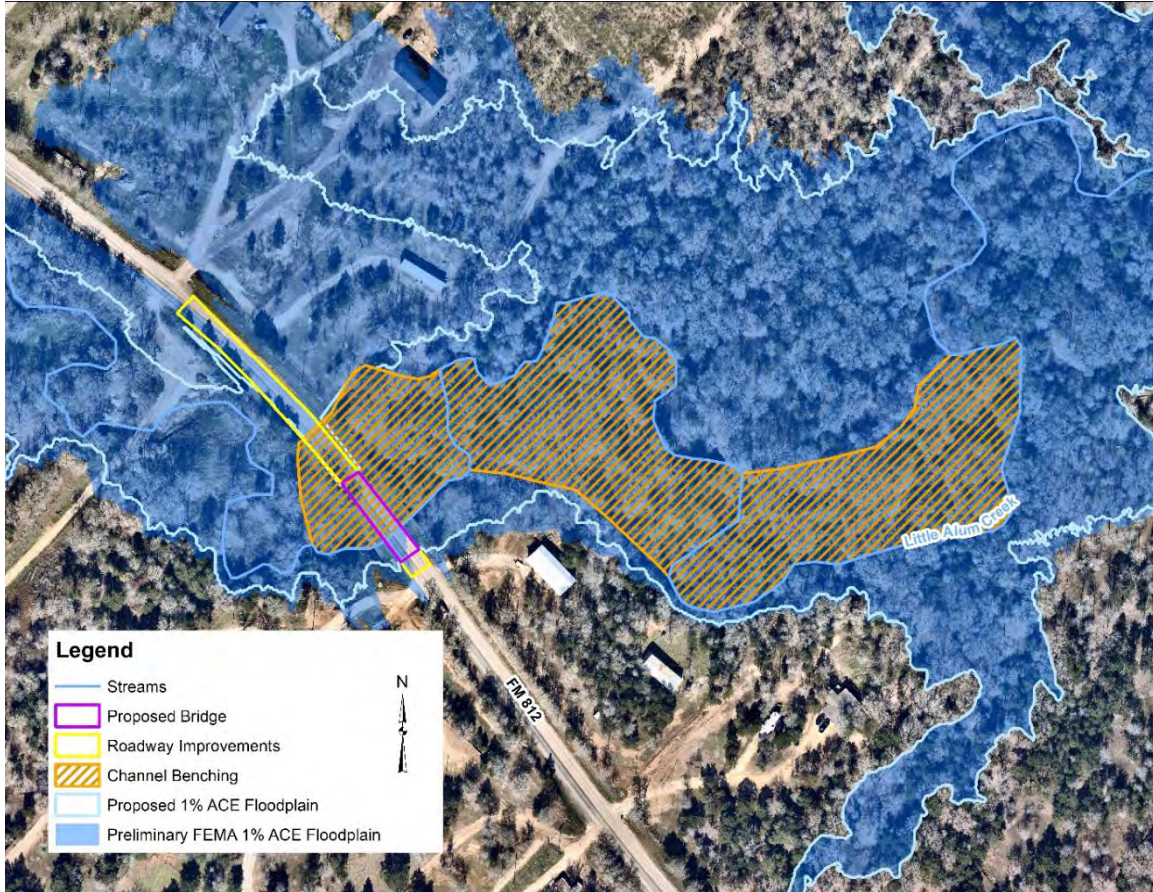
## Proposed Improvements

To provide a higher level of service changes to FM 812 and the Little Alum Creek are proposed. Proposed changes for FM 812 include raising the road approximately 2.35 feet and replacing the existing 2 – 7' x 7' box culverts with a bridge. The proposed bridge is a double span bridge with each span measuring 70' feet for a total bridge length of 140' feet.

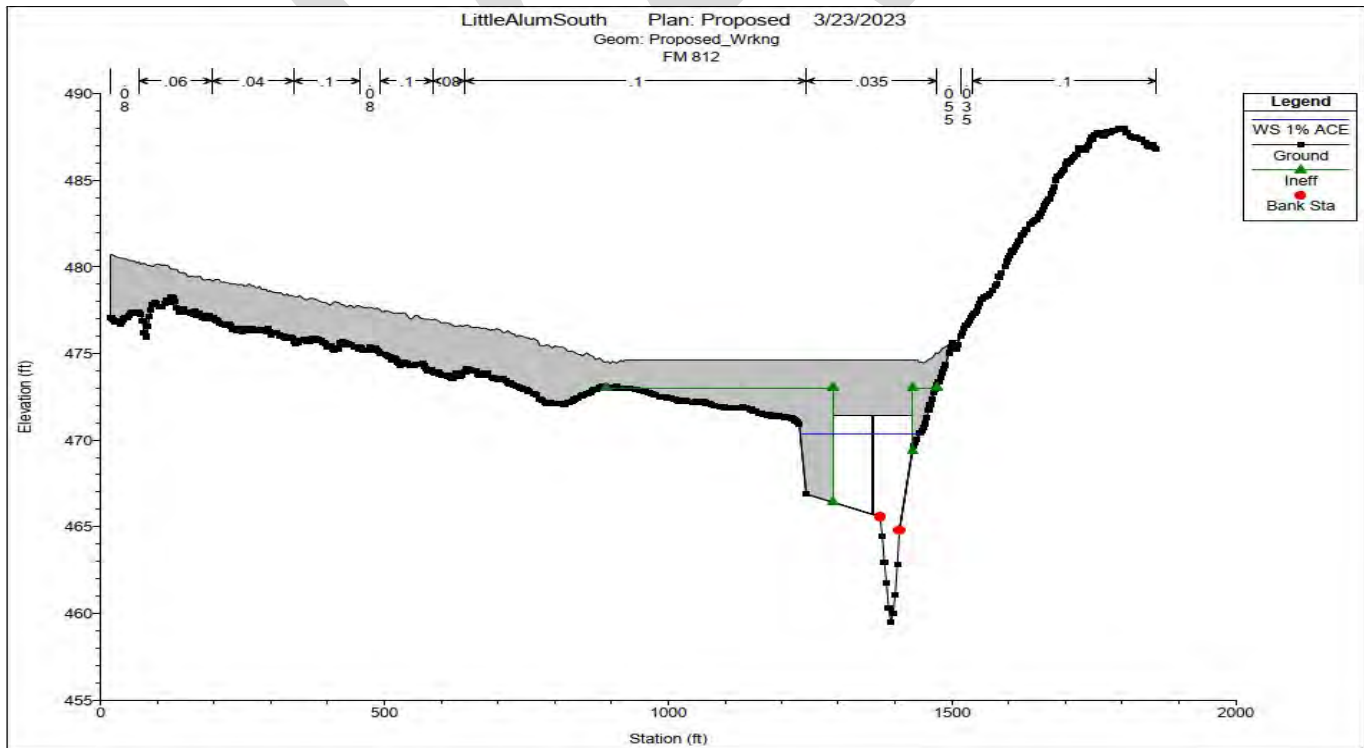
Proposed changes for Little Alum Creek include benching into the channel banks approximately 1,930 feet downstream of the road, through the proposed bridge, and approximately 70 feet upstream of the road. An ordinary high-water mark was assumed approximately 2 feet above the channel thalweg because a Waters of the United States (WOTUS) delineation has not occurred yet. The bench section has a maximum cut of 300 feet and a minimum slope of 1%. To get back to existing grade a 3:1 slope is proposed at the end of the bench cut. As a result of the channel benching there will be a larger flow area and the heavily wooded areas will be thinned resulting in lower water surface elevations downstream of the bridge to help offset losses through the bridge.

**Figure 3** shows the proposed changes for FM 812 and the channel benching extents and **Figure 4** shows a cross section of the proposed bridge with the proposed channel benching. A table summarizing the proposed project is attached to this technical memorandum as **Attachment 1**.





**Figure 3: Proposed Improvements**



**Figure 4: Bridge Cross Section**

## Project Benefits

FM 812 provides residents their primary ingress/egress. During large storm events the road is impassible for vehicle traffic. With the road impassible during large storm events residents are unable to move to safer locations and emergency vehicles must make detours, delaying response times for emergency needs. Providing a higher level of service for the roadway will allow residents and emergency vehicles a safe travel route during large storm events. Additionally, the residential structure located within the effective FEMA 100-year floodplain near FM 812 is not in the proposed 100-year floodplain. **Table 3** provides a summary of the risk reduction benefits.

**Table 3: Risk Reduction Benefits**

Flood Risk Condition	Number of At-Risk Buildings	Number of At-Risk Critical Facilities	Number of At-Risk Roadway Crossings (low water crossings)	Estimated At-Risk Daytime Population (based on building populations)	Impacted Agricultural Land (square miles of at-risk land cover)
Existing Condition 1% Annual Chance (100-year)	1	N/A	1	N/A	N/A
Post-Project Condition 1% Annual Chance (100-year)	0	N/A	0	N/A	N/A

For every FMP the TWDB requires Table 16 from their technical guidance and a project details table be filled out. These tables are attached to this technical memorandum as **Attachment 1**.

## Estimate of Probable Cost

An opinion of probable cost was prepared for the proposed project. The cost estimate includes construction and soft costs (engineering, permitting, O&M, etc.). Local and regional Texas Department of Transportation (TxDOT) average bid unit costs provided a basis for estimating unit costs for construction items. A percentage of the construction costs was applied for each soft cost item. A 30% contingency was applied to the project subtotal to account for uncertainties in the conceptual design development. The total project cost is estimated at \$8,288,617. The cost estimate is provided in **Attachment 2**.

## Project Constraints

Potential constraints including environmental constraints, utility conflicts, and drainage easements for the proposed project were evaluated.

### Environmental Constraints

A desktop level environmental constraints analysis was performed for the proposed project. The analysis included water resources, biological resources, and cultural resources assessments. A report was prepared discussing the findings of the analysis and is included as **Attachment 3**. Below summarizes the environmental constraints.

### Water Resources

The proposed project is located within a regulated FEMA Zone A, 100-year floodplain. FEMA CLOMR and LOMR permits are required for changes to the channel or structures crossing the channel. In addition to coordinating

with FEMA, coordination with the local floodplain administrator is required to comply with local floodplain ordinances.

The United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) and the United States Geological Survey (USGS) National Hydrology Dataset (NHD) show surface waters features within the study area including one freshwater forested/shrub wetland and one riverine feature (Little Alum Creek). A site survey by a qualified environmental scientist is required to delineate WOTUS and comply with US Army Corps of Engineers (USACE) permitting. USACE permitting procedures fall under Section 404 of the Clean Water Act (CWA). A site survey is required to determine impacts to WOTUS and if the project qualifies for a nationwide permit or if an individual 404 permit is required.

The Texas Commission on Environmental Quality (TCEQ) 2022 Texas Integrated Report of Surface Water Quality for Clean Water Sections 305(b) and 303(d) was also reviewed. Little Alum Creek is not identified as an impaired water body; therefore, no permit with TCEQ for impaired water bodies is required.

### *Biological Resources*

The USFWS Information for Planning and Consultation (IPaC) report includes eleven (11) federally listed threatened or endangered species that should be considered in a Threatened and Endangered (T&E) species effects analysis. There were no USFWS designated critical habitats located within the study area.

The Texas Parks and Wildlife (TPWD) Rare, Threatened, and Endangered Species of Texas (RTEST) list for Bastrop County includes sixty-five (65) state listed species or species of greatest conservation need. A Texas Natural Diversity Database (TXNDD) search did not identify records of sightings of rare or endangered species within two (2) miles of the project area.

A biological resources on-site evaluation conducted by a qualified biologist is recommended to field verify any potential effects and impacts to federal or state protected species.

The proposed project is not located within any TPWDs Wildlife Management Areas (WMAs). Therefore, no further permitting is required for TPWD WMAs.

A review of the US Department of Agriculture (USDA) National Resource Conservation Services (NRCSs) Web Soil Survey revealed the proposed project is not within prime farmland or farmland of statewide importance. Therefore, no further permitting is required with the USDA.

### *Cultural Resources*

The project falls under purview of the Antiquities Code of Texas (ACT) (Title 9, Chapter 191 of the Texas Natural Resources Code) requiring the Texas Historical Commission (THC) to review actions that have the potential to impact archeological historic properties within the public domain. A review of the THC Atlas records indicated no archeological historic properties, National Register of Historic Places (NRHP) properties/districts, State Antiquities Landmarks (SALs), cemeteries, or Official Texas Historical Markers (OTHMs) within the vicinity of the proposed project. Additionally, there are no known cultural resource surveys previously done in the area and no archeological historic properties that have been documented within the vicinity of the proposed project. Although there are no known cultural resources near the proposed project, an ACT permit application and coordination with THC are required.



### Utility Conflicts

A QL D level subsurface utility analysis was conducted to determine utilities in the project area. Only one utility, AT&T, was identified within the proposed project boundaries. AT&T shows a buried cable running along the FM 812 and downstream of the road. During the design process coordination with AT&T is required to determine if protecting or relocating the cable is required. Although no other utilities were discovered during this preliminary phase, during design confirmation of additional utilities is recommended.

### Drainage Easement

To maintain the proposed channel benching, a drainage easement is required. A drainage easement will allow Bastrop County to perform needed maintenance to ensure the channel benching functions as designed. The easement should extend the entire limits of the benching. During design, more detailed extents of the easement will need to be determined. A meets and bounds legal description and sketch of the easement should be prepared.

### Texas Department of Transportation

FM 812 is identified as a major collector for Texas Department of Transportation (TxDOT) and considered an on-system road. Coordination with TxDOT is required for any changes to the roadway.

### Benefit Cost Analysis

The TWDB Benefit Tool Kit was used to determine the Benefit Cost Analysis (BCA) for the FM 812 at Little Alum Creek project. Traffic counts were taken from the TxDOT TPP Statewide Annual Average Daily Traffic (AADT). To determine damages, the 10-, 25-, and 100-year storm events were used to estimate expected damages for residential structures. As the project advances, unknown data not included in this BCA can be obtained to refine the BCA. The known available data was entered into the TPWD Benefit Tool Kit to determine a preliminary benefit cost ratio of 0.0. See **Attachment 2** for the data inputs for the Benefit Cost Analysis (BCA).

## No Negative Impact

In accordance with the *TWDB Technical Guidelines for Regional Flood Planning*, “No Negative Impact means that a project will not increase flood risk of surrounding properties. Using best available data, the increase in flood risk must be measured by the 1 percent annual chance event water surface elevation and peak discharge. It is recommended that no rise in water surface elevation or discharge should be permissible, and that the analysis extent must be vast enough to prove proposed project conditions are equal to or less than the existing conditions.”

The preliminary modeling confirms the following:

- Stormwater does not increase inundation in areas beyond the public right-of-way, project property, or easement.
- Stormwater does not increase inundation of storm drainage networks, channels, and roadways beyond design capacity.
- Maximum increase of 1D Water Surface Elevation rounds to 0.0 feet (< 0.05ft) measured along the hydraulic cross-section within the right-of-way.

This memorandum is prepared to serve as certification of no negative impact for the FM 812 at Little Alum Creek flood mitigation project. As the project is advanced, the impact analysis should be updated to reflect final design and confirm no negative impacts.

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## Technical Memorandum Attachments

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**Attachment 1.** TWDB-Required Tables

- Table 16: Recommended Flood Mitigation Projects
- Geodatabase Table: Project Details

**Attachment 2.** Flood Mitigation Project

- FMP Summary Sheet
- Cost Estimate
- Benefit Cost Ratio

**Attachment 3.** Environmental Constraints Report

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# Attachment 1

## TWDB-Required Tables



# Attachment 2

## Flood Mitigation Project

# Flood Mitigation Project (FMP)

Title				ID#		Commitment	Yes	No
	Sponsor (note if City or County)	Yes	No	RFPG recommend	Yes			
Technical committee recommend	Yes	No	RFPG recommend	Yes	No			

## Project Type

### STRUCTURAL

Detention    
  Channel modification    
  Bridge/culvert    
  Storm drain    
  Levee/floodwall

Other

### NON-STRUCTURAL

Property buyouts    
  Floodproofing    
  Flood readiness/resilience    
  Flood warning system/gauges

Other

## Problem Area

City \_\_\_\_\_ County \_\_\_\_\_

Watershed name(s) \_\_\_\_\_

Tributary(ies) \_\_\_\_\_

HUC#(s) \_\_\_\_\_ Stream miles (est.) \_\_\_\_\_

Drainage area: square miles, est \_\_\_\_\_ or acreage, est \_\_\_\_\_

Social Vulnerability Index (SVI)  
(SVI score 0.0 indicates least vulnerable; 1.0 indicates most vulnerable.)

Other \_\_\_\_\_



## Flood Risk Description

Proposed level-of-service \_\_\_\_\_ Status \_\_\_\_\_ Atlas 14 rainfall used

## Project Description

## Related Goal(s)

## Estimated Project Cost

Capital cost \_\_\_\_\_ Ongoing O&M costs \_\_\_\_\_ Cost/benefit analysis \_\_\_\_\_

Potential funding source(s) \_\_\_\_\_

**Project:** FM 812 at Little Alum Creek  
**Stream:** Little Alum Creek  
**Engineer's Estimate of Probable Construction Cost**  
**Date:** April 7, 2023



PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QTY	TOTALS
<b>BENCHING COSTS</b>					
1	PREPARING ROW	AC	\$40,000	10	\$400,000
2	EXCAVATION (CHANNEL)	CY	\$25	75,379	\$1,884,467
3	PERMANENT EROSION CONTROL	SY	\$20	48,400	\$968,000
<b>BENCHING SUBTOTAL</b>					<b>\$3,252,467</b>
<b>BRIDGE COSTS</b>					
4	EXCAVATION (ROADWAY)	CY	\$41	120	\$4,920
5	RIPRAP (STONE PROTECTION)(D <sub>50</sub> =18 IN)	CY	\$223	435	\$97,175
6	BRIDGE (PLAN VIEW)	SF	\$150	3,900	\$585,000
7	RAIL	LF	\$180	200	\$36,000
8	REMOV STR (WINGWALL)	EA	\$2,202	2	\$4,404
9	REMOV STR (BOX CULVERT)	LF	\$200	142	\$28,400
10	EMBANKMENT (FINAL)(DENS CONT)(TY C)	CY	\$45	187	\$8,415
11	FL BS (CMP IN PLACE)(TY A GR 1-2)(8")	SY	\$20	1,490	\$29,800
12	D-GR HMA(SQ) TY-C PG64-22	TON	\$223	160	\$35,680
<b>BRIDGE SUBTOTAL</b>					<b>\$829,794</b>
<b>Unit Total</b>					<b>\$4,082,261.42</b>
13	MOBILIZATION		10%		\$408,200
14	TEMPORARY EROSION CONTROL		2%		\$81,600
15	UTILITY RELOCATION		5%		\$366,700
16	TRAFFIC CONTROL		2%		\$81,600
<b>PROJECT SUBTOTAL</b>					<b>\$5,020,361</b>
<b>30% CONTINGENCY</b>					<b>\$1,506,108</b>
<b>BASE TOTAL</b>					<b>\$6,526,470</b>
17	ENVIRONMENTAL PERMITTING		2%		\$130,529
18	ENGINEERING DESIGN & GEOTECH		15%		\$978,970
19	CONSTRUCTION SERVICES & TESTING		10%		\$652,647
<b>PROJECT TOTAL</b>					<b>\$8,288,617</b>

This statement was prepared utilizing standard cost estimate practices. It is understood and agreed that this is an estimate only, and that Engineer shall not be held liable to Owner or third party for any failure to accurately estimate the cost of the project, or any part thereof. Unit prices are in current dollars and should be adjusted as required when letting schedule for project is determined.



Project Name

[Project Region](#)

Project Type

Start Construction Year

End Construction Year

**Input up to 3 Recurrence Intervals for which you have water level (H&H) data.**

**At least 1 Recurrence Interval must be the 100-year storm.**

**Recurrence Intervals must be input in decreasing order of likelihood (i.e., 50-year storm before 100-year storm).**

Recurrence Interval 1

Recurrence Interval 2

Recurrence Interval 3

**Types of Project Impacts**

Residential Structure Damage Reduction	<input type="text" value="No"/>
Commercial Structure Damage Reduction	<input type="text" value="No"/>
Critical Facility (Police, Fire, Hospital) Loss of Function Reduction	<input type="text" value="No"/>
Reduction in Street Flooding	<input type="text" value="Yes"/>
Utility Outage Reduction	<input type="text" value="No"/>
Agricultural Damage Reduction	<input type="text" value="No"/>
Water Supply Benefits	<input type="text" value="No"/>
Recreation Benefits	<input type="text" value="No"/>

Input water levels and detour information in the 'Flooded Streets' sheet; Damage totals will be shown in 'Total Impacts'

Does this project include Green Infrastructure elements?

Does this project replace a low-water crossing?

<b>Capital Cost</b>	
Right-of-Way	
Utility Relocation	\$366,700
Construction	\$7,921,917
<b>Total Capital Cost</b>	<b>\$8,288,617</b>
<b>Operations &amp; Maintenance (O&amp;M)</b>	
Baseline Annual O&M	
Project Annual O&M	
Increased Annual O&M	\$0
<b>Project Lifespan (years)</b>	

	10 - year storm		25 - year storm		100 - year storm	
	Baseline	Project	Baseline2	Project2	Baseline3	Project3
How many miles of roadway is flooded >6"?	0.088	0	0.098	0	0.111	0
How long are the roadways impassable (hours)?	1.7	0	2.05	0	2.75	0
What is the daily traffic (vehicle count) on the affected roadways?	2,265	2,265	2,265	2,265	2,265	2,265
How much mileage does the detour add to the route? (Difference between direct route and detour)	18	0	18	0	18	0
How much time (minutes) does the detour add to the route? (Difference between direct route and detour)	36	0	36	0	36	0
Normal Emergency Medical Services (EMS) response time (minutes)	23					
EMS response time during storm event	23	23	23	23	23	23
Number of households impacted by EMS delay due to flooded streets	0	0	0	0	0	0
Number of commercial buildings impacted by EMS delay due to flooded streets	0	0	0	0	0	0



Project Impacts by Recurrence Interval	10 - year storm		25 - year storm		100 - year storm	
	Baseline	Project	Baseline2	Project2	Baseline3	Project3
Residential Flood Damage	-	-	-	-	-	-
Commercial Flood Damage	-	-	-	-	-	-
Flooded Streets	\$5,852	\$0	\$7,057	\$0	\$9,467	\$0
Utility Impacts	-	-	-	-	-	-
Agricultural Losses	-	-	-	-	-	-
Low Water Crossing Damages	-	-	-	-	-	-

Flooded Structures by Recurrence Interval	10 - year storm		25 - year storm		100 - year storm	
	Baseline	Project	Baseline2	Project2	Baseline3	Project3
<b>Flooded residential structures</b>	-	-	-	-	-	-
Impacted Residents	-	-	-	-	-	-
<b>Flooded commercial structures</b>	-	-	-	-	-	-
Impacted Employees	-	-	-	-	-	-

Other Project Impacts	Benefits
Water Supply Benefits	-
Environmental Benefits	-
Residual Value of Investment	\$0
Recreational Benefits	-

Input Into BCA Toolkit		
Project Useful Life	0	
Event Damages	Baseline	Project
10 - year storm	\$5,852	\$0
25 - year storm	\$7,057	\$0
100 - year storm	\$9,467	\$0
Total Benefits from BCA Toolkit	\$9,009	
Other Benefits (Not Recreation)	\$0	
Recreation Benefits	-	
Total Costs	\$5,531,486	
Net Benefits	-\$5,522,477	
Net Benefits with Recreation	-\$5,522,477	
<b>Final BCR</b>	<b>0.0</b>	
<b>Final BCR with Recreation</b>	<b>0.0</b>	

# Attachment 3

## Environmental Constraints Report



Firm Registration No. 312

# Environmental Constraints Analysis

## FM 812 at Little Alum Creek Project

*for*

**Bastrop County, Texas**

*Prepared by*

**Halff**

**AVO 43796**

**April 2023**

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## 1. Introduction

Halff is conducting a hydrologic and hydraulic study for the proposed Farm to Market Road (FM) 812 at Little Alum Creek Project in Bastrop County, Texas. The proposed project includes a 140-foot long bridge span with 2,000 linear feet of channel benching improvements along Little Alum Creek. The study area encompasses approximately 0.4 acres, and the benching area encompasses approximately 0.2 acres (see **Appendix A - Figures 1.0 and 2.0**).

## 2. Summary of Environmental Constraints

Halff prepared this Environmental Constraints Analysis that summarizes the potential environmental constraints and permitting requirements associated with the proposed project. Reviewed data sources include Texas Parks and Wildlife Department (TPWD), U.S. Fish and Wildlife Service (USFWS), U.S. Geological Survey (USGS), and Natural Resource Conservation Service (NRCS). No site visit was conducted to assess environmental constraints.

### 2.1 AERIAL IMAGERY DESCRIPTION

Aerial imagery maps were reviewed and show undeveloped land to the east of the study area. This land may have been subject to agricultural practices. One residential neighborhood is located west of the study area adjacent to FM 812. The study area is intersected by Little Alum Creek, with undeveloped forested land along the western boundary of the study area. Land to the south of the study area is primarily residential.

### 2.2 TOPOGRAPHIC MAP DESCRIPTION

The USGS topographic map for 2022 depicts the study area as containing primarily undeveloped land, depicted as herbaceous landcover (indicated by no-or-sparse green shading), adjacent to Little Alum Creek (depicted by a dashed blue line) (see **Appendix A - Figure 3.0**). The study area also intersects one roadway, FM 812. No urban developments are shown in or around the study area.

### 2.3 WATER RESOURCES

Water resources includes surface water features (e.g., wetlands, tributaries, rivers, impoundments, and other potential waters of the United States), floodplains and groundwater features. Water resources within the study area were evaluated to identify local, state, and/or federal permitting requirements that may be associated with construction of the proposed project.

Wetlands are identified as areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Based on the review of USFWS National Wetlands Inventory (NWI) data and USGS National Hydrography Dataset (NHD) data, surface water features within the study area include one freshwater forested/shrub wetland and one riverine feature (Little Alum Creek) (see **Appendix A - Figure 4.0**).

Federal Emergency Management Agency (FEMA) floodplain data were reviewed to evaluate the location of the mapped floodplains in relation to potential aquatic resources located within the study area. According to the FEMA National Flood Hazard Layer (NFHL) dataset, a majority of the study area is located within the 1-percent annual chance flood hazard (100-year floodplain) zone. The southeastern portion of the study area is located in the area of minimal flood hazard. The FEMA NFHL Map depicts the floodplain limits within the study area (see **Appendix A - Figure 5.0**).

### 2.4 BIOLOGICAL RESOURCES

The USFWS Information for Planning and Consultation (IPaC) report for the study area includes eleven federally listed species that should be considered in an effects analysis for the project. Critical habitats are specific geographic areas that contain features essential for the conservation of a threatened or

endangered species and that may require special management and protection. There are no USFWS-designated critical habitats located within the study area.

The USFWS critical habitat mapper was reviewed March 9, 2023. The review did not identify mapped critical habitat within 2 miles of the study area. The closest mapped critical habitat is for the Houston toad (*Bufo houstonensis*) and is approximately 14 miles northeast of the study area.

The TPWD Rare, Threatened, and Endangered Species of Texas (RTEST) list for Bastrop County includes 65 species that are state listed or species of greatest conservation need. A Texas Natural Diversity Database (TXNDD) search was also conducted on March 6, 2023. The TXNDD search identified no element occurrence records (records of sightings of rare or endangered species) within 2 miles of the study area (see **Appendix A - Figure 6.0**).

USFWS and TPWD data cannot substitute for on-site evaluations conducted by qualified biologists. A field visit by a qualified biologist is recommended prior to construction to determine the potential effects and impacts to protected species.

## 2.5 GEOLOGY

Surface geology data derived from the USGS Texas Geology database were reviewed to identify rock units within the study area. One rock unit, Wilcox Group, undivided (Ewi), was identified within the study area (see **Appendix A - Figure 7.0**).

## 2.6 SOIL SURVEY

Soil data for the study area were obtained from the NRCS Web Soil Survey, which is derived from the U.S. Department of Agriculture (USDA) Soil Survey for Bastrop County, Texas. Soil units within the study area are shown atop an aerial imagery map in **Appendix A - Figure 8.0. Table 1** describes characteristics of these soil types.

Table 1: Soil Units within the Study Area

Soil Unit	Topography	Frequency of Flooding	Hydrologic Soil Group]
Sa – Sayers fine sandy loam	0-1% Slopes	Occasionally flooded	A
AfC2 – Edge fine sandy loam	2-5% Slopes	None	D

Note: Hydric soil groups are a classification system defined by NRCS in which soils are categorized into four runoff potential groups.

- Group A: High permeability, little to no runoff production.
- Group D: Low permeability, high runoff production.

## 2.7 CULTURAL RESOURCES

Because the project is being developed by the City of Bastrop, a political sub-entity of the State of Texas, the project falls under purview of the Antiquities Code of Texas (Title 9, Chapter 191 of the Texas Natural Resources Code), which requires the Texas Historical Commission (THC) to review actions that have the potential to impact archeological historic properties within the public domain.

Halff conducted desktop research to determine the potential for the project to impact archeological historic properties eligible for listing on the National Register of Historic Places (NRHP) or State Antiquities Landmark (SAL) designation. The Texas Archeological Sites Atlas (Atlas), maintained by the THC, was reviewed to determine whether any archeological historic properties, NRHP properties/districts, SALs, cemeteries, Official Texas Historical Markers (OTHMs), and previous cultural resource surveys are documented within or adjacent to the study area.

Review of THC Atlas records revealed that there are no archeological historic properties, NRHP properties/districts, SALs, cemeteries or OTHMs documented within or adjacent to the study area. In addition, the study area has not undergone previous cultural resources surveys and no archeological historic properties have been documented in the surrounding 1-kilometer vicinity.

### 3. Conclusions

Based on the assessment of potential environmental constraints within the study area, additional actions regarding potential environmental impacts may be required. These actions are included in **Appendix B**. The study area contains aquatic resources which may be regulated as waters of the United States (WOTUS) by the U.S. Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act (Section 404). Aquatic resources within the study area may be considered WOTUS to the extent of the ordinary high water mark (OHWM), and adjacent wetlands where present. To facilitate avoidance of these resources, Halff proposes to perform an on-the-ground delineation of aquatic resources within the study area in accordance with the USACE “Wetland Delineation Manual, Technical Report Y-87-1” and the “Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region (Version 2.0).” Additionally, to demonstrate compliance with the Endangered Species Act (ESA), Halff proposes to conduct a threatened and endangered species and habitat (T&E) assessment, which includes an evaluation of federal and state-listed threatened and endangered species for Bastrop County.

#### 3.1 WATER AND BIOLOGICAL RESOURCES

At a minimum, recommended additional studies include a WOTUS delineation, and a T&E assessment. The WOTUS delineation would include employing GPS surveying techniques per USACE Fort Worth District’s operating procedures to delineating the limits of potential WOTUS, including wetlands; completing necessary wetland data forms and take on-site photography for representative site features; and, preparing draft and final reports describing the methodology and results of the investigation, so that the report may satisfy the jurisdictional determination requirement for future permits, if necessary. Geographic Information System shapefiles of the field data collected will be provided with the final report. The T&E assessment would include an effects determination for species occurring within the study area. The effect determination would identify whether any listed species are likely to be present; whether the project affects or has the potential to affect federal-listed species; and Halff shall address the best management practices for avoiding impacts to other wildlife during construction, specifically migratory birds and bald and golden eagles. At this phase of project development, the preliminary cost estimate for these additional studies is \$21,000.

#### 3.1 CULTURAL RESOURCES

Based on Halff’s evaluation of the study area, future ground disturbing activity would not impact any documented cultural resources, including those listed eligible for NRHP inclusion or SAL designation. However, given that the study area has not undergone any prior cultural resources investigations, cultural resources surveys would likely be required for any proposed ground disturbing activity within the study area to comply with the Antiquities Code of Texas (ACT). In addition, if the project includes any federal funding or permitting, compliance with Section 106 of the National Historic Preservation Act would be required.

Cultural resources services would be provided when the extent of ground disturbing activities have been identified (e.g., during the project design phases). Compliance with the ACT and Section 106 will at minimum require direct coordination with the THC and submittal of an ACT permit application and scope of work to perform the cultural resources field investigations in the study area. Upon issuance of the ACT permit number assigned to the project by the THC, Halff will conduct an intensive cultural resources survey that conforms to the standards outlined by the Council of Texas Archeologists and approved by the THC. The survey will be performed by Halff archeologists who meet the U.S. Secretary of the Interior’s (SOI) Professional Qualification Standards for Archeology and Historic Preservation under the direction of an

SOI-qualified Principal Investigator. The survey may include pedestrian reconnaissance, shovel testing and mechanized trenching within the proposed study area, depending on the horizontal and vertical extents of proposed ground disturbance. For example, if proposed construction activities are greater than 3 feet in depth, mechanized trenching may be required to test for deeply-buried archeological sites. If any above-ground historic resources are identified within or adjacent to the study area, an SOI qualified historian will perform an effects assessment.

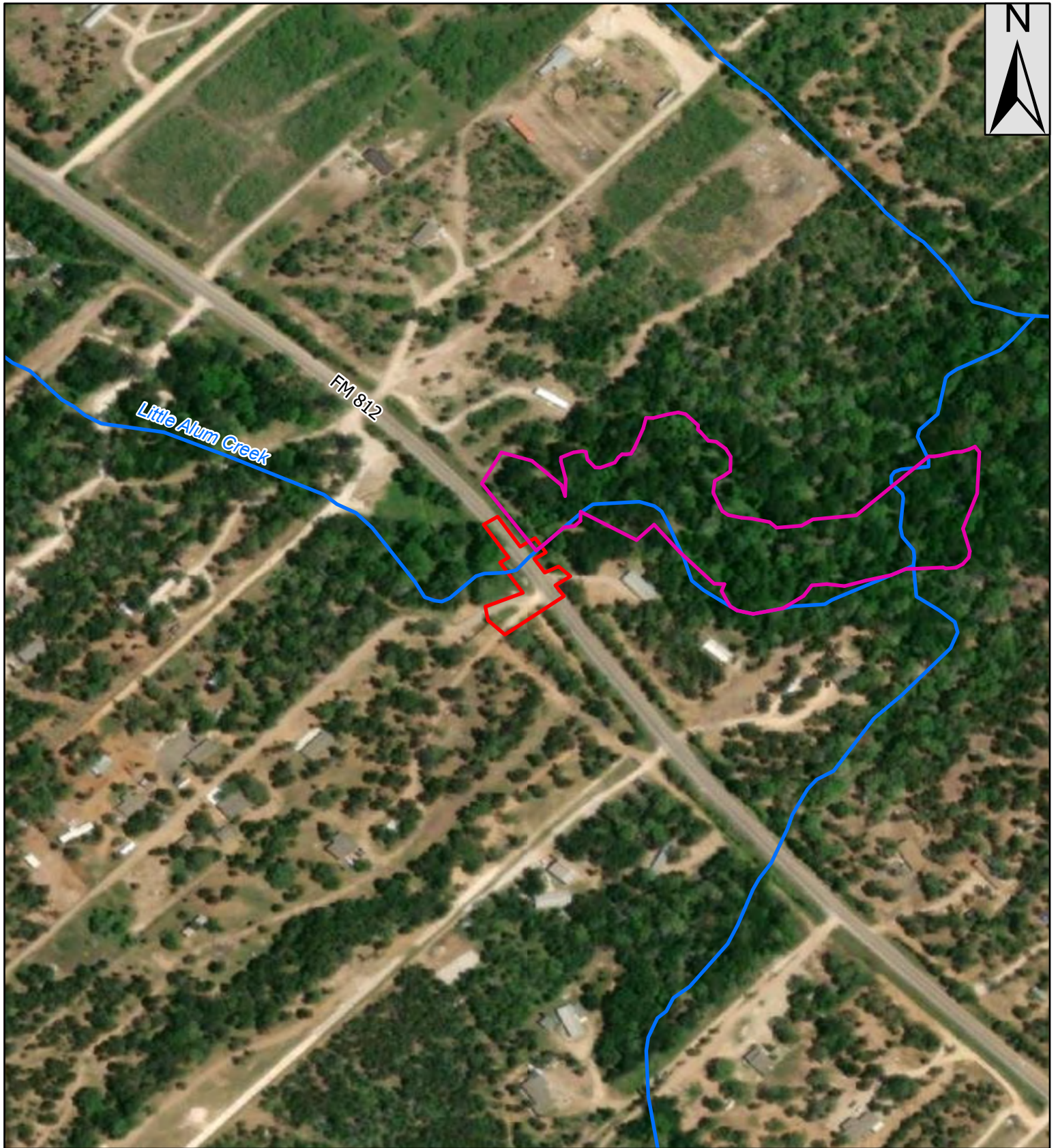
At the conclusion of the field survey, Halff will prepare and submit a draft report that conforms to the SOI Guidelines for Archaeology and Historic Preservation. The report will summarize the findings of the cultural resources survey, provide recommendations regarding any effects to archeological historic properties and determine whether additional ACT or Section 106 compliance is required. Following a period of City review, the draft report will be submitted for review by THC and all other applicable state/federal agencies as needed. After acceptance of the draft report by the THC, a final report will be submitted and all field records, photographs and collected artifacts will be prepared for permanent curation at the Center for Archaeological Studies located at Texas State University in San Marcos, Texas.

The preliminary cost estimate for the cultural resources services described above is \$18,000, which is subject to change based on the project design. The cultural resources services include the ACT permit application, archeological and historic resources surveys, survey reports and curation tasks described above. Any further ACT and Section 106 requirements, including but not limited to formal NRHP/SAL eligibility evaluations of archeological historic properties discovered in the study area, and the documentation, exhumation or repatriation of human burials discovered in the study area would be scoped separately as additional services.

## Appendix A – Figures



## Appendix B – Environmental Constraints Table



### Legend

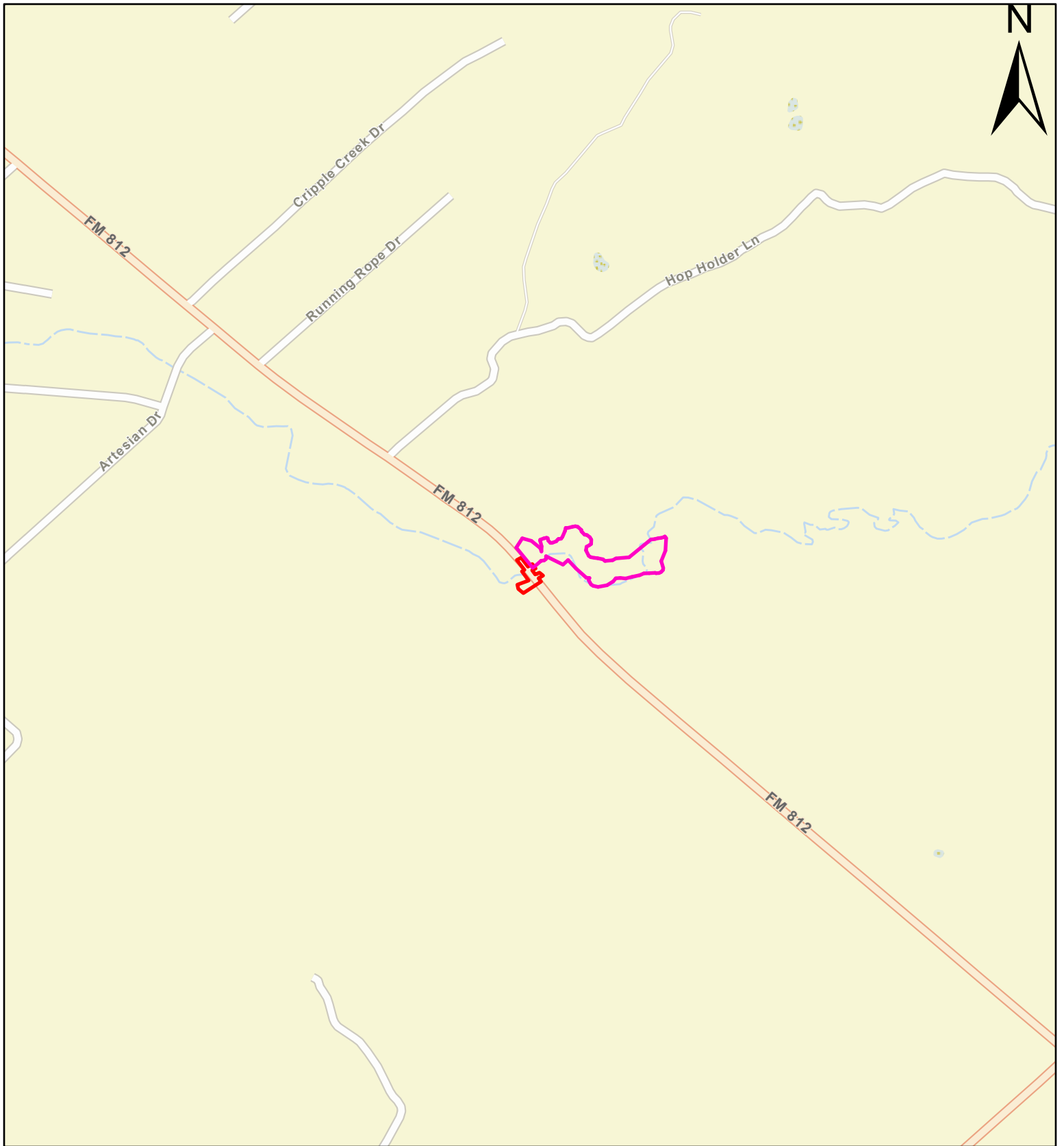
- Study Area
- Bench Area
- NHD
- Stream/River

0 150 300 600 Feet

Notes:  
 1. Map Center: 97.52611°W  
 30.01169°N  
 2. World Imagery: Maxar  
 3. USGS National Hydrography Dataset

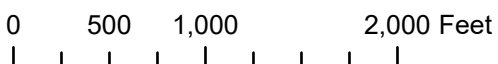
FM 812 at Little Alum Creek Project  
 Bastrop County, Texas  
 Figure 1.0 - Location Map  
 AVO: 43796  
 Date: 4/10/2023





### Legend

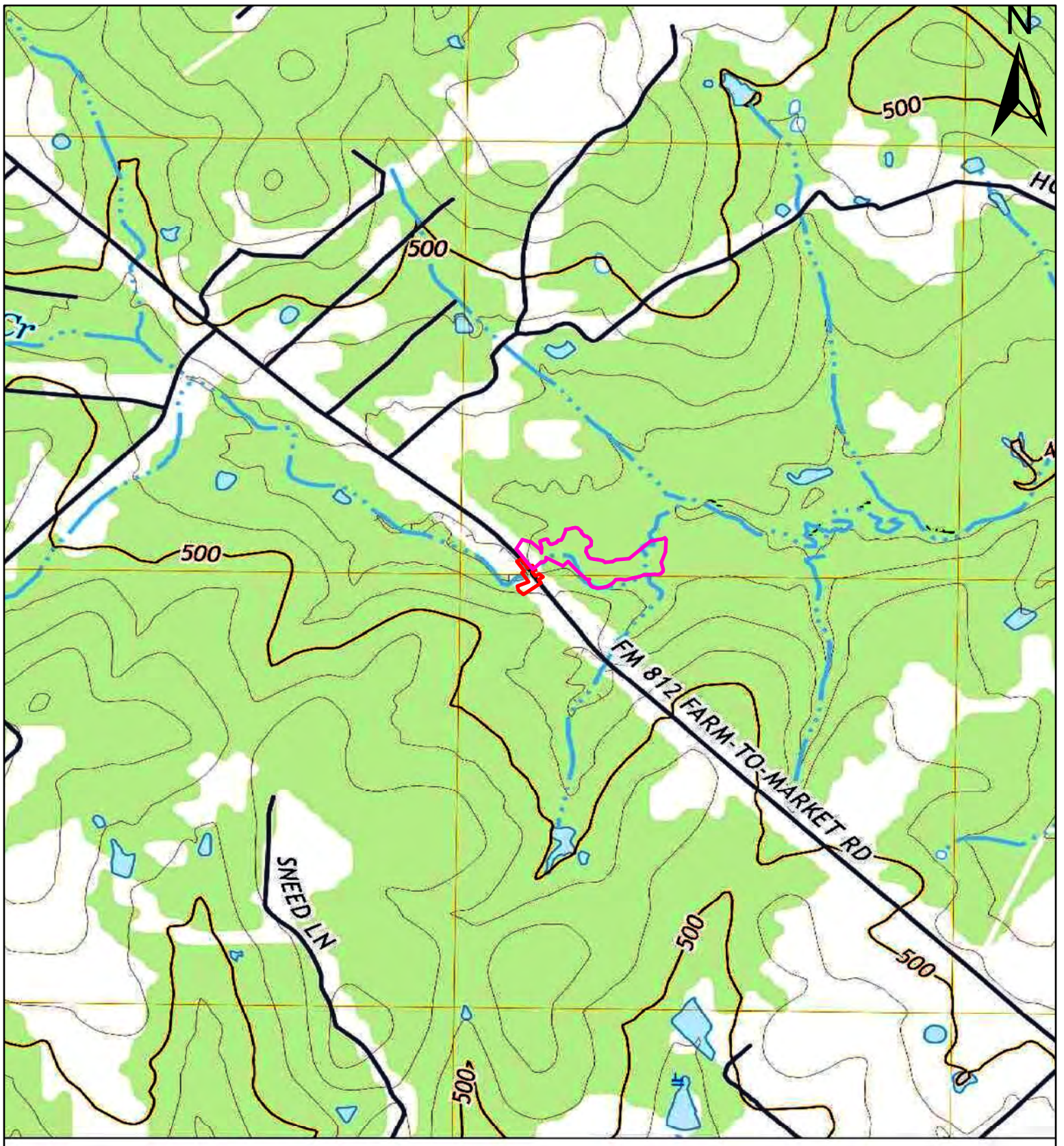
- Study Area
- Bench Area



Notes:  
 1. Map Center: 97.52611°W  
 30.0117°N  
 2. World Street Map: Esri  
 Community Maps Contributors,  
 Baylor University, City of Austin,  
 Texas Parks & Wildlife,  
 CONANP, Esri, HERE, Garmin,  
 SafeGraph, GeoTechnologies,  
 Inc, METI/NASA, USGS, EPA,  
 NPS, US Census Bureau,  
 USDA

**FM 812 at Little Alum Creek Project**  
 Bastrop County, Texas  
 Figure 2.0 - Vicinity Map  
 AVO: 43796  
 Date: 4/10/2023





### Legend

- Study Area
- Bench Area

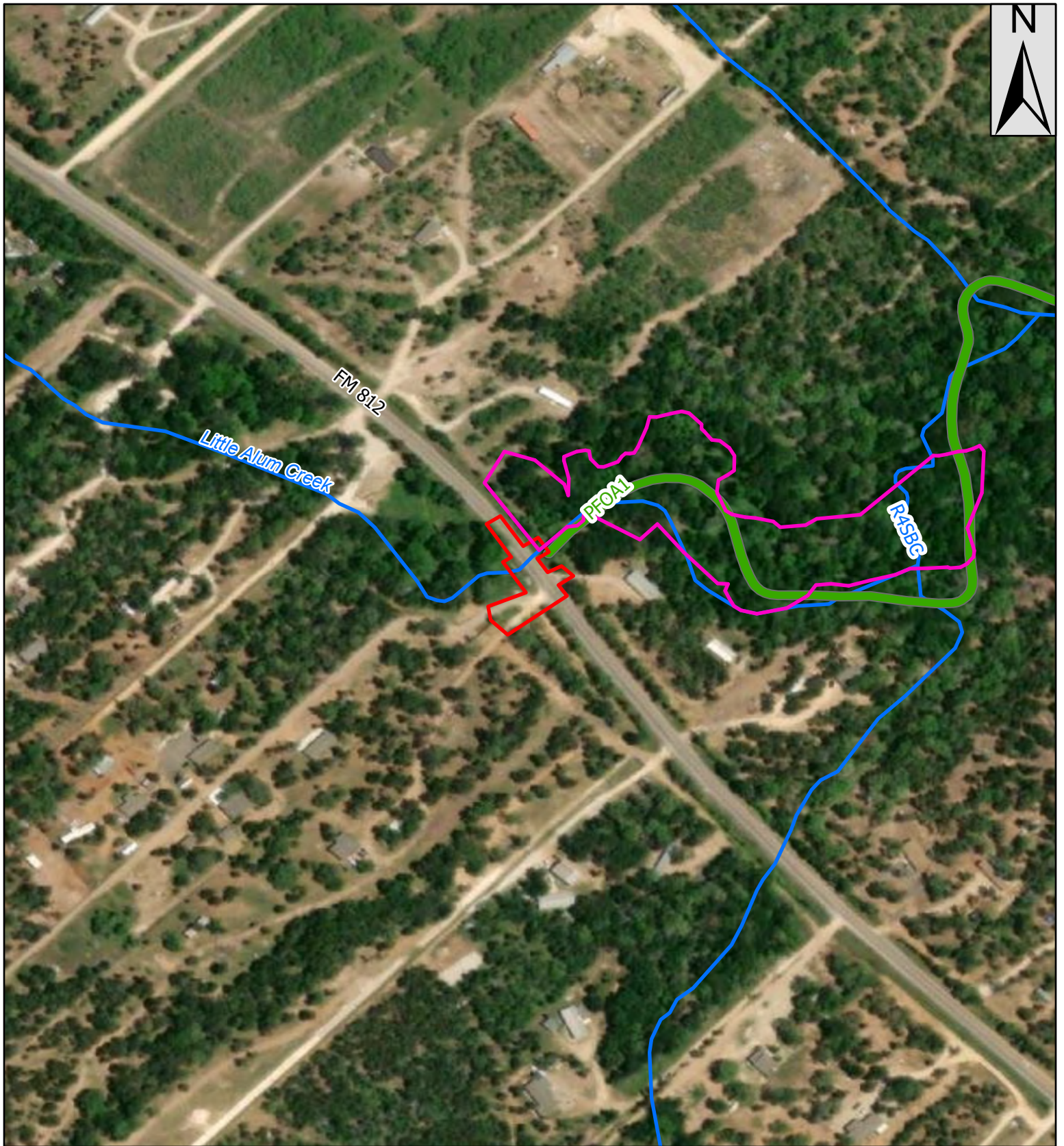
0 500 1,000 2,000 Feet

Notes:  
 1. Map Center: 97.52611°W  
 30.0117°N  
 2. topoview - "Lytton Springs,  
 Texas" USGS quadrangle,  
 2022

FM 812 at Little Alum Creek Project  
 Bastrop County, Texas  
 Figure 3.0 - 2022 USGS  
 Topographic Map  
 AVO: 43796  
 Date: 4/10/2023







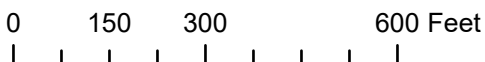
**Legend**

- ▭ Study Area
- ▭ Bench Area

**NWI**

- ▭ Freshwater Forested/Shrub Wetland

- NHD**
- Stream/River

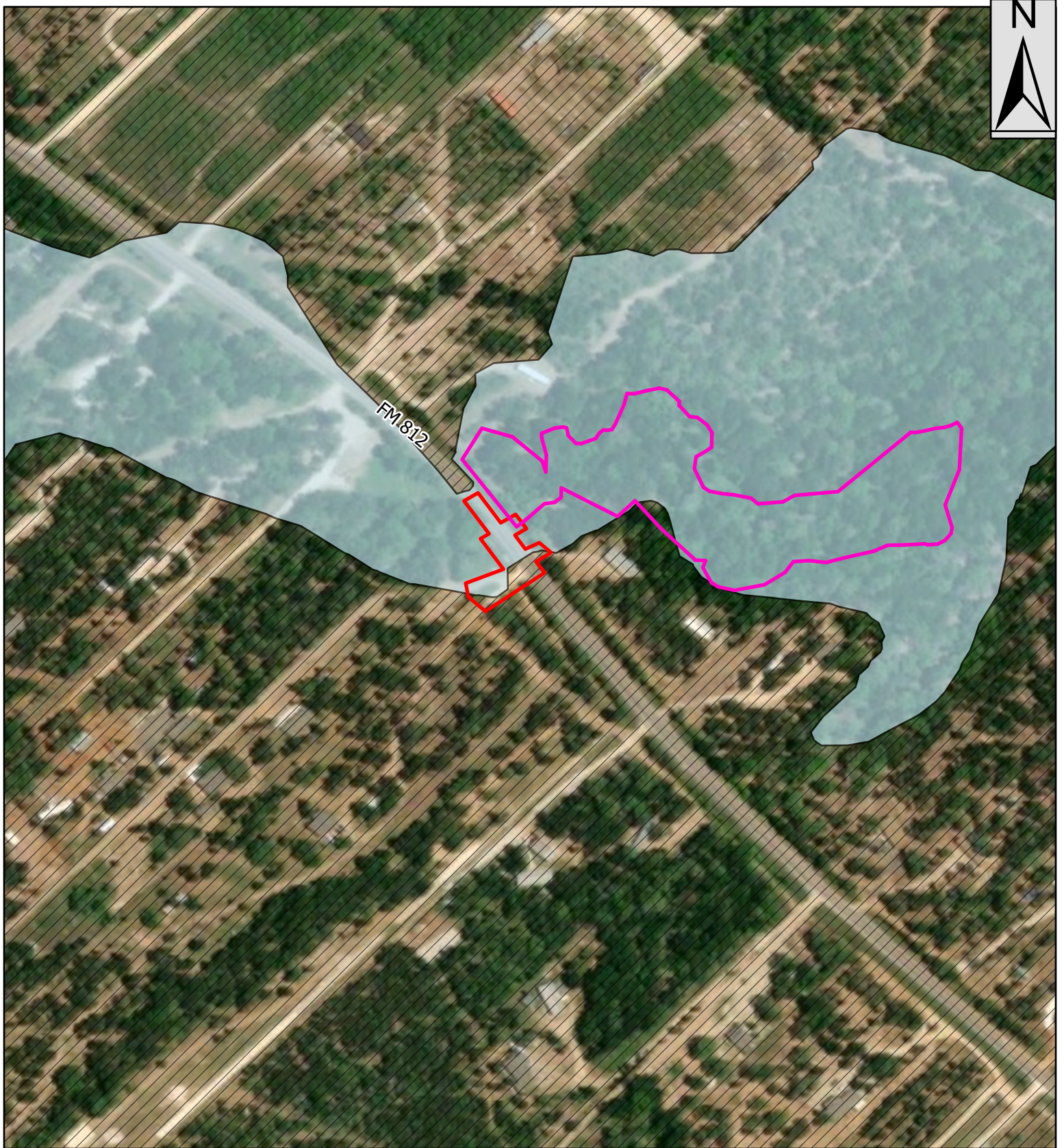


Notes:  
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 30.0117°N  
 2. World Imagery: Maxar  
 3. USFWS National Wetlands Inventory  
 4. USGS National Hydrography Dataset

FM 812 at Little Alum Creek Project  
 Bastrop County, Texas  
 Figure 4.0 - NWI/NHD Map  
 AVO: 43796  
 Date: 4/10/2023





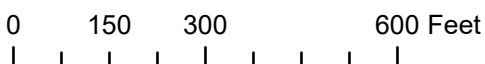


**Legend**

- Study Area
- Bench Area

**FEMA NFHL**

- 1% Annual Chance Flood Hazard
- Area of Minimal Flood Hazard



Notes:  
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 30.01154°N  
 2. World Imagery: Maxar  
 3. FEMA NHFL




FM 812 at Little Alum Creek Project  
 Bastrop County, Texas  
 Figure 5.0 - FEMA NFHL Map  
 AVO: 43796  
 Date: 4/10/2023







## Legend

-  Study Area
-  2-Mile Buffer
-  Bench Area

0 2,500 5,000 10,000 Feet

- Notes:
1. Map Center: 97.52648°W  
30.01702°N
  2. World Imagery: Earthstar  
Geographics
  3. TPWD TXNDD Element  
Occurrence
  4. USFWS Critical Habitat

FM 812 at Little Alum Creek Project  
Bastrop County, Texas  
Figure 6.0 - TPWD TXNDD Map  
AVO: 43796  
Date: 4/10/2023





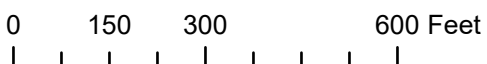


### Legend


- Study Area
- Bench Area

### USGS Rock Unit

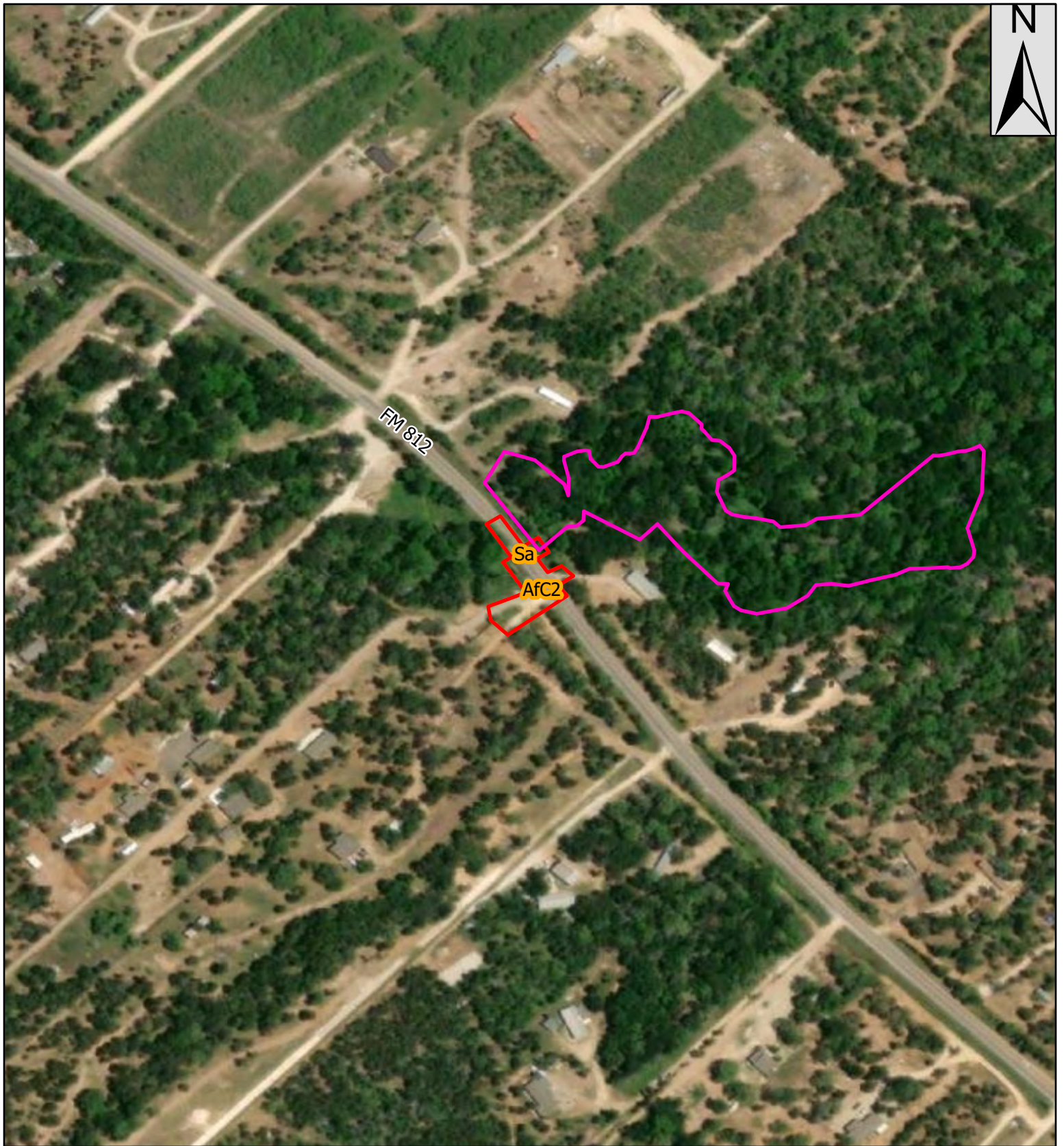
- Wilcox Group (Ewi)



Notes:  
 1. Map Center: 97.52611°W  
 30.0117°N  
 2. World Imagery: Maxar  
 3. USGS Geology of Texas

FM 812 at Little Alum Creek Project  
 Bastrop County, Texas  
 Figure 7.0 - USGS Geologic Rock  
 Unit Map  
 AVO: 43796  
 Date: 4/10/2023  




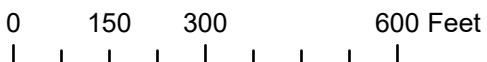


**Legend**

- ▭ Study Area
- ▭ BenchArea

**NRCS Soils**

- ▭ Edge fine sandy loam (Afc2)
- ▭ Sayers fine sandy loam (Sa)



Notes:  
 1. Map Center: 97.52611°W  
 30.0117°N  
 2. World Imagery: Maxar  
 3. USDA Web Soil Survey  
 NRCS SSURGO

FM 812 at Little Alum Creek Project  
 Bastrop County, Texas  
 Figure 8.0 - NRCS Soil Map  
 AVO: 43796  
 Date: 4/10/2023

## Environmental Constraints Table

Resource / Regulating Entity (or Policy)	Database Review	Database Findings	Applicable Regulations & Following Steps
<b>Water Resources</b>			
Jurisdictional Waters of the U.S. / U.S. Army Corps of Engineers (USACE), Section 404 of the Clean Water Act (CWA)	Data from the National Hydrography Dataset, The USFWS National Wetland Inventory (NWI), and aerial imagery data were reviewed to identify mapped surface waters and wetlands within the study area. The database review is utilized only as a general guide to the potential location of aquatic resources and does not substitute for site surveys to identify and delineate streams and wetlands regulated under Section 404.	NHD data shows Little Alum Creek within the study area. The study area contains NWI-mapped wetlands.	<ul style="list-style-type: none"> <li>The USACE regulates activities within jurisdictional waters, such as streams, rivers and lakes.</li> <li>Conduct a site survey to identify any USACE regulated water features and delineate boundaries.</li> <li>Follow USACE permitting procedures under Section 404 of the CWA, if applicable.</li> <li>Depending on the nature of activity, activities that result in the placement of fill within waters of the U.S. under ½-acre or below 300 linear feet are generally authorized under a nationwide permit. A pre-construction notification and compensatory mitigation may be required. Impacts to waters of the U.S. above these thresholds may require an individual permit.</li> </ul>
Floodplains / Federal Emergency Management Agency (FEMA)	Digital data derived from FEMA Flood Insurance Rate Maps were reviewed.	Portions of the study area are located within the 100-year floodplain (Zones A, AE or X).	<ul style="list-style-type: none"> <li>Comply with FEMA floodplain regulations and local ordinances, and coordinate with the local floodplain administrator.</li> <li>If federal funding is utilized, comply with Executive Order (EO) 11988.</li> </ul>



## Environmental Constraints Table

Resource / Regulating Entity (or Policy)	Database Review	Database Findings	Applicable Regulations & Following Steps
Impaired Assessment Units / TCEQ, Section 303(d) of the CWA	The 2022 Texas Integrated Report – Texas 303(d) List was reviewed in conjunction with TCEQ geospatial data to determine if any impaired assessment units occur within the study area.	No impaired assessment units occur within the study area.	No applicable regulations or following steps.
<b>Biological Resources</b>			
Protected Species / USFWS	A USFWS Information for Planning and Consultation (IPaC) was generated for Bastrop County.	According to data in the IPaC report, four bird species, two amphibian species, one insect species, three arachnid species, and one plant species are federally listed as either threatened or endangered in Bastrop County. One insect species is as a candidate for listing, and four clam species are proposed threatened or endangered.	<ul style="list-style-type: none"> <li>The Endangered Species Act regulates for the protection of habitat and species.</li> <li>Based on the report findings and a review of aerial photography, the study area has the potential to contain habitat for listed species.</li> <li>A site visit, conducted by a qualified biologist, should occur to determine if habitat for listed species is present within the study area.</li> </ul>
Critical Habitat / USFWS	The USFWS Critical Habitat for Threatened & Endangered Species online mapper was reviewed.	No mapped critical habitat is located within the study area.	No applicable regulations or following steps.

## Environmental Constraints Table

Resource / Regulating Entity (or Policy)	Database Review	Database Findings	Applicable Regulations & Following Steps
Rare, Threatened, and Endangered Species of Texas (RTEST) / TPWD	The TPWD's RTEST by County lists were reviewed for Bastrop County. TPWD's Texas Natural Diversity Database data were obtained for the study area.	<p>There are 65 species listed on TPWD's RTEST list for Bastrop County that include the following: Amphibians (5), birds (13), crustaceans (1), fish (5), insects (7), mammals (13), mollusks (2), reptiles (9), plants (10).</p> <p>No TXNDD element occurrence records are located within 2 miles of the study area.</p>	<ul style="list-style-type: none"> <li>• The Texas Parks and Wildlife (TPW) Code and Texas Administrative Code (TAC) protect state-listed species and prohibit take of state-listed species. Comply with TPW Code and the TAC for laws and regulations pertaining to endangered or threatened species.</li> <li>• Based on the report findings and a review of aerial photography, the study area has the potential to contain habitat for listed species.</li> <li>• A site visit, conducted by a qualified biologist, should occur to determine if habitat for listed species is present within the study area.</li> </ul>
Wildlife Management Areas / TPWD	The TPWD's wildlife management areas (WMAs) were reviewed.	No WMAs occur within the study area.	No applicable regulations or following steps.
Farmland / Natural Resources Conservation Service (NRCS),	The U.S. Department of Agriculture (USDA) NRCS Web Soil Survey was utilized to identify prime farmland, farmland of statewide importance, farmland of local importance, or unique farmland within the study area.	Portions of the study area are not located within an urbanized area. Based on the soil survey, soils mapped as prime farmland or farmland of statewide importance are not mapped within the study area.	No applicable regulations or following steps.