WETLAND AND STREAM MITIGATION BANK PROSPECTUS

SAND HILL FARM MITIGATION BANK
SWG-2021-00571
Waller County, Texas

Prepared for Submittal to:

U.S. Army Corps of Engineers, Galveston District

On Behalf of:

Wild Horse Capital, LLC

Prepared By:

Wildwood Environmental Credit Company, LLC

WILDWOOD
ENVIRONMENTAL CREDIT COMPANY

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ACRONYMS AND ABBREVIATIONS

ARS	Agricultural Research Service
FAA	Federal Aviation Administration
FCI	Functional Capacity Index
FCU	Functional Capacity Unit
GIS	Geographic Information System
HCFCD	Harris County Flood Control District
HUC	Hydrologic Unit Code
iHGM	Hydrogeomorphic Functional Assessment (Interim)
NHD	National Hydrography Dataset
NMSU	New Mexico State University
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
PC	Prior Converted Cropland
PEM	Palustrine Emergent Wetland
PJD	Preliminary Jurisdictional Determination
SAR	Stream Assessment Reach
SSURGO	Soil Survey Geographic
SWG	Galveston District, U.S. Army Corps of Engineers
TNRIS	Texas Natural Resources Information System
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Service
WAA	Wetland Assessment Area

1 INTRODUCTION

1.1 Project Overview

Wild Horse Capital, LLC (the "sponsor") proposes to develop a ~955-acre wetland and stream mitigation bank in Waller County, Texas known as the Sand Hill Farm Mitigation Bank. The site consists of row crop agricultural fields, upland hay and grazing pastures, small components of palustrine[1] emergent[2] and scrub-shrub[3] wetlands, and an intermittent[4] stream. The property is in eastern Waller County, approximately 7 miles south of Waller, Texas.

Implementation of the mitigation plan would result in the restoration, and enhancement of palustrine emergent and scrub-shrub wetlands and an intermittent stream channel. The bank will be established and operated in accordance with 33 CFR Part 332, *Compensatory Mitigation for Losses of Aquatic Resources*; Final Rule, dated April 10, 2008 (2008 Rule, 2008).

1.2 Responsible Parties (Ownership / Sponsorship / Long-term Steward)

The property is owned by the sponsor fee simple. The sponsor would be responsible for establishing and operating the bank. The sponsor would be responsible for the implementation, performance, and long-term stewardship of the project (the long-term steward). Wildwood Environmental Credit Company, LLC is acting as the sponsor's agent. Contact information is provided below. Please direct all correspondence to the sponsor's agent.

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[1] Palustrine includes all nontidal wetlands dominated by trees, shrubs, persistent emergent, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean derived salts is below 0.5%. It also includes wetlands lacking such vegetation, but with all of the following four characteristics: (1) area less than 20 acres; (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of basin less than 2 meters at low water; and (4) salinity due to ocean-derived salts less than 0.5% (Cowardin, Carter, Golet, & LaRoe, 1979).
[2] Emergent wetlands are characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years (Cowardin, Carter, Golet, & LaRoe, 1979).
[3] Scrub-shrub wetlands are areas dominated by woody vegetation less than 6 m (20 feet) tall. The species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions (Cowardin, Carter, Golet, & LaRoe, 1979).
[4] Intermittent streams are those that flow water during certain times of the year, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow (U.S. Army Corps of Engineers, 2013).

1.3 Project Location

The site is approximately 955 acres located 7.0 miles south of Waller in eastern Waller County, Texas (**Figure 5**). The attributes of the bank's location are provided in **Table 1**. **APPENDIX A** contains maps of the project area. **APPENDIX B** contains photographs of the site. The site is part of a larger tract of land of approximately 6,907 acres. The bank is bisected into two portions by Penick Road which travels north-south (**Figure 6**). The site is located across the street from the Katy Prairie Conservancy's Indiangrass Preserve Field Office.

Table 1. Location of the mitigation bank.

Type	Description
Longitude/Latitude	-95.917070 / 29.945429
UTM	Zone 15; Easting 218442; Northing: 3316320
USGS Quad	Hockley Mound
County	Waller

Driving Directions to the Bank

From the intersection of Hwy 290 Bus and Mathis Road. in Waller, travel south on Mathis Road for 2.0 miles. Turn right to continue traveling south on Mathis Road and continue 4.0 miles. Continue on Berry Lane for 1.0 mile after Mathis Road turns west. Turn south onto Penick Road for 1.0 mile. This location is where Live Oak Creek crosses Penick Road and the bank is located east and west of Penick Road along Live Oak Creek (**Figure 5**).

1.4 Project Goals and Objectives

The purpose of the bank would be to sell credits commercially as compensatory mitigation for unavoidable impacts to waters of the United States, including wetlands, which result from activities authorized under Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act of 1899, provided such use has met all applicable requirements and is authorized by the U.S. Army Corps of Engineers.

The goal of the bank would be to replace the functions of the waters of the U.S. that will be lost or degraded due to impacts authorized under Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act of 1899.

The goal of the bank will be achieved by attaining the following objectives:

1. Re-establishment[5] of 228 acres of depressional palustrine emergent wetlands by excavating soil deposited by past land leveling activities and plugging ditches within areas that were historically emergent wetlands and reestablishing native emergent wetland vegetation.
2. Rehabilitation[6] of 15.4 acres of palustrine emergent and scrub-shrub wetlands by removal of levee along Live Oak Creek, and reestablishing native emergent wetland vegetation.

[5] Re-establishment is the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a net gain in aquatic resource area and functions (2008 Rule, 2008).

3. Re-establishment of 12,400 linear feet of intermittent stream channel by restoring incised and/or channelized stream segments with a natural meandering channel.
4. Ensure long-term viability and sustainability of the site by establishing an approved long-term management plan and long-term funding mechanism to provide for its implementation.
5. Ensure long-term site protection by executing a perpetual conservation easement on the site.

Figure 26 is a map showing the location of the restoration and enhancement areas. **Table 2** contains a summary of the bank's objectives by resource and activity type.

Table 2. Project objectives by resource type and activity type.

	Projected Acres/Feet			
Current Resource Type	Upland Buffer[2]	PEM Re-Establishment (acres)	PEM / PSS Rehabilitate (acres)	Intermittent Stream Re-Establishment (feet)
Non-wetland	710.9	228.1		
PEM / PSS[1]			15.4	
Excavated Pond		0.6		
Intermittent Stream				12,400
Total Acres	710.9	228.7	15.4	
Total Bank Acres				955

[1] PEM = Palustrine emergent wetland; PSS = Palustrine scrub-shrub wetland.

[2] These are preliminary conservative values. Upland buffer area is expected to decrease and palustrine emergent re-establishment area is expected to increase upon further application of the design method described in the mitigation work plan.

[6] Rehabilitation means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a former or degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function but does not result in a gain in aquatic resource area (2008 Rule, 2008).

2 ECOLOGICAL SUITABILITY

2.1 Site Selection

The proposed site was selected due to its ability to generate functional uplift with minimal risk of failure, and its location in an area of long-term anticipated need for compensatory mitigation credits. Attributes of the site which led to its selection include:

1. The site's location adjacent to existing conservation lands, allowing this project to add 955 acres to a preexisting ~4,500-acre conservation corridor (**Figure 5**).
2. The historic presence of wetlands which have been lost due to agricultural activities, creating an opportunity to re-establish those wetlands by re-connecting the Live Oak Creek to its natural floodplain and reclaiming areas that have been filled or ditched **(Figure 10** and **Figure 26**).
3. The site's location in the headwaters of Cypress Creek and as a contributor to the Cypress Creek Overflow[7], allowing restoration at the site to benefit the Addicks Reservoir and areas downstream.
4. The site's location in the headwaters of Cypress Creek, a stream previously listed on the 303d list as bacteria impaired. Removing agricultural uses from the site and restoring wetlands will reduce runoff and reduce bacteria loading to Cypress Creek.
5. The site's location in terms of its ability to adequately mitigate for losses to aquatic resources within an area experiencing substantial population growth and associated development.

2.2 Biophysical Location

The site is located within the 34a Northern Humid Gulf Coastal Prairies portion of the Western Gulf Coastal Plain Ecoregion (Griffith, Bryce, Omernik, & Rogers, 2007) (**Figure 7**). **Table 3** describes this ecoregion in more detail and **Table 4** describes the geographic attributes of the site more specifically.

Table 3. Local ecoregion description from **(Griffith, Bryce, Omernik, & Rogers, 2007)**.

Level IV Ecoregion	**34a. Northern Humid Gulf Coastal Prairies**
Level III Ecoregion	34 Western Gulf Coastal Plain
Total Ecoregion Area (sq. mi.)	9,009
Physiography	Low, flat plains, low gradient rivers & streams (some channelized) with sandy, silty, & clayey substrates
Elevation / Local Relief (feet)	0-300 / 5-35
Surficial / Bedrock Geology	Late Pleistocene marine sand, silt, and clay. Some salt domes.
Soil Order (Great Groups)	Vertisols (Dystraquerts, Hapluderts), Mollisols (Argiudolls, Argiaquolls, Hapludolls), Alfisols (Epiaqualfs, Hapludalfs, Glossaqualfs, Glossudalfs, Vermaqualfs)
Common Soil Series	Beaumont, Morey, Mocarey, Bernard, Lake Charles, Verland, Edna, Aris, Anahuac, Clodine, Cieno, Nada, Telferner, Dacosta
Soil Temp. / Moisture Regimes	Hyperthermic, Thermic / Aquic, Udic
Mean Annual Precipitation (in)	37-58
Mean Annual Frost-Free Days	260-300
Mean Temperature (F)	42/62; 74/92 (Jan. min/max; July min/max)
Vegetation	Prairie grasslands with little bluestem, yellow Indiangrass, brownseed paspalum, gulf muhly, and switchgrass, with some clusters of southern live oak. Riparian forests of water oak, pecan, southern live oak, American elm, cedar elm, and sugar hackberry, as well as some cane brakes.
Land Use and Land Cover	Cropland with rice, soybeans, grain sorghum, cotton, hay and pastureland, urban and industrial, rangeland, oil and gas production, waterfowl hunting.

[7] See the Final Study Report: Cypress Creek Overflow Management Plan for more information (Harris County Flood Control District, Harris County, and TWDB, 2015).

Table 4. Descriptive geographic information related to the bank site.

Type	Description
Soil Characteristics	
Dominant NRCS Map Units	Katy fine sandy loam, 0 to 1 percent slopes (79%) Snakecreek fine sandy loam, 0 to 1 percent slopes, occasionally flooded (7%) Snakecreek fine sandy loam, 0 to 1 percent slopes, frequently flooded (8%)
NRCS Ecological Site & Historic Climax	R150AY534TX – Loamy Bottomland R150AY741TX – Northern Loamy Prairie R150AY537TX – Lowland
Hydrologic Characteristics	
Associated Named Stream	Live Oak Creek
Local Watershed (HUC 12)	Live Oak Creek – 120401020102
Local Watershed (HUC 10)	Little Cypress Creek-Cypress Creek - 1204010201
Sub-basin (HUC 8)	Spring - 12040102
Basin (HUC 6)	San Jacinto 120401
Ecoregion Characteristics	
Omernik Level IV	34a: Northern Humid Gulf Coastal Prairies
Omernik Level III	34: Western Gulf Coastal Plain (Griffith, Bryce, Omernik, & Rogers, 2007)
Major Land Resource Area	150A: Gulf Coast Prairies
Land Resource Region	LRR T: Atlantic and Gulf Coast Lowland Forest and Crop Region
Geologic Characteristics	
USGS 250k Geology Types	Ql-Lissie Formation / Qw-Willis Formation (Army Map Service, 1982)
Annual Precipitation (Cypress Station) (1943 – 2019)	47.4 inches (average) (three out of ten years less than 40.64 inches to greater than 54.93 inches) (AgACIS, 2020)

2.3 Site History

The following is an abbreviated history of the site and the surrounding area:

Prior to 1957 Aerial photography indicates the area prior to 1957 did not show significant evidence of rice production. A portion of the north-central part of the site appears to be farmed and areas south of the site. Live Oak Creek appears to not be channelized; however, dams are visible along the creek that back up water in the channel. In the southeast portion of the site Live Oak Creek appears to have no channel. (**Figure 9**, **Figure 10**, and **Figure 11**)

1957 – 1996 Live Oak Creek was channelized in the southeast portion of the site prior to 1957. Indicators of farming and/or grazing are apparent throughout the site. Terraces of past rice farming activities are visible on the southeast portion of the site. Drainage ditches and irrigation canals have been constructed. A pipeline has been constructed crossing the

site east to west through the central portion. (**Figure 11**, **Figure 12**, **Figure 13**, and **Figure 14**)

1996 to present Rice farming terraces are no longer visible. Pimple mounds visible on the 1996 aerial appear to be leveled and drained in subsequent aerials. Most of the site is under various forms of agricultural use throughout most years. The majority of the southeastern portion of the site becomes fallow after 2006 (**Figure 14**, **Figure 15**, **Figure 16**, and **Figure 8**).

2.4 Adjacent Land Uses and Anticipated Future Development

Existing and future land uses for areas adjacent to the site are considered compatible with the project. Most of the area east and south of the site is protected by the Katy Prairie Conservancy (**Figure 5**). The remaining is surrounded by land owned by the sponsor. The project, when constructed, would also consists of a mosaic of wetlands surrounded by restored upland intended to buffer the wetlands (**Figure 26**).

2.5 Topography

A map of the topographic relief based on 2018 LiDAR is included as **Figure 17** and a topographic map is included as **Figure 6**. Elevations range from almost 193 feet in the northwest portion to approximately 174 feet in the southeast portion following Live Oak Creek. The site is located within the floodplain of Live Oak Creek which is broad and flat. The entire site was rice farmed at one time and relict ditches, levees, and canal infrastructure are present throughout the site. There is generally a levee present all along Live Oak Creek, especially in the downstream portions where it has been channelized.

2.6 Vegetation

Historic Vegetation

The NRCS characterizes the site as historically being a mix of loamy bottomland along Live Oak Creek, surrounded by northern loamy prairie, intermixed with lowlands. The following descriptions of the historic vegetation for these sites are from the Ecological Site Descriptions obtained from the NRCS, USDA Agricultural Research Service (ARS) Jornada Experimental Range, and New Mexico State University (NMSU) - Ecosystem Dynamics Interpretive Tool (NRCS, USDA ARS, and NMSU, 2020):

Prior to European settlement, the Loamy Bottomland site supported an open tallgrass savannah of scattered trees, and mottes with a canopy cover of 20 percent or less. This site also contained an abundance of giant cane (*Arundinaria gigantea*). The tallgrass savannah state has an overstory of hackberry, live oak, pecan (*Carya illinoinensis*), cedar elm (*Ulmus crassifolia*), green ash (*Fraxinus pennsylvanica*), black willow (*Salix nigra*), cottonwood (*Populus deltoides*), sycamore (*Platanus occidentalis*), and bald cypress (*Taxodium distichum*). A minimal shrub and vine layer occur with large breaks of giant cane. The herbaceous layer consists primarily of eastern gamagrass (*Tripsacum dactyloides*), big bluestem (*Andropogon gerardii*), yellow Indiangrass (*Sorghastrum nutans*), switchgrass, and little bluestem (*Schizachyrium scoparium*). With disturbance from overgrazing, etc., less productive midgrasses increase in volume. These species include bushy bluestem (*Andropogon glomeratus*), rustyseed paspalum (*Paspalum langei*), Texas wintergrass (*Nassella leucotricha*), longspike tridens

(*Tridens strictus*), peaked panicum (*Panicum anceps*), sedges (*Carex spp.*), common bermudagrass (*Cynodon dactylon*), smutgrass (*Sporobolus indicus*), and bahiagrass (*Paspalum notatum*) (NRCS, 2020).

The Northern Loamy Prairie site naturally contains tallgrass prairie interspersed with occasional motts of live oak or loblolly pine with major influences consisting of soils, fire, and grazing. Major tallgrass species include little bluestem, yellow Indiangrass, big bluestem, and switchgrass. Midgrass species include Florida paspalum (*Paspalum floridanum*), marshhay cordgrass (*Spartina patens*), gulfhairawn muhly (*Muhlenbergia filipes*), brownseed paspalum (*Paspalum plicatulum*), bushy bluestem, longspike tridens, meadow dropseed (*Sporobolus compositus*); perennial forms include powderpuff (*Mimosa strigillosa*), bundleflower (*Desmanthus spp.*), button snake root (*Eryngium yuccifolium*), and gayfeather (*Liatris spp.*). Excessive grazing, lack of fire, and overuse encourages encroachment of knotroot bristlegrass (*Setaria parviflora*), carpet grass (*Axonopus sp.*), Dallisgrass (*Paspalum dilatatum*), smutgrass, bahiagrass, and bermudagrass. Continued overuse of site will allow more woody species to invade that include huisache (*Acacia farnesiana*), yaupon (*Ilex vomitoria*), eastern baccharis, wax myrtle, hackberry, common persimmon (*Diospyros virginiana*), ash (*Fraxinus sp.*), Chinese tallow (*Triadica sebifera*), and McCartney rose (*Rosa bracteata*) (NRCS, 2020).

The Lowland site is distinct from surrounding prairie because of its wetness. However, it developed as part of the mid/tallgrass complex on the coastal prairie. This site is heavily influenced by fluctuating water regimes, grazing, and fire. During wet cycles, wet-tolerant species dominate, while during dry cycles species adapted to drier conditions dominant. Common tallgrass species are switchgrass, eastern gamagrass, maidencane, giant cutgrass (*Zizaniopsis miliacea*), and Florida paspalum. Midgrasses and herbaceous species common on site include longtom paspalum, knotroot bristlegrass, green flatsedge, jointed flatsedge (*Cyperus articulatus*), spikerush (*Eleocharis spp.*). Common perennial and annual forms include bundleflower, button snakeroot, sumpweed (*Iva spp.*), ragweed (*Ambrosia spp.*), arrowhead (*Sagittaria longiloba*), water clover (*Marsilea macropoda*), and dock (*Rumex spp.*) Increased grazing and reduced fire introduce more of the following species: smutgrass, bahiagrass, common bermudagrass, sennabean (*Sesbania drummondii*), mesquite (*Prosopis glandulosa*), huisache, baccharis, wax myrtle, and Chinese tallow (NRCS, 2020).

Current Vegetation

There were six predominant vegetation communities present on the site during the jurisdictional delineation: row crop agriculture, hay pasture, livestock grazing pasture, fallow agricultural land, riparian corridor, and recently plowed ag. fields. The row crop agriculture included cotton, corn, watermelon, and sunflower. In July, August, and October, Wildwood installed 65 vegetation assessment plots at the site. An additional 34 points were collected outside the proposed bank boundary. Additional plot data was also collected at reference locations.

Dominant vegetation across the site varies depending on past and current land uses. The vegetation communities on the Sand Hill Farm Mitigation Bank, at the time of the delineation, are summarized below:

- The western portion (west of Live Oak Creek) consists mostly of watermelon production on the north and south sides of Live Oak Creek. Watermelon fields contained other species that included hogwort (*Croton capitatus*), Bermudagrass (*Cynodon dactylon*), spiny amaranth

(*Amaranthus spinosus*), and various other species. This portion of the site also contained recently plowed areas with little to no vegetation and a planted sunflower field.

- Much of the area adjacent to Live Oak Creek consists of forested and shrub-scrub riparian habitat dominated by an overstory of sugarberry (*Celtis laevigata*) and Chinese tallow (*Triadica sebifera*) and a mid/understory that includes Chinese privet (*Ligustrum sinense*), southern dewberry (*Rubus trivialis*), and poison ivy (*Toxicodendron radicans*).
- The northeastern portion of the site (east of Penick Rd and northeast of Live Oak Creek) is primarily dominated by Bermudagrass, hogwort, and deep-rooted sedge (*Cyperus entrerianus*). This area is used primarily for livestock grazing.
- The southeast portion of the site (east of Penick Rd and west of Live Oak Creek) is dominated by vine mesquite (*Panicum obtusum*) in the northern area (hay pasture), Bermudagrass in the southern area (hay pasture), and row crop corn field in the central area.
- The southeast portion of the site (east of Penick Rd and east of Live Oak Creek) is dominated by eastern baccharis (*Baccharis halimifolia*), deep-rooted sedge, southern dewberry, hogwort, annual marsh elder (*Iva annua*), and Bermudagrass. Wetter areas contained more coverage of Pennsylvania smartweed (*Polygonum pensylvanicum*) and maidencane (*Panicum hemitomon*).

The area west of the proposed bank boundary was also assessed and consisted of row crop cotton field with little other vegetation. The entire assessment area with transects and data points are included in **Figure 21**. Note that the subject boundary in **Figure 21** contains a larger footprint than the current proposed bank site boundary.

Designed Post-Project Vegetation

Post-project vegetation would be similar in composition to the natural vegetation described by the NRCS Ecological Site Descriptions as northern loamy prairie, loamy bottomland, and lowlands habitat types prior to extensive disturbance. The site would consist of depressional lowland habitats, within a mid/tallgrass prairie complex. Reference conditions are described in Section 2.13.

2.7 Soils

As shown in **Table 5** and **Figure 18**, soils at the site are mapped by the NRCS as loams or fine sandy loams (Soil Survey Staff, n.d.). The most dominant series on site is Katy fine sandy loam. The NRCS classifies these soils as having hydric components however observations onsite indicate that most of the hydric soil indicators are too deep to qualify as meeting hydric soil conditions.

Table 5. NRCS SSURGO soil map units present within the proposed bank site **(Soil Survey Staff, n.d.)**.

Map Unit Symbol	Map Unit Name	Acres	Percent of Site	Percent Hydric	Drainage Class
KaA	Katy fine sandy loam, 0 to 1 percent slopes	760	80	1	Moderately Well Drained
SnkA	Snakecreek fine sandy loam, 0-1 % slopes, freq flooded	65	7	1	Somewhat Poorly Drained
SnlA	Snakecreek fine sandy loam, 0-1 % slopes, occ. flooded	81	8	1	Somewhat Poorly Drained
WoA	Wockley fine sandy loam, 0 to 1 percent slopes	48	5	2	Somewhat Poorly Drained
WoB	Wockley fine sandy loam, 1 to 3 percent slopes	1	<1	2	Somewhat Poorly Drained
	Total	**955**			

2.8 National Wetlands Inventory

Figure 19 is a map of the National Wetlands Inventory (NWI) for the site and **Table 6** is an acreage summary of the map. Most of the site has no NWI designation. Locations mapped with a NWI designation area predominantly mapped as palustrine emergent persistent seasonally flooded and riverine intermittent streambed seasonally flooded.

Table 6. National Wetlands Inventory mapping of the site **(U.S. Fish and Wildlife Service, 2020)**.

Type	Acres	System	Subsystem	Class	Subclass	Water Regime	Special Modifier
PEM1A	1.73	Palustrine		Emergent	Persistent	Temporary Flooded	
PEM1C	1.24	Palustrine		Emergent	Persistent	Seasonally Flooded	
PEM1Fx	4.54	Palustrine		Emergent	Persistent	Semipermanently Flooded	Excavated
PUBFx	0.74	Palustrine		Unconsolidated Bottom		Semipermanently Flooded	Excavated
Pf	0.23	Palustrine					Farmed
R4SBC	2.72	Riverine	Intermittent	Streambed		Seasonally Flooded	
R4SBCx	3.39	Riverine	Intermittent	Streambed		Seasonally Flooded	Excavated
R5UBFx	0.98	Riverine	Unknown Perennial	Unconsolidated Bottom		Semipermanently Flooded	Excavated
R5UBH	0.03	Riverine	Unknown Perennial	Unconsolidated Bottom		Permanently Flooded	
Total	**15.6**						

2.9 Hydrology

Historical Hydrology

Wetland hydrology was historically driven by surface runoff, direct precipitation, and overbank flooding of Live Oak Creek. The 1940 aerial photograph shows depressional wetland areas throughout the site (**Figure 10**). This photograph also shows two small dams on Live Oak Creek which create in-channel ponds. There is no obvious channel on Live Oak Creek on the southeastern portion of the site.

As described in the Site History Section 2.3, aerial photography indicates that agricultural production began to have a significant impact on the site's hydrology in the late 1940's and early 1950's. This included the ditching and leveeing of Live Oak Creek, and the construction of a network of ditches, canals, and levees to facilitate rice production and other forms of agriculture.

Current Hydrology

Surface runoff and direct precipitation remain the primary driver of hydrology at the site. Due to the channelization and levee construction along Live Oak Creek, the frequency and duration of overbank events have been reduced. Relic rice field levees, canals, and ditches impede the natural flow of water through the site, similarly reducing the frequency and duration of flooding.

Designed Post-Project Hydrology

Post-project hydrology is expected to be as close to pre-disturbance conditions as possible. This would be achieved by performing the wetland and stream restoration activities described in the mitigation plan. These activities include reconnecting Live Oak Creek with its historic floodplain, degrading the series of irrigation canals, ditches, and levees present throughout the site, and excavating wetland depressions filled by past agricultural activities. Post-project hydrology will be primarily driven by precipitation and runoff in association with overbank events from Live Oak Creek.

2.10 Jurisdictional Delineation

Wildwood submitted a jurisdictional delineation of the site to the U.S. Army Corps of Engineers Galveston District (SWG) for verification as a Preliminary Jurisdictional Determination on May 5, 2021. A determination has not yet been issued. The unverified aquatic resources are summarized in **Table 7**.

Table 7. Aquatic resources at the proposed Sand Hill Farm Mitigation Bank.

Resource Type	Acres in Project Area	Linear Feet in Project Area
Jurisdictional		
Palustrine Scrub-Shrub and Emergent Wetland	15.44	
Intermittent Stream		12,400
Drainage Ditches and Irrigation Canals		23,713
Pond	0.63	
Total	**16.07**	**35,573**

The NRCS completed a certified wetland determination of the site on March 16, 2021 (**APPENDIX C)**. Their determination separated the project area into five fields which have unique farm and tract numbers. The NRCS considers the entire project area Prior Converted Cropland (PC).

Wetlands

A summary of the wetland acreages by type and presence within the 100-year floodplain are included in **Table 8** below. A map of the delineated wetland features is also included in **Figure 22**. Note that the subject area boundary within **Figure 22** has a larger footprint than the current proposed bank site.

Table 8. Summary of delineated wetlands.

Wetland Name	Wetland Type	Acreage	Within 100-year Floodplain	NRCS Designation	Status
Wetland 1	Emergent	1.48	Yes	PC	Farmed
Wetland 2	Emergent	0.11	Yes	PC	Farmed
Wetland 3	Emergent	0.11	No	PC	Grazed
Wetland 4	Emergent	3.97	No	PC	Grazed
Wetland 5	Scrub-Shrub	5.50	No	PC	Abandoned
Wetland 6	Scrub/Shrub	4.27	Yes	PC	Abandoned
Total		5.40	Yes		
		10.04	No		
Grand Total		**15.44**			

Below are descriptions of the six wetland resources identified within the boundary of the proposed bank.

Wetland 1 is an emergent wetland that is 1.48 acres in size, located west of Penick Road, and within the 100-year floodplain of Live Oak Creek (**Photo 1**). This feature is a long narrow swale and appears to be an area excavated to construct the adjacent levee that parallels Live Oak Creek. During the time of the investigation, Wetland 1 was along the edge of an actively farmed watermelon field. One primary indicator of wetland hydrology was present that was oxidized rhizospheres along living roots. Dominant vegetation present during the field evaluation consisted of lanceleaf fogfruit (*Phyla lanceolata*), hogwort (*Croton capitatus*), annual ragweed (*Ambrosia artemisiifolia*), and climbing hempvine (*Mikania scandens*). The upper inch of the soil profile had a matrix color of 10YR 5/2 and a fine sandy loam

texture. From 1 to 14 inches, the matrix color consisted of 10YR 3/1 (90%) with 5YR 4/6 (10%) redox concentrations present in pore linings and matrix and a fine sandy loam texture.

Wetland 2 is an emergent wetland 0.11 acres in size, located west of Penick Road, and within the 100-year floodplain of Live Oak Creek (**Photo 2**). The wetland is located within a concave area adjacent to a recently plowed field and up to the levee that parallels Live Oak Creek. Wetland hydrology present included oxidized rhizospheres along living roots (primary indicator) and the FAC-neutral test (secondary indicator). Dominant vegetation present within the area included: eastern baccharis (*Baccharis halimifolia*), eastern annual saltmarsh aster (*Symphyotrichum subulatum*), button eryngo (*Eryngium yuccifolium*), and mild water pepper (*Polygonum hydropiperoides*). Soils were very hard and difficult to dig, only the upper 8 inches of the soil profile was observed due to this and appeared to have a hard pan. The upper 2 inches of the soil profile contained a matrix color of 10YR 4/2 and a loam texture. From 2 to 8 inches, the soil had a matrix color 10YR 4/2 (90%) with 7.5YR 5/8 (10%) redox concentrations within the matrix and pore linings, and a fine sandy loam texture.

Wetland 3 is an emergent wetland in a small concave feature 0.11 acres in size, within an actively grazed pasture east of Penick Road, and outside the 100-year floodplain of Live Oak Creek (**Photo 3**). One primary indicator of wetland hydrology present and consisted of oxidized rhizospheres along living roots. Dominant vegetation present included Bermudagrass and deep-rooted sedge. Vegetation was considered problematic due to the seeding Bermudagrass for use as a livestock forage. The upper 3 inches of the soil profile had mixed matrix colors of 10YR 3/1 (50%) and 10YR 3/2 (50%) within a fine sandy loam texture. From the 3 to 8 inches, the matrix color was 10YR 4/2 (98%) with 7.5YR 4/6 (2%) redox features within pore linings and matrix with a fine sandy loam texture. The profile from 8 to 14 inches had mixed matrix colors of 10YR 4/1 (70%) and 10YR 5/2 (20%) with 10YR 3/6 (5%) redox concentrations within the matrix and a fine sandy loam texture.

Wetland 4 is an emergent wetland 3.97 acres in size, adjacent to a levee that parallels a relic irrigation canal identified as Ditch 3, and within an actively grazed pasture that appeared too wet to mow (**Photo 4**). This location is outside the 100-year floodplain. However, Wetland 4 is identified as an emergent wetland (PEM1A – Palustrine, Emergent, Persistent, Temporarily Flooded) on the NWI map (**Figure 19**) and is identified on the NHD map as lake/pond (**Figure 20)**. Hydrology appears to be driven by surface water runoff that collects along the levee. One primary indicator of wetland hydrology was observed that was oxidized rhizospheres along living roots. The dominant species was Pennsylvania smartweed (*Polygonum pensylvanicum*) with non-dominant species that included annual marsh-elder (*Iva annua*), smooth witchgrass (*Panicum dichotomiflorum*), and hogwort. The upper 2 inches of the matrix soil color was 10YR 3/2 with a fine sandy loam texture. From 2 to 10 inches, the matrix color was 10YR 4/2 (97%) with 10YR 4/6 (3%) redox concentrations within the pore linings and matrix and a fine sandy loam texture. The soil profile from 10 to 14 inches had a matrix color of 10YR 5/2 (96%) with 10YR 4/6 (4%) redox concentrations within the matrix and a fine sandy loam texture.

Wetland 5 is a scrub-shrub wetland 5.50 acres in size (**Photo 5**). A relic drainage ditch (Ditch 3) that intersects Ditch 2 goes through the wetland and is located outside the 100-year floodplain of Live Oak Creek. However, this feature is identified on the NHD map as lake/pond (**Figure 20**). The wetland is within an area that was historically rice farmed but has been fallow/abandoned with no commodity crop grown in over 5 years. A week prior to the field work, a strip was mowed through a portion of the

wetland area. Wetland hydrology indicators included oxidized rhizospheres along living roots (primary indicator) and the FAC-neutral test (secondary indicator). Dominant vegetation present included eastern baccharis and deep-rooted sedge. The upper 3 inches of the soil profile had a matrix color of 10YR 4/2 and a fine sandy loam texture. From 3 to 10 inches, matrix color was 10YR 4/2 (94%) with 7.5YR 4/6 (6%) redox concentrations within pore linings and matrix and a fine sandy loam texture. From 10 to 14 inches, the matrix color was 10YR 4/1 (94%) with 7.5YR 4/6 (6%) redox concentrations within pore linings and matrix and a fine sandy loam texture.

Wetland 6 is a scrub-shrub wetland 4.27 acres in size and adjacent to a drainage ditch identified as Ditch 4 (**Photo 6)**. Of the total area, 3.81 acres are located within the 100-year floodplain of Live Oak Creek and 0.46 acres are outside the 100-year floodplain. The wetland area has been fallow/abandoned with no commodity crop grown in over 5 years; however, the area adjacent is a row cropped corn field that has been under agricultural production since before 1985. Wetland hydrology included one primary indicator that consisted of oxidized rhizospheres along living roots. Dominant vegetation included eastern baccharis, Chinese tallow, southern dewberry, Canada goldenrod (*Solidago canadensis*), and peppervine (*Nekemias arborea*). Soils were very hard and difficult to dig; however, hydric soil indicators were observed in the top 10 inches. The upper 3 inches of the soil profile had a matrix color of 10YR 3/2 with a loam texture. From 3 to 10 inches, the matrix color was 10YR 3/2 (95%) with 7.5YR 4/6 (5%) redox concentrations in the pore linings and matrix and a loam texture

Streams, Ditches, and Open Water

A summary of the stream, ditches, and open water identified within the subject area are presented in **Table 9**.

Table 9. Summary of the stream, ditches, and open water identified within the proposed mitigation bank.

Name	Type	Length (feet)	Width* (feet)	Acreage
Live Oak Creek	Intermittent	12,400	14.7	4.18
Ditch 1	Ephemeral	5,753	14	1.85
Ditch 2	Ephemeral	9,080	20	4.17
Ditch 3	Ephemeral	2,258	5	0.26
Ditch 4	Ephemeral	2,977	6	0.41
Ditch 5	Ephemeral	3,105	14	1.00
Pond	Off-Channel			0.63
Total	**Intermittent**	**12,400**		**4.18**
	Ephemeral Ditch	**23,173**		**7.69**
	Pond			**0.63**
Grand Total		**35,573**		**14.42**

* - Width of stream is average of OHWM's; width of ditches are average top bank widths from LiDAR.

One stream was identified at the site. The stream is named on USGS 7.5-minute topographic maps as Live Oak Creek. It is mapped as an intermittent stream and has been observed as being intermittent with perennial pools. The stream begins approximately 2.7 miles northwest of the project boundary and continues flowing southeast to the confluence with Cypress Creek located approximately 1.6 miles from the project boundary. Maps of the stream, ditches, and open water within the project area is included as **Figure 23.**

2.11 Hydrogeomorphic Functional Assessment

The field investigation identified six wetland locations within the project area that totaled 15.44 acres. This consisted of four emergent wetlands and two shrub/scrub wetland habitats. **Table 10** below contains the baseline Herbaceous/Shrub iHGM Functional Capacity Index (FCI) and Functional Capacity Unit (FCU) score results for wetlands at the bank site.

Table 10. Baseline Herbaceous/Shrub iHGM variable scores, FCI scores, and FCU for wetlands at the proposed SHFMB.

Wetland ID	Wetland 1	Wetland 2	Wetland 3	Wetland 4	Wetland 5	Wetland 6
Landform	Depression	Depression	Depression	Depression	Depression	Depression
Wetland Type	Emergent	Emergent	Emergent	Emergent	Shrub/Scrub	Shrub/Scrub
Vdur	0.50	0.75	0.25	0.25	0.50	0.75
Vfreq	1.00	1.00	0.25	0.25	0.25	0.75
Vtopo	0.40	0.70	0.10	0.40	0.70	0.40
Vwood	0.10	0.10	0.10	0.10	0.75	0.50
Vmid	0.10	0.10	0.10	0.10	1.00	0.50
Vherb	1.00	1.00	1.00	1.00	1.00	1.00
Vconnect	0.75	0.50	0.50	0.75	0.50	0.75
Vdetritus	0.10	0.10	0.30	0.30	0.30	0.30
Vredox	0.10	0.10	0.10	0.10	0.10	0.10
Vsorpt	0.50	0.50	0.50	0.50	0.50	0.50
FCI						
TSDSW	0.58	0.74	0.29	0.34	0.55	0.66
MPAC	0.62	0.53	0.53	0.62	0.83	0.75
RSEC	0.47	0.54	0.26	0.28	0.54	0.59
Wetland Acres	1.48	0.11	0.11	3.97	5.50	4.27
FCU						
TSDSW	0.9	0.1	0.0	1.3	3.0	2.8
MPAC	0.9	0.1	0.1	2.5	4.6	3.2
RSEC	0.7	0.1	0.0	1.1	3.0	2.5

Wetland 1 is an emergent wetland, 1.48 acres in size, located west of Penick Road, and within the 100-year floodplain of Live Oak Creek. As previously mentioned, this feature is a long narrow swale and appears to be a shallow excavated area to construct that adjacent levee that parallels Live Oak Creek. During the time of the investigation, Wetland 1 was along the edge of an actively farmed watermelon field.

This feature collects surface water runoff from the adjacent agricultural fields that back-up within this wetland which is adjacent to part of the levee along the south side of Live Oak Creek. It is also located within the flood prone area of Live Oak Creek. Portions appear to maintain flooded or ponded water for longer durations. There is no woody vegetation coverage or a midstory layer. Herbaceous coverage is over 75 percent of the wetland. Habitats within 600 feet of the perimeter include the following: forested, herbaceous/prairie/abandoned ag field, shrub/sapling, active agricultural field, and wetland (i.e., Wetland 2). Also, detritus was absent from the location, redox concentrations were less than 20%, and the soils were a fine sandy loam.

Wetland 2 is an emergent wetland, 0.11 acres in size, located west of Penick Road, and within the 100-year floodplain of Live Oak Creek. This wetland is located between a recently plowed field with no vegetation during the field survey and a levee that parallels the north side of Live Oak Creek.

As with Wetland 1, this feature appears to collect surface water runoff from the adjacent agricultural fields and is located within the flood prone area of Live Oak Creek. The location is relatively flat with little woody vegetation and midstory consisting of a small quantity of eastern baccharis. Herbaceous vegetation coverage was high. Habitats within 600 feet of the perimeter of the wetland include: herbaceous/prairie/abandoned ag field, shrub/sapling, active agricultural field, and wetland (i.e., Wetland 1). Detritus was absent from the location, redox concentration was less than 20%, and the soils were dominated by fine sandy loam.

Wetland 3 is a depressional emergent wetland, 0.11 acres in size, located east of Penick Road and within an actively grazed pasture. Since this location is also outside the 100-year floodplain of Live Oak Creek, the duration and frequency of flooding is less than Wetland 1 and Wetland 2. Hydrology originates from direct precipitation and overland flow. The location has been leveled in the past and is flat with little topographic features. There was no presence of woody vegetation or a midstory. Herbaceous vegetation covered the entire wetland and was dominated by Bermudagrass. Habitats within 600 feet of the perimeter include: open water and active agricultural field. Detritus was minimal within the location, redox concentration was less than 20%, and soils consisted of fine sandy loam.

Wetland 4 is an emergent wetland, 3.97 acres in size, located east of Penick Road and within an actively grazed field. It appears this portion of the field was previously left un-mowed possibly due to being too wet. Wetland 4 is adjacent to a levee that parallels Ditch 2 and collects surface water runoff. As with Wetland 3, this feature is outside the 100-year floodplain of Live Oak Creek which reduces the score for frequency and duration of flooding. The location is relatively flat with no woody vegetation or midstory. Herbaceous vegetation was over 75%. Habitats within 600 feet of the perimeter include: forested, shrub/sapling, and active agricultural field. Detritus was minimal within the location, redox concentration was less than 20%, and soils consisted of fine sandy loam.

Wetland 5 is a shrub-scrub dominated wetland habitat, 5.50 acres in size, and is outside the 100-year floodplain of Live Oak Creek. However, a portion of the wetland is identified on the NHD map as a lake/pond (**Figure 20**) which increased the Vdur variable. This location consists of an area that was previously utilized for rice farming and has been abandoned/fallow with no commodity crop grown in over five years. Topography is mostly flat with some variability and a ditch (i.e., Ditch 3) going through. Wetland 5 is dominated by woody vegetation and midstory coverage with a large herbaceous component as well. Habitats within 600 feet of the perimeter include: herbaceous/prairie/abandoned field and shrub/sapling. Detritus was minimal within the location, redox concentration was less than 20%, and soils consisted of fine sandy loam.

Wetland 6 is also a shrub-scrub dominated wetland habitat, 4.27 acres in size, and the majority is within the 100-year floodplain of Live Oak Creek. This feature is also adjacent to a drainage ditch (i.e., Ditch 5) that flows into Live Oak Creek. The wetland has been under row crop agriculture production; however, Wetland 6 has not been utilized for a commodity crop in over 5 years. Areas adjacent are continuing to be farmed for corn. As with Wetland 5, topography is mostly flat with some variability with Ditch 4 going along the northern portion. Woody vegetation and a midstory of shrubs and saplings are present

with a herbaceous layer that is over 75%. Habitats within 600 feet of the perimeter include: forested, herbaceous/prairie/abandoned ag field, shrub/sapling, and active agriculture field. Detritus was minimal within the location, redox concentration was less than 20%, and soils consisted of fine sandy loam.

2.12 Stream Condition Assessment

Wildwood utilized the USACE Galveston District's Stream Condition Assessment 2013 (US Army Corps of Engineers - Galveston District, 2013) to evaluate Live Oak Creek and its riparian buffer in February and March of 2021. The SOP assesses the condition of the stream channel, riparian buffers, in-stream habitat, and anthropogenic alterations impacting the channel or hydrologic regime. A Level 1 assessment including Bank Erosion Hazard Index (BEHI) was used to evaluate Live Oak Creek. Due to the timing of this functional assessment, Level 2 parameters such as the regional Index of Biotic Integrity for macroinvertebrates and fish will be assessed in portions of Live Oak Creek containing perennial pools during the next critical period and incorporated at a later date as directed by the U.S. Army Corps of Engineers.

Live Oak Creek was separated into five SARs based upon channel condition, channel alterations, and buffer conditions. As detailed in the SOP guidance, the transects were established within SARs and separated into lengths of 350 feet with 125 feet of separation between. A total of 25 transects were assessed across the stream (**Figure 29**). Transects were periodically adjusted to account for varying stream lengths and to adequately describe stream segments. The results of the stream functional assessment are within **Table 11** below. The Aquatic Use variable is 1 or 2 for each transect due to Live Oak Creek being unassessed by the TCEQ for water quality. A score of 1 is for unassessed intermittent and ephemeral streams; a score of 2 is for unassessed intermittent stream with perennial pools.

Table 11. Live Oak Creek bankfull heights, Level I SOP scores, and BEHI scores by SAR and transect.

SAR	Transect	Bankfull Height (ft)	Channel Condition	Riparian Buffer	Aquatic Use	Channel Alteration	Condition Index	Reach Condition Index	BEHI
1	1	3.7	3	2.9	2	3	2.73		High
1	2	2	4	2.8	2	4	3.20	**3.15**	Moderate
1	3	2.4	5	2.1	2	4	3.28		Moderate
1	4	2.4	5	2.65	2	4	3.41		Moderate
2	1	2.5	4	2.15	2	3	2.79		High
2	2	2.8	5	2.7	2	4	3.43		Moderate
2	3	2.8	5	2.9	1	5	3.48	**3.03**	High
2	4	3.5	2	2.15	1	3	2.04		Very High
2	5	4	4	2.7	2	5	3.43		Moderate
3	1	4.5	4	2.95	2	1	2.49		Low
3	2	4.5	4	2.68	2	1	2.42	**2.45**	Low
3	3	4.5	4	2.75	2	1	2.44		Low
4	1	5.3	4	2.93	2	1	2.48		Moderate
4	2	3.9	4	2.9	2	1	2.48		Low
4	3	3.7	4	2.9	2	1	2.48	**2.46**	Low
4	4	5.4	4	2.75	2	1	2.44		Moderate
4	5	4.4	4	2.8	2	1	2.45		Moderate
4	6	5	4	2.85	2	1	2.46		Moderate

Table 11 continued. Live Oak Creek bankfull heights, Level I SOP scores, and BEHI scores by SAR and transect.

SAR	Transect	Bankfull Height (ft)	Channel Condition	Riparian Buffer	Aquatic Use	Channel Alteration	Condition Index	Reach Condition Index	BEHI
5	1	4.5	4	2.93	2	1	2.48		Moderate
5	2	4	4	3	2	1	2.50		Moderate
5	3	2.4	3	3	2	1	2.25		Moderate
5	4	2.9	3	2.85	2	1	2.21	**2.31**	Moderate
5	5	3	3	2.85	2	1	2.21		Moderate
5	6	2.2	3	3	2	1	2.25		Moderate
5	7	2.2	3	2.98	2	1	2.24		Moderate

2.13 Watershed and Geomorphic Assessment

The Natural Channel Design Review Checklist will be used to guide the development of the stream restoration plan (Harman & Starr, 2011).

Watershed Assessment

LiDAR, available from TNRIS, was used to delineate project reach watersheds using the spatial analyst extension in ArcGIS Pro. The watershed is flat and historic rice cultivation and road construction has led to ditches, embankments, levees, ponds, reservoirs, and canals which alter the flow patterns and make watershed delineation difficult. The project has been separated into three general reaches for discussion purposes. The drainage area in square miles is provided for each reach in **Table 12**. The watershed is currently rural with minimal (<3%) impervious cover. The design condition will be for the current rural setting since significant changes to impervious surface area within the watershed are not expected within a time frame that would impact the design and implementation of the project. Impervious coverage is currently not rapidly increasing in the source watershed. The current land use in the watershed is open agricultural land intermixed with narrow wooded riparian areas. Agriculture currently consists of pasture / grazing land, row crop cultivation of cotton, corn, sunflowers, watermelon, etc.

Table 12. Project stream reaches, Strahler stream orders, and drainage areas.

	Stream	Drainage Area (Sq. Mi.)			Length (ft)		
Reach	Order	Upstream	Downstream	Description	Stream	Valley	Sinuosity
1	3	8.75	10.17	Upstream of Penick Road	4,906	3,054	1.61
2	3	10.17	10.96	Penick Road to Hebert tract	1,280	1,058	1.21
3	3	10.96	13.04	Ditch to Hebert Road	6,313	5,569	1.13

The watershed is expected to urbanize in the future. The proposed project encompasses approximately 15 percent of its watershed, and the sponsor owns another 10-15 percent of the watershed and have not indicated any plans to develop commercial or residential areas.

The Katy Prairie Conservancy is also actively involved with protecting land adjacent to the site with plans to expand its footprint. The floodplain of the restoration reaches is located within the project's boundaries. This buffers the area immediately surrounding the restoration reaches. The future

urbanization of the watershed for this area does not create an unusual or unique risk that would preclude restoration as an option.

A flood study has not been completed for the restoration reaches. The stream's broad and undeveloped floodplain is contained within the proposed project boundary. Flows greater than bankfull discharge will spread out over the floodplain, and the increase in depth, shear stress and velocity will be minimal (Harman & Starr, 2011). A stream gage is operational on Live Oak Creek at Penick Road.[8] These data will be analyzed and included in the final design report.

Basemapping

A registered professional land surveyor (Atkinson Engineers) was engaged to develop a survey-grade basemap for the project showing the location of property lines and easements that will be used as the basis of laying out the restoration design. SITECH was engaged to collect elevation surfaces of the site using high-precision drone and GPS instrumentation. These data will be supplemented with survey-grade elevation data gathered in key locations (Hebert and Penick Road crossings) to facilitate the accurate layout of the design.

Hydraulic Assessment

At this time a hydraulic assessment of the conceptual design has not been completed. An assessment will be included in the design report provided with the draft mitigation banking instrument. Expected bankfull discharge and velocity as determined by the regional curve are provided in **Table 13**.

Bankfull Verification

The Harris County regional curve is applicable to the site and was developed using datapoints collected within the vicinity of the project and within the same hydrophysiographic region. To validate the curve each representative reach of Live Oak Creek was surveyed with multiple cross sections. Due to the impacted and incised nature of Live Oak Creek, bankfull indicators are sparse in some areas. Where stable bankfull indicators are present (upstream of reach 1), they agree with the Harris County regional curve. A summary of the predicted channel parameters for each reach as determined by the Harris County regional curve are provided in **Table 13**.

[8] See Harris County Flood Warning System for Gage 1186 Live Oak Creek @ Penick Road: https://www.harriscountyfws.org/GageDetail/Index/1186?From=8/5/2021%207:26%20AM&span=24%20Hours&r=1&v=surfaceBox&selIdx=0

Table 13. Drainage area by reach and regional curve predicted parameters.

				Regional Curve Predictions							
	Drainage Area (Sq. Mi.)		Existing				E-Streams		C-Streams		
Reach	Upstream	Downstream	Type	Q_{bkf}	u_{bkf}	A_{bkf}	W_{bkf}	D_{bkf}	W_{bkf}	D_{bkf}	A_{ib}
1	8.75	10.17	C & E	197.2	2.6	75.7	25.5	2.9	32.4	2.1	36.8
2	10.17	10.96	E	211.8	2.6	81.0	26.4	3.1	33.5	2.2	39.5
3	10.96	13.04	E & B	230.1	2.6	87.7	27.5	3.2	34.7	2.3	42.8

Q_{bkf} = Bankfull discharge in cubic feet per second.
u_{bkf} = Bankfull velocity in feet per second.
A_{bkf} = Bankfull cross sectional area in square feet.
W_{bkf} = Bankfull width in feet.
D_{bkf} = Bankfull mean depth in feet.
A_{ib} = Inner berm cross sectional area in square feet.

Project Reach Geomorphic Assessment

A geomorphic assessment of the three representative reaches within the project is currently underway. Several cross sections were installed within each reach, slope determined, and low bank height measured to complete a modified level III river stability assessment of each reach (Rosgen D. , 2014). **Table 14** summarizes the general conditions and sources of impairments by reach.

Table 14. Summary of impairments by reach.

Reach	In-Channel Source of Instability	Severity of Impairment	Riparian Buffer Condition
1	Incised / On-Channel Dams / Overwidened	High	Agricultural field / levees
2	Incised / Cattle	Moderate	Improved pasture / invasives / cattle
3	Channelized / Incised / Entrenched	Severe	Agricultural field / levees / invasives

Vertical instability is present throughout the reaches due to past channelization of reach 3. This has led to incision of all reaches, and the entrenchment of the lower parts of reach 3. Within reach 1 there is one on-channel dam that appears to have served as a source of water for livestock or irrigation and at least one other past on-channel dam that has failed resulting in lateral migration of the channel. There are several beaver dams throughout reach 1. While beaver dams are not a major concern their presence within reach 1 is associated with these relic dam features and other areas where instability has created suitable habitat for dam construction which is uncommon in 3rd order drainages. These factors combine to created ongoing system-wide sources of vertical instability.

Lateral instability is present throughout the reaches as well. The channelized reach 3 will undergo long-term lateral change as the stream recovers from being straightened and follows the natural tendency of streams to reestablish meanders. This is already evident by the present of vegetated and unvegetated midchannel bars within the lower portion of reach 3. Within the remaining reaches, lateral instability is associated with channel blockages, such as the dams. The lower part of reach 1 immediately upstream of the Penick Road bridge is an example of this where the on-channel dam resulted in Live Oak Creek cutting a new channel 700 feet around the dam. LiDAR data show scars to the channel throughout reaches 1 and 2 where cattle and vehicle traffic have repeatedly crossed the channel **Figure 1**. These factors indicate that lateral instability can be expected system wide. This is also indicated by the BEHI values summarized in **Table 11**.

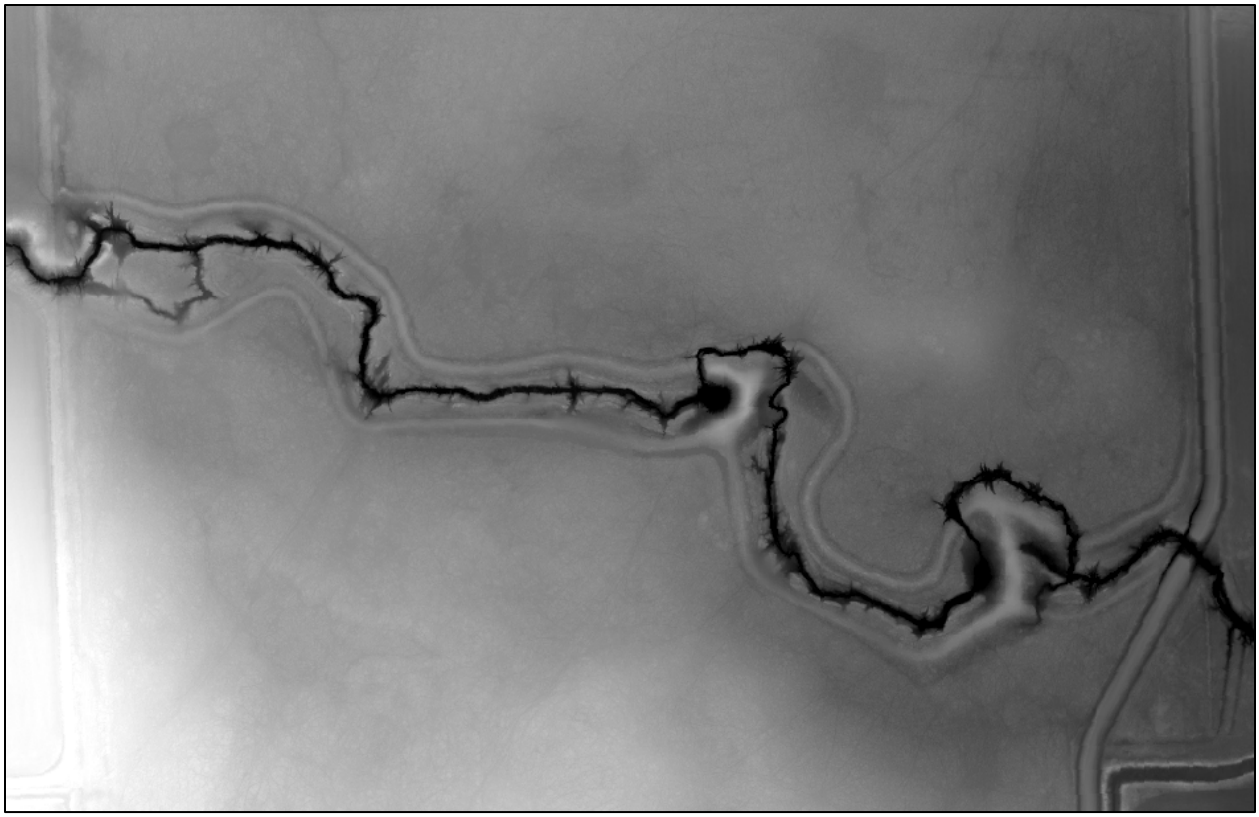

Figure 1. LiDAR shaded relief image of reach 1 above the Penick Road crossing showing vertical and lateral instability sources.

The predicted channel evolution is undergoing a long-term trend toward the development of a C or E channel at a lower floodplain elevation than historically existed. In the future this trend will be interrupted by headcuts established as the blockages fail within reach 3 causing additional headcuts throughout reaches 1-3. The lower portion of reach 3 appear to be aggrading. This follows the trend described in Rosgen's scenario 5 where a stream has been channelized to reduce flooding and subsequently reestablishes a stable channel at a lower elevation (Rosgen D. , 2014).

Constraints

The primary constraints observed that would prevent full restoration are the presence of the bridge on Penick Road and the culverts on Hebert Road. These present vertical constraints to restoration that will need to be considered when designing the restored stream channel. It is anticipated that the designed channel will need to tie into the bottom elevations of these road crossings and that grade control structures will be necessary to facilitate this. Given the flat topography, this may influence when the historic floodplain elevation can be reached below the Penick Road crossing before subsequently tying back into the Hebert Road culverts. A secondary constraint is the southeast corner of the project site where previous wetland restoration work was conducted by the Katy Prairie Conservancy under a Ducks Unlimited grant. The conservancy has indicated they do not want to disturb this work and so the stream restoration must avoid this area. This area is shown on the maps as the rectangle cutout of the project boundary in the southeast corner of the site. No credit is associated with this area and it would not be in the mitigation bank.

Restoration Potential Summary

Given the expansive floodplain and scale of the site the project presents an opportunity to restore Live Oak Creek. Full restoration throughout the reach to pre-disturbance conditions cannot likely be achieved due to the constraints of the Penick Road and Hebert Road crossings, but the scale of the site lends itself to reconnection of the floodplain throughout the majority of the site affording a high degree of hydrologic benefit to the entire floodplain and the wetlands that would be restored on it. While the largest degradation to the stream has already occurred through channelization and construction of on-channel irrigation ponds, the resulting long-term instability has not completely run its course. Lateral channel adjustments are expected to occur long into the future as the stream trends toward a natural meandering channel and cuts around channel blockages. Vertical instability will continue as the lower parts of channelized reaches aggrade, and headcuts originate as channel blockages fail allowing headcuts to migrate through the site. Active channel restoration can address these issues by restoring floodplain connectivity and improving floodplain health, reducing erosion as a result of system wide instability, increasing flood capacity by improving channel dimension, pattern, and profile.

2.14 Reference Conditions and Reference Sites

A reference-based approach will be used to develop the mitigation banking instrument and mitigation work plan. Several reference areas have been selected for this purpose. These represent reference conditions for the various resources to be restored onsite: streams, depressional wetlands, and prairie. **Figure 28** is a map of the reference wetland and prairie locations discussed in this section. **Table 15** is a summary of the vegetation data collected at the reference sites.

Table 15. Summary of vegetation observed on the four reference areas.

				Depression Reference Areas		Prairie Reference Areas	
Species	Common Name	Indicator Status	Invasive (Y/N)	Natural (n=2)	Restored (n=6)	Upland (n=3)	Wetland (n=3)
Ambrosia artemisifolia	Annual ragweed	FACU	N	2%	-	3%	1%
Baccharis halimifolia	Eastern baccharis	FAC	N	-	-	6%	2%
Conyza canadensis	Canadian horseweed	NI	N	5%	-	-	-
Croton capitatus	Hogwort	NI	N	1%	-	3%	-
Cyperus articulatus	Jointed flat sedge	OBL	N	-	2%	-	2%
Cyperus entrerianus	Deep-rooted sedge	FACW	Y	-	-	-	10%
Cyperus sp.	Unknown square stem sedge	UNK	N	-	45%	-	-
Cyperus virens	Green flatsedge	FACW	N	6%	-	-	-
Diospyros virginiana	Common persimmon	FAC	N	1%	-	-	-
Echinochloa colona	Jungle rice	FACW	Y	-	8%	-	-
Eupatorium capillifolium	Dog-fennel	FACU	N	-	-	8%	-
Eupatorium serotinum	Late-flowering boneset	FAC	N	-	-	7%	6%
Unknown filamentous algae	Unknown filamentous algae	UNK	N	-	5%	-	-
Hydrolea ovata	Ovate false fiddleleaf	OBL	N	5%	-	-	1%
Hypericum hypericoides	St. Andrew's-cross	FAC	N	-	-	2%	-
Ilex vomitoria	Yaupon	FAC	N	-	-	3%	-
Juncus interior	Inland rush	FACU	N	-	-	3%	-
Juncus marginatus	Grassleaf rush	FACW	N	-	-	-	15%
Juncus torreyi	Torrey's rush	FACW	N	-	-	2%	1%
Liatris punctata	Dotted blazing star	NI	N	-	-	3%	-
Ludwigia repens	Creeping primrose-willow	OBL	N	-	10%	-	-
Mikania scandens	Climbing hempvine	FACW	N	3%	-	-	-
Oenothera lindheimeri	Lindheimer's beeblossom	NI	N	-	-	6%	2%
Panicum dichotomiflorum	Smooth witchgrass	FACW	N	-	-	-	2%
Panicum hemitomon	Maiden-cane	OBL	N	48%	15%	-	-
Paspalum plicatulum	Brown-seed crown grass	FAC	N	-	-	22%	-
Paspalum sp.	Unknown species	UNK	N	-	8%	-	-
Paspalum urvillei	Vasey's grass	FAC	Y	-	-	7%	-
Passiflora incarnata	Purple passionflower	NI	N	-	-	2%	-
Pinus taeda	Loblolly pine	FAC	N	-	-	-	15%

				Depression Reference Areas		Prairie Reference Areas	
Species	Common Name	Indicator Status	Invasive (Y/N)	Natural (n=2)	Restored (n=6)	Upland (n=3)	Wetland (n=3)
Polygonum hydropiperoides	Mild water pepper	OBL	N	-	-	-	5%
Polygonum pensylvanicum	Pennsylvania smartweed	FACW	N	6%	-	-	-
Rhynchospora corniculata	Short-bristle horned beak sedge	OBL	N	-	-	-	3%
Rubus trivialis	Southern dewberry	FACU	N	-	-	10%	13%
Schizachyrium scoparium	Little bluestem	FACU	N	-	-	12%	-
Setaria parviflora	Marsh bristlegrass	FACW	N	-	-	-	3%
Solidago odora	Anisescented goldenrod	NI	N	-	-	5%	8%
Sporobolus indicus	Smutgrass	FACU	N	-	-	-	3%
Symphyotrichum subulatum	Eastern annual saltmarsh aster	OBL	N	45%	1%	7%	12%
Triadica sebifera	Chinese tallow	FAC	Y	-	-	-	4%
Verbena brasilensis	Brazilian vervain	FACU	Y	-	-	-	3%
	Total Absolute Cover			**120%**	**94%**	**112%**	**111%**
	# of Native Species >1%			**10**	**7**	**17**	**16**

Depressional Wetlands

Four reference depressional wetlands have been selected adjacent to the site. Two locations are considered high quality natural emergent wetlands (Reference Wetland 1 & Reference Wetland 2); the other two locations are recently restored emergent wetlands at the Katy Prairie Conservancy's Indian Grass Preserve across the road from the bank (Reference Wetland 3 & Reference Wetland 4). Vegetation, functional assessment data, and geometry from these wetlands will be used to assist the development of excavation and revegetation plans for former depressional wetlands within the bank. They will also be used to develop ecological performance standards and functional lift projections.

Reference Wetlands 1 and 2 – Natural

Reference wetlands 1 and 2 are located on the parent tract and approximately 1.2 miles northeast of the bank. The size of reference wetland 1 is approximately 7.3 acres and reference wetland 2 is approximately 2.3 acres. Both are depressions and within the regulatory floodway of Mound Creek.

In an average year, over 80-percent of these wetlands flood and/or pond for at least 14 consecutive days 5 out of 5 years. Less than 15 percent is represented by topographic features. Reference wetland 1 contains 0-10 percent woody vegetation cover; Reference wetland 2 contains 11 to 33 percent woody vegetation cover. For each, the midstory coverage is between 1-25 percent and herbaceous cover averages greater than 75 percent. The wetlands have an O or A horizon in greater than 85 percent of the area, redox features are less than 20 percent, and are dominated by sandy soils. Also, connectivity includes wetland plus two or more habitat types (other than forested) or three or more habitat types; this includes shrub/sapling, wetland, and herbaceous/prairie/abandoned ag field.

These wetlands are different from what could be expected within the mitigation bank because they are currently not subject to any routine ongoing management. They have higher midstory and woody vegetation coverage levels than would be expected with ongoing invasive species control, prescribed fire, or other forms of vegetation management to maintain emergent wetland conditions. As a result, they currently score higher with the iHGM than would be expected at the bank under a long-term management plan.

Reference Wetlands 3 and 4 – Recently Restored

Reference wetlands 3 and 4 are restored wetlands across the road from the bank at the Katy Prairie Conservancy's Indiangrass Preserve. The size of reference wetland 3 is approximately 0.9 acres and

reference wetland 4 is approximately 0.5 acres. These areas were restored in approximately 2015 using the same methods proposed in the mitigation work plan. They have naturally revegetated and represent expected conditions five-years post-construction.

Due to their depressional nature, over 80 percent of these wetlands flood and/or pond for at least 14 consecutive days. They are mapped by FEMA as being outside the 100-year floodplain and have a low flood frequency. Less than 15 percent is represented by topographic features. Woody vegetation coverage is 0-10 percent, midstory coverage is equal to or less than 1 percent, and herbaceous cover averages greater than 75 percent. The wetlands have an O or A horizon over 11-84 percent of the area, redox features are less than 20 percent, and are dominated by sandy soils. For reference wetland 3, connectivity includes wetland plus four habitats and/or surrounded by forested; this includes shrub/sapling, wetland, open water, and herbaceous/prairie/abandoned ag field. Reference wetland 4 connectivity includes wetland plus two or more habitat types (other than forested) or three or more habitat types; this includes wetland, shrub/sapling, and herbaceous/prairie/abandoned ag field.

Reference Prairie

Several vegetation plots were installed within high-quality natural upland and wetland prairies adjacent to the bank on land owned by the sponsor. Data from these plots will be used to validate seed mixes available from seed providers as well as to estimate post-project vegetation conditions outside of the restored depressions. The data will be used to develop ecological performance standards for wet prairie areas and upland buffers, such as percent coverage and species richness.

Reference Streams

Planform, longitudinal, and cross-sectional geometry data from stable reference streams are necessary to develop the restoration plan for Live Oak Creek. These data need to span the range of variability in conditions that exist onsite. These data are available for Panther Branch at Gosling Road. These are the same reference data used to develop the nearby Katy Prairie Stream Bank. The sponsor anticipates using these data unless more desirable reference sites are located during the permitting process. Wildwood is actively involved in surveying other reference reaches within the watershed and may during permitting identify more suitable sites. The draft mitigation banking instrument will contain a report on the final geomorphic parameters and reference data used in the design.

Variables	Symbol	Unit	Panther Br. @ Gosling Rd - E Reference Reach		
HUC				12040102	
Ecoregion				35f	
Stream Order				4	
Valley Type				X	
Stream Type				E5	
Drainage Area		mi^2		25.9	
Bankfull Width	W_{bkf}	feet		22.8	
Bankfull Mean Depth	d_{bkf}	feet		3.9	
Max Depth/Mean Depth				1.4	
Width/Depth Ratio	W_{bkf}/d_{bkf}			5.8	
Bankfull Cross-Sectional Area	A_{bkf}	ft^2		88.19	
Wetted Perimeter	WP			33.8	
Hydraulic Radius	R				
Manning's N	n			0.04	
Bankfull Mean Velocity	V_{bkf}			2.07	
Bankfull Discharge		cfs		182	
Bankfull Max Depth				5.52	
Low Flow Cross Sectional Area				38	
Low Bank Height to Max Dbkf Ratio			1.11		1.22
Width of Flood Prone Area	W_{fpa}	feet		200	
Entreachment Ratio	W_{fpa}/W_{bkf}			8.77	
Meander Length	L_m	feet	110	164.5	210
Ratio of Meander Length to Bankfull Width	L_m/W_{bkf}		4.8	7.2	9.2
Radius of Curvature	R_c		44	61.2	89
Ratio: Radius of Curvature to Bankfull Width	R_c/W_{bkf}		1.9	2.7	3.9
Beld Width	W_{blt}	feet	70	105	125
Meander Width Ratio	W_{blt}/W_{bkf}		3.1	4.6	5.5
Riffle Length	L_{riff}	feet	16.1	34.9	43.2
Riffle Length	L_{riff}/W_{bkf}		0.7	1.5	1.9
Sinuosity (stream length/valley distance)	K			1.28	
Valley Slope	S_{val}	ft/ft		0.0011	
Average Slope (Savg) - (Svalley/K)	S_{avg}	ft/ft		0.00086	
Riffle Water Suface Slope	S_{riff}	ft/ft	0.0024	0.0037	0.0051
Ratio of Riffle Slope to Bankfull Slope	S_{riff}/S_{bkf}		3.5	5.3	7.2
Pool Slope	S_{pool}	ft/ft	0	0.0001	0.0003
Ratio of Pool Slope to Bankfull Slope	(S_{pool}/S_{bkf})		0	0.1143	0.3571
Maxium Pool Depth	d_{pool}	feet	6.2	7.1	7.6
Ratio of Pool Depth to Average Bankfull Depth	d_{pool}/d_{bkf}		1.6	1.8	1.9
Pool Width	W_{pool}	feet		29.93	
Ratio of Pool Width to Bankfull Width	W_{pool}/W_{bkf}			1.3	
Pool Area	A_{pool}	ft^2		128.61	
Ratio of Pool Area to Bankfull Area	A_{pool}/A_{bkf}			1.5	
Pool to Pool Spacing	p-p	feet	96	127	175
Ratio of Pool to Pool Spacing to Bankfull Width	p-p/W_{bkf}		4.21	5.57	7.68

Figure 2. Reference reach data anticipated for use in designing Live Oak Creek.

2.15 Threatened and Endangered Species

No observations have been made of threatened or endangered species during the site visits conducted to date. An official species list of federally listed threatened and endangered species was obtained from the U.S. Fish and Wildlife for the site (**APPENDIX D**). Species identified on this list either have no critical habitat designated or critical habitat that falls outside project area. The project will have no effect on these listed species.

2.16 Cultural Resources

The proposed bank site has not been formally surveyed for the presence of historic or prehistoric cultural resources. The Texas Historic Sites Atlas (Texas Historical Commission, 2021), indicates that no known sites have been identified within the proposed project boundary. The project has been submitted to the Texas Historical Commission for official review through the Review and Compliance (eTRAC) system. The Texas Historical Commission concluded that no historic properties are present or affected by the project as proposed and was unable to complete a review of archeological resources at this time. A copy of the correspondence with the Texas Historical Commission is within **APPENDIX G**.

The sponsor anticipates conducting a cultural resources survey of areas to be disturbed prior to submittal of the mitigation banking instrument.

2.17 Existing and Known Proposed Airports

To comply with FAA Advisory Circular 150/5200-33B a Geographic Information System (GIS) was used to determine the presence of known or proposed private or commercial airports within five miles of the bank. **Table 16** is a list of airports within 5 miles of the bank. The project is not expected to create a wildlife hazard to aviation for nearby airports.

Table 16. Nearby airports to proposed site.

Airport	FAA Identifier	Distance / Direction	Operational
Pfeffer & Son Farms Airport	4XS0	1.8 miles / Southwest	Yes
Skydive Houston Airport	37XA	2.4 miles / North	Yes
Laas Farm Airport	1TS1	4.0 miles / Southwest	No / Cultural Site
Harbican Airport	9XS9	5.0 miles / Southeast	No

2.18 General Need

Authorization of the mitigation bank would allow for consolidation of compensatory mitigation projects into one site where functional uplift can occur with less risk and uncertainty than at multiple small and scattered permittee-responsible mitigation projects.

The proposed service area would primarily include the Spring and Buffalo-San Jacinto HUC-8 watersheds **Figure 27**. The Spring watershed contains the Katy-Cypress Wetland Mitigation Bank, the Katy Prairie Stream Mitigation Bank, and the Katy Hockley Mitigation Bank. According to RIBITS[9], the Katy-Cypress Wetland Mitigation Bank is effectively sold out. The Katy Prairie Stream Mitigation Bank has approximately 31,000 stream credits remaining and has sold nearly half of its inventory in the past nine years. The Katy Hockley Mitigation Bank is listed on RIBITS as a single-client bank for Harris County. The Buffalo-San Jacinto watershed contains the Greens Bayou Wetland Mitigation Bank. This bank has no stream credits and a limited amount of non-forested mitigation credits remaining.

[9] RIBITS can be accessed at:
https://ribits.ops.usace.army.mil/ords/f?p=107:158:12093625383141::NO::P158_CANNED_ID:CLEAR

Based on the RIBITS review, the two watersheds within the proposed primary service area have a limited supply of non-forested wetland credits and stream credits. There is a general need for additional credit inventory within these areas.

2.19 Technical Feasibility

The conceptual mitigation plan is described in Section 3.1 and a map of the conceptual mitigation plan is included as **Figure 26**. Implementation of the conceptual mitigation plan would result in the restoration and enhancement of emergent, and scrub-shrub wetlands, and the intermittent stream channel identified as Live Oak Creek. The proposed activities have no significant technical impediments.

The Katy Prairie Conservancy – Indiangrass Preserve and Sheldon Lake State Park have successfully implemented the same wetland restoration activities proposed at the bank. This included excavations to restore depressional emergent wetland habitats and revegetating the adjacent upland areas with native herbaceous species. The depressional wetlands were allowed to naturally revegetate at the Indiangrass Preserve, but they were planted at Sheldon Lake State Park. The methodology has been documented in a manner that ensures it can be replicated at this site (Texas Coastal Watershed Program, 2013) (Texas Coastal Watershed Program, 2013). Wildwood and the sponsors' staff have successfully managed similar restoration projects using the same types of equipment proposed for use at this project.

The stream restoration proposed along Live Oak Creek is also technically feasible. It consists of Priority 1 stream restoration to reconnect the stream to its historic floodplain (Rosgen D. L., 1997). These techniques are routinely implemented in the field of stream restoration (Harman W. , et al., 2012). In existing channelized segments, a new channel would be constructed on the floodplain and the material used to fill the existing channelized segment. Ponds or wetlands would be scattered along the existing channel to balance material. Grade control structures are used to tie the constructed channel into the existing channel at the end of the restoration reach.

For this project the tie in points would be the bridge over Penick Road, and the culverts along Hebert Road. **Figure 3** illustrates this approach. Within less incised segments with stable pattern, it may be possible to raise the streambed at the riffle with structures to restore floodplain connectivity. This may be the case in the watermelon field west of Penick Road. This approach has greater risk as it is structure dependent but may be less impactful to the resource than the previously described method. Given the layout of the site with a broad floodplain in a rural open setting, it is expected that the plug and pond method of priority 1 stream restoration will be the most desirable approach. This will be studied in further detail and described in the mitigation plan within the mitigation banking instrument.

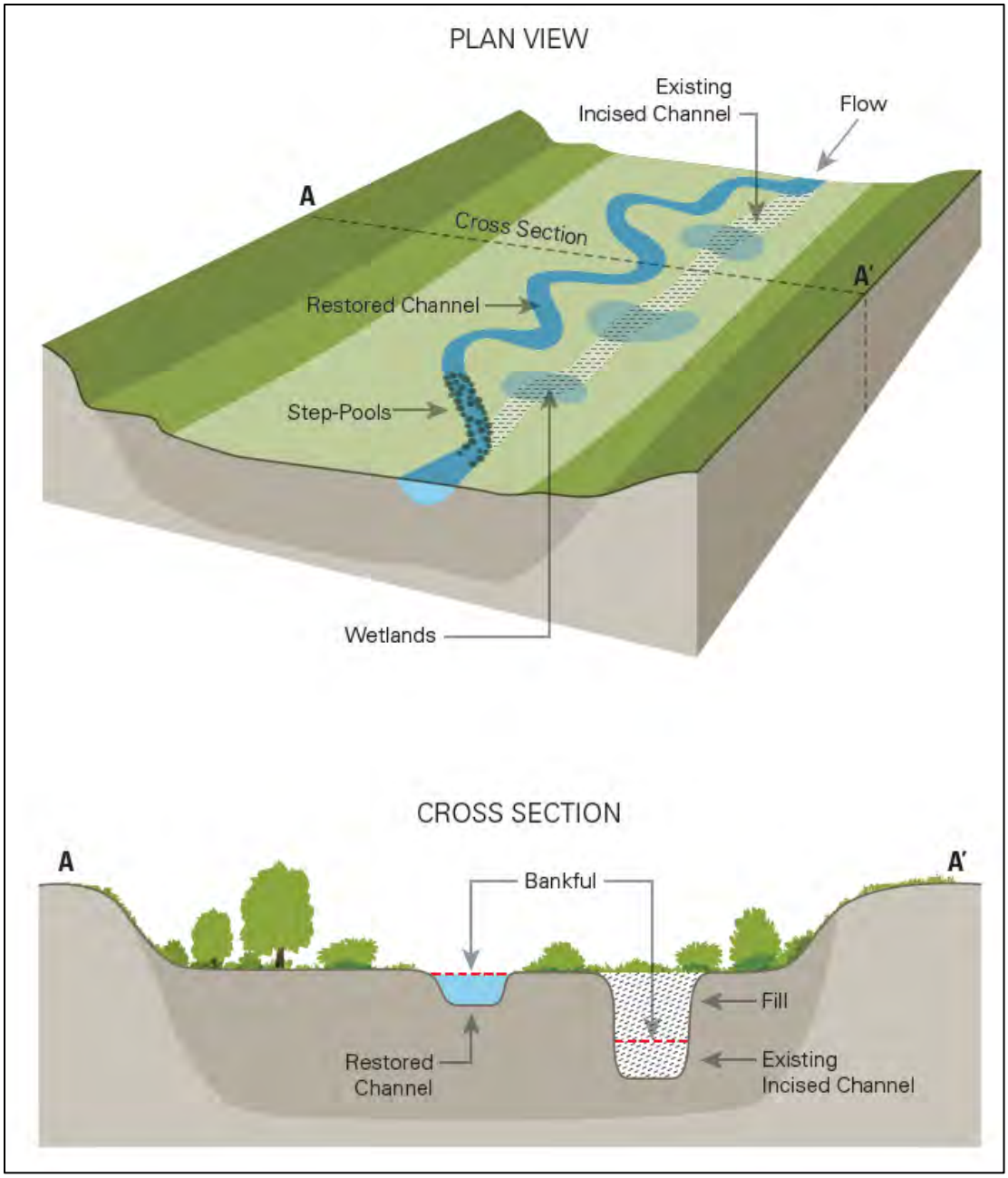

Figure 3. Rosgen Priority Level 1 Restoration Approach (Figure 3.8 from Harman et al 2012).

2.20 Mortgages, Easements, and Encumbrances

The site is not subject to any mortgages or liens and is owned fee simple by the sponsor. The property has been acquired in three acquisitions by the sponsor in the past six years. Each time, the sponsor has obtained a title policy by a title company operating within the state of Texas. These four policies are dated January 31, 2017, February 2, 2017, and November 19, 2019, and included as **APPENDIX E**. Note that Wild Horse Capital, LLC is the general partner of Waller County Land & Cattle, Ltd. Penick Road Partners, LLC encompasses the same officers and managers. This group owns the ~6,800 acres that encompasses this site. Survey plats that accompany the policies are included as **Figure 24** and **Figure 25**.

The survey plats show the location of the easements on the subject tracts. The title searches associated with these policies went as far back in time as possible and include instruments as far back as 1928, or 93 years ago.

As evidenced on the plats, portions of the tracts are subject to several right-of-way easements. These primarily are associated with the pipeline corridor that passes along a portion of the northern boundary of the bank and bisects the north central portion of the site west of Penick Road. Waller County has a drainage easement along a ditch from Penick Road to Live Oak Creek. Wildwood has coordinated with Waller County regarding this easement and the county has indicated a willingness to release a portion of this easement to facilitate additional hydrology to the site. Surrounding the southern Hebert Tract is an old canal easement that expired when it ceased to be used decades ago. No credits will be associated within the area covered by active easements.

The Katy Prairie Conservancy sold a 640-acre parcel that encompasses the section east of Penick Road and north of Hebert Road to the sponsor in December of 2019 (called the Hebert Tract). As part of the transfer, the sponsor granted the Katy Prairie Conservancy a conservation easement on the tract. Wildwood has coordinated with the Katy Prairie Conservancy (Mary Anne Piacentini and Elisa Donovan) regarding the compatibility of the proposed restoration and mitigation bank with their existing easement. The conclusion was that conducting restoration work is consistent with the easement and is not precluded by it. Evidence of this coordination and their willingness to work toward placing an easement on the additional acreage within the bank is evidenced in **APPENDIX F**.

2.21 Site Risks

The project has been proposed in such a way as to reduce long-term risks to the maximum extent practicable. The primary long-term risks to the wetland restoration design would be invasive species. This is not a risk unique to the site and would be addressed in the mitigation plan and long-term management plan by reducing the potential inputs of invasive plants (livestock and agricultural practices), restoring a vigorous native plant community by seeding and managing the system with fire, and by ongoing herbicide applications.

The size of the project includes extensive buffer areas meant to enhance the function of the restored wetlands and stream. These buffer areas would be restored by reestablishment of native prairie. This would buffer the site's aquatic resources from potential long-term impacts from development within the area. The sponsor owns most of the Live Oak Creek floodplain downstream of the site and is currently pursuing a floodplain protection and restoration easement through the NRCS on that portion. That in conjunction with grade control structures along Live Oak Creek will buffer the creek itself from any potential future degradation of Live Oak Creek downstream of the site.

Future risks from the expansion or improvement of Hebert and Penick Roads would be addressed by the incorporation of grade control structures into the design above each of these roads. This would reduce the risk of any activities associated with the road crossings from causing vertical instability that could impact the upstream segments of the creek.

3 BANK ESTABLISHMENT & OPERATION

3.1 Determination of Credits

The U.S. Army Corps of Engineers, Galveston District's interim hydrogeomorphic model (SWG-iHGM) for Riverine Herbaceous/Shrub wetlands would be used to estimate the amount of wetland credits that would be created by implementation of the mitigation work plan.[10] Lift and credit yield would be determined by comparing current baseline conditions to those projected to result from implementation of the mitigation work plan, based on site specific soils and hydrology data as well as vegetation data collected from the reference sites discussed in Section 2.14. Herbaceous / scrub-shrub wetlands are expected to reach their maximum potential SWG-iHGM scores four years after U.S. Army Corps of Engineers receipt of the as-built report.

The U.S. Army Corps of Engineers, Galveston District's standard operating procedure (SOP) for streams would be used to estimate the amount of stream credits that would be generated by implementation of the mitigation work plan (U.S. Army Corps of Engineers, 2013). Credit yield would be determined by multiplying the creditable linear feet within the project by the factors assigned to the corresponding work type described within Section 5.0 of the SOP. Live Oak Creek is anticipated to receive re-establishment credit. Credit adjustments would be made for riparian buffers with wetlands.

Hundreds of acres of mesic prairies would be restored in the area surrounding and between the reestablished wetlands. These areas provide additional habitat connectivity and improve the function of the restored wetlands. The sponsor would permanently protect these areas. To account for the benefits of the upland buffer, credits would be added to the wetland and stream credits generated through rehabilitation and reestablishment. This would be reflected as a percentage added to the total projected credit yield.

Credit Release Schedule

Credit releases would only take place after coordination with and approval from the U.S. Army Corps of Engineers. All credit releases would be contingent on the sponsor being in compliance with all terms and conditions of the permit and with all of the terms of the mitigation banking instrument including any revision, modification, or amendment thereof.

Wetland Credits:

1st Credit Release (Administrative)	10 percent of the site's total projected wetland credits for executing the mitigation banking instrument, recording the conservation easement, establishment of the financial assurance and long-term management fund.
2nd Credit Release (Construction)	10 percent of the site's total projected wetland credits for completing construction / planting and submittal of the as-built.

[10] Riverine Herbaceous/Shrub iHGM Interim: https://www.swg.usace.army.mil/Portals/26/docs/regulatory/functional%20Assessment/SWGRiverineHerbaceousiHGM.pdf

Subsequent Releases	Upon U.S. Army Corps of Engineers verification that the site has accrued wetland functional lift beyond previous credit releases.
Stream Credits:	
1st Credit Release (Administrative)	20 percent of the site's total projected stream credits for executing the mitigation banking instrument, recording the conservation easement, establishment of the financial assurance and long-term management fund.
2nd Credit Release (Construction)	20 percent of the site's total projected stream credits for completing construction / planting and submittal of the as-built.
1st Bankfull Event	20 percent of the site's total projected stream credits after the first bankfull event is documented post-construction provided all applicable stream performance standards are met after the event.
2nd Bankfull Event	20 percent of the site's total projected stream credits after the second bankfull event is documented post-construction provided all applicable stream performance standards are met after the event. No more than one bankfull event will be recognized per year.
Year 5 Monitoring (Final Stream)	20 percent of the site's total projected stream credits after five growing seasons from the date of the submittal of the as-built report.

3.2 Conceptual Mitigation Work Plan

Figure 26 is an illustration of the conceptual mitigation plan showing the location of the proposed wetlands and stream. This conceptual layout is expected to change as more data become available to reflect the true historic extent of wetlands at the site. The design stream channel pattern would meander between the wetlands. The current stream pattern shown is conceptual and based on the plan form of streams at the Katy Prairie Stream Bank.

Wetland Design Approach

The wetland design will be developed using the methodology applied to Sheldon Lake State Park (Texas Coastal Watershed Program, 2013). The methodology consists of using georeferenced historic aerial photography to identify wetland boundaries that have since been disturbed by land levelling. The wetland boundaries identified on the aerial photography help set the plan view of the restoration and soil cores collected on a subset of the wetlands are used to verify the aerial delineation and determine the depth to the original soil horizons.

The earliest known aerial photographs of the site were gathered in the 1930's at an unknown date. These data were provided by the Katy Prairie Conservancy. The clarity of the aerial photography makes delineating the historic wetland boundaries within the bank challenging. The next known available aerial photograph of the site is dated February 10, 1940. A high-quality scan of this photograph was obtained

from TNRIS and georeferenced to the site (**Figure 10**). The only visible change between the two photographs is that Penick Road was shifted to the east after the 1930's photograph was taken. The 1940 aerial photograph was taken prior to significant rice cultivation and hydrology impacts to the floodplain. The Antecedent Precipitation Tool indicates the photograph was taken during the wet season, but the site was drier than normal at that time and experiencing a moderate drought. Therefore, the wetland extents visible on the aerial photograph represent a reasonable if not conservative extent.

The depressional areas and high mima mounds will be digitized from this aerial photograph and used to define the wetland boundaries for the restoration project (**Figure 26**). Several wetland sites will be groundtruthed using soil cores to verify the methodology accurately defined the potential historical wetland site locations. Appropriate excavation depths would be examined from soil cores to determine how deep the original soil horizons are present. Once verification is complete, the georectified maps will be translated into engineering (construction) documents, with accurate excavation depths that vary across each pothole. Excavated material would be used to construct low elevation (0.5 to 1.0 foot above grade) berms on the downslope sides of the excavations in order to enhance short-term retention of stormwater. This material would also be used to re-establish some of the mima mound type features where they once existed. Hydrologic models will be used to model the depth and duration of depressions and compared to natural depressions to minimize the risk that the depth and duration of water within the depressions would adversely affect the vegetative community anticipated within the depressions.

Cross section surveys of the natural reference depressions located northeast of the bank have a maximum depth of approximately two feet, and a mean depth of 1.5 feet from ground surface. Many of the historic wetlands are smaller and were likely shallower than the remnant reference wetlands. Application of the Sheldon Lake State Park methodology would refine final excavation depths. Detailed designs would be included in the mitigation banking instrument.

Stream Design Approach

The 1930's and 1940 aerial photographs indicate that Live Oak Creek was altered in several locations prior to the photographs being taken. On the photographs several on-channel impoundments are visible, likely as a source of water for irrigation or livestock. Natural channel design principles and reference stream data would be used to design a stable channel pattern through the project site along the general historic path of Live Oak Creek. The design channel would be based on the geometry of a stable reference stream. The design alignment would be set after the historic wetlands have been mapped. The channel would meander between the wetlands. The existing channelized segment would be filled using material from the levees currently present on both sides of the channel, material excavated during construction of the new channel, and material excavated from nearby wetlands reestablished during the wetland restoration process. Ponds or wetlands would be constructed along the path of the existing channel to balance any remaining fill requirements. This is typical of stream restoration projects that restore the stream to its historic floodplain (Rosgen D. L., 1997) (**Figure 3**).

Structures will be utilized along the constructed stream channel to reduce the risk of erosion and lateral and vertical instability. These structures will also improve in-stream habitat and utilize woody riparian vegetation removed from the levees along the existing stream as it is filled. Anticipated structures would be brushy toe and toe wood structures, root wad / log and rock j-hook vanes, gravel augmented riffles, and rock cross vanes. Cross vanes would be used in the vicinity of the road crossings for grade control

and toe / j-hook structures at bends where near bank stress would be a concern. Gravel augmented riffles may also be used where slope is gentle enough to allow their substitution instead of cross vanes. Given the low valley slope and anticipated low stream slope, anticipated structure use would be minimal. Detailed designs would be included in the mitigation banking instrument.

The appropriate restoration strategy for the incised segment of Live Oak Creek west of Penick road will be evaluated with a stream restoration designer once additional data is gathered. The stream is incised 2-4 feet. It may be possible to raise the streambed at the riffles with structures and install structures to reduce near bank stress at eroding bends. This approach would be more structure intensive and could pose greater risk of failure versus constructing a new channel on the floodplain and filling the old channel. Wildwood is a member of the riverSHARED network of stream practitioners and has a working relationship with several qualified stream designers that will be consulted for the design.

Construction Sequencing and Methodology

The following describes the construction methods, timing and sequence, and soil management and erosion control measures on a general step by step basis:

Step 1 – Install Fencing

Fencing would be established as needed to ensure livestock remain excluded from the site. Temporary fence (i.e., electric) may be used, if necessary, to facilitate construction activities. Upon completion of construction, any areas where temporary fence was used to facilitate construction would be permanently fenced as needed to ensure livestock remain excluded from the site.

Step 2 – Install Soil Management & Erosion Control Measures

Soil management and erosion control measures would be in place prior to initiation of construction and would be maintained as the project was underway. Silt fence, hay socks, hay bales, etc. to prevent offsite movement of suspended sediments would be in place during the construction process and following until the site is revegetated.

Step 3 – Stream Re-establishment

Live Oak Creek will be re-established to a natural stable meandering pattern throughout the project site using excavators, dirt movers, bulldozers, and dump trucks. This work is expected to occur during the dry season to reduce risks of erosion. Live stakes of black willow and sod mats will be used to allow the channel to revegetate and stabilize stream banks. Disturbed areas would be seeded upon completion of construction.

Step 4 – Wetland Re-establishment, Rehabilitation, and Enhancement

Concurrent with stream restoration activities, wetlands would be reestablished using earth movers, bulldozers, excavators, and dump trucks. Material excavated from near the existing Live Oak Creek channel will be used to supplement the fill requirements of the channel. Other material will be placed on the downslope side of re-established depressions as low elevation berms (0.5 to 1.0 foot above grade) to improve short-term retention of stormwater. In some areas topographic complexity within the floodplain will be enhanced by using material to re-establish low elevation mounds to mimic mima mounds.

Step 5 – Revegetation

All non-wetland and temporarily flooded and saturated wetlands will be reseeded with native coastal prairie vegetation. Temporarily to semi-permanently flooded wetlands will be monitored to determine if transplanting with herbaceous wetland plants will be necessary to achieve performance standards. Observations of restored wetlands at the Indiangrass Preserve and at nearby wetland construction projects indicates that minimal transplanting will be required, and that vegetation becomes naturally established in a short time frame. A conceptual seed mix is provided in Table **17**.[11] This mix may be adjusted to reflect greater proportions of hydrophytic vegetation and may vary depending on the source of the seed acquired (e.g. the coastal prairie seed mix available from Native American Seed).

Table 17. Conceptual native prairie seed mix.

Seed Variety	% of Mix	Planting Rate (Lbs. PLS/ac.)
Blackwell switchgrass	5%	0.10
Carrizo Blend little bluestem	25%	2.00
Duval Germplasm red lovegrass	20%	0.20
Haskell sideoats grama	5%	0.25
Lavaca Canada wildrye	10%	1.00
Mariah Germplasm hooded windmillgrass	10%	0.10
Welder Germplasm shortspike windmillgrass	10%	0.10
Wilson Germplasm indiangrass	15%	0.60
Total	100%	4.35
Forbs and Legumes		
Commanche Partridge pea	5%	0.65
Eldorado Englemann's daisy	5%	0.75

Step 6 – Invasive Species Control

Invasive species control will be accomplished primarily using herbicides throughout the construction process and during the maintenance and long-term management periods. Initial applications may consist of broadcast methods for invasive herbaceous species and over time transition to directed single plant applications as densities of invasive species decrease at the site. Invasive woody plants such as Chinese privet and Chinese tallow will be controlled by stem injection, basal bark applications and foliar applications for smaller plants.

Step 7 – Post-project Monitoring and Maintenance

Bank monitoring, reporting, and long-term management is discussed in the following sections.

3.3 Performance Standards

In accordance with 33 CFR 332.5 performance standards shall be ecologically based criteria that will be used to determine whether the bank is achieving its objectives.

[11] Seed mix obtained from the Coastal Prairie Native Seed Project, Caesar Kleberg Wildlife Research Institute for Sandy Gulf Coast Prairies and Marshes in Waller County: https://www.ckwri.tamuk.edu/sites/default/files/2019-11/gulf_coast_prairies_-_sandy_8.pdf

1. Prior to initial credit release the sponsor shall provide to the U.S. Army Corps of Engineers, a copy of a conservation easement recorded with the Waller County Clerk that has been approved by the U.S. Army Corps of Engineers in coordination with the Interagency Review Team.
2. Prior to initial credit release the sponsor shall provide to the U.S. Army Corps of Engineers a copy of an established and executed financial assurance approved by the U.S. Army Corps of Engineers in coordination with the Interagency Review Team.
3. Prior to initial credit release the sponsor shall provide to the U.S. Army Corps of Engineers a copy of an established and executed long-term management fund with a first deposit made.
4. Within five calendar years of the date of the initial credit release, the sponsor shall fully fund the long-term management fund.
5. Within thirty-six (36) months of the date of the initial credit release, the sponsor must provide the U.S. Army Corps of Engineers and Interagency Review Team an as-built report with plan drawings (to scale) that include elevations and horizontal distances and a signed statement demonstrating that construction, including hydrologic improvements, and planting / seeding, is complete and compliant with the entirety of the mitigation work plan.
6. Within two calendar years of the U.S. Army Corps of Engineers receipt of the as-built report the sponsor must achieve and maintain a minimum of fifty (50) percent aerial cover of herbaceous plant species either identified in the planting list or other native hydrophytic species naturally recruited throughout the site. Within wetlands at least sixty-six (66) percent of the aerial cover of the plant community present must comprise plant species with wetland indicator status of FACW or OBL.
7. Within four calendar years of the U.S. Army Corps of Engineers receipt of the as-built report the sponsor must achieve and maintain a minimum of eighty (80) percent aerial cover of herbaceous plant species either identified in the planting list or other native hydrophytic species naturally recruited throughout the site. Within wetlands at least sixty-six (66) percent of the aerial cover of the plant community present must comprise plant species with wetland indicator status of FACW or OBL.
8. Within four calendar years of the U.S. Army Corps of Engineers receipt of the as-built report, all herbaceous wetland areas must contain less than twenty (20) percent aerial cover of unvegetated, open water.
9. Within four calendar years of the U.S. Army Corps of Engineers receipt of the as-built report, at least twenty (20) native herbaceous plant species shall be present within the bank with one percent or greater aerial cover.
10. Within four calendar years of the U.S. Army Corps of Engineers receipt of the as-built report, Deep-rooted sedge (*Cyperus entrerianus*), Macartney rose (Rosa bracteate), trifoliate orange (*Citrus trifoliata*), privets (*Ligustrum* spp.), elephant ear (*Colocasia esculenta*), Johnson grass (*Sorghum halepense*), cogon grass (*Imperata cylindrica*), bermudagrass (*Cynodon dactylon*), Vasey's grass (*Paspalum urvillei*) and all other non-native improved pasture grasses, and all species listed by the most current Texas Department of Agriculture Noxious and Invasive Plant List (Title 4, Part 1, Chapter 19, Subchapter T, §19.300 of the Texas Administrative Code) must comprise less than five (5) percent of the herbaceous and shrub/sapling stratum and zero (0) percent of the tree stratum.
11. Prior to a bankfull event credit release and the final stream credit release, the sponsor must document that Live Oak Creek's bank height ratio, pool to pool spacing, and meander width ratio are within the range of the reference reach data using the monitoring protocol. In-stream structures must be stable and functioning.

3.4 Monitoring Requirements

Monitoring of the site would be performed to determine whether the project is on track to meet performance standards or if adaptive management is needed. Monitoring would be performed annually for the first ten years following signature of the mitigation banking instrument or until all performance standards have been met, whichever is later. Monitoring would be conducted as follows:

1. Infrastructure:

    i. Monitoring of infrastructure would consist of annual inspection of boundary markers (fencing, signage, etc.), and access gates. If deficiencies are found they would be documented, included in the annual report, and corrected according to the maintenance plan as soon as practicable.

2. Vegetation:

    i. Following construction, permanent monitoring stations would be established within each wetland assessment area and within the riparian buffer of Live Oak Creek. Each plot would be permanently marked, and the location recorded with a GPS unit. Vegetation monitoring would be made annually, at a consistent time late in the growing season.

    ii. Number of Stations:

        1. The number of monitoring stations would be determined prior to submittal of the draft mitigation banking instrument.

    iii. Annual Vegetation Monitoring Protocol

        1. Annually for the first ten years following signature of the mitigation banking instrument or until all performance standards have been met, whichever is later, each station would be visited at a consistent time late in the growing season. From the station, digital photographs would be taken facing north, east, south, and west for comparison with other years.

    iv. Quantitative Vegetation Monitoring

        1. Following the initial credit release, quantitative monitoring would be performed in year's corresponding with subsequent credit releases or associated with specific quantitative performance standards. Herbaceous and scrub-shrub vegetation would be assessed using quadrats (1 m^2) placed on alternating sides of a transect at each of the odd-numbered intervals (1m, 3m, 5m, 7m, and 9 m.). The transects would originate at a monitoring station and be in a cardinal direction selected randomly at the time of each survey (e.g. one year possibly going north and the next year possibly going in a different direction). The herbaceous cover within each of the five quadrat samples would be identified and absolute percent cover will be estimated for each transect. All vegetation would be

identified to the lowest possible taxonomic group and categorized by the most recently published National Wetland Plant List's wetland indicator status.

3. Hydrology

    i. Annual Hydrology Monitoring Protocol

        1. Indicators of hydrology as described in the 1987 Manual (U.S. Army Corps of Engineers, 1987) and the Atlantic and Gulf Coastal Plain Regional Supplement (U.S. Army Corps of Engineers, 2010) would be recorded for all vegetation monitoring stations during each monitoring event.

    ii. Quantitative Hydrology Monitoring

        1. Following submittal of the as-built report, hydrology within representative portions of the re-established wetland assessment areas would be monitored using piezometers. The piezometers would be placed at the lowest, highest, and midpoint elevations of each respective area. Data from these recorders would be continually collected and compiled annually. The data would be correlated to hydrology field indicators sampled and observed throughout the site at the other permanent monitoring locations as well as local precipitation data and stream gage height sampled at the Harris County Flood Control District's gage located onsite on Live Oak Creek or at another nearby site if this is not available. These data would be graphed and compared to previous years' data to determine the level of conformance with the performance standards.

        2. Quantitative hydrological monitoring would cease upon the achievement of all wetland performance standards.

4. Wetland Function Monitoring

    i. Following the initial credit release, the results of an iHGM analysis would be performed in year's corresponding with credit releases or associated with specific quantitative wetland performance standards. Wetland function would be assessed using the appropriate iHGM model based on the hydrological and vegetation monitoring results. This analysis would be used as the basis for credit releases following submittal of the as-built report.

5. Stream Monitoring

    i. Bankfull Events

        1. Bankfull events would be documented as they occur during the monitoring period using data obtained from the onsite Harris County

Flood Control gage or direct on-site observation of floodwater and or evidence of drift deposits, drainage patterns, etc.

ii. In-Stream Structures

1. A visual assessment of instream structures would be conducted annually to determine if they are functioning.

iii. Lateral Stability

1. Lateral stream stability would be monitored using the meander width ratio measured at permanent locations within each reach. This data would be compared to the range of data observed from reference reaches used to design the stream as well as those parameters described in "A Function-Based Framework for Stream Assessment & Restoration Projects" (Harman W. , et al., 2012).

2. Lateral stability monitoring would cease upon the release of all stream credits.

iv. Floodplain Connectivity

1. Floodplain connectivity would be monitored by measuring the bank height ratio at permanent monitoring stations established at riffles within each reach. This data would be compared to the range of data observed from reference reaches used to design the stream as well as those parameters described in "A Function-Based Framework for Stream Assessment & Restoration Projects" (Harman W. , et al., 2012).

2. Floodplain connectivity monitoring would cease upon the release of all stream credits

v. Bed Form Diversity

1. Within each reach a permanent section would be established to monitor pool to pool spacing. This data would be compared to the range of data observed from reference reaches used to design the stream as well as those parameters described in "A Function-Based Framework for Stream Assessment & Restoration Projects" (Harman W. , et al., 2012).

2. Bed form diversity monitoring would cease upon the release of all stream credits.

3.5 Reporting Requirements

The sponsor would provide annual monitoring reports in hard copy and in editable electronic format to the U.S. Army Corps of Engineers and Interagency Review Team. Annual monitoring reports would be submitted by January 31 of each year for the preceding calendar year's activities.

Each monitoring report would contain the following:

1) Project Overview Section
    a. Corps Permit Number and Mitigation Bank Name
    b. Name and contact information of party responsible for monitoring and the date(s) monitoring was conducted
    c. A brief paragraph describing the purpose of the bank, and the acreage and type of work authorized to improve and protect aquatic resources.
    d. Written description of the location, and coordinates of the mitigation site (expressed as latitude/longitude).
    e. Dates the project commenced and/or was completed.
    f. Dates covered by the monitoring period.
    g. Short statement on whether the performance standards are being met.
    h. Dates of any recent corrective or maintenance activities conducted since the previous report submission.
    i. Specific recommendations for any additional corrective or remedial actions.
2) Requirements Section
    a. List the monitoring requirements and performance standards, as specified in the mitigation banking instrument, and evaluate whether the bank is successfully achieving the approved performance standards or trending towards success. A table would be created to compare the performance standards to the conditions and status of the site.
3) Summary Data Section
    a. Summary data would be provided to substantiate the success and/or potential challenges associated with the bank. Photo documentation would be provided to support the findings and recommendations referenced in the monitoring report and to assist the U.S. Army Corps of Engineers in assessing whether the compensatory mitigation project is meeting applicable performance standards for that monitoring period. Submitted photos would be formatted to print on a standard 8 ½" x 11" sheet of paper, dated, and clearly labeled with the direction from which the photo was taken. The photo location points would also be identified on a map included with the report.
4) Maps and Plans Section
    a. Maps would be provided to show the location of the mitigation site relative to other landscape features, habitat types, and locations of photographic reference points, sampling data points, and/or other features pertinent to the mitigation work plan. Maps would clearly delineate the bank perimeter. Each map and diagram would be formatted to print on an 8 ½ x 11 sheet of paper. As-built plans may be included.
5) Conclusions Section
    a. A general statement would be included that describes the condition of the bank. If performance standards are not being met, then a description of the difficulties and potential remedial actions proposed by the sponsor including a timetable would be provided.
6) Copy of the Credit Ledger
    a. An annual ledger report would be included with the annual monitoring report. The sponsor would compile an annual ledger report showing the beginning and ending balance of available credits and permitted impacts for each resource type, all additions and subtractions of credits, and any other changes in credit availability (e.g., additional credits released, credit sales suspended). The ledger report is part of

the administrative record for the mitigation bank or in-lieu fee program. The U.S. Army Corps of Engineers would make the ledger report available to the public upon request.

7) Financial Assurance and Long-term Management Funding Report
    a. A financial assurance and long-term management fund report would be included with the annual monitoring report. The report would include an itemization of all account activity related to the long-term management fund for the reporting year and an assessment of the fund's current performance to reasonably ensure perpetual funding for long-term management.
8) Conservation Easement Holder Report
    a. The conservation easement holder would monitor the site annually. The sponsor would provide a copy of the conservation easement holder's most recent signed and dated annual report within the annual monitoring report.
9) As-built Report (reported one time only)
    a. Upon completion of the proposed construction and reforestation activities, an as-built report would be provided within the following annual monitoring report, or sooner, to document post construction conditions and compare them to planned conditions.

3.6 Long-Term Management

The long-term owner and steward of the bank would be the sponsor. The sponsor will act as the long-term steward through its agent, but at any time may choose to assign this role to a Corps-approved entity.

Implementation of long-term management practices would be necessary to maintain the bank as a prairie ecosystem once restoration activities have occurred. A long-term management plan, including an itemized budget, will be included in the draft mitigation banking instrument. Anticipated long-term management needs include invasive plant control using chemical and mechanical means on a biennial basis, posting and/or fencing of the boundary as needed, prescribed fire, nuisance wildlife control, monitoring, and coordination by the steward.

The long-term management plan will be funded by a non-wasting endowment held by the Texas Parks and Wildlife Foundation. The endowment will be funded incrementally as a prerequisite to credit releases. The sponsor proposes to fully fund the endowment within five years of the initial credit release. Funding of the endowment would include provisions to address inflationary adjustments and cost contingencies. Additional details would be provided in the draft mitigation banking instrument.

3.7 Site Protection

Prior to the release of credits, the sponsor would protect the bank site in perpetuity through the use of an appropriate, U.S. Army Corps of Engineers-approved, conservation easement held by a third party. The sponsor proposes to use the Katy Prairie Conservancy as the third-party easement holder. The Katy Prairie Conservancy holds conservation easements on thousands of acres surrounding the bank site. Katy Prairie Conservancy is an accredited land trust by the Land Trust Accreditation Commission and is a member of the Texas Land Trust Council and the Land Trust Alliance. A letter of intent to hold the conservation easement has been provided by the Katy Prairie Conservancy and it is included as **APPENDIX F**.

4 ASSURANCE OF SUFFICIENT WATER RIGHTS

Hydrology at the site would be supplied by direct precipitation, surface rainfall runoff, and overbank flooding of Live Oak Creek. Restoration activities would involve excavating fill previously cast into wetland depressions. These depressions, once restored, may hold state water in the event of an overbank flood. However, these depressions would be partially filled with surface rainfall runoff and direct precipitation prior to a flood event. Water budgets developed using site specific environmental data will be applied to the design to determine how much state water may be stored in the event of an overbank flood. The results of this analysis and the design will be used to coordinate with the Texas Commission on Environmental Quality to determine if a water rights permit is required prior to submittal of the mitigation banking instrument.

5 PROPOSED SERVICE AREA

5.1 Credit Types and Use

The bank would have two credit types: herbaceous/scrub-shrub wetland credits and stream credits. Herbaceous/scrub-shrub wetland credits would be used for impacts to freshwater non-forested wetlands as defined by the Classification of Wetlands and Deepwater Habitats of the United States (Cowardin, Carter, Golet, & LaRoe, 1979).[12] Stream credits would only be used for impacts to streams. Use of the bank's credits would be limited to only in-kind wetland compensation.

Due to the prolific nature of Chinese tallow throughout the historic prairie wetlands within the service area, the sponsor proposes that herbaceous/scrub-shrub wetland credits may be utilized to offset permitted impacts to certain forested wetlands within the service area. Herbaceous/scrub-shrub wetlands credits may be utilized to compensate for forested wetland impacts within the service area only under the following conditions: 1) greater than 95 percent of the trees within impacted wetlands are Chinese tallow; and 2) the wetlands are not located within NRCS SSURGO soil map units identified as being wooded under natural conditions; and 3) the maximum functional score of impacted wetlands is assumed (an FCI of 1.0 for each function). If these three conditions are met, then the herbaceous/scrub-shrub wetland credits could be utilized to compensate for impacts to certain forested wetlands within the service area.

5.2 Service Area

The bank will have a primary and secondary service area based on the U.S. Geological Survey (USGS) 8-digit and 10-digit Hydrologic Unit Code (HUC) system. The primary service area would be defined as the entire 8-digit HUC that the bank is located within and the 10-digit HUCs that receive water from the Cypress Creek Overflow (Harris County Flood Control District, Harris County, and TWDB, 2015). The primary service area encompasses HUC 12040102 (Spring), HUC 1204010402 (Addicks Reservoir), HUC 1204010403 (Whiteoak Bayou-Buffalo Bayou), HUC 1204010406 (Greens Bayou), HUC 1204010407 (Buffalo Bayou – San Jacinto River), and HUC 1204010407 (East Fork Goose Creek – Frontal Galveston Bay). The secondary service area is defined as the following 8-digit HUCs: HUC 12040101 (West Fork San Jacinto), HUC 12040204 (West Galveston Bay), HUC 12040203 (North Galveston Bay), and HUC 12040205 (Austin-Oyster). The secondary service area also includes the following 10-digit HUCs: HUC 1204010401 (Barker Reservoir), HUC 1204010404 (Brays Bayou), and HUC 1204010405 (Sims Bayou). Debiting ratios for service areas will be as follows: Primary Service Area 1:1, Secondary Service Area 1.5:1. **Figure 27** is a map of the bank service area.

The service area specifically excludes the following: Galveston Island, Follets Island, and all lands owned, leased, or managed by Texas Parks and Wildlife Department.

<u>Primary Service Area Rationale</u>

The primary service area encompasses the entire Spring Subbasin HUC 12040102 which is the HUC the project is located within. It also includes those adjacent 10-digit HUCs that are within or downstream of

[12] Emergent wetland class is characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. The scrub-shrub wetland class includes areas dominated by woody vegetation less than 20 feet tall. The species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions.

the five-year floodplain of Cypress Creek. These areas are subject to flooding in a "typical year" as described by the Navigable Waters Protection Rule and considered adjacent and connected by the same storm event that determines the jurisdictional status of other depressional wetland features within the floodplain of Live Oak Creek and Cypress Creek.

The interchange between this area of the two subbasins is described in detail within "Final Study Report: Cypress Creek Overflow Management Plan" dated August 18, 2015 (see page 28 of the report) (Harris County Flood Control District, Harris County, and TWDB, 2015). Appendix A page 6 of that report indicates that "According to the USACE, approximately one-third of the volume of Addicks Reservoir on government land is relegated to overflows from the Cypress Creek watershed". On page 7 of the report, it states the following: "The overflow is predicted to occur about once every 5-10 years. The total number of times the Cypress Creek overflow has occurred has not been well documented; however, the overflow has been recorded five times in the past 30 years. Two of the largest overflow events were observed in October 1994 and October 1998; smaller overflow events were also recorded in 2002, 2003, and 2012". The Cypress Creek overflow area is presented in **Figure 4** below and **APPENDIX A – Figure 30**.

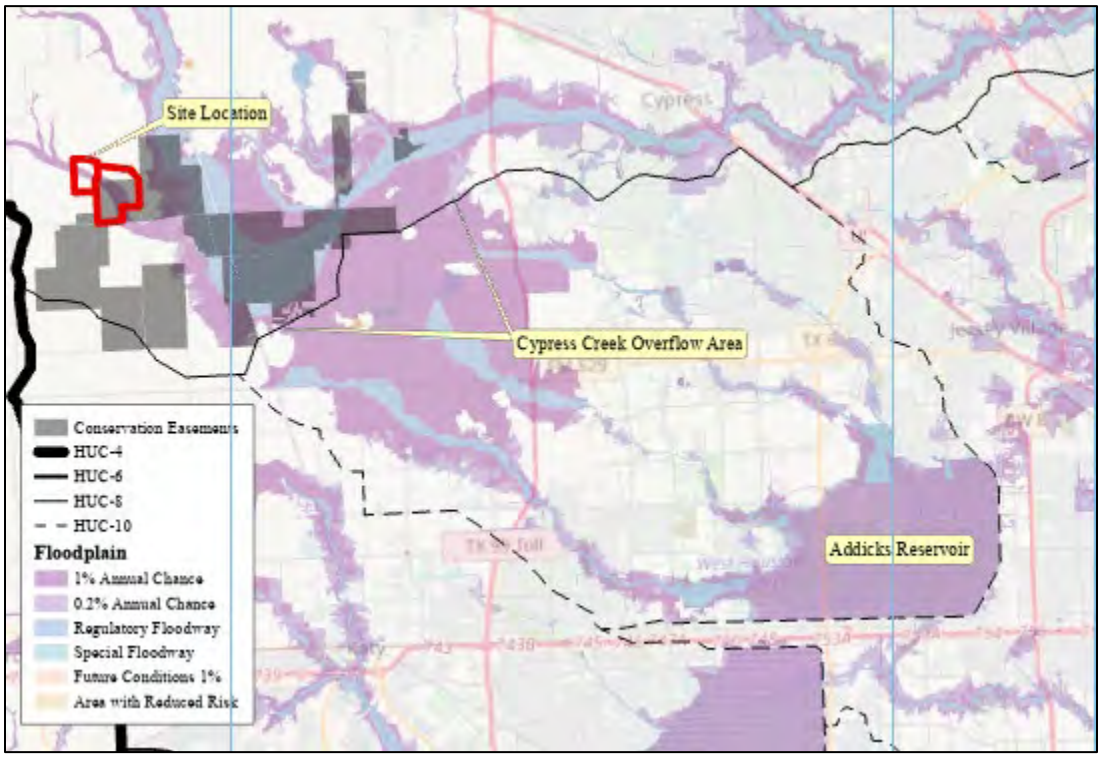

Figure 4. Cypress Creek overflow area crossing HUC-8 boundary.

Secondary Service Area Rationale

The secondary service area would be defined as the entire 8-digit HUCs that are adjacent to the primary service area HUCs within the Galveston Bay – San Jacinto basin. This includes HUC 12040101 (West Fork San Jacinto), HUC 12040205 (Austin-Oyster), HUC 12040204 (West Galveston Bay), and HUC 12040203 (North Galveston Bay). This also includes the three 10-digit HUCs within the remaining portion of HUC 12040104 (Buffalo-San Jacinto) that are not part of the primary service area. These areas

are all part of the Galveston Bay - San Jacinto basin with the Spring and West Fork San Jacinto both being a part of the smaller San Jacinto Basin. The Austin-Oyster, North Galveston Bay, and West Galveston Bay subbasins also share the Western Gulf Coastal Plain ecoregion in their entirety with the site.

6 QUALIFICATIONS OF THE SPONSOR

The sponsor has engaged with Wildwood Environmental Credit Company, LLC to manage the implementation, performance, and long-term stewardship of the project. Wildwood manages six permitted compensatory mitigation banks and two permittee-responsible mitigation sites in Texas and Oklahoma. These include the Pineywoods Mitigation Bank (SWF-2004-00458), Burleson Wetlands Mitigation Bank (SWF-2009-00189), Sea Breeze Mitigation Bank (SWG-2016-00086), Mill Creek Mitigation Bank (SWG-2008-00305), American Burying Beetle Conservation Bank (2014-F-0455), and Catcher Ranch Conservation Bank. Permittee-responsible mitigation sites include the mitigation site associated with SWF-2014-00303, and the Keystone McAlester Conservation Area associated with U.S. Fish and Wildlife permit number TE80492A-0. Wildwood also provides monitoring and reporting services for other compensatory mitigation projects in Texas and New Mexico and is in the process of permitting several other mitigation banks within the Galveston and Fort Worth regulatory districts.

Wild Horse Capital, LLC owns the bank site and several thousand acres surrounding the site. Over the years the sponsor has granted Katy Prairie Conservancy conservation easements on portions of their property and has a working relationship with the conservancy which abuts their property. The sponsor has a dedicated staff of land managers that oversee the property and its ongoing operations and maintenance.

7 CONCLUSION

In conclusion, the bank has high potential for rehabilitating, re-establishing, and enhancing approximately 243.5 acres of herbaceous/shrub wetlands and 12,400 feet of intermittent stream channel in Waller County, Texas. The site consists of historic prairie habitat that now exists primarily as agricultural land that has filled and drained relic wetland features. Implementation of the mitigation plan would result in the re-establishment and rehabilitation of herbaceous/shrub wetlands and reestablishment of intermittent stream channel. The bank will be established and operated in accordance to 33 CFR Part 332, *Compensatory Mitigation for Losses of Aquatic Resources*; Final Rule, dated April 10, 2008 (2008 Rule, 2008). Additional details will be provided in the draft Mitigation Banking Instrument.

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APPENDIX A - PROJECT MAPS

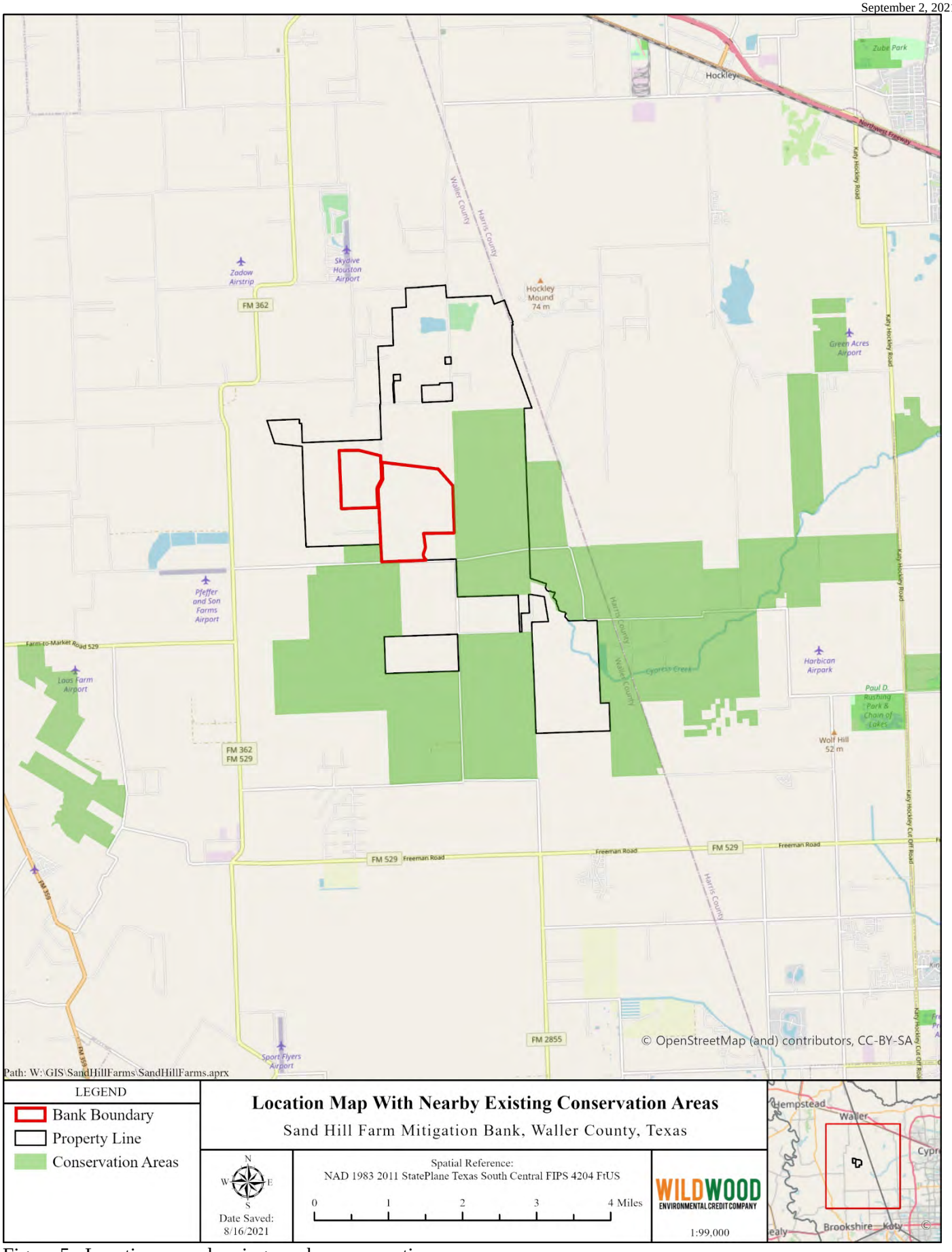

Figure 5. Location map showing nearby conservation areas.

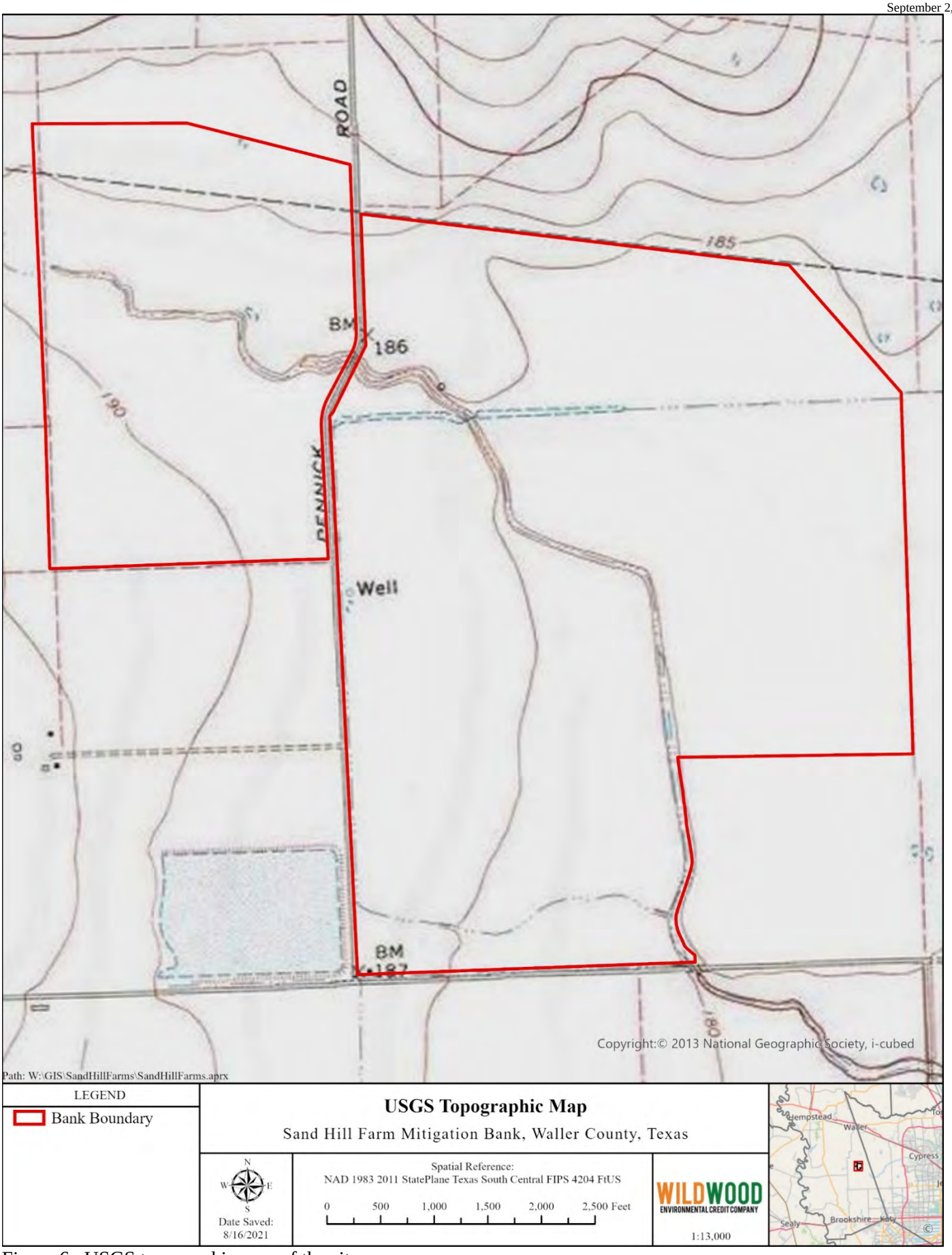

Figure 6. USGS topographic map of the site.

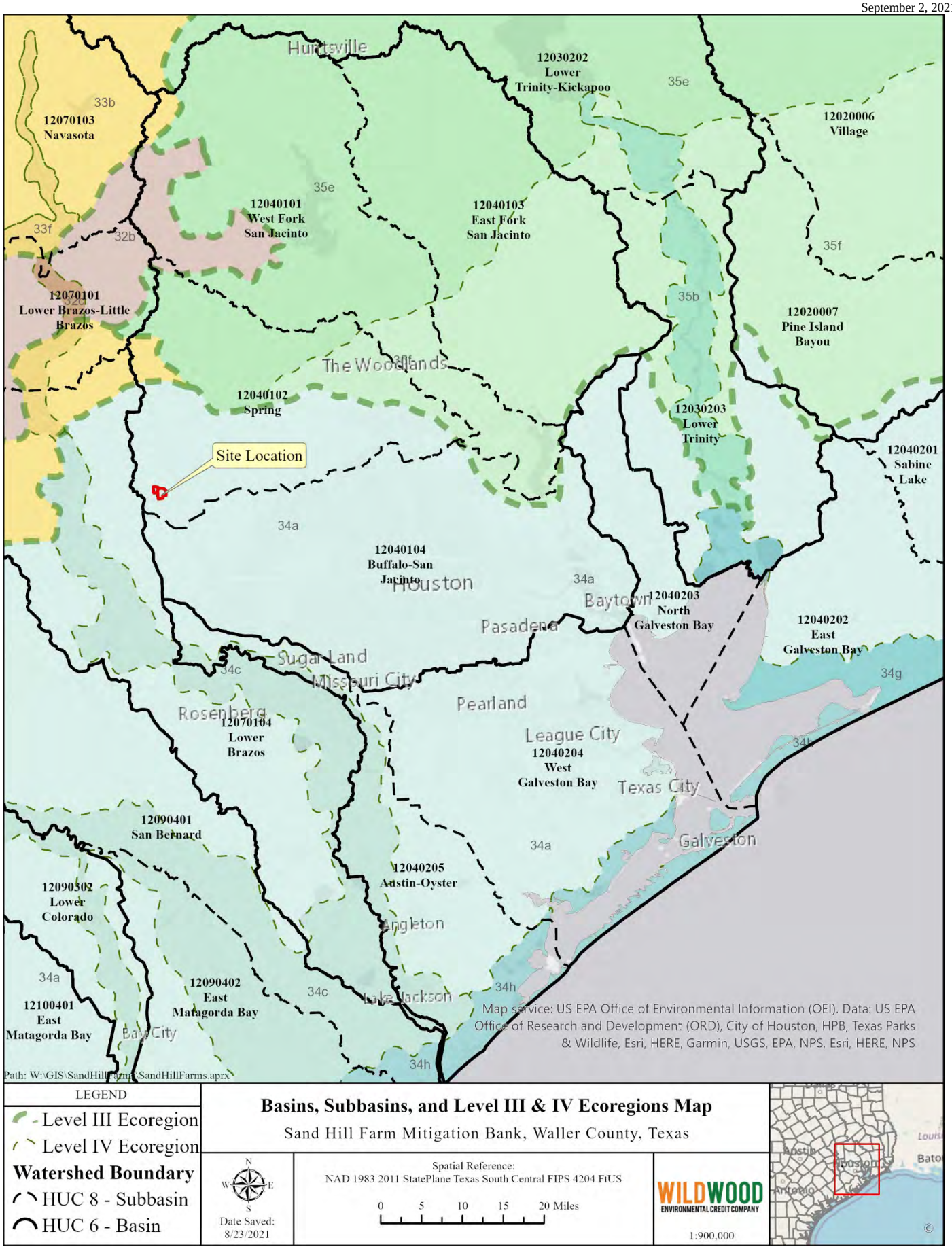

Figure 7. Area showing the Watershed Boundary Dataset and Omernik ecoregions.

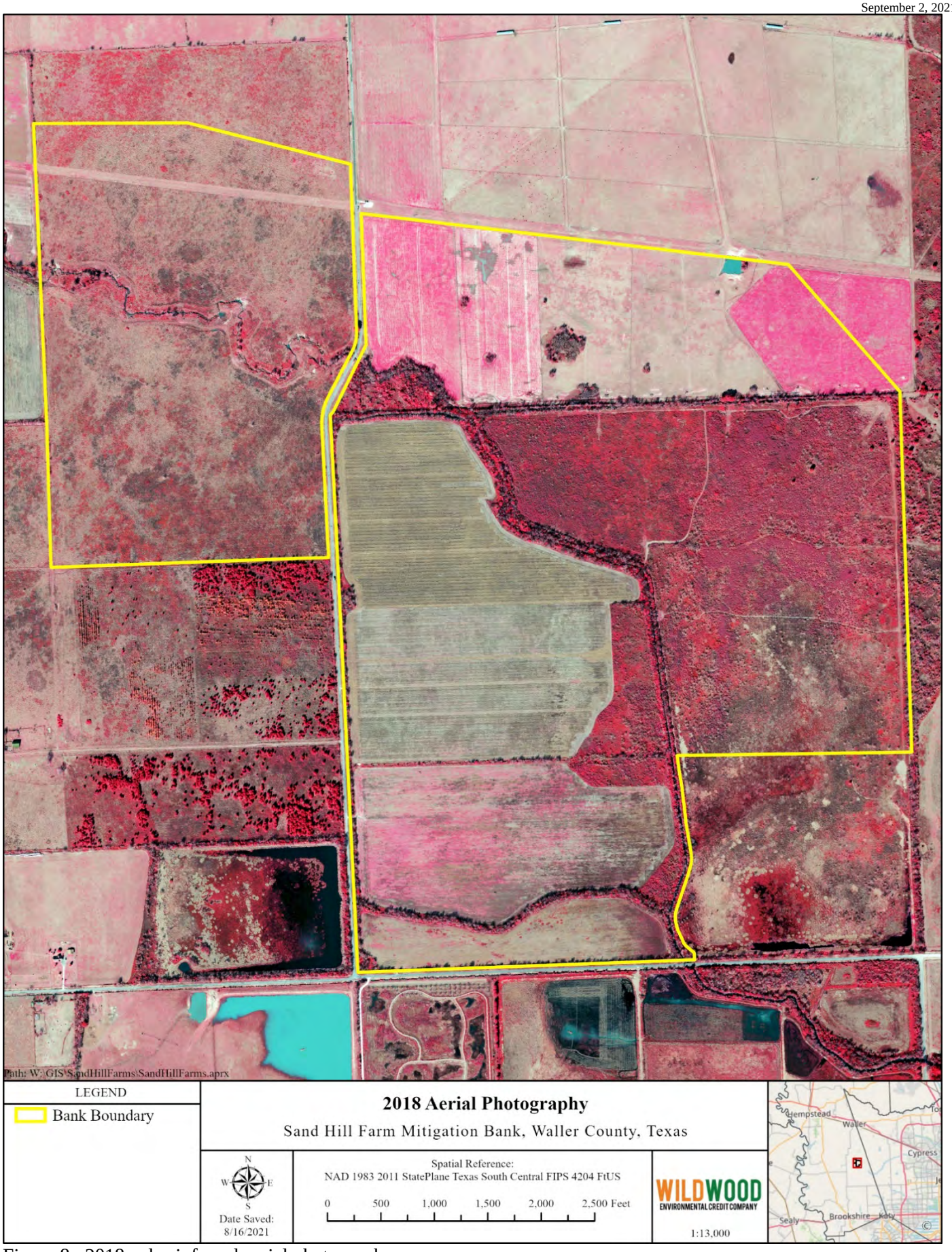

Figure 8. 2018 color infrared aerial photograph.

Figure 12. Aerial photograph of the site in 1964.

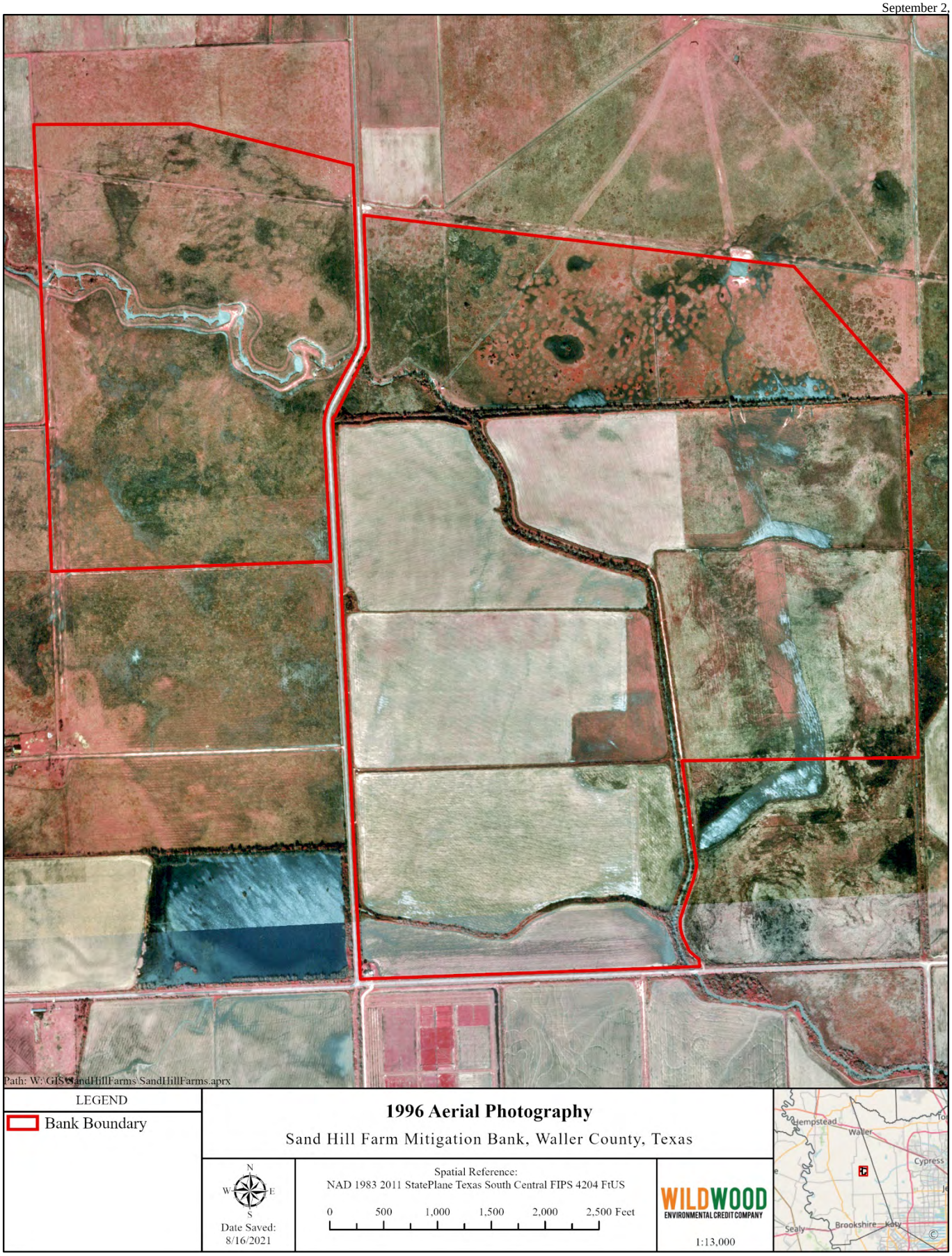

Figure 14. Aerial photograph of the site in 1996 showing farming activities ceasing in the southeast portion and becoming fallow.

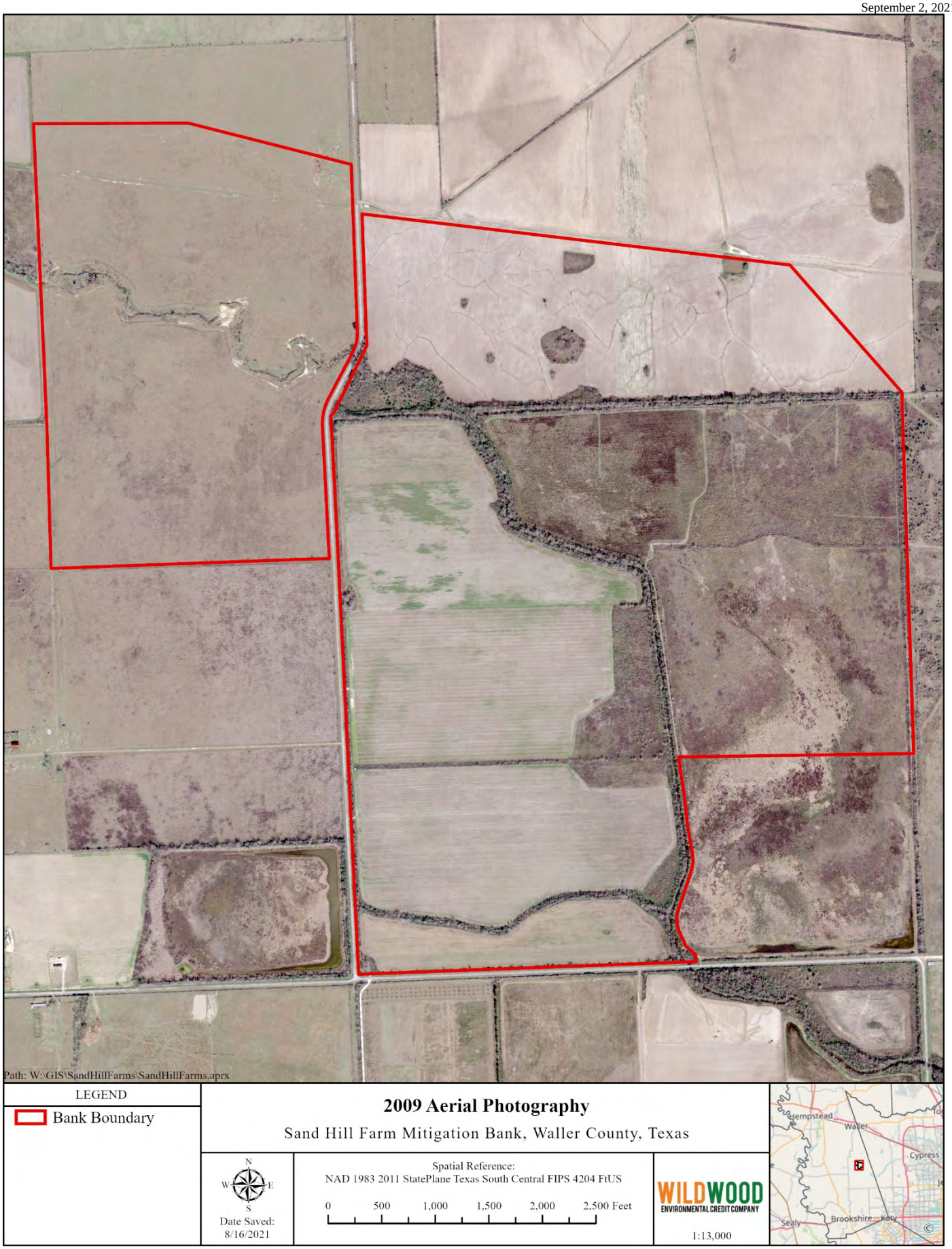

Figure 15. Aerial photograph of the site in 2009.

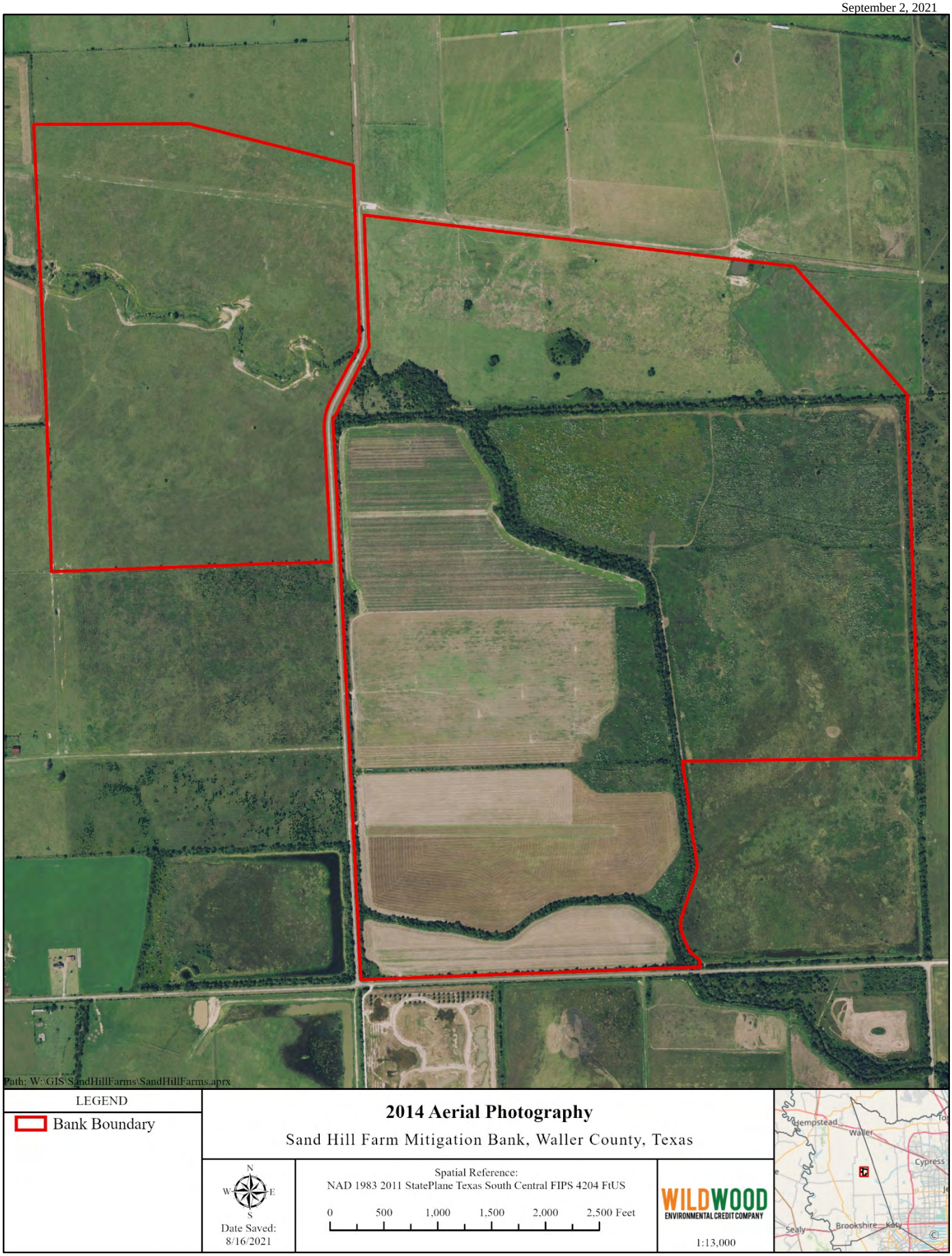

Figure 16. Aerial photograph of the site in 2020 showing the southeastern portion being fallow.

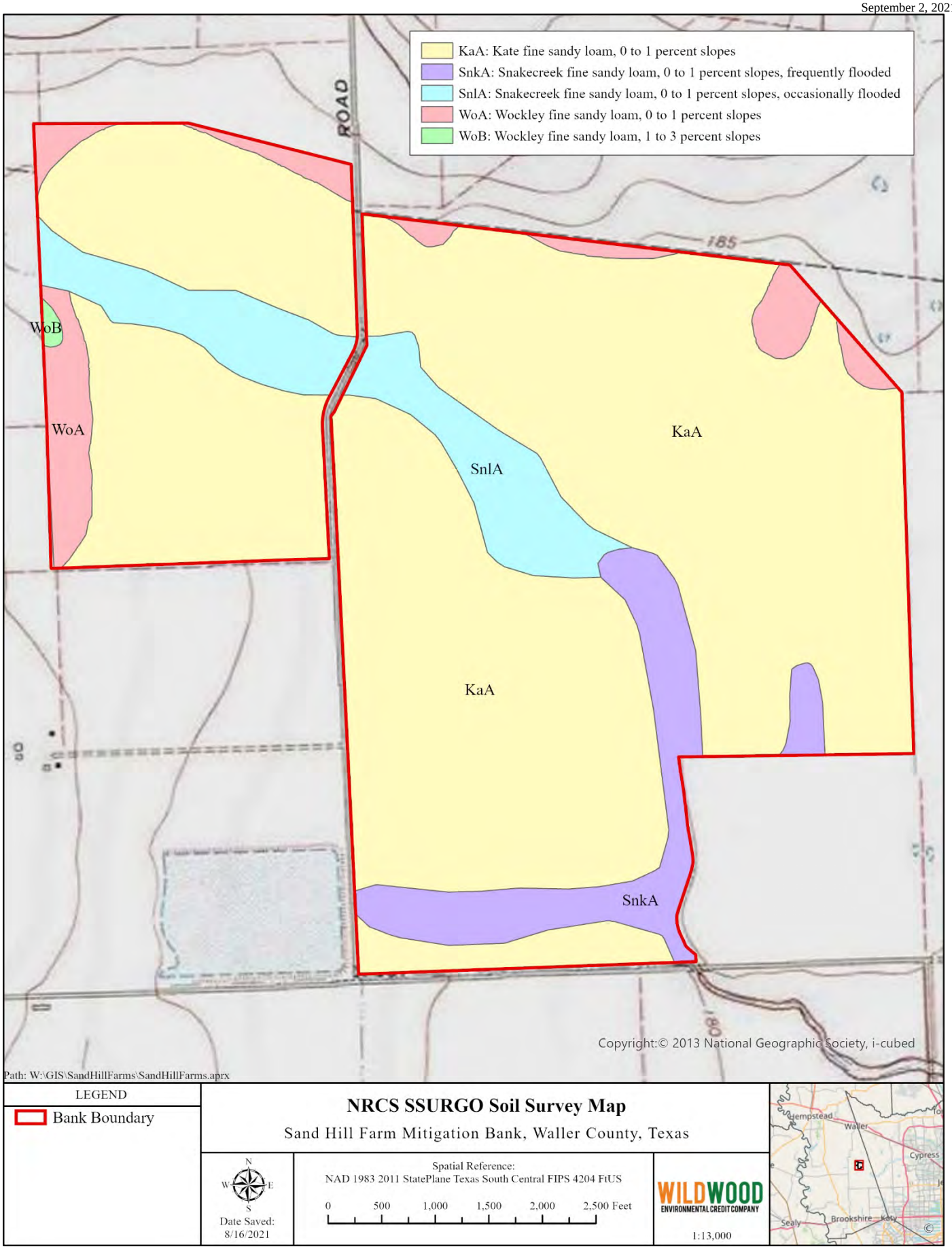

Figure 18. NRCS SSURGO Soil survey map of the site over the USA Topo Map base layer.

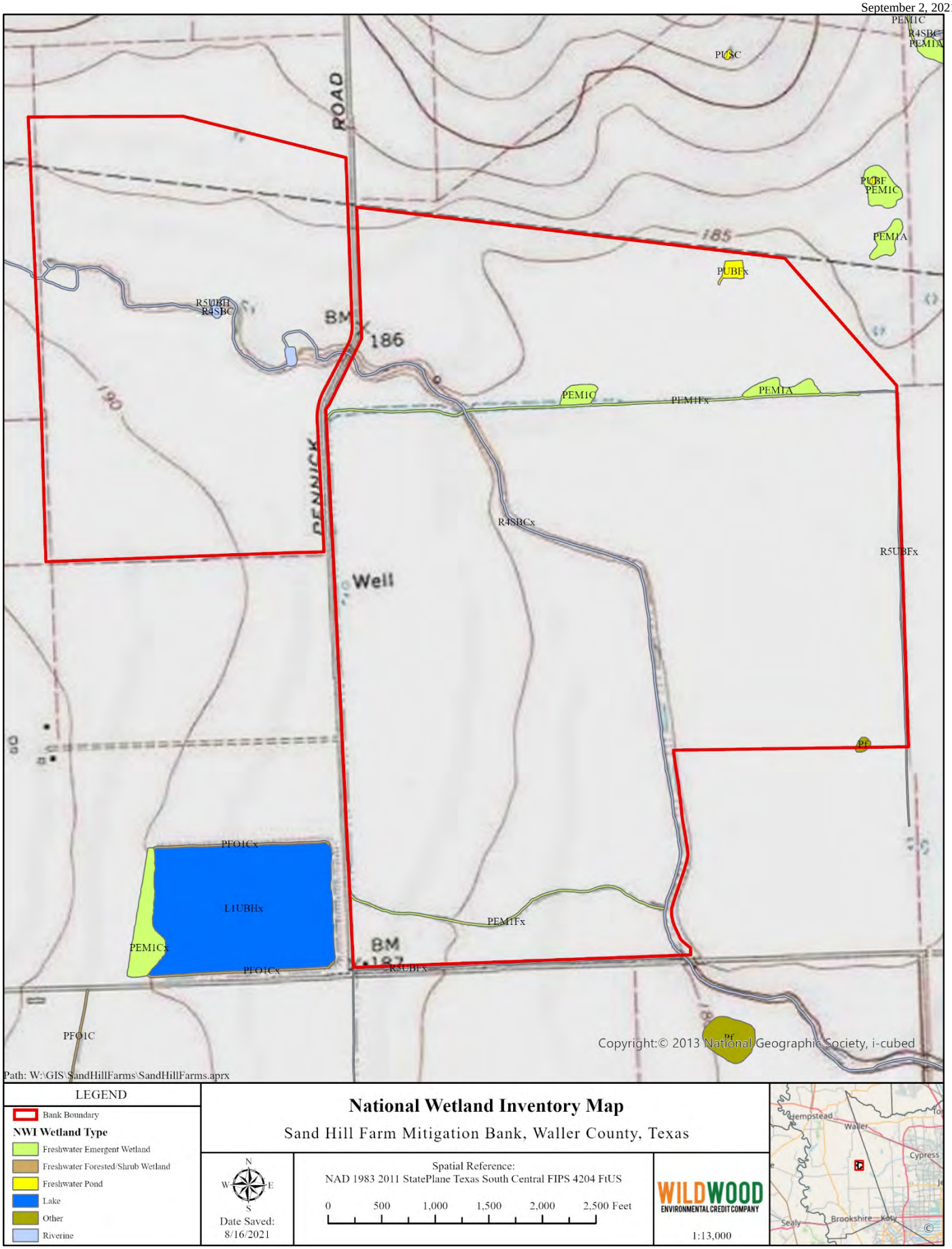

Figure 19. National Wetland Inventory classification of the site.

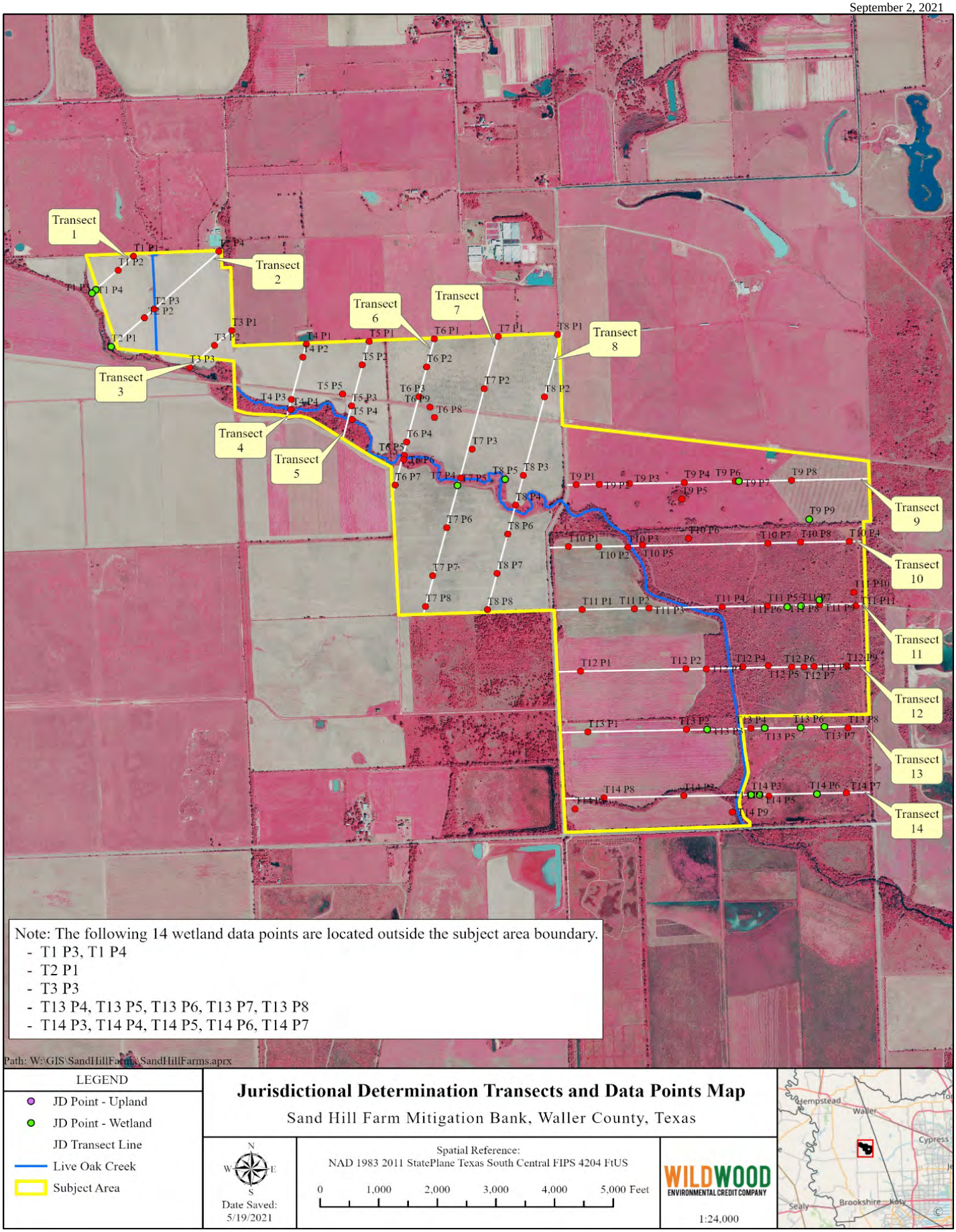

Figure 21. Jurisdictional delineation map that includes transects, data points, and Live Oak Creek.

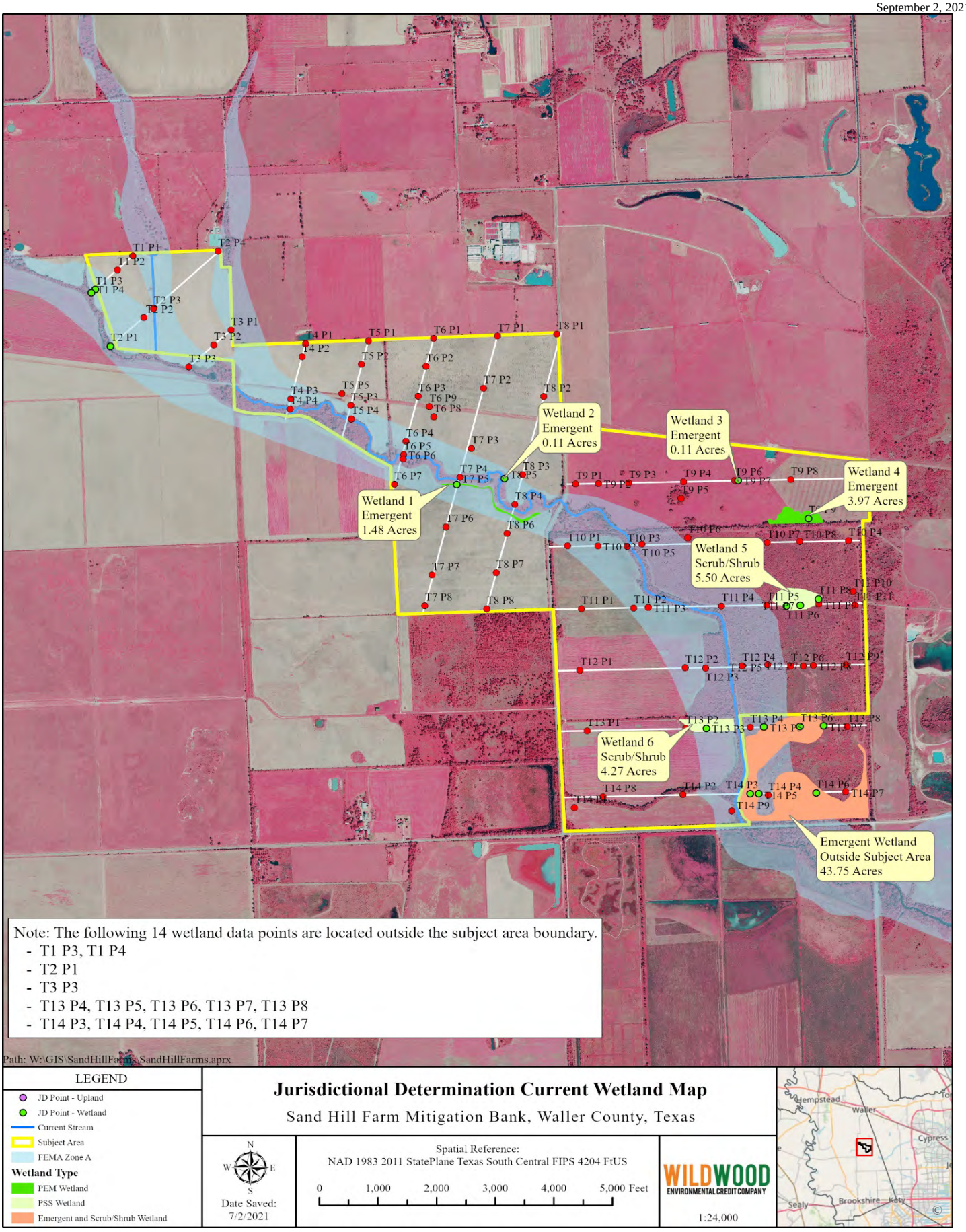

Figure 22. Jurisdictional delineation map that includes wetlands, transects, data points, and Live Oak Creek

Figure 23. Map showing the location of Live Oak Creek, ditches, and open water / pond.

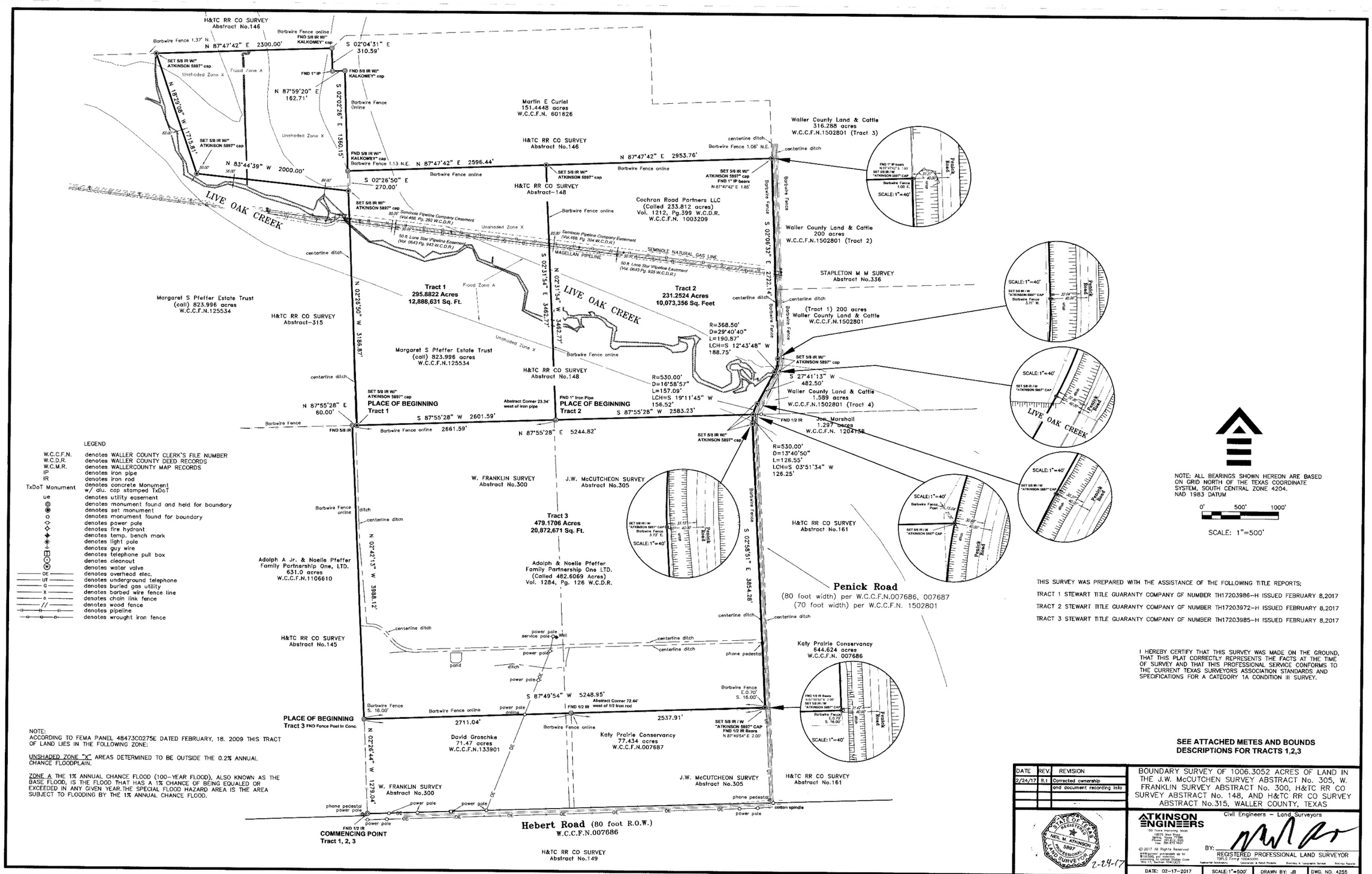

Figure 24. Location of existing and adjacent easements west of Penick Road.

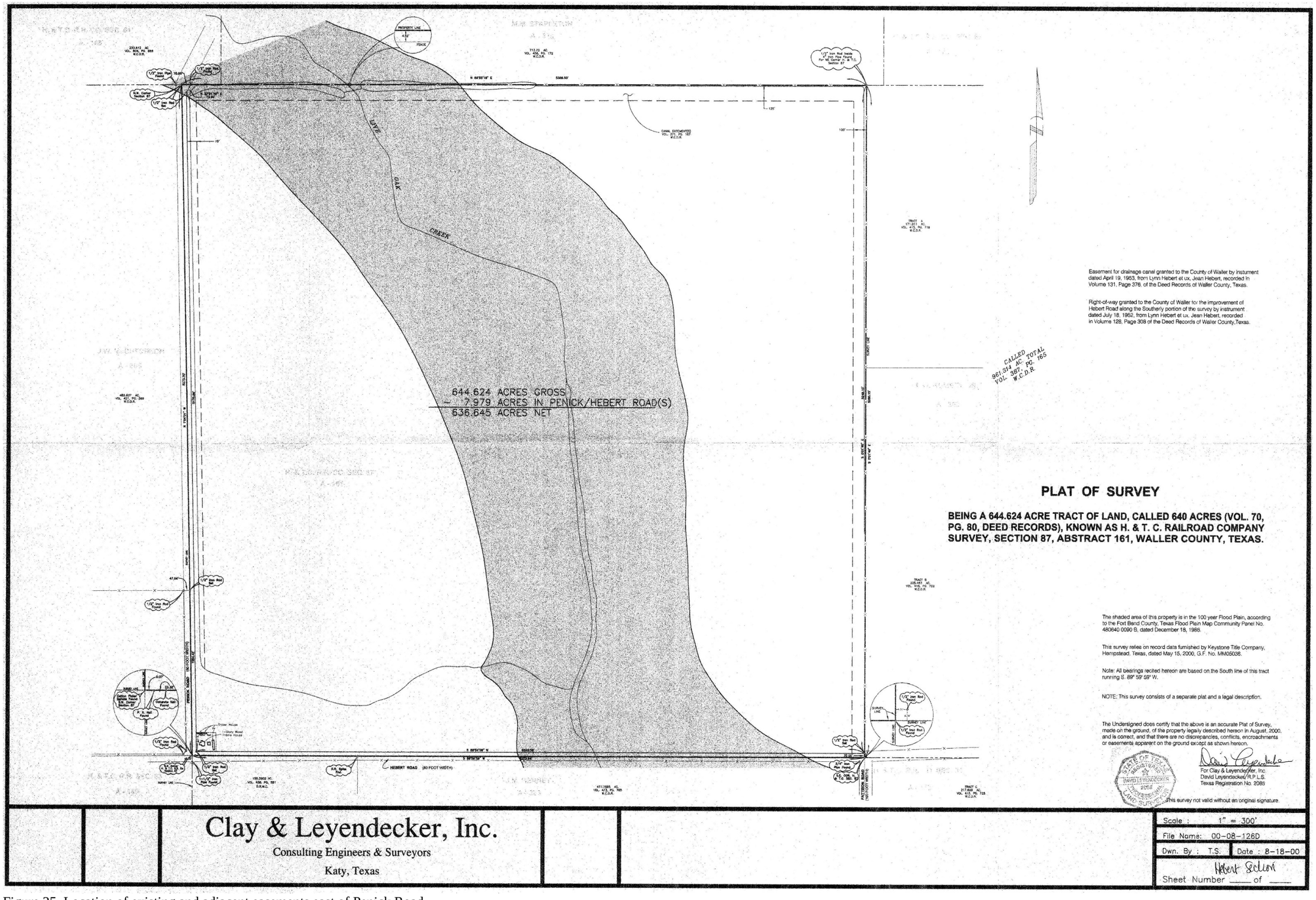

Figure 25. Location of existing and adjacent easements east of Penick Road.

Figure 27. Proposed service area map.

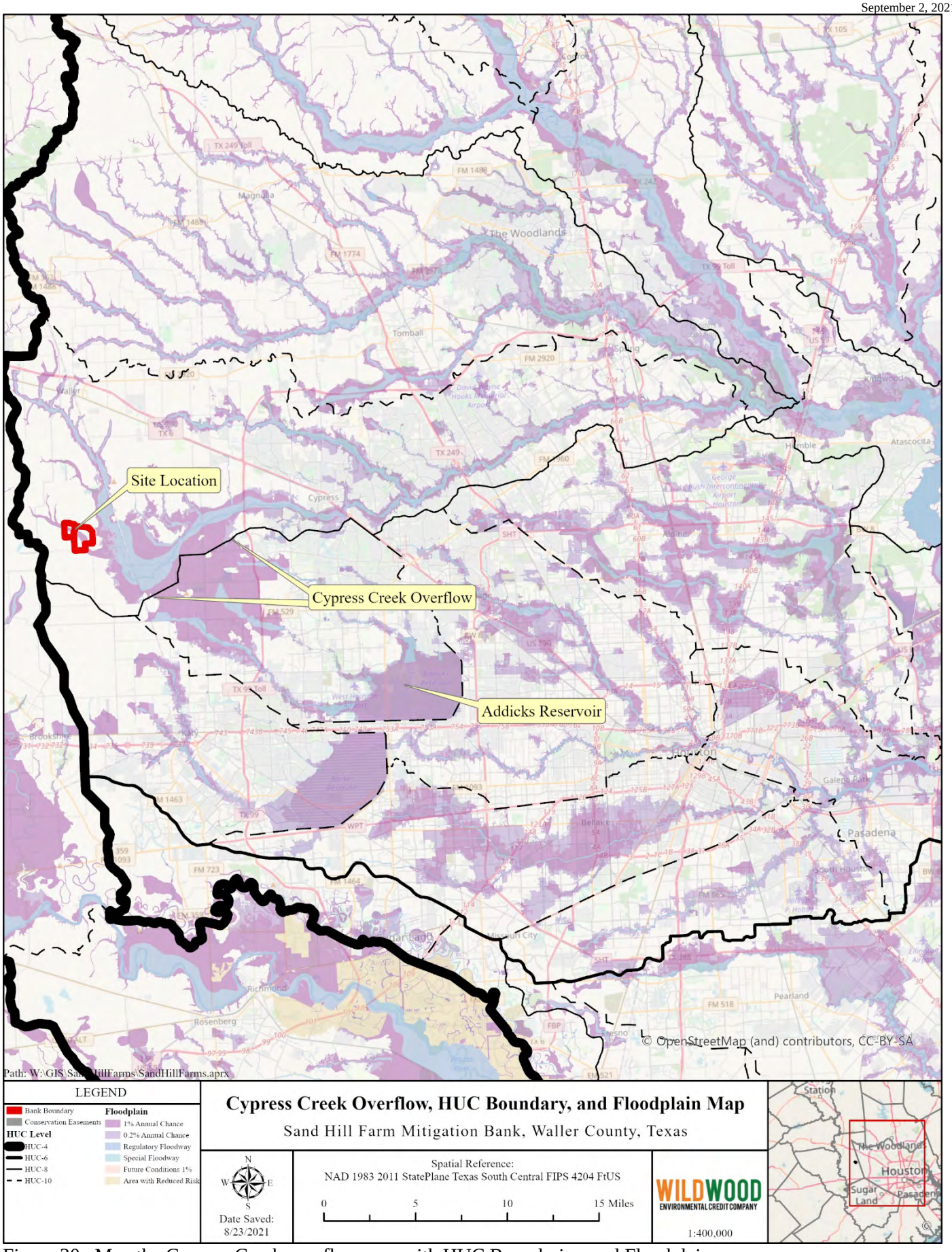

Figure 30. Map the Cypress Creek overflow area with HUC Boundaries, and Floodplains.