Mitigation Banking Instrument
Cow Island Bayou Mitigation Bank
Liberty County, Texas
SWG-2013-00223

Sponsor: Third Texas Resource, LLC
Agent: RES

Submitted for Approval to:
U.S. Army Corps of Engineers
Galveston District
and
Interagency Review Team

April 15, 2019

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I. INTRODUCTION

A. BANK PURPOSE:

All mitigation banks require a banking instrument. The Mitigation Banking Instrument (MBI) is the legal document for the establishment, use, operation, and maintenance of the proposed mitigation bank. The proposed mitigation bank will be used for compensatory mitigation for unavoidable impacts to waters of the United States, including wetlands, that result from activities authorized under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, provided such activities have m*et all* applicable requirements and are authorized by the U.S. Army Corps of Engineers (USACE). All mitigation banks must comply with 33 CFR Part 332 if they are to be used to provide compensatory mitigation for Department of the Army (DA) permits. The Sponsor is responsible for developing, operating, and maintaining the bank subject to the requirements of this MBI; and the Sponsor agrees to satisfy and assume the legal responsibility for the mitigation requirements assigned to a respective permit by USACE.

The Cow Island Bayou **Mitigation Bank is a bank sited on** private **lands. Credits for compensatory mitigation projects on public land must be based solely on aquatic resource functions provided by the compensatory mitigation project, over and above those provided by public programs already planned or in place. Bank credits for DA permits may also be used to satisfy the requirements of other programs (e.g. tribal, state, or local wetlands regulatory programs, USACE civil works projects, and Department of Defense military construction projects, Endangered Species Act), consistent with the requirements of the programs, if the appropriate credits required by a DA permit is supplemental to such programs. Under no circumstances may the same credits be used to provide mitigation for more than one permitted activity.**

This MBI serves to ensure compliance with Section 404 of the Clean Water Act 33 USC 1344 et seq, Section 10 of the Rivers and Harbors Act 33 USC 401 et seq and the implementing regulations found at 33 CFR 320-332, which are controlling in any conflict between the MBI and those laws and regulations. The Corps role is regulatory only; the MBI should not be construed as a contract with the Government enforceable at law by the applicant or any third party. The sponsor agrees to the extent allowed by the laws of the State of Texas to defend, indemnify and hold the United States harmless in any action where any party, including the sponsor, the beneficiary or any third party brings a claim, monetary or otherwise, against the United States that relates in any way to the Corps execution of mitigation banking documents for the establishment of this mitigation bank.

B. BANK CONTACT INFORMATION:

Mitigation Bank Name: Cow Island Bayou Mitigation Bank

Name of Sponsor: Third Texas Resource, LLC
Mailing Address: 6575 West Loop South, Suite 300
Bellaire, TX 77401
Phone Number: 346-310-6211
Email Address: mgenotte@res.us
Point of Contact (POC): Matt Genotte

Name of Sponsor's Agent(s): Resource Environmental Solutions, LLC
Mailing Address: 6575 West Loop South, Suite 300
Bellaire, TX 77401
Phone Number: 346-310-6211
Email Address: mgenotte@res.us
POC: Matt Genotte

Name of Property Owner(s): Resource Environmental Solutions, LLC
Mailing Address:
Phone Number:
Email Address:
POC:

Name of Mineral Owner(s): see Attachment G
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Name of Conservation Easement Holder: Texas Land Conservancy
Mailing Address: P.O. Box 12481
Austin, TX 78716
Phone Number: 512-301-6363
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POC: Mark Steinbach, PhD

Name of Long-term Steward: Third Texas Resource, LLC
Mailing Address:
Phone Number:
Email Address:
POC:

Name of Endowment Fund Managing Entity: RLI Surety
Mailing Address: 2925 Richmond Ave., Suite 1600
Houston, TX 77098
Phone Number: 713-961-1300
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POC: Patrick Hennesy, AFSB

C. REGULATORY AUTHORITIES:

The establishment, use, and operation of the Cow Island Bayou Mitigation Bank will be carried out in accordance with the following authorities:

- **Clean Water Act (33 USC 1251 et seq.)**
- **Rivers and Harbors Act (33 USC 403)**
- **Fish and Wildlife Coordination Act (16 USC 661 et seq.)**
- **Regulatory Programs of the U.S. Army Corps of Engineers, Final Rule (33 CFR 320-332)**
- **Guidelines for Specification of Disposal Sites for Dredged and Fill Material (40 CFR 230)**

- **Memorandum of Agreement between the Environmental Protection Agency and the Department of the Army Concerning Determination of Mitigation Under the Clean Water Act, Section 404(b)1 Guidelines (February 6, 1990)**
- **Final Rule for the Compensatory Mitigation for Losses of Aquatic Resources issued by the U.S. Army Corps of Engineers and the Environmental Protection Agency (April 10, 2008)**
- **Water Resources Development Act of 2007-Section 2036: Mitigation for Fish and Wildlife and Wetlands Losses**
- **Section 7 of the Endangered Species Act**
- **Section 106 of the National Historic Preservation Act"**
- **Food Security Act of 1985, as amended**
- **Texas State Water Quality Certification [30 Tex. Admin. Code §279.12 (2001)]**
- **Texas State Water Quality Standards [30 Tex. Admin. Code § 307 (2000)]**
- **Texas Parks and Wildlife Code Chapter 14 Powers and Duties Concerning Wetlands**

D. INTERAGENCY REVIEW TEAM:

The Interagency Review Team (IRT) for the Cow Island Bayou **Mitigation Bank is composed of the individuals representing the agencies listed below:**

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E. LEGAL RESPONSIBILITY STATEMENT:

The Sponsor assumes all legal responsibility for satisfying all mitigation requirements of Department of the Army (DA) permits for which the bank has been utilized, or fees have been accepted (i.e. the implementation, performance, and long-term management of the compensatory mitigation project approved under this agreement). The transfer of liability from permittee to the Sponsor is established by the following: 1) the approval of this MBI by the Sponsor and District Engineer (DE), 2) receipt of a credit transaction report by the DE that is signed and dated by the Sponsor and the Permittee, and 3) the transfer of fees required from the Permittee to the Sponsor.

The responsibility for financial success and risk to the investment initiated by the Bank Sponsor rests solely with the Bank Sponsor. The IRT agencies administer their regulatory programs to best protect and serve the public's interest, and not to guarantee the financial success of banks, specific individuals, or entities. Accordingly, there is no guarantee of profitability for any individual mitigation bank. Bank sponsors should not construe the MBI as a guarantee in any way that the IRT agencies will ensure sale of credits or that the IRT agencies will forgo other mitigation options that may also serve the public interest. Since the IRT agencies do not control the number of banks proposed or the resulting market impacts upon success or failure of individual banks, in depth market studies of the potential and future demand for bank credits are the sole responsibility of the Sponsor.

USACE approval of this Instrument constitutes the regulatory approval required for the Cow Island Bayou Mitigation Bank to be used to provide compensatory mitigation for Department of the Army permits pursuant to 33 C.F.R. 332.8(a)(1). This Instrument is not a contract between the Sponsor or Property Owner and USACE or any other agency of the federal government. Any dispute arising under this Instrument will not give rise to any claim by the Sponsor or Property Owner for monetary damages. This provision is controlling notwithstanding any other provision or statement in the Instrument to the contrary.

F. OWNERSHIP DOCUMENTATION

Neither this MBI nor any Department of the Army (DA) permit convey any property rights, either in real estate or material, or any exclusive privileges. Furthermore, this MBI or DA permit does not authorize any injury to property, or invasion of rights or any infringement of Federal, state or local laws or regulations. The Sponsor's signature on the MBI is an affirmation that the Sponsor possesses or will possess the requisite property interest to undertake all activities discussed and required in the MBI (33CFR320.4(g)6).

Sponsor agrees that there are no encumbrances on the property that have not been identified and fully disclosed to USACE and the IRT.

The Cow Island Bayou Mitigation Bank shall protect 252.0 acres in the required ecological condition in perpetuity which is to be guaranteed by the execution of a legally binding conservation easement. There are no liens, mortgages, or security interests on the property. To ensure that the conservation easement is conveyed without encumbrances that would affect the viability of the bank, Sponsor has provided the following:

- ✓ Survey with legal description of the Bank showing all existing easements and encumbrances, if any, as identified in the title document. This information will be submitted in recordable form. A title abstract, including a 60-year title search with an attorney's Opinion of Title is being prepared and will be included in the Final MBI.
- ✓ Any liens, mortgages, or security interests of any type on the property will be subordinated to the conservation easement, and subordination agreements are provided to verify that any liens, mortgages and security interests of any type on the property are subject to and bound by the conservation easement established for the property.
- ✓ A draft conservation easement is included in Attachment H. A copy of the filed publicly recorded executed conservation easement will be submitted to the USACE following approval of the MBI.

The Sponsor is the legal owner of the property on which the Bank Site is located. Documentation of ownership, including title insurance policy, mineral assessment report, and survey plat can be found within Attachment D and Attachment F. All liens affecting the Bank have been identified and will be satisfied or subordinated to the recorded CE (Attachment F). The property is subject to those encumbrances listed in Attachment F and appearing in the Public Records of Liberty County. Bank lands shall not be identified or used as collateral for any business transaction.

There are several rights-of-way (ROWs) associated with the site. The Sponsor is completing negotiations to terminate and release the access road easement that crosses the Bank Site shown in the Title Survey (Attachment D). This will allow for restoration of the topography of the Bank Site and eliminate the potential hydrologic obstruction. A pipeline ROW crosses the property from northeast to southwest. This pipeline ROW will be maintained by the easement holder as open space per the ROW agreement. No mitigation credit will be generated from this acreage, and this area will not be subordinate to the CE or included within the Bank boundary. The Sponsor set the Bank boundaries outside of an additional buffer 50 feet on either side of the 70-foot-wide existing pipeline ROW, allowing a total ROW width of approximately 170 feet. The Sponsor will carry out invasive species management activities within the ROW in order to reduce the potential for spread of these species within the Bank Site.

There are no other recorded liens, encumbrances, easements, servitudes, or restrictions that have been identified on the portion of the property proposed for restoration; therefore, no known conflicts exist with the conservation purposes of the CIBMB.

The inclusion of the Sponsor's property and the granting of a CE restricting future land uses for the benefit of the Bank shall not convey or establish any ownership interest in the property on the part of any party to this instrument nor to any purchaser of bank credits. The MBI does not authorize, nor shall it be construed to permit, the establishment of any lien, encumbrance, or other claim with respect to the property, with the sole exception of the right on the part of the USACE under Section 404 of the Clean Water Act. This exception shall be used to require the Sponsor to implement components of the MBI, including recording any CE, required as a condition of the issuance of a USACE permit for discharges of dredged and fill material into waters of the United States, including wetlands, associated with construction, operation, and maintenance of the Bank.

II. MITIGATION PLAN

A. OBJECTIVES:

The goal of the CIBMB is to provide appropriate compensatory mitigation for unavoidable impacts to wetlands authorized by the USACE. The objectives of CIBMB are to:

1) re-establish, rehabilitate, and sustain wetland functions to 117.4 acres of existing cleared agricultural land as forested wetlands (WAA3, WAA4, WAA5 and WAA6);

2) re-establish and sustain wetland functions to 46.8 acres as herbaceous wetlands (WAA7), including an approximately 2.0-acre portion of WAA8 that will have submerged aquatic vegetation;

3) enhance 11.2 acres of existing forested wetlands and re-establish and sustain 13.1 acres of forested wetlands to result in a 70% / 30% wetland / upland ratio within a 34.7-acre forested area with gilgai (WAA1);

4) re-establish and sustain 14.8 acres of forested wetland to result in a 50% / 50% wetland/upland ratio within a 29.5-acre forested area with gilgai (WAA2);

5) re-establish and sustain 23.8 acres as native prairie upland buffer (Table 1 and Attachment A - Figure 6).

According to §332.2,

> "Restoration means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided into two categories: re-establishment and rehabilitation.
>
> Re-establishment means 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 gain in aquatic resource area and functions.
>
> Rehabilitation means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function, but does not result in a gain in aquatic resource area."

Functional increases from the practices detailed in this MBI will be quantified (Attachment C) and used to replace functions lost or degraded through permitted impacts to waters of the United States within the service area (Attachment A).

Table 1. Wetland Assessment Areas.

Wetland Assessment Area	**Type**	**Acres (rounded to tenth)***
WAA1	Forested Wetland Enhancement/Re-establishment	34.7
WAA2	Forested Wetland Re-establishment	29.4
WAA3	Forested Wetland Rehabilitation	1.9
WAA4	Forested Wetland Rehabilitation	40.8
WAA5	Forested Wetland Re-establishment	57.1
WAA6	Forested Wetland Re-establishment	17.6
Subtotal	**Forested Wetland Rehabilitation/Re-Establishment**	**181.5**
WAA7	Herbaceous Wetland Re-establishment	39.7
WAA8	Herbaceous Wetland Re-establishment	7.0
Subtotal	**Herbaceous Wetland Re-Establishment**	**46.8**
Upland	Upland Prairie Buffer	23.8
Total	**Habitat within Bank Site**	**252.0**

* Due to rounding, the total does not correspond with the sum of the separate areas.

B. SITE SELECTION:

Site selection was an intensive process that included land use analyses and ecologic, hydrologic, and biogeochemical spatial modeling to identify potential sites. Considerations were given to:

- surface water connectivity;
- hydric status of mapped soil units;
- existing and historical vegetative cover;
- compatibility with adjacent land uses and habitat types;
- level of disturbance;
- projected watershed mitigation needs;
- willingness of existing owners to sell or permanently restrict their properties; and
- the likelihood and economic feasibility of successful restoration.

Based on the above analysis, the Bank Site was selected after careful consideration of alternative sites. The CIBMB exhibits the potential to accomplish aquatic resource re-establishment. As described in Section II.E. the Bank Site contains areas converted to agricultural use, which makes this an attractive site from a mitigation perspective, as there is significant potential for functional improvement and ecological uplift.

The functions to be provided by the CIBMB can be categorized as follows:

- Biological - Maintenance of Plant and Animal Communities (MPAC) – provide habitat for native wildlife populations and migratory species (e.g., bats, birds, and insects).
- Physical - Temporary Storage of Surface Water (TSSW) – provide temporary water storage during rainfall and flood events that will lessen downstream flood impacts.
- Chemical - Removal and Sequestration of Elements and Compounds (RSEC) – provide chemical processes that remove sediment, heavy metals, man-made chemicals, excess nutrients, and other pollutants washed into the system during rainfall and flooding events, which will improve downstream water quality.

The site was selected based on technical (e.g., ecological, chemical, and logistical) and economic considerations. The following discussions present reasons for the selection of the property.

Ecological Considerations

The most important reasons the site was considered as a mitigation bank are based on the ability to provide feasible, ecologically suitable mitigation to forested and herbaceous wetlands. As such, the Sponsor considered previous and current land use, hydrology, landscape context, and connectivity with existing habitat.

In general, undisturbed, remnant forested wetland communities are dominated by woody species including green ash (*Fraxinus pennsylvanica*), oaks (*Quercus nigra, Q. texana*), water hickory *(Carya aquatica*), and sugarberry (*Celtis laevigata*) as native overstory species (Rosen and Miller 2005). Understory species typical to the area include hollies (*Ilex decidua, I. vomitoria, I. opaca*), swamp dogwoods (*Cornus foemina*), box elder (*Acer negundo*), common persimmon (*Diospyros virginiana*), and buttonbush (*Cephalanthus occidentalis*). Coastal prairie wetlands may develop in depressions with poorly drained soils. Undisturbed coastal prairie wetlands are generally dominated by a variety of grasses (e.g., *Paspalum* spp., *Panicum* spp., *Andropogon* spp.,), sedges (e.g.,

Carex spp., *Cyperus* spp., *Eleocharis* spp., *Rhynchospora* spp., *Scleria* spp.), rushes (e.g., *Juncus* spp.), water plantains (e.g., *Sagittaria* spp.), and other hydrophytic plant species (Rosen 2007, Smeins *et al*. 1991).

The rich soils in the region have led to the conversion of the native habitats to widespread agricultural and urban developments, thereby greatly reducing the range and acreage of forested and coastal prairie wetland habitat. In addition to the loss of much of the habitat, the area has grown increasingly fragmented to the point that persisting remnants of forested wetland are disparate, often separated by large expanses of agricultural land. Landscape fragmentation and the reduction in the average size of usable habitat generally leads to reduced biodiversity and population viability of species within these patches (MacArthur and Wilson 1967). Over time, this can lead to the degradation of the ecological community and trophic relationships, both of which are associated with landscape alteration.

Re-establishing portions of forested and herbaceous wetland, especially in areas adjacent to existing, high quality fragments, will increase the size of usable habitat and will foster broad-scale community dynamics (e.g., metapopulation interactions, dispersal) which will further stabilize native populations and community interactions (Pashley and Barrow 1993; Evans *et al*. 2012; Brudvig *et al*. 2015). The CIBMB is located between a large complex of forested wetland and areas converted to agricultural use. The location of the Bank would provide potential for protected habitat linkages to develop with existing conservation lands such as the Trinity River National Wildlife Refuge (NWR) to the west and Davis Hill State Park (DHSP) to the north and provide additional forested habitat expansion. Corridor conservation and restoration is identified as a strategy to facilitate wildlife and plant migration in response to transitions anticipated with predicted climate change (National Fish, Wildlife and Plants Climate Adaptation Strategy Management Team [Strategy] 2012).

The forests along the Trinity River and associated tributaries are the first contiguous wooded habitats available to neotropical migrants arriving across the Gulf of Mexico in the vicinity of Trinity and Galveston Bays and High Island. The existing forested areas of CIBMB are identified as a priority protection area for migratory landbirds by the Gulf Coast Joint Venture bird habitat conservation partnership. Forested wetland habitat is critical to migratory species as stopover habitat. Migrating birds use the resources of the forested wetland habitat to replenish energy after spring trans-gulf migration flights and as a staging area and source of critical fat storage before fall trans-gulf migration and molt (Barrow *et al*. 2005). Large expanses of forested wetlands are vital for the management of bird species such as wood ducks (*Aix sponsa*), American woodcock (*Scolopax minor*), and Swainson's warbler (*Limnothlypis swainsonii*) (North American Waterfowl Management Plan 2004, Kelly and Rau 2006, Meanley 1971).

Coastal prairies in this region were formed via Pleistocene fluviodeltic sediment depositions, resulting in diverse microtopographic features such as intermoundal flats, drainage swales, depressions, and mima mounds that were bisected by gallery forests along perennial streams (Wilcox *et al*. 2011, Smeins *et al*. 1991). The proposed prairie wetlands are located near the edge of the 100-year floodplain of Cow Island Bayou where frequent fires would presumably have resulted an ecotone between woody and herbaceous areal dominance. The deepest portions of prairie wetlands occur in concave depressions that typically range in depth of 6-24 inches. Subsurficial hydrostatic pressures result in these areas providing increased periods of saturation for surrounding intermoundal flats that increase frequency of anaerobic conditions present on Western Gulf Coastal Prairies (Starowitz 1994). The addition of prairie wetlands will increase site heterogeneity and provide habitat for several guilds of wildlife not associated with forested wetlands including marshbirds, shorebirds, sparrows, sedge wren (*Cistothorus platensis*), and certain insect taxa.

Hydrological and Chemical Considerations

Nearly all of the Bank Site is within the Federal Emergency Management Agency (FEMA) Zone A (100-year) floodplain of Cow Island Bayou (Attachment A - Figure 5). Only the easternmost approximately 15 acres of the Bank Site is outside of the 100-year floodplain. WAAs 1-7 will be within the 100-year floodplain; and WAA8 is partially within the floodplain, with the remaining area excavated below the floodplain elevation.

It is widely accepted that riparian and floodplain wetlands and forests are physically, chemically, and biologically integrated with streams and provide ecological functions that improve downstream water quality (EPA 2015; Hubbard and Lowrance 1994; Ferguson, *et al*. 2003; Struck *et al*. 2007; Davies *et al*. 2000; Johnston 2009; Lowrance *et al*. 1986). Floodplain wetlands decrease stream velocity by retaining large volumes of stormwater during flood events and release (desynchronize) it over longer periods of time (EPA 2015). They reduce stream eutrophication by receiving and storing the deposition of sediment, nutrients, contaminants, and organic matter during the temporary storage of stormwater that could otherwise negatively affect the condition of streams (Lowrance *et al*. 1986; EPA 2015). Sediment and agrichemicals in rainwater runoff are reduced after passing through riparian forests both through physical and biological mechanisms, including deposition, uptake by vegetation, and loss of microbiological processes such as denitrification (Hubbard and Lowrance 1994). Wetlands are effective at reducing pathogen concentrations in surface water and groundwater, reducing loads in adjacent streams (Ferguson, *et al*. 2003; Struck *et al*. 2007; Davies *et al*. 2000; Lowrance *et al*. 1986).

The restored forested wetlands would contribute to improved water quality in Cow Island Bayou, Lake Anahuac, Trinity Bay, and Galveston Bay. Although Cow Island Bayou is not listed on the Draft 2016 303(d) list of impaired waters (TCEQ 2016), exceedances of water quality standards have been reported in the Lower Trinity Watershed (TRA 2012). The detection of Chlordane in fish tissue has led to fishing bans in several urban segments of the Trinity River. Sources of pollution in the watershed include wastewater overflows, septic system leakage, leachate from solid waste facilities, construction activities, agricultural operations, and urban expansion. The CIBMB aligns with the goals of the Trinity River Basin Master Plan to reverse the deteriorating water quality conditions in the Trinity River Basin. Replacing agricultural land with forested and herbaceous wetland habitat within the watershed will reduce the pollutant load on waters within the Lower Trinity Watershed and in Galveston Bay downstream.

The restored wetland habitat will increase soil organic matter, decrease soil bulk density, increase hydraulic conductivity, increase soil saturation potential, and increase the formation of redoximorphic features (Collins and Kuehl 2001). Soil organic carbon is critical to soil reduction which will increase as soil organic material increases from the deposition of leaf litter, coarse woody debris, and decaying root material (Collins and Kuehl 2001). The restored forested wetland plant community will reduce runoff by canopy and leaf litter interception of rainfall and the increased stem density will reduce surface water sheet flow velocities. The result is a reduction in erosion runoff and an increase in soil infiltration (Richardson *et al*. 2001). All of these processes are needed to improve water quality of Cow Island Bayou and wildlife habitat in the riparian buffer of the Bayou.

Logistical Considerations

The Sponsor evaluated the on-site hydrologic conditions, soil characteristics, existing vegetative communities on adjacent parcels, and opportunities for maximizing gains in ecological functions to determine the extent to which it would successfully serve as a wetland mitigation site.

Two Approved Jurisdictional Determinations (AJDs) were obtained for the existing cleared and forested areas of the CIBMB site on January 28, 2015 and February 10, 2015, respectively, that identified 52.87 acres of wetlands and 0.23 acre of tributaries within the Bank Site, not including Cow Island Bayou itself, which is not within the Bank Site but was within the AJD review area (Attachment C). The AJD for the cleared area indicated that a 41.63-acre jurisdictional herbaceous wetland is present. This wetland is located in the northwestern portion of the cleared area, near Cow Island Bayou. The proposed mitigation work at the Bank Site would convert this existing herbaceous wetland to a forested wetland (rehabilitation). The remainder of the cleared area of the Bank Site was determined by the USACE to contain no jurisdictional features.

Within the forested area of the Bank Site, the USACE, during the AJD, identified one forested wetland totaling 0.3 acre and another 34.4-acre upland/wetland mosaic that was determined to consist of 31.8% (10.94 acres) wetland and 68.2% (23.46 acres) upland. A total of 11.24 acres of jurisdictional forested wetlands were identified by the USACE within the proposed Bank Site (Attachment C). These existing forested wetlands would be preserved and enhanced through management of invasive species and increasing density of preferred hard mast tree species. The proposed restoration work plan for the Bank is intended to increase the wetland percentage of the areas of mosaic wetland.

The principal consideration for establishing the desired habitat types on the Bank Site is the previous landcover. Although the property has most recently been in agricultural use, then allowed to revegetate from natural recruitment with the attendant opportunistic herbaceous and shrub species, historical aerial photographs demonstrate that the site previously contained forest and prairie habitats (Attachment B – Figure 1).

The conversion of the site from forest and prairie to agricultural use likely led to a significant decrease in wetland functions below those that would have been associated with the undisturbed state. Therefore, the presence of historical forest and prairie cover makes the restoration of the habitat features across the majority of Bank Site appropriate and practicable.

The entire Bank Site is classified as Vamont Clay, 0 to 1 percent slopes (U.S. Department of Agriculture Natural Resources Conservation Service 2015). The Soil Survey of Liberty County, Texas (1996) describes the soil as somewhat poorly drained, with slow surface runoff, very slow permeability, and high available water capacity. It is described as well suited to growth of hardwoods such as sweetgum, willow oak, and green ash; and is also suitable for growing grasses, and rice due to low permeability. These characteristics indicate an appropriate soil type for the proposed CIBMB. Furthermore, a site-specific study conducted by Richard W. Griffin, PhD, PG, CPSSc (Attachment M) found active forms of iron in the soil, indicating ponding/waterlogged conditions at the site.

Based on the precipitation in the region in an average year, poorly-drained soils, and overland flow of water across the site, the Hydrologic Analysis Report demonstrates that the criteria for wetland hydrology is expected to be met throughout proposed wetland areas of CIBMB (Attachment K). Flow of water from Cow Island Bayou into the Bank Site has been observed to occur regularly. For example, on January 27, 2018, the Sponsor (Matthew Genotte) observed water flowing from the Bayou into the Bank Site following a 1-inch rain event recorded with an on-site rain gauge.

The National Wetlands Inventory (NWI) classifies portions of the existing forested areas within the Bank Site and immediately southwest of CIBMB as palustrine forested, broad-leaved deciduous, temporarily flooded (PFO1A) wetlands (Attachment A - Figure 9). Observations of these areas by the Sponsor support the NWI classification. Ecological Mapping Systems of Texas (EMST; TPWD and Texas Natural Resources Information

System 2013) data classify these forested areas as a mix of wetlands and uplands (Attachment - Figure 10), containing:

- **Pineywoods: Wet Hardwood Flatwoods**, which is similar to the proposed habitat type for the majority of the wetland re-establishment;
- **Chenier Plain: Mixed Live Oak / Deciduous Hardwood Fringe Forest**, which is described as a forest type that "generally occurs over wet soils";
- **Pine Plantation > 3 meters tall**; and
- **Non-Native Invasive: Chinese Tallow Forest, Woodland, or Shrubland**, Chinese tallow (*Triadica sebifera*) is expected to be a common invasive species, and Section II.H. describes the invasive species management plan for CIBMB.

Financial Considerations

CIBMB is located within a watershed that encompasses portions of Chambers, Liberty, and San Jacinto Counties. In addition to providing mitigation for residential and commercial development related to continued population growth, CIBMB will provide mitigation for projects associated with oil and gas development. From 2014 to 2035 natural gas pipeline capacity in the Southwest Region (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas) is predicted to increase from 4.8 billion cubic feet per day (cf/d) to 10.2 billion cf/d (INGAA 2014). Pipeline construction projects are occurring frequently in this watershed due to its proximity to Mont Belvieu, which is a major hub for natural gas liquids (NGL). Mont Belvieu sits on top of underground salt dome formations that are used to store petrochemicals. Pipelines connect these wells to fractionators and other facilities used to produce various products, and to brine storage ponds for operation of the wells. This industrial expansion and the associated residential and commercial development takes place in a landscape with many existing wetlands, which creates a strong demand for wetland mitigation.

The CIBMB will provide a single, large restored wetland habitat as compensatory mitigation for multiple, smaller, scattered impacts within the service area. The CIBMB will provide ecological benefit to the watershed by restoring forested and herbaceous wetland habitat, which has been lost from the watershed in the past. The following parameters were considered in the selection of the CIBMB for wetland restoration:

- the increasing requests for wetland mitigation within the watershed;
- the lack of sufficient mitigation credits within the service area;
- the relatively low landscape position;
- the likely historical presence of forested wetlands and herbaceous wetland as evidenced by existing adjacent wetlands and on-site soil conditions;
- the compatibility with surrounding land uses;
- agricultural practices uphill from the CIBMB that are likely contributing non-point-source pollution to Cow Island Bayou that could be mitigated by increased wetland functions at CIBMB;
- the need to support the objectives of the Trinity River Basin Master Plan (TRA 2012).

C. SERVICE AREA:

The service area is the watershed, ecoregion, physiographic province, and/or other geographic areas within which the mitigation bank is authorized to provide compensatory mitigation required by DA permits. Service areas must be appropriately sized for each credit type to ensure that the aquatic resources provided will effectively compensate for adverse environmental impacts across the entire service area respectively.

The primary service area for the Cow Island Bayou Mitigation Bank is identified as the Lower Trinity USGS 8-digit Hydrologic Unit Code (HUC) 12030203. The primary service area includes portions of Liberty, Chambers, and San Jacinto Counties. Impacts occurring within the primary service area shall be debited on a 1 : 1 basis.

The secondary service area for the Cow Island Bayou Mitigation Bank is identified as the North Galveston Bay and northwestern portion of East Galveston Bay USGS 8-digit HUC 12040203 and USGS 12-digit HUC 120402020100. The secondary service area includes portions of Liberty, Chambers, and Harris Counties. Impacts occurring within the secondary service area shall be debited on a 1.5 : 1 basis (see map attached as Attachment A – Figure 4).

The North Galveston Bay Secondary Service Area is an adjacent watershed, drains into same receiving waters as Cow Island Bayou Mitigation Bank (Trinity Bay and upper Galveston Bay), and is within the same Level IV Ecoregion as Cow Island Bayou Mitigation Bank. The East Galveston Bay Secondary Service Area does not include the portion of the East Galveston Bay HUC that is within the Texas-Louisiana Coastal Marshes Level IV Ecoregion. This coastal Level IV Ecoregion is dominated by estuarine marshes and is a different habitat type than Cow Island Bayou Mitigation Bank. This secondary service area only includes the western 12-digit HUC that drains into the same receiving waters as Cow Island Bayou Mitigation Bank – Trinity Bay. The portion of the East Galveston Bay watershed included in the Secondary Service Area is an adjacent watershed, drains to the same receiving waters, and is within the same Level IV ecoregion as the Bank Site.

D. SITE PROTECTION INSTRUMENT:

The Sponsor shall record a conservation easement with the Liberty County Clerk that has been approved by USACE, in coordination with the IRT, and provide a copy of the recorded conservation easement to the USACE Galveston District. A draft Conservation Easement is included as Attachment H.

A Mineral Management Plan is included as Attachment G. A remoteness opinion will be included in the Final MBI.

E. BASELINE INFORMATION:

Land Use in the Region

The Bank Site is located within the Northern Humid Gulf Coastal Prairie Level IV Ecoregion (Griffith *et al*. 2007). Within the vicinity of the Bank Site, this ecoregion historically consisted of a mosaic of forests and prairie systems and was shaped by prescribed burns carried out by the Akokisa Indians, a band of the Atakapa Tribe, lightning ignited fires (Noss 2013), and by bison herbivory (Perttula 2012). This region was noted by settlers for its seasonal flooding, mosquitoes, and heavy clay soils. Spanish military explorations of the area described seasonal inundation that spread for twenty square miles from Moss Bluff to Wallisville (Bolton, 1913). Multiple settlements were attempted in the 1700s and 1800s within 5 miles of the Bank Site, and all failed due to the inhospitable wetland conditions. It wasn't until cattle ranching expanded into the region in the 1820s that Anglo settlers began to successfully establish homesteads, with the most prominent ranch in vicinity to the Bank Site being White's Ranch, at the confluence of Turtle Bayou and Whites Bayou. Ranching methods required wetlands and marshes to provide high quality forage, implying that the floodplains and interstitial areas between these bayous were primarily prairie wetlands. With the introduction of the livestock trade within the region, Anglo settlers became the de facto land stewards, by carrying out seasonal prescribed burns and replacing bison with cattle and later with agricultural crops (Handbook of Texas Online, 2016).

In the late 1880s, railroad and timber speculators opened the region to further settlement. With the aid of financial backing from the railroad industry, farmers began to settle the region and experiment with rice cultivation. This region economically benefited from World War II due to an increase in demand for petroleum as well as an increase in demand for rice. This led to an increase in population, commodity export infrastructure, and most importantly, the mechanized clearing and cultivation of lands. The expansion of lands under rice cultivation continued through the 1950s. Following the 1950s, the market price of rice dropped significantly, and many areas that were historically farmed have been converted into new uses, such as pasture, crawfish farming, and natural reforestation (Handbook of Texas Online, 2016).

Land Use at the Bank Site

No parties to the Bank Site are or have been USDA or other Federal (e.g., Wetlands Reserve Program, Conservation Reserve Program, Partners for Fish and Wildlife Program) or State Program participants.

Historic aerial photos of the bank site are provided in Attachment B. A 1939 aerial index shows the Bank Site to be largely forested, other than a cleared area to the east of Cow Island Bayou (Attachment B – Figure 1a). Cow Island Bayou and the tributary that is present along the northern boundary of the Bank Site appear to have already been channelized. The Bank Site was historically an ecotone, as the boundary between expansive rice fields to the north and east and contiguous hardwood forests and riparian areas to the south and west. The pasture use seen on the property in the 1930s was separated from cultivated rice fields by drainages and forest cover.

The next available aerial imagery is from 1952 and shows a large amount of deforestation to have taken place, exposing depressional wetlands that had previously been forested (Attachment B – Figure 1b). By 1960, the areas that presently exist as herbaceous cover had been fully cleared and converted into rice cultivation. Areas of recently cleared forest show exposed depressional wetlands. Areas that had been in pasture/prairie use along Cow Island Bayou in the 1930s show early signs of reforestation by the 1960s.

The pipeline corridor that crosses the Bank Site appears to have been constructed prior to 1980. In the 1990s, the northern portion of the agricultural area within the Bank Site was converted from rice cultivation to pasture use, and the southern agricultural portion was allowed to go fallow and was colonized by Chinese tallow (Attachment B – Figure 1c). The 1996 image indicates that the area east of Cow Island Bayou that was pasture in 1939 has reforested primarily in pine trees. Other areas of existing forest east of Cow Island Bayou appear to be a mix of pine and hardwood, while the portion of the Bank Site west of Cow Island Bayou appears to be dominated by hardwoods.

The Bank Site has been significantly impacted by agriculture which has resulted in channelization of natural waterways; creation of a network of ditches, berms, and field drains; and deforestation. These actives have substantially decreased the hydroperiods and wetland functions at the Bank site. Despite the presence of soils conducive to wetland establishment, the USACE determined that there are only 41.93 acres of wetlands, 13.36 acres of forested wetland within a wetland/upland mosaic, and 2.35 acres of tributaries, of which 2.12 acres are a portion of Cow Island Bayou (Attachment C).

Baseline Vegetation

The Bank Site consists of a fallow agricultural field dominated by an upland herbaceous community and forested areas along the east and west sides of Cow Island Bayou. The fallow agricultural field is dominated by species common to old fields. The majority of the fallow field is dominated by an upland herbaceous plant community. Based on an AJD, 41.63 acres of existing emergent wetland are present on the western side of the field (Attachment C).

Plant species frequently occurring within the CIBMB are listed below.

Emergent wetland:

- Graminoids: bushy bluestem (*Andropogon glomeratus*), broomsedge bluestem (*Andropogon virginicus*), bahiagrass (*Paspalum notatum*), and common rush (*Juncus effusus*).

- Shrubs: Chinese tallow and eastern baccharis (*Baccharis halimifolia*) are present, but are not dominant within this habitat type.

Herbaceous Upland:

- Grasses and forbs: annual ryegrass (*Lolium perenne*), bermudagrass (*Cynodon dactylon*), bahiagrass, broomsedge bluestem, and annual marsh elder (*Iva annua*).

Existing Forested Upland:

- Trees and shrubs: willow oak (*Quercus phellos*), sweetgum *(Liquidambar styraciflua),* green ash *(Fraxinus pennsylvanica),* loblolly pine *(Pinus taeda),* laurel oak *(Quercus laurifolia),* water oak *(Quercus nigra),* and yaupon *(Ilex vomitoria).*

- Herbaceous species and vines: poison ivy (*Toxicodendron radicans),* slender woodoats (*Chasmanthium laxum),* trupet creeper *(Campsis radicans),* and cat greenbrier (*Smilax glauca).*

Existing Forested wetland/Upland Mosaic:

- Trees and shrubs: willow oak (*Quercus phellos*), cherrybark oak (*Quercus* pagoda), parsley hawthorn (*Crataegus* marshalli), sweetgum *(Liquidambar styraciflua),* green ash *(Fraxinus pennsylvanica),* loblolly pine *(Pinus taeda),* American holly (*Ilex* opaca), laurel oak *(Quercus laurifolia),* water oak *(Quercus nigra),* and yaupon *(Ilex vomitoria).*

- Herbaceous species and vines: dwarf palmetto (*Sabal* minor), muscadine grape (*Vitis* rotundifolia), poison ivy (*Toxicodendron radicans),* Cherokee sedge (*Carex* cherokeensis), slender woodoats (*Chasmanthium laxum),* trupet creeper *(Campsis radicans),* and cat greenbrier (*Smilax glauca).*

Baseline Soils

Surface soils of the site are identified as Vamont clay, 0 to 1 percent slopes, by the Natural Resources Conservation Service (NRCS *et al*, 1996; Attachment A - Figure 5). Vamont series soils are classified as fine, smectitic, thermic Oxyaquic Dystruderts that are generally dominated by clay and silt deposits (NRCS 1999). As a soil derived from fluviomarine deposits in flats of the coastal prairie, it is somewhat poorly drained and often demonstrates redoximorphic features.

Vamont clays consist of clayey fluviomarine deposits derived from mixed origin Beaumont Formation materials during the late Pleistocene. These soils are somewhat poorly drained and have very slow permeability with very slow runoff. The most prominent feature within the flats that dominate this soil are microrelief gilgai (microlows) that may become saturated or inundated during January through March. The adjacent microhighs become saturated during this time but do not reduce or have aquic conditions. Water tables frequently are found at depths of less than 3 feet throughout the winter. The microlows make up less than 50 percent of the pedon. NRCS considers Vamont clay, 0 to 1 percent slopes to be a hydric soil. Additional information regarding the soils present on the Bank Site are provided in Attachment M.

Baseline Hydrology

In the region of the Bank Site, September is the wettest month of the year with an average precipitation of 5.44 inches, and February is the driest month of the year with an average precipitation of 2.93 inches. Average annual runoff ranges from 0.47 to 1.95 inches. Evaporation exceeds rainfall six months of the year in this region (TWDB, 2010). Hydric soils indicate that in the recent past, the CIBMB was inundated or saturated to the surface for at least 14 consecutive days per year.

More than 90% of the Bank Site is within the FEMA 100-year floodplain of Cow Island Bayou (Attachment A - Figure 5). Upstream of the Bank Site, Cow Island Bayou flows through an area dominated by agricultural land uses. Downstream of the Bank Site, water flows almost entirely through forested private lands until reaching Trinity Bay. From CIBMB, Cow Island Bayou travels southeast for 5.2 miles to the confluence with Turtle Bayou. Turtle Bayou continues for 3.2 miles until it reaches the confluence with Whites Bayou and then continues for another 2.4 miles until it flows into Lake Anahuac. Lake Anahuac drains into the Trinity River near Browns Pass and the Trinity River flows into Trinity Bay.

Existing herbaceous uplands on the northern, northeastern, and southeastern portions of the Bank Site receive hydrology from rainfall and overbank flooding from Cow Island Bayou and, the channelized tributaries and man-made ditches. Inundation from overbank flooding is more common in the lower-lying areas to the northwest, but

the entire area except for the far eastern portion is in the 100-year floodplain. Two field drains provide quick exit for water to leave the herbaceous upland habitat and flow directly into Cow Island Bayou. One low berm (approximately 4 inches tall) between the herbaceous upland and the forest to the west and south retards water movement into the forest except at the field drains. This causes shallow water the height of the low berm to temporarily pool up-slope of the berm within the eastern and southern borders of the herbaceous upland habitat areas.

Historically, the entire Bank Site, including the herbaceous upland habitat, would have received significant volumes of water via overland flow from upslope properties after rain events, which would have created significantly longer hydroperiods. Today, berms and ditches along the entire eastern property boundary (up-hill from the Bank) prevent overland runoff from reaching the herbaceous wetlands by directing it through a series of channels to Cow Island Bayou upstream of the Bank Site. When the property was used for rice farming, water was pumped out of these ditches or released through water control structures (culverts, screw gates, control boards, etc.) used to inundate the area that is now herbaceous uplands. This diversion of overland flow water and absence of human activity transferring the water from the ditches to the field has likely caused significantly drier conditions in the herbaceous upland habitat than ever before.

Prior to agricultural activates that have smoothed out the surface (e.g. plowing, soil compaction, soil redistribution), the herbaceous upland habitat consisted of forest and prairie, with shifting boundaries between the two, depending on influences such as drought, wildfire, etc. with significantly more organic matter mixed into the soils and significant microtopography throughout. Smeins *et al*. (1992) state "drainage systems have… undoubtedly had an influence on soil-forming processes and soil-plant relationships. The organic matter held water for longer periods of time than the nearly pure clay in the area today, the native vegetation (trees or native grasses) created surface texture and slowed the retreat of surface water flows compared to the lack of floristic diversity in place today, and the microtopography slowed the retreat of surface water flows and held small pools of inundation for longer periods, all of which created longer hydro periods that are present in the area today. The addition of the two field drains only adds to the artificially short hydroperiods caused by human modifications.

Existing herbaceous wetlands on the northern portion of the Bank Site have similar hydrology and modifications to the hydrologic regime as the herbaceous uplands; however, they receive overland rainwater flow from approximately 60 acres of herbaceous upland, are at elevations low enough to receive very frequent overbank flooding from Cow Island Bayou, and are adjacent to a berm bordering the down-slope boundary which retains water in the area. These influences result in hydroperiods long enough to meet the wetland criteria.

Existing upland forest on the southern portion of the Bank Site receives hydrology from rainfall and overbank flooding from Cow Island Bayou. The forest floor has severe undulations (gilgai), with highpoints up to 3 feet higher than the adjacent low points. Most of the humps and the depressions are approximately 5 feet to 40 feet in diameter. Naturally, the humps are much drier than the depressions. A berm and ditch on the up-slope boundary of the forested upland habitat prevents rainwater overland flow from reaching the forest, causing shorter hydroperiods. An additional berm and ditch transecting the forest habitat from north to south has a similar effect. A pipeline was installed through the area in the 1970s or 1980s which transects from northeast to southwest. The pipeline corridor has slightly raised lines and slightly depressed lines where the sidecast soil was placed and the pipelines were installed and backfilling was not perfect. These act as berms and ditches and have a similar effect retarding surface water movement across the habitat, reducing hydroperiods, except immediately adjacent to the berm and within the ditch.

An existing 34.7-acre forested wetland/upland mosaic on the southwestern portion of the Bank Site has similar conditions to the upland forest, however receives longer hydroperiods. According to a wetland delineation verification and an approved jurisdictional determination from the USACE, this area is a wetland/upland mosaic. The wetlands are located in the depressions and the uplands are located in the higher areas between the depressions.

Protected Species

A threatened and endangered species review is included in Attachment N. Based on this review, the CIBMB should have no negative effects on threatened and endangered or otherwise protected species due to the lack of suitable habitat on the property. The Sponsor received comments from the USFWS and TPWD regarding the prospectus for the CIBMB dated June 12, 2013, and June 13, 2013, respectively; and no concerns regarding impacts to protected species were noted at that time.

Cultural Resources

RES submitted a request for State Historic Preservation Office (SHPO) consultation to the Texas Historical Commission (THC) on January 30, 2015. In a response dated February 18, 2015, the THC determined that the proposed activities within CIBMB would result in "no historic properties affected" and indicated that the project could proceed (Attachment P).

F. Determination of Credits:

For the Bank to be considered acceptable for mitigating wetland impacts associated with DA permits, the vegetation, soils, and hydrology therein must at least meet the wetland criteria described in the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region, Version 2.0* (Regional Supplement) or subsequent manual. Mitigation credits will be established as Functional Capacity Units (FCUs) calculated based on the USACE's Hydrogeomorphic interim (HGMi) tools (USACE 2010b, 2010c). Forested wetlands will be assessed using the Riverine Forested HGMi model, and herbaceous wetlands will be assessed using the Riverine Herbaceous/Shrub HGMi model (Attachment C). The HGMi models will be used to assign values to the expected biological, chemical, and physical functions of wetlands within the Bank , reviewed at Year 3, and finalized after 15 years of monitoring. The native prairie upland buffer within the Bank Site is not expected to meet the three wetland criteria and is not planned to generate credits.

The Bank will establish two ledgers, one to track Riverine Forested HGMi credits and one to track Riverine Herbaceous/Shrub HGMi credits. Advanced credit releases based on administrative and construction/ planting activities are described in Section III.C. The final credit release will occur following 15 years of monitoring and achievement of performance standards.

G. Mitigation Work Plan:

This Mitigation Work Plan (MWP) describes the administrative, construction, and ecological restoration techniques that will be employed by the sponsor to implement the CIBMB. To establish compensatory mitigation credits, hydrological enhancements will be made that increase the duration of soil saturation for durations sufficient to produce seasonally flooded wetlands. To assess and predict the duration of saturation within the Bank site, the Sponsor prepared a water budget study. Please refer to Attachment K for the results of the water budget study. The water budget study shows saturation or inundation for a total of 133 days in a dry year, 257 days in a typical year and 309 days in a wet year; including at least 14 consecutive days during the growing season for each modeled year.

The conversion of the site is expected to justify the issuance of at least the number of credits requested for initial release. However, subsequent HGMi assessments may allow for increases or decreases in credit availability (Attachment C).

Vegetation Sources

The objective of restoration activities is to create fully-functional and diverse communities indicative of historical forested and herbaceous wetlands with a mixed population of desirable species native to the region. The existing vegetation community in the existing pasture portions of the site is not amenable to this goal and will be replaced during the construction phase.

To the extent practicable, RES will preferentially source vegetation from nearby nursery facilities to provide greater control over the quantity and species composition of the seedling stock, greater assurance regarding the source of seeds, decreased seedling mortality from transportation and transplantation, and the ability to produce supplemental seedlings if needed. Seed, root stock, and cuttings will be gathered from within the ecoregion. For species that cannot be sufficiently gleaned from native sources, stock will be grown in RES's nurseries in Louisiana or on site, preferentially from stock derived from the Western Gulf Coastal Plain Ecoregion. To reduce shock to the plants, planting activities will be performed during the dormant season.

Installing Hydrology Monitors

To assess the efficacy of hydrologic improvements, RES will install and monitor one continuous water level recorder in each WAA, for a total of eight recorders. This spacing will allow the Sponsor to make reasonable assessments of the hydrology throughout the site and, thereby, determine hydrologic function. The hydrology monitoring stations will be installed using USACE protocols (USACE 2005, Noble 2006) with the location of each hydrology monitoring station recorded using GPS and clearly marked to facilitate field identification.

The hydrographs generated by these recorders will be correlated to sampled hydrology field indicators and climatological data including local rainfall conditions, Palmer Drought Severity Index, NRCS WETS data, and other suitable metrics. These values will be incorporated into the HGMi to corroborate

hydrologic measurements. Hydrologic improvements will be monitored until performance standards are fully achieved.

Developing Microtopography

Past farming practices have created relatively uniform topography throughout the Bank Site. Prior to planting and seeding the Bank Site, a sub-soil treatment will be applied to alleviate soil compaction and establish microtopography. Restoration of surficial roughness (microtopography) will increase floral and habitat diversity by fostering the development of small humps and shallow depressions. Grace *et al*. (2000) found microtopographic relief the principle explanatory variable in determining floristic biodiversity on coastal prairie sites. Furthermore, the diversity of microtopography influences hydroperiods, soil permeability, and will help establish a more complex wetland vegetation community and a more diverse assemblage of wildlife species. Additionally, microtopography may improve nutrient cycling and removal (Wolf *et al*. 2011).

Low-water Crossing Construction

The existing levees on both sides of Cow Island Bayou have five erosional cuts through them within the Bank Site, the bottoms of which are below grade. These cuts are illustrated on Attachment A - Figure 6 with green squares. These cuts are unstable and getting deeper with every rain event. They provide access for overbank flows to enter the Bank Site; they also act like a drain drawing surface water from the bank site and into Cow Island Bayou. The Sponsor will construct stable low-water crossings into the levees (Attachment A - Figure 13) at the locations of the five existing cuts, which will maintain hydrological connection between Cow Island Bayou and the Mitigation Site, prevent further erosion and deepening of the connection points, and lengthen hydroperiods. The Sponsor will implement four additional low-water crossings in the levees to facilitate better hydrologic connectivity than the five currently provide and to reduce the volume of water passing through each of the crossings and the associated erosional stress, further protecting the integrity of the crossings. These three proposed low water crossings are depicted as yellow squares on Attachment A - Figure 6. The eight low-water crossings in the levees of Cow Island Bayou and tributary will have widths sized to match the percentage of water from the Bank site that they will receive, but will generally be 10 to 15 feet wide at the base. They will be constructed with a similar slope to the berms with which they are integrated. The low-water crossings will be lined with immobile rock and will provide approximately 6 inches of relief at the center of the crossing (Attachment A - Figure 13). The Sponsor has coordinated the proposed low-water crossing designs along Cow Island Bayou with Mr. Tony Scott, President of the Raywood Drainage District (936-346-1753) who manages the adjacent section of Cow Island Bayou. Mr. Scott had no objections to construction of the proposed low-water crossings.

Degradation of Field Drains and Berms

Channels/field drains have been cut from the bank site to Cow Island Bayou that are approximately 6 inches deep except where they exit the levee they are up to 3 feet deep. These field drains total approximately 3,000 feet in length are depicted as light blue lines with black dashes on Attachment A -

Figure 6. These field drains will be degraded, including complete filling or plugging to remove the drain on the wetlands and lengthen hydroperiods.

Approximately 6,000 feet of shallow (<1 ft.) ditches with side cast berms are located within the bank site. These ditches are depicted on Attachment A - Figure 6 as purple lines. The Sponsor will level long sections of these features to allow surface water to flow over the forest floor, returning it to wetland/upland mosaic, and flow toward Cow Island Bayou.

A large man-made canal/ditch approximately 4 feet deep and 4,000 feet long is located along the northeastern Bank boundary that once transferred rainwater runoff from several hundred acres of agricultural and pasture land to the east to Cow Island Bayou. The canal is depicted as a light blue line on Attachment A - Figure 6. In the past, water from the canal was pumped from the canal to the Bank Site for rice farming. The canal currently has two collapsed culverts in it that prevent the flow of water. These collapsed culverts are depicted on Attachment A - Figure 6 as orange hexagons. The Sponsor will remove these collapsed culverts to restore the flow of rainwater runoff from adjacent properties. The Sponsor will plug (red dot on Attachment A - Figure 6) the canal at the northeastern corner of the Bank Site and install four armored low water crossings (yellow squares on Attachment A - Figure 6) at grade between the Canal and Bank Site. During rain events, gravitational hydrologic pressure will cause the water to flow out of the canal and sheet flow across the Bank Site, lengthening hydroperiods.

A small man-made canal/ditch approximately 1 foot deep and 900 feet long is located along the short eastern Bank Site boundary. This canal carries rainwater runoff from the pasture located the east of the Bank Site through a large canal that transects property owned by the Sponsor, but not within the Bank Site to a channelized tributary of Cow Island Bayou. The sponsor will cut a 500-foot-long ditch (red line on Attachment A - Figure 6) from the canal to a depression (WAA8) with a base elevation lower than the bottom of the small canal. This will allow surface water runoff from adjacent properties to the east to flow into the Bank Site, lengthening hydroperiods. This will mimic historic conditions, before the canals and berms were constructed, when rainwater runoff freely moved as sheet flow toward Cow Island Bayou. The Sponsor has coordinated the proposed new ditch with the adjacent landowner to the east, Mr. Ray Spiller (713-412-0363) who has approved the proposed ditch to extend on-to his property and connect to the existing north/south ditch at a right angle.

On Figure 2, there are blue arrows showing which direction surface water will flow after the ditches and berms are degraded and low-water crossings are installed. These were created using elevation contours from Light Detection and Ranging (LIDAR) images.

Depressions (WAA3 and WAA8)

The sponsor will excavate a 7-acre depression (WAA8) surrounded by native upland prairie habitat on the southeastern portion of the Bank Site on the edge of the FEMA 100-year floodplain in an area that is the highest elevation of the Bank Site (Attachment A - Figure 6). Subsoil will be removed and used for a road in an upland area outside of the Bank Site. The topsoil will be segregated and spread back over the surface of the depression. The deepest portion of the depression (approximately 2 acres) will be designed to support submerged aquatic vegetation and will be 2 to 3 feet lower than the upland prairie

to the east and 1 to 2 feet lower than the prairie to the west. The fringes (approximately 5 acres) of the depression will be sloped gradually and are expected to support herbaceous and emergent wetland vegetation. These vegetation zones will naturally shift based on wet or dry seasons and years. Gravity will draw rainwater runoff from a small canal on the eastern Bank boundary into this depression. The depression will have a lower base elevation than the canal and a ditch will connect the canal to the depression and will slope toward the depression. Rainwater runoff from an approximately 100-acre pasture to the east will fill the depression and overflow as sheet flow and run to the west to downslope portions of the Bank Site, including herbaceous wetlands (WAA7) and forested wetlands (WAA1, WAA2, and WAA6), increasing the hydroperiods of each.

Plantings for WAA8 were derived from similar habitats at Sheldon Lake State Park (Attachment O) and depressional pond type communities described at Candy Abshier Wildlife Management Area (CAWMA) by Singhurst *et al*. (2014a). Deepest inundation at the center of depressional wetland will be plugged with white water lily (*Nymphaea odorata*) and American lotus (*Nelumbo lutea*). It is anticipated that humped bladderwort (*Utricularia gibba*) and floating bladderwort (*U. radiata*) will be transported site via seed/vegetative material carried in floodwaters or bird. The following zonation, with water depths between 6-24 inches may consist of squarestem spikesedge (*Eleocharis quadrangulata*), Gulf Coast spikesedge (*E. cellulosa*), common rush (*Juncus effusus*), maidencane (*Panicum hemitomon*), swamp smartweed (*Persicaria hydropiperoides*), mermaidweed (*Proserpenica palustris*), and softstem bulrush (*Schoenoplectus tabernaemontani*). The exterior zonation, with water depths between 0-6 inches may consist of blue waterleaf (*Hydrolea ovata*), winged loosestrife (*Lythrum alatum*), green flatsedge (*Cyperus virens*), shortbristle beaksedge (*Rhynchospora corniculata*), anglestem beaksedge (*R. caduca*), narrowleaf water primrose-willow (*Ludwigia linearis*), redtop panicum (*Panicum rigidulum*), arrowheads (*Sagittaria* spp.), mountain spikesedge (*Eleocharis montana*), southern cutgrass (*Leersia hexandra*), and longtom (*Paspalum denticulatum*).

The Sponsor will excavate a shallow 1.9-acre depression (WAA3) on the northern portion of the Bank Site surrounded by an area that will be restored to forested wetland habitat. The depression will be approximately 1 to 2 feet lower than the surrounding elevations and is anticipated to support 12-24 inches of prolonged inundation well into the growing season during typical climatic conditions. The depression will be designed to mimic similar habitat at Sheldon Lake State Park and will be planted with bald cypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*) bare root seedlings or potted plants.

The two depressions will increase topographic heterogeneity, create a wider variety of habitat types, store additional water, support additional plant species, and provide habitat for waterfowl and other wildlife that occur in such habitats. While deeper habitats often support lower floristic diversity, these areas generally tend to have increased nutrient cycling processes, soil organic matter, decomposition rates, and increased denitrification potential (Jessop *et al*. 2015).

Forested Wetland Re-establishment (WAA5 and WAA6)

Two herbaceous upland areas, 57.1-acre WAA5 and 17.6-acre WAA6, are located on the northern and south-central portions of the Bank Site, respectively, and will be restored/re-established to forested wetland (Attachment A - Figure 6). RES will lengthen the hydroperiods within the areas by 1) reconnecting the areas to the rainwater runoff sheet flow that historically flowed across them, 2) recreating microtopography similar to the historic condition, and 3) improving hydrologic connectivity to Cow Island Bayou. The goal of the work plan for this area is to create saturated soils for longer portions of the growing season, but not create frequent inundation, except for the heaver rain events that cause Cow Island Bayou to overtop its banks and inundate the areas.

Prior to planting, GPS-guided equipment will plow, prepare, and sub-soil the site to create rows approximately 9 to 10 feet apart that can be accurately planted and easily located in the future. Performed during dry conditions, sub-soiling will fracture the clay soils onsite to facilitate seedling establishment and survival and enhance microtopography. After preparing the soil, seedlings will be planted at a density of approximately 500 stems per acre (9 to 10-foot centers). The utilization of bareroot seedlings has three primary advantages 1) results in rapid canopy closure, 2) increased microbial diversity, and 3) is more resilient to invasion by ruderal and non-native species (Peralta *et al*. 2017).

The tree species to be planted will consist of native species adapted to the floodplain environments within the Western Gulf Coastal Plain (Table 2), and were chosen using a reference site specific to the CIBMB. The nearest (southernmost) tract of the Trinity River National Wildlife Refuge (TRNWR), located approximately 10 miles to the west of the Bank Site, was selected as a reference site for the forested wetland portion of the CIBMB (Attachment A - Figure 7). Dominant tree species in this reference site are listed in Table 2; a full list of plant species recorded in TRNWR can be found in Attachment O.

Table 2. Native overstory tree species present at TRNWR reference site and selected for planting in CIBMB.

Species Name	Common Name	Wetland Status	Selected for Planting
Carya aquatica	water hickory	OBL	✓
Quercus lyrata	overcup oak	OBL	✓
Taxodium distichum	Bald cypress	OBL	✓
Celtis laevigata	sugarberry	FACW	✓
Fraxinus pennsylvanica	green ash	FACW	✓
Platanus occidentalis	sycamore	FACW	
Quercus phellos	willow oak	FACW	✓
Quercus laurifolia	laurel oak	FACW	✓
Quercus similis	Bottomland post oak	FACW	

Table 2. Native overstory tree species present at TRNWR reference site and selected for planting in CIBMB.

Species Name	Common Name	Wetland Status	Selected for Planting
Quercus texana	nuttall oak	FACW	✓
Liquidambar styraciflua	sweetgum	FAC	
Quercus nigra	water oak	FAC	✓
Ulmus americana	American elm	FAC	✓
Ulmus crassifolia	cedar elm	FAC	✓
Carya illinoinensis	pecan	FACU	✓

For the initial planting, the exact species composition will depend upon seedling availability but will be composed of at least 70% hard mast producing tree species (e.g., oak and hickory) planted in mixed-species rows to maximize the within-stand heterogeneity. Overstory tree species composition will consist of at least five species with no single species accounting for more than 25% of the cumulative cover. Whenever possible, seedlings will be planted according to wetness tolerance to minimize mortality (McLeod *et al*., 2000). Obligate wetland species (water hickory, overcup oak, and bald cypress) will be planted in lower elevation portions of the wetland cells. If encountered, Chinese tallow (*Triadica sebifera*) and other exotic and/or undesirable species will be targeted for removal (Section 4.7.5 of the MBI). Pioneer tree species that were observed at the reference site such as sycamore (*Platanus occidentalis*) and black willow (*Salix nigra*) may also be targeted for removal or left onsite during overstory tree establishment (through approximately year 5) if monitoring reveals these species are functioning as a beneficial nurse crop.

Over time, it is expected that production of propagules from the dominant overstory trees, surrounding communities, and existing seedbank in will fill in the midstory (shrub-sapling stratum) to provide a wide variety of habitat and resources to the community. Supplemental plantings could add midstory trees, understory shrubs, and vines to the site following stand thinning events (after approximately year 3) and as initially planted trees begin to reach sexual maturity (approximately year 5). If necessary, native seedlings of midstory trees, woody shrubs, or woody vines (Table 3) found at the TRNWR reference site will be planted to achieve a woody midstory coverage greater than 10%.

Table 3. Native midstory vegetation within forested areas of TRNWR.

Stratum	Species Name	Common Name	Wetland Status
Midstory	*Crataegus viridis*	green hawthorn	FACW
Midstory	*Crataegus spathulata*	littlehip hawthorn	FAC
Midstory	*Crataegus marshallii*	parsley hawthorn	FAC
Midstory	*Cornus drummondii*	roughleaf dogwood	FAC
Shrub	*Cephalanthus occidentalis*	buttonbush	OBL
Shrub	*Forestiera acuminata*	eastern swampprivet	OBL

Table 3. Native midstory vegetation within forested areas of TRNWR.

Stratum	Species Name	Common Name	Wetland Status
Shrub	*Cornus foemina*	Swamp dogwood	FACW
Shrub	*Ilex decidua*	possumhaw	FACW
Shrub	*Sabal minor*	dwarf palmetto	FACW
Shrub	*Sambucus nigra var. canadensis*	American black elderberry	FACW
Shrub	*Forestiera ligustrina*	upland swamp privet	FAC
Shrub	*Ilex vomitoria*	yaupon holly	FAC
Shrub	*Viburnum dentatum*	southern arrowwood	FAC
Shrub	*Zanthoxylum clava-herculis*	Hercules' club	FAC
Vine	*Brunnichia ovata*	American buckwheat vine	FACW
Vine	*Ampelopsis arborea*	peppervine	FAC
Vine	*Berchemia scandens*	Alabama supplejack	FAC
Vine	*Campsis radicans*	trumpet creeper	FAC
Vine	*Cocculus carolinus*	Carolina coralbead	FAC
Vine	*Smilax rotundifolia*	roundleaf greenbrier	FAC
Vine	*Vitis cinerea*	graybark grape	FAC

Although the total dry biomass of the herbaceous layer may be relatively small compared to woody vegetation, soft-stemmed plants often account for the majority of the biodiversity of a forest and are critical to nutrient cycling (Gilliam 2007). Additionally, herbaceous cover provides important wildlife habitat, food sources, natural erosion control, and may reduce invasibility by exotic species. Similar to the woody shrub-sapling stratum, it is expected over time, that production of propagules from adjacent herbaceous communities and the existing seedbank in the soil will fill in an understory (herbaceous stratum). No attempt will be made to restrict the growth of native volunteer plants unless they grow to densities that are undesirable, are invasive species, or are considered a threat to sapling survival in forested areas. The lag in time between tree saplings planting and herbaceous understory growth will provide the tree saplings a growth advantage and prevent aggressive soft-stemmed plants from rapidly outgrowing tree seedlings (Barbier *et al*. 2008). At the Sponsor's discretion, seeds representing native herbaceous vegetation (Table 4) found at the TRNWR reference site may be planted to achieve an herbaceous layer that provides greater than 30% cover.

Table 4. Native herbaceous species within forested areas of TRNWR.

Species Name	Common Name	Wetland Status
Boehmeria cylindrica	Smallspike false nettle	OBL
Carex joorii	Cypress swamp sedge	OBL
Carex louisianica	Louisiana sedge	OBL

Table 4. Native herbaceous species within forested areas of TRNWR.

Carex lupulina	Hop sedge	OBL
Persicaria hydropiperoides	swamp smartweed	OBL
Phanopyrum gymnocarpon	savannah-panicgrass	OBL
Rhynchospora mixta	Mingled beaksedge	OBL
Saccharum baldwinii	Narrow plumegrass	OBL
Saururus cernuus	lizard's tail	OBL
Triadenum walteri	Greater marsh St. Johnswort	OBL
Chasmanthium laxum	slender woodoats	FACW
Cyperus virens	green flatsedge	FACW
Panicum rigidulum	Redtop panicgrass	FACW
Chasmanthium latifolium	Indian woodoats	FAC
Polygonum virginianum	jumpseed	FAC
Ruellia strepens	limestone wild petunia	FAC
Scleria oligantha	littlehead nutrush	FAC
Vernonia missurica	Missouri ironweed	FAC
Viola sororia	common blue violet	FAC

Forested Wetland Re-establishment on Upland/Wetland Matrix (WAA1 and WAA 2)

The two areas on the east and west sides of Cow Island Bayou and depicted as WAA1 on Attachment A - Figure 6 as green hatching currently consist of 35 acres of forested wetland/upland mosaic. According to a Jurisdictional Determination from the USACE (Attachment C), WAA1 is currently 31.8% wetlands and 68.2% uplands with a 0.3-acre area of 100% wetland. The field drains in these areas will be plugged or filled and associated cuts through the levees along Cow Island Bayou will be replaced with low water crossings, which will prevent the existing rapid draining of the areas and lengthen hydroperiods. A low berm currently separates the existing cleared areas (WAA3-WAA6) from the forested areas (WAA1 and WAA2). Removing this berm will allow for overland flow from the cleared areas to reach WAA1 and WAA2 and lengthen hydroperiods. These actions will result in increased wetland percentage and reduced upland percentage in the areas. The goal for WAA1 will be at least 70% wetland and 30% upland as a mosaic within these areas.

WAA2 consists of three upland forest communities near each other within the central portion of the Bank Site, totaling 29.4 acres and depicted on Attachment A - Figure 6 as yellow hatching. These areas have undulations in the surface (gilgai). They will receive longer hydroperiods when the field drains are plugged/filled, the low water crossings are installed, and the internal berms are degraded. The goal for WAA2 will be at least 50% wetland and 50% upland as a mosaic within these areas.

In both WAA1 and WAA2, the existing forested vegetative community will be preserved for the most part. It is expected that some species may die when the hydroperiods are increased and invasive species will be removed. Initial or supplemental plantings may be conducted to enhance the ecological community and help the WAAs to meet the success criteria. Plantings will mimic native species found at the reference site (Attachment O).

Forested Wetland Rehabilitation (WAA4)

An existing 40.8-acre herbaceous wetland on the north-central portion of the Bank Site will be rehabilitated to forested wetland. This area currently has very long hydroperiods. This area receives frequent inundation from overbank flow from Cow Island Bayou and receives sheet flow from rainwater that falls in the up-slope WAA5. There is a 6-inch tall berm along the western and southern boundaries of WAA4 that holds surface water, depicted as a purple line on Attachment A - Figure 6. The berm to the west will be degraded to reduce ponding. Overland flow will be increased by the plugging the canal/ditch and degradation of associated berm. These actions will restore historic hydrological conditions to the area and result in saturated soils long enough to maintain wetland conditions but reduce ponding and extremely long inundation periods. Reforestation and subsoiling will be completed similar to WAA5.

Herbaceous Wetland Re-establishment (WAA7)

A 39.7-acre area on the southeastern portion of the Bank Site will be restored/re-established from herbaceous upland to herbaceous wetland (WAA7). RES will lengthen the hydroperiods within the area by reconnecting the areas to the rainwater runoff sheet flow that historically flowed across them. Rainwater runoff from several hundreds of acres of pasture and agricultural land to the east will flow out of the canal/ditch to the northeast and sheet flow across the northern portion of the area proposed for herbaceous wetlands. Rainwater runoff from approximately 100 acres of pasture will overflow from a ditch and depression across the southern portion of the area proposed for herbaceous wetland.

The hydroperiod will also be lengthened by improving hydrologic connectivity to Cow Island. The goal of the work plan for this area is to create saturated soils for longer portions of the growing season, but not create frequent inundation, except for the heaver rain events that cause Cow Island Bayou to overtop its banks and inundate the areas. Anaerobic conditions are likely to occur from winter through spring and sporadically following significant precipitation events during summer and fall (Starowitz 1994, Griffin *et al*. 1996).

The current vegetative community here is typified by brownseed paspalum (*Paspalum plicatulum*), Gulf muhly (*Muhlenbergia capillaris*), hirsute sedge (*Carex complanta*), swamp sunflower (*Helianthus angustifolia*), anglestem beaksedge (*Rhynchospora caduca*), and bluestems (*Andropogon* spp.).

Following completion of construction activates, the Sponsor will restore/re-establish herbaceous wetland vegetation within the area. Diversity within this vegetation assemblage is largely driven by seasonal shifts in areal coverage, with C3 plants dominating early in the growing season being supplanted by C4 grasses and diverse forbs in summer and fall. Cyperaceae, Juncaceae, Poaceae, and

Asteraceae typically co-dominate these communities depending on time of year. The Sponsor anticipates to establish this area through a combination of germination from the existing seed bank, drill seeding, bale busting hay collected from remnant sites, and plantings plugs. Additional seeding will occur in February or early March based on experience of local experts (Tjelmeland 2018, personal communication; Stephens 2018, personal communication).

The Sponsor anticipates graminoid dominance to include clustered beaksedge (*Rhynchospora glomerata*), anglestem beaksedge (*Rhynchospora caduca*), sand spikerush (*Eleocharis montevidensis*), mountain spikerush (*Eleocharis montana*), longtom (*Papslum denticulatum*), field paspalum (*P. laeve*), brownseed paspalum (*P. plicatulum*), rushes (*Juncus* spp.), longspike tridens (*Tridens strictus*), redtop panicgrass, local ecotype switchgrass (*Paslaum virgatum*), chalky bluestem (*Andropogon capillipes*), bushy bluestem (*A. glomerate*), broomsedge bluestem (*A. virginicus*), flatsedges (*Cyperus* spp.), and true sedges (*Carex* spp.). The Sponsor wants to promote graminoid areal dominance the during the initial two growing seasons to provide sufficient areal cover to outcompete non-native ruderal species and native annual broadleaf species (e.g. marshelder [*Iva annua*]). Once sufficient graminoid dominance is achieved, if warranted, the Sponsor anticipates overseeding/plugging the area with forbs including Texas coneflower (*Rudbeckia texana*), ovateleaf prairie plantain (*Arnoglossum ovatum*), bearded beggarticks (*Bidens aristosa*), downy lobelia (*Lobelia puberula*), sharp blazing star (*Liatris acidota*), and swamp sunflower (*Helianthus angustifolia*). Based on Sponsor experience with local prairies, the following wind and floodwater dispersed species are anticipated in the seed bank: winged loosestrife (*Lythrum alatum*), narrowleaf primrose-willow (*Ludwigia linearis*), Mexican primrose-willow (*L. octovalvis*), bushy goldtop (*Euthamia leptocephala*), and small-head doll's daisy (*Boltonia diffusa*). Potential planting lists were developed by observation of vegetative community assemblages within depressional wetlands and intermoundal flats at Katy Prairie Conservancy properties, Deer Park Prairie, Nash Prairie, Mowotony Prairie, Addicks Reservior edaphically maintained prairies, and other smaller remnant prairies within Harris, Fort Bend, Brazoria, and Chambers County. Additionally, Rosen (2007), Rosen et. Al (2015), and Singhurst (2014a, 2014b) were consulted to confirm Sponsor observations. A list of plants at Sheldon Lake State Park that could be planted at CIBMB is included as in Attachment K.

RES will promote herbaceous vegetation vigor using controlled burns, haying, and/or mowing as needed. The inclusion of these disturbance regimes mimics natural periodic fires and high-intensity grazing by bison.

The need to employ supplemental vegetation establishment will be informed by monitoring activities documenting the success of native recruitment. This monitoring will dictate planting method and density decisions. RES anticipates establishing an herbaceous layer that provides greater than 75% cover throughout the herbaceous wetlands by year 5.

Native Prairie Upland Buffer

The highest 24 acres of the bank site will be maintained as a native prairie upland buffer and will be included in the Bank and associated conservation easement but are not expected to achieve wetland criteria or generate credits. The vegetative community is currently dominated by native herbaceous

species. Invasive species will be identified and removed and regular burning or mowing events will prevent the encroachment of woody species.

H. Maintenance Plan

The Sponsor will be responsible for all maintenance activities required for the Bank through the final credit release. This section outlines specific maintenance activities that the Sponsor will undertake to ensure the Bank continues to exhibit the biological and physical characteristics described in the following sections until all credits are released or until the end of all required monitoring, whichever is later. Regularly scheduled site visits and monitoring activities will identify areas of concern. When necessary, adaptive management plans will be submitted to the USACE and IRT for review, comment, and approval.

Site Condition

The Sponsor will make annual inspections of the Bank Site to verify that its use is consistent with this MBI and the CE as well as to assess any damage caused by flood, fire, storm, wind, accident, trespass, vandalism, negligence, or other act or event that causes damage to the Bank. The Sponsor will ensure that all structures and facilities will be properly maintained for as long as necessary to reach Performance Standards and provide effective access for management and monitoring activities identified in the MBI and CE. The patrol of structures and access controls within and around the Bank Site will occur as part of these inspections. This includes road and low water crossing inspection. Any structural maintenance needs will be addressed within 30 days of discovery. In addition, the Sponsor will remove trash during these inspections.

Site Accessibility

Protective fencing may be required to deter trespass by humans, wildlife, or domestic animals that may cause damage to the site. The need for fencing and other access controls (e.g., gates, barbed wire) will be based on monitoring efforts and evidence that vegetation or topography has been damaged. Low fencing will be used where practicable to allow passage by wildlife; however, fencing to exclude feral hogs may be necessary. Installation of fencing will be done in coordination with the USACE and IRT. All Bank Site boundaries shall be marked with a metal post which reads “Wetland Conservation Area” to prevent casual trespass while allowing necessary access. Inspections will serve to note the condition of signs, crossings, and property boundaries and address fence inspection and repair.

Vehicular access will be restricted to grass roadways and will be designated as special easement areas from which no wetland mitigation credits will be sought. Although gravel or sand may be used as spot treatments for erosion, no impervious structure (i.e., concrete, asphalt) will be used to maintain passages. Roads will be kept clear of debris and encumbering vegetation and any maintenance (i.e., minor dirt moving and or addition of gravel) will be as limited as necessary while still permitting necessary access. Access to off-road areas will be restricted to pedestrian traffic once planting efforts are completed.

Berm Maintenance

The site should require minimal on-going maintenance once vegetation becomes established. The Sponsor will conduct annual inspections of the levees and low water crossings along Cow Island Bayou and its tributary along the northern Bank Site boundary to verify structural integrity. Inspections will also be conducted following unusual events (e.g., floods, storms, and unauthorized access). Any erosion detected will be repaired and stabilized using appropriate natural materials in coordination with the USACE, IRT, and Raywood Drainage District. Because the crossings act as water conveyance points, the Sponsor will remove materials that may snag on the crossings so that the crossings remain operational.

Forested Wetland Vegetation Maintenance (WAA1-WAA6)

Consistent with the Bank's Performance Standards, the areas of the Bank that will be restored to a forested community will be planted with native hardwood species. As the stand matures and canopy closure commences, light limitation and competition will decrease population densities which, in concert with forest management strategies, will produce a sustainable and productive community of native tree species.

If the forest overstory (tree stratum) or midstory (shrub-sapling stratum) becomes too densely populated, selective thinning and clearing of competing vegetation may be needed. Thinning emulates plant community dynamics, promotes biocomplexity, and allows for succession to drive future forest composition (Thomas *et al*. 1999, Carey 2003). If needed, the Sponsor will selectively thin the trees, but not until the forest canopy has closed and species reach sexual maturity (approximately Year 5). Any thinning cuts will be performed using hand-held equipment. In general, felled trees will be left in place to provide coarse woody debris that will act as habitat for ground-dwelling organisms and increase soil organic material. If stand composition warrants, the sponsor will interplant desirable tree species to increase the proportion of the stand composition and improve species diversity. Planting trees at varying times introduces vertical structural diversity and the natural patchiness that is important to wildlife and stand stability (DeGraaf *et al*. 1998). If needed, interplantings will attempt to replace trees lost from the original planting effort with similar (hard or soft mast) trees.

The Sponsor will ensure that the mature forest stand composition is dominated by desired hardwood species. Monitoring activities will confirm that the Performance Standards are upheld and undesirable and invasive species are controlled.

The efficacy of the forest management strategies will be based on data collected from field monitoring stations and will be reported to the USACE and IRT following the schedule specified in Section III.B. Data gathered from annual surveys will establish demographic trends for the tree populations and will inform management decisions. If a negative trend is detected, the Sponsor will report this to the USACE and IRT along with suggested management activities for correcting the trend. Corrective actions will be implemented after approval by the USACE in coordination with the IRT.

The existing forested areas are dominated by hydrophytic tree species and have few invasive species. These areas will be maintained free of invasive trees and native trees will be allowed to mature. A small percentage of the existing loblolly pine trees may be felled and left on the ground to slow the retreat of surface water, increase hydroperiods, and provide coarse woody debris that will act as habitat for ground-dwelling organisms. The sponsor will use herbicides for the treatment of invasive species such as Chinese tallow.

No herbaceous community management is anticipated for existing forested areas, other than utilizing herbicides to control herbaceous invasive species. In the areas restored from herbaceous uplands and herbaceous wetlands to forested wetlands (WAA3-WAA6), site preparation activities will remove existing herbaceous cover. Natural regeneration from the seed bank is expected to result in rapid regrowth of herbaceous vegetation cover. Relative species richness and evenness (e.g., Shannon-Wiener index values), relative percent cover, and the species composition detected during monitoring efforts will inform management decisions. The sponsor will use mowing, herbicides, or manual removal of herbaceous species that are determined to restrict the growth of trees. Such activities are not expected to be necessary once the trees begin to form an overstory and shade out the herbaceous competition.

Herbaceous Vegetation Maintenance (WAA7, WAA8, and Native Prairie Upland Buffer)

Trends toward decreasing biodiversity or unfavorable relative cover will indicate that corrective actions, such as introducing moderate disturbance regimes (Dial and Roughgarden 1988), may be necessary to maintain a highly-functional herbaceous community. Following the establishment of native herbaceous wetland within the Bank Site, maintenance activities during the Establishment and Long-Term Maintenance phases will emulate historic disturbance regimes as appropriate. Historic disturbances that maintained prairie conditions within this region included naturally occurring fires and light, migratory grazing (Lehmann 1965; Jordan 1973). The herbaceous wetland vegetation management activities may include mowing, brush-hogging, and/or prescribed burning, dependent on site conditions and weather, as discussed below. A prescribed fire return interval of every three years reflects the historic fire regime within the region (NRCS 2007; Noss 2013) and will be the goal for the Bank. The type of maintenance will depend on hydrologic and vegetative site conditions, local governmental air quality attainment status, and meteorological conditions, with prescribed burning being the preferred method of treatment.

An ecologically-based prescribed burn program is the cornerstone of restoration and maintenance of the coastal prairie ecosystem. Fire suppression allows native shrubs such as wax myrtle (*Morella cerifera*), persimmon, and eastern baccharis (*Baccharis halimifolia*) to grow to undesirable densities in coastal prairies and facilitates the invasion by Chinese tallow. To mimic natural fire regimes, controlled burns will be preferentially used during the growing season. Additionally, fires may be seasonally timed to enhance the occurrence of certain species valuable to ecosystem restoration. A prescribed burn plan following the guidelines provided in 30 TAC § 111.201-221 will be prepared for each burn event. The height of all mowed vegetation will not be lower than 8 inches, with the exception of time of initial seeding and any potential reseedings.

Areas surrounding the submerged aquatic habitat and fringe wetlands would be restored to upland prairie. The upland prairie will be seeded with native prairie species and maintained in a manner consistent with the herbaceous wetland areas of the Bank, including management of invasive species and application of prescribed fires.

Invasive Species Control

Exotic, noxious, and invasive plant species compete with desirable plants for resources, thereby reducing the growth potential for desired vegetation (D'antonio *et al*. 1998). In extreme cases, invasive species can produce monocultures that have detrimental effects on the wildlife that would otherwise use the native habitat (Forseth and Innis 2004). Therefore, the control of invasive species is a high priority.

In addition to the species identified in the most recent Noxious Plant List in 4 TAC §19.300, the Sponsor will initiate management efforts for other invasive species if they are detected within the site. As species are identified by the IRT, USACE, and peer-reviewed journals, they will be added to the list of invasive species that will be monitored and controlled.

The Sponsor will employ biological, manual, mechanical, physical, and/or chemical control methods based on the best management practices for the removal of undesirable target species in consideration. For all invasive species, the Sponsor will implement control techniques based on published research regarding the timing and efficacy of treatment options (Conway *et al*. 1999) and will provide descriptions of these treatments through the Banks's annual report to the USACE. Integrating these approaches will help control invasive species, prevent ecological damage within the site, and decrease incidental export of these species to neighboring sites. Regardless of the techniques employed, the focus will be to use the least ecologically damaging option available that will effectively achieve the management objectives specified.

a) Manual Removal

The use of hand tools is an effective way of removing some unwanted species, and typically exerts minimal impact on neighboring vegetation. Due to the cost of labor, manual removal is often cost-prohibitive at large scales but may serve as an effective spot treatment. As such, manual removal will be employed in smaller areas or in areas where herbicide treatments must be kept to a minimum and machinery should be avoided.

b) Mechanical Removal

For larger areas and areas dominated by monocultures of unwanted species, the use of machinery (e.g., bulldozers, backhoes, or mowers) may be implemented as a more effective method. Mechanical removal can be costly in terms of time and physical labor, but it may be cost-effective if large areas require significant vegetation removal. It is also important to note that mechanical removal does not target particular species and the large-scale disruption caused by such techniques may facilitate the growth of weedy species, including the invasive species that are targeted.

c) Chemical Removal

Chemical control involves the use of EPA-approved herbicides and is a cost-effective, long-term control method available for undesirable plant species. Chemical compounds function by interrupting normal biological processes within the plant, thereby reducing growth or inducing mortality. Herbicides that may be employed include: Garlon, Roundup, Arsenal, Accord, and Clearcast. Herbicide applications are relatively inexpensive across large scales and can provide some specificity, but the control of specific plants will require judicious application. For instance, treatments will be made when growth stages and weather conditions are optimum. Wind direction and speed will be monitored to prevent drift onto desirable vegetation. Chemical applications will not be done if rain is expected within 48 hours because rain can wash the herbicide off the target vegetation or dilute the herbicide to a concentration that is ineffective.

Pre-emergent herbicide applications will be made in coordination with tree planting as a best management practice to control and suppress grassy and broad leaved weeds and thereby reduce herbaceous competition with newly-planted saplings. Immediately preceding planting, Barricade® (prodiamine) and Gallery® (isoxaben) or their generic equivalents will be applied at the rate described on the product labels. These chemicals will be applied with ground equipment as the label directions do not permit aerial application. Following planting, foliar herbicide will be applied between rows for two years to suppress herbaceous competition for nutrients and light. These herbicides act synergistically and can control a large number of herbaceous weed species.

Toxicological information indicates that prodiamine has a relatively high LD_{50} in tested animals. Furthermore, prodiamine has a water solubility of 0.013 ppm, making this herbicide unlikely to move laterally with sheet flow or percolate into ground water. Based on reactivity, isoxaben is considered slightly toxic. Although isoxaben has a relatively high water solubility (1000 ppm), the adsorption coefficient K_{oc} is moderately high (1400) meaning that the heavy clay soils on the site should retard movement off the site or into ground water. The half-lives of prodiamine and isoxaben are both approximately 110 days in aerobic soils.

The Sponsor will make every effort to avoid adverse impacts to herbaceous wetland areas when using herbicide. Preventative measures may include a no-spray buffer around the perimeter, timing of herbicide application to avoid sensitive environmental conditions, and planned management actions. Treatment of invasive species within the herbaceous wetland area will be done exclusively by spot application.

Control of invasive Chinese tallow within the herbaceous wetland areas will be accomplished by wicking, aerial, or basal chemical spray application. To prevent herbicide damage to herbaceous prairie wetland vegetation, herbicides deployed will generally be those selective for broadleaf plant species control. Aerial spray and basal herbicide applications eliminate or minimize soil disturbance which is critical in Chinese tallow control operations. Bare ground and openings found below dead tallow trees provide an excellent location for inter-seeding and transplanting herbaceous species. The use of non-broadleaf herbicides may be necessary to control noxious grass species.

Wildlife Management

The site is expected to function as a wetland area and, as such, it will be attractive to a wide range of organisms. Therefore, it is expected that the site will serve as high quality habitat for a rich community of animals in addition to plants, fungi, and microorganisms. The animals within a community provide numerous intrinsic benefits including nutrient cycling, seed dispersal, and pollination. The benefit of wildlife to humans includes aesthetic values; a healthier, more balanced ecosystem, as well as resources for outdoor education, fishing, and hunting. However, the interaction of animal and plant communities can be fragile and may be sensitive at various seral and phenological stages. As such, wildlife management strategies may be necessary to ensure the long-term ecological function of the Bank.

Overgrazing and overbrowsing of vegetation by wildlife can lead to stunting of growth, girdling, and direct consumption of trees by wildlife. This, in turn, degrades the vegetative community and may reduce biodiversity through uneven feeding pressure. Large- and small-scale land cover conversion may also be caused by wildlife (beavers and feral hogs, respectively) in wetland areas. Abnormally high animal population densities, even if only for a brief period, may also cause lasting impacts on aquatic systems (Unckless and Makarewicz 2007). Significant wildlife impacts on-site will be documented as part of the vegetation and infrastructure monitoring.

If physical, chemical, or biological functions of the Bank are experiencing significant negative effects, the Sponsor will take actions to control any detrimental impacts by wildlife. Management actions may include installing fences, using deterrents, live trapping, and/or harvesting to prevent the undesirable activity of animals that pose a material threat to people, native animals, or habitat conditions within CIBMB. The Sponsor will harvest exotic species (i.e., those that are not known to be native to the area based on historical county records) to prevent establishment of these organisms within the Bank. Invasive native species (i.e., those species that grow to populations that negatively affect other species in the community) will be controlled to prevent loss of biodiversity. Nuisance or problem species include species that are native or naturalized that have demonstrated a negative effect on the establishment and survival of the wetland (e.g., pigs, beavers that graze on freshly planted saplings) rather than those traditionally considered problematic (e.g., foxes, coyotes). For species to be controlled, the Sponsor will act in accordance with state and federal regulations.

I. Performance Standards

- **The Sponsor shall record a conservation easement with the Liberty County Clerk that has been approved by the USACE in coordination with the IRT and provide a copy of the recorded conservation easement to the USACE SWG Regulatory Division Chief, prior to initial credit release.**

- **The Sponsor shall establish and execute financial assurances, approved by the USACE in coordination with the IRT, and provide copies of the respective executed documentation to the USACE SWG Regulatory Division Chief prior to initial credit release.**

- **The Sponsor shall establish and execute the long-term management fund prior to initial credit release and shall fully fund the long-term management endowment prior to submittal of an as-built report and prior to the submittal of the construction and planting credit release request.**

- **Within two calendar years of the date the MBI is signed by the USACE, the Sponsor must provide the USACE and IRT an as-built report with plan drawings (to scale) that include elevations and horizontal distances, and a signed statement demonstrating that construction and planting is complete and compliant with the MBI.**

- **Deep-rooted sedge (*Cyperus entrerianus*), Macartney rose (*Rosa bracteata*), trifoliate orange (*Poncirus trifoliata*), privets (*Ligustrum* spp.), elephant ear (*Colocasia esculenta*), Johnson grass (*Sorghum halepense*), cogon grass (*Imperata cylindrica*), Chinese tallow (*Triadica sebifera*), and all noxious and invasive species currently listed by the Texas Department of Agriculture (TDA 2007) (Texas Register. Volume 32, Number 23. June 8, 2007. Pages 3077-3422) must comprise no more than five percent (5%) actual cover of the herbaceous or other strata.**

- **Sponsor shall submit all monitoring, transaction, and other reports on time in accordance with the requirements of this MBI.**

- **The Sponsor shall conduct the hydrologic improvements in accordance with the specifications of the MBI. To assess hydrologic improvements, the Sponsor will install, maintain, and monitor continuous water level recorders at locations indicated in the MBI. Hydrographs produced from data collected will be correlated to the field indicators sampled and be provided in all monitoring reports. This will include documentation of precipitation conditions (normal, wet, dry) during annual monitoring periods using a National Food Security Act Manual WETS analysis, the Palmer Drought Severity Index, or other suitable metric.**

- **At Year 5 the Sponsor will submit a monitoring report to the USACE and IRT that will include a wetland delineation demonstrating that all areas in each WAA meet wetland parameters including hydrographs documenting the presence of wetland hydrology.**

Herbaceous Wetland Areas (WAA7 and WAA8)

- **Within three years of USACE receipt of the as-built report, WAA7 and WAA8 must have a minimum of 50 percent areal cover of live native herbaceous plant species. At least 66 percent of this plant cover must be made up of species with wetland indicator status of facultative (FAC), facultative wetland (FACW) or obligate (OBL).**

- **Within five years of USACE receipt of the as-built report, WAA7 and WAA8 must have a minimum of 75 percent areal cover of live native herbaceous plant species. At least 66**

percent of this plant cover must be made up of species with wetland indicator status of facultative (FAC), facultative wetland (FACW) or obligate (OBL).

- **After three years from the USACE receipt of the as-built report, WAA7 and WAA8 will have no single species that exceeds 50 percent areal cover and it will have at least 4 species with at least 5 percent areal cover.**

- **After three years from the USACE receipt of the as-built report, WAA7 and WAA8 must contain less than 15% unvegetated open water at any time, with the exception of the 2-acre depression in the center of WAA8 planned for submerged aquatic vegetation.**

Forested Wetland Areas (WAA1-WAA6)

- **Within one year of USACE receipt of the as-built report, WAA3 through WAA6 must have a minimum density of 400 live stems per acre of species identified in the planting list, with no single species representing more than 33 percent of live stems.**

- **Within five years of USACE receipt of the as-built report, WAA3 though WAA6 must have a minimum density of 250 live stems per acre of species identified in the planting list that average greater than 3 feet tall, with no single species representing more than 33 percent of live stems.**

- **Within ten years of USACE receipt of the as-built report, WAA1 through WAA6 must have a minimum of 67 percent areal cover of woody vegetation (e.g., trees and shrubs) comprised of a minimum of five tree species identified in the planting list or other natively recruited hydrophytic species.**

J. Monitoring Requirements

Monitoring and reporting requirements are to be in accordance with USACE Regulatory Guidance Letter (RGL) 08-03 "Minimum Monitoring Requirements for Compensatory Mitigation Projects Involving the Restoration, Establishment, and/or Enhancement of Aquatic Resources". Reports presenting documentation of monitoring findings will be submitted to the USACE by December 31 of each year, for the first 15 years following signature of the MBI by the Sponsor and the USACE, or until all Performance Standards are met, whichever is later.

K. Long-term Management & Funding Plan

In order to ensure that funds are available to provide a source of funding for the perpetual maintenance of the Bank, the Sponsor shall establish an investment account for long-term management funds. This financial assurance must be sufficient to provide for perpetual maintenance and operation of the bank's activities, including but not limited to site protection,

management, monitoring, reporting, and remedial actions that might be necessary. The long-term management fund investment account must be established and executed prior to initial credit release and must be fully funded prior to the submittal of an as-built report and prior to the construction and planting credit release request. A cost estimate created using Property Analysis Record (PAR3) software, and draft language for the investment account agreement is presented in Attachment I. The Sponsor calculated the long-term funding amount by estimating the labor, materials, and equipment costs for those items necessary to comply with the successful long-term maintenance of the Bank. The Sponsor adjusted maintenance costs based on a 2% annual inflation rate and used a 2.935% capitalization (cap) rate based on a 5% annual rate of return, 2% inflation, and 0.065% fund management fee rate.

The account will be capitalized through annual deposits and funded in the amount of $198,345 prior to the submittal of an as-built report and prior to the construction and planting credit release request. This requirement is not contingent on credit sales. The Sponsor included investment returns in its planning, and based on past experience and estimated future performance, assumed a 5% percent annual return. The Sponsor will invest the funds into a Current Income Portfolio (CIP) managed by Capstone Asset Management Company. The fund is expected to return an average annual rate of approximately 5% under current market conditions, projected to produce a balance of $412,345.00 when long-term management begins, and is designed to be non-wasting (Attachment I). Notwithstanding economic indicators, projections, or future performance, the Sponsor remains legally and financially responsible for maintaining the Bank pursuant to the DA Permit Conditions including this MBI.

Any accrued interest shall be used in the operation, maintenance, or other purpose that directly benefits the Bank. Only accumulated interest may be withdrawn for this purpose. The principal shall not be used and shall remain as part of the Bank's assets to ensure that sufficient funds are available should USACE approve a future request to transfer perpetual maintenance responsibilities to a third party. The Sponsor or a USACE approved Long-Term Steward may withdraw the accumulated interest after approval from the USACE.

The Sponsor is responsible for ensuring that the funding of the Long-Term Maintenance and Protection account is sufficient. In the event capitalization of the account proves insufficient to meet the long-term management needs of the Bank, the Sponsor, or USACE approved long-term steward, remains liable for such costs. Prior to approving a request to transfer liability to a 3rd party long-term steward, the USACE in coordination with the IRT, will determine whether any additional funding by the Sponsor is necessary and if so, in what amount. The USACE may not approve a transfer of liability until the long-term maintenance account is sufficiently funded. In the event the financial assurance or long-term funding mechanism is due to expire, or the sponsor proposes to replace the respective mechanism with another type, the sponsor shall notify the USACE at least 120 days prior to the expiration or replacement to allow for USACE review and approval. If a USACE approved funding mechanism has not been established, mitigation bank credits will be suspended until such time financial assurances are approved. Failure to

maintain adequate long-term funding shall constitute good cause for suspending or terminating operation of the Bank.

L. Adaptive Management Plan

Adaptive management necessitates stated management objectives to guide decisions about what to try and explicit assumptions about expected outcomes to compare against actual outcomes. The linkages among management objectives, learning about the system, and adjusting direction based on what is learned distinguish adaptive management from a simple trial and error process. Therefore, success in adaptive management ultimately depends on effectively linking monitoring and assessment to objective-driven decision making. During the operational phase of the bank. Prior to and during long-term management, adaptive management is not a short-term fix, an assumed resolution to non-compliance or failure to meet a performance standard(s), or responding to single events or short-term problems caused by weather, normal cyclical fluctuations in plant and animal populations, or human interruptions. Accordingly, the conditions and components of adaptive management will be a product of analyzing whether the Bank is currently progressing toward desired outcomes; whether new or improved methods are available to prescribe; and predicting the expected effects of the plan.

M. Financial Assurances

Per 33CFR332, the Sponsor must provide sufficient financial assurances to ensure a high level of confidence that the compensatory mitigation project will be successfully completed and maintained in accordance with applicable performance standards. The Sponsor will secure sufficient financial resources, taking into account inflation, to ensure compliance with the requirements of the MBI in the event that the Sponsor is no longer able or willing to operate the bank in compliance with the MBI. This financial assurance should be sufficient to provide for maintenance and operation of the bank's activities, monitoring, reporting, and any remedial actions that might be necessary. Site-specific considerations, such as the position of the bank within the watershed, normal hydrology, soils, type and extent of site development activities proposed, and expected relative ease or difficulty of achieving the performance standards, may affect the size of the financial assurance. Failure to maintain an adequate financial assurance shall constitute good cause for suspending or terminating operation of the bank. Financial assurances are described in Attachment I.

PART III: BANK OPERATIONS

A. ACCOUNTING PROCEDURES

Sponsor will establish and maintain a system for tracking the production of credits, credit transactions, and financial transactions between Sponsor and permitee. Credit production, credit transactions, and financial transactions must be tracked on a bank basis and separately for each individual permit. Credits will be debited from the ledger once a financial transaction

has occurred. The Sponsor will notify the USACE of each transaction and provide the USACE a copy of the ledger entry within 15 days of each transaction. Sponsor will inform the IRT of the status of credits reserved on an independent submittal.

Each ledger entry will include the following information: Date of submittal. USACE-permit applicant's name, address, and telephone number,

- **USACE-permit and/or other identification number,**
- **Brief description of the location and type of the authorized work (8-dHUC),**
- **Brief description of the nature and extent of adverse project impacts,**
- **Sponsor assumes legal responsibility for the mitigation requirements,**
- **Account balance before transaction,**
- **Date of transaction,**
- **Number of credits currently available,**
- **Number of credits debited from the credit availability account, and**
- **Account balance after transaction.**

The Sponsor shall also provide an annual statement of the account to USACE by January 31 of each year until all credits have been withdrawn and bank closed."

The Sponsor shall be responsible for maintaining the bank's credit ledger in the Regulatory In- lieu Fee and Bank Information Tracking System (RIBITS). All credit transactions shall be entered into the database no later than seven calendar days after the transaction has occurred or the USACE reserves the right to suspend credit sales until sales transactions are deemed current and compliant. RIBITS mandatory information fields include the following:

1. **Jurisdiction Type**
2. **Transaction Date**
3. **Credits Debited**
4. **USACE Permit Number (Format: SWG/Yr/Permit # (e.g.SWG-2000-00150)**
5. **Name of Permittee**
6. **Credit Classification (if applicable, with functional assessment subcategories identified; (e.g. iHGM identify amounts within each functional category TSSW/RSEC/MPAC, etc.)**

Compliance with RIBITS reporting does not supersede the requirement of the sponsor to submit individual transaction reports.

B. REPORTING PROTOCOLS

In accordance with USACE Regulatory Guidance Letter 08-03 (USACE 2008), the Sponsor will submit an annual report to the District Engineer and the IRT. The annual report will be submitted no later than December 31 of the year the monitoring was conducted, or the following business day if that date falls on a weekend. Annual reports will be submitted for the first 15 years following submittal of as-built drawings or until all Performance Standards have been met, whichever is later. The report

will identify the Bank and the party that conducted monitoring activities. An adequate description (acreage, type of aquatic resources, location, etc.) of the project will be provided to identify the Bank. The overview will also contain a timeline of commencement, scheduled actions, and corrective actions. Annual ledger reports and the most recently completed Conservation Easement Monitoring Report will be included.

The Sponsor will provide an itemized, annual financial report to the USACE SWG by June 30 of each year in which financial assurances are required. The annual financial report will include:

- For each year in which financial assurance is required – itemization of any and all activity associated with the construction and establishment of financial assurance and an assessment of that assurance including current status and potential expiration.
- A statement as to whether the long-term management fund account is in compliance with the MBI.
- A distribution schedule of the long-term management fund account.
- Itemization of any and all account activity associated with the long-term management endowment and an assessment of the endowment's current performance to reasonably ensure perpetual funding for long-term management.

In accordance with 33 CFR 332.3(n)(5), the Sponsor is required to give the DE at least 120 days advance notice if the financial assurance instrument will be amended, terminated, or revoked. In addition, the financial assurance instrument must be written in such a way that it is the obligation of the bonding company or financial institution to provide USACE SWG notice. Inclusion of a summary of any changes to the financial assurance instrument in the reporting year does not alter this separate obligation. Both provisions are clearly stated in the financial assurance documents contained in Attachment I.

C. CREDIT RELEASE SCHEDULE

Credit releases shall occur based on the following schedule:

1. *Advanced credit releases:*
    a. *Administrative:* Sponsor may apply for a release of 25% of the 15-year projected Riverine Forested HGMi and Riverine Herbaceous/Shrub HGMi credits (Attachment C) available upon the execution of this MBI, filing of the USACE approved CE, ceasing all land uses that are not consistent with this MBI, and establishment of appropriate USACE-approved financial assurance mechanisms.
    b. *Construction/Planting Activities:* Sponsor may apply for a release of 50% of the 15-year projected Riverine Forested HGMi and Riverine Herbaceous/Shrub HGMi credits upon construction of hydrologic improvements (e.g., microtopography), site preparation, vegetation re-establishment, fully funding the long-term management fund account, and providing an as-built report to the USACE.

2. *Final Credit Release:* Sponsor may apply for an additional credit release after completing 15 years of monitoring and successfully meeting all performance standards. The Sponsor will conduct an HGMi functional assessment of the Bank to determine the total FCUs provided. The final credit release will be equal to the amount of biological, chemical, and physical FCUs above the ones previously released.

Along with the Year 3 monitoring report, the Sponsor will submit an HGMi functional assessment with a revised estimate of 15-year projected Riverine Forested HGMi and Riverine Herbaceous/Shrub HGMi credits. If this revised 15-year projected number of credits is below the initial estimate (indicating that the Bank is not trending toward meeting the credit totals that the advanced credit releases were based upon), then the number of released credits will be reduced to 75% of the revised 15-year estimate until the issue is resolved. If the credit reduction would require more than the remaining available credits, then the USACE may require that the Sponsor provide off-site compensatory mitigation sufficient to meet the deficit.

Under no circumstances will credits be sold before they are released by the USACE, in coordination with the IRT. If at any time this occurs, CIBMB will be immediately suspended. All credit releases shall be contingent on the Sponsor being in compliance with all terms and conditions of permit number SWG-2013-00223 and MBI with all associated documents.

D. CONTINGENCY PLANS/REMEDIAL ACTIONS

In the event the CIBMB or a specific part of the Bank fails to achieve Performance Standards as specified in this MBI, the Sponsor will notify USACE and develop necessary contingency plans to implement appropriate remedial actions for approval by USACE, in coordination with the IRT. In the event the Sponsor fails to implement remedial actions within the USACE-approved timeframe, USACE will take appropriate actions to enforce compliance with the terms of the MBI. If reasonable efforts by the Sponsor fail to bring the Bank into compliance with the requirements of the MBI, the USACE will notify the Sponsor, the CE holder, and the agent responsible for the transfer of financial assurances of non-compliance. The CE holder may then collect the funds necessary to correct the deficiency and cause corrective action to be taken. Any remedial action may, but will not automatically, demonstrate compliance with DA Permit #SWG-2013-00223 which has independent compliance enforcement provisions.

In the event that all or part of this property is taken by exercise of eminent domain or acquired by purchase in lieu of condemnation so as to terminate the CE in whole or in part, the Sponsor is responsible for replacing any wetland mitigation credits lost with in-kind wetland mitigation credits as approved by the USACE in coordination with the IRT.

E. APPROVED CREDIT QUANTITIES

Credits will be released in accordance with the requirements of the release schedule. Estimates of wetland development and future HGMi values and credit quantities are provided in Attachment C and Table 5.

Table 5. Estimated Credit Releases in FCUs

Credit Type	Administrative FCU Release (credits)	Construction/ Planting FCU Release (credits)	Maximum Estimated FCU (credits)
Riverine Forested HGMi Physical	25.0	50.1	100.1
Riverine Forested HGMi Biological	26.8	53.6	107.1
Riverine Forested HGMi Chemical	26.1	52.2	104.5
Riverine Herbaceous/Shrub HGMi Physical	9.0	18.1	36.2
Riverine Herbaceous/Shrub HGMi Biological	8.0	16.1	32.1
Riverine Herbaceous/Shrub HGMi Chemical	7.9	15.7	31.4

F. FORCE MAJEURE

Any delay or failure of the Sponsor to comply with the terms of the MBI shall not constitute a default if and to the extent that such delay or failure is primarily caused by any force majeure event, as determined by the USACE, resulting in conditions beyond the Sponsor's reasonable control and significantly adversely affects its ability to perform its obligations hereunder. The Sponsor shall give written notice to the USACE and IRT if affected by any such event within 60 days in order to restore compliance. Following a force majeure event the Sponsor should not expect the bank to be in compliance with the MBI, therefore, the bank may be suspended, terminated or closed. Because of a force majeure event, the bank may not be in compliance or meet performance standards. If the Corps agrees that a force majeure event, the bank will be suspended until remedial actions and remaining mitigation obligations are approved. In the event that the bank is not in compliance, not meeting performance standards, and ultimately if the result of the force majeure event is that the bank is suspended, terminated or closed, the Sponsor remains liable for fulfilling all remaining mitigation obligations including maintenance, monitoring, reporting, and long-term management requirements.

G. VALIDITY, MODIFICATION, OR TERMINATION OF THE MITIGATION BANK

This MBI will become valid upon signature by the U.S. Army Corps of Engineers and bank sponsor. This MBI may be amended, altered, released, or revoked only by written approval by USACE to the parties hereto or their heirs, assigns or successors-in-interest. The amendment must follow the appropriate procedures listed in 33 CFR 332.8 unless the district engineer determines that the streamlined review process described in 33 CFR 332.8(g)(2) is warranted. Any of the IRT members may terminate their participation upon written notification to all signatory parties. Participation of IRT members will terminate 30 days after written notification.

H. CONTROLLING LANGUAGE

To the extent that specific language in this document or appendices changes, modifies, or deletes terms and conditions contained in those documents that are incorporated into the MBI by reference, and are not legally binding, the specific language within the Department of the Army Permit SWG-2013-00223 **and MBI shall be controlling.**

I. DEFAULT/CLOSURE PROVISIONS

If the USACE/IRT determines that the Sponsor has failed to provide the required compensatory mitigation performance standards, submit monitoring reports on time, establish and maintain ledgers and reports in accordance with the provisions in Sections II.I, II.J., III.A., and III.B, and/or otherwise comply with the terms of the MBI, the USACE will take appropriate action to enforce compliance with the terms of the MBI. Such actions may include suspending credits sales, decreasing available credits, requiring adaptive management measures, utilizing financial assurances or contingency funds, terminating the MBI, or referring the non-compliance with the terms of the instrument to the Department of Justice. The Sponsor shall remain responsible for fulfilling these obligations until such time as the long-term financial obligations have been met and the long-term liability of all mitigation has been transferred to a party approved by USACE, in coordination with the IRT.

Bank closure shall be the first date that all of the following have occurred:
1) all performance standards have been achieved and verified by USACE,
2) all monitoring requirements have been met and verified by USACE,
3) all financial responsibilities have been met, including 100% of long-term management funding in place for not less than one year, and
4) USACE approval, in coordination with the IRT, of either the sponsor's written request for bank closure or otherwise determined closed by discretion of the District Engineer.

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ATTACHMENTS

A. MBI Figures (Vicinity, Project, Topographic, Soils, and Service Area Maps)

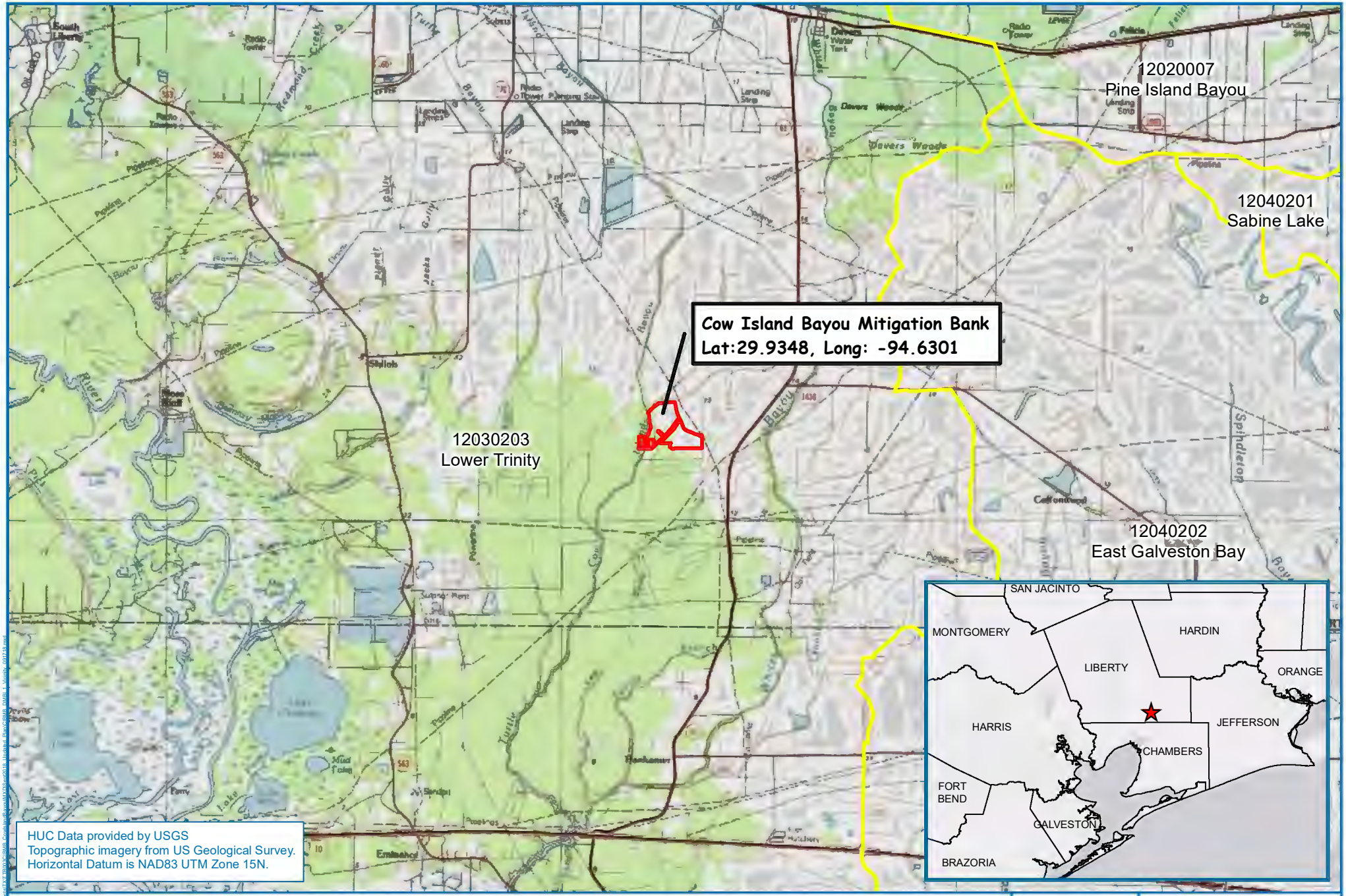

Figure 1

Vicinity
Cow Island Bayou Mitigation Bank

Liberty County, Texas

Date:	9/26/2018
Drawn by:	AB; BRG
Checked by:	HT
	Draft MBI

April 15, 2019

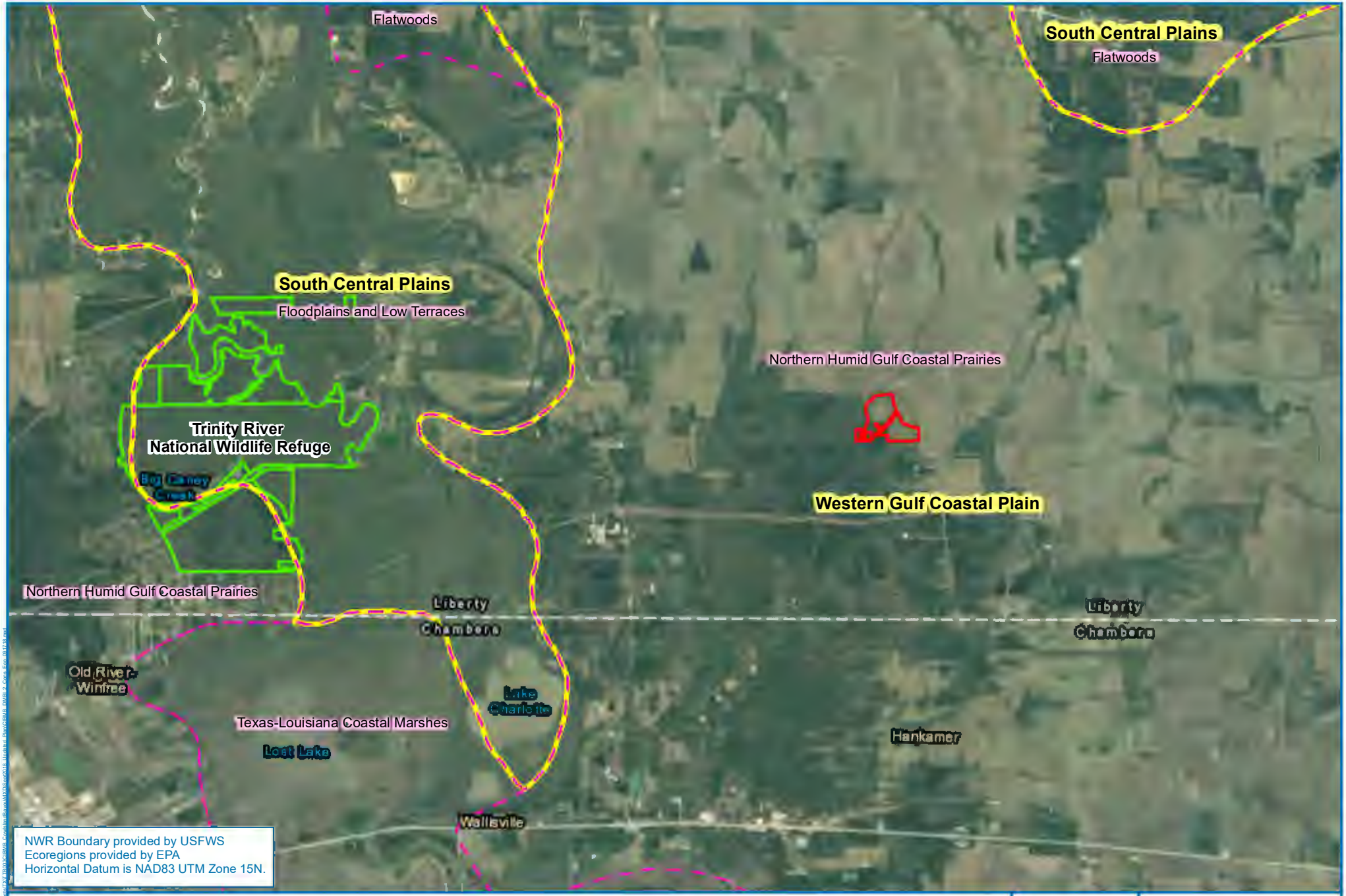

Figure 2

Existing Conservation Areas and EPA Ecoregions
Cow Island Bayou Mitigation Bank

Liberty County, Texas

- Cow Island Bayou Mitigation Bank
- EPA Level III Ecoregion
- EPA Level IV Ecoregion
- Conservation Areas

Date: 9/17/2018
Drawn by: AB
Checked by: DJ
Draft MBI

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April 15, 2019

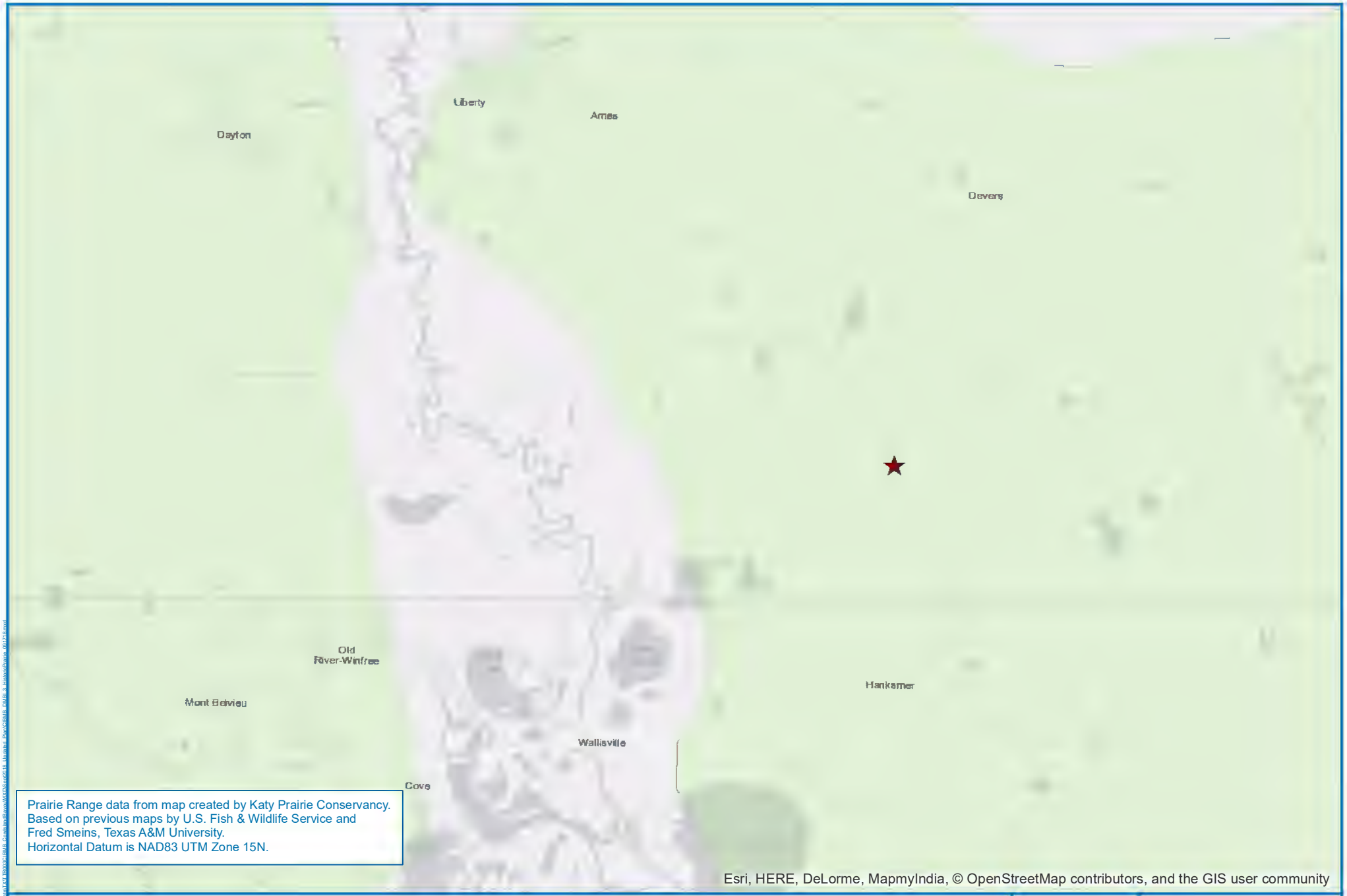

Figure 3

Historical Range of Coastal Prairie
Cow Island Bayou Mitigation Bank

Liberty County, Texas

★ Cow Island Bayou Mitigation Bank

Historical Prairie Range

Date: 9/17/2018

Drawn by: AB

Checked by: DJ

Draft MBI

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April 15, 2019

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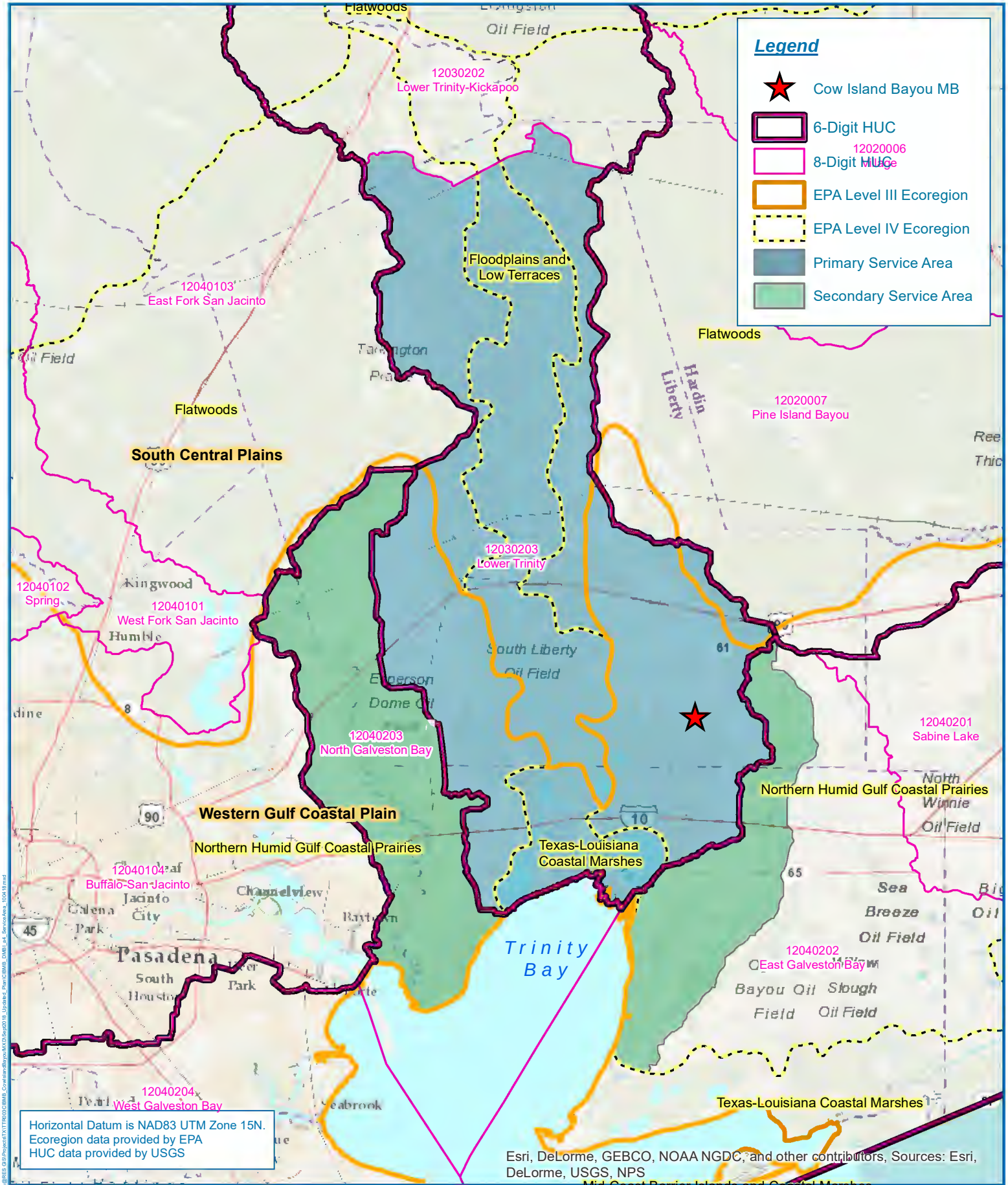

Figure 4

Primary and Secondary Service Areas
Cow Island Bayou Mitigation Bank

Liberty County, Texas

Date: 11/6/2018
Drawn by: AB
Checked by: DJ
Draft MBI

April 15, 2019

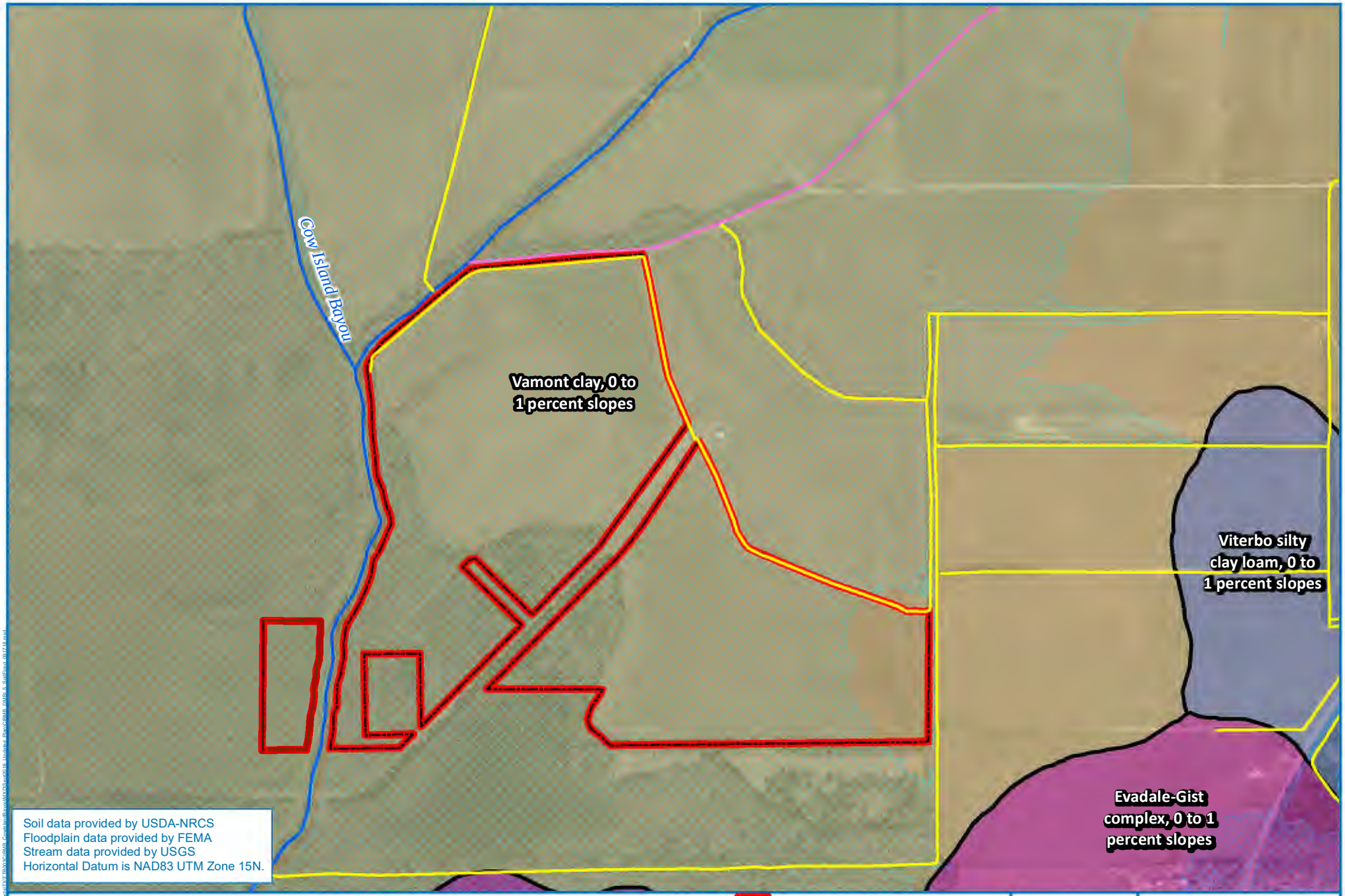

Figure 5

Soils, Waters, and Floodplain
Cow Island Bayou Mitigation Bank

Liberty County, Texas

Cow Island Bayou Mitigation Bank
FEMA 100-Year Floodplain
NHD Data
Canal/Ditch
Intermittent Stream
Perennial Stream

Date:	9/17/2018
Drawn by:	AB; BRG
Checked by:	HT
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April 15, 2019

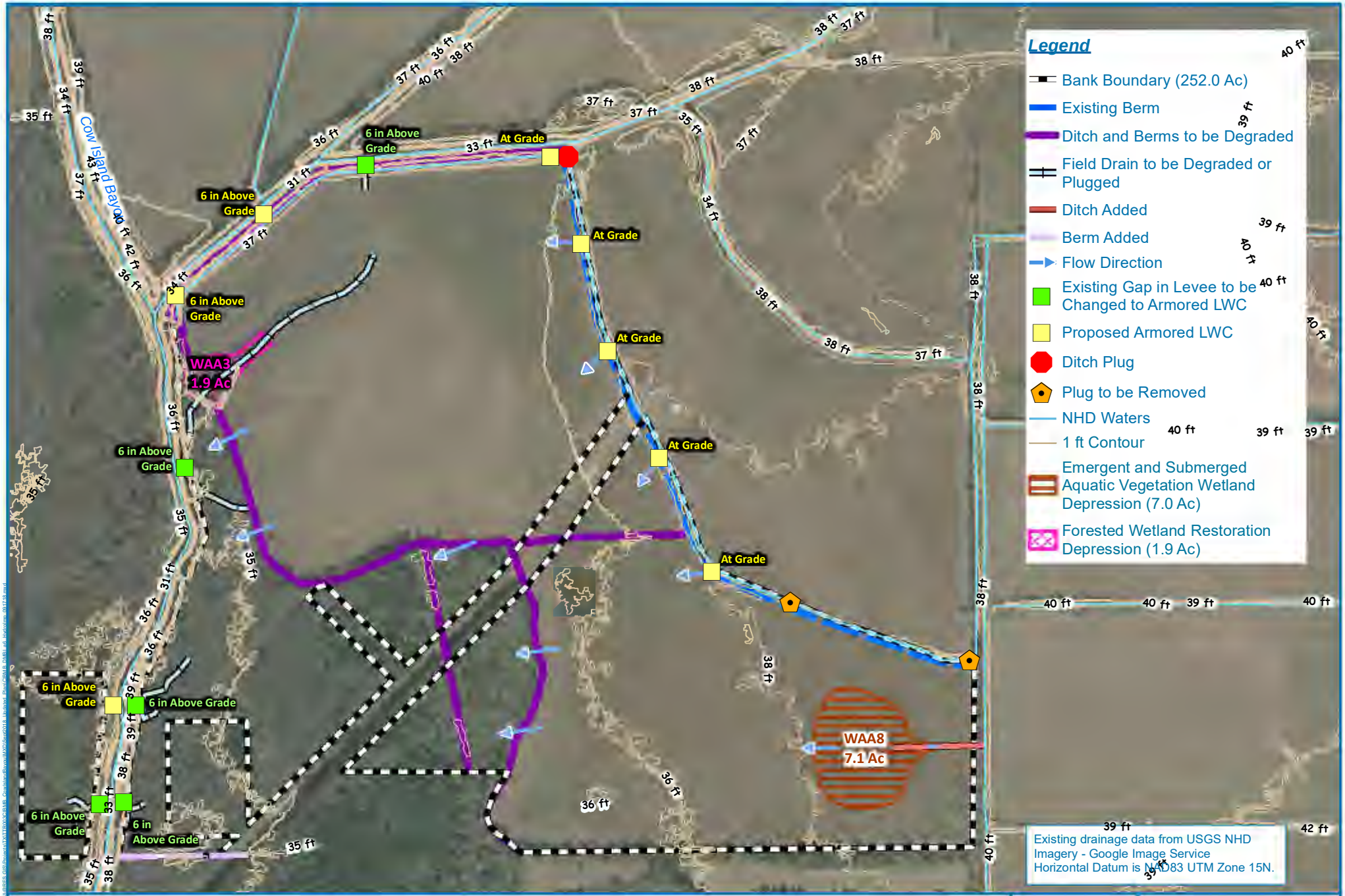

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Figure 6

Hydrologic Improvements
Cow Island Bayou Mitigation Bank

Liberty County, Texas

Date: 11/6/2018

Drawn by: AB, BRG

Checked by: HT

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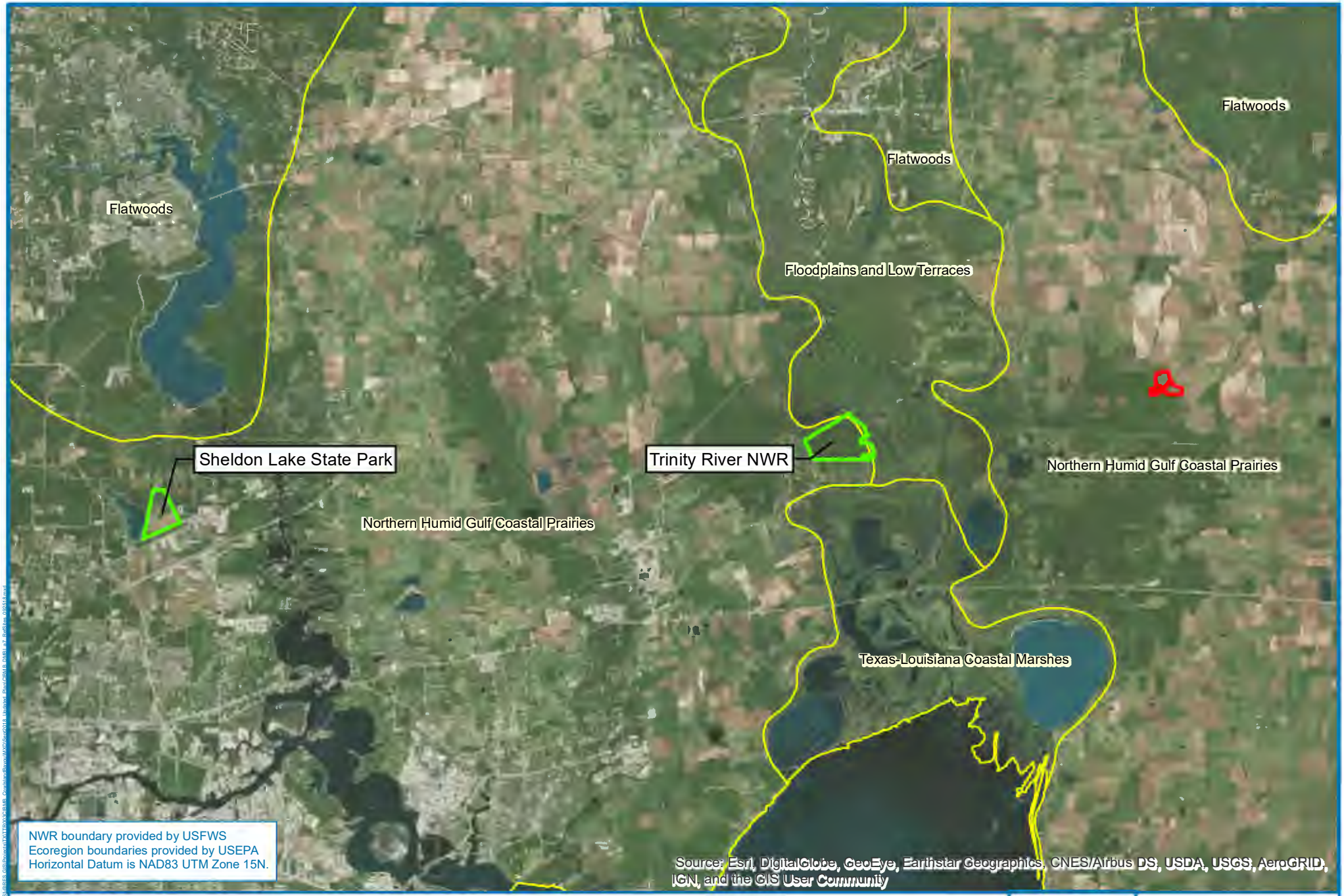

Figure 7

Reference Sites
Cow Island Bayou Mitigation Bank

Liberty County, Texas

Cow Island Bayou Mitigation Bank
Reference Sites
USEPA Level IV Ecoregions

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Date:	11/6/2018
Drawn by:	AB, BRG
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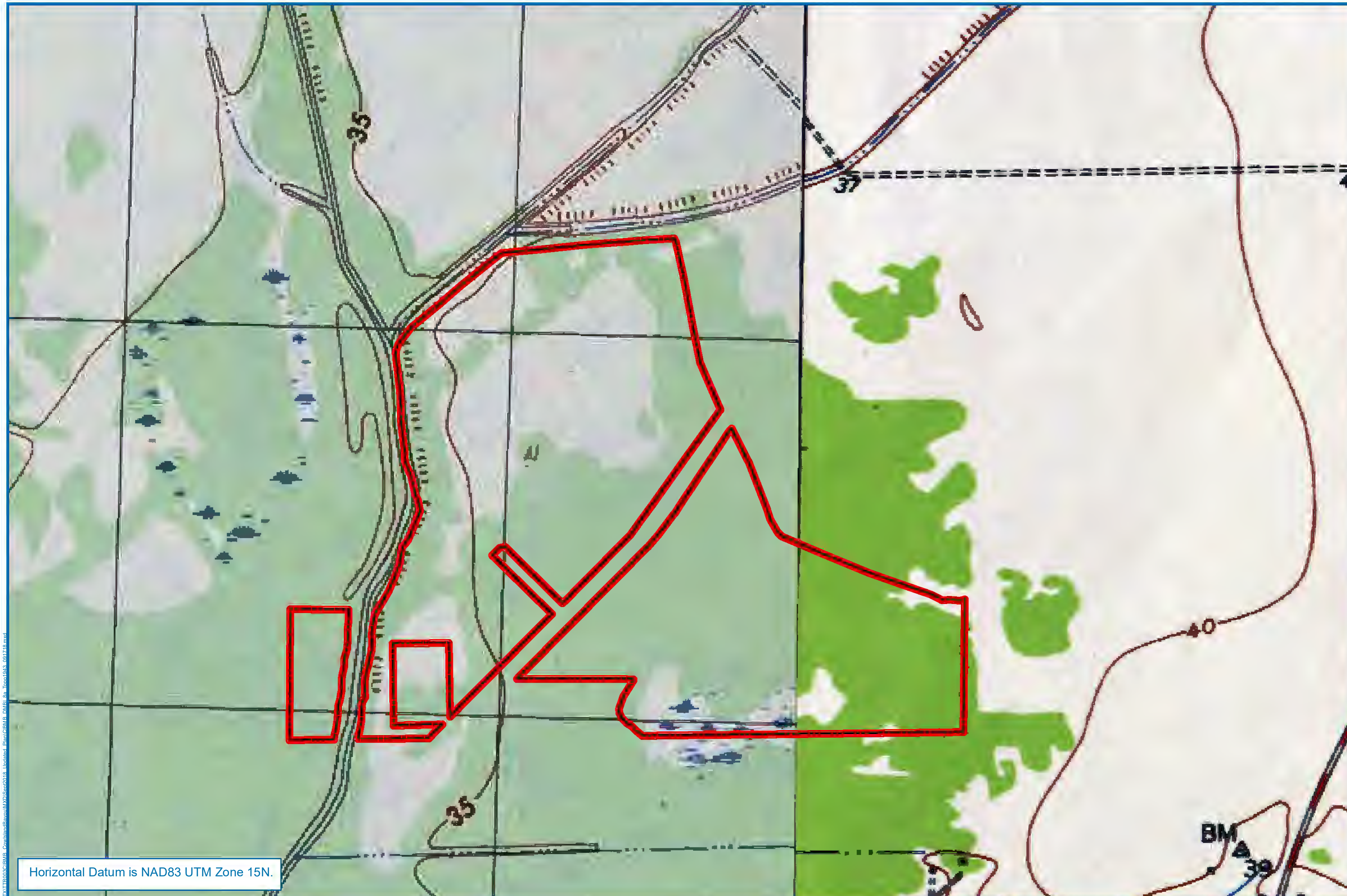

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April 15, 2019

Figure 8a

Historical Topographic Map - 1943
Cow Island Bayou Mitigation Bank

Liberty County, Texas

Cow Island Bayou Mitigation Bank

Date: 9/21/2018

Drawn by: AB,BRG

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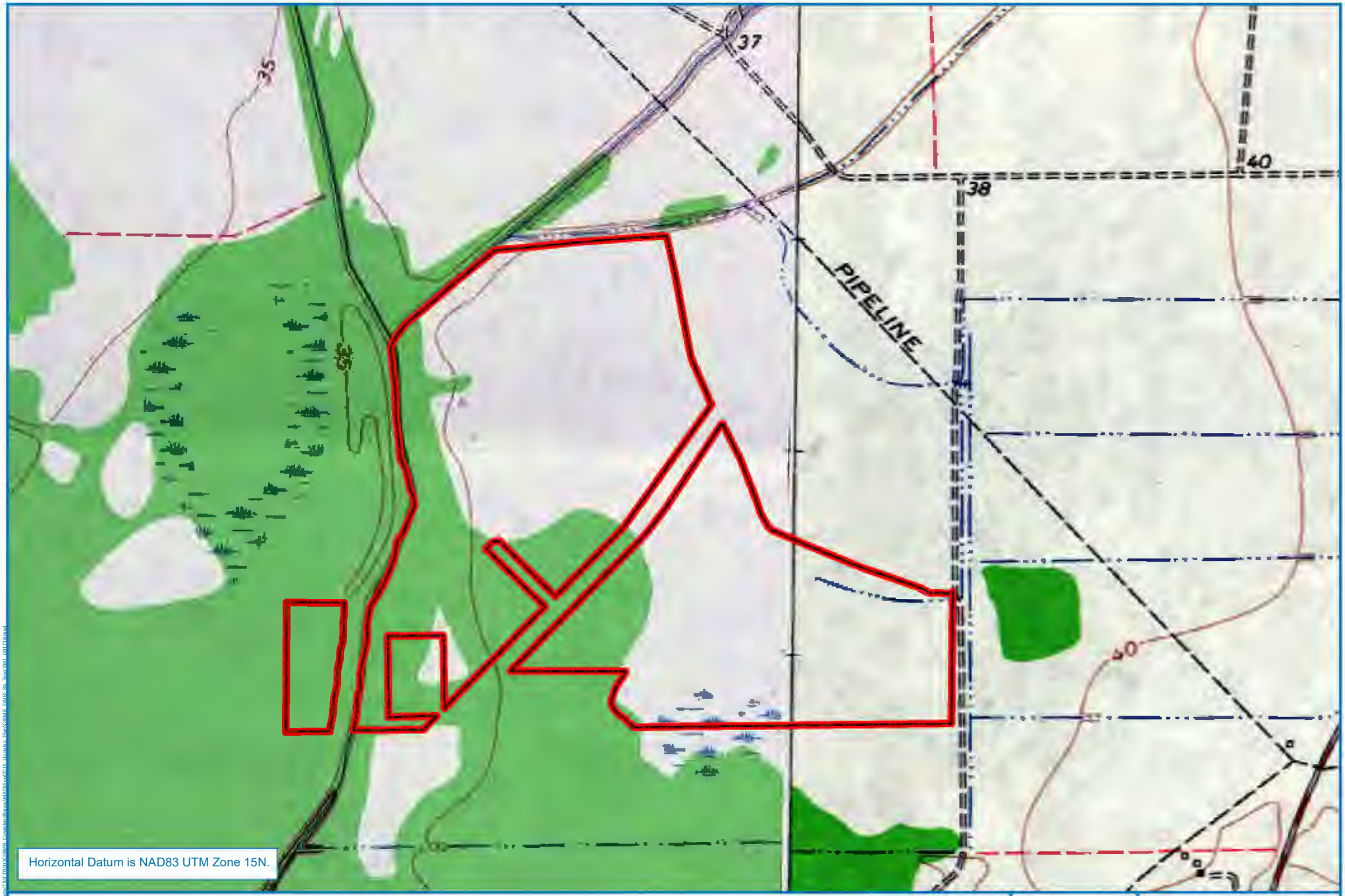

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Figure 8b

Historical Topographic Map - 1961
Cow Island Bayou Mitigation Bank

Liberty County, Texas

Cow Island Bayou Mitigation Bank

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Drawn by: AB, BRG	
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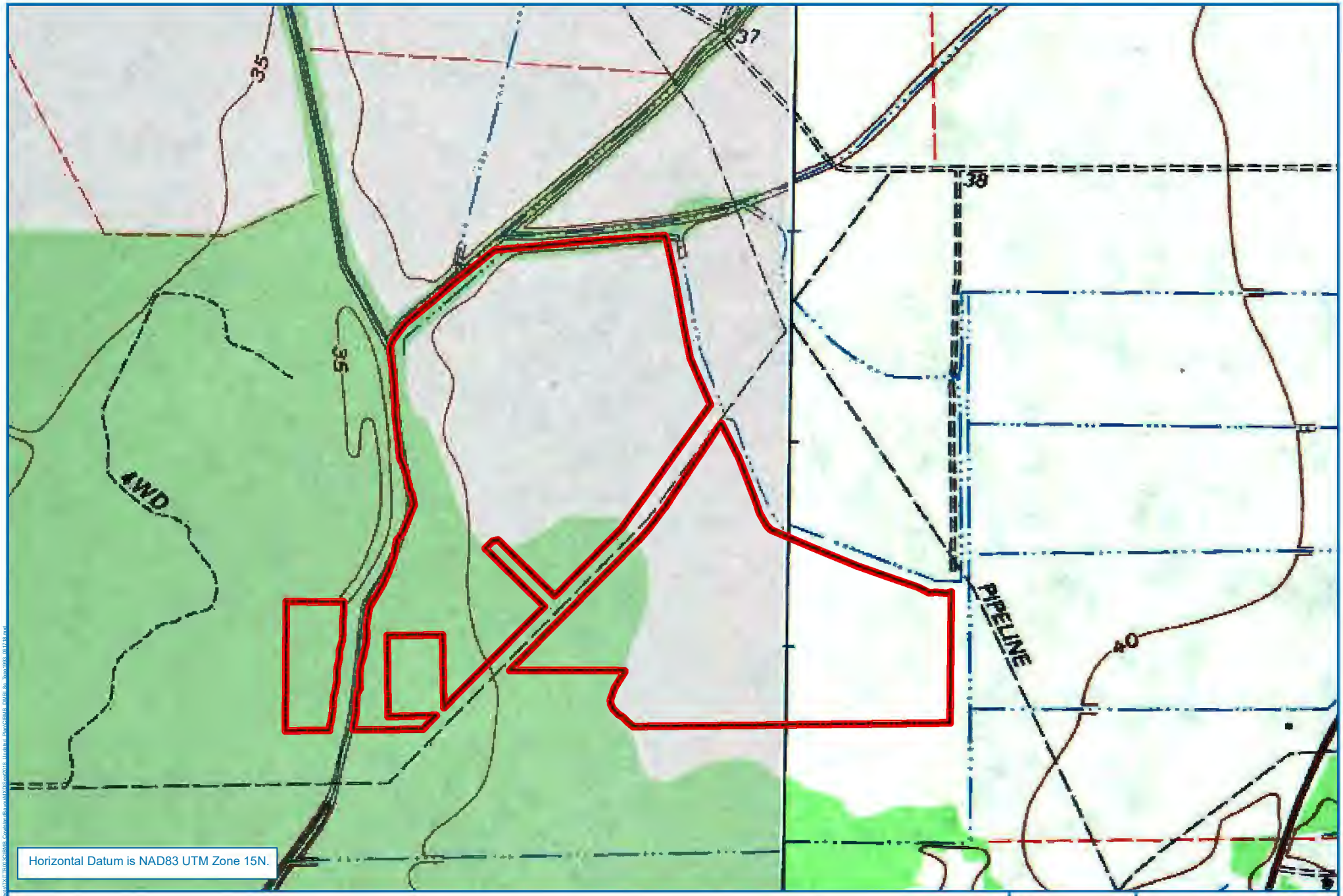

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Figure 8c

Historical Topographic Map - 1993
Cow Island Bayou Mitigation Bank

Liberty County, Texas

Cow Island Bayou Mitigation Bank

Date: 9/17/2018	
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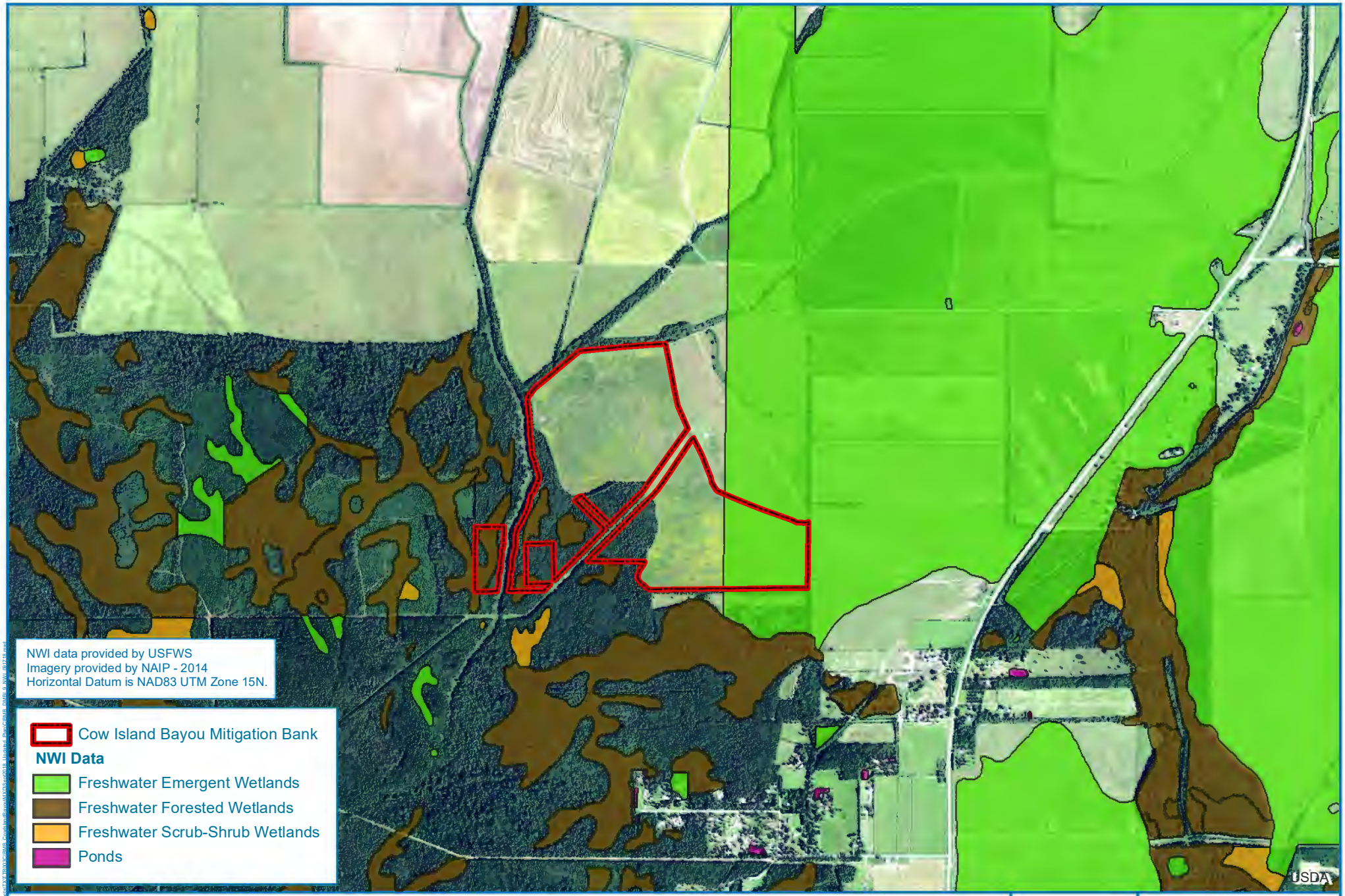

Figure 9

National Wetlands Inventory
Cow Island Bayou Mitigation Bank

Liberty County, Texas

Date: 9/21/2018
Drawn by: AB, BRG
Checked by: DJ
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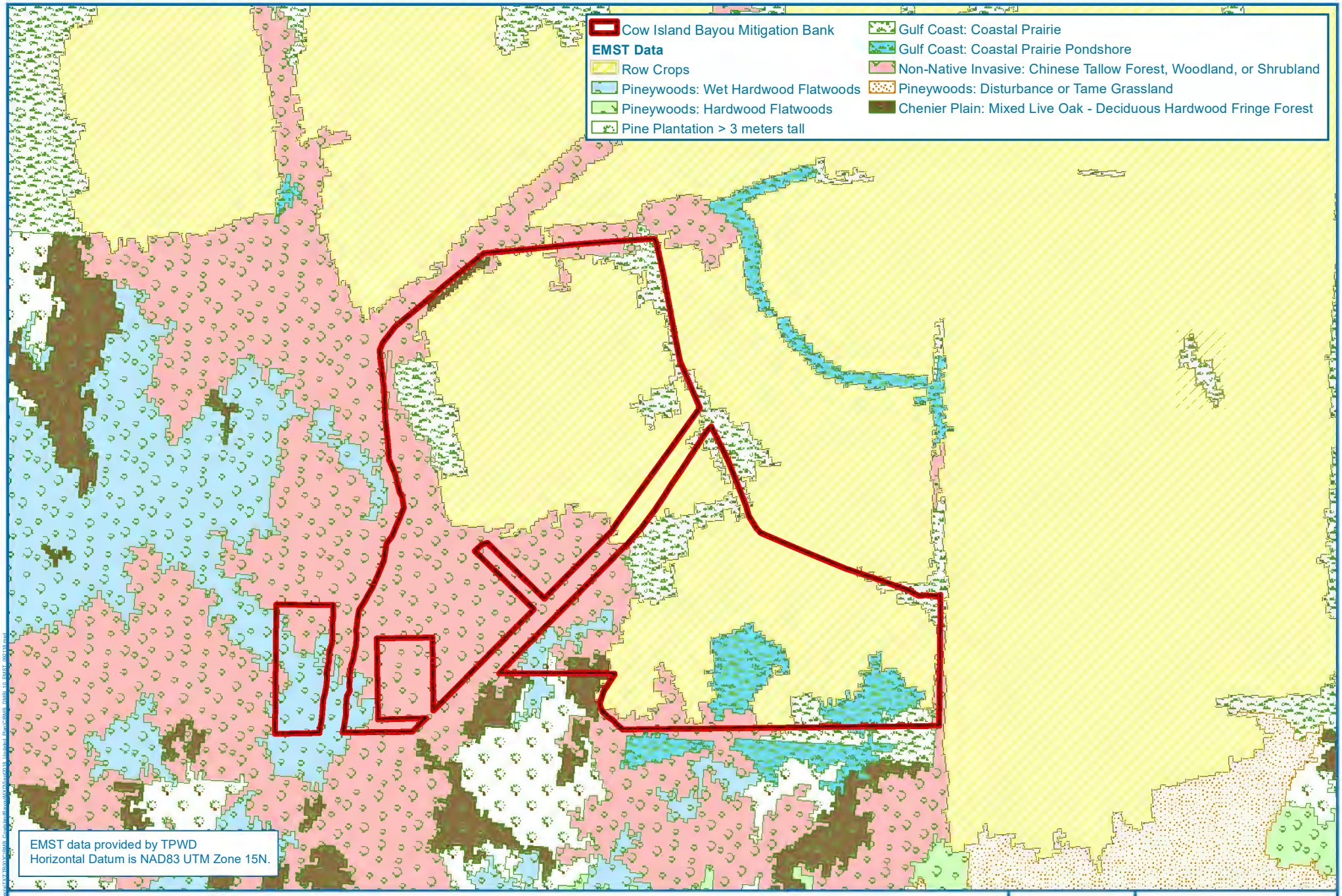

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Figure 10

Ecological Mapping Systems of Texas
Cow Island Bayou Mitigation Bank

Liberty County, Texas

Date: 9/21/2018
Drawn by: AB
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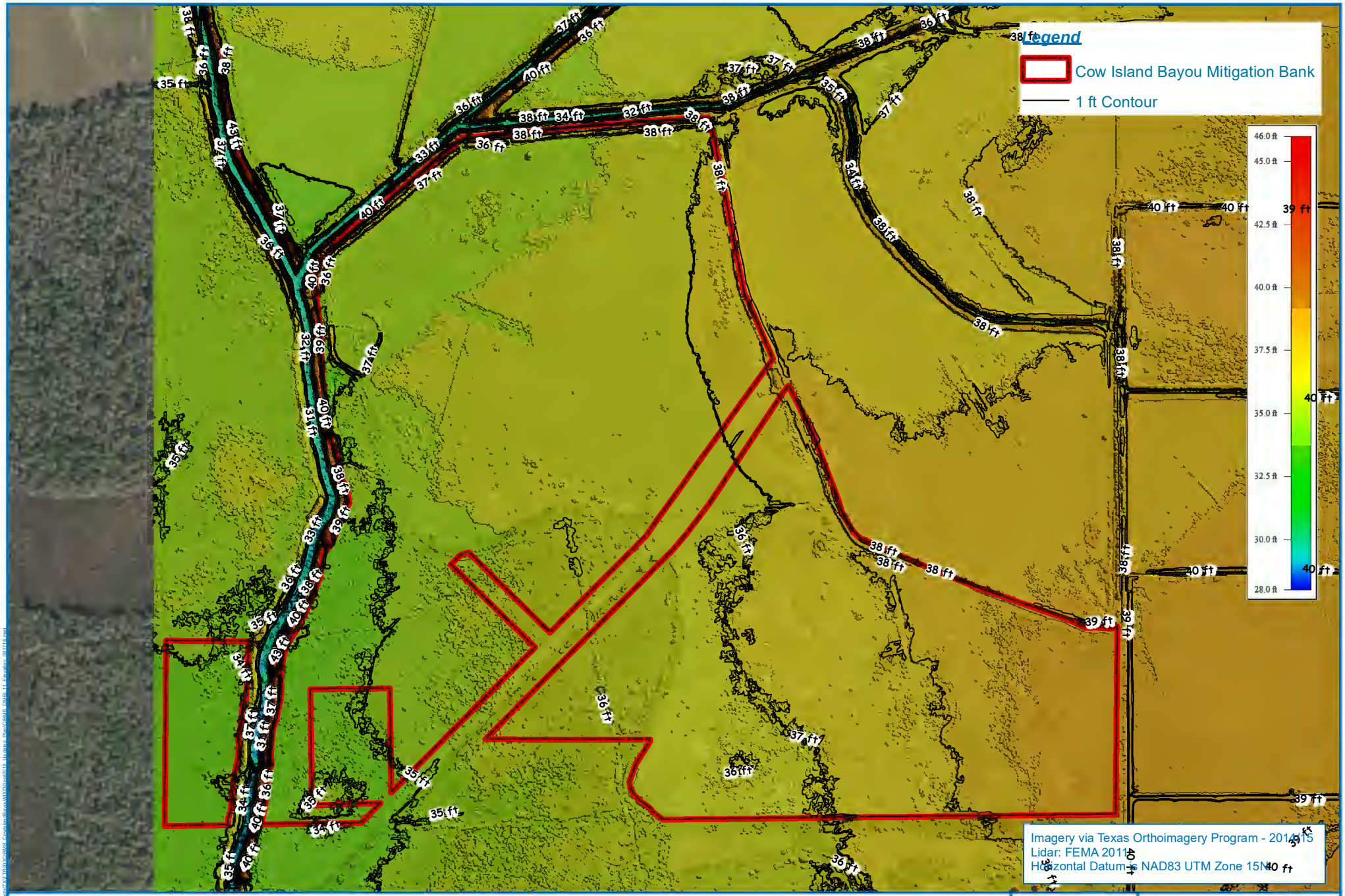

Figure 11

Elevation Contours
Cow Island Bayou Mitigation Bank

Liberty County, Texas

Date: 9/26/2018
Drawn by: AB; BRG
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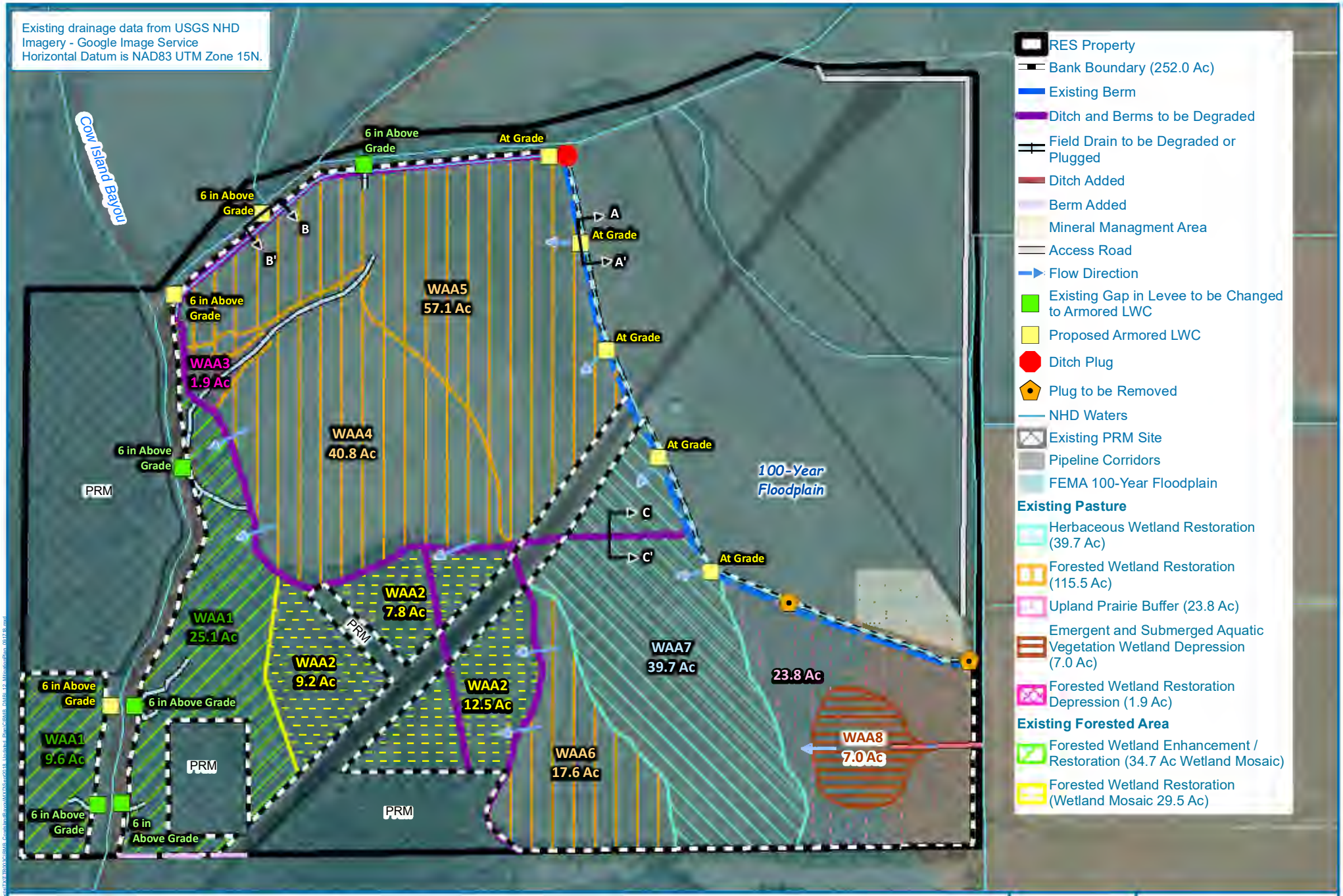

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Figure 12

Mitigation Plan
Cow Island Bayou Mitigation Bank

Liberty County, Texas

Date: 9/27/2018
Drawn by: AB, BRG
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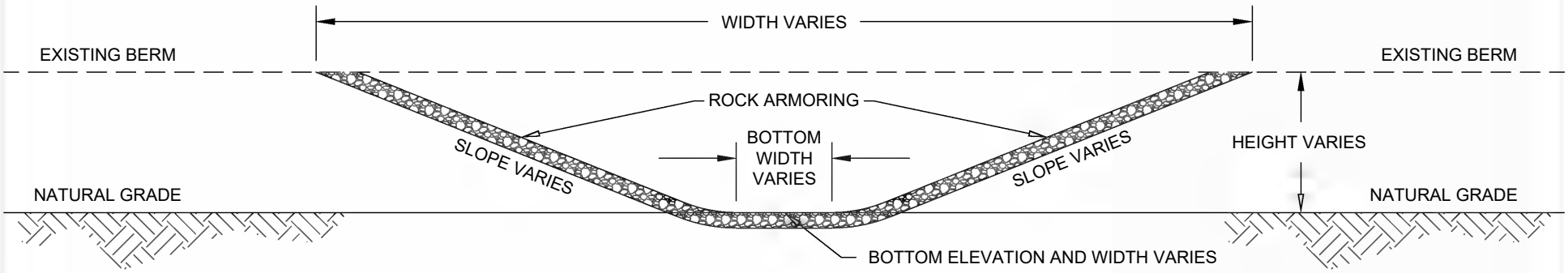

TYPICAL CROSS-SECTION A-A' LOW WATER CROSSING

NOT TO SCALE

FIGURE 13A

TYPICAL CROSS-SECTION A-A'

COW ISLAND BAYOU MITIGATION BANK
LIBERTY COUNTY, TEXAS

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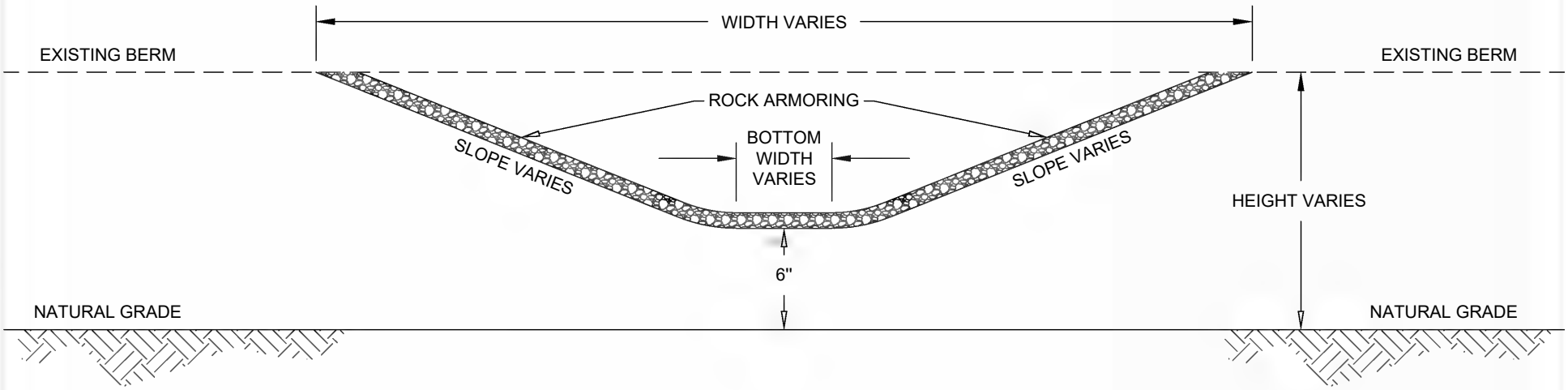
April 15, 2019



TYPICAL CROSS-SECTION B-B' LOW WATER CROSSING

NOT TO SCALE

FIGURE 13B

TYPICAL CROSS-SECTION B-B'

COW ISLAND BAYOU MITIGATION BANK
LIBERTY COUNTY, TEXAS

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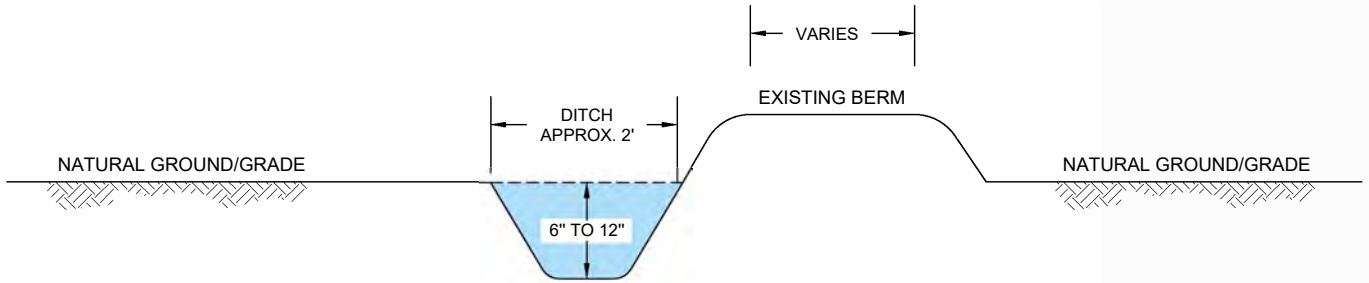
April 15, 2019



TYPICAL CROSS-SECTION C-C'

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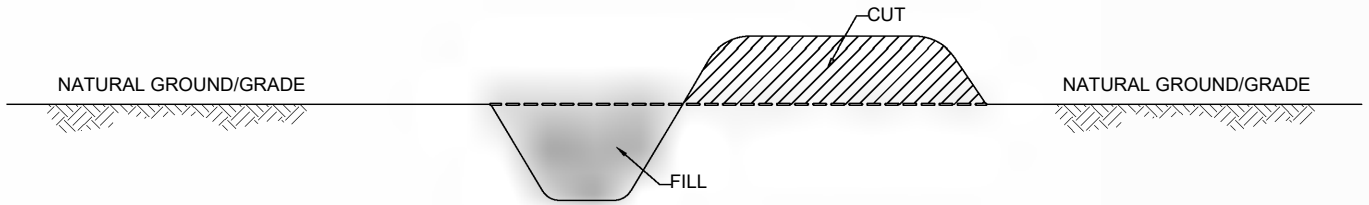

TYPICAL CROSS-SECTION C-C' BERM AND DITCH CREATED

NOT TO SCALE

Note: Ditch to be filled using existing spoil, no outside fill material utilized.

FIGURE 13C

TYPICAL CROSS-SECTION C-C'

COW ISLAND MITIGATION BANK
LIBERTY COUNTY, TEXAS

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April 15, 2019

B. Imagery (contemporary and historical aerial photography/imagery)

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April 15, 2019

Figure 1a

Historical Aerial - 1939
Cow Island Bayou Mitigation Bank

Liberty County, Texas

Cow Island Bayou Mitigation Bank

Date: 11/6/2018
Drawn by: AB;BRG
Checked by: HT
Draft MBI

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Figure 1b

Historical Aerial - 1952
Cow Island Bayou Mitigation Bank

Liberty County, Texas

Cow Island Bayou Mitigation Bank

Date:	11/6/2018
Drawn by:	AB;BRG
Checked by:	HT
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April 15, 2019

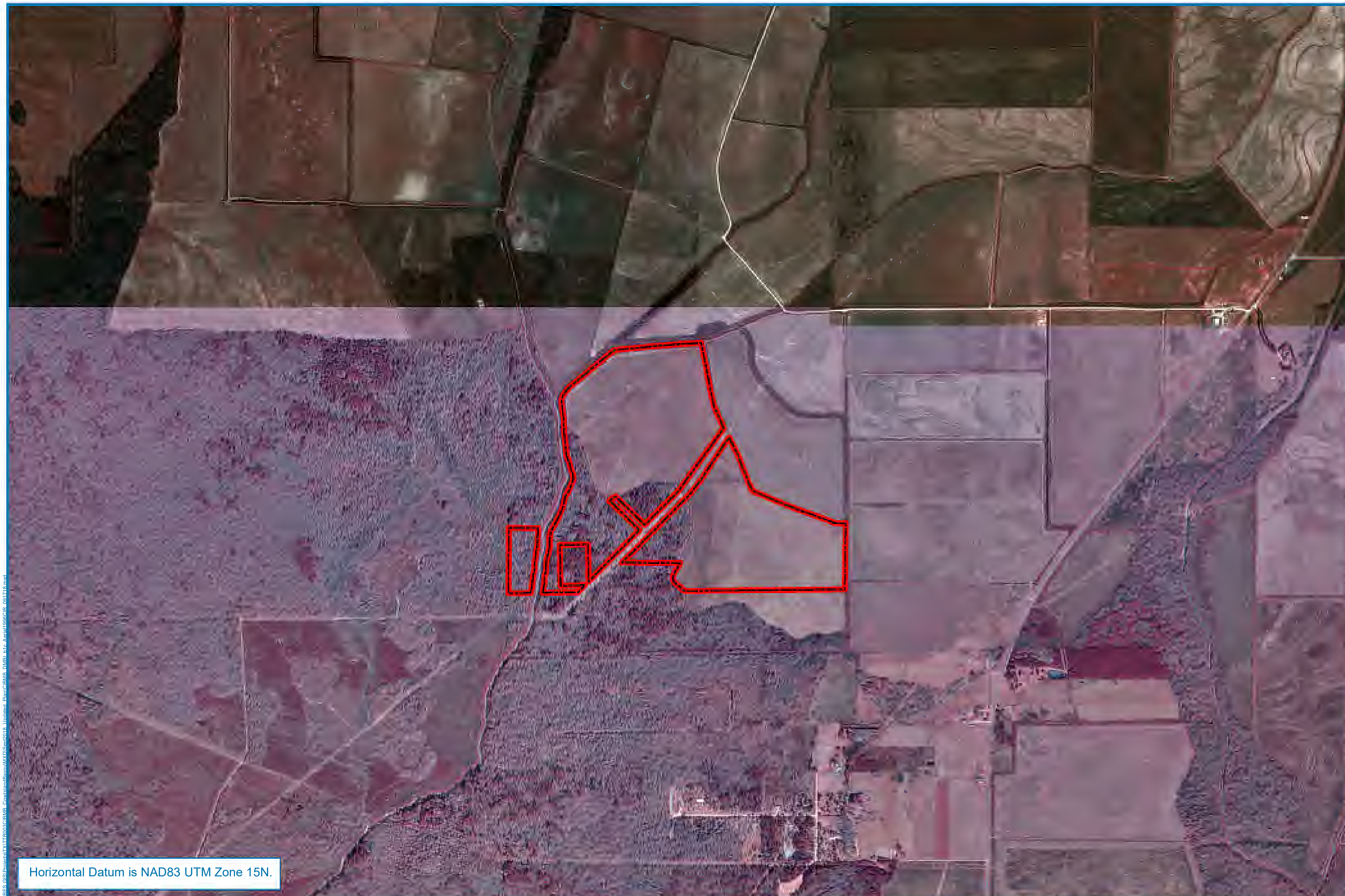

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Figure 1c

Historical Aerial - 1996 Color Infrared
Cow Island Bayou Mitigation Bank

Liberty County, Texas

Cow Island Bayou Mitigation Bank

Date: 11/6/2018

Drawn by: AB;BRG

Checked by: HT

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April 15, 2019

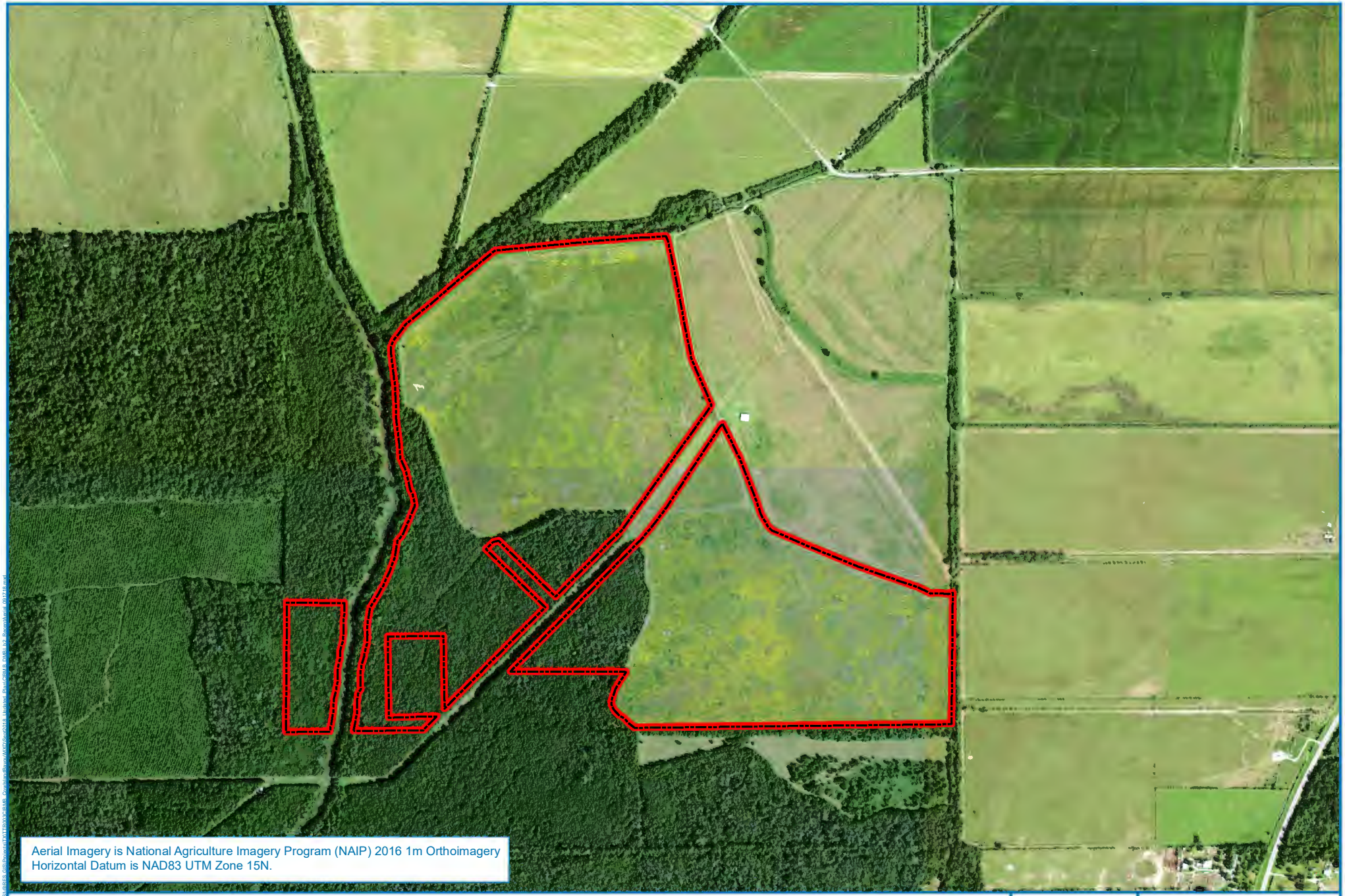

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Figure 2

Recent Aerial - 2016
Cow Island Bayou Mitigation Bank

Liberty County, Texas

Cow Island Bayou Mitigation Bank

Date:	11/6/2018
Drawn by:	AB;BRG
Checked by:	HT
	Draft MBI

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April 15, 2019

C. Environmental Baseline Report (Jurisdictional Delineation & Functional Assessment)

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

January 28, 2015

Compliance Branch

SUBJECT: **SWG-2013-00223**; Resource Environmental Solutions, Approved Jurisdictional Determination, Proposed Cow Island Bayou Mitigation Bank, Approximate 316.9-Acre Tract, Liberty County, Texas

Ms. Kristine Swann
Resource Environmental Solutions
5020 Montrose Boulevard, Suite 650
Houston, Texas 77006

Dear Ms. Swann:

This letter is in response to Resource Environmental Solutions' request, dated February 26, 2013, for a jurisdictional delineation verification on an approximate 473-acre tract for the proposed Cow Island Bayou Mitigation Bank. By e-mail on May 12, 2014, RES reduced the proposed Cow Island Bayou Mitigation Bank project site from 473 to 316.9 acres. The tract is located approximately 9,200 feet southwest of the State Highway 61 and Farm-to-Market Road 1410 intersection, in Liberty County, Texas.

Based on our December 5, 2013, April 23, 2014, and June 19, 2014 site visits and a subsequent desk review, we determined that the approximate 316.9-acre tract contains 41.63 acres of waters of the United States (see enclosed map), specifically an adjacent wetland (Wetland WA4). Wetland WA4 is neighboring and therefore adjacent to Cow Island Bayou, a relatively permanent water. Wetland WA4 has a significant nexus to Lake Anahuac, the nearest downstream Traditional Navigable Water, and is a water of the United States subject to Section 404 of the Clean Water Act (Section 404). The discharge of dredged and/or fill material into Wetland WA4 is subject to Section 404 and requires a Department of the Army (DA) permit. The wetland was identified using the Atlantic and Gulf Coastal Plain Region Supplement of the 1987 Corps of Engineers Wetland Delineation Manual, and under normal circumstances exhibits wetland hydrology, a dominance of hydrophytic vegetation, and hydric soils. Also be aware that Cow Island Bayou is a relatively permanent water and is a water of the United States subject to Section 404. The discharge of dredged and/or fill material into Cow Island Bayou requires a DA permit.

This determination has been conducted to identify the limits of the United States Army Corps of Engineers (USACE) CWA jurisdiction for the site identified in this request. However, this determination may not be valid for the wetland conservation provisions of the Food Security Act of 1985 as amended. If you or your tenant are USDA program participants or anticipate participation in USDA programs, you should request a certified wetland determination from the local office of the Natural Resources Conservation Service prior to starting work.

This letter contains an approved jurisdictional determination for your subject site. If you wish to appeal the approved jurisdictional determination, please see the enclosed sheets regarding the administrative appeal process for jurisdictional determinations: Notification of Appeals Process (NAP) fact sheet and Request for Appeal (RFA) form. If you object to this determination, you may request an administrative appeal under USACE regulations at 33 CFR Part 331. If you request to appeal this determination, you must submit a completed RFA form to the Southwest Division Office at the following address:

Mr. Elliott Carman
Appeal Review Officer, CESWD-PD-O
U.S. Army Corps of Engineer Division,
Southwestern
1100 Commerce Street, Room 831
Dallas, Texas 75242-1731
Telephone: 469-487-7061; FAX: 469-487-7199

In order for an RFA to be accepted by the Corps, the Corps must determine that it is complete; that it meets the criteria for appeal under 33 CFR Part 331.5, and that it has been received by the Division Office within **60 days** of the date of the NAP. It is not necessary to submit an RFA form to the Division office if you do not object to the determination in this letter.

This approved jurisdictional determination is valid for 5 years from the date of this letter unless new information warrants a revision prior to the expiration date. If you have any questions concerning this jurisdictional determination please reference file number **SWG-2013-00223** and contact me at the letterhead address or by telephone at 409-766-3933 or email at john.davidson@usace.army.mil. To assist us in improving our service to you, please complete the survey found at http://corpsmapu.usace.army.mil/cm_apex/f?p=136:4:0 and/or if you would prefer a hard copy of the survey form, please let us know, and one will be mailed to you.

Sincerely,

John Davidson
Team Lead
Compliance Branch

Enclosures

April 15, 2019

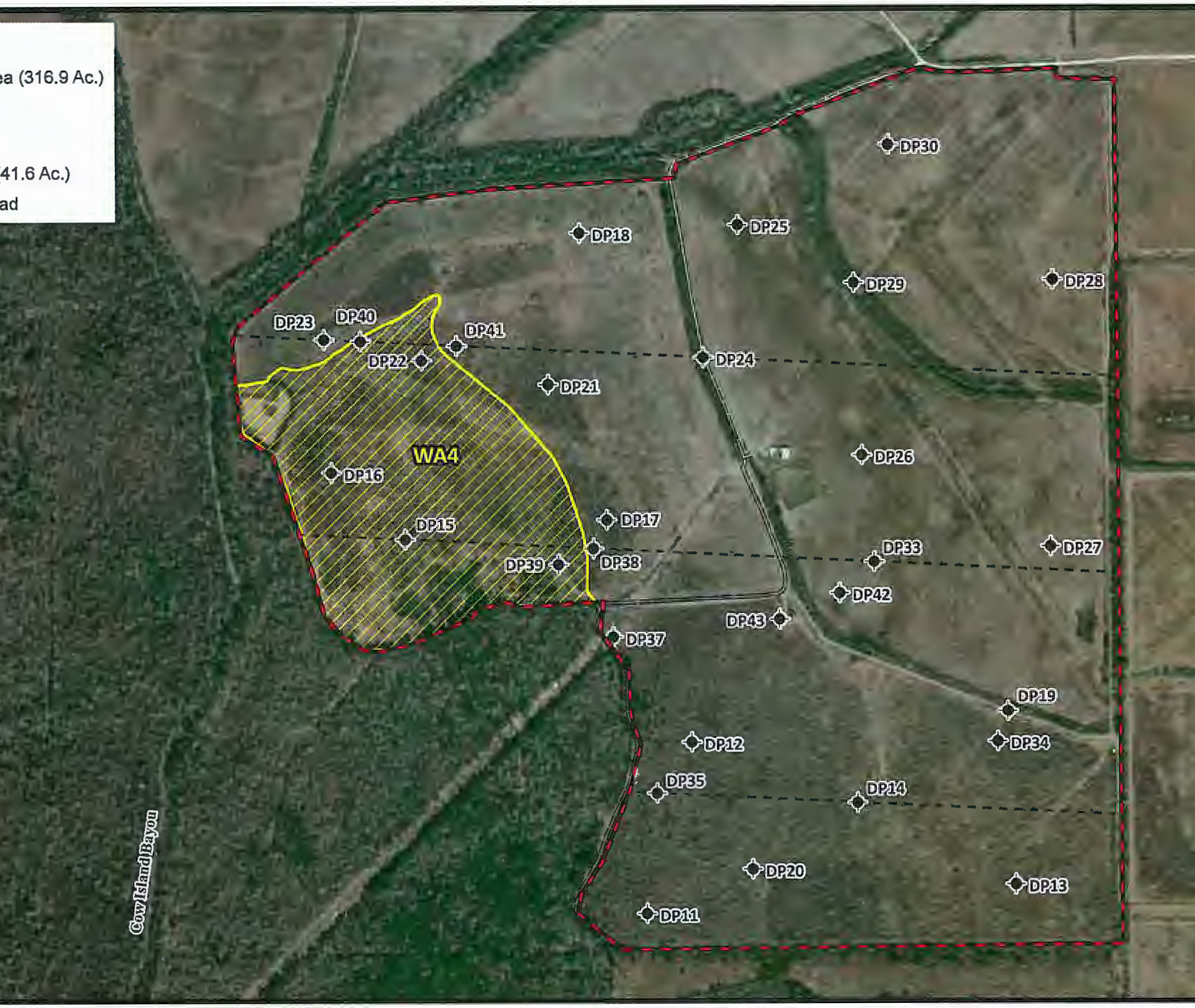

FIGURE 2

SWG-2013-00223

COW ISLAND BAYOU MITIGAITON BANK
WETLAND DELINEATION MAP

LIBERTY COUNTY, TEXAS

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NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant:	File Number:	Date:
RESOURCE ENVIRONMENTAL SOLUTIONS	**SWG 2013-00223**	**01/28/2015**

Attached is:		See Section below
	INITIAL PROFFERED PERMIT (Standard Permit or Letter of Permission)	A
	PROFFERED PERMIT (Standard Permit or Letter of Permission)	B
	PERMIT DENIAL	C
X	APPROVED JURISDICTIONAL DETERMINATION	D
	PRELIMINARY JURISDICTIONAL DETERMINATION	E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://www.usace.army.mil/inet/functions/cw/cecwo/reg/ Or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved jurisdictional determination (JD) or provide new information.

- ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact: John Davidson Compliance Section Team Lead CESWG-RD-C P.O. Box 1229 Galveston, Texas 77553-1229 Telephone: 409-766-3933 FAX: 409-766-6301	If you only have questions regarding the appeal process you may also contact: Elliott Carman Regulatory Appeals Review Officer Southwestern Division USACE (CESWD-PD-O) 1100 Commerce Street, Suite 831 Dallas, Texas 75242 Phone: 469-487-7061 FAX: 469-487-7199

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.

_____ Signature of appellant or authorized agent.	Date:	Telephone number:

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

February 10, 2015

Compliance Branch

SUBJECT: **SWG-2014-00797**; Resource Environmental Solutions, Approved Jurisdictional Determination, Approximate 80-Acre Tract, Liberty County, Texas

Ms. Kristine Swann
Resource Environmental Solutions
5020 Montrose Boulevard, Suite 650
Houston, Texas 77006

Dear Ms. Swann:

This letter is in response to Resource Environmental Solutions' request, dated September 16, 2014, for a jurisdictional delineation verification on an approximate 80-acre tract for a proposed forested preservation area. The tract is located approximately 11,000 feet southwest of the State Highway 61 and Farm-to-Market Road 1410 intersection, in Liberty County, Texas.

Based on our December 5, 2013, April 23, 2014, and June 19, 2014 site visits and a subsequent desk review, we determined that the approximate 80-acre tract contains 16.01 acres of waters of the United States (see enclosed map), specifically, a 0.3-acre adjacent wetland (Wetland F-WA1), 13.36 acres of adjacent mosaic wetlands, and 2.35 acres of tributaries, of which 2.12 acres is Cow Island Bayou, a relatively permanent water. The other tributaries are located within the adjacent mosaic wetland. Wetland F-WA1 and the adjacent mosaic wetlands are neighboring and therefore adjacent to Cow Island Bayou. Wetland F-WA1 and the adjacent mosaic wetlands, along with the similarly situated wetlands within the relevant reach outside the subject tract, have a significant nexus to Lake Anahuac, the nearest downstream Traditional Navigable Water, and are waters of the United States subject to Section 404 of the Clean Water Act (Section 404). The discharge of dredged and/or fill material into Wetland F-WA1 and/or the adjacent mosaic wetlands is subject to Section 404 and requires a Department of the Army (DA) permit. The wetlands were identified using the Atlantic and Gulf Coastal Plain Region Supplement of the 1987 Corps of Engineers Wetland Delineation Manual, and under normal circumstances exhibit wetland hydrology, a dominance of hydrophytic vegetation, and hydric soils. We also determined that Cow Island Bayou is a relatively permanent water and is a water of the United States subject to Section 404. The discharge of dredged and/or fill material into Cow Island Bayou requires a DA permit.

This determination has been conducted to identify the limits of the United States Army Corps of Engineers (USACE) CWA jurisdiction for the site identified in this request. However, this determination may not be valid for the wetland conservation provisions of the Food Security Act of 1985 as amended. If you or your tenant are USDA program participants or anticipate participation in USDA programs, you should request a certified

wetland determination from the local office of the Natural Resources Conservation Service prior to starting work.

This letter contains an approved jurisdictional determination for your subject site. If you wish to appeal the approved jurisdictional determination, please see the enclosed sheets regarding the administrative appeal process for jurisdictional determinations: Notification of Appeals Process (NAP) fact sheet and Request for Appeal (RFA) form. If you object to this determination, you may request an administrative appeal under USACE regulations at 33 CFR Part 331. If you request to appeal this determination, you must submit a completed RFA form to the Southwest Division Office at the following address:

Mr. Elliott Carman
Appeal Review Officer, CESWD-PD-O
U.S. Army Corps of Engineer Division,
Southwestern
1100 Commerce Street, Room 831
Dallas, Texas 75242-1731
Telephone: 469-487-7061; FAX: 469-487-7199

In order for an RFA to be accepted by the Corps, the Corps must determine that it is complete; that it meets the criteria for appeal under 33 CFR Part 331.5, and that it has been received by the Division Office within **60 days** of the date of the NAP. It is not necessary to submit an RFA form to the Division office if you do not object to the determination in this letter.

This approved jurisdictional determination is valid for 5 years from the date of this letter unless new information warrants a revision prior to the expiration date. If you have any questions concerning this jurisdictional determination please reference file number **SWG-2014-00797** and contact me at the letterhead address or by telephone at 409-766-3933 or email at john.davidson@usace.army.mil. To assist us in improving our service to you, please complete the survey found at http://corpsmapu.usace.army.mil/cm_apex/f?p=136:4:0 and/or if you would prefer a hard copy of the survey form, please let us know, and one will be mailed to you.

Sincerely,

John Davidson
Team Lead
Compliance Branch

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant:	File Number:	Date:
RESOURCE ENVIRONMENTAL SOLUTIONS	**SWG 2014-00797**	**02/10/2015**

Attached is:		See Section below
	INITIAL PROFFERED PERMIT (Standard Permit or Letter of Permission)	A
	PROFFERED PERMIT (Standard Permit or Letter of Permission)	B
	PERMIT DENIAL	C
X	APPROVED JURISDICTIONAL DETERMINATION	D
	PRELIMINARY JURISDICTIONAL DETERMINATION	E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://www.usace.army.mil/inet/functions/cw/cecwo/reg/ Or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit

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	Date:	Telephone number:
_____ Signature of appellant or authorized agent.		

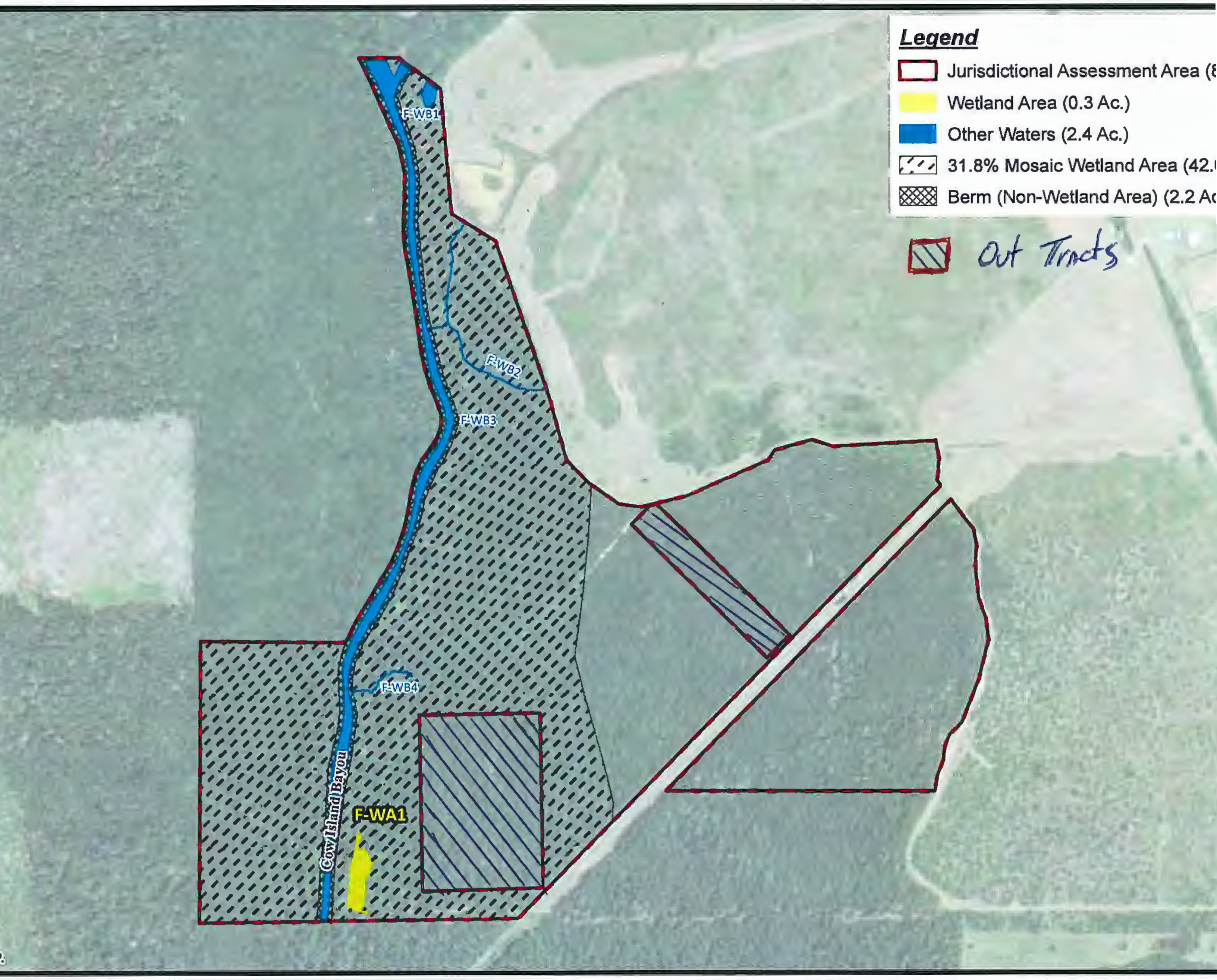

FIGURE 2

SWG-2014-00797

COW ISLAND BAYOU MITIGATION SITE
FORESTED PRESERVATION AREA WETLAND DELINEATION MAP

LIBERTY COUNTY, TEXAS

ForestWetlandDelineationMapSimplified_020315.mxd

April 15, 2019

Projected Interim Hydrogeomorphic Functional Assessment for Cow Island Bayou Mitigation Bank Liberty County, Texas

Permit No.: SWG-2013-00223

Sponsor

Third Texas Resource, LLC

Agent

RES

April 15, 2019

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1 INTRODUCTION

RES (Agent) conducted an assessment of compensatory mitigation credits based on the interim hydrogeomorphic (HGMi) approach for riverine, low gradient wetlands developed by the U.S. Army Corps of Engineers (USACE), Southwest Galveston District. RES employed the HGMi model to determine the baseline and potential post-construction values for the proposed Cow Island Bayou Mitigation Bank (CIBMB or Bank) based on the functional lift expected resulting from the restoration activities described in the Mitigation Banking Instrument (MBI).

The HGMi classification system provides a mechanism through which generally-defined functions can be quantified for comparative purposes. Within this framework, major classes of wetland functions are described as indices which can be compared to other wetlands. The HGMi approach serves as a means to gauge the performance of the Mitigation Work Plan (MWP) described in the MBI in accomplishing the goals and objectives of the MBI and will determine the availability of releasable credits.

2 METHODS

The HGMi uses multiple variables to evaluate three ecological functions that describe and measure forested and herbaceous/shrub riverine wetlands in this region. The three functional capacity indices (FCI) used to determine credits for each Wetland Assessment Area (WAA) within the Bank are based on the Riverine Forested HGMi functional assessment and the Riverine Herbaceous/Shrub and Riverine Forested HGMi functional assessments (USACE 2009, 2010a). The FCI quantify temporary storage of surface water (TSSW), maintenance of plant and animal communities (MPAC), and removal and sequestration of elements and compounds (RSEC) for each wetland to determine physical, biological, and chemical functions, respectively.

The Riverine Herbaceous/Shrub HGMi functional assessment uses 10 variables to evaluate non-forested (herbaceous or scrub-shrub) riverine wetlands. The three indices are expressed as:

$$TSSW = \sqrt{\sqrt{V_{dur} * V_{freq}} * \left(\frac{V_{topo} + \frac{V_{herb} + V_{mid}}{2}}{2} \right)}$$

$$MPAC = \frac{V_{mid} + V_{herb} + V_{connect}}{3}$$

$$RSEC = \frac{V_{wood} + V_{freq} + V_{dur} + \left(\frac{V_{topo} + V_{herb} + V_{mid}}{3} \right) + \left(\frac{V_{detritus} + V_{redox} + V_{sorpt}}{3} \right)}{5}$$

with the variables:

- V_{dur} - Duration of flooding and ponding in an average year
- V_{freq} - Frequency of flooding and ponding
- V_{topo} - Percent containing topographic features
- V_{herb} - Percent of herbaceous cover
- V_{mid} - Percent of relative cover between the herbaceous and tree strata
- V_{wood} - Percent covered by woody vegetation
- $V_{detritus}$ - Percent of area with detritus at the soil surface
- V_{redox} - Abundance of redox features within the top 12 inches of soil
- V_{sorpt} - Absorptive properties of the soil
- $V_{connect}$ - Number of habitat types found within 600 feet

The values of the variables range from zero to one based on site conditions at the time of the assessment, as described in the Riverine Herbaceous/Shrub HGMi functional assessment (USACE 2010a).

The Riverine Forested HGMi model includes the variables found in the Riverine Herbaceous/Shrub HGMi functional assessment with five additional variables that account for the ecological effects of the tree stratum and associated detritus. Comparable to the herbaceous/shrub model, forest indices are expressed as:

$$TSSW = \sqrt{\sqrt{V_{dur} * V_{freq}} * \left(\frac{V_{topo} + V_{cwd} + V_{wood}}{3}\right)}$$

$$MPAC = \frac{V_{tree} + V_{cwd} + V_{rich} + \frac{\left(V_{basal} + V_{density}\right)}{2} + \frac{\left(V_{mid} + V_{herb}\right)}{2} + V_{connect}}{6}$$

$$RSEC = \frac{V_{wood} + V_{freq} + V_{dur} + \left(\frac{V_{topo} + V_{cwd} + V_{wood}}{3}\right) + \left(\frac{V_{detritus} + V_{redox} + V_{sorpt}}{3}\right)}{5}$$

with the additional tree stratum variables:

- V_{cwd} - Number of 3-inch or greater diameter pieces of woody debris found along a 100-foot transect
- V_{tree} - Percent tree canopy cover
- V_{rich} - Number of species representing greater than 5 percent of the tree stand within the sample plot
- V_{basal} - Basal area of trees in square feet per acre
- $V_{density}$ - Number of trees per acre

The values of these variables also range from zero to one based on site conditions at the time of the assessment, as described in the Riverine Forested HGMi functional assessment (USACE 2009).

Thus, a wetland scoring closer to one for each variable will generate a higher FCI score for each ecological function (TSSW, MPAC, RSEC) than one in which variable values are near zero. Once an FCI has been calculated for each wetland, the FCU can be determined based on the product of the total acreage of a wetland and its corresponding FCI values.

RES projected an estimated HGMi based on the improvements in hydrology, vegetation restoration, and implementation of different types of management practices (i.e., adding topographic features, planting, thinning as part of management, and invasive species removal) based on the MBI. RES judged the potential effect that an integrated management strategy may have on the variables within the HGMi to predict the potential FCUs associated with the WAAs proposed by the Sponsor. The existing forested wetlands within the Bank Site are used in the estimation of potential future values for forested wetland restoration areas.

3 RESULTS

3.1 Baseline HGMi Scores

3.1.1 Herbaceous Wetlands

A total of 41.63 acres of jurisdictional wetlands were identified by the USACE within the proposed forested wetland rehabilitation areas of CIBMB. This area has been recently impacted by agricultural land use and is dominated by herbaceous vegetation. There is an approximately 2-acre depression within the existing wetland area that has significantly longer hydroperiods and is herein referred to as "depressional area."

Existing conditions in the herbaceous wetland area are evaluated using the Riverine Forested HGMi functional assessment method to determine the baseline scores. This area is not currently forested, but using the forested assessment method for the baseline will allow comparison to the forested wetland that will be established in this area, and the difference in functional value will represent the value provided by this area. Wetland delineation datasheets for the existing wetland area are included in the Wetland Delineation Report for the site (RES 2013). The variable values below apply only to the wetland areas.

Duration of flooding (V_{dur}) is estimated using hydrology indicators listed in the *Corps of Engineers Wetland Delineation Manual* (Manual; USACE 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain* (Regional Supplement; USACE 2010b). Based on the indicators of wetland hydrology and prevalence of wetland plant species, a value of 0.75 is used for the majority of this area, with a value of 1.0 in the depressional area.

Frequency of flooding (V_{freq}) uses indicators listed from the *Manual* (USACE 1987), the *Regional Supplement* (USACE 2010b), and Federal Emergency Management Agency (FEMA) floodplain maps. The existing wetland area is mapped within the existing FEMA 100-year floodplain, and portions of this area have been ponded in each of the past three years; therefore, a value of 0.75 is used for the majority of this area, with a value of 1.0 in the depressional area.

Topography (V_{topo}) relies on visual estimates conducted in the field to determine what percent of the project site is composed of heterogeneous topographic features (e.g., dips, hummocks, channel sloughs). A portion of the WAA is a swale, but topographic heterogeneity of the rest of the area has been reduced due to agricultural activity; therefore, a value of 0.4 is used for the majority of this area, with a value of 1.0 in the depressional area.

Woody vegetation (V_{wood}) can be assessed using aerial imagery, field data, and visual observations. Woody vegetation cover is less than 10 percent, scoring 0.10.

Midstory (V_{mid}) describes the shrub and sapling vegetation layer found between ground level and an upper forest canopy. Shrub and sapling cover is less than 25 percent, scoring 0.25.

The variable V_{herb} quantifies herbaceous vegetation cover. Herbaceous vegetation cover is greater than 50%, scoring 0.30.

Connectivity to other habitat types ($V_{connect}$) is assessed using aerial imagery extending 600 feet from the project site. Four or more other habitats are present within 600 feet of the WAA, scoring 1.00.

Detritus ($V_{detritus}$) refers to the presence of either an O or A horizon associated with wetlands. Previous cultivation has prevented formation of a detritus layer, scoring 0.10.

Redoximorphic process (V_{redox}) is the percent of redox features based on the presence or absence of redox concentrations in the top 4 inches of the soil profile as determined through field effort. Redox features were less than 20%, scoring a 0.1.

Sorptive soil properties (V_{sorpt}) are determined using the Natural Resources Conservation Service (NRCS) Soil Survey (2011) and data recorded in the field. According to the NRCS Soil Survey, soils on the site are poorly drained with slow surface runoff (Appendix E of the MBI). The wetland delineation of the site (RES 2013) revealed a clay soil texture across the site. Based on the dominance of clay soils, a subindex value of 1.00 is used.

The existing herbaceous wetland area will have the minimum values for the variables associated with trees: coarse woody debris (V_{cwd}), woody vegetation (V_{wood}), trees that are mast producers (V_{tree}), tree species richness (V_{rich}), tree basal area (V_{basal}), and tree density ($V_{density}$). The existing herbaceous wetland would receive a score of 0.1 for each of these variables.

3.1.2 Forested Wetlands

Within the forested area of the Bank Site, the USACE identified one forested wetland totaling 0.3 acres and another 34.4-acre upland/wetland mosaic with gilgai that was determined to consist of 31.8% (10.94 acres) wetland and 68.2% (23.46 acres) upland. A total of 11.24 acres of jurisdictional forested wetlands were identified by the USACE within the proposed Bank Site (see Jurisdictional Determination included in this Appendix). Existing conditions in the wetland areas are evaluated using the Riverine Forested HGMi functional assessment method to determine the baseline scores. Wetland delineation datasheets for the existing wetland area are included in the Wetland Delineation Report for the site (RES 2013). The variable values below apply only to the wetland areas. The estimated baseline values reported below are based on previous wetland delineation data, baseline scores may be adjusted to reflect existing conditions at the monitoring points in the As-Built Report.

Duration of flooding (V_{dur}) is estimated using hydrology indicators listed in the *Corps of Engineers Wetland Delineation Manual* (Manual; USACE 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain* (Regional Supplement; USACE 2010b). Based on the indicators of wetland hydrology and prevalence of wetland plant species, a value of 0.75 is used for this area. The duration of flooding is expected to increase with the proposed low-water crossings to be installed on Cow Island Bayou.

Frequency of flooding (V_{freq}) uses indicators listed from the *Manual* (USACE 1987), the *Regional Supplement* (USACE 2010b), and Federal Emergency Management Agency (FEMA) floodplain maps. The existing wetland area is mapped as entirely within the existing FEMA 100-year floodplain, close to a bayou, and portions of this area have been ponded in each of the past three years; therefore, a value of 1.0 is used.

Topography (V_{topo}) relies on visual estimates conducted in the field to determine what percent of the project site is composed of heterogeneous topographic features (e.g., dips, hummocks, channel sloughs). These wetlands have a high density of mounds and depressions, so a value of 1.0 is used.

Coarse woody debris (V_{cwd}) is measured by the point-intercept method along a 100-foot transect. Frequent flooding of this area results in deposits of woody debris in certain areas, but not distributed evenly across the site. An average value of 3-7 pieces of coarse woody debris over 3 inches in diameter is used to account for this variability, scoring 0.5.

Woody vegetation (V_{wood}) can be assessed using aerial imagery, field data, and visual observations. Woody vegetation cover is 67-90 percent, scoring 0.75.

Tree species (V_{tree}) accounts for the trees in all WAAs that are hard mast producers. Tree cover in existing forested wetland areas is approximately half hard mast producing species, scoring 0.8.

Tree richness (V_{rich}) is the diversity of species within the WAAs. Four tree species each make up at least 5% of the existing forested wetland stand, scoring 0.8.

Tree basal area (V_{basal}) is the mean basal area per acre of the trees in the WAA. Tree basal area is between 80 and 100 square feet per acre, scoring 0.8.

Tree density ($V_{density}$) is based on the number of trees per acre that are at least 3 inches in diameter at breast height (dbh). Density is 100 to 250 trees per acre, scoring 1.0.

Midstory (V_{mid}) describes the shrub and sapling vegetation layer found between ground level and an upper forest canopy. Shrub and sapling cover is 31-50%, scoring 0.75.

The variable V_{herb} quantifies herbaceous vegetation cover. Herbaceous vegetation cover is between 5-30%, scoring 1.0.

Detritus ($V_{detritus}$) refers to the presence of either an O or A horizon associated with wetlands. This layer is present in the wetland areas, scoring 1.0.

Redoximorphic process (V_{redox}) is the percent of redox features based on the presence or absence of redox concentrations in the top 4 inches of the soil profile as determined through field effort. Redox features were at least 20%, scoring a 1.0.

Sorptive soil properties (V_{sorpt}) are determined using the Natural Resources Conservation Service (NRCS) Soil Survey (2011) and data recorded in the field. According to the NRCS Soil Survey, soils on the site are poorly drained with slow surface runoff. The wetland delineation of the site (RES 2013) revealed a clay soil texture across the site. Based on the dominance of clay soils, a subindex value of 1.0 is used.

Connectivity to other habitat types ($V_{connect}$) is assessed using aerial imagery extending 600 feet from the project site. Four or more other habitats are present within 600 feet of the WAA, scoring 1.0.

3.2 Projected HGMi Scores

The MBI describes the forested, coastal prairie, and emergent habitats that will be constructed. Coastal prairie and emergent wetlands will be assessed using the Riverine Herbaceous/Shrub HGMi model, and forested wetlands will be assessed using the Riverine Forested HGMi model. RES used proposed management actions to predict the result of anticipated land management practices on the WAAs. The MBI calls for the implementation of multiple management actions over several years. Scores are summarized in Tables 1, 2, and 3, and a discussion of subindex variables follows.

As described in the MBI:

- WAA1 is currently a gilgai mosaic with 31.8% forested wetlands and 68.2% forested uplands. The goal for WAA1 will be at least 70% wetland and 30% upland as a mosaic within these areas. WAA1 contains 0.3 acres that are existing wetland (not mosaic) which will be enhanced;
- WAA2 is currently upland forest with gilgai. The goal for WAA2 will be 50% wetland and 50% upland as a mosaic within these areas;
- WAA3 and WAA4 are existing herbaceous wetlands that will be rehabilitated as forested wetlands;
- WAA5 and WAA6 are existing uplands that will be re-established as forested wetlands;
- WAA7 is currently herbaceous uplands that will be re-established as herbaceous wetlands; and
- WAA8 is an existing herbaceous upland that will be re-established as a depression wetland with submerged aquatic vegetation.

Duration of flooding (V_{dur}). Based on the Hydrologic Analysis Report, the addition of microtopography and increased inflow of water into the Bank Site is projected to improve wetland hydrology by the end of the first year. The Hydrologic Analysis Report demonstrates that in the dry, wet, and average years WAA is expected to be saturated or inundated for at least 14 consecutive days. Existing wetland areas are expected to have a greater duration of flooding (scoring 1.00) than existing uplands (scoring 0.75).

Frequency of flooding (V_{freq}). Nearly all of the Bank Site is within the existing FEMA 100-year floodplain. As shown in the Hydrologic Analysis Report, all WAAs will have substantial portions of their areas inundated at least 3 out of 5 years and would be within the existing FEMA 100-year floodplain. Existing wetland areas and proposed depressions are expected to have a greater frequency of flooding (scoring 1.00) than existing uplands (scoring 0.75).

Topography (V_{topo}). Site preparation activities will involve the restoration of microtopography typical of on-site soils. In addition to the microtopographic features, shallow depressional areas will be added to the WAAs in order to increase topographic heterogeneity. Existing forested areas have a high density of mounds and depressions. RES assigns a score of 1.00 for the V_{topo} subindex value for all WAAs after site preparation is complete.

Woody vegetation (Vwood). At Year 15, a subindex value of 1.00 is assigned for all existing forested WAAs with an expected increase in canopy cover from 67-90 to greater than 90 percent. In forested wetland restoration WAAs a value of 0.75 is used, corresponding to 67-90 percent woody cover of the areas based on the planting guidelines, estimated growth rates, and selective thinning practices outlined in the MBI. This value is consistent with values found in existing forested wetlands within the Bank Site. Management practices in WAA7 and WAA8 will limit woody vegetation cover to less than 10 percent, scoring 0.10.

Midstory (V_{mid}). Based on experience in forested riparian wetlands on the Texas Gulf Coast, midstory layers are often able to reach cover densities between 11 and 30 percent. Therefore, a subindex value of 0.50 is chosen for Year 15 for forested restoration WAAs. Existing forested areas currently have a value of 0.75, so this will not be changed. This stratum will be limited to less than 1 percent in WAA7 and WAA8, resulting in a score of 0.10.

Herbaceous layer (V_{herb}). Within forested restoration areas, a subindex value of 0.50 is selected for V_{herb} for Year 15 based on management practices conducive to the establishment of an herbaceous vegetation layer covering 31 to 50 percent of forested restoration WAAs. The existing forested WAAs already have herbaceous vegetation cover between 5-30%, scoring 1.0. Coastal prairie wetlands typically exhibit an herbaceous cover near 100 percent. WAA7 is expected to achieve a subindex value of 1.00 by Year 15. WAA8 is expected to have lower cover of herbaceous vegetation, scoring 0.75.

Detritus ($V_{detritus}$). A subindex value of 1.00 was assigned to all WAAs at Year 15 because at least 85 percent of the area is likely to possess an acceptable O or A horizon.

Redoximorphic process (V_{redox}). Based on the characterization of the soils during the wetland delineation, the presence of redox features varies across the site, ranging from 0-40% of the top 4 inches of the soil profile. The expected highly anaerobic conditions following hydrologic modification of the site are expected to result in development of redox features in all WAAs; therefore, a subindex value of 1.00 is assigned in Year 15 for all WAAs.

Sorptive soil properties (V_{sorpt}). According to the NRCS Soil Survey, soils on the site are poorly drained with slow surface runof). The wetland delineation of the site revealed a clay soil texture across the site. Based on the dominance of clay soils, a subindex value of 1.00 is assigned for Years 1 through 15 throughout all WAAs.

Connectivity to other habitat types ($V_{connect}$). The proposed habitat types in adjacent WAAs are included when analyzing each WAA. RES assigns subindex values of 1.00 to all WAAs, due the presence of 4 or more habitat types within 600 feet.

Coarse woody debris (V_{cwd}) is measured by the point-intercept method along a 100-foot transect. The planting phase of the project will increase the woody vegetation and tree density on the site. During the 15 years following initial planting, dead trees and managed thinning practices will increase the amount of coarse woody material found within forested WAAs. Frequent flooding of the Bank Site will result in deposits of woody debris in certain areas, but not distributed evenly across the site. An average value of 3-7 pieces of coarse woody debris over 3 inches in diameter is used to account for this variability, scoring 0.5 in forested wetland areas. The Riverine Herbaceous/Shrub HGMi model does not include this variable.

Tree species (V_{tree}) accounts for the trees in all WAAs that are hard mast producers. Per the MBI, hard mast species will be managed to compose at least 60 percent of the dominant forest species throughout WAAs. Therefore, for Year 15, the subindex expected to be 1.00 for all forested WAAs. Existing forested WAAs will be managed to increase cover of hard mast producing trees. The Riverine Herbaceous/Shrub HGMi model does not include this variable.

Tree richness (V_{rich}) is the diversity of species within the WAAs. Based on the MBI, the stand will be planted with a mixed population of desirable, native tree species including more than five species of hard mast producing trees. Therefore, a subindex value of 1.00 is assigned for Year 15 for all forested WAAs. The Riverine Herbaceous/Shrub HGMi model does not include this variable.

Tree basal area (V_{basal}) is the mean basal area per acre of the trees in the WAA. A subindex value of 0.60 is chosen for Year 15 for all forested restoration WAAs because the planting density, management practices, and species compositions outlined in the MWP are expected to provide the growth rates necessary to produce average basal areas of 60–80 square feet per acre for each forested WAA. In existing forested WAAs, tree basal area is between 80 and 100 square feet per acre, scoring 0.8. The Riverine Herbaceous/Shrub HGMi model does not include this variable.

Tree density ($V_{density}$) is based on the number of trees per acre that are at least 3 inches in diameter at breast height (dbh). A subindex value of 1.00 is assumed for all forested WAAs for Year 15 based on the density of the stand indicated by the management plan in the MBI. If the tree density exceeds 250 trees per acre, trees will be selectively thinned to reduce the density to optimum levels. Existing forested WAAs currently have the desired tree density.

Table 1. Estimated HGMi values and associated FCUs in WAA1 forested wetland enhancement areas (existing wetlands).

Wetland Assessment Area 1 (forested wetland enhancement) 11.24 Acres		
Variable	**Existing**	**Projected Year 15**
V_{dur}	0.75	1.00
V_{freq}	1.00	1.00
V_{topo}	1.00	1.00
V_{cwd}	0.5	0.5
V_{wood}	0.75	1.00

Wetland Assessment Area 1 (forested wetland enhancement) 11.24 Acres		
Variable	**Existing**	**Projected Year 15**
V_{tree}	0.80	1.00
V_{rich}	0.80	1.00
V_{basal}	0.80	0.80
$V_{density}$	1.00	1.00
V_{mid}	0.75	0.75
V_{herb}	1.00	1.00
$V_{detritus}$	1.00	1.00
V_{redox}	1.00	1.00
V_{sorpt}	1.00	1.00
$V_{connect}$	1.00	1.00
TSSW FCI	0.81	0.91
MPAC FCI	0.81	0.88
RSEC FCI	0.85	0.97
TSSW FCU	9.06	1.20*
MPAC FCU	9.13	0.75*
RSEC FCU	9.55	1.31*

* Compared to existing

Table 2. Estimated HGMi values and associated FCUs in WAA1 re-establishment areas (forested uplands to forested wetlands).

Wetland Assessment Area 1 (re-establishment) 13.05 Acres		
Variable	**Existing**	**Projected Year 15**
V_{dur}	0	0.75
V_{freq}	0	0.75
V_{topo}	0	1.00
V_{cwd}	0	0.5
V_{wood}	0	1.00
V_{tree}	0	1.00
V_{rich}	0	1.00
V_{basal}	0	0.80
$V_{density}$	0	1.00
V_{mid}	0	0.75
V_{herb}	0	1.00
$V_{detritus}$	0	1.00

Wetland Assessment Area 1 (re-establishment) 13.05 Acres		
Variable	**Existing**	**Projected Year 15**
V_{redox}	0	1.00
V_{sorpt}	0	1.00
$V_{connect}$	0	1.00
TSSW FCI	0	0.87
MPAC FCI	0	0.96
RSEC FCI	0	0.90
TSSW FCU	0	11.32
MPAC FCU	0	11.47
RSEC FCU	0	11.31

Table 3. Estimated HGMi values and associated FCUs in WAA2 re-establishment areas (forested upland to forested wetlands).

Wetland Assessment Area 2 14.75 Acres		
Variable	**Existing**	**Projected Year 15**
V_{dur}	0	0.75
V_{freq}	0	0.75
V_{topo}	0	1.00
V_{cwd}	0	0.5
V_{wood}	0	1.00
V_{tree}	0	1.00
V_{rich}	0	1.00
V_{basal}	0	0.80
$V_{density}$	0	1.00
V_{mid}	0	0.75
V_{herb}	0	1.00
$V_{detritus}$	0	1.00
V_{redox}	0	1.00
V_{sorpt}	0	1.00
$V_{connect}$	0	1.00
TSSW FCI	0	0.79
MPAC FCI	0	0.88
RSEC FCI	0	0.87
TSSW FCU	0	11.66

Wetland Assessment Area 2 14.75 Acres		
Variable	**Existing**	**Projected Year 15**
MPAC FCU	0	12.97
RSEC FCU	0	12.78

Table 4. Estimated HGMi values and associated FCUs in WAA3 forested wetland rehabilitation (emergent wetlands to forested wetlands).

Wetland Assessment Area 3 1.9 Acres		
Variable	**Existing**	**Projected Year 15**
V_{dur}	1.00	1.00
V_{freq}	1.00	1.00
V_{topo}	1.00	1.00
V_{cwd}	0.10	0.5
V_{wood}	0.10	0.75
V_{tree}	0.10	1.00
V_{rich}	0.10	1.00
V_{basal}	0.10	0.60
$V_{density}$	0.10	1.00
V_{mid}	0.25	0.50
V_{herb}	0.30	0.50
$V_{detritus}$	0.10	1.00
V_{redox}	0.10	1.00
V_{sorpt}	1.00	1.00
$V_{connect}$	1.00	1.00
TSSW FCI	0.63	0.87
MPAC FCI	0.28	0.80
RSEC FCI	0.58	0.90
TSSW FCU	1.20	0.44*
MPAC FCU	0.53	0.99*
RSEC FCU	1.10	0.61*

* Compared to existing

Table 5. Estimated HGMi values and associated FCUs in WAA4 forested wetland rehabilitation (emergent wetlands to forested wetlands).

Wetland Assessment Area 4 40.8 Acres		
Variable	**Existing**	**Projected Year 15**
V_{dur}	0.75	1.00
V_{freq}	0.75	1.00
V_{topo}	0.40	1.00
V_{cwd}	0.10	0.5
V_{wood}	0.10	0.75
V_{tree}	0.10	1.00
V_{rich}	0.10	1.00
V_{basal}	0.10	0.60
$V_{density}$	0.10	1.00
V_{mid}	0.25	0.50
V_{herb}	0.30	0.50
$V_{detritus}$	0.10	1.00
V_{redox}	0.10	1.00
V_{sorpt}	1.00	1.00
$V_{connect}$	1.00	1.00
TSSW FCI	0.39	0.87
MPAC FCI	0.28	0.80
RSEC FCI	0.44	0.90
TSSW FCU	15.80	19.53*
MPAC FCU	11.39	21.25*
RSEC FCU	17.95	18.77*

* Compared to existing

Table 6. Estimated HGMi values and associated FCUs in WAA5 and WAA6 forested wetland re-establishment (herbaceous uplands to forested wetlands).

Wetland Assessment Areas 5 and 6 74.6 Acres		
Variable	**Existing**	**Projected Year 15**
V_{dur}	0.00	0.75
V_{freq}	0.00	0.75
V_{topo}	0.00	1.00
V_{cwd}	0.00	0.5

Wetland Assessment Areas 5 and 6 74.6 Acres		
Variable	**Existing**	**Projected Year 15**
V_{wood}	0.00	0.75
V_{tree}	0.00	1.00
V_{rich}	0.00	1.00
V_{basal}	0.00	0.60
$V_{density}$	0.00	1.00
V_{mid}	0.00	0.50
V_{herb}	0.00	0.50
$V_{detritus}$	0.00	1.00
V_{redox}	0.00	1.00
V_{sorpt}	0.00	1.00
$V_{connect}$	0.00	1.00
TSSW FCI	0.00	0.75
MPAC FCI	0.00	0.80
RSEC FCI	0.00	0.80
TSSW FCU	0.0	55.95
MPAC FCU	0.0	59.68
RSEC FCU	0.0	59.68

Table 7. Estimated HGMi values and associated FCUs in WAA7 herbaceous wetland re-establishment (herbaceous upland to herbaceous wetlands).

Wetland Assessment Area 7 39.7 Acres		
Variable	**Existing**	**Projected Year 15**
V_{dur}	0.00	0.75
V_{freq}	0.00	0.75
V_{topo}	0.00	1.00
V_{wood}	0.00	0.10
V_{mid}	0.00	0.10
V_{herb}	0.00	1.00
$V_{detritus}$	0.00	1.00
V_{redox}	0.00	1.00
V_{sorpt}	0.00	1.00
$V_{connect}$	0.00	1.00
TSSW FCI	0.00	0.76

Wetland Assessment Area 7 39.7 Acres		
Variable	**Existing**	**Projected Year 15**
MPAC FCI	0.00	0.70
RSEC FCI	0.00	0.66
TSSW FCU	0.0	30.27
MPAC FCU	0.0	27.79
RSEC FCU	0.0	26.20

Table 8. Estimated HGMi values and associated FCUs in WAA8 herbaceous wetland re-establishment (herbaceous upland to herbaceous wetland depression).

Wetland Assessment Area 8 7 Acres		
Variable	**Existing**	**Projected Year 15**
V_{dur}	0.00	1.00
V_{freq}	0.00	1.00
V_{topo}	0.00	1.00
V_{wood}	0.00	0.10
V_{mid}	0.00	0.10
V_{herb}	0.00	0.75
$V_{detritus}$	0.00	1.00
V_{redox}	0.00	1.00
V_{sorpt}	0.00	1.00
$V_{connect}$	0.00	1.00
TSSW FCI	0.00	0.84
MPAC FCI	0.00	0.62
RSEC FCI	0.00	0.74
TSSW FCU	0.0	5.91
MPAC FCU	0.0	4.32
RSEC FCU	0.0	5.20

4 CONCLUSION

A potential for 100.1 physical (TSSW), 107.1 biological (MPAC), and 104.5 chemical (RSEC) Riverine Forested HGMi FCUs (credits) and 36.2 physical (TSSW), 32.1 biological (MPAC), and 31.4 chemical

(RSEC) Riverine Herbaceous/Shrub HGMi FCUs (credits) are estimated to be generated through Year 15 of CIBMB. These estimates are subject to verification as the wetlands develop. Therefore, RES asks that the USACE and the Interagency Review Team (IRT) members use these values only as estimates of future conditions and as a basis for initial credit releases. The final credit release will be based on HGMi assessments that demonstrate attained functional values.

5 REFERENCES

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Riverine Forested HGM Interim Worksheet

Pre-project

WAA# 1

Variable	Subindex
V_{dur}	0.75
V_{freq}	1
V_{topo}	1
V_{cwd}	1
V_{wood}	0.75
V_{tree}	0.8
V_{rich}	0.8
V_{basal}	0.8
$V_{density}$	1
V_{mid}	0.75
V_{herb}	1
$V_{detritus}$	1
V_{redox}	1
V_{sorpt}	1
$V_{connect}$	1

Post Project

WAA# 1

Variable	Subindex
V_{dur}	1
V_{freq}	1
V_{topo}	1
V_{cwd}	1
V_{wood}	1
V_{tree}	1
V_{rich}	1
V_{basal}	0.8
$V_{density}$	1
V_{mid}	0.75
V_{herb}	1
$V_{detritus}$	1
V_{redox}	1
V_{sorpt}	1
$V_{connect}$	1

Riverine Forested (Interim) HGM Worksheet
Functional Capacity Index (FCI)

Temporary Storage & Detention of Storage Water:

$$\sqrt{\left[\sqrt{(V_{dur} * V_{freq})} * \frac{(V_{topo} + V_{cwd} + V_{wood})}{3}\right]}$$

[{ 0.75 x 1 } 1/2 x { 1 + 1 + 0.75 } /3] 1/2 = FCI

[{ 1 x 1 } 1/2 x { 1 + 1 + 1 } /3] 1/2 = FCI

Maintain Plant and Animal Communities:

$$\frac{\left[V_{tree} + V_{cwd} + V_{rich} + \frac{[V_{basal} + V_{density}]}{2} + \left[\frac{(V_{mid} + V_{herb})}{2}\right] + V_{connect}\right]}{6}$$

[0.8 + 1 + 0.8 +[{ 0.8 + 1 } /2]+[{ 0.75 + 1 }/2]+ 1]/6 = FCI

[1 + 1 + 1 +[{ 0.8 + 1 } /2]+[{ 0.75 + 1 }/2]+ 1]/6 = FCI

Removal & Sequestration of Elements and Compounds:

$$\frac{\left[V_{wood} + V_{freq} + V_{dur} + \left[\frac{(V_{topo} + V_{cwd} + V_{wood})}{3}\right] + \left[\frac{(V_{\text{det ritus}} + V_{redox} + V_{sorpt})}{3}\right]\right]}{5}$$

[0.75 + 1 + 0.75 +[{ 1 + 1 + 0.75 }/3] + [{ 1 + 1 + 1 }/3] /5 = FCI

[1 + 1 + 1 +[{ 1 + 1 + 1 }/3] + [{ 1 + 1 + 1 }/3] /5 = FCI

Functional Capacity Units (FCU); FCI x wetland acres per WAA…

Acres: 11.24

WAA # **1**	Pre-project FCUs	Post Project FCUs	FCU Increase
Temp Storage of Water	10.01	11.24	1.23
Maintain Plant & Animal	10.07	10.82	0.75
Removal of Elements	9.93	11.24	1.31

Riverine Forested HGM Interim Worksheet

Pre-project

WAA# 1

Variable	Subindex
V_{dur}	0
V_{freq}	0
V_{topo}	0
V_{cwd}	0
V_{wood}	0
V_{tree}	0
V_{rich}	0
V_{basal}	0
$V_{density}$	0
V_{mid}	0
V_{herb}	0
$V_{detritus}$	0
V_{redox}	0
V_{sorpt}	0
$V_{connect}$	0

Post Project

WAA# 1

Variable	Subindex
V_{dur}	0.75
V_{freq}	0.75
V_{topo}	1
V_{cwd}	1
V_{wood}	1
V_{tree}	1
V_{rich}	1
V_{basal}	0.8
$V_{density}$	1
V_{mid}	0.75
V_{herb}	1
$V_{detritus}$	1
V_{redox}	1
V_{sorpt}	1
$V_{connect}$	1

Riverine Forested (Interim) HGM Worksheet
Functional Capacity Index (FCI)

Temporary Storage & Detention of Storage Water:

$$\sqrt{\left[\sqrt{(V_{dur} * V_{freq})} * \frac{(V_{topo} + V_{cwd} + V_{wood})}{3}\right]}$$

[{ 0 x 0 } 1/2 x { 0 + 0 + 0 } /3] 1/2 = FCI

[{ 0.75 x 0.75 } 1/2 x { 1 + 1 + 1 } /3] 1/2 = FCI

Maintain Plant and Animal Communities:

$$\frac{\left[V_{tree} + V_{cwd} + V_{rich} + \frac{[V_{basal} + V_{density}]}{2} + \left[\frac{(V_{mid} + V_{herb})}{2}\right] + V_{connect}\right]}{6}$$

[0 + 0 + 0 +[{ 0 + 0 } /2]+[{ 0 + 0 }/2]+ 0]/6 = FCI

[1 + 1 + 1 +[{ 0.8 + 1 } /2]+[{ 0.75 + 1 }/2]+ 1]/6 = FCI

Removal & Sequestration of Elements and Compounds:

$$\frac{\left[V_{wood} + V_{freq} + V_{dur} + \left[\frac{(V_{topo} + V_{cwd} + V_{wood})}{3}\right] + \left[\frac{(V_{det\ ritus} + V_{redox} + V_{sorpt})}{3}\right]\right]}{5}$$

[0 + 0 + 0 +[{ 0 + 0 + 0 }/3] + [{ 0 + 0 + 0 }/3] /5 = FCI

[1 + 0.75 + 0.75 +[{ 1 + 1 + 1 }/3] + [{ 1 + 1 + 1 }/3] /5 = FCI

Functional Capacity Units (FCU); FCI x wetland acres per WAA…

Acres: 13.05

WAA # **1**	Pre-project FCUs	Post Project FCUs	FCU Increase
Temp Storage of Water	0.00	11.30	11.30
Maintain Plant & Animal	0.00	12.56	12.56
Removal of Elements	0.00	11.75	11.75

Riverine Forested HGM Interim Worksheet

Pre-project

WAA# 2

Variable	Subindex
V_{dur}	0
V_{freq}	0
V_{topo}	0
V_{cwd}	0
V_{wood}	0
V_{tree}	0
V_{rich}	0
V_{basal}	0
$V_{density}$	0
V_{mid}	0
V_{herb}	0
$V_{detritus}$	0
V_{redox}	0
V_{sorpt}	0
$V_{connect}$	0

Post Project

WAA# 2

Variable	Subindex
V_{dur}	0.75
V_{freq}	0.75
V_{topo}	1
V_{cwd}	1
V_{wood}	1
V_{tree}	1
V_{rich}	1
V_{basal}	0.8
$V_{density}$	1
V_{mid}	0.75
V_{herb}	1
$V_{detritus}$	1
V_{redox}	1
V_{sorpt}	1
$V_{connect}$	1

Riverine Forested (Interim) HGM Worksheet
Functional Capacity Index (FCI)

Temporary Storage & Detention of Storage Water:

$$\sqrt{\left[\sqrt{(V_{dur} * V_{freq})} * \frac{(V_{topo} + V_{cwd} + V_{wood})}{3}\right]}$$

[{ 0 x 0 } 1/2 x { 0 + 0 + 0 } /3] 1/2 = FCI

[{ 0.75 x 0.75 } 1/2 x { 1 + 1 + 1 } /3] 1/2 = FCI

Maintain Plant and Animal Communities:

$$\frac{\left[V_{tree} + V_{cwd} + V_{rich} + \frac{[V_{basal} + V_{density}]}{2} + \left[\frac{(V_{mid} + V_{herb})}{2}\right] + V_{connect}\right]}{6}$$

[0 + 0 + 0 +[{ 0 + 0 } /2]+[{ 0 + 0 }/2]+ 0]/6 = FCI

[1 + 1 + 1 +[{ 0.8 + 1 } /2]+[{ 0.75 + 1 }/2]+ 1]/6 = FCI

Removal & Sequestration of Elements and Compounds:

$$\frac{\left[V_{wood} + V_{freq} + V_{dur} + \left[\frac{(V_{topo} + V_{cwd} + V_{wood})}{3}\right] + \left[\frac{(V_{detritus} + V_{redox} + V_{sorpt})}{3}\right]\right]}{5}$$

[0 + 0 + 0 +[{ 0 + 0 + 0 }/3] + [{ 0 + 0 + 0 }/3] /5 = FCI

[1 + 0.75 + 0.75 +[{ 1 + 1 + 1 }/3] + [{ 1 + 1 + 1 }/3] /5 = FCI

Functional Capacity Units (FCU); FCI x wetland acres per WAA…

Acres: 14.75

WAA # **2**	Pre-project FCUs	Post Project FCUs
Temp Storage of Water	0.00	12.77
Maintain Plant & Animal	0.00	14.20
Removal of Elements	0.00	13.28

Riverine Forested HGM Interim Worksheet

Pre-project

WAA# 3

Variable	Subindex
V_{dur}	1
V_{freq}	1
V_{topo}	1
V_{cwd}	0.1
V_{wood}	0.1
V_{tree}	0.1
V_{rich}	0.1
V_{basal}	0.1
$V_{density}$	0.1
V_{mid}	0.25
V_{herb}	0.75
$V_{detritus}$	0.1
V_{redox}	0.1
V_{sorpt}	1
$V_{connect}$	1

Post Project

WAA# 3

Variable	Subindex
V_{dur}	1
V_{freq}	1
V_{topo}	1
V_{cwd}	1
V_{wood}	1
V_{tree}	1
V_{rich}	1
V_{basal}	0.6
$V_{density}$	1
V_{mid}	0.5
V_{herb}	0.5
$V_{detritus}$	1
V_{redox}	1
V_{sorpt}	1
$V_{connect}$	1

Riverine Forested (Interim) HGM Worksheet
Functional Capacity Index (FCI)

Temporary Storage & Detention of Storage Water:

$$\sqrt{\left[\sqrt{(V_{dur} * V_{freq})} * \frac{(V_{topo} + V_{cwd} + V_{wood})}{3}\right]}$$

[{ 1 x 1 } 1/2 x { 1 + 0.1 + 0.1 } /3] 1/2 = FCI

[{ 1 x 1 } 1/2 x { 1 + 1 + 1 } /3] 1/2 = FCI

Maintain Plant and Animal Communities:

$$\frac{\left[V_{tree} + V_{cwd} + V_{rich} + \frac{[V_{basal} + V_{density}]}{2} + \left[\frac{(V_{mid} + V_{herb})}{2}\right] + V_{connect}\right]}{6}$$

[0.1 + 0.1 + 0.1 +[{ 0.1 + 0.1 } /2]+[{ 0.25 + 0.75 }/2]+ 1]/6 = FCI

[1 + 1 + 1 +[{ 0.6 + 1 } /2]+[{ 0.5 + 0.5 }/2]+ 1]/6 = FCI

Removal & Sequestration of Elements and Compounds:

$$\frac{\left[V_{wood} + V_{freq} + V_{dur} + \left[\left[\frac{(V_{topo} + V_{cwd} + V_{wood})}{3}\right] + \left[\frac{(V_{detritus} + V_{redox} + V_{sorpt})}{3}\right]\right]\right]}{5}$$

[0.1 + 1 + 1 +[{ 1 + 0.1 + 0.1 }/3] + [{ 0.1 + 0.1 + 1 }/3] /5 = FCI

[1 + 1 + 1 +[{ 1 + 1 + 1 }/3] + [{ 1 + 1 + 1 }/3] /5 = FCI

Functional Capacity Units (FCU); FCI x wetland acres per WAA…

Acres: 1.9

WAA # **3**	Pre-project FCUs	Post Project FCUs	FCU Lift
Temp Storage of Water	1.20	1.90	0.70
Maintain Plant & Animal	0.60	1.68	1.08
Removal of Elements	1.10	1.90	0.80

Riverine Forested HGM Interim Worksheet

Pre-project

WAA# 4

Variable	Subindex
V_{dur}	0.75
V_{freq}	0.75
V_{topo}	0.4
V_{cwd}	0.1
V_{wood}	0.1
V_{tree}	0.1
V_{rich}	0.1
V_{basal}	0.1
$V_{density}$	0.1
V_{mid}	0.25
V_{herb}	0.75
$V_{detritus}$	0.1
V_{redox}	0.1
V_{sorpt}	1
$V_{connect}$	1

Post Project

WAA# 4

Variable	Subindex
V_{dur}	1
V_{freq}	1
V_{topo}	1
V_{cwd}	1
V_{wood}	1
V_{tree}	1
V_{rich}	1
V_{basal}	0.6
$V_{density}$	1
V_{mid}	0.5
V_{herb}	0.5
$V_{detritus}$	1
V_{redox}	1
V_{sorpt}	1
$V_{connect}$	1

Riverine Forested (Interim) HGM Worksheet
Functional Capacity Index (FCI)

Temporary Storage & Detention of Storage Water:

$$\sqrt{\left[\sqrt{(V_{dur} * V_{freq})} * \frac{(V_{topo} + V_{cwd} + V_{wood})}{3}\right]}$$

[{ 0.75 x 0.75 } 1/2 x { 0.4 + 0.1 + 0.1 } /3] 1/2 = FCI

[{ 1 x 1 } 1/2 x { 1 + 1 + 1 } /3] 1/2 = FCI

Maintain Plant and Animal Communities:

$$\frac{\left[V_{tree} + V_{cwd} + V_{rich} + \frac{[V_{basal} + V_{density}]}{2} + \left[\frac{(V_{mid} + V_{herb})}{2}\right] + V_{connect}\right]}{6}$$

[0.1 + 0.1 + 0.1 +[{ 0.1 + 0.1 } /2]+[{ 0.25 + 0.75 }/2]+ 1]/6 = FCI

[1 + 1 + 1 +[{ 0.6 + 1 } /2]+[{ 0.5 + 0.5 }/2]+ 1]/6 = FCI

Removal & Sequestration of Elements and Compounds:

$$\frac{\left[V_{wood} + V_{freq} + V_{dur} + \left[\frac{(V_{topo} + V_{cwd} + V_{wood})}{3}\right] + \left[\frac{(V_{detritus} + V_{redox} + V_{sorpt})}{3}\right]\right]}{5}$$

[0.1 + 0.75 + 0.75 +[{ 0.4 + 0.1 + 0.1 }/3] + [{ 0.1 + 0.1 + 1 }/3] /5 = FCI

[1 + 1 + 1 +[{ 1 + 1 + 1 }/3] + [{ 1 + 1 + 1 }/3] /5 = FCI

Functional Capacity Units (FCU); FCI x wetland acres per WAA…

Acres: 40.8

WAA # **4**	Pre-project FCUs	Post Project FCUs	FCU Lift
Temp Storage of Water	15.80	40.80	25.00
Maintain Plant & Animal	12.92	36.04	23.12
Removal of Elements	17.95	40.80	22.85

Riverine Forested HGM Interim Worksheet

Pre-project

WAA# 5 and 6

Variable	Subindex
V_{dur}	0
V_{freq}	0
V_{topo}	0
V_{cwd}	0
V_{wood}	0
V_{tree}	0
V_{rich}	0
V_{basal}	0
$V_{density}$	0
V_{mid}	0
V_{herb}	0
$V_{detritus}$	0
V_{redox}	0
V_{sorpt}	0
$V_{connect}$	0

Post Project

WAA# 5 and 6

Variable	Subindex
V_{dur}	0.75
V_{freq}	0.75
V_{topo}	1
V_{cwd}	1
V_{wood}	1
V_{tree}	1
V_{rich}	1
V_{basal}	0.6
$V_{density}$	1
V_{mid}	0.5
V_{herb}	0.5
$V_{detritus}$	1
V_{redox}	1
V_{sorpt}	1
$V_{connect}$	1

Riverine Forested (Interim) HGM Worksheet
Functional Capacity Index (FCI)

Temporary Storage & Detention of Storage Water:

$$\sqrt{\left[\sqrt{(V_{dur} * V_{freq})} * \frac{(V_{topo} + V_{cwd} + V_{wood})}{3}\right]}$$

[{ 0 x 0 } 1/2 x { 0 + 0 + 0 } /3] 1/2 = FCI

[{ 0.75 x 0.75 } 1/2 x { 1 + 1 + 1 } /3] 1/2 = FCI

Maintain Plant and Animal Communities:

$$\frac{\left[V_{tree} + V_{cwd} + V_{rich} + \frac{[V_{basal} + V_{density}]}{2} + \left[\frac{(V_{mid} + V_{herb})}{2}\right] + V_{connect}\right]}{6}$$

[0 + 0 + 0 +[{ 0 + 0 } /2]+[{ 0 + 0 }/2]+ 0]/6 = FCI

[1 + 1 + 1 +[{ 0.6 + 1 } /2]+[{ 0.5 + 0.5 }/2]+ 1]/6 = FCI

Removal & Sequestration of Elements and Compounds:

$$\frac{\left[V_{wood} + V_{freq} + V_{dur} + \left[\frac{(V_{topo} + V_{cwd} + V_{wood})}{3}\right] + \left[\frac{(V_{detritus} + V_{redox} + V_{sorpt})}{3}\right]\right]}{5}$$

[0 + 0 + 0 +[{ 0 + 0 + 0 }/3] + [{ 0 + 0 + 0 }/3] /5 = FCI

[1 + 0.75 + 0.75 +[{ 1 + 1 + 1 }/3] + [{ 1 + 1 + 1 }/3] /5 = FCI

Functional Capacity Units (FCU); FCI x wetland acres per WAA…

Acres: 74.6

WAA # **5 and 6**	Pre-project FCUs	Post Project FCUs
Temp Storage of Water	0.00	64.61
Maintain Plant & Animal	0.00	65.90
Removal of Elements	0.00	67.14

Riverine Herb/Shrub HGM (Interim) Worksheet

Pre-project

WAA# 7

Variable	Subindex
V_{dur}	0
V_{freq}	0
V_{topo}	0
V_{wood}	0
V_{mid}	0
V_{herb}	0
$V_{detritus}$	0
V_{redox}	0
V_{sorpt}	0
$V_{connect}$	0

Post Project

WAA# 7

Variable	Subindex
V_{dur}	0.75
V_{freq}	0.75
V_{topo}	1
V_{wood}	0.1
V_{mid}	0.1
V_{herb}	1
$V_{detritus}$	1
V_{redox}	1
V_{sorpt}	1
$V_{connect}$	1

Riverine Herb/Shrub (Interim HGM) Worksheet
Functional Capacity Index (FCI)

Temporary Storage & Detention of Storage Water:

$[\{V_{dur} \times V_{freq}\}1/2 \times \{V_{topo} + \{V_{herb} + V_{mid}/2\}\}/2]\ 1/2$

[{ 0 x 0 } 1/2 x { 0 + { 0 + 0 /2} /2] 1/2 = FCI

[{ 0.75 x 0.75 } 1/2 x { 1 + { 1 + 0.1 /2} /2] 1/2 = FCI

Maintain Plant and Animal Communities:

$\{V_{mid} + V_{herb} + V_{connect}\}/3$

{ 0 + 0 + 0 } /3 = FCI

{ 0.1 + 1 + 1 } /3 = FCI

Removal & Sequestration of Elements and Compounds:

$[[V_{wood} + V_{freq} + V_{dur} + [\{V_{topo} + V_{herb} + V_{mid}\}/3] + [\{V_{detritus} + V_{redox} + V_{sorpt}\}/3]]/5$

[[0 + 0 + 0 +[{ 0 + 0 + 0 }/3] + [{ 0 + 0 + 0 }/3]] /5 = FCI

[[0.1 + 0.75 + 0.75 +[{ 1 + 1 + 0.1 }/3] + [{ 1 + 1 + 1 }/3]] /5 = FCI

Functional Capacity Units (FCU); FCI x wetland acres per WAA…

Acres: 39.7

WAA # **7**	Pre-project FCUs	Post Project FCUs
Temp Storage of Water	0.00	30.27
Maintain Plant & Animal	0.00	27.79
Removal of Elements	0.00	26.20

Riverine Herb/Shrub HGM (Interim) Worksheet

Pre-project

WAA# 8

Variable	Subindex
V_{dur}	0
V_{freq}	0
V_{topo}	0
V_{wood}	0
V_{mid}	0
V_{herb}	0
$V_{detritus}$	0
V_{redox}	0
V_{sorpt}	0
$V_{connect}$	0

Post Project

WAA# 8

Variable	Subindex
V_{dur}	1
V_{freq}	1
V_{topo}	1
V_{wood}	0.1
V_{mid}	0.1
V_{herb}	0.75
$V_{detritus}$	1
V_{redox}	1
V_{sorpt}	1
$V_{connect}$	1

Riverine Herb/Shrub (Interim HGM) Worksheet
Functional Capacity Index (FCI)

Temporary Storage & Detention of Storage Water:

$[\{V_{dur} \times V_{freq}\}1/2 \times \{V_{topo} + \{V_{herb} + V_{mid}/2\}\}/2]\ 1/2$

[{ 0 x 0 } 1/2 x { 0 + { 0 + 0 /2} /2] 1/2 = FCI

[{ 1 x 1 } 1/2 x { 1 + { 0.75 + 0.1 /2} /2] 1/2 = FCI

Maintain Plant and Animal Communities:

$\{V_{mid} + V_{herb} + V_{connect}\}/3$

{ 0 + 0 + 0 } /3 = FCI

{ 0.1 + 0.75 + 1 } /3 = FCI

Removal & Sequestration of Elements and Compounds:

$[[V_{wood} + V_{freq} + V_{dur} + [\{V_{topo} + V_{herb} + V_{mid}\}/3] + [\{V_{detritus} + V_{redox} + V_{sorpt}\}/3]]/5$

[[0 + 0 + 0 +[{ 0 + 0 + 0 }/3] + [{ 0 + 0 + 0 }/3]] /5 = FCI

[[0.1 + 1 + 1 +[{ 1 + 0.75 + 0.1 }/3] + [{ 1 + 1 + 1 }/3]] /5 = FCI

Functional Capacity Units (FCU); FCI x wetland acres per WAA…

Acres: 7

WAA # **8**	Pre-project FCUs	Post Project FCUs
Temp Storage of Water	0.00	5.91
Maintain Plant & Animal	0.00	4.32
Removal of Elements	0.00	5.20

Long-Term Management Plan for Cow Island Bayou Mitigation Bank Liberty County, Texas

Permit No.: SWG-2012-00223

Sponsor

Third Texas Resource, LLC

Agent

Resource Environmental Solutions, LLC

November 28, 2018

April 15, 2019

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1 PURPOSE AND RESPONSIBILITIES

The goal of the Cow Island Bayou Mitigation Bank (CIBMB or Bank) is to provide appropriate compensatory mitigation for unavoidable impacts to wetlands authorized by the U.S. Army Corps of Engineers (USACE) within the Lower Trinity watershed and adjacent areas. The objectives of CIBMB are to:

1) re-establish, rehabilitate, and sustain wetland functions to 117.4 acres of existing cleared agricultural land as forested wetlands (WAA3, WAA4, WAA5 and WAA6);

2) re-establish and sustain wetland functions to 46.8 acres as herbaceous wetlands (WAA7), including an approximately 2.0-acre portion of WAA8 that will have submerged aquatic vegetation;

3) enhance 11.2 acres of existing forested wetlands and re-establish and sustain 13.1 acres of forested wetlands to result in a 70% / 30% wetland / upland ratio within a 34.7-acre forested area with gilgai (WAA1);

4) re-establish and sustain 14.8 acres of forested wetland to result in a 50% / 50% wetland/upland ratio within a 29.5-acre forested area with gilgai (WAA2);

5) re-establish and sustain 23.8 acres as native prairie upland buffer.

Once all performance standards defined in the Mitigation Banking Instrument (MBI) are achieved and the required minimum of 15 years of monitoring have been completed, the Bank will enter the long-term management phase. The long-term goal for the Bank, as described in this Long-Term Management Plan (LTMP), is to maintain the restored forested and herbaceous wetlands within the Bank site in perpetuity. This goal will be accomplished by the Long-Term Steward maintaining the ecological characteristics of the site and the conservation easement (CE) holder monitoring the Bank site and ensuring that no prohibited activities take place.

1.1 Sponsor and Land Owner

Third Texas Resource, LLC is the Sponsor of CIBMB and legal owner of the Bank site, with Resource Environmental Solutions, LLC (RES) as its agent. All liens affecting the Bank have been identified and will be satisfied or subordinated to the recorded CE. The Sponsor, after receiving approval from the USACE in coordination with the Interagency Review Team (IRT), may appoint a separate Long-Term Steward in accordance with 33 CFR 332.7(d)(1). Until a successor Long-Term Steward is appointed, the Sponsor shall fulfill the role of Long-Term Steward.

The Sponsor is responsible for establishing, funding, and ensuring sufficiency of the Long-Term Management Fund. Prior to beginning the long-term management phase, when the required minimum of 15 years of monitoring of the Bank are near completion, the Sponsor will evaluate the expected annual costs for managing the Bank site in order to determine whether or not the Long-Term Management Fund is expected to be sufficient to provide for management of the Bank site in perpetuity, and submit the evaluation to the USACE and IRT. If deemed necessary to meet the expected long-term management costs, funds will be added by the Sponsor to the Long-Term Management Fund.

In the event capitalization of Long-Term Management Fund proves insufficient to meet the expected long-term management needs of the Bank site, the Sponsor, or the entity to whom Bank management has been transferred, as applicable, remains liable for such costs while they are managing the Bank. Should Bank management be transferred to another entity, the Sponsor shall submit current information and analyses

concerning the anticipated long-term costs of managing the Bank, the sufficiency of existing funding, and a plan to address any foreseeable deficit, if applicable, to the USACE. In the event that Bank management is to be transferred, the USACE, in coordination with the IRT, will determine whether any additional funding by the Sponsor is necessary and, if so, in what amount.

Subject to restrictions dictated by the CE, the landowner may convey fee simple title to, or other forms of property interest in, any property included within the Bank, provided the necessary protective mechanisms are recorded respective to this MBI. In the event of a transfer in land ownership, the landowner will make a reasonable effort to ensure that the property is conveyed to an environmentally-responsible party who understands the restrictions of the CE. Property taxes and insurance will be the responsibility of the land owner and are accounted for in the long-term funding.

The Sponsor may request to transfer sponsorship of CIBMB to another entity, such as a non-profit land trust, governmental entity, or private party, provided that the new Sponsor agrees to abide by the terms of the MBI or a USACE-approved, modified MBI. Upon transfer of sponsorship, all obligations for future performance of the original Sponsor shall be terminated and the successor Sponsor shall provide all such obligations. Unless a substitute financial assurance mechanism is established, all unused funds in the long-term endowment, as well as the right to draw against the account, will be transferred to the successor Sponsor. The physical ownership of Bank lands and the operating rights (sponsorship) are separable components and may be transferred independently.

1.2 Long-Term Steward

The Long-Term Steward will carry out monitoring and management activities required to maintain the ecological functions of the Bank site in perpetuity. Consistent with 33 CFR 332.7(b), the Bank is designed to minimize requirements for ongoing management following the active phase and to be self-sustaining to the maximum extent practicable. The Long-Term Steward will be responsible for tasks, including, but not limited to:

- inspections;
- reporting;
- management of invasive species and herbivory;
- mowing/prescribed burning of herbaceous wetlands;
- vegetation management;
- trash removal;
- maintenance of berms, boundaries, signs, and roads; and
- project management and administration.

Bank site management strategies and tasks are described in Section 4, below. When necessary, the Long-Term Steward will work in coordination with the USACE and IRT to determine what, if any, changes are required for the site to maintain or regain wetland functions, as described in the Adaptive Management Section (4.5.1) below.

Disbursements from the Long-Term Management Fund shall be used by the Long-Term Steward for management activities, and will be limited to the inflation-adjusted costs identified in this LTMP, with tasks completed at the frequency specified in the cost estimate (Attachment I). Provided that when necessary, the Long-Term Steward shall be allowed to spend above the inflation-adjusted costs in the LTMP and after doing so, shall provide a statement to the USACE and IRT indicating the reasons for the additional spending and a statement showing the spending was below the cap rate existing at that time based on Long-Term Management Fund earnings and the published Consumer Price Index.

If the Long-Term Steward fails to complete the tasks described in this LTMP, then at the discretion of the USACE, a replacement Long-Term Steward can be designated. The Long-Term Management Fund balance, with all accrued interest and earnings, less any authorized annual expenditures, shall be available upon transfer of the long-term management responsibilities from the approved Long-Term Steward (or Sponsor) to a successor Long-Term Steward.

1.3 Long-Term Endowment Fund Managing Entity

Capstone Asset Management Company (Capstone) is the managing entity for the Long-Term Management Fund. Capstone will be responsible for investing and managing the funds dedicated to the long-term management of the Bank site. The Long-Term Steward will be authorized to withdraw funds as described above.

The Long-Term Management Fund's principal amount is intended to increase in value to keep up with inflation. A portion of the interest and earnings on the principal balance shall be reinvested into the account annually, as necessary, to adjust the principal. Any revenues (including earnings and interest) remaining after the principal is adjusted for inflation that exceed the anticipated annual long-term management line-item expenses shall be retained in the account and may be made available to fund expenses in following years.

1.4 Conservation Easement Holder

The CE Holder for CIBMB will be Texas Land Conservancy. The primary role of the CE Holder will be to ensure enforcement of the CE, which prohibits uses of the land that are detrimental to the conservation values of the property (Attachment C of the MBI). This will include baseline documentation and ongoing monitoring of the Bank site. As described in Attachment C of the MBI, the CE Holder has the responsibility to identify actions or conditions that are detrimental to the long-term sustainability of the ecological functions of the Bank site; and the right to require the Long-Term Steward to restore any damages due to activities that are inconsistent with the CE. The CE Holder will be responsible for legal defense of the CE. These responsibilities are accounted for in the fee paid to the CE Holder by the Sponsor.

2 SITE CHARACTERIZATION

The Bank site consists of approximately 46.8 acres of restored herbaceous wetland and 181.5 acres of restored forested wetland located in the U.S. Geological Survey (USGS) Lower Trinity Watershed, 8-digit Hydrologic Unit Code (HUC) 12030203, approximately 6 miles south of Devers, Liberty County, Texas (Attachments A and B). The purpose of the long-term monitoring and maintenance is to ensure the Bank site continues to function as a native wetland ecosystem. The site is more fully described in the CE and MBI.

3 HABITAT DESCRIPTIONS

The Bank site will be restored to herbaceous wetland and forested wetland habitat. The restoration work plan includes planting and seeding a mixture of native plant species consistent with wetlands currently and historically found in the Lower Trinity Watershed.

4 MANAGEMENT STRATEGIES AND TASKS

All long-term management tasks will be performed by the Long-Term Steward, who will conduct annual inspections to monitor and assess the Bank site's biological resources and infrastructure. The tasks

described below are designed to maintain the structure and function of the wetlands within the Bank site in perpetuity.

4.1 Biological Resources

4.1.1 Monitor Waters of the U.S.

The Long-Term Steward will conduct an annual inspection of the Bank site. During this inspection, the presence or absence of indicators of wetland soils (hydrophytic vegetation, and wetland hydrology) will be recorded in each wetland restoration area. Any areas that lack wetland indicators would be evaluated for adaptive management, as described in Section 4.5.1 below. An annual report presenting the results of the monitoring will be prepared and submitted to the USACE if requested (Section 4.4).

4.1.2 Invasive Species Control

Invasive species can produce monocultures that have detrimental effects on ecosystems and their performance of ecological functions. If monitoring of the Bank site identifies populations of undesirable invasive species, then the Long-Term Steward will employ biological, manual, mechanical, physical, and/or chemical control methods based on the best management practices for the removal of the species in consideration. For all invasive species, the Long-Term Steward will implement control techniques based on published research regarding the timing and efficacy of treatment options and will provide descriptions of these treatments through the annual report (Section 4.4). Integrating these approaches will help control invasive species, prevent ecological damage within the site, and decrease incidental export of these species to neighboring sites. Regardless of the techniques employed, the focus will be to use the least ecologically damaging option available that will effectively achieve the management objectives specified.

4.1.2.1 MANUAL REMOVAL

The use of hand tools is an effective way of removing some unwanted species, and typically exerts minimal impact on neighboring vegetation. Due to the cost of labor, manual removal is often cost-prohibitive at large scales but may serve as an effective spot treatment. As such, manual removal will be employed in smaller areas or in areas where herbicide treatments must be kept to a minimum and machinery should be avoided.

4.1.2.2 MECHANICAL REMOVAL

For larger areas and areas dominated by monocultures of unwanted species, the use of machinery (e.g., bulldozers, backhoes, or mowers) may be a more effective method. Mechanical removal can be costly in terms of time and physical labor, but it may be cost-effective if large areas require significant vegetation removal. It is also important to note that mechanical removal does not target particular species and the large-scale disruption caused by such techniques may facilitate the growth of weedy species, including the invasive species that are targeted. The Bank site is not expected to require mechanical removal techniques, but this is included as an option.

4.1.2.3 CHEMICAL REMOVAL

Chemical control involves the use of EPA-approved herbicides and is considered the most cost-effective, long-term control method available. Chemical control compounds function by interrupting normal biological processes within the plant, thereby reducing growth or inducing mortality. Herbicides that could be employed include: Garlon, Roundup, Arsenal, Accord, and Clearcast. Herbicide applications are relatively inexpensive across large scales and can provide some specificity, but the control of specific plants

will require judicious application. For instance, treatments must be made when growth stages and weather conditions are optimum. Wind direction and speed must be monitored to prevent drift onto desirable vegetation. Chemical applications will not be done if rain is expected within 48 hours because rain can wash the herbicide off the target vegetation or dilute the herbicide to a concentration that is ineffective.

4.1.3 Wildlife Management

If physical, chemical, or biological functions of the wetland are experiencing significant negative effects, the Long-Term Steward will take actions to control any detrimental impacts by wildlife. Management actions may include installing fences, using deterrents, live trapping, and/or harvesting to prevent the undesirable activity of animals that pose a material threat to people, native animals, or habitat conditions within the Bank site. The Long-Term Steward will harvest exotic species (i.e., those that are not known to be native to the area based on historical county records) to prevent establishment of these organisms within the Bank site. Invasive native species (i.e., those species that grow to populations that negatively affect other species in the community) will be controlled to prevent loss of biodiversity. Nuisance or problem species include species that are native or naturalized that have demonstrated a negative effect on the establishment and survival of the wetland (e.g., pigs, beavers) rather than those traditionally considered problematic (e.g., foxes, coyotes). For species to be controlled, the Long-Term Steward will act in accordance with state and federal regulations.

4.1.4 Herbaceous Wetland Vegetation Management

Maintenance activities during the Long-Term Management phase will emulate historic disturbance regimes as appropriate. Historic disturbances that maintained prairie wetland conditions within this region included naturally occurring fires and light, migratory grazing. The goal is for mowing, brush-hogging, and/or prescribed burning to occur every three years, subject to site conditions and weather. This return interval reflects the historic fire regime within the region. The type of maintenance will depend on hydrologic and vegetative site conditions, local governmental air quality attainment status, and meteorological conditions, with prescribed burning being the preferred method of treatment. The cost estimate assumes that the Long-Term Steward has the capability to perform a prescribed burn.

An ecologically-based prescribed burn program is the cornerstone of restoration and maintenance of the herbaceous wetland ecosystem. Fire suppression allows native shrubs such as wax myrtle (*Myrica* spp.) and baccharis (*Baccharis halimifolia*) to grow to undesirable densities in herbaceous wetlands and facilitates the invasion by Chinese tallow (*Triadica sebifera*). To mimic natural fire regimes, controlled burns will be preferentially used during the growing season. Additionally, fires may be seasonally timed to enhance the occurrence of certain species valuable to ecosystem restoration. The prescribed fire and smoke management plan will follow the guidelines provided in 30 TAC § 111.201-221. Mowing, if used, will occur near the end of June and the height of all mowed vegetation will not be lower than 8 inches.

4.2 Infrastructure

4.2.1 Site Condition

The Long-Term Steward and CE holder will make annual inspections of the Bank site to verify that use of the land is consistent with the CE and MBI; and to assess any damage caused by flood, fire, storm, wind, accident, trespass, vandalism, negligence, or other act or event that causes damage to the Bank site. The Long-Term Steward will ensure that all structures and facilities (i.e., berms, roads, trails) will be properly maintained. In addition, the Long-Term Steward will remove trash from the Bank site during these annual inspections.

4.2.2 Site Accessibility

Protective fencing may be required to deter trespass by humans, wildlife, or domestic animals that may cause damage to the Bank site. The need for fencing and other access controls (e.g., gates, barbed wire) will be based on monitoring efforts and evidence that vegetation or topography has been damaged. Low fencing will be used where practicable to allow passage by wildlife; however, fencing to exclude feral hogs could be desirable and may be used. All Bank site boundaries shall be marked with a metal post which reads "Wetland Conservation Area" to prevent casual trespass while allowing necessary access. Inspections will serve to note the condition of signs, crossings, and property boundaries, and address fence inspection and repair.

Vehicular access will be restricted to grass roadways, or along low berms used to control hydrology, and will be designated as special easement areas from which no wetland mitigation credits will be sought. Although gravel or sand may be used as spot treatments for erosion, no impervious structure (i.e., concrete, asphalt) will be used to maintain passages. Roads will be kept clear of debris and encumbering vegetation and any maintenance (i.e., minor dirt moving and/or addition of gravel) will be limited as necessary while still permitting necessary access. Replacement of culverts located within the existing roads will occur on an as-needed basis to ensure flow and restoration of the appropriate hydroperiod. Access to off-road areas will be restricted to pedestrian traffic once planting efforts are completed.

The long-term cost estimate includes costs for up to five site visits each year, with a mileage rate that covers all costs for vehicle fuel and maintenance. The costs also include use and maintenance of a field vehicle (all-terrain vehicle), assuming that the field vehicle would be used for multiple sites.

4.2.3 Berm Maintenance

Based on the design and construction of the berms, the Bank site is expected to require minimal long-term structural maintenance. The risk of erosion on the earthen berms is minimized by designing shallow approaches and allowing plant growth along the berms. However, the Long-Term Steward will conduct annual inspections of the berms to verify structural integrity. Additional berm inspections will also be conducted following unusual events (e.g., floods, storms, and unauthorized access). Any erosion detected will be repaired and stabilized using appropriate natural materials. As with the berms, low-water crossings should also require only minimal maintenance. However, the crossings will also be inspected annually for damage and signs of wear. Because the crossings act as water conveyance points, it may be necessary to remove materials that snag on the crossings so that the crossings remain operational. Damaged or impassable crossings will be cleared or repaired by the Long-Term Steward as needed.

4.3 Administration

Additional costs are included for project administration. The administration costs include updating this LTMP every five years. Separate costs are included for annual project management tasks and accounting. Taxes for the property are included in the long-term cost estimate at $3.00 per acre each year, subject to standard inflation rates.

4.4 Reporting

If requested by the USACE, the Long-Term Steward will prepare an annual report to be submitted to the USACE. The report may include information such as completed tasks for anticipated and unanticipated site conditions, a financial summary including project accounting, a summary of the long-term management fund's balance and performance, and results of the annual site inspection.

4.5 Risk Management

4.5.1 Adaptive Management

Adaptive management of the Bank site allows for changes to management practices in response to the development of new management techniques, external influences that affect the Bank, or other unanticipated circumstances. If monitoring of the Bank site indicates that it is failing to meet its goals, the Long-Term Steward will propose a course of action to remedy the situation. If the Bank site would be expected to return to meeting the goals, for example if experiencing natural climactic cycles, then adaptive management actions might not be considered necessary. In other cases, management actions could be conducted, such as altering site hydrology or managing plant species, that would allow the Bank site to meet its goals. If adaptive management is necessary on the Bank site, the Long-Term Steward will submit a proposed Adaptive Management Plan to the USACE and IRT for review and approval. The Adaptive Management Plan will include estimated costs, and a statement of the impact of these costs on the Long-Term Management Fund.

4.5.2 Contingencies

An additional 10% is included in the annual cost estimate for contingencies. This includes any unanticipated physical and biological events.

5 FUNDING

The annual cost of long-term management of the Bank site is estimated in Attachment I. This estimate is based on the tasks described in Section 4 above. In order to provide a non-wasting endowment, the earnings on the investment account need to be sufficient to fund the annual maintenance cost while accounting for inflation.

6 AMENDMENTS AND NOTICES

6.1 Amendments

This LTMP can be amended to better meet the management objectives. Any proposed changes shall be approved by the USACE, IRT, and Long-Term Steward; to be incorporated into a revised LTMP and implemented by the Long-Term Steward.

6.2 Notices

Any notices regarding this LTMP shall be directed as follows:

Long-Term Steward and Sponsor:

Agent:	**Resource Environmental Solutions, LLC**
Primary Contact:	Matt Genotte
Mailing Address:	5020 Montrose Blvd., Suite 650 Houston, TX 77006
Phone Number:	346-310-6211
Fax Number:	713-520-5401
Email Address:	mgenotte@res.us

USACE and IRT (Chair):

U.S. Army Corps of Engineers; Galveston District; SWG-RD-P
Primary Contact: Sam Watson
Mailing Address: 2000 Fort Point Road
Galveston, TX 77553
Phone Number: 409-766-3946
Fax Number: 409-766-3931
Email Address: sam.watson@usace.army.mil

M. Soils Report

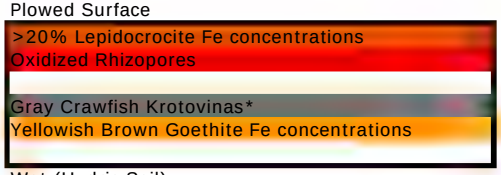
Cow Island Bayou (CIB) Site Soils Report, 8-6-2014

Richard W. Griffin, PhD

The following narrative contains my observations from the CIB site with a focus on the active versus relict Fe redox features by landscape position.

Site 1 - Plowed field, Southeast of Farm Road and Pipeline Easement

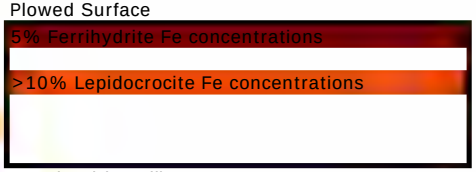
Interior of Field
Plowed Surface



Wet (Hydric Soil)

Site 2 - Plowed field, Southeast of Farm Road and Pipeline Easement

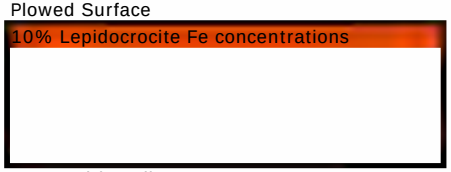
Edge of Field
Plowed Surface



Wet (Hydric Soil)

Site 3 - Plowed field, East of Farm Road and Southeast of Pipeline Easement

Interior of Field
Plowed Surface

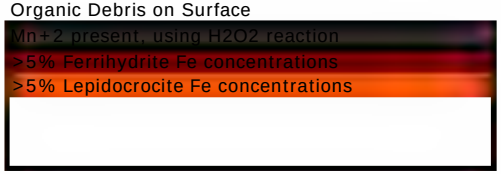


Non-Hydric Soil?

Note: *Crawfish Burrows built under reduced conditions during ponding of water

Site 4 - Drainage Ditch, Southeast of Farm Road and Pipeline Easement

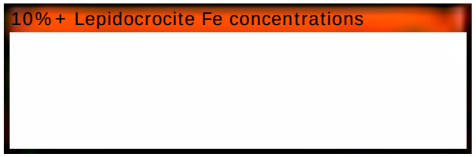
Bottom of Drainageway
Organic Debris on Surface



Wet (Hydric Soil)

Site 5 - Plowed field, Northwest of Farm Road and Northwest of Pipeline Easement

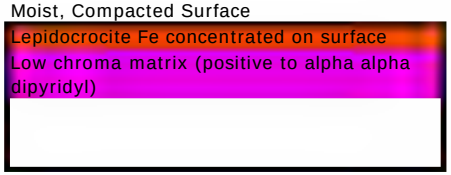
Interior of Field
Plowed Surface



Non-Hydric Soil?

Site 6 - Rut on Farm Road and Southeast of Pipeline Easement

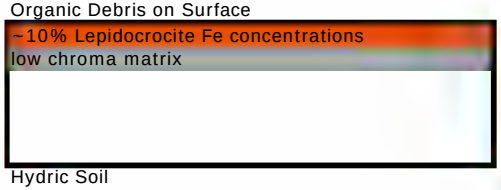
Rut on Farm Road
Moist, Compacted Surface



* 4 Pictures Taken

Site 7 - Along Trail in Wooded Area North of Pipeline Easement

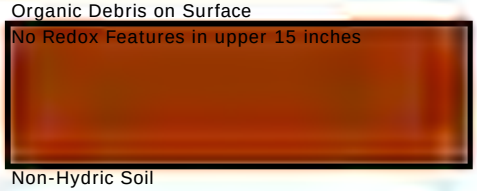
Wooded Wet Depression
Organic Debris on Surface



Hydric Soil

Site 8 -West of Trail in Wooded Area North of Pipeline Easement

Wooded Micromound
Organic Debris on Surface



Non-Hydric Soil

Summary

1) Active Fe forms present in soil due to surface ponding; quantification of ≥14 days required.
2) Highly active Fe (ferrihydrite and lepidocrocite) due to low pH conditions (4.9-5.2).
3) Fe precipitated in drainageways - Check Google Earth historical imagery.

Recommendation

Locate archived satellite or aerial photo imagery for ponded surface water signatures to relate the abundance of active Fe forms to the ponding / waterlogged conditons at the site.

TEXAS A&M AGRILIFE EXTENSION

Soil Analysis Report

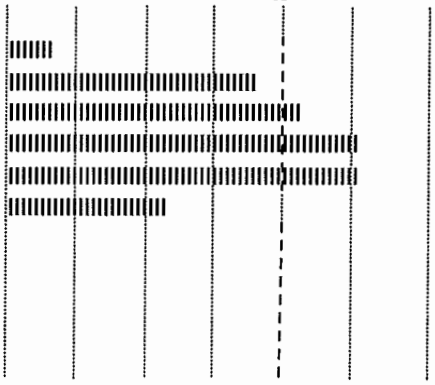
Soil, Water and Forage Testing Laboratory
Department of Soil and Crop Sciences
2478 TAMU
College Station, TX 77843-2478
979-845-4816 (phone)
979-845-5958 (FAX)
Visit our website: http://soiltesting.tamu.edu

Report generated for:
Resource Environmental Solutions, LLC
412 N 4th St, Ste 300
Baton Rouge, LA 70802

Sample received on: 11/25/2013
Printed on: 11/27/2013
Area Represented: not provided

Out of State County
Laboratory Number: 398091
Customer Sample ID: Cow Island Bayou 1 0-6"
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	5.0	(5.8)	-	Strongly Acid	
Conductivity	238	(-)	umho/cm	None	
Nitrate-N	1	(-)	ppm**		95 lbs N/acre
Phosphorus	4	(50)	ppm		115 lbs P2O5/acre
Potassium	117	(150)	ppm		50 lbs K20/acre
Calcium	2,752	(180)	ppm		0 lbs Ca/acre
Magnesium	496	(50)	ppm		0 lbs Mg/acre
Sulfur	46	(13)	ppm		0 lbs S/acre
Sodium	182	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					1.40 tons 100ECCE/acre



*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates.
http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

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April 15, 2019

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Sample received on: 11/25/2013
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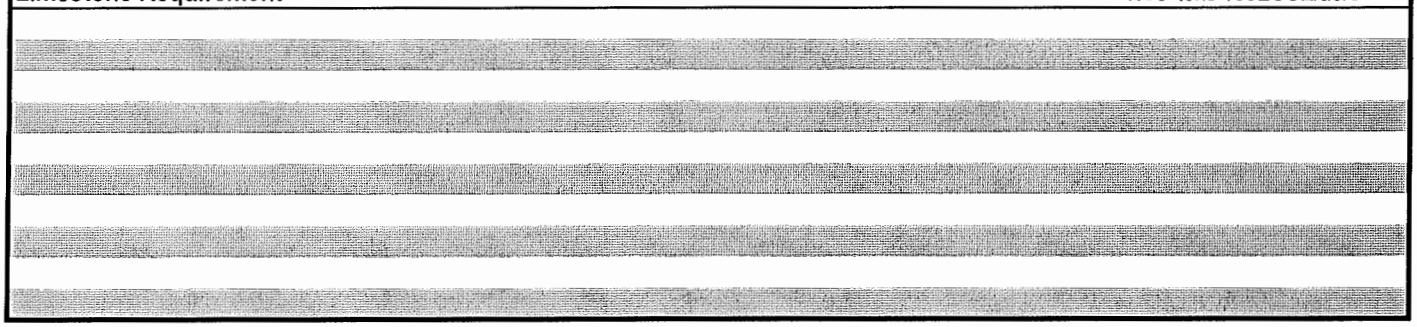
Area Represented: not provided

Out of State County
Laboratory Number: 398092
Customer Sample ID: Cow Island Bayou 1 6-12"
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	5.0	(5.8)	-	Strongly Acid	
Conductivity	291	(-)	umho/cm	None	
Nitrate-N	0	(-)	ppm**		95 lbs N/acre
Phosphorus	2	(50)	ppm		120 lbs P2O5/acre
Potassium	133	(150)	ppm		25 lbs K20/acre
Calcium	2,955	(180)	ppm		0 lbs Ca/acre
Magnesium	521	(50)	ppm		0 lbs Mg/acre
Sulfur	75	(13)	ppm		0 lbs S/acre
Sodium	202	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					1.80 tons 100ECCE/acre



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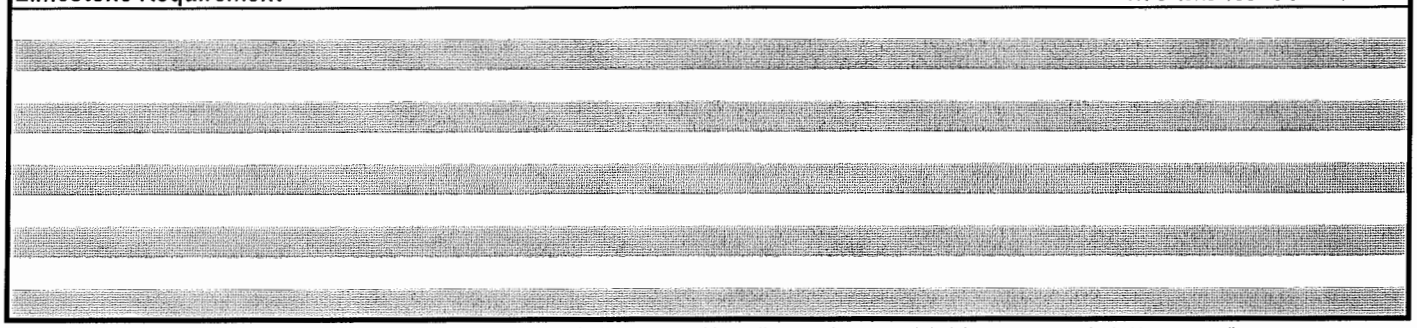
Area Represented: not provided

Out of State County
Laboratory Number: 398093
Customer Sample ID: Cow Island Bayou 2 0-6"
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	4.9	(5.8)	-	Strongly Acid	
Conductivity	188	(-)	umho/cm	None	
Nitrate-N	0	(-)	ppm**		95 lbs N/acre
Phosphorus	3	(50)	ppm		115 lbs P2O5/acre
Potassium	101	(150)	ppm		80 lbs K20/acre
Calcium	2,544	(180)	ppm		0 lbs Ca/acre
Magnesium	480	(50)	ppm		0 lbs Mg/acre
Sulfur	20	(13)	ppm		0 lbs S/acre
Sodium	168	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					1.70 tons 100ECCE/acre



*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates. http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

ProAnalysisVer. 2.19i

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Baton Rouge, LA 70802

Sample received on: 11/25/2013
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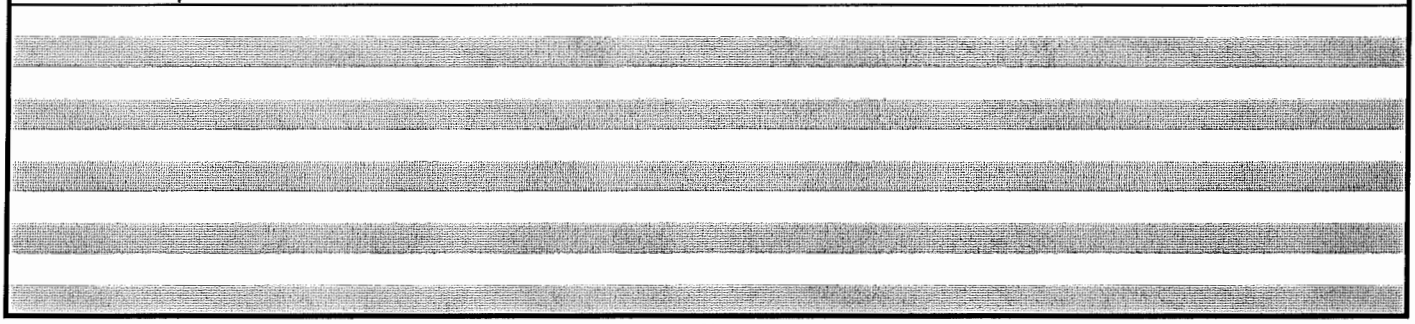
Area Represented: not provided

Out of State County
Laboratory Number: 398094
Customer Sample ID: Cow Island Bayou 2 6-12"
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	4.9	(5.8)	-	Strongly Acid	
Conductivity	169	(-)	umho/cm	None	
Nitrate-N	1	(-)	ppm**		95 lbs N/acre
Phosphorus	3	(50)	ppm		115 lbs P2O5/acre
Potassium	103	(150)	ppm		75 lbs K20/acre
Calcium	2,381	(180)	ppm		0 lbs Ca/acre
Magnesium	438	(50)	ppm		0 lbs Mg/acre
Sulfur	26	(13)	ppm		0 lbs S/acre
Sodium	170	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					1.70 tons 100ECCE/acre



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Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

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ProAnalysisVer. 2.19

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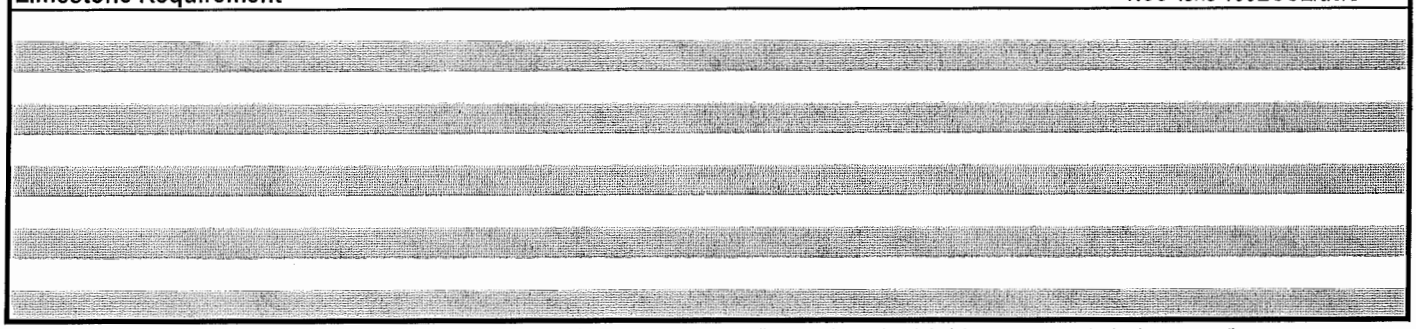
Laboratory Number: 398095
Customer Sample ID: Cow Island Bayou 3 0-6"
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	5.2	(5.8)	-	Strongly Acid	
Conductivity	185	(-)	umho/cm	None	
Nitrate-N	0	(-)	ppm**		95 lbs N/acre
Phosphorus	5	(50)	ppm		110 lbs P2O5/acre
Potassium	103	(150)	ppm		75 lbs K20/acre
Calcium	2,512	(180)	ppm		0 lbs Ca/acre
Magnesium	442	(50)	ppm		0 lbs Mg/acre
Sulfur	21	(13)	ppm		0 lbs S/acre
Sodium	112	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					1.00 tons 100ECCE/acre



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ProAnalysisVer. 2.19l

April 15, 2019

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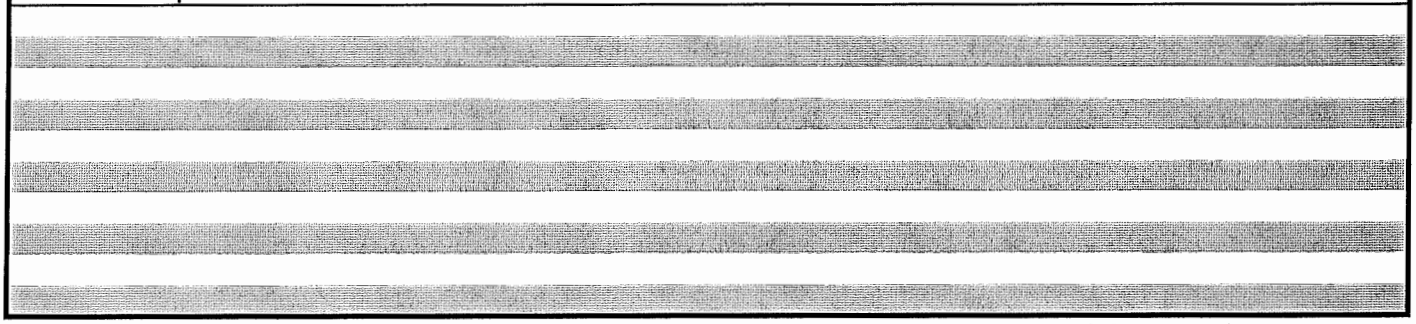
Area Represented: not provided

Out of State County
Laboratory Number: 398096
Customer Sample ID: Cow Island Bayou 3 6-12"
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	5.0	(5,8)	-	Strongly Acid	
Conductivity	169	(-)	umho/cm	None	
Nitrate-N	2	(-)	ppm**		95 lbs N/acre
Phosphorus	2	(50)	ppm		115 lbs P2O5/acre
Potassium	123	(150)	ppm		45 lbs K20/acre
Calcium	2,894	(180)	ppm		0 lbs Ca/acre
Magnesium	502	(50)	ppm		0 lbs Mg/acre
Sulfur	30	(13)	ppm		0 lbs S/acre
Sodium	164	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					1.50 tons 100ECCE/acre



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Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

ProAnalysisVer. 2.19

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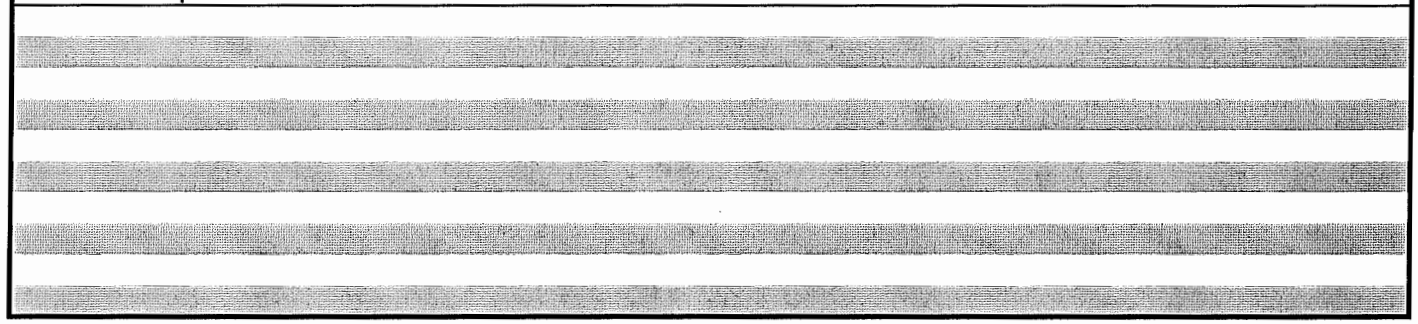
Sample received on: 11/25/2013
Printed on: 11/27/2013
Area Represented: not provided

Out of State County
Laboratory Number: 398097
Customer Sample ID: Cow Island Bayou 4 0-6"
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	4.9	(5.8)	-	Strongly Acid	
Conductivity	141	(-)	umho/cm	None	
Nitrate-N	1	(-)	ppm**		95 lbs N/acre
Phosphorus	7	(50)	ppm		105 lbs P2O5/acre
Potassium	89	(150)	ppm		100 lbs K20/acre
Calcium	2,530	(180)	ppm		0 lbs Ca/acre
Magnesium	474	(50)	ppm		0 lbs Mg/acre
Sulfur	17	(13)	ppm		0 lbs S/acre
Sodium	109	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					1.70 tons 100ECCE/acre



*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates.
http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

April 15, 2019

TEXAS A&M AGRILIFE EXTENSION

Soil Analysis Report

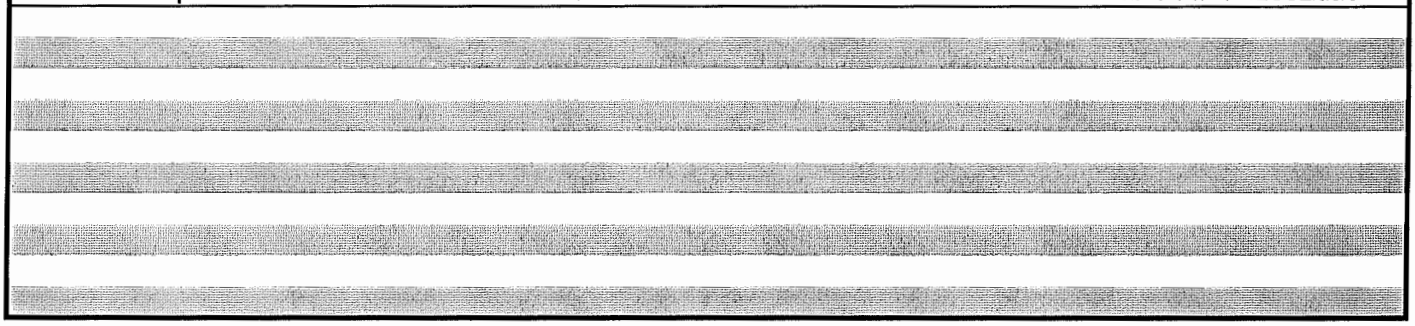
Soil, Water and Forage Testing Laboratory
Department of Soil and Crop Sciences
2478 TAMU
College Station, TX 77843-2478
979-845-4816 (phone)
979-845-5958 (FAX)
Visit our website: http://soiltesting.tamu.edu

Report generated for:
Resource Environmental Solutions, LLC
412 N 4th St, Ste 300
Baton Rouge, LA 70802

Sample received on: 11/25/2013
Printed on: 11/27/2013
Area Represented: not provided

Out of State County
Laboratory Number: 398098
Customer Sample ID: Cow Island Bayou 4 6-12"
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	4.7	(5.8)	-	Strongly Acid	
Conductivity	129	(-)	umho/cm	None	
Nitrate-N	1	(-)	ppm**		95 lbs N/acre
Phosphorus	2	(50)	ppm		115 lbs P2O5/acre
Potassium	90	(150)	ppm		95 lbs K20/acre
Calcium	2,369	(180)	ppm		0 lbs Ca/acre
Magnesium	432	(50)	ppm		0 lbs Mg/acre
Sulfur	16	(13)	ppm		0 lbs S/acre
Sodium	123	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					2.10 tons 100ECCE/acre



*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates. http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

ProAnalysisVer. 2.19i

April 15, 2019

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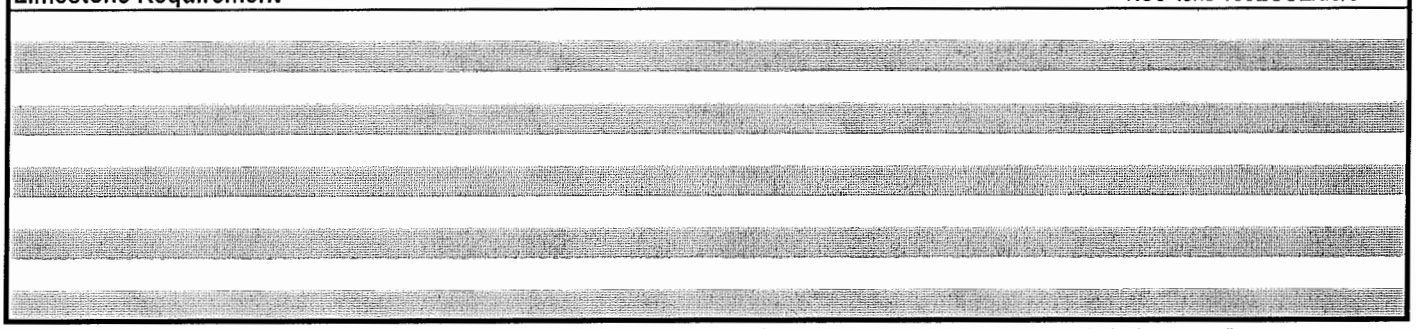
Baton Rouge, LA 70802

Sample received on: 11/25/2013
Printed on: 11/27/2013
Area Represented: not provided

Out of State County
Laboratory Number: 398099
Customer Sample ID: Cow Island Bayou 5 0-6"
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	4.8	(5.8)	-	Strongly Acid	
Conductivity	150	(-)	umho/cm	None	
Nitrate-N	0	(-)	ppm**		95 lbs N/acre
Phosphorus	5	(50)	ppm		110 lbs P2O5/acre
Potassium	82	(150)	ppm		110 lbs K20/acre
Calcium	1,950	(180)	ppm		0 lbs Ca/acre
Magnesium	343	(50)	ppm		0 lbs Mg/acre
Sulfur	19	(13)	ppm		0 lbs S/acre
Sodium	101	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					1.50 tons 100ECCE/acre



*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates. http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

ProAnalysisVer. 2.19

April 15, 2019

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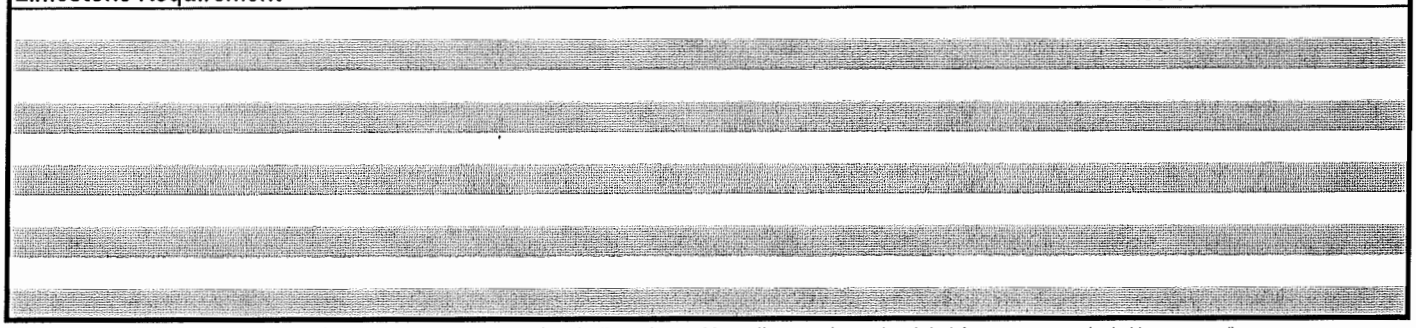
412 N 4th St, Ste 300
Baton Rouge, LA 70802

Sample received on: 11/25/2013
Printed on: 11/27/2013
Area Represented: not provided

Out of State County
Laboratory Number: 398100
Customer Sample ID: Cow Island Bayou 5 6-12"
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	4.6	(5.8)	-	Strongly Acid	
Conductivity	150	(-)	umho/cm	None	
Nitrate-N	0	(-)	ppm**		95 lbs N/acre
Phosphorus	3	(50)	ppm		115 lbs P2O5/acre
Potassium	77	(150)	ppm		120 lbs K20/acre
Calcium	1,747	(180)	ppm		0 lbs Ca/acre
Magnesium	306	(50)	ppm		0 lbs Mg/acre
Sulfur	23	(13)	ppm		0 lbs S/acre
Sodium	101	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					1.80 tons 100ECCE/acre



*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates.
http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

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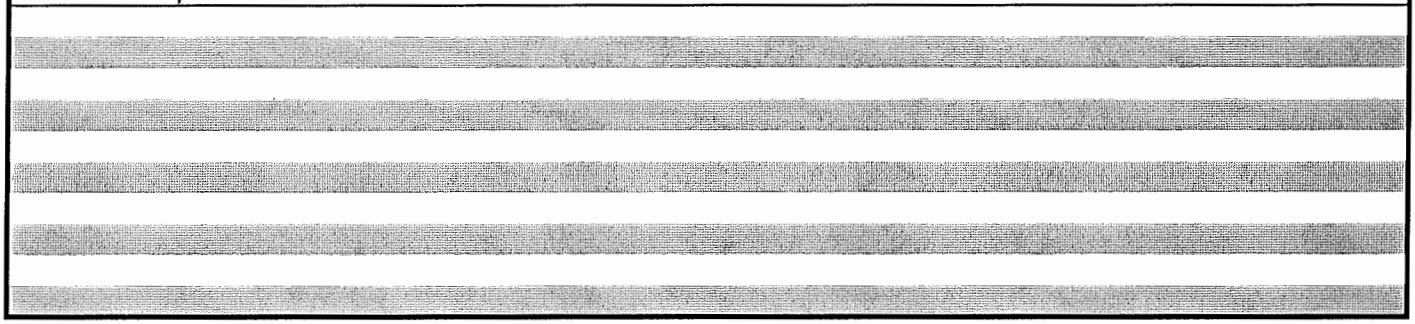
Baton Rouge, LA 70802

Sample received on: 11/25/2013
Printed on: 11/27/2013
Area Represented: not provided

Out of State County
Laboratory Number: 398101
Customer Sample ID: Cow Island Bayou 6 0-6"
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	4.9	(5.8)	-	Strongly Acid	
Conductivity	168	(-)	umho/cm	None	
Nitrate-N	0	(-)	ppm**		95 lbs N/acre
Phosphorus	3	(50)	ppm		115 lbs P2O5/acre
Potassium	94	(150)	ppm		90 lbs K20/acre
Calcium	2,292	(180)	ppm		0 lbs Ca/acre
Magnesium	443	(50)	ppm		0 lbs Mg/acre
Sulfur	16	(13)	ppm		0 lbs S/acre
Sodium	109	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					1.50 tons 100ECCE/acre



*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates. http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

ProAnalysisVer. 2.19i

April 15, 2019

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Resource Environmental Solutions, LLC
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Baton Rouge, LA 70802

Sample received on: 11/25/2013
Printed on: 11/27/2013
Area Represented: not provided

Out of State County
Laboratory Number: 398102
Customer Sample ID: Cow Island Bayou 6 6-12"
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow	VLow	Low	Mod	High	VHigh	Excess.	Fertilizer Recommended
pH	5.1	(5.8)	-	Strongly Acid							
Conductivity	197	(-)	umho/cm	None				CL*			
Nitrate-N	0	(-)	ppm**								95 lbs N/acre
Phosphorus	2	(50)	ppm								120 lbs P2O5/acre
Potassium	98	(150)	ppm								85 lbs K20/acre
Calcium	2,499	(180)	ppm								0 lbs Ca/acre
Magnesium	465	(50)	ppm								0 lbs Mg/acre
Sulfur	26	(13)	ppm								0 lbs S/acre
Sodium	152	(-)	ppm								
Iron											
Zinc											
Manganese											
Copper											
Boron											
Limestone Requirement											1.10 tons 100ECCE/acre

*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates. http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

ProAnalysisVer. 2.19l

April 15, 2019

TEXAS A&M AGRILIFE EXTENSION

Soil Analysis Report

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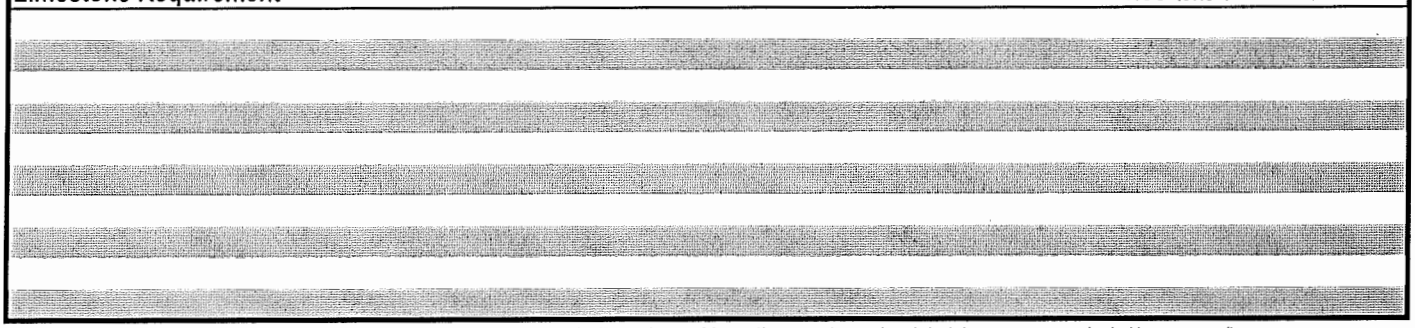
Report generated for:
Resource Environmental Solutions, LLC
412 N 4th St, Ste 300
Baton Rouge, LA 70802

Sample received on: 11/25/2013
Printed on: 11/27/2013
Area Represented: not provided

Out of State County
Laboratory Number: 398103
Customer Sample ID: Cow Island Bayou 7 0-6"
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	4.9	(5.8)	-	Strongly Acid	
Conductivity	163	(-)	umho/cm	None	
Nitrate-N	1	(-)	ppm**		95 lbs N/acre
Phosphorus	4	(50)	ppm		110 lbs P2O5/acre
Potassium	86	(150)	ppm		105 lbs K20/acre
Calcium	2,246	(180)	ppm		0 lbs Ca/acre
Magnesium	385	(50)	ppm		0 lbs Mg/acre
Sulfur	17	(13)	ppm		0 lbs S/acre
Sodium	104	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					1.60 tons 100ECCE/acre



*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates. http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

ProAnalysisVer. 2.19i

April 15, 2019

TEXAS A&M AGRILIFE EXTENSION

Soil Analysis Report

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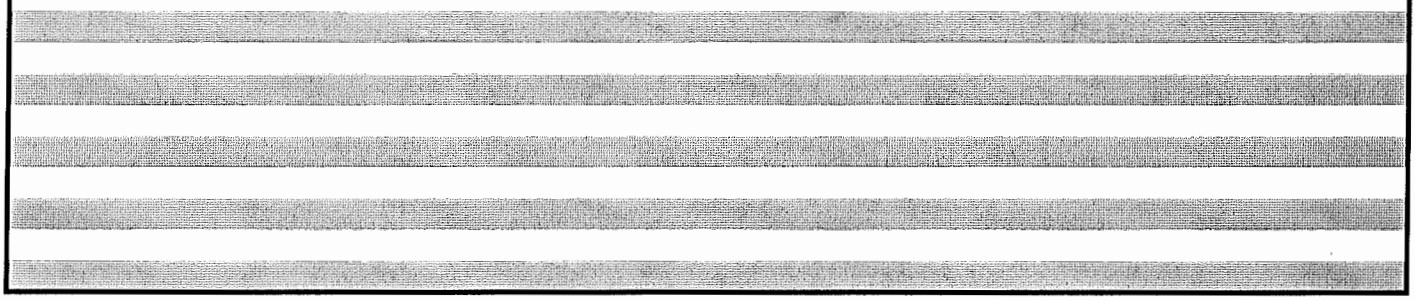
Baton Rouge, LA 70802

Sample received on: 11/25/2013
Printed on: 11/27/2013
Area Represented: not provided

Out of State County
Laboratory Number: 398104
Customer Sample ID: Cow Island Bayou 7 6-12"
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	4.9	(5.8)	-	Strongly Acid	
Conductivity	145	(-)	umho/cm	None	
Nitrate-N	0	(-)	ppm**		95 lbs N/acre
Phosphorus	3	(50)	ppm		115 lbs P2O5/acre
Potassium	84	(150)	ppm		110 lbs K20/acre
Calcium	2,221	(180)	ppm		0 lbs Ca/acre
Magnesium	361	(50)	ppm		0 lbs Mg/acre
Sulfur	18	(13)	ppm		0 lbs S/acre
Sodium	117	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					1.40 tons 100ECCE/acre



*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates.
http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

ProAnalysisVer. 2.19

April 15, 2019

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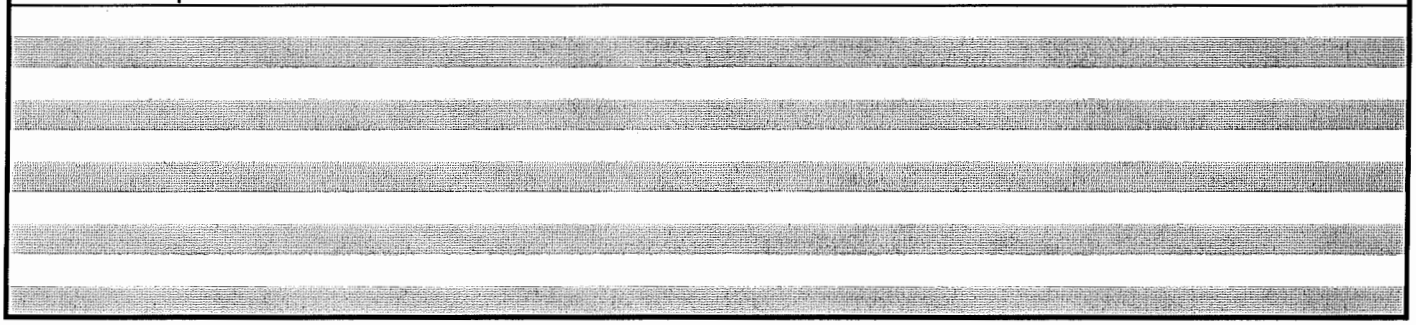
Baton Rouge, LA 70802

Sample received on: 11/25/2013
Printed on: 11/27/2013
Area Represented: not provided

Out of State County
Laboratory Number: 398105
Customer Sample ID: Cow Island Bayou 8 0-6"
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	5.0	(5.8)	-	Strongly Acid	
Conductivity	168	(-)	umho/cm	None	
Nitrate-N	2	(-)	ppm**		95 lbs N/acre
Phosphorus	7	(50)	ppm		105 lbs P2O5/acre
Potassium	88	(150)	ppm		100 lbs K20/acre
Calcium	2,494	(180)	ppm		0 lbs Ca/acre
Magnesium	389	(50)	ppm		0 lbs Mg/acre
Sulfur	13	(13)	ppm		0 lbs S/acre
Sodium	70	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					1.40 tons 100ECCE/acre



*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates.
http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

ProAnalysisVer. 2.19i

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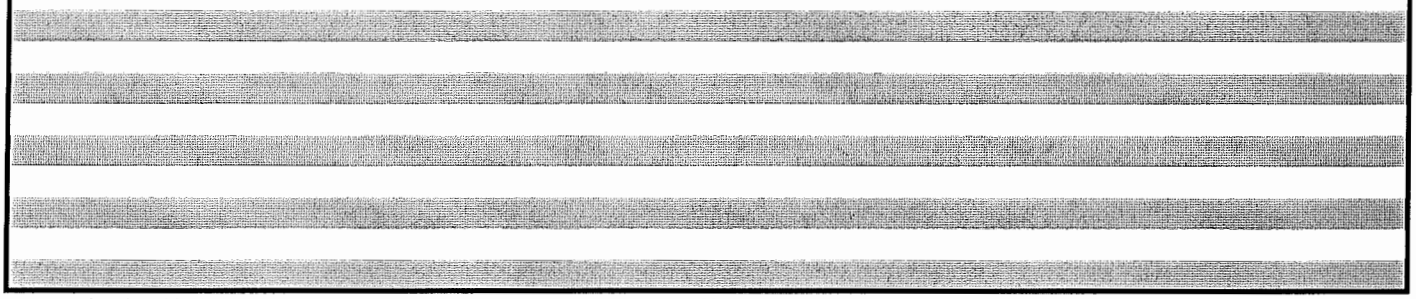
Baton Rouge, LA 70802

Sample received on: 11/25/2013
Printed on: 11/27/2013
Area Represented: not provided

Out of State County
Laboratory Number: 398106
Customer Sample ID: Cow Island Bayou 8 6-12"
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	4.8	(5.8)	-	Strongly Acid	
Conductivity	137	(-)	umho/cm	None	
Nitrate-N	0	(-)	ppm**		95 lbs N/acre
Phosphorus	4	(50)	ppm		115 lbs P2O5/acre
Potassium	69	(150)	ppm		135 lbs K20/acre
Calcium	2,251	(180)	ppm		0 lbs Ca/acre
Magnesium	334	(50)	ppm		0 lbs Mg/acre
Sulfur	13	(13)	ppm		5 lbs S/acre
Sodium	76	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					1.60 tons 100ECCE/acre



*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

Sulfur: Available sulfur may be found deeper in soil profile, thus limiting any response to added sulfur.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates.
http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

ProAnalysisVer. 2.19

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Baton Rouge, LA 70802

Sample received on: 11/25/2013
Printed on: 11/27/2013
Area Represented: not provided

Out of State County
Laboratory Number: 398107
Customer Sample ID: Cow Island Bayou 1
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow	VLow	Low	Mod	High	VHigh	Excess.	Fertilizer Recommended
pH	4.9	(5.8)	-	Strongly Acid							
Conductivity	251	(-)	umho/cm	None				CL*			
Nitrate-N	1	(-)	ppm**								95 lbs N/acre
Phosphorus	0	(50)	ppm								120 lbs P2O5/acre
Potassium	131	(150)	ppm								30 lbs K20/acre
Calcium	2,463	(180)	ppm								0 lbs Ca/acre
Magnesium	469	(50)	ppm								0 lbs Mg/acre
Sulfur	62	(13)	ppm								0 lbs S/acre
Sodium	171	(-)	ppm								
Iron											
Zinc											
Manganese											
Copper											
Boron											
Limestone Requirement											1.80 tons 100ECCE/acre

*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates.
http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

ProAnalysisVer. 2.19

April 15, 2019

TEXAS A&M AGRILIFE EXTENSION

Soil Analysis Report

Soil, Water and Forage Testing Laboratory
Department of Soil and Crop Sciences
2478 TAMU
College Station, TX 77843-2478
979-845-4816 (phone)
979-845-5958 (FAX)
Visit our website: http://soiltesting.tamu.edu

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Resource Environmental Solutions, LLC
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Baton Rouge, LA 70802

Sample received on: 11/25/2013
Printed on: 11/27/2013
Area Represented: not provided

Out of State County
Laboratory Number: 398108
Customer Sample ID: Cow Island Bayou 2
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow	VLow	Low	Mod	High	VHigh	Excess.	Fertilizer Recommended
pH	4.9	(5.8)	-	Strongly Acid							
Conductivity	156	(-)	umho/cm	None				CL*			
Nitrate-N	2	(-)	ppm**								**95** lbs N/acre
Phosphorus	3	(50)	ppm								**115** lbs P2O5/acre
Potassium	97	(150)	ppm								**85** lbs K20/acre
Calcium	2,287	(180)	ppm								**0** lbs Ca/acre
Magnesium	429	(50)	ppm								**0** lbs Mg/acre
Sulfur	21	(13)	ppm								**0** lbs S/acre
Sodium	160	(-)	ppm								
Iron											
Zinc											
Manganese											
Copper											
Boron											
Limestone Requirement											**1.60** tons 100ECCE/acre

*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates. http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

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April 15, 2019

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Sample received on: 11/25/2013
Printed on: 11/27/2013
Area Represented: not provided

Out of State County
Laboratory Number: 398109
Customer Sample ID: Cow Island Bayou 3
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow	VLow	Low	Mod	High	VHigh	Excess.	Fertilizer Recommended
pH	5.0	(5.8)	-	Strongly Acid							
Conductivity	198	(-)	umho/cm	None				CL*			
Nitrate-N	0	(-)	ppm**								95 lbs N/acre
Phosphorus	2	(50)	ppm								115 lbs P2O5/acre
Potassium	122	(150)	ppm								45 lbs K20/acre
Calcium	2,767	(180)	ppm								0 lbs Ca/acre
Magnesium	484	(50)	ppm								0 lbs Mg/acre
Sulfur	32	(13)	ppm								0 lbs S/acre
Sodium	166	(-)	ppm								
Iron											
Zinc											
Manganese											
Copper											
Boron											
Limestone Requirement											1.70 tons 100ECCE/acre

*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates.
http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

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Baton Rouge, LA 70802

Sample received on: 11/25/2013
Printed on: 11/27/2013
Area Represented: not provided

Out of State County
Laboratory Number: 398110
Customer Sample ID: Cow Island Bayou 4
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow	VLow	Low	Mod	High	VHigh	Excess.	Fertilizer Recommended
pH	5.0	(5.8)	-	Strongly Acid							
Conductivity	144	(-)	umho/cm	None				CL*			
Nitrate-N	1	(-)	ppm**								**95** lbs N/acre
Phosphorus	4	(50)	ppm								**115** lbs P2O5/acre
Potassium	85	(150)	ppm								**105** lbs K20/acre
Calcium	2,371	(180)	ppm								**0** lbs Ca/acre
Magnesium	426	(50)	ppm								**0** lbs Mg/acre
Sulfur	14	(13)	ppm								**0** lbs S/acre
Sodium	117	(-)	ppm								
Iron											
Zinc											
Manganese											
Copper											
Boron											
Limestone Requirement											**1.30** tons 100ECCE/acre

*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates.
http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

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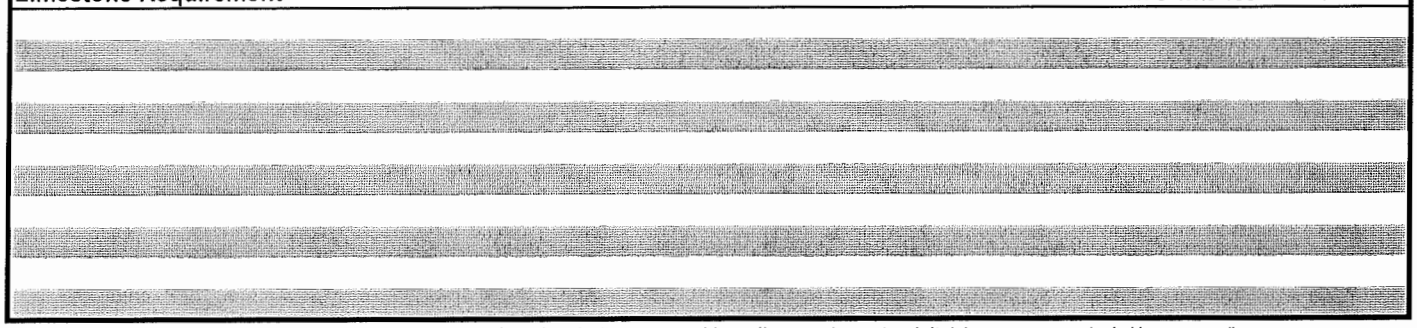
Baton Rouge, LA 70802

Sample received on: 11/25/2013
Printed on: 11/27/2013
Area Represented: not provided

Out of State County
Laboratory Number: 398111
Customer Sample ID: Cow Island Bayou 5
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	4.7	(5.8)	-	Strongly Acid	
Conductivity	178	(-)	umho/cm	None	
Nitrate-N	1	(-)	ppm**		95 lbs N/acre
Phosphorus	4	(50)	ppm		115 lbs P2O5/acre
Potassium	76	(150)	ppm		120 lbs K20/acre
Calcium	1,861	(180)	ppm		0 lbs Ca/acre
Magnesium	326	(50)	ppm		0 lbs Mg/acre
Sulfur	21	(13)	ppm		0 lbs S/acre
Sodium	105	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					1.70 tons 100ECCE/acre



*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates.
http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

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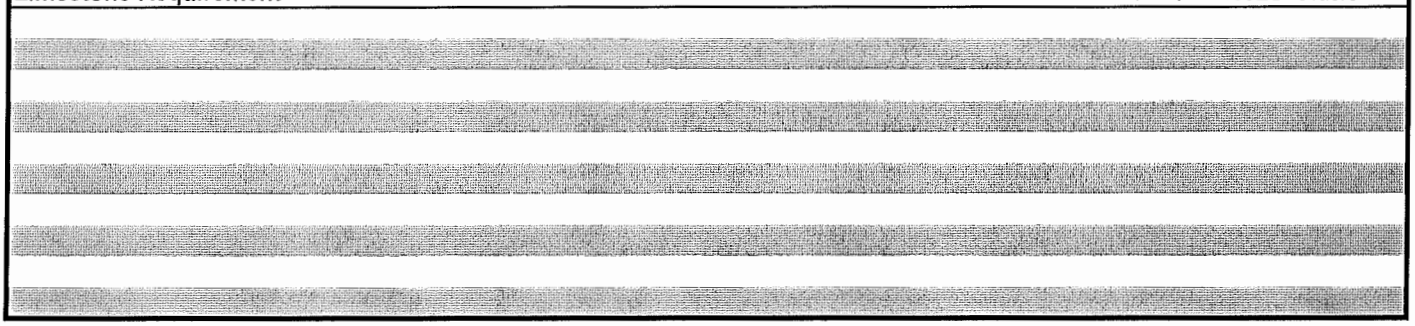
Sample received on: 11/25/2013
Printed on: 11/27/2013
Area Represented: not provided

Out of State County
Laboratory Number: 398112
Customer Sample ID: Cow Island Bayou 6
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	5.0	(5.8)	-	Strongly Acid	
Conductivity	170	(-)	umho/cm	None	
Nitrate-N	1	(-)	ppm**		95 lbs N/acre
Phosphorus	1	(50)	ppm		120 lbs P2O5/acre
Potassium	85	(150)	ppm		105 lbs K20/acre
Calcium	2,409	(180)	ppm		0 lbs Ca/acre
Magnesium	451	(50)	ppm		0 lbs Mg/acre
Sulfur	21	(13)	ppm		0 lbs S/acre
Sodium	138	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					1.40 tons 100ECCE/acre



*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates. http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

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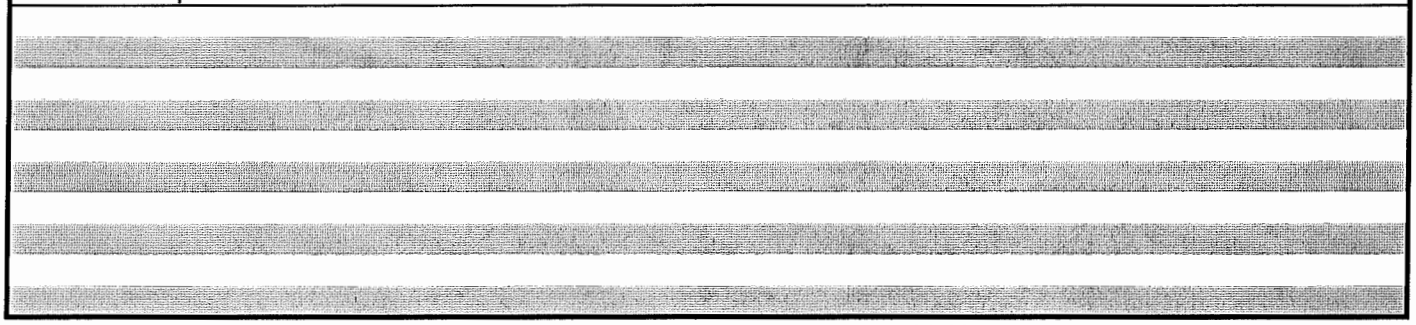
Baton Rouge, LA 70802

Sample received on: 11/25/2013
Printed on: 11/27/2013
Area Represented: not provided

Out of State County
Laboratory Number: 398113
Customer Sample ID: Cow Island Bayou 7
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	4.9	(5.8)	-	Strongly Acid	
Conductivity	151	(-)	umho/cm	None	
Nitrate-N	0	(-)	ppm**		95 lbs N/acre
Phosphorus	2	(50)	ppm		115 lbs P2O5/acre
Potassium	84	(150)	ppm		110 lbs K20/acre
Calcium	2,198	(180)	ppm		0 lbs Ca/acre
Magnesium	359	(50)	ppm		0 lbs Mg/acre
Sulfur	21	(13)	ppm		0 lbs S/acre
Sodium	125	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					1.50 tons 100ECCE/acre



*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates. http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

ProAnalysisVer. 2.19

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Sample received on: 11/25/2013
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Area Represented: not provided

Out of State County
Laboratory Number: 398114
Customer Sample ID: Cow Island Bayou 8
Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow	VLow	Low	Mod	High	VHigh	Excess	Fertilizer Recommended
pH	4.8	(5.8)	-	Strongly Acid							
Conductivity	183	(-)	umho/cm	None				CL*			
Nitrate-N	0	(-)	ppm**								**95** lbs N/acre
Phosphorus	4	(50)	ppm								**110** lbs P2O5/acre
Potassium	80	(150)	ppm								**115** lbs K20/acre
Calcium	2,465	(180)	ppm								**0** lbs Ca/acre
Magnesium	366	(50)	ppm								**0** lbs Mg/acre
Sulfur	15	(13)	ppm								**0** lbs S/acre
Sodium	82	(-)	ppm								
Iron											
Zinc											
Manganese											
Copper											
Boron											
Limestone Requirement											**1.90** tons 100ECCE/acre

*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Limestone recommendations are based on 100 ECCE liming products. Limestone applications >3 tons/acre should be made >4 months prior to crop establishment to lessen micro-nutrient availability issues.

Nitrogen: Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates.
http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

N. Threatened and Endangered Species Report

Threatened and Endangered Species Report for Cow Island Bayou Mitigation Bank Liberty County, Texas

Permit No.: SWG-2013-00223

Sponsor

Third Texas Resource, LLC

Agent

Resource Environmental Solutions, LLC

April 2016

CONTENTS

1 Introduction 1
2 Methods 1
2.1 Species Identification 1
2.2 Species Evaluation 3
3 Results 4
3.1 Species Evaluation 4
3.1.1 Red-cockaded Woodpecker (Picoides borealis) 4
3.1.2 Bald Eagle (Haliaeetus leucocephalus) 4
4 References 5

FIGURE

Figure F1 Texas Natural Diversity Database

ATTACHMENTS

Attachment 1 TPWD Annotated County Lists of Rare Species

Attachment 2 USFWS IPaC Trust Resource Report

1 INTRODUCTION

Resource Environmental Solutions (RES or Agent) performed a threatened and endangered species review to determine which federally listed species have the potential to occur within the vicinity of the Cow Island Bayou Mitigation Bank (CIBMB). RES assessed the potential presence of species listed by the U.S. Fish and Wildlife Service (USFWS) threatened and endangered species lists for Liberty County. Biological and life history requirements for each species are evaluated and the project's potential effect on each species is considered.

The project site is primarily a fallow agricultural field dominated by an upland herbaceous community. The site is crossed by agricultural ditches (intermittent/ephemeral streams), and contains herbaceous wetlands as depicted in Figure 5 and Appendix D of the Mitigation Banking Instrument (MBI).

The Endangered Species Act (ESA) of 1973 (16 United States Code [USC] A-1535-1543, P.L. 93-205) prohibits any person or entity from causing a *take* of any plant or animal species on the Secretary of the Interior's list of threatened and endangered species (Section 9(a)(1)(b)) and states that it is the responsibility of each federal agency to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence, or result in the destruction or adverse modification of habitat determined to be critical to the conservation of any such species (Section 7(a)(2)). The ESA defines a *take* as the harassment, harm, pursuit, hunting, shooting, killing, trapping, capture, or collection of such species.

The Bald and Golden Eagle Protection Act (BGEPA), originally passed in 1940, and amended in 1962, provides for the protection of the bald eagle (*Haliaeetus leucocephalus*) and the golden eagle (*Aquila chrysaetos*) by prohibiting the *take* of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit (16 USC 668(a); 50 Code of Federal Regulations [CFR] 22). The BGEPA defines a *take* as the pursuit, shooting, shooting at, poisoning, wounding, killing, capturing, trapping, collecting, molesting, or disturbing of a bald or golden eagle.

2 METHODS

2.1 Species Identification

The species evaluated in this report were identified from the USFWS threatened and endangered species list for Liberty County, Texas (Table 1, USFWS 2015a). RES also referenced the Texas Parks and Wildlife Department (TPWD) Annotated County List of Rare Species (Attachment 1, Table 2) and Texas Natural Diversity Database (TXNDD), which provides known occurrence records for listed species (Figure F1, TPWD 2015a). RES's assessment of the potential for occurrence of these species within the vicinity of CIBMB is based on documented occurrences, evaluation of the project site, and existing information on distribution. Qualitative assessments were made of the habitat requirements of each species compared with vegetation communities and landscape features observed within the bank. Potential effects to these species were evaluated based on activities described in the Mitigation Work Plan (Appendix H of the MBI) during the active management phase.

The USFWS Information for Planning and Conservation (IPaC) identified four federally-listed threatened and endangered species (Table 1) and 34 migratory bird species that have the potential to occur within the Bank Site (Attachment 2).

Table 1: Threatened and Endangered Species with the Potential to Occur Liberty County, Texas, listed by USFWS

Taxon	**Scientific Name**	**Species**	**Status**
Bird	*Sterna antillarum*	Least Tern	Endangered, Conditional*
Bird	*Charadrius melodus*	Piping Plover	Threatened, Conditional
Bird	*Calidris canutus rufa*	Red Knot	Threatened, Conditional
Bird	*Picoides borealis*	Red-cockaded Woodpecker	Endangered

* Species listed as Conditional only need to be considered for wind related projects within migratory route

TPWD maintains a list of rare threatened and endangered species at the state level (Attachment 1). TPWD assessments of potential occurrence of federally-listed species differs from the information provided by USFWS (Table 2).

Table 2. Rare, Threatened, and Endangered species of Liberty County, Texas, listed by TPWD.

Taxon	**Scientific Name**	**Common Name**	**Federal Status**	**State Status**
Amphibians	*Anaxyrus houstonensis*	Houston toad	LE	E
Birds	*Plegadis chihi*	White-faced Ibis		T
	Mycteria americana	Wood Stork		T
	Elanoides forficatus	Swallow-tailed Kite		T
	Haliaeetus leucocephalus	Bald Eagle	DL	T
	Falco peregrinus	Peregrine Falcon	DL	T
	Falco peregrinus anatum	American Peregrine Falcon	DL	T
	Falco peregrinus tundrius	Arctic Peregrine Falcon	DL	
	Charadrius melodus	Piping Plover	LT	T
	Calidris canutus rufa	Red Knot	LT	
	Picoides borealis	Red-cockaded Woodpecker	LE	E
	Anthus spragueii	Sprague's Pipit	C	
	Aimophila aestivalis	Bachman's Sparrow		T
	Ammodramus henslowii	Henslow's Sparrow		
Fishes	*Polyodon spathula*	Paddlefish		T
	Anguilla rostrata	American eel		
	Erimyzon oblongus	Creek chubsucker		T
Mammals	*Myotis austroriparius*	Southeastern myotis bat		
	Corynorhinus rafinesquii	Rafinesque's big-eared bat		T
	Canis rufus	Red wolf	LE	E
	Ursus americanus	Black bear	LT/SA;NL	T
	Ursus americanus luteolus	Louisiana black bear	LT	T
	Spilogale putorius interrupta	Plains spotted skunk		
Plants	*Carex decomposita*	Cypress knee sedge		
	Spigelia texana	Florida pinkroot		
	Cuscuta attenuata	Marsh-elder dodder		

Taxon	Scientific Name	Common Name	Federal Status	State Status
Reptiles	*Macrochelys temminckii*	Alligator snapping turtle		T
	Phrynosoma cornutum	Texas horned lizard		T
	Cemophora coccinea copei	Northern scarlet snake		T
	Crotalus horridus	Timber rattlesnake		T
Insects	*Gomphus modestus*	Gulf Coast clubtail		
Mollusks	*Fusconaia askewi*	Texas pigtoe		T
	Lampsilis satura	Sandbank pocketbook		T
	Pleurobema riddellii	Louisiana pigtoe		T
	Fusconaia lananensis	Triangle pigtoe		T
	Potamilus amphichaenus	Texas heelsplitter		T

* LE or LT = Federally Listed Endangered or Threatened; SA = Federally Listed Endangered or Threatened by Similarity of Appearance; C = Federal Candidate for Listing; DL = Federally Delisted; E or T State Listed Endangered or Threatened; NT = Not tracked or no longer tracked by the State

2.2 Species Evaluation

The potential for occurrence of each species is classified according to the categories listed below. Because not all species are accommodated precisely by a given category (i.e., category definitions may be too restrictive), an expanded rationale for each category assignment is provided.

- *Known to occur* – the species has been documented in the project area by a reliable observer.
- *May occur* – the project area is within the species' currently known range, and vegetation communities, soils, etc., resemble those known to be used by the species.
- *Unlikely to occur* – the project area is within the species' currently known range, but vegetation communities, soils, etc., do not resemble those known to be used by the species, or the project area is clearly outside the species' currently known range.
- *Does not occur* – the species does not occur in the project area.

Those species listed by the USFWS were assigned to one of three categories of possible effect following USFWS recommendations. The effects determinations recommended by USFWS include:

- *May affect, is likely to adversely affect* – adverse effects to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial.
- *May affect, is not likely to adversely affect* – the proposed action may affect listed species and/or critical habitat; however, the effects are expected to be discountable, insignificant, or completely beneficial.
- *No effect* – the proposed action will not affect federally-listed species or designated critical habitat.

3 RESULTS

3.1 Species Evaluation

USFWS lists four threatened and endangered species as having the potential to occur in Liberty County. Additionally, one delisted species is evaluated in this report because it is known to occur within the county and is otherwise protected by the BGEPA. Three of the listed species are identified by USFWS as conditional, only needing to be considered for wind-related projects; and are therefore not evaluated in this report (Table 1).

The site does not provide suitable habitat for any of the additional federally-listed species that could potentially occur in Liberty County that are identified by TPWD (Table 2). CIBMB does not have the deep sandy soils required by Houston toad, and the history of agricultural activities on the site has removed suitable habitat. TXNDD does record an occurrence of Houston toad within approximately 10 miles of the CIBMB. Piping plover and red knot require shoreline habitat, which is not present on the site. The red wolf is considered extirpated by TPWD, and CIBMB does not contain forested habitats required by black bear or Louisiana black bear.

3.1.1 Red-cockaded Woodpecker (Picoides borealis)

The red-cockaded woodpecker is approximately 7 inches long, with a wingspan of about 15 inches. Its back is barred with black and white horizontal stripes. Its most distinguishing feature is a black cap and nape that encircle large white cheek patches. The male has a small red streak on each side of its black cap called a cockade, females lack the red cockade. Juvenile males have a red patch in the center of their black crown. This patch disappears during the fall of their first year at which time their red-cockades appear (USFWS 2015b).

The red-cockaded woodpecker's diet consists mostly of insects found in or on pine trees, with fruits and seeds making up a small portion of the overall diet. Large, older trees are preferred for foraging. Mature pine forests, particularly longleaf pines (*Pinus palustris*), are most commonly preferred nesting habitat. Cavities are excavated in mature pines, generally over 80 years old. The typical territory for a group of red-cockaded woodpeckers ranges from about 125 to 200 acres (USFWS 2015b).

Determination of Impact: The project area does not contain the mature pine trees used by red-cockaded woodpeckers for foraging and nesting. Liberty County is within the known range of the red-cockaded woodpecker, but the site lacks suitable habitat; therefore, the species is *unlikely to occur* at CIBMB.

As a mitigation bank, CIBMB serves to restore and preserve in perpetuity forested areas which may serve as red-cockaded woodpecker habitat in the future. However, the site will be intended to support coastal prairie wetland and hardwood species, not the pines required by red-cockaded woodpeckers. RES determines this project will have *no effect* on this species.

3.1.2 Bald Eagle (Haliaeetus leucocephalus)

The bald eagle was delisted in 2007 but continues to be protected by the BGEPA, the Migratory Bird Treaty Act (MBTA), and state-specific laws and regulations. Immature bald eagles are predominantly dark brown with variable amounts of light splotching on the body, under-wing coverts, flight feathers, and tail base, and have a brownish-yellow bill. Bald eagles attain adult plumage by 5 years of age and have a dark brown body, dark brown wings, a white head, white tail, yellow feet, and a large yellow bill. Females are often noticeably larger than males (TPWD 2015b). Bald eagle distribution varies seasonally.

Bald eagles that nest in southern latitudes frequently move northward in late spring and early summer, often summering as far north as Canada. Most eagles that breed at northern latitudes migrate southward during winter, or to coastal areas where waters remain unfrozen. Bald eagles primarily feed on fish; however, waterfowl, seabirds, mammals, and carrion are also documented food sources (TPWD 2015b).

Bald eagle nests can be found along coastlines, rivers, lakes, and streams. Bald eagles are known to nest in snags, cliffs, old-growth trees, and on man-made structures (USFWS 2007). Nests can be between four and six feet in diameter and greater than three feet deep. The phenology of typical reproductive activities of bald eagles in the United States lists breeding season in Arkansas and east Texas as occurring from September to May (USFWS 2007). Bald eagles have been found to use the same nesting area year after year and typically build multiple nests in close proximity. Bald eagle wintering habitat is characterized by abundant, readily available food sources. Most wintering habitat is associated with open water or waterfowl concentrations. During the winter months, bald eagles will roost communally in large trees in close proximity to open water or in canyons (USFWS 2007).

Determination of Impact: The project area does not contain large trees suitable for bald eagle nesting, and the relatively small intermittent/ephemeral streams do not provide suitable habitat for hunting. The TXNDD identifies a known occurrence of bald eagles within 10 miles of CIBMB, and large trees are present in the vicinity of the site; therefore, bald eagles *may occur* at CIBMB.

As a mitigation bank, CIBMB serves to restore and preserve in perpetuity forested areas which may serve as bald eagle habitat. The long-term goal of the bank aligns with management practices outlined in the National Bald Eagle Management Guidelines (USFWS 2007). Proposed project activities, including the construction of roads (specifically, the removal and surface grading of existing earthen roads) and agriculture operations (i.e., subsoiling and disking in preparation for tree planting), will be limited in duration and may be classified as "temporary impacts". RES determines this project *may affect, but is not likely to adversely affect* this species.

4 REFERENCES

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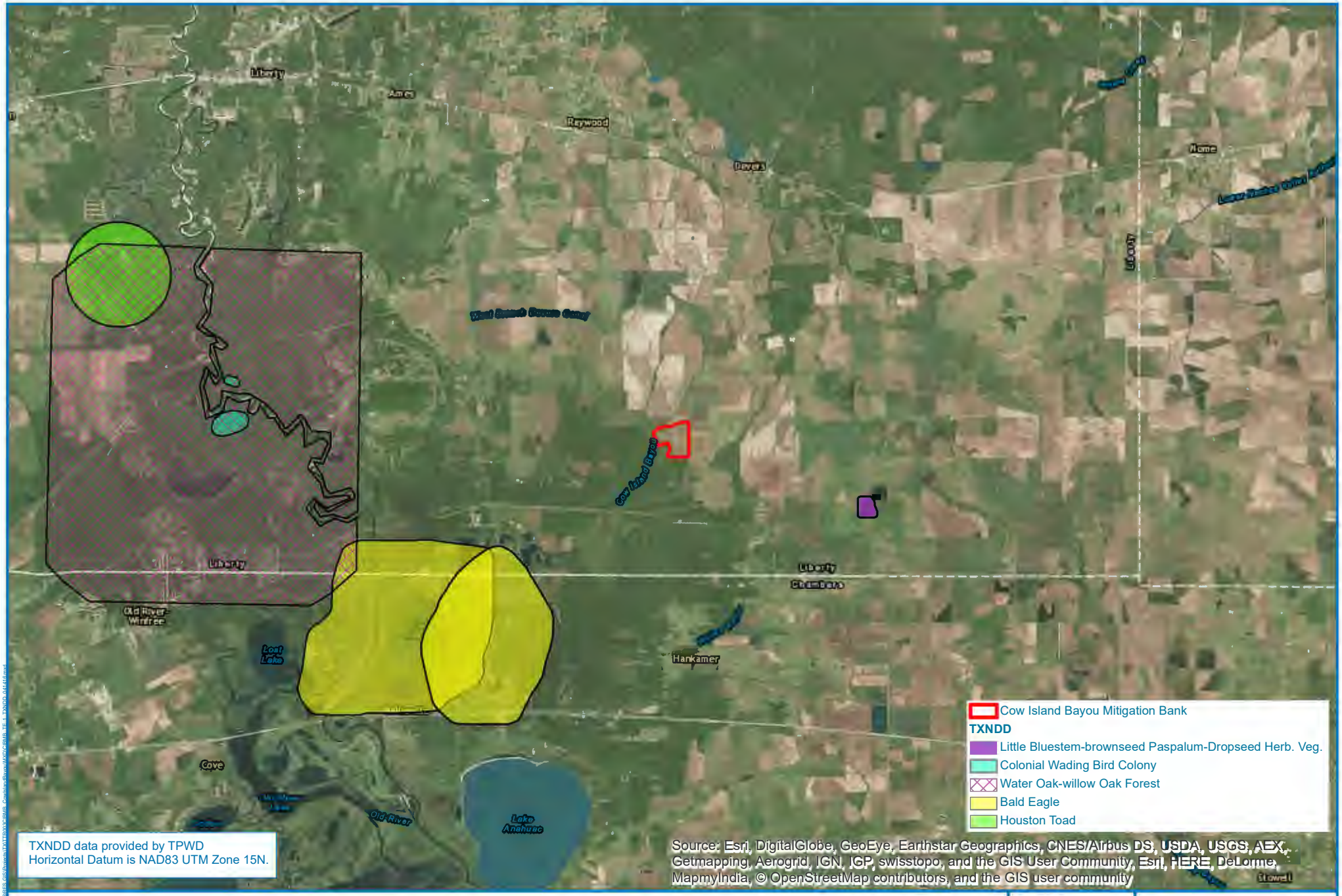
FIGURE



0 3 6
Miles

Figure N1

Texas Natural Diversity Database
Cow Island Bayou Mitigation Bank

Liberty County, Texas

Date: 2/14/2017
Drawn by: AB
Checked by: DJ
T&E Species Report

res

April 15, 2019

ATTACHMENT 1

TPWD Annotated County Lists of Rare Species

Last Revision: 2/7/2016 3:52:00 PM

LIBERTY COUNTY

AMPHIBIANS

		Federal Status	State Status
Houston toad	*Anaxyrus houstonensis*	LE	E

endemic; sandy substrate, water in pools, ephemeral pools, stock tanks; breeds in spring especially after rains; burrows in soil of adjacent uplands when inactive; breeds February-June; associated with soils of the Sparta, Carrizo, Goliad, Queen City, Recklaw, Weches, and Willis geologic formations

BIRDS

		Federal Status	State Status
American Peregrine Falcon	*Falco peregrinus anatum*	DL	T

year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

Arctic Peregrine Falcon	*Falco peregrinus tundrius*	DL	

migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

Bachman's Sparrow	*Aimophila aestivalis*		T

open pine woods with scattered bushes and grassy understory in Pineywoods region, brushy or overgrown grassy hillsides, overgrown fields with thickets and brambles, grassy orchards; remnant grasslands in Post Oak Savannah region; nests on ground against grass tuft or under low shrub

Bald Eagle	*Haliaeetus leucocephalus*	DL	T

found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds

Henslow's Sparrow	*Ammodramus henslowii*		

wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking

Peregrine Falcon	*Falco peregrinus*	DL	T

both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.

Piping Plover	*Charadrius melodus*	LT	T

wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats

LIBERTY COUNTY

BIRDS

		Federal Status	State Status
Red Knot	*Calidris canutus rufa*	T	

Red knots migrate long distances in flocks northward through the contiguous United States mainly April-June, southward July-October. A small plump-bodied, short-necked shorebird that in breeding plumage, typically held from May through August, is a distinctive and unique pottery orange color. Its bill is dark, straight and, relative to other shorebirds, short-to-medium in length. After molting in late summer, this species is in a drab gray-and-white non-breeding plumage, typically held from September through April. In the non-breeding plumage, the knot might be confused with the omnipresent Sanderling. During this plumage, look for the knot's prominent pale eyebrow and whitish flanks with dark barring. The Red Knot prefers the shoreline of coast and bays and also uses mudflats during rare inland encounters. Primary prey items include coquina clam (Donax spp.) on beaches and dwarf surf clam (Mulinia lateralis) in bays, at least in the Laguna Madre. Wintering Range includes- Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kennedy, Kleberg, Matagorda, Nueces, San Patricio, and Willacy. Habitat: Primarily seacoasts on tidal flats and beaches, herbaceous wetland, and Tidal flat/shore.

Red-cockaded Woodpecker	*Picoides borealis*	LE	E

cavity nests in older pine (60+ years); forages in younger pine (30+ years); prefers longleaf, shortleaf, and loblolly

Sprague's Pipit	*Anthus spragueii*	C	

only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.

Swallow-tailed Kite	*Elanoides forficatus*		T

lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees

White-faced Ibis	*Plegadis chihi*		T

prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats

Wood Stork	*Mycteria americana*		T

forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960

LIBERTY COUNTY

FISHES

		Federal Status	State Status
American eel	*Anguilla rostrata*		

coastal waterways below reservoirs to gulf; spawns January to February in ocean, larva move to coastal waters, metamorphose, then females move into freshwater; most aquatic habitats with access to ocean, muddy bottoms, still waters, large streams, lakes; can travel overland in wet areas; males in brackish estuaries; diet varies widely, geographically, and seasonally

Creek chubsucker	*Erimyzon oblongus*		T

tributaries of the Red, Sabine, Neches, Trinity, and San Jacinto rivers; small rivers and creeks of various types; seldom in impoundments; prefers headwaters, but seldom occurs in springs; young typically in headwater rivulets or marshes; spawns in river mouths or pools, riffles, lake outlets, upstream creeks

Paddlefish	*Polyodon spathula*		T

prefers large, free-flowing rivers, but will frequent impoundments with access to spawning sites; spawns in fast, shallow water over gravel bars; larvae may drift from reservoir to reservoir

INSECTS

		Federal Status	State Status
Gulf Coast clubtail	*Gomphus modestus*		

medium river, moderate gradient,and streams with silty sand or rocky bottoms; adults forage in trees, males perch near riffles to wait for females, larvae overwinter; flight season late Apr - late Jun

MAMMALS

		Federal Status	State Status
Black bear	*Ursus americanus*	T/SA;NL	T

bottomland hardwoods and large tracts of inaccessible forested areas; due to field characteristics similar to Louisiana Black Bear (LT, T), treat all east Texas black bears as federal and state listed Threatened

Louisiana black bear	*Ursus americanus luteolus*	LT	T

possible as transient; bottomland hardwoods and large tracts of inaccessible forested areas

Plains spotted skunk	*Spilogale putorius interrupta*		

catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie

Rafinesque's big-eared bat	*Corynorhinus rafinesquii*		T

roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures

Red wolf	*Canis rufus*	LE	E

extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies

Southeastern myotis bat	*Myotis austroriparius*		

roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures

LIBERTY COUNTY

MOLLUSKS

		Federal Status	State Status
Louisiana pigtoe	*Pleurobema riddellii*		T

streams and moderate-size rivers, usually flowing water on substrates of mud, sand, and gravel; not generally known from impoundments; Sabine, Neches, and Trinity (historic) River basins

Sandbank pocketbook	*Lampsilis satura*		T

small to large rivers with moderate flows and swift current on gravel, gravel-sand, and sand bottoms; east Texas, Sulfur south through San Jacinto River basins; Neches River

Texas heelsplitter	*Potamilus amphichaenus*		T

quiet waters in mud or sand and also in reservoirs. Sabine, Neches, and Trinity River basins

Texas pigtoe	*Fusconaia askewi*		T

rivers with mixed mud, sand, and fine gravel in protected areas associated with fallen trees or other structures; east Texas River basins, Sabine through Trinity rivers as well as San Jacinto River

Triangle pigtoe	*Fusconaia lananensis*		T

mixed mud, sand, and fine gravel substrates; Neches River basin in the Angelina branch and possibly Village Creek

REPTILES

		Federal Status	State Status
Alligator snapping turtle	*Macrochelys temminckii*		T

perennial water bodies; deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October

Northern scarlet snake	*Cemophora coccinea copei*		T

mixed hardwood scrub on sandy soils; feeds on reptile eggs; semi-fossorial; active April-September

Texas horned lizard	*Phrynosoma cornutum*		T

open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September

Timber rattlesnake	*Crotalus horridus*		T

swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto

PLANTS

		Federal Status	State Status
Cypress knee sedge	*Carex decomposita*		

GLOBAL RANK: G3G4; Occurs in shallow water or on baldcypress stumps and logs in wooded ponds or swamps; Perennial; Flowering/Fruiting April-May

LIBERTY COUNTY

PLANTS	Federal Status	State Status

Florida pinkroot *Spigelia texana*

GLOBAL RANK: G3; Woodlands on loamy soils; Perennial; Flowering March-Nov; Fruiting April-Nov

Marsh-elder dodder *Cuscuta attenuata*

GLOBAL RANK: G1G3; Parasitizes a particular sumpweed (Iva annua) almost exclusively as well as ragweed and heath aster. Host plants typically found in open, disturbed habitats like fallow fields and creek bottomlands; Annual; Flowering late summer through October

ATTACHMENT 2

USFWS IPaC Trust Resource Report

U.S. Fish & Wildlife Service

Cow Island Bayou Mitigation Bank

IPaC Trust Resources Report

Generated April 05, 2016 11:31 AM MDT, IPaC v3.0.0

This report is for informational purposes only and should not be used for planning or analyzing project level impacts. For project reviews that require U.S. Fish & Wildlife Service review or concurrence, please return to the IPaC website and request an official species list from the Regulatory Documents page.

IPaC - Information for Planning and Conservation (https://ecos.fws.gov/ipac/): A project planning tool to help streamline the U.S. Fish & Wildlife Service environmental review process.

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Project Description 1
Endangered Species 2
Migratory Birds 4
Refuges & Hatcheries 7
Wetlands 8

U.S. Fish & Wildlife Service

IPaC Trust Resources Report

NAME

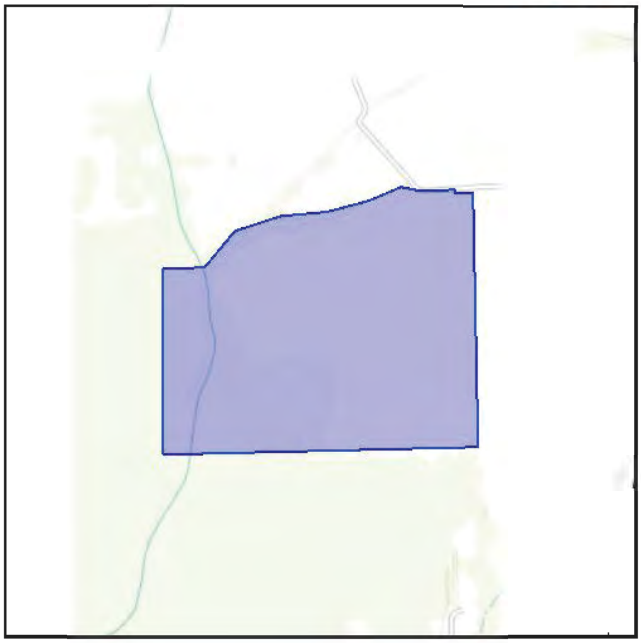
Cow Island Bayou Mitigation Bank

LOCATION

Liberty County, Texas

IPAC LINK

https://ecos.fws.gov/ipac/project/MITEO-SJDGF-DOLEU-B3OYY-3D75OE



U.S. Fish & Wildlife Service Contact Information

Trust resources in this location are managed by:

Texas Coastal Ecological Services Field Office
17629 El Camino Real, Suite 211
Houston, TX 77058-3051
(281) 286-8282

Endangered Species

Proposed, candidate, threatened, and endangered species are managed by the Endangered Species Program of the U.S. Fish & Wildlife Service.

This USFWS trust resource report is for informational purposes only and should not be used for planning or analyzing project level impacts.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list from the Regulatory Documents section.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency.

A letter from the local office and a species list which fulfills this requirement can only be obtained by requesting an official species list either from the Regulatory Documents section in IPaC or from the local field office directly.

The list of species below are those that may occur or could potentially be affected by activities in this location:

Birds

Least Tern Sterna antillarum — Endangered

THIS SPECIES ONLY NEEDS TO BE CONSIDERED IF THE FOLLOWING CONDITION APPLIES
Wind related projects within migratory route.

CRITICAL HABITAT
No critical habitat has been designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B07N

Piping Plover Charadrius melodus — Threatened

THIS SPECIES ONLY NEEDS TO BE CONSIDERED IF THE FOLLOWING CONDITION APPLIES
Wind related projects within migratory route.

CRITICAL HABITAT
There is **final** critical habitat designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B079

Red Knot Calidris canutus rufa — Threatened

THIS SPECIES ONLY NEEDS TO BE CONSIDERED IF THE FOLLOWING CONDITION APPLIES
Wind related projects within migratory route.

CRITICAL HABITAT
No critical habitat has been designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0DM

Red-cockaded Woodpecker Picoides borealis — Endangered

CRITICAL HABITAT
No critical habitat has been designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B04F

Critical Habitats

There are no critical habitats in this location

Migratory Birds

Birds are protected by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act.

Any activity that results in the take of migratory birds or eagles is prohibited unless authorized by the U.S. Fish & Wildlife Service.[1] There are no provisions for allowing the take of migratory birds that are unintentionally killed or injured.

Any person or organization who plans or conducts activities that may result in the take of migratory birds is responsible for complying with the appropriate regulations and implementing appropriate conservation measures.

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1. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

Additional information can be found using the following links:

- Birds of Conservation Concern
  http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Conservation measures for birds
  http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Year-round bird occurrence data
  http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/akn-histogram-tools.php

The following species of migratory birds could potentially be affected by activities in this location:

American Oystercatcher Haematopus palliatus — Bird of conservation concern
Year-round
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0G8

Bald Eagle Haliaeetus leucocephalus — Bird of conservation concern
Year-round
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B008

Black Rail Laterallus jamaicensis — Bird of conservation concern
Year-round
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B09A

Black Skimmer Rynchops niger — Bird of conservation concern
Year-round
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0EO

Brown-headed Nuthatch Sitta pusilla — Bird of conservation concern
Year-round

Burrowing Owl Athene cunicularia — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0NC

Dickcissel Spiza americana — Bird of conservation concern
Season: Breeding

Fox Sparrow Passerella iliaca — Bird of conservation concern
Season: Wintering

Gull-billed Tern Gelochelidon nilotica — Bird of conservation concern
Year-round
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0JV

Henslow's Sparrow Ammodramus henslowii — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B09D

Hudsonian Godwit Limosa haemastica — Bird of conservation concern
Season: Migrating

Le Conte's Sparrow Ammodramus leconteii — Bird of conservation concern
Season: Wintering

Least Bittern Ixobrychus exilis
Season: Breeding
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B092

Lesser Yellowlegs Tringa flavipes — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0MD

Loggerhead Shrike Lanius ludovicianus — Bird of conservation concern
Year-round
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0FY

Long-billed Curlew Numenius americanus — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B06S

Marbled Godwit Limosa fedoa — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0JL

Nelson's Sparrow Ammodramus nelsoni — Bird of conservation concern
Season: Wintering

Painted Bunting Passerina ciris — Bird of conservation concern
Season: Breeding

Peregrine Falcon Falco peregrinus — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0FU

Prothonotary Warbler Protonotaria citrea — Bird of conservation concern
Season: Breeding

Red Knot Calidris canutus rufa — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0DM

Red-headed Woodpecker Melanerpes erythrocephalus — Bird of conservation concern
Season: Wintering

Reddish Egret Egretta rufescens — Bird of conservation concern
Year-round
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B06U

Rusty Blackbird Euphagus carolinus — Bird of conservation concern
Season: Wintering

Sedge Wren Cistothorus platensis — Bird of conservation concern
Season: Wintering

Short-billed Dowitcher Limnodromus griseus — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0JK

Short-eared Owl Asio flammeus — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0HD

Snowy Plover Charadrius alexandrinus — Bird of conservation concern
Season: Breeding

Swainson's Warbler Limnothlypis swainsonii — Bird of conservation concern
Season: Breeding

Swallow-tailed Kite Elanoides forficatus — Bird of conservation concern
Season: Breeding
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0GB

Wilson's Plover Charadrius wilsonia — Bird of conservation concern
Season: Breeding

Worm Eating Warbler Helmitheros vermivorum — Bird of conservation concern
Season: Migrating

Yellow Rail Coturnicops noveboracensis — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0JG

Wildlife refuges and fish hatcheries

There are no refuges or fish hatcheries in this location

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

DATA LIMITATIONS

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

DATA EXCLUSIONS

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

DATA PRECAUTIONS

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

This location overlaps all or part of the following wetlands:

Freshwater Emergent Wetland

PEMf 2690.0 acres

Freshwater Forested/shrub Wetland

PFO1C 65.2 acres

PFO1A 40.2 acres

A full description for each wetland code can be found at the National Wetlands Inventory website: http://107.20.228.18/decoders/wetlands.aspx

O. Reference Sites Plant Lists

U.S. Fish and Wildlife Service

Plants of
Trinity River National Wildlife Refuge

The Trinity River NWR plant list was developed by Larry E. Brown, Guy Nesom, Stuart J. Marcus and David Rosen. As of April 2009, 632 plants have been documented.

***Acanthaceae*, Acanthus Family**
Dicliptera brachiata
Hygrophila lacustris Lake Acanthus
Justica ovata var. *lanceolata* Lance-Leaved Water Willow
Ruellia caroliniensis Wild Petunia
R. humilis var. *humilis* Low Ruellia
R. strepens Wild Petunia
***Aceraceae*, Maple Family**
Acer negundo Ash-Leaved Maple
A. rubrum Red Maple
***Alismataceae*, Water Plantain Family**
Echinodorus cordifolius
Sagittaria montevidensis Arrowhead
S. papillosa Arrowhead
S. platyphylla Arrowhead
***Amaranthaceae*, Amaranth Family**
Alternanthera philoxeroides Alligator-Weed
Amaranthus rudis Water Hemp
A. spinosus Spiny Amaranth
A. viridis Slender Amaranth
***Amaryllidaceae*, Amaryllis Family**
Cooperia pedunculata Rain-lily
Crinum americanum Spider Lily
Hymenocallis liriosme Spider Lily
Hypoxis curtisii Yellow-star grass
Lyoris radiate Red Spider-Lily
***Anacardiaceae*, Cashew Family**
Toxicodendron radicans Poison Ivy
***Apocynaceae*, Dogbane Family**
Trachelospermum difforme Climbing Dogbane
***Aquifoliaceae*, Holly Family**
Ilex deciduas Deciduous-Leaved Holly
I. opaca American Holly
I. vomitoria Yaupon
***Araceae*, Arum Family**
Arisaema dracontium Green Dragon
***Araliaceae*, Ginseng Family**
Aralia spinosa Hercules Club
***Asclepiadaceae*, Milkweed Family**
Asclepias perennis Swamp Milkweed
Matelea gonocarpa Milkvine
***Azollaceae*, Water Fern Family**
Azolla caroliniana Mosquito Fern
***Berberidaceae*, Barberry Family**
Podophyllum peltatum Mayapple
***Betulaceae*, Birch Family**
Carpinus caroliniana Ironwood
Ostrya virginiana Hop Hornbeam
***Bignoniaceae*, Trumpet Creeper Family**
Bignonia capreolata Crossvine
Campsis radicans Trumpet Creeper
Catalpa speciosa Northern Catalpa
***Boraginaceae*, Borage Family**
Heliotropium indicum Turnsole
H. procumbens Heliotrope
Myosotis macrosperma Forget-Me-Not
***Bromeliaceae*, Pineapple Family**
Tillandsia recurvata Ball Moss
T. usneoides Spanish Moss
***Callitrichaceae*, Water Starwort Family**
Callitriche heterophylla Larger Water-Starwort
C. nuttallii Sand-Starwort
C. peploides Water-Starwort
***Campanulaceae*, Bellflower Family**
Lobelia cardinalis Cardinal Flower
L. puberula Downy Lobelia
Sphenoclea zeylanica Chickenspike
Triodanis perfoliata var. *biflora* Venus-Looking-Glass
T. perfoliata var. *perfoliata*
***Cannaceae*, Canna Family**
Canna indica Indian Shot
***Caprifoliaceae*, Honeysuckle Family**
Lonicera japonica Japanese Honeysuckle
Sambucus canadensis Elderberry
Viburnum rufidulum Rusty Black Haw
***Caryophyllaceae*, Pink Family**
Cerastium glomeratum Mouse-Eared Chickweed
Sagina decumbens Pearlwort
Silene antirrhina Sleepy Catchfly
Stellaria media Chickweed
S. parvan Chickweed
***Celastraceae*, Staff Tree Family**
Euonymus americanus Strawberry Bush
***Ceratophyllaceae*, Coon-Tail Family**
Ceratophyllum demersum, Coon-Tail
***Chenopodiaceae*, Goosefoot Family**
Chenopodium ambrosioides Mexican Tea
***Commelinaceae*, Spiderwort Family**
Commelina diffusa Spreading Dayflower
C. erecta Dayflower
C. virginica Virginia Dayflower
Murdannia nudiflora
Tradescantia ohiensis Spiderwort
***Compositae*, Sunflower Family**
Acmella oppositifolia var. *repens* Creeping Spotflower
Ambrosia artemisiifolia Ragweed
A. cumanensis Western Ragweed
A. trifida Giant Ragweed
Aster fragilis Tall White Aster
A. subulatus Blueweed
Baccharis halimifolia Sea-Myrtle
Bidens bipinnata Spanish Needles
B. discoidea Sticktight
Cacalia plantaginea Indian Plantian
Calyptocarpus vialis Stagger Daisy
Chloracantha spinosa var. *spinosa* Spiny Aster
Cirsium horridulum Bull Thistle
Conyza canadensis Horseweed
Coreopsis basalis Goldenwave
Croptilon rigidifolium Scratch-Daisy
Eclipta prostrata Yerba De Tago
Elephantopus carolinianus Elephantfoot
E. tomentosus Elephantfoot
Erechtities hieraciifolia Burnweed
Erigeron philadelphicus Philadelphia Fleabane
E. tenuis Slender Fleabane
Eupatorium capillifolium Dogfennel
E. coelestinum Mist Flower
E. compositifolium Yankee Weed
E. incarnatum Pink Boneset
E. rugosum Boneset
E. serotinum Lateflowering Boneset
Euthamia leptocephala False Goldenrod
Gaillardia pulchella var. *pulchella* Indian Blanket
Gnaphalium falcatum Cudweed
G. purpureum Cudweed
Helenium amarum var. *amarum* Bitterweed
Heterotheca subaxillaris Goldenaster
Hypochaeris microcephala var. *albiflora* Cat's Ear
Iva annua Marsh Elder
Krigia cespitosa Dwarf Dandelion
K. wrightii Sandy Soil Dwarf Dandelion
Lactuca canadensis Wild Lettuce
L. floridana Fall Wild Lettuce
Mikania scandens Hempweed
Pluchea camphorata Camphorweed
Pterocaulon virgatum Blackroot
Polymnia uvedalia Bearsfoot
Pyrrhopappus carolinianus False Dandelion
P. pauciflorus False Dandelion
Rudbeckia hirta Black-Eyed Susan
Senecio glabellus Butter-Weed
S. tampicanus Butter-Weed
Solidago canadensis Goldenrod
S. rugosa Roughleaf Goldenrod
Soliva sessilis Burweed
Sonchus asper Sow Thistle
Verbesina encelioides Cowpen Daisy
V. virginica Frostweed
Vernonia missurica Ironweed
Xanthium strumarium Cocklebur
***Convolvulaceae*, Morning Glory Family**
Cuscuta obtusiflora var. *glandulosa* Dodder
Dichondra carolinensis Pony-Foot
Ipomoea cordatotriloba Common Morning Glory
I. lacunosa Small White Morning Glory
Jacquemontia tamnifolia Tie Vine
***Cornaceae*, Dogwood Family**
Cornus drummondii Rough-Leaved Dogwood
C. florida Flowering Dogwood
Nyssa aquatica Water Tupelo
N. sylvatica Blackgum
***Cruciferae*, Mustard Family**
Armoracia lacustris Lake Cress
Capsella bursa-pastoris Shepherd's Purse
Cardamine hirsuta Hairy Crest
C. parviflora var. arenicola Bitter Crest
Lepidium virginicum Pepper-Grass
Rorippa sessiliflora Sessile-Flowered Cress
***Cucurbitaceae*, Gourd Family**
Cayaponia quinqueloba
Citrullus lanatus var. *lanatus* Watermelon

Cucumis melo Muskmelon
Melothria pendula Melonette
***Curpressaceae,* Cypress Family**
Juniperus virginiana Eastern Red Cedar
***Cyperaceae,* Sedge Family**
Carex albicans var. *australis*
C. annectens
C. aureolensis
C. austrina
C. blanda
C. brevior
C. bulbostylis
C. caroliniana
C. cherokeensis
C. complanata
C. corrugata
C. crus-corvi
C. flaccosperma
C. frankii
C. gigantea
C. hyalina
C. hyalinolepis
C. intumescens
C. joorii
C. leavenworthii
C. louisianica
C. lupuliformis
C. oxylepis
C. retroflexa
C. texensis
C. tribuloides
C. verrucosa
C. vulpinoidea
Cyperus acuminatus
C. articularis
C. compressus
C. croceus
C. entrerianus
C. erythrorhizos
C. esculentus
C. iria
C. ochraceus
C. odoratus
C. polystachyos
C. pseudovegetus
C. retrorsus var. retrorsus
C. rotundus
C. surinamensis
C. thyrsiflorus
C. virens
Eleocharis microcarpa
E. montana
E. montevidensis
E. obtusa
E. palustris
Fimbristylis annua Annual Fimbry
F. autumnalis Slender Fimbry
F. dichotoma Forked Fimbry
F. miliacea Globe Fimbry
F. vahlii Vahl Fimbry
Isolepis carinata Little-Sedge
Kyllinga odorata White Flat Sedge
Rhynchospora caduca Beakrush
R. colorata White Top Sedge
R. corniculata Horned Beakrush
Schoenoplectus californicus
Scleria oligantha Nut-Rush
***Dioscoreaceae,* Yam Family**
Dioscorea bulbifera Air Yam
Dioscorea villosa Potato Yam
***Ebenaceae,* Ebony Family**
Diospyros virginiana Persimmon
***Equisetaceae,* Horsetail Family**
Equisetum hyemale Scouring-Rush
***Ericaceae,* Heath Family**
Vaccinium arboreum
***Euphorbiaceae,* Spurge Family**
Acalypha gracilens var. gracilens Threeseeded Mercury
A. rhomboidea
A. virginica Threeseeded Mercury
Caperonia palustris Marsh Caperonia
Croton capitatus Woolly Croton
C. glandulosus Tropic Croton
C. monanthogynus Single-Seed Croton
Euphorbia bicolor Flowering Spurge
E. dentata Toothed Spurge
E. humistrata Spreading Spurge
E. maculata Spotted Spurge
E. nutans Eyebane
E. spathulata Warty Spurge
Phyllanthus caroliniensis Leaf Flower
P. pudens Leaf Flower
P. urinaria Leaf Flower
Sapium sebiferum Chinese Tallow Tree
***Fagaceae,* Beech Family**
Quercus alba White Oak
Q. falcata Southern Red Oak
Q. lyrata Overcup
Q. michauxii Swamp-Chestnut Oak
Q. nigra Water Oak
Q. phellos Willow Oak
Q. sinuata var. sinuata Bottomland White Oak
Q. stellata var. stellata Post Oak
Q. texana Nuttall's Oak
Q. virginiana Live Oak
***Fumariaceae,* Fumitory Family**
Corydalis micrantha var. australis Scrambled Eggs
***Geraniaceae,* Geranium Family**
Geranium carolinianum Geranium
***Gramineae (Poaceae),* Grass Family**
Agrostis hyemalis Winter Bentgrass
A. perennans Fall Bentgrass
Aira elegans Hairgrass
Alopecurus carolinianus Carolina Foxtail
Andropogon glomeratus Bushy Bluestem
A. virginicus Broomsedge
Arundinaria gigantea Cane
Avena fatua Oats
Axonopus fissiflius Carpetgrass
Briza minor Quakinggrass
Bromus catharticus Rescuegrass
Cenchrus incertus Grass Bur
Chasmanthium latifolium Woodoats
C. laxum Spikegrass
C. laxum var. sessiliflorum Spikegrass
Cynodon dactylon Bermudagrass
Dactyloctenium aegyptium Crowfootgrass
Dichanthelium aciculare
D. acuminatum var. *densiflorum*
D. acuminatum var. *lindheimeri*
D. acuminatum var. *longiligulatum*
D. boscii
D. commutatum
D. dichotomum
D. laxiflorum
Digitaria ciliaris Southern Crabgrass
D. ischaemum Smooth Crabgrass
Echinochloa colona Jungle Rice Grass
E. walteri Barnyard Grass
Eleusine indica Goosegrass
Elymus virginicus Wildrye
Eragrostis glomerata Pond Lovegrass
E. hirsuta Bigtop Lovegrass
E. hypnoides Teal Lovegrass
E. reptans Creeping Lovegrass
Eremochloa ophiuroides Centipedegrass
Festuca arundinacea Fescue
Hordeum pusillum Little Barley
Leersia lenticularis Catchflygrass
L. virginica Whitegrass
Leptochloa panicoides Amazon Sprangletop
Limnodea arkansana Ozarkgrass
Lolium perenne Ryegrass
Melica mutica Twoflower Melicgrass
Muhlenbergia schreberi Nimblewill
Oplismenus hirtellus Basketgrass
Panicum anceps Beaked Panicum
P. dichotomiflorum Fall Panicum
P. gymnocarpon Savannah Panicum
P. hians Gaping Panicum
P. rigidulum Redtop Panicum
P. virgatum Switchgrass
Paspalum conjugatum
P. dilatatum Big Paspalum
P. distichum Knotgrass
P. laeve Field Paspalum
P. langei Rustyseed Paspalum
P. notatum Bahiagrass
P. pubiflorum Hairseed Paspalum
P. repens var. *fluitans* Water Paspalum
P. setaceum Thin Paspalum
P. urvillei Vaseygrass
Phalaris caroliniana Southern Carnarygrass
Piptochaetium avenaceum Blackseed Needlegrass
Poa annua Annual Bluegrass
P. autumnalis Autumn Bluegrass
Setaria parviflora Knotroot Bristlegrass
Sorghum halepense Johnsongrass
Sphenopholis longiflora Wedgescale
S. obtusata Prairie Wedgescale
Sporobolus indicus Smutgrass
Stenotaphrum secundatum St. Augustine grass
Tridens flavus var. flavus Purpletop
Tripsacum dactyloides Eastern Gamagrass
Urochloa platyphylla Broadleaf Signalgrass
U. reptans
Vulpia octoflora Sixweeksgrass
Zizaniopsis miliacea Southern Wild Rice
***Haloragaceae,* Water Milfoil Family**
Myriophyllum heterophyllum Variable-leaf Water-Milfoil
M. pinnatum Water-Milfoil
Proserpinaca palustris Mermaid Weed
***Hamamelidaceae,* Witch Hazel Family**
Liquidambar styraciflua Sweet Gum
***Hippocastanaceae,* Buckeye Family**
Aesculus pavia var. *pavia* Red Buckeye
***Hydrocharitaceae,* Frogbit Family**
Hydrilla verticillata Hydrilla
Limnobium spongia American Frogbit
***Hydrophyllaceae,* Waterleaf Family**
Hydrolea ovata Water Olive
H. uniflora One-Flowered Hydrolea
Nemophila aphylla Baby Blueeyes
***Hypericaceae,* St. John's Wort Family**
Hypericum gymnanthum Clasping St. Johns-Wort
H. hypericoides St. Andrews Cross
H. mutilum Dwarf St. Johns-Wort
Triadenum tubulosum Water St. Johns-Wort
T. walteri Water St. Johns-Wort
***Iridaceae,* Iris Family**
Herbertia lahue Herbertia
Iris hexagona Wild Iris
Sisyrinchium langloisii Blue-Eyed-Grass
S. rosulatum White-Eyed-Grass
***Juglandaceae,* Walnut Family**
Carya aquatica Water Hickory
C. glabra Pignut Hickory

C. illinoinensis Pecan
C. texana Black Hickory
Juglans nigra Black Walnut

***Juncaceae,* Rush Family**
Juncus acuminatus
J. coriaceus
J. dichotomus
J. diffusissimus Longpod Rush
J. effusus Common Rush
J. interior
J. marginatus Grassleaf Rush
*J. tenuis*Path Rush
J. validus Flat Rush

***Labiatae (Lamiaceae),* Mint Family**
Hedeoma hispida Rough Hedeoma
Lamium amplexicaule Henbit
Lycopus rubellus Bugle Weed
L. virginicus Bugle Weed
Micromeria brownei Texas Micromeria
Monarda citriodora var. citriodora Lemon Beebalm
M. punctata var. punctata Spotted Beebalm
Perilla frutescens Beefsteak Plant
Physostegia intermedia Obedient Plant
Prunella vulgaris Selfheal
Salvia lyrata Lyreleaf Sage
Scutellaria parvula Skullcap
Stachys crenata Shade Betony
S. tenuifolia Hedge Nettle
Teucrium canadense Wood Sage

***Lauraceae,* Laurel Family**
Sassafras albidum Sassafras

***Leguminosae (Fabaceae),* Legume Family**
Aeschynomene indica Jointvetch
Albizia julibrissin Silktree Mimosa
Alysicarpus vaginalis Alyce Clover
Amorpha fruticosa Indigobush
Baptisia alba var. macrophylla White Wild Indigo
B. bracteata Nodding Wild Indigo
Centrosema virginianum Butterfly Pea
Cercis canadensis Redbud
Chamaecrista fasciculata Senna
Desmodium canescens Tick Trefoil
D. glabellum Tick Trefoil
D. paniculatum Tick Trefoil
Erythrina herbacea Coralbean
Galactia volubilis Milkpea
Gleditsia aquatica Water Locust
G. triacanthos Honey Locust
Lespedeza striata Japanese Bush Clover
Medicago lupulina Black Medic
M. polymorpha Bur-Clover
Mimosa strigillosa Powderpuff
Rhynchosia minima Snoutbean
Schrankia unicata Sensitive Brier
Senna marilandica Wild Senna
S. obtusifolia Sicklepod
S. occidentalis Coffee Senna
Sesbania drummondii Rattlebush
S. exaltata Coffebean
S. vesicaria Bladderpod
Sophora affinis Eve's Necklace
Strophostyles helvula Trailing Wildbean
Trifolium dubium Small Hop Clover
*T. repens*White Clover
T. resupinatum Persian Clover
Vicia ludoviciana Vetch
V. minutiflora Pygmy-Flowered Vetch
Wisteria frutescens Wisteria

***Lemnaceae,* Duckweed Family**
Lemna aequinoctialis Duckweed
Spirodela polyrrhiza Common Duckmeat
S. punctata Small Duckmeat
Wolffia brasiliensis Water-Meal
W. columbiana Water-Meal
Wolffiella gladiata

***Lentibulariaceae,* Bladderwort Family**
Utricularia gibba Bladderwort
U. radiata Floating Bladderwort

***Liliaceae,* Lily Family**
Allium canadense Wild Onion
Nothoscordum bivalve False Onion
Smilax bona-nox Saw Greenbrier
*S. glauca*Cat Greenbrier
S. rotundifolia Roundleaf Greenbrier
S. smallii Small's Greenbrier
S. tamnoides Bristly Greenbrier

***Loganiaceae,* Logania Family**
Gelsemium sempervirens Yellow Jessamine
Mitreola petiolata Hornpod
Polypremum procumbens Poly-Prim
Spigelia loganioides Texas Pink-Root

***Lythraceae,* Loosestrife Family**
Ammannia coccinea Tooth-Cup
Cuphea carthagenensis Waxweed
Lagerstromia indica Crepe Myrtle
Lythrum alatum var. *lanceolatum* Loosestrife
Rotala ramosior Rotala

***Magnoliaceae,* Magnolia Family**
Magnolia grandiflora Southern Magnolia

***Malvaceae,* Mallow Family**
Callirhoe papaver Wine Cup
Hibiscus moscheutos Rose Mallow
H. leavis Scarlet Mallow
Malvaviscus arboreus Turks Cap
Modiola caroliniana Modiola
Sida rhombifolia Axocatzin
S. spinosa

***Marsileaceae,* Pepperwort Family**
Marsilea vestita Water-Clover

***Meliaceae,* Mahogy Family**
Melia azedarach Chinaberry

***Menispermaceae,* Moonseed Family**
Cocculus carolinus Snailseed

***Molluginaceae,* Carpet-Weed Family**
Glinus lotoides
Mollugo verticillata Carpet-Weed

***Moraceae,* Mulberry Family**
Maclura pomifera Osage Orange
Morus rubra Mulberry

***Nyctaginaceae,* Four-O-Clock Family**
Mirabilis jalapa Cultivated Four-O'Clock

***Nymphaeaceae,* Water-Lily Family**
Nelumbo lutea American Lotus
Nymphaea odorata Fragrant Water Lily

***Oleaceae,* Olive Family**
Forestiera acuminata Swamp Privet
F. ligustrina Privet Forestiera
Fraxinus americana White Ash
F. caroliniana Pop Ash, Water Ash
F. pensylvanica Green Ash
Ligustrum lucidum Privet
Ligustrum sinense Chinese Privet

***Onagraceae,* Evening-Primrose Family**
Ludwigia decurrens Wing-Stem Water Primrose
L. glandulosa Cylindric-Fruited Water Primrose
L. leptocarpa Water Primrose
L. octovalvis Common Water Primrose
L. palustris Marsh Purslane
L. peploides Smooth Water Primrose
L. grandiflora Hairy Water Primrose
Oenothera biennis Evening Primrose
O. laciniata Cut-Leaved Evening Primrose
O. speciosa Mexican Primrose
O. elata ssp. hirsutissima

***Ophioglossaceae,* Adder's-Tongue Family**
Ophioglossum crotalophoroides Bulbous Adder's-Tongue Fern

***Orchidaceae,* Orchid Family**
Habernaria repens Water-spider Orchid
Spiranthes cernua Nodding Ladies' -Tresses
S. lacera var. gracilis Fall Ladies'-Tresses
S. ovalis Oval Ladies'-Tresses
S. vernalis Spring Ladies'-Tresses

***Oxalidaceae,* Wood-Sorrel Family**
Oxalis debilis Rose Wood Sorrel
O. dillenii Sour-Grass
O. violacea Violet Sour-Grass

***Palmae (Araceae),* Palm Family**
Sabal minor Palmetto

***Passifloraceae,* Passion-Flower Family**
Passiflora incarnata Maypop
P. lutea Yellow Maypop

***Phrymaceae,* Lopseed Family**
Phryma leptostachya Loopseed

***Phytolaccaceae,* Pokeweed Family**
Phytolacca americana Pokeberry

***Pinaceae,* Pine Family**
Pinus taeda Loblolly Pine

***Plantaginaceae,* Plantain Family**
Plantago rhodosperma Redseed Plantain
P. virginica Paleseed Plantain

***Platanaceae,* Plane Tree Family**
Platanus occidentalis Sycamore

***Polemoniaceae,* Phlox Family**
Phlox pilosa Phlox

***Polygonaceae,* Buckwheat Family**
Brunnichia ovata Eardrop Vine
Polygonum cespitosum var. longisetum Smartweed
P. densiflorum
P. hydropiperoides Swamp Smartweed
P. lapathifolium Curltop Smartweed
P. pensylvanicum Pink Smartweed
P. punctatum Dotted Smartweed
P. ramosissimum Bushy Knotweed
P. scandens Hedge Smartweed
P. virginianum Jumpseed
Rumex chrysocarpus Amnastla
R. crispus Curly Dock
R. hastatulus Heart Sorrel
R. pulcher Fiddle Dock

***Polypodiaceae,* Fern Family**
Asplenium platyneuron Ebony Spleenwort
Onoclea sensibilis Sensitive Fern
Pleopeltis polypodioides Resurrection Fern
Polystichum acrostichoides Christmas Fern
Thelypteris kunthii Southern Shield Fern
Woodsia obtusa Blunt-Lobed Woodsia
Woodwardia areolata Chain Fern

Pontederiaceae, Pickerel-Wheel Family
Eichhornia crassipes Water Hyacinth

***Portulacaceae,* Purslane Family**
Claytonia virginica Spring Beauty
Portulaca oleracea Purslane

***Potamogetonaceae,* Pondweed Family**
Potamogeton diversifolius Pondweed
P. pusillus Pondweed

***Primulaceae,* Primrose Family**
Anagallis arvensis Scarlet Pimpernel
Centunculus minimus Chafweed
Hottonia inflata Featherfoil
Lysimachia radicans Loosestrife
Samolus valerandi var. *parviflorus* Water Pimpernel

***Ranunculaceae,* Crowfoot Family**
Clematis crispa Leather-Flower
Ranunculus hispidus var. *nitidus* Bottomland Crowfoot
R. muricatus Roughseed Crowfoot

Spider Lily *(Hymenocallis liriosme)*

Photograph by Michael Blessington

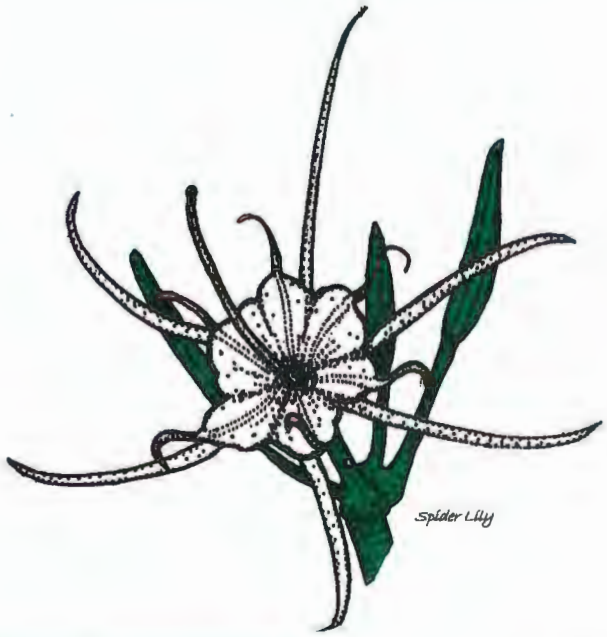
R. parviflorus Sticktight Crowfoot
R. pusillus Weak Crowfoot
R. sardous Common Crowfoot
***Rhamnaceae,* Buckthorn Family**
Berchemia scandens Rattan-Vine
Rhamnus caroliniana Carolina Buckthorn
***Rosaceae,* Rose Family**
Crataegus marshallii Parsley Hawthorn
C. opaca Mayhaw
C. spathulata Littlehip Hawthorn
*C. texana*Texas Hawthorn
C. viridis Green Hawthorn
Duchesnea indica Mock-Strawberry
Eriobotrya japonica Loquat
Geum canadense White Avens
Prunus caroliniana Laurel Cherry
P. umbellata Flatwoods Plum
Pyrus calleryana Red-Spire
Rubus argutus Blackberry
R. riograndis Dewberry
Spiraea cantoniensis Spiraea
***Rubiaceae,* Madder Family**
Cephalanthus occidentalis Buttonbush
Diodia teres Upright Buttonweed
D. virginiana Trailing Buttonweed
Galium aparine Bedstraw
G. pilosum Hairy Bedstraw
G. tinctorium Dye Bedstraw
Houstonia micrantha Little Bluet
H. pusilla Bluet
Mitchella repens Partridge Berry
Pentodon pentandrus
Richardia brasiliensis Tropical Mexican-Clover
Sherardia arvensis Field Madder
Spermacoce glabra Buttonweed
***Rutaceae,* Rue Family**
Poncirus trifoliata Trifoliate Orange
Zanthoxylum clava-herculis Prickly Ash
***Salicaceae,* Willow Family**
Populus deltoides Cottonwood
Salix nigra Black willow
***Salviniaceae* Salvinia Family**
Salvinia molesta
***Sapindaceae,* Soapberry Family**
Cardiospermum halicacabum Balloon-Vine
Sapindus saponaria var. *drummondii* Soapberry
***Sapotaceae,* Sapodilla Family**
Sideroxylon lanuginosum Gum Bumelia
***Saururaceae,* Lizard's-Tail Family**
Saururus cernuus Lizard's-Tail
***Saxifragaceae,* Saxifrage Family**
Lepuropetalon spathulatum
Penthorum sedoides Ditch Stonecrop
***Schizaeaceae,* Climbing Fern Family**
Lygodium japonicum Japanese Climbing Fern
***Scrophulariaceae,* Figwort Family**
Agalinis fasciculata Rough Agalinis
Bacopa monnieri Water Hyssop
B. rotundifolia
*Buchnera americana*Blue Hearts
Gratiola neglecta Sticky Hedge Hyssop
G. virginiana Virginia Hedge Hyssop
Leucospora multifida Narrowleaf Conobea
Lindernia crustacea Introduced Pimpernel
L. dubia False Pimpernel
Mazus pumilus
Mecardonia acuminata Sawtooth Water Hyssop
M. procumbens Yellow Mecardonia
Micranthemum umbrosum Mud-Flower
Mimulus alatus Monkey Flower
Nuttallanthus texanus Toadflax
Penstemon laxiflorus Beardtongue
Scoparia dulcis Sweetbroom
Verbascum thapsus Mullein
Veronica arvensis Corn Speedwell
V. peregrina Purslane Speedwell
***Solanaceae,* Nightshade Family**
Physalis angulata Smooth Groundcherry
P. heterophylla Clammy Groundcherry
P. longifolia Groundcherry
Solanum capsicastrum False Jerusalem
S. carolinense Horse Nettle
S. ptycanthum Black Nightshade
***Symplocaceae,* Sweet-Leaf Family**
Symplocos tinctoria Sweet Leaf
***Taxodiaceae,* Bald Cypress Family**
Taxodium distichum Bald Cypress
***Tiliaceae,* Linden Family**
Tilia americana var. *americana* Basswood
Tilia americana var. *caroliniana* Basswood
***Typhaceae,* Cat-Tail Family**
Typha latifolia Cattail
***Ulmaceae,* Elm Family**
Celtis laevigata Hackberry
Planera aquatica Planer Tree
Ulmus alata Winged Elm
U. americana American Elm
U. crassifolia Cedar Elm
***Umbelliferae (Apiaceae),* Parsley Family**
Chaerophyllum tainturieri Chervil
Ciclospermum leptophyllum Wild Celery
Cynosciadium digitatum
Daucus pusillus Southwestern Wild Carrot
Eryngium hookeri Hooker Eryngo
Hydrocotyle ranunculoides Water Pennywort
H. umbellata Water Pennywort
H. verticillatta Whorled Penneywort
Ptilimnium capillaceum Mock Bishop's Weed
Sanicula canadensis Black Snakeroot
Spermolepis divaricata Forked Scaleseed
Trepocarpus aethusae
***Urticaeae,* Nettle Family**
Boehmeria cylindrica False Nettle
Parietaria pensylvanica Pellitory
Urtica chamaedryoides Stinging Nettle
***Valerianaceae,* Valerian Family**
Valerianella radiata Corn Salad
***Verbenaceae,* Vervain Family**
Callicarpa americana Beautyberry
Lantana camera
Phyla lanceolata Frogfruit
P. nodiflora Frogfruit
Verbena brasiliensis Brazilian Vervain
V. canadensis Canadian Vervain
V. officinalis Slender Vervain
V. xutha Coarse Vervain
V. urticifolia White Vervain
***Violaceae,* Violet Family**
Viola palmata Lobed Blue Violet
V. sororia var. sororia Unlobed Blue Violet
***Viscaceae,* Mistletoe Family**
Phoradendron leucarpum Mistletoe
***Vitaceae,* Grape Family**
Ampelopsis arborea Peppervine
A. cordata False Grape
Parthenocissus quinquefolia Virginia Creeper
Vitis aestivalis var. aestivalis Summer Grape
V. cinerea var. cinerea Sweet Grape
V. mustangensis Mustang Grape
V. palmata Red Grape
V. rotundifolia Muscadine Grape

Fragrant Water Lily *(Nymphaea odorata)*
Photograph by Michael Blessington

TEXAS PARKS AND WILDLIFE

WETLAND PLANTS OF SHELDON LAKE STATE PARK

AND ENVIRONMENTAL LEARNING CENTER



A FIELD GUIDE

2014

April 15, 2019

Publication: TAMU-SG-14-418

Cover illustration by Melissa LaChance adapted from "Aquatic and Wetland Plants of the Western Gulf Coast" by Charles Stutzenbaker

Created by Amanda Solitro 2014

The Value of Wetlands

Wetlands are the transition zones between the land and open water, or as you see here at Sheldon Lake State Park, the transition area between the high prairie down to the open pond. These wetlands are dependent on rainfall and experience fluctuations in water levels throughout the year based on rainfall. However, these habitats are well-adapted to these changes, which may change with the season or within periods of drought.

Wetlands have many unique natural characteristics which provide both ecological and functional benefits that are irreplaceable. These include floodwater storage, protecting and improving water quality, and providing habitat for both fish and wildlife.

These critical habitats, however, are diminishing on our landscape. According to the US Fish and Wildlife Service, less than 1% of this precious habitat, prairie wetlands, exist along the Texas-Lousiana coastline. The egregious loss makes the restoration of wetland habitats, like those here at Sheldon Lake State Park, vital and essential to the vitality of our native landscape.

PLANTS YOU MIGHT ENCOUNTER IN THE PRARIE WETLANDS...

Canna, *Canna glauca*

Usually found in marshes and swamps; Yellow flowers may be seen throughout summer; can grow to be 3-6 feet tall; thrive in water-logged mineral soils.

Virginia iris, *Iris virginica*

Can grow up to two feet tall; possess large blue to purple colored flowers; leaves are narrow and pointed; ideal for ponds, marshes, or ditches.

Maidencane, *Panicum hemitomon*

An aquatic to semi-aquatic grass; can grow up to three feet tall; provides food, protection, and nesting materials for wildlife.

Woolly Rose-mallow, *Hibiscus moscheutos*

Large perennial with heart shaped leaves; large white blossoms with a crimson eye at the center; petals of the blossom fold up at night.

Pickerel Weed, *Pontederia cordata*

Resides in freshwater zones where salinity ranges 0-0.5 ppt; flowers are blue and marked with yellow; leaves are heart shaped.

American Lotus, *Nelumbo lutea*

Perennial often confused for water lilies; leaves are conical if emerged and flat if floating; large white fragrant flower.

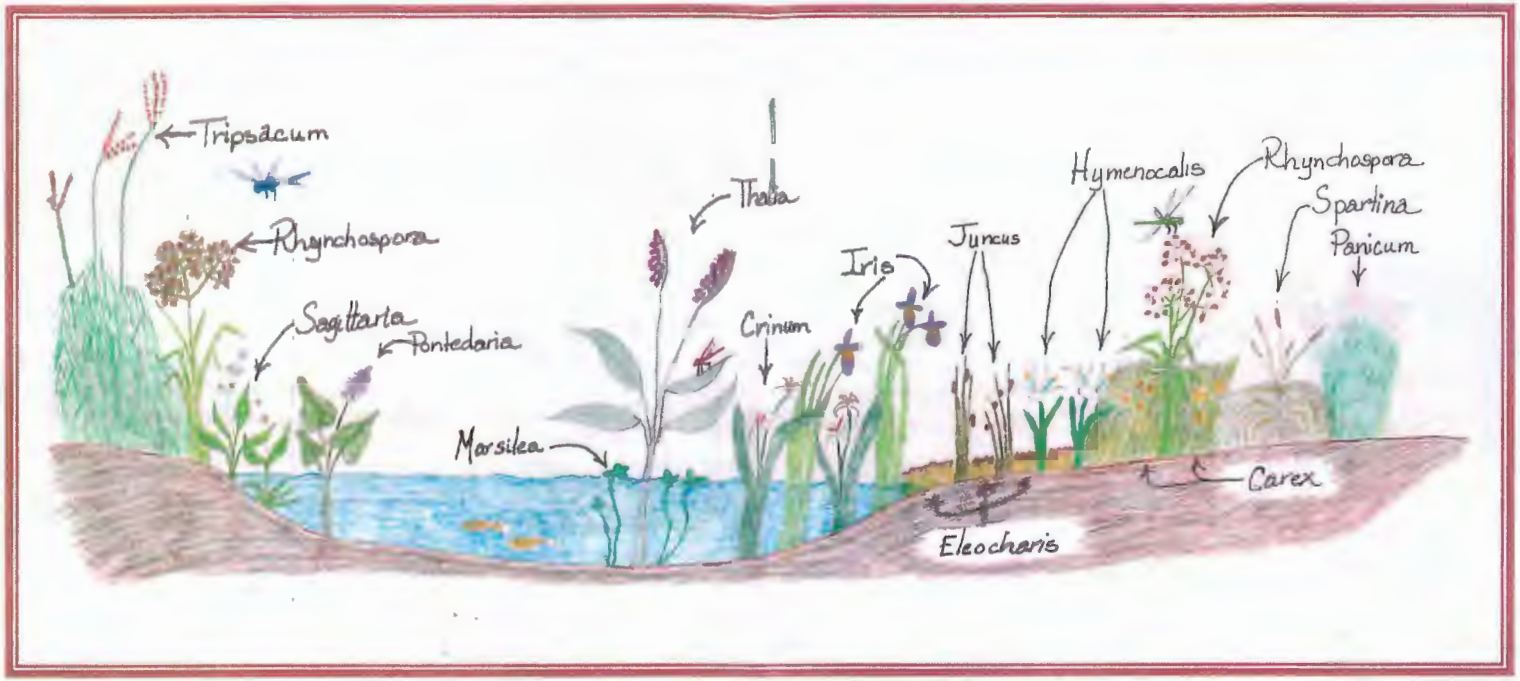
Marsh Hay Cordgrass, *Spartina patens*

Often be found growing in dense colonies on elevated ridges in freshwater marshes and shallow ponds; can thrive in low salinity ranges.

Spider Lily, *Hymenocallis liriosme*

Flowers can be very fragrant; can grow to be 1-3 feet tall, with 2-3 blossoms at the top; flowers have showy long petals.

Cross section of a Generalized Prairie Wetland



Wetland restoration involves more than just replacing what has been disturbed, displaced or destroyed.

Here at Sheldon Lake State Park, the original wetland basins were plowed and filled for agricultural purposes, leaving little or no "signatures" on the surface of where these basins once existed. To restore these critical wetlands, they were first identified and mapped, which allow for their re-excavation. Low levees were erected to hold water within the basins—mimicking the original hydrology of the area. The final step of planting the basins, completed the restoration. Six years later, vegetation monitoring showed the Sheldon-Sipocz method of re-excavating and restoring intact buried wetlands has proven to be a success.

Powdery Thalia, *Thalia dealbata*

Purple and blue flowers covered with a white powdery coating; aquatic perennial; can grow 3-6 feet tall.

Thinscale Sedge, *Carex hyalinolepis*

Produces an abundance of seeds eaten by small birds, waterfowl, and rodents; typically found in swamps and periodically wet areas.

American Bulrush, *Shoenoplectus pungens*

Resides in fresh to intermediate marshes and often forms large dense colonies; triangular stem with leaves found only at the base.

White water lily, *Nymphaea Odorata*

Floating aquatic plant with large, white, fragrant flowers; flat, round, floating leaves with one flower to every stem.

Delta duck potato, *Sagittaria platyphylla*

Commonly growing in freshwater marshes and roadside ditches; seed heads are shorter than the leaves; tubers are consumed by ducks and geese.

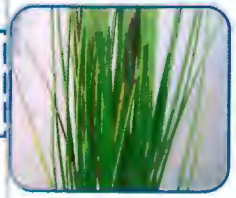
Square stem spikerush, *Eleocharis quadrangulata*

Stems of this plant is square (quadrangular) in shape; most commonly found in organic soils of freshwater ponds and marshes.

Southern cutgrass, *Leersia hexandra*

Leaves have sharp edges; can grow up to six feet tall with leaves that are 2-3 feet long; can tolerate salinities between 0 to 0.5 ppt.

Soft rush, *Juncus effusus*



May be found as a single clump, a colony of clumps, or single stems reaching several feet; has no leaves; seed heads appear on the side of the stem.

April 15, 2019

WETLAND RESTORATION T·E·A·M

A PARTNERSHIP OF Texas Coastal Watershed Program & Texas Master Naturalist Program

Come and volunteer to restore wetlands

Contact m-sipocz@tamu.edu to be added to the Listserv

April 15, 2019

April 15, 2019

Prairie Plants at Sheldon Lake State Park

Similar to the Wetland Restoration Team, the Prairie Team has worked on restoring the prairie edges and uplands adjacent to the ponds. Their volunteer effort has been equally heroic, producing thousands of potted, well-established prairie grasses and forbs for all phases of the restoration at Sheldon Lake State Park.

Panicum virgatum	*Silphium spp.*
Tripsacum dactyloides	*Veronia baldinii*
Muhlenbergia capillaris	*Monarda citriodora*
Schizachyrum scoparium	*Salvia azurea*
Triden strictus	*Sorghastrum nutans*
Eragrostis intermedia	*Eryngium yuccifolium*
Elymus canadenis	*Helianthus angustifolius*
Bouteloua curtipendula	*Bothriochloa saccharoides*
Andropogon gerardii	*Spartina spartinae*
Paspalum plicatulum	*Paspalum floridanum*
Centaurea Americana	*Saccharum giganteum*
Amsonia tabernaemontana	*Andropogon ternarius*
Rudbeckia hirta	*Ratibida Columnifera*
Hyptis alata	*Baptisia sphaerocarpa*
Rudbeckia texana	*Eryngium hookerii*
Guara lindheimerii	*Arnoglossum plantagineum*
Liatris acidota	*Liatris pynostachya*

Wetland Plants at Sheldon Lake State Park

Andropogon glomeratus
Bacopa monnieri
Bacopa rotundifolia
Canna glauca
Carex hyalinolepis
Carex joorii
Cladium jamaicense
Crinum americanum
Cyperus articulatus
Cyperus virens
Echinodorus rostratus
Eleocharis macrostachya
Eleocharis montevidensis
Eleocharis montana
Eleocharis quadrangulata
Fimbristylis autumnalis
Hibiscus moscheutos
Hydrolea ovata
Hymenocallis liriosme
Iris virginica
Iris brevicaulis
Juncus marginatus
Juncus effusus
Juncus nodatus
Juncus validus
Juncus diffusisimus
Juncus scirpoides
Leersia hexandra
Leptochloa nealleyi
Marsilea vestita
Nymphea odorata
Panicum hemitomon
Panicum virgatum
Paspalidium geminatum
Physostegia virginiana
Polygonum hydropiperoides
Pontederia cordata
Potamogeton nodosus
Rhynchospora caduca
Rhynchospora colorata
Rhynchospora indianalensis
Rynchospora corniculata
Saccharum balwinii
Sagittaria graminea
Sagittaria longiloba
Sagittaria papillosa
Sagittaria platyphylla
Saururus cernuus
Scirpus pungens
Scirpus olneyii
Spartina patens
Spartina spartinae
Thalia dealbata
Tradenscantia ohiensis
Tripsacum dactyloides
Utricularia radiata
Xyris iridifolia

Wetland Planting efforts conducted by Wetland Restoration Team, a trained crew of Master Naturalist volunteers working with the guidance of Texas Parks and Wildlife Department and Texas A&M AgriLife Extension Service/Texas Sea Grant.

Wetland Plants at Sheldon Lake State Park

Scientific Name	Common Name	Wetland Status
Andropogon glomeratus	bushy bluestem	FACW
Bacopa monnieri	herb of grace	OBL
Bacopa rotundifolia	disk waterhyssop	OBL
Canna glauca	maraca amarilla	OBL
Carex hyalinolepis	shoreline sedge	OBL
Carex joorii	Carex joorii	OBL
Cladium jamaicense	Jamaica swamp sawgrass	
Crinum americanum	seven sisters	OBL
Cyperus articulatus	jointed flatsedge	OBL
Cyperus virens	green flatsedge	FACW
Echinodorus rostratus	upright burhead	OBL
Eleocharis macrostachya	pale spikerush	
Eleocharis montevidensis	sand spikerush	FACW
Eleocharis montana	mountain spikerush	OBL
Eleocharis quadrangulata	squarestem spikerush	OBL
Fimbristylis autumnalis	slender fimbry	OBL
Hibiscus moscheutos	crimsoneyed rosemallow	OBL
Hydrolea ovata	ovate false fiddleleaf	OBL
Hymenocallis liriosme	spring spiderlily	OBL
Iris virginica	Virginia iris	OBL
Iris brevicaulis	zigzag iris	OBL
Juncus marginatus	grassleaf rush	FACW
Juncus effusus	common rush	OBL
Juncus nodatus	stout rush	OBL
Juncus validus	roundhead rush	FACW
Juncus diffusissimus	slimpod rush	FACW
Juncus scirpoides	needlepod rush	FACW
Leersia hexandra	southern cutgrass	OBL
Leptochloa nealleyi	Nealley's sprangletop	OBL
Marsilea vestita	hairy waterclover	OBL
Nymphaea odorata	American white waterlily	OBL
Panicum hemitomon	maidencane	OBL
Panicum virgatum	switchgrass	FAC
Paspalidium geminatum	Egyptian panicgrass	OBL
Physostegia virginiana	obedient plant	FACW
Polygonum hydropiperoides	swamp smartweed	OBL
Pontederia cordata	pickerelweed	OBL
Potamogeton nodosus	longleaf pondweed	OBL
Rhynchospora caduca	anglestem beaksedge	OBL
Rhynchospora colorata	starrush whitetop	FACW
Rhynchospora indianolensis	Indianola beaksedge	FACW
Rhynchospora corniculata	shortbristle horned beaksedge	OBL
Saccharum baldwinii	narrow plumegrass	OBL
Sagittaria graminea	grassy arrowhead	OBL
Sagittaria longiloba	longbarb arrowhead	OBL

Wetland Plants at Sheldon Lake State Park

Scientific Name	Common Name	Wetland Status
Sagittaria papillosa	nipplebract arrowhead	OBL
Sagittaria platyphylla	delta arrowhead	OBL
Saururus cernuus	lizard's tail	OBL
Schoenoplectus pungens	common threesquare	OBL
Schoenoplectus americanus	chairmaker's bulrush	OBL
Spartina patens	saltmeadow cordgrass	FACW
Spartina spartinae	gulf cordgrass	OBL
Thalia dealbata	powdery alligator-flag	OBL
Tradescantia ohiensis	bluejacket	FAC
Tripsacum dactyloides	eastern gamagrass	FAC
Utricularia radiata	little floating bladderwort	OBL
Xyris iridifolia	irisleaf yelloweyed grass	

P. Cultural Resources Consultation

res

FEB 0 3 2015

January 30, 2015

Texas Historical Commission
P.O. Box 12276
Austin, TX 78711-2276
Attn: Mark Wolfe

RE: Proposed Cow Island Bayou Mitigation Bank Site Request for SHPO Consultation

Dear Mr. Wolfe:

Resource Environmental Solutions, LLC. (RES) has prepared and enclosed the following items for a Request for SHPO Consultation in regards to our proposed Cow Island Bayou Mitigation Bank (Mitigation Bank):

- Texas Historical Commission Request for SHPO Consultation Form.
- Attachment A: Maps
- Attachment B: Photographs

This letter will outline the Project Work Description and will identify Historic Properties and the Area of Potential Effects. Besides consulting with the Texas Historical Commission, no other consulting parties/public notification have been carried out, as no formal submissions for this project have occurred at this time.

No professional that meets the Secretary of the Interior's Professional Qualifications Standards is involved in the completion of the form or attachments. It is understood that the THC will make a determination of effect based on the information provided.

The Mitigation Bank is located on an 316.9 acre tract in Liberty County approximately 5.5 miles north of the town of Hankamer, Texas and adjacent to Cow Island Bayou (Attachment A, Figure 1). The project area is located within a larger parcel, which RES owns. The tract is located west of Texas State Highway 61, between Interstate 10 and U.S. Highway 90 E. The approximate site center is located between the geographic limits of the United States Geological Survey (USGS) 7.5-minute quadrangles "Shiloh" and "Whites Bayou" at Latitude 29.935641 north and Longitude -94.626332 west.

412 N. Fourth St., Suite 300
Baton Rouge, LA 70802
P 225.372.6161
F 225.372.6162

5020 Montrose Blvd., Suite 650
Houston, TX 77006
P 713.520.5400
F 713.520.5401

643 Magazine St., Suite 402
New Orleans, LA 70130
P 504.493.6148

1738 E. Third St., Suite 175
Williamsport, PA 17701
P 717.829.0017

The Mitigation Bank Site Instrument proposes to enhance, restore and protect the wetland resources throughout the site in order to mitigate for unavoidable impacts to aquatic resources elsewhere. The nature of wetland restoration will require ground disturbance.

Existing Conditions:

Figure 2 shows the requisite USGS 7.5" Topographic Map overlaid with the project boundary. Figure 3 shows present day aerial coverage of the site. Land cover on site is almost 100% pasture, with no present grazing occurring. Cattle were removed from the property one year ago. There are multiple drainages, levee roads, and pipelines within the site. Representative site photos are included as Attachment B to show existing conditions on site.

There are no historic structures identified within the project footprint. However, there is a recently constructed pre-fabricated barn structure on site.

Historic Land Cover Changes:

Note that because this property lies between two USGS 7.5" Topographic Map areas, historic topographic maps were not always available in the same year. Maps were combined in as close of temporal proximity as possible. The earliest available maps of this area are from 1943 and 1952 (Attachment A, Figure 4). The earliest available aerial imagery is from 1952 (Attachment A, Figure 5). While the topographic maps show the site to have been largely forested or at least vegetatively unmaintained, the aerial imagery shows the site to have been largely cleared, with a small island of forest remaining in the center of the site, and surrounding what is likely a drainage feature running diagonally in the northwestern corner of the site.

According to topographic maps from 1961, the site had been fully cleared, a pipeline had been constructed through the site, and multiple drainages and berms had been established onsite for rice production (Attachment A, Figure 6). By 1993, drainages had been extended through the site, and an additional pipeline was constructed through the site (Attachment A, Figure 7). Aerial imagery from 1996 shows that the site was still used for rice production (Attachment A, Figure 8). Present day use has been for cattle pasture and bahia grass production (Attachment A, Figure 3).

Project Work Description:

The Area of Potential Effects (APE) is the entire footprint of the site, 316.9 acres. The majority of the work will entail microtopographic alterations, including:

- The plugging and possible filling/deconstruction of all swales, ditches, ponds, roads, and levees/berms within the site that have no third-party easements on them.
- The development of perimeter berms (less than 2 feet in height) with outflow control weirs that will allow for rainwater catchment and hydrologic flow into Cow Island Bayou. When possible, soil from prior spoil piles will be used in the construction of the berm system. No fill will come from off site.
- Tilling the land (6 inches in depth), sub-soiling in 9 foot increments (8-10 inches in depth) for tree planting, and native tree planting.

Please contact me at 281.254.7179 should you have any questions regarding this request or the contents of the report.

I look forward to working with you on this request.

Sincerely,

Kristine Swann

NO HISTORIC PROPERTIES AFFECTED
PROJECT MAY PROCEED
by
for Mark Wolfe
State Historic Preservation Officer
Date 2-18-15
Track#

Kristine Swann

Restoration Ecologist
Resource Environmental Solutions, L.L.C.
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Mobile: 832.512.7459
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