Attachment D-4
Essential Fish Habitat Assessment

ESSENTIAL FISH HABITAT ASSESSMENT

GULF INTRACOASTAL WATERWAY, BRAZOS RIVER FLOODGATES AND COLORADO RIVER LOCKS FEASIBILITY STUDY

US Army Corps of Engineers ®

Texas Department of Transportation ®

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Acronyms and Abbreviations

Acronym or Abbreviation	Definition or Meaning
BMP	Best management practices
BRFG	Brazos River Floodgates
CFR	Code of Federal Regulations
CRL	Colorado River Locks
DMPA	Dredged material placement areas
EFH	Essential Fish Habitat
FR-EIS	Integrated Feasibility Report-Environmental Impact Statement
FMP	Fishery management plan
GIWW	Gulf Intracoastal Waterway
GMFMC	Gulf of Mexico Fishery Management Council
HAPC	Habitat Areas of Particular Concern
H&H	Hydrology and hydraulics
NCCOS	National centers for Coastal Ocean Science
NEPA	National Environmental Policy Act
NMFS	National Marine Fishery Service
ODMDS	Ocean dredged material disposal sites
PED	Planning, Engineering, and Design
ppt	Parts per thousand
SONAR	Sound Navigation and Ranging
TxDOT	Texas Department of Transportation
USACE	U.S. Army Corps of Engineers

1.0 INTRODUCTION

The United States Army Corps of Engineers (USACE), in cooperation with the Texas Department of Transportation (TxDOT) Maritime Division, is conducting a feasibility study to investigate improvements to the Gulf Intracoastal Waterway (GIWW), Brazos River Floodgates (BRFG) and Colorado River Locks (CRL) facilities that would reduce navigational difficulties, delays, and accidents occurring as tow operators transit the BRFG and CRL structures and across the Brazos and Colorado Rivers. As part of the Feasibility Study, the USACE has prepared an integrated Feasibility Report and Environmental Impact Statement (FR-EIS) in compliance with the National Environmental Policy Act (NEPA), USACE regulation ER-200-2, 33 Code of Federal Regulations (CFR) 230, the Flood Control Act of 1970 – Section 216, and other Federal, state, and local environmental policies and procedures.

This assessment was prepared to fulfill the USACE's requirements under the Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-297), which addresses the authorized responsibilities for the protection of essential fish habitat (EFH) by the National Marine Fisheries Service (NMFS) in association with regional Fishery Management Councils. The Act establishes eight regional Fishery Management Councils responsible for the protection of marine fisheries within their respective jurisdictions. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." This definition extends to habitat specific to an individual species or group of species, whichever is appropriate, within each Fishery Management Plan (FMP). The Act also authorizes the designation of Habitat Areas of Particular Concern (HAPC) for marine fisheries. HAPCs are subsets of EFH that are rare, susceptible to human degradation, ecologically important, or located in an ecologically stressed area. Any Federal agency that proposes an action that potentially affects or disturbs EFH must consult with the Secretary of Commerce and Fishery Management Council authority per the Magnuson-Stevens Act, as amended (2005). Interim final rules were published on December 19, 1997, in the Federal Register (Vol. 62. No. 244) to establish guidelines for the identification and description of EFH in fishery management plans. These guidelines include impacts from fishing and non-fishing activities as well as the identification of actions needed to conserve and enhance EFH. The rule was established to provide protection, conservation, and enhancement of EFH.

Per 50 CFR 600.920(e)(3), all EFH assessments must include the following information:

1. Description of the action;
2. Analysis of the potential adverse effects of the action on EFH and the managed species;
3. Federal agency's conclusions regarding the effects of the action on EFH; and
4. Proposed mitigation, if applicable.

This assessment includes a description of the proposed action (Section 2.0), a review of EFH and managed species in the BRFG and CRL study areas (Section 3.0), and discussion of the anticipated effects of the proposed action on EFH and managed species and proposed mitigation (Section 4.0).

2.0 DESCRIPTION OF THE PROPOSED ACTION

2.1 Background Information

The GIWW is a shallow-draft navigation channel that extends from Brownsville, Texas, to the Okeechobee waterway at Fort Meyers, Florida. The authorized channel in the GIWW is 125 feet wide and is typically about 12 feet deep. The GIWW is an essential component of the transportation network of Texas and the nation, reducing congestion on highway and rail systems, thereby decreasing maintenance costs and extending the life of these transportation systems. Compared to truck or rail transport, the use of barges to transport goods produces fewer air emissions, is more fuel-efficient, and provides a safer mode of transportation. The GIWW is also used by the commercial fishing industry and for recreational activities such as fishing, skiing, sightseeing, and traveling long distances in the protected waterway (TxDOT 2016).

The BRFG and CRL are two lock-type structures on the GIWW located about 40 miles apart on the upper to mid-Texas coast, in Brazoria and Matagorda Counties, respectively (**Figure 1**). They were initially installed in the early 1940s to prevent heavy sediment loads in the Brazos and Colorado Rivers from entering the GIWW. The structures are over 60 years old and were installed at a time when most tug boats pulled barges behind them, rather than using the modern pushing method. At each facility, the gate openings are 75 feet wide, which is much narrower than the 125-foot-wide GIWW navigation channel. Although regulations restrict the width of tows to 55 feet, oversize tow permits are routinely granted for tows as wide as 108 feet, particularly along the upper Texas coast (TxDOT 2016). To move these wider tows through the BRFG and CRL, vessel operators must park the tows, break the barges apart, move them through the locks in smaller sets or individually, and reconnect the tows on the other side. This process, known as "tripping," is inefficient and causes delays that result in substantial costs to the towing industry each year (TxDOT 2013). In addition to the narrow gates, high flows in the Brazos and Colorado Rivers make navigation through the BRFG and CRL structures more difficult and result in temporary navigation restrictions and/or closures imposed by the USACE and U.S. Coast Guard. These restrictions and closures result in additional delays and economic impact to the towing industry.

2.2 Project Location

As described above, the BRFG and CRL are located about 40 miles apart on the upper to mid-Texas coast, in Brazoria and Matagorda Counties, respectively (**Figure 1**). For each facility, existing environmental conditions were evaluated within a study area that encompassed the maximum disturbance area for the reasonable alternatives. The BRFG study area encompasses roughly 600 acres and extends along the GIWW 1 mile east and west of the Brazos River crossing and up to 0.5 mile along the Brazos river north and south of the GIWW crossing (**Figure 2)**. The CRL study area encompasses roughly 400 acres and extends along the GIWW 1 mile east and west of the Colorado River crossing and up to 0.25 mile along the Colorado River north and south of the GIWW crossing (**Figure 3)**. Under the reasonable alternatives, all direct construction activities and impacts to EFH would occur within these study areas. In addition to the study areas, EFH and potential for managed species were evaluated in the surrounding areas to assess potential indirect effects to these resources.

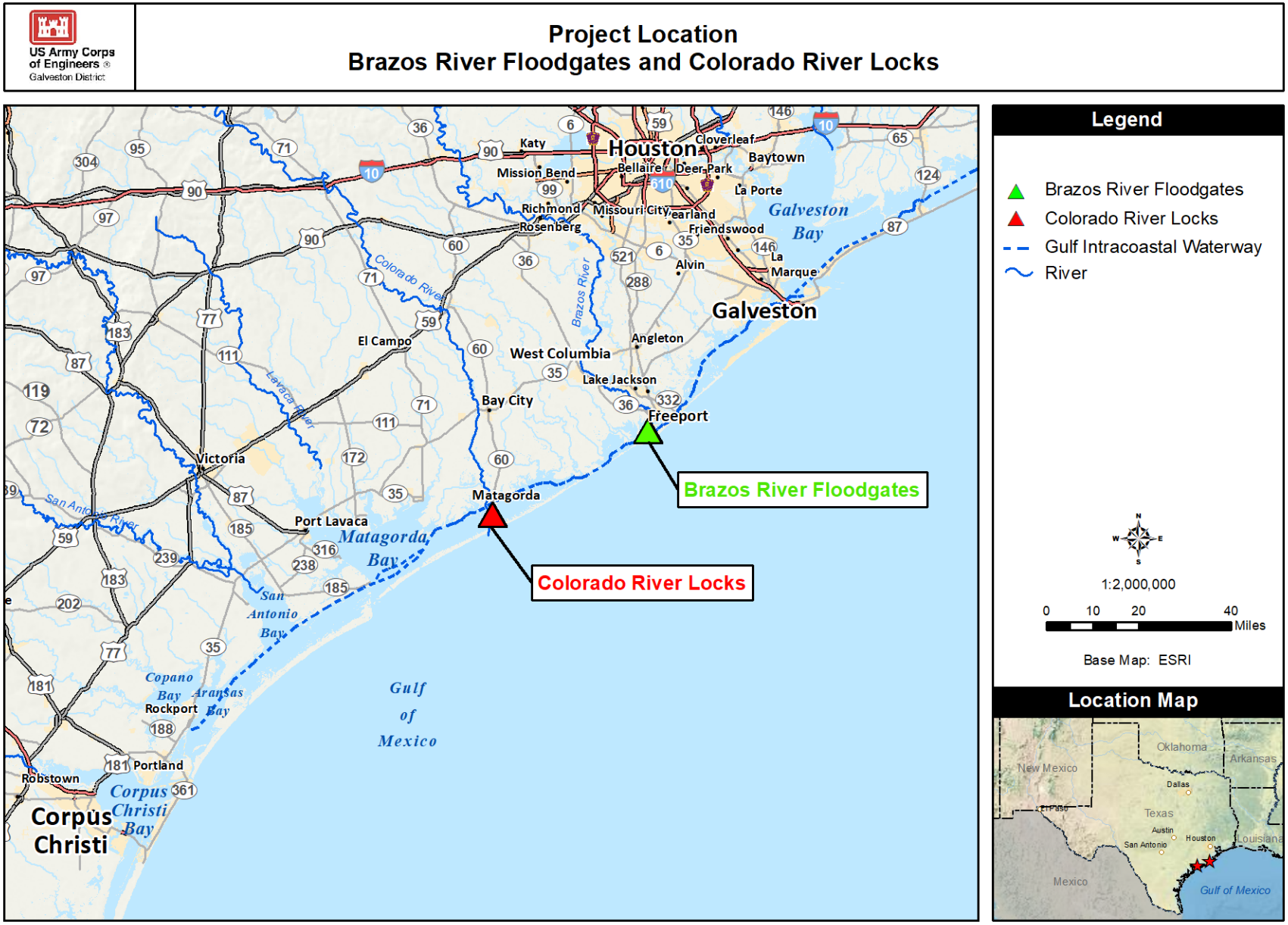

Figure 1 Project Location

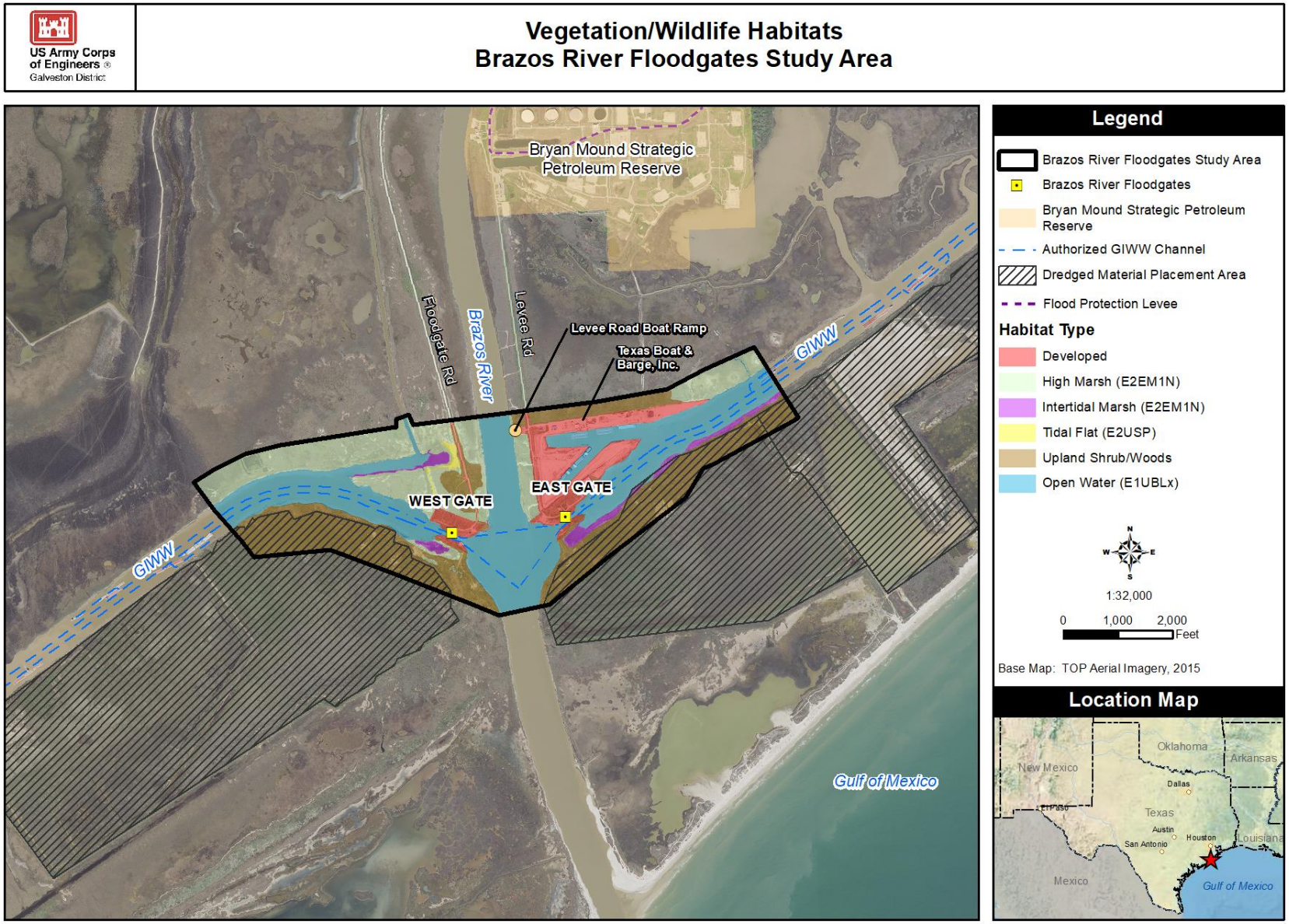

Figure 2 Habitats in BRFG Study Area

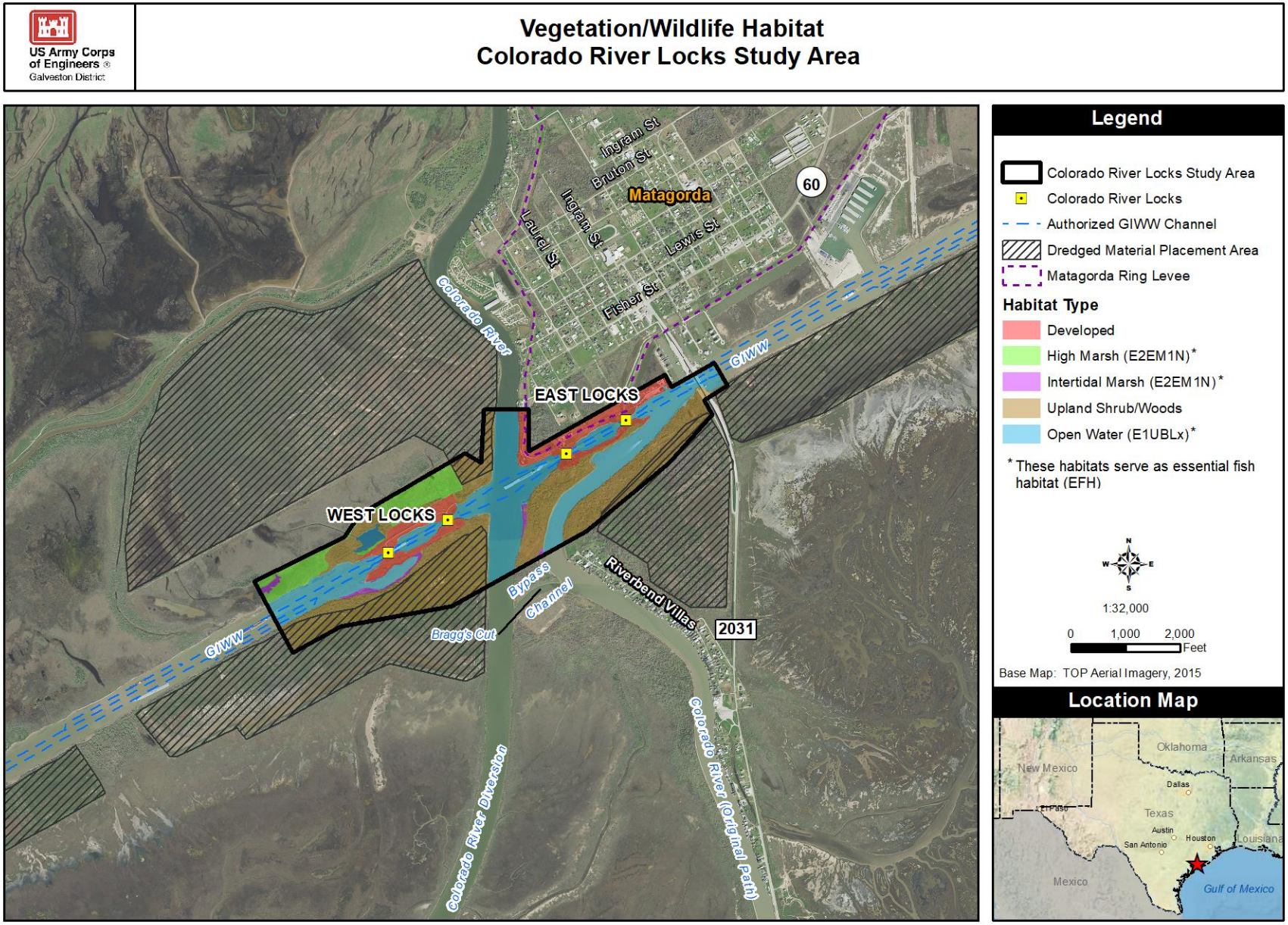

Figure 3 Habitats in CRL Study Area

2.3 Summary of Alternatives Considered

The FR-EIS describes the alternatives that were evaluated for the project, but the alternatives are also summarized here for reference. Early on in alternatives development, the USACE and TxDOT identified a number of alternatives that involved various measures to improve navigation through the BRFG and CRL facilities. Through multiple screening efforts, the USACE and TxDOT narrowed the reasonable alternatives to the No Action Alternative and five Action Alternatives at the BRFG facility, and the No Action Alternative and three Action Alternatives at the CRL facility. In an effort to minimize environmental impacts, the disturbance areas associated with the reasonable alternatives are located in and adjacent to the existing GIWW, BRFG, and CRL facilities. The USACE and TxDOT further evaluated these alternatives through hydrology and hydraulics (H&H) modeling, economic analysis, and environmental analysis to identify a Recommended Plan. **Table 1** lists the alternatives, provides a general overview of each alternative, and provides an estimated area that would be affected by the alternative.

Table 1. Summary of BRFG and CRL Alternatives Considered

Alternative	Alternative Overview	Estimated Acreage Affected	Recommended Plan?
BRFG Alternatives			
No Action	No improvements would be made to the BRFG facility. Normal maintenance activities would continue.	0	No
2a	Rehab Existing Facilities – Rehabilitate existing floodgates, guide walls, and other infrastructure; no major changes to overall footprint, orientation, operations, or bathymetry; H&H and salinity modeling and analysis assume conditions would be the same as existing.	0[1]	No
3a	Gate Relocation on Existing Alignment – Move floodgates farther from Brazos River along existing GIWW alignment; widen chamber wall opening from 75 feet to 125 feet wide.	83	No
3a.1	**Open Channel West/East Gate Relocation – Similar to Alternative 3a but only includes a new east floodgate; removes west floodgate, leaving an open channel on the west side of the river.**	**79**	**Yes[2]**
9a	Open Channel – Remove floodgates and excavate an open channel north of the existing GIWW alignment to straighten this section of the GIWW.	75	No
9b/c	New Alignment/Gates with Control Structures – Excavate new channel north of existing GIWW alignment and construct 125-foot-wide floodgates on the new channel. Alt. 9c includes a flow control structure at existing west gate location, while Alt. 9b does not.	87	No
CRL Alternatives			
No Action	No improvements would be made to the BRFG facility. Normal maintenance activities would continue.	0	No
2a	Rehab Existing Facilities – Rehabilitate existing locks, guide walls, and other infrastructure as needed; no major changes to overall footprint, guide wall orientation, gate operations, or bathymetry; H&H and salinity modeling/analysis assume conditions would be the same as existing.	0[1]	No
3b	Open Channel – Remove existing locks, creating an open channel through the intersection at the GIWW.	71	No
4b.1	**Removal of Riverside Gates – Remove riverside gates, converting the locks to floodgates.**	**71**	**Yes[2]**

[1] BRFG Alternative 2a and CRL Alternative 2a would rehabilitate the existing facilities within the existing footprints.
[2] The Recommended Plan presented in the February 2018 DIFR-EIS was BRFG Alternative 3a.1 and CRL Alternative 4b.1.

The Recommended Plan that was presented to the public for review in the February 2018 DIFR-EIS included implementing Alternative 3a.1 (Open Channel West/East Gate Relocation) at the BRFG facility and Alternative 4b.1 (Removal of Riverside Gates) at the CRL facility. At the BRFG facility, the Recommended Plan consisted of(1) removing the existing floodgates, (2) constructing a new 125-foot-wide floodgate on the east side of the river (along the existing GIWW alignment and set back approximately 1,000 feet from the river), and constructing a minimum 125-foot-wide open channel (no floodgate) on the west side of the river crossing. At the CRL facility, the Recommended Plan consisted of the removal of the existing river side sector gate structures and rehabilitation of the existing GIWW side sector gate structures.

2.4 Refinement of the Recommended Plan

In consideration of public comments and further discussions with the navigation industry, the USACE and TxDOT refined the Recommended Plan at each facility. First, the GIWW alignment at both facilities was shifted to the south of the existing alignment in order to maintain operation of the existing structures during construction. This refinement was made in response to concerns that the originally proposed temporary bypass channel, which would have remained open during the entire 1 to 2 years of anticipated construction, would result in excessive sedimentation and maintenance dredging costs in the GIWW and Freeport Channel during that period. Second, at the CRL facility, the Recommended Plan was refined to remove all four existing gate structures and construction a new 125-foot-wide gate on each side of the river. The following sections describe the refined plans at each facility.

2.4.1 Refined Plan at the BRFG

At the BRFG, the main features of the Recommended Plan are the removal of the existing gates on both sides of the river crossing, the construction of a 125-foot-wide open channel (no gate structure) on the west side of the river, and construction of a new 125-foot-wide sector gate structure on the east side of the river. **Figure 4** shows the refined plan at the BRFG. Detailed drawings are provided in **Attachment 1**. The centerline of the GIWW through the BRFG area would be shifted 300 feet south of the existing centerline, allowing the existing floodgates to remain in operation until the new channel and west floodgate are completed. The open channel on the west side of the river will have a bottom width of 125 feet and bottom depth of -12 feet NAVD88. The new 125-foot-wide sector gate on the east side of the river will be set back approximately 1,300 feet from the existing gate structure, providing increased safety and efficient vessel operation through the crossing. Construction of the open channel and new sector gate at the BRFG will take approximately two years to complete, if adequate funding is provided. Assuming one contract, the general construction sequence will include the following:

- Dredge the new channel alignment on the west and east sides of the river, leaving a plug at the existing floodgates to maintain separation between the new channel and the river.
- Construct the new gate structure, guidewalls, and end cells on the east side of the river.
- Excavate the plugs at the river, and complete dredging of the new channel.
- Transfer navigation traffic to the new GIWW channel and gate structure.

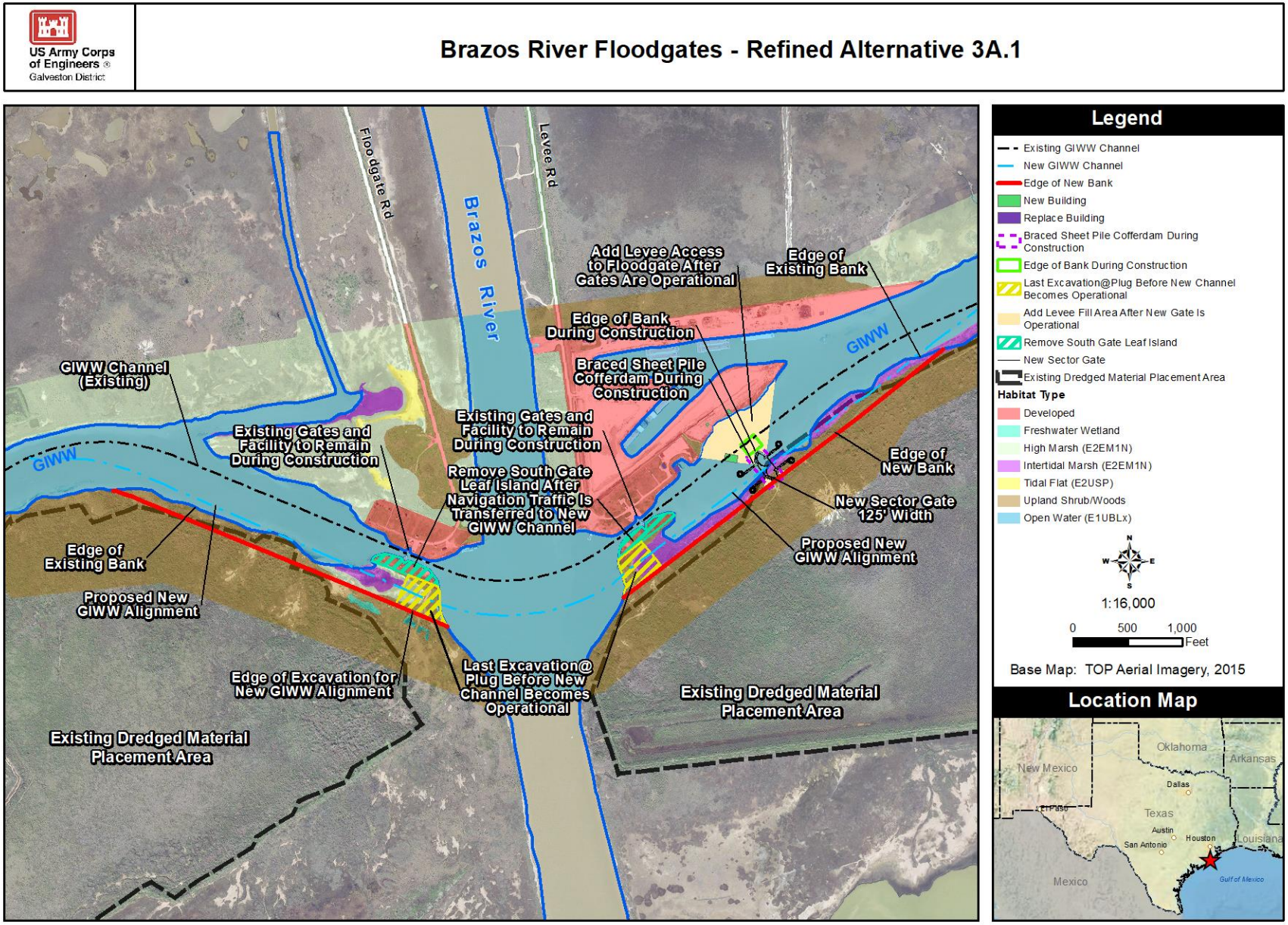

Figure 4 BRFG Refined Alternative 3a.1 in Relation to Vegetation/Wildlife Habitats

- Decommission existing floodgates, demolish the southern gate leaf on both sides of the river, and build levee access to the new gate structure.

- Complete final site work, including grading, parking, and support buildings.

Anticipated pile-driving activities associated with the proposed BRFG plan are outlined in **Table 2**.

Table 2. Anticipated Pile-Driving for the BRFG Recommended Plan

Project Component	Pile Size	Pile Type	Number of Piles	Hammer Type	Water Depth (meters)
Gate Structure Foundation	24”	Steel Pipe	246	Impact	< 5
Guidewalls	13”	Timber Piles	96	Impact	< 5
End Cells	18”	Steel Pipe	120	Impact	< 5
	20”	PS 31 Sheet Pile	930 LF	Impact	< 5
Needle Girder Storage	24”	Concrete	60	Impact	0 (on land)
Reservation Buildings	13”	Timber Piles	272	Impact	0 (on land)

2.4.2 Refined Plan at the CRL

At the CRL, the main features of the Recommended Plan are the decommissioning of all four existing gate structures and the construction of a new 125-foot-wide sector gate structure on the east and west sides of the river. **Figure 5** shows the refined plan at the BRFG. Detailed drawings are provided in **Attachment 1**. The centerline of the GIWW through the CRL area would be shifted 260 feet south of the existing centerline, allowing the existing lock structures to remain in operation until the new channel and gates are completed. The new channel will have a bottom width of 125 feet and bottom depth of -12 feet NAVD88. Construction of the new CRL facility will take approximately two years to complete, if adequate funding is provided. Assuming one contract, the general construction sequence will include the following:

- Dredge the new channel alignment on the west and east sides of the river, leaving a plug to maintain separation between the new channel and the river.

- Construct the new gate structures, guidewalls, and end cells on each side of the river.

- Excavate the plugs at the river, and complete dredging of the new channel.

- Transfer navigation traffic to the new GIWW channel and gate structures.

- Decommission the existing lock facilities, demolish the southern gate leaf at each gate, and build levee access to the new gate structures.

- Complete final site work, including grading, parking, and support buildings.

The new CRL gate structures will be the same general dimensions as the new BRFG gate structure, so pile-driving activities associated with the proposed CRL plan are expected to be double the anticipated pile-driving at the BRFG (**Table 3**).

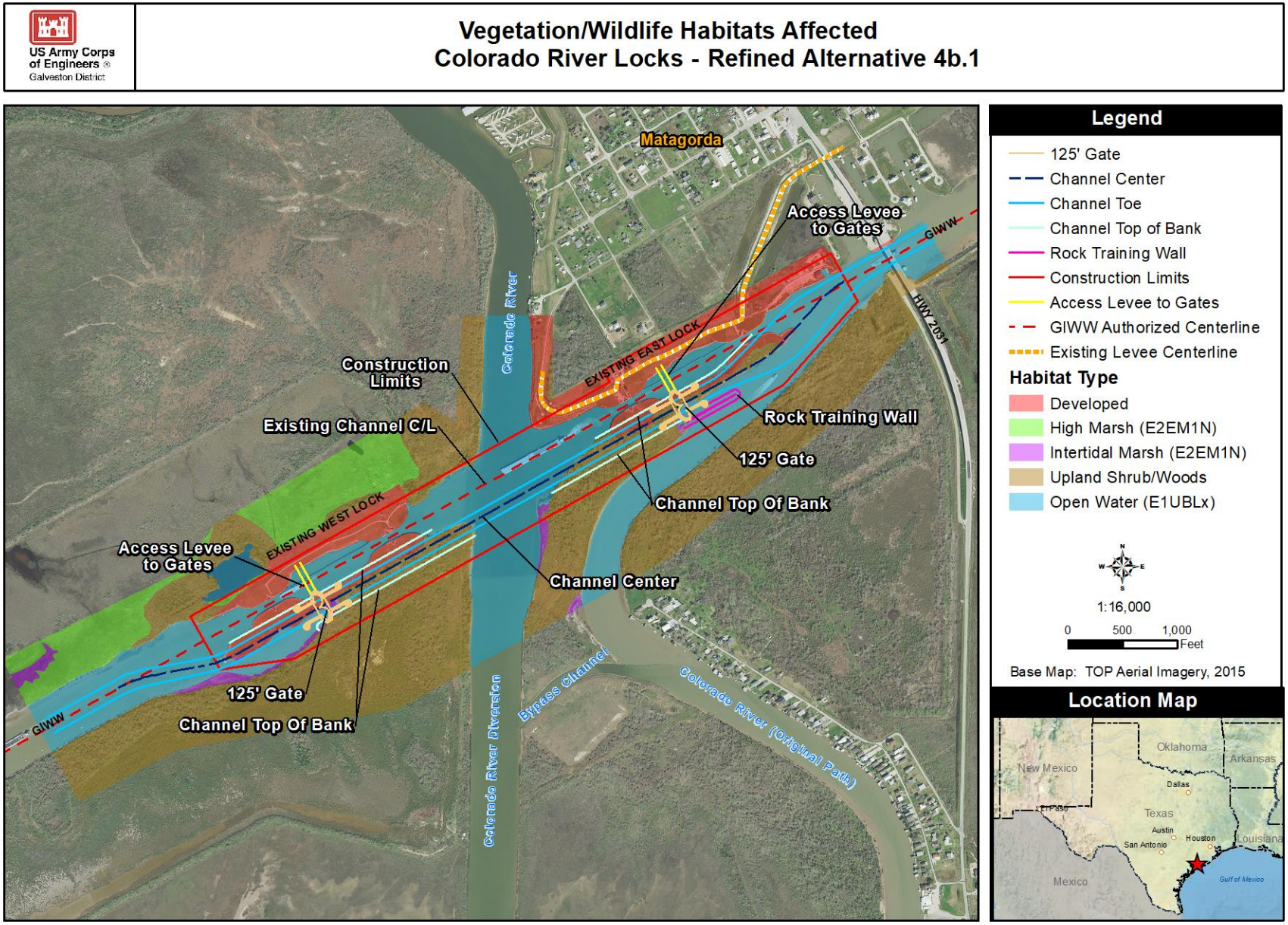

Figure 5 CRL Refined Alternative 4b.1 in Relation to Vegetation/Wildlife Habitats

Table 3. Anticipated Pile-Driving for the CRL Recommended Plan

Project Component	Pile Size	Pile Type	Number of Piles	Hammer Type	Water Depth (meters)
West Gate Structure					
Gate Structure Foundation	24”	Steel Pipe	246	Impact	< 5
Guidewalls	13”	Timber Piles	96	Impact	< 5
End Cells	18”	Steel Pipe	120	Impact	< 5
	20”	PS 31 Sheet Pile	930 LF	Impact	< 5
East Gate Structure					
Gate Structure Foundation	24”	Steel Pipe	246	Impact	< 5
Guidewalls	13”	Timber Piles	96	Impact	< 5
End Cells	18”	Steel Pipe	120	Impact	< 5
	20”	PS 31 Sheet Pile	930 LF	Impact	< 5
Reservation Buildings	13”	Timber Piles	272	Impact	0 (on land)
Flow Separator	22”	PZ-22 Sheet Pile	500	Vibratory	< 5

2.5 Potential Effects of the Recommended Plan

Potential effects of the Recommended Plan on EFH are expected to be relatively minor and localized, and losses of estuarine wetland habitats would be mitigated. The general setting of the study areas would not change, and the study areas would continue to be exposed to environmental factors that will affect the area, including hurricanes, climate change and projected sea level rises, local subsidence, and periodic disposal of dredged material from maintenance dredging. These effects are expected to be similar to the baseline conditions and to future without project conditions. Anticipated impacts of the Recommended Plan that may affect EFH are discussed in the following paragraphs.

Habitat Loss and Disturbance

The Recommended will result in the loss of estuarine wetland habitats at both facilities (**Table 4**). At the BRFG, the Recommended Plan would remove approximately 13.8 acres of wetlands, most of which consists of intertidal marsh that currently exists along the south side of the GIWW. At the CRL, the Recommended Plan would remove approximately 0.7 acre of wetland.

In addition to the anticipated wetland losses, the Recommended Plan is expected to affect roughly 94 acres of open water at the BRFG and 61 acres of open water at the CRL; however, most of the open water impacts consist of temporary construction impacts (e.g., barge access, pile driving, dredging, and turbidity) and were assumed to potentially affect the entire area of open water present in the study area between the points where the new GIWW alignment converges with the existing GIWW alignment. Approximately 6.7 acres of open water at the BRFG and 2.8 acres of open water at the CRL would be filled to construct the new floodgates and levee access. In contrast, an estimated 27 acres of open water would be created at the BRFG, and an estimated 11 acres of open water would be created at the CRL by realigning the GIWW and removing existing portions of the existing floodgate structures. Therefore, the Recommended Plan would result in a net increase in open water in the study areas.

During the Planning, Engineering, and Design (PED) phase, the USACE will incorporate best management practices (BMPs) and other options for further reducing impacts to wetlands, if possible, into detailed design

Table 4. Impacts to Habitats (acres)[1]

Habitat Type	Description of Habitat Type	BRFG Recommended Plan (Alternative 3a.1)	CRL Recommended Plan (Alternative 4b.1)
Open Water*	Open water areas include the GIWW and Brazos and Colorado Rivers. These areas provide habitat for fish, shrimp, crabs, bottlenose dolphins (*Tursiops truncatus*), and other estuarine species. Most of the open water habitat experiences regular disturbances by barge tows and other vessels traveling through the GIWW, as well as periodic maintenance dredging.	94.4[2,3]	61.0[2,3]
Intertidal Marsh*	Intertidal marsh are wetland areas that occur in the study areas at elevations between the low and high tides (intertidal zone). These areas are dominated by smooth cordgrass (*Spartina alterniflora*), with species common to the high marsh habitat present along the edges.	11.4	0.7
High Marsh*	High marsh habitat occurs in the study areas at low elevation areas that are only infrequently inundated by very high tides. Common plant species observed in this habitat include turtleweed (*Batis maritima*), saltgrass (*Distichlis spicata*), saltworts (*Salicornia* spp.), Gulf cordgrass (*Spartina spartinae*), marshhay cordgrass (*S. patens*), sea-oxeye daisy (*Borrichia frutescens*), seepweed (*Suaeda linearis*), and marsh-elder (*Iva frutescens*). Scattered threesquare (*Schoenoplectus pungens*), wolfberry (*Lycium carolinianum*), saltcedar (*Tamarix ramosissima*), smooth cordgrass (*Spartina alterniflora*), and common reed (*Phragmites australis*) were also observed.	2.4	0
Tidal Flat*	One small area of unvegetated tidal flat is located in the BRFG study area adjacent to an intertidal marsh. This habitat contained less than 5 percent plant cover; species include turtleweed, smooth cordgrass, saltwort, and saltgrass. Algal mats covered an estimated 50 percent of the flat during a February 2017 field investigation. The area also showed evidence of disturbance from cattle.	0	0
Freshwater Wetland	Two wetland areas with freshwater influence are present in the BRFG study area. Plant species in and adjacent to the wetlands include sea oxeye daisy, rattlebush (*Sesbania drummondii*), eastern baccharis (*Baccharis halimifolia*), Chinese tallow (*Triadica sebifera*), saltgrass, sand spikerush (*Eleocharis montevidensis*), common rush (*Juncus effusus*).	0	0
Upland Shrub/Woods	Upland shrub/woods vegetation occurs in high elevations in the study areas, such as portions of the river banks and in DMPAs.	14.0	11.4
Developed	Developed areas include the floodgate and lock facilities and a nearby private facility.	3.1	12.7
	Total	**125.3**	**85.8**

* These habitats serve as EFH.

[1] Most of the impacted areas identified in this table would be converted to open water to realign the GIWW, construct the open channel west of the Brazos River, and remove portions of the existing floodgate structures. Therefore, the project would result in a net increase in open water habitat.

[2] Most of the reported impacts to open water are temporary construction impacts (e.g., barge access, pile-driving, turbidity, dredging) and include the entire area of open water present in the study area between the beginning and end of the new GIWW alignment.

[3] Approximately 6.7 acres of open water at BRFG and 2.8 acres of open water at CRL would be filled to construct the new floodgates and levee access.

and construction plans. The USACE will also provide on-site, in-kind mitigation for the impacted wetlands. During detailed design, the excavation and placement plan will include areas within both project sites in which to construct high marsh and intertidal marsh. Based on the mitigation analysis conducted for the project, the USACE will create a total of 14.9 acres of wetland habitat to offset the impacted wetlands. This mitigation acreage includes 14.14 acres of wetland habitat at the BRFG (2.45 acres of high marsh and 11.69 acres of intertidal marsh) and 0.76 acre of wetland habitat (intertidal marsh) at the CRL. The Recommended Plan would result in short-term losses of wetland functions and values during construction, but this impact is not considered significant because the impacted wetlands account for a small percentage of the wetlands and EFH in the study areas and surrounding region.

Water Quality Impacts

Water-based construction activities such as barge access, pile driving, and dredging will disturb soils and sediments, resulting in suspended sediments and increased turbidity in the GIWW, Brazos River, and Colorado River. During land-based construction activities adjacent to the GIWW at both facilities, runoff from exposed earth could contribute to temporary increases in suspended sediment and turbidity in adjacent water. The increase in turbidity would be temporary, and local water quality is expected to return to existing conditions after construction activities are completed. BMPs would be used to reduce suspended solids from land runoff, including installation of silt fences. Similarly, during the PED phase, the USACE would incorporate BMPs such as turbidity screens or silt collection curtains around construction equipment if needed to reduce the amount of sediment in the water. Following construction, periodic disturbance of sediments and suspension of sediments in the water column would occur as a result of maintenance dredging operations, barge traffic, and flooding at levels similar to the existing conditions.

Prior to disturbance, sediment sampling will be conducted at the BRFG and CRL to characterize any contaminants present. If contaminated, the material will be handled and disposed of in accordance with applicable local, state, and federal permits, statutes, and regulations. With the implementation of appropriate BMPs and handling/disposal procedures as needed, the Recommended Plan will have temporary adverse effects to water quality in the vicinity, but these impacts are not expected to be significant.

Construction Noise

The proposed construction activities will temporarily increase noise levels in the study area, particularly underwater noise and vibration from pile driving. Underwater noise from pile driving has been documented to cause hearing loss, behavioral changes, physiological effects, and even death in fish (Buehler et al. 2015), but pile driving is expected to affect a relatively small area at any one time and is not expected to result in significant impacts to fish communities. Temporary, localized disturbances and turbidity increases would affect fishery habitats and juvenile fish in the immediate vicinity of the construction, but there are large amounts of habitat in the surrounding area that support fisheries. No blasting or Sound Navigation and Ranging (SONAR) is anticipated during construction.

Salinity

At the BRFG, the Recommended Plan is expected to result in salinity changes compared to the No Action Alternative, particularly in the West GIWW where the existing floodgate will be removed and an open

channel will remain between the GIWW and Brazos River. Projected salinity changes and associated effects at the BRFG are discussed below. At the CRL, the Recommended Plan includes new floodgates on both sides of the Colorado River, and salinity conditions are expected to be similar to the No Action Alternative. At both facilities, salinities are expected to gradually increase over time regardless of the selected alternative due to projected sea level rises.

At the BRFG, removal of the west floodgate would allow for free exchange between the Brazos River and the West GIWW, which could cause salinity changes due to saltwater intrusion into the river and/or increased freshwater flows into the GIWW. Therefore, the PDT modeled existing and projected salinity conditions to assess salinity changes attributable to the Recommended Plan. The primary salinity analysis was conducted for four zones, which are shown on **Figure 6** and include the West GIWW, Brazos Basin, East GIWW, and Freeport Channel. Descriptions of the modeling and results are provided in Engineering Appendix A-1 of the FR-EIS. **Tables 5 and 6** summarize the projected average salinities for each of the modeled zones under low and high freshwater flows, respectively. Note that the model was calibrated using salinity data collected during the 13-month period spanning March 2015 through March 2016, which was a relatively wet period when the Brazos River exhibited multiple high flow events and had greater flows throughout the period relative to periods with less rainfall.

Figure 6 Zones for Salinity and Sedimentation Analyses Near the BRFG

Table 5. Mean Salinity (and change from existing) (ppt) at the BRFG, October-December (High Freshwater Flow)

Site (Recommended Plan)	West GIWW	Brazos Basin	East GIWW	Freeport Channel
Existing (= No Action/FWOP)	5.7	1.7	5.0	15.0
Recommended Plan at BRFG	3.9 (-1.8)	2.1 (0.4)	5.2 (0.2)	15.2 (0.2)

Table 6. Mean Salinity (and change from existing) (ppt) at the BRFG, June-August (Low Freshwater Flow)

Site (Recommended Plan)	West GIWW	Brazos Basin	East GIWW	Freeport Channel
Existing (= No Action/FWOP)	3.1	0.4	3.8	15.0
Recommended Plan at BRFG	0.9 (-2.2)	0.2 (-0.2)	2.6 (-1.2)	15.1 (0.1)

Based on the modeling, the greatest salinity change resulting from the Recommended Plan would occur in the West GIWW, where there would be a decrease in salinity during both low and high freshwater flows. The average projected decrease in the West GIWW is 1.8 ppt during low freshwater flows and 2.2 ppt during high freshwater flows. Because modeled existing salinities were already low (5.7 ppt for low flow and 3.1 ppt for high flow), the projected changes represent a 32% decrease under the low-flow condition and 71% decrease under the high-flow condition.

As noted above, the salinity model was calibrated using data collected during a relatively wet period spanning 13 months. To estimate average salinities based on a larger dataset, the projected percentage decreases reported above were applied to average salinities calculated from the 5-year gauge data discussed in Chapter 2 (see Section 2.2.5 – average high salinity of 25.7 ppt in August [low freshwater flow] and average low salinity of 9.2 ppt in May [high freshwater flow]). Based on this calculation, estimated salinities in the West GIWW resulting from the Recommended Plan would average 17.5 ppt during low freshwater flows and 2.7 ppt during high freshwater flows.

In contrast to the projected salinity decreases in the GIWW, the model results show an increase in projected salinity in the Brazos Basin during low freshwater flows. Although the salinity change is slight (0.4 ppt), it constitutes a 24% increase compared to the existing salinity level. Applying this percent increase to the 5-year gauge data, estimated salinities in the Brazos Basin could average as high as 32 ppt during low freshwater flows. However, this is still within the range of an estuary system, and review of data further upstream in the Brazos River indicate there would be little to no change in salinities upstream.

Although the Recommended Plan would affect salinities, with potentially significant percent decreases in salinity in the West GIWW, the projected salinities are within the broad range of an estuarine system. Furthermore, the projected lowest average salinities would occur temporarily during high flows after rainfall events and would gradually recover as river flows reduce. As a result, salinity changes resulting from the Recommended Plan at the BRFG are not expected to have a significant effect on estuarine habitats or wildlife in or near the study area.

3.0 ESSENTIAL FISH HABITAT AND MANAGED SPECIES IN THE STUDY AREA

The study area is located within the jurisdiction of the Gulf of Mexico Fishery Management Council (GMFMC). The GMFMC jurisdiction (federal waters) extends from three to 200 miles off the coasts of Louisiana, Mississippi, and Alabama, and nine to 200 miles off Texas and the west coast of Florida. The Council prepared fishery management plans designed to manage fisheries from where state waters end out to the 200-mile limit of the Gulf of Mexico. These waters are knowns as the Exclusive Economic Zone.

The GMFMC has identified and described EFH for hundreds of species covered by seven FMPs (NMFS 2010):

- Shrimp FMP
- Red Drum FMP
- Reef Fish FMP
- Stone Crab FMP
- Spiny Lobster FMP
- Coral and Coral Reef FMP
- Coastal Migratory Pelagic FMP

There are also a number of species managed in the Gulf of Mexico under Federally Implemented FMPs, including tuna, swordfish, billfish, large coastal sharks, small coastal sharks, and pelagic sharks (NMFS 2010).

Table 7 provides a list of representative areas in the Gulf of Mexico that are designated as EFH by the GMFMC.

Table 7. Representative Categories of Essential Fish Habitats in the Gulf of Mexico

Estuarine Areas	Marine Areas
Estuarine emergent wetland	Water column
Mangrove wetland	Vegetated bottoms
Submerged aquatic vegetation	Non-vegetated bottoms
Algal flats	Live bottoms
Mud, sand, shell, and rock substrates	Coral reefs
Estuarine water column	Geologic features
	Continental Shelf Features

Source: NMFS 2010

In estuarine environments, EFH is defined as "all estuarine waters and substrates (mud, sand, shell, rock, and associated biological communities), including the sub-tidal vegetation (seagrasses and algae) and adjacent inter-tidal vegetation (marshes and mangroves)" (GMFMC 2004). The estuary habitats (open water, high marsh and intertidal marsh, and tidal flats) in the BRFG and CRL study areas have been identified as EFH for red drum (*Sciaenops ocellatus*), shrimp, coastal migratory pelagics (3 species), 43 species of reef fish, and several shark species: blacknose shark (*Carcharhinus acronotus*), blacktip shark (*Carcharhinus limbatus*), bonnethead shark (*Sphyrna tiburo*), bull shark (*Carcharhinus leucas*), great hammerhead shark (*Sphyrna mokarran*), lemon shark (*Negaprion brevirostris*), scalloped hammerhead shark (*Sphyrna lewini*), and spinner shark (*Carcharhinus brevipinna*) (NMFS 2010, 2015). EFH for BRFG is shown on **Figure 6**, and EFH for CRL is shown on **Figure 7**. The FMPs for each of these EFH designations for species managed by the GMFMC is discussed in the following paragraphs. Note that no HAPCs are located in the study areas.

Red Drum FMP – EFH for red drum consists of all Gulf of Mexico estuaries; waters and substrates extending from Vermilion Bay, Louisiana, to the eastern edge of Mobile Bay, Alabama, out to depths of 25

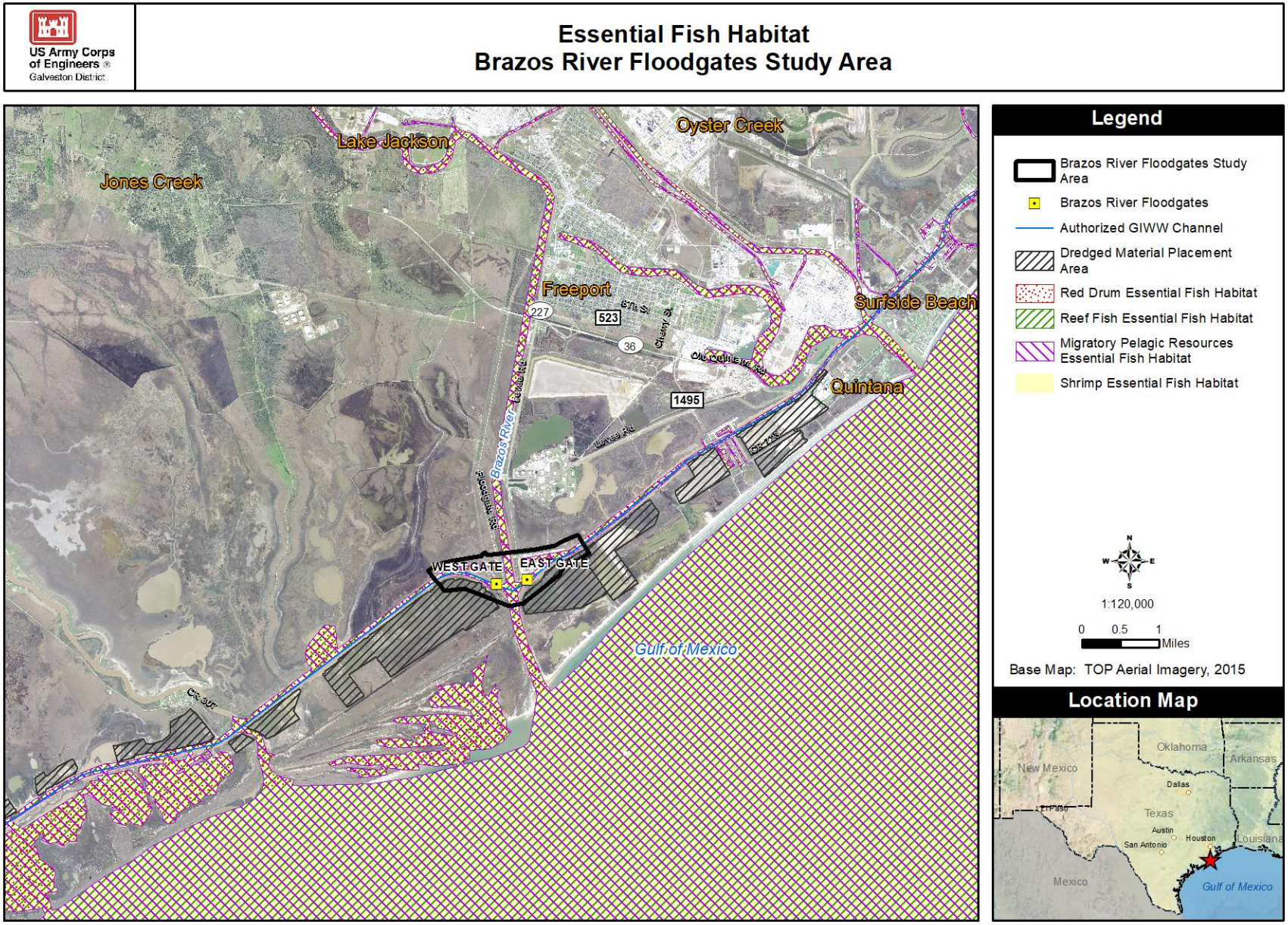

Figure 7 Essential Fish Habitat in the BRFG Study Area

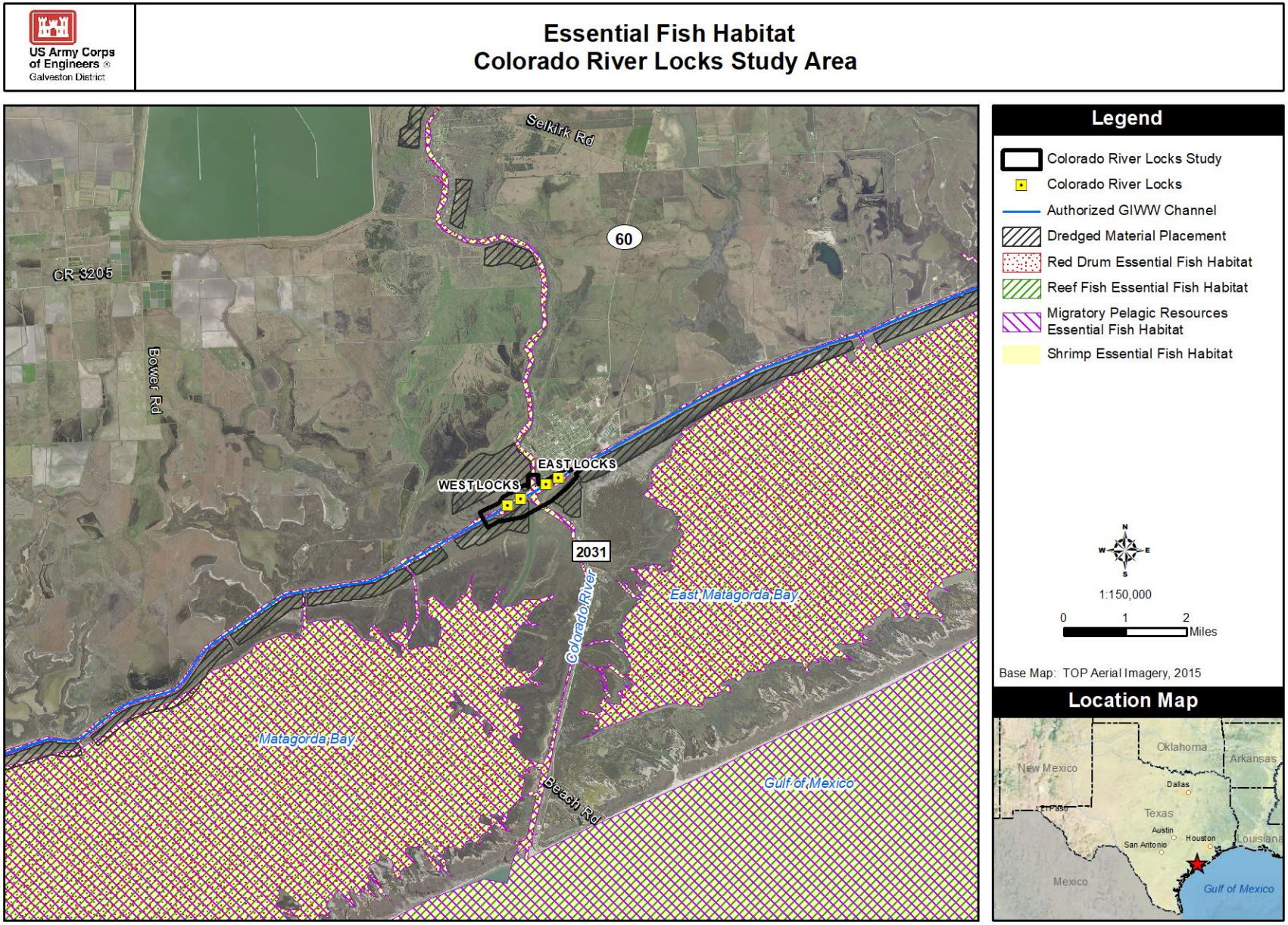

Figure 8 Essential Fish Habitat in the CRL Study Area

fathoms; waters and substrates extending from Crystal River, Florida, to Naples, Florida, between depths of 5 and 10 fathoms; waters and substrates extending from Cape Sable, Florida, to the boundary between the areas covered by the GMFMC and the South Atlantic Fishery Management Council between depths of 5 and 10 fathoms.

Shrimp FMP – EFH for shrimp consists of Gulf of Mexico waters and substrates extending from the US/Mexico border to Fort Walton Beach, Florida, from estuarine waters out to depths of 100 fathoms; waters and substrates extending from Grand Isle, Louisiana, to Pensacola Bay, Florida, between depths of 100 and 325 fathoms; waters and substrates extending from Pensacola Bay, Florida, to the boundary between the areas covered by the GMFMC and the South Atlantic Fishery Management Council out to depths of 35 fathoms, with the exception of waters extending from Crystal River, Florida, to Naples, Florida, between depths of 10 and 25 fathoms and in Florida Bay between depths of 5 and 10 fathoms.

Coastal Migratory Pelagic FMP – EFH for coastal migratory pelagics consists of all Gulf of Mexico waters and substrates extending from the U.S./Mexico border to the boundary between the areas covered by the GMFMC and the South Atlantic Fishery Management Council from estuarine waters out to depths of 100 fathoms.

Reef Fish FMP – EFH for reef fish consists of Gulf of Mexico waters and substrates extending from the US/Mexico border to the boundary between the areas covered by the GMFMC and the South Atlantic Fishery Management Council from estuarine waters out to depths of 100 fathoms.

The National Centers for Coastal Ocean Science (NCCOS) Estuarine Living Marine Resources Database (NMFS 2017b) was queried to identify the potential for occurrence for each of the species managed by the FMPs discussed above. These species are listed in **Table 8**, along with the potential for each to occur within the Brazos River and Matagorda Bay estuaries.

Table 8. Potential for EFH Managed Species to Occur in Vicinity of the BRFG and CRL Study Areas

Species	Brazos River Estuary			Matagorda Bay Estuary		
	Eggs/Larvae	Juveniles	Adults	Eggs/Larvae	Juveniles	Adults
Red Drum FMP						
Red drum *Sciaenops ocellatus*	Not present	Common year-round	No data	Rare to common Aug-Nov	Rare to common year-round	Rare to common year-round
Shrimp FMP						
Brown shrimp *Farfantepenaeus aztecus*	Rare to abundant Feb-Apr	Abundant year-round	Rare year-round	Rare Aug-Dec Common to highly abundant Feb-July	Rare to common Aug-Feb Abundant to highly abundant Mar-July	Rare year-round
Pink shrimp *Farfantepenaeus duorarum*	Not present	Rare Dec-May	Not present	Not present	Rare year-round	Common to highly abundant Feb-May
Royal red shrimp *Pleoticus robustus*	No data	No data	No data	No data	No data	No data

Table 8. Potential for EFH Managed Species to Occur in Vicinity of the BRFG and CRL Study Areas

Species	Brazos River Estuary			Matagorda Bay Estuary		
	Eggs/Larvae	Juveniles	Adults	Eggs/Larvae	Juveniles	Adults
White shrimp *Litopenaeus setiferus*	Abundant July-Oct	Abundant to highly abundant year-round	Common May-June	Common to highly abundant March-Nov	Rare to common Dec-Feb Abundant to highly abundant March-Nov	Rare to common year-round
Coastal Migratory Pelagic FMP						
Cobia *Rachycentron canadum*	No data	No data	No data	No data	No data	No data
King mackerel *Scomberomorus cavalla*	No data	No data	No data	No data	No data	No data
Spanish mackerel *Scomberomorus maculatus*	Not present	Rare July-Oct, Dec-May	Rare June-Nov	Not present	Rare Dec-Oct	Rare to common June-Nov
Reef Fish FMP[1]						
Gray snapper *Lutjanus griseus*	Not present	Not present	Not present	Not present	Rare May-Nov	Rare year-round
Sharks[2]						
Bull shark *Carcharhinus leucas*	Not present	No data	Rare year-round	Not present	Rare to common year-round	Rare year-round

Source: GCFMC 2004, NMFS 2010, 2017a, 2017b
[1] No occurrence data available for other reef fish species.
[2] No occurrence data available for other shark species.

4.0 EFFECTS OF PROPOSED ACTION ON EFH AND MANAGED SPECIES

As defined by the Magnuson-Stevens Act (50 CFR 600.810), "adverse effect" includes any impact that reduces the quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

4.1 Effects on EFH

As discussed above, construction of the Recommended Plan will affect approximately 13.8 acres of wetlands and 94 acres of open water at the BRFG and 0.7 acre of wetland and 61 acres of open water at the CRL (**Table 2**). Most of the open water impacts consist of temporary construction impacts (e.g., barge access, pile driving, dredging, and turbidity). The USACE has worked with NMFS and other resource agencies to evaluate the wetland habitats and develop a mitigation plan for offsetting anticipated wetland losses resulting from the Recommended Plan. To ensure that the mitigation plan would adequately compensate for wetland losses over the 50-year analysis period, the USACE compared average annual benefits of potential mitigation projects, in terms of Average Annual Habitat Units (AAHU), to the AAHUs under the Future Without Project condition. The identified mitigation plan entails creating 14.14 acre of tidal marsh habitats at the BRFG site and 0.76 acre of tidal marsh at the CRL site.

Open water impacts will be temporary during construction and will be minimized by the use of BMPs. Water column turbidity will increase during and immediately after construction activities, and displacement of water column food sources for finfish are expected; however, recovery is expected to be rapid after construction activities are complete. If any stormwater runoff occurs it would result in localized, temporary increases in suspended sediment in adjacent water. The increase in turbidity is temporary and local, and water quality is expected to return to existing conditions after dredging and construction activities are completed.

4.2 Effects on Managed Species

Construction activities at each facility is expected to take approximately two years. It is assumed that once construction has commenced, work would occur throughout the year, to the extent practicable. Due to the length of construction, there is the potential to impact a variety of EFH managed species that occur in and near the study areas throughout the year. Similarly, it is assumed that maintenance dredging activities may occur at any time during the year and, therefore, may impact a variety of EFH managed species. However, the study areas are already partially developed with navigation-related structures and do not provide high-quality EFH. Additionally, marine water column and marine non-vegetated bottoms occur in abundance in the surrounding areas and are, therefore, not a unique resource.

During maintenance dredging activities, mobile species are expected to move away from the equipment; therefore, impacts would be considered short-term and not dissimilar to the existing conditions or future without project conditions. Dredging activities would result in temporary loss of benthic organisms, which are prey species for many fish species, but the benthic organisms are expected to rapidly recolonize the area when construction activities are complete. It is expected that the EFH species that are present in the area can rapidly recover after maintenance dredging occurs.

Four shrimp species have the potential to occur in the study areas, and the eggs/larvae and juveniles of brown shrimp (*Farfantepenaeus aztecus*) and white shrimp (*Litopenaeus setiferus*) are considered to be common to abundant in the vicinities of the study areas. After hatching, larvae enter estuaries and remain there throughout the juvenile stage. Estuarine habitat serves as a nursery area for shrimp, offering a suitable substrate, an abundant food supply, and protection from predators. Sub-adult shrimp consume organic matter, including marsh grasses and microorganisms, found in estuarine sediments. It is expected that juvenile shrimp would avoid areas of disturbance; however, these species may be impacted by temporary substrate disturbances and loss of prey. Therefore, the project may have a minor adverse effect on shrimp, although the effect would be localized and temporary.

Red drum is an important commercial and recreational gamefish found in coastal waters throughout the Gulf of Mexico. Juveniles occupy estuarine environments until maturation, and are considered to be rare to common in the vicinities of the study areas throughout the year (**Table 8**). Red drum are predatory in all life stages, and sub-adults primarily consume small marine invertebrates, including mysids and copepods. It is expected that juvenile red drum would avoid areas of disturbance; however, this species would be impacted by temporary substrate disturbances and loss of prey. Therefore, the project may have a minor adverse effect on red drum, although the effect would be localized and temporary

Based on the rarity of ***coastal migratory pelagics***, ***reef fish***, and ***sharks*** in the vicinities of the study areas (**Table 8**), and considered in conjunction with the relatively minor impacts of the project, no effects to these species are anticipated.

4.3 Conclusion

The Recommended Plan would have ***minor, temporary adverse effects*** on EFH for shrimp and red drum because of substrate disturbances and loss of prey during construction and maintenance dredging. Construction is expected to last 2 years at the BRFG and 2 years at the CRL. The adverse effects are expected to be localized in nature, short-term in duration, and overall relatively minor; the Recommended Plan will not result in permanent adverse effects to EFH after mitigation has been implemented.

No effect on coastal migratory pelagics, reef fish, or sharks are anticipated.

5.0 LITERATURE CITED

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ATTACHMENT 1

ENGINEERING DRAWINGS OF PROPOSED PLANS